Tentative schedule

Events for:
Monday, August 30th - Friday, September 3rd

Monday, August 30th

8:45am **Introduction Remarks**

9:00am **Alexander Alexandrov**

Title: KP integrability of triple Hodge integrals

Abstract: n my talk, I will describe a relation between the Givental group of rank one and the Heisenberg-Virasoro symmetry group of the KP integrable hierarchy. It appears that only a two-parameter family of the Givental operators can be identified with elements of the Heisenberg-Virasoro symmetry group. This family describes triple Hodge integrals satisfying the Calabi-Yau condition. Using the identification of the elements of two groups it is possible to prove that the generating function of triple Hodge integrals satisfying the Calabi-Yau condition and its Θ-version are tau-functions of the KP hierarchy. This generalizes the result of Kazarian on KP integrability in the case of linear Hodge integrals. I will also describe the relation of this family of tau-functions with the deformation of the Kontsevich matrix model. My talk is based on two papers, arXiv:2009.01615 and arXiv:2009.10961

10:00am **Michael Gekhtman**

Title: GENERALIZED CLUSTER STRUCTURES AND PERIODIC DIFFERENCE OPERATORS

Abstract: I will present a construction that ties together of several diverse notions including spaces of periodic difference operators, Poisson sub manifolds of a Drinfeld double of GL(n) and subsets of Grassmannians stable under the action of powers of a cyclic shift. The theory of generalized cluster algebras serves as a unifying theme. Time permitting, I will discuss potential applica- tions to representation theory of quantum affine algebras at roots of unity.Based on a joint work with M. Shapiro and A. Vainshtein and an ongoing project with C. Fraser and K. Trampel.

11:00am **Mattia Cafasso**

Title: On a class of KdV tau functions related to integrable probability

Abstract: During my talk, I will discuss some of the analytical properties of a large class of KdV tau functions related to the Airy point process and, more generally, to integrable probability.

1:00pm **P. Di Francesco**

Title: Triangular Ice: Combinatorics and Limit Shapes

Abstract: We consider the triangular lattice version of the two-dimensional ice modelwith suitable boundary conditions, leading to an integrable 20 Vertex model.Configurations give rise to generalizations of Alternating Sign Matrices, which we call Alternating Phase Matrices (APM). After reviewing a few facts on the square lattice version and the role of integrability, we compute the number of APM of any given size in the form of a determinant, which turns out to match the number of quarter-turn symmetric domino tilings of a quasi-Aztec square with a central cross-shaped hole. We also present results/conjectures for triangular Ice with other types of boundary conditions, and results on the limit shape of large APM, obtained by applying the so-called ``Tangent Method". (joint works with E. Guitter (IPhT Saclay) and B Debin (U Louvain))

2:00pm **Nicolai Reshetikhin**

Title: Limit shapes in large tensor products

Abstract: of the typical questions in asymptotic representation theory are concerned with the statistics of irreducible components of "large" representations of "large" groups, or algebras. An example of this is: what is the asymptotic probability distribution of irreducible components of large tensor products of a Lie group G with respect to the Plancherel measure. In this talk we will focus on statistics of irreducible components for groups and quantum groups at roots of unity and on combinatorial models for corresponding multiplicities.

Tuesday, August 31st

9:00am **John Harnad**

Title: ear expansions of lattices of KP Tau-function in BKP Tau-functions: a fermionic approach

Abstract: otion of Kadomtsev-Petviashvili (KP) and BKP τ functions will
be recalled, together with their representations as fermionic expectation values.
Schur-type lattices of such KP and BKP τ-functions will be defined, corresponding to
a given infinite general linear or orthogonal group element, labelled by partitions
and strict partitions respectively. A bilinear expansion expressing elements of these lattices of KP
τ-functions as sums over products of pairs of elements of associated lattices of BKP τ-
functions will be presented, generalizing earlier results relating determinants and Pfaffians of
minors of skew symmetric matrices, with applications to Schur functions and Schur Q-functions.
Further applications include inhomogeneous polynomial τ-functions of KP and BKP type, with
their determinantal and Pfaffian representations.

10:00am **Sergey Shadrin**

Title: Spectral curves for KP tau functions of hypergeometric type.

Abstract: KP tau functions of hypergeometric type (also known as Orlov--Scherbin tau functions) are very simple objects which, however, cover enormous amount of enumerative geometric and combinatorial problems (Gromov-Witten invariants, various Hurwitz numbers, topological vertex, colored HOMFLY-PT polynomials, enumeration of (hyper)maps and constellations, etc.)I want to present a closed algebraic formula for the corresponding n-point functions that conceptually explains how the spectral curve formula of Alexandrov--Chapuy--Eynard--Harnad naturally emerges and why it universally covers all cases studied in the literature.This formula appears to be a very powerful tool for the further analysis of KP tau functions of hypergeometric type, and it leads through the theory of topological recursion to remarkable applications resolving a number of open conjectures in algebraic geometry and integrable systems.The talk will be partly based on a joint work with Bychkov, Dunin-Barkowski, and Kazarian, and Carlet, van de Leur, and Posthuma.

