Contents

- Using moller events to determine beam position for each run.
  Table is currently at: /work/hallb/prad/xbai/offset/offset.txt

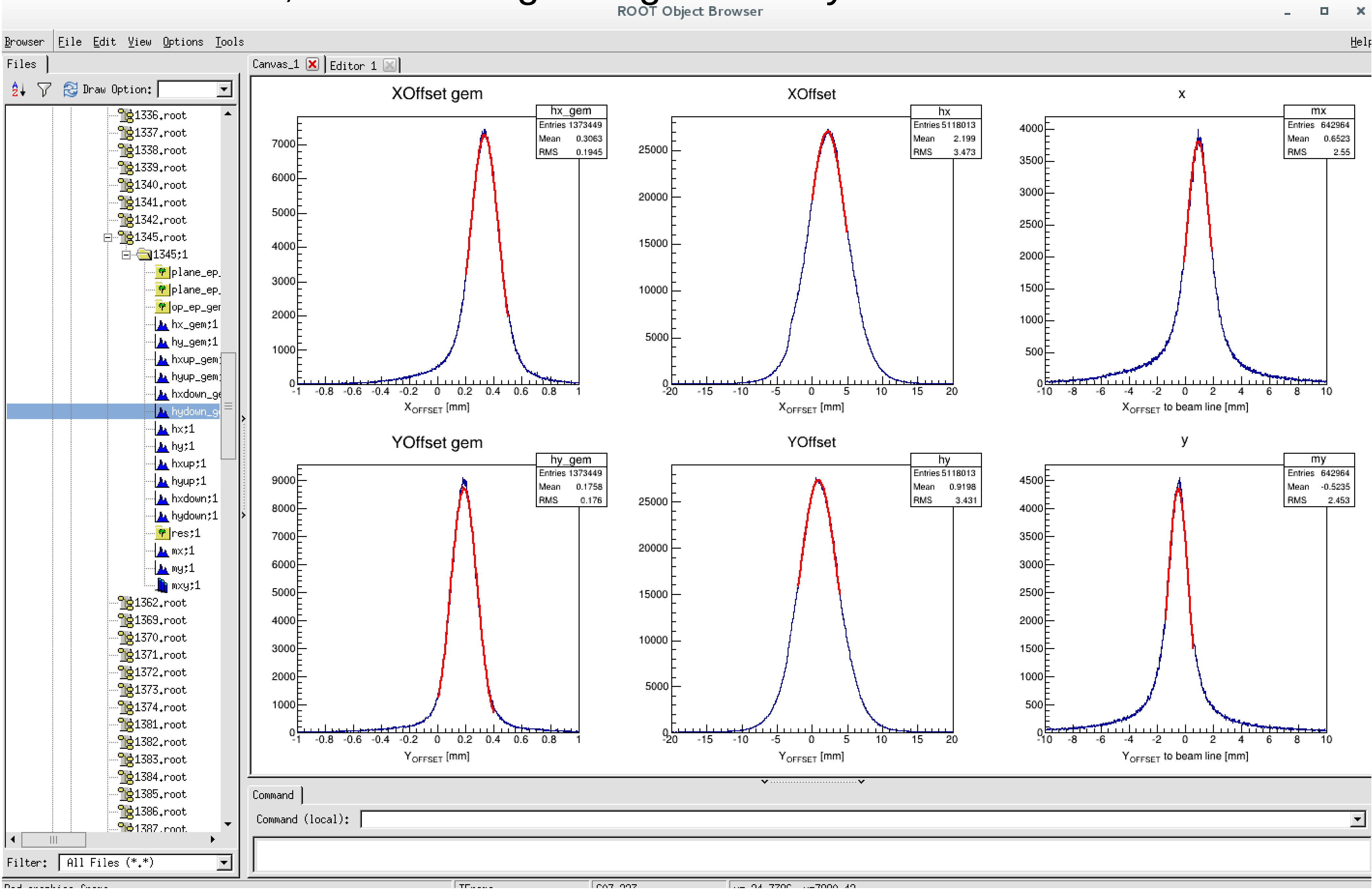
- Efficiency update from calibration data.

New organization:

```
# The least run will be chosen as the default offset
# Lists the origin offsets of detectors to beam center and the tilting angles
# Units are in mm and mradian
#         run     detector    x_origin    y_origin     z_origin      x_tilt      y_tilt#     z_tilt
         1123     PRadGEM1   -0.552455   -0.162949        5304           0           0           0
         1123     PRadGEM2   -0.894915   -0.358795        5264           0           0           0
         1123        HyCal     1.01244    0.652137        5817           0           0           0

         1125     PRadGEM1     0.51515    -6.76916        5304           0           0           0
         1125     PRadGEM2     0.17732    -6.95296        5264           0           0           0
         1125        HyCal     2.12307    -5.91165        5817           0           0           0

         1126     PRadGEM1   -0.529138  -0.0713081        5304           0           0           0
         1126     PRadGEM2   -0.868931   -0.263425        5264           0           0           0
         1126        HyCal     1.16641    0.730456        5817           0           0           0

         1127     PRadGEM1   -0.550107    -1.59799        5304           0           0           0
         1127     PRadGEM2   -0.892663    -1.79354        5264           0           0           0
         1127        HyCal      1.2307    -0.75634        5817           0           0           0
```

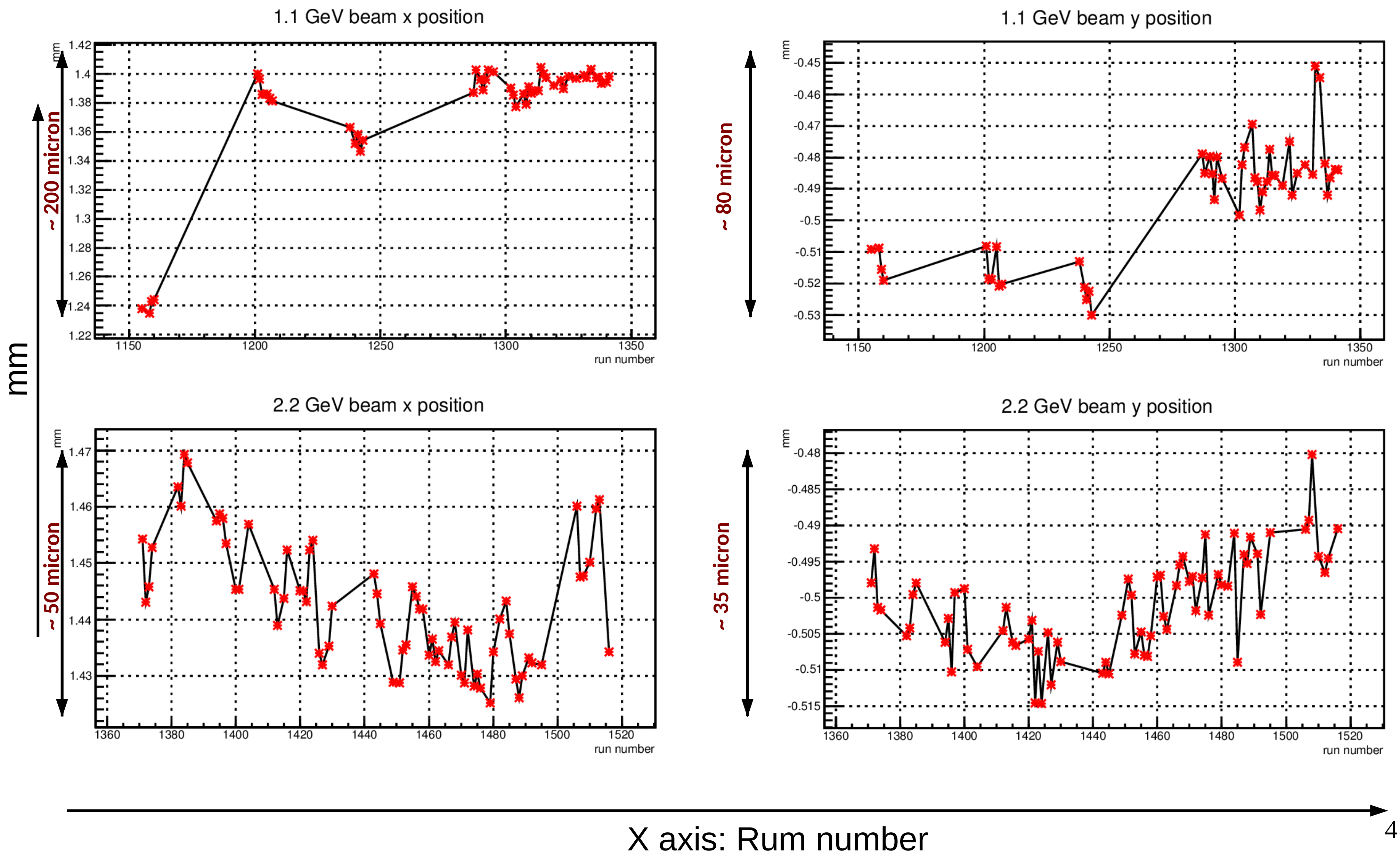
Detector origin coordinates in beam frame.

For each run, there's fitting histograms for you to check.

