THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics
SEMINAR

Uniaxial Control of Quantum Matter: Application to Cuprates

by

Dr. Gediminas SIMUTIS
Paul Scherrer Institute, Switzerland

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ALL INTERESTED ARE WELCOME
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Abstract

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. Technically, 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. We further show how superconducting transition temperature is affected by uniaxial pressure applied in different directions by combining uniaxial pressure and polarized neutron scattering.

To achieve the fine-tuning in-situ, 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. I will demonstrate the advanced capabilities of this device by reporting the control of charge and structural degrees of freedom as studied by X-rays in an archetypical cuprate.

Enquiries: 3943 6303