Overview of the n3He Experiment and Target Chamber

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for the n3He Collaboration

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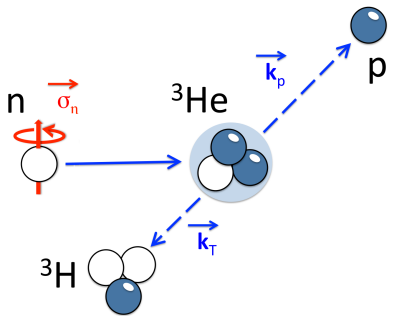
n3He Introduction

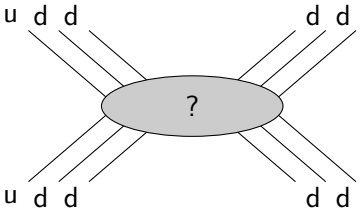
The n3He experimental goal is to make a high precision measurement of the parity violating directional asymmetry in the proton emission direction from the reaction

$$\vec{n} + {}^3He \rightarrow p + T + 765keV$$

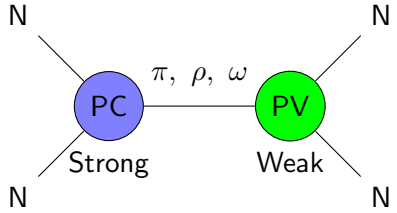


The asymmetry is expected to be small, of order 10^{-7}, and our goal is to measure it to 2×10^{-8}.

Theoretical Motivation



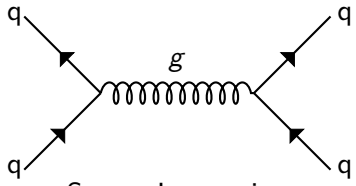
Uncertain HWI



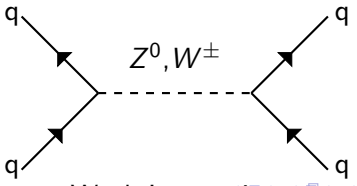
DDH Parameterization

DDH Meson Exchange Parameters:

$$O_{pv} = a_\pi^1 h_\pi^1 + a_\rho^0 h_\rho^0 + a_\rho^1 h_\rho^1 + a_\rho^2 h_\rho^2 + a_\omega^0 h_\omega^0 + a_\omega^1 h_\omega^1 + a_\omega^{1'} h_\omega^{1'}$$

