

Winter 2008  
University of Michigan-Department of Mathematics  
<http://www.math.lsa.umich.edu/seminars/index.shtml>  
Ann Arbor, MI 48109-1043  
**February 4th – February 10th**

**Monday, February 4**

- 3:10-4:00pm **Student Analysis Seminar** --- TBA --- 3866 EH  
3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Not meeting this week --- 2866 EH  
3:10-4:00pm **Working Group in Integrable Systems and Asymptotics** --- Zhengjie Xu (UM) *Inverse Scattering for the Benjamin-Ono Equation, II* --- 3088 EH  
3:10-5:00pm **Number Theory and Representation Theory Seminar** --- Kathrin Bringmann (U. Minn) *Hypergeometric functions, automorphic forms, and mock theta functions* --- 4096 EH  
4:10-5:00pm **Several Complex Variables Seminar** --- Anne-Katrin Herbig (U of Wien) *Plurisubharmonic defining functions* --- 3096 EH  
4:10-6:00pm **Geometry & Physics** --- TBA --- 4088 EH  
5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3088 EH

**Tuesday, February 5**

- 2:10-3:00pm **"What is ... " Seminar** --- Dan Burns (UM) *What is ... DNA modeling?* --- 3096 EH  
3:10-4:00pm **Algebra Seminar** --- Jerzy Weyman (Northeastern University) --- *The Boij-Soderberg conjectures on Betti numbers of graded modules* --- 3096 EH  
3:10-4:00pm **Geometry Seminar** --- Jean-Francois Lafont (Ohio State) *Ultraflats and geometric rank of geodesics* --- 4088 EH  
3:10-4:00pm **Student Algebraic Geometry Seminar** --- TBA --- 3088 EH  
4:10-5:00pm **Colloquium (Ziwet Lectures)** --- Curtis T. McMullen (Harvard) *Dynamics and moduli spaces – Billiards and Teichmüller Theory* --- 1360 EH

**Wednesday, February 6**

- 3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH  
3:10-4:00pm **Student Representation Theory/Lie Theory Seminar** --- Harlan Kadish (UM) *Gabriel's Insight, or the Great Conspiracy* --- 3088 EH  
3:10-4:00pm **Student Arithmetic Seminar** --- TBA --- 3866 EH  
3:10-4:00pm **Student AIM Seminar** --- TBA --- Room TBA  
4:10-5:00pm **Colloquium (Ziwet Lectures)** --- Curtis T. McMullen (Harvard) *Dynamics and moduli spaces – Islands on algebraic surfaces* --- 1360 EH  
4:10-5:00pm **Complex Analysis Seminar** --- TBA --- 3096 EH  
4:10-5:30pm **Working Seminar in Several Complex Variables and Complex Dynamics** --- Not meeting this week --- 4088 EH  
4:10-6:00pm **Algebraic Geometry Seminar** --- Not meeting this week --- 3088 EH

**Thursday, February 7**

- 3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Not meeting this week --- 3088 EH  
3:10-4:00pm **Commutative Algebra Seminar** --- TBA --- 3096 EH  
3:10-4:00pm **Colloquium (Ziwet Lectures)** --- Curtis T. McMullen (Harvard) *Dynamics and moduli spaces – Topology of numbers* --- 1360 EH  
4:10-5:00pm **Topology Seminar (Unusual Time/Location)** --- Matthew Day (U Chicago) *Using right-angled Artin groups to interpolate between mapping class groups and linear symplectic groups* --- 2866 EH  
4:10-5:00pm **Differential Equations** --- Frank Merle (Paris Cergy-Pontoise) *Collision of solitons in the nonintegrable case for GKdV* --- 4088 EH  
4:10-5:00pm **Math Club** --- Kyle Petersen (UM) *Conway's napkin problem* --- 2<sup>nd</sup> floor Nesbitt Common Room

**Thursday, February 7 ...continued**

- 4:10-5:00pm **Student Combinatorics** --- Austin Shapiro (UM) *Hyperplane Arrangements II* --- 3866 EH  
4:10-6:00pm **Study Seminar** --- Marshall Williams (UM) *Rectifiable sets in metric and Banach spaces (after Ambrosio and Kirchheim)* --- 3088 EH

**Friday, February 8**

- 10:50-12:00pm **EECS Theory Seminar** --- Quentin Stout (UM) *Power, Time, and Location: Parallel algorithms addressing them all* --- CSE 3941  
2:10-3:00pm **Topics in Geometry** --- Cagatay Kutluhan (UM) *End of introduction* & Dan Burns (UM) *Seiberg-Witten-Floer homology for a contact 3-manifold* --- 3866 EH  
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Herb Winful (UM) TBA --- 1084 EH  
3:10-4:00pm **Student Geometry/Topology** --- Ricardo Portilla (UM) *Buildings* --- 3096 EH  
4:10-5:00pm **Combinatorics** --- Bridget Tenner (DePaul) *Pattern avoidance and the Bruhat Order*--- 3866 EH

