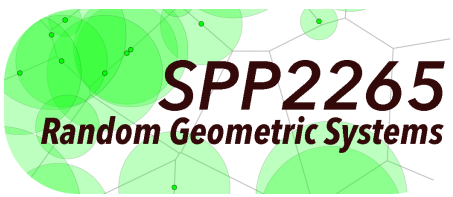
Weierstrass Institute for
Applied Analysis and Stochastics

Leibniz Association

Survey on

SPP2265 *Random Geometric Systems*

Wolfgang König (WIAS and TU Berlin)



From the application text for the SPP:

- Goal: mathematical analysis of effects and phenomena that emerge from an interplay between randomness and geometry
- analysis dominant, but simulations, numerics, statistics and modelling also present
- main focus on the development of new and the refinement of existing methods, and on the creation and analysis of new random spatial models
- substantial further developments into various timely directions, e.g., time-dependent random media, continuous-space modelling, long-range dependence, entire geometries instead of characteristic quantities, introduction of spatiality into mean-field models

The Programme Comitee (PC)

- Nina Gantert (TU München)
- Wolfgang König (WIAS Berlin and TU Berlin)
- Günter Last (Karlsruher Institut für Technologie)
- Peter Mörters (Universität Köln)
- Matthias Sperl (Universität Köln and DLR)

The SPP2265 received for October 2020 – September 2023:

- 24 projects (mostly with one position for a PhD or postdoc)
- travel/guest funds 3000 € per project, funded position and year
- 225.000 € for workshops and annual conference
- 75.000 € for schools and minicourses
- 27.000 € for central coordination (freely consumable)
- 65.000 € for start-up funding
- 38.000 € for equal-opportunity masures

Core Areas

(1) Point processes

(2) Random fields

(3) Percolation in the continuum

(4) Random geometric graphs

(5) Energy-based random point configurations

(6) Stochastic processes in random media

Our Workshops and schools (I)

- 2-4 Nov 2020, *Stochastic geometry and communications*, WIAS Berlin, hybrid, 0 Euro
- 28 Feb – 2 March 2022, *New trends in point process theory*, Karlsruhe, 4 700 Euro
- 7-9 March 2022, *Analysis and geometry of point processes*, Bielefeld, 4 800 Euro
- 14-17 March, *Random spatial networks*, Bonn, 16 300 Euro
- 28 March - 1 April 2022, *Spring School: Random geometric graphs*, Darmstadt, 21 600 Euro
- 11-14 April 2022, *First Annual Conference*, WIAS Berlin, 42.100 Euro
- 29 June - 1 July, 2022, *Random point processes in statistical physics*, WIAS Berlin, 8 800 Euro
- 7-9 September 2022, *Limit theorems for random spatial structures*, Bochum, 3 400 Euro
- 12-16 September 2022, *Summer School: Processes on random geometric graphs*, Cologne, 20 700 Euro
- 10-11 November 2022, *Reinforcement and statistical mechanics*, TU Munich, 0 Euros
- 23-25 November 2022, *Stochastic Geometry*, Osnabrück, 1 700 Euro
- 13-15 February 2023, *Mathematics and microscopic theory for soft matter systems*, Düsseldorf, 13 800 Euro

Our Workshops and schools (II)

- 20-22 February 2023, *Hyperuniform structures, rigid point processes and related topics*, Lille (only partially supported by PP2265 with 6 900 Euro)
- 22-24 February 2023, *BOS workshop on stochastic geometry*, Osnabrück, 2 300 Euro
- 27 February - 2 March 2023, *Branching and interacting particle systems*, Mainz, 6 900 Euro
- 27-30 March 2023, *Second Annual Conference*, DLR Cologne, 26 500 Euro
- 17-21 July 2023, *Summer School: probability and geometry on configuration spaces*, WIAS Berlin, 33 000 Euro
- 31 July – 2 August 2023, *Phase transitions in spatial particle systems*, WIAS Berlin, 8 000 Euro
- Fall 2023, *Geometric and topological properties of random algebraic varieties*, Cologne, 15 300 Euro
- 29-31 January 2024, *Dynamic random spatial systems*, WIAS Berlin, 3 000 Euro (only partially supported by PP2265)
- Summer 2024, *Random walks, scaling limits, criticality*, London, 34 000 Euro

Currently 26 000 Euro available.

