Silicon Tracking for Plug Electrons

Erik Brubaker

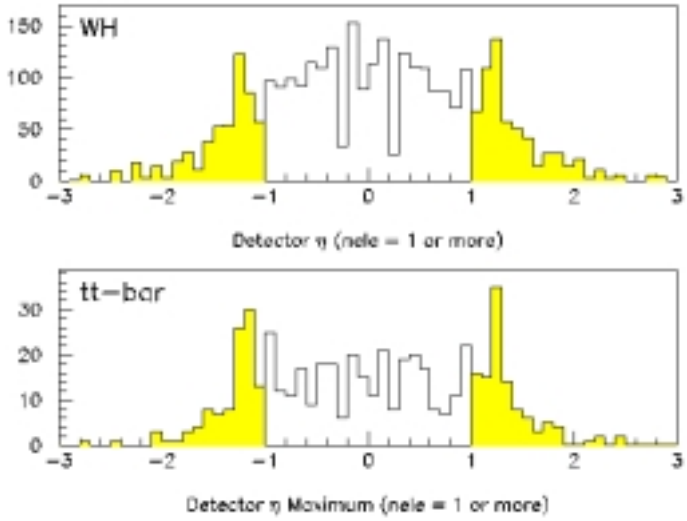
UC Berkeley/LBNL

CDF Week
June 1, 2001

Plug Electron Identification

Why do plug electron ID using silicon?

• Plug has large acceptance for important physics processes...



… and in contrast to calorimeter-only electron ID, algorithms using tracking info give you:

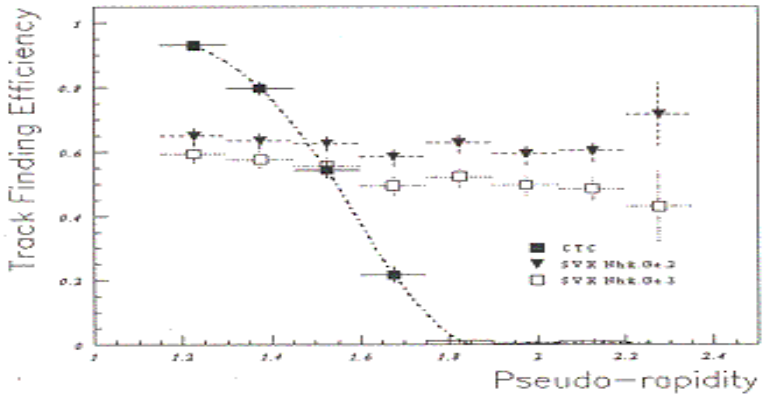
• charge information

• rejection of fakes

Plug electron ID options using silicon:

