



FROG

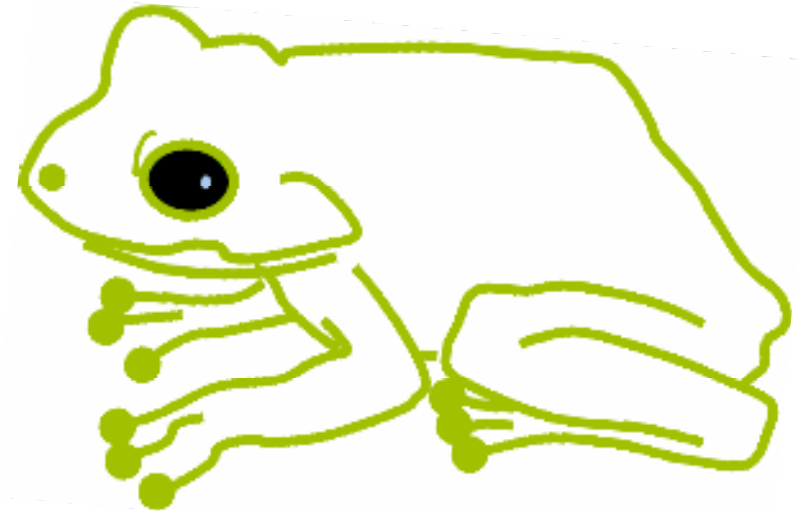
The Fast and Realistic OpenGL Event Display

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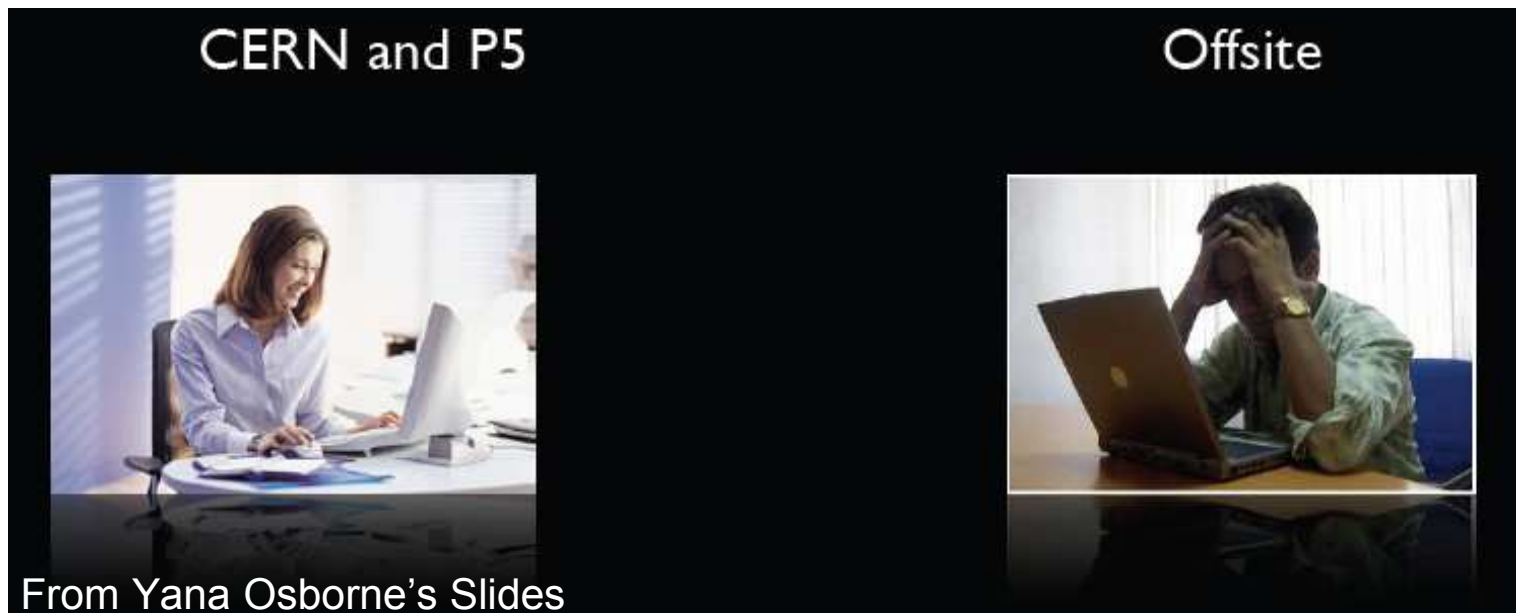
CP3 Lunch Seminar - 30 April 2008

- **Why an other Event Display ?**
- **FROG Philosophy and consequences**
- **Pictures, Pictures and Pictures...**
- **Live Demonstration**
- **To Do List**
- **Conclusions**
- **(if time) Tutorial**



Why an other Event Display ?

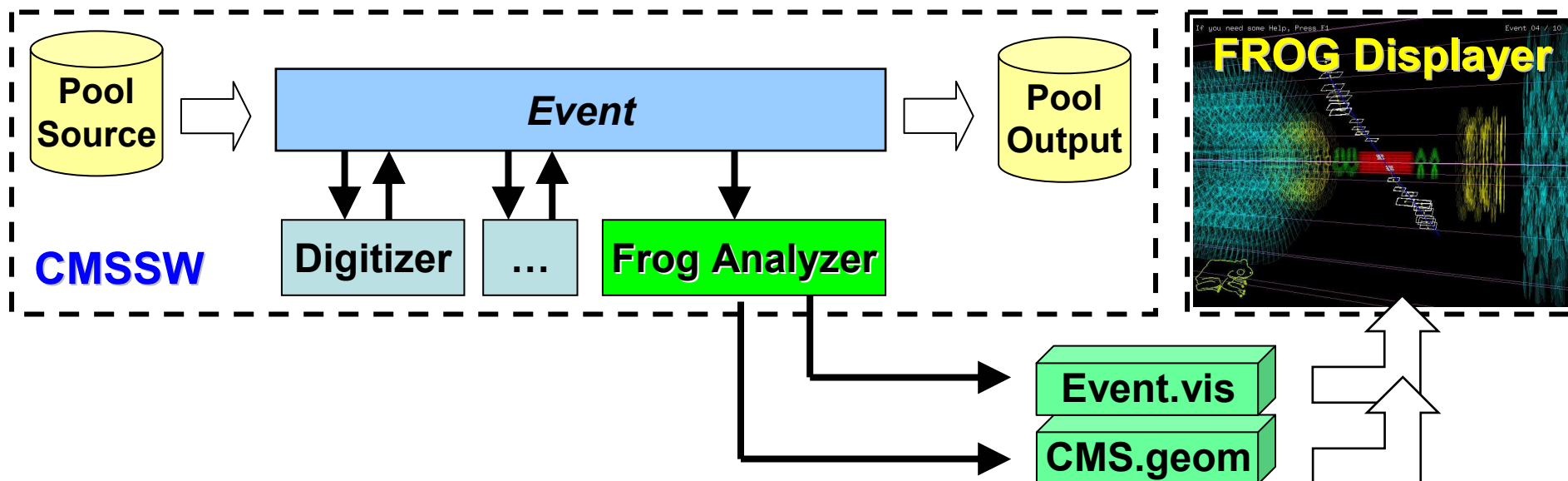
- **IGUANA** : Interactive Graphics for User Analysis
 - Official/Main CMS event display
 - Pretty Slow (slower than CMSSW) → ~5Minutes to initialise,
~1Minutes to display the next event
 - Even slower on a remote computer (must export heavy graphics)
 - Need CMSSW (~10GB by Release)
→ You cannot easily run it on your own computer.



- IGUANA is slow because (hypothesis) :
 - it is complete (too much ?)
 - **Solution : know exactly
which information we want to see !**
 - it relies on CMSSW and on ROOT
 - **Solution : Store data in a simple custom format**
 - Avoid to install these tools on your personal computer
 - Avoid problems linked to version incompatibility
 - Avoid long initialisation (~5 minutes in Iguana)
 - Issues → Data are stored in Root Files
→ Geometry/EventSetup comes from CMSSW

The Frog Philosophy

- **Solution : Split the soft into two parts.**
 - **A CMSSW analyzer :**
 - Read data from RootFiles and Geometry from CMSSW
 - Store everything in a compact binary format
 - **An OpenGL Displayer :**
 - Only relies on binary files previously produced.



