TT 35: CE: Low-dimensional Systems - Materials 3

Time: Wednesday 14:00–19:45 Location: HSZ 301

TT 35.1 Wed 14:00 HSZ 301

EELS and RIXS measurements of $La_{1-x}Sr_{1+x}MnO_4$, signatures of polarons — •Roberto Kraus[1], Matthias Schrade[1], Valentina Bisogni[1], Pieter Glatzel[2], Martin Knupfer[1], Bernd Büchner[1], and Jochen Geck[1] — [1]IFW Dresden, Germany — [2]ESRF Grenoble, France

The manganites show a variety of magnetic and electronic phases which are connected to charge, spin and orbital degrees of freedom. One example is the single layered perovskite $La_{1-x}Sr_{1+x}MnO_4$. Upon hole doping new in-gap states appear and up to now it is unclear if they are of charge-transfer or Mott-Hubbard type. To characterize the excitations in the system, we have performed electron energy-loss spectroscopy (EELS) and resonant inelastic X-ray scattering (RIXS) at the Mn K-edge. The observed in-gap excitation shows a small positive dispersion, which is a sign of a delocalized excitation. As a function of temperature a clear positive shift for this peak was found in the half-doped sample, implying a strong coupling of charge and spin dynamics. We present a model of electronic polarons for the new in-gap states which are created around the doped holes. The finite dispersion provides further the indication of polaron-ploaron interactions.

TT 35.2 Wed 14:15 HSZ 301

Magnetic and phononic excitation spectrum of the spin dimer system $Sr_3Cr_2O_8$ — •Dirk Wulferding[1], Peter Lemmens[1], Kwang-Yong Choi[1,2], Vladimir Gnezdilov[1,3], Diana Quintero-Castro[4], Bella Lake[4], Seunghun Lee[5], Hiroaki Ueda[6], Yutaka Ueda[6], and Joachim Deisenhofer[7] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]Chung-Ang Univ., Seoul, Korea — [3]ILTPE NAS, Ukraine — [4]Helmholtz-Zentrum Berlin, Germany — [5]Dep. of Phys., Univ. of Virginia, USA — [6]ISSP, Tokyo, Japan — [7]EP V, Univ. Augsburg, Germany

We present a Raman spectroscopic investigation of $Sr_3Cr_2O_8$, a spin dimer system with appreciable interdimer interactions. At T = 275 K the system undergoes a structural phase transition from hexagonal to monoclinic together with strong Jahn-Teller induced orbital fluctuations, that persist down to 120 K. Our temperature dependent study reveals phonon anomalies in this temperature range, as well as two magnetic modes with further decrease of temperature. We compare our results to theoretical calculations and previous neutron and infrared spectroscopic studies.

Work supported by DFG, IGSM and NTH.

TT 35.3 Wed 14:30 HSZ 301

Magnons in the Quantum Dimer Antiferromagnet $Sr_3Cr_2O_8$ — •Diana Lucia Quintero-Castro[1,2], Bella Lake[1,2], Elisa Maria Wheeler[1], and Nazmul Islam[1] — [1]Helmholtz Zentrum Berlin, Berlin 14109, Germany — [2]Institut für Festkörperphysik, Technische Universität Berlin, D-10623 Berlin, Germany

$Sr_3Cr_2O_8$ consists of a three-dimensional frustrated arrangement of antiferromagnetically coupled pairs of Cr ions or dimers. The Cr ions are in the unusual 5+ valence state resulting in one electron in the 3d shell and a spin value of 1/2 while a tetrahedral crystal field ensures that this electron occupies the doubly degenerate eg orbitals. Below room temperature $Sr_3Cr_2O_8$ undergoes a cooperative Jahn Teller distortion that lifts the orbital degeneracy so that only the $3z^2$-r^2 orbital is occupied. The low temperature structure is characterized by monoclinic crystal symmetry and antiferro-orbital ordering. The transition also gives rise to spatially anisotropic exchange paths and results in three crystal twins. We have grown single crystals of $Sr_3Cr_2O_8$ and have performed DC susceptibility measurements, high field magnetisation and powder and single crystal inelastic neutron scattering experiments. The data reveals a singlet ground state and gapped triplet excitations consisting of three modes, coming from the three crystal twins. Using a random phase approximation, we have extracted the magnetic exchange interactions within the dimer and between dimers. $Sr_3Cr_2O_8$ is a candidate for the study of the critical properties in the quantum phase transition as the magnetic field can drive a Bose Einstein condensation of magnons.

