Shanks Conference on
Low-dimensional Topology and Geometry

Vanderbilt University, May 15–19, 2017

	Monday	Tuesday	Wednesday	Thursday
8:30	registr./coffee	registr./coffee	registr./coffee	registr./coffee
9:25	welcome			
9:30	**Charney**	**Minsky**	**Manning**	**Markovic**
10:30	coffee break	coffee break	coffee break	coffee break
11:15	**Taylor**	**Koberda**	**Stover**	**Sun**
12:15	lunch	lunch	lunch	lunch
2:15	**Rafi**	**Leininger**	**Tao**	**Bromberg**
3:15	coffee break	coffee break	coffee break	coffee break
4:00	**Strenner**	**Patel**	**Agol**	**Erlandsson**
5:00			photo	
5:15			reception	
6:30				banquet

	Friday
8:30	registr./coffee
9:30	**Dunfield**
10:30	coffee break
11:00	**Baik**
12:00	lunch
1:30	**Futer**
2:30	coffee break
3:00	**Przytycki**

All talks will take place in **Wilson Hall** room 103. Registration and all coffee breaks will be in the lobby of Wilson Hall. A selection of snacks, sweets, fruits, etc will be provided at the coffee breaks.

Abstracts

Ian Agol (UC Berkeley) Wednesday at 4:00

Flow and Yamada polynomials of cubic graphs

Abstract: We'll discuss Tutte's golden identity for flow polynomials of planar cubic graphs, and an extension to Yamada polynomials of spatial cubic graphs. This explains a curious property of flow polynomials of cubic graphs (mod 5). We conjecture that the golden identity becomes an inequality for non-zero flow polynomials of general cubic graphs which characterizes planarity, and have proved this for certain infinite classes of cubic (non-planar) graphs. We'll introduce the chromatic algebra to help explain these phenomena, and use it to show that the number of flow polynomials of planar cubic graphs grows exponentially with the degree, answering a question of Treumann–Zaslow. This is joint work with Slava Krushkal.

Harry Hyungryul Baik (KAIST) Friday at 11:00

From 1-dimensional dynamics to 2-dimensional geometry

In this talk, we will see a few approaches to obtain surfaces with either hyperbolic structures or singular Euclidean structures from 1-dimensional dynamical systems. A part of the project is related to the Fried's conjectural characterization of pseudo-Anosov stretching factors. If time permits, we will also briefly mention a statistical answer to an easy version of Fried's conjecture. This talk is partially based on joint work with J. Alonso-E. Samperton and A. Rafiqi-C. Wu.

Kenneth Bromberg (Utah) Thursday at 2:15

Lower bounds on renormalized volume of hyperbolic 3-manifolds

Abstract: Motivated by ideas in physics Krasnov and Schlenker defined the renormalized volume of a hyperbolic 3-manifold. This is a way of assigning a finite volume to a hyperbolic 3-manifold that has infinite volume in the usual sense. While coarsely equally to the volume of the convex core, renormalized volume has the extra property that there is a simple formula, due to Krasnov and Schlenker, for its derivative as a function on the space of convex co-compact hyperbolic structures on a fixed manifold. One curious feature of this "volume" is that it is not a priori non-negative. We will begin by giving a definition of renormalized volume and some of its properties that demonstrate why the definition is natural from the perspective of

a mathematician. We will then describe our joint work with M. Bridgeman and J. Brock proving that renormalized volume is positive for manifolds with incompressible boundary.

Ruth Charney (Brandeis) Monday at 9:30

Are CAT(0) spaces determined by their boundaries?

Abstract: Boundaries of hyperbolic spaces have played a key role in low dimensional topology and geometric group theory. In 1993, Paulin showed that the topology of the boundary of a (Gromov) hyperbolic space, together with its quasi-mobius structure, determines the space up to quasi-isometry. One can define an analogous boundary, called the Morse boundary, for any proper geodesic metric space. I will discuss an analogue of Paulins theorem for Morse boundaries of CAT(0) spaces. (Joint work with Devin Murray.)

