Deep Processes Working Group Report

CLAS Collaboration Meeting
Jefferson Lab, 13th July 2018

Publications:

CLAS 2017-06
Semi-inclusive π^0 target and beam-target asymmetries from 6 GeV electron scattering with CLAS
S. Jawalkar, published on Phys. Lett. B

CLAS 2017-12
Hard exclusive pion electro-production at backward angles with CLAS,
K. Park, published on Phys. Rev. Lett.

CLAS 2017-09
Measurement of Unpolarized Cross Sections and Polarized Cross Section Differences for Deeply Virtual Compton Scattering (DVCS) on the proton at the Jefferson Laboratory with CLAS, at $0.1 < x_B < 0.58$, $1.0 < Q2 < 4.8$ GeV^2, and $0.09 < -t < 2.0$ GeV^2,
H. Saylor, submitted to Phys. Rev. C

Ad Hoc Review

Analysis	Data	Lead Author	In progress
Beam spin asymmetries of ep->epη in the deep inelastic regime	**e1f**	**B. Zhao, A. Kim**	Done Sep 17

Analysis Review

Analysis	Data	Author	In progress
Exploring the structure of the proton via semi-inclusive pion electroproduction	**e1f**	**N. Harrison** **K. Joo**	Done Feb 18
Beam asymmetries in exclusive π^+ electro production for W> 1.7 GeV from e16	**e16**	**P. Bosted**	Ongoing

Analysis Review

Analysis	Data	Author	In progress
Exclusive electroproduction of the f0(980) and f2(1270) on the proton with CLAS	**e1f**	**B. Garillon** **S. Niccolai**	Brice busy with other project
Di-hadron beam spin asymmetry in SIDIS electro production	**eg1-dvcs**	**S. Pisano**	Silvia busy with other project
Deep-virtual production of the ρ^+ meson off the proton	**e1-dvcs**	**A. Fradi**	Ahmed busy with other projects. Slow progress
Semi-inclusive pion production	**e16**	**M. Osipenko**	Working on a better alignment
Time-like Compton scattering	**g12**	**I. Abayrak**	Last record 2015

DPWG

Deep Process Physics Analysis Meeting
weekly meetings on Thursday morning (8:30 EST)

https://clas12-docdb.jlab.org/cgi-bin/DocDB/private/DisplayMeeting?conferenceid=9

Mini-workshops
DVMP at last coll. Meeting and on 6th of June

DPWG Representatives at CSC

Carlos Munoz Camacho confirmed as representative

Aram Movsisyan elected as Alternate Member

DVMP at CLAS - Research Meeting

Wednesday 6/13, Rm CC F226

Morning: 9:00 AM

- Status of G-K theoretical approach *pseudoscalar* and *vector* mesons.
  P. Kroll

- Prognosis for incorporating GK theoretical framework into PARTON.
  Paweł Sznajder

- Status and physics for π^0, and η at 6 and 11 GeV .
  Valery Kubarovsky, Stefan Diehl, et al.
  .

- $k-\Lambda$ experiment and physics at 11 GeV.
  Kyungseon Joo, Stefan Diehl, et al.

- **Afternoon: 1:30 PM**

- Status and physics of ϕ and ρ at 6 GeV and 11 GeV.
  F-X Girod, Stefan Diehl, et al.

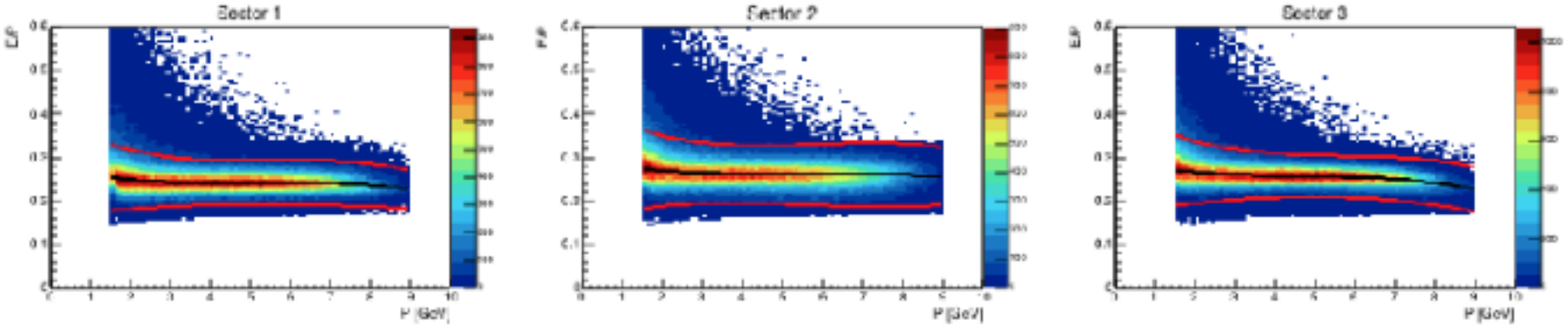
- BSA from exclusive π^0 production off ^{4}He.
  C.R. Ji

