PREX/CREX Software and Simulation

Seamus Riordan
seamus@anl.gov

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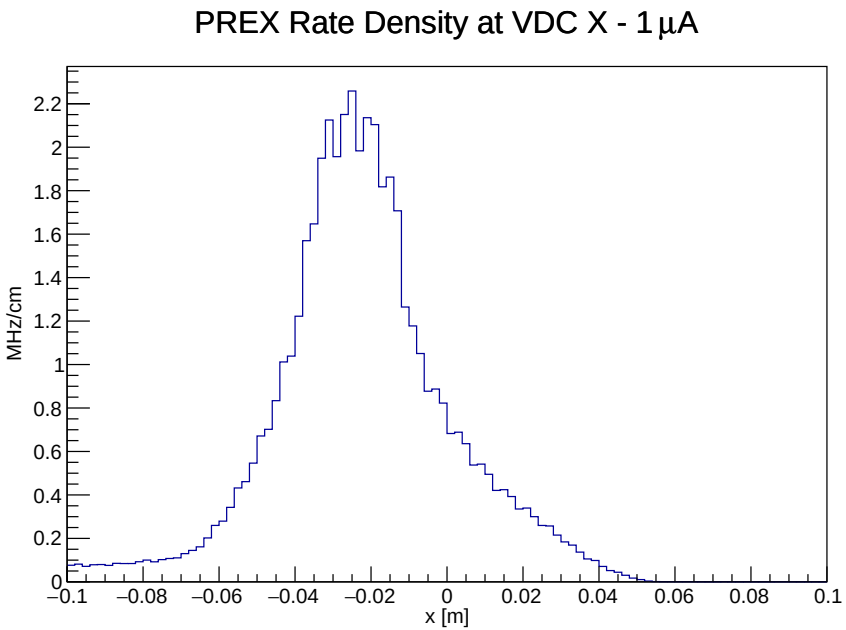
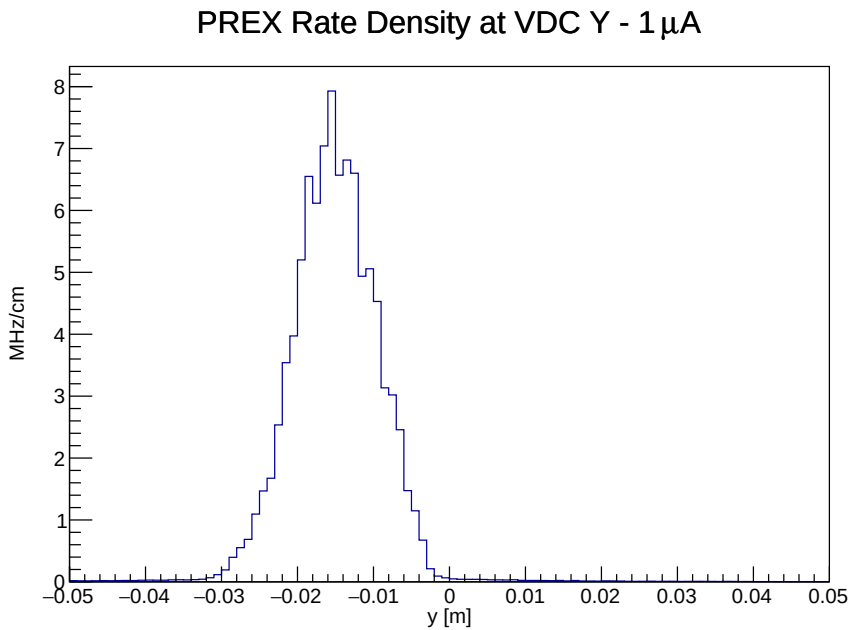
Overview

- Tracking Requirements and Software
- Optics MC

Requirements

- We have a track rate of $\sim$ 10 MHz/μA
  - Need 1 μA to use standard beam monitors
  - Max $\sim$ 2 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^2





