Artg4 and the art framework

Summer internship 07/29/2013 – 09/27/2013

Antonio Anastasi

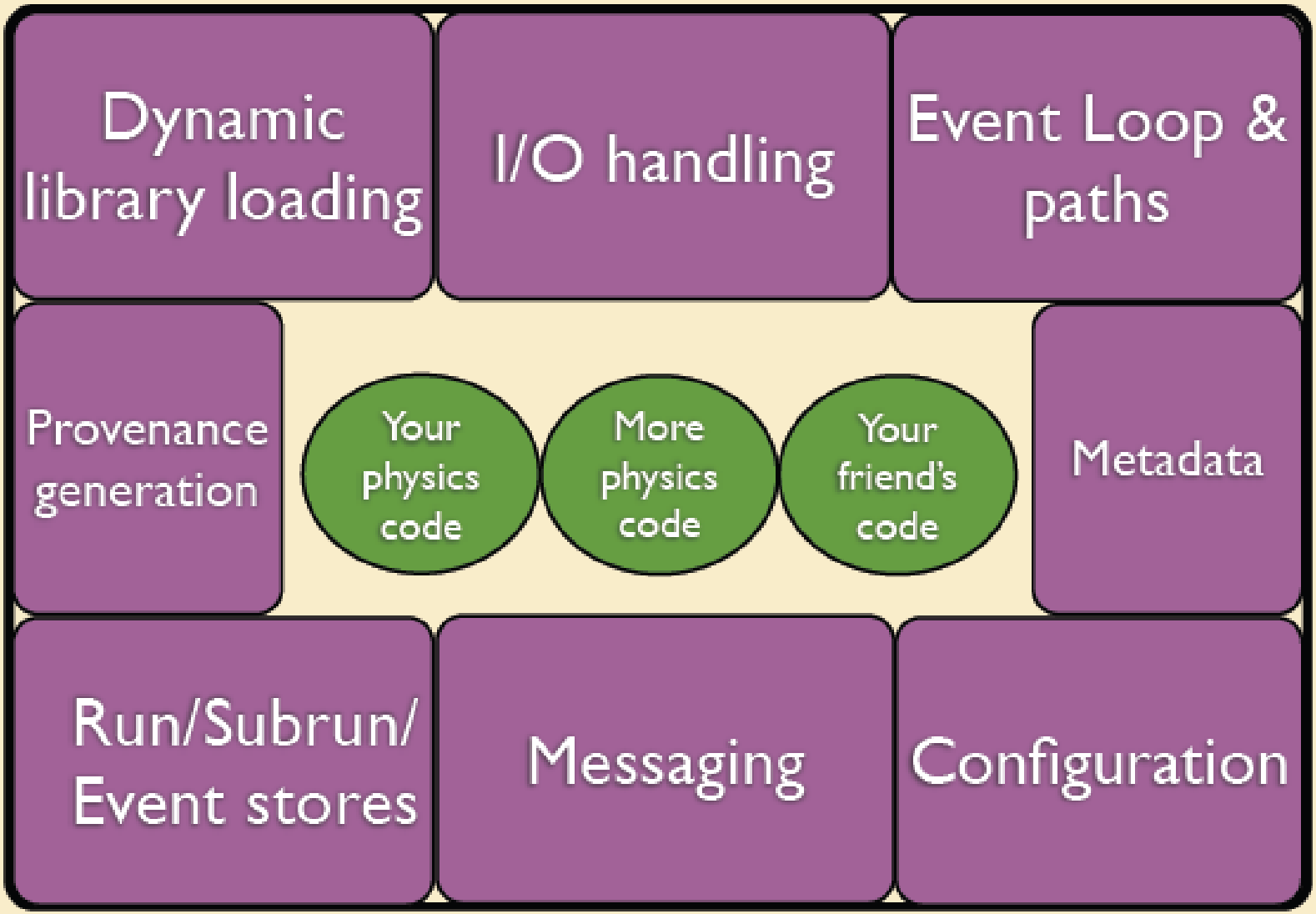
Fermi National Accelerator Laboratory

Outline:

- Learning the art Framework
- Artg4
- Gm2ringsim:
  - TestBeam
  - Input file for a prototype gain study
- Conclusion

Learning Art

- First weeks of training.
- It was necessary, to learn how to move in the simulation world.
- The ArtWorkbook: a very useful guide to learn art, very well explained and a lot of useful example in it.
- Exercise of the first workshop.
- Impressions: very great idea! I found this system liberating. Easy to understand and very useful about the the management of the code, splitted in different part.


Dynamic library loading
I/O handling
Event Loop & paths
Provenance generation
Your physics code
More physics code
Your friend's code
Metadata
Run/Subrun/ Event stores
Messaging
Configuration
Code you write
Code you use from the framework

ArtG4

- ArtG4 training.
- Try to solve Q8 of the first workshop:
  Q8: Implement the Geant4 example N02 in ArtG4.
- Work done after 3 weeks of work with the help of the wiki in RedMine.

