ALERT Proposals:

Tagged EMC
Nuclear DVCS
(Φ production)
(others)

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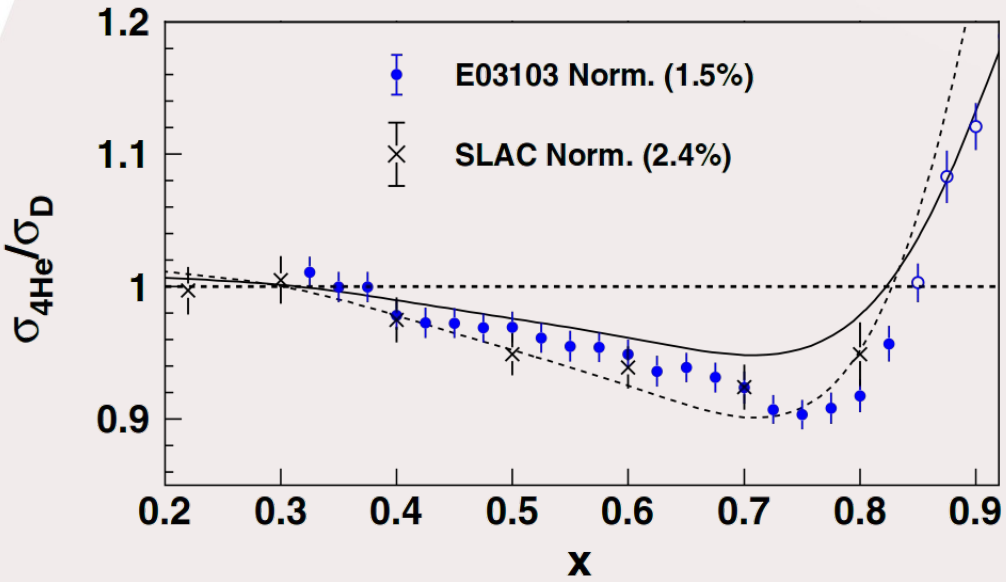
The EMC Effect

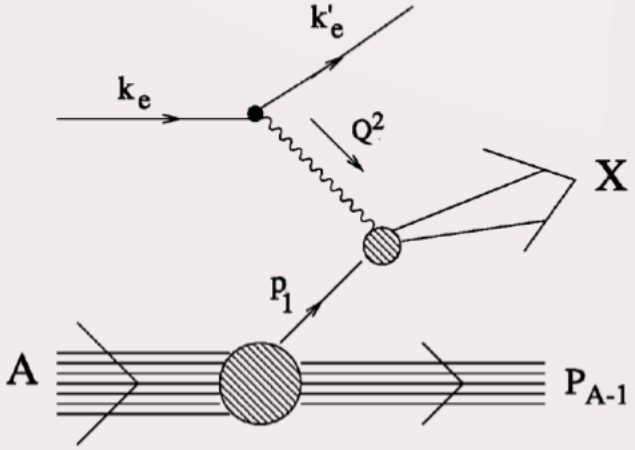


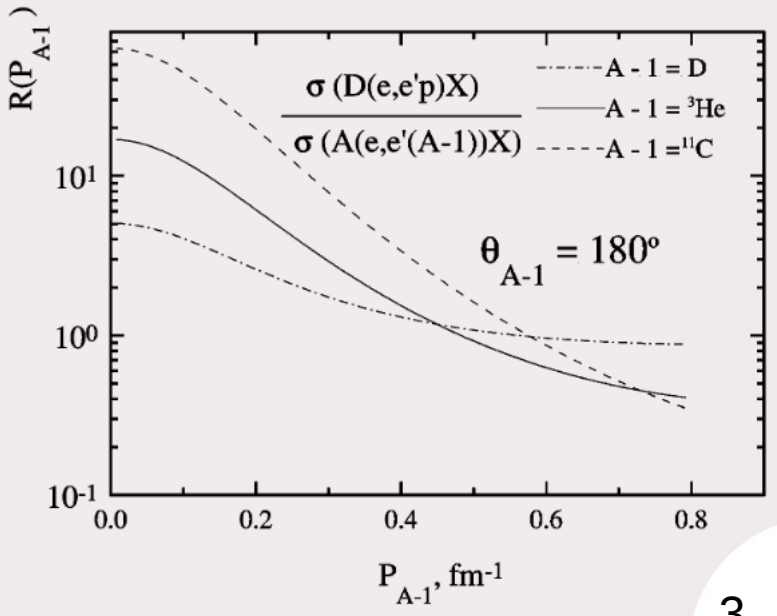
- **Modification of bound nucleons at the partonic level**
  - The effect has been measured at several facilities with great precision in light nuclei since JLab E03-103 experiment
- **An unexplained effect**
  - Many models explain the data similarly well with no resolution in sight by just reducing errors → need new observables
- **Main Focus of ALERT Proposals**
  - Tagged EMC
  - DVCS for 3D EMC
  - Phi production for gluon EMC

The Spectator Mechanism

- **Spectator recoil nucleon**
  - Part of the nuclei that do not interact with the virtual photon and other hadronic products of the reaction
  - Necessitate to control final state interactions with hadrons produced and nucleon knocked out
  - Need to select the right kinematic (usually backward and moderate momentum)
  - Used by the BoNuS experiment successfully for neutron PDF

