Romain Aimino

Random Lorentz gas and deterministic walks in random environments

(joint work with Carlangelo Liverani)

Abstract: Although one could naively expect that random Lorentz gases are easier to investigate than deterministic periodic ones, this seems not to be the case as essentially no results are available in the non periodic case. In this talk, I will present some general ideas towards studying random Lorentz gases and I will show how to apply them for a class of deterministic walks in random environments with one-dimensional uniformly expanding local dynamics.

Peter Balint

The system of two falling balls

(joint work with Andras Nemedy Varga)

Abstract: The system of falling balls, introduced and first studied by Wojtkowski, describes N point particles moving along a vertical halfline, subject to constant gravity force, and colliding elastically with each other and the floor. Here we focus on the case $N = 2$, and obtain bounds on the rate of mixing, polynomial in discrete, and superpolynomial in continuous time.

Jozef Bobok

Constant slope maps, the Vere Jones classification, Lipschitz constants and entropy

(joint work with Henk Bruin and Samuel Roth)

Abstractr: We study continuous countably piecewise monotone interval maps, and formulate conditions under which these are conjugate to maps of constant slope, particularly when this slope is given by the topological entropy of the map. We confine our investigation to the Markov case and phrase our conditions in the terminology of the Vere-Jones classification of infinite matrices.

We also study the infimum of Lipschitz constants in a conjugacy class of interval maps. For positive entropy maps, the exponential of the topological entropy gives a well-known lower bound. We show that for piecewise monotone maps, these two quantities are equal, but for countably piecewise monotone maps, the inequality can be strict. Moreover, in the topologically mixing and Markov case, we characterize the infimum of Lipschitz constants as the exponential of the Salama entropy of a certain reverse Markov chain associated with the map.

Henk Bruin

The Dolgopyat inequality for BV observables

(joint work with Dalia Terhesiu)

Abstract: In this joint work with Dalia Terhesiu, we give estimates on the norm of twisted transfer operators, known as the "Dolgopyat inequality". The underlying system is a non-Markov AFU map on the interval, and the Banach space of observables is BV. Whilst following largely the approach of Baladi & Vallee (extended by Avila et al. and Araujo & Melbourne), the focus will be on what needs to be implemented to deal with the discontinuities that non-Markov maps generate.

Keith Burns

Mixing properties of the Weil-Petersson geodesic flow

Abstract: The Weil-Petersson metric is a Riemannian metric on the moduli space of a surface. It has negative curvature, but is incomplete. The incompleteness makes it difficult to apply the usual Hopf argument to ergodic properties of the geodesic flow. The talk will outline how these difficulties were overcome. It will also describe recent results on the rate of mixing of the flow. This is joint work with Carlos Matheus, Howard Masur and Amie Wilkinson.

Vaughn Climenhaga

Young towers for surface diffeomorphisms

Abstract: An important tool for studying the statistical properties of a non-uniformly hyperbolic dynamical system is the construction of a Young tower together with an estimate on the rate of decay of its tail. This has been carried out for certain classes of examples, but remains challenging in the most general settings. I will discuss joint work with Stefano Luzzatto and Yakov Pesin, in which we give a general construction of a Young tower for any non-uniformly hyperbolic surface diffeomorphism, and formulate conditions on the system that give a decay estimate for the tail.

Yves Coudène

Generic properties of the geodesic flow in nonpositive curvature

Abstract: I will survey recent results on the generic properties of probability measures invariant by the geodesic flow defined on a nonpositively curved manifold. Such a flow is one of the early example of a non-uniformly hyperbolic system. I will talk about ergodicity and mixing both in the compact and noncompact setting, and ask some questions about the associated frame flow, which is partially hyperbolic.

Sylvain Crovisier

Singular hyperbolicity and homoclinic tangencies of 3-dimensional flows

(joint work with Dawei Yang)

Abstract: The notion of singular hyperbolicity for vector fields has been introduced by Morales, Pacifico and Pujals in order to extend the classical uniform hyperbolicity and include the presence of singularities. This covers the Lorenz attractor. I will present a joint work with Dawei Yang which proves a dichotomy in the space of three-dimensional C^1-vector fields, conjectured by J. Palis: every three-dimensional vector field can be C^1-approximated by one which is singular hyperbolic or by one which exhibits a homoclinic tangency.

Jerome Dedecker

Large and Moderate deviations for slowly mixing Markov chains

(joint work with S. Gouezel and F. Merlevède)

Abstract: We consider Markov chains which are polynomially mixing, in a weak sense expressed in terms of the space of functions on which the mixing speed is controlled. In this context, we prove polynomial large and moderate deviations inequalities. These inequalities can be applied in various natural situations coming from probability theory or dynamical systems. Finally, we discuss examples from these various settings showing that our inequalities are sharp.

