$E \times B$ drift velocity

$$egin{aligned} ec{v} &= -c ig\{ B_z + rac{mc}{q} ig( rac{cE_A \sin\{2\pi (rac{t}{T} - rac{LR_0 heta}{\lambda}) + rac{\pi}{2}\}}{B_z^2} \xi_r ig) ig\}^{-1} ig( E_A \sin\{2\pi ig( rac{t}{T} - rac{LR_0 heta}{\lambda} ig) + rac{\pi}{2} ig) - rac{\mu}{q} \xi_r + rac{mc^2}{q} rac{(E_A \sin\{2\pi (rac{t}{T} - rac{LR_0 heta}{\lambda}) + rac{\pi}{2} ig)^2 \xi_r}{B_z^3} ig) ec{e_{ heta}} \end{aligned}$$

if electric field is constant,

$$ec{v} = -c\{B_z + rac{mc}{q}(rac{cE_A}{B_z^2}\xi_r)\}^{-1}(E_A - rac{\mu}{q}\xi_r + rac{mc^2}{q}rac{(E_A)^2\xi_r}{B_z^3})ec{e_ heta}$$

assumption: E\_A 3 mV/m

$$3\mathrm{mV}=3 imes10^{-3} imesrac{10^8}{3.0 imes10^{10}}\mathrm{statV}=10^{-5}\mathrm{statV}$$

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

assumption 
$$B_z=rac{B_E}{L^3}$$
 (in magnetic equator) ,  $B_E=3.11 imes10^{-5}{
m T}=3.11 imes10^{-1}{
m G}$  if  $L=6$ ,  $B_z=1.4 imes10^{-7}{
m T}=1.4 imes10^{-3}{
m G}$ 

assumption :  $v_{\perp}=0.01c=3.0 imes10^8 {
m cm/s}$ 

$$\mu = rac{mv_{\perp}^2}{2B_z} = rac{(9.1 imes10^{-28}{
m g}) imes(3.0 imes10^8{
m cm/s})^2}{2.0 imes1.4 imes10^{-3}{
m G}}$$

$$\xi_r = rac{\partial B_z}{\partial r} = rac{\partial B_z}{\partial L} rac{\partial L}{\partial r} = -3 rac{B_E}{L^4} rac{1}{R_0} = rac{-3 imes 3.1 imes 10^{-1} 
m G}{6^4 imes 6 imes 10^8 
m cm}$$

$$\{B_z + \frac{mc}{q}(\frac{cE_A}{B_z^2}\xi_r)\} = 1.4 \times 10^{-3} \text{G} +$$

$$\frac{9.1\times10^{-28}\,\mathrm{g}\times3.0\times10^{10}\,\mathrm{cm/s}}{4.8\times10^{-10}\,\mathrm{statC}}\big(\frac{3.0\times10^{10}\,\mathrm{cm/s}\times10^{-7}\,\mathrm{statV/cm}}{(1.4\times10^{-3}\,\mathrm{G})^2}\,\frac{-3\times3.1\times10^{-1}\,\mathrm{G}}{6^4\times6\times10^8\,\mathrm{cm}}\big) = 1.4\times10^{-3}\,\mathrm{G} - \frac{9.1\times3.0\times3.0\times3.0\times3.1}{4.8\times1.4\times1.4\times6^4\times6}\,\frac{10^{-16}}{10^{-8}} = 1.4\times10^{-3}\,\mathrm{G} - 0.01\times10^{-8}\,\mathrm{G}$$

about 
$$(E_A-rac{\mu}{q}\xi_r+rac{mc^2}{q}rac{(E_A)^2\xi_r}{B_z^3})ec{e_ heta}$$

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

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

$$\frac{\mathit{mc}^2}{\mathit{q}}\frac{(E_A)^2\xi_\mathit{r}}{B_\mathit{z}^3} = \frac{\mathit{mc}}{\mathit{q}}(\frac{\mathit{c}(E_A)^2\xi_\mathit{r}}{B_\mathit{z}^3}) = \{\frac{\mathit{mc}}{\mathit{q}}(\frac{\mathit{c}E_A\xi_\mathit{r}}{B_\mathit{z}^2})\}(\frac{E_A}{B_\mathit{z}}) = -(0.01\times10^{-8}\mathrm{G})\times\frac{10^{-7}\mathrm{statV/cm}}{1.4\times10^{-3}\mathrm{G}} = -\frac{1}{1.4}\times10^{-14}\mathrm{statV/cm} = -7.1\times10^{-15}\mathrm{statV/cm}$$

$$\begin{array}{l} v = -c\{B_z + \frac{mc}{q}(\frac{cE_A}{B_z^2}\xi_r)\}^{-1}(E_A - \frac{\mu}{q}\xi_r + \frac{mc^2}{q}\frac{(E_A)^2\xi_r}{B_z^3}) = \\ c\frac{(10^{-7}\mathrm{statV/cm} - 7.3 \times 10^{-11}\mathrm{statV/cm} - 7.1 \times 10^{-15}\mathrm{statV/cm})}{1.4 \times 10^{-3}\mathrm{G} - 0.01 \times 10^{-6}\mathrm{G}} = 3.0 \times 10^{10}\mathrm{cm/s} \times (7.1 \times 10^{-5} - 5.2 \times 10^{-8} - 5.0 \times 10^{-12}) = (2.1 \times 10^6 - 1.6 \times 10^3 - 1.5 \times 10^{-1})\mathrm{cm/s} \end{array}$$

from Basic space plasma physics

$$|\vec{v_E}| = v_E = rac{E}{B} = rac{3 ext{mV/m}}{1.4 imes 10^{-7} T} = 2.1 imes 10^4 ext{m/s}$$