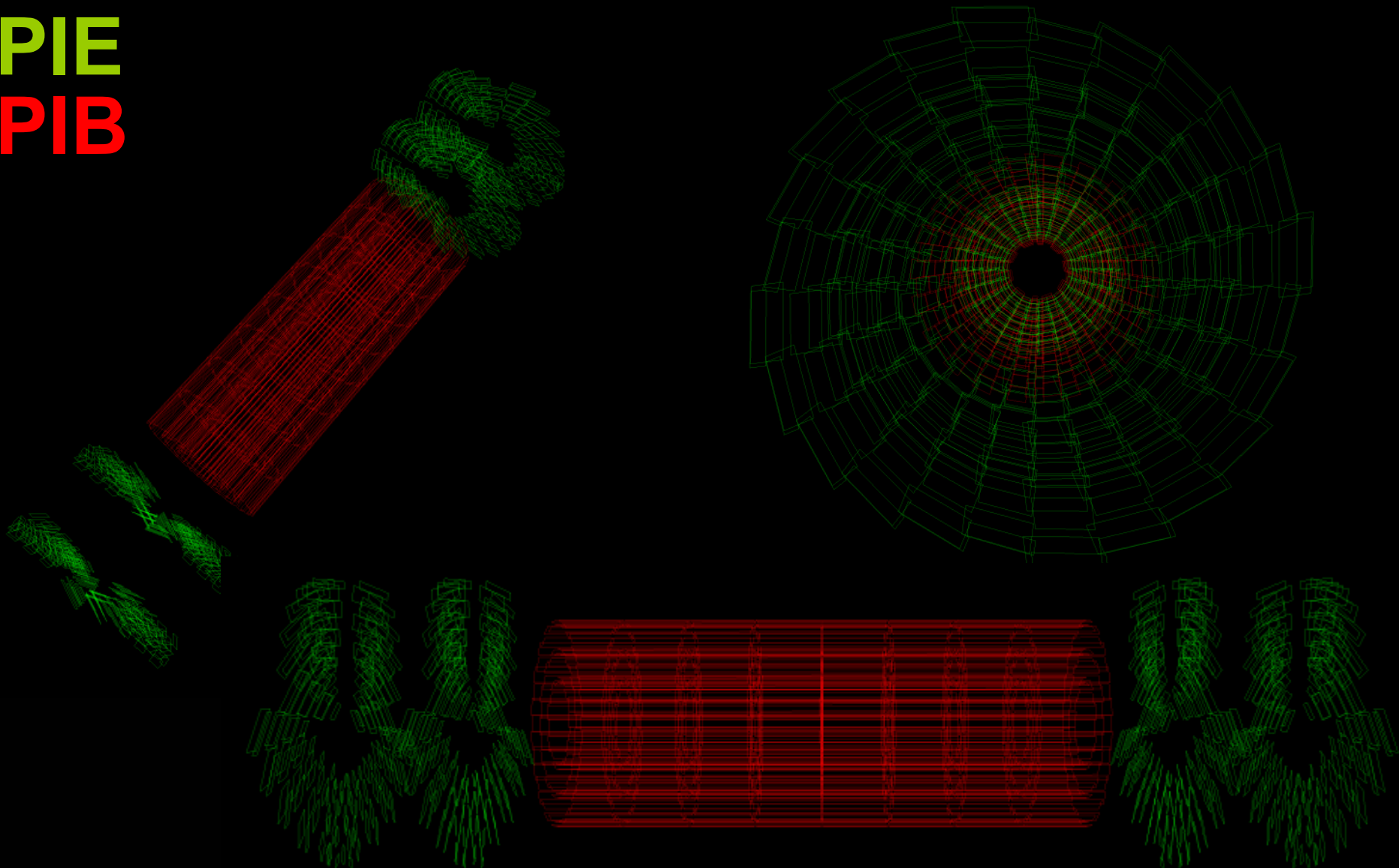
Consequences of this philosophy

- **FROG is able to display some SIM and RECO information :**
 - MC Truth : **SimTracks, SimVertex, SimHits** (CaloHits not yet in)
 - Tracks : **RecHits**
 - Calorimeter : **ECAL/HCAL Hits**
 - Muons : **DT/CSC Segments and RPC Hits**
 - The **Full Geometry** of the detector
- **FROG is really fast :**
 - **Loading time : few seconds** (up to 10 seconds for 100 MinBias events)
 - Time to display the **next event** : in general **much less than a second !**
- **What else ?**
 - thanks to CMSSW independence and to the OpenGL Utility Toolkit (GLUT) it works both on **linux and windows**
(in theory it works also on mac... but nobody tried yet)
 - **Once binary files have been produced, CMSSW is not needed anymore...**
So, you can still display events from old/expired CMSSW release.
 - Can be **used easily for other experiments** (only need to create a Frog Analyzer)

