Status of HPS Monte Carlo

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SLAC

Simulation with time dependence

- For realistic simulation of trigger, readout, and t0 reconstruction, the DAQ needs to be simulated in a time-dependent way
  - Step through DAQ simulation with 2 ns steps (bunch spacing): input to detector simulation has one beam bunch per event
- To simulate background triggers, run detector simulation on pure beam background
  - This is very inefficient
- To simulate triggers on A' (or tridents), run detector simulation on beam background + 1 MHz A' (enough time to guarantee no pileup between successive A')
  - Tridents simulated in this way are our main MC sample (as used in the MDC)

Steps

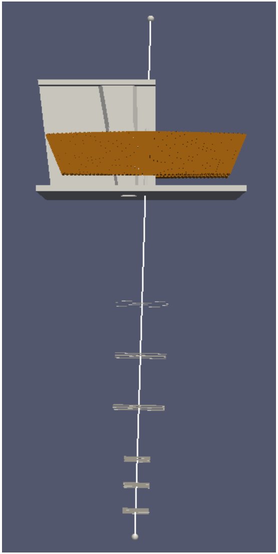
- Primary generators (MadGraph, EGS5, Geant4): see Takashi's talk
  - Tridents are run through EGS5 to add multiple scattering
  - Output StdHep files in one-event-per-interaction format
- Merge generated particles into simulated beam bunches
  - Beam current, size, and position are applied in this step
  - Output StdHep files in one-event-per-beam-bunch format
- Run beam bunches through the detector geometry (in SLIC) to get hits in detector volumes
  - Output LCIO files in one-event-per-beam-bunch format
- Run hits through readout simulation (in hps-java) to get simulated data
  - Output LCIO files in one-event-per-trigger format; these files get stored
  - Contents of these files map directly to EVIO banks; conversion (using hps-java) is easy in both directions

Detector simulation

- We're using Geant4 v9.6.p01, QGSP_BERT physics list
  - Overestimates large-angle multiple scattering, but so far we don't think this matters anywhere but the target (where EGS5 is used)
- SLIC can take input from StdHep files, or use Geant4's built-in generators (particle gun or General Particle Source)
  - MC as described here uses StdHep; built-ins are useful for detector studies

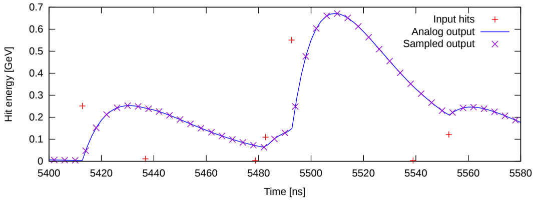
Detector geometry

- Detector volumes generated with Java code in GeomConverter or imported from GDML
  - Work needed to allow import of alignment constants
- Geometry built from a combination of imported GDML files and Java code (GeomConverter)
- Detector geometry contains pair spec vacuum chamber, SVT (Si and carbon fiber only), ECal vacuum chamber (with honeycomb), ECal crystals
  - Missing: magnet, ECal dead material, anything before the target or after the ECal
- Dipole field is a constant box
  - Interpolated 3D field map in progress (needs testing and optimization, measurement)



Readout and trigger simulation

- Simulate pulse shapes and readout pipelines for ECal preamp/FADC and SVT APV25
  - ECal crystal and preamp simulations are being updated
- Associate SVT readout hits with MC primary particles
- FADC, CTP, SSP simulated as part of trigger decision
  - Will need to be updated with new trigger firmware
- Detector pipelines read out after trigger; digitized hits saved to LCIO file



Production

- All software is installed at JLab
- Work in progress for batch jobs and testing; mock data challenge will be first test of full MC
- See Homer's talk for data management and access

Resource needs: MC

- MC needs for commissioning run shown; large uncertainties (factor of 2) but MDC will test and benchmark everything

	Data+recon (TB)	DST (TB)	Sim+recon ($\times 10^6$ CPUh)
1.1 GeV	14	1.6	0.57
2.2 GeV	13	1.7	0.59
Total	27	3.3	1.16

Resource needs: running

- Data sizes and recon times are relatively well-understood; uncertainties are in running time and trigger rates

	Data (TB)	Recon (TB)	DST (TB)	Recon ($\times 10^6$ CPUh)
1.1 GeV	73	159	33	0.14
2.2 GeV	67	145	29	0.12
Total	140	304	62	0.26