Laser Self-Trapping in Optical Tweezers for Nonlinear Particles

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Research Article

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Abstract

The optical tweezers are used to trap the particles embedded in a suitable fluid. The optical trap efficiency is significantly enhanced for nonlinear particleswhich response to the Kerr effect. The optical transverse gradient force makes these particles' mass density in trapping region increasing, and the Kerr medium can be created. When the laser Gaussian beam propagates through it, the self-focusing, and consequentlyself-trappingcan appear. In this paper, a model describing the laser self-trapping in nonlinear particle solution of optical tweezers is proposed. The expressions for the Kerr effect, effective refractive index of nonlinear particle solution and the intensity distribution of reshaped Gaussian laser beam are derived, and the self-trapping of laser beam is numerically investigated. Finally, the guide properties of nonlinear particles-filled trapping region and guiding condition are analysed and discussed.

Full Text

This preprint is available for download as a PDF.

Figures

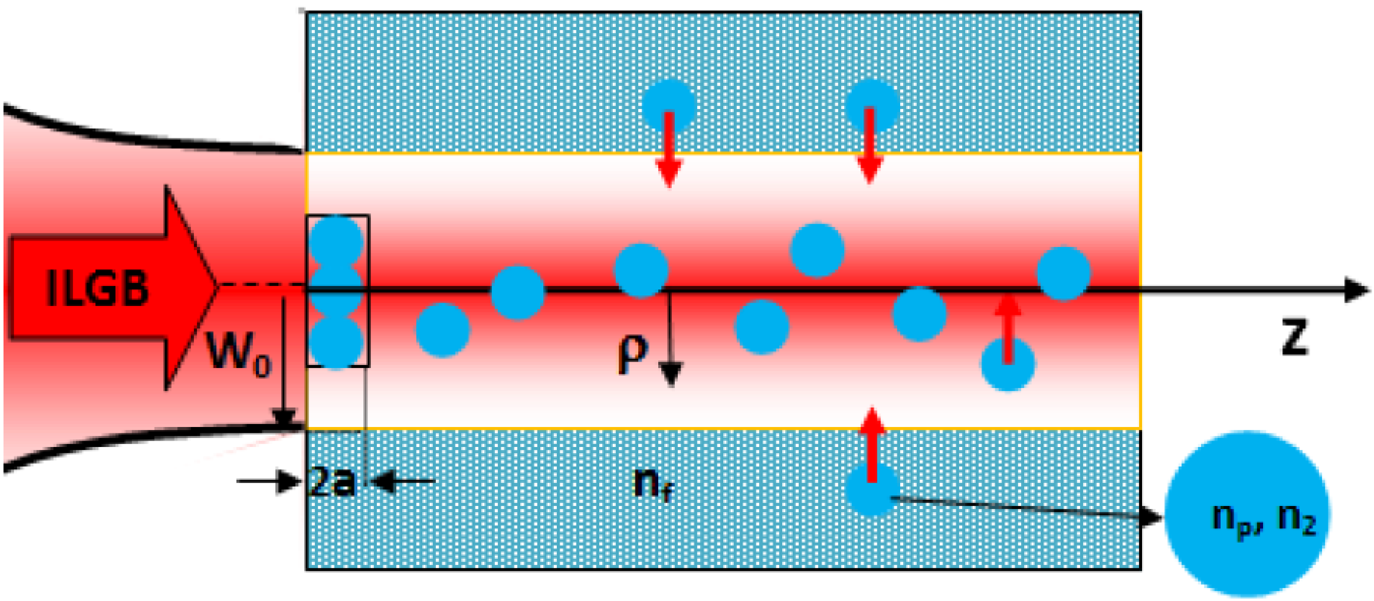

Figure 1

The sketch of optical tweezers to trap nonlinear particles embedded in fluid for self-trapping simulation.