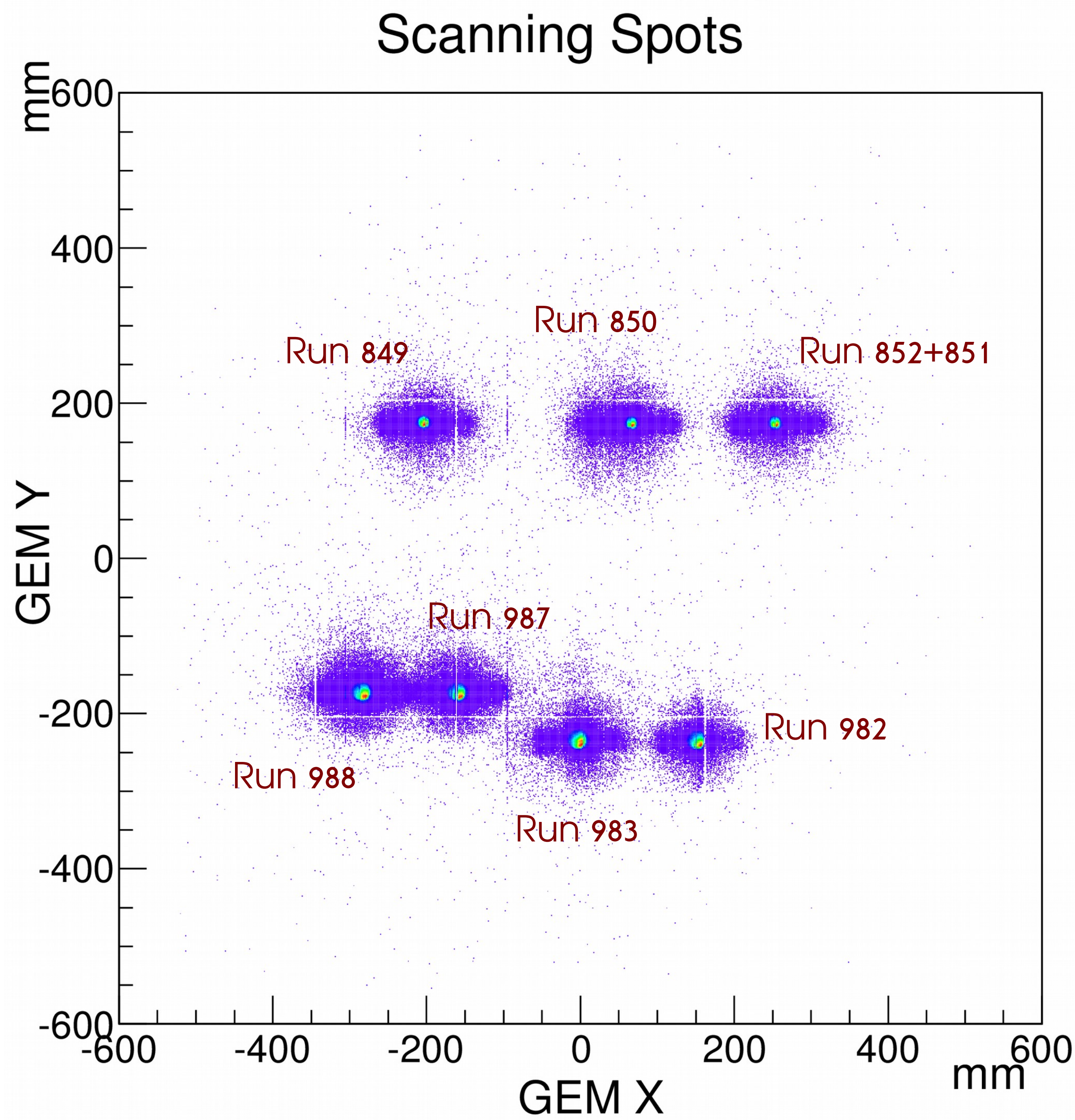


Average beam position determined by GEM detector

Runs not included yet : 1136, 1137, 1345, 1405, 1498.



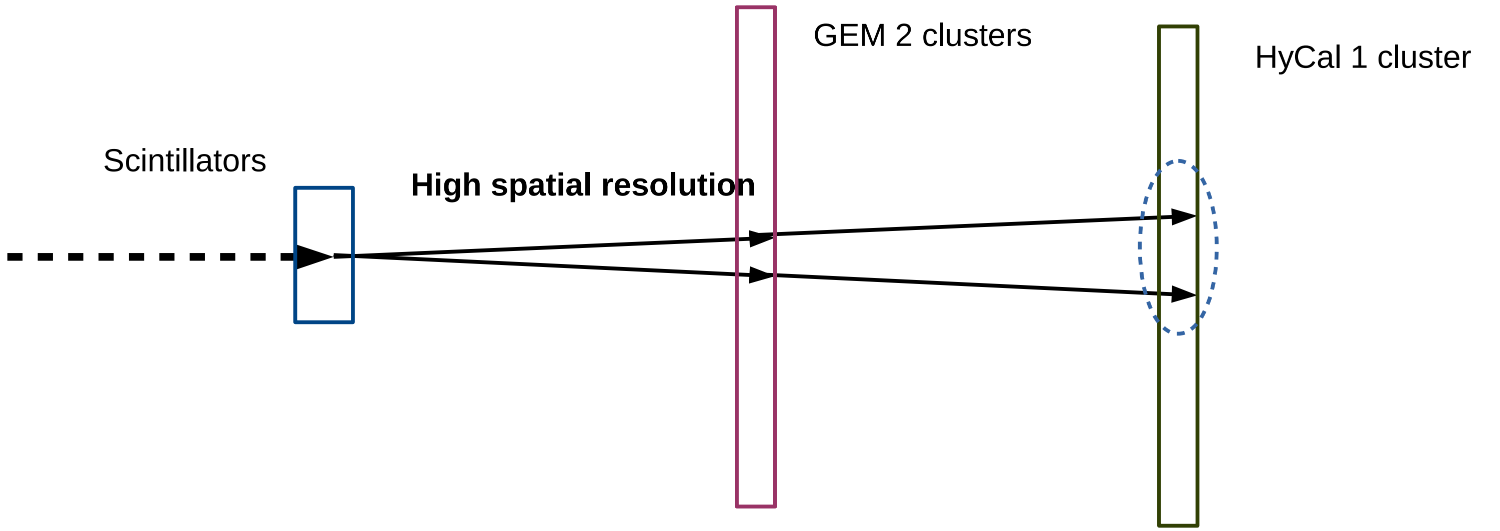
Spots Scanned



Comments on calibration data

- Calibration data is different from production data, the current matching may not work properly on calibration data.
- Production, ep and ee events → each HyCal cluster induced by one electron: only one real GEM cluster matching with it.
- In Calibration, things are different, GEMs are detecting electrons converted from photons in scintillators.
- Mostly pair production, two electrons separated by 2~10 mm. GEMs can distinguish these different electrons, but HyCal cannot, sees both as one cluster.
- So in some cases, for each cluster on HyCal, there will be more than one real GEM clusters which can match with them.
- Calibration data is not very proper for GEM efficiency calculation. We will see a higher than reality value.
- X cluster and Y Cluster match ambiguity.

Comments on calibration data

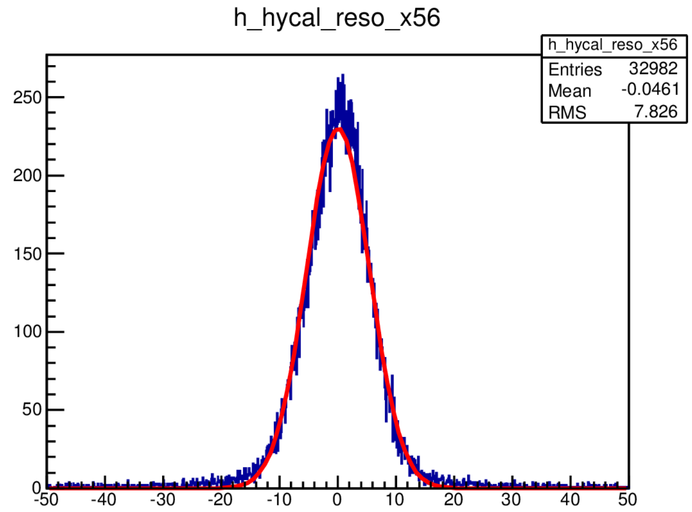


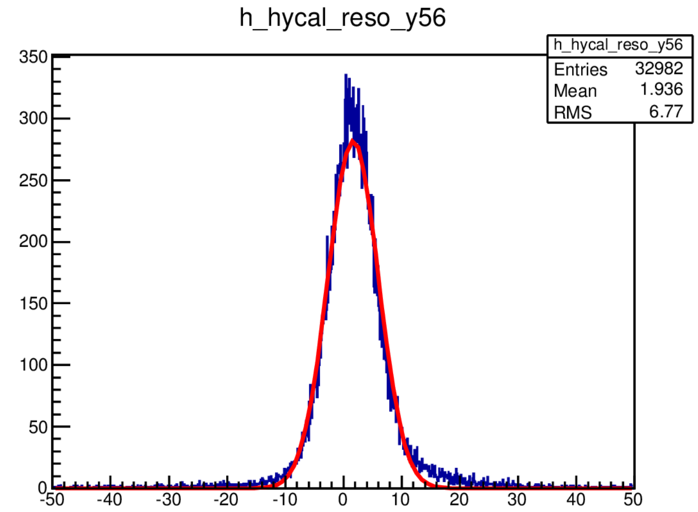
- Estimate the events ratio between 1), photon ionization, 2), Compton effect, 3), pair production.
- Photon ionization won't induce signals on gem, but can induce signal on Scintillator and HyCal.
- Compton effect electrons depends on electron energy.
- Pair production induces signal on both.
- Efficiency we calculate is inflated by pair production, and reduced by Compton.

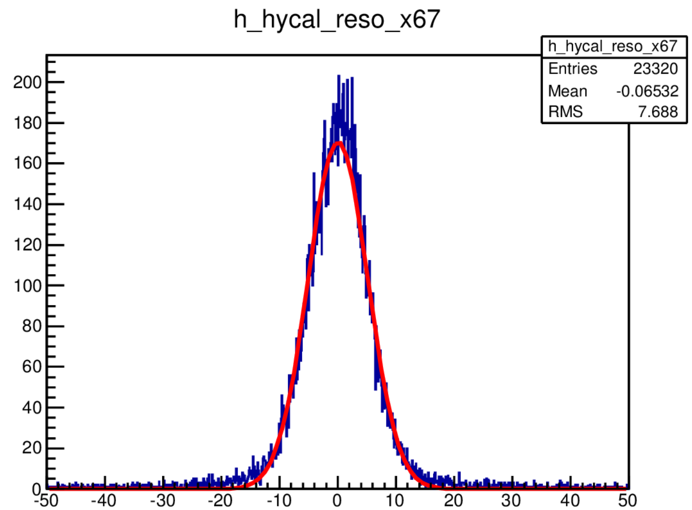
$$Eff_{cali} = R_{pair} \times \left(1 - \left(1 - Eff_{real}\right)^2\right) + R_{\text{forward compton electron}} \times Eff_{real}$$

