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Neutron spectroscopy with nitrogen-filled Spherical Proportional Counters

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Neutron spectroscopy is an invaluable tool for many scientific and industrial applications, including searches for dark matter. In deep underground dark matter experiments, neutron induced background produced by cosmic ray muons and natural radioactivity, may mimic a signal. However, neutron detection techniques are complex and, thus, measurements remain elusive. Use of ^{3}He based detectors - the most widely used technique, to date –is not a viable solution, since ^{3}He is scarce and expensive.

A promising alternative for fast neutron spectroscopy is the use of a nitrogen-filled Spherical Proportional Counter. The neutron can be detected and its energy measured through the ^{14}N(n,α)^{11}B and ^{14}N(n,p)^{14}C reactions, which for fast neutrons have comparable cross sections to the ^{3}He(n,p)^{3}H reaction. Furthermore, the use of a light element, such as nitrogen, keeps γ-ray efficiency low and enhances the signal to background ratio in mixed radiation environments. This constitutes a safe, inexpensive, effective and reliable alternative.

The latest developments in spherical proportional counter instrumentation, such as resistive multi-anode sensors for high-gain operation with high-charge collection efficiency and gas purifiers that minimize gas contaminants to negligible levels, which enable neutron detection with increased target mass, and thus higher efficiency, are presented. Measurements for fast and thermalised neutrons from an Am-Be source and from the University of Birmingham MC40 cyclotron are shown, and compared with simulations.

Collaboration / Activity

n/a

Primary authors: Mr ROGERS, Giovanni (University of Birmingham); Dr KATSIOULAS, Ioannis (ESS/University of Birmingham); MANTHOS, Ioannis (University of Birmingham); NIKOLOPOULOS, Konstantinos (University of Hamburg/University of Birmingham); KNIGHTS, Patrick (University of Birmingham); NEEP, Thomas (University of Birmingham)

Presenter: NIKOLOPOULOS, Konstantinos (UNI/EXP (Uni Hamburg, Institut fur Experimentalphysik))

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