Shower Containment and the Size of a Test Calorimeter

Adam Para, September 6, 2006

Why Test Calorimeter???

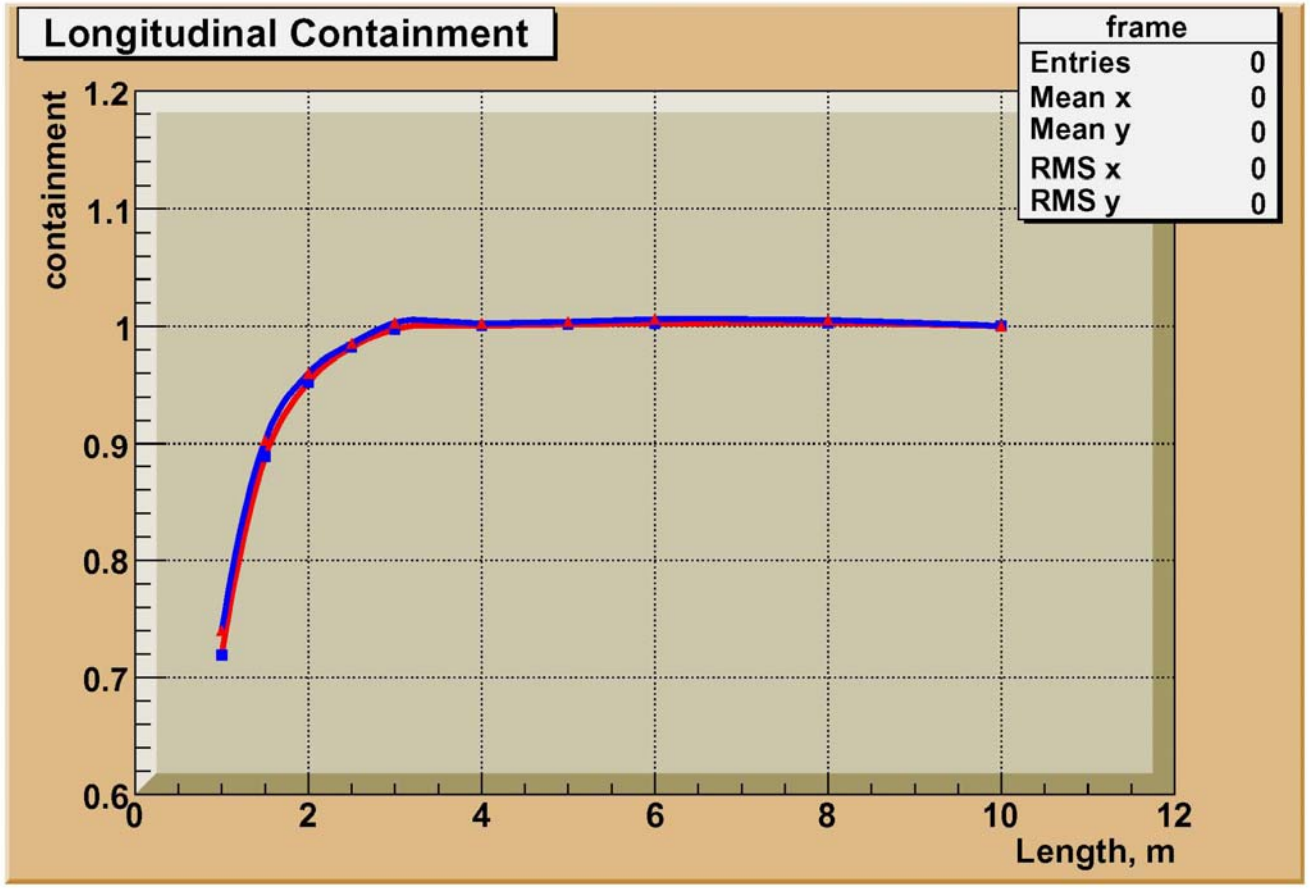
- It is not yet proven, but it is quite plausible that a dual readout calorimeter may offer very good energy resolution for jets ➔ simulation and analysis
- It is plausible that high enough light collection efficiency can be attained for Lead Glass + fiber, or Lead Glass + APD configuration ➔ optical test laboratory
- It is plausible that cheap enough Lead Glass (or other Cherenkov radiator) can be produced ➔ vendors contacts
- It is plausible that a realistic mechanical design of a large hermetic calorimeter can be produced ➔ engineering studies
- We need to demonstrate the energy resolution, linearity and e/π response in the test beam

How Big a Test Calorimeter?

