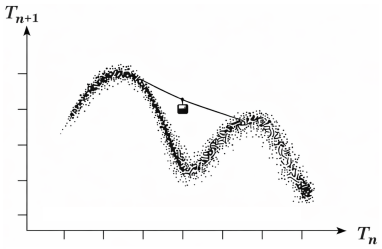
RDS Rio 2026

International Conference on Random Dynamical Systems and Related Fields

Fórum de Ciência e Cultura da UFRJ, Rio de Janeiro, Brazil
March 2–6, 2026

Celebrating Ale Jan Homburg 60



Time	Monday 3/2	Tuesday 3/3	Wednesday 3/4	Thursday 3/5	Friday 3/6
8:35 - 9:00	Registration				
9:00 - 9:25		Baxendale	Blumenthal	Pacifico	Kuske
9:25 - 9:50	Lamb				
9:50 - 10:15		Tenaglia	Punshon-Smith	Bakhtin	Toyokawa
10:15 - 10:40	Homburg				
10:40 - 11:05		Coffee	Coffee	Coffee	Coffee
11:05 - 11:30	Coffee	Bassols	Kétri	Tey	Callizaya
11:30 - 11:55	Barrientos	Morelli	Apaza	Kourliouros	Tikhomirov
11:55 - 12:20	Melo	Goverse	Mailybaev	Matias	Stadlbauer
12:20 - 12:45	Lunch	Lunch		Lunch	
12:45 - 13:10					Final Remarks Lunch
13:10 - 13:35					
13:35 - 14:00					
14:00 - 14:25	Obata	Ruffino		Fontes	
14:25 - 14:50					Discussion time
14:50 - 15:15	Liu	Högele		Gibson	
15:15 - 15:40	Araujo	Salcedo		Coffee	
15:40 - 16:05	Coffee	Coffee		Al-Qaiwani	
16:05 - 16:30	Castro	Verbitskii	Free afternoon	Bian	
16:30 - 16:55				Discussion time	
16:55 - 17:20	Amorim	Coates			
17:20 - 17:45	Chalhoub	Nisoli			
17:45 - 18:00	Poster Session and Drinks Reception				
18:00 - 18:30					
18:30 - 19:00				Conference Dinner (18:30 start)	
19:00 - 19:45					

Monday, March 2

08:35 - 09:25 **Registration**

09:25 - 10:15 **Jeroen Lamb (Imperial College London, UK)**

From chaos to noise

We survey the development of dynamical systems research in the deterministic and random settings since the mid 1960s, highlighting various contributions by Ale Jan Homburg and pointing out current challenges and opportunities.

10:15 - 11:05 **Ale Jan Homburg (University of Amsterdam, Netherlands)**

Intermingled basins for skew product systems

In the context of skew product systems, I'll revisit some constructions of maps with multiple attractors that have intermingled basins, and I'll discuss some novel constructions.

11:05 - 11:30 **Coffee Break**

11:30 - 11:55 **Pablo Gutiérrez Barrientos (UFF, Brazil)**

Integral representation of Lyapunov exponents

The standard theory of Random Dynamical Systems (RDS) typically models random maps as a deterministic skew-product over a shift transformation on a path space Ω. While this allows the use of classical tools, it comes with a significant conceptual and structural heavy lifting: the Lyapunov exponents $\lambda_i = \lambda_i(\omega, x)$ is defined as a function of the initial phase x and the entire infinite future history of the noise $\omega = (\omega_0, \omega_1, \dots)$.
However, it is a well-known observation that for i.i.d. random iterations, Kolmogorov's 0-1 Law implies that the exponent is effectively decoupling it from the specific realization of the future path. This suggests that the dependence on Ω is often an artifact of the formalism rather than a property of the system itself.
In this talk, based on joint work with Nisoli, we present a new approach that circumvents the path space construction entirely. Taking advantage of the recent extension of Kingman's subadditive theorem for Markov operators (Barrientos & Malicet, 2024), we developed an abstract formalism using two operators representing base and lift Markov chains. This

allows us to introduce Lyapunov exponents in a different way by showing new asymptotic characterizations and variational representations of these objects in various contexts.
In particular, we prove that for RDS driven by Markovian noise (even in the non-ergodic and place-dependent regime), the Lyapunov exponent depends only on the current noise state ω_0 and the phase x, not on the future path sequence; i.e., $\lambda_i = \lambda_i(\omega_0, x)$. Furthermore, we derive a unified variational principle that covers deterministic singular systems, Banach bundle morphisms, and random singular bundle maps. Namely, we show that

$$\sum_{i=1}^{k} \lambda_i = \sup_{\hat{\nu}} \int \phi_k \, d\hat{\nu}$$

where ϕ_k is the potential describing the log-volume growth of k-dimensional distinct subspaces, and the supremum is taken over the invariant measures $\hat{\nu}$ of the lifted Markov chain on the projective (or Grassmann) bundle which project on the initial law of the Markov chain in the base. Moreover, the sup is attained on ergodic measures having zero mass in the degeneracy locus.

