TT 19: Low Dimensional Systems: Other Topics

Time: Monday 17:00–18:30 Location: HSZ 103

TT 19.1 Mon 17:00 HSZ 103

Luttinger liquids with inhomogeneous interactions — Sebastian Huber[1] and •Marcus Kollar[2] — [1]Theoretical Solid State Physics, Ludwig- Maximilians-University, Munich, Germany — [2]Theoretical Physics III, University of Augsburg, Germany

We study a generalization of the two-flavor spinless Tomonaga-Luttinger model which includes inhomogeneous local interactions and scattering potentials. For a wide range of parameters we obtain the spectrum and Green function exactly using Kronig identities with momentum transfer [1]. While Green functions have a power-law form as in homogeneous Luttinger liquids, a sufficiently strong position dependence of the interaction breaks their translational invariance. Furthermore, the Luttinger-liquid interrelations between excitation velocities and Green function exponents are modified in such 'Luttinger droplets' [2].
[1] S. Huber, M. Kollar, Verhandl. DPG (VI) 52, 2/TT24.1 (2017)
[2] S. Huber, M. Kollar, arXiv:1911.03158

TT 19.2 Mon 17:15 HSZ 103

Drude weight increase by orbital and repulsive interactions in fermionic ladders — Andreas Haller[1], •Matteo Rizzi[2,3], and Michele Filippone[4] — [1]Institute of Physics, Johannes Gutenberg University, D-55099 Mainz, Germany — [2]Institute of Quantum Control (PGI-8), Forschungszentrum Jülich, D-52425 Jülich, Germany — [3]Institute for Theoretical Physics, University of Cologne, D-50937 Köln, Germany — [4]Department of Quantum Matter Physics, Ecole de Physique, University of Geneva, CH-1211 Geneva 4, Switzerland

In strictly one-dimensional systems, repulsive interactions tend to reduce particle mobility on a lattice. Therefore, the Drude weight, controlling the divergence at zero-frequency of optical conductivities in perfect conductors, is lower than in non-interacting cases. We show that this is not the case when extending to quasi one-dimensional ladder systems. Relying on bosonization, perturbative and matrix product states (MPS) calculations, we show that nearest-neighbor interactions and magnetic fluxes provide a bias between back- and forward-scattering processes, leading to linear corrections to the Drude weight in the interaction strength. As a consequence, Drude weights counter-intuitively increase (decrease) with repulsive (attractive) interactions. Our findings are relevant for the efficient tuning of Drude weights in the framework of ultracold atoms trapped in optical lattices and equally affect topological edge states in condensed matter systems.
[1] arXiv:1911.11160

TT 19.3 Mon 17:30 HSZ 103

Signature of isotropic electric dipole dynamics in $BaFe_2X_3$ (X = S/Se) — •Yuk Tai Chan[1], Seulki Roh[1], Soohyeon Shin[2,3], Tuson Park[2,3], Martin Dressel[1], and Ece Uykur[1] — [1]1. Physikalisches Institut, Universität Stuttgart, Germany — [2]Department of Physics, Sungkyunkwan University, Suwon, Republic of Korea — [3]Center for Quantum Materials and Superconductivity (CQMS), Sungkyunkwan University, Suwon, Republic of Korea

$BaFe_2S_3$ (BFS) and $BaFe_2Se_3$ (BFSe) hold a rare and interesting quasi-1D Fe-ladder structure. Although they are isostructual, magnetic ground states of these are significantly different: BFSe possesses a block-type antiferromagnetic (AFM) order along the leg with $T_N \sim 200$ K, whereas BFS forms a stripe-type AFM order along the leg with $T_N \sim 100$ K. The block-type AFM in BFSe has the potential to generate ferroelectric polarization and hence raise hope for a realization of robust multiferroic order. In this study, polarization-dependent dielectric spectroscopy has been performed on single crystals BFS and BFSe. Counterintuitive to the highly anisotropic quasi-1D structure, nearly isotropic relaxor ferroelectric behaviors are observed for both compounds. The range of temperature for the relaxation in BFSe is ~ 100 K above that in BFS, which follows their AFM order, T_N, and therefore suggests a shrouded relationship between the magnetism and electric dipole dynamics.

TT 19.4 Mon 17:45 HSZ 103

1D coordination polymers on metal surfaces with distinct structures defined by the choice of the transition metal — •Vijai Meena Santhini, Christian Wackerlin, Ales Cahlik, Oleksander Stetsovych, Pingo Mutombo, and Pavel Jelinek — Institute of Physics, Czech Academy of Sciences, Prague, Czech Republic

2,5-diamino-1,4-benzoquinonediimines (QDIs)belong to one of the most important classes of π-conjugated molecules and are particularly interesting because of the unusual distribution of their overall 12-π electrons system which can be described as two nearly-independent 6-π electrons subunits chemically connected through two C-C single bonds.

