

## Schedule

Monday	Thursday	Wednesday	Thursday	Friday
9h30 Welcome	9h – 10h Bowen II	9h – 10h Bestvina III	9h – 10h Deroin II	
9h45 – 10h45 Bestvina I	10h30 – 11h30 Deroin I	10h30 - 11h30 Kenyon II	10h30 – 11h30 Bowen III	9h45 – 10h45 Kenyon III
11h15 – 12h15 Kenyon I	11h45 – 12h30 Ferenczi	11h45 – 12h30 Wu	11h45 – 12h30 Hooper	11h15 – 12h15 Deroin III
			15h30 – 16h15 Schraudner	
16h – 17h Bowen I	16h – 17h Bestvina II		16h20 – 17h05 Gautero	
17h15 – 18h Bufetov	17h15 – 18h Sunic		17h20 – 18h05 Gutman	
18h10 – 18h55 Goetz	18h10 – 18h55 Petite		18h10 – 18h55 Lustig	

### Workshop Speakers (3 hours)

- Mladen Bestvina (University of Utah)
  - Lecture 1: Outer space and the Lipschitz metric
  - Lecture 2: The train track theorem and laminations for automorphisms of free groups
  - Lecture 3: Applications of laminations: Tits Alternative for  $\text{Out}(F)$ , Subgroup Classification (work of Handel-Mosher)
- Lewis Bowen (Texas A&M University)
  - Lecture 1: Subshifts of finite type over the free group and applications to geometric group theory
  - Lecture 2: Sofic entropy theory and Gottschalk's conjecture I
  - Lecture 3: Sofic entropy theory and Gottschalk's conjecture II
- Bertrand Deroin (Université Paris-Sud)
  - Lecture 1: Laminations by Riemann Surfaces I: Uniformization
  - Lecture 2: Laminations by Riemann Surfaces II: The problem of moduli and translation surface structures
  - Lecture 3: Laminations by Riemann Surfaces III: Laminations in complex projective spaces
- Richard Kenyon (Brown University)
  - Lecture 1: Random tilings and statistical mechanics I: Can we tile?
  - Lecture 2: Random tilings and statistical mechanics II: In how many ways?
  - Lecture 3: Random tilings and statistical mechanics III: What is the large-scale structure of a random tiling?

## Seminar Speakers

- Alexander Bufetov
  - Title: Limit theorems for self-similar tilings (with Boris Solomyak)
  - Abstract: Deviation of ergodic averages is studied for dynamical systems given by self-similar tilings on the plane and in higher dimensions. The main object is a special family of finitely-additive measures for our systems. An asymptotic formula is given for ergodic integrals in terms of these finitely-additive measures, and, as a corollary, limit theorems are obtained for dynamical systems given by self-similar tilings. This is joint work with Boris Solomyak, arXiv:1201.6092.
- Sébastien Ferenczi
  - Title: Interval exchanges from billiard in the regular  $2n$ -gons
  - Abstract: We generate the trajectories of billiards in the  $2n$ -gons by applying the self-dual induction to a one-parameter family of  $n$ -interval exchanges. In this way we get results equivalent to those of Smillie and Ulcigrai, but different, and new results on weak mixing properties in this family
- François Gautero
  - Title: Dynamics on tiling spaces, invariant measures and generalized Thurston semi-norm.
  - Abstract: The problem of deciding whether a given finite set of tiles can tile the euclidean plane is known to be an undecidable problem. An aim of this work is to translate this undecidability in a purely topological and geometrical way. When non-empty the set of tilings of the euclidean plane constructed from a given finite set of tiles  $T$  inherits a natural structure of compact metric space: this is a compact laminated space with transverse structure a Cantor set, equipped with an action of  $R^2$  on the leaves of the lamination. There is then a non-empty set of invariant measures: each one defines a certain homology-class in the second homology group of a branched surface constructed from  $T$ . The aim of the current work is to characterize, among all the homology classes, those coming from invariant measures on the laminated space. This is done by the introduction of a kind of Thurston semi-norm.
- Arek Goetz
  - Title: Tilings of the plane by Mendes bricks
  - Abstract: We illustrate a better understanding of the two half plane piecewise rotation recently investigated with Anthony Quas. In particular, in the rational case, the plane can be partitioned into male and female Mendes blocks. We illustrate the associated symbolic dynamics and substitutions. We comment on the asymptotics of the portion of the areas covered by rotationally coded polygons.
- Yonatan Gutman
  - Title: Topological Dynamical Embedding and Jaworski-type Theorems
  - Abstract: Given a metric space  $X$  of dimension  $d$  it is a classical fact that the minimal  $n$  that guarantees that  $X$  can be embedded in  $[0, 1]^n$ , is  $n=2d+1$ . An analogous problem in the category of dynamical systems, is under what conditions one can guarantee that the metric topological system  $(X, T)$  is embeddable in  $([0, 1]^n)^{\mathbb{Z}, \text{shift}}$ . The embedding is induced by  $n$  real continuous functions on  $X$ , so this question can also

be thought as a topological dynamical analogue of the Krieger Generator Theorem. A well known theorem by Jaworski states that if  $(X, T)$  is aperiodic and  $X$  is finite dimensional then  $n=1$  is sufficient. I will discuss several generalizations of this theorem to the infinite-dimensional setting.

