Contents

Sunday, June 9th

14:00-14:30

1. KOTANI, Motoko: Discrete geometric analysis for materials research

Tohoku University

New Tsinghua Xuetang, Tsinghua　清华大学新清华学堂

Abstract: I would like to discuss application of discrete geometric analysis to understand the relation between macroscopic properties and microscopic structure of materials. Advanced technology enables us to observe and control atoms and molecules in materials and therefore new mathematical methods to bridge different scales in materials are required. Discrete geometric analysis aims to develop discrete version of geometric analysis and study continuum structures behind discrete objects. Through collaborations with materials scientists in the past few years, we found several interesting connections of mathematics with materials, which I would like to share with you.

14:30-15:00

2. BOURGUIGNON, Jean-Pierre: Mathematicians as Actors of the Development of Science and Technology. A European Perspective

European Research Council and CNRS-IHÉS

New Tsinghua Xuetang, Tsinghua　清华大学新清华学堂

Abstract: During its history Mathematics has always developed following a dual logic: addressing purely internal questions as well as solving problems coming from outside. In recent years this double source of inspiration has even broadened with the development of new disciplines and new interfaces. The process of digitalisation that impacts many areas in society has given a great push to this process when, at the same time, the internal dynamics of mathematics remains very strong and diversified.

This results in a permanent restructuring of the architecture of Mathematics and also in an urgent need to revisit the offer of courses and exposures at the training level to prepare the next generation of mathematicians in an optimal way.

Taking advantage of the possibility to observe such developments at European level, I will offer a personal perspective on these issues focusing on some of the key challenges mathematicians face and are engaging in at the research level.

Monday, June 10th

08:30-09:30

3. SCHOEN, Richard: The role of the MOTS and Jang equations in relativity

Stanford University

Auditorium, Tsinghua 清华大学大礼堂

Abstract: This talk will discuss the marginally outer trapped surface (MOTS) equation and the related Jang equation. This equation was originally used by S. T. Yau and the speaker to prove the spacetime positive energy theorem. We then used it to prove that large concentrations of matter force the formation of trapped surfaces and hence the spacetime is singular. It has also been used to construct MOTS under suitable boundary conditions. In this talk we will give the history of this equation, summarize its applications, and discuss current issues which may be related to this approach.

09:30-10:30

4. ESNAULT, Hélène: Subloci of the moduli of local systems

Freie Universität Berlin

Auditorium, Tsinghua 清华大学大礼堂

Abstract: We link Simpson's conjectures on geometricity and integrality of special subloci of the moduli of complex local systems on complex algebraic varieties to arithmetic properties, reviewing recents progresses.

10:50-11:50

5. RAPOPORT, Michael: Moduli spaces of abelian varieties and their p-adic analogues

University of Bonn

Auditorium, Tsinghua 清华大学大礼堂

Abstract: Moduli spaces of abelian varieties belong to the most studied algebraic varieties. They are also the most accessible Shimura varieties, i.e., roughly speaking, hermitian locally symmetric space.

Since their definition by Deligne in 1971, Shimura varieties have played an important role in algebraic geometry and number theory. Now let p be a prime number. In my talk I will address the question of defining p-adic analogues of Shimura varieties. They are rigid-analytic varieties over p-adic fields, and are expected to play a role similar to Shimura varieties in p-adic algebraic geometry and p-adic number theory. Scholze recently defined local Shimura varieties and showed that Rapoport-Zink formal moduli spaces of p-divisible groups give examples of local Shimura varieties. I will discuss this circle of ideas.

11:50-12:50

6. ENGQUIST, Bjorn: Fast numerical algorithms for frequency domain wave propagation

The University of Texas at Austin

Auditorium, Tsinghua 清华大学大礼堂

Abstract: Direct numerical approximation of high frequency wave propagation typically requires a very large number of unknowns and is computationally very costly. We will discuss two aspects of this type of problem formulated in frequency domain. One is the development and analysis of fast numerical algorithms of optimal computational complexity for boundary integral formulations and variable coefficient partial differential equations. The other aspect is analysis revealing when algorithms of this type of operator compression are possible and when they are not. Rigorous upper bounds on the computational complexity will be presented.

14:00-15:00

7. YUN, Zhiwei: Endoscopy for Hecke Category and Character Sheaves

Massachusetts Institute of Technology

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: Hecke categories are geometric incarnations of Hecke algebras, and they play an important role in the classification of irreducible representations of finite groups of Lie type. We consider a version of the Hecke category for the reductive group G with prescribed monodromy under the left and right actions of the maximal torus. We show that this monoidal category can essentially be identied with the usual Hecke category (with trivial torus monodromy) for an endoscopic group H of G, which is a reductive group of smaller dimension sharing a maximal torus with G but is not necessarily a subgroup of G. As a consequence, we show that character sheaves on G and on H are closely related. Joint work with G. Lusztig.

8. LU, Jiang-Hua: Poisson structures from Lie theory

The University of Hong Kong

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Poisson structures are semi-classical limits of quantum structures, and many important varieties in Lie theory carry natural Poisson structures coming from the theory of quantum groups. In this talk, we explain some examples of Poisson varieties associated to complex semisimple Lie groups, and we discuss connections between the Poisson structures and some other aspects of the underlying varieties, such as Lusztig total positivity and cluster structures, that also have their origins in quantum groups.

9. JIN, Jiashun: Co-authorship and Citation Networks of statisticians

Carnegie Mellon University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: We have collected a data set for the networks of statisticians, consisting of titles, authors, abstracts, MSC numbers, keywords, and citation counts of papers published in representative journals in statistics and related fields. In Phase I of our study, the data set covers all published papers from 2003 to 2012 in Annals of Statistics, Biometrika, JASA, and JRSS-B. In Phase II of our study, the data set

covers all published papers in 36 journals in statistics and related fields, spanning 40 years. The data sets motivate an array of interesting problems in social networks, topic learning, and knowledge discovery.

In the first part of the talk, I will discuss the problem of network membership estimation. We propose a new spectral approach called Mixed-SCORE, and reveal a surprising simplex structure underlying the networks. We explain why Mixed-SCORE is the right approach and use it to investigate two networks constructed from the Phase I data.

In the second part of the talk, I will report some Exploratory Data Analysis (EDA) results including productivity, journal ranking, topic learning, citation patterns. This part of result is based on Phase II data.

10. ZENG, Huihui: On The Life-Span of Smooth Solutions to the 3-D Vacuum Free Boundary Problem for Compressible Euler Equations with Frictional Damping and Physical Singularity

YMSC, Tsinghua University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: The compressible Euler equations with frictional damping is closely related to the porous media equation, for which the basic understanding of the finite mass is provided by the Barenblatt self-similar solution. Due to the slow (sublinear) growth rate of the gas-vacuum interface for the Barenblatt solution, it has been a challenging problem to establish the long time dynamics of vacuum boundary in 3D perturbations for compressible Euler equations with frictional damping and physical singularity. In this talk, these issues will be addressed and the estimates on the life-span of smooth solutions will be discussed.

15:10-16:10

11. LI, Chao: On the Kudla-Rapoport conjecture

Columbia University

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: The Kudla-Rapoport conjecture predicts a precise identity between the arithmetic intersection numbers of special cycles on unitary Rapoport-Zink spaces and the derivatives of local representation densities of hermitian forms. It is a key local ingredient to establish the arithmetic Siegel-Weil formula, relating the height of generating series of special cycles on Shimura varieties to the derivative of Eisenstein

series. We discuss a proof of this conjecture and global applications. This is joint work with Wei Zhang.

12. WANG, Chin-Lung: Quantum Flips

NTU

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: We study analytic continuations of quantum cohomology under simple flips $f : X \dashrightarrow X'$ along the extremal ray quantum variable q^ℓ. A unique deformation $\hat{\Phi}$ of the inverse correspondence $\Phi = [\Gamma_f]^*$ is obtained which induces a canonical non-linear embedding

$$QH(X') \hookrightarrow QH(X)$$

in the category of F-manifolds into the regular integrable loci of $QH(X)$ near $q^\ell = \infty$. This provides examples of functoriality of quantum cohomology beyond K-equivalent transformations. This is an ongoing project with Yuan-Pin Lee (Utah) and Hui-Wen Lin (NTU).

13. LI, Xue-Mei: Recent developments in connections between stochastic dynamics, geometry, and analysis

Imperial College London

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Brownian motion is the mathematical model for the 'inexplicable' movements made by pollens suspended in liquid at equilibrium, observed and studied by Botanist Brown (1827). The same phenomenon was 'predicated' by Einstein with the not yet accepted atomic theory of Dalton. Einstein' s theoretical explanation uses a diffusion equation

$$\frac{\partial u}{\partial t} = D\Delta u.$$

The solution measures the probability to find the Brownian particle at a particular location at a specific time. Based on this, J. B. Perrin conducted a physical experiment verifying the atomic theory (Nobel prize 1926). More physical models are obtained by taking the parameter ϵ to zero in the Langevin equation

$$\dot{x}_t = v_t, \qquad \dot{v}_t = -\frac{1}{\epsilon}v_t + \frac{1}{\epsilon}dW_t.$$

BM's, which can be defined on any Riemannian manifolds, give a dynamical picture of the heat equation.

I hope to explain how this and the subsequent developments fare in current thinking, via historical account. Then I hope to report on how stochastic averaging and homogenisation are used, focusing more on more recent developments. The averaging method in two scale perturbation theory, first introduced for approximate periodic motions, is now widely used for a large class of problems in both pure and applied mathematics. The Ornstein-Uhlenbeck-Smoluchowski-Krammer's dynamic description for Brownian motion, mentioned earlier, fits in both the stochastic averaging theory and the diffusion creation/homogenisation theory (the latter is not as obvious). The Markovian stochastic averaging theory is deep and wide, it taps into the spectral theory of diffusion operators, Hörmander's theory, martingale theories, and Birkhoff's ergodic theorems.

Once the stochastic dynamics looses the Markov property and has 'memory', stochastic perturbation and averaging theory is at a new cutting edge [1]. For fractional noise, this leads to very different behaviour from the white noise case. The effective limits are obtained with the help of the very recent stochastic techniques (which, paradoxically, was meant to generalize an important lemma in the pathwise theory of rough paths.) I will explain the problems, difficulties, and novelties.

The talk will be suitable for a general mathematical audience. A list of my recent relevant work, related to the talk, is appended below for the interested reader.

References

[1] Averaging dynamics driven by fractional brownian motion. arXiv:1902.11251, 2019. With Martin Hairer.

14. MOREIRA, Carlos Gustavo: Fractal geometry, dynamics and Diophantine approximations: the Markov and Lagrange spectra

Instituto de Matemática Pura e Aplicada

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: We will discuss some recent results on the fractal geometry of the Markov and Lagrange spectra from Diophantine approximations, and their set difference. We will relate these results to symbolic dynamics, continued fractions and to the study of the fractal geometry of arithmetic sums of regular Cantor sets, a subject also related to the study of homoclinic bifurcations in Dynamical Systems. We will also present some recent results on dymanical generalizations of these spectra.

16:30-17:15

15. YUAN, Xinyi: TBD

University of California, Berkeley

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: TBD

16. LUO, Tao: Some Singular Limits in Plasma or Fluids in the Presence of Boundaries or Initial Layers

City University of Hong Kong

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will first present a result on some singular limits problems of viscous plasma (joint with Qiangchang Ju & Xin Xu) in the presence of physical boundaries as the Debye length and viscosity tend to zero. The nonlinear stability of the approximation solutions involving the strong boundary layer due to the breakdown of the quasi-neutrality near the boundary will be discussed. Another part of the talk will be on the zero relexation limit problem from the thermal non-equilibrium to equilibrium of gas dynamics in the presence of initial layers and physical boundaries based on the joint work with Chengjie Liu.

17. LIU, Jian-Guo: Dynamics of a degenerate PDE model of epitaxial crystal growth

Duke University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Epitaxial growth is an important physical process for forming solid films or other nano-structures. It occurs as atoms, deposited from above, adsorb and diffuse on a crystal surface. Modeling the rates that atoms hop and break bonds lead in the continuum limit to degenerate 4th-order PDE that involve exponential nonlinearity and the p-Laplacian with $p = 1$. For example, we discuss a number of analytical results for such models, some of which involve subgradient dynamics for Radon measure solutions.

18. CHEN, Zhen-Qing: Stability of heat kernel estimates and parabolic Harnack inequalities for symmetric Dirichlet forms

University of Washington and Beijing Institute of Technology

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will present recent progress in the study of heat kernels and parabolic Harnack inequalities for symmetric Markov processes that have both diffusive and jumping parts on general metric measure spaces. Under general volume doubling condition and some mild assumptions on the scaling functions, we establish stability results for two-sided estimates for heat kernels in terms of the jumping kernels, the generalized capacity inequalities, and Poincare inequalities. Stable characterizations of the associated parabolic Harnack inequalities will also be given. Our results hold on spaces even when the underlying spaces have walk dimensions are larger than 2.

Joint work with Takashi Kumagai and Jian Wang.

19. FENG, Dejun: Estimates on the dimension of self-similar measures with overlaps

The Chinese University of Hong Kong

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will present some algorithms for the computation of the lower and upper bounds for the dimension of self-similar measures with overlaps. As examples, we provide some numerical estimates on the dimension of Bernoulli convolutions. This is joint work with Zhou Feng.

20. YAU, Stephen S.-T.: Variation of complex structures and variation of Lie algebras

Tsinghua University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: The classification of nilpotent Lie algebras in higher dimensions (> 7) remains to be open. There are one-parameter families of non-isomorphic nilpotent Lie algebras (but no two-parameter families) in dimension seven. Dimension seven is the watershed of the existence of such families. It is well-known that no such family exists in dimension < 7, while it is hard to construct one-parameter family in dimension > 7. We construct an one-parameter family of solvable (resp. nilpotent) Lie algebras

of dimension 11 (resp. 10) from $\tilde{E}_7$ singularities and show that the weak Torelli-type theorem holds. We shall also construct an one-parameter family of solvable (resp. nilpotent) Lie algebras of dimension 12 (resp. 11) from $\tilde{E}_8$ singularities and show that the Torelli-type theorem holds.

Joint with B.-Y. Chen, N. Hussain and H.-Q. Zuo (Tsinghua University).

21. YANG, Tong: Some studies on the Boltzmann equation without angular cutoff

City University of Hong Kong

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: After reviewing the progress on the Boltzmann equation without angular cutoff in recent years both on spatially homogeneous and inhomogeneous Boltzmann equation, I will present two results. One is about the regularizing effect of the homogeneous Boltzmann equation with Debye-Yukawa potential for measure valued solutions.

Another one is about the well-posedness of perturbative solution to the inhomogeneous Boltzmann equation when the initial perturbation has only algebraic decay in the velocity variable.

22. LUI, Ronald Lok-Ming: Computing quasiconformal folds

The Chinese University of Hong Kong

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: We propose a novel way of computing surface folding maps via solving a linear PDE.This framework is a generalization to the existing quasiconformal methods and allows manipulation of the geometry of folding. Moreover, the crucial quantity that characterizes the geometry occurs as the coefficient of the equation, namely the Alternating Beltrami Coefficient (ABC). This allows us to solve an inverse problem of parametrizing the folded surface given only partial data but with known folding topology. Various interesting applications such as fold sculpting on 3D models and self-occlusion reasoning are demonstrated to show the effectiveness of our method.

This is a joint work with Qiu DI. This work is supported by HKRGC GRF.

23. WANG, Xiao-Ping: The iterative convolution-thresholding method (ICTM) for image segmentation with intensity inhomogeneity

Hong Kong University of Science and Technology

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: We propose a novel iterative convolution-thresholding method (ICTM) that is applicable to a range of variational models for image segmentation with intensity inhomogeneity. A variational model usually minimizes an energy functional consisting of a fidelity term and a regularization term. In the ICTM, the interface between two different segment domains is implicitly represented by their characteristic functions. The fidelity term is then usually written as a linear functional of the characteristic functions and the regularized term is approximated by a functional of characteristic functions in terms of heat kernel convolution. This allows us to design an iterative convolution-thresholding method to minimize the approximate energy. The method is simple, efficient and enjoys the energy-decaying property. Numerical experiments show that the method is easy to implement, robust and applicable to various image segmentation models.

24. CHEN, Jein-Shan: The algorithmic applications of SOC-functions

NTNU

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: This talk aims to introduce how the so-called SOC-functions (vector-valued functions associated with second-order cone) are used in algorithmic methods for solving second-order cone programs. In particular, we focus on two types of algorithms: (i) proximal-like algorithms (ii) penalty and barrier algorithms. The issues include motivations, convergence analysis, and performance profiles.

25. TAI, Xue-Cheng: A New Operator Splitting Method for Euler's Elastica Model

Hong Kong Baptist University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Euler's elastica model has a wide range of applications in Image Processing and Computer Vision. However, the non-convexity, the non-smoothness and the nonlinearity of the associated energy functional make its minimization a challenging task, further complicated by the presence of high order derivatives in the model. In

this article we propose a new operator-splitting algorithm to minimize the Euler elastica functional. This algorithm is obtained by applying an operator-splitting based time discretization scheme to an initial value problem (dynamical flow) associated with the optimality system (a system of multivalued equations). The sub-problems associated with the three fractional steps of the splitting scheme have either closed form solutions or can be handled by fast dedicated solvers. Compared with earlier approaches relying on ADMM (Alternating Direction Method of Multipliers), the new method has, essentially, only the time discretization step as free parameter to choose, resulting in a very robust and stable algorithm. The simplicity of the sub-problems and its modularity make this algorithm quite efficient. Applications to the numerical solution of smoothing test problems demonstrate the efficiency and robustness of the proposed methodology.

This talk is based on a joint work with Liangjian Deng and Roland Glowinski, (https://arxiv.org/pdf/1811.07091).

26. CAO, Huai-Dong: Deformation of Fano Manifolds

Lehigh University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: A theorem of N. Koiso in early1980s states that if a Fano Kähler-Einstein manifold X does not admit any nontrivial holomorphic vector field then each small deformation of X also admits a Kähler-Einstein metric. In this talk, we shall present a new necessary and sufficient condition on the existence of Kähler-Einstein (KE) metrics on small deformations of a Fano KE manifold with non-discrete automorphism group. This is a joint work with Xiaofeng Sun, S.-T. Yau, and Yingying Zhang.

27. POON, Yat-Sun: Holomorphic Poisson Structures on Nilmanifolds

University of California, Riverside

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Holomorphic Poisson structures could be treated as a kind of generalized geometry in the sense of Hitchin-Gaultieri.

We present a proof that on nilmanifolds with abelian complex structure, there exists a holomorphic Poisson structure such that the cohomology space is isomorphic, as Gerstenhaber algebra, to the one of the underlying complex manifolds.

We will also discuss its implication to extended deformation of complex structures on such manifolds, in the sense of Kontsevich-Barannikov.

28. MOK, Ngaiming: Uniformization Problems on Subvarieties of Finite-Volume Quotient Spaces of Bounded Symmetric Domains

The University of Hong Kong

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: By the Uniformization Theorem a compact Riemann surface of genus ≥ 2 is uniformized by the unit disk Δ and equivalently by the upper half plane $\mathcal{H}$. $\mathcal{H}$ is also the universal covering space of the moduli space of elliptic curves equipped with an appropriate level structure. In Several Complex Variables, the Siegel upper half plane $\mathcal{H}_g, g \geq 1$, is an analogue of $\mathcal{H} = \mathcal{H}_1$, and it is the universal covering space of moduli spaces of polarized Abelian varieties with appropriate level structures. $\mathcal{H}_g$ belongs, up to biholomorphic equivalence, to the set of bounded symmetric domains, on which a great deal of mathematical research is taking place. Especially, finite-volume quotients of bounded symmetric domains Ω, which are naturally quasi-projective varieties, are objects of immense interest to Several Complex Variables, Algebraic Geometry, Arithmetic Geometry and Number Theory, and an important topic is the study of covering spaces of algebraic subsets of such quasi-projective varieties. While a lot has already been achieved in the case of Shimura varieties by means of methods of Diophantine Geometry, Model Theory, Hodge Theory and Complex Differential Geometry, techniques for the general case of not necessarily arithmetic quotients Ω/Γ have just begun to be developed. We will explain a differential-geometric approach leading to various characterization results for totally geodesic subvarieties of finite-volume quotients Ω/Γ, which are necessarily quasi-projective by earlier works of the speaker with Jiaqing Zhong. Especially, we will explain how the study of holomorphic isometric embeddings of the Poincaré disk and more generally complex unit balls into bounded symmetric domains can be further developed to derive uniformization theorems for bi-algebraic varieties and more generally for the Zariski closure of images of algebraic sets under the universal covering map.

29. LEUNG, Conan Nai-Chung: Asymptotic analytic approach to scattering diagrams

The Chinese University of Hong Kong

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will explain asymptotic analytic approach to the study of scattering diagrams and its refined version.

Tuesday, June 11th

08:30-09:30

30. JONES, Vaughan: Subfactors of small index

Vanderbilt University

Auditorium, Tsinghua 清华大学大礼堂

Abstract: A subfactor is a noncommutative version of a field extension. As such it possesses and index which is in principle any real number greater than or equal to one. There is an invariant of subfactors called the standard invariant, far more powerful than the index, which allows a detailed and in some cases complete classification. The standard invariants of subfactors are known up to index 5.25. I will describe this classification and how it interacts with other parts of mathematics and physics, especially conformal field theory.

09:40-10:40

31. RIBET, Kenneth: Some arithmetic geometry associated to modular forms

University of California, Berkeley

Auditorium, Tsinghua 清华大学大礼堂

Abstract: I plan to discuss some recent arithmetic work (not necessarily by this speaker) on Jacobians of modular curves. I am especially interested in relations between weight-2 Eisenstein series and cusp forms, as governed by the group of classes of divisors coming from the set of cusps of a modular curve. My lecture will in some sense by an advertisement for the workshop entitled "Eisenstein Ideal and Iwasawa Theory" that will be held June 17-22 in Beijing.

11:00-12:00

32. EXNER, Pavel: Topologically induced spectral behavior: the example of quantum graphs

Czech Academy of Sciences

Auditorium, Tsinghua 清华大学大礼堂

Abstract: The aim of this talk is to provide a new illustration of how a nontrivial topology can lead to a variety of spectral types. We focus on second-order equations used to describe periodic quantum systems. Such a PDE in a Euclidean space has typically the spectrum which is absolutely continuous, consisting of bands and gaps, the number of the latter being determined by the dimensionality. We are going to show that for analogous second-order operators on metric graphs, many different situations may arise. Using simple examples, we show that the spectrum may then have a pure point or a fractal character, and also that it may have only a finite but nonzero number of open gaps. Furthermore, motivated by recent attempts to model the anomalous Hall effect, we investigate a class of vertex couplings that violate the time reversal invariance. We find spectra of lattice graphs with the simplest coupling of this type and demonstrate that it depends substantially on the parity of the vertices, and discuss some consequences of this property.

13:30-14:15

33. YU, Jeng-Daw: Periods attached to cohomology of powers of the Kloosterman connection

NTU

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: Previously with J. Fresán and C. Sabbah, we construct the motives of the cohomology of powers of the Kloosterman connection, and investigate the de Rham and étale realizations using irregular Hodge theory and exponential motives. Here we continue the investigations in constructing explicitly bases of the Betti realizations via rapid decay cycles with coefficients, computing the periods and justifying numerical evidences obtained beforehand.

34. CHEN, Zeqian: Formula for local solutions to the Navier-Stokes equation

Wuhan Institute of Physics and Mathematics, CAS

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will report that an infinite linear hierarchy is introduced for the homogeneous, incompressible three-dimensional Navier-Stokes equation. The Cauchy problem of the hierarchy with a factorized divergence-free initial datum is shown to be equivalent to that of the incompressible Navier-Stokes equation in Sobolev space $H^1(R^3)$. This allows us to present an explicit formula for local solutions to the incompressible Navier-Stokes equation under consideration. The obtained formula is an expansion in terms of binary trees encoding the collision histories of the "particles" in a concise form. Precisely, each term in the summation of n "particles" collision is expressed by an n-parameter singular integral operator with an explicit kernel in Fourier space, describing a kind of processes of two-body interaction of n "particles". Therefore, this formula is a physical expression for the solutions of the incompressible Navier-Stokes equation.

35. CHENG, Lixin: On Measure of Noncompactness of Banach Spaces

Xiamen University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we first present a brief review about the study of measure of noncompactness of Banach spaces. Then we show that every infinite dimensional space admits a regular measure of noncompactness, which is not equivalent to the Hausdorff measure. This gives an affirmative answer to a 40 year question. Then we prove a representation theorem of general regular measures of noncompactness defined on Banach spaces in terms of $C(K)$-space version.

36. WANG, Qihua: Bias-Corrected Kullback-Leibler Distance Criterion Based Model Selection with Covariables Missing at Random

AMSS, Chinese Academy of Sciences

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Let Y be the response variable, and (X, Z) the covariable vector. We consider the model selection problem for $f_{Y|X,Z}(y|x, z)$ with X missing at random, where $f_{Y|X,Z}(y|x, z)$ is the conditional probability function of Y given (X, Z). Two

novel model selection criteria are suggested. One is called bias-corrected Kullback-Leibler distance (BCKL) criterion and another one is called empirical-likelihood-based biascorrected Kullback-Leibler distance (ELBCKL) criterion. Both the criteria specify a parametric model, which do not need to be correct, for $f_{X|Y,Z}(x|y,z)$, the conditional probability function of the missing covariates given the observed variables. It is shown, however, that the model selection by both the proposed criteria is consistent and that the population parameter estimators, corresponding to the selected model, are also consistent and asymptotically normal even if the parametric model for $f_{X|Y,Z}(x|y,z)$ is misspecified. This is a remarkable superiority of our proposed criteria to some existing model selection strategies. Extensive simulation studies are conducted to investigate the finite-sample performances of the proposed two criteria and a thorough comparison is made with some related model selection methods. The simulation results show that our proposals perform competitively especially when the conditional distribution of the missing covariates given the observed variables is misspecified. Supplementary materials for this article are available online.
Keywords: Missing at random, Model selection, Conditional probability function.

37. ZHU, Yongchang: Addition Formula and γ-factors for Local Fields

Hong Kong University of Science and Technology

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: We prove the following addition formula for a local field F:

$$(c_1c_2)(x+y)-(c_1c_2)(x)-(c_1c_2)(y)=\int_{\widehat{F^*}}\frac{\rho(||_Fc_1c_2)}{\rho(||_Fc_1\chi)\rho(||_Fc_2\chi^{-1})}(c_1\chi)(x)(c_2\chi^{-1})(y)d\chi.$$

where c_1, c_2 are quasi-characters of F^* and $\rho(c)$ denotes the Iwasawa-Tate gamma factor for a quasi-character c, the integration is on the Pontryagin dual of F^*. This formula is an analytic analog of the binomial expansion $(x+y)^n=\sum_{i=0}^m\binom{m}{i}x^iy^{m-i}$, the binomial coefficients $\binom{m}{i}$ are now replaced by

$$\frac{\rho(||_Fc_1c_2)}{\rho(||_Fc_1\chi)\rho(||_Fc_2\chi^{-1})}$$

which coincides with string amplitudes in special cases. We will also show the relations of our addition formulas with Dougall-Ramanujan formula and Barnes' identity.

38. SHEN, Linhui: Quantum geometry of moduli spaces of local systems and representation theory

Michigan State University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: Let G be a split semi-simple algebraic group over $\mathbb{Q}$. We introduce a natural cluster structure on moduli spaces of G-local systems over surfaces with marked points. As a consequence, the moduli spaces of G-local systems admit natural Poisson structures, and can be further quantized. We will study the principal series representations of such quantum spaces. It will recover many classical topics, such as the q-deformed Toda systems, quantum groups, as well as the modular functor conjecture for such representations, which should lead to new quantum invariants of threefolds. This talk will mainly be based on joint work with A. B. Goncharov.

39. QI, You: Categorification at a prime root of unity

California Institute of Technology

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Topological quantum field theory, in the sense of Atiyah and Segal, is an excellent organizational principle in understanding different kinds of manifold invariants. We outline a program aimed at categorically lifting the 3-dimensional Witten-Reshetikhin-Turaev topological quantum field theories into a 4-dimensional theories. This would eventually give rise to a combinatorial construction of 3- and 4-manifold invariants, previously obtainable only through gauge theoretical methods.

The talk is based on previous joint work and projects in progress with B. Elias, M. Khovanov and J. Sussan.

40. LU, Benzhuo: Ion conductance in membrane-channel systems: models, meshing, computing, and applications

LSEC, Chinese Academy of Sciences

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Ion channels are pore-forming membrane proteins, as life's nano-valves that allow ions to pass through the channel pore. Many ion channel proteins are specialized to select for only a particular ion species. The continuum electrodiffusion model can qualitatively capture some macroscopic properties of certain ion channel systems such as current-voltage characteristics, conductance rectification, and inverse

membrane potential. However, the macroscopic models are often challenged by the requirements: model accuracy, treatment of complex geometry of the membrane-channel protein system, and robustness of numerical computing. I will talk about the Poisson-Nernst-Planck type of PDE models (and the corresponding energy variational forms), meshing method for molecular surface and membrane-protein system, numerical techniques and finite element implementation. A particular application example is the simulation study of a potassium channel. With incorporation of ion solvation effect, the model is capable of simulating selective permeation in potassium channel, in which the larger potassium ions can much more easily pass through the channel than the relatively smaller sodium ions, although both type of ion species carry a same positive unit charge. Another application example is gene sequencing in nanopore.

41. WEI, Guo-Wei: Can AI discover new drugs?

Michigan State University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: The dominant win of Google's Alphafold in the latest Critical Assessment of Structure Prediction (CASP) competition has ushered a new era of scientific discovery. Researchers are excited about what the future may hold for drug design. Artificial intelligence (AI) might make new drug discovery significantly faster and cheaper. This could be particularly beneficial to patients with rare medical ailments, for whom drug discovery is currently not profitable, or for those whose medical ailments currently can't be effectively treated with drugs, such as Alzheimer's disease. However, drug design is much more complex than protein folding prediction. Due to the structural complexity of protein-drug interactions, the high dimensionality of drug candidates' chemical space, and the involved molecular simulation and machine learning, even all the world's computers put together do not have enough power to design drug automatically. In my lab, we tackle these challenges mathematically. Our work focuses on reducing the geometric complexity of protein-drug complexes for computers. We have introduced differential geometry, algebraic topology, and graph theory to obtain high-level abstractions of protein-drug interactions and thus significantly enhance AI's ability to handle excessively large datasets in drug discovery. Our mathematical AI has made us a top competitor in D3R Grand Challenges, a worldwide competition series in computer-aided drug design and discovery in the past three years.

This work supported by NIH R01GM126189, NIH R01GM090208, NSF DMS-1721024, NSF DMS-1761320, NSF IIS-1302285, Pfizer, Bristol-Myers Squibb, and Michigan State University.

42. ZHENG, Weiying: Conservative finite element method for incompressible MHD equations

LSEC, Chinese Academy of Sciences

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: We propose a finite element method for the three-dimensional transient incompressible magnetohydrodynamic equations that ensures exactly divergence-free approximations of the velocity and the magnetic induction. We employ second-order semi-implicit timestepping, for which we rigorously establish an energy law and, as a consequence, unconditional stability. We prove unique solvability of the linear systems of equations to be solved in every timestep. For those we design an efficient preconditioner so that the number of preconditioned GMRES iterations is uniformly bounded with respect to the number of degrees of freedom As both meshwidth and timestep size tend to zero, we prove that the discrete solutions converge to a weak solution of the continuous problem. Finally, by several numerical experiments, we confirm the predictions of the theory and demonstrate the efficiency of the preconditioner.

43. ZHANG, Xiangwen: The Anomaly Flow

University of California, Irvine

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: We discuss the development on geometric and analytic aspects of the Anomaly flow. Such flow naturally arises in the study of a system of equations for supersymmetric vacua of superstrings proposed independently by C. Hull and A. Strominger in 1980s. The system allows non-vanishing torsion and they incorporate terms which are quadratic in the curvature tensor. As such they are also particularly interesting from the point of view of both non-Kaehler geometry and the theory of nonlinear partial differential equations. It turns out that the corresponding flow shares some features with the Ricci flow and preserves the conformally balanced condition of Hermitian metrics.

