清華大學 丘成桐数学科学中心
Yau Mathematical Sciences Center, Tsinghua University

POSTDOC WORKSHOP II 2026

April 18-19, Shuangqing C548, YMSC

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About

Postdoc Workshop II 2026

Date

April 18-19, 2026

Venue

清华大学双清综合楼C548
Room C548, Shuangqing Complex Building, Tsinghua University

Zoom

Meeting ID: 878 8186 9237
Password: YMSC

Purpose

Promote interaction and communication among postdocs and researchers.

Scientific and Organizing Committee

清华大学丘成桐数学科学中心博士后工作组

Support Fundings

清华大学丘成桐数学科学中心博士后活动经费
Funds for Postdoc Academic Activities, YMSC, Tsinghua University

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Timetable

April 18, Saturday

Time		
9:40 - 9:50	**Welcome to Tsinghua** 丘成桐 **Shing-Tung Yau**	Opening
	Chair: William Donovan	
9:50 - 10:15	赵启弦 **Qixian Zhao**	Representations of real groups, p-adic groups, and affine vertex algebras
10:15 - 10:35	**Break and Group Photo**	
10:35 - 11:00	**Satyabrat Sahoo**	Generalized Fermat equation of signatures (p,p,p) and (r,r,p) over totally real fields
11:00 - 11:25	**Roy Zhao**	Transcendence Results for the Gamma Function
11:25 - 11:50	**Lamarche Alicia Mae**	Towards Homological Mirror Symmetry for Arithmetic Toric Varieties
	Lunch	
	Chair: Bin Xu	
13:30 - 13:55	**Tarun Dalal**	Automorphisms of Modular Curves and Their Quotients
13:55 - 14:20	成枭将 **Xiaojiang Cheng**	Cohomology of local systems and its applications to algebraic cycles
14:20 - 14:45	王浩旭 **Haoxu Wang**	Motivic Nearby Cycles at Infinity for Laurent Polynomials
14:45 - 15:10	赵瑞屾 **Zhao Ruishen**	Overconvergent Eichler-Shimura theory and geometry of Eigenvariety
15:10 - 15:30	**Break**	
	Chair: Junya Yagi	
15:30 - 15:55	**Takumi Otani**	Global dimension function on stability conditions for Dynkin quivers
15:55 - 16:20	**Benjamin Zhou**	Genus-1 Gromov-Witten invariants of twistor space
16:20 - 16:45	**Mohamed Elmi**	Open Topological String Theory on Compact Calabi-Yau Threefolds
16:45 - 17:10	**Boujakhrout Youssra**	Integrability, 4d Chern-Simons and 2d Beta-Gamma
17:10 - 17:35	喻淞 **Song Yu**	Holomorphic anomaly equations for toric Calabi-Yau 3-orbifolds
	Dinner	

April 19, Sunday

Time	Welcome to Tsinghua	
Chair: Jianfeng Lin		
9:30 - 9:55	胡家昊 **Jiahao Hu**	A bisimplicial homotopy theory featuring Aeppli and Bott-Chern homotopy groups
9:55 - 10:20	陆凡 **Fan Lu**	How rare Subfactors are?
10:20 - 10:40	**Break**	
10:40 - 11:05	**Sohail Farhangi**	Parreau Systems and Disjointness from Mixing
11:05 - 11:30	刘洋 **Yang Liu**	Nonexistence results for semilinear elliptic equations on metric graphs
11:30 - 11:55	孙浩天 **Haotian Sun**	Models for branched optimal transportation
Lunch		
Chair: Angelica Aviles-Rivero		
13:30 - 13:55	张震 **Zhen Zhang**	Equilibrium Stress and Rigidity
13:55 - 14:20	王大洵 **Daxun Wang**	Grothendieck rigidity of generalized Baumslag-Solitar groups
14:20 - 14:45	李永涛 **Yongtao Li**	A result for hemi-bundled cross-intersecting families
14:45 - 15:10	李慧慧 **Huihui Li**	Mutual mana: Converting local magic into correlations via discrete beamsplitters
15:10 - 15:30	**Break**	
Chair: Jingfu Peng		
15:30 - 15:55	陈远星 **Yuanxing Chen**	Cross-Validation in Bipartite Networks
15:55 - 16:20	张晏杭 **Yanhang Zhang**	A Minimax Optimal Approach to High-dimensional Double Sparse Linear Regression
16:20 - 16:45	柏浩 **Hao Bai**	Structure-Guided Prototype-Aware Network for Remote Sensing Image Segmentation
16:45 - 17:10	龚慧莹 **Huiying Gong**	Topological Network Regulation of Bottom-Up Vertical Ecological Transmission in Soil Ecosystem Multifunctionality Across the Yellow River Basin
Dinner		

