

Workshop Schedule

Events for:

Monday, September 26th - Friday, September 30th

Monday, September 26th

9:30am **Gurbir Dhillon - SCGP 102**

Speaker: Gurbir Dhillon

Title: On the log Kazhdan--Lusztig correspondence

Abstract: An influential conjecture of Feigin--Gainutdinov--Semikhatov--Tipunin from the mid 2000s relates representations of small quantum groups and triplet vertex algebras at positive integer values of the Kac--Moody level. We will formulate an extension of the conjecture to all rational Kac--Moody levels and will describe a way to prove it conditional on some (in-reach) conjectures in the quantum geometric Langlands program.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Nadav Drukker - SCGP 102**

Speaker: Nadav Drukker

Title: Global symmetry breaking and defect conformal manifolds

Abstract: In the presence of exactly marginal operators, one can deform a conformal field theory to other such theories, forming a space of theories living on what's known as the conformal manifold. In a theory with conformal defects, one may be able to retain the bulk theory but transform the defect along what I'll call the "defect conformal manifold". This requires the existence of exactly marginal defect operators. A simple setting where this happens is in the presence of a global symmetry broken by the defect. The broken symmetry current gives rise to an exactly marginal defect operator and a defect conformal manifold which is the symmetry breaking coset. This simple observation lets us derive an exact identity for integrated 4-point functions of the marginal defect operator which is highly nontrivial. We implement this in several models where the 4-point functions have been previously calculated.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Mikhail Khovanov - SCGP 102**

Speaker: Mikhail Khovanov

Title: Foam evaluation and its uses in categorification and representation theory

Abstract: I'll explain the foam evaluation formula due to Louis-Hadrien Robert and Emmanuel Wagner and show how it's used to construct state spaces of planar graphs. These state spaces categorify networks of intertwiners between exterior powers of representations of quantum $\mathfrak{sl}(N)$ and used to build link homology theories. The limiting case of this theory can be used to recover the category of Soergel bimodules, via disk-like foams in 3-space.

2:30pm **Nikita Nekrasov - SCGP 102**

Speaker: Nikita Nekrasov

Title: One flew over the QQ-nest

Abstract: I will discuss the recent progress in Omega-deformed $N=2$ $d=4$ supersymmetric quiver theories of A-type with A-type gauge group, in the presence of various arrangements of surface defects. According to the BPS/CFT dictionary their expectation values are given by the conformal blocks of some (analytically continued) CFT, and, at the same time, by the matrix elements of quantum XXX spin chains. Using the qq-characters I derive (as opposed to postulate) the $Q\{\tilde{Q}\}$ -system and the Lax operators, filling some gaps in the 30 year cycle of ideas connecting supersymmetry and integrability. Based on the ongoing works in progress with S.Jeong and N.Lee, with A.Grekov, and with I.Krichever.

3:30pm **Tea - SCGP Cafe**

Tuesday, September 27th

9:30am **Elli Pomoni - SCGP 102**

Speaker: Elli Pomoni

Title: Spin chains for 4D $N=2$ SCFTs

Abstract: We will give an overview of the recent developments in the spin chains encoding the spectral problem of four-dimensional $N=2$ superconformal gauge theories.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Azat Gainutdinov - SCGP 102**

Speaker: Azat Gainutdinov

Title: New $U_q \mathfrak{sl}(2)$ -invariant boundary conditions for the XXZ spin chain

Abstract: I am going to talk about new XXZ integrable models based on products with Verma modules for $U_q \mathfrak{sl}(2)$ and the corresponding Schur-Weyl duality. The relevant K-matrices are constructed via $U_q \mathfrak{sl}(2)$ -intertwining operators and one can use the standard Bethe ansatz techniques to solve the model. On the algebraic side, the centraliser of $U_q \mathfrak{sl}(2)$ is given by representations of the universal two-boundary Temperley-Lieb algebra. Using representation theoretic results we relate these spin-chains to the non-diagonal XXZ models where the standard Bethe ansatz can not be applied. This is a joint work with D. Chernyak and H. Saleur.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Evgeny Mukhin - SCGP 102**

Speaker: Evgeny Mukhin

Title: Integrable systems related to quantum toroidal algebras.