- Summary of program and JLab theoretical issues.
  Christian Weiss

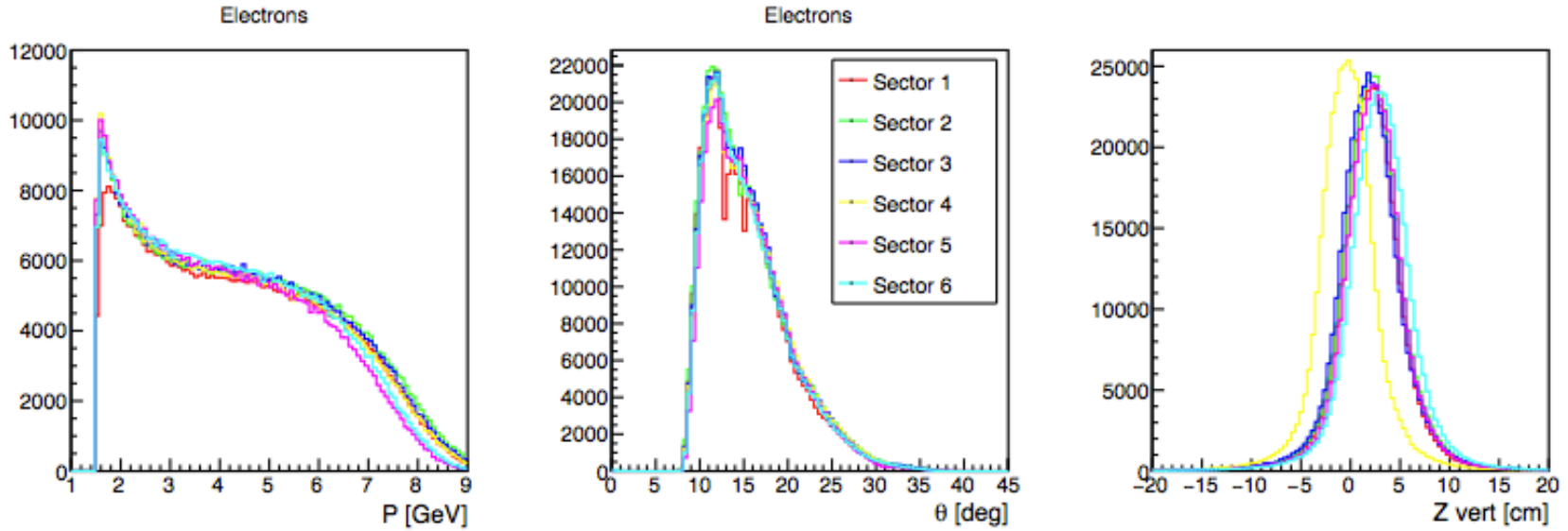
Forward Detector Reconstruction Studies

A. Movsisyan
INFN-Ferrara

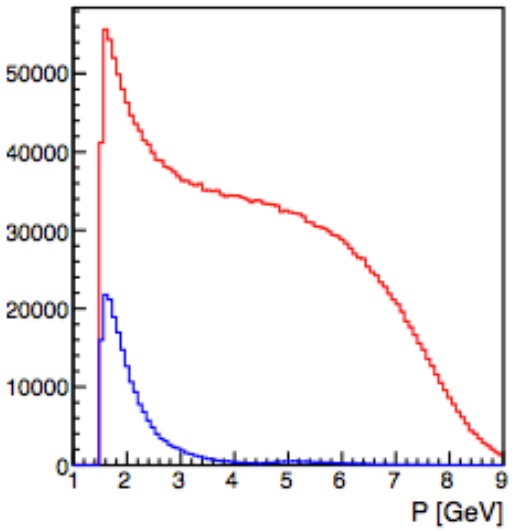
Sampling fraction for 6 sectors

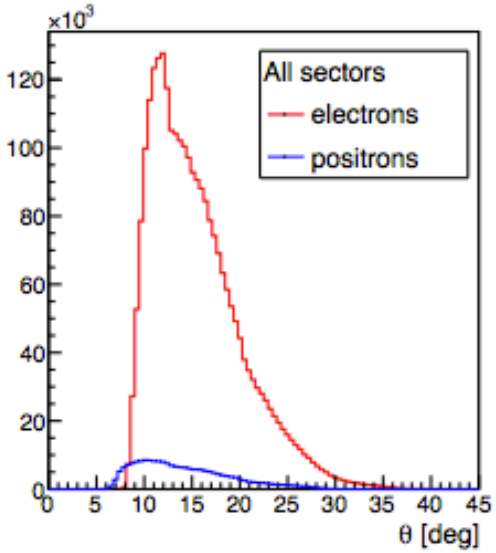


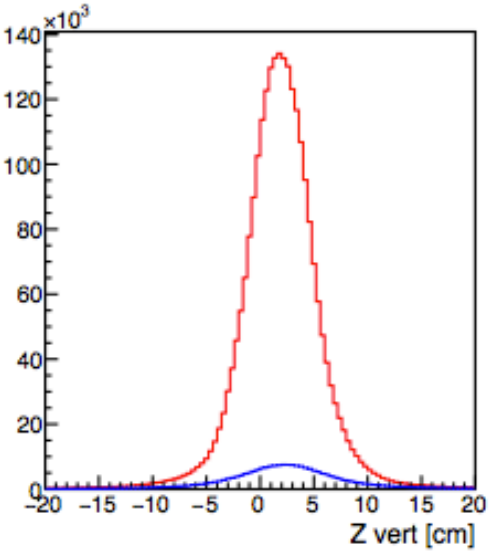
Sector dependence of electron yields.



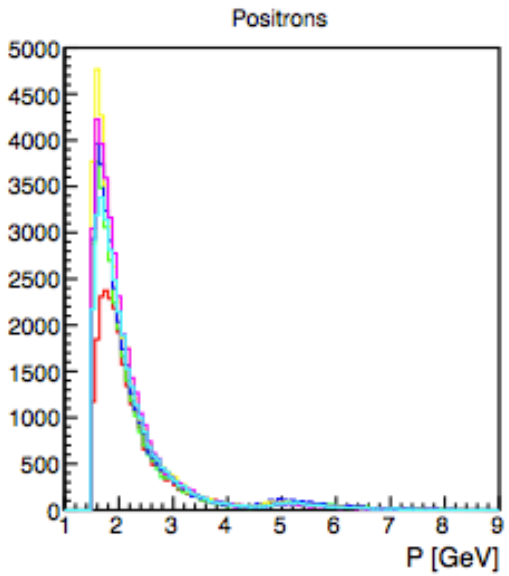
Comparison between electrons and positrons

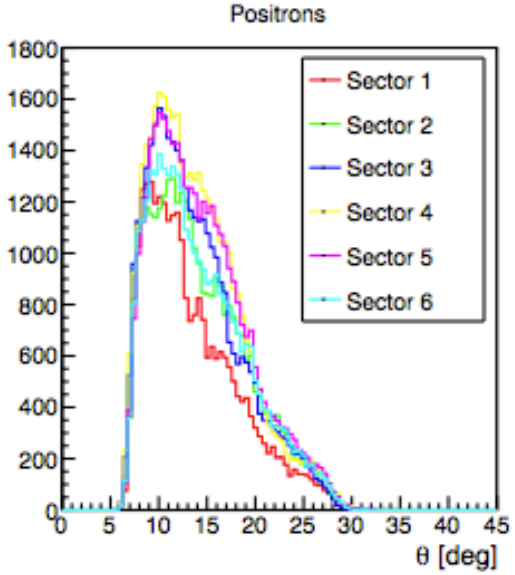


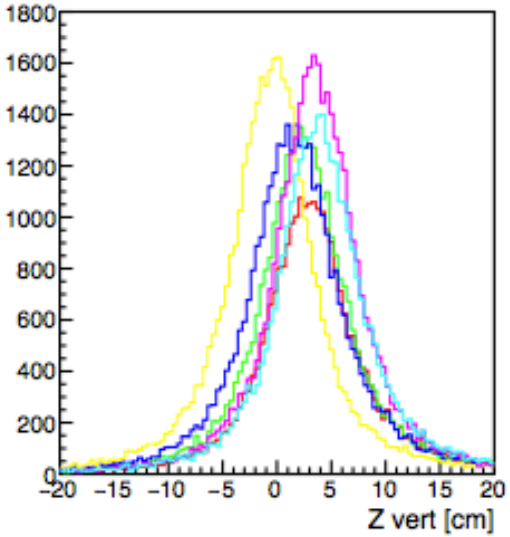




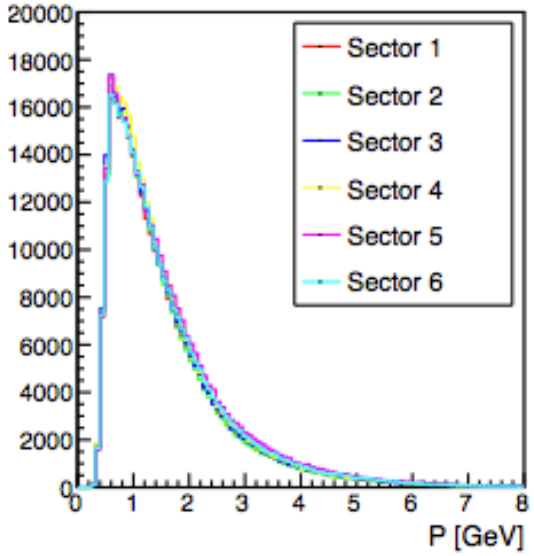
Sector dependence of positron yields.

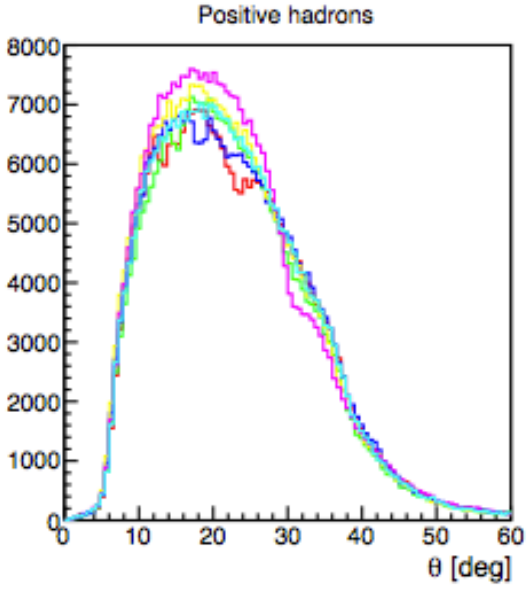


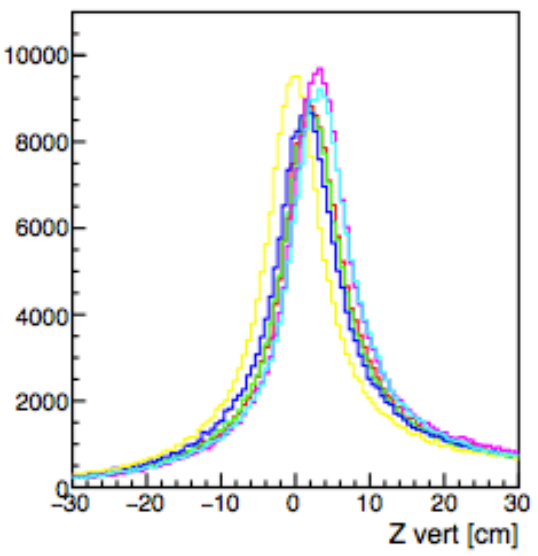




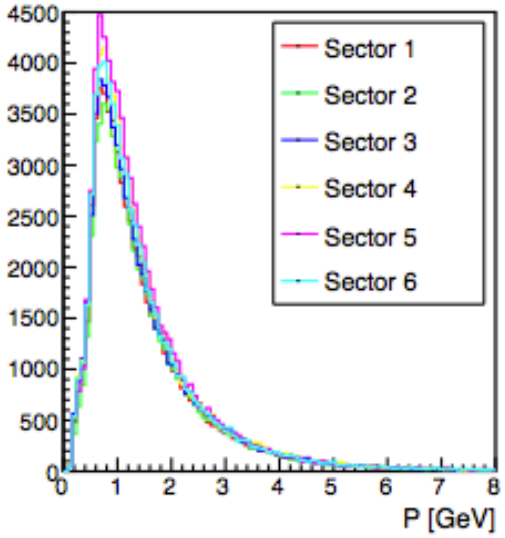
Sector dependence for positive hadrons.

