



# EPS SNPD Prize Award Session

**Wednesday 6 September 2017**

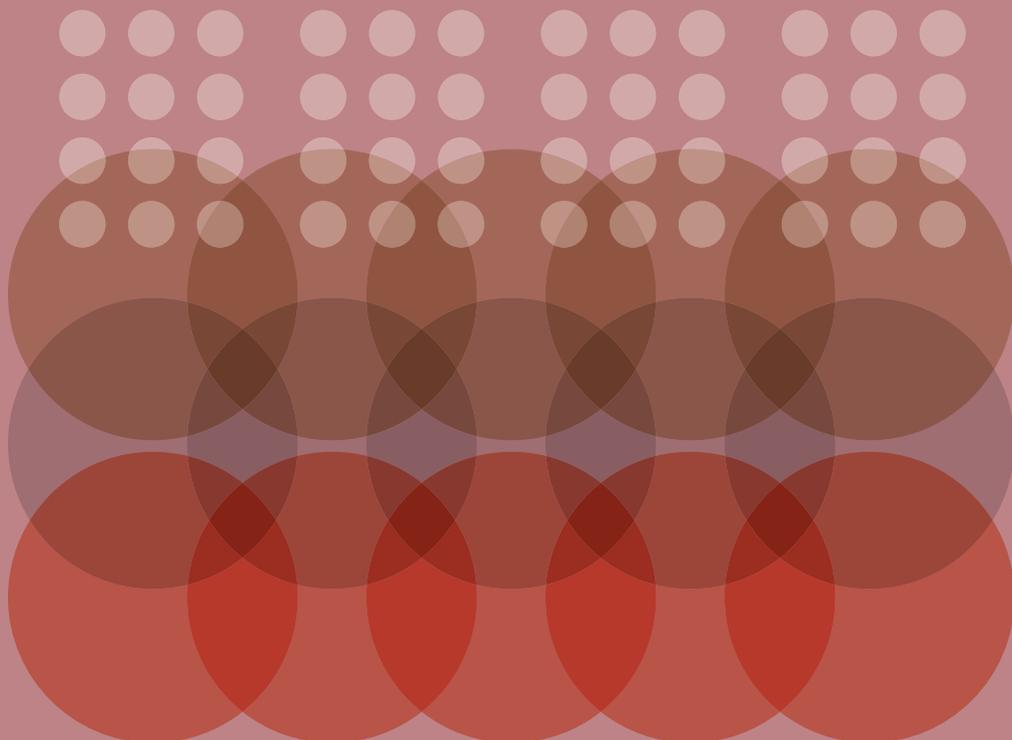
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14:00–14:05

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### EPS SNPD Prize Award to Peter Grassberger and Itamar Procaccia

Christian Beck (chairman of EPS SNPD)

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14:05–14:35

### Prize-winner talk: Peter Grassberger

*“For his seminal contributions to nonlinear physics, in particular for the development of the Grassberger–Procaccia algorithm to analyse nonlinear chaotic time series, and the development of highly innovative numerical simulation techniques for complex phenomena such as directed percolation, the dynamics of chain polymers, epidemic spreading, and transient chaos.”*



Peter Grassberger got his PhD in theoretical high-energy physics at the University of Vienna in 1965. In the early 1970s he switched his research area from high-energy physics (bound-state scattering theory) to statistical physics and nonlinear dynamics, where he made his best-known research contributions. After temporary positions in Kabul, Bonn, Geneva (CERN) and Nice he became a professor at the University of Wuppertal in 1977. During 1996–2005, while on leave of absence from Wuppertal, he was the head of the complex-system research group, Forschungszentrum Jülich. During 2006–2012 he was at the University of Calgary.

Peter Grassberger’s most-known breakthrough is the characterization of the fractal structure of attractors in dynamical systems, of their entropies and generalized dimensions including the famous method for the calculation of the correlation dimension (joint work with Procaccia). But he has also made pioneering contributions in many other fields, such as studies of the critical properties of percolation, epidemic spreading and self-organized criticality. In particular, he was the first who realized the equivalence of these types of generalized random walk models with Reggeon field theory. In the area of chaotic dynamics, he developed novel approaches for the quantitative characterization of complex phenomena, such as the Kantz–Grassberger formula for transient chaos and symbolic dynamics techniques for non-hyperbolic systems. He is a world-leading expert in advanced numerical methods and highly innovative simulation techniques for a variety of complex systems in equilibrium and non-equilibrium statistical physics, including the dynamics of chain polymers and protein folding.



