Patrik Ferrari

Academic career

2001	Diploma in Physics, EPF Lausanne, Switzerland
2004	Dr. rer. nat., TU Munich
2004 - 2006	Postdoc, TU Munich
2006 - 2008	Research Position, Weierstrass Institute for Applied Analysis and Stochastics, Berlin
2008 - 2009	Akademischer Oberrat, University of Bonn
Since 2009	Professor (W2), University of Bonn

Honours

2001	Award for the second best general exams average of the complete academic program at EPFL (over all departments)
2004	Distinction "Summa Cum Laude" for the PhD thesis
2009	Heinz Maier-Leibnitz Prize 2009 of the German Research Foundation (DFG)
2018	Alexanderson Award from the American Institute of Mathematics (AIM)

Offers

2008	Professor (W2), University of Bochum
2008	Professor (W2), University of Bonn
2011	Professor (W3), University of Leipzig

Invited Lectures

2008	Lecture of 11.5h on Random Matrices and Related Problems at the Beg Rohu Summer School in Bretagne, France
2009	Minicourse of 4h on Dimers and orthogonal polynomials: connections with random matrices at the Workshop Dimer models and random tilings, Institut Henri Poincaré, Paris, France
2011	Short lecture of 6h on Random Matrices and Interacting Particle Systems at the Finnish Center of Excellence in Analysis and Dynamics Research, Helsinki, Finland
2013	Minicourse at the School/Workshop "Random Matrices and Growth Models", ICTP, Trieste, Italy
2013	Advanced course at the Alea in Europe School, Marseille, France

Research Projects and Activities

DFG Collaborative Research Center SFB 611 "Singular Phenomena and Scaling in Mathematical Models"
Principal Investigator of Project A12 "Universality of fluctuations in mathematical models of physics"
DFG Collaborative Research Center SFB 1060 "The Mathematics of Emergent Effects"
Principal Investigator of Project B04 "Random matrices and random surfaces"

Research profile

The KPZ universality class of stochastic growth models in 1+1 dimensions consists in models with the same physical properties of the KPZ equation. Through the Feynman-Kac representation one sees that the KPZ class includes equilibrium models as directed random polymers as well. The study of special models with a determinantal structure allowed to determine the (conjectural universal) limit processes that describes the fluctuations of interfaces for KPZ models (see e.g. [9, 10, 11, 12]). Along special space-time lines, correlations decay much more slowly

than along spatial directions [8]. This property can be used to study decoupling around shocks [5]. In the last few years the number of solvable models has been extended beyond the class with determinantal correlations, leading to a number of results in agreement with the universality conjecture. For these new models, results are so-far available for one-point distributions. This is the case for the semi-discrete directed polymer [6], from which results on the distribution function of the solution of the KPZ equations are obtained [4, 6].
Nevertheless, showing universality beyond integrability is still a big challenge and results are not as strong as in random matrix theory. The integrable models are an important starting point, as they could be used for perturbation theory, involving renormalization techniques. Further, if one proves universality using probabilistic argument also for non-integrable models, the identification of the limit processes goes through the solution of the integrable models. One of the major open question (regardless of the model under consideration, i.e., even for models with determinantal structure at fixed time), is the precise description of the limiting process for the time-time correlations.

Editorships

- Annals of Applied Probability (since 2013)
- Mathematical Physics, Analysis and Geometry (since 2013)
- Electronic Journal of Probability / Electronic Communications in Probability (since 2018)

Research Area G My research deals with stochastic models of interacting particle systems

and study random variables like the integrated current, which can be seen as height functions of a growing interface with stochastic dynamics. We determined the large time limit processes in the context of the exclusion process [11, 10, 9] and the space-time covariance [12]. For models like directed polymers at positive temperature, the random variable to be studied is the free energy [6]. The system under consideration are often discrete, but in the large time limit the fluctuation laws becomes universal. The same laws arise in the KPZ equation, which is a singular equation. Some of the models with a tunable parameter governing the asymmetry of the dynamics, can even be scaled directly to converge to the KPZ equation [4]. Recently we studied also time-time correlations [3], random but not stationary initial conditions [2], the space-time covariance structure [**?**] of a 2+1 dimensional model in the anisotropic KPZ class [7], and finally showed universality for flat initial conditions [1].

Supervised theses

Master theses: 15, currently 1
Diplom theses: 8
PhD theses: 2, currently 1

Selected PhD students

René Frings (2014): “Interlacing Patterns in Exclusion Processes and Random Matrices”
Peter Nejjar (2015): “Shock Fluctuations in KPZ Growth Models”,
now Postdoc, Institute of Science and Technology, Austria

Selected publications

[1] P.L. Ferrari and A. Occelli. Universality of the goe tracy-widom distribution for tasep with arbitrary particle density. *preprint, arXiv:1704.01291*, 2017.

[2] S. Chhita, P.L. Ferrari, and H. Spohn. Limit distributions for kpz growth models with spatially homogeneous random initial conditions. *preprint: arXiv:1611.06690; To appear in Ann. Appl. Probab.*, 2016.

[3] Patrik L. Ferrari and Herbert Spohn. On time correlations for kpz growth in one dimension. *SIGMA Symmetry Integrability Geom. Methods Appl.*, 12:Paper No. 074, 23, 2016.

[4] Alexei Borodin, Ivan Corwin, Patrik Ferrari, and B’alint Vetö. Height fluctuations for the stationary kpz equation. *Math. Phys. Anal. Geom.*, 18(1):Art. 20, 95, 2015.

[5] Patrik L. Ferrari and Peter Nejjar. Anomalous shock fluctuations in tasep and last passage percolation models. *Probab. Theory Related Fields*, 161(1-2):61–109, 2015.

[6] Alexei Borodin, Ivan Corwin, and Patrik Ferrari. Free energy fluctuations for directed polymers in random media in 1+1 dimension. *Comm. Pure Appl. Math.*, 67(7):1129–1214, 2014.

[7] Alexei Borodin and Patrik L. Ferrari. Anisotropic growth of random surfaces in 2+1 dimensions. *Comm. Math. Phys.*, 325(2):603–684, 2014.

[8] Ivan Corwin, Patrik L. Ferrari, and Sandrine P'ech'e. Universality of slow decorrelation in kpz growth. *Ann. Inst. Henri Poincar'e Probab. Stat.*, 48(1):134–150, 2012.

[9] Jinho Baik, Patrik L. Ferrari, and Sandrine P'ech'e. Limit process of stationary tasep near the characteristic line. *Comm. Pure Appl. Math.*, 63(8):1017–1070, 2010.

[10] Alexei Borodin, Patrik L. Ferrari, and Tomohiro Sasamoto. Transition between $\mathrm{A}iry_1$ and $\mathrm{A}iry_2$ processes and tasep fluctuations. *Comm. Pure Appl. Math.*, 61(11):1603–1629, 2008.

[11] Alexei Borodin, Patrik L. Ferrari, Michael Prähofer, and Tomohiro Sasamoto. Fluctuation properties of the tasep with periodic initial configuration. *J. Stat. Phys.*, 129(5-6):1055–1080, 2007.

[12] Patrik L. Ferrari and Herbert Spohn. Scaling limit for the space-time covariance of the stationary totally asymmetric simple exclusion process. *Comm. Math. Phys.*, 265(1):1–44, 2006.

[13] Patrik L. Ferrari and Herbert Spohn. Step fluctuations for a faceted crystal. *J. Statist. Phys.*, 113(1-2):1–46, 2003.