Tagged EMC Effect

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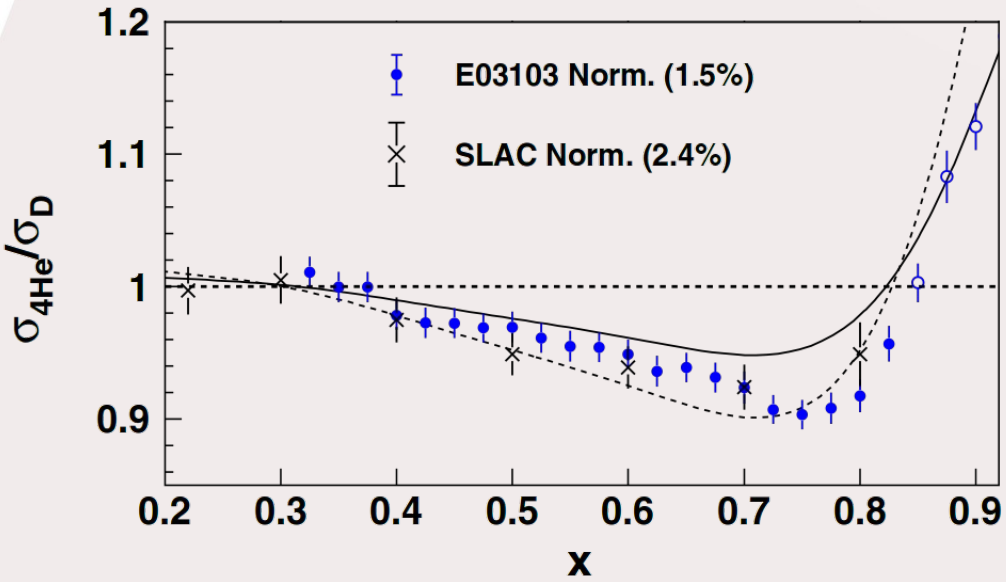
The EMC Effect

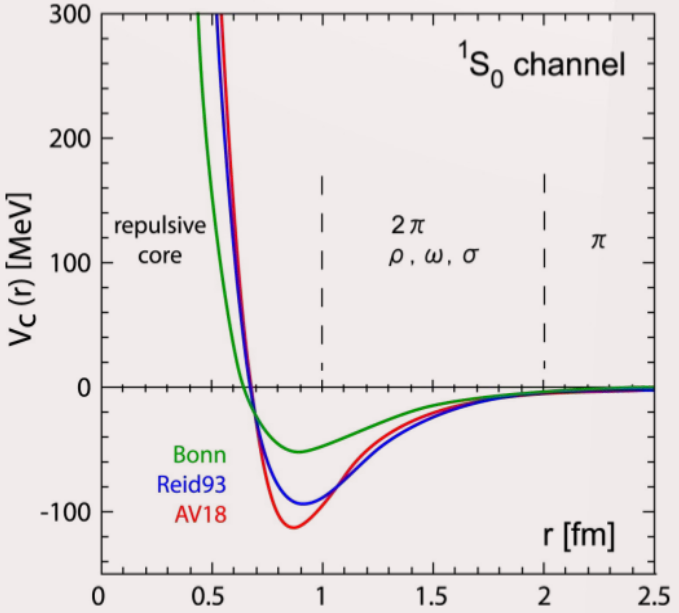


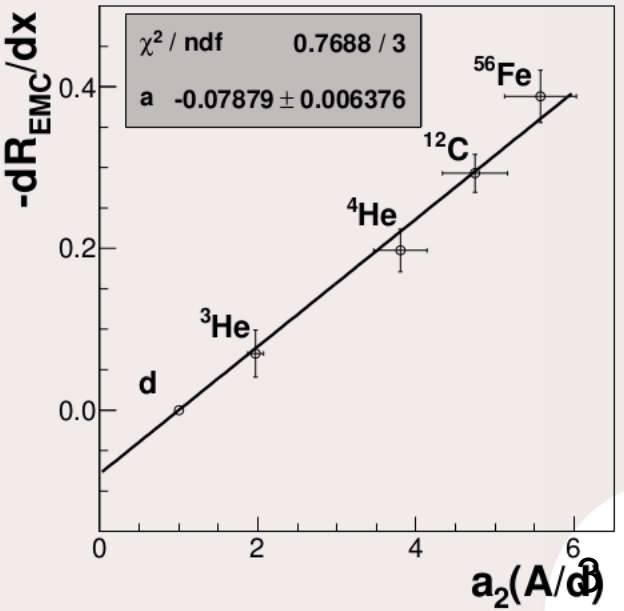
- **Modification of bound nucleons at the partonic level**
  - The effect has been measured at several facilities with great precision fo light nuclei since JLab E03-103 experiment
- **An unexpected effect**
  - Because of the large difference between the nucleon binding energy and the DIS energy scales
- **An unexplained effect**
  - Many models explain the data similarly well with no resolution in sight by just reducing errors → need new observables