11:55 - 12:20 **Aline Melo (PUCV, Chile)**

Regularity of Lyapunov Exponents for Markov Cocycles

An important problem in ergodic theory is the study of the regularity of Lyapunov exponents with respect to their parameters. In this talk, we establish the joint Hölder continuity of the maximal Lyapunov exponent as a function of the Markov cocycle and the transition kernel. Our approach combines tools from ergodic theory and stochastic dynamical systems, with particular emphasis on stationary measures. This is joint work with Ao Cai, Marcelo Durães, and Silvius Klein.

12:20 - 14:00 **Lunch**

14:00 - 14:50 **Davi Obata (Brigham Young University, USA)**

Absolute continuity of stationary measures

We study random dynamical systems generated by smooth surface diffeomorphisms. Brown and Rodriguez Hertz showed that hyperbolic stationary measures typically have the SRB property—meaning absolute continuity along unstable manifolds—except in the presence of specific obstructions. We aim to identify conditions under which SRB stationary measures are absolutely continuous with respect to Lebesgue measure on the ambient space. This is

a joint work with Aaron Brown, Homin Lee, and Yuping Ruan.

14:50 - 15:15 **Yingjian Liu (IMPA, Brazil)**

Regularity of Lyapunov Exponents for Random Matrix Products

We study the regularity of Lyapunov exponents for random matrix products at probability measures exhibiting a one-point Lyapunov spectrum, that is, when all Lyapunov exponents coincide. While continuity and Hölder continuity of Lyapunov exponents are well understood under irreducibility and simplicity assumptions, the degenerate case of a collapsed spectrum is typically excluded due to the lack of hyperbolicity.
In this talk, we show that despite this degeneracy, the top Lyapunov exponent enjoys enhanced regularity at one-point spectrum measures. Under compactness and semisimplicity conditions, we prove pointwise logarithmic Hölder continuity of the Lyapunov exponents with respect to perturbations of the underlying probability measure. The mechanism relies on a quantitative control of the random walk on projective space and a careful analysis of mass accumulation governed by invariant structure.

15:15 - 15:40 **Ana Araújo (IMPA, Brazil)**

Hölder regularity of the top Lyapunov exponent in random matrix products

This talk discusses the regularity of Lyapunov exponents for products of random invertible matrices in arbitrary dimension. In particular, we show that the top Lyapunov exponent depends in a pointwise Hölder continuous way on the underlying probability measure, with respect to the Wasserstein-Hausdorff distance on the space of compactly supported measures. This result holds under the assumptions that the top exponent is simple and that the associated equator has dimension at most one. This is joint work with El Hadji Yaya Tall, Adriana Sánchez, and Marcelo Viana.

15:40 - 16:05 **Coffee Break**

16:05 - 16:55 **Matheus M Castro (UNICAMP, Brazil)**

On the cardinality of measures of maximal relative entropy for smooth skew products

Let Ω and M be compact smooth manifolds and let $\Theta : \Omega \times M \to \Omega \times M$ be a $\mathcal{C}^{1+\alpha}$ skew-product diffeomorphism over an Anosov base. We show that Θ has at most countably many ergodic hyperbolic measures of maximal relative entropy. When $\dim M = 2$, if Θ has positive relative topological entropy, then Θ has at most countably many ergodic measures of maximal relative entropy. This is a joint work with Gary Froyland.

16:55 - 17:20 **Artur Assis Amorim (IMPA, Brazil)**

Analyticity of Lyapunov exponents and the distribution of zeros

In 1991, Peres proved the analyticity of Lyapunov exponents with respect to the transitional probabilities in the context of random matrix products, under hypothesis of simplicity and finite support. We generalize this theorem for compactly supported measures, substituting the simplicity hypothesis with a weaker condition related to the invariant subspaces of a measure. We then use this result and some perturbation lemmas to study topological and geometrical properties of the zeros of Lyapunov exponents, proving that, under general conditions, the zeros have empty interior with respect to very strong metrics. This is a joint work with Aline Melo and Marcelo Durães.

