SoLID SIDIS-NH_3 Studies (update)

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SoLID Simulation Meeting

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Reminder on the SIDIS-NH_3 studies

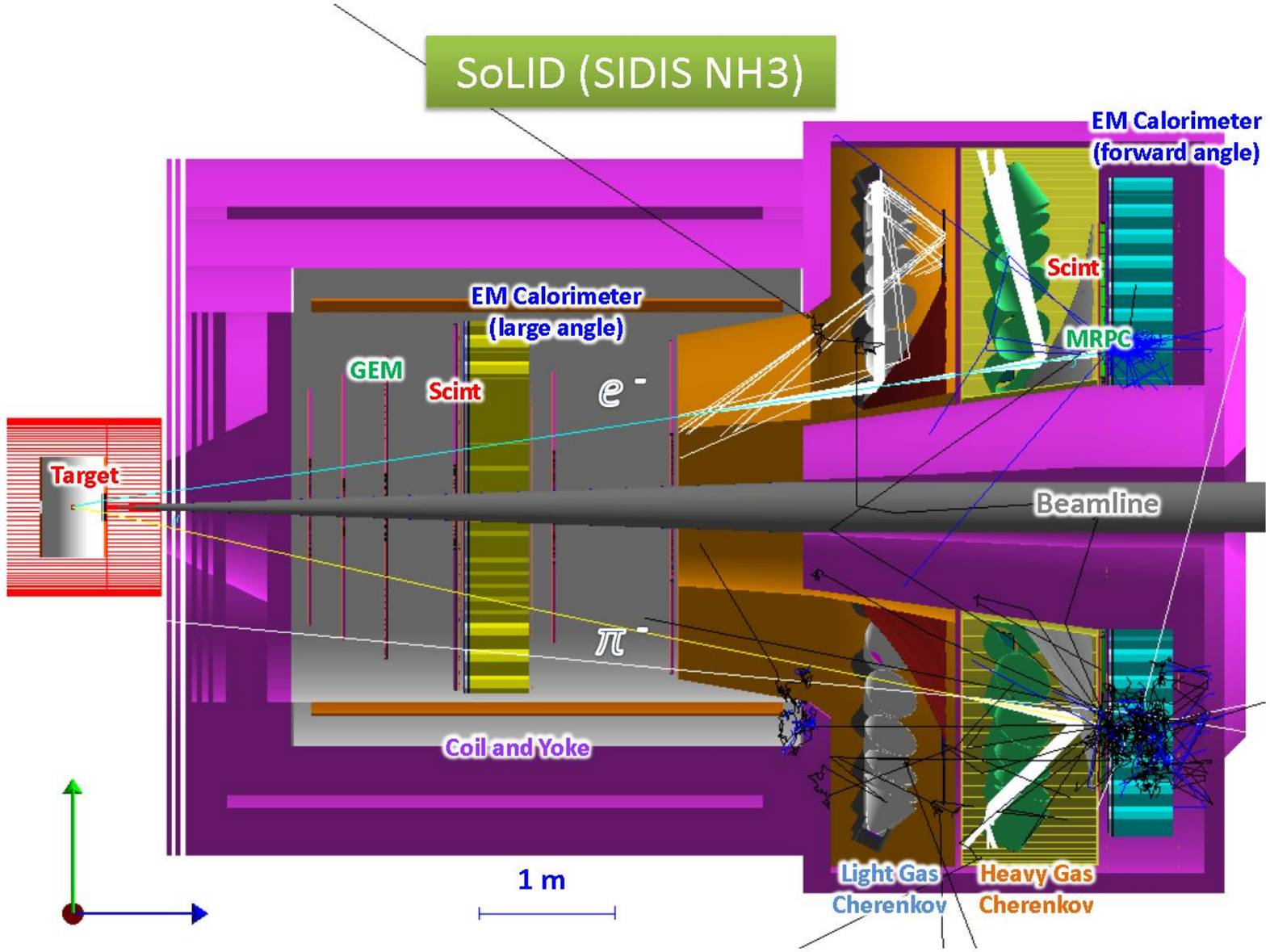
- In the SoLID SIDIS-proton experiment, we will be measuring SSA/DSA in SIDIS using transversely polarized NH_3 target
- We use the eDIS and Wiser generators, as well as full Geant4 simulations for the trigger, background and acceptance studies
- We look at particle hit rate, which is based upon the material budget in the target
- During the Collaboration Meeting I had shown some preliminary rate numbers
- Today I would like to show updated new numbers since some of them are now different compared to those shown previously

Reminder on SIDIS-NH_3 studies

$$e + p \rightarrow e' + \pi^{+/-} + X$$

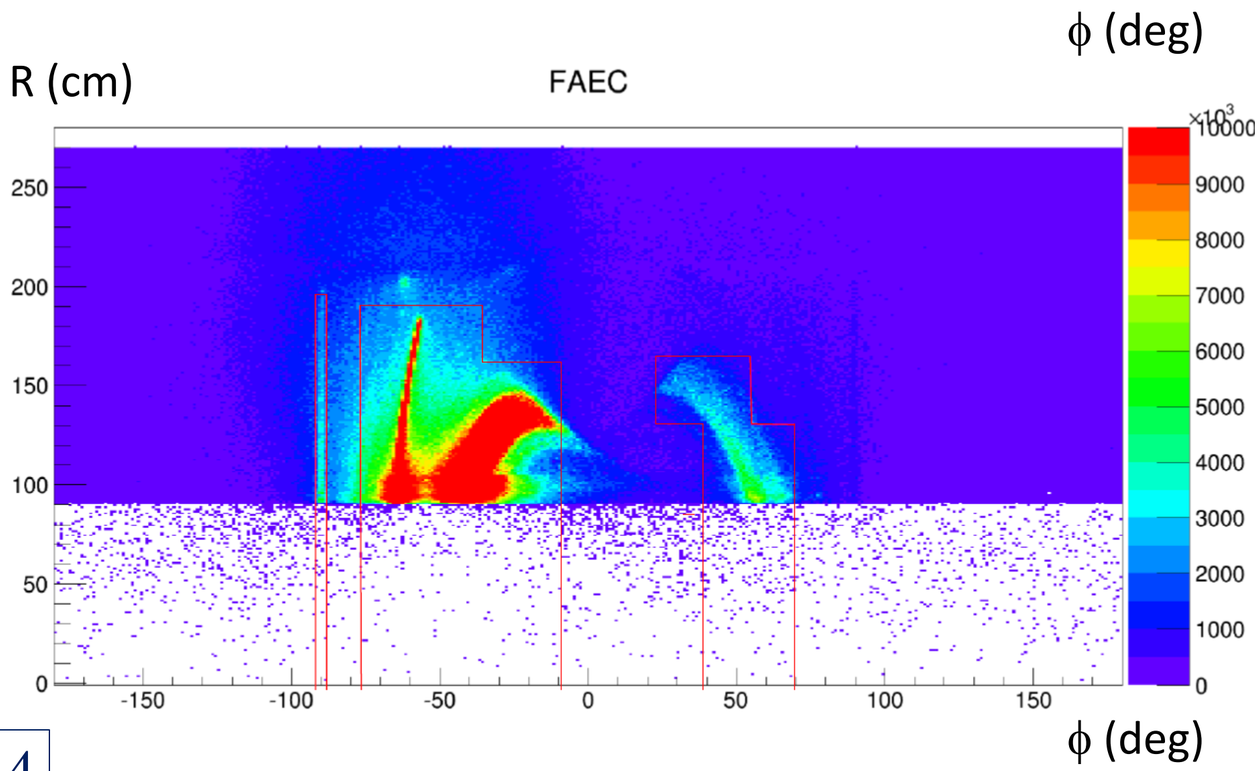
- The NH_3 target polarization is required to be higher than 70% with the spin flip in every few hours.
- Two Beam energies: 11 GeV and 8.8 GeV