TT 35.4 Wed 14:45 HSZ 301

Evidence for strong orbital fluctuations below the Jahn-Teller transition in $Sr_3Cr_2O_8$ — •Zhe Wang[1], Michael Schmidt[1], Axel Günther[1], Sebastian Schaile[1], Nikola Pascher[1], Franz Mayr[1], Yurri Goncharov[1], Diana Quintero-Castro[2,3], A. T. M. Nazmul Islam[2], Bella Lake[2,3], Hans-Albrecht Krug von Nidda[1], Alois Loidl[1], and Joachim Deisenhofer[1] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, Institute of Physics, University of Augsburg, D-86135 Augsburg, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, D-14109 Berlin, Germany — [3]Institut für Festkörperphysik, Technische Universität Berlin, D-10623 Berlin, Germany

We report on the magnetic and phononic excitation spectrum of $Sr_3Cr_2O_8$ determined by THz and infrared (IR) spectroscopy, specific heat, and electron spin resonance measurements. We identify the singlet-triplet excitations in the dimerized ground state and observe an extended temperature range 125 K < T < 285 K below the Jahn-Teller transition, where the IR active phonons change only gradually with decreasing temperature. A clear anomaly in the specific heat marks the onset of orbital ordering at 285 K, but a detailed analysis of the orbital contribution to the specific heat shows the persistence of strong fluctuations down to 125 K in agreement with the IR data. Due to these fluctuations we can observe electron spin resonance absorptions only below 125 K with a linewidth proportional to exp(-Δ/kT) indicating an Orbach-type spin relaxation via the excited orbital state of the Cr e-doublet split by Δ/k=388 K.

TT 35.5 Wed 15:00 HSZ 301

Low dimentional magnetic properties of compounds belonging to the $CrVO_4$-type structure — •Joseph M. Law[1,2] and Reinhard K. Kremer[1] — [1]Max Planck Institute for Solid State Research, Heisenbergstrasse 1, D-70569 Stuttgart — [2]Department of Physics Loughborough University, Loughborough, Leics, LE11 3TU United Kingdom

Compounds with the ABX_4 composition exhibit a range of different magnetic properties. In recent years we have concentrated on only those adopting the $CrVO_4$-type structure, where we have a magnetic atom occupying the A position and a diamagnetic only atom within the B position. The A atom is housed within a distorted octahedral environment, the AO_6 units are edge sharing and form buckled ribbon chains along the c-axis. The B atoms are contained within tetrahedral Oxygen environments which bridge the ribbon chains.

We are present first results on the magnetic properties of some selected of this series which show, multiferroic behavior, spin-Peierls transitions and conventional long-range magnetic ordering.

15 min. break

TT 35.6 Wed 15:30 HSZ 301

Magnetic phase diagram of quasi one-dimensional Ising spin-1/2 chain system $BaCo_2V_2O_8$ — •Sandra Niesen, Gerhard Kolland, Oliver Heyer, Daniel Löwen, Martin Valldor, and Thomas Lorenz — II. Physikalisches Institut, Universität zu Köln

$BaCo_2V_2O_8$ contains screw chains of CoO_6 octahedra which are running along the c axis of the tetragonal crystal structure and are separated by nonmagnetic Ba^{2+} und V^{5+} ions. Due to a compression of the octahedra along c the threefold degeneracy of the t_{2g} orbitals is lifted and the magnetic ground state can be described by an effective Ising spin-1/2 antiferromagnetic chain. Due to a finite inter-chain coupling, $BaCo_2V_2O_8$ shows long-range antiferromagnetic order below $T_N \simeq 5.5$ K with the spins oriented along c. Here, we present the magnetic phase diagram extracted from measurements of the magnetization, the specific heat, the thermal expansion, magnetostriction, and the thermal conductivity in magnetic fields up to 17 T. The magnetic field influence is highly anisotropic: in case of $H \parallel c$, the Néel order is strongly suppressed already for low fields and changes into an incommensurate phase above about 4 T. Apart from this expected Ising anisotropy, we have discovered a new magnetic anisotropy for fields applied within the aa plane. For fields applied along [110] T_N is only weakly suppressed, while for magnetic fields applied along [100] T_N is completely suppressed above about 10 T. In this case the T-H-phase boundary exhibits most probably a quantum critical point.

