Polarization control of incident microwave for non-inductive formation of spherical tokamak by electron Bernstein wave heating and current drive in LATE

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Non-inductive formation of spherical tokamak in LATE is performed by electron Bernstein (EB) wave heating and current drive. The microwaves at 2.45GHz from four magnetrons are injected obliquely to the toroidal field from low field side on mid-plane.

Line-averaged electron density increases up to about seven times the plasma cutoff density at the last stage of a discharge, when the fundamental electron cyclotron resonance (ECR) layer is located in the plasma core and the second ECR layer is located outside the upper hybrid resonance (UHR) layer. It is important to control the polarization of incident microwave in order to optimize the mode-conversion rate from incident microwave to EB wave.

The optimal injection polarization varies from O-mode like polarization to X-mode like one as the electron density gradient near the UHR layer becomes higher, according to the linear mode-conversion rate theory with cold plasma resonance absorption model in a slab geometry [1].

Two polarizers are used to convert the rectangular TE_{10} mode from magnetrons to O-mode like polarization or to X-mode like one [2]. The powers of the O-mode like polarization and the X-mode like one are changed by preprogrammed control, respectively. The driven plasma current is increased by 20% in the case that the power fraction of the O-mode like polarization is larger than that of the X-mode like one at the first stage of a discharge and then that of the X-mode like one is larger than that of O-mode like one at the last stage of a discharge, compared to the case that all the injection power is O-mode like one.

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[1] Igami H. *et al.,* Plasma Phys. Control. Fusion **48** (2006) 573.

[2] Noguchi Y. *et al.,* Plasma Phys. Control. Fusion **55** (2013) 125005.