ABSTRACTS

NEW TRENDS IN HOLOMORPHIC DYNAMICS IN DIMENSION ONE AND HIGHER

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Institut Denis Poisson
Orléans, France

Mini-courses

Fabrizio Bianchi

Title: Applications of thermodynamic formalism in holomorphic dynamics

Abstract. Thermodynamic formalism connects dynamical systems with dimension theory, Teichmüller theory, mathematical physics, and counting problems. In holomorphic dynamics, these connections fit into the broader perspective of the Sullivan dictionary, relating periodic orbits, fine geometric properties of Julia sets, and ergodic properties of invariant measures.

This minicourse will present some applications of thermodynamic methods in the complex setting, from Ruelle's and McMullen's work on the variation of Hausdorff dimension and the Weil–Petersson type metrics on parameter spaces to Oh–Winter's results on the distribution of multipliers of periodic points and prime-orbit theorems. More generally, I will emphasize the role of pressure, zeta functions, and transfer operators in this circle of ideas.

Davoud Cheraghi

Title: The joint actions of the parabolic, and near-parabolic, renormalisation operators

Abstract. We look into the global dynamics of pairs of parabolic, and near-parabolic, renormalisation operators acting on an infinite dimensional class of maps. In particular, we establish the full renormalisation conjecture for the pair of near-parabolic renormalisation operators, including the existence of a horseshoe-like Cantor set, on which the joint operators act as a shift map on bi-infinite sequences on infinite alphabets, the existence of global co-dimension-1 stable manifolds, one dimensional unstable manifolds, etc. We also explain the compactness of the invariant Cantor set by parabolic maps arriving from a Cantor invariant set for the joint action of the parabolic renormalisations. This is based on a joint work with Mitsuhiro Shishikura.

The mini-course consists of three lectures. In lecture 1 we present the pair of top and bottom parabolic renormalisation, and the pair of their perturbations, tangential and peripheral renormalisation. We explain some of the difficulties involved in the study of these operators. In lecture 2 we discuss some applications of the tangential (top) near parabolic renormalisation scheme, including a toy model for the renormalisation. In lecture 3, we discuss the joint action of the pair of near parabolic renormalisations, and present the full renormalisation attractor. We also discuss some of the applications of the hyperbolicity, such as the universality of the scaling laws, and dichotomy of the satellite renormalisations. The latter is partly based on a joint work with Mohammad Pedramfar.

Giulio Tiozzo

Title: Random walks on isometry groups of hyperbolic spaces

Abstract. We present the theory of random walks on groups of isometries of (non-locally compact) hyperbolic metric spaces, with focus on the problems of convergence of random walks to the Gromov boundary and on the identification of the Poisson boundary.

We will discuss a few applications to holomorphic dynamics, in particular to the Cremona group. Most of the work is joint with J. Maher.

Talks

François Bacher

Title: Birational structures on Kato surfaces coming from Hénon maps

Abstract. Let f be a contracting superattracting germ of holomorphic maps in dimension 2. Under some conditions, one can compactify and desingularize the quotient by the dynamics of the basin of attraction of f into a Kato surface. Such maps giving rise to a Kato surface were completely classified by Favre in his thesis. In the case where f is the local restriction of a birational map, one obtains a birational structure on the Kato surface. Conversely, does any Kato surface admit such a birational structure?

I will discuss some cases for which it is known, along with uniqueness properties of the obtained birational structure in the case of Hénon maps. Also, if I am fast enough, I will present a strategy to show that it might be true for any Kato surface.

Romain Dujardin

Title: Multiplier rigidity for complex Hénon maps

Abstract. In a recent joint work with Serge Cantat, we investigate the multiplier rigidity problem for polynomial automorphisms of $\mathbb{C}^2$. A first result states that a complex Hénon map of given degree is determined up to finitely many choices by its multiplier spectrum, or more generally by the unstable multipliers of its saddle periodic points. This is the counterpart in this setting of a classical result of McMullen for one-dimensional rational maps.

For compositions of Hénon maps, the same rigidity holds provided the multi-degree and the multi-Jacobian are fixed. As in McMullen's theorem, this follows from the nonexistence of stable algebraic families in the corresponding parameter space. This in turn relies on precise asymptotic bounds for the Lyapunov exponents of the maximal entropy measure along diverging families.

Charles Favre

Title: Generalized rescaling limits of a sequence of rational maps

Abstract. Joint work with Chen Gong. We consider a sequence of complex rational maps (f_n) of a fixed degree $d \geq 2$. Building on the seminal work of Kiwi, we introduce the notion of generalized rescaling limits. These are rational maps, possibly defined over a non-Archimedean field, obtained by renormalizing at some scale a fixed iterate of the sequence (f_n).

We explain that the set of all generalized rescaling limits is naturally organized as a tree, and bound the size of this tree in terms of the degree d. We apply our theory to quadratic rational maps. Using Kiwi's classification, we describe all possible trees in this case, and prove a uniform bound on the number of cycles with small multipliers.

