2021 Data Reconstruction & Calibration

Norman Graf (SLAC)

HPS Weekly Meeting

January 19, 2022

Trigger Skims

- We decided to skim several of the low-rate triggers from the ~1PB of data taken during 2021.

- Nathan set up the scripts, ran and monitored the skim jobs which used Maurik's program to skim the evio files.

- Process is done and files are available on

  - */cache/hallb/hps/physrun2021/production/evio-skims*

    - *fee* FEE triggers alignment/calibration
    - *moll* Møller triggers alignment/calibration
    - *muon* Muon triggers physics
    - *rndm* Random triggers MC beam overlay

  - 85 TB of data

- Files are not pinned and will be migrating to tape

  - */mss/hallb/hps/physrun2021/production/evio-skims*

- nb. in the course of this exercise Scicomp found and resolved an issue with tape job ordering causing files not to be read contiguously. Accessing files on tape in the future should be much quicker and more efficient.

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 is 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

- FEE trigger skims are done and reconstruction of the Ecal for those events is ongoing.

- 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.

- Andrea gave a nice presentation at last week's general HPS meeting.

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 Hit Finding/Fitting

- Alic and Cameron are working to calibrate the fitting of the SVT APV25 readout waveforms

  - Expect better resolution on hit times

  - Expect more good hits and $\therefore$ more tracks to be found.

- Will then study the SVT strip clustering to see if improvements can be made

- Expect to see a detailed presentation on this in the coming weeks.

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

- Will use field-on data using both top and bottom SVT positioning wires.

- A dedicated SVT alignment meeting was held at the end of last year. Documentation available at https://confluence.slac.stanford.edu/pages/viewpage.action?pageId=326526876

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
    - Done. See Nathan's presentation for details.

- 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
    - See Andrea's presentation for status and plans.

- Improve the SVT hit finding
    - Calibrate the fitting of the APV25 waveforms
    - Analyze the strip clustering

- 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)
    - A dedicated SVT alignment meeting was held at the end of last year. Documentation available at
      https://confluence.slac.stanford.edu/pages/viewpage.action?pageId=326526876

- Please get involved!