Kitaev models and materials: Quo Vadis?

Roser Valentí

Institut für Theoretische Physik, Goethe-Universität Frankfurt,
Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany

In the search for novel materials' properties, the generation and manipulation of highly entangled quantum states is a grand challenge of solid state research. Amongst the most entangled proposed states are quantum spin liquids. In this context, the exactly solvable Kitaev Z_2 spin-liquid model, for which finely tuned anisotropic interactions exactly fractionalize spins into fermionic Majorana spinons and gauge fluxes has activated an enormous amount of interest. Most specially since possible realizations may be achieved in octahedral coordinated spin-orbit-coupled 4d5 and 5d5 insulators. However, the low symmetry environment of the known Kitaev materials also allows interactions beyond the Kitaev model that open possible new routes for further exotic excitations.

Based on *ab initio* and many-body simulations and comparison to experimental observations, we will discuss in this talk, the challenges that one faces in designing such materials and in identifying the origin of their excitations. We will further present recent results [1-7] on possible field- and pressure-induced phases in relation to honeycomb iridates and α-$RuCl_3$.

Work done in collaboration with Steve M. Winter, Kira Riedl, David Kaib, Ying Li, Sananda Biswas, Pavel A. Maksimov, Alexander L. Chernyshev and Radu Coldea

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