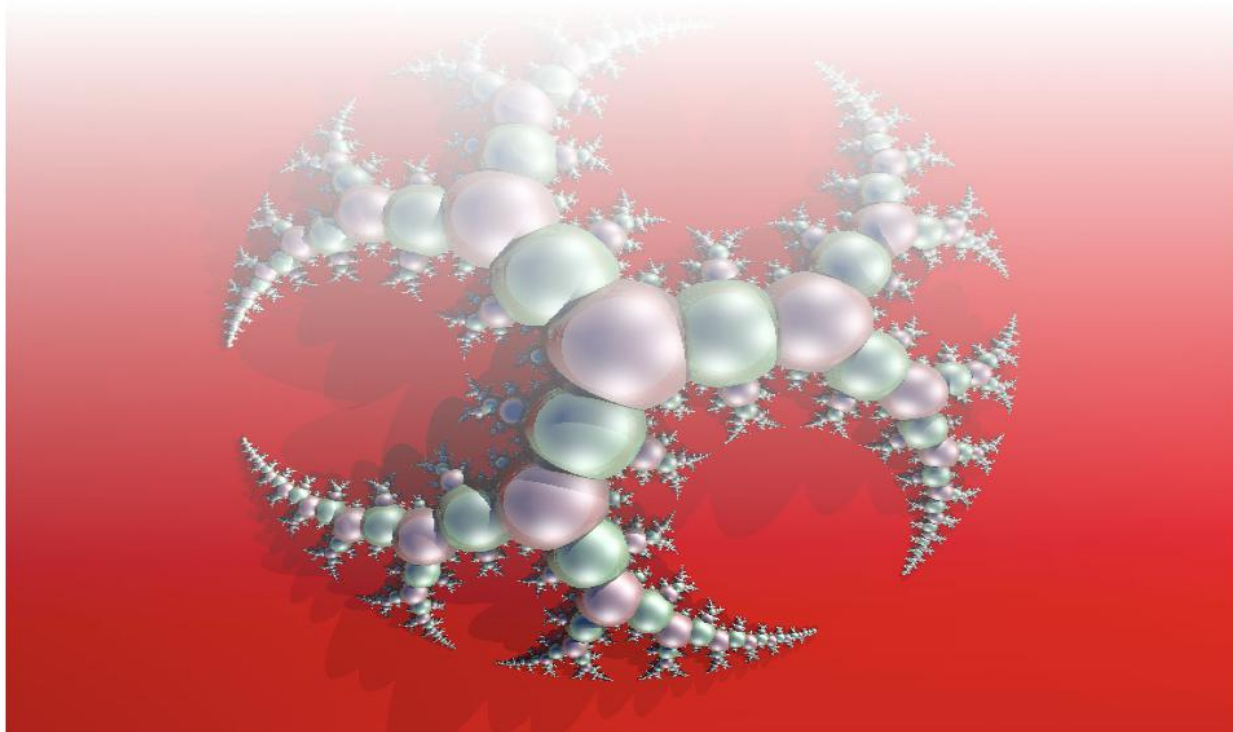




Junior Retreat

University of Michigan at Ann Arbor, 23 May - 1 June 2014

Participants' Research Interests



Research Interests

CHRISTOPHER
ABRAM

Arizona State University

I'm interested in hyperbolic geometry. In particular, my interests include cellular decompositions/cellular constructions of hyperbolic manifolds.

VINCENT
ALBERGE

Université de Strasbourg

My research interests are geometry and analysis on Riemann surfaces. Especially, the study of Teichmüller spaces from conformal and hyperbolic points of view. Much of my work concerns the study of Gardiner-Masur boundary. It is a natural compactification of Teichmüller space by using extremal length.

I am currently trying to study the asymptotic behavior between ueller rays and stretch lines. This study is made with respect to Teichmüller's metric and Thurston's asymmetric metric.

DANIELE
ALESSANDRINI

University of Heidelberg

My main research interest is about geometric structures on surfaces and on manifolds, and their relations with the varieties of representations of the fundamental group of the manifold in a Lie group. The geometric structures I prefer are hyperbolic and projective structures.

I studied several properties of Teichmüller spaces, from the point of view of hyperbolic geometry, e.g. the Thurston compactification, the Thurston asymmetric metric, and the length spectrum metric. In this setting I worked a lot about surfaces of infinite topological type.

I also like to generalize all this to convex projective structures, for example I worked at the compactification of the parameter space of convex projective structures, and its relations with tropical geometry

DYLAN
ALLEGRETTI

Yale University

cluster algebras, moduli spaces of local systems, quantum Teichmüller theory, two-dimensional conformal field theory, TQFTs, mirror symmetry, scattering amplitudes, noncommutative geometry, stability conditions and wall crossing

YAHYA
ALMALKI

Florida State University

My research interests are the geometry of Riemann surfaces and Teichmüller spaces and the theory of Kleinian groups.

I am studying the methods developed by Mika Seppälä and Tuomas Sorvali for studying the geometry of Teichmüller spaces. These methods are based on the complex analytic theory of Riemann surfaces and their uniformization by groups of Möbius transformations. In 1972, T. Sorvali introduced a new metric on Teichmüller space of Surface groups. This metric is defined in terms of traces and multipliers of Möbius transformations. It turned out that this metric is topologically equivalent to the Techimüller metric in the case of compact (or finite type) Riemann surfaces. I work on developing Seppälä-Sorvali methods to more general settings.

FABIÁN
ARIAS

Universidad de Los Andes

My area of research is differential geometry, particularly the study of principal fibre bundles and more specifically, bundles of linear frames and its G -structures. The objective goal is construct

geometrical objects, as characteristic classes, in these structures and to obtain similar results to the Hopf- Poincaré's Theorem and Gauss-Bonnet's Theorem in this context.

SHINPEI
BABA

Caltech

My research interests are complex projective structure, hyperbolic geometry, Teichmüller theory.

SAMUEL
BALLAS

University of California Santa Barbara

My research focuses on the study of convex projective structures, mostly on non-compact 3-dimensional manifolds. These structures have many similarities to hyperbolic structures on manifolds, however they are more flexible. In particular the geometry of their end is more diverse than their hyperbolic counterparts. My research currently focuses on classifying convex projective structures and understanding their geometry.

DAVID
BARAGLIA

University of Adelaide

I am interested in differential geometric structures on manifolds and their moduli spaces. Some moduli spaces I have worked on are: the moduli space of Higgs bundles on a Riemann surface, the moduli space of contact instantons on a contact 5-manifold and the moduli space of coassociative submanifolds in a G_2 -manifold.

At present I am particularly interested in studying aspects of the Higgs bundle moduli space related to mirror symmetry and geometric Langlands. Kapustin and Witten gave a physical derivation of the geometric Langlands correspondence using S-duality. This point of view highlights the importance of studying distinguished submanifolds of the Higgs bundle moduli space, known as branes. Roughly speaking branes are either complex Lagrangian or hypercomplex submanifolds, equipped with a vector bundle. I am looking at various constructions of these branes and studying their topology and geometry. The study of these branes may help in understanding character varieties of 2- and 3-manifolds.

BRIAN
BENSON

University of Illinois at Urbana-Champaign

I study the spectral theory of and the isoperimetric problem on Riemannian manifolds. For a fixed $t \in [0, \text{Vol}_n(M)]$, the isoperimetric problem on a Riemannian n -manifold M seeks to find n -dimensional subset A of M so that $\text{Vol}_n(A) = t$ and so that $\text{Vol}_{n-1}(\partial A)$ is minimal among all subsets of M having n -volume equal to t . The ratio $\text{Vol}_{n-1}(\partial A)/\text{Vol}_n(A)$ is called the isoperimetric ratio of A . A quantity related to the isoperimetric problem on M is the Cheeger constant of M , denoted $h(M)$, which can be thought of as the infimum of isoperimetric ratios over all solutions to isoperimetric problems with $t \in (0, \text{Vol}_n(M)]$. Cheeger showed that $h(M)$ can be used to give a non-trivial lower bound on the smallest positive eigenvalue of the Laplacian on M , denoted $\lambda_1(M)$. When M is closed, Buser's inequality gives an upper bound on $\lambda_1(M)$ in terms of $h(M)$. One success of my research program is to give an analog of Buser's inequality which gives an upper bound on the higher eigenvalues of M in terms of the Cheeger constant; this result is an eigenvalue comparison between the eigenvalues of the Laplacian on M and the eigenvalues of a Sturm-Liouville (ODE) problem which depends on $h(M)$.

My initial motivation for studying $h(M)$ and $\lambda_1(M)$ came from the work of Lackenby, who showed how these quantities are related several problems in the theory of 3-manifolds such as the virtually Haken conjecture (later resolved by Ian Agol) and the rank versus Heegaard genus question for hyperbolic 3-manifolds (later resolved by Tao Li). Despite the resolution of many of these problems, Lackenby's work provides more than adequate motivation to classify sets achieving the Cheeger constant (Cheeger minimizers) and improve our ability to compute the Cheeger constant for hyperbolic 2- and 3-manifolds. Along these lines, my program has produced such a classification for hyperbolic

2-manifolds as well as an existence theorem for Cheeger minimizers in Riemannian manifolds which applies to hyperbolic 3-manifolds.

MAXIME
BERGERON

University of British Columbia

I am intrigued by the topology of spaces of homomorphisms. Concretely, this means I spend a lot of my time studying the topology of varieties $\text{Hom}(\Gamma, G)$ of representations from a finitely generated group Γ into a reductive linear algebraic group G (e.g. $\text{GL}(n, \mathbb{C})$ or $\text{GL}(n, \mathbb{R})$) and the corresponding character varieties $\text{Hom}(\Gamma, G)//G$.

From the point of view of algebraic topology, it is easier to understand the compact subspace $\text{Hom}(\Gamma, K) \subset \text{Hom}(\Gamma, G)$ where K is a maximal compact subgroup of G (e.g. $\text{O}(n)$ or $\text{U}(n)$). However, the topological spaces $\text{Hom}(\Gamma, K)$ and $\text{Hom}(\Gamma, G)$ usually have very little to do with each other; for instance, some of the connected components of $\text{Hom}(\Gamma, G)$ may not even intersect $\text{Hom}(\Gamma, K)$! What I find interesting is that in some exceptional cases $\text{Hom}(\Gamma, G)$ and $\text{Hom}(\Gamma, K)$ happen to be homotopy equivalent and this allows one to compute otherwise inaccessible topological invariants. This phenomenon is not well understood and my current work focusses on producing classes of finitely generated groups Γ for which there is such a homotopy equivalence at the level of representation varieties or character varieties. So far, I have shown this to be true for nilpotent groups and certain right-angled Artin groups but I'm constantly looking for new (counter)examples.

EDGAR
A. BERING IV

University of Illinois at Chicago

I am a second year graduate student still searching for a precise research direction; at present my search has narrowed to looking at problems in 3-manifolds and geometric group theory from an effective point of view.

JAKOB
BLAAVAND

University of Oxford

My research area is the geometry of moduli spaces of Higgs bundles. I study Higgs bundles via Nahm and Fourier–Mukai transforms. Such transformations turns a Higgs bundle into a different type of object on a manifold naturally associated to the Riemann Surface on which the Higgs bundle lives. The hope is that these transformed objects will reveal new aspects of Higgs bundles.

A Fourier–Mukai transform for Higgs bundles was initially constructed by Bonsdorff in his Oxford-thesis. Still many questions need to be resolved. It is expected that the transform is a hyperkähler isometry, but there is still long way to go. Firstly we do not know what the essential image of the transform is. Bonsdorff proved that the transform is invertible, and identified a number of properties of the transformed bundles by using purely algebraic methods. I hope to be able to shed new light on the transform by, among other things, approaching it from a differential geometric viewpoint.

