Brinfest schedule.

Conference webpage
http://www.math.umd.edu/research/dynamics/conferences/md08/
contains updated conference information.

All talks are in room 3206 (colloquium room) except for some parallel session talks which are in room B0421. (B refers to the very lowest floor, which can be reached from the elevator at the end of the third floor – not from the elevator by the colloquium room.)

Participants have many more interesting talks than we have talking spaces. We've posted a number of titles and abstracts for *virtual talks* at the conference webpage. Please check them out!

Bagels, fruit and coffee will be provided in the morning and through the day.

If you owe us some money (usually if you are NOT an invited speaker and you do NOT share a room) please write the check in the amount of $ 40 per night payable to *University of Maryland* and give it to Mike Boyle.

There will be several social events during the conference. The reception on Saturday will take place in the rotunda (on the ground floor of the Math Bldg). The party on Friday will be at the Boyles' house and the banquet on Sunday will be at the UMUC Conference Center. The directions to these events can be found at the conference homepage. The banquet cost is $ 25 for students and $ 35 for all others.

Friday, March 14

3:00–4:00 (Department colloquim) A. Wilkinson *Accessibility*
7:00–late Party chez Boyle

Saturday, March 15.

9:20–9:30 Welcome and organizational details.
9:30–10:20 C. Pugh *Focal Stability*
10:40–11:30 K. Burns *Ergodicity of partially hyperbolic diffeomorphisms*
11:50–12:40 Yu. Kifer *Thermodynamic formalism for random transformations revisited.*
2:40–5:40 Brin Prize ceremony and related talks.
6:00-9:00 Reception.

Sunday, March 16.

9:30–10:20 G. Margulis *Superrigidity, generalized harmonic maps, and uniformly convex spaces.*
10:50–11:40 F. Ledrappier *Liouville property on regular covers.*
11:40-11:50 conference photo
1:40–2:30 R. Schwartz *Outer billiards on kites.*
2:50—3:15
Room 3206 J. de Simoi *Stability and Instability results for a model of Fermi acceleration*
Room B0421 J. Chaika *Universal ranges for minimal sequences.*
3:25–3:50
Room 3206 F. Cellarosi *Renewal-type limit theorem for continued fractions with even partial quotients*
Room B0421 D. Constantin *Rank rigidity via ergodic 2-frame flow.*
4:00–4:25
Room 3206 D. Ralston *Continued Fractions and Heavy Sequences*
Room B0421 D. Thompson *The Irregular Set for Maps with the Specification Property Carries Full Topological Pressure.*
4:45–5:35 A. Avila *On the regularization of conservative maps*
7:00-10:00 Banquet.

Monday, March 17.

9:30-10:20 D. Burago *Dynamical Coherence of Partially Hyperbolic Diffeomorphisms of the 3-Torus.*
10:50-11:40 F. Dal'Bo *On the growth of nonuniform lattices in pinched negatively curved manifolds*
1:40–2:30 J. Athreya *Deviation of ergodic averages for billiards in polygons*
3:00–3:50 R. Spatzier *Rigidity and Classification of Group Actions*
4:05-4:30 F. Ramirez *Cohomology of actions on quotients of simple Lie groups.*

Tuesday, March 18.

9:30–10:20 W. Ballmann *Rank One and Rank Rigidity*
10:40–11:30 P. Eberlein *Riemannian 2-step nilmanifolds with prescribed Ricci tensor*
11:50–12:40 F. Rodriquez Hertz *New criteria for ergodicity and the Pugh Shub conjecture*

Abstracts.

Jayadev Athreya *Deviation of ergodic averages for billiards in polygons*

In joint work with Giovanni Forni, we prove a polynomial upper bound for the deviation of ergodic averages for billiard flow in rational-angled polygons. Our main tools are recurrence estimates for Teichmuller geodesic flow.

Werner Ballmann *Rank One and Rank Rigidity*

I will discuss spaces of nonpositive curvature and problems concerned with the geometric rank of such spaces. I will explain some of the more recent developments related to these problems.

Keith Burns *Ergodicity of partially hyperbolic diffeomorphisms*

I will discuss some of the progress in recent years towards proving that typical conservative partially hyperbolic diffeomorphism is ergodic.

Francoise Dal'Bo *On the growth of nonuniform lattices in pinched negatively curved manifolds*

Joint work with M.Peigne, J-P Picaud, A.Sambusetti. (To appear in Journal fur die reine und angewandte Mathematik) Let X be a complete and simply connected Riemannian manifold whose sectional curvature is bounded between two negative constant. By definition, the volume entropy $W(X)$ of X is the limit superior of $(LogV(x,R))/R$, as R goes to infinity, where $V(x,R)$ is the volume of the open ball of X centered at x with radius R. By analogy, we define the critical exponent $D(G)$ of a discrete subgroup G acting by isometries on X as the limit superior of $(LogV(x,R,G))/R$, where $V(x,R,G)$ is now the number of g in G such that $d(x,g(x))$ is less than R. This exponent is always less or equal to $W(X)$.