Chen Gong

Title: Non-Archimedean Rigidity and Uniformity

Abstract. Let k be a non-Archimedean field of residue characteristic zero. We prove a non-Archimedean rigidity theorem for Julia sets: if two polynomials of degree at least 2 over k have the same Julia set, and this Julia set is not a singleton, then the two polynomials are dynamically related.

As a consequence, we show that for any two complex polynomials f and g of degree at least 2, either their sets of preperiodic points coincide, or the number of their common preperiodic points is uniformly bounded above by a constant depending only on the degrees, thereby confirming a conjecture of DeMarco–Krieger–Ye in the polynomial setting. This is joint work with Jit Wu Yap.

Anna Jové Campabadal

Title: Lyapunov exponents for a family of tangent-like maps

Abstract. I will discuss the Lyapunov exponent associated with a model family of meromorphic (tangent-like) maps with respect to harmonic measure. I will address its integrability, positivity, and its dependence on parameters within the family. Some of the methods and results extend beyond this setting and apply more generally to simply connected attracting basins of meromorphic maps.

This is joint work in progress with Matthieu Astorg.

Lorena López Hernanz

Title: Logarithmic-power series solutions of vector fields in dimension two

Abstract. We are interested in the study of formal solutions of a vector field X in dimension 2. Camacho and Sad proved that X always has an invariant curve, which is analytic whenever X is. Cano gave an alternative proof of that result using the Newton–Puiseux polygon of X and proved that any side of the polygon satisfying a certain condition (which always holds for at least one side) provides a "starting term" of an invariant curve, which is again analytic whenever X is.

We extend Cano's result, showing that almost every side of the polygon provides a starting term of a solution, which in general is not given by a power series but rather by a logarithmic-power series (i.e. a series whose expansion includes powers and logarithms of the variable) and which in general is not analytic even when X is. We also discuss some possible applications of this result to the study of the local dynamics of tangent-to-the-identity diffeomorphisms.

This is joint work in progress with José Cano and Sergio Carrillo.

Hsueh-Yung Lin

Title: The MRC-dimension of motivic invariants of birational automorphisms

Abstract. Over a subfield $\mathbb{C}$, Blanc–Lamy–Zimmermann showed that $\mathrm{Bir}(\mathbb{P}^n)$ with $n \geq 3$ is not generated by de Jonquières maps (i.e. maps preserving a linear fibration in $\mathbb{P}^1$). Using motivic invariants of birational automorphisms, we show that $\mathrm{Bir}(\mathbb{P}^n)$ with $n \geq 4$ is not generated by maps preserving a conic bundle or a rational surface fibration structure.

Joint work with E. Shinder.

Carsten Lunde Petersen

Title: Q.c. homeomorphism between neighbourhoods of the roots of same period satellite copies — The power of Douady–Fatou coordinates

Abstract. Joint work with Luna Lomonaco.

The Mandelbrot set M contains little topological copies of itself, so-called renormalization copies, and hence copies in copies, etc. These come in two flavours: primitive copies and satellite copies. The first are readily recognized as having a cusp at the root, similarly to the Mandelbrot set itself. The latter derive their name from the root being a parabolic parameter, where a k-periodic orbit merges with another orbit whose period is qk for some $q \geq 2$.

The top-level (not inside any other strict copy) satellite renormalization copies have their root on the main cardioid of M, where a fixed point merges with a q-cycle. These are characterized by their rotation number

$$\lambda = \exp(2\pi ip/q), \qquad (p, q) = 1,$$

and are denoted $M_{p/q}$.

It was speculated for many years that all satellite copies $M_{p/q}$ were quasi-conformally homeomorphic. It turned out that having different periods is an obstruction to copies being q.c.-homeomorphic. In this talk I will outline why, for every pair p/q and p'/q, there is a q.c. homeomorphism from a neighbourhood of $M_{p/q}$ to a neighbourhood of $M_{p'/q}$.

I will emphasize how to construct such a homeomorphism between neighbourhoods of the roots. Our proof exploits Douady–Fatou coordinates, which are also the main tool in parabolic implosion.

Rohini Ramadas

Title: TBA

Abstract. TBA

Pascale Roesch

Title: Biggest bounded type Siegel disks of monic polynomials include those that stick to all critical points

Abstract. This is joint work with X. Buff and A. Chéritat.

We prove that for all degrees $d \geq 2$ and all bounded-type irrational numbers θ, in the space of monic polynomials having a fixed Siegel disk Δ of rotation number θ, the maximum locus of the conformal radius of Δ with respect to its fixed point contains polynomials having all critical points on the boundary of Δ.

We apply this result to reduce a conjecture of Douady (optimality of the Bruno condition) to a weaker statement.

Virgile Tapiero

Title: Normal forms and Lyapunov exponents of endomorphisms of $\mathbb{P}^k(\mathbb{C})$

Abstract. I will present some recent results on the Lyapunov exponents of the measure of maximal entropy μ of endomorphisms of $\mathbb{P}^k(\mathbb{C})$.

A fundamental result by J.-Y. Briend and J. Duval (1999) states that the Lyapunov exponents

$$\lambda_1 \geq \cdots \geq \lambda_k$$

of μ are always bounded below by $\log(d)/2$, where $d > 1$ is the degree of f.

