

Development of a low energy neutron TOF array

A. Vitéz, A. Algora, M. Csatlós, Z. Gácsi, J. Gulyás,
M. Hunyadi, A. Krasznahorkay

Institute of Nuclear Research of the Hungarian Academy of Sciences

Relativistic heavy-ion beams and especially rare-isotope beams, which will be soon available at GSI, open up a new avenue for studying giant resonances in inverse kinematic reactions. In addition, a large part of the physical background can be suppressed by using kinematically complete experiments.

The proposed experiments will study the isotopic dependence of the neutron-skin thickness in a wide range of Sn nuclei by observing isovector magnetic giant resonances, especially the spin-dipole resonance (SDR) and Gamow-Teller resonance (GTR). The reaction kinematics for Sn isotopes at a bombarding energy of 400 MeV/nucleon determines certain conditions for an optimal geometrical arrangement of the neutron detectors, on which the construction plans of a plastic scintillator array were based.

Spin-isospin giant resonances can be strongly excited in (p,n)-type reaction. Using thick targets without disturbing the energy spectrum of the recoiled neutrons has an importance in experiments with rare-isotope beams to achieve reasonable statistics. On the other hand, a resolution of 10% in the determination of the neutron kinetic energy, a resolution of 1° in the scattering angle in laboratory frame and high efficiency for the spectrometer are required. The whole detector system will be mounted on a hollow aluminium frame, to prevent the scattering of the neutrons as much as possible. Reliable performance of the scintillator also required test measurements.

Monte-Carlo simulations were used to provide detector efficiencies and the amount of neutron scattering events in the proposed construction as a function of geometrical parameters.

The light output of such a scintillator material is known. The generated light of 0.5 MeV neutron is near to the single-electron noise in electron equivalent. [1] Therefore improved package of the scintillator material, to get higher light output, and fast photo-multipliers with high gain was used. In such way we reached high light output efficiency in the low energy neutron region. We also measured the total efficiency of neutron detection of the scintillator material, and, finally, till the end of the summer, we are planning to build and test one segment of the whole detector system,

I would like to present the results of our latest test experiments, development and design of low energy neutron time of flight detector.

References:

[1] M. Gettner and W. Selove, Rev. of Sci. Instr. **31**, 450 (1960).