1. Silicon stand-alone tracking -> match tracks with plug EM clusters

2. Silicon stub algorithm developed in run I by Fan Qun & Arie Bodek.

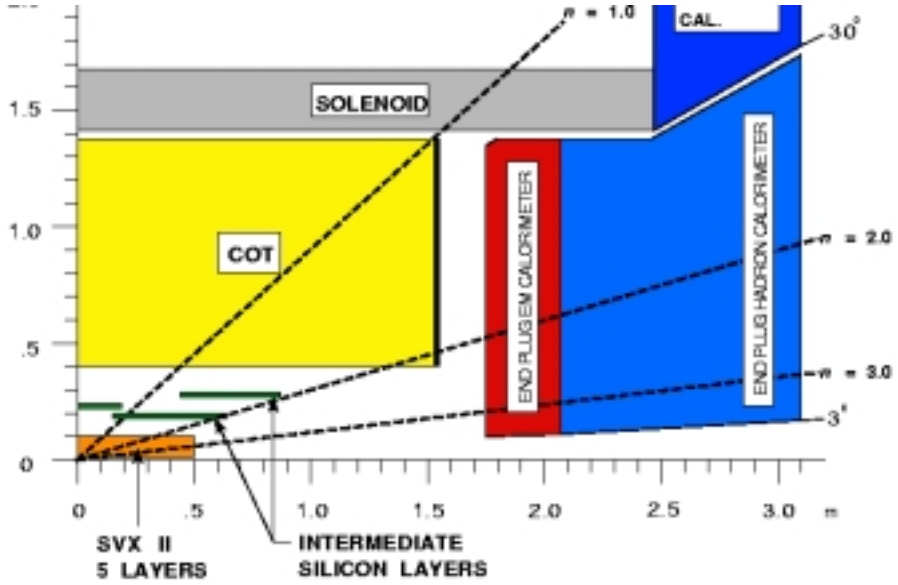


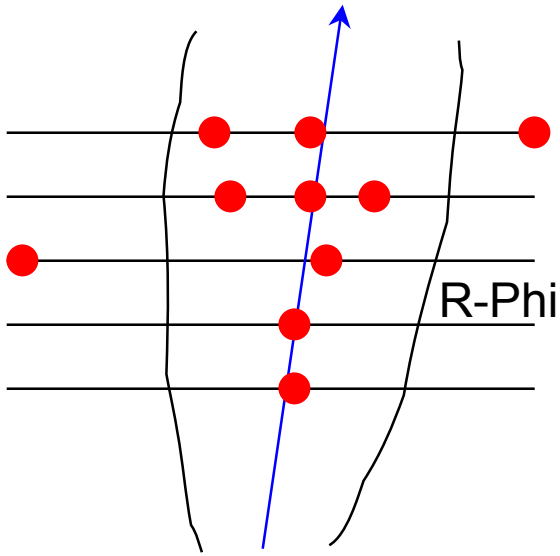
-- intended for high-pT, isolated electrons.

-- advantages include greater speed, simplicity, eta reach, efficiency.

Stub finding algorithm

- Upstream:
  - Do EM, showermax clustering
  - Run RegionDefModule
    - Creates detector region seeded from an EmCluster.
  - Run SiClusteringModule
    - Does silicon clustering in region.
- Loop through all combinations of r-phi hits in the eight layers of silicon, fit with a fast circle fitter.
  - After each fit, check residuals, discard bad hits.
  - Cut on min number of hits (4), max d_0 (50 microns).
  - Exhaustive method of fitting all combinations is simple, made possible by looking only at hits in region.
- Finally, “clean up” phase selects best stubs with no shared hits.





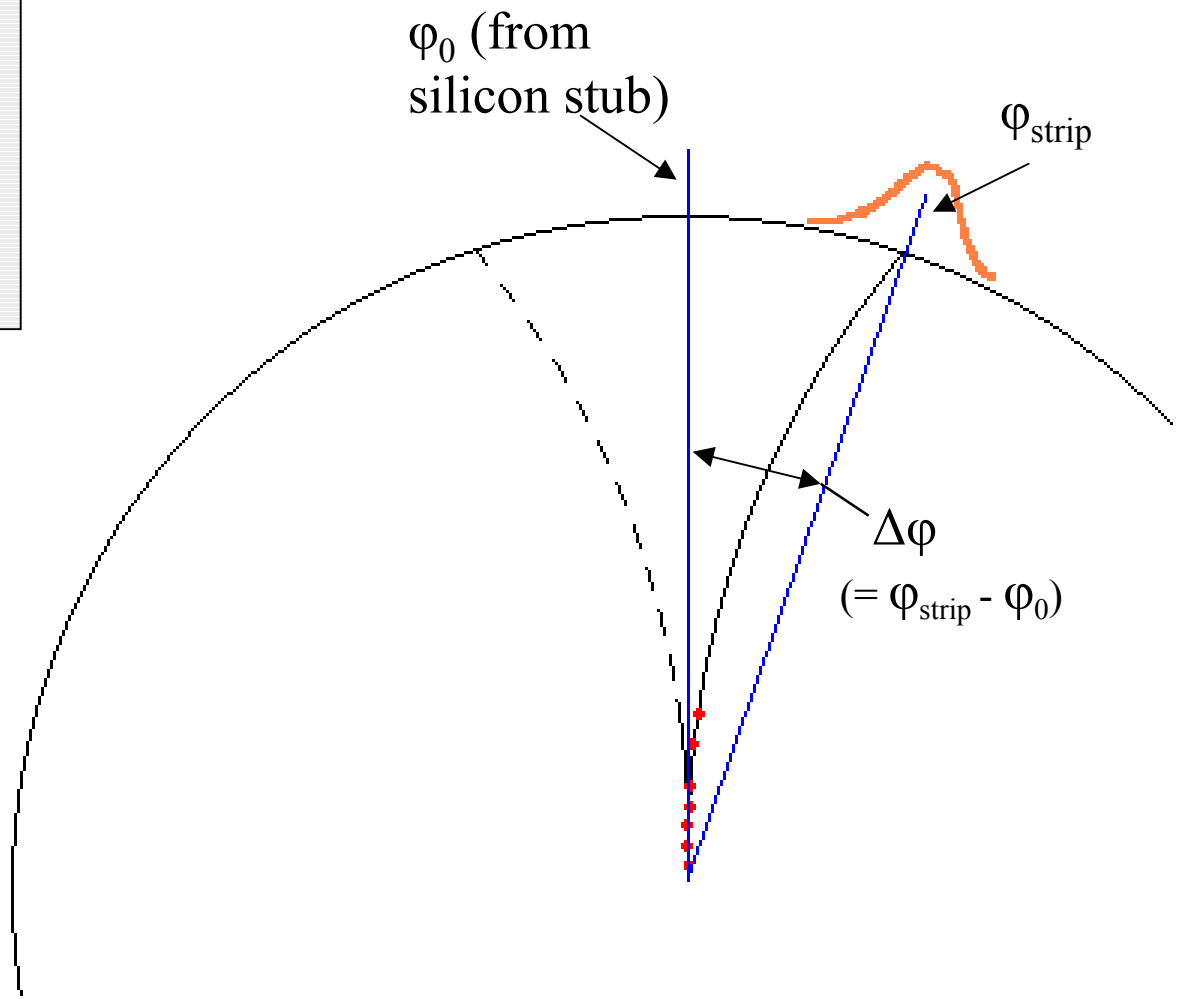
Variables: $\Delta\varphi/\Delta\varphi_{exp}$

$\Delta\varphi_{exp}$ calculated from E_t of EmCluster.

