1. Rutherford scattering cross section $d\sigma/d\Omega$ is calculated via the transverse impulse due to transverse electric force zeE_{trans}. When we replace the electric charge ze with the magnetic charge g, $d\sigma/d\Omega$ must be modified to use transverse magnetic force gB_{trans}.

   (11.152) relates the transverse magnetic force to the transverse electric force

$$B_{\text{trans}} = \beta E_{\text{trans}} \qquad \Longrightarrow \qquad gB_{\text{trans}} = g\beta E_{\text{trans}} = \frac{g\beta}{ze}\left(zeE_{\text{trans}}\right) \tag{1}$$

   This allows us to write $d\sigma/d\Omega$ due to magnetic scattering by replacing ze with $g\beta$ in the electric case, and equation (13.1) becomes

$$\left.\frac{d\sigma}{d\Omega}\right|_{\text{mag}} = \left(\frac{\beta ge}{2pv}\right)^2 \operatorname{cosec}^4\left(\frac{\theta}{2}\right) \tag{2}$$

   Consequently, the derivation from equation (13.1) to (13.14) can be repeated with the same replacement, and we find that the energy loss per unit length for magnetic scattering is (ignoring spin)

$$\left.\frac{dE}{dx}\right|_{\text{mag}} = 4\pi NZ\frac{g^2e^2}{mc^2}\ln\left(\frac{2\gamma^2\beta^2mc^2}{\hbar\langle\omega\rangle}\right) \tag{3}$$

2. By the Dirac quantization condition (6.153) (in Gaussian units)

$$g = \frac{n\hbar c}{2e} \tag{4}$$

   in order to have the same energy loss rate as the magnetic monopole with $\beta \approx 1$, we must have

$$ze \approx g \qquad \Longrightarrow \qquad z \approx \frac{g}{e} = \frac{n\hbar c}{2e^2} = \frac{n}{2\alpha} \approx 68.5n \tag{5}$$

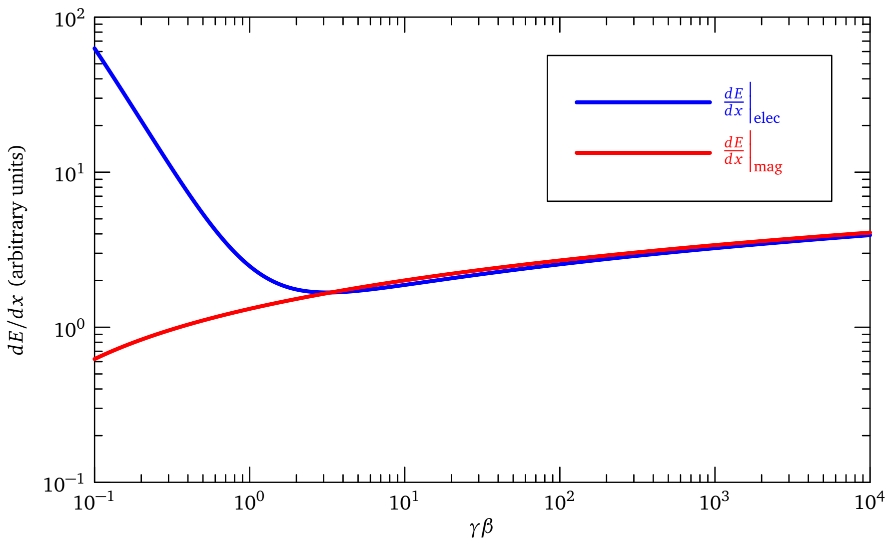
   The energy loss per unit length (13.14) in the electric scattering case is

$$\begin{aligned}\left.\frac{dE}{dx}\right|_{\text{elec}} &= \overbrace{4\pi NZ\frac{z^2e^4}{mc^2}}^{\equiv\eta}\frac{1}{\beta^2}\left[\ln\left(\frac{2\gamma^2\beta^2mc^2}{\hbar\langle\omega\rangle}\right) - \beta^2\right] \qquad \text{let } x = \gamma\beta \\ &= \eta\left(1 + \frac{1}{x^2}\right)\ln\left(\frac{2x^2mc^2}{\hbar\langle\omega\rangle}\right) - \eta\end{aligned} \tag{6}$$

   The magnetic case (3) is now written

$$\left.\frac{dE}{dx}\right|_{\text{mag}} = \overbrace{4\pi NZ\frac{g^2e^2}{mc^2}}^{\lambda}\ln\left(\frac{2x^2mc^2}{\hbar\langle\omega\rangle}\right) = \lambda\ln\left(\frac{2x^2mc^2}{\hbar\langle\omega\rangle}\right) \tag{7}$$

   The log-log plots of $dE/dx \sim \gamma\beta$ are shown below (with $\eta = \lambda = 0.15$, $mc^2 = 0.511$Mev, $\hbar\langle\omega\rangle = 160$eV)



   Obviously, the energy loss rate for magnetic monopole is monotonically increasing with $\gamma\beta$.