Evaluation of halo-neutral contribution to the fast-ion charge exchange spectroscopy (FICXS) on LHD

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The confinement of fast ion is a common physics issue for toroidal magnetic devices since the plasma sustainement by fusion-born alphas is necessary in fusion-reactors. Therefore, it is important to evaluate the confinement properties of fast-ions in those devices.

On Large Helical Device(LHD), the influences of magnetic-ripples and MHD instabilities on fast-ion confinement have been observed by a fast neutral diagnostic. Since this diagnostic observes the limited region in the velocity space of fast-ions, it is very difficult to investigate their whole confinement properties. A fast ion charge exchange spectroscopy(FICXS) diagnostic has been recently applied on LHD[1]. This method is similar to the fast ion deuterium-alpha (FIDA) diagnostic which was developed on DIII-D[2]. From the Doppler-shifted H-alpha spectra of charge exchanged fast-neutrals, this method can evaluate both spatial and energy distribution of fast-ions. Therefore, it is suitable to use this method in evaluating the fast-ion confinement properties.

For an accurate mearuement of the fast ion profile by FICXS, the effect of halo neutrals, which are subsequently generated with the charge exchange process between bulk-ions and injected neutral beams, must be treated properlyIn the current analysis of FICXS spectra on LHD, the contribution of halo neutrals are estimated empirically from the shape of the spectra. In this paper, the amount of halo neutrals are estimated numerically both by using the EIRENE-3D Monte-Carlo code [3] and by solving simple diffusion equation. In solving the diffusion equatgion, the diffusion coefficient of Hydrogen neutral is evaluated from the thermal velocities of bulk ions and the life time of the neutral particles. The contribution of these halo neutrals are shown and discussed at the presentation.

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