SoLID Simulation Overview

Zhiwen Zhao

2020/10/09

magnet with longer endcap

longer endcap gives room for FAEC cables, Cherenkov tank and window
Prepare for next iteration of design and verify basic performance
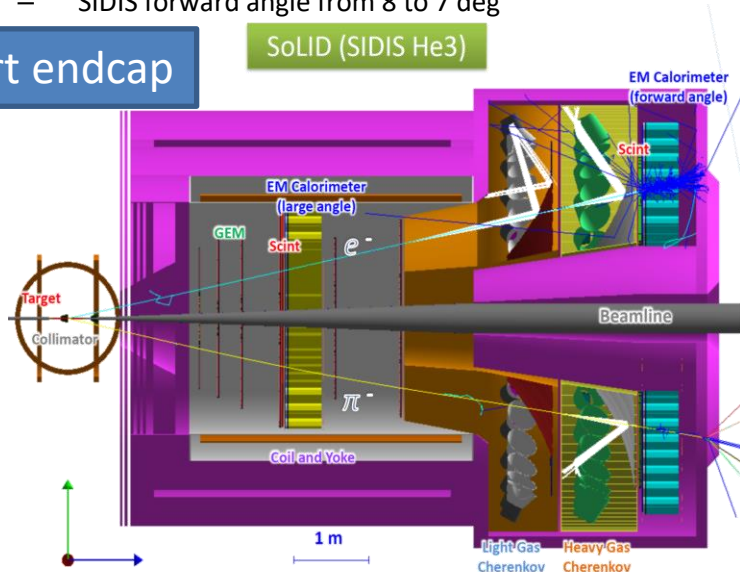Not update everything for science review

- Layout change
  - enlarge endcap space in Z by 45cm=(530-485)
  - Move downstream of FASPD,MRPC,GEM 4 5 of PVDIS, and FAEC
  - Adjust LGC,HGC position in Z and optics
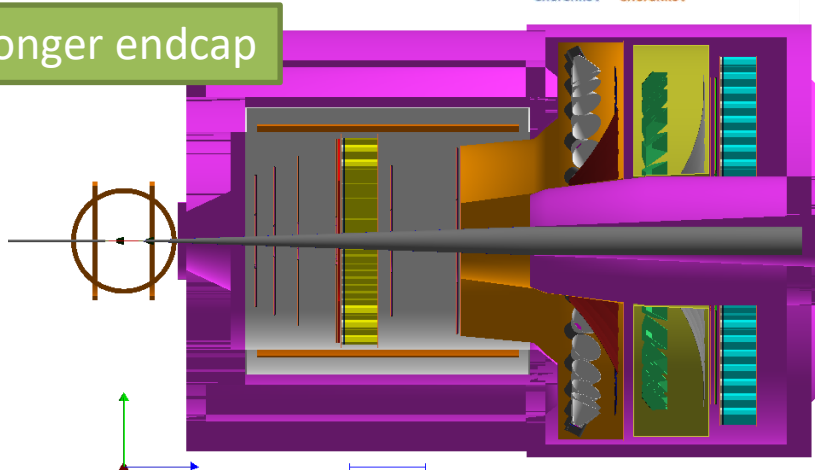 - SIDIS forward angle from 8 to 7 deg

