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Magnetic Structure and Dynamics in the Itinerant High-Temperature Ferromagnet MnBi TRAVIS WILLIAMS, ALICE TAYLOR, ANDREW CHRISTIANSON, STEVEN HAHN, RANDY FISHMAN, MICHAEL MCGUIRE, BRIAN SALES, MARK LUMSDEN, Oak Ridge National Laboratory
— The high-temperature ferromagnet MnBi has been receiving much attention as a rare-earth-free permanent magnet to replace more costly rare-earth-containing magnets in applications above room temperature. This is due to MnBi containing strong Mn moments and large energy products. The synthesis of MnBi also allows for crystals that are free from interstitial Mn, allowing for the study of a more fundamental member of this family of binary Mn-based ferromagnets. In this work, we use polarized neutron diffraction to measure the magnetic moments of Mn and Bi, and find that the Bi atoms also have a magnetic moment, but 2 orders of magnitude smaller than Mn. We study their behavior through the spin reorientation that occurs at $T_S \approx 100$ K, finding that both moments reorient simultaneously. We also use inelastic neutron scattering to measure the spin waves of MnBi in order to determine the magnetic exchange at low temperatures. Consistent with the strongly temperature-dependent magnetic anisotropy, we find that the spin gap is very small, and so the magnetic order arises from the strongly ferromagnetic nearest-neighbor term, but interactions up to sixth nearest neighbor are required to fully characterize the spin waves, suggesting that the Mn moments are strongly itinerant.

Travis Williams
Oak Ridge National Laboratory

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