PH 105 – Quantum Mechanics

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7)

Assume a free electron absorbs a photon,

Energy conservation gives

$hc/\lambda + mc^2 = \gamma mc^2$ ---(1)

Momentum conservation gives

$h/\lambda = \gamma mv$ ---(2)

Substitute (2) in (1)

$\gamma mvc + mc^2 = \gamma mc^2$

$\gamma vc + c^2 = \gamma c^2$

$\gamma(c-v) = c$

On solving,

$(c-v)(c+v) - (c-v)^2 = 0$

i.e. v=c or v=0

If v=0 momentum is not conserved

And if v=c , Energy is not conserved.

Hence a free electron cannot absorb a photon.

In case of Compton effect, there-radiated photon conserves momentum and energy.