N02 Example

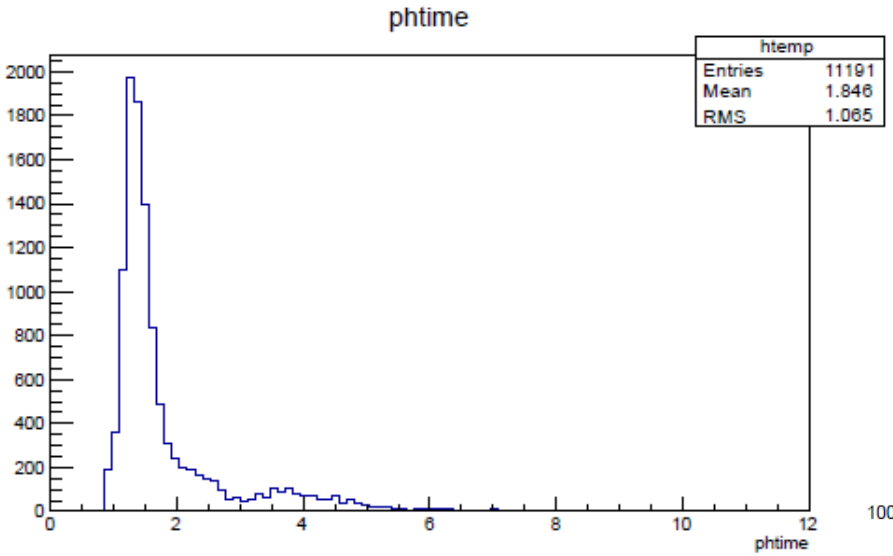
```
hp@HP-Pavilion-g6-Notebook-PC: ~
```

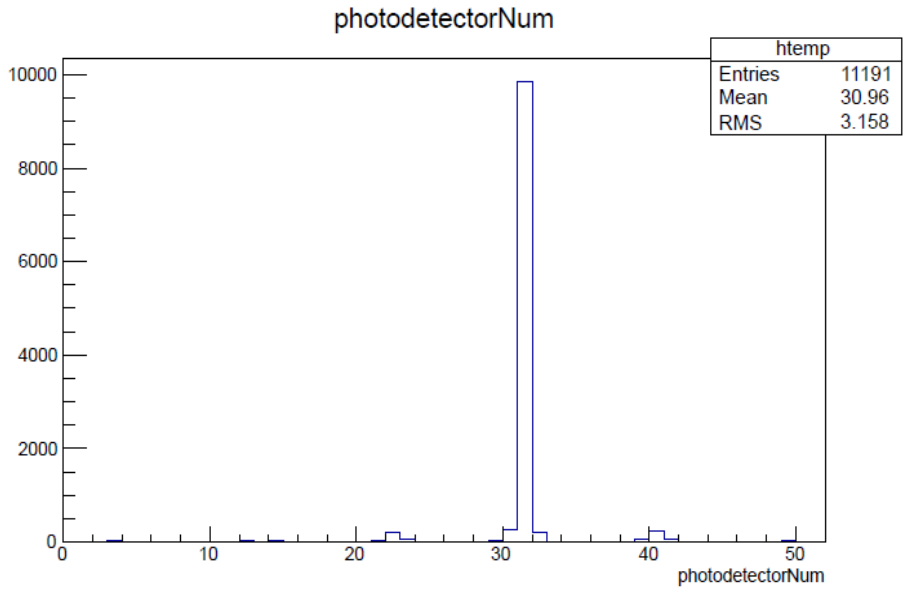
```
process_name:exampleN02

source: {
  module_type: EmptyEvent
  maxEvents: 100
}
services: {

  TFileService: {
    fileName: "myoutput1.root"
  }
  message: {
    debugModules: ["*"]
    suppressInfo: []
    destinations: {
      LogToConsole: {
        type: "cout"
        threshold: "INFO"
        categories: {
          default: { limit: 20}
        }
      }
    }
  }

  user: {
    RandomNumberGenerator: {}
    DetectorHolder: {}
    ActionHolder: {}
    Material: {}
    physicslist: {}
    PhysicsListHolder: {}
    //Detector
      world: {
        name: "world"
        category: "world"
        mother_category: ""
      }
      tracker: {
        name: "tracker"
        category: "tracker"
        mother_category: "world"
      }
      target: {
        name: "target"
        category: "target"
        mother_category: "world"
      }
      chamber: {
        name: "chamber"
        category: "chamber"
        mother_category: "tracker"
      }

    //Actions
      ClockAction: {}
      particlegunaction: {
        name: "Gun"
      }
      eventaction: {
        name: "EventAction"
      }
  }
}

outputs: {
out1: {
  module_type: RootOutput
  fileName: "out.root"
  }
}
```

```
physics: {
  producers: {
    artg4Main: {
      module_type: artg4Main
      enableVisualization: false
      macroPath: ".:./macros"
      visMacros: "vis.mac"
      afterEventause: pause
    }
  }
   analyzers: {
    reader: {
      module_type: readmyhits
      hist: ""
      tree: ""
      hitmodulelabel: artg4Main
      instancename: "chamber"
    }
  }

  path1: [artg4Main]
  path2: [reader]
  stream1: [out1]
  trigger_paths: [path1]
  end_paths: [stream1, path2]
}
```

