TT 81: Frustrated Magnets: General II

Time: Thursday 16:30–18:00 Location: H 2053

TT 81.1 Thu 16:30 H 2053

Order-by-disorder scenarios in the antiferromagnetic J_1-J_2-J_3 transverse-field Ising model on the ruby lattice — •Antonia Duft, Jan Koziol, Patrick Adelhardt, Matthias Mühlhauser, and Kai Phillip Schmidt — Friedrich-Alexander-Universität Erlangen-Nürnberg

We investigate the highly frustrated J_1-J_2-J_3 transverse-field Ising model on the ruby lattice. We derive effective models in the low-field limit and determine the gap closing of the high-field polarized phase by series expansions. The extensive ground-state degeneracy at zero field is lifted by two different order-by-disorder mechanisms. For $J_2 > J_3$, we find an emergent clock-ordered phase at low fields stabilized by resonating plaquettes and a 3d-XY quantum phase transition to the polarized phase similar to the triangular lattice. For $J_3 > J_2$, a diagonal order-by-disorder mechanism stabilizes a distinct $k = (0, 0)$ order and the phase transition to the high-field phase is in the 3d-Ising universality class. The special case $J_2 = J_3$ displays an enhanced ground-state degeneracy in the zero-field limit and no gap closing of the high-field gap can be detected reliably. The physics of the clock-ordered phase for $J_2 > J_3$ can be implemented in Rydberg atom arrays.

TT 81.2 Thu 16:45 H 2053

Signatures of Domain-Wall Confinement in Raman Spectroscopy of Ising Spin Chains — •Stefan Birnkammer[1,2], Johannes Knolle[1,2,3], and Michael Knap[1,2] — [1]Technical University of Munich, TUM School of Natural Sciences, Physics Department, 85748 Garching, Germany — [2]Munich Center for Quantum Science and Technology (MCQST), Schellingstr. 4, 80799 Munich, Germany — [3]Blackett Laboratory, Imperial College London, London SW7 2AZ, United Kingdom

Mesonic bound states of domain walls can be stabilized in quasi one-dimensional magnetic compounds. Here, we theoretically study the Raman light scattering response of a twisted Kitaev chain with tilted magnetic fields as a minimal model for confinement in $CoNb_2O_6$. By both numerical matrix product states and few-domain wall variational states, we show that confinement-induced bound states directly manifest themselves as sharp peaks in the Raman response. Near quantum criticality the Raman spectrum exhibit the famous E_8 symmetry. Remarkably, by tuning the polarization of the incident light field, we demonstrate that the Raman response offers new insights into the intrinsic structure of the bound state wavefunction.

TT 81.3 Thu 17:00 H 2053

Magneto- and barocaloric properties of the ferro-antiferromagnetic sawtooth chain — •Nico Reichert[1], Henrik Schlüter[1], Tjark Heitmann[2], Johannes Richter[3], Roman Rausch[4], and Jürgen Schnack[1] — [1]Fakultät für Physik, Universität Bielefeld — [2]Fachbereich Mathematik/Informatik/Physik, Universität Osnabrück — [3]Institut für Physik, Otto-von-Guericke-Universität Magdeburg; Max-Planck-Institut für Physik komplexer Systeme, Dresden — [4]Institut für Mathematische Physik, Technische Universität Braunschweig

Materials that are susceptible to pressure and external magnetic fields allow the combined use of both for caloric processes. Here we report investigations of the ferromagnetic-antiferromagnetic sawtooth chain that due to its critical behavior not only allows for both barocaloric as well as magnetocaloric processes but also features very large cooling rates in the vicinity of the quantum critical point [1].

[1] N. Reichert, H. Schlüter, T. Heitmann, J. Richter, R. Rausch, J. Schnack, Z. Naturforsch. A (2023) accepted

TT 81.4 Thu 17:15 H 2053

Quantum criticality in the sawtooth chain compound atacamite — •Leonie Heinze[1,2], Tommy Kotte[3], Albin Demuer[4], Sven Luther[3], Ralf Feyerherm[5], Andrew Ammerlaan[6], Uli Zeitler[6], Dirk Menzel[1], Kirrily C. Rule[7], Anja U. B. Wolter[8], Hannes Kühne[3], and Stefan Süllow[1] — [1]IPKM, TU Braunschweig, Braunschweig, Germany — [2]FZ Jülich GmbH, JCNS at MLZ, Garching, Germany — [3]HLD-EMFL, HZDR, Dresden-Rossendorf, Germany — [4]LNCMI, CNRS, Grenoble, France — [5]HZB, Berlin, Germany — [6]HFML-EMFL, Nijmegen, The Netherlands — [7]ANSTO, Kirrawee, Australia — [8]IFW Dresden, Dresden, Germany

We present an extensive high-field heat capacity study of the natural mineral atacamite, a material realization of the non-uniform quantum sawtooth chain in a very weak 3D coupling network [1]. For applied magnetic fields up to 35 T, we have mapped out the highly distorted entropy landscape of this frustrated material for $\mathbf{H} \parallel c$ axis. We found evidence for a field-induced quantum critical point in the phase diagram of atacamite, which appears to separate the field region of the antiferromagnetic phase present in lower magnetic fields and a field region without long-range magnetic order in higher magnetic fields—but far away from the saturation field.

[1] L. Heinze *et al.*, Phys. Rev. Lett. **126** (2021) 207201

TT 81.5 Thu 17:30 H 2053

Quantum-criticality of transverse-field Ising models with quenched disorder extracted by quantum Monte-Carlo methods — •Calvin Krämer, Anja Langheld, Jan Alexander Koziol, Max Hörmann, and Kai Phillip Schmidt — Lehrstuhl für Theoretische Physik, Staudtstraße 7, Universität Erlangen-Nürnberg, D-91058 Erlangen, Germany

We study the one- and two-dimensional transverse-field Ising model with quenched disorder at $T = 0$ by quantum Monte Carlo simulations. Using averaged binder ratios and a sample-replication method, we can extract critical points and correlation length exponents ν by finite-size scaling. Scaling of the averaged magnetisation at the critical point is used further to determine the order-parameter critical exponent β. The dynamical scaling in the Griffiths phase is investigated by measuring the local susceptibility in the disordered phase and the dynamical exponent z' is extracted.

TT 81.6 Thu 17:45 H 2053

Cooling and heating in the Bose-Hubbard model by parameter tuning — •Axel Pelster[1], Sven Stawinski[2], and Sebastian Eggert[1] — [1]University of Kaiserslautern-Landau, Landesforschungszentrum OPTIMAS — [2]Universität Bonn

We investigate short-range interacting Bosons in an optical lattice at finite temperature. It is well known that the system shows a Mott-Superfluid transition when changing the repulsion U, the hopping t and/or the filling. However, it is much less clear how the temperature is affected by those changes, assuming the parameter t and/or U are tuned adiabatically. We now present for the full Free energy in a higher-order mean field theory and derive the temperature and entropy in a large parameter space. We discuss where significant heating or cooling effects can be expected in the superfluid phase, in the Mott region and near the phase transition lines.