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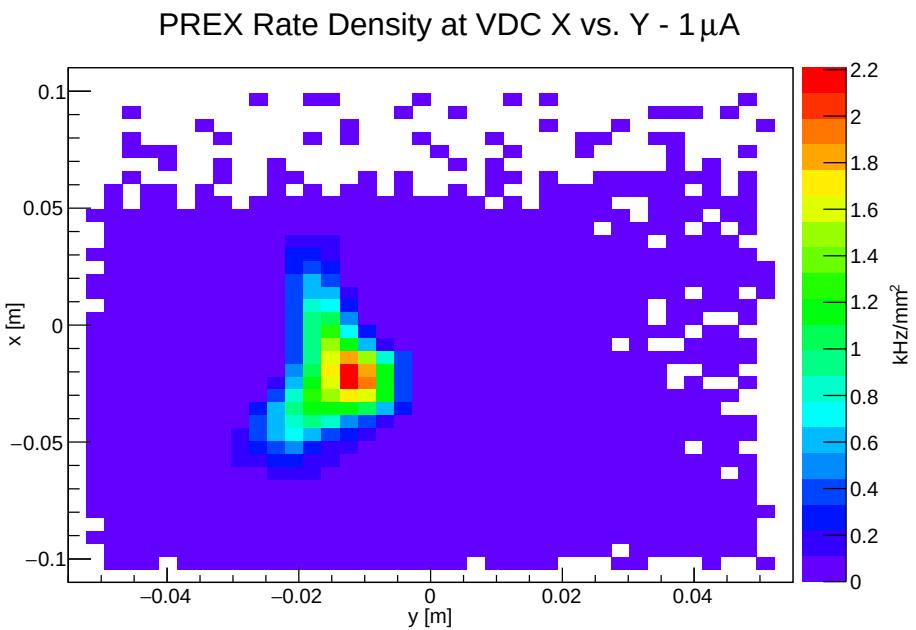
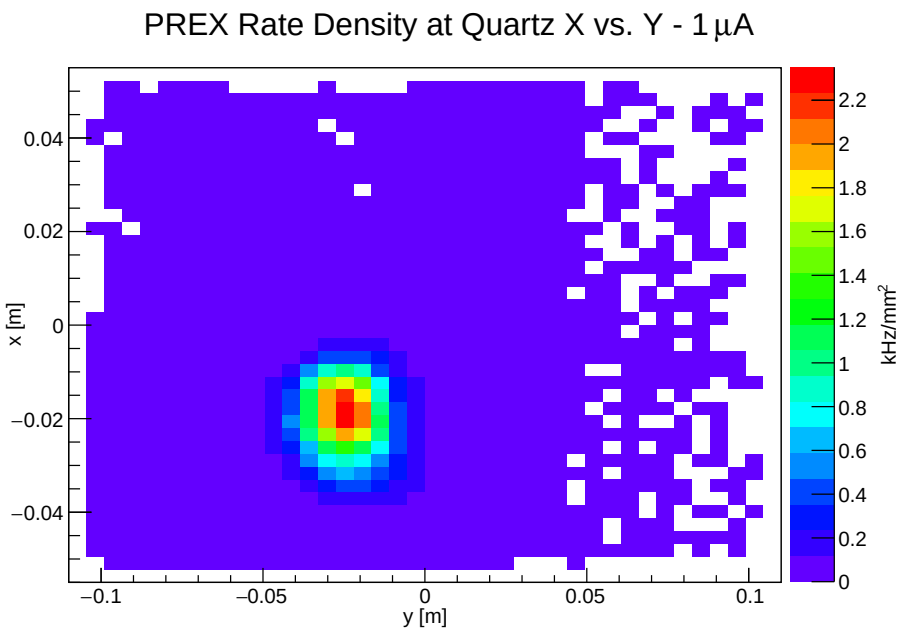
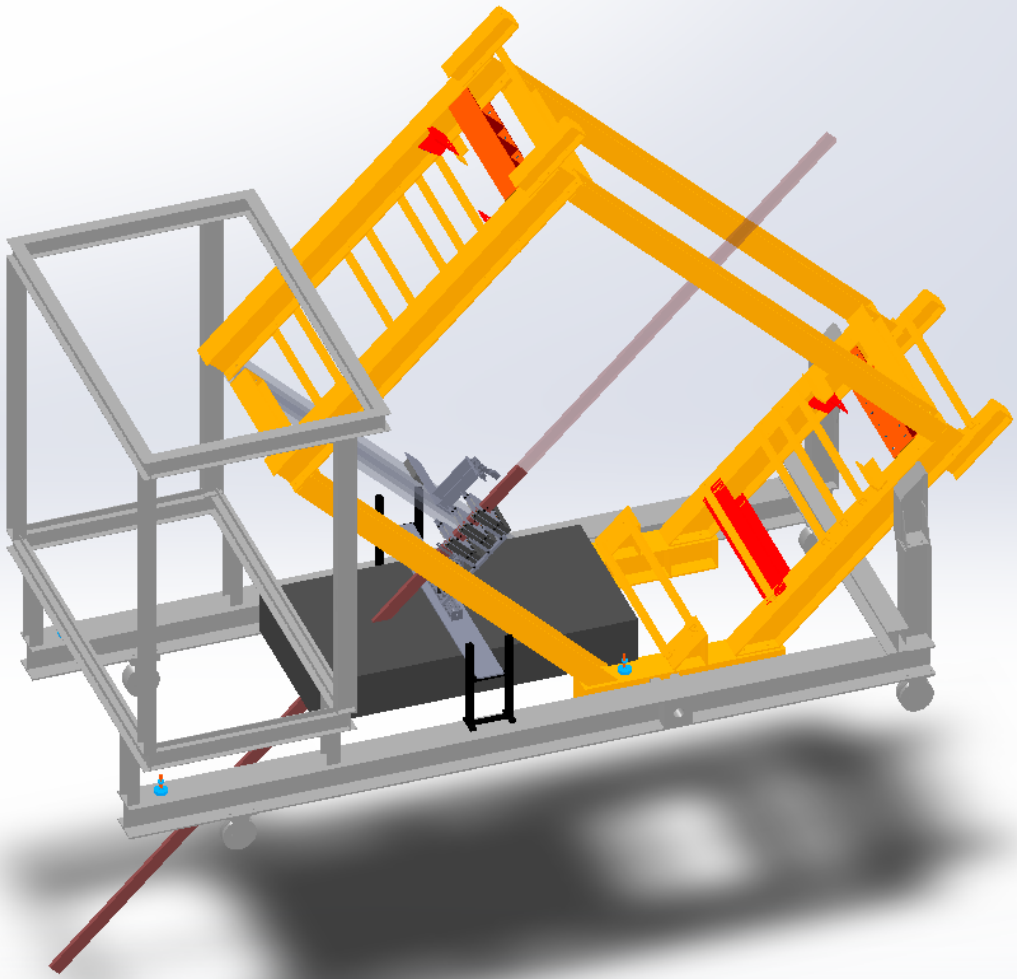




