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Impact of the γ-Ray Strength Functions on the 138La and 139La Galactic Production

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Abstract content
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The odd-odd neutron-deficient 138La is very long-lived but one of the less abundant nuclei in the solar system. It is expected to be one of 35 p-nuclei. Most p-nuclei with A>110 are thought to be produced by photodisintegration from s- and r- process seed nuclei. However, this photodisintegration cannot satisfactorily explain the observed abundance of 138La and more exotic processes such as the electron neutrino capture on 138Ba have been called for to explain its synthesis [1,2]. The neutrino reactions can to some extent explain the observed abundance of 138La but the significance of the photodisintegration process cannot be ruled out due to the limited knowledge and uncertainties of nuclear properties entering the 138La production, such as the nuclear level densities (NLD) and γ-ray strength function (γSF) [2]. These are critical model input parameters for the astrophysical reaction rate calculations.

Measurements are necessary to place the nuclear properties on a solid footing in order to make statements regarding the importance of neutrino reactions.

In this presentation I will discuss our recently measured NLD and γSF of 138, 139La. These quantities were measured using the 139La(3He, 3Heγ)139La and 139La(3He, αγ)138La reactions with a 38 MeV 3He beam at the Cyclotron Laboratory of the University of Oslo. From particle-γ coincidences, measured using the SiRi array (64 silicon channels from particle telescopes) and CACTUS array (26 NaI detectors), the NLD and γSF were simultaneously extracted. Moreover, I will also discuss 137La(n,γ) and 138La(n,γ) cross sections and astrophysical rates, calculated with the combinatorial plus Hartree-Fock-Bogoliubov model of NLD and using our experimental γSF as input parameters, and address the astrophysical implications.

[1] S.E. Woosley et al., Ap. J. 356, 272 (1990).
[2] S. Goriely et al., A&A 375, 35 (2001).

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