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Multi-q crystal and magnetic structure in $TbMnO_3$: Evidence for a Soliton-lattice N. ALIOUANE, D.N. ARGYRIOU, S. LANDSGESELL, C.J. MILNE, Hahn-Meitner-Institut, Glienicker Strasse 100, D-14109 (Germany), J. STREMPFER, Max Planck Institute for Solid State Research, Heisenbergsse 1, D-70569 Stuttgart (Germany), W. CALIEBE, NSLS Brookhaven National Laboratory, P.O. Box 5000, Upton, NY 11973-5000 (USA) — In $TbMnO_3$, Mn-spins order with a sinusoidal antiferromagnetic (AF) propagation wave vector Q_{Mn}=[0,k+/-q,l] ($q \sim 0.288b^*$) at T_N(Mn)=41K. The propagation vector Q_{Mn} varies with temperature on cooling until T_{Lock}(Mn) ∼30K, which coincides with a ferroelectric transition. In addition to Q_{Mn} reflections we find magnetic reflections at $3Q_{Mn}$. Our X-ray measurements show that the magneto-elastic coupling gives rise to a structural modulation at twice the magnetic wavevector ($2Q_{Mn}$). Field cooling the sample under a magnetic field oriented along the a-direction with H>9T shows that all magnetic wavevectors for Mn and Tb collapse to a single q structure with Q=[0,1/4,0], an up-up, down-down phase, and coincide with anomalies in the polarization. We argue that the temperature and field dependence of the magnetic and superlattice reflections are consistent with a soliton formalism which predicts a stable commensurate single q=1/4 phase [1]. [1] Kimura *et al.*, *PRB* 68, 60403(2003).

D.N. Argyriou
Hahn-Meitner-Institut

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