Nonlinear absorption coefficient of the Brillouin scattered mode in quantum semiconductor plasma: Phase mismatch effects

K.Jain , Swati Dubey. S Ghosh

School of Studies in Physics ,Vikram University Ujjain

Jainrupam1987@gmail.com

**Abstract**. Comprehensive understanding of nonlinear optical parameters of materials is an essential requirement to describe the effect of propagation, interaction of laser pulses and optimisation of the processes that take place in the nonlinear optical media. The study of the frequency conversion of laser sources leading to coherent output has great significance in this area .The main challenge lies in the realization of four wave mixing effects is to minimize phase mismatch between the interacting waves. The amount of phase mismatch sets a limit on the crystal length for efficient frequency conversion for ideal materials [1]. The non linear coefficient is modulated with a period equal to twice the coherence length of the interaction to offset the accumulated phase mismatch [2]. On the other end plasma systems have become matter of significant interest especially in situations where quantum effects are important. Quantum plasmas[3] are characterised by sufficiently high density and low temperature in charged particle system, exhibiting plasma and quantum effects.

 Quantum Hydrodynamic model of a homogeneous one component infinite extent plasma medium subjected to a spatially uniform pump field, under thermal equilibrium is used in the present investigations. Numerical estimations of developed mathematical model are carried out assuming a compound semiconductor crystal duly irradiated by a CW laser at 77K. We considered the latest temperature 77 K which defines a deeply quantum regime. Coupled mode theory is utilised to obtain the nonlinear polarisation and linear and nonlinear Brillouin susceptibility of the medium. It is found that the maximum absorption is obtainable at 2.5 micron coherence length in quantum plasma medium. Doping profile appeared as a prominent control parameter for nonlinear absorption characteristics of the quantum plasma medium under phase mismatch medium.

References:

1. A .Bahabad , M.M. Murnane and H.C.Kapteyn, Nature Photonics , 4, 570(2010).
2. G.A . Mourou, Appl. Phys. B 65, 205 (1997).
3. F. Hass , Quantum plasmas: An Hydrodynamic Approach , Springer ,London (2011).