Posters

Guilherme Almeida (SISSA)
Differential geometry of orbit space of extended affine Jacobi group A_n

We define certain extensions of Jacobi groups of A_n, prove an analogue of Chevalley theorem for their invariants, and construct a Frobenius structure on their orbit spaces.

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Marvin Anas Hahn (Frankfurt Universität)
Triply mixed coverings of arbitrary base curves: quasi-modularity, quantum curves and a mysterious topological recursion

Simple Hurwitz numbers are classical invariants in enumerative geometry counting branched morphisms between Riemann surfaces with fixed ramification data. In recent years, several modifications of this notion for genus 0 base curves have appeared in the literature. Among them are so-called monotone Hurwitz numbers, which are related to Harish–Chandra–Itzykson–Zuber integral in random matrix theory and strictly monotone Hurwitz numbers which enumerate certain Grothendieck dessins d'enfants. We generalise the notion of Hurwitz numbers to interpolations be- tween simple, monotone and strictly monotone Hurwitz numbers for arbitrary genera and any number of arbitrary but fixed ramification profiles. This yields generalisations of several results known for Hurwitz numbers. When the target surface is of genus one, we show that the generating series of these interpolated Hurwitz numbers are quasi-modular forms. In the case that all ramification is simple, we refine this result by writing this series as a sum of quasi-modular forms corresponding to tropical covers weighted by Gromov–Witten invariants. Moreover, we derive a quantum curve for monotone and Grothendieck dessins d'enfants Hurwitz numbers for arbitrary genera and one arbitrary but fixed ramification profile. Thus, we obtain spectral curves via the semiclassical limit as input data for the Chekhov–Eynard–Orantin (CEO) topological recursion. Astonishingly, we find that the CEO topological recursion for the spectral curve of the strictly monotone genus 1 Hurwitz numbers compute the monotone Hurwitz numbers in genus 0. Thus, we give a new proof that monotone Hurwitz numbers satisfy CEO topological recursion. This points to an unknown relation between those enumerants. Finally, specializing to target surface $\mathbb{P}^1$, we find recursions for monotone and Grothendieck dessins d'enfants double Hurwitz numbers, which enables the computation of the respective Hurwitz numbers for any genera with one arbitrary but fixed ramification profile.

This is based on joint work with Jan-Willem M. van Ittersum and Felix Leid.

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Severin Barmeier (MPIM)
L_∞-algebras for deformations of categories of coherent sheaves

We explain how to obtain an explicit L_∞ algebra structure on the Gerstenhaber–Schack complex controlling the deformation theory of diagrams of algebras. When the diagram of algebras is the restriction of the structure sheaf of a smooth complex algebraic variety X to an affine open cover, this controls the deformation theory of $\mathrm{Coh}(X)$ as an abelian category. Such deformations are parametrized by $HH^2(X)$ and can be seen to combine "classical" deformations of the complex structure with complex deformation quantizations.

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Alessandro Giacchetto (MPIM)
Topological recursion for Masur–Veech volumes

We show that the Masur–Veech volume for the principal stratum of the moduli space of quadratic differentials on curves of genus g with n boundary components is the constant term of a family of polynomials governed by the topological recursion. This is equivalent to a formula giving these polynomials as a sum over stable graphs, and retrieves a known result proved by combinatorial methods. Our arguments are different: they rely on the geometric recursion and its application to statistics of hyperbolic lengths of simple multicurves.

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Evgeniy Glukhov (Landau Institute for Theoretical Physics)
On algebraic geometrical approach to Ribaucour transformations

We are developing the idea of using an algebraic geometrical approach to classical differential geometry problems. This idea was presented in works of I.M. Krichever, A.E. Mironov and I.A. Taimanov. They described orthogonal curvilinear coordinate systems in terms of theta-functions of algebraic curves. It was also shown how this construction could be applied to the associativity equations and Frobenius manifolds.

In this work we present results on Ribaucour transformations of orthogonal nets. Ribaucour transformations naturally occurred in the field of discrete integrable systems. We introduce an algebraic geometrical construction to obtain any number of smooth orthogonal nets that are Ribaucour transformations of the initial orthogonal net. This construction also allows us to illustrate the permutability property. Starting with algebraic geometric data we obtain a family of orthogonal nets and prove that some pairs of them are Ribaucour pairs. We show how to get all the formulae expressed in terms of elementary functions choosing special set of algebraic geometrical data.

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Pengfei Huang (Université de Nice)
Flat λ-connections and twistor spaces

The notion of flat λ-connection as the interpolation of usual flat connection and Higgs field was suggested by Deligne, later illustrated and further studied by Simpson. In a recent joint work with Zhi Hu [1], we first collect some basic results for λ-flat bundles, and then get an estimate for the norm of λ-flat sections, which leads to some vanishing theorem. The non-abelian Hodge correspondence, mainly based on the work of Corlette, Hitchin and Simpson, which gives a correspondence between the category of (poly-)stable Higgs bundles with vanishing Chern classes and that of (semi-)simple flat bundles, these two categories are related by the existence of pluri-harmonic metrics on the two sides. Mochizuki generalizes this to parabolic λ-bundles and built the parabolic non-abelian Hodge correspondence, in particular, he shows the existence of pluri-harmonic metrics for (poly-)stable λ-flat bundles with vanishing Chern classes, where we called the Mochizuki correspondence in [1]. Mochizuki correspondence provides a homeomorphism between the moduli space of (poly-)stable λ-flat bundles and that of (poly-)stable Higgs bundles, and provides a dynamical system on the Dolbeault moduli space. We investigate such dynamical system, in particular, we discuss the corresponding first variation and asymptotic behaviour. Finally, we generalize the Deligne's twistor construction by any element of outer automorphism group of the fundamental group of Riemann surface, and apply the twistor theory to study a Lagrangian submanifold of the de Rham moduli space.

