High-field low-temperature properties of frustrated Heisenberg antiferromagnet on one-dimensional lattices

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We consider the spin-1/2 antiferromagnetic Heisenberg model on several one-dimensional frustrated lattices (double-tetrahedral chain [1], octahedral chain [2] and triangular tube [1]) with almost dispersionless (flat) lowest magnon band in a strong magnetic field. If the band is strictly flat, the thermodynamics of the model can be studied in detail in the low-temperature high-field regime after mapping the problem onto classical hard-core lattice-gas models. The aim of our study is to develop a systematic theory of the low-temperature high-field properties of the considered chains using the concept of localized magnons [3,4]. For this purpose we construct the low-energy effective Hamiltonians using the standard strong-coupling perturbation theory. To analyze the region of the applicability of the obtained effective Hamiltonians we perform extensive exact diagonalization and density matrix renormalization group calculations and compare them with the results for the initial models. We examine the constructed effective models to explain properties of the frustrated quantum Heisenberg antiferromagnets in the regime of high magnetic fields and low temperatures with special focus on the magnetization and the specific heat.

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