44. YAN, Min: Converse of Smith Theory

Hong Kong University of Science and Technology

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Suppose G is a finite group, and f is a map from a CW-complex F to the fixed point of a G-CW-complex Y. Is it possible to extend F to a finite G-CW-complex X satisfying $X^G = F$, and extend f to a G-map $g : X \to Y$, such that g is a homotopy equivalence after forgetting the G-action?

In case Y is a single point, the problem becomes whether a given finite CW-complex F is the fixed point of a G-action on a finite contractible CW-complex. In 1942, P. A. Smith showed that the fixed point of a p-group action on a finite $\mathbb{Z}_p$-acyclic complex is still $\mathbb{Z}_p$-acyclic. In 1971, Lowell Jones proved a converse, that any $\mathbb{Z}_n$-acyclic finite CW-complex is the fixed point of a semi-free $\mathbb{Z}_n$-action on a finite contractible CW-complex. In 1975, Robert Oliver proved that, for a given finite group G of not prime power order, whether a finite CW-complex F is the fixed point of a general G-action on a finite contractible CW-complex is determined by the Euler characteristic of F.

It is rather surprising that the more general setting was not studied earlier, because it is necessary for certain interesting problems about group actions on topological manifolds. We explain how to extend the classical results of Lowell Jones and Robert Oliver to the general setting. We also find some new phenomenon that did not occur in the contractible setting.

This is a joint work with Sylvain Cappell of New York University, and Shmuel Weinbeger of University of Chicago.

45. LIN, Yu-Shen: Existence of Special Lagrangians and Fibrations for Log Calabi-Yau Surfaces

Boston University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: Special Lagrangians submanifolds introduced by Harvey-Lawson are important examples of area minimzers. It is generally an open question for the given homology class there exists a special Lagrangian representative. In modern language, they are the candidates of Bridgeland stable objects of Fukaya categories.

On the other hand, the Strominger-Yau-Zaslow conjecture plays the role of guiding principle for mirror symmetry, yet not much examples are known. In this talk, we will give the existence of special Lagrangians in the Tian-Yau spaces and confirm the SYZ conjectures in the cases of hyperKähler surfaces under suitable assumptions with explicit examples. If the time allows, we will explain the application to mirror symmetry.

46. TSENG, Li-Sheng: A Twist for the Algebra of Differential Forms on Symplectic Manifolds

University of California Irvine

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: On symplectic manifolds, there is a novel A-infinity algebra of differential forms introduced by Tsai, Tseng, and Yau. We will review this algebra structure and introduce a twist to the algebra that does not preserve the A-infinity structure conditions. This twist can be motivated when considering fiber bundles over symplectic manifolds and sections on them. It leads to a natural flatness condition for such bundles which we will discuss. This talk is based on a joint work with Jiawei Zhou.

14:25-15:10

47. XU, Bin: Local descent construction and Vogan L-packets

Sichuan University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: We will introduce a twisted version of the local descent construction in supercuspidal case, which could recover the local Vogan L-packets for classical groups parametrized by simple L-parameters. We will also talk about its relation to some other topics, such as the local Gan-Gross-Prasad conjecture and the local theta correspondence.

48. SHI, Ronggang: Quantitative multiple pointwise ergodic theorem

Fudan University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The multiple pointwise ergodic theorem is a generalization of the Birkhoff ergodic theorem. The question is initiated by Hill Furstenberg who proved multiple recurrence. Although there are many cases known, the general question is still open. We show that effective multiple correlations imply quantitative multiple pointwise ergodic theorem. This result can be applied to subgroup actions on homogeneous spaces, nilmanifold automorphisms and subshifts of finite type.

49. XIAO, Ming: Embeddability of real hypersurfaces into hyperquadrics and spheres

University of California, San Diego

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: We discuss the embeddability problems of real hypersurfaces into hyperquadrics and in particular spheres. The talk is based on joint work with Huang and Li and work with Kossovskiy.

50. WONG, Ngai-Ching: Normal states are determined by their facial distances

NSYSU

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Let M be a semi-fnite W^*-algebra with normal state space $\mathfrak{S}(M)$. For any $\phi \in \mathfrak{S}(M)$, let

$$M_\phi := \{x \in M : x\phi = \phi x\}$$

be the centralizer of ϕ with center $\mathcal{Z}(M_\phi)$. We show that for $\phi, \psi \in \mathfrak{S}(M)$, the following are equivalent.

- $\phi = \psi$.
- $\mathcal{Z}(M_\psi) \subseteq \mathcal{Z}(M_\phi)$ and $\phi|_{\mathcal{Z}(M_\phi)} = \psi|_{\mathcal{Z}(M_\phi)}$.
- ϕ, ψ have the same distances to all the closed faces of $\mathfrak{S}(M)$.

We are then able to give an alternative proof of the following fact. Let G be a locally compact group. Let A be any one of the (complex) Banach algebras: $L_1(G)$, $M(G)$, $WAP(G)$, $LUC(G)$, $B(G)$, and $A(G)$, consisting of integrable functions, regular Borel complex measures, weakly almost periodic functions, bounded left uniformly continuous functions, positive definite functions, and positive defnite functions vanishing at infinity, respectively, on G. We show that the metric semigroup

$$A_{+,1} := \{f \in A : f \geq 0 \text{ and } ||f|| = 1\}$$

(the convex structure is not considered) is a complete invariant for G.

This is a joint work with Anthony To-Ming Lau (Alberta) and Chi-Keung Ng (Nankai)

51. DOU, Dou: Entropy, metric mean dimension and variational principles

Nanjing University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: Mean dimension is a meaningful quantity introduced by Gromov, Lindenstrauss and Weiss. It measures the dimensional characteristic for dynamical systems with infinite entropy. Based on entropy theory, we obtain several kinds of variational principles for metric mean dimensions.

52. HAO, Rong-Xia: The faulty diagnosability and fault-tolerant Hamiltonicity of some networks

Beijing Jiaotong University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: The diagnosability and the pessimistic diagnosability are two important parameters to measure ability of diagnosing faulty processors in a multiprocessor system. In this paper, the results about conditional diagnosability and pessimistic diagnosability of some regular graphs are given. As applications, some known results for many famous networks such as alternating group networks, alternating group graphs etc are obtained. The k-dimensional data center network with n-port switches, denoted by $D_{k,n}$, has been proposed for data centers as a server centric network structure. The vertex-pancyclicity and conditional edge-fault-tolerant Hamiltonicity of $D_{k,n}$ are derived.

53. KANG, Ming-Hsuan: New Invariants and Geometric Factorizaions of Affine Weyl Groups

NCTU

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we introduce some new invariants of affine Weyl groups arisen from their Poincaré series, which admit some interesting geometric interpretations. Moreover, we show that there exist length preserving factorizations of affine Weyl groups of type A_n and C_n, which involves the alternating product of all parabolic subgroups.

54. SHAO, Meiyue: Handling algebraic branch points in nonlinear eigenvalue problems

Fudan University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: In several real world applications of nonlinear eigenvalue problems, functions with branch points appear in the nonlinear matrix-valued functions. This type of nonlinear eigenvalue problems is challenging to tackle because existing nonlinear eigenvalue algorithms usually require the matrix-valued function to be analytic in the region where the desired eigenvalues are located. We propose an efficient way to handle algebraic branch points and reliably compute eigenvalues in the neighborhood of branch points. Our approach consists of applying appropriate transformations of variables after a possible subdivision of the region of interest. The transformed nonlinear matrix-valued functions are always analytic inside its corresponding subregion, and can be approximated by low order rational approximations due to their analyticity. We are then free to use a nonlinear eigenvalue solver of choice to solve the remaining problem.

55. YAO, Yuan: TBD

Hong Kong University of Science and Technology

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: TBD

56. BIAN, Kaigui: Information diffusion and network applications in mobile social networks

Peking University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: In parallel with the increase of various mobile technologies, the Mobile Social Network (MSN) service has brought us into an era of mobile social big data, where people are creating new social data every second and everywhere. It is of vital importance for businesses, governments, and institutions to understand how peoples' behaviors in the online cyberspace can affect the underlying computer network or their offline behaviors at large. This lecture will introduce the collection of a dataset over WeChat Moments, called WeChatNet, which involves 25,133,330 WeChat users with 246,369,415 records of link reposting on their pages. Based on the data analytics of

information diffusion over WeChatNet, this lecture revisits three network applications, i.e., the influence maximization in mobile networks, the network resource allocation in edge networks, and the mobile population distribution projection. This lecture also discusses potential research opportunities for developing new network applications.

57. CHEN, Jie: Generalized Multiscale Approximation of Mixed Finite Elements with Velocity Elimination for Subsurface Flow

Xi'an Jiaotong University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: A frame work of the mixed generalized multiscale finite element method (GMsFEM) for solving Darcy's law in heterogeneous media is studied in this talk. Our approach approximates pressure in multiscale function space that is between fine-grid space and coarse-grid space and solves velocity directly in the fine-grid space. To construct multiscale basis functions for each coarse-grid element, three types of snapshot space are raised. The first one is taken as the fine-grid space for pressure and the other two cases need to solve a local problem on each coarse-grid element. We describe a spectral decomposition in the snapshot space motivated by the analysis to further reduce the dimension of the space that is used to approximate the pressure. Since the velocity is directly solved in the fine-grid space, in the linear system for the mixed finite elements, the velocity matrix can be approximated by a diagonal matrix without losing any accuracy. Thus it can be inverted easily. This reduces computational cost greatly and makes our scheme simple and easy for application. Moreover, the proposed method preserves the local mass conservation property that is important for subsurface problems. Numerical examples are presented to illustrate the good properties of the proposed approach. If offline spaces are appropriately selected, one can achieve good accuracy with only a few basis functions per coarse element according to the numerical results.

58. HUNG, Pei-Ken: The linear stability of the Schwarzschild spacetime in the harmonic gauge

Massachusetts Institute of Technology

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: We study the solution of the linearlized Einstein equation on the Schwarzschild background and in the harmonic gauge. With the aid of the Regge-Wheeler and Zerilli equations, we estimate the Lichnerowicz d'Alembertian equation. In particular, we show that up to a one dimensional stationary mode, the solution decays to a linearlized Kerr solution. This is ongoig joint work with S. Brendle.

59. LI, Chunyi: Stronger Bogomolov-Gieseker type Inequality and stability condition

University Warwick

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: The classical Bogomolov inequality gives a bound for the second Chern character of slope stable sheaves on smooth projective varieties. The inequality is known to be sharp for some varieties (e.g. Abelian varieties), as well as non-sharp for some others (e.g. the projective plane). Besides Fano and K3 surfaces, it is always difficult to get stronger Bogomolov type inequalities for other surfaces and higher dimensional varieties. I will talk about the method to set up such inequalities via the Bridgeland stability condition.

The stronger Bogomolov type inequality has several implications. One upshot will be the existence of stability condition on smooth quintic threefolds. They are the first examples of Calabi-Yau threefolds with trivial fundamental group known to have geometric stability conditions.

60. LU, Xin: Slope of fibred surfaces and its applications

East China Normal University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: For a fibred surface $f : S \to C$, its slope λ_f is heavily related to the geometrical properties of both the fibers of f and the surface S itself. In this talk, I will report the joint work with K. Zuo on the lower bound of the slope, and its applications.

61. ZHOU, Zhe: The rotation number for the Schröedinger equation with δ-potentials and uniform ergodic theorem

AMSS, Chinese Academy of Sciences

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: It is well-known that autonomous ODEs may yield dynamical systems (flows). For non-autonomous ODEs, someones, such as Sacker and Sell, Johnson and Moser, construct skew-products in this setting. Here the dimension of the base space of skew-products is infinite. In this talk, we will construct skew-products in the setting of the Schröedinger equation with δ-potentials, and then show that it admits a well-defined rotation number. Then we will show some uniform ergodic theorem

for discontinuous skew-products. This is based on joint works with D. Damanik, M. Zhang and Z. Zheng.

15:30-16:15

62. WEI, Fu-Tsun: On Kronecker terms over function fields

NTHU

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I shall present a function field analogue of the Kronecker limit formula (in mixed characteristic), which connects a special value of "non-holomorohic" Ensenstein series on the Drinfeld period domain with the Drinfeld-Siegel units. This leads to analytic means of deriving a Colmez-type formula for "stable Taguchi height" of CM Drinfeld modules having arbitrary rank. A Lerch-Type formula for "totally real" function fields is also obtained, with the Heegner cycle on the Bruhat-Tits buildings intervene. Also our limit formula is naturally applied to the special values of both the Rankin-Selberg L-functions and the Godement-Jacquet L-functions associated to automorphic cuspidal representations over global function fields.

63. ZHANG, Guohua: Symbolic Extensions of Amenable Group Actions

Fudan University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The entropy theory of symbolic extensions for a single transformation, built mainly by T. Downarowicz, M. Boyle, S. Newhouse, etc., plays an important role in the study of topological dynamics and smooth dynamical systems. In this talk, we shall extend this theory to actions of countable infinite discrete amenable groups. This is a joint work with T. Downarowicz from Poland.

64. ZHAO, Yun: Dimension estimates of non-conformal repellers and non-ergodic measures

Soochow University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will give some recent results in the dimension theory of dynamical systems, including the lower and upper bounds of a non-conformal repeller

which are given by the zero of super/sub-additive topological pressure with suitably chosen potentials, and the dimension formula for non-ergodic measures supported on an average conformal repeller which is related to the zero of measure-theoretic pressure.

65. WANG, Xuecheng: Local and global well-posedness of the water waves system

Tsinghua University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we give a brief survey on the recent progresses of the water waves system in different settings with emphasize on the propagation of regularity side. Some interesting open questions will also be discussed.

66. ZHANG, Ke: Random Hamilton-Jacobi equations and non-uniformly hyperbolic dynamics

University of Toronto, Canada

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: We discuss an approach to study randomly forced Hamilton-Jacobi equations on a torus. This line of study originated with the work of E, Khanin, Mazel and Sinai around 2000, where the 1-dimensional equation is studied. The higher dimensional version is quite different, and requires a combination of weak KAM theory and non-uniformly hyperbolic dynamics. Based on joint works with K. Khanin and R. Iturriaga, we obtain results on uniqueness and regularity of the stationary solution, as well as the speed of convergence to this stationary solution.

67. YUAN, Liping: On $\mathcal{F}$-convexity and related problems

Hebei Normal University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: Let $\mathcal{F}$ be a family of sets in $\mathbb{R}^d$. A set $M \subset \mathcal{F}$ is called $\mathcal{F}$-*convex* if for any pair of distinct points $x, u \in M$, there is a set $F \in \mathcal{F}$ such that $x, y \in F$ and $F \subset M$. A family $\mathcal{F}$ of compact sets is called *complete* if $\mathcal{F}$ contains all compact $\mathcal{F}$-convex sets. A convex body is called *selfish*, if the family $\mathcal{F}_K$ of all convex bodies similar to K is complete.

In this talk we'll discuss $\mathcal{F}$-convexity and related problems for some interesting families $\mathcal{F}$ and, also, the selfishness of convex bodies.

68. YUE, Qin: Some Orthogonal Problems in Algebraic Coding Theory

Nanjing University of Aeronautics and Astronautics

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we review some orthogonal problems in algebraic coding theory, mainly involving linear complementary dual codes (LCD codes), quantum MDS codes, and self-dual codes.

69. XIE, Xiaoping: Efficient algorithms for time fractional diffusion and wave equations

Sichuan University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: We consider several numerical methods for time fractional diffusion and wave problems. The regularity of the weak solutions to the problems with nonsmooth data are investigated. For the time fractional diffusion problems, we analyze a time-stepping finite element method and a discontinuous Galerkin method. For the time fractional wave problems, we analyze three numerical methods, i.e. a time-spectral finite element method, a space-time finite element method, and a Petrov-Galerkin method. Stability and convergence of the algorithms are derived. Numerical experiments are performed to verify the theoretical results.

This is joint work with Binjie Li and Hao Luo.

70. XU, Xiaowen: Fast Algorithms for Laser Fusion Simulations

Institute of Applied Physics and Computational Mathematics

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: Laser fusion, belonging to inertial confinement fusion(ICF), uses a high power laser as a driver to implode capsules filled with fusion fuel and produce thermonuclear energy. Numerical simulation is a crucial capacity for understanding laser fusion physics and designing experiment. Designing high efficient numerical algorithms for ICF is a great challenge task due to its multi-physics, multi-material, multi-scale issues. In this talk, we will introduce the recent progress for designing

fast algorithms for ICF applications. Especially, the adaptive and multigrid type algorithms and their parallel implementations on massively parallel machine will be discussed. We will show large-scale numerical results for a number of typical realistic examples using ICF codes on $O(10^4)$ CPU cores.

Keywords. Laser Fusion, Inertial Confinement Fusion (ICF), Radiation Hydrodynamics, Numerical Simulation, Fast algorithms.

71. LING, Shuyang: Solving Inverse Problems on Networks: Graph Cuts, Optimization Landscape, Synchronization

New York University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Information retrieval from graphs plays an increasingly important role in data science and machine learning. This talk focuses on two such examples. The first one concerns the graph cuts problem: how to find the optimal k-way graph cuts given an adjacency matrix. We present a convex relaxation of ratio cut and normalized cut, which gives rise to a rigorous theoretical analysis of graph cuts. We derive deterministic bounds of finding the optimal graph cuts via a spectral proximity condition which naturally depends on the intra-cluster and inter-cluster connectivity. Moreover, our theory provides theoretic guarantees for spectral clustering and community detection under stochastic block model.

The second example is about the landscape of a nonconvex cost function arising from group synchronization and matrix completion. This function also appears as the energy function of coupled oscillators on networks. We study how the landscape of this function is related to the underlying network topologies. We prove that the optimization landscape has no spurious local minima if the underlying network is a deterministic dense graph or an Erdös-Renyi random graph. The results find applications in signal processing and dynamical systems on networks.

72. ZHANG, Jian: Efficient Exponential Time Differencing Algorithm for Phase Field Models and Applications on Modern High Performance Computers

Computer Network Information Center, Chinese Academy of Sciences

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Exponential time differencing (ETD) methods are popular for stiff temporal differential equations. the linear operators of the high-order derivative are precisely handled. As a result, the corresponding stability constraint is completely removed, and large time steps can be used. We report a high order ETD scheme for

multi-variable phase field equations. The stability is a consequence of the operator splitting and the fact that ETD schemes are essentially semi-implicit schemes. We will present recent results on energy stability analysis of fully discretized scheme. Furthermore, a localized matrix exponential computing algorithm based on overlapping domain-decomposition is adopted to enhance the scalability, and the resulting Scalable Localized ETD scheme enable us to perform efficient large-scale long-time simulations on modern High Performance Computers. Applications on microstructure evolution and fluid dynamics are presented to demonstrate the efficiency of the algorithm.

73. FONG, Frederick Tsz-Ho: Curvature Estimates of Long-Time Solutions to the Kahler-Ricci Flow

Hong Kong University of Science and Technology

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: The speaker will discuss the local curvature estimates of the Kahler-Ricci flow on compact Kahler manifolds with semi-ample canonical line bundles. On such a manifold, the Kahler-Ricci flow has long-time solutions and its convergence and singular behaviors have been widely studied by various authors. In this talk, the speaker will discuss his works on this topic, in particular showing that the set of fibers (either singular or regular) on which the Riemann curvature blow up along the flow is an invariant set independent of the choice of initial Kahler metric. The talk is based on two joint works, one with Zhou Zhang, another with Yashan Zhang. The research conducted is partially supported by Hong Kong RGC Grants #26301316 and #16300018.

74. LIANG, Xiangyu: Unique tangent behavior for 1-dimensional stationary varifolds

Beihang University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: The uniqueness of tangent behavior is an important regularity property, and has been widely investigated in many circumstances in geometric measure theory and calculus of variations. In this talk we discuss the unique tangent behavior for stationary 1-varifolds in arbitrary Riemannian manifolds. Stationary varifolds are weak solutions for Plateaus problem in the setting of measures, defined as critical points of measure while deforming along any vector fields. We will first introduce the background of the problem, following by basic definitions and examples. Then we will focus on tangent behavior for stationary varifolds, and discuss some recent progresses on this subject.

75. ZHANG, Hui-Chun: Some recent developments on harmonic maps between singular spaces

Sun Yat-sen University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will introduce some developments of our recent program about (variational) harmonic maps between/into singular metric spaces. In particular, we will give the quantitative gradient estimates for them and some applications. This is a joint work with Xiao Zhong and Xi-Ping Zhu.

76. HUANG, Minxin: Refined topological string theory

University of Science and Technology of China

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: Topological string theory, originally defined in physics, can compute enumerative invariants in Calabi-Yau geometries, known as Gromov-Witten invariants, Gopakumar-Vafa invariants. In this talk we consider the refinement, a further deformation from the Omega background in gauge theory. On the mathematical side, the refined enumerative invariants are defined using various techniques such as stable pair invariants, perverse sheaf.

16:25-17:10

77. SHENG, Mao: Arithmetic Higgs bundle

University of Science and Technology of China

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: I shall talk on the notion of arithmetic Higgs bundle whose importance was first envisioned by Professor Kang Zuo. To begin with, I shall define the categories of arithmetic de Rham bundles and arithmetic Higgs bundles over a smooth projective variety X over a field k of characteristic zero. They form Tannakian categories and there is an obvious grading functor Gr from the first category to the second. We prove that many objects of these categories are provided by direct factors of Gauss-Manin systems of smooth projective families over X, and conjecture that they are essentially all objects in these categories when $\dim X > 0$ (Motivic conjeture). We conjecture furthermore that the functor Gr is an equivalence of categories (Arithmetic

Simpson conjecture). These two conjectures together shall form a part of sought-for nonabelian Hodge theory over global fields. If time permits, I shall talk on a conjectural characterization of Shimura curves and triangle curves via arithmeticity on the rank two uniformizing Higgs bundle attached to a smooth projective hyperbolic curve, as well as a mass formula for a Shimura curve of Hodge type via arithmetic Higgs bundle. The talk is based on a joint work with Raju Krishnamoothy.

78. LU, Siyuan: Recent progress on isometric embedding

Rutgers University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will first discuss the recent progress on the existence of isometric embedding the general Riemannian manifolds. In the second part, we will discuss the uniqueness and non-uniqueness of isometric embedding in Schwwarzschild manifold.

79. YUNG, Po-Lam: Variational norm estimates for some oscillatory integrals related to Carleson's operator

The Chinese University of Hong Kong

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Carleson's operator is a useful device in the study of pointwise convergence of Fourier series of a general L^2 function. Stein and Wainger studied a variant of Carleson's operator, where a linear phase function is replaced by a polynomial phase. In this talk, we study a variant of the result of Stein and Wainger, where the maximal operator is replaced by its variational norm counterpart. Connections will be made to square function estimates and local smoothing estimates of the linear Schrödinger equation. This work is joint with Shaoming Guo and Joris Roos, and was partially supported by a GRF grant CUHK14303817 from the HKRGC.

80. XIAO, Qinghua: Wellposedness of Vlasov-Poisson-Boltzmann system and inertial Kuramoto-Sakaguchi equation around equilibriums

Wuhan Institute of Physics and Mathematics

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: This talk is concerned with the wellposedness of Cauchy problem for Vlasov-Poisson-Boltzmann system and inertial Kuramoto-Sakaguchi equation around

equilibriums. For the whole range of the one-species Vlasov-Poisson-Boltzmann system with cutoff soft potentials, we introduce a new time-velocity weighted energy method and based on optimal temporal decay estimates on the solution itself and some of its derivatives with respect to both the spatial and the velocity variables and obtain a unique global smooth solution for small initial perturbation. On the other hand, We also present the global-in-time existence of strong solutions and its large-time behavior for the Kuramoto-Sakaguchi equation with inertia. This equation describes the evolution of the probability density function for a large ensemble of Kuramoto oscillators under the effects of inertia and stochastic noises. We consider a perturbative framework around a Maxwellian type equilibrium and use the classical energy method together with our careful analysis on the macro-micro decomposition. We establish the global-in-time existence and uniqueness of strong solutions when the initial data are sufficiently regular, not necessarily close to the equilibrium, and the noise strength is also large enough. For the large-time behavior, we show the exponential decay of solutions towards the equilibrium under the same assumptions as those for the global regularity of solutions. These are joint works with Professors Seung-Yeal Ha, Huijiang Zhao et. al.

81. ZHU, Baocheng: Dual Orlicz-Brunn-Minkowski theory

Hubei Minzu University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: The dual Brunn-Minkowski theory, initiated by Lutwak, provides powerful tools to solve the long-standing Busemann-Petty problem in the 1990's. Among those deep results, the dual Brunn-Minkowski and dual Minkowski inequalities are the most important.

In this talk, I will discuss the newly introduced dual Orlicz-Brunn-Minkowski theory, a nontrivial extension of the dual Brunn-Minkowski theory. In particular, I will talk about the dual Orlicz-Minkowski and dual Orlicz-Brunn-Minkowski inequalities. These inequalities are based on the Orlicz-addition of star bodies, and are thought to be the heart of the dual Orlicz-Brunn-Minkowski Theory. Finally, I will mention the Orlicz intersection bodies and the Orlicz-Busemann-Petty problem (an unsolved problem).

82. XU, Quan: A functorial Riemann Roch theorem in positive characteristic

YMSC, Tsinghua University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: For any morphism which is proper and smooth of relative dimension 1, Deligne provided a functorial version of Riemann Roch theorem and applied it to Arakelov geometry. In the case of positive characteristic, R. Pink and D. Rössler provided a new proof for the Adams Riemann Roch theorem. By their ideas, we will provide a functorial Riemann Roch theorem in positive characteristic, which induces an analogue of Deligne's functorial Riemann Roch theorem. By the generalized Deligne pairing defined by S. Zhang, we will provide an functorial Riemann Roch theorem for any relative dimension n in positive characteristic which induces the Knudsen-Mumford extension in positive characteristic.

83. SI, Lin: Lattice Point, Convex Cone and Related Problems

Beijing Forestry University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: We give a definition of polar of a convex lattice set in n-dimensional Euclidean space and get some properties. Basic facts about geometry of the cone of positive semi-definite matrices are briefly discussed. We also review some problems on lattice point and convex cone with the recent developments.

84. TONG, Ping: PDE-constrained inverse problems and multi-scale subsurface imaging

Nanyang Technological University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk I will first give a brief introduction to the mathematical inverse problems based on the eikonal equation in spherical coordinates

$$\left(\frac{\partial T}{\partial r}\right)^2+\frac{1}{r^2}\left(\frac{\partial T}{\partial \theta}\right)^2+\frac{1}{r^2\sin^2\theta}\left(\frac{\partial T}{\partial \varphi}\right)^2=\frac{1}{c^2(x)}, \qquad (1)$$

and the elastic wave equation for weakly anisotropic media

$$\rho(x)\frac{\partial^2 u_i(x,t)}{\partial t^2}-\frac{\partial}{\partial x_j}\left(c_{ijkl}(x)\frac{\partial u_k(x,t)}{\partial x_l}\right)=f_i(x,t). \quad x\in\Omega \qquad (2)$$

Novel numerical modelling tools for solving the two PDEs and the state-of-the-art inversion technologies developed recently will be presented. Seismic imaging or tomography is a mathematical inverse problem in solid geophysics. Basically, optimal material parameters such as wave speed $c(x)$ in eqn. (1) and elastic properties $m = [\rho(x), c_{ijkl}(x)]$ in eqn. (2) are sought to fit numerical predictions with real observations. Relying on high performance computing, a huge volume of high-quality seismic traveltime data and full waveform contents are inverted to generate multi-scale seismic velocity models of the crust and mantle in the broad region of Southeast Asia. These high-resolution subsurface models provide some new insights into the hydrological, thermal, compositional, and other geodynamic processes and evolution of the Earth planet and shed lights on the efforts of mitigating geologic hazards such as earthquakes, landslides, tsunamis, and volcanic eruptions in Southeast Asia.

85. WANG, Liqun: A Petrov-Galerkin FEM for solving interface problems and its application on the band structure computation of phononic crystals

China University of Petroleum-Beijing

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: Interface problems arise when two or more materials meet, they are widely seen in science and engineering. The difficulty of solving interface problems lies in capturing the complex interface geometry and jump conditions effectively while the PDE is not valid across the interface. This talk will present the Petrov-Galerkin Finite Element Method for the numerical solution of elliptic/elasticity interface problems with Blochperiodic boundary conditions. Its application on the band structure computation of 2D phononic crystals will also be discussed.

86. ZHANG, Zhiwen: Computing effective diffusivity of chaotic and stochastic flows using structure-preserving schemes

The University of Hong Kong

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: We study the problem of computing the effective diffusivity for a particle moving in chaotic and stochastic flows. In addition, we numerically investigate the residual diffusion phenomenon in chaotic advection. Instead of solving the Fokker-Planck equation in the Eulerian formulation, we compute the motion of particles in the Lagrangian formulation, which is modeled by stochastic differential equations (SDEs).

We propose effective numerical integrators based on a splitting method to solve the corresponding SDEs in which the deterministic subproblem is symplectic-preserving while the random subproblem can be viewed as a perturbation. We provide rigorous error analysis for the new numerical integrators using the backward error analysis (BEA) technique and show that our method outperforms standard Euler-based integrators. Numerical results are presented to demonstrate the accuracy and efficiency of the proposed method for several typical chaotic and stochastic flow problems of physical interests. The existence of residual diffusivity for these flow problems is also investigated.

In addition, we report some recent results in this project, especially when the flows are stochastic and/or time-dependent.

87. ZHOU, Zhennan: Path integral molecular dynamics with surface hopping for thermal equilibrium sampling of nonadiabatic systems and its infinite-swap limit

Peking University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: A novel ring polymer representation for multi-level quantum system is proposed for thermal average calculations. The proposed representation keeps the discreteness of the electronic states: besides position and momentum, each bead in the ring polymer is also characterized by a surface index indicating the electronic energy surface. A path integral molecular dynamics with surface hopping (PIMD-SH) method ("DS" method) is also developed to sample the equilibrium distribution of ring polymer configurational space. Besides, The infinite-swap limit of this representation has been investigated, which provides an alternative formulation for thermal average calculations and overcomes the limitations of the "DS" method. We also introduce a multi-scale integrator to efficiently sample the infinite-swap limit. This is joint work with Jianfeng Lu.

88. YANG, Xiangdong: Bott-Chern blow-Up formula and bimeromorphic invariance of the $\partial\bar{\partial}$-Lemma for threefolds

Chongqing University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we consider the bimeromorphic invariants of compact complex manifolds in terms of Bott-Chern cohomology. Using a sheaf-theoretic approach we prove a blow-up formula for Bott-Chern cohomology groups. As an application, we show that for compact complex threefolds the non-Kählerness degrees, introduced by

Angella-Tomassini [Invent. Math. 192, (2013), 71-81], are bimeromorphic invariants. Consequently, the $\partial\bar{\partial}$-Lemma on threefolds admits the bimeromorphic invariance. This is a joint work with Song Yang of Tianjin University.

89. TANG, Xiudi: The flexibility of symplectic forms and the semiglobal structure of integrable systems

Cornell University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Volume forms are very flexible. The only invariants of smooth manifolds under volume preserving diffeomorphisms are the total volume and, when it is noncompact, the finiteness of the volume at each end, proven by Greene–Shiohama. We prove a parametric version of the flexibility of volume forms with some extra conditions, as well as a more general framework of fiber bundles where the volumes forms are on the fibers.

Gromov's seminal non-squeezing theorem, distinguishing symplectic forms from volume forms, shed light on the rigidity aspect of symplectic forms. After that, vast theories of symplectic capacities have been developed to give necessary conditions for symplectic embeddings. Moser proved that on a compact manifold, a smooth deformation within a cohomology class would leave symplectic forms diffeomorphic. Gromov's h-principle provides smooth cohomological paths between symplectic forms on noncompact manifolds and we prove that the Moser's theorem still applies if the path is subject to a growth condition at the infinity. Then we display how to remove a ray from the manifold without changing the symplectic structure.

We then consider Hamiltonian $\mathbb{R}^n$-spaces, which are integrable systems. We are interested in singular points of the focus-focus type and we give a complete classification of the germ at a compact fiber of the momentum map with multiple such points by a tuple of formal power series.