11:00am **Johan van de Leur**

Title: Reductions of KP type hierarchies, related to conjugacy classes of the Weyl group of classical Lie algebras

Abstract: Victor Kac and Dale Peterson showed in 1985 that one can associate to each conjugacy class of the Weyl group of the Lie algebras of type A, D and E a vertex-operator construction of the basic module of the corresponding affine Lie algebra. This gives, for instance, 112 different realizations for the Lie algebra of type E_8.It is also well-known that a hierarchy of differential equations describes the loop group orbit of the highest weight vector. For the Lie algebra of type A_1, there are two conjugacy classes. One is related to the KdV hierarchy and the other to the AKNS hierarchy.We will show that each conjugacy class of the Weyl group leads to a (different) hierarchy of differential equations. We achieve this as follows:We embed all loop algebras of a classical Lie algebra in an infinite matrix algebra of a certain type. Using some representation theory of these matrix algebras, we can describe the corresponding group orbit of the highest weight vector, which are parametrized by a fermionic (bosonic for type C) version of the KP hierarchy of type A, B, C or D. The restriction to the loop algebra/group gives a reduction of this hierarchy. And finally, each conjugacy class of the Weyl group gives a vertex-operator realization of the module and as such a different hierarchy of differential equations for each conjugacy class. This is based on joint work with Victor Kac.

1:00pm **Leonid Chekhov**

Title: Planar directed networks and quantum loop equations

Abstract: I show how, under mild restrictions, we can construct solutions to quantum loop equations out of a directed planar network. All definitions will be given. Variables of faces of the network then ensure a log-canonical (Darboux) coordinate parameterization of the corresponding finite-dimensional Poisson leaf of the quantum loop algebra. Many open questions will be discussed.Based on arXiv:2012.10982 and on my joint paper with Misha Shapiro arXiv:2003.07499

2:00pm **Rinat Kedem**

Title: Duality in Macdonald theory and the q-Whittaker limit of spherical DAHAs

Abstract: We use a duality property of the spherical DAHA and the eigenfunctions of Macdonald polynomials to compute the relations satisfied by certain τ_+-translated Macdonald and Koornwinder operators in the q-Whittaker limit. We find the subset of operators which satisfy the recursion relation known as the quantum Q-systems for root systems whose finite Weyl groups are of classical types, by making use of this duality. [Joint with P. Di Francesco]

Wednesday, September 1st

9:00am **Simonetta Abenda**

Title: Kasteleyn theorem, geometric signatures and KP-II divisors on planar bipartite networks in the disk

Abstract: Abstract : Maximal minors of Kasteleyn sign matrices on planar bipartite graphs in the disk count dimer configurations with prescribed boundary conditions, and the weighted version of such matrices provides a natural parametrization of the totally non--negative part of real Grassmannians. In this talk I will show that this variant of Kasteleyn theorem is equivalent to the geometric construction in Abenda-Grinevich (arXiv:1908.07437). I will then use Kasteleyn system of relations to solve the spectral problem for the family of KP multi-soliton solutions. Indeed the KP wave function solves such system at the nodes of the spectral curve if the dual graph of the latter represents the soliton data. The talk is mainly based on the results in arXiv:2012.13797 and this research is part of a project in collaboration with P.G. Grinevich (Steklov Institute, Moscow).

10:00am **Tamara Grava**

Title: Correlation functions for unitary invariant ensembles and Hurwitz numbers.

Abstract: We provide effective formulae for generating functions of multipoint correlators for unitary invariants ensembles.As an application we show that the multipoint correlators of the Laguerre and the Jacobi ensembles are obtained in terms of Hahn polynomials and Wilson polynomials generalising earlier formula for one-point correlators. Finally we provide an enumerative interpretation of the topological expansion of these multipoint correlators. This is a joint work with M. Gisonni and G. Ruzza.

11:00am **Marta Mazzocco**

Title: Isomonodromic deformations: Confluence, Reduction and Quan- tization

Abstract: In this talk I will discuss the isomonodromic deformations of systems of differential equations with poles of any order on the Riemann sphere as Hamiltonian flows on the product of co-adjoint orbits of the Takiff algebra (i.e. truncated current algebra). This is based on work in collaboration with Ilia Gaiur and Volodya Rubtsov. Our motivation is to produce confluent versions of the celebrated Knizhnik–Zamolodchikov equations and explain how their quasiclassical solution can be expressed via the isomonodromic ?-function.

In order to achieve this, we study the confluence cascade of r + 1 simple poles to give rise to a singularity of arbitrary Poincar\’e rank r as a Poisson morphism and explicitly compute the isomon-odromic Hamiltonians.

1:00pm **Richard Kenyon**

Title: Multinomial models

Abstract: We define "multinomial" counterparts of classical stat mech models like the dimer model, Potts model, and random tiling models.These multinomial versions are computationally tractable, and we can computephase transitions, correlations, and scaling limits.

