Correlated Uncertainties in the i-process

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Nuclear astrophysics simulations aiming to study the origin of the elements in stars require a multitude of nuclear physics input. Both systematic model dependent and statistically correlated uncertainties need to be considered. An application where realistic uncertainty assessments are especially important is the intermediate neutron capture process or i process: a neutron capture regime with neutron densities intermediate between the slow and rapid processes. Accordingly, the main network flux proceeds on the neutron-rich unstable isotopes up to 4-5 species off the valley of stability. The i process has been clearly identified to be active in post-AGB stars during the Very Late Thermal Pulse H-ingestion event, and a recent work infers about its important role in early generations of stars. Here we demonstrate the effect of propagating systematic nuclear uncertainties from different theoretical models to final abundances for a region around the 2nd peak at $A-Z = 80$ for elemental ratio predictions involving Ba, La and Eu in i-process conditions. These elements are used to distinguish different n-capture contributions observed in low-metallicity stars. For the simple 1-zone model adopted here, predictions vary as much as a factor of 22 in on possible observational plane ([La/Eu] vs. [Ba/La]). To consider statistically correlated uncertainties, we similarly perform a full nuclear physics uncertainty study within a given Hauser-Feshbach model and demonstrate the role of correlations on the final stellar abundance uncertainties. We show that in i-process conditions the main result of neglecting correlations is to underestimate the impact of nuclear uncertainties on the final nucleosynthesis yields by as much as two orders of magnitude. In the mass region of the neutron shell closure N = 82 Cs final abundances are the most affected by correlated nuclear uncertainties with an uncertainty of about a factor of about 3.5 compared to a factor of 6 Å~ 10−3 when uncorrelated nuclear uncertainties are used. In both cases Te and I final abundances shows a negligible effect.