

SoLID Simulation

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2016/08/27

Review Comment

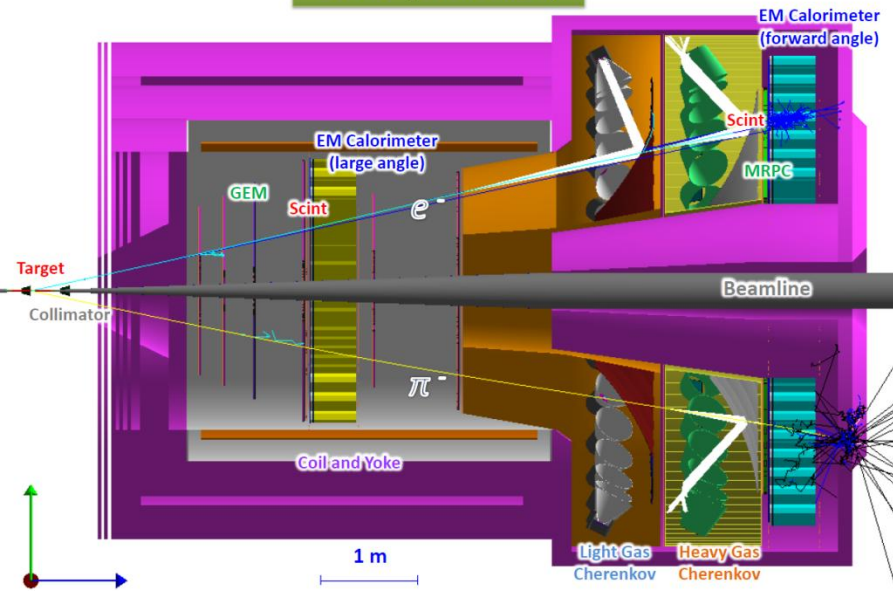
(general simulation)

- End-to-end simulations with realistic subsystem responses and material budgets
- The development of a simulation framework with realistic reconstruction and analysis should be pursued with high priority and increased resources.
- Having a functional simulation and reconstruction routines as soon as possible should be a high priority in the software effort. Such software will pay off many times over in experimental design and avoiding pitfalls.
- Acceptances, efficiencies, and systematic uncertainties should be simulated for each of the core measurements.

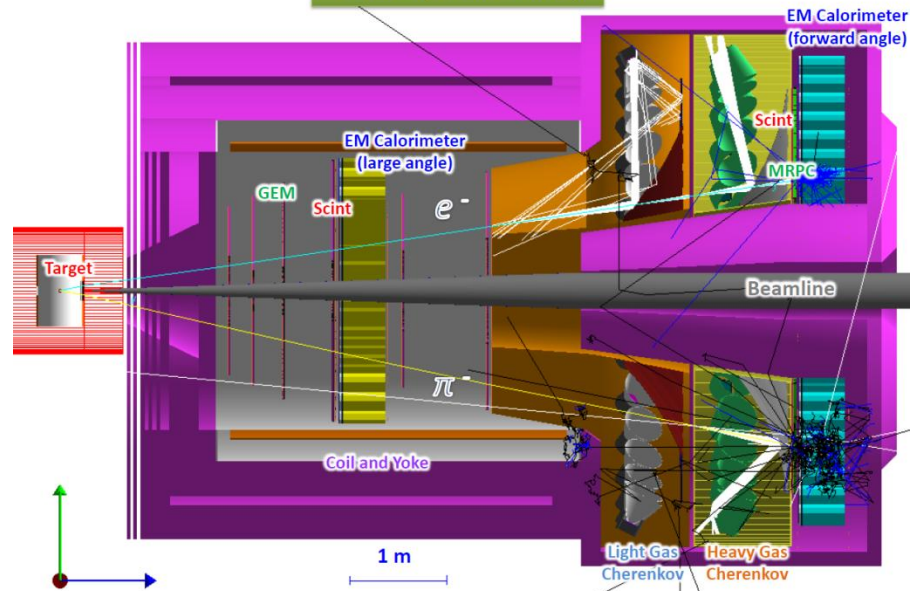
all subsystems with various level of details in the unified simulation

“solid_gemc”

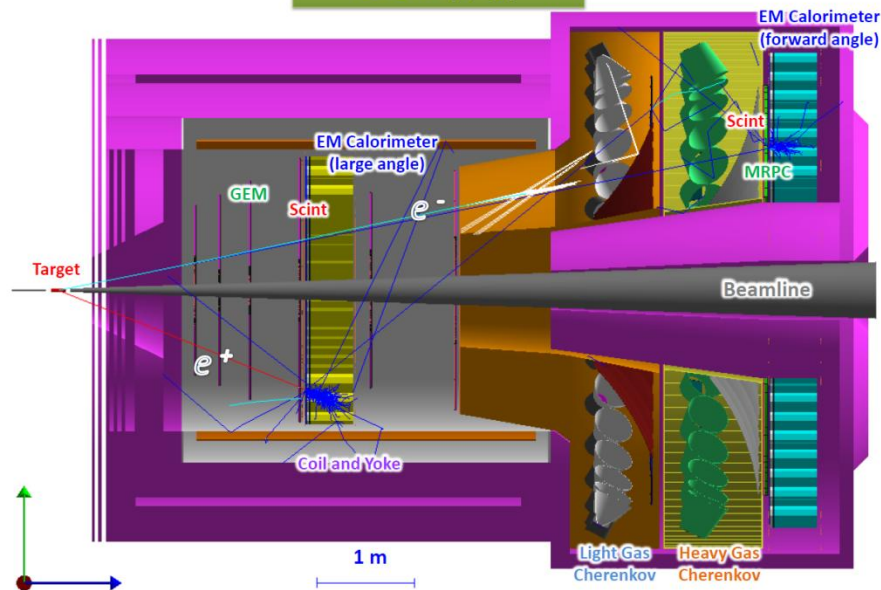
SoLID (SIDIS He3)



