

Test Beam Oriented CMSSW Tutorial

FIU CMS Workshop



Sergei Gleyzer
Professor Harrison Prosper

Today's Tutorial


- Real combined **Test Beam** data taken this summer
- You can learn how to:
 - **unpack** and **reconstruct** data from the testbeam
 - modify and write your own **analysis** code
 - solve a variety of tasks within the Framework
- Mainly ECAL oriented
 - Combined ECAL + HCAL tasks included for those interested

Setup Environment

- Data location: FSU GRID `grid.hep.fsu.edu`
 - login: `cms(your#)` pwd: `physics`
- Tutorial Setup:
 - `mkdir yourSpace`
 - `cd yourSpace/`
 - `scramv1 project CMSSW CMSSW_0_8_1`
 - `cd CMSSW_0_8_1/`
 - `cp /home/sergei/h2/Tutorial.tar .`
 - `tar zxvf Tutorial.tar`
 - `cd src/`
 - `scramv1 b`
 - `cd Tutorial/Tb06Analysis/src`
 - `eval `scramv1 runtime -sh``

In your tutorial directory:

Tutorial/Tb06Analysis/src

- `run_tb06_ECAL.cfg`
`run_tb06_combined.cfg`  Configuration Files
- `Tb06Analyzer.cc` Analyzer Framework
- `Tb06Analysis.cc` “Actual Analysis” code
- `h2.0003...0.root` link to a raw data file

run_tb06_ECAL.cfg

- Standard Framework modules and sources
 - **unpacker** unpacks the data
 - **filter** filters the data
 - **PoolSource** input source
- ECAL/HCAL modules
 - **rechitmakers** produce rechits
 - EB Ecal Barrel
 - HBHE HCAL Barrel/Endcap
 - HO HCAL Outer
- CMS Geometry
- Custom Analyzer **change as you see fit!**

Module Syntax

module tag



module name



```
module analysis = Tb06Analyzer {  
  string HistogramFile = "test.root"  
  string EcalRecHitProducer = "ecalRecHitMaker"  
}
```



Module parameters

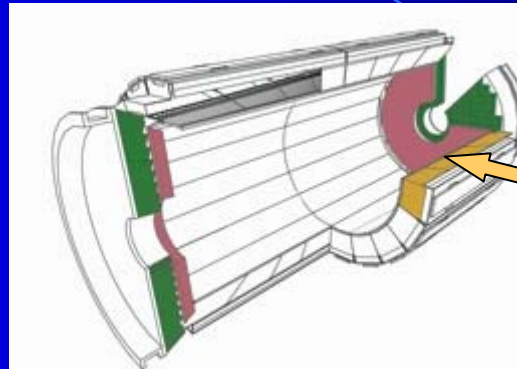
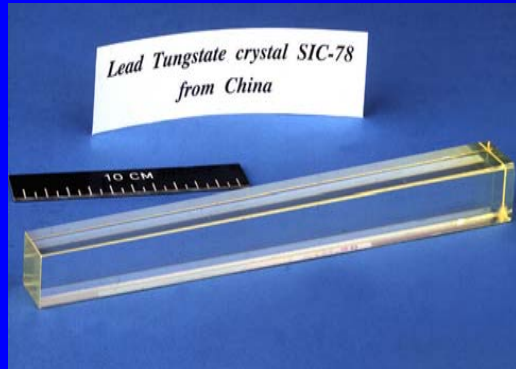
Tb06Analyzer.cc

- Knows nothing about actual analysis
- Acts as “Broker” between event, configuration file and analysis object
- Required methods:
 - Analyze()
 - endJob()

