2020 Vision for Dynamics

Będlewo, 11-16 August 2019

Abstracts

Flexibility of entropy of boundary maps for surfaces of constant negative curvature
Adam Abrams

Joint work with Svetlana Katok and Ilie Ugarcovici. Geodesic flow on a quotient of the hyperbolic plane by a Fuchsian surface group can be realized as a special flow over a symbolic system in either a "geometric" or "arithmetic" way. For genus $g \geq 2$, the Bowen–Series expanding boundary map can be generalized via a set of $8g - 4$ parameters, and, for an open set of parameters, (1) the natural extension of the boundary map has a global attractor with finite rectangular structure, (2) this attractor parameterizes a cross-section for the geodesic flow, and (3) the first return map to this cross-section is precisely a two-sided shift. Recent results focus on the boundary of the parameter space, for which "dual" codes exist, and on the flexibility of entropy in the Teichmüller space of surfaces of genus g.

[1] A. Abrams, S. Katok. *Adler and Flatto revisited: cross-sections for geodesic flow on compact surfaces of constant negative curvature*, Studia Mathematica **246** (2019), 167–202.
[2] S. Katok, I. Ugarcovici. *Structure of attractors for boundary maps associated to Fuchsian groups*, Geometriae Dedicata **191** (2017), 171–198.

Influence of the work of A. Katok on the study of non-ergodic dynamics
Pierre Berger

Flexibility of Lyapunov exponents
Jairo Bochi

I will sketch the flexibility program proposed by A. Katok, focusing on flexibility of Lyapunov exponents of conservative smooth diffeomorphisms. A representative problem in this program is to describe all Lyapunov spectra of Anosov diffeomorphisms in a given homotopy class. I will present results in this direction, obtained jointly with A. Katok and F. Rodriguez Hertz.

Finite Time Dynamics
Leonid Bunimovich

Traditionally the dynamical systems theory deals with asymptotic in time properties like ergodic theorems, mixing (decay of correlations), etc, unless solutions are known and thus could be computed for any moment of time. Analogously probability theory deals with limit, i.e. again asymptotic in time, theorems, like e.g. Central Limit Theorem, large deviations, etc. Moreover, all basic notions we use like Lyapunov exponents, entropies, various types of mixing, etc involve taking a limit when time tends to infinity or integration over an infinite time interval. I will demonstrate that some interesting finite time properties of the most chaotic" dynamical systems and of "the most random" stochastic processes can be rigorously studied. In fact, it is possible to say what "more likely" is going to happen already at the next moment of time. Numerical simulations show that similar types of predictions can be made for systems of chaotic and random systems of a general type.

Keywords: chaotic systems, random systems, finite time dynamics

Measure rigidity and projective actions of lattices
Aaron Brown

I will discuss various rigidity properties of projective actions of higher-rank lattices. To establish the main results, we show a measure classification theorem for certain actions of higher-rank abelian groups; this closely follows work of A. Katok and his collaborators.

Quasi-isometry between warped cones and uniform measured equivalence
Kajal Das

Warped cone is a geometric object associated to a measure preserving isometric action of a finitely generated countable group on a compact manifold. It encodes the geometry of the manifold, geometry of the group (Cayley graph) and the dynamics of the group. This geometric object has been introduced by J. Roe [3] in the context of Coarse Baum-Connes conjecture. On the other hand, Measure Equivalence (ME) is equivalence relation between two countable groups introduced by Gromov as a measure-theoretic analogue of quasi-isometry in [3]. If the 'cocyles' associated with measured equivalence relation are bounded, the relation is called Uniform Measured Equivalence. In this lecture, we prove that if two warped cones are quasi-isometric, then the groups are Uniform Measured Equivalence. As an application, we will speak about different ME-invariants which distinguish two warped cones up to quasi-isometry. This is a work in progress [1].

[1] K. Das, *Coarse equivalence between sofic-type metric measured groupoids*, Work in progress.
[2] M. Gromov, *Asymptotic invariants of infinite groups*, in Geometric Group Theory 2, London Math. Soc. Lecture Note Ser. 182, Cambridge Univ. Press, Cambridge, 1993 .
[3] J. Roe *Warped cones and property A*, Geom. Topol., Volume 9, Number 1 (2005), 163-178. Volume 9, Number 1 (2005), 163-178.

