

Cross-section measurements of (α, n) reactions in light nuclei

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Introduction

The investigation of (α, n) reactions is crucial due to their wide-ranging impact across several critical fields of nuclear physics. In nuclear power technologies, accurate neutron yield data from these reactions is necessary for designing and optimizing these systems, where controlling neutron production is the key to both efficiency and nuclear safety. In nuclear safeguards, these reactions play an essential role in monitoring and verifying nuclear materials to prevent proliferation [1]. In nuclear astrophysics, these reactions are involved in nucleosynthesis processes, contributing to our understanding of the origins of elements in the universe [2]. The (α, n) reactions are important in the production of medical isotopes, which are widely used in diagnostic imaging and cancer treatment [3]. In detector simulation, these reactions help to refine the models that predict the behavior of radiation detectors, improving their accuracy and reliability. In the field of fusion research, understanding these reactions aids in the development of fu-

sion reactors, which promise a future source of nearly limitless, clean energy. Hence, the study of (α, n) reactions is essential not only for advancing the scientific knowledge but also for its applications in technology, medicine, and energy.

The reactions which involve the interaction of α particles with the nuclei of light elements such as *Li, Be, B, C* and others up to *K*, are of particular interest because they produce neutrons: a process that has significant practical and theoretical implications. Therefore, we performed experiments involving α -induced reactions on the light elements, such (¹⁹F and ²⁷Al), using an array of ³He counters, named ELI- Gamma Above Neutron Threshold for Thermal Neutrons (ELIGANT TN) [4].

Experimental Details

ELIGANT-TN, a high-and-flat efficiency moderated neutron detection array of 28 ³He counters, as shown in Fig 1, has been developed for neutron cross section measurement at Extreme Light Infrastructure - Nuclear Physics (ELI-NP) [5]. It has three rings geometry of 28 counters with a 37% efficiency flat within 5% in the 10 keV to 5 MeV neutron energy interval [4]. This state-of-the-

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