Titles and Abstracts

1. **Ara Basmajian** (The City University of New York)

Title: Extremal length calculations and applications to the geodesic flow

Abstract: A collar neighborhood of a simple closed geodesic in a hyperbolic surface is an open neighborhood of the geodesic which is topoogically an annulus. It is well-known that a simple closed geodesic on a hyperbolic surface has a natural (or standard) collar. The outstandng feature of the natural collar is that its size depends on local data, namely its size depends only on the length of the geodesic. Using this collar, one can make extremal length calculations of curve families that are transverse to the geodesic. In this talk, after defining extremal length and discussing its properties, we define a collar which we call a non-standard collar. Using the non-standard collar we are able to improve estimates on the extremal length of curve families that are transverse to the geodesic and give a number of applications to the geodesic flow on an infinite type hyperbolic surface. In particular, we give sufficient conditions on Fenchel-Nielsen parameters to guarantee that the geodesic flow acts ergodically. This is joint work with Hrant Hakobyan and Dragomir Saric.

2. **Martin Bridgeman** (Boston College)

Title: Uniform bounds on harmonic Beltrami differentials and Weil-Petersson curvatures

Abstract: We show that for every finite area hyperbolic surface X of type (g, n) and any harmonic Beltrami differential μ on X, then the magnitude of μ at any point of small injectivity radius is uniform bounded from above by the ratio of the Weil-Petersson norm of μ over the square root of the systole of X up to a uniform positive constant multiplication. We apply the uniform bound above to show that the Weil-Petersson Ricci curvature, restricted at any hyperbolic surface of short systole in the moduli space, is uniformly bounded from below by the negative reciprocal of the systole up to a uniform positive constant multiplication. As an application, we show that the average total Weil-Petersson scalar curvature over the moduli space is uniformly comparable to $-g$ as the genus g goes to infinity. This is joint work with Yunhui Wu.

3. **Jeffrey Brock** (Yale University)

Title: On the renormalized volume gradient flow and the Weil-Petersson metric on Teichmüller space

Abstract: In this talk I will describe history context and recent developments that use Graham and Witten's notion of "renormalized volume", as elaborated by Krasnov and Schlenker, to provide a satisfying analytic explanation for the connection between volumes of convex cores of hyperbolic 3-manifolds and the Weil-Petersson distance on Teichmüller space. Understanding its gradient flow leads to a new range of questions about efficient geometric evolutions of hyperbolic 3-manifolds, providing new context

for understanding a range of tools developed to address their geometric classification. I'll discuss an array of applications to Weil-Petersson geometry as well as some new results. This talk describes joint work with Ken Bromberg and Martin Bridgeman.

4. **David Dumas** (University of Illinois at Chicago)

Title: Coarse and fine geometry of the Thurston metric

Abstract: I will discuss some results on the geometry of Thurston's metric on Teichmueller space. This asymmetric metric is based on the Lipschitz constants of maps between hyperbolic surfaces. The results include some coarse properties of Thurston metric geodesics in general, and some finer properties (local isometric rigidity, quantitative non-uniqueness of geodesics) in the case of the punctured torus. This is joint work with Anna Lenzhen, Kasra Rafi, and Jing Tao.

5. **Subhojoy Gupta** (Indian Institute of Science)

Title: Monodromy of projective structures on punctured surfaces

Abstract: A complex projective structure on a Riemann surface is determined by a holomorphic quadratic differential via the Schwarzian differential equation. I shall talk about the case when the surface has punctures, and the quadratic differential has poles of finite order at the punctures. The space of such meromorphic projective structures admits a monodromy map to the moduli space of framed representations of the surface group to $PSL(2, C)$. I shall discuss a recent result characterizing the image of the monodromy map, that answers a question of Allegretti-Bridgeland. Part of this is joint work with Mahan Mj.

6. **Steven Kerckhoff** (Stanford University)

Title: Geometric Transitions: From Rigidity to Flexibility

Abstract: Hyperbolic structures on 3-manifolds tend to be rigid, relative to certain boundary data. Families of such structures, with varying boundary data, can degenerate to other types of geometric structures that are much more flexible. The particular limit structures typically are solutions to extremal problems. This lecture will discuss several examples of this phenomenon, each with some connection to Teichmüller theory.

7. **Jinsong Liu** (Chinese Academy of Sciences)

Title: Localization of the Kobayashi metric and applications

Abstract: In this talk we will introduce a new class of domains — log-convex domains. Then we will localize the Kobayashi metric in log-convex subdomains. As an application, we prove a local version of continuous extension of rough isometric maps between two bounded domains with log-convex Dini-smooth boundary points. Moreover we prove that the Teichmüller space $T_{g,n}$ is not biholomorphic to any bounded pseudoconvex domain C^{3g-3+n} which is log-convex near some boundary points. This is a joint work with Hongyu Wang.

