

PrimordialPy: a Python library for computing primordial power spectrum and PBHs abundances in single-field inflation

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Abstract

We present PrimordialPy, an open-source Python library designed to streamline the analysis of single-field inflationary models. Unlike existing tools often integrated into larger Boltzmann solvers, PrimordialPy provides a lightweight, modular, and object-oriented framework focused specifically on the inflationary epoch. The library numerically solves the background inflaton evolution and the Mukhanov-Sasaki equations for linear perturbations without relying on slow-roll approximations, ensuring accuracy for models with non-trivial kinetic terms or potential features. A key distinction of PrimordialPy is its dedicated module for computing the abundance of Primordial Black Holes (PBHs) directly from the primordial power spectrum, facilitating constraints on dark matter scenarios from inflation. We detail the numerical implementation, validate the code against standard benchmarks, and demonstrate its usage through examples. The source code is fully documented, unit-tested, and available at [GitHub](https://github.com), allowing researchers to easily extend the framework to new phenomenological models.

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15 **1 Introduction**

16 La inflación cósmica se ha convertido en la piedra angular y el esquema teórico líder para
17 explorar la física del universo temprano, proporcionando una teoría sólida sobre el origen y
18 evolución de las perturbaciones primordiales y de la formación de estructura a gran escala.
19 De acuerdo con esta teoría, el universo sufrió una expansión acelerada en una época muy
20 temprana,

21 **2 Physics of single-field inflation**

22 **3 Primordial black holes (PBHs) formation**

23 **3.1 Abundance of PBHs**

24 **4 Structure of the library**

25 **5 Examples**

26 **5.1 Starobinsky inflation**

27 **5.2 α -attractors**

28 **5.3 KKLT inflation with a bump**

29 **References**