**EVENTS THIS WEEK**

**Ziwet Lectures**

**Feb. 5-7, 2008**

**Speaker: Curtis McMullen**

***Series Title: Dynamics and moduli spaces***

**Schedule:**

**Tuesday, February 5, 4:00-5:00pm --- Room 1360 EH**  
***Billiards and Teichmueller Theory***

**Wednesday, February 6, 4:00-5:00pm --- 1360 EH**  
***Islands on algebraic surfaces***

**Thursday, February 7, 3:00-4:00pm --- Room 1360 EH**  
***Topology of numbers***

These talks will present progress and open problems at the interface between dynamical systems and moduli spaces of complex manifolds and Euclidean lattices.

Note: all talks will be accessible to a general audience, and none is a prerequisite for any other.

**UPCOMING EVENTS**

**Graduate Student Recruitment Weekend**  
**March 14 & 15, 2008**

**ABSTRACTS FOR THE WEEK OF FEB. 4 – FEB. 10, 2008**

**Number Theory and Representation Theory Seminar**

**Monday, February 4, 3:10-5:00pm**

**4096 EH**

**Kathrin Bringmann (U. Minn)**

***Hypergeometric functions, automorphic forms, and mock theta functions***

The literature on examples of hypergeometric series related to modular forms is extensive, and the pursuit and interpretation of such examples has many applications in mathematics and physics. However, proofs of such scattered results fall short of a comprehensive theory to describe the interplay between hypergeometric series and automorphic forms. The situation is further complicated by mock theta functions, a collection of 22  $q$ -series defined by Ramanujan in his last letter to Hardy. They resemble modular  $q$ -series but do not arise as minor modifications of the Fourier expansions of modular forms. Recently much light has been shed on the nature of these mock theta functions, and it is now known that they are the holomorphic parts of weight- $1/2$  weak Maass forms. A clearer picture is beginning to emerge of which modular forms and Maass forms arise from basic hypergeometric series. I will describe part of these results.

**Several Complex Variables Seminar**

**Monday, February 4, 4:10-5:00pm**

**3096 EH**

**Anne-Katrin Herbig (U of Wien)**

***Plurisubharmonic defining functions***

Let  $D$  be a bounded domain with smooth boundary. Suppose that  $D$  admits a smooth defining function which is plurisubharmonic on the boundary of  $D$ . This implies that the so-called Diederich-Fornæss exponent can be chosen arbitrarily close to 1 and that the closure of  $D$  admits a Stein neighborhood basis. I shall try to explain (some parts of) the proof of this. This is joint work with J.E. Fornæss.

**“What is ...” Seminar**

**Tuesday, February 5, 2:10-3:00pm**

**3096 EH**

**Dan Burns (UM)**

***What is ... DNA modeling?***

Everyone knows that our genetic blueprint is carried by molecules of DNA in the nuclei of every cell, where the blueprint is encoded in the succession of constituent bases. There are 3 billion such bases and such a double helix is about a meter in length. Mechanical, geometric and topological features of these molecules come into play in the packing of DNA into the nucleus, and the subsequent regulation of its use in the normal functioning of the cell. There are interesting ways to extract information about these features from the sequence of constituent bases, as well as analogues at other scales. These are related to development and cellular differentiation. We will discuss some example models currently in use, at two different scales of organization of DNA, related to gene transcription and chromatin structure and organization.

**Algebra Seminar**  
**Tuesday, February 5, 3:10-4:00pm**  
**3096 EH**  
**Jerzy Weyman (Northeastern University)**  
***The Boij-Soderberg conjectures on Betti numbers of graded modules***

I will report on the contents of two recent papers: "The Existence of Pure Free Resolutions" by Eisenbud, Floystad, and myself ([arXiv:0709.1529](https://arxiv.org/abs/0709.1529)) and "Betti Numbers of Graded Modules and Cohomology of Vector Bundles" by Eisenbud and Schreyer ([arXiv:0712.1843](https://arxiv.org/abs/0712.1843)). These two papers give the proof of Boij-Soderberg conjectures on Betti diagrams of graded Cohen-Macaulay modules over polynomial rings over a field of characteristic zero. These conjectures imply the multiplicity conjectures of Herzog-Huneke and Srinivasan.

**Geometry Seminar**  
**Tuesday, February 5, 3:10-4:00pm**  
**4088 EH**  
**Jean-Francois Lafont (Ohio State)**  
***Ultraflats and geometric rank of geodesics***

We'll explain how, in the presence of Riemannian non-positive curvature, bi-Lipschitz flats inside asymptotic cones can be used to construct parallel orthogonal Jacobi fields along geodesics. Applications to geometric problems will be discussed. This was joint work with S. Francaviglia (Univ. Pisa).

