Title of the doctoral program

Metrologia

Title of the research activity

Quantum Technologies with Sr optical clock

Short description of the research activity

This research activity aims to develop a new high-stability optical lattice clock setup based on ultracold strontium atoms coupled to a high-cooperativity optical cavity. The interplay between the quantized photonic field and collective atomic clock states will be used to investigate and study new methods to progress optical clocks beyond their classical limits, such us the thermal noise from the local laser oscillator and the quantum projection noise due to destructive measurements, towards a new generation of quantum-enhanced optical clocks. The proposed activitywill include atomic spin squeezing [1], superradiance [2] and cavity-enhanced spectroscopy [3]. The experiment will also represent a test bed for cavity QED experiments on long-lived atomic states driven by an optical transition [4]. The ultracold strontium apparatus and the clock lasers are under construction [5]. The research activity will exploit new methods to create compact and stable laser sources for transportable systems.

References:
[1] Hosten et al., ”Measurement noise 100 times lower than the quantum-projection limit using entangled atoms”, Nature 529, 505 (2016).
[2] Norcia et al., “Superradiance on the millihertz linewidth strontium clock transition”, Sci. Adv. 2, e1601231 (2016)
[3] Westergaard et al., “Observation of MotionDependent Nonlinear Dispersion with Narrow Linewidth Atoms in an OpticalCavity”, Phys. Rev. Lett 114, 093002 (2015)
[4] Walther et al. Rep. Prog. Phys. 69 1325 (2006)
[5] Tarallo et al. "A strontium optical lattice clock apparatus for precise frequency metrology and beyond", IEEE Xplore, doi:10.1109/FCS.2017.808902 (2017)

Scientific tutor (name, surname, role, email)

Marco G. Tarallo, Ph.D

Qualification: Researcher

SSD: FIS/01 -FIS/03

Affiliation: IstitutoNazionale di RicercaMetrologica (INRIM)

email: m.tarallo@inrim.it

Number of international-review papers (last 5 years): 9

Total number of citations: 1675 (source: ISI-Web of Knowledge)

h-index: 22 (source: source: ISI-Web of Knowledge)

Type of research activity

The PhD candidate will primarily perform experimental laboratory activity. Modeling (simulation) activity is also present.

Site of activity

INRIM (Division of Quantum Metrology and Nanotechnology)

Active collaboration on the proposed research activity

ICFO (Spain), CNR-INO (Italy), LENS (Italy), N. Copernicus University (Poland)

Specific requirements (experiences, skills)

A Master di degree in Physics is welcome, in particular with experience with lasers and laser optics.

Website of the research group (if any)