

Solution and testing of the Abraham-Minkowski controversy of light-atom interacting system

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Abstract

We present the origin of the Abraham-Minkowski controversy of light-matter wave interacting system, which is a special case of the century-old Abraham-Minkowski controversy. We solve the controversy of laser-atom interacting case and find that for systems with perfect atomic spatial coherence, the systems prefer to show Minkowski momentum and canonical momentum for the atoms and light, respectively; while for the systems where the atoms are spatially incoherent, the momenta of light and atoms would choose the Abraham and kinetic forms. The provement of our solution can be realized with current techniques, using three-dimensional optical lattices and electromagnetically-induced absorption (EIA) to distinguish the kinetic and canonical recoil momentum of ultra-cold atoms.

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