SBS Simulation and Software

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for the Software Working Group

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Overview

- Present group and manpower
- Progress in the last year
- Short Term Projects
- Long Term Goals

Stony Brook University	Seamus Riordan
University of Connecticut	Andrew Puckett
	Freddy Obrecht
Carnegie Mellon	Vahe Mamyan
	Juan Carlos Cornejo
Jefferson Lab	Ole Hansen
	Alex Camsonne
	Dasuni Adikaram
University of Virginia	Vladimir Nelubin
	Danning Di
Glasgow	John Annand
	Kieran Hamilton
INFN	Evaristo Cisbani

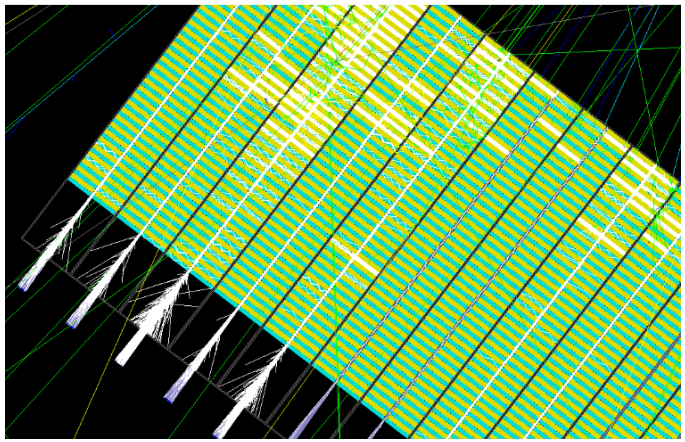
Research scientist or postdoc

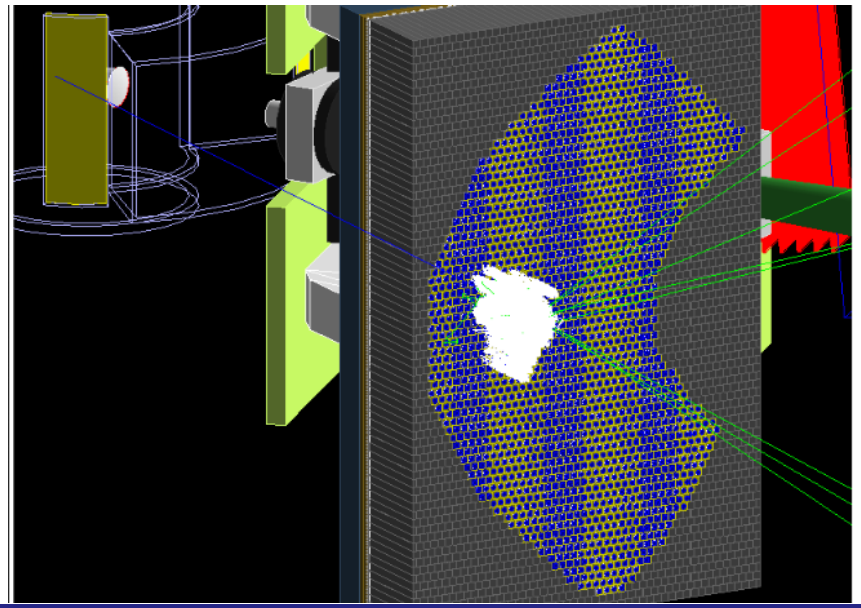
Graduate student

Progress in Last Year

Continued excellent progress since last meeting!

- Significant progress in organizing Geant4 simluation
- Continued improvement of rates and generators
- C16 G4 simulation (DOE requirement for last winter)
- Continued work on radiation calculations
- Spin transport code development