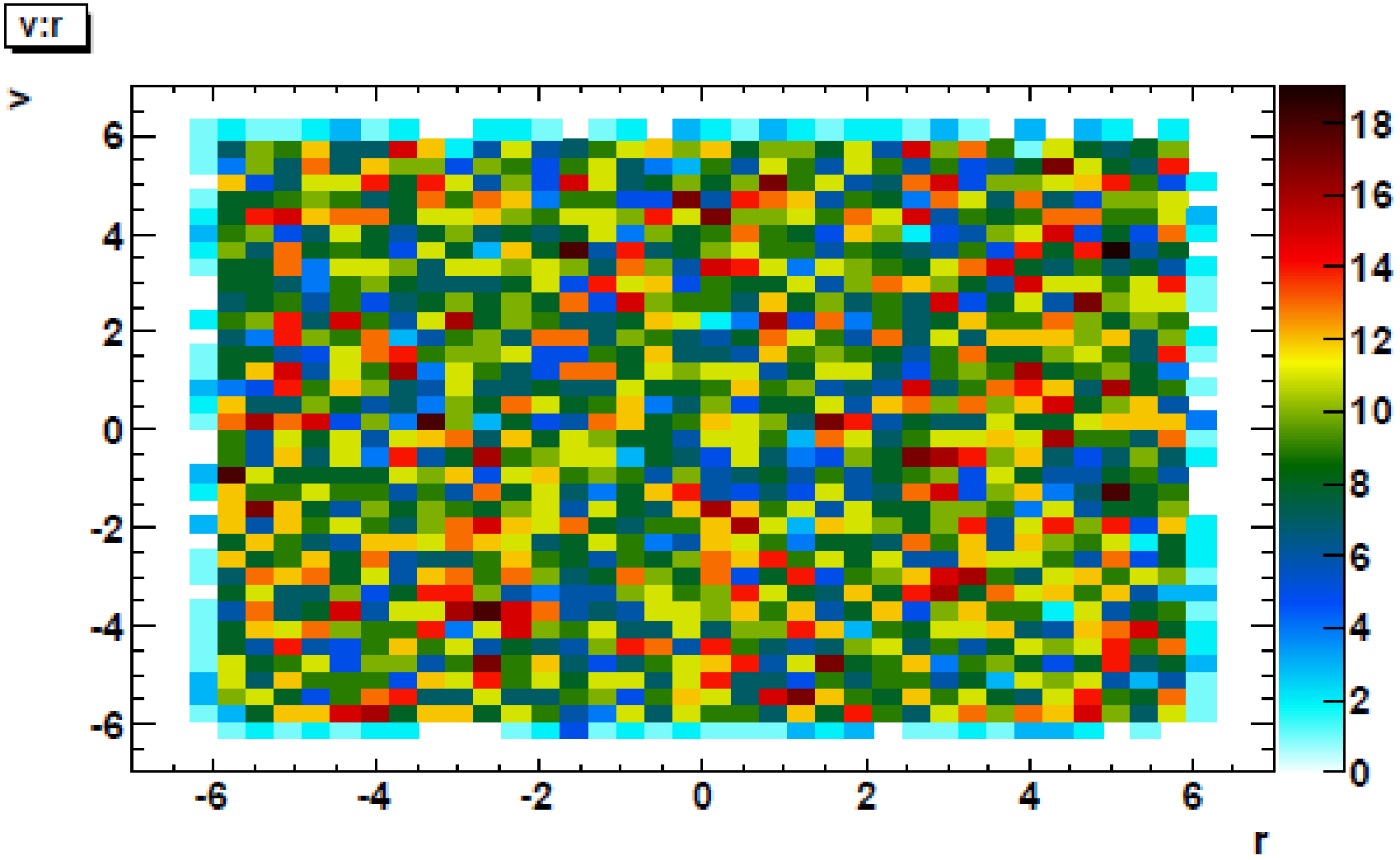
GM2RINGSIM

TestBeam: TestBeam Performed using TestBeamCal.fcl



