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Slow-roll inflation from Kähler moduli couplings in CY flux compactification

ABSTRACT

Obtaining a slow-roll inflaton potential from superstring theory connecting the ten dimensional high scale physics with four dimensional effective theories through various quantum corrections is a long standing problem in string cosmology [1]. Recently PLANCK-2018 [2] and BICEP/KECK [3] have also proved the accuracy of such potentials in explaining various experimental constraints regarding large scale structure, CMBR anisotropy and polarization data with significant precessions. Vigorous investigations (see [4] for example) over past ten years or so reveal that the perturbative effects in Kähler moduli stabilizations cannot alone be responsible for achieving a stable dS-vacuum. Therefore, in this work we have studied the KKLT type non-perturbative corrections in tree level superpotential for one [5] and two [6] Kähler moduli arising from E-instantons [7] and gaugino condensation [8] over D7 stacks. Our framework is based on type IIB/F-theory compactified on a T^6/Z_N Calabi-Yau (CY) orientifold, equipped with three magnetized non-interacting and intersecting D7 branes, O7 planes and the quantized closed 3-form world volume fluxes threading the 4-cycle CY volume. The quantum corrections break the supersymmetric no-scale structure of tree level Kähler potential giving an F-term AdS potential which is dynamically uplifted by D-term potential originating from U (1) charges of D7 branes in gravitational sector thereby providing the inflaton potential after proper canonical normalization. In the two-moduli set up we have shown that there exist four couplings depending upon the sizes of the 4-cycles and amounts of non-trivial flux aids by the branes which ultimately decide the final shape and energy scale of the inflaton potential. Our derivations show that the effects of wrapping and intersecting of D7 branes could bring forth the slow-roll plateau acting on the top of the perturbative ingredients like LVS [9] and multi-graviton scattering [10]. The relevant cosmological parameters are obtained by k-space analysis of linear cosmological perturbations by the novel *dynamical horizon exit method* [11] and found [5, 6] to be consistent with PLANCK and BICEP/KECK constraints viz.,$n_s = 0.995525 - 0.995540$, $r = 2.325{\times}10^{-5} - 2.345{\times}10^{-5}$, $N = 58.915 - 58.930$, $n_t = (-2.905{\times}10^{-6}) - (-2.930{\times}10^{-6})$ at $k = 0.001 - 0.009$ Mpc^{-1} in strong coupling regime, for example. By taking into account the interaction between moduli fields (τ_1 and τ_2) we get a reduced value of tensor-to-scalar ratio which is favorable for future CMB-experiments [12].

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