Astrophysics > Cosmology and Extragalactic Astrophysics

Standard Big-Bang Nucleosynthesis up to CNO with an improved extended nuclear network

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Primordial or Big Bang nucleosynthesis (BBN) is one of the three strong evidences for the Big- Bang model together with the expansion of the Universe and the Cosmic Microwave Background radiation. In this study, we improve the standard BBN calculations taking into account new nuclear physics analyses and we enlarge the nuclear network until Sodium. This is, in particular, important to evaluate the primitive value of CNO mass fraction that could affect Population III stellar evolution. For the first time we list the complete network of more than 400 reactions with references to the origin of the rates, including \approx 270 reaction rates calculated using the TALYS code. Together with the cosmological light elements, we calculate the primordial Beryllium, Boron, Carbon, Nitrogen and Oxygen nuclei. We performed a sensitivity study to identify the important reactions for CNO, 9Be and Boron nucleosynthesis. We reevaluated those important reaction rates using experimental data and/or theoretical evaluations. The results are compared with precedent calculations: a primordial Beryllium abundance increase by a factor of 4 compared to its previous evaluation, but we note a stability for B/H and for the CNO/H abundance ratio that remains close to its previous value of 0.7 \times 10-15. On the other hand, the extension of the nuclear network has not changed the 7Li value, so its abundance is still 3-4 times greater than its observed spectroscopic value.

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