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Stability of the Yang-Mills theory vacuum and Cosmological Inflation.

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We examine the phenomena of the chromomagnetic gluon condensation in Yang-Mills theory and the problem of stability of the vacuum state. The stability of the vacuum state is analysed in the nonlinear regime. It is shown that an apparent instability of the Yang Mills vacuum is a result of quadratic approximation. In the case of (anti)self-dual fields the interaction of chromomagnetic modes of the quantised field in the direction of zero modes is calculated by using a new method of infrared regularisation as well as by the integration over the collective variables of self-interacting zero modes. The deformation of (anti)self-dual fields is also considered in the nonlinear regime by the integration, in this case, over the collective variables of self-interacting unstable modes. All these vacuum field configurations are stable and indicate that the vacuum is stable and is a superposition of many states. The deep interrelation between elementary particle physics and cosmology manifests itself when one considers the contribution of quantum fluctuations of vacuum fields to the dark energy and the effective cosmological constant. The contribution of zero-point energy exceeds by many orders of magnitude the observational cosmological upper bound on the energy density of the universe. Therefore it seems natural to expect that vacuum fluctuations of the fundamental fields would influence the cosmological evolution in any way. Our aim is to describe a recent investigation of the influence of the Yang-Mills vacuum polarisation and of the chromomagnetic condensation on the evolution of Friedmann cosmology, on inflation and on primordial gravitational waves.

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