TWO-FERMION DYNAMIC SUSCEPTIBILITIES
OF SPIN-1/2 XX CHAINS

Oleg Derzhko and Taras Krokhmalskii

Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine, 1 Svientsitskii Street, L’viv-11, 79011, Ukraine

One-dimensional quantum spin-1/2 models are known to undergo a spin-Peierls transition (see, for example, Refs. [1,2]). In our study we consider the spin-1/2 XX chains to examine rigorously a relation between the spin-Peierls dimerization and the dynamic properties of the model. For this purpose we calculate the dynamic susceptibilities

\[ \chi_{AB}(\kappa, \omega) = \sum_n \exp(i\kappa n) \int_0^\infty dt \exp\left(\frac{1}{2} \left\langle [A_j(t), B_{j+n}] \right\rangle \right) \exp(\frac{1}{2}(\omega + i\epsilon)t), \quad \epsilon \to +0 \]

with the local spin operators \( \{A_m, B_m\} = \{s^z_m, D_m\} \) where \( s^z_m \) is the transverse spin operator and \( D_m = s^x_m s^x_{m+1} + s^y_m s^y_{m+1} \) is the dimer operator. These dynamic quantities for the considered models can be calculated analytically employing the Jordan-Wigner transformation. All of them are determined entirely by two-fermion excitations and can be analyzed in detail. The obtained results for the special case which corresponds the a free fermion point should be valuable as a guide for attacking the general case of spin-1/2 XXZ chains.