PREX Original GEM Layout



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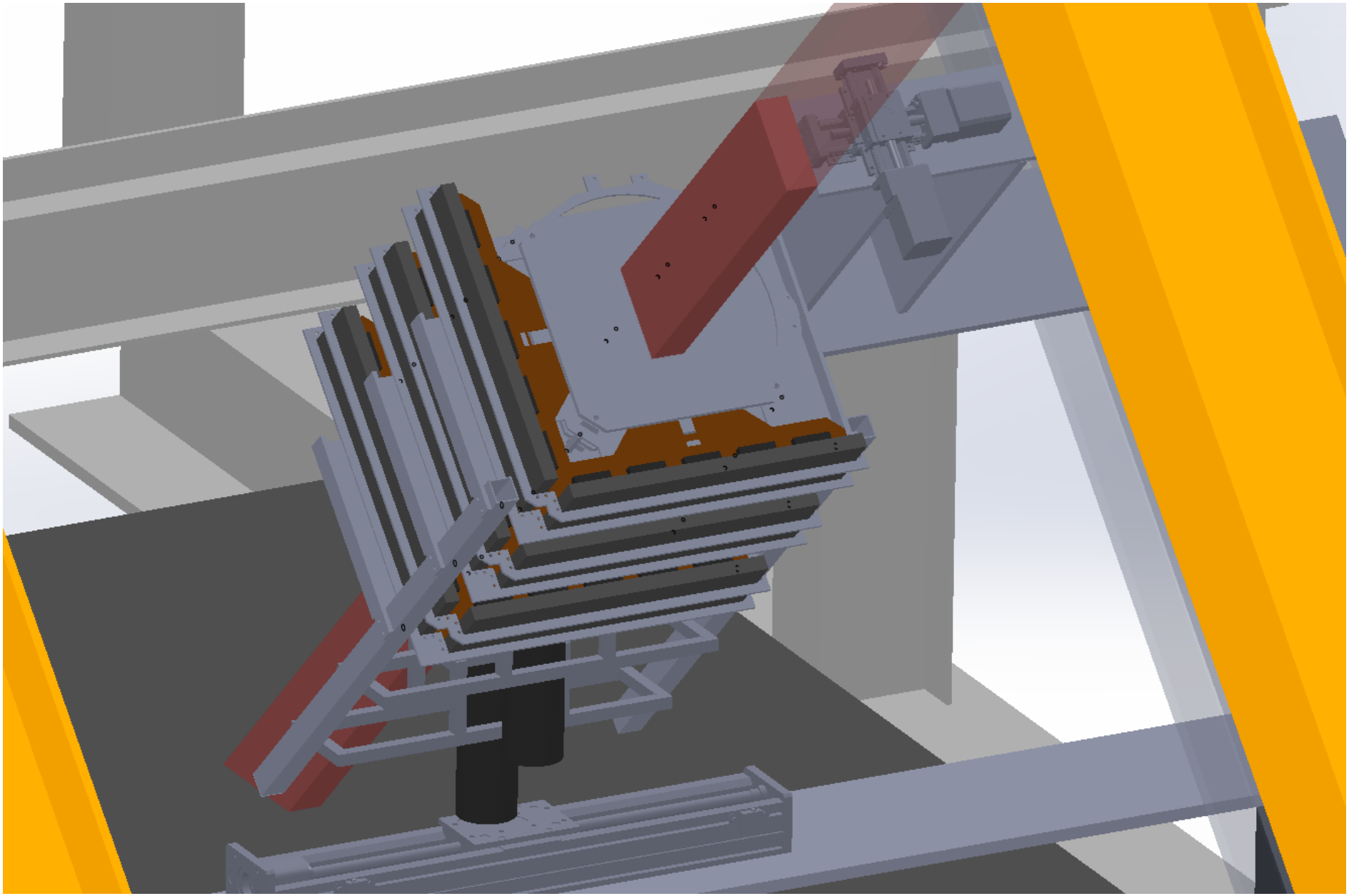

