RIKEN QUANTUM COMPUTING

https://rqc.riken.jp/

# 47th RQC Colloquium

## Quantum Science with Ultracold Atoms


**Prof. Yoshiro Takahashi**

Kyoto University


**July 15, 2026** (Wed.) **15:00–16:00** (JST)

This colloquium will be held in **HYBRID format**.

**On-site Venue**: Wako C00 HQ 2F Large Meeting Room

**Online Venue:** Zoom. To receive the link, register in advance at https://krs2.riken.jp/m/rqc_registration_form


A system of ultracold atoms in an optical lattice or an optical tweezer array is an ideal experimental system for studying fundamental aspects of quantum science such as quantum simulation of strongly-correlated quantum many-body systems, quantum metrology/precision measurement, and quantum computing. Ultracold ytterbium (Yb) offers unique possibilities in these studies owing to several unique features.

In this talk, in addition to a brief introduction of our quantum simulation research, I will report I detail our recent experiments of quantum sensor for new physics beyond the Standard Model, and quantum computing. Owing to the existence of ultranarrow optical transitions between the ground and metastable states and many isotopes we search for a new hypothetical particle mediating a force between an electron and a neutron, through precision isotope-shift measurements using ultracold bosonic Yb atoms in a magic-wavelength lattice. By King plot approaches we set bounds for new particle coupling constants as well as nuclear parameters. The prospects using a radioactive isotope of 166Yb will be discussed.

Towards quantum computation, we have recently developed Yb atom tweezer array. In particular, novel Yb hybrid atom tweezer array with nuclear spin qubits and optical clock qubits shows negligible crosstalk, useful for quantum-error correction(QEC). Successful implementation of Yb 3D atom array with novel plane selectivity is an important first step from the view point of scalability and possible implementation of 3D QEC codes. More recent successful demonstration of novel spin cat qubits is promising for reducing a QEC error threshold due to biased errors. Furthermore, we recently demonstrate minimally destructive fast imaging of Yb atoms in an atom tweezer array, an important step for fast QEC cycles.