- Other change
  - Magnet geometry can be from CAD model directly
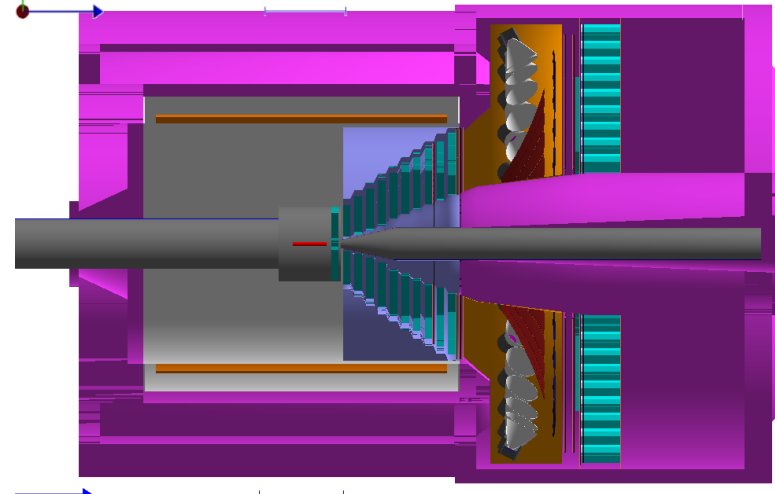 - Magnet field map 3D with 4fold rotation symmetry from TOSCA
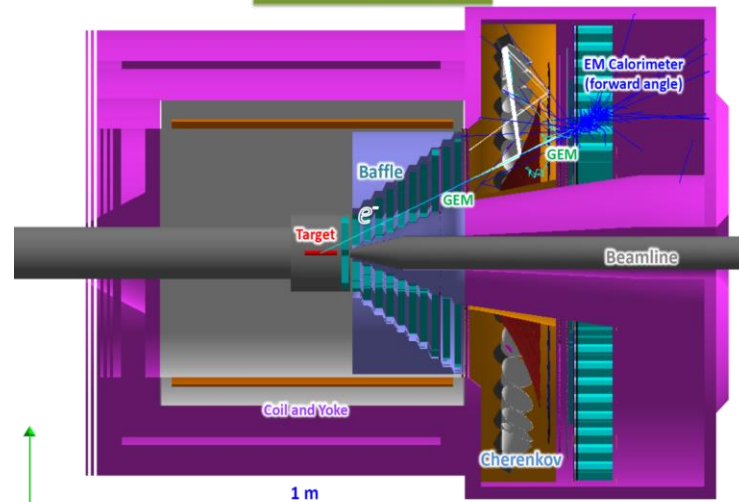
PVDIS FOM comparison

Requiring primary eDIS hit on EC, W > 2 GeV, 110 cm < r < 270 cm, and the latest EC trigger curve (from the shorter endcap version)
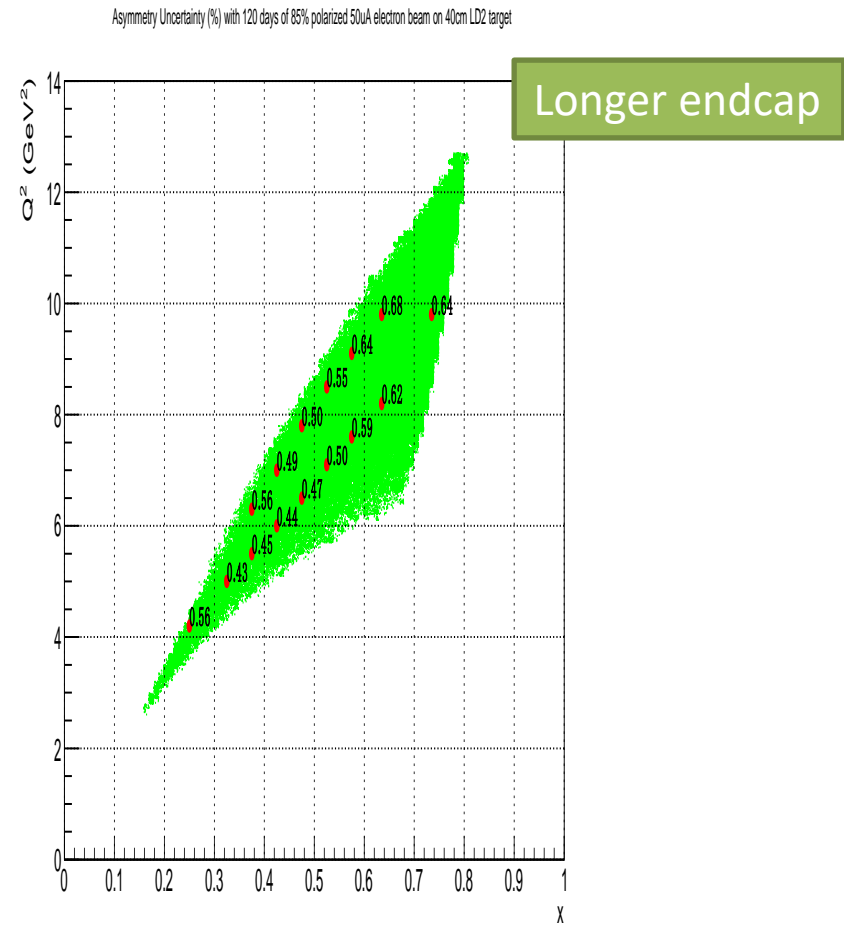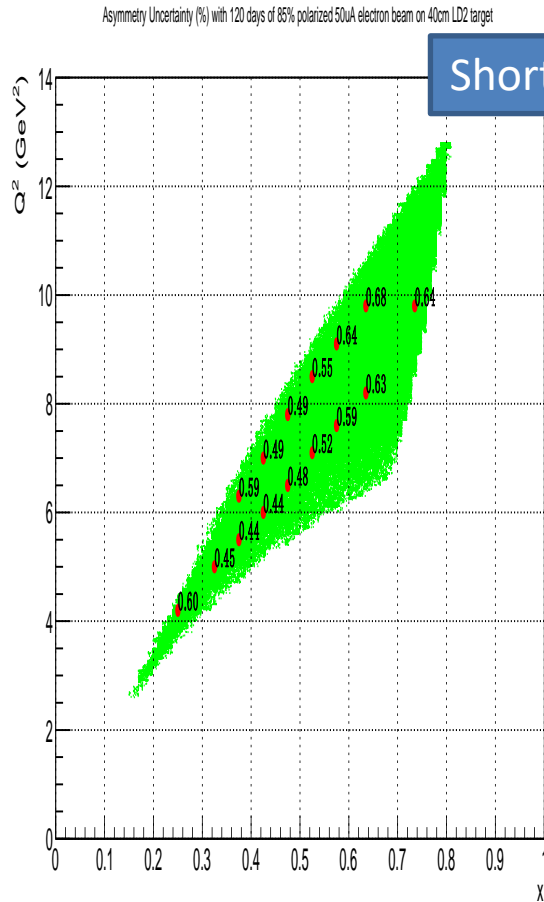
GEM 4 and 5 new size evaluated, FAEC edge effect study ongoing