Tb06Analysis.cc

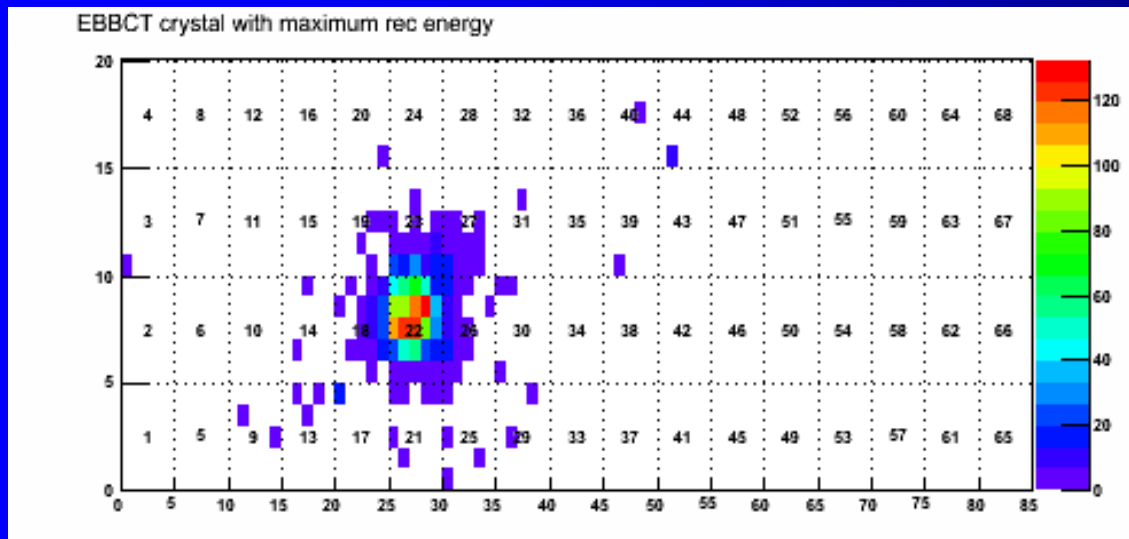
- Actual **analysis** code
- Here you can:
 - Analyze **rechits**
 - Loop over **rechit** collections
 - Access individual cell's
 - **Energy**, detector ID, η , φ
- ...

ECAL



Typical ECAL Barrel
Super Module

● 1700 Crystals



Test Beam
Coordinates:

● $0 < \eta < 85$

● $0 < \phi < 20$

Tutorial Tasks

- Setup your working area
- Make the configuration file work
 - **Hint:** framework needs a path that shows the order of modules to be executed
 - To run: `cmsRun run_tb06_ECAL.cfg`
- **Analysis Tasks (ECAL):**
 - Plot the energy of individual crystals for all the events
 - See if there is a natural place to put a noise threshold

Tutorial Tasks (continued)

- Plot the total **energy** in ECAL
- Make a 2D plot of the total **energy** in ECAL in η - ϕ space
- **Beam profile (ECAL)**
 - Analyze beam profile using ECAL
 - From beam profile estimate extent of electron shower
 - **Hint:** First find the nominal beam position per event. Then make a plot of $\Delta r = \sqrt{(\Delta\phi^2 + \Delta\eta^2)}$ for all the ECAL rechits. Crystal width is 2.2 cm.

Tutorial Tasks (continued)

- Plot the total **energy** in HCAL
- Make a 2D plot of the total **energy** in HCAL in η - ϕ space
- **Beam profile (HCAL)**
 - Analyze beam profile using HCAL
 - From beam profile estimate extent of electron shower
 - **Hint:** First find the nominal beam position per event. Then make a plot of $\Delta r = \sqrt{(\Delta\phi^2 + \Delta\eta^2)}$ for all the HCAL rechits

Tutorial Tasks (continued)

- Combined Tasks (HCAL+ECAL)
 - Plot the total **energy** (HCAL+ECAL)
 - Make a 2D “banana” plot of HCAL versus ECAL **energy** in the η - ϕ space
 - Can you identify hits due to muons, electrons... ?

Tutorial Hints and Solutions

- /home/sergei/h2/Hints_and_solutions

A photograph of a laboratory or workshop environment. In the center, a yellow metal frame holds a large, rectangular object wrapped in shiny, reflective foil. To the left, there is a complex arrangement of wires and cables connected to a piece of equipment. The background shows a yellow wall with a metal railing and various pieces of equipment. The text "Congratulations! Tutorial Complete." is overlaid in green on the image.

Congratulations! Tutorial Complete.