一、主办单位

首都师范大学数学科学学院

二、会议安排

时间：2023 年 11 月 15日 13：10-17：00

分组报告地点（13：30开始）：

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第二组	偏微分方程	教二楼913
第三组	组合与信息技术	教二楼927
第四组	数学物理	教二楼727

		A local almost euclidean isoperimetric inequality
		Almost Rigidity Theorems Of Manifolds With Bounded Curvature
		Index theory and distance estimates under scalar curvature bounded from below
		Optimal quadratures for weighted Sobolev and Besov classes on localizable homogenous spaces
		Resurgent treatment of the two equations
		Introduction to the Moduli spaces of stable holomorphic vector bundles and flat connections over Riemann Surfaces

		Stability for the 2D Micropolar equations near Couette flow
		Blow up criteria for the 2D compressible Navier-Stokes equations
		Global well-posedness and optimal decay for incompressible MHD equations with fractional dissipations
		Well-posedness for the incompressible Hall-MHD equations
		Stability and large-time behavior of 2D Tropical climate model with zero thermal diffusion
		Global Well-Posedness of 3D Navier-Stokes Equations with Variable Viscous Coefficient
		Existence of Nontrivial Solutions for the Nonlinear Equation on Locally Finite Graphs
		Global existence and large-time behavior of compressible two-phase flow

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		The constant term algebra of type A: the structure
		Fast Evaluation of Generalized Todd Polynomials
		Algebraic Volume for Polytope Arise from Ehrhart Theory
		A Combinatorial Approach to Frobenius Numbers of Some Special Sequences
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		Codes for correcting deletions
		On twisted generalized Reed-Solomon codes with L twists
		GPU based Iterative Reconstruction Algorithm for Multi-scale 3D High-resolution Cone Beam Computed Tomography
		A ring artifact removal model with dual domain regularization for x-ray computed tomography

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		The commutative and non-commutative versions of extended KP equation, extended mKP equation and their Miura transformation
		Higher form symmetry and 't hooft anomaly
		$\boldsymbol{W_{1+\infty}}$ $\boldsymbol{n}$ −algebra and hierarchies related to Deformed Calogero-Sutherland model
		W-representation of tensor model
		Sharing EPR steering between sequential pairs of observers
		Super-additivity Relations for Quantum Coherence Measures
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		General monogamy and polygamy relations of arbitrary quantum correlations for multipartite systems
		Uncertainty of quantum channels via modified generalized variance and modified generalized Wigner Yanase Dyson skew information

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1

A local almost euclidean isoperimetric inequality

: a domain with integral Ricci curvature bound. It gives an almost Euclidean isoperimetric inequality on a small domain in a unit metric ball. In case of nonnegative Ricci curvature the inequality is almost sharp.

2

Almost Rigidity Theorems Of Manifolds With Bounded Curvature

: Man-Chun Lee, Aaron Naber and Robin Neumayer propose a weaker notion of convergence, d_p-convergence, which is valid for a class of rectifiable Riemannian spaces. Under this d_p notion of closeness, a space with almost nonnegative scalar curvature and small entropy bound must be close to Euclidean space, and this constitute -regularity theorem.
In this report we give a new -regularity theorem that replaces the scalar curvature lower bound with an integral scalar curvature lower bound. Moreover, under this condition, we also have the compactness theorem, an L^{∞}-Sobolev embedding and apriori L^p scalar curvature bounds for $p<1$.

3

Index theory and distance estimates under scalar curvature bounded from below

: In this talk, I will introduce some classical results about the geometry and topology of positive scalar curvature from the point of view of index theory. Then based on Callias-type operator approach, I will discuss my results on the long neck problem and width estimates of the geodesic collar neighborhood proposed by Gromov. An important step is to introduce the relative Gromov-Lawson pair on a compact manifold with boundary, relative to a background manifold. Additionally, I will give an alternative harmonic level set proof of width estimates of generalized geodesic collar neighborhood in dimension three. If time permits, finally, I will present my recent works on the tilted spacetime positive mass theorem with arbitrary ends. Moreover, I will give a quantitative shielding theorem where the underlying initial data sets are unnecessarily complete, and in a sense, the symmetric-time case of our dominant energy shield condition improves and sharpens the largeness assumptions in the papers [Lesourd-Unger-Yau 2021] and [Lee-Lesourd-Unger 2022].

