MATHEMATICS DEPARTMENT SEMINAR SCHEDULE
March 4 – March 8, 2002

All seminars are held in Boyd Graduate Studies unless otherwise noted.

MONDAY, March 4, 2002

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

Group Representation & Cohomology
2:30-3:30p.m., Room 302
Speaker: Dave Benson, University of Georgia
Title of talk: *"Representations of Symmetric Groups and Pieces of Tensor powers"*

Topology
3:00 p.m., Room 322
No Meeting this week

Number Theory
3:30 p.m., Room 304
Speaker: Paulo Almeida, University of Georgia
Title of talk: *"An interesting paper in analytic number theory"*

Numerical Analysis
3:30 p.m., Room 410
Speaker: Okkyung Cho, University of Georgia
Title of talk: *"Construction of Biorthogonal Wavelets"*
Abstract: In this talk, we discuss how to construct concrete examples of biorthogonal wavelets.

Lie Theory
3:30 p.m., Room 302
Speaker: Markus Hunziker, University of Georgia
Title of talk: *"On a Duality Theorem of Wallach", Part II*

CATS
4:40 p.m., Room 306
Speaker: Bob Robinson, Professor, Computer Science Dept.
Title of talk: *"Feynman Diagrams: Progress and Problems"*
Abstract: A Feynman diagram D of the type considered has a vertex set U of cardinality 2n for some $n > 0$, along with n undirected V-edges forming a perfect matching on U and 2n directed G-edges forming a permutation on U. Here n is called the order of D. One of the vertices is designated as the root of D. If D is connected and cannot be disconnected by removing some two G-edges it is called irreducible. The number C(n) of

nonisomorphic connected Feynman diagrams of order n has been known under various guises for at least 50 years. However the number I(n) of those which are irreducible appears not to have been previously studied. A 2-stage decomposition of connected diagrams in terms of irreducible components is developed which leads to recurrence relations for I(n) in terms of C(1), C(2), ... , C(n). Standard methods are applied to find the asymptotic rate of growth for C(n) and I(n). In particular it is shown that I(n)/C(n) --> e^{-2} as n --> infinity. The study of C(n) and I(n) is motivated by research which aims to combine Monte Carlo summation techniques with self-consistent high-order Feynman diagram expansions to computationally solve interacting fermion models in quantum physics.

For the physics computations complete catalogs of the irreducible diagrams of orders up to 8 have been produced. This was accomplished by generating canonical representations of all connected diagrams of those orders and testing each one for irreducibility. The canonical connected diagram generation was a form of depth-first search (DFS) in the space of all canonical connected partial diagrams. The leaves of the search tree correspond to the full connected diagrams. In turn, DFS is also applied at the diagram level to define canonicity.

Irreducibilty of a diagram is equivalent to 3-edge-connectivity of the underlying graph after contracting the V-edges. There are known linear algorithms to decide 3-edge-connectivity, but the one actually used in conjunction with diagram generation is quadratic in asymptotic time complexity. This was developed by Qun Wang and me; it is described in her M.S. thesis "Reducibility and Flows on Feynman Diagrams" (UGA, Dec., 2001). The quadratic algorithm is capable of producing a basis for the diagram's cycle space, a feature required for some of the physics applications.

An unsolved problem is to find a practical fully dynamic irreducibility algorithm for Feynman diagrams. Rubao Ji is currently investigating this.

TUESDAY, March 5, 2002

VIGRE
2:00 p.m-3:15 p.m., Room 304
Speaker: Csilla Tamás, University of Georgia
Title of talk: *"A taste of birational geometry"*
Abstract: At the basis of algebraic geometry stands the study of solutions of systems of polynomial equations in an affine or projective space (e.g. C^n or P^n). These solution sets are the building blocks of algebraic varieties.

One fundamental problem in algebraic geometry is to classify all algebraic varieties up to isomorphism. For example, while both P^2 and P^1 x P^1 are compactifications of C^2, they are not isomorphic. A perhaps easier question to ask is to classify varieties up to birational equivalence. (Two algebraic varieties are birational if they are "almost the same" -for example, they contain isomorphic open sets. So P^2 and P^1 x P^1 are birational.)

