

**Name :** Renaud Leplaideur

**Profession :** Maître de Conférences (HC) at the Université de Bretagne Occidentale, France.

1er Septembre 2017, Maître de Conférences (HC) at the Université de Nouvelle Calédonie

**Nationality :** French

47, M.

### Education and Professional History

- Student at École Normale Supérieure de Cachan.
- 1994-1997 : PdD, University Paris-Sud XI, Advisors : Ph. Thieullen and Y-C. Yoccoz.
- 1998-2001 Maître de Conférences at the Université de Bretagne Sud (Vannes-Lorient, France).
- Since 2001 Maître de Conférences at the Université de Bretagne Occidentale (Brest-France).
- October 2008 Habilitation thesis at Université de Bretagne Occidentale.

**Research area.** I work in mathematics in the topic of Dynamical Systems and smooth Ergodic Theory. A dynamical system is given by a space  $X$  and a map  $f$  acting on  $X$ . The goal is to describe trajectories of points under the action of  $f$ . It turns out that it is usually difficult to describe all the trajectories, but possible to describe almost all of them.

Part of my research consisted of producing for hyperbolic dynamical systems, good invariant measures, which give sense to *almost all trajectories*. Given a “potential”  $\phi$ , we characterize the measures which realize the maximum in a variational principle. These “good” measures are *equilibrium states* associated to the potential  $\phi$  and the maximized quantity is the *pressure*  $\mathcal{P}(\phi)$ .

Since 2004, I am concentrating my researches on ergodic optimization, and more specially on the problem of selection at zero temperature : one studies the limit or the accumulation points for the equilibrium state for the one-parameter family of potentials  $\beta \cdot \phi$  as  $\beta \rightarrow +\infty$ . These accumulations points are called *ground states* in Statistical Mechanics.

I was thus naturally led to study freezing phase transitions, that is when the pressure is eventually affine. This means that the ground state is reached at positive temperature. Therefore the question of why do phase transition arise, or what kind of potentials generate phase transitions naturally arise.

### Most important invitations to present at scientific conferences.

1. The Second Palis-Balzan International Symposium on Dynamical Systems, June 2013 Paris.
2. Advanced course at 29° Colóquio Brasileiro de Matemática IMPA, Rio de Janeiro, July 2013.
3. ICTP-ESF School and Conference in Dynamical Systems June 2012.
4. Jacob Palis 70th birthday conference, March 2010.
5. Bicentennial workshop on dynamical systems Chile, may 2010.

### Most important research projects funded

1. Scientific coordinator for FP7 IRSES DynEurBraz 2009-2012, which involves about 280 months-missions between CNRS, UBO, Imperial, Warwick, Pisa in one hand and IMPA, UFF, UFRJ, UFAL, UFRGS, Unicamp in the other hand. Total budget around 450 k €.
2. Since January 2013 : french coordinator for BREUDS (FP7-People-IRSES) renewal of DynEurBraz.
3. Capes-Cofecub ma762-13 TPTZ between France and Brazil. It involves exchanges of 2 researchers per year and for both sides. 2013-2016.
4. International conference and summer school (CNRS) Dynamique en Cornouaille, June 2011, at Fouesnant (Brittany). budget around 35 k €.
5. Member of several past Capes-Cofecub programs and ANR programs.

### Key international cooperation partners

1. D. Yang University of Soochow, China.
2. H. Bruin, University of Vienna, Austria.
3. A. Baraviara & A.O. Lopes, UFRGS, Porto Alegre, Brazil.
4. I. Rios, UFF, Niteroi Brazil.

### Organization of conferences

1. Ouessant meeting ANR DynNonHyp December 2010.
2. Fouesnant, Dynamique en Cornouaille, June 2011.
3. Ouessant, meeting ANR DynNonHyp December 2012.
4. CIMPA school on Dynamical systems in Katmendou November 2014.

