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Accurately and precisely determining the strength of an optical trap

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Content :

Since its inception, optical trapping has found its place in the field of physics, biology and recently in micro-fluidics. To a physicist, this technique opens up avenues to carry out force measurement with utmost accuracy and precision on the micro-scale level. This is attained by measuring the magnitude of the trapping force required to restrain a trapped particle to its equilibrium position. Here three such methods will be discussed in light of their relevance to the current optical system in the laboratory. The most direct method carried out was the drag force method, by keeping the particle fixed while accurately controlling the movement of the automated stage we were able to measure the magnitude of the force applied to a particle in order to release it from the trap. Alternatively, since trapped particles are submerged in liquid medium, any thermal fluctuation within the medium would lead to the trapped particle displacing from its equilibrium position. Under this condition, the particle is said to behave as a simple harmonic oscillator. By measuring the variation of the trapped particle with respect to its equilibrium position we were able determine the trap stiffness using the Equipartition theorem. Lastly, we discuss the Allan variance method. Since most systems contain some form of noise, the Allan variance method was used to eliminate any form of white noise that could exist to accurately and precisely determine the trapping force using CMOS technology. Most scientific programs can be used to determine the Allan variance; we used Labview as a platform for the analysis. An overview of all the methods mentioned will be discussed in detail to give an understanding of the most accurate and precise method of calibrating an optical trap.

Level (Hons, MSc, PhD, other)? :

MSc

Consider for a student award (Yes / No)? :

Yes

Short Paper :

No

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