Use of *Equal opportunity funds:*

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Use of *Start-up funds:*

- Fall-back option for associated PhD student (not realized).
- Funds for bridging gaps of 2-5 months for three young promising associated researchers (second half of 2023): TU München five months 33 000 Euro, DLR 4 Monate 24 000 Euro, Uni Düsseldorf 5 Monate 33 000 Euro. (The means for central coordination also went into this.)

- One annual SPP conference every year
- Many workshops organised by PIs. All SPP members and non-successful applicants admitted. Regular calls and deadlines for funds. Short applications texts. Decisions by PC.
- 1-3 schools per year organized by early-career members of SPP. Regular calls and deadlines for funds. Short application texts. Decisions by PC. Participation also for non-SPP members.
- **Module "Start-up Grant":** Funds for own position for up to 12 months for early-career scientists on application/competition. Main purpose: writing application for own funds. Annual calls and deadlines. Short applications. Decision by PC.
- **Module "Equal-Opportunity Measures in Networks"**: Funds for child care and participation fees for mentoring programmes, soft-skill courses etc. Organization of workshops with exclusively female speakers, bringing together established and young female researchers.
- General SPP-wide funds for acquiring laptops and paying Open Access publication costs. Available on request without explicit call.

On the research output (as of 24 Aug, 2023)

- 166 preprints (including books and book chapters etc.) since January 2020.
- 90 of these are published or accepted for publication
- These appeared in 53 different journals.
- Among these publications, 4 appeared in journals of information science, 3 in journals of chemical physics, 3 in journals of mathematical physics, 20 in journals of physics, 25 in general mathematical journals, 35 in probability journals.

Collaboration mathematics – physics (selection)

- MICHAEL A. KLATT, GÜNTER LAST, NORBERT HENZE:
  A genuine test for hyperuniformity (preprint Oct 2022)
- RENÉ WITTMANN, SABINE JANSEN, HARTMUT LÖWEN:
  Geometric criteria for the absence of effective many-body interactions in nonadditive hard particle mixtures (preprint Sep 2022)
- MICHAEL A. KLATT, GÜNTER LAST:
  On strongly rigid hyperfluctuating random measures (preprint Aug 2020)

- Benedikt Jahnel, Jonas Köppl, Bas Lodewijks, András Tóbiás:
  Percolation in lattice k-neighbor graphs
- Alejandro Caicedo, Matthew Dickson:
  Critical Exponents for Marked Random Connection Models
- Matthew Dickson, Markus Heydenreich:
  The Triangle Condition for the Marked Random Connection Model
- Benedikt Jahnel, Sanjoy Kumar Jhawar, Anh Duc Vu:
  Continuum Percolation in a Nonstabilizing Environment
- Alexander Drewitz, Olof Elias, Alexis Prévost, Johan Tykesson, Fredrik Viklund:
  Percolation for two-dimensional excursion clouds and the discrete Gaussian free field
- Peter Gracar, Lukas Lüchtrath, Christian Mönch:
  Finiteness of the percolation threshold for inhomogeneous long-range models in one dimension

- MICHAEL A. KLATT, GÜNTER LAST, NORBERT HENZE:
  A genuine test for hyperuniformity
- CHRISTIAN HIRSCH, BENEDIKT JAHNEL, STEPHEN MUIRHEAD:
  Sharp phase transition for Cox percolation
- MICHAEL A. KLATT, STEFFEN WINTER:
  Geometric functionals of fractal percolation. II. Almost sure convergence and second moments

- Moritz Otto, Christoph Thäle:
  Large nearest neighbour balls in hyperbolic stochastic geometry
- Florian Besau, Daniel Rosen, Christoph Thäle:
  Random inscribed polytopes in projective geometries
- Jens U. Neurohr, Friederike Nolle, Thomas Faidt, Samuel Grandthyll, Anton Wittig, Michael A. Klatt, Karin Jacobs, Frank Müller:
  Impact of geometry on chemical analysis exemplified for photoelectron spectroscopy of black silicon
- Lorenzo Dello Schiavo, Eva Kopfer, Karl-Theodor Sturm:
  A Discovery Tour in Random Riemannian Geometry
- Michael Goldman, Martin Huesmann:
  A fluctuation result for the displacement in the optimal matching problem
- Dan Coman, Wen Lu, Ma Xiaonan, George Marinescu:
  Bergman kernels and equidistribution for sequences of line bundles on Kähler manifolds
- Martin Huesmann, Bastian Müller:
  Transportation of random measures not charging small sets

