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Complex phase diagram in $HoMnO_3$ due to large spin-lattice coupling[1]

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The coexistence of ferroelectric and magnetic orders in multiferroic hexagonal rare-earth manganites is of fundamental and practical interest. The magnetic transitions in these compounds result in sharp anomalies of the dielectric constant indicating an interesting correlation between magnetic and ferroelectric orders. We derive the T-H phase diagram of hexagonal $HoMnO_3$from magnetic, thermodynamic, and dielectric measurements and find several reentrant phases, a tetracritical point, and first order phase transitions reflecting a wealth of physical phenomena due to the correlation between Mn-spin arrangements, Ho-moment order, ferroelectricity, and frustration. We show that the magnetic phase transitions in $HoMnO_3$ are accompanied by large anomalies of the thermal expansion coefficients along the different crystallographic directions the origin of which lies in extraordinarily strong magnetic correlations and spin-lattice coupling. We propose that the magneto-dielectric coupling observed in hexagonal rare earth manganites results from the lattice strain induced by the magnetoelastic effect.

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