LCD dataset: Window selection, Local coordinates update

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Issue

- Events in h5 dataformat are centered based on barycenter of ECAL+HCAL energy deposits
  - Save 25x25x25 in ECAL, 5x5x60 in HCAL

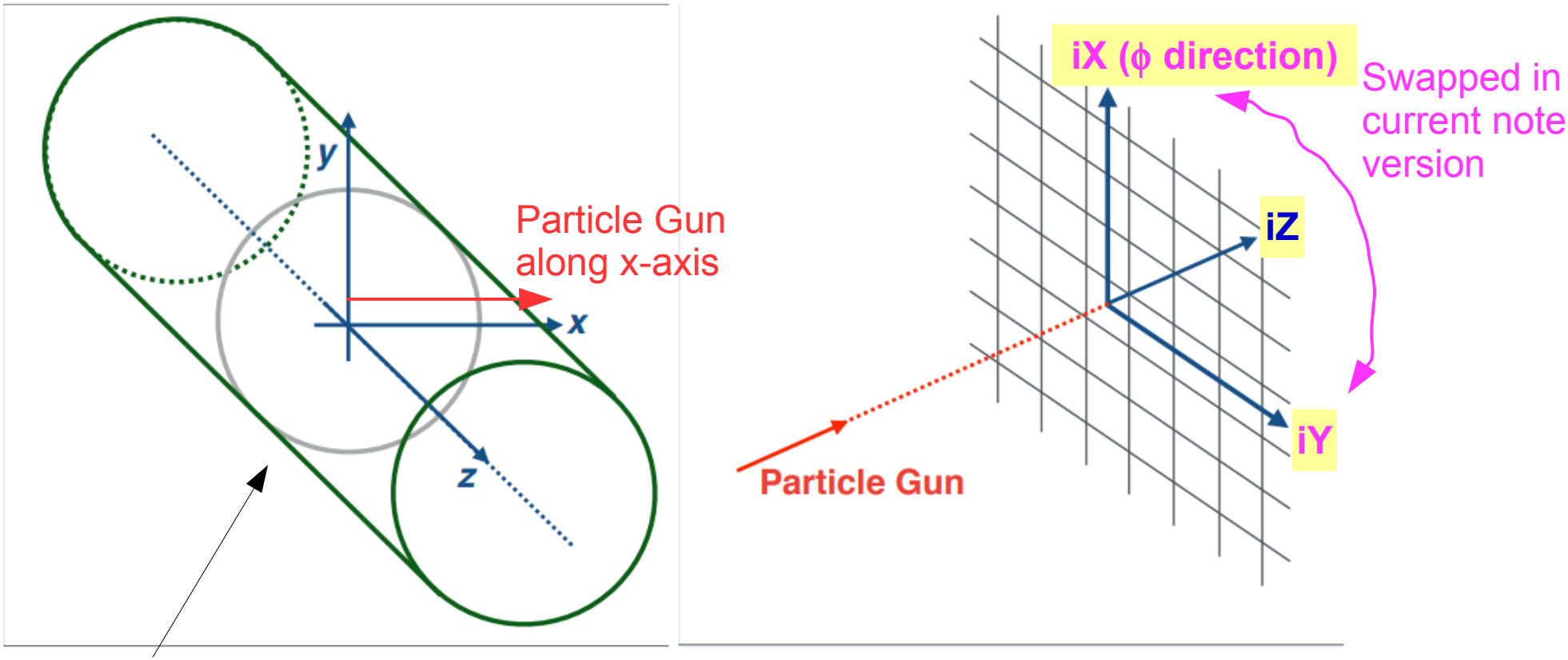
- Calo barycenter calculation was done in global coordinates
- Cells were saved based on local coordinates
  - In Maurizio's variable angle samples (±10° in ϕ / θ), wrong (empty) window is saved ~20-30% of the time for electrons
  - Need a fix before we can convert txt → h5

- Last time: found 2 issues with local iX (ϕ direction)
  - iX numbering only unique within a ϕ module, 1/12 of detector
    - Needed to add module information to txt files
  - iX granularity depends on depth layer in ECAL and HCAL
    - ECAL: 159-171 cells per module
    - HCAL: 31-59 cells per module

- **Solution**: remap iX to account for these issues
  - And center / save window entirely in local coordinates