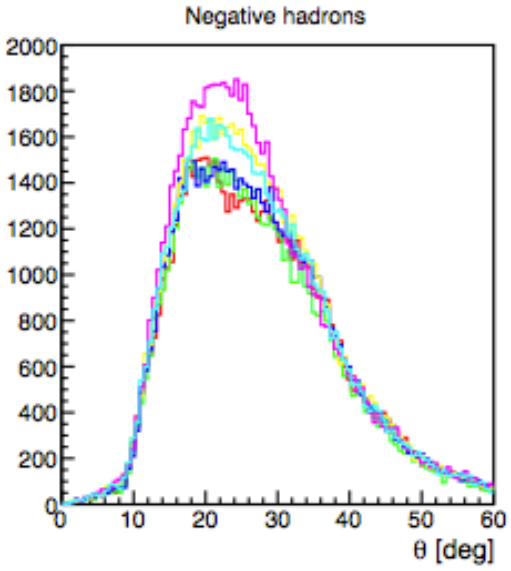


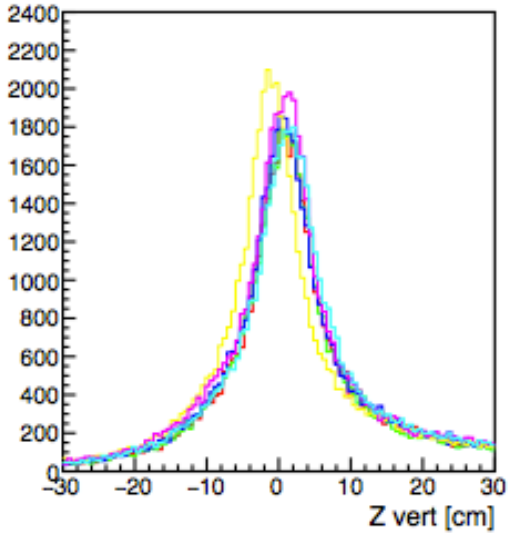




Sector dependence for negative hadrons.



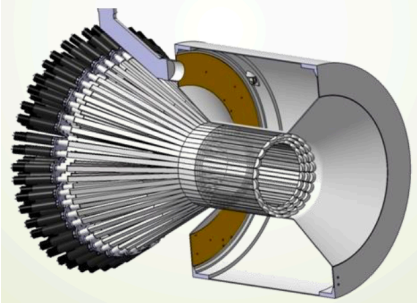




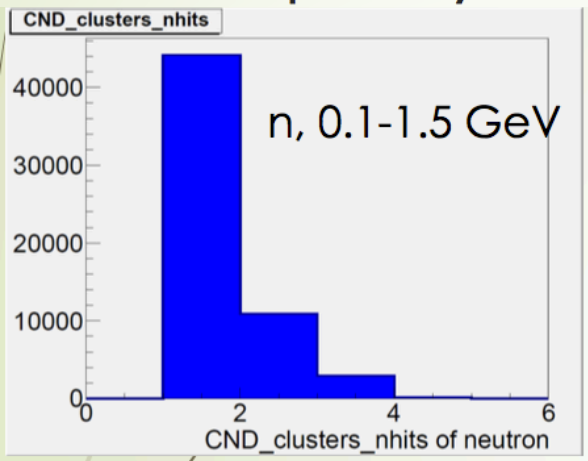
Central neutron reconstruction based on CND

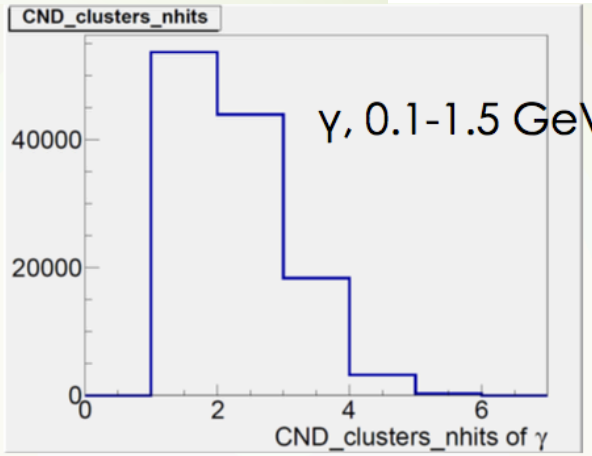
Rong WANG, Pierre CHATAGNON, Silvia NICCOLAI, ...

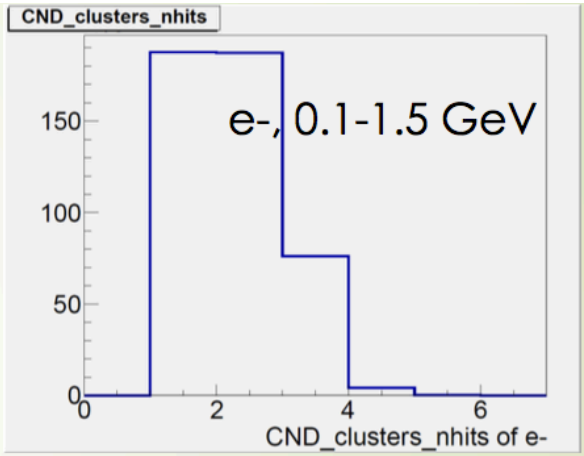
Institut de Physique Nucléaire d'Orsay, France