Abstract: We give an introduction to the quantum toroidal algebras and their representation theory. Then we study a family of remarkable commutative subalgebras given explicitly by multiple integrals with elliptic kernels. We discuss the spectrum of these subalgebras in various modules and relations to more familiar integrable systems. Our main examples are quantum toroidal algebras associated to $\mathfrak{gl}(n)$ and quantum comodule algebras \mathcal{K}_n with emphasis on the case of $n=1$.

2:30pm **Yan Soibelman - Zoom**

Speaker: Yan Soibelman

Title: Exponential integrals, wall-crossing structures and Chern-Simons theory.

Abstract: I am going to discuss exponential integrals in finite and infinite dimensions from the point of view of Holomorphic Floer Theory. The underlying algebraic structure known as wall-crossing structure controls analytic/resurgent properties of the arising perturbative expansions. If time permits I am going to illustrate some of these ideas in the example of Chern-Simons theory. This is a joint project with Maxim Kontsevich.

3:30pm **Tea - Math 4-125**

4:00pm **Nathan Haouzi - SCGP 102**

Speaker: Nathan Haouzi

Title: Developing the quantum q-Langlands program

Abstract: In its simplest incarnation, the geometric Langlands program was defined by Beilinson and Drinfeld in the 90's as relating, on one side, a flat connection on a Riemann surface, and on the other side, a more sophisticated structure known as a D-module. Since its inception, this conjectured correspondence has been a highly active and fruitful topic of research both for mathematicians and theoretical physicists. In this talk, we will review a generalization of the correspondence known as the quantum q-Langlands program, due to Aganagic-Frenkel-Okounkov, which establishes an isomorphism between q-deformed versions of conformal blocks, for a W-algebra on one side, and a Langlands dual affine Lie algebra on the other side. Next, we will elucidate the meaning of ramification in this program, or adding punctures with data on the Riemann surface. We will present various applications: the construction of the primary vertex operators of deformed W-algebras, and the physics of handsaw quiver gauge theories in three dimensions with N=2 supersymmetry. Finally, we will comment on the conformal limit; for instance, when the Lie algebra is specialized to be $sl(2)$, one obtains a new (dual) perspective on recent results of Nekrasov and Tsybaliuk.

Wednesday, September 28th

9:30am **Alexander Braverman - SCGP 102**

Speaker: Alexander Braverman

Title: S-duality for boundary conditions coming from Lie super-algebras.

Abstract: In the physics language we explain (mostly conjectural) statements providing explicit description of S-duals of certain super-symmetric boundary conditions in 4d gauge theory, which are associated to simple (or almost simple) Lie super-algebras with an invariant bilinear form (such as for example $gl(M|N)$). Mathematically this leads to a geometric realizations of categories of representations of the corresponding quantum super-groups. Based on joint works with Finkelberg, Ginzburg and Travkin and conjectures of D.Gaiotto.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Gus Schrader - Zoom**

Speaker: Gus Schrader

Title: The chromatic Lagrangian and its quantization

Abstract: The chromatic Lagrangian is a Lagrangian subvariety inside a symplectic leaf of the cluster Poisson moduli space of Borel-decorated $PGL(2)$ local systems on a punctured surface. I will describe the cluster quantization of the chromatic Lagrangian, and explain how it canonically determines wavefunctions associated to a certain class of Lagrangian 3-manifolds L in Kahler \mathbb{C}^3 , equipped with some additional framing data. These wavefunctions are formal power series, which we conjecture encode the all-genus open Gromov-Witten invariants of L . Based on joint work with Linhui Shen and Eric Zaslow.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Mykola Dedushenko - SCGP 102**

Speaker: Mykola Dedushenko

Title: Gauge-theoretic realization of a geometric approach to quantum integrability

Abstract: I will discuss recent progress in understanding the physics setting, in which one recovers the geometric constructions of stable envelopes and chamber R-matrices that constitute a geometric approach to quantum integrability. Based on past and future works with N. Nekrasov.