90. SUN, Zhe: McShane identities for higher Teichmuller theory and the Goncharov-Shen potential

University of Luxembourg

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: Goncharov and Shen introduce a family of mapping class group invariant regular functions on the moduli space $\mathcal{A}_{G,\hat{S}}$ of decorated twisted G-local systems. They use them to parametrize certain canonical bases and to formulate an explicit homological mirror symmetry picture. We observe these functions as generalized

horocycle lengths, called Goncharov–Shen potential, to describe a family of Mcshane-type identities for simple root length on positive surface group representations into $\mathrm{PGL}(n, \mathbb{R})$. It looks very similar to Mirzakhani's generalized McShane identity for bordered surfaces which is used to again prove Witten-Kontsevich theorem, except new parameters appear. We find nice properties for these new parameters. We find applications for these identities. This is joint work with Yi Huang.

91. LAM, Wai Yeung: Dimers and circle patterns

Brown University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: The bipartite planar dimer model is the study of random perfect matchings ("dimer coverings") of a bipartite planar graph. Several two-dimensional models of statistical mechanics, including the Ising model and the spanning tree model, can be regarded as special cases of the dimer model by subdividing the underlying graph.

A circle pattern is a realization of a graph in the plane with cyclic faces, i.e. where all vertices on a face lie on a circle. Circle patterns are central objects in discrete conformal geometry. Following original ideas of William Thurston, two circle patterns with the same intersection angles are considered discretely conformally equivalent.

In this talk, we present a correspondence between the dimer model on a bipartite graph and a circle pattern with the combinatorics of that graph, which holds for graphs that are either planar or embedded on the torus. Under this correspondence, which extends the previously known isoradial case, the urban renewal (local move for dimer models) is equivalent to the Miquel move (local move for circle patterns).

This is joint work with Richard Kenyon, Sanjay Ramassamy, Marianna Russkikh.

Wednesday, June 12th

08:30-09:30

92. LAI, Tze Leung: A New Approach to Adaptive Particle Filters for Joint State and Parameter Estimation in Hidden Markov Models

Stanford University

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: We introduce herein a new approach to adaptive particle filters in hidden Markov models with unknown parameters. We provide a complete asymptotic theory that shows (i) its computational and statistical advantages over previous methods and (ii) its asymptotic efficiency in achieving certain "oracle bounds". This approach also yields consistent estimates of (a) the standard errors for the Monte Carlo estimate and (b) mean squared errors of the adaptive particle filter. We accomplish this by combining the theory of particle filters for state estimation when the parameters are known with that of a novel MCMC scheme with sequential state substitutions for parameter estimation. We also provide implementation details and give substantive applications to biomedicine, economics and engineering.

93. CHANG, Chieh-Yu: On Furusho's conjecture over function fields

Taiwan Tsing Hua University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will introduce the developments of the classical theory of multiple zeta values (MZV's) as well as their function field analogues. Our primary result is to verify a function field analogue of Furusho's conjecture asserting that the p-adic MZV's satisfy the same linear relations that their corresponding real-valued MZV's satisfy (joint work with Y. Mishiba). If time is permitted, we will introduce function field analogues of motivic MZV's and give logarithmic interpretations for their Taylor coefficients (joint work with Y. Mishiba and N. Green).

94. SUN, Song: Collapsing of Calabi-Yau metrics and complex structure degenerations

University of California, Berkeley

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Yau's solution of the Calabi conjecture yields canonical Ricci-flat Kahler metrics on compact Kahler manifolds with trivial canonical bundle. It is an interesting question to understand the relationship between singularity formation of these metrics, in particular the collapsing phenomena, and degeneration of complex structures. We will discuss some recent progress on this.

95. HUANG, Lan-Hsuan: Mass rigidity and spacetime symmetry

University of Connecticut

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: The study of scalar curvature deformation and rigidity has been one of the central topics in geometric analysis. The seminal work of Schoen and Yau on the Riemannian positive mass theorem gives striking connections between the ADM mass and positive scalar curvature. In particular, it is shown that Euclidean space is uniquely characterized by having zero ADM mass among a large class of manifolds with nonnegative scalar curvature. In general relativity, those intriguing phenomena extend to a broader setting. It has been conjectured (in various situations) that a manifold minimizing the ADM mass in certain classes of manifolds must have symmetry, in the sense that the corresponding spacetime possesses a Killing vector field. We will overview some recent progress along this direction, with the focus on the spacetime positive mass theorem and Bartnik¡¯s stationary conjecture.

09:40-10:40

96. CHUNG, Eric: Adaptive multiscale model reduction with generalized multiscale finite element methods

The Chinese University of Hong Kong

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we discuss a general multiscale model reduction framework based on multiscale finite element methods. We give a brief overview of related multiscale methods, and present a general adaptive multiscale model reduction framework

called the Generalized Multiscale Finite Element Method. Besides the method's basic outline, we discuss some important ingredients needed for the method's success. We also discuss several applications. The proposed method allows performing local model reduction in the presence of high contrast and no scale separation.

97. LIU, Yifeng: Recent progress on Beilinson-Bloch-Kato conjecture

Yale University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will summarize recent progress on the Beilinson-Bloch-Kato conjecture, which is the higher dimensional generalization of Birch and Swinnerton-Dyer conjecture. The conjecture predicts deep relation between L-functions and certain arithmetic invariants for motives defined over number fields. We will also survey certain progress for related problems.

98. SHAN, Peng: Center of GIT-modules and affine Springer fibres

YMSC, Tsinghua University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Representations of many remarkable objects, such as Lie algebras, Hecke algebras, algebraic groups, etc., have deep relationships with geometry of some algebraic varieties. A manifestation of such relationship is that sometimes we can realise the center of representation categories as cohomology ring of certain algebraic varieties. In this talk, we will survey some important examples in this direction, and explain a new example relating center of G1T-modules to the cohomology ring of some affine Springer fibre (joint work with Eric Vasserot).

99. LIU, Jinsong: Circle packing and its quasiconformal deformations

Chinese Academy of Sciences

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: W. Thurston introduced circle packings, which are configuration of circles with specified patterns of tangency. Quasiconformal maps and Teichmüller space are branches of modern complex analysis, which study the different conformal structures on a Riemann surface.

In this talk, by using quasiconformal maps and Teichmüller space, I will give some results on circle packings.

11:00-11:45

100. LAN, Kai-Wen: De Rham comparison and Poincaré duality for rigid varieties

University of Minnesota, Twin Cities

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: I will give an overview on the de Rham comparison isomorphisms for p-adic étale local systems over smooth algebraic varieties (and their suitable rigid analytic analogues) that are not necessarily proper, in the context of p-adic Riemann-Hilbert correspondences, which are compatible with the formation of cohomology with (partial) compact supports and with Poincaré duality (among such cohomology). If time permits, I will also mention some application to the study of the cohomology of general Shimura varieties with nontrivial coefficients. (This is joint work with Ruochuan Liu and Xinwen Zhu.)

101. ZHAO, Huijiang: Asymptotics of the Homogeneous Boltzmann Equation for Maxwellian Molecule

Wuhan University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The Boltzmann H-theorem implies that the solution to the Boltzmann equation tends to an equilibrium, that is, a Maxwellian when time tends to infinity. This has been proved in varies settings when the initial energy is finite. However, when the initial energy is infinite, the time asymptotic state is no longer described by a Maxwellian, but a self-similar solution obtained by Bobylev-Cercignani. The purpose of this talk is to rigorously justify this for the spatially homogeneous problem with Maxwellian molecule type cross section without angular cutoff.

102. CHEN, Qun: On some generalizations of harmonic maps

Wuhan University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Harmonic map is an extensively studied geometric variational model. In this talk, we will discuss some geometric analytical models generalizing harmonic maps, which have been introduced from considerations in geometry and physics. We will talk about results on the existence and nonexistence problems.

103. LOU, Yuan: Qualitative properties of principal eigenvalues for second order elliptic operators with drift

Ohio State University and Renmin University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will discuss various qualitative properties of principal eigenvalues for second order elliptic operators with drift. First, the asymptotic behaviors of the principal eigenvalues, as the drift rate tends to infinity, will be addressed. Second, the monotonicity of the principal eigenvalue, as a function of the drift rate, will be discussed. We will also include some discussions on the monotonicity of the principal eigenvalue for time-periodic operators, as a function of the period.

104. CHERN, Jann-Long: Singular Points Effects in Parabolic Evolutions Equations

Central University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we are interested in the following topic:
How about the singularities affect the existence, nonexistence and behaviors of solutions for Parabolic Evolutions Equations.
This talk is based on the joint work with Professors Hwang, Takahashi and Yanagida.

105. DONG, Chongying: A survey on the monstrous moonshine

University of California, Santa Cruz

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: This is an expository talk on the monstrous moonshine. Proposed by McKay-Thompson-Conway-Norton, the moonshine conjecture says there is a genus zero modular function associated to each element of the Monster simple group. This conjecture was proved by Borcherds by using the theory of generalized Kac-Moody algebra and vertex operator algebra. Norton also proposed the generalized moonshine conjecture-there is a genus zero modular function associated to any commuting paring in the monster simple group. The most parts of the generalized moonshine conjecture were established by Dong-Li-Mason by using the twisted modules of vertex operator algebras. Based on Ekeren-Moller-Scheithauer¡¯s work on holomorphic vertex operator algebra, Carnahan recently complete the proof of the generalized moonshine conjecture.

106. MOY, Allen: Decompositions of Euler-Poincaré presentations and resolutions

Hong Kong University of Science and Technology

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Work of Bezrukavnikov-Kazhdan-Varshavsky use an equivariant system of idempotents of trivial representations of Moy-Prasad groups to obtain an Euler-Poincaré presentation of the r-depth Bernstein projector. Bestvina-Savin showed this system of idempotents allows a resolution of a smooth representation generated by its depth r-vectors (generalizing earlier work of Schneider-Sthuler). We report on:

(i) joint work with Barbasch-Ciubotaru which establish in the depth zero case a decomposition of the equivariant system and therefore of the Euler-Poincaré presentation and the resolution,
and

(ii) work in progress with Gordan Savin establishing similar decompositions for positive depth.

107. LU, Pinyan: Classifying Computational Counting Problems

Shanghai University of Finance and Economics

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: The main theme of theoretical computer science is to classify various computational problems in terms of their inherent computational difficulty. In this talk, I will try to demonstrate this general theme by some cases study of my own research on the algorithms and complexity for counting problems.

108. HAN, Bin: Wavelet-based Methods for Numerical Solutions of Differential Equations

University of Alberta

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: As the major multiscale representation systems, wavelets have a lot of successful applications in mathematics such as characterization of function spaces and in data sciences such as image compression and denoising. Though wavelet methods have been studied for computational mathematics for many years now, wavelet methods so far appear to only provide some advantages such as sparse coefficient matrices and uniformly bounded condition numbers over more traditional methods such as

finite element methods and finite difference methods. In this talk we demonstrate that newly developed wavelet methods can lead to satisfactory numerical methods at least in dimension one for two challenging boundary value problems in computational mathematics: elliptic differential equations with highly oscillating coefficients, and Helmholtz equations with high Reynolds numbers. For these two problems, all traditional numerical methods have a great difficult in capturing the true solutions. In this talk, we shall first discuss recent progresses on wavelets on intervals satisfying various boundary conditions. Then we show that our developed wavelet method can satisfactorily resolve the problems of one-dimensional elliptic differential equations with highly oscillating coefficients and one-dimensional Helmholtz equations with high Reynolds numbers. This is joint work with Qiwei Feng, Michelle Michelle, Petar Minev, and Yau Shu Wong at the University of Alberta.

109. HUANG, Shi: Evolution, prime numbers, and an algorithm for the creative process

Central South University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Unpredictable creations of novelty seem to characterize the evolution of human civilizations, biological species, or the universe, appearing both orderly and random. Remarkably similar, prime numbers are also both orderly and random or just like coin toss as meant by the Riemann Hypothesis. A unified understanding of evolution and prime numbers may shed light on the mystery behind the order-randomness duality. Our research suggests that order and unpredictability (hence randomness) are the necessary outcomes of a creation algorithm, the iterative applications of which can create both uniqueness and uniformity, the two defining characteristics of any creation, be it a human thought, a biological species, or a prime number. The algorithm consists of a pair of opposite principles, uniformity selection to create uniqueness and uniqueness selection to form uniformity. It has solved a half century old puzzle of evolution, the genetic equidistance phenomenon that has originally mis-inspired the molecular clock and in turn the neutral theory of molecular evolution. The study suggests that the order-randomness duality is a result of a lawful process rather than of a random process.

110. SHEN, Jie: Structure preserving schemes for complex nonlinear systems

Purdue University and Xiamen University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Many complex nonlinear systems have intrinsic structures such as energy dissipation or conservation, and/or positivity/maximum principle preserving. It is desirable, sometimes necessary, to preserve these structures in a numerical scheme.

I will first present a new approach to deal with nonlinear terms in a large class of gradient flows and Hamiltonian systems. The approach is not restricted to specific forms of the nonlinear part of the free energy or Hamiltonian. It leads to linear and unconditionally energy stable schemes which only require solving decoupled linear equations with constant coefficients. Hence, these schemes are extremely efficient and very accurate when combined with higher-order BDF schemes. However, this approach, in general, will not preserve positivity or maximum principle.

I will then present a strategy to construct efficient energy stable and positivity preserving schemes for certain nonlinear evolution systems, such as the Poisson-Nernst-Planck (PNP) equation and KellerSegel equation, whose solutions remain to be positive.

111. ZHU, Xi-Ping: Geometric analysis on metric spaces

Sun Yat-sen University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: The concept of sectional curvature (or Ricci curvature, respectively) bounded from below was successfully extended to certain metric spaces by Alexandrov (or Lott-Sturm-Villani, respectively). In this talk we will first show the compatibility of these two senses. Next, we will study the Laplacian equation and heat equation on metric spaces. In particular, we will obtain the asymptotic behaviors of the eigenvalues. Finally, we will extend Yau's gradient estimates to harmonic maps between Alexandrov spaces. This is a joint work with Hui-Chun Zhang.

112. CHAN, Kwokwai: Geometry of the Maurer-Cartan equation near degenerate Calabi-Yau varieties

The Chinese University of Hong Kong

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will explain the construction of a differential graded Batalin-Vilkovisky (dgBV) algebra associated to a possibly degenerate Calabi-Yau variety equipped with local thickening data. This gives a singular version of the (extended) Kodaira-Spencer dgLa, which is applicable to both log smooth and maximally degenerated Calabi-Yau varieties. We use this to prove unobstructedness of the smoothing of degenerated log Calabi-Yau varieties satisfying the Hodge-to-deRham degeneracy property, which can be viewed as a singular version of the results of Kontsevich-Katzarkov-Pantev. This is a joint work with Naichung Conan Leung and Ziming Nikolas Ma.

113. WONG, Bun: Smooth domains with non-compact automorphisms

University of California, Riverside

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: In this lecture I will survey some recent progress towards the solution of a conjecture of Greene-Krantz stating that the boundary accumulation point of the automorphisms of a smooth bounded domain in $\mathbb{C}^n$ must be of finite type. We will discuss in particular the case when the domains are Euclidean convex, a result of Dylan Noack in his 2019 UC Riverside doctoral thesis will be discussed.

114. JIANG, Yunfeng: Vafa-Witten invariants via surface Deligne-Mumford stacks and mirror symmetry

University of Kansas

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: Motivated by S-duality conjecture in physics, Tanaka-Thomas have developed a theory of the Vafa-Witten invariants for projective surfaces and proved that the generating series of the Vafa-Witten invariants are modular forms. The formula matches the predictions of Vafa and Witten in the 1994 paper. A similar story of the Vafa-Witten invariants for projective Deligne-Mumford surfaces were constructed and studied by P. Kundu and the author. In this talk I will talk about the Vafa-Witten invariants for Deligne-Mumford surfaces and how the Vafa-Witten invariants

for surface Deligne-Mumford stacks are related to the famous SYZ-fibration and mirror symmetry for the moduli space of Higgs bundles on curves.

13:30-14:15

115. QIN, Hourong: Congruent numbers, quadratic forms and K_2

Nanjing University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: A positive integer is called a congruent number if it is the area of a right-angled triangle, of which all the sides have rational length. A celebrated theorem due to Tunnell gives a criterion for a positive integer to be congruent (under the BSD). We show that if a square-free and odd (respectively, even) positive integer n is a congruent number, then

$$\#\{(x,y,z)\in\mathbb{Z}^3|n=x^2+2y^2+32z^2\}=\#\{(x,y,z)\in\mathbb{Z}^3|n=2x^2+4y^2+9z^2-4yz\},$$

respectively,

$$\#\{(x,y,z)\in\mathbb{Z}^3|\frac{n}{2}=x^2+4y^2+32z^2\}=\#\{(x,y,z)\in\mathbb{Z}^3|\frac{n}{2}=4x^2+4y^2+9z^2-4yz\}.$$

If we assume that the weak Brich-Swinnerton-Dyer conjecture is true for the elliptic curves $E_n: y^2=x^3-n^2x$, then, conversely, these equalities imply that n is a congruent number.

To prove the above, we take a new approach to establish an explicit correspondence between an eigenform of weight 3/2, if this form arises from ternary quadratic forms, and a corresponding eigenform of weight 2; especially it provides a new method to set up the Shimura lift in this case. This method is first used to deal with the congruent problem case and then to be specific on some other cases.

We shall also discuss some applications of the proposed method. In particular, for a prime p, we show that if $p\equiv 1 \pmod 8$ is a congruent number, then the 8-rank of $K_2O_{\mathbb{Q}(\sqrt{p})}$ equals one, and if $p\equiv 1 \pmod{16}$ with $h(-p)\not\equiv h(-2p) \pmod{16}$, then $2p$ is not a congruent number.

To the author's best knowledge, all the known results on non-congruent numbers in the literature treated the cases when the order of the 2-primary part of the corresponding Shafarevich-Tate groups is at most 4, while our treatment improves 4 to 16. Our approach also gives considerable simplification on the proofs of known results on non-congruent numbers.

116. XIA, Qinglan: Ramified optimal transportation and its multidisciplinary applications

University of California, Davis

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will give a brief introduction to the theory of ramified (also called branching) optimal transportation. The optimal transportation problem aims at finding a cost efficient transport from sources to targets. In contrast to the well-known Monge-Kantorovich problem, the ramified optimal transportation problem is used to model the transport economy of scale in group transportation observed widely in branching transport systems. Many living systems such as trees, the veins on a leaf, as well as animal cardiovascular/circulatory systems exhibit branching structures, as do many non-living systems such as river channel networks, railways, airline networks, electric power supply and communication networks. Why do nature and engineers both prefer these ramifying structures? What are the advantages of these branching structures over non-branching structures? These questions partially motivates us to explore the mathematics behind them. Here I will first talk about how to set up a mathematical theory for this general phenomenon in terms of optimal transport paths, using geometric measure theory. An optimal transport path can be viewed as a geodesic in the space of probability measures with a suitable metric. We will study the existence, regularity, as well as numerical simulations of optimal transport paths. After these theoretic studies, I will also survey some of its applications that I have found in ultidisciplinary areas such as mathematical biology (e.g. the dynamical formation of tree leaves; bio-markers of autism found in the vascular structures of placentas), metric geometry (e.g. the geodesic problems in quasimetric spaces), fractal geometry (e.g. the modified diffusion-limited aggregation), geometric analysis (e.g. transport dimension of measures) and mathematical economics (e.g. ramified optimal allocation problem).

117. HUANG, Yong: Geometric flows to Minkowski problems

Hunan University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we recall how to solve Minkowski problems by using geometric flows, such as Gauss curvature flow. In particular, a recent joint work, the regularity of Lp dual Minkowski problem with Chuanqiang Chen, Yiming Zhao will be particularly discussed.

118. URES, Raúl: Robust transitivity and mostly expanding diffeomorphisms

Southern University of Science and Technology

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: We show that if f is a partially hyperbolic diffeomorphism with mostly expanding center and its stable foliation is minimal, then the stable foliation is C^1-robustly minimal. This is a consequence of a more general theorem where the condition of mostly expansiveness is replaced by a weak form of expansion along the center direction.

These results allow us to present new examples of robustly transitive diffeomorphisms. For instance, we show that for a generic volume preserving perturbation of the time-one map of the geodesic flow of a surface with constant negative curvature, either the strong stable or the strong unstable foliation is robustly minimal in its dissipative neighborhood.

The talk is based in a joint work with Marcelo Viana and Jiagang Yang.

119. ZHOU, Feng: Some existence results on conformal curvature equations in whole space

East China Normal University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: We present some existence results about the conformal curvature equations in higher dimension space. We are looking for solutions with logarithmic growth at infinity for nonpositive curvature functions. We present also a more general condition for the existence of solutions for Gaussian curvature equation and we give an explicit example for which we prove the existence of new type solutions with different remainder term at infinity. This is based on joint works with H. Y. Chen, X. Huang and D. Ye.

120. LIU, Dongwen: Automorphic forms on Kac-Moody groups

Zhejiang University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we survey the recent works on Eisenstein series for Kac-Moody groups, and the construction of cusp forms on loop groups using the method of theta lifting. It is based on the joint work with L. Carbone, H. Garland, K.-H. Lee, S. D. Miller, and the joint work with Y. Zhu.

121. DING, Qi: Area-Minimizing Hypersurfaces in Manifolds

Fudan University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will discuss the existence and non-existence of area-minimizing hypersurfaces in manifolds of nonnegative curvature, and introduce the Sobolev and Neumann-Poincare inequalities on area-minimizing hypersurfaces in manifolds with Ricci curvature bounded below. As special cases, minimal graphs in product manifolds, we will further discuss Liouville type theorems and gradient estimates for the solutions of the minimal hypersurface equation on complete manifolds of nonnegative Ricci curvature.

122. BAO, Yiming: TBD

Beijing Institute of Genomics

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: TBD

123. CAO, Zhigang: Cooperative Functions

Beijing Jiaotong University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: We study a common scenario in industry where returns to scale are nondecreasing and thus full cooperation via pooling all the resources together among related firms is usually the most efficient way of production. This scenario is often modelled as a class of cooperative games, referred to as resource pooling games. We argue that resource pooling games could be better understood via directly analyzing the underlying functions that are referred to as the cooperative functions than via analyzing the induced cooperative games. By combining the pioneering works of Sharkey and Telser (1978) and Aubin (1981), we provide a framework for analyzing cooperative functions. We focus on cooperative functions that are supportable in that nonemptiness of the core is guaranteed for all related resource pooling games, and argue that Aubin core can be adapted to study cooperative functions and has several remarkable advantages over the core. We characterize concave supportable functions and convex supportable function. We find that a cooperative function always derives a convex game if and only if it is ultramodular (i.e., supermodular and coordinate-wise convex). Various related solution concepts, including unnormalized Aubin core and

PMAS, are studied. We also provide several applications of this framework, including linear production games, EOQ games, and newsvendor games.
Keywords. Cooperative games; core; Aubin core; supportable functions; marginal pricing; Aumann-Shapley pricing; PMAS
JEL Classification. C71; D51

124. ZHANG, Zhiyue: Control Problems with PDEs Constraints and its Applications

Nanjing Normal University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, some control problems with PDE constraints and its applications are introduced. Firstly, CNOPs of QG flow are obtained numerically. These results suggest that the CNOPs are applicable to the study of predictability and sensitivity analysis when nonlinearity is of importance. Then, optimal error estimates for the control, state and adjoint state for optimal control problems governed by elliptic PDEs with interfaces in the cases of homogeneous and nonhomogeneous jump conditions are respectively derived. Numerical examples are provided to confirm the theoretical results. Finally, numerical results are presented for optimal control problems with nonlinear singular differential equations constraints.

125. JIN, Xiao-Qing: A Brief Survey of Matrix Manifold Computation

University of Macau

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: This talk is divided into three parts. In the first part, we study the nonnegative inverse eigenvalue problem. We reformulate the problem as an underdetermined constrained nonlinear matrix equation over several matrix manifolds. Then we propose a Riemannian inexact Newton-CG method for solving the nonlinear matrix equation. The global and quadratic convergence of the proposed method is established under some assumptions. Numerical experiments are reported to illustrate the efficiency of the proposed method.

We give the formulation of a Riemannian Newton algorithm for solving a class of nonlinear eigenvalue problems by minimizing a total energy function subject to the orthogonality constraint. Under some mild assumptions, we establish the global and quadratic convergence of the proposed method. Moreover, the positive definiteness condition of the Riemannian Hessian of the total energy function at a solution is derived. Some numerical tests are reported to illustrate the efficiency of the proposed method.

In the last part, we talk about some possible future works.

126. HUA, Bobo: Harmonic functions on graphs

Fudan University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we survey some results about discrete harmonic functions on graphs, including Liouville type theorems, dimensional estimates of the space of polynomial growth harmonic functions, etc. Moreover, we discuss some generalizations to ancient solutions of heat equations.

127. TEH, Jyh-Haur: A characterization of analytic cycles by real rectifiable currents

NTHU

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Analytic cycles are fundamental objects in complex geometry. In this talk I will give a brief review of results given by King, Harvey, Shiffman and Alexander in characterizing integral analytic cycles by integral currents, and introduce my work with Chin-Jui Yang in characterizing real holomorphic chains by real rectifiable currents.

128. JIANG, Yi: Teichmuller spaces of negatively curved metrics on hyperbolic manifolds

YMSC, Tsinghua University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: The Teichmuller space of negatively curved metrics on a hyperbolic manifold M is the quotient of the space of all negatively curved Riemannian metrics on M by the action of the group of all self-diffeomorphisms that are homotopic to the identity. F. T. Farrell and P. Ontaneda have proved that the Teichmuller space of negatively curved metrics on a real hyperbolic manifold is, in general, not contractible. In this talk, I will present joint work with M. Bustamante and F. T. Farrell on showing that the Teichmuller spaces of negatively curved metrics on some real hyperbolic manifolds have nontrivial higher rational homotopy groups.

129. LAU, Siu-Cheong: Equivariant SYZ mirror construction

Boston University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: Teleman conjectured that the mirror of a Hamiltonian G-manifold is a fibration over its Lie algebra. In this talk, I will introduce an equivariant version of SYZ and Lagrangian Floer theory to construct a candidate for such a fibration. We apply the construction to immersed Lagrangians in toric Calabi-Yau manifolds, and obtain certain generating functions which are closely related to the equivariant open GW invariants found by Aganagic-Klemm-Vafa and studied by Katz-Liu, Graber-Zaslow, Fang-Liu-Zong and many others.

14:25-15:10

130. XUE, Cong: Cohomologies of Stacks of Shtukas

University of Cambridge

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: Let G be a connected split reductive group over a finite field $\mathbb{F}_q$ and X a smooth projective geometrically connected curve over $\mathbb{F}_q$. The ℓ-adic cohomology with compact support of stacks of G-shtukas is a generalization of the space of automorphic forms with compact support over the function field of X.

In this talk, I will recall the definition of stacks of G-shtukas and their cohomology groups. I will also construct constant term morphisms on the cohomology groups, which is a generalization of the constant term morphism for automorphic forms.

Then we use the constant term morphisms to show that the cohomology groups of stacks of shtukas are of finite type as modules over the Hecke algebra at an unramified place. This allows us to extend the excursion operators of V. Lafforgue from the space of cuspidal automorphic forms to the space of all automorphic forms with compact support, and gives the Langlands parametrization for some quotient spaces of the latter, in the way compatible with parabolic induction.

131. ZHANG, Weiyi: From smooth to almost complex

The University of Warwick

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: An almost complex manifold is a smooth manifold equipped with a smooth linear complex structure on each tangent space. We will discuss differential topology of almost complex manifolds, explain how to use transversality statements for smooth manifolds to formulate and prove corresponding results for an arbitrary almost complex manifold. The examples include intersection of almost complex manifolds, structure of pseudoholomorphic maps and zero locus of certain harmonic forms.

One of the main technical tools is Taubes' notion of "positive cohomology assignment", which plays the role of local intersection number. I will begin with explaining its motivation through multiplicities of zeros of a smooth function.

Our results would lead to a notion of birational morphism between almost complex manifolds. Various birational invariants, including Kodaira dimension, for almost complex manifolds will be introduced and discussed (this part is joint with Haojie Chen).

132. YU, Hongjun: Spectrum analysis of some kinetic equations

South China Normal University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: We analyze the spectrum structure of some kinetic equations qualitatively by using semi-group theory and linear operator perturbation theory. The physical models include the classical Boltzmann equation for hard potentials with or without angular cutoff and others.

133. JIANG, Jin-Cheng: Boltzmann Collision Operator for the Infinite Range Potential: A Limit Problem

NTHU

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: The conventional Boltzmann collision operator for the infinite range inverse power law model was derived by Maxwell by adopting a collision kernel which is a limit of that for the finite range model by ignoring the glancing angles. Since the interpretation of collision operator for the infinite range potential through limit process to the one with finite range potential is natural in regard to the derivation of

the Boltzmann equation. It is the purpose of this work to clarify the physical meaning of the conventional collision operator for the infinite range inverse power law model through the study of the limiting process of the collision operator as the cutoff radius tends to infinity. We first estimate the extent in which the glancing angles can be ignored in the limiting process. Furthermore we prove that taking limit to collision operator with finite range potential directly will lead to the conventional one with algebraic convergence rate. This is a joint work with Tai-Ping Liu.

134. HE, Danqing: Some recent progress on bilinear operators and multipliers

Sun Yat-sen Universiry

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: Bilinear operators and bilinear multipliers appear often in harmonic analysis and PDEs and their theory has found fruitful uses and applications. In this talk we plan to discuss some recent progress on them and how they diverge from the analogous linear ones. The talk is based on joint work with L. Grafakos, P. Honzík, and L. Slavíková.

135. LIU, Hongwei: Study on Matrix Product Codes over Finite Frobenius Rings

Central China Normal University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: Coding theory is a branch of mathematics concerned with transmitting data across noisy channels and recovering the message. Constructing codes from smaller ones and discussing their properties via those of small ones is an important and hot topic. Blackmore and Norton (2001) introduced the notion of *matrix product code* over a finite field, which is a generalization of many well-known constructions of codes, such as the $(u|u+v)$-construction etc. The properties of matrix product codes and their duals were studied when the related matrix A is *non-singular by columns*. Analogous study on matrix product codes over finite chain rings was given by van Asch in 2008. Some applications of matrix product codes to quantum codes and decoding methods were also studied by several researchers. In this talk, we present some recent results on matrix product codes over finite commutative Frobenius rings. We first explore some properties of matrix product codes over finite commutative Frobenius rings. Minimum Hamming distances of matrix product codes constructed with several types of matrices are bounded in different ways. The dual codes of matrix product codes are also explicitly described in terms of matrix product codes.

We then generalize the results (van Asch, 2008) to matrix product codes over finite principal ideal rings (PIRs) under some assumption on these rings. Very recently, we obtain a necessary and sufficient condition for a homogeneous distance to be a metric. By using this condition, we give a complete description of the lower homogeneous distance bound of matrix product codes over an arbitrary PIR. This talk is based on joint works with Yun Fan, San Ling and Jingge Liu.

136. JIANG, Zilin: Rainbow structures via algebraic topology

Massachusetts Institute of Technology

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Given a (finite) family of structures, is it possible to choose an element from each structure to form a new structure of the same kind? This new structure is poetically called rainbow for we can think of each given structure is in a different color. Some longstanding combinatorial problems, such as transversals in a Latin square and the Caccetta–Haggkvist conjecture, are rainbow in nature. In this talk, we will discuss a line of attacks to such problems via algebraic topology.

137. LEUNG, Shing-Yu: Adjoint State Methods for Solving Inverse Problems of Partial Differential Equations

The Hong Kong University of Science and Technology

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: We present recent numerical methods for solving inverse problems for partial differential equations. In the first part of the talk, we discuss various numerical methods to some inverse problems originated from traveltime tomography and inverse gravimetry. We first formulate these inverse problems in variational formulations. To minimize the energy in the variational formulation, we derive the gradient of the nonlinear functional which can be efficiently computed using the adjoint state method. In the second part, we propose a simple algorithm for solving an inverse problem for the Schrödinger equation. To speed up the computations, we also develop a cascadic initialization strategy to provide a better initial condition for the inversion process. To be more realistic for real life applications, we incorporate techniques from the level set method to handle cases with only a set of finite number of Dirichlet-to-Neumann (DN) measurements. Moreover, based on a usual reduction, this inverse problem can be linked to the standard Calderón inverse problem for the electrical impedance tomography (EIT).