Local time for ergodic sums
Manfred Denker

Let $(X, \mathcal{F}, T, \mu)$ be an ergodic probability preserving dynamical system and f a measurable function. The local time at $t \in \mathbb{R}$ is the distribution the ergodic sums $\sum_{k<n} f \circ T^k$ spend at the value t up to time $n \leq N$. I shall discuss the convergence of these distributions (as $N \to \infty$) to a Mittag-Leffler distribution, in particular its connection to local limit theorems. This is based on X. Zheng's dissertation and subsequent joint publications.

Central Limit Theorem in Dynamical Systems
Dmitry Dolgopyat

The fact that ergodic sums of smooth observables often satisfy Central Limit Theorem is one of the hallmarks of chaotic behavior. In this talk I surveys several methods of proving Central Limit Theorem and its strenthenings and present some applications as well as open questions.

Flexibility of Lyapunov exponents on the torus
Alena Erchenko

There are several interesting classes of measures. We will concentrate on the invariant measure that is absolutely continuous with respect to the Lebesgue measure and the measure of maximal entropy. We show that positive Lyapunov exponents with respect to these two probability measures for Anosov area-preserving diffeomorphisms on a two-torus that are homotopic to a fixed area-preserving Anosov automorphism take on all values that satisfy some well-known inequalities.

Distributions in dynamical systems
Livio Flaminio

Invariant measures are a common object of study in dynamical systems. Invariant distributions for a smooth dynamical system are more exotic and less understood objects, whose importance has been underlined by Anatole Katok for over 35 years. In this talk we shall present a panorama of the progress on this subject.

Hyperbolic Dynamics and Spectral Theory
Anton Gorodetski

The main objects of hyperbolic dynamics (hyperbolic cocycles, horseshoes, dynamically defined Cantor sets) appear in a natural way in spectral theory of ergodic Schrödinger operators. For example, Johnson's Theorem claims that the resolvent set of such an operator is exactly the set of energies for which the corresponding Schrödinger cocycle is uniformly hyperbolic. As another example, the spectrum of the Schrödinger operator with the potential defined by Fibonacci substitution is a dynamically defined Cantor set [1]. Moreover, many open questions in one field have their counterparts in the other. For instance, the questions about the intersections or sums of Cantor sets became popular in dynamical systems community since the discovery of Newhouse phenomena. At the same time the spectrum of an operator with separable potential on a two- (or higher) dimensional lattice is the sum of spectra of the corresponding operators on the one dimensional lattice, and this analogy leads to many interesting insights [2, 3]. The picture is even more interesting in the case of operators with continuum potentials. Think about an intersection of a curve with the stable set of a partially hyperbolic nowhere dense invariant set. This intersection is a Cantor set that does not have to be dynamically defined, but still has many nice features, e.g. one can estimate its thickness using an improved version of the distortion estimates. In this way jointly with David Damanik and Jake Fillman we obtained some aperiodic analogs of the Bethe-Sommerfeld conjecture [4, 5].

[1] D. Damanik, A. Gorodetski, W. Yessen, The Fibonacci Hamiltonian, *Inventiones Mathematicae*, vol. 206 (2016), pp. 629–692.
[2] D. Damanik, A. Gorodetski, B. Solomyak, Absolutely Continuous Convolutions of Singular Measures and an Application to the Square Fibonacci Hamiltonian, *Duke Mathematical Journal*, vol. 164 (2015), pp. 1603–1640.
[3] D. Damanik, A. Gorodetski, Spectral transitions for the square Fibonacci Hamiltonian, *Journal of Spectral Theory*, vol. 8 (2018), pp. 1487–1507.
[4] D. Damanik, J. Fillman, A. Gorodetski, Multidimensional Almost-Periodic Schrödinger Operators with Cantor Spectrum, *Annales Henri Poincare*, vol. 20 (2019), pp. 1393–1402.
[5] D. Damanik, J. Fillman, A. Gorodetski, Multidimensional Schrödinger Operators Whose Spectrum Features a Half-Line and a Cantor Set, work in progress.

Randomness for group actions
Alexander Gorodnik

We discuss a general approach for proving the Central Limit Theorem and the Invariance Principle for group actions that satisfy quantitative estimates on higher order correlations. Our method, in particular, applies in the case of groups subexponential growth which are exponentially mixing of all orders. This a joint work with M. Björklund.

