KEY REACTION RATES OF S-PROCESS NUCLEOSYNTHESIS AND THE IMPACTS OF NUCLEAR-PHYSICS UNCERTAINTY

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The sequence of slow-neutron captures and β-decays, known as s-process nucleosynthesis, is a major production process of elements heavier than iron. Theoretical studies of the s-process are based on nuclear reaction network calculations that include thermonuclear (n,γ) and β-decay rates that themselves still have significant uncertainty. In addition, in stellar environments of high temperature (8–30 keV) there may be crucial contributions from exited states of nuclei, even for cases where the β-decay rate has been determined.

We evaluated the uncertainty relevant to s-process nucleosynthesis using a Monte-Carlo centred approach. Based on a realistic and general prescription of temperature dependent uncertainty, we have examined the impact on the s- process in several stellar environments. We considered massive stars at both solar and very-low metallicities (the weak s-process) as well as AGB stars (the main s-process). We find that the adopted uncertainty for (n,γ) rates, tens of per cent on average, affect the production of s-process nuclei along the β-stability line, while for β-decay, for which the uncertainty is enhanced by contributions from excited states, has the strongest impact on branching points. The uncertainty in final abundances for each isotope is generally caused by just a few neighbour reactions and decays. In the presentation, we will suggest the priority list of (n,γ) reactions and β-decay rates to be investigated in future experiments and/or calculations.