Winter 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
March 30th – April 5th

Monday, March 30

3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- TBA --- 2866 EH
3:10-4:00pm **Colloquium (Special Seminar - Note: Non-standard day/time/location) ---** Peter Lax (Courant Institute) **–** *Degenerate Matrices* **---** 3088 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Alex Kontorovich (Brown) *Apollonian Circle Packings and Horospherical Flows on Hyperbolic 3-Manifolds* --- 4096 EH
4:10-5:00pm **Combinatorics (Special Seminar)** --- Michael Gekhtman (MIT) *Cluster algebras on rational functions and Backlund-Darboux transformations of Toda flows* --- 3866 EH
4:10-5:00pm **Student Combinatorics** --- Not meeting this week --- 3866 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Kyounghee Kim (Florida State U / Indiana U) *Linearization on a large set* --- 3096 EH
4:10-6:00pm **Geometry and Physics Seminar** --- Paul Aspinwall (Duke) *Probing Geometry with the Derived Category and Stability Conditions* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- TBA --- 3096 EH

Tuesday, March 31

2:10-3:00pm "**What is … " Seminar** --- Igor Kriz (UM) *What is … supersymmetry?* --- 3096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Student Algebraic Geometry Seminar** --- Mihai Fulger (UM) *Proof of the Enriques-Kodaira classification of surfaces assuming the MMP* --- 3088 EH
3:10-4:00pm **Geometry Seminar** --- TBA --- 3866 EH
3:10-4:00pm **Student Seminar in Complex Dynamical Systems** --- TBA --- 4088 EH
4:10-5:00pm **Colloquium ---** Xiaobo Liu (U of Notre Dame) **–** *Universal equations for Gromov-Witten invariants* **---** 1360 EH
4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH

Wednesday, April 1

3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH
3:10-4:00pm **Student Representation Theory Seminar** --- Paul Johnson (UM) --- *Hurwitz numbers and the infinite wedge* --- 3096 EH
3:10-4:00pm **Student Arithmetic Seminar** --- TBA --- 3088 EH
4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- TBA --- 3096 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Maxim Kazarian (Moscow) *Enumeration of multisingularities* --- 3088 EH

Thursday, April 2

3:10-4:00pm **Commutative Algebra Seminar** --- Ian Aberbach (U of Missouri) TBA --- 3096 EH
3:10-4:00pm **Topology Seminar** --- Juan Souto (UM) *Geometric limits of knot complements* --- 4088 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- TBA --- 3088 EH
4:10-5:00pm **Differential Equations ---** Marty Golubitsky (Ohio State) *Symmetry-Breaking; Synchrony Breaking* **---** 4088 EH
4:10-5:00pm **Math Club** --- David Montague (UM) *The Geometry of the Hausdorff Metric* --- 2nd floor Nesbitt Room
4:10-6:00pm **RTG Study Seminar** --- TBA --- 3088 EH

Friday, April 3

11:10-12:00pm **Theoretical Computer Science Seminar** --- Patrick Poon (UM) --- *Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space O(n log^2 n)-Time Algorithm* --- CSE 3941

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Jesse Otero (National Security Agency) TBA --- 1084 EH

3:10-4:00pm **Student Geometry/Topology** --- Max Glick (UM) --- *The Filling Theorem* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Philippe Di Francesco (Saclay / UIUC) *Q-systems and cluster positivity* --- 3866 EH

UPCOMING EVENTS

RTG Workshop on SCV and Geometry
April 10 - April 12, 2009

Ziwet Lectures
April 13-16, 2009
John Tyson (Virginia Polytechnic Institute & State University)
1. How do Cells Compute?
2. Temporal Organization of the Eukaryotic Cell Cycle
3. Mathematical Challenges in Systems Biology

Ziwet Lectures
Cedric Villani (Ecole Normale Superieure de Lyon)
October 2009

ABSTRACTS FOR THE WEEK OF MARCH 30 – APRIL 5, 2009

Colloquium (Special Seminar)
Monday, March 30, 3:10-4:00pm (Note: Non-standard day/time/location)
3088 EH
Peter Lax (Courant Institute)
Degenerate Matrices

A symmetric matrix is called degenerate by physicists if it has a multiple eigenvalue.Wigner and von Neumann have shown long ago that the degenerate matrices form a variety of codimension two in the space of all symmetric matrices.This explains the phenomenon of "avoidance of crossing". I will show that if A,B,C are nXn symmetric matrices, and n is congruent 2 mod 4, there always exist three real numbers a,b,c, not all zero, such that aA+bB+cC is degenerate.This has interesting applications to symmetric hyperbolic systems of PDE-s.such as the equations of crystal optics. Degenerate matrices are characterized by the single equation discr[S]=0, where discr[S] is the discriminant of S.I shall present a new proof of the proposition that the discriminant can be represented as a sum of squares.

