GOETHE UNIVERSITÄT FRANKFURT AM MAIN

Fachbereich Physik
Institut für Theoretische Physik

CONDENSED MATTER THEORY SEMINAR

Subject: **Realizing first-order quantum phase transitions in a driven optical lattice**

Speaker: **Prof. Dr. Ulrich Schneider (University of Cambridge)**

Date & time: **Friday, May 20th, 2022 at 3:15 p.m.**

Venue: **Room 01.114**

Phase transitions and critical phenomena have been at the heart of many-body physics—and quantum simulations with ultracold atoms—from the beginning. While almost all phase transitions in cold atoms systems are continuous, there is a renewed interest in discontinuous (first-order) phase transitions and the associated quantum metastability. We experimentally combine an optical lattice with a resonant Floquet drive that couples the lowest two bands of the lattice. This coupling can not only induce the superfluid to Mott insulator transition but furthermore enables us to control its character and turn the Mott transition into discontinuous transition. This opens the door to quantum simulations of the early universe (false vacuum decays) and interacting topological transitions in condensed matter systems.
In the second part I will in addition give an update on our work on optical quasicrystals. Quasicrystals are a novel form of condensed matter that is not periodic, but nonetheless long-range ordered. They can be described by self-similar, fractal tilings containing more than one type of unit cell, such as the celebrated Penrose tiling. Many foundational concepts of periodic systems such as Blochwaves or Brillouin zones are not applicable to quasicrystals, thereby giving rise to new physics. In particular, quasiperiodic potentials might host 2D Many-Body Localized states.