This talk is intended as a brief introduction to the problem of birational classification. While the results for curves and surfaces date back to more than a century ago, in higher dimensions results started appearing only after 1980.

Algebraic Geometry
3:30 p.m., Room 326
Speaker: Robert Varley, University of Georgia
Title of talk: *"The local singularity theory of Gauss maps"*
Abstract: I will give an introductory discussion of the notions of Lagrangian map germ and generating family of functions. Then I will indicate applications to Gauss maps of surfaces.

Analysis
3:30 p.m., Room 304
No Meeting this week

Student Number Theory
3:30 p.m., Room 302
No Meeting this week

WEDNESDAY, March 6, 2002

Group Representation and Cohomology
2:30 - 3:20, Room 410
Speaker: Dave Hemmer, University of Georgia
Title of talk: *"Elementary talk on the Schur functor"*

UGA Math Club Problem Solving Group
2:30 p.m., Room 302

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

Arithmetic Geometry
3:30 p.m., Room 304
No Meeting this week

Special Topology Seminar
4:00 p.m., Room 304
Speaker: John Etnyre, University of Pennsylvannia
Title of talk: *"Legendrian connected sums"*

THURSDAY, March 7, 2002

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

Colloquium
3:30 p.m., Room 304
Speaker: Prof. John Etnyre, University of Pennsylvania
Title of talk: *"Geometry and Topology In Fluid Mechanics"*.
Abstract: Describe the trajectories of particles floating in a liquid. This is a surprisingly difficult problem and attempts to understand it have involved many diverse techniques. In the 60's Arold, Marsden, Ebin and others began to introduce topological techniques into the study of fluid flows. In this talk we will discuss some of these ideas and see how they naturally lead to the introduction of contact geometry into the study of fluid flows. We then consider some of the results one can obtain from this contact geometry perspective. For example we will show that for a sufficiently smooth steady ideal fluid flowing in the three sphere there is always some particle whose trajectory is a closed loop that bounds an embedded disk.

FRIDAY, March 8, 2002

Geometry
2:30 p.m., Room 322
Speaker: Ileana Streinu, Smith College
Title of talk: *"Folding Carpenter's Rules, Robot Arms, Proteins: a Combinatorial Approach"*
Abstract: Is it always possible to convexify a simple planar polygon with a continuous motion that rotates the fixed-length edges around the vertices, stays in the plane and avoids self-intersections? If so, then one can move continuously from any configuration of a simple fixed-edge-length polygon (or planar robot arm) to any other and maintain simplicity throughout. A positive answer to this long standing open question (called the Carpenter's Rule Problem) was given two years ago by Connelly, Demaine and Rote.

In this talk I describe an extension of this result (which was based on the existence of the global motion as the solution of an implicit differential equation) to an effective, efficient and surprisingly simple combinatorial approach for finding the convexifying motion. It is based on a novel class of embedded minimally rigid planar graphs called pseudo triangulations, which possess rich combinatorial properties and can be characterized in many equivalent ways. Using animations and other graphical tools, I will discuss the rigidity-theoretical properties of pseudo triangulations and several algorithms for constructing and using them in the convexifying motion.

Special Seminar Series
3:30 – 4:30 p.m., Room 322
Speaker: Cal Burgoyne, University of Georgia
Subject: *"Talks on Electro-magnetic theory."*
Abstract: I plan to give a short series of talks on Electromagnetism. We will be looking at some of the various ways Maxwell's equations have been formulated and try to see what sort of "picture" we get in each case. Some of the ways we will look at are in terms of 3-vectors, 4-vectors, differential forms, Lagrangians and Feynman diagrams. We will also look at various symmetries of Maxwell's equations using some ideas from Lie algebras and invariant algebras.

Upcoming Seminars

MONDAY, March 11, 2002

Joint Group Cohomology/Lie Theory Seminar
2:30 p.m., Room 302
Speaker: Georgia Benkart, University of Wisconsin, Madison
Title of talk: *"The Ups and Downs of Quantum Groups"*