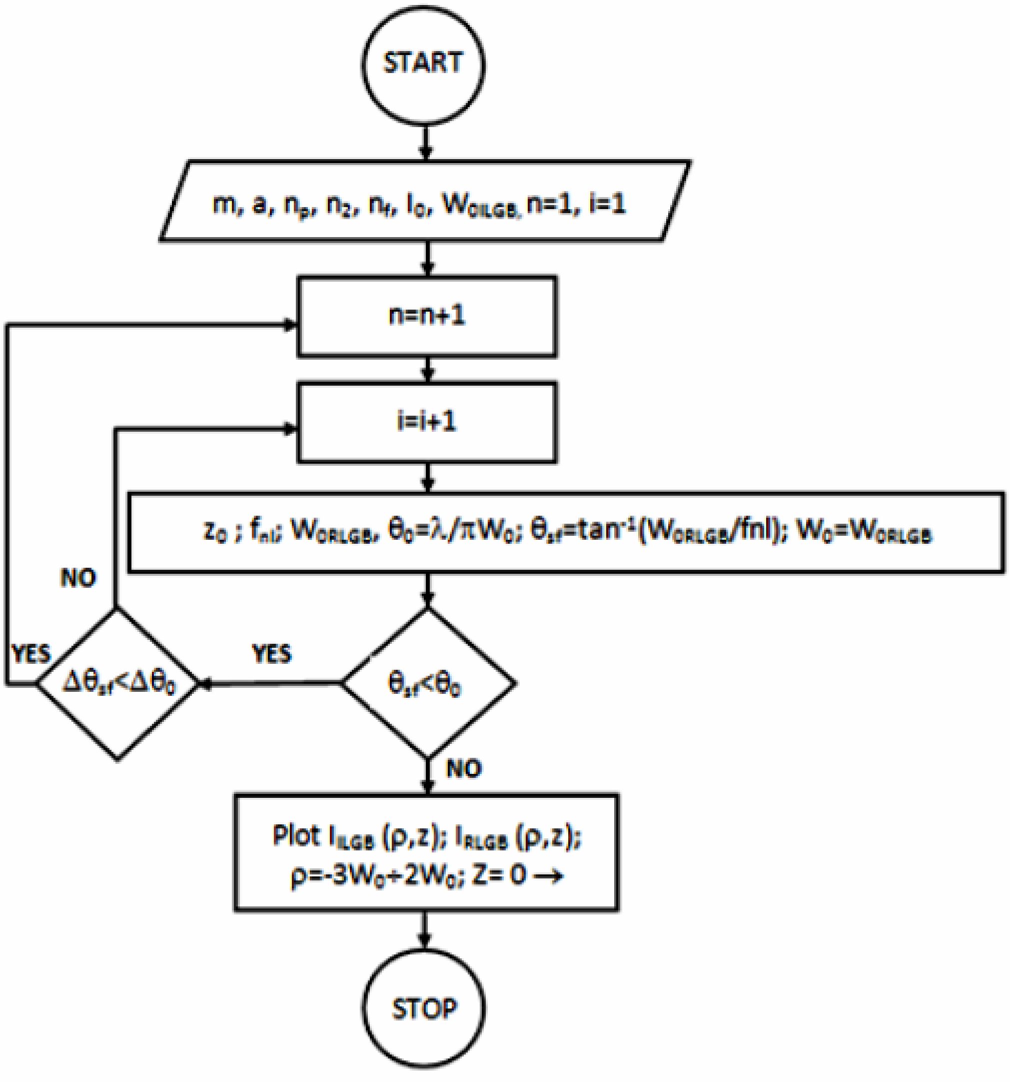

Figure 2

Simulation scheme for self-trapping.