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Optimal quadratures for weighted Sobolev and Besov classes on localizable homogenous spaces

：We consider the numerical integration

$$_{\Omega^d,w}(f) = \int_{\Omega^d} f(x)w(x)dx$$

for a continuous function f defined on a localizable homogenous type space Ω^d which contains many regular domains, such as sphere, ball, simplex, conic domain and so on. In this lecture, we obtain the upper estimates of optimal quadrature errors for weighted Sobolev and Besov classes on localizable homogenous spaces in the deterministic and randomized settings. Besides, in generally, these estimates are also optimal.

6

Resurgent treatment of the two equations

：Resurgence Theory has become more and more used in the mathematics / physics research literature. In this talk we start with two equations, which show the role of Resurgent theory in topological string theory.

7

Introduction to the Moduli spaces of stable holomorphic vector bundles and flat connections over Riemann Surfaces

：Higgs bundle, a crossroad between Algebraic Geometry, Differential Geometry, Algebraic Topology, Complex Geometry, Symplectic Geometry, has developed rapidly during the lasting 40 years.
In this talk(two parts), I will briefly describe the sketch of this huge systematic theory, by drawing the origins two deeply relevant structures, with highly nontrivial deformations under the quotient of some infinitely Lie group action, contacted to several elegant branches moment map, sheaf cohomology, charactic classes, Morse function, and index theorem. If time permits, I want to show my partly progress, focus on the parabolic Higgs bundles over the projective line minus n points, and the Non-Abelian Hodge correspondence.

1

Stability for the 2D Micropolar equations near Couette flow

：Recently, the stability of shear flows for Navier-Stokes equations have been studied in a number of literatures. In this talk, we consider the stability for the 2D Micropolar equations with different dissipation cases. The key is to overcome the difficulty caused by the higher order derivatives in right side of velocity equations. We adopt the Fourier multiplier method to prove. A new horizontal $\frac{1}{3}$-order dissipation is created by special structure $y\partial_x - \partial_{yy}$ and a time-dependent elliptic operator $\Lambda_b^t = (1 - \partial_x{}^2 - (\partial_y + t\partial_x)^2)^{\frac{b}{2}}$ will be used to get more concise estimates. The relationship among viscosities and transition thresholds will be shown.

2

Blow up criteria for the 2D compressible Navier-Stokes equations

：This report is to derive three new blow-up criterion for the 2D barotropic Navier-Stokes equations、full compressible Navier-Stokes equations、full compressible N-S equations without heat conduction. The initial vacuum is permitted in this report. We show that if the strong solution to 2D viscous compressible flows blows up in finite time, then either the concentration of the density or the temperature. These results extend previous results and give an answer to Nash conjecture.

3

Global well-posedness and optimal decay for incompressible MHD equations with fractional dissipations

：We investigate the n-dimensional incompressible magnetohydrodynamic (MHD) equations with fractional dissipation and magnetic diffusion. Firstly, We have established existence and uniqueness in different sobolev spaces for the same dissipative case. Secondly, we use frequency truncation techniques to obtain an important lemma to obtain the decay result. In the case 0 , the system corresponds to a damped MHD equations. Our results improve previous results by extending the solution space from $H^s(s \quad \frac{n}{2} \quad 1)$ to $B^s_{2,1}(s \quad \frac{n}{2} \quad 1)$.

4

Well-posedness for the incompressible Hall-MHD equations

：We will talk about well-posedness for the incompressible Hall-MHD equations in 3-D or 2.5-D. For 3-D case, we study the Cauchy problem for the axisymmetric Hall-MHD system with horizontal velocity dissipation and vertical magnetic diff usion. And the 2.5-D case, we prove the global regularity of a certain system of equations with horizontal or vertical dissipation and magnetic hyper-diff usion for large initial data. The two-and-a-half-dimensional (2.5-D for brief) is three components of vector fields with spatial variations in two directions.

5

Stability and large-time behavior of 2D Tropical climate model with zero thermal diffusion

：In this talk, we investigate the stability and large-time behavior of 2D Tropical climate model with zero thermal diffusion under small initial data. Due to the absence of thermal dissipation in the system, this has brought some difficulties and also aroused our great interest. First, by exploiting the structure of the system to overcome the difficulties and then utilizing the generated linear equation, we obtain the global well-posedness and precise large-time decay rates. Then, we also consider the stability of Couette flow for the system with zero thermal dissipation in $\mathbb{T}$ $\mathbb{R}$. By the enhanced dissipation created by the operator y_x , we establish the expected stability results.

