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Comment to numerical study of a long range Ising spin-glass: exact results for small samples

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Ariosa et al. [1] have studied Ising $s_i = \pm 1$ spin chains with a Ruderman-Kittel-Kasuya–Yosida-like interaction

$$J_{ij} = J_0 \frac{\cos(\alpha\,|x_i - x_j|)}{|x_i - x_j| + 1} \tag{1}$$

with $J_0 = -10$, $\alpha = 7\pi$ and random spin positions ($x_i = x_{i-1} + 20 \cdot r$, r being a random number, $0 \le r \le 1$) as a model for a long range spin-glass. To have a well

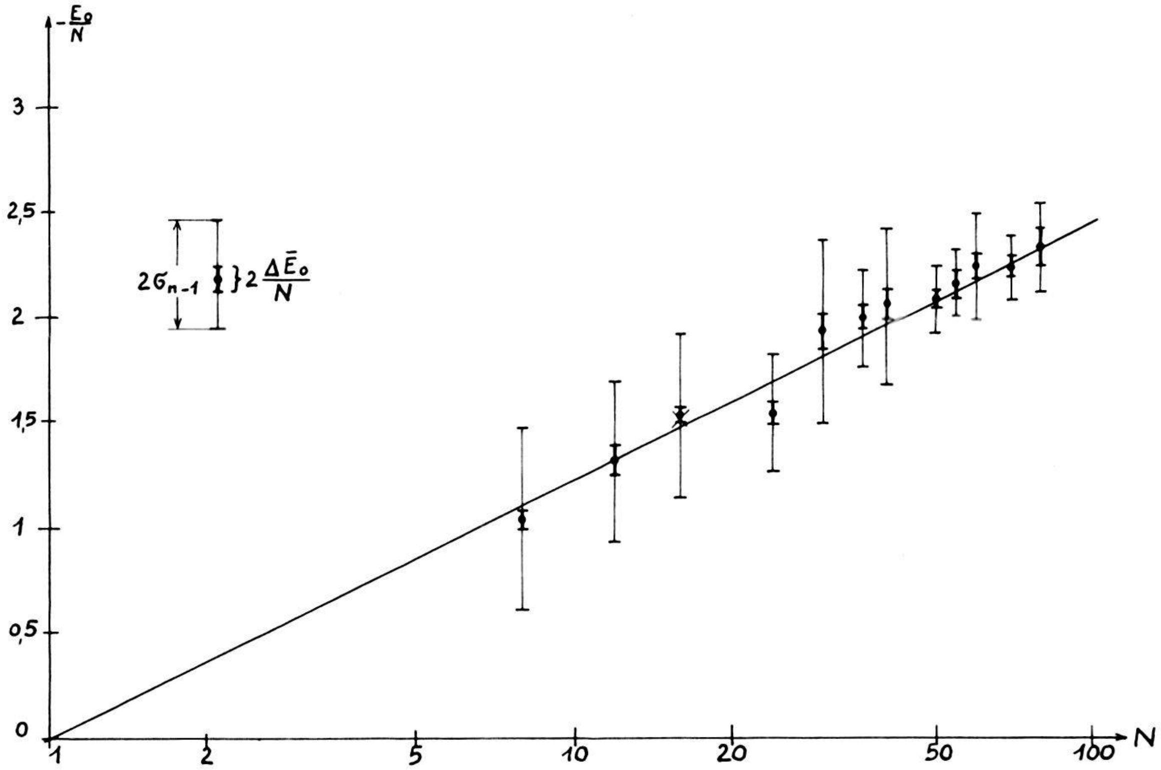

Figure 1
Averaged ground state energy per spin E_0/N as function of the number of spins N. The points represent the values $\bar{E}_0/N$ averaged about n configurations with standard deviations σ_{n-1} and $\Delta\bar{E}_0/N = \sigma_{n-1}/\sqrt{n-1}$; × from [1]. The straight line represents $E_0/N = -0.53 \ln N$.

defined thermodynamic limit the coupling constant J_0 has to be replaced by $J_0/\rho(N)$, $\rho(N)$ being such that the free energy becomes extensive. In [1] $\rho(N) = N^{0.35}$ is determined numerically by extrapolation of the ground state energy for small samples with $N = 8$, 12 and 16 having in mind that this power law approximates the suggestion

$$\rho(N) = \ln N \tag{2}$$

very well for small N.

Using a new procedure to find the exact ground state of Ising systems without enumeration of all 2^{N-1} states [2] we were able to recalculate $\rho(N)$ up to $N = 80$. The samples were chosen following the same criteria as in [1], section III [3].

The results (Fig. 1) show that the function (2) is more suitable than a power law for the given case. For the averaged ground state energy we found $\bar{E}_0(N) = -0.53N \ln N$. Thus the rescaling procedure in [1] for energies and temperature on the basis of (2) is confirmed with greater confidence.

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