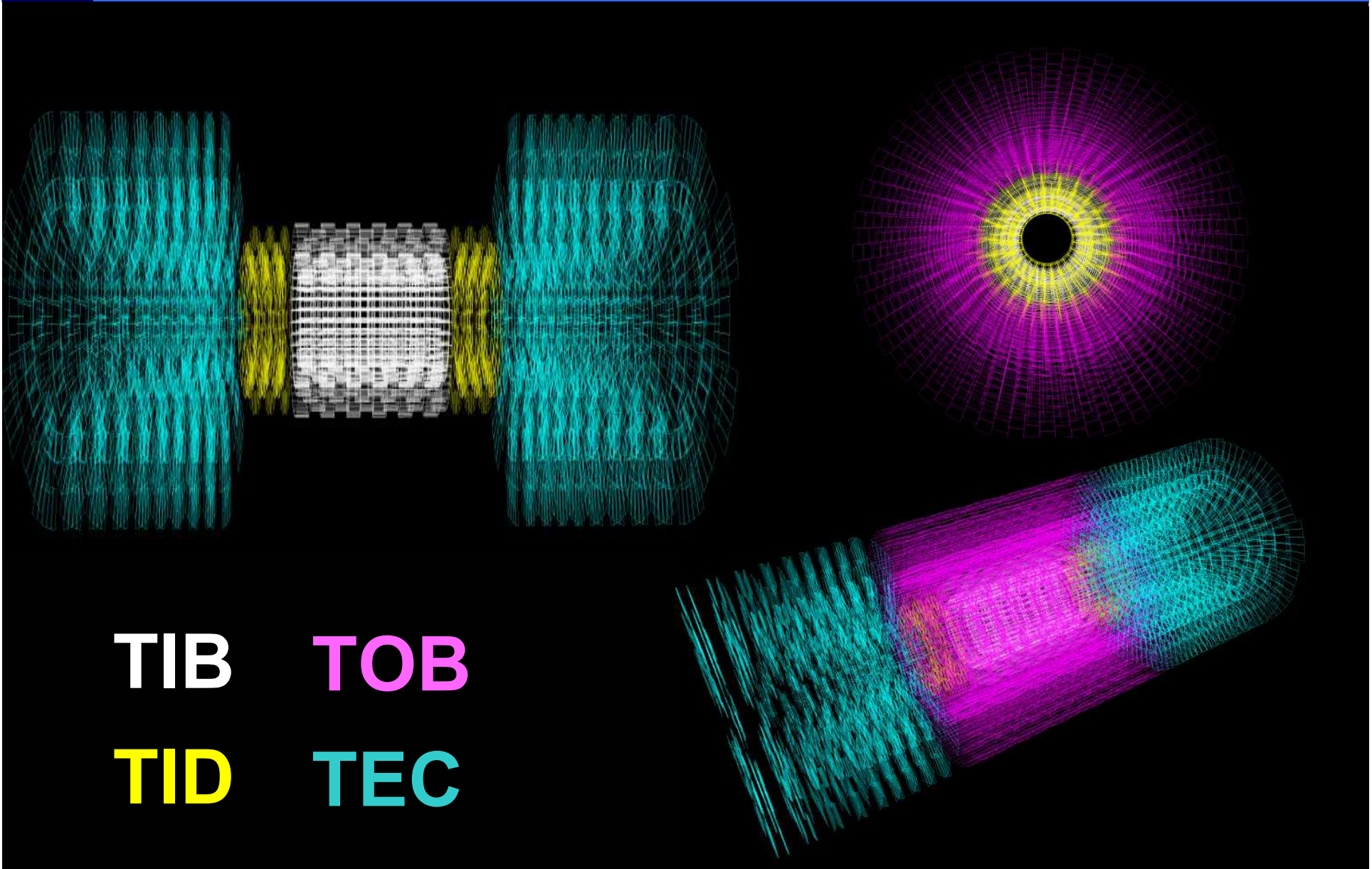


Pictures : CMS Geometry in FROG

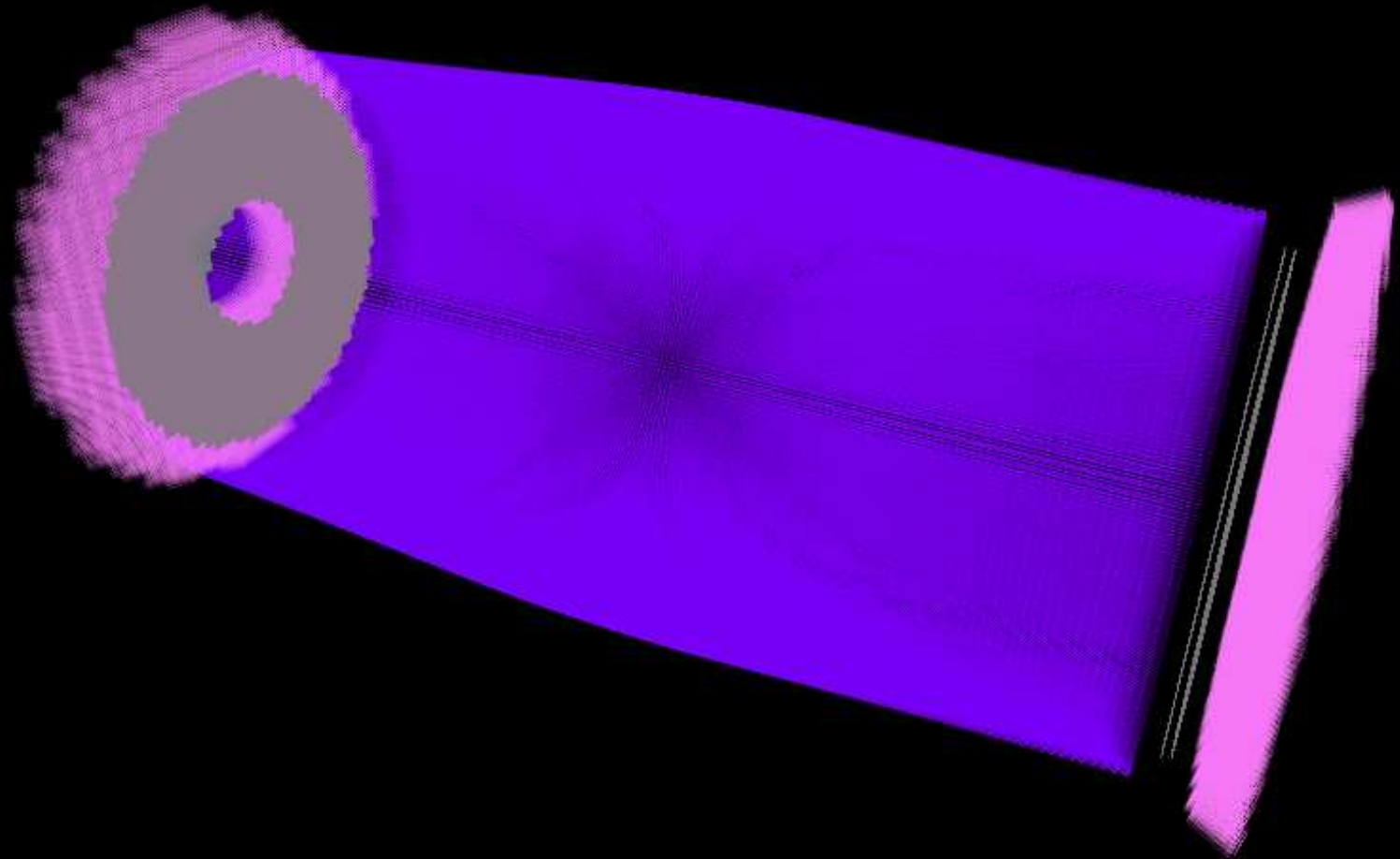
PIE
PIB



CMS Geometry in FROG : the SiStrips



CMS Geometry in FROG : ECAL



EB

EE

PS

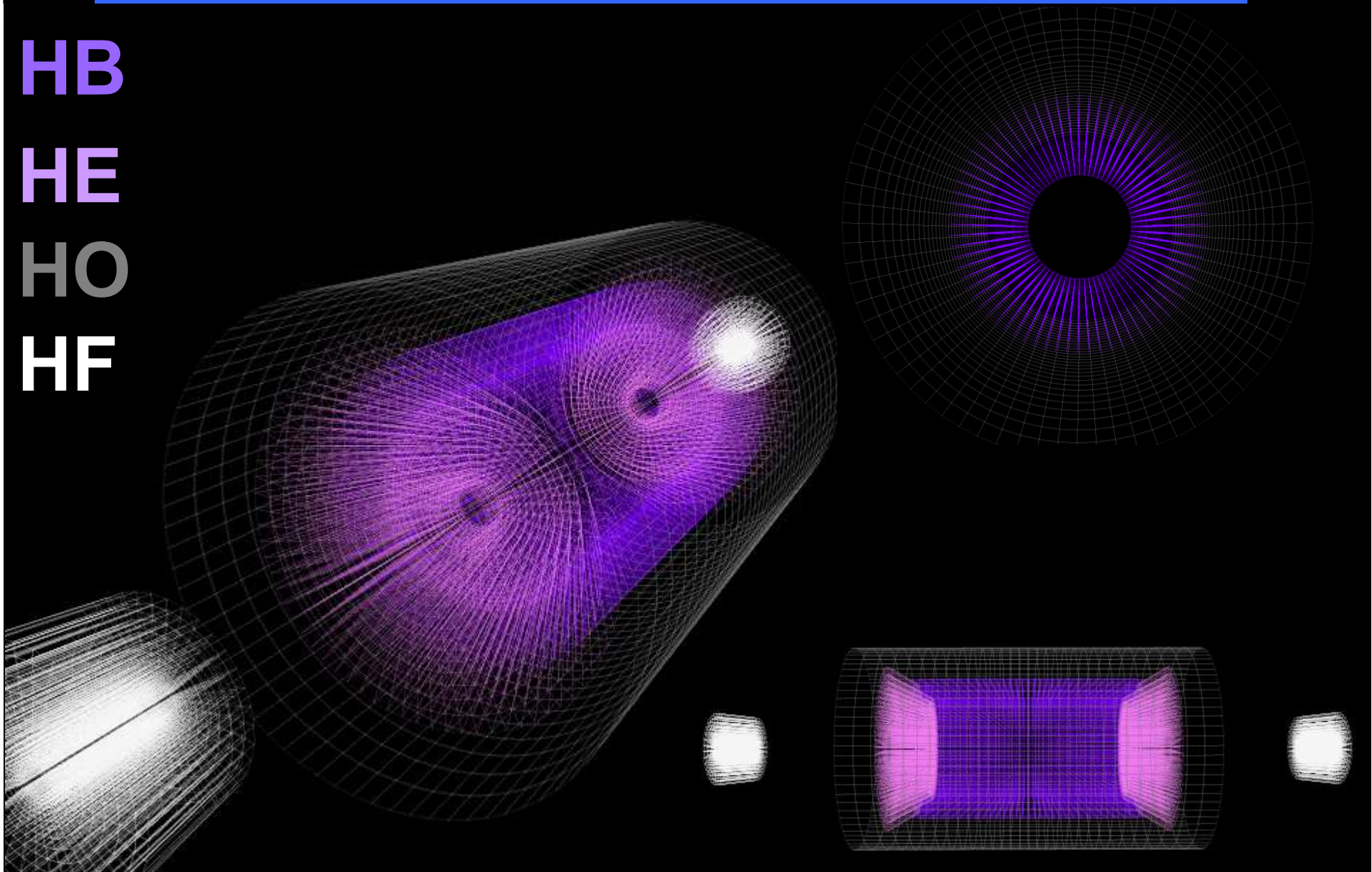
CMS Geometry in FROG : HCAL

