Kitaev Magnetism in Honeycomb RuCl₃ with Intermediate Spin-Orbit Coupling

Intensive studies of the interplay between spin-orbit coupling (SOC) and electronic correlations in transition metal compounds have recently been undertaken. In particular, \(j_{\text{eff}} = 1/2\) bands on a honeycomb lattice provide a pathway to realize Kitaev’s exactly solvable spin model. However, since current wisdom requires strong atomic SOC to make \(j_{\text{eff}} = 1/2\) bands, studies have been limited to iridium oxides. Contrary to this expectation, we demonstrate how Kitaev interactions arise in 4d-orbital honeycomb \(\alpha\)-RuCl₃, despite having significantly weaker SOC than the iridium oxides, via assistance from electron correlations. A strong coupling spin model for these correlation-assisted \(j_{\text{eff}} = 1/2\) bands is derived, in which large antiferromagnetic Kitaev interactions emerge along with ferromagnetic Heisenberg interactions. Our analyses suggest that the ground state is a zigzag-ordered phase lying close to the antiferromagnetic Kitaev spin liquid.