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Study on EBW assisted start-up and heating experiments via direct XB mode conversion from low field side injection in VEST

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EBW is an effective heating method to generate over dense plasma in low magnetic field devices such as ST. The direct XB MC from LFS injection may be used effectively because the LFS X-mode can be easily transmitted to right hand (RH) polarized slow X wave or mode converted to highly damping Bernstein wave. In addition, it requires no injection angle adjustment and complicated hardware preparation like OXB MC. EBW heating experiments using direct XB MC from LFS injection has been performed in VEST and start-up schemes based on the EBW heating including trapped particle configuration (TPC) are suggested.
In the case of pure toroidal field, initial plasma is generated near the ECR when the MW power is lower, but density peak moves outward with higher heating power, by noting the collisional damping of EBW. Simulated results from 1-D full wave code confirm the tunneling and MC efficiencies of the injected X wave. As toroidal magnetic field decreases, plasma density decreases with low MC efficiency. But as the ECR layer moves toward the inboard side, density peak reappears where LB is lower. Therefore, high density plasmas can be generated both outboard and inboard sides with high XB MC efficiency due to small Ln and LB. By utilizing EBW collisional heating, two start-up schemes are suggested. In the case of the lower Bt which has the high density plasma near the inboard side, low loop voltage start-up can be realized with relatively high electric field. The other start-up scheme of the solenoid free start-up utilizing outer PF coils may be possible by utilizing high density plasmas toward the outboard region with the help of plasma evolution from the outboard to the inboard.
The density peak near the outboard side has the possibility of making higher EBW MC efficiency with short Ln, resulting in efficient plasma heating. More rapid plasma density increase with additional MW power from LFS X mode is observed near the core region. By noting that additional power is applied, abrupt density increase may be explained by the steep density profile due to plasma current. The EBW heating experiment with additional 10 kW MW power clearly shows density increase, but increase of Te is still not observed. Te increase via decrease of collisional damping will be pursued by decreasing operating pressure and impurity control as well as increasing ohmic heating power.

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