TT 89: Disordered Quantum Systems

Time: Thursday 11:30–12:45 Location: HFT-FT 131

TT 89.1 Thu 11:30 HFT-FT 131

Spin freezing and spin dynamics in the reentrant spin glass Fe_xCr_{1-x} — •Georg Benka[1], Steffen Säubert[1,2], Philipp Schmakat[2,3], Andreas Bauer[1], Stephen M. Shapiro[4], Peter Böni[3], and Christian Pfleiderer[1] — [1]Lehrstuhl für Topologie korrelierter Systeme, Technische Universität München, Garching, Germany — [2]Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching, Germany — [3]Lehrstuhl für Neutronenstreuung, Technische Universität München, Garching, Germany — [4]Brookhaven National Laboratory, Department of Physics, Upton, USA

Fe_xCr_{100-x} shows reentrant spin glass behaviour below a concentration dependent freezing temperature T_f. In contrast to a classical spin glass, the ground state changes from antiferromagnetic to ferromagnetic order with increasing iron concentration x. For intermediate concentrations a coexistence of the spin glass and magnetic order is discussed [1, 2]. We present a comprehensive study of the Fe_xCr_{100-x} system over a wide range of concentrations by means of magnetisation measurements in combination with neutron depolarisation and neutron spin echo methods. This allows us to compare the relaxation process depending on the particular state at high temperatures. Our measurements provide an unprecedented combination of microscopic information on the spin dynamics and spin freezing on multiple length and time scales.

[1] S. K. Burke et al., J. Phys. F: Met. Phys. 13 (1983) 451
[2] S. M. Shapiro et al., Phys. Rev. B 24 (1981) 6661

TT 89.2 Thu 11:45 HFT-FT 131

Low Temperature Properties of Amorphous Polymers containing Nuclear Quadrupole Moments — •Benedikt Frey, Nicole Assmann, Patrick Schygulla, Annina Luck, Andreas Fleischmann, Andreas Reiser, and Christian Enss — Kirchhoff-Institute for Physics, Heidelberg University, D-69120 Heidelberg

The low temperature properties of amorphous solids are governed by atomic tunneling systems and can be described by the phenomenological standard tunneling model (STM). In recent years, two-pulse polarization echoes and dielectric measurements, have revealed the importance of nuclear electric quadrupole moments for the tunneling dynamics. Dielectric properties of the multicomponent glasses N-KZFS11 and HY-1, containing atoms with very large nuclear electric quadrupole moments, show significant deviations from the STM. This can be interpreted as a new quadrupole mediated relaxation process, which dominates the relaxation rate at low temperatures.

In order to further study this relaxation mechanism, we measured the low temperature dielectric properties of several amorphous polymers, which contain nuclear quadrupole moments with quadrupole splittings ranging from 30 MHz to 250 MHz. The well known chemical structure of these polymers and the large variety of chemically accessible compositions enables systematic investigations. We present first results from dielectric measurements of three different polymers at frequencies between 60 Hz and 140 MHz. In particular, the brominated samples show strong deviations from the STM at low temperatures and low frequencies.

TT 89.3 Thu 12:00 HFT-FT 131

Loschmidt amplitude in disordered spin systems — •Sebastian Paeckel[1], Francisco Simao[1], Timo Mutas[2], Thomas Köhler[1], Markus Schmitt[1], and Salvatore Manmana[1] — [1]Institut für Theoretische Physik, Georg August Universität Göttingen, Germany — [2]University of Copenhagen, Copenhagen, Denmark

Motivated by recent studies on systems exhibiting time translational symmetry breaking [1,2] we investigated the Loschmidt echo for disordered spins systems with special focus onto the transverse Ising model. Starting from the Z_2 symmetric limit ($h_z \equiv 0$) we analytically calculated the time-evolution for various short ranged correlated initial states. Our results enable us to draw an intuitive picture for the emergence of time translational symmetry breaking which also permits to generalize our findigs to the case of $h_z \neq 0$ and consider more elaborated systems breaking Z_n symmetry.

We acknowledge funding by DFG FOR 1807.

[1] D V. Else, B Bauer, Ch Nayak, Phys. Rev. Lett. 117, 090402
[2] K. Sacha, J. Zakrzewski, arXiv:1704.03735

TT 89.4 Thu 12:15 HFT-FT 131

Spectral densities of disordered quantum spin ladders — •Max Hörmann, Paul Wunderlich, and Kai Phillip Schmidt — Institut für Theoretische Physik, FAU Erlangen-Nürnberg, Staudtstr. 7, D-91058 Erlangen

We investigate the zero-temperature dynamic structure factor of a two-leg spin-1/2 Heisenberg ladder with quenched disorder relevant for inelastic neutron scattering. To this end we apply perturbative continuous unitary transformations about the limit of isolated rungs using a white-graph expansion [1] to derive the physical properties of the elementary triplon and two-triplon excitations of the disordered spin ladder in the thermodynamic limit. Here we study bimodal disorder on rungs and legs realizable in experiments by intential doping of existing spin-ladder compounds. The effect of disorder on the two-triplon properties is calculated with high precision in the weakly-coupled rung regime and with that the fate of the bound states is predicted. For the material class of $BPCB_xC_{1-x}$ one- and two-triplon neutron scattering responses are calculated in both symmetry sectors.

[1] K. Coester and K.P. Schmidt, Phys. Rev. E 92, 022118 (2015).

TT 89.5 Thu 12:30 HFT-FT 131

Corrections to the self-consistent Born approximation for Weyl fermions — •Andreas Sinner and Klaus Ziegler — Institut für Physik, Theorie II Universität Augsburg Universitätsstr. 1 D-86159, Augsburg, Germany

The average density of states of two- and three-dimensional Weyl fermions is studied in the self-consistent Born approximation (SCBA) and its corrections [1]. The latter have been organized in terms of a 1/N expansion. It turns out that an expansion in terms of the disorder strength is not applicable, as previously mentioned by other authors. Nevertheless, the 1/N expansion provides a justification of the SCBA as the large N limit of Weyl fermions.

[1] A. Sinner, K. Ziegler, Phys. Rev. B 96, 165140 (2017).