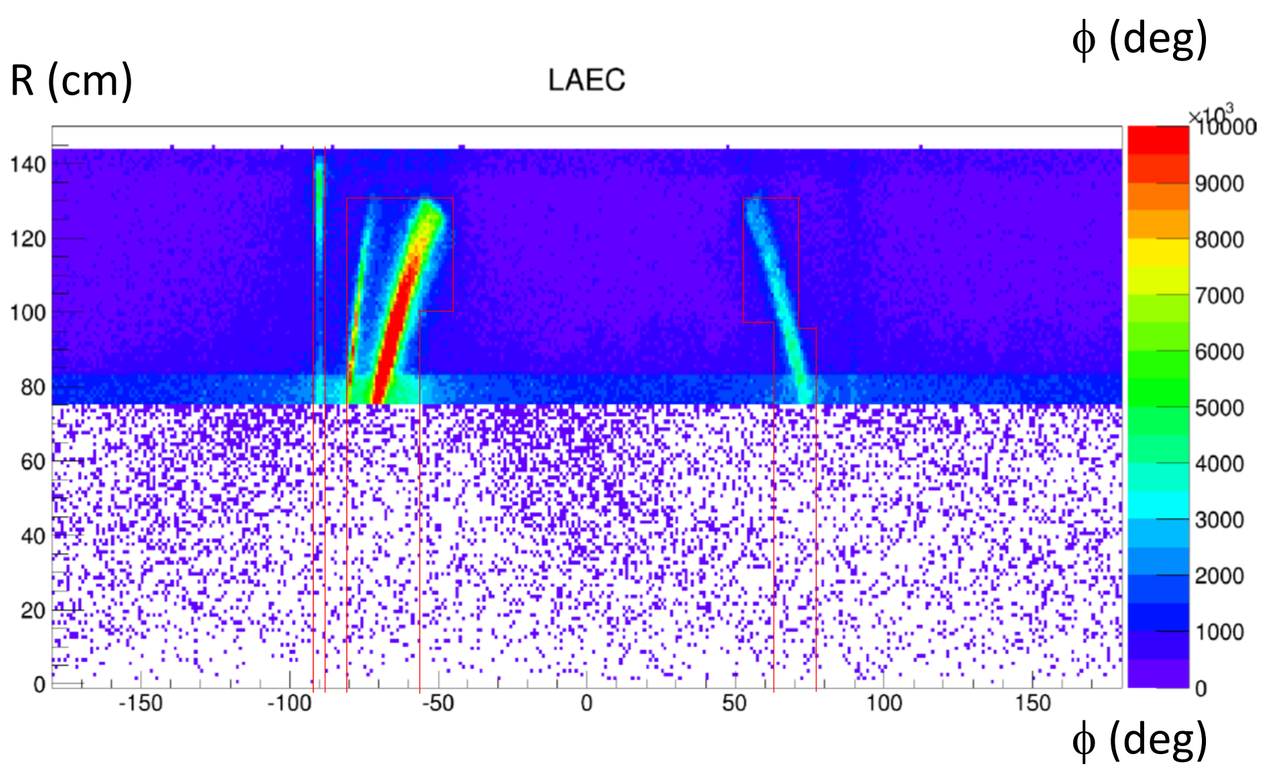
- Total luminosity
  $5.95 \cdot 10^{35}\ cm^{-2}\ s^{-1}$
- Beam current: 100nA
- The beam goes through 5T target magnetic field
- Density of the NH_3 target
  $0.819\ g\ cm^{-3}$
- NH_3 target thickness
  2.826 cm



