Primordial black holes from confinement *

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work with Gia Dvali and Florian Kühnel

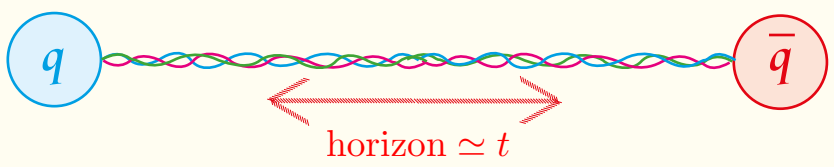
Key: The same force responsible for the confinement of hadrons can explain dark matter

Mechanism

Inflationary fluctuations produce quarks which are diluted by inflationary expansion

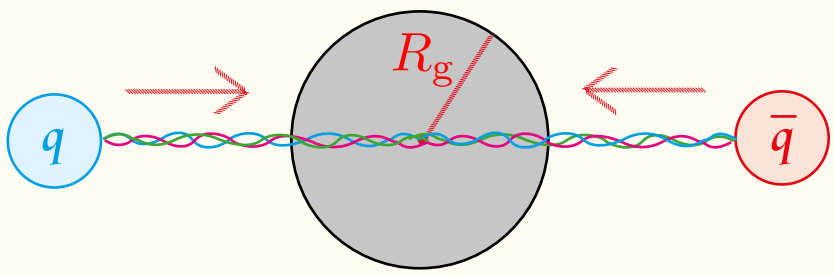
- By the end of inflation $d \propto e^{N_e}$ N_e being the number of e-folds

Quarks are confined at energy scale Λ_c



- Coloured flux tubes (strings) connecting them form
- Collapse cannot be immediate due to causality $d \gg$ horizon
- String stability $\Longrightarrow$ $\Lambda_c \gtrsim m_{\rm quark}$

Eventually quarks enter in casual contact and accelerate relativistically toward each other

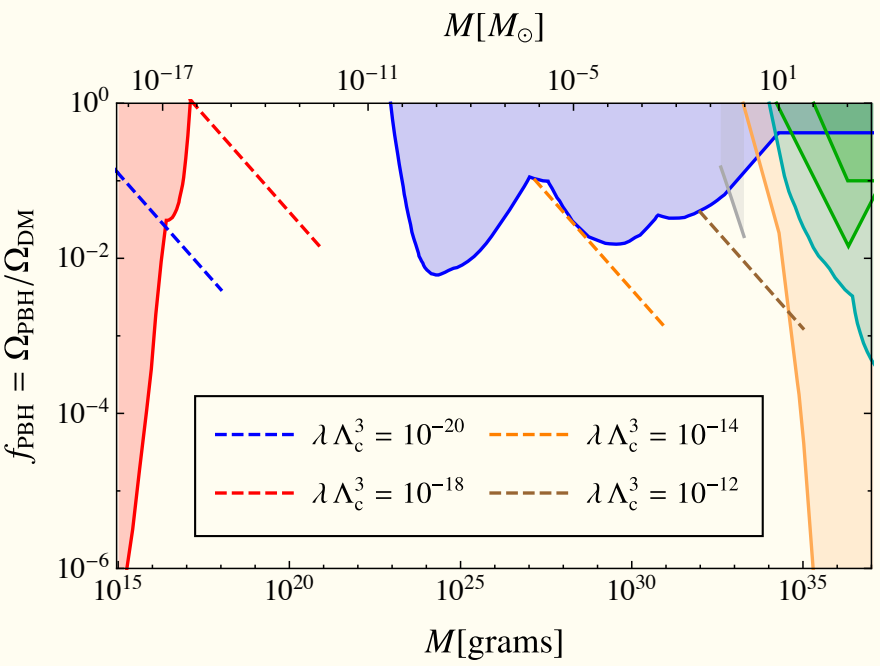


- Configuration Schwarzschild radius is

$$R_g \simeq l_{\rm Pl}^2 \, \Lambda_c^2 \, t \gg \Lambda_c^{-1}$$

$\Longrightarrow$ Primordial black hole forms

Dark matter



$$f_{\rm PBH} = \frac{\Omega_{\rm PBH}}{\Omega_{\rm DM}} \propto \Lambda_c^3 \, M_{\rm PBH}^{-1/2}$$

- Filled areas correspond to pheno. costraints
- 100 % of dark matter @ $M_{\rm PBH} \sim 10^{17}$g
- Naturally explains supermassive black holes in galactic centres $f_{\rm PBH} \propto M_{\rm PBH}^{-1/2}$
- Lighter black holes can be maximally spinning due to impact parameter induced by the string fluctuations
- Compatible with QCD if during fomation

$$\Lambda_c \gtrsim m_{\rm quark}$$

generic in string theory (moduli)

- Formation generates unique gravitational - waves signal

$$\Omega_{\rm GW} \text{ is flat}$$

interesting for NANOGrav and LISA

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