Contribution ID : **219** Type : **Plenary/section talk**

The high-frequency gravitational waves in exact inflationary models with Gauss-Bonnet term

Tuesday, 11 October 2016 17:00 (15)

The theory of the cosmological inflation successfully describes the accelerated expansion of the universe evolution at early stages. Also, inflation in the early universe has become the standard model for the generation of cosmological perturbations in the universe, the seeds for large-scale structure and temperature anisotropies of the cosmic microwave background. Quantum fluctuations of the inflaton field give rise to an almost scale-invariant power spectrum of cosmological perturbations.

String theory is often regarded as the leading candidate for unifying gravity with the other fundamental forces and for a quantum theory of gravity. It is known that the effective supergravity action from superstrings induces correction terms of higher order in the curvature, which may play a significant role in the early universe. The simplest such correction is the Gauss-Bonnet term in the low-energy effective action of the string theory. Such term provides the possibility of avoiding the initial singularity of the Universe.

We consider an action with the Gauss-Bonnet term that is coupled to a scalar field \begin{equation} S_{GB}=\int dˆ{4}x\sqrt{-g}\left[\frac{1}{2}R-\frac{1}{2}(\partialˆ{\mu}\phi\partial_{\mu}\phi)-V(\phi)-\frac{1}{2}\xi(\phi)Rˆ{2}_{GB}\right], \end{equation} where ϕ is an inflaton field with a potential $V(\phi)$, R is the Ricci scalar curvature of the space-time, $R^2_{\rm GB} = R_{\mu\nu\rho\sigma}R^{\mu\nu\rho\sigma} - 4R_{\mu\nu}R^{\mu\nu} + R^2$ is the Gauss-Bonnet term, and $8\pi G = c = 1$. The Gauss-Bonnet coupling $\xi(\phi)$ is required to be a function of a scalar field in order to give nontrivial effects on the background dynamics.

The method of exact solutions of the background dynamical equations in a spatially flat Friedmann-Robertson-Walker universe is based on the connection between Hubble parameters for inflation with Gauss-Bonnet term and standard inflation is considereded in this work.

On the basis of this connection we calculate the exact values of the parameters of cosmological perturbations at the crossing of the Hubble radius for the inflationary models with Gauss-Bonnet correction.

The detection of relic gravitational waves can provide the main information about early universe and can be used to test the theoretical models. In this context, it is important to develop a new methods for the detection of gravitational waves. One of the promising method in the high-frequency part of the spectrum is based on the low-frequency optical resonance phenomenon in the Fabry-Perot interferometers. The description of this method and comparison with another methods are also presented.

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Session Classification : Nuclear physics and particle physics - parallel III

Track Classification : Nuclear physics and particle physics