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APODORA:
A Novel Code for Describing Big Bang Nucleosynthesis

Everything we see around us is made of atoms, which at their core contain a nucleus. Atomic nuclei are the fundamental building blocks that make up the stars, planets, and the humans that live on them. Understanding the creation of atomic nuclei is to understand the origin of the world itself.

The goal of this thesis is to present the development of a new BBN code APODORA (Adaptable Python interface Offering Determination Of Relic Abundances). APODORA is designed to be more flexible than existing codes, with an emphasis on the use of modern standardized computing methods. Derivations of the equations describing the time evolution of various components in the early universe are presented. These are implemented in a flexible IPython environment with the reaction network being created using interfaces from pynucastro. The numerical uncertainty associated with every relevant input parameter of the code is systematically examined to ensure a high level of numerical precision. An in-depth comparison between APODORA and AlterBBN is performed, demonstrating equal or superior precision and speed. Finally, the resulting final abundances from APODORA are compared with multiple existing BNN codes as well as observational data.

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Master's Thesis

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