Electron reconstruction and identification at the startup

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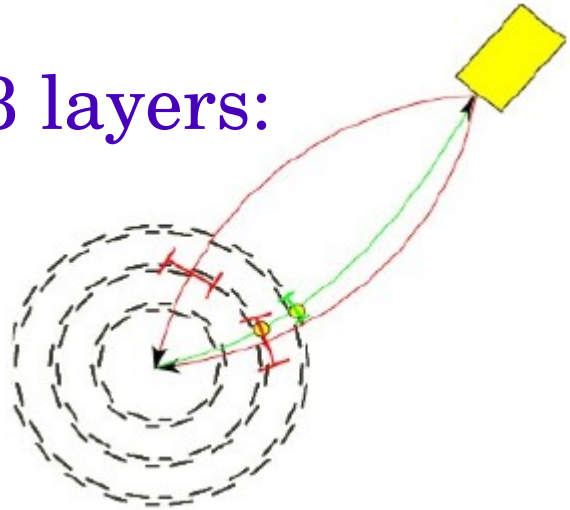
Outline

- Electron reconstruction
- Recent modification in electron reconstruction sequence
- Proposed cut-based electron identification
- eID startup related issues
- Conclusions

Electron Reconstruction

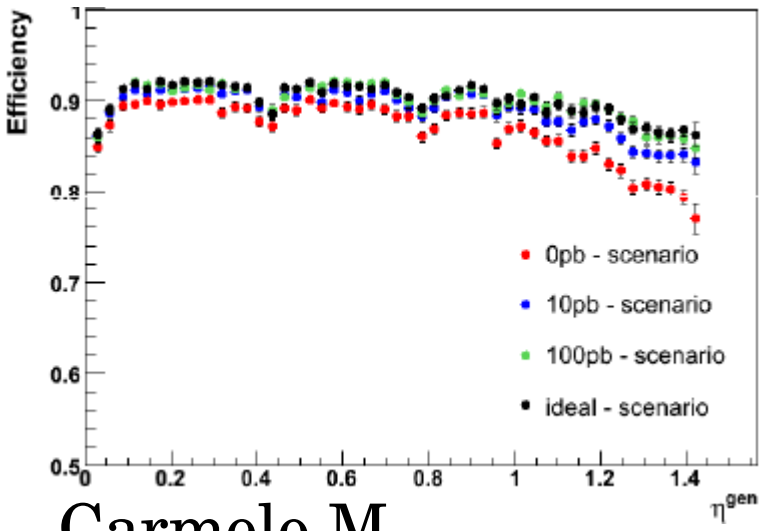
- Super cluster driven seeding approach
  - Seed builder: filter tracker hits to build trajectory seeds.
- Search hits using a z-phi (r-phi) roads determined from measured SC E_T:
  - Both charge hypothesis are considered
  - Implicit E_T/p_T match
- Seeds built from two hits from 2 out of 3 layers:
  - Recently extended to forward region.



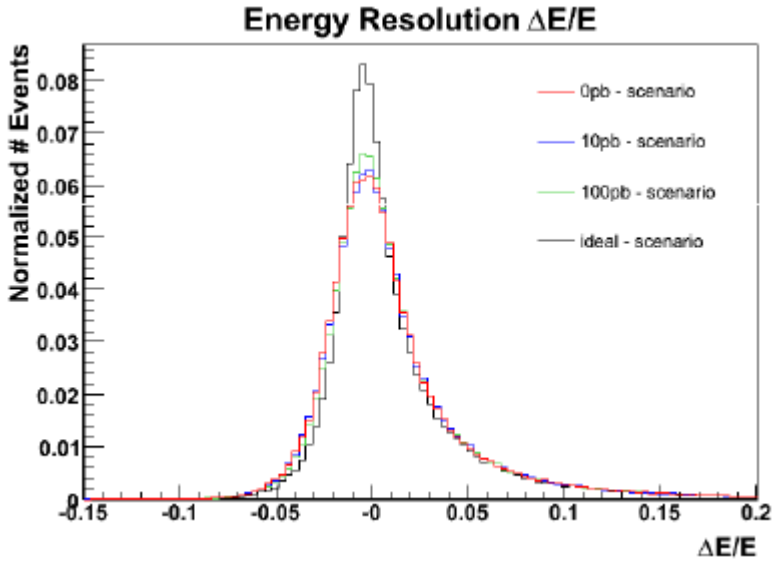
Different scenarios

➔Not many studies have been carried on to determine/improve electron reconstruction performance at startup.