This work is supported by the DFG through SFB 608.

TT 35.7 Wed 15:45 HSZ 301

***Ab initio* modeling of Bose-Einstein condensation in $Pb_2V_3O_9$** — •Alexander Tsirlin and Helge Rosner — Max Planck Institute CPfS, Dresden, Germany

We present the computational approach to the microscopic study of Bose-Einstein condensation (BEC) in quantum magnets. Using density functional theory band structure calculations, we establish the microscopic magnetic model of a BEC compound $Pb_2V_3O_9$, refine the model by fitting the experimental data, and further simulate the full temperature-vs-field phase diagram. In contrast to previous theoretical descriptions based on the alternating-spin-chain model, we find that $Pb_2V_3O_9$ represents an unfrustrated quasi-two-dimensional spin system of coupled spin dimers. The intradimer coupling is about 30 K, whereas the interdimer couplings are both ferro- and antiferromagnetic. The structural implementation of the model is rather non-trivial, with weaker ferromagnetic couplings along the chains of corner-sharing VO_6 octahedra and stronger antiferromagnetic couplings between the structural chains. Our model leads to remarkable agreement with the available experimental data on the BEC in $Pb_2V_3O_9$ and discloses the role of individual exchange couplings in this compound. While antiferromagnetic couplings alone lead to a one-dimensional spin system, the presence of ferromagnetic couplings and the two-dimensionality are essential for the BEC high-field ground state of $Pb_2V_3O_9$.

TT 35.8 Wed 16:00 HSZ 301

Spin orbit coupling induced phonon anomalies and relevant electronic energy scales in Sr_2IrO_4 — •Mehmet Fatih Cetin[1,2], Peter Lemmens[1,2], Vladimir Gnezdilov[1,3], Dirk Wulferding[1,2], Dirk Menzel[1], Wolfram Brenig[4,2], Tomohiro Takayama[5], Kei Ohashi[5], and Hidenori Takagi[5,6] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]NTH, Germany — [3]ILTPE NAS, Ukraine — [4]ITP, TU-BS, Braunschweig, Germany — [5]AM, University of Tokyo, Japan — [6]RIKEN Advanced Science Institute, Japan

Sr_2IrO_4 is a Mott insulator due to the interplay of strong spin orbit coupling and crystal field interactions. The strong spin orbit interaction is evident in our study via pronounced phonon anomalies and multiphonon scattering. In addition we observe broad high energy modes that are attributed to exchange scattering on a square plane with J_{eff}=1/2.

Work is supported by DFG, IGSM and NTH School for Contacts in Nanosystems.

TT 35.9 Wed 16:15 HSZ 301

Helica magnetic structure in the distorted triangular antiferromagnet α-$CaCr_2O_4$ — •Sandor Toth[1,2], Bella Lake[1,2], Nazmul Islam[1], Simon Kimber[3], Oliver Pieper[1], Dimitri Argyriou[1], Manfred Reehuis[1], and Oksana Zaharko[4] — [1]Helmholt Zentrum Berlin, Hahn-Meitner-Platz 1, 14109 Berlin, Germany — [2]Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany — [3]ESRF, 6 Rue Jules Horowitz BP 220, 38043 Grenoble Cedex 9, France — [4]Laboratory for Neutron Scattering, PSI, CH-5232 Villigen, Switzerland