### Publications. Total number (published or accepted) : 24

1. Existence d'une mesure de Sinai-Ruelle-Bowen pour des systèmes non uniformément hyperboliques. *C. R. Acad. Sci. Paris Sér. I Math.*, 326(10) :1217–1220, 1998.
2. Local product structure for equilibrium states. *Trans. Amer. Math. Soc.*, 352(4) :1889–1912, 2000.
3. Existence of *SRB*-measures for some topologically hyperbolic diffeomorphisms. *Ergod. Th. & Dynam. Sys.*, 24, 2004.
4. A dynamical proof for the convergence of Gibbs measures at temperature zero. *Nonlinearity*, 18(6) :2847–2880, 2005.
5. Fluctuations of the  $N$ th return time for Axiom A diffeomorphisms. With J.-R. Chazottes. *Discrete Contin. Dyn. Syst.*, 13(2) :399–411, 2005.
6. Invariant manifolds and equilibrium states for non-uniformly hyperbolic horseshoes. With I. Rios. *Nonlinearity*, 19(11) :2667–2694, 2006.
7. Large deviation for return times in non-rectangle sets for axiom A diffeomorphisms. With B. Saussol. *Discrete Contin. Dynam. Systems*, 22(1& 2) :327–344, 2008.

8. On the  $t$ -conformal measures and Hausdorff dimension for a family of non-uniformly hyperbolic horse shoe. With Isabel Rios. *Ergodic Theory Dynam. Systems* (2009), 29, 1917–1950.
9. Totally dissipative measures for the shift and conformal  $\sigma$ -finite measures for the stable holonomies. *Bull. Braz. Math. Soc. (N.S.)*, 41 (2010), no. 1, 1–36.
10. Selection of measures for a potential with two maxima at the zero temperature limit. With A. Baraviera, and A.O. Lopes. *SIAM J. Appl. Dyn. Syst.* 11, pp. 243–260.
11. Equilibrium States for partially hyperbolic horseshoes. With Krerley Oliveira & Isabel Rios. *Ergod. Th. & Dynam. Sys.* (2011), 31, 179–195 .
12. Thermodynamic formalism for a family of non-uniformly hyperbolic horseshoes and the unstable Jacobian. *Ergod. Th. & Dynam. Sys.* (2011) Volume 31, Issue 02, pp 423 - 447.
13. Central Limit theorem for dimension of Gibbs measures for skew expanding maps. With Benoît Saussol. *Stoch. & Dynam.* Volume : 12, Issue : 2(2012).
14. Flatness is a criterion for selection of maximizing measures, *Journal of Statistical Physics*, 2012, Volume 147, Number 4, pp. 728-757.
15. Renormalization for Manneville-Pomeau maps : the potential point of view. With A. Baraviera, and A.O. Lopes. *Stoch. & Dynam.* Volume : 12, Issue : 4(2012).
16. Renormalization, thermodynamic formalism for quasi-crystals in subshifts. With H. Bruin. *Commun. Math. Phys.* **231** (2013), 209–247.
17. *Ergodic optimization, zero temperature limits and the Max-Plus algebra*. With A. Baraviera, and A. Lopes. Book for conference at IMPA 2013. ISBN = 978-85-244-0356-9.
18. About Phase transition and Zero Temperature, Selected papers, Proceedings of 6th World Conference on 21st Century Mathematics 2013.
19. From local to global equilibrium states : thermodynamic formalism via an inducing scheme. *To appear in Elec. Resear Announc.* . Vol. 21 (2014).
20. With H. Bruin, Renormalization, freezing phase transition and Fibonacci quasi-crystals. *Annales scientifiques de l'ENS* 48, fascicule 3 (2015), 739-763.
21. With J.F. Alves, SRB measures for almost Axiom A diffeomorphisms. *Ergodic Theory Dynam. Systems* 36 (2016), no. 7, 2015–2043.
22. Chaos : butterflies can also generate phase transition. *J. Stat. Phys.* 161 (2015), no. 1, 151–170.
23. With I. Rios. One explicit example of non-uniformly hyperbolic diffeomorphism, Kupka-Smale and at the border of the uniformly hyperbolic ones. Accepted at *NonLinearity*.
24. With D. Yang. SRB measure for higher dimensional singular partially hyperbolic flows. Accepted at *Annales de l'Institut Fourier*.

