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Parallel Transport on Open Magnetic Field Lines ZEHUA GUO, XIANZHU TANG — The plasma parallel transport on open magnetic fields can become dominant, and its theory becomes especially challenging when the mean-free-path(*mfp*) of the plasma is comparable to or greater than the field line length scale of B modulation. Here we present a fluid theory based on the lowest order expansion of Vlasov equation in ρ/L. The different roles of $\|B\|$ modulation and the two components of the parallel heat flux (q_n and q_s, associated with the parallel and perpendicular thermal energies respectively), in determining the plasma profiles (n, $T_\|$, $T_\perp$, ϕ, and $u_\|$), are elucidated by general analytical expressions and confirmed by first-principle kinetic simulations of a flux expander into absorbing walls. The parallel heat flux, calculated from kinetic theory in the long *mfp* regime, is shown to have surprising behaviors along an open field line. For example, q_n can run against the parallel temperature gradient when there is significant flux expansion toward the wall. A scan from low to high collisionality is then performed to clarify the dramatic difference in plamsa profiles. This work was supported by the DOE OFES.

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