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# Intrinsic current drive by electromagnetic electron drift wave turbulence in tokamak pedestal region

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**Abstract**: The local intrinsic parallel current density driven by electron drift wave (DW) turbulence including electromagnetic (EM) effects is analytically studied. The scalings of the ratios of intrinsic current density driven by residual turbulent flux and turbulent source to the bootstrap current density with electron density and temperature are predicted to be $T_{\mathrm{e}}^{3/4}T_{\mathrm{i}}/n_e$ and $T_{\mathrm{e}}T_{\mathrm{i}}/n_e$, respectively. Based on the typical parameters in DIII-D pedestal region, the local intrinsic current density driven by both the residual turbulent flux and the turbulent source is negligible. However, despite the negligible turbulent source driven current, the residual turbulent flux driven local intrinsic current density by EM DW turbulence can reach about 66% of the bootstrap current density for ITER pedestal parameters due to much lower collisionality in ITER than in DIII-D. Moreover, the contributions from adiabatic ES parts, non-adiabatic ES parts and non-adiabatic EM parts of the plasma response to electromagnetic fluctuations are analyzed. It is found that there exists strong cancelation between non-adiabatic ES response and the non-adiabatic EM response for the ITER pedestal case, and thus the kinetic stress contributed by the adiabatic ES response of parallel electron pressure dominates the intrinsic current drive. This is different from the ES electron DW case. Therefore, the EM effects on turbulence driven intrinsic current density should be carefully considered in the future reactor with high ratio of electron pressure to the magnetic pressure and steep pressure profile.

Note: Abstract should be in 1 page.