Workshop on Quantum Geometry

Report of Contributions

https://indico.math.cnrs.fr/e/7514

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

Gromov-Witten Theory of Complete Intersections I

Monday, April 25, 2022 2:00 PM (1 hour)

I will describe an inductive algorithm computing Gromov-Witten invariants in all genera with arbitrary insertions of all smooth complete intersections in projective space. This uses a monodromy analysis, as well as new degeneration and splitting formulas for nodal Gromov–Witten invariants. This is joint work with Pierrick Bousseau, Rahul Pandharipande, and Dimitri Zvonkine. This will be the first introductory part to the topic – the second more advanced part will be in the talks of Pierrick Bousseau.

Presenter: ARGÜZ, Hülya (IST Austria)

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

Quantizations of Complex Lagrangian Fibrations, Normal Forms, and Spectra

Monday, April 25, 2022 3:30 PM (1 hour)

Under certain conditions, it is possible to compute the spectrum of a polynomial differential operator via its Birkhoff normal form. In this talk, I will explain a geometric approach for obtaining the Birkhoff normal form of a quantized Hamiltonian using the variation of Hodge structure for a formal deformation of a complex Lagrangian fibration. This is joint work in progress with Maxim Kontsevich.

Presenter: SOIBELMAN, Alexander (IHES)

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

Gromov-Witten Invariants of Complete Intersections II

Tuesday, April 26, 2022 2:00 PM (1 hour)

I will describe an inductive algorithm computing Gromov-Witten invariants in all genera with arbitrary insertions of all smooth complete intersections in projective space. This uses a monodromy analysis, as well as new degeneration and splitting formulas for nodal Gromov–Witten invariants. This is joint work with Hülya Argüz, Rahul Pandharipande, and Dimitri Zvonkine. This will be the continuation of the talk of Hülya Argüz on the same topic.

Presenter: BOUSSEAU, Pierrick (ETH Zurich)

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

Riemann-Hilbert Problems from Refined Donaldson-Thomas Theory

Tuesday, April 26, 2022 3:30 PM (1 hour)

The notion of BPS structure (or symmetric stability structure) describes the output of Donaldson-Thomas's theory on a 3-Calabi-Yau category and can be realized also from a quadratic differential on a Riemann surface. A BPS structure can be associated with a Riemann-Hilbert problem, which allows us to understand the Kontsevich-Soibelman wall-crossing formula as an iso-Stokes property when the BPS structure varies appropriately. In this talk, I will review the notion of BPS structure together with some examples and what is known about associated Riemann-Hilbert problems. I will then present a solution to the problem in a simple case said: "uncoupled". The solution is obtained analytically and, time permitting, will be compared with a more recent solution (due to Iwaki-Kidwai) obtained by means of Voros symbols.

Presenter: BARBIERI, Anna (University of Milano Statale)

Contribution ID: **6** Type: **not specified**

Moduli Spaces of Irregular Singular Connections: Quantization and Braiding

Tuesday, April 26, 2022 4:45 PM (1 hour)

Holomorphic connections on Riemann surfaces have been widely studied, as well as their monodromy representations. Their moduli spaces have natural Poisson/symplectic structures, and they can be both deformed and quantized: varying the Riemann surface structure leads to the action of mapping class groups on character varieties (the "symplectic nature" of the fundamental group of surfaces), while geometric quantization is related to complex Chern–Simons theory.

A lesser-known extension of this story involves meromorphic connections, and in that case there are new local moduli (at each pole) complementing those of the underlying pointed Riemann surface: in this talk we will present recent work about their deformations, and about the quantization of the resulting Poisson/symplectic family of moduli spaces.

Presenter: REMBADO, Gabriele (Hausdorff Centre for Mathematics, Bonn)

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

Length Partition of Random Multi-geodesics on Large Genus Hyperbolic Surfaces

Monday, April 25, 2022 4:45 PM (1 hour)

On a hyperbolic surface, a closed geodesic is said to be simple if it has no self-intersection. A multi-geodesic is a multiset of disjoint simple closed geodesics. A multi-geodesic can be decomposed into connected components, and therefore induces a partition of its total length. In this talk, I will present an attempt to answer the following question: what is the shape of the length partition of a random multi-geodesic on a hyperbolic surface with large genus? In particular, I will explain why the average lengths of the three largest components of a random multi-geodesic on a large genus hyperbolic surface are approximately, 75.8%, 17.1%, and 4.9%, respectively, of the total length. And we shall see that intersection numbers on the moduli spaces of curves have a crucial role to play. This is based on joint work with Vincent Delecroix.

