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Observation of a Toroidally Symmetrical Electric Field Fluctuation with Radially Elongated Structure in Heliotron J

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An electric field fluctuation with radially elongated structure is found inside the last closed flux surface (LCFS) in a medium sized helical device, Heliotron J. The experiment is conducted in low-density ECH plasma discharges with line averaged density ne ~ 0.3×10^19 m and the edge plasma parameters of T_e ~ 50 eV and n_e ~ 0.4×10^18 m^-3 at LCFS. Multiple Langmuir probes installed at different toroidal/poloidal sections of Heliotron J reveal a high correlation between floating potential signals measured with the probes is observed in the low frequency range less than 4 kHz, which implies the fluctuation has a symmetric structure in the toroidal direction. The fluctuation has electrostatic characteristics but is not accompanied by density perturbation. These characteristics are quite similar to those of zonal flows, however, its radial wavelength is, unlike those in other devices, comparatively large. The electric field fluctuation generates the velocity shear synchronized with the fluctuation around LCFS since the fluctuation amplitude sharply increases inside LCFS. The maximum shearing rate of the velocity shear is about 1.5 x 105 s-1 at just inside LCFS, which is comparable to that observed in other devices for turbulence decorrelation. Cross-bicoherence analysis shows that nonlinear coupling between the radial and poloidal electric field fluctuations exists in the low frequency range, which implies that the fluctuation with meso-scale structure might be driven by the Reynolds stress.

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