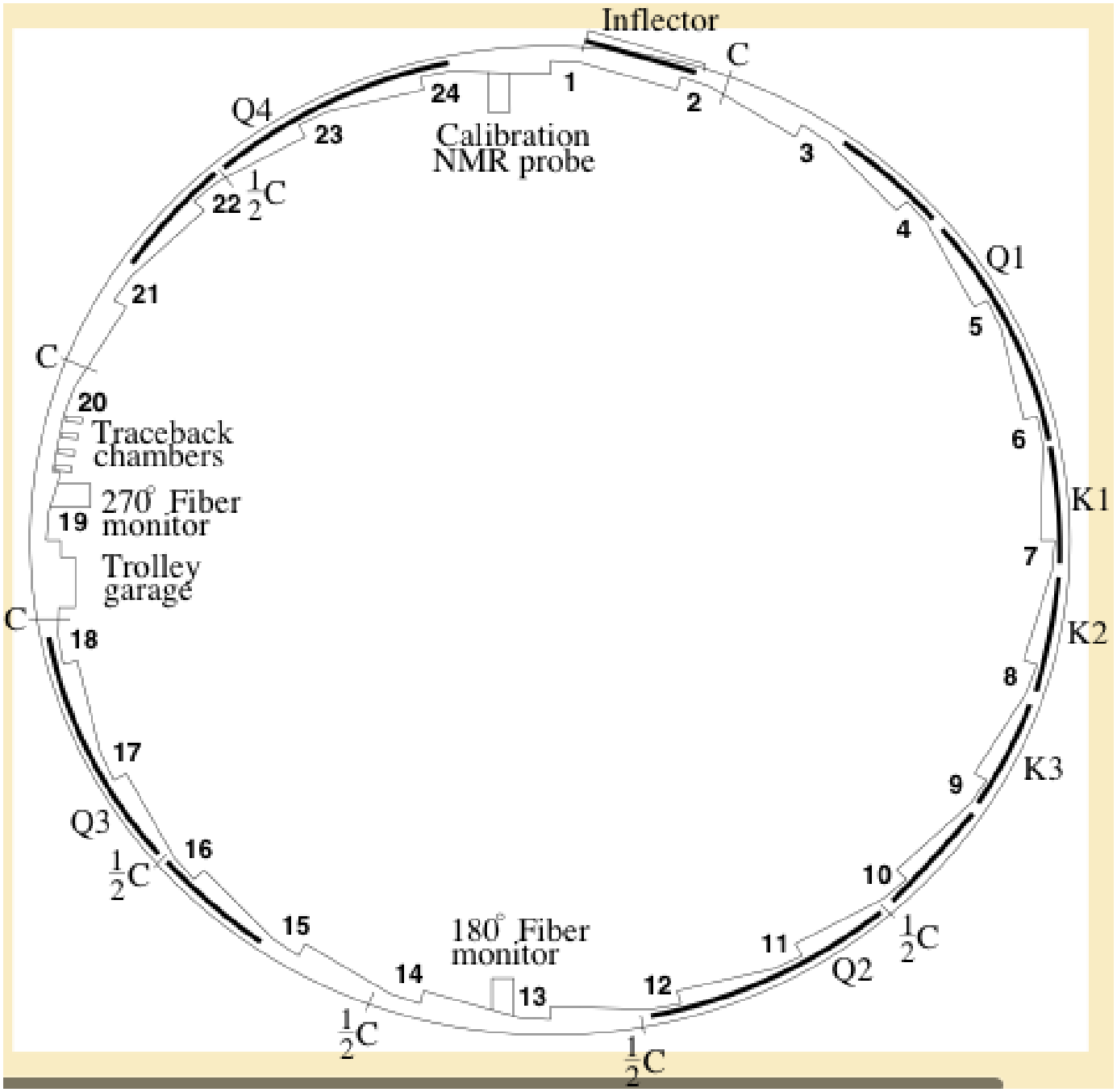


Map of the photon hit on the most hitted photodetector (SiPM).

