

## Special Colloquium

*From constraint satisfaction problems to the mean-field approximation, and back*

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**Abstract:** The Ising model is one of the most widely studied probabilistic models in statistical physics, and has found connections to fields as diverse as statistics, theoretical computer science, combinatorics, machine learning, and economics. A fundamental quantity of interest in the study of Ising models is the partition function which, despite the simplicity of its definition, is analytically and computationally intractable. Owing to its myriad applications, there is therefore considerable interest in approximation schemes for the partition function, of which the mean-field approximation is perhaps the simplest and most widely used.

In this talk, I will discuss some recent progress in our understanding of the mean-field approximation for general Ising models. In particular, I will introduce some tools commonly used in the study of dense constraint satisfaction problems (CSPs), such as correlation rounding, the Frieze-Kannan weak regularity lemma, and convex programming hierarchies, and discuss how they can be used to provide strong theoretical and algorithmic results for the mean-field approximation. This connection between the mean-field approximation and dense CSPs is also profitable in the 'reverse direction' – the mean-field inapproximability of spin-glasses can be used to show the optimality of correlation rounding, thereby refuting a conjecture in theoretical computer science.

Wednesday, January 29 at 3:00 PM in 636 SEO
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Based on several joint works with Frederic Koehler (MIT), Elchanan Mossel (MIT), and Andrej Risteski (CMU).

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