

Workshop on Resurgence, wall-crossing and geometry



Report of Contributions

Contribution ID: 1

Type: **not specified**

From the Kronecker quiver to a Painleve III tau function

Monday 13 January 2025 09:30 (1 hour)

I will explain how to relate the two objects in the title. Along the way we will encounter stability conditions, Donaldson-Thomas invariants, Riemann-Hilbert problems, Joyce structures and isomonodromic deformations. This is joint work with Fabrizio Del Monte.

Presenter: BRIDGELAND, Tom

Contribution ID: 2

Type: **not specified**

Summability for state integrals of hyperbolic knots

Monday 13 January 2025 11:00 (1 hour)

Given a hyperbolic knot K , state integrals are convergent integrals of products of Faddeev's quantum dilogarithm associated with certain triangulations of $S^3 \setminus K$. Their asymptotic expansions are divergent power series conjectured to be resurgent and Borel summable by Garoufalidis, Gu and Mariño. In this talk, I will prove this conjecture for the knots 4_1 and 5_2 . This is based on a joint project with C. Wheeler, arXiv:2410.20973

Presenter: FANTINI, Veronica

Contribution ID: 3

Type: **not specified**

Refined Gromov-Witten invariants

Monday 13 January 2025 16:30 (1 hour)

I will discuss a conjectural definition of refined curve counting invariants of local Calabi–Yau threefolds in terms of equivariant stable maps on Calabi–Yau fivefolds. The corresponding disconnected generating function should conjecturally equate the Nekrasov–Okounkov K-theoretic membrane index under a refined version of the GW/PT correspondence. Physically, this provides a world-sheet definition of the Omega-background refinement of the ordinary topological string.

I’ll present several acid tests validating the conjecture, both in the A and the B-model. This is based on joint work with Yannik Schuler (ETH Zurich), arXiv:2410.00118.

Presenter: BRINI, Andrea

Contribution ID: 4

Type: **not specified**

Analytic continuation of topological strings

Monday 13 January 2025 18:00 (1 hour)

The partition function of topological string theory on any family of Calabi-Yau threefolds is defined perturbatively as an asymptotic series in the topological string coupling and encodes, in a holomorphic limit, higher genus Gromov-Witten as well as Gopakumar-Vafa invariants. I will prove that the partition function of topological strings of any CY in this limit can be written as a product, where each factor is given by the partition function of the resolved conifold with shifted arguments, raised to the power of certain sheaf invariants. I will use this result to put forward an expression for an analytic continuation of the topological string partition function in this limit, as a product over analytic functions in the topological string coupling which correspond to the Borel sums for the resolved conifold found previously using resurgence.

Presenter: ALIM, Murad

Contribution ID: 5

Type: **not specified**

Periods and the meromorphic 3d index

Tuesday 14 January 2025 09:30 (1 hour)

Presenter: GAROUFALIDIS, Stavros

Contribution ID: 6

Type: **not specified**

Wall-crossings in Painlevé equations

Tuesday 14 January 2025 11:00 (1 hour)

The series of works by Gaiotto, Moore, and Neitzke demonstrated a deep connection between the wall-crossing phenomena of BPS invariants and the Stokes phenomena in exact WKB analysis. In this talk, I will propose an interpretation of the wall-crossing formulas through the analysis of Painlevé equations. Part of this talk is based on joint work with M. Mariño (SIGMA, 2024).

Presenter: IWAKI, Kohei

Contribution ID: 7

Type: **not specified**

Integral Representations of Quantum Invariants of Three-Manifolds

In this talk we focus on finite dimensional integral representations of topological invariants of three-manifolds which are motivated by resurgence.

Our first example will be the Witten-Reshetikhin-Turaev (WRT) quantum invariant of a three-manifold with a colored link. Our corresponding integral representation, which is joint with Andersen and Hindson, is motivated by Witten's works on analytic continuation of quantum Chern-Simons field theory. Our integral representation leads to a formal semi-classical expansion in terms of Chern-Simons invariants of flat connections in accordance with Witten's asymptotic expansion conjecture.

Additionally, I will present a new result, a proof of Witten's asymptotic expansion conjecture for the WRT invariants of a Seifert fibered integral homology three-sphere M , which is joint with Andersen, Han, Li, Sauzin and Sun. This proof is based on resurgence, quantum modularity and a previous result, which is joint with Andersen and inspired by work of Gukov, Marino and Putrov, namely the so-called radial limit theorem for M . This theorem concerns the BPS q -series invariant of M defined by Gukov, Pei, Putrov and Vafa, and the theorem asserts that as q tends to a root of unity, this series limits the WRT invariant of M at that root of unity.

