TRR 80 Sonderseminar

Am Donnerstag, den 14. Januar um 13:30 Uhr

spricht

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über das Thema

Magnetic heat transport and thermal relaxation effects in pure and dilute spin ice

The spin-ice materials $R_2Ti_2O_7$ with R = Ho, Dy crystallize in a pyrochlore lattice with the magnetic R^{3+} ions forming a network of corner-sharing tetrahedra. The crystal electric field induces a strong Ising anisotropy, which forces the magnetic moments to point either into or out of each tetrahedron. This results in a geometric frustration with a ground-state degeneracy described by the so-called "2in/2out" ice-rule, meaning that 2 spins point into and 2 out of each tetrahedron, which is equivalent to the hydrogen displacement in water ice. Excited states are created by single spin flips resulting in "3in/1out" and "3out/1in" pairs, which, in zero magnetic field, fractionalize and are described as independently propagating magnetic (anti-)monopoles.
In this talk, I will report thermal conductivity measurements to clarify the influence of the monopole excitations on the total heat transport. From the anisotropic magnetic-field dependence and by additional measurements on reference compounds, we are able to separate the phononic and the magnetic contributions to the total heat transport, which both depend on the magnetic field. We also observe pronounced relaxation phenomena, which strongly increase with decreasing temperature and may even extend over hours at the lowest temperatures. In pure spin ice, these ultra-slow relaxation effects make an unambiguous determination of the ground state and its degeneracy very difficult. The partial substitution of the magnetic Dy^{3+} ions by non-magnetic Y^{3+}, however, rapidly suppresses these ultra-slow relaxation effects and in the dilution series $(Dy_{1-x}Y_x)_2Ti_2O_7$ we observe a systematic decrease of the low-temperature entropy with increasing x. Thus, our data suggest a rapid crossover from spin-ice physics in pure $Dy_2Ti_2O_7$ towards weakly interacting single-ion physics in $(Dy_{1-x}Y_x)_2Ti_2O_7$ at intermediate dilution levels. This contradicts the expected zero-temperature residual entropy obtained from a generalization of Pauling's theory for dilute spin ice, but is supported by Monte Carlo simulations.

Gäste sind herzlich willkommen.
Der Vortrag findet im Seminarraum S-403 / Institut für Physik, Universität Augsburg statt.

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