Light-induced topological magnons in two-dimensional van der Waals magnets

Presenter:
Emil Vinas Boström
(Max Planck Inst Structure & Dynamics of Matter)

Authors:
Emil Vinas Boström
(Max Planck Inst Structure & Dynamics of Matter)

Martin Claassen
(Flat Iron Institute)

James McIver
(Max Planck Inst Structure & Dynamics of Matter)

Gregor Jotzu
(Max Planck Inst Structure & Dynamics of Matter)

Angel Rubio
(Max Planck Inst Structure & Dynamics of Matter)

Michael Sentef
(Max Planck Inst Structure & Dynamics of Matter)

Driving a two-dimensional Mott insulator with circularly polarized light breaks time-reversal and inversion symmetry, which induces an optically-tunable synthetic scalar spin chirality interaction in the effective low-energy spin Hamiltonian. We show that this mechanism can stabilize topological magnon excitations in honeycomb ferromagnets and in optical lattices. We find that the irradiated quantum magnet is described by a Haldane model for magnons and hosts topologically protected edge modes. The evolution of the magnon spectrum is studied in the Floquet regime and via time propagation of the magnon Hamiltonian for a slowly varying pulse envelope. Compared to a magneto-optical interaction based on the Aharanov-Casher effect, the dimensionless light-matter coupling parameter at fixed electric field strength is enhanced by five orders of magnitude and the topological band gap by ten orders of magnitude. This increase of the coupling parameter allows to induce a topological gap of the order of 2 meV with realistic laser pulses, bringing an experimental realization of light-induced topological magnon edge states within reach.