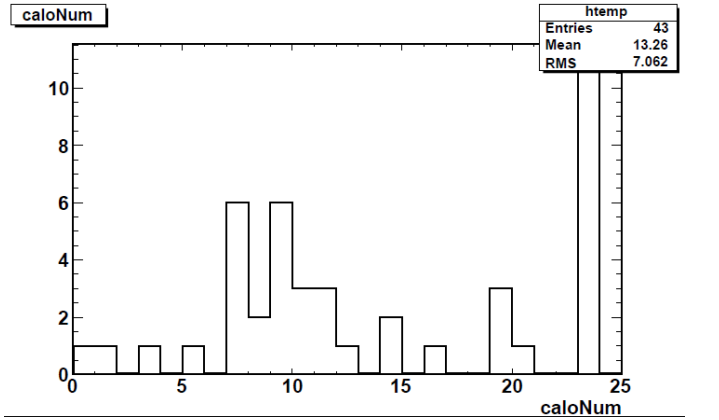


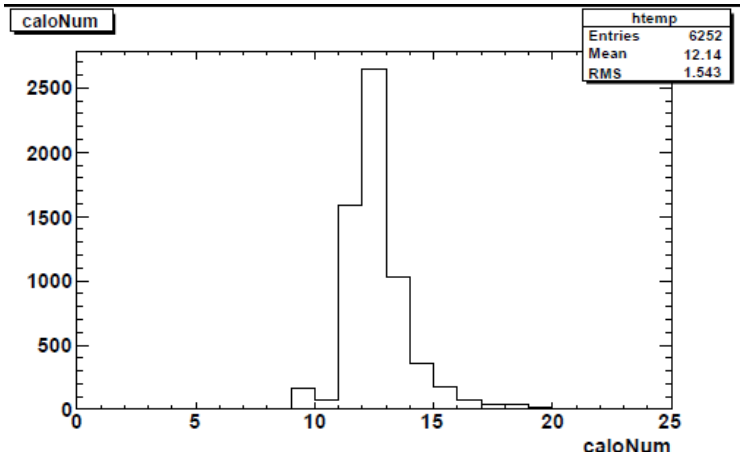
INPUT FILE OF A PROTOTYPE GAIN STUDY

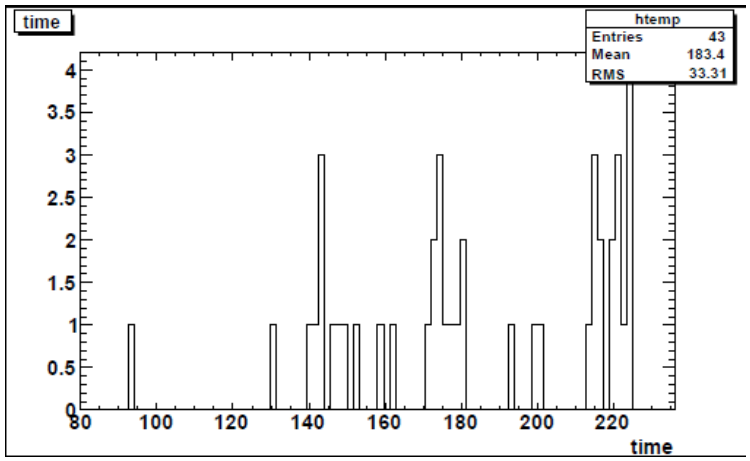
- I'm developping a prototype of a possible gain study for my Master Thesis
- I need some spatial and time distributions of the hits of the decay electrons and the shower's photons from a single muon fill.
- Different test to choose (slide before) the right setup to use.

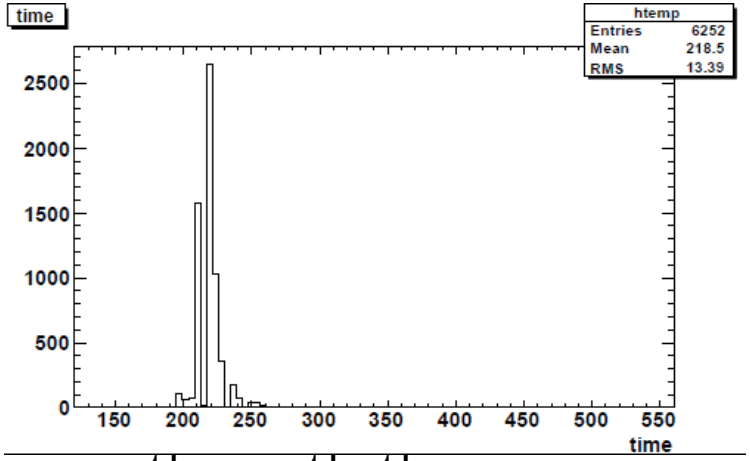

Inflector
C
1
2
3
4
Q1
5
6
K1
7
K2
8
K3
9
10
$\frac{1}{2}$C
Q2
11
12
$\frac{1}{2}$C
13
180° Fiber monitor
14
$\frac{1}{2}$C
15
16
Q3
$\frac{1}{2}$C
17
18
C
19
270° Fiber monitor
Trolley garage
20
Traceback chambers
C
21
22
$\frac{1}{2}$C
23
Q4
24
Calibration NMR probe

Inflector gun:
Simulates a muon decay.
Different set of parameters give the chance to choose the setup you need.
Possibility to create different event with a single muon per event or one event with several muons. It could be good to simulate a single fill.