α-$CaCr_2O_4$ is a distorted triangular lattice antiferromagnet. The S=3/2 magnetic Cr^{3+} ions are located on slightly distorted stacked triangular layers. The octahedral enviroment ensures that the 3 d-electrons occupy the low lying t_{2g} levels and that the orbital moment is quenched. Magnetic susceptibility suggests strong magnetic correlations below 50 K. Powder and single crystal neutron diffraction show helical magnetic ordering below T_N=42.6 K, where the ordering wave vector k$\sim$(0 1/3 0) and the angle between neighboring spins within the triangular plane is 120°. Spherical neutron polarimetry unambiguously proved that the helical plane is perpendicular to the b axis. The observed magnetic order is a characteristic of nearest neighbor Heisenberg interactions on an equilateral triangular lattice in apparent contradiction to the distorted crystal which allows for 4 inequivalent nearest neighbour exchange paths. By simulating the magnetic order of α-$CaCr_2O_4$ as a function of these 4 interactions it is found that 120° helical order is in fact stable over a large range of parameter space.

TT 35.10 Wed 16:30 HSZ 301

Imaging of the two-dimensional polarization landscape at the $LaAlO_3/SrTiO_3$ interface — •Tim Günter[1], Andrea Rubano[1], Thomas Fink[1], Domenico Paparo[2], Fabio Miletto Granozio[2], Umberto Scotti di Uccio[2], Lorenzo Marrucci[2], Jochen Mannhart[3], and Manfred Fiebig[1] — [1]HISKP, University of Bonn, Germany — [2]CNR-INFM Coherentia, Università Federico II, Napoli, Italy — [3]Center for Electronic Correlations and Magnetism, University of Augsburg, Germany

$LaAlO_3/SrTiO_3$ interfaces are a challenging topic in the field of perovskite oxides. A conductive two-dimensional electron liquid (2DEL) appears at the interface for a $LaAlO_3$ thickness of n$\geq$4 unit cells. However, many questions regarding the origin and characteristics of the 2 DEL have to be adressed yet. In particular, this includes the spatial homogeneity of the interface reconstruction.

Second Harmonic Generation (SHG) is an ideal tool for studying interfaces, since it is sensitive to the interfacial symmetry breaking along the stacking direction. Furthermore, the spatial degrees of freedom of optical techniques can be exploited. Here we use SHG with amplified femtosecond laser pulses for imaging the $LaAlO_3/SrTiO_3$ interface with a spatial resolution of $\approx$ 2 μm. For n=1 a pronounced interfacial inhomogeneity on a lengthscale of $<$ 1 μm is observed. The lateral dimension of these inhomogeneities increases for n=2 pointing to a step-like reconstruction of the interface. At n=3, the interface becomes homogeneous which may reflect the completion of a fully reconstructed interface, though yet without the emergence of conductivity.

15 min. break

TT 35.11 Wed 17:00 HSZ 301

Evaluation of Realistic Parameters in Organics — •Andreas Dolfen and Erik Koch — German Research School For Simulation Sciences, FZ-Jülich and RWTH Aachen University, 52425 Jülich, Germany

The study of exotic correlation effects in real strongly correlated materials evidently requires realistic parameters for the model Hamiltonians. Traditionally, they have been fitted to experiment, or semi-empirically determined. This approach is, obviously, unsatisfactory. Still, for general materials these procedures are state-of-the-art as no feasible other way is known. For organic crystals, however, we devised an approach to systematically evaluate realistic, material-specific model parameters for extended Hubbard models. Starting from density-functional calculations we include the renormalization of the model parameters due to the down-folded degrees using a distributed dipole approach. We apply the method to Θ-$(BEDT\text{-}TTF)_2I_3$.

