

**Aspects of
hyperbolicity in
geometry,
topology, and
dynamics**

25th – 27th July 2011

Titles and Abstracts

Jean-Marc Schlenker (Toulouse)

A cyclic extension of the earthquake flow

Monday July 25, 09:30

Abstract: The earthquake flow is a flow on the product of Teichmüller space by the space of measured laminations. Among its key properties are Thurston's Earthquake Theorem (given two hyperbolic metrics, there is a unique left earthquake sending one to the other), and McMullen's complex earthquakes, which extend earthquake lines as holomorphic disks. We will describe an extension of the earthquake flow, which is a circle action on the product of Teichmüller space with itself. When one of the factors tends projectively to a measured lamination, we recover the earthquake flow. Our extension shares many properties with the earthquake flow, in particular the two described above. The heuristics and some of the proofs use 3-dimensional AdS geometry. This is joint work with Francesco Bonsante and Gabriele Mondello.

Kasra Rafi (Oklahoma)

Hyperbolicity in Teichmüller space

Monday July 25, 11:00

Abstract: We develop a theory for applying combinatorial tools, for example the curve complex, in the study of geometric properties of Teichmüller space. We then use this theory to examine in what way Teichmüller space equipped with the Teichmüller metric resembles or differs from a Gromov hyperbolic space.

David Dumas (UIC)

Holonomy of projective structures and flat surfaces in hyperbolic space

Monday July 25, 13:30

Abstract: We discuss a new application of the Epstein-Thurston construction of locally convex surfaces in hyperbolic space as envelopes of horospheres. Starting with a holomorphic quadratic differential on a compact Riemann surface, we construct a map of the universal cover into hyperbolic space that is equivariant with respect to the holonomy representation of the associated complex projective structure. Using the geometry of these surfaces we characterize limit points of holonomy representations in the Morgan-Shalen boundary of the character variety. If time permits we will discuss applications to skinning maps of hyperbolic 3-manifolds.

Jack O. Button (Cambridge)

Establishing largeness for a family of closed hyperbolic 3-manifolds

Monday July 25, 14:40

Abstract: A finitely generated group is said to be large if it has a finite index subgroup possessing a homomorphism onto a non-Abelian free group. This is a powerful notion, both in abstract group theory and in 3-manifold topology. We first review the definition and consequences of largeness, then discuss results which are able to conclude largeness for the fundamental groups of some closed hyperbolic 3-manifolds.

Jeffrey Brock (Brown)

The Weil-Petersson metric on Teichmüller space, and the geometry of hyperbolic 3-manifolds

Monday July 25, 16:15

Abstract: In this talk I will discuss a range of analogies between the geometry and spectra of Teichmüller space with its Weil-Petersson metric and the internal geometry of hyperbolic 3-manifolds. In particular, connections between volume in 3-dimensions and length in Teichmüller space seem too strong to be accidental, but I will present fundamental distinctions that arise in the thin part of moduli space.

Bill Goldman (Maryland)

Deformation spaces of 3-dimensional affine space forms

Tuesday July 26, 09:30

Abstract: In the early 1980's Margulis, answering a question of Milnor, discovered 3-manifold quotients of Euclidean 3-space by nonsolvable groups of affine transformations. Such groups are virtually free and appear naturally as fundamental groups of hyperbolic surfaces canonically associated to the 3-manifolds. The 3-manifolds themselves carry geodesically complete flat Lorentz metrics and correspond to deformations of hyperbolic surfaces. We describe the topology, dynamics, and classification of these 3-manifolds. In particular the Fricke trace coordinates on the deformation spaces of complete hyperbolic surfaces extend, using a marked Lorentzian length spectrum due to Margulis, to coordinates on the space of proper affine deformations. This talk represents joint work with Charette, Drumm, Fried, Labourie and Margulis.

Corinna Ulcigrai (Bristol)

Ergodicity in Z-covers of translation surfaces

Tuesday July 26, 11:00

Abstract: While the ergodic theory of compact translation surfaces is well understood, thanks to its connection with the Teichmüller flow, very little is known about infinite translation surfaces. Recently there has been a lot of interest in the ergodic properties of directional flows on infinite translation surfaces, in particular Z-covers of compact translation surfaces. Hubert and Weiss proved ergodicity for a.e. direction when the Veech group of the Z-cover is a lattice. In joint work with K. Fraczek, we exhibit a class of Z-covers (whose Veech group is infinitely generated) for which the directional flow is not ergodic for a.e. direction.

