



Education and Culture DG

ERASMUS MUNDUS



EUROPHOTONICS-POESII MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: April 1st, 2016 – September 30th, 2016

Laboratory : ICFO – The Institute of Photonic Sciences
City, Country : Castelldefels, Spain

Title of the master thesis : Parametric Feedback cooling in a mobile optical trap.

Name of the tutor of the master thesis : Pau Mestres and Romain Quidant

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Summary of the subject: Trapping and cooling of levitated objects in high vacuum opens a new route for testing quantum mechanics in the mesoscopic regime. This includes quantum control of massive objects at room temperature and study of decoherence of massive objects with unprecedented decoupling from the environment. In order to bring a levitated nanoobject into ground state, it should be coupled to a high finesse optical cavity in high vacuum, requiring a robust delivery method. Mobile optical traps can fulfil this goal provided they have a feedback mechanism that cools and stabilizes the trapped object in the absence of friction.

In this experimental project, the student will have to build a mobile optical trap with a suitable detection system to implement a parametric feedback scheme. The student will be involved in the design and implementation of the optical setup and in the realization of experiments to optimize the detection signal and feedback scheme. The long term goal of this project is to build a ultra-stable mobile optical trap in high vacuum to cool, position and deliver optically levitated nano-objects into a high finesse optical cavity.

Keywords : Optical levitation, Optomechanics, Feedback Cooling

Additional information : * Required skills : Experience in optics, electronic instrumentation and signal processing (Phase Lock Loops...)

* Miscellaneous (References):

-Gieseler, Jan, et al. "Subkelvin parametric feedback cooling of a laser-trapped nanoparticle." *Physical review letters* 109.10 (2012): 103603.

-Aspelmeyer, Markus, Tobias J. Kippenberg, and Florian Marquardt. "Cavity optomechanics." *Reviews of Modern Physics* 86.4 (2014): 1391.

-Mestres, Pau, et al. "Cooling and manipulation of a levitated nanoparticle with an optical fiber trap." *Applied Physics Letters* 107.15 (2015): 151102.