8P37

QUEST におけるセンタースタック上のフラックスループを用いた高磁場側入射時のEBW電流駆動の調査

Investigation of EBW current drive on high-field-side injection using flux loop on center stack in QUEST

周 俊堯1)、花田 和明2)、恩地 拓己2)、小島 信一郎3)、岳 其霖1)、黒田 賢剛2)、河野 香2)、井戸 毅2) 、池添 竜也2) 、長谷川 真2)、出射 浩2) 、関谷 泉2)、東島 亜紀2) 、永田 貴大2) 、坂井　聖也2)

ZHOU Junyao1), HANADA Kazuaki2), ONCHI Takumi2), Kojima Shinichiro3), YUE Qilin1), KURODA Kengoh2), KONO Kaori2), IDO Takeshi2), IKEZOE Ryuya2), HASEGAWA Makoto2), IDEI Hiroshi2) , SEKIYA Izumi2), HIGASHIJIMA Aki2), NAGATA Takahiro2) , Seiya Sakai2)

(1)九大総理工，(2) 九大応力研，(3) 量研機構

(1)IGSES , Kyushu Univ.，(2) RIAM, Kyushu Univ.，(3) QST.

For spherical tokamak (ST) which has limited space for induction coils in the central part of the torus and high f_p/f_{ce}, electron Bernstein wave (EBW) is studied as a promising method for plasma current start-up because the propagation is not limited by plasma density, where f_p and f_{ce} are plasma frequency and electron cyclotron frequency [1]. So far, several studies have been conducted using O-X-B mode conversion by injecting electron cyclotron wave (ECW) from the low field side (LFS) to excite EBW, however the refraction of O-mode ECW in high-density plasma makes it difficult to clarify efficient EBW current drive (EBWCD) [2-4]. There have been reports about a higher absorption efficiency of EBW [5] and the formation of high-density plasma started by EBW using X-B mode conversion using RF injection from the high field side (HFS) [6], but EBWCD remains to be confirmed.

This study has been conducted to identify the effect of EBWCD by injecting the X-mode ECW from HFS. The ECW was injected perpendicularly to the magnetic field using an incident antenna located 17 cm above the equatorial plane. The ECW was expected to be efficiently converted to EBW at upper-hybrid resonance layer (UHRL), then absorbed near electron cyclotron resonance layer (ECRL) to drive the plasma current. By applying a magnetic configuration with a high n-index ($-\frac{R}{B_z}\frac{\partial B_z}{\partial R} = 0.3$), the closed flux surface (CFS) was successfully formed in experiments. In order to evaluate the distribution of EBWCD, the vertical magnetic flux distribution was carefully measured using flux loop coils distributed every 10 cm longitudinally on the center stack. To clarify the effect of EBWCD, the direction of the toroidal magnetic field which determines the direction of EBWCD was changed during the experiments to distinguish the EBWCD from pressure driven current. Consequently, the peak of the magnetic flux appeared above or below the equatorial plane, which can be explained by the inversion of the EBWCD direction due to the $n_{//}$ shift of EBW pertaining to toroidal and horizontal magnetic field direction, where n// is a refractive index parallel to the magnetic field line. The plasma current was expected to concentrate on the equilibrium position in open magnetic field configuration to do a favor for the formation of CFS.

[1] Ram A K, 2000, PP, 7(10): 4084-4094.
[2] Maekawa T, 2001, PRL, 86(17): 3783.
[3] Shevchenko V F, 2010, NF, 50(2): 022004.
[4] Shevchenko V, 2002, PRL, 89(26): 265005.
[5] Hatem E, 2020, PPCF 62(3): 035018.
[6] Kojima S, 2020, PFR 15: 2402063.