# Intersections of Topological Recursion, Conformal Field Theory, and Random Geometry


# Report of Contributions

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Contribution ID: **1** Type: **not specified**

# Bertrand Eynard

*Monday 25 August 2025 09:00 (1h 15m)*

Lectures on Topological recursion and CFT

Contribution ID: **2** Type: **not specified**

# Guillaume Baverez and Remi Rhodes

*Monday 25 August 2025 10:45 (1h 15m)*

Probablistic construction of CFT and applications to Virasoro conformal blocks.

We present a probabilistic construction of Liouville Conformal Field Theory (LCFT), starting with Segal's axioms and the structure constants (the DOZZ formula). Then, we show how to extract the Virasoro algebra from the semigroup of annuli, and use this data in the spectral theory of the Hamiltonian. Finally, we exploit this structure to address the holomorphic factorisation of amplitudes, and give an intrinsic definition of the conformal blocks involved in the bootstrap formulas. We will conclude with aspects of LCFT on surfaces with boundaries, and mention some consequences for the Virasoro conformal blocks.

Contribution ID: **3** Type: **not specified**

# Bertrand Eynard

*Tuesday 26 August 2025 09:00 (1h 15m)*

Lectures on Topological recursion and CFT

Contribution ID: **4** Type: **not specified**

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*Wednesday 27 August 2025 09:00 (1h 15m)*

Lectures on Topological recursion and CFT

Contribution ID: **5** Type: **not specified**

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Contribution ID: **7** Type: **not specified**

# Vladimir Fock and Alexander Goncharov

*Monday 25 August 2025 14:30 (1h 15m)*

Quantization of cluster Poisson varieties and its applications to CFT

The first talk will be an introductory lecture about cluster quantization. In the second talk we plan to cover some more advanced subjects (integration on moduli and recurrence relations using clusters). The third talk concerns Steinberg symbols, vertex operators and clusters.

Contribution ID: **8** Type: **not specified**

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Contribution ID: **10** Type: **not specified**

# Alba Grassi

*Monday 25 August 2025 16:15 (1 hour)*

On quantum curves and q-deformed isomonodromic equations.

In recent years, a rich interplay has developed between topological string theory, quantum operators associated with mirror curves, and isomonodromic equations together with their q-deformations. In this talk, I will focus on two operators: the well-known modified Mathieu operator and the less familiar but equally intriguing McCoy-Tracy-Wu operator. The latter is of particular interest due to its connections with the 2d Ising model, topological recursion, and Seiberg–Witten theory. I will show how both operators can be embedded into the geometric framework of quantum mirror curves and q-deformed Painleve equations, and in particular how this perspective leads to a simple functional relation between them.

This talk is based on joint work with M. Francois [arXiv:2503.21762], as well as earlier collaborations with G. Bonelli, P. Gavrylenko, Q. Hao, and A. Tanzini [arXiv:1603.01174, arXiv:1710.11603, arXiv:2304.11027].

Contribution ID: **11** Type: **not specified**

# Shinji Koshida

*Monday 25 August 2025 17:30 (1 hour)*

Tensor categories arising from the Virasoro algebra and quantum groups.

When studying conformal field theory in two dimensions, one naturally encounters primary fields and their operator product expansions. These can be interpreted as simple objects and tensor products in a tensor category.

Two well-known sources of tensor categories are quantum groups and vertex operator algebras (VOAs). While the module category of a quantum group is naturally a tensor category, establishing the tensor structure on the module category of a VOA is more subtle and relies on the Huang–Lepowsky–Zhang theory.

In this talk, I will try to clarify some aspects of the tensor structure of VOA modules, describe a tensor category arising from the Virasoro algebra at generic central charge, and compare it with the module category of a quantum group.

Contribution ID: **12** Type: **not specified**

# Kento Osuga

N = 1 Super Topological Recursion.

A concrete relation between topological recursion and (modules of) the Virasoro algebra is well understood from the perspective of Airy structures. In fact, the notion of Airy structures plays an important role to generalise into the higher-rank setting, i.e. higher-ramified spectral curves and W-algebras of higher rank. Now, an intereseting question is: can we incorporate supersymmetry into topological recursion by considering modules of the N=1 super Virasoro algebra? In this talk, I will introduce what we call the N=1 super topological recursion from the super-geometric perspective. I will present similarities and differences from the classical case, and will discuss phonemona that appear only in the super setting. This is based on joint work in progress with N. Aghaei, R. Kramer, and N. Orantin.