SIDIS_He3 acceptance & efficiency

Short endcap

SIDIS electron acceptance & efficiency
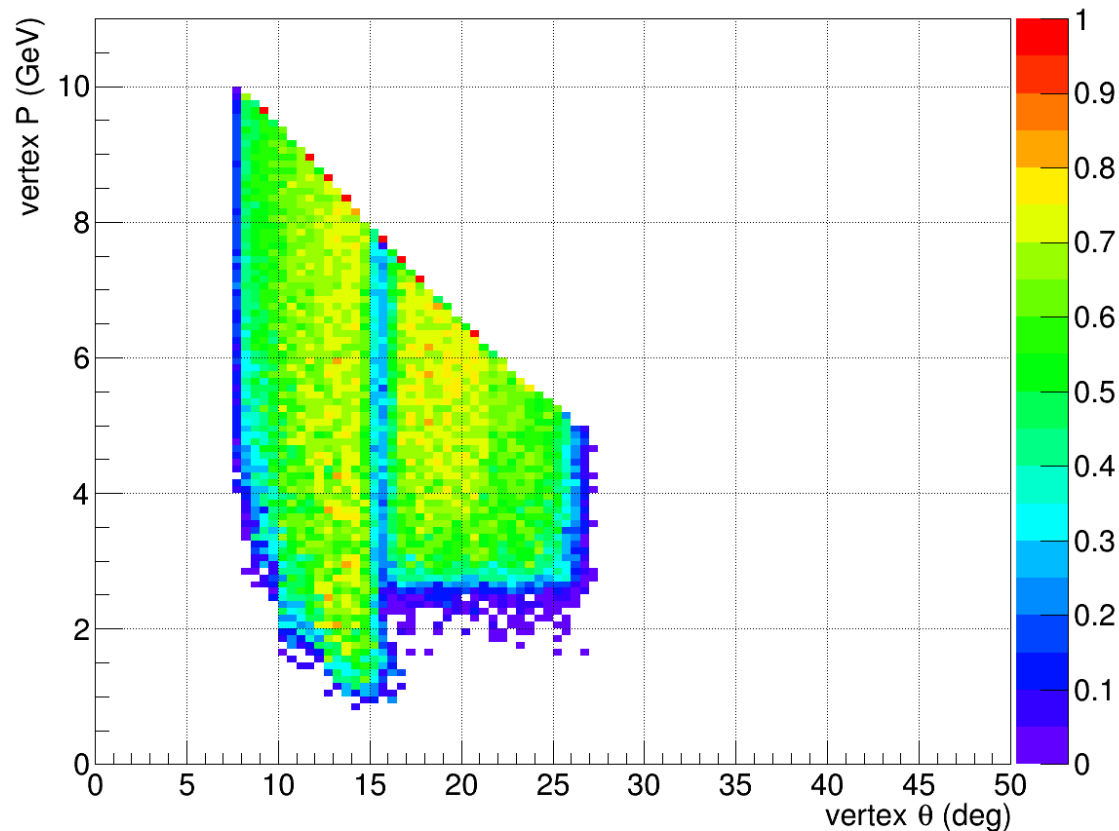
- eDIS with EC and LGC trigger condition applied
- Longer endcap may improve forward angle from 8 to 7 deg

