Contribution ID: **99** Type: **not specified**

The Ising model on a square lattice with stochastic interactions

Tuesday, 7 July 2015 16:10 (20 minutes)

The Ising model offers an excellent testing ground for examining classical and quantum phase transitions. Although the Ising model has been studied extensively for a long time (see e.g. [1]), its analytical solutions are known only for some cases. Applications of the Ising model are reaching far beyond molecular level of physical complexity, scaling and universality of critical phenomena. For example, it has been shown that the Ising model is capable of reproducing complex behaviour of actual financial and economic markets [2].
In the present study, I will discuss the Ising model on a square lattice with no external field in the case when the spin coupling interactions are known with some uncertainity. The uncertainty itself is modeled by the addition of a Gaussian noise to the interactions. The model is studied by means of Monte Carlo simulations using the Metropolis algorithm according to the implementation described by other authors [3, 4]. Numerical results for the so called Binder rations [4], related to the finite-size lattice scaling properties, give a clear evidence of the shift in the value of the effective critical temperature due to the presence of the random Gaussian interactions [5].
This finding may have an application when comparing experimental results with some phase transition theory predictions. In particular, the results obtained in the present study give some indication regarding possible effects which may arise due to uncertainties of the system parameters in real experimental situations.

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Session Classification: New Ideas and Advanced Methods