UNIVERSITY OF MICHIGAN
Department of Mathematics

Seminar & Events Bulletin: Student Geometry/Topology

01-01-2013 to 06-30-2013

Monday, January 28, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- David Renardy (UM) *Computing the Khovanov Homology* -- 3096 East Hall

Monday, February 04, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Tengren Zhang (UM) *A Gentle Introduction to Higher Teichmuller Theory* -- 3096 East Hall

Monday, February 11, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Andrew Zimmer (UM) *Random walks on discrete subgroups of Lie groups* -- 3096 East Hall

Monday, February 18, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Andrew Schaug (UM) *An outline of basic Hodge theory* -- 3096 East Hall

Monday, February 25, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Russell Ricks (UM) *Patterson-Sullivan Theory* -- 3096 East Hall

Monday, March 11, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Tengren Zhang (UM) *What are Affine Spheres?* -- 3096 East Hall

Monday, March 25, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- David Renardy (UM) *How to compute hyperbolic volume* -- 3096 East Hall

Monday, April 01, 2013	
3:00pm-4:00pm	**Student Geometry/Topology** -- Patrick Boland (UM) *SL(2,Z)\SL(2,R)* -- 3096 East Hall

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Abstracts

Student Geometry/Topology
Monday, January 28, 2013, 3:00pm-4:00pm
3096 East Hall
David Renardy (UM)
Computing the Khovanov Homology

The focus of this talk will be the basic procedure for computing the Khovanov homology of a knot or link. We will begin by discussing the Jones polynomial, and how to compute it given the "n-cube of resolutions" for a picture of a link with n crossings. Khovanov homology is the so called "categorification" of the Jones Polynomial; the graded Euler characteristic of the Khovanov chain complex yields the Jones polynomial. This talk will be example driven; we will see that two knots sharing the same Jones polynomial can sometimes be differentiated by their Khovanov homology (so Khovanov homology is strictly stronger than the Jones polynomial) and that Khovanov homology can detect the unknot (it is unknown if the Jones polynomial can do this). One of the most appealing and interesting things about Khovanov homology, compared to other knot invariant homology theories, is its computability. We will explicitly compute the Khovanov homology for several knots using Dror Bar-Natan's Mathematica module.

Student Geometry/Topology
Monday, February 04, 2013, 3:00pm-4:00pm
3096 East Hall
Tengren Zhang (UM)
A Gentle Introduction to Higher Teichmuller Theory

In this talk, I will be motivating and introducing Higher Teichmuller Theory using an example-oriented approach. The main example we will focus on is the relationship between Teichmuller space and the deformation space of convex projective structures on surfaces. If time permits, I will show how other abstract definitions (e.g. Hyperconvexity, Anosovness) are generalizations of very concrete phenomena in the main example. No prior experience with Higher Teichmuller Theory required.

Student Geometry/Topology
Monday, February 11, 2013, 3:00pm-4:00pm
3096 East Hall
Andrew Zimmer (UM)
Random walks on discrete subgroups of Lie groups

In this talk we will discuss random walks on discrete groups. The first half of the talk will be devoted to basic examples and terminology. In the second half of the talk we will specialize to discrete subgroups of Lie groups. It turns out that knowing properties of the ambient Lie group says a lot about the statistics of random walks on the discrete subgroup and understanding random walks on the discrete subgroup can tell you information about the ambient Lie group. I will mainly focus on the special linear group so the talk should be very accessible.

Student Geometry/Topology
Monday, February 18, 2013, 3:00pm-4:00pm
3096 East Hall
Andrew Schaug (UM)
An outline of basic Hodge theory

A brief overview of KÃ¤hler manifolds, Dolbeaut cohomology and Hodge's theorem of harmonic forms.

Student Geometry/Topology
Monday, February 25, 2013, 3:00pm-4:00pm
3096 East Hall
Russell Ricks (UM)
Patterson-Sullivan Theory

Patterson-Sullivan measures provide a way to use measure theory to study the geometry of nonpositively curved manifolds. We will introduce Patterson-Sullivan measures and discuss some of the basic concepts from ergodic theory that allow us to obtain results about geometry. The talk is intended to emphasize ideas and be accessible at a very basic level.

Student Geometry/Topology
Monday, March 11, 2013, 3:00pm-4:00pm
3096 East Hall
Tengren Zhang (UM)
What are Affine Spheres?

The goal of this talk is to define affine spheres and describe some of their properties. We will begin by giving a brief description of some affine invariants, such as the affine normal and the shape parameter, of hypersurfaces embedded in affine space. Then, we will define affine spheres, and give some typical examples. Finally, we will state some local and global classification theorems. To make the talk accessible, I will focus on the case where the affine space is 3-dimensional.

Student Geometry/Topology
Monday, March 25, 2013, 3:00pm-4:00pm
3096 East Hall
David Renardy (UM)
How to compute hyperbolic volume

From the Gauss-Bonet theorem, we know that the area of a hyperbolic triangle is determined completely by its three angles. In particular the area of a triangle with angles a, b and c is pi-a-b-c. If the triangle is ideal (i.e. all angles are 0) then the triangle has (maximal) area pi. Given a simplex of higher dimension, how do we compute its volume? What is the maximal volume of a hyperbolic n-simplex? It turns out that maximal volume is achieved by the regular ideal simplex (much as in the n=2 case). The upshot of this result is that many manifolds have rather accessible triangulations in terms of ideal simplices. Knowing the volumes of ideal simplices will allow us to calculate the volume of a given manifold. I will attempt to leave the "computation" in this talk to a minimum (and to computers), relying on diagrams and pictures for most of the arguments. I will also provide some classic examples on the computer using the geometry/topology program Snap Pea.

Student Geometry/Topology
Monday, April 01, 2013, 3:00pm-4:00pm
3096 East Hall
Patrick Boland (UM)
SL(2,Z)\SL(2,R)

We show that the homogeneous space in the title is homeomorphic to a knot complement in the three sphere.Â Thinking of this space as the unit tangent bundle of the modular curve, we discuss results of Ghys and SarnakÂ about linking numbers of geodesics in the modular curve and the missing knot in the three sphere. If time permits,Â we will discuss preliminary results on linking between certain geodesics in the modular curve and generalizations.Â