MARTIN
BRIDGEMAN

Boston College

I am interested in the connection between hyperbolic geometry, dynamics, geometric analysis, and number theory. In particular using methods from dynamics to construct geometric measures associated with hyperbolic manifolds in order to define structures on moduli spaces. Such measures include the Hausdorff measure on the limit set of a Kleinian group, the geodesic currents introduced by Bonahon to study Teichmüller space, the Patterson-Sullivan measure of a Kleinian group, and push-forwards of volume measures by certain geometrically defined functions.

JEAN-PHILIPPE
BURELLE

University of Maryland

I am interested in geometric structures modeled on homogeneous spaces including hyperbolic, affine, projective, flat conformal and conformal lorentzian structures.

DUVÁN
CARDONA

Universidad de los Andes at Bogotá - Colombia

My area of research in geometry is pseudo-differential operators on manifolds and compact lie groups, particularly the study of invertibility and boundedness of these operators. Much of my work thus far concerns the study of invertibility and behaviour of pseudo-differential operators on the torus; the central goal are applications to partial differential equations and quantization on compact lie groups and homogeneous spaces.

At this time, I am working on applying the ideas I have developed to the study of quantization os these operators on manifolds, due relationship between elliptic pseudo-differetial operators and index theory.

SAIKAT
CHATTERJEE

Institut des Hautes Études Scientifiques

I mainly work in the areas of differential geometry and higher category theory. I have studied (with Amitabha Lahiri, Ambar N. Sengupta) the categorical connections on categorical fibre bundles. In order to describe categorical connections we need “higher” connection forms, which are given by 2 forms with “suitable properties,” as well ordinary connection 1-forms. Let (A, B) defines a categorical connection, where A is a connection 1 form on a principal G bundle P, M and B be and $L(G)$ (Lie algebra of G) valued 2 form on P . Then it can be shown they define a ”higher curvature” $(F_A - B, d_A B) := (F, G)$ and satisfies higher Bianchi identities

$$\begin{aligned}d_A F &= -G \\d_A G &= F \wedge B.\end{aligned}$$

Using local trivialization on (P, M) we can equivalently describe the system by 1 forms and 2-forms on M (we also denote them as (A, B)). Now a generalized Yang-Mills action is given by

$$S(A, B) := \int_M \text{Tr}(F \wedge *F) + \text{Tr}(G \wedge *G),$$

where $*$ is the Hodge star operator on M . Extremizing the action one obtains following solutions:

$$\begin{aligned}d_A * G &= - * F, \\d_A * F &= *G \wedge B.\end{aligned}$$

Suppose M to be a 5 dimensional (semi)Riemannian manifold with a metric having an even number of minus signs in the signature. If we assume there exists a higher connection pair (A, B) for which $F = *G$. Then by higher Bianchi identity such a higher connection automatically satisfies higher Yang-Mills equation. Thus we call the condition

$$F = *G$$

the ”higher self-duality” condition. I would like to study the moduli space of solutions of higher Yang-Mills equations. More specifically I would be focusing on higher self-dual solutions.

EDWARD
CHIEN

Rutgers, The State University of New Jersey

My area of research is discrete approximations to smooth geometric structures on low-dimensional manifolds. Such ideas can often be used to demonstrate continuous results in the limit.

I have recently been studying piecewise flat metrics on surfaces, and a new notion of discrete conformality. Such a metric on a surface S is locally flat, except at a specified vertex set V . Choosing a triangulation τ with this same vertex set allows one to describe the metric with length assignments to each edge. Discrete conformal changes involve scaling edge lengths emanating from a vertex, up to preservation of a Delaunay condition. With this notion comes a uniformization result, and a discrete Ricci flow. It offers hope for a constructive proof of the Riemann Mapping Theorem, á la Thurston’s circle packing. This uniformization result realizes an identification of Penner’s decorated Teichmüller space with the space of piecewise flat metrics on S .

ANTOINE
CLAIS

Université Lille 1, France

My area of research is the geometric group theory. My work is related to the following topics : hyperbolic groups, Coxeter groups, buildings, cubical complexes, quasi-conformal analysis on boundaries, combinatorial modulus of curves.

For my PhD thesis, I am studying quasi-conformal structures on boundaries of right-angled hyperbolic buildings using the combinatorial modulus of curves on the boundary. In particular, I am looking for examples of groups whose boundary satisfies the Combinatorial Loewner Property (CLP). This property of the boundary can lead to some rigidity results in the building.

I found examples of right-angled hyperbolic buildings with a boundary that satisfy the CLP in dimension 3 and in dimension 4. These examples are graph products whose underlying Coxeter groups are the reflection group of the right-angled dodecahedron of \mathbb{H}^3 or the right-angled 120-cell of \mathbb{H}^4 . At this time I am trying to extend the methods I used to find the CLP on boundaries of other graph products.

NEAL
COLEMAN

Indiana University Bloomington

My area of research is global harmonic analysis on 2- and 3-dimensional manifolds and its relationship with moduli spaces of geometric structures. In particular, I am interested in how the spectrum of the Laplace operator varies under deformations of geometric structure.

I have recently focused on three-dimensional hyperbolic cone orbifolds with the objective of better understanding the behavior of the Laplace spectrum under hyperbolic Dehn surgery. As part of this project, I am applying perturbation theory methods to simpler two-dimensional geometric structures. I hope to apply similar techniques in the three-dimensional hyperbolic setting.

NELSON A.
COLÓN

University of Iowa

My area of research is Quantum Topology. In particular skein algebras and their algebraic extensions on 3-manifolds for A an N -th root of unity, that is $K_A(M)$. I'm more concern with finite extensions of such algebras and their relations with the character variety.

At this time I'm working on simplifying skein algebras of compact, oriented, 3 manifolds M , by finding a local annulus in M and using properties of the relative skein of the annulus to simplify locally. A computational paper of this simplification will be uploaded soon to the Archive, under the tittle of Computations In The Relative Skein Algebra Of A Local Annulus.

ELLIE
DANNENBERG

University of Illinois at Chicago

My area of research is the study of geometric structures on surfaces.

SAIKAT
DAS

Rutgers-Newark

I am a beginning graduate student have not developed a research interest yet. Nonetheless, I have studied Thurston's Works on Surfaces and Mapping Class Groups.

Currently, I am studying out F_n and the geometry of the outer spaces and the notion of train track maps with respect to $OutF_n$. I aim to work in Outer space.

KAJAL
DAS

Ecole Normale Supérieure de Lyon

I am a first year PhD student in ENS de Lyon, working with Romain Tessera in Université Paris-Sud 11. My area of research is geometric group theory and measurable group theory.

In the last few months, I had been working on the relations between quasi-isometry and integrable measure equivalence. The ‘integrable measure equivalence’ relation became very significant after a rigidity result of the lattices in $Isom(H_n)$ (for $n \geq 2$) by Bader, Furman and Sauer. I, with Tessera, recently found a nice result on the relations between these two equivalence relations of groups.

At this time, I am working on some questions of embedding a sequence of graphs coarsely inside some metric spaces, more precisely inside an Hadamard manifold.

ARTUR
DE ARAUJO

Universidade do Porto

The subject of my thesis is the study of the geometry and topology of character varieties for representations of surface groups in real Lie groups by methods of the theory of Higgs bundles. I am also interested in the study of geometric structures, especially using methods of Higgs bundles, as well as interactions with theoretical physics.

SPENCER
DOWDALL

University of Illinois at Urbana-Champaign

My research interests include low-dimensional and geometric topology, geometric group theory, and dynamics. I am particularly interested in Teichmüller spaces and mapping class groups, with additional focus on the dynamical properties of surface homeomorphisms and free group automorphisms.

More specifically, my research has involved studying pseudo-Anosov homeomorphisms of surfaces with a particular focus on those arising from “point-pushing.” Other work has focused on certain classes of purely pseudo-Anosov subgroups of mapping class groups and on relating this property to convex cocompactness. I have also done work quantifying the prevalence of negative curvature phenomena in Teichmüller space, investigating questions such as “how thin are most geodesic triangles?” More recently I have become interested in $Out(F_n)$ and have undertaken a project to study the various splittings of a free-by-cyclic group with the aim of understanding how their associated monodromy automorphisms are related to each other.

BENJAMIN
DOZIER

Stanford University

Broadly, I am interested in geometric structures in two and three dimensions and associated moduli spaces. I am particularly interested in dynamical questions regarding the individual objects as well as the moduli spaces. I am only just diving into research, but some of the specific problems that I have started to think about regard asymptotics of saddle and cylinder counts on flat surfaces, and the similarities and differences between this and the problem of counting closed geodesics on negatively curved surfaces. I am also interested in using geometric techniques to study mapping class groups, for instance via the analogy between (i) the action of the mapping class group on Teichmüller space and its Thurston boundary, and (ii) the action of a Kleinian group on hyperbolic space and its sphere at infinity.

GEORGE
DRAGOMIR

McMaster University

My research concerns the geometry and topology of orbifolds, and includes themes from Riemannian geometry, geometric group theory and algebraic topology. A central topic of my work is investigating the existence of closed geodesics on compact developable orbifolds. This involves the study of (discrete) group actions on manifolds and reveals some very interesting connections between the algebraic properties of such groups and the geometry of the quotient space. Adapting ideas developed for geometric actions on manifolds to the more general setting of actions on metric spaces relates this line of research to many interesting questions in geometric group theory, especially problems regarding infinite torsion groups and their finiteness properties.

The modern perspective on orbifolds is based on the concept of groupoid (a small category in which all morphisms are invertible), and this point of view has been playing an increasingly important

role in the recent advances of orbifold theory. One notable achievement of this perspective is the development of the algebraic topology of orbifolds. In particular, invariants as the homotopy type of an orbifold and the singular orbifold cohomology can be defined using the classifying space of the groupoid representing it. These cohomology groups computed with ring coefficients are a powerful invariant for orbifolds as the information on the orbifold structure is contained precisely in the torsion occurring in these groups. Understanding these torsion classes is a very difficult, but important problem. Another direction of my research considers using Morse theory to describe the singular orbifold cohomology with integer coefficients and to extract information about the torsion classes.

DAVID
DUMAS

University of Illinois at Chicago

I study spaces of geometric structures on low-dimensional manifolds and related topics in analysis and geometry. Real and complex projective structures on surfaces and their connections to hyperbolic geometry in two and three dimensions have been a particular focus of my work. I often explore geometric questions using complex-analytic tools, such as methods from Teichmüller theory or from analytic constructions of moduli spaces and character varieties.

Numerical experiments and computer visualization aid and inform my theoretical work. I develop open-source software tools to help others do the same.

YEN
DUONG

University of Illinois at Chicago

I'm interested in the hip subject of special cube complexes and small cancellation theory, which Ian Agol used in proving the Virtual Haken Conjecture. In particular, I'm interested in how these two tools can be used to determine the hyperbolicity of groups, and/or to analyze the splittings of certain types of groups.

MATTHEW
DURHAM

University of Illinois at Chicago

My research interests lie in geometric group theory and low dimensional topology. I have been mainly studying the coarse geometry of mapping class groups and Teichmüller space via the associated machinery built from the curve complex. I am also interested in the geometry of hyperbolic 3-manifolds, cubical geometry, and $\text{Out}(F_n)$, especially in its analogy to the mapping class group.