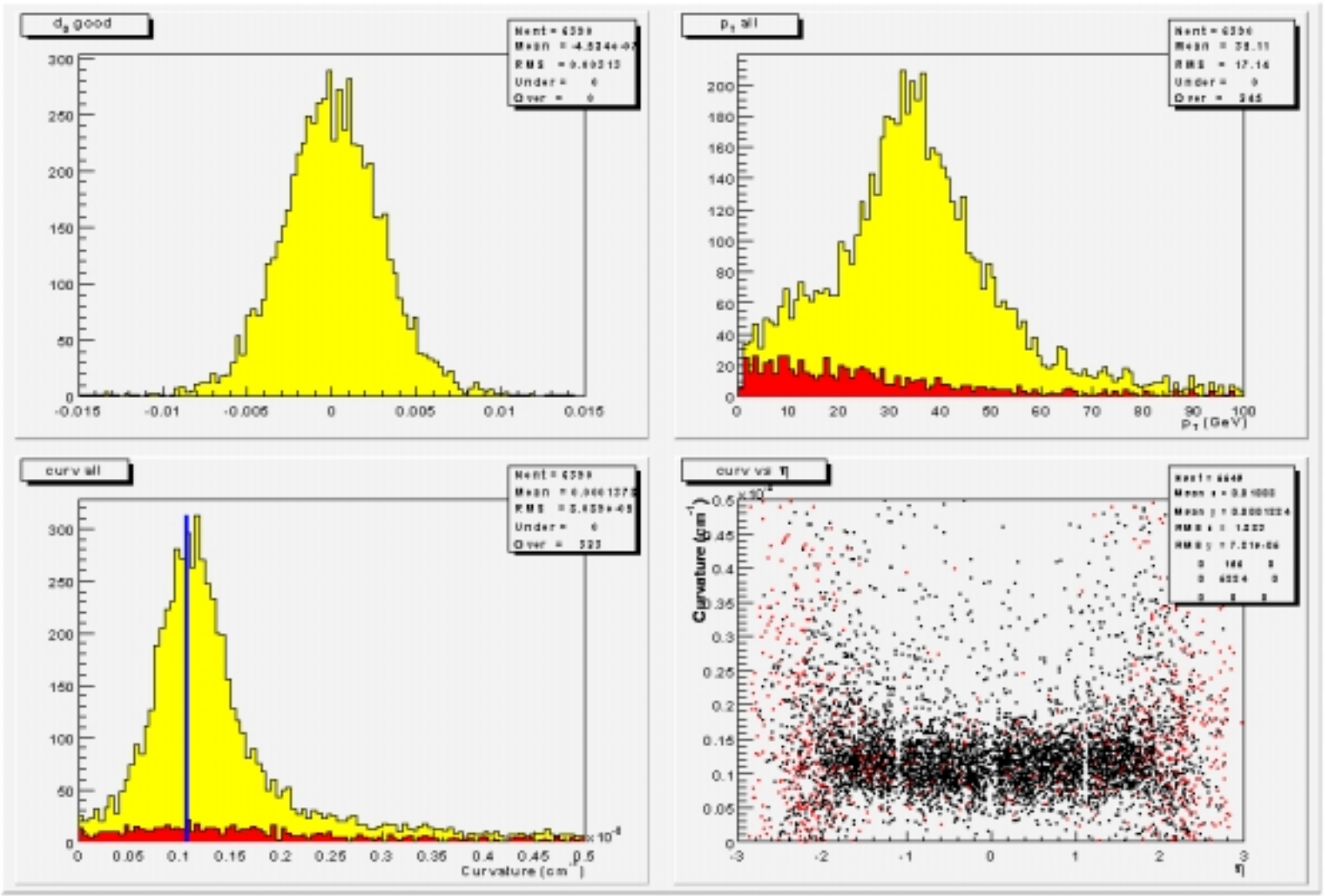
$\Delta\varphi_{exp} \propto 1/E$

$\Delta\varphi \propto 1/p$

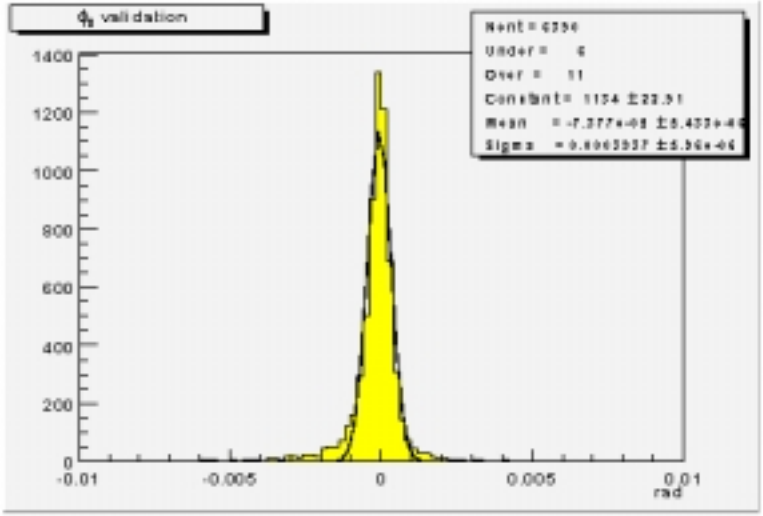
$\therefore\ \Delta\varphi/\Delta\varphi_{exp} \propto E/p$

