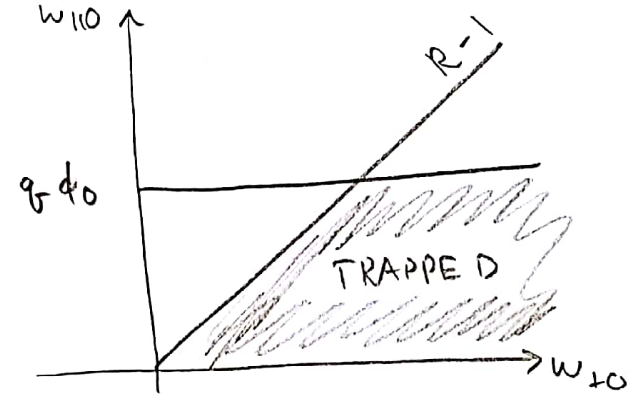
2016 II: Q1 GPP

$$B = \begin{cases} B_0\left(1 + (R-1)\frac{z^2}{L^2}\right) & -L < z < 0 \\ B_0 & z > 0 \end{cases} \qquad \phi = \begin{cases} 0 & z < 0 \\ \phi_0\left(z^2/L^2\right) & 0 \le z < L \\ \phi_0 & z > L \end{cases}$$

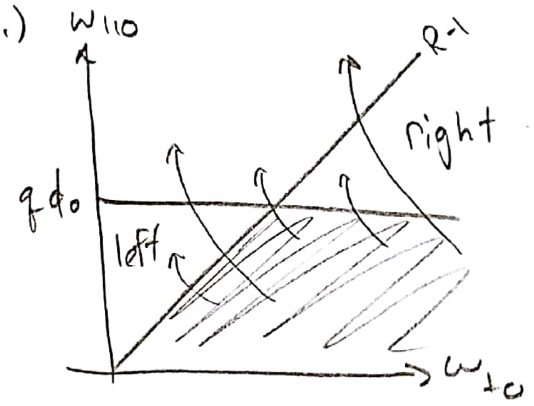
(a.) Ions are trapped on the left by B-fields due to the mirror force (μ conservation) and and the right by electrostatic repulsion. Electrons are trapped on the left by ∇B, but not on the right.

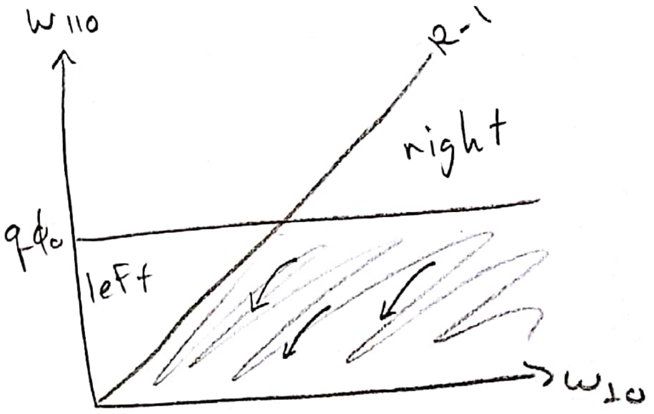
$w_{\parallel 0} + w_{\perp 0} = \cancel{w_\parallel}^{\,0} + w_\perp \nearrow \mu B_0 R$

$w_{\parallel 0} = w_{\perp 0}(R-1)$



(b.)





pitch-angle scattering

⇓

leave on either side depending on size of scatter and energy (most events are small scatterings)

slowed-down

⇓

stay trapped ($\frac{w_{\parallel 0}}{w_{\perp 0}}$ = const.)

or

leave on left if collisions only slow $v_\perp$ (or slow $v_\perp$ more) (c.) $\Omega_i = \frac{ZeB}{m_i c} \sim \frac{Ze}{m_i}$

The rf source can thus be used to resonate with one of the ion species but not the other. This will push one species up in $w_{\perp 0}$ while the other is dragged down in energy through collisions. Pitch-angle scattering with the buffer gas will then force the two species out on different ends of the device.