MATHEMATICS DEPARTMENT SEMINAR SCHEDULE
February 3 – February 7, 2003

All seminars are held in Boyd Graduate Studies unless otherwise noted

MONDAY, February 3, 2003

Group Representation and Cohomology
2:30p.m., Room 302
Speaker: Graham Matthews, University of Georgia
Title of talk: *Projective Resolutions*

Topology
2:30p.m.Room 326
Speaker: Clint McCrory, University of Georgia
Title of talk: *"More about virtual Betti numbers."*

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Arpad Toth, Fordham University
Title of talk: *Exponential sums in number theory*
Abstract: This talk will concentrate on the role exponential sums play in the theory of Diophantine equations. At the end of the talk I will review some recent developments concerning improved estimates for sums of exponential sums.

CATS
4:40 p.m., Room 306 Boyd Graduate Studies
Speaker: Bob Robinson, Computer Science Dept.
Title of talk: *Generating Feynman Diagrams -- an Update*
Abstract: An overview and update on generating Feynman diagrams (FDs) is presented. There have been several previous seminars this academic year on generating and counting FDs; the web version of this abstract contains links to them; see
http://www.cs.uga.edu/research/Cats.htm/.
In this talk we present the basics of CAT generation algorithms for canonical FDs and for all labeled FDs, then discuss related open problems. Here CAT stands for "Constant Amortized Time".

Note: The research reported is being carried out for the NSF project "ITR/ACS: Stochastic summation of high-order Feynman graph expansions", led by Prof. H.-B. Schuttler of the UGA Physics Dept. (PI) with the speaker and others as co-PIs.

TUESDAY, February 4, 2003

VIGRE
2:00-3:15 p.m., Room 304
Speaker: Bree Ettinger, University of Georgia
Title of talk: *Derivative approximations on time scales*
Abstract: This talk will be an overview of the VIGRE research done on approximating derivatives on time scales. We will explore the two routes of approximating the derivative, examine different time scale performances on different derivatives and look into approximating the derivative by the points we pick. This talk will feature the Maple package designed by last summer's REU group.

Student Number Theory
3:30 p.m., Room 222
Speaker: Charles Pooh, University of Georgia
Title of talk: *It's as easy as abc (Part II)*

Analysis
3:30p.m., Room 322
No Meeting this week

WEDNESDAY, February 5, 2003

Wavelet Analysis
10:10-11:10 a.m., Room 542
Speaker: Haipeng Liu, University of Georgia
Title of talk: *Regular compactly supported wavelets in sobolev spaces, continued*

Graduate Student Seminar
2:30 p.m., Room 302
Speaker: Malcolm Adams, University of Georgia
Title of talk: *Tips for teaching calculus labs*
**Please bring your teaching journals to the seminar*

Algebraic Geometry
2:30 p.m., Room 303
Speaker: Robert Varley, University of Georgia
Title of talk: *The Prym variety realizations of the intermediate Jacobian of a cubic threefold (- a survey)*

Problem Solving Group
2:30 p.m., Room 322

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Numerical Analysis
Meeting on Friday, February 7, 2003
Special Joint Seminar with Geometry

Lie Theory
3:30 p.m., Room 303
Speaker: TBA
Title of talk: TBA

Arithmetic Geometry/Number Theory
3:30 p.m., Room 304
Speaker: Dino Lorenzini, University of Georgia
Title of talk: *What is a Neron Model?*

THURSDAY, February 6, 2003

Special Seminar
1:00-2:00p.m., Room 410
Speaker: Misha Kapovich, University of Utah
Title of talk: *"Conformally flat metrics on 4-manifolds"*
Abstract. Let M be a smooth closed 4-dimensional spin-manifold. We will show that there exists a closed 4-manifold N such that the connected sum $M\# N$ admits a conformally flat Riemannian metric. An application of this result is that for each finitely-presented group G there exists a group H such that the free product $G*H$ is the fundamental group of a closed complex 3-manifold which admits a holomorphic projective structure. This generalizes a theorem of Cliff Taubes on existence of anti-selfdual Riemannian metrics on 4-manifolds.

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Professor Alex Patukhov, University of South Carolina:
Title of talk: *Wavelet frames and their applications*
Abstract: We begin with a short introduction to general and wavelet frames.
The theoretical part of the talk includes the discussion of the methods for constructing wavelet frames with the given properties. Some ideas of applications of frames to data

representation (including compression, resilience to the errors of transmission) will be given. Frame-based algorithms for the recovery of corrupted data (images) with the results of numerical modelling will be presented.

FRIDAY, February 7, 2003

Special Joint Geometry and Numerical Analysis Seminar
2:30 p.m., Room 322
Speaker: Mary Pugh, University of Toronto
Title of talk: *Thin film equations --- analysis meets computation*

Abstract: We consider long-wave unstable interface models of the type
$$
h_t = - (h^n h_{xxx})_x - B (h^m h_x)_x
$$
where B, n and m are constants. Equations of this type arise in many situations. If one has just painted the floor then $B < 0$ and h is the thickness of the paint at location x and time t. If one has just painted the ceiling, then $B > 0$.

Starting with smooth strictly positive initial data, if $B < 0$ then only one thing can go wrong with the solution: h goes to zero at some location in space. If $B > 0$ then two types of singularities can occur: h goes to zero at one location and/or h goes to infinity at a different location.