HB

HE

HO

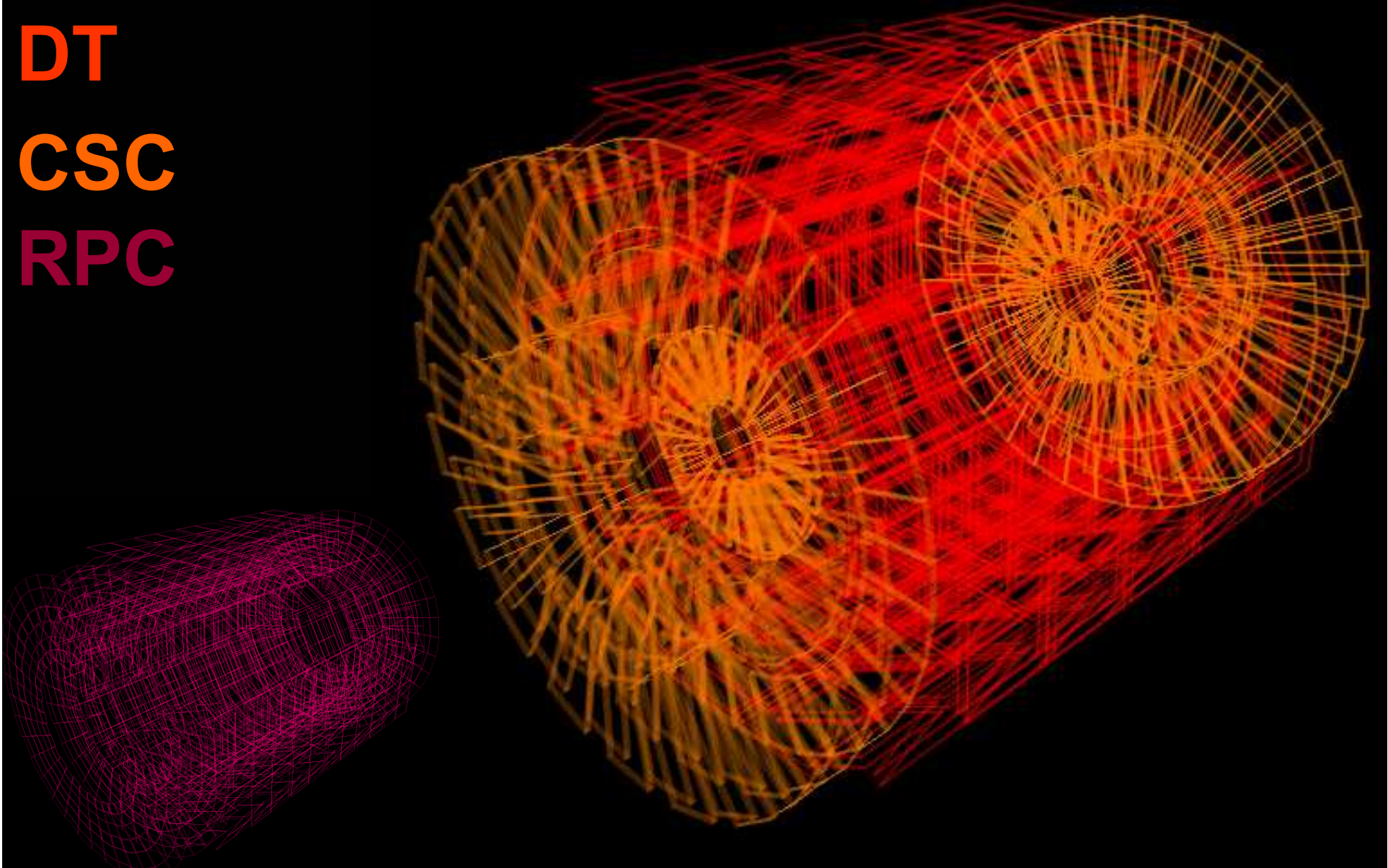
HF



DT

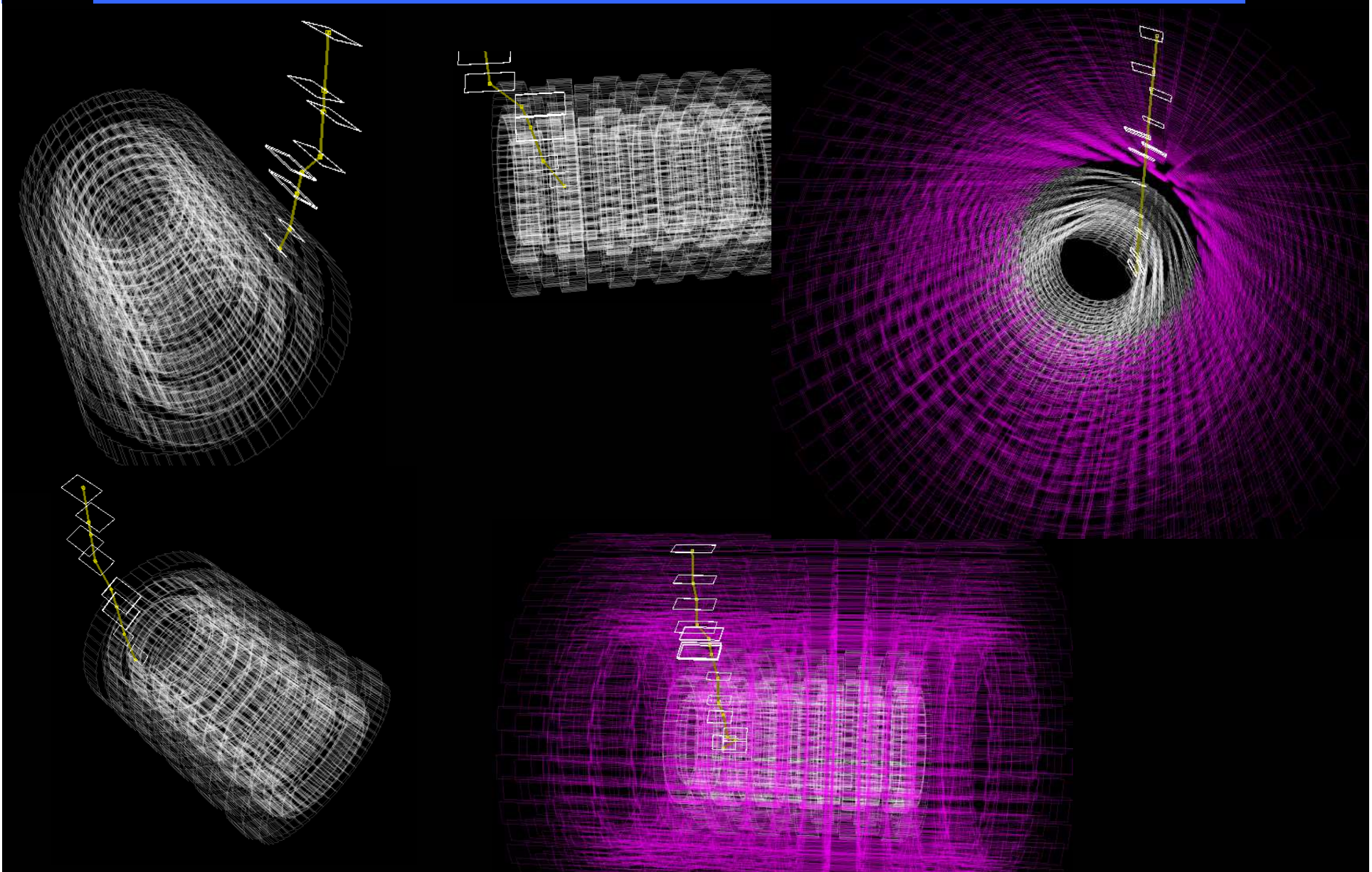
CSC

RPC



Pictures : Simple Event Display's

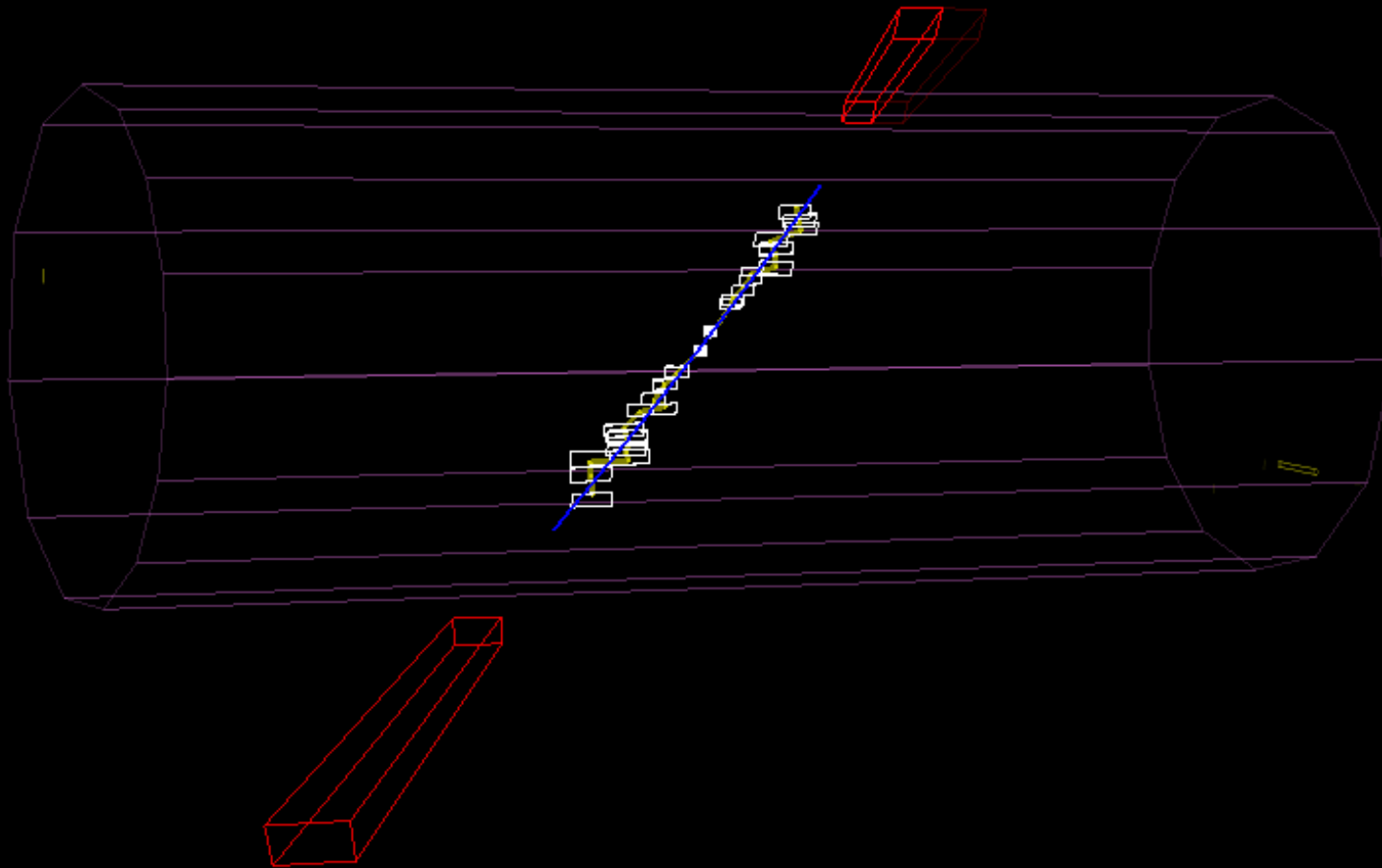
Cosmic Events From TIF



Two back-to-back 20GeV Pions (Pythia)

