PH-105 QM Sheet 1

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5. **A $200MeV$ photon strikes a stationary proton. If the photon is back scattered, what is the kinetic energy of the recoiling proton?**

Solution :
Use the Compton scattering formula
$\lambda^{'} - \lambda = \frac{h}{m_0 c}(1 - cos\theta)$
where θ = angle of scattering = π
m_0 = mass of stationary proton
Writing the equation in terms of energies of the incoming and scattered photons, we get
$\frac{hc}{E'} - \frac{hc}{E} = \frac{2h}{m_0 c}$
$E = 200MeV$. Solving, we get $E^{'} = 140.22MeV$. Using the principle of energy conservation, kinetic energy of proton = energy lost by photon = $200 - 140.22 = 59.78MeV$.