Development of ^{3}He Linear Position-Sensitive Detector for the SANS Instrument at CPHS

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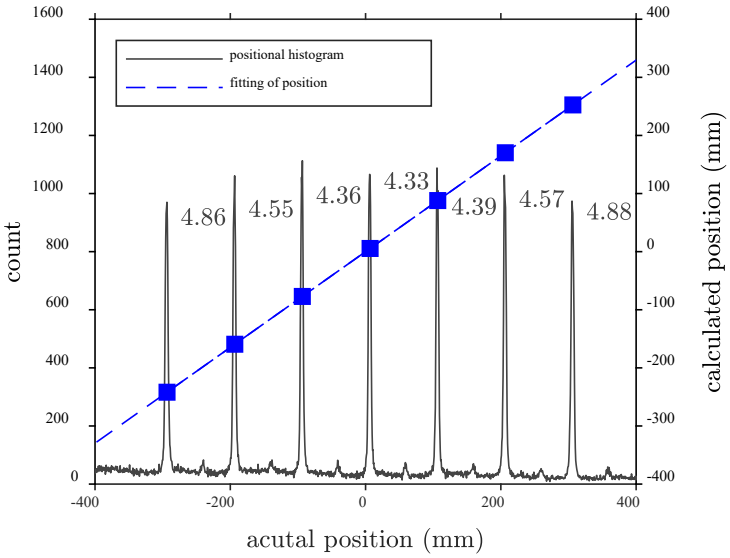

Fig. 2 Neutron position histogram and peak linear fitting result.

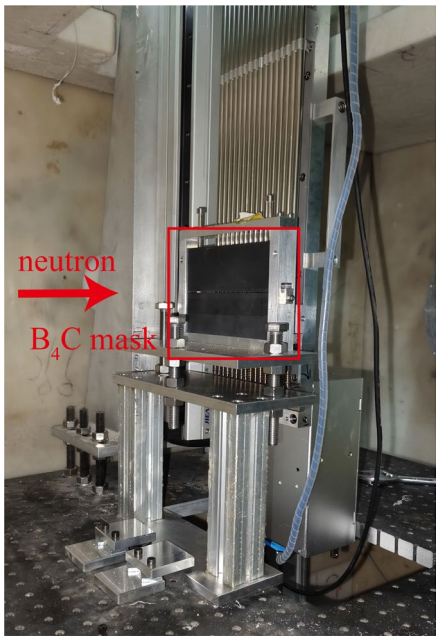

Fig. 1 Schematic representation of the prototype detector module in beam test environment.

The Compact Pulsed Hadron Source (CPHS) at Tsinghua University is a 13 MeV/16 kW high-current proton linac-driven neutron source, serving as a platform for education and research. To leverage the facility's capabilities, a Small Angle Neutron Scattering (SANS) instrument was among the first to be built. The primary detector of the CPHS-SANS consists of a two-dimensional array of 96 ^{3}He linear position-sensitive detectors (LPSD), each 800 mm in length and 8 mm in diameter. A modular design was implemented for ease of testing and installation, with each module comprising 16 LPSDs. To process the signals from this 2-D array detector, a compact and low-noise readout system has been developed. Recent tests of the prototype detector module with the CPHS neutron beam showed that the LPSD counting plateau was between 1450 V and 1750 V, with a slope within ±1%/100V. A conservative working voltage of 1650 V was chosen to optimize the LPSDs' lifespan. At this voltage, the position resolution achieved was 4.3 mm in the central region and 4.9 mm at the ends. Additionally, the thermal neutron detection efficiency of the LPSD was measured to be 62.2%. The testing of the remaining five detector modules will proceed accordingly, with the full 2-D array detector expected to be operational by the end of 2025.

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