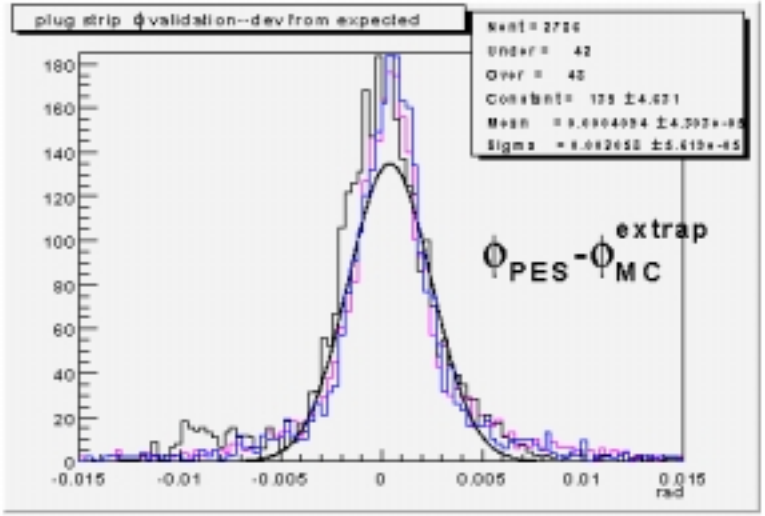


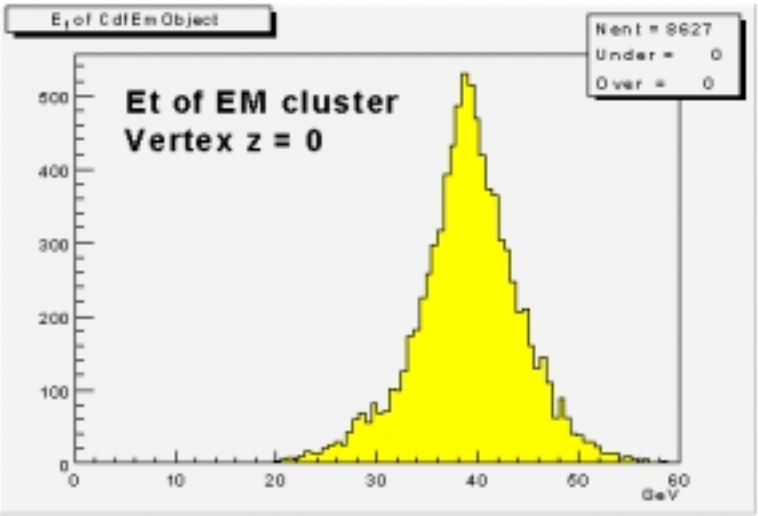
Single positron MC sample

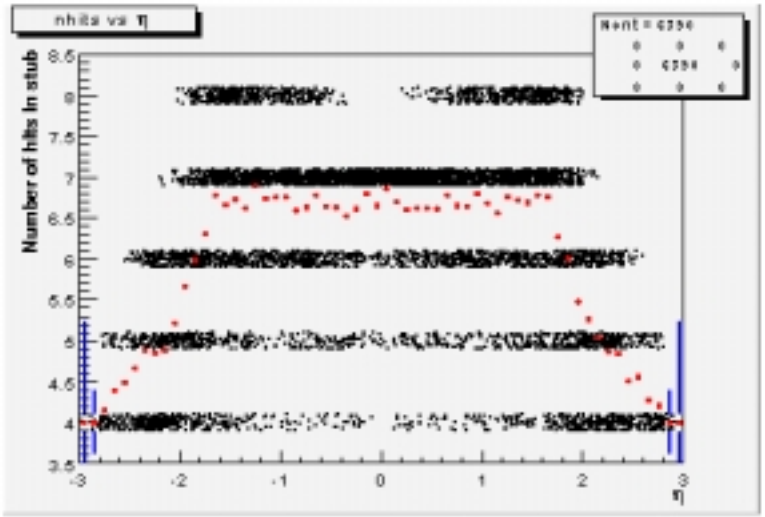


Single positron MC sample

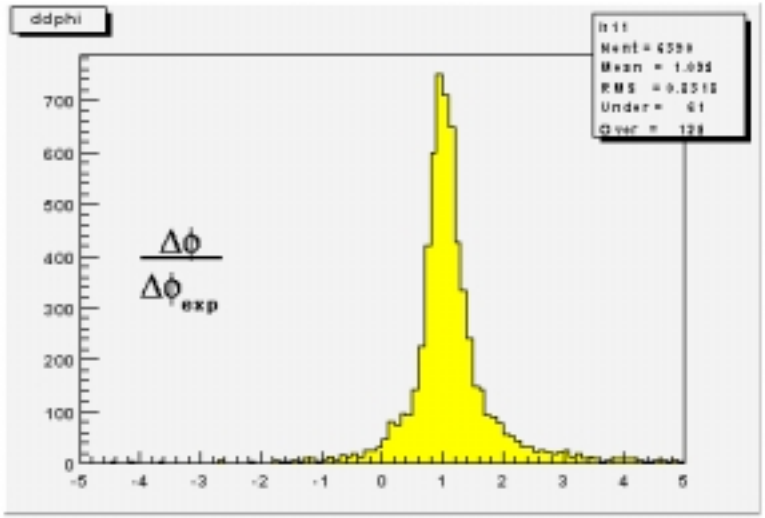


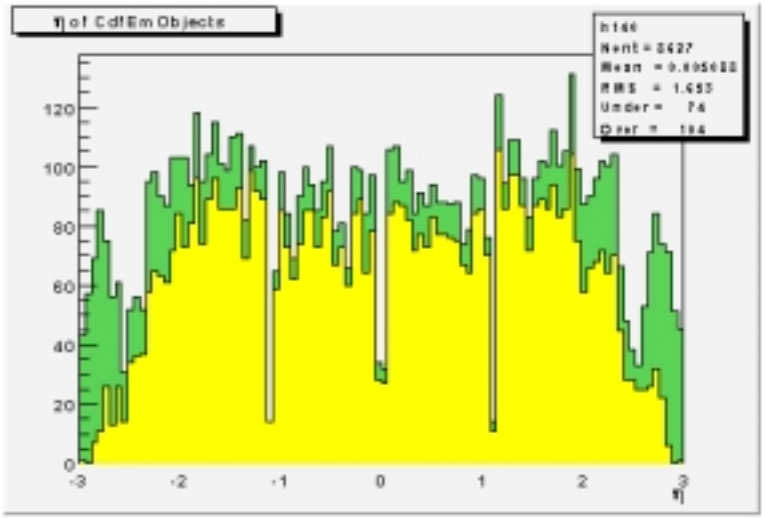


