

Understanding the Three-Body Nuclear System: Asymmetry Measurements in Quasi-Elastic ${}^3\text{He}(\vec{e}, e'd)$ and ${}^3\text{He}(\vec{e}, e'p)$

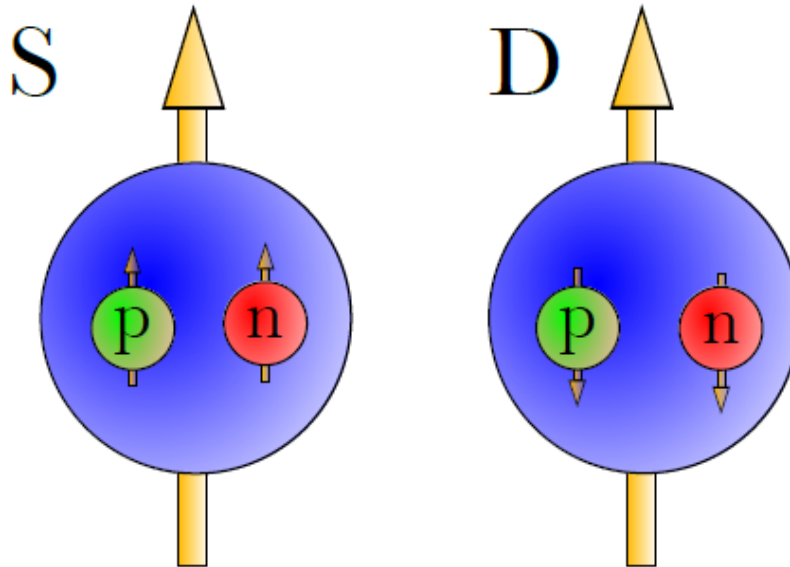
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For the E05-102 Collaboration

Deuterium Spin Structure

- Spin-1 Particle, 2 spin- $1/2$ Nucleons (Proton and Neutron)



