Study of track resolution in IDEA

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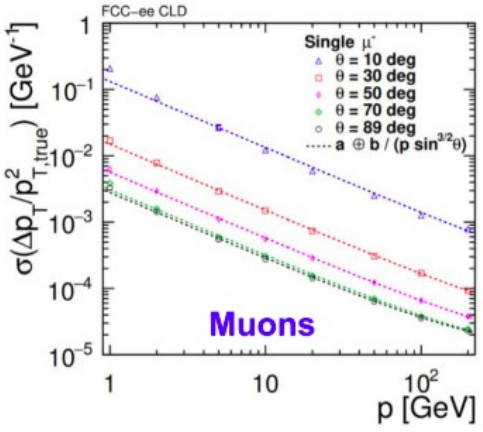
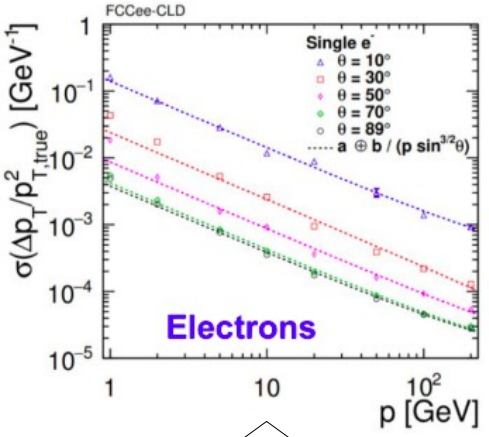
CLD by E. Perez, M. Selvaggi, 2022-12-12



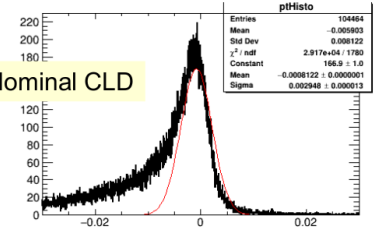


Non gaussian brem tails

The resolutions on the previous slides :

- The σ of a Gaussian fit to the core of the distribution
- The electron p is that of the track. KF fit.

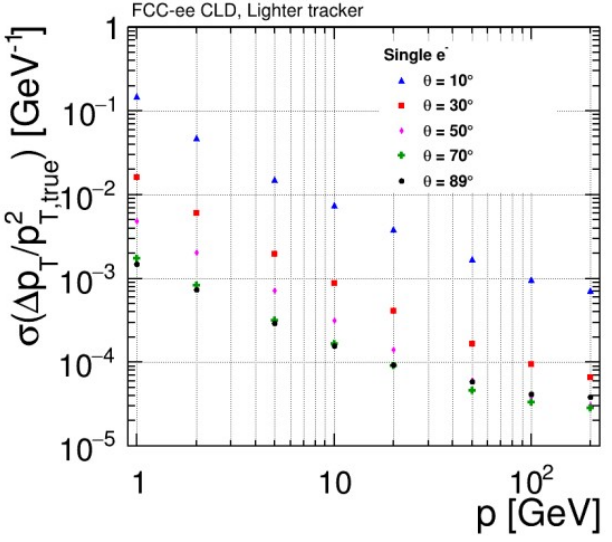
Nominal CLD



HACK

Repeat the CLD study with a “lighter tracker”

Reduce the material of the Si tracker of CLD such that the total material budget is similar to that of IDEA.



Repeat the study with IDEA standalone

- Full procedure and code uploaded to HEP-FCC / FCCeePhysicsPerformance
- Created directory: FCCeePhysicsPerformance/DetectorPerformanceStudies/IDEAPerformanceStudies/electrons

analysis	python script for histos and resolution graph
generate_mac	generation of mac files for simulation with particle gun
run_production.sh	bash script for full production (sim+reco)

- README in git & instruction on website

README.md

How to simulate electrons with particle gun and evaluate the tracking resolution

Which code to use

Use the IDEA code in https://github.com/lialavezzi/IDEADetectorSIM.git master branch (I did the pull request for the official repository, not yet accepted). There are some modifications w.r.t. the official repo. The modifications I made are:

