

§7. Synergy Effect of ECCD and NBCD on Profiles of Electron Temperature, Electric Potential and Rotational Transform

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In LHD, conditions for the formation of internal transport barrier for electrons (e-ITB) have been investigated from the aspects of such as NB direction, profile of rotational transform ι , deposition region of electron cyclotron heating (ECH).¹⁾ Recently the effect of electron cyclotron current drive (ECCD) on the e-ITB formation was reported.²⁾ In LHD 16th experimental campaign, it was found that a synergy effect of ECCD and NBCD also affect the profiles of electron temperature T_e . The experiment was performed with the magnetic configuration of $R_{ax} = 3.6\text{m}$ and $B = -1.375\text{T}$ for second harmonic ECH and ECCD, and using NBI#1 and NBI#2 so that measurements of electric potential and rotational transform were not available.

In the 17th campaign, an experiment to study the synergy effect by measuring potential and rotational transform was performed with the magnetic configuration of $R_{ax} = 3.6\text{m}$ and $B = 1.375\text{T}$, and using NBI#2 for co-NBCD, NBI#1 and #3 in half-power operations each for counter (ctr)-NBCD. From 3.3s to 4.8s the co-NBCD, and from 4.7s to 6.3s the ctr-NBCDs sustained plasmas. 77GHz EC-waves injected from 2-O port (0.76 MW) for co- or ctr-ECCD were additionally applied from 3.8s to 5.8s.

Figure 1 shows the experimental results: the top row for the profiles of electric potential, middle for the rotational transform and bottom for T_e , and left column for the case of ctr-ECCD, middle for co-ECCD and right for no ECCD as a reference. The synergetic behavior in T_e profile obtained in the 16th campaign such as peaked (flattened) profile in the cases of co-NBCD + co-ECCD or ctr-NBCD + ctr-ECCD (co-NBCD + ctr-ECCD or ctr-NBCD + co-ECCD) was not reproduced, and so far the reason is not clear. The potential profile is decreased and increased in the cases of ctr-ECCD and co-ECCD from that of the reference, respectively. The behavior of rotational transform is a little complex, however it might be said that ctr- (co-) ECCD decreases (increases) the profile. Further investigations are required for detailed understandings of the synergy effect of ECCD and NBCD.

1) Shimozuma, T. *et al.*: Nucl. Fusion **45** (2005) 1396.

2) Igami, H. *et al.*: EPJ Web of Conf. **32** (2012) 02006

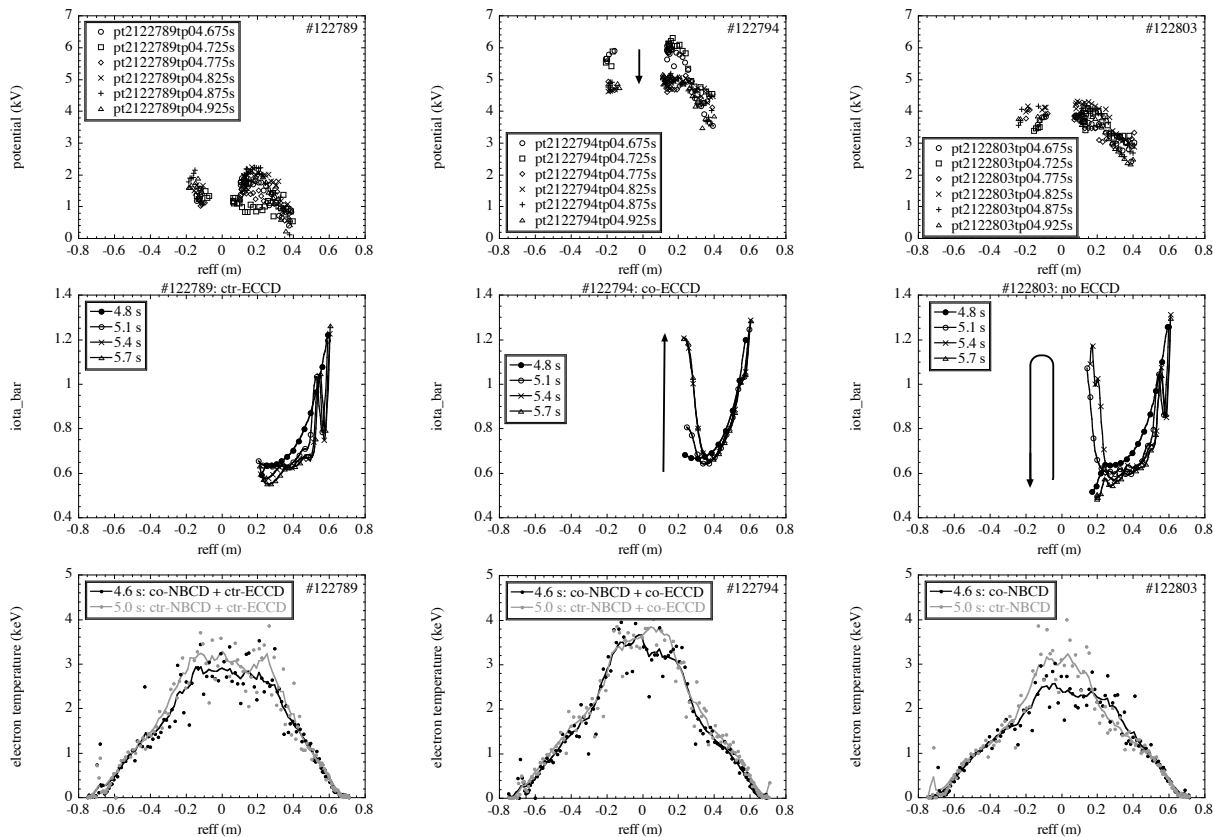


Fig. 1. Variations in the profiles of electric potential, rotational transform and electron temperature in the combinations of co-/ctr-NBCD and co-/ctr-ECCD.