Angular Momentum $l=0$

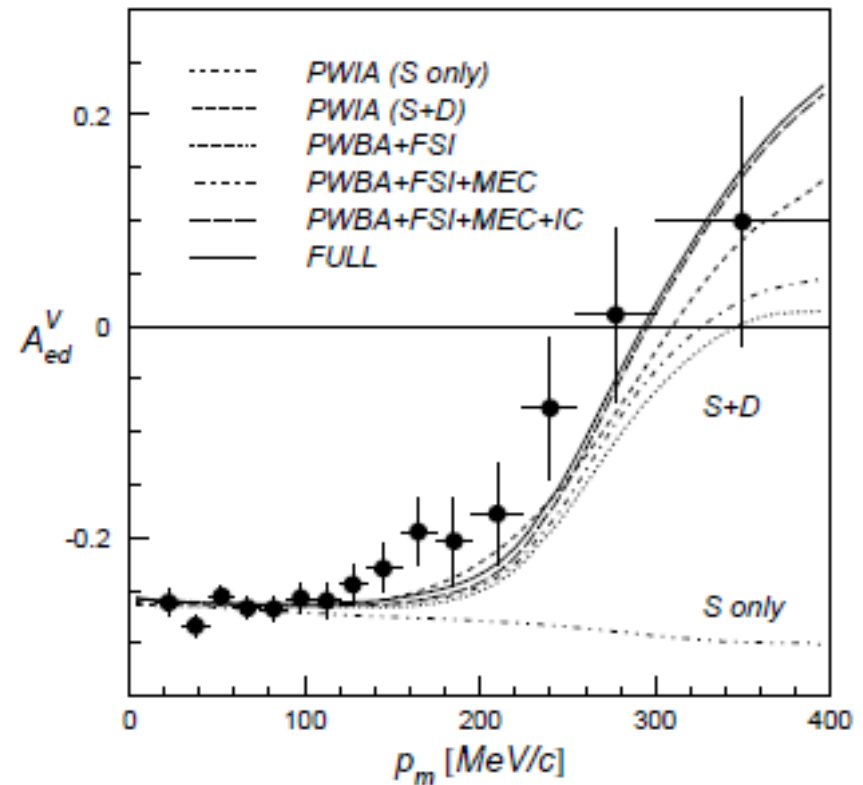
$\sim 90\%$

$l=2$

$\sim 10\%$

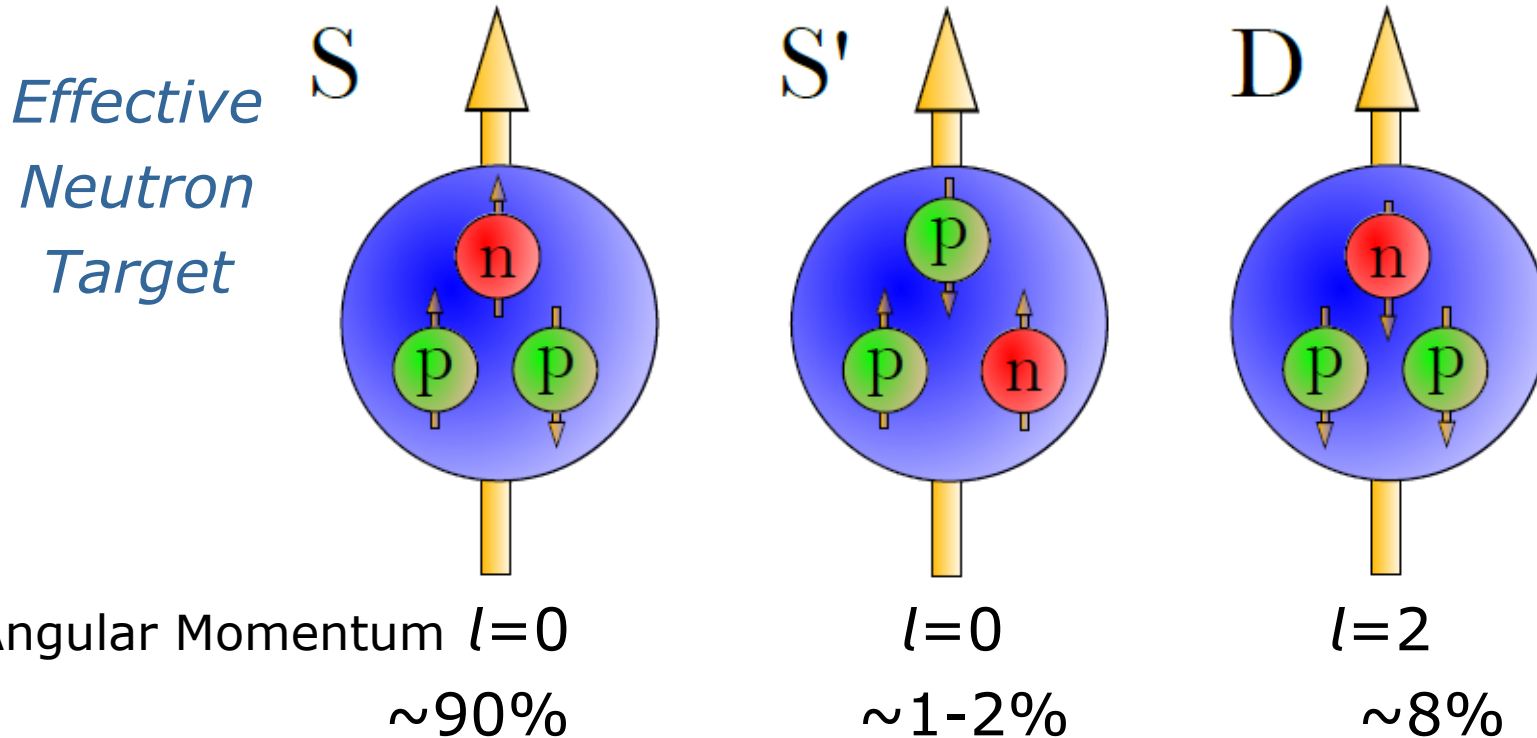
$\vec{D}(\vec{e}, \vec{e}'p)n$ Asymmetry Measurements at NIKHEF

- A sign flip of asymmetry with the increase of missing momentum gave an indication of the existence of D state
- Sign flip happened at around Fermi momentum of deuterium nucleus

