

A New Magnetic Intermediate State, “*B-Phase*”, in MnSi Probed by Small-Angle Neutron Scattering and Muon Spin Rotation

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A violation of space-inversion symmetry entails a Dzyaloshinskii-Moriya interaction originating from the spin-orbit interaction, which stabilizes a chiral helimagnetic spin alignment. The chiral helimagnetic structures have attracted attention because of the emergence of unique topological magnetic textures such as magnetic skyrmion lattices (SkL) [1] and chiral magnetic soliton lattices [2]. Recently, Laliena and Campo suggested theoretically, that at low T the conical (CH) and forced-ferromagnetic (FFM) phases in cubic helimagnets, are not connected but are separated by another SkL, which could be metastable, and a new phase of unknown nature (*B-phase*) just below the critical field H_c at low T [3]. By using careful ac susceptibility measurements at low temperature, we determined the magnetic phase diagrams of oriented crystals of MnSi [4]. It is consistent with the theoretical prediction for the new unknown low temperature phase.

To clarify the nature of this new phase, we performed small-angle neutron scattering (SANS) measurements at TAIKAN in J-PARC [5] and muon spin rotation (μ SR) measurements at M15 in TRIUMF. At both 0.3 T (CH phase) and 0.5 T (*B-phase*), the SANS patterns show two peaks along the horizontal axis for $H \perp$ in coming neutron beam wave vector \mathbf{k}_i . These are the magnetic Bragg peaks of the conical state. On the other hand, no diffraction peaks were observed for $H \parallel \mathbf{k}_i$, in which, for example, a six-fold-symmetric diffraction pattern due to a formation of SkL is observed in *A-phase*. These results suggest the CH phase exists in *B-phase* and *B-phase* is different from *A-phase* near T_c . According to the μ SR results, we found the internal magnetic field distribution in *B-phase* is apparently different from that in CH and FFM phases, consistent with the SANS results. In the presentation, we will talk about the results of both SANS and μ SR in detail and discuss a spin texture in *B-phase*.

References:

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