Quantum Groups and Cluster Algebras
ABSTRACTS

December 5, 2025

1. Karin Baur (Ruhr-Universität Bochum)

   Comparing additive and monoidal categorifications of Grassmannians

   Both additive and monoidal categorifications for cluster algebras are studied intensively. We study how these two are linked and how this relates to the reachability conjectures. On the monoidal side, we consider the approach of Hernandez and Leclerc to work with subcategories of the category of finite dimensional modules for a quantum affine algebra of type A. On the additive side, we consider the Grassmannian cluster categories introduced by Jensen-King-Su. This has applications in the representation theory of infinite dimensional algebras, e.g. a construction of non-rigid modules.

2. Nicola Bellumat (ICMS - Sofia)

   The local-to-global principle via topology of the Balmer-Favi support

   Tensor triangulated categories are fundamental objects in homotopy theory, since they allow us to encapsulate disparate mathematical settings in a coherent framework regulated by simple axioms. The work of Balmer started the branch of mathematics known as tensor triangular geometry, relating the categorical structure of a tensor triangulated category to the properties of its Balmer spectrum. Recently, Barthel, Heard and Sanders developed a theory of stratification via the Balmer-Favi support, classifying the localizing tensor ideals of a tensor triangulated category by means of a new notion of support extending to the whole category the pre-existing Balmer support defined only for compact objects.

   The stratification of a tensor triangulated category is equivalent to two properties: the minimality of particular localizing tensor ideals and the local-to-global principle. In this talk, we will focus on the latter. Adapting a result of Benson, Iyengar and Krause, it has been shown that if the Balmer spectrum is noetherian space then the local-to-global principle holds. But what if this condition is satisfied by the support of a single object, without imposing any condition on the whole Balmer spectrum? We will show that this still implies the claim of the local-to-global principle for that particular object and deduce some interesting consequences.

3. Alessandro Contu (Kyoto University)

   A quantum cluster algebra structure on the semi-derived Hall algebra

   In 2011, Hernandez–Leclerc discovered a surprising isomorphism between the quantum Grothendieck ring of a quantum loop algebra of ADE type and the derived Hall algebra of any Dynkin quiver of the same type. Thanks to this isomorphism, we can endow the derived Hall algebra with a quantum cluster algebra structure, by transporting the quantum cluster algebra structure on the quantum Grothendieck ring described by Fujita–Hernandez–Oh–Oya in 2023. On the other hand, generalizing Bridgeland's work, in 2014, Gorsky defined the semi-derived Hall algebra and showed that the derived Hall algebra can be obtained as a specialization. Building on the combination of these results, we provide the semi-derived Hall algebra with a quantum cluster algebra structure. In particular, we propose a lift of the (q, t)-characters to the semi-derived Hall algebra, showing that they satisfy a lifted version of the quantum T-system. Finally, we define a braid group action on the semi-derived Hall algebra, lifting Kashiwara–Kim–Oh–Park's braid group action on the quantum Grothendieck ring.

4. İlke Çanakçı (Vrije Universiteit Amsterdam)

   Infinite superfriezes

   In the classical setting, the Conway–Coxeter friezes associated with triangulated polygons extend to periodic infinite friezes on the annulus, as shown by Baur, Parsons, and Tschabold. Supersymmetric analogues in the finite case were introduced by Morier-Genoud, Ovsienko, and Tabachnikov, and were later related to Penner–Zeitlin's decorated super-Teichmüller theory by Musiker, Ovenhouse, and Zhang; in this setting, they arise from oriented triangulations of the disc. Building on the latter construction, I will report on an ongoing project in which we extend superfriezes to the infinite setting.

5. Ben Davison (University of Edinburg)

   Stable envelopes and critical cohomology

   I will talk about recent work with Tommaso Botta in which we identify the Lie algebras g_{MO} generating Maulik-Okounkov Yangians with BPS Lie algebras generating certain cohomological Hall algebras. This identification completed a proof of Okounkov's conjecture, identifying the dimensions of the graded pieces of g_{MO} with Kac polynomials. The main idea of the proof is a relation between BPS cohomology and the nonabelian stable envelopes of Aganagic-Okounkov.

   In this talk I will give a survey of some of these objects, and then focus on a generalisation of stable envelopes to vanishing cycle cohomology that falls out from this relation between BPS cohomology and nonabelian stable envelopes.

