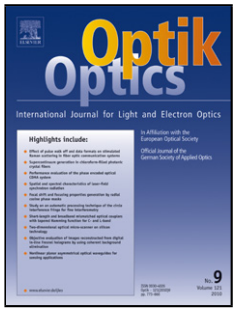

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Contribution to the study of lowest order Bessel-Gaussian beams propagating in thermal quantum plasma

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Abstract

In this paper, the self-focusing of lowest order Bessel-Gaussian beams in relativistic thermal quantum plasma is investigated. To describe the behavior propagation beams in the considered medium plasma, nonlinear differential equation of beam-width parameter is derived by using Wentzel-Kramers-Brillouin and paraxial approximations. It is shown that the quantum effects enhance the relativistic self-focusing of laser beam in thermal quantum plasma by comparison to relativistic cold quantum and classical relativistic regimes.

Keywords*: Relativistic thermal quantum plasma; Self-focusing; Lowest order Bessel-Gaussian beams; Wentzel-Kramers-Brillouin approximation.*

1. Introduction

The propagation in quantum plasma has been received a great interest in recent years due to its large applications such as quantum dots [1], astrophysical and cosmological environments [2, 3], nonlinear quantum optics [4, 5], nanotechnology [6, 7], etc. The characterization of the quantum plasma physics is defined by two conditions high temperature and low plasma electrons density. However when the inter-particle distance is equal or smaller than the Broglie wavelength of electrons, the quantum effects become more important. The properties of quantum plasmas can be described by three mathematical methods such as Wigner-Poisson, Schrodinger-Poisson and quantum hydrodynamic (QHD) models.

The self-focusing of laser beam through thermal quantum plasma has studied by Zare et al. [8], they have demonstrated that the self-focusing length in the thermal quantum plasma under density ramp becomes shorter and the oscillation amplitude of beam-width parameter is larger than the classical plasma regime. Also, the quantum effects on the self-focusing of the Gaussian laser beam in thermal quantum plasma have been reported by Patil and Takale [9]. Other works are interesting to self-focusing in cold quantum plasma when the Fermi electron temperature is