量子场论的现代性

Modern Aspects of Quantum Field Theory

Date

2024-02-19 ~ 2024-02-23

Location

Venue: Room A-120, TSIMF

Organizer

Babak Haghighat, Tsinghua University

Wenbin Yan（颜文斌）, Tsinghua University

Mauricio Romo, Tsinghua University

Junya Yagi, Tsinghua University

Song He, Beijing ITP

Sergei Gukov, Caltech

Proposal

The goal of this workshop is to bring together renowned local and international experts on modern aspects of quantum field theory for talks and discussions. The range of topics covered will include Anomalies, Scattering Amplitudes, Categorical Symmetries, GLSMs and Mirror Symmetry, Supersymmetric Localization, and Instanton partition functions.

The aim will be to give participants a global view on current developments in quantum field theory and encourage cross-field interactions and connections.

TSIMF
清华三亚国际数学论坛

Schedule

Time/Date	2024-02-19	2024-02-20	2024-02-21	2024-02-22	2024-02-23
7:30-8:30	Breakfast				
9:30-10:30		Mykola Dedushenko	Yehao Zhou	Albrecht Klemm	Qu Cao
10:45-11:45		Ioana Coman	Dongmin Gang	Satoshi Nawata	Jin Chen
12:00-13:30	Lunch				
14:00-15:00	Kimyeong Lee	Du Pei		Emanuel Scheidegger	
15:15-16:15		Kaiwen Sun		Jie Gu	
17:30	Dinner				

Titles and Abstracts

On Twisting Little String Theory

Kimyeong Lee

Korea Institute for Advanced Study

The T-duality of twisted (2,0) and (1,1) little string theories is overviewed. Both Coxeter and Dual Coxeter numbers appear as the 2-group structure constant of these theories on a circle. We also provide some evidence by comparing the elliptic genus of the theories on torus times R4 with Omega-background.

Cigar reduction and vertex algebras in SCFT

Mykola Dedushenko

Stony brook University

Reduction of a 4d N=2 SCFT on the 2d cigar with topological twist and Omega-deformation establishes a connection between multiple topics in the study of mathematical structures of SCFT. These include vertex operator algebras (VOA) in 4d N=2, boundary VOA in 3d N=4 (with or without the topological twist in the bulk), VOA in 2d N=(0,2); the constructions of 3d N=4 rank-0 theories, etc. I will describe these ideas and their interrelations.

VOAs from 3d SQFTs

Ioana Coman

IPMU

Relations between quantum field theories and vertex operator algebras (VOAs) have proven ubiquitous. Here I will discuss one such instance, where VOAs arise on the boundary of topologically twisted 3d supersymmetric quantum field theories. These VOAs are defined from non-Abelian quiver gauge theories with an H-twist, by restricting to the boundary and performing a BRST reduction. The quiver description plays a key role, with many parallels between the geometry of the associated quiver variety and structures of the corresponding VOA. There are two interconnected perspectives here: i) physically, BRST closed operators allow to construct an explicit homomorphism from affine W-algebras into the H-twisted VOAs of particular quiver gauge theories, while ii) mathematically, the VOAs are defined as a

chiralization of the extended quiver variety. The latter point of view is particularly powerful as it allows to implement a reduction procedure for the quiver diagrams, which leads to free-field realisations when lifted to the VOAs.

On a new type of 4d TQFTs

Du Pei(裴度)
University of Southern Denmark

TBA

Hecke operator, intermediate Lie algebra and Borcherds product

Kaiwen Sun(孙凯文)
Uppsala university

I discuss several recent progress on 2d CFTs. 1, a Hecke operator that connects the characters of different 2d CFTs, 2, some novel 2d CFTs related to intermediate Lie algebras such as $E_{7+1/2}$ and $D_{6+1/2}$, 3, the classification of certain automorphic forms called Borcherds products, which are closely related to 2d holomorphic CFT/SCFT and nontrivial automorphism of fusion algebras.

Revisiting type A deformed double current algebras, affine Yangians, rectangular W-algebras, and their coproducts

Yehao Zhou(周业浩)
IPMU

In this talk I will discuss a new presentation of deformed double current algebra of type gl_k, denoted by $A^{(k)}$, such presentation is motivated by the study of algebra of observables on M2 branes in the twisted M-theory. I will explain how to find an algebra embedding from $A^{(k)}$ to the mode algebra of $W^{(k)}_\infty$, which is a matrix-extended generalization of $W_{1+\infty}$ algebra. The embedding is motivated by the M2-M5 junction. $A^{(k)}$ can be "doubled" to get an algebra $Y^{(k)}$. When k is not 2, $Y^{(k)}$ is isomorphic to affine Yangian of type A_{k-1}. Conjecturally, such isomorphism also holds for k=2. I will also discuss various coproducts of these algebras, which are motivated by corresponding fusions of branes. This talk

is based on the joint work with Davide Gaiotto and Miroslav Rapcak (arXiv: 2309.16929).

