Nonminimal Inflation on the Randall-Sundrum II Brane with Induced Gravity

Kourosh Nozari [a,b]   and   **M. Shoukrani**[a]

[a]*Department of Physics, Faculty of Basic Sciences,*
University of Mazandaran,
P. O. Box 47416-95447, Babolsar, IRAN

[b]*Research Institute for Astronomy and Astrophysics of Maragha,*
P. O. Box 55134-441, Maragha, IRAN
knozari@umz.ac.ir

Abstract

We study an inflation model that inflaton field is non-minimally coupled to the induced scalar curvature on the Randall-Sundrum (RS) II brane. We investigate the effects of the non-minimal coupling on the inflationary dynamics of this braneworld model. Our study shows that the number of e-folds decreases by increasing the value of the non-minimal coupling. We compare our model parameters with the minimal case and also with recent observational data. In comparison with recent observation, we obtain a constraint on the values that the non-minimal coupling attains.

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1

1 Introduction

It is well known that inflation provides a natural explanation for some long-standing problems of the standard hot big bang cosmology. Inflation is also a successful scenario for production and evolution of the perturbations in primary stages of the universe evolution [1]. Although inflation paradigm is successful in these respects, there is a problem for realization of this scenario that we do not know how to integrate it with ideas of the particle physics [2,3,4]. One important feature of the inflationary paradigm is the fact that inflaton can interact with other fields such as gravitational sector of the theory. This interaction is shown by the non-minimal coupling of the inflaton field and Ricci scalar in the spirit of the scalar-tensor theories. In fact, there are several compelling reasons for inclusion of an explicit non-minimal coupling of the inflaton field and gravity in the action. For instance, non-minimal coupling arises at the quantum level when quantum corrections to the scalar field theory are considered. Even if for the classical, unperturbed theory this non-minimal coupling vanishes, it is necessary for the renormalizability of the scalar field theory in curved space. In most theories used to describe inflationary scenarios, it turns out that a non-vanishing value of the coupling constant cannot be avoided. Also, in general relativity, and in all other metric theories of gravity in which the scalar field is not part of the gravitational sector, the coupling constant necessarily assumes the value of $\frac{1}{6}$ (see [5,6] for more details). Thus, it is natural to study an extension of the inflation proposal that contains explicit non-minimal coupling of the scalar field and gravity. Currently, theories of extra spatial dimensions, in which the observed universe is realized as a brane embedded in a higher dimensional spacetime, have attracted a lot of attention. In this framework, ordinary matters are trapped on the brane, but gravitation propagates through the entire spacetime [7-15]. The cosmological evolution on the brane is given by an effective Friedmann equation that incorporates the effects of the bulk in a non-trivial manner [16,17,18,19]. The chaotic inflation on the RSII brane has been studied for first time in [20]. Then extension of this study to warm inflation has been preformed in [21].

With these preliminaries, the goal of the present study is to investigate a braneworld viewpoint of inflation with an explicit non-minimal coupling of the scalar field and Ricci curvature on the brane. We study possible impact of the non-minimal coupling on the dynamics of this braneworld-inspired inflation. Our setup is based on the RS II braneworld model and we assume that brane is stable and inflation dynamics on the brane is independent of the bulk dynamics. We study modifications of this slow-roll inflation due to non-minimal coupling of the inflaton field and gravity on the brane. We study also parameter space of the

model numerically to obtain constraints imposed on this model by recent observations released by WMAP5+SDSS+SNIa datasets and we compare our results with the minimal case studied in Ref. [20]. Through this paper a dot on a quantity marks its time differentiation while a prime denotes differentiation with respect to the scalar field, φ.

2 The Setup

We start with the following action to construct a braneworld non-minimal inflation scenario

$$S = \frac{1}{2\kappa_5^2} \int_{bulk} d^5X \sqrt{-g^{(5)}}(R^{(5)}-2\Lambda_5) + \int_{brane} d^4x\sqrt{-g}\left[\frac{R}{2\kappa_4^2}-\frac{1}{2}g^{\mu\nu}\partial_\mu\varphi\partial_\nu\varphi-\frac{1}{2}\xi R\varphi^2-V(\varphi)-\lambda\right] \tag{1}$$

