

# Extreme Universe

## The 14th COLLOQUIUM

March 16<sup>th</sup> (Thu.) ONLINE

TALK 17:00 - 18:00 (JST)

March 16<sup>th</sup> (Thu.) 8:00 - 9:00 am (GMT)

March 16<sup>th</sup> (Thu.) 9:00 - 10:00 am (CET)

ONLINE COFFEE TIME  
18:00 - 19:00 (JST)

Registration required (click [HERE](#))

Extreme Universe, JAPAN



Speaker

Prof. Monika Aidelsburger

Ludwig-Maximilians-Universität München

Title

## Quantum simulation with ultracold atoms - from Hubbard models to gauge theories

### Abstract

Well-controlled synthetic quantum systems, such as ultracold atoms in optical lattices, offer intriguing possibilities to study complex many-body problems in regimes that are beyond reach using state-of-the-art classical computations. The basic idea is to construct and use a well-controlled quantum many-body system in order to study its in- and out-of-equilibrium properties and potentially use it to develop more efficient tailored numerical methods that can then be applied to other systems that are not directly accessible with the simulator.

An important future quest concerns the development of novel experimental techniques that allow us to expand the range of models that can be studied. I will demonstrate this using the example of topological lattice models, which in general do not naturally appear in cold-atom experiments. I will show how the technique of periodic driving facilitates their realization and demonstrate how this technique can be used to realize genuine out-of-equilibrium topological phases without any static analogue.

A key ingredient for quantum simulation is the degree of control one has over the individual particles and the microscopic parameters of the model. We are currently developing a novel hybrid optical lattice platform, where tightly focused optical tweezers are used to locally control the motion of the atoms in the lattice, paving the way towards quantum simulation of simplified lattice gauge theories, which despite their simplicity display several salient features of more complex gauge theories, such as confinement and non-trivial real-time dynamics.

MEXT -KAKENHI- Grant-in-Aid for Transformative Research Areas (A)

The Natural Laws of Extreme Universe -A New Paradigm for Spacetime and Matter from Quantum Information-

Collaboration

2023