

东南大学丘成桐中心青年数学家论坛	
Dec. 20 th , morning	
8:45-9:00	Opening Remarks
9:00-9:30	文豪 “ DGBV algebra, L^2 -Hodge theory and Frobenius manifold ”
9:30-10:00	刘杰 “Positivity of tangent bundle and its subsheaves”
10:00-10:20	Break
10:20-10:50	李永雄 “A classical family of elliptic curves having rank one and the 2-primary part of their tate-shafarevich group non-trivial”
10:50-11:20	王振建 “ Monotonic Invariants Under Blowups ”
11:20-11:30	
11:30-12:00	蒋云峰 “Twisted Vafa-Witten invariants and S-duality”
Dec. 20 th , afternoon	
Free Discussion	
Dec. 21 th morning	
9:00-9:30	王林 “ 切触Hamilton系统的全局动力学与Hamilton-Jacobi方程”
9:30-10:00	黄意 “The Super McShane Identity”
10:00-10:20	Break
10:20-10:50	蔚辉 “ Self-Organized Hydrodynamic models for nematic alignment and the application to myxobacteria.”
10:50-11:20	Break
11:20-11:30	胡鹰翔 “Harmonic mean curvature flow and geometric inequalities”
11:30-12:00	胡创强 “A new modular interpretation of bbs towers”
12:00-12:30	裴度 “New Developments in Physical Mathematics”
Dec. 21 th , afternoon	
Free Discussion	
Dec. 22 th morning	
9:00-9:30	刘海东 “On the canonical bundle formula and the quasi-log canonical theory”
9:30-10:00	王一男 “Calabi-Yau manifolds and the supersymmetric landscape”
10:00-10:20	Break

10:20-10:50	余成龙 “Moduli of symmetric cubic fourfolds and nodal sextic curves ”
10:50-11:20	邱凌云 “The inverse problem for wave equations based on optimal transportation theory and deep learning”
11:20-11:30	Break
11:30-12:00	刘诗南 “Local model of Shimura varieties”
Dec. 22 th , afternoon	Free Discussion

姓名	单位	题目	摘要
蔚辉 12.20（12 点到）-22	清华大学	Self-Organized Hydrodynamic models for nematic alignment and the application to myxobacteria.	A continuum model for a population of self-propelled particles interacting through nematic alignment is derived from an individual-based model. The methodology consists of introducing a hydrodynamic scaling of the corresponding mean field kinetic equation. The resulting perturbation problem is solved thanks to the concept of generalized collision invariants. It yields a hyperbolic but nonconservative system of equations for the nematic mean direction of the flow and the densities of particles flowing parallel or antiparallel to this mean direction. An application to myxobacteria is presented.
王一男 12.21-23	University of Oxford	Calabi-Yau manifolds and the supersymmetric landscape	In theoretical physics, there have been a lot of recent developments and debates on the global set of consistent quantum gravity and field theories. For the supersymmetric theories, it was suggested that all of them can be constructed as dimensional reduction of superstring theories on various geometric spaces. A particularly interesting class of the geometric spaces is the Calabi-Yau manifolds with or without singularities, which is also a fascinating subject by itself. In this talk, I am going to present my explorations on the following two classes of theories: (1) the set of 4d N=1 supergravity theories from F-theory on elliptic Calabi-Yau fourfolds; (2) the set of 5d N=1 superconformal field theories from M-theory on Calabi-Yau threefolds with canonical singularity.
裴度 12.20-23	Harvard University	New Developments in Physical Mathematics	The existence of quantum field theories in higher dimensions leads to many interesting predictions in mathematics. In this talk, I will survey some recent developments where such quantum field theories were used to study 1) quantization of moduli spaces, 2) new invariants of 3- and 4-manifolds, and 3) new types of topological quantum field theories in low dimensions.
王林 12.19-12.21	清华大学	切触Hamilton系统的全局动力学与Hamilton-Jacobi方程	基于与王楷植和严军教授发展的作用量极小方法，我会介绍关于切触Hamilton系统全局极小轨道动力学的相关工作（Aubry-Mather理论和弱KAM理论），并介绍其对Hamilton-Jacobi方程粘性解理论的应用。

刘杰 12.19-22	中科院	Positivity of tangent bundle and its subsheaves	It is a very classical problem in algebraic geometry to derive geometric information of algebraic varieties from the properties of tangent bundles. In recent years, it has been lots of interest in understanding the positivity of tangent bundle via its subsheaves. I will talk about examples, known results and present some ideas lying behind our recent work towards this problem.
刘海东 12.19-23	北大数学中心	On the canonical bundle formula and the quasi-log canonical theory	In the classification of algebraic surfaces, Kodaira's canonical bundle formula plays an important role. It is natural to expect that some general kinds of canonical bundle formula (quasi-log canonical theory in slightly different language) will play a similar role in the study of higher dimensional varieties. In this talk, I will try to explain the relative set-up and report some recent results on this direction.
胡鹰翔 12.20-22	清华大学	Harmonic mean curvature flow and geometric inequalities	In this talk, we use the harmonic mean curvature flow to prove Alexandrov-Fenchel type inequalities for strictly convex hypersurfaces in hyperbolic space. Using the new Alexandrov-Fenchel type inequalities and the inverse mean curvature flow, we show that the Alexandrov-Fenchel inequality for the total curvature in terms of the area for strictly convex hypersurfaces.
王振建 12.19-23	清华大学	Monotonic Invariants Under Blowups	We discuss a conjecture on the quotient of Milnor number μ and Tjurina number τ for a singular reduced plane curve stating that $\mu/\tau < 4/3$. This conjecture was posed of A. Dimca and G.M. Greuel in 2018, and it aroused a great deal of interest in 2019. It has already been completely proved in October 2019. In this talk, we will show that $3\mu - 4\tau$ has some monotonicity under blowups. This monotonicity leads to a solution to the conjecture for an irreducible curve. Since the conjecture has been proved in the general case, we will not discuss the details of proof of our results; instead, we discuss the idea of seeking monotonic quantities under blowups, which is inspired by the theory of geometric flows.

