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Cosmological perturbations and primordial black hole formation

Cosmological perturbations could collapse after horizon crossing giving rise to primordial black holes (PBHs) in the early universe if the perturbation amplitude is large enough to overcome a critical threshold depending on the equation of state and the density profile. In this talk I will present results coming from numerical simulations of PBH formation, where a time independent curvature profile has been used to generate initial conditions describing supra-horizon scale perturbations of a type which could have come from inflation. The connection between the abundance of PBHs constrained by the observations, and the critical amplitude calculated numerically, allows to understand more about the history of the early universe and the possible structures that could have been formed. The simulations shows that PBHs are characterised by critical collapse, with the mass spectrum described by a characteristic feature as a scaling law. I will show examples of simulations describing the collapse of perturbations, also when it is specified on top of a second perturbation with a larger scale.

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