

# MAGIC<sup>+</sup> WORKSHOP

## Magnetism, Interactions and Complexity

Invited

### 2D Relativistic Mott Insulators: Exotic Phase Diagram and Ultrafast Control of Spin Interactions

Alireza Qaiumzadeh<sup>1</sup>

<sup>1</sup>Center for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology,  
NO-7491 Trondheim, Norway

In this talk, I first present the ground states and exotic phase diagram of a 2D honeycomb lattice described by an extended Kane-Mele-Hubbard model at half-filling and in the strongly correlated regime, i.e., an antiferromagnetic spin-orbit Mott insulator.

Next, I will discuss the effect of high-frequency polarized laser pulses on spin-spin interactions in this system. Developing a modified Floquet formalism, we demonstrate that by changing the amplitude and frequency of laser pulses, the strengths and signs of the Heisenberg exchange and intrinsic Dzyaloshinskii-Moriya interactions are tuned, separately. Our results pave the way for ultrafast optical spin manipulation in recently discovered 2D magnetic materials. [1], [2]

[1] J. M. Losada, A. Brataas, and A. Qaiumzadeh, Phys. Rev. B **100**, 060410(R) (2019).

[2] I. Ushakov and A. Qaiumzadeh, to be submitted (2021).