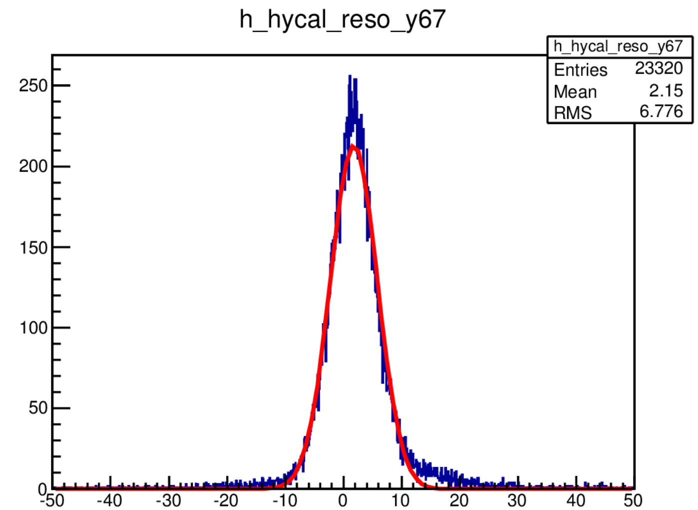
Run 982

Energy cut: 500MeV - 600MeV







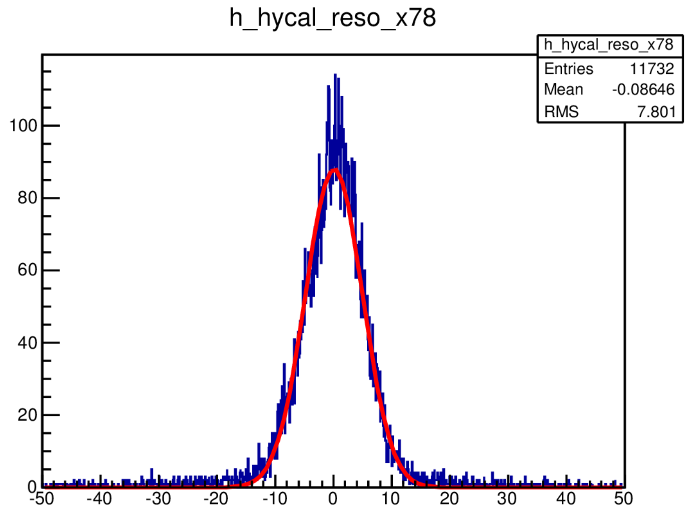


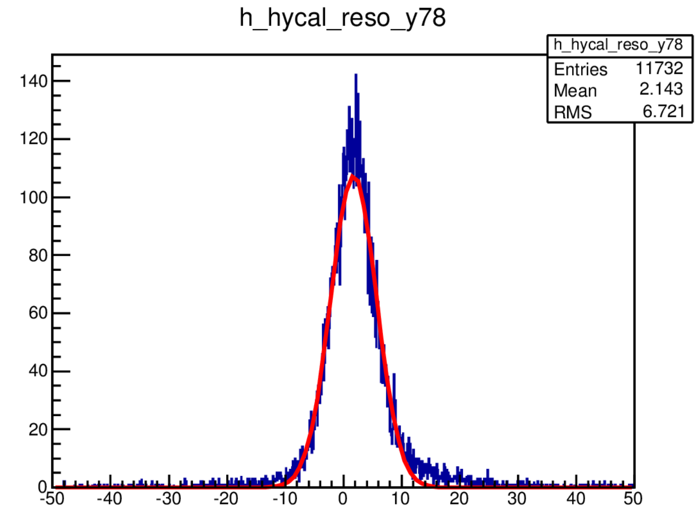
Energy cut: 600MeV - 700MeV

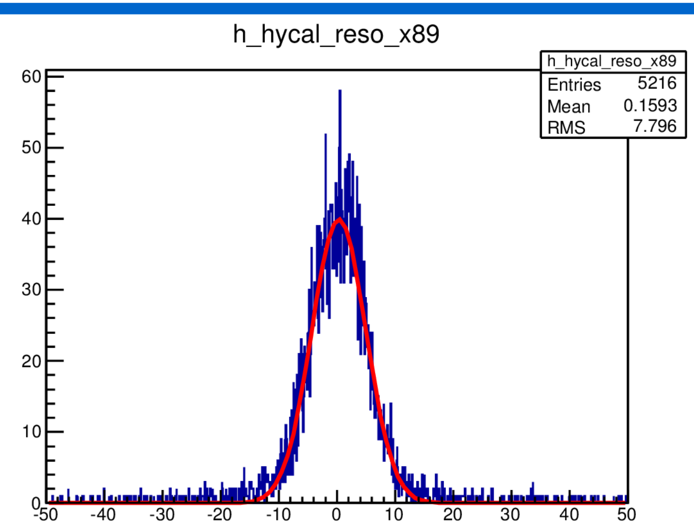
These do not represent the resolution of HyCal, because due to two combined showers due to e-e+ pair.

