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Primordial black holes and stochastic inflation beyond slow roll

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Primordial Black Holes (PBHs) may form in the early universe, from the gravitational collapse of large density perturbations, generated by large quantum fluctuations during inflation. Since PBHs form from rare over-densities, their abundance is sensitive to the tail of the primordial probability distribution function (PDF) of the perturbations. It is therefore important to calculate the full PDF of the perturbations, which can be carried out non-perturbatively using the 'stochastic inflation' framework. In single field inflationary models, generating large enough perturbations to produce an interesting abundance of PBHs requires violation of slow roll. It is therefore necessary to extend the stochastic inflation formalism beyond slow roll, and consequently there has been a surge in the research interest in this direction in the recent years. A crucial ingredient for this is the stochastic noise matrix corresponding to the small wavelength fluctuations. In this talk, after providing a brief introduction to PBHs and ultra slow-roll inflation, the speaker will discuss analytical and numerical calculations of these matrix elements for an inflaton potential with a feature which violates slow roll and produces large, potentially PBH generating, perturbations. The talk will be based on the following work carried out at the Particle Cosmology Group, University of Nottingham, in collaboration with Prof. Edmund J. Copeland and Prof. Anne M. Green [arXiv: 2303.17375].

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