

Homework #7

- Calculate the full width at half maximum relative energy resolution for the mono-chromatic gamma-ray emission of ^{137}Cs line of a NaI(Tl) scintillator with a mean excitation energy of 22 eV read out by a PMT with a quantum efficiency of 0.3%.
- Estimate how much the particle flow technique can improve the jet energy resolution for a typical high-energy physics experiment.
- For charged particle (eg. charged hadron, muon, ...) tracking usually the so-called Kalman filter method is used in collider experiments to take into account random process noise in the tracking. For electrons, however, a different technique is necessary (such as Gaussian Sum Filter method). Why and how electron tracks differ from other charged particle tracks?
- The anti-proton was discovered in the process $p + p \rightarrow p + p + p + \text{anti-p}$ by shooting a proton beam to a proton target at rest. What is the minimal center-of-mass energy for this process to happen? What is the minimal proton beam energy in the laboratory system?
- In the anti-proton discovery, the few anti-p produced had to be efficiently separated from the more numerous pions and kaons. Discuss how the collaboration of Chamberlain and Segrè achieved this task based on the setup of the Nobel prize winning experiment.