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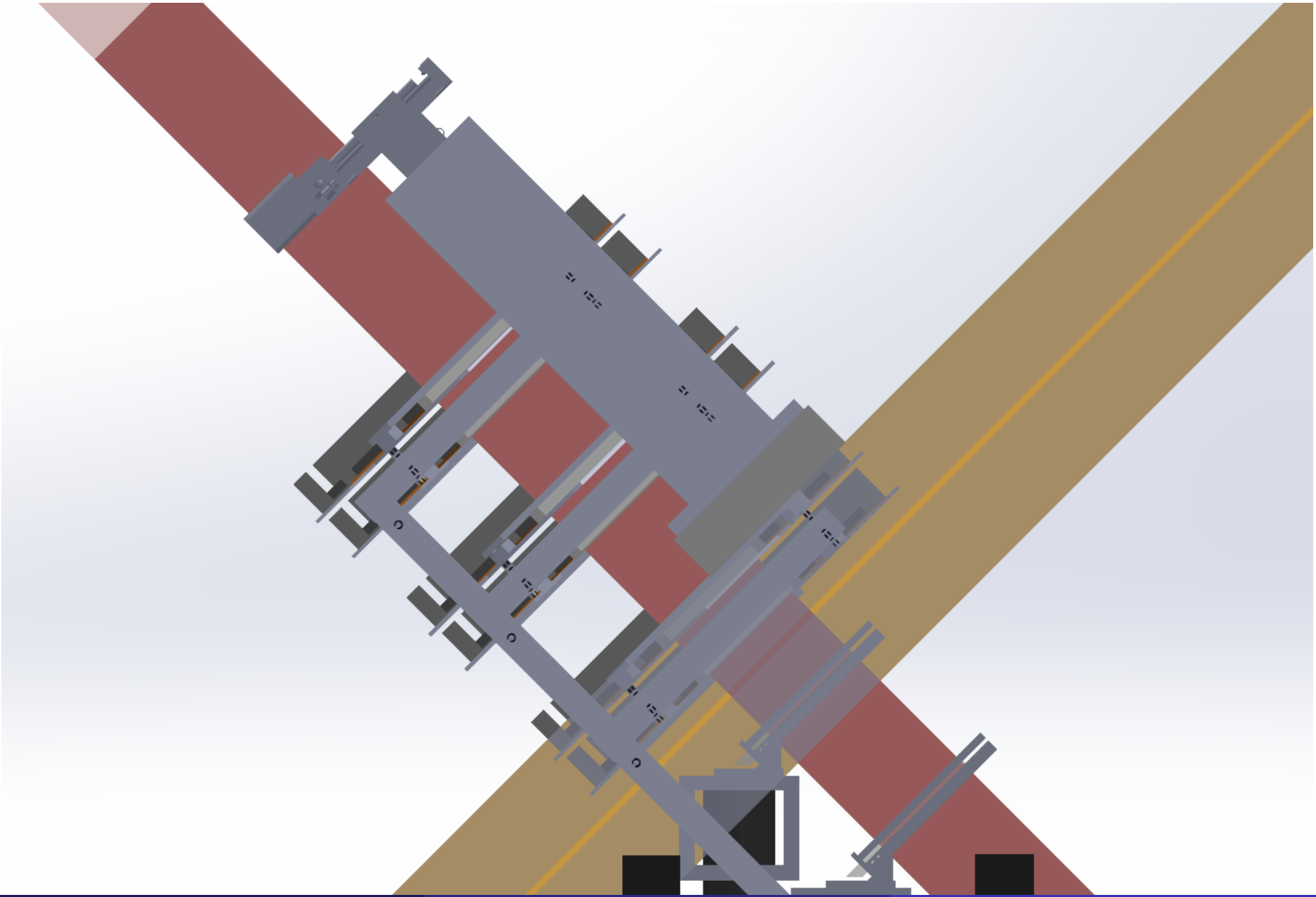

