6-16 Testing primordial black-hole (PBH) dark matter by MeV gamma-ray, CMB and gravitational wave observations

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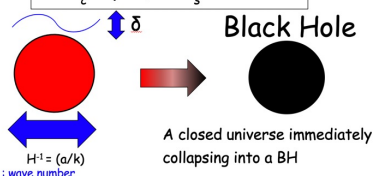
Conditions for a PBH formation in Radiation dominated (RD) Universe

Zel'dovich and Novikov (1967), Hawking (1971), Carr (1975)

Harada,Yoo and KK (2013)

- Gravity could be stronger than pressure

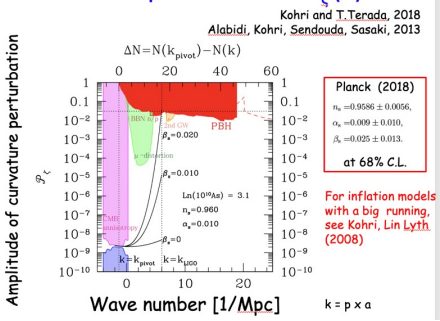
$$\delta > \delta_c \sim p/\rho \sim c_s^2 = w = 1/3$$



Curvature perturbation $P_\zeta(k)$

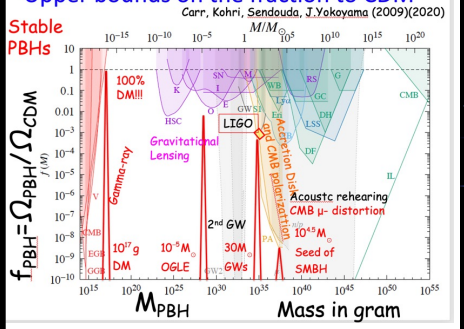
Kohri and T.Terada, 2018

Alabidi, Kohri, Sendouda, Sasaki, 2013



Upper bounds on the fraction to CDM

Carr, Kohri, Sendouda, J.Yokoyama (2009)(2020)



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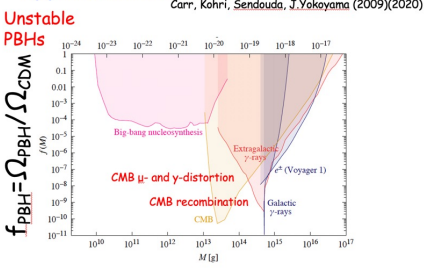
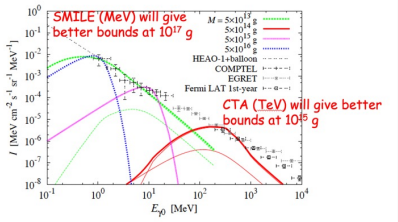


γ-rays: Evaporating PBHs through Hawking Process

$$\mathrm{d}\dot{N}_s = \frac{\mathrm{d}E}{2\pi}\frac{\Gamma_s}{e^{E/T_{\rm BH}}-(-1)^{2s}}$$

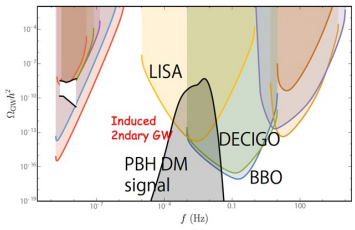
Carr, Kohri, Sendouda and Yokoyama (2010)



Primordial Black Holes and Second Order Gravitational Waves from Tachyonic Instability induced in Higgs-R^2 Inflation

Dhong Yeon Cheong, Kazunori Kohri, Seong Chan Park, arXiv:2205.14813 [hep-ph]

See also, K. Kohri and T. Terada, arXiv:2009.11853



Conclusion

1. Primordial black holes (PBHs) are good candidates for dark matter (masses 10^{17} g - 10^{23} g)
2. PBHs (masses 10^{17} g - 10^{18} g) evaporating due to quantum effects can be observed in the MeV gamma-ray spectrum, the spectral distortion of the CMB and the change in the recombination history, and gravitational wave
3. .We may have a hint for quantum gravity effects near the horizon