VIVEKA
ERLANDSSON

Aalto University

My research interests lie in hyperbolic geometry. In my dissertation I investigated the geometry and dynamics of screw translations (parabolic isometries with a rotational part) acting on hyperbolic 4-space and the corresponding Margulis cusps of hyperbolic 4-manifolds. The description of the shape of the corresponding Margulis region in the upper half space model implies a necessary discreteness condition for the isometry group, which can be viewed as a generalization to Shimizu's and Jorgensen's conditions in lower dimensions. I am currently working on generalizing these results to arbitrary dimensions as well as to complex hyperbolic space.

I am also interested in the action of quasi-isometries on hyperbolic spaces. I am investigating to what extent quasi-isometries distort certain geometric properties of the space and how close they are to being isometries.

FEDERICA
FANONI

University of Fribourg

My research interests are in hyperbolic surfaces, hyperbolic two-dimensional orbifolds and Teichmüller theory. My general goal is to understand which kind of hyperbolic structures one can put on topological surfaces. To do that, I want to study on the one hand properties shared by all metrics and, on the other hand, 'extremal' surfaces (surfaces minimizing or maximizing some quantity in their moduli space).

More precisely, I am working on two problems. The first one is finding bounds for the maximum injectivity radius of hyperbolic orbifolds, i.e. for the maximal radius of a hyperbolic disk that can be isometrically embedded in an orbifold. So far, I have obtained a lower bound for orbifolds and I am still working on this problem in various contexts. The second problem is studying surfaces with many systoles and bounding the kissing number (the number of systoles) in terms of the signature of the surface.

AARON
FENYES

University of Texas at Austin

I'm interested in the geometric aspects of physics in general, and field theories in particular. My current project, supervised by Andrew Neitzke, involves deformations of flat $SL_2\mathbb{C}$ connections which are similar in spirit to Dreyer's cataclysms for Anosov representations, and may also be distantly related to other wall-crossing-type constructions. I'd like to learn more about these constructions, in the hopes of distilling some useful knowledge about their common features.

LAURA
FREDRICKSON

University of Texas at Austin

Broadly, my area of research is Higgs bundles. I am working on explicitly describing solutions of Hitchin's equations when the L^2 -norm of the Higgs field is very large. As the L^2 -norm of the Higgs field goes to infinity, solutions of the $G = SU(n)$ Hitchin's equations are "abelianized" away from the spectral points. I am currently working on constructing explicit approximate solutions by gluing "fiducial" solutions at the spectral points to the abelianized solutions of Hitchin's equations away from the spectral points.

SER-WEI
FU

University of Illinois at Urbana-Champaign

My research interests centers around hyperbolic geometry, geometric group theory, low-dimensional topology, and dynamical systems. These topics are tied together by the study of homotopy classes of closed curves. Some of the main objects in my study are quadratic differentials, measured foliations, and train tracks.

All my past and current projects consider simple closed curves. I am interested in the dynamics of their lengths under deformations of either hyperbolic metrics or Euclidean cone metrics. As a side project, I also study vectors generated by geometric intersection numbers.

LINDSEY K.
GAMARD

Arizona State University

I am a first-year graduate student exploring research possibilities in differential geometry. My current interests include Riemannian geometry and the Ricci flow.

JONAH
GASTER

Boston College

I am interested in \ddot{u} ller theory, geometric structures, and curves on surfaces. My work has focused on Thurston's *skinning map*, a holomorphic self-map of \ddot{u} ller space that arises in the setting of geometrically finite hyperbolic structures on open 3-manifolds, and separately on mapping class group orbits of maximal collections of curves on a closed surface pairwise intersecting once. The latter involved Sageev's dual cube complex to a collection of curves and some detailed drawings of curves on surfaces, while the former involved elementary complex analysis and symmetries of some quasi-Fuchsian manifolds.

I like to hear and wonder about quasi-Fuchsian 3-manifolds, complex projective structures, $PSL(2, \mathbb{C})$ -character varieties, the Goldman Lie algebra of closed curves on a fixed topological surface, trace equivalence and lengths of curves on hyperbolic surfaces, among other things.

GHAZOUANI
SELIM

DMA, ENS Ulm

My main interest of research is the study of geometric structures of surfaces, their moduli spaces and their holonomy maps. Recently I have been studying the specific case of complex affine structures, focusing on the mapping class group action on affine characters .

SOURAV
GHOSH

Universite Paris-Sud 11

My area of research is the geometry, dynamics and analysis of the Moduli Space of Margulis Space Time. Much of my work thus far concerns the study of Anosov structures on a Margulis Space Time; the central goal is to define a Pressure metric on the aforementioned moduli space and show that it is a Riemannian metric.

Apart from that, I am also interested in learning about Teichmüller theory and geometry of hyperbolic 3-manifolds.

JORDANE
GRANIER

Université de Grenoble, Université de Fribourg

My research interests lie in the study of hyperbolic structures (mainly real) and the study of discrete groups of isometries of the hyperbolic space H^n . I am also concerned with the arithmeticity properties of these groups.

The main object I have been working on is the moduli space of flat cone metrics on the sphere S^2 with a given number of cone singularities and given cone angles. Thurston showed that the moduli space of such metrics (up to isometry and scaling) has a complex hyperbolic structure. If we restrict ourselves to metrics with a certain symmetry, the new moduli space is endowed with a real structure: each of its components is a real hyperbolic arithmetic orbifold, which can be explicitly described. There is then a natural way to glue these components together, and I want to study the geometric structures that can be put on the space obtained by this gluing process.

RYAN
GREENE

The Ohio State University

I work on geometric aspects of reflection groups, particularly deformation problems for geometric structures on reflection orbifolds and actions of reflection groups on homogeneous spaces – so far, mainly real projective space, hyperbolic space, and complex hyperbolic space.

I am currently working on applications of group cohomology to projective deformations of right angled hyperbolic reflection groups and generalizations of previous results of mine on cohomology of Coxeter groups to the setting of representations of Hecke algebras and complex reflection groups.

CLEMENT
GUERIN

Université de Strasbourg

I am working on the geometry of the variety of representations of a fuchsian group into a semi-simple (or just reductive) Lie group. Although much work has been done when the fuchsian group is the fundamental group of a compact surface, there are still many things to understand when the fuchsian group is not a surface group (e.g. triangular group or more specifically $T_{2,3,7}$).

Actually, it is well known that for fuchsian groups without parabolic elements, we can always find a normal surface group of finite index in it, so I am interested in the link between the two representation varieties associated.

I hope that this method will allow me to get some ”local” results (singularities) and also some ”global” results (number of connected components).

SERGEI
GUKOV

California Institute of Technology and MPI, Bonn

I work on problems at the interface of representation theory, low-dimensional topology and physics. More specifically, I continue the line of work with various collaborators on physical realization of link homologies in terms of enumerative invariants of certain Calabi-Yau manifolds, a subject interesting on its own right (e.g. recently studied by Kontsevich-Soibelman and others). Another, closely related line of research is to understand the duality transformation of branes on the Hitching moduli space, as predicted by the four-dimensional gauge theory. In many interesting cases, it requires going beyond the sigma-model approximation and understanding what happens at the singularities of the Hitchin moduli space.

SUBHOJOY
GUPTA

Caltech/QGM

My interests lie in Teichmüller theory and hyperbolic geometry and my recent work has focused on the dynamics of “grafting” deformations of complex-projective structures on surfaces. I am particularly interested in its relation to the Teichmüller geodesic flow, and more generally, in a comparison of complex-earthquake deformations and orbits of the $SL_2(\mathbb{R})$ -action on moduli space. This entails trying to understand geometric structures on surfaces that arise as limits of such deformations (eg. “half-plane differentials” that induce singular-flat structures of infinite area). Most irreducible representations of the surface-group $\pi_1(S)$ to $PSL_2(\mathbb{C})$ arise as the holonomy of complex-projective structures on S , and we hope to probe properties of the $PSL_2(\mathbb{C})$ -character variety via this holonomy map.

ROSEMARY
GUZMAN

University of Iowa

My research area is in low-dimensional topology, hyperbolic geometry, and geometric group theory. My work explores the interaction between the algebraic-topological properties of a hyperbolic 3-manifold and its geometry. Some of my research generalizes in the k -free case results shown by Peter Shalen and Marc Culler in the 4-free case, and in doing so with appropriate group-theoretic assumptions, improves known bounds on the volume of a closed, orientable hyperbolic 3-manifold with k -free fundamental group. In particular, I have shown that one can choose a point P in such a manifold M with 5-free fundamental group such that the set of all elements of $\pi_1(M, P)$ represented by loops of length less than $\log 9$ is contained in a subgroup of rank at most 2; more explicitly, they generate a free group. This theorem requires fewer group-theoretic assumptions than its predecessors, and the existence of this special point P in the manifold provides new information about its geometry and volume – a current project. A key ingredient I have shown that builds upon the work of Kent and Louder–McReynolds (related to the verified Hanna Neumann Conjecture), is that given two rank-three subgroups of a free group, if the rank of their intersection is greater than or equal to three, then the rank of their join is less than or equal to three. A side endeavor is exploring the validity of this statement for higher values.

MUSTAFA
HAJJI

Louisiana State University

My research uses combinatorial and skein theoretical techniques to study problems in low-dimensional topology. My current research focuses on understanding the coefficients of the colored Jones polynomial.

At this time, I am using skein theory to study q -series that arise from knots and quantum spin networks in S^3 . These q series, also called the head and tail of knots and quantum spin networks, seem to be connected to some classical number theoretic identities. In particular I have recently used skein theory to prove the Andrews-Gordon identities for the two variable Ramanujan theta function as well to corresponding identities for the false theta function. I am working on studying other identities that could arise from this point of view.

OSKAR
HAMLET

Gothenburg University

My research thus far concerns the geometry of Hermitian symmetric spaces. I have been studying how the Kähler form behaves under totally geodesic maps and classified so called tight maps. From the Kähler form one can construct a continuous bounded cohomology class known as the bounded Kähler class. Knowing how the Kähler form behaves under totally geodesic maps is equivalent to knowing how the bounded Kähler class behaves under homomorphisms between Hermitian Lie groups. The bounded Kähler class is the source of an important invariant, the Toledo invariant, for surface group representations in Hermitian Lie groups. Representations $\rho: \pi_1(\sigma) \rightarrow G$ with maximal Toledo invariant carry many interesting properties, one being that they leave invariant a tightly embedded subspace of the symmetric space corresponding to G .

The Toledo invariant can also be constructed for representations of complex hyperbolic lattices in quaternionic Lie groups. This time the source of the invariant is the bounded cohomology class coming from the invariant 4-form of quaternionic symmetric spaces. In my current research I am trying to understand the geometry of quaternionic symmetric spaces and this 4-form.

SEBASTIAN
HENSEL

University of Chicago

My research interest lies at the intersection of low-dimensional topology and geometric group theory. Broadly speaking, I am interested in everything that involves a mapping class group somewhere – be it of a surface, a handlebody, a doubled handlebody or something else.

Recently, I have been particularly interested in the geometry of curve graphs and their analogs (arc, sphere and disk graphs). With Piotr Przytycki and Richard Webb I found a new and short proof of hyperbolicity of curve and arc graphs with small uniform constants. In joint work with Piotr Przytycki and Damian Osajda I developed a version of dismantlability for arc, sphere and disk graphs, which has various implications. As an example, it implies Nielsen realisation type results in all these settings with a unified proof, and can be used to show that very natural candidates are in fact classifying spaces for proper actions for mapping class groups. As work-in-progress I try to use these methods with Dawid Kielak to show Nielsen realisation for outer automorphism groups of RAAGs.

