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Observation of Vertical Charge Separation Current in a Toroidal ECR Plasma KENGOH KURODA, MASAKI UCHIDA, HITOSHI TANAKA, TAKASHI MAEKAWA, Kyoto University — In plasmas immersed in the toroidal field B_ϕ, electrons drift downward while ions drift upward due to the field gradient and curvature ($B_\phi > 0$ is assumed). The plasma is usually bounded at the top and bottom by the conducting vessel walls. The same amount of current must flow into and out from the walls at the top and bottom, respectively, to complete the current circulation via the vacuum vessel. In an ECR plasma in the LATE device radial profiles of vertical charge separation currents has been measured by radially aligned multi-electrodes fabricated at the top and bottom. Both the profiles at the top and bottom are nearly the same as the profile $2p_e/RB_\phi$ in the plasma as theoretically predicted. Note that p_i is usually much lower than p_e in ECR plasmas. Current characteristics upon the sweep of external voltage onto the top ion collectors show that the current is due to inflow of ions with no secondary electron emission. Those results indicate that the current carrier is replaced from electrons to ions in the top boundary, where a steep down-slope of space potential develops toward the top wall, suggesting that the ions gain kinetic energy as they descend the potential slope by the charge separation vertical drift toward the top wall [Nishi et al., PPCF 52 125004 (2010) sections 4.4 and 4.5]. We are now investigating how the ion's kinetic energy increases on the potential down slope toward the top wall using an ion sensitive probe.

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