2:30pm **Ivan Cherednik - Zoom**

Speaker: Ivan Cherednik

Title: Motivic superpolynomials and LGSM for singularities

Abstract: We will begin with LGSM with superpotentials $W(x,y)$ associated with plane curve singularities. The new vintage is when their compactified Jacobians and Bun (torsion free sheaves) are considered. The corresponding motivic superpolynomials will be defined, presumably coinciding with colored Khovanov-Rozansky polynomials for algebraic links and DAHA superpolynomials. The latter are connected with QKZ, Kac-Moody algebras etc. So they are linked to SCFT: superpotentials are not needed for them. The functional equation for motivic superpolynomials and the corresponding Riemann Hypothesis will be discussed at the end. If time permits, I will state the Lee-Yang circle theorem (Ising models), which clarifies what RH of this kind can be physically.

3:30pm **Tea - Math 4-125**

4:00pm **Daniel Sage - SCGP 102**

Speaker: Daniel Sage

Title: Meromorphic connections on the projective line with specified local behavior

Abstract: A fundamental problem in the theory of meromorphic connections on P^1 is to understand the space of such systems with given local behavior. Here, the local behavior of a connection at a singular point means the "formal type" there--the isomorphism class of the induced formal connection. Given a collection of singular points and corresponding formal types, there are several natural questions one might ask: 1) Does there exist a connection with these formal types? 2) If such a connection exists, is it unique up to isomorphism? 3) Can one construct an explicit moduli space of such connections? Classically, these questions were studied under the assumption that all singularities are regular singular (i.e. simple poles). For example, in 2003, Crawley-Boevey solved the Deligne-Simpson problem for Fuchsian connections (a variant of question 1) by reinterpreting the problem in terms of quiver varieties. Later, mathematicians including Boalch, Hiroe, and Yamakawa investigated these questions when "unramified" irregular singularities are allowed. (Unramified means that the formal types can be expressed in upper triangular form without introducing roots of the local parameter.) In recent years, there has been increasing interest in meromorphic connections (and G -connections where G is a reductive group) with ramified singularities due to developments in the geometric Langlands program. In this talk, I will give an overview of recent progress on the ramified version of these problems due to myself and various collaborators.

Thursday, September 29th

9:30am **Oleksandr Tsybaliuk - Zoom**

Speaker: Oleksandr Tsybaliuk

Title: BGG-type relations for transfer matrices of rational spin chains and the shifted Yangians

Abstract: In this talk, I will discuss: (1) the new BGG-type resolutions of finite dimensional representations of simple Lie algebras that lead to BGG-relations expressing finite-dimensional transfer matrices via infinite-dimensional ones, (2) the factorization of infinite-dimensional ones into the product of two Q -operators, (3) the construction of a large family of rational Lax matrices from antidominantly shifted Yangians. This talk is based on the joint works with R.Frassek, I. Karpov, and V.Pestun.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Leonid Rybnikov - SCGP 102**

Speaker: Leonid Rybnikov

Title: Bethe subalgebras and Kirillov-Reshetikhin crystals

Abstract: Bethe subalgebras form a family of maximal commutative subalgebras of the Yangian of a simple Lie algebra, parametrized by regular elements of the corresponding adjoint Lie group. We introduce an affine (Kirillov-Reshetikhin) crystal structure on the set of eigenlines for a Bethe subalgebra in a representation of the Yangian (under certain conditions on the representation, satisfied by all tensor products of fundamental representations in types A and C). This helps to describe the monodromy of solutions of Bethe ansatz for the corresponding XXX Heisenberg magnet chain. This is a joint project with Inna Mashanova-Golikova and Vasily Krylov.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Vasily Krylov - SCGP 102**

Speaker: Vasily Krylov

Title: Equivariant Hikita-Nakajima conjecture for ADHM spaces

Abstract: Equivariant Hikita-Nakajima conjecture is a general conjecture about the relation between the geometry of symplectically dual varieties. We will consider the example of the Hilbert scheme of points on the affine plane and discuss the proof of the conjecture in this particular case. We will also discuss the generalization of this proof to the case of ADHM spaces (moduli spaces of certain instantons on \mathbb{R}^4). Time permitting, we will talk about the possible approach towards the proof of Hikita-Nakajima conjecture for other symplectically dual pairs (such as Higgs and Coulomb branches of quiver gauge theories). The talk is based on the joint work with Pavel Shlykov arXiv:2202.09934.

