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The phase diagram of $BaFe_2(As_{1-x}P_x)_2$ as determined by neutron diffraction JARED ALLRED, KEITH TADDEI, DANIEL BUGARIS, SEVDA AVCI, OMAR CHMAISSEM, Argonne National Lab, CLARINA DELA CRUZ, Oak Ridge National Lab, DUCK YOUNG CHUNG, MERCOURI KANATZIDIS, STEPHAN ROSENKRANZ, RAY OSBORN, Argonne National Lab — The iron-arsenides are a now famous family of high-T_c superconductors where the superconducting state is stabilized by suppressing a magnetic ground state in a parent compound. The phenomenon is quite robust, and $BaFe_2As_2$, for example, can be made superconducting either by applying pressure or by electron, hole, or isovalent doping. The isovalently doped $BaFe_2(As_{1-x}P_x)_2$ materials are particularly interesting because it is not obvious what is driving the suppression of the SDW and enhancing T_c. The driving force has been variously ascribed to chemical pressure, changes in polarity of the Fe-(As,P) bond, and other even more subtle chemical effects. Moreover, reports on various general features in the iron-arsenide phase diagram—such as short-range nematic order and the separation of the Néel transition (T_N) and the structural transition (T_s)—remain contradictory and underexplored. We have undertaken a detailed neutron diffraction study of the phase diagram in order to clarify some of the ambiguities. We find that $T_s = T_N$ and that the superconducting dome rises more sharply than for the aliovalently doped materials. Moreover, the T dependence of the structural and magnetic order parameters and a discontinuous increase in c/a below T_N suggest a first order phase transition.

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