

Anton Bovier



Academic career

1986	PhD, ETH Zürich, Switzerland
1986 - 1988	Irvine Visiting Assistant Professor, University of California, Irvine, CA, USA
1988 - 1991	Researcher, University of Bonn
1991 - 1992	Researcher, University of Bochum
1992 - 1995	Deputy Head, RG Interacting Random Systems, Weierstrass Institute for Applied Analysis and Stochastics, Berlin
1995 - 2008	Head, RG Interacting Random Systems, Weierstrass Institute for Applied Analysis and Stochastics, Berlin
1995	Habilitation, TU Berlin
2003 - 2008	Professor (C4), TU Berlin
Since 2008	Professor (W3), University of Bonn

Honours

2008 - 2012	Member of the Review Board for Mathematics, German Research Council
2008 - 2014	Member of the Selection Committee, Minerva Foundation
2009	Eurandom Chair, Technical University of Eindhoven, Netherlands
2010	Lady Davies Visiting Professor, Technion, Haifa, Israel
2012	Kloosterman Chair, Leiden University, Netherlands
2013	Elected Fellow, Institute of Mathematical Statistics
2014 - 2016	Member of the Award Committee for the "Heinz Maier Leibnitz Prize" of the German Research Foundation (DFG)
2015 - 2017	IMS Committee on Fellows

Offers

2002	Professor, University of Groningen, Netherlands
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Invited Lectures

2006	Invited talk, International Congress of Mathematicians, Madrid, Spain
2010	Plenary talk, Annual meeting of German Mathematical Society, Munich
2014	Plenary talk, 37th Conference on Stochastic Processes and their Applications, Buenos Aires, Argentina

Research Projects and Activities

DFG Priority Program SPP 1590 "Probabilistic structures in evolution"
Project leader, since 2012

DFG Collaborative Research Center CRC 1060 "The Mathematics of Emergent Effects"
Project leader, since 2013

DFG Cluster of Excellence "ImmunoSensation"
Principal Investigator, since 2014

DFG Cluster of Excellence "Hausdorff Center for Mathematics"
Principal Investigator, since 2014

Research profile

My research focuses on probability theory and its applications in physics and biology. A major topic I have been working on is the statistical mechanics of disordered systems, both from the

equilibrium and the dynamical point of view. This requires in particular the analysis of the structure of the extreme values of the underlying random fields. The recent book [3] reviews a large body of work with various co-authors where we answered such questions in the context of certain Gaussian processes, in particular branching Brownian motion. A second topic is the theory of metastability, a common and important phenomenon occurring in non-linear stochastic dynamics. We developed a new approach to the analysis of metastability, the so-called potential theoretic approach. The theory and numerous applications are presented and summarised in a recent monograph with Frank den Hollander [1].

In the coming years I plan to shift the focus of my interest more on problems from the life sciences. We have already started to work on a class of interacting spatial branching processes in inhomogeneous environments that are motivated by the biological theory of adaptive dynamics, that attempts to describe the qualitative features of evolving biological populations.

A major result we obtained recently with Martina Baar and Nicolas Champagnat [5] is the derivation of the so-called canonical equation of adaptive dynamics in a joint limit of large populations, small mutation rates, and small mutation steps. Using similar models, we have also initiated a collaboration with oncologists on the modelling of the evolution of cancer under treatment [6]. This poses numerous challenging problems both with respect to modelling, and the mathematical analysis of these models.

Editorships

- Journal of Statistical Physics (Editorial Board, 1996 - 1999)
- Markov Processes and Related Fields (Editorial Board, since 1996)
- Electronic Journal of Probability (Editorial Board, 2006 - 2014)
- Electronic Communications in Probability (Editorial Board, 2006 - 2014, Chief Editor, 2012 - 2014)
- Annales Henri Poincaré (Editorial Board, since 2012)
- ALEA, Brazilian Journal of Probability (Editorial Board, since 2013)

Research Area G A focal point of research is the analysis of extremal structures of random processes, in particular branching Brownian motion (BBM) and its variants. The main results here were the identification of the full extremal process for standard (BBM) [10, 4] and for variable speed BBM in the low correlation regime [7]. These results are motivated by and relevant for our understanding of equilibrium and dynamic properties of disordered systems such as spin glasses.

In another line of work we studied scaling limits for interacting special branching process that arise in modelling of the evolution of biological populations, in biology described as adaptive dynamics. A major achievement here was the rigorous derivation of the so-called canonical equation of adaptive dynamics in a simultaneous limit of large population, small mutation rate and small mutation steps [5]. Similar models were also used in cooperation with experimental partners to model processes occurring in immunotherapy of cancer [6].