138. SHIUE, Ming-Cheng: Data assimilation algorithms based on Synchronization of truth and models

NCTU

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we first recall continuous and discrete data assimilation algorithms that were proposed for designing finite-dimensional feedback controls for two-dimensional Navier-Stokes equations. Then, two new nudging methods, hybrid nonlinear and delay-coordinate nudging are considered and studied.

In the first part, hybrid nonlinear continuous data assimilation algorithms for Lorenz systems will be studied and presented. In the literature, Pecora and Carrol (1990) considered a linear synchronization for a three-variable Lorenz model and numerically found that observing the z variable did not lead to synchronization while observing x or y did. Later, for the same type of synchronization, it was found that synchronizing with y observations is more efficient than with x in Yang et al. (2006). These phenomena will be proven mathematically and explained. Furthermore, three-type hybrid nonlinear nudging techniques are considered to speed up the convergence of rate for the linear nudging one. It is shown that the approximate solutions converge to the unknown reference solutions over time provided that the first or second variable of Lorenz systems is only synchronized. Numerical simulations are performed to demonstrate these results. This is joint work with Yi Juna Du.

In the second part, two new continuous and discrete data assimilation algorithms for two-dimensional Navier-Stokes equations are presented and studied. The explicit use of present and past observations at each time step provides a way that new methods might outperform the old one, which was successfully tested for Lorenz 96 model. In this talk, we will give preliminary results that provide sufficient conditions on the finite-dimensional spatial resolution of the collected data and observational measurements to make sure that the approximate solutions obtained from the new algorithms converge to the unknown reference solutions over time.

139. REN, Kui: Hybrid Inverse Problems with Nonlinear Physics: Modeling and Analysis

University of Texas at Austin

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Hybrid inverse problems appear in imaging modalities where one combines two imaging methods that are based on different physics to achieve imaging abilities that can not be offered by only one of the methods involved. In this talk, we discuss some recent developments on the mathematical, computational and modeling

aspects of hybrid inverse problems where nonlinear physical effects play essential roles for the application purposes.

140. CHENG, Xiuyuan: Group-equivariant Representation by Jointly Decomposed Convolution

Duke University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Explicit encoding of group actions in data representation is desired for convolutional neural networks (CNNs) to successfully handle global deformations in input signals. In this talk, we introduce group-equivariant deep CNNs where the convolutional filters are jointly decomposed over steerable bases on the space and the group geometry simultaneously. This decomposition significantly reduces the model size and computational complexity while preserving network performance, and it also serves to regularize the convolutional filters by the truncation of bases expansion. The stability of the equivariant representation with respect to input variations is proved theoretically and also demonstrated on computer vision tasks where the datasets involve in-plane and out-of-plane object rotations. The work provides a general approach to achieve group equivariant features in deep CNNs with representation stability and computational efficiency.

141. PAN, Yu: Stable Maps, Cycles And Fano Varieties

Massachusetts Institute of Technology

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will report our works on the geometry of moduli spaes of rational curves on Fano varieties (e.g. low degree complete intersections) and the applications to some cycle-problems.

142. WANG, Ye-Kai: Evaluating Quasi-local Angular Momentum and Center-of-Mass at Null Infinity

NCKU

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: We calculate the limits of the quasi-local angular momentum and center-of-mass defined by Chen-Wang-Yau (Commun. Math. Phys. 2015) for a family of

spacelike twospheres approaching future null infinity in an asymptotically flat spacetime admitting a Bondi-Sachs expansion. We obtain explicit expressions for the angular momentum and center-of-mass at future null infinity in terms of the observables appearing in the Bondi-Sachs expansion of the spacetime metric. This is a joint work with Jordan Keller and Shing-Tung Yau.

143. XU, Zhouli: The intersection form of spin 4-manifolds and Pin(2)-equivariant Mahowald invariants

Massachusetts Institute of Technology

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: A fundamental problem in 4-dimensional topology is the following geography question: "which simply connected topological 4-manifolds admit a smooth structure?" After the celebrated work of Kirby-Siebenmann, Freedman, and Donaldson, the last uncharted territory of this geography question is the "11/8-Conjecture". This conjecture, proposed by Matsumoto, states that for any smooth spin 4-manifold, the ratio of its second-Betti number and signature is least 11/8.

Furuta proved the "$10/8 + 2$"-Theorem by studying the existence of certain Pin(2)-equivariant stable maps between representation spheres. In this talk, we will present a complete solution to this problem by analyzing the Pin(2)-equivariant Mahowald invariants of powers of certain Euler classes in the RO(Pin(2))-graded equivariant stable homotopy groups of spheres. In particular, we improve Furuta's result into a "$10/8 + 4$"-Theorem. Furthermore, we show that within the current existing framework, this is the limit. For the proof, we use the technique of cell-diagrams, known results on the stable homotopy groups of spheres, and the j-based Atiyah-Hirzebruch spectral sequence.

This is joint work with Michael Hopkins, Jianfeng Lin and XiaoLin Danny Shi.

144. LI, Wei: How to glue plane partitions to construct new VOAs/affine Yangians.

ITP Beijing

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: There exists a useful triangle connecting W symmetry, affine Yangian, and plane partition representations. Further, this triangle can serve as the building block for new VOA's and affine Yangians. I will explain the gluing procedure in this construction.

As an example, we construct a four-parameter family of affine Yangian algebras by gluing two copies of the affine Yangian of $gl1$, which is a two-parameter generalization of the $N = 2$ supersymmetric affine Yangian. All algebras that we construct

have natural representations in terms of "twin plane partitions", a pair of plane partitions appropriately joined along one common leg. We observe that the geometry of twin plane partitions, which determines the algebra, bears striking similarities to the geometry of certain toric Calabi-Yau threefolds.

15:30-16:15

145. CHI, Jingren: Geometry of Kottwitz-Viehmann varieties

Université Paris-Sud

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: We survey some results and conjectures on the geometric properties of the so-called Kottwitz-Viehmann varieties, which are analogues of affine Springer fibers that encode orbital integrals of spherical Hecke functions on a reductive group over equi-characteristic non-archimedean local fields.

146. FU, Yongqiang: Multiplicity and bifurcation of positive solutions for nonhomogeneous semilinear fractional Laplacian problems

Harbin Institute of Technology

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: We consider the following nonhomogeneous semilinear fractional Laplacian problem $(-\Delta)^s u+u = \lambda(f(x,u)+h(u))$ in $H^s(\mathbb{R}^n)$. We prove that under suitable conditions on f and h, there exists $\lambda^* \in (0,\infty)$ such that the problem has at least two positive solutions if $\lambda \in (0,\lambda^*)$, a unique positive solution if $\lambda = \lambda^*$, and no solution if $\lambda > \lambda^*$. We also obtain the bifurcation of positive solutions for the problem at $(\lambda^* *, u^*)$ and further analyse the set of positive solutions.

147. FANG, Xiang: Random Weighted Shifts

NCU

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: The term "Random Operator Theory (ROT)", as a random counterpart of bounded and non-selfadjoint operator theory, is not really well conceived. Random

Matrix Theory (RMT) has evolved into a remarkably sophisticated subject, yet much less is known for its infinite dimensional counterpart. Our knowledge on ROT so far is devoted (almost) exclusively to self-adjoint and unbounded differential operators, such as random Schrodinger operators. In this report we introduce and study a clearly fundamental yet unexplored model, which we call "random weighted shifts". This appears to be the first in-depth analyzed random model for non-selfadjoint, bounded operators. Other models, such as random Hardy/Bergman spaces, random Toeplitz operators, random coefficient multipliers, random Carleson measures, etc., are proposed, but we have more questions than answers.
(Joint work with Cheng Guozheng and Zhu Sen.)

148. GUO, Qi: Minkowski valuation compatible with translations and a linear transformation

Suzhou University of Science and Technology

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will introduce a kind of Minkowski valuations on convex bodies which are compatible in some sense with the translation transformation group and a linear transformation on the Euclidean space $\mathbb{R}^n$, and then show their properties. More concretely, for Minkowski valuations we first define a kind of compatibility which all linear transformations (as valuations) possess naturally, and then characterize such a kind of valuations. As a consequence, we obtain the characterization of linear transformations as valuations.

149. JIAO, Yong: Recent Advances on the Theory of Noncommutative Differentially Subordinate Martingales

Central South University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will report some new advances regarding the theory of noncommutative differentially subordinate martingales. The classical differential subordination of martingales, introduced by Burkholder in the eighties, is generalized to the noncommutative setting. Working under this domination, we establish the strong-type inequalities with the constants of optimal order as $p \to 1$ and $p \to \infty$, and the corresponding endpoint weak-type $(1,1)$ estimate. In contrast to the classical case, we need to introduce two different versions of noncommutative differential subordination, depending on the range of the exponents. For the Lp-estimate, $2 \leq p < \infty$, a certain weaker version is sufficient; on the other hand, the strong-type (p,p) inequality, $1 < p < 2$, and the weak-type $(1,1)$ estimate require a stronger

version. We also introduce a notion of strong differential subordination of noncommutative semimartingales, establish the maximal weak-type $(1,1)$ inequality under the additional assumption that the dominating process is a submartingale, and show the corresponding strong-type (p,p) estimate for $1 < p < \infty$ under the assumption that the dominating process is a nonnegative submartingale. Finally, we give some estimates of square functions for noncommutative differentially subordinate martingales. This is accomplished by combining several techniques, including interpolation flavor method, Doob-Meyer decomposition, a significant extension of the maximal weak-type estimate of Cuculescu and a Gundy-type decomposition of an arbitrary noncommutative submartingale. This is several joint work with Adam Osekowski, Lian Wu, Narcisse R. and Dejian Zhou.

150. ZHOU, Bo: Some aspects of spectral graph theory

South China Normal University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: Spectral graph theory studies the properties of a graph in relationship to the eigenvalues, eigenvectors, and characteristic polynomials of its associated matrices, such as adjacency matrix, Laplacian matrix, signless Laplacian matrix, distance matrix, etc. We discuss some aspects of spectral graph theory, including adjacency eigenvalues, Laplacian eigenvalues and characteristic polynomials, signless Laplacian eigenvalues and distance eigenvalues.

151. JI, Lijun: t-wise balanced designs, orthogonal arrays and large sets

Soochow University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: A t-wise balanced design (tBD) $S(t,K,v)$ is a pair $(X,\mathcal{B})$, where X is a v-element set and $\mathcal{B}$ is a set of subsets of X, each of cardinality from K (called *blocks*) with the property that every t-subset of X is contained in a unique block. For $t = 2$, much work has been done, however, there is a little progress on $t \geq 3$. In this talk, we survey constructions known results about tBD, including the related orthogonal arrays and large sets of triple systems.

152. LI, Martin Man-Chun: Mean curvature flows with boundary

The Chinese University of Hong Kong

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Mean curvature flow (MCF) is the negative gradient flow for the area functional in Euclidean spaces, or more generally in Riemannian manifolds. Over the past few decades, there have been substantial progress towards our knowledge on the analytic and geometric properties of MCF. For compact surfaces without boundary, we have a fairly good understanding of the convergence and singularity formation under the flow. In this talk, we will discuss some recent results on MCF of surfaces with boundary. In the presence of boundary, suitable boundary conditions have to be imposed to ensure the evolution equations are well-posed. Two such boundary conditions are the Dirichlet (fixed or prescribed) and Neumann (free or prescribed contact angle) boundary conditions. We will mention some new phenomena in contrast with the classical MCF without boundary and discuss some potential applications. These works are partially supported by RGC grants from the Hong Kong Government.

153. LI, Hengguang: New 3D Anisotropic Algorithms for Singular Solutions

Wayne State University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: New mesh algorithms were developed for finite element approximations of elliptic equations with singularities. These algorithms are simple, intuitive, and impose fewer geometric constraints on the domain. The resulting mesh is generally anisotropic and may not possess the maximum angle condition. In this talk, we present the principles that lead to these algorithms, as well as recent developments in relevant areas, such as new regularity results on polyhedral domains, optimal numerical schemes approximating 3D solutions with vertex and edge singularities, and the conditioning of the discrete system.

154. WU, Haijun: Finite Element Methods for Helmholtz Equation with High Wave Number

Nanjing University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will discuss several aspects on finite element methods for Helmholtz equation with high wave number, including a preasymptotic priori

error estimates, a posteriori error estimates, convergence and quasi-optimality of the adaptive algorithm, and how to reduce the pollution error.

155. HUANG, Jianguo: Some high performance numerical methods for high order evolution equations

Shanghai Jiao Tong University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: High order evolution equations are frequently encountered in the fields of civil engineering, material science, structural analysis and electrical engineering. In this talk, we will present several high performance numerical methods for solving such equations.

For an abstract second order evolution equation, we first derive the a posteriori error bound for a numerical method discretized by the P2-continuous discontinuous Galerkin method in time. Based on this bound and some technical treatment, we propose an adaptive time stepping method for the previous equation. Then, the method is applied to develop an adaptive time stepping algorithm for a fully discrete method of wave equations, after deriving a posteriori error bound of the discrete method by means of a tricky construction of an elliptic reconstruction operator and the energy method. Next, we develop a fast compact time integrator method for numerically solving a family of general order semilinear evolution equations in regular domains. The spatial discretization is carried out by a fourth-order accurate compact difference scheme in which fast Fourier transform can be utilized for efficient implementation. The resulting semi-discretized problem consists of a system of ordinary differential equations whose solution can be explicitly expressed in term of the Duhamel principle, and the final numerical method is then obtained by further adopting multistep approximations of the nonlinear term and exact evaluation of related integrals. Extensive numerical experiments are reported to demonstrate the efficiency of the proposed methods.

This is a joint work with Yuling Guo, Lili Ju, Junjiang Lai, Huashan Sheng, Tao Tang and Bo Wu

156. XIA, Chao: New Minkowski type formulas for free boundary hypersurfaces in balls and applications

Xiamen University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will present a family of new Minkowski formulas for free boundary hypersurfaces, or more generally capillary hypersurfaces, in balls.

Two applications will be given. On one hand, we use it to classify all stable capillary hypersurfaces in balls to be umbilical ones. One the other hand, we use it to define a class of locally constraint inverse type curvature flows and show a family of Alexandrov-Fenchel¡¯s inequalities for free boundary hypersurfaces in balls. The talk is based on joint works with Guofang Wang and Julian Scheuer.

157. CHUANG, Wu-Yen: The Hilbert scheme of a multiple plane and the W-vacuum

NTU

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: A W-algebra action is constructed on the equivariant Borel-Moore homology of the Hilbert scheme of points on a multiple plane, identifying it to the vacuum W-module. This is based on a generalization of the ADHM construction as well as the W-action on the equivariant Borel-Moore homology of framed sheaves on the projective plane constructed by Schiffmann and Vasserot.

158. GE, Jian: Geometric Properties of Fillings of Positively Curved Alexandrov Spaces

Peking University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: We call an Alexandrov space X is a filling of a positively curved Alexandrov space V, if the boundary of X is isometric to V with respect to the induced length metric. Various geometric properties of such fillings will be studied. In particular we show that when V is large in some sense, X is rigid. Part of this talk is based on joint works with Ronggang Li.

159. LIOU, Jia-Ming: An Explicit Solution to the Mean Field Equation on Hyperelliptic Curves

NCKU

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: The mean field equation originally came from the study of prescribing (Gaussian) curvature problems in differential geometry. Lin and Wang studied the mean field equation of the following type:

$$\Delta u + \rho e^u = \rho \delta_0 \tag{1}$$

on flat torus T and discovered that the equation posses a solution if and only if the Green's function on T has critical points other than the three half-period points when $\rho = 8\pi$. In a recent paper by Chai, Lin, Wang, they showed that when $4\pi(2n+1)$, $n \in \mathbb{Z}_+$, the number of solutions to 1 is $n+1$ except for a finite number of conformal isomorphism classes of flat tori and when $\rho = 8\pi n$, where n is a positive integer, the solvability of 1 depends on the moduli space of flat tori.

Let X be a compact Riemann surface of genus $g \geq 2$ and ds^2 be the canonical metric on X: Lewittes proves that the Gaussian curvature function K of (X, ds^2) is nonpositive and the zero set Z of K is nonempty if and only X is hyperelliptic. In the case $Z \neq \emptyset$, Z coincides with the set of the set of Weierstrass points of K: If we denote $u = \log(-K)$ on $U = X - Z$, then we proved that u is a solution to the mean field equation of the following type

$$\Delta u + 6e^u = 4\pi \sum_{P \in \mathbb{Z}} \delta_P \tag{2}$$

when $g = 2$. When $g > 2$, the function $u = \log(-K)$ is no longer a solution to 2. We will give an algebraic construction of a solution to 2 for higher genus hyperelliptic curves over $\mathbb{C}$.

In the first part of the talk, I will briefly review the notion of the canonical metric on a compact Riemann surface; in the second part of the talk, I will present the construction of solutions to 2 on complex hyperelliptic curves of genus $g \geq 2$. At the end of the talk, I will discuss the future work in this direction.

16:25-17:10

160. HU, Haoyu: Ramification theory of ℓ-adic sheaves

Nanjing University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will introduce developments of the ramification theory of ℓ-adic sheaves on higher dimensional positive characteristic varieties following approaches of A. Abbes, A. Beilinson, T. Saito... As an application, I will introduce a recent work joint with J.-B. Teyssier that studies a ramification bound of Galois actions on nearby cycles of ℓ-adic sheaves.

161. LI, Ke: Probability, Statistics and Information in our Quantum World

Harbin Institute of Technology

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: At first, I will review the mathematical foundations of quantum mechanics, and explain why we are interested in the interplay among probability, statistics and information in our quantum world, as well as the new features and difficulties. Then, I will report my results in this research topic: 1) second-order asymptotics and multiple Chernoff distance in the asymptotic theory of quantum hypothesis testing; 2) a de Finetti theorem in quantum probability.

162. WU, Senlin: Covering and illumination of convex bodies

North University of China

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Hadwiger's covering conjecture is a long-standing open problem in Discrete and Convex geometry asserting that each n-dimensional convex body which is not affinely equivalent to the n-cube can be covered by $2^n - 1$ of its smaller homothetic copies. One of the equivalent forms of this conjecture is: the boundary of each n-dimensional convex body which is not affinely equivalent to the n-cube can be illuminated by $2^n - 1$ directions. We present several of our recent progresses in this direction.

163. LAW, Chun-Kong: Spectral analysis of periodic quantum graphs associated with Archimedean tilings

NSYU

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: There are totally 11 kinds of Archimedean tilings for the plane, including hexagonal tiling (6^3) and truncated square tiling $(4, 8^2)$. Applying the Floquet-Bloch theory, we use a characteristic function approach to derive the dispersion relations of all the periodic quantum graphs associated with these Archimedean tilings. With these dispersion relations, we can make further analysis on the structure of spectra. We shall also show the existence of infinitely many Dirac points for certain periodic quantum graphs. Under the quantum network model, graphene and carbon allotropes can be viewed as periodic quantum graphs associated with some tilings. Our results

offer a rigorous mathematical analysis of these models. This is motivated by the pioneering works of Kuchment-Post, Korotyaev-Lobanov, and Fefferman-Weinstein.

164. ZHOU, Douglas: The structure, dynamics and function of neuronal networks

Shanghai Jiao Tong University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will describe how mathematics can play important roles in revealing the relationship among the structure, the dynamics and the function of neuronal networks. First, I will present our modeling work about how to establish an effective point neuron model which is capable of capturing the nonlinear dendritic integration of real neurons, therefore, one can efficiently simulate the real neuron dynamics without taking into account the complicated morphology of real neurons. Then I will discuss how to infer the network connectivity structure by measuring the output signals of neuronal networks. By solving this inverse problem, one can build up the large-scale computational neuronal network model of certain cortical regions. Finally, I will focus on the early visual pathway of primates and use our modeling, analysis and simulation, in comparison with experimental observations, to understand the coding principle of the primary visual cortex.

165. SU, Changjian: Maulik-Okounkov stable bases and representation theory

University of Toronto

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: The stable bases was introduced by Maulik and Okounkov in their study of quantum cohomologies of symplectic resolutions. In this talk, we will review basic facts about the stable bases for the Springer resolution, focusing on their relations to representations of Lie algebras over complex numbers and algebraically closed positive characteristic fields, and of the Langlands dual group over non-Archimedean local fields.

166. MA, Jicheng: On the automorphism groups of arc-transitive covering graphs

Chongqing University of Arts and Sciences

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In the classification of arc-transitive covering graphs, not many effective methods are known to determine the full automorphism groups of the covering graphs. The reason is that, for each automorphism of the covering graph, it is difficult to tell the projection along a given regular covering projection. In this talk, we will discuss and give the recent results on the automorphism groups of arc-transitive covering graphs.

167. CAI, Li: IB/FE Method for Cardiac FSI Problems

Northwestern Polytechnical University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: The immersed boundary method is an approach to FSI that uses a Lagrange description of the structural and an Eulerian description of the fluid-structure system. Based on the weak formulation, the standard nodal finite element method is used to calculate the internal force density and the transmission force density. Hence, our approach uses a finite element discretizations of the structure while using a finite difference scheme for the Eulerian variables. The proposed method is used to study the fluid-structure interaction problems encountered in human cardiovascular system (left ventricle, artery, mitral valve and etc).

168. GONG, Wei: Analysis and approximations of Dirichlet boundary controls of PDEs

LSEC, Chinese Academy of Sciences

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk I will summarize our recent results on Dirichlet boundary control problems governed by PDEs. We study Dirichlet boundary control problems in different formulations, including the $L^2(\Gamma)$-setting and the energy space method, for different PDEs such as the elliptic equation, parabolic equation and Stokes equation. We show the well-posedness of the optimization problems and give the corresponding regularity results, which behaves quite different for different formulations and PDEs. Moreover, we present several numerical methods for approximating the Dirichlet boundary control problems, and give the respective convergence results.

169. WANG, Yingwei: Fast Structured Spectral Methods

SAS Institute Inc.

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Spectral methods have been used extensively in numerical PDEs due to their higher order of accuracy when compared to finite differences and finite elements methods. However, other low order methods usually lead to sparse linear systems while spectral methods often suffer from a huge computational complexity caused by dense matrices. In this talk, I will show that although the matrices arising from spectral methods are dense, they enjoy a hidden low-rank structure. This property could be exploited to dramatically reduce the computational cost and give birth to direct solvers with nearly optimal complexity and memory, thanks to the hierarchically semiseparable (HSS) representation for structured matrices. Both theoretical analysis and numerical experiments verify the efficiency and accuracy of our proposed methods.

170. LO, Wing-Cheong: Modeling Morphogen-mediated Patterning and Growth Control

City University of Hong Kong

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Morphogens are diffusive molecules produced by cells, sending signals to neighboring cells in tissues for communication. As a result, tissues develop cellular patterns that depend on the concentration levels of the morphogens. The formation of morphogen gradients is among the most fundamental biological processes during development, regeneration, and disease. During the past two decades, sophisticated mathematical models have been utilized to decipher the complex biological mechanisms that regulate the spatial and temporal dynamics of morphogens. In this talk, we will discuss the model formulations for morphogen systems and present the mathematical questions and numerical tools that arise from the model analysis, with an emphasis on Drosophila.

171. GONG, Sherry: The Novikov conjecture, the group of volume preserving diffeomorphisms, and Hilbert-Hadamard spaces

UCLA Department of Mathematics

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: We discuss the Novikov conjecture and explain that a version of it holds for manifolds whose fundamental groups admit proper and isometric actions on certain non-positively curved infinite dimensional spaces called Hilbert-Hadamard spaces. This talk is based on joint work with Jianchao Wu and Guoliang Yu (arxiv1811.02086).

172. GUO, Lujun: The Spherical Harmonics in Convex Geometric Analysis and Related Problems

Henan Normal University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Spherical integral transforms are important tools in modern geometry and have a wide rang of applications in functional analysis, geometric tomography, convex geometry analysis and statistical geometry. The thesis originates from the use of harmonics analysis in convex geometry analysis, and even more precisely, the applications of spherical integral transforms to the questions of uniqueness and stability for convex bodies and the questions of volume inequalities. These problems have attracted increased interest for this direction and some important results have been obtained.

173. CHENG, Lijuan: Characterization of Pinched Ricci Curvature by Functional Inequalities

University of Luxembourg

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will introduce some functional inequalities for diffusion semigroups on Riemannian manifolds (possibly with boundary), which are equivalent to pinched Ricci curvature, along with gradient estimates, L^p-inequalities and log-Sobolev inequalities. These results are further extended to differential manifolds carrying geometric flows. As application, it is shown that they can be used in particular to characterize general geometric flow and Ricci flow by functional inequalities.

174. GARCIA-GARCIA, Antonio Miguel: Sachdev-Ye-Kitaev model: chaos, wormholes and combinatorial analysis

Shanghai Jiao Tong University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: I introduce the Sachdev-Ye-Kitaev (SYK) model, N Majorana fermions with infinite range interactions, which is a toy model for holography.

By using the Riordan-Touchard theorem and other combinatorial analysis techniques, I compute analytically the spectral density and show that it is consistent with that of a quantum black hole. For sufficiently long times, the SYK model is ergodic and spectral correlations are given by random matrix theory which suggests that this is also a generic feature of quantum black holes. In the low energy region, the coupling of two SYK's models is dual to a traversable wormhole. The spectral density of this model, which is computed analytically by mapping the problem to a charged particle in a hyperbolic space, has continuous and discrete parts. The latter is related to the wormhole phase whose spectral statistics show deviations from the random matrix theory prediction.

Thursday, June 13th

08:30-09:30

175. LI, Wen-Ching Winnie: The Ramanujan conjecture: from theory to applications

Pennsylvania State University

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: Originally predicted by Ramanujan in 2016 for the discriminant function, the Ramanujan conjecture is a very deep statement concerning the size of the Fourier coefficients of cusp forms. The generalized Ramanujan conjecture expects that a generic cuspidal irreducible unitary automorphic representation of a reductive group over a global field should be locally tempered. While this conjecture is largely open to-date, it is established for certain cases.

In this survey talk we shall review the current status of this conjecture and explain some novel applications of the proven cases to explicitly construct Ramanujan graphs and Ramanujan complexes, uniformly distributed points on spheres, and Golden Gate sets in quantum computing. The Ramanujan conjecture is closely tied to the Riemann Hypothesis. We shall also explain the connection between Ramanujan graphs/complexes and the Riemann Hypothesis satisfied by their associated zeta functions.

176. TSAI, Tai-Peng: Global existence of Navier-Stokes equations for non-decaying initial data

University of British Columbia

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Consider the Cauchy problem of incompressible Navier-Stokes equations in $\mathbb{R}^3$ with uniformly locally square integrable initial data. If the square integral of the initial datum on a ball vanishes as the ball goes to infinity, the existence of a time-global weak solution was known. However, such data do not include constants, and

the only known global solutions for non-decaying data are either for perturbations of constants, or when the velocity gradients are in L^p with finite p. In this talk, I will outline how to construct global weak solutions for non-decaying initial data, first for those whose local oscillations decay, no matter how slowly, and second for those whose uniform local square integral grows in scale under a certain rate. These are joint work with Kwon and Bradshaw, respectively.

177. LIU, Chiu-Chu Melissa: Topological recursion and enumerative geometry

Columbia University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: TBD

178. XIE, Feng: Vanishing Viscosity Limit and Boundary Layer Theory in Magneto-Hydrodynamics

Shanghai Jiao Tong University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will recall the classical Prandtl boundary layer double-scale asymptotical expansions in the analysis of structure of fluids with the high Reynolds number in a domain with boundaries. Vanishing viscosity limit can be regarded as a direct application of Prandtl boundary layer asymptotical expansions. The Prandtl boundary layer theory includes the well-posedness of solutions to the Prandtl boundary layer equations and the justification of Prandtl boundary layer asymptotical expansions etc. Motivated by one open problem in the classical book "Mathematical models in Boundary Layer Theory" by O.A. Oleinik and V.N. Samokhin. We consider the boundary layer theory in Magneto Hydrodynamics. The solvability of MHD boundary layer equations and the validity of Prandtl boundary layer ansatz for MHD equations are studied in Sobolev spaces. Compared with the well-posedness theory of the classical Prandtl equations for which the monotonicity condition of the tangential velocity plays a crucial role, this monotonicity condition is not needed for MHD boundary layer any more. Moreover, the validity of Prandtl boundary layer ansatz for MHD is also achieved in Sobolev spaces for some physical parameter regime.

09:40-10:40

179. ZHU, Xinwen: From arithmetic Langlands to geometric Langlands and back

California Institute of Technology

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: The arithmetic Langlands program, proposed by Robert Langlands in 1960s, unifies many questions in number theory and representation theory, and has found significant applications to solving classical Diophantine equations. The geometric Langlands program, formulated by Drinfeld and Laumon in 1980s, enlarges the scope of the Langlands philosophy and makes it contact with other subjects such as physics. Interestingly, in recent years, some ideas from the geometric theory also inspire and lead developments of the traditional arithmetic theory and related problems. I will give an impression of some of these recent developments.

180. XUE, Jinxin: Noncollision singularities in Newtonian four-body problem

YMSC, Tsinghua University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: It was conjectured by Painleve in 1897 that in Newtonian N-body problem for $N > 3$ there exist initial conditions leading to finite time blow up solutions without passing through collisions. This kind of initial conditions are called noncollision singularities. In this talk, we explain our proof of this conjecture in the $N = 4$ case.

181. LI, Si: Singularities: from L^2 Hodge theory to Seiberg-Witten geometry

YMSC, Tsinghua University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Let X be a non-compact Calabi-Yau manifold and f be a holomorphic function on X with compact critical locus, satisfying a general asymptotic condition. We establish a version of twisted L^2 Hodge theory for the pair (X, f) and prove the corresponding Hodge-to-de Rham degeneration property. It can be viewed as a generalization of Kyoji Saito's higher residue theory and primitive forms for isolated

singularities, putting Landau-Ginzburg B-model of the pair (X, f) into the same setting as compact Calabi-yau manifolds. In the second part of the talk, I will explain a connection between primitive forms and 4d N=2 Seiberg-Witten geometry.

182. LI, Jing: On Compressible Navier-Stokes Flows with Degenerate Viscosities

AMSS, Chinese Academy of Sciences

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we consider the existence of global weak solutions to the barotropic compressible Navier-Stokes equations with degenerate viscosity coefficients. We construct suitable approximate system which has smooth solutions satisfying the energy inequality, the BD entropy one, and the Mellet-Vasseur type estimate. Then, after adapting the compactness results due to Bresch-Desjardins (2002, 2003) and Mellet-Vasseur (2007), we obtain the global existence of weak solutions to the barotropic compressible Navier-Stokes equations with degenerate viscosity coefficients in two or three dimensional periodic domains or whole space for large initial data. This, in particular, solved an open problem proposed by Lions (1998). This is a joint work with Zhoupng Xin (CUHK).

11:00-11:45

183. CHEN, Huayi: On comparison between minima and slopes

Université Paris Diderot

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: The successive minima of Minkowski are classic invariants of Euclidean lattices. More recently, the notion of slopes has been discovered by Stuhler and Grayson, inspired by the geometry of vector bundles over a smooth projective curve. In this lecture, I will explain the construction of these invariants and their comparison.

184. JIN, Long: Control and stabilization on hyperbolic surfaces

Tsinghua University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we discuss some recent results concerning the control and stabilization on a compact hyperbolic surface. In particular, we show that the Laplacian eigenfunctions have uniform lower bounds on any nonempty open set; the linear Schrödinger equation is exactly controllable by any nonempty open set; and the energy of solutions to the linear damped wave equation with regular initial data decay exponentially for any smooth damping function. The new ingredient is the fractal uncertainty principle for porous sets by Bourgain-Dyatlov. This is partially based on joint work with Semyon Dyatlov.

185. DUAN, Renjun: Global well-posedness for the Boltzmann equation

The Chinese University of Hong Kong

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk I will present our recent study of global-in-time existence of solutions to the Boltzmann equation in perturbation framework. The focus is on the choice of function spaces for initial data in different settings of the problem. In the cutoff case, initial data are allowed to have large oscillations and even contain vacuum. In the non cutoff case, since the existence of classical solutions has been well established, we look for solutions with mild regularity in space and velocity variables. Through discussions of these results, I will also propose some related problems that still remain to be solved.