17:20 - 17:45 **Chris Chalhoub (Imperial College London, UK)**

Critical Asymptotics and Analytic Dependence for Random Matrix Products

We consider the product of i.i.d. random matrices sampled according to a probability measure μ on $GL(d, \mathbb{R})$. We study the transition to a zero top Lyapunov exponent λ regime under variation of the probability measure μ. We consider the number of back-and-forth escapes from a ball around the origin and prove that the expected number of such escapes scales as λ^{-1} in the $\lambda \to 0$ limit. We also establish analyticity of the moments of the random matrix product in the probability measure μ (in total variation norm).

17:45 - 20:00 **Poster Session + Drinks Reception**

Tuesday, March 3

09:00 - 09:50 **Peter Baxendale (University of Southern California, USA)**

Stability and bifurcation for random dynamical systems

Consider the flow of a stochastic differential equation on a manifold N with a submanifold M which is invariant under the flow. Examples include an SDE in Euclidean space with a fixed point, and also the two-point motion of an SDE on M (where we identify M with the diagonal in $N = M \times M$). We are interested in the stability or instability of M; more precisely in the behavior of solutions of the SDE with initial position near M. We are especially interested in how this behavior changes as parameters in the SDE are changed.
We will review known methods and results for the cases of a fixed point in Euclidean space and for the two-point motion on a compact manifold M. In particular we will demonstrate how the eigenfunctions associated with the moment Lyapunov exponent for the derived process on the tangent bundle TM can be used to construct martingales for the linearized motion and pairs of sub- and supermartingales for the non-linear motion. This is based on joint work with Dan Stroock.
These methods and results rely strongly on the compactness of M, and it is not clear what additional growth restrictions will be needed when M is not compact. We will describe some recent advances on this question.

09:50 - 10:40 **Giuseppe Tenaglia (Imperial College London, UK)**

Non-uniform expansion and diffusive noise imply dense random horseshoes and existence of a random Gibbs-Markov map

We propose a notion of random horseshoe and prove density of random horseshoes and existence of a random Gibbs-Markov map with exponential tail for non uniformly expanding random dynamical systems with bounded diffusive noise

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10:40 - 11:05 **Coffee Break**

11:05 - 11:30 **Bernat Bassols Cornudella (Imperial College London, UK)**

Conditioned Stochastic Stability of Equilibrium States on Repellers

Stochastic stability provides a framework to identify relevant invariant measures in a dynamical system in the sense that they persist under random perturbations of the dynamics.

Adding noise to a system washes out any invariant repelling sets and smears all points towards an attracting region of the state space. Consequently, stochastic stability has only been studied for measures on attractors. In this talk, we introduce the notion of conditioned stochastic stability of invariant measures on repellers: we consider whether quasi-ergodic measures of absorbing Markov processes, generated by random perturbations of the deterministic dynamics and conditioned upon survival in a neighbourhood of a repeller, converge to an invariant measure in the zero-noise limit.
This is joint work with Matheus M de Castro (UNSW, UNICAMP) and Jeroen S.W. Lamb (Imperial College London).

11:30 - 11:55 **Pedro Augusto da Silva Morelli (ICMC-USP, Brazil)**

Besov Spaces and Statistical Properties of the Shift

We define distributions on an abstract measure space endowed with a sequence of partitions, and introduce analogues of Besov spaces with negative smoothness in this setting. In particular, we describe these spaces of distributions using unconditional Schauder bases consisting either of Haar wavelets or of pairs of Dirac masses (dipoles). This framework allows us to obtain duality results between Besov spaces of negative smoothness and Hölder spaces of functions with respect to an appropriately defined pseudo-metric and employ the functional approach to study statistical properties of the one-sided shift by understanding the spectrum of the transfer operator on those spaces.

11:55 - 12:20 **Vincent Goverse (Imperial College London, UK)**

Intermittent two-point dynamics at the transition to chaos for random dissipative standard map

We establish the existence of intermittent two-point dynamics and infinite stationary measures for a class of random diffeos with zero Lyapunov exponent, as a dynamical characterisation of the transition from synchronisation (negative Lyapunov exponent) to chaos (positive Lyapunov exponent).

12:20 - 14:00 **Lunch**

14:00 - 14:50 **Paulo Ruffino (UNICAMP, Brazil)**

Structure of jointly uniform attractor for nonautonomous random dynamical systems

We introduce a notion of minimal uniform attractor for nonautonomous random dynamical systems, which depends jointly on time and on a random parameter.
Several examples are provided to illustrate the concept and to compare it with existing notions of uniform attractors in the literature.
We further apply the abstract theory to nonautonomous random differential equations with a non-compact symbol space. In particular, we develop a method to compactify the symbol space, by adapting techniques from the theory of deterministic nonautonomous differential equations. We also establish the stability of the minimal jointly uniform attractor by exploiting the relationship between deterministic and random dynamics. Finally, we show that such structures arise naturally in stochastic differential equations whose noise terms carry additional time dependence, by establishing a topological conjugacy between the resulting stochastic flows and nonautonomous random dynamical systems.