Presenter: LIU, Mingkun (IMJ-PRG)

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

Gromov-Witten Invariants of Complete Intersections III

Wednesday, April 27, 2022 2:00 PM (1 hour)

I will describe an inductive algorithm computing Gromov-Witten invariants in all genera with arbitrary insertions of all smooth complete intersections in projective space. This uses a monodromy analysis, as well as new degeneration and splitting formulas for nodal Gromov–Witten invariants. This is joint work with Hülya Argüz, Rahul Pandharipande, and Dimitri Zvonkine. This will be the continuation of the talk of Hülya Argüz on the same topic.

Presenter: BOUSSEAU, Pierrick (ETH Zurich)

Contribution ID: **9** Type: **not specified**

Argyres-Douglas Theories, Isomonodromy and Topological Recursion

Wednesday, April 27, 2022 3:00 PM (1 hour)

Argyres-Douglas theories are certain supersymmetric physical theories in four dimensions, many of which belong to "Class S" and are in some sense the simplest examples of such. On the other hand, isomonodromy is the analogue of the Gauss-Manin connection in non-abelian Hodge theory. I will explain how physical dualities between different Argyres-Douglas theories lead to remarkable identifications between different isomonodromy systems, closely related to those discovered by Boalch around ten years ago (as well as some that seem to go beyond these); I will also discuss how such dualities are related to the x-y symmetry in topological recursion due to Eynard and Orantin.

Presenter: LAM, Joshua (IHES)

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

Donaldson-Thomas Invariants of Toric Quivers

Wednesday, April 27, 2022 4:30 PM (1 hour)

Donaldson-Thomas theory aims at counting sheaves on Calabi-Yau threefolds. The category of sheaves on a toric threefold is derived equivalent to the category of representation of a quiver with potential obtained from a tiling of the torus. On this class of example, the virtual Euler number of the moduli space of quiver representations can be computed by toric localization with respect to an action scaling the arrows of the quiver, by enumerating the fixed points, described combinatorially by pyramids partitions. A toric localization formula is provided by the K-theoretic DT formalism in order to compute the virtual cohomology of this moduli space, but these computations were shown not to agree with computations of the virtual cohomology based on the formalism of vanishing cycles even in the simplest cases. We present here how to interpret and solve this mismatch, using an equivalent of the Bialynicki-Birula decomposition for virtual cohomology. DT invariants for toric threefolds without compact divisors are completely classified, but those of toric threefolds with compact divisors are generally expected to be wild. We present a conjectural formula for attractor invariants of any toric quivers, elementary bricks from which all the DT invariants can be built, corresponding to initial data of the stability scattering diagram of the quiver. We will prove this formula for the projective plane, the simplest example with compact divisor.

Presenter: DESCOMBES, Pierre (Sorbonne Université UPMC)

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

Jeffrey-Kirwan Localization for Quiver Varieties

Wednesday, April 27, 2022 5:30 PM (1 hour)

In this talk, I will present an ongoing project on Jeffrey-Kirwan localization in the theory of quiver moduli spaces. In order to motivate the interest in this topic, in the first part of the talk I will recall the content of a previous joint work with Jacopo Stoppa (SISSA). Given a complete bipartite quiver, there is a natural way to construct a log Calabi-Yau surface. We show how the Gross-Hacking-Keel mirror to this, which is known to encode both Gromov-Witten and quiver invariants, can be computed also in terms of residues of meromorphic forms, by using a formula of Szenes and Vergne. The main focus of the
the seminar will be on this formula and on its derivation from a localization procedure for Hamiltonian actions on symplectic manifolds due to Jeffrey and Kirwan.