In this context, we explore here the reaction between transition metal atoms (Cr, Fe, Co, Ni and Cu) and QDI directly at the solvent-free solid-vacuum interface. The metals are introduced as neutral metal atoms from an electron-beam evaporator (all except Cu) or they are provided by the substrate (Cu). QDI is introduced by sublimation, and is let to react on Au(111) and Cu(111) surfaces with the metal atoms. . The {Cr, Fe, Co, Ni}-based wires are built from a four-fold rectangular-planar coordination motif while with Cu the wires are based on two-fold linear coordination motifs. The reaction products are characterized by combined scanning tunneling microscopy (STM) non-contact atomic force microscopy (nc-AFM) and N K near edge X-ray absorption fine structure (NEXAFS) spectroscopy.

TT 19.5 Mon 18:00 HSZ 103

RKKY-coupled Co adatom spins on WS_2 monolayers — •Jan Honolka[1], Charlotte Sanders[3], Sergey Mankovsky[4], Brian Kiraly[2], Sanjoy Mahatha[3], Svetlana Polesya[4], Martin Vondracek[1], Ales Cahlik[1], Sarnjeet Dhesi[6], Jan Minar[5], Hubert Ebert[4], Philip Hofmann[3], and Alexander Khajetoorians[2] — [1]Inst. of Physics ASCR, Na Slovance 4, CZ-8000 Praha — [2]Radboud Univ. Nijmegen, Inst. Molecules & Mat., NL-6525 AJ Nijmegen — [3]Aarhus Univ., Dept. Physics and Astronomy, DK-8000 Aarhus — [4]Ludwig Maximilians Univ. Muenchen, Dept. Chem., D-81377 Munich — [5]Univ. West Bohemia, New Technol. Research Center, Univ. 2732, CZ-30614 Pilsen — [6]Diamond Light Source, UK-OX11 0DE Didcot

Antiferromagnetic order can potentially change fundamental symmetries in 2D materials. Here we report on magnetic and structural properties of cold-deposited Co atoms on single layer WS_2/Au(111), which are characterised by X-ray magnetic circular dichroism (XMCD) measurements and scanning tunneling microscopy (STM) and spectroscopy (STS), respectively. We observe a highly compensated magnetic state at intermediate Co coverages of 0.2 - 0.3 monolayers. Density functional theory shows that indirect RKKY coupling constants between Co adatoms are of the order of few meV and negative at Co-Co distances 0.5 - 1 nm, which creates a non-collinear magnetic structure. In the limit of 1 monolayer ferromagnetism sets in. Strain effects due to the substrate are discussed.

TT 19.6 Mon 18:15 HSZ 103

Preferential out-of-plane conduction and quasi-one-dimensional electronic states in layered van der Waals material 1T-TaS_2 — Edoardo Martino[1,2], Andrea Pisoni[1], Luka Ćirić[1], Alla Arakcheeva[1], Helmuth Berger[1], Ana Akrap[2], Carsten Putzke[1], Philip Moll[1], Ivo Batistić[3], Eduard Tutiš[4], László Forró[1], and •Konstantin Semeniuk[1] — [1]EPFL, Lausanne, Switzerland — [2]University of Fribourg, Fribourg, Switzerland — [3]University of Zagreb, Zagreb, Croatia — [4]Institute of Physics, Zagreb, Croatia

The prevailing strategy for functionalising layered crystals is manipulating coupling between atomic sheets to create novel exploitable electronic states. The responsible interactions can be sensitively gauged by the interlayer charge transport, which has remained largely unexplored. We conducted an unambiguous study of resistivity anisotropy of 1T-TaS_2 — a system known for its plethora of diverse phases and a metal-insulator transition of highly debated origin. We present an unprecedented case of drastically better electronic coherence in the out-of-plane direction than within the planes, resulting in the resistivity anisotropy of the order of 1. In the unique nano-composite phase, the complex aperiodic lattice structure suppresses the in-plane conduction. Simultaneously, the material exhibits a conventional metallicity along the c-axis, predicted to originate from the charge-density-wave-induced formation of quasi-one-dimensional orbital chains. The proposed behaviour favours the band-insulator nature of the low-temperature state of 1T-TaS_2, contrary to the long-standing Mott localisation picture.