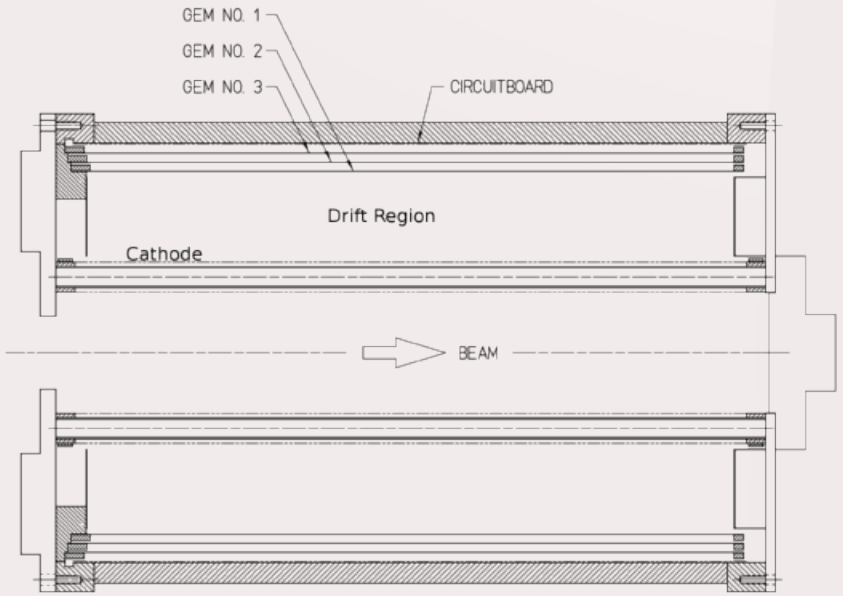
- **Spectator recoil nuclei**
  - The integrity of the recoil nuclei gives an extra guaranty against FSI
  - But reduced at high momentum



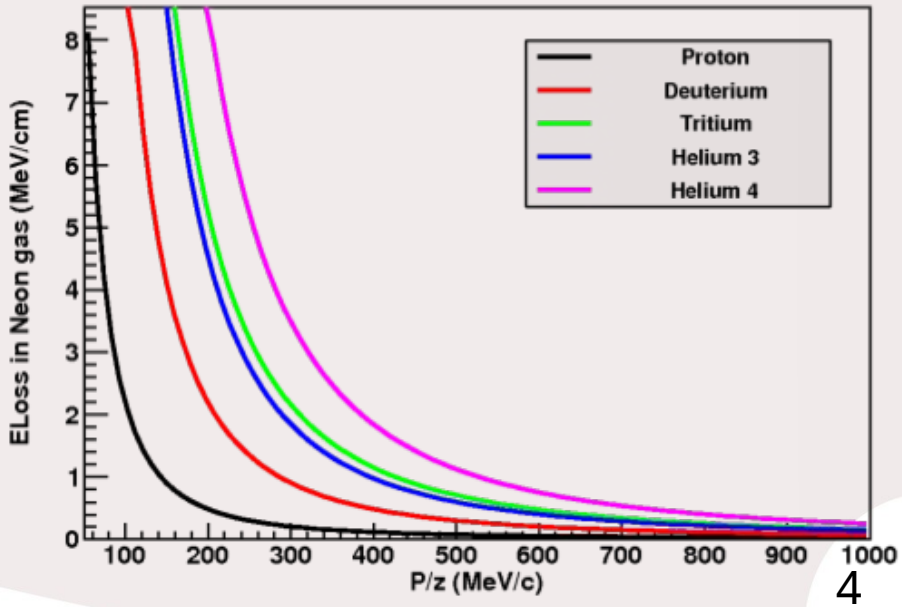


Spectator Detection

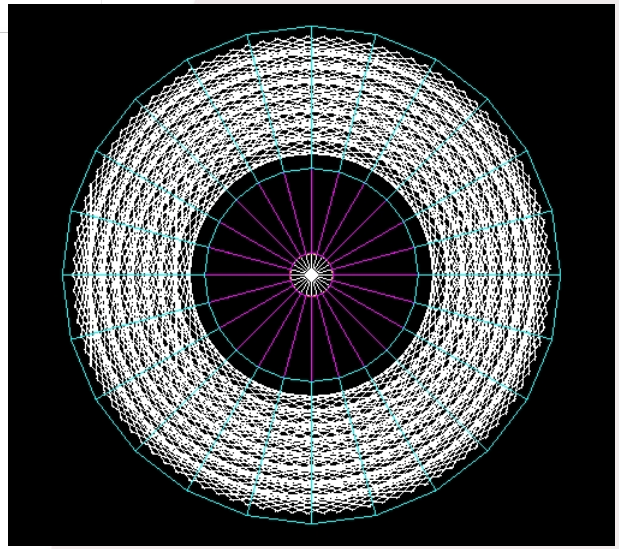
- **CLAS12**
  - The central detector of CLAS12 will not be able to detect the recoil spectators at low enough energy

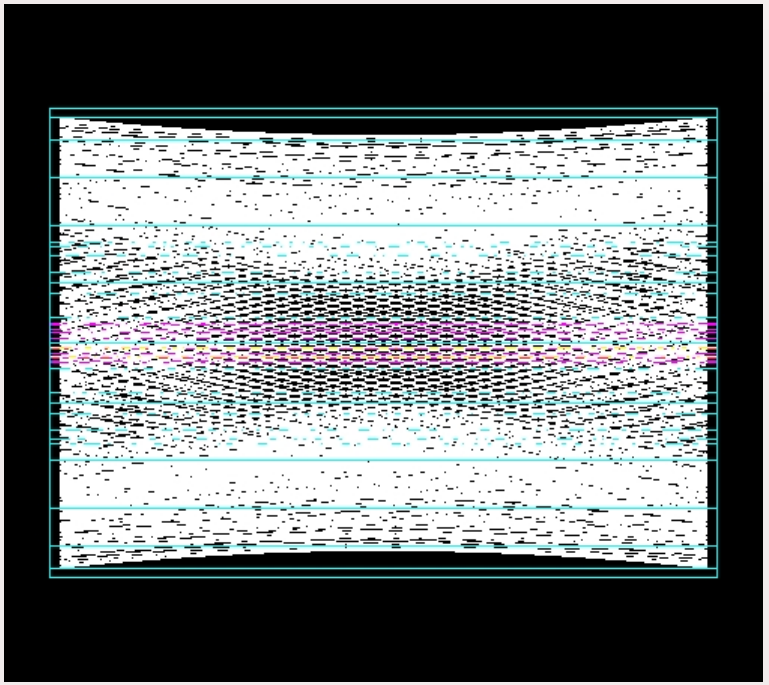


- **BoNuS**
  - The radial time projection chamber has great capabilities in order to detect slow recoils
  - One important issue is the limited identification capabilities
  - In particular 3He and 3H give very similar signal because we measure P/Z only