6. Ivan Dimitrov (Queen's University)

   Inversion sets of roots

   For an element w of a Weyl group W, its inversion set is the set of all positive roots that w sends to negative roots. Inversion sets of roots play an important role in Lie theory, Geometric Invariant theory, etc. Despite the very simple definition, inversion sets are very difficult to study. In this talk I will present an approach to inversion sets based on an induction procedure in the context of quotient root systems. Our methods provide elegant solutions to several problems that have either been open for a while or have had very long solutions (often based on extensive use of computer algebra).

7. Pavel Etingof (MIT)

   On Lagrangianity of p-supports of holonomic D-modules and q-D-modules

   M. Kontsevich conjectured and T. Bitoun proved that if M is a nonzero holonomic D-module then the p-support of a generic reduction of M to characteristic $p > 0$ is Lagrangian. We provide a new elementary proof of this theorem and also generalize it to q-D-modules. The proofs are based on Bernstein's theorem that any holonomic D-module can be transformed by an element of the symplectic group into a vector bundle with a flat connection, and a q-analog of this theorem. We also discuss potential applications to quantizations of symplectic singularities and to quantum cluster algebras.

8. Tatiana Gateva-Ivanova (American University in Bulgaria & IMI-BAS)

   Quadratic algebras and Braided Sets

   We study the Yang-Baxter $\mathbf{k}$-algebras $A = A(\mathbf{k}, X, r)$ associated to finite set-theoretic solutions (X, r) of the braid relations, where $\mathbf{k}$ is a field. These 'Yang-Baxter algebras' are braided-symmetric and behave like 'quantum affine spaces' particularly in cases when r is involutive ($r^2 = 1$), but have very different properties in the non-involutive case when r is idempotent ($r^2 = r$). We prove that if (X, r) is a finite nondegenerate involutive solution then the Yang-Baxter algebra A is PBW if and only if (X, r) is *square-free*. In contrast, we prove that if (X, r) is left-nondegenerate and idempotent then the YB-algebra A is always PBW.

   It is interesting to notice that all algebras $A(\mathbf{k}, X, r)$ in this case share the same normal $\mathbf{k}$-basis and the same Hibert series $H_A(t) = (1 + (n-1)t)/(1-t)$, where $|X| = n$. Following a recent trend to develop noncommutative algebraic geometry on various quantum spaces we study the properties of various types of Yang-Baxter algebras via Veronese subalgebras and Segre products and Veronese and Segre morphisms (first steps in noncommutative algebraic geometry on these spaces). We show that for (X, r) left-nondegenerate idempotent, the d-Veronese subalgebra $A(\mathbf{k}, X, r)^{(d)}$ is itself a YB- algebra, which can be identified with $A(\mathbf{k}, X, r^{(d)})$, where $(X, r^{(d)})$ are all left-nondegenerate idempotent solutions. We determine the Segre product in the case of nondegenerate involutive solutions (X, r), and in the left-nondegenerate idempotent setting.

9. Iain Gordon (University of Edinburg)

   Gaudin algebras, RSK and Calogero–Moser cells in type A

   (Joint with A.Brochier and N.White.) A few years ago, Bonnafé-Rouquier defined 'Calogero-Moser cells' through the representation theory of rational Cherednik algebras. These cells partition the elements of a complex reflection group, G, but are currently difficult to calculate except in small rank examples. In the special case when G is a finite Coxeter group, the cells are conjectured to be the same as Kazhdan-Lusztig cells. In other words, conjecturally 'Calogero-Moser cells' generalise Kazhdan-Lusztig cell theory from Coxeter groups to complex reflection groups. I will discuss a confirmation of this conjecture for G being the symmetric group. The proof uses ideas from integrable systems (Gaudin algebras), algebraic geometry (moduli of points on genus zero curves), and combinatorics (crystals).

10. Wonwoo Kang (ICMS - Sofia)

    Combinatorics in Generalized Cluster Algebras from Orbifolds

    Generalized cluster algebras, introduced by Chekhov and Shapiro, generalize the usual cluster algebra framework by replacing the standard binomial exchange relation with an arbitrary polynomial. One important class of examples arises from orbifolds. These algebras retain many desirable properties of ordinary cluster algebras, including the Laurent phenomenon and positivity. In this work, we show that the combinatorial tools used for cluster algebras from surfaces extend naturally to the orbifold setting in the generalized case. A potential application of this approach is establishing the bangle, bracelet, and band bases for generalized cluster algebras from orbifolds. This is joint work with Esther Banaian, Elizabeth Kelley, Ezgi Kantarcı Oğuz, and Emine Yıldırım.