List of Abstracts

April 18, Saturday

Representations of real groups, p-adic groups, and affine vertex algebras

赵启弦 ***Qixian Zhao***

YMSC

In this talk, I review two series of works I took part in during my postdoc at YMSC. We start with a geometric relation between representations of real unitary groups and p-adic symplectic or orthogonal groups, with applications towards Arthur packets. This is based on joint works with Taiwang Deng, Chang Huang, and Bin Xu. We then shift to simple affine vertex algebras. We present conjectures for their associated varieties and simple modules, as well as suggestions of a new framework for studying them. This is based on joint works with Peng Shan and Wenbin Yan.

Generalized Fermat equation of signatures (p, p, p) and (r, r, p) over totally real fields

Satyabrat Sahoo

YMSC

Following Wiles's proof of Fermat's Last Theorem, there has been substantial progress in the study of the solutions to the generalized Fermat equation $Ax^p + By^q = Cz^r$, where $p, q, r > 2$ are rational primes and A, B, C are non-zero coprime integers. In this talk, we study the solutions of the generalized Fermat equation of signature (p, p, p) and (r, r, p) i.e., $Ax^p + By^p = Cz^p$ and $x^r + y^r = dz^p$ over totally real fields K, where $p, r \geq 5$ are rational primes and $A, B, C, d \in \mathcal{O}_K \setminus \{0\}$. We further provide several class of totally real fields for which these results hold.

Transcendence Results for the Gamma Function

Roy Zhao

YMSC

In the past few years, unlikely intersection and functional transcendence results have been proven for the exponential function, the modular j-function, and recently for all solutions of algebraic differential equations. These take the form of the proof of the Manin–Mumford Conjecture, Ax–Lindemann–Weierstrass Theorem, and recently the André–Oort Conjecture. We will briefly cover these results and their history, and then discuss recent progress towards making similar results for transcendentally differential functions, like the Euler Gamma function. This is joint work with Sebastian Eterović and Adele Padgett.

Towards Homological Mirror Symmetry for Arithmetic Toric Varieties

Lamarche Alicia Mae

YMSC

Homological mirror symmetry for a smooth projective toric variety X establishes an equivalence between the derived category of coherent sheaves of X and a partially wrapped Fukaya category determined by the fan of X. In ongoing work with Catherine Cannizzo, Alex Duncan, and Patrick McFaddin, we work to establish this equivalence over non-algebraically closed fields. In particular, we wish to determine what the mirror to a Severi-Brauer variety (or more generally, an arithmetic toric variety) must be.