Geodesic stretch and marked length spectrum rigidity
Colin Guillarmou

It was conjectured by Burns and Katok that the marked length spectrum of negatively curved Riemannian manifolds determines the metric up to isometry. In joint work with Lefeuvre and Knieper, we give some new results on this problem by using the geodesic stretch. This gives a new proof of the local rigidity for the marked length spectrum obtained last year with Lefeuvre, together with new results on this question. This includes the construction of a pressure metric on the space of Riemannian isometry classes of metrics extending Mc Mullen/Thurston/Wolpert pressure metric on Teichmüller space to variable curvature settings.

The essential coexistence phenomenon in Hamiltonian dynamics
Huyi Hu

We construct an example of a Hamiltonian flow f^t on a 4-dimensional smooth manifold M which after being restricted to an energy surface M_e demonstrates essential coexistence of regular and chaotic dynamics, that is, there is an open and dense f^t-invariant subset U of M_e such that restricted to U f^t has non-zero Lyapunov exponents in all directions, except the direction of the flow, and is a Bernoulli flow while on the boundary of U, which has positive volume, all Lyapunov exponents of the system are zero. This is a joint work with Jianyu Chen, Yakov Pesin and Ke Zhang.

Rigidity and Classification of Cantor Actions
Steven Hurder

We discuss the classification problem for weak (or generalized) solenoids [1], and relate this to the classification problem for minimal, equicontinuous actions of finitely generated groups on a Cantor set [3, 4]. There is dichotomy for these actions: if the acting group G is Noetherian, then all such actions satisfy the local quasi-analytic property, and hence satisfy a rigidity property. Otherwise, G has uncountably many subgroups, and its Cantor actions can be wild [5]. Many types of examples of wild actions are known [2, 6], and the classification problem for wild actions suggests many open questions.

[1] A. Clark, S. Hurder and O. Lukina, *Classifying matchbox manifolds*, Geometry and Topology, 23:1-38, 2019.
[2] M. Groeger and O. Lukina, *Invariant random subgroups for wild Cantor actions*, in preparation, 2019.
[3] S. Hurder and O. Lukina, *Wild solenoids*, Transactions A.M.S., 371:4493–4533, 2019.
[4] S. Hurder and O. Lukina, *Orbit equivalence and classification of weak solenoids*, arXiv:1803.02098..
[5] S. Hurder and O. Lukina, *Limit group invariants for wild Cantor actions*, arXiv:1904.11072.
[6] O. Lukina, *Arboreal Cantor actions*, J. Lond. Math. Soc., 99:678–706, 2019.

Global bifurcations on the two sphere: first steps of a new theory
Yulij Ilyashenko

This talk gives a survey of the first four years of the development of a new branch of the bifurcation theory: global bifurcations on the two sphere outlined in [1]. Bifurcations in generic one-parameter families were classified; the answer appeared to be somewhat unexpected [2] [3] [4] An important and non-trivial question "who bifurcates?" was answered. Natalya Goncharuk and the speaker defined a set called *large bifurcation support*; bifurcations that occur in a small neighborhood of this set determine the global bifurcations on the two-sphere [5]. This result is a starting point for systematic classification of global bifurcations in two-parameter families. Structurally unstable three-parameter families were discovered [6]; new examples were found recently. New numeric invariants for three-parameter families are recently found [7]. There was a conjecture that in a small neighborhood of a hyperbolic polycycle the family that unfolds it is structurally stable. This conjecture is now disproved. Functional invariants of topological classification of generic families of vector fields are found. Open problems will be stated.

