Contribution ID: **16** Type: **Oral**

Using Big Bang Nucleosynthesis to constrain f(R) gravity scalarons and primordial black hole masses

Big Bang Nucleosynthesis (BBN) is a strong probe for testing new physics of the early universe. Introducing modified gravity in the very early universe gives rise to some interesting effects. In this work, the effects of $f(R)$ gravity scalarons introduced in *Kalita (2018, 2020, 2021)* on the BBN era is investigated. Observed BBN constraints on the shift of freezeout temperature and elemental abundance of He^4 have been employed to give constraint on scalaron mass range and hence constraint on the primordial black hole (PBH) masses that is expected to contribute to non-baryonic dark matter. It has been found that for the range of PBH mass $(10^{-15} - 10^{6})$ $M_{\odot}$, the observed BBN bound is satisfied. The associated scalaron mass range is $(10^{5} - 10^{-16})$ eV. The effects of $f(R)$ scalarons on neutron fraction and deuterium abundance has also been studied. It has been found that there is no appreciable change in neutron fraction value from the General Relativistic (GR) scenario and therefore the scalarons are found not to spoil the BBN era.

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Session Classification: Cosmology

Track Classification: Cosmology