Mark Demers

Hitting Times and Escape Rates

(joint work with Henk Bruin and Mike Todd)

Abstract: We discuss a natural connection between two types of recurrence law: hitting times to shrinking targets, and hitting times to a fixed target (often described as escape through a hole). We show that for systems which mix exponentially fast, one can move through a natural parameter space from one law to the other. On the other hand, if the mixing is subexponential, there is a phase transition between the hitting times law and the escape law.

Davor Dragičević

Almost sure invariance principle for random piecewise expanding maps

(joint work with G. Froyland, C. González-Tokman and S. Vaienti)

Abstract: We will describe how the recent developments in the theory of martingales can be used to establish the fiberwise almost sure invariance principle for random piecewise expanding maps.

Aihua Fan

Oscillating sequences realized by dynamical systems

(joint work with J. Schmeling)

Abstract: We discuss the randomness of sequences realized by dynamical systems, in the spirit of Sarnak's conjecture. Sequences are qualified oscillating with different orders. We try to prove a topological polynomial Wiener-Wintner theorem for totally strictly ergodic systems and to show that there are nilsequences which are oscillating of all orders. It generalizes a Robinson's theorem for polynomials of degree one. The measure-theoretic polynomial Wiener-Wintner theorem is due to Lesigne. The conditions involves the quasi-discrete spectrums of the system in both senses of Abramov and of Hahn-Pary.

Frédéric Faure

Global normal form and asymptotic spectral gap for open partially expanding maps

Abstract:

We are interested in the quantity $\gamma_{\text{asympt.}} := \limsup_{\nu\to 0} \log\left(r_s\left(\mathcal{L}_\nu\right)\right)$, namely the logarithm of the spectral radius of the transfer operator $\mathcal{L}_\nu u := e^{i\nu\tau+V} u\circ E$ in the limit of high frequencies ν, where τ, V are smooth functions and E is an expanding map on intervals. Under some hypothesis it is known from D. Dolgopyat [2002] that $\exists \epsilon > 0, \gamma_{\text{asympt.}} \leq \gamma_{\text{Gibbs}} - \epsilon$ with $\gamma_{\text{Gibbs}} = \Pr\left(V - J\right)$ and $\Pr\left(.\right)$ being the topological pressure and J$= \log|E'| > 0$ is the expansion rate. Using semiclassical analysis [faure arnoldi tobias 13] it is known that $\gamma_{\text{asympt.}} \leq \gamma_{\text{sc}} = \text{tsup}\left(V - \frac{1}{2}J\right)$. We show that $\gamma_{\text{asympt.}} \leq \gamma_{\text{up}} := \frac{1}{2}\Pr\left(2\left(V-J\right)\right) + \frac{1}{4}\left\langle J\right\rangle$ where $\langle.\rangle$ is an "average" and we will discuss the conjecture that generically $\gamma_{\text{asympt.}} = \frac{1}{2}\Pr\left(2\left(V-J\right)\right)$. We explain the consequence for an expansion of correlations.

Stefano Galatolo

Computer aided results in ergodic theory and Existence of Noise Induced Order

Abstract: Having rigorous quantitative information about the statistical properties of dynamics is not easy. One of the reasons is that the interesting systems for which we can have a direct analytical way of computing the invariant measure of interest are very few. The use of computers and certified computation techniques can help much in extending our knowledge of these statistical properties in many interesting systems. After a short overview about the rigorous computational methods for this kind of problems, we see how a computer aided proof can rigorously show the existence of noise induced order. This is a phenomenon firstly discovered by simulations of models of chaotic chemical reactions and then confirmed by real experiments. The system behavior appears to be less chaotic and more stable when a certain quantity of noise is added. We show that in the original model of Matsumoto and Tsuda, consisting in a random dynamical system, the addition of noise causes the Lyapunov exponent to decrease from positive to negative. The method is based on a certified approximation of the stationary measure in the Lź norm. This is done by an efficient algorithm which is general enough to be adapted to any dynamical system with additive noise on the interval.

Cecilia González Tokman

Non-autonomous dynamical systems and multiplicative ergodic theory

Abstract: In this talk we discuss recent developments and applications of multiplicative ergodic theory, which have allowed us to enhance our understanding of statistical properties and stability aspects of non-autonomous dynamical systems.

Carangelo Liverani

Fast-Slow partially hyperbolic systems: an example

Abstract: I will discuss the simplest possible (non trivial) example of a fast-slow partially hyperbolic system with particular emphasis on the problem of establishing its statistical properties.

Giorgio Mantica

Regularity properties of Minkowski's question mark measure

Abstract: I will discuss some properties of Minkowski's question mark measure, which originates from Minkowski's 1904 question mark function. These properties mix in tantalizing contrast singularity (with respect to Lebesgue) and regularity (in terms of potential theory in the complex plane). In particular, I will prove regularity in the sense of Ullman, Saff, Stahl and Totik. The proof employs: an Iterated Functions System composed of Moebius maps, which yields the classical Stern-Brocot sequences, an estimate of the cardinality of large spacings in these sequences and a criterion due to Stahl and Totik. Consequences of this result will also be discussed and illustrated with numerical experiments.

