



Contribution ID: 324

Type: Poster

## EX/P6-16: Electron Bernstein Wave Heating and Electron Cyclotron Current Drive by Use of Upgraded ECH System in LHD

Thursday, 11 October 2012 14:00 (4h 45m)

In LHD, electron Bernstein wave (EBW) heating was successfully demonstrated by two ways of mode conversion to EBWs from injected EC-waves, by so-called slow-XB and OXB techniques. To realize the excitation of EBWs by the slow-XB technique, EC-waves in X-mode polarization should be injected to plasmas from high magnetic field side (HFS). In LHD, newly installed inner-vessel mirror close to a helical coil is used for the HFS injection. Evident increases in  $T_e$  at the plasma core region and  $W_p$  were caused by the HFS injection with 0.18 s pulse width to a plasma with  $n_e(0)$  of  $24 \times 10^{19} \text{ m}^{-3}$ , that is, 3.3 times higher than the plasma cut-off density for O-mode waves, and 1.6 times higher than the left-hand cut-off density of  $14.7 \times 10^{19} \text{ m}^{-3}$  for slow-X-mode waves. Thus, the heating effects especially the increase in  $T_e$  at the plasma core region should be attributed to the mode-converted EBWs, not to the X- or O-mode waves.

For excitation of EBWs by the OXB technique, O-mode waves should be injected from the low magnetic field side toward the so-called "mode conversion window". Two pulses of 77 GHz, 1.05 MW EC-wave (0.1 s pulse width each with a 0.1 s interval) in O-mode polarization were injected to an NB-sustained plasma, aiming at the mode conversion window calculated in advance. With both of the two ECH pulses, increases in  $W_p$  and mitigations of decreasing trend in  $T_e$  measured with ECE are recognized. The line average electron density continuously increased during the ECH pulse injection. At the start timing of the 1st pulse,  $n_e(0)$  was equal to the O-mode cut-off density,  $7.35 \times 10^{19} \text{ m}^{-3}$ , and  $n_e(0)$  gradually increased to  $7.7 \times 10^{19} \text{ m}^{-3}$  at the end of the 2nd pulse. The heating efficiency  $P_{\text{abs}}/P_{\text{ech}}$  is evaluated as  $\sim 15\%$ .

Using the high-power, long-pulse 77 GHz ECH system, 2nd harmonic on-axis ECCD experiments with 775 kW injection power and the line average electron density of  $0.3 \times 10^{19} \text{ m}^{-3}$  were conducted. At optimum beam directions, maximum EC-driven currents up to 40 kA in both the co- and counter-ECCD directions were achieved. Also, recent experiment indicated that ECCD could affect the formation of an electron internal transport barrier (e-ITB). The powerful ECCD is expected to be an effective tool to control the MHD activity and the formation of e-ITB through the modification of current and rotational transform profiles.

### Country or International Organization of Primary Author

Japan

**Primary author:** Mr YOSHIMURA, Yasuo (Japan)

**Co-authors:** Dr SUZUKI, Chihiro (National Institute for Fusion Science); Dr MOTOJIMA, Gen (National Institute for Fusion Science); Dr IGAMI, Hiroe (National Institute for Fusion Science); Dr TAKAHASHI, Hiromi (National Institute for Fusion Science); Dr IDEI, Hiroshi (Kyusyu University); Prof. YAMADA, Hiroshi (National Institute for Fusion Science); Prof. IDA, Katsumi (National Institute for Fusion Science); Dr TANAKA, Kenji (National Institute for Fusion Science); Dr NISHIURA, Masaki (National Institute for Fusion Science); Dr YOSHINUMA, Mikiro (National Institute for Fusion Science); Mr MAKINO, Ryohei (Nagoya University); Prof. KU-

MAZAWA, Ryuhei (National Institute for Fusion Science); Dr SAKAKIBARA, Satoru (National Institute for Fusion Science); Dr OHDACHI, Satoshi (National Institute for Fusion Science); Prof. KUBO, Shin (National Institute for Fusion Science); Mr OGASAWARA, Shinya (Nagoya University); Prof. MUTOH, Takashi (National Institute for Fusion Science); Prof. SHIMOZUMA, Takashi (National Institute for Fusion Science)

**Presenter:** Mr YOSHIMURA, Yasuo (Japan)

**Session Classification:** Poster: P6

**Track Classification:** EXW - Magnetic Confinement Experiments: Wave-plasma interactions; current drive; heating; energetic particles