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Spin Hamiltonian and Dimensionality in (Ba,Sr)CuSi2O6

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The quantum magnet BaCuSi2O6, consisting of stacked spin dimer bilayers, undergoes an anomalous dimensional reduction from 3D to 2D close to the quantum critical point [1]. Mechanisms for this dimensional reduction were proposed based on inter-bilayer frustration resulting from an antiferromagnetic intra-bilayer exchange. Ab initio calculations propose a ferromagnetic intra-bilayer exchange rendering such a frustration impossible [2].
In addition to previous measurements of BaCuSi2O6, we have performed neutron spectroscopy on the child compound Ba0.9Sr0.1CuSi2O6 [3] using the cutting-edge neutron spectrometer CAMEA at PSI. Furthermore, we have measured the phase boundary of the Bose Einstein Condensate phase in BaCuSi2O6, which has a lower critical magnetic field of 23.15T, using neutron diffraction under extreme conditions on HFM/EXED at HZB.
Our results suggest ferromagnetic intra-bilayer exchanges with at least three different dimer types in BaCuSi2O6 and only one dimer type in Ba0.9Sr0.1CuSi2O2. We conclude that the existence of different dimer types in BaCuSi2O6 might lead to the observed quasi 2D behavior.

[1] C. E. Sebastian et al., Nature 441, 617 (2006).
[2] V. V. Mazurenko et al., PRL 112, 107202 (2014).
[3] P. Puphal et al., PRB 93, 174121 (2016).

Position

Phd

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