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**Electron Beam Injection to Non-Inductively-Produced Spherical Tokamak Plasmas by Electron Bernstein** Wave in LATE

H. TANAKA, T. KUZUMA, R. ASHIDA, R. KAJITA, T. NAGAEKI, T. NAKAI, S. MATSUI, S. YAMAGATA, R. NAKAI, X. GUO, Y. NOZAWA, M. UCHIDA, T. MAEKAWA Graduate School of Energy Science, Kyoto University, Kyoto 606-8502, Japan E-mail: h-tanaka@energy.kyoto-u.ac.jp

#### ABSTRACT

• Electron beam with energy of 100 ~ 600 eV and current up to 800 A is injected into a ST plasma which is produced non-inductively by electron Bernstein wave. The electron density increases to more than 30 times the plasma cutoff density and is maintained by EBW and EBI. Significant increment of plasma current is not observed. It may be partly because the feedback control of vertical magnetic field is not performed to maintain the tokamak equilibrium. When the density increase is mild (~20 times the plasma cutoff density) at the early stage in EBI, the significant core heating around the ECR layer.

## **EXPERIMENTAL RESULT**

Initial cathode voltage = -10kV

# BACKGROUND

- Electron Bernstein wave (EBW) is an electrostatic wave and can propagate into the core plasma and heat electrons without density limit. It is effective for non-inductive start-up of over-dense ST plasmas by ECH/ECCD.
- Electron beam injection (EBI) from a cathode can drive plasma current directly and effectively. It has been investigated from the view point of helicity injection for non-inductive start-up of ST plasmas.



### PURPOSE

An attempt to produce higher plasma current and density noninductively by EBI and EBW, expecting synergy effects such as preferential heating of electrons injected from a cathode by EBW.

## LATE (Low Aspect ratio Torus Experiment)



Cylindrical Vacuum Vessel :  $R = 5.7 \sim 50 \text{ cm}$  $Z = -50 \sim 50 \text{ cm}$ A ≥ 1.24 Toroidal Field @ R = 25 cm Bt  $\leq$  1.6 kG, > 0.13 sec Vertical Field @ R = 25 cm Bv ≦ 250 G, 2 sec

Microwave Sources : 5 GHz ; 200 kW, 0.1 sec 1 klystron 2.45 GHz : 20 kW, 2 sec, 3 magnetrons

Diagnostics : Magnetic Measurement (17 Flux Loops, 14 MPs) 4 ch 70 GHz Interferometers XUV Cameras (20ch x 3) Fast CCD Camera Visible Light Spectrometer 4 ch HX PHA system HX pin-hole camera HIBP system (Rb+, 20kV)

#### Images taken by a fast CCD camera and plasma current profiles



Until t = 0.1703 sec, LCFS coincides with the bright image.

## **EXPERIMENTAL SETUP**



Power supply : 20kV, 250µF capacitor bank + 2 ignitrons

#### Time evolution of density profile at the mid-plane