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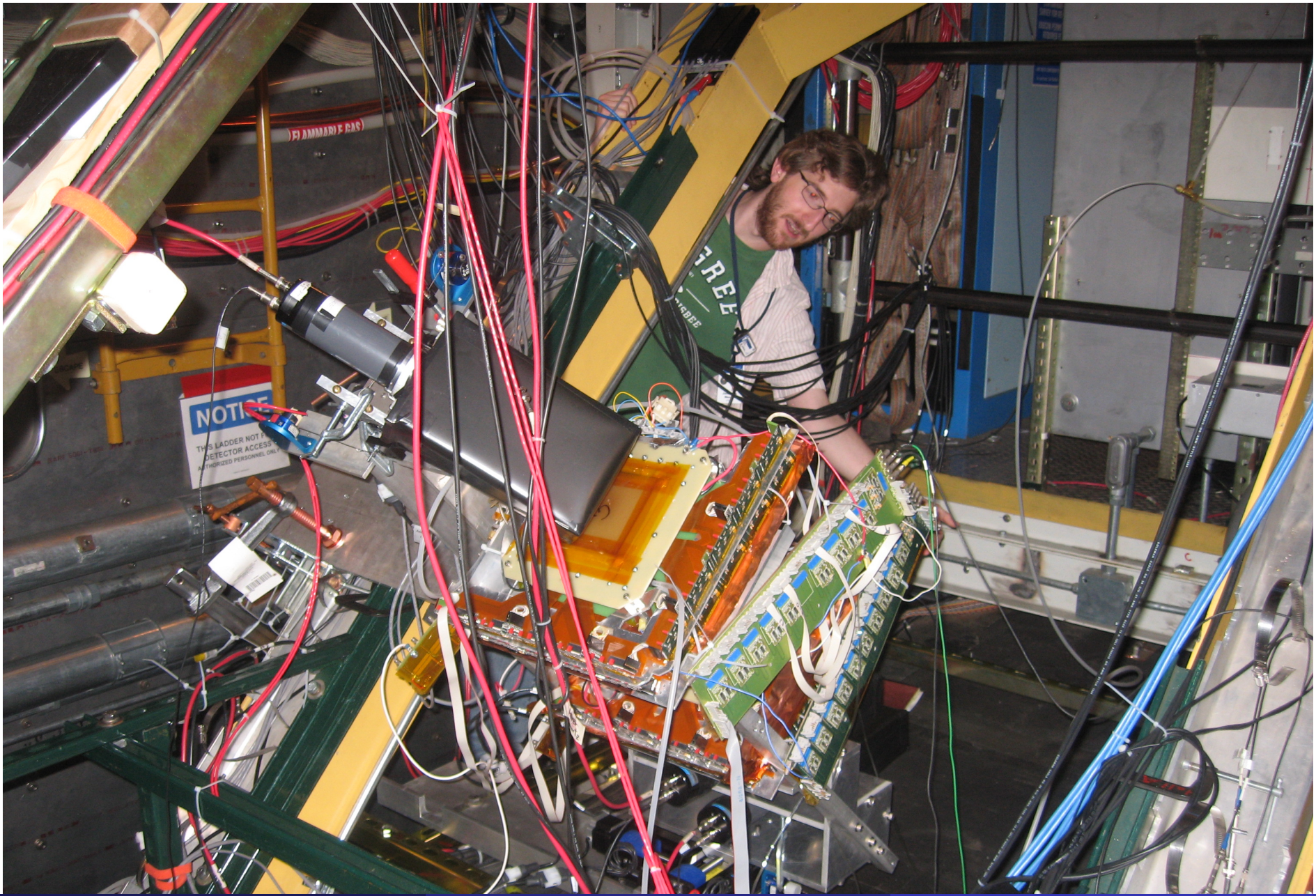
