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NEAR-EDGE AND BULK REGIONS OF SEMI-INFINITE TWO- AND THREE-DIMENSIONAL HEISENBERG ANTIFERROMAGNETS

Niina Voropajeva, Aleksei Sherman

Institute of Physics, University of Tartu, Tartu, Estonia

e-mail: niinav@ut.ee

Using the spin-wave approximation elementary excitations and nearest-neighbor spin correlations of semi-infinite two- and three-dimensional Heisenberg spin-1/2 antiferromagnets on square/simple cubic lattices are considered. The presence of the edge divides the antiferromagnet into near-edge and bulk regions, which are characterized by different dominant spin excitations. The spectrum of the near-edge region, which is formed by the first two rows/layers of spins nearest to the edge, consists of a d-1 dimensional mode of boundary spin waves. Here d=2 or 3 is the dimensionality of the antiferromagnet. Excitations of the rest of the antiferromagnet are d dimensional standing spin waves. Due to the lower dimensionality of the boundary spin-wave mode absolute values of the nearest-neighbor spin correlations near the edge exceed the bulk value which leads to the appearance of the comb structure of spin correlations near the edge [1]. The description of perturbations introduced by the edge into the spectrum of spin excitations is in many respects similar to the problem of a local defect in a crystal [2]. In this latter problem, the crystal is also divided by a perturbation into two regions with different elementary excitations – a vicinity of the defect with localized states and the rest of the crystal with bulk states.

References

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