TT 35.12 Wed 17:15 HSZ 301

Vibrational control of Mottness in the organic Mott insulator ET-F2TCNQ — Stefan Kaiser[1], •Daniele Nicoletti[1], Raanan I. Tobey[2], Nicky Dean[2], Stefano Lupi[3], Hiroshi Okamoto[4], Jun'ya Tsutsumi[4], Tatsuo Hasegawa[4], and Andrea Cavalleri[1,2] — [1]Max Planck Research Department for Structural Dynamics, Center for Free Electron Laser Science & University of Hamburg, c/o DESY, Hamburg, Germany — [2]Department of Physics, Oxford University, UK — [3]Department of Physics, University of Rome La Sapienza, Italy — [4]AIST, Tsukuba, Japan

Control of on-site electronic wavefunctions is achieved in the organic conductor ET-F2TCNQ by resonant excitation of localized vibrational modes of the ET molecule. Such excitation modulates the on-site Coulomb repulsion and modifies the relative strength of electron correlations and hopping, thus controlling the Mott criterion. We performed pump-probe experiments using optical parametrical amplifiers, with a time resolution of 80 fs. Excitation was achieved with mid-IR pulses from difference frequency mixing, resonant with two different intramolecular vibrations at 10 and 6 microns. The probe was tuned over the whole IR range, in order to trace the reflectivity changes in the charge-transfer band and the possible filling of the Mott gap, thus providing a direct evidence of the control of on-site Coulomb repulsion. Through such mode-selective excitations, the Mott gap can be filled and the system is pushed forward to the less correlated and metallic side. This approach promises a new way of control for electronic and even superconducting properties in correlated electron systems.

TT 35.13 Wed 17:30 HSZ 301

Thin films and single crystals of new organic charge transfer salts — •Milan Rudloff and Michael Huth — Physikalisches Institut, Goethe-Universität, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main

We synthesized and characterized both, thin films and single crystals of several new organic charge transfer (CT) systems. In general these materials consist of donor and acceptor molecules that show an additional electrostatic attraction induced by Coulomb interaction between donor and acceptor. The electronic behaviour of the resulting new complex (depending on crystal structure, temperature and pressure) can be insulating, semiconducting, metallic or superconducting.

The thin films were prepared by organic molecular beam deposition (OMBD) while single crystals were grown from solution. Samples were primarily characterized by light microscopy, X-ray diffractometry and (temperature dependent) transport measurements.
We succeeded in synthesizing a series of CT salts and thus extended the material base of CT thin films. The results presented here focus on the system 4,5,9,10-Tetramethoxypyrene-9-Dicyanomethylene-2-4-7-trinitrofluorene, especially its electronic transport characteristics.

TT 35.14 Wed 17:45 HSZ 301

Spin Excitations in the Odd Homonuclear Antiferromagnetic Molecular Nanomagnet Fe_9 — •Nikolaos P. Konstantinidis, Joscha Nehrkorn, Stefan Stuiber, and Oliver Waldmann — Physikalisches Institut, Universität Freiburg, 79104 Freiburg, Germany

The homonuclear ring Fe_9 has an odd number of antiferromagnetically coupled Fe^{III} spin-5/2 centers, therefore frustration plays an important role in determining its magnetic properties. Molecular wheels of odd size have been known to possess a doubly-degenerate lowest level in each total spin S sector in the absence of magnetic anisotropy. We have performed inelastic neutron scattering measurements which produced very sharp peaks that located the transitions between the energy levels very accurately. Our magnetic susceptibility data also provided an estimate for the strength of the exchange interactions, while torque magnetometry reveals the presence of weak magnetic anisotropy. Different Hamiltonians are used to find the appropriate model for the magnetic properties of Fe_9, with the energy levels characterized by the symmetry of the Hamiltonian. Exchange interactions that respect the spatial symmetry of the molecule coupled with a uniform single-site anisotropy term can not reproduce the splitting of the lowest energy levels. Especially the lowest lying $S = 3/2$ doublet is unexpectedly robust against perturbations. This particular nature of the theoretically generated low-energy spectrum will be discussed.

