Spec Parameter standardization and Initialization

Definition

c : lightspeed

$c = 2.99792458 \times 10^{10}$cm/s

$m = m_e m^*$

$m_e = 9.10938356 \times 10^{-28}$g

$m^* = 1$

$q = q_e q^*$

$q_e = 4.8 * 10^{-10}$ Fr

$q^* = 1$

$v = cv^*$

T ULF wave period

$T = 100$ s

$x = cTx^*$

$\vec{B} = B_{eq}\vec{B}^*$

$\vec{E} = B_{eq}\vec{E}^*$

Here, it is assumed that B_{eq} is the equatorial magnetic field in the Lshell of interest.
That's mean $B_{eq}(L)$

$R_0 = 6371$km $\approx 6.4 * 10^3$km $= 6.4 * 10^8$cm

$\lambda = \frac{L * R_0 * 2\pi}{m_{number}}$

$t = Tt^*$

$\frac{\partial B_z}{\partial r} = \xi_r$

$\frac{\partial (B_z^* B_{eq})}{\partial (cTr^*)} = \frac{B_{eq}}{cT}\frac{\partial B_z^*}{\partial r^*} = \frac{B_{eq}}{cT}\xi_r^* = \xi_r$

$B = \frac{B_E}{L^3}\frac{(1+3\sin^2\Lambda)^{\frac{1}{2}}}{\cos^6\Lambda}$(from:Basic Space Plasma Physics)
($B_E = 3.11 * 10^{-5}$T $= 3.11 * 10^{-1}$G)

when $\Lambda = 0$,

$B_{eq} = \frac{B_E}{L^3}$

$\xi_r^* = \xi_r \frac{cT}{B_{eq}} = \frac{\partial B_z}{\partial r}\frac{cT}{B_{eq}} = \frac{\partial B_z}{\partial L}\frac{\partial L}{\partial r}\frac{cT}{B_{eq}} = \frac{\partial B_z}{\partial r}\frac{cT}{B_{eq}}\frac{\partial L}{\partial r} = -3\frac{B_E}{L^4}\frac{cTL^3}{B_E}\frac{\partial L}{\partial r} = -3\frac{cT}{L}\frac{\partial L}{\partial r}$

$r = LR_0$

$\xi_r^* = -3\frac{cT}{L}\frac{1}{R_0}$

$\mu = \frac{mv_\perp^2}{2B} = \frac{m^* m_e c^2 v_\perp^{*2}}{2B^* B_{eq}} = \frac{c^2 m_e}{B_{eq}}\frac{m^* v_\perp^{*2}}{2B^*} = \frac{c^2 m_e}{B_{eq}}\mu^*$

$E_A = 4$mV/m $= 4 * 10^{-3}$V/m = $4 * 10^{-3} * 10^6 c^{-1}$statV/cm $= 4 * 10^3 c^{-1}$statV/cm

$\vec{v^*} = -\{B_z^* + \frac{m^*}{q^*}\frac{\xi_r^*}{T\Omega_e}(\frac{E_A^*}{(B_z^*)^2}\sin\{2\pi(t^* - \frac{r\theta}{\lambda}) + \frac{\pi}{2}\})\}^{-1}(E_A^*\sin\{2\pi(t^* - \frac{r\theta}{\lambda}) + \frac{\pi}{2}\} -$
$\frac{\mu^*}{q^*}\frac{\xi_r^*}{T\Omega_e} + \frac{m^* c}{q^*}\frac{1}{(B_z^*)^3}\frac{\xi_r^*}{T\Omega_e}(E_A^*\sin\{2\pi(t^* - \frac{r\theta}{\lambda}) + \frac{\pi}{2}\})^2)\vec{e_\theta}$

$\vec{v^*} = -\{B_z^* + \frac{m^*}{q^*}\frac{\xi_r^*}{T\Omega_e}(\frac{E_A^*}{(B_z^*)^2}\sin\{2\pi(t^* - \frac{LR_0\theta}{\lambda}) + \frac{\pi}{2}\})\}^{-1}(E_A^*\sin\{2\pi(t^* - \frac{LR_0\theta}{\lambda}) + \frac{\pi}{2}\} -$
$\frac{\mu^*}{q^*}\frac{\xi_r^*}{T\Omega_e} + \frac{m^* c}{q^*}\frac{1}{(B_z^*)^3}\frac{\xi_r^*}{T\Omega_e}(E_A^*\sin\{2\pi(t^* - \frac{LR_0\theta}{\lambda}) + \frac{\pi}{2}\})^2)\vec{e_\theta}$

$\frac{\partial f}{\partial t} + v\frac{\partial f}{\partial x} = 0$

$\frac{\partial f}{\partial (Tt^*)} + cv^*\frac{\partial f}{\partial (cTx^*)} = 0$

$\frac{\partial f}{\partial t^*} + v^*\frac{\partial f}{\partial x^*} = 0$