



Contribution ID: 85

Type: Oral Presentation

Nuclear level densities and gamma-ray strength functions of $^{180,181,182}\text{Ta}$ and neutron capture cross sections

Thursday, 6 July 2017 14:40 (20 minutes)

Most stable and extremely low abundance proton-rich nuclei with $A \sim 110$ are thought to be produced by the photodisintegration of s - and r -process seed nuclei. However, this so-called p -process is insufficient to explain the observed low abundance (0.012%) of the ^{180}Ta isotope. Hence combinations of several processes are considered to reproduce the observed abundance of ^{180}Ta in the cosmos, provoking debates and making it a unique case to study. Significant uncertainties in the predicted reaction rates in p -nuclei arise due to large uncertainties in nuclear properties such as the nuclear level densities (NLD) and gamma-ray strength functions (γSF) [1], as well as the actual astrophysical environments. An experiment was performed in October 2014 to extract the NLD and γSF in $^{180,181,182}\text{Ta}$ isotopes which provide important input parameters for nuclear reaction models. In the present case study, these parameters were measured using the reactions $^{181}\text{Ta}(^3\text{He}, ^4\text{He})\gamma$ and $^{181}\text{Ta}(^3\text{He}, \alpha\gamma)$ with 34 MeV beam, $^{181}\text{Ta}(d, d'\gamma)$ and $^{181}\text{Ta}(^3\text{He}, t\gamma)$ with 15 MeV beam, and $^{181}\text{Ta}(d, d'\gamma)$ and $^{181}\text{Ta}(d, p\gamma)$ with 12.5 MeV beam at the Oslo Cyclotron Laboratory. Using the SiRi array at backward angles (64 silicon particle telescopes) and the CACTUS array (26 NaI(Tl) detectors), the NLD and γSF were simultaneously extracted below the neutron separation energy from particle- γ coincidence matrices through iterative procedures using the Oslo method [2]. The experimental results have been used to determine the corresponding neutron capture cross sections, which in turn were utilized to extract Maxwellian averaged cross sections. The latter can be used in astrophysical network calculations to investigate the galactic production mechanism of ^{180}Ta . In this talk I will present results of this investigation.

[1] S. Goriely et al., *A&A J.* 375, L35 (2001).[2] A. Schiller et al., *NIM Phys. Res. A* 447, 498 (2000).

Apply to be considered for a student award (Yes / No)?

Yes

Level for award (Hons, MSc, PhD, N/A)?

PhD

Main supervisor (name and email) and his / her institution

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Would you like to submit a short paper for the Conference Proceedings (Yes / No)?

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Session Classification: Nuclear, Particle and Radiation Physics 1

Track Classification: Track B - Nuclear, Particle and Radiation Physics