Use the sheet-of-flame cuts

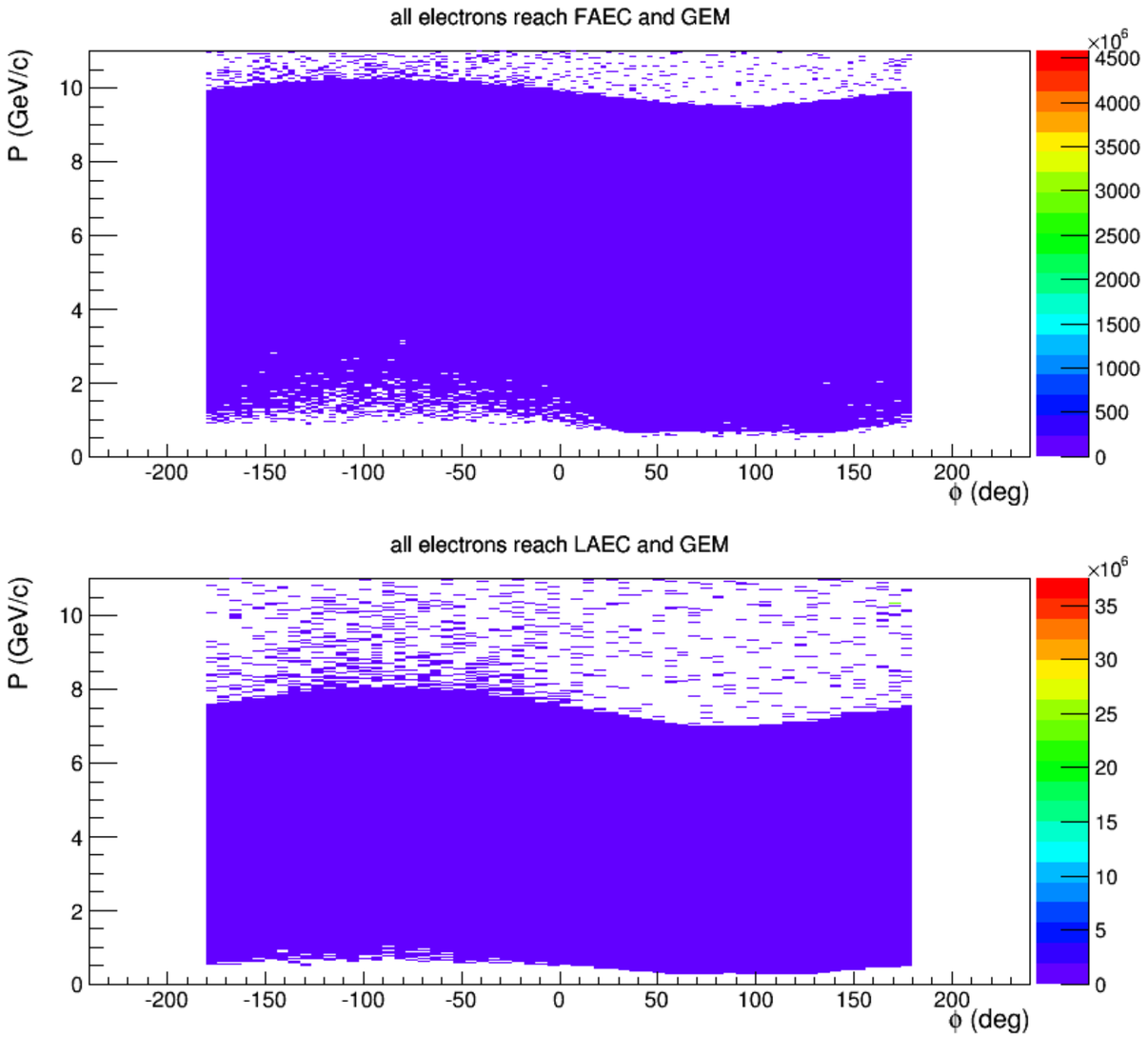
- Due to the large magnetic field in the transverse direction, there is a different kind of background compared to that of the low field He^3 experiment
- As a result, a very high rate of charged particles will be localized in a quite narrow region of the acceptance. We refer to this strong, specific type of background as sheet-of-flame
- In order to avoid any damage to the apparatus, the detector and sub-detector sectors in the direct line-of sight of any sheet-of-flame plane should be shielded and/or turned off during the NH_3 experiment

