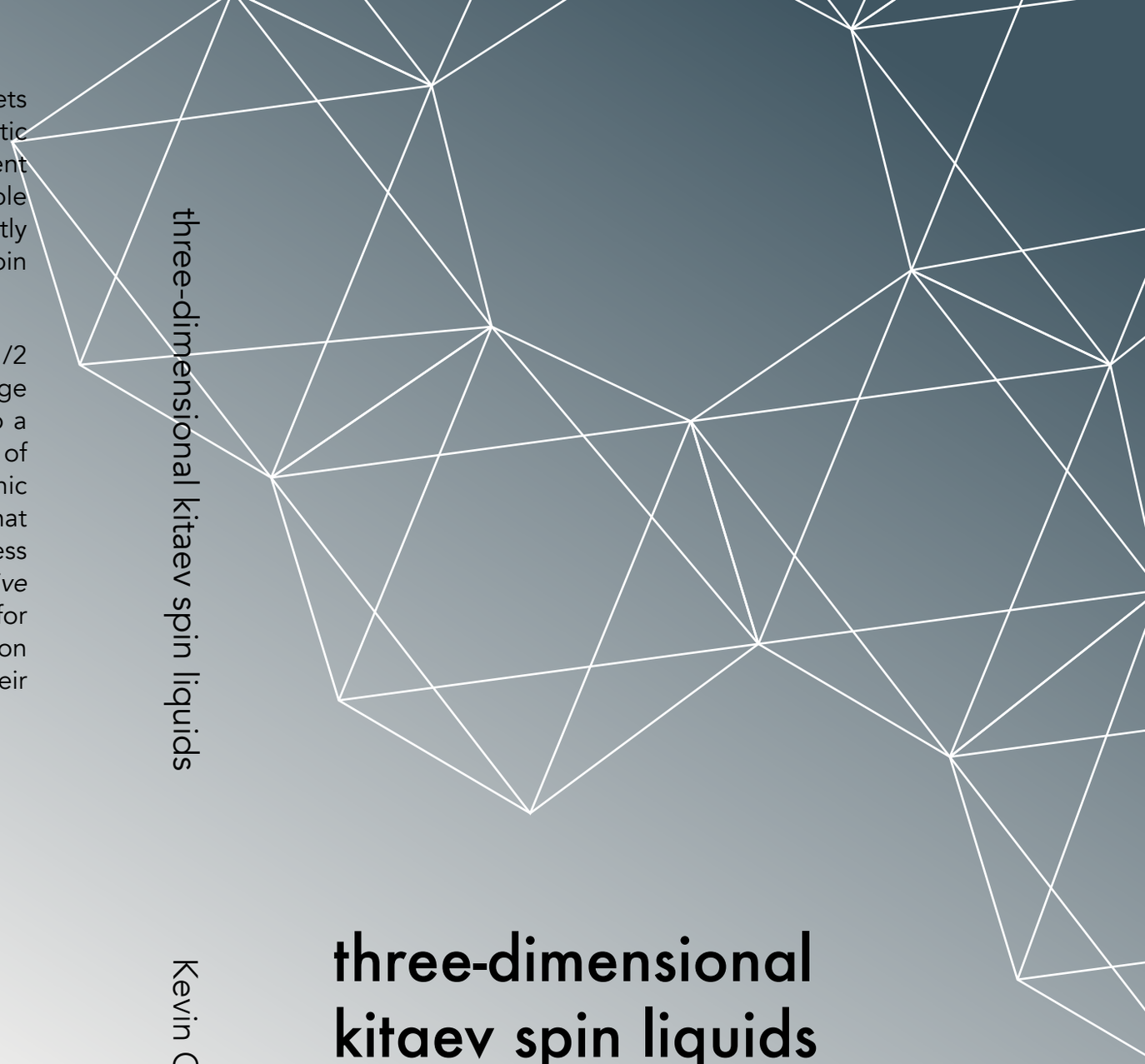
The formation of quantum spin liquids in frustrated magnets represents an exciting possibility due to their rather exotic features, including fractionalized excitations and emergent gauge fields. The Kitaev honeycomb model is a notable example of a frustrated quantum spin model which is exactly solvable and which hosts a number of distinct quantum spin liquid ground states.

In this thesis, we study the fractionalization of spin-1/2 moments into Majorana fermions and an emergent Z_2 gauge field in a generalization of the Kitaev honeycomb model to a number of three-dimensional lattices. While the excitations of the gauge field are always gapped, the fermionic quasiparticles may exhibit a gapless dispersion. We show that one can deduce rather general constraints on the gapless excitations by making use of an object called the *projective symmetry group*. In doing so we provide a scheme for classifying the various gapless Kitaev spin liquids. In addition to analyzing these gapless modes, we also investigate their effects on certain equal-time spin correlation functions.



three-dimensional kitaev spin liquids

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Dissertation

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