6

Global Well-Posedness of 3D Navier-Stokes Equations with Variable Viscous Coefficient

：In this manuscript, we are concerned with the global well-posedness of 3D inhomogeneous incompressible Navier-Stokes equations with density-dependent viscosity when the initial velocity is sufficiently small in the critical Besov space $\dot{B}^{\frac{1}{2}}_{2,1}$. Compared with the previous result of Abidi and Zhang (Science China Mathematics 58 (6) (2015) 1129-1150), we remove the smallness assumption of the viscosity ($_0$) 1 in L -norm.

7

Existence of Nontrivial Solutions for the Nonlinear Equation on Locally Finite Graphs

Suppose that G (V,E) be a locally finite and connected graph with symmetric weight and uniformly positive measure, where V denotes the vertex set and E denotes the edge set. We are concerned with the following problem

$$\begin{aligned} u \quad hu \quad f(x,u), \quad &\text{in} \quad , \\ u \quad 0, \quad &\text{on} \quad , \end{aligned}$$

on the graph, where : , f: $\mathbb{R}$ $\mathbb{R}$ and u: $\mathbb{R}$. When f and h satisfies certain assumption conditions, we can ascertain the existence of one or two nontrivial solutions on the graph.

8

Global existence and large-time behavior of compressible two-phase flow

：In this talk, I will introduce our resent work on the global existence and large-time behavior of strong solutions to the Cauchy problem for two-phase flow models, including the compressible Euler-Navier-Stokes system and the pressureless Euler-Navier-Stokes system. These results show the effect of the interaction through the drag force on the motion of two fluids.

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Evans

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The constant term algebra of type A: the structure

: In this paper, we discover a new noncommutative algebra. We refer this algebra as the constant term algebra of type A, which is generated by certain constant term operators. We characterize a structural result of this algebra by establishing an explicit basis in terms of certain forests. This algebra arises when we apply the method of the iterated Laurent series to investigate Beck and Pixton's residue computation for the Ehrhart series of the Birkhoff polytope. This algebra seems to be the first structural result in the area of the constant term world since the discovery of the Dyson constant term identity in 1962.

2

Fast Evaluation of Generalized Todd Polynomials

: The Todd polynomials $td_k \quad td_k(b_1, b_2, \quad , b_m)$ are defined by their generating functions $\sum_{k\ 0} td_k s^k \quad \prod_{i\ 1}^{m} \frac{b_i s}{e^{b_i s} \quad 1}$. It appears as a basic block in Todd class of a toric variety, which is important in the theory of lattice polytopes and in number theory. We find generalized Todd polynomials arise naturally in MacMahon's partition analysis, especially in Ehrhart series computation. We give fast evaluation of generalized Todd polynomials for numerical b_i's. In order to do so, we develop fast operations in the quotient ring $\mathbb{Z}_p[[s]]$ modulo $s^{d\ 1}$ for large prime p. As applications, i) we recompute the Ehrhart series of magic squares of order 6, which was first solved by the first named author. The running time is reduced from 70 days to about 1 day; ii) we give a polynomial time algorithm for Integer Linear Programming when the dimension is fixed, with a good performance.

3

Algebraic Volume for Polytope Arise from Ehrhart Theory

: Volume computation for d-polytopes P is fundamental in mathematics. There are known volume computation algorithms, mostly based on triangulation or signed-decomposition of the polytope. We consider the cone cone(P) over P in view of Ehrhart theory. By using technique from algebraic combinatorics, we obtain an algorithm using only signed simplicial cone decompositions of cone(P). Each cone is associated with a simple algebraic volume formula. Summing them gives the volume of the polytope. Our volume formula applies to various kind of cases. In particular, we use it to explain the traditional triangulation method and Lawrence's signed decomposition method.

4

A Combinatorial Approach to Frobenius Numbers of Some Special Sequences

: The Frobenius problem includes the determination of Frobenius number g(A) and the related Sylvester number n(A) and Sylvester sum s(A). We present a new approach to the Frobenius problem. We illustrate the idea by giving concise proofs of some existing formulas and finding some interesting new formulas of g(A), n(A), s(A). Moreover, we find that MacMahon's partition analysis applies to give a new way of calculating n(A), s(A) by using a rational function representation of a polynomial determined by A. This talk is based on joint work with Guoce Xin.