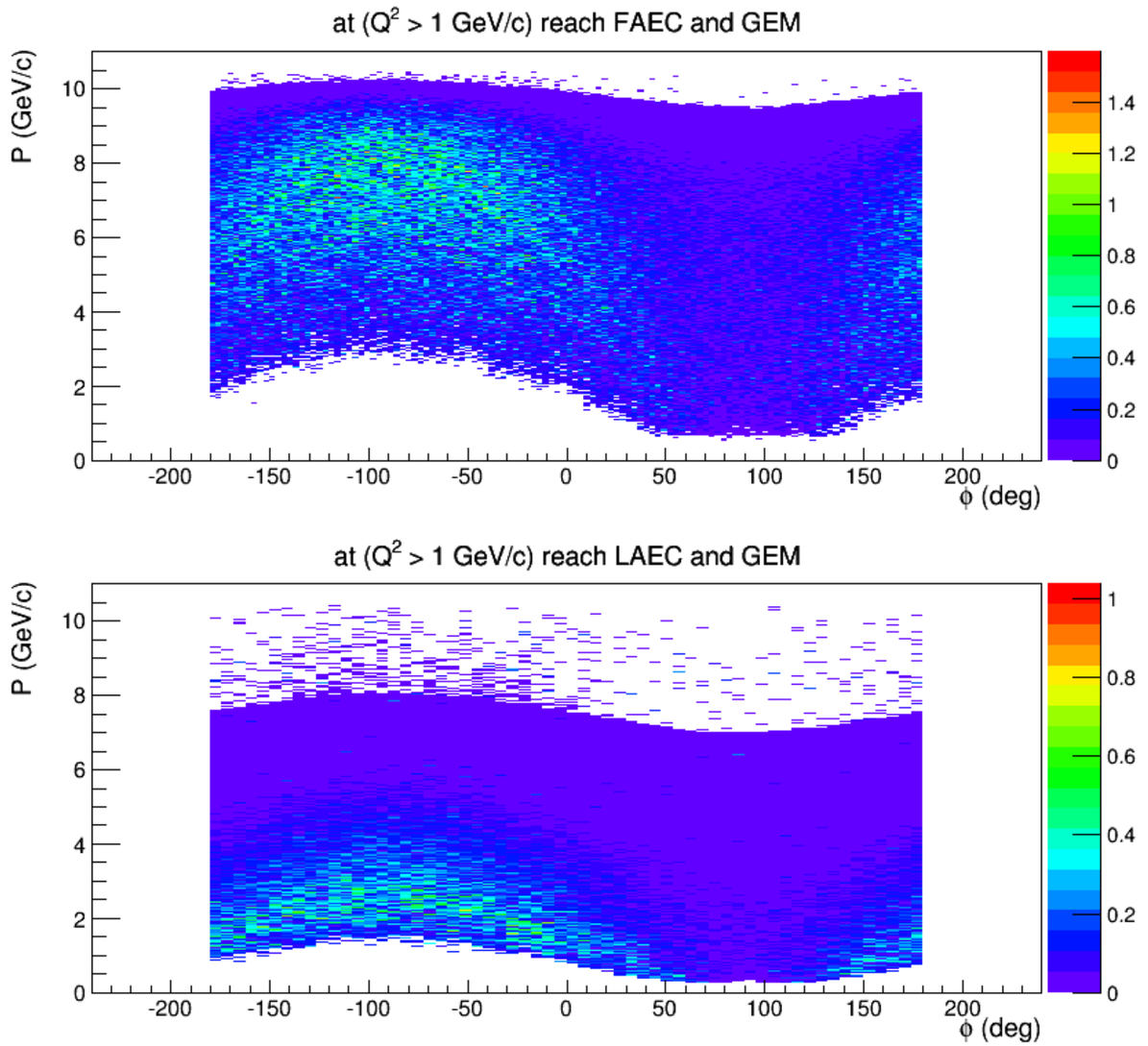




Electron momentum – azimuthal angle plots

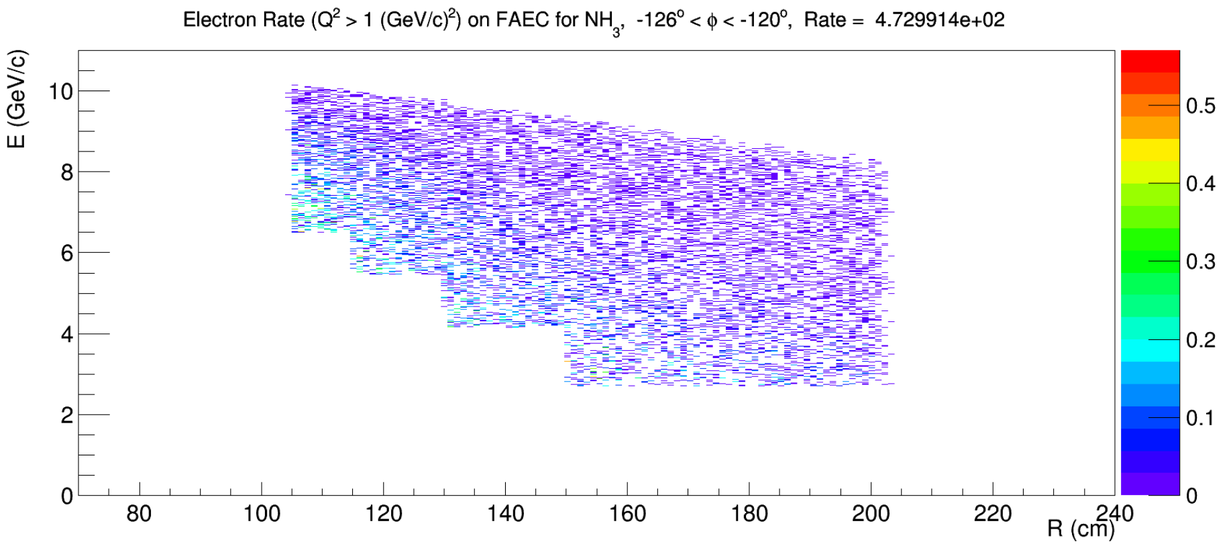
- Let's now look at the momentum P (in GeV/c) of electrons (reaching FAEC, LAEC and GEM) vs. the ϕ angle
- In the right plots, $Q^2 > 1$ (GeV/c)^2 cuts are also implemented for these sub-detectors