**Student Representation Theory/Lie Theory Seminar**  
**Wednesday, February 6, 3:10-4:00pm**  
**3088 EH**  
**Harlan Kadish (UM)**  
***Gabriel's Insight, or the Great Conspiracy***

We introduce the dimension vector of a quiver representation and define an inner product on dimension vectors, whose value depends on the homological algebra of the respective representations. We then consider the euclidean space of dimension vectors for a given quiver. After a brief review of root systems and Dynkin diagrams, we prove that a connected quiver is of finite type (has finitely many indecomposable representations) if and only if its undirected graph is of the form  $A_n$ ,  $D_n$ ,  $E_6$ ,  $E_7$ , or  $E_8$ .

**Topology Seminar (Unusual Time/Location)**  
**Thursday, February 7, 4:10-5:00pm**  
**2866 EH**  
**Matthew Day (U Chicago)**  
***Using right-angled Artin groups to interpolate between mapping class groups and linear symplectic groups***

The right-angled Artin group (RAAG) of a graph is the group whose generators are the vertices of the graph and whose only relations are that adjacent vertices commute. I will use RAAGs to define a family of groups, called  $\text{maph}\{\text{mapping class groups over graphs}\}$ , that interpolate between the mapping class group of a genus  $g$  surface with a single boundary component and the symplectic group  $\text{Sp}(2g, \mathbb{Z})$ . I will sketch a proof that these groups are finitely generated. As part of the proof, I will develop some algorithmic techniques from the study of free groups and linear groups that have been adapted to apply to right-angled Artin groups.

**Math Club**  
**Thursday, February 7, 4:10-5:00pm**  
**2<sup>nd</sup> floor Nesbitt Common Room**  
**Kyle Petersen (UM)**  
***Conway's napkin problem***

Conway's napkin problem is the following. A large number of mathematicians sit at a table in random order and are ignorant of proper etiquette: each prefers to choose the left napkin with some probability  $p$  and the right napkin with probability  $q = 1-p$ . The mathematicians sit down in order, so some of them may have only 1 choice of napkin (in which case they choose that napkin) or no napkin at all! If the number of people is sufficiently large, what proportion of them are expected to go napkinless?

We will present a clever solution of this problem in the case  $p = \frac{1}{2}$ , and then outline a solution in the general case. Along the way we will see some nice applications of formal power series and enumerative combinatorics.

**Student Combinatorics**  
**Thursday, February 7, 4:10-5:00pm**  
**3866 EH**  
**Austin Shapiro (UM)**  
***Hyperplane Arrangements II***

Continuing where Luis left off, I will develop some properties of the intersection poset of a hyperplane arrangement, then talk about the number of regions in an arrangement in general position. A quick review will be provided for those who missed Luis's talk. We are following Richard Stanley's notes <<http://www-math.mit.edu/~rstan/arrangements/arr.html>>.

**Study Seminar**  
**Thursday, February 7, 4:10-6:00pm**  
**3088 EH**  
**Marshall Williams (UM)**  
***Rectifiable sets in metric and Banach spaces (after Ambrosio and Kirchheim)***

We will discuss a paper by Luigi Ambrosio and Bernd Kirchheim analyzing rectifiable subsets of metric spaces (a set is  $k$ -rectifiable if it is, up to an  $H^k$  null set, a countable union of Lipschitz images of subsets of  $\mathbb{R}^k$ ). Using isometric embeddings into dual Banach spaces, the authors define a weak\* differential, which is shown to be intrinsic in a suitable sense. Weak\* differentiation is closely related to "metric differentiation", introduced in an earlier paper of Kirchheim. We will discuss these differentiation theorems and their applications, including a Rectifiability criterion as well as area and coarea formulas.

**Student Geometry/Topology**  
**Friday, February 8, 3:10-4:00pm**  
**3096 EH**  
**Ricardo Portilla (UM)**  
***Buildings***

We will give an brief introduction to buildings and their connections with different geometries.

**Combinatorics**  
**Friday, February 8, 4:10-5:00pm**  
**3866 EH**  
**Bridget Tenner (DePaul)**  
***Pattern avoidance and the Bruhat Order***

The structure of order ideals in the Bruhat order for the symmetric group is elucidated via permutation patterns. We characterize the permutations with boolean principal order ideals and show that they form an order ideal which is a simplicial poset. We generalize this characterization to describe a larger class of permutations whose principal order ideals are related to boolean posets. It is determined when the set of permutations avoiding a particular set of patterns is an order ideal, and the rank generating functions of these ideals are computed. Finally, we will discuss the Bruhat order in types B and D, and characterize the elements with boolean principal order ideals, as well as enumerate them by length.