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EINLADUNG zum IFP-SEMINAR

Atomic scale imaging of strain-tuned emergent phases of matter

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Host: Silke Bühler-Paschen

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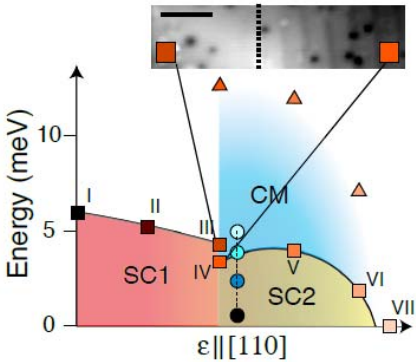
In many high temperature superconductors, small orthorhombic distortions of the lattice
structure result in surprisingly large symmetry breaking of the electronic states, an effect often referred to as nematicity. This symmetry breaking has been observed both microscopically using quasi-particle interference as well as in macroscopic properties. It has been studied extensively in iron-based superconductors with an orthorhombic crystal structure, where the lattice symmetry is already reduced from four-fold (C4) to two-fold (C2).
In order to directly study the impact of the lattice symmetry and small distortions of the lattice on the electronic states, we introduce strain STM, enabling in-situ strain tuning of the samples. We image at the atomic scale the influence of the strain-tuned lattice distortions on the correlated electronic states using low temperature scanning tunneling microscopy and spectroscopy [1]. In the iron-based superconductor LiFeAs, a material which in its ground state is tetragonal, with C4 symmetry, our experiments uncover a new strain-stabilised nematic phase which exhibits a unidirectional charge density wave (CDW) order, an electronic state which not only breaks rotational symmetry but also reduces translational symmetry. The state is apparent in topographic STM images through a characteristic long-range stripe-like modulation of the electronic density of states. We follow the evolution of the superconducting gap as well as this charge-ordered state from the unstrained material with C4 symmetry through the new nematic phase with C2 symmetry and CDW order to a state where superconductivity is completely suppressed.



Phase diagram of uniaxially strained LiFeAs as a function of strain ε. [1]

References:
[1] Chi Ming Yim, Christopher Trainer, Ramakrishna Aluru, Shun Chi, Walter N. Hardy, Ruixing Liang, Doug Bonn, and Peter Wahl, Discovery of a strain-stabilised charge density wave in LiFeAs, cond-mat:1802.05019 (2018).