On a different side of the spectrum, I am interested in dynamical properties of foliations and interval exchange transformations (and of course their connections to mapping class groups). As a step in that direction, I showed with Jon Chaika that the set of uniquely ergodic interval exchange transformations is path-connected (unless the permutation presents obvious combinatorial obstructions)

SON LAM
HO

University of Maryland

My research interests are geometric structures and their relation with low-dimensional topology. I am currently working on flat conformal circle bundles over closed surfaces. These are boundary at infinity of disc bundles over surfaces with complete hyperbolic metrics. The goal of my research so far has been to describe how the existence of this geometry restrict the topology of the circle/disc bundle in terms of a bound on the Euler number.

The holonomy group of these manifolds are surface groups in $G = \text{Isom}(\mathbb{H}^4)$. These groups (in nice cases) are quasi-Fuchsian groups with quasi-circle limit set in S^3 . An interesting question is: to what extent does the Euler number (of the quotient manifold) classify the components of the set of quasi-Fuchsian surface groups $QF(\pi) \subset \text{Hom}(\pi, G)/G$?

ANDY
HUANG

Rice University

I'm interested in harmonic maps between compact Riemann surfaces of different genus and those geometric structures which can be obtained from them, e.g., through a composition of a representation and the induced fundamental group homomorphism, or through prescribing a geometric structure to the domain coming from the geometry of the harmonic map.

GAHYE
JEONG

California Institute of Technology

I am interested in geometry and analysis of 2,3 dimensional hyperbolic manifolds. I want to have an opportunity to study about dynamics of spaces.

LIZHEN
JI

University of Michigan

I have been interested in actions of discrete groups. One example is the action of discrete subgroups of semisimple Lie groups on symmetric spaces, and their quotients are locally symmetric spaces. Both discrete subgroups of Lie groups and locally symmetric spaces admit several generalizations and specializations. For example, Kleinian groups and hyperbolic groups are particularly important cases. Some important moduli spaces are given by locally symmetric spaces. They motivate and shed light on other moduli spaces which are not, for example, action of the mapping class group on Teichmüller space, moduli spaces of Riemann surfaces, and higher Teichmüller spaces. The last is related to interaction between discrete subgroups of Lie groups with other Lie groups through representations.

These analogy and interaction between different subjects and concepts are fascinating and beautiful to me, and I hope to understand them better.

LIEN-YUNG
(NYIMA) KAO

University of Notre Dame

My primary area of research is dynamical systems, especially its application to geometry. More precisely, I'm studying pressure metrics as an application of thermodynamical formalism and entropy rigidity problems of negative curved manifolds and representations of hyperbolic groups. My current project is to construct a pressure metric on the Teichmüller space of puncture surfaces (i.e. finite type Riemann surfaces). Since there is not constrain on compactness on Riemann surface in the original Teichmüller theory. In detail, I'm trying to apply the Thermodynamical formalism like the previous works of McMullen; Bridgeman, Canary, Labourie and Sambarino. But the main difficulty is that the coding of geodesics is much complicated than the compact cases. However, the works of Ledrappier and Sarig show a promising method to overcome this technicality.

CURTIS
KENT

University of Toronto

An asymptotic cone of a group G is the space obtained by observing G with a fixed word metric from infinitely far away. Or more precisely, an asymptotic cone of a group G with word metric, dist , is the ω -limit of the sequence of metric spaces $(G, \text{dist}/d_n)$ where (d_n) is a divergent sequence of scaling constants and ω is an ultrafilter. There are many connections between the combinatorial and algorithmic properties of groups and the geometric structure of its asymptotic cones.

I am particularly interested in examining how the geometry of the asymptotic cones of a group relates to the isoperimetric inequalities of the group. I have shown that in many cases an exponential isoperimetric function for curves implies that all asymptotic cones of the group are not semi-locally simply connenected. Papasoglu has shown that having a quadratic isoperimetric function implies that all cones are simply connected. It has been conjectured that all CAT(0) groups satisfy a linear isoperimetric inequality for all dimensions at least the CAT(0)-rank of the group. This follows from hyperbolicity when the rank is one. Also, Stefan Wenger has recently shown that CAT(0) groups have a sub-Euclidean isoperimetric function for metric currents with dimension at least the rank of the group. My current approach is to use asymptotic cones of a group to study a class of geometrically defined simplicies which were originally defined by Bruce Kleiner.

MUHAMMAD
ALI KHAN

University of Porto

My area of research is dynamical systems and ergodic theory, in particular the study of statistical

stability for chaotic dynamics. In my work I consider parameter families of one-dimensional maps that naturally arise from the Lorenz equations. It is well known that for typical parameters the system has a (unique) physical measure, which may be either an average of Dirac measures supported on a periodic orbit or an absolutely continuous invariant measure. My aim is to study that in the full set of parameters for which the corresponding dynamical system has a physical measure is there continuous dependence of the physical measure with respect to the parameter.

SEMIN
KIM

Brown University

My research interests are geometric analysis, harmonic map and Teichmüller theory. I am working on applying analytic techniques, such as harmonic map and Higgs bundle, to geometric objects like Teichmüller space.

My current project is understanding compactification of (higher) Teichmüller space using sequence of representations and their convergence behavior in the view of corresponding harmonic map and Higgs bundle.

THOMAS
KOBERDA

Yale University

I am interested in the algebraic and geometric structure of groups that naturally arise in the study of mapping class groups of surfaces. In particular, I am most interested in mapping class groups themselves, right-angled Artin groups, and 3-manifold groups.

My recent projects (most of them joint with Sang-hyun Kim) have included applying mapping class group methods to study the algebra of right-angled Artin groups, and to understand the types of right-angled Artin groups that embed in a given mapping class group. I have been developing a Masur–Minsky style curve complex machinery for right-angled Artin groups with the eventual goal of understanding the quasi-isometry classification of right-angled Artin groups.

Another project (joint with Alex Suciu) has used 3-manifold topology and various group-theoretic methods to understand the residual properties of the fundamental group of the complement of a line arrangement in the complex projective plane.

ALEXANDER
KOLPAKOV

University of Toronto

My area of research is the geometry and combinatorics of hyperbolic Coxeter groups, associated Coxeter polytopes and higher-dimensional manifolds. The main goal is to reach the understanding of the properties of the action of Coxeter groups (as well as other discrete groups) on hyperbolic spaces in dimensions beyond 3.

At the moment I'm carrying out a project that intends to use the ideas and methods from hyperbolic geometry, the theory of reflection groups and the theory of convex polytopes in order to study the structure of four-dimensional hyperbolic manifolds.

JULIEN
KORINMAN

Institut Fourier

I am interested in Topological Quantum Field Theories and low dimensional topology in general. More precisely, I study the representations of the Mapping Class Group of surfaces coming from theories associated to compact Lie groups.

KENJI
KOZAI

UC Berkeley

My area of research is geometric structures on 3-manifolds. In particular, I study deformations of hyperbolic structures and transitions to other geometric structures. My research thus far has centered on regenerating hyperbolic structures from the natural Sol structure on a fibered 3-manifold.

I am currently thinking about extending these results in various ways: removing the hypotheses on the pseudo-Anosov monodromy, obtaining bounds on how far the cone deformations can be continued, and constructing the deformations more explicitly using triangulations. The long term vision is to connect the complete hyperbolic structure with the singular Sol structure on fibered manifolds, the latter being easily computed from any reasonable description (e.g. Dehn twists) of the pseudo-Anosov map.

GEORGIOS
KYDONAKIS

University of Illinois at Urbana-Champaign

I'm interested in maximal representations and Higgs bundles.

RAMIRO A.
LAFUENTE

Universidad Nacional de Córdoba

My research is focused on problems related to geometric flows and distinguished geometric structures, with a particular emphasis on situations with extra symmetry assumptions. I am mainly interested in questions about the Ricci flow of homogeneous manifolds, its long-time behavior, convergence and regularity issues, special solutions and stability, structure and classification of its solitons. In particular, I study non-compact homogeneous Einstein metrics.

One of my research lines is related to the classification of homogeneous Einstein manifolds, aiming to contribute to the study of a long-standing conjecture usually attributed to D.V. Alekseevskii which states that in the non-compact case, a homogeneous Einstein manifold must be diffeomorphic to a Euclidean space. I am now working to extend the results obtained in this direction in my Ph.D. thesis, which are strongly based on an interplay with geometric invariant theory applied to some group action on the algebraic variety of Lie algebras of a fixed dimension. I am also looking forward to applying this theory in other problems involving the Ricci curvature.

MICHAEL
LANDRY

Yale

I'm interested in foliations, minimal surfaces, and Teichmüller space.

JOHN
LAWSON

Durham University

I have been studying for my PhD for only a few months and as such have been looking at a variety of topics. My research has been mainly involving two areas: cluster algebras and complex hyperbolic space.

Cluster algebras were developed in 2002 by Fomin and Zelevinsky. Since then they have found relevance in many topics from the study of Coxeter groups to mathematical physics. These algebras are generated by variables which are found through a process of mutations on directed graphs called quivers. Mutations are involutions which change the shape of the graph according to specific rules. It has been shown by Felikson, Shapiro and Tumarkin that the number of quivers possibly attained from a specific starting quiver is finite when the starting quiver is from a triangulation or one of the known 11 exceptional types. I have been considering whether there is a classification of those quivers which admit an infinite number of other quivers through mutation, but whose sub-quivers attained by removing a vertex do not.

Complex hyperbolic space has a similar construction to real hyperbolic space but often has surprising results compared to its real counterpart. It is usually studied through a model to provide easier to understand structure on the space. The common models are the projective model, the unit ball model and the Siegel domain model. The projective model is based on a subspace of the projective $\mathbb{C}^{2,1}$ space, while the others are subspaces of \mathbb{C}^2 . In these models the isometry group of complex hyperbolic space is the projective group $PU(2,1)$. Following his recent work with Pierre Will finding representations of the free group of rank two in $PU(2,1)$ with 7 parabolic elements, I have been working with John Parker trying to find a representation of the free group of two elements such that 8 of the isometries were parabolic.

GYE-SEON
LEE

University of Heidelberg

I'm interested in the study of deformation spaces of geometric structures on manifolds (or orbifolds) and associated representation varieties, particularly real projective structures.

CHRISTINE
LEE

Michigan State University

My main area of research is in knot theory and 3-manifolds. Specifically, I am interested in relating geometric and topological properties of link complement to the colored Jones polynomial of the link based on recent work of Futer, Kalfagianni, and Purcell, where the machinery of polyhedral decomposition was developed and strengthened the connection between the colored Jones polynomial and geometric properties of semi-adequate link complements. My work so far has been on relating the colored Jones polynomial of a non semi-adequate link to properties of the link diagram.

My present goal is to obtain more understanding of the topological information that state surfaces carry in the link complement. Futer and Purcell's work has shown that certain diagrammatic conditions on the diagram of an alternating link can give a lower bound on the genus of the link based on the number of twist regions and components of the link. I hope to understand the restraints that this result may impose on the kind of state surfaces that an alternating link satisfying these diagrammatic conditions can have.

MICHELLE
LEE

University of Maryland

My research interests lie in studying the relationship between dynamics on character varieties and deformation spaces of geometric structures. I am interested in finding domains of discontinuity for the action of $\text{Out}(\Gamma)$ on the G -character variety of Γ , where Γ is a hyperbolic group and G is a Lie group. Often, sitting inside the G -character variety is a deformation space of geometric structures, and I am particularly interested in finding domains of discontinuity that are strictly larger than these deformation spaces.

ARIELLE
LEITNER

University of California, Santa Barbara

I am interested in geometric transitions. Specifically, I am trying to understand the conjugacy limits of the Cartan subgroup in $\text{SL}(n, \mathbb{R})$. A limit group is the limit under a sequence of conjugations of the diagonal Cartan subgroup. In $\text{SL}(3, \mathbb{R})$, there are 5 possible limit groups up to conjugacy. Each limit group is determined by an equivalence class of degenerate triangle. I am working to extend the ideas of Haettel to determine the limits of the Cartan subgroup in $\text{SL}(n, \mathbb{R})$, with some new approaches via nonstandard analysis and degenerate simplices.