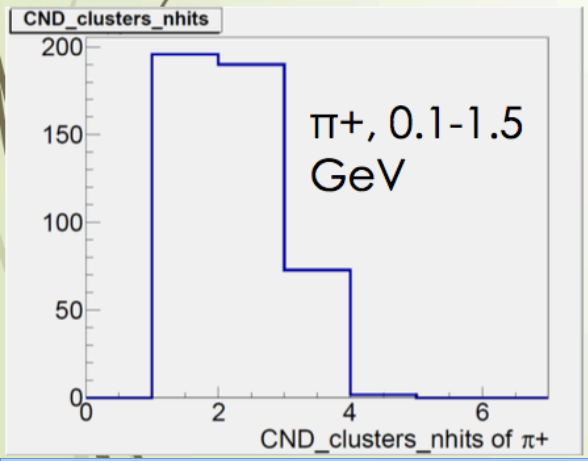


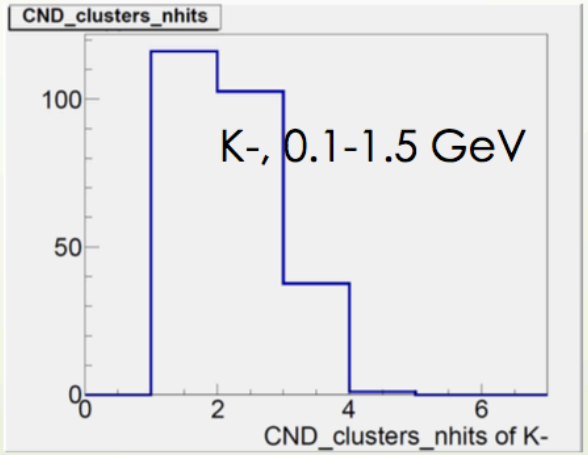
Hit-multiplicity of CND_clusters

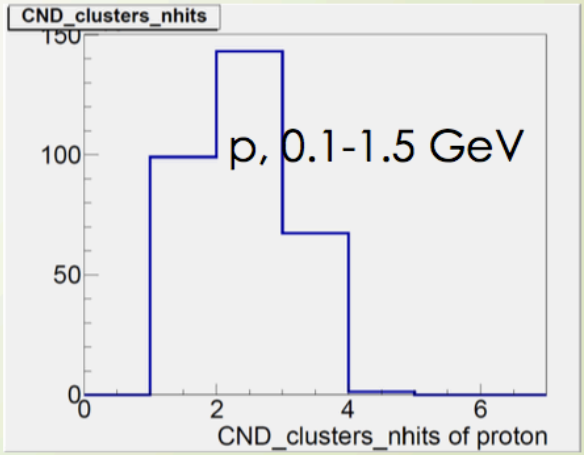




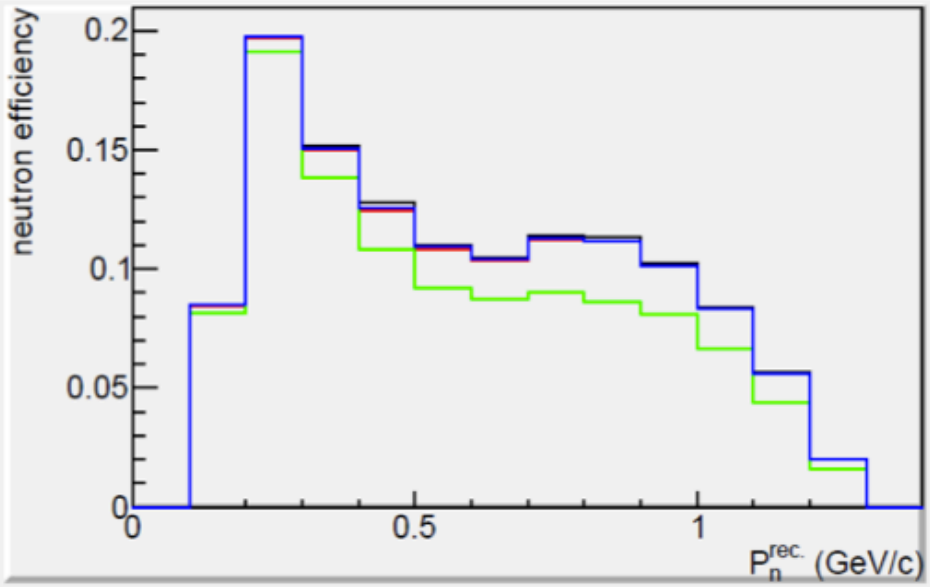


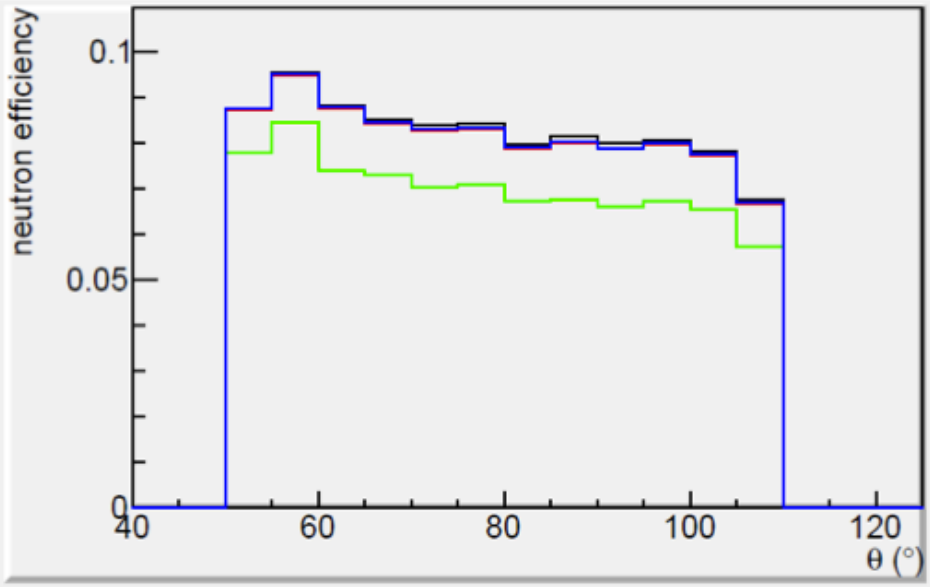


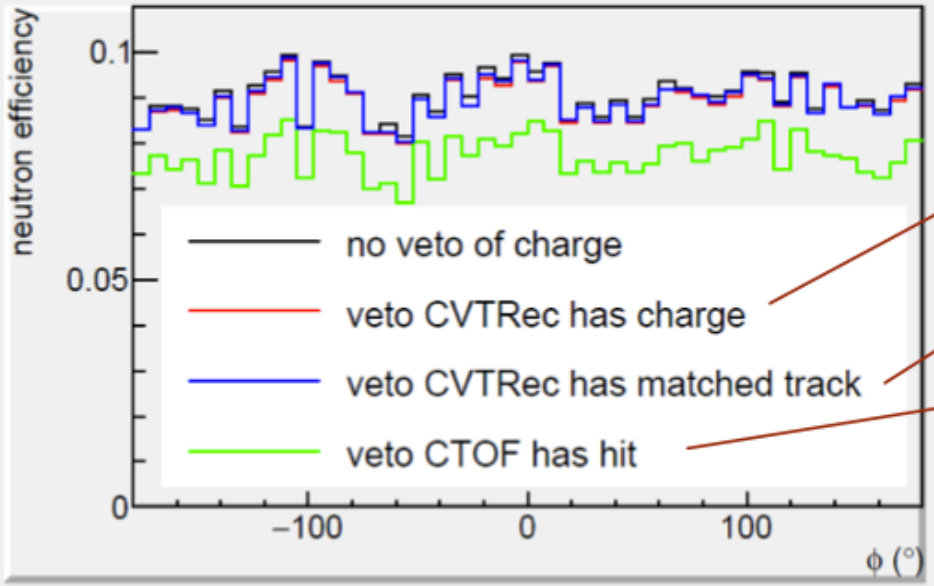




Neutron efficiency





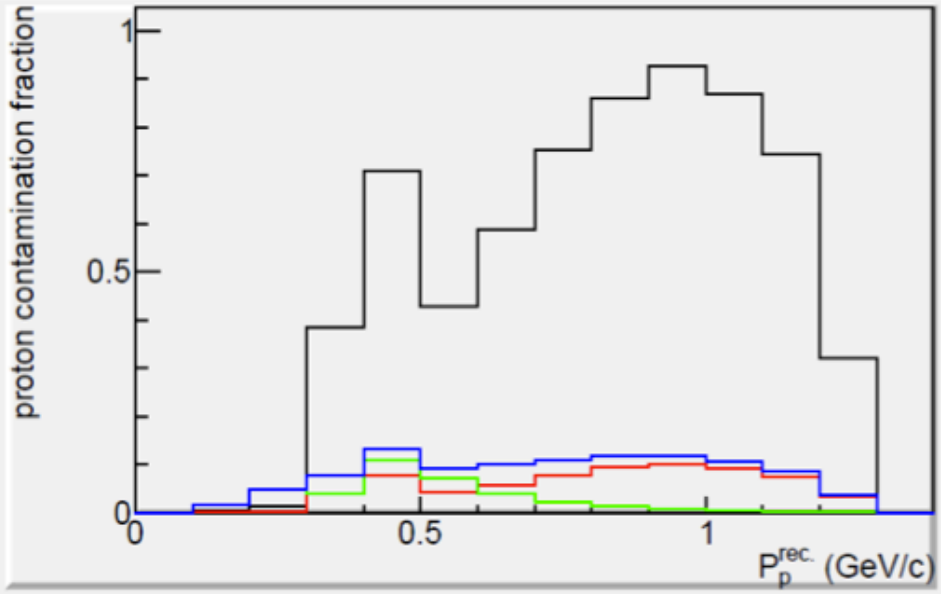


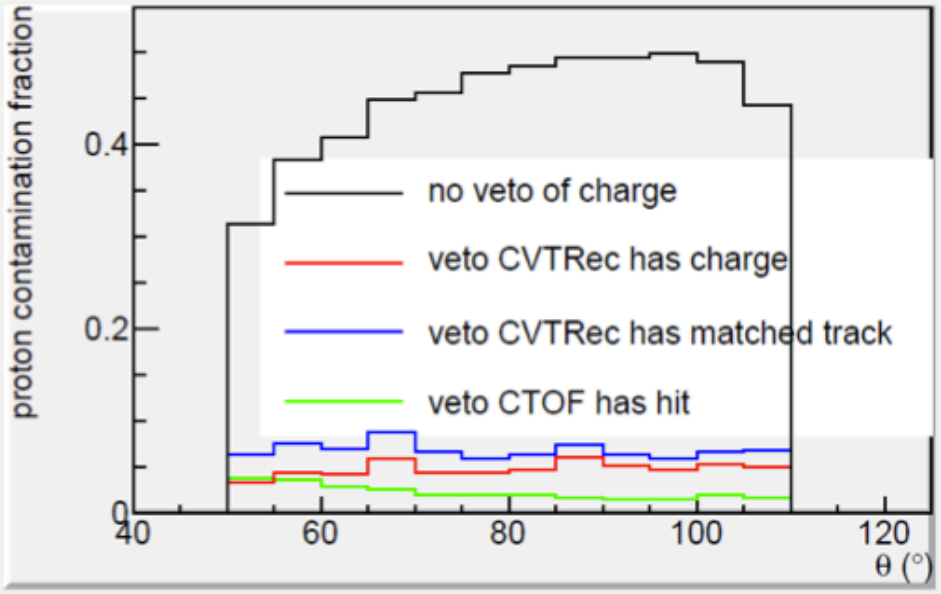
No track of charged particle found

