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Title of the Thesis :Non Linear Effects in Plasmas at High Powers of Electromagnetic Fields

ABSTRACT

This thesis presents the Non Linear Effects in Plasmas at High Powers of Electromagnetic Fields .The propagation dynamics of laser beams through non-linear media has been broadly studied. The work has been done related to harmonic generation (HG) ,stimulated Raman scattering (SRS) , cross focusing of Dark Hollow Gaussian Beams (DHGB's) ,and HG in DHGB .The focus of my whole work has been in the relativistic non-linearity. The work includes analytical modelling and numerical simulation to study the filamentation process (which leads to change in the laser beam spatial structure) of laser beam.

The occurrence of localization of the electrostatic modes of the plasma changes the scenario of different nonlinear phenomenon and hence coupling efficiency between the laser and plasma. These findings are relevant for many recent areas of laser plasma research, prime examples being the currently unsolved problems of stimulated Raman and Brillioun scattering. The plasma modes are localized as it gets coupled to the filamented laser beam. The motivation for this research work is the generation of the harmonics due to laser beam filamentation effects.

In this work, the author has studied the laser beam in extended –paraxial region. The higher order terms are accounted for in the expansion of dielectric constant and eikonal . The laser intensity profile and other relevant quantities of plasma were expanded up to the 4^{th} power of radial distance r. The mechanisms of the

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plasma wave, third-harmonic generation, and the parameters, which govern the third-harmonic yield and hence the spectrum of third harmonics, have been studied in detail. Correlation of the third harmonic spectrum with the filamentation has been pointed out.

The effect of filamentation of the laser beam is studied on the localization of the Electron Plasma Wave (EPW) and on stimulated Raman scattering (SRS). Landau damping of plasma wave has been studied. The studies show that as it increases, the SRS is suppressed. The SRS back-reflectivity is found to be suppressed by a factor of approximately 8 %.

The intensity distribution has been taken in the form of zero central intensity called the dark hollow beams (DHGB's) because beam dynamics depend on the non-linear propagation which is sensitive to transverse intensity distribution of the main beam. Various methods have been developed to generate DHBs such as Laguerre-Gaussian beams, high-order Bessel-Gaussian beams, high-order Mathieu beams, doughnut hollow beams, LP_{01}-mode output hollow beam, localized hollow beams, and so on. This is the family of special light beams or DHBs.