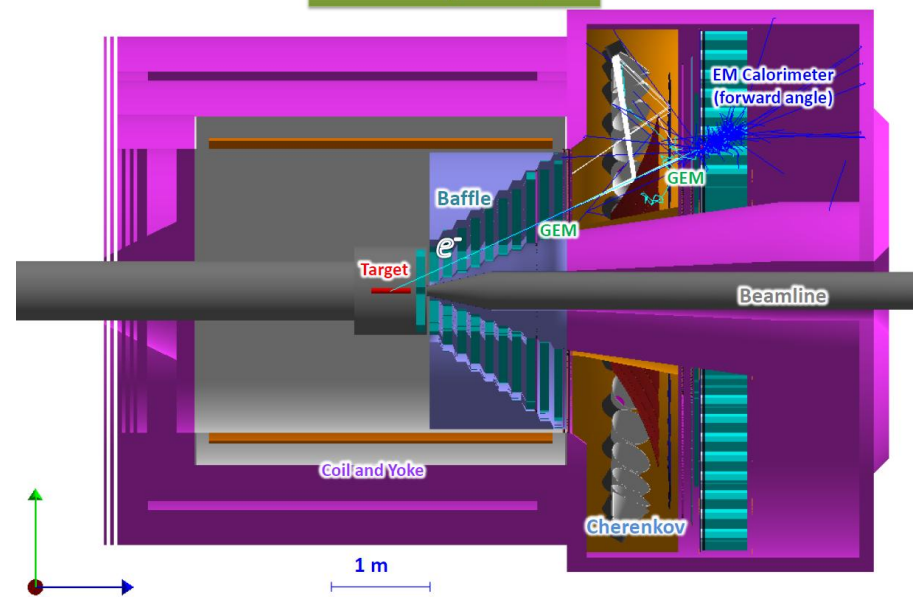
SoLID (SIDIS NH3)



SoLID (J/ψ)



SoLID (PVDIS)



Subsystems in simulation (non-detectors)

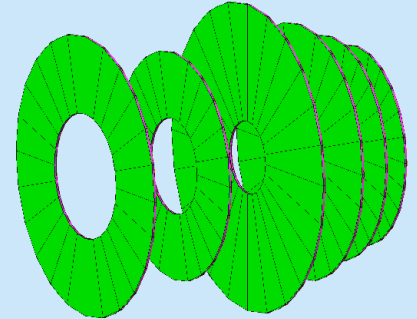
- **Target systems** have materials where beam and final particles pass
- **Beamline** are just Al pipes with BeO window, need real design
- **Magnet** has coil, cryo, iron flux return according to the 2D field model
- **Baffle** is pure lead
- **neutron shielding**, has for PVDIS, **not** for all others

Subsystems in simulation (detectors)

- GEM has all layers, no dead area
- SPD just a layer of scintillator
- MRPC has all layers, no dead area

All these layer kind of
detectors record hit
pid,mom,position,vertex,
energy deposition

GEM SIDIS



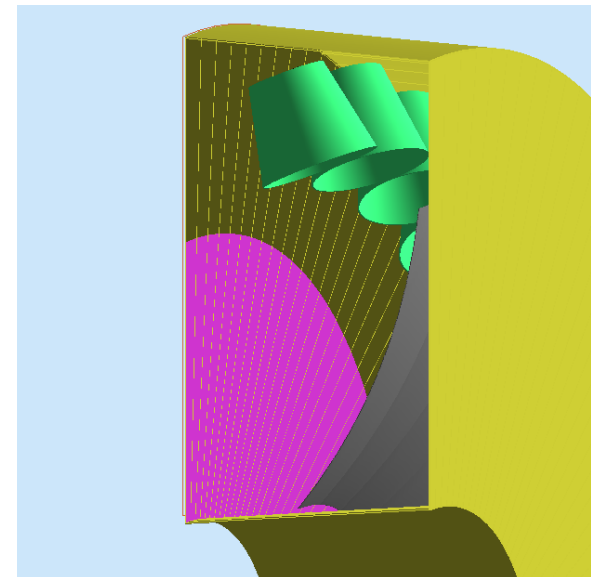
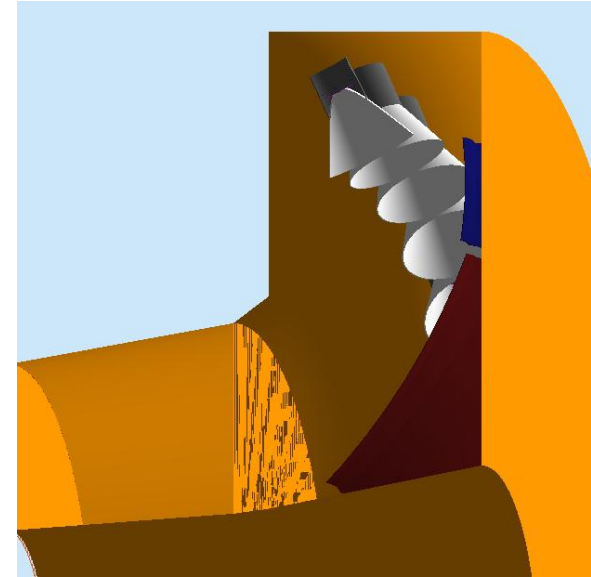
GEM one layer