SIDIS_He3 acceptance & efficiency

Longer endcap
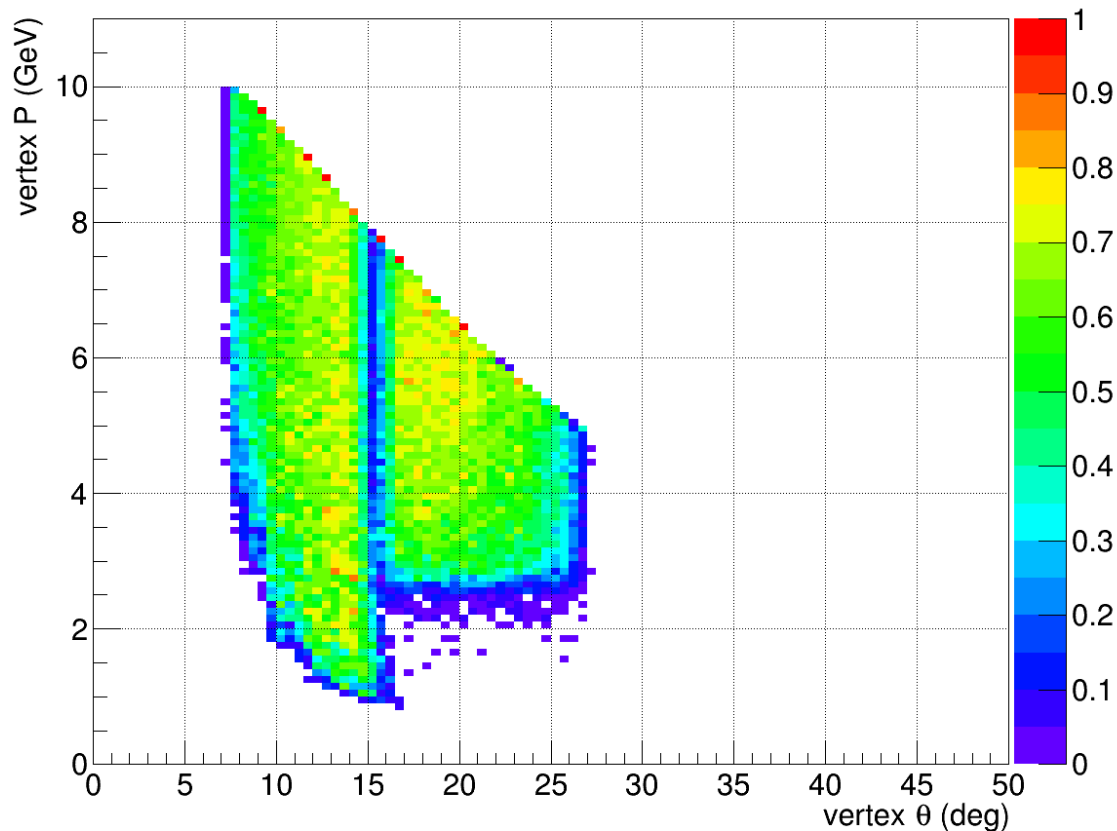
SIDIS electron acceptance & efficiency

