GEOMETRY & INTEGRABLE SYSTEMS

A Franco-Japanese conference

Institut de Mathématiques de Bourgogne

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Abstracts

Philip Boalch
Université Paris-Sud

TQFT approach to meromorphic connections on curves

Abstract: Just as holomorphic connections on curves have a topological classification in terms of local systems (or representations of the fundamental group), meromorphic connections (or better: algebraic connections on vector bundles on an open curve) may be classified in terms of Stokes local systems, enriching the local system by adding the wild monodromy or Stokes automorphisms. I'll review the the TQFT-type construction of moduli spaces of Stokes local systems, the wild character varieties, as algebraic symplectic manifolds. A key point is the notion of *fission* breaking the structure group at the boundary. Whilst, for generic connections such spaces appeared in work of Birkhoff from 1913 and Jimbo-Miwa-Ueno 1981 (and the symplectic geometry was worked out 20 years ago) the general case is relatively recent. The final step, involving twisted fission, is joint work with D. Yamakawa.

Guido Carlet
Université de Bourgogne

An infinite-dimensional Frobenius manifold structure
on the space of simple analytic curves in the complex plane.

Abstract: The notion of Frobenius manifold was introduced by B. Dubrovin as a geometric formulation of WDVV equations from two-dimensional topological field theory and proved important, in particular, in the study of integrable hierarchies of PDEs with one spatial dimension. In this talk we introduce a structure of infinite-dimensional Frobenius manifold on a subspace in the space of pairs of functions analytic in the inner/outer regions of the unit circle in the complex plane with simple poles at 0/infinity respectively, which is related to integrable hierarchies with two spatial variables. From a joint work with B. Dubrovin and L. Ph. Mertens.

Giovanni Felder
ETH Zürich

Representation homology and supersymmetric gauge theory

Abstract: Representation homology arises in the derived version of the space parametrizing finite dimensional representations of an associative algebra. I will discuss some examples of this notion related to quivers and its relation to supersymmetric gauge theory in 4 dimensions, with an application to the analytic properties of the Nekrasov partition functions. The talk is based on joint work with Y. Berest, M. Müller-Lennert, S. Patotski, A. Ramadoss and T. Willwacher.

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Michio Jimbo
Rikkyo University

Deforming integrals of motion via quantum toroidal algebras

Abstract: Integrals of motion in conformal field theory is a topic old enough yet not fully understood. After q-deformation their relation to quantum toroidal algebras becomes apparent, leading to description of eigenvalues by Bethe ansatz. We give a survey about these developments done jointly with B. Feigin, T. Miwa and E. Mukhin.

Oleg Lisovyy
Université de Tours

Tau functions, Fredholm determinants and combinatorics

Abstract: I will explain how to associate a tau function to the Riemann-Hilbert problem set on a union of non-intersecting smooth closed curves with generic jump matrix. The main focus will be on the one-circle case, relevant to the analysis of Painlevé VI equation. The tau functions in question will be defined as block Fredholm determinants of integral operators with integrable kernels. They can be alternatively represented as combinatorial sums over tuples of Young diagrams which coincide with the dual Nekrasov-Okounkov instanton partition functions for Riemann-Hilbert problems of isomonodromic origin.

Frank Loray
CNRS / Université Rennes 1

Neighborhoods of elliptic curves in complex surfaces

Abstract: In this talk, we consider an elliptic curve C with an embedding into a smooth complex surface S and we want to understand the structure of the germ of surface (S, C) near the image of the curve. With O. Thom and F. Touzet, we recently completed the formal classification of such germs of neighborhood. In this talk, I will mainly focus on the analytic classification, which is a work in progress with F. Touzet and S. M. Voronin.

Takuro Mochizuki
RIMS, Kyoto University

Kobayashi-Hitchin correspondences for periodic monopoles

Abstract: An interesting theme in complex differential geometry is to find a correspondence between algebraic objects and differential geometric objects. One of the most attractive is the equivalences of harmonic bundles, Higgs bundles, and flat bundles on compact Riemann surfaces, due to Donaldson, Hitchin, Corlette and Simpson.
In this talk, we shall explain variants of the correspondences in the context of monopoles with periodicity, i.e., correspondences between (doubly) periodic monopoles and (q-)difference modules.

Luis Paris
Université de Bourgogne

Artin groups, symmetries, and linear representations

Abstract: The talk is based on a join work with Olivier Geneste and Jean-Yves Hée. One of the most popular questions on braid groups has been for a long time whether these groups are linear. This question was solved in the late 90s by Bigelow and Krammer. Krammer's construction was then extended to all simply laced Artin groups of spherical type by Cohen–Wales and Digne, and, afterwards, to all simply laced Artin groups without triangles by myself. Now, we would like to extend the construction to the other Artin groups, or, at least, to some Artin groups that are not simply laced. An answer partially lies in some works by Digne and Castella that, in particular, provide such a construction for the Artin groups of type B_n, F_4, and G_2, by means of symmetries of Coxeter graphs. We will explain this story in more detail, show how Digne's ideas can be extended to other Artin groups, and what are the limits of such a construction.

