MAR10-2009-006770

Abstract for an Invited Paper
for the MAR10 Meeting of
the American Physical Society

New insights from one-dimensional spin glasses

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Spin glasses are paradigmatic models that deliver concepts relevant for a variety of systems. However, despite ongoing research spanning several decades, there remain many fundamental open questions. Concepts from the solution of the mean-field model, such as ergodicity breaking, aging, ultrametricity, and the existence of an instability line at finite magnetic fields known as the Almeida-Thouless line, have been applied to realistic short-range spin-glass models as well as to fields as diverse as structural biology, computer science and financial analysis. Rigorous analytical results are difficult to obtain for spin glasses, in particular for realistic short-range systems. Therefore typical studies involve large-scale numerical simulations, as well as the use of efficient algorithms and improved model systems. It is of paramount importance to understand which properties of the mean-field solution carry over to short-range systems. The use of one-dimensional spin glasses with (diluted) power-law interactions has been instrumental in elucidating the properties of spin-glass systems. Large system sizes can be simulated, and different universality classes ranging from the mean-field to the short-range case can be probed by tuning the power-law exponent of the interactions. Recent results on spin-glass problems using the aforementioned one-dimensional model are presented with special emphasis on the existence of a spin-glass state in a field.