Nathan Dunfield (UIUC) Friday at 9:30

Orderability and Dehn filling

Abstract: Motivated by conjectures relating group orderability, Floer homology, and taut foliations, I will discuss a systematic and broadly applicable technique for constructing left-orders on the fundamental groups of rational homology 3-spheres. Specifically, for a compact 3-manifold M with torus boundary, I will give several criteria which imply that whole intervals of Dehn fillings of M have left-orderable fundamental groups. The technique uses certain representations from $\pi_1(M)$ into $\widetilde{\mathrm{PSL}_2\mathbb{R}}$, which are organized into an infinite graph in $H^1(\partial M; \mathbb{R})$ called the translation extension locus. I will show many plots of such loci which inform the proofs of the main results and suggest interesting avenues for future research. This is joint work with Marc Culler. Based on: https://arxiv.org/abs/1602.03793

Viveka Erlandsson (Helsinki/Bristol) Thursday at 4:00

Counting curves on surfaces

Abstract: Let S be a surface of genus g and r punctures. Mirzakhani has shown that when S is equipped with a hyperbolic metric the number of curves in each mapping class group orbit with length bounded by L grows asymptotically as a constant times $L^{6g-6+2r}$. In this talk we discuss generalisations of this result. We show that the same asymptotics hold if one measures length with respect to the word length in the fundamental group of S, or with respect to any Riemannian metric on S.

Dave Futer (Temple) Friday at 1:30

Abundant quasifuchsian surfaces in cusped hyperbolic 3-manifolds

Abstract: I will discuss the theorem that a cusped hyperbolic 3-manifold M contains an abundant collection of immersed, undistorted surfaces. The boundaries of these surfaces are Jordan curves that are abundant in the sense that they separate any pair of points on the sphere at infinity. As a corollary, we recover Wise's theorem that the fundamental group of M is cubulated. This is joint work with Daryl Cooper.

Thomas Koberda (Virginia) Tuesday at 11:15

Square roots of Thompson's group F

Abstract: I will discuss square roots of Thompson's group F, which are certain two-generator subgroups of the homeomorphism group of the interval, the squares of which generate a copy of Thompson's group F. We prove that these groups may contain nonabelian free groups, they can fail to be smoothable, and can fail to be finitely presented. This represents joint work with Y. Lodha.

Christopher J. Leininger (UIUC) Tuesday at 2:15

Surface bundles over Teichmüller curves

Abstract: I will discuss joint work-in-progress with Dowdall, Durham, and Sisto on the coarse geometry of the canonical surface bundle over a Teichmüller curve.

Jason Manning (Cornell) Wednesday at 9:30

Generalized triangle groups and expanders

Abstract: We describe a family of hyperbolic groups analogous to classical triangle groups, but which exhibit very diverse properties; many are cubulated, but many others have Property (T). They all occur as peripherally finite quotients of a single relatively hyperbolic group pair (G, P) with G hyperbolic and virtually special, thus answering a question related to Wise's Malnormal Special Quotient Theorem posed in different forms by Agol and Wise. This is joint work with Henry Wilton and Alex Lubotzky.

Vladimir Markovic (Caltech) Thursday at 9:30

Caratheodory's Metrics on Teichmüller Spaces

Abstract: One of the most important results in Teichmüller theory is the theorem of Royden which says that the Teichmüller and Kobayashi metrics agree on any Teichmüller spaces. In this talk, I will discuss the recent result that the Teichmüller and Caratheodory metrics disagree on Teichmüller spaces of a closed surface of genus at least two. In addition, I shall explain the role of some difficult theorems from Teichmüller dynamics in the remaining open problem of characterizing Teichmüller discs where the two metrics agree.

Yair Minsky (Yale) Tuesday at 9:30

Skinning bounds and deformation spaces

Abstract: Thurston's skinning map is a self-map of Teichmüller space associated to the quasiconformal deformation space of a hyperbolic 3-manifold with incompressible boundary. Beyond Thurston's use of this map in the proof of his geometrization theorem, one can use it as a tool for quantitative control of the geometry of a hyperbolic 3-manifold, and to answer questions about boundary structure of the deformation space. I will define the skinning map and talk about two results: One, joint with Bromberg and Kent, gives a bound on the skinning image of an epsilon-thick Teichmüller ray which depends on the genus of the boundary but not on the 3-manifold. Another, joint with Brock, Bromberg, Canary and Lecuire, is that the boundary of the deformation space of a 3-manifold with incompressible boundary is locally connected at all quasiconformally rigid points.

