

Parameter standardization

Definition

c : lightspeed

$$m = m_e m^*$$

$$q = q_e q^*$$

$$v = cv^*$$

T ULF wave period

$$x = cTx^*$$

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

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

$$t = Tt^*$$

so,

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

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

$$\vec{v} = -\left\{B_z + \frac{mc}{q} \left(\frac{cE_A \sin\{m2\pi(\frac{t}{T} - \frac{R_0\theta}{\lambda}) + \frac{\pi}{2}\}}{B_z^2} \xi_r \right)\right\}^{-1} \left(E_A \sin\{m2\pi(\frac{t}{T} - \frac{R_0\theta}{\lambda}) + \frac{\pi}{2}\} - \frac{\mu}{q} \xi_r + \frac{mc^2}{q} \frac{(E_A \sin\{m2\pi(\frac{t}{T} - \frac{R_0\theta}{\lambda}) + \frac{\pi}{2}\})^2 \xi_r}{B_z^3} \right) \vec{e}_\theta$$

$$\vec{v} = -\left\{B_{eq} B_z^* + \frac{m_e m^* c}{q_e q^*} \left(\frac{ccB_{eq} \vec{E}_A^* \sin\{m2\pi(\frac{Tt^*}{T} - \frac{R_0\theta}{\lambda}) + \frac{\pi}{2}\}}{(B_z^* B_{eq})^2} \frac{B_{eq}}{cT} \xi_r^* \right)\right\}^{-1} \left(cB_{eq} \vec{E}_A^* \sin\{m2\pi(\frac{t}{T} - \frac{r\theta}{\lambda}) + \frac{\pi}{2}\} - \frac{\mu}{q} \xi_r + \frac{mc^2}{q} \frac{(cB_{eq} \vec{E}_A^* \sin\{m2\pi(\frac{t}{T} - \frac{r\theta}{\lambda}) + \frac{\pi}{2}\})^2 \frac{B_{eq}}{cT} \xi_r^*}{(B_z^* B_{eq})^3} \right) \vec{e}_\theta$$