QUANTIFICATION OF NUCLEAR UNCERTAINTIES IN NUCLEOSYNTHESIS OF ELEMENTS BEYOND IRON

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Additional challenges for nucleosynthesis beyond Fe, compared to that of lighter nuclei, are reviewed, with focus on stellar rate uncertainties. Generally higher temperatures and nuclear level densities often do not allow measurements to provide *stellar* reaction rates and theory contributions remain important. We present large-scale studies of sensitivities of cross section and reaction rate predictions to nuclear input from proton- to neutron-dripline and point out their impact on the s-, r-, ⊚-, rp-, and ⊚p-processes. Also presented are large-scale predictions of ground-state contributions to the stellar rates, allowing an estimate of how well rates can be directly constrained by experiment. Even for the s-process considerable rate uncertainties are found, despite available data and low temperature. This impacts the understanding of presolar grains. Rates are less constrained in other processes at higher temperature and involving unstable nuclei, possibly except for the ⊚p-process, mainly governed by equilibria and (n,p) reactions for which rate predictions appear reliable. Finally, we present the new *PizBuin* framework for reaction network Monte Carlo studies to quantify the cumulative impact of derived rate uncertainties on final abundances. Using parallelization, in principle it becomes possible to vary several 10000 rates. First results for more limited rate sets in explosive nucleosynthesis of massive stars were obtained within a Hertfordshire-Keele collaboration.