- RENÉ WITTMANN, SABINE JANSEN, HARTMUT LÖWEN:
  Geometric criteria for the absence of effective many-body interactions in nonadditive hard particle mixtures
- ANNA GUSAKOVA, JOHANNES HEINY, CHRISTOPH THÄLE:
  The volume of random simplices from elliptical distributions in high dimension
- BENEDIKT JAHNEL, JONAS KÖPPL:
  Dynamical Gibbs Variational Principles for Irreversible Interacting Particle Systems with Applications to Attractor Properties
- ORPHÉE COLLIN, BENEDIKT JAHNEL, WOLFGANG KÖNIG:
  The free energy of a box-version of the interacting Bose gas
- ALEXANDRA QUITMANN, LORENZO TAGGI:
  Macroscopic loops in the Bose gas, Spin $O(N)$ and related models
- PETER GRACAR, LUKAS LÜCHTRATH, CHRISTIAN MÖNCH:
  The Emergence of a Giant Component in One-Dimensional Inhomogeneous Networks with Long-Range Effects

- M. te Vrugt, H. Löwen, R. Wittkowski:
  Classical dynamical density functional theory: from fundamentals to applications
- Michael Andreas Klatt, Hartmut Löwen, René Wittmann
  Foundation of classical dynamical density functional theory: uniqueness of time-dependent density-potential mappings
- René Wittmann, Hartmut Löwen, Joseph M. Brader:
  Order-preserving dynamics in one dimension – single-file diffusion and caging from the perspective of dynamical density functional theory

- LORENZO DELLO SCHIAVO, RONAN HERRY, EVA KOPFER, KARL-THEODOR STURM:
  Polyharmonic Fields and Liouville Quantum Gravity Measures on Tori of Arbitrary Dimension: from Discrete to Continuous
- LORENZO DELLO SCHIAVO, RONAN HERRY, EVA KOPFER, KARL-THEODOR STURM:
  Conformally invariant random fields, quantum Liouville measures, and random Paneitz operators on Riemannian manifolds of even dimension
- IMAN ABDOLI, HARTMUT LÖWEN, JENS-UWE SOMMER, ABHINAV SHARMA:
  Tailoring the escape rate of a Brownian particle by combining a vortex flow with a magnetic field
- MICHAEL A. KLATT, MAX HÖRMANN, KLAUS MECKE:
  Characterization of anisotropic Gaussian random fields by Minkowski tensors
- NILS ENGLER, BENEDIKT JAHNEL, CHRISTOF KUELSKE:
  Gibbsianness of locally thinned random fields

- Luisa Andreis, Wolfgang König, Heide Langhammer, Robert I.A. Patterson:
  A large-deviations principle for all components in a sparse inhomogeneous random graph
- Luisa Andreis, Tejas Iyer, Elena Magnanini:
  Gelation, hydrodynamic limits and uniqueness in cluster coagulation processes
- Yingxin Mu, Artem Sapozhnikov:
  On questions of uniqueness for the vacant set of Wiener sausages and Brownian interlacements
- Yingxin Mu, Artem Sapozhnikov:
  Visibility in Brownian interlacements, Poisson cylinders and Boolean models
- Christian Hirsch, Moritz Otto, Takashi Owada, Christoph Thäle:
  Large deviations for hyperbolic k-nearest neighbor balls
- Matthias Schulte, Christoph Thaele:
  Moderate deviations on Poisson chaos
- René Wittmann, Paul A. Monderkamp, Jingmin Xia, Louis B. G. Cortes, Iago Grobas, Patrick E. Farrell, Dirk G. A. L. Aarts, Hartmut Löwen
  Smectic structures in button-like confinements: experiment and theory
- Andreas Greven, Frank den Hollander, Anton Klimovsky, Anita Winter:
  The grapheme-valued Wright-Fisher diffusion with mutation