Progress in the Pellet Charge Exchange Diagnostics on LHD and Local Neutral Particle Spectra Analysis

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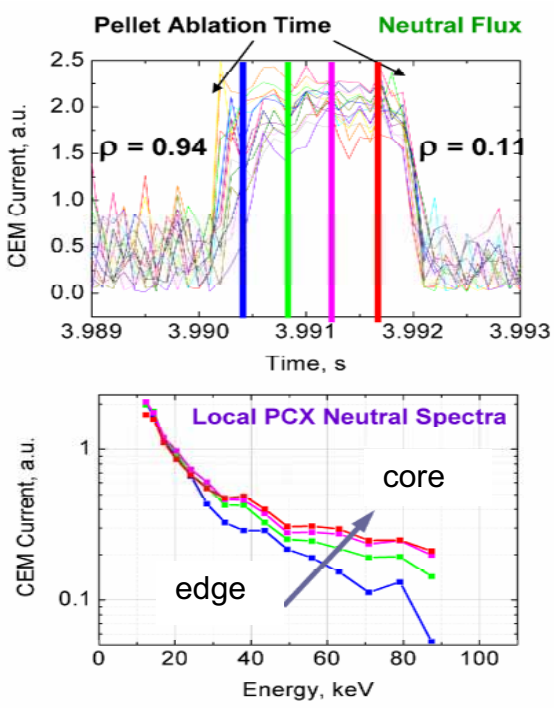
First radially resolved data on escaping neutral particle energy spectra have been obtained on LHD by using an impurity solid pellet ablation cloud as a localized target for charge exchange. The measured atomic flux in this method is expressed as

$$\Gamma^{(PCX)}(E,\mathbf{r}(t)) = \frac{S_a S}{4\pi L(t)^2} F_0(E)\, \mathrm{v}_i n_i(\mathbf{r}(t))\, f_i(E,\mathbf{r}(t))\, e^{-\int_0^{L(t)} \frac{d\varsigma}{\lambda_{mfp}(E,\varsigma)}},$$

where $n_i(\mathbf{r}(t))f_i(E, \mathbf{r}(t))$ is the plasma ion distribution function at the current pellet location $\mathbf{r}(t)$, v_i is the ion velocity corresponding to the kinetic energy E, $F_0(E)$ is the proportion of the incident ions neutralized by the cloud. The attenuation of the atomic flux in the plasma is determined by the mean free path λ_{mfp} with respect to ionization. The energy-independent geometric factor contains the aperture area S_a, the visible cloud area S and the distance $L(t)$ between the pellet and the aperture [1].



Polystyrene $(\text{-}C_8H_8\text{-})_n$ balls pneumatically accelerated to v_{pel} = 300-400 m/s were injected transversally; typical D_{pel} = 500-900 μm. The angle between the compact neutral particle analyzer (CNPA) [2] sight line and the pellet injection axis was 2° horizontally and 1° vertically. The values of the local $v\|/v$ for the observable particles were in the range -0.25 to +0.25 along the average pellet flight. The initial data analysis and the interpretation of the neutral spectra from ECRF/tangential NBI heated plasmas and from ICRF plasmas using the estimated carbon/hydrogen ablation cloud neutralization fraction [3] will be discussed.

[1] P.R. Goncharov, T. Saida et al., Rev. Sci. Instrum., **74** (2003), 1869

[2] F.V. Chernyshev, V.I. Afanasyev, A.V. Detch et al., Instr. and Exp. Tech., **47** (2004), 214

[3] V.Yu.Sergeev et al., 29th EPS Conf. on Contr. Fusion Plasma Phys., vol. **26B**, P-2.120 (2002)