

Neutron yield calculation for (α,n) reactions with SOURCES4

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The sensitivity of underground experiments searching for rare events such as dark matter, proton decay, neutrinoless double-beta decay, and low-energy neutrino physics is often limited by the background caused by neutrons from spontaneous fission and (α,n) reactions.

Neutron yields and energy spectra due to these reactions can be calculated by using a variety of codes. Here we present the cross-sections of (α,n) reactions and the transition probabilities to excited states calculated with TALYS 1.96 [1] and EMPIRE 3.2.3 [2] nuclear reaction codes considering different optical model parameters and the comparison with the experimental data where available.

Furthermore, we present the calculations of neutron production using the modified SOURCES4 code with recently updated cross-sections for (α,n) reactions and the comparison of the results with experimental ones from thick target neutron yields obtained with alpha beams and radioactive decay chains. The cross-sections for (α,n) reactions in SOURCES4 [3,4] have been taken from reliable experimental data where possible, and complemented by the calculations with EMPIRE 3.2.3, TALYS 1.96 and JENDL-5 [5] where the data were scarce or unavailable.

[1] A. Koning, et al., Eur. Phys. J.A 59 (6) (2023) 131.

[2] M. Herman, et al., Nucl. Data Sheets, 108 (2007) 2655-2715.

[3] W. B. Wilson, et al., Radiation Protection Dosimetry, 115 (2005) 117–121.

[4] W. B. Wilson, et al., Technical Report LA–13639-MS (1999).

[5] T. Murata et al., JAEA-Research 2006-052.

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