Neutron Capture Cross Sections Of The s-Process Branching Points ^{147}Pm, ^{171}Tm and ^{204}Tl

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(Received September 8, 2016)

The neutron capture cross section of several key unstable isotopes acting as branching points in the s-process are crucial for stellar nucleosynthesis studies, but they are very challenging to measure due to the difficult production of sufficient sample material, the high activity of the resulting samples, and the actual (n,γ) measurement, for which high neutron fluxes and effective background rejection capabilities are required.

As part of a new program to measure some of these important branching points, radioactive targets of ^{147}Pm, ^{171}Tm and ^{204}Tl have been produced by irradiation of stable isotopes (^{146}Nd, ^{170}Er and ^{203}Tl) at the Institut Laue-Langevin (ILL) high flux reactor. After breeding in the reactor and a certain cooling period, the resulting mixed ^{204}Tl/^{203}Tl sample was used directly while ^{147}Pm and ^{171}Tm were radiochemically separated in non-carrier-added quality at the Paul Scherrer Institut (PSI), then prepared as targets.

A set of theses samples has been used for time-of-flight measurements at the CERN n_TOF facility using the 19 and 185 m beam lines, during 2014 and 2015. The capture cascades were detected with a set of four C_6D_6 scintillators, allowing to observe the associated neutron capture resonances. The results presented in this work are the first ever determination of the resonance capture cross sections of ^{147}Pm, ^{171}Tm and ^{204}Tl.

Activation experiments on the same ^{147}Pm and ^{171}Tm targets with a high-intensity quasi-Maxwellian flux of neutrons have been performed using the SARAF accelerator and the Liquid-Lithium Target (LiLiT) in order to extract the corresponding Maxwellian Average Cross Section (MACS). The experimental setups are here described together with the first, preliminary results of the n_TOF measurement.

KEYWORDS: neutron capture, cross sections, MACS, s-process, branching point, neutron beam, n_TOF, LiLiT, ^{171}Tm, ^{147}Pm