Global vs Local Coordinates

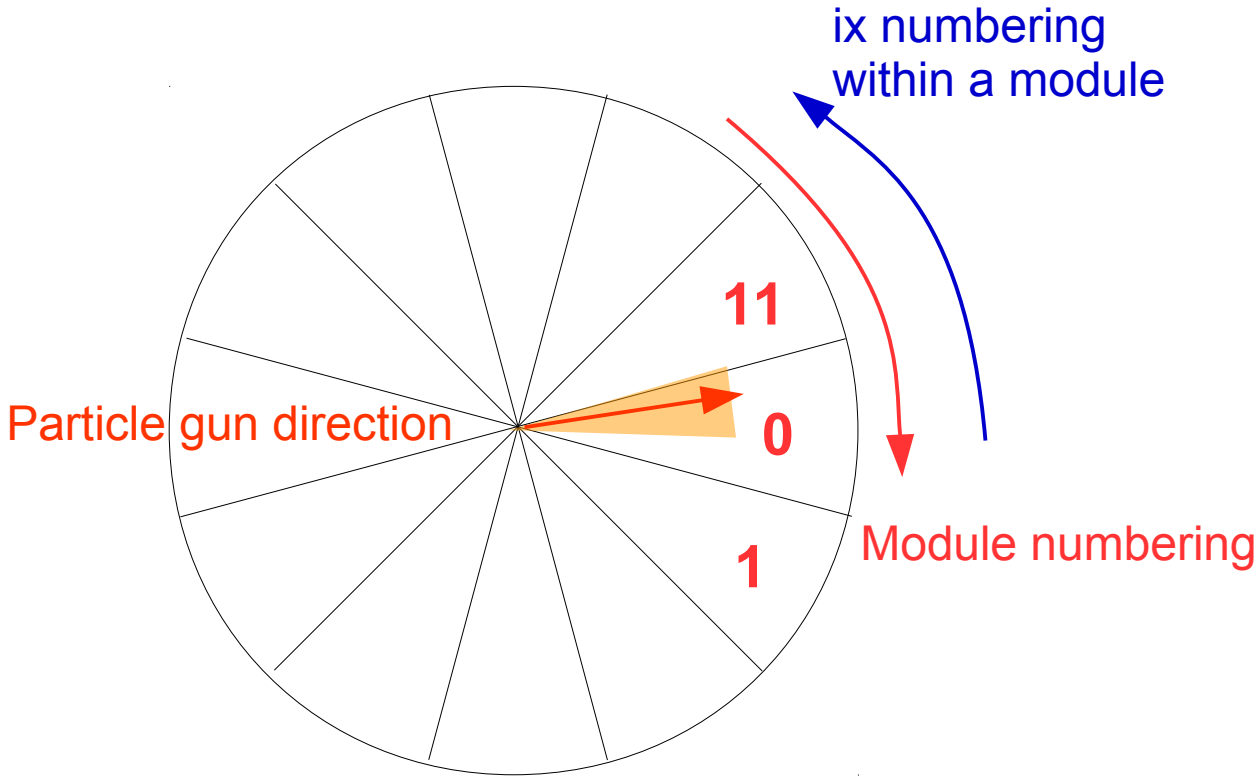
- Calo barycenter calculation was done in global coordinates
- Cells were saved based on local coordinates



From older note version:
https://www.dropbox.com/s/ktu1ly0ge9n4jyd/CaloImagingDataset.pdf?dl=0

