Poster Session #D
Binary sources of Gravitational Waves and cosmology

D09

Suppression of Ultra Slow-Roll Primordial Black Holes from Inflaton momentum

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Inflation is a period of accelerated expansion in the early universe, driven by a scalar field called the inflaton, that solves the horizon and flatness problems. Crucially it also provides a method by which small scale quantum fluctuations can be grown to super-Hubble size, classicalise and cause density perturbations that act as the seeds for large-scale structure formation. If these density perturbations are sufficiently overdense then they can collapse to form Primordial Black Holes (PBHs), a possible dark matter candidate. It has been shown that the standard Slow-Roll version of inflation does not produce enough sufficiently overdense density perturbations to form enough PBHs to make up a significant proportion of dark matter. One method to enhance the number of PBHs formed is to consider the Ultra Slow-Roll regime characterised by a plateau in the inflaton potential where quantum diffusion is the dominant effect on the inflaton. Previous calculations have indicated that a sufficiently wide plateau could enhance the density fluctuations sufficiently for PBHs to form all or a substantial quantity of dark matter. We revisit these calculations taking into account the velocity of the inflaton as it enters the plateau and its backreaction on the expansion rate. We find that it can significantly supress the formation of PBHs. We derive analytic formulae for the mass fraction $\beta(M)$ of PBHs formed due to the inflaton entering a USR region and plot the dependence of $\beta(M)$ on the inflaton's momentum as it enters the plateau and the width of the plateau itself. This allows us to put new constraints on how wide a plateau region could be without overproducing PBHs.