Classification of 3D Kitaev spin liquids

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The Kitaev honeycomb model has become one of the archetypal spin models exhibiting topological phases of matter, where the magnetic moments fractionalize into Majorana fermions interacting with a $\mathbb{Z}_2$ gauge field. In this talk, I discuss generalizations of this model to three-dimensional crystal structures; in particular, what types of metallic states the emergent Majorana fermions can form, and how these Majorana metals depend on the details of the underlying lattice structure. Besides (almost) conventional metals with a Majorana Fermi surface, one also finds various realizations of Dirac semimetals, where the gapless modes form Fermi lines or even Weyl nodes. I also discuss how this zoo of gapless quantum spin liquid phases can be comprehensively classified using a projective symmetry analysis.