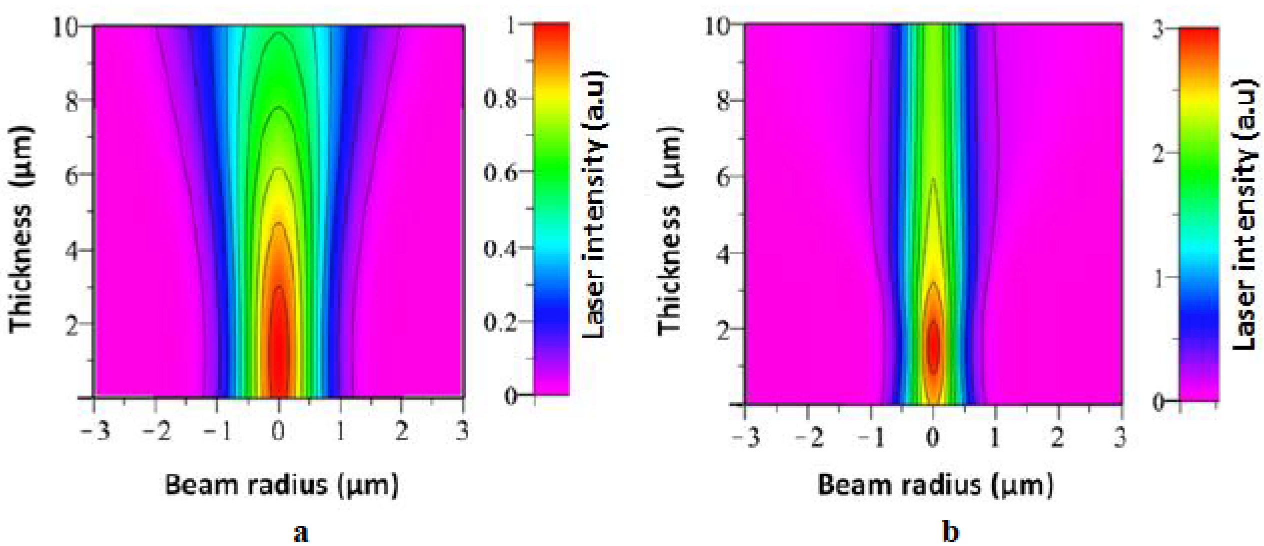

Figure 3

The laser intensity distribution in plane (p,z). a: ILGB; b: RLGB.