14:50 - 15:15 **Michael Högele (Universidad de los Andes, Colombia)**

Almost Sure Convergence Rates via Borel-Cantelli Moment Estimates

We present a quantitative refinement of the classical Borel-Cantelli lemma that yields explicit moment estimates for the overlap count and last-index random variables associated to a sequence of events. The key tool is a moment equation for nested events, derived via summation by parts, which extends to general event sequences through a union bound argument. This framework naturally encodes a tradeoff between almost sure error tolerance and mean deviation frequency: given a rate at which probabilities of exceedance decay, one obtains sharp integrability conditions on the random modulus of almost sure convergence.

15:15 - 15:40 **Graccyela Salcedo (PUC-Rio, Brazil)**

Weakly Contracting on Average Random Dynamical Systems

We study random dynamical systems (RDSs) that are weakly contracting on average and show that this property leads to strong probabilistic consequences. These include uniqueness of the stationary measure, decay of correlations for Lipschitz observables, concentration inequalities, and an almost sure central limit theorem. Several examples are presented, including RDSs on the circle and systems arising from the projective action of linear cocycles.

15:40 - 16:05 **Coffee Break**

16:05 - 16:55 **Evgeny Verbitskii (Leiden University, Netherlands)**

Gibbs formalism in Statistical Mechanics & Dynamical Systems.

In this talk I will give a broad introduction to the Gibbs formalism and the way it appears in both statistical mechanics and dynamical systems. In the second part of the talk, the focus will be on fibred systems, including random dynamical systems, where one studies simultaneously the dynamics along fibres and the driving (base) process. In this setting, classical notions such as specification, regularity of conditional measures, and the equilibrium–Gibbs correspondence can exhibit new subtleties. I will highlight parallels and contrasts between approaches to fibred systems developed in statistical mechanics and dynamical systems, and argue that some form of "unification" could be beneficial.

16:55 - 17:20 **Douglas Coates (UFRJ, Brazil)**

Almost-sure behaviour of empirical measures for intermittent maps

Interval maps with several equally sticky and sufficiently sticky neutral fixed points can present non-statistical behaviour where the sequence of empirical measures does not converge for Lebesgue almost every initial condition. If the order of the tangency of the map to the identity at the fixed points is small enough there is a unique physical measure (equivalent to Lebesgue) and the map is statistical. If instead this tangency is sufficiently high, then empirical measures almost surely accumulate to the full simplex of invariant measures supported at the fixed points and the map is non-statistical. I will present recent ongoing work with Tanja Schindler where we describe the almost sure behaviour of the empirical measures at the boundary case between these two phenomena. Moreover, I will describe some applications of these types of results to studying cutting sequences for the geodesic flow on surfaces with cusps.

17:20 - 17:45 **Isaia Nisoli (UFRJ, Brazil**

Certified self consistent measures

In this work, in collaboration with Galatolo and Tanzi we present an algorithm to certify approximations of stationary measures of self consistent operators. I will introduce the theoretical framework and show some certified results.

09:00 - 09:50 **Alex Blumenthal (Georgia Institute of Technology, USA)**

Stability and instability of almost-surely invariant structures in stochastic systems

For many models of practical interest, e.g. those coming from mechanical evolutions such as fluid mechanics, symmetries in the law of evolution lead to the existence of flow-invariant subsets along which some symmetry is preserved. Interesting dynamical changes can happen when these symmetric subspaces become dynamically unstable under changes in the parameter, e.g., degeneration of laminar flow as the Reynolds number is increased.

For complicated invariant sets along which the dynamics acts nontrivially, simple linear stability analysis no longer suffices and it can be extremely hard to establish dynamical instability. The purpose of this talk will be to describe a remarkably simple, systematic procedure for proving instability of almost-surely invariant subsets of random dynamical systems, e.g. the stochastic flow of an SDE, using carefully-constructed Lyapunov exponents and some large deviations analysis. As a proof of concept, we apply our results to a degenerately-forced stochastic Lorenz 96 system and establish a bifurcation from one to two stationary measures – one supported on a symmetric subset, and the other supported off the subset governing the asymptotic behavior of Lebesgue-typical initial data. Some outlook and potential future applications to fluid systems will also be discussed.