[1] Z. Hu, P. Huang, Flat λ-connections, Mochizuki correspondence and twistor spaces, arXiv:1905.10765.

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Hélder Larraguível and Dmitry Noshchenko (University of Warsaw)
Quantum curves from Nahm equations, quivers and DT-invariants

We provide a method to construct both classical and quantum curves from deformed Nahm equations, which correspond to saddle-point approximation for symmetric quivers. The associated partition function is known to generate motivic Donaldson–Thomas invariants, and conjecturally corresponds to topological strings in orbifold geometries. We also study relation with topological recursion and consistency with WKB expansion.

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Hsiao-Fan Liu (National Tsing Hua University)
Evolution of invariants of the Schrödinger flows on $\mathbb{S}^2$

We study geometric curves flows whose invariants flow according to some soliton equations. One classical example is the vortex filament equation, that is related to the nonlinear Schrödinger equation (NLS), which can be found via the Schrödinger flow on $\mathbb{S}^2$ as well. We will mainly discuss the correspondence between the Schrödinger flow on $\mathbb{S}^2$ and NLS equation. The existence of solution to the Cauchy problem of such a curve flow with periodic boundary conditions follows from the given correspondence. We then obtain geometric algorithms to solve periodic Cauchy problems numerically.

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Nikita Nikolaev (Université de Genève)
The WKB method as abelianization

We formulate the WKB method in geometric terms as a search for an invariant splitting of an extension of a vector bundle with connection, as initiated in [1]. This point of view allows us to make a direct comparison with abelianisation of connections as in [2]. Abelianisation is a functorial correspondence between vector bundles with connections and line bundles with connections over an appropriate spectral cover. We argue that the WKB method is abelianisation applied to the special case of opers. Abelianisation should therefore be seen in particular as a generalisation of the WKB method to connections which are not necessarily opers. Furthermore, our geometric point of view allows us to establish the link with the spectral correspondence of Higgs bundles: indeed, we prove that the abelianisation correspondence recovers the spectral correspondence in the limit as $\hbar \to 0$.

[1] N. Nikolaev, Abelianisation of logarithmic connections, PhD Thesis, 2018, University of Toronto.
[2] N. Nikolaev, Abelianisation of logarithmic $\mathfrak{sl}(2)$-connections, arXiv:1902.03384.

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Kento Osuga (University of Edmonton/University of Sheffield)
Super Airy structures I

Topological recursion has become known as a powerful mathematical formalism that recursive computes a variety of enumerative invariants, and it is now viewed as a special example of a more general framework, so called Airy structure. Since a Lie algebra plays a crucial role in Airy structures, a possible interesting generalization is: can we incorporate supersymmetry into Airy structures by upgrading a Lie algebra to a super Lie algebra ? In this poster, I will first give a brief review of topological recursion as well as Airy structures. Following it I will propose super Airy structures as a supersymmetric generalization of Airy structures, and discuss a promising approach towards enumerative interpretation in terms of vertex operator superalgebras.

This is a joint work in progress with V. Bouchard, P. Ciosmak, L. Hadasz, B. Ruba and P. Sulkowski.

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Blazej Ruba (Institute of Physics, Jagiellonian University)
Super Airy structures II

Airy structures were introduced in as a reformulation and generalization of the topological recursion for spectral curves. They encode data necessary to formulate certain recursive equations encountered in matrix models, enumerative geometry and several other contexts as differential equations. I will present results on the analytic structure of the associated free energy and attempts at a supersymmetric generalization.

This is a joint work with V. Bouchard, P. Ciosmak, L. Hadasz, K. Osuga and P. Sulkowski.

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Zhaoting Wei (Kent State University at Geauga)
Twisted complexes on simplicial spaces

Twisted complex is a way to formulate higher coherence conditions of locally defined chain complexes of sheaves. Recently it has been proved that twisted complexes form a dg-category, which gives the homotopy limit of cosimplicial diagrams of dg-categories. Hence twisted complexes play important roles in the descent theory of higher structures. In my poster I will present some general results on twisted complexes as well as some recent progresses. In particular I will show show the relation between two concepts:

(1) simplicial homotopies between morphisms of simplicial spaces;

(2) A_∞-equivalences between the induced dg-functors between twisted complexes.

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Campbell Wheeler (MPIM)
On the Kontsevich geometry of the combinatorial Teichmüller space

We consider the geometry of the universal cover of the moduli space of metric ribbon graphs which can be realised as the moduli space of embedded metric ribbon graphs in surfaces. These spaces are foliated by leaves isomorphic to the moduli space of curves and the Teichmüller space respectively. We therefore call this universal cover the combinatorial Teichmüller space and we construct global coordinates analogous the the Fenchel–Nielsen coordinates on the ordinary Teichmüller space. We then prove that the lift of the Kontsevich form on the moduli space of metric ribbon graphs satisfies an analogue of the Wolpert formula for the Weil–Petersson form. Then we construct an analogue of the Mirzakhani–McShane identity which along with the combinatorial Wolpert formula gives a proof of the Witten conjecture/Kontsevich theorem. Using the framework of geometric recursion we can generalise this result to prove that statistics of combinatorial length can be calculated by the geometric recursion and as a result their average over the moduli space satisfies the topological recursion. We then compare combinatorial and hyperbolic geometries and how they interact with the geometric recursion in general.