

Fall 2006
University of Michigan-Department of Mathematics
<http://www.math.lsa.umich.edu/seminars/index.shtml>
Ann Arbor, MI 48109-1043
October 2nd – October 8th

Monday, October 2

- 3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Charles Cadman (UM) *Hypergeometric Functions and Variation of Hodge Structure* --- 3866 EH
- 3:10-4:30pm **Arithmetic/Number Theory Seminar** --- Hugh Montgomery (UM) *The error term in the prime number theorem* --- 4096 EH
- 4:10-5:00pm **Several Complex Variables Seminar** --- Zbigniew Blocki (Jagiellonian Univ, Krakow) *On the Suita conjecture* --- 3096 EH
- 4:10-5:00pm **Differential Equations** --- Mikhail Feldman (Wisconsin) *Existence and regularity of solutions to shock reflection problem* --- 3866 EH
- 4:10-6:00pm **Group Theory/Lie Theory Seminar** --- Not meeting this week --- 4088 EH
- 4:10-6:00pm **Geometry & Physics** --- Yongbin Ruan (UM) *Witten equation and the singularities theory* --- 3088 EH

Tuesday, October 3

- 12:10-1:00pm **Student Algebraic Geometry Seminar** --- Yogesh More (UM) *The fundamental group of the complement of a plane curve* --- 1068 EH
- 2:10-3:00pm **Geometry Seminar** --- Gopal Prasad (UM) *Fake projective spaces* --- 4088 EH
- 3:10-4:00pm **Algebra Seminar** --- Not meeting this week --- 3096 EH
- 4:10-5:00pm **Colloquium** --- Shing-Tung Yau (Harvard) *Canonical metrics on complex manifolds* --- 1360 EH

Wednesday, October 4

- 3:10-4:00pm **Student Arithmetic Seminar** --- Johnson Jia (UM) *A Glance at Iwasawa Theory* --- 3866 EH
- 3:10-4:00pm **Student AIM Seminar** --- Patrick Rooney (UM) *Genetic algorithms* --- 3096 EH
- 3:10-4:00pm **Financial/Actuarial Mathematics Seminar (Special Time)** --- Ioannis Karatzas (Columbia Univ) *Stochastic Differential Games of Control and Stopping: Some Results and a Lot of Open Problems* --- 3088 EH
- 3:10-5:00pm **Geometric Function Theory Seminar** --- Pekka Pankka (UM) *Slow quasiregular mappings into closed manifolds* --- 4096 EH
- 4:10-5:30pm **Working Seminar in Several Complex Variables and Complex Dynamics** --- Michal Jasiczak (UM) *The \bar{d} equation on currents* --- 4088 EH
- 4:10-5:00pm **Student Analysis Seminar** --- Ellen Veomett (UM) TBA --- 3866 EH
- 4:10-6:00pm **Algebraic Geometry Seminar** --- Ivan Petrakiev (UM) *On Zero-dimensional schemes with small Hilbert functions* --- 3088 EH

Thursday, October 5

- 3:10-4:00pm **Commutative Algebra Seminar** --- TBA --- 3096 EH
- 3:10-4:00pm **Topology Seminar** --- Anna Lenzhen (UM) *Teichmuller geodesics which do not have a limit in PMF* --- 4096 EH
- 3:10-5:00pm **Analysis Study Seminar** --- Pekka Pankka (UM) *Volume growth and hyperbolicity (continued)* --- 2866 EH
- 4:10-5:00pm **Math Club** --- Leo Goldmakher (UM) *A One Sentence Proof* --- 1324 EH
- 4:10-5:00pm **Student Combinatorics** --- Kelli Carlson (UM) TBA --- 3866 EH
- 4:10-5:30pm **Logic Seminar** --- Not meeting this week --- 3096 EH

Thursday, October 5 (continued)

