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Spin-Peierls instability of three-dimensional Kitaev spin liquids with Majorana Fermi surface MARIA HERMANNNS, SIMON TREBST, ACHIM ROSCH, University of Cologne — The Kitaev honeycomb model is one of the paradigmatic examples of a frustrated spin system exhibiting a quantum spin liquid ground state. The emergent low-energy degrees of freedom are Majorana fermions that can form various different (semi-)metallic states. Three-dimensional variants of this model can, in particular, harbor gapless quantum spin liquids with a Majorana Fermi surface. In this talk, we discuss Fermi surface instabilities arising from additional spin exchange terms (such as a Heisenberg coupling), which induce interactions between the emergent Majorana fermion degrees of freedom. We show that independent of the details of the interactions, the Majorana Fermi surface is always unstable. Generically, the system spontaneously dimerizes at exponentially small temperatures and forms a quantum spin liquid with nodal lines. Depending on the microscopic details, further symmetries of the system may be broken at this transition. These spin-Peierls instabilities of a 3D spin liquid are closely related to BCS instabilities of fermions¹.

¹M. Hermanns, S. Trebst, A. Rosch, PRL 115, 117205 (2015).

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