CONSTRAINTS ON INFLATION AND THE ORIGIN OF SPACE-TIME

Abstract

by

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The constraints on various evidences for Physics at the Planck scale are examined in the context of inflation. This thesis considers that in three parts.In one we examine resonant particles or superstrings that may have been present during inflation. In another part we examine the effects of extra dimensions in the brane-world cosmology on inflation. Also the effects on dark radiation is checked and examined.

The primordial power spectrum is believed to derive from quantum fluctuations generated during the inflationary epoch. The various observed power spectra of the cosmic microwave background (CMB) are then modified by the dynamics of the cosmic radiation and matter fluids as various scales re-enter the horizon along with effects due to the transport of photons from the epoch of last scattering to the present time. Indeed, the *Planck* data have provided the highest resolution yet available in the determination of the CMB power spectra. Although the temperature TT primordial power spectrum is well fit with a simple tilted power law, there remain at least two interesting features that may suggest deviations from the simplest inflation paradigm.

One such feature is the well known suppression of the $\ell = 2$ moment of the CMB power spectrum observed both by *Planck* and by the Wilkinson Microwave

Anisotropy Probe (*WMAP*). There is also a feature of marginal statistical significance in the observed power spectrum of both *Planck* and *WMAP* near multipoles $\ell = 10 - 30$. Both of these deviations occur in an interesting region in the CMB power spectrum because they correspond to angular scales that are not yet in causal contact when the CMB photons were emitted. Hence, the observed power spectrum is close to the true primordial power spectrum for these features.

Number of mechanisms have been proposed to deal with the suppression of the power spectrum on large scales and low multipoles. In this thesis, a particular approach is proposed to explain irregularities in the low ℓ of the CMB power spectrum. In a series of papers we have explained that deviations at $\ell = 2$ and $\ell = 10 - 30$ could be of the resonant creation of Planck-scale fermions that couple to the inflaton. This thesis explores the possibility that a specific sequence of super-string excitations may have made itself known via its coupling to the inflaton field of inflation. If these ideas are correct this could be the first evidence of new physics during the Planck scale.

Here, an analysis of the Randal Sundrum brane-world cosmology in the context of the latest CMB constraints from *Planck* is done. We summarize constraints on the most popular classes of models and explore some more realistic potentials. The constraint on standard inflationary parameters changes in the brane-world scenario. The constraints on the so called 'Dark' radiation term from the latest light-element nuclear reaction rates and the latest CMB data is studied. Here I also summarize the constraints on the higher dimensional cosmology.