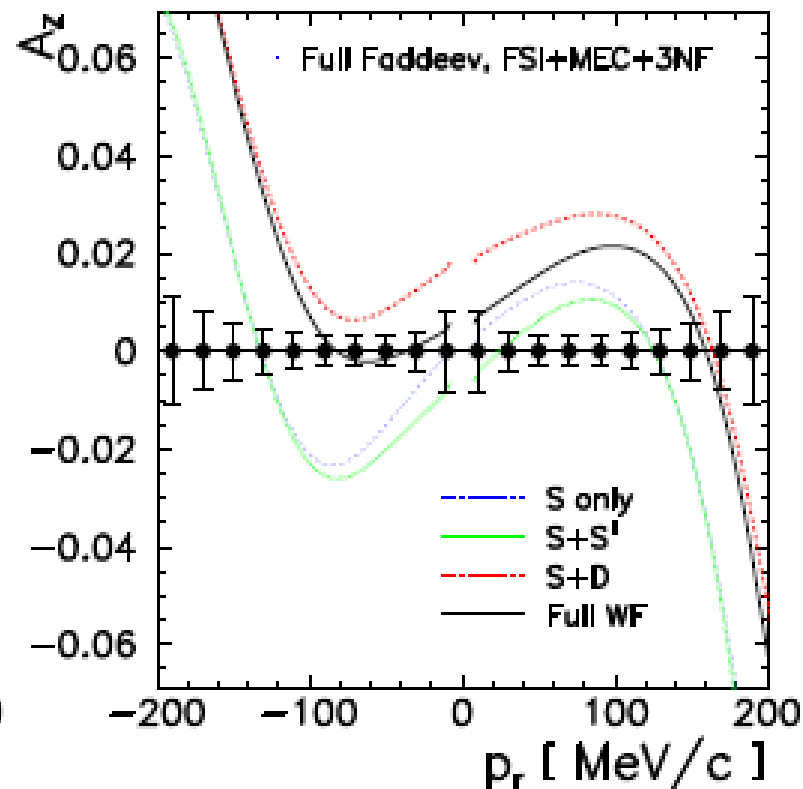
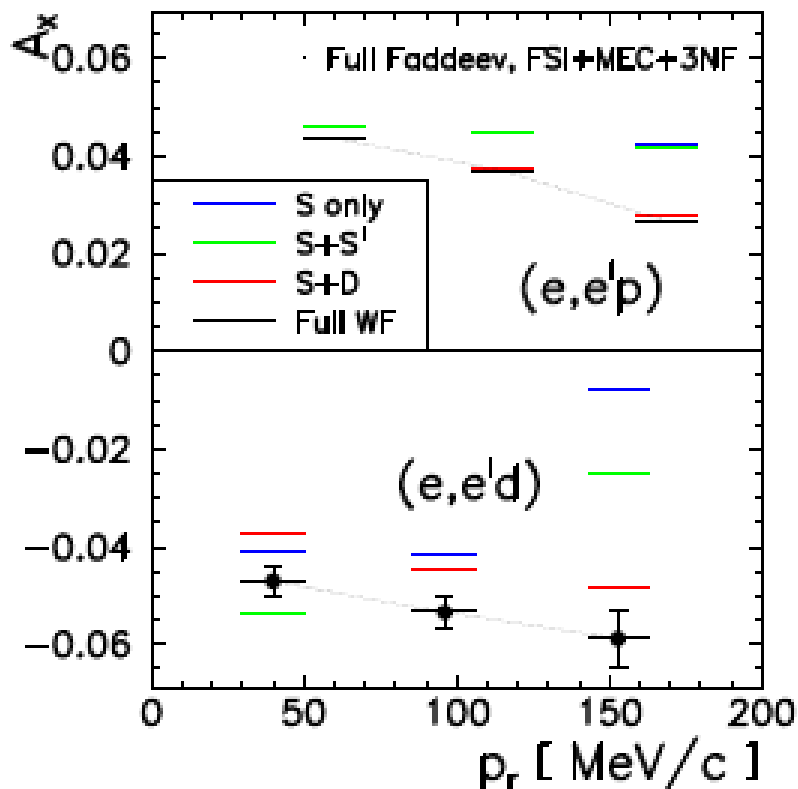


^3He Spin Structure: Will Similar Things Happen with Asymmetry?

