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Analyzing Neutron Scattering Data on the Excitations in the Spin 1 Haldane System NENP

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A 1D chain of antiferromagnetic spin systems is a critical topic in quantum many-body physics. Theory has predicted that different spins (S) would result in different behaviors. Here, I will focus on the excitations of the Spin 1 Haldane system in the ground state.

In the S=1 system, both experiments and theories indicate that the ground state is topological and that there is a spin gap, Delta, in the dispersion. Some experiments have been conducted previously with neutron spectroscopy on the IN5 spectrometer, ILL, on the compound NENP by co-supervisor Sonja Holm-Dahlin. The data shows spin gaps at Delta and 2 Delta, and it has been speculated that either double scattering of magnons, multiple scattering, or a combination of both contribute to these gaps.

In my thesis project, I conducted a detailed analysis on the previous data taken at IN5 using Horace, a tool designed for analyzing time-of-flight neutron inelastic scattering data. By masking signals such as Bragg peaks and phonons, I isolated the magnetic scattering signals. It is expected to observe single-magnon gaps at odd k and double-magnon gaps at even k along the chain axis. From the reduced data, I approximated the Haldane gap energy. After performing a series of data deductions, I concluded the cause of the observed gaps and calculated the contribution of double-magnon scattering based on the result.

Field of study

Physics of Complex Systems

Supervisor

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Session Classification: Poster session: Enjoy the posters!