Automorphisms of Modular Curves and Their Quotients

Tarun Dalal

BIMSA

"Classifying elliptic curves with cyclic isogenies defined over a number field K is an active area of research. Such an object corresponds naturally to a K-rational point on the modular curve $X_0(N)$. Thanks to the foundational work of Mazur and Kenku, the $\mathbb{Q}$-rational points on $X_0(N)$ are now well understood. Yet a full classification of points on $X_0(N)$ over arbitrary number fields remains an open and challenging problem. Intensive research is underway to address this question, and the automorphism group of $X_0(N)$ turns out to be a powerful tool in this context. Except in a few exceptional cases, the automorphism group of $X_0(N)$ consists solely of the well-studied Atkin–Lehner involutions. In the first part of this talk, I will introduce these automorphisms. Then, I will turn to the quotient of $X_0(N)$ by the Atkin-Lehner involutions, and introduce some special automorphisms of these quotient curves that cannot be lifted to automorphisms of $X_0(N)$. I will conclude by presenting some properties of these special automorphisms."

Cohomology of local systems and its applications to algebraic cycles

成枭将 ***Xiaojiang Cheng***

YMSC

Algebraic cycles and their algebraic invariants are central topics in algebraic geometry. We calculate the cohomology of local systems over locally symmetric varieties with automorphic forms. We then apply these results to study algebraic cycles for certain families of varieties.

Motivic Nearby Cycles at Infinity for Laurent Polynomials

王浩旭 ***Haoxu Wang***

MCM

In this talk, I study the limiting mixed Hodge structure at infinity of a non-degenerate Laurent polynomial on the algebraic torus. Using motivic nearby cycles at infinity and toric compactifications associated with the Newton polytope, I obtain an explicit formula for the motivic nearby cycle at infinity in terms of the faces at infinity of the Newton polytope. As a consequence, the Hodge-theoretic invariants of the limiting mixed Hodge structure at infinity are determined by the Newton polytope. In the simplicial-at-infinity case, this further yields an explicit formula for the Hodge polynomial.

Overconvergent Eichler-Shimura theory and geometry of Eigenvariety

赵瑞屾 ***Ruishen Zhao***

YMSC

This talk is about overconvergent Eichler-Shimura theory over certain unitary Shimura varieties and applications to eigenvarieties. I will present a perfectoid construction of overconvergent automorphic forms and establish p-adic family Eichler-Shimura maps between overconvergent cohomology and overconvergent forms. Further I will also discuss relations with higher Colemna theory. These results will deduce etaleness of the weight map around nice points on the eigenvariety and also produce family of Galois representations. It further has arithmetic applications to p-adic L-functions etc.

Global dimension function on stability conditions for Dynkin quivers

Takumi Otani

YMSC

"As a categorical analogue of the (classical) $K(\pi, 1)$-conjecture, it is expected that the spaces of Bridgeland stability conditions are contractible. Ikeda and Qiu introduced the notion of the global dimension for a stability condition on a triangulated category, which generalizes the global dimension of an algebra. Qiu proposed that, for a triangulated category admitting a full exceptional collection, the global dimension function provides the contractible flow on the space of stability conditions. In this talk, I will explain that there is a Whitney stratification on the space of stability conditions on the derived category of a Dynkin quiver.Moreover, I will show the contractibility of this space of stability conditions using the global dimension function."

Genus-1 Gromov-Witten invariants of twistor space

Benjamin Zhou

YMSC

We explain how genus-1 Gromov-Witten invariants of twistor space of hyperbolic manifolds are defined and computed. This provides one of the few examples of higher genus Gromov-Witten invariants of non-Kahler manifolds.

Open Topological String Theory on Compact Calabi-Yau Threefolds

Mohamed Elmi

YMSC

Walcher has shown that open topological string free energies on compact Calabi-Yau threefolds can be computed via mirror symmetry by identifying certain normal functions on the mirror geometry. These are families of Abel-Jacobi like maps that are computed from a pair of algebraic curves in the mirror geometry. I will present some recent work on computation of topological string free energies on fibred product of elliptic surfaces.

Integrability, 4d Chern-Simons and 2d Beta-Gamma

Boujakhrout Youssra

YMSC

We investigate the relation between four-dimensional Chern-Simons gauge theory and a chiral two-dimensional beta-gamma system, linking the latter to integrable lattice systems in 2d space-time. We also discuss the coupling of 4dCS to surface defects extending on the complex curve.

