P627, YK
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Home Work #10

(due Tuesday April 8, 2008)

1. Electromagnetic calorimeter is made of alternating 48 copper plates with thickness of 7 mm and 48 scintillator plates with thickness of 4 mm stacked together. Find what fraction of energy of 100-GeV electron will leak longitudinally escaping detection in calorimeter. Assume that there are no leakages in transverse direction.

2. (a) Estimate longitudinal leakage for 200 GeV pions in the hadron sampling calorimeter made of 40 layers of Fe-plates with thickness of 2 cm and proportional gas chambers (thickness 7 mm of gas 90% Ar + 10% CO_2) in between iron plates. (b) Estimate probability of "punch-through pion", i.e. probability that pion will pass the hadron calorimeter without inelastic interaction and will look at the exit like muon.

3. Build in GEANT3 a sampling calorimeter with the structure described below and "measure" by simulations the resolution for 80-GeV/c electron and 80-GeV/c pion. Show "measured" energy distributions with 1000 events per histogram. Calculate r.m.s. and σ of fitted Gaussian for each distribution and find e/π response ratio.

Transverse size of calorimeter: 80 cm × 80 cm. Longitudinal structure: 50 Pb plates 2 cm thick with 50 plastic scintillator plates 5 mm thick

Assume that all the energy released in the scintillator was converted to detectable signal. Recalculate the energy response of the calorimeter when Birk's quenching in scintillator is taken into account. Find in the literature a typical value for k_B for plastic scintillator.