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Spin Excitations in Fe(Se,Te)[1]

MARK LUMSDEN, Oak Ridge National Laboratory

The full spectrum of magnetic excitations in both superconducting $FeTe_{0.51}Se_{0.49}$ (x=0.49) and non- superconducting $Fe_{1.04}Te_{0.73}Se_{0.27}$ (x=0.27) was studied using inelastic neutron scattering on single crystal samples. The magnetic excitations are two-dimensional in nature and are observed for energy transfers as high as 300 meV. The zero energy extrapolation of the measured dispersion shows incommensurate excitations emanating from a wavevector near (0.5,0.5), the location of the resonance in the superconducting material. For low energy transfers, the spectrum consists of a set of incommensurate spots, four-fold symmetric about the (1,0) (square lattice (π,π)) wavevector. At higher energies, these spots evolve into rings centered on Q=(1,0). These excitations are notably different than the cones of scattering expected from a long-range magnetically ordered material and likely reflect the itinerant nature of the magnetism. The qualitative evolution of the incommensurate excitation spectrum is similar that seen previously in the cuprates. Despite the incommensurate nature of the spectrum, the observed resonance in the x=0.49 sample remains peaked at the (0.5,0.5) wavevector as in other Fe-based superconductors. At low energies, the x=0.27 sample exhibits an additional feature in the excitation spectrum centered near Q=(0.5,0), the wavevector of magnetic order in $Fe_{1+y}Te$. This scattering persists for all energies below about 10 meV and forms the short range order observed for this concentration. This scattering is completely absent in the x=0.49 sample which contains no excess Fe.

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