Contribution ID: **33** Type: **not specified**

No slow-roll inflation à la Generalized Chaplygin Gas in General Relativity

Wednesday 23 September 2020 15:20 (20 minutes)

The Generalized Chaplygin Gas (GCG) model is characterized by the equation of state $P = -A\rho^{-\alpha}$, where $A > 0$ and $\alpha < 1$. The model has been extensively studied due to its interesting properties and applicability in several contexts, from late-time acceleration to primordial inflation. Nonetheless we show that the inflationary slow-roll regime cannot be satisfied by the GCG model when General Relativity (GR) is considered. In particular, although the model has been applied to inflation with $0 < \alpha < 1$, we show that for $-1 < \alpha \leq 1$ there is no expansion of the Universe but an accelerated contraction. For $\alpha \leq -5/3$, the second slow-roll parameter η_H is larger than unity, so there is no sustained period of inflation. Only for α very close to -1 the model produces enough e-folds, thus greatly reducing its parameter space. Moreover, using the Planck 2018 results, we constrain the parameters of the model to $1.391 < A < 1.522$ and $-1.0131 < \alpha < -1.0103$. Finally, we extend our analysis to the Generalized Chaplygin-Jacobi Gas (GCJG) model. We find that the introduction of a new parameter does not solve the previous problems or change the bounds on the parameters of the model. We conclude that the violation of the slow-roll conditions is a generic feature of the GCG and GCJG models during inflation when GR is considered.

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Session Classification: CoCo