X-ray and ion emission studies from low density gold targets

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The utilization of laser plasma produced X-rays for investigating the plasma's emission and absorption properties and in measurement of opacity, radiography, ICF is well known. This triggers the demand of high conversion efficiency (CE) for achieving a bright X-ray source.

In this work, enhancement in X-ray emission and reduction of kinetic energy of ions from low density gold foam plasma is demonstrated by performing experiment and its validation with hydrodynamic simulation. The plasma is produced by irradiation of solid gold and gold foam targets (densities 0.193 g/cc, 0.128 g/cc and 0.0965 g/cc) with 500 ps laser at intensities in the range of 4 x 10^{13}-10^{14} W/cm^2. Time resolved X-ray emission is observed by X-ray streak camera with 10 ps resolution. The X-ray measured by streak camera from low density gold foam shows 8.5 % enhancement in comparison to solid gold. On the other hand, there is decrease in velocity of ions in case of low density gold foam. The angular distribution of peak ion velocity is measured by employing Time-of-Flight technique with four ion collectors placed at different angles (22.5º, 45º, 52º and 63º) from target normal. The maximum peak velocity of ions is 6.8 times high in case of solid gold (31x10^4 m/s) in comparison to 0.0965 g/cc (4.5 x10^4 m/s) gold foam towards target normal. Lower charge states of gold ions are found in case of solid gold which are absent in gold foam as detected by Thomson Parabola ion Spectrometer. However the difference in integrated ion flux for both cases is less indicating the process of volumetric absorption. A hydrodynamic simulation is performed by using POLLUX code. The results supports the volumetric absorption of laser light in case of low density gold foam and shows a good match with our experimental results. The detailed analysis will be presented in the conference.