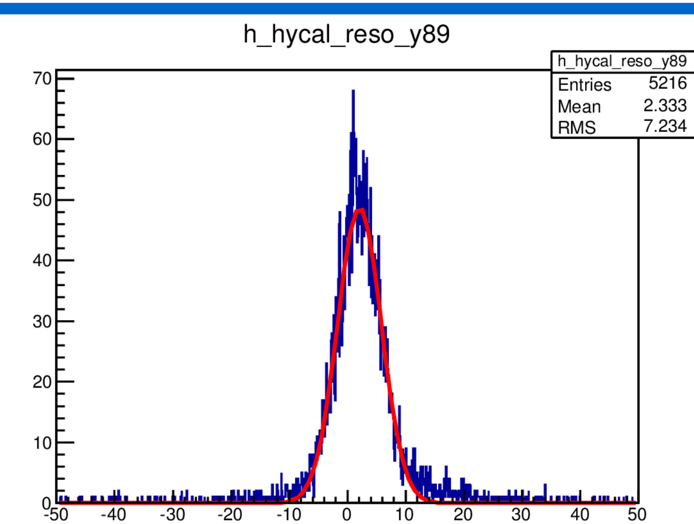
Run 982

Energy cut: 700MeV - 800MeV





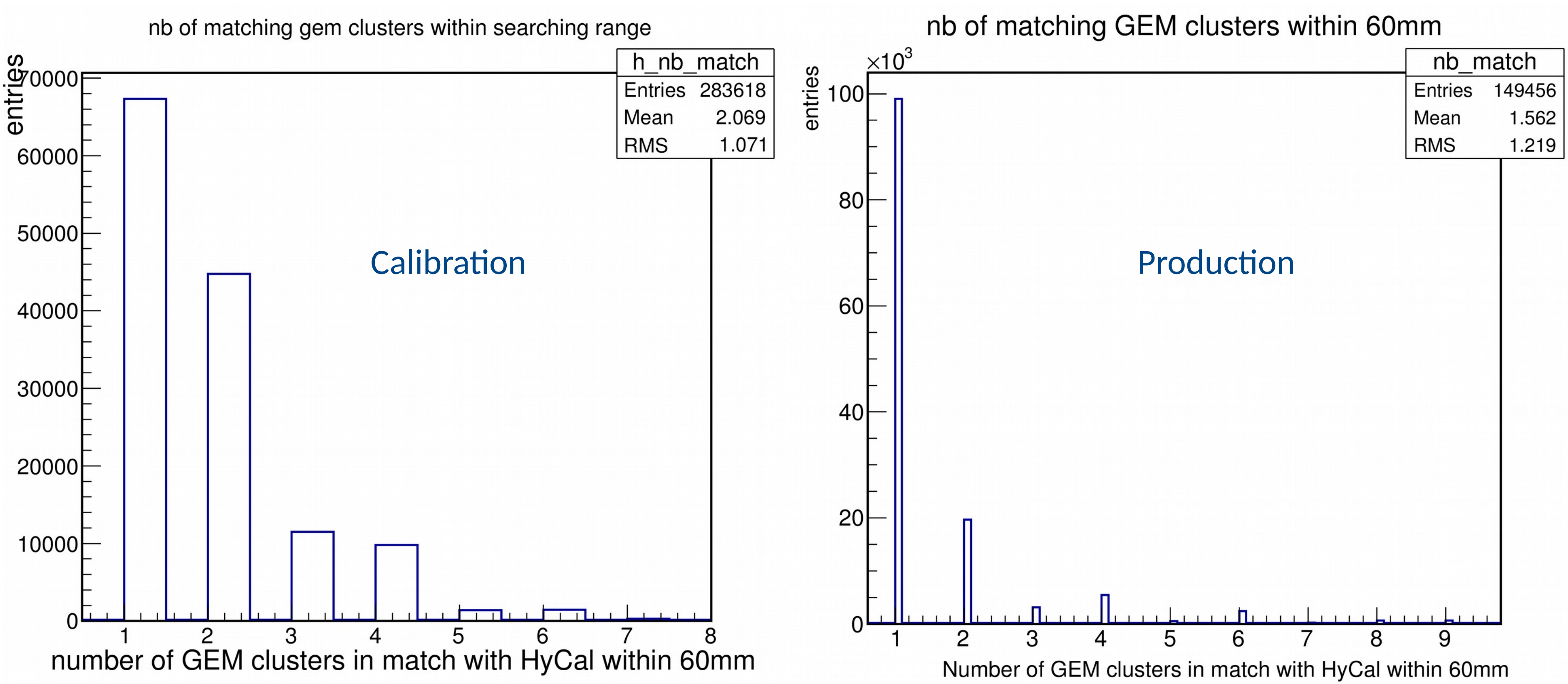




Energy cut: 800MeV - 900MeV

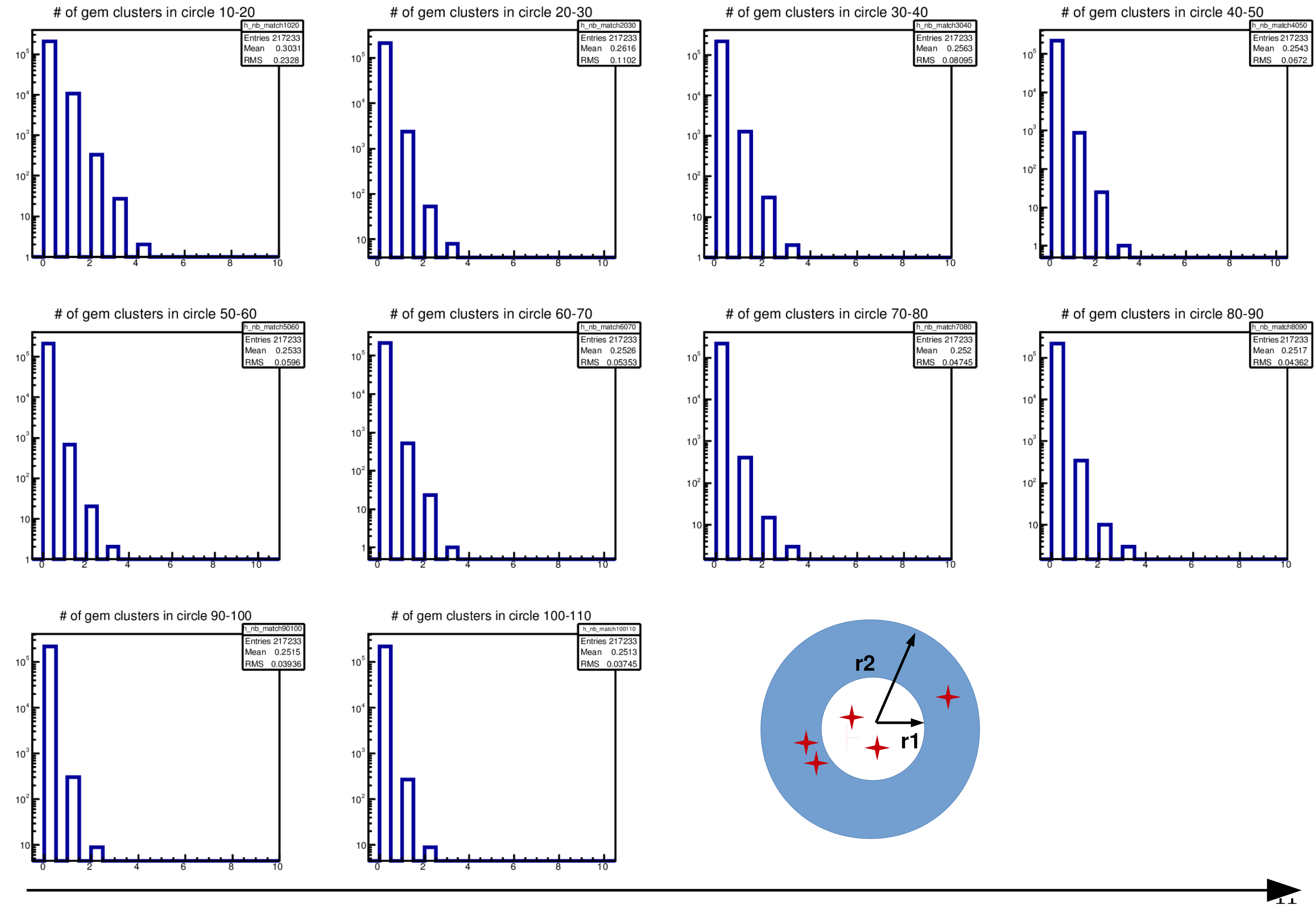
These do not represent the resolution of HyCal, because due to two combined showers due to e-e+ pair.

Run 982



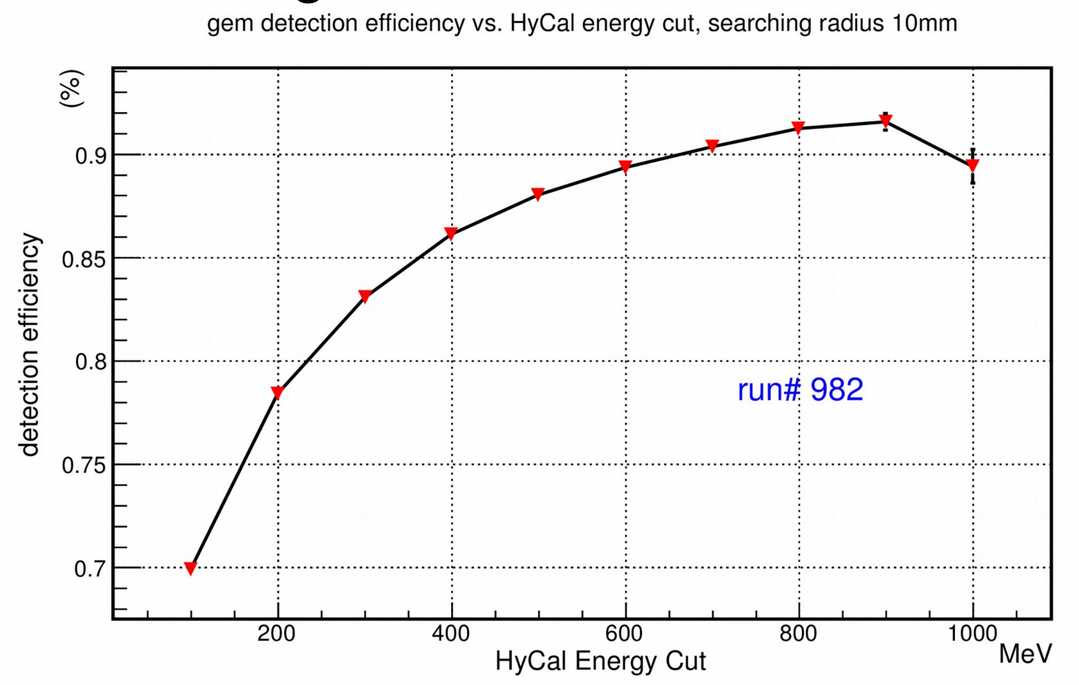
- This plot shows how many GEM clusters were found in a 60 mm circle during matching.
- Expect to see more clusters due to pair production, in calibration.
- More than 50% cases there are **>=2** clusters matching. Which means >50% of matching is unreliable.
- This is very different with production data.
- Production data is much cleaner.

Run 982

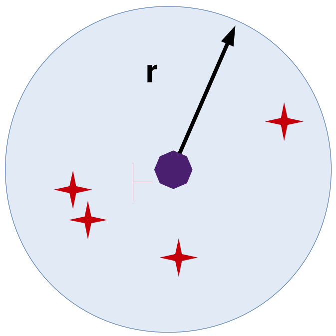


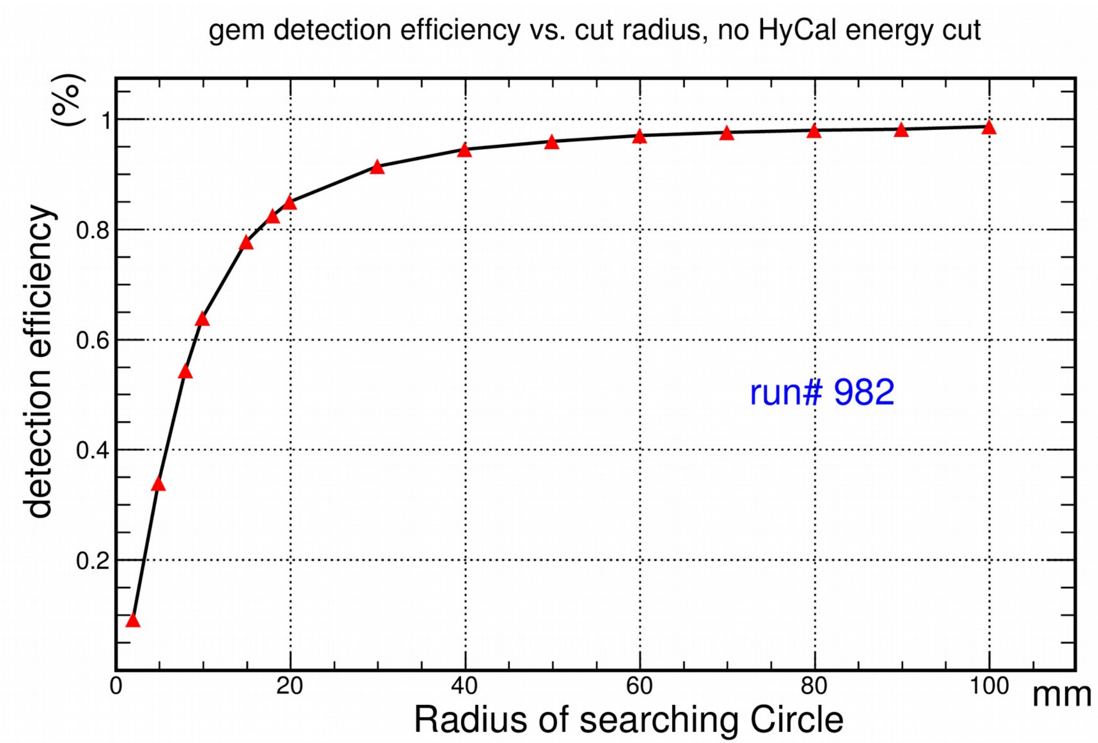
X axis: Number of matching gem clusters

Efficiency vs Searching Radius



Matching radius: 10mm.