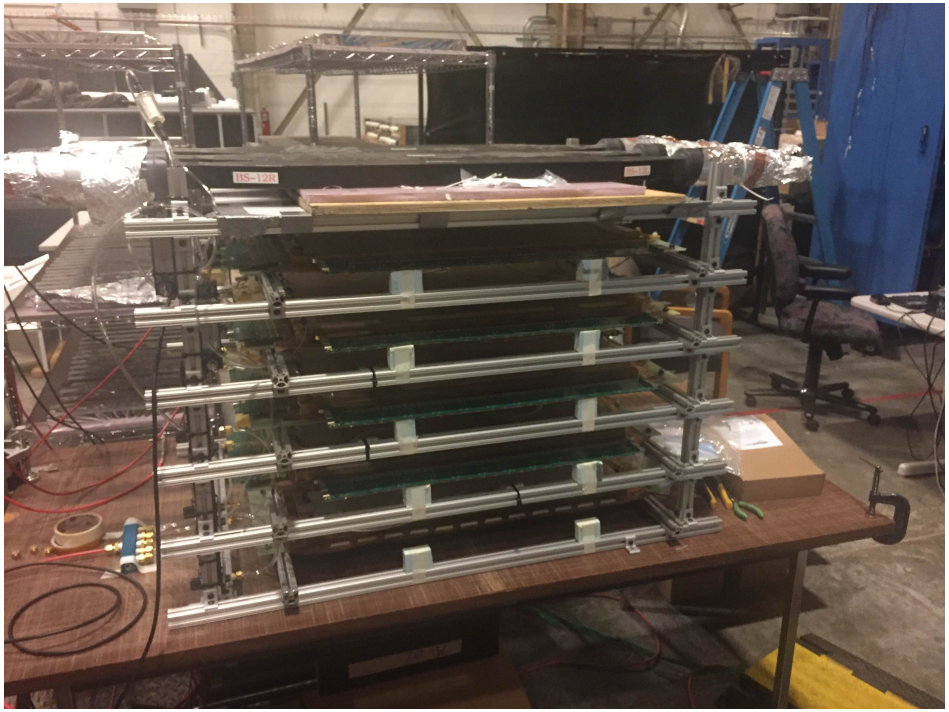
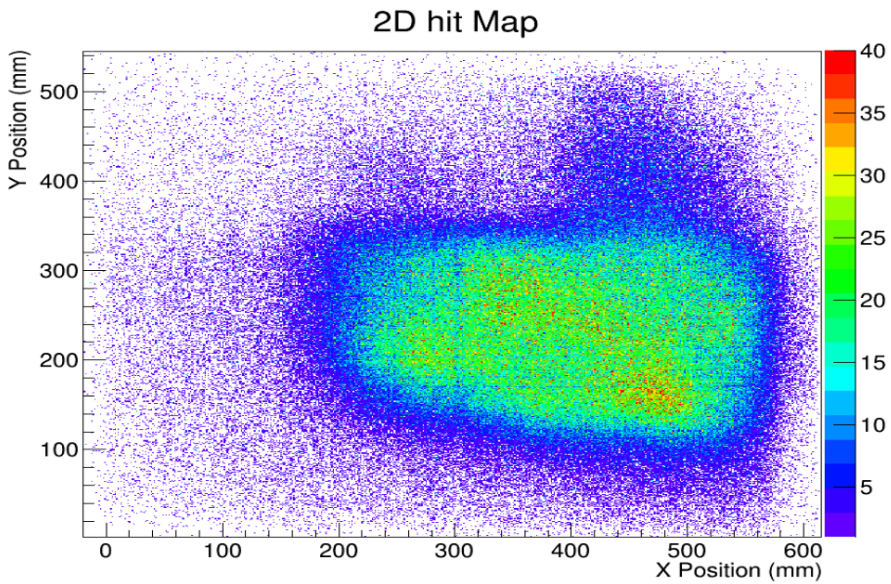