In this action, which is written in the Jordan frame, X is coordinate in the bulk, while x shows induced coordinate on the brane. κ_5^2 is 5-dimensional gravitational constant, $R^{(5)}$ is 5-dimensional Ricci scalar and ξ is the nonminimal coupling (NMC) of the scalar field φ and Ricci curvature on the brane,Λ_5 is the 5-dimensional cosmological constant in the bulk and λ is the brane tension. We have chosen a conformal coupling of the inflaton and gravity on the brane for simplicity. In other words, non-minimal coupling of the scalar field and gravity on the brane is $\alpha(\varphi) = \frac{1}{2}(1-\xi\varphi^2)$ with $\kappa_4^2 = 8\pi G = 1$. We note that there are two critical values of φ given by $\varphi_c = \pm\frac{1}{\sqrt{\xi}}$ that should be avoided to have well-defined field equations. Variation of the action with respect to φ leads to the equation of dynamics for scalar field on the brane

$$\ddot{\varphi} + 3H\dot{\varphi} + \xi R\varphi + \frac{dV}{d\varphi} = 0, \tag{2}$$

where $R = 6(\frac{\ddot{a}}{a}+\frac{\dot{a}^2}{a^2})$ for spatially flat FRW geometry on the brane and $H = \frac{\dot{a}}{a}$ is the brane Hubble parameter. In the slow-roll approximation where $\ddot{\varphi} \ll V(\varphi)$, equation of motion for the scalar field takes the following form

$$\dot{\varphi} = -\frac{\xi R\varphi + V'(\varphi)}{3H}. \tag{3}$$

The energy density and pressure of the non-minimally coupled scalar field are given by (see Ref. [5,6] for discussion on the various representations of the energy-momentum tensor of a non-minimally coupled scalar field)

$$\rho_\varphi = \frac{1}{2}\dot{\varphi}^2 + V(\varphi) + 6\xi H\varphi\dot{\varphi} + 3\xi H^2\varphi^2 \tag{4}$$

and

$$P_\varphi = \frac{1}{2}\dot{\varphi}^2 - V(\varphi) - 2\xi\varphi\ddot{\varphi} - 2\xi\dot{\varphi}^2 - 4\xi H\varphi\dot{\varphi} - \xi(2\dot{H}+3H^2)\varphi^2 \tag{5}$$

3

respectively. The conservation equation for scalar field energy density in this setup is given by

$$\dot{\rho}_\varphi + 3H(\rho_\varphi + P_\varphi) = \dot{\varphi}V' + \dot{\varphi}\ddot{\varphi} + 3H\dot{\varphi}^2 + \xi R\varphi\dot{\varphi} \tag{6}$$

where from equation (2) we find

$$\dot{\rho}_\varphi + 3H(\rho_\varphi + P_\varphi) = 0 \tag{7}$$

Note that the authors of Ref. [22] have treated this conservation on the brane in a relatively different way. They have defined a total energy-momentum tensor which consists of two parts: a pure (canonical) scalar field energy-momentum tensor and a non-minimal coupling-dependent part. The total energy density defined in this manner is then conserved. In our case, we have included all possible terms in equations (4) and (5) from the beginning and therefore, total energy density defined in this manner is conserved too.

Now, in a cosmological scenario based on the Randall-Sundrum II braneworld, the effective Friedmann equation on the brane can be written as follows [16,17,18,19]

$$H^2 = \frac{8\pi}{3M^2}\rho(1 + \frac{\rho}{2\lambda}), \tag{8}$$

where we have assumed that metric on the brane is spatially flat FRW type and the effective cosmological constant on the brane is negligible during inflation phase. M is the four-dimensional Plank scale, ρ is the total energy density on the brane, namely $\rho = \rho_\varphi + \rho_m$ where ρ_m is energy density of ordinary matter on the brane and λ is 3-brane tension. In the low energy limit where $\lambda \gg \rho$, one recovers the standard Friedmann cosmology. In the high energy limit where $\rho \gg \lambda$, the braneworld effects are dominant. In which follows we set $\rho_m = 0$ for simplicity.

In the slow-roll approximation, ρ_φ attains the following approximate form

$$\rho_\varphi \approx V(\varphi) + 6\xi H\varphi\dot{\varphi} + 3\xi H^2\varphi^2, \tag{9}$$

We use this approximate form in equation (10) to find cosmological dynamics of the model. Now the Friedmann equation of the model takes the following form(see[23,24] for more details)

$$H^2 + \frac{k}{a^2} = \left[r_c\alpha(\varphi)(H^2 + \frac{k}{a^2}) - \frac{\kappa_5^2}{6}(\rho + \lambda)\right]^2. \tag{10}$$

where we assume that the metric on the brane is spatially flat FRW type ($k = 0$). $r_c = \frac{\kappa_5^2}{2\kappa_4^2}$, is the induced -gravity crossover length scale.