2:30pm **Andrey Smirnov - SCGP 102**

Speaker: Andrey Smirnov

Title: Stable envelopes and local systems

Abstract: discuss a new type of combinatorial formulas for K-theoretic stable envelopes arising from local systems on a cylinder. I also discuss a possible connection with Fukaya categories, leading to the categorification of stable envelopes. The talk is based on the joint work in progress with Ivan Danilenko.

3:30pm **Tea - SCGP Common Room 515**

Friday, September 30th

9:30am **Michael Shapiro - SCGP 102**

Speaker: Michael Shapiro

Title: Symplectic groupoid and log-canonical parameters for closed genus 2 surfaces.

Abstract: We consider the problem of finding the object of symplectic groupoid for a fixed groupoid morphism. The problem is completely solved in terms of Fock-Goncharov parametrization of the morphism. This construction leads to discovery of log-canonical parameters for Goldman Poisson bracket on the algebra of geodesic functions on Teichmüller space of closed genus 2 surfaces. This is a joint work with L.Chekhov.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Aleksei Ilin - Zoom**

Speaker: Aleksei Ilin

Title: Simplicity of spectra for Bethe subalgebras

Abstract: In this talk we will discuss the problem of simplicity of spectra of (inhomogeneous, trigonometric and XXX) Bethe subalgebras in finite-dimensional representations. We will see how one can use limit Bethe subalgebras and their parameter space in order to get some results in this direction.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Valerio Toledano Laredo - Zoom**

Speaker: Valerio Toledano Laredo

Title: Stokes phenomena, Poisson-Lie groups and quantum groups

Abstract: Let G be a complex reductive group, G^* its dual Poisson-Lie group, and \mathfrak{g} the Lie algebra of G . G -valued Stokes phenomena were exploited by P. Boalch to linearise the Poisson structure on G^* . I will explain how $U_{\mathfrak{g}}$ -valued Stokes phenomena can be used to give a purely transcendental construction of the quantum group $U_{\mathfrak{g}}$, in a way related to, but different from Kazhdan and Lusztig's. I will also show that the semiclassical limit of this construction recovers Boalch's. The latter result is joint work with Xiaomeng Xu, and based on <https://arxiv.org/abs/2202.10298>

2:30pm **Dymtro Volin - SCGP 102**

Speaker: Dymtro Volin

Title: Fused geometry of Bethe Algebra

Abstract: Maximal commutative algebra of conserved charges (Bethe Algebra) admits the action of a group G related by Langlands duality to the symmetry group of the underlying integrable model. Typical approaches using nested Bethe equations, QQ-systems, and conventional computations of q -characters disguise this feature, but it is possible to extend the collection of Baxter Q -functions and offer an alternative description where the covariance under G -action is manifest. This covariant approach allows us to describe Bethe Algebra in a purely geometric way using the concept of the fused flag, to offer compact expressions for transfer matrices (q characters) in any KR representations, and to explicitly compute the spectrum of integrable models in a more efficient way than is done by nested Bethe equations. Moreover, this perspective allows us to design a new method of monodromy bootstrap to build quantum spectral curves of the AdS/CFT type systematically.

3:30pm **Tea - SCGP Cafe**

4:00pm **Alexei Oblomkov - SCGP 102**

Speaker: Alexei Oblomkov

Title: EGL formula for PT theory of local curves.

Abstract: I will present a formula that expresses fully-equivariant PT invariants with descendants of $\mathbb{P}^1 \times \mathbb{C}^2$ as a contour integral of some natural hypergeometric function. A relative version of the formula for the relative invariants implies rationality of the PT generating function for PT invariants with descendants. I plan to discuss other applications of the formula.