MON 12: Quantum Magnets

Time: Monday 14:15–15:45 Location: ZHG105

MON 12.1 Mon 14:15 ZHG105

Quantum skyrmions and antiskyrmions in monoaxial chiral magnets — Stefan Liscak, Andreas Haller, Andreas Michels, •Thomas L. Schmidt, and Vladyslav M. Kuchkin — Department of Physics and Materials Science, University of Luxembourg, L-1511 Luxembourg, Luxembourg

Classical monoaxial chiral magnets represent a unique magnetic system that allows for the stabilization of both skyrmions and antiskyrmions of equal energy. Unlike a similar situation in frustrated magnets, the energy landscape here is much simpler, consisting of four states: the saturated ferromagnetic state, spin-spiral, skyrmion, and antiskyrmion. This simplicity makes such systems interesting for potential applications that rely on manipulating these states. We study the quantum analog of the already established classical theory by investigating the low-energy excitation spectra of a spin-1/2 quantum Heisenberg model with monoaxial Dzyaloshinskii-Moriya interaction. Using the density matrix renormalization group method, we establish that such a model supports the existence of skyrmion and antiskyrmion states of equal energy. This degeneracy allows for the existence of a mesoscopic Schrödinger cat state exhibiting properties of both skyrmion and antiskyrmion. To characterize this superposition, we calculate two-point correlation functions that can be measured in neutron scattering experiments. Finally, we introduce a perturbation in the form of a magnetic field gradient to induce a non-trivial time evolution of the superposition state. We study this time evolution using both a numerical variational method and the collective coordinates approach.

MON 12.2 Mon 14:30 ZHG105

Revealing Magnetic Chirality in Non-Collinear Kagome Antiferromagnets through Spin-Seebeck Measurements — •Feodor Svetlanov Konomaev, Mithuss Tharmalingam, and Kjetil Magne Dørheim Hals — Department of Engineering Sciences, University of Agder, 4879 Grimstad, Norway

Non-collinear antiferromagnets (NCAFMs) are attractive for antiferromagnetic spintronics, as they combine the advantages of collinear antiferromagnets with novel emergent phenomena arising from their complex spin textures. One such phenomenon is the intrinsic chirality of the ground-state spin configuration, which strongly influences the spin-wave excitation spectrum. In this work, we investigate an NCAFM with a kagome lattice structure interfaced with a normal metal and demonstrate that the ground-state chirality can be probed via measurements of the spin Seebeck effect (SSE). Starting from a microscopic spin Hamiltonian, we derive the corresponding bosonic Bogoliubov-de Gennes (BdG) Hamiltonians for the distinct chiral configurations. Using linear response theory, we obtain a general expression for the spin current thermally pumped into the normal metal due to the SSE. Our results show that a substantial in-plane spin current arises only when the NCAFM is in the negative chiral state, offering a clear experimental signature for real-time detection of chirality switching in kagome NCAFMs.

MON 12.3 Mon 14:45 ZHG105

The effect of Rashba on the magnetic field dependence of Ising superconductors — •Joren Harms, Michael Hein, and Wolfgang Belzig — Fachbereich Physik, Universität Konstanz, Konstanz, Germany

Ising superconductors are transition metal dichalgogenides which can withstand large in-plane external magnetic fields. To a large extent, the protection of the superconducting state from the external magnetic *eld comes from the presence of Ising spin-orbit coupling (ISOC). Since ISOC breaks inversion symmetry and not time-reversal symmetry (TR) it could protect against external magnetic fields. In this work, we study the influence of Rashba SOC on the magnetic field dependence of Ising superconductors.