No track matches the CND cluster

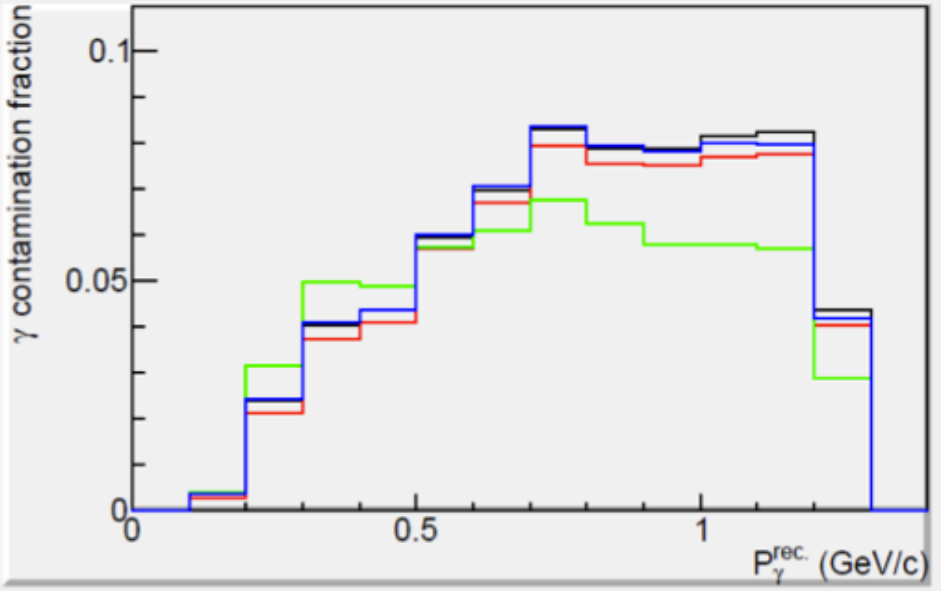
No CTOF hit nearby the CND cluster

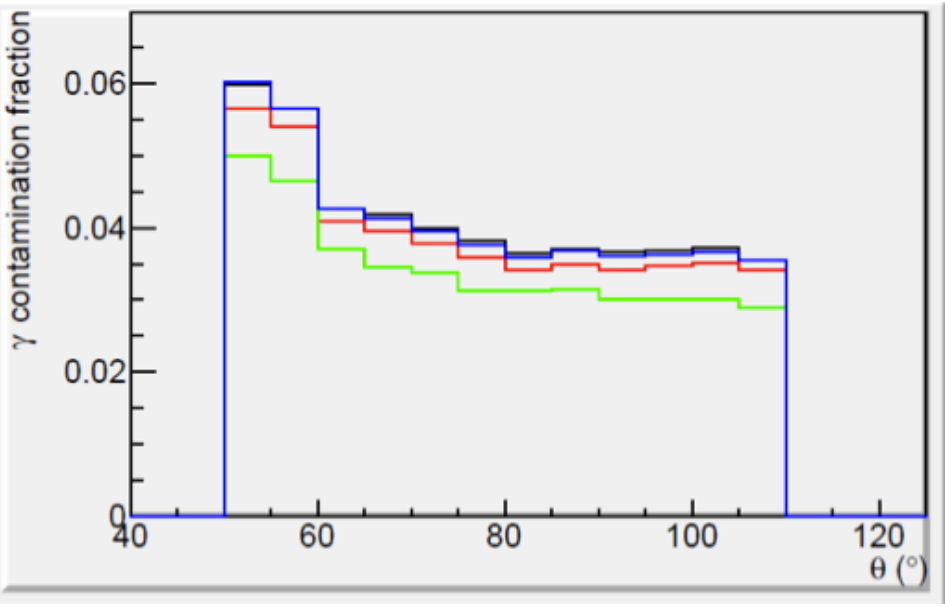
Mis-identification of protons



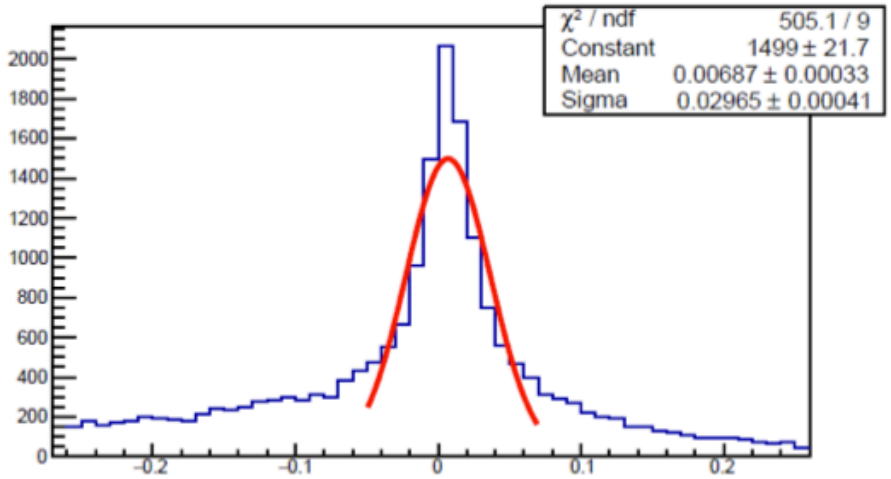


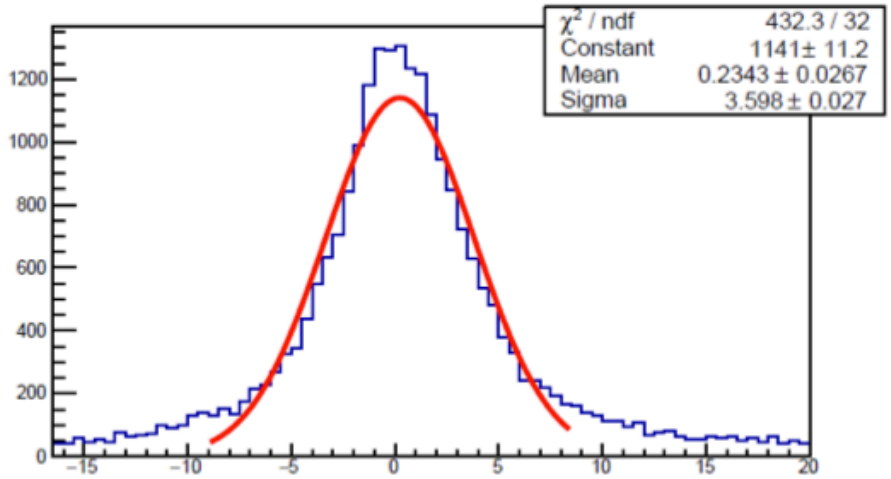
Mis-identification of gammas

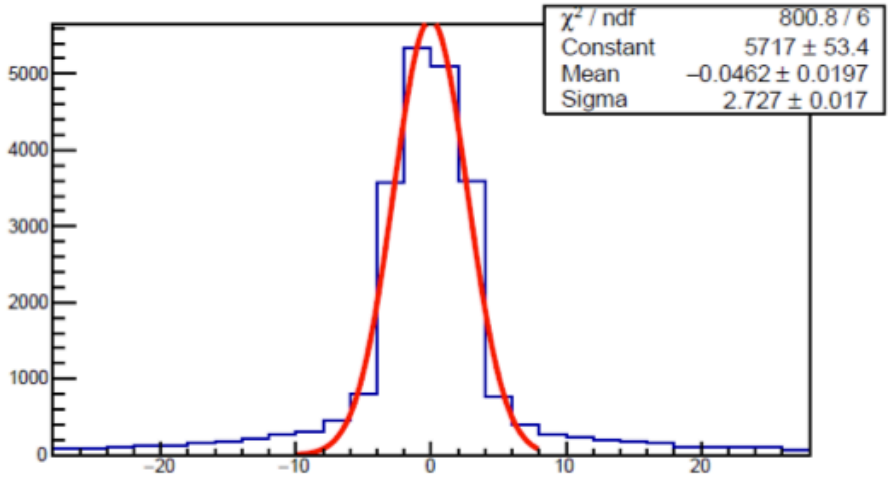


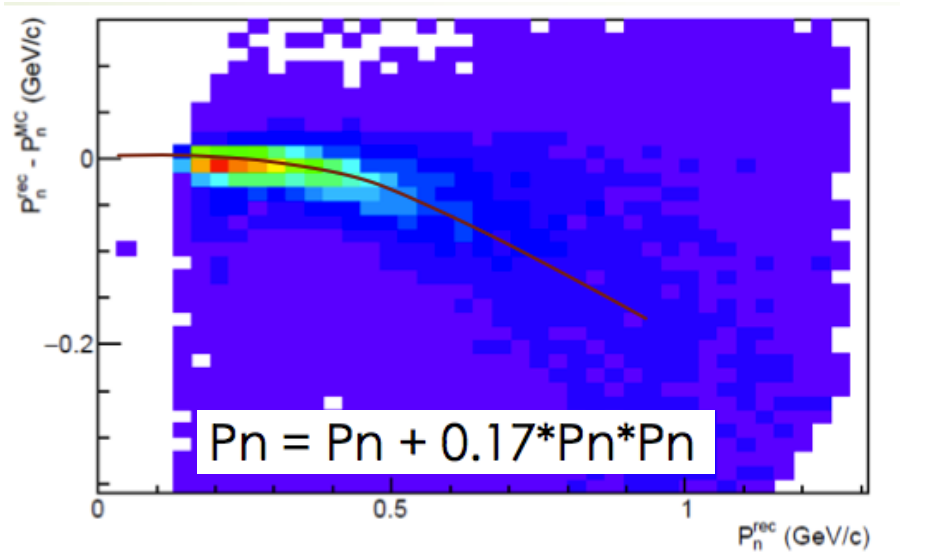


Resolution of neutrons with Eloss correction