Subsystems in simulation (detectors)

- **LGC**, has tank, window, gas, mirror, cone, PMT window with optical features
- **HGC**, has tank, window, gas, mirror, cone with optical features, no PMT window yet

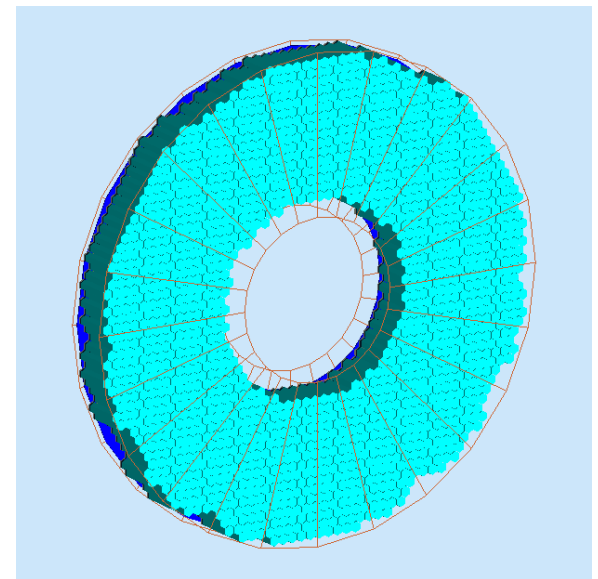
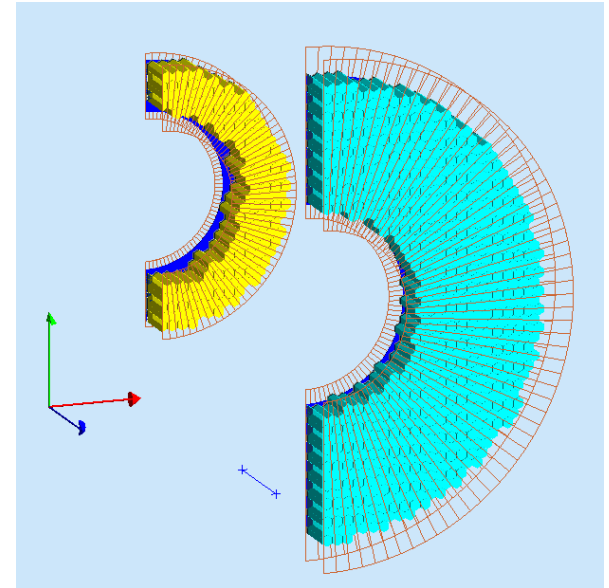
All these optical photon collecting detectors can record all hits too.
LGC already fully digitized.
HGC not yet.



Subsystems in simulation (detectors)

- EC
 - has lead shield, preshower, shower with all layers
 - No fibers, no PMT yet
 - PVDIS FAEC layout is done according to ANL drawing, SIDIS FAEC and LAEC layout are done by removing modules from ANL drawing (design needed)

Energy deposition sum in scintillator of preshower and shower are recorded for each module



Use simulation to study

- All files with production version and devel version are in SVN
- Documentation on wiki
- Official binary builds are on farm and we have streamline installation scripts for local machines, we also provide virtual machine ready to use
- we have a work flow from various generators to simulation output on farm with semi-auto scripts, anyone can run it with a little setup
- For any setup, a set of files are generated at a shared central location and used for studies like acceptance, efficiency, trigger, background, tracking etc. This ensures consistent results

Analysis simulation output

- Mainly use output root
- All detector responses are recorded in separated trees which follow same index for same event

Some simple modulized script
for general study

- [analysis.C](#)
 - [analysis tree solid ec.C](#)
 - [analysis tree solid mrpc.C](#)
 - [analysis tree solid spd.C](#)
 - [analysis tree solid lgc.C](#)
 - [analysis tree solid hgc.C](#)
 - [analysis tree solid gem.C](#)

GEM digitization
and tracking are
separate codes,
even though they
read the same
output file from
simulation