- Hadron calorimeters are large (m^3), hence expensive. Can't afford to be bigger than necessary.

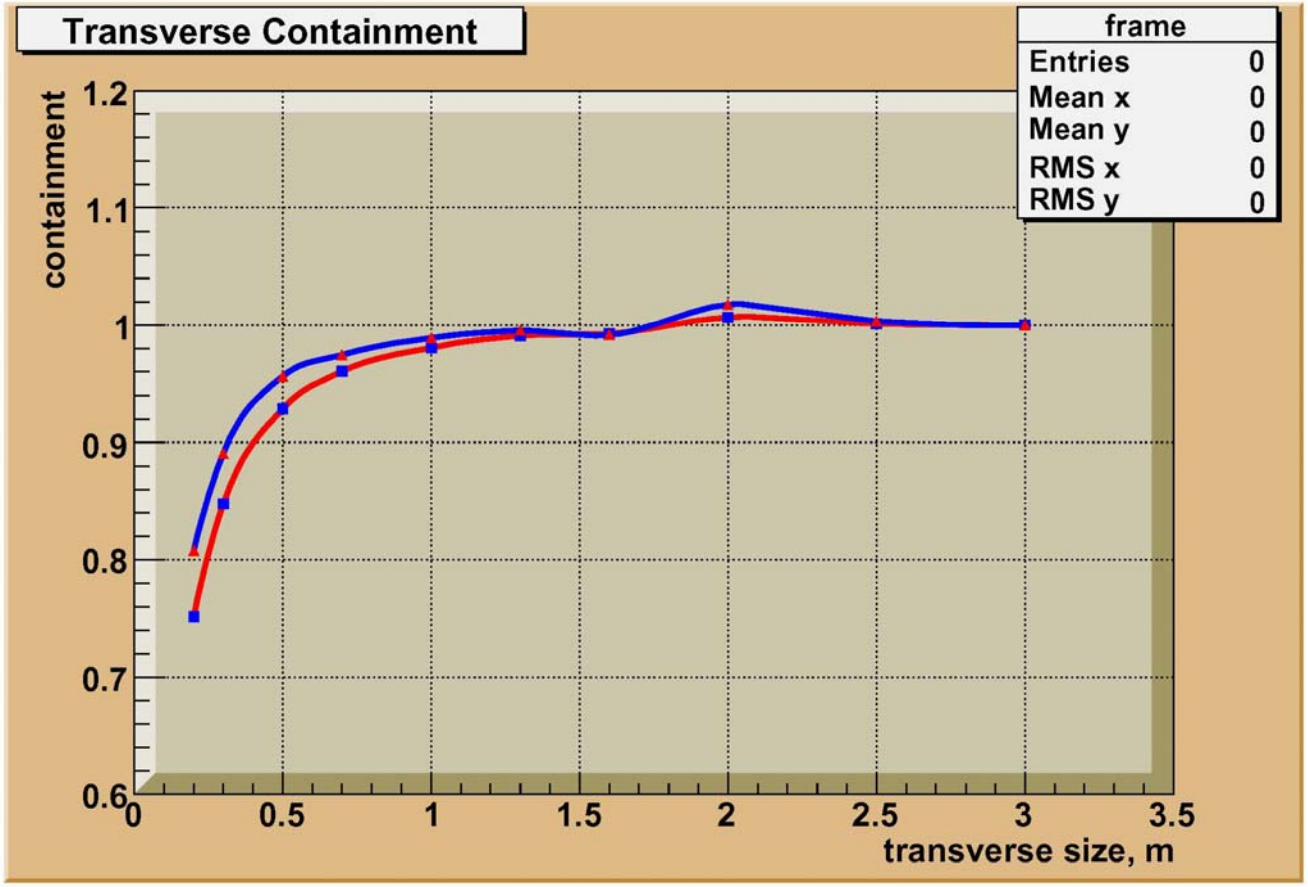
- (if we build it) we want to demonstrate good energy resolution ~(20-30)%/sqrt(E), that is ~2-3% energy resolution at 100 GeV. If the calorimeter is not long/wide enough there will be some energy leakage from the calorimeter and its fluctuations will contribute to the energy resolution. Need containment ~98% or better.