09:50 - 10:40 **Sam Punshon-Smith (Tulane University, USA)**

Preventing Spectrum Collapse: Lower Bounds on Lyapunov Exponents for Infinite-Dimensional Stochastic Cocycles

I will discuss recent work (with M. Hairer, T. Rosati, and J. Yi) on the top Lyapunov exponent (λ_1) for infinite-dimensional cocycles generated by linear PDEs driven by the 2D stochastic Navier-Stokes equations. A key challenge is ruling out spectrum collapse ($\lambda_1 = -\infty$), where advection and diffusion conspire to create super-exponential decay. We establish a quantitative lower bound in the diffusivity κ of the form $\lambda_1^\kappa \geq -C\kappa^{-q}$, which also provides a rigorous bound on the smallest length scale in the fluid.
The proof analyzes the projective dynamics on the (non-compact) L^2 unit sphere. We introduce the concept of "high-frequency stochastic instability": the idea that the noise dynamically prevents the process from concentrating in high-frequency states, where dissipation is strongest. This mechanism yields a Lyapunov drift condition for the median of the spectral distribution, which leads to the existence of a projective stationary measure, and gives a lower bound via a Furstenberg-Khasminskii-type formula.

10:40 - 11:05 **Coffee Break**

11:05 - 11:30 **Anne Kétri Pasquinelli da Fonseca (IGCE-UNESP-Rio Claro, Brazil)**

Understanding and describing a phase transition from limited to unlimited diffusion in a billiard system

The aim of this work is investigate and characterize a phase transition from limited to unlimited diffusion observed in a dissipative and time-dependent oval billiard due to the variation of control parameters. We focus on a transition that occurs as we introduce a dissipation in each of the collisions. Near the phase transition, the dynamics is scaling invariant, characterizing a continuous phase transition. The central phenomenology uses a set of scaling hypotheses, the solution of the probability distribution and a generalized homogeneous function. From them we obtain a relation between the critical exponents leading to a scaling law, which can be proved using numerical simulations or analytic descriptions.

11:30 - 11:55 **Leonardo Felix Apaza Pilco (Universidad Pública de El Alto, Bolivia)**

Renormalized center-of-mass diffusion in a nonreciprocal overdamped Rouse chain

We study an overdamped Rouse chain with nonreciprocal nearest-neighbor couplings that break left–right symmetry and drive the dynamics out of equilibrium. For free boundaries, nonreciprocity prevents exact cancellation of internal forces at the chain level, coupling the center-of-mass motion to global deformations. The center-of-mass mean-squared displacement remains asymptotically diffusive, but with a renormalized effective diffusivity that depends on the nonreciprocity strength and chain length, reducing to the standard Rouse result in the reciprocal limit. Langevin simulations using an Ito-consistent Euler–Maruyama scheme show quantitative agreement with the theoretical prediction at long times, with short-time deviations arising from internal relaxation. These findings provide a minimal, directly testable signature of nonreciprocal interactions in polymer-like and active chain models.

11:55 - 12:45 **Alexei A Mailybaev (IMPA, Brazil)**

Renormalization-group perspective on spontaneous stochasticity

We present a renormalization-group perspective on spontaneous stochasticity in hydro-

dynamic turbulence, viewed through the lens of multiscale random dynamical systems. Building on previously established results for a solvable multiscale Arnold's cat model, we show that spontaneous stochasticity emerges as a universal fixed point of an RG transformation acting on Markov kernels. Classical examples - including the Feigenbaum equation, the central limit theorem, and hierarchical spin models - are reinterpreted within the same framework, placing spontaneous stochasticity alongside other universality phenomena. This lecture is based on joint works with Artem Raibekas and Luca Moriconi.

Free Afternoon

Thursday, March 5

09:00 - 09:50 **Rachel Kuske (Georgia Institute of Technology, USA)**

Critical scales for tipping captured in non-smooth and noisy model features

We consider tipping mechanisms facilitated by model features that are often overlooked in the study of dynamic bifurcations or early warning signals.
First, we consider stochastic forcing in Stommel-type models, where the interplay of noise, non-smoothness and multiple time scales can substantially advance dynamic bifurcations. Also termed tipping, these transitions are advanced relative to both deterministic systems and systems with traditional "smooth" bifurcations. Analytical results identify different tipping scenarios related to the balance of stochastic forcing, the (nearly) non-smoothness of the bifurcations, bi-stability, and the slow variability of critical physical and environmental process. The presence of high and low frequency forcing must also be considered, resulting in a competition between these important contributions.
Second, we consider the potential ubiquity of correlated additive and multiplicative (CAM) noise, focusing on a variety of applications where models predict advanced tipping near bifurcations. Again, the dynamics depends on the interplay of hidden slow time scales and parametric fluctuations in the CAM setting.

09:50 - 10:40 **Yuri Bakhtin (Courant Institute of Mathematical Sciences, New York University, USA)**

Diffusions, transitions, nonergodic attractors.

