Modulated magnetic ground state and complex phase diagram in the chiral helimagnet Cr$_{1/3}$NbS$_2$ EM CLEMENTS, R DAS, Univ. of South Florida, L LI, Univ. of Tennessee, P LAMPEN-KELLEY, Univ. of Tennessee, Oak Ridge National Lab, MH PHAN, Univ. of South Florida, VEERLE KEPPENS, Univ. of Tennessee, D MANDRUS, Univ. of Tennessee, Oak Ridge National Lab, H SRIKANTH, Univ. of South Florida — The chiral helimagnetic ground state of noncentrosymmetric Cr$_{1/3}$NbS$_2$ originates from competition between coexisting symmetric ferromagnetic (FM) exchange and the antisymmetric Dzyaloshinskii-Moriya (DM) interaction. Previously, it has been shown via Lorentz microscopy that a field induced chiral soliton lattice (SL) exists followed by an incommensurate-commensurate metamagnetic transition to a FM state. The high crystalline anisotropy as well as magnetic and temperature control of the c-axis oriented spin spiral has generated interest for spintronic applications. Currently, only a preliminary phase diagram has been proposed and details of the phase evolution, specifically from the paramagnetic (PM) to the helicoid HM and SL states, have not yet been determined. In this study, we exploit the magnetocaloric effect (MCE) to construct a phase diagram by determining the magnetic entropy change ($\Delta S_M$) under the influence of applied field and temperature variations. Well below the Curie temperature ($T_c \approx 131$K) we see the onset of SL formation at $\approx 1kOe$ and a FM transition $\approx 1.2kOe$. A negative $\Delta S_M$ value indicates that the system also shows weak FM behavior in a narrow region just below $T_c$, where thermal fluctuations destabilize the weaker DM coupling, before transitioning into the HM phase at lower temperatures.

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