Monte-Carlo Evaluations of Low-Energy Neutron Radiative Capture in ^{93}Nb Nucleus and γ-Quanta Forward-Backward Asymmetry Caused by Geometry and Kinematics

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A study of forward-backward asymmetry of γ-quanta emitted at the radiative decay of nuclei at a capture of neutrons with energies near low-energy p-wave resonances allows obtaining their parameters – the neutron $\Gamma_{n1/2}$ and $\Gamma_{n3/2}$ partial widths. For this purpose the trial experiment already started by the time-of-flight method at 10-m flight-path of the IREN facility (FLNP, JINR) with ^{93}Nb nucleus.

For a correct experimental determination of forward-backward asymmetry of γ-quanta from ^{93}Nb(n,γ) reaction in the energy region of the 35.8, 42.3 and 94.3 eV p-wave resonances, it is necessary to define a compromise between a desirable high yield of gammas (i.e. the target must be thick enough) and minimization of an undesirable distortion of the required forward-backward γ-asymmetry which demands a thin target.

To define this compromise Monte-Carlo calculations were made. The results are presented for 4×4 cm^2 niobium plate-targets of three thicknesses (400 mcm, 2 mm and 6 mm). The asymmetries caused by a multiple scattering of neutrons in the target before their capture as well as by finite thickness of target, which distort counts of the detectors and inevitably contribute to the required spatial γ-anisotropy, were established by Monte-Carlo calculations for taking them into account.