$$H^2 = \left[r_c\alpha(\varphi)H^2 - \frac{\kappa_5^2}{6}\left(V(\varphi) - 2\xi^2 R\varphi^2 - 2\xi\varphi V' + 3\xi H^2\varphi^2 + \lambda\right)\right]^2 \tag{11}$$

4

Using the definition of $\dot{\varphi}$ as given by equation (3), this leads to a forth order equation for Hubble parameter of the model

$$H^4\left(r_c\alpha(\varphi) - \frac{\xi\varphi^2\kappa_5^2}{2}\right)^2 - H^2\left[1 + 2\left(r_c\alpha(\varphi) - \frac{\xi\varphi^2\kappa_5^2}{2}\right)\left(\frac{\kappa_5^2}{6}\left(V(\varphi) - 2\xi^2R\varphi^2 - 2\xi\varphi V' + \lambda\right)\right)\right]$$

$$+\left[\frac{\kappa_5^2}{6}\left(V(\varphi) - 2\xi^2R\varphi^2 - 2\xi\varphi V' + \lambda\right)\right]^2 = 0 \tag{12}$$

With a minimally coupled scalar field ($\xi = 0$)and in the absence of induced gravity on the brane (the pure Randall-Sandrum case with $r_c = 0$) we find

$$H^2 \simeq \frac{8\pi}{3M^2}V(\varphi)\left(1 + \frac{V(\varphi)}{2\lambda}\right),$$

$$\dot{\varphi} \simeq -\frac{V'}{3H}$$

which are appropriate Friedmann and scalar field equations for this case [20]. By assuming a non-vanishing value of the non-minimal coupling ξ, we can solve equation (12) for H^2 to find the following the following solutions

$$H^2 = \frac{\lambda}{b^2}\left[\frac{8\pi}{m_p^2} + \frac{8\pi r_c}{3m_p^2}b\left(1 + \frac{a}{\lambda}\right)\right] \pm \frac{2}{b}\sqrt{\frac{1}{b^2} + \frac{r_c}{b}\left(1 + \frac{a}{\lambda}\right)} \tag{13}$$

where a and b are defined as follows

$$a \equiv V - 2\xi\varphi(\xi R\varphi + V'), \qquad b \equiv 2r_c - 3\xi\varphi^2\kappa_4^2. \tag{14}$$

To be more specific, in which follows we consider just the plus sign in equation (13). We note that reality of the solution for H^2 requires that

$$\lambda \geq \frac{-\beta a}{1 + \beta}$$

where $\beta \equiv r_c b$. Now, we define the slow-roll parameters of our model as follows

$$\varepsilon \equiv -\frac{\dot{H}}{H^2},$$

$$\eta \equiv -\frac{\ddot{H}}{H\dot{H}}$$

and

$$\gamma^2 \equiv 2\varepsilon\eta - \frac{d\eta}{dt}.$$

5

We need to calculate these parameters in our non-minimal braneworld model. For ε we find

$$\varepsilon = \frac{2\dot{A}B - 2\dot{B}A - \dot{C}C^{-1}A}{4H^3A},$$ (15)

where we have defined

$$A = \frac{\left(2r_c - 3\xi\kappa_4^2\varphi^2\right)^2}{\lambda}$$

$$B = \frac{8\pi}{m_p^2} + \frac{8\pi r_c}{3m_p^2}b\left(1 + \frac{a}{\lambda}\right),$$

and

$$C = \frac{4}{b^4} + \frac{4r_c}{b^3}\left(1 + \frac{a}{\lambda}\right).$$

The second slow-roll parameter, η, is calculated as follows

$$\eta = \left[4A^2H^3(2\dot{B}A - 2\dot{B}\dot{A} + \dot{C}C^{-1}A)\right]^{-1}\left[(8\dot{A}AH^2 + 2\dot{B}A - 2\dot{A}B + \dot{C}C^{-1}A)(2\dot{B}A - 2\dot{A}B + \dot{C}C^{-1}A)\right.$$

$$\left. -(2\ddot{B}A - 2\ddot{A}B + \ddot{C}C^{-1}A - \dot{C}^2C^{-2}A + \dot{C}C^{-1}\dot{A})4A^2H^2\right].$$ (16)

And finally, the third slow-roll parameter, γ^2, in our model takes the following form

$$\gamma^2 = -\frac{\dot{\varphi}V'''}{3H^3}.$$ (17)