3D rank-0 N=4 SCFTs, rational chiral algebras and modular functions

Dongmin Gang
Seoul National University

I will talk about recently discovered connections among 3D rank-0 N=4 superconformal field theories, rational chiral algebras, and modular functions.

Calabi-Yau period motives in quantum field theory and general relativity

Albrecht Klemm
University of Bonn

We show that Feynman integrals occurring in standard quantum field theories or perturbative worldline approaches to the scattering of real black holes are related to periods of Calabi-Yau varieties of various dimensions. After defining what mathematical properties a Calabi-Yau period motive has, we explain how the applications of the latter lead to an efficient analytic evaluation of the Feynman integrals in dimensional regularisation.

Instanton Counting or Class S on S^2?

Satoshi Nawata(绳田聪)
Fudan University

For this talk, I will prepare two distinct topics and am unsure which one the audience would prefer. To align with the interests of the audience, I plan to start the talk with a vote.

Should the majority opt for Instanton Counting, I will talk about the recent progress in my understanding of instanton counting in various gauge theories, including qq-characters, freezing, and the phenomenon of BPS jumping.

Alternatively, if the audience leans towards Class S on S^2, I will discuss N=(0,2) and (0,4)

theories obtained by twisted compactifications of Class S theories on S^2, which highlights the connections to VOA, duality, and TQFT structures.

On genus one fibered Calabi-Yau threefolds

Emanuel Scheidegger

Peking University

Genus one fibered Calabi-Yau threefolds appear in various places in string theory and algebraic geometry. We will present a class of such fibrations with 5-sections that arise as homologically projective dual pairs. Their realization in physics is in terms of a gauged linear sigma model with nonabelian gauge group. Their topological string partition function shows interesting modular behaviour. We will also comment on the case of 6-sections.

Resurgent structures of free energies and Wilson loops in topological string

Jie Gu(顾杰)

Yau Center Nanjing

'

Perturbative series in topological string theory, such as perturbative free energies and perturbative Wilson loops, can be computed to higher orders.   They also have non-perturbative corrections, and the resurgence theory predicts that they can be encoded in trans-series, and furthermore they control the perturbative series via Stokes transformations.   Based on the previous results of Couso-Santamaria et.al., we solve the non-perturbative trans-series for both free energies and Wilson loops exactly through a trans-series extension of the BCOV holomorphic anomaly equations.   We also give strong evidence that the Stokes constants associated to the Stokes transformations are identified with BPS/DT invariants.

Hidden zeros for particle/string amplitudes

Qu Cao (曹趣)
Zhejiang University

The tree-level Tr(φ3) field theory amplitudes have a hidden pattern of zeros when a special set of non-planar Mandelstam invariants is set to zero. Furthermore, near these zeros, the amplitudes simplify, by factoring into a non- trivial product of smaller

amplitudes. Remarkably the amplitudes for pions and gluons are observed to also vanish in the same kinematical locus. These properties further generalize to the "stringy" Tr($\varphi3$) amplitudes. There is a unique shift of the kinematic data that preserves the zeros, and this shift is precisely the one that unifies colored scalars, pions, and gluons into a single object.

On 6d Elliptic Quantum Curves and Their 5d Descendants

Jin Chen(陈晋)

Xiamen University

In this talk, I will discuss Quantum Seiberg-Witten theory in 6d SCFTs and their 5d descendants. I will first discuss the general procedures to introduce codimensional two surface defects and Wilson surface defects, and then use a path-integral formalism to establish the elliptic quantum curves in the 6d SCFTs. The quantum curves turn out to coincide with the spectral curves of different quantum integrable systems. By taking various masses limit, I will show that the 6d curves will descend to the quantum curves of a series 5d SCFTs. The main examples include the curves associated with the elliptic Ruijsenaar-Schneider, and the van Diejen integrable systems.

Welcome to TSIMF

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.
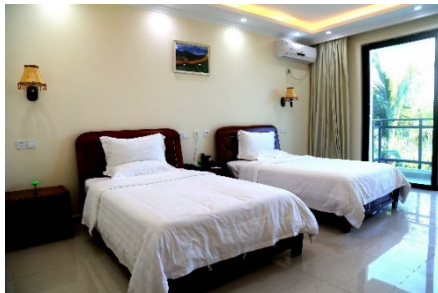
About Facilities