➔Is a fine tuning of the windows needed ?



Carmelo M.



Beam Spot Displacement

- The electron reconstruction heavily rely on the BS position to identify the pixel-seeds for the electron tracking.
- A possible solution to reduce the dependence on the BS measurement is to determine the vertex position event by event:
  - Could be useful also for trigger paths.

Improved sequence

➔The seed filter has been modified:

- Same match ideas from pixel-match
- Can filter tracker hits belonging to built seeds
- The algorithm can be used with any external seed collection.

➔Regional seeding is used with vertex constraint:

- Benefit from tracker development
- EtaPhiRegion extrapolation SC driven
- Reduce dependence on beam spot

➔Very recent development, tests are needed.

SiStrip Electrons

- Electron reconstruction using only SiStrip could also be useful during startup.
- No code change is needed in the improved sequence to adapt reconstruction to a staged detector.
- This reconstruction sequence needs to be tested and thresholds have to be properly tuned for the different scenario.
- A comparison with the code developed for off-line SiStrip electrons by Avishek Chatterjee et al. is also needed.

Electron Identification

- ➔ At the startup period we want a robust and simple electron selection until we have data to verify and tune.
  - At least for startup is desirable to avoid complicate selections
  - Needs for a tight selection to be used with isolation
- ➔ Recently a new cut based electron ID has been proposed:
  - relying on most predictable and stable electron variable (not very sensitive to mis-alignment/calibration conditions)
  - improving electron categories idea already implemented
- ➔ More information on e-ID can be found:
  - **http://indico.cern.ch/conferenceDisplay.py?confId=18239**

Cut-based Electron Id

- The new cut-based selection provides three level of identification:
  - "robust", based on four simple cut
  - "loose", based on five category dependent cuts
  - "tight", like "loose" but with tighter thresholds
- These levels are defined such that events passing "higher" levels are a subset of those passing the previous.
- The idea is to provide analysis group with a baseline selection, optimization must be channel dependent.

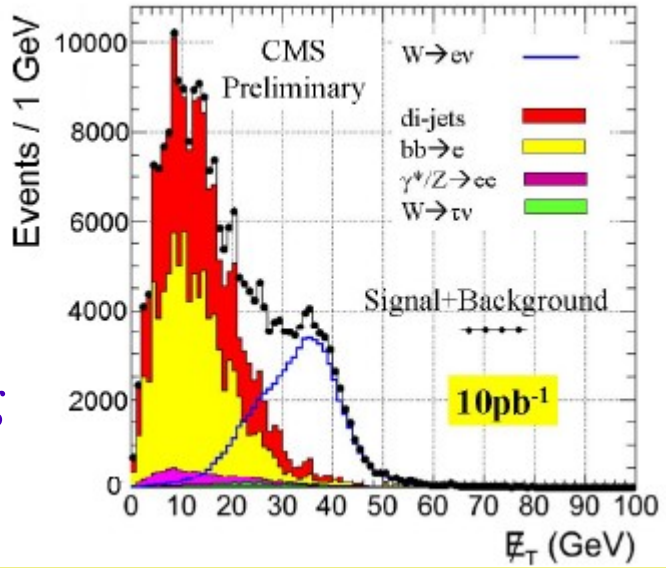
"Robust" Selection

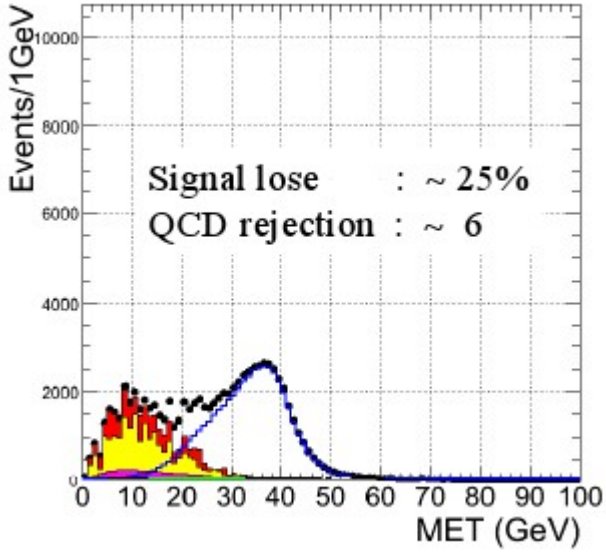
➔ No classification, use variables which are independent of measured bremsstrahlung fraction and insensitive to tracker mis-alignment.