8. **Yi Liu** (Peking University)

Title: Virtual homological spectral radii for automorphisms of surfaces

Abstract: A surface automorphism is an orientation-preserving self-homeomorphism of a compact orientable surface. A virtual property for a surface automorphism refers to a property which holds up to lifting to some finite covering space. It has been conjectured by C. T. McMullen that any surface automorphism of positive mapping-class entropy possesses a virtual homological eigenvalue which lies outside the unit circle of the complex plane. In this talk, I will review some background and outline a proof of the conjecture.

9. **John Loftin** (Rutgers University)

Title: Neck pinch limits for Hitchin representations for $PSp(4, R)$

Abstract: It is well known that on a closed oriented surface S of genus at least 2, Teichmüller space can be viewed a component of the representation variety of the fundamental group of S into $PSL(2, R)$. Hitchin used Higgs bundles to formulate a generalization of this component for higher rank split real Lie groups such as $PSL(n, R)$. In the rank 2 cases $PSL(3, R)$, $PSp(4, R)$, and G_2, there is additional interesting structure: 1) Labourie showed that one may reformulate Hitchin's construction, which involves a fixed background conformal structure on S, invariantly under the action of the mapping class group, and 2) Baraglia showed that Hitchin's equations, which in general produce a metric on a vector bundle, reduce in this case to coupled equations which are amenable to study by the maximum principle. We present this theory in terms of limits of representations for which the conformal structure on S degenerates to a nodal curve, and we discuss new joint work in progress with Qiongling Li and Andrea Tamburelli in the case of $PSp(4, R)$ representations.

10. **Feng Luo** (Rutgers University)

Title: Koebe conjecture, Weyl problem and discrete uniformization

Abstract: We will discuss some of the recent work relating Koebe's circle domain conjecture, Weyl's problem on convex surfaces and discrete uniformization problem for polyhedral surfaces. This is a joint work with Tianqi Wu.

11. **Marcello Lucia** (The City University of New York)

Title: Asymptotic behavior of minimal immersions in 3-dimensional hyperbolic manifold

Abstract: We will discuss the Gauss-Codazzi equations that arise when one considers minimal immersions of closed surfaces in hyperbolic three-manifolds. If one prescribes on a surface of genus higher than two a conformal structure and a holomorphic quadratic differential, each solution to from these Gauss-Codazzi equations allows to construct a minimal immersion in some hyperbolic 3-dimensional manifold whose second quadratic form will be the real part of the assign quadratic differential. Existence of one solution for this equation was established by Uhlenbeck. In this talk we will show that there are at least two solutions, and will also discuss the behavior

of such solutions when the norm of the second fundamental form is small. This is joint work with Z. Huang and G. Tarantello.

12. **Xin Nie** (Tsinghua University)

Title: Planar convex domains and cubic differentials

Abstract: The Cheng-Yau affine sphere construction endows every properly convex domain in the real projective planar with a canonical holomorphic cubic differential. We will first explain this construction and its consequences on the moduli space of convex real projective structures, then we will talk about some recent results and open problems arising from the construction.

13. **Kasra Rafi** (University of Toronto)

Title: Sub-linearly Morse boundary

Abstract: To every Gromov hyperbolic space X one can associate a space at infinity called the Gromov boundary of X. As shown by Gromov, quasi-isometries of hyperbolic metric spaces induce homeomorphisms on their boundaries, thus giving rise to a well-defined notion of the boundary of a hyperbolic group. Croke and Kleiner showed that quasi-isometric CAT(0) spaces can have non-homeomorphic boundaries and hence the visual boundary of a CAT(0) group is not well-defined. For any sublinear function k, we consider a subset of the visual boundary consisting of k-Morse geodesics and equip this space with a coarse version of cone topology. We show that this space is invariant under quasi-isometries, that is to say, the sub-linearly Morse boundary of a CAT(0) group is well-defined. We also show that, for any group G acting properly and co-compactly on a CAT(0) space X, the sub-linearly Morse boundary of X is a model for the Poisson boundary of G with respect to any finitely supported random walk on G.

14. **Jean-Marc Schlenker** (University of Luxembourg)

Title: Minimizing maps from a hyperbolic surface to a hyperbolic 3-manifold

Abstract: Let (S, h) be a closed hyperbolic surface and let M be a quasi-Fuchsian 3-manifold. We will consider maps from S to M that are critical points of an "energy" functional F which is homogeneous of degree 1. These "minimizing" maps are solutions of a non-linear elliptic equation, and reminiscent of harmonic maps. When the target is Fuchsian, minimizing maps are minimal Lagrangian diffeomorphisms to the totally geodesic surface in M. There is at most one smooth minimizing maps from (S,h) to M in a given homotopy class. When (S,h) is fixed, smooth minimizing maps from (S,h) are described by a simple holomorphic data on S: a complex self-adjoint Codazzi tensor of determinant 1. The space of admissible data is smooth and naturally equipped with a complex structure, for which the monodromy map taking a data to the holonomy representation of the image is holomorphic. Minimizing maps are in this way reminiscent of shear-bend coordinates, with the complexification of F analoguous to the complex length. Joint work with Francesco Bonsante and Gabriele Mondello.

