Technology Innovation Institute

Quantum Research Centre

Verònica Ahufinger

Associate Professor

Universitat Autònoma de Barcelona

Talk Title: Orbital angular momentum dynamics of Bose-Einstein condensates trapped in two stacked rings

Abstract: Ultracold atoms trapped in ring potentials are one of the most promising systems in the field of atomtronics [1]. They have been proposed for quantum sensing applications such as rotation sensing, magnetometry, Sagnac interferometry, or the atomic analogue to the superconducting quantum interference devices (SQUIDs). In addition, weakly coupled condensates have been proposed as basic building blocks for quantum technologies and the dynamics of Bose-Einstein condensates in tunnel-coupled ring potentials have been thoroughly explored in a variety of geometries. In this work [2], we investigate a Bose-Einstein condensate trapped in two tunnelscoupled rings in a stack configuration with the aim to explore the interplay between the orbital angular momentum (OAM), the tunneling dynamics, and the repulsive nonlinear interactions. First, we consider an initial state with a single OAM mode equally populated in both rings, which gives rise to symmetric and antisymmetric stationary states. The stability conditions for these states against OAM perturbations were derived within the mean-field theory and using Bogoliubov analysis in [3]. Here, we revisit the problem and demonstrate that the system can be described by a two-state model with fixed point solutions. In particular, we derive a classical Hamiltonian that characterizes the dynamics of the system in terms of the orbits around the critical points. Second, by populating a single orbital angular momentum mode with an arbitrary population imbalance between the rings, we derive analytically the boundary condition between Josephson oscillations and self-trapping regimes. We also study numerically the stability of these regimes against perturbations in higher order OAM modes.