The main theme of this talk is stochastic dynamics structured by manifolds of dimension lower than the entire phase space, where the evolution is punctuated by various transitions. First, I will talk about small noisy perturbations of dynamical systems near heteroclinic networks. In the vanishing noise limit, I will describe typical and rare transitions giving rise to a hierarchy of clusters and transition time scales given by powers of the noise amplitude. This is joint work with Hong-Bin Chen and Zsolt Pajor-Gyulai. Then I will talk about diffusions with varying degrees of degeneracy. The invariant manifolds on which the diffusion degenerates may carry invariant measures and the long-term statistical properties of such a system may be governed by one or more such invariant measures and transitions between them. The resulting nonergodic intermittent averaging cannot be described by the classical ergodic theory. This is joint work with Renaud Raquepas and Lai-Sang Young.

10:40 - 11:05 **Coffee Break**

11:05 - 11:30 **Wei Hao Tey (Imperial College London, UK)**

Hénon map with bounded noise

Random system with bounded noise can be analysed using set-valued system, where we consider the compound behaviour of the system with all possible noise realisations. However, set-valued systems are hard to study and many traditional theory for bifurcation are inaccessible. We present a pilot numerical study of a novel - boundary map - which showcase two types of topological and boundary bifurcations. The aim is to illustrate bifurcations in set-valued system are traditional bifurcation of a single-valued boundary map, built from following evolution of the boundary of a set under the set-valued system.

11:30 - 11:55 **Konstantinos Kourliouros (Imperial College London, UK)**

Contact Geometry and Dynamics of Random Diffeomorphisms with Bounded Noise

In this talk I will present a contact geometric approach to the study of attractors and other invariant sets of random diffeomorphisms with bounded noise. I will show in particular that to any such random diffeomorphism there is naturally associated a contactomorphism of the unit cotangent bundle of the state space –the so-called boundary map– with the following characteristic weak cocycle property: boundaries of invariant sets of the random diffeomorphism lift in a unique way to backward invariant Legendrian submanifolds (possibly with singularities) of the boundary map. Using this correspondence principle, I will present recent results on the stability and bifurcations of attractors of random diffeomorphisms, in relation to the associated Legendrian manifold and singularity/bifurcation theory of the boundary map. Finally, I will indicate further challenges and future perspectives towards the deeper interconnections between the theory of random dynamical systems and the contact geometry and dynamics of their boundary cocycles.

11:55 - 12:20 **Edgar Matias (ICMC-USP, Brazil)**

Synchronization in random iterations of circle homeomorphisms

In this talk, we study ergodic properties of random iterations of maps driven by a Markov chain in a general setting, with a focus on circle homeomorphisms. Assuming that the homeomorphisms do not preserve a common measure and under a weak assumption on the transition kernel of the Markov chain, we establish a local contraction property and the finiteness of ergodic stationary measures for the induced two-point motion on the torus. As an application, we obtain global synchronization for a discrete dynamical system on the

circle with a north–south random impulse.

12:20 - 14:00 **Lunch**

14:00 - 14:50 **Luiz Renato Gonçalves Fontes (USP, Brazil)**

Random walks in Markovian dynamical environments

We survey recent results on the asymptotics of continuous time random walks on Z^d with time inhomogeneous jump rates given by a decreasing function of an environment given by independent birth-and-death or house-of-cards processes. In particular, we look at diffusive behavior under sufficient ergodicity of the environment, and subdiffusivity under weaker ergodicity, null recurrence and transience. Joint work with Maicon Pinheiro, Pablo Gomes and Thomás Freud.

14:50 - 15:15 **Emilia Gibson (Imperial College London, UK)**

Learning iterated function systems from data

We develop methodologies to learn random iterated function systems from time series of partial observations using delay embeddings. We obtain a model of minimum dimension and complexity for the observed dynamics, using a hidden variable representation, that is diffeomorphic to the original system.

15:15- 15:40 **Coffee Break**

15:40 - 16:05 **Rayyan Al-Qaiwani (Imperial College London, UK)**

The Morse spectrum for linear random dynamical systems

We prove that the projectivisation of a finite-dimensional linear random dynamical system admits a unique finest weak Morse decomposition. Based on this, we introduce the Morse spectrum and study its basic properties. In particular, we show that the Morse spectrum is a finite union of closed intervals. Moreover, under a bounded growth condition, we prove that the Morse spectrum coincides with the dichotomy spectrum.