15. **Weixu Su** (Fudan University)

Title: Distance and angles between Teichmüller geodesics

Abstract: We show that the angles between Teichmüller geodesic rays issuing from a common point, defined by using the law of cosines, do not always exist. The proof uses an estimation for the Teichmüller distance on finite dimensional Teichmüller spaces. As a consequence, the Teichmüller space equipped with the Teichmüller metric is not a $CAT(k)$ space. We also discuss some necessary conditions for the existence of angle between the Teichmüller geodesics.

16. **Jeremy Toulisse** (Université de Nice, CNRS)

Title: Quasi-circles and maximal surfaces in the pseudo-hyperbolic space

Abstract: Quasi-circles in the complex plane are fundamental objects in complex analysis; they were used by Bers to define an infinite-dimensional analogue of the usual Teichmüller space. After introducing the notion of quasi-circles in the boundary of the pseudo-hyperbolic space $H^{2,n}$, I will explain how to construct a unique complete maximal surface in $H^{2,n}$ bounded by a given quasi-circle. This construction relies on Gromov's theory of pseudo-holomorphic curves and provides a generalization of maximal representations of surface groups into rank 2 Lie groups. This is a joint work with Francois Labourie and Mike Wolf.

17. **Richard Wentworth** (University of Maryland)

Title: Asymptotic structure in the Hitchin moduli space

Abstract: The aim of this talk is to explain some of the large scale relationships between $SL(2, C)$ representations of a surface group, solutions to Hitchin's self-duality equations, and harmonic maps. In particular, we relate the limiting configuration construction of Mazzeo, et. al., to the geometric-topological parametrization of pleated surfaces in hyperbolic space of Bonahon-Thurston. This is joint work with Andreas Ott, Jan Swoboda, and Michael Wolf.

18. **Yunhui Wu** (Tsinghua University)

Title: Systole functions and Weil-Petersson geometry

Abstract: The Weil-Petersson gradients of geodesic-length functions along systolic curves are studied. We show that the $L^p(1 \leq p \leq \infty)$-norms of them at every closed hyperbolic surface X are uniformly comparable to $(systole(X))^{1/p}$. Several applications to Weil-Petersson geometry of the moduli of curves will be discussed.

19. **Hao Xu** (Zhejiang University)

Title: Asymptotics of Weil-Petersson volume and Masur-Veech volume

Abstract: Mirzakhani and Zograf initiated the large genus asymptotics of Weil-Petersson volume of moduli spaces of curves. We will talk about recent progress on their applications to random surface theory and the asympotics of Masur-Veech volumes of moduli space of quadratic differentials.

20. **Wenyuan Yang** (Peking University)

Title: Exponential genericity of pseudo-Anosov elements in Teichmüller metric

Abstract: It is an interesting question to quantify the phenomenon that "most" of elements in mapping class groups are pseudo-Anosov. One of ways is looking at the asymptotic proportion of pseudo-Anosov elements in a growing ball in Teichmüller metric. In this talk, I will show that the proportion of pseudo-Anosov ones tends exponentially quick to 1 as the radius of ball goes to infinity. This strengthens a result of Maher with the exponential convergence speed. Our proof replies on a study of contracting elements in any "statistically" convex-cocompact action on a geodesic metric space.

21. **Ying Zhang** (Soochow University)

Title: Comparing the minimal equal lengths in a once-punctured hyperbolic torus varying in its relative Teichmuller space: the asymptotic case

Abstract: We consider the problem of minimizing the equal length of a pair of simple closed geodesics of given topological type in a once-punctured hyperbolic torus with fixed geometric boundary data as the torus runs over its relative Teichmüller space. It is natural to compare the minimal lengths for inequivalent pair with the same intersection number. There is a conjecture that the minimal equal length of the specific pair of slopes $(1/0, 1/n)$ is smaller than that of any other pair of slopes $(1/0, m/n)$, regardless of the geometric boundary data. In joint work with Da Lei, we obtain a result of this type as the geometric boundary of the torus is a conic point and the cone angle is approaching 2π.

22. **Xuwen Zhu** (University of California, Berkeley)

Title: The Weil-Petersson metric on Riemann moduli spaces

Abstract: The subject of this talk is the moduli space of Riemann surfaces, which is the set of isometry classes of constant curvature metrics on a surface. The cotangent space of the moduli space is given by holomorphic quadratic differentials, and there is a natural Weil-Petersson metric defined by an L^2-type pairing. I will discuss the behavior of the moduli space when approaching the boundary of the Deligne-Mumford compactification, and show how to use tools from microlocal analysis to understand the degeneration of the Weil-Petersson metric. If time permits, I will talk about some recent work in progress on understanding its Ricci curvature, which can be viewed as a complete metric itself and has interesting spectral properties. This is joint work with Richard Melrose.