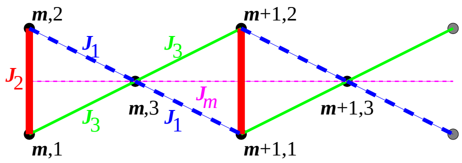
High-field low-temperature properties of distorted diamond chain

Oleg Derzhko[a], Johannes Richter[b], and Olesia Krupnitska[c]
[a] *Institute for Condensed Matter Physics NASU, L'viv, 79011, Ukraine*
[b] *Universität Magdeburg, P.O. Box 4120, 39016 Magdeburg, Germany*
[c] *Department for Theoretical Physics, Ivan Franko National University of L'viv, L'viv, 79005, Ukraine, E–mail: krupnitskaolesya@gmail.com*

In the present paper we consider the spin-1/2 antiferromagnetic Heisenberg model with the Hamiltonian

$$H = \sum_{(ij)} J_{ij}\mathbf{s}_i \cdot \mathbf{s}_j - hS^z, \quad S^z = \sum_i s_i^z$$

on a distorted diamond chain, see below. The ideal diamond chain is obtained



by setting $J_1 = J_3$, $J_m = 0$, and $J_2 > 2J_1$. The high-field low-temperature thermodynamics of the ideal diamond chain can be obtained within the frames of the independent localized magnon picture [1]. We extend the independent localized magnon description for small deviations from ideal geometry. The obtained (approximate) analytical results for the high-field magnetization curve at low temperatures are in a reasonable agreement with exact diagonalization data for finite systems of 18 sites. We also discuss the high-field magnetization curve for the azurite $Cu_3(CO_3)_2(OH)_2$, which can be regarded as a model compound of distorted diamond spin chain [2] with the set of exchange constants $J_1 = 15.51$ K, $J_2 = 33$ K, $J_3 = 6.93$ K, $J_m = 4.62$ K [3].

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[2] H.Kikuchi et.al., Phys. Rev. Lett. **94**, 227201 (2005).
[3] H.Jeschke et.al., Phys. Rev. Lett. **106**, 217201 (2011).