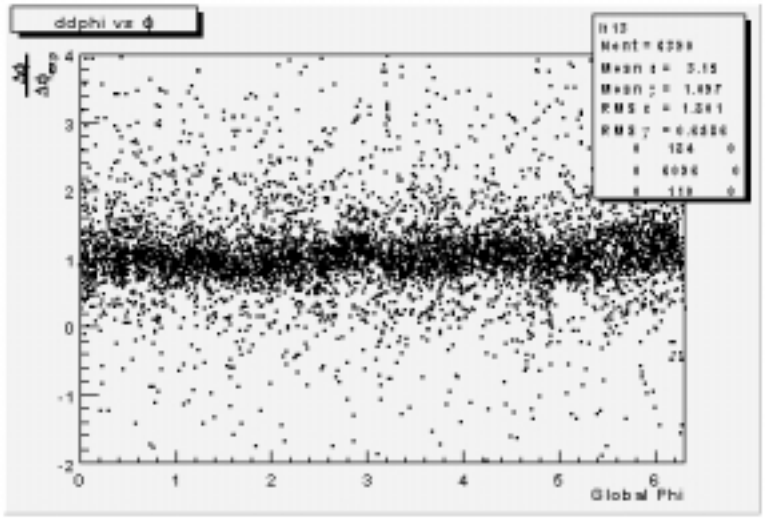


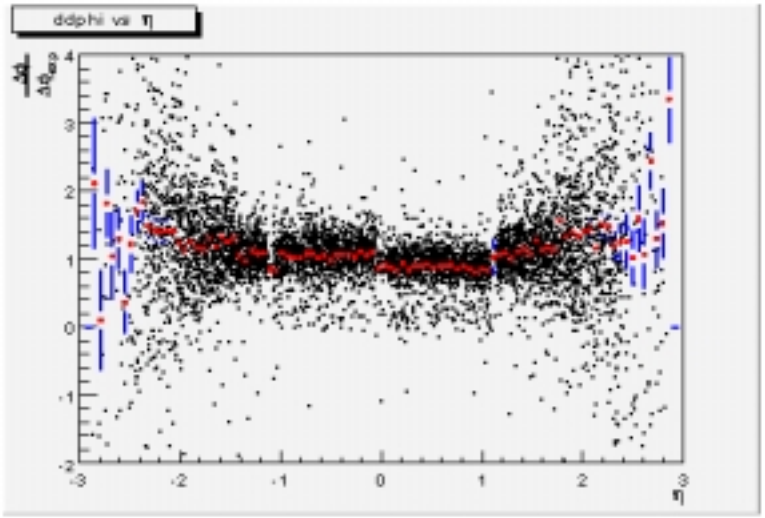


Single positron MC sample

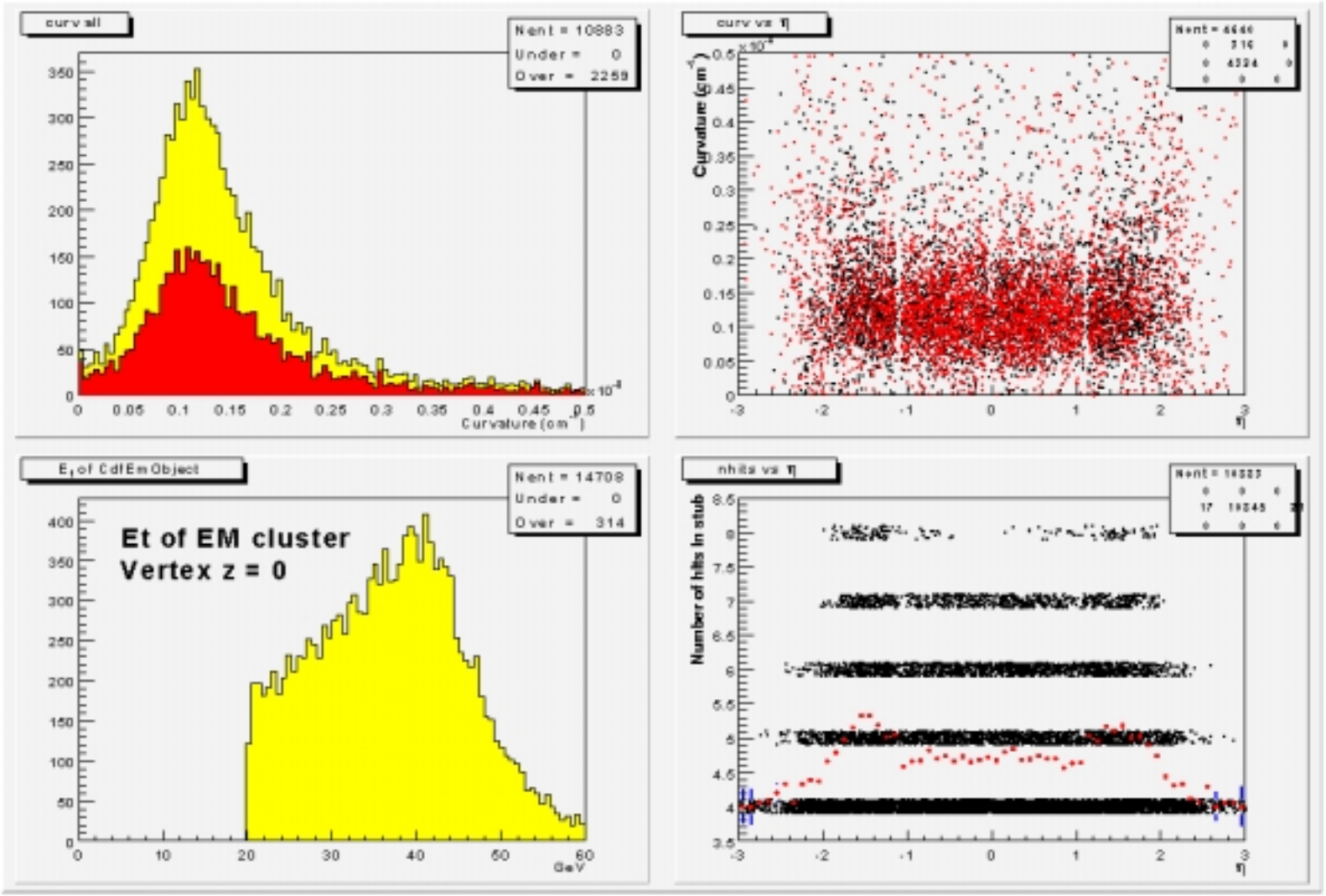




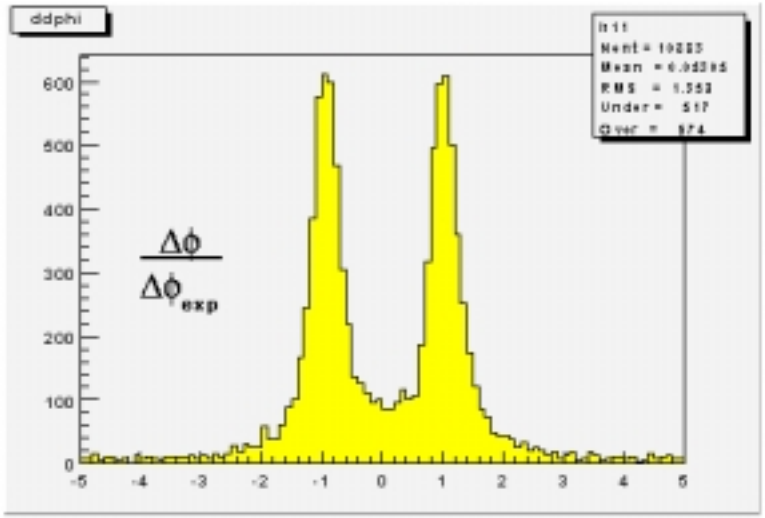


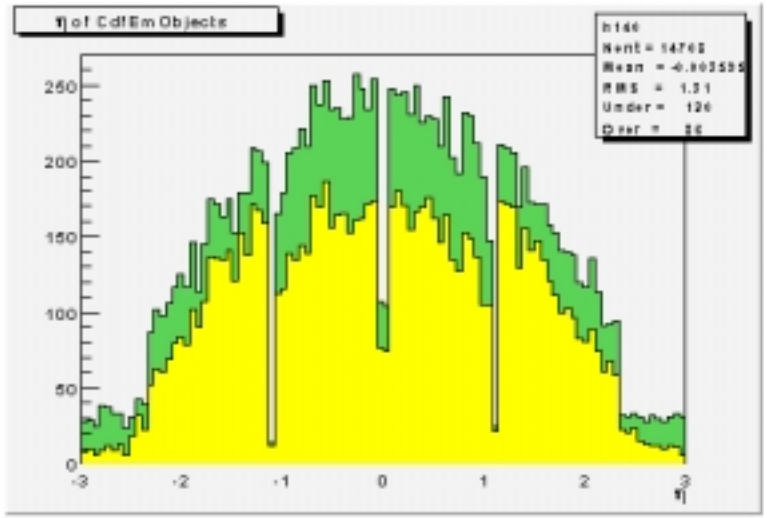


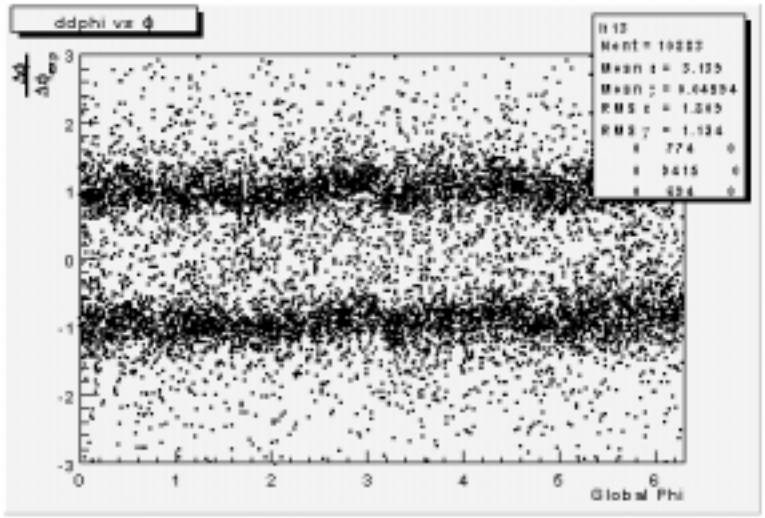
