PHYSICS 198-620B

Experimental Techniques in Sub-Atomic Physics

CALORIMETRY ASSIGNMENT

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deadline : February 3^{rd}, 2011. *legible handwriting!*

You and your group are at a **test beam** delivering particles of momenta 5, 15, 40 and 100 GeV/c. The beam contains pions (π^+), positrons (e^+) and muons (μ^+). Just assume they each come in similar amounts and each at the same instantaneous rate of 10 kHz.

Your **equipment** list would consist of:

- several scintillators with PMT's, etc..
- a pair of wire chambers
- a sampling calorimeter (scintillator plates and a choice of Fe, Pb or W absorber plates)
- each of the above would be equipped with full readout/trigger electronics.

The **goals** would be:

- identify the incoming particles with the calorimeter as efficiently as possible/reasonnable
- make a compromize between containment and price
- evaluate the performances of the calorimeter

For each of the following **steps**, *brief* comments and justifications should be given towards accomplishing the goals:

1. Design schematically your setup in the beamline. *(10%)*
2. Design the calorimeter. The maximum volume available would be $1{\times}1{\times}1$ m^3. *(35%)*

   Select the absorber material. Define the geometries (structure, sizes, layering, ..)
3. Evaluate the performance for each type of particle and energy. *(40%)*

   Calculate leakages, determine energy resolutions, estimate particle ID efficiencies.
4. What will be the e/h ratio of the device? *(5%)*
5. What is the probability of double events? *(5%)*
6. Assume market price for absorber material to estimate the minimal raw cost. *(5%)*

Important **notes**:

- use lecture notes and your own arguments
- there is no unique solution, it's all about the concept
- only rough numbers are expected
- maximum of 5 original pages