Merged Plasma Formation and D-D Neutron Generation by High-intensity Laser Irradiation onto Inner Surface of Shell Target

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We are developing laser induced neutron sources as the application of high-energy laser. Neutron generation experiments were performed by using GXII laser system at Osaka University. More than 10^8 D-D neutron were observed in these experiments, by irradiating (2-3)x10^{16} W/cm^2 laser pulse (2.0-2.6 kJ with 100 ps FWHM) onto the inner surface of a deuterated polystyrene shell. Compared to experiments conducted with similar targets [1], the number of generated neutrons was more than doubled, despite the laser energy being one quarter to one third. The number of neutrons was highest at the laser intensity used to the best of our knowledge.

We cut a circular hole on the shell (500-2000 μmϕ) and a laser light irradiated the inner surface of the shell through the hole. A surprisingly uniform merged plasma was formed even with one side laser irradiation as shown in X-ray image in Fig. 1. Details of the uniform merged plasma forming mechanism are not fully understood, but both multi-scattering of the laser light within the cavity and transfer of high energy electrons along the inner surface may cause rather uniform ablation of the inner surface.

Figure 2 shows a typical signal of neutron detector in this experiment. The maximum neutron yield of 3.1x10^8 was observed. We discuss the possibility of both thermonuclear fusion and beam nuclear fusion. In order to understand this neutron generation mechanism, both theoretical and experimental study has been performed in our laboratory. I would like to offer my special thanks to Prof. H. Azechi, Prof. M. Nakai, Prof. S. Fujioka and Dr. A. Sunahara.

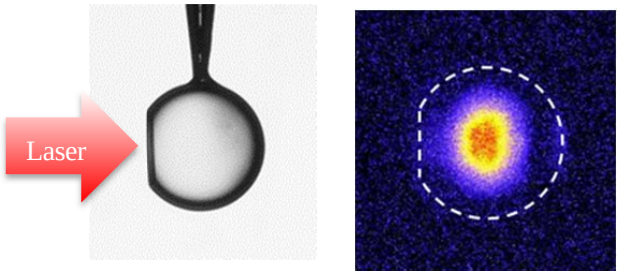

Fig. 1: Shell shape and X-ray image by XPC

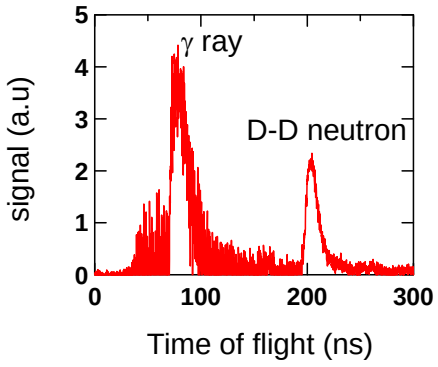

Fig.2: Typical signal of neutron detector

References

[1] H. Daido, *et al.*, Phys. Rev. Lett. 51, 2195 (1987).