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Collisionless neoclassical polarization drift in a spatio-temporally sheared radial electric field in a tokamak plasma[1] HOYUL BAIK, Department of Physics, Korea Advanced Institute of Science and Technology, SEUNGHOE KU, C.S. CHANG, New York University and KAIST — Neoclassical polarization drift of plasma ions is of critical importance in the dynamics of a radial electric field E_r. Neoclassical polarization drift speed $V_{\rm NP}$ of collisionless single ions is studied using a guiding center code in a time-varying, spatially sheared E_r in a realistic tokamak geometry. It is found numerically that $V_{\rm NP}$ is not only a function of the time derivative dE_r/dt, as conventionally understood, but also a strong function of the radial shear dE_r/dr if the shear length is on the same order as the ion banana width. If the radial shear $(\Delta r)dE_r/dr$ has the same sign as E_r, where Δr is the banana excursion width, then the radial shear effect adds to $V_{\rm NP}$; but if $(\Delta r)dE_r/dr$ has the opposite sign to E_r, then its effect opposes $V_{\rm NP}$. Due to this effect, $V_{\rm NP}$ can even be in the opposite direction from the $dE_r/dr = 0$ case for fat banana ions. An analytic investigation reveals that this effect is simply due to the finite banana modification to the orbital average E_r. An approximate analytic formula has been presented for majority ions in a conventional tokamak plasma.

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