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Magnetic Excitations in the Iron-based Superconductors[1]

DAOXIN YAO, JIANGPING HU, ERICA W. CARLSON, Department of Physics, Purdue University — We calculate the expected inelastic neutron scattering response based on the spin-orderings found in the iron-based superconductors, using spin-wave theory. For the two-sublattice collinear antiferromagnet, we consider two types of superexchange couplings between Fe atoms: nearest-neighbor coupling J_1 and next-nearest-neighbor coupling J_2. We show how to distinguish experimentally between ferromagnetic and antiferromagnetic J_1. We show the existence of saddle-points near $(\pi, \pi/2)$ and $(0, \pi/2)$, which are expected to give rise to extra scattering intensity. We find that the sublattice magnetization can be reduced by the zero-point motion of spin waves, although not enough to account for the small moments observed in experiment. By comparison with experimental results on $SrFe_2As_2$, we estimate that the effective magnetic interlayer coupling is rather large, about 1/8 the value of the in-plane couplings. References: 1) Phys. Rev. Lett. 101, 167203 (2008); 2) Phys. Rev. B 78, 052507 (2008)

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