§9. N_2 Rotational Raman Calibration for YAG Thomson Scattering on CHS

Minami,T., Yamada, I., Narihara,K.

There are several methods of calibration of Thomson scattering system for measuring an absolute electron density value. The Rayleigh scattering method has been most frequently used on several fusion plasma devices. When a stray light level is too high to separate Rayleigh signal from the stray light, the Raman scattering method [1][2] can be also used.

Hydrogen gas is most suitable for the Raman scattering calibration, because Hydrogen has a large frequency shift of the rotational Raman lines and a large cross section [2]. But it is possible for the hydrogen to degrade the wall recycling on CHS. Nitrogen gas has small possibility, but the shift of the Raman lines is small, so that the cross section of the observable lines is small [1]. However, interference polychromators were used in the Nd:YAG Thomson scattering system of CHS which have the filters of a wide band width. There are many observable Raman lines that can be transmitted through the filter. Therefore, the level of the Raman scattered light is enough to calibrate the Thomson scattering system.

We calculated the Raman scattering cross section of the nitrogen at the wavelength of the Nd:YAG laser (λ =1064 nm). Fig. 1 shows the result of this calculation and the transmittance of the typical interference filter used in our system (CW=1045 nm, BW= 12 nm). This filter is used in the set for high temperature, so that the range of transmitted wave length is far from the laser wavelength. There are many lines that can be transmitted even in this case.

The calibration experiment was carried out on CHS. The Raman scattered light of N_2 was measured at the pressure of 0-780 torr and at the room temperature. Fig. 2 shows the typical electron density profile of the CHS plasma was measured using the calibration factors calculated from the above experiments. This profile has good agreement with line averaged density measured with HCN Interferometer. The ratio of the measured absolute densities with both methods is 0.95.

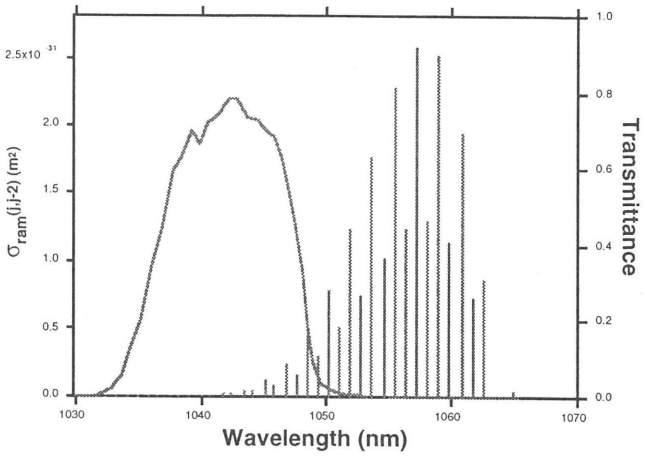

Fig.1 The calculation of the Raman cross section of the nitrogen at the Nd:YAG laser wavelength and the transmittance of the typical interference filter (CW=1045 nm, BW= 12 nm).

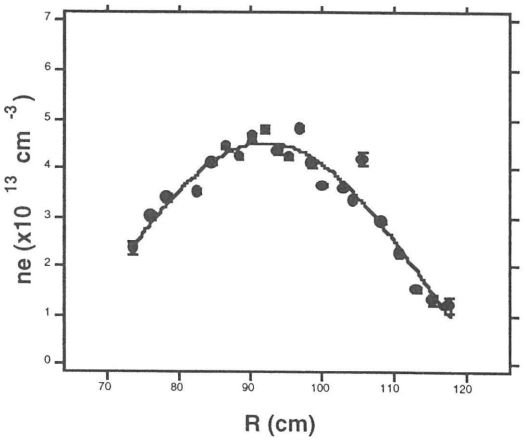

Fig. 2. The typical profile of the electron density that was measured with YAG Thomson scattering system using the factors calculated from the result of the N_2 Raman scattering calibration.

References

1)Howard,J et.al.J.Phys.D 12 pp 1435-1440 (1979)

2)Rohr,H, Phys. lett. 81A(8)pp 451-453 (1981)