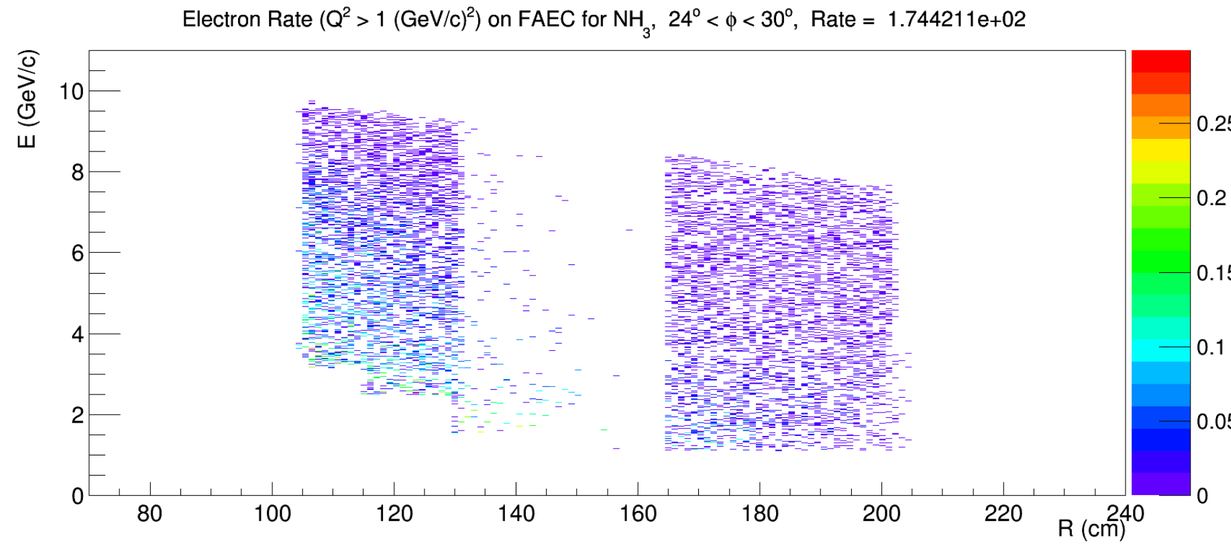


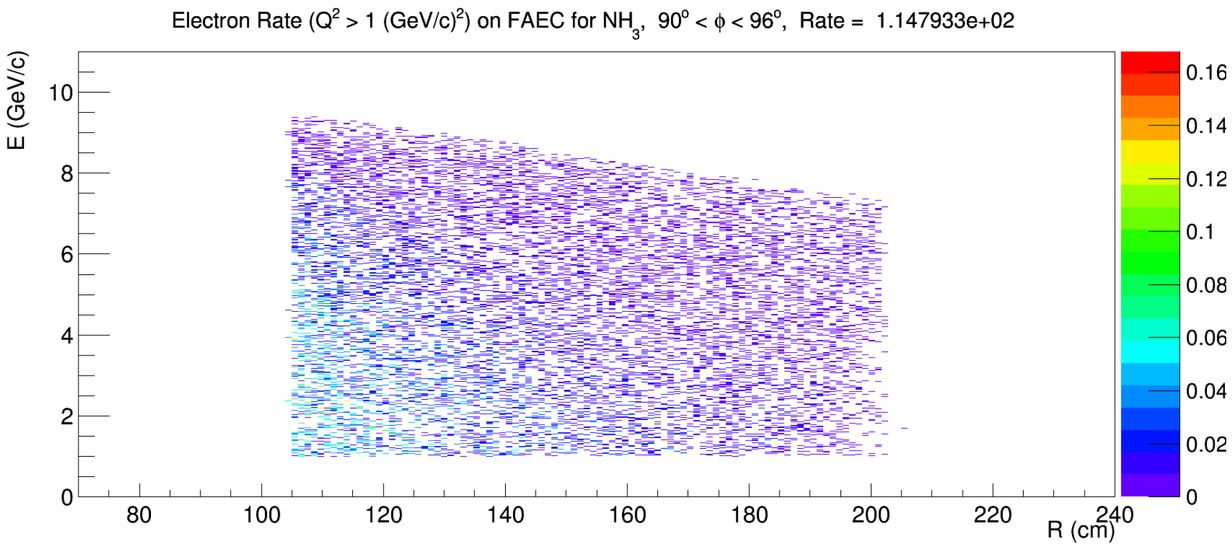


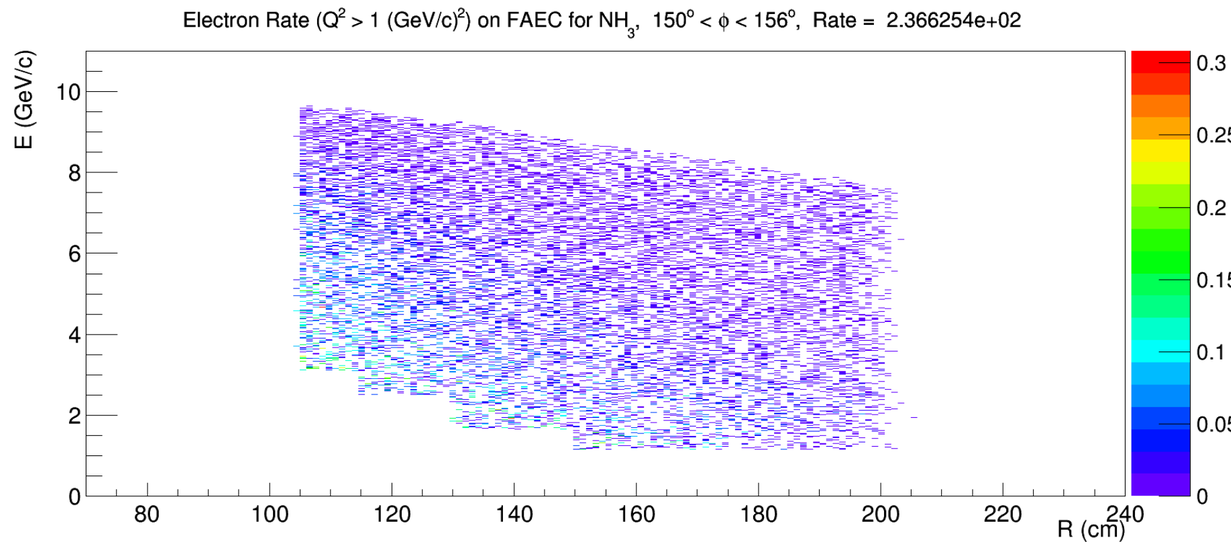
Electron energy – radius plots for FAEC

- Plots for the Energy (in GeV) of electrons vs. the radius R (in cm) on FAEC
- We have found the $Q^2 = 1\ (GeV/c)^2$ lines and implement them as step functions in $\phi = 6°$ bins from -180° to 180°. Totally there are sixty ϕ bins



