

RENCONTRE ANR “ALÉATOIRE, DYNAMIQUE ET SPECTRE”

All the lectures will take place in the amphithéâtre of the LS2N (close to the math building).

NOVEMBER, 8TH 2021

- 1:00 pm. Lunch at the Restaurant Universitaire La Lombarderie
- 2:30-3:30 pm. **Damien Gayet** (Grenoble) – *Topology of random nodal sets: a survey.*

If a smooth function is taken at random over a manifold, what can be said about the topology of its vanishing locus? In this talk for non specialists, I will present various natural aspects of this question.

- 3:30-4:00 pm. Coffee break.
- 4:00-5:00 pm. **Lucas Vacossin** (Paris Saclay) – *A spectral gap for obstacle scattering in dimension 2.*

We consider a finite numbers of strictly convex obstacles (with smooth boundary) in the plane and we assume that they satisfy the no-eclipse condition. It is known that the resolvent of the Laplace operator outside the obstacles continues meromorphically to the logarithmic cover of the complex plane. Its poles are the scattering resonances of this open system. In a work in progress, I am interested in the existence of a spectral gap in the first sheet of the cover, namely a band without resonances below the physical plane. For such a system, it is also known that the billiard flow has a chaotic behavior and the trapped set, consisting of all the light rays which do not escape backward and forward, exhibits a fractal structure. In my presentation, I will explain the tools I use to exploit this fractal structure and show the existence of a spectral gap. In particular, it relies on a fractal uncertainty principle developed by S. Dyatlov and several collaborators since 2016, especially a more recent (2019) use in the context of negatively curved surfaces.

NOVEMBER, 9TH 2021

- 9:45-10:45 am. **Yann Chaubet** (Paris Saclay) – *Counting periodic trajectories under constraints.*

On a closed negatively curved surface, Margulis gave the asymptotic growth of

the number of closed geodesics of bounded length, when the bound goes to infinity. In this talk, we will present such asymptotic results for geodesics that satisfy certain (topological or geometric) constraints.

- 10:45 am. Coffee break.
- 11:30-12:30 pm. **Caroline Wormell** (Sorbonne Université) – *Applications of Chebyshev transfer operators methods*.

Full-branch uniformly expanding maps and their long-time statistical quantities are commonly used as simple models in the study of chaotic dynamics, as well as being of their own mathematical interest. However, common algorithms for computing these quantities are typically unspecialised to the high-order differentiability of many maps of interest, and so have a weak tradeoff between computational effort and accuracy.

This talk will cover a rigorous, highly efficient method to calculate statistics of these maps by discretising transfer operators in a Chebyshev polynomial basis. This discretisation is highly efficient: for analytic maps, numerical estimates obtained using this discretisation converge exponentially quickly in the order of the discretisation, for a polynomially growing computational cost. We will present some applications of the method to other tricky questions in dynamics including computing statistics of intermittent maps and finding non-hyperbolic structures in mean-field limit systems.

- 1:00 pm. Lunch at the Restaurant Universitaire La Lombarderie.
- 2:30-3:30 pm. **Antoine Meddane** (Nantes) – *A Morse complex for Axiom A flows*.

Axiom A flows are flows introduced by Smale in 1967 to generalize two types of flows which carry chaotic behaviors: the Morse flows (induced by the gradient of a Morse function) and the geodesic flows on negatively curved manifolds. Since the pioneer work of Morse 1934, it is well-known that the Morse flows are related with the topology of the underlying manifold. This link deeply rests on the construction of an algebraic tool called a Morse complex. More recently, many contributions were made in the quantum point of view of Pollicott-Ruelle resonances which led to the definition of a Morse complex for geodesic flows on negatively curved manifolds. In this talk, I will explain how this spectral approach can be used to define a Morse complex for Axiom A flows which gives a better insight on the relations between the dynamic of an Axiom A flow and the topology of the manifold.

- 3:30-4:00 pm. Coffee break.

- 4:00-5:00 pm. **Erwan Lanneau** (Grenoble) – *Diffusion rate in the wind-tree model and shape of Lyapunov exponents*

I will report on a work on the wind-tree model (this is a joint work with S. Crovisier, P. Hubert and A. Pardo). We show that any real number in $[0, 1)$ is a diffusion rate for the periodic wind-tree model introduced by P. and T. Ehrenfest. If time permits, I will explain some recent advances on the shape of Lyapunov spectrum for cocycles taking values in $SL(2, \mathbb{R})^2$.

- 8:00 pm. Conference dinner at A cantina – 28 Rue Kervegan (Nantes downtown).

NOVEMBER, 10TH 2021

- 9:45-10:45 am. **Laura Monk** (Bonn) – *Geometry and spectrum of random hyperbolic surfaces.*

The aim of this talk is to describe typical compact hyperbolic surfaces: results will be stated for most surfaces rather than every single one of them. In order to motivate this idea, I will first present examples introduced in literature as limiting cases of famous theorems, and argue that they might be seen as "atypical". This will allow us to appreciate the contrast with a fast-growing family of new results in both geometry and spectral theory, which are established with probability close to one in various settings, while being false for these atypical surfaces. In particular, I will discuss results on the distribution of eigenvalues and the geometry of long geodesics, as well as ongoing research on spectral gaps.

- 10:45 am. Coffee break.
- 11:30-12:30 pm. **Bram Petri** (Sorbonne Université) – *Random 3-manifolds with boundary.*

If one randomly glues a finite number of tetrahedra together along their faces, the probability that the resulting complex is a manifold tends to zero as the number of tetrahedra grows. However, the only non-manifold points are the vertices of this complex. So, if we truncate the tetrahedra at their vertices, we obtain a random manifold with boundary. This talk will be about the geometry and topology of that manifold. This is joint work with Jean Raimbault.

- 1:00 pm. Lunch at the Restaurant Universitaire La Lombarderie.