The spin 1 Blume Capel model with RKKY interactions

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In many magnetic materials, long-range exchange interactions play a dominant role, the most familiar being those that stem from the indirect coupling of localised atomic spins arising through the intermediacy of the spins of the itinerant conduction electrons, the so-called Ruderman-Kittel-Kasuya-Yosida (RKKY) interaction. Recently [1] one of us (TB), has shown how the Pair Approximation (PA) can be readily extended to treat such long-range interactions in the case of a spin 1/2 Ising model with RKKY interactions. However, to our knowledge, a spin 1 model with long-range interactions has not yet been studied. The purpose of our paper is to show that despite an additional difficulty arising from the additional complexity of the density matrix for these problems, over that of the spin 1/2 Ising model, the PA is still a tractable technique in these cases. This will be done by application of the method to a specific problem, a study of the phase diagrams of the Blume Capel (BC) model with RKKY interactions on a face-centered cubic lattice [2]. The critical temperatures of the second- and first-order transitions, the tricritical points, and various pair correlation functions are all studied. In particular, their dependence on any truncation approximation of the RKKY interactions is explored.

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