How Long a Calorimeter



- Need 2.5-3 m long lead glass
- Blue = Cherenkov
- Red = ionization

How Wide a Calorimeter?

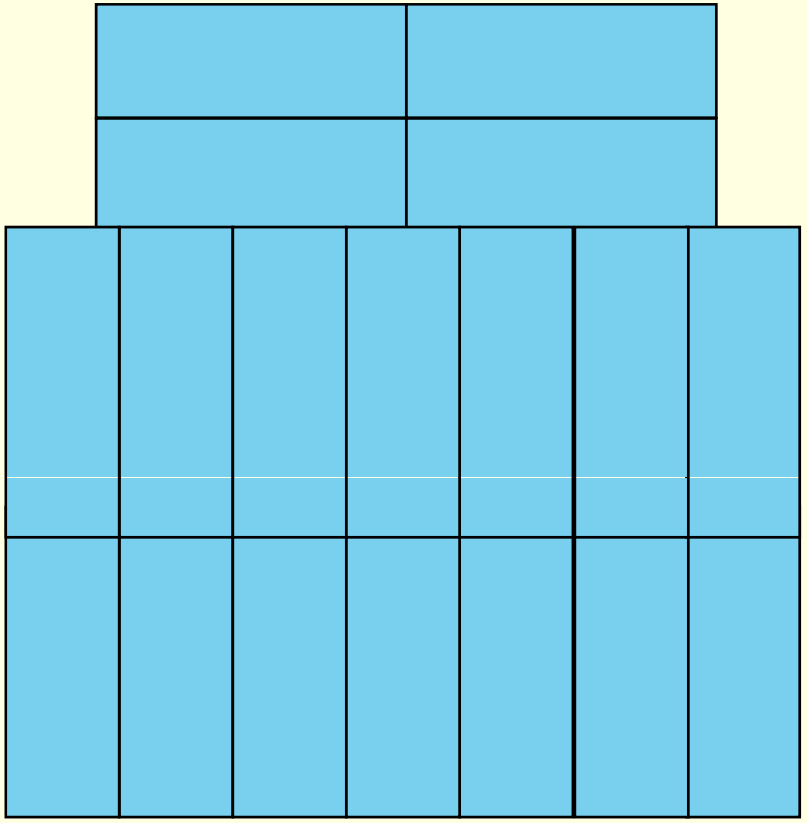


- Need ~ 1m wide test module
- Red = ionization
- Blue = Cherenkov

Available Building Blocks

- E70 experiment (Lederman, upsilon): SF5 lead glass blocks 6”x6”x16”
- 6” is far too thick. Optimal absorber thickness needs study (sampling fluctuations): 3” (thick)? 2”(thin)? Options
- 3 m = 120”:
  - 40 thick planes
  - 60 thin planes
- 7 x 6” = 105 cm wide
- 32”+12” = 110 cm tall
- 18 ‘pixels’ per plane
- Fundamental unit: lead glass

  + scintillator plate
- Transverse segmentation:
  - Common LG and scintillator
  - Is 6”x16” sufficient?
  -



Readout?

- Assume: LG block and the scintillator plates are read out via a single waveshifting fiber (light collection efficiency and uniformity to be demonstrated)
- Channel count: 18 x 2 x 40 (60) = 1440 (2160)
- Assume Hamamatsu 5800-M64 phototube (?) ➔ need 25(35) tubes
- Electronics?
- DAQ?

Cutting the Lead Glass Blocks

- Cut along the long axis:
  - Diamond band saw
  - Water-jet (with abrasives)
- Initial vendor contacts: promising
- Surface quality: do cut surfaces need to be polished (manpower = cost)
  - Need to find out what the surface quality is
  - Need to find out what is the acceptable surface quality