IVAN
LEVCOVITZ

CUNY Graduate Center

My research area is geometric group theory which studies the relationship between a group's natural geometry and its algebraic properties. I also study low-dimensional topology and its application to geometric group theory.

Some questions which I am interested in include those regarding quasi-isometric classification and rigidity of groups. In particular, I plan to study groups such as relatively hyperbolic groups, Artin groups and mapping class groups.

QIONGLING
LI

Rice University

My research area is representations of surface group into Lie groups, in particular Hitchin components for $\text{PSL}(n, \mathbb{R})$, the dynamics on the deformation space, and the relation with cross ratios. My work thus far concerns the construction of a Riemannian metric on the Hitchin component for $\text{PSL}(3, \mathbb{R})$ satisfying certain properties, analyzing the asymptotic behaviors of certain families of representations inside Hitchin component for $\text{PSL}(n, \mathbb{R})$ in terms of Higgs bundles.

At the time I am also considering the asymptotic behaviors of more general families of representations inside Hitchin component for $PSL(n, \mathbb{R})$ or even other components. Moreover, I am also working on the moduli theory for the space of representations into other Lie group $SU(2,1)$.

BENJAMIN
LINOWITZ

University of Michigan

I am interested in the geometry and topology of arithmetic groups and enjoy applying techniques from algebra and number theory to problems arising in the geometry of locally symmetric spaces. I have a particular interest in the spectral geometry of arithmetically defined manifolds.

JOHN
LOFTIN

Rutgers Newark

I am a geometric analyst who studies geometric structures and geometric ways of realizing representations of surface groups, among other things. In particular, I have studied affine and projective manifolds by using differential geometry and PDEs.

A lot of my recent interests involve special surfaces whose structure equations are integrable up to the solution of a single semilinear elliptic PDE (whose solution will provide a conformal factor for the metric). One such example is the hyperbolic affine spheres (which can be used to study real projective structures and Hitchin representations into $PSL(3, \mathbb{R})$). Another is minimal Lagrangian surfaces in the complex hyperbolic plane, which can be used to study representations which are close to Fuchsian into $SU(2, 1)$.

BRICE
LOUSTAU

University of Paris Sud 11

I am focusing on trying to understand the hyperkähler geometry of the deformation space of complex projective structures on a surface. This involves Teichmüller theory, representations of discrete groups into Lie groups and geometric structures, 3-dimensional hyperbolic geometry, complex and symplectic geometry, wildfire, self-duality equations on a Riemann surface and Higgs bundles.

JOEL
LOUWSMA

The University of Oklahoma

My research is in geometric group theory and low-dimensional topology. Most of my work has involved the notions of stable commutator length and quasimorphisms. Many problems in this area involve trying to understand the “simplest” surfaces with a prescribed boundary.

In recent work with Matt Clay and Max Forester, I studied stable commutator length in Baumslag–Solitar groups. For a certain class of elements of these groups, we show how to compute stable commutator length and show that it takes only rational values. We also show that there is a uniform gap in the stable commutator length spectrum of Baumslag–Solitar groups: no element has stable commutator length between 0 and $1/12$.

ANTON
LUKYANENKO

UIUC

I am primarily interested in metric and dynamical properties of the Heisenberg group Heis^n and related spaces.

On the GEAR side of things, the Heisenberg group plays the role of the boundary of complex hyperbolic space CH^{n+1} (in the same sense that the complex plane is the boundary of real hyperbolic 3-space). The isometries of CH^{n+1} correspond to conformal maps of Heis^n with respect to a sub-Riemannian metric. Likewise, quasi-isometries of CH^{n+1} turn into quasi-conformal maps of Heis^n on the boundary. We can use the geometry of the sub-Riemannian Heisenberg group to study complex hyperbolic space.

Studying quasi-conformal maps on Heis^n leads one into working with geometry and analysis on sub-Riemannian spaces in general. These have quite interesting properties (for example, taking derivatives becomes more intricate), and various applications ranging from robot motion planning to modeling human vision.

TIANYU
MA

University of Maryland

My research interest area is projective geometry and cartan geometry, particularly the geometric structures characterized by unparametrized geodesics. I am also interested in the local symmetry of semi-Riemannian manifolds.

SARA
MALONI

Brown University

My research interests lie at the intersection of hyperbolic geometry and low-dimensional topology. As a graduate student, I studied Kleinian groups and their limits. In particular, I investigated quasifuchsian groups, groups whose limit set is a topological circle, using different plumbing constructions. These constructions are particularly useful to study limits in some specific slices of quasifuchsian space. They also play a central role in the study of hyperbolic manifolds and of dynamics on moduli spaces of geometric structures.

Now, as a postdoc, I am interested in different generalisations of quasifuchsian groups to other kind of geometries such as anti-de Sitter geometry and complex hyperbolic geometry, or, more generally, to Anosov representations into complex Lie groups.

Another central theme of my research is the geometric and dynamical decompositions of character varieties. The classical example of the relationship between character varieties and geometric structures is Teichmüller space $\mathcal{T}(\Sigma)$, which is the space of marked hyperbolic structures on a closed orientable surface Σ or, equivalently, a component of the character variety $\chi(\pi_1(\Sigma), \mathrm{PSL}(2, \mathbb{R}))$ consisting of discrete and faithful representations. Fricke showed that the action of the mapping class group $\mathrm{Mod}(\Sigma)$ on $\mathcal{T}(\Sigma)$ is properly discontinuous, where $\mathrm{Mod}(\Sigma)$ is an index two subgroup of the outer automorphism group $\mathrm{Out}(\pi_1(\Sigma))$. It is natural to attempt to generalize this beautiful result by studying the dynamics of the action of the outer automorphism group $\mathrm{Out}(\Gamma)$ of a finitely generated group Γ on the space $\chi(\Gamma, G)$ of (conjugacy classes of) representations into a semi-simple Lie group G .

KATHRYN
MANN

University of Chicago

Broadly speaking, my research concerns actions of infinite groups on manifolds and the deformation spaces of such actions (e.g. character varieties and spaces of flat bundles).

One problem I am interested in is understanding the spaces $\mathrm{Hom}(\Gamma, G)$ where Γ is a surface group, and G an infinite-dimensional Lie group such as $\mathrm{Homeo}(S^1)$. These spaces have natural interpretations (e.g. parameterizing flat bundles), but are not well studied and quite poorly understood. I'm working now on understanding the parallels and differences between $\mathrm{Hom}(\Gamma, \mathrm{Homeo}_+(S^1))$ and $\mathrm{Hom}(\Gamma, \mathrm{PSL}(2, \mathbb{R}))$, as well as understanding how "geometric" representations (such as those with image in $\mathrm{PSL}(2, \mathbb{R})$) sit inside the larger space $\mathrm{Hom}(\Gamma, \mathrm{Homeo}_+(S^1))$. I'm also interested in analogous questions for other groups – for instance, comparing $\mathrm{Hom}(\Gamma, \mathrm{PSL}(2, \mathbb{C}))$ with $\mathrm{Hom}(\Gamma, \mathrm{Homeo}_+(S^2))$.

JULIEN
MARCHÉ

University Pierre et Marie Curie at Paris

My main research area is quantum topology. More precisely, I have been studying topological quantum field theory - that is quantum invariants of knots and 3-manifolds - focusing on asymptotic invariants, i.e. the "large level" limit.

This limit is related to the character variety of a surface or a 3-manifold into SU_2 : since then I have tried to understand better these spaces. For instance, I have been studying the relation between character varieties and skein modules. More recently, I am involved in problems concerning the dynamics of the mapping class group on character varieties (into SU_2 or $\mathrm{SL}_2(\mathbb{R})$).

STÉPHANE
MARSEGLIA

Université de Strasbourg

My main research area is real projective geometry, particularly the study of convex projective manifolds of finite volume (i.e. quotients Ω/Γ of finite volume, where Ω is a convex open subset of the real projective space and Γ is a discrete group of projective transformations preserving Ω).

I am currently trying to extend some results of Y. Benoist on divisible convex sets (i.e. subsets Ω for which the quotient Ω/Γ is compact) to the more general case of finite volume quotients. To do so, I am studying the structure of maximal cusps in Ω/Γ and of discrete subgroups of Γ associated to these cusps. Studying the Lie algebra of the Zariski closure of such a subgroup helps to understand the structure of the whole group Γ and the geometry of our convex projective manifold.

JUSTIN
MARTEL

University of Toronto

I am interested in the dynamics of lorentz structures on noncompact surfaces and 3-manifolds and their relations to symplectic geometry.

SIMONE
MARZIONI

QGM - Aarhus University

My interests are mainly in the (quantum) topology and geometry in dimension 2 and 3, particularly the study of certain Topological Quantum Field Theories and related quantum invariants. I am actually studying the Andersen-Kashaev TQFT's, which extend the quantization of the Teichmüller space to a topological theory which reproduces the Kashaev invariant for knot's complements. This is of high interest because it is conjecturally correlated to the hyperbolic volume of 3-manifolds.

PERE
MENAL-FERRER

Georgia Tech

My research is mainly concerned with low-dimensional topology, especially hyperbolic 3-manifolds and knot theory. Currently, I am working on the growth of torsion of the homology groups of sequences of covers of a hyperbolic 3-manifolds.

BABAK
MODAMI

University of Illinois at Urbana-Champaign

I am working on geometric and dynamical properties of the Weil-Petersson (WP) metric on Teichmüller spaces mainly in analogy with Teichmüller metric. Study of subgroups of mapping class groups using their action on Teichmüller space equipped with the WP metric and other metrics and natural compactifications of Teichmüller space is another topic I am working on.

DUC-MANH
NGUYEN

University of Bordeaux

I am interested in flat surfaces (translation surfaces), dynamics in Teichmüller space, and related questions such as Mapping Class Groups, hyperbolic geometry, representations of surface groups.

THANG
NGUYEN

Indiana University

My research interest is studying about geometry structure of non-positively curved spaces and geometric group theory. In particular, I am interested in the rigidity questions about geometric properties of spaces and groups.

I have been working on the question about measure equivalent rigidity of rank 1 semisimple Lie groups. In some sense, it is a generalization of Mostow rigidity, so using Mostow's proof idea appropriately, I hope we still can say something about groups that are measure equivalent with rank 1 Lie groups or their lattices. Another type of question that I have been also thinking about is quasi-isometric embedding between spaces. Many spaces are very nice for quasi-isometry rigidity question, but if we change the question to be quasi-isometric embedding, things are unknown. I am studying embeddability of such non-positively curved spaces.

DUC-MANH
NGUYEN

University of Bordeaux

I am working on various questions concerning objects called "translation surfaces", which can be viewed as holomorphic one-forms on Riemann surfaces, or Euclidean flat metric structures with conical singularities and trivivial linear holonomy. These objects can be associated with several dynamical systems: directional flows on surfaces, interval exchange transformations, Teichmüller geodesic flow, action of $SL(2, \mathbb{R})$ on strata... The properties of those dynamical systems have deep connections with the geometry and topology of Teichmüller space and moduli space of Riemann surfaces. The main questions of the field include: -Computing dynamical invariants of Teichmüller geodesic flow (for instance, the Lyapunov spectrum of the Kontsevich-Zorich cocycle) -Classification of $SL(2, \mathbb{R})$ -orbit closures, the topology of those orbit-closures are closely related to the behaviors of the directional flows on the surfaces, and the Teichmüller geodesic flow on moduli space. -Understanding the Veech groups (stabilizer subgroups of the $SL(2, \mathbb{R})$ action on strata). -Understanding various aspects of directional flows on translation surfaces (weak mixing properties, dilatation constant of pseudo-Anosov homeomorphisms, limit set of Teichmüller geodesic ray at the boundary of Teichmüller space). -Classification of the unipotent orbit closures.

