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Experimental investigation of microscopic engines and critical Casimir forces by optical tweezers

Alessandro Magazzù
(CNR-IPCF, Messina)

Since their invention in 1986, optical tweezers have become a key technique for the contactless manipulation and investigation of microscopic and nanoscopic particles of different nature, such as biomolecules, bacteria, cells, plasmonic nanoparticles, nanotubes and nanowires. Furthermore, optical tweezers are also a powerful tool for nanotechnology allowing the manipulation and assembling of biomolecules, cells, and nanostructures, and measuring and exerting forces at nanoscale. Following this idea, optical tweezers have been recently used to measure critical Casimir forces (CCFs) between colloidal particles.

Historically CCFs have never aroused a lot of attentions and they have always been considered mostly like a scientific curiosity. However, now, thanks to the advances of nano-science a new interest in the CCFs has blossomed because of their promising applications in nano-technology. For instance, they can be used to manipulate objects (e.g. by controllable periodic deformations of chains), to assemble devices (e.g. via the self-assembly of colloidal molecules). These applications of CCFs can be possible thanks to their piconewton strength and nanometric action ranges, which match the requirements of nanotechnology. Furthermore, CCFs can be finely tuned as a function of temperature and present a strong dependence on the surface properties of the confining objects.

In this talk, after a brief introduction about optical trapping mechanism and CCFs, the realization of a microscopic engine and the experimental effects of CCFs on the free dynamics of a couple of colloidal particles will be discussed.

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