Contribution ID: **13** Type: **not specified**

# Norman Do

Contribution ID: **14** Type: **not specified**

# Antti Kupiainen

*Tuesday 26 August 2025 18:00 (1 hour)*

Wess-Zumino-Witten models and path integrals.

The Wess-Zumino-Witten (WZW) model is a 2 dimensional conformal field theory (CFT) where the field takes values in a Lie group G or its coset space. For a compact group G this CFT is rational and its cosets G/H include for instance all unitary rational CFTs (e.g. the two dimensional Ising model). WZW model has a formal path integral representation whose rigorous construction has remained elusive and in fact most of its conjectured properties have been discussed using the representation theory of affine Lie algebras. In this talk I will review the basic facts about the path integral formulation of WZW models and then discuss the coset theory SL(2,C)/SU(2). This theory can be formulated in terms of field taking values in the 3-dimensional hyperbolic space and it has been studied as one of the simplest realisations of the AdS/CFT correspondence. By the work of Ribault, Teschner, Hikida and Schomerus it has also been argued to have a mapping to the Liouville CFT which is the basic building block of two dimensional quantum gravity and random surface theory. This map has been argued to provide a "quantum"deformation of the geometric and analytic Langlands correspondence. I will explain briefly how this theory can be constructed probabilistically using the theory of Gaussian Multiplicative Chaos and how in a very general setup the correlation functions of its primary fields can be mapped to those of the Liouville CFT.

Contribution ID: **15** Type: **not specified**

# Baptiste Cercle

Conformal Bootstrap for boundary Liouville CFT.

In this talk we will discuss a geometric problem related to boundary Liouville CFT and closely related to uniformisation of open Riemann surfaces. Namely in a first part we will consider the classical problem of finding a conformal metric with constant scalar curvature, piecewise constant geodesic curvature and prescribed conical singularities and corners. In particular we will explain how to define the associated classical stress-energy tensor using CFT-inspired techniques.

In a second part we will show, based on its probabilistic formulation, that the semi-classical limit of boundary Liouville CFT describes this classical geometry. Thanks to this we can determine the accessory parameters associated to the classical stress-energy tensor and show that it gives rise to higher equations of motion.

Contribution ID: **16** Type: **not specified**

# Dalimil Mazac

*Thursday 28 August 2025 09:00 (1 hour)*

L-functions, automorphic spectra, and the conformal bootstrap.

Recently, a close parallel emerged between the spectral theory of automorphic forms and conformal field theory in general dimension. I will review this connection and explain how it can be leveraged to prove new results in number theory and spectral geometry using ideas borrowed from the conformal bootstrap. In particular, I will discuss new subconvex bounds on L-functions, and the spectral gaps of hyperbolic manifolds. I will speculate about the implications of this correspondence for quantum field theory.

Contribution ID: **17** Type: **not specified**

# Kohei Iwaki

*Thursday 28 August 2025 10:30 (1 hour)*

Topological recursion and irregular conformal block via Painleve and WKB

Abstract: We will compare topological recursion and irregular conformal blocks, focusing on the Painlevé I equation. If time permits, we will also discuss a relation between the Heun accessory parameter with irregular singularities and the Voros periods.

This talk is based on joint work with N. Iorgov, O. Lisovyy, and Y. Zhuravlov (arXiv:2505.16803), as well as ongoing joint work with H. Nagoya and A. Shukuta.

Contribution ID: **18** Type: **not specified**

# Leonid Chekhov

*Thursday 28 August 2025 11:30 (1 hour)*

Fool's crowns, Schwarzian, and topological recursion.