In this talk, I will discuss the analytical causes and ramifications of such singularities. I will also discuss how one uses the analytical existence theory to design good numerical schemes to compute these solutions. Also, I will discuss a different type of scheme that one uses when no singularities occur and one's goal is resolving long-time behavior.

The talk will include work with Andrea Bertozzi (Duke) and work with Richard Laugesen (University of Illinois at Urbana Champaign). My goal is for at least 75% of the talk to be accessible to any grad student who knows what a PDE is.

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Professor Misha Kapovich, University of Utah
Title of talk: *Generalized triangle inequalities with applications to algebraic groups*
Abstract: Everybody knows how to construct triangles with the prescribed side-lengths $\al_1$, $\al_2$, $\al_3$ in the Euclidean plane: The necessary and sufficient conditions for this are the usual triangle inequalities $\al_i \le \al_j+\al_k$. In this talk I will explain

how to solve (in a unified fashion) the analogous problem for other geometries X: nonpositively curved symmetric spaces (and their infinitesimal analogues) and Euclidean buildings. The notion of ``side-length" in this generality becomes more subtle: {\em side-lengths} are elements of the appropriate Weyl chamber $\Delta$. One of the suprising results is that the ``generalized triangle inequalities" for X determine a polyhedral cone $D_3(X)\subset \Delta^3$, which depends on X and on the type of geometry only weakly: $D_3(X)$ is completely determined by the finite Coxeter group corresponding to X. The linear inequalities describing $D_3(X)$ are determined by the ``Schubert calculus" (computing the integer cohomology ring) in the associated generalized flag varieties. Our techniques for proving these results about $D_3(X)$ are mostly geometric (with a bit of dynamics): By relating triangles with weighted configurations ``at infinity", the idea which goes back to Gauss.

I then talk about application of these results to several problems in the algebraic group theory: Decomposing tensor products of representations of complex reductive Lie groups, computing structure constants of Hecke rings and generalizations of the Weyl's and Thompson's problems on eigenvalues (resp. singular values) of sums (resp. products) of $n\times n$ matrices.

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Upcoming Events

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WEDNESDAY, February 12, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Dr. Yi-jen Lee**,** Harvard University
Title of talk: *Torsion Invariants In Symplectic Floer Theories*
Abstract: The symplectic Floer homology was originally defined to detect periodic orbits in Hamiltonian dynamical systems. However, it may vanish in many variants. I will describe a more refined invariant of symplectic Floer theory that takes into account not only p-holomorphic disks, but also (perturbed) p-holomorphic tori. Some applications will also be discussed.

THURSDAY, February 13, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Dr. Xin Guo, IBM, New York
Title of talk: TBA
Abstract: TBA

MONDAY, February 17, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Jorge Cortés Monforte, University of Illinois
Title of talk: *Geometric Methods For Control and Coordination Of Autonomous Systems*
Abstract: In this talk we present recent progress on motion planning and control algorithms for single and multiple vehicle systems. This work is motivated by applications to autonomous robotic systems and mobile sensing networks. On the basis of our approach is the idea of exploiting the geometric structures behind the differential equations governing the evolution of mechanical control systems. For single-input systems, we present results on controllability, on series expansions describing the evolution of the trajectories, and on averaging under high amplitude and high frequency forcing. For multiple vehicle systems, we focus on decentralized control laws for the coordination of networks performing spatially distributed sensing tasks. The technical approach relies on a collection of tools from Nonlinear Control Theory, Geometric Mechanics, Nonsmooth Analysis and Distributed Algorithms.

THURSDAY, February 20, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Pavel Lushnikov, Los Alamos National Laboratory
Title of talk: *Nonlinear Theory of the excitation of surface waves by wind due to the Kelvin-Helmholtz instability*
Abstract: The interface of two ideal fluids is unstable to linear perturbations if the relative speed (wind) of two fluids exceeds a threshold value, which depends on the surface tension and the acceleration of gravity, as was discovered by Kelvin and Helmholtz in 19th century. Does nonlinearity saturate the linear instability or cause a finite time singularity at the boundary surface? To answer that question a nonlinear theory of the Kelvin-Helmholtz instability is developed on a basis of the Hamiltonian description of a boundary surface of two ideal fluids. Perturbation theory exploits a

small-angle approximation of surface elevation. The basic nonlinear process is the wave-wind interaction which differs significantly from the nonlinear interaction in the absence of wind. It is shown that nonlinearity does not saturate the linear instability but, on the contrary, leads to an explosive growth of the amplitude. Near the instability threshold, the envelope of surface elevation is described by a nonlinear (2+1)-dimensional Klein-Gordon equation. An exact analytical proof of singularity formation in a finite time is given and depends on the initial condition for the nonlinear Klein-Gordon equation. Singularity formation allows one to explain satellite and airplane observations of the very sharp dependence of the fraction of sea surface covered by foam on the wind velocity. Implication of the proposed theory to recent year experimental observation of Kelvin-Helmholtz instability at the interface between superfluid 3He-A and superfluid 3He-B is discussed.

WEDNESDAY, February 26, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Cristian Popescu
Title of talk: *TBA*
Abstract: TBA