

## **Towards quantum simulation with cold gases**

Ultracold atoms in an optical lattice offer a unique toolbox for engineering the prototypical models of strongly correlated condensed matter physics, which remain controversial and poorly understood. These systems have the potential to develop into full quantum simulators by solving those models, which would allow us to develop more accurate descriptions of real materials. A prerequisite is, however, that these quantum simulators are verified and calibrated against known numerical results in tractable parameter regimes, which has recently received a lot of attention and is the topic of this talk. I will give an overview of our recent numerical studies with ultracold bosonic and fermionic systems in an optical lattice, starting with a full comparison between experimental time-of-flight images and ab-initio quantum Monte Carlo simulations of the Bose-Hubbard model. I will show how in-situ single-site resolution and addressability can be useful for determining temperature and the equation of state in the edges of the trap. For the Fermi-Hubbard model, temperature and entropy can be determined on the basis of measuring the double occupancy. Tools for observing the Mott insulator and antiferromagnetic phase will be presented.