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**Successive magnetic field-induced phase transition in a multiferroic hexagonal system up to 92 T** J.W. KIM, E. MUN, M. JAIME, N. HARRISON, V. ZAPF, Los Alamos National Laboratory, Y. OH, J. YANG, S.-W. CHEONG, S. ARTYUKHIN, D. VANDERBILT, Rutgers University — We report the observation of successive magnetic field-induced phase transitions in a multiferroic hexagonal system up to 92 T. We find unusually strong magnetoelectric coupling at a hysteresis-free phase transition at low fields in which magnetization can be switched by electric fields and electric polarization can be switched by magnetic field. This transition is accompanied by a large magnetoelectric response that is due to the very small energy barrier between the low and high field phase. We explore this compound to high magnetic fields and observe another phase transition at $\sim 50$ T in magnetization ($M$), electric polarization ($P$), and magnetostriction measurements. The high field transition displays a relatively small jump in $M$ but much larger change in $P$ compared to the low field one. Measurements to very high magnetic field in combination with modeling reveal the hierarchy of exchange and dipole interactions that is relevant to the successive magnetic transitions in this compound and suggests possible spin structures at each phases. Both field-induced transitions in this material shows a sharp and large jump in magnetostriction which, in combination with the non-centrosymmetric structure, allow for significant changes in the electric polarization.

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