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Constraining experimentally photon strength functions using real photons at the HIGS/TUNL facility

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This presentation brings into focus ^{78,80}Kr(γ,γ'), ^{93}Mo(γ,n) and ^{90}Zr(γ,n) cross section measurements carried out using real photons at the HγGS/TUNL facility. The overarching physics motivation for these experimental investigations is to advance knowledge on a forefront topic in nuclear astrophysics –the nucleosynthesis beyond Fe of the rarest *stable* isotopes naturally occurring on Earth (the origin of p-nuclei) by constraining the statistical models that are used to calculate unknown stellar reaction rates. In particular, these stellar reaction rates are highly sensitive to the low-energy tail of the nuclear photon strength function (pSF).
Due to its high selectivity for dipole excitations, real photon scattering via nuclear resonance fluorescence (NRF) is the method of choice to extract experimentally, with high accuracy and model independently, the dipole pSFs in stable nuclei. The quasi-monochromatic and linearly polarized photon beam of very high flux available at HγGS makes this facility ideal for investigation of photoabsorption reaction cross section with p-nuclei as targets.
The NRF measurements on ^{78,80}Kr will provide for the first time information for the low-energy part of the E1-pSF in ^{78,80}Kr, as direct input into the p-process nucleosynthesis modeling. In this presentation, we will report on the status of data analysis of these very recent measurements.
The cross sections for ^{94}Mo(γ,n) and ^{90}Zr(γ,n) reactions were measured with high precision, from the respective neutron emission thresholds up to 13.5 MeV. In order to constrain the dipole pSFs in the A $\approx$ 90 mass region, the measured cross sections were compared with predictions of Hauser-Feshbach statistical model calculations using two different dipole pSF models. Since these models are based on fundamentally different physics, they can reflect the existing uncertainties affecting the pSF and also the impact of such uncertainties on reaction cross sections and corresponding astrophysical reaction rates. In this presentation, we will showcase our final results that show how sensitive the ^{94}Mo(γ,n) and ^{90}Zr(γ,n) stellar reaction rates can be to the corresponding measured cross sections, as discussed in detail in our recent publication, Phys. Rev. C 99, 025802 (2019).

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