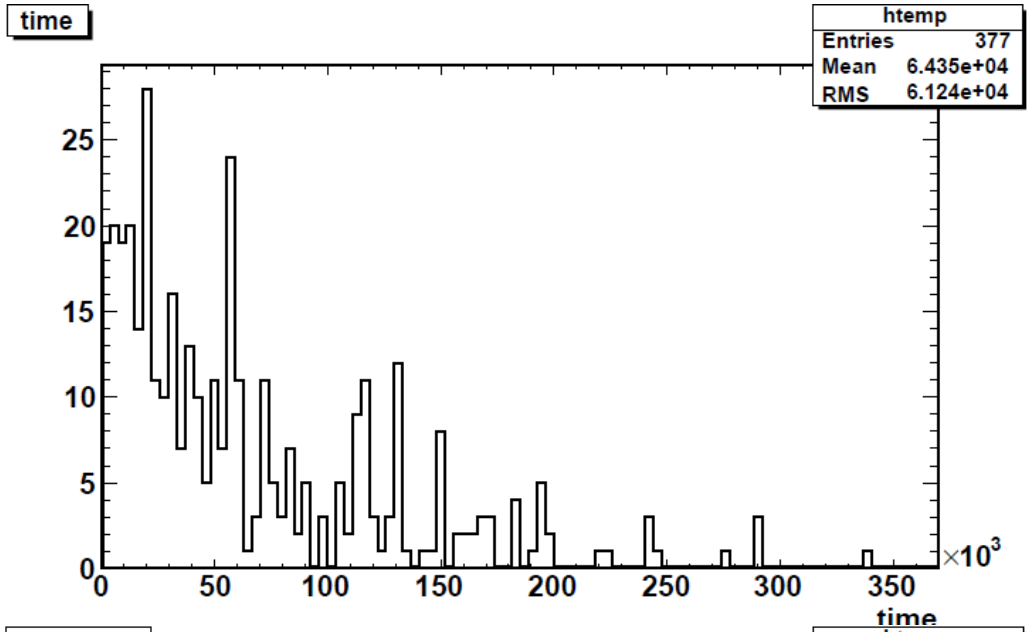


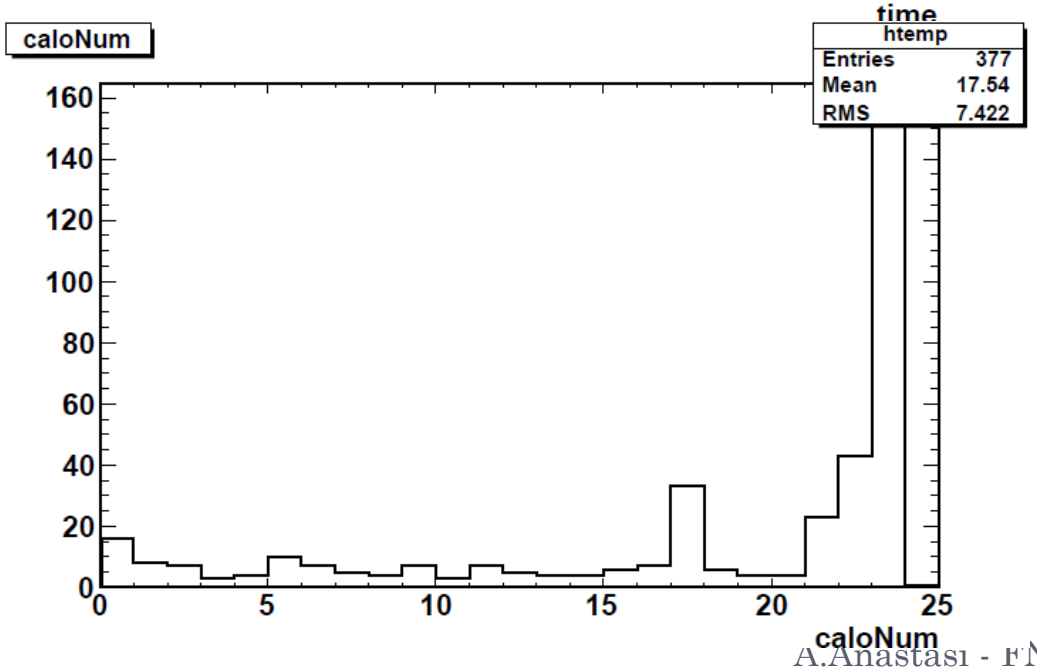


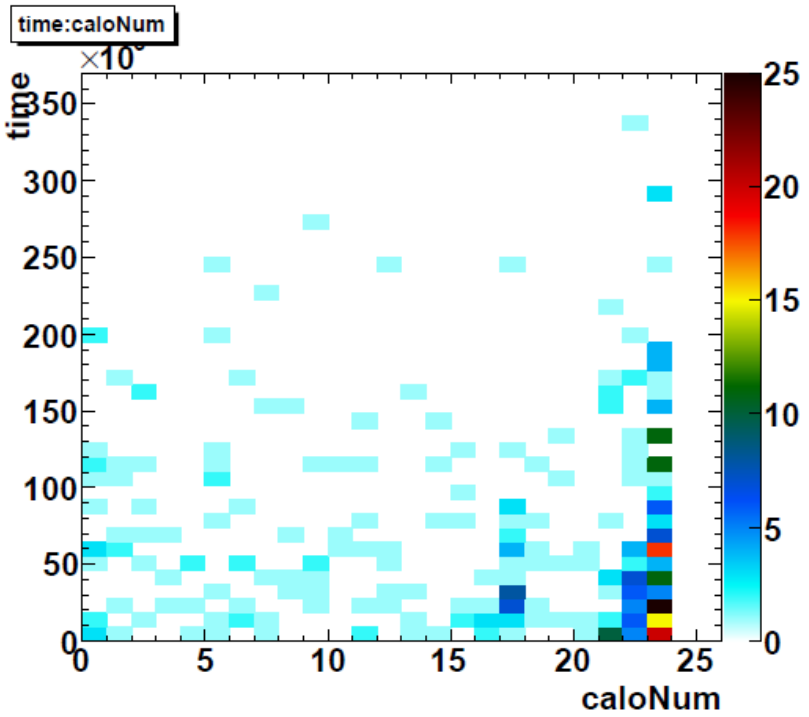


Problems: weird behaviour. This gun uses muons with exactly the same charachteristics if you set more particles per event. This gun as is it currently configured