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Repulsively bound magnon excitations of a spin-1/2 XXZ chain in a staggered transverse field

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We study the excitation spectrum of the one-dimensional spin-1/2 XXZ chain with antiferromagnetic Ising anisotropy across a magnetic quantum phase transition induced by the application of a site-dependent transverse magnetic field. Motivated by the chain antiferromagnet BaCo2V2O8, we consider a situation where the transverse magnetic field has a strong uniform component and a weaker staggered part. Using a combination of analytical approaches and the numerically exact time-dependent matrix product state method, we determine the nature of the excitations giving rise to the spin dynamical structure factor. Below the quantum phase transition, we identify high-energy many-body two-magnon and three-magnon repulsively bound states which are clearly visible due to the staggered component of the magnetic field. At high magnetic fields and low temperature, single magnons dominate the dynamics. These results are in very good agreement with terahertz spectroscopy measurements.

Keyword-1

strongly correlated systems

Keyword-2

condensed matter theory

Keyword-3

quantum many-body physics

Primary author: BERNIER, Jean-Sébastien (University of Northern British Columbia)

Presenter: BERNIER, Jean-Sébastien (University of Northern British Columbia)

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