2021 Data Reconstruction: Calibration

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Software Meeting

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2021 Offline Data Reconstruction

- Software development for the 2021 run should be done on git branch Run2021.
- Reconstruction Version
  - hps-java 5.1 snapshots on Run2021 branch
- Detector
  - HPS_Run2021Pass1Top
- Steering File
  - PhysicsRun2021_pass0_recon_evio.lcsim
    - n.b. this runs only the Kalman Filter track finding & fitting

2021 Data Samples

- A few special runs (e.g. FEE & Møller trigger runs) and sample partitions from other runs have been processed and made available for analysis.
- /volatile/hallb/hps/production/physrun2021/recon/HPS_Run2021Pass1Top/
  - 14* : physics runs, ten partitions 40-49
  - 14168: FEE run
  - 14362, 14364: Møller special runs at 3.74 GeV
  - 14652, 14653: Møller special runs at 1.92 GeV
  - 14753, 14754 SVT positioning wire target
  - 14764, 14768 Field-off (2H02 HARP, collimator wire target)
- Not an exhaustive list, but representative of the various data sets available for calibration and alignment.

Calibration Current Status

- Ecal is using the correction factors derived for the 2019 data
  - Corrections for the 2021 data are being worked on
    - Will skim the FEE trigger events from the 2021 data and perform the iterative crystal-by-crystal corrections and any run-dependent corrections (e.g. temperature, radiation exposure)
    - MC samples of single electrons, positrons and photons at a number of energies for the 1.92 and 3.7 GeV runs have been generated and will be used to determine the “sampling fraction” corrections
    - Please contact Andrea Celentano for details and to offer your assistance.
- SVT top has had an initial alignment pass performed on the SVT top sensors using FEEs
  - Will extend this to bottom sensors
  - Will use positrons as well as electrons
  - Will use lower-energy matched clusters as momentum constraint once Ecal is calibrated.
  - See PF’s presentation for details

Ecalibration: Process

- Will use FEEs to iteratively derive the crystal-by-crystal corrections in the data
- Will use MC single particles (e^+, e^-, γ) to derive the position and energy-dependent "sampling fraction" corrections, i.e the energy lost in the interstitial regions or off the edges of the calorimeter
- Process and procedures are in place. Andrea Celentano will be leading this effort, as he did for the 2019 data.

ECalibration: Data and MC

- Will use the dedicated FEE run 14168 and skims of the FEE triggers throughout the run*
- MC single particle events (e^+, e^-, γ) have been generated at a range of energies and positions which uniformly cover the face of the ECal

ECalibration: Validation

- FEE samples at both 1.92 and 3.7 GeV will be used by requiring single cluster energies to equal the beam energies.
- WAB samples will be used to test the “sampling fraction” corrections for both electrons and positrons at lower cluster energies by requiring that the energy sum of electron + photon clusters equals the beam energies
- Three-prong tridents will be used to test the “sampling fraction” corrections for positrons by requiring the energy sum of the two electrons and one positron to equal the beam energies.

SVT Alignment / Calibration

- PF has performed an initial alignment of the SVT top layers using FEEs
- Need to address bottom SVT
- Will then need to extend alignment to positron side and to lower momenta
  - Will use E/p to constrain momentum for tracks associated with ECal clusters once the ECal has been calibrated.
- Will use field-off data from two z locations

SVT Calibration : Validation

- Will derive / validate SVT alignment / calibration using FEEs at 3.74 and 1.92 GeV
- E/p using calibrated ECal clusters
- WABs: e^- momentum + γ energy = beam energy
- Three-prong tridents: momentum sum = beam momentum and direction
- Møllers:
  - Use θ-p relations to validate calibration and alignment
  - Use invariant mass and resolution to validate calibration and alignment.
- Validate global alignment with SVT wire data

Action Items

- Skim the FEE, Møller, di-muon and random triggers
  - Maurik has updated his trigger skim program
  - Nathan has run a few test jobs
    - output is at /volatile/hallb/hps/baltzell/trigtest3
    - fee 2.0%
    - moll 3.3%
    - muon 1.9%
    - rndm 2.9%
  - Represents ~10% of the data
  - Need to validate the output before proceeding with production skimming
  - Need to establish a “good run” list for 2021
- Derive the Ecal calibrations
  - Crystal-by-crystal corrections from the FEE data
    - available at 1.92 and 3.74 GeV
  - “Sampling Fraction” corrections from MC
    - MC single-particle e^-, e^+, γ samples at various energies are available
  - Run-dependent corrections from the data
  - Procedure is well-established and well-documented and I am sure Andrea would welcome volunteers
- Align the SVT
  - Huge amount of effort from PF has gone into developing the tools and infrastructure to support this effort
  - Huger amount of effort is needed to actually align and calibrate the tracker
  - Numerous data samples are available to study/constrain this effort
    - FEEs, WABs, three-prong Tridents provide momentum-constrained tracks for sensor alignment
    - Møllers at both 1.92 and 3.74 GeV provide strong momentum-angle constraints for global alignment
    - Tracks from two different z locations (SVT positioning wires on top and bottom)
    - Straight tracks at two different z locations (2H02 Harp and collimator wires)
  - There will be an SVT alignment meeting next week. Stay tuned for details.
- Please get involved!