Title: Panel Discussion - Black hole puzzles (Di Filippo, Gregory, Holdom, Myers, Stelle)

Speakers: Francesco Di Filippo, Ruth Gregory, Bob Holdom, Robert Myers, Kellogg Stelle

Collection: Puzzles in the Quantum Gravity Landscape: viewpoints from different approaches

Date: October 26, 2023 - 1:30 PM

URL: https://pirsa.org/23100015

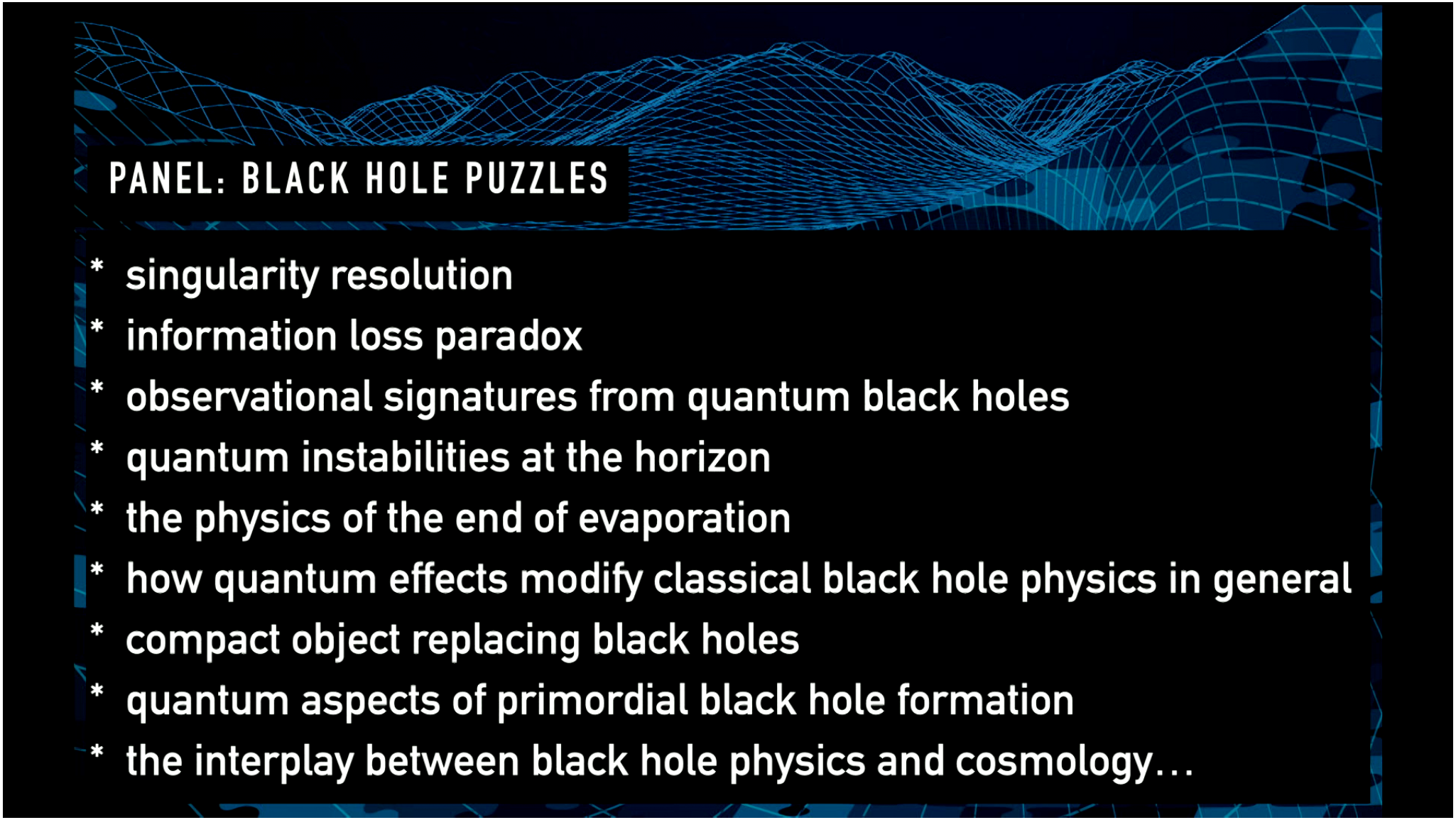
PUZZLES IN THE QUANTUM GRAVITY LANDSCAPE