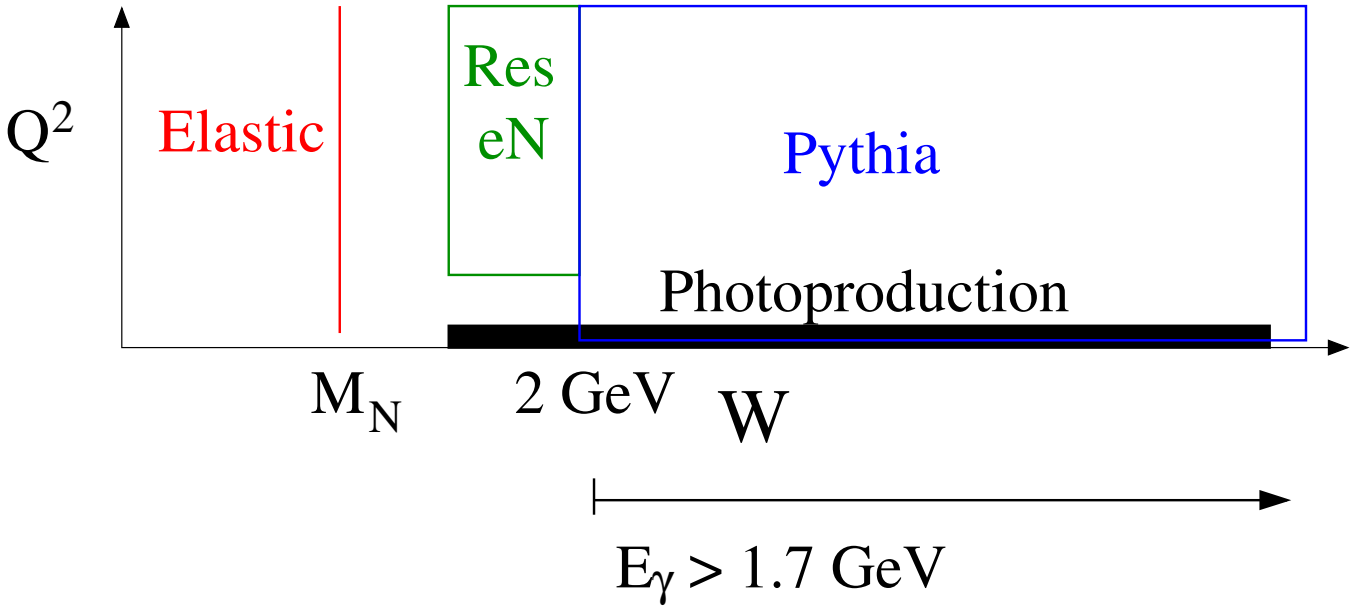




Trigger Rates at Review - UConn Group

Pythia6 integrated into existing MC

- Geant4 would require prohibitive computation time as minimum bias generator for rare events
- Doesn't include elastics, resonances - but offers place to start with minimum bias trigger
- Integrated in with updated crescent geometry and trigger organization
- Present results are single Pythia events - working on superimposing backgrounds



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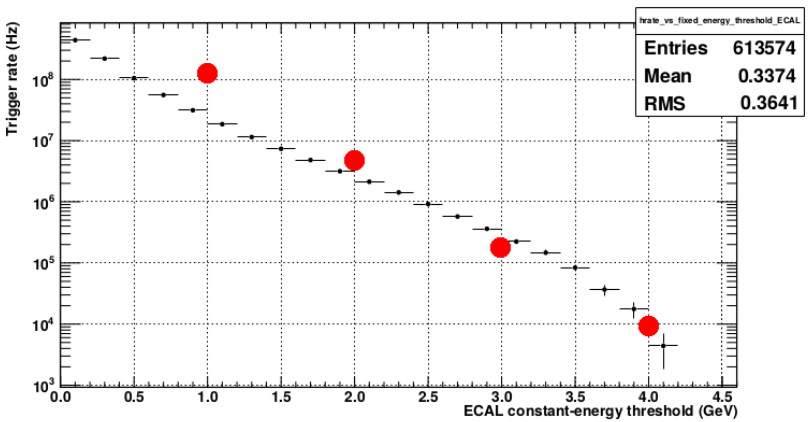

