

PREX/CREX Software and Simulation

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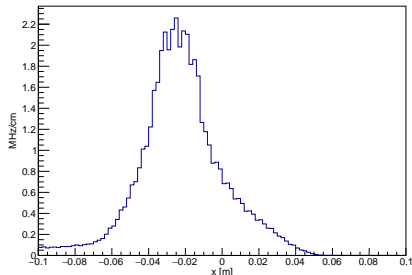
October 1, 2017

- Tracking Requirements and Software
- Optics MC

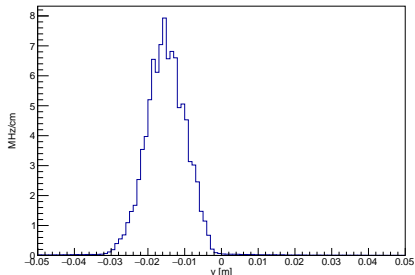
Requirements

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

PREX Rate Density at VDC X - $1 \mu\text{A}$



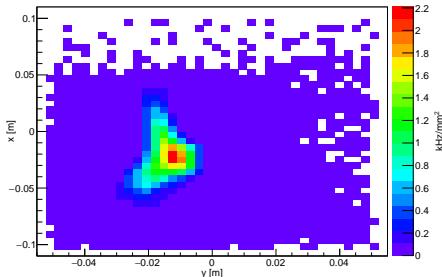
PREX Rate Density at VDC Y - $1 \mu\text{A}$



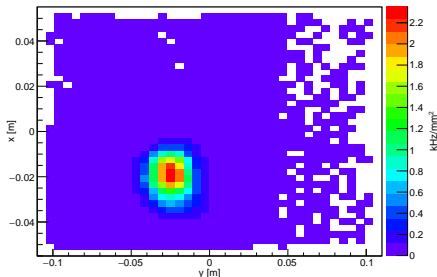
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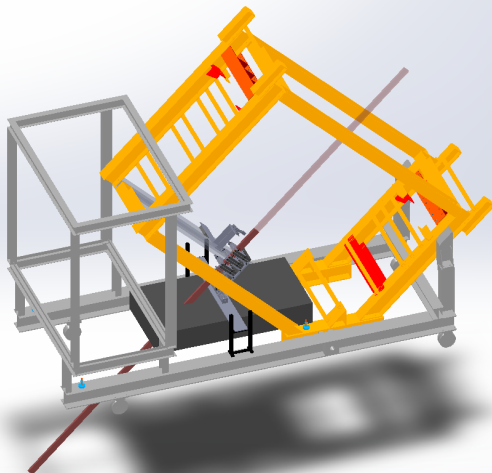
PREX Rate Density at VDC X vs. Y - $1 \mu\text{A}$



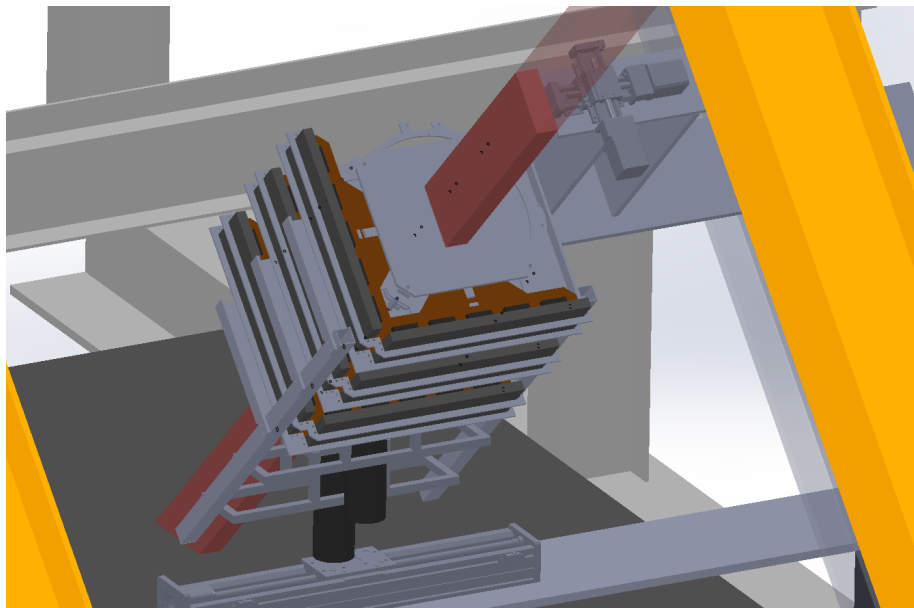
PREX Rate Density at Quartz X vs. Y - $1 \mu\text{A}$



