MA 28: Frustrated Magnets - Spin Liquids 2 (joint session TT/MA)

Time: Tuesday 14:00–15:15 Location: HSZ 304

MA 28.1 Tue 14:00 HSZ 304

Theory of partial quantum disorder in the stuffed honeycomb Heisenberg antiferromagnet — •Urban F. P. Seifert and Matthias Vojta — Institut für Theoretische Physik and Würzburg-Dresden Cluster of Excellence ct.qmat, Technische Universität Dresden, 01062 Dresden, Germany

Recent numerical results [Gonzalez *et al.*, Phys. Rev. Lett. **122**, 017201 (2019); Shimada *et al.*, J. Phys. Conf. Ser. **969**, 012126 (2018)] point to the existence of a partial-disorder ground state for a spin-1/2 antiferromagnet on the stuffed honeycomb lattice, with 2/3 of the local moments ordering in an antiferromagnetic Néel pattern, while the remaining 1/3 of the sites display short-range correlations only, akin to a quantum spin liquid.

In this talk, we derive an effective model for this disordered subsystem, by integrating out fluctuations of the ordered local moments, which yield couplings in a formal $1/S$ expansion, with S being the spin amplitude. The result is an effective triangular-lattice XXZ model, with planar ferromagnetic order for large S and a stripe-ordered Ising ground state for small S, resulting from frustrated Ising interactions. Within semiclassical analysis, the transition point between the two orders is located at $S_c = 0.646$, being very close to the relevant case $S = 1/2$. Near $S = S_c$ quantum fluctuations tend to destabilize magnetic order. We conjecture that this applies to $S = 1/2$, thus explaining the observed partial-disorder state.

MA 28.2 Tue 14:15 HSZ 304

Dirac Spin Liquid on the Spin-1/2 Triangular Heisenberg Antiferromagnet — •Shijie Hu[1], Wei Zhu[2], Sebastian Eggert[1], and Yin-Chen He[3] — [1]Physik und OPTIMAS, Technische Universität Kaiserslautern — [2]Natural Sciences, Westlake Institute of Advanced Study, Hangzhou — [3]Perimeter Institute, Waterloo

We study the spin liquid candidate of the spin-1/2 J_1-J_2 Heisenberg antiferromagnet on the triangular lattice by means of density matrix renormalization group (DMRG) simulations. By applying an external Aharonov-Bohm flux insertion in an infinitely long cylinder, we find unambiguous evidence for gapless U(1) Dirac spin liquid behavior. The flux insertion overcomes the finite size restriction for energy gaps and clearly shows gapless behavior at the expected wave-vectors. Using the DMRG transfer matrix, the low-lying excitation spectrum can be extracted, which shows characteristic Dirac cone structures of both spinon-bilinear and monopole excitations. Finally, we confirm that the entanglement entropy follows the predicted universal response under the flux insertion [1].

[1] Phys. Rev. Lett. **123**, 207203 (2019).

MA 28.3 Tue 14:30 HSZ 304

Phonon attenuation in $\mathbb{Z}_2$ quantum spin liquids — •Johannes Lang[1], Francesco Piazza[1], Roderich Moessner[1], and Matthias Punk[2] — [1]Max-Planck Institut für Physik komplexer Systeme, Dresden, Deutschland — [2]Ludwig-Maximilians-Universität München, München, Deutschland

In $\mathbb{Z}_2$ quantum spin liquids low lying excitations in the form of visons can couple to lattice vibrations. The high degree of frustration in the spin lattice results in an enlarged unit cell for the visons, which in turn has characteristic signatures in phonon attenuation.

MA 28.4 Tue 14:45 HSZ 304

Rank-2 Coulomb Spin Liquids from Classical Spins — •Owen Benton[1], Han Yan[2], Ludovic Jaubert[3], and Nic Shannon[2] — [1]Max Planck Institute for the Physics of Complex Systems — [2]Okinawa Institute of Science and Technology Graduate University — [3]CNRS Bordeaux

Coulomb spin liquids are well studied spin liquid states exhibiting emergent electromagnetism, having a coarse-grained description corresponding to Maxwell's laws. It has recently been appreciated that even more exotic scenarios are possible, realizing generalizations of electromagnetism with rank-2 electric and magnetic fields. These are of particular interest since the emergent charges of the rank-2 electromagnetism can be fractons, with fundamentally constrained mobility.

In this talk I will describe an approach to finding simple, bilinear models, for classical spins which realize rank-2 Coulomb phases at low temperature. Such models provide access to rank-2 Coulomb phase physics in a setting amenable to efficient numerical study and also suggest directions to look for rank-2 Coulomb phases in experiment.

Remarkably, we find that a traceless, vector-charged, rank-2 Coulomb phase can be generated by perturbing a simple Heisenberg model on the pyrochlore lattice with breathing anisotropy and weak Dzyaloshinskii-Moriya interactions. This enables us to identify Yb-based breathing pyrochlores as potential candidate systems and to make explicit predictions for how the rank-2 Coulomb phase would manifest itself in experiment.

MA 28.5 Tue 15:00 HSZ 304

Single-site magnetic anisotropy governed by interlayer cation charge imbalance in triangular-lattice $AYbX_2$ — •Ziba Zangenehpourzadeh, Stanislav Avdoshenko, Jeroen van den Brink, and Liviu Hozoi — IFW Dresden, 01069 Dresden, Germany

The behavior in magnetic field of a paramagnetic center is characterized by its g tensor. Here we shed light on the anisotropy of the g tensor of Yb^{3+} $4f^{13}$ ions in $NaYbX_2$ and $NaYbO_2$, layered triangular-lattice materials suggested to host spin-liquid ground states. Using quantum chemical calculations we show that, even if the ligand-cage trigonal distortions are significant in these systems, the decisive role in realizing strongly anisotropic, g factors is played by interlayer cation charge imbalance effects. The latter refer to the asymmetry experienced by a given Yb center due to having higher ionic charges at adjacent metal sites within the magnetic ab layer. This should be a rather general feature of $4f^{13}$ layered delafossites: less interlayer positive charge is associated with stronger in-plane magnetic response [1].

[1] Z. Zangeneh, et al, Phys. Rev. B **100**, 174436 (2019).