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Bonus Question 5

Due Monday, Oct. 14

The design luminosity of the LHC is $\mathcal{L} = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ at CMS. The total pp cross section at the planned LHC center of mass energy of 13 TeV is approximately 100 mb. There will be 2808 bunches in each beam, so that during a complete revolution there are 2808 bunch crossings at the center of CMS.

1. (5 pts) How many collisions are there per bunch crossing at the center of CMS? Hint: think about the total number of collisions per second then think about how many of them must occur per revolution and then how many must occur per bunch crossing.
2. (5 pts) We want to measure a process that has a cross section of 50 fb and has a detection efficiency of 2.5%. We assume that the accelerator runs approximately 10^7 seconds per year, which takes into account shutdowns and the fact that the luminosity steadily decreases during running and must be filled repeatedly. How long in years should the accelerator be run for CMS to measure 40 decays of this process?