- in converter/convertHits.cc: added the conversion of MC primary tracks to EDM4Hep.
- in install_standalone.sh: changed the wget file location and set the ROME revision to download, to fix installation problems.
- in converter/convertTracks.cc fixed bug related to "skipped" vector, added the exception catching

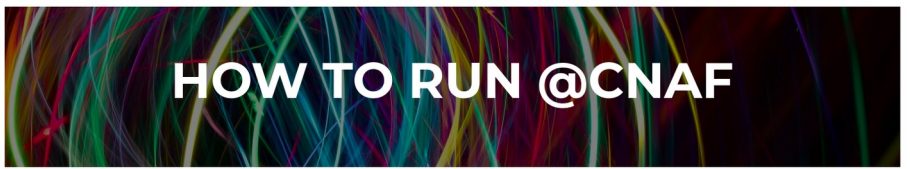
How to prepare the code

- Download the code from git https://github.com/lialavezzi/IDEADetectorSIM.git
- If you need to save space, modify by hand the file:
  $STANDALONE_INSTALL_DIR/IDEADetectorSIM/simulation/g4GMC/src/GMCG4EventAction.cc adding the line marked with asterisks here, in order not to save non primary tracks:

```
for (G4int i=0;i < n_trajectories;i++) {
      G4VTrajectory *tmpTrk = (*trajectoryContainer)[i];
      *** if(tmpTrk->GetParentID() != 0) continue; ***
      cnttracks.push_back( new GMCG4Particle( tmpTrk->GetTrackID(), tmpTrk->GetParentID(), ...
```

- Perform the usual installation with install_standalone.sh (instructions are in the README)
- The code for our studies is in: DetectorPerformanceStudies/IDEAPerformanceStudies/electrons/ where there are two directories and a file:
  - generate_mac/
    It contains the bash script generate_mac.sh to generate all the .mac files to shoot each particle we need. If you open it, you find the section SETTINGS where you might need to make changes:

```
      nevts = number of events
      pdg='e' or 'pi' for the electrons or negative pions
```



How to request an account at CNAF

go to the first point here: https://www.cnaf.infn.it/en/users-faqs/

How to run the IDEA simulation for performance studies

Use the IDEA code in https://github.com/lialavezzi/IDEADetectorSIM.git **master** branch (pull request for the official repository not yet accepted).
There are some modifications w.r.t. the official repo.
The modifications that were made are:

- in converter/convertHits.cc: added the conversion of MC primary tracks to EDM4Hep.
- in install_standalone.sh: changed the wget file location and set the ROME revision to download, to fix installation problems.
- in converter/convertTracks.cc fixed bug related to "skipped" vector, added the exception catching procedure:

Procedure

1. Download the code from git https://github.com/lialavezzi/IDEADetectorSIM.git

Run @ CERN & CNAF

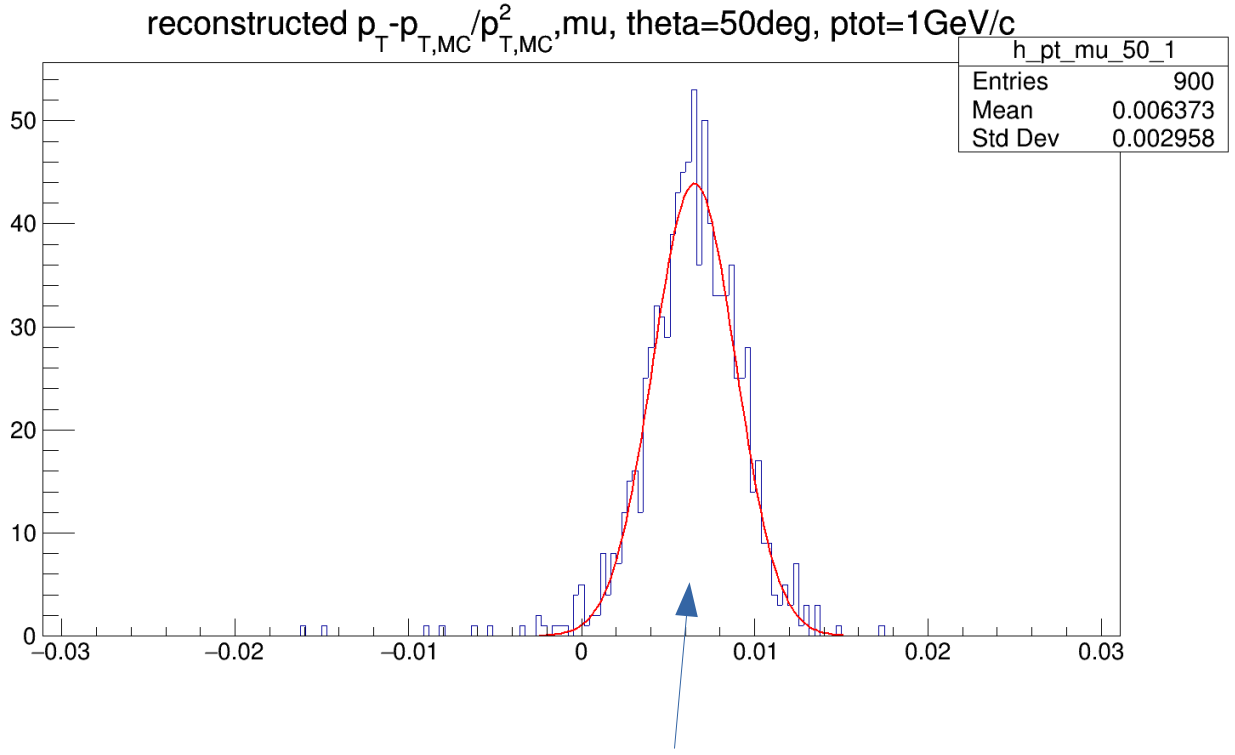
- **electrons**
  - I could run electron production @ lxplus with the procedure (1000 events/point)
- BUT, the procedure at CERN fills quickly the disk quota → moved to CNAF for muons
- For now we cannot run on the grid, we can run locally on the cluster → use HTCondor scheduler
- **muons**
  - I adapted the installation and run procedure to be launched by condor (but still have some questimuonsons)
  - I could do 100 event runs and then merge them together for analysis
  - 11 runs for each point for muons
- **pions**
  - Adelina is working on them but there was a bug (my bad!) in the first procedure script, so she had to start over the production

ANALISYS PROCEDURE AS FOR CLD

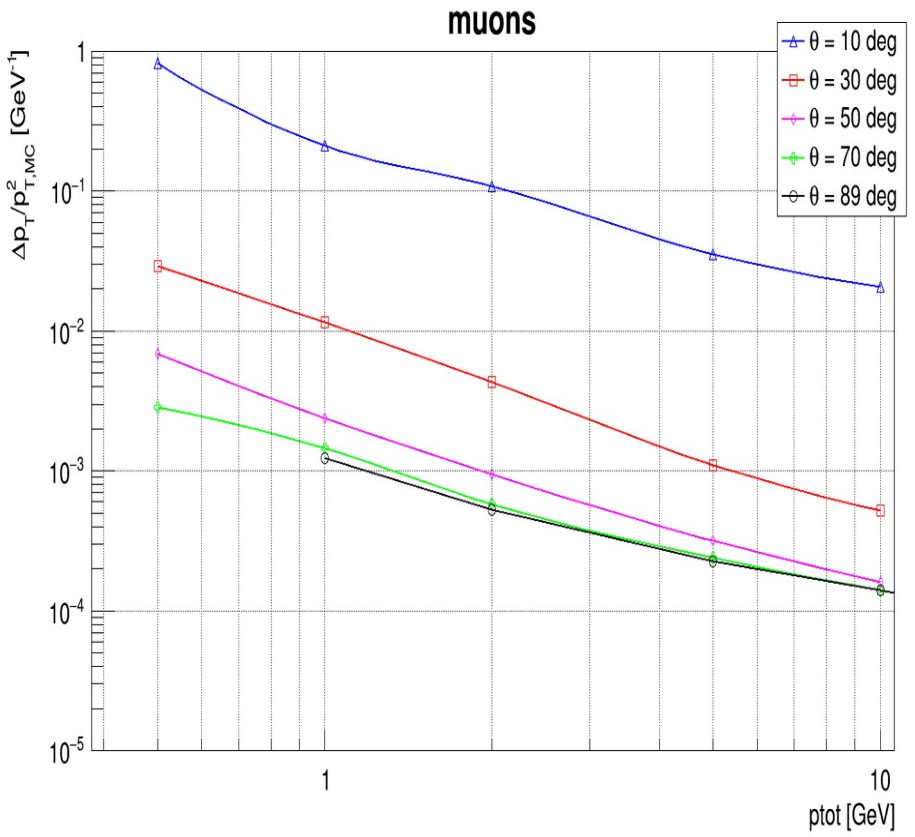
- Plot $(p_{T,RECO} - p_{T,MC}) / p_{T,MC}^2$
- Fit with a single gaussian
- Plot sigma vs pTOT