2:00pm **Philip Boalch**

Title: Diagrams, nonabelian Hodge spaces and global Lie theory

Abstract: The class of moduli spaces appearing in nonabelian Hodge theory has been significantly enriched over the past 20 years or so, by considering solutions of the 2d self-duality equations with more involved behaviour at the boundary. In brief one can relax Simpson's tameness condition, and this leads to stable meromorphic connections/Higgs fields with arbitrary order poles (on parabolic vector bundles). Much of this was motivated by examples occurring in Seiberg-Witten theory, and in the classical integrable systems literature. For example the topological Atiyah-Bott/Goldman symplectic structures were extended to this context by the speaker (Adv. Math 2001), the Corlette/Donaldson correspondence with complex connections was extended by Sabbah (Ann. Inst. Fourier 1999), and the construction of the hyperkahler moduli spaces plus the extension of the Hitchin/Simpson correspondence with Higgs bundles was carried out by Biquard and the author (Compositio 2004). Some more recent work has extended the TQFT (quasi-Hamiltonian) approach to these holomorphic symplectic varieties from the generic case to the general case, and clarified the extra deformation parameters that occur, leading to the notion of ``wild Riemann surface". In this talk I'll review some of the simplest examples of complex dimension two, and their link to affine Dynkin diagrams (leading to the notion of ``global Weyl group"). Then I'll explain a way to extend this link by attaching a diagram to {\em any} nonabelian Hodge space on the affine line. This is an attempt to organise the vast bestiary of examples of complete hyperkahler manifolds that occur. A key idea is that all the nonabelian Hodge spaces have concrete descriptions as moduli spaces of Stokes local systems (the wild character varieties), generalising the well-known explicit presentations of the (tame) character varieties, coming from a presentation of the fundamental group. This is joint work with D. Yamakawa (Compte Rendus Math. 2020).

Thursday, September 2nd

9:00am **Smirnov Fedor**

Title: On the fermonic basis and its classical meaning for integrable models.

Abstract: In this talk I shall introduce basis objects which occur in the study

of correlation functions for the six-vertex model and its generalisations.
I shall emphasise the relation to the deformation of the algebra-geometric
structures, and discuss the classical limit.

10:00am **Michael Shapiro**

Title: Noncommutative cluster integrability (joint w/ N.Ovenhouse and S.Arthamonov)

Abstract: We define a discrete dynamical system (non commutative pentagram map) and prove its noncommutative integrability.To prove integrability we define non commutative double quasi Poisson bracket on the space of non commutative arc weights of a directed graph on a cylinder which gives rise to the quasi Poisson bracket of Massuyeau and Turaev on the group algebra of the fundamental group of a surface. We show that the induced double quasi Poisson bracket on the boundary measurements can be described via non-commutative r-matrix formalism which gives a conceptual proof of the result by N.Ovenhouse that the traces of powers of Lax matrix form an infinity system of Hamiltonians in involution.

11:00am **Nikita Nekrasov**

Title: Beyond tau-functions, or how to tame anyons out of free fermions, with a little bit of blowups and confinement

Abstract: TBD

1:00pm **Ken McLaughlin**

Title: A soliton interacting with a regular gas of solitons

Abstract: We study the dynamics of a single (tracer) soliton as it interacts with a continuum limit of solitons. Detailed asymptotics of the soliton's position will be enjoyed. Joint work with Tamara Grava, Robert Jenkins, and Alexander Minakov.

2:00pm **Oleg Lisovyi**

Title: Logarithmic Painlevé functions and Mathieu stability chart

Abstract: The tau function of Painlevé III_3 equation (parameterless PIII) corresponding to generic monodromy data is known to coincide with the dual Nekrasov-Okounkov partition function and admits explicit combinatorial series representation. I will explain how to derive an analog of this representation for the one-parameter family of non-generic solutions of Painlevé III_3 characterized by the logarithmic asymptotics. I will also discuss a connection between such logarithmic tau functions and the characteristic values of Mathieu equation describing the band structure of the Schroedinger operator with a cosine potential

Friday, September 3rd

9:00am **Di Yang**

Title: On tau-functions for the KdV hierarchy

Abstract: For an arbitrary solution to the KdV hierarchy, we derive a formula for

the generating series of logarithmic derivatives of the tau-function of the solution explicitly in terms of matrix resolvents. Then, using the wave functions, we give two other formulae for the generating series. Applications to the Witten--Kontsevich tau-function, to the generalized BGW tau-function, as well as to a modular deformation of the generalized BGW tau-function are given. The talk is based on a series of joint works with Marco Bertola, Boris Dubrovin and Don Zagier.

10:00am **Vladimir Roubtsov**

Title: Quantization of Monodromy data for confluent Painleve? systems, Calabi-Yau 3-algebras and degenerated non-commutative del Pezzo surfaces.

Abstract: I shall review relations between the subjects of my title based on my recent work with L. Chekhov and M. Mazzocco

(Adv. Math. vol. 376, 2021)

11:00am **Gaetan Borot**

Title: Topological recursion/intersection numbers correspondences

Abstract: The correlation functions of topological recursion can be quite generally expressed in terms of intersection numbers on the moduli space of curves. Such representations come from the knowledge of basic case and the compatibility between smooth deformations of spectral curves and topological recursion. In this overview talk, I will present several of these techniques at work in enumerative geometry, in particular in Hurwitz theory