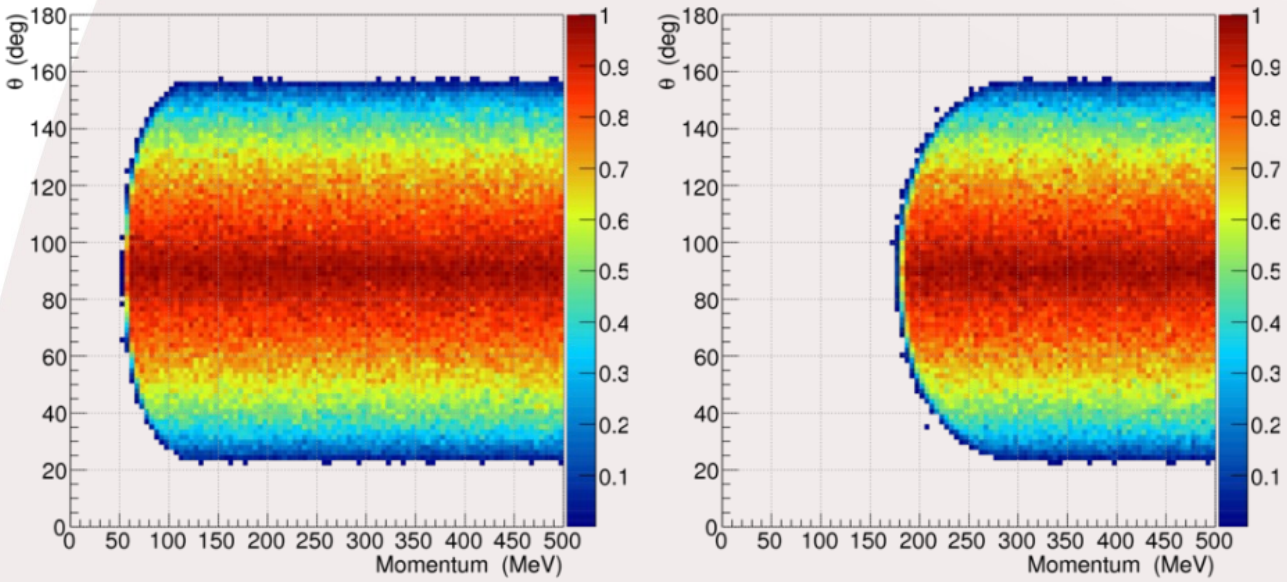
ALERT Detector





- **ALERT Detector**
  - Hyperbolic drift chamber
  - Scintillators for TOF and total energy measurement
- **GEANT 4 simulation**
  - To define the characteristics of the chamber
    (See Whitney's talk for recent progresses)
- **Still to be done**
  - TOF system geometry to be finalized
  - Electronics options to be evaluated
  - Mechanical integration on going