The EMC Effect & SRC

- **Short Range Correlations**
  - Observation of fast back to back nucleons in nuclei
  - Due to the short range strongly repulsive core of the NN interaction

- **Proportion of SRC linked to EMC effect?**
  - Recently the link between the processes has been pointed out
  - Is the link just due to similar density dependence or to more specific link?

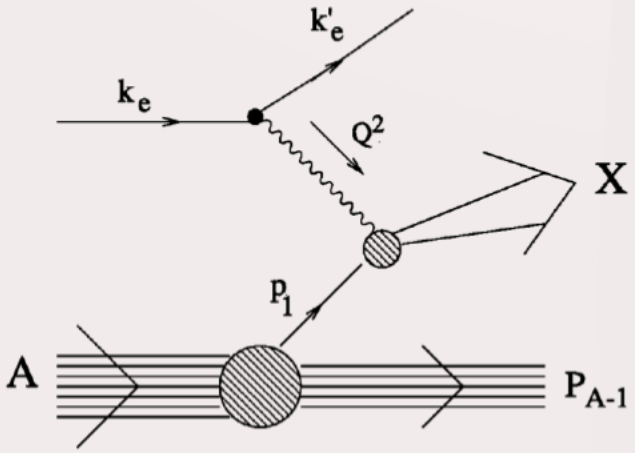


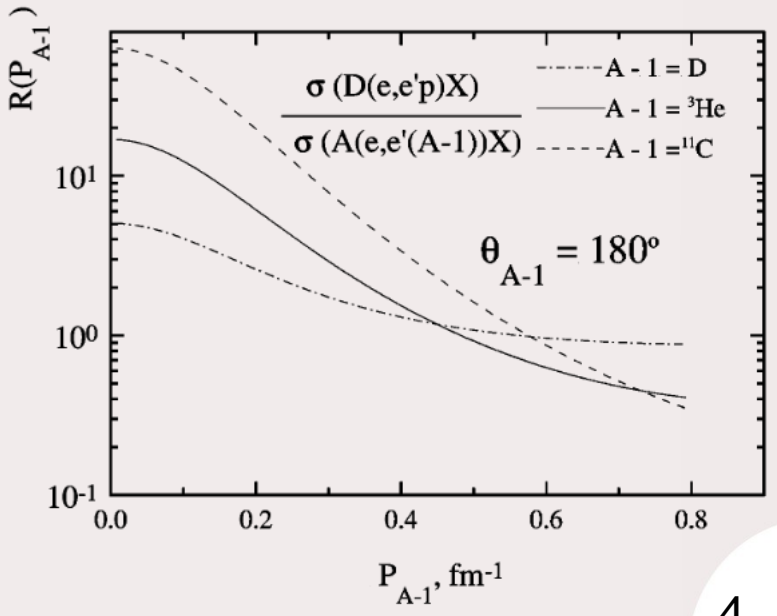


The Spectator Mechanism

- **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

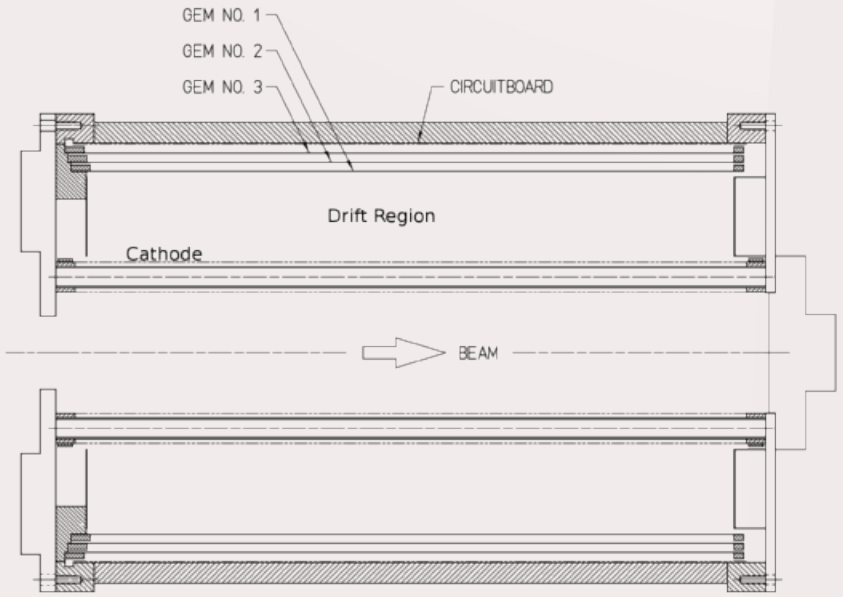