Group Theory/Lie Theory/Number Theory Seminar
Monday, March 30, 3:10-5:00pm
4096 EH
Alex Kontorovich (Brown)
Apollonian Circle Packings and Horospherical Flows on Hyperbolic 3-Manifolds

We prove an asymptotic formula for the number of circles in an Apollonian packing of bounded curvature. Using the affine linear sieve, we give sharp upper bounds for the number of circles of prime curvature, and the number of "twin prime" tangent circles. The main ingredient of our proof is the equidistribution of long horospherical flows in the unit tangent bundle of an infinite volume hyperbolic 3-manifold, under the assumption that the Hausdorff dimension of its limit set exceeds one. This is joint work with Hee Oh.

Combinatorics (Special Seminar)
Monday, March 30, 4:10-5:00pm
3866 EH
Michael Gekhtman (MIT)
Cluster algebras on rational functions and Backlund-Darboux transformations of Toda flows

We use a special kind of directed networks in an annulus to study a cluster algebra structure on a space of rational functions with a pole at infinity and subject to some genericity conditions. Distinguished clusters in this cluster algebra are in natural correspondence with pairs of Coxeter elements of the permutation groups. We show that sequences of cluster transformations connecting two distinguished clusters are closely associated with Backlund-Darboux transformations of Toda flows on corresponding double Bruhat cells in GL(n). This is joint work with M. Shapiro and A. Vainshtein.

Several Complex Variables and Complex Dynamics Seminar
Monday, March 30, 4:10-5:00pm
3096 EH
Kyounghee Kim (Florida State U / Indiana U)
Linearization on a large set

We will discuss a discrete family of automorphisms. These maps have a curve of fixed points. There are two cases. In the first case, the curve is attracting/repelling, and its basin has full volume. In the other case, the curve is the "\emph{center}" of a rotation domain, which is "\emph{large}" because it contains both a curve of fixed points, as well as isolated fixed points. We will discuss how to linearize these mappings.

Geometry and Physics Seminar
Monday, March 30, 4:10-6:00pm
4088 EH
Paul Aspinwall (Duke)
Probing Geometry with the Derived Category and Stability Conditions

The notion of putting D-Branes on a Calabi-Yau 3-fold leads the idea of "stability conditions" on the bounded derived category of coherent sheaves. Mirror symmetry also gives the notion of a "complexified Kahler cone" on a Calabi-Yau. Specifying a location in the complexified Kahler cone yields a stability condition. I will discuss to what extent the moduli space of stable skyscraper sheaves can recover the given Calabi-Yau in various examples.

"What is … " Seminar
Tuesday, March 31, 2:10-3:00pm
3096 EH
Igor Kriz (UM)
What is … supersymmetry?

Perhaps contrary to popular belief, supersymmetry is a notion of mathematics and not physics. While supersymmetry is used in nuclear physics to simplify certain calculations, no known experimental system exhibits fundamental supersymmetry. On the other hand, ``super'' aspects of geometry have rigorous mathematical treatments. In this talk, I will outline the relevant definitions, and will give some examples. In particular, I will talk about supersymmetry between translations and spinors, which leads to physical speculations of supersymmetry between bosons and fermions (which is not the same thing as the boson-fermion correspondence). I also hope to talk about N-super-Riemann surfaces which are used in conformal field theory, about the N-superconformal algebra, and perhaps even more specifically about the N=2 case, and precise mathematical definitions corresponding to notions such as ``A-models'' and ``B-models''.

