§50. Particle Confinement Analysis Using the Ice Pellet Injection

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Particle confinement analysis has been carried out using the ice pellet injection in LHD. A hydrogen ice pellet was injected into He plasma in order to distinguish the hydrogen behavior, which can be measured by a neutral particle analyzer (NPA). It should be noted that NPA does not have sensitivity for He.

Figure 1 shows the time evolution of the line integrated electron density and charge exchange (CX) neutral hydrogen flux. A hydrogen ice pellet is injected at t=1.8 s as shown by a broken line. We classify the time evolution of CX flux under four phases as follows: (I) The CX flux increases rapidly just after the pellet injection. The rapid increase seems to be caused by the charge exchange between the residual hydrogen ions in He plasma and the ablated hydrogen neutrals. (II) The CX flux decreases at 10 ms after the pellet injection. The decrease is caused by shielding of CX flux due to local density increase. (III) The CX flux recovers after several tens ms due to redistribution of electron density (i.e. the decrease of the local density) and (IV) it decreases again.

Now, we focus on the decay time of CX flux in the phase (IV). The decay of CX flux is caused by the hydrogen diffusion. The energy of CX flux may correspond to the position of the plasma. The dependence of the decay time of CX flux is shown in Fig.2. The decay time is in the range of 0.11 to 0.15 s. A clear dependence of the decay time on the energy cannot be seen. It is considered that the behavior of CX flux depends on the penetration depth of the ice pellet. In the simple model calculation [1], the diffusion coefficient can be estimated to be 0.8 m^2/s form the decay time of CX flux, assuming that plasma configuration is cylindrical, diffusion coefficient is constant, inward velocity is zero and atomic process should become equilibrium. In this experiment, the coefficient of 0.8 m^2/s means the diffusion of the peripheral region of the plasma. There is a possibility of estimation of a radial profile of diffusion coefficient of hydrogen by using different penetration depth of the ice pellet. The detail analysis is required but it is future work.

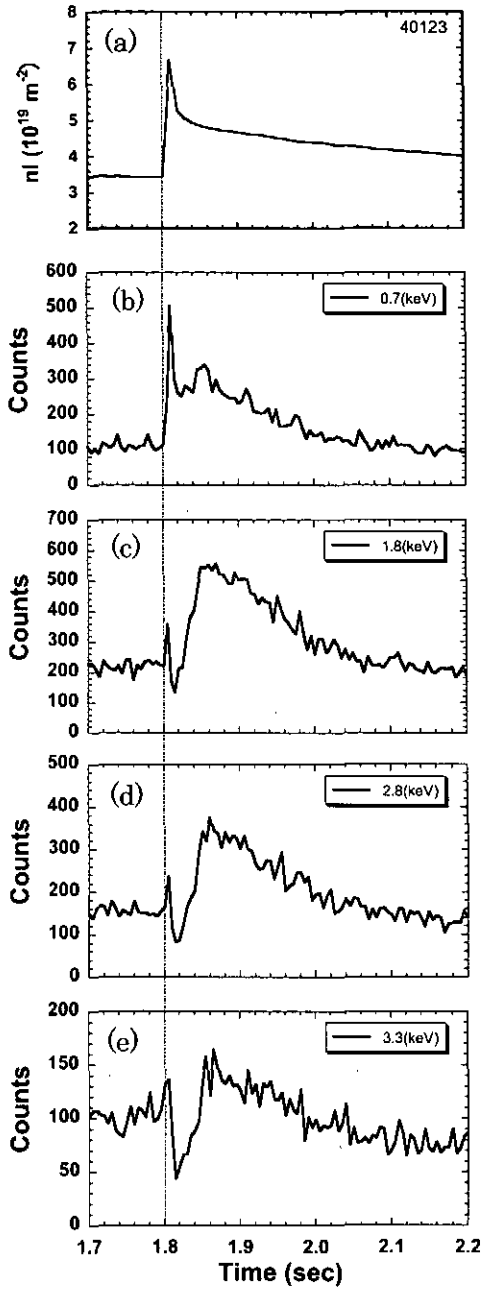

Fig.1 Time evolution of (a) electron density and CX neutral flux of (b) 0.7keV, (c) 1.8keV, (c) 2.8keV and (d) 3.3keV in the pellet injection

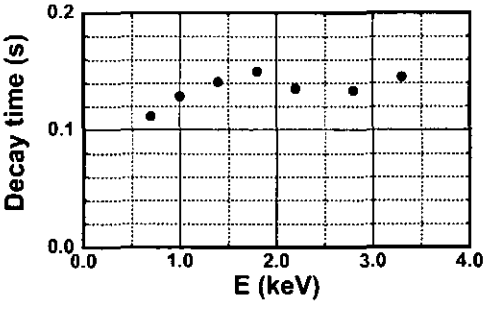

Fig.2 Energy dependence of the decay time of CX neutral flux.

Reference
1) Ozaki, T. et al, 8th IAEA TCM on Energetic Particles (2003)