Stable magnetic bundles achieved at room temperature and zero magnetic field

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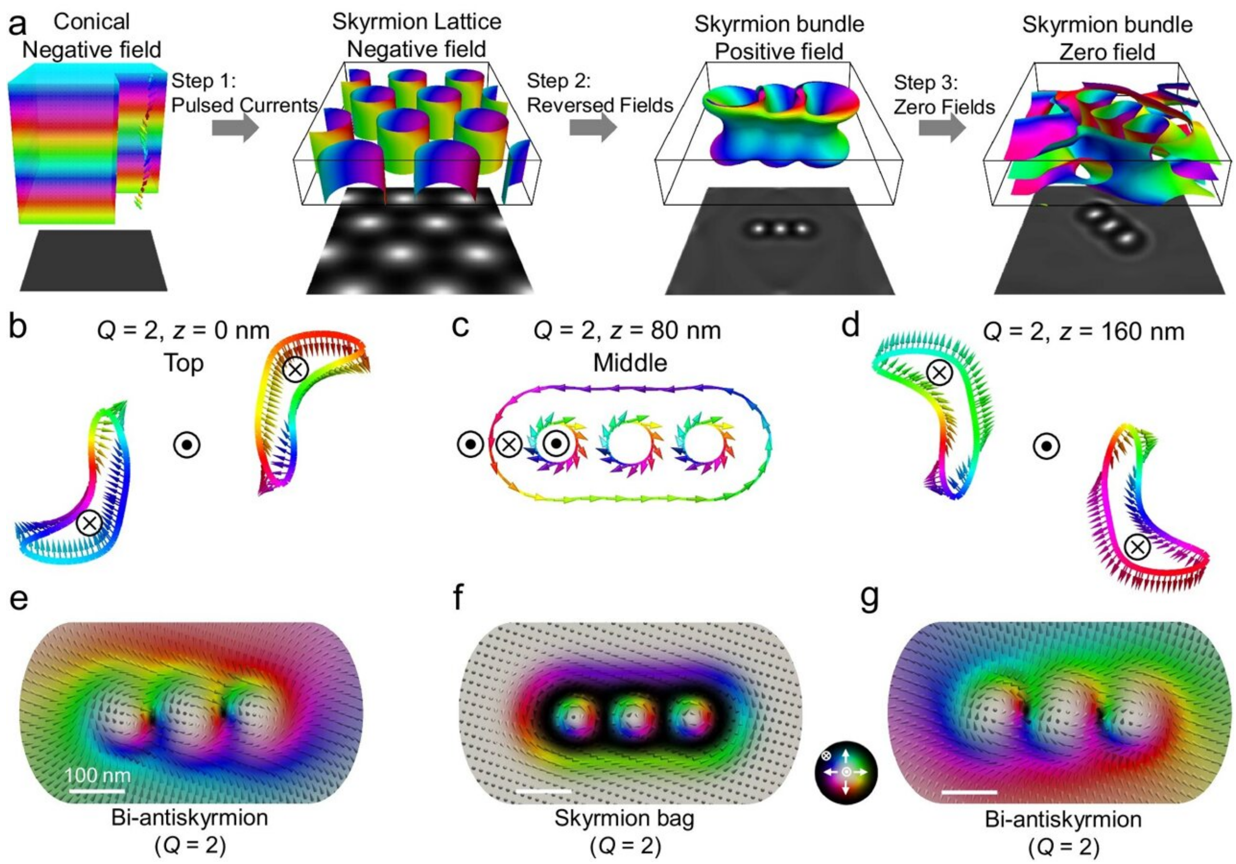

Scenario of creating zero-field skyrmion bundles and their three-dimensional magnetic configurations. **a** Scenario of creating skyrmion bundles. The images below display corresponding simulated Fresnel images. **b–d** Contour of m_z = –0.1 at the top surface (z = 0 nm), at the middle layer (z = 80 nm), and the bottom surface (z = 160 nm) of a Q = 2 bundle. ⊙ and ⊗\otimes represent up and down orientations of the polarity. **e–g** Magnetic configurations at the top, middle, and bottom layers of the Q = 2 bundles. The colorwheel represents the magnetizations. Credit: *Nature Communications* (2024). DOI: 10.1038/s41467-024-47730-6

Recently, the research team led by Prof. Du Haifeng from the High Magnetic Field laboratory at Hefei Institutes of Physical Science of the Chinese Academy of Sciences achieved stable magnetic bundles at room temperature without the need for any external magnetic field.

Their work is published in *Nature Communications*.

Topological magnetic structures are a type of spin arrangement with nontrivial topological properties. These structures hold promise as the next-generation data carriers and could overcome the limitations of traditional magnetic storage technologies in spintronics.

In previous research, the team proposed a method for inducing magnetic skyrmion bundles in a chiral helimagnetic material called FeGe. However, achieving stable magnetic bundles at room temperature and without an external magnetic field remained a significant challenge for practical applications in spintronics.

To address this challenge, the researchers ingeniously combined pulsed currents with reversed magnetic fields in the room-temperature chiral helimagnetic material $Co_8Zn_{10}Mn_2$. This approach allowed them to achieve a rich variety of room-temperature chiral magnetic skyrmions, avoiding the complex field cooling processes required in previous skyrmion bundle generation.

Furthermore, they introduced a special zero-field vertical spiral domain magnetization background to stabilize the magnetic skyrmion bundles. By establishing a complete magnetic field-temperature phase diagram for skyrmion bundles, they ultimately achieved stable isolated magnetic skyrmion bundles at room temperature with zero external magnetic fields under free boundary conditions.

This work could enhance the development of topological spintronic devices, leveraging the freedom of topological parameter constraints, according to the team.

More information: Yongsen Zhang et al, Stable skyrmion bundles at room temperature and zero magnetic field in a chiral magnet, *Nature Communications* (2024). DOI: 10.1038/s41467-024-47730-6

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