

## Mémoire

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# Erratum for *Modified Gravity Theories and the Amplification of Inflationary Perturbations*

Augustin Tribolet

June 28, 2024

## Introduction

This document lists corrections for errors found in the original submission of my thesis titled *Modified Gravity Theories and the Amplification of Inflationary Perturbations* submitted on June 3, 2024.

## List of Corrections

- **Page 11, Eq. (23):**

- Original text:

$$S = S_E + S_\phi = \frac{M_P^2}{2} \int d^4x \sqrt{-g} R + \int d^4x \sqrt{-g} \left[ -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \partial_\nu \phi - V(\phi) \right]$$

- Corrected text:

$$S = S_E + S_\phi = \frac{M_P^2}{2} \int d^4x \sqrt{-g} R + \int d^4x \sqrt{-g} \left[ -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \partial_\nu \phi + V(\phi) \right]$$

- **Page 12, Footnote 6:**

- Original text:  $ds^2 = -dt^2 + e^{2Ht} d\vec{x}^2$

- Corrected text:  $ds^2 = dt^2 - e^{2Ht} d\vec{x}^2$

- **Page 15, Section 1.3.2:**

- Original text: In the literature, it is usually assumed that the inflaton field evolves towards a de Sitter attractor.

- Corrected text: In the literature, it is usually assumed that the inflaton field evolves towards SR inflation, i.e. a quasi-de Sitter attractor.

- **Page 17, Section 1.3.3:**

- Original text: In SR inflation, we had  $w < -1/3$ , while in USR we have  $w \rightarrow -1$  as it can be seen from Eq. (28) taking  $\dot{\phi}^2 \ll V(\phi)$ .

- Corrected text: In SR inflation, we had  $w \ll 1$ , while in USR we have  $w \rightarrow -1$  extremely rapidly, as can be seen from Eq. (28) taking  $\dot{\phi}^2 \ll V(\phi)$ .

- **Page 21, Figure 4:**

- Original text: Evolution of perturbations during the inflation and the Hot Big Bang. Each mode enters the super-horizon regime because of inflation. During this phase, perturbations are causally connected.
- Corrected text: Evolution of perturbations during the inflation and the Hot Big Bang. Each mode enters the super-horizon regime because of inflation. In the sub-horizon regime, perturbations are causally connected.

- **Page 33, Section 3:**

- Original text: where  $G$  is the gravitational constant,  $M$  is the mass of the black hole, and  $c$  is the speed of light.
- Original text: where  $G$  is the gravitational constant,  $M_{BH}$  is the mass of the black hole, and  $c$  is the speed of light.

- **Page 36, Section 3.1.1:**

- Original text:

$$\Delta N_{\text{form}} = \ln \left( \frac{10}{H_{k=aH}} \right)^{1/2} - \ln \left( \frac{10}{H_{k=aH}} \right) \approx 1.$$

- Corrected text:

$$\Delta N_{\text{form}} = \ln \left( \frac{10}{H_{k=aH}} \right)^{1/2} - \ln \left( \frac{1}{H_{k=aH}} \right)^{1/2} \approx 1.$$

- **Page 37, Section 3.1.3:**

- Original text: The density contrast  $\delta$  represents the fluctuation in density w.r.t. to the average density of the universe.
- Corrected text: The density contrast  $\delta$  represents the fluctuation in density w.r.t. the average density of the universe.

- **Page 42, Section 3.3.1:**

- Original text: Therefore, close to the USR attractor, we can also use the same results.
- Corrected text: Therefore, close to the USR or CR attractor, we can also use the same results.

- **Page 47, Section 4:**

- Original text: During the CR and USR phases, the scalar field evolves towards a quasi-de Sitter attractor and a de Sitter attractor solution, respectively.
- Corrected text: During the SR and USR (or CR) phases, the scalar fields evolve towards a quasi-de Sitter attractor and a de Sitter attractor solution, respectively.

- **Page 59, Eq. (168)**

- Original text:  $\gamma < 3$
- Corrected text:  $0 < \gamma < 3$

- **Page 75, Section 6:**

- Original text: The important point is that the action (225) is defined on the spacetime as the original action (224).
- Corrected text: The important point is that the action (225) is defined on the same spacetime as the original action (224).

- **Page 77, Section 6:**

- Original text: which combined gives finally the analytical expression of the function  $f(R)$ , see:
- Corrected text: which combined gives finally the analytical expression of the function  $f(R)$ :

- **Page 84, Section 6.2.2:**

- Original text: The solutions are stable provided that  $0 < n < 2$ , using Eq. (258).
- Corrected text: The solutions are stable provided that  $0 < n < 2$ , using Eq. (258), which corresponds to  $\beta < 0$ .

- **Page 85, Section 6.2.4:**

- Original text:

$$n_F(R_0) = \frac{1 + \frac{M^2 n(n-1)}{2R_0 \alpha(n-2)}}{1 + \frac{M^2(n-1)}{2R_0 \alpha(n-2)}} \equiv \frac{1 + n\nu}{1 + \nu} \quad \text{where} \quad \nu = \frac{M^2(n-1)}{2R_0 \alpha(n-2)}.$$

In the case  $n > 1$ , the stability condition is respected if  $-1/n < \nu < 0$  and  $\nu < -1$ . While the case  $n < 2$  requires  $\nu > 0$  to have a stable solution.

- Corrected text:

$$n_F(R_0) = \frac{1 + \frac{M^2 n(n-1)}{2R_0 \alpha(n-2)}}{1 + \frac{M^2(n-1)}{R_0 \alpha(n-2)}} \equiv \frac{1 + \frac{n}{2}\nu}{1 + \nu} \quad \text{where} \quad \nu = \frac{M^2(n-1)}{R_0 \alpha(n-2)}.$$

In the case  $n > 2$ , the stability condition is respected if  $-2/n < \nu < 0$ . The cases  $0 < n < 1$  and  $1 < n < 2$  require  $\nu > 0$  or  $\nu < -2/n$  to have a stable solution. Finally, when  $n < 0$ , the stability condition requires  $0 < \nu < -2/n$ .