- $\sigma_{\eta\eta}$: shower shape σ along η
- $\Delta\eta_{in}$: delta eta between track ans super-cluster
- $\Delta\phi_{in}$: delta phi between track and super-cluster
- H/E: hadronic over electromagnetic energy

Georgios D.

➔ In W/Z cross section analysis with 10 pb^{-1} has been shown that the "robust" e-ID is adequate even if a small fine tuning is needed.

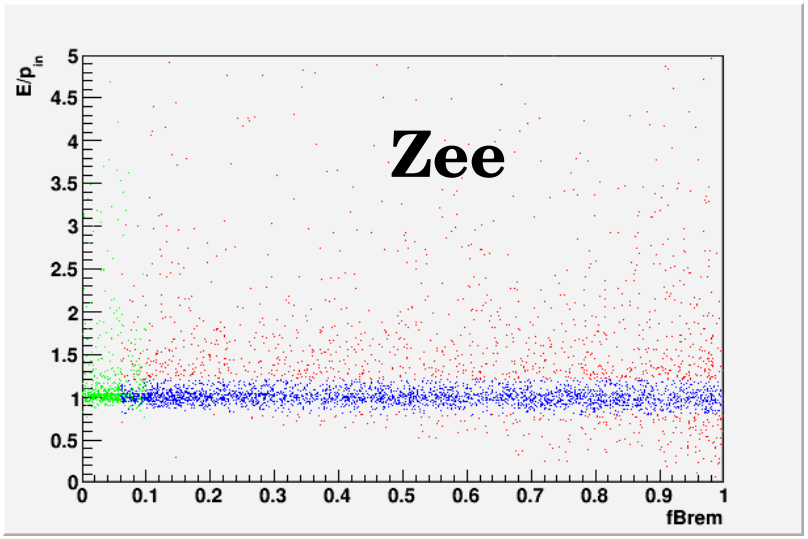


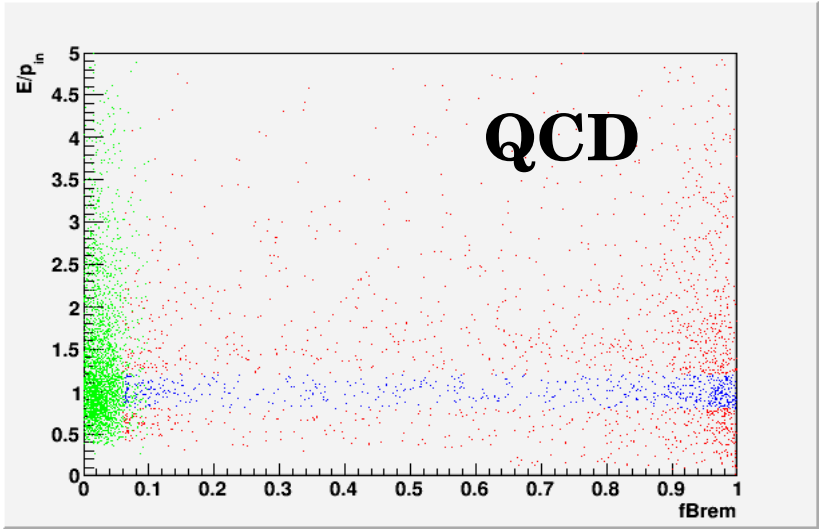


“Loose” Selection

➔ Introduces classification with three classes based on the E/p and fBrem:

- bremming electrons with E/p ~ 1 (little contamination from fakes)
- low brem electrons (high population from both real and fake)
- bad track, E/p ≠ 1





