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Wave-particle interaction in parallel transport of long mean-free-path plasmas along open field magnetic field lines[1] ZEHUA GUO, XIANZHU TANG, Los Alamos National Laboratory — A tokamak fusion reactor dumps a large amount of heat and particle flux to the divertor through the scrape-off plasma (SOL). Situation exists either by necessity or through deliberate design that the SOL plasma attains long mean-free-path along large segments of the open field lines. The rapid parallel streaming of electrons requires a large parallel electric field to maintain ambipolarity. The confining effect of the parallel electric field on electrons leads to a trap/passing boundary in the velocity space for electrons. In the normal situation where the upstream electron source populates both the trapped and passing region, a mechanism must exist to produce a flux across the electron trap/passing boundary. In a short mean-free-path plasma, this is provided by collisions. For long mean-free-path plasmas, wave-particle interaction is the primary candidate for detrapping the electrons. Here we present simulation results and a theoretical analysis using a model distribution function of trapped electrons. The dominating electromagnetic plasma instability and the associated collisionless scattering, that produces both particle and energy fluxes across the electron trap/passing boundary in velocity space, are discussed.

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