园区平面图 Park Plan
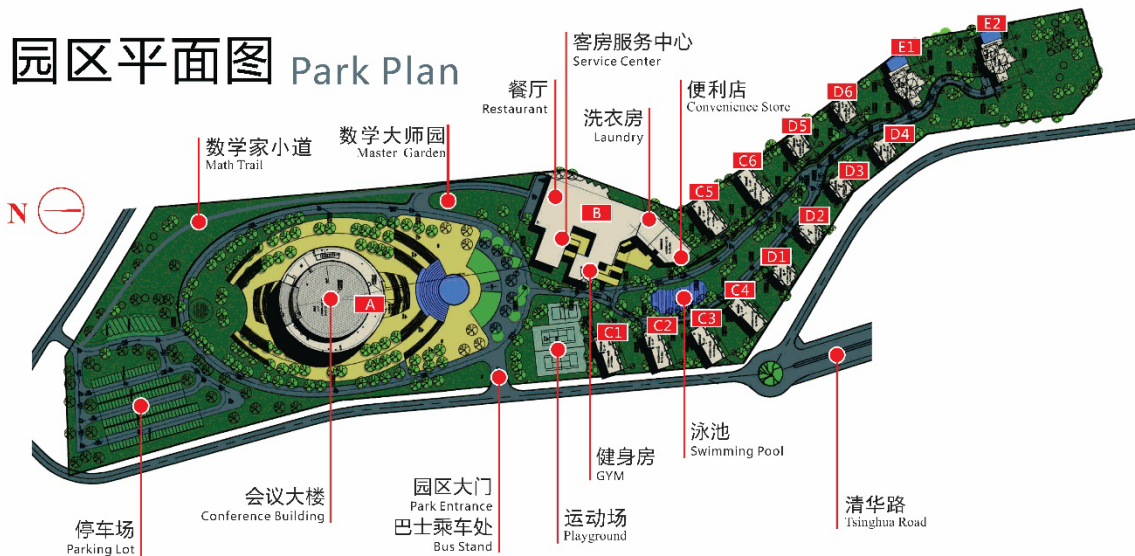
Registration

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.
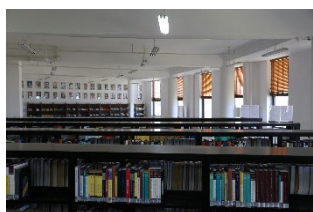
Guest Room

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

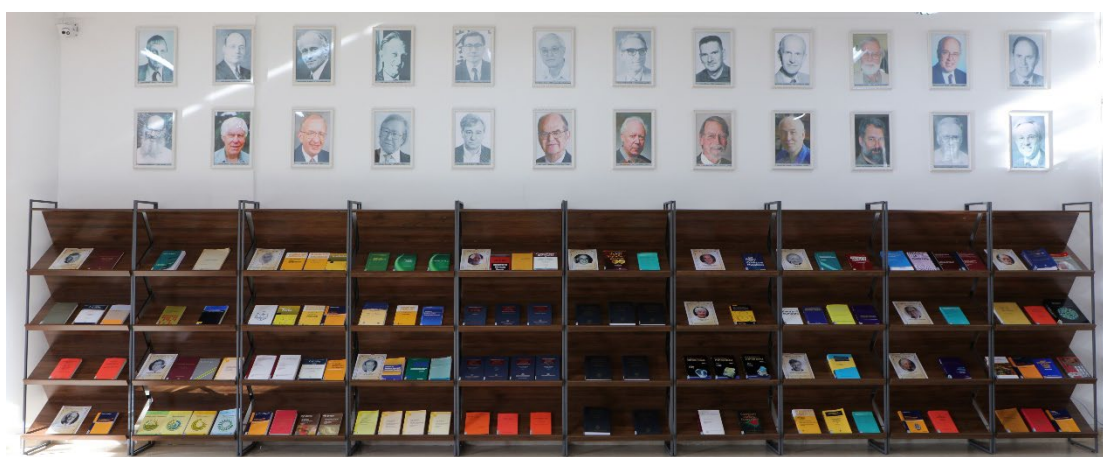Family rooms are also equipped with kitchen and refrigerator.
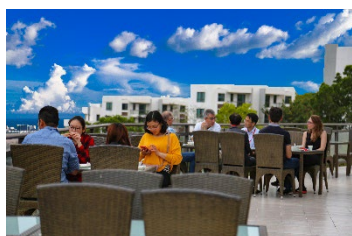
Library

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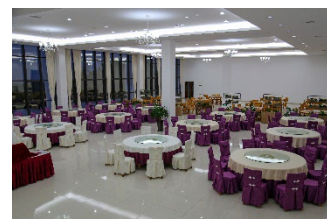
So far, there are 271 books from 49 authors in the Special Collection of Fields Medalists of TSIMF library. They are on display in room A220. The participants are welcome to visit.

Restaurant

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

Breakfast   07:30-08:30
Lunch   12:00-13:30
Dinner   17:30-19:00

For the detailed information,please kindly visit the conference homepage at www.tsimf.cn

TSIMF
清华三亚国际数学论坛

Laundry

Opening Hours: 24 hours
The self-service laundry room is located in the Building(B1).

Gym

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 note that there are no lifeguards. We will not be responsible for any accidents or injuries. In case of any injury or any other emergency, please call the reception hall at +86-898-38882828.

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.

For the detailed information,please kindly visit the conference homepage at www.tsimf.cn

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: hesx@tsimf.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: yeli@tsimf.cn

*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 :cuikai@tsimf.cn

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