



CRC 1227  
Designed Quantum States of Matter



## GUEST LECTURE

**Prof. Dr. Leticia Tarruell**

**ICFO and ICREA, Barcelona, Spain**

(Guest of Prof. P. Schmidt and Prof. K. Hammerer)

Leibniz Universität Hannover

DQ-mat Colloquium

**17 November 2022, 4.00 pm**

**(ONLINE!!!)**

### **"Engineering gauge theories with Bose-Einstein condensates"**

Quantum gases constitute a versatile testbed for exploring the behaviour of quantum matter subjected to electric and magnetic fields. While most experiments consider classical gauge fields that act as a static background for the atoms, gauge fields appearing in nature are instead quantum dynamical entities that are influenced by the spatial configuration and motion of matter, and fulfil local conservation laws. Gauge theories describe the coupling between such quantum matter and gauge fields. In my talk, I will discuss the progress in simulating gauge theories with engineered AMO systems. I will then present our recent quantum simulation of a one-dimensional reduction of the topological Chern-Simons theory, an effective gauge theory for fractional quantum Hall states, using a Bose-Einstein condensate. This allows us to reveal the key properties of the one-dimensional gauge theory: the formation of chiral solitons and the emergence of an electric field generated by the system itself. These results expand the scope of quantum simulation to new classes of gauge theories, and are a first step towards implementing similar schemes in higher dimensions.

**All DQ-mat members and all interested are cordially invited to attend.**