TT 35.15 Wed 18:00 HSZ 301

3d-4f molecular nanomagnets investigated by X-ray magnetic circular dichroism — •Jan Dreiser[1], Cinthia Piamonteze[1], Frithjof Nolting[1], Stefano Rusponi[2], Harald Brune[2], Kasper S. Pedersen[3], Jesper Bendix[3], and Hoegni Weihe[3] — [1]Paul Scherrer Institut, Swiss Light Source, CH-5232 Villigen PSI, Switzerland — [2]Ecole Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland — [3]Department of Chemistry, University of Copenhagen, Universitetsparken 5, DK-2100 Copenhagen, Denmark

Single-molecule magnets are exchange-coupled spin clusters showing slow relaxation of magnetization. In recent years, efforts have been intensified to increase the magnetization reversal barrier and thus enhance relaxation times by combining rare earth ions with transition-metal ions. Rare-earth ions exhibit very large magnetic anisotropies due to their strong spin-orbit coupling and their mostly unquenched orbital momentum. In this contribution we use X-ray magnetic circular dichroism to observe element-specific magnetization curves. In conjunction with SQUID magnetization and susceptibility measurements, we are able to determine the magnetic coupling between 3d and 4f ions.

15 min. break

TT 35.16 Wed 18:30 HSZ 301

Nanogranular Metals: From electronic correlations to strain-sensing applications — •Christian H. Schwalb[1,2] and Michael Huth[1] — [1]Physikalisches Institut, Goethe-Universität, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany — [2]NanoScale Systems GmbH, Robert-Bosch-Str. 7, 64293 Darmstadt, Germany

Granular metals are artificial materials in which a conducting phase made of metallic nanoparticles is (randomly) dispersed into an insulating matrix. The charge transport in such systems is dominated by tunneling between neighboring metallic nanoparticles, a process that is strongly influenced by correlation effects. These fundamental processes can be used for practical applications, since the tunnel coupling has an intrinsically exponential dependence on the inter-grain distance that is altered under strain.

In this work, we present a novel methodology for strain-sensing based on nanogranular metals using focused electron-beam-induced deposition (FEBID). The gauge factor for these nanogranular metals depends on the conductivity of the sensor element that can be altered by electron-beam irradiation leading to a distinct maximum in the sensitivity that can be attributed to a persistent change of the dielectric carbon matrix.[1] Additionally an analysis scheme is presented that draws on recent advances in the understanding of charge transport mechanisms in granular metals [2] and allows for a semi-quantitative description of the sensitivity of granular metal based strain sensors.
[1] C. H. Schwalb *et al.*, Sensors **10**, 9847 (2010)
[2] M. Huth, J. Appl. Phys. **107**, 113709 (2010)

TT 35.17 Wed 18:45 HSZ 301

Tomonaga-Luttinger Liquid Behavior in Atomic-Scale Gold Chains on a Semiconductor — •Christian Blumenstein[1], Jörg Schäfer[1], Sebastian Meyer[1], Sebastian Mietke[2], Michael Lochner[2], Rene Matzdorf[2] und Ralph Claessen[1] — [1]Physikalisches Institut, Universität Würzburg — [2]Institut für Physik, Universität Kassel

Atomic nanowires formed by self-organization of metal adatoms on semiconductor surfaces offer a vast playground for physics in low dimensions. While effects like a charge density wave were reported there, the quest for the observation of Tomonaga-Luttinger liquid (TLL) behavior has been ongoing. Recently, Au-induced chains on Ge(001) have been prepared [1], which are structurally and electronically of exceptional one-dimensional (1D) character. Therefore they provide an opportunity to study exotic 1D physics.

The talk will address the electronic properties of these Au chains, which have been investigated by scanning tunneling spectroscopy (STS) and angle-resolved photoemission (ARPES) over a wide temperature range. A power-law behavior in the density of states upon energy has been discovered, characteristic of a TLL. The corresponding exponent α is found independently by both STS and ARPES. Furthermore, *universal scaling* behavior is observed as a hallmark of TLL physics. This renders the Au/Ge(001) chains the first TLL system at a crystal surface, opening new possibilities to probe modified interactions from specific atomic configurations.
[1] J. Schäfer et al., Phys. Rev. Lett. 101, 236802 (2008).