Holomorphic anomaly equations for toric Calabi-Yau 3-orbifolds

喻淞 ***Song Yu***

YMSC

We will discuss a proof of the Bershadsky-Cecotti-Ooguri-Vafa holomorphic anomaly equations for toric Calabi-Yau 3-orbifolds via Chekhov-Eynard-Orantin topological recursion. If time permits, we will also discuss the extended version for open Gromov-Witten theory. This talk is based on joint work in progress with Bohan Fang, Chiu-Chu Melissa Liu, and Zhengyu Zong.

April 19, Sunday

A bisimplicial homotopy theory featuring Aeppli and Bott-Chern homotopy groups

胡家昊 ***Jiahao Hu***

YMSC

I will discuss a work in progress on building a homotpy theory on the category of bisimplicial sets. This homotopy theory is so designed that its rational localization is equivalent to the recent pluripotential homotopy theory on bigraded differential algebras. This is a bigraded version of Sullivan's formalism of rational homotopy theory, and is potentially suitable for studying the topology of complex manifolds.

How rare Subfactors are?

陆凡 ***Fan Lu***

BIMSA

"We develop a systematic classification theory for exchange relation planar algebras. At the critical rank six, we discover infinitely many new infinite depth subfactors. A central result is the equivalence between exchange relation and forest fusion graphs, which reduces the classification problem to the combinatorial study of finite forest data. Using this framework, we implement an automated procedure that enables the examination of approximately 34 billion graph configurations and the verification of the associated consistency equations. Finally, we establish reflection positivity for the resulting family of planar algebras, ensuring that they arise from genuine subfactors."

Parreau Systems and Disjointness from Mixing

Sohail Farhangi

BIMSA

We will review some basic notions from abstract ergodic theory, including joining, disjointness, ergodicity, and strong mixing. We will then discuss Parreau systems and show how they naturally fit into the classical framework of ergodic dichotomies as the dual notion to strong mixing. We will see that partially rigid systems, which include many systems of interest such as interval exchange transformations and minimal substitution systems, are finite extensions of Parreau systems.

Nonexistence results for semilinear elliptic equations on metric graphs

刘洋 ***Yang Liu***

YMSC

In this talk, we focus on the nonexistence of solutions to semilinear elliptic equations with a positive potential on metric graphs. In particular, the Laplacian under consideration is of a special type, related to both the vertices and edges of metric graphs. We construct a modified distance function, introduce appropriate test functions, and establish the nonexistence of global solutions under suitable volume growth conditions imposed on the potential. More precisely, the nonnegative solutions or sign-changing solutions to the equations are the trivial zero solutions.

Models for branched optimal transportation

孙浩天 ***Haotian Sun***

YMSC

"Branched optimal transportation generalizes the classical non-branched transportation models, and models in branched optimal transportation can be categorized into Lagrangian models and Eulerian models. Lagrangian models focus on each particle and its trajectory, while Eulerian models focus more on the “total mass” flow at each point. In this talk, we will focus on Eulerian models which can be defined using vector measures or rectifiable $1-$currents. Moreover, we will see how the notion of capacity constraints that occur in real life transportation can be incorporated into the Eulerian models."

Equilibrium Stress and Rigidity

张震 ***Zhen Zhang***

YMSC

In this talk, we introduce the equilibrium stress for graphs embedded in Euclidean spaces. This object was first studied by James Maxwell in 1870s as a way to understand polyhedral surfaces. Then it showed up in many seemingly unrelated areas such as unique graph embeddings, convex polytopes, and spectral graph theory. We’ll discuss stress from a rigidity theoretic point of view, and several open problems related to stress.

