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Is there a de Almeida-Thouless line in finite-dimensional spin glasses?¹

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The question of whether there is a line of transitions in a magnetic field in an Ising spin glass (the de Almeida-Thouless, or AT, line) is important for two reasons: (i) its existence or otherwise is a major difference between the “droplet” and “replica symmetry breaking (RSB)” pictures of the spin glass state, and (ii) the spin glass in a field is argued to be quite similar to structural glasses, and, in this analogy, the spin glass AT line corresponds to the “ideal glass” transition of structural glasses. “Standard” finite-size scaling (FSS) methods do not find evidence for an AT line in three- or four-dimensional spin glasses. However, these results have been called into question by Leuzzi et al., Phys. Rev. Lett. 103, 267201 (2009) who perform a “non-standard” FSS analysis, in which they state that one should not include fluctuations at $k = 0$ since these are argued to have larger corrections to FSS than $k > 0$ fluctuations. Using the “non-standard” analysis Leuzzi et al. find an AT line in four dimensions and also in a one-dimensional long-range model which is a proxy for four dimensions. In this talk I will describe results of large-scale Monte Carlo simulations for one-dimensional models which are proxies for three and for four dimensions, analyzed using both the “standard” and “non-standard” FSS approaches. I will also briefly discuss the merits of these two approaches to FSS.

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