[1] Yu. Ilyashenko, *Towards the general theory of global planar bifurcations*, in the book "Mathematical Sciences with Multidisciplinary Applications, In Honor of Professor Christiane Rousseau. And In Recognition of the Mathematics for Planet Earth Initiative", Springer 2016, pp 269 – 299.
[2] N. Solodovnikov, *Global bifurcations in generic one-parameter families with a separatrix loop on* S^2, Moscow Math. J., 2018, pp. 93 – 115
[3] N. Goncharuk, Yu. Ilyashenko, N. Solodovnikov, *Global bifurcations in generic one-parameter families with a parabolic cycle on* S^2, to appear in MMJ
[4] V. Starichkova, *Global bifurcations in generic one-parameter families on* S^2, Regular and Chaotic Dynamics, 2018, Vol. 23, No. 6, pp. 1 - 18.
[5] N. Goncharuk, Yu. Ilyashenko, *Large bifurdation supports*, submitted
[6] Yu. Ilyashenko, Yu. Kudryashov and I. Schurov , *Global bifurcations in the two-sphere: a new perspective*, Invent. math., 2018, Volume 213, Issue 2, pp 461 – 506
[7] N. Goncharuk, Yu. Kudryashov, *Bifurcations of the polycycle 'tears of the heart': multiple numerical invariants*, to appear in MMJ

Center foliation rigidity for partially hyperbolic toral diffeomorphisms
Boris Kalinin

We study perturbations of an irreducible ergodic toral automorphism L with non-trivial center. For a small perturbation f of L with smooth center foliation we obtain results on regularity of the leaf conjugacy to L and of a Hölder topological conjugacy to L, when it exists. As a corollary, we show that for any symplectic perturbation a Hölder conjugacy to L must be smooth. For a totally irreducible L with two-dimensional center, we establish a number of equivalent conditions that ensure smooth conjugacy between L and f. This is joint work with Andrey Gogolev and Victoria Sadovskaya.

On dynamical spectral rigidity of planar domains
Vadim Kaloshin

Consider a convex domain on the plane and the associated billiard inside. The length spectrum is the closure of the union of perimeters of all period orbits. The length spectrum is closely related to the Laplace spectrum, through the wave trace and the well-known question: 'Can you hear the shape of a drum?' A domain is called dynamically spectrally rigid if any smooth deformation preserving the length spectrum is an isometry. During the talk I will discuss recent results on dynamical spectral rigidity of convex planar domains.

Bernoulli and K properties in smooth dynamics
Adam Kanigowski

A measure preserving system (T, X, μ) is called *Bernoulli* if it is isomorphic to a Bernoulli shift. (T, X, μ) is a *K-system*, if every (non-trivial) factor of T has positive entropy. One of the central class for which K and Bernoulli properties was studied is that of smooth systems on manifolds preserving a smooth measure. I will review classical results and discuss some recent developments.

Furstenberg theorem: now with a parameter!
Victor Kleptsyn

For a random product of i.i.d. matrices A_i, randomly chosen from $\mathrm{SL}(2, \mathbb{R})$,

$$T_n = A_n ... A_2 A_1,$$

the classical Furstenberg theorem (under some very mild nondegeneracy conditions) states that the norm of such a product almost surely grows exponentially in n.

What happens if each of these matrices $A_i(s)$ depends on an additional parameter s, and hence so does their product $T_n(s)$? For each individual s, the Furstenberg theorem is still applicable. However, what can be said almost surely for the random products $T_n(s)$, depending on a parameter? In particular, what can be said about the limit (Lyapunov exponent) $\lim_n (1/n) \log \|T_n(s)\|$? Does it exist for all (and not only almost all) parameter values s?

Under a few (physically reasonable) assumptions, we show that:

- **"For the limsup, everything is OK"**. Almost surely for all the parameter values the upper Lyapunov exponent (the upper limit) equals to the Furstenberg one. This can be considered as a dynamical analog of the result by Craig and Simon from spectral theory.
- **"Sometimes, the limit does not exist"'**. However, in the no-uniform-hyperbolicity parameter region there exists a dense subset of parameters, where the lower Lyapunov exponent vanishes.
- **"The disaster is limited"**. Almost surely there is a zero Hausdorff dimension (random) set in the space of parameters, outside which the Lyapunov exponent exists and equals to the Furstenberg one.

This theorem is proven via a geometric description of the ("highly probable") behavior of finite-length products; these results are applicable to the setting of the one-dimensional Anderson localization, providing a purely dynamical viewpoint on its proof.

This is a joint work with Anton Gorodetski.