Presenter: ONTANI, Riccardo (SISSA)

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

Integrable Systems on (Multiplicative) Quiver Varieties

Thursday, April 28, 2022 2:00 PM (1 hour)

Following the pioneering work of Wilson who realized the phase space of the (classical complex) Calogero-Moser system as a quiver variety, Chalykh and Silantyev observed in 2017 that various generalizations of this integrable system can be constructed on quiver varieties associated with cyclic quivers. Building on these results, I will explain how such systems can be visualized at the level of quivers, and how to prove that we can form (degenerately) integrable systems. I will then outline how this construction can be adapted to obtain generalizations of the Ruijsenaars-Schneider system if one uses multiplicative quiver varieties associated with the same quivers. The main tool that I want to advertise is the notion of double (quasi-) Poisson brackets due to Van den Bergh. This talk is partly based on previous works with Oleg Chalykh and Tamás Görbe.

Presenter: FAIRON, Maxime (University of Glasgow)

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

The Negative Side of Witten's Conjecture

Friday, April 29, 2022 3:15 PM (1 hour)

In 2017, Norbury introduced a collection of cohomology classes on the moduli space of curves, and predicted that their intersection with psi classes solves the KdV hierarchy. In a joint work in progress with N. Chidambaram and E. Garcia-Failde, we consider a deformation of Norbury's class and, via the Givental–Teleman reconstruction theorem, we express such deformation in terms of kappa classes establishing new tautological relations recently proposed by Kazarian–Norbury. The recursive construction of these classes reduces in the limit to certain Virasoro constraints satisfied by Norbury's class, equivalent to the KdV hierarchy. This result corresponds to spin -2 intersection numbers. In the same work, we establish the analogous results for general negative spin: we introduce some new cohomology classes, analogous to the Witten r-spin classes, get tautological relations through the Givental–Teleman reconstruction, and prove W-constraints equivalent to the r-KdV hierarchy.

Presenter: GIACCHETTO, Alessandro (IPhT)

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

Quantisation of Spectral Curves of Arbitrary Rank and Genus via Topological Recursion

Thursday, April 28, 2022 4:45 PM (1 hour)

The topological recursion is a ubiquitous procedure that associates to some initial data called spectral curve, consisting of a Riemann surface and some extra data, a doubly indexed family of differentials on the curve, which often encode some enumerative geometric information, such as volumes of moduli spaces, intersection numbers and knot invariants. The quantum curve conjecture claims that one can associate to a spectral curve a differential equation, whose solution can be reconstructed by the topological recursion applied to the original spectral curve. I will explain how starting from loop equations, one can construct a system of KZ equations whose solutions are vectors of wave functions built from topological recursion. These equations can often be interpreted as PDEs with respect to the moduli of the spectral curves. I will explain the idea to obtain an associated Lax pair that shares the same pole structure as the initial spectral curve, which in particular solves the conjecture affirmatively for a large class of spectral curves. I will comment on the technicalities that arise when attacking this conjecture for generic algebraic spectral curves, the solutions we proposed and what remains to be done. This is based on joint work with B. Eynard, in which we treated the hyperelliptic case, and with N. Orantin and O. Marchal, in which we deal with the generalisation to spectral curves of arbitrary rank, albeit with simple ramifications.

Presenter: GARCIA-FAILDE, Elba (IMJ-PRG)

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

Combinatorial Quantisation of Supergroup Chern-Simons Theory

Friday, April 29, 2022 2:00 PM (1 hour)

Chern-Simons Theories with gauge super-groups appear naturally in string theory and they possess interesting applications in mathematics, e.g. for the construction of knot and link invariants. In my talk, I will review the framework of combinatorial quantization of Chern Simons theory and explain how this framework can be adapted for applications to superalgebras. This will give rise to interesting new observables which can be computed by exploiting the rich representation theory of Lie superalgebras.

Presenter: AGHAEI, Nezhla (SDU/QM Center)

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

The Invariant Part of the Center of the Small Quantum Group

Thursday, April 28, 2022 3:30 PM (1 hour)

The Hitchin fibration has already found many beautiful applications to representation theory, such as Cherednik algebras and automorphic representations. Using the recent work of Bezrukavnikov-Boixeda Alvarez-Shan-Vasserot relating the invariant part of the center of the small quantum group to the geometry of a specific singular Hitchin fiber, we prove a conjecture of Igor Frenkel describing the dimension of the center. Furthermore, when G is of type A, we prove (conditionally on a conjecture of Carlsson-Mellit) that there is a bigraded structure on the center, coinciding with Haiman's diagonal coinvariant ring. This is joint work with Anna Lachowska and Nicolas Hemelsoet.

Presenter: KIVINEN, Oscar (EPFL)