SCIENTIFIC ACTIVITY

SLAVA RYCHKOV, in collaboration with postdocs Apratim Kaviraj and Emilio Trevisani, resolved a long-standing puzzle concerning phase transition in lattice models with magnetic impurities (random field Ising model). Their work explained why, from the renormalization group theory point of view, an old and famous conjecture by Giorgio Parisi and Nicolas Sourlas only holds above a certain critical dimension. The conjecture was that the transition in d dimensions must exhibit a form of supersymmetry and the same critical exponents as the ordinary Ising model in d-2 dimensions.
His project concerned the renormalization group. In collaboration with mathematical physicists Prof. Alessandro Giuliani (University of Rome) and Prof. Vieri Mastropietro (University of Milan), he developed a rigorous renormalization group theory of non-Gaussian fixed points in models containing only fermionic fields, establishing the analytic dependence of critical indices on these models' parameters. This work is an example of historical continuity and relates to articles from the 1980s written by the late IHES professor Oscar E. Lanford III, and Krzysztof Gawędzki, then CNRS researcher at IHES.
Slava Rychkov is also continuing his collaboration with his PhD student Jiaxin Qiao and postdoc Petr Kravchuk (IAS Princeton) on the analytic continuation of Euclidean conformal field theories towards the Lorentzian signature. Preliminary results were reported in his Cours de l'IHES in 2019, and in an online seminar "Analysis, Quantum Fields, and Probability" in 2020. The first article on this project has now appeared in JHEP, and three more are in preparation.
In addition, he has recently started a collaboration with PhD student Benoit Sirois, postdoc Marten Reehorst, and Prof. Balt van Rees (École polytechnique) to develop a new numerical conformal bootstrap algorithm. Preliminary results are encouraging.

Slava RYCHKOV

Theoretical Physics,
permanent professor since 2017.

DISTINCTIONS

New Horizons Prize in Physics (2014)
Institut Universitaire de France, junior member (2012-2017)
Grand prix Mergier-Bourdeix, Académie des sciences de Paris (2019)

Editor of:
SciPost Physics
Communications in Mathematical Physics

PUBLICATIONS

With D. J. Binder
Deligne Categories in Lattice Models and Quantum Field Theory, or Making Sense of O(N) Symmetry with Non-integer N
J. High Energ. Phys. **2020**, 117 (2020), pre-publication arXiv:1911.07895.

With A. Kaviraj and E. Trevisani
Random Field Ising Model and Parisi-Sourlas Supersymmetry I. Supersymmetric CFT
J. High Energ. Phys. **2020**, 90 (2020), pre-publication arXiv:1912.01617.

Random Field Ising Model and Parisi-Sourlas Supersymmetry II. Renormalization Group
Pre-publication arXiv:2009.10087.

With A. Giuliani and V. Mastropietro
Gentle Introduction to Rigorous Renormalization Group: a Worked Fermionic Example
Pre-publication arXiv:2008.04361.

3D Ising Model: a View from the Conformal Bootstrap Island
C. R. Physique **21** (2020)2, pre-publication arXiv:2007.14315.

With P. Kravchuk and J. Qiao
Distributions in CFT, Part I. Cross-Ratio Space
J. High Energ. Phys. **2020**, 137 (2020), pre-publication arXiv:2001.14315

CONFERENCES

France

Rencontres Théoriciennes, LPTHE, Sorbonne Université, Paris (23 January) ***Random Field Ising Model and Parisi-Sourlas Supersymmetry*** (seminar)

Inhomogeneous Random Systems - Emergent CFTs in Statistical Mechanics, Institut Curie, Paris (29 January) ***3D Ising Model: a View from the (Conformal Bootstrap) Island*** (conference)

Conférence grand public des Amis de l'IHES, IHES, Bures-sur-Yvette (29 October) ***Contre la logique du légo*** (video conference)

A Glimpse into the Institut des Hautes Études Scientifiques, Friends of IHES, IHES, Bures-sur-Yvette (7 December) ***Universality in Physics*** (video conference)

Germany

Webinar Analysis, Quantum Fields, and Probability, Max-Planck-Institute für Mathematik, Leipzig (8 October) ***CFT Osterwalder-Schrader Theorem*** (video seminar)

India

Quantum Spacetime Seminars, Tata Institute for Fundamental Research, Mumbai (15 June) ***Supersymmetry and its Absence in the Random Field Ising Model*** (video seminar)

Israel

Joint Seminars in Theoretical High Energy Physics, Haifa University - Technion, Haifa (5 May) ***Supersymmetry and its Absence in the Random Field Ising Model*** (video seminar)

United States

Physics Department Colloquium, Harvard University, Cambridge (24 February) ***The Conformal Bootstrap Approach to Criticality in 3 and 2+1 Dimensions*** (colloquium)

Particle Theory Seminar, Harvard University, Cambridge (25 February) ***Random Field Ising Model and Parisi-Sourlas Supersymmetry*** (seminar)

Condensed Matter Theory Seminars, Massachusetts Institute of Technology, Cambridge (25 February) ***Understanding O(N) Symmetry for Non-integer N via Deligne Categories*** (seminar)

Simons Collaboration on the Nonperturbative Bootstrap, Simons Foundation, New York (22 April) ***Supersymmetry and its Absence in the Random Field Ising Model*** (video seminar)

Simons Collaboration on the Nonperturbative Bootstrap, Simons Foundation, New York (9 September) ***Musings and Some Results about Non-perturbative RG*** (video seminar)

Physics Department Colloquium, Boston University, Boston (3 November) ***The Conformal Bootstrap Approach to Criticality in 3 and 2+1 Dimensions*** (video colloquium)