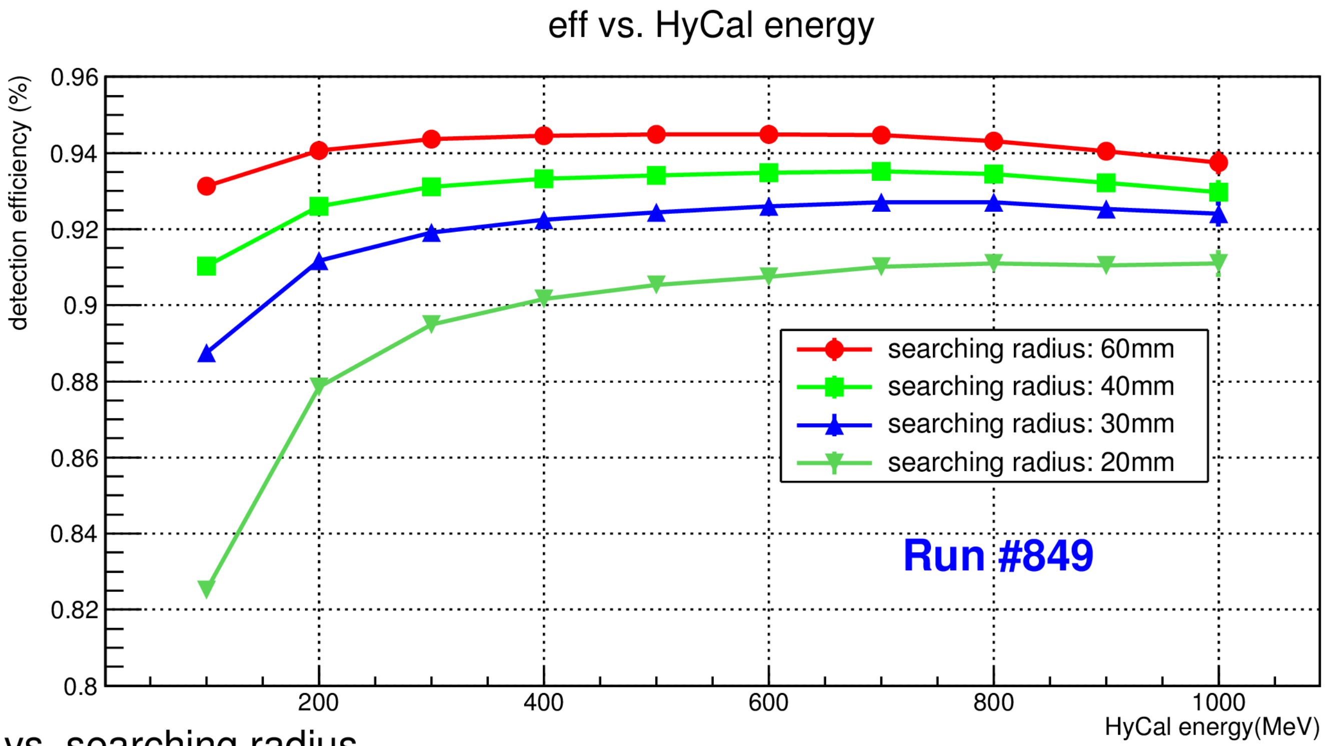


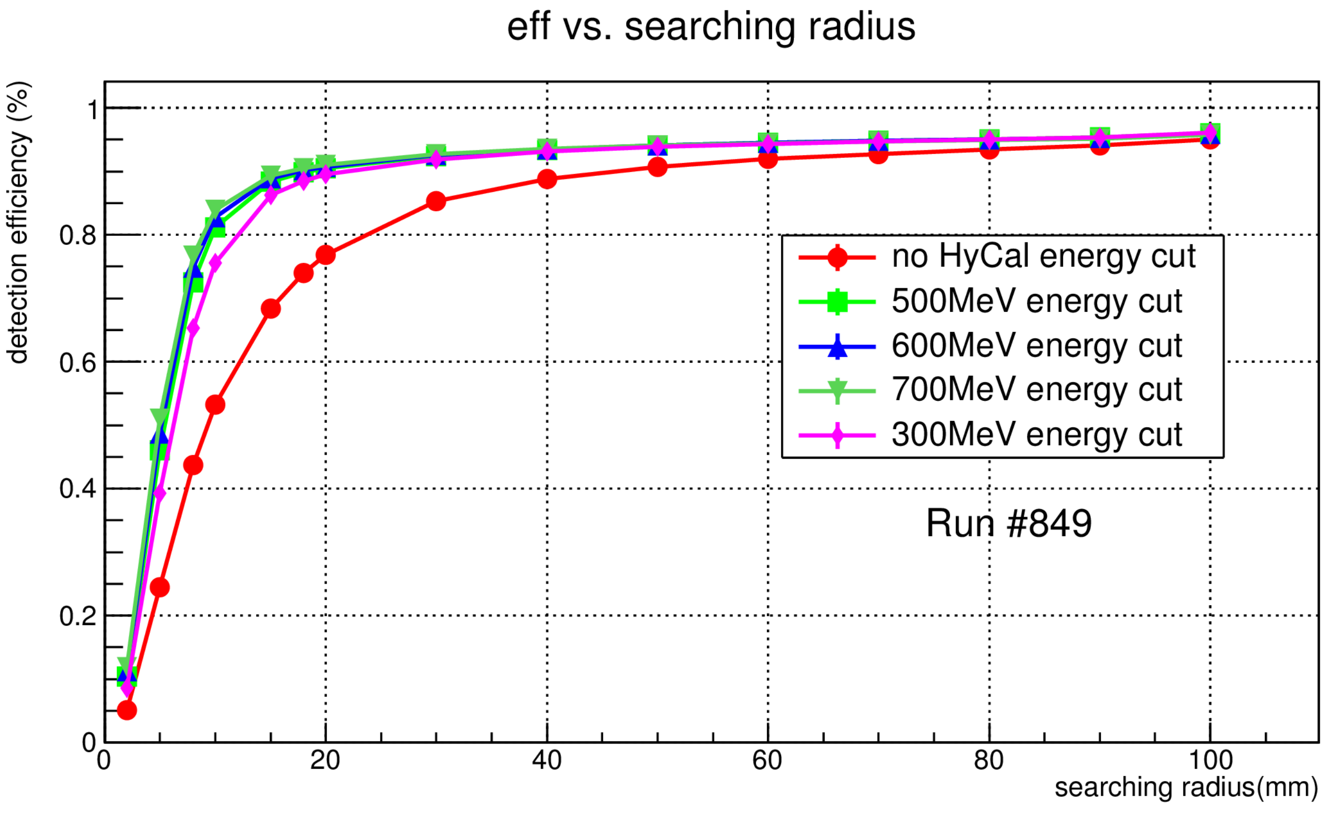


No HyCal energy cut in this plot,

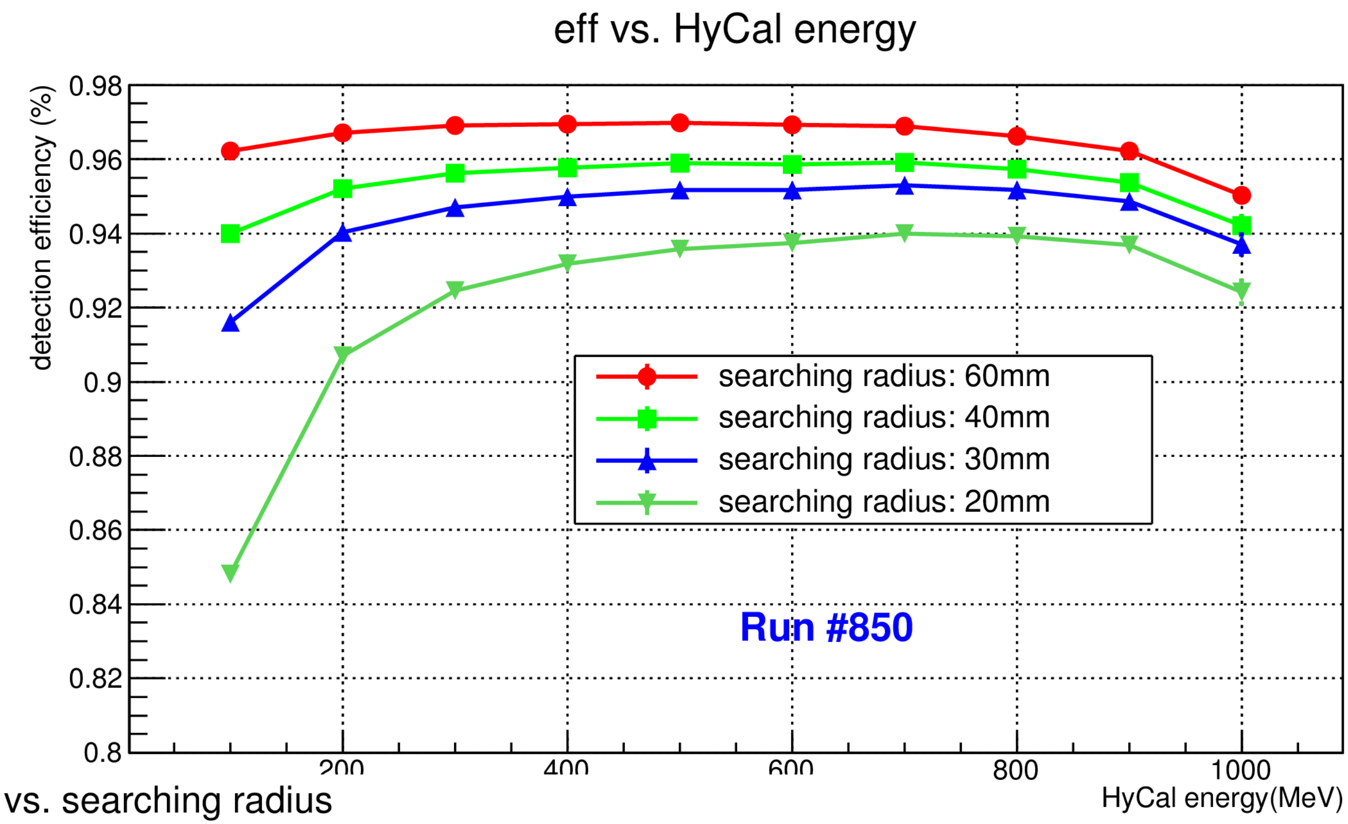
error bars < 0.1%, hided by the triangle mark.

