Confinement and Cosmological Phase Transition

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I. ABSTRACT

In this paper we use a simple Lagrangian density with few parameters to investigate confinement of gluons and first order cosmological transition in Higgs-like potential with a real scalar field ϕ. We investigate the characteristics of the gluons at low energies where particles are created by nonperturbative parametric resonance of the scalar (inflaton) field ϕ. We study the cosmological phase transition and inflation by converting the gauge field $F^{\mu\nu}F_{\mu\nu}$ into thermodynamic potential density Φ using *effective field theory*. This is intended to serve as a quantum correction to the Higgs-like potential bringing about cosmological phase transition. Even though the gauge field is coupled to a color dielectric function $G(\phi)$ in the Lagrangian density, we carefully define $G(\phi)$ to provide the needed confinement and the cosmological phase transition. The quantum correction is also intended to remove the *domain wall* problem associated with the *spontaneous symmetry breaking* (SSB) models and to provide smooth transition to inflationary regime. We analyse the *vacuum energy density* ρ_v and the *cosmological constant* Λ associated with the vacuum to establish inflation before, during and after the phase transition. We verify the potency of the model by fitting it into the Planck data. Finally, we investigate confinement of gluons after the phase transition and the associated glueball masses in such high energy regime in the order of M_p.

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