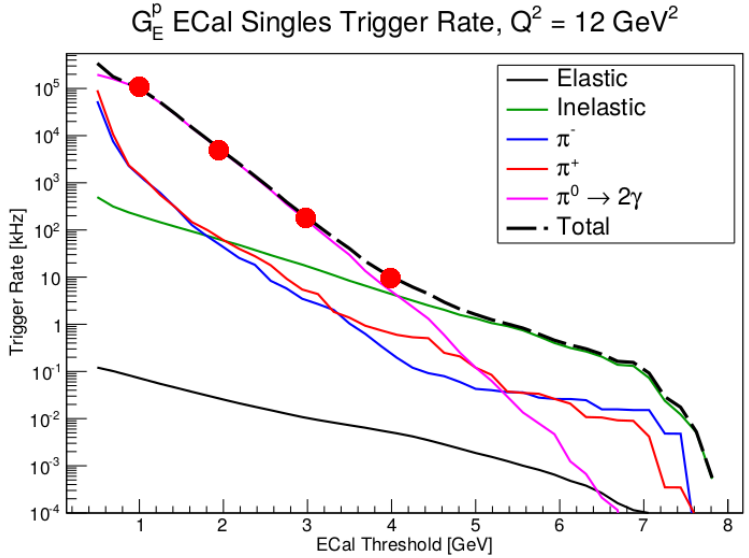

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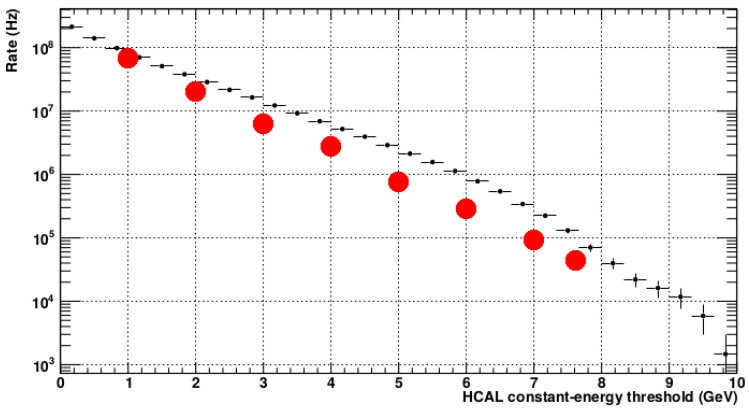
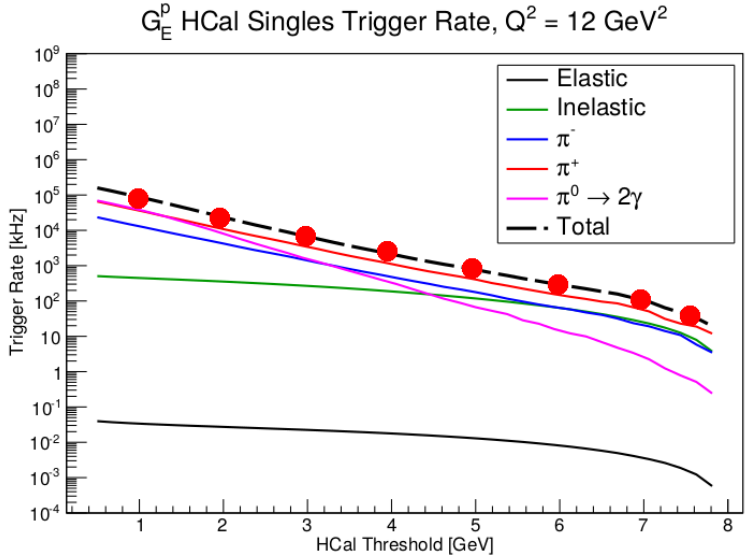
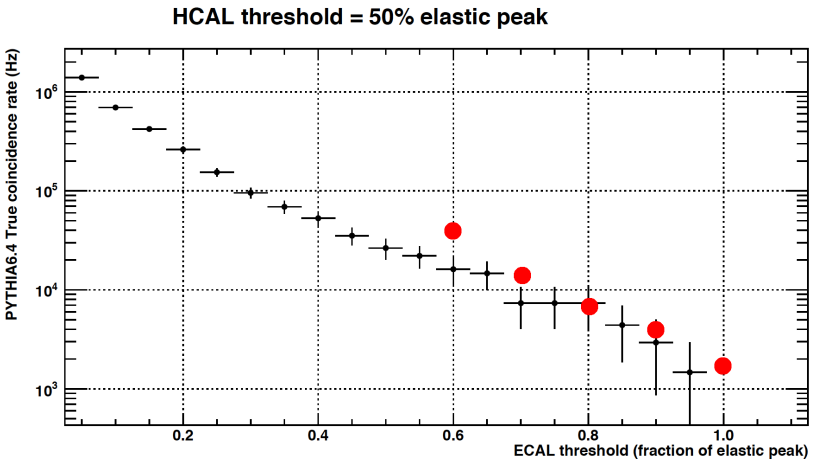
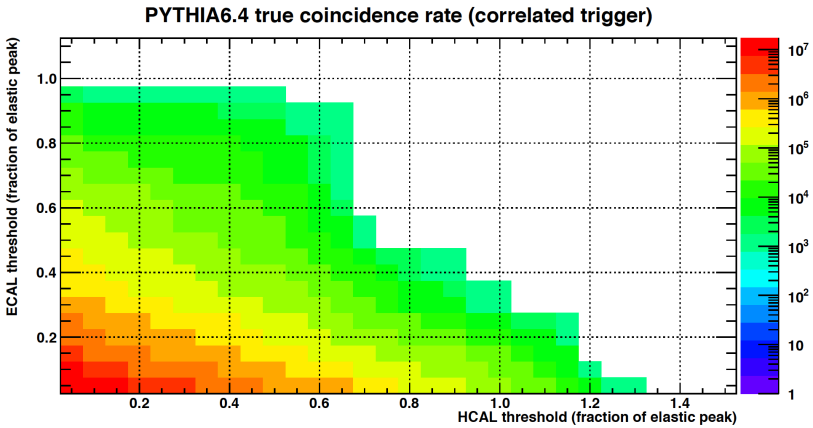
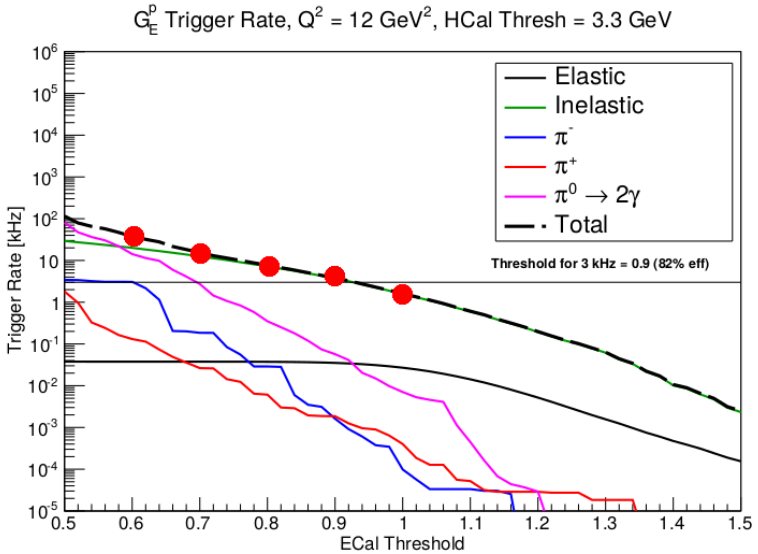




GEp Trigger Rates - Coincidence







- Compare well to results from last review
- Need to improve Pythia statistics
- Analysis of event types and particles
- Will continue introducing accidental complexity

Further Work Done

Lots of important work done for simulation
`https://github.com/JeffersonLab/g4sbs`

