



Contribution ID: 55

Type: Oral

Demonstration of sub-micron UCN position resolution using room-temperature CMOS sensor

Wednesday, March 15, 2023 10:20 AM (20 minutes)

Authors: S. Lin^{1,2}; W. Li¹; T. Bailey³; J. K. S. Baldwin¹; M. Blatnik⁴; N. B. Callahan⁵; J. H. Choi^{3,6}; S. M. Clayton¹; C. Cude-Woods^{1,3,6}; S. A. Currie¹; M. Dawid^{7,8}; B. W. Filippone⁴; W. Fox^{7,8}; E. M. Fries⁴; P. Geltenbort⁹; E. George¹⁰; F. M. Gonzalez^{7,8,11}; L. Hayen^{3,6}; K. P. Hickerson⁴; M. A. Hoffbauer¹; K. Hoffman¹⁰; A. T. Holley¹⁰; T. M. Ito¹; A. Komives¹²; C.-Y. Liu^{7,8,13}; M. Makela¹; C. L. Morris¹; R. Musedinovic^{3,6}; N. Naheed^{1,14}; C. O'Shaughnessy¹; R. W. Pattie, Jr.¹⁵; J. Ramsey¹¹; D. J. Salvat^{7,8}; A. Saunders¹¹; E. I. Sharapov¹⁶; S. Slutsky⁴; S. Spannagel¹⁷; V. Su⁴; X. Sun⁴; C. Swank⁴; Z. Tang¹; W. Uhrich¹; J. Vanderwerp^{7,8}; P. Walstrom¹; W. Wei⁴; B. Wolfe¹; A. R. Young^{3,6}; H. Zhu²; Z. Wang¹

¹ Los Alamos National Laboratory, Los Alamos, NM 87545, USA

² Department of Electrical and Computer Engineering, The University of Texas at Austin, Austin, TX 78712, USA

³ Department of Physics, North Carolina State University, Raleigh, NC 27695, USA

⁴ Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, CA 91125, USA

⁵ Argonne National Laboratory, Lemont, IL 60439, USA

⁶ Triangle Universities Nuclear Laboratory, Durham, NC 27708, USA

⁷ Department of Physics, Indiana University, Bloomington, IN, 47405, USA

⁸ Center for Exploration of Energy and Matter, Indiana University, Bloomington, IN, 47405, USA

⁹ Institut Laue-Langevin, CS 20156, 38042 Grenoble Cedex 9, France

¹⁰ Tennessee Technological University, Cookeville, TN 38505, USA

¹¹ Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA

¹² DePauw University, Greencastle, IN 46135, USA

¹³ Department of Physics, University of Urbana-Champaign, Urbana, IL 61801, USA

¹⁴ Benedict College, Columbia, SC 29204, USA

¹⁵ East Tennessee State University, Johnson City, TN 37614, USA

¹⁶ Joint Institute for Nuclear Research, 141980 Dubna, Russia

¹⁷ Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg, Germany

Corresponding Author: zwang@lanl.gov

(For ULITIMA 2022 Conference, SLAC, Menlo Park, CA 94025, USA; Oct. 3-6, 2022)

High spatial resolution of ultracold neutron (UCN) measurement is crucial to several experiments using ultracold neutrons, including UCN spectrometers, UCN polarimeters, quantum physics of UCNs, and quantum gravity. Here we describe experimental results to demonstrate sub-micron spatial resolutions for UCN position measurements obtained using a room-temperature CMOS sensor, extending our previous work [1] that demonstrated a position uncertainty of 1.5 microns. We also explore the use of machine learning and the open-source software Allpix Squared to automatically analyze the UCN position. The automated analysis for sub-micron position resolution in UCN detection combined with the fast data rates of current and next generation UCN sources will enable improved precision for all modern UCN studies.

[1] K. Kuk, et. al. "Projection imaging with ultracold neutrons." Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Vol. 1003, 165306 (2021).

LA-UR-22-25693

Primary author: LIN, Shanny (Los Alamos National Laboratory)

Co-author: ET AL., et al. (UCNtau Collaboration)

Presenter: LIN, Shanny (Los Alamos National Laboratory)

Session Classification: Application

Track Classification: Applications