Loosely Bernoulli odometer-based systems whose corresponding circular systems are not loosely Bernoulli
Philipp Kunde

M. Foreman and B. Weiss [FW2] obtained an anti-classification result for smooth ergodic diffeomorphisms, up to measure isomorphism, by using a functor $\mathcal{F}$ mapping odometer-based systems, $\mathcal{OB}$, to circular systems, $\mathcal{CB}$. The class $\mathcal{OB}$ includes all finite entropy ergodic transformations with an odometer factor, while the class $\mathcal{CB}$ contains all transformations realizable as diffeomorphisms using the untwisted Anosov-Katok method. This functor $\mathcal{F}$ preserves weakly mixing extensions, compact extensions, factor maps, the rank-one property, and certain types of isomorphisms [FW1]. Thus it is natural to ask whether $\mathcal{F}$ preserves other dynamical properties. In a joint work with Marlies Gerber we show that $\mathcal{F}$ does *not* preserve the loosely Bernoulli property by providing positive and zero entropy examples of loosely Bernoulli odometer-based systems whose corresponding circular systems are not loosely Bernoulli.

[FW1] M. Foreman and B. Weiss, *From Odometers to Circular Systems: A Global Structure Theorem*, Preprint, arXiv:1703.07093.
[FW2] M. Foreman and B. Weiss, *Measure preserving Diffeomorphisms of the Torus are unclassifiable*, Preprint, arXiv:1705.04414.

Feldman-Katok convergence and entropy of nonuniformly hyperbolic measures
Dominik Kwietniak

I will discuss a new tool: the Feldman-Katok pseudometric on orbits. It leads to a notion of convergence for invariant measures. We introduced it with Martha Łącka [6], and we used it to show that the entropy of nonuniformly hyperbolic measures constructed using the method of Gorodetski, Ilyashenko, Kleptsyn, and Nalsky [5] (see also [3]) is zero. Furthermore, these measures are always Kakutani equivalent to an ergodic group rotation. Time permits, I will discuss a related result obtained with Bonatti and Díaz [4]: Assuming robust transitivity, we prove that in the partially hyperbolic setting, there robustly exists an ergodic nonhyperbolic measure with full support and positive entropy. The novelty of this result is that we address all four conditions (robustness, ergodicity, positive entropy, and full support) together, while previous works (Bochi, Bonatti and Díaz, [1, 2]) dealt only with a subset of these conditions.

[1] J. Bochi, Ch. Bonatti, L. J. Díaz, *Robust criterion for the existence of nonhyperbolic ergodic measures*, Comm. Math. Phys. **344** (2016), no. 3, 751–795.
[2] J. Bochi, Ch. Bonatti, L. J. Díaz, *A criterion for zero averages and full support of ergodic measures*, Mosc. Math. J. **18** (2018), no. 1, 15–61.
[3] Ch. Bonatti, L. J. Díaz, A. Gorodetski, *Non-hyperbolic ergodic measures with large support*, Nonlinearity **23** (2010), no. 3, 687–705.
[4] Ch. Bonatti, L. J. Díaz, D. Kwietniak, *Robust existence of nonhyperbolic ergodic measures with positive entropy and full support*, preprint, (2018) `arXiv:1810.02384`.
[5] A. S. Gorodetski, Yu. S. Ilyashenko, V. A. Kleptsyn, M. B. Nalski, *Nonremovability of zero Lyapunov exponents* (Russian) ; translated from Funktsional. Anal. i Prilozhen. **39** (2005), no. 1, 27–38, 95 Funct. Anal. Appl. **39** (2005), no. 1, 21–30.
[6] D. Kwietniak, M. Łącka, *Feldman-Katok pseudometric and the GIKN construction of nonhyperbolic ergodic measures*, preprint (2017) `arXiv:1702.01962`.

On some spectral problems in ergodic theory
Mariusz Lemańczyk

I will be discussing some old and new results concerning classical spectral problems in ergodic theory, mainly focusing on the problem of multiplicity. The talk is based on a joint article with Anatole Katok.

Partially hyperbolic systems with center close to identity
Carlangelo Liverani

The focus will be on the statistical properties of Partially Hyperbolic systems when the dynamics in the center bundle is close to an isometry (or, better yet, identity). I will first mention the physical relevance of these systems. Then I will discuss a couple of strategies to study these systems applied to a simple example and finally, time permitting, I will make some considerations on future perspective.

Coarse entropy
Michał Misiurewicz

Coarse geometry studies metric spaces from the large scale point of view. One looks at the space from further and further away. Bounded sets look very much like singletons. Thus, if we want to define coarse topological entropy of a map of a space to itself, using (n, ε)-separated or (n, ε)-spanning sets, we have to let ε go to infinity rather than to zero.

