Overview of the n3He Experiment and Target Chamber

Mark McCrea
University of Manitoba

for the n3He Collaboration

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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

\[ n + ^3He \rightarrow p + T + 765keV \]

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

DDH Meson Exchange Parameters:

\[ O_{\rho \nu} = a_\pi^1 h_\pi^1 + a_\rho^0 h_\rho^0 + a_\rho^1 h_\rho^1 + a_\rho^2 h_\rho^2 + a_\omega^0 h_\omega^0 + a_\omega^1 h_\omega^1 + a_\omega^1 h_\omega^1' \]
• 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

Unchopped
Chopped
Target/Detector Chamber

- 0.47 atm He-3 fill gas
- 144 signal wires
- −350 V bias voltage
- Aluminum housing
\[ \vec{n} + ^3\text{He} \rightarrow p + T + 765\text{keV} \]

Objects are to scale.
Measured Charge Distribution in the Chamber

Beam Letter

Wire Letter

Layer Number

Layer Number

1

10-1

10-2

1
Asymmetry Calculation

For an ideal target and detector:

\[ Y_{k}^{\uparrow/\downarrow} = I_{0} \epsilon_{k} (1 \pm P \cos \theta A_{PV} \pm P \sin \theta A_{PC}) \]  

(1)

For a real target and detector:

\[ Y_{k}^{\uparrow/\downarrow} = I_{0} \epsilon_{k} (1 \pm P G_{PV} A_{PV} \pm P G_{PC} A_{PC}) \]  

(2)

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

To calculate the asymmetry:

\[ A_{PV} = \frac{1}{P G_{PV}} \frac{Y^{\uparrow} - Y^{\downarrow}}{Y^{\uparrow} + Y^{\downarrow}} \]  

(3)

J12.00006 : A measurement of the parity violating asymmetry in the neutron capture on 3He at the SNS
J12.00006 : A measurement of the parity violating asymmetry in the neutron capture on 3He at the SNS (January 29)
• n3He Data taking completed end of 2015
• Asymmetry calculations underway
• We expect to reach the goal statistical accuracy
n3He Collaboration

Arizona State University
  • R. Alarcon
  • D. Blyth

Duke University, Triangle Universities Nuclear Laboratory
  • Pil-Neo Seo

Istituto Nazionale di Fisica Nucleare, Sezione di Pisa
  • Michele Viviani

Oak Ridge National Laboratory
  • David Bowman
  • Vince Cianciolo
  • Paul E. Mueller
  • Seppo Penttilä
  • Jack Thomison
  • T. Tong

University of Indiana
  • Chad Gillis

University of Kentucky
  • Chris Crawford
  • Latiful Kabir
  • Aaron Sprow

Western Kentucky University
  • Ivan Novikov

University of Manitoba
  • Michael Gericke
  • Mark McCrea
  • Carlos Olguin

Universidad Nacional Autónoma de México
  • Libertad Baron
  • Andrés Ramirez-Morales

University of New Hampshire
  • John Calarco

University of Nevada at Las Vegas
  • A. Barzilov

University of South Carolina
  • Vladimir Gudkov
  • Matthias Schindler
  • Young-Ho Song

University of Tennessee
  • Nadia Fomin

  • Geoff Greene
  • Serpil Kucuker
  • Chris Coppola
  • Chris Hayes
  • Irakli Garishvili
  • Eric Plemmons
  • Noah Birge
  • Connor Gautham
  • Mae Scott

University of Tennessee at Chattanooga
  • Josh Hamblen
  • Jeremy Watts
  • Caleb Wickersham

Middle Tennessee State University
  • Robert Mahurin

University of Virginia
  • Stefan Baessler
  • Septimiu Balascuta
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, $P(\vec{\sigma}) = \vec{\sigma}$.

Original state:
Beam

Parity transformed:

Spin flipped:
Spallation Target Shielding
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
- 9 signal wires per frame
- 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