Anomalous magnetocaloric properties of the spin-1/2 Ising model on a decorated square lattice in a vicinity of second-order phase transitions

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ABSTRACT

Thermodynamic properties of the exactly solvable transverse Ising model on decorated planar lattices were rigorously studied by the use of a generalized decoration-iteration transformation [1, 2]. In the present work we will report basic magnetocaloric properties for the particular case of this exactly solved model, more specifically, for the spin-1/2 Ising model on a decorated square lattice in a transverse magnetic field. Our main attention is focused upon three essential magnetocaloric characteristics: the change of temperature during the adiabatic demagnetization, the isothermal entropy change and the adiabatic temperature change. It is convincingly evidenced that the isothermal entropy change and the adiabatic change of temperature exhibit anomalous weak singularities in a vicinity of second-order phase transitions observed at finite temperatures, which are very different from analogous thermal dependences observed near first-order phase transitions. In addition, one finds in the isothermal entropy change at a certain temperature a crossover from the normal magnetocaloric effect to the inverse magnetocaloric effect upon decreasing of temperature.

References

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