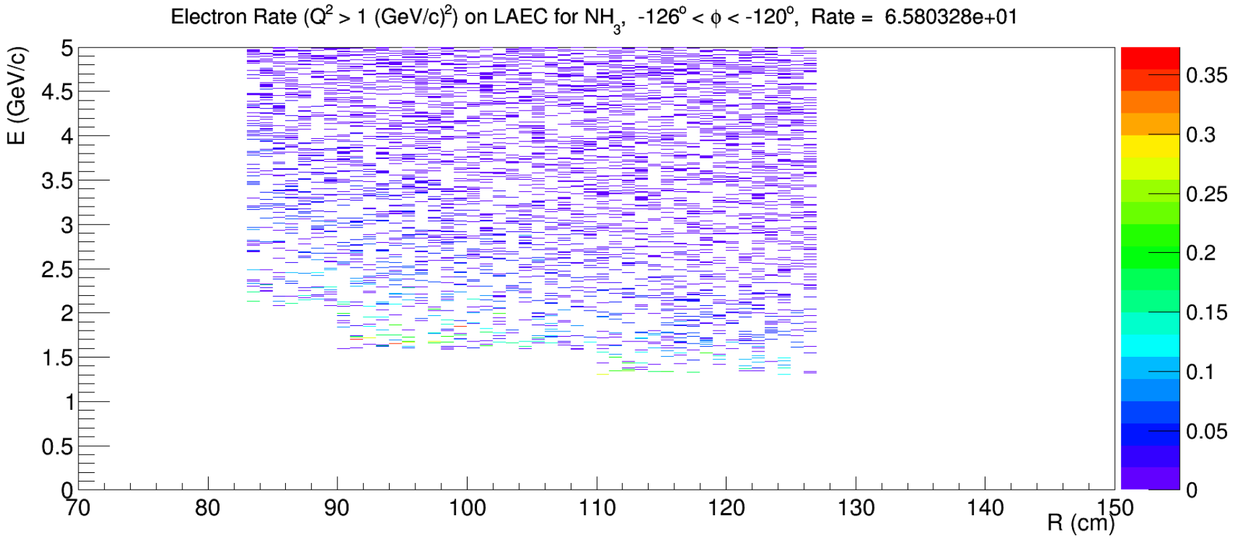


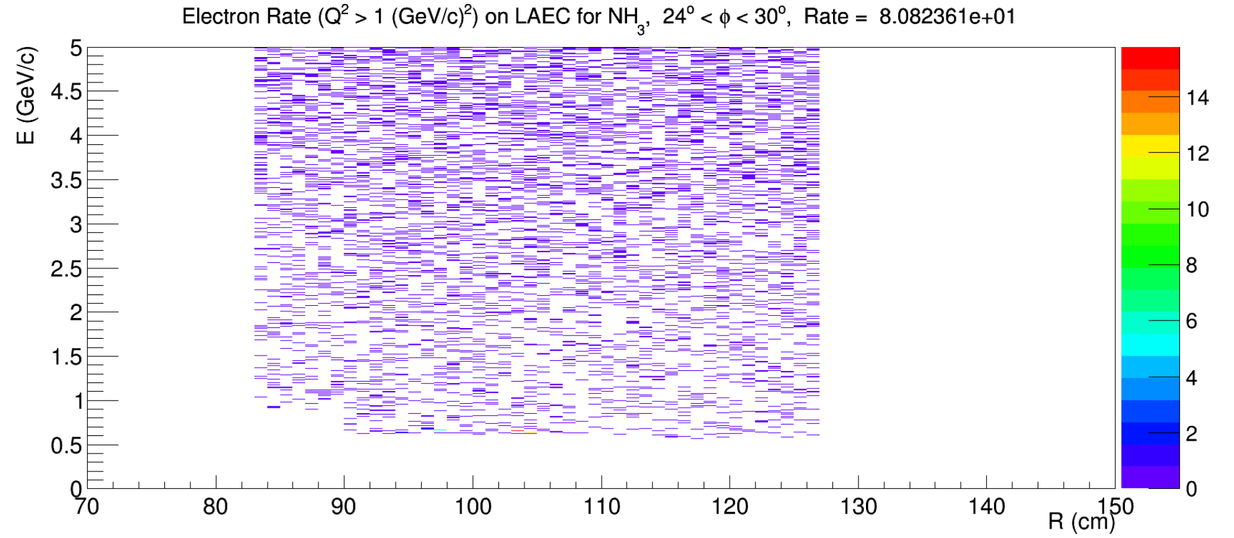


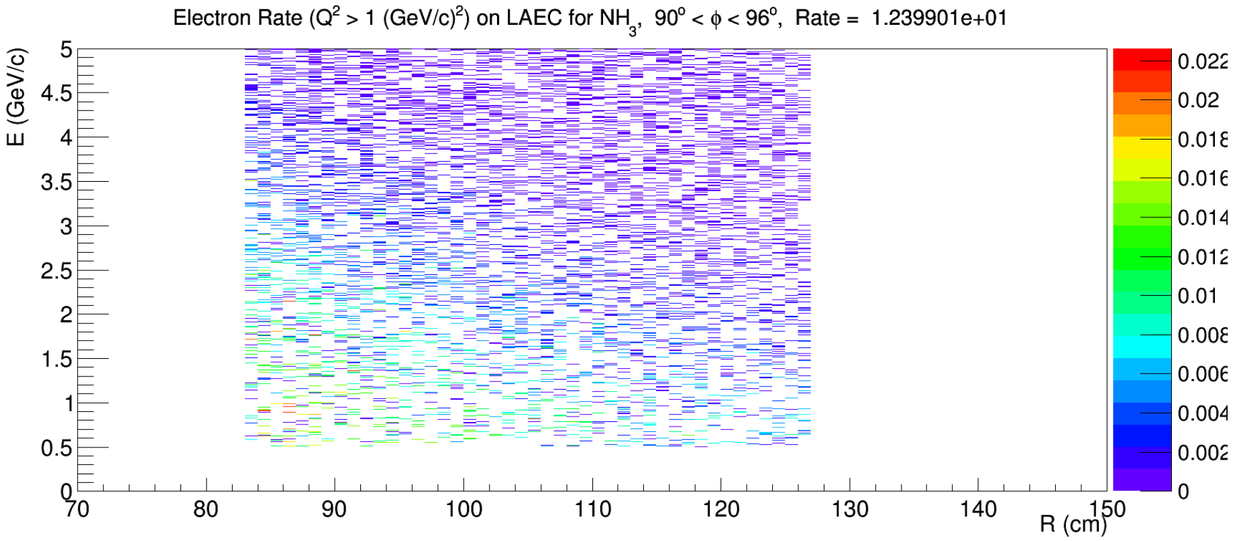


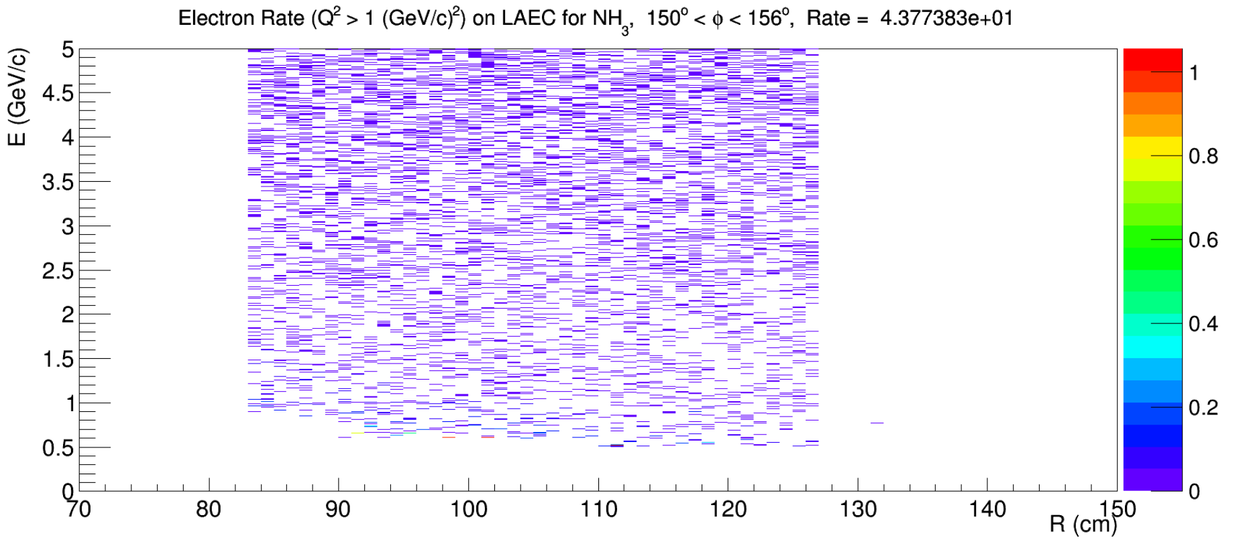
Electron energy – radius plots for LAEC

- Plots for the Energy (in GeV) of electrons vs. the radius R (in cm) on LAEC
- We have found the $Q^2 = 1\ (GeV/c)^2$ lines and implement them as step functions in $\phi = 6°$ bins from -180° to 180°. Totally there are sixty ϕ bins