Kyoji Saito
Kavli IPMU, University of Tokyo

Integrable hierarchy associated with primitive forms without higher residue structure

Abstract: We consider primtive forms without higher residue structure. Then, it induces, so called, Saito structure without metric due to Sabbah, and, then furhther, some integrable hierarchies which was studied by Dubrovin and others. We try to understand them more geometrically. Joint work with K. Aleshkin.

Masa-Hiko Saito
Kobe University

Moduli spaces of parabolic Higgs bundles and parabolic connections on curves and integrable systems

Abstract: We review on algebraic GIT constructions of moduli spaces of parabolic Higgs bundles and connections on curves and their relation to integrable systems, like Painleve equations coming from isomonodroic deformation of connections. If times allow, we also review on related subjects such as wild charcter varieties, apparent singularities and geometric Langlands conjectures.

Yoshihisa Saito
Rikkyo University

Elliptic Artin Groups

Abstract: In the study of representation theory of Lie groups and Lie algebras, the regular Weyl group orbit spaces and their fundamental groups (called Artin groups or generalized braid groups) have quite important roles.
In the middle of 80's, motivated by the study of singularity theory, Kyoji Saito introduced the notion of elliptic root systems, and study their basic properties. Especially, he introduced an "elliptic analogue" of the regular Weyl group orbit spaces, so-called the elliptic regular orbit spaces, and study their detailed structure in algebaric and differential geometrical points of view.
In this talk, we study the fundamental groups of the regular elliptic Weyl group orbit spaces. These groups are presented by a generator system associated with the elliptic Dynkin diagrams, and we call them the elliptic Artin groups. Furthermore, some basic properties of these groups will be also discussed. Especially, the elliptic regular orbit space is defined over the moduli space of elliptic curves. This fact leads us to the description of the elliptic modular group actions on elliptic Artin groups. This talk is based on a joint work with Kyoji Saito.

Peter Schauenburg
Université de Bourgogne

The prime factors of a modular category

Abstract: Given a modular subcategory $\mathcal{D}$ of a modular category $\mathcal{D}$, there is a unique complement modular subcategory, namely the commutant $\mathcal{D}'$, such that $\mathcal{C}$ factors as the Deligne product of $\mathcal{D}$ and $\mathcal{D}'$. In particular, a modular category factors as a product of "prime" factors, i.e. modular categories without proper modular subcategories. However, since Müger proved this fact, it was also known that the factorization is not unique. If the category is pointed, this is a question on the factorization of abelian groups with nondegenerate quadratic forms; defining relations of the monoid of such groups have been known since the 1980's. In the other extreme, in the "unpointed" case when the category has no invertible objects, the prime factors are unique (not only up to equivalence, but even as subcategories). We will say as much as possible on the general case: How unique and how non-unique the prime factors of a modular category are in the neither pointed nor unpointed case.

Christoph Schweigert
Department of Mathematics, Hamburg University

Bulk Fields in Conformal Field Theory

Abstract: In this talk, we present recent results on fields and on correlators for conformal field theories beyond rational conformal field theories, for chiral data that are described by non-semisimple categories. In particular, we explain a new compact formula for bulk fields that can be easily extended to disorder and defect fields.

Michel Semenov-Tian-Shansky
Université de Bourgogne

Scattering on Riemannian symmetric spaces and Huygens principle

Abstract: The strong Huygens principle for hyperbolic equations is a rather subtle property which has once been discussed by Hadamard who stated the corresponding problem. Representation theory of semisimple groups provides interesting examples related to this problem; other examples have unexpected links with integrable systems.

Yan Soibelman
Kansas State University

Quantization of symplectic surfaces and periodic monopoles

Abstract: Deformation quantization of complex symplectic manifolds gives rise (under some assumptions) to an analytic family of categories of holonomic DQ-modules. I am going to discuss the Riemann-Hilbert correspondence for this category. In the some special cases of complex symplectic surfaces the "Betti side" of the RH-correspondence is related to the categories of periodic 3-dimensional monopoles with singularities.

Szilárd Szabó
Budapest University of Technology and Rényi Institute of Mathematics, Budapest

Perversity equals weight for Painlevé systems

Abstract: An important conjecture in non-Abelian Hodge theory by de Cataldo, Hausel and Migliorini asserts that the weight filtration on the cohomology spaces of a character variety agrees with the perverse Leray filtration on the cohomology spaces of the corresponding Dolbeault moduli space. We prove an analogous result for wild character varieties and the corresponding irregular Hitchin systems associated to the Painlevé cases. The proof is based on an earlier description of the wild character varieties arising in these cases by Marius van der Put and Masa-Hiko Saito on one hand, and on our study of the geometry of irregular Hitchin systems on the other hand.

Masahito Yamazaki
Kavli IPMU, University of Tokyo

Tau-function for Lens-Elliptic Discrete Painlevé Equation

Abstract: We introduce a new "lens-elliptic" generalization of the discrete Painlevé equation associated with the $E8$ root lattice. We found special solutions to the bilinear equations for the tau-function in terms of "lens" generalization of the elliptic gamma function.