2021 Data Reconstruction & Calibration for Analysis: Workshop Snapshot

> Norman Graf (SLAC) HPS Weekly Meeting March 23, 2022

Data Processing & Analysis

- Using the latest Ecal corrections as derived by Andrea (see his talk earlier today).
- Using HPS_Run2021Pass2FEE
- Using the usual mix of FEE, WAB & three-prong Tridents to study energy and momentum calibration
- Look at Møllers to study mass scale

FEE Ecal Cluster Energy 14168



FEE Track Momentum 14168



FEE E/p 14168



FEE Track p vs nHits 14168



FEE Cluster ix vs iy 14168

-22

-20

-16

-14

-12

-10

-8

-6

-4

-2

0

6

8

10

12

14

16

18

20

cluster ix vs iy 86938 Entries 5.5 T XMean 4.7438 5.0412 XRms : 5.0 YMean : -0.037210 YRms : 3.1815 4.5 4.0 3.5+ -1000 3.0 2.5 2.0 1.5 1.0+ 0.5 -100 0.0 -0.5 -1.0+ -1.5 -2.0 -2.5 -10 -3.0 -3.5 -4.0--4.5--5.0 -5.5--18 2 22

FEE E/p vs Cluster x 14168

EoverP vs cluster x top



EoverP vs cluster x bottom



FEE Track Finding Efficiency 14168



FEE Ecal Cluster Energy 14771

Top cluster energy

Bottom cluster energy



FEE Track Momentum 14771



Track momentum bottom

FEE E/p 14771



FEE Cluster ix vs iy 14771

47491 Entries 5.5 T 4.4172 XMean : 5.6204 XRms 5.0 YMean : -0.62117 4.5 YRms : 3.1498 -1000 4.0 3.5 3.0 2.5 2.0 1.5 1.0 -100 0.5 0.0 -0.5 -1.0+ -1.5 -2.0 -10 -2.5 -3.0 -3.5--4.0--4.5--5.0 -5.5--20 -18 -2 10 18 20 22 -22 -16 -14 -12 -10 -8 -6 -4 0 2 6 8 12 14 16

cluster ix vs iy

FEE Track p vs nHits 14771



FEE E/p vs Cluster x 14771

EoverP vs cluster x top



EoverP vs cluster x bottom



FEE Track Finding Efficiency 14771

Bottom cluster energy - electron Bottom cluster energy - photon Bottom cluster energy

Top cluster energy - electron Top cluster energy - photon Top cluster energy

Top cluster energy Bottom cluster energy 6,600 -5,000 -📕 electron Top cluster energy electron Bottom cluster energy 6,400-4,800photon Top cluster energy photon Bottom cluster energy 6,200-4,600-6.000-4,400-5,800 5.600 4,200-5,400-4,000 5.200 3.800-5,000-4,800-3.600-4,600-3,400-4,400-3,200-4.200-4,000-3,000 3,800-2.800 3,600-2,600-3,400-3,200-2,400 3,000-2,200-2,800-2,000 2.600 2,400-1,800-2,200-1,600 2,000-1,400-1.800-1,600-1,200-1,400-1,000-1,200-800-1,000-600-800-600-400 400-200-200-0-0 -6 6 0 2 3 5 7 8 9 10 0 2 3 Δ 5 7 8 9 ¹⁰16

FEE Vertex Positions 14168



FEE Vertex Positions 14771



18

FEE Tracking vs time

- Early run 14168 appears to be well behaved.
- Later run 14771 has issues with track-finding efficiency, momentum reconstruction and global position

WAB Data Selection and Recon

- Reran the reconstruction over a selected set of WAB candidates from the 2021 run.
 - Two-cluster events which reconstruct as electron +photon with esum>3GeV
- Using the latest snapshot of iss887 which has Andreas' gains (from FEEs) and "sampling fractions" (from MC and data WABs)

Electron Energy + Photon Energy



21

Electron Energy + Photon Energy

Gaussian Fit - bottom Electron + Photon cluster Esum



Electron Momentum + Photon Energy



23

Electron Momentum + Photon Energy

Gaussian Fit - bottom Electron momentum + photon Energy



WABs

- Ecal corrections are working well
- Track momentum appears to reconstruct a few percent low.

Three-prong Tridents



Three-prong Tridents: Electron1



Three-prong Tridents: Electron2



Three-prong Tridents: Positron



Trident Vertex Position



Tridents

- Electron track calibration appears to be OK
- Positron track momentum is low
- Difficult to say much about vertex position knowing that the FEE "vertices" show such a large top/bottom discrepancy
 - Perhaps look at positron-same-side-electron vertexing

Møllers Signal Selection track sum pX final track sum pY final x10⁵ Entries : 976901 x10⁵ Entries: 977599 Mean: 0.10303 Mean: 1.6321E-4 3.0 -2.4-Rms: 0.012275 Rms: 8.2367E-3 2.2 2.5-2.0 1.81 2.0-1.6 1.4 1.5-1.2-1.0 1.0-0.8 0.6-0.5 0.4 0.2-0.0+ 0.0 0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 -0.10 -0.08 -0.06 -0.04 -0.02 0.00 0.02 0.04 0.06 0.08 psum final invariant mass x10⁵ Entries : 977599 x10⁵ Entries : 977417 Mean: 3.5742 Mean: 0.061291 1.4 -1.2-Rms: 0.26280 Rms: 0.011571 1.1 1.2+ 1.0 0.9 1.0+ 0.8 0.7 0.8 0.6 0.6+ 0.5 0.4 0.4 0.3 0.2 0.2+ 0.1 0.0+ 0.0 2 3 5 0.12 0 4 6 7 0.00 0.02 0.04 0.06 0.08 0.10 32⁰¹⁴ 1

0.10

Møllers Out-of-time Backgrounds



Møllers Background Subtracted



Møller Candidate Mass

Møller Mass Gaussian Fit



Next steps

- Need to systematically study the SVT alignment as a function of time to understand track-finding efficiency as well as momentum scale and resolution.
- The data taken using the SVT positioning wires (runs 14753 and 14754) should be used when imposing a beamspot constraint as target location is not as well known as the wires
- Use energy of well-calibrated Ecal clusters associated with tracks to impose a momentum constraint on the tracker alignment
- Use WAB and three-prong tridents to check both energy and momentum calibration scale and resolution
- Use track-by-track p-θ constraint from Møller events to obtain global alignment.