AZIZEH
NOZAD

University of Porto

I am interested in the study of character varieties of surface groups for real Lie groups using Higgs bundle methods. My current project is to carry out a study of the variation of the parameter dependent moduli spaces of $U(p, q)$ -Hitchin pairs with a view to obtaining information about the topology and geometry of the moduli spaces of $U(p, q)$ -Higgs bundles.

FREDERIC
PALESI

Aix-Marseille Universite

I am interested in topological and dynamical properties of the space of representations of surface groups, and the various interpretation in terms of geometric structures on the surface. To be more specific, I mainly focus on the action of the mapping class group Γ on such representation spaces. This action is known to be properly discontinuous on many spaces of geometric structures (Teichmüller space, Anosov representation, ...), and is also known to be ergodic when the target group is compact.

At this time my focus is on the action of Γ in the case of the $SL(2, \mathbb{C})$ character variety $X(S)$. For small surfaces (one-holed torus and four-holed sphere), using trace parameters, one can define a subset of the space of representations on which Γ acts properly discontinuously. Main problems are:

1. Giving a geometric interpretation to representations in this subset. (In the one-holed torus case, the space is conjecturally related to quasi-fuchsian space)
 2. Understanding the dynamic of the action on the complementary of this subset. Are there invariant subset of positive measure? Is the action ergodic?
 3. Finding a nice framework to apply the methods to general surface groups or free groups.
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JOHN
R. PARKER

Durham University

My main area of research is discrete isometry groups of hyperbolic spaces. Most of the time I am interested in the case of complex hyperbolic space, but sometimes I also consider quaternionic and octonionic (as well as real!) hyperbolic geometry.

The sorts of problems that interest me are (a) the construction of particular discrete groups, (b) deciding which groups within a representation space are discrete and (c) giving conditions which mean a group is not discrete. For example, recent work of type (a) includes a project with Martin Deraux and Julien Paupert where we have constructed new examples of non-arithmetic complex hyperbolic lattices. Recent problems of type (b) include work with Pierre Will on deformations of free groups with many parabolic elements. Results of type (c) are generalisations of Jorgensen's inequality and associated geometric consequences of this result.

ANNE
PARREAU

Université de Grenoble, France

I am interested in representations of a finitely generated group Γ into higher rank reductive group G over \mathbb{R} , and over ultrametric fields, and actions of groups on nonpositively curved metric spaces, especially symmetric spaces of noncompact type and euclidean building (including non discrete ones). More specifically, I study degenerations of representations and compactifications of representation spaces. I constructed a compactification for representation spaces generalizing Thurston's compactification for Teichmüller space, using length functions, which boundary points come from actions on non discrete buildings / representations in a field with ultrametric absolute value. A natural question is to study this compactification in special cases, corresponding to spaces of geometric structures on manifolds, and to higher Teichmüller spaces (where Γ is the fundamental group of a surface and $G = SL_n(\mathbb{R})$). I am currently working on the space of convex projective structures on a surface, and actions of surface groups on euclidean buildings of type A_2 (corresponding to $G = SL(3)$). A major question in that case is to determine the topology of the compactification : is it a closed ball like for usual Teichmüller space ?

PRIYAM
PATEL

Purdue University

My current research focuses on understanding the virtual properties of hyperbolic surfaces and 3-manifolds and the algebraic finiteness properties of their fundamental groups. Hyperbolic surface groups are known to enjoy two algebraic finiteness properties called *residual finiteness* and *subgroup separability* that have intimate ties with topological surface theory. The recent resolutions of the Virtually Haken and Virtually Fibered conjectures relied heavily on showing that hyperbolic 3-manifold groups also enjoy such properties.

The question that motivates my current research is whether one can obtain bounds on the degrees of the finite index covers/subgroups associated with these finiteness properties. This process is often called *quantifying* subgroup separability. Since quantification proofs usually proceed constructively, such a proof could help us gain insight into how the special finite index subgroups actually arise. At this time, I am working on generalizing the techniques used to quantify subgroup separability for hyperbolic surface groups to hyperbolic 3-manifold groups, with the hope of better understanding the relationship between hyperbolic 3-manifolds and their Haken or fibered covers.

JULIEN
PAUPERT

Arizona State University

My research interests lie in low-dimensional geometry and topology. More precisely, I study hyperbolic geometry (mostly complex), reflection groups, and lattices in rank 1 semisimple Lie groups.

DU
PEI

Caltech

The focus of my current research is on physics and geometry of the moduli space of Higgs bundles. More generally, my interests range from low-dimensional topology and geometry on the mathematical side to TQFT, quantum gauge theory and string theory on the physical side.

ANA
PEÓN-NIETO

Ruprecht-Karls Universität Heidelberg, Germany

Up to now, my work has focused on the geometry and topology of moduli spaces of Higgs bundles. More concretely, I have studied the Hitchin system for G -Higgs bundles, where G is a real form of a complex reductive Lie group (for example, $SL(n, \mathbb{R})$, $SU(n)$, $SU(p, q)$ are all real forms of $SL(n, \mathbb{C})$). The Hitchin map is a surjective morphism onto an affine space which in the case of complex groups has the structure of an algebraically completely integrable system, and so it contains a lot of geometric information about the moduli space. In the case of real forms, this does not hold anymore, but we can still give a reasonable description of the system, and in particular, the fibers (through spectral or cameral data).

At the moment, I am working on applications of my thesis, such as the study of the topology of the moduli space, the mirror symmetric picture of the gerbe of G -Higgs bundles, or the interpretation in terms of representations of surface groups of the so-called Hitchin–Kostant–Rallis section of the Hitchin map.

BRAM
PETRI

University of Fribourg

My research focuses on low dimensional topology and geometry. In particular, I work on the study of random surfaces and (combinatorial) moduli spaces. The main goal is to understand the distribution of surfaces in various moduli spaces with respect to their geometric properties. More concretely, I study the probability distributions of geometric variables (like for instance the systole) in various combinatorial moduli spaces and moduli space endowed with the Weil-Petersson metric.

Currently, I am working on comparing combinatorial moduli spaces with moduli space endowed with the Weil-Petersson metric. I am hoping that this will allow me to apply techniques I have developed for the combinatorial setting to the Weil-Petersson setting.

YULAN
QING

Technion

Currently I am interested in building connections between various type of boundaries of CAT(0) groups and CAT(0) spaces. Specifically I am studying the connection between Roller boundary and visual boundary and understand how the group actions can be extended to these boundary for CAT(0) spaces.

JEAN
RAIMBAULT

MPIM, Bonn

I work maily with manifolds with geometric structures and their fundamental groups: roughly speaking, I study quotients of Riemannian homogeneous spaces of Lie groups by their discrete subgroups. The questions I'm are basically of two types: given an homogeneous space X , one can either study properties of the individual manifolds isometric to (or of the groups acting discontinuously on) X , or one can consider families of such manifolds or groups and look at asymptotic questions. A nice example (among many) of the former would be Kazhdan's property (T) which gives topological constraints on all finite-volume quotients of some symmetric spaces (or algebraic constraints on the lattices in the group of isometries); an example of the latter would be Gromov's theorem that the Betti number of quotients of a negatively curved symmetric space are linearly bounded in the volume. Here are a few problems in this vein that I am particularly interested in:

- Can one get a sublinear bounds on the Betti numbers for some specific sequences of locally symmetric spaces?
 - When does the size of the torsion subgroup in $H_1(M_n; \mathbb{Z})$ grow exponentially in the volume for a sequence of hyperbolic three-manifolds?
 - How do large-volume arithmetic hyperbolic manifolds look?
 - Are there zero-divisors in the group rings of torsion-free lattices in Lie groups? (this is a very particular case of a famous, old conjecture of I. Kaplansky)
-

HUYGENS
RAVELOMANANA

CIRGET-UQAM

My interest and area of research are low dimensional topology and symplectic topology. At this moment my work is focusing on finding an answer to the question: when does two distincts hyperbolic surgeries on an oriented 3-manifold gives orientation preserving homeomorphic manifolds? The study of this problem can be split in two cases: the first one is when the result of the surgery is hyperbolic, this is the generic situation by Thurston Dehn surgery theorem, and the second one is when the surgeries are exceptional. I am now working on the exceptional case.

The main results and techniques I am applying comes from Heegaard Floer theory and $PSL_2(\mathbb{C})$ -character varieties. The former theory gives a way to study surgeries via some algebraic machineries, the later tells some informations about embedded essential surfaces and properties of slopes on the "boundary" of cusped "hyperbolic" 3-manifolds.

DAVID
RENARDY

University of Michigan

I am interested in the global topology of deformation spaces of hyperbolic 3-manifolds.

DOREEN
REUCHSEL

Brown University

As a Visiting Student at Brown University it still remains to be seen at what point my interests will have the chance to transform into actual research interests but for the time being I am mainly interested in low-dimensional geometry, geometric group theory and algebraic topology.

RUSSELL
RICKS

University of Michigan

I am interested in the dynamics of groups acting geometrically on CAT(0) spaces. In some of my recent research, for instance, I found that one could use the Patterson-Sullivan measure on the boundary to build a generalization of the Bowen-Margulis measure, an invariant probability measure for the geodesic flow. One can then use the Bowen-Margulis measure to make some new statements about the structure of the original CAT(0) space.

CLARA
ROSSI SALVEMINI

University of Paris-Sud 11

My area of reserch is geometry and dynamics on lorentian manifolds. The most part of my work concerns the study of globally hyperbolic Lorentzian manifolds, especially the conformally flat ones. The conformally flat lorentzian manifold in dimension greater then 3 are special case of (G, X) -structures. Here $X = \text{Ein}_{1,n}$ is the Einstein space-time, the unique conformally flat simply connected compact lorentzian manifold, with its group of conformal diffeomorphisms $G = O(2, n + 1)$.

Let M be a conformally flat Lorentzian manifold which is globally hyperbolic (this is a property of the causal structure of M , an example is when there is a foliation by compact spacelike hypersurfaces, called Cauchy-hypersurfaces).

When the dimension $n + 1 \geq 3$ is odd, and the holonomy representation of M take its values into the subgroup $U(1, n) \subset O(2, 2n)$ the conformal Lorentzian structure of M gives a canonical spherical CR -structure over space-like Cauchy hypersurfaces. We are interested to understand the interaction between these two structures; in particular which spherical CR -structure on a given space-like hypersurface comes from some conformal lorentzian globally hyperbolic structure?

Another problem is to classify which open sets of $\text{Ein}_{1,n}$ are homogenous by the action of a subgroup of $O(2, n + 1)$. This appears much more richer then the Riemannian case. This will gives information about all differents tipologies of conformally flat Lorentzian structure on manifolds.

KIM
RUANE

Tufts University

My area of research is the study of boundaries of CAT(0) spaces that admit geometric group actions. I study both the visual and Tits boundaries of such spaces. Much of my work has been about the topological properties of these boundaries that are reflected in the group theory of the group that acts on the CAT(0) space in question.

There are two major questions that influence my work on boundaries. The first, is the homeomorphism problem. It is well-known that the topological type of the visual boundary is not unique to the group since a quasi-isometry between CAT(0) spaces does not, in general, induce a homeomorphism on the boundaries (not even in the presence of a group action on both spaces). However, there are some topological properties of the visual boundary that should be inherent to the group. For example, a specific question is this: if a CAT(0) group Γ acts geometrically on a CAT(0) space X and $\partial_\infty X$ is locally connected, then must all CAT(0) boundaries for Γ be locally connected?

