

# Workshop on Geometry and Mathematical Physics

**Time:** December 19 (Friday) - December 21 (Sunday) , 2025

**Place:** M1001, College of Science Building, SUSTech

**Organizer:** Longting Wu

**Description:** The workshop will bring together researchers in geometry and mathematical physics for discussions and exchange of ideas.

Schedule			
Date Time	December 19	December 20	December 21
9:00-10:00	Xiaobo Liu Peking University	Maosong Xiang Huazhong University of Science and Technology	Chongyu Wang Peking University
10:15-11:15	Chenglang Yang Wuhan University	Xin Wang Shandong University	Hao Zhuang Peking University
11:30-12:30			Jae Hwang Lee Peking University
Lunch			
14:00-15:00	Wanxu Yang Peking University	Free Discussion	Free Discussion
15:15-16:15	Danhua Song Peking University		
16:30-17:30	Yan Xu Nankai University		
Dinner			

## List of Titles and Abstracts:

### Xiaobo Liu (Peking University)

Title: Polar foliations on symmetric spaces

Abstract: The notion of polar foliations is a generalization of the concept of polar actions on Riemannian manifolds. In space forms, polar foliations coincide with isoparametric foliations. In general Riemannian manifolds, these two notions are different from each other. This talk will focus on polar foliations in simply connected symmetric spaces with nonnegative curvature. I will describe relations between polar foliations and isoparametric submanifolds, a splitting theorem for polar foliations, and uniqueness of minimal regular leaves. This talk is based on a joint work with Marco Radeschi.

### Chenglang Yang (Wuhan University)

Title: Symmetric Function Expansions in Mathematical Physics and W-Type Actions.

Abstract: W-type operators, which arise in the realization of certain infinite-dimensional Lie algebras, provide symmetries for the KP and BKP hierarchies. In this talk, I will introduce the action formulas of W-type operators on Schur functions and Schur Q-functions. I will also discuss their applications in symmetric function expansions of mathematical physics models. This talk is based on a series of joint works with Professor Xiaobo Liu.

### Wanxu Yang (Peking University)

Title: Mean Curvature Flow for Isoparametric Submanifolds in Hyperbolic Spaces.

Abstract: Mean curvature flows of isoparametric submanifolds in Euclidean spaces and spheres have been studied by Liu and Terng. In particular, it was proved that such flows always have ancient solutions. This is also true for mean curvature flows of isoparametric hypersurfaces in hyperbolic spaces by a result of Reis and Tenenblat. In this paper, we study mean curvature flows of isoparametric submanifolds in hyperbolic spaces with arbitrary codimension. In particular, we will show that they always have ancient solutions and study their limiting behaviors. This is a joint work with Professor Xiaobo Liu.

### Danhua Song (Peking University)

Title: Higher Chern-Simons theory based on strict higher groups

Abstract: This talk is devoted to higher Chern-Simons (HCS) theory, which is a strict higher gauge theory—a generalization of ordinary gauge theory where gauge potentials and field strengths are extended to differential forms valued in higher algebras. We develop HCS theories in 4D and 5D using a generalized construction. Furthermore, we present a generalization of the 4D theory to  $(2n+2)$  dimensions. Finally, by applying the extended Cartan homotopy formula to HCS theory, we show that it yields both the higher Chern–Weil theorem and the higher triangle equation, thus unifying these fundamental results.

## Yan Xu (Nankai University)

title: Fano 3-folds and holomorphic 2-spheres of constant curvature with degree 6 in the complex Grassmannian  $G(2,5)$

abstract: In this talk, I will introduce our recent works on the classifications of holomorphic 2-spheres of constant curvature and of degree 6 in the complex Grassmannian  $G(2,5)$ . The Fano 3-fold and the representation theory of  $SU(2)$  and its finite subgroups play important roles. Many explicit examples can be constructed. These are joint works with Prof. Quo-Shin Chi and Prof. Zhenxiao Xie, arXiv:2208.08525, arXiv:2504.14168.

## Maosong Xiang (Huazhong University of Science and Technology)

Title: Quantization of  $L$  infinity algebroids

Abstract: I will first introduce the notion of  $(-1)$ -shifted derived Poisson manifolds and their BV infinity quantization introduced by Behrend-Peddie-Xu, which can be viewed as the homotopy counterpart of BV quantization of  $(-1)$ -shifted Poisson manifolds. Then I will focus on  $(-1)$ -shifted derived Poisson manifolds arising from  $L$  infinity algebroids. If two  $L$  infinity algebroids are related by a homotopy transfer, we prove that quantization of the two  $(-1)$ -shifted derived Poisson manifolds are equivalent as well. This is a joint work with Ping Xu in progress.

## Xin Wang (Shandong University)

Title: Tautological Relations on the Moduli Space of Curves

Abstract: In the first part, we review several formulae for the Hodge character class  $ch_{2g-1}(E)$  on  $\bar{M}_g$ , Liu–Pandharipande relations and the Blot–Shadrin–Singh relations, and discuss their consequences. In the second part, we construct new explicit relations among Hodge classes,  $\psi$ -classes, and boundary classes. Using these results, we derive new universal equations for descendant Hodge integrals.

## Chongyu Wang (Peking University)

Title: Complexity for 2D TQFT determined by quantum cohomology of (co)minuscule homogeneous spaces

Abstract: Quantum circuit complexity, which quantifies the minimal resources needed to execute a specific quantum computation, is fundamental in quantum computing. Since the important proposal by Harlow and Hayden, people want to define and understand complexity directly within quantum field theory (QFT) itself. I will explain in this talk the situation of 2D TQFT determined by quantum cohomology of (co)minuscule homogeneous spaces.

## Hao Zhuang (Peking University)

Title: Filtered semi-characteristics of closed symplectic manifolds

Abstract: In 2012 and 2016, Tsai, Tseng, and Yau defined a symplectic invariant called the  $p$ -filtered cohomology ( $p = 0, 1, 2, \dots$ ). The  $p$ -filtered cohomology involves the symplectic form on the manifold. An important fact is, for any  $p$  and any closed symplectic manifold, the alternating sum of the

dimensions of the  $p$ -filtered cohomology groups of the manifold is 0. Thus, we expect some geometric information carried out by the even-degree part of the  $p$ -filtered cohomology.

## Jae Hwang Lee (Peking University)

Title: Quantum modules of Semipositive Toric Varieties

Abstract: Quantum cohomology is an interesting object to both mathematicians and physicists due to its relation to string theory. Its product structure, called the quantum product, deforms the product structure of the ordinary cohomology ring via 3-pointed Gromov-Witten invariants. The associativity equations is called WDVV equations. In a similar way, one can use 2|1-quasimap invariants, which are similar to Gromov-Witten invariants, to define such a quantum deformation. It defines no longer a product structure, but a quantum module structure. This is an analogue of the WDVV equations. The semipositive conjecture asks what is the relations in the quantum module for all smooth projective toric semipositive varieties. It turns out that all relations are the same as the Batyrev relations. In this talk, a proof will be given.

# College address and Map

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