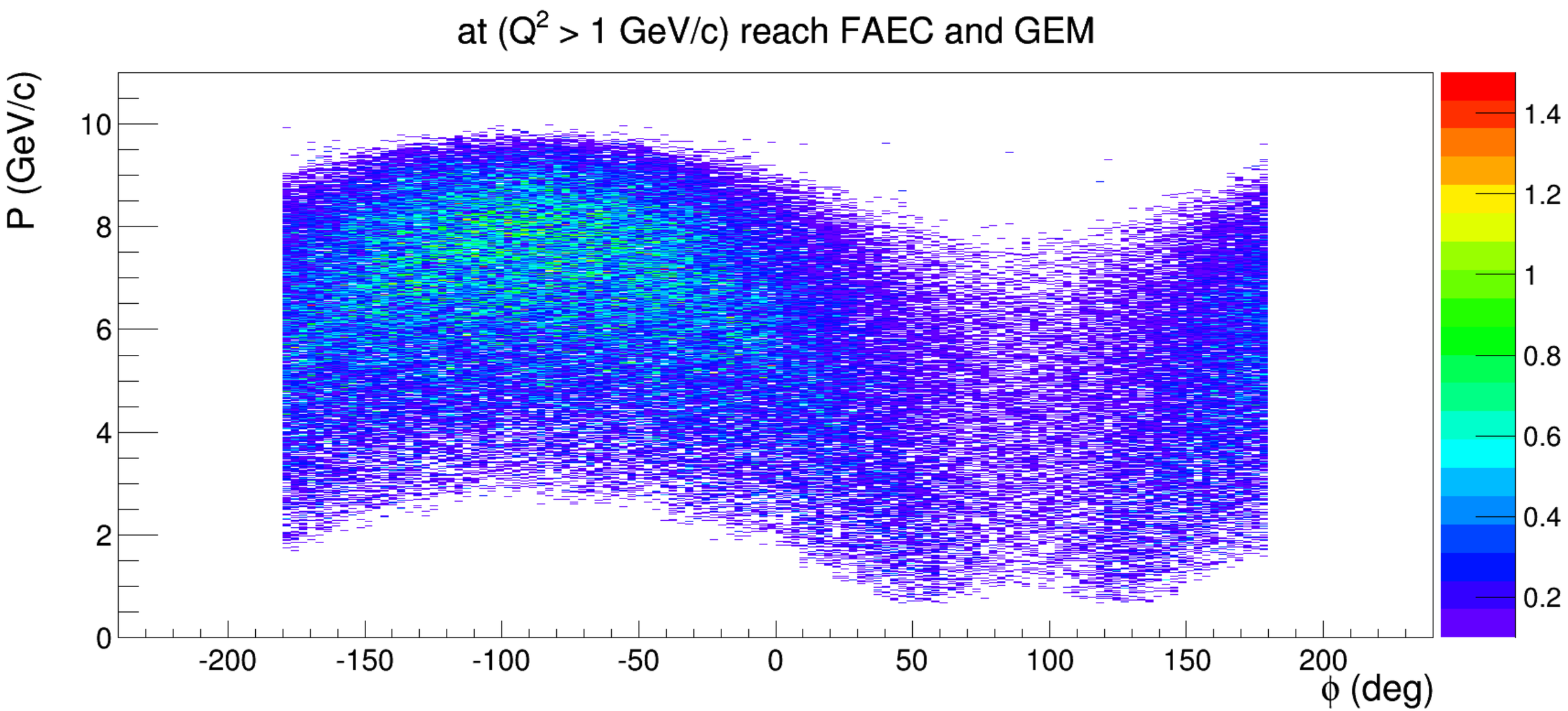




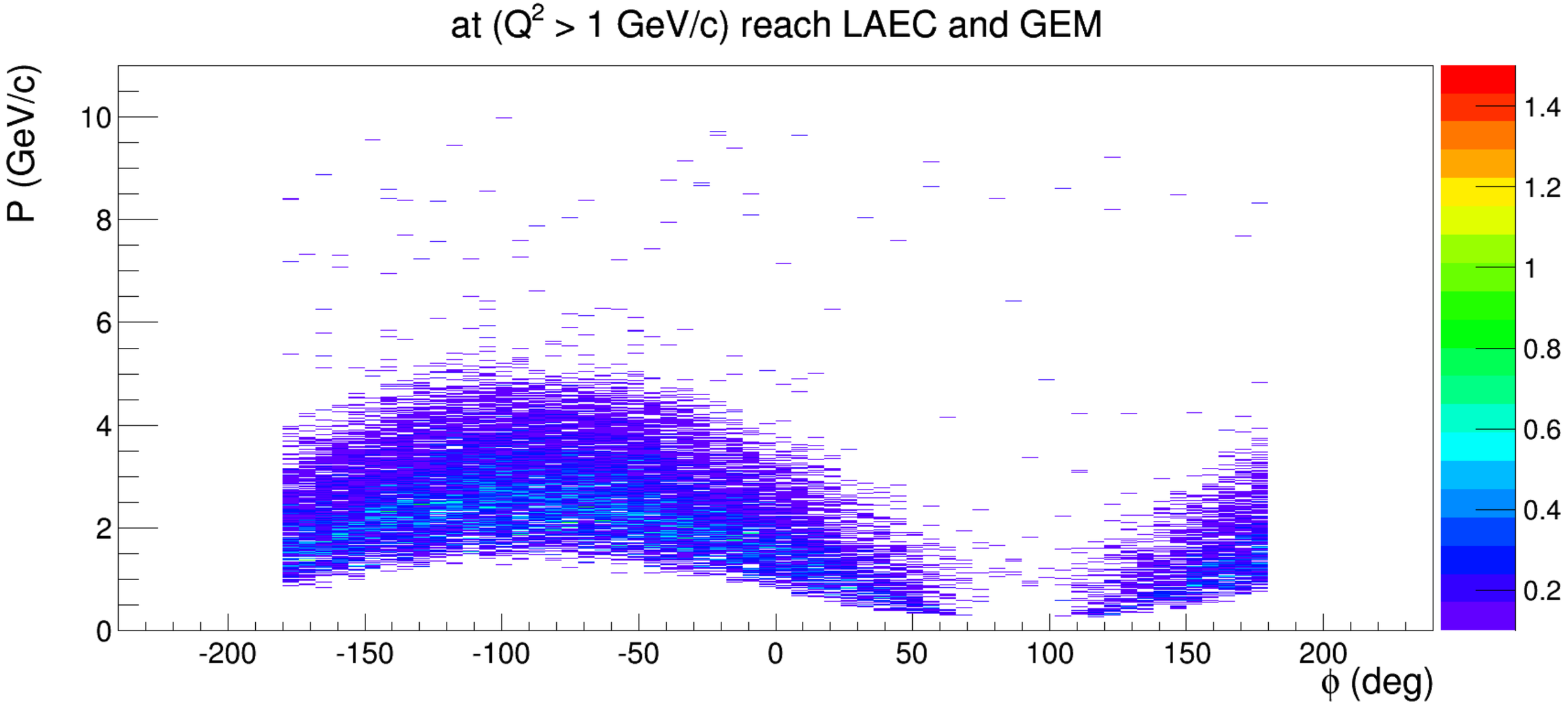




For FAEC, now we take the range 30° < ϕ < 138° to put a ϕ-independent plain cut, since in the region ϕ > 138° the trigger cut is also well visible.



For LAEC, now we take the range 30° < ϕ < 180° to put a ϕ-independent plain cut, since in the region ϕ > 138° the trigger cut is not well visible. Here, instead of the trigger cut one can also use a ϕ-independent cut.



Rates for eDIS (*previous numbers from collab. meeting)

for FAEC (with the cut E = 1 GeV for 42° < ϕ < 138°)

and

for LAEC (with the cut E = 0.5 GeV for 42° < ϕ < 138°)

FAEC	Rates are in kHz
with trigger cut	7.83*
no trigger cut	19.44*
with trigger cut	7.19
no trigger cut	19.44

LAEC	Rates are in kHz
with trigger cut	2.41*
no trigger cut	6.43*
with trigger cut	1.91
no trigger cut	6.43

Rates for eDIS (the most recent results)

for FAEC (with the cut E = 3.5 GeV for 30° < ϕ < 138°)

and

for LAEC (with the cut E = 1.5 GeV for 30° < ϕ < 180°)

Rates for π^- (*previous numbers from collab. meeting)

for FAEC (with the cut E = 1 GeV for 42° < ϕ < 138°)

and

for LAEC (with the cut E = 0.5 GeV for 42° < ϕ < 138°)

FAEC	Rates are in kHz
with trigger cut	447.1*
no trigger cut	1.81e+03*
with trigger cut	223.7
no trigger cut	1.81e+03

LAEC	Rates are in kHz
with trigger cut	1.42e+03*
no trigger cut	3.72e+03*
with trigger cut	657.6
no trigger cut	3.72e+03

Rates for π^- (the most recent results)

for FAEC (with the cut E = 3.5 GeV for 30° < ϕ < 138°)

and

for LAEC (with the cut E = 1.5 GeV for 30° < ϕ < 180°)

Rates for π^+ (*previous numbers from collab. meeting)

for FAEC (with the cut E = 1 GeV for 42° < ϕ < 138°)

and

for LAEC (with the cut E = 0.5 GeV for 42° < ϕ < 138°)

FAEC	Rates are in kHz
with trigger cut	679.1*
no trigger cut	2.24e+03*
with trigger cut	337.6
no trigger cut	2.24e+03

LAEC	Rates are in kHz
with trigger cut	1.31e+03*
no trigger cut	4.44e+03*