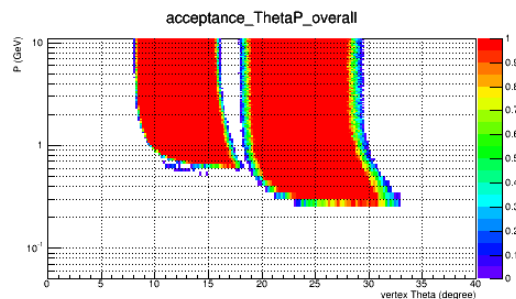
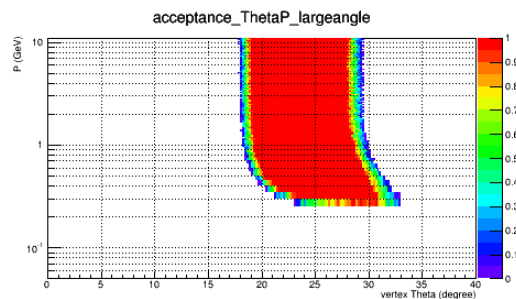
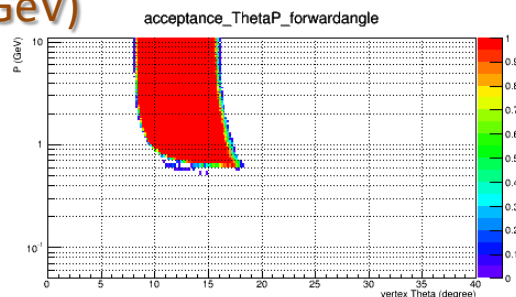
Simple setup without secondary
Only field effect, pass EC+GEM

Jpsi and PVDIS Acceptance

JPsi

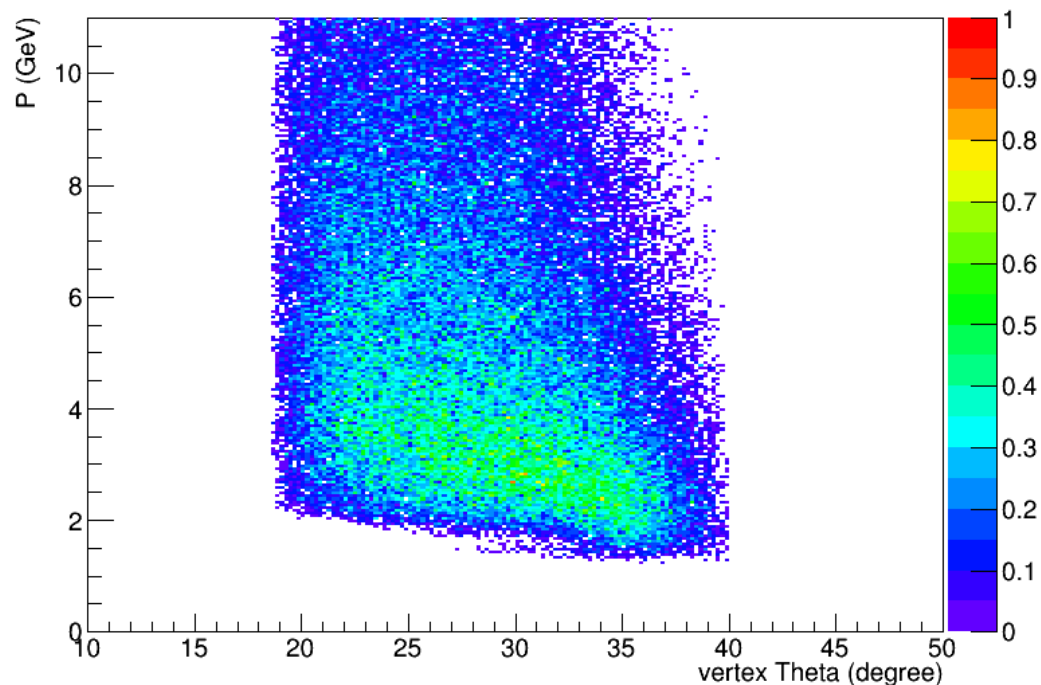
PVDIS e

P(GeV)



Theta(deg)

acceptance_ThetaP_forwardangle



Simple setup without secondary
Only field effect, pass EC+GEM

SIDIS Acceptance

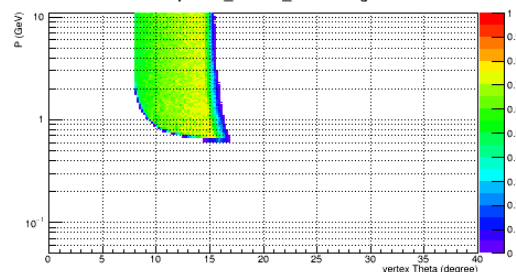
He3

NH3 2D

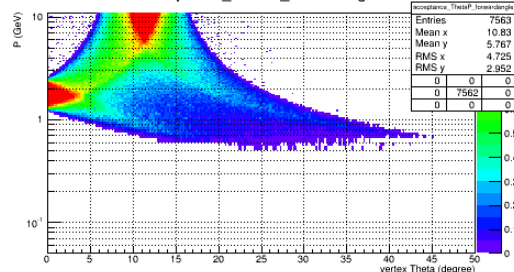
NH3 3D

P(GeV)

