Exactly solvable random spin-$\frac{1}{2}$ XX chain with three-site interactions

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We consider the spin-$\frac{1}{2}$ XX chain with three-site interactions in a random (Lorentzian) transverse field. The Hamiltonian of the model reads [1]

$$\begin{aligned} H &= \sum_n \left[J \left(s_n^x s_{n+1}^x + s_n^y s_{n+1}^y \right) \right. \\ &\quad \left. + K \left(s_n^x s_{n+1}^z s_{n+2}^x + s_n^y s_{n+1}^z s_{n+2}^y \right) + \Omega_n s_n^z \right] . \end{aligned}$$

Here J and K are the interaction constants and Ω_n is the external transverse magnetic field on the site n. The on-site fields are assumed to be independent random variables each with the Lorentzian probability distribution $p(\Omega_n) = (1/\pi)\{\Gamma/[(\Omega_n - \Omega_0)^2 + \Gamma^2]\}$. The introduced spin model can be mapped via the Jordan-Wigner transformation onto a tight-binding model of spinless fermions with nearest and next-nearest hopping and random on-site energy. Furthermore, exploiting the old Lloyd's idea [2], the random-averaged Green functions can be obtained. As a result, we obtain exact analytical results for the random-averaged density of states and thermodynamic quantities.

The nonrandom counterpart of the spin model has a rich ground-state phase diagram exhibiting quantum phase transitions. With our results for the thermodynamic quantities we discuss how the quantum critical behavior is modified by randomness.

For further details see Refs. [1].

[1] Derzhko V., Derzhko O., Richter J. Preprint arXiv:1012.2058.

[2] Lloyd P., J. Phys. C, 1969, **2**, 1717.