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Excitation Spectrum Gap and Spin-Wave Stiffness of XXZ Heisenberg Chains: Global Renormalization-Group Calculation OZAN S. SARIYER, Istanbul Technical University, A. NIHAT BERKER, Koç University, MICHAEL HINCZEWSKI, Feza Gursey Research Institute — The anisotropic XXZ spin-$\frac{1}{2}$ Heisenberg chain is studied using renormalization-group theory, thoughout the entire temperature and anisotropy ranges in both ferromagnetic and antiferromagnetic regions.[1] We obtain, for all anisotropies, the antiferromagnetic spin-liquid spin-wave stiffness and the Isinglike ferromagnetic excitation spectrum gap, exhibiting the spin-wave to spinon crossover. In the latter case, we also obtain a crossover in the leading algebraic behavior of the specific heat. A number of other purely quantum characteristics are found: The in-plane interaction $s_i^x s_j^x + s_i^y s_j^y$ induces an antiferromagnetic correlation in the out-of-plane s_i^z component. Conversely, an antiferromagnetic $s_i^z s_j^z$ interaction induces a correlation in the s_i^{xy} component. As another purely quantum effect, (i) in the antiferromagnet, the value of the specific heat peak is insensitive to anisotropy and the temperature of the specific heat peak decreases from the isotropic (Heisenberg) with introduction of either type (Ising or XY) anisotropy; (ii) in complete contrast, in the ferromagnet, the value and temperature of the specific heat peak increase with either type of anisotropy.
[1] O.S. Sariyer, A.N. Berker, and M. Hinczewski, arXiv:0704.1064v1 [cond-mat.stat-mech].

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