Detection Capabilities

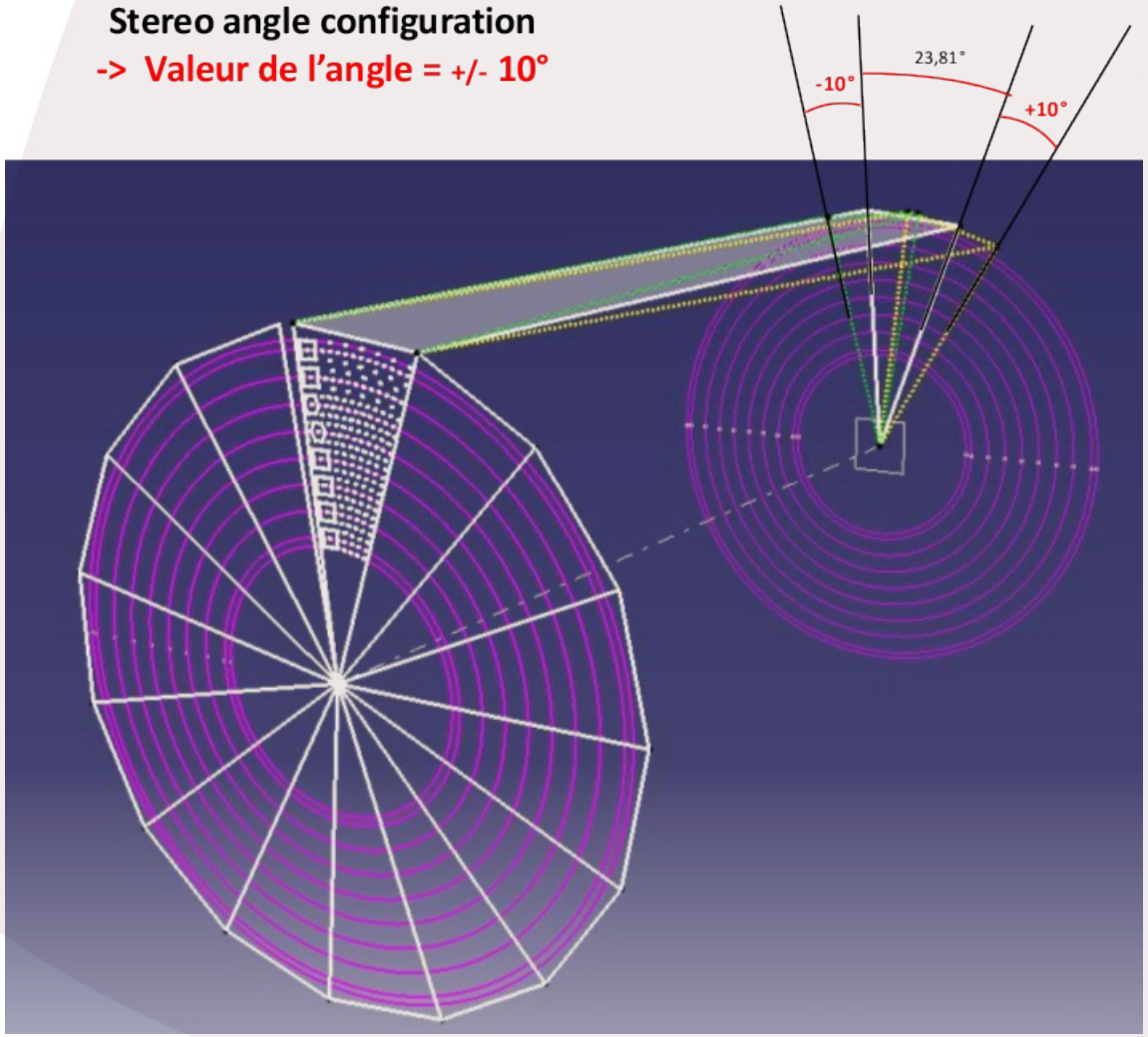


- **Capabilities at very low momentum**
  - Down to ~60 MeV for protons / 160 MeV for 3He
  - Goes to very large angle forward and backward (25° from the beam)
  - Most of the limits are due to recoil stopped in target
  - Target is planned to be only 3 atm, 0.5 cm radius with 15 µm kapton walls
- **Capabilities to handle high rates**
  - Short drift time <250 ns (5 µs in RTPC)
  - Translate into an average 0.6 background track per event for 3 MHz of protons (10 in RTPC)