The aim of our work is to compare $W(X)$ and $D(G)$, when G is a lattice (i.e. the volume of the manifold $G\backslash X$ is finite). When $G\backslash X$ is compact, it is well known that $D(G) = W(X)$. But what happens when this manifold is not compact (i.e. G is a nonuniform lattice)? The answer depends on the growth of the maximal parabolic subgroups P of G. We first observe that $D(P)$ may be different from the limit inferior $d(P)$ of the quantity $(\mathrm{Log}V(x,R,P))/R$. More precisely, we prove two different theorems

Theorem 1: Let G be a nonuniform lattice of X. If for any maximal parabolic subgroup P of G the critical exponent $D(P)$ of P is less or equal to $2d(P)$, then $D(G) = W(X)$.

Theorem 2: There exists a complete and simply connected Riemannian surface X with pinched strictly negative curvature which admits a nonuniform lattice G such that $D(G)$ is stricly less than $W(X)$.

Patrick Eberlein *Riemannian 2-step nilmanifolds with prescribed Ricci tensor*

Fix a pair of positive integers (p,q). We obtain a lower bound in terms of p,q for the dimension of the space of isometry classes of metric 2-step nilpotent Lie algebras $\{\mathfrak{N}, \langle , \rangle\}$ of type (p,q) with a fixed Ricci tensor. We also consider two special types of Ricci tensors : optimal and geodesic flow invariant, where the first is an example of the second. We show that if $(p,q) \neq (2, 2k+1)$ or its dual $(D-2, 2k+1)$, where $D = (1/2)(2k+1)(2k)$, then a generic 2-step nilpotent Lie algebra $\mathfrak{N}$ of type (p,q) admits an inner product $\langle , \rangle$ whose Ricci tensor is optimal.

Yuri Kifer *Thermodynamic formalism for random transformations revisited.*

We return to the thermodynamic formalism constructions for ran- dom expanding in average transformations and for random subshifts of finite type with random rates of topological mixing, as well as to the Perron Frobenius type theorem for certain random positive linear operators. Recent examples show that the standard first step of the proof employed in the deterministic case relying on the Schauder-Tychonoff fixed point theorem cannot work in the random situation. Our approach here is based on Hilbert projective norms which produce contraction and enable us to treat simultaneously both random expanding and subshifts cases and in a similar way also the random positive operators case.

Francois Ledrappier *Liouville property on regular covers.*

Let (M, g) be a complete connected Riemannian manifold with bounded sectional curvature. Under the assumption that M is a regular covering of a manifold with finite volume, we show that M is Liouville (the only bounded harmonic functions are the constant functions) if, and only if, the linear rate of escape of the Brownian motion on M vanishes. This is a joint work with A. Karlsson.

Gregory Margulis *Superrigidity, generalized harmonic maps, and uniformly convex spaces.*

I will talk about a joint paper with T.Gelander and A.Karlsson recently published in GAFA. We prove several superrigidity results for isometric actions on Busemann non-positively curved metric spaces. The proofs rely on certain notions of harmonic maps and the study of their existence, uniqueness, and continuity.

Charles Pugh *Focal Stability*

Generically, how many geodesic arcs of equal length join two points? In particular, how many geodesic loops originate at a common point for the generic Riemann structure? Ivan Kupka, Mauricio Peixoto, and I answer this and related questions using Abraham's Bumpy Metric Theorem and Anosov's proof of it. Our focal stability conjecture, which we have proved in some two dimensional cases, has been our goal and has motivated our work on geodesic loops.

Federico Rodriquez Hertz *New criteria for ergodicity and the Pugh Shub conjecture*

We describe a new criterion for ergodicity and nonuniform hyperbolicity. This criterion is used to establish a version of the Pugh Shub conjecture about ergodicity of partially hyperbolic diffeomorphisms in case the center bundle is 2-dimensional. We also prove that transitive surface diffeomorphisms may have at most one SRB measure. This is joint work with M.A. Rodriguez Hertz, A. Tahzibi and R. Ures.

Richard Schwartz *Outer billiards on kites.*

Outer billiards is a simple dynamical system, based on a convex planar shape. In my talk I will discuss outer billiards on kite-shaped quadrilaterals - i.e. "kites". I will connect outer billiards to such topics as polytope exchange maps, Diophantine approximation, and self-similar tilings. As a consequence of these connections, I will show that outer billiards on any irrational kite has unbounded orbits. (A kite is irrational if it is not affinely equivalent to a lattice polygon.) The unboundedness result resolves the Moser-Neumann question, first posed around 1960, about the stability of outer billiards. I will also discuss some other structural results, such as

the density of periodic orbits. I will illustrate all my work with Billiard King, a graphical user interface I created in order to explore outer billiards on kites.

