

Dynamic control of optical trapping in air

General Scope : Since their introduction in 1986 by A. Ashkin (Nobel Prize 2018), optical tweezers become an essential non-invasive observation, characterization and manipulation tool in microbiology, chemistry, and solid state physics. The majority of optical tweezers are actually optimized for trapping particles in suspension. Optical trapping in air is a more challenging task as one has to compensate the stronger Brownian motion and consider the very strong adhesion forces of particles on a surface. On the other hand, it opens interesting possibilities for studying light matter interactions or to investigate the optical properties of small particles without any environmental perturbation. In this context, we have developed a fiber-optical air-tweezers allowing very efficient particle trapping on only one single interference fringe.

In our configuration with two counter-propagating laser beams the optical trapping properties can be dynamically modified by controlling for example (i) the relative polarization of the two beams, (ii) the relative intensity of the two beams, and (iii) the distance of the two optical fibers facing each-other. The main scope of this internship is to investigate these features in order to realize a high speed, feedback optical tweezers reconfiguration which is of great interest for studying the light-matter interactions.

Research topic and facilities available : In a first step the student will study the influence of the above listed parameters by “manually” modifying them. After this calibration step the dynamic control will be realized by adding the required equipment (e.g. Pockels-cell, ...) and implementing the feedback loops into the control software. Running dynamically stabilized optical trapping experiments will be the final part of the internship.

Possible collaboration and networking : If necessary we will use specific lensed fibers printed in H. Giessens' group at Univ. Stuttgart (Germany) and get theoretical support from O. Hellesø from Univ. Tromsø (Norway).

Possible extension as a PhD : YES

Required skills: Knowledge in optics/ photonics including integrated optics, fiber optics and optical trapping. The student should also have skills in optics experiments and basic knowledge in LabView-programming would be useful.

Starting date : free, as a function of the students program.

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