

Laser light scattering and x-ray emission from laser heated gas clusters

Interaction of intense laser pulses with atomic clusters of noble gases is of much scientific interest and has technological applications such as production of high energy electrons and ions, intense x-ray emission etc. These targets, while retaining the advantages of an overall low density gas and debris-free operation, offer very high local solid density, leading to strong laser heating. The dynamics of laser driven cluster explosion determines the details of laser coupling, which in turn affects the production yield of electrons, ions and x-rays. Optical scattering from these cluster plasmas is an important means of characterizing the dynamics of laser-cluster interaction. Our experimental study on scattering of laser light from argon gas clusters irradiated by multi-picosecond Nd:glass laser pulses at a laser intensity of 10^{15} W/cm², and the x-ray emission from these clusters have yielded some interesting results and provided a better insight in the dynamics of intense laser-cluster interaction.

Contrary to the expectation, the space-resolved side-scattered laser light was observed to have only a blue-shifted and broadened spectrum with no red component. Scattered signal intensity and average blue-shift exhibited marked dependence on backing pressure of the gas. At a backing pressure of 70 bar, the maximum blue shift is as large as 6 nm (Fig.1). The occurrence of large blue shift and absence of any red shift are explained from self-phase modulation accumulated by the laser radiation in its passage through the cluster plasma during resonance interaction phase in the vicinity of three times the critical density. To corroborate this hypothesis, the spectral shift of the laser light transmitted through argon cluster plasma was also studied. The transmitted laser light spectrum also showed blue shift only with some unshifted laser light (Fig.2). The blue shift was found to be consistent with the one observed in the side scattered light. This blue-shift may be useful as a diagnostics for understanding the resonant interaction phase of laser-cluster interaction.

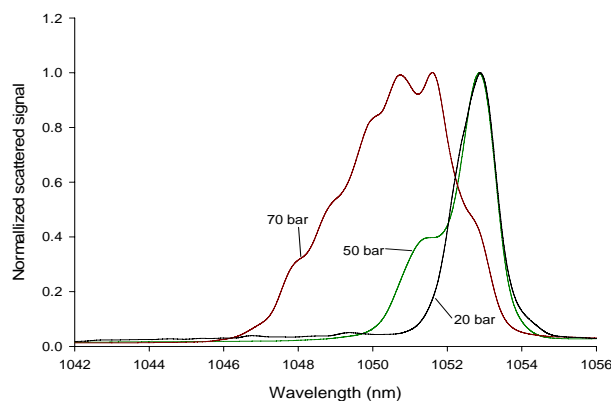


Fig.1 : Normalized spectra of scattered laser light from argon cluster plasma at different backing pressures

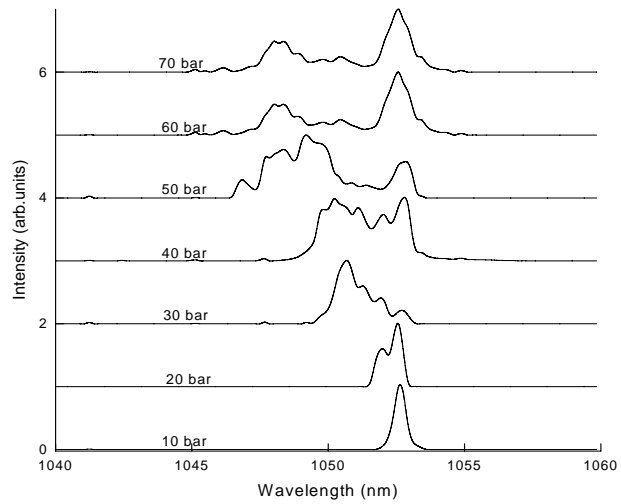


Fig.2 :Spectrum of the light transmitted through the cluster plasma at different backing pressures

References :

- 1) Spectral blue shifts in laser light scattered from argon gas cluster plasma
H. Singhal, V. Arora, P. A. Naik, and P. D. Gupta
Physical Review A 72, 043201, 2005