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Possible proximity of the Iridates $(Na,Li)_2IrO_3$ to a topologically ordered Mott insulator: Phase diagram of the Heisenberg-Kitaev model

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Motivated by the recent experimental observation of a Mott insulating state for the layered Iridates $(Na,Li)_2IrO_3$, we discuss possible ordering states of the effective Iridium moments taking into account the extreme sensitivity of these 5d transition metal oxides to crystal field effects and strong spin-orbit coupling. The microscopic exchange has been argued [1,2] to be a combination of isotropic Heisenberg and highly anisotropic Kitaev exchange, which can be tracked back to the spin and orbital components of the effective momenta. Depending on the relative strength of these two couplings, the system exhibits either various types of conventional magnetic order or a more exotic gapless spin-liquid ground state. Carefully studying [3] the stability of these phases at finite-temperatures – and the role of frustration, i.e. a considerable suppression of the ordering temperature from the Curie-Weiss temperature – allows us to connect back to thermodynamic experiments [4] on the Iridates $(Na,Li)_2IrO_3$ and possibly estimate microscopic coupling parameters. Finally, we discuss the effects of a magnetic field applied in the [111] direction – perpendicular to the hexagonal lattice formed by the Iridium moments – and show that a topologically ordered ground state is found over a small range of coupling parameters [5], also indicating the existence of an exotic critical point whose location might not be far from actual material parameters.

Work done in collaboration with H.C. Jiang, Z.C. Gu, X.L. Qi, J. Reuther, and R. Thomale.

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