Small Primordial Black Holes as Window on Quantum Gravity

Sebastian Zell

UCLouvain

Work[1] with Gia Dvali, Lukas Eisemann and Marco Michel

20th June 2023

[1] M. M., S. Z., *The Timescales of Quantum Breaking*, arXiv:2306.09410.
G. D., L. E., M. M., S. Z., *Black Hole Metamorphosis and Stabilization by Memory Burden*, Phys. Rev. D **102** (2020), arXiv:2006.00011.

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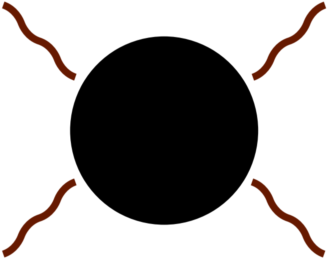

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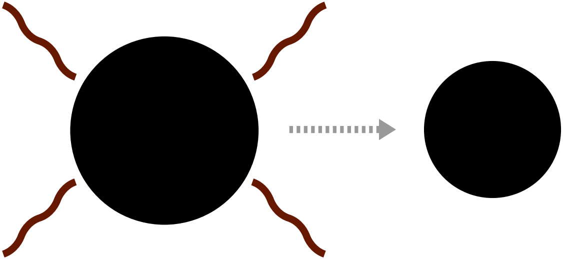

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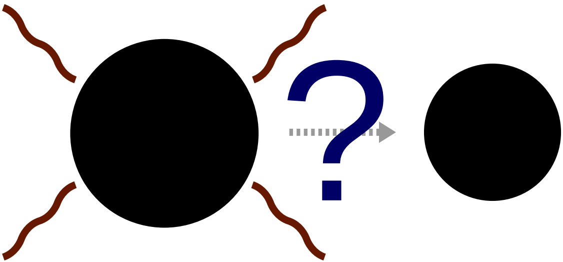

Outline

What happens to a black hole as it evaporates?

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1. Why it is an open question
2. Searching for small primordial black holes
3. Hints from analogue models

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- Naive timescale of (half) evaporation

$$t_{1/2} \sim S r_g$$

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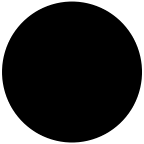

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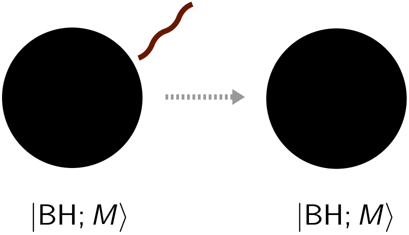

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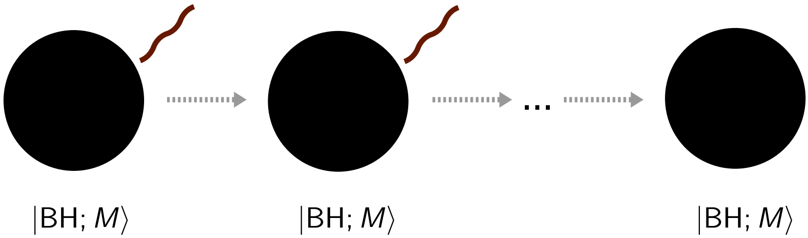

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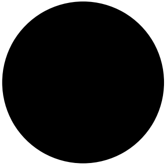

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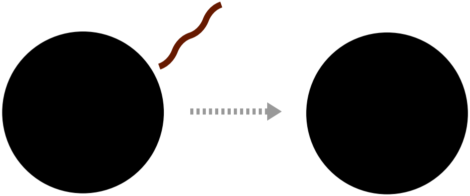

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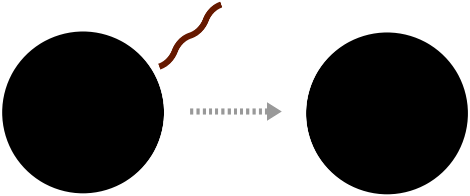

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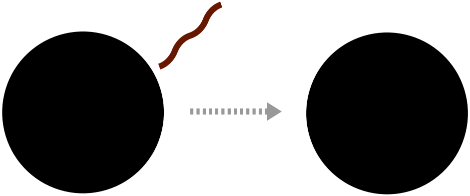

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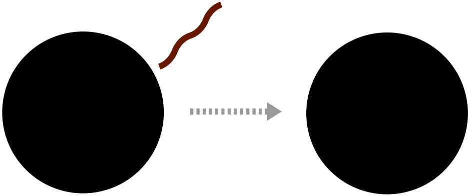