- **Spectator recoil nuclei**
  - The integrity of the recoil nuclei gives an extra guaranty against FSI
  - But reduced at high momentum



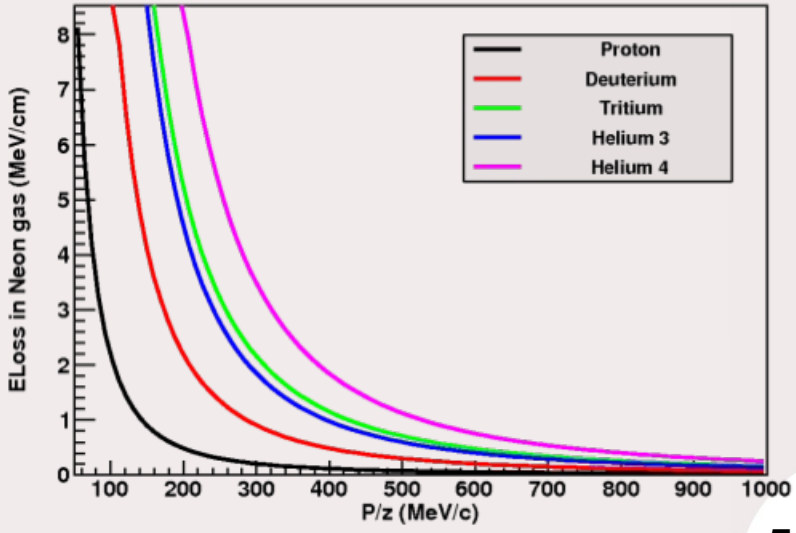


Spectator Detection (1)

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



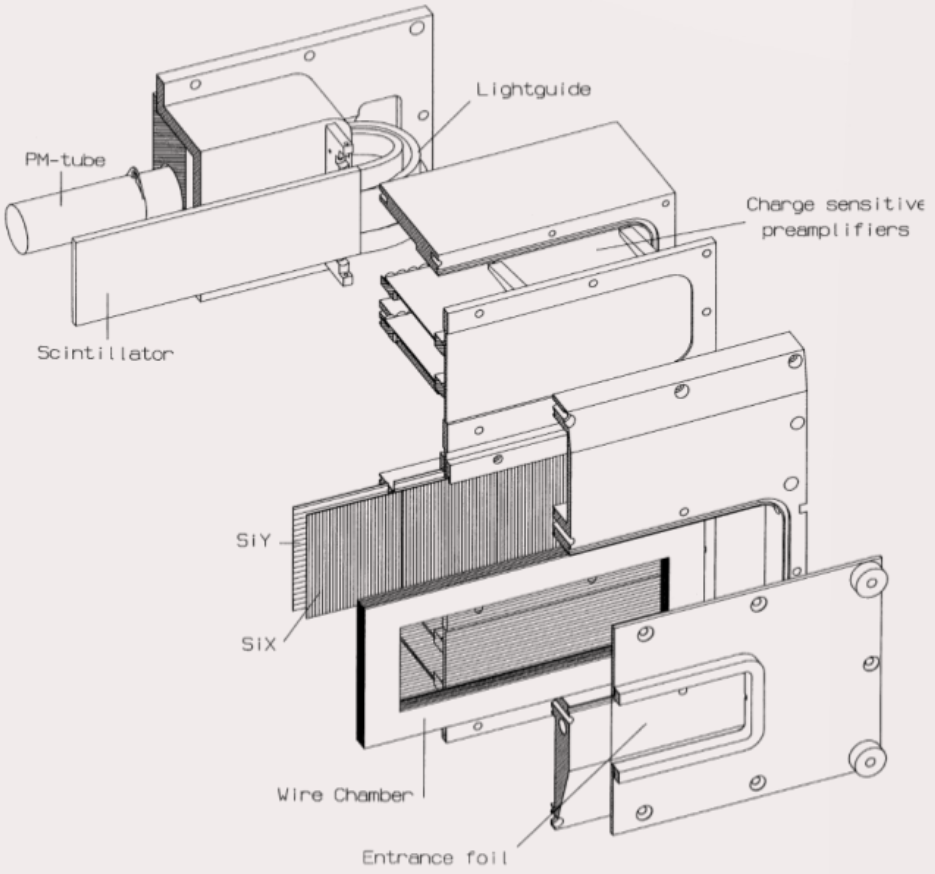
- **BoNuS**
  - The radial time projection chamber has great capabilities in order to detect slow recoils
  - One important issue is the limited identification capabilities
  - In particular 3He and 3H give very similar signal because we measure P/Z only



