



ID de la contribución : 1065

Tipo : Talk

## New equipment and methodologies for ( $\alpha$ ,n) measurements within MANY at CNA HiSPANoS

*jueves, 20 de noviembre de 2025 9:00 (15)*

Neutrons from ( $\alpha$ ,n) reactions are essential for astrophysics, dark matter experiments, and nuclear material interrogation, yet available cross-section and yield data are limited and often uncertain [1]. To improve this situation, the Spanish nuclear physics community has established the MANY Collaboration (Measurement of Alpha Neutron Yields).

At CNA [2], the 3 MV tandem accelerator provides alpha beams up to 9 MeV, either in continuous mode (maximum 500 nA with the ALPHATROSS source [3]) for activation and neutron counting, or in pulsed mode (2% duty cycle) for time-of-flight [4].

Recent and planned upgrades at the neutron beam line CNA-HiSPANoS aim to expand its capabilities for ( $\alpha$ ,n) measurements: a new buncher system has been installed, improving the structure of the pulsed beam and allowing for more precise time-of-flight measurements, a more intense  $\text{He}^{++}$  ion source (NEC-TORVIS [5]) has been acquired and is expected to increase the beam intensity by an order of magnitude, and the purchase of a new array of fast neutron detectors (EJ-309) is underway in order to improve detection efficiency and angular coverage.

In parallel, an innovative technique for beam current determination in non-conductive materials and/or some gaseous elements, using aluminum alloys. By employing an AlN alloy target, the ( $\alpha$ ,n) reaction on  $^{14}\text{N}$ , in principle a gaseous target that would pose a serious difficulty, is measured with respect to the well-known  $^{27}\text{Al}(\alpha,n)^{30}\text{P}$  reaction, enabling a reliable Thick Target Yield (TTY) measurement by means of activation.

This contribution will include the definitive results for the measurement of the  $^{27}\text{Al}(\alpha,n)^{30}\text{P}$  reaction by activation as well as preliminary results for the  $^{14}\text{N}(\alpha,n)^{17}\text{F}$  measurements and the commissioning of the new bunching system for  $\alpha$  beams. Then, planned upgrades of the ion source and the neutron detectors will be presented.

[1] D. Cano-Ott et al., Review of Neutron Yield from ( $\alpha$ , n) Reactions: Data, Methods, and Prospects, [<https://arxiv.org/abs/2405.07952>]

[2] J. Gómez-Camacho, J. García López, C. Guerrero et al. Research facilities and highlights at the Centro Nacional de Aceleradores (CNA), Eur. Phys. J. Plus 136, 273 (2021). <https://doi.org/10.1140/epjp/s13360-021-01253-x>

[3] NEC Alphasource RF-Charge Exchange Ion Source <https://www.pelletron.com/>

[4] M.A. Millán-Callado et al., Continuous and pulsed fast neutron beams at the CNA HiSPANoS facility. Rad. Phys. & Chem. 217 (2024) 111464

[5] NEC Toroidal Volume Ion Source <https://www.pelletron.com/>

### Abstract

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This contribution will include the definitive results for the measurement of the <sup>27</sup>Al(a,n)<sup>30</sup>P reaction by activation as well as preliminary results for the <sup>14</sup>N(a,n)<sup>17</sup>F measurements and the commissioning of the new bunching system for alpha beams. Then, planned upgrades of the ion source and the neutron detectors will be presented.

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**Clasificación de la sesión :** Red FNUC (Red Temática de Física Nuclear)

**Clasificación de temáticas :** Red Temática de Física Nuclear (FNUC)