Evidence of EBW heating on the TST-2 spherical tokamak

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Electron Bernstein wave (EBW), which can propagate in a overdense plasma and strongly absorbed by electron cyclotron damping, is an attractive candidate for heating spherical tokamak (ST) plasmas. A key issue for EBW heating is to identify the optimum mode-conversion (MC) scenario for ST. Perpendicular X-mode injection from the low field side has advantages such as a simple launcher design and a possibility of density scale length (L_n) control, required for good MC efficiency, independent of the core plasma. So far, only low power EBW receiving experiments have been reported using this scenario. In order to examine the feasibility of this scenario, EBW heating experiments were performed on the Tokyo Spherical Tokamak -2 (TST-2), which was temporarily moved to Kyushu University to take advantage of 200 kW of 8.2GHz microwave power.

A new launcher consisting of 8 waveguide horn antennas, and a movable local limiter surrounding the antennas, were installed on the low filed side of the torus, below the midplane. The local limiter was used to change L_n in front of the antennas and could be moved in the range R = 625 mm to 665 mm. Up to 140 kW of microwave power was injected perpendicularly from the low field side. In some discharges, all of $n_e l$, H_α, radiated power P_{rad} (measured by an absolute extreme ultraviolet detector) and soft X-ray (SX) emission (1-10 keV) measured by a surface barrier diode with a Be filter increased , after RF turn-on. The increase of SX emission indicates the generation of high energy electrons by EBW injection, though a direct electron temperature measurement was not available. Equilibrium reconstruction also shows the increase of the stored energy by about 15% after RF turn-on. However, the break-in-slope analysis shows heating power by RF is at most ~15 kW, indicating that a significant portion of the injected power may have been absorbed before reaching the plasma core.