Status for Pass0 of 2019 MC

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2019 Data Analysis Readiness Workshop

Outline

- General setup based on experiment
- Software updates and development
  - Generation level
  - SLIC level
  - Readout level
  - Reconstruction
- Data samples so far
  - Generation level
  - SLIC level
  - Readout level
  - Reconstruction
- Discussion
- Summary

General Setup Based on 2019 Experiment

Setup is based on experimental situations for production runs during Sep. 1st to 9th of 2019.

- Beam
  - Energy: 4.55 GeV
  - Current: 120 nA
  - Bunch size: 1500
- Target: tungsten
  - Density: 6.306e-2 $cm^{-1}bar^{-1}$
  - Thickness: 20 um
- Target offsetting, beam rotation and diffusion:
  - Target offset: -7.5 mm
  - Beam rotation: 30.5 mrad around y
  - Beam size: 0
- ap mass points: 50 75 100 150 200 250 300 MeV/c^2
  - Prompt: all outgoing particles by MadGraph pass through target
  - Displaced: only recoiled electrons pass through target; ctau = ?

Software: Generation Level

Kinematic limits in run cards of MadGraph and EGS5 programs with consideration of MC efficiency, acceptance, cuts in trigger, cuts in event selection and divergence of MadGraph:

- For pass0, it should be safe to keep the same angular lower limits as 2016. We actually can increase lower limits since SVT Layer0 is added.
- Set lower limits for energy as twice as 2016 for pass0 since beam energy is increased.
- Adjust setup after getting more information from reconstruction and data analysis

- ap for e+e- pair: No limits in 2016; Also no limits for 2019

- RAD:

Limits	2016	2019
Minimum for energy of e^+ or e^- from pair	50 MeV	100 MeV
Minimum for y direction (p_y/p) of e^+ or e^- from pair	0.005	0.005
Minimum for total energy of e^+e^- pair	500 MeV	1000 MeV
Minimum for invariant mass of e^+e^- pair	10 MeV/c^2	10 MeV/c^2

- Tri-trig:

Limits	2016	2019
Minimum for energy of e^+	100 MeV	200 MeV
Minimum for y direction (p_y/p) of e^+ or e^- from pair	0.005	0.005
Minimum for total energy for at least one pair	1000 MeV	2000 MeV
Minimum for invariant mass for at least one pair	10 MeV/c^2	10 MeV/c^2

- wab:

Limits	2016	2019
Minimum for energy of photon	400 MeV	800 MeV
Minimum for y direction (p_y/p) of photon	0.005	0.005

- beam:

Limits	2016	2019
Minimum for energy of e^-	0.005*E_{beam}	0.005*E_{beam}
Minimum for transverse (2016) / y (2019) direction if energy is larger than 0.6*E_{beam} for e^-	0.005	0.005
Minimum for y direction of photon	0.004	0.004
Maximum for y direction if energy is larger than 400 MeV (800 MeV for 2019) for photon	0.005	0.005

Software: SLIC Level

- Detector: HPS-PhysicsRun2019-v2-4pt5

Software: Readout Level

- Bug fixing: effects of the bugs on 2016 MC are estimated to be non-significant
    - To let the digitization driver can process hodoscope hits like Ecal hits, hodoscope gains need to be converted from self-defined-unit/ADC in the database to MeV/ADC.
    - The threshold-crossing sample is a part of NSA instead of NSB.
    - Deadtime for pulse integration is 32 ns instead of 32 clock-cycles.
- New drivers for the trigger system:
    - HodoscopePatternReadoutDriver: hodoscope hit patterns for geometry matching with Ecal in the trigger system
    - SinglesTrigger2019ReadoutDriver: singles trigger
    - PairsTrigger2019ReadoutDriver: pairs trigger
- Steering files: parameters are set based on the DAQ configuration file: hps_v12_1.cnf
    - /org/hps/steering/readout/PhysicsRun2019TrigSingles.lcsim: singles trigger
    - /org/hps/steering/readout/PhysicsRun2019TrigPairs.lcsim.: pairs trigger
    - /org/hps/steering/readout/PhysicsRun2019TrigPulse.lcsim: pulse trigger
- Look into details for the above updates and development from the talk: https://confluence.slac.stanford.edu/display/hpsg/2020.03.25+--+Software+Meeting?preview=/275089973/275089925/Updates%20of%20the%20Readout%20System%20for%202019%20MC.pdf
- Updates for SVT: in Omar's talk

Software: Reconstruction Level

- In Omar's and PF's talks

Samples: Generation Level

- ap: 1k files for each mass points, and 10k - 20k events per file; Madgraph -> EGS5 -> stdhep tools

- rad, wab, tritrig: 1k files, and 10k events per file; Madgraph -> EGS5 -> stdhep tools

- beam: 1k files (10k files in plan), and 250k bunches per file; EGS5 -> stdhep tools

- Note: Interval of signal events when spacing is 250, so 10 beam files (250k * 10 bunches) is merged with 1 spaced signal file (10k * 250 events).

Samples: SLIC Level

- tritrig
- wab
- beam

Samples: Readout Level

- Pure samples: event spacing -> readout
  - tritrig: singles trigger
  - wab: pulse trigger
- Samples with beam overlay: signal event spacing and 10to1 bundling for beam files -> merging signal events with beam bunches -> readout
  - tritrig-beam: singles trigger
  - wab-beam: pulse trigger

Samples: Reconstruction Level

- Pure samples: recon -> hpstr
  - tritrig: singles trigger
  - wab: pulse trigger
- Samples with beam overlay: recon -> hpstr
  - tritrig-beam: singles trigger
  - wab-beam: pulse trigger

More Samples in Progress

- ap-beam: singles trigger; pairs trigger
- rad-beam: singles trigger
- wab-beam: singels trigger

Discussion: ctau for ap displaced

ctau is 10 mm for 2016 MC. We need to re-consider ctau value for 2019 MC.

- vertex = beta * gamma * ct, where ct is randomized with parameter of ctau, and beta * gamma = E_{ap}/m_{ap}, where E_{ap} depends on beam energy.

- SVT L0 is applied for 2019. What's zMax? L0 location according to 2016?

Summary

- Plenty of software updates for the MC system have been made and been tested well.

- Some large-scale MC samples have been produced, and production for more samples is in progress.

- For more details, please look into the confluence page https://confluence.slac.stanford.edu/display/hpsg/2019+MC+Data.