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Investigation on hohlraum energetics at the SG laser facilities

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Hohlraum plays an important role in indirect drive inertial confinement fusion. It converts intense laser into soft x rays which is used to drive the D-T capsule to achieve ignition. In hohlraum physics studies, hohlraum energetics is one of the key issues because it is directly related to the scale of ignition laser facility. Another important issue in hohlraum physics study is the radiation asymmetry. The integrated experiments at the National Ignition Facility indicated that the radiation asymmetry control in cylindrical hohlraums is an extremely challenging problem and one of the main obstacles in achieving ignition [1]. Recently, Lan *et al.* proposed an octahedral spherical hohlraum which has the natural superiority in providing high radiation symmetry [2]. As a new and promising hohlraum, the spherical hohlraum attracts much research interests. Here, we report on the spherical hohlraum energetics experiments performed at the SG series laser facility.

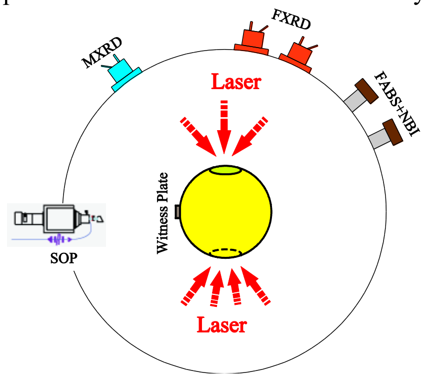

Figure 1. Schematic view of the experimental setup at SGIII-prototype and the arrangement of the main diagnostics.

At the SGIII-prototype laser facility, we performed the first spherical energetics experiment[3]. In this experiment, the radiation temperature is measured by using an array of flat-response x-ray detectors through a laser entrance hole at different angles, as shown in Fig. 1. The radiation temperature and M-ban fraction inside the hohlraum are determined by the shock wave technique [4]. It is found that the measured radiation temperatures of FXRDs depend on the observation angle. At present, the simulation code cannot reproduce all the measurement results, so the exact hohlraum conversion efficiency is quite difficult to be determined. Therefore, what we obtained is not an accurate conversion efficiency but a range of hohlraum conversion efficiency. The conversion efficiency of the vacuum spherical hohlraum is in the range from 60% to 80%, which is consistent with that of the cylindrical hohlraums at the same energy scale.

At the hundred-kilojoule laser facility, we accomplished the first octahedral spherical hohlraum energetics experiment [4]. The 32 of 48 laser beams enter the hohlraum through six laser entrance holes, as indicated in Fig. 2. In order to obtain the comprehensive energetics experimental data, we used two techniques to diagnose the radiation field of the octahedral spherical hohlraum. The radiation flux streaming out of laser entrance holes is measured by six flat-response x-ray detectors (FXRDs) and four M-band x-ray detectors. The peak radiation temperature inside hohlraum is determined by the shock wave technique. The experimental results show that the radiation temperature is in the range of 170–182 eV with drive laser energies of 71 kJ to 84 kJ. The radiation temperature inside the hohlraum determined by the shock wave technique is about 175 eV at 71 kJ.

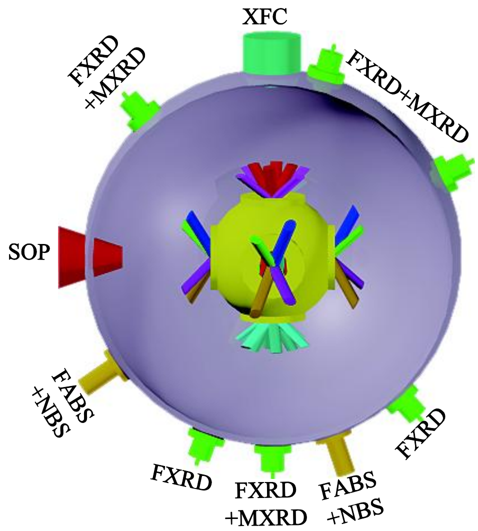

Figure 2. Schematic view of the experimental setup of the first octahedral spherical hohlraum energetics experiment.

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