Inflation occurs when the condition $\varepsilon < 1$ (or equivalently $|\eta| < 1$) is fulfilled. With this condition and using (15) we find

$$\rho_\varphi < V + 3\xi H^2\varphi^2.$$ (18)

This is the condition for realization of the non-minimal inflation on the brane. Therefore, to have an inflationary period on the brane, the condition (18) should be fulfilled. Inflationary phase will terminates when the universe heats up so that the condition $\varepsilon = 1$ (or $|\eta| = 1$) is satisfied. We should stress here that in our non-minimal setup, depending on the values of the non-minimal coupling ξ, it is possible to fulfill $|\eta| = 1$ condition even before fulfilling $\epsilon = 1$. In other words, for some values of the non-minimal coupling, inflation terminates if the condition $|\eta| = 1$ is fulfilled. Figure 1 shows the the natural exit from inflation phase when the condition $|\eta| = 1$ is fulfilled before occurrence of $\epsilon = 1$. In this case we have

$$\rho_\varphi \simeq V + 3\xi H^2\varphi^2.$$ (19)

By comparison with the minimal case as has been studied in Ref. [20], we see that non-minimal coupling of the scalar field and gravity on the brane plays an important role on

the natural exit from inflationary phase. On the other hand, it is possible to achieve the condition $\varepsilon = 1$ before occurrence of $|\eta| = 1$, so that inflation phase terminates when the condition $\varepsilon = 1$ is fulfilled. This feature is shown in figure 2 for different values of the non-minimal coupling. We stress that in this figure the minimal case with $\xi = 0$ accounts for natural exit without additional mechanism too. This is possible in our setup because of the braneworld effect. In the standard 4-dimensional inflationary scenario with one minimally coupled inflaton field, it is impossible to exit inflationary phase naturally. We note also that the values of the non-minimal coupling ξ used in the figures lie within the acceptable range for ξ as has been obtained in Ref. [25] by confrontation of a non-minimally coupled phantom cosmology with the recent observations (see also [26]).
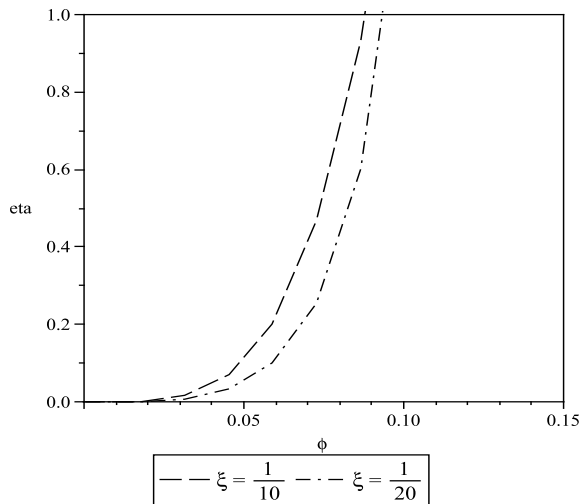

Figure 1: Natural exit from inflation phase when the condition $|\eta| = 1$ is fulfilled before occurrence of $\epsilon = 1$.

Now we focus on the number of e-folds as another important quantity in a typical inflation scenario. The number of e-folds is defined as

$$N \equiv \int_t^{t_{end}} H dt = \int_\varphi^{\varphi_{end}} \frac{H}{\dot{\varphi}} d\varphi$$

In our setup, the number of e-folds at the end of the inflation pase is given by

$$N = - \int_{\varphi_i}^{\varphi_e} \left(\frac{3H^2}{\xi R \varphi + V'} \right) d\varphi. \tag{20}$$

