#### PREX/CREX Software and Simulation

Seamus Riordan seamus@anl.gov



October 1, 2017

- Tracking Requirements and Software
- Optics MC

#### Requirements

- ullet We have a track rate of  $\sim$  10 MHz/ $\mu A$ 
  - $\bullet\,$  Need 1  $\mu {\rm A}$  to use standard beam monitors
  - $\bullet~\text{Max}\sim 2~\text{kHz}/\text{mm}^2$  at VDC and quartz
- VDC's with standard electronics can operate at 20 kHz/wire (1 cm spacing), APEX goes to 75 kHz/wire
- $\bullet$  GEMs dmonstrated to work at 25  $\rm kHz/mm^2$



#### Requirements

- We have a track rate of  $\sim 10 \text{ MHz}/\mu\text{A}$ 
  - Need 1  $\mu$ A to use standard beam monitors
  - Max  $\sim 2 \text{ kHz/mm}^2$  at VDC and quartz
- VDC's with standard electronics can operate at 20 kHz/wire (1 cm spacing), APEX goes to 75 kHz/wire
- GEMs dmonstrated to work at 25 kHz/mm<sup>2</sup>



Seamus Riordan (ANL)

Oct 1, 2017 3 / 12









#### SBS GEM Production



- UVA produced 48 50 $\times$ 60 cm<sup>2</sup> modules for SBS rear tracker
- Testing has been ongoing with beam and cosmics with setup at JLab
- New frame will have to be designed

#### Readout

- Two APV25 readout systems have been employed for GEMs in JLab-related development activities
  - MPD used in INFN development, will be employed by SBS, VME based (1 module = 2048 channels)
- Need 2 working systems only need to instrument 4000 channels in each arm
- Have MPD decoder integrated into analyzer that works but not integrated with higher level analysis yet
- Only works with latest analyzer

https://github.com/JeffersonLab/ SBS-Offline



sbs.gems.x1.adc1:sbs.gems.x1.strip

# Tracking

- Tracking for GEMs can be solved using standard Hall A Tree Search Alogrithm by Ole
- Has been integrated in with analyzer by Ole (TreeSearch-GEM library exists) - just needs to be worked into our replay
- SBS and SoLID need to produce GEM pseudodata to test tracking software - this is a good addition
- UConn postdoc has been actively working on doing pseudodata simulation
  - Milestone of having running by end of 2017
- Events with full detector chain



- Analysis of test GEM data ongoing with SBU students (Bishop, Wellman, Li
  - Worked out fitting time structures
  - Have method to do zero suppression, common mode noise
  - Needs to be integrated into replay
- Clustering algorithm needs to be included simple fits probably OK for low rate
- Tracking needs to be set up for configuration
- Really need operational experience in collaboration test stands eventually with CODA important

- Sufficient GEMs will exist for PREX/CREX running for our tracking purposes
- Frame design needs to be considered for SBS option
- DAQ electronics exist and will need to be incorporated into our system already integrated into CODA
- Counting mode decoder and software libraries need to be updated to handle tree search with GEMs

• Produced second order transport code a while ago

https://github.com/sbujlab/hrstrans

• Uses basic matrices using elements calculated here

https://cds.cern.ch/record/283218/files/SLAC-75.pdf

- Nickie validated with his G4MC transport and SNAKE
- Have PREX and standard tune configurations
- Example code on optimizing matrix elements and acceptance for tunes

# **Optics Software**

- Working with HAMC for figure of merit and understanding optics
  - Vetted with previous proposals and comparisons
  - Unified 5 deg configuration uses same transport functions
- G4MC refactored into g4hrs
  - Tyler has been working to get running again
  - Included virtual geometries to do FORTRAN trasnport functions
  - Absolute values of fields needs to be understood didn't work out of the box

#### https://github.com/sbujlab/g4hrs



Oct 1, 2017

11 / 12

More in Ryan's talk

- Is origin of transport predictable in optics?
- Are ther optimization to tune
- $\bullet$  Optimal detector placement w/ GEMs