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Magnetic soliton layers in epitaxial MnSi

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We have charted the phase diagram of epitaxial MnSi films grown on Si(111) by magnetometry, differential susceptibility, extended X-ray absorption fine structure, planar Hall, polarised neutron reflectometry and small-angle neutron scattering [1-3]. Our experimental results are supported by micromagnetic simulations, which jointly reveal a magnetic phase diagram dominated by a field-induced cascade of single-Q soliton layers. The soliton layers are stabilized through the applied field which modifies a zero-field, out-of-plane propagating helix with $\lambda = 11.5$ nm. Field and temperature history provide specific routes for the nucleation of the distinct soliton phases, comprising of four-, three-, two-, and single-soliton layers depending on the field strength. At low temperatures ($T < 10$ K) a discrete phase regime can be discerned unambiguously in the susceptibility, which may be attributed to the irreversibility of the two-soliton and single-soliton regimes. These observations provide insights into the integral role of magnetic anisotropy and dimensionality on the low-temperature phase diagram of thin film MnSi.

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