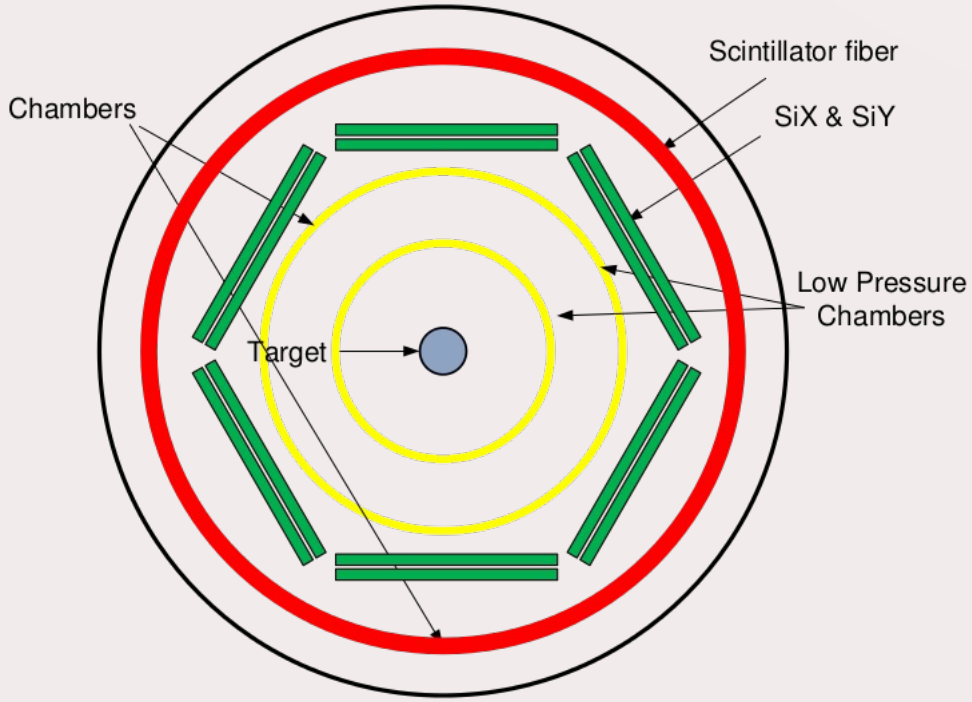
Spectator Detection (2)

- **Nikhef detector**
  - We can inspire ourselves from lower energy experiments
  - Low pressure wire chamber
  - Double sided Si detector
  - Scintillator
  - Can it run in our busy environment close to an intense electron beam?