We give such a definition, show that it has reasonable properties, and present basic examples. However, it seems that some strange effects are unavoidable. For instance, if the phase space is infinite-dimensional, then the coarse entropy of the identity is infinite. This is because from far away we cannot see any difference between no movement and small movement, but small movement in infinite number of directions after sufficiently long time produces infinitely many distinguishable orbits.

This is joint work with William Geller.

Nonexistence of wandering domains for infinitely renormalizable Hénon maps
Dyi-Shing Ou

We generalize the nonexistence of wandering domains from unimodal maps to strongly dissipative infinitely renormalizable Hénon-like maps with arbitrary periodic combinatorics. This solves an open problem proposed by van Strien (2010) and Lyubich and Martens (2011).

To prove the theorem, we partition the phase space of a Hénon-like map into two regions: the good region and the bad region. The good region is where the method of proof for unimodal maps applies to Hénon-like maps, while the bad region is where serious difficulties occur. These difficulties are resolved by the Two-Row Lemma, an inequality that relates the contraction of areas to the contraction of bad regions. After analyzing the competition of the two types of contraction, we show that the case of bad regions happens at most finitely many times and complete the proof.

As an application, the theorem enriches our understanding of the topological structure of the heteroclinic web: the union of the stable manifolds of periodic orbits forms a dense set in the domain.

Actions of mapping class groups on the circle
Kamlesh Parwani

We use a version of Thurston's Stability Lemma to show that mapping class groups of surfaces with genus greater than 3 have no C^1 effective orientation preserving actions on the circle.

Nonconvexity of Lyapunov Spectra
Mark Pollicott

The Lyapunov spectrum $\mathcal{L}(\alpha)$ of a smooth dynamical system can be thought of as a function that describes the size (in terms of the Hausdorff dimension) of the set of points for which the Lyapunov exponent takes a real value α. For simple examples of "cookie cutters" (expanding maps on Cantor sets in the unit interval) H. Weiss showed that on the appropriate domain $\alpha \mapsto \mathcal{L}(\alpha)$ is analytic and posed the question of the convexity of $\alpha \mapsto \mathcal{L}(\alpha)$ [2]. G.Iommi and J. Kiwi answered this by giving an example of such a map with a non-convex Lyapunov function with two points of inflection [1]. They then posed the question of whether there existed examples for which the number of inflection points was larger than any given value. We show that this is indeed the case.

[1] Iommi, Godofredo; Kiwi, Jan The Lyapunov spectrum is not always concave. J. Stat. Phys. 135 (2009), no. 3, 535-546
[2] Weiss, Howie: The Lyapunov spectrum for conformal expanding maps and axiom?A surface diffeomorphisms. J. Stat. Phys. 95(3-4), 615-632 (1999)

Dynamical properties of generalized pinwheel tilings
E. Arthur (Robbie) Robinson

We begin by reviewing the definition and properties of finite local complexity tiling dynamical systems, and in particular, those coming from primitive tiling substitutions. They are zero entropy, strictly ergodic, and may be weakly mixing, but cannot be strongly mixing. Then we discuss the family of "generalized pinwheel tilings" [1], which are not locally finite. Primitivity requires some care, (but occurs generically), and implies as usual, strictly ergodicity (though via a different proof) and entropy zero. We show that unlike the finite local complexity case, these dynamical systems have Lebesgue spectrum and are mixing of all orders. This is joint work with Natalie P. Frank.

[1] Sadun, Lorenzo, *Some generalizations of the pinwheel tiling*, Discrete and computational geometry **20** (1998).

Exponential mixing and its consequences
Federico Rodriguez-Hertz

In this talk I will discuss some simple consequence of various rates of mixing and propose some problems related to it.

Group-valued cocycles over hyperbolic systems and their periodic data
Victoria Sadovskaya

We consider a Hölder continuous cocycle over a hyperbolic dynamical system (X, f) with values in one of the following groups: $GL(d, \mathbb{R})$, the group of bounded invertible linear operators on a Banach space, and the group of diffeomorphisms of a compact manifold. We discuss what conclusions can be made about a cocycle based on its periodic data, that is, the set of its return values along the periodic orbits of f. We consider the cases of the identity periodic data and of bounded periodic data. We also discuss cohomology of cocycles with equal and, more generally, conjugate periodic data, as well as growth estimates for cocycles.