Priyam Patel (UC Stanta Barbara) Tuesday at 4:00

Algebraic and topological properties of big mapping class groups

Abstract: The mapping class group of a surface is the group of homeomorphisms of the surface up to isotopy (a natural equivalence). Mapping class groups of finite type surfaces have been extensively studied and are, for the most part, well-understood. There has been a recent surge in studying surfaces of infinite type and in this talk, we shift our focus to their mapping class groups, often called big mapping class groups. The groups arise naturally when studying group actions on surfaces (dynamics) and foliations of 3-manifolds. In contrast to the finite type case, there are many open questions regarding the basic algebraic and topological properties of big mapping class groups. Until now, for instance, it was unknown whether or not these groups are residually finite. We will discuss the answer to this and several other open questions after providing the necessary background on surfaces of infinite type. This work is joint with Nicholas G. Vlamis.

Piotr Przytycki (McGill) Friday at 3:00

Arcs on spheres intersecting at most twice

Abstract: We prove that on an n-punctured sphere the maximal cardinality of a set of non-homotopic arcs pairwise intersecting at most twice is $n(n-1)(n-2)$. This is joint work with Christopher Smith.

Kasra Rafi (Toronto) Monday at 2:15

Geodesic currents and counting problems

Abstract: We show that, for every filling geodesic current, a certain scaled average of the mapping class group orbit of this current converges to multiple of the Thurston measure on the space of measured laminations. This has applications to several counting problems, in particular, we count the number of lattice points in the ball of radius R in Teichmlller space equipped with Thurstons asymmetric metric. This is a joint work with Juan Souto.

Matthew Stover (Temple) Wednesday at 11:15

Geometry & topology of complex hyperbolic 2-manifolds

Abstract: I will discuss the geometry and topology of complex hyperbolic 2-manifolds, highlighting open questions and recent progress directly inspired by the last 40 years of work on hyperbolic 2- and 3-manifolds. Emphasis will be on explicit topological constructions (particularly of minimal volume manifolds), fibrations, and betti numbers. Much of this will cover joint work with Luca Di Cerbo.

Balázs Strenner (Georgia Tech) Tuesday at 4:00

Fast computation in mapping class groups

Abstract: The talk will be on a project, joint with Dan Margalit and Oyku Yurttas, whose goal is to give a framework for fast computation in mapping class groups. We show that there is a quadratic-time algorithm that computes the Nielsen-Thurston type of a mapping class (finite order, pseudo-Anosov or reducible). It also finds the reducing curves and the stretch factors and invariant foliations on pseudo-Anosov components.

Hongbin Sun (UC Berkeley/Rutgers) Thursday at 11:15

Geometrically finite amalgamations of hyperbolic 3-manifold groups are not LERF

Abstract: We will show that, for any two finite volume hyperbolic 3-manifolds, the amalgamations of their fundamental groups along nontrivial geometrically finite subgroups are always not LERF. A consequence of this result is: all arithmetic hyperbolic manifolds with dimension at least 4, with possible exceptions in 7-dimensional manifolds defined by the octonion, their fundamental groups are not LERF.

Jing Tao (Oklahoma) Wednesday at 2:15

Coarse and fine geometry of the Thurston metric

Abstract: I will present some recent results on the geometry of the Thurston metric on Teichmüller space. This is an asymmetric metric based on the Lipschitz constants of maps between hyperbolic surfaces. We study the coarse properties of Thurston metric geodesics in general, and some finer properties in the case of the punctured torus. This is joint with Anna Lenzhen, David Dumas, and Kasra Rafi.

Samuel Taylor (Yale/Temple) Monday at 11:15

Largest projections for random walks and shortest geodesics in random mapping tori

Abstract: We show that the largest subsurface projection distance between a marking and its image under the nth step of a random walk in the mapping class group grows logarithmically in n, with probability approaching 1 as n goes to infinity. As an application, we confirm a conjecture of Rivin about the asymptotic behavior of the systole of random mapping tori. This is joint work with Alessandro Sisto.