Tata Institute of Fundamental Research

Survey No. 36/P, Gopanpally Village, Serilingampally Mandal, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Spin liquid and deconfined quantum criticality: Shastry-Sutherland model and material

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The 2D Shastry-Sutherland model (SSM) of coupled S=1/2 dimers [1] is a corner stone in the theory of frustrated quantum magnetism and has a close realization in $SrCu_2(BO_3)_2$ (SCBO). Under ambient pressure, SCBO exhibits a gapped state with properties matching the SSM with ratio g=J/J'~0.63 of the inter- to intra-dimer couplings, where the ground state is an exact product state of dimer singlets. Numerical studies (e.g., [2]) have shown that the ground state of the SSM changes by a level crossing at g=0.68 into a doubly-degenerate plaquette-singlet (PS) state. It was believed that this type of ground state persists until a Neel antiferromagnetic state forms at g=0.76. However, recent work shows that there is also a gapless spin liquid phase between the PS and Neil states [3], and that this spin liquid may be connected to a so-called deconfined quantum critical point, beyond which there is a direct first-order PS-Neel transition. In $SrCu_2(BO_3)_2$, the coupling ratio g can be substantially increased under pressure, and both PS and Neel states are indeed observed. The spin liquid state is absent, possible because of 3D couplings. Recent high-pressure NMR experiments [4] show a direct very weakly first-order PS-Neel transition versus an external magnetic field, and scaling behavior of the spin-lattice relaxation rate indicates proximity to a deconfined quantum critical point. I will review the current status of spin liquid and deconfined quantum criticality in the SSM and in $SrCu_2(BO_3)_2$.

[1] B. S. Shastry and B. Sutherland, Physica B+C 108, 1069 (1981).
[2] J. Y. Lee, Y.-Z. You, S. Sachdev, and A. Vishwanath, PRX 9, 041037 (2019).
[3] J. Yang, A. W. Sandvik, and L. Wang, PRB 105, L060409 (2022).
[4] Y. Cui et al., Science 380, 1179 (2023).

Thursday, Apr 9th 2026

11:30 Hrs (Tea / Coffee 11:15 Hrs)

Auditorium, TIFRH