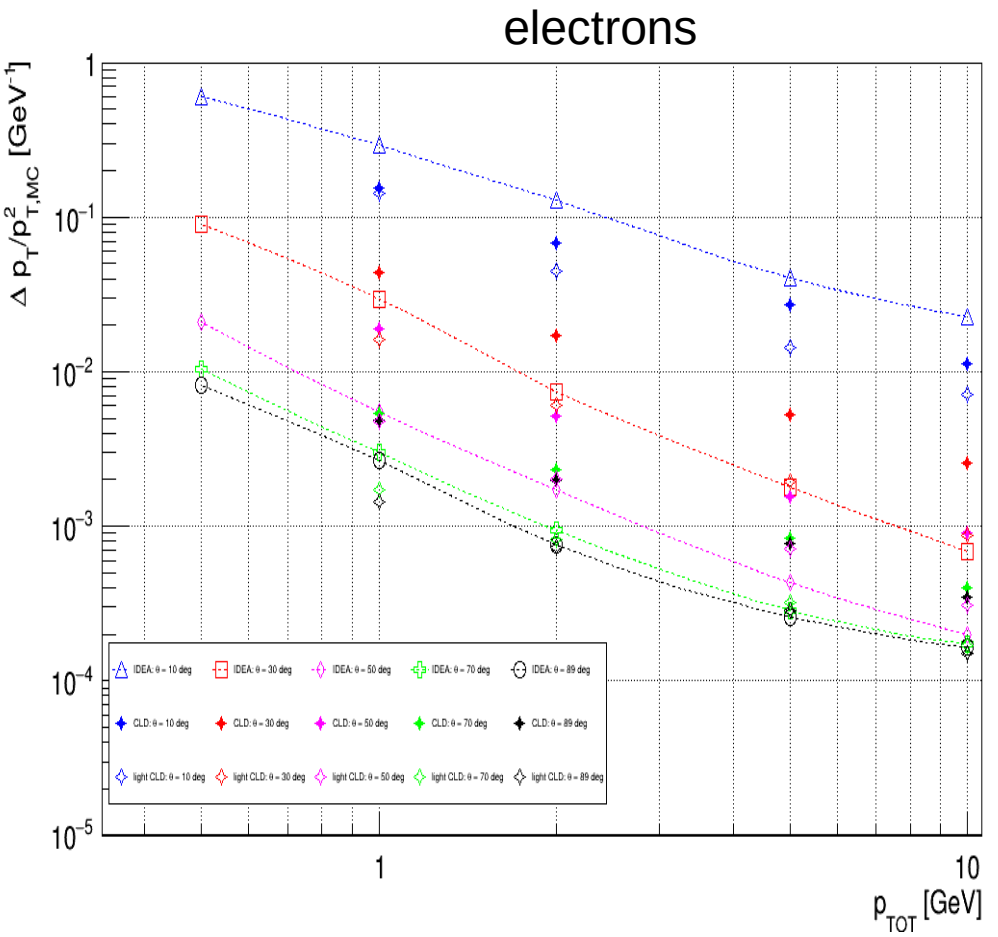
l_theta = [10, 30, 50, 70, 89]
l_ptot = [0.5, 1, 2, 5, 10]

