Production of milli-charged particles (mCP) is proportional to ϵ^2 where $\epsilon = Q/e$. Detection efficiency per scintillator (P) for particles with $\epsilon \leq 10^{-3}$ is approximately proportional to ϵ^2 as well. The acceptance of the detector is A. The detector is composed of two scintillator layers ($n = 2$) as shown in the cartoon. For $\epsilon = 10^{-3}$, the number of mCPs produced at collisions is N_{-3} and the detection efficiency P is 1.

1. If $N_{sig} = N_{-3}A = 10^{10}$, what is the number of events that contain hits in two layers at the same time? Assume that there is one mCP per event.

2. What is N_{sig} for $\epsilon = 10^{-4}$?

3. If the expected background events is 10, how many observed signal events do you need to exclude your model at 95% CL (p-value = 0.05)? Use Poisson as your likelihood.

4. In this case, what is the corresponding value of ϵ?