### Submitted preprint

1. N. Bedaride, P. Hubert & R. Leplaideur Thermodynamic formalism and substitutions.
2. R. Leplaideur & F. Watbled, Easy Ising.

## Works in Progress

1. R. Leplaideur & R. Ruggiero, Transitions de phases type Manneville-Pomeau pour des flots géodésiques sur des surfaces à courbure négative s'annulant sur une géodésique fermée.
2. R. Leplaideur & D. Yang, Mélange pour les attracteurs quasi-hyperboliques en dimension 3.
3. R. Leplaideur & J.Mengue, Sélections des mesures maximisantes.
4. A. Baraviera & R. Leplaideur , Renormalisations, substitutions et transitions de phases congelantes pour des arbres.
5. R. Leplaideur & F. Watbled, Easy Ising II.

## 10 most important publications. Chronological order.

1. Local product structure for equilibrium states. *Trans. Amer. Math. Soc.*, 352(4) :1889–1912, 2000.
2. A dynamical proof for the convergence of Gibbs measures at temperature zero. *Nonlinearity*, 18(6) :2847–2880, 2005.
3. On the  $t$ -conformal measures and Hausdorff dimension for a family of non-uniformly hyperbolic horse shoe. With Isabel Rios. *Ergodic Theory Dynam. Systems* (2009), 29, 1917–1950.
4. Thermodynamic formalism for a family of non-uniformly hyperbolic horseshoes and the unstable Jacobian. *Ergod. Th. & Dynam. Sys.* (2011) Volume 31, Issue 02, pp 423 - 447.
5. Central Limit theorem for dimension of Gibbs measures for skew expanding maps. With Benoît Saussol. *Stoch. & Dynam.* Volume : 12, Issue : 2(2012).
6. Flatness is a criterion for selection of maximizing measures, *Journal of Statistical Physics*, 2012, Volume 147, Number 4, pp. 728-757.
7. Renormalization for Manneville-Pomeau maps : the potential point of view. With A. Baraviera, and A.O. Lopes. *Stoch. & Dynam.* Volume : 12, Issue : 4(2012).
8. Renormalization, thermodynamic formalism for quasi-crystals in subshifts. With H. Bruin. *Commun. Math. Phys.* **231** (2013), 209–247. *Introduction to selection of measures.* With A. Baraviera, and A. Lopes. Book for conference at IMPA 2013. ISBN = 978-85-244-0356-9.
9. With H. Bruin, Renormalization, freezing phase transition and Fibonacci quasi-crystals , *Annales scientifiques de l'ENS* 48, fascicule 3 (2015), 739-763 .
10. R. Leplaideur, D. Yang SRB measure for higher dimensional singular partially hyperbolic flows. Accepted at *Annales de l'Institut Fourier*.

## Other publications .

1. *Structure locale produit de mesures hyperboliques.* Thèse de doctorat, Université Paris-Sud, 1997.
2. *Formalisme thermodynamique pour des systèmes dynamiques hyperboliques. Mesures de Gibbs et mesures optimisantes..* Habilitation à Diriger des Recherches, Université de Brest, 2008.

**Invitations abroad**

1. Brazil (UFF-IMPA-UFBA-UFAL-UFRGS) around 11 months during the last 4 years.
2. Chile PUC Santiago march 09 january 12 and 13.
3. England April-May 2010 London-Warwick-Guildford.
4. China Suzhou October 2012 April 2015 and 2017
5. Japan, Kyoto University June 2017.
6. Pakistan Lahore ASSMS February 2014 and October 2015.

**Students**

1. Edgardo Perez, at Univ Sao Paulo, with Rodrigo Bissacot. Defended in 2016.
2. Shamsa Ishaq at ASSMS Pakistan Lahore. Still in progress.