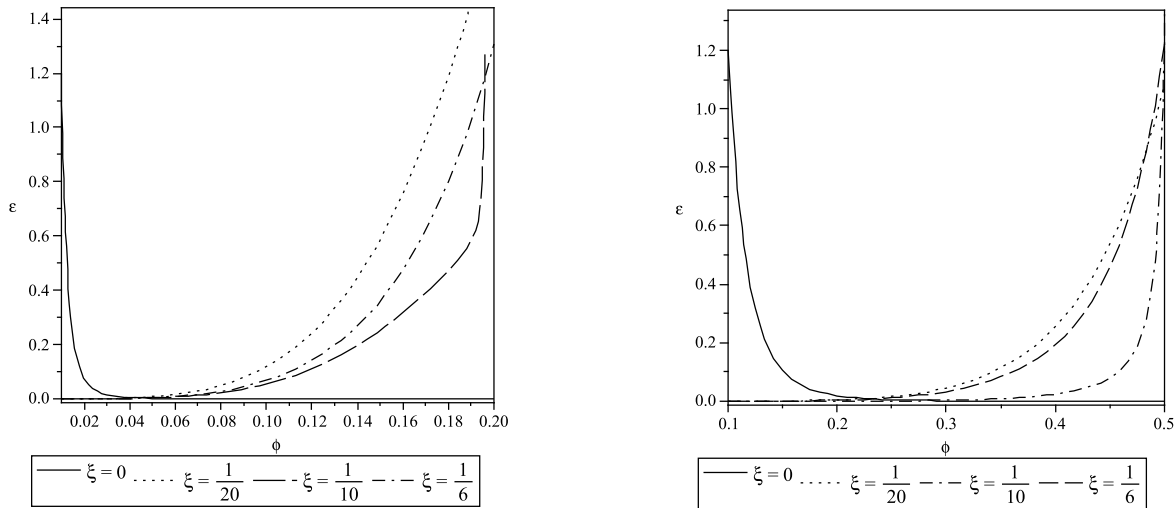Using the explicit form of H^2 with positive sign as given by equation (13), the number of

Figure 2: Natural exit from inflationary phase with various values of the non-minimal coupling for $V(\varphi) = V_0\varphi^2$ (left) and $V(\varphi) = V_0\varphi^4$ (right) in the case that hen the condition $\varepsilon = 1$ is fulfilled before occurrence of $|\eta| = 1$. The minimal case is given by $\xi = 0$. As these figure show, incorporation of the non-minimal coupling causes considerable difference in the variation of the slow-roll parameter ε, but there is graceful exit as for the minimal case.

e-folds in our non-minimal setup takes the following form

$$N = -\int_{\varphi_i}^{\varphi_e} \left(\frac{3}{\xi R\varphi + V'}\right)\left\{\frac{\lambda}{b^2}\left[\frac{8\pi}{m_p^2} + \frac{8\pi r_c}{3m_p^2} b\left(1 + \frac{a}{\lambda}\right)\right] + \frac{2}{b}\sqrt{\frac{1}{b^2} + \frac{r_c}{b}\left(1 + \frac{a}{\lambda}\right)}\right\}d\varphi \qquad (21)$$

with a and b as defined in (14). φ_i denotes the value of the scalar field φ when universe scale observed today crosses the Hubble horizon during inflation, while φ_e is the value of the scalar field when the universe exits the inflationary phase. To study the effect of the non-minimal coupling on the number of e-folds, we define

$$g \equiv \left(\frac{3}{\xi R\varphi + V'}\right)\left\{\frac{\lambda}{b^2}\left[\frac{8\pi}{m_p^2} + \frac{8\pi r_c}{3m_p^2} b\left(1 + \frac{a}{\lambda}\right)\right] + \frac{2}{b}\sqrt{\frac{1}{b^2} + \frac{r_c}{b}\left(1 + \frac{a}{\lambda}\right)}\right\}$$

which is the integrand of equation (21). The number of e-folds is proportional to the area enclosed between the g-curve and horizontal axis from φ_i to φ_e. Figure 3 shows the variation of g versus φ for different values of the non-minimal coupling and for two different energy scales. As the value of the non-minimal coupling increases, the enclosed area between g-curve and horizontal axis decreases leading to the conclusion that the number of e-folds reduces by increasing the values of the non-minimal coupling. Comparison with the minimal case shows also that the number of e-folds reduces by inclusion of a positive non-minimal
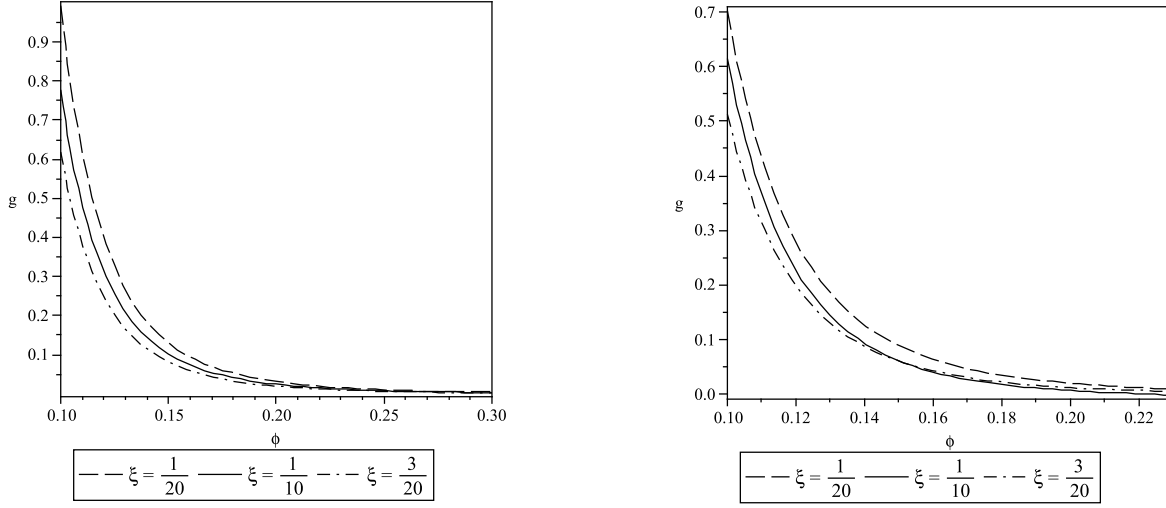
8