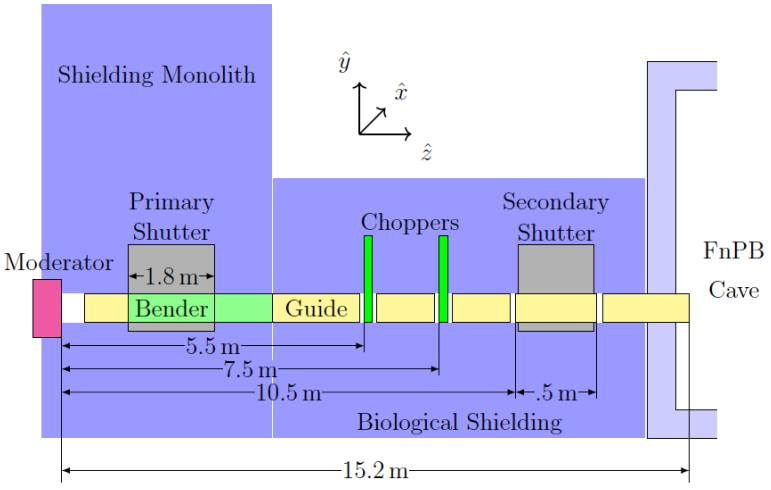


Strong Interaction



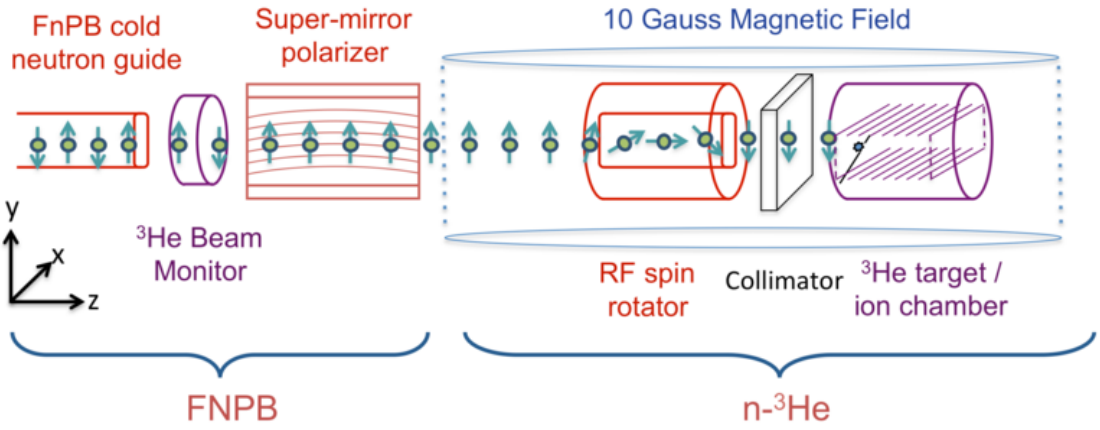
Weak Interaction

FnPB Schematic

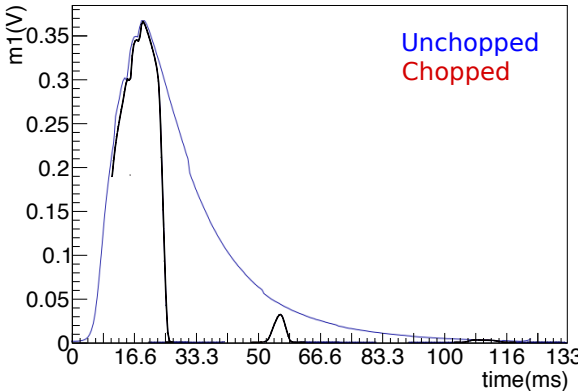


- Located at the Oak Ridge National Laboratory in Tennessee
- 60 Hertz pulsed spallation source
- n3He was located at the FnPB
- 20K liquid hydrogen moderator for cold neutron beam lines

