Physics 247 HW 12

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Due: December 1, 2022

Problem 1

Let $E_{initial}$ be the initial energy of the π^0, and E_p - the final energy of each of the photons. Since the π^0 has no momentum in its rest frame, its total energy will be equal to its rest energy, that is, $E_{initial} = 134.9766\,MeV$. After the decay, the total energy will be conserved. Therefore, the final energy of the photons will be:

$$E_{initial} = 2E_p;$$
$$E_p = 0.5 \times E_{initial} = 67.4883\,MeV.$$

In the lab frame, the momentum of the π^0 will be conserved after the decay, so each of the photons will have $p_x = 0.5 \times 60\,\frac{GeV}{c} = 30,000\,\frac{MeV}{c}$. Since photons have no mass, $p_y = \frac{E_p}{c} = 67.4883\,\frac{MeV}{c}$. Therefore, the angle θ between the two photons will be:

$$\theta = 2\arctan\frac{p_y}{p_x} = 2\arctan\frac{67.4883}{30,000} = 2 \times 0.1288929^\circ = 0.2577859^\circ.$$

Answering the final question, since the detector can detect photons $>= 0.1^\circ$ apart, it should be able to detect the two photons.