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Novel coupling of Tb- and Mn-magnetic orders in multiferroic $TbMnO_3$ D.N. ARGYRIOU, O. PROKHNENKO, R. FEYERHERM, Hahn-Meitner-Institut, Glienicker Str. 100, Berlin D-14109, Germany, M. MOSTOVOY, Zernike Institute for Advanced Materials, University of Groningen, 9747 AG Groningen, Netherlands, N. ALIOUANE, E. DUDZIK, A.U.B. WOLTER, A. MALJUK, Hahn-Meitner-Institute, Glienicker Str. 100, D-14109 Berlin, Germany — We report on diffraction measurements on multiferroic $TbMnO_3$ which demonstrate that the Tb- and Mn-magnetic orders are coupled below the ferroelectric transition T_{FE} =28 K. For $T < T_{FE}$ the magnetic propagation vectors (τ) for Tb and Mn are locked so that τ^{Tb}=τ^{Mn}, while below T_N^{Tb}=7 K we find that τ^{Tb} and τ^{Mn} lock-in to rational values of $3/7\mathbf{b}^*$ and $2/7\mathbf{b}^*$ respectively, and hold the relationship $3\tau^{\mathrm{Tb}}$ - τ^{Mn} = 1. We explain this novel matching of wave vectors within the frustrated ANNNI model coupled to a periodic external field produced by the Mn-spin order. The τ^{Tb}=τ^{Mn} behavior is recovered while the τ^{Tb}=3/7 regime is stabilized by an optimal Tb spin-density wave ordering with 6 domain walls, superimposed on the τ^{Mn}=2/7 Mn-ordering.

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