

*September, 20-25, 2021*

**Directional sensitivity investigation of two coordinate neutron detector  
based on  $^{10}\text{B}$  layer and wire chamber**

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# Introduction

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**The most of the existing slow neutron activation, scintillation, and gaseous detectors do not have selective sensitivity to the neutron motion direction. At the same time, the neutron source flux, as a rule, is accompanied by a large background of scattered neutrons. Therefore, the spatial distribution measurement of the neutron flux causes enormous difficulties. Recently, it was shown that a neutron detector based on a 3- $\mu\text{m}$   $^{10}\text{B}$  layer and a wire chamber has a weak sensitivity to the thermal neutron background in contrast to a  $^3\text{He}$  counter.**

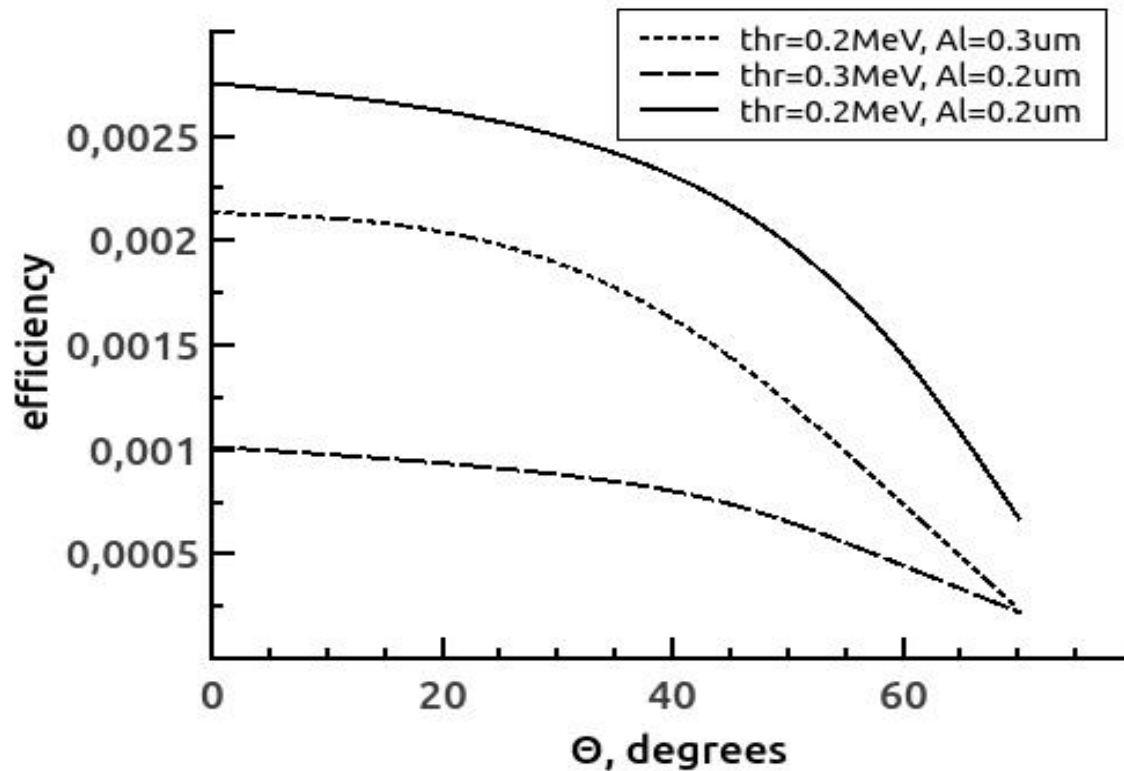
**[ И. В. Мешков, С. И. Поташев, А. А. Афонин, Ю. М. Бурмистров и др, Известия РАН. Серия физическая, 2020, Т. 84, № 4, С. 497].**

# Possible explanation

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The sensitive 3- $\mu\text{m}$  layer of  $^{10}\text{B}$  is adsorbed on the internal surface of glass plate. This layer is coated with 0.2 - 0.3  $\mu\text{m}$  aluminum layer which serves as the first cathode of the chamber. Ionization signals from two gaps of the proportional chamber are proportional to energy losses of the secondary  $^4\text{He}$  and/or  $^7\text{Li}$  nuclei. Let us the neutron fall on the  $^{10}\text{B}$  layer at a large angle to plane normal. If the neutron interacts with  $^{10}\text{B}$  nearely after entering the layer the energy of the secondary  $^4\text{He}$  or  $^7\text{Li}$  nucleus may be insufficient to penetrate in the second detector gap. At the same time, the neutron flux in the depth of  $^{10}\text{B}$  layer will be reduced due to the increased inclined neutron path in boron. To test this hypothesis simulation was performed. Results are shown in the following graph.

