$E \times B$drift velocity

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

if electric field is constant,

$$\vec{v} = -c\{B_z + \frac{mc}{q}(\frac{cE_A}{B_z^2}\xi_r)\}^{-1}(E_A - \frac{\mu}{q}\xi_r + \frac{mc^2}{q}\frac{(E_A)^2\xi_r}{B_z^3})\vec{e_\theta}$$

assumption: E_A $3\mathrm{mV/m}$

$$3\mathrm{mV} = 3 \times 10^{-3} \times \frac{10^8}{3.0\times10^{10}}\mathrm{statV} = 10^{-5}\mathrm{statV}$$

$$3\mathrm{mV/m} = 10^{-7}\mathrm{statV/cm}$$

assumption $B_z = \frac{B_E}{L^3}$ (in magnetic equator) , $B_E = 3.11 \times 10^{-5}\mathrm{T} = 3.11 \times 10^{-1}\mathrm{G}$
if $L = 6$, $B_z = 1.4 \times 10^{-7}\mathrm{T} = 1.4 \times 10^{-3}\mathrm{G}$

assumption : $v_\perp = 0.01c = 3.0 \times 10^8\mathrm{cm/s}$

$$\mu = \frac{mv_\perp^2}{2B_z} = \frac{(9.1\times10^{-28}\mathrm{g})\times(3.0\times10^8\mathrm{cm/s})^2}{2.0\times1.4\times10^{-3}\mathrm{G}}$$

$$\xi_r = \frac{\partial B_z}{\partial r} = \frac{\partial B_z}{\partial L}\frac{\partial L}{\partial r} = -3\frac{B_E}{L^4}\frac{1}{R_0} = \frac{-3\times3.1\times10^{-1}\mathrm{G}}{6^4\times6\times10^8\mathrm{cm}}$$

$$\{B_z + \frac{mc}{q}(\frac{cE_A}{B_z^2}\xi_r)\} = 1.4 \times 10^{-3}\mathrm{G} + \frac{9.1\times10^{-28}\mathrm{g}\times3.0\times10^{10}\mathrm{cm/s}}{4.8\times10^{-10}\mathrm{statC}}(\frac{3.0\times10^{10}\mathrm{cm/s}\times10^{-5}\mathrm{statV}}{(1.4\times10^{-3}\mathrm{G})^2}\frac{-3\times3.1\times10^{-1}\mathrm{G}}{6^4\times6\times10^8\mathrm{cm}}) = 1.4 \times 10^{-3}\mathrm{G} - \frac{9.1\times3.0\times3.0\times3\times3.1}{4.8\times1.4\times1.4\times6^4\times6}\frac{10^{-14}}{10^{-8}} = 1.4 \times 10^{-3}\mathrm{G} - 0.01 \times 10^{-6}\mathrm{G}$$

about $(E_A - \frac{\mu}{q}\xi_r + \frac{mc^2}{q}\frac{(E_A)^2\xi_r}{B_z^3})\vec{e_\theta}$

$$E_A = 10^{-7}\mathrm{statV/cm}$$

$$\frac{\mu}{q}\xi_r = \frac{(9.1\times10^{-28}\mathrm{g})\times(3.0\times10^8\mathrm{cm/s})^2}{2.0\times1.4\times10^{-3}\mathrm{G}} \times \frac{1}{4.8\times10^{-10}\mathrm{statC}} \times \frac{-3\times3.1\times10^{-1}\mathrm{G}}{6^4\times6\times10^8\mathrm{cm}} = -\frac{9.1\times3.0\times3.0\times3\times3.1}{2.0\times1.4\times4.8\times6^4\times6} \times \frac{10^{-13}}{10^{-5}}\mathrm{statV/cm} = -0.0073 \times 10^{-8}\mathrm{statV/cm} = -7.3 \times 10^{-11}\mathrm{statV/cm}$$

$$\frac{mc^2}{q}\frac{(E_A)^2\xi_r}{B_z^3} = \frac{mc}{q}(\frac{c(E_A)^2\xi_r}{B_z^3}) = \{\frac{mc}{q}(\frac{cE_A\xi_r}{B_z^2})\}(\frac{E_A}{B_z}) = -(0.01 \times 10^{-6}\mathrm{G}) \times \frac{10^{-7}\mathrm{statV/cm}}{1.4\times10^{-3}\mathrm{G}} = -\frac{1}{1.4} \times 10^{-12}\mathrm{statV/cm} = -7.1 \times 10^{-13}\mathrm{statV/cm}$$

$$v = -c\{B_z + \frac{mc}{q}(\frac{cE_A}{B_z^2}\xi_r)\}^{-1}(E_A - \frac{\mu}{q}\xi_r + \frac{mc^2}{q}\frac{(E_A)^2\xi_r}{B_z^3}) = c\frac{(10^{-7}\mathrm{statV/cm}-7.3\times10^{-11}\mathrm{statV/cm}-7.1\times10^{-13}\mathrm{statV/cm})}{1.4\times10^{-3}\mathrm{G}-0.01\times10^{-6}\mathrm{G}} = 3.0 \times 10^{10}\mathrm{cm/s} \times (7.1 \times 10^{-5} - 5.2 \times 10^{-8} - 5.0 \times 10^{-10}) = (2.1 \times 10^6 - 1.6 \times 10^3 - 1.5 \times 10^1)\mathrm{cm/s}$$

from Basic space plasma physics

$$|\vec{v_E}| = v_E = \frac{E}{B} = \frac{3\mathrm{mV/m}}{1.4 \times 10^{-7} T} = 2.1 \times 10^4 \mathrm{m/s}$$