MnAs UNDER HIGH PRESSURE: SPIN DENSITY WAVES AND THREE-DIMENSIONALLY MODULATED STRUCTURE

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Among binary Mn pnictides, MnAs is a historically important and yet in many ways unique system since its discovery more than a century ago. Unlike its counterpart MnP, which has a double-helical structure and develops pressure-induced superconductivity [1], MnAs does not exhibit any noncollinear magnetic order under ambient conditions. The most stable phase of MnAs is the ferromagnetic (FM) hexagonal which under pressure vanishes near 0.44 GPa, and a long-range antiferromagnetic (AFM) phase develops below 230 K at least up to ~1 GPa [2]. Upon further compression above 0.8 GPa, an orthorhombic [Space group *Pnma*] FM phase is stabilized over entire pressures, however, its origin remains unclear.

By combining high-pressure synchrotron x-ray diffraction, neutron scattering, and transport measurements up to 5.5 GPa, we reveal a novel phase sequence in MnAs. Above ~1.1 GPa, a broad FM phase is indeed stabilized. Within this FM state, upon cooling below a temperature T^* that increases with pressure, neutron diffraction reveals the emergence of additional magnetic reflections. These signal the formation of a spin density wave (SDW), coexisting with the FM background, as evidenced by the itinerant character of the transition (absence of a specific heat peak). Furthermore, at 4.6 GPa, x-ray diffraction uncovers a static structural modulation characterized by a tripling of the unit cell and a transition to the noncentrosymmetric space group $Pna2_1$ (the *Pnma* sub-group). The existence of the isomorphic $Pna2_1$ sub-groups tripled in the directions a, b and c substantiates the possibility for modulation in MnAs structure with the vector components close to $a^*/3$, $b^*/3$ and $c^*/3$ or their combination. Our results demonstrate that MnAs under pressure evolves into a system where a lattice instability drives the formation of a pressure-stabilized SDWs within an itinerant ferromagnet, presenting a rare example of intertwined structural and magnetic modulations that are enhanced by compression.

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[2] N. Menyuk (1969). Effects of Pressure on the Magnetic Properties of MnAs. Phys. Rev. 177, 942.