Figure 3: g versus φ and ξ for two different regimes: $\lambda \gg 1$ and $\lambda \ll 1$. Number of e-folds is given by the area bounded between g-curve and the horizontal axis from φ_i to φ_e in $g - \varphi$ plot. The number of e-folds decreases by increasing ξ.

coupling. Now, we study scalar and tensor perturbations in this non-minimal model. These perturbations are supposed to be adiabatic on the brane. We define the scalar curvature perturbation amplitude of a given mode when re-enters the Hubble radius as follows

$$A_s = \frac{2}{5}\frac{H}{\dot{\varphi}}\delta\varphi. \tag{22}$$

The scalar spectrum index is defined as follows

$$n_s = 1 + \frac{d\ln A_s^2}{d\ln k} \tag{23}$$

The interval in wave number is related to the number of e-folds by the relation $d\ln k(\varphi) = -dN(\varphi)$. Substituting (3) into the relation (22) we find for A_s

$$A_s^2 = \frac{36}{25}\frac{H^4}{(\xi R\varphi + V')^2}\delta\varphi^2 \tag{24}$$

Using the slow-roll parameters, we have

$$n_s = 1 - \frac{7}{2}\varepsilon + \frac{3}{2}\eta. \tag{25}$$

The running of the spectral index which is defined as

$$\alpha_s = \frac{dn_s}{d\ln k} \tag{26}$$

9

in our model takes the following form

$$\alpha_s = \frac{9}{2}(2\varepsilon\eta - 4\varepsilon^2) + \frac{3}{2}\left(2\varepsilon\eta - \gamma^2\right). \tag{27}$$

Tensor perturbations are bounded to the brane at long-wavelength and up to the first order these perturbations are decoupled from matter on the brane [21]. Therefore, on the large scale we can use the classical expression for these amplitudes [20]. These amplitudes at the Hubble crossing are given by

$$A_T^2 = \frac{4}{25\pi}\left(\frac{H}{M}\right)^2\bigg|_{k=aH} \tag{28}$$

where in our non-minimal case and within the slow-roll approximation H is given by equation (13)with positive sign, explicitly depended on the non-minimal coupling, ξ. The tensor spectral index is given by

$$n_T \equiv \frac{d\ln A_T^2}{d\ln k} \approx -2\varepsilon \tag{29}$$

where ε is given by equation (15). The ratio between the amplitude of tensor and scalar perturbations is given by

$$\frac{A_T^2}{A_s^2} \approx \frac{4\pi\left(\xi R\varphi + V'(\varphi)\right)^2}{9M^2H^4}. \tag{30}$$

After constructing the basic formalism, we study inflationary dynamics of this non-minimal model numerically. For this goal, in which follows and in all of our numerical calculations, we consider the well-known large-field inflationary potential $V(\varphi) = V_0\varphi^n$ with $n = 2$, 4 to investigate outcomes of our model. As has been shown previously in figures 1 and 2, this non-minimal model accounts for natural exit from inflationary phase without any additional mechanism. In fact, non-minimal coupling of the inflaton field and gravity on the brane provides a suitable parameter space for natural exit from inflationary phase. Figure 4 shows the variation of n_s for different values of the non-minimal coupling versus the inflaton field. Combining WMAP5 with SDSS and SNIa data, the spectral index is given by (see for instance [27] and references therein)

$$n_s = 0.960^{+0.014+0.026}_{-0.013-0.027} \qquad (1\sigma, 2\sigma \ CL). \tag{31}$$

