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Plasma Flows and Fluctuations with Resonant Magnetic Perturbations on the Edge Plasmas of the J-TEXT Tokamak

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Plasma flows and fluctuations are studied with resonant magnetic perturbations (RMPs) using Langmuir probe arrays on the edge plasmas of the J-TEXT tokamak. The toroidal velocity near the last closed flux surface (LCFS) tends to increase at first with increasing RMP current. When the RMP current reaches 6kA, the toroidal velocities increase (inside the LCFS) and decease (outside the LCFS). The effects of RMPs on toroidal rotations suggest that the intrinsic rotation is driven with RMPs. The absolute amplitude of the radial electric field Er near the LCFS also increases at first with RMP, then significantly decreases at 6kA. A narrow zone (NZ) is detected in the edge plasmas. In the NZ, the Er sign is changed from negative to positive, and the electron temperature, and turbulence and zonal flow intensity all drop. Significantly, the profile of poloidal and toroidal turbulent stresses is also changed in the NZ. The occurrence of the NZ results in the formation of a new shear layer in the edge plasma. The results suggest that the NZ formation occurs due to the magnetic island overlap near the rational flux surface of q=3, due to 3/1 RMP coils. The measurements of turbulent stresses and Er are consistent with that the intrinsic rotation can be driven with RMPs. Both Low frequency zonal flows (LFZFs) and geodesic acoustic modes (GAMs) are damped by strong RMPs.

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