For a Riemann surface with holes, we propose a variant of the action on a circumference-P boundary component with n bordered cusps attached (a "fool's crown") that is decoration-independent and generates finite volumes V crown of the corresponding moduli spaces when integrated against the volume n,P form obtained by inverting the Fenchel–Nielsen (Goldman) Poisson bracket on a set of decoration-independent combinations of Penner's \lambda lengths. In the limit as n \to ∞, the integrals transform into a functional integral with the measure containing the Schwarzian and reproducing the measure by Stanford—Witten and Alekseev–Meinrenken. I will discuss hypothetical links to topological recursion systems and the volumes of moduli spaces for a disc with n bordered cusps. Based on arXiv.2411.03913.

Contribution ID: **19** Type: **not specified**

# Xin Sun

*Thursday 28 August 2025 17:30 (1 hour)*

Three Theorems on the 6j symbol of the modular double of Uq(sl2(R)).

The modular double of Uq(sl2(R)) is an important quantum group in mathematical physics with a continuous spectrum of representations. The 6j symbol from its tensor structure, also known as the Racah-Wigner coe- ficients, were computed explicitly by Ponsot and Teschner. In this talk, I will present three theorems I proved with various coauthors on this object. The first is that it describes the boundary 3-point structure constant of Liouville theory, joint with M. Ang, G. Remy, T. Zhu. The second is that it describes the fusion transformation of Liouville conformal blocks, joint with P. Ghosal, G. Remy, Y. Sun, and B. Wu. The third is that its semiclassical limit is described by the hyperbolic and AdS volumes of tetrahedra according to its parameter regimes, joint with T. Liu, S. Ming, B. Wu, and T. Yang. Time permits, I will also present the semiclassical limit of the Turaev-Viro invariant for this 6j symbol, which is the hyperbolic volume as expected from the Volume Conjecture.

Contribution ID: **20** Type: **not specified**

# Promit Ghosal

*Friday 29 August 2025 09:00 (1 hour)*

Semiclassical Limit of Conformal Blocks, Nekrasov–Rosly–Shatashvili Relations, and the Trieste Formula for the Heun Equation.

This talk reviews recent advances in understanding the semiclassical limit of conformal blocks on the torus. Within this framework, we present ongoing work on the Nekrasov–Rosly–Shatashvili relations in gauge theory, their implications for semiclassical Liouville theory, and strategies for proving these relations via semiclassical analysis of conformal blocks. We also explore recent developments on exact connection formulas for integrable ODEs. In particular, for the Heun equation — which governs the semiclassical limit of the four-point conformal block — an explicit formula for its connection constant, known in the physics literature as the Trieste formula, has been conjectured via conformal field theory, and we show how to prove this conjecture rigorously.

Contribution ID: **21** Type: **not specified**

# Baojun Wu

*Friday 29 August 2025 10:30 (1 hour)*

Conformal Bootstrap for boundary Liouville CFT.

In this talk, I will explain how to compute the Liouville correlation function for surfaces with boundary via the conformal bootstrap method. In the first part, I will explain my previous work establishing the integrability of Liouville CFT on the annulus. This result leveraged the known spectral resolution for the bulk Liouville theory and rigorously implemented Cardy's doubling trick. As an application, we derived explicit formulas for the annulus/torus partition function. In the second part, I will discuss the joint work with Colin Guillarmou and Remi Rhodes. This includes our work on Segal's axioms for boundary Liouville CFT and our ongoing project on conformal bootstrap for boundary Liouville CFT.

Contribution ID: **22** Type: **not specified**

# Open problem and discussion session

*Friday 29 August 2025 11:30 (1 hour)*

Contribution ID: **23** Type: **not specified**

# Baptiste Cercle

*Thursday 28 August 2025 16:15 (1 hour)*

Boundary Liouville theory: from classical to quantum and back again.

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Contribution ID: **24** Type: **not specified**

# Norman Do

*Thursday 28 August 2025 14:45 (1 hour)*

The double-scaled SYK model and Weil-Petersson volumes.

Okuyama expressed correlators in the double-scaled SYK model in terms of q-dependent polynomials arising from topological recursion on a particular spectral curve. He claimed that these polynomials recover the Weil-Petersson volumes studied by Mirzakhani in the limit as q approaches 1. In this talk, we discuss one-and-a-bit proofs of this conjecture. This is joint work with Paul Norbury and Arlo Taylor.

Contribution ID: **25** Type: **not specified**

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