- **Hall C chamber**
  - A similar low pressure wire chamber was used during hypernuclei experiments !
  - Appeared to functioning properly

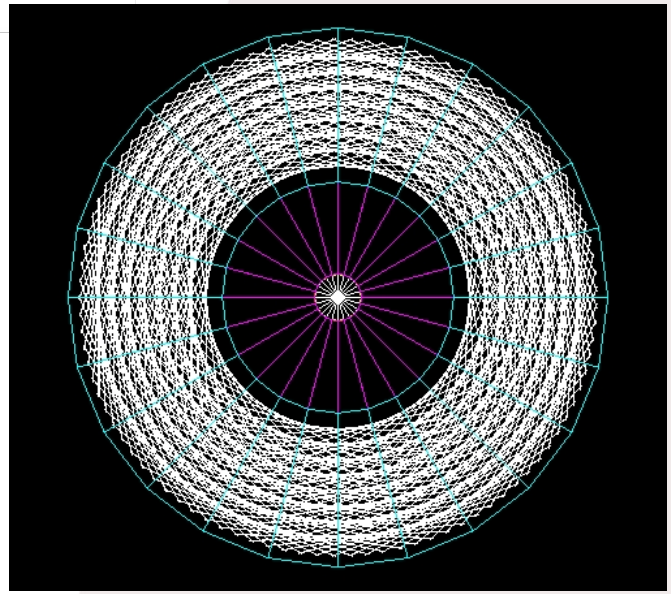


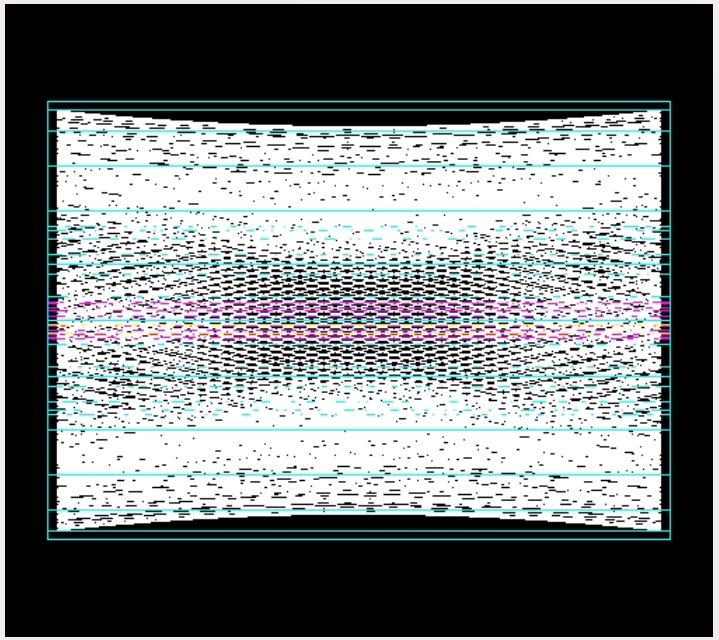
Our Detector (1)



- **Large acceptance recoil detector**
  - Low pressure chamber (2-10 Torr of isobutane)
    - Very fast → integrated to trigger to reduce impact of target windows on the trigger rates
    - Insensitive to MIPs
  - Two sided Si (100 & 400 µm)
  - Scintillator (2 cm thick)

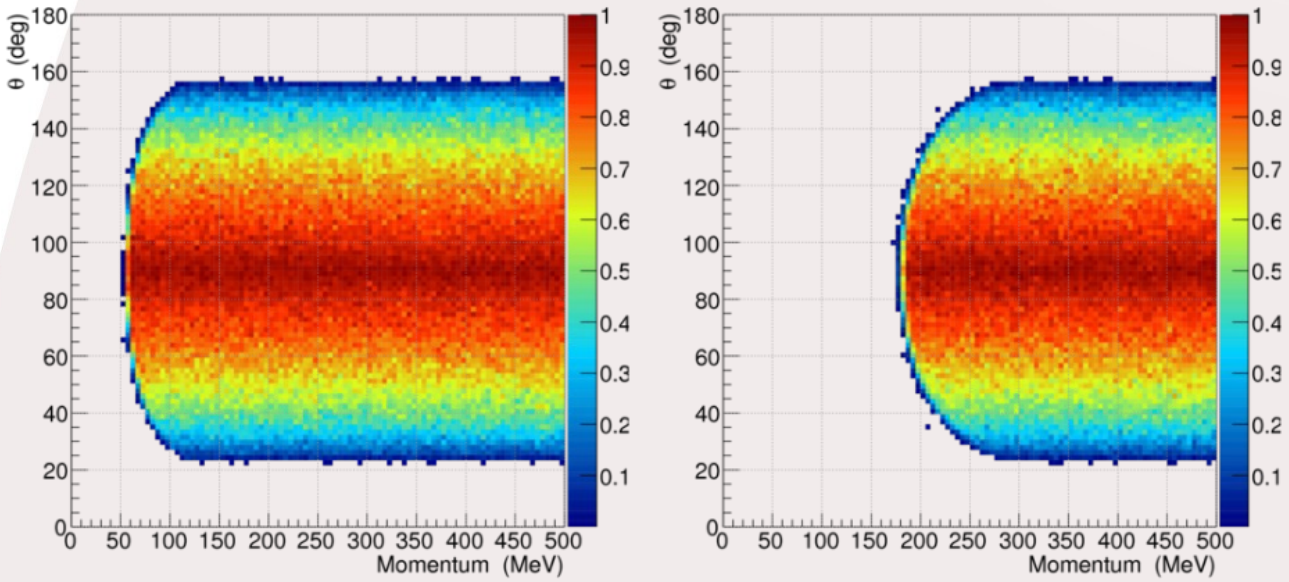
Our Detector (2)