Design and Prototyping

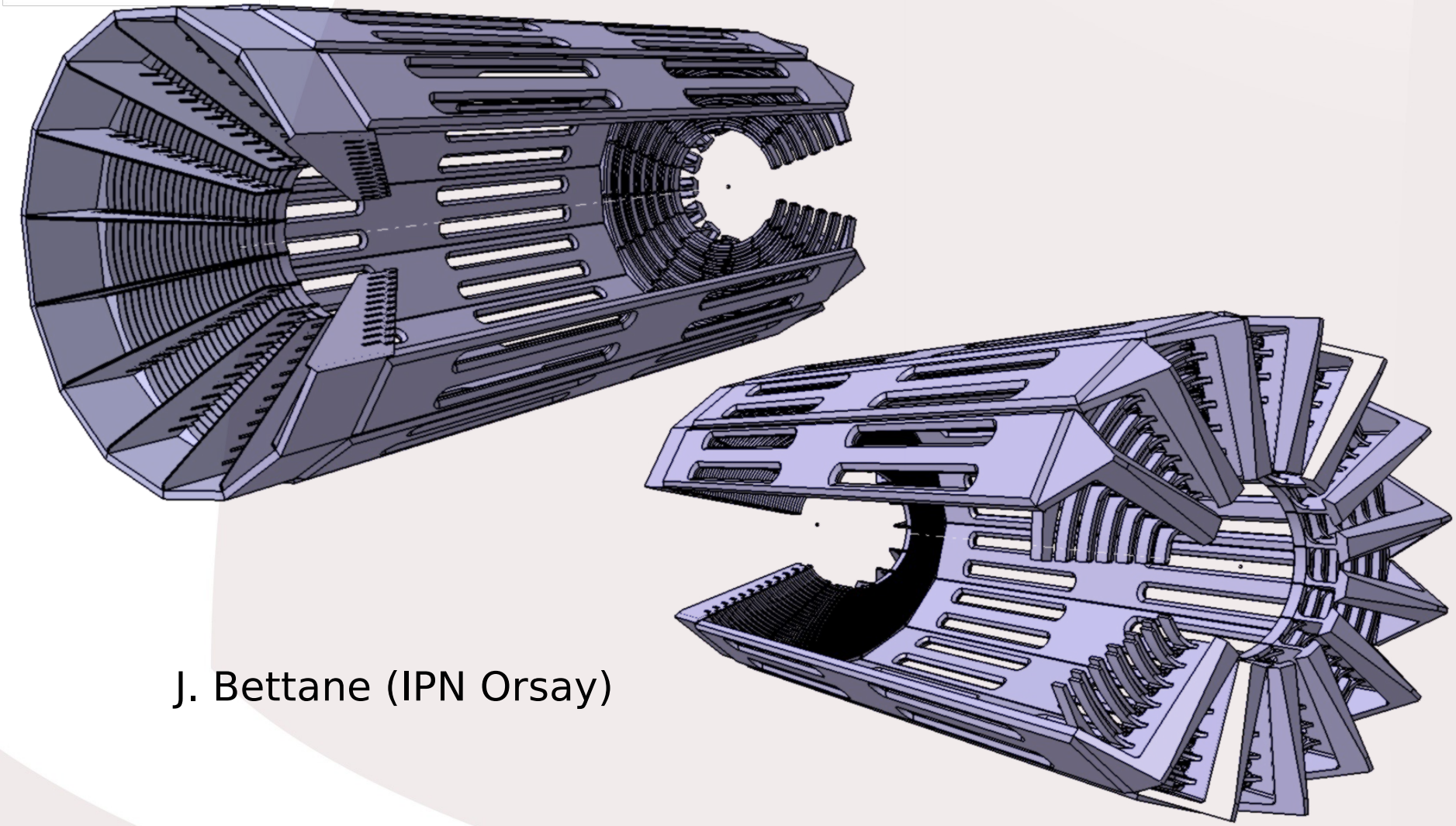
Stereo angle configuration

-> Valeur de l'angle = +/- 10°



- **Stereo angles makes everything more complicated**

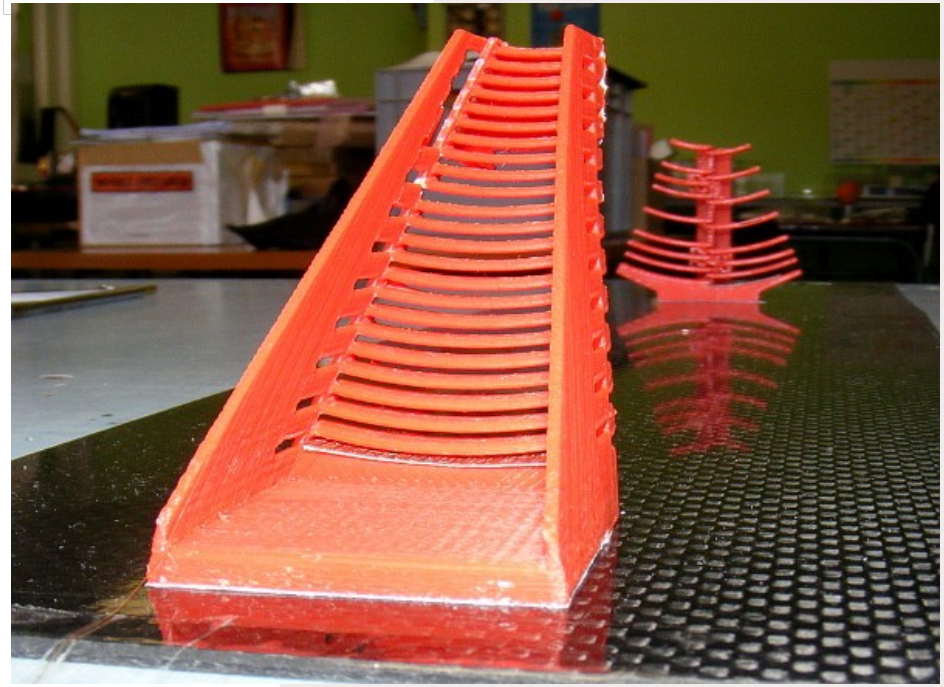
Design and Prototyping

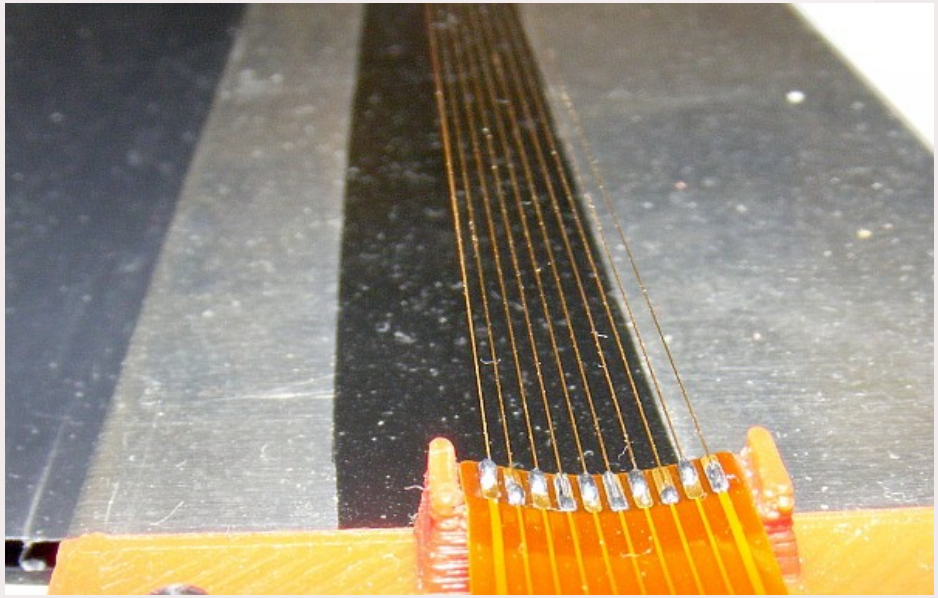


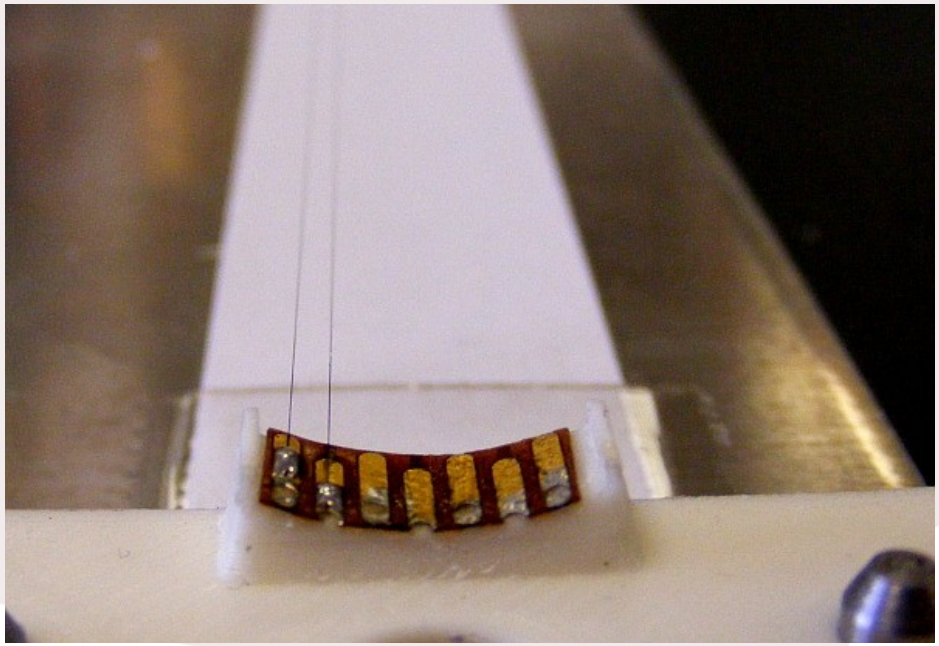
J. Bettane (IPN Orsay)