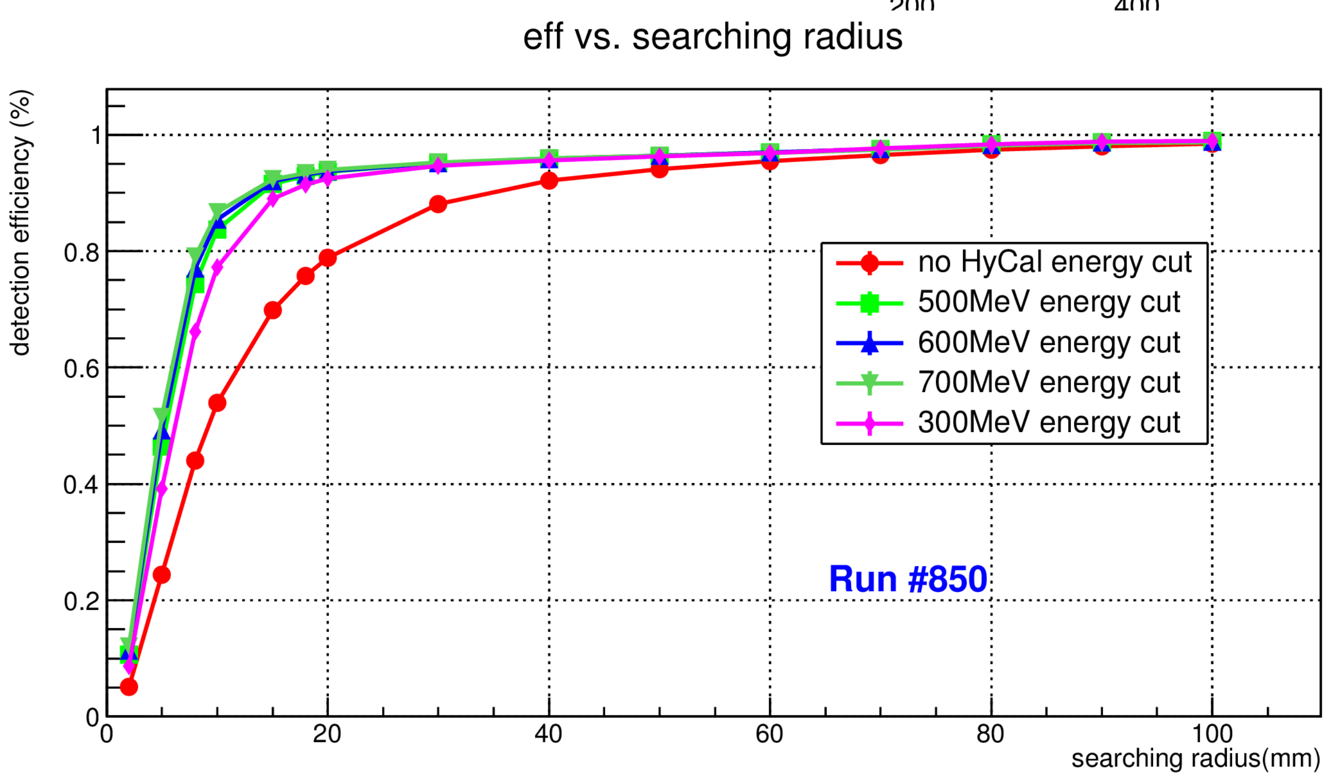
Summary Run 849





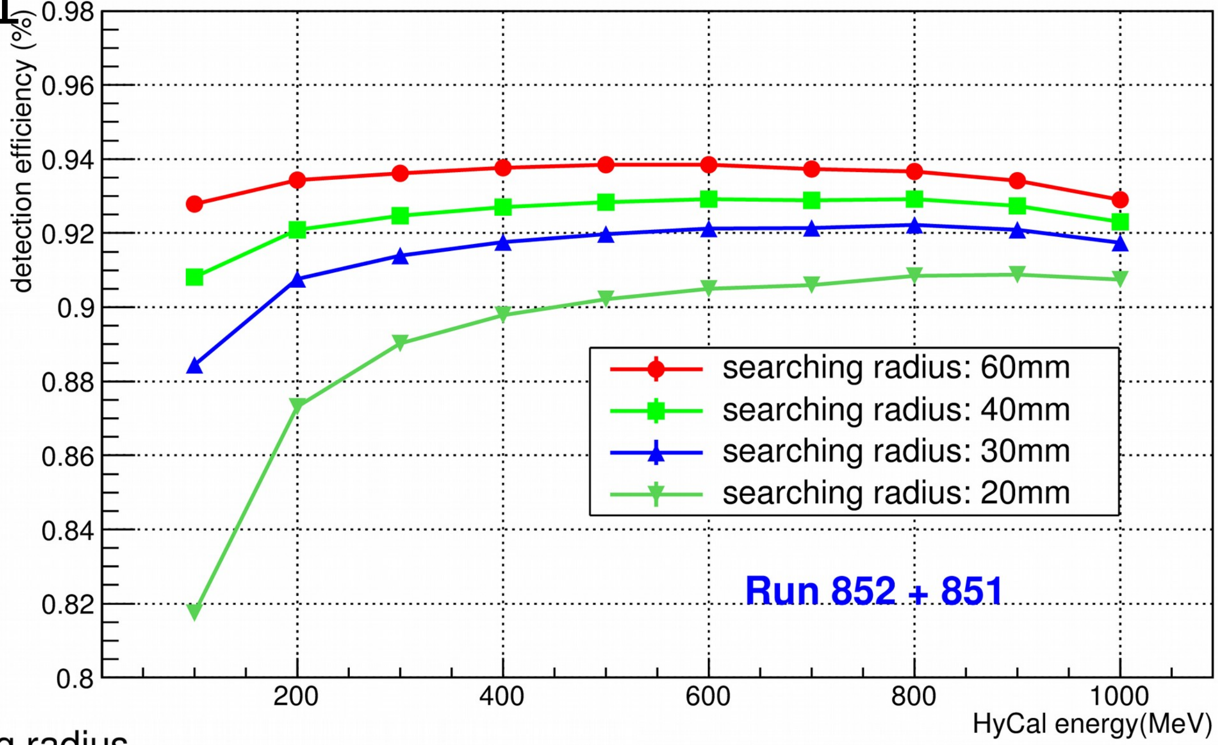
Summary Run 850



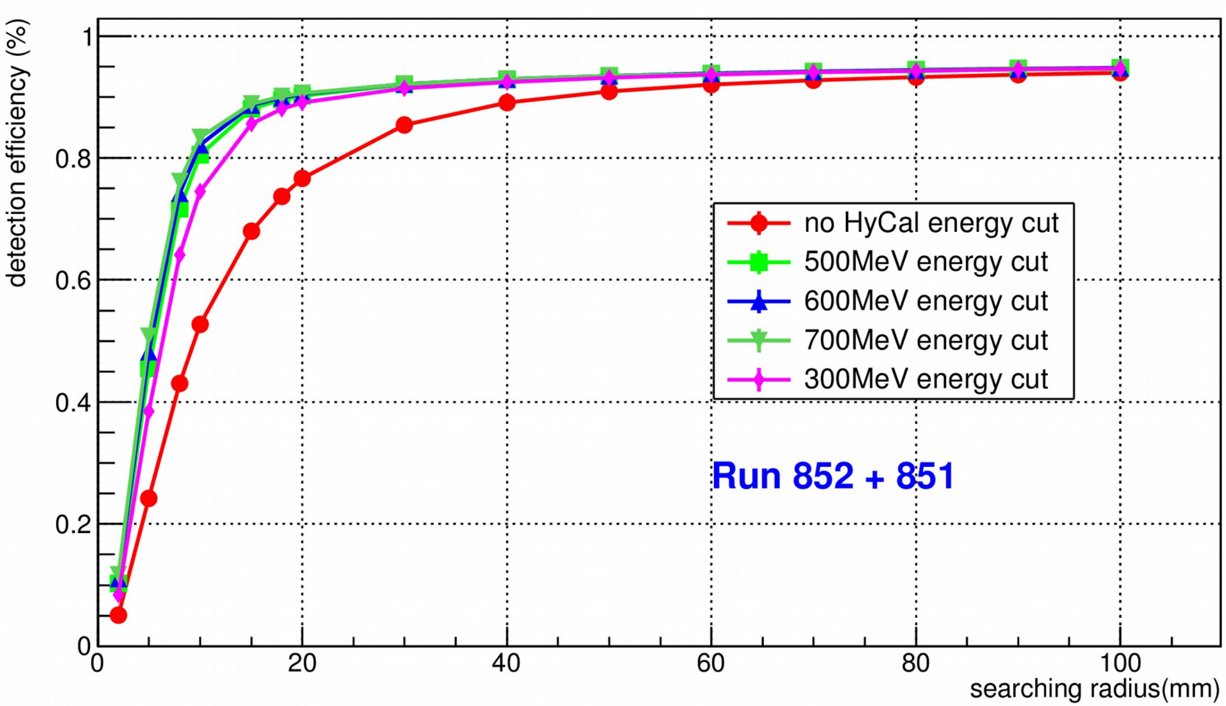


Summary Run 852 + 851

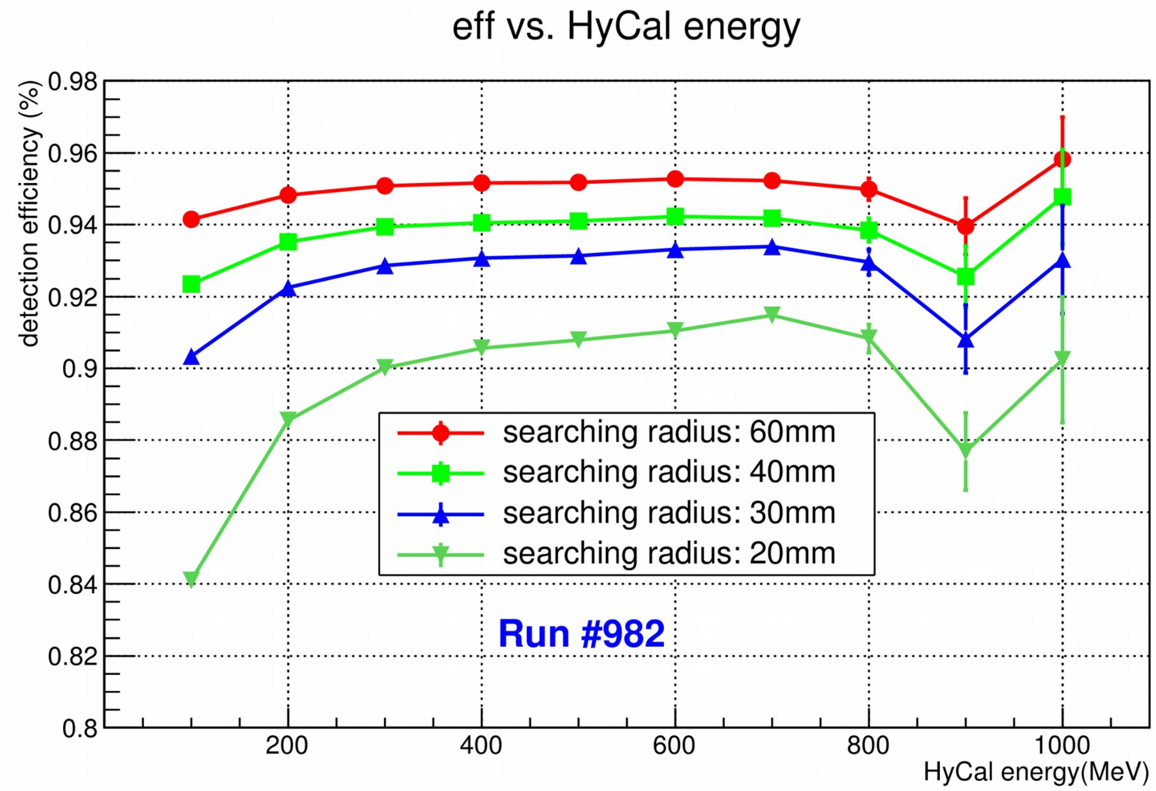
eff vs. HyCal energy

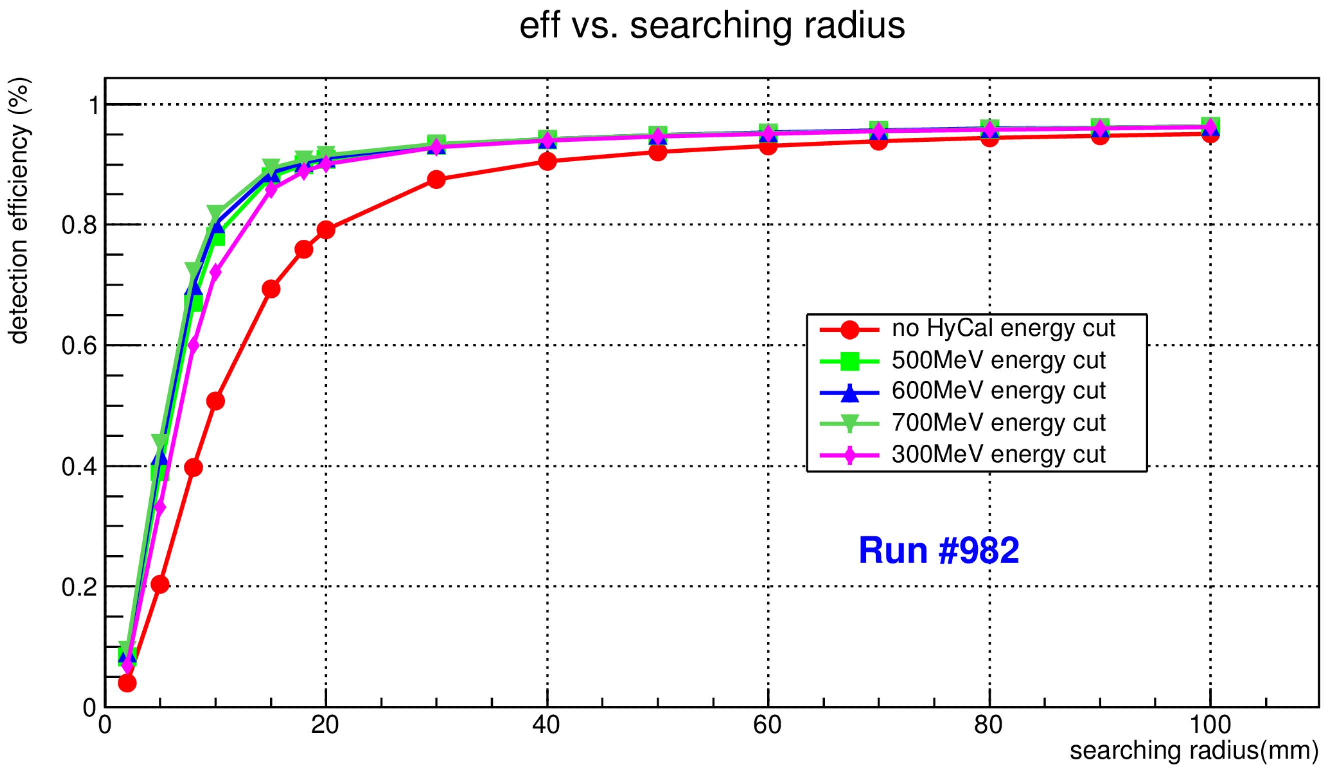


eff vs. searching radius

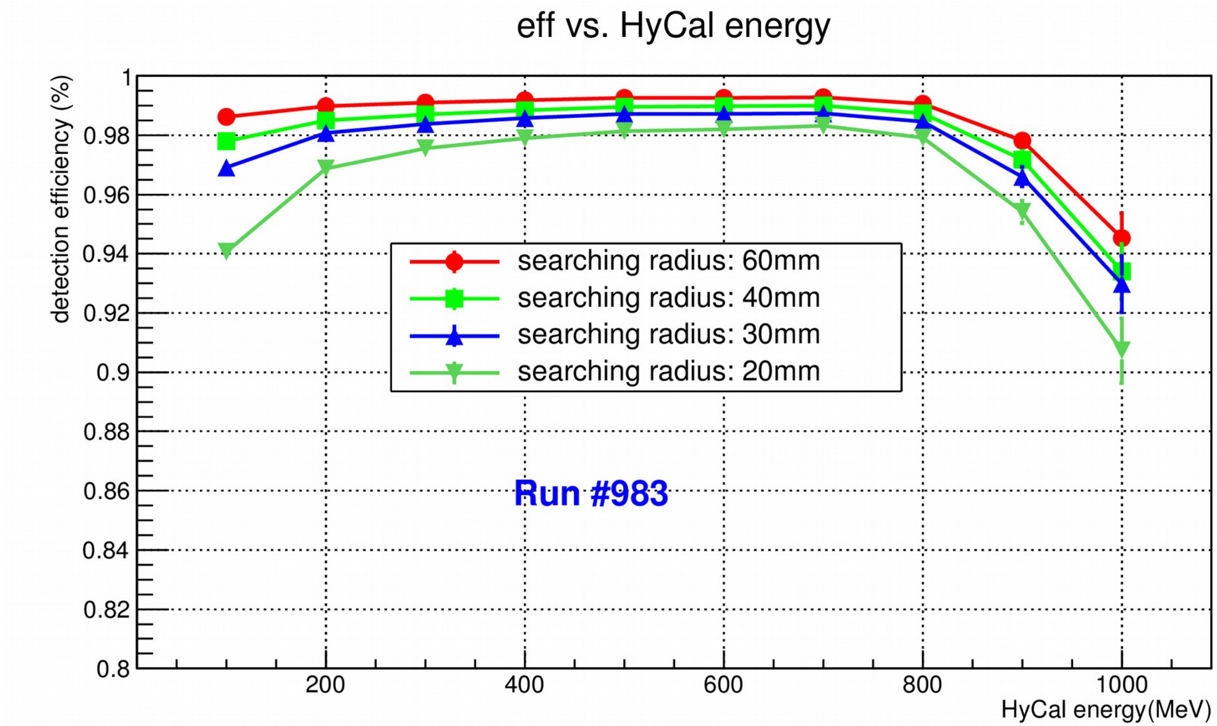