IDEA results

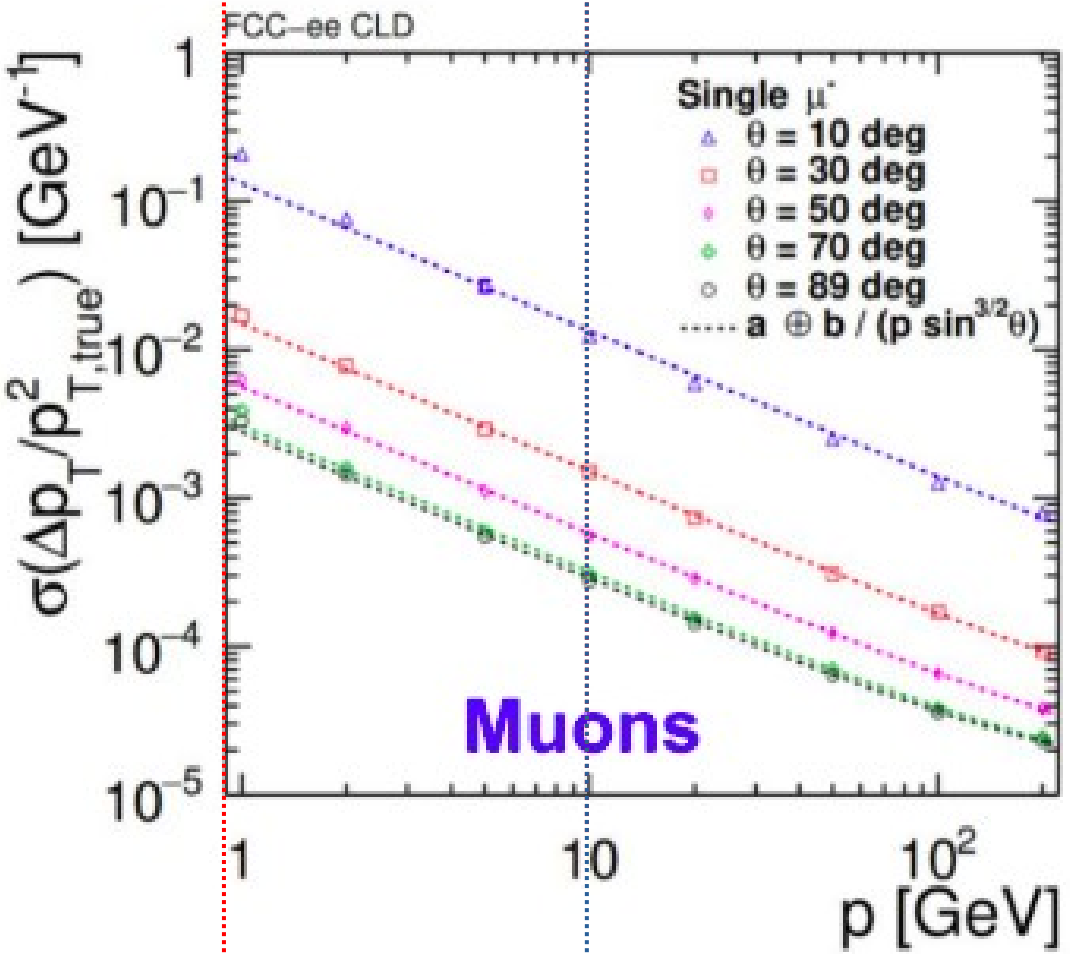


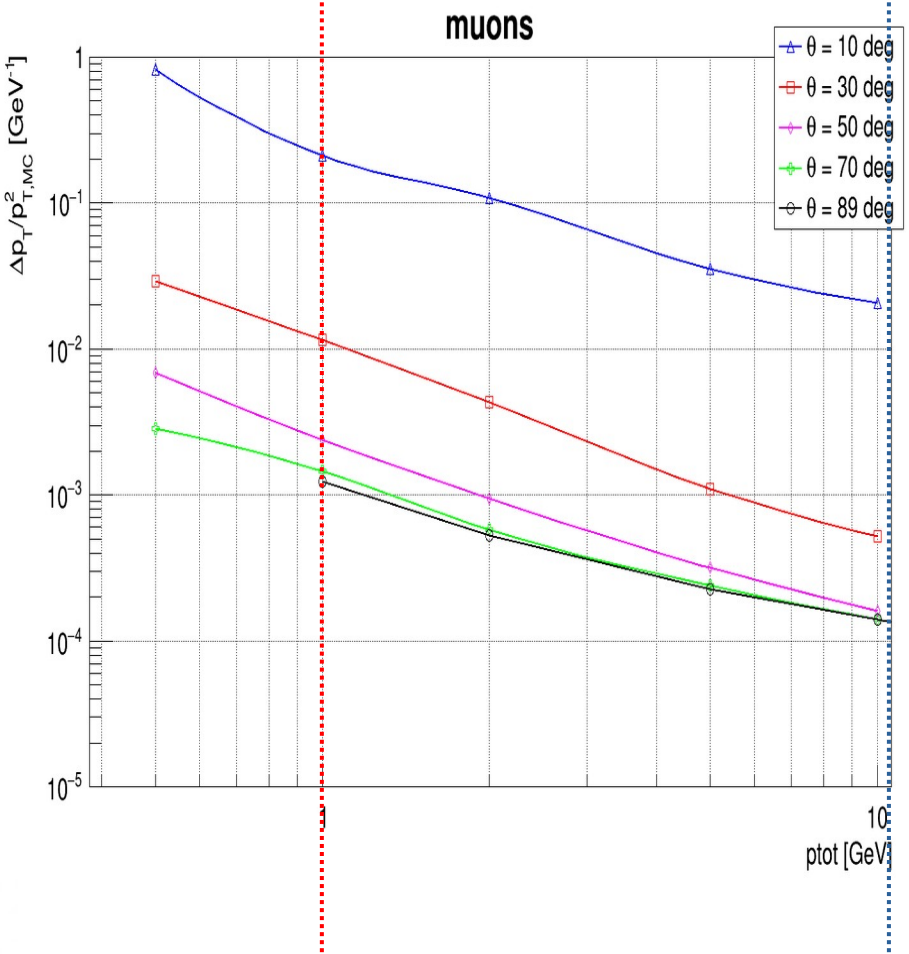
IDEA results



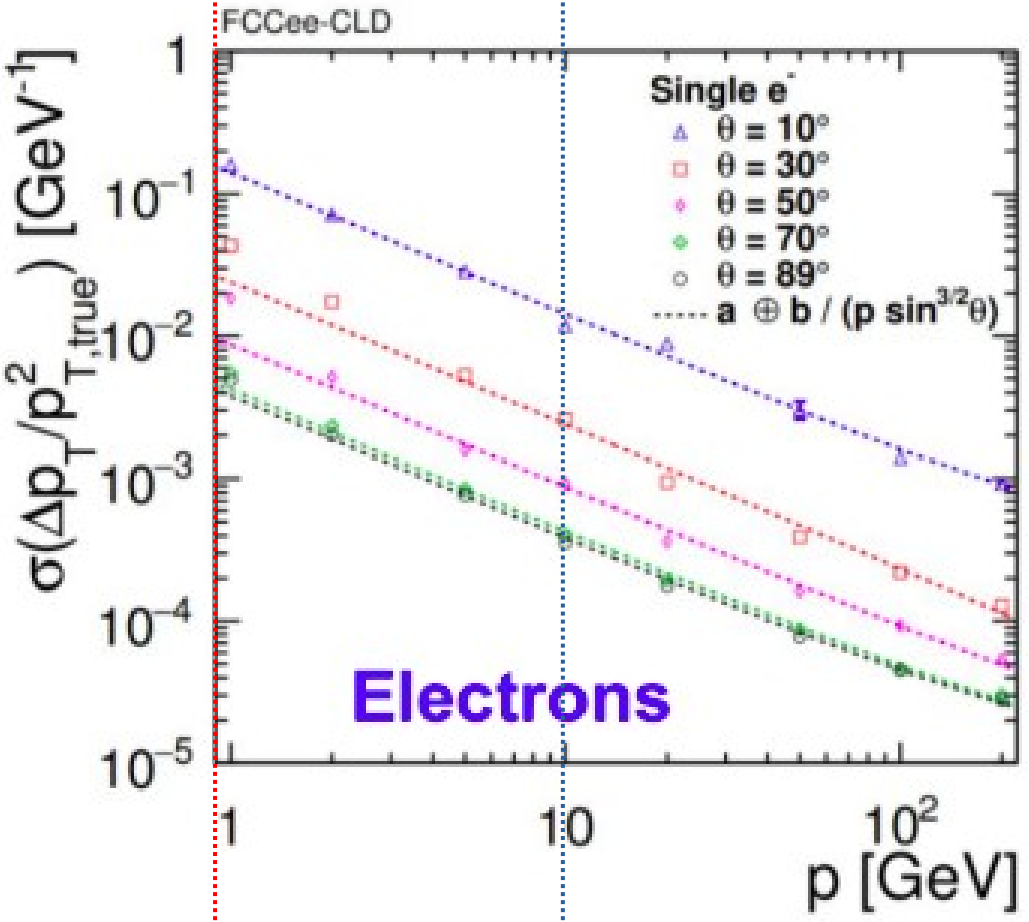


