Premières mesures de section efficace (n,alpha) avec le détecteur SCALP

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Abstract

Reliable nuclear data are essential for a wide range of applications, including the nuclear industry. Molten-salt reactors are types of reactor using a nuclear fuel mixed most often with a fluorinated salt. Few measurements have been made of the cross-section of the 19F(n,α)16N reaction, and discrepancies between measurements and evaluations can be up to a factor of 3 at certain energies. Uncertainty in the cross-section of this reaction leads to significant uncertainties in molten-salt reactor parameters, particularly in the effective multiplication factor. To carry out new cross-section (n,α) measurements on light nuclei of interest, the LPC Caen has developed a new detector, the SCALP detector. This detector uses an ionization chamber to measure deposited energy and four photomultipliers to determine the time of flight (and therefore neutron energy) from scintillation at facilities delivering a pulsed beam. By coincidentally measuring the deposited energy and kinetic energy of incident neutrons, the SCALP device is able to identify the (n,α) reactions and measure thecross-section of the (n,α) reactions of interest. The first experiment with SCALP was carried out at NFS, the neutron line at GANIL-SPIRAL2 in Caen. This thesis work covers the analysis of experimental data as well as a complete Monte-Carlo simulation of the experiment carried out. The cross-section results of the 19F(n,α)16N reaction measured with the SCALP detector confirm structures observed in previous experiments and evaluations. In addition, SCALP has enabled the first-ever observation of structures in certain neutron energy ranges. However, the results obtained suffer from a large systematic uncertainty due to inconsistencies between methods for determining neutron beam intensity.