The progress of indirect-drive implosion experiments On ShenGuang-III Proto-Type facility in china

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A series experiments on SG-III Proto-type facility (8beams/8kJ/351nm) were performed to study low to middle compression ratio implosion physics from 2007-2015. Meanwhile, some experimental technique were improved for high accuracy implosion experiment study such as Spherical-Bent-Crystal Radiography and KB radiography.

Firstly, the low compression ratio (CR~5) DD implosion experiments were preformed to study the shock yield only implosion and examine the 1D hydrodynamic code (RDMG). The experimental results proposed highly repetitive neutron yield. The two type capsules with different scale-length produce 9.9×10^7(±9.7%) and 3.1×10^7(±6.5%) neutrons respectively. Based on RDMG simulations, the ion-flux-limit-factor (IF) from 0.05 to 1 will influence the neutron yield for shock yield process few times and had a little influence on inertial yield process. In our shock yield only experiments, the YOC_{1D} will reached at 80%~105% with the IF equal to 1. Meanwhile, the NIF shock yield shots (Pape S.L, Phys.Rev.Lett 112, 225002(2014)) make 85% YOC_{1D} using RDMG code with IF equal to 1.

Secondly, the low-middle compression ratio (CR~10) DT implosion experiments with different ablator thickness, different gas fill and 220eV Radiation temperature were performed. For thin shell implosion, nearly all neutrons comes from shock yield, 3×10^9 DT neutrons were collected and YOC_{1D} is nearly 70%.on the other hand, for thick shell implosion, the inertial yield accounts for the main in 1D simulation, 8×10^8 DT neutron were collected and YOC_{1D} is less than 10% because of non-1D factor decreased implosion performance.

At last, two advanced diagnostic technique were developed for high accuracy implosion experiments. The SBC Radiography was used for implosion stream line measurement. The uncertainty of implosion velocity was around 9% and better than traditional slit radiography which with the uncertainty of 15%; The KB radiography was used for hot-spot self-emission because of high-spatial resolution (~3μm). The uncertainty of hot-spot shape was around ±2μm and better than traditional pinhole-array radiography which with the uncertainty of around ±5μm.