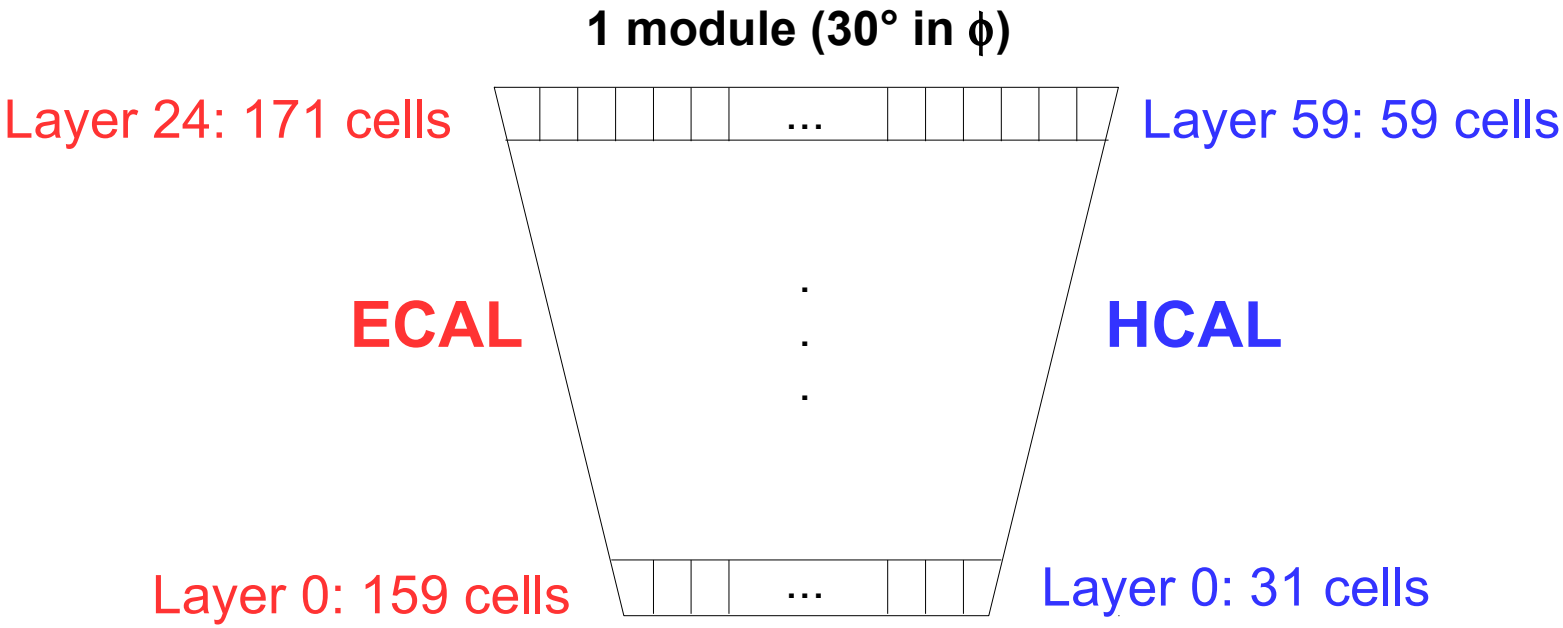
ϕ Modules / Numbering

- Created an **"absolute iX"** including module info, to be unique in the detector
  - Reversed module numbering in "absolute iX" to keep neighboring cells together
  - Also shifted so wrap-around is on opposite side of calo from our particle gun



