

Phys106, II-Semester 2018/19, Assignment 7

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1. A photon and a particle have the same wavelength. Relate their linear momenta, relate photon energy and particle's total energy, relate photon energy and particle's kinetic energy.
2. Show that the de-Broglie wavelength of a particle of mass m with total energy $E_{\text{tot}} \gg mc^2$ is approximately that of a photon with the same total energy.
3. Find the energy levels of a neutron in a one-dimensional box of size $L = 10$ fm. This corresponds roughly to the diameter of a nucleus. Discuss your results.
4. Find the de-Broglie wave-length of the objects below (treat the all non-relativistically). Discuss your results and expectations. Compare with the sizes of the objects.
 - An electron with velocity 1m/s.
 - An electron with velocity 5000m/s.
 - An proton with velocity $0.01c$.
 - A plane with mass $m = 150$ tons and velocity 1000km/h.
 - A bacterium with mass $m = 10^{-12}$ g and velocity $50\mu\text{m/s}$.