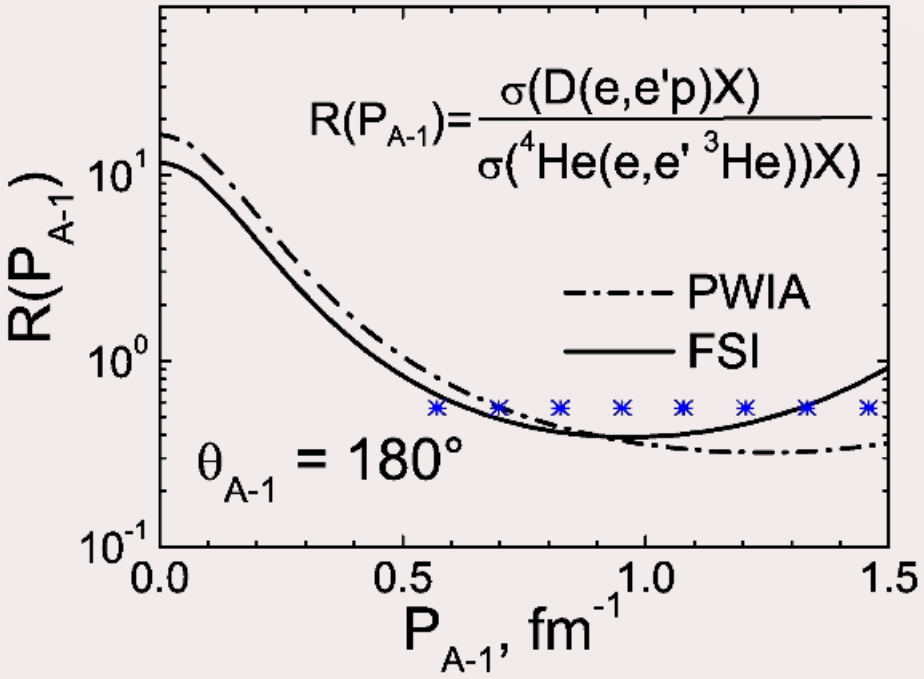
- **GEANT 4 simulation**
  - Allow to test the effective detection range and efficiency
  - Used to define the main characteristics of the chamber
- **Still to be done**
  - No specific needs for electronics, but still need to be detailed
  - Mechanical integration might cause issues that need to be figured out
- **See Talk from G. Charles about ongoing work in Orsay**

