

New Horizons in Primordial Black Hole physics (NEHOP)



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Small Primordial Black Holes as Window on Quantum Gravity

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Hawking's calculation of particle production by a black hole is based on the semi-classical limit of a fixed metric. This approximation may break down after a finite time as a black hole evolves due to back-reaction. Therefore, I shall argue that two far-reaching questions remain to be answered:

- (1) How long is the semi-classical description valid?
- (2) What happens after a potential breakdown?

Primordial black holes (PBHs) offer unique opportunities to address these issues by observations. Since one possible option is a slowdown of evaporation, it is conceivable that PBHs below 10^{15} g can have survived until today. Such long-lived small PBHs could not only act as dark matter, but detecting even a single one of them would also greatly advance our understanding of quantum gravity. Finally, I will attempt to answer the above questions using explicitly solvable analogue models. A non-perturbative computation of real-time evolution reveals indications that (1) the semi-classical description can break down long before half of the mass is lost and that indeed (2) evaporation slows down drastically at this point.

Based on:

M. Michel, S. Zell, *The Timescales of Quantum Breaking*, arXiv:2203.XXXXX, to appear.

G. Dvali, L. Eisemann, M. Michel, S. Zell, *Black hole metamorphosis and stabilization by memory burden*, Phys. Rev. D 102 (2020) 103523, arXiv:2006.00011.

Primary authors: MICHEL, Marco (Ben-Gurion University of the Negev); ZELL, Sebastian (UCLouvain)

Presenter: ZELL, Sebastian (UCLouvain)

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