QUANTUM PHASE TRANSITION IN GENERALIZED ONE-DIMENSIONAL XZ MODEL

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9.7 cm

We introduce a one-dimensional (1D) anisotropic XZ model with different interactions on even and odd bonds. As a special case the interactions interpolate between the 1D Ising model and the 1D quantum compass model with frustrated pseudospin interactions $\sigma_i^z\sigma_{i+1}^z$ and $\sigma_i^x\sigma_{i+1}^x$, alternating between even/odd bonds [1]. We present an exact solution which employs the mapping to fermions with spin $S = 1/2$ and demonstrate that the pseudospin correlation functions undergo in general the second order quantum phase transition, while for particular choice of interactions this transition is first order. The properties of the compass model are investigated and we prove its disordered ground state with degeneracy 2^{N-1} for the chains of length $2N$ ($N \geq 2$), while for $N \to \infty$ the degeneracy is 2×2^N. The nearest neighbor pseudospin correlation functions are identical to those of the 1D XZ model for the interacting pairs of pseudospins. The results obtained for long-range correlation functions indicate divergent correlation length when the point of quantum phase transition is approached. Possible extensions to the ladder geometry will also be discussed.

[1] W. Brzezicki, J. Dziarmaga and A. M. Oleś, Phys. Rev. B **75**, 134415 (2007).

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