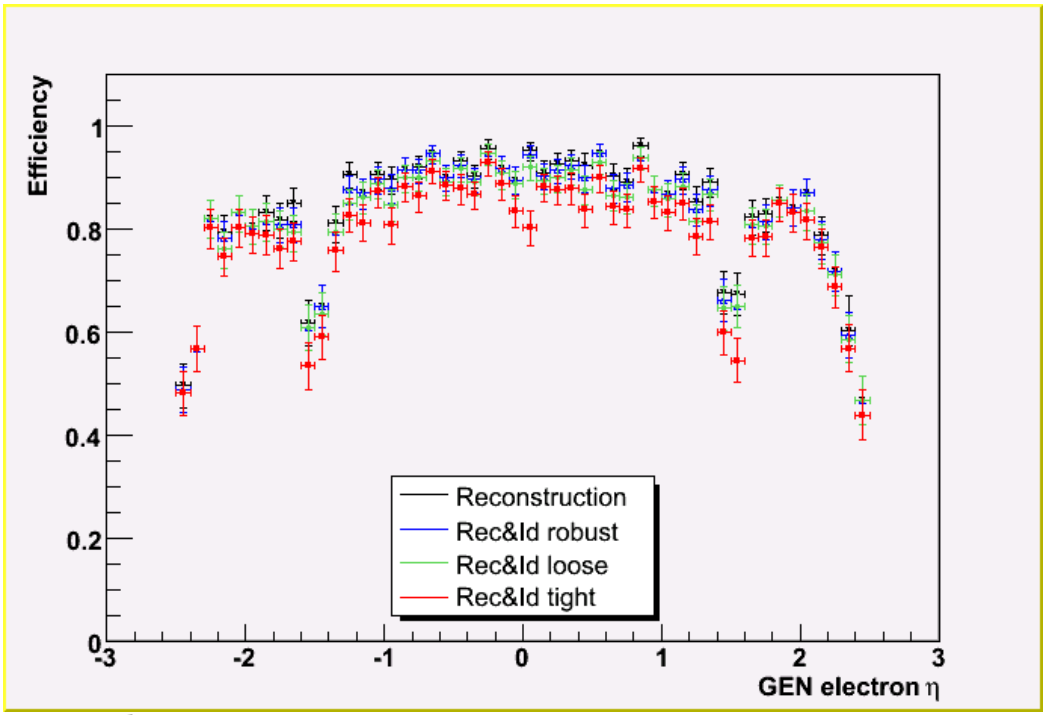
Physics motivations

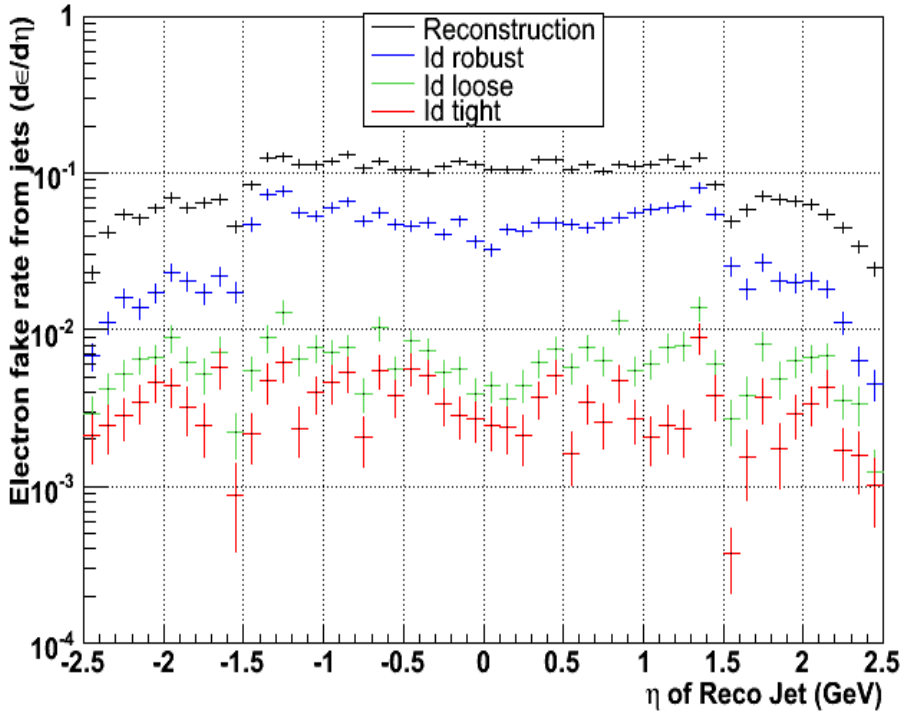
1. E/p is often well measured for electrons
2. Electrons usually radiate a good deal of energy in the tracker
3. E/p is not often measured to be less than 1 for electrons
4. Fakes from jets usually have fBrem around 0 (just charged pion tracks...)
5. Many fakes from jets have E/p<1 partly because of the low response of ECAL to charged pions...

