Zig-Zag Ground State and Kitaev Interactions in The Spin-1 Honeycomb Material $KNiAsO_4$

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Despite the exciting implications of the Kitaev spin Hamiltonian, finding and confirming the quantum spin-liquid state have proven incredibly difficult. Recently, the applicability of the model has been expanded through the development of a microscopic description of a spin- 1 Kitaev interaction. Here we explore a candidate spin-1 honeycomb system, $KNiAsO_4$, which meets many of the proposed criteria to generate such an interaction. Neutron diffraction measurements show magnetic order at 19 K which results in the well-known "zig- zag" magnetic structure thought to be adjacent to the spin-liquid ground state. Inelastic neutron scattering experiments show a well-defined gapped spin-wave spectrum with no evidence of the fractionalized excitations found in the spin-1/2 model. Modeling of the spin waves using linear spin-wave theory together with a machine learning based optimization shows that the extended Kitaev spin Hamiltonian is generally necessary to model the spectra and reproduce the observed magnetic order. These results suggest that $KNiAsO_4$ may be a new playground to study spin-1 Kitaev physics.