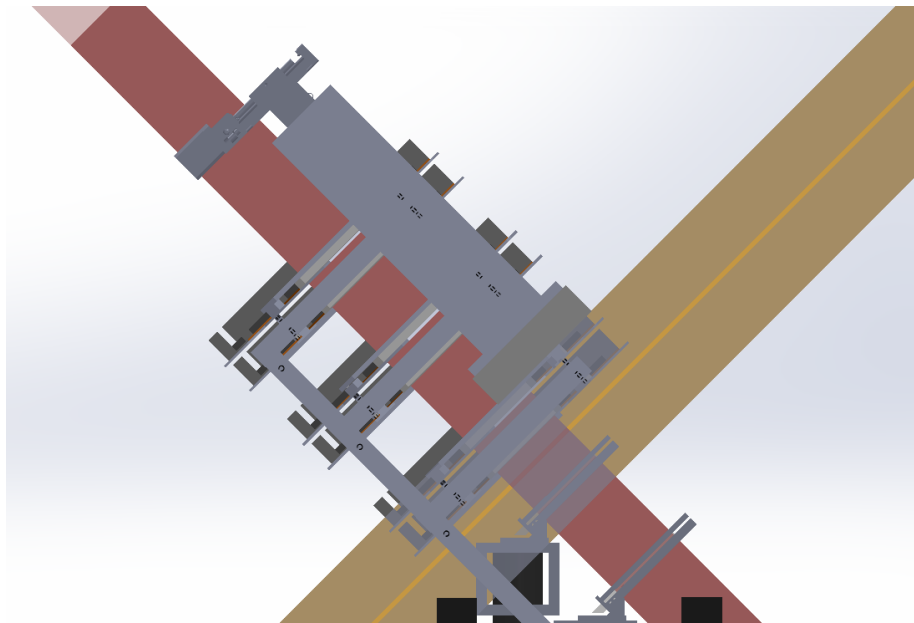
PREX Original GEM Layout



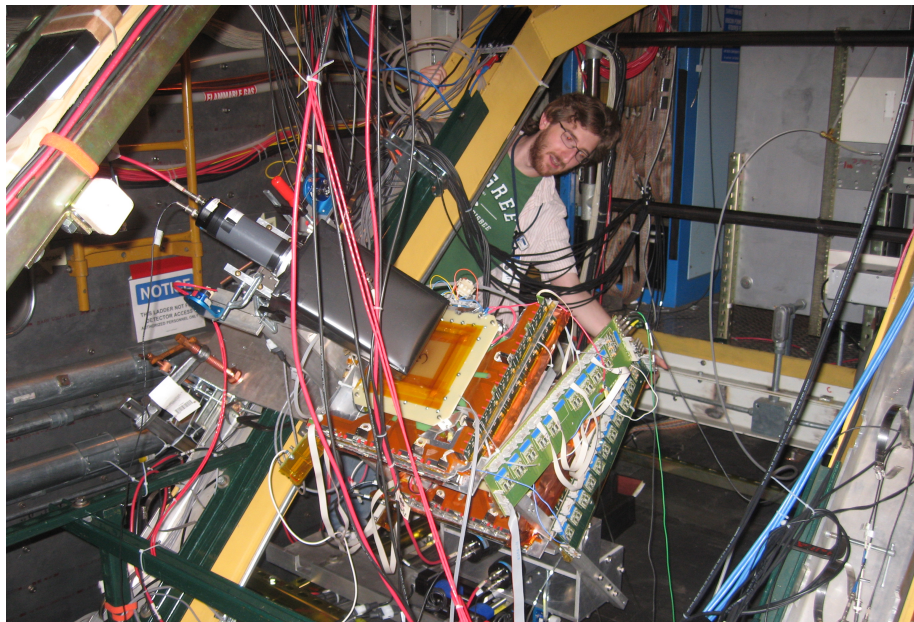
PREX Original GEM Layout



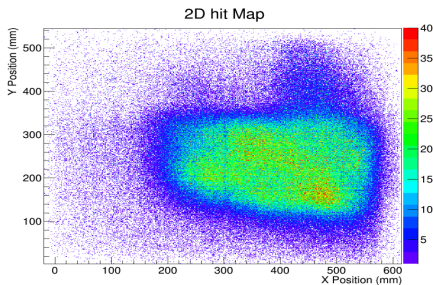
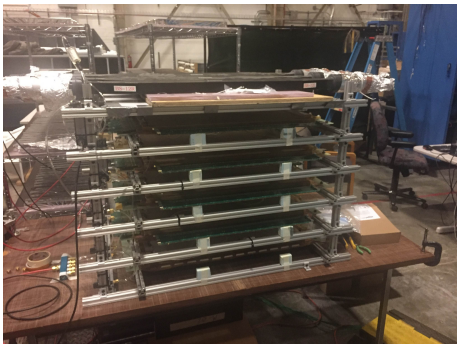
PREX Original GEM Layout



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SBS GEM Production

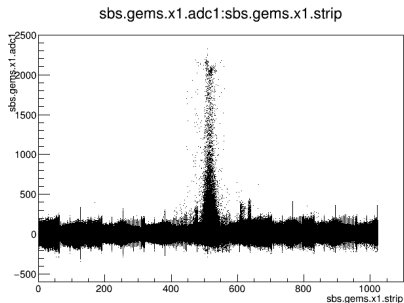


- UVA produced 48 $50 \times 60 \text{ cm}^2$ modules for SBS rear tracker
- Testing has been ongoing with beam and cosmics with setup at JLab
- New frame will have to be designed

Readout

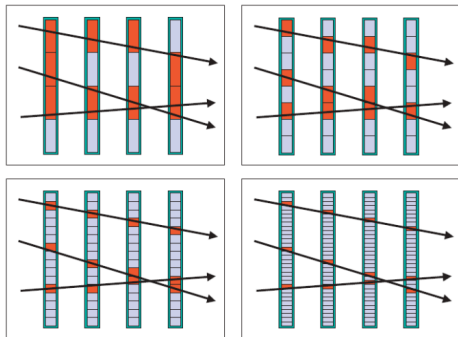
- Two APV25 readout systems have been employed for GEMs in JLab-related development activities
 - MPD - used in INFN development, will be employed by SBS, VME based (1 module = 2048 channels)
- Need 2 working systems - only need to instrument 4000 channels in each arm
- Have MPD decoder integrated into 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 Algorithm 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
- MS resolution effects should be evaluated - we have 10% RL of quartz



- 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

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

- Produced second order transport code a while ago

<https://github.com/sbujlab/hrstrans>

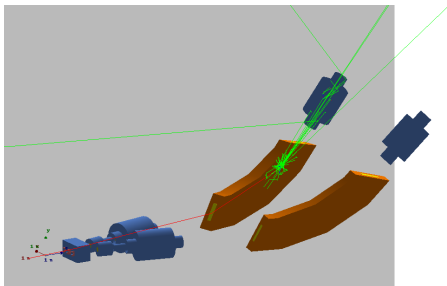
- Uses basic matrices using elements calculated here

<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

- 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 transport functions
 - Absolute values of fields needs to be understood - didn't work out of the box

<https://github.com/sbujlab/g4hrs>



More in Ryan's talk

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