SELF-TRAPPED LASER BEAMS AND SELF-FOCUSING IN PLASMA

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ABSTRACT

In recent years, the interest in plasma has grown primarily because of its many applications in electrical and aeronautical engineering, in geophysics and space science and above all in the possible development of thermonuclear power generation. One of the most active areas of research in optics today is the process of self-focusing and soliton generation. Study of self-focusing of laser beam in plasma is needed to understand laser driven fusion, laser based particle accelerators, laser-plasma x-rays lasers, laser material processing and other opto-electronic applications. Our aim was to study self-focusing and self-trapping of laser beam through the plasma computationally and analytically using nonlinear Schrödinger wave equations. Prior to our work conventional paraxial theories based on Taylor expansion of the refractive index were used to study self-trapping and self-focusing of laser beam in the region near the axis. The results were not so good as in our case. We infact used <u>corrected paraxial theory</u> based on non-Taylor expansion of the refractive index.

In this thesis soliton forming conditions have been studied (chapter-2), which is one of the essential features of self-trapping of the laser beam. These conditions for self-trapping have also been studied for circular cylindrical and elliptical cylindrical laser beams (chapter-5) using corrected paraxial theory which is based on non-Taylor series expansion of refractive index unlike earlier work which used old (incorrect) paraxial theory based on Taylor series expansion of the refractive index (chapter-6). While analyzing the simulation of the beam propagation on the computer a new method known as matrix formulation method or simply matrix method for paraxial self-focusing of laser beam has been given first time (chapter-7).