Indirect experimental technique for constraining the ^{193,194}Ir(n,γ) cross sections

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June 24, 2025

Abstract

The formation of elements, particularly those heavier than iron, predominantly occurs through two neutron capture processes: slow neutron capture process and rapid neutron capture process, each contributing approximately 50%. These are known as the s- and r-processes, respectively [1].

The neutron capture reactions ^{192}Ir(n,γ)^{193}Ir and ^{193}Ir(n,γ)^{194}Ir were indirectly studied by analyzing data obtained from the Oslo Cyclotron Laboratory (OCL). These data enabled the study of the ^{193,194}Ir isotopes, originating from the ^{192}Os(α,tγ) and ^{192}Os(α,dγ) reactions, respectively. The ^{193}Ir(n,γ)^{194}Ir cross sections constrained by our measurements provided a comparison to existing (n,γ) measurement data [2]. Additionally, the ^{192}Ir(n,γ)^{193}Ir reaction maps a branching point in the s-process, making it highly significant. However, directly measuring the (n,γ) cross section is challenging due to the instability of ^{192}Ir. Therefore, the OCL data provided valuable information on the ^{192}Ir(n,γ)^{193}Ir cross section by indirectly constraining it using the experimental nuclear level density (NLD) and γ-strength function (γSF).

An array of Sodium Iodine (NaI)Tl detectors, called CACTUS, detected γ-rays, while the silicon particle telescope array, called SiRi, was used to detect charged particles in coincidence. The NLDs and γSFs were extracted below the neutron separation energy, S_n, using the Oslo Method [3]. Furthermore, the NLDs and γSFs were used as

inputs in the open-source code TALYS to calculate the neutron capture cross-sections and Maxwellian averaged neutron capture cross sections (MACS) for ^{193,194}Ir. Final results of this study will be presented in comparison to existing data.

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This work is based on research supported in part by the National Research Foundation of South Africa (Grant Number:PMDS22070734847), SAINTS Prestigious Doctoral Scholarship, U.S. Department of Energy, Office of Science, Office of Nuclear Physics under Contract No. DE-AC02-05CH11231 and the SARChI under grant No REP-SARC180529336567.