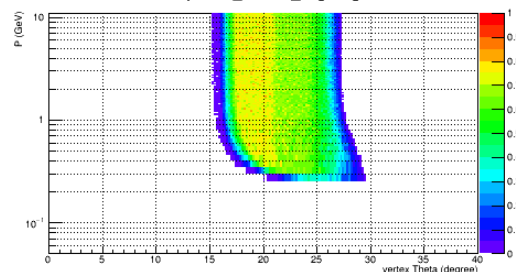
acceptance_ThetaP_forwardangle



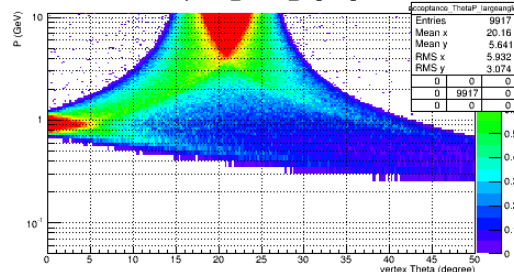
acceptance_ThetaP_forwardangle



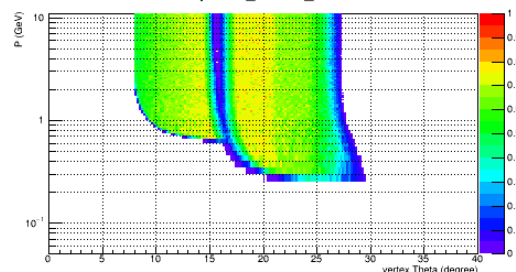
acceptance_ThetaP_largeangle



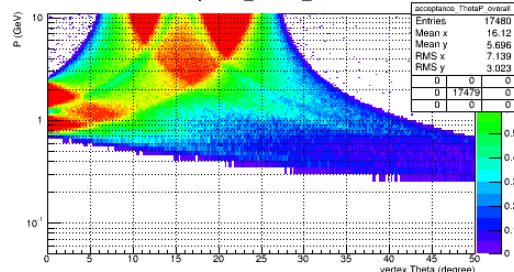
acceptance_ThetaP_largeangle



acceptance_ThetaP_overall

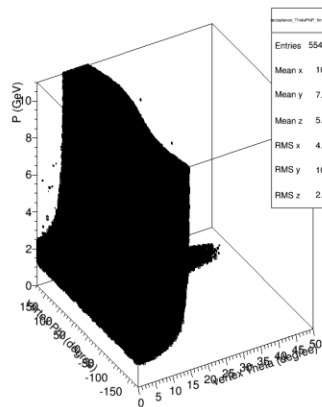


acceptance_ThetaP_overall

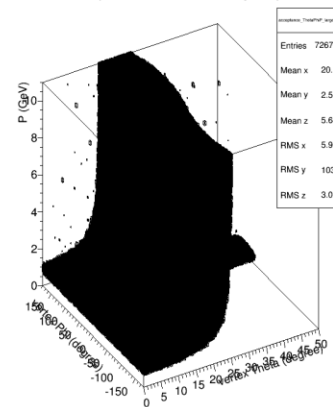


Theta(deg)