Vaibhav Gadre (Harvard)

Hitting measures on the Thurston boundary

Tuesday July 26, 13:30

Abstract: Kaimanovich and Masur proved that a typical random walk on the mapping class group when projected into Teichmüller space, converges with probability 1 to the Thurston boundary. This defines a measure on the Thurston boundary giving the distribution of the limit points of sample paths. We show that if the initial distribution is finitely supported then the harmonic measure is singular with respect to the natural Lebesgue measure on Thurston boundary. This result is analogous to the result of Guivarc'h and LeJan that a finitely supported random walk on the fundamental group of a finite volume hyperbolic surface with cusps, when projected to the hyperbolic plane, gives a singular measure on S^1 .

Hideki Miyachi (Osaka)

Limits of geodesic rays and non-visible points of Teichmüller space

Tuesday July 26, 14:40

Abstract: I will talk about behaviours of various geodesic rays in Teichmüller space in the Gardiner-Masur compactification. I shall discuss the continuity and discontinuity of the limits on the Teichmüller geodesic rays when rays vary. We will also discuss non-visible points in the boundary in terms of almost geodesics.

Dick Canary (Michigan)

Dynamics on character varieties

Wednesday July 27, 09:30

Abstract: Given a closed surface F , the mapping class group $\text{Mod}(F)$ of F acts on the $\text{PSL}(2, \mathbb{R})$ -character variety. This action is properly discontinuous on the components associated to the Teichmüller spaces of F and of F with the opposite orientation. It is conjectured to act ergodically on all other components. In this talk, we consider a compact 3-manifold M with boundary. The outer automorphism group of the fundamental group of M acts on the $\text{PSL}(2, \mathbb{C})$ -character variety of M . It acts properly discontinuously on the interior of the space of (characters of) discrete faithful representations. We will discuss the dynamics of the action on the entire character variety. In particular, we will discuss work of Canary, Lee, Magid, Minsky and Storm which exhibits domains of discontinuity for this action which are larger than the interior of the space of discrete faithful representations.

Frédéric Paulin (Paris-Sud)

On the hyperbolic geometry of binary Hamiltonian forms

Wednesday July 27, 11:00

Abstract: We use 5-dimensional hyperbolic geometry (in particular volume computations of hyperbolic 4- and 5-manifolds) to study various arithmetic properties of the binary quaternionic Hermitian forms: their geometric reduction theory, the asymptotic expansion of the number of their representations of integers, etc. This is a joint work with J. Parkkonen.

Ken Bromberg (Utah)

Bounded cohomology for groups with hyperbolic actions

Wednesday July 27, 13:30

Abstract: Recently Hamenstädt has proven a collection of theorems that, for a variety of different types of groups G , the 2^{nd} bounded cohomology with coefficients in $l^p(G)$ is infinite dimensional. In joint work with Bestvina and Fujiwara we give a unified approach to Hamenstädt's theorems. The key to our approach is an action of G on a quasi-tree, constructed in our earlier proof that the asymptotic dimension of the mapping class group is finite. This construction works for groups that act on δ -hyperbolic spaces with Bestvina-Fujiwara's weak proper discontinuity condition. It further works for groups that act on spaces that are not necessarily hyperbolic but exhibit some hyperbolic behavior, such as the action of the mapping class group on Teichmüller space and $\text{Out}(F_n)$ on Outer space.

Makoto Sakuma (Hiroshima)

Simple loops on 2-bridge spheres in 2-bridge link complements

Wednesday July 27, 14:40

Abstract: We give complete answers to the following problems. (1) For an essential simple loop on a 2-bridge sphere in a 2-bridge link complement, when is it: null-homotopic in the link complement, peripheral, or primitive? (2) For two distinct essential simple loops on a 2-bridge sphere in a 2-bridge link complement, when are they homotopic in the link complement?

We will also discuss an application of these results to the study of the end invariants of $SL(2, \mathbb{C})$ -representations of punctured torus groups, introduced by Bowditch and Tan-Wong-Zhang.

This is a joint work with Donghi Lee.

Steve Kerckhoff (Stanford)

Hyperbolic and AdS geometry in dimension 3

Wednesday July 27, 16:15

Abstract: In the early 90's Geoff Mess discovered a beautiful analogue in AdS geometry to the Ahlfors-Bers theory of quasi-Fuchsian groups. This analogy has been reinforced by the connection between the work of Series and of Bonahon on almost Fuchsian quasi-Fuchsian groups and parallel work of Bonsante and Schlenker in the AdS setting. We will take a new look at this phenomenon from the point of view of Transitional Geometry, as recently developed by Jeff Danciger.