- 4:30-5:30pm **Theoretical Computer Science Seminar** --- Julia Lipman (UM) *Publish and Perish* --- CSE 3941
- 5:15-6:30pm **Teaching Mathematics** --- Deborah Ball (UM) *The National Mathematics Advisory Panel and Its Implications for Higher Education* --- 3088 EH

Friday, October 6

- 3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Robert Ziff (UM) *Percolation density profiles and transitions points* --- 1084 EH
- 3:10-4:00pm **Student Geometry/Topology** --- Stephanie Jakus (UM) *Morse theory* (First of a three talk series) --- 3096 EH
- 4:10-5:00pm **Combinatorics** --- Pavlo Pylyavskyy (MIT) *Poset generating functions and log-supermodularity* --- 3866 EH

UPCOMING EVENTS:

**2006-07 Rainich Lectures
October 30-November 3, 2006
Phil Holmes (Princeton University)
Schedule and talks TBA**

ABSTRACTS FOR THE WEEK OF OCT. 2 – OCT. 6, 2006

**Several Complex Variables Seminar
Monday, October 2, 4:10-5:00pm
3096 EH
Zbigniew Blocki (Jagiellonian Univ, Krakow)
*On the Suita conjecture***

Let D be any bounded domain on the plane and z any point in D . It was conjectured by N. Suita (1972) that then the following estimate holds:

$$(*) \quad c_D(z) \leq \pi \int_D |K_D(z, z)|^2$$

where $c_D(z)$ is the logarithmic capacity of the complement of D wrt z and K_D is the Bergman kernel. One can easily check that there is in fact equality in (*) for simply connected domains. By approximation, it is clear that it is enough to show (*) for smooth multiply connected domains. In fact, Suita showed that the strict inequality holds in (*) if D is an annulus, and thus also for any smooth doubly connected domain. The inequality (*) is equivalent to the following statement: one can find a holomorphic function f in D such that $f(z)=1$ and $\int_D |f|^2 \leq \pi \int_D |K_D(z, z)|^2$, which suggests a relation to the Ohsawa-Takegoshi extension theorem from Several Complex Variables. Indeed, in 1995 T. Ohsawa using similar methods showed the estimate $c_D(z) \leq 750 \pi \int_D |K_D(z, z)|^2$. The aim of the talk will be to improve the Ohsawa estimate to $c_D(z) \leq 2 \pi \int_D |K_D(z, z)|^2$. As the main tool we use a result of B. Berndtsson and also simplify the Ohsawa approach.

Differential Equations
Monday, October 2, 4:10-5:00pm
3866 EH

Mikhail Feldman (Wisconsin)
Existence and regularity of solutions to shock reflection problem

When a plane shock hits a wedge, a reflection-diffraction process occurs, and a reflected shock moves outward as the original shock moves forward in time. Experimental, computational, and asymptotic analysis has shown that various patterns of shock reflection may occur, including regular and Mach reflection. In a recent joint work with G.-Q. Chen, we show existence of global solutions to shock reflection by large-angle wedges for potential flow. We reduce the shock reflection problem to a free boundary problem for a nonlinear elliptic equation, with ellipticity degenerate on a part of the boundary (the sonic line), and solve this problem by an iteration procedure. We also study optimal regularity of solutions near the sonic line.

Student Algebraic Geometry Seminar
Tuesday, October 3, 12:10-1:00pm
1068 EH

Yogesh More (UM)
The fundamental group of the complement of a plane curve

Fulton's result that the algebraic fundamental group of the complement of a nodal curve is abelian will be explained. The proof uses the Fulton-Hansen connectedness theorem.