186. DONG, Hongjie: Mixed boundary value problem in irregular domains

Brown University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: I will report some recent results about the mixed Dirichlet-conormal boundary value problem in irregular domains. We consider the cases when the interfacial boundary is sufficiently flat or Lipschitz. This is based on joint work with Jongkeun Cho and Zongyuan Li.

187. ZHANG, Ruibin: Affine Temperley-Lieb categories and Schur-Weyl duality for certain infinite dimensional representations of quantum SL(2)

University of Sydney

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: We show that the Temperley-Lieb category of type B is equivalent to the full subcategory of $U_q(\mathfrak{sl}_2)$-modules with objects $M \otimes V^{\otimes r}$ $(r \geq 0)$, where V is the 2-dimensional simple module and M is any fixed projective Verma module. This generalises the well-known finite dimensional Schur-Weyl duality between $U_q(\mathfrak{sl}_2)$ and the Temperley-Lieb algebra, which underlies the quantum group theoretical construction of the Jones polynomial. We prove the equivalence of categories by using a new formulation of the affine Temperley-Lieb category and various incarnations of it, including the type B Temperley-Lieb category, as subquotients of the framed tangle category. This is joint work with Gus Lehrer and Kenji Iohara.

188. NIE, Sian: Geometric properties of affine Deligne-Lusztig varieties

AMSS, Chinese Academy of Sciences

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Affine Deligne-Lusztig varieties (ADLVs) are natural analogues of classic Deligne-Lusztig varieties. The study of ADLVs arose from the field of arithmetic geometry, which plays an important role in the study of Shimura varieties. I will give a survey on the geometric properties of ADLVs, with an emphasis on recent progresses.

189. ZHANG, Linbo: Some Core Algorithms for the Implementation of Parallel Adaptive Finite Element Methods

LSEC, Chinese Academy of Sciences

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will present some core algorithms for the implementation of parallel adaptive finite element methods, including algorithms for local mesh refinement and coarsening, mesh partitioning and dynamical load balancing, and numerical quadrature for high order FEM and XFEM. The algorithms presented in this talk have been implemented in the open source parallel adaptive finite element toolbox Parallel Hierarchical Grid (PHG, http://lsec.cc.ac.cn/phg/). They are the basic building blocks and are crucial for the good performance and parallel scalability of parallel adaptive finite element application programs.

190. WANG, Wei-Cheng: An Efficient Solver for Fractional Diffusion Equations

NTHU

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: The fractional order differential operators have attracted considerable attention recently as an essential tool for developing more sophisticated mathematical models that can accurately describe complex anomalous systems. Since the fractional order differential operators are nonlocal, the corresponding linear system involves a dense, structured Toeplitz matrix. Many research activities are devoted to developing robust and efficient solvers for such linear systems. In this talk, we propose a numerical method for the fractional diffusion equations based on a new preconditioner that can be used to develop direct and iterative solvers for fractional diffusion equations with total $O(N \log N)$ operations per time step. Numerical results suggests the new method is a competitive alternative to existing methods.

191. YEH, Li-Ming: Uniform estimates for Maxwell equations in a periodic heterogeneous domain

NCTU

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: We present some uniform estimates for the solutions of the time-harmonic Maxwell's equations in a periodic heterogeneous domain. The domain is assumed to consist of two periodic sub-regions. One type of sub-region of small size is compactly embedded in each period so that this region is globally disconnected. The other type of sub-region consists of the rest of the domain. The ratios between the electric permittivity and magnetic permeability in one sub-region and those in the other sub-region are assumed to have high contrast. In this talk, some classical uniform estimates for elliptic equations in a periodic heterogeneous domain are recalled first. Then L^p estimates for the solutions of the time-harmonic Maxwell's equations are given. The estimates are uniform in the contrast ratio, the size of embedded region, and the size of period.

192. TANG, Huazhong: Physical-constraints-preserving schemes for special relativistic magnetohydrodynamic equations

Peking University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: We first study the admissible state set G of special relativistic magnetohydrodynamics (RMHD). It paves a way for developing physical-constraints-preserving (PCP) schemes for the special RMHD equations with the solutions in G. To overcome the difficulties arising from the extremely strong nonlinearities and no explicit formulas of the primitive variables and the flux vectors with respect to the conservative vector, two equivalent forms of G with explicit constraints on the conservative vector are skillfully discovered. The first is derived by analyzing roots of several polynomials and transferring successively them, and further used to prove the convexity of G with the aid of semi-positive definiteness of the second fundamental form of a hypersurface. While the second is derived based on the convexity, and then used to show the orthogonal invariance of G. The LxF splitting property does not hold generally for the nonzero magnetic field, but by a constructive inequality and pivotal techniques, we discover the generalized LxF splitting properties, combining the convex combination of some LxF splitting terms with a discrete divergence-free condition of the magnetic field. Based on the above analyses, several 1D and 2D PCP schemes are then studied. In the 1D case, a first-order accurate LxF-type scheme is first proved to be PCP under the CFL condition, and then the high-order accurate PCP schemes are proposed via a PCP limiter. In the 2D case, the discrete divergence-free condition and PCP property are analyzed for a first-order accurate LxF-type scheme, and two sufficient conditions are derived for high-order accurate PCP schemes. Our analysis reveals in theory for the first time that the discrete divergence-free condition is closely connected with the PCP property. Several numerical examples demonstrate the theoretical findings and the performance of numerical schemes.

193. LI, Tian-Jun: Geometry of symplectic log Calabi-Yau surfaces

University of Minnesota

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: This is a survey on the geometry of symplectic log Calabi-Yau surfaces, which are the symplectic analogues of Looijenga pairs.

We address the classification up to symplectic deformation, the relations between symplectic circular sequences and anti-canonical sequences, contact trichotomy, and symplectic fillings.

This is a joint work with Cheuk Yu Mak.

194. AN, Jinpeng: Bounded orbits on homogeneous spaces of Lie groups

Peking University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Subgroup actions on homogeneous spaces of Lie groups exhibit rich structures. The investigation of such actions from the dynamical viewpoint, also known as homogeneous dynamics, has been a central topic in dynamical systems and is closely related to number theory. In this talk, we will discuss problems and results concerning bounded orbits of such actions and their relations with Diophantine approximation.

195. LI, Song-Ying: Sharp and uniform estimates for $\bar{\partial}$

University of California, Irvine

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: Let Ω be a bounded domain in $\mathbb{C}^n$ and f is a $\bar{\partial}$-closed $(0,1)$-form. We consider the canonical solution u for the Cauchy-Riemann equation $\bar{\partial}u = f$. Let g be the Bergman metric on Ω and $|f(z)|_g^2 = \sum_{i,j=1}^n g^{ij} f_i(z) f_j(z)$.

This talk is based on a joint work with X. Dong and J. Treuer on the estimate for solution u on a smoothly bounded strictly pseudoconvex domain in $\mathbb{C}^n$ or on bounded symmetric domains Ω. We gave sharp pointwise estimate on u or L^∞ estimate on u in terms of the uniform norm of $|f(z)|_g$ or some other norms.

196. YANG, Yisong: Minimization and Topological Bounds of Bending Energy for Cell Membranes

New York University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: The Helfrich bending energy, which contains the well-known Willmore energy in differential geometry as a limiting case, plays an important role in providing a mechanism for the conformation of a lipid vesicle, modeling cell membranes, in theoretical biophysics. Such a vesicle is a closed surface and governed by the principle of energy minimization over configurations of appropriate topological characteristics. We will show that the presence of a quantity called the spontaneous curvature obstructs the existence of a minimizer of the Helfrich energy over the set of embedded ring tori. Besides, despite the well-realized knowledge that lipid vesicles may present themselves in a variety of shapes of complicated topology, there is a lack of topological

bounds for the Helfrich energy. To overcome these difficulties, we consider a general scale-invariant anisotropic curvature energy that extends the Canham elastic bending energy developed in modeling a biconcave-shaped red blood cell. We will show that, up to a rescaling of the generating radii, there is a unique minimizer of the energy over the set of embedded ring tori, in the entire parameter regime, which recovers the Willmore minimizer in its Canham isotropic limit. We also show how elevated anisotropy favors energetically a clear transition from spherical-, to ellipsoidal-, and then to biconcave-shaped surfaces, for a lipid vesicle. We then establish some genus-dependent topological lower and upper bounds for the anisotropic energy. Finally, we derive the shape equation of the generalized bending energy, which extends the well-known Helfrich shape equation.

13:30-14:15

197. SHEN, Xu: On the mod p geometry of Shimura varieties with parahoric level structures

Morningside Center of Mathematics, Academy of Mathematics and Systems Science, CAS

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: To study the geometry of reduction modulo p of Shimura varieties with parahoric level structures, Xuhua He and Michael Rapoport have introduced certain axioms on the integral models. Assuming the verification of these axioms, they constructed the EKOR (Ekedahl-Kottwitz-Oort-Rapoport) stratifications on the special fibers of these integral models. These stratifications are refinements of the Kottwitz-Rapoport stratifications, and they should play the same role as what Ekedahl-Oort stratifications do for good reductions. Recently, Kisin and Pappas have constructed integral canonical models for many Shimura varieties of abelian type with parahoric level structures. In this talk, we will explain some direct and geometric constructions of EKOR strata for the Kisin-Pappas integral models. This is joint work with Chia-Fu Yu and Chao Zhang.

198. CHEN, Po-Ning: Quasi-local mass and Penrose inequality

University of California, Riverside

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The positive mass theorem is one of the fundamental results in general relativity. It states that the total mass of asymptotically flat spacetime is non-negative. The Penrose inequality provides a lower bound on mass by the area of the black hole and is closely related to the cosmic censorship conjecture in general

relativity. Recently, Lu and Miao proved a quasi-local Penrose inequality for the quasi-local energy with reference in the Schwarzschild manifold. In this article, we prove a quasi-local Penrose inequality for the quasi-local energy with reference in any spherically symmetric static spacetime.

199. HERTZ, Jana: Mechanisms activating stable ergodicity

Southern University of Science and Technology

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we give a panoramic view of stable ergodicity and we propose minimality of an expanding or contracting foliation as a generic mechanism that activates it.

200. SHI, Enhui: The realization and classification for topologically transitive group actions on 1-manifolds

Soochow University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will introduce some recent results around topologically transitive group actions on the circle $\mathbb{S}^1$ and on the real line $\mathbb{R}$. Specially, we will talk about the existence of topologically transitive actions on $\mathbb{R}$ by some discrete groups and the classification of a specified class of topologically transitive actions by $\mathbb{Z}^d$ on $\mathbb{S}^1$ up to topological conjugations.

201. CHEN, Xiao-Wu: The Derived Morita Theory–Standard Derived Equivalences

University of Science and Technology of China

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: We will describe how derived equivalences between module categories arise naturally as one of the central topics in the modern representation theory of finite dimensional algebras. The famous open question on whether any derived equivalence is standard will be discussed. We will report some recent progress. This is based on joint work with Xiaofa Chen, Yu Ye and Chao Zhang.

202. LU, Zaiping: Odd index subgroups of the alternating groups

Nankai University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Using the classification of maximal subgroups of the alternating and symmetric groups, we investigate the subgroups of odd index in the alternating and symmetric groups and their natural orbits, and classify some 2-arc-transitive graphs associated with the alternating groups.

203. LEI, Jinzhi: Evolutionary dynamics of cancer: from epigenetic regulation to cell population dynamics

Tsinghua University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Cancer development is a long-term process which remains mostly unknown; predictive modeling of the evolutionary dynamics of cancer is one of the major challenges in computational cancer biology. In this talk, I introduce a general mathematical framework for understanding the behavior of heterogeneous stem cell regeneration, and the application of the model framework to study the evolutionary dynamics of cancer. The proposed model framework generalizes the classical G0 cell cycle model, incorporates the epigenetic states of stem cells that are represented by a continuous multidimensional variable, and the kinetic rates of cell behaviors, including proliferation, dierentiation, and apoptosis, which are dependent on their epigenetic states. The random transition of epigenetic states is represented by an inheritance probability that can be described as a conditional beta distribution. Moreover, the model framework can be extended to investigate gene mutation-induced tumor development. The model equation further suggests a numerical scheme of multi-scale modeling for tissue growth where a multiple cell system is represented by a collection of epigenetic states in each cell. We applied the numerical scheme to model the two processes of inflammation-induced tumorigenesis and tumor relapse after CD19 chimeric antigen receptor (CAR) T cell therapy of acute B lymphoblastic leukemia (B-ALL). Model simulations reveal the multiple path-ways of inflammation-induced tumorigenesis, and the mechanism of tumor relapse due to leukemic cell plasticity induced by CAR-T therapy stress.

204. ZHANG, Yong: Fast convolution-type nonlocal potential solvers in Nonlinear Schrödinger equation and Lightning simulation

Tianjin University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: Convolution-type potential are common and important in many science and engineering fields. Efficient and accurate evaluation of such nonlocal potentials are essential in practical simulations. In this talk, I will focus on those arising from quantum physics/chemistry and lightning-shield protection, including Coulomb, dipolar and Yukawa potential that are generated by isotropic and anisotropic smooth and fast-decaying density, as well as convolutions defined on a one-dimensional adaptive finite difference grid. The convolution kernel is usually singular or discontinuous at the origin and/or at the far field, and density might be anisotropic, which together present great challenges for numerics in both accuracy and efficiency. The state-of-art fast algorithms include Wavelet based Method(WavM), kernel truncation method(KTM), NonUniform-FFT based method(NUFFT) and Gaussian-Sum based method(GSM). Gaussian-sum/exponential-sum approximation and kernel truncation technique, combined with finite Fourier series and Taylor expansion, finally lead to a $O(N \log N)$ fast algorithm achieving spectral accuracy. Applications to NLSE, together with a useful recently-developed sum-ofexponential algorithm are reviewed. Tree-algorithm for computing the one-dimensional convolutions in lighting-shield simulation is also covered as the last application.

205. LI, Yibao: Direct discretization method for the phase field modeling on surfaces

Xi'an Jiaotong University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: An unconditionally stable direct discretization method for solving the phase-field crystal equation on surfaces is presented. The surface is discretized by using an unstructured triangular mesh which consists of triangles and dual surface polygonal tessellation. Therefore, we can directly define the gradient, divergence, and Laplacian operators on triangular meshes. The proposed scheme, derived by combining a backward differentiation and a direct discretization for the time and space derivative terms, respectively, is second-order accurate in time and space. The proposed scheme leads to linear elliptic equations to be solved at each time step, which makes it easy to implement. We prove that the proposed scheme satisfies an analogous discrete energy-dissipation law for any time step and is therefore unconditionally stable. A fast and efficient biconjugate gradients stabilized solver is used to

solve the resulting discrete system. Various numerical experiments are performed to demonstrate the performance of our proposed algorithm.

206. SUN, Haiwei: Fast algorithms for numerical solutions of fractional partial differential equations

University of Macau

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: The fractional partial differential equation is discretized by the implicit finite difference scheme with the shifted Grunwald formula. The scheme is unconditionally stable and the coefficient matrix possesses the Toeplitz-like structure. Several fast iterative methods are proposed to solve the resulting systems. Meanwhile, the fast Toeplitz matrix-vector multiplication is utilized to lower the computational cost with only $\mathbf{O}(N \log N)$ complexity, where N is the number of grid points. Numerical experiments are given to demonstrate the efficiency of the proposed methods.

207. JING, Wenjia: Recent progresses on the homogenization of front propagations

Tsinghua University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: Front propagation phenomena occur and play important roles in may applications, such as in combustion theory and collective motions. Certain such evolution problems can be modeled by Hamilton-Jacobi equations with heterogeneous Hamiltonians that capture the microscopic rules for the front propagation. The long time effective behavior then amounts to the homogenization of such H-J equations. We report some recent progresses on such homogenization theory and related refined problems, like the inverse type questions and the convergence rates.

208. HO, Nan-Kuo: Kostant, Steinberg, and the Stokes matrices of the tt*-Toda equations

NTHU

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: We propose a Lie-theoretic definition of the tt*-Toda equations for any complex simple Lie algebra, based on the concept of topological-antitopological fusion

which was introduced by Cecotti and Vafa. Our main result concerns the Stokes data of a certain meromorphic connection, whose isomonodromic deformations are controlled by these equations. First, by exploiting a framework introduced by Boalch, we show that this data has a remarkable structure. It can be described using Kostant's theory of Cartan subalgebras in apposition and Steinberg's theory of conjugacy classes of regular elements, and it can be visualized on the Coxeter Plane. Second, we compute canonical Stokes data for a certain family of solutions of the tt*-Toda equations in terms of their asymptotics.

This is joint work with Martin Guest.

209. CHEN, Xi: Rational Curves on K3 Surfaces

University of Alberta

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: It is conjectured that there are infinitely many rational curves on every projective K3 surface. A large part of this conjecture was proved by Jun Li and Christian Liedtke, based on the characteristic p reduction method proposed by Bogomolov-Hassett-Tschinkel. They proved that there are infinitely many rational curves on every projective K3 surface of odd Picard rank. Over complex numbers, there are a few remaining cases: K3 surfaces of Picard rank two excluding elliptic K3' s and K3' s with infinite automorphism groups and K3 surfaces with two particular Picard lattices of rank four. We have settled these leftover cases and also generalized the conjecture to the existence of curves of high genus. This is a joint work with Frank Gounelas and Christian Liedtke.

210. SUN, Zheng: A dataset of R-symmetric Wess-Zumino models

Sichuan University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: This work makes an exhaustive search for R-symmetric Wess-Zumino models with up to 5 chiral fields, and checks the consistency of their vacuum solutions with predictions from the Nelson-Seiberg theorem and its extensions. Models are recorded as cubic polynomial superpotentials with generic coefficients, and R-charges of all fields in each model. Redundancy from permutation symmetries and decoupled models are properly handled in the search algorithm. We found that among 925 models in total, 20 of them are counterexamples to both the Nelson-Seiberg theorem and its extensions, with SUSY vacua which the theorems fail to predict. Such inconsistency can be viewed as non-genericness in the R-charge assignment. Implications of the search result for the string landscape are discussed. More applications of the dataset are expected in future work.

14:25-15:10

211. WAN, Chen: The residue method for period integrals

Massachusetts Institute of Technology

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will explain how to use the residue method and Langlands-Shahidi's theory for residues of Eisenstein series to study the period integrals of spherical varieties. In joint works with Aaron Pollack and Michal Zydor, we applied this method to seven spherical varieties. For each case, we proved a relation between the period integrals and certain automorphic L-functions.

212. ZHOU, Chunqin: Vanishing Pohozaev constant and removability of singularities

Shanghai Jiao Tong University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: Conformal invariance of two-dimensional variational problems is a condition known to enable a blow-up analysis of solutions and to deduce the removability of singularities. In this paper, we identify another condition that is not only sufficient, but also necessary for such a removability of singularities. This is the validity of the Pohozaev identity. In situations where such an identity fails to hold, we introduce a new quantity, called the Pohozaev constant, which on one hand measures the extent to which the Pohozaev identity fails and, on the other hand, provides a characterization of the singular behavior of a solution at an isolated singularity. We apply this to the blow-up analysis for super-Liouville type equations on Riemann surfaces with conical singularities, because in the presence of such singularities, conformal invariance no longer holds and a local singularity is in general non-removable unless the Pohozaev constant is vanishing.
Keywords. Pohozaev constant, removability of singularities, super-Liouville equations, blow-up analysis.
2010 MSC: 35J60, 35A20, 35B44, 58E05

213. LIU, Rui: Bases, frames and operator-valued measures on Banach and operator spaces

Nankai University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: We introduce the concept of frames for Banach and operator spaces, show the equivalence with the (completely) bounded approximation property and complemented embedding, give an example of cb-frames for reduced free group C^*-algebra, and prove the duality theorems for frames and associated basis in reflexive Banach spaces. Recently, we give a general dilation theory of operator-valued measures and frames for Banach spaces, motivated by the observation that there is a connection between the analysis of dual pairs of frames (both the discrete and the continuous cases) and the dilation theory of operator-valued measures on Banach spaces. As a continuation, we prove that every operator-valued measure with bounded p-variation can be dilated to a projection-valued measure with the same variation property.

214. YU, Hui: Regularity of the singular set in the fully nonlinear obstacle problem

Columbia University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Obstacle problem is one of the well-studied free boundary problems. When the operator is the Laplacian, it is known that the free boundary consists of two parts: the regular part and the singular part. The regular part is an analytic hypersurface, and the singular part is covered by C1-manifolds with various dimensions.

While the tools for the study of the regular part is robust enough that the theory has been generalized to many other free boundary problems, up to now all developments on the singular part rely on monotonicity formulae. Such formulae are only expected for the Laplacian and linear operators with very regular coefficients. Consequently, very little is known about the singular set when the operator is not the Laplacian.

In this talk we describe a new method to study the singular set in the obstacle problem. This method does not depend on monotonicity formulae and works for fully nonlinear elliptic operators. The result we get matches the best-known result for the case of Laplacian.

This is based on joint work with Ovidiu Savin from Columbia University.

215. ZHANG, Ruixiang: Studying Parsell-Vinogradov Systems via Decoupling

University of Wisconsin-Madison

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: We will talk about our recent proof of a sharp upper bound on the number of integer solutions of the Parsell-Vinogradov system in every dimension via the method of decoupling (joint with Shaoming Guo).

216. LIU, Chun-Hung: Clustered coloring on old graph coloring conjectures

Texas A&M University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: Hadwiger (Hajos and Gerards and Seymour, respectively) conjectured that the vertices of every graph with no K_{t+1} minor (topological minor and odd minor, respectively) can be colored with t colors such that any pair of adjacent vertices receive different colors. These conjectures are stronger than the Four Color Theorem and are either wide open or false in general. A weakening of these conjectures is to consider clustered coloring which only requires every monochromatic component to have bounded size instead of size 1. It is known that t colors are still necessary for the clustered coloring version of those three conjectures. Joint with David Wood, we prove a series of tight results about clustered coloring on graphs with no subgraph isomorphic to a fixed complete bipartite graph. These results have a number of applications. In particular, they imply that the clustered coloring version of Hajos' conjecture is true for bounded treewidth graphs in a stronger sense: K_{t+1} topological minor free graphs of bounded treewidth are clustered t-listcolorable. They also lead to the first linear upper bound for the clustered coloring version of Hajos' conjecture and the currently best upper bound for the clustered coloring version of the Gerards-Seymour conjecture.

217. LI, Chengju: Constructions of linear codes with one-dimensional hull

East China Normal University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: The hull of a linear code is defined to be the intersection of the code and its dual, and was originally introduced to classify finite projective planes. In this talk,

we present some sufficient and necessary conditions that linear codes and cyclic codes have one-dimensional hull. Based on these characterizations, some constructions of linear codes with one-dimensional hull were given by employing quadratic number fields and cyclotomic fields.

218. LV, Songjun: Affine invariant information measures and information theoretic inequalities

Chongqing Normal University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: It is presented that there are different ways to introduce affine invariant information measures such as affine moments and affine Fisher information of a random vector. A usual way to define affine invariant information measures is to consider an optimization problem minimizing the information measures under all linear transformations. This is inspired by the well-known characterizations of the classical covariance matrix and Fisher information matrix, whereas it leads to profound investigation on general information matrices. The existence results of general information matrices guarantee the rationality of the definitions of affine invariant information measures of the first type. Another way presented in this talk is achieved by introducing the Cosine transforms of the involved density functions and Fisher scores of a random vector. With these affine invariant information measures of the second type at hand, Stam's inequality and moment-entropy inequality that are much sharper than the canonical ones are proved. As a by-product, we establish an affine version Cramer-Rao inequality.

219. CAO, Zhoujian: Numerical Relativity for Gravitational Wave detection

AMSS, Chinese Academy of Sciences

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In order to aid the development of the gravitational wave astronomy, solving Einstein equations accurately and efficiently with a supercomputer is urgently required. How to solve Einstein equations numerically has been developed into an independent research direction called numerical relativity. In this talk I will introduce the back ground for numerical relativity, the main difficulties and current situations of numerical relativity. How to setup a solid mathematical foundation for numerical relativity is an interesting problem. How to construct a geometric algorithm for numerical relativity may be another deeper problem. In this talk I would like to point out these issues.

220. CHEN, Rongliang: Scalable Parallel Methods for Patient-specific Blood Flow Simulations

Shenzhen Institutes of Advanced Technology Chinese Academy of Sciences

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Numerical simulation of blood flows in compliant arteries based on patient-specific geometry and parameters can be clinically helpful for physicians or researchers to study vascular diseases, to enhance diagnoses, as well as to plan surgery procedures. In this talk, we will discuss some scalable parallel domain decomposition methods for the simulation of blood flow in compliant arteries on large scale supercomputers. The blood flow is modeled by 3D unsteady incompressible Navier-Stokes equations with a lumped parameter boundary condition, which are discretized with a stabilized finite element based on unstructured meshes in space and a fully implicit method in time. The large scale discretized nonlinear systems are solved by a parallel Newton-Krylov-Schwarz method. Several mathematical, biomechanical, and supercomputing issues will be discussed in detail, and some numerical experiments for patient-specific arteries will be presented. We will also report the parallel performance of the methods on a supercomputer with a large number of processors.

221. XU, Xianmin: Analysis and Simulations for complicated two-phase flow problems

LSEC, Chinese Academy of Sciences

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Many two-phase flow problems are quite complicated due to the existence of moving contact lines and shape changes of two-phase interfaces. Both numerical simulations and analytical study for these problems are very challenging, especially to quantitatively compare with physical experiments. In this talk, we will review some of our recent analysis and approximations to the problem. In particular, we show that the Onsager principle can be used as a powerful approximation tool to quantitatively study many interesting two-phase flow phenomena.

222. GAO, Honghao: Augmentations and sheaves for links

Institut Fourier

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: We study two different invariants of framed oriented links. Augmentations are rank one representations of a non-commutative algebra, whose definition

is motivated by Floer homology. Sheaves in microlocal theory can be thought of as generalizations of link group representations. We will demonstrate two constructions going back and forth between these invariants. We will also tell a motivating story behind the scene, using SFT and microlocalization correspondence in symplectic topology.

223. ZHANG, Qinghai: MARS: An Analytic and Computational Framework for Incompressible Flows with Moving Boundaries

Zhejiang University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Current methods such as VOF methods, level-set methods, and phase-field methods avoid geometry and topology by converting them into problems of numerical PDEs. In comparison, we try to tackle geometric and topological problems with tools in geometry and topology.

As the first part of our MARS framework, we propose a topological space called the Yin space as a mathematical model for physically meaningful material regions. Each element in the Yin space is a regular semianalytic set with bounded boundaries. We further equip the Yin space with Boolean algebra so that the topology info (such as the Betti numbers of a material region) can be extracted in constant time. In particular, non-manifold points on the fluid boundary, a key problem in studying topological changes, are handled naturally. The second part of MARS is the donating region theory in the context of hyperbolic conservation laws. For a fixed simple curve in a nonautonomous flow, the fluxing index of a passively advected Lagrangian particle is the total number of times it goes across the curve within a given time interval. Such indices naturally induce donating regions, equivalence classes of the particles at the initial time. Under the MARS framework, many explicit methods such as VOF methods and fronting tracking methods can be unified and proved to be second-order accurate. MARS also leads to new methods of fourth- and higher-order accuracy for interface tracking and curvature estimation.

The MARS framework can be further expanded with a fourth-order projection method called GePUP for numerically solving the incompressible Navier-Stokes equations (INSE). We have augmented GePUP to irregular domains and are currently working on coupling GePUP with our new interface tracking methods to form a fourth-order solver for INSE with moving boundaries.

224. ZHAO, Yiming: The dual Minkowski problem for o-symmetric convex bodies

Massachusetts Institute of Technology

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: The talk is going to focus on the set of all convex bodies (compact convex sets) in Rn. This class of geometric objects is natural in the sense of Euclidean geometry as it is closed with respect to Hausdorff metric. Note that the boundaries of convex bodies need not to be smooth. The loss of smoothness means that quantities such as Gauss curvature are not well-defined and must be replaced by geometric measures to properly capture the shape information about a convex body. Recently, Huang-Lutwak-Yang-Zhang introduced the so-called *dual curvature measures* which is a family of such measures. The dual Minkowski problem asks for the necessary and sufficient conditions on a given measure μ so that it can be realized as the dual curvature measure of a convex body. Just like the classical Minkowski problem, the dual Minkowski problem reduces to Monge-Ampère type equation. However, in this talk, we shall solve the dual Minkowski problem for o-symmetric convex bodies directly for measures using variation of calculus. The solution is closely connected to a measure concentration condition.

225. ZHANG, Huafeng: Quantum groups of affine type and three-term relations

Université de Lille

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: Associated to a finite-dimensional complex simple Lie algebra are three classes of quantum groups: Drinfeld's Yangian, quantum loop algebra due to Drinfeld and Jimbo, and Felder's elliptic quantum groups. The representation theory of these quantum groups is very rich. In this talk we explain how to construct Verma-like infinite-dimensional modules from finite-dimensional ones via analytic continuation. Inspired by Baxter's TQ relations for the spectra of quantum integrable systems, we establish similar three-term relations involving these Verma modules in the Grothendieck ring of a suitable representation category.

15:30-16:15

226. CAO, Yang: Cohomological obstruction to local-global principle

Leibniz Universität Hannover

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: One basic philosophy in Diophantine Geometry is local-global principle (Hasse principle). In 1970s, Manin defined the first cohomological obstruction to local-global principle: the Brauer-Manin obstruction. In this talk, I will discuss some general cohomological obstructions: descent obstruction, étale Brauer-Manin obstruction, iterated descent obstruction, and I will show that, for all known cohomological obstructions, the étale Brauer-Manin obstruction is the finest one.

227. LI, Hai-Liang: Recent progress on the analysis of compressible Navier-Stokes equations

Capital Normal University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we present the recent analysis on the well-posedness of solution to compressible Navier-Stokes equations with the density possibly containing vacuum, such as global existence of weak solution and the non-existence of classical solution with finite energy space, etc.

228. LI, Hongquan: The Carnot-Carathéodory distance on 2-step groups and its applications

Fudan University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we present some results on a fundamental problem of obtaining the explicit formula for the sub-Riemannian distance on 2-step groups.

229. LI, Jinkai: Well-posedness of entropy-bounded solutions of the compressible Navier-Stokes equations with vacuum

South China Normal University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: The entropy is one of the fundamental physical states of a fluid. For the ideal gases, the entropy can be expressed as some linear combination of the logarithms of the density and temperature in the non-vacuum region, and, in the viscous case, the equation that it satisfies is highly singular in the region close to the vacuum. Due to the singularity of the logarithmic function at zero, which may lead to the singularity of the entropy, and the singularity of the entropy equation near the vacuum region, in spite of its importance in the gas dynamics, the mathematical analyses on the behavior of the entropy near the vacuum region, were rarely carried out; in particular, in the presence of vacuum, it was unknown if the entropy remains its boundedness. We will show in this talk that the ideal gases retain their uniform boundedness of the entropy, locally or globally in time, if the vacuum occurs at the far field only and the density decays slowly enough at the far field. Precisely, we consider the Cauchy problem to the full compressible Navier-Stokes equations, with or without heat conductivity, and establish the local and global existence and uniqueness of entropy-bounded solutions, in the presence of vacuum at the far field only. These are joint works with Prof. Zhouping Xin.

230. LI, Wei-Xi: Compactness criteria for the resolvents of the Fokker-Planck operator and Witten Laplacian

Wuhan University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will recall the classical hypoelliptic techniques and their global counterparts developed recently for the spectral analysis of the Fokker-Planck operator and Witten Laplacian. In particular we will focus on the compactness criteria for their resolvents and the close relationship between the two operators.

231. FENG, Yan-Quan: Groups and Graphs

Beijing Jiaotong University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we overview the past and present of groups and graphs in China and abroad. Some hot research topics, including conjectures and problems in

groups and graphs, are introduced. The main research topics mentioned in this talk are automorphism groups of symmetric graphs, vertex-transitive non-Cayley graphs and symmetric graphs, where the first is basic and concentrates on Weiss conjecture, CI-problem and normality of Cayley graphs.

232. ZHOU, Jin-Xin: Metacirculants and weak metacirculants

Beijing Jiaotong Uniervsity

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Metacirculants are a basic and well-studied family of vertex-transitive graphs, and weak metacirculants are generalizations of them. A graph is called a weak metacirculant if it has a vertex-transitive metacyclic automorphism group. In this talk, we shall introduce our recent work on metacirculants and weak metacirculant.

