Title:	Theoretical investigation on nonlinear optical effects in laser trapping of dielectric nanoparticles with ultrafast pulsed excitation
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Abstract:	The use of low-power high-repetition-rate ultrafast pulsed excitation in stable optical trapping of dielectric nanoparticles has been demonstrated in the recent past; the high peak power of each pulse leads to instantaneous trapping of a nanoparticle with fast inertial response and the high repetition-rate ensures repetitive trapping by successive pulses However, with such high peak power pulsed excitation under a tight focusing condition, nonlinear optical effects on trapping efficiency also become significant and cannot be ignored. Thus, in addition to the above mentioned repetitive instantaneous trapping, trapping efficiency under pulsed excitation is also influenced by the optical Kerr effect, which we theoretically investigate here. Using dipole approximation we show that with an increase in laser power the radial component of the trapping potential becomes progressively more stable but the axial component is dramatically modulated due to increased Kerr nonlinearity. We justify that the relevant parameter to quantify the trapping efficiency is not the absolute depth of the highly asymmetric axial trapping potential but the height of the potential barrier along the beam propagation direction. We also discuss the optimal excitation parameters leading to the most stable dipole trap. Our results show excellent agreement with previous experiments.
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