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Nematic phase persisting above the superconducting dome of $BaFe_2(As_{1-x}P_x)_2$ S. KASAHARA, H.J. SHI, K. HASHIMOTO, T. SHIBAUCHI, T. TERASHIMA, Y. MATSUDA, Kyoto University, T. FUKUDA, JAEA SPring-8, K. SUGIMOTO, JASRI SPring-8, A.H. NEVIDOMSKYY, Rice University — Strongly interacting electrons can exhibit novel collective phases, among which the electronic nematic phases are perhaps the most surprising as they spontaneously break rotational symmetry of the underlying crystal lattice. Here, we provide the first thermodynamic evidence in pure crystals of $BaFe_2(As_{1-x}P_x)_2$ that the nematicity develops well above the structural transition and persists to the nonmagnetic superconducting regime, resulting in a new phase diagram strikingly similar to the pseudogap phase diagram in the cuprates. Our highly sensitive magnetic anisotropy measurements using microcantilever torque-magnetometry under in-plane field rotation reveal pronounced two-fold oscillations, which break the tetragonal symmetry. Combined with complementary high-resolution synchrotron X-ray and resistivity measurements, our results consistently identify two distinct temperatures—one at T^*, signifying a true nematic transition, and the other at $T_s(< T^*)$, which we show to be not a true phase transition, but rather what we refer to as a "meta-nematic transition", in analogy to the well-known metamagnetic transition in the theory of magnetism.

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