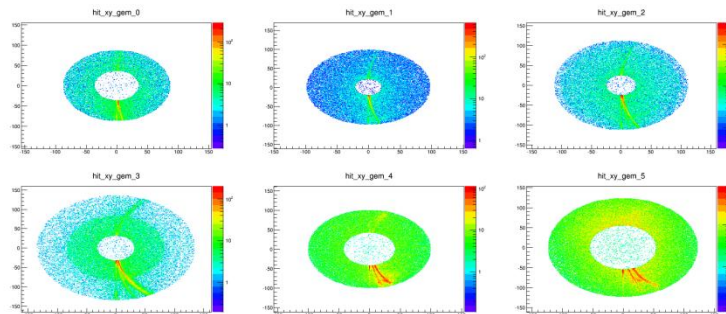
acceptance_ThetaPhiP_forwardangle



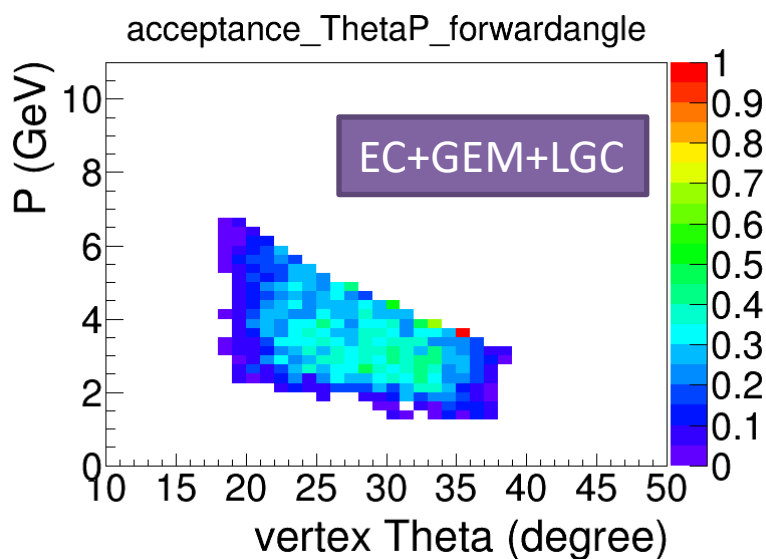
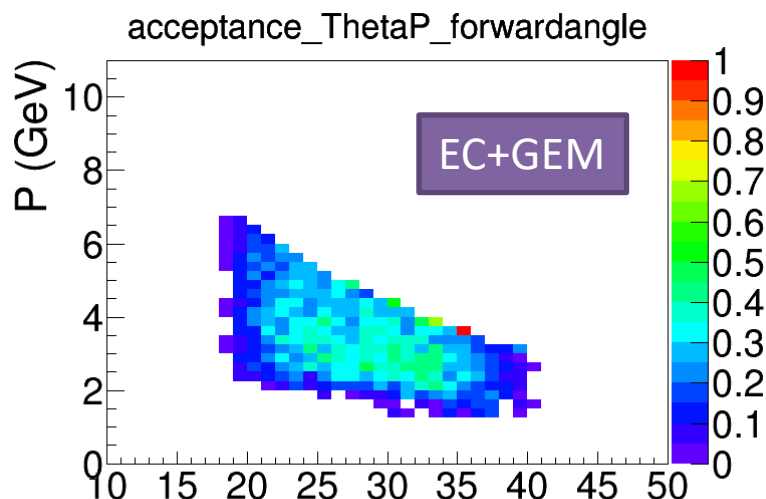
acceptance_ThetaPhiP_largeangle



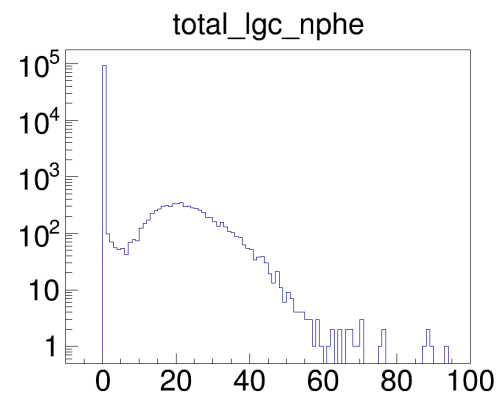
NH3 sheet of flam on GEM



Test toward overall efficiency (PVDIS)



- A simple test, not complete study
- Throw eDIS into PVDIS full setup, consider it's accepted when
 - it passes all GEM planes and entering EC
 - In addition, LGC has number of total photons > 10
- Essentially it will need to involve from a simple into a full reconstruction code



setup with secondary

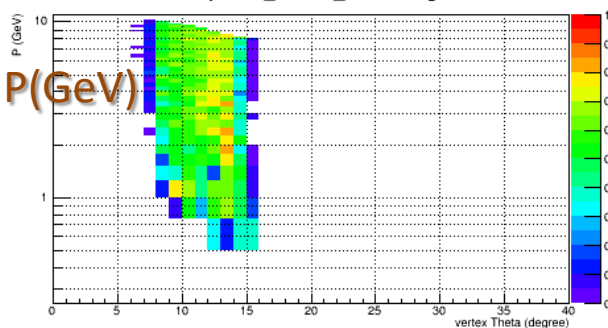
Toward overall efficiency (SIDIS_He3)