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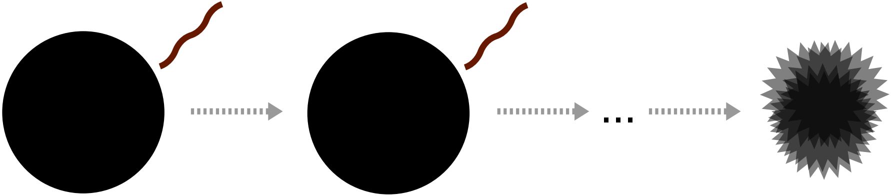

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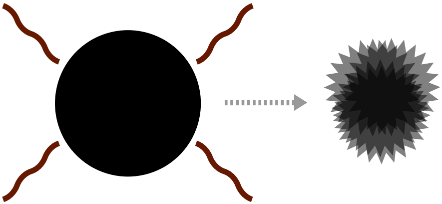

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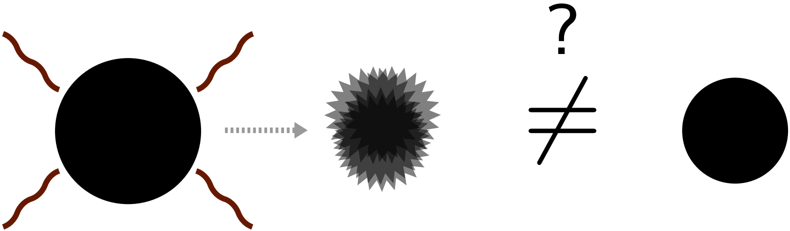

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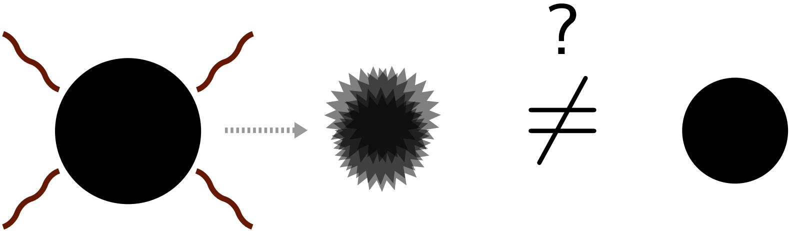

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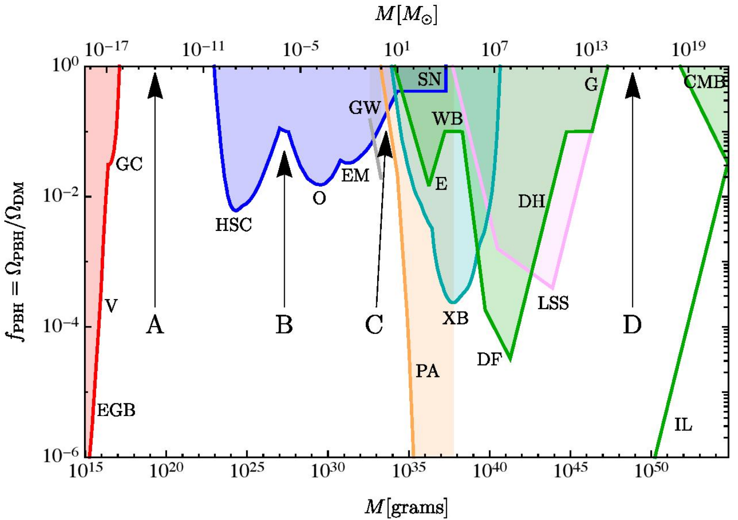

Figure from: B. Carr, F. Kühnel, *Primordial Black Holes as Dark Matter: Recent Developments*, `arXiv:2006.02838`.

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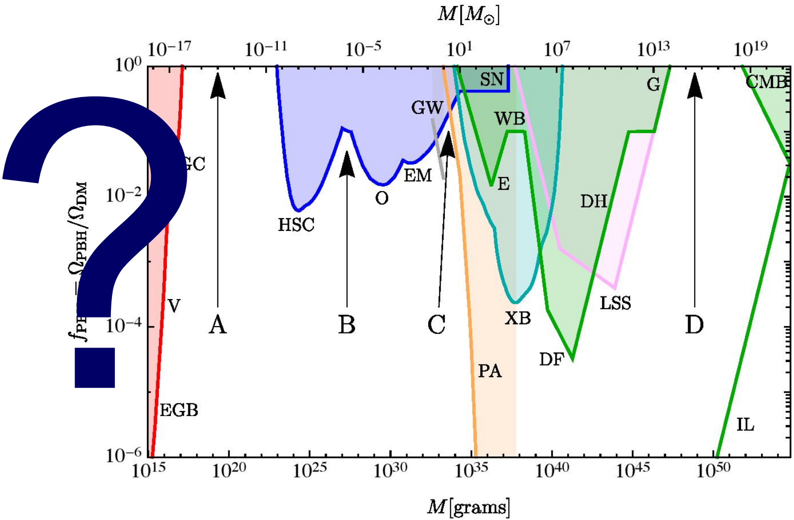