- eDIS with EC and LGC trigger condition applied
- Longer endcap may improve forward angle from 8 to 7 deg

5

GEM geometry
with frame,dead area,layout

putting design into simulation is ongoing
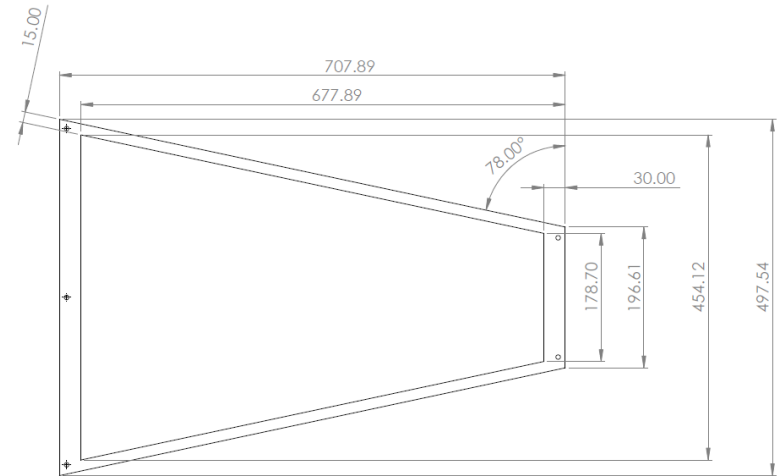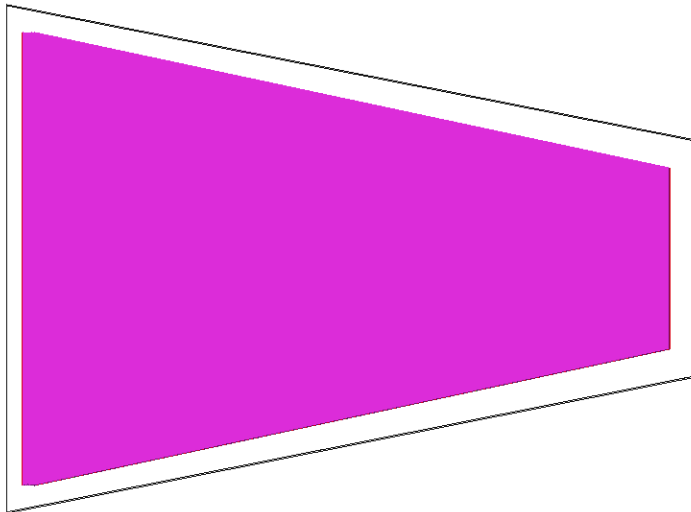
SIDIS - Z1
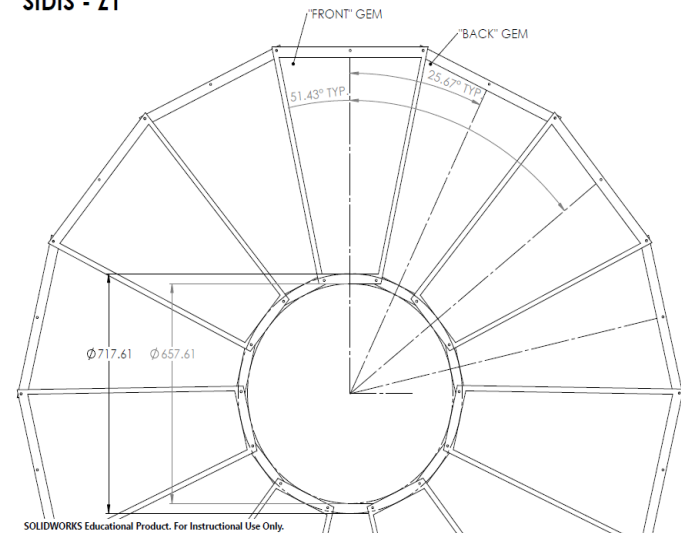
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Cherenkov preRD sim at low rate location events after trigger

e⁻ and π⁰ from ³He gas

Number of Photo-electrons

Cherenkov preRD sim at high rate location events after trigger

e^- and π^0 from ^{3}He gas

Rate (khz)