蒋云峰 12.20-22	堪萨斯大学	Twisted Vafa-Witten invariants and S-duality	For a real four manifold, the S-duality conjecture of Vafa-Witten (1994) predicts that the S-transformation sends the gauge group $SU(r)$ -invariants counting instantons to the Langlands dual gauge group $SU(r)/Z_r$ -invariants; and both of the invariants satisfy modularity properties. The $SU(r)$ -Vafa-Witten invariants have been constructed by Tanaka-Thomas using the moduli space of semistable Higgs bundle or sheaves on a smooth projective surface. In this talk I will present the idea of using moduli space of twisted sheaves and twisted Higgs sheaves on a projective surface to define the Langlands dual gauge group $SU(r)/Z_r$ -Vafa-Witten invariants, and prove the S-duality conjecture of Vafa-Witten for projective plane in rank two and K3 surfaces in prime ranks.
黄意 12.20-21	清华大学	The Super McShane Identity	Classical manifold theory constructs topological and geometric objects which locally resemble open patches in R^n . Super manifold theory is a natural generalization where the analytic and/or algebra geometric role of the field of real numbers is supplanted by Grassmann algebras. We give a friendly introduction to super hyperbolic surface theory, and show that the celebrated McShane identity generalizes to this super context.
李永雄 12.19-22 (下午一点走)	清华大学	A classical family of elliptic curves having rank one and the 2-primary part of their Tate-Shafarevich group non-trivial	In this talk, we will focus on the elliptic curve E of the form $x^3 + y^3 = 2p$ or $2p^2$, where p is an odd prime congruent to 2, 5 mod 9. We will first show that the 3-part Birch and Swinnerton-Dyer conjecture for E holds. Then we will discuss a relation between the 2-rank of the ideal class group of $Q(\sqrt[3]{p})$ and the 2-part of the Tate-Shafarevich group of E . In the rank one situation, we get some evidence for the existence of elliptic curves with rank one and non-trivial 2-part of Tate-Shafarevich group. This is a joint work with Y. Kezuka.
文豪	清华大学	DGBV algebra, L^2 -Hodge theory and Frobenius manifold	I will talk about the application of L^2 -Hodge theory in constructing Frobenius manifolds from DGBV algebras, including the work of Kontsevich-Barannikov in Calabi-Yau geometry and the work of Si Li and me in Landau-Ginzburg models.
胡创强 12.19-23	清华大学	A new modular interpretation of bbs towers	In 2000, Elkies had given explicit equations of rank-2 Drinfeld modular curves which coincide with the asymptotically optimal towers of curves constructed by Garcia and Stichtenoth. To generalize this result, we develop a new procedure to obtain equations of rank- m Drinfeld modular curves, with $m \geq 2$. The resulting modular curves coincide with the celebrate (recursive) towers of curves constructed by Bassa, Beelen, Garcia, and Stichtenoth.

刘诗南	中科院晨 兴中心	Local model of Shimura varieties	<p>The Hasse-Weil zeta function of an algebraic variety over a number field is conjectured to have a meromorphic extension and a functional equation, in other words it is related to automorphic forms. In the case of a Shimura variety, the calculation of zeta function is more accessible and has been explored by the famous Langlands-Kottwitz method. In this talk we explain ideas around this method, and in particular we explain how to use the local modelan explicitly defined closed subvariety of a grassmannian-to calculate the local zeta factor of a Shimura variety at a bad prime.</p>
丘凌云	清华大学	The inverse problem for wave equations based on optimal transportation theory and deep learning	<p>The wave-based inverse problems aiming at geological imaging is often accompanied by nonlinearity, significant ill-posedness, and high computational cost. It usually uses the iterative method based on gradient descent to solve the corresponding optimization problem and is easy to fall into local minimums. Therefore, improving the convexity of the objective function of the optimization problem, avoiding the local minimization, and improving the efficiency of the large-scale inversion are the key issues in the study of the inverse problem of the wave equation.</p> <p>First, with the aid of optimal transport theory, we propose a new data transformation method, improve the stability and convexity of the inverse problem, and expand the convergence radius of the inverse problem. At the same time, we also study the noise in the data and the inaccuracy of the measurement to the disturbance of the optimal transport metric, and systematically propose a fast and stable solution. Second, convolutional neural networks are also used to improve the performance and accuracy of the algorithm further. The network architecture we use is modified from the deep class aware model. This model does not use a fully connected layer, so fewer training samples are needed in the training step, and less memory and lower arithmetic complexity are required in the inference step. We use only a small amount of representative data during the training of the network, and the trained model can be used to extract the main features from the high-dimensional intermediate results automatically. This approach provides a novel platform for data-driven inversion/imaging methods.</p>

余成龙	宾夕法尼亚大学	Moduli of symmetric cubic fourfolds and nodal sextic curves	<p>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. I will also discuss similar identifications and applications for some families of Calabi-Yau 3-folds. This is joint work with Zhiwei Zheng.</p>
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