§6. H_α Spectra in a NBI Heated CHS Plasma

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As a validation of the Monte Carlo simulation method (DGAS) for the neutral atoms and molecules, a study is conducted to reproduce H_α spectra in the CHS by the simulation method [1]. In the present simulation, only low energy hydrogen atoms produced by recycling at inboard-side wall are taken into account, and thus an effect of NBI as the high-energy neutral source is neglected. In experiments, however, the H_α spectra have wide wavelength broadenings even when they are observed at toroidal sections where the beams do not pass and thus emissions due to the charge exchange excitation are negligible. In an NBI experiment (shot number of 106770) investigating the ETB (edge transport barrier) [2], the spontaneous H_α emission is measured by using the vertically viewing chord for the background radiation at a vertically elongated section, which is also assumed in the simulation [1]. The two beams were injected in 60ms<t<100ms and the L/H transition occurred at t=65ms. Figure 1 shows the H_α spectra in this shot with the time-integration in 80ms<t<100ms at major radial positions of 0.88m<R<1.10m.

The FWHM is about 0.09nm corresponding to a hydrogen gas temperature of 4eV which is consistent with the dissociation processes assumed in the simulation. The measured H_α intensity is a decreasing function of major radial position R suggesting that the main source of atoms locates at the inboard-side wall. This radial profile also can be reproduced by the simulation [1]. However, the theory, which takes only the inner wall as the source into account, predicts that the wavelength broadening depends on the major radial positions. The measurement result does not have this dependence. Furthermore, by comparing the measured spectrum profile with single Gaussian profile as shown in Figure2, we can see that it has a high-energy tail in spite of a fact that there are not charge exchange excitations by the beams. Therefore the role of the neutral beams in the distribution of atoms and molecules will be a next theme in the validation.

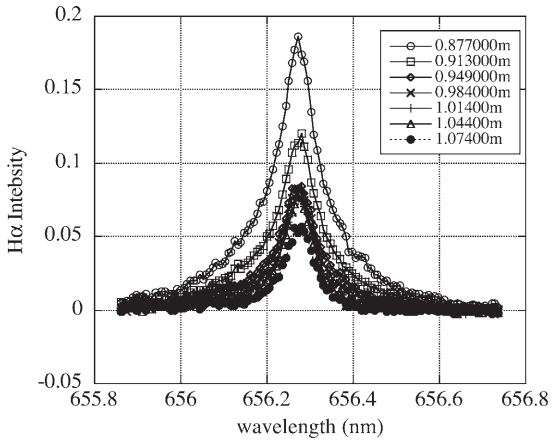

Fig.1 H_α spectra measured by using the vertically viewing chords at the vertically elongated section [3]. The measured intensity is a decreasing function of major radial position R.

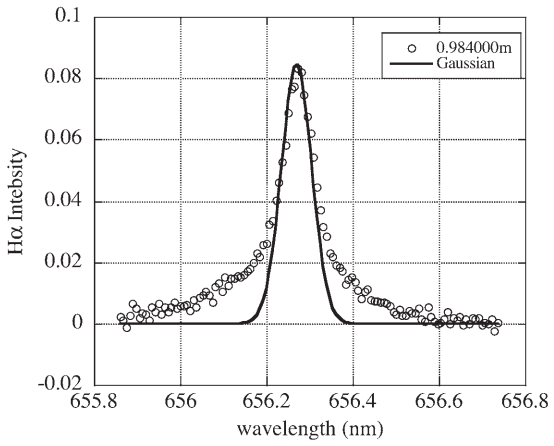

Fig.2 A comparison of the measured spectrum at R=0.984m with the singe Gaussian profile having identical FWHM value. It can be seen that the measured spectrum has a high temperature component with T≅7eV.

1) H.Matsuura, K.Nakano, S.Nishimura, M.Shoji, C.Suzuki, and S.Okamura, in ICPP2008 (8-12 Sep. 2008, in Fukuoka, Japan); also in this report
2) S.Nishimura, et al., Plasma Fusion Res. 2, 037 (2007)
3) S.Nishimura, et al., Phys.Plasmas 7, 437 (2000)