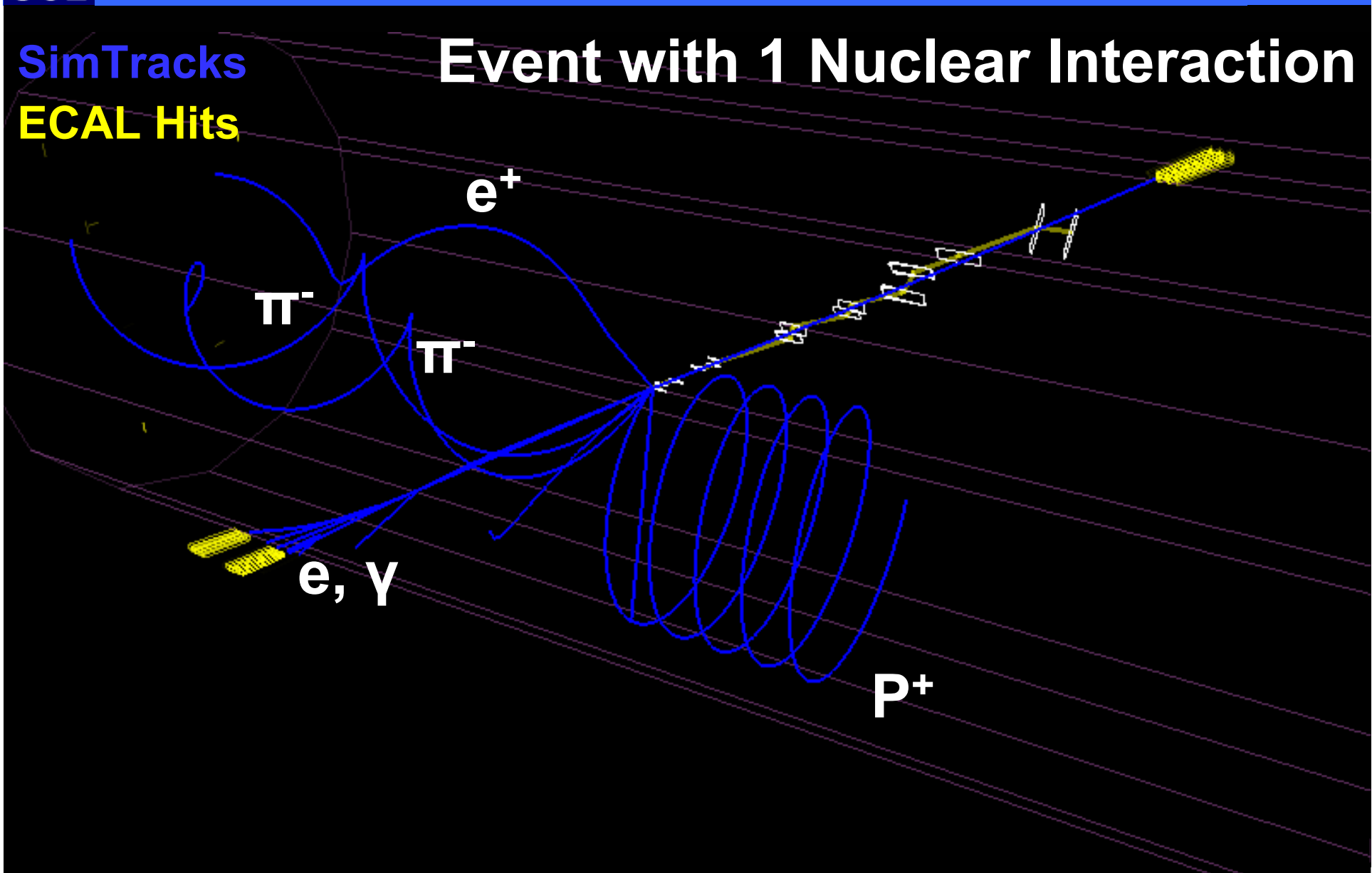
SimTracks
HCAL Hits

The Perfect Event



SimTracks ECAL Hits

Event with 1 Nuclear Interaction



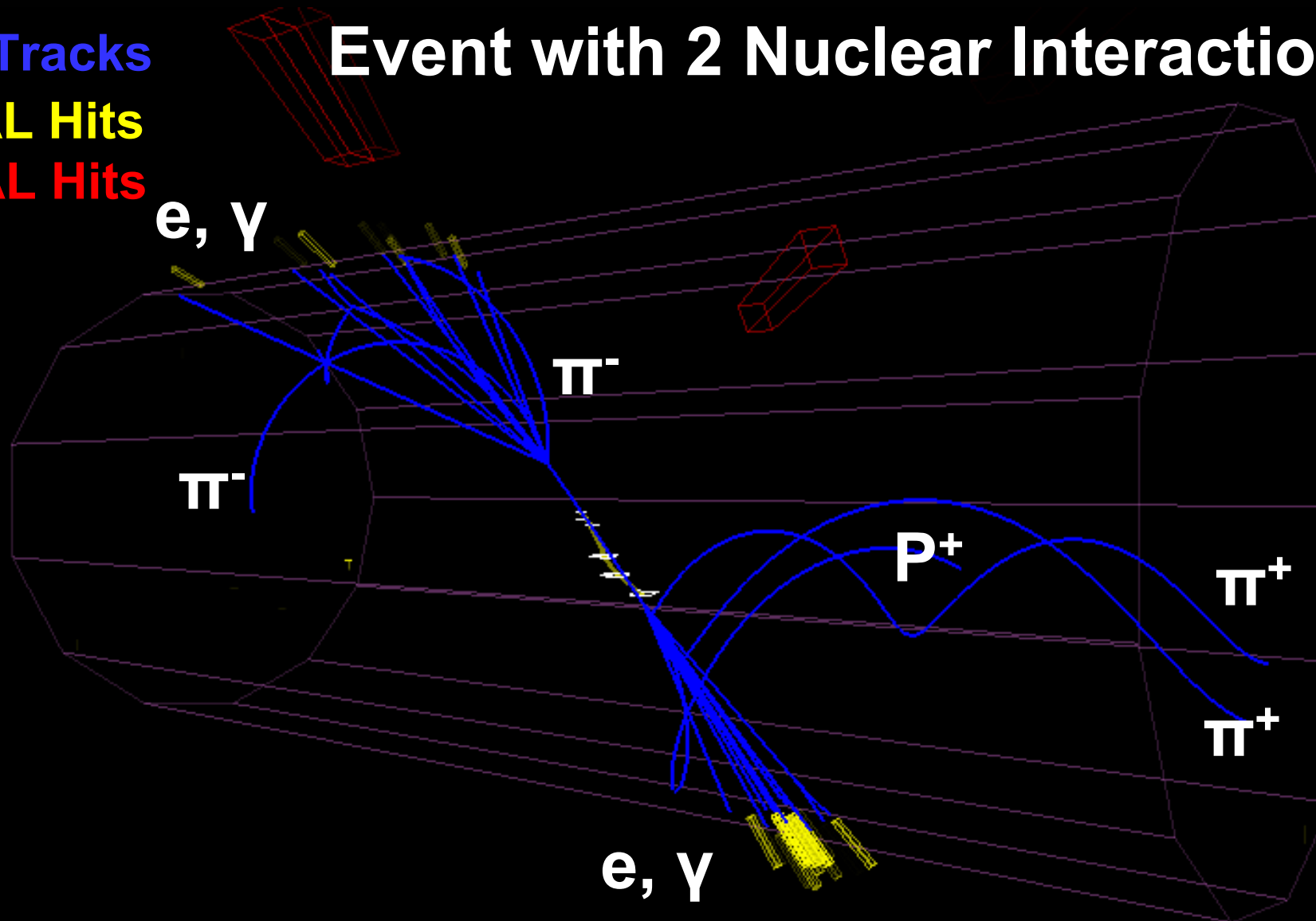
Two back-to-back 20GeV Pions (Pythia)

SimTracks

ECAL Hits

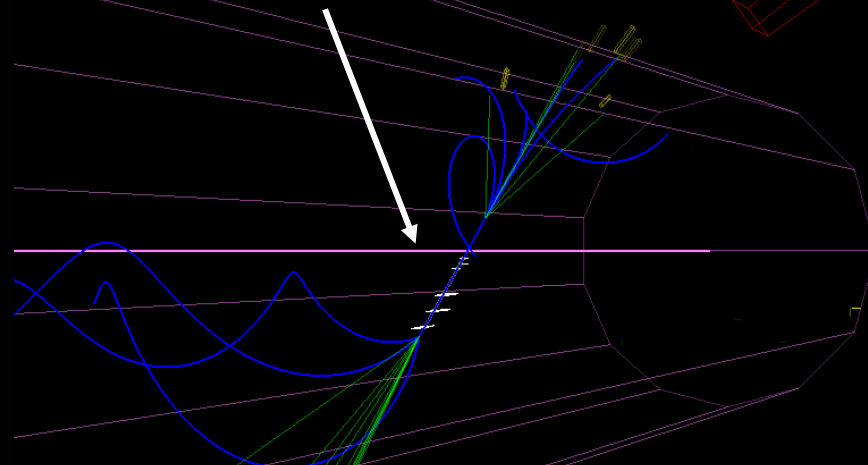
HCAL Hits

Event with 2 Nuclear Interactions

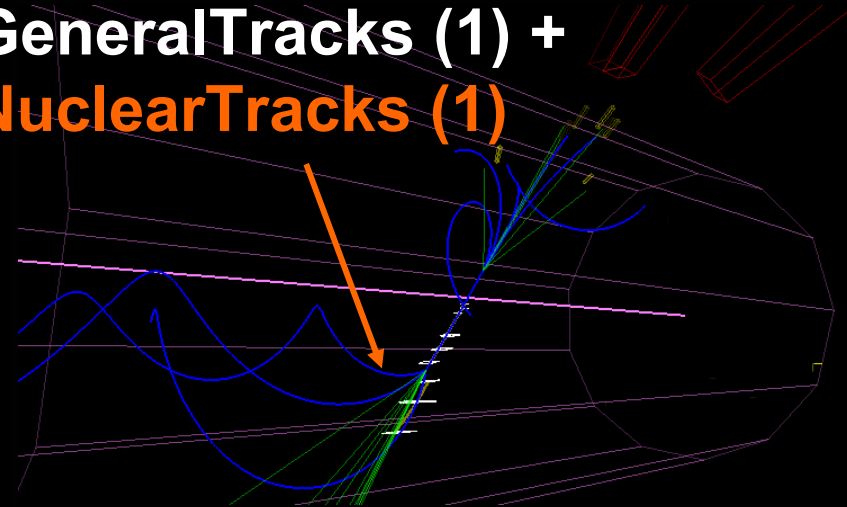


Two back-to-back 20GeV Pions (Pythia) Reconstruction of Secondary Tracks

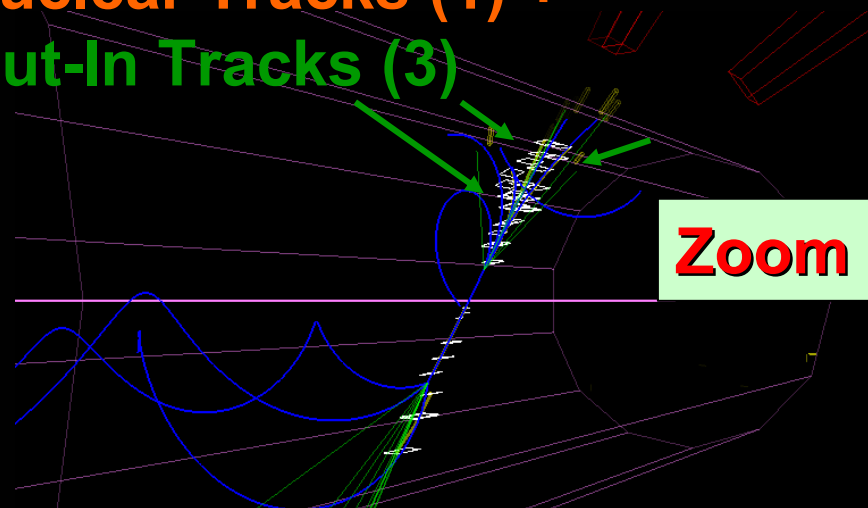
GeneralTracks (1)



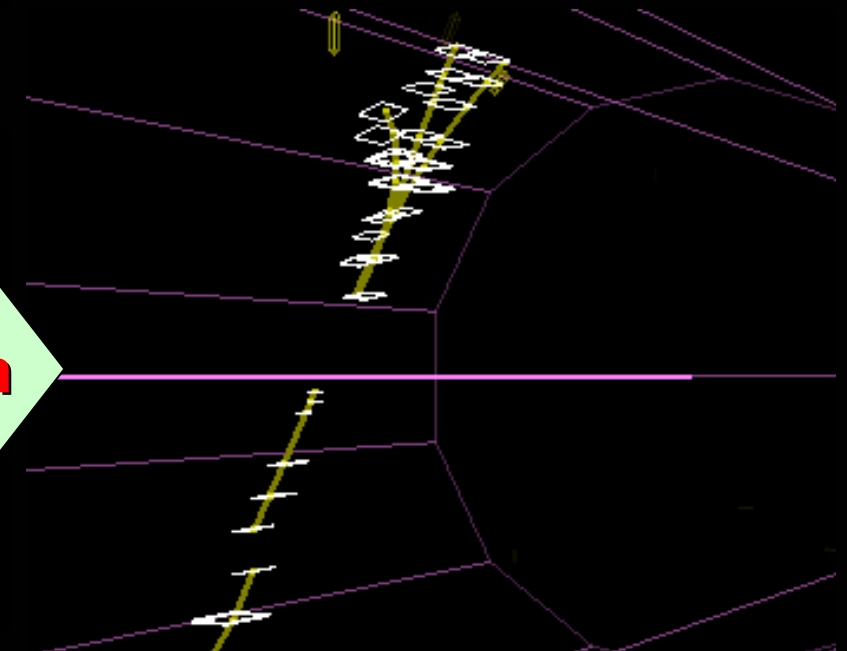
GeneralTracks (1) +
NuclearTracks (1)



General Tracks (1) +
Nuclear Tracks (1) +
Out-In Tracks (3)