This result shows that a red power spectrum is favored and $n_s > 1$ is disfavored even when gravitational waves are included, which constrains the models of inflation that can produce significant gravitational waves, such as chaotic or power-law inflation models, or a blue spectrum, such as hybrid inflation models. As we have shown, our non-minimal scenario on
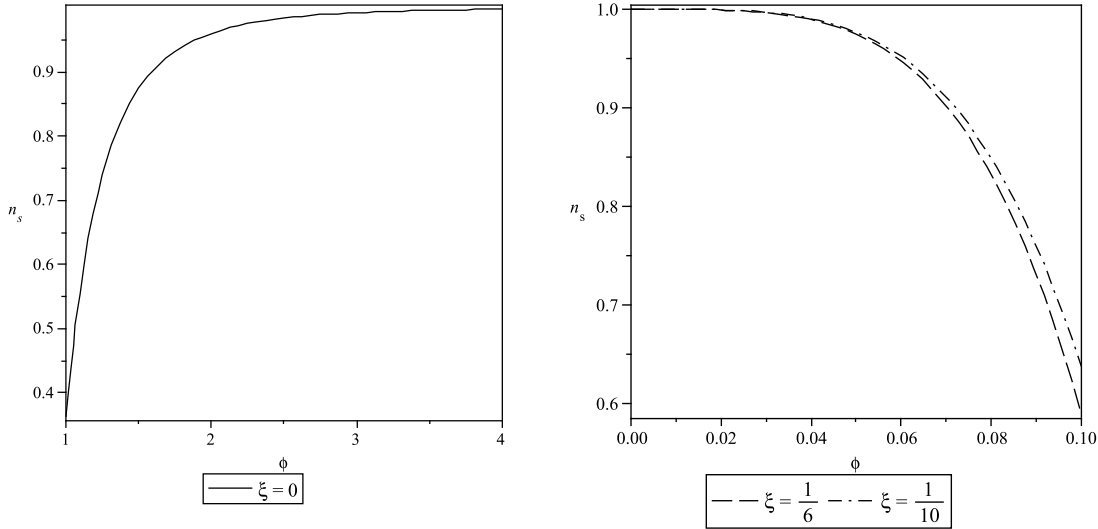
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Figure 4: Variation of n_s versus the inflaton field for three values of the non-minimal coupling.

the brane gives also a red and nearly scale invariant power spectrum which excludes blue spectrum. Since, $0.92 \leq n_s \leq 1$, our numerical calculation shows that we can constraint ξ to the following range

$$0 \leq \xi \leq 0.114 \,, \tag{32}$$

which lies within the acceptable range for ξ as has been obtained in Ref. [25] by confrontation of a non-minimally coupled phantom cosmology with the recent observations. Note that negative values of ξ corresponding to anti-gravitation are excluded from our considerations.

If there is running of the spectral index, the constraint on this running from combined data of WMAP5+SDSS+SNIa is given by $\frac{dn_s}{d\ln k} = -0.032^{+0.021}_{-0.020}$ within the 1σ CL [27]. The special case with $n_s = 1$ and $\frac{dn_s}{dl\ln k} = 0$ results in the scale invariant spectrum. The significance of n_s and $\frac{dn_s}{dl\ln k}$ is that different inflation models motivated by different physics make specific, testable predictions for the values of these quantities. Figure 5 shows the running of the spectral index versus the inflaton field for different values of the non-minimal coupling for $V(\varphi) = V_0 \varphi^2$. Evidently, our non-minimal setup agrees with this dataset and again we can use this observational data to constraint the values of the non-minimal coupling. In other words, since $-0.052 \leq \alpha_s \leq -0.011$, we can constraint ξ so that $0 \leq \xi \leq 0.106$. Comparing this range of ξ with constraint (32), we see that confrontation of this non-minimal brane inflation with recent observations leads to the result that $0 \leq \xi \leq 0.106$ which is acceptable from other studies such as Ref. [25].