14:35–15:05

**Prize-winner talk:** Itamar Procaccia

*“For his seminal contributions to nonlinear physics, in particular for the development of the Grassberger–Procaccia algorithm to analyse nonlinear chaotic time series, and the development of powerful theoretical approaches to describe complex phenomena such as multifractals, diffusion-limited aggregation, anisotropic turbulence and drag reduction in turbulent flows.”*



Since his doctoral thesis, Itamar Procaccia has held a highly visible position at the frontiers of research in nonlinear and statistical physics. He gained his PhD in theoretical chemistry at the Hebrew University, Jerusalem, in 1976, followed by a postdoctoral position at MIT (1977–1979), a position at the Weizmann Institute (Rehovot), and a visiting professorship in Chicago 1984–1985, where he wrote his famous paper on  $f(\alpha)$  spectra jointly with Kadanoff and others. He became a full professor at the Weizmann Institute in 1985 and has been head of the department of chemistry and dean of the faculty for a long time. Itamar Procaccia obtained many prizes and recognitions during his career and has educated more than 130 PhD students and postdocs. Currently, he is chair of the IUPAP C3 Commission.

Itamar Procaccia's early research breakthrough in the 1980s was the Grassberger–Procaccia algorithm for the characterization of chaotic attractors and the estimation of the correlation dimension and other dynamical quantities. He made seminal contributions to the understanding of fractal structures and their scaling properties, and took an eminent part in the early development of the theory of multifractals and of multifractal spectra, with particular applications to fractal measures at the onset of chaos and to the case of diffusion limited aggregation. Later he concentrated on the physics of turbulent flows, where his seminal work has significantly improved our understanding of the anisotropy of small-scale fluctuations, of the anomalous scaling exponents observed, as well as the drag reduction in turbulent flows by addition of a small concentration of polymers. During the last decade he made further important contributions to the statistical physics and mechanical properties of amorphous solids.

15:05–15:10

**EPS SNPD Early Career Prize Award to Laura Foini and Edgar Roldan**

Christian Beck (early career prizes co-sponsored by EPS-SNPD and EPL)



## EPS SNPD Prize Award Session

15:10–15:40

**Prize-winner talk:** Laura Foini

*“For her outstanding research contributions in the field of glassy systems and nonequilibrium dynamics of isolated quantum systems.”*



Laura Foini obtained her PhD in October 2011 at the International School of Advanced Studies (SISSA) in Trieste under the supervision of Andrea Gambassi and Francesco Zamponi. She was then a postdoc at the University Pierre et Marie Curie in Paris and the University of Geneva. Currently she is at the Laboratoire de Physique Statistique at ENS Paris, in the group of Florent Krzakala. Her research activities span different directions in statistical physics where non-equilibrium effects and metastable states crucially determine the properties of the system. Exploiting ideas coming from statistical physics, she has made highly important contributions to the understanding of quantum annealing on the one hand, and the dynamics of quantum integrable systems on the other. For the latter problem, she found a very powerful relation between the effective temperature of the generalized frequency-dependent fluctuation-dissipation theorem and the ones of the generalized-Gibbs ensemble.

15:40–16:10

**Prize-winner talk:** Edgar Roldan

*“For his outstanding research contributions at the interface of stochastic thermodynamics and biophysics.”*



Edgar Roldan received his PhD from the Universidad Complutense de Madrid and GISC (Madrid, Spain) in 2013. His thesis entitled ‘Irreversibility and dissipation in microscopic systems’ was supervised by Juan M R Parrondo, and was awarded a Springer Theses Prize in 2014. After a short stay as a postdoc at ICFO (Barcelona) in 2014, he joined the group of Frank Jülicher at the Max Planck Institute for the Physics of Complex Systems (MPIPKS, Dresden, Germany) as a guest scientist in 2014, working at the interface between biophysics and stochastic thermodynamics. In 2017 he was appointed as a distinguished PKS postdoctoral fellow at the MPIPKS Dresden.