First prototype is designed and being ordered

Orsay Tests







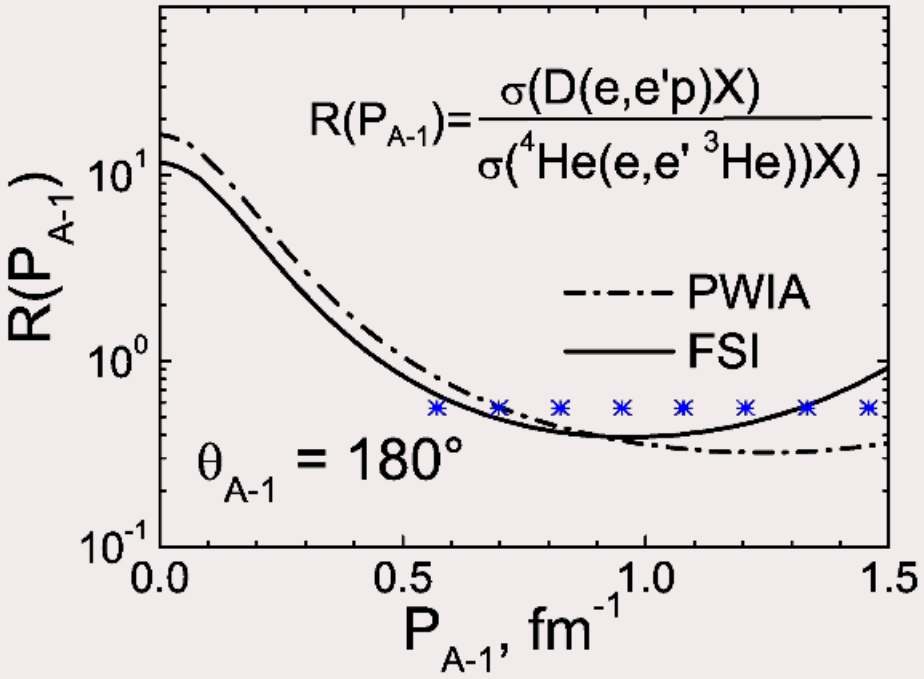
Progress in Orsay:

- 3D printed tests
- Soldering wires on curved surface
- Gluing and soldering carbon wires

The proposals

- **Going to next PAC as a run group:**
  - Tagged EMC
  - Nuclear DVCS
  - (Φ production)
  - (Deuteron and neutron DVCS)
  - Others?
    - Tagged Form Factors
    - Everybody is welcome!
- **We have regular meetings**
  - Let us know if you want to be on the list

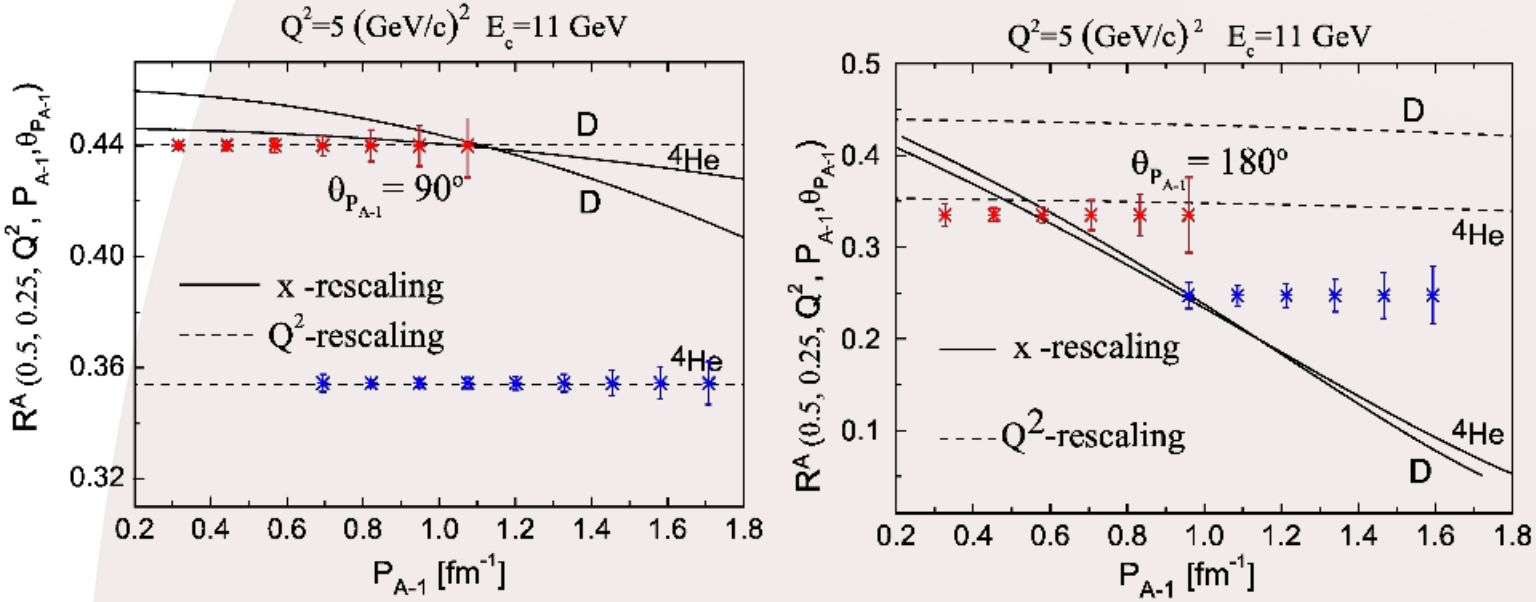
Testing the Spectator Model



- **First step is to test the spectator model**
  - Can be tested on a large spectrum with very good precision
  - Comparison of Helium and Deuterium targets
  - First look at the helium low energy FSI in such process