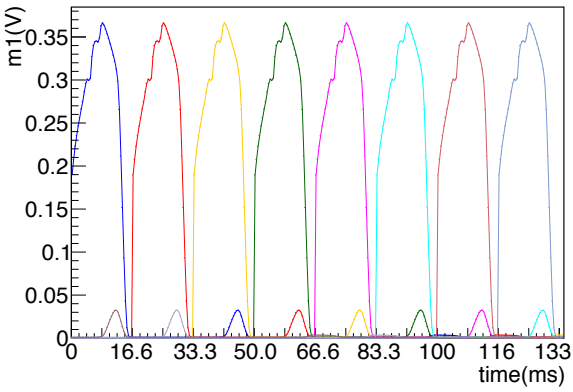
n3He Schematic Diagram



Neutron Pulse

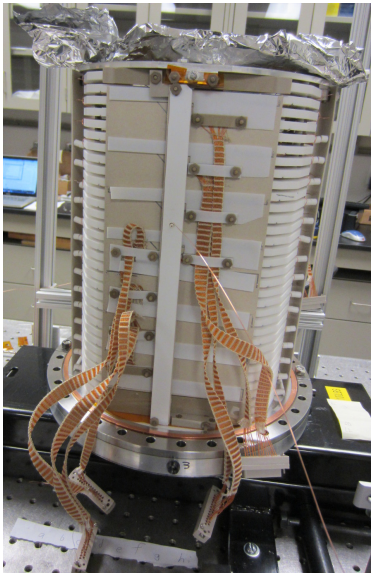


1 Hz Pulse

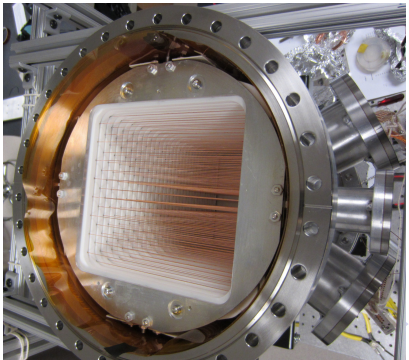


60 Hz Pulses

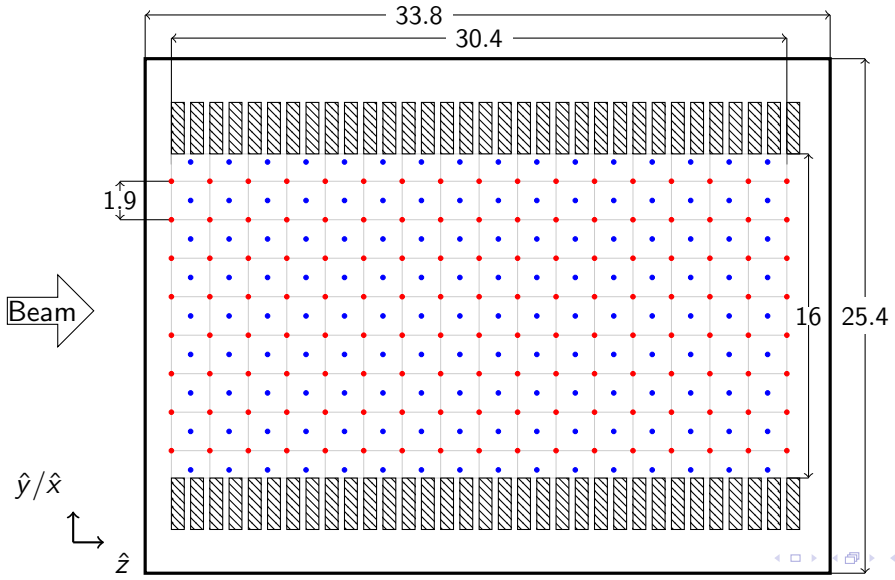
Target/Detector Chamber



- 0.47 atm He-3 fill gas
- 144 signal wires
- -350 V bias voltage
- Aluminum housing

