The Unresolved Origin of <kkk> Reflections in UAs0.8Se0.2

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The presence of multiple order parameters and their phase coherence on the microscopic scale is a subject of much current debate. In the following it is suggested that the observation of coherent Bragg peaks in multi-**k** magnetic structures, together with detailed studies of their polarisation, energy, azimuth and temperature dependencies, may provide a useful experimental forum to examine some aspects of this problem. Using resonant x-ray scattering, to perform diffraction experiments tuned to the uranium M_4 edge, novel reflections of the generic form <k k k> have been observed in antiferromagnetic $UAs_{0.8}Se_{0.2}$ where **k** = <k 0 0 >, with k = 1/2 reciprocal lattice units. These new reflections, with 10^{-4} of the <k 0 0> magnetic intensities, cannot be explained on the basis of the primary order parameter within standard scattering theory.

It is suggested that the resonant x-ray probe is able to observe the new <k k k> periodicity, arising from the phase coherent superposition of 3 primitive (magnetic) order parameters, through the electric dipole scattering operator. This rationalises the details of measured polarisation, energy and unusual azimuth dependence of the <k k k> peaks in addition to their thermal evolution.