The performance and anomalies of the 1D implosion campaign on the SG-III laser facility

S.Y. Zou[1*], F.G. Ge[1], T.X. Huang[2], Y.D. Pu[2], H.S. Zhang[1], D. Yang[2], J.F. Gu[1], Z.S. Dai[1], C.S. Wu[1], D.G. Kang[1], C.Y. Li[1], S.W. Li[2], Y.K. Ding[1], S.P. Zhu[1] and J.G. Wang[1]

1) Institute of Applied Physics and Computational Mathematics, Beijing, China

E-mail: zou_shiyang@iapcm.ac.cn

2) Research Center of Laser Fusion, China Academy of Engineering Physics, Mianyang, China

In this talk, we present an overview of the performance and anomalies of a series integrated hohlraum-capsule experiments on the SG-III laser facility carried out in the last two years. The ultimate goal is to optimize the target design in order to achieve the (near) one-dimensional (1D) implosion performance at the convergence ratio of ~20. The laser-hohlraum coupling efficiency is better 88% for both the vaccum and gas-filled hohlraums. Moreover, the experiments shows that the P4 asymmetry can be largely reduced by placing the laser spots on the optimized positions and the P2 asymmetry can be controlled through the adjusting of the inner/outer cone fraction of laser powers. In the first round of the campaign, we drive the capsule implosion with square laser pulses. The target has been designed carefully, so that the degradation of neutron yield is mainly due to the low-mode driven asymmetry and is nearly not affected by other effects. The highest neutron yield is 2.4×10^{12} with the YOC (experimental measured yield over that of 1D simulation) being of ~75%, in which the convergence ratio is of ~15 and the hot-spot pressure is about 10 Gbar. 2D simulations show that the YOC drops quickly with the increasing of P2 driven asymmetry on the present target design, say 2% P2 driven asymmetry alone can reduced the neutron yield by 30%. For this reason, we may conclude that the driven asymmetry in the experiments is less than 2%.

In the second round of the campaign, we conduct the implosion driven by shaped pulses with different trough lengths. It is found that the neutron yield decreased exponentially with the increasing of trough time, which is due to the shell broken and the mixing of ablator materials into hot spot caused by the coupling of low- and high-mode instabilities. However, the size capsule defects measured is only about half of that applied in the numerical simulations.

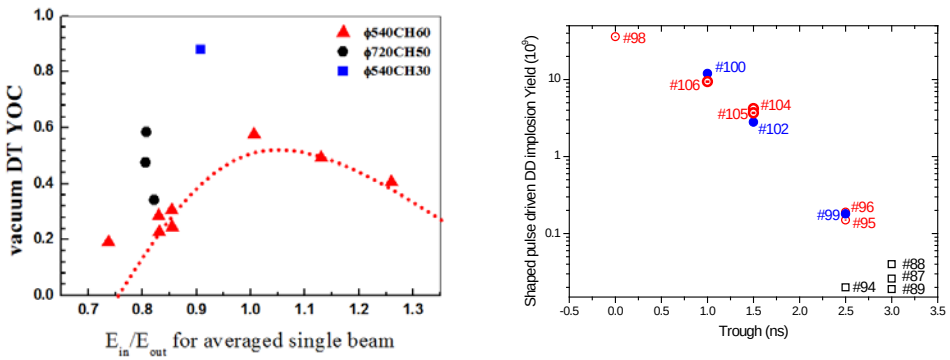

Figure 1: YOC vs. inner/outer cone fraction of laser energy for implosions driven by square pulse(left) and the neutron yield vs trough length for implosions by shaped pulses (right). Here different symbols stand for different size of hohraums.