1. **Electron Energy Spectrum in $\beta$ Decay and the Neutrino Mass**

The density of states is

$$d^2N = \frac{16\pi^2}{h^6} p^2_{c} p^2_{\nu} dp_{c} dp_{\nu}$$  \hspace{1cm}(1)$$

Neglecting the recoil kinetic energy of the nucleus, but assuming a single neutrino mass $m_{\nu}$, we can write ($c = 1$):

$$E_{\nu} = E_{0} - E_{e} = \sqrt{p^2_{\nu} + m^2_{\nu}}$$

For fixed $p_{\nu}$ and $m_{\nu} = 0$, we find

$$dp_{\nu} = dE_{0}$$

and the distribution of electron momenta is then

$$\frac{d^2N}{dE_{0}dp_{c}} \propto p^2_{c}(E_{0} - E_{e})^2$$

The **Kurie plot** is of $\sqrt{\frac{d^2N}{dE_{0}dp_{c}}/p^2_{c}}$ vs $E_{e}$ and is a straight line.

Here is the problem:

(a) For $m_{\nu} \neq 0$ show that:

$$\frac{d^2N}{dE_{0}dp_{c}} \propto p^2_{c}(E_{0} - E_{e})^2 \sqrt{1 - (m_{\nu}/(E_{0} - E_{e}))^2}$$

(b) For tritium decay, $E_{0} = 18.6$ KeV. Make a Kurie plot near the end-point, for $m_{\nu} = 0$ and 0.25 KeV.