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Collisional Relaxation of a Strongly Magnetized, Two Isotope, Pure Ion Plasma[1] C.Y. CHIM, T.M. O'NEIL, D.H.E. DUBIN, UCSD — The collisional relaxation of a strongly magnetized pure ion plasma[2] that is composed of two species with slightly different mass is discussed. We have in mind two isotopes of the same singly ionized atom. Parameters are assumed to be ordered as Ω_{c1}, $\Omega_{c2} \gg |\Omega_{c1} - \Omega_{c2}| \gg \overline{v}/b$, where Ω_{c1} and Ω_{c2} are the two cyclotron frequencies, $\overline{v}$ is the thermal velocity, and b is the classical distance of closest approach. For this ordering, the total cyclotron action for the two species, $J_1 = \sum_{j\epsilon 1} m_1 v_{\perp_1}^2 / 2\Omega_{c1}$ and $J_2 = \sum_{j\epsilon 2} m_2 v_{\perp_j}^2 / 2\Omega_{c2}$, are adiabatic invariants that constrain the collisional dynamics. On the time scale of a few collisions, entropy is maximized subject to the constancy of the total Hamiltonian H and the two actions J_1 and J_2, yielding a Gibbs distribution of the form $\exp[-H/T - \alpha_1 J_1 - \alpha_2 J_2]$. Collisional relaxation to the usual Gibbs distribution, $\exp[-H/T]$, takes place on two time scales, each of which is exponentially longer than the usual collisional time scale. First, the two species share action so that α_1 and α_2 relax to a common value α. On an even longer time scale, the total action ceases to be a good constant of the motion and α relaxes to zero.

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[2]P.J. Hjorth and T.M. O'Neil, Phys. Fluids 26, 2128 (1983).

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