One important point in our study is the issue of frame. There is a conformal transformation which transforms the action (1) (which is written in the Jordan frame) to corresponding action in the Einstein frame [5,6]. In the Einstein frame, the gravitational sector is expressed
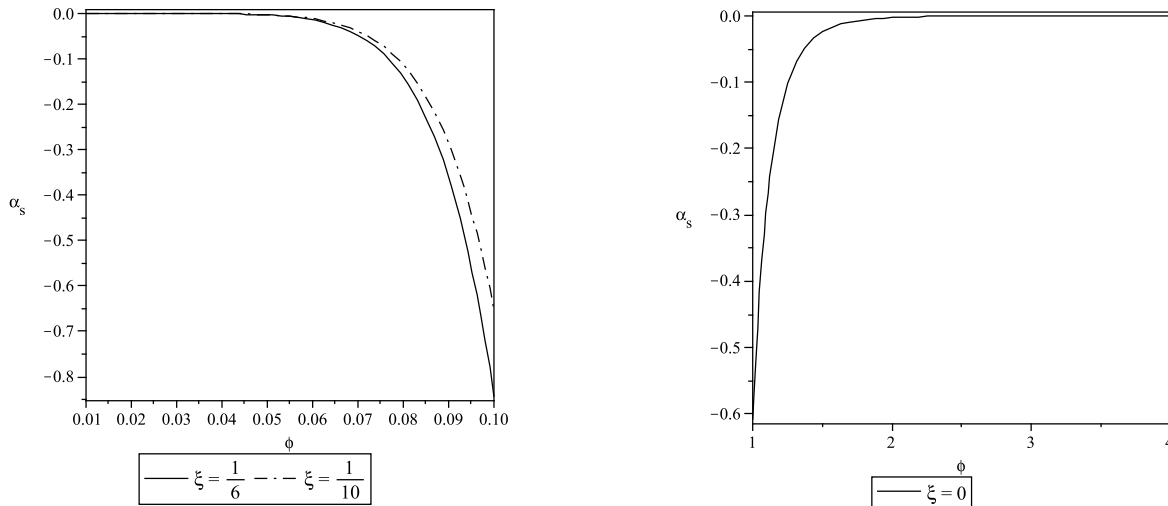
Figure 5: α_s versus φ for different values of ξ.

in terms of a re-scaled scalar field which is minimally coupled to gravity and evolves in a re-scaled potential, thereby simplifying the formalism. However, we should keep in mind that the matter sector is strongly affected by such a conformal transformation since all of the matter fields are now non-minimally coupled to the re-scaled metric: in particular, stress tensor conservation in the matter sector is no longer ensured [28,29]. On the other hand, as Makino and Sasaki [30] and Fakir *et al* [31] have shown, the amplitude of scalar perturbation in the Jordan frame exactly coincides with that in the Einstein frame. This proof (for details see [32]) allows us to calculate the scalar power spectrum in the Jordan and Einstein frame. As a result, the scalar power spectrum has no dependence on the choice of frames, i.e., it is conformally invariant. So, our results can be compared to observations directly without any ambiguities. This is an important point since one has to check validity of non-gravity experiments in Einstein frame. For instance, validity of electro-magnetic related experiments such as CMB experiment should be checked in Einstein frame. As Komatsu and Futamase have shown, the scalar power spectrum is independent on the choice of frames [32].

3   Summary and Conclusions

In the inflationary paradigm, inflaton field can interact with other fields such as Ricci curvature. This interaction is shown by the non-minimal coupling of the inflaton and gravity in the action of the scenario. There are many compelling reasons to include an explicit non-minimal coupling in the action of the theory. So, naturally we should include non-minimal

coupling of gravity and inflaton field in the action of an inflation scenario. Usually by incorporation of the non-minimal coupling it is harder to realize inflation even with potential that are known to be inflationary in the minimal case. However, inclusion of the non-minimal coupling is inevitable from field theoretical viewpoint especially their renormalizability. In this paper we have studied an inflation model that there is an explicit non-minimal coupling of the inflaton field and gravity on the Randall-Sundrum II brane. This is an extension of the study presented in Ref. [20] to scalar-tensor type theories. We have studied impact of the non-minimal coupling on the dynamics of this braneworld-inspired inflation. As we have shown, this model provides a natural exit from the inflationary phase without adopting any additional mechanism for appropriate values of the conformal coupling. The number of e-folds decreases by increasing the values of the conformal coupling, ξ. A confrontation with recent WMAP5+SDSS+ SNIa combined data shows that this model gives a red and nearly scale invariant power spectrum for $V(\varphi) = V_0 \varphi^2$ and $V(\varphi) = V_0 \varphi^4$. From another viewpoint, comparison of this non-minimal inflation model with observational data could provide severe constraints on the values of the non-minimal coupling. In this paper our numerical analysis shows that $0 \leq \xi \leq 0.106$ is favored by non-minimal inflation on the Randall-Sundrum II brane. Since we have calculated the first order contributions in slow-roll parameters, our results are valid in both Jordan and Einstein frames. However, higher order corrections could lead to different results in these two frames. Finally, we note that inclusion of the non-minimal coupling of gravity and inflaton field produces a wider parameter space relative to minimal case. This wider parameter space provides much more freedom than single self-interacting scalar field to fit with the observational data.

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