16:05 - 16:30 **Zheng Bian (IME/USP, Brazil; Imperial College London, UK)**

Mean-field and fluctuations for hub dynamics in heterogeneous random networks

We study a class of heterogeneous random networks, where the network degree distribution follows a power-law, and each node dynamics is a random dynamical system, interacting with neighboring nodes via a random coupling function. We characterize the hub behavior by the mean-field, subject to statistically controlled fluctuations. In particular, we prove that the fluctuations are small over exponentially long time scales and obtain Berry-Esseen estimates for the fluctuation statistics at any fixed time. Our results provide an explanation for several numerical observations, namely, a scaling relation between system size and frequency of large fluctuations, the system size induced desynchronization, and the Gaussian behavior of the fluctuations.

16:30 - 19:00 **Discussion time**

19:00 - 22:00 **Conference Dinner - Churrascaria Palace**

Friday, March 6

09:00 - 09:50 **Maria José Pacifico (UFRJ, Brazil)**

On Stationary Densities under BV Noise

We study stationary measures of random dynamical systems obtained by perturbing deterministic maps with i.i.d. additive noise whose distribution has bounded variation density. Our first goal is to establish the existence and regularity properties of stationary densities, highlighting the smoothing effect induced by noise and its interaction with the deterministic dynamics.
Our second goal is to develop a rigorous framework for their numerical approximation, providing validated error bounds suitable for computer-assisted proofs via finite-rank discretizations of transfer operators.
We apply the theory to non-uniformly hyperbolic systems, including the Contracting Lorenz Attractor and the Hénon map, illustrating both regularization phenomena and the feasibility of validated computation. This is joint work with Ricardo Bioni and Isaia Nisoli.

09:50 - 10:40 **Hisayoshi Toyokawa (Kitami Institute of Technology, Japan)**

Invariant measures for random piecewise convex maps

We investigate one-dimensional random dynamical systems referred to as random piecewise convex maps, specifically the existence of conservative and ergodic σ-finite invariant measures absolutely continuous with respect to the Lebesgue measure. For this purpose, we develop a technique to classify Markov operators: "mean constrictivity," which is a refinement of the classical constrictivity introduced by Lasota–Li–Yorke and Komornik. Furthermore, we estimate the asymptotic size of these invariant measures and establish limit theorems such as the Darling–Kac law and the Dynkin–Lamperti type arcsielaw. This is joint work with P. G. Barrientos (Universidade Federal Fluminense), F. Nakamura (KIT), and Y. Nakano (Hokkaido U), and with T. Inoue (Ehime U).

10:40 - 11:05 **Coffee Break**

11:05 - 11:30 **Oscar Bautista Callizaya (UFF, Brazil)**

Lyapunov Exponents and Periodic Approximation in Fibered Hyperbolic Systems

A fundamental question in smooth dynamics is whether ergodic measures can be approximated by measures supported on periodic orbits. While this is true for hyperbolic systems (via the Anosov Closing Lemma), the situation becomes more delicate for partially hyperbolic systems or skew-products.
In this talk, we will focus on skew-products over a hyperbolic base with circle fibers. We will discuss a result showing that when the fibered Lyapunov exponent is non-zero, the ergodic measure can indeed be approximated by periodic measures in the weak-$\star$ topology. Furthermore, we will explore the critical case of vanishing Lyapunov exponents, presenting examples where the approximation of exponents holds, but the approximation of measures fails.

11:30 - 11:55 **Sergey Tikhomirov (PUC-Rio, Brazil)**

Probabilistic aspects of the shadowing property

The celebrated Shadowing Lemma states that, in a neighborhood of a hyperbolic set, a diffeomorphism satisfies the shadowing property. In fact, this property is Lipschitz. In 2010, jointly with Pilyugin, we proved that Lipschitz shadowing is equivalent to hyperbolicity (structural stability). This result raises the question of what type of shadowing a non-hyperbolic system can have.
Based on numerical simulations, Grebogi and Yorke conjectured that, for a wide class of nonuniformly hyperbolic systems, a d-pseudotrajectory of length $1/\sqrt{d}$ can be $\sqrt{d}$-shadowed. Note that this conjecture concerns finite pseudotrajectories whose length increases as d tends to 0.
We present a probabilistic approach to shadowing and show that, for a class of partially hyperbolic linear skew products, a statement similar to the Grebogi-Yorke conjecture is correct. At the same time, for infinite pseudotrajectories, probabilistic shadowing is almost equivalent to deterministic shadowing.
We suggest that the generalized (C, λ)-structure for infinite-dimensional dynamics plays a role similar to "Axiom A and strong transversality condition" for dynamics on compact manifolds. For diffeomorphisms of reflexive Banach space we showed that generalized (C, λ)-structure implies Lipschitz (periodic) shadowing and is robust under C^1-small perturbations. Assuming that generalized (C, λ)-structure is continuous for diffeomorphisms of arbitrary Banach spaces we obtain a weak form of structural stability: the diffeomorphism is semiconjugated from both sides with any C^1-small perturbation.

