

# Phys 586 Homework

## Problem Set 4

Due Wednesday, March 24

1. Estimate the energy loss of a 10 GeV muon through 1 meter of iron. You do not have to do a numerical evaluation of the Bethe-Bloch equation.
2. Calculate the maximum kinetic energy delta ray a 10 GeV muon can produce. What is the range of this delta ray in air?
3. The LHC beam is 7 TeV protons. The LHC accelerator is 27 km in circumference. If the LHC accelerator were filled with air (it's not) at STP, how much ionization energy would a proton lose each turn? If the velocity  $v = c$  for the protons, how long would it take to lose the total beam energy by ionization?
4. Use the EGS simulator to make a rough estimate the range of electrons in water and aluminum for electron energies of 1 and 10 MeV. Use 100 particles in the beam. You may need to change the radius of the target to get a usable picture. Compare your estimate from the simulation with the calculated CSDA range from standard tables. Include the simulation plots from EGS. The EGS simulator is at [www2.slac.stanford.edu/vvc/egs/basicsimtool.html](http://www2.slac.stanford.edu/vvc/egs/basicsimtool.html).