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Unified Spin Model for Magnetic Excitations in Iron Chalcogenides PATRICIA BILBAO ERGUETA, Rice University, ZHENTAO WANG, The University of Tennessee, WEN-JUN HU, ANDRIY H. NEVIDOMSKYY, Rice University — Recent inelastic neutron scattering (INS) measurements on the iron chalcogenides FeSe and Fe($Te_{1-x}Se_x$) have sparked intense debate over the role of magnetism in these materials. We will argue that magnetic frustrations of the underlying Fe spin-1 degrees of freedom are the key to understanding the nature of the ground states. We propose an effective bilinear-biquadratic spin model which is shown to consistently describe the evolution of low-energy spin excitations in FeSe, both under applied pressure and upon Se/Te substitution. The phase diagram, studied using a combination of variational mean-field, flavor-wave, and density-matrix renormalization group (DMRG) calculations, exhibits a sequence of transitions between the non-magnetic ferroquadrupolar phase attributed to FeSe and several other magnetically ordered phases[1]. The calculated spin structure factors mimic closely those observed with INS in FeSe and in the Fe($Te_{1-x}Se_x$) series[2]. In addition to the experimentally established phases, the possibility of incommensurate magnetic order is also predicted.

[1] P. Bilbao Ergueta, Z. Wang, W.-J. Hu, and A. H. Nevidomskyy, arXiv: 1607.05295.

[2] Z. Xu *et al.*, Phys. Rev. B. **93**, 104517 (2016).

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