TT 35.18 Wed 19:00 HSZ 301

Tuning the electrical properties of Pt-based granular metals prepared by focused electron beam induced deposition — •Roland Sachser, Fabrizio Porrati, Christian H. Schwalb, and Michael Huth — Physikalisches Institut, Goethe-Universität, D-60438 Frankfurt am Main, Germany

We investigated granular metals which have been prepared by focused electron beam induced deposition (FEBID) using the precursor trimethyl(methylcyclopentadienyl)platinum. Microstructural changes of the matrix caused by additional electron beam irradiation after the deposition process lead to an increase of the tunnel coupling between the metallic particles and thus allow a continuous tuning from insulating to metallic behavior with increasing irradiation dose. Transport measurements in the range from 2 K to 260 K were performed on a set of samples which had been exposed to different irradiation doses. For samples with low irradiation dose Efros-Shklowski variable range hopping is observed. Longer irradiated samples show instead a logarithmic conductivity versus temperature dependence over a wide range, e. g. from about 7 K to 260 K for an irradiation dose of $4.4 \cdot 10^5 C/m^2$. Applying a recent theoretical model [1] on this specific sample gives characteristic values for the dimensionless tunnel coupling strength, which is expected close to the metal insulator transition. The observed logarithmic temperature dependence of the conductivity is also predicted by this theory. For much higher irradiation doses we observe a metallic behavior with a positive temperature coefficient of the resistance.
[1] I. S. Beloborodov et al., Rev. Mod. Phys. **79**, 469 (2007)

TT 35.19 Wed 19:15 HSZ 301

Four-leg Shastry-Sutherland tubes in a magnetic field — •Gregor Foltin[1], Salvatore Manmana[2], Frederic Mila[3], and Kai Phillip Schmidt[1] — [1]Lehrstuhl für Theoretische Physik I, TU Dortmund, 44221 Dortmund, Germany — [2]JILA, University of Colorado at Boulder, Colorado 80309, USA — [3]CTMC, EPF Lausanne, 1015 Lausanne, Switzerland

The origin of the exotic magnetization of the highly frustrated quantum magnet $SrCu(BO_3)_2$ is currently not understood. One theoretical challenge is the fact that it is microscopically well described by the so-called two-dimensional Shastry-Sutherland model in a parameter regime close to a quantum critical point. Especially the experimentally most prominent plateau at 1/8 seems to be not stable in the Shastry-Sutherland model at least up to intermediate couplings. The latter finding is obtained by deriving an effective low-energy model using perturbative continuous unitary transformations (pCUTs) which is

then solved in the classical approximation (CA).

In this contribution, we focus on quasi-1d versions of the model where the pCUT(+CA) approach can be compared with density matrix renormalization group (DMRG). This has been already done successfully for a two-leg Shastry-Sutherland tube. Interestingly, a novel type of magnetization plateau is found at 1/5 consisting of bound states of triplons with different quantum numbers. Here we want to extend this work by studying a Shastry-Sutherland tube with four orthogonal dimer chains. To this end results from pCUT(+CA) and DMRG are compared.

TT 35.20 Wed 19:30 HSZ 301

Quantum transport in correlated nanosystems — •Malcolm Einhellinger[1], Alex Cojuhovschi[1], Eric Jeckelmann[1], Sabine Tornow[2], and Gertrud Zwicknagl[2] — [1]Leibniz Universitaet Hannover — [2]TU Braunschweig

We investigate the transient dynamics and steady-state transport properties of correlated nanowires and the charge transfer through molecular bridges contacted to donor and acceptor species. The time-evolving block decimation (TEBD) [1] and time-dependent numerical renormalization group (TD-NRG) [2] methods are used to simulate the nonequilibrium dynamics of quantum many-body fermion models. Correlated nanowires are described as interacting one-dimensional fermion chains such as the spinless fermion model and the Hubbard model. We obtain a good agreement with the predictions of the Luttinger liquid theory. To study the charge transfer through molecules we propose a model describing a complex interacting structure contacted to non-interacting leads, which generalizes the tight-binding model proposed in [3], and discuss the TEBD and TD-NRG performances and predictions for this model.

[1] G. Vidal, Phys. Rev. Lett. 91, 147902 (2002); 93, 040502 (2004)
[2] F.B. Anders and A. Schiller, Phys. Rev. Lett. 95, 196801 (2005)
[3] S.S. Skourtis et al., Phys. Rev. Lett. 101, 238103 (2008)