



Congratulations to New ICFO PhD Graduate

Dr Lorena Bianchet graduated with a thesis entitled *'A versatile system for the study of light-matter interactions at the level of individual particles'*

February 25, 2022

We congratulate Dr Lorena Bianchet who defended her thesis today in ICFO's auditorium with online participations.?

Dr Bianchet obtained her MSc degree in Physics from the Universidad de Buenos Aires Argentina. She joined the Atomic Quantum Optics research group led by ICREA Prof D Morgan Mitchell to carry out her PhD studies on quantum optics and quantum metrology with atoms and non-classical light. Dr Bianchet thesis entitled *'A versatile system for the study of light-matter interactions at the level of individual particles'* was supervised by ICREA Prof D Morgan Mitchell

ABSTRACT:

In this thesis, a single-atom trap in a $\frac{1}{2}$ "Maltese cross" geometry (MCG) was designed, built up and characterized. A MCG atom trap uses four in-vacuum lenses to achieve four-directional high-numerical-aperture optical coupling to single trapped atoms and small atomic array

. Here, we describe the theoretical background, the design, and the optical methods used for trapping and cooling atoms in a MCG geometry optimized for high coupling efficiency. We also characterize the resulting properties of the trap and trapped atoms. For this purpose we measure occupancy, loading rate, lifetime, temperature, fluorescence anti-bunching and trap frequencies using current best practices. We also report another use of the optical control and coupling offered by the MCG: we use the two on-trap-axis lenses to produce a 1D optical lattice, the sites of which are stochastically filled and emptied by the trap loading process. The two off-trap-axis lenses are used for imaging and single-mode collection. Correlations of single-mode and imaging fluorescence signals are then used to map the single-mode collection efficiency

y. We observe trap characteristics comparable to what has been reported for single-atom traps with one- or two-lens optical systems. This shows that four-direction high-NA coupling can be achieved with little reduction in trap performance. Finally, we conclude with the near-future plans of the experiment

Thesis Committee:<

Dr Daniel Barredo Gonzalez, Centro de Investigacion en Nanomateriales y Nanotecnologia

Prof Dr Darrick Chang, ICFO

Dr Robin Kaiser, Institut de Physique de Nice