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Uniaxial Control of Quantum Matter

Monday, 20 March 2023 11:00 (30 minutes)

Quantum matter is characterised by competing and intertwined orders. Here I will present our recent advances in using uniaxial pressure as a clean "surgical"tool to tune quantum phases while simultaneously obtaining microscopic insights via scattering experiments. In particular, we address two directions - minimizing the background and enabling the tuning in-situ.

First, we study spin order in cuprate superconductors characterized by small moments, which remains challenging for pressure studies. We overcome this challenge by designing a low-background uniaxial strain cell, optimizing the experiment based on neutron-tracing simulations and using aggressive focusing and energy analysis. We show that the spin order parameter in cuprates is uniaxial and coupled to the charge channel [1].

Second, to further improve the feasibility and speed of such experiments, we have designed a new in-situ uniaxial device for large-scale facility research based on an actuator-motor mechanism, efficient feedback loops and the sample-holder design enabling rapid exchange of the samples [2]. I will demonstrate the improved capabilities of this device reporting the control of charge order in cuprates and magnetic phases in skyrmion materials, respectively.

[1] Simutis et al. in review and arXiv:2204.02304 (2022)
[2] Simutis et al. in review and arXiv:2207.13194 (2022)

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