Edgar Roldan’s main research contributions are both theoretical and experimental. He developed a theoretical framework to describe the thermodynamics of symmetry breaking, and used this theory to design a colloidal Szilard engine using optical tweezers. He also participated in the construction and characterization of a Brownian Carnot engine. In his outstanding work on entropy-production fluctuations, he discovered new universal properties of stochastic entropy production using the theory of martingales, a well-known concept in quantitative finance, and explored the implications of his results in active molecular processes.



## EPS SNPD Prize Award Session

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16:10–16:40

Coffee break

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16:40–16:45

**EPL session welcome**

Sir John Enderby (EPLA senior scientific adviser)

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16:45–17:15

**The (random) matrix reloaded. Old tricks for new dogs – and return**

Pierpaolo Vivo (EPL invited lecturer)

*Department of Mathematics, King's College London, Strand, London WC2R 2LS, UK*

Matrices with random entries – much like cats – enjoy several lives. Studied in one context, they usually prove more useful in another, giving rise to more and more baffling challenges and unexpected twists as time goes by. But the field of random matrices is also plagued by false myths, inaccurate historical accounts, and true gems that – while jealously kept from our colleagues – would certainly deserve a better fate. I will give a cheerful account of the ‘old tricks’ of the trade on the occasion of the 89th birthday of random matrix theory, and how well they assist us with a few – nasty – ‘new dogs’. Also, how technical advancements in the field have made it possible – at long last – to make significant progresses in our understanding of old problems. In the course of my talk, I will likely get many cats out of the bag – as progress in science often relies on not letting sleeping dogs lie!



Pierpaolo Vivo studied theoretical physics at the Università degli Studi di Parma (Italy). Then he moved to Brunel University (London) on a Marie Curie Early Training fellowship, where he obtained his PhD in 2008 under the supervision of Gernot Akemann. He was then awarded a three-year postdoctoral fellowship at Abdus Salam ICTP – Trieste (Italy), where he worked in the condensed matter and statistical physics group led by Vladimir Kravtsov. There he collaborated mainly with Antonello Scardicchio and Matteo Marsili on interdisciplinary applications of random matrix theory. During the period 2011–2014 he worked as a research scientist at the Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS) in Orsay (France), where he mainly collaborated with Satya N Majumdar and Gregory Schehr. He has been a permanent member of the disordered system group at King's College London since September 2014. His research interests focus on random matrix theory and applications to complex systems and condensed matter, and on interdisciplinary and socio-economic applications of statistical mechanics.



17:15–17:45

## Random matrices meet trapped fermions

Gregory Schehr (EPL invited lecturer)

*Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS), Université de Paris-Sud, Bâtiment 100, 91405 Orsay Cedex, France*

I will review some recent results exploring the connection between non-interacting fermions in a  $d$ -dimensional trapping potential and random matrix theory. The presence of the trap introduces an edge where the average density of fermions vanishes. Far from the edge, near the centre of the trap (the so-called ‘bulk regime’), physical properties of the fermions have traditionally been understood using the local density approximation. However, this approximation drastically fails near the edge where the density vanishes. In this talk, I will show that, even near the edge, novel universal properties emerge, independently of the details of the confining potential. These universal correlations can be described by random matrix theory (in one dimension and at zero temperature) and by more general determinantal processes in higher dimensions and finite temperature. References: D S Dean, P Le Doussal, S N Majumdar, G Schehr 2015 *Phys. Rev. Lett.* **114** 110402; 2015 *EPL* **112** 60001; 2016 *Phys. Rev. A* **94** 063622.



Gregory Schehr is a permanent CNRS research scientist at the Laboratoire de Physique Théorique et Modèles Statistiques. His research interests are in statistical mechanics. The main topics that are of interest to him include, in particular: extreme value statistics, non-equilibrium dynamics, first-passage problems, disordered systems and random matrices.

17:45–20:00

## Reception (sponsored by EPL)

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