Number of Photo-electrons

Sim Tasks before Science Review

- Defend preCDR as it is but include new progress (longer endcap setup)
- Improve some physics studies (Jpsi and SIDIS_NH3) to the same level of other studies.
- support preRD

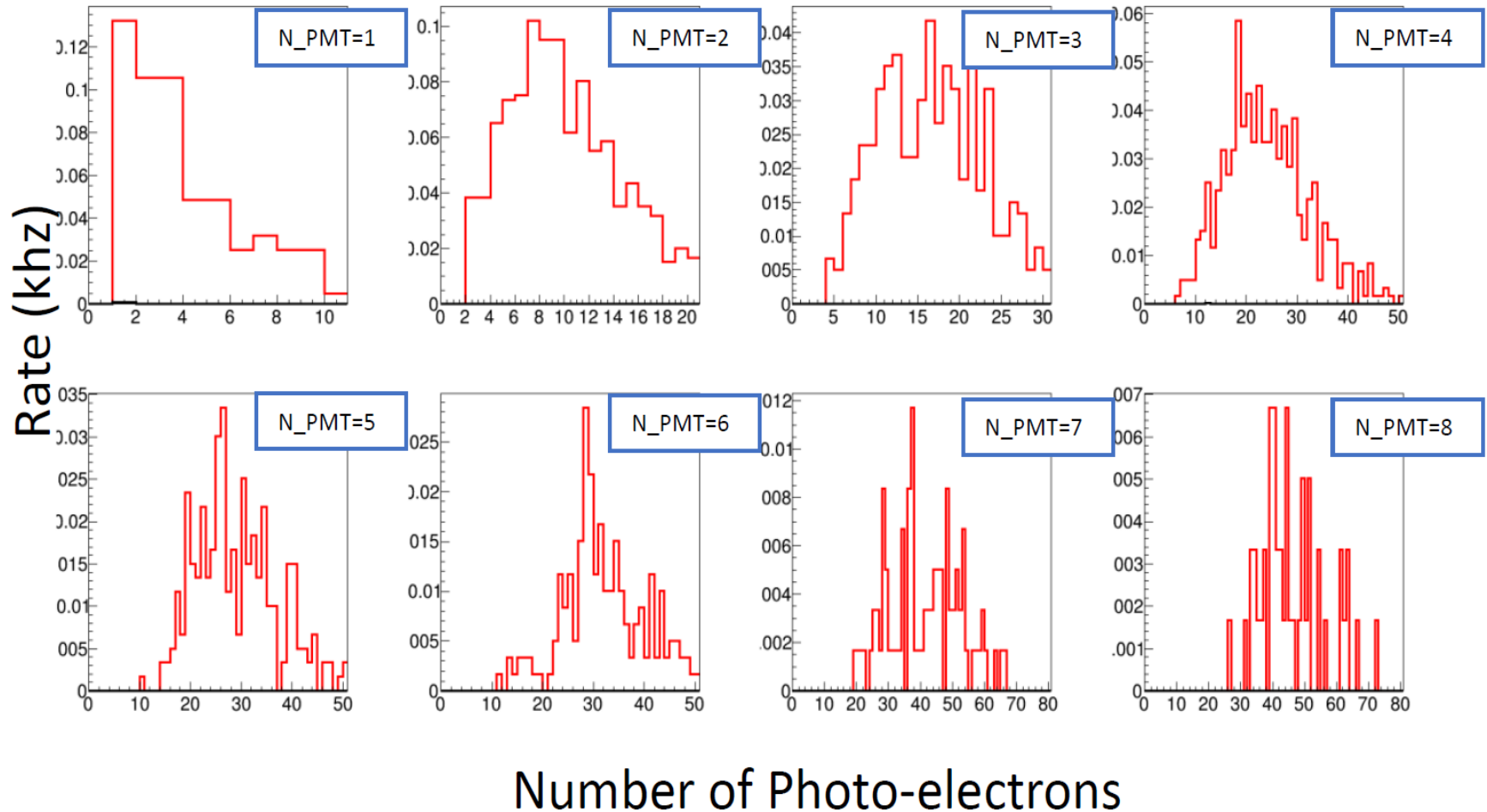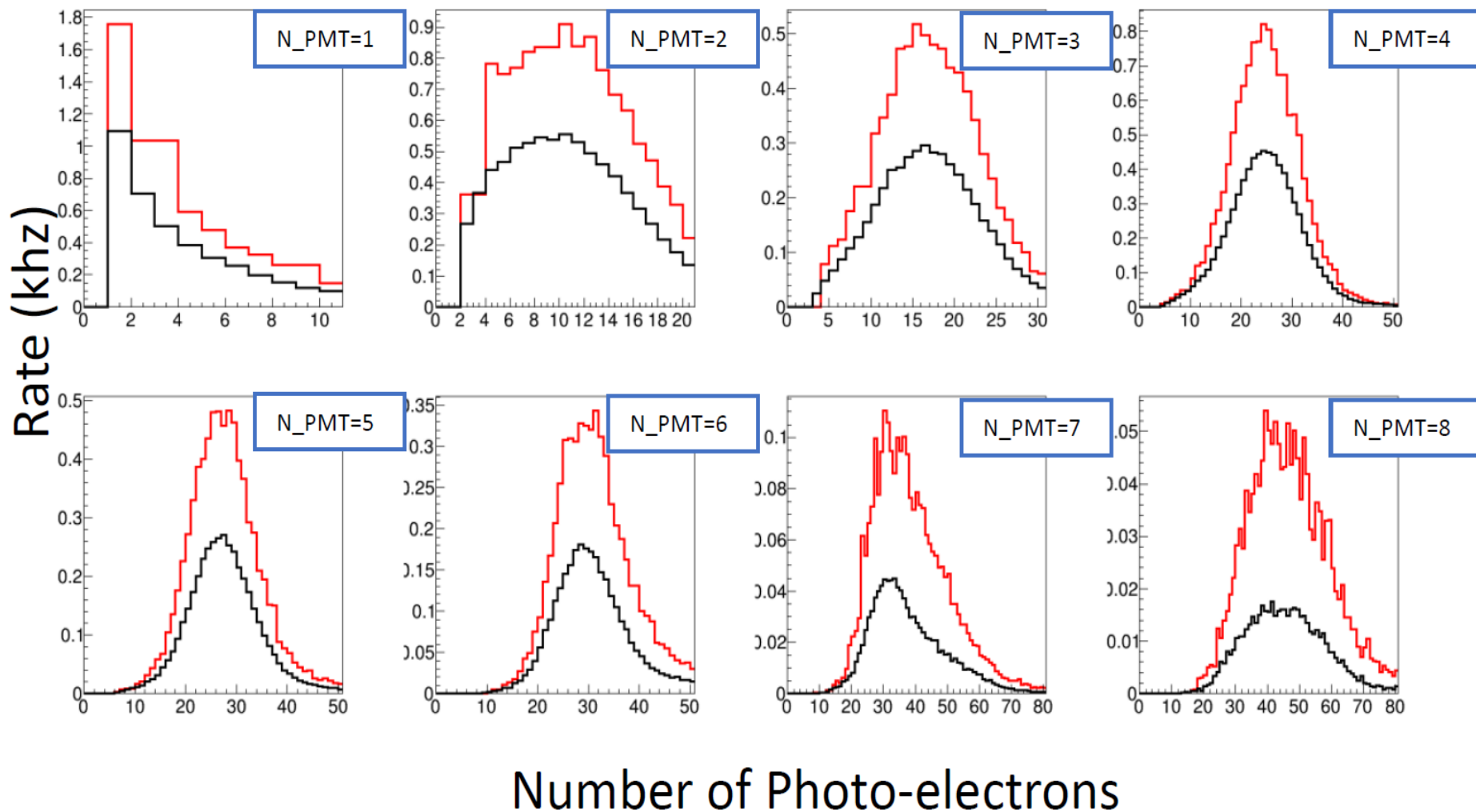|	description	who	status	end
1	Cherenkov simulation for preRD to support test	Zhiwen, Michael	ongoing	Dec/spring
2.1	GEM digitization with VMM and update tracking	Jinlong	close to finish	Oct
2.2	GEM frame,dead area,layout in the simulation and update tracking for initial study	Weizhi, UVa	ongoing	Dec
2.3	SIDIS_NH3 electron tracking, SIDIS_He3 hadron tracking	Weizhi	finished	
2.4	Initial tracking for multiple particles	Weizhi	ongoing	Nov
3.1	check longer endcap setup: acceptance	Zhiwen	close to finish	Oct
3.2	check longer endcap setup: EC edge effect, background and trigger with existing method (PVDIS, SIDIS_He3)	Ye Tian	ongoing	Nov
4	JPsi, background and trigger	Sylvester	Start in Nov	Dec
5	SIDIS_NH3, background and trigger	Vlad	close to finish	Dec
6	evaluate e- generators and compare generators to Geant4	Ye Tian	ongoing	Dec

