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ABSTRACT

Exploring the Origin of the Rarest Stable Isotopes via Photon-Induced Activation Studies at the Madison Accelerator Laboratory

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The focus of this research work is to determine experimentally the ground state reaction rates for eight photoneutron reactions proposed to be investigated via photon-induced activation at the Madison Accelerator Laboratory (MAL), a unique bremsstrahlung facility on the campus of James Madison University, in Harrisonburg, Virginia. The eight photoneutron reactions are – 64Zn(γ,n), 70Ge(γ,n), 74Se(γ,n), 78,80Kr(γ,n), 84,86Sr(γ,n), 90Zr(γ,n). The corresponding proton-rich stable nuclei of interest belong to the region A < 124 that is notoriously underproduced by the current stellar evolution models for the astrophysical p-process. Because in the laboratory one only has access to target nuclei in the ground state, the stellar photodisintegration reaction rates, dominated by excited state contributions at the high temperature regime of the p--process, cannot be directly constrained experimentally. With the measurements at MAL, we can provide instead nuclear input to constrain crucial parameters of the statistical nuclear reaction models, i.e. γ-ray strength function, especially relevant for photoneutron reactions, which is the overarching goal of this research project at MAL. This presentation seeks to disseminate the progress made at MAL towards that end, highlighting the current R&D challenges encountered when trying to implement the so-called superposition technique at an unconventional bremsstrahlung facility that features a repurposed medical electron linear accelerator.

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