

§16. Hit-point Distributions of Escaping Fast Ions on the Vacuum Vessel

Kotani, J. (Dep. Energy Eng. Science, Nagoya Univ.),
 Toi, K., Isobe, M.,
 Shimizu, A. (Dep. Energy Eng. Science, Nagoya Univ.),
 CHS Group

It is required that fast ions produced by neutral beam injection (NBI) are well confined in the toroidal magnetic configuration until most of their kinetic energy is transferred to a bulk plasma. Fast ions in the CHS magnetic field are categorized into four groups, depending on the pitch angle: passing, local (toroidal) mirror trapped, helically trapped and transition ions^{1),2)}. The latter three groups would be lost localized area on the vacuum chamber. In order to understand loss processes and mechanisms of fast ions in CHS, direct measurement of escaping fast ions in various locations around the CHS plasma is very important. The hit points of escaping fast ions on the vessel wall are numerically studied to determine installation positions of lost ion detectors.

A fast proton having 40 keV energy was launched from the following positions shown by crosses in Fig.1 and the trajectory was tracked using a particle orbit code. In this calculation, the pitch angle of the fast particle χ is varied every 10° from 0° to 180° , where $\chi < 90^\circ$ corresponds to counter-going and $\chi > 90^\circ$ to co-going. This analysis has been done for three typical magnetic configurations of CHS, that is, $R_{ax}=92.1$ cm, 94.9 cm, and 97.4 cm (R_{ax} : the magnetic axis position of the vacuum field). In any configurations, fast ions having $80^\circ \leq \chi \leq 120^\circ$ are preferentially lost toward the vessel wall. Moreover, the escaping fast ions hit the vacuum wall in the helically localized areas on the vessel wall, as shown in Fig.2. It should be noted that most of hit-points are localized away from the diagnostic ports of CHS for escaping fast ions measurement, which are shown by open circles. When fast ion driven MHD instabilities are excited in a plasma, fast ions might be lost in such areas resonating with the MHD instabilities.

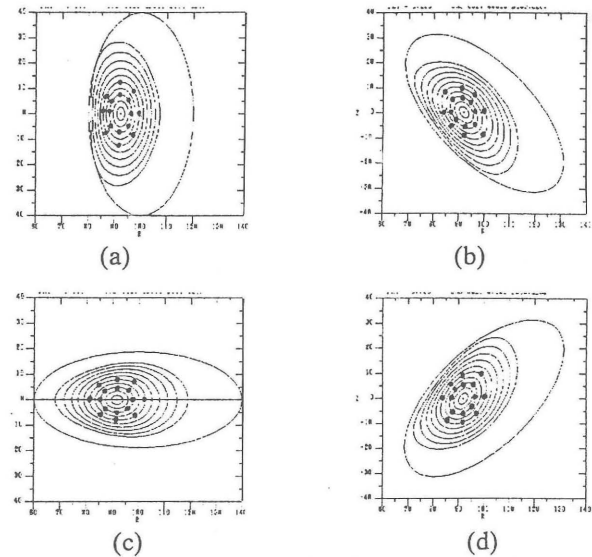


fig.1. Launching positions of a fast proton in the CHS magnetic configurations of $R_{ax}=92.1$ cm, where the toroidal locations at (a) $\phi=0^\circ$ (b) $\phi=11.25^\circ$ (c) $\phi=22.5^\circ$ and (d) $\phi=33.75^\circ$.

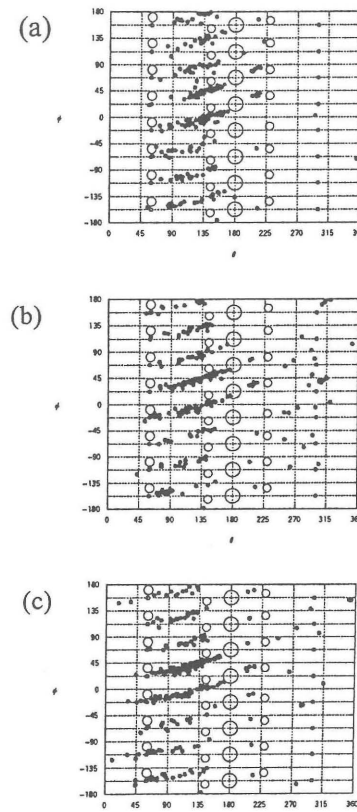


Fig.2 hit-points of escaping fast ions on the vessel wall in the magnetic configurations of (a) $R_{ax}=92.1$ cm (b) $R_{ax}=94.9$ cm and (c) $R_{ax}=97.4$ cm. Diagnostic ports are shown by open circles.

Reference

- [1] T. Kondo et al., Nucl. Fusion **40**,1575(2000)
- [2] H. Sanuki et al., Phys.Fluids B2 (1990) 2115