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Power Coupling of Lower Hybrid Fast Wave in VEST

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An efficient heating and current drive in the central or off-axis region of tokamak plasma should be developed for the steady state operation of a tokamak fusion reactor. A fast wave within lower hybrid resonance frequency range(LHFW) could be a scheme for the current drive in a high-density, high-temperature reactor grade plasmas.[1,2] A proof-of-principle experiment was planned for the LHFW H&CD concept in VEST[3], and a LHFW RF system has been successfully developed and installed in VEST through collaboration between KAERI, KWU, SNU, and KAPRA.[4,5] The klystron RF power is 10 kW with center frequency of 500 MHz and bandwidth of 20 MHz. The N|| spectrum of the comb-line type traveling wave antenna ranges 3 to 5 corresponding to the operating frequency. Recently, RF commissioning was started and 10 kW RF power was transmitted to the comb-line antenna in the vacuum after intensive RF vacuum conditioning. About 3.5 kW RF power was transmitted to antenna with plasma and 50~60% of input power was coupled to the plasma. The target plasma was generated with Ohmic power of about 60 kW. The peak plasma current was about 30 kA and the edge electron density varies from LHSW to LHFW launching density with the current evolution. The coupled RF power abruptly increased with the launching densities of LHWs. The driven plasma current by LHFW seems to be less than 1 kA compared to pure Ohmic plasmas. The reproducibility and higher power experiments are progressing. The low driven current may be because that the plasma density window in front of antenna for LHFW propagation into core region is very narrow due to the low toroidal magnetic field of 0.1T. In addition, the electron temperature and RF power is not as high as for efficient current drive of LHFW. More progressing and detailed experimental results will be presented with analysis based on theory and numerical simulation in the conference.

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[1] S.H.Kim et al., Fusion Engineering and Design, 109-111, 707-711 (2016).
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[3] K.J.Chung et al., Plasma Science and Technology, 15, 244 (2013).
[4] S.H.Kim et al., 2017 International Spherical Tokamak Workshop (2017).
[5] H.W.Lee et al., Fusion Engineering and Design, submitted (2017).

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Author: Dr KIM, Sun-Ho (Korea Atomic Energy Research Institute, Daejeon, Korea)

Co-authors: Dr JUNG, Bong-Ki (Korea Atomic Energy Research Institute); Prof. LEE, Byung-Je (Kwangwoon University); Mr LEE, Hyun-Woo (Kwangwoon University); Mr JO, Jong-Gab (Seoul National University); Mr WANG, Jong-In (Seoul National University); Dr JEONG, Seung-Ho (Korea Atomic Energy Research Institute); Prof. HWANG, Yong-Seok (Seoul National University)

Presenter: Dr KIM, Sun-Ho (Korea Atomic Energy Research Institute, Daejeon, Korea)

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