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Magnetic properties and lattice dynamics of $\text{Mn}_3\text{Fe}_2\text{Si}_3$ single crystal

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We have investigated the macroscopic magnetic properties of a magnetocaloric $\text{Mn}_3\text{Fe}_2\text{Si}_3$ single crystal, which indicate a strong anisotropy. Applying the field perpendicular to c-direction, the magnetic response exhibits two features at $T_1 \approx 123$ K and $T_2 \approx 69$ K, and only one feature in field parallel to c-direction at $T_2 \approx 69$ K. Even above T_1 the magnetic response is far from Curie-Weiss behavior, indicating the significance of short range magnetic correlations. To elucidate the spin and lattice dynamics in the system, neutron inelastic scattering was carried out on the MERLIN time-of-flight spectrometer [1]. Taking advantage of the repetition rate multiplication (RRM), five separate incident energies (9 meV, 13 meV, 21 meV, 40 and 108 meV) were recorded simultaneously to explore the excitation spectrum in a wide range with adapted resolution conditions. Besides that, the experiment, which provides a complete coverage of large portions of reciprocal space, clearly showed that the magnetic structure of this compound is more complex than previously thought.

[1] R. I. Bewley et al, Physica (Amsterdam) 385B–386B, 1029 (2006).

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