



<mark>丘成桐数学科学中心</mark> YAU MATHEMATICAL SCIENCES CENTER



计数几何中的顶点算子 Vertex Operators in Enumerative Geometry

December 23-27, 2024 Room A-103, TSIMF

组织者 ORGANIZERS

Andrei Okounkov, Columbia University Peng Shan(单芃), Tsinghua University

Contents

About1	Ĺ
Schedule2	2
December 23, 2024, Monday2	2
December 24, 2024, Tuesday2	2
December 25, 2024, Wednesday	3
December 26, 2024, Thursday	3
December 27, 2024, Friday4	1
Titles and Abstracts5	5
Tomoyuki Arakawa	5
Yehao Zhou(周业浩)	5
Gurbir Dhillon	5
David Yang	5
Henry Liu (刘华昕)	5
Sam Dehority	5
Tudor Padurariu	5
Chenjing Bu (卜辰璟)	7
Yalong Cao(曹亚龙)	7
Arkadij Bojko	3
Welcome to TSIMF)
About Facilities)
Contact Information of Administration Staff13	3

About

Vertex Operators in Enumerative Geometry 计数几何中的顶点算子

Date December 23-27, 2024

Venue Room A-103, TSIMF

Organizers

Andrei Okounkov, Columbia University Peng Shan(单芃), Tsinghua University

Abstract

In recent years, many enumerative problems have been successfully analyzed using geometric representation theory of Lie algebras and, more generally, quantum groups. However, many appearances of vertex operators of various flavors in enumerative computations all point to the possibility that the theory of vertex algebras may provide more flexible, more versatile, and more widely applicable tools for the analysis of enumerative problems. Particularly intriguing is the fact that all enumerative problems come with a natural deformation from cohomology to K-theory. This suggests that all relevant vertex algebras should have a q-deformation, which thus necessitates a deeper algebraic study of such q-vertex algebras.

The goal of this conference is to discuss recent developments around these topics.

Description of the aim

This conference will gather experts to discuss the most recent developments in enumerative geometry and its connections to geometric representation theory, with a particular focus on vertex algebras, their quantizations and relevant geometric realizations. Talks will be given by world leading experts on these subjects.



Schedule

December 23, 2024, Monday

Time	Name	Title
7:30-8:45	Breakfast	
9:30-10:00	Opening: Andrei Okounkov	
10:00-11:35	Tomoyuki Arakawa	TBA
11:35-11:50	Group Photo	
12:00-13:30	Lunch	
13:30-14:00	Break	
14:00-15:30	Yehao Zhou (周业浩)	Stable envelope for critical cohomology of symmetric quiver variety with potential
15:30-15:50	Coffee Break	
15:50-16:20	Discussions lead by Hiraku Nakajima	
17:30-19:00	Dinner	

December 24, 2024, Tuesday

Time	Name	Title
7:30-8:45	Breakfast	
10:00-11:30	Gurbir Dhillon	Some results on representations of affine Lie algebras
12:00-13:30	Lunch	
13:30-14:00	Break	
14:00-15:30	David Yang	TThe column filtration in geometric Langlands and applications to W-algebras
15:30-15:50	Coffee Break	
15:50-16:20	Discussions lead by Peng Shan(单芃)	
18:00-20:00	Banquet	

December 25, 2024, Wednesday

Time	Name	Title
7:30-8:45	Breakfast	
9:00-10:30	Henry Liu(刘华昕)	Multiplicative vertex algebras and wall- crossing in equivariant K-theory
10:30-11:00	Coffee Break	
11:00-12:30	Sam Dehority	Orthosymplectic Modules of Cohomological Hall Algebras
12:30-13:30		Lunch
13:30-17:30		Free discussion
17:30-19:00		Dinner

December 26, 2024, Thursday

Time	Name	Title
7:30-8:45	Breakfast	
9:00-10:30	Tudor Padurariu	Conjectural equivalences of derived categories of Higgs bundles
12:00-13:30	Lunch	
13:30-14:00	Break	
14:00-15:30	Chenjing Bu(卜辰璟)	Vertex algebras and the homology of moduli stacks
15:30-15:50	Coffee Break	
15:50-16:20	Discussions lead by Andrei Okounkov	
17:30-19:00	Dinner	

3

December 27, 2024, Friday

Time	Name	Title
7:30-8:45	Breakfast	
9:00-10:30	Yalong Cao(曹亚龙)	TBA
10:30-11:00	Coffee Break	
11:00-12:30	Arkadij Bojko	Deformations of vertex algebras from wall- crossing
12:30-13:30	Lunch	
13:30-17:30	Departure	
17:30-19:00	Dinner(if plan to leave on Dec.28)	



Tsinghua Sanya International Mathematics Forum(TSIMF)

Titles and Abstracts

TBA

Tomoyuki Arakawa Kyoto University/Ningbo University

TBA

Stable envelope for critical cohomology of symmetric quiver variety with potential

Yehao Zhou(周业浩) Kavli IPMU, University of Tokyo

In this talk I will introduce a generalization of Maulik-Okounkov's stable envelope to equivariant critical cohomology of symmetric quiver (i.e. quiver with symmetric adjacency matrix) variety with potential, and its application to the study of geometric representation theory. In the case of a tripled quiver with standard cubic potential, this recovers MO's stable envelope for Nakajima quiver variety of the doubled quiver along the dimensional reduction.

