

# REPORT on scipost\_202508\_00070v1

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**Title:** Primordial nucleosynthesis in the era of cosmological tensions

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## Overview

The manuscript presents a pedagogical introduction to big bang nucleosynthesis (BBN), covering plasma thermodynamics, weak interactions, nuclear reactions, and observational constraints. The author provides a concise but thorough overview of the theoretical framework and links it to current cosmological tensions, particularly those related to light element abundances and the effective number of neutrino species.

## Strengths

The lecture notes are clearly structured and written in an accessible style, making them suitable for advanced students and researchers wishing to familiarise themselves with BBN. The derivations are pedagogical, and the connection to cosmological tensions makes the material timely and relevant. Additionally, these notes are shorter in comparison to others, but provide a direct pedagogical connection that can be very useful.

## Weaknesses

*On the Tritium Decay Chain.* The text states that Tritium ( $^3\text{H}$ ) decays into  $^3\text{He}$ . This is chemically correct, but maybe for a lecture note intended to be pedagogical, it would be beneficial to add a note that the  $^7\text{Be}$  decay into  $^7\text{Li}$  occurs specifically via electron capture. This detail adds completeness, especially as the  $^7\text{Li}$  abundance remains the most notable discrepancy between BBN theory and observation.

*Target audience.* Since the lecture notes are tailored to people who are not experts in the field, some equations and approximations (e.g. neglecting chemical potentials, using order-one factors in deuterium equilibrium estimates) are made quickly. A short explanatory sentence in each case would make the text more accessible for students and non-experts.

## Minor corrections

- “sastisfied”  $\rightarrow$  “satisfied” (p. 5).
- “equilbrium”  $\rightarrow$  “equilibrium” (p. 3).
- On p. 6, “ $^3\text{Li}$ ” is meant to be  $^7\text{Li}$  or “lithium-7”???
- Eq. (2): briefly remind the reader that  $\rho_\gamma$  is the photon energy density.
- Eq. (15): the approximation step could be explained more clearly (mention dropping order-one factors).
- Eq. (17): clarify that  $Y_P = 4X_{\text{He}}$  corresponds to the helium mass fraction.
- Fig. 1: axis labels are a bit small compared to the text; increasing font size would improve readability.

- The phrase “up to unimportant order one numerical factors” could be rephrased as “up to factors of order unity, which do not significantly affect the estimate”.

I recommend acceptance after minor revisions. The manuscript is clear, correct, and well suited for publication in SciPost Lecture Notes, but I encourage the author to expand slightly on the discussion of cosmological tensions, and to consider adding one or two pedagogical figures (e.g., a BBN reaction network diagram).