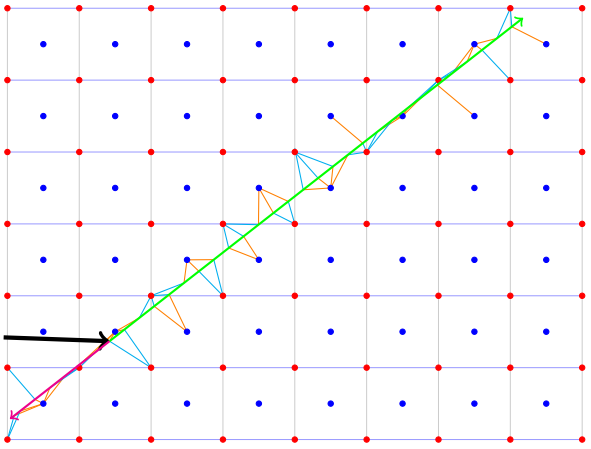


n3He Target Chamber Schematic



Signal Formation in Chamber

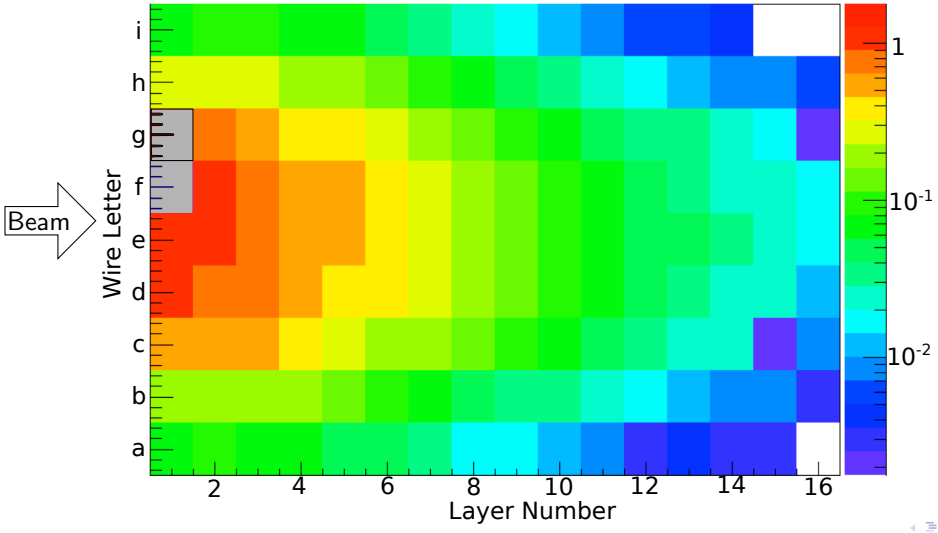
$$\vec{n} + {}^3He \rightarrow p + T + 765keV$$



neutron
proton
Triton
Electron Collection
Ion Collection

Objects are to scale.

Measured Charge Distribution in the Chamber



Asymmetry Calculation

For an ideal target and detector:

$$Y_k^{\uparrow/\downarrow} = I_0 \epsilon_k (1 \pm P \cos\theta A_{PV} \pm P \sin\theta A_{PC}) \tag{1}$$

For a real target and detector:

$$Y_k^{\uparrow/\downarrow} = I_0 \epsilon_k (1 \pm P G_{PV} A_{PV} \pm P G_{PC} A_{PC}) \tag{2}$$

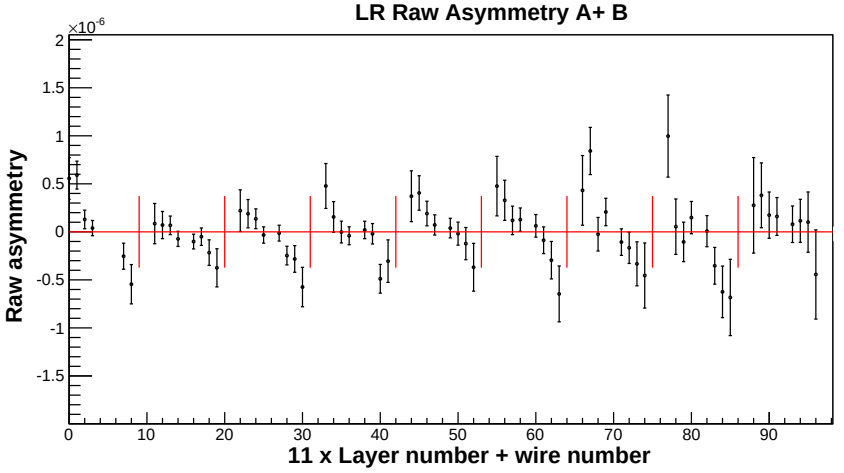
S13.00008 : Simulation of ion chamber signals in the n+3Hep+t experiment (next talk)

To calculate the asymmetry:

$$A_{PV} = \frac{1}{P G_{PV}} \frac{Y^{\uparrow} - Y^{\downarrow}}{Y^{\uparrow} + Y^{\downarrow}} \tag{3}$$

J12.00006 : A measurement of the parity violating asymmetry in the neutron capture on 3He at the SNS

Preliminary Asymmetry Results



J12.00006 : A measurement of the parity violating asymmetry in the neutron capture on 3He at the SNS (January 29)