https://hallaweb.jlab.org/wiki/index.php/SoLID_Study#Science_Review_preparation_.282020.2F05-2020.2F09.29

How to move forward with general software

Is DD4hep the solution for detector definition?

- Need instruction to test solid in DD4hep
- Need some comparison studies between DD4hep and current simulation

Simulation software

- How good is the geant4 interface in DD4hep?
- Can gemc/solid_gemc work with DD4hep?

ANL software ready for test in Nov

Digitization, reconstruction and analysis software

- Need some framework to combine information from different subdetectors for high level analysis like PID and trigger
- Need some consistent data format or model

backup

Simulation Software Status

- solid_gemc
  - for preCDR, using production version based on modified gemc 2.3 and geant4.10.1.p03 and physcis list "QGSP_BERT_HP"
  - For longer endcap setup, testing devel version based on latest gemc 2.x and geant4.10.06 and and physcis list "QGSP_BERT_HP"
    - This geant4 has fix of correct treatment for the recoiled nucleon with Deuterium, but not Tritium or Helium3 yet
- Digitization
  - MRPC, standalone code
  - GEM, standalone code using Analyzer
  - Others, simple optical photons and energy deposition
- Reconstruction and analysis
  - MRPC, standalone code
  - Tracking, standalone code using Analyzer
  - Root scripts with some structures

Tasks in mid term before FY22

Simulation goal

- Study figure-of-merit for experiments
- Optimize detector designs
- Understand experimental conditions and mitigate technical risks.

Item	Curr.per.(FTE)	Req.per. Y1(FTE)	Req.Per. hY2(FTE)
GEM	0.2 (Duke) 0.3 (SBU)		
		0.5 (UVa Liyanage)	0.25 (UVa Liyanage)
Other detector	0.3 (SBU)		
		0.3 (UVa Zheng)	0.15 (UVa Zheng)
	0.1 (Temple)	0.1 (Temple Sparv.)	0.05 (Temple Sparv.)
	0.1 (Duke)	0.1 (Duke)	0.05 (Duke)
physics	1.0 (Syracuse) 0.5 (Duke)	0.5 (Duke)	0.4 (Duke)
		0.5 (Temple Sparv.)	0.4 (Temple Sparv.)
General software		0.5 (JLab*)	0.25 (JLab*)
reconstruction	0.3 (Syracuse)		
Total	2.8	2.5	1.55

- With existing effort only, we can cover different aspects, but with less deliverables. We don't have general software covered
    - GEM has no UVa part and simulation can't be connected to hardware well
    - EC simulation and reconstruction conflict. EC need to study edge effect for longer endcap. Reconstruction needs improvement to do better high level study combining different sub-detectors
    - We need to move forward with general software
- To ramp up effort, we need more people
    - Some standalone efforts in detector study and software can be a few months efforts. But overall performance and physic studies are constantly involving. There is a learning curve for any work.
    - It's ideal to have long term commitment from new contributors
    - How to get new contributors?

Idea of SoLID software ecosystem

arrows with different colors mean different interfaces

Detector creator

Calibration and Survey

Detector definition
(field,geometry,material,optical property etc)

Analysis (physics and detector)

simulation

Digitization

Reconstruction

Real Data