Another fundamental result is that the minimality of all the Lyapunov exponents

$$\lambda_1 = \cdots = \lambda_k = \log(d)/2$$

is equivalent to $\mu \ll \omega_{FS}^k$. This was proved by several authors, including F. Ledrappier and A. Zdunik for $k = 1$ (1980s), and F. Berteloot, C. Dupont, and J.-J. Loeb for $k > 1$ (2000s).

The generalization of this result to the case where only some exponents are minimal, but not all of them, was explored later. In particular, R. Dujardin (2012) proved in dimension $k = 2$ that if

$$\mu \ll T \wedge \omega_{FS},$$

where T is the Green current of f, then the smallest exponent $\lambda_2 = \log(d)/2$ is minimal. He also raised the question of whether the converse holds.

I will present my own work on Lyapunov exponents, focusing on a new theorem (2025) that provides a positive answer to Dujardin's question. The theorem states that, in any dimension $k > 1$, for any $1 \leq r \leq k-1$, if the $k-r$ smallest exponents are minimal (and the others are not), then

$$\mu \ll T^r \wedge \omega_{FS}^{k-r}.$$

This result gives a positive answer to Dujardin's question by taking $r = 1$.

The proof relies on pluripotential theory, ergodic theory, and the use of normal forms for the dynamics.

Marco Vergamini

Title: Green currents of holomorphic correspondences

Abstract. Green currents are central objects in holomorphic dynamics. They appear naturally as limit objects for the iteration of submanifolds, and they allow for a precise measure-theoretical study of the dynamics, especially beyond dimension one.

In this talk, I will survey their construction and their main properties in various classical settings. I will then present recent results in the case of holomorphic correspondences of Kähler manifolds.

This talk is based on joint work with Muhan Luo.

Jit Wu Yap

Title: Uniform boundedness of torsion points for abelian varieties over function fields

Abstract. Let K be a function field of a curve B over $\mathbb{C}$ and let A/K be an abelian varietey with no constant part. The uniform boundedness conjecture predicts that the number of torsion points in $A(K)$ is bounded solely in terms of $\dim A$ and K. In this talk, I will explain a proof of the conjecture, emphasizing the dynamical and potential-theoretic ideas that are essential to the argument. This is joint work with Nicole Looper.

Short talks

Alonso Beaumont

Title: Centralisers of endomorphisms of the projective line

Abstract. We will discuss semigroups of endomorphisms of the projective line whose elements are strongly dynamically related. Since the work of Baker and Eremenko, we know that polynomials with a common Julia set form a semigroup that is "almost cyclic", with the exception of monomial and Chebyshev polynomials. Analogous assertions for rational functions remain conjectural.

In this direction, F. Pakovich proved that the centraliser $C(f)$ of an endomorphism f is finitely generated, with few exceptions. We will show that semigroups with a common set of periodic points are also finitely generated, and discuss further generalisations.

Sobir Boymurodov

Title: Measures of large entropy for holomorphic automorphisms of compact Kähler manifolds

Abstract. In this talk, we consider holomorphic automorphisms of compact Kähler manifolds. Under a natural cohomological assumption on the dynamical degrees, we prove that every ergodic measure with sufficiently large metric entropy is supported on the Julia set. This generalizes to this setting previous results obtained by de Thélin, Dinh, and Bazarbaev–Bianchi–Rakhimov in the case of endomorphisms of $\mathbb{P}^k$ and polynomial-like maps.

The proof relies on quantitative estimates for the speed of convergence towards the Green currents, with respect to a suitable norm on an adapted functional space of not necessarily closed currents.

This is joint work with Fabrizio Bianchi and Karim Rakhimov.

Tom Potthink

Title: Attracting Skew-Products and Fatou Components

Abstract. Classifying Fatou components in higher dimensions remains open, in contrast to the well-understood one-dimensional case. In this short talk I will introduce skew-products and the notion of bulging, which links the dynamics on a fibre to the full dynamics of the map.

I will focus on a recent result concerning orbitally unbounded Fatou components over an attracting fibre whose bulging depends sensitively on perturbations of the fibre dynamics.

Alexandre Roy

Title: On the hybrid compactification of M_d

Abstract. Let Rat_d be the space of rational functions of degree d and M_d its quotient by the action of SL_2. We will present a compactification of M_d called the hybrid compactification, based on J. Poineau's construction.

We will discuss some of its dynamical properties and show that this compactification is naturally homeomorphic to the quotient of the hybrid compactification of Rat_d by the action of SL_2.

Yugang Zhang

Title: Equilibrium measure rigidity of regular polynomial endomorphisms and applications

Abstract. To a polynomial of one complex variable, one can associate a unique invariant probability measure of maximal entropy, introduced by Brolin, Lyubich, and Freire–Lopes–Mañé. This measure encodes a great deal of dynamical information about the polynomial.

Conversely, Beardon showed that if two polynomials have the same equilibrium measure, then they differ by an affine transformation that preserves the measure.

I will present these results, as well as their generalization to higher dimensions and some applications.
