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Incommensurate Spin Density Wave state in metamagnetic Fe_3Ga_4 YAN WU, Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803, HUIBO CAO, ANTNIO DOS SANTOS, Quantum Condensed Matter Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, GREG MCCANDLESS, JULIA CHAN, Department of Chemistry, University of Texas at Dallas, Richardson, TX 75080, AMAR KARKI, RONGYING JIN, JOHN DITUSA, Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803 — Fe_3Ga_4 displays a rich competition between magnetic states without structural transitions: a ferromagnetic(FM) ground state transitions to an antiferromagnetic(AFM) intermediate state above 68 K followed by a reemergence of the FM state above room temprature(T). The reentrance of the FM state hints of a coupling of the magnetic degrees of freedom to other modes. To explore the nature of the magnetic states, we have performed extensive single crystal neutron diffraction measurements over a wide range of T and pressure. These measurements revealed two very different magnetic states with the low T FM state having magnetic moments along the c-axis while we discovered that the AFM state is in an incommensurate spin density wave(SDW) order with moments mostly along the a-axis. However, there is still considerable non-collinear and non-coplanar contributions along the b- and c-axial directions. This non-coplanar moment is likely to be the origin of the very large anomalous Hall effect(HE) including a substantial topological HE that we discovered in Fe_3Ga_4. Study of the effect of hydrostatic pressure indicates a reduction of the T_c and a destabilization of the SDW phase.

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