Summary

- n3He Data taking completed end of 2015
- Asymmetry calculations underway
- We expect to reach the goal statistical accuracy

n3He Collaboration

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- Pil-Neo Seo

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- Caleb Wickersham

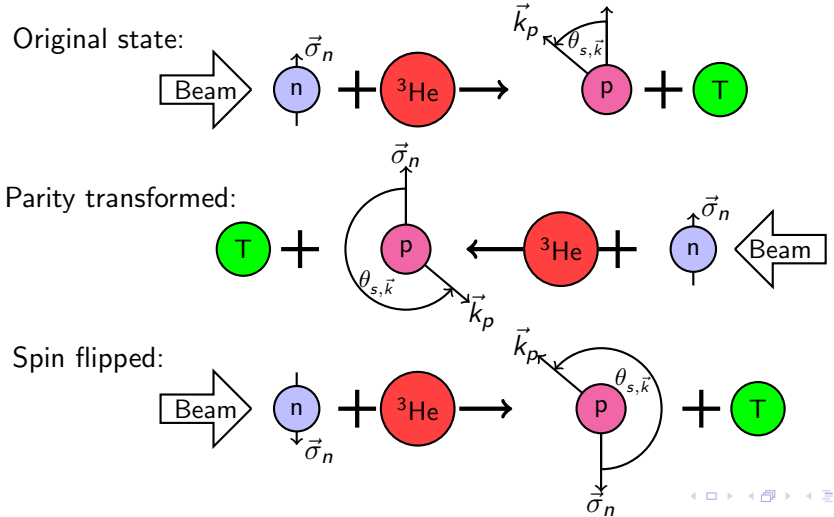
Middle Tennessee State University
- Robert Mahurin

University of Virginia
- Stefan Baessler
- Septimiu Balascuta

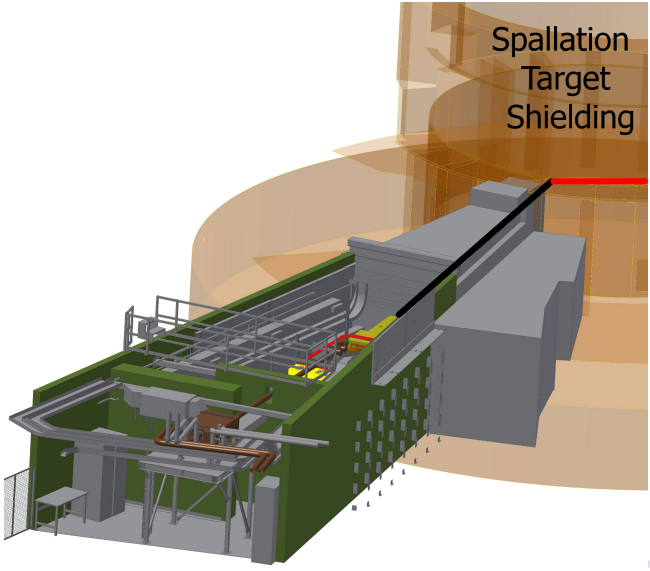
Spare Slides

Parity Transformation

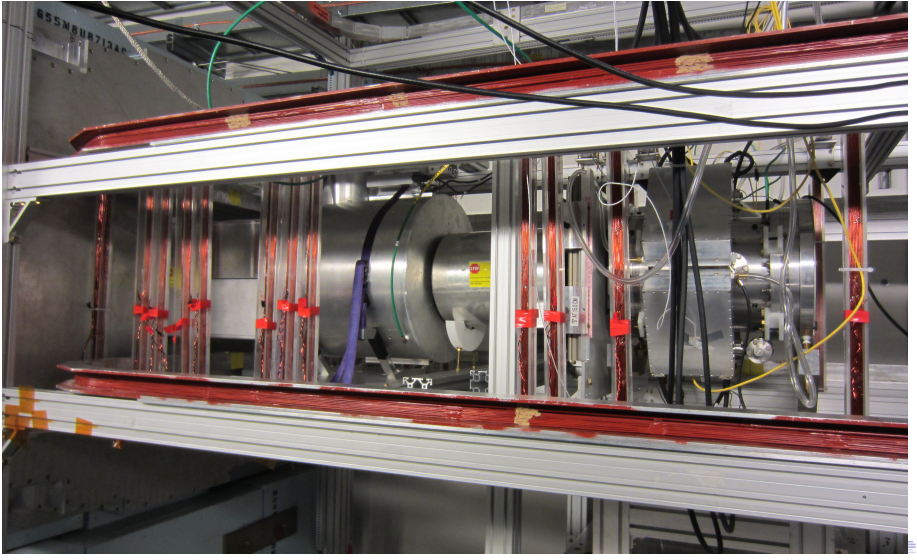
A parity transformation, P inverts the spatial coordinates, inverting polar vectors, such as momentum , $P(\vec{k}) = -\vec{k}$, but not axial vectors, such as spin, $P(\vec{\sigma}) = \vec{\sigma}$.



