

## 二维位置灵敏闪烁体中子探测器的模拟研究

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摘要：中国散裂中子源工程已于 2011 年 10 月破土动工，闪烁体中子探测器作为可替代  $^3\text{He}$  气体的中子探测器，目前成为国际上的研究热点。本文基于 GEANT4 蒙特卡罗模拟平台，构建了二维位置灵敏型  $6\text{LiF}/\text{ZnS}(\text{Ag})$  闪烁体中子探测器模型，对探测器的关键性能进行了系统的模拟研究。模拟结果表明，当采用双层闪烁屏中间夹二维波移光纤阵列的“三明治”式探测器结构时，其热中子探测效率可达 49.1%；模拟和实验也展现了探测器良好的  $n/\gamma$  抑制能力， $\gamma$  灵敏度可达小于  $10^{-5}$ ；中子位置分辨率随着光纤芯间距和光纤与闪烁屏距离的减小而减小，其本征空间分辨率最好可达 0.08mm（X 方向）和 0.12mm（Y 方向）；模拟结果也表明探测器具有良好的二维成像能力。该研究工作为中国散裂中子源闪烁体位置灵敏中子探测器的设计和优化提供了可靠的参考数据。

关键词：GEANT4； $6\text{LiF}/\text{ZnS}(\text{Ag})$  闪烁体；热中子探测；波移光纤

The Simulation on Two-dimensional position sensitive  
scintillation neutron Detector

Yang Zhen<sup>1,2</sup> Zhang Qiang<sup>1,2,3</sup> Tang Bin<sup>1,2</sup> Sun Zhi-jia<sup>1,2</sup> Yang Gui-an<sup>1,2</sup> Zhou Jian-rong<sup>1,2</sup> Xu Hong<sup>1,2</sup>  
Wang Tuo<sup>1,2,3</sup>

1. State Key Laboratory of Particle Detection and Electronics (Institute of High Energy Physics, CAS and University of Science and Technology of China)

2. Institute of High Energy Physics CAS

3. China University Of Petroleum Beijing

Abstract: Chinese Spallation Neutron Source(CSNS) project has started since October 2011, As substitute of  $^3\text{He}$  gas detector, scintillator neutron detector has been a research focus internationally. In this paper, a module of position sensitive neutron detector based on  $6\text{LiF}/\text{ZnS}(\text{Ag})$  scintillator was constructed by GEANT4 package, and its key properties were studied. The simulation results show that the thermal neutron detection efficiency could reach 49.1% when “sandwich structure” of detector was set. Both simulation and experimental result reveal its good ability of  $n/\gamma$  rejection ration, and the gamma sensitive could be less than  $10^{-5}$ . The smaller of the distance between each WLSF, and the gap between the WLSFs array and scintillator are, the better the position resolution is. The intrinsic spatial resolution is 0.08mm for X-axis and 0.12mm for Y-axis. The simulation results and that of parts experimental results plot the detector have a good 2D imaging capability. Work above can provide reliable data for scintillation neutron detector in CSNS.

Key words: GEANT4;  $6\text{LiF}/\text{ZnS}(\text{Ag})$  scintillator; thermal Neutron detection; Wave Length Shifting Fiber

**Primary author:** Mr 杨, 振 (epc)

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