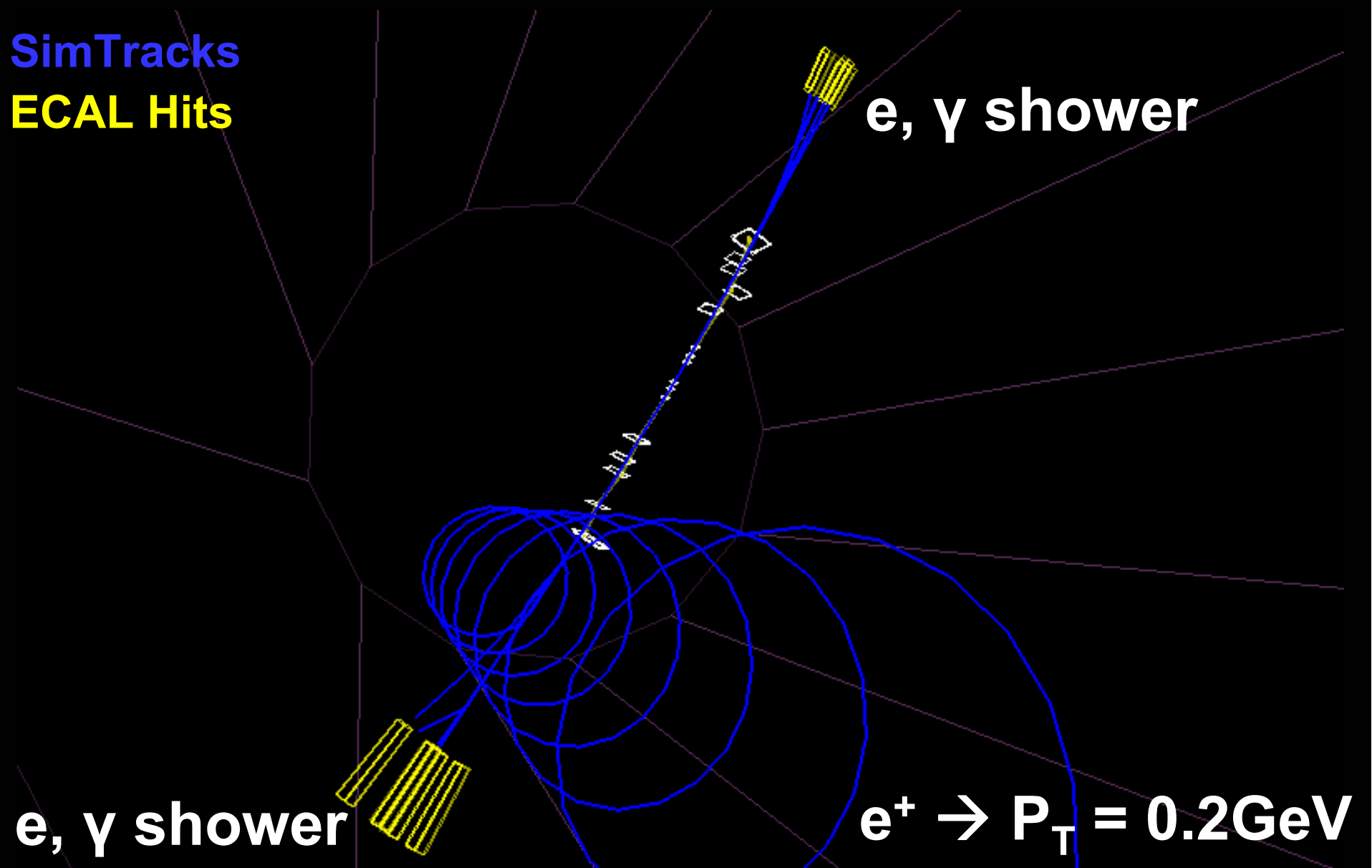


Zoom In



Two back-to-back 20GeV Electrons (Pythia)

SimTracks
ECAL Hits



SimTracks
ECAL Hits

e, γ shower

e, γ shower

e^-

e^+

Hits in PS

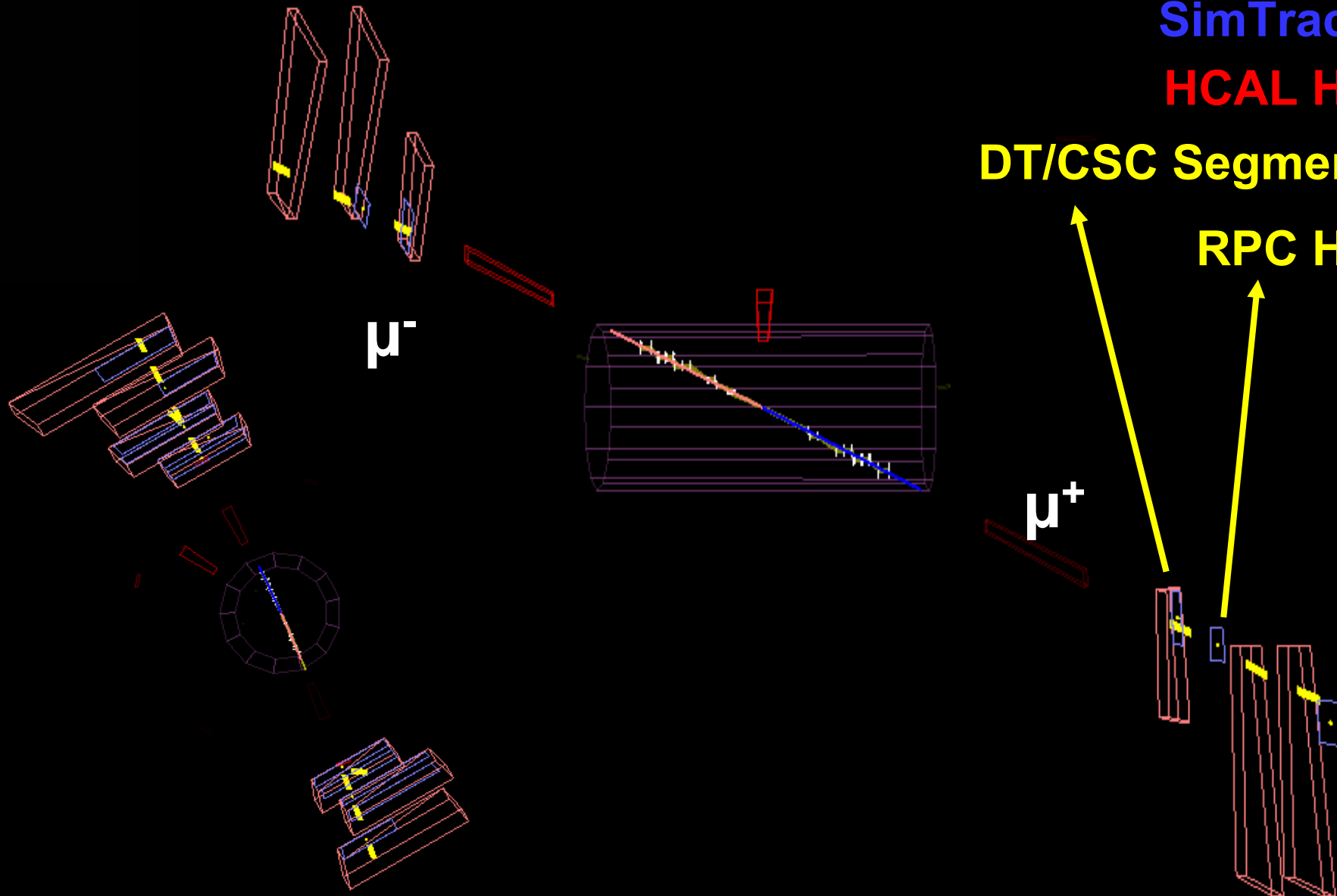
Two back-to-back 50GeV Muons (Pythia)

