The s-process nucleosynthesis in low mass stars: impact of the uncertainties in the nuclear physics determined by Monte Carlo variations

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We investigated the impact of uncertainties in neutron-capture and weak reactions (on heavy elements) on the s−process nucleosynthesis in low-mass stars using a Monte-Carlo based approach. We performed extensive nuclear reaction network calculations that include newly evaluated temperature-dependent upper and lower limits for the individual reaction rates. Consistent with previous studies, we found that β-decay rate uncertainties affect only a few nuclides near s-process branchings, whereas most of the uncertainty in the final abundances is caused by uncertainties in neutron capture rates, either directly producing or destroying the nuclide of interest. Combined total nuclear uncertainties due to reactions on heavy elements are in general less than 50% (see Fig.1).

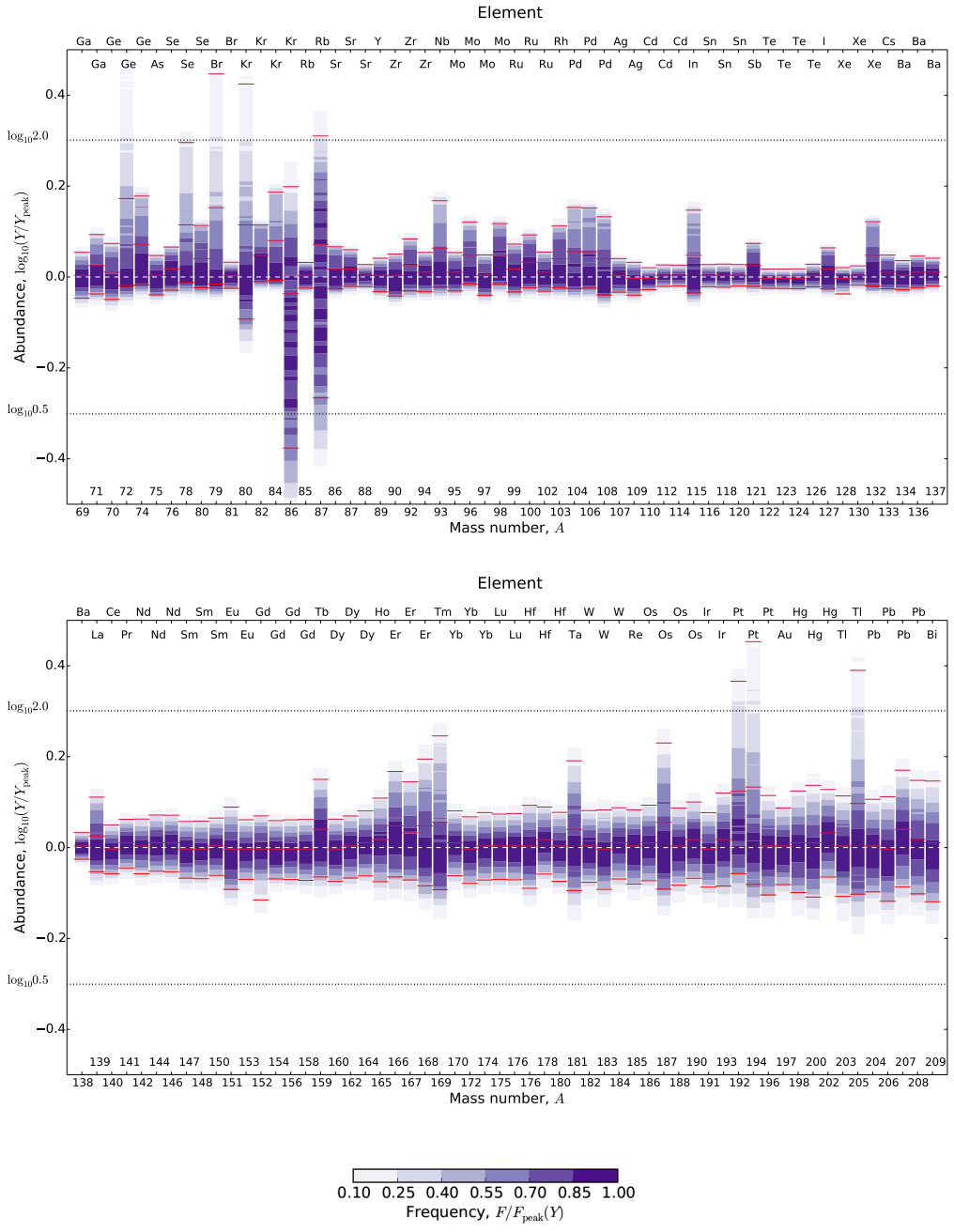

Figure 1: Total production uncertainties in the final s-process abundances for a ^{13}C pocket. The color shading denotes the probabilistic frequency and the 90% probability intervals up and down are marked for each nuclide with the red lines. The final abundances are normalised by the final abundance at the peak of the distribution. Horizontal dotted lines indicate a factor of two uncertainties.