

Supplementary movies

Supplementary Movie 1

Far from the ordering temperatures, the lattice transforms into the homogeneous state by infinite expansion of the period at some critical field. For such a magnetic-field-driven evolution of the skyrmion lattice, two processes occur: an extension of the lattice period and a contraction of the skyrmion cores. The lower symmetry phase (skyrmion lattice) does not disappear completely during this transition but remains in the high symmetry phase (saturated state) in a form of localized states (isolated skyrmions). De Gennes has designated this transition as the nucleation type.

The video shows the vector field of the magnetization (blue arrows, upper layer) within the hexagonal skyrmion lattice as well as the contour plot of the m_z -component of the magnetization (bottom layer; the color changes from blue to red and signifies the magnetization opposite and along the field).

Supplementary Movie 2

Confined skyrmions arise from the disordered state through a rare case of an instability-type nucleation transition. Decreasing the temperature (i.e., the parameter a in our non-dimensional units) from the paramagnetic region leads to the appearance of skyrmion matter already in the form of the hexagonal lattice.

And opposite, the magnetization modulus in skyrmionic lattice gradually decreases to zero with approaching the Curie temperature from the low-temperature part. However, the lattice retains its symmetry up to the critical point. Such a transition is attributed to a remarkable confinement effect of skyrmions.

Supplementary Movie 3

Phenomenon of the confinement effect: near the ordering temperature skyrmions exist only as bound states. By trying to expand the skyrmion lattice, i.e., by controllably increasing its period, one immediately destroys it.

The equilibrium skyrmion state corresponds to an energy minimum. Any “departure” from this minimum results in zero modulus in skyrmion centers, and the lattice disappears.

$a=0.23$, $h=0.03$.

Supplementary Movie 4

Field-driven transformation of the hexagonal skyrmion lattice according to Fig. 5.

Supplementary Movie 5

Field-driven transformation of the square half-skyrmion lattice according to Fig. 6.