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# P3.059 Laser transfer technique using wavefront correction and homogenizers for Thomson scattering diagnostics

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A Thomson scattering system providing electron temperature and density profile requires a high energetic laser. YAG lasers amplified by flash lamps (~50-100 Hz of repetition frequency with a few Joules output) sometimes suffer from wavefront distortion and peaked beam profile. The wavefront distortion deteriorates beam profile in the far field. Since a focusing lens is used toward the plasma to ensure good spatial resolution (~10mm), the deteriorated profile degrades spatial resolution and the collection optics miss measurement of scattered photons, which results in degradation of SN ratio. We employ a deformable mirror, which can deform the mirror surface using multiple piezo actuators so that the wavefront of the reflected beam becomes flat. To test the application, a YAG laser to be used for JT-60SA, which has some wavefront distortion (0.46 wavelength of peak-to-valley), is employed. Use of deformable mirror enables an improvement of the wavefront distortion to 0.1 wavelength (peak-to-valley). The expected beam waist in the JT-60SA plasma can be reduced from 13mm to 5mm, which is preferable for collection optics with limited collecting power.
A peaked beam profile causes damages on optical components such as lenses and mirrors. This limits a long beam transfer and use of amplifiers with crystals providing population inversion. We developed a new homogenizer, which is a diffraction optical element (DOE) to change the profile from peaked to non-peaked. The output at the image was designed to have a super-Gaussian shape. We use a continuous-wave laser (Gaussian) of 1064nm as an input to evaluate scale with the non-peaked profile. The homogenizer having the super-Gaussian shape sustained a non-peaked profile longer by a factor of 3.5 (=700mm/200mm) than that designed to have a top-hat shape at the image. This sustained scale is applicable for various optical components.

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