The categories

- ➔ The categorization allows to have better results while keeping selection quite simple:
  - Looser cuts for best electrons makes selection more robust
  - Tighter cuts in overlap region maintains robust rejection of fakes.
- ➔ Separation of regions with different S/B ratios since pion tracks should have fBrem ≈0.
- ➔ No dependence on cluster reconstruction algorithms
- ➔ More handles for different analysis to tune the identification levels.

Performance



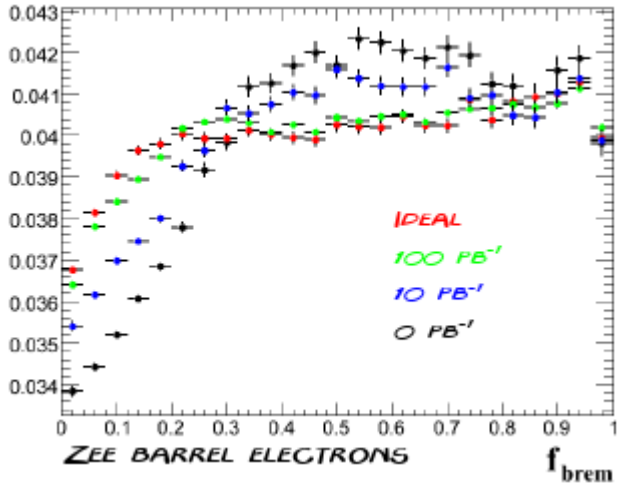


Pedro R.

Efficiency

Efficiency	Reconstruction	Id robust	Id loose	Id tight	Rec&Id robust	Rec&Id loose	Rec&Id tight
Z->ee	0.84	0.99	0.98	0.94	0.83	0.82	0.78
W->e vu_e	0.85	0.99	0.97	0.93	0.84	0.83	0.79
Z'->ee	0.82	0.99	0.97	0.94	0.82	0.80	0.78

Other classifications



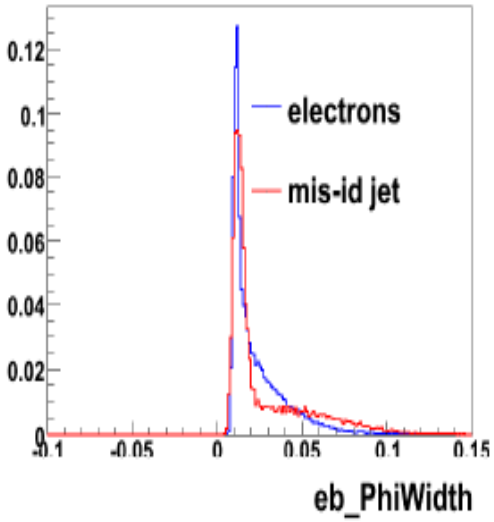
Roberto S.

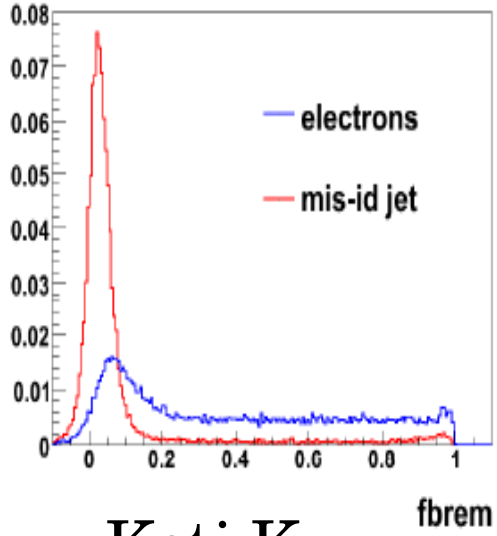
➔ The major concern is about the use of fBrem in the classification:

- This variable is sensitive to the mis-alignment/calibration conditions

➔ More stable variables have been tried (phi-width for example) by far worse discrimination power.

➔ The migration between different categories does not worry too much: we cut on the electrons anyway.