11:55 - 12:45 **Manuel Stadlbauer (UFRJ, Brazil)**

Non-expanding random dynamical systems with positive Lyapunov exponents

In this talk, we begin with considering skew products of the form

$$T : \Sigma \times X \to \Sigma \times X, \quad (\xi, x) \mapsto (\theta\xi, \kappa_\xi(x)),$$

where Σ and X are compact metric spaces, T is a uniformly expanding map and κ is a continuous map from Σ into the homeomorphisms of X. Under a suitable condition, coined *local backward contraction on average*, with respect to a potential function $\varphi : \Sigma \to \mathbb{R}$, it turns out that a Perron–Frobenius–Ruelle theorem holds. This provides us with a canonical station measure for T and, in terms of random dynamical systems, this implies that $(\kappa_{\theta^n\xi})$ is a stationary, psi-mixing sequence of maps, whose associated random orbits show synchronization and satisfy a VASIP.
However, verifying backward contraction is sometimes challenging, which is the second part of the talk. So assume that G is a countable hyberbolic group and that $\gamma : \Sigma \to G$ is a map, and that ∂G refers to the Gromov boundary of G. This now gives rise to a skew product

$$S : \Sigma \times G \times X \to \Sigma \times G \times X, (\xi, g, x) \mapsto (\theta\xi, g\gamma_\xi, \gamma_\xi^{-1}(x)).$$

Using Martin boundary theory, it is now possible to show that a Karlsson-Margulis type ergodic theorem holds on $X \times G$, and that the associated Lyapunov exponent is positive. As a corollary, one obtains, under suitable conditions, that there is a Brownian motion B_t and $\lambda > 0$ such that, for any $\epsilon > 0$ and almost surely, the drift in G satisfies

$$d(\mathrm{id}, g_\xi \cdots g_{\theta^{n-1}(\xi)}) = \lambda n + B_n + o(n^{1/4+\epsilon}).$$

This is joint work with Gil Astudillo.

12:45 - 14:25 **Final Remarks and Lunch**

14:25 - 18:00 **Discussion time**

Poster Presentations

1. **Ergodic Results for Iterated Function Systems**
   Ana Cláudia Rodrigues e Silva (ICMC-USP)
2. **Large Deviations for some unbounded observables**
   Anselmo de Souza Pontes Junior (PUC-RIO)
3. **Existence of Stationary Measures for Circle Maps with Additive Noise**
   Bella Figliaggi (ICMC-USP)
4. **Rigorous Computation of Stationary Measures and Lyapunov Exponents in Random Dynamical Systems with Gaussian Noise**
   Charles Edgar Lopez Vereau (UERJ)
5. **Markov Chains on Trees in Networks of Labeled Nodes**
   Cristiana Aparecida Nogueira Couto (USP)
6. **Computational approaches using the adjoint method**
   João Henrique Lírio da Silva (UFRJ)
7. **Periodicity characterized synchronization of a trio of Rulkov neurons**
   Kevin Angel Cordero Iglesias (Universidad Mayor de San Andrés)
8. **Determinación del crecimiento estocástico de células tumorales mediante el método de perturbación de homotopía**
   Lia Marisol Crespo Arguedas (UPEA)
9. **Ergodic Theory of Normal Numbers**
   Mateus Blanco de Sousa (ICMC-USP)
10. **Invariant Sets of Differential Equations with Bounded Noise**
    Michal Fedorowicz (Imperial College London)
11. **Intermittent Diffusion and Subdiffusion in Random Walks with Bounded Potentials**
    Moacir Aloisio Nascimento dos Santos (UFVJM/ICMC-USP)
12. **Molecular-Level Screening of Ionic, Organic, and Deep Eutectic Electrolytes for Sodium-Ion Batteries**
    Muhammad Arfan (IQSC-USP)
13. **Tatjer tangencies in periodic perturbations of generic unfoldings of the three-dimensional nilpotent singularity**
    Paula Álvarez (Universidad de Oviedo)
14. **Besov Spaces and Statistical Properties of the Shift**
    Pedro Augusto da Silva Morelli (ICMC-USP)
15. **Sparse recovery of dynamical systems from mean-filed data**
    Sajjad Bakrani Balani (ICMC-USP)
16. **A dynamical compactification for monomial maps in two complex dimensions**
    Samanta Santos Avelino Silva (UFF)

17. **Spectral Gap and Cutoff of Simple Exclusion Process with IID Conductances**
Shangjie Yang (UFF)

18. **Stochastic resonance from a nonautonomous random dynamical systems viewpoint**
Tianyi Liu (Imperial College London)