Grothendieck rigidity of generalized Baumslag-Solitar groups

王大洵 ***Daxun Wang***

YMSC

A finitely generated residually finite group G is said to be Grothendieck rigid if for any finitely generated proper subgroup $H < G$, the inclusion induced homomorphism $\widehat{H} \to \widehat{G}$ on their profinite completions is not an isomorphism. In this talk, we will prove that all residually finite generalized Baumslag-Solitar groups are Grothendieck rigid.

A result for hemi-bundled cross-intersecting families

李永涛 ***Yongshou Li***

YMSC

"Two families $\mathcal{F}$ and $\mathcal{G}$ are called cross-intersecting if for every $F \in \mathcal{F}$ and $G \in \mathcal{G}$, the intersection $F \cap G$ is non-empty. It is significant to determine the maximum sum of sizes of cross-intersecting families under the additional assumption that one of the two families is intersecting. Such a pair of families is said to be hemi-bundled. In particular, Frankl (2016) proved that for $k \geq 1, t \geq 0$ and $n \geq 2k + t$, if $\mathcal{F} \subseteq \binom{[n]}{k+t}$ and $\mathcal{G} \subseteq \binom{[n]}{k}$ are cross-intersecting families, in which $\mathcal{F}$ is non-empty and $(t + 1)$-intersecting, then $|\mathcal{F}| + |\mathcal{G}| \leq \binom{n}{k} - \binom{n-k-t}{k} + 1$. This bound is achieved when $\mathcal{F}$ consists of a single set. In this paper, we generalize this result under the constraint $|\mathcal{F}| \geq r$ for every $r \leq n - k - t + 1$. Moreover, we investigate the stability results of Katona's theorem for non-uniform families with the s-union property. Our result extends the stabilities established by Frankl (2017) and Li and Wu (2024). As applications, we revisit a recent result of Frankl and Wang (2024) as well as a result of Kupavskii (2018). Furthermore, we determine the extremal families in these two results. (This is a joint work with Yongjiang Wu and Lihua Feng)"

Mutual mana: Converting local magic into correlations via discrete beamsplitters

李慧慧 ***Huihui Li***

YMSC

Magic (non-stabilizerness) is a key resource for achieving universal fault-tolerant quantum computation beyond classical computation. While previous studies have primarily focused on magic in single systems, its interactions and distribution in multipartite settings remain largely unexplored. In this work, we introduce mutual mana as a measure of magic correlations defined in close analogy with quantum mutual information. Our definition builds upon mana, which is the established quantifier of magic based on discrete Wigner function negativity. We characterize magic correlations generated by discrete beamsplitters, whose Gaussian counterparts are fundamental components in quantum optics and quantum technologies. We show that coupling a magic state with a stabilizer vacuum state via a discrete beamsplitter will induce a full conversion of local magic into mutual mana, thereby establishing a mechanism for redistributing magic resources as magic correlations. We reveal the fundamental properties of mutual mana and derive its explicit expressions for several prototypical qutrit states subject to a discrete beamsplitter. We make a comparative study of mutual mana with several established quantifiers of correlations generated by the qutrit beamsplitter, including quantum mutual information, mutual L^1-norm magic, and mutual stabilizer 2-Rényi entropy.

Cross-Validation in Bipartite Networks

陈远星 ***Yuanxing Chen***

YMSC

Bipartite networks, which encode interactions between two distinct types of entities, arise widely in applications and exhibit inherent asymmetry across node sets. Despite a growing literature on bipartite community detection, estimating community numbers (K_1, K_2) is critical for bipartite network analysis, yet principled model selection remains theoretically underdeveloped. Moreover, the inherent asymmetry and the two-dimensional parameter space pose unique challenges differ from unipartite cases, as candidate models may simultaneously overfit one node set while underfitting the other. To address this challenge, we propose Bipartite Cross-Validation (BCV), a penalized cross-validation framework that jointly selects (K_1, K_2) in a fully data-driven manner. We establish the first model selection consistency for bipartite networks, notably accommodating the regime where the number of communities scales with the network size, revealing the fundamental interplay between sparsity and model complexity. Simulations and real-data applications demonstrate strong finite-sample performance.