- Pat Hooper
  - Title: Renormalization, Corner Percolation, and Rectangle Exchanges
  - Abstract: The corner percolation model was invented by Valint Toth and studied in depth by Gabor Pete. In this model, you join each point in  $\mathbb{Z}^2$  to two neighbors using edges, while making sure that the two edges are orthogonal. You can think of the collection of such configurations as a dynamical system, where the action is given by following a curve. The possible configurations naturally correspond to the choice of two elements of the full two sided shift space on an alphabet with two letters. I will describe a renormalization procedure for this dynamical system, and explain how it can be used to calculate the prevalence of periodic orbits in the system. Here, prevalence is measured using some invariant probability measure. Pete considered the measures with positive entropy, while my primary interest is in measures with zero entropy which make the system measurably conjugate to a rectangle exchange transformation.
- Martin Lustig
  - Title: Cylinders, double-cylinders and their images under a substitution (or a free group automorphism)
  - Abstract: This is joint work with Fedaa Ibrahim. A cylinder  $C_u$  is the set of infinite words with fixed prefix  $u$ . A double-cylinder is "the same" for bi-infinite words. We show that for every word  $u$  and any substitution (or free group automorphism)  $\phi$  the image of  $C_u$  is a finite union of cylinders. The analogous statement is true for double cylinders. We give (a) an algorithm, and (b) a precise formula which allows one to determine this finite union of cylinders.  
 We then fix  $\phi$  and vary the word  $u$ . We show that up to the natural action of the free group on cylinders  $C_u$  there is only a finite collection of such finite unions that describe  $\phi(C_u)$ . The talk finishes with some natural questions about these elementary but so far little studied combinatorial invariants that are canonically associated with any  $\phi$  as above.
- Samuel Petite
  - Title: A representation of unimodular Pisot substitutions
  - Abstract: In a joint work with F. Durand, we prove that a substitutive dynamical system generated by an unimodular Pisot substitution on a finite alphabet is measurably conjugate to an exchange of domains in a self-similar compact subset of the Euclidean space. Our proof does not use the standard hypothesis on the substitution called "coincidence condition". This extends then seminal results of V. Canterini and A. Siegel. I propose to explain the proof by using Bratteli diagrams.
- Michael Schraudner
  - Title: Entropies realizable by block gluing  $\mathbb{Z}^d$  shifts of finite type
  - Abstract: Hochman-Meyerovitch gave a complete recursion theoretic characterization of the topological entropies appearing in  $\mathbb{Z}^d$  shifts of finite type (SFTs). Nevertheless their method of construction is quite rigid and yields only relatively degenerate  $\mathbb{Z}^d$  SFTs being a specific extension of a non-trivial zero-entropy subshift factor and lacking any strong mixing

property. In this talk we will give a necessary condition for a real number to be realizable as the topological entropy of a block gluing  $\mathbb{Z}^d$  SFT showing that only certain well-computable numbers may appear in the uniform mixing regime. Subsequently we will present a technique to realize a large class of those real numbers as entropies of block gluing  $\mathbb{Z}^d$  SFTs for any  $d > 2$ . As a corollary we obtain a result about the non-existence of equal-entropy  $\mathbb{Z}^d$  full-shift factors strengthening previous work of Boyle-Schraudner. The presented results are joint work with Ronnie Pavlov.

- Zoran Šunić

- Title: Self-similar groups: symbolic dynamics point of view
- Abstract: The notion of a self-similar group of rooted tree automorphisms and related notions can be rephrased in terms of symbolic dynamics on rooted trees. The circle of ideas relating the group theoretic and the symbolic points of view produces results such as the following: (1) A group of tree automorphisms is finitely constrained (it is a group tree shift of finite type) if and only if it is the topological closure of a (countable) group branching over a level stabilizer, (2) If  $G$  is a sofic group tree shift that contains a self-replicating subgroup acting level transitively on the tree, then  $G$  is finitely constrained (it is a group tree shift of finite type). Note that (1) is a characterization of group tree shifts of finite type in terms of the branching structure of its subgroups, and (2) is an application of (1) leading to a generalization of Kitchens' Theorem to the setting of group tree shifts.

- Meng Wu

- Title: Multi-fractal analysis of multiple ergodic averages, some attempts
- Abstract: Ergodic averages (simple) have been extensively studied from the point of view of multifractal analysis, based on a solid base (Birkhoff theorem, concept of entropy, Gibbs measures, variational principle). We propose to study two generalizations of the ergodic averages (simple): multiple ergodic averages and von Mises statistics from the point of view of multifractal analysis in the case of symbolic dynamics. The few results obtained show that these are challenges, especially the multiple ergodic averages. The results also show that the multifractal spectrum of entropy often present discontinuities, even for very regular potential