SBS GEM Production





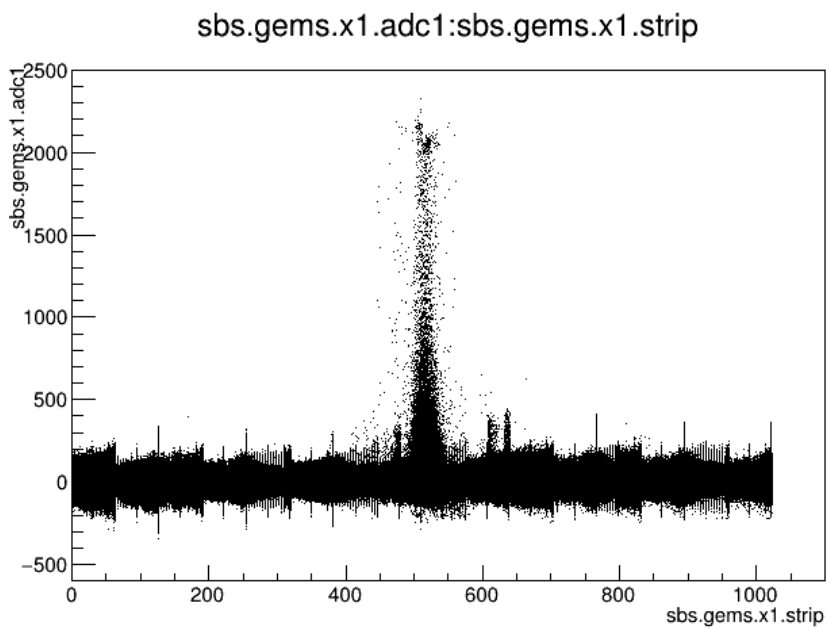
- UVA produced 48 50×60 cm^2 modules for SBS rear tracker
- Testing has been ongoing with beam and cosmics with setup at JLab
- New frame will have to be designed

