Confined and Deconfined Fractional Spin Excitations in two-dimensional Mott Insulators: A Spectral Perspective

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In this talk, I will present our recent work on spectral properties of the antiferromagnetic J1-J2 Heisenberg model, based on the extension of the electronic cluster perturbation theory to spin systems by using the mapping between spin-1/2 operators and hard-core bosons [1]. We find that deconfined spin-1/2 spinons beyond the conventional spin-1 magnons have already emerged partially even in the limit J2=0 and develop with J2, exhibiting as a continuum close to (π,0) in the Brillouin zone. In the region near J2=0.5J1, the entire spectrum is characterized by a broad continuum in which all magnons are deconfined into spinons, whose ground state is attributed to a Z2 quantum spin liquid with a help of the variational-Monte-Carlo analysis. The spinon continua are also found in the stripe phase with J2>0.6J1. In addition, I will also show the coexistence of fractional spin excitations and magnons in the spectra of the Kitaev-Γ (off-diagonal) model, which is suggested to describe the spin-orbital Mott insulator α -$RuCl_3$ [2,3].

Reference:

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[3] K.J. Ran, J.H. Wang, W. Wang, Z.Y. Dong, X. Ren, S. Bao, S.C. Li, Z. Ma, Y. Gan, Y.T. Zhang, J.T. Park, G.C. Deng, S. Danilkin, S.L. Yu, J.X. Li, and J.S. Wen Phys. Rev. Lett. **118**, 107203 (2017)