Some results on representations of affine Lie algebras

Gurbir Dhillon UCLA

We will discuss some completed results, ongoing results, expectations, and speculations on aspects of the representation theory of affine Lie algebras in characteristic zero and characteristic p > 0, including wild ramification. This is based on works in progress with Faergeman, Losev, and Yang.

The column filtration in geometric Langlands and applications to W-algebras

David Yang MIT

The (conjectural) local geometric Langlands correspondence leads to many conjectures on the structure of representation categories of affine Lie algebra and W-algebras, some of which have since been proven. After reviewing these, we will explain a new filtration in local geometric Langlands and discuss its implications for these representation categories.

Multiplicative vertex algebras and wall-crossing in equivariant K-theory

Henry Liu (刘华昕) IPMU

I will give an overview of recent developments in wall-crossing for equivariant K-theoretic invariants of moduli spaces of objects in certain abelian categories, based on a new framework of Joyce. A multiplicative and equivariant version of vertex algebras appears naturally from the geometric wall-crossing setup, and plays a central role in the resulting wall-crossing formulas. I will discuss some direct applications to enumerative geometry, some connections to K-theoretic Hall algebras, and some possible directions for future work.

Orthosymplectic Modules of Cohomological Hall Algebras

Sam Dehority Columbia University

Various flavors of affine-type quantum groups, including the Yangians and quantum affine algebras have a current presentation which deforms the current presentation related to affine vertex algebras. Geometrically the current presentation naturally arises in the geometric realization of quantum group actions using shuffle algebras, where the current variable is the generator of the cohomology of BG_m. We investigate modules for the shuffle algebra realization of the positive half of Yangians through the cohomology of moduli stacks of orthosymplectic quiver representations and discuss a partially conjectural relationship between orthosymplectic quiver moduli stacks, Joyce-Liu vertex coalgebra comodules and twisted Yangians. In the special case of the Jordan quiver we interpret the representation in terms of orthosymplectic perverse coherent sheaves.

Conjectural equivalences of derived categories of Higgs bundles

Tudor Padurariu

CNRS - Sorbonne Université, Chargé de recherche

I will report on joint work with Yukinobu Toda (partially in progress) about the derived category of coherent sheaves of semistable Higgs bundles on a curve.

These categories have semiorthogonal decompositions in certain categories analogous to the ``window categories" of Segal, Halpern-Leistner, Ballard-Favero-Katzarkov, Špenko-Van den Bergh. In the first part of the talk, I will discuss the general theory of ``window categories" through examples.

Next, I will focus on two conjectural dualitities. The first is between semistable Higgs bundles of degree zero and a "limit" category. This equivalence aims to make precise the proposal of Donagi-Pantev of considering the classical limit of the de Rham Langlands equivalence. The second is a primitive version of the first, and it relates categories of sheaves on moduli of semistable Higgs bundles (for various degrees). This equivalence may be regarded as a version of the D-equivalence conjecture / SYZ mirror symmetry. We can prove (partial) versions of these conjectures for topological K-theory of these categories. I will discuss the relation between these categories and BPS invariants, and between these dualities and the phenomenon of \chi-independence.

Time permitting, I will also discuss applications to the Hall algebra of Higgs sheaves on a curve, with a special focus on the case of the elliptic curve.

Vertex algebras and the homology of moduli stacks

Chenjing Bu (卜辰璟) University of Oxford

We introduce Joyce's vertex algebra structure on the homology of linear moduli stacks. This structure can be used to define homological enumerative invariants, which are a generalization of virtual fundamental classes to Artin stacks, and to write down wall-crossing formulae relating the invariants for different stability conditions.

We then discuss applications and generalizations of this theory. For example, we give a neat new formula for the fundamental class of the moduli space of stable vector bundles on a Riemann surface, previously studied in the works of Witten, Jeffrey, Kirwan, and others. We also outline how to extend this theory of vertex algebra structures to general Artin stacks.

TBA

Yalong Cao(曹亚龙) Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences

TBA

Deformations of vertex algebras from wall-crossing

Arkadij Bojko

Institute of Mathematics, Academia Sinica

While working on the proof of wall-crossing for sheaves on Calabi-Yau fourfolds and developing its applications, I recovered the axioms of formal deformations of vertex algebras from the geometric set up. In fact, more can be said about the underlying algebraic structure which naturally leads to the definition of additive formal families of vertex algebras. In applications, these are used to replace Joyce's wall-crossing formulae dealing with full virtual fundamental classes by wall-crossing for concrete tautological invariants. This can be used to address existing conjectures akin to the famous DT/PT correspondence.