Z->ee MC sample

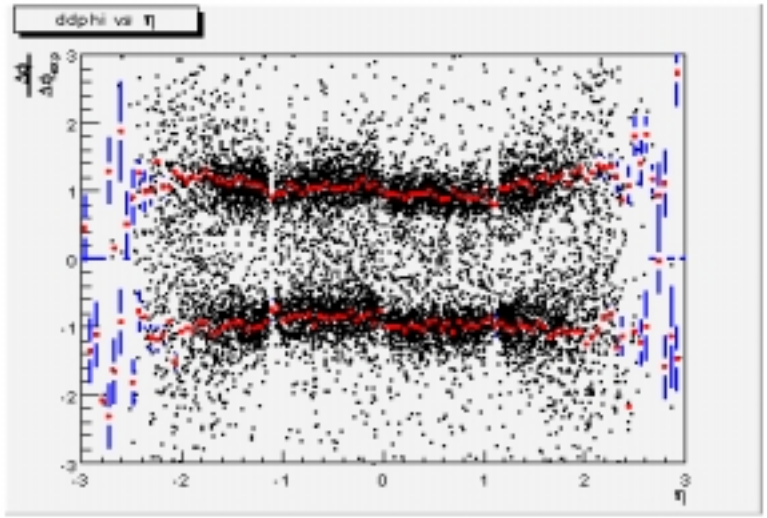


Z->ee MC sample

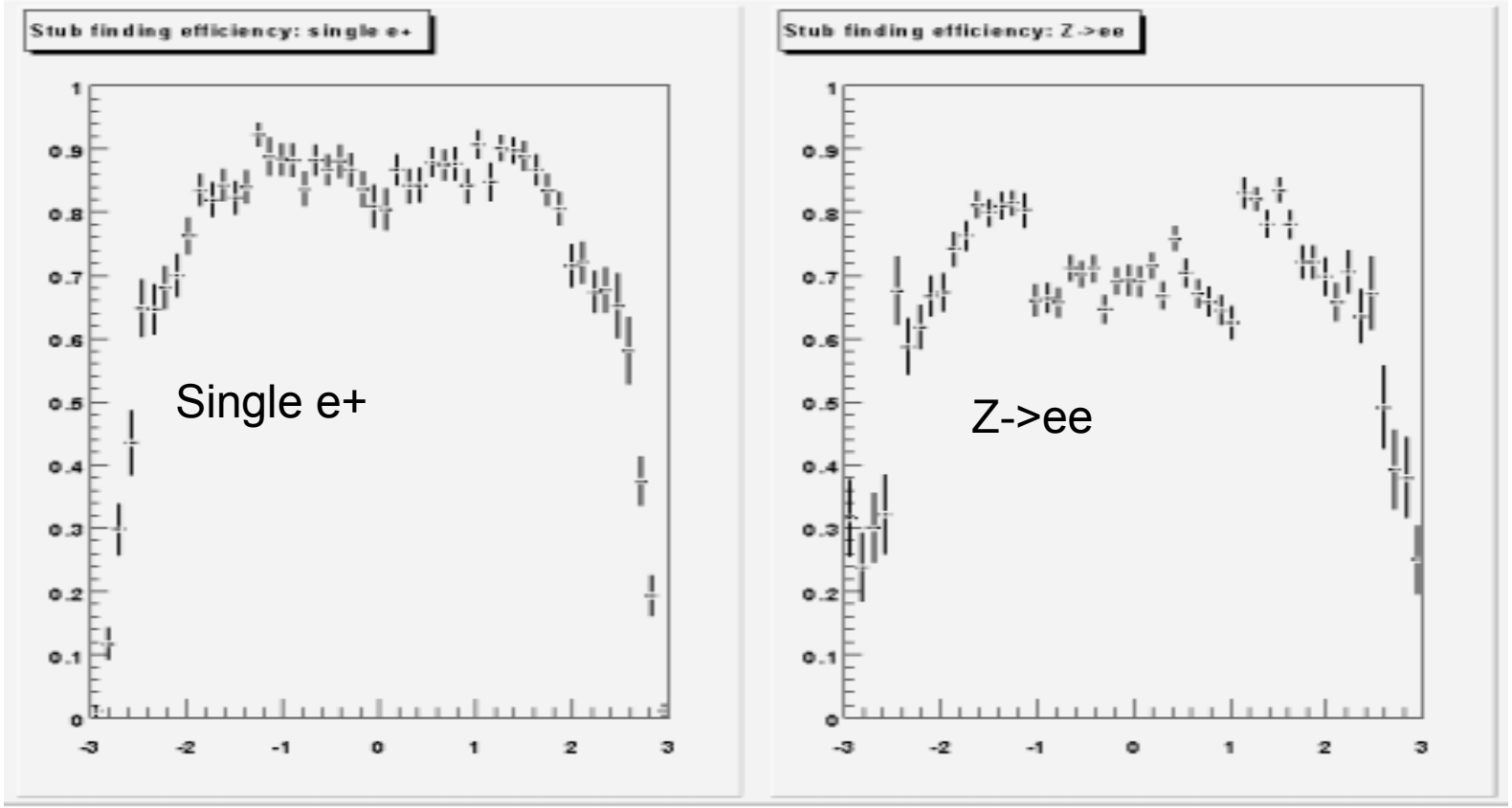








Crude efficiency plots



- Efficiency = (Number of CdfEmObjects with silicon stub found) / (Total number of CdfEmObjects)
- Caveat: No tweaking of region size, algorithm parameters, etc.

Conclusion

- Silicon stub algorithm can complement other electron ID methods in run II as in run I.
- Still some work to do on the algorithm:
  - Straight line fitting for eta > 2?
  - Add information from COT hits when available.
  - Improve Et calculation.
  - Look at fake rate in various physics samples, min bias.
  - Understand effect of material in forward region.
- Once we graduate from monte carlo and understand how it behaves with real data … can be used in a level 3 plug electron filter?