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An effective theory for Heisenberg antiferromagnet on one-dimensional frustrated lattices at high magnetic fields

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We consider the spin-1/2 antiferromagnetic Heisenberg model on one-dimen-sional frustrated lattices (double tetrahedra chain [1], deformed octahedral chain [2]) placed in an external magnetic field with almost dispersionless (almost flat) lowest magnon band. The main goal of our study is to develop a systematic theory for the low-temperature high-field properties of these models, using the localized magnons approach [3,4]. We construct an effective description of one-dimensional chains with triangular and quadrangular traps by means of the localized magnons concept within the strong coupling approximation. The obtained effective models are much simpler than the initial ones: firstly, the effective models have smaller number of sites and secondly, and most importantly, they are unfrustrated. As a result, one can apply well elaborated methods of the quantum spin systems theory to discuss the properties of the initial frustrated quantum antiferromagnets at high fields and low temperatures. We perform extensive exact diagonalization calculations to check the validity of the obtained effective Hamiltonians by comparison with the initial models.

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