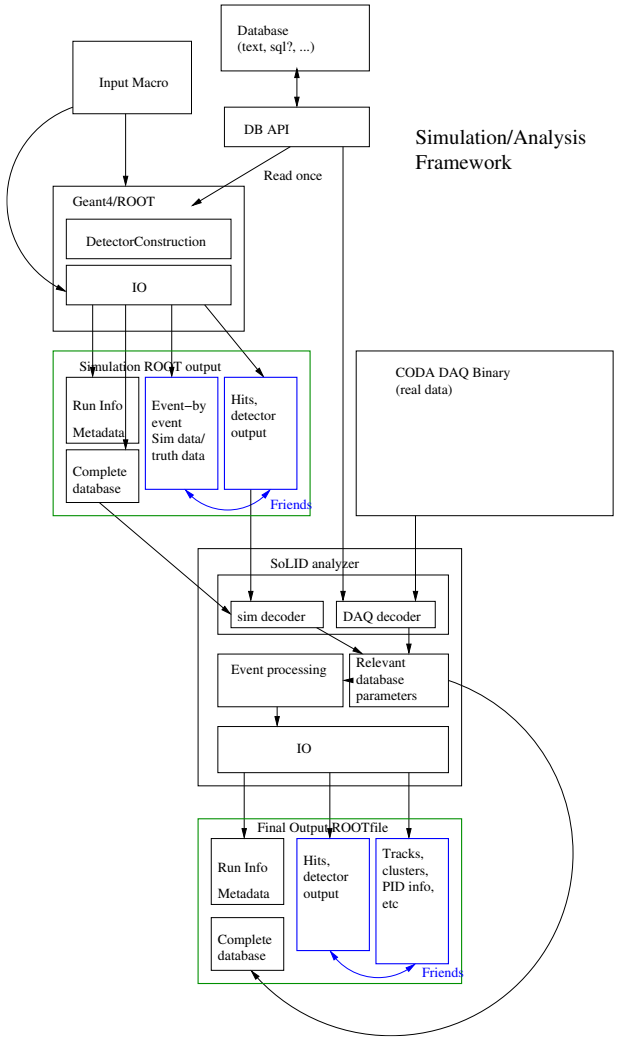
- uconn_dev branch merged to master
- Code migrated to Geant4.10
- Compatible with ROOT6
- Significant cleaning up of code and example scripts (thank you Juan Carlos!)
  - Few inconsistancies found with configuration numbers
- Automated build tests through Travis CI
- Documentation migrated to github wiki (thank you Andrew!)
  - `https://github.com/JeffersonLab/g4sbs/wiki`

Work To Do - Software

- Review and include development branches from various groups
- Continue to iterate geometries, analysis
  - Shielding - Electronics hut (Dasuni)
- Spin-transport code
- Digitization, full analysis (more later)
- Maintain/improve codebase
  - Import remoll-style generators
  - Pre-vertex radiative effects and multiple scattering missing
  - Adapt so has output trees compatible with SBS GEM response code

Analysis Software

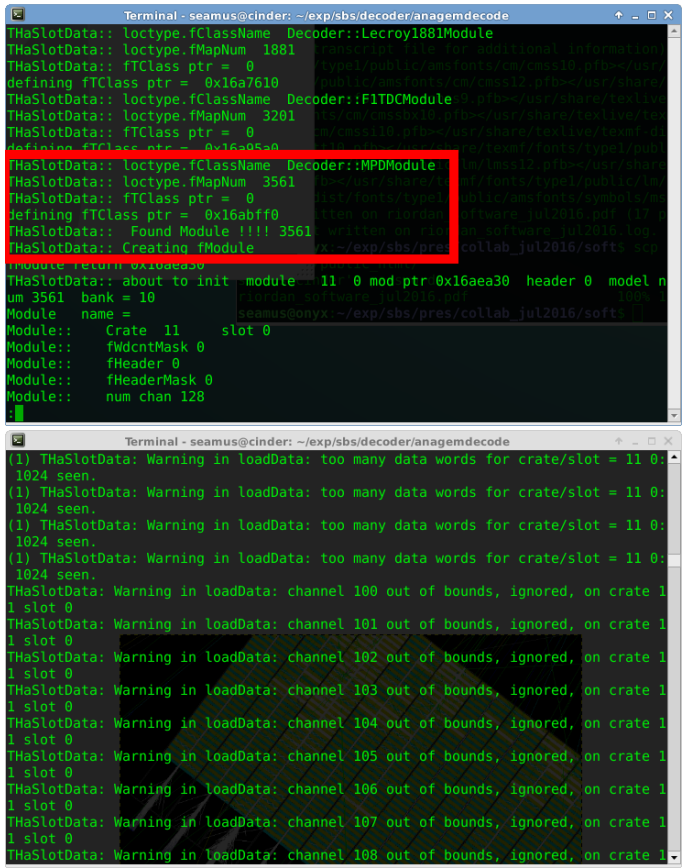
- GEM classes integrated with TreeSearch tracking - test of clustering algorithms
- Framework for CDet, GRINCH, ECal, RICH
- Analysis class for HCal FADCs
- Coherent track association and PID between all detector sets
- Improved GEM digitization using Xray box inputs
  - More than just us needs this
- "End to end" simluation with production of pseudodata - simulation of data sizes
- Demonstration of event-by-event analysis for full experiment