Geometry Seminar
Tuesday, October 3, 2:10-3:00pm
4088 EH

Gopal Prasad (UM)
Fake projective spaces

In this talk I will outline the results of my two recent joint papers with Sai-Kee Yeung. A fake projective plane is a smooth compact complex surface which is not the complex projective plane but has the same Betti numbers as the complex projective plane. It is known that such a surface is projective algebraic and it is the quotient of the open unit ball in \mathbb{C}^2 by a cocompact torsion-free arithmetic subgroup of $PU(2,1)$. The Euler-Poincaré characteristic of such an arithmetic subgroup is 3. The first fake projective plane was constructed by David Mumford in 1979 using p -adic uniformization and two more examples were found using a similar method by Ishida and Kato. There is one more example constructed last year by JongHae Keum, a former student of Igor Dolgachev, which appears to be related to Mumford's original example. An interesting problem in complex algebraic geometry is to determine all fake projective planes and study their geometric (and arithmetic) properties. Using a formula for the covolume of principal arithmetic subgroups which I had found in 1987, and some intricate number theoretic considerations, we have been able to list all arithmetic subgroups of $PU(2,1)$ whose orbifold Euler-Poincaré characteristic is at most 3. From this we get an explicit description of seventeen finite classes of fake projective planes, and we show that there can be at most three more. From our explicit description of fake projective planes, we are able to derive interesting geometric properties of these exotic complex algebraic surfaces. For example, we have shown that for most of them the canonical line bundle is divisible by 3, and the ones with this property are embeddable in P^4 . We have also determined all arithmetic subgroups of $SU(n-1,1)$ whose orbifold Euler-Poincaré characteristic is reciprocal of a positive integer. We have proved that there are no such subgroups unless $n = 3$ or 5 . For $n=5$ we have enumerated them all. This led to the very first examples of fake P^4 (smooth ball quotients of dimension 4 with same Betti numbers as complex P^4). We found that there are four of them.

Student Arithmetic Seminar
Wednesday, October 4, 3:10-4:00pm
3866 EH
Johnson Jia (UM)
A Glimpse at Iwasawa Theory

I will discuss some general notions, present some known results, and survey some conjectures in Iwasawa theory, following Greenberg's article "Iwasawa Theory for P-adic Representations".

Student AIM Seminar
Wednesday, October 4, 3:10-4:00pm
3096 EH
Patrick Rooney (UM)
Genetic algorithms

The genetic algorithm as an optimization method was first developed by John Holland here at Michigan in the early 1970's. Since then, genetic algorithms have become useful in various engineering applications, and recently, they have been used to find optimal laser pulses for quantum control applications. The usage of these algorithms however is based on empirical success and their theoretical foundations are still sparse. I will discuss the mechanics of genetic algorithms, as well as the known mathematics behind them.

Financial/Actuarial Mathematics Seminar (Special Time)
Wednesday, October 4, 3:10-4:00pm
3088 EH
Ioannis Karatzas (Columbia Univ)

Stochastic Differential Games of Control and Stopping: Some Results and a Lot of Open Problems

Imagine that two players observe the evolution of a random motion, to be modeled in this talk as a diffusion process. One of the players (the controller) can intervene and influence the local characteristics, or "dynamics", of the process, such as its local drift and variance; whereas the other player (the stopper) can stop the game at any time of his choice. When the game ends the controller pays the stopper a certain amount, which depends on the position of the process at the time of termination -- and perhaps also on the entire trajectory of the process up to that time. It is, of course, in the interest of the controller (respectively, of the stopper) to minimize (respectively, to maximize) this amount, at least in expectation. Does the resulting stochastic zero-sum game have a value? Does it have a saddle point (that is, a pair of strategies by the two players that are best responses to each other)? If so, how does one characterize, or even compute, these quantities? How about the corresponding non-zero-sum game, in which one looks for Nash equilibria rather than for saddles? Questions such as these have been asked and addressed only recently, and very few results exist. We shall describe some of them, small islands in a sea of open questions.

(Joint work with William Sudderth, University of Minnesota.)

