A full aperture backscattering light diagnostic system installed in the
Shenguang-III prototype laser facility
Xu Tao, Wei Huiyue, Peng Xiaoshi, Wang Feng, Yang Dong, Liu Shenye

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

Inertial confinement fusion (ICF) experiments and high energy density physical experiments rely on efficient coupling of the laser energy with the targets. One important energy loss mechanism is scattering of the incident beam by the plasma surrounding the target. Scattering of laser light out of the hohlraum results in loss of x-ray drive on the capsule and potential loss of symmetry control. It is therefore important to temporally diagnose and control the energy backscattering from targets; besides, backscattering light measurement is a basic tool used to provide insight into laser-plasma interactions (LPI). Both ion and electron waves are driven to large amplitude in the plasmas by the processes of stimulated Brillouin scattering (SBS) over the wavelength range of 348–354 nm and stimulated Raman scattering (SRS) over the wavelength range of 400–700 nm. When the laser intensity is very high, these waves can produce scattering well above the thermal scattering level.

The Shen Guang-III prototype laser facility is a large laser facility which operates at an energy of 15 KJ using 8 laser beams of 3ω (λ=351nm) laser. Aiming to diagnostic the backscatter light in hohlraum experiments, a full aperture backscatter light diagnostic system (FABLDS) implemented on this facility is described in the paper. FABLDS measures both SBS and SRS with a series of optical detectors. Energy sensors record the integrated energy and streak camera coupled with spectrometers measure the temporal spectrum of the backscattering light. This paper provides an overview of the FABLDS and detailed descriptions of the optical path. Special components including off-axis parabolic mirror, spatial filter and optical light filters are adopted in the beam path for purifying the scattering light. Several hohlraum targets were employed including C5H12 gas-filled targets and empty targets in the experiments. Results presented and explained in the paper indicate that the fraction of backscatter light have been obviously decreased when the laser are smoothed by continuous phase plates (CPP).