This is related to the second major question that motivates my work. It is known from the beautiful work of Bowditch and many others that one can detect all of the splittings of the group over 2-ended subgroups just from the topological properties of the boundary (in particular, the existence of local cut points). A big step in that work is to show that one-ended hyperbolic groups have locally connected boundary. I would like to understand how to generalize this theory to the setting of CAT(0) groups. The problem is very different in this setting because of the non-uniqueness of boundaries mentioned above but also because there are one-ended CAT(0) groups with non-locally connected boundary.

JORDAN
SAHATTCHIEVE

University of Michigan

I am interested in questions in geometric group theory and 3-manifold topology. In particular, I am interested in various growth and asymptotic properties of groups, and fibering properties of 3-manifolds.

ANDREW SANDERS **University of Illinois at Chicago**

My area of research is the the geometry, dynamics and analysis of 2 and 3-dimensional manifolds, particularly the study of geometric structures. Much of my work thus far concerns the study of minimal surfaces in hyperbolic 3-manifolds; the central goal is to understand how the geometry of minimal surfaces influences the geometry of the ambient hyperbolic 3-manifold.

At this time, I am working on applying the ideas I have developed to the study of other geometric manifolds arising from representations of fundamental groups of surfaces into semisimple Lie groups (like $SL(n, \mathbb{R})$ or $SL(n, \mathbb{C})$). Spaces of such representations admit a parameterization coming from the complex analytic theory of Higgs bundles developed by Hitchin. The study of equivariant minimal surfaces has a natural interpretation in terms of Higgs bundles, and I am hoping to use this relationship to better understand certain aspects of the non-abelian Hodge correspondence.

RAMANUJAN
SANTHAROUBANE

Institut de mathématiques de Jussieu

My area of research is quantum topology. I am interested in representations of the mapping class group of surfaces arising from Witten-Reshetikhin-Turaev topological quantum field theories (TQFT) : my goal is to understand the link between theses quantum representations and the Nielsen-Thurston classification.

I also study the asymptotic of 3-manifold invariants that we can build from these TQFT.

FLORENT
SCHAFFHAUSER

Universidad de Los Andes

I work in the area at the intersection between the theory of vector bundles on curves and real algebraic geometry. Themes which are of special interest to me are:

- Topology of sets of real points of moduli schemes of vector bundles on a real algebraic curve (connected components, Betti numbers).
- Narasimhan-Seshadri, Hitchin-Kobayashi-Simpson and Donaldson-Corlette correspondences over real algebraic curves.

Research interests, by AMS subject classification number :

- Vector bundles on curves and their moduli (14H60)
 - Special connections and metrics on vector bundles (Hermite-Einstein-Yang-Mills) (53C07)
 - Topology of real algebraic varieties (14P25)
-

ANNA-SOFIE
SCHILLING

University of Heidelberg

In my diploma thesis I studied the horofunction compactification and the Busemann points of finite-dimensional normed spaces and of symmetric spaces with Finsler structures. In the finite-dimensional case I characterised the sequences converging to some Busemann point and showed that only the limiting direction and an eventual parallel shift of the sequence have influence on this Busemann point. In the end of my thesis I made a short comparison of the horofunction and the Furstenberg compactification of $Sp(4, \mathbb{R})/U(2)$. For my PhD thesis I want to study more kinds of compactifications of symmetric spaces and compare them with each other.

LAURA
SCHAPOSNIK

University of Illinois at Urbana Champaign

During the last years I have been studying the moduli space of principal Higgs bundles and its relation to other areas of mathematics and physics through spectral data associated to the Hitchin fibration. In particular, I'm currently looking at the relation of Poisson geometry and branes in the moduli space of Higgs bundles, as well as quantisation of moduli spaces.

DMITRIY
SLUTSKIY

Université de Strasbourg

I defended my PhD thesis in October 2013 at Paul Sabatier University (Toulouse, France) under the joint supervision of Jean-Marc Schlenker (Toulouse-Luxembourg) and Victor Alexandrov (Novosibirsk, Russia). My thesis contains three main results. The first chapter is devoted to the construction of an infinitesimally flexible polyhedron in hyperbolic 3-space such that its volume is not stationary under the infinitesimal flex. In the second chapter one obtain a necessary condition for flexibility of suspensions in hyperbolic 3-space. The last two chapters are about the existence of a quasi-Fuchsian convex compact manifold such that the induced metric on its boundary coincides with a prescribed hyperbolic polyhedral metric.

Currently I am a post-doc within the research group of Olivier Guichard at the University of Strasbourg.

ISAAC
SOLOMON

Brown University

I am a first-year graduate student at Brown University. I am interested in low-dimensional geometry, topology and dynamics, particularly with regards to Teichmüller spaces, moduli spaces, geometric structures, 3-manifolds, and their connections with other branches of mathematics, e.g. geometric group theory.

MARCO
SPINACI

Institut Fourier, Grenoble

My area of research is the interplay between the analysis, algebra and geometry of the moduli space of representations of the fundamental group Γ of a compact Kähler manifold X . This space is indeed homeomorphic to the moduli space of Higgs bundles on the same manifold, and this duality adds much to our understanding of its topology. However, due to difficulties of technical nature, a complete understanding of these spaces is available only in few very special cases (in particular, only for $\dim(X) = 1$, i.e., Riemann surfaces).

During my Ph.D. thesis, from the analytic and differential geometric points of view, I have studied the deformations of harmonic maps along a family of representations, up to the second order. The conditions for existence of these deformations nicely incorporates algebraic properties of the representations. This allows us to compute the variations of Hitchin's energy Morse function up to the second order for general Kähler groups; in particular, this permits to characterize critical points as variations of Hodge structures, to compute Morse indices and prove the strict plurisubharmonicity of the energy. These are some of the technical steps that were used in the case of Riemann surfaces to compute the topology (that is, the number of connected components and the Betti numbers) of the moduli space.

More recently, I have started focusing on questions about the rigidity of maximal representations. To every representation of a surface group Γ to a Lie group of Hermitian symmetric type G , one can associate a number (the Toledo invariant) which is invariant under deformations. It satisfies a "Milnor-Wood" inequality, and maximal representations (that is, those for which this inequality is an equality) generally enjoy special properties. Here, the picture in higher dimension is less clear; a complete definition of the Toledo invariant is available only for cocompact lattices Γ (of some other Lie group of Hermitian type H). Furthermore, in this case, the study of maximal representations is still not complete. They are thought to enjoy strong rigidity properties (which are trivially false for surface groups), but complete proofs are available only for some special groups G .

ZHE
SUN

University of Paris-Sud 11

My area of research is the geometric structures of higher Teichmüller spaces. Particular, swapping algebra, cluster algebra and Poisson-Lie group structure, numerical problems in higher Teichmüller spaces.

The swapping algebra is created by F. Labourie very recently to characterize the natural Poisson structure of the space of cross ratios, space that contains both the space of opers and the universal (in genus) Hitchin component. In my thesis, inspired by the swapping algebra and rank n cross ratio, I construct rank n swapping algebra as an integer domain with the swapping Poisson bracket. Then I relate the rank 3 swapping algebra to the Fock-Goncharov algebra for $\mathrm{PSL}(3, \mathbb{R})$. On the other hand, I relate the rank 2 swapping algebra to the Virasoro algebra.

At this time, I am working on three different things:

1. Understanding swapping algebra through some Poisson-Lie group structure, particularly, its relation with cluster algebra.
2. Defining some numerical problems through the swapping algebra.
3. Its relation with bi Goldman Lie algebra.

KRZYSZTOF
SWIECICKI

Texas A&M University

I am a first year PhD student at the Texas A&M University, interested in a geometric group theory and coarse geometry. I recently finished my master degree at the University of University of Warsaw, where my supervisor was Paweł Zawiślak. In my master thesis I proved the analogue of Helly's theorem for systolic complexes.

Recall classical Helly's theorem concerning convex subsets of Euclidean spaces. Suppose that X_1, X_2, \dots, X_n is a collection of convex subsets of \mathbb{R}^d (where $n > d$) such that the intersection of every $d + 1$ of these sets is nonempty. Then the whole family has a nonempty intersection. This result gave rise to the concept of Helly dimension. For a geodesic metric space X we define its *Helly dimension* $h(X)$ to be the smallest natural number such that any finite family of $(h(X) + 1)$ -wise non-disjoint convex subsets of X has a non-empty intersection. Clearly, Helly's theorem states that Helly dimension of the Euclidean space \mathbb{R}^d is $\leq d$. It is very easy to find examples showing that it is exactly equal to d .

Systolic complexes are connected, simply connected simplicial complexes satisfying some additional local combinatorial condition, which is a simplicial analogue of nonpositive curvature. Systolic complexes inherit lots of $CAT(0)$ -like properties, however being systolic neither implies, nor is implied by nonpositive curvature of the complex equipped with the standard piecewise euclidean metric.

There is a well known result for $CAT(0)$ cube complexes which states that, regardless their topological dimension, they all have Helly dimension equal to one. This motivates a question about Helly-like properties of systolic complexes. We obtained the following results:

Let X be a 7-systolic complex and let X_1, X_2, X_3 be pairwise intersecting convex subcomplexes. Then there exists a simplex $\sigma \subseteq X$ such that $\sigma \cap X_i \neq \emptyset$ for $i = 1, 2, 3$. Moreover, the dimension of σ is at most two.

In other words 7-systolic complexes have Helly dimension less or equal to 1. It is easy to see that this is not necessarily true for 6-systolic complexes, but we prove that any systolic complex has Helly dimension less or equal to 2. More precisely:

Let X be a systolic complex and let X_1, X_2, X_3, X_4 be its convex subcomplexes such that every three of them have a nontrivial intersection. Then there exists a simplex $\sigma \subseteq X$ such that $\sigma \cap X_i \neq \emptyset$ for $i = 1, 2, 3, 4$. Moreover, the dimension of σ is at most three.

SAMUEL
TAYLOR

University of Texas

My primary research interests lie in the fields of geometric topology and geometric group theory. Specifically, I am interested in interactions between mapping class groups, $Out(F_n)$, cubical geometry, and hyperbolic 3-manifolds. These areas of mathematics are highly interrelated and employ methods found in topology, geometry, group theory, combinatorics, and dynamics.

My research focuses on similarities between $Mod(S)$, $Out(F_n)$, and hyperbolic groups. I also study the extent to which $Out(F_n)$ can be understood by analogy to the more familiar mapping class group. A focal point of my work involves using right-angled Artin groups and developing tools for $Out(F_n)$ that are inspired by successful approaches for studying the geometry of $Mod(S)$. I also work on the geometry of the curve graph and the pants graph, two graphs that have strong connections to hyperbolic structures on surfaces and 3-manifolds.

NICOLAS
THOLOZAN

University of Nice-Sophia Antipolis

I am mainly interested in pseudo-Riemannian geometric structures. So far, I have mostly studied closed manifolds locally modeled on a rank 1 Lie group with its Killing metric. In particular, I have worked on the case of $PSL(2, \mathbb{R})$, which corresponds to anti-de Sitter geometry in dimension 3.

This led me to study how to compare some representations of surface groups in $PSL(2, \mathbb{R})$ using the theory of equivariant harmonic maps. These questions would make sense in higher rank Lie groups like $SL(n, \mathbb{R})$, and I am currently trying to learn about Higgs bundle theory in hope of generalizing some of my results to this setting.

