

Measurement of the $^{139}\text{La}(n,\gamma)$ Cross Section at n_TOF*

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This contribution reports on a recent measurement of the $^{139}\text{La}(n,\gamma)$ cross section from 0.6 eV up to 9 keV using the time-of-flight technique. The measurement has been performed at the n_TOF-facility at CERN which makes use of spallation reactions for the generation of the neutron beam, while the γ -rays from capture events are detected with liquid organic scintillators (C_6D_6)-based detectors. A detailed description of the experimental setup and of the data analysis procedures will be presented. The extracted resonance parameters allow to derive the capture cross section and other nuclear quantities up to 9 keV.

Up to date, the $^{139}\text{La}(n,\gamma)$ cross section has been measured at Oak Ridge [1] and JAERI [2]. The results obtained in independent activation measurements are in substantial disagreement (up to 40%) with the previous prompt γ -ray capture measurements. The large discrepancies between different kinds of data and their strong implications motivated a new capture measurement at the innovative n_TOF facility at CERN. In fact, the unique features of n_TOF such as the high resolution, the extremely high instantaneous neutron flux, and favorable background conditions, allow to accurately measure in a wide energy range both radioactive samples as well as isotopes with low capture cross section such as ^{139}La .

The implications of this measurement will be discussed in detail. In fact, the neutron magic isotopes as ^{139}La ($N=82$ and $Z=57$), are of special interest in nuclear physics. Their nuclear structure is characterized by low level density and small strength in the reaction channels, determining a low total neutron cross section that is dominated by the elastic channel. Therefore the experimental information on cross sections of such nuclei is very useful both for fundamental aspects (microscopic calculation of quantum many-body systems and nuclear astrophysics) as well as for applications.

Lanthanum plays also an important role in nuclear astrophysics. In fact, the low capture cross sections of neutron magic nuclei like Ba, La and Ce act as bottlenecks for the reaction flow from light (Sr, Zr and Y) towards heavy elements (Sm, Eu and Gd) giving rise to a large slow neutron capture process (s process) contribution to the abundances. Therefore, the abundances of the neutron magic isotopes of these elements can be used for monitoring the s -process production while other elements (e.g. europium), characterize the r -process component of neutron capture nucleosynthesis. Maxwellian averaged cross sections of ^{139}La were calculated over a wide range of temperatures, will be presented within the framework of the open new scenarios for the nucleosynthesis and the chemical evolution of heavy nuclei in the Galaxy.

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