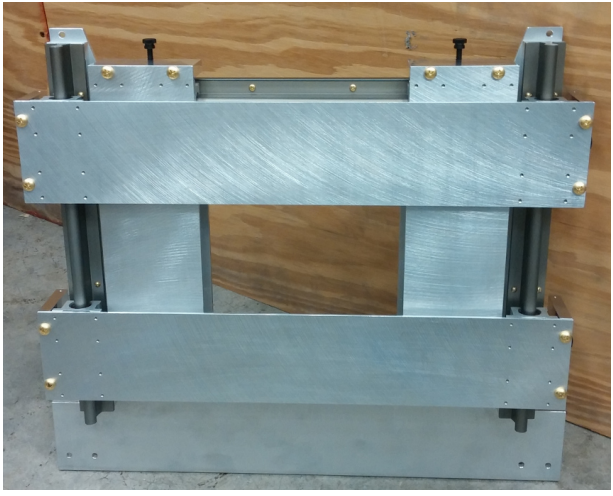
FnPB CAD Model



n3He In FnPB

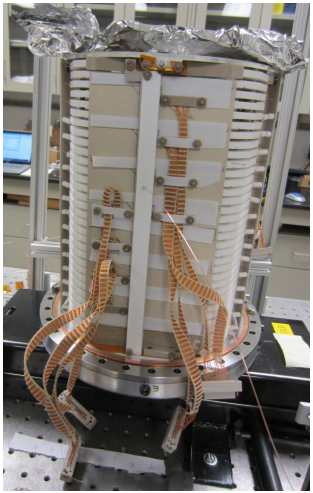


Collimator



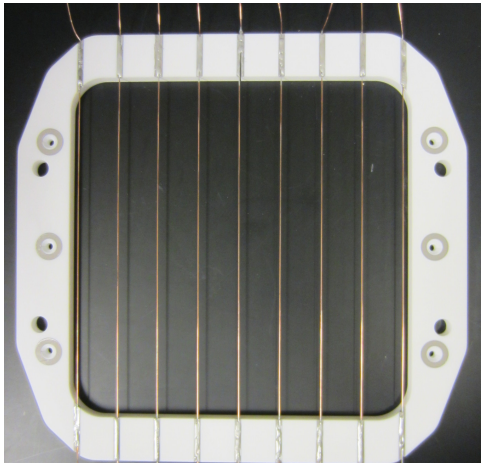
- 4 independent haws
- Cd and Li-6 neutron absorbing layers used to stop beam

Assembled Frame Stack

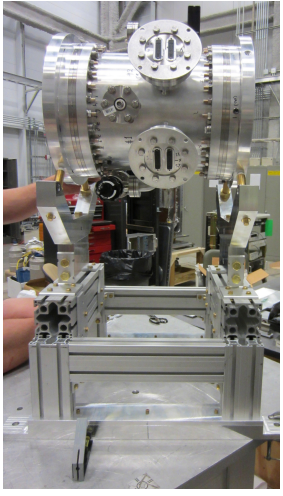


- 17 HV frames
- 16 signal frames

- 144 signals to read out
- 0.02" diameter wires



Chamber Assembly



- 1mm aluminum windows
- 4 signal feed thrus
- 2 gas feed thrus
- 2 HV feed thrus
- 0.47 atm He-3 fill gas
- operated at -350V
- 4 point kinematic mount allows the target to be aligned to the magnetic field and neutron beam