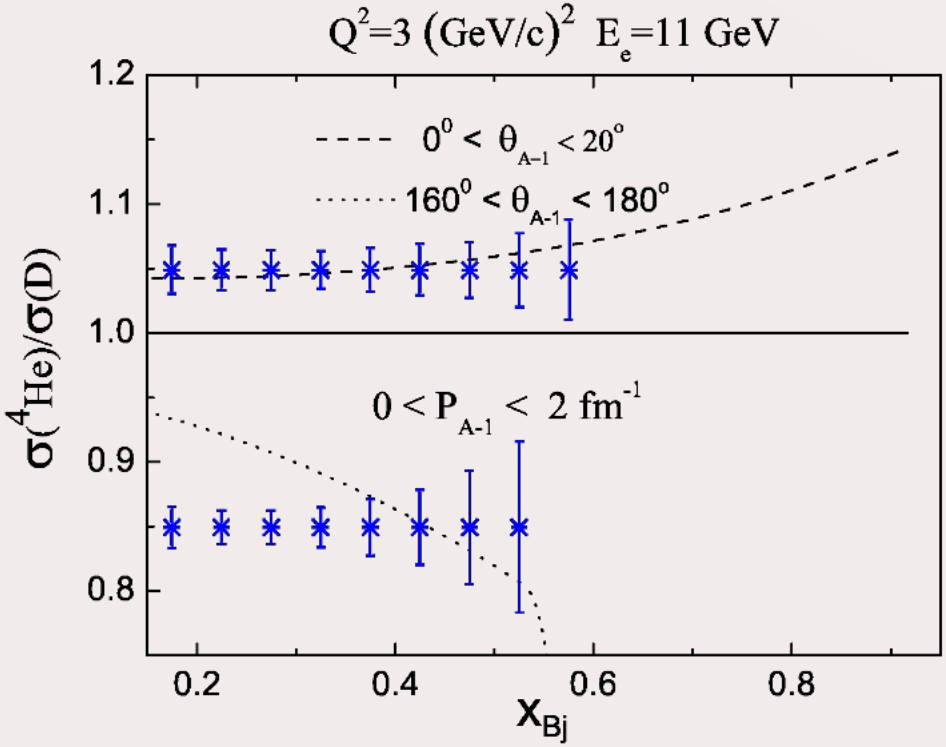
    C. Ciofi degli Atti, L. P. Kaptari, and S. Scopetta, Eur. Phys. J. A5, 191 (1999)

Rescaling x or Q^2?



- **Rescaling models**
  - Impossible to differentiate x and Q2 rescaling with inclusive measurements but gives strong signature with semi-inclusive
  - Comparison of D to 4He is particularly interesting, no isospin issues but already strong EMC effect!
  - We will be able to give clear confirmation or exclusion for these models

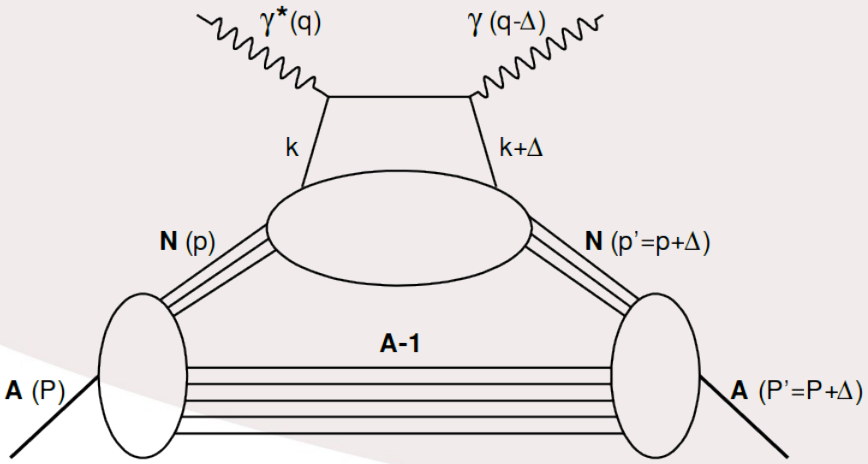
Local EMC Model



- **EMC effect due to local conditions and shell of the nucleon**
  - In this model EMC effect is due to the cancellation of much larger effects that can be separated with spectator detection
  - We will be able to give clear confirmation or exclusion for this model
- **For all these we need to make sure we have 3He not 3H!**
  - Needs ALERT detector

Nuclear DVCS

- **Helium is Spin 0**
  - makes for simple extraction of GPDs
  - See in Mohammad talk the first exclusive data
  - Already a model independent extraction of H!
- **3D imaging of the EMC effect**
  - Is it in the center, on the outside or everywhere?
- **Access to “forbidden” regions**
  - x>~0.25 similar to x>1 physics
  - Can probe the structure of SRC pairs



Nuclear DVCS Generator

- ***Ad Hoc* generator based on our 6 GeV data**
  - Used to estimate count rates and kinematics
  - To be compared with other models

