ESTIMATE OF ELECTRIC POLARIZABILITY OF NEUTRON IN COULOMB FIELD OF HEAVY NUCLEUS

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The electric polarizability α_n is one of the characteristics of the neutron as an elementary particle and determines the induced electric dipole moment in an external electric field: $D = \alpha_n E$. It is known [1 — 4], that information about polarizability of the neutron can be received from the neutron total cross section measurements for heavy nuclei. The principle of extraction of the electric polarizability from total cross sections is based on the different energy dependence of contributions that composed σ^{tot}.

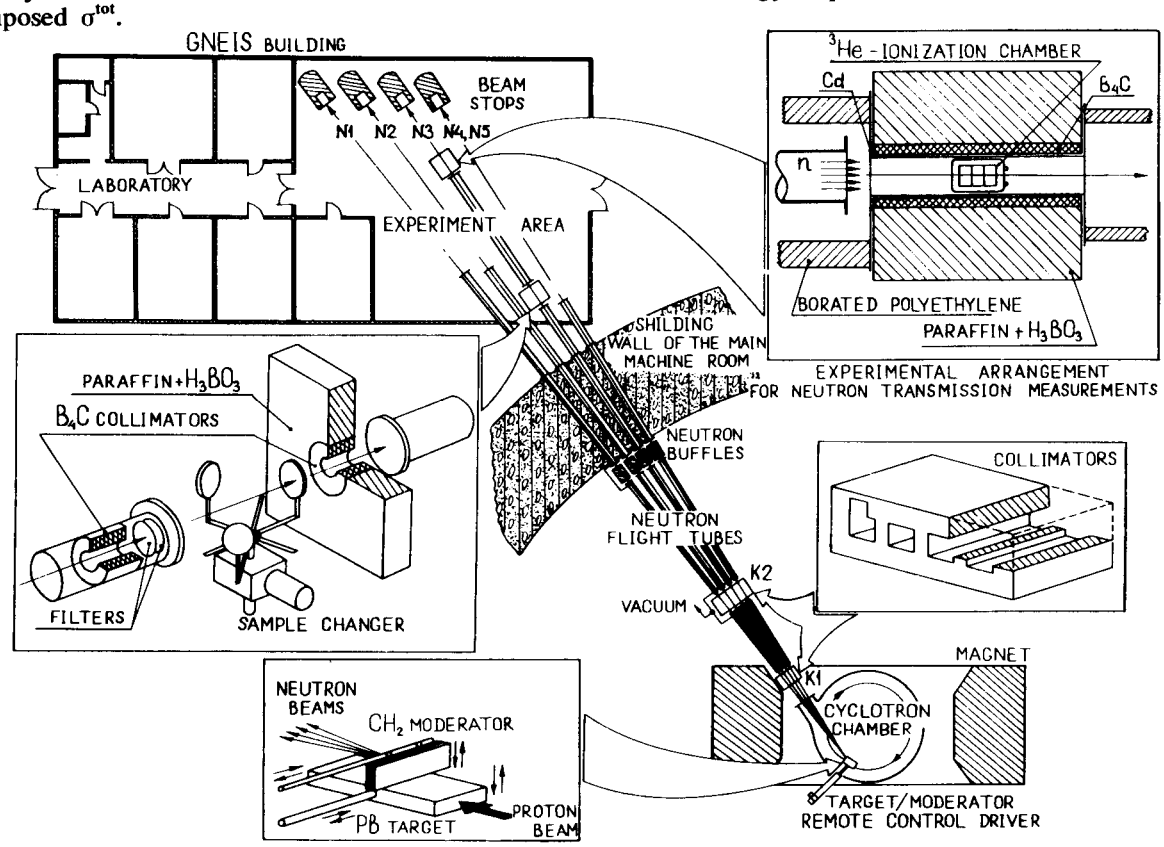

Fig. 1. Schematic layout of experiment

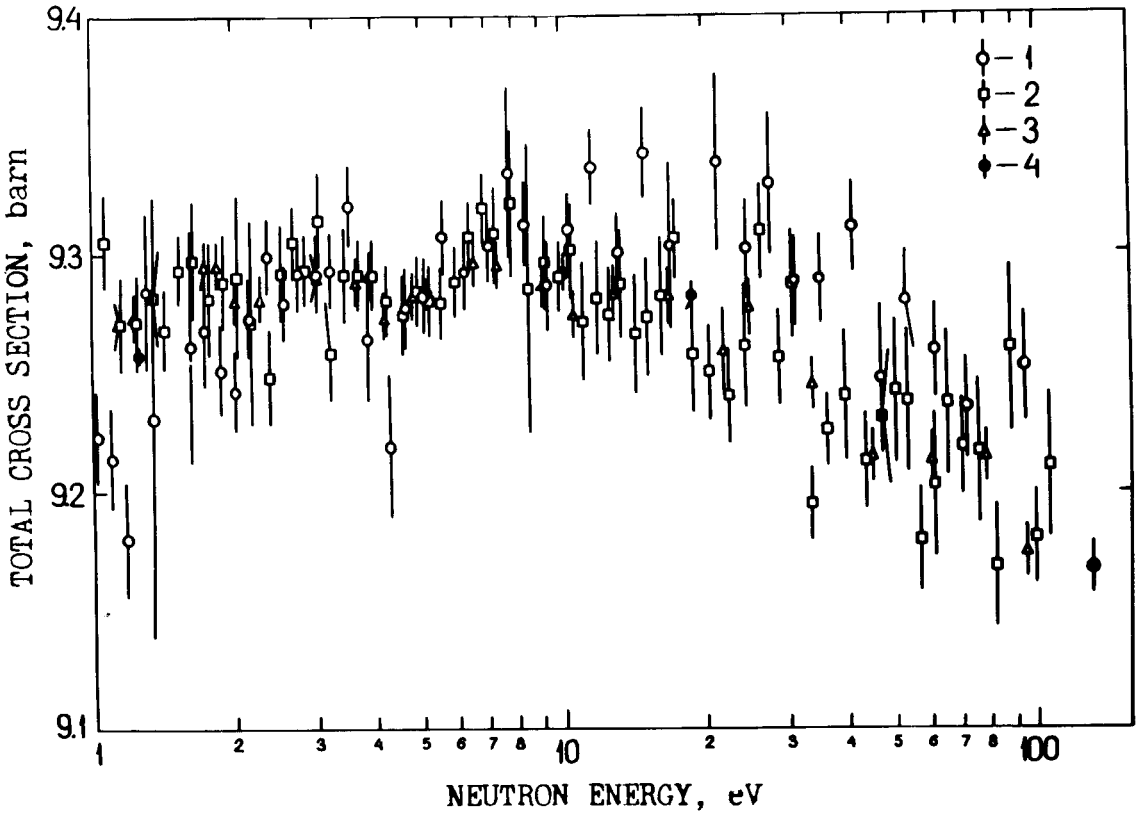

Fig. 2. Total cross section of ^{209}Bi: *1* — present work, *2* — [6], *3* — [2], *4* — [3]

The neutron total cross section of ^{209}Bi in the energy region 1 — 100 eV was measured with the neutron time-of-flight spectrometer GNEIS [5]. The schematic layout of the experiment is shown in fig. 1. The ionization ^{3}He-chamber located in the composite shielding was used as a neutron detector. Resonance filters of Co, W and In were placed in the beam for permanent background monitoring. The characteristic peculiarity of these measurements is the low (~0.5%) neutron background weakly altering in the explored energy region. To decrease the influence of systematic errors the 'sample in beam' and 'sample out of beam' measurements were carried out in short (10 min.) runs. Simultaneously the total cross section measurements for silicon were carried out as a zero-test of the experiment. For silicon the polarizability influence should be negligibly small in comparison with that of bismuth because the polarizability contribution into the cross section is proportional to the square of nucleus charge Z^2.

The measured total cross section of ^{209}Bi is shown in fig. 2 together with the other data [2,3,6]. Preliminary analysis of our data indicated that α_n-value and its uncertainty significantly depends on the involved analysis method. For example, using of method [2] leads to the value $\alpha_n = (9.2 \pm 1.6) \cdot 10^{-3}$ fm^3 while a simultaneous variation of two parameters — polarizability and P_2 from [2] — — leads to another value: $\alpha_n = (25 \pm 11) \cdot 10^{-3}$fm^3. This situation indicates that there is a need of more detailed analysis of data treatment methods and as well as the results of our predecessors.

Presently, measurements of the total cross section of ^{208}Pb are carried out as a continuation of the experiment. For this nucleus the resonance contribution into the cross section in the energy range of 1 eV — 5 keV is much less than that of ^{209}Bi.

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