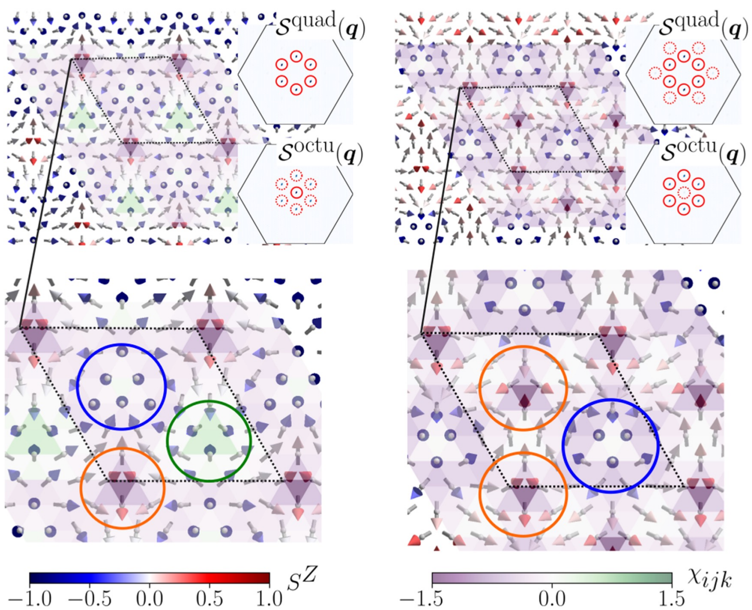
# Multipolar Skyrmion Crystals in Non-Kramers Doublet Systems




Panels E and F present enlarged views of MSkX-I and MSkX-II within a single magnetic unit cell (indicated by the dotted parallelogram). The orange circle marks a meron with a winding number $\mathcal{W}$ =−1, the blue circle denotes an antimeron with $\mathcal{W}$ =2, and the green circle indicates another antimeron with $\mathcal{W}$ =−1.

## Scientific Achievement

We present the first realistic mechanism for the emergence of multipolar skyrmion crystals — topological magnetic structures that can form in heavy fermion systems with an even number of outer-shell electrons.

## Significance and Impact

Beyond advancing skyrmion research, our findings may also have broader implications for other areas of condensed matter physics, including altermagnetism and the study of hidden order effects.

## Research Details

- Identify non-Kramers doublet as low energy degree of freedom in cubic crystal with f2 configuration.
- Derive Kondo lattice model based on symmetry principle
- Find the multipolar texture, particularly skyrmion crystals that emerge without the need for an external magnetic field
- Obtain spontaneous Hall effect for the multipolar skyrmion crystals, which provides a way to detect these elusive multipolar phases, often referred to as hidden orders.

Work was performed, in part, at the Center for Integrated Nanotechnologies.

Zhang, H.; Lin, S.-Z. Multipolar Skyrmion Crystals in Non-Kramers Doublet Systems. Physical Review Letters 2024, 133 (19).