RGM 2025 Poster Session Abstracts

1. **Dinmukhammed Akpan, Friedrich Schiller University Jena**

Title: A New Perspective on Beltrami's Problem via Nijenhuis Geometry

Abstract: Two (pseudo)-Riemannian metrics are geodesically equivalent if they share the same geodesics as unparameterized curves. Beltrami first posed the problem of describing such metrics in 1865, with major progress made by Dini, Levi-Civita, and later Bolsinov and Matveev. This poster presents recent results (joint with A. Bolsinov) that complete the two-dimensional case by addressing the singular points where the Segre type of the (1,1)-tensor connecting the metrics changes. The approach combines classical methods based on integrals of the geodesic flow with modern techniques from Nijenhuis geometry, offering new tools for understanding this classical problem.

2. **Anibal Aravena, University of Massachusetts, Amherst**

Title: The Fano visitor problem for K3 surfaces

Abstract: Let X be a K3 surface with Picard number 1 and genus g, such that $g \not\equiv 3 \bmod 4$. We prove that X is a Fano visitor, i.e., there is a smooth Fano variety Y and an embedding $Db(X) \hookrightarrow Db(Y)$ given by a fully faithful functor. If $g \equiv 3 \bmod 4$, we construct a smooth weak Fano variety Y. The proof is based on several results concerning a sequence of flips associated with a K3 surface and an ample line bundle. This sequence is constructed by using the work of Bayer and Macrì on the description of the birational geometry of a moduli space of sheaves on a K3 surface through Bridgeland stability conditions, and the study of the fixed locus of antisymplectic involutions on hyperkähler manifolds by Saccà, Macrì, O'Grady, and Flapan.

3. **Sayantan Chakraborty, Michigan State University**

Title: Comparison theorems in Kahler geometry

Abstract: Kahler manifolds are a special class of Riemannian manifolds where three structures on the manifold interact in a compatible way. Due to this special feature, comparison theorems can behave differently in the Kahler setting. I will state a collection of results that illustrate the difference. We will also observe the difference in proof approaches in the Kahler setting for some of these results.

4. **Avik Chakravarty, University of Pennsylvania**

Title: Positivity of coinvariant divisors on $\overline{\mathrm{M}}_{0,n}$ and the parafermions

Abstract: We give criteria for determining the positivity of line bundles coming from vertex operator algebras (VOAs) on the moduli space $\overline{\mathrm{M}}_{0,n}$ of rational curves with n marked points. The criteria use the multiplicative structure of VOA representations encoded in the fusion ring. Using them, we construct positive line bundles on $\overline{\mathrm{M}}_{0,n}$ from certain parafermion VOAs. These give the first examples of commutant VOAs producing positive line bundles.

5. **Xingyu Cheng, University of North Carolina, Chapel Hill**

Title: Stability of parabolic Hodge bundles over punctured P^1
Abstract: TBA

6. **Daniel Halmrast, Lafayette College**

Title: Supersymmetric Topological Sigma Models and Doubling Spaces

Abstract: Building on the methods of Y. Qin, we propose a method of analyzing the derived category of coherent sheaves on an abelian variety in the framework of the “double field theory” of Hull and Reid-Edwards. A holomorphic line bundle on the abelian variety can be lifted to a Lagrangian torus in the product of the abelian variety and its dual, and in certain cases the derived hom-space between two line bundles is shown to be encoded in the intersection Floer cohomology of their lifts. We also examine the relationship between the Lagrangian lifts and generalized complex geometry in the sense of Hitchin and Gualtieri.

7. **Jon Kim, University of Colorado Boulder**

Title: Moduli of (b,c)-weighted stable marked cubic surfaces

Abstract: In 2024, Nolan Shock constructed several KSBA compactifications of the moduli space of cubic surfaces. More precisely, he considered pairs consisting of a cubic surface and a boundary divisor given by the sum of the 27 lines, all with the same weight value in the interval (1/9, 1] and provided a finite wall-and-chamber decomposition and described the weighted stable pairs parameterized by the moduli spaces in each chamber. In this poster, I will describe

recent work where I provide a similar finite wall-and-chamber decomposition for KSBA compactifications where we weight one “heavy” line with weight b, and the other 26 lines uniformly with weight c.

8. **Roman Krutowski, University of California, Los Angeles**

Title: Morse theory of loop spaces and Hecke algebras

Abstract: One can associate a higher-dimensional Heegaard Floer (HDHF) wrapped Fukaya category to a Liouville domain by counting higher genus curves, which are required to be branched covers. In this work we present a Morse-theoretic model that computes the HDHF A_\infty-algebra of k fibers of the cotangent bundle of an orientable smooth manifold. We use this model to describe the A_\infty-algebra of k cotangent fibers of the two-dimensional sphere, and show that it is quasi-equivalent to a certain dga that can be regarded as a derived HOMFLY skein algebra of the sphere. This talk is based on a joint work with Honda, Tian, and Yuan.

9. **Louisa Liles, The Ohio State University**

Title: (t,q)-series Invariants of Seifert Manifolds

Abstract: Gukov, Pei, Putrov, and Vafa developed a q-series invariant of negative definite plumbed 3-manifolds with spin^{c} structures, building on earlier work of Lawrence and Zagier. This was recently generalized to an an infinite family of two-variable (t,q)-series invariants by Akhmechet, Johnson, and Krushkal (AJK). We calculate one such series for all Seifert manifolds with $b_{1}=0.$ These results extend a previous theorem of Liles and McSpirit to any number of exceptional fibers, and the Reduction Theorem of Gukov, Katzarkov, and Svoboda to the two-variable case. As a consequence, a previous result of Liles and McSpirit on modularity properties and radial limits is enhanced to a larger family of manifolds. We also calculate the infinite collection of (t,q)-series invariants for three infinite families of manifolds, finding mixed modularity properties for one such family.

10. **Jianqi Liu, University of Pennsylvania**

Title: Tensor Category from Conformal Blocks of Vertex Operator Algebras

Abstract: The notion of conformal blocks on stable curves defined by modules over a vertex operator algebra (VOA) is a generalization of the WZNW-conformal blocks defined by modules over affine Lie algebras. The recent advances in the theory of VOA-conformal blocks shed new

light on the representation theory of VOAs. The braided tensor category structure on the module category of a VOA can be built from conformal blocks of VOAs using algebraic geometric method. This poster is based on a joint work with Angela Gibney, Daniel Krashen, and Xu Gao.

11. **Sixuan Lou, University of Illinois Chicago**

Title: Threefolds containing all curves are rationally connected

Abstract: Any smooth projective curve embeds into P3. More generally, any curve embeds into a rationally connected variety of dimension at least three. We prove conversely that if every curve embeds in a threefold X, then X is rationally connected. In particular "all curves embed" is a birational property for threefolds.

12. **Yangxiao Luo, University of Virginia**

Title: Cornered skein lasagna theory

Abstract: The Khovanov-Rozansky skein lasagna module was introduced by Morrison-Walker-Wedrich as an invariant of 4-manifold with a framed oriented link in the boundary. I will discuss an extension of the skein lasagna theory to 4-manifolds with codimension 2 corners, its behavior under gluing, and applications to trisections of 4-manifolds. This is joint work with Sarah Blackwell and Slava Krushkal.

13. **Agniva Roy, Boston College**

Title: Anchored Symplectic Embeddings

Abstract: Given two four-dimensional symplectic manifolds, together with knots in their boundaries, we define an ``anchored symplectic embedding'' to be a symplectic embedding, together with a two-dimensional symplectic cobordism between the knots (in the four-dimensional cobordism determined by the embedding). We use techniques from embedded contact homology to determine quantitative criteria for when anchored symplectic embeddings exist, for many examples of toric domains. In particular we find examples where ordinarily symplectic embeddings exist, but they cannot be upgraded to anchored symplectic embeddings unless one enlarges the target domain. This is joint work with Michael Hutchings, Morgan Weiler, and Yuan Yao.

14. Max Throm, Michigan State University

Title: Khovanov and sl(3) homology and equivariant knots

Abstract: An equivariant link is a link that has a finite order group action preserving the link. From this group action, one can define a compatible group action on the Khovanov homology of the knot. This gives rank inequalities on the odd and even Khovanov homologies for the knot [arXiv:1810.04769v2]. We hope to generalize this for the sl(3) link homology.

15. **Bryson Owens, Virginia Commonwealth University**

Title: Chern Classes of the Hodge Bundle of Cyclic Admissible Covers

Abstract: Moduli spaces of marked curves form an important class of examples of moduli spaces whose geometry can be studied in terms of some combinatorial data. There are related moduli spaces of admissible covers of marked curves whose branch points are the marked points of the base curve, where the genus, degree, and monodromy data of the covers are fixed. This allows us to study families of such covers in terms of combinatorial data, yielding a powerful computation tool for doing intersection theory on these moduli spaces. In this talk, I will introduce these moduli spaces and then discuss a project (joint with Seamus Somerstep and Renzo Cavalieri) in which we compute the first Chern class of the Hodge bundle on spaces of cyclic admissible covers.

16. **Dipali Swain, Florida Polytechnic University**

Title: The geometry of our universe- Knots, Quandles and Invariants of Knots using Quandles

Abstract: The geometry of our universe connects deeply with knot theory, where knots model tangled structures in three-dimensional space. Knot invariants help classify knots, with quandles serving as algebraic structures that encode their symmetries. Quandles provide powerful invariants that distinguish knots and relate to space-time topology. Unlike polynomial invariants, quandle invariants offer a geometric and combinatorial approach to classification. This study highlights the role of knots and quandles in understanding the universe's structure, with applications in mathematical physics, quantum theory, and topology.

17. **Rithwik Susheel Vidyarthi, Michigan State University**

Title: Knot floer homology and monodromy detection

Abstract: We prove that the Knot Floer complex along with the data of the flip map detects the fibered knot whose monodromy is given by a boundary Dehn twist on a punctured genus g surface.

18. **Peyton Wood, University of California, Davis**

Title: Transvection Groups of Quandles

Abstract: We prove that the transvection group of the dihedral quandle with n elements is isomorphic to the group generated by rotations of the n/2 -gon when n is even and the n-gon when n is odd. We additionally show that any quandle with at least one trivial column has equivalent transvection and inner automorphism groups. Then, using the enumeration of quandles given by Vojtěchovský and Yang which we also confirmed up to order 10, we verify the automorphism group and the inner automorphism group of all quandles (up to isomorphism) of orders less than or equal to 7 as first shown in Macquarrie, Restrepo, and Elhamdadi. We then extend these results by computing the automorphism and inner automorphism groups of all quandles of orders 8, 9 and 10 and transvection group of all quandles (up to isomorphism) of order ≤ 10.