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Interstitial Iron Effects on Magnetic Excitations in Parent Phases $Fe_{1+x}Te$ from Polarized and Inelastic Neutron Scattering

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One of the simplest systems of the iron-based superconducting family, $Fe_{1+x}Ch$ (where Ch = S, Se, or Te) presents ample opportunity to study the relationship between antiferromagnetism and superconductivity. Several studies have demonstrated how the makeup of the Ch anions changes the electronic properties drastically, but the effect of excess interstitial iron, the x in $Fe_{1+x}Ch$, is not as well understood. Our previous diffraction experiments on samples varying x from 4 % to 16 % demonstrated how the magnetic ordering changes from collinear antiferromagnetic to helical incommensurate via a spin-density wave state at the special composition of $x \approx 12\%$. We present inelastic neutron scattering measurements of the phases $Fe_{1+x}Te$ for two amounts of interstitial iron in the lattice, 5% and 14 %. We have combined data from cold neutron triple-axis, thermal neutron triple-axis, and spallation source time-of-flight to provide a full picture of the magnetic excitations in $Fe_{1+x}Te$ for $x = 14\%$ from 0.5 meV to 150 meV. In addition, we present polarized inelastic studies on this particular composition to investigate the nature of the spin waves, *i.e.* longitudinal *vs.* transverse. The results are compared with those found in the phase with low amounts of interstitial iron ($\approx$ 5 %), in order to understand the nature of the exchange interactions in this important parent compound.