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DNA

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6

Codes for correcting deletions

：A k-deletion correcting code is a set of binary sequences of length n in which any two distinct sequences do not share one subsequence of length n-k. The history of studying the constructions of k-deletion correcting codes dates back to 1966, when Levenshtein proved that the optimal redundancy of any k-deletion correcting code is lower bounded by (k+o(1)) log n and the celebrated Varshamov-Tenengolts (VT) code is a single-deletion correcting code with at most log (n+1) bits of redundancy that achieves the lower bound above. Although there is a rich literature on k-deletion correcting codes, the problem of giving an explicit construction with (k+o(1)) log n bits of redundancy remains unsolved even for k=2. In this talk, we will introduce results on deletion correcting codes in the literature as well as our recent improvements.

7

On twisted generalized Reed-Solomon codes with L twists

：In this report, we study a class of twisted generalized Reed-Solomon (TGRS) codes with general L twists. A sufficient and necessary condition for the TGRS codes to be MDS or L-MDS ($L \quad \min\ k, n \quad k$) is determined. A sufficient and necessary condition that such a TGRS code is self-dual for $L \quad \frac{k \quad 1}{3}$ is also presented. Finally, we give an explicit construction of self-dual TGRS codes.

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GPU BASED ITERATIVE RECONSTRUCTION ALGORITHM FORMULTI-SCALE 3D HIGH-RESOLUTION CONE BEAM COMPUTED TOMOGRAPHY

: Cone beam CT is widely used in defect detection, reverse engineering and tissue analysis due to its high ray utilization and fast scanning speed[1]. However, due to the large amount of cone beam CT scan data, image reconstruction is often time-consuming, especially the iterative class of reconstruction algorithms that require multiple forward and backward projections. With the rapid development of computing hardware, the use of graphics hardware (GPU) has been proposed to improve the reconstruction speed of iterative algorithms. However, the existing acceleration methods still have some deficiencies: (1) Due to the limitation of GPU graphics memory, single GPU devices cannot reconstruct high-resolution 3D CT images; (2) Multi-GPU based acceleration methods need to exchange data among multiple GPUs during forward projection, which affects the reconstruction speed. To address the above deficiencies, this paper proposes a GPU based multi-scale parallel iterative reconstruction method. Theoretically, the method is able to reconstruct arbitrarily high-resolution 3D CT images on a single GPU. For multi-GPU devices, the method does not require data exchange between GPUs, realizing true parallelism and further accelerating the reconstruction speed.

10

A ring artifact removal model with dual domain regularization for x-ray computed tomography

: **Purpose** Ring artifacts are a common class of artifacts in CT images, which are mainly caused by inconsistent response between detector units. These artifacts can seriously affect measurement and visualized inspection, sometimes even resulting in inaccurate diagnosis of the reconstructed CT image. Therefore, it is crucial to remove ring artifacts without compromising image quality.

Method In order to remove ring artifacts from CT images, we proposed a regularized ring artifact removal model:

$$\arg\min_{x,S^T}\{\frac{1}{2}\| \mathcal{R}(Ax \quad p) \quad 1 \; S^T \|_F^2 \quad {}_1\| Dx \|_{2,1} \quad {}_2 \sum_i R_i | s_i | \}$$

where $p \in R^m$ is real projection data, $m=m_v \times m_b$, m_v is the number of projection view, m_b is the number of detector bins; $x \in R^n$ is the clean reconstructed image, $n=n_x \times n_y$, n_x and n_y are the number of rows and columns of the reconstructed image, respectively; $A \in R^{m \times n}$ is a measurement matrix; $\mathcal{R}(\cdot)$ denotes the operator that resets the vector to matrix; $\mathcal{R}(Ax \quad p) \in R^{m_v \times m_b}$; $\mathbf{1} \in R^{m_v}$ is the unit column vector; $S \in R^{m_b}$; T represents the transpose operator, and $\mathbf{1} \cdot S^T \in R^{m_v \times m_b}$ is the stripe artifact image; $D=(D_H, D_V)^T \in R^{2n \times n}$ is the finite difference matrix, where $D_H \in R^{n \times n}$ and $D_V \in R^{n \times n}$ are the difference matrices in horizontal and vertical directions, respectively; $Dx \in R^{2n}$; $\| Dx \|_{2,1} \quad \sum_{i \; 1}^{n} ((D_H x)_i^2 \quad (D_V x)_i^2)^{1/2}$; λ_1 and λ_2 are regularization parameters; R_i is the distance from the i-th detector pixel to the center of the detector, which is used to apply different weights to the pixels at different distances from the center of the detector. s_i is the i-th element of S. An alternating direction method was designed to solve model (1). The advantage of the proposed method is that it considers both the prior information of the reconstructed image and the structural information of the stripe artifacts in the projection domain. On the one hand, it can avoid the incomplete removal of artifacts by focusing only on the structural information of stripe artifacts; on the other hand, it can avoid the destruction of image details by focusing only on the reconstructed image itself.