Finally, based on joint work with Murakami, I will present a new integral formula for a certain average of the BPS q -series invariants of pairs (Y, b) , where Y is a general negative definite plumbed homology three-sphere Y and b is a spin- c structure. This integral formula is used to establish, for this class of three-manifolds, the radial limit conjecture for non-semisimple quantum invariants due to Costantino, Gukov and Putrov. This asserts that the limit of this average of BPS q -series invariants is equal to the non-semisimple quantum invariant of Y defined by Costantino, Geer, Patureau and Mirand.

Presenter: MISTEGARD, William

Contribution ID: 8

Type: **not specified**

European Research Council (ERC) information session

Tuesday 14 January 2025 18:00 (1 hour)

The European Research Council's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all fields, based on scientific excellence. I will give an overview of the ERC programme and its funding opportunities, open to researchers of any nationality and age. The session will provide insights into the evaluation and selection processes, focusing on details of particular interest for mathematicians and mathematical physicists. Discussion with the audience and Q&A will be encouraged.

Presenter: VAZQUEZ MOLINA, Joan

Contribution ID: 9

Type: **not specified**

A guided tour of BPS sectors in 5d, 3d and 3d-5d systems from the viewpoint of exponential networks

Wednesday 15 January 2025 18:00 (1 hour)

BPS states associated to different kinds of resurgent structures, such as Riemann-Hilbert problems for Donaldson-Thomas theory, exact WKB analysis, and knot theory, share deep connections through string theory. In this talk I will review how interactions among these BPS sectors, and related mathematical structures, can be studied through exponential networks

Presenter: LONGHI, Pietro

Contribution ID: 10

Type: **not specified**

Integral Representations of Quantum Invariants of Three-Manifolds

Thursday 16 January 2025 09:30 (1 hour)

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Presenter: MISTEGARD, William

Contribution ID: 11

Type: **not specified**

Studying the Borel plane of one-parameter Calabi-Yau models

Thursday 16 January 2025 11:00 (1 hour)

The topological string amplitude on hypergeometric Calabi-Yau threefolds is known to sufficiently high genus to permit a resurgence analysis. In this talk, based on joint work with Simon Douaud, we study the position of Borel singularities and the associated Stokes constants for these geometries. We find in particular that in models which exhibit massless D-branes at a singular point, the central charge of the D-brane close to the singular point coincides with the location of the leading Borel singularity, and the large radius generalized Donaldson-Thomas invariant associated to the charge of the D-brane, in as far as its value is known, coincides with the Stokes constant associated to the Borel singularity.

Presenter: KASHANI-POOR, Amir

Contribution ID: 12

Type: **not specified**

A categorification of Stokes coefficients in Chern-Simons theory on plumbed 3-manifolds

Thursday 16 January 2025 16:30 (1 hour)

The Stokes coefficients of the perturbative expansions in Chern-Simons theory around flat connections on a 3-manifold are known to be integers. In my talk, I will describe a way to promote those integers to $\mathbb{Z}/2$ -graded vector spaces for a certain large class of non-hyperbolic 3-manifolds. The vector spaces are given by a version of Lagrangian Floer homology in a finite-dimensional space, with an explicit algorithm to calculate them. The talk is based on a joint work with S. Gukov.

Presenter: PUTROV, Pavel

Contribution ID: 13

Type: **not specified**

BPS algebras: overview and recent progress

Thursday 16 January 2025 18:00 (1 hour)

Presenter: LI, Wei

Contribution ID: 14

Type: **not specified**

Energy Trans-series of Hofstadter Butterfly from Supersymmetric Field Theory

Friday 17 January 2025 09:30 (1 hour)

Electron in a 2d square lattice immersed in a perpendicular magnetic field is known to exhibit a fractal energy spectrum known as the Hofstadter Butterfly. To account for this interesting energy spectrum nonperturbative corrections must be taken into account. We capitalise on an interesting connection between Hofstadter butterfly and 5d supersymmetry field theory, and by making use of the resurgent structure and the BPS spectrum of the 5d gauge theory, we are able to construct the full energy trans-series of Hofstadter butterfly that includes all the non-perturbative corrections when the magnetic flux through a lattice plaquette is $2\pi/Z$.

Presenter: GU, Jie

Contribution ID: 15

Type: **not specified**

Spectral networks and spectral determinants

Friday 17 January 2025 11:00 (1 hour)

Spectral networks encode an awful lot of information about four-dimensional $N=2$ theories of class S , but are also an incredibly useful tool to study spectral problems that come up in this context. In this talk I will explain how to analyse spectral problems from the perspective of spectral networks, and how to formulate spectral determinants in terms of spectral coordinates. Parallel to Tom Bridgeland's talk, I will focus on $SU(2)$ theories. This is based on work in progress with Alba Grassi and Qianyu Hao

Presenter: HOLLANDS, Lotte