233. YUAN, Guangwei: Cell-centered finite volume schemes for heterogeneous diffusion equation on distorted meshes

Institute of Applied Physics and Computational Mathematics

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Diffusion problems arise in various fields, for example, the petroleum engineering or applications related with inertial confinement fusion and magnetic confinement fusion. In particular, for the numerical simulation of multi-material Lagrangian radiation hydrodynamic problems, radiation diffusion equations with discontinuous and strong anisotropic tensor coefficients should be solved on meshes moving with the fluid flow. The discontinuity and the strong anisotropy of diffusion coefficient, together with extremely distorted meshes, bring significant difficulties in designing accurate and efficient discrete schemes for solving diffusion equations.

To give a reliable solution of diffusion equations on general distorted meshes, it is important to preserve some key physical-characters for a discrete scheme, such as the conservativeness, positivity or monotonicity, and discrete maximum principle (which can preserve physical bounds of problem unknowns), etc. In the context of heat conduction, a discrete scheme without maximum-principle-preserving can lead to non-physical oscillation and even negative temperatures, which may cause the abnormal interruption of nonlinear iteration and in turn become a source of numerical instability.

However, it is well known that classical finite volume and finite element schemes fail to satisfy the discrete maximum principle for strong anisotropic diffusion tensors and on distorted meshes.

For the recent years, various conservative numerical schemes with second accuracy have been proposed to ensure monotonicity or discrete maximum principle for solving two (and three) dimensional diffusion problems on general meshes. Moreover, some theoretical results have been obtained, including that the coercivity property of the scheme is proved under some geometric constraint on cell deformation, and then the existence and convergence of discrete solutions and the consistency of flux are proved. Numerical tests are performed to show the accuracy of the scheme and verify the maximum principle.

234. ZHANG, Zhimin: Construction of H^2 (curl) conforming elements and their application

Wayne State University & Beijing Computation Science Research Center

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In 1980 and 1986, Nedelec proposed $H(curl)$-conforming elements to solve electromagnetic equations that contains the "curl" operator. It is more or less as the H^1-conforming elements (or C^0 elements) for elliptic equations that contains the "grad" operator. As is well known in the finite element method literature, in order to solve 4th-order elliptic equations such as the bi-harmonic equation, H^2-conforming elements (or C^1-elements) were developed. Recently, there have been some research in solving electromagnetic equations which involve four "curl" operators. Hence, construction of $H(curlcurl)$-conforming elements becomes necessary. In this work, we construct $H(curlcurl)$-conforming elements for rectangular and triangular meshes and apply them to solve quad-curl equations as well as related eigenvalue problems.

235. GUO, Tiexin: L^0-convex compactness and its applications to optimization of conditional convex risk measures

Central South University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Random metric spaces, random normed modules and random locally convex modules are a random generalization of ordinary metric spaces, normed spaces and locally convex spaces, respectively. Random functional analysis is functional analysis based on these random frameworks. Let K denote the scalar field R of real numbers or C of complex numbers, $(\Omega, \mathcal{F}, P)$ a probability space and $L^0(\mathbb{F}, K)$ the topological algebra of equivalence classes of K-valued random variables on $(\Omega, \mathcal{F}, P)$, which is endowed with the linear topology of convergence in probability. Then, random normed modules and random locally convex modules, which are often endowed with the (ε, λ)-topology, are generally a class of not locally convex topological module

over $L^0(\mathcal{F}, K)$, so that the conventional theory of conjugate spaces, which is based on the theory of locally convex spaces, fails for the topological modules. To overcome the difficulty, the theory of random conjugate spaces has been presented and has made random functional analysis deeply and systematically developed. Now, random functional analysis has provided a proper analytical framework for the study of conditional (or dynamic) convex risk measures and the related optimization problems, which stimulates the introducing of another topology, called the locally L^0-convex topology, for random locally convex modules, which further produces random convex analysis. When random convex analysis is applied to optimization problems of conditional convex risk measures, the conventional notion of compactness no longer applies. For this, this paper introduces the notion of L0-convex compactness for a closed L^0-convex subset of a random locally convex module endowed with the (ε, λ)-topology and continues to establish the James-type characterization theorem for a closed L^0-convex subset of a complete random normed module to be L^0-convexly compact, which shows that this notion reduces to that of weak compactness in the context of Banach spaces, but it is important to realize that the notion of L^0-convex compactness still applies to the study of optimization problems in not locally convex spaces such as random normed modules. As applications, this paper gives a better solution to the fundamental optimization problem of conditional convex risk measures.

236. XU, Liwei: Boundary integral equation methods for the elastic wave

University of Electronic Science and Technology of China

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will present some new regularized formulations of hypersingular boundary integral operators associated with the elastic waves and the thermal elastic waves in two and three dimensions. Based on these results, we consider boundary element solutions for the exterior or transmission problems of elastic waves, and elastic waves in open arcs. Numerical examples are presented to verify and validate the theoretical results.

237. YANG, Tian: Recent progress on the volume conjecture for the Turaev-Viro invariants

Texas A&M University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: In 2015, Qingtao Chen and I conjectured that at the root of unity $\exp(2\pi\sqrt{-1}/r)$ instead of the usually considered root $\exp(\pi\sqrt{-1}/r)$, the Turaev-Viro

and the Reshetikhin-Turaev invariants of a hyperbolic 3-manifold grow exponentially with growth rates respectively the hyperbolic and the complex volume of the manifold. In this talk, I will recall known results about this conjecture and present a recent joint work with Giulio Belletti, Renaud Detcherry and Effie Kalfagianni on an infinite family of cusped hyperbolic 3-manifolds, the fundamental shadow links complement, for which the conjecture is true.

238. QIU, Yu: q-Stability conditions on Calabi-Yau-X cetegories

YMSC, Tsinghua University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: We introduce q-deformation of categories and stability conditions and discuss various applications that are related to cluster theory, mirror symmetry and quadratic differentials.

239. LIN, Longzhi: Energy convexity of harmonic & bi-harmonic maps and its applications

University of California, Santa Cruz

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: We will discuss some recent results on the energy convexity and uniqueness of weakly harmonic and bi-harmonic maps, in particular the energy convexity and uniqueness for weakly harmonic maps with Dirichlet and free boundaries on 2 dimensional domains and for weakly intrinsic bi-harmonic maps on 4 dimensional domains. Applications of these results include the existence of minimal disks with free boundary in closed Riemannian manifolds and the long time existence and uniform convergence of intrinsic bi-harmonic map heat flow with small initial bi-energy. This is based on joint work with P. Laurain and with X. Zhou & A. Sun.

240. HUNG, Ling-Yan: p-adic AdS/CFT as a tensor network

Fudan University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: We will discuss recent progress in constructing a tensor network that recovers the generating function of an arbitrary p-adic CFT. We will demonstrate

that this tensor network naturally reproduces features of the AdS/CFT correspondence. We also demonstrate how this network could emerge from a purported "Chern-Simons" like theory. We will also show that concepts of RG flow can be introduced in the tensor network construction.

16:25-17:10

241. XU, Daxin: Kloosterman crystals for reductive groups

California Institute of Technology

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: I will first review the relationship between the classical Bessel equation

$$(x\frac{d}{dx})^2u - xu = 0,$$

and the classical Kloosterman sum

$$\mathrm{Kl}(a) := \sum_{xy=a\in\mathbb{F}_p} \exp(\frac{2\pi i}{p}(x+y)).$$

Such a relation can be regarded as an instance of the geometric Langlands correspondence for GL_2. I will survey the recent generalizations of this story for arbitrary reductive groups, based on the works by Frenkel-Gross, Heinloth-Ngô-Yun, and X. Zhu. In the end, I will report the joint work in progress with X. Zhu, where we study the p-adic aspect of this theory.

242. SHI, Yi: C^r Closing lemma for partially hyperbolic diffeomorphisms with 1-dimensional center bundle

Peking University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The C^r-closing lemma is one well-known problem in the theory of dynamical systems. The problem is to perturb the original dynamical system so as to obtain a C^r-close system that has a periodic orbit passing through a given point. And this point is called C^r-closable. Steve Smale listed the C^r-closing lemma as one of mathematical problems for this century.

In this talk, we prove the C^r-closing lemma ($r = 2, 3, \cdots, \infty$) for partially hyperbolic diffeomorphisms with 1-dimensional center bundle: every non-wandering point

of these diffeomorphisms is C^r-closable. Moreover, we will show that C^r-generic conservative partially hyperbolic diffeomorphisms with 1-dimensional center bundle have dense periodic points.

This is a joint work with Shaobo Gan.

243. LI, Aijun: Grassmannian Loomis-Whitney inequality and its dual inequality

Henan Polytechnic University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: The classical Loomis-Whitney inequality and its dual version are fundamental in convex geometry and have been widely used in many mathematical areas. Based on reverse isoperimetric inequalities on Grassmann manifolds, the Grassman Loomis-Whitney inequality and its dual inequality are established, which provide a lower bound of the volume of a convex body in terms of its lower dimensional sections. These inequalities generalize and unify the sphere cases.

244. GUO, Jianhua: TBD

Northeast Normal University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: TBD

245. DU, Xiumin: Schrödinger maximal estimates and refined Strichartz type estimates

University of Maryland College Park

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: We consider Carleson's pointwise convergence problem of Schrödinger solutions. It is shown that the solution to the free Schrödinger equation converges to its initial data almost everywhere, provided that the initial data is in the Sobolev space $H^s(\mathbb{R}^n)$ with $s > n/2(n+1)$ (joint with Larry Guth and Xiaochun Li in the case $n = 2$, and joint with Ruixiang Zhang in the case $n > 2$). This is sharp up to the endpoint, due to a counterexample by Bourgain. This pointwise convergence problem can be approached by estimates of Schrödinger maximal functions. The key ingredients are refined Strichartz type inequalities derived from Bourgain–Demeter decoupling theorem and induction on scales.

246. WEI, Erling: Homeomorphically irreducible spanning trees in cubic hexangulations of surfaces

Renmin University of China

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: A homeomorphically irreducible spanning tree (HIST) of a connected graph is a spanning tree without vertices of degree two. The determination of the existence problem of a homeomorphically irreducible spanning tree in a plane cubic graph is NP-complete. A hexagulation of a surface is a cubic graph embedded on a surface such that every face is bounded by a hexagon. It is a problem asked by Hoffmann-Ostenhof and Ozeki that whether there are finitely or infinitely many hexagulations of torus with homeomorphically irreducible spanning trees. In this paper, we show that a family of hexagulations of the surface, denoted by $H(m, n)$ with $m \geq 4$ being even and $n \geq 2$, have a homeomorphically irreducible spanning tree if and only if $m \equiv 2 \pmod 4$, which settles the problem of Hoffmann-Ostenhof and Ozeki.

247. WU, Jianchao: The rational strong Novikov conjecture, the group of volume preserving diffeomorphisms, and Hilbert-Hadamard spaces

The Pennsylvania State University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: The rational strong Novikov conjecture is a deep problem in noncommutative geometry. It implies important conjectures in manifold topology and differential geometry such as the (classical) Novikov conjecture on higher signatures and the Gromov-Lawson conjecture on positive scalar curvature. Using C^*-algebraic and K-theoretic tools, we prove that the rational strong Novikov conjecture holds for any discrete group admitting an isometric and proper action on an admissible Hilbert-Hadamard space, which is a (typically infinite-dimensional) generalization of complete simply connected nonpositively curved Riemannian manifolds. In particular, this result applies to geometrically discrete subgroups of the group of volume preserving diffeomorphisms of a closed smooth manifold. This is joint work with Sherry Gong and Guoliang Yu.

248. DI, Yana: Onsager's variational principle as an approximation tool in dynamics

LSEC, Chinese Academy of Sciences

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Many basic equations describing the dynamics are derived from a variational principle proposed by Onsager in his celebrated paper on the reciprocal relation (1931). This includes Stokes equation for hydrodynamics, Cahn-Hilliard equation for phase separation, elasto-diffusion equation for gels, Leslie-Ericksen equation for liquid crystals etc. In this talk, I will discuss how this principle is useful in solving practical problems. It is illustrated by the examples for sliding droplets on an inclined surface, capillary rising between a flexible film and a solid wall, and die coating problem. An explicit time evolution equation is obtained which could be numerically solved. The results that predict the dynamical transition are consistent with the experiments. These examples demonstrate the potentiality of the present method to wider classes of problems which involve contact line moving, surface tension gradients and evaporation. This is a joint work with Xianmin Xu and Masao Doi.

249. GONG, Haipeng: Applying machine learning in protein structure prediction and sampling

Tsinghua University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: Machine learning techniques have been extensively used to facilitate the protein structure prediction nowadays. In this work, I will introduce our application of machine learning methods in improving the two aspects of protein structure prediction and sampling: fragment selection and contact prediction. In the first aspect, we engaged multiple cutting-edge deep learning techniques to optimize the extraction of near-native templates for fragments of 7-15 residues in the target protein. Our method significantly improves the quality of recruited fragments, and is capable of enhancing the accuracy of structure models constructed using the fragment assembly approach. In the second aspect, we optimized architectures of neural networks for the prediction of the native residue contacts of proteins through an evolutional approach. Employment of the newly identified model architectures effectively enhances the accuracy of contact prediction. Moreover, we developed a novel gradient-descent-based algorithm to rapidly fold the protein structure following the constraints of predicted residue contacts. Combination of our new contact predictor and protein folder allows remarkably faster prediction of protein tertiary structures without sacrificing prediction accuracy in comparison to the state-of-the-art methods.

250. LIU, Xiaodong: Inverse scattering problems with phaseless far field data

AMT, Chinese Academy of Sciences

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: A well known property of the phaseless far field patterns with incident plane waves is the translation invariance. Thus it is impossible to reconstruct the location of the underlying scatterers even for multiple incident directions and frequencies. To overcome this difficulty, we take the superpositions of plane waves and point sources as the incident fields. Based on this, we introduce a simple and fast phase retrieval scheme. Besides, we also propose two direct sampling methods for location and shape reconstruction of the underlying objects.

251. LUO, Li: Scalable finite element methods for interface problems on 3D unstructured mesh

King Abdullah University of Science and Technology

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: We present parallel finite element methods for the simulation of interface problems in two main aspects: (1) a phase-field model consisting of the Cahn-Hilliard and Navier-Stokes equations; and (2) the two-phase flow governed by Darcy law in porous media. For the former, a decoupled strategy using different solvers for different components of the semi-implicit discretization is demonstrated. For the latter, a coupled strategy based on a one-level or two-level Newton-Krylov-Schwarz algorithm is developed for solving the nonlinear system arising from the fully implicit discretization. We present extensive numerical experiments to show the robustness and efficiency of these strategies for 3D interface problems in complex domains, including droplet spreading over a rough surface, solid object impacting on water, and oil displacement in heterogeneous reservoir. Accurate simulation of the interface motion requires very fine meshes, thus the use of high performance computers is indispensable. Our algorithms share the same parallel framework through mesh generation, partitioning, element assembly, and composite solver. Large scale numerical tests show that the algorithms are scalable for 3D problems with tens of millions DOFs on a supercomputer with up to 10,000 cores.

252. LIU, Shiping: Discrete Ricci curvature and related graph classification problems

University of Science and Technology of China

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: We are going to survey some recent development in the discrete Ricci curvature theory, with a particular interest on Ollivier-Ricci curvature and related graph classification problems. This includes various classifications of Ricci-flat graphs with large girth, Ricci-nonnegative graphs with small vertex degree, Ricci-positive graphs with curvature-diameter or curvature-eigenvalue restrictions. In particular, we discuss an interesting interaction between differential geometry and combinatorics via the topic of so-called spherical graphs.

253. LIN, Jianfeng: New applications of the Seiberg-Witten invariants in 4-dimensional topology

Massachusetts Institute of Technology

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: By studying the Seiberg-Witten equations, topologists have achieved huge success in distinguishing smooth 4-manifolds. In this talk, I will represent two new results in this direction. 1) In a joint work with Danny Ruberman and Nikolai Saveliev, we proved a gluing formula for the Seiberg-Witten-Casson invariants 4-manifolds with $b_1 = 1$ and $b_2 = 0$, which allows us to obtain several new results in gauge theory, knot theory and contact geometry. 2) In a joint work with Mike Hopkins, XiaoLin Danny Shi and Zhouli Xu, we combined the Pin(2)-equivariant stable homotopy theory with the Seiberg-Witten theory to prove the "10/8+4" theorem on the intersection form of spin 4-manifolds.

254. LEE, Man-Chun: Canonical line bundle and negative real bisectional curvature

University of British Columbia

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: A recent breakthrough of Wu and Yau asserts that a compact projective Kahler manifold with negative holomorphic sectional curvature must have ample canonical line bundle. In this talk, we will discuss some recent extension of Yau's conjecture when the Kahlerity of the complex manifold is not known. In particular, we

show that if a compact pluriclosed manifold admits a Hermitian metric with negative real bisectional curvature, then It has a ample canonical line bundle. If time permits, we will discuss the case when curvature is quasi-negative. Part of this is joint work with J. Streets.

255. WU, Longting: Structures in relative Gromov-Witten theory

ETH Zürich

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will review the moduli of stable maps, WDVV equation, and the construction of quantum cohomology at first. Then we change our focus to relative Gromov-Witten (GW-) theory. We will generalize the definition of relative GW-theory to include negative contact orders, and discuss some parallel structures (quantum cohomology, WDVV, etc.) on relative GW-theory. As an application, we will present some calculations on certain relative GW-invariants using the WDVV equation in relative theory. This is based on joint work with Honglu Fan and Fenglong You.

17:20-17:40

256. YANG, Yunan: Optimal transport for seismic inversion: tackling the nonlinearity

New York University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: Full waveform inversion (FWI) is a seismic imaging method which is now part of the current imaging workflow in the industry. It is also used for global and regional scale imaging in seismology. Its primary interest compared to tomography is its high-resolution power. FWI is formulated as a least-squares (L2) minimization problem. The L2 misfit function is highly nonconvex. Mitigating this nonconvexity is a longstanding difficulty. Despite important advances yielding successful applications through multi-scale approaches, obtaining robust and flexible FWI algorithms remains a challenge. We have proposed to use the Wasserstein distance as a misfit function. This distance, from the optimal transport (OT) theory, is convex with respect to shifted patterns. For FWI, the convexity with respect to time-shifts is a proxy for the convexity with respect to the subsurface velocities, making the Wasserstein distance an ideal tool.

257. HUANG, Shaochuang: Instantaneously complete Chern-Ricci flow and Kähler-Einstein metrics

Tsinghua University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we prove some existence results of Chern-Ricci flows and the corresponding potential flows on complex manifolds with possibly incomplete initial data. We discuss the behaviour of the solution as time tends to 0. These results can be viewed as generalization of an existence result by Giesen and Topping for surfaces of hyperbolic type of Ricci flow to higher dimensions in certain sense. On the other hand, we also discuss the long time behaviour of the solution and obtain some sufficient conditions for the existence of Kähler-Einstein metric on complete noncompact Hermitian manifolds, which generalizes the work of Lott-Zhang and Tosatti-Weinkove to complete noncompact Hermitian manifolds with possibly unbounded curvature. These works are joint with Man-Chun Lee and Professor Luen-Fai Tam.

258. DONG, Rui: A novel approach to clustering genome sequences using inter-nucleotide covariance

Tsinghua University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Classification of DNA sequences is an important issue in the bioinformatics study, yet most existing methods for phylogenetic analysis including Multiple Sequence Alignment (MSA) are time-consuming and computationally expensive. The alignment-free methods are popular nowadays, while the manual intervention in those methods usually decreases the accuracy. Also, the interactions among nucleotides are neglected in most methods. Here we propose a new Accumulated Natural Vector (ANV) method which represents each DNA sequence by a point in R^{18}. By calculating the Accumulated Indicator Functions of nucleotides, we can further find an Accumulated Natural Vector for each sequence. This new Accumulated Natural Vector not only can capture the distribution of each nucleotide, but also provide the covariance among nucleotides. Thus global comparison of DNA sequences or genomes can be done easily in R^{18}. The tests of ANV of datasets of different sizes and types have proved the accuracy and time-efficiency of the new proposed ANV method.

259. HOU, Songming: Some Mathematical Problems related to the Rubik's Snake Toy

Louisiana Tech University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: The Rubik's Snake is an interesting toy invented almost 40 years ago. However, very few serious mathematical studies have been found in the literature. In this talk, I will present our recent work on some theoretical derivations and the application to Rubik's Snake shape design.

260. LIU, Anning: Asymptotic analysis and uniformly convergent method for a fourth order singular perturbation problem

Tsinghua University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this report, we present the asymptotic analysis for a fourth order singular perturbation problem (SPP) and propose a tailored finite point method (TFPM) to solve this problem numerically. We first make an asymptotic analysis for the solutions of the SPP with two different boundary conditions. Based on these asymptotic results, we propose the TFPM to solve the SPP. We prove that our scheme converges uniformly with respect to the small parameter. Our numerical examples show the efficiency and feasibility of our method and verify the theoretical results.

261. LI, Yifan: Algebraic Approaches to Orbifold Landau-Ginzburg B-models

Tsinghua University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will explain our recent work on orbifold Landau-Ginzburg B-models. We study the G-twisted version of algebraic structures on Hochschild (co)chains of G-curved algebras. Based on this, we construct Frobenius manifold structures for a large class of orbifold LG B-models, which is conjectured to be the mirror to that of FJRW theory in the A-sides. This is a joint work with Weiqiang He and Si Li.

262. WANG, Zhongjian: Proper orthogonal decomposition method to nonlinear filtering problems in medium-high dimension

The University of Hong Kong

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In this paper, we investigate the proper orthogonal decomposition (POD) method to numerically solvethe forward Kolmogorov equation (FKE). Our method aims to explore the low-dimensional structures in thesolution space of the FKE and to develop efficient numerical methods. As an important application and our primary motivation to study the POD method to FKE, we solve the nonlinear filtering (NLF) problems with a real-time algorithm proposed in combined with the POD method. This algorithm is referred as POD algorithm in this paper. Our POD algorithm consists of off-line and on-line stages. In the off-line stage, we construct a small number of POD basis functions that capture the dynamics of the system and compute propagation of the POD basis functions under the FKE operator. In the on-line stage, wes ynchronize the coming observations in a real-time manner.Its convergence analysis has also been discussed. Some numerical experiments of the NLF problems are performed to illustrate the feasibility of our algorithm and to verify the convergence rate. Our numerical results show that the POD algorithm provides considerable computational savings over the particle filter. (This is joint work with Xue Luo, Stephen Shing-Toung Yau, Zhiwen Zhang.)

263. REN, Jinbo: Mathematical logic and its applications in number theory

University of Virginia

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: A large family of classical problems in number theory such as:

a) Finding rational solutions of the so-called trigonometric Diophantine equation $F(\cos 2\pi x_i, \sin 2\pi x_i) = 0$, where F is an irreducible multivariate polynomial with rational coefficients;

b) Determining all $\lambda \in \mathbb{C}$ such that $(2, \sqrt{2(2-\lambda)})$ and $(3, \sqrt{6(3-\lambda)})$ are both torsion points of the elliptic curve $y^2 = x(x-1)(x-\lambda)$;

can be regarded as special cases of the Zilber-Pink conjecture in Diophantine geometry. In this short talk, I will explain how we use tools from mathematical logic to attack this conjecture. In particular, I will present a series partial results toward the Zilber-Pink conjecture, including those proved by Christopher Daw and myself.

264. LUO, Ma: Galois theory for multiple modular values

University of Oxford

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will talk about a category of 'mixed modular motives'. The semi-simple objects in this category are motives associated to Hecke eigenforms. The periods are called multiple modular values, which include iterated integrals of modular forms that have been studied by Manin and Brown. A Galois theory for these periods works much the same way as in the case of multiple zeta values, which are periods of mixed Tate motives over the integers. In fact, I will walk through the latter case first, which naturally motivates the previous case.

265. YU, Chenglong: Moduli of symmetric cubic fourfolds and nodal sextic curves

University of Pennsylvania

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Period map is a powerful tool to study geometric objects related to K3 surfaces and cubic 4-folds. In this talk, we focus on moduli of cubic 4-folds and sextic curves with specified symmetries and singularities. We identify the geometric (GIT) compactifications with the Hodge theoretic (Looijenga, mostly Baily-Borel) compactifications of locally symmetric varieties. As a corollary, the algebra of GIT invariants is identified with the algebra of automorphic forms on the corresponding period domains. One of the key inputs is the functorial property of semi-toric compactifications of locally symmetric varieties. Our work generalizes results of Matsumoto-Sasaki-Yoshida, Allcock-Carlson-Toledo, Looijenga-Swierstra and Laza-Pearlstein-Zhang. This is joint work with Zhiwei Zheng.

266. YANG, Sen: Deformation of Algebraic Cycles and Higher Algebraic K-Theory

Southeast University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: Green and Griffiths study deformation of algebraic cycles and pose a list of open questions in their Annals book(no.157). In this talk, we explain some of these questions and show how to approach them by using higher algebraic K-theory and tensor triangular geometry. We also recall related work on variational(infinitesimal) Hodge conjecture by Bloch, Esnault and Kerz.

267. WANG, Zhiyuan: Abstract Quantum Field Theory and Its Realizations

Tsinghua University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: This is a joint work with Professor Jian Zhou. We introduce a formalism called the abstract quantum field theory and its realizations, based on the stratifications of $\overline{\mathcal{M}}_{g,n}$. We develop various types of recursion relations for the abstract free energies and abstract n-point functions. By assigning different Feynman rules, we recover various recursion relations already known in Gromov-Witten theory, including the BCOV holomorphic anomaly equations and the Schrödinger equations of some quantum spectral curves. We also introduce new recursion relations in some other problems. In particular, we solve the problem of computations of the orbifold Euler characteristics of $\overline{\mathcal{M}}_{g,n}$. We understand this formalism as transformations on the space of field theories.

268. GAO, Anningzhe: Finiteness of abelian varieties and the Tate conjecture

University of California, Berkeley

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: The finiteness of abelian varieties over some finite field with fixed dimension is first proved by Zarhin. In 2011, Lieblich, Maulik and Snowden proved that the Tate conjecture of K3 surface over finite fields is equivalent to the finiteness of K3 surface over finite fields in large characteristic ($p > 3$). In this talk, I will use Tate conjecture to give another proof of the finiteness of abelian varieties over finite fields.

17:50-18:10

269. WANG, Zhihan: Deformations of Singular Minimal Hypersurfaces

Princeton University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: A natural problem in minimal surfaces theory is to study the existence and moduli of minimal hypersurfaces in a given manifold. In higher dimension, the existence of singularities forms a major difficulty to local deformation of minimal

hypersurfaces. In this talk, we shall present some results on local structures of minimal hypersurfaces with isolated singularities and area-minimizing tangent cones. As an application, we see that certain singular minimal hypersurface can be deformed to a regular one by perturbing ambient metric. This generalizes the results by Nathan Smale.

270. YANG, Yuxuan: Distribution of geodesic on cube and other surfaces

Rutgers University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The distribution of a straight line on closed surface is a basic problem in mathematics. One famous result is irrational flow on torus. It is dense and uniformly distributed. A geodesic on a cube is another example after that, but the uniformity here is not as good as irrational flow on torus. Surprisingly, the representation theory will work here. "Short-line" method will be introduced, then it will be combined with representation theory to illustrate cube line.

Classification: Combinatorics, Discrepancy theory, Application of representation theory.

271. CHEN, Zhangchi: A counterexample to Hartogs' type extension of holomorphic line bundles

Université Paris-Saclay

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Let Ω be a domain in $\mathbb{C}^n$ with $n \geqslant 2$. Let K be a relatively compact subset of Ω such that $\Omega \backslash K$ is connected. The Hartogs' extension theorem states that any holomorphic function over $\Omega \backslash K$ extends to a holomorphic function over Ω. Instead of functions, one could conjecture a Hartogs' type extension for holomorphic line bundles. When $n \geqslant 3$ and K of special shape, it is true and proven by Fornaess-Sibony-Wold in 2012. But there is nonextendable K in any dimension $n \geqslant 2$, constructed in 2018. In this talk I will review some useful techniques in several complex variables and transmit the idea of construction by drawing figures.

272. SUN, Weifeng: A brief introduction to ECH and ECH capacities

Harvard University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: ECH (embedded contact homology) is a topological invariant of a 3-dimensional contact manifold, first introduced by Micheal Hutchings. ECH has the same information with Seiberg-Witten Homology and Heggard Floer Homology. However, ECH can be directly used to define ECH capacities for 4-dimensional symplectic manifolds, which is useful in 4-dimensional symplectic embedding problems. An amazing fact about ECH capacity is, certain limit of ECH capacities converges to the volume.

This talk is a brief introduction to ECH and (if time permits) ECH capacities and their applications.

273. WANG, Jian: The scattering matrix for 0th order pseudodiferential operators

University of California, Berkeley

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: I will define the scattering matrix for certain type of zeroth order pseudodifferential operators and introduce some of the properties of the scattering matrix. Zeroth order pseudodifferential operators arise naturally in the study of fluids and the evolution equation of such operators is studied by Colin de Verdière and Saint-Raymond and then by Dyatlov and Zworski using tools in microlocal analysis. They showed the singular formation of the solutions at the attractive hyperbolic cycles of the (rescaled) Hamiltonian flow as time goes to infinity. In this talk I will introduce the study of the stationary states of these operators. The distributional solutions we consider admits a decomposition into a sum of two Lagrangian distributions that are microlocalized near the Lagrangian submanifolds generated by the repulsive and attractive hyperbolic cycles of the (rescaled) Hamiltonian flow. I will show the correspondence between these two distributions and that implies the definition of the scattering matrix.

274. QIAN, Shuaijie: Non-Concave Portfolio Optimization without the Concavification Principle

National University of Singapore

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: The problems of non-concave portfolio optimization appear in many areas of finance and economics, such as in behavior economics, incentive schemes, and goal problems. Almost all of existing literature solves these problems using the concavification principle. We provide a general framework for numerically solving non-concave portfolio optimization problems, where the concavification principle may not hold and the utility functions can be discontinuous. In particular, we find that adding portfolio constraints, which makes the concavification principle invalid, can significantly affect economic insights in the existing literature. Theoretically, we show that a monotone, stable, and consistent finite difference scheme is still convergent under the general framework. This work is jointly with Min Dai, Steven Kou, and Xiangwei Wan.

275. YANG, Jiaowen: Information geometry and Optimal Transport

University of Southern California

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: I will give an introduction to the theory of information geometry and a new statistical divergence logarithmic L-divergence. The logarithmic divergence is equivalent to a conformal transformation of the Bregman divergence and builds the connection of information theory and optimal transport theory. This is a joint work with Ting-Kam Leonard Wong and will be presented on the 4th conference on Geometric Science of Information in August.

276. MAO, Yixiang: Uncertainty quantification for non-absolute continuous perturbation

Harvard University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Uncertainty quantification is an important subject in evaluating model robustness under perturbation. In Dupuis et al. (2016), variational representation of relative entropy is used to produce useful uncertainty bounds. However, when the perturbed noise is not absolutely continuous with respect to the original one, this

bound turns out useless. In this talk, I will introduce a new method to deal with such situation as well as a new class of divergence that generalizes relative entropy.

277. YANG, Liyang: Analytic Continuation of Twisted Adjoint L-functions

California Institute of Technology

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will discuss holomorphic continuation of (complete & twisted) adjoint L-functions for GL(n) via Jacquet-Zagier trace formula. The geometric side will be related to certain Artin L-series, and the speatral side gives L-functions defined by Langlands-Shahidi method and Rankin-Selberg convolution for non-cuspidal automorphic representations. Convergence issues will be discussed as well.

278. ZHENG, Zhiwei: Classification of Symplectic Automorphism Groups of Smooth Cubic Fourfolds

Tsinghua University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: Cubic fourfold is an intensively studied object in algebraic geometry, with close relations to hyper-Kahler geometry. In this talk I will report a recent work with Radu Laza on a classification of all groups of symplectic automorphisms of smooth cubic fourfolds. The main inputs are the global Torelli theorem for cubic fourfolds and the classification of the fixed-point sublattices of the Leech lattice. Among the highlights of our results, we note that there are exactly 34 possible groups of symplectic automorphisms, with 6 maximal cases, and all the groups are subgroups of the Conway group.