A Minimax Optimal Approach to High-dimensional Double Sparse Linear Regression

张晏杭 ***Yanhang Zhang***

YMSC

In this paper, we focus our attention on the high-dimensional double sparse linear regression, that is, a combination of element-wise and group-wise sparsity. To address this problem, we propose an IHT-style (iterative hard thresholding) procedure that dynamically updates the threshold at each step. We establish the matching upper and lower bounds for parameter estimation, showing the optimality of our proposal in the minimax sense. More importantly, we introduce a fully adaptive optimal procedure designed to address unknown sparsity and noise levels. Our adaptive procedure demonstrates optimal statistical accuracy with fast convergence. Additionally, we elucidate the significance of the element-wise sparsity level s_0 as the trade-off between IHT and group IHT, underscoring the superior performance of our method over both. Finally, we demonstrate the superiority of our method by comparing it with several state-of-the-art algorithms on both synthetic and real-world datasets.

Structure-Guided Prototype-Aware Network for Remote Sensing Image Segmentation

柏浩 ***Hao Bai***

BIMSA

Remote sensing image segmentation is challenged by complex land-cover patterns, elongated structures, large intra-class variations, and ambiguous object boundaries. To address these issues, we propose a novel segmentation network that integrates a structure-guided spatial–context backbone with a prototype-guided hierarchical decoder. In the backbone, a directional branch and a large-context branch are introduced to jointly model local structural cues and contextual semantics. Furthermore, a lightweight structural guidance extractor is designed to explicitly encode Sobel-driven structural priors, which are injected into the context competition and spatial–context balancing processes to improve structure preservation in boundary-sensitive and elongated regions. In the decoder, a hierarchical semantic steering strategy is adopted to progressively fuse high-level semantics with low-level details. Meanwhile, semantic prototypes are extracted from cross-layer features, fused into shared semantic tokens, and then used to guide intermediate feature refinement through prototype-guided cross-attention, thereby enhancing semantic consistency and discriminative representation. In addition, an auxiliary supervision branch and a token consistency constraint are introduced during training to stabilize optimization and enforce cross-layer prototype alignment. Extensive experiments on remote sensing segmentation benchmarks demonstrate that the proposed method achieves competitive performance and effectively improves the segmentation quality of complex structures and fine boundaries.

Topological Network Regulation of Bottom-Up Vertical Ecological Transmission in Soil Ecosystem Multifunctionality Across the Yellow River Basin

龚慧莹 ***Huiying Gong***

BIMSA

Soil ecosystem multifunctionality (EMF) in the Yellow River Basin is jointly regulated by within-profile network structure and interlayer vertical coupling, yet the bottom-up mechanism of vertical ecological transmission remains poorly understood. Using multilayer soil attribute data, we constructed within-layer and interlayer coupling networks and integrated topological feature extraction, functional classification, and structural equation modeling to reveal the topological network regulation of soil EMF. The results showed a clear topological backbone characterized by upward propagation of deep negative networks, transmission through mid–shallow positive networks, and cascading vertical coupling. Based on the coupling patterns between topology and EMF, soil units were classified into three regimes: stress-dominated, independent, and synergistic. In the stress-dominated regime, deep negative networks and local mid–shallow structures jointly suppressed EMF, whereas vertical coupling formed structural cascades without significant positive functional effects. In the independent regime, the direct negative effect of deep negative networks on EMF was strongest, and vertical coupling showed weak links to surface structure and the functional endpoint. In the synergistic regime, mid–deep structures strengthened the positive effect of intermediate-range vertical coupling on EMF, enabling structural integration to translate into functional gains. Overall, the decline of macro-scale soil multifunctionality is closely associated with the weakening, mismatch, and partial decoupling of vertical ecological subsidies, while the structural integrity of deep soil networks is crucial for buffering environmental stress and maintaining regional ecosystem stability.