9

The facilities of TSIMF are built on a 23-acre land surrounded by pristine environment at Phoenix Hill of Phoenix Township. The total square footage of all the facilities is over 29,000 square meter that includes state-of-the-art conference facilities (over 10,000 square meter) to hold many international workshops simultaneously, two reading rooms of library, a guest house (over 10,000 square meter) and the associated catering facilities, a large swimming pool, gym and sports court and other recreational facilities.

Management Center of Tsinghua Sanya International Forum is responsible for the construction, operation, management and service of TSIMF. The mission of TSIMF is to become a base for scientific innovations, and for nurturing of innovative human resource; through the interaction between leading mathematicians and core research groups in pure mathematics, applied mathematics, statistics, theoretical physics, applied physics, theoretical biology and other relating disciplines, TSIMF will provide a platform for exploring new directions, developing new methods, nurturing mathematical talents, and working to raise the level of mathematical research in China.

About Facilities



Registration

Conference booklets, room keys and name badges for all participants will be distributed at the front desk. Please take good care of your name badge. It is also your meal card and entrance ticket for all events.



Family rooms are also equipped with kitchen and refrigerator.

Guest Room

All the rooms are equipped with: free Wi-Fi (Password:tsimf123), TV, air conditioning and other utilities.



Library



Opening Hours: 09:00am-22:00pm

TSIMF library is available during the conference and can be accessed by using your room card. There is no need to sign out books but we ask that you kindly return any borrowed books to the book cart in library before your departure.



In order to give readers a better understanding of the contributions made by the Fields Medalists, the library of Tsinghua Sanya International Mathematics Forum (TSIMF) instituted the Special Collection of Fields Medalists as permanent collection of the library to serve the mathematical researchers and readers.

So far, there are 271 books from 49 authors in the Special Collection of Fields Medalists of TSIMF library. They are on display in room A220. The participants are welcome to visit.



Breakfast07:30-08:45Lunch12:00-13:30Dinner17:30-19:00

Restaurant

All the meals are provided in the restaurant (Building B1) according to the time schedule.





Laundry

Opening Hours: 24 hours

The self-service laundry room is located in the Building(B1).





Opening Hours: 24 hours

The gym is located in the Building 1 (B1), opposite to the reception hall. The gym provides various fitness equipment, as well as pool tables, tennis tables etc.



Playground

Playground is located on the east of the central gate. There you can play basketball, tennis and badminton. Meanwhile, you can borrow table tennis, basketball, tennis balls and badminton at the reception desk.

Swimming Pool

Please enter the pool during the open hours, swimming attire and swim caps are required, if you feel unwell while swimming, please stop swimming immediately and get out of the pool. The depth of the pool is 1.2M-1.8M. Opening Hours: 13:00-14:00 18:00-21:00



Free Shuttle Bus Service at TSIMF

We provide free shuttle bus for participants and you are always welcome to take our shuttle bus, all you need to do is wave your hands to stop the bus.

Destinations: Conference Building, Reception Room, Restaurant, Swimming Pool, Hotel etc.



Contact Information of Administration Staff

Location of Conference Affairs Office: Room 104, Building A

Tel: 0086-898-38263896 Conference Manager: Shouxi He 何守喜 Tel:0086-186-8980-2225 Email: heshouxi@tsinghua.edu.cn

Location of Accommodation Affairs Office: Room 200, Building B1

Tel: 0086-898-38882828 Accommodation Manager: Ms. Li YE 叶莉 Tel: 0086-139-7679-8300 Email: yel@tsinghua.edu.cn

IT

Yuanhang Zhou 周远航 Tel: 0086-133-6898-0169 Email: 13368980169@163.com

*Reception duty hours: 7:00-23:00, chamber service please call: 0086-38882828 (exterior line) 80000 (internal line)

*Room maintainer night duty hours: 23:00-7:00, if you need maintenance services, please call: 0086-38263909 (exterior line) 30162 (internal line)

Director Assistant of TSIMF

Kai CUI 崔凯 Tel/Wechat: 0086- 136-1120-7077 Email :cuik@tsinghua.edu.cn

Director of TSIMF

Prof.Xuan GAO 高瑄 Tel: 0086-186-0893-0631 Email: gaoxuan@tsinghua.edu.cn



清华大学三亚国际论坛管理中心 | 三亚清华数学论坛管理中心 Tsinghua Sanya International Mathematics Forum (TSIMF)



0086-898-38883896 FAX 0086-898-38883895

0086-898-38882828

tsimf@tsinghua.edu.cn



https://www.tsimf.cn



海南省三亚市天涯区清华路100号,清华三亚国际数学论坛 No.100, Tsinghua Road, Tianya District, Sanya, Hainan, P. R. China.

