Orbital Order and Chiral Currents of Interacting Bosons with Pi-Flux

Nathan Goldman

Fonds de la Recherche Scientifique (FNRS), Université Libre de Bruxelles, Belgium

Email: goldman@ulb.ac.be

Higher Bloch bands provide a remarkable setting for realizing many-body states that spontaneously break time-reversal symmetry, offering a promising path towards the realization of interacting topological phases. In this talk, I will introduce a different approach by which chiral orbital order effectively emerges in the low-energy physics of interacting bosons moving on a square plaquette pierced by a pi-flux. We will analyze the low-energy excitations of the condensate in terms of two orbital degrees of freedom and identify a gapped collective mode corresponding to the out-of-phase oscillations of the relative density and phase of the two orbitals. We will further highlight the chiral nature of the ground state by revealing the cyclotron-like dynamics of the density upon quenching an impurity potential on a single site. These single-plaquette results can be used as building blocks for extended dimerized lattices, as we will exemplify using the BBH model of higher-order topological insulators. Our results provide a distinct direction to realize interacting orbital-like models that spontaneously break time-reversal symmetry, without resorting to higher bands nor to external drives.