MON 12.4 Mon 15:00 ZHG105

Thermoelectric response in Altermagnets — •Javad Vahedi[1], Martin Gärttner[1], and Ali Moghaddam[2] — [1]Institute of Condensed Matter Theory and Optics, Friedrich-Schiller-University Jena, Max-Wien-Platz 1, 07743 Jena, Germany — [2]Computational Physics Laboratory, Physics Unit, Faculty of Engineering and Natural Sciences, Tampere University, FI-33014 Tampere, Finland

We study the thermoelectric properties of altermagnets using semiclassical Boltzmann transport theory with constant relaxation time. Altermagnets, with zero net magnetization but spin-split bands from staggered magnetic order, enable exploration of unconventional transport. Using a 2D tight-binding model with spin-independent hopping, altermagnetic exchange, and spin-orbit coupling, we analyze both Drude and Berry curvature contributions. Without a magnetic field, longitudinal conductivities σ_{xx} and α_{xx} vary strongly with spin-orbit coupling λ and exchange J, peaking at intermediate λ. Symmetry-induced Berry curvature cancellation suppresses transverse responses σ_{xy} and α_{xy}. A weak out-of-plane magnetic field breaks these symmetries, inducing notable transverse transport tied to band topology. Finite doping leads to complex Berry curvature patterns and sharp peaks in the anomalous Nernst signal α_{xy}, reflecting resonant entropy transport. The transport behavior as a function of μ, λ, and J highlights the interplay between spin-orbit coupling, magnetic order, and topology. Our findings position altermagnets as tunable platforms for topological and spintronic applications.

MON 12.5 Mon 15:15 ZHG105

V_2Se_2O and Janus V_2SeTeO: Monolayer altermagnets for the thermoelectric recovery of low-temperature waste heat — •Shubham Rakesh Singh, Paresh C. Rout, Mohammed Ghadiyali, and Udo Schwingenschlögl — Physical Science and Engineering Division (PSE), King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabi

We determine the thermoelectric properties of the V_2Se_2O and Janus V_2SeTeO monolayer altermagnets with narrow direct band gaps of 0.74 and 0.26 eV, respectively. Monte Carlo simulations reveal Néel temperatures of 800 K for V_2Se_2O and 525 K for Janus V_2SeTeO. The electrical conductivity is higher for p-type charge carriers than for n-type charge carriers due to lower effective masses. The presence of heavy Te atoms in Janus V_2SeTeO results in lower phonon group velocities, higher phonon scattering rates, and higher lattice anharmonicity than in the case of V_2Se_2O, leading to an almost 19-fold reduction of the lattice thermal conductivity at 300 K. The thermoelectric figure of merit of V_2Se_2O reaches 0.4 (0.1) and that of Janus V_2SeTeO reaches 2.7 (1.0) just below the Néel temperature at the optimal p-type (n-type) charge carrier density, demonstrating that altermagnets have excellent potential in the thermoelectric recovery of low-temperature waste heat.

MON 12.6 Mon 15:30 ZHG105

Katsura-Nagaosa-Balatskiy magnetoelectricity in molecular magnets: Bipartite entanglement transfer with the aid of electric field. — •Zhirayr Adamyan[1,2], Vadim Ohanyan[1,2], Ani Chobanyan[1], Hamid Arian Zad[3], Jozef Strecka[3], Azadeh Ghannadan[4], and Saeed Haddadi[4,5] — [1]Laboratory of Theoretical Physics, Yerevan State University, 1 Alex Manoogian, 0025 Yerevan, Armenia — [2]Synchrotron Research Institute, 31 Acharyan Str., 0040 Yerevan, Armenia — [3]Department of Theoretical Physics and Astrophysics, Faculty of Science, P. J. Safarik University, Park Angelinum 9, 041 54 Kosice, Slovak Republic — [4]Saeeds Quantum Information Group, P.O. Box 19395-0560, Tehran, Iran — [5]Faculty of Physics, Semnan University, P.O. Box 35195-363, Semnan, Iran

The quantum entanglement of spin states in molecular magnets has important applications in quantum information technologies. Currently, qubit models based on magnetic molecules are being developed to advance quantum computation and communication technologies. In this study, we examine a molecular magnet consisting of a spin-1/2 triangular configuration, with a Katsura-Nagaosa-Balatsky(KNB) mechanism to couple spin degrees of freedom with an external electric field. Thanks to the KNB mechanism, the system allows for extensive control over quantum entanglement through the magnitude and direction of the electric field. By utilizing a rotating configuration of the KNB-coupled electric field where the field magnitude remains fixed while its direction rotates-the controllable transfer of bipartite entanglement between different pairs of spins in the model is demonstrated.