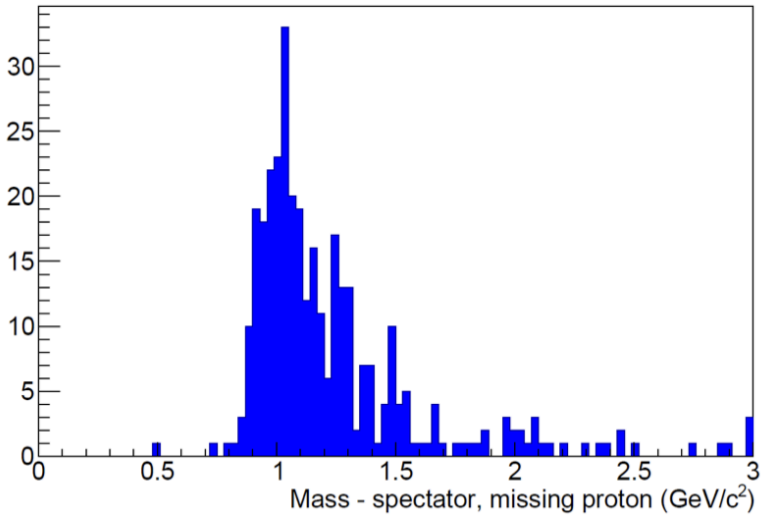




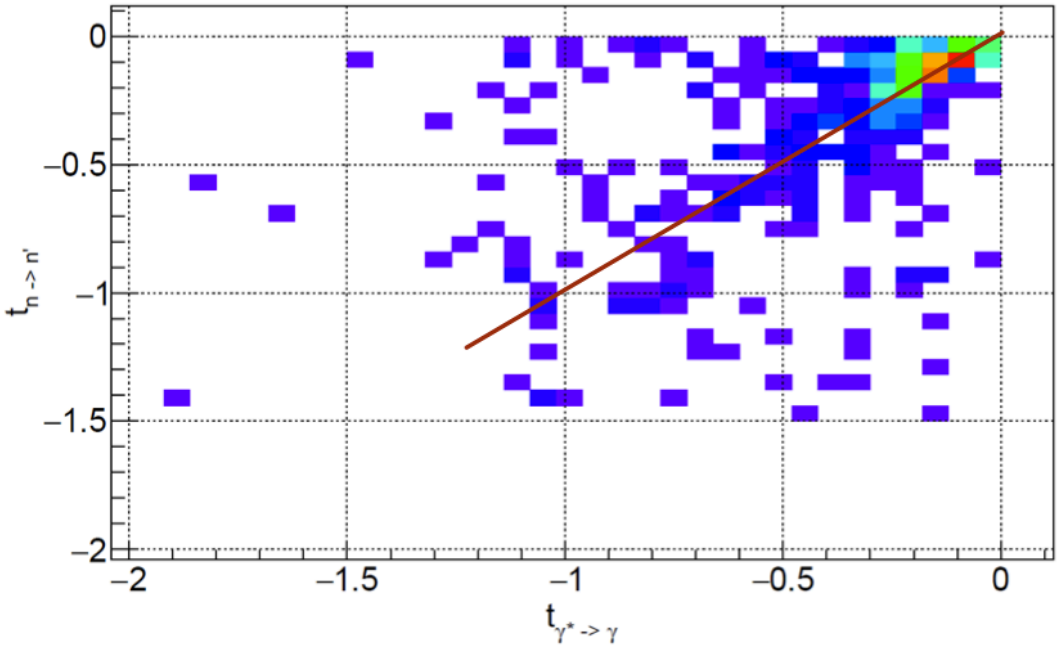


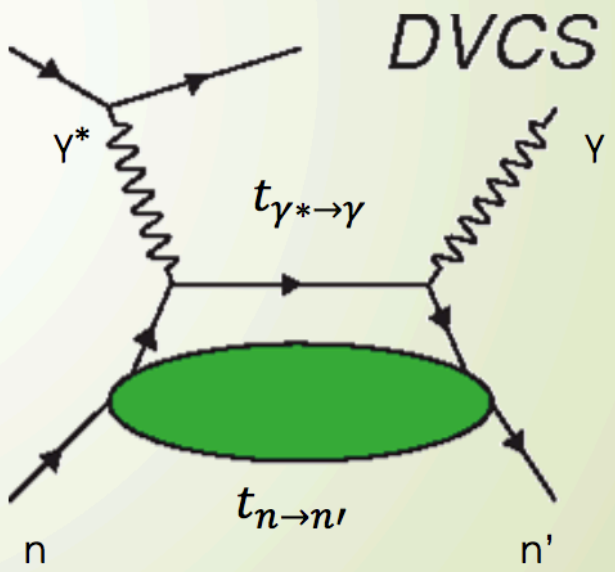
neutron-DVCS simulation

- e d → e' n γ (p)



Squared four-momentum transfer from gamma to gamma, and from neutron to neutron

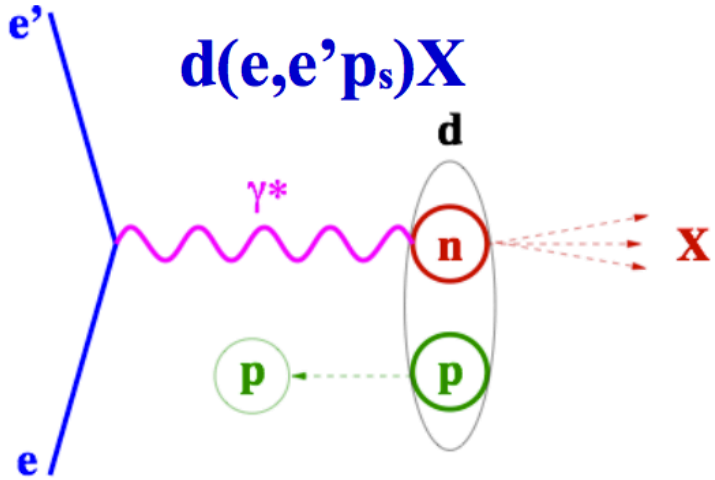




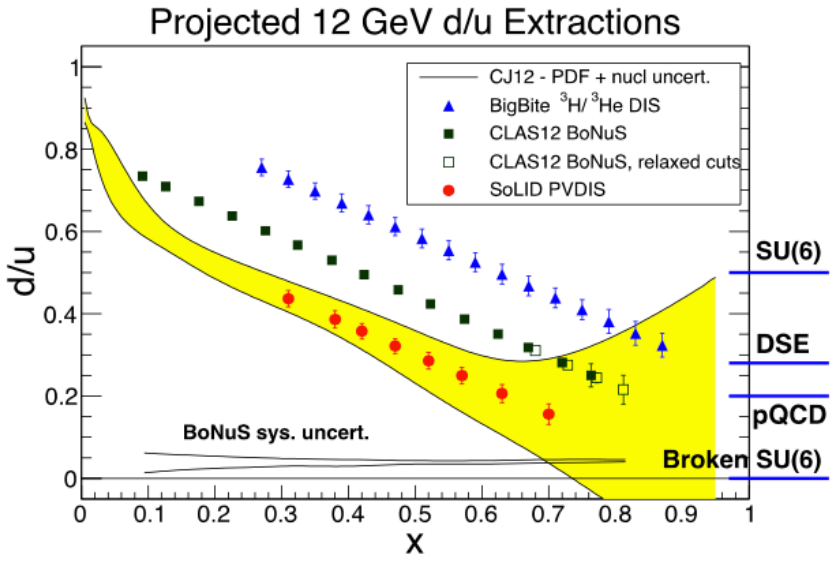
Status Report on BONuS12 Preparation

(E12-06-113, CLAS12 Run Group F)