- Spin-1/2 Particle, 3 spin-1/2 Nucleons (Proton and Neutron)

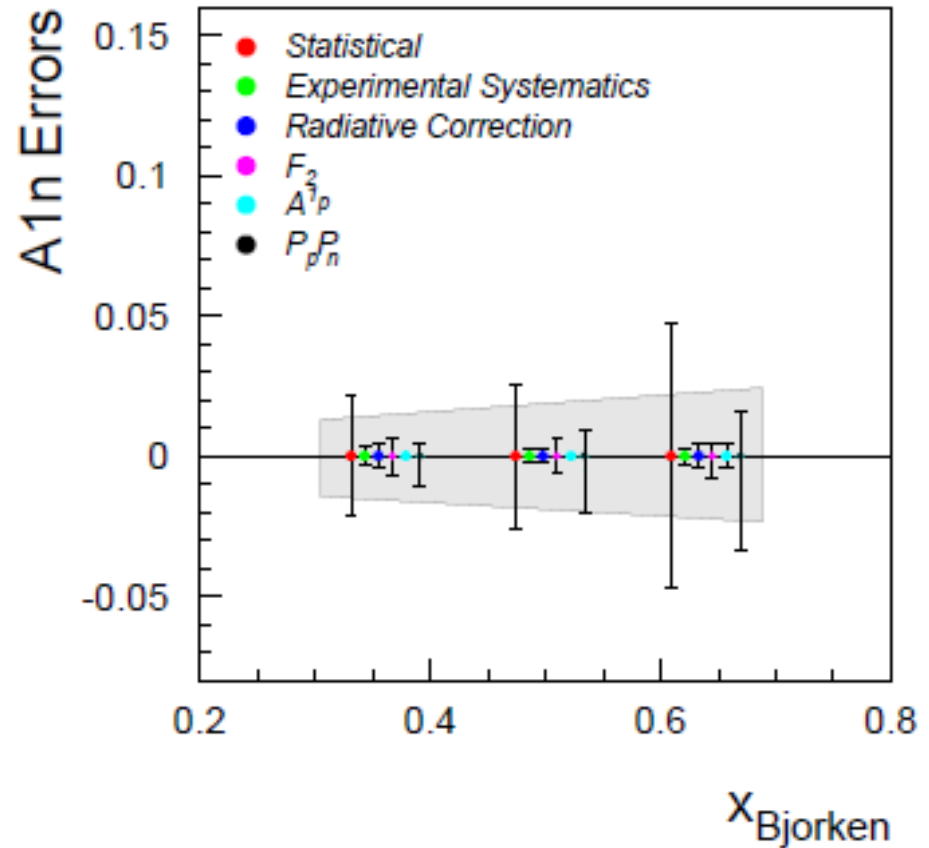


Theoretically, Yes, according to Faddeev Calculation on ${}^3\text{He}(\vec{e}, e' d)$ and ${}^3\text{He}(\vec{e}, e' p)$



Our Lack of Knowledge of ^3He is Affecting Other JLab Experiments!

- JLab experiment E99-117 measured neutron asymmetry A_n^1 in DIS region, the leading error other than statistical is caused by uncertainty in the effective proton and neutron polarization in ^3He