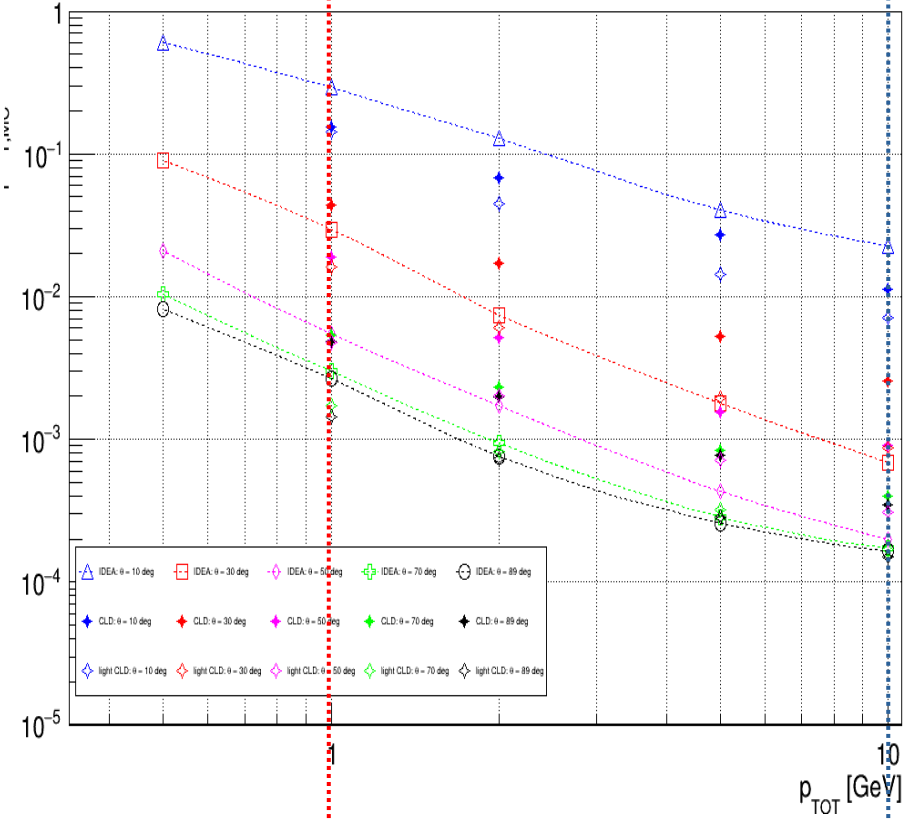
Muons (cfr)


FCC-ee CLD
Single μ⁻
θ = 10 deg
θ = 30 deg
θ = 50 deg
θ = 70 deg
θ = 89 deg
a ⊕ b / (p sin^{3/2}θ)
Muons
σ(Δp_T/p²_T,true) [GeV⁻¹]
p [GeV]


muons
θ = 10 deg
θ = 30 deg
θ = 50 deg
θ = 70 deg
θ = 89 deg
Δp_T/p²_T,MC [GeV⁻¹]
ptot [GeV]

Electrons (cfr)





Electrons (cfr)