# Congratulations to New ICFO PhD Graduate

## Dr. Natalia Domingues Alves graduated with a thesis entitled ?Single-atom motional dynamics in an optical dipole trap'

June 16, 2023

We congratulate Dr. Natalia Domingues Alves who defended her thesis today in ICFO's Auditorium.
Dr. Domingues obtained her MSc in Physics from the Universidade Federal de Pernambuc (UFPE) in Brazil. She joined the Atomic Quantum Optics research group at ICFO led by Pro . Dr. Morgan Mitchell as a PhD student to work on the quantum optics of individual atoms. D . Alves's thesis entitled ?Single-atom motional dynamics in an optical dipole trap' w s supervised by Prof. Dr. Morgan W. Mitchel

**ABSTRACT:**
This thesis studies, using simulation and experiment, the motional dynamics of a single atom in an optical dipole trap. The optical dipole trap we study is a single-beam, red-detuned, far-off-resonance trap (FORT). This FORT is located at the centre of an arrangement of four

high-NA lenses in the "Maltese cross" geometry, which facilitates measurements based on atomic fluorescence.
We make a detailed study, combining simulation with experimental measurements, of the temperature of the atom in this system. We note reasons why a single-temperature description could fail to describe the motional statistics of the atom in the trap.
We then study the sensitivity of an established method, the release-and-recapture, to a possible anisotropic temperature distribution of the atom.
We also measure the optical extinction produced by the atom, from which we extract a lower bound on the strength of interaction.
Finally, we show with simulation results and experiments, how parametric excitation of the atom in the FORT can be used to manipulate its phase-space distribution, which can lead to an effective decrease or increase of the atom's kinetic energy.

**Thesis Committee:**
Prof. Dr. Hugues de Riedmatten, ICFO
Prof. Dr. Axel Kuhn, University of Oxford
Dr. Raul Celistrino Teixeira, Universidade Federal de Sao Carlos