A74, Dartmouth College
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A74 EXERCISES: Compton Scattering (7)

1. Calculate the energy loss of a photon in the following situations.

   (a) One single Compton scattering through 180°.

   (b) Two successive scatterings through 90° each.

   (c) Three successive scatterings through 60° each. Except I'm not going to have you actually do this calculation because its a pain. But know that this will *not* get the same as the previous two parts. See solutions if interested.

   (d) A "typical" interaction (i.e., averaged over scattering angle). Simplify the result in the Thompson limit. We'll see this is the Compton y parameter lecture and Sec. 7.4 (the Compton y parameter describes whether a photons energy will be changed by subsequent scatterings).

2. The Fermi bubbles are extended features seen γ rays from the Fermi telescope. One possible origin for the γ ray emission is inverse Compton scattering of the radio photons produced by synchrotron emission. Consider the Comptonization of radio emission of about $E = 10^{-4}$ eV (or about 10 GHz), producing γ ray photons with energies of about 1 GeV. What would be the required electron energies?

   The answer you'll get is pretty darn fast, but not impossible. However, as far as I can tell, neither this explanation nor the alternatives fit all avaialable data, see e.g. `https://cerncourier.com/a/elephants-in-the-gamma-ray-sky/`.