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

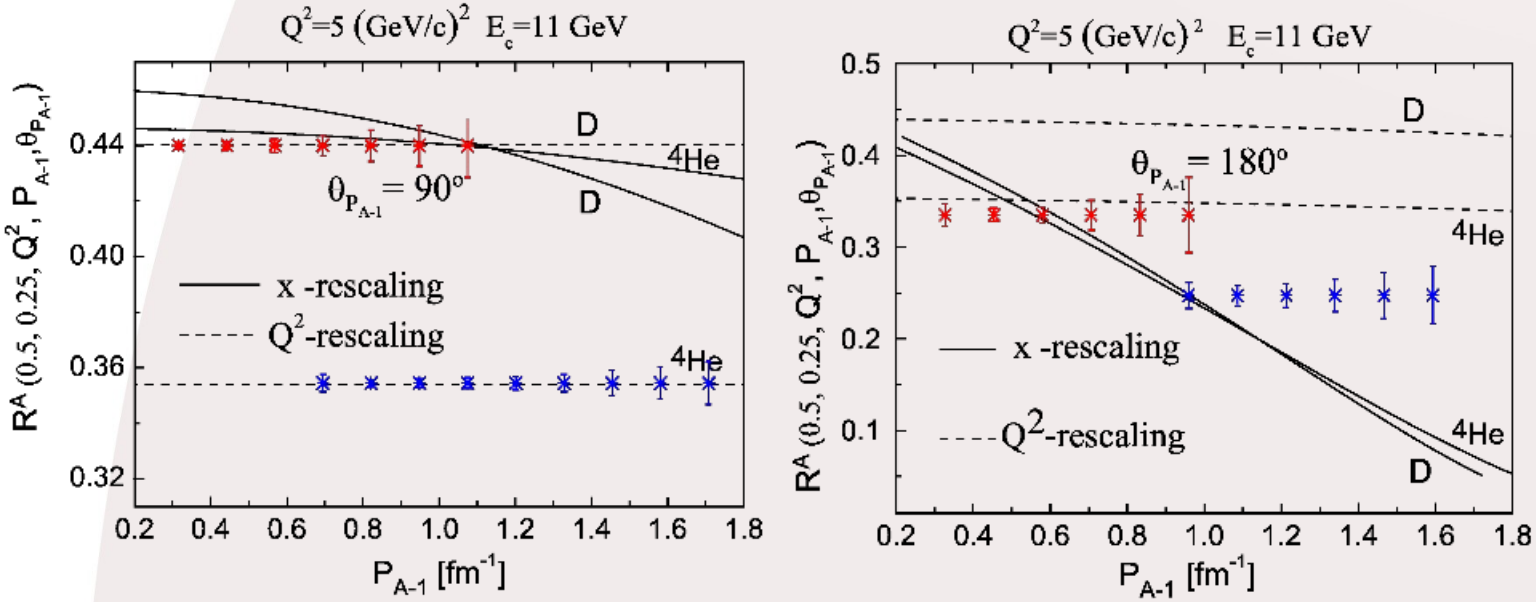
Testing the Spectator Model



- **First step is to test our spectator model**
  - Can be tested on a large spectrum with very good precision
  - Comparison of Helium and Deuterium targets
  - Possibility to share time/data with BoNuS needs to be worked out

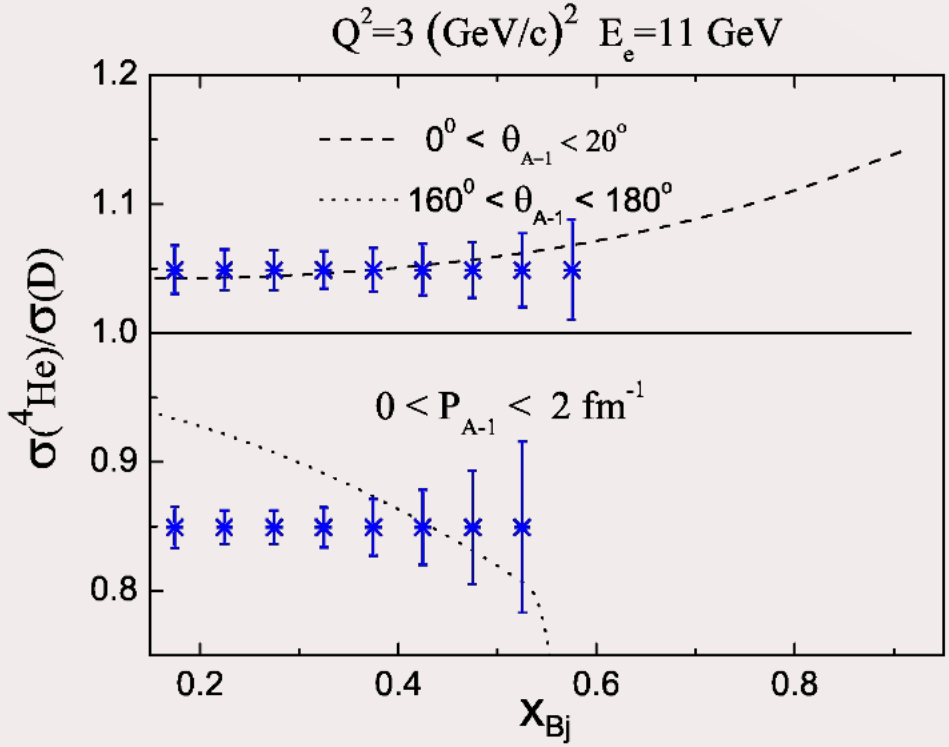
    C. Ciofi degli Atti, L. P. Kaptari, and S. Scopetta, Eur. Phys. J. A5, 191 (1999)

