ABSTRACT

MAGNETIC PROPERTIES OF SPIN-1/2 ISING-HEISENBERG MODEL ON THE DECORATED BETHE LATTICE

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The spin-1/2 Ising-Heisenberg model on diamond-like decorated Bethe lattices is exactly solved by combining the decoration-iteration mapping transformation with the rigorous method based on exact recursion relations. Apart from the classical ferromagnetic phase, the investigated quantum spin model with the ferromagnetic XXZ Heisenberg interaction may also exhibit a disordered spin liquid ground state on behalf of the geometric frustration triggered by a competition between the easy-plane XXZ Heisenberg interaction and the easy-axis Ising-type interaction, respectively. It is evidenced that the finite-temperature phase boundary between the spontaneously ordered and disordered phases basically depends on a coordination number q of the underlying Bethe lattice.

It is shown that the finite-temperature phase boundary approaches the zero-temperature phase transition between the ordered and disordered phases with a negative slope for the Bethe lattices with the coordination number $q<4$, with a positive slope for the Bethe lattices with the coordination number $q>4$ and with an infinite gradient for the Bethe lattice with the particular value of the coordination number $q=4$. Owing to this fact, reentrant phase transitions can be observed in a close vicinity of the zero-temperature transition between the ordered and disordered phases for the diamond-like decorated Bethe lattices with a sufficiently high coordination number $q>4$. In addition to the finite-temperature phase diagrams, our attention is also focused on temperature variations of the spontaneous magnetization, which may provide an independent check of the observed reentrance.

Key Words: Ising-Heisenberg model; the transformation of the decoration-iteration; complete solutions; magnetic characteristics.