SimTracks

HCAL Hits

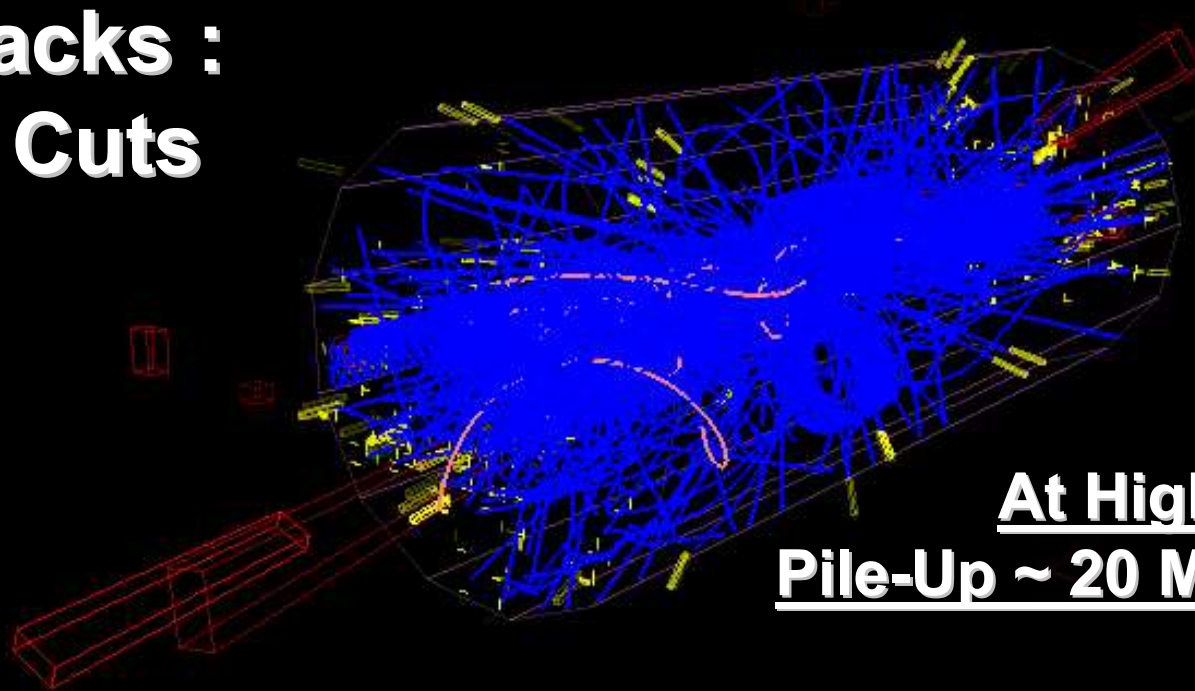
DT/CSC Segments

RPC Hits

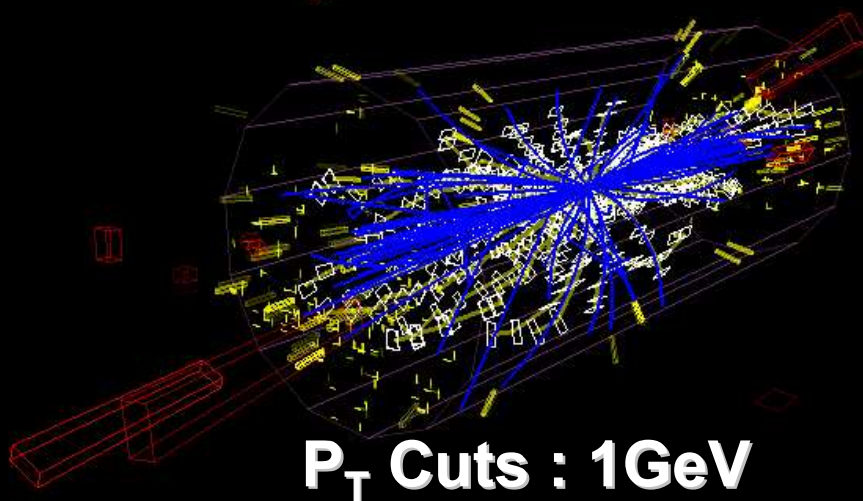


1 MinBias Events (Pythia)

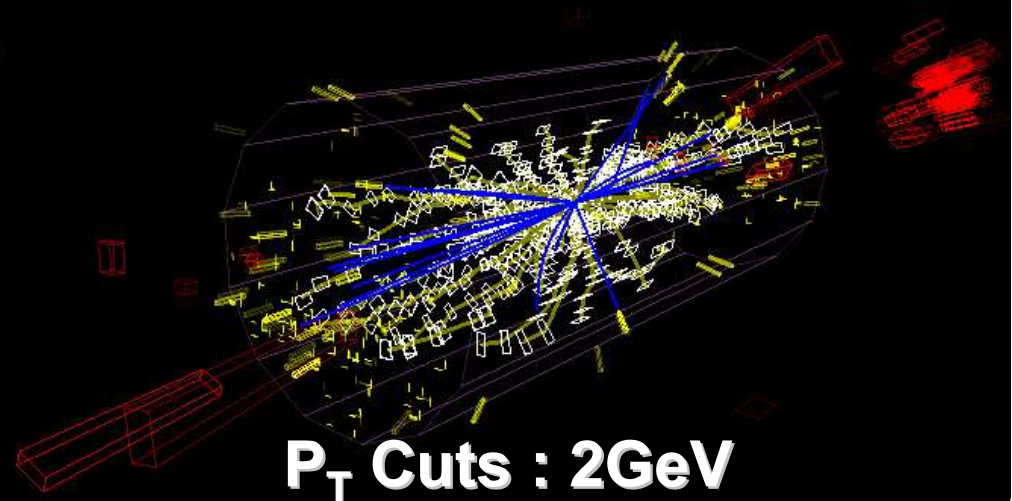
**SimTracks :
No PT Cuts**



**At High Luminosity :
Pile-Up ~ 20 MinBias events**

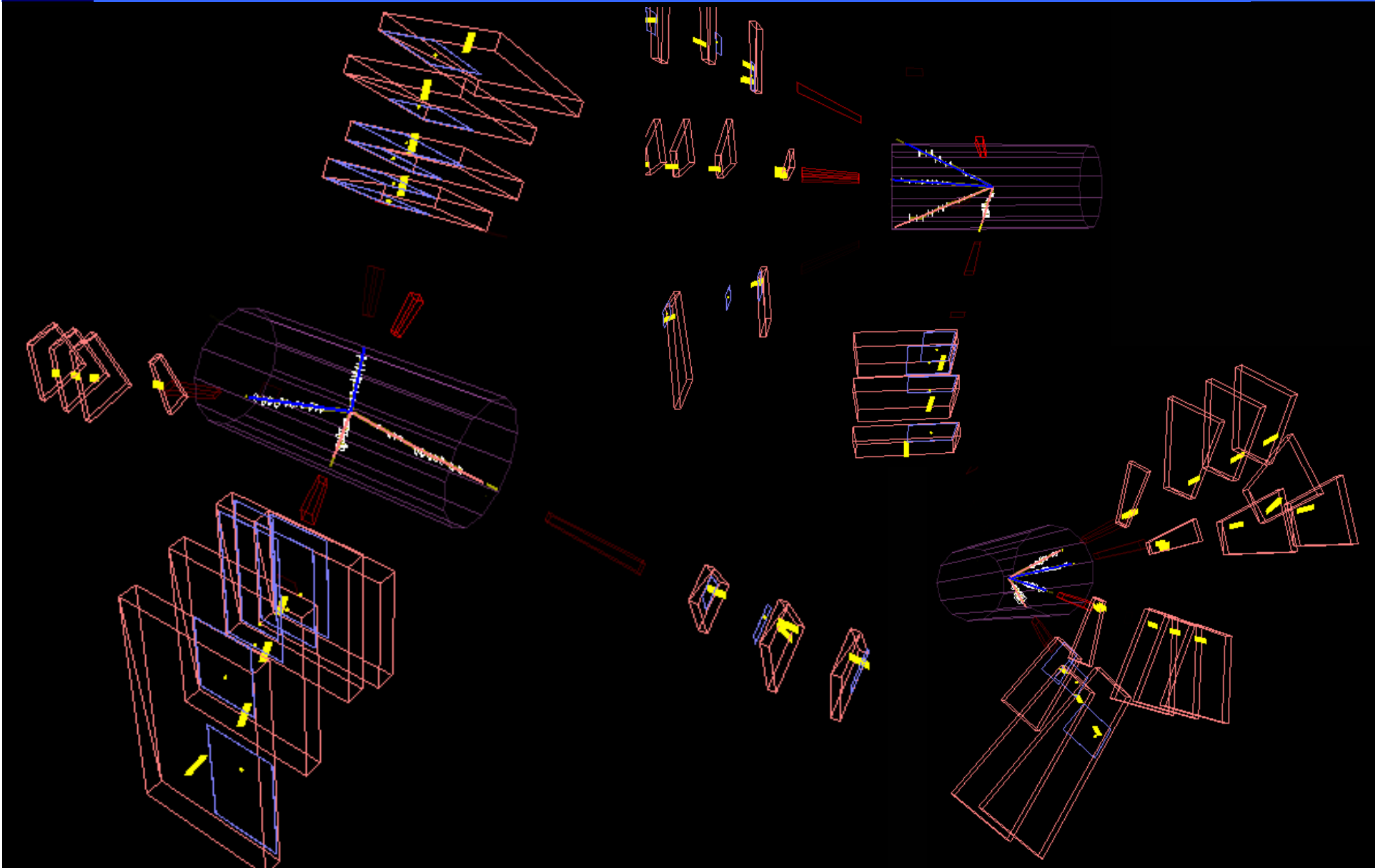


P_T Cuts : 1GeV



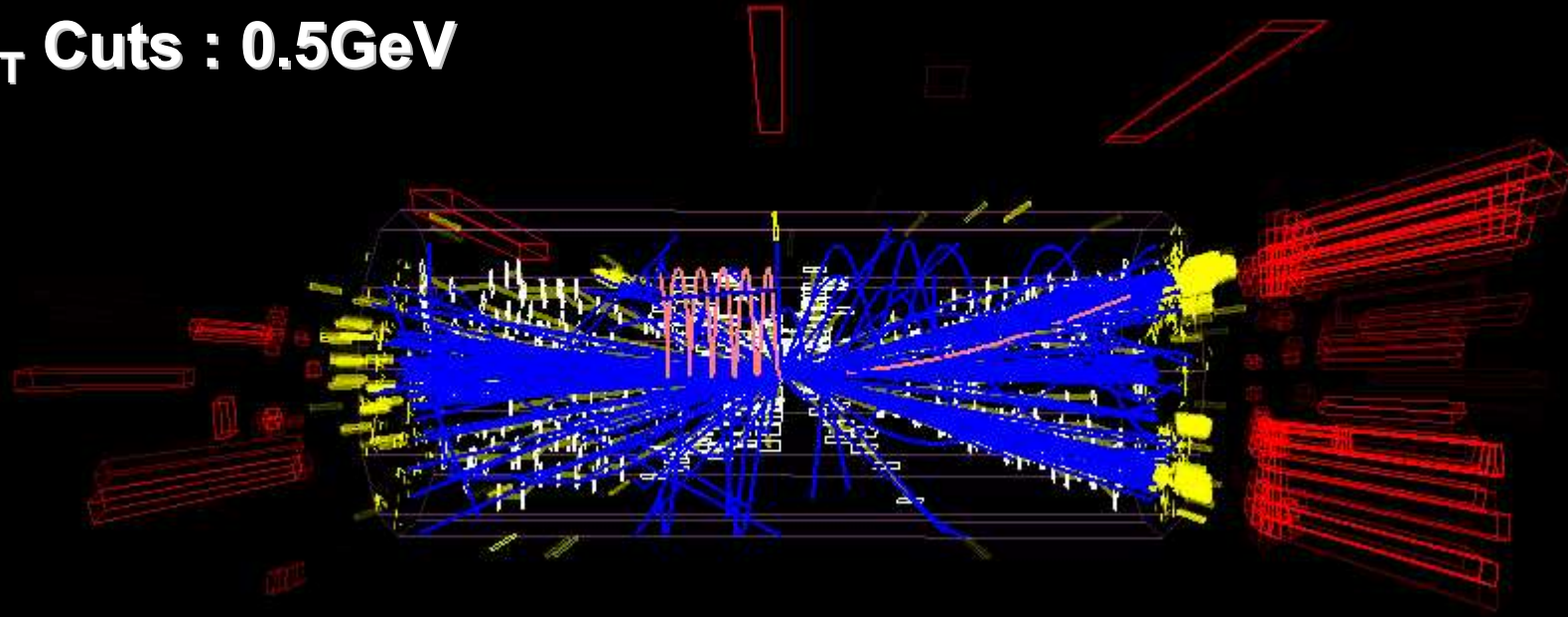
P_T Cuts : 2GeV

Higgs (190GeV) $\rightarrow$ ZZ $\rightarrow$ 4Muons Events (Pythia)