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

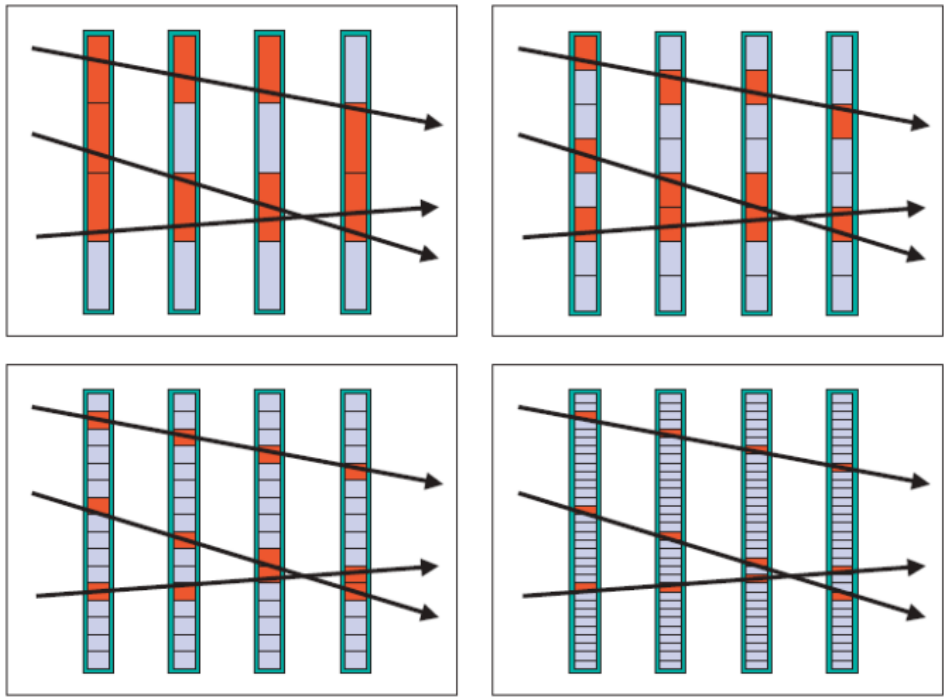
- Have MPD decoder integrated into analyzer that works but not integrated with higher level analysis yet
- Only works with latest analyzer

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



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 should be simulated



Tracking (cont)

- 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

Tracking Summary

- 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

Optics Software

- Produced second order transport code a while ago

  `https://github.com/sbujlab/hrstrans`

- Uses basic matrices using elements calculated here

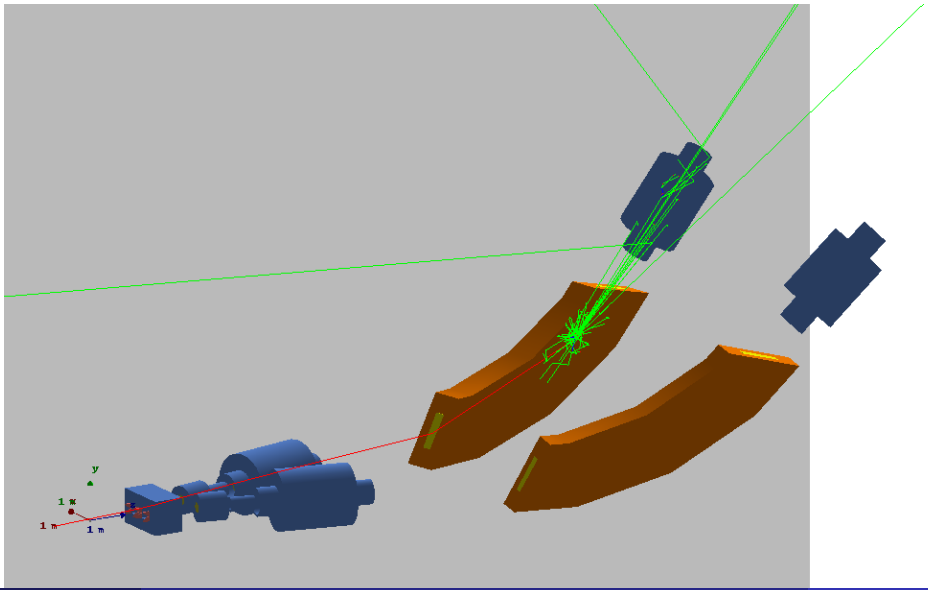
  `https://cds.cern.ch/record/283218/files/SLAC-75.pdf`

- 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`



Questions and Work

More in Ryan's talk

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