Instability and diffusion in Hamiltonian systems via the Approximation by conjugation method
Maria Saprykina

Method of Approximation by conjugation, developed by Anosov and Katok in the 70-th, is the main way of constructing smooth dynamical systems with given abstract properties. In the last decade it is has been experiencing revival. We present examples of Hamiltonian systems with several strong diffusion properties, obtained by modifications of this method. The talk is based on joint works with Bassam Fayad.

L^∞ and pointwise estimates of generalized Thue-Morse trigonometric polynomials
Jörg Schmeling

Periodic orbit growth on covers of Anosov flows
Richard Sharp

It is well-known that the topological entropy of an Anosov flow on a compact manifold describes the exponential growth rate of its periodic orbits. If we pass to a regular cover of the manifold then we can consider a corresponding growth rate for periodic orbits of the lifted flow. This growth rate is bounded above by the original topological entropy but if the cover is infinite then the growth rate may be strictly smaller. In the important special case of a geodesic flow over a compact manifold with negative sectional curvatures, we have equality if and only if the cover is amenable [1]. This statement fails for general Anosov flows but we will discuss a recent result that gives a natural generalisation [2]. (Joint work with Rhiannon Dougall.)

[1] R. Dougall and R. Sharp, *Amenability, critical exponents of subgroups and growth of closed geodesics*, Mathematische Annalen 365, 1359–1377, 2016.
[2] R.Dougall and R. Sharp, *Anosov flows, growth rates on covers and group extensions of subshifts*, arXiv:1904.01423.

On triple instability
Dmitry Turaev

We consider bifurcations of a periodic orbit with three or more multipliers equal to 1. We show that the richness of chaotic dynamics that can emerge due to such bifurcations is unrestricted.

Singular spectrum for smooth flows in genus two
Corinna Ulcigrai

The study of ergodic properties of smooth area-preserving flows on surfaces of genus $g \geq 1$ has seen many recent advances. While we now understand quite well their typical mixing properties, still very little is known about the nature of the spectrum. After some background and history, we will describe recent joint work in which we show that the typical smooth, area-preserving flow on a surface of genus two with two isomorphic saddles has purely singular spectrum. Joint work with J. Chaika, K. Frączek and A. Kanigowski.

Equilibrium states of almost Anosov diffeomorphisms
Dominic Veconi

Almost-Anosov diffeomorphisms form a mild generalization of Anosov diffeomorphisms, and thus make for a good class of maps to investigate when studying nonuniformly hyperbolic behavior. In this talk, I will discuss existence and uniqueness of equilibrium states for non- Hölder geometric potentials using Young towers. I will additionally discuss how one can use thermodynamics of hyperbolic towers to prove exponential decay of correlations and the central limit theorem for these equilibrium measures.

Dynamical Invariants for Unipotent Flows
Kurt Vinhage

Kakutani equivalence is a notion which is stronger than orbit equivalence but weaker than measurable conjugacy, and is a natural relation to study for zero-entropy systems. For unipotent flows, orbit equivalence and measurale conjugacy have remarkably simple classifications (with difficult proofs), and can be described completely from algebraic data for unipotent flows. Ratner developed an entropy-like invariant of Kakutani equivalence to exhibit two such flows which were not Kakutani equivalent. We compute this invariant for every unipotent flow on homogeneous spaces of semisimple groups. The answer is extremely different from the case of nilflows. We also compute the slow entropy, introduced by Katok and Thouvenot, for such flows. Joint with Adam Kanigowski and Daren Wei.

Equilibrium measures for some partially hyperbolic systems
Agnieszka Zelerowicz

In this joint work with Vaughn Climenhaga and Yakov Pesin we study thermodynamic formalism for topologically transitive partially hyperbolic systems in which the center-stable bundle is integrable and nonexpanding, and show that every potential function satisfying the Bowen property has a unique equilibrium measure. Our method is to use tools from geometric measure theory to construct a suitable family of reference measures on unstable leaves as a dynamical analogue of Hausdorff measure, and then show that the averaged pushforwards of these measures converge to a measure that has the Gibbs property and is the unique equilibrium measure.