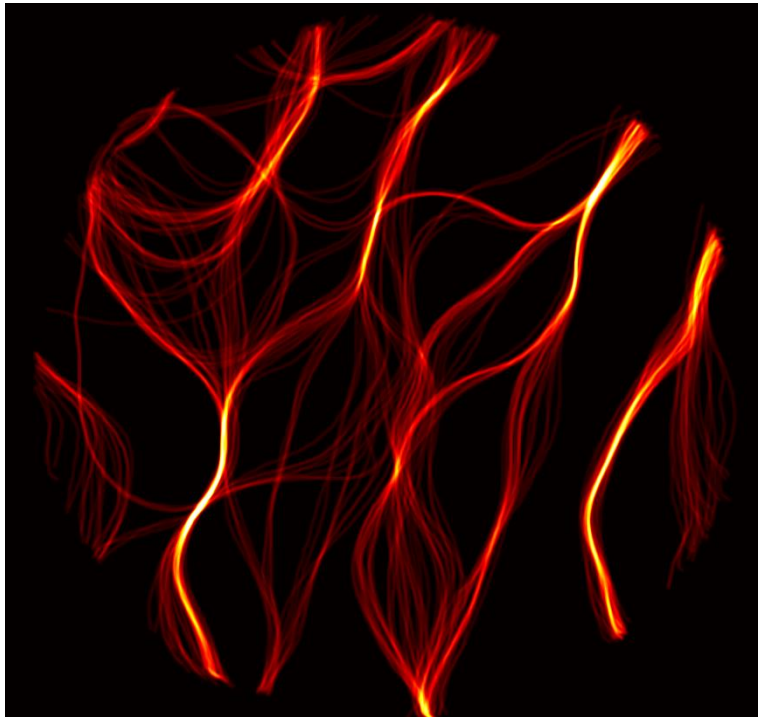
Revealing Collective Electronic Orderings in Space and Time



The image shows the areas where the borders of magnetic domains accumulate over time, and thus define the presence of pinning sites.

Scientific Achievement

Scientists developed a new analysis technique — named coherent correlation imaging (CCI) — to directly image fluctuating and dynamic collective electronic ordering with high time and space resolution. It resulted in direct visualization of domain wall dynamics for the first time.

Significance and Impact

Understanding the dynamical behavior of magnetic materials at the nanoscale offers a pathway to developing new technology that harnesses material properties for data storage, processing, and potential advanced applications (including in QIS).

Research Details

- CCI method allowed researchers to directly image dynamic collective electronic ordering in materials for the first time.
- Analysis visualized the distribution of pinning sites on the specific magnetic material, showing how these sites shape the magnetic landscape and the movement of domain walls.
- The method is available at the CSX beamline at NSLS-II.
- This method can be extended to completely different datasets.

C. Klose, F. Büttner, W. Hu, C. Mazzoli, K. Litzius, R. Battistelli, I. Lemesh, J. M. Bartell, M. Huang, C. M. Günther, M. Schneider, A. Barbour, S. B. Wilkins, G. S. D. Beach, S. Eisebitt, B. Pfau. *Nature* **614**, 256–261 (2023).