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

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9.7 cm

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

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

with the local spin operators $\{A_m,B_m\}=\{s_m^z,D_m\}$ where s_m^z is the transverse spin operator and $D_m=s_m^xs_{m+1}^x+s_m^ys_{m+1}^y$ 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.

[1] P. Pincus, Solid State Commun. **9,** 1971 (1971).
[2] M. C. Cross and D. S. Fisher, Phys. Rev. B **19,** 402 (1979).

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