Incident Polarized Electron

h

Scattered Electron

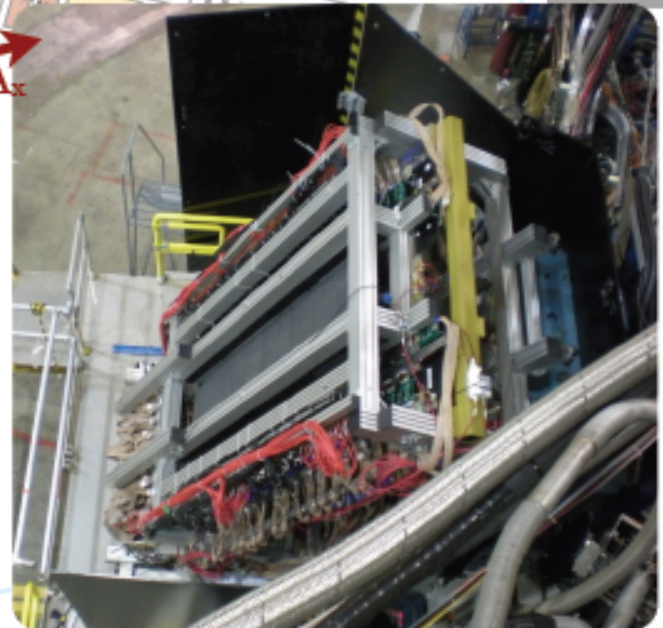
θ_{sc}

θ_q

A_y

A_z

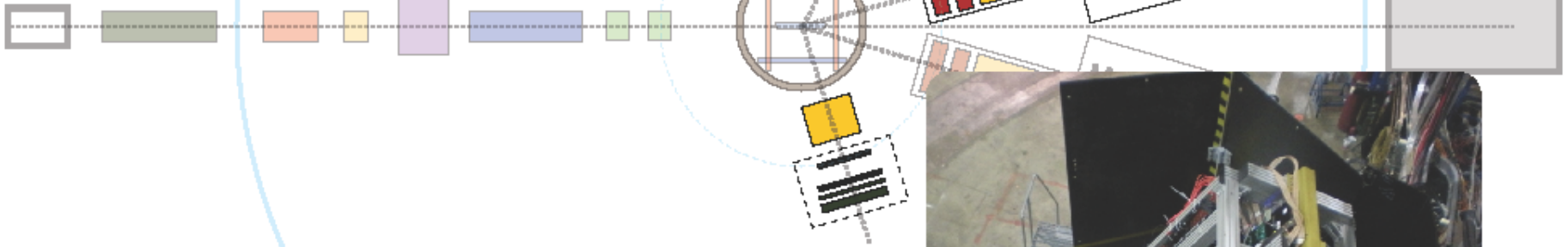
A_x





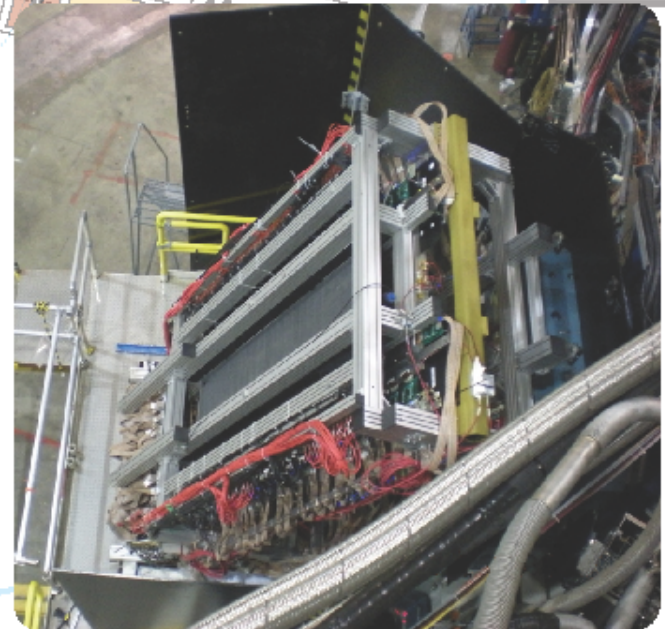
High-resolution spectrometers (HRS)

- Detects scattering electrons with high resolution
- Angular resolution:
 - ~0.6mr in non-dispersive plane
 - ~0.2mr in dispersive plane
- Momentum acceptance: $\pm 4.5\%$
- Angular acceptance:
 - ~22mr in non-dispersive plane
 - ~60mr in dispersive plane