11. Stefan Kolb (Newcastle University)

    Short star products for quantum symmetric pairs

    Short star products were developed by Etingof and Stryker as filtered deformations of graded (commutative, Poisson) algebras. In this talk, I will explain how quantum symmetric pairs can be interpreted as short star products on quantum horospherical algebras. This approach has several applications, including a conceptual formula for the quasi K-matrix, which is a main ingredient in many constructions for quantum symmetric pairs (e.g. canonical bases, universal K-matrices and braid group actions). The talk is based on joint work with Milen Yakimov.

12. Robert Laugwitz (University of Nottingham)

    From quantum groups to monoidal 2-categories

    In this talk, I will report on joint work with Azat Gainutdinov concerning monoidal 2-categories that are constructed from finite braided tensor categories. The objects are a subclass of exact module categories with the relative Deligne product as the monoidal structure. These monoidal 2-categories are non-semisimple but have strong dualizability properties. Therefore, the monoidal 2-categories obtained provide a natural generalization of fusion 2-categories obtained from separable module categories over braided fusion categories. To obtain examples, we consider the case of braided tensor categories of representations of quasi-triangular Hopf algebras (quantum groups). The easiest non-trivial example is based on the four-dimensional Hopf algebra of Sweedler. In this case, we can classify indecomposable objects, which form a continuous spectrum, and compute tensor product decompositions and morphism categories.

13. Valentin Ovsienko (CNRS - Reims)

    q-rationals and dimers

    The notion of q-deformed rational numbers was introduced in our work with Sophie Morier-Genoud. I will explain the relationships between q-rationals and the theory of dimer models. I will also discuss a natural q-deformation of the classical Markov numbers.

    The talk will be elementary and accessible to everyone. It is based on two recent preprints, arXiv:2507.19080 (jointly with Sam Evans, Sophie Morier-Genoud, and Perrine Jouteur) and arXiv:2510.16270.

14. Charles Paquette (Royal Military College of Canada)

    Continuous cluster categories

    Cluster categories are certain triangulated categories that arise in the categorification of cluster algebras. In the acyclic case, where a cluster algebra is determined by a quiver Q, Buan, Marsh, Reineke, Reiten, and Todorov defined the cluster category as the orbit category of the bounded derived category of finite-dimensional kQ-modules under the action of the Serre functor composed with the shift functor $[-2]$. Šťovíček and van Roosmalen extended this construction to discrete thread quivers — roughly speaking, quivers in which each arrow is replaced by a linearly ordered set. Their approach is analogous: they consider the bounded derived category of finitely presented modules over a thread quiver, which is known (by work of Berg and van Roosmalen) to admit a Serre functor, and then form the corresponding orbit category. However, this method requires discreteness, since the existence of a Serre functor is essential in their construction. In this work, we show how the discreteness assumption can be relaxed under mild hypotheses. Building on the framework of Šťovíček and van Roosmalen, we explain how to construct more general cluster categories even in cases where a Serre functor is not available. We also indicate how these enlarged constructions can be used to "complete" certain cluster categories. This is work in progress with J. Daisie Rock and Emine Yıldırım.

15. Deepanshu Prasad (ICMS - Sofia)

    Growth of infinite T-friezes of affine type

    We investigate the growth coefficients of infinite T-friezes arising in the context of cluster-tilted algebras of tame type. We prove that the growth coefficients for those friezes given by the non-homogeneous stable tubes all have the same growth coefficient. We use the Caldero-Chapoton (CC) map, a technique widely employed in the literature, to construct infinite frieze patterns. We also provide an explicit formula for the k-th growth coefficient, expressed directly in terms of data from homogenous tubes. This is a joint work with Emine Yıldırım.

16. Nicolai Reshetikhin (Beijing Institure for Mathematical Sciences and Applications (BIMSA))

    TBA.

17. Siddhartha Sahi (Rutgers University)

    Hypergeometric functions of matrix argument

    Hypergeometric functions ${}_pF_q(A)$ of matrix argument were introduced by Herz (1955) for symmetric matrices and by James (1962) for Hermitian matrices. These functions, which depend only on the eigenvalues $x = (x_1, \ldots, x_n)$ of A, have many applications in number theory, multivariate statistics, signal processing, and random matrix theory.