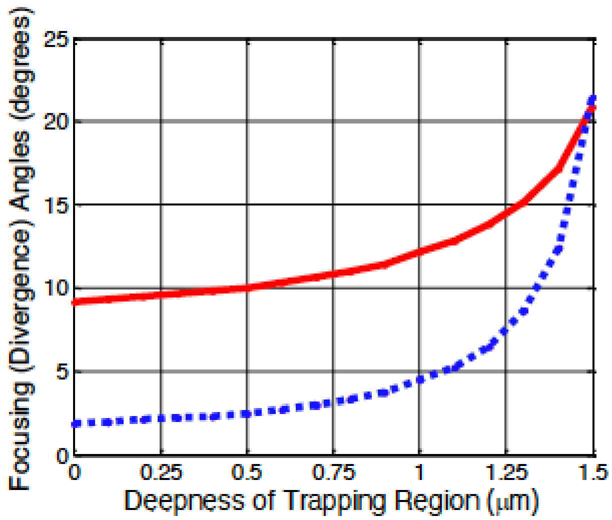

Figure 4

Divergence θ0 (solid-red) and focusing θsf (dots- blue) angles along z

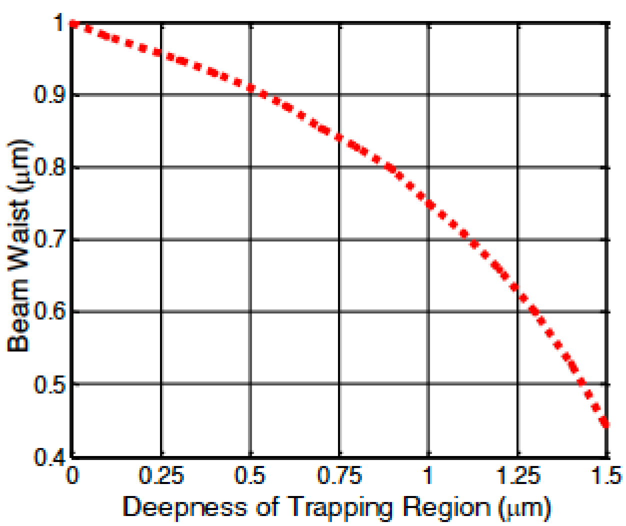

Figure 5

Beam waist W0RLGB’s change in z

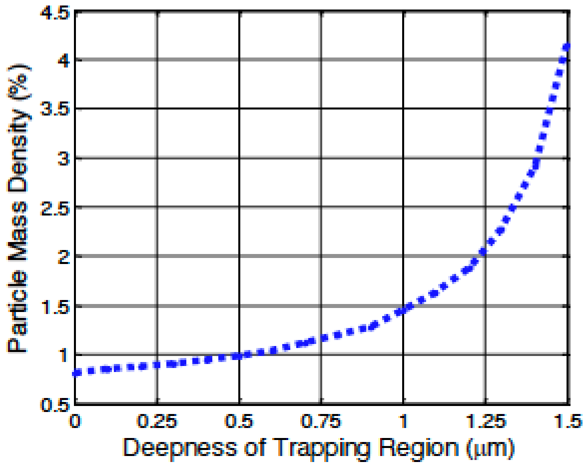

Figure 6

Particle mass density mp along z.

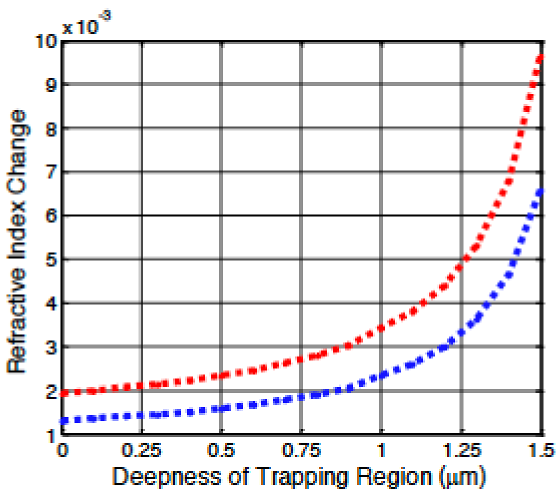

Figure 7

Refractive index change Δ along z for neff (p = 0) and neff (p = W ORLGB/2) (blue).

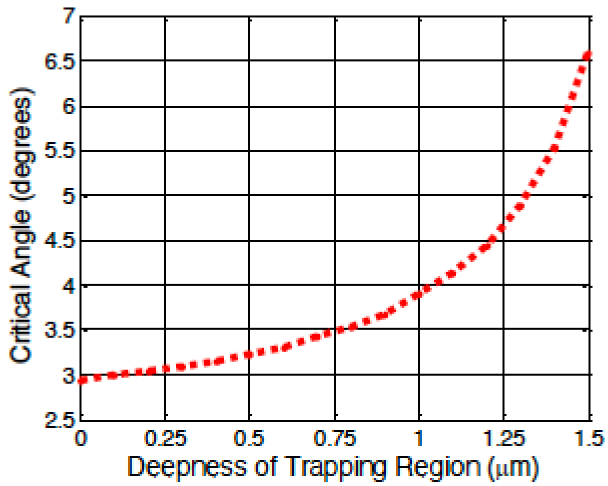

Figure 8

Critical angle θc along z using neff (p = W ORLGB/2).

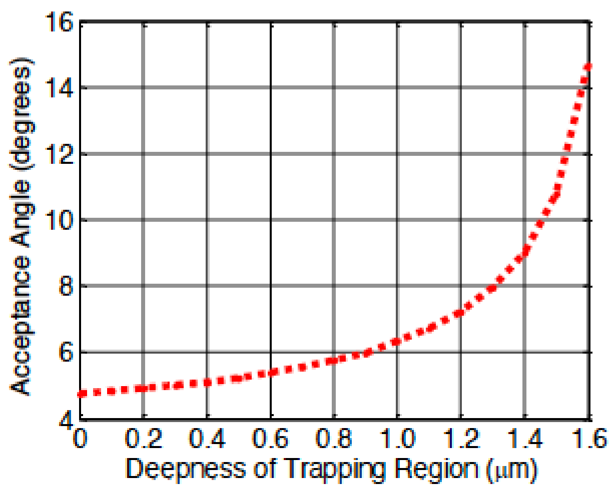

Figure 9

Acceptance angle θc along z using neff (p = 0).