279. XU, Kai: Principal bundles over elliptic curves

Harvard University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: It is a classical theorem that the GIT moduli space of G bundles over an elliptic curve is a weighted projective space when G is simply connected. We will show how to extend this result to a general reductive group, and also present some applications to the 4 dimensional gauge theory.

280. LI, Linjun: Anderson-Bernoulli localization on 3D lattice

University of Pennsylvania

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: Consider a piece of metal with uniform impurity and an electron hopping inside it. It is argued by physicists that the low energy eigenstate should decay exponentially in space and remain localized during the time. This phenonenon is called *Anderson localization*(AL). The math model is given by a Hamiltonian which is a Laplacian plus a random potential with i.i.d. random variables on each lattice point. This operator is studied since 80's and AL was proved for absolutely continuous distribution. The proof of AL for Bernoulli potential was a challenge and it was made possible in 2004 by Bourgain and Kenig on continuum $\mathbb{R}^d$. Recently, Ding and Smart(2018) proved it on $\mathbb{Z}^2$. We followed their line and proved it on $\mathbb{Z}^3$. The key ingredient is a 3D discrete unique continuation principle. This is a joint work with Lingfu Zhang.

281. YANG, Lu: Incompressible limit of non-isentropic compressible magnetohydrodynamic equations with zero magnetic diffusivity in bounded domains

Renmin University of China

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: This report verifies the incompressible limit of the non-isentropic compressible magnetohydrodynamic (MHD) equations without magnetic diffusion in a three-dimensional bounded C^4-domain. The uniform estimates in both the Mach number ε and the Peclet number κ for the local strong solutions, which exclude the estimate of high-order derivatives of the velocity in the normal directions to the boundary, are established in a short time interval independent of ε and κ, provided that the "well-prepared" initial condition for the solution and the non-slip boundary condition for the velocity are imposed.

Friday, June 14th

08:30-09:30

282. CHANG, Huailiang: NMSP: An algebraic geometry realization of BCOV Feynman structures for all genus GW invariants

The Hong Kong University of Science and Technology

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: Gromov Witten(GW) theory enumerates geneus g curves mapped to compact Calabi-Yau threefolds. The general genus case predicted by BCOV (1993) had been open for 25 years in mathematics.

Recently, for quintic CY threefolds, the moduli of N-Mixed-Spin-P (NMSP) fields is used to prove various conjectures determining GW generating functions F_g's. They are (i) BCOV Feynman structure (1993), (ii) Yamaguchi-Yau (YY) finite generation, (iii) YY functional equation (HAE, 2004), and that (iv) F_g is analytic. As a result NMSP verifies all-genus mirror symmetry up to finitely many $(3g-3)$ initial conditions. In particular we verify genus two mirror symmetry.

Indeed, many notions in BCOV theory, such as "propagators" or "holomorphic ambiguities" (B side, path integral), find their intersection-theory interpretations in NMSP moduli (A side, algebraic geometry). I shall discuss about these remarkable correspondences.

These results follow from a series of works with Shuai Guo, Young Hoon Kiem, Jun Li, Weiping Li, Melissa C.C. Liu, and Jie Zhou, taking the past decade.

283. ZHU, Yihang: Orbital integrals and Shimura varieties

Columbia University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Orbital integrals are fundamental objects in the local harmonic analysis of real and p-adic groups, while they also naturally show up in the study of Shimura varieties and other variants. One may thus hope to apply trace formula methods

to relate the arithmetic and geometry of Shimura varieties to representation theory. We report on some recent progress reflecting this philosophy. We shall discuss: 1) the Langlands-Kottwitz project for abelian-type Shimura varieties, including some non-compact cases, and 2) a study of the geometry of affine Deligne-Lusztig varieties using orbital integrals.

284. TANG, Yunqing: Reductions of abelian surfaces over global function fields

Princeton University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: For a non-isotrivial ordinary abelian surface A over a global function field with everywhere good reduction, under mild assumptions, we prove that there are infinitely many places modulo which A is geometrically isogenous to the product of two elliptic curves. This result can be viewed as a generalization of a theorem of Chai and Oort. This is joint work with Davesh Maulik and Ananth Shankar.

285. WU, Damin: Invariant metrics and the Greene-Wu conjectures

University of Connecticut

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: This talk is based on the joint work with S. T. Yau. An invariant metric on a complex manifold is in some sense a generalization of the Poincare metric on the unit disk. The classical invariant metrics are the Bergman metric, Caratheodory-Reiffen metric, the Kobayashi-Royden metric, and the complete Kahler-Einstein metric of negative scalar curvature. In 1979, R. E. Greene and H. Wu conjectured that on a simply-connected com- plete Kahler manifold of negatively pinched sectional curvature, the Bergman metric and the Kobayashi-Royden metric are uniformly equivalent to the background Kahler metric. In this talk, we shall start from elementary complex analysis, present the ideas of the proof of these conjectures, as well as a result on the Kahler-Einstein metric, and some further development.

286. MIAO, Pengzi: Scalar Curvature and Boundary Mean Curvature

University of Miami

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: The simplest curvature invariants of Riemannian manifolds and their hypersurfaces are scalar curvature and mean curvature, respectively. In a relativistic context, scalar curvature relates to matter distribution in spacetimes and mean curvature is used to compute the quasi-local mass of a given region. If the manifold is noncompact, fundamental results on manifolds with nonnegative scalar curvature include the Riemannian positive mass theorem and the Riemannian Penrose inequality. In this lecture, we discuss implications of these theorems to compact manifolds with boundary. More precisely, we aim to understand how nonnegative scalar curvature of a compact manifold influences the mean curvature of its boundary hypersurface.

09:40-10:40

287. YANG, Xiaokui: The geometry of manifolds with RC-positive tangent bundles

YMSC, Tsinghua University

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: We will present some recent progress on the geometry of compact complex manifolds with RC-positive tangent bundles including Yau's rational connectedness conjecture and various rigidity theorems of holomorphic maps and harmonic maps.

288. ZHENG, Weizhe: Around the Euler characteristics of étale sheaves

Morningside Center of Mathematics, CAS

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Over a field of positive characteristic, the study of Euler characteristics of constructible étale sheaves is complicated by phenomena of wild ramification. Great progress was made in recent years, culminating in T. Saito's analogue of the Kashiwara-Dubson global index formula. I will report on some of the recent progress and related developments.

289. WAN, Xin: Iwasawa theory and Bloch-Kato conjecture for unitary groups

Morningside Center, CAS

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: We present some recent progresses on Iwasawa theory for motives associated to cusp forms on unitary groups of general signature over totally real fields, twisted by a Hecke character. We also prove cases of Bloch-Kato conjecture for these motives, which states that if the central L-value vanishes, then the Selmer group has positive rank.

290. HUANG, An: General relativity from p-adic strings

Brandeis University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: We shall discuss motivations from mathematics and physics for developing p-adic sigma models. In particular, for bosonic p-adic strings moving in a curved target spacetime, we construct the sigma model, and show that the vacuum Einstein equations of the target are a consequence of a worldsheet scaling symmetry of the quantum p-adic strings, similar to the ordinary bosonic strings case. If time permits, we shall also mention motivations from physics for considering p-adic strings mapping to p-adic targets. This is based on a recent joint work with Bogdan Stoica and Shing-Tung Yau.

291. CHEN, Zhijie: On Simply-Periodic and Elliptic Solutions of Stationary KdV Hierarchy

YMSC, Tsinghua University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will talk about simply-periodic and elliptic KdV potentials, such as the classical Lamé potential. Our original motivation comes from mean field equations with singularities on flat tori. Among other things, I will introduce our recent result that as the moduli $\tau \to i\infty$, any zero of the classical Lamé function converges to either ∞ or a finite point p satisfying Re $p = \frac{1}{2}$ and $e^{2\pi i p}$ being an algebraic number.

11:00-11:45

292. LIU, Zhengwei: Quantum Fourier Analysis

Tsinghua University

Room 107, Leo KoGuan Building 廖凯原楼

Abstract: We propose a program Quantum Fourier Analysis to investigate the analytic aspects of quantum symmetries and their Fourier dualities. We introduce a topological analogue of the Brascamp-Lieb inequality. We discuss some recent results and perspectives.

293. CHEN, Zhi-You: On the uniqueness and structure of solutions to the system arising from Maxwell-Chern-Simons $O(3)$ sigma model

NCUE

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we prove the uniqueness of topological multivortex solutions for the self-dual Maxwell-Chern-Simons $O(3)$ sigma model with Chern-Simons coupling parameter sufficiently large and the charge of electron either sufficiently small or large. Besides, we also establish the sharp region of flux-pairs for the non-topological solutions and provide the classification of radial solutions of all types for single vortex point case.

294. WU, Kung-Chien: Asymptotic behavior of the Boltzmann equation

NCKU

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will focus on the asymptotic behavior (space variable $|x|$ large) of the Boltzmann equation for Grad cutoff hard potential. I will present two cases, one is time dependent whole space problem, the other is time independent half space problem.

295. ZHANG, Jun: Statistical Mirror Symmetry

The University of Michigan, Ann Arbor

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: A parametric statistical model is a family of probability density functions over a given sample space, whereby each function is indexed by a parameter taking value in some subset of R^n. Treating parameterization as a local coordinate chart, the family forms a manifold M endowed with a Riemannian metric g given by the Fisher-information (the well-known Fisher-Rao metric). The classical theory of information geometry (which we call A-Model) also prescribes a family of dualistic, torsion-free connections $\nabla^{(\alpha)}$, called alpha-connections ($\alpha \in R$), constructed from Amari-Chensov tensor as deformation from the Levi-Civita connection associated with g. Here we prescribe an alternative geometric framework of the manifold M by treating the parameter as an affine parameter of a flat connection and then prescribing its dual connection (with respect to g) ∇ as one that is curvature-free but carries torsion (which we call B-model). We then investigate properties of the tangent bundle TM based on the Sasaki lift of g and a canonical split using data from the base manifold M (i.e., either A- or B-model). For A-model, TM has the structure of an almost Kähler manifold, with an α-dependnet almost complex structures yet an identical symplectic structure for all alpha-connections which, when pushed forward to the cotangent bundle T^*M, is its canonical symplectic form. For B-model, TM has the structure of a Hermitian manifold constructed from the flat connection and an almost Kähler structure constructed from ∇ which, when pushed forward to T^*M, is also the canonical symplectic structure. Therefore, we establish a "mirror correspondence" between a Hermitian structure on TM and an almost Kähler structure on T^*M, each constructed from one of the pair of dual connections in the B-model. In analogous to mirror symmetry in string theory, we call this "statistical mirror-symmetry," and speculate its meaning in the context of statistical inference.

296. LI, Wei-Ping: Geometry of N-mixed spin p-fields and Gromov-Witten invariants for quintic Calabi-Yau threefolds

Hong Kong University of Science and Technology

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: I will discuss a recent method, N-mixed spin p-fields (NMSP for short), to study the Gromov-Witten invariants of the quintic Calabi-Yau three-folds. The NMSP is a generalization of mixed spin-p-fields theory, developed by H. L. Chang, J. Li, W. P. Li and Melissa Liu, to study the relations between Gromov-Witten invariants of the quintic Calabi-Yau threefold and the Fan-Jarvis-Ruan-Witten invariants of the

corresponding quintic polynomial. NMSP can be used to prove BCOV conjecture on Gromov-Witten invariants of the Calabi-Yau three-folds of any genus.

297. LAU, Anthony To-Ming: Fixed point set for semigroup of mappings on Banach spaces related to harmonic analysis

University of Alberta

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I shall describe the set of fixed points for a semigroup of affine mapping acting on a closed convex subset of a Banach space with applications to harmonic analysis on groups or semigroups.

298. LAM, Ngau: Solutions between Knizhnik-Zamolodchikov equations and super Knizhnik-Zamolodchikov equations

NCKU

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: The Knizhnik-Zamolodchikov equation is a system of complex partial differential equations originated from studying the correlation functions of Wess-Zumino-Novikov-Witten model in 2-dimensional conformal field theory. In this talk, we will discuss the connection between the singular solutions of Knizhnik-Zamolodchikov equations and super Knizhnik-Zamolodchikov equations for classical Lie (super)algebras of finite and infinite ranks. If time allows, we will discuss the analogous results for trigonometric Knizhnik-Zamolodchikov equations. This is joint work with Bintao Cao.

299. HAN, Deren: Some Extended Proximal Point Algorithms with Applications

Beihang University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: The classical proximal point algorithm (PPA) for solving the problem of finding zero points of a given maximal monotone operator, which includes the variational inequality problem, the complementarity problem, mathematical optimization problem as special cases. In the literature, the metric proximal parameter is usually required to be positive definite and symmetric, because it plays the role of the

measurement matrix of a norm in the convergence proof. Our main goal is to show that (i) the metric proximal parameter can be asymmetric if the proximal center is shifted appropriately; (ii) the metric proximal parameter can be indefinite. The resulting extended PPAs maintain the same implementation difficulty and convergence properties as the original PPA; while the relaxed requirements of the metric proximal parameter allow us to design highly customized algorithms that can effectively take advantage of the structures of the model under consideration. In particular, some efficient structure-exploiting splitting algorithms can be easily developed. We illustrate these algorithmic benefits by a saddle point problem and a convex minimization model with a generic separable objective function, both of which have wide applications in various fields. We also report some preliminary computational results, which are promising.

Keywords. Proximal Point Algorithm, Variational Inequality, Splitting Algorithms, Convex Programming, Rate of Convergence.

300. FUCHS, Michael: Some Combinatorial Problems Arising from Phylogenetics

Taiwan Chiao Tung University Hsinchu

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: Phylogenetic trees are used in biology to visualize the relationship of species, genes, etc. Reconstruction of phylogenetic trees is one of the main problems and several random models have been proposed for that purpose, e.g., the PDA model and and the Yule-Harding model. A more general class of random models is given by Aldous' beta-splitting model which contains both the PDA model and the Yule-Harding model as special cases.

In this talk, we will discuss some problems for random phylogenetic trees that we investigated recently and that were solved with combinatorial tools (in particular, tools from Analytic Combinatorics). The topics we plan to discuss will include:

(a) Correlation between phylogenetic diversity indices of rooted phylogenetic trees under the beta-splitting model;

(b) Stochastic analysis of the extra-clustering model for animal grouping under the PDA model and the Yule-Harding model;

(c) Moments and limit laws for ancestral configurations with matching gene and species trees under the PDA model and the Yule-Harding model.

This talk is based on joint work with Filippo Disanto (University of Pisa), Chih-Hong Lee (Taiwan Chiao Tung University), Ariel R. Paningbatan (Taiwan Chiao Tung University and University of the Philippines) and Noah A. Rosenberg (Stanford University).

301. CHEN, Wei: Information and Influence Propagation in Social Networks: Modeling and Influence Maximization

Microsoft Research Asia

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Information and influence propagation is a fundamental phenomenon in social networks that leads to many applications both for business and for public good, such as viral marketing, social recommendations, rumor control, epidemic prevention, etc. In this talk, I will survey the research area on information/influence diffusion dynamics and the influence maximization problem, which is the problem of selecting a small number of seed nodes in a social network such that their influence spread is maximized. The talk will cover basic stochastic diffusion models, algorithmic techniques for scalable influence maximization, as well as some of my recent research work on influence-based centrality, competitive and complementary influence diffusion, etc.

302. YANG, Xu: Seismic Tomography, Frozen Gaussian Approximation and Deep Learning

University of California, Santa Barbara

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Three-dimensional (3-D) elastic wave propagation and seismic tomography is computationally challenging in large scales and high-frequency regime. In this talk, we propose the frozen Gaussian approximation (FGA) to compute the 3-D elastic wave propagation and use it as t he forward modeling tool for seismic tomography with high-frequency data. The accuracy and parallelizability of the FGA algorithm is illustrated by comparing to the spectral element method. With a parallel FGA solver built as a computational platform, we explore various applications in 3-D seismic tomography, including seismic traveltime tomography and full waveform inversion, respectively. Global minimization for seismic tomography is investigated based on particle swarm algorithm. We also apply the FGA algorithm to train deep neural networks to learn the object of low velocity in the interested areas.

303. DONG, Yuxin: On Eells-Sampson type theorems for subelliptic harmonic maps

Fudan University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we discuss critical maps of a horizontal energy functional for maps from a sub-Riemannian manifold to a Riemannian manifold. These critical maps are referred to as subelliptic harmonic maps. In terms of the subelliptic harmonic map heat flow, we investigate the existence problem for subelliptic harmonic maps. Under the assumption that the target Riemannian manifold has non-positive sectional curvature, we are able to establish some Eells-Sampson type existence results, and also some Hartman type results for the flow.

304. SHENG, Weimin: An Anisotropic shrinking flow and L_p Minkowski problem

Zhejiang University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will introduce my recent work with Caihong Yi on studying anisotropic shrinking flows and the application on L_p Minkowski problem. We consider an shrinking flow of smooth, closed, uniformly convex hypersurfaces in Euclidean R^{n+1} with speed $fu^{\alpha}\sigma_n^{-\beta}$, where u is the support function of the hypersurface, $\alpha, \beta \in R^1$, and $\beta > 0$, σ_n is the n-th symmetric polynomial of the principle curvature radii of the hypersurface. We prove that the flow exists an unique smooth solution for all time and converges smoothly after normalisation to a smooth solution of the equation $fu^{\alpha-1}\sigma_n^{-\beta} = c$ provided the initial hypersuface is origin-symmetric and f is a smooth positive even function on S^n for some cases of α and β. In the case $\alpha \geq 1 + n\beta$, $\beta > 0$, we prove that the flow converges smoothly after normalisation to a unique smooth solution of $fu^{\alpha-1}\sigma_n^{-\beta} = c$ without any constraint on the initial hypersuface and the function f. When $\beta = 1$, our argument provides a uniform proof to the existence of the solutions to the L_p Minkowski problem $u^{1-p}\sigma_n = \phi$ for $p \in (-n-1, +\infty)$ where ϕ is a smooth positive function on S^n.

305. HUA, Zheng: TBD

University of Hong Kong

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: TBD

306. ZHANG, Youjin: Special Cubic Hodge Integrals and the Fractional Volterra Hierarchy

Tsinghua University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: We show that the generating function of cubic Hodge integrals satisfying the local Calabi-Yau condition is the tau function of a particular solution of an integrable hierarchy called the fractional Volterra hierarchy. This integrable hierarchy is a certain generalization of the Volterra lattice hierarchy (also called the discrete KdV hierarchy) which is well known in the theory of nonlinear integrable systems. The talk is based on joint work with Si-Qi Liu, Di Yang and Chunhui Zhou.

13:30-14:15

307. HU, Yongquan: The cohomology of Shimura curves and the p-adic Langlands program for GL_2

Morningside Center of Mathematics, Academy of Mathematics and Systems Science, CAS

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: The p-adic and mod p local Langlands correspondence is well-understood for GL_1 and $\mathrm{GL}_2(\mathbb{Q}_p)$, but is still very mysterious in other cases. In my talk, I will first review the story of the correspondence for $\mathrm{GL}_2(\mathbb{Q}_p)$, then discuss some recent results for $\mathrm{GL}_2(F)$ where F is a finite unramified extension of $\mathbb{Q}_p$ (based on joint work with Haoran Wang).

308. QIU, Yanqi: Determinantal point processes and spaces of holomorphic functions

Chinese Academy of Sciences

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The determinantal point processes arise naturally from different areas such as random matrices, representation theory, random graphs and zeros of holomorphic functions etc. In this talk, we will briefly talk about determinantal point processes related to spaces of holomorphic functions, in particular, we will discuss some results concerning the conditional measures, Lyons-Peres completeness conjecture and Patterson-Sullivan construction for point processes.

309. WANG, Meng: Weak convergence of the Landau-de Gennes flow to motion by mean curvature

Zhejiang University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this paper, we consider the asymptotic behavior of the Landau-de Gennes flow as the elastic constant tends to zero. Similar as Ginzburg-Landau approximation in Bethuel et. [Bethuel 2006], we also obtained that vorticity evolves according to motion by mean curvature in Brakke's weak formulation. One main obstacle of this paper lies in that minimal stable states of the polynomial bulk energy of Landau-de Gennes equations are of $\mathbb{RP}^2$ with a set of uniaxial Q-tensors, which is different from that in [Bethuel 2006] with a minimum on $\mathbb{S}^2$. To overcome it, we have to explore the detailed properties in each stable state.

310. WU, Qi: The Wave-interference-like motion of Multi-allele Systems in Population Dynamics

Institute of Microbiology, Chinese Academy of Sciences

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Since Kimura introduced diffusion approximation to describe the process distribution of allele frequencies changing with time in 1955. The dynamic process quantified by diffusion equation has played a central role in evolutionary population genetics. In details, the probability distribution of stochastic variables can be used to quantify the distribution of allele frequencies in one or more loci in a population. By introducing a simple model in random walking one can describe the changes of allele frequencies in the population among different generations. This approach has gained great success and, at the same time, caused intensive debates. The most controversy is, a dynamic process under such description must be a slow fluctuation in the system, but in evolution, one can always observe the process with greatly varied evolutionary rate. The random fluctuation is not persuasive for those rapid changes. Here we showed a theoretical possible breakthrough and performed some initial test with population dynamic simulation. Theoretically speaking, starting from the Kolmogorov equation which is a first-order differential equation with respect to time, one can deduce the Langevin equation which contents a second-order differential term to time. Thus, it is possible to describe the variable speed motion of allele frequency in the population. In fact, the Langevin equation is one of the most essential approaches in physics to represent quantum theory based on the wave-particle duality. We simulated the dynamics of a multi-allele system and found that when allele type is much smaller or much larger than the population size. The dynamics of allele frequency distribution will appear like a particle. But when the allele type is in

the same order of magnitude of population size, with the certain condition a wave-inference-like process can be observed. We further discussed why it makes sense that a population being a macroscopic "object" can have wavy motion in three aspects, 1) the punctuated evolution as the quantum transition, 2) the polymorphism and state superposition, and 3) the non-repeatability of observations. By suggesting a wave-like motion in population dynamics, we hope to offer a completely different insight for evolution.

311. WANG, Yi: The limit to the compressible Euler equations in the setting of Riemann solutions

AMSS, Chinese Academy of Sciences

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: I will talk about the hydrodynamic limit of the Boltzmann equation and/or the vanishing viscosity limit of compressible Navier-Stokes equations to the compressible Euler equations in the setting of Riemann solutions, which includes the 1D generic superposition of three basic wave patterns, namely, two nonlinear waves, i.e., shock and rarefaction waves, and a linearly degenerate wave, called contact discontinuity, and the case of multi-dimensional planar rarefaction wave.

312. ZHU, Fuhai: On Frobenius Lie algebras and their applications

Nanjing University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: A Frobenius Lie algebra $\mathfrak{g}$ is a Lie algebra with linear function $f \in \mathfrak{g}^*$ such that symplectic form $df(x, y) = f([x, y])$ is nondegenerate. In this talk, we will give the classification of some classes of Frobenius Lie algebras and will explain the application of our results to differential geometry, representation theory and some other algebraic problems.

313. SHU, Bin: Classification of blocks for a parabolic category O of Cartan type Lie superalgebras

East China Normal University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will introduce certain BGG category O of Cartan type Lie superalgebras and its blocks. Historically, it has been known on blocks of finite

dimensional category over $W(n)$ (one of Cartan type). In our work, we make thorough study on the minimal parabolic BGG category for all Cartan type Lie superalgebras. The final result provides a classification of blocks for such categories, including the case of finite dimensional modules for all Cartan type LIe superalgebras. This is a joint work with Feifei Duan and Yufeng Yao.

314. CHEN, Xujin: Densities, Matchings, and Fractional Edge-Colorings

AMSS, Chinese Academy of Sciences

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: Given a multigraph $G = (V, E)$ with a positive rational weight $w(e)$ on each edge e, the *weighted density problem* (WDP) is to find a subset U of V , with $|U| \geq 3$ and odd, that maximizes $\frac{2w(U)}{|U|-1}$, where $w(U)$ is the total weight of all edges with both ends in U, and the *weighted fractional edge-coloring problem* (WFECP) can be formulated as the linear program

$$\begin{array}{ll} \text{Minimize} & 1^T x \\ \text{subject to} & Ax = w \\ & x \geq 0 \end{array}$$

where A is the edge-matching incidence matrix of G. These two problems are closely related to the celebrated Goldberg-Seymour conjecture on edge-colorings of multigraphs, and have great interests in their own rights. Even when $w(e) = 1$ for all edges e, determining whether WDP can be solved in polynomial time was posed by Jensen and Toft [*Topics in Chromatic Graph Theory*, Cambridge University Press, Cambridge, 2015, pp. 327-357] and by Stiebitz *et al.* [*Graph Edge Colouring: Vizing's Theorem and Goldberg's Conjecture*, John Wiley, New York, 2012] as an open problem. We design strongly polynomial-time algorithms for solving WDP and WFECP exactly, and develop a novel matching removal technique for multigraph edge-coloring. (Joint work with Wenan Zang, Qiulan Zhao.)

315. TANG, Qinglin: Numerical methods on computing the ground state and dynamics of the rotating dipolar Bose-Einstein condensate

Sichuan University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will present efficient numerical methods to compute the ground state and dynamics of the rotating dipolar Bose-Einstein condensate. The methods consist of three merits: (i) efficient and accurate numerical methods will be

proposed to evaluate the nonlocal dipole-dipole interaction. (ii) a nonlinear conjugate gradient method, accelerated by some well-adapted preconditioners, will be developed to compute the ground states. (iii) a rotating Lagrangian coordinate transformation will be presented to eliminate the rotation term, based on which time splitting spectral methods will be presented to simulate the dynamics. Extension to other systems will also be considered.

316. WANG, Li-Ping: Two new module-code-based KEMs with rank metric

Institute of Information Engineering, Chinese Academy of Sciences

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we use a class of module codes to construct a suite of code-based public-key schemes—Piglet, which includes a new IND-CPA-secure public-key encryption scheme Piglet-1.CPAPKE and an IND-CCA-secure key encapsulation mechanism (KEM for short) Piglet-1.CCAKEM by applying the KEM variant of Fujisaki-Okamoto transform to Piglet-1.CPAPKE. We also put a new IND-CPA-secure KEM Piglet-2.CPAKEM into Piglet. Then, we present the parameters comparison between our schemes and some code-based NIST submissions. The results show that our schemes are good long-term-secure candidates for post-quantum cryptography.

317. WANG, Yanfei: Compressive seismic data acquisition, regularization and imaging

Institute of Geology and Geophysics, Chinese Academy of Sciences

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: We address two main problems in seismic data processing: the first is the compressive seismic acquisition and multi-trace seismic wavefield recovery. To take account of the collective correlation from a given set of testing samples as well as each individual, a matrix minimization model is presented to jointly representing all the testing samples over the coding bases simultaneously. A generalized matrix norm $l_{2,p}(0 < p \leq 1)$ is employed to measure the interrelation of the multiple samples and the entries of each one. A unified algorithm is developed and the convergence analysis is demonstrated for the range of parameters $p \in (0, 1]$. The second problem is the seismic imaging. We consider Gaussian beams migration with nonzero initial curvature. Extensive experimental tests are performed to exhibit the efficient performance of the developed methods.
Keywords: Seismic data processing, joint matrix minimization, seismic imaging

318. ZHANG, Lei: Optimal coarse graining for multiscale problems

Shanghai Jiao Tong University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: Problems with a wide range of coupled temporal and spatial scales are ubiquitous in many physical phenomena and processes. Multiscale modeling and simulation is therefore essential for the discovery in key areas such as energy, information technology and biomedicine. To design scalable multiscale computational methods, it is crucial to identify low dimensional approximation spaces or coarse grained models to effectively represent unresolved scales and optimally approximate fine scale problems. Furthermore, based on the theoretical advancements and insights gained from coarse graining methods, efficient fine scale solvers such as multilevel/multigrid methods can be built to accelerate the direct simulation of multiscale problems. I will ellaborate on those points using two representative examples: (1) construction and analysis of multiscale atomistic-to-continuum (a/c) and QM/MM coupling methods; (2) numerical homogenization and related numerical methods for media with nonseparable scales.

319. XIE, Zhizhang: Noncommutative geometry: K-theory of operator algebras and higher index theoretic invariants

Texas A&M University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: K-theory of operator algebras has played a fundamental role in the developments of various branches of mathematics during the last thirty years or so. In particular, its applications to geometry and topology have greatly advanced some of the most important problems in those areas of mathematics, such as the Novikov conjecture, the Baum-Connes conjecture and the Gromov-Lawson-Rosenberg conjecture. One of the most fruitful interactions of K-theory of operator algebras with geometry and topology is through higher index theoretic invariants. In this talk, I will give a brief introduction to some of the most recent advances in K-theory of operator algebras and it applications to geometry and topology, such as the positive scalar curvature problem in geometry and the manifold rigidity problem in topology.

320. FEI, Teng: Recent progress in Anomaly flow

Columbia University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: The Hull-Strominger system describes the geometry of compactifications of heterotic superstrings with flux, which can be viewed as a generalization of Ricci-flat Kahler metrics on non-Kahler Calabi-Yau manifolds. To overcome the difficulty of lacking ddbar-lemma, Phong-Picard-Zhang initiated the program of Anomaly flow to understand the Hull-Strominger system. It has been proved in many cases that the Anomaly flow serves as an effective way to investigate the Hull-Strominger system and in general canonical metrics on complex manifolds, such as giving new proofs of the Calabi-Yau theorem and the existence of Fu-Yau solution. In this talk, we present some new progress on the Anomaly flow, including the behavior of Anomaly flow on generalized Calabi-Gray manifolds and a unification of the Anomaly flow with vanishing slope parameter and the Kahler-Ricci flow, which further allows us to generalize the notion of the Anomaly flow to arbitrary complex manifolds. This talk is based on joint work with Z.-J. Huang, D.H. Phong and S. Picard.

321. YANG, Greg: Tensor Programs: A Swiss-Army Knife for Nonlinear Random Matrix Theory of Deep Learning and Beyond

Microsoft Research

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: The resurgence of neural networks has revolutionized artificial intelligence since 2010. Luckily for mathematicians and statistical physicists, the study of large random network scaling limits, which can be thought of as *nonlinear* random matrix theory, is both practically important and mathematically interesting. We describe several problems in this setting and develop a new comprehensive framework, called “tensor programs”, for solving these problems. This framework can be thought of as an automatic tool to derive the behavior of computation graphs with large matrices, as used in neural network computation. It is very general, and from it we also obtain new proofs of the semicircle and the Marchenko-Pastur laws. Thus, “tensor programs” is broadly useful to linear and nonlinear random matrix theory alike, and we hope it will be adopted as a standard tool. This talk presents the work arXiv:1902.04760.

14:25-15:10

322. QIAN, Zicheng: One problem in mod p local global compatibility for $\mathbf{GL}n(\mathbb{Q}_p)$

Université Paris-sud

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: Given a mod p automorphic Galois representation r, it is widely expected that the the Hecke eigenspace with a fixed level prime to p, as a mod p representation of a certain p adic reductive group, determines the restriction of r at places above p. We will discuss some recent progress along this line when the p adic reductive group is $\mathrm{GL}n(\mathbb{Q}_p)$. This is a joint work with V. B. Le Hung, D. Le, S. Morra and C. Park.

323. LU, Jian: Some recent progress of the Orlicz-Minkowski problem

Zhejiang University of Technology

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: The Orlicz-Brunn-Minkowski theory is one of the most important developments of the classical Brunn-Minkowski theory about convex geometry. The Orlicz-Minkowski problem is the basic problem in this new theory. It is equivalent to solving a Monge-Ampere type equation on the unit sphere, which may be degenerate or singular in different situations. We will talk about some recent progress about this problem, including existence and non-uniqueness results of solutions. We will also provide new results for the centroaffine Minkowski problem and dual Lp-Minkowski problem.

324. LI, Zhiqiang: Krein-Milman Type Theorems for C^*-algebras

Chongqing University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we present Krein-Milman type theorems for C^*-algebras. Given a Markov operator on $C[0,1]$ leaving a certain type of subspace invariant, which corresponds to a certain type of subhomogeneous C^*-algebra on $[0,1]$, we approximate it by an average of $*$-homomorphisms on $C[0,1]$ in the strong operator topology; additionally, we require the average also leaves the subspace invariant. These results extend Thomsen-Li's theorems for homogeneous C^*-algebras. Moreover, such results could be applied to construct concrete $*$-homomorphisms of subhomogeneous C^*-algebras. This is a joint work with G. Elliott and X. Zhao.