Ian Melbourne

Mixing and rates of mixing for infinite measure flows

(joint work with Bruin and Terhesiu)

Abstract: We obtain results on mixing and rates of mixing for infinite measure semiflows and flows. The results on rates of mixing rely on operator renewal theory and a Dolgopyat-type estimate. The results on mixing hold more generally and are based on a deterministic (ie non iid) version of Erickson's continuous time strong renewal theorem.

Frederic Naud

Non trivial Ruelle spectrum in uniformly and partially hyperbolic systems

Abstract: The Ruelle correlation spectrum determines the rate of mixing of standard hyperbolic systems such as expanding maps, Anosov diffeos etc... In this talk we will discuss recent quantitative results on the Ruelle spectrum such as existence of non trivial spectra and density estimates for various systems, including some partially hyperbolic examples (skew extensions of Anosov diffeos).

Matt Nicol

Dynamical Borel-Cantelli lemmas and rates of growth of Birkhoff sums of non-integrable observables on chaotic dynamical systems

(joint with Meagan Carney.)

Abstract: We consider implications of dynamical Borel-Cantelli lemmas for rates of growth of Birkhoff sums of non-integrable observables on ergodic dynamical systems on a probability space. Some general results are given as well as some more concrete examples involving non-uniformly expanding maps, intermittent type maps as well as uniformly hyperbolic systems.

Françoise Pène

Time-space study of visits to small sets

(joint work with Benoît Saussol)

Abstract: Given a dynamical system, we are interested in the time-space study of visits of its orbits to a small set. More precisely we investigate the behaviour of the corresponding point process as the measure of the set goes to 0. We prove the convergence to a Poisson process (after suitable normalization) under general assumptions. We apply our results to weakly hyperbolic dynamical systems, including the Sinai billiard and the Bunimovich stadium billiard (we get results for the billiard map and also for the billiard flow).

Mark Pollicott

Central Limit Theorems for Circle Packings

(joint work with Mariusz Urbanski (UNT))

Abstract: Given the Apollonian Circle packing, or something similar, one can consider the distribution of the logarithms of the radii. These can be shown to satisfy a Central Limit Theorem. The method of proof uses iterated function schemes and transfer operators and has applications to other conformal dynamical systems.

Imre Toth

The method of standard pairs in the rare interaction limit of a dynamical heat conduction model

(joint work with Péter Bálint, Péter Nándori and Domokos Szász)

Abstract: When averaging methods are applied to describe the stochastic evolution in the rare interaction limit of a deterministic fast-slow system, the problem of recollisions is one of the main difficulties. One has to show, that after a change in the slow variable (a "collision" happens, the fast subsystem has enough time to "equilibirate" before a next collision. The problem is that the probability of collisions happening soon is only easy to calculate in equiblibrium, which is exactly what the system hasn't reached yet.

In this talk I present a possible way to overcome this difficulty, using the method of "standard pairs" developed by Chernov and Dolgopyat, applied in a hyperbolic system with singularities (actually a billiard). A key part is a statement about the evolution of unstable manifolds, called a "growth lemma".

Jimmy Tseng

Ergodic theory and Diophantine approximation for translation surfaces and affine forms

(joint work with J. Athreya and A. Parrish)

Abstract: Using erogdicity, we present a unified and conceptually simple way of counting saddle connections on translation surfaces and counting integer solutions to affine forms, counting both in certain thinning regions. The solution to the counting problem for affine forms (or even linear forms) is more complicated because we are really interested in a certain submanifold (corresponding to the expanding horospherical subgroup of a suitable diagonal flow). To overcome this, we find a suitable parametrization of $SL(d, \mathbb{R})$ and construct an approximation argument.

Our technique yields a new result for translation surfaces and an alternate way of realizing, for the standard error function, the main term in Schmidt's theorem for affine forms.

Anatoly Vershik

Past of the Markov chains : theory of filtrations

Abstract : Filtration is a decreasing sequence of sima-fields of the measure space. The universal example is past (or future) of the (nonstationary) random process. I will explain the notion of standardness which is a natiral generalztion of the Independence (or Bernoullisity) and similar to Ornstein WVB. The examples of standard and nonstandard filtrations as well as "the highest law of 0-1" will be given.

Hongkun Zhang

Decay of correlations for various types of billiards with flat points

Abstract: We investigate statistical properties of 4 types of billiards with flat points. This include billiards with cusps, dispersing billiards on a torus with infinite horizon, etc. The decay rates are proven to depend on the degree of the flat points, which varies from n^{-a}, for $a \in (0, \infty)$.