Result Numerical experiments were performed on the real projection data obtained by the photon counting detector, and some of the reconstruction results are shown in Figure 1. Figure 1(a) shows the result of the FBP method, Figure 1(b) shows the result of the WF method [1], Figure 1(c) shows the result of the Wu method [2], and Figure 1(d) shows the result of the proposed method. The reconstruction results show that there are slight low-frequency artifacts remain in the result of both the WF method and the Wu method, while the proposed method can remove the ring artifacts in the reconstructed images more effectively and preserve the details of the images.

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: Lotka-Volterra Toda Hankel

Lax Toda Lotka-Volterra

Firstly, we establish the negative flow of the nonisospectral Lotka-Volterra and Toda lattices and present its corresponding solutions in terms of Hankel determinants. Secondly, the Lax pair of these lattices is given in the form of the orthogonal polynomials and symmetric orthogonal polynomials. Besides, we find a transformation from the negative flow of the nonisospectral Toda lattice to the nonisospectral Lotka-Volterra lattice proposed in this paper.

2 MUHAMMAD KASHIF

The commutative and non-commutative versions of extended KP equation, extended mKP equation and their Miura transformation

: We employ the Hirota direct method to derive Pfaffian solutions for both the extended Kadomtsev-Petviashvili (eKP) equation and the extended modified KP (emKP) equation. Additionally, the investigation extends to the establishment of Miura transformations related to these solutions. Furthermore, the non-commutative (NC) counterparts of the extended and emKP equations are considered, yielding quasi-determinant solutions. This study achieves the clarification of Miura transformations linking solutions within the framework of the NC eKP and NC emKP equation.

3

: 2d Schur, Jack, Macdonald

KP\Toda tau ;

Calagero-Moser-Sutherland

Weyl

U m|n ,)

Yangian DIM Cartan Fock

loop MacMahon 3d

4

Higher form symmetry and 't hooft anomaly

: A p-form global symmetry is a global symmetry for which the charged operators are of space-time dimension p; e.g. Wilson lines, surface defects, etc. Many of the properties of ordinary global symmetries (p = 0) apply here. Such global symmetries can be coupled to classical background fields and they can be gauged by summing over these

higher form global symmetries fit into a more general symmetry structure called higher group symmetry.

$W_{1+\infty}$ n −algebra and hierarchies related to Deformed Calogero-Sutherland model

: We constructed with $W_{1+\infty}$ n −algebra and hierarchies related to Deformed Calogero-

to experimentally measure the corresponding lamata-moments.

10

General monogamy and polygamy relations of arbitrary quantum correlations for multipartite systems

Monogamy and polygamy of quantum correlations are the fundamental properties of quantum systems. We study the monogamy and polygamy relations satisfied by any quantum correlations in multipartite quantum systems. General monogamy relations are presented for the -th (,) power of quantum correlation, and general polygamy relations are given for the -th (,) power of quantum correlation. We show that these newly derived monogamy and polygamy inequalities are tighter than the existing ones. By applying these results to specific quantum correlations such as concurrence and the square of convex-roof extended negativity of assistance (SCRENoA), the corresponding new classes of monogamy and polygamy relations are obtained, which include the existing ones as special cases. Detailed examples are given to illustrate the advantages of our results.

11

Uncertainty of quantum channels via modified generalized variance and modified generalized Wigner Yanase Dyson skew information

: Uncertainty relation is a fundamental issue in quantum mechanics and quantum information theory. By using modified generalized variance (MGV), and modified generalized Wigner Yanase Dyson skew information (MGWYD), we identify the total and quantum uncertainty of quantum channels. The elegant properties of the total uncertainty of quantum channels are explored in detail. In addition, we present a trade-off relation between the total uncertainty of quantum channels and the entanglement fidelity and establish the relationships between the total uncertainty and entropy exchange/coherent information. Detailed examples are given to the explicit formulas of the total uncertainty and the quantum uncertainty of quantum channels.