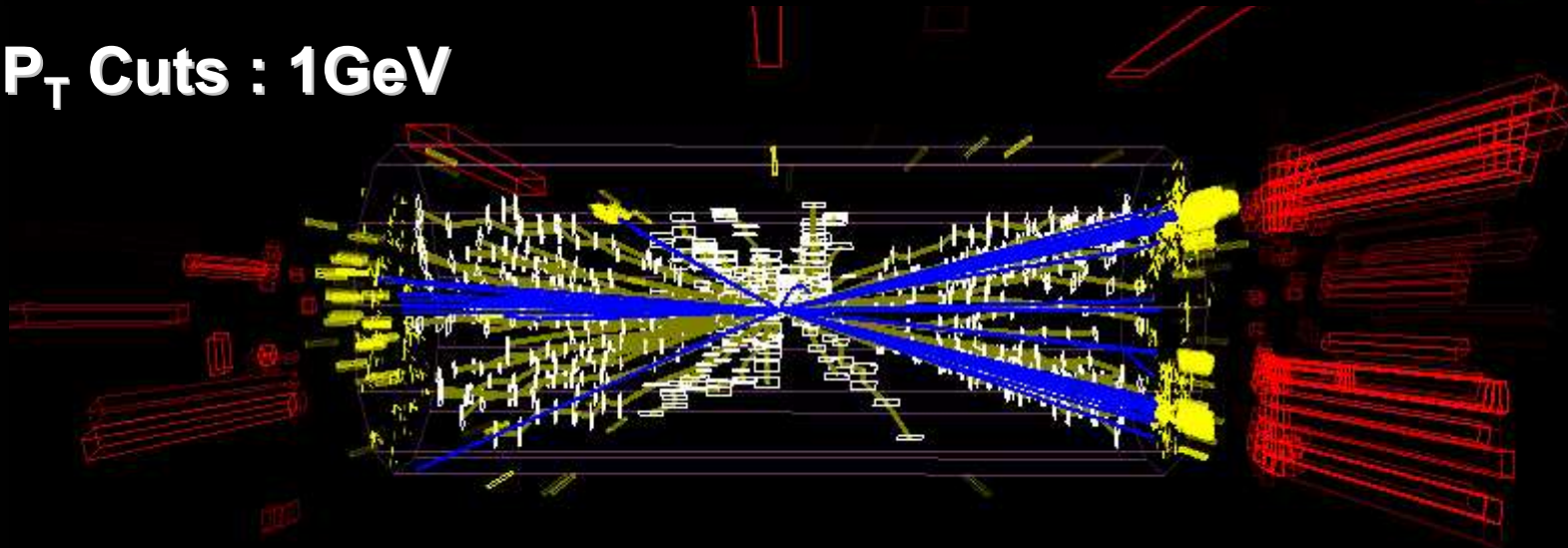


$Z'(700\text{GeV}) \rightarrow \text{Jet Jet (Pythia)}$

P_T Cuts : 0.5GeV

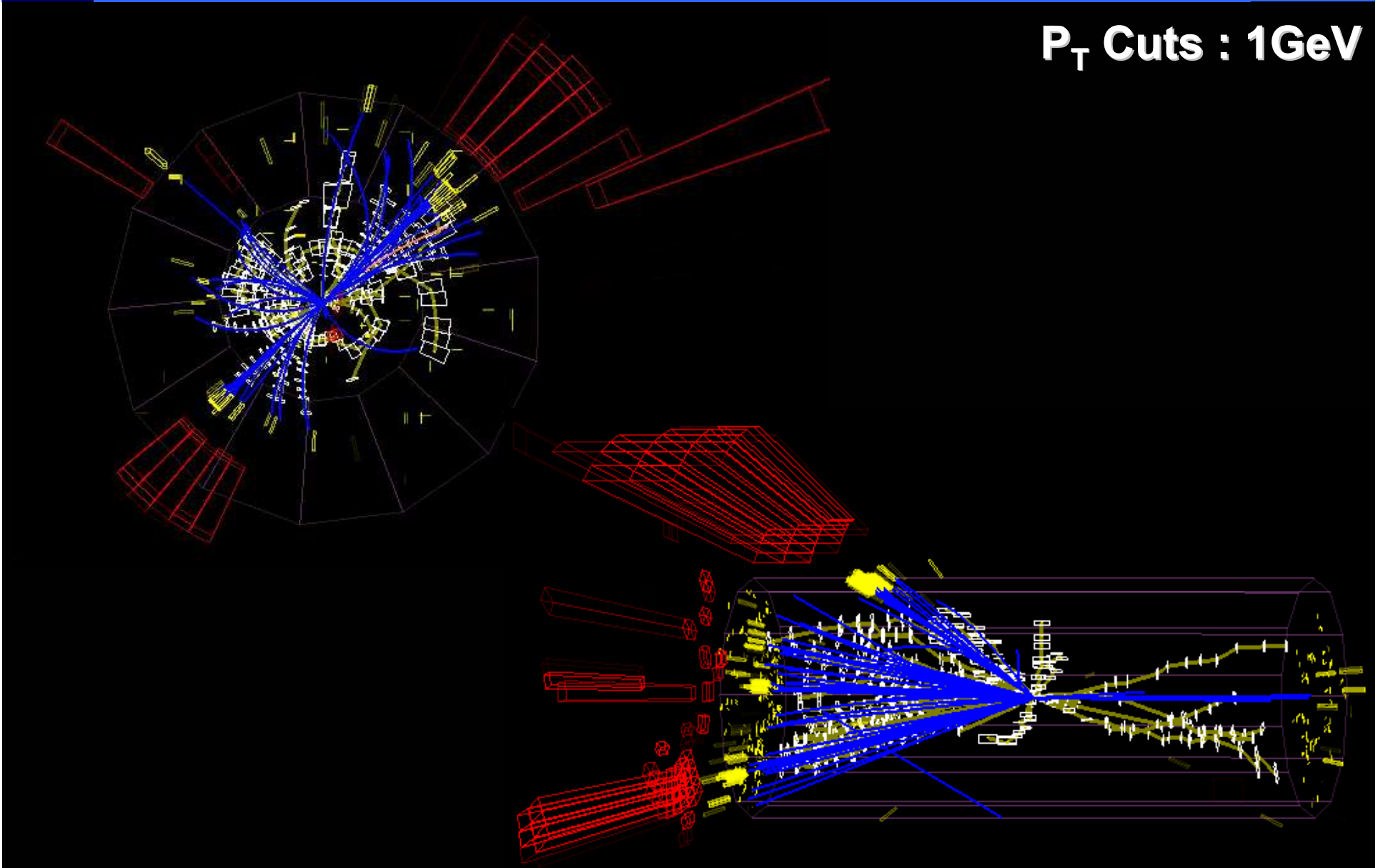


P_T Cuts : 1GeV



$Z'(700\text{GeV}) \rightarrow \text{Jet Jet (Pythia)}$

P_T Cuts : 1GeV





Live Demo

To Do List...

- **Complete the list of displayable objects**
 - Jets
 - Missing Energy
 - Complete available set of information about RecoTracks : Pt, χ^2 , ...
 - Whatever you are interested in... and can help you in your work.
- **Add other views**
 - R-Z → Longitudinal View
 - R-Phi → Transverse View
 - Eta-Phi or Z-Phi → Lego Plot
 - Whatever you are interested in... and can help you in your work.
- **Improve the Object Selection with mouse**
- **Improve the wiki page : <https://twiki.cern.ch/twiki/bin/view/CMS/FROG>**
- ...

- **FROG works...**
- **It is Fast...**
 - Fortunately because “FROG” is more funny than “ROG”
 - Slowness is not a fatality for 3D Event Display
- **It is useful to understand/debug event reconstruction**
 - At least for Vincent R
- **It can be used live during a meeting...**
 - Educational / General lectures
- **You can easily ask the developers to add features in.**

Thanks...

* Don't forget to have a look at the wiki page : <https://twiki.cern.ch/twiki/bin/view/CMS/FROG>



Backup Material

How to use it ? (I)

The FROG Analyzer

1. Have a look on the “Installation How to” on the Wiki page :
<https://twiki.cern.ch/twiki/bin/view/CMS/FROG>
2. Setup CMSSW and Checkout FROG
 - `scramv1 project CMSSW CMSSW_2_0_0`
 - `cd CMSSW_2_0_0/src`
 - `cvs co -d Visualisation/Frog UserCode/FastOpenGIDisplay`
 - `cd Visualisation/Frog`
 - `scramv1 b`
 - `cd test`
3. Edit `Frog_Analyzer.cfg` : select source files, output file name, etc...
4. Run CMSSW with this config file
 - `eval `scramv1 runtime -sh` (-csh)`
 - `cmsRun Frog_Analyzer.cfg`
5. That's it... The analyzer have produced :
 - **outputName.vis**
 - **Tracker.geom, Ecal.geom, Hcal.geom, Muon.geom**

How to use it ? (II)

The FROG Displayer on Linux

1. Copy/Paste all FROG files on your local machine

- `scp -rd Frog your_login@your_machine:~/where_you_want`

2. Compile FROG on your machine

- `cd where_you_want/Frog/soft`
- `make`

3. Edit the config card : "config.txt"

- Choose the input file, the first event to display
- Simtracks Pt cut's, Calo Hits Energy threshold
- Simtracks Colors (has a function of particle type), others colors...
- And many other things

4. FROG is ready to be run... open your eyes... :

- `./main`

How to use it ? (III)

The FROG Displayer on Windows

1. Copy/Paste all FROG files on your local machine

- WinFTP is fine to do that

2. (Optional) Compile FROG on your machine

- Use your favourite compiler (a project file for VC++ is already in the package)

3. Edit the config card : "config.txt"

- Choose the input file, the first event to display
- Simtracks Pt cut's, Calo Hits Energy threshold
- Simtracks Colors (has a function of particle type), others colors...
- And many other things

4. FROG is ready to be run... open your eyes... :

- Use the run functionality of your favourite compiler
- Or.... Just double click on **FROG.exe**

Cosmic Events (TIF) : Frog Vs Iguana

From Giuseppe Zito's Slides

