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The Fu Foundation School of Engineering and Applied Science

Distinguished Colloquium Series in Interdisciplinary & Applied Mathematics

Stanislav Smirnov

Professor of Mathematics, University of Geneva

The Ising Model of a Ferromagnet from 1920 to the Present Day

The Ising model is an archetypical model of the order-disorder phase transition: though simple to formulate, it exhibits a complex behavior, much like the real-world phenomena in solid-state physics, ferromagnetism, chemistry, biology, computer science.

In 1920 the physicist Wilhelm Lenz proposed to model ferromagnetic materials by a lattice of plus-minus spins with interacting neighbors. His student Ernst Ising solved the model in dimension one four years later. The one-dimensional behavior turned out to be trivial, with no phase transition when the interaction strength changes, and for a decade people searched for other possible models. However, a ferromagnetic phase transition was established by Rudolf Peierls in higher dimensions, and in 1944 Lars Onsager famously calculated the free energy for the Ising model in two dimensions.

Since then the Ising model became widely studied, as it exhibits complicated phase transition behavior, yet allows a very detailed analysis in dimension two. We will give a historical introduction to the model, and then describe some recent results.

Stanislav Smirnov is a professor at the University of Geneva, Switzerland, and holds a part-time position at the St. Petersburg State University. He received his PhD in 1996 at the California Institute of Technology under the direction of Nikolai Makarov, and worked at Yale and KTH Stockholm before moving to Geneva in 2003. Smirnov's research interests include analysis, dynamical systems, probability and mathematical physics. In 2010 he was awarded the Fields Medal for his work on conformal invariance of the percolation and Ising models at criticality.

Thursday, October 23, 3:30pm

Davis Auditorium, CEPSR (Shapiro Center)