325. WANG, Haitao: Pointwise estimates of some kinetic equations

Shanghai Jiao Tong University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, I will present some recent results on the space-time pointwise behaviors of several kinetic equations, including Boltzmann equation, Landau equation and Fokker-Planck equation. The results show detailed wave propagation of the localized perturbation. Moreover, we will see how different molecular interactions influence the spatially asymptotic behaviors and how initial singularity evolves for different models.

326. ZHANG, Xiongtao: Complete Predictability of the Cucker-Smale Model on the Real Line

Huazhong University of Science and Technology

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we consider Cucker-Smale mdoel (C-S) on the real line and then the integrability of the 1-D model allows us to do much more refined analysis and obtain complete structure of the dynamics. In the first part, we will study the C-S model with regular communication weight. We will show the sufficient and necessary condition of both mono-cluster and multi-cluster formation emergence. In the second part, we will focus on the C-S model with singular communication. For long range interaction, we will prove the finite time collisions and thus derive the uniqueness of the solution. For short range interaction, we will show the avoidance of collisions by constructing the lower bound of the distance between particles. Therefore, the solution is analytic and unique. Moreover, we will also show the sufficient and necessary condition of multi-cluster formation in the singular case.

327. FEI, JiaRui: Tensor Product Multiplicity via Upper Cluster Algebras

Shanghai Jiao Tong University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: By tensor product multiplicity we mean the multiplicities in the tensor product of any two finite-dimensional irreducible representations of a simply connected Lie group. Finding their polyhedral models is a long-standing problem. The

problem asks to express the multiplicity as the number of lattice points in some convex polytope.

Accumulating from the works of Gelfand, Berenstein and Zelevinsky since 1970's, around 1999 Knutson and Tao invented their hive model for the type A cases, which led to the solution of the saturation conjecture. Outside type A, Berenstein and Zelevinsky's models are still the only known polyhedral models up to now. Those models lose a few nice features of the hive model.

In this talk, I will explain how to use upper cluster algebras, an interesting class of commutative algebras introduced by Berenstein-Fomin-Zelevinsky, to discover new polyhedral models for all Dynkin types. Those new models improve the ones of Berenstein-Zelevinsky's, or in some sense generalize the hive model. It turns out that the quivers of relevant upper cluster algebras are related to the Auslander-Reiten theory of presentations, which can be viewed as a categorification of these quivers. The upper cluster algebras are graded by triple dominant weights, and the dimension of each graded component counts the corresponding tensor multiplicity.

The proof also invokes another categorification-Derksen-Weyman-Zelevinsky's quiver-with-potential model for the cluster algebra. The bases of these upper cluster algebras are parametrized by μ-supported g-vectors. The polytopes will be described via stability conditions. The talk is based on the preprint arXiv:1603.02521.

328. HOU, Jianfeng: On bipartitions of graphs and directed graphs

Fuzhou University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Many classical partition problems in Combinatorics and Computer Science seek a partition of a combinatorial object (e.g., a graph, directed graph, hypergraph, etc.) which optimizes a single parameter. One such problem are the Max-Cut problem, where one seeks to partition the vertex set $V(G)$ of a graph G into two disjoint parts V_1 and V_2 so that the number of edges of G crossing between V_1 and V_2 is maximal.

Judicious partition problem is to partition the vertex set of a graph such that several quantities are optimized simultaneously. In 2002, Bollobás and Scott studied the graph and digraph partition problems from several different angles and proposed many problems.

In this talk, we will investigate some of them through combinatorial and probabilistic arguments.

Keywords: graph, digraph, Max-Cut problem, judicious partition

329. GAO, Fengnan: Something old and something new: On bridging the probabilistic theory of urn models and statistical inference in preferential attachment networks

Fudan University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: After gaining its traction due to its ability to model power laws, the preferential attachment (PA) network is a popular way among probabilists and physicists to model the social networks, the collaboration networks and etc. The PA network model is an evolving network model where new nodes keep coming in. Each incoming new node establishes only one connection with one of the existing node. The probability to pick the node to connect to is proportional to preferences based on a PA function, mapping the natural numbers "degrees" to a positive real number "preference". The PA function is assumed apriori non-decreasing, which means the nodes with high degrees are more likely to get new connections, i.e., "the rich get richer". To solve the inverse problem of estimating the PA function statistically without relying on the historical evolution of the network, we propose a history-free maximum likelihood estimator (MLE). However, the lack of straightforward martingales in the history-free likelihood puts us in the blindfold in proving the central limit result for the said estimator. We draw an equivalence between the infinite dimensional evolution of PA networks ("something new") and the finite dimensional urn model ("something old"), to overcome the impossibility of modeling the PA networks' evolution with the existing operator theory, and to eventually prove the central limit theorem for the MLE. This is joint work with Aad van der Vaart.

330. CHEN, Huangxin: Threshold dynamics method for topology optimization for fluids

Xiamen University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk we will introduce an efficient threshold dynamics method for topology optimization for fluids modeled with the Stokes equation. We aim to minimize an objective energy function that consists of the dissipation power in the fluid and the perimeter approximated by nonlocal energy subject to a fluid volume constraint and an incompressibility condition. In order to solve the problem in the whole domain, a one-domain approach for fluids over porous media will be introduced. Then we show that the minimization problem can be solved with an iterative scheme in which the Stokes problem is approached with a Brinkman problem. The indicator functions of the fluid-solid regions are then updated according to simple convolutions followed by a thresholding step. The total energy decaying property of

the iterative algorithm can be obtained. Some numerical results will be shown to verify the efficiency of the proposed algorithm.

331. CUI, Tao: Parallel 3-D Adaptive Finite Element Method and its Application on EDA tools

LSEC, Chinese Academy of Sciences

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: Electronic design automation (EDA), also referred to as electronic computer-aided design (ECAD), is a category of software tools for designing electronic systems such as integrated circuits and printed circuit boards. As the VLSI technology scales down to nanoscale and the circuit's frequency reaches GHz, EDA tools play a more and more important role in today's integrated circuits (IC) industry. The finite element method (FEM) is a powerful tool for the numerical simulation of a wide range of problems. In this talk, the parallel adaptive finite element method for parasitic extraction of large scale interconnects and thermomechanical stress evaluation of 3D IC is developed to provide extremely high parallel scalability and numerical accuracy. Numerical results of some large scale adaptive finite element simulations with up to 1 billion degrees of freedom and using up to ten thousand CPU cores are presented to demonstrate that the our adaptive method is robust and scalable for analysis of very complicated geometries.

332. SHI, Zuoqiang: PDE-based Methods for Interpolation on High Dimensional Point Cloud

Tsinghua University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: Interpolation on high dimensional point cloud provides a fundamental model in many data analysis and machine learning problems. In this talk, we will present some PDE based methods to do interpolation on point cloud. Applications in image processing and machine learning are shown to demonstrate the performance of our methods.

333. SHEN, Shu: Recent progress on Fried conjecture

Sorbonne Université

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: The relation between the spectrum of the Laplacian and the dynamical flow on a closed Riemannian manifold is one of the central themes in differential geometry. Fried conjectured that the analytic torsion, which is an alternating product of regularized determinants of the Hodge Laplacians, equals the zero value of the dynamical zeta function of Ruelle. We will discuss this conjecture in the case of flows including the geodesic flow, the Anosov flow, and the Morse-Smale flow.

334. WU, Yunhui: Small eigenvalues of closed Riemann surfaces for large genus

Tsinghua University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: We study the asymptotic behavior of small eigenvalues of Riemann surfaces for large genus. We show that for any positive integer k, as the genus g goes to infinity, the smallest k-th eigenvalue of Riemann surfaces in any thick part of moduli space of Riemann surfaces of genus g is uniformly comparable to $\frac{1}{g^2}$ in g.

In the proof of the upper bound, for any constant $\epsilon > 0$, we will construct a closed Riemann surface of genus g in any ϵ-thick part of moduli space such that it admits a pants decomposition whose boundary curves all have length equal to ϵ, and the number of separating systole curves in this surface is uniformly comparable to g. This is a joint work with Yuhao Xue.

335. CHEN, Qingtao: TBD

University of California, Berkeley

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: TBD

336. HUANG, Huichi: Mean ergodic theorem for amenable discrete quantum groups and its applications

Chongqing University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: We generalize von Neumann's mean ergodic theorem to amenable discrete quantum groups. Then we give its applications to abstract harmonic analysis and ergodic theory.

15:30-16:15

337. MA, Liming: The asymptotic behavior of automorphism groups of function fields over finite fields

Yangzhou University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: The purpose of this paper is to investigate the asymptotic behavior of automorphism groups of function fields when genus tends to infinity. Motivated by applications in coding and cryptography, we consider the maximum size of abelian subgroups of the automorphism group $\mathrm{Aut}(F/\mathbb{F}_q)$ in terms of genus g_F for a function field F over a finite field $\mathbb{F}_q$. Although the whole group $\mathrm{Aut}(F/\mathbb{F}_q)$ could have size $\Omega(g_F^4)$, the maximum size m_F of abelian subgroups of the automorphism group $\mathrm{Aut}(F/\mathbb{F}_q)$ is upper bounded by $4g_F+4$ for $g_F \geq 2$. In the present paper, we study the asymptotic behavior of mF by defining $M_q = \limsup_{g_F\to\infty} \frac{m_F \cdot \log_q m_F}{g_F}$, where F runs through all function fields over $\mathbb{F}_q$. We show that M_q lies between 2 and 3 (or 4) for odd characteristic (or for even characteristic, respectively). This means that m_F grows much more slowly than genus does asymptotically.

The second part of this paper is to study the maximum size b_F of subgroups of $\mathrm{Aut}(F/\mathbb{F}_q)$ whose order is coprime to q. The Hurwitz bound gives an upper bound $b_F \leq 84(g_F-1)$ for every function field $F/\mathbb{F}_q$ of genus $g_F \geq 2$. We investigate the asymptotic behavior of b_F by defining $B_q = \limsup_{g_F\to\infty} \frac{b_F}{g_F}$, where F runs through all function fields over $\mathbb{F}_q$. Although the Hurwitz bound shows $B_q \leq 84$, there are no lower bounds on B_q in literature. One does not even know if $B_q = 0$. For the first time, we show that $B_q \geq 2/3$ by explicitly constructing some towers of function fields in this paper.

338. LUO, Sijie: Some characterizations for order preserving and order reversing mappings in convex analysis

YMSC, Tsinghua University

Room B102, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will give a representation theorem for an order reversing (resp. preserving) mapping from the cone $\mathrm{Conv}(X)$ to itself, where $\mathrm{Conv}(X)$ consists of all lower semicontinuous convex functions defined on Banach space X. Some representations of such self-mappings defined on some subcones of $\mathrm{Conv}(X)$ will also be discussed. We conclude this talk with some connections between convex analysis and operator theory.

339. POON, Yiu-Tung: Preservation of the joint essential matricial range

Iowa State University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Let $\mathbf{A} = (A_1, \ldots, A_m)$ be an m-tuple of self-adjoint elements of a unital C*-algebra $\mathcal{A}$. The **joint q-matricial range** $W^q(\mathbf{A})$ is the set of $(B_1, \ldots, B_m) \in \mathbf{M}_q^m$ such that $B_j = \Phi(A_j)$ for some unital completely positive linear map $\Phi : \mathcal{A} \to M_q$. When $\mathcal{A} = \mathcal{B}(\mathcal{H})$, where $\mathcal{B}(\mathcal{H})$ is the algebra of bounded linear operators on the Hilbert space $\mathcal{H}$, the **joint spatial q-matricial range** $W_s^q(\mathbf{A})$ of $\mathbf{A}$ is the set of $(B_1, \ldots, B_m) \in \mathbf{M}_q^m$ such that B_j is a compression of A_j on a q-dimensional subspace. The **joint essential spatial q-matricial range** is defined as

$$W_{ess}^q(\mathbf{A}) = \cap\{\mathbf{cl}(W_s^q(A_1 + K_1, \ldots, A_m + K_m)) : K_1, \ldots, K_m \text{ are compact operators}\},$$

where **cl** denotes the closure. Suppose $\mathcal{K}(\mathcal{H})$ is the set of compact operators in $\mathcal{B}(\mathcal{H})$, and π is the canonical surjection from $\mathcal{B}(\mathcal{H})$ to the Calkin algebra $\mathcal{B}(\mathcal{H})/\mathcal{K}(\mathcal{H})$. We prove that $W_{ess}^q(\mathbf{A})$ is C^*-convex and equals the joint q-matricial range $W^q(\pi(\mathbf{A}))$, where $\pi(\mathbf{A}) = (\pi(A_1), \ldots, \pi(A_m))$. Furthermore, for any positive integer N, we prove that there are self-adjoint compact operators $K_1, \ldots, K_m$ such that

$$W_s^q(A_1 + K_1, \ldots, A_m + K_m) = W_{ess}^q(\mathbf{A}) \quad \text{for all } q \in \{1, \ldots, N\}.$$

If $W_{ess}^1(\mathbf{A}) = W^1(\pi(\mathbf{A}))$ is a simplex in $\mathbf{R}^m$, then we prove that there are self-adjoint compact operators $K_1, \ldots, K_m$ such that $W_s^q(A_1 + K_1, \ldots, A_m + K_m) = W_{ess}^q(\mathbf{A})$ for all positive integers q. These results generalize those of Narcowich-Ward and Smith-Ward, obtained in the case when $m = 2$, and also generalize the result of Müller when $m \geq 1$ and $q = 1$.

Co-author(s): Chi-Kwong Li and Vern I. Paulsen

340. DONG, Dong: Multilinear operators and their applications

University of Maryland

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Several important integral operators in harmonic analysis will be presented in an organized way. The fundamental question about these operators is the boundedness on Lebesgue spaces. We will show that the difficulty to establish the boundedness will change dramatically once we move from the classic type of operators to their curved and discrete analogs. It is very interesting to see that these operators interact with many fields of mathematics such as PDE, ergodic theory, number theory, combinatorics, and even algebraic geometry.

341. YANG, Chao: TBD

Peking University

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: TBD

342. WANG, Yuan: Rational Curves on Hypersurfaces

Northwestern University

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: It is a well known fact that a general hyperplane of degree d in $\mathbb{P}^n$ is rationally connected if $d \leq n$, but contains very few curves if $d \geq n+1$. More generally let X be a smooth projective variety and H a hypersurface of X such that $K_X + H$ is anti-ample, then by the adjunction formula and a classical result of Kollár-Miyaoka-Mori we know that H is rationally connected. We use the minimal model program as well as other techniques in birational geometry to study further how the behavior of rational curves on X as well as the positivity of $-(K_X + H)$ and H influence the behavior of rational curves on H. In this talk I will present several results and examples of this kind. In particular we will see criteria for uniruledness and rational connectedness of H.

343. ZHU, Bin: Cluster-tilting subcategories in triangulated categories

Tsinghua University

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Cluster tilting objects in cluster categories, or in 2-Calabi-Yau triangulated categories were introduced by Buan-Marsh-Reineke-Reiten-Todorov, Keller and Iyama. They provide a categorification of Fomin-Zelevinsky's cluster algebras. In this talk, we will survey some recent results on their generalization to arbitrary triangulated categories.

344. CHEN, Yichao: An Euler-genus approach to the calculation of embedding distributions of a graph

Hunan University

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: In 1994, J. Chen, J. Gross, and R. Rieper demonstrated how to use the overlap matrix to calculate the distribution of the embeddings of a graph in the non-orientable surfaces. That has ever since been by far the most frequent way that these distributions have been calculated. This talk introduces a combinatorial way to calculate the Euler-genus polynomial of a graph, which combines the orientable and the non-orientable embeddings, without using the overlap matrix. The non-orientable embeddings is then easily calculated from the Euler-genus polynomial and the genus polynomial. In addition, some other results are also discussed.

345. TANG, Min: Derivation of various macroscopic chemotaxis models from a pathway-based kinetic model

Shanghai Jiao Tong University

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: One of the central problems in biology is to understand the underlying mechanisms responsible for spatial pattern formation in complex systems. This is a difficult task because the essential mechanisms for pattern formation often involve multiple space and time scales and are often buried in overwhelmingly complex physiological details. The pathway-based kinetic model is a bridge of deriving macroscopic models from knowledge at the microscopic scales. Compared with classical kinetic models, the pathway-based kinetic model has one additional variable that takes into

account the internal state of bacteria, thus leads to abundant phenomena and brings interesting new mathematical problems.

In this talk, I will give several examples of macroscopic chemotaxis models derived from the pathway-based kinetic equation, give the rigorous derivations and show their biological applications.

346. HE, Fei: Answers to several questions on fixed point theorem in b-metric spaces

Inner Mongolia University

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: It is well known that b-metric space is a generalization of metric space. Many results on fixed point are established in b-metric space. Recently, the researchers posed several open questions on fixed point theorems in b-metric spaces. In this talk, we discuss and answer some of these questions.

347. YING, Wenjun: Recent developments of a potential theory based Cartesian grid method for elliptic and parabolic PDEs

Shanghai Jiao Tong University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: This talk will be on a potential theory based Cartesian grid method. The method solves a boundary value or interface problem of PDE in the framework of second-kind Fredholm boundary integral equations. It avoids some limitations of the traditional boundary integral method. It does not need to know or compute the fundamental solution or Green's function of the PDE. Instead, it allows the solution of variable coefficients and nonlinear PDEs. The method evaluates boundary and volume integrals involved indirectly by solving equivalent but much simpler interface problems on Cartesian grids, based on properties of single, double layer boundary integrals and volume integrals in potential theory. In addition to its taking advantage of the well-conditioning property of the second-kind Fredholm boundary integral equations, the method makes full use of fast solvers on Cartesian grids. The Cartesian grid method can also accurately compute nearly singular and hypersingular boundary integrals. This talk will present recent developments of the method on applications in fluid dynamics and acoustic scattering as well as new theoretical results on error estimates.

348. QIN, Fan: Bases for upper cluster algebras and tropical points

Shanghai Jiao Tong University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: It is known that many (upper) cluster algebras possess very different good bases which are parametrized by the tropical points of Langlands dual cluster varieties. For any given injective reachable upper cluster algebra, we describe all of its bases parametrized by the tropical points. In addition, we obtain the existence of the generic bases for such upper cluster algebras. Our results apply to many cluster algebras arising from representation theory, including quantized enveloping algebras, quantum affine algebras, double Bruhat cells, etc.

349. PAN, Xuanyu: Stable Maps, Cycles and Fano Varieties

AMSS, Chinese Academy of Sciences

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will report our works on the geometry of moduli spaes of rational curves on Fano varieties (e.g. low degree complete intersections) and the applications to some cycle-problems.

350. HOU, Shaoxiong: Mixed Volumes and Anisotropic Potentials

Hebei Normal University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: This talk studies several mixed volumes from anisotropic Riesz and logarithmic potentials as geometric extensions of the Newton gravitational potential. Isovolumetric inequalities are established, which are widely applied to dual Minkowski inequalities in convex geometry analysis, Cordes-Nirenberg space embeddings and related Dirichlet problems.

351. IP, Ivan Chi-Ho: Positive Peter-Weyl Theorem

Hong Kong University of Science and Technology

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: I will explain the Peter-Weyl Theorem for split real quantum groups of type An, generalizing the previous result in the case of $\mathcal{U}_q(\mathfrak{sl}(2,\mathbb{R}))$. I will talk about the necessary ingredients needed to state and proof the theorem, including the GNS representation of C*-algebra, Heisenberg double construction, and cluster realization of positive representations. This is a joint work with Gus Schrader and Alexander Shapiro.

16:25-17:10

352. YANG, Lei: Multiplicative Diophantine approximation on planar lines

Sichuan University

Room B101, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will talk about multiplicative Diophantine approximation on planar lines. We will prove that for any planar line, a strengthening of Littlewood's conjecture holds for almost every point on the line. This is done by establishing an effective equidistribution result for one parameter unipotent orbits in the moduli space of three dimensional unimodular lattices. This is a joint work with Sam Chow.

353. LUO, Tianwen: Some results on the three-dimensional prandtl equations

Tsinghua University

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: Adapting the convex integration framework introduced by De Lellis-Székelyhidi, we construct Hölder continuous weak solutions to the three dimensional Prandtl system. This is a joint work with Prof. Zhouping Xin.

354. ZHANG, Yinglong: Collective Dynamics of Cucker-Smale and Kuramoto Model

Seoul National University

Room B103, Leo KoGuan Building 廖凯原楼

Abstract: Self-organized collective motions, such as the aggregation of bacteria, flocking of birds, and swarming of fish, are often observed in complex biological systems. Recently, collective motions have been extensively investigated because of their potential applications to unmanned aerial vehicles and client network equipment. In this presentation, I will first talk about the flocking dynamics of Cucker-Smale model, which was first proposed by F. Cucher and S. Smale modeling the flocking of birds or fishes. Then I will talk about the synchronization dynamics for Kuramoto model, which was first proposed by Y. Kuramoto modeling the synchronization of weakly coupled limit-cycle oscillators. Finally, I will talk about the large time behavior for the kinetic Kuramoto model.

355. WANG, Changjun: A Tractable Network Game of Atomic Dynamic Flows

Beijing University of Technology

Room B122, Leo KoGuan Building 廖凯原楼

Abstract: We propose a new game model for selfish routing of atomic agents, who compete for use of a network to travel from their origins to their destinations as fast as possible. Our model is arguably not only a good simulation of the dynamic characteristics of atomic selfish routing, but also more tractable than most related ones. Our study follows a frequently used rule that the latency an agent experiences on an edge is a constant free-flow transit time plus a variable waiting time in a queue. A key feature that differentiates the flow dynamic in our model from the related ones is our edge-based tie-breaking rule for prioritizing agents who reach an edge at the same time.

We study the game on multiple-origin single-destination networks for either non-adaptive agents (each choosing a one-off origin-destination path simultaneously at the very beginning) or adaptive ones (each making an online decision at nonterminal vertices they reach as to which next edge to take). We constructively prove that a (pure) Nash equilibrium (NE) always exists for non-adaptive agents, and show that every NE possesses several desirable properties, including weak Pareto efficiency and global First-In-First-Out. We are among the first to consider adaptive agents, for which we show that a subgame perfect equilibrium (SPE) always exists. As a useful bridge between non-adaptive and adaptive submodels, we prove that each NE for non-adaptive agents is realizable by some SPE of adaptive agents. On the computational

side, we present efficient algorithms for finding an NE and best responses of non-adaptive agents. (joint work with Zhigang Cao, Bo Chen, Xujin Chen)

356. LEI, Yuanjie: The Vlasov-Maxwell-Boltzmann system in the perturbative framework

Huazhong University of Science and Technology

Room B104, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will present the following three results: the first result is concerned with the construction of global-in-time solutions of the Cauchy problem of the Vlasov-Maxwell-Boltzmann system near Maxwellians for the very soft potentials, which extends the work by Guo (Invent Math 153(3): 593-630) for hard sphere models to the non-hard sphere models. The second result is concerned with the construction of global-in-time solutions of the Cauchy problem of the Vlasov-Maxwell-Boltzmann system near Maxwellians with strong uniform background magnetic field, which can be any given non-zero constant vector rather than vacuum in the previous results available up to now. The third work is about a rigorous global in time mathematical justification of the limit from the Vlasov-Maxwell-Boltzmann system to the Vlasov-Poisson-Boltzmann system in the perturbative framework for the whole range of cutoff intermolecular interactions as the light velocity parameter c tends to infinity. These are joint works with Prof. R.-J. Duan, Prof. N. Jiang, Prof. T. Yang and Prof. H.-J. Zhao.

357. JIN, Wei: Finite s-geodesic-transitive graphs

Jiangxi University of Finance and Economics

Room B105, Leo KoGuan Building 廖凯原楼

Abstract: In a finite graph Γ, a geodesic from a vertex u to a vertex v is one of the shortest paths from u to v, and this geodesic is called an i-geodesic if the distance between u and v is i. The graph Γ is said to be s-geodesic-transitive if the graph automorphism group is transitive on the set of s-geodesics. In this talk, I will compare the s-geodesic-transitivity with other two well-known transitive properties, namely s-arc-transitivity and s-distance-transitivity, and determine the local structure of 2-geodesic-transitive graphs, and also give some results about the family of locally disconnected 2-geodesic-transitive but not 2-arc-transitive graphs.

358. FENG, Baofeng: Integrable discretization and two-component generalization of the Dapasperis-Procesi equation

The University of Texas Rio Grande Valley

Room B110, Leo KoGuan Building 廖凯原楼

Abstract: Recently, much attention has been paid to a class of nonlinear wave equations, which include the Camassa-Holm equation, the Degasperis-Procesi (DP) equation and their two-dimensional generalizations. These equations share some common features: (1) they are connected to some well-known integrable systems via hodograph (reciprocal) transformations; (2) they admit bizarre solutions such as loop, cuspon, peakon, or breather solutions.

In this talk, we will report our recent work on the Degasperis-Procesi equation. We will first made it clear for the bilinear equations and the tau functions for the DP equation. Then, we will construct the integrable semi-discrete DP equation. We propose a two-component Dapasperis-Procesi (DP) equation by finding its Lax pair; we also show that the short wave limit of the two-component Dapasperis-Procesi (DP) equation can be derived from a 3-reduction of BKP- or CKP-Toda equations through a hodograph transformation. In the last, we will show how integrable discretizations can be used as a novel numerical method: self-adaptive moving mesh method for numerical simulations.

This is a joint work with Dr. Youjin Zhang (Tsinghua University), Dr. Kenichi Maruno (Waseda University) and Dr. Yasuhiro Ohta (Kobe University).

359. DU, Ye: No-Regret Learning, Games and Option Pricing

Southwestern University of Finance and Economics

Room 110, Leo KoGuan Building 廖凯原楼

Abstract: No-regret learning is a fundamental model in the intersection of statistics, game theory, and machine learning. In the first part of this talk, we investigate a dynamic decision making problem with constraints. The decision maker is free to take any action as long as the empirical frequency of the actions played does not violate pre-specified linear constraints. For this purpose, we introduce the constrained no-regret learning model. In this model, the set of alternative strategies, with which a dynamic decision mechanism is compared, is the set of mixed actions that satisfies the set of linear constraints. We show that there is indeed a strategy that guarantees a constrained no-regret learning. In the second part of the talk, we study American option pricing through the lens of no-regret learning. An analytical upper bound of the price of an American option is given. The bound is very robust, which does not require the continuity of stock price paths, the completeness of markets, or any spec-

ification on the pricing kernel. This talk is based on joint works with Ehud Lehrer, Shan Xue and Yanchu Liu.

360. HUANG, Jizu: A multi-scale asymptotic approach for the ablative materials

LSEC, Chinese Academy of Sciences

Room 111, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we discuss the multi-scale asymptotic approach for the ablative materials with a periodic microstructure. The system satisfies a nonlinear parabolic equation with rapidly oscillating discontinuous coefficients. To save the computational cost, we present the homogenization method and first/second order multi-scale asymptotic. An explicit rate of convergence is derived for the first/second order multi-scale asymptotic. Several numerical tests are carried out to confirm the efficiency and accuracy of the approaches

361. CHANG, Xiangke: Isospectral deformations related to orthogonal functions: Integrable peakon and Toda lattices

LSEC, Chinese Academy of Sciences

Room 505, Leo KoGuan Building 廖凯原楼

Abstract: A class of nonlinear integrable PDEs admit some special weak solutions called “peakons”, which are characterised by ODE systems, namely peakon lattices. The celebrated Toda lattice was originally obtained as a simple model for describing a chain of particles with nearest neighbor exponential interaction and has been generalized in different directions. Both of the peakon and Toda lattices could be regarded as isospectral deformations related to certain orthogonal functions. In fact, for some initial value problems, these lattices can be explicitly solved by use of inverse spectral method involving certain “orthogonality”, approximation problems and continued fractions. In this talk, I will illustrate this picture with some typical examples.

362. RAO, Zhiping: Junction conditions for optimal control problems on multi-domains

Wuhan University

Room 509, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we consider finite horizon optimal control problems on multi-domains which are composed by a group of disjoint subdomains. The proper definition of solution to the corresponding Hamilton-Jacobi-Bellman (HJB) equation becomes a delicate issue due to the discontinuity of the Hamiltonian on the interfaces between the subdomains. We will discuss the junction conditions on the interfaces which allow to deduce the existence, uniqueness and stability results of the solution. This is based on the joint work with Daria Ghilli and Hasnaa Zidani.

363. LIN, Hai: Generalized Complete Intersection Calabi-Yau Manifolds and Their Aspects of Cohomology of Sheaves

Tsinghua University

Room B111, Leo KoGuan Building 廖凯原楼

Abstract: The Complete Intersection Calabi-Yau manifolds can be generalized to the construction of new Calabi-Yau manifolds through bundles with no global sections on the ambient space, in which case one can use rational functions. We consider generalized complete intersection manifolds in the product space of projective spaces, and work out useful aspects pertaining to the cohomology of sheaves over them. We consider and prove a vanishing theorem on the cohomology groups of sheaves for subvarieties of the ambient product space of projective spaces, which is useful for computing the Hodge numbers. We then prove an equivalence between configuration matrices of complete intersection Calabi-Yau manifolds. We also present a formula of the genus of curves in generalized complete intersection manifolds. Some of these curves arise as the fixed point locus of symmetry group actions on the generalized complete intersection Calabi-Yau manifolds. We also make a blowing-up along the curves, by which one can generate new Calabi-Yau manifolds. Furthermore, an approach on spectral sequences is used to compute Hodge numbers of generalized complete intersection Calabi-Yau manifolds and the genus of curves contained therein.

364. YE, Shengkui: Symmetries of flat manifolds and actions of automorphism group of free groups

Xi'an Jiaotong-Liverpool University

Room B112, Leo KoGuan Building 廖凯原楼

Abstract: For a given flat manifold M, we obtain a sufficient and necessary condition for a finite group that could act effectively on M. Two applications will be discussed. The first is about topological Zimmer's program and the second is about the Jordan's property of homeomorphism groups.

365. LI, Qiongling: Domination results for harmonic maps in higher Teichmüller theory

Nankai University

Room B113, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we study the harmonic maps in higher Teichmüller theory from the viewpoint of the Higgs bundles. Let $X = (S, J)$ be a closed Riemann surface with genus at least 2. The non-abelian Hodge theory gives a correspondence between the moduli space of representations of the fundamental group of a surface S into a Lie group G with the moduli space of G-Higgs bundles over the Riemann surface X. The correspondence is through looking for an equivariant harmonic map from X to the symmetric space associated to G. Hitchin representations are an important class of representations of fundamental groups of closed hyperbolic surfaces into $\mathbb{PSL}(n, \mathbb{R})$, at the heart of higher Teichmüller theory. We discover some geometric properties of such harmonic maps for Hitchin representations or more general representations by using Higgs bundles techniques.

366. ZHU, Xiaojue: Exploring the ultimate of turbulence with numerical simulations

Harvard University

Room B114, Leo KoGuan Building 廖凯原楼

Abstract: In this talk, we will present our newest results on fully developed turbulence. We mainly focus on two systems, Rayleigh-Bénard and Taylor-Couette flows, which share many similar features. In Rayleigh-Bénard turbulence, for the first time in two-dimensional numerical simulations we find the transition to the ultimate regime,

namely at critical Rayleigh number $Ra = 10^{13}$. We reveal how the emission of thermal plumes enhances the global heat transport, leading to a steeper increase of the Nusselt number than the classical Malkus scaling. Beyond the transition, the temperature profiles are only locally logarithmic, namely within the regions where plumes are emitted, and where the local Nusselt number has an effective scaling $Nu \propto Ra^{0.38}$, corresponding to the effective scaling in the ultimate regime. In Taylor-Couette turbulence, we show how wall roughness greatly enhances the overall transport properties and the corresponding scaling exponents associated with wall-bounded turbulence. We reveal that if only one of the walls is rough, the bulk velocity is slaved to the rough side, due to the much stronger coupling to that wall by the detaching flow structures. If both walls are rough, the viscosity dependence is eliminated, giving rise to asymptotic ultimate turbulence—the upper limit of transport—the existence of which was predicted more than 50 years ago. In this limit, the scaling laws can be extrapolated to arbitrarily large Reynolds numbers.

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