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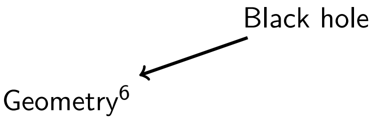

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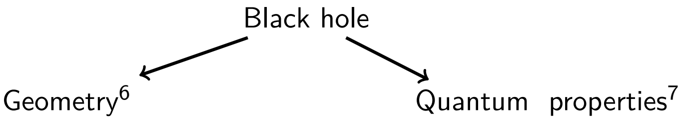

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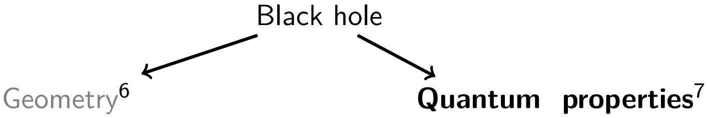

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- Analogue models: indications for early slowdown

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Prototype model[12]

- Use S modes $\hat{a}_1^\dagger, \ldots, \hat{a}_S^\dagger$

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- Dictionary

$\hat{n}_0$: carries mass

$\langle\hat{n}_0\rangle = S$: black hole state

$\hat{n}_k$: carry entropy

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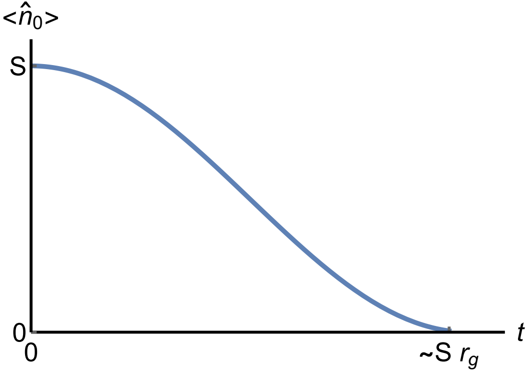

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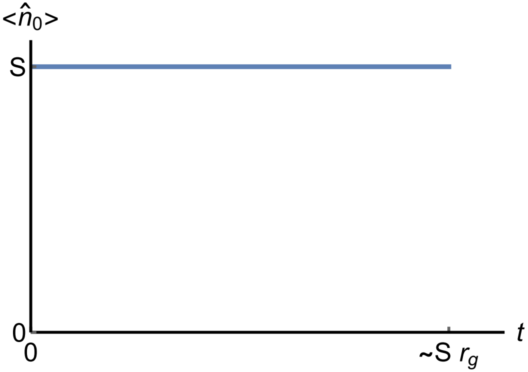

Time evolution

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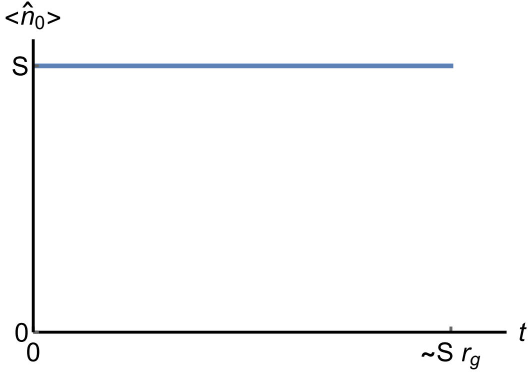

Memory burden:[13] entropy prevents evaporation

[13] G. Dvali, *A Microscopic Model of Holography: Survival by the Burden of Memory*, `arXiv:1810.02336`.

Full model[16]

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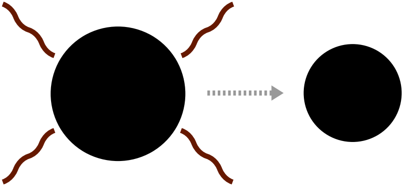

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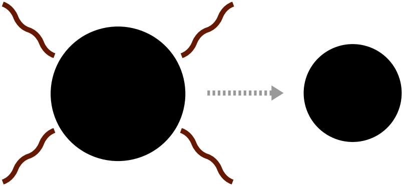

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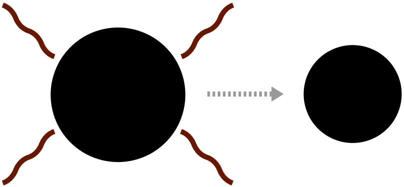

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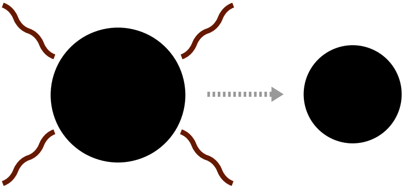

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back