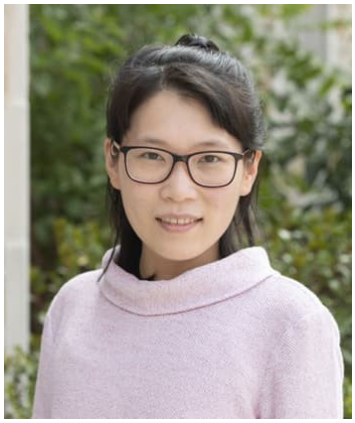
Fundamental Quantum Science Program
Seminar series No.14

● Date & Time : **Friday 16th JAN. 2026 16:00-17:30**
● Venue : # Room309, Frontier Research Laboratory



Prof. Qiong Ma

Assistant Professor
Boston college

“A new topological monolayer "

I will present experimental studies of the topological and correlated electronic properties of a new van der Waals monolayer TaIrTe4. I first discuss the realization of a dual quantum spin Hall (QSH) insulator arising from the interplay between single-particle band topology and density-tuned electronic correlations. At charge neutrality, monolayer TaIrTe4 exhibits QSH behavior, characterized by enhanced nonlocal transport and quantized helical edge conduction. Upon electron doping, the system briefly becomes metallic before entering a correlated insulating state, likely driven by an electronic instability near conduction-band van Hove singularities, such as a charge density wave. IInterestingly, within this correlated gap, the QSH state re-emerges.

I will then report the observation of a nonvolatile superlattice memory effect in the same material. In this pristine monolayer, we observe the spontaneous formation of a long-period superlattice that can be reversibly programmed ON and OFF via electrostatic tuning of low-energy electronic states. This switching toggles between two lattice configurations with unit-cell areas differing by nearly two orders of magnitude. Our results reveal two distinct but coupled instabilities—one electronic and one structural—enabling electrostatic control of lattice configurations with nonvolatile memory. These findings are established through a combination of nonlinear Hall measurements that probe quantum geometry and Raman spectroscopy that tracks lattice reconstruction.

・Hosted by : Dr. Naoto Nagaosa
(Fundamental Quantum Science Program)