Rescaling x or Q^2?



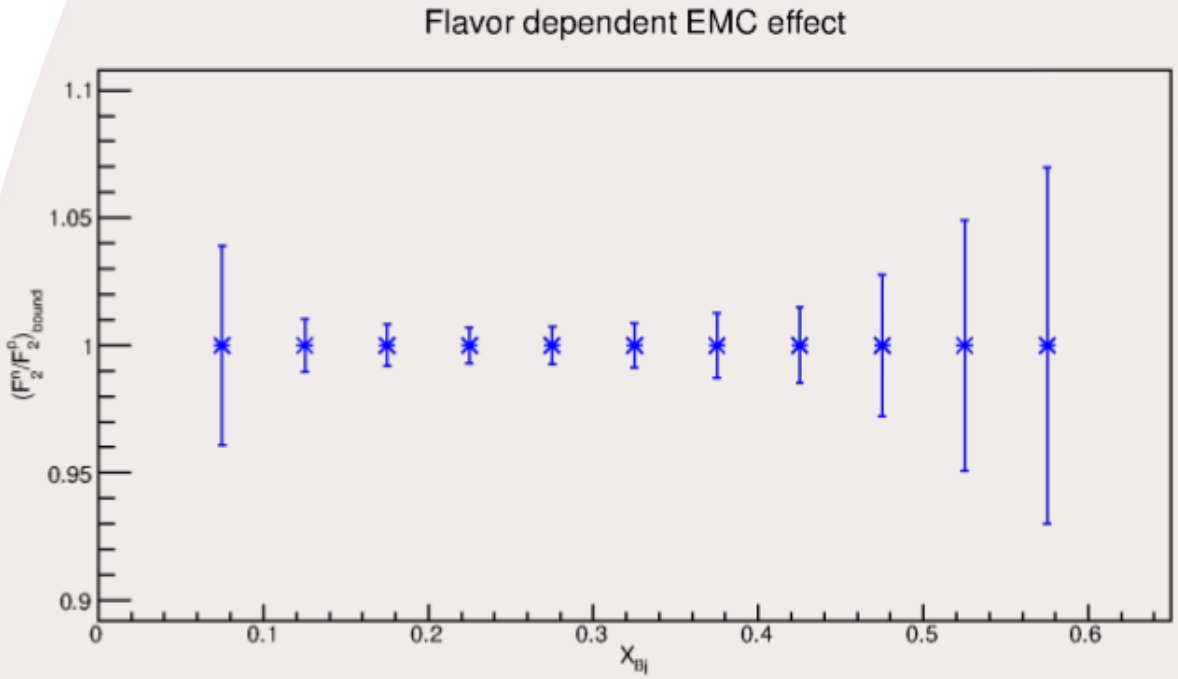
- **Rescaling models**
  - Impossible to differentiate x and Q2 rescaling with inclusive measurements but gives strong signature with semi-inclusive
  - Comparison of D to 4He is particularly interesting, no isospin issues but already strong EMC effect!
  - We will be able to give clear confirmation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

Flavor Dependent EMC



- **Is the EMC effect identical for u and d quarks?**
  - We will be able to test the flavor dependence of the EMC effect in 4He at the % level
  - We do not have theoretical predictions matching our measurement for this

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!

- **Beam time request**
  - 30 days on 2H (to be shared with BoNuS?)
  - 20 days on 3He (?)
  - 15 days on 4He (new beam time)
  - 4He data can be shared with a prolongation of the 4He DVCS experiment (LOI-10-009 for 12 GeV)