Geometric Function Theory Seminar
Wednesday, October 4, 3:10-5:00pm
4096 EH

Pekka Pankka (UM)

Slow quasiregular mappings into closed manifolds

I will discuss quasiregular mappings with additional growth condition called slowness. The aim of the talk is to show that closed manifolds receiving slow quasiregular mappings from Euclidean n -space or from a punctured n -ball are of special type.

Analysis Study Seminar
Thursday, October 5, 3:10-5:00pm
2866 EH

Pekka Pankka (UM)

Volume growth and hyperbolicity (continued)

I will discuss a theorem of Varopoulos on the growth bounds for fundamental groups of closed quasiregularly elliptic manifolds [Varopoulos - Saloff-Coste - Coulhon, Analysis and geometry on groups, Theorem X.5.1].

Math Club
Thursday, October 5, 4:10-5:00pm
1324 EH

Leo Goldmakher (UM)

A One Sentence Proof

In 1990, simplifying work of Heath-Brown, D. Zagier published a beautiful one-sentence proof of the following classic result:

Theorem: Every prime which is one more than a multiple of four can be expressed as the sum of two squares.

In this talk, we will explore Zagier's proof, not only by trying to understand how the proof works, but also (perhaps more importantly) trying to recreate the process of the discovery of the proof.

If time permits, I will also present Dedekind's proof of the above theorem, which may be considered one of the first successes of Algebraic Number Theory.

Teaching Mathematics
Thursday, October 5, 5:15-6:30pm
3088 EH

Deborah Ball (UM)

The National Mathematics Advisory Panel and Its Implications for Higher Education

Deborah Loewenberg Ball, dean of the University of Michigan School of Education, is a member of the National Mathematics Advisory Panel. Its 17 members include several prominent figures in mathematics education, mathematics, psychology and education policy from across the nation.

The panel, modeled in part after the National Reading Panel, is charged to advise President Bush and U.S. Education Secretary Margaret Spellings on wise use of scientifically based research to advance the teaching and learning of mathematics. The panel will examine and summarize the scientific evidence related to the teaching and learning of mathematics, with a specific focus on preparation for and success in learning algebra. The panel's work is aimed at identifying what we know and what we need to know about effective ways to teach mathematics to the full diversity of American students, who are increasingly falling behind their peers in other countries. The panel also is expected to provide more guidance for effective ways to implement the Bush Administration's \$250 million program for improving mathematics education.

Ball will discuss her perspective of the panel's work as well as the implications that this work has on higher education.

Applied and Interdisciplinary Mathematics Seminar

Friday, October 6, 3:10-4:00pm

1084 EH

Robert Ziff (UM)

Percolation density profiles and transitions points

The Bernoulli percolation model has been intensely investigated for over 50 years yet keeps yielding new exact results. The model will be introduced and some recent work will be reviewed, including the recent history of the crossing problem first studied by Cardy and by Langlands and co-workers, and more recently rigorously solved by Schramm and Werner (the recent Fields medalist). In recent work with Peter Kleban, we have found explicit expressions for density profiles and a surprising superposition property for clusters that touch two points on a boundary. In other recent work with Christian Scullard, we have found a kind of generalization of the star-triangle transformation (independently found by Lincoln Chayes at about the same time) and show how it can be used to find transition points of a wide variety of new lattices.

Combinatorics

Friday, October 6, 4:10-5:00pm

3866 EH

Pavlo Pylyavskyy (MIT)

Poset generating functions and log-supermodularity

In [joint work with T.Lam and A.Postnikov](#), we establish Schur positivity conjectures due to Okounkov and Fomin-Fulton-Li-Poon, and a special case of a conjecture by Lascoux-Leclerc-Thibon. [We study](#) log-supermodularity properties of more general poset generating functions, proving a positivity result in terms of fundamental quasisymmetric functions. We introduce quasisymmetric functions called wave Schur functions, and provide a Jacobi-Trudi like formula for them. Finally, we look at the related partial order on pairs of partitions introduced by J. Stembridge, and characterise maximal elements of that poset.