This is a job for a full time postdoc with a bent for programming+ grad student/collaboration support leading up to run

GEM Decoding

- GEM test stand used with CODA readout
- Decoding done with stand-alone reading directly EVIO
- SBU (w/ grad student Charlie Shugert) working on
  - Integrating with modular decoder (analyzer 1.6)
  - Getting TreeSearch algorithm and existing GEM classes to work with this decoder



- SBS-offline repository
- `http://github.com/JeffersonLab/SBS-offline`
- Requires databases - will be talking to GEM experts
- analyzer can read data and first pass decoder library (based much on Evaristo's work) responds to data

Continuing Work and Shifting Focus

Have working whitepaper

`http://cinder.physics.sunysb.edu/~seamus/sbs/sim_whitepaper.pdf`

- Need to have offline analysis library with complete subsystems
- Requires work, support, and organization from subsystem leaders
- SBS will start having scrutiny from JLab reviews
  - Software Review Nov 10-11
  - Need to have set of clear milestones ready
- Need work also on complete event analysis, optics models

Continuing Work and Shifting Focus - From Ole ca. 2012

SBS Reconstruction Software Tasks (Preliminary)

- C++ Analyzer upgrades
  - Automatic event-level parallelization (ETA mid-2013)
  - Pipelined electronics decoders
    - ★ SBS plans to make extensive use of pipelined electronics
    - ★ Decoder software needed for both standard and SBS custom modules
- GEM track reconstruction
  - Prototype reconstruction code exists. Works with Monte Carlo data, using a couple of shortcuts
  - Needs further testing, esp. with real data, & algorithm optimization
  - Optics/vertex reconstruction
  - GEp(5) kinematic correlation analysis to determine tracking search window
- Coordinate detector analysis
- GEp(5) recoil polarimetry
- Calorimeter cluster reconstruction
  - Several calorimeter setups proposed for the different SBS experiments
  - At least some cluster analysis software will need to be written. Different algorithms needed for different calorimeters.

Continuing Work and Shifting Focus - Assigning Responsibility

General Purpose Software	
analyzer Development	Hansen (JLab)
Front End Decoders	Camsonne (JLab)
Event Reassembly	JLab DAQ Group
SBS Specific	
Overall Coordination	Riordan w/ Software Group
MPD Decoding	SBU, JLab, UVA, INFN
GEM Tracking	INFN, JLab
HCal Analysis	CMU
ECal Analysis	?
Coord. Det	?
BigBite	?
GEp Event Recon.	?
GEn, GMn Event Recon.	SBU, CMU

Based on previous table from Ole

Milestones

Need to converge on this ASAP!

- Sep 2016 - GEM Decoding Implemented
- Oct 2016 - Analysis Library Skeleton
- Jan 2017 - Start Digitized Simulation Output
- Jul 2017 - Each detector system in analyzer
  - Data decoding ready at this point
- Dec 2017 - Simulation Interfaced to analysis
- Jan 2018 - Start simulated analysis for Neutron Experiments
- Jun 2018 - Neutron full offline analysis
- Jan 2019 - Start simulated analysis for GEp
- Jun 2019 - GEp full offline analysis

Requires several *dedicated* people

Summary

- Excellent progress has been made in producing more complete simulations
- Simulation has received much needed attention in getting more organized
- Present goals are focusing on radation shielding and full digitized output
- Work on analysis framework should continue to ramp up