JÉRÉMY
TOULISSE

Université du Luxembourg

I study hyperbolic surfaces and special diffeomorphism between them. In particular, I'm interested in the existence of a minimal Lagrangian diffeomorphism between hyperbolic surface with cone singularities (the classical case has been studied in the 90' by F. Labourie and R. Schoen). These diffeomorphisms are related with maximal surfaces in Globally Hyperbolic AdS spacetime of dimension 3.

In another hand, I'm interested in the study of quantum Teichmüller space and its relation with the topology of hyperbolic 3-manifolds.

ANH T.
TRAN

The Ohio State University

My research interests are in Quantum Topology and Knot Theory. I have been working on the AJ conjecture that relates two different knot invariants: the A-polynomial and the colored Jones polynomial.

The Jones polynomial was discovered by V. Jones in 1984 and has made a revolution in knot theory. Despite many efforts little is known about the relationship between the Jones polynomial and classical topology invariants like the fundamental group. The A-polynomial of a knot, introduced by D. Cooper, M. Culler, H. Gillett, D.D. Long and P.B. Shalen, describes the representation space of the knot group into $SL(2, C)$, and has been fundamental in geometric topology.

S. Garoufalidis and T. Le proved that for every knot, the colored Jones polynomial satisfies a recurrence relation. The AJ conjecture states that when reducing the quantum parameter to 1, the recurrence polynomial is essentially equal to the A-polynomial.

NICOLAUS
TREIB

University of Heidelberg

My main research interests concern representations of surface groups or hyperbolic groups into semisimple Lie groups. My goal is to further the study of Anosov representations in particular and apply this theory to describe proper actions of discrete groups. The main example here is the left-right action of a discrete subgroup of $G \times G$ on G . There are especially interesting questions about deformations of such groups and the geometric behavior of boundary cases. Much of this is inspired by work of Danciger, Guéritaud and Kassel on anti de Sitter geometry and the limiting flat case, i.e. Minkowski geometry.

Having previously worked through the Kahn-Markovic theorem on the existence of surface subgroups of compact hyperbolic 3-manifolds, I am always interested in the geometry of these manifolds. Similarities and possible connections between the theory of quasifuchsian groups and anti de Sitter geometry also fascinate me.

WESTON
UNGEMACH

University of Chicago

My interests lie in hyperbolic geometry and low dimensional topology, with my particular research done in inverse spectral geometry and three manifold topology. In the former, I have worked with the combinatorial structure of Teichmüller space to count the size of isospectral families of finite-area hyperbolic surfaces. In the latter, I examined Heegaard splittings of compact three manifolds and their relationship to the topology of the manifold they split. In the future, I intend to work more directly in the intersection of these two fields.

CAGLAR
UYANIK

University of Illinois at Urbana-Champaign

My research is in Geometric Topology and Geometric Group Theory. In particular, I am very much interested in mapping class groups, Teichmüller Space and their analogies with $Out(F_N)$ and Culler-Vogtmann's Outer space.

So far, my research has focused on dynamics of pseudo-Anosovs and fully irreducible outer automorphisms on the space of geodesic currents. Recently, I have been working on analogs of the Curve Complex in the $Out(F_N)$ setting, including free factor and free splitting complexes. I also have a side interest in dynamics on translation surfaces. Specifically, I am working on gap distributions of slopes of saddle connection on various L-shaped polygons.

NICHOLAS
G. VLAMIS

Boston College

My research interests lie in hyperbolic geometry and its connections to low-dimensional topology. To date, my research has focused on the dynamics of geodesic flow in relation to moduli space identities and on quasiconformal homogeneity of hyperbolic surfaces.

Moduli space identities generally relate length spectra of geodesic paths on a surface to volume or other intrinsic properties. My current focus has been on extending these identities to representation varieties beyond $PSL(2, \mathbb{R})$.

The structure of quasiconformally homogeneous hyperbolic n -manifolds in dimension $n \geq 3$ is well understood. Due a lack of rigidity, the tools used in higher dimensions fail and some of the structure is lost for hyperbolic surfaces. My research focuses on understanding what structure persists in dimension 2.

Additionally, a new direction in my research has been studying the dynamics of the handlebody group on Teichmüller space as well as the geometry of the disk complex. In particular, I am interested in the behavior at infinity for both of these objects.

YOHISUKE
WATANABE

University of Utah

My area of research is the geometric topology. Much of my work thus far concerns the study of the curve complex. At this time, I am working on $Out(F_n)$ and Mapping class group by applying the ideas I have developed in the study of tight geodesics on the curve graph and subsurface projections.

RICHARD
WEBB

University of Warwick

I'm interested in mapping class groups, ueller theory and hyperbolic geometry. In particular, I am fond of the use of geometric group theory techniques in these areas. I'm currently working on describing curves that are short somewhere on a ueller disc in a combinatorial way, with Robert Tang.

JOSEPH
WELLS

Arizona State University

At this time, I am studying convex hulls in complex hyperbolic n -space. In particular, I am working iterative methods to construct such minimal convex sets in $H_{\mathbb{C}}^n$ other than the obvious ones - metric balls and convex subsets of totally geodesic subspaces.

DAPING
WENG

Yale University

My research interests include cluster algebras, integrable systems, and mathematical physics in general.

RICHARD A.
WENTWORTH

University of Maryland

My work is mostly in the complex geometry surrounding the relationship between notions of stability in algebraic geometry and the existence of special metrics or solutions to nonlinear pde. I am interested in using analytic techniques to obtain results on the topology and geometry of moduli spaces. Ideas coming from physics are also a motivation.

I am currently working on several projects in the areas above. One concerns the structure of singular sets for bubbling sequences of Yang-Mills connections on Kaehler manifolds and their relationship to singular sets of coherent sheaves. Another seeks to relate notions of stability in complex geometry to weighted Busemann functions and conformal centers of mass introduced by Kapovich, Leeb, and Millson. I am also working to explore generalizations of notions of zeta regularized determinants of Laplace operators and their use in the geometry of moduli spaces. Finally, I would like to understand better the relationship between holomorphic Higgs bundles and their spectral data and the geometry of conformal harmonic maps to symmetric spaces.

GRACE
WORK

University of Illinois at Urbana Champaign

My research interest lie in studying the dynamics of the $SL(2, \mathbb{R})$ action on the moduli space of translation surfaces. Currently this has taken the form of analyzing the gap distribution between slopes of saddle connections on the translation surface associated to the regular octagon. In the future I hope to generalize these results.

BINBIN
XU

Institut Fourier

I'm working with the convexity of Hitchin component and quantum Teichmüller theory. The motivations of the first part are Kerckhoff's resultat of the convexity of the geodesic length function along earthquake and Wolpert's resultat of the convexity of the geodesic-length function along the Weil-Petersson geodesic. The aim of this part is to find out if these results can be generalized to the Hitchin component.

The second part is motivated by the action of Virasoro algebra on Teichmüller space. As the Virasoro algebra can be looked as $W(2)$ algebra, one can try to find out if the $W(n)$ algebra can acts on Hitchin component $H(n)$.

TIAN
YANG

Stanford University

My research focuses on 2- and 3-dimensional hyperbolic geometry and its applications in low dimensional topology. The topics I have been working on include: classical and quantum Teichmüller spaces and their relationship with skein algebras, variational method on finding geometric structures on 2- and 3-manifolds.

ANDREW
YARMOLA

Boston College

My research focuses on hyperbolic geometry, Teichmüller dynamics, and low-dimensional topology. In the realm of Teichmüller dynamics, I am interested in how local features of earthquakes along measured laminations relate to properties of Kleinian groups and projective structures. Recently, I have also began studying identities on moduli spaces of hyperbolic surfaces. Moduli space identities relate length spectra of geodesic paths to fixed intrinsic properties of hyperbolic surfaces, such as area. Aside from their intrinsic value, these identities have applications to computing volumes of the moduli spaces and to functional equations of dilogarithms.

Beyond generalizing these identities to higher dimensional hyperbolic manifolds, I am studying techniques of extending them to different representation varieties. Many of these identities may be stated in terms of underlying fuchsian representations and should have natural general formulations.

REN
YI

Brown University

My research interests are generally in low-dimensional geometry and dynamical systems, particularly in billiards, symbolic dynamics and piecewise isometry systems. Much of my work so far concerns the study of polytope exchange transformations which are higher dimensional generalizations of interval exchange transformations.

TENGREN
ZHANG

University of Michigan, Ann Arbor

I am interested in studying the geometric structures and dynamics behind surface group representations into semisimple Lie groups. My work so far has been in the special case when the Lie group is $SL(3, \mathbb{R})$. In this case, I can use a well-known parameterization of the Hitchin component to construct large classes of sequences that have the following property: the geometric structures associated to the representations become “less and less like hyperbolic structures” as we deform along these sequences.

Currently, I am working on constructing such families of sequences in the case when the Lie group is $PSL(n, \mathbb{R})$. Eventually, I hope my work will allow me to better understand the pressure metric on these Hitchin components.

ANDREW
ZIMMER

University of Michigan

My research involves dynamics, Riemannian geometry, and discrete subgroups of Lie groups. I especially enjoy using dynamics to prove rigidity theorems of the following form: one starts with some property of the symmetric spaces and then one proves that any object with this property must in fact be a symmetric space. These types of theorems not only lead to surprising results but also help determine the “generic” properties of certain classes of objects.

GEAR Junior Retreat

University of Michigan at Ann Arbor, 23 May - 1 June 2014

http://www.math.umich.edu/~schapos/Junior_Retreat.html

Mini-Courses

- * Martin Bridgeman (Boston College) on Geodesic flows, convex Anosov representations and pressure metrics.
- * David Dumas (UIUC) on complex projective structures and their holonomy limits.
- * Sergei Gukov (CalTech) on Geometry and physics of Higgs bundles and branes.
- * Julien Marché (Jussieu) on Representation spaces, Chern-Simons theory, and TQFTs.
- * Yair Minsky (Yale) on Recent advances in Kleinian group theory.
- * John Parker (Durham) on Complex hyperbolic geometry and quasi-Fuchsian groups.
- * Kim Ruane (Tufts) on Boundaries of CAT(0) spaces.
- * Richard Wentworth (Maryland) on The geometry of the moduli space of Higgs bundles.

Organizers

Dick Canary
Steve Kerckhoff
Michelle Lee
Ben Linowitz
Sara Maloni
Andy Sanders
Laura Schaposnik
Anna Wienhard

Senior Speakers

- * David Baraglia (Adelaide)
- * Subhojoy Gupta (Yale)
- * Sebastian Hensel (Chicago)
- * Sarah Koch (Michigan)
- * Johanna Mangahas (Brown)
- * Duc-Manh Nguyen (Université Bordeaux 1)
- * Anne Parreau (Institut Fourier)
- * Julien Paupert (Arizona State)
- * Florent Schaffhauser (UniAndes)
- * Christian Zickert (Maryland)

GEAR Executive Committee

Steven Bradlow
William Goldman
Steve Kerckhoff
Richard Wentworth
Anna Wienhard

GEAR is an NSF funded network of mathematicians working on GEometric structures And Representation varieties. The meeting is mainly aimed at PhD students and recent post-docs. There will be 8 mini-courses in the following themes:

1. Dynamics on Moduli Spaces
2. Geometric and Analytical Group Theory
3. Geometric Structures and Teichmüller Spaces
4. Higgs Bundles
5. Hyperbolic manifolds

Each mini-course will have an exercise session, as well as an open problems hour. Experts in the field shall present new developments in each area, and there will be short talks by young researchers. For more information about GEAR go to <http://gear.math.illinois.edu/>.

Registration and Funding

Funding will preferentially go to GEAR members and graduate students/postdocs at GEAR nodes; excess resources may be available for other participants. Applications received by February 1st are guaranteed full consideration, although applications will be accepted after this target date.