Summary Run 982

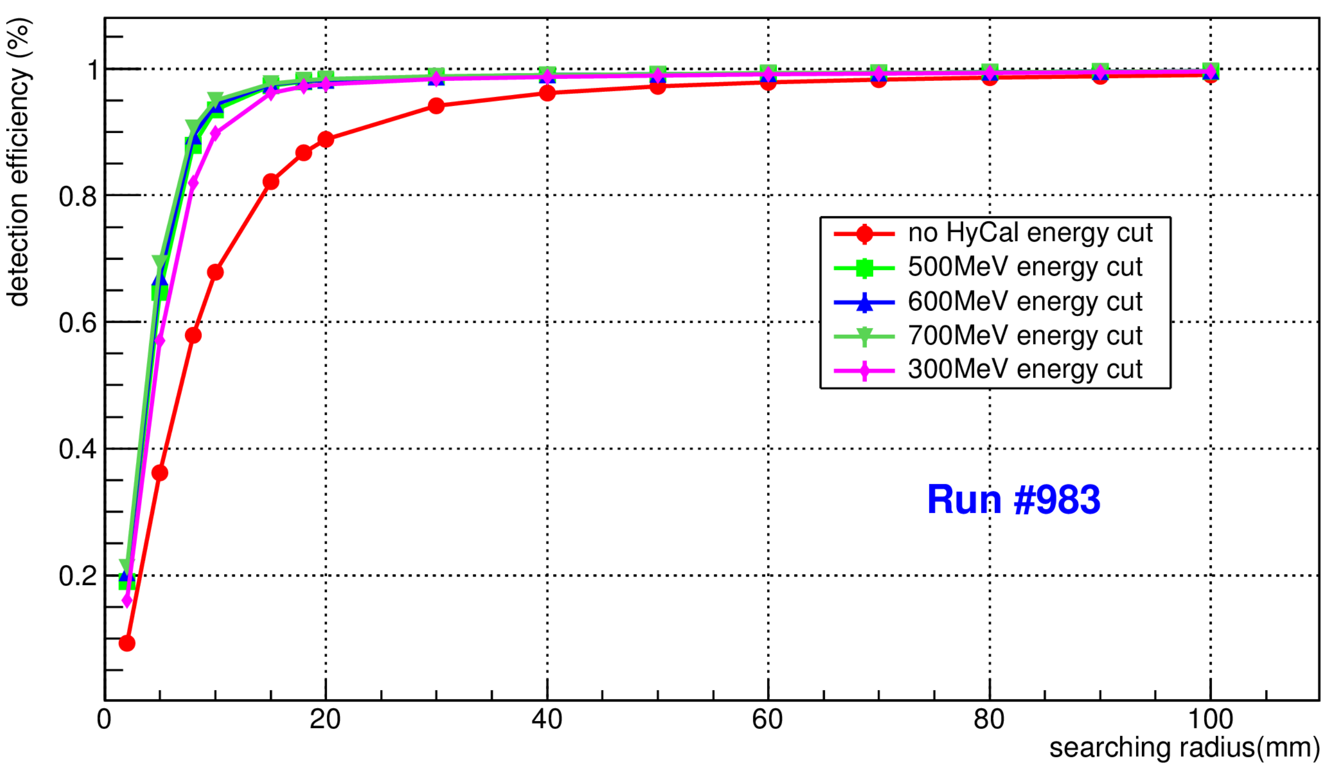




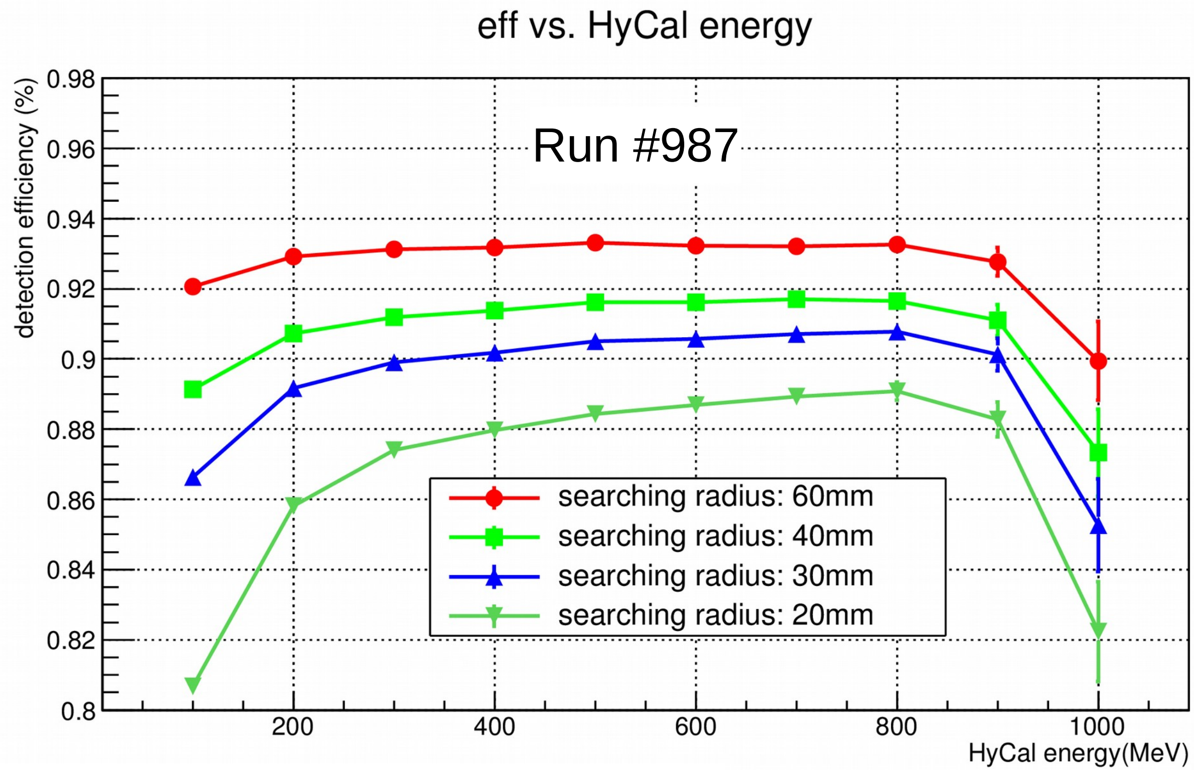
Summary Run 983

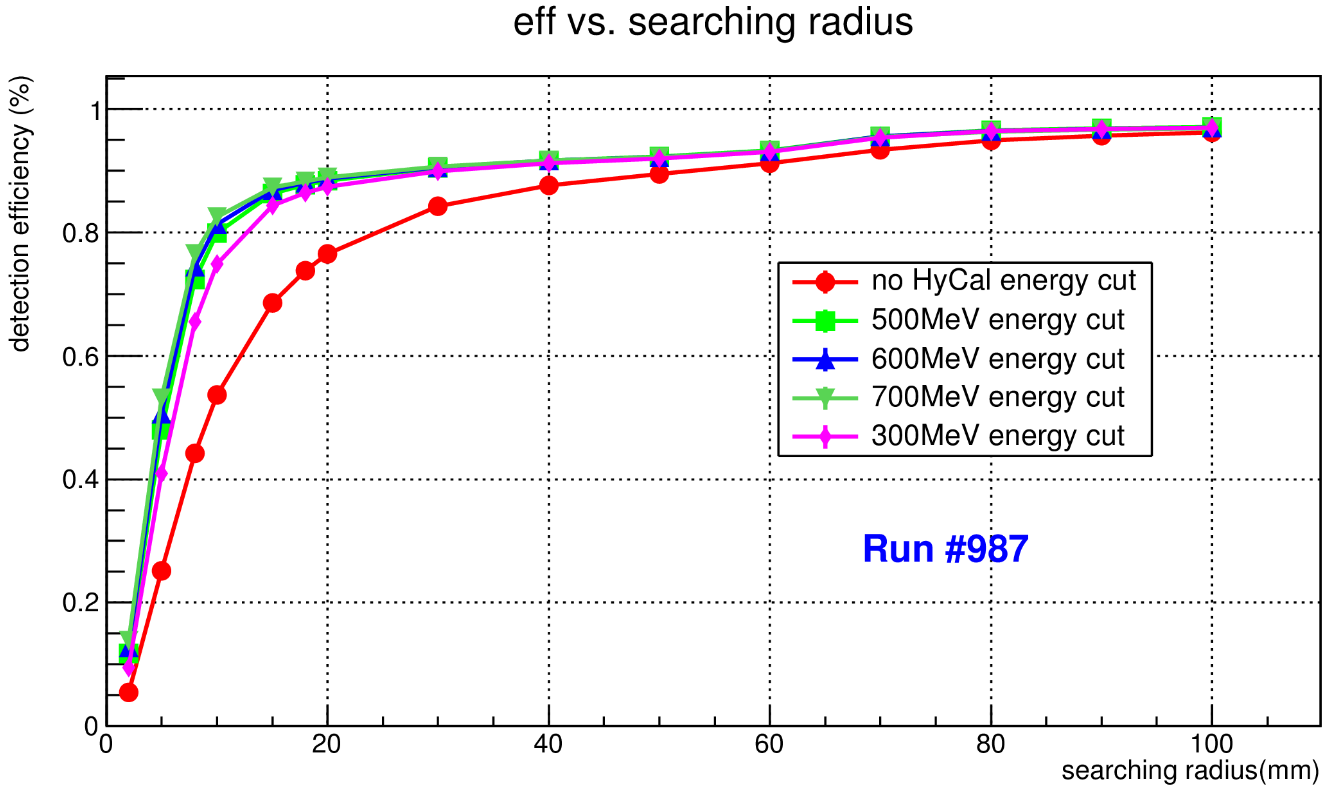


eff vs. searching radius

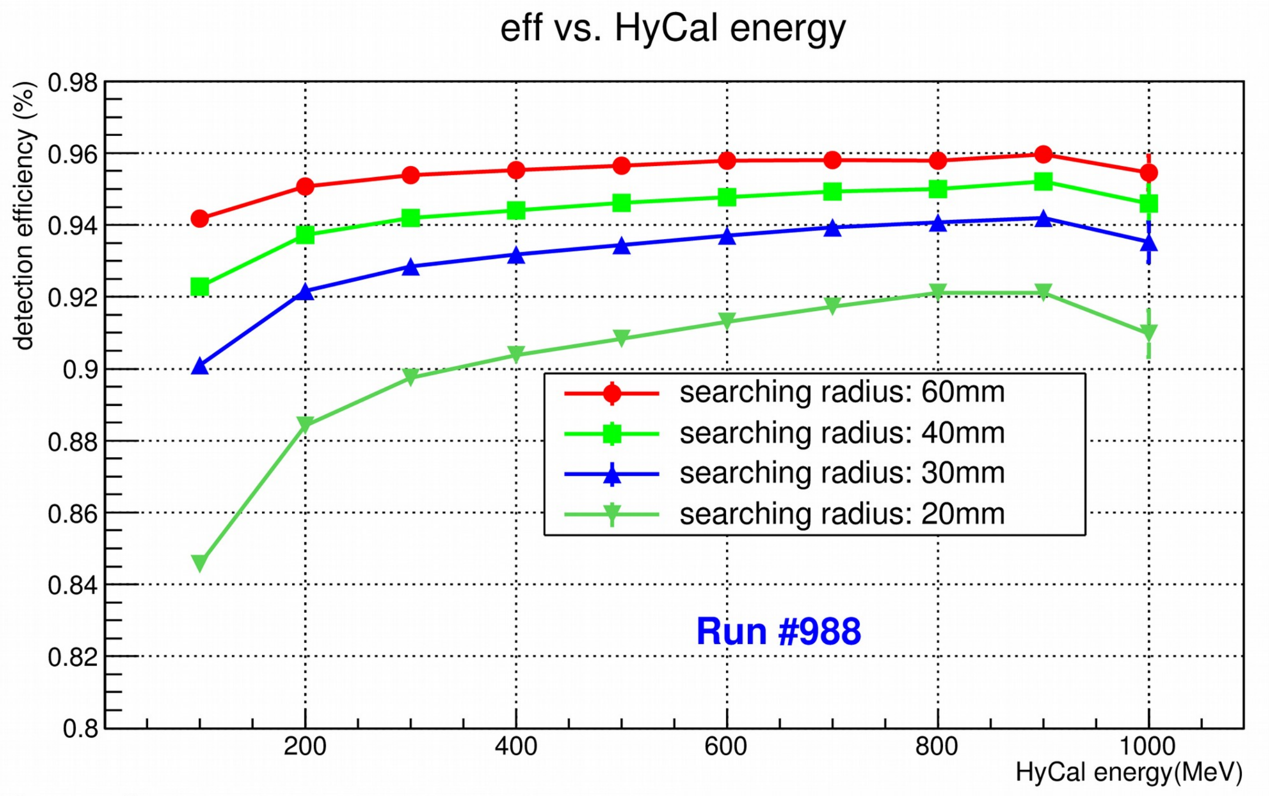


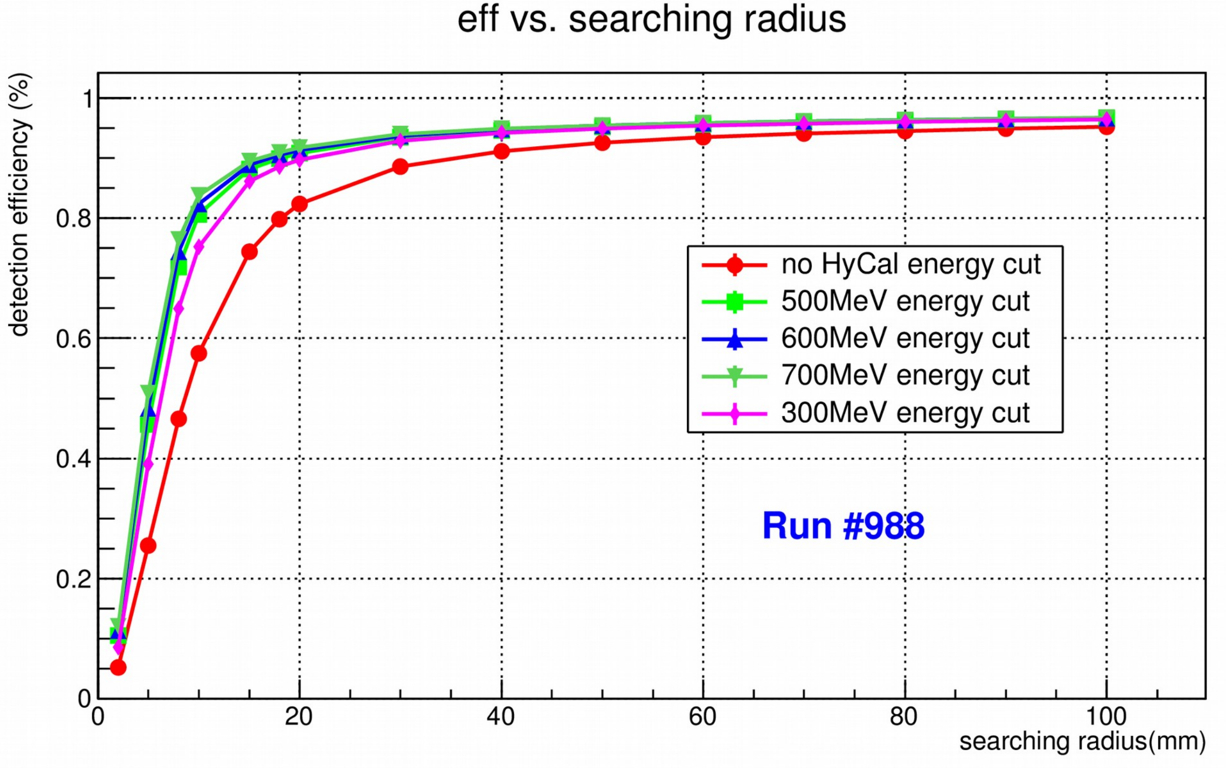
Summary Run 987





Summary Run 988





Summary

- Need to get GEM detection efficiency from calibration run.
- Using *(# GEM clusters)/(# HyCal clusters)* gives rough value, not correct value.
- Need to be corrected by pair production factor, Compton factor, HV sector/Spacer factor. (May need Geant simulation for this).
- Cross check with the efficiency results from production runs.
- Production data is cleaner than calibration data for efficiency calculation.