

Homework #8

- A charged particle enters a 0.5 mm thick Silicon detector element at a normal angle and suffers multiple scattering while transversing it. How much will its direction change on average if the particle's momentum is 5 GeV/c or 50 GeV/c?
- Consider a cylindrical drift chamber with a radius of 5 mm, operated at a voltage of 2.4 kV. The positive ions have a mobility of $\mu = 1 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$, where mobility links the drift velocity and the electric field as $v_{\text{drift}} = \mu E$. The anode wire radius is 12.5 μm . Calculate the maximum drift time.
- Compare the two experiments that discovered the J/psi meson. What are their strong points and challenges?
- At the Large Electron Positron Collider the Z-particle was produced in the interaction of electrons and positrons with a cross section of 32 nb at an energy of 91 GeV. How long did they have to wait for the first Z event after switching on the experimental apparatus if the luminosity was $2.3 \times 10^{31} \text{ cm}^{-2}\text{s}^{-1}$? How many Z particles were produced in 1 week if the data taking efficiency was 20% and the luminosity is assumed to be constant? What was the expected statistical precision on the measured mass of the Z boson from this data sample if a detector with 10 GeV or 0.1 GeV resolution is used and only the di-muon final state is analysed?
- Formulate an “educational” problem (either a quantitative exercise or one that requires deduction starting from information learnt during these lectures) that could be asked as part of the written exam. Give also the solution of the problem.