M. Hattawy
Old Dominion University

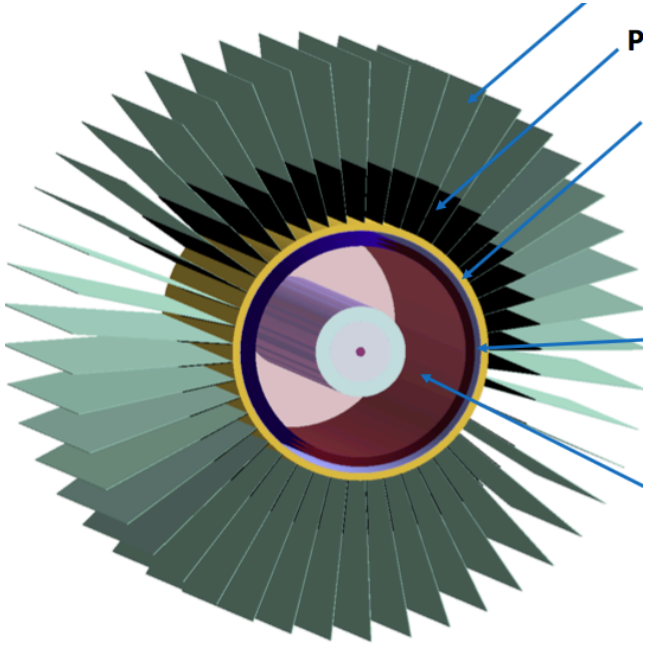


$$\frac{F_{2n}}{F_{2p}} \approx \frac{1+4d/u}{4+d/u} \Rightarrow \frac{d}{u} \approx \frac{4F_{2n}/F_{2p}-1}{4-F_{2n}/F_{2p}}$$