isn't realistic for simulating a whole fill at once.

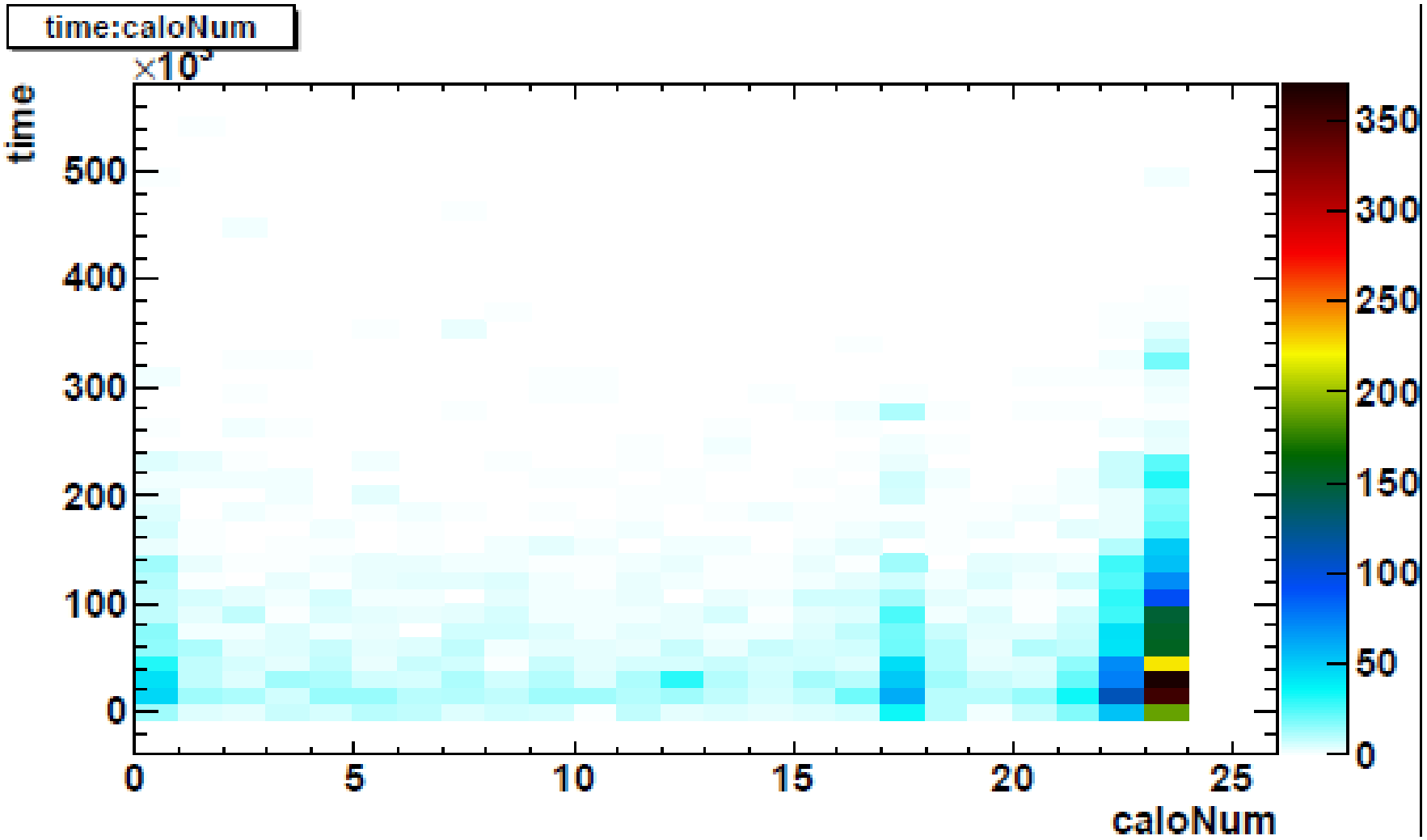
Muongas gun: You can't fire more muons per event…BUT
It takes the muons randomly from a muon gas distribution. It means different muons. It's possible to simulate a fill firing 6000 events.





