



ERASMUS MUNDUS



## **MASTER IN PHOTONICS – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”**

### **MASTER THESIS PROPOSAL**

**Dates: April - September 2019**

**Laboratory :** Plasmon Nano-Optics group  
**Institution:** ICFO - The Institute of Photonic Sciences  
**City, Country :** Barcelona, Spain

**Title of the master thesis: Automated loading of nanoparticles in vacuum**

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**Keywords :** Ultrahigh vacuum, optics, lasers, paul traps

**Summary of the subject (maximum 1 page) :**

**Optically levitated nanoparticles in vacuum is in comparison a young, fast progressing field enlarging the versatility of optomechanical platforms. While many optomechanical platforms suffer from clamping losses and decoherences due to the direct contact to the environment (even in cryogenic environments), levitated nanoparticles are completely isolated from the experimental setup, only being influenced by photon recoil and residual gas molecules. This condition make them unique in the optomechanical world.**

**However, up to today most of the levitated nanoparticles are loaded at atmospheric pressure by hand, making ultrahigh vacuum conditions beyond the  $10^{-7}$ mbar hard to reach and the experiment cycle time very long (up to 2days).**

**While the latter one poses an issue on statistics and repeatability of the experiments, the first presents a ultimate limit on the kind of experiments that can be performed and their decoherence rates.**

**Therefore, it is highly desirable to load the nanoparticles in vacuum into their optical trap, in order to reach ultrahigh vacuum (UHV) conditions ( $< 10^{-9}$  mbar) on a daily basis.**

**While previous experiments demonstrated the loading of nanoparticles in vacuum they did not manage to trap for a very long time. Furthermore the optical trapping potential is conservative and the dissipation mechanism due to electrostatic forces or laser mediated radiation pressure are needed.**

**The aim of this master project is develop a reliable loading mechanism for nanoparticles (100-300nm) in vacuum, based on the previous progress in the community.**

**The project will be mainly lab based and finally implemented in one of the existing experiments. The main task will be 1) to explore different mechanisms in order to launch the nanoparticles from a surface and 2) to accelerate and decelerate the particle in a controlled way to reach trapping efficiencies of  $< 40\%$ .**

**The successful candidate will be fully integrated in the optomechanics sub-group in the Plasmon Nano-optics group to carry out the project but is also expected to show appropriate levels of independence and initiative in the laboratory**

**Additional information :**

- \* Beneficial skills: experience with lasers, handling and aligning optics
- \* Miscellaneous: basic level of English