Contribution ID: **186** Type: **Talk**

Quantum Field Simulator –Relativistic scalar field in curve spacetime

Sunday, 10 September 2023 18:50 (35 minutes)

The study of space-continuous quantum physics in the many-body limit is natural for ultracold gas systems. The term Quantum 'Field'Simulators emphasizes the continuum aspect of space-time as well as the quasi-continuous observables such as density, phase and collective spin.

In this talk, I will present how one can use the system of a two-dimensional potassium gas to simulate the dynamics of a scalar field in time dependent curved spacetime. The experimental setup allows for controlled realizations of density distributions as well as the control of the stiffness of the gas via controlling the microscopic interaction between the atoms via a Feshbach resonance. With that control at hand, we can realize a Friedmann-Lemaitre-Robertson-Walker metric in two dimensions. This is the most general form of a metric satisfying the constraints of homogeneity and isotropy.

I will summarize our findings on wave packet propagation in curved space-time as well as on particle production in accelerated and decelerated expansion [1,2]. I will also give a glimpse on the results on bouncing universes and the connection to pattern formation leading to the emergence of a new quantum material.

[1] Quantum field simulator for dynamics in curved spacetime, Nature 611, 260 (2022)
[2] Curved and expanding spacetime geometries in BECs, PRA 106, 033313 (2022)

Primary author: Prof. OBERTHALER, Markus (Heidelberg University)

Presenter: Prof. OBERTHALER, Markus (Heidelberg University)

Session Classification: Quantum simulation

Track Classification: Quantum Gases in Low Dimensions