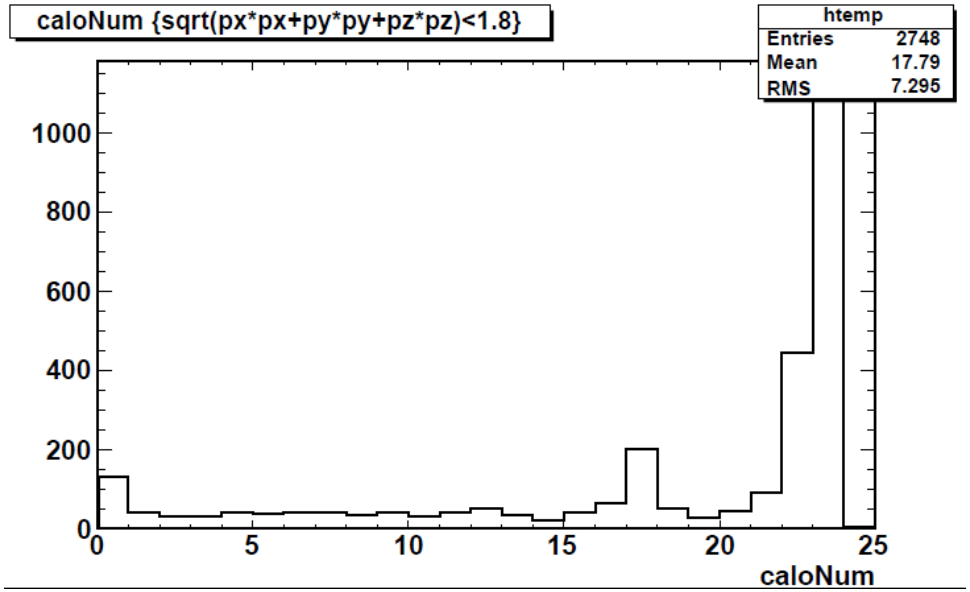


Run with 60000 events



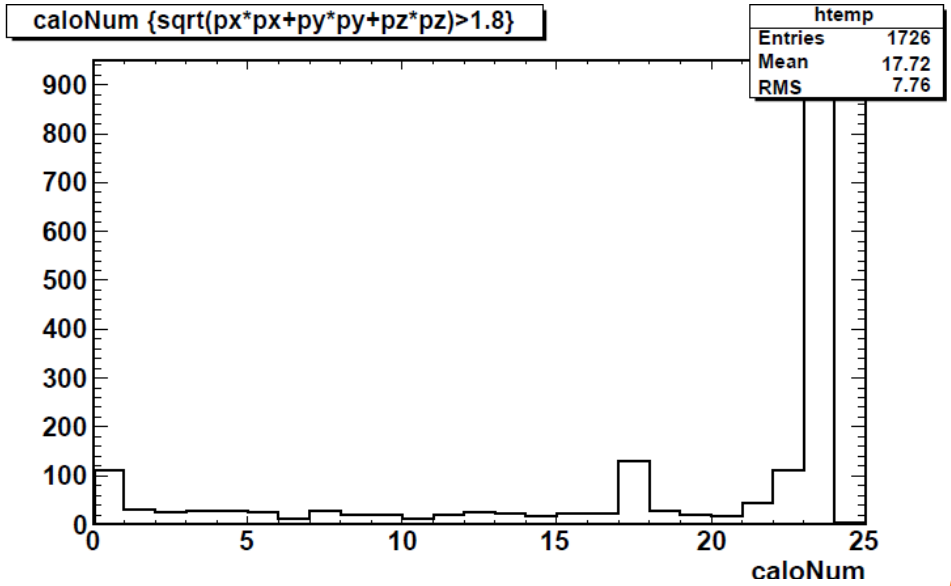
Same behaviour as before.
The major part of the events is on calorimeter station number 24.

Test with different energy cut.



Particles below 1.8 GeV.

Particles above 1.8 GeV.



Conclusion

- I really appreciate this framework.
- It is still in development.
- I will be very glad to be able to continue to work on it for the g-2 collaboration.

ACKNOWLEDGEMETS

I am very grateful to all the Fermilab guys. I will mention here Brendan K. and Thomas for the help.

In particular to Adam Lyon which has found the time to guide and help me.

And finally to all the organizer of the Summer Internship that made this experience possible.

THANK YOU FOR THE ATTENTION