Colloquium
Tuesday, March 31, 4:10-5:00pm
1360 EH
Xiaobo Liu (U of Notre Dame)
Universal equations for Gromov-Witten invariants

It is well known that relations in tautological rings of moduli spaces of curves produce differential equations for generating functions of Gromov-Witten invariants for all compact symplectic manifolds. We call such equations universal equations. These equations are very helpful in understanding structures of Gromov-Witten theory and played an important role in the so called Virasoro conjecture. However finding explcit universal equations seems to be a hard problem especially when genus is large. I will talk about a class of universal equations of all genera proved in a joint work with R. Pandharipande. Some of these equations were conjectured by K. Liu and H. Xu.

Algebraic Geometry Seminar
Wednesday, April 1, 4:10-6:00pm
3088 EH
Maxim Kazarian (Moscow)
Enumeration of multisingularities

According to R.Thom's principle, the cohomology classes represented by the cycles of prescribed local singularity type for a generic holomorphic mapping are represented by universal polynomials in the Chern classes of considered manifolds. An extension of this principle describes in a similar way the cycles of multisingularities lying in the target manifold. The very existence of universal expressions allows one to reconstruct these expressions from the consideration of a number of relatively simple particular examples. This gives a uniform and efficient approach to a solution of hundreds enumerative problems of projective algebraic geometry. We shell discuss the existence theorem for universal expressions and the ways of their explicit computations.

Differential Equations
Thursday, April 2, 4:10-5:00pm
4088 EH
Marty Golubitsky (Ohio State)
Symmetry-Breaking; Synchrony Breaking

A coupled cell system is a network of interacting dynamical systems. Coupled cell models assume that the output from each cell is important and that signals from two or more cells can be compared so that patterns of synchrony can emerge. We ask: which part of the qualitative dynamics observed in coupled cells is the product of network architecture and which part depends on the specific equations? In our theory, local network symmetries replace symmetry as a way of organizing network dynamics, and synchrony-breaking replaces symmetry-breaking as a basic way in which transitions to complicated dynamics occur.

Math Club
Thursday, April 2, 4:10-5:00pm
2nd Floor Nesbitt Room
David Montague (UM)
The Geometry of the Hausdorff Metric

Have you ever tried to measure the distance between two objects, but weren't sure exactly how you should do it?

Perhaps the shortest distance between the two? What if the objects are touching? Maybe the distance between their “middles”? What if there isn't a well-defined “middle”? It turns out that, in the early 20th century, Felix Hausdorff introduced the Hausdorff metric as a way of measuring the distance between the nonempty and compact subsets of a given metric space. By applying the Hausdorff metric to n-dimensional Euclidean space, we have a mathematically sound way of measuring the distance between the aforementioned objects.

The Hausdorff metric over Euclidean space, however, gives us more than just a way of measuring distance; it also gives rise to a fascinating geometry with many unexpected properties. In this talk, we will define metric spaces and introduce the Hausdorff metric, develop its basic properties, and discuss some of the many geometric generalizations that have been investigated.

Theoretical Computer Science Seminar
Friday, April 3, 11:10-12:00p
CSE 3941
Patrick Poon (UM)
Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space O(n log^2 n)-Time Algorithm

Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space O(n log^2 n)-Time Algorithm Philip Klein, Shay Mozes, Oren Weiman Presented by Patrick Poon We give an O(n log^2 n)-time, linear-space algorithm that, given a directed planar graph with positive and negative arc-lengths, and given a node s, finds the distances from s to all nodes. The best previously known algorithm requires O(n log^3 n) time and O(n log n) space.

Combinatorics
Friday, April 3, 4:10-5:00pm
3866 EH
Philippe Di Francesco (Saclay / UIUC)
Q-systems and cluster positivity

We consider the cluster algebra associated to the Q-system of type A_r , a system of discrete integrable equations occurring in the context of quantum spin chains. Cluster variables may be viewed as initial data for the Q-system.

We show that the conserved quantities of the Q-system are partition functions for hard particles on particular target graphs, determined by the initial data. This allows to interpret the fundamental solutions of the Q-system as generating functions of weighted paths on suitable dual target graphs. The generating functions take the form of finite continued fractions. In this setting, the cluster mutations correspond to local rearrangements of the fractions that leave their final value unchanged. Finally, the remaining solutions of the Q-system are interpreted as partition functions for strongly non-intersecting families of lattice paths on target lattices, namely paths with nearest neighbor exclusion rules. This displays all cluster variables as manifestly positive Laurent polynomials of any initial data, thus proving the cluster positivity conjecture for the Q-system of type A_r . This is joint work with R. Kedem.