    In the 1980s, Macdonald introduced a common generalization ${}_pF_q(x;\alpha)$, which for $\alpha = 1$ and $\alpha = 2$ reduces to the functions of James and Herz. In recent work with Hong Chen, we have obtained differential equations that characterize ${}_pF_q(x;\alpha)$, thereby answering a question of Macdonald.

    Such equations were previously known only for a small number of cases, all with p and q at most 3. The main difficulty was that the differential operators involved became very complicated for large p and q, a complexity that halted progress for almost 40 years. Our work was made possible by the realization that the operators admit a compact description by means of a generating series.

18. Hadi Salmasian (University of Ottowa)

    Counting rational points of orbital varieties over finite fields

    Let $\mathfrak{g}$ be a semisimple Lie algebra and let $\mathfrak{u}$ be a $\mathfrak{b}$-stable ideal of $\mathfrak{n}$, where $\mathfrak{b} = \mathfrak{h} \oplus \mathfrak{n}$ is a Borel subalgebra of $\mathfrak{g}$. An orbital variety of $\mathfrak{g}$ is the intersection of a nilpotent orbit of $\mathfrak{g}$ with $\mathfrak{u}$. When $\mathfrak{g}$ is of type A, we obtain explicit formulas for the number of $\mathbb{F}_q$-points of an orbital variety, in terms of well-known families of symmetric functions.

    In the special case where $\mathfrak{u}$ is the nilradical of a parabolic subalgebra, our result specializes to a theorem of Karp and Thomas that provides a formula in terms of coefficients of Macdonald polynomials. We also discuss some applications, e.g., a generalization (with a new proof) of the Kirillov–Melnikov–Ekhad–Zeilberger formula for the number of elements of $\mathfrak{n}$ with a given matrix rank.

    This talk is based on joint work with M. Bardestani, K. Karai, and S. Ram.

19. Alexander Shapiro (University of Edinburgh)

    Coisotropic reduction on cluster varieties

    Coisotropic reduction of an associative algebra A by its 1-sided ideal I is the quotient $N(I)/I$ of the normalizer of I by the ideal. If A has a structure of a quantum cluster algebra, one may ask under which conditions on the ideal I, the quotient $N(I)/I$ inherits a cluster structure from A. While the question seems hopeless in this generality, I will demonstrate a small class of examples for which $N(I)/I$ indeed admits a cluster structure. I will also discuss a powerful application these examples yield in higher Teichmüller theory. This talk will be based on a joint work in progress with Corey Lunsford and Gus Schrader, as well as ongoing discussions with Misha Bershtein, David Cueto, Philippe Di Francesco, Rinat Kedem, and Misha Shapiro.

20. Valerio Toledano Laredo (Northeastern University)

    A Riemann-Hilbert correspondence for q-difference equations in several variables

    A Riemann-Hilbert correspondence for Fuchsian q-difference equations in one variable was obtained by Birkhoff in 1913 and elegantly recast as an equivalence of categories by Sauloy in 2003. We propose a definition of regular singularities in several variables and obtain the classification of the corresponding q-difference equations in terms of elliptic monodromy data.

    This is joint work with Julien Roques (U. Lyon 1).

21. Kent Vashaw (University of California, Los Angeles)

    <u>The homological spectrum for monoidal triangulated categories</u>

    If K is a monoidal triangulated category, then the Balmer spectrum $Spc(K)$ is a topological space which parametrizes the thick ideal subcategories of K, and in many examples is closely related to the projective spectrum of the cohomology ring of K. In 2020, Balmer introduced another spectrum, called the homological spectrum, for K (under a commutativity assumption), which is based on the maximal Serre tensor ideals of the category mod-K of functors from K to abelian groups; Balmer further conjectured, based on a wealth of examples, that the homological spectrum of K is always homeomorphic to the Balmer spectrum of K. We generalize Balmer's construction to the noncommutative case, and prove the analogous conjecture for stable categories of coordinate rings of finite group schemes as a special case of a more general theorem for crossed product categories. This is joint work with Daniel Nakano and Milen Yakimov.

22. Gordana Todorov (Northeastern University)

    TBA.