e-

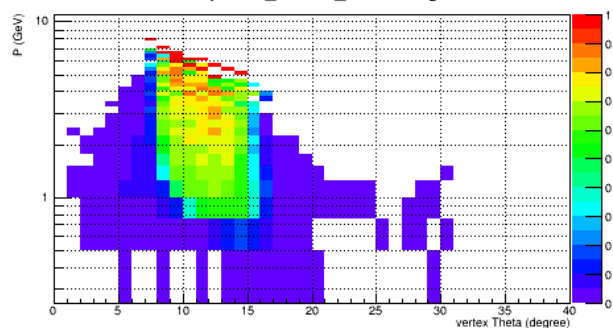
EC+GEM

pi-

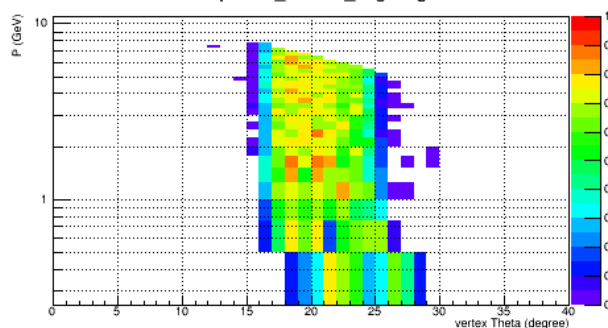
acceptance_ThetaP_forwardangle



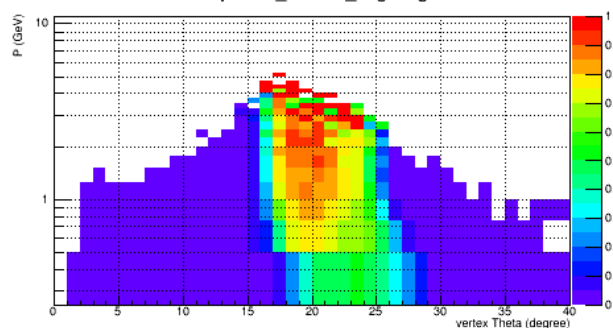
acceptance_ThetaP_forwardangle



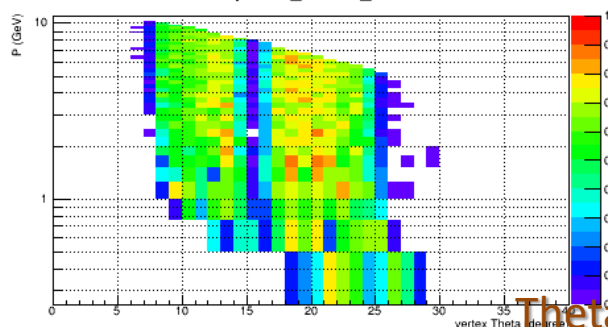
acceptance_ThetaP_largeangle



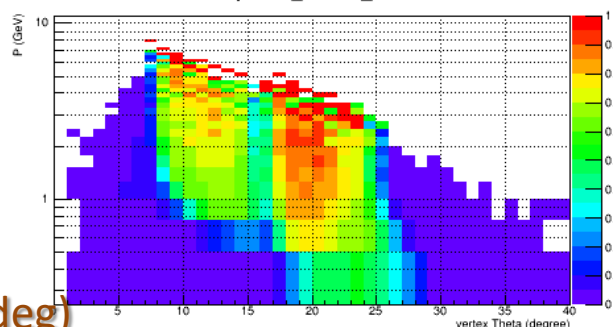
acceptance_ThetaP_largeangle



acceptance_ThetaP_overall



acceptance_ThetaP_overall



- A simple test, not complete study
- Throw eDIS or pimWiser into SIDIS_He3 full setup, consider it's accepted when
 - it passes all GEM planes and entering EC
 - In addition, LGC or HGC has number of total photons > 10

setup with secondary

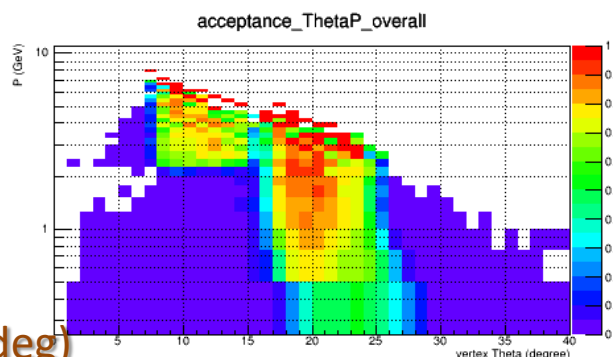
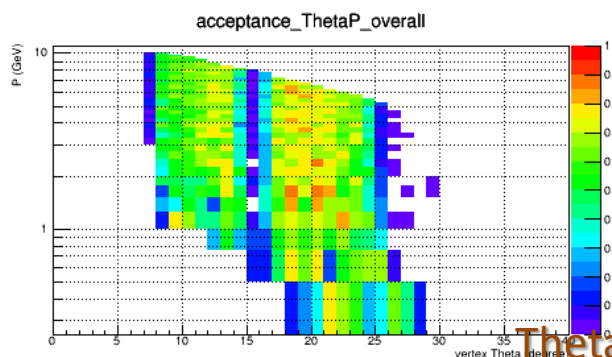
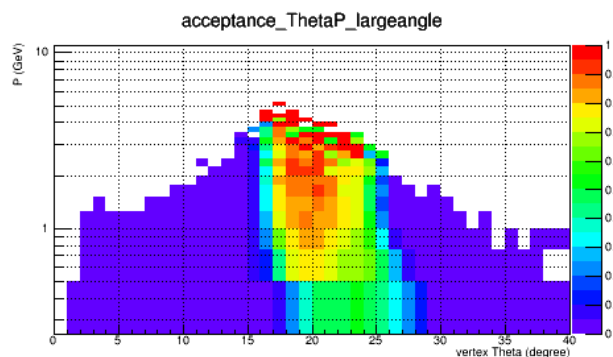
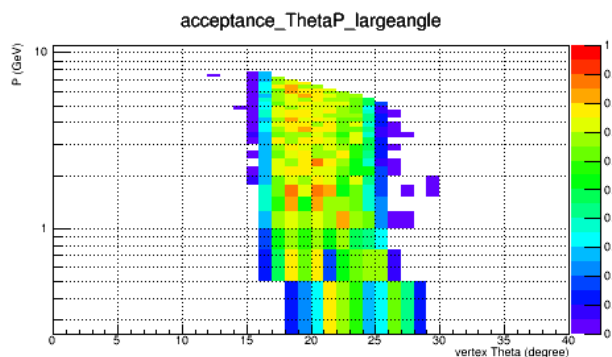
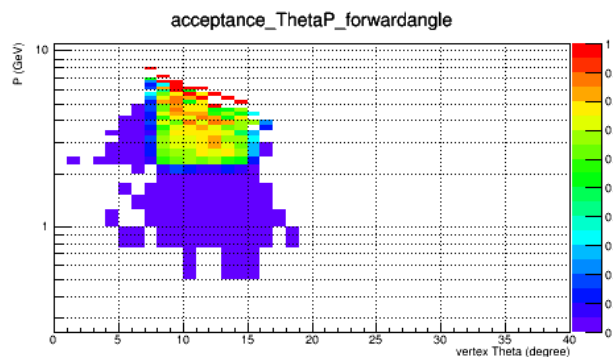
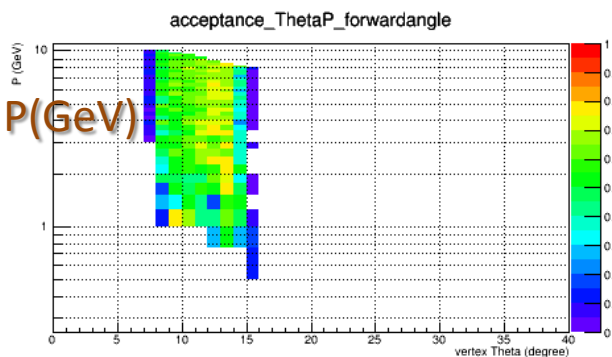
Toward overall efficiency (SIDIS_He3)