Ralf Spatzier *Rigidity and Classification of Group Actions*
This talk will survey rigidity and classification results for smooth actions by higher rank abelian groups, and other related groups.

Student talks.

Francesco Cellarosi (Princeton) *Renewal-type limit theorem for continued fractions with even partial quotients*
We prove the existence of the limiting distribution for a sequence of denominators generated by continued fraction expansions with even partial quotients, which were introduced by F. Schweiger and studied also by C. Kraaikamp and A. Lopes. Our main result is proven following the strategy used by Ya. Sinai and C. Ulcigrai in their proof of a similar renewal-type theorem for Euclidean continued fraction expansions and the Gauss map. The main steps in our proof are the construction of a natural extension of a Gauss-like map and the proof of the mixing property of a related special flow.

Jon Chaika (Rice) *Universal ranges for minimal sequences.*
This talk will address the questions of whether a non-minimal sequence $(z_1, \dots)$ where the z_i are in X is guaranteed to have $(f(z_1), \dots)$ non minimal for some continuous $f : X \to Y$ where Y is some smaller space.

Dave Constantin (Ann Arbor) *Rank rigidity via ergodic 2-frame flow.*
The rank rigidity theorem of Ballmann and Burns-Spatzier states that a non-positively curved space with higher rank is locally symmetric. Analogous notions of higher rank in strict negative and positive curvature have been developed and similar theorems proven in those curvature settings. In this talk I'll present a recent result in this vein for negatively curved spaces, namely if a compact, negatively curved manifold has what's called higher hyperbolic rank then (subject to a curvature pinching condition in even dimension) it has constant curvature. This provides a new proof of Hammenstadt's hyperbolic rank rigidity theorem (subject to the pinching condition) and also addresses some previously untouched curvature settings. The proof relies on the geometric description of the dynamics of the frame flow given by Brin.

Jacopo de Simoi (Maryland) *Stability and Instability results in a model of Fermi Acceleration*
In 1949 Enrico Fermi proposed a simple acceleration mechanism to explain the existence of high energy particles called cosmic rays. The key idea that a particle can gain a large amount of energy by successive interactions with a stationary environment.

A bouncing ball system is an Hamiltonian system that can be used to model the mechanism underlying Fermi acceleration. We consider a ball bouncing elastically on a infinite plate that performs a sinusoidal motion. The ball is subject to a potential force that brings it back to the plate. One of the main questions about this kind of systems regards the abundance of escaping orbits, i.e. orbits such that energy grows to infinity along with time. In the talk we show that, under

appropriate conditions on the potential, one has abundance of stable and unstable motions for all energies. Namely we show that, for all sinusoidal motions of the plate, the set of escaping orbits has full Hausdorff dimension. On the other hand for almost all sinusoidal motions we show how to construct stable two-periodic elliptic islands for arbitrarily high energies. In the proof of the second result we prove a Diophantine-like approximation condition that is of independent interest.

David Ralston (Rice) *Continued Fractions and Heavy Sequences.*

A sequence is said to be heavy relative to a function if it maintains certain lower bounds for all finite averages, regardless of asymptotic behavior. We present a classification of those numbers x such that the sequence (taken modulo one) $x, 2x, 3x \ldots$ is heavy for certain closed subintervals of $[0, 1]$. The proof relies on induced transformations of irrational circle rotations, and will imply as a corollary an answer to a question regarding fractal properties of discrepancy sums asked by D. Hensley.

Felipe Ramirez (Ann Arbor) *Cohomology of actions on quotients of simple Lie groups.*

I will treat the cohomology problem for smooth real-valued cocycles over certain actions on quotients of simple Lie groups. Specifically, I will consider actions coming from two commuting flows; one along a nilpotent element of the Lie algebra, and the other along a semisimple element. The aim is to show that such cocycles are cohomologous to constant cocycles. Many of the methods involved here are drawn from work of D. Mieczkowski, where the case of $SL(2, R) \times SL(2, R)$ is settled.

Dan Thompson (Warwick) *The Irregular Set for Maps with the Specification Property Carries Full Topological Pressure.*

We describe a result that applies to any dynamical system (X, T) with the specification property. Systems satisfying specification include any continuous map which is a factor of a topologically mixing shift of finite type and any topologically mixing continuous interval map. We show that, for a generic function f on X, the irregular set of f (the set of points for which the Birkhoff average of f does not exist) carries full topological pressure (in the sense of Pesin and Pitskel). Topological pressure is interpreted as a 'weighted' dynamical size, so the result says that the irregular set is as 'large' as it can be in an appropriate topological sense. This result may be surprising given that the irregular set has zero measure with respect to any invariant measure. In the case of topological entropy, this phenomenon was first noticed for Bernoulli shifts by Pesin and Pitskel and generalised to a variety of uniformly hyperbolic systems by Barreira and Schmeling. As an application, we show that the irregular set for a suspension flow over a continuous map with specification carries full topological entropy, generalising a result of Barreira and Saussol.