INSTITUTE SEMINAR

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Speaker:

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Title:

Theory of Magnetisation Plateaus in Shastry-Sutherland Model

Abstract:

The magnetisation plateaus in SrCu_2(BO_3)_2, the material that realises the famous Shastry-Sutherland model of frustrated quantum spin-1/2's, is a difficult problem that has been around for about fifteen years, and remains unresolved. Experimentally, the most prominent plateaus as a function of magnetic field occur at the fractions 1/8, 1/4 and 1/3 of the saturation magnetisation. More recently, 1/6 and 1/2 have also been clearly added to this list. The plateaus at other exotic fractions have also been reported, but their occurrence remains debatable. On the theoretical side, while the singlet ground state of the Shastry-Sutherland model is exactly known at zero magnetic field, the same is not true at finite fields. Hence, a neat understanding of the magnetisation plateaus has been lacking. The most actively taken route to study this problem is to derive effective models for the Shastry-Sutherland problem in magnetic field. Despite a great amount of effort and sophisticated effective models, an unambiguous understanding of the plateaus, especially at the lower fractions such as 1/8 and 1/6, has remained a challenge.

Very recently, we too have developed an effective model for this problem, but in a way that is different from what has been done thus far. Interestingly, all the prominent plateaus occur unambiguously in our simple effective model. It reveals an underlying particle-hole symmetry that relates 1/6 to 1/3, and predicts a plateaus at 3/8 due to the one at 1/8.

We have also shown that a weak Dzyaloshinskii-Moriya interaction in SrCu_2(BO_3)_2 disturbs this particle-symmetry. This nicely explains the experimental asymmetry below and above 1/4 plateau. Our minimal effective model for this problem is a quantum Ising problem with anisotropic Ising interactions and inhomogeneous transverse fields.

In this talk, first I will introduce this problem, and then discuss our approach that provides a neat and confident understanding of most of the features of the magnetisation behaviour of SrCu_2(BO_3)_2.

*Ref. *B. Kumar and B. Danu, arXiv:1408.3529**
