Exploring Quantum Emergent Properties using Resonant Inelastic X-ray Scattering

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Exploring quantum emergent properties of correlated systems will overcome the conventional trial-error approach. Recently, some researchers suggested an innovative way to search for the properties via controlling 'spin-orbit coupling' rather than the conventional physical picture (charge-spin-lattice). However, understanding of the new picture is yet incomplete due to experimental limitations.

In this project, we propose a new experimental approach based on resonant inelastic x-ray scattering (RIXS) and strong spin-orbit coupling systems. Specifically, we will demonstrate new quantum emergent properties (j_{eff} system) of lacunar spinel (GaTa₄Se₈), which is a newly proposed material in theory.

Our project offers a creative and unique approach based on the realization of theoretically-proposed model systems combined with an advanced hard x-ray RIXS. RIXS is a powerful tool to unveil the detailed mechanisms and to detect elementary excitations related to spin-orbit coupling. Furthermore, we will present *in situ* RIXS combined with high pressure and electric field, which can generate new phases and quantum emergent physical properties.