58(4): Effect of Photon Mass on the Wavelength Change in Compton Scattering.

The formula in terms of angular frequency is:

$$\omega_1 - \omega_2 = \frac{\hbar}{\underline{m}c^2}\omega_1\omega_2(1-\cos\theta) + \frac{m^2c^2}{\hbar\underline{m}} \quad -(1)$$

Now use:

$$\omega = 2\pi f, \quad \lambda f = c, \quad \omega = \frac{2\pi c}{\lambda} \quad -(2)$$

to obtain:

$$\boxed{\lambda_2 - \lambda_1 = \left(\frac{h}{\underline{m}c}\right)(1-\cos\theta) + \frac{\lambda_1\lambda_2}{2\pi}\left(\frac{c}{\hbar\underline{m}}\right)m^2} \quad -(3)$$

The Compton wavelength is:

$$\frac{h}{\underline{m}c} = 2.426309\times10^{-12}\,\text{m} \quad -(4)$$

so:

$$\boxed{\lambda_2 - \lambda_1 = 2.426309\times10^{-12}(1-\cos\theta) + 3.120596\times10^{72}\,m^2\,\frac{\lambda_1\lambda_2}{2\pi}} \quad -(5)$$

It is seen that the effect of photon mass is

2) to make Compton scattering wavelength dependent

It is an advantage to use long wavelengths, or low frequencies, because this procedure maximizes the effect of photon mass on $\lambda_2 - \lambda_1$.
Therefore it is an advantage to use radio frequency Compton scattering where the wavelength is of the order of $1 - 10$ m. The X ray frequencies as used by Compton are of the order of 10^{17} to 10^{19} Hz, wavelength of the order of 0.1 nm