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Entanglement and quantum phase transitions[1] HAI-QING LIN, SHI-JIAN GU, GUANG-SHAN TIAN, The Chinese University of Hong Kong — In this work, we study the ground state entanglement of two spins, as measured by the concurrence, in a class of spin systems including the XXZ model, the Ising model with transverse field, the spin ladder, the Kondo necklace model, and the Majumdar-Ghosh. We seek if there is any relation between the entanglement and quantum phase transitions (QPT) in these systems. First we show rigorously that the concurrence reaches maximum at QPT for some models. Then we analyze analyticity of the concurrence at QPT. We categorize their behaviors as follows: (i) if the QPT is induced by the ground state level crossing, then the entanglement is singular at QPT; (ii) if the ground state is non-degenerate so the QPT is induced by the excited state level crossing, then whether the entanglement is extreme or singular at QPT depends on the symmetry of the system and the existence of long-range order. It is obviously from point (ii) that dimensionality plays an important role in the behavior of the entanglement.

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