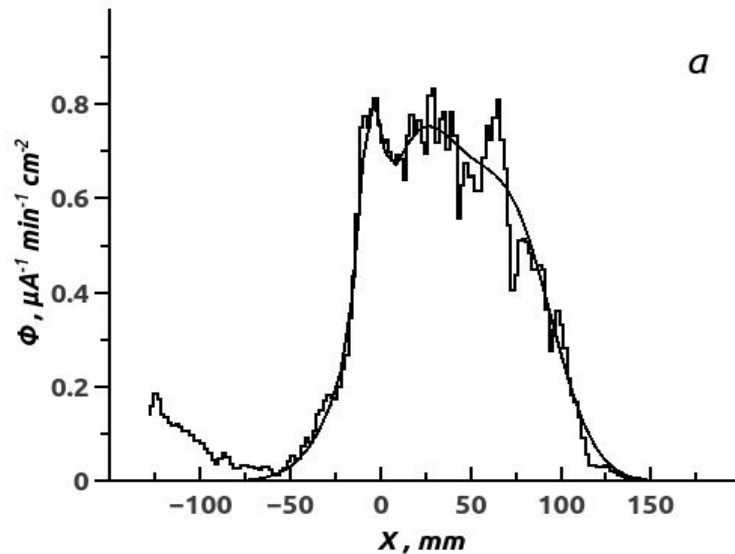
# Simulation



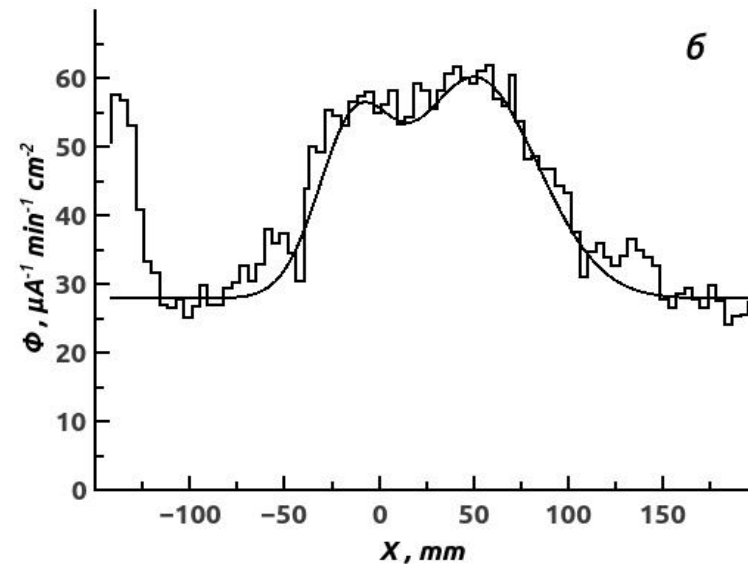
**Detection efficiency versus angle of incidence. The degree of efficiency falling at large angle depends on aluminum thickness and energy threshold**

# Experimental neutron flux spatial distribution

Electrons of Linear Accelerator LUE-8 INR RAS produced bremsstrahlung in W-target. Then  $\gamma$ -rays with  ${}^9\text{Be}(\gamma, n){}^8\text{Be}$  reaction with 1.69-MeV threshold produced neutrons



measured by  ${}^{10}\text{B}$  – PSND  
counter



measured by  ${}^3\text{He}$  – tube

# Summary and conclusions

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**The directional sensitivity of two coordinate neutron detector based on  $3 - \mu\text{m}$   $^{10}\text{B}$  layer and a wire chamber was studied [1]. In the experiment, the detection of scattered neutrons by the detector was found to be suppressed in comparison with the data from the helium-3 tube counter in the experimental area.**

**A simulation shows that this phenomena can be explained by two factors acting simultaneously: a neutron flux strong absorption in the  $^{10}\text{B}$  layer which falling at a large angle to the detector plane and the fact that secondary nucleus energy of  $^4\text{He}$  or  $^7\text{Li}$  is not enough to exceed the energy threshold if nucleus outgoes from the depth of the  $^{10}\text{B}$  layer.**

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**• Thank you!**