

Primordial black holes from Higgs inflation?

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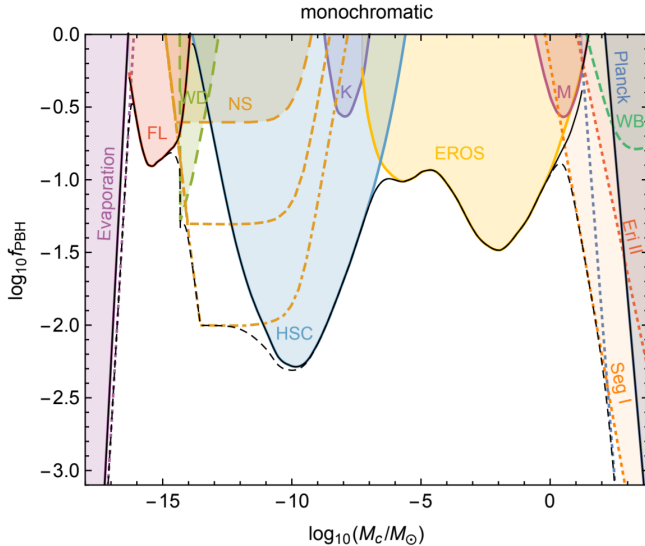
[1810.12608]

In collaboration with Syksy Räsänen

Primordial black holes (PBHs)

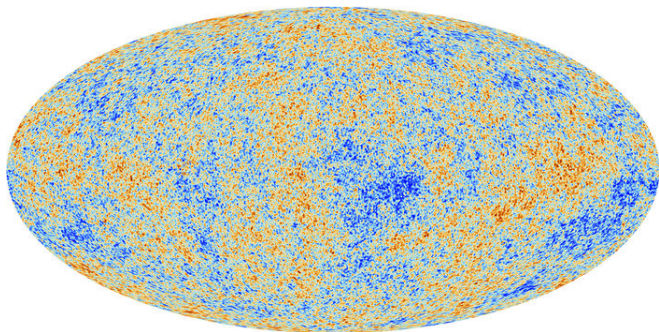
- ▶ Black holes formed in the early universe
- ▶ Dark matter candidate
- ▶ Observable by GW detectors?

PBHs as dark matter [1705.05567]



Origin of PBHs

- ▶ A possible origin: primordial density perturbations from cosmic inflation



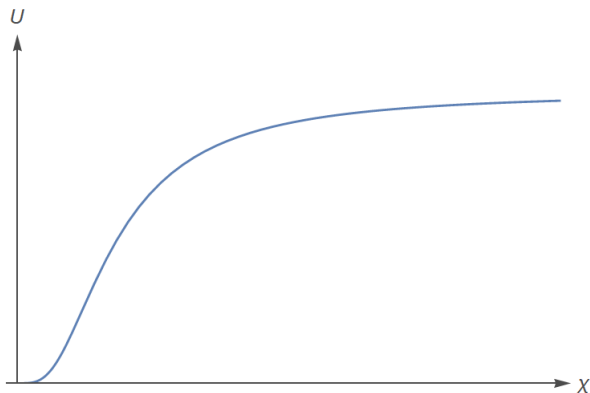
Higgs inflation

- ▶ Standard Model Higgs, coupled non-minimally to gravity, drives cosmic inflation

$$S = \int d^4x \sqrt{-g} \left[-\frac{1}{2} (M^2 + \xi h^2) R + \frac{1}{2} g^{\mu\nu} \partial_\mu h \partial_\nu h - \frac{\lambda}{4} h^4 \right]$$

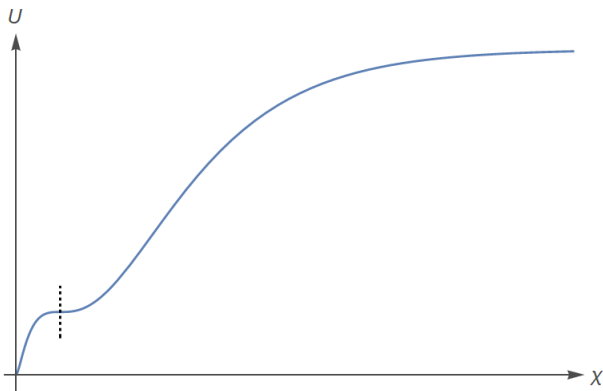
Higgs inflation

- ▶ “Einstein frame potential”:



- ▶ Compatible with Planck CMB results; in particular, $n_s = 0.9625 \pm 0.0048$ [1807.06211]

PBHs from a feature in the potential



- ▶ Feature from quantum corrections to effective potential

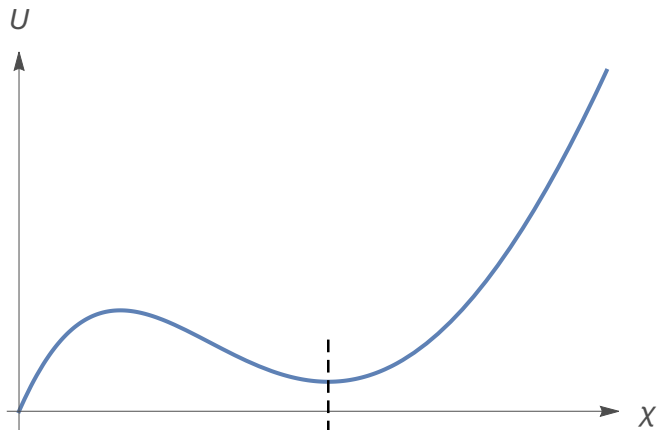
Quantum corrections

- ▶ Model is non-renormalizable
- ▶ At large field values, can use effective field theory: chiral SM
- ▶ Freedom in connecting this to electroweak scale physics (jumps in couplings)

Quantum corrections

- ▶ Scan over all quantum-corrected potentials with a suitable feature
- ▶ Check PBH formation for them

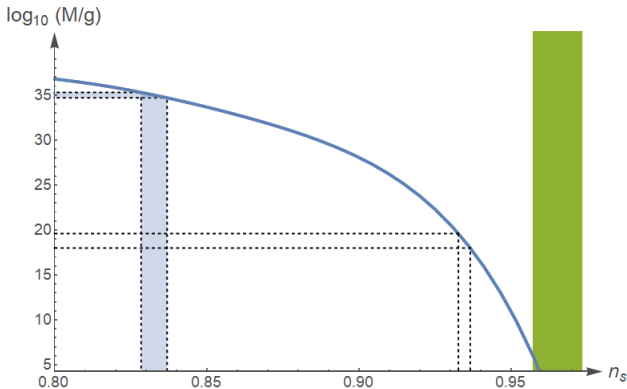
Results



- ▶ PBH abundance can be fine-tuned

Results

▶ PBH mass:



▶ Discrepancy between PBH limits and CMB measurements

Planck scale dark matter?

- ▶ In Higgs inflation, measured n_s is only compatible with small PBHs
- ▶ These evaporate quickly by Hawking radiation
- ▶ IF Planck mass relics left behind: these could constitute DM

Conclusions

- ▶ PBHs can be produced abundantly in Higgs inflation
- ▶ Big black holes not compatible with CMB observations
- ▶ Planck mass relics as DM still possible