with trigger cut	706.5
no trigger cut	4.44e+03

Rates for π^+ (the most recent results)

for FAEC (with the cut E = 3.5 GeV for 30° < ϕ < 138°)

and

for LAEC (with the cut E = 1.5 GeV for 30° < ϕ < 180°)

Rates for the photons from π^0 (*previous numbers from collab. meeting)

for FAEC (with the cut E = 1 GeV for 42° < ϕ < 138°)

and

for LAEC (with the cut E = 0.5 GeV for 42° < ϕ < 138°)

FAEC	Rates are in kHz
with trigger cut	7.17e+03*
no trigger cut	39.31e+03*
with trigger cut	342.4
no trigger cut	37.85e+03

LAEC	Rates are in kHz
with trigger cut	721.9*
no trigger cut	51.43e+03*
with trigger cut	1.41e+03
no trigger cut	62.30e+03

Rates for the photons from π^0 (the most recent results)

for FAEC (with the cut E = 3.5 GeV for 30° < ϕ < 138°)

and

for LAEC (with the cut E = 1.5 GeV for 30° < ϕ < 180°)

Rates for the electrons from π^0 (*previous numbers from collab. meeting)

for FAEC (with the cut E = 1 GeV for 42° < ϕ < 138°)

and

for LAEC (with the cut E = 0.5 GeV for 42° < ϕ < 138°)

FAEC	Rates are in kHz
with trigger cut	2.05e+03*
no trigger cut	40.14e+03*
with trigger cut	33.81
no trigger cut	10.20e+03

LAEC	Rates are in kHz
with trigger cut	33.8*
no trigger cut	60.03e+03*
with trigger cut	45.68
no trigger cut	3.75e+03

Rates for the electrons from π^0 (the most recent results)

for FAEC (with the cut E = 3.5 GeV for 30° < ϕ < 138°)

and

for LAEC (with the cut E = 1.5 GeV for 30° < ϕ < 180°)

Next steps

- For the electron trigger rate, now we are working to apply the EC trigger response correctly for electron and pion instead of the simple cut, and we should also add LGC into the trigger.

- We will see whether the trigger satisfies the requirement of < 100 kHz trigger rate

- Depending on the outcome we maybe need to make a coincidence trigger of the electron and hadron

- Finally, the NH_3 acceptance will be re-made, based upon which one may re-address some of the SoLID physics plots to be included in the Science Review