§42-3 Development of Electron Density and Temperature Measurements for Plasmoid using Laser Thomson Scattering

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In ITER, control of transient heat and particle loads due to ELMs and its impact to divertor materials will be an important issue. For the assessment of the transients, it is necessary to characterize the high density plasmoid, and it is thought that laser Thomson scattering diagnostics will be the best tool for the characterization. For Thomson scattering diagnostics, laser transmission mirrors and a neodymium - doped yttrium aluminum garnet (Nd:YAG) laser at 1064 nm will be used for future fusion devices. In previous year, the Rayleigh scattering signal was obtained using nitrogen gas, but the signal to noise ratio was low. In the FY2014, the optical system was improved and the signal to noise ratio was improved by two orders of magnitude.

The measurement system of the laser Thomson scattering system was installed in the divertor simulator NAGDIS-II [1]. A Nd:YAG laser at the wavelength of 532 nm was used for the laser, and Brewster windows are used for the injection of the laser beam to the chamber to reduce the stray light. To increase the signal to noise ratio, several improvements were conducted. Firstly, a beam expander was introduced to increase the laser radius to double the original size. Consequently, the size of the laser injection tube was exchanged to a larger one for larger laser beam. In addition, beam dump located outside the vacuum vessel was replaced to the one with higher extinction ratio and the alignment of the laser was accurately conducted. For the detector, image intensified charge coupled device (ICCD) (Princeton instruments, PIMAX-IV) was used. The spectrometer used has focal length of 300 mm.

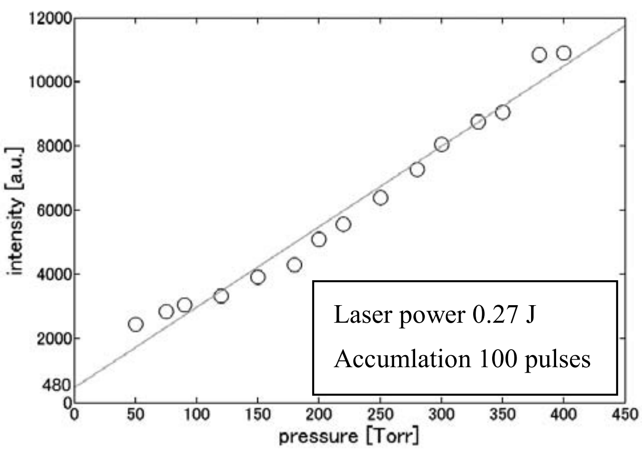

Fig. 1 Signal intensity as a function of the gas pressure. The laser pulse energy was 0.27 J, and 100 number of signal was accumulated.

Figure 1 shows the nitrogen gas pressure dependence of the signal intensity without plasma. The laser pulse energy was 0.27 J, and 100 number of signal was accumulated. The signal contains the Rayleigh signal and stray light when gas was injected to the chamber. The intensity increased with the gas pressure linearly indicating the component is Rayleigh signal. The intercept of the fitting line corresponds to the stray light level.

Figure 2 shows the Rayleigh signal at 5.6 mTorr and the stray light obtained without gas injection. The Rayleigh signal intensity was 10800, while the stray light level was 235. At 5.6 mTorr, the Rayleigh to stray light ratio was ~46 in the present configuration. Before the improvement, the ratio was 0.3, indicating that the signal to noise ratio was increased by two order of magnitude.

In FY2014, signal from the plasma was not clearly identified, indicating further improvement would be necessary to increase the signal and decrease the stray light. For that purpose, we plan to introduce a doublet lens for collection optics and increase the signal to noise ratio.

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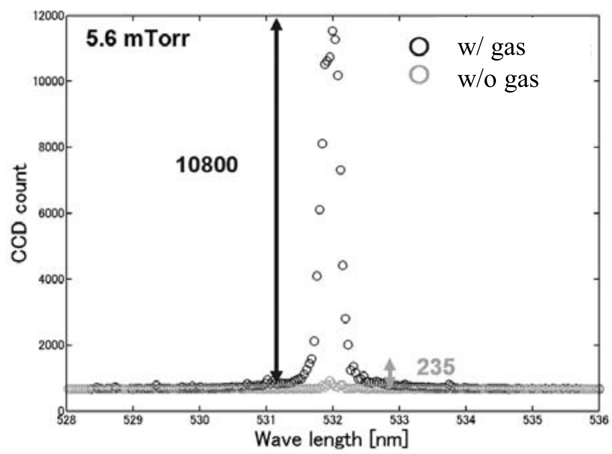

Fig. 2: Rayleigh signal at 5.6 mTorr and the stray light (without gas).

1) N. Ohno, D. Nishijima, S Takamura, *et al*., Nuclear Fusion, 41 (2011) 1055.