

Nuclear and Particle Physics - Problem Set 4

Problem 1)

A high-energy physicist at SLAC is using a 20 GeV electron beam to study the structure of the proton. She has set up a spectrometer with 2 msr acceptance at an angle of 4.5 degrees with respect to the beam line. The spectrometer accepts scattered electrons at energies E' between 14.900 and 15.100 GeV. The average beam current (averaged over one second) is 0.5 μA , and the target thickness 0.14 g/cm^2 (pure H_2). Calculate the count rate (detected electrons per second).

- a) Calculate the kinematic variables x , Q^2 and whatever else you need to determine the cross section.
- b) You can use the formula for deep inelastic scattering (assume scaling). Why? Ignore the contribution from $F_1(x)$ - the $F_2(x)$ part is sufficient. To find the proper value of $F_2(x)$, you can either use the figure in Povh or the data compilation by the Particle Data Group (https://pdg.lbl.gov/2025/reviews/contents_sports.html).
- c) Use your result under b) and the information given to get the count rate.