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Single-domain stripe order in a high-temperature superconductor

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The coupling of spin, charge and lattice degrees of freedom results in the emergence of novel states of matter across many classes of strongly correlated electron materials, ranging from unconventional superconductivity to skyrmions, multiferroicity, materials with a giant magnetoresistance, or hidden order states. Although, the importance of coupled degrees of freedom is widely appreciated, how this coupling is realized microscopically remains a key issue in many materials. A model example is high-temperature superconductivity, which is widely believed to arise from the coupling of electrons via spin excitations. In cuprates the interplay of charge and spin degrees of freedom is also reflected in a zoo of charge and spin-density-wave orders that are intertwined with superconductivity. A key question is whether the different types of density waves merely coexist or are indeed directly coupled. Here I will present our latest result on the prototypical high-temperature superconductor La1.88Sr0.12CuO4, where we used neutron diffraction with superior beam-focusing that allows us to probe the subtle spin-density wave order under applied uniaxial pressure to demonstrate that the two density waves respond to the external tuning parameter in the same manner [1-3]. Our result shows that suitable models for high-temperature superconductivity must equally account for charge and spin degrees of freedom via uniaxial charge-spin stripe fluctuations.
[1] G. Simutis et al. Comm. Physics and arXiv:2204.02304
[2] J. Choi et al., Phys. Rev. Lett. 128, 207002 (2022)[
3] Q. Wang et al. Nat. Commun. 13, 1795 (2022)

Author: MAZZONE, Daniel (Paul Scherrer Institut)

Co-authors: WANG, Chennan (Paul Scherrer Institut); BUCHER, Damian (University of Zurich); BOURDAROT, Frédéric (CEA); SIMUTIS, Gediminas (Paul Scherrer Institute); CHOI, Jaewon (Diamond Light Source); CHANG, Johan (University of Zurich); KÜSPERT, Julia (University of Zurich); BERTELSEN, Mads (European Spallation Source); JANOSCHEK, Marc (Paul Scherrer Institut); BOEHM, Martin (Institut Laue-Langevin); MANSSON, Martin (KTH); ODA, Migaku (Hokkaido University); MOMONO, Naoki (Muroran Institute of Technology); CHRISTENSEN, Niels Bech (Technical University of Denmark); WANG, Qisi (University of Zurch); KUROSAWA, Tohru (Hokkaido University); SASSA, Yasmine (Chalmers University of Technology)

Presenters: MAZZONE, Daniel (Paul Scherrer Institut); SIMUTIS, Gediminas (Paul Scherrer Institute)

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