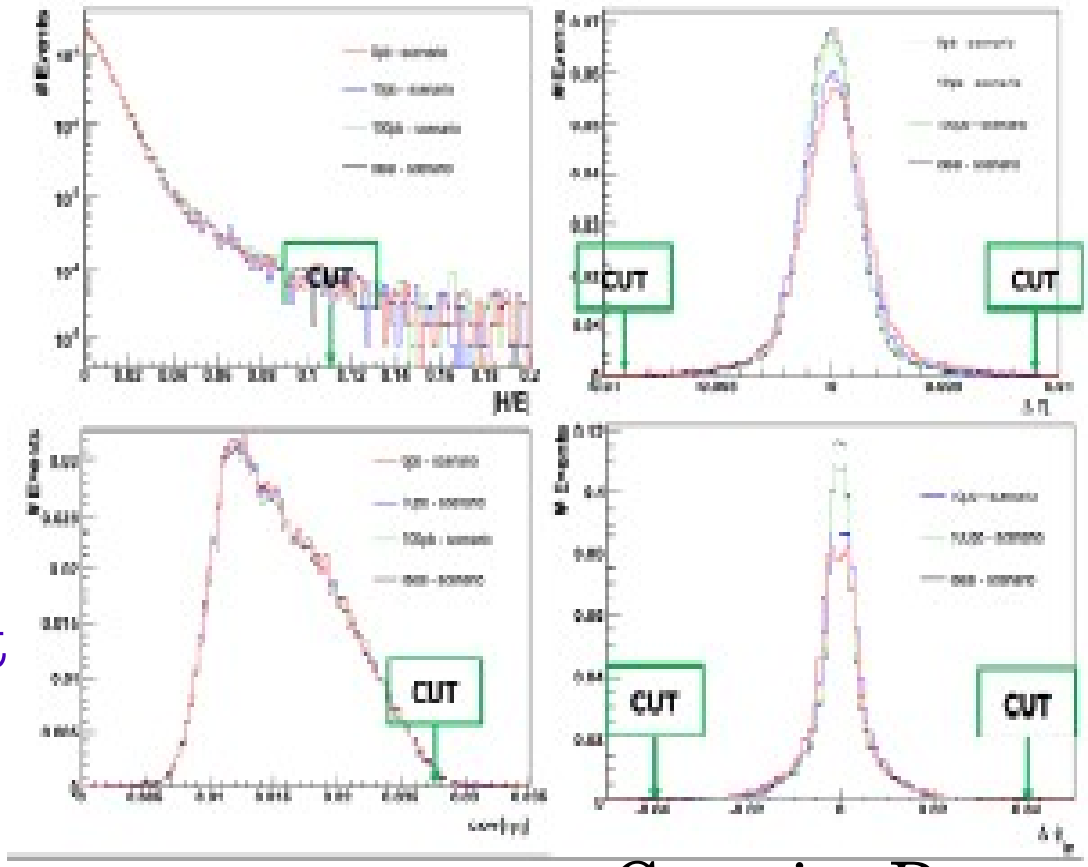




Keti K.

Which variables ?

- Variables used in the loose/tight cut-based ID:
  - H/E, $\sigma_{\eta\eta}$, $\Delta\phi_{in}$, $\Delta\eta_{in}$, E_{seed}/p_{in}
- The aim is to keep the selection as simple and robust as possible.
- Other variables should be added if and only if they provide a dramatical improvement in the selection.



Georgios D.

Efficiency from the data

➔Electron reconstruction and identification efficiency can be measured from the data using the tag and probe method:

- $\varepsilon = N2/N1$
  - (N1 = all electrons passing tag condition, N2 = all cases where 2nd electron passes probe condition (off-line /tight/ loose/robust ID)

➔Golden channel for the startup period is $Z \rightarrow ee$:

- Other more difficult channels later (J/Ψ, Υ).
- Any feasibility study carried on ?

Conclusions

➔Not many studies to check if electron reconstruction needs to be tuned for the startup period.

➔A new sequence has been recently implemented:

- Takes pixel-match idea to filter seeds.
- Regional seeding with pixel vertex constraint.
- Easy re-configuration for staged configuration.

➔Very recent implementation, lot of testing is still needed.

Conclusions

- Simple cut-based electron ID proposed for the startup period.
- Rely on stable variables and quite robust electron classification criteria.
- Proposed definition of ID levels might not have long lifetime since specifically designed for first 10-100pb^{-1}.
- Baseline selection must be studied together with isolation then a channel dependent optimization is needed.