9.7 cm

SPIN-$\frac{1}{2}$ PERIODIC NONUNIFORM XX CHAINS AND THE SPIN–PEIERLS INSTABILITY

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We consider the spin-$\frac{1}{2}$ XX chain in a random Lorentzian transverse field assuming that the exchange coupling, the mean value of the transverse field and the width of its probability distribution vary regularly from site to site having a period p. With the help of the Jordan–Wigner transformation the spin model can be reformulated in terms of noninteracting spinless fermions. We are interesting in the thermodynamic quantities that can be expressed through the density of magnon states which in its turn can be obtained from the Green functions. Averaging a set of equations for the Green functions (this can be done exactly because we have the Lorentzian probability distribution) and using the continued–fraction representation for the diagonal Green functions we can derive the density of states explicitly for any finite p (since the problem reduces to the calculation of periodic continued fractions). We analyse in detail the thermodynamic properties of the spin chain in the presence of periodic nonuniformity. As an application of the obtained results we consider a toy model of the spin–Peierls instability with respect to dimerization in the presence of a non–random/random external field. Namely, we calculate the (averaged) ground state energy of the spin system and examine the total energy as a function of the dimerization parameter. We discuss how the non–random/random field may influence this dependence.

13.4 cm

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