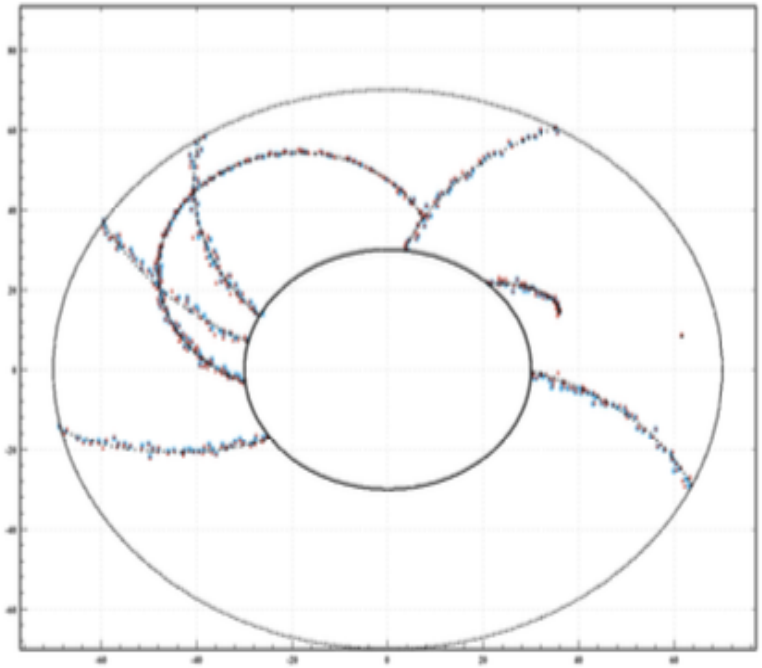


BONuS12: An Overall systematic uncertainities will be less than 6%

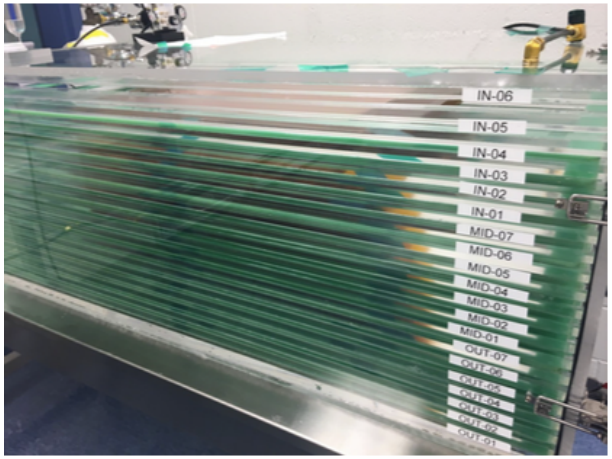
GEMC simulation of the RTPC

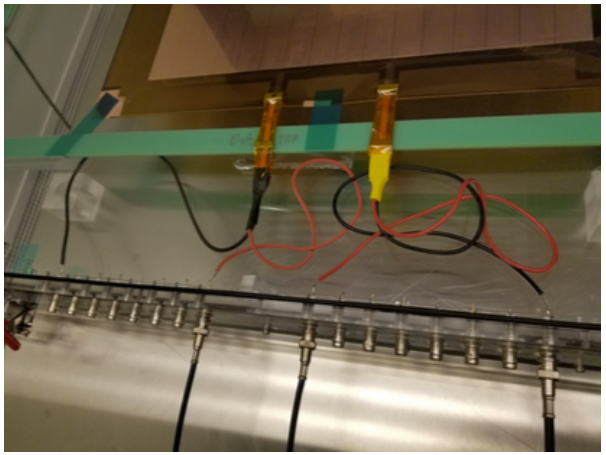


Improving Track Reconstruction

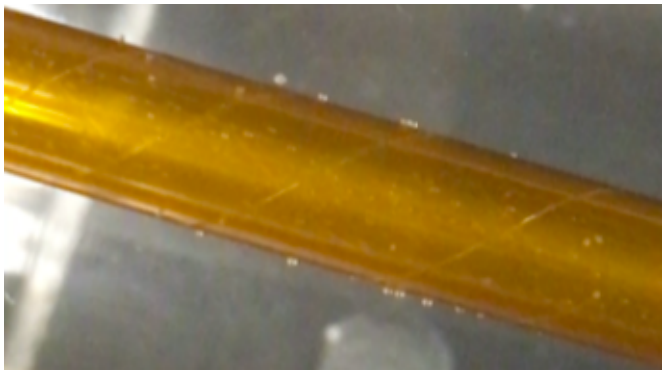


GEM quality tests completed

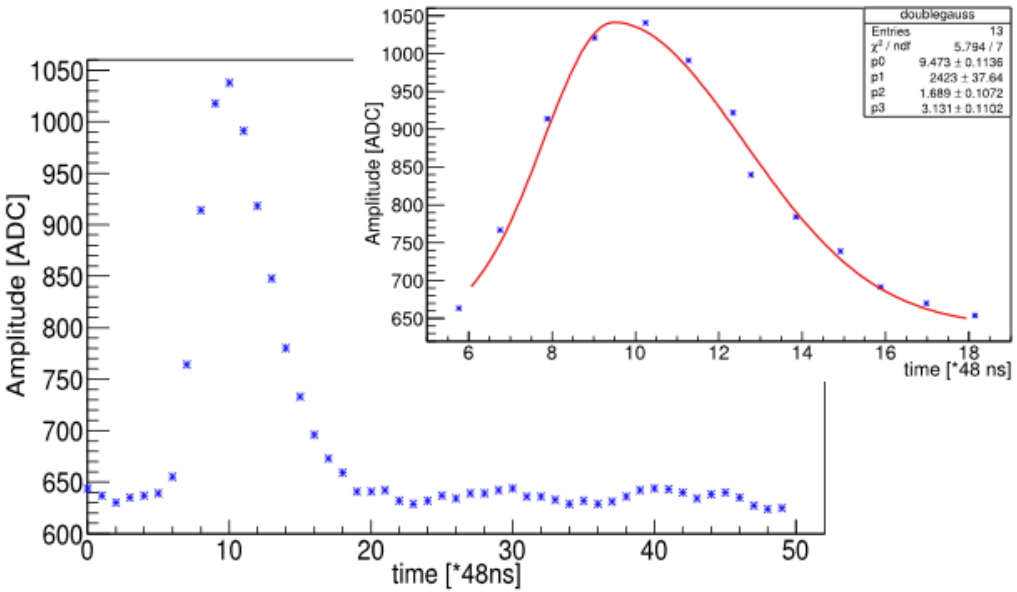


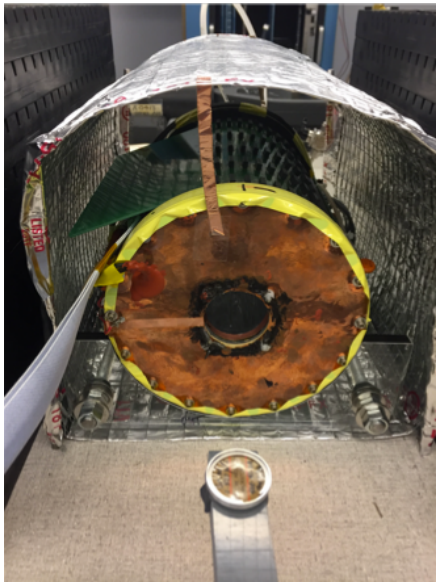


Testing target Kapton tube

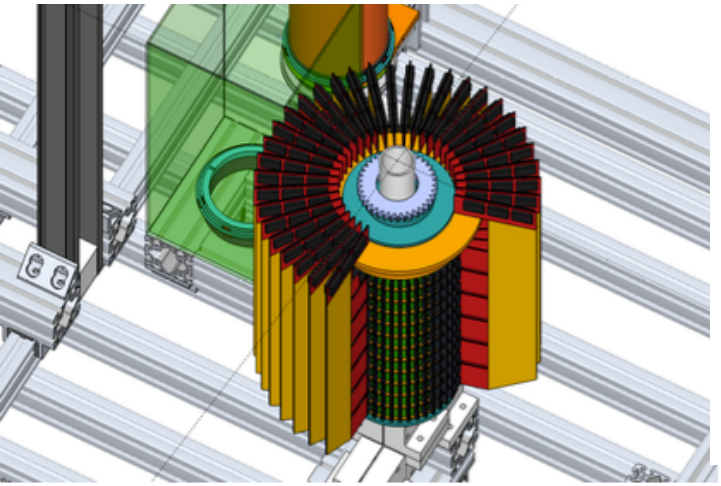


Same Micromegas readout based on DREAM chip

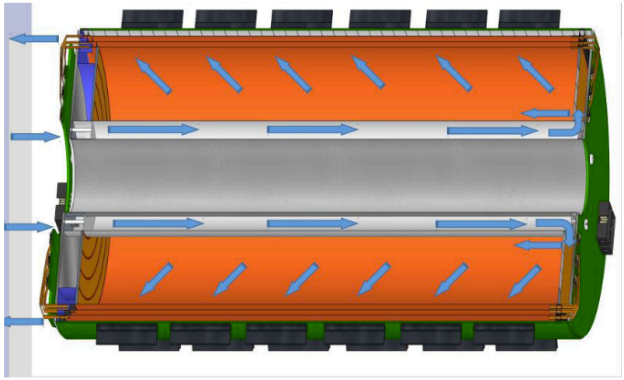




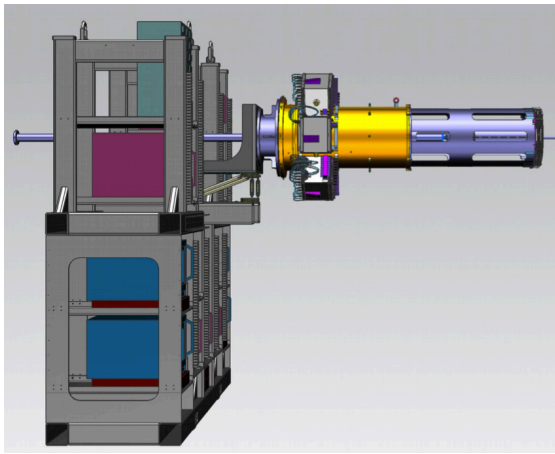
Assembling



Drift Gas system



Installation



DPWG @ CLAS Coll. Meeting

10:30 - 12:30

Deep Processes Working Group - II

Remote connection: https://bluejeans.com/158136600

Convener: Mr. Marco Contalbrigo (INFN Ferrara)

Location: F224-225

10:30 **Round table: Standards for DPWG Result Release** *30'*

Speaker: Mr. Marco Contalbrigo (INFN Ferrara)

Material: **Slides**

11:00 **Round table: Validation of Extraction Mothods** *30'*

Speaker: Mr. Marco Contalbrigo (INFN Ferrara)

11:30 **SIDIS Extraction Methods** *15'*

Speaker: Dr. Harut Avagyan (Jefferson Lab)

Material: **Slides**

11:45 **Dihadron Extraction Methods** *15'*

Speaker: Dr. Anselm Vossen (Duke University)

Material: **Slides**

12:00 **Exclusive Reaction Extraction Methods** *15'*

Speaker: Francois-Xavier Girod (UConn)

Material: **Slides**

CLAS12 @ DNP

Public release of CLAS12 performance and results

Demonstrate the detector is working properly and
the experiment is on track for a broad and timely physics outcome

- data MC comparison
- known particles (pi0…)
- basic dependencies (missing mass….)
- only (very) preliminary results

Collaboration among the analyzers:

- consistency of data selection (fiducial volume…)
- consistency of corrections (kinematic correction, background subtraction…)
- cross-check of yields and kinematic dependencies
- common MC productions

Extraction Methods

Validation of Extraction Methods

Harut Avakian (JLab)

EVA Framework should allow

1) test the extraction procedures
2) Estimate systematic uncertainties from modeling
3) Evaluate the relevance of experimental uncertainties
4) ……..

Radiative Correction to SSA

$$\sigma_0(1+sS_T\sin\phi_S)R_0(1+r\cos\phi_h)\rightarrow\sigma_0R_0(1+sr/2S_T\sin(\phi_h-\phi_S)+sr/2S_T\sin(\phi_h+\phi_S))$$

Simultaneous extraction of all moments is important also because of correlations!

Development of a reliable techniques for the extraction of 3D PDFs and fragmentation functions from the multidimensional experimental observables with controlled systematics requires close collaboration of experiment, theory and computing

Extraction Methods

Asymmetry extraction and verification

Anselm Vossen

Duke

- Smearing Corrections –Unpolarized Case: Example Belle Λ analysis (Boer-Mulders should be similar)

  Use SVD unfolding in all kinematic variables (including angle)

- **First COMPASS result used 'Double Ratio':**

$$\begin{aligned}\mathrm{DR}(\Phi_k) &= \frac{N_U^{\uparrow}(\Phi_k)\cdot N_D^{\uparrow}(\Phi_k)}{N_U^{\downarrow}(\Phi_k)\cdot N_D^{\downarrow}(\Phi_k)} \\ &= \frac{c_U^{\uparrow}\cdot c_D^{\uparrow}}{c_U^{\downarrow}\cdot c_D^{\downarrow}}\cdot\frac{a_U^{\uparrow}(\Phi_k)\cdot a_D^{\uparrow}(\Phi_k)}{a_U^{\downarrow}(\Phi_k)\cdot a_D^{\downarrow}(\Phi_k)}\cdot\frac{(1+A^{\mathrm{mod}_i}\sin\Phi_k)^2}{(1-A^{\mathrm{mod}_i}\sin\Phi_k)^2} \\ &\approx C\cdot\frac{a_U^{\uparrow}(\Phi_k)\cdot a_D^{\uparrow}(\Phi_k)}{a_U^{\downarrow}(\Phi_k)\cdot a_D^{\downarrow}(\Phi_k)}\cdot(1+4A^{\mathrm{mod}_i}\sin\Phi_k)\end{aligned}$$

- **Example from STAR: cancel relative luminosity**

$$A_{UT}\cdot P\cdot sin(\phi_{RS}) = \frac{\sqrt{N^{\uparrow}(\phi_{RS})N^{\downarrow}(\phi_{RS}+\pi)}-\sqrt{N^{\downarrow}(\phi_{RS})N^{\uparrow}(\phi_{RS}+\pi)}}{\sqrt{N^{\uparrow}(\phi_{RS})N^{\downarrow}(\phi_{RS}+\pi)}+\sqrt{N^{\downarrow}(\phi_{RS})N^{\uparrow}(\phi_{RS}+\pi)}}.$$

Extraction Methods

Exclusive Reaction
Extraction Methods and Validation

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Multidimensional

Cross-sections and acceptances may display steep gradients inside bins. If gradients change significantly within the bins, this entails substantial corrections

Folding

Radiative corrections are folded in together with acceptances and resolutions, up to a "vcut": may be a series of correlated cuts, the result of a likelihood, or even a purity cut based on a neural network

Model Iteration

Phenomenological GPDs/CFFs used as input in the model iterated until agreement between input and output observables. This validates the chain entire from the generator and is used to evaluate systematical uncertainties.