DVCS event generator

We generate events uniformly in the following ranges:
Q^2 = [1, 10.0] GeV2/c2,
xB = [0.04, 0.7],
-t = [0., 0.5] GeV2/c2
phi = [0, 360] deg.
Then the produced events are weighted by this cross section parameterization:

$$\frac{d^4\sigma}{dQ^2 dx_B dt d\phi} = (\frac{Q_0^2}{Q^2})^{\alpha} * \frac{1}{1+(\frac{x_B - x_c}{c})^2} * \frac{1}{(1+bt)^{\beta}} * (1 - d(1 - cos(\phi)))$$

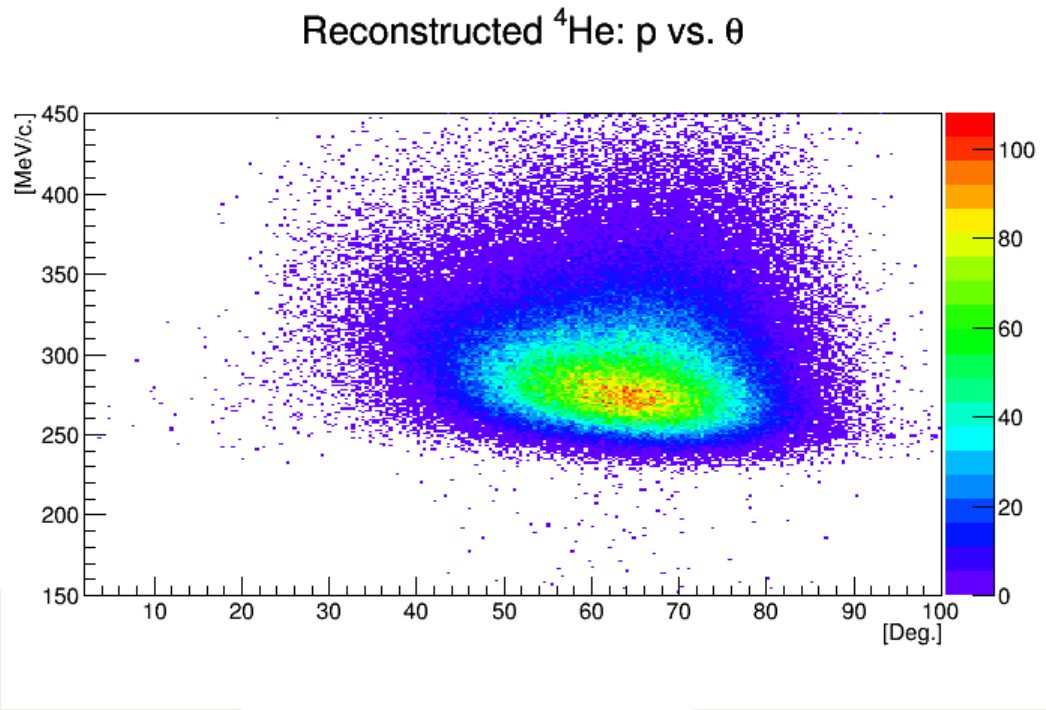
where the parameters are: (for the moment, we use the same parameters as at 6 GeV beam energy)
Q^{2}_{0} = 1.0 GeV2/c2
alpha = 2.5
b = -11.0 GeV2/c2
beta = 12.0
c = 0.2
d = 0.4

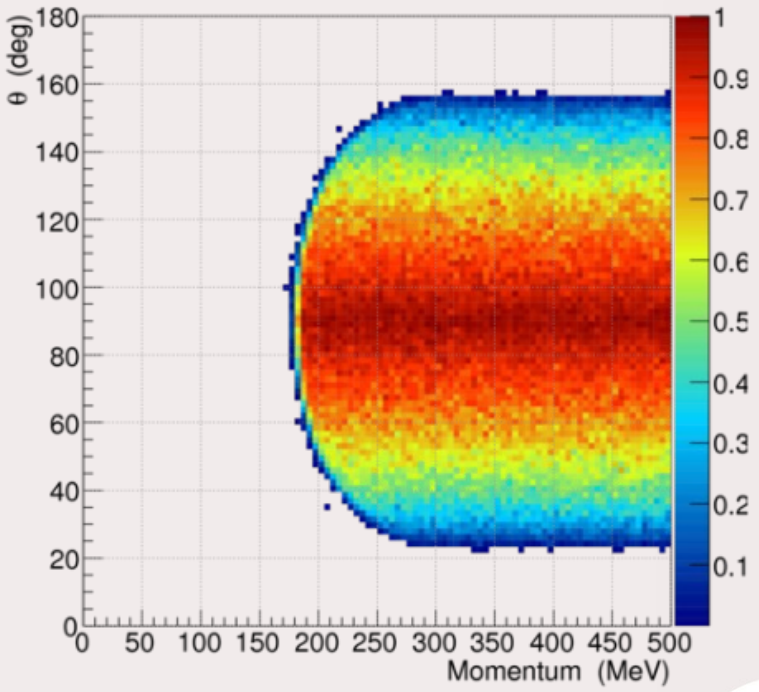
M. Hattawy

Helium distribution

Kinematic of the helium nuclei match our geometry

- Eg6 lacks statistics badly (only 3 pts)
- Main issue here is to have high rate
  - For this we need the ALERT detector





Summary

- **We will explore the dynamic properties of the EMC effect with spectator detection**
  - Allow to test many models that give equally good descriptions of inclusive EMC effect
  - Model predictions are very large effects that will be tested with high confidence!
- **Run group is forming**
  - Tagged EMC
  - Nuclear DVCS
  - Φ production
  - Neutron DVCS
  - Tagged Form Factors
  - Others? (https://clasweb.jlab.org/wiki/index.php/ALERT_Collaboration)
- **Beam time request to be refined**
  - Estimated to ~50 days
  - (30 if BoNuS adopts ALERT instead of RTPC)