Research Area H

Research Area B

Supervised theses

Master theses: 14

Diplom theses: 18

PhD theses: 17, currently 3

Selected PhD students

Véronique Gayrard (1992),
now Directeur de Recherche, CNRS, Marseille, France

Christof Külske (1993): “Renormierungsgruppenanalyse zur Untersuchung der Stabilität von Oberflächen in ungeordneten Medien”,
now Professor, University of Bochum

Anton Klimovsky (2008): “Sums of Correlated Exponentials: Two Types of Gaussian Correlation Structures”,

now Lecturer, University of Duisburg-Essen

Martin Slowik (2012): “Contributions to the Potential Theoretic Approach to Metastability with Applications to the Random Field Curie-Weiss-Potts Model”,

now Researcher, TU Berlin

Giacomo di Gesù (2013): “Semiclassical spectral analysis of discrete Witten Laplacians”,

now École Nationale des Ponts et Chaussées, Paris, Champs-sur-Marne, France

Adela Svejda (2014): “Contributions to the study of ageing in disordered systems”,

now Raiffeisenbank, Zürich, Switzerland

Hannah Mayer (2016): “Contributions to Stochastic Modelling in the Immune System”,

now Researcher, Bayer Research, Wuppertal

Patrick Müller (2016): “Hydrodynamic Limit, Propagation of Chaos, Energy Landscape and Large Deviations”,

now Boston Consulting

Lisa Hartung (2016): “Brownian motion and friends”,

now Courant Instructor, New York University, NY, USA

Martina Baar (2017): “Stochastic, individual-based models and macroscopic approximations for adaptive dynamics with applications in cancer immunotherapy”,

now Postdoc, University of Bonn

Rebecca Ströfer (2017): “The fate of a recessive allele in a Mendelian diploid Model”

Habilitations

Véronique Gayraud (2000), now Directeur de Recherche, CNRS, Marseille, France

Christof Külske (2001), now Professor, University of Bochum

Barbara Gentz (2003), now Professor, University of Bielefeld

Irina Kourkova (2004), now Professor, University of Paris VI, France

Selected publications

- [1] Anton Bovier and Frank den Hollander. *Metastability*, volume 351 of *Grundlehren der Mathematischen Wissenschaften [Fundamental Principles of Mathematical Sciences]*. Springer, Cham, 2015. A potential-theoretic approach.
- [2] Anton Bovier. *Statistical mechanics of disordered systems*, volume 18 of *Cambridge Series in Statistical and Probabilistic Mathematics*. Cambridge University Press, Cambridge, 2006. A mathematical perspective.
- [3] Anton Bovier. *Gaussian processes on trees*, volume 163 of *Cambridge Studies in Advanced Mathematics*. Cambridge University Press, Cambridge, 2017. From spin glasses to branching Brownian motion.
- [4] Anton Bovier and Lisa Hartung. Extended convergence of the extremal process of branching brownian motion. *Ann. Appl. Probab.*, 27(3):1756–1777, 2017.
- [5] Martina Baar, Anton Bovier, and Nicolas Champagnat. From stochastic, individual-based models to the canonical equation of adaptive dynamics in one step. *Ann. Appl. Probab.*, 27(2):1093–1170, 2017.
- [6] Martina Baar, Anton Bovier, Loren Coquille, Michael Hölzel, Hannah Mayer, Meri Rogava, and Thomas Tüting. A stochastic model for immunotherapy of cancer. *Scientific Reports*, 6:24169, 4 2016.
- [7] Anton Bovier and Lisa Hartung. Variable speed branching brownian motion 1. extremal processes in the weak correlation regime. *ALEA Lat. Am. J. Probab. Math. Stat.*, 12(1):261–291, 2015.
- [8] Anton Bovier, Michael Hölzel, and Thomas Tüting. Plasticity of tumour and immune cells: a source of heterogeneity and a cause for therapy resistance? *Nat. Rev. Cancer*, 13(5):365–376, 5 2013.
- [9] Anton Bovier and V'eronique Gayraud. Convergence of clock processes in random environments and ageing in the p-spin sk model. *Ann. Probab.*, 41(2):817–847, 2013.
- [10] Louis-Pierre Arguin, Anton Bovier, and Nicola Kistler. The extremal process of branching brownian motion. *Probab. Theory Related Fields*, 157(3-4):535–574, 2013.