e-

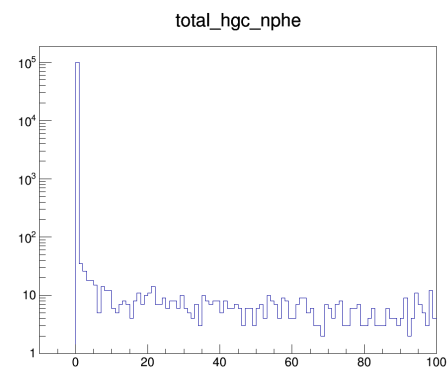
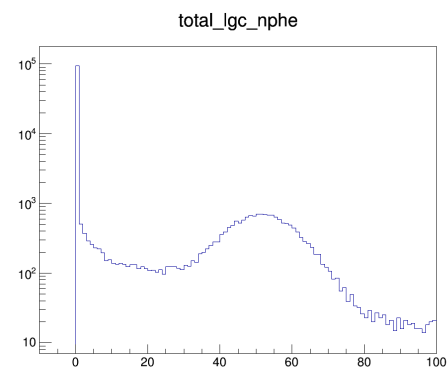
EC+GEM+LGC/HGC

pi-

- In addition, LGC or HGC has number of total photons > 10

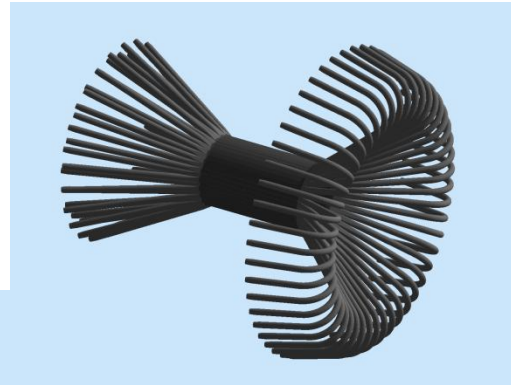


Theta(deg)



Simulation future plan

- Continue using and improving current software and setup for various studies
- **fastMC**: using acceptance, resolution, pid from detailed simulations, for SIDIS and Jpsi setup
- Test using “solid_gemc” as simulation engine for art framework
 - gemc is very much modulized already
 - solid_gemc uses gemc as library already
 - Input format can be expended, existing
 - Geant4 solid in simple form with attribute
 - CLARA geometry service
 - GDML with attribute (**new**)
 - CAD with attribute (**new**)
 - Mixed together



Update from Rakitha

- generator updates
 - Hall D generator code is now standalone code, separate from full Hall D simulation framework
 - Generates events for PVIDS LH and LD, SIDIS 3He and J/Psi LH configurations to produce LUND files as input for solid_gemc
- ECAL Simulation Updates
 - Finished PVDIS ECAL performance and trigger rates in remoll
 - Working on SIDIS He3 performance and trigger in solid_gemc while adopting previous analysis tool
 - Jpsi and SIDIS NH3 later
- Happy at [Louisiana](#), staying away from flood



Acceptance	Zhiwen, Kalyan	Done with simple setup, working on more supplicated setup
PVDIS Q2	Bob	Initial result
SIDIS impact	Tianbo and others	Initial result
J/psi bin migration and signal/background	Michael and others	Initial result
Hadron generator	Rakitha	Done, producing file, adding e would be nice
EC trigger	Rakitha	PVDIS down, SIDIS ongoing, need Jpsi
LGC trigger	Michael	PVDIS and SIDIS, under tuning
SPD trigger	Sanghwa	Initial result
MRPC trigger	Sanghwa	needed
Overall trigger	Yuxiang	PVDIS done, SIDIS e under study, need SIDIS hadron, and Jpsi e
DAQ deadtime	Alex, Bob	ongoing
GEM response parameterization		ongoing
GEM Digitization and Occupancy	Weizhi,Ole	done with initial result, need UVa input to finalize
tracking	Weizhi,Ole	Initial result
Baffle optimization	Rich	Initial result