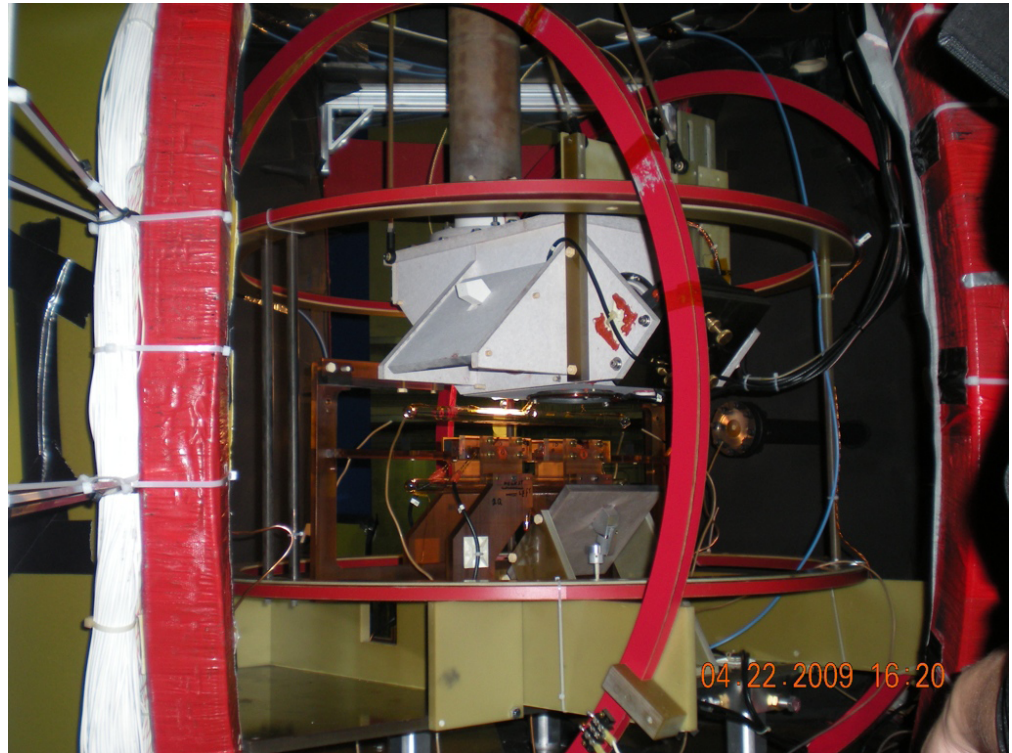
BigBite spectrometer

- Detects protons and deuterons with large acceptance and relatively low resolution
- Solid angle of 96 msr
- Momentum acceptance: 200-900MeV/c
- Two wire chambers and two scintillator planes (3 mm and 30 mm thick each)



