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Effective mass in Rosenbluth-Hinton type zonal flows[1] W. SENGUPTA, A.B. HASSAM, University of Maryland College Park — The temporal buildup of sub-bounce frequency tokamak zonal flows, in response to an external perpendicular force, $F_\perp$, is considered. In the collisionless regime, the trapped particle (TP) response is the well-known rapid toroidal precession at the speed $(q/\epsilon)u_E$, where u_E is the ExB drift. The untrapped particles respond mainly as poloidal and oscillating "Pfirsch Schluter" flows. The effective mass of the system, defined by $M(d/dt)u_E = F_\perp$, is shown to include the factor $1+2q^2+1.6q^2/\sqrt{\epsilon}$, where $1.6q^2/\sqrt{\epsilon}$ is the Rosenbluth-Hinton (RH) factor. However, additional factors of $O(q^2/\epsilon^{3/2})$, representing the kinetic energy of TPs may also be present.The system is analogous to two mass beads on a rigid massless rod pushed perpendicularly, with the beads free to slide on the rod, but one bead constrained to a linear 1-D channel. A similar effective mass is obtained. The mathematical origin of this extra factor is a shift, proportional to E, of the usual energy coordinates in phase space. Importantly, this shift contributes to the effective mass even in the linearized E problem and can be interpreted as a first order linear shift in the Jacobian. Comparisons will also be made to RH zonal flows in collisional regime.

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