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Quadruple Bessel beam traps and broadband light scattering to study single submicron aerosol particles

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To study submicron aerosol particles, we use Bessel beam optical traps to isolate a single particle a long time in air (several hours or days). The stability of commonly used counter-propagating Bessel beam (CPBB) traps, however, is very sensitive to the alignment [1]. Its trapping position may change with the particle size and the particle may wobble by several tens of micrometers. This can be a major problem for single particle studies, such as broadband light scattering experiment [2]. We suggest a new type of trap much less sensitive to small optical misalignment [1]: the quadruple Bessel beam trap (QBB) consisting of two sets of CPBBs in a perpendicular arrangement. This presentation will show the first experimental realization and characterization of the stability and confinement of single particles in a QBB trap and compares it with numerical simulations of the three-dimensional particle dynamics [3]. The QBB trap is shown to be more predictable and several times more stable than the CPBB trap, while it confines the particle much more tightly by several orders of magnitude. QBB traps are thus better suited for single particles studies.

In addition, we have developed a broadband scattering experiment, working in the UV and visible spectral range, to determine the size and refractive index of submicron particles. This presentation will present results for the water uptake/release and for the aging of metastable submicron particles obtained by using this broadband scattering experiment.

References

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