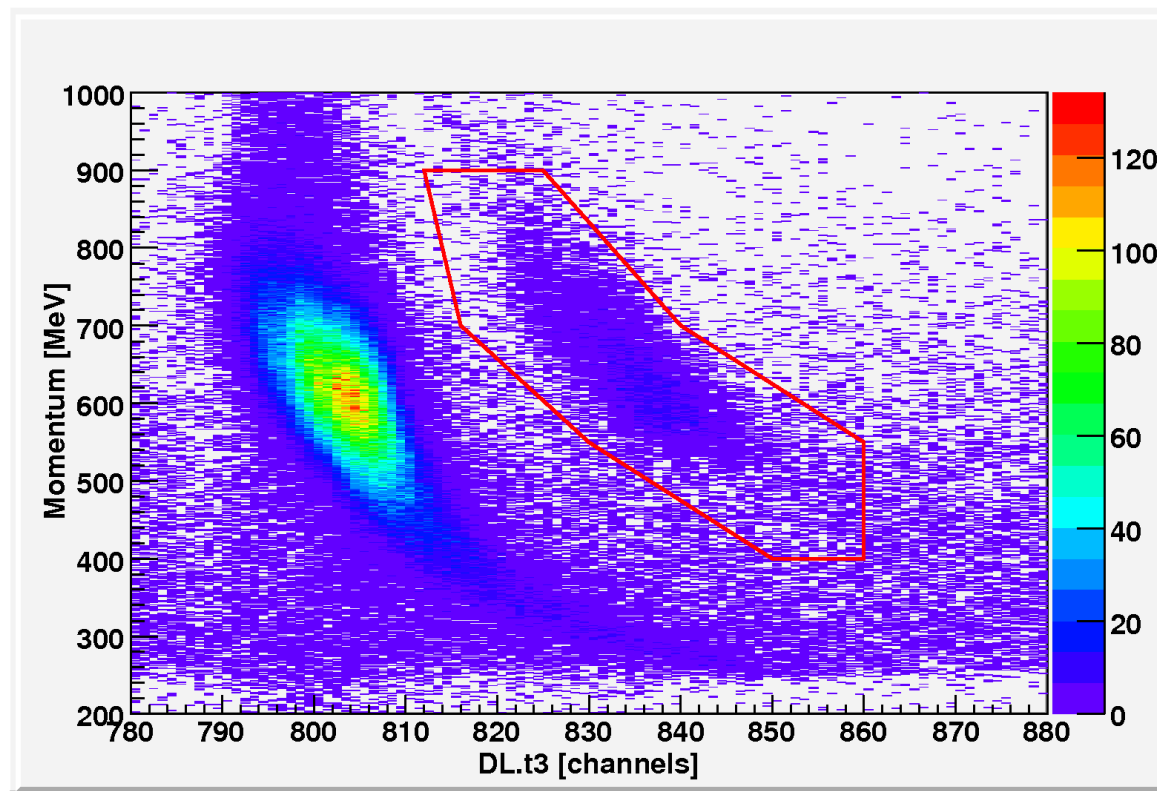
^3He Target

- Optical pumping and spin exchange
- Polarization $\sim 60\%$

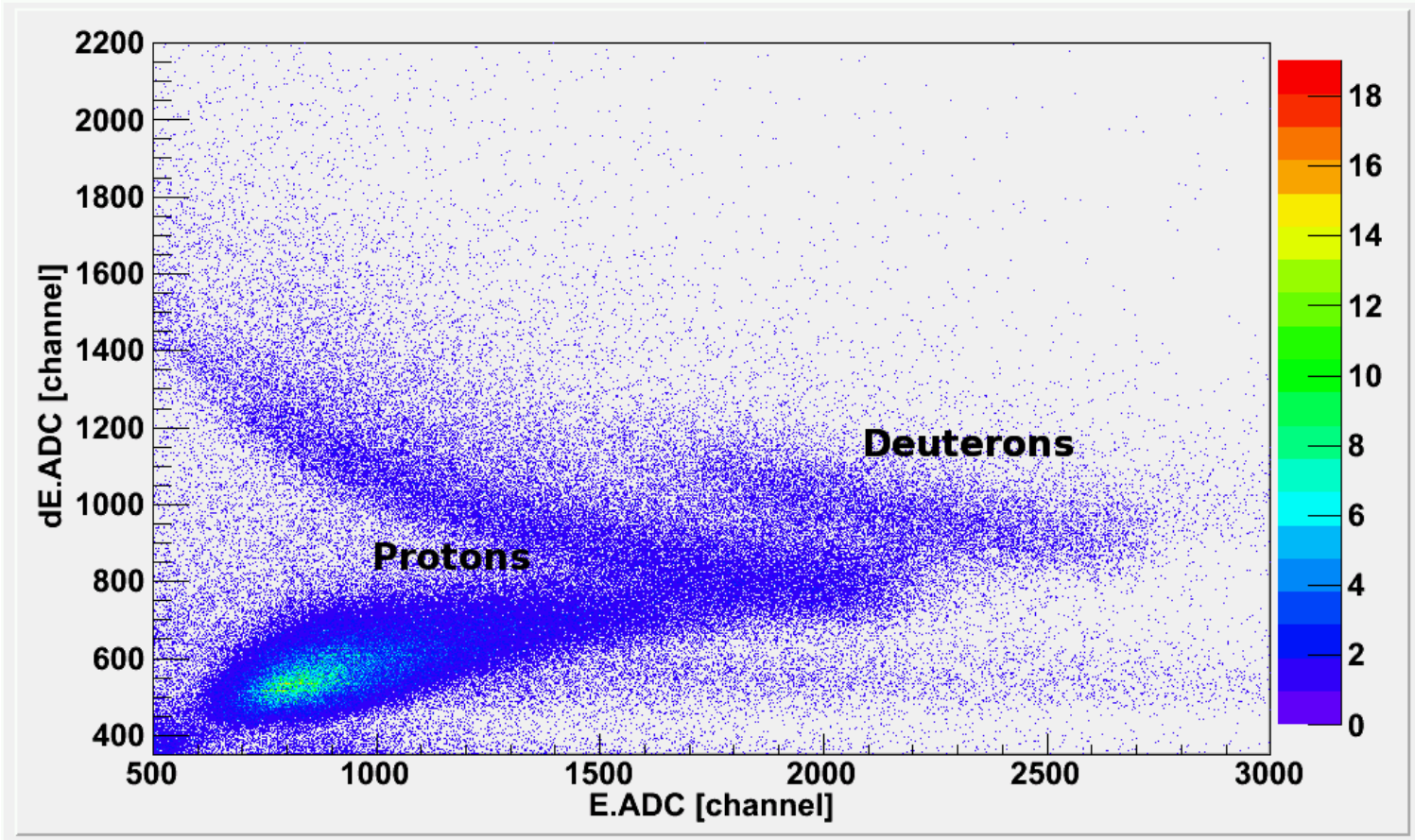


Separating protons and deuterons

- 1.2% deuterons and rest are protons



Energy Deposited by Protons and Deuterons in Scintillator Planes



Thanks to the Hall A Quai-Elastic Family Experiments

E05-015,
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and E05-102

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