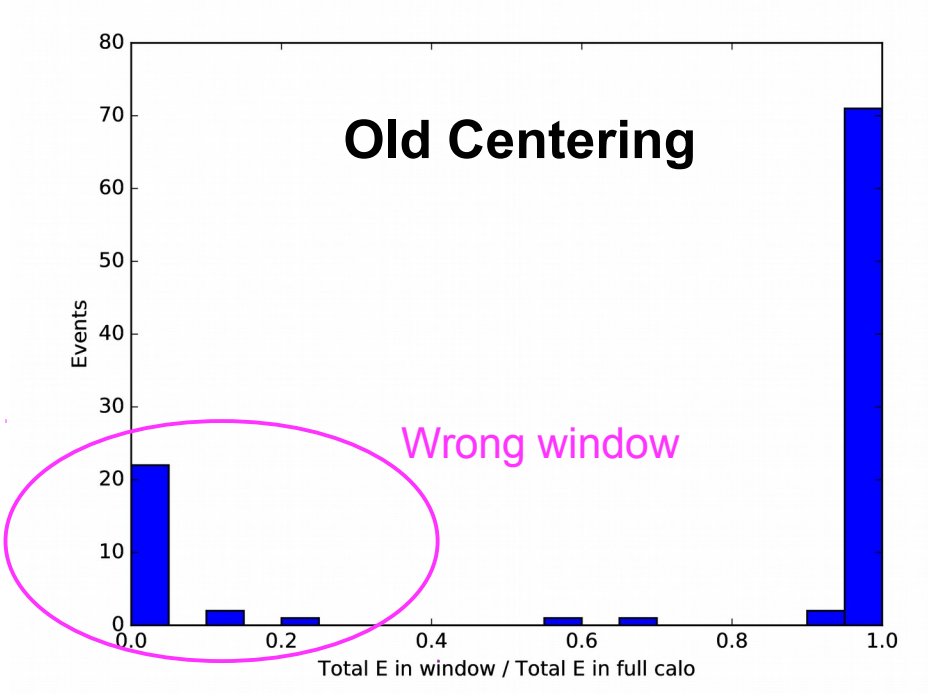
ϕ Granularity vs Depth

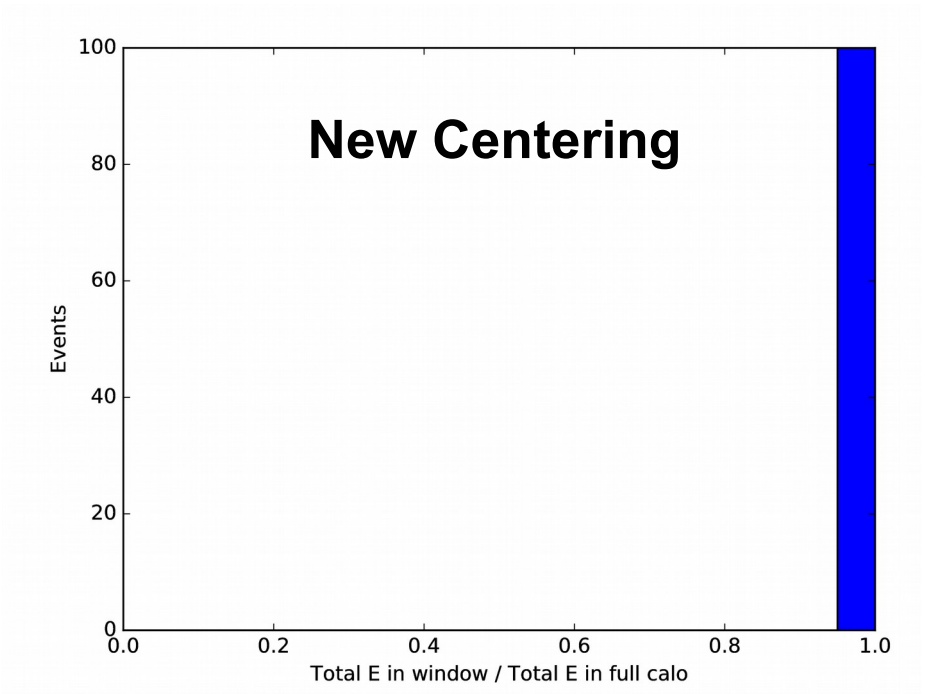
- Different ϕ granularity for each depth layer in ECAL, HCAL
- To center in local coordinates, apply a multiplicative transformation to iX
  - Scale every layer to look like innermost ECAL layer
  - Seems to work well



Results: Varying Angle Electrons

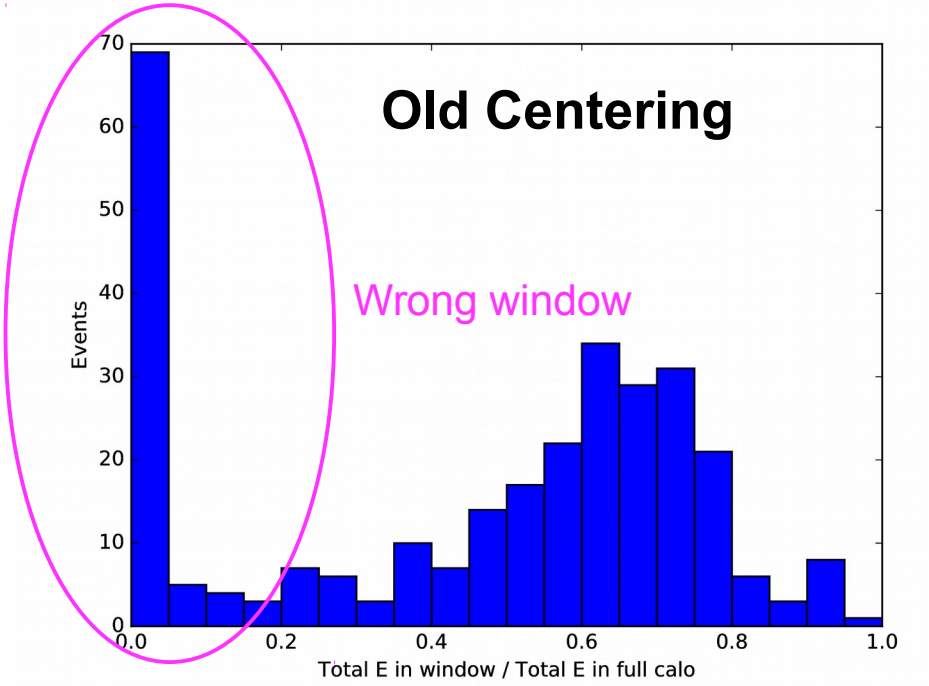
- New centering manages to capture ~full energy for all electrons in test sample (100 events)
  - Previous algorithm missed window completely for 20-30%
- Visual inspection of event displays also looks reasonable

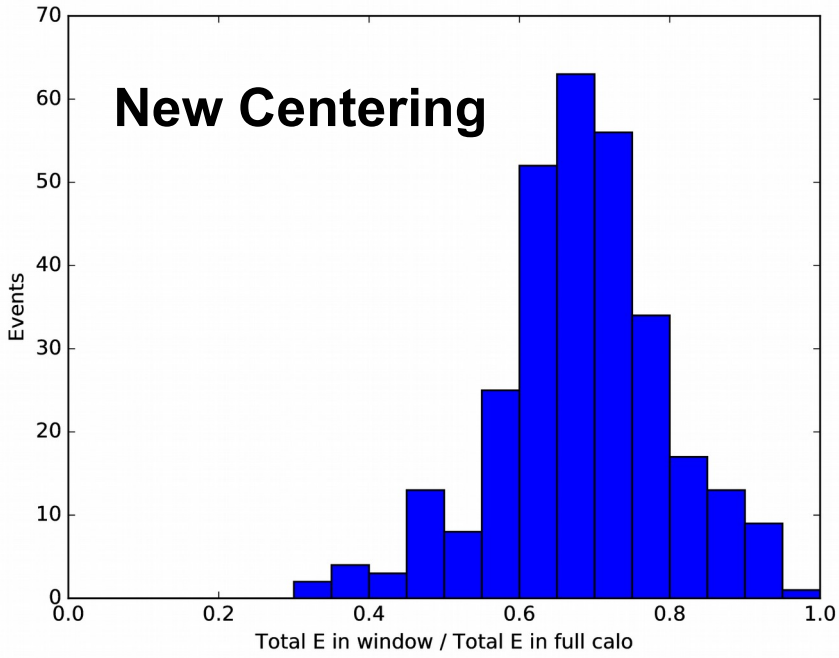




Results: Varying Angle ChPi

- New centering manages to capture energy reasonably well for test sample (300 events)
  - Previous algorithm missed window completely for ~30%
  - Comparable performance now to fixed angle sample
- Visual inspection of event displays also looks reasonable
  - Some events not perfectly centered, presumably from other deposits, but on the whole reasonable





Summary

- Have new centering algorithm based on local coordinates
  - Accounts for ϕ modules, different ϕ granularity by depth layer

- Performs well on variable angle samples ($\pm 10°$ in ϕ / θ)
  - Checked both electrons and charged pions

- **Can commit today if people agree**
  - root → txt: now save module info
  - txt → h5: new centering algorithm based on local coords

Bonus Slides

Workflow Reminder

- Workflow:
  - root → txt: save calorimeter hits as (ix,iy,iz,E,x,y,z,module)
    - ix,iy,iz are cell numbers in "local coordinates"
    - x,y,z are distance in "global coordinates"
    - https://github.com/UTA-HEP-Computing/CaloSampleGeneration/blob/master/Converting/python/Convert_to_txt.py
    - 12 modules in phi, newly added info
  - txt → h5: save subset of calo cell info around calo barycenter
    - https://github.com/UTA-HEP-Computing/CaloSampleGeneration/blob/master/Converting/python/Convert_to_h5.py
    - Updated to use local info, including module