

Titles and abstracts of longer talks/lectures/demonstrations

Since this is only a 2-day event, there are two 40-minute lectures, a limited number of 30-minute research talks, and some time devoted to 5-minute lightning talks. There is also a small math demonstration after Saturday lunch. We aim to leave ample time for discussions.

The Euler class of the normal bundle of a Seifert fibration and manifolds admitting co-oriented taut foliations, but none with vanishing Euler class

Steve Boyer (UQAM)

Abstract: We provide examples of rational homology 3-spheres that admit co-oriented taut foliations and have left-orderable fundamental groups, but none of the left-orders arise from the universal circle actions associated to co-oriented taut foliations. Thus, the connection between foliations and left-orders contended by the L-space conjecture is not as direct as might have been hoped. This is joint work with Cameron McA. Gordon and Ying Hu

Character varieties and essential surfaces in arbitrary characteristic

Grace Shanti Garden (IMJ-PRG)

Abstract: In the seminal work of Culler and Shalen (1983) a method is outlined to detect essential surfaces in a three-manifold by studying their $SL(2, \mathbb{C})$ -character variety. The method underscores connections between the theory of incompressible surfaces in three-manifolds, splittings of fundamental groups, group actions on trees, and the geometry of representation varieties. In this talk, we will motivate and then lay a general foundation for this theory in arbitrary characteristic by using the same approach instead over F , an algebraically closed field of positive characteristic. We then apply the theory to a variety of settings. This is joint work with Stephan Tillmann.

Tiling Hyperbolic Manifolds: Algorithms and Applications

Matthias Goerner (Pixar)

Abstract: I introduce a new tiling algorithm for hyperbolic 3-manifolds. Applications include the maximal cusp area matrix (completely characterizing the space of all embedded and disjoint horocusp neighborhoods) and the optimal Margulis number. I focus on a new length spectrum algorithm as an application. The new length spectrum algorithm is verified and also much faster than the previous algorithm in SnapPy (e.g., <1s vs >16h in some extreme cases). Time permitting, I also show a method to drill a simple closed geodesic allowing us to extend the isometry signature to closed hyperbolic manifolds. This is joint work with Robert Haraway, III, Neil Hoffman and Maria Trnkova.

Skein modules, character varieties and essential surfaces of 3-manifolds

Efstratia Kalfagianni (MSU)

Abstract: The $SL(2, \mathbb{C})$ -skein modules of closed 3-manifolds were defined in the 90's but till recently little was known about their structure. The modules depend on a parameter A and can be considered over $\mathbb{Z}[A, A^{-1}]$ or over $\mathbb{Q}(A)$. The $\mathbb{Q}(A)$ -module is known to be finitely generated while the structure over $\mathbb{Z}[A, A^{-1}]$ can be complicated.

We will discuss how the existence of essential surfaces in manifolds reflects on the structure of their $\mathbb{Z}[A, A^{-1}]$ -module. We will also discuss how this information allows to compute the dimension of the $\mathbb{Q}(A)$ -modules for "small" manifolds, and understand their relation to their character varieties.

Arithmeticity and commensurability of links in thickened surfaces

Rose Kaplan-Kelly (Le Moyne College)

Abstract: In this talk, we will consider a generalization of alternating links and their complements in thickened surfaces. In particular, a family of generalized alternating links which each correspond to a Euclidean or hyperbolic tiling and have a right-angled complete hyperbolic structure on their complement. We will describe a complete characterization of which of these links are arithmetic, and which are pairwise commensurable. This is joint work with David Futer.

Atoroidal surface bundles

Autumn Kent (U. Wisconsin)

Abstract: I will discuss recent work with C. Leininger in which we produce purely pseudo-Anosov surface subgroups of mapping class groups, obtaining the first compact atoroidal surface bundles over surfaces. We do this by constructing a type-preserving representation of the figure eight knot group into the mapping class group of the thrice-punctured sphere.

Filling links in 3-manifolds

Christopher Leininger (Rice)

Abstract: This is joint work with Yandi Wu in which we answer a question of Freedman and Krushkal, constructing "filling links" in any closed, orientable 3-manifold. The links are hyperbolic and can be chosen to have arbitrarily large "essential systole".

Deformation theory, gluing problems and uniform models (lecture, suitable for graduate students)

Yair Minsky (Yale U.)

Abstract: In this background talk I will discuss how the deformation theory of Kleinian groups connects to the problem of gluing 3-manifolds together. That is, I will explain how Thurston's skinning map, used in his proof of the Haken geometrization theorem, leads to some interesting quantitative questions. I will also try to explain how this relates to the problem of obtaining "uniform models" for hyperbolic 3-manifolds.

Branched Bending in Finite-Volume Hyperbolic Manifolds

Casandra Monroe (U. Michigan)

Abstract: We define branched bending deformations as deformations supported on a piecewise totally geodesic complex of $(n-1)$ -dimensional faces meeting along $(n-2)$ -dimensional branching loci. We establish a lower bound on the dimension of the deformation space of such manifolds containing a branched complex, and establish some facts about the Borromean rings as a special example (recovering a result of Menasco and Reid)

Character Varieties of Hyperbolic 3-Manifolds (lecture, suitable for graduate students)

Kate Petersen (U. Minnesota Duluth)

Abstract: I'll provide an introduction to $SL(2, \mathbb{C})$ character varieties of finite volume hyperbolic 3-manifolds and discuss computations.

Mathematical 3D prints demonstration

Henry Segerman (Oklahoma State U)

Abstract: I'll bring some 3D printed illustrations, mechanisms, and puzzles for people to play with. If you have an idea for a three-dimensional illustration you'd like to make, let's talk!

Ideal points, incompressible surfaces, and left-orderability

Yi Wang (UIUC)

Abstract: Motivated by the L-space conjecture, we discuss techniques to prove left-orderability of Dehn fillings of 1-cusped hyperbolic 3-manifolds. In particular, we highlight new techniques inspired by the work of Culler-Dunfield and Gao which uses representations into the universal cover of $PSL_2(\mathbb{R})$. This will lead to establishing new families of left-orderable Dehn fillings in situations ranging from the existence of particular genus one Seifert surfaces and essential Conway spheres. In particular, we will highlight the use of computational techniques in providing explicit examples of orderable Dehn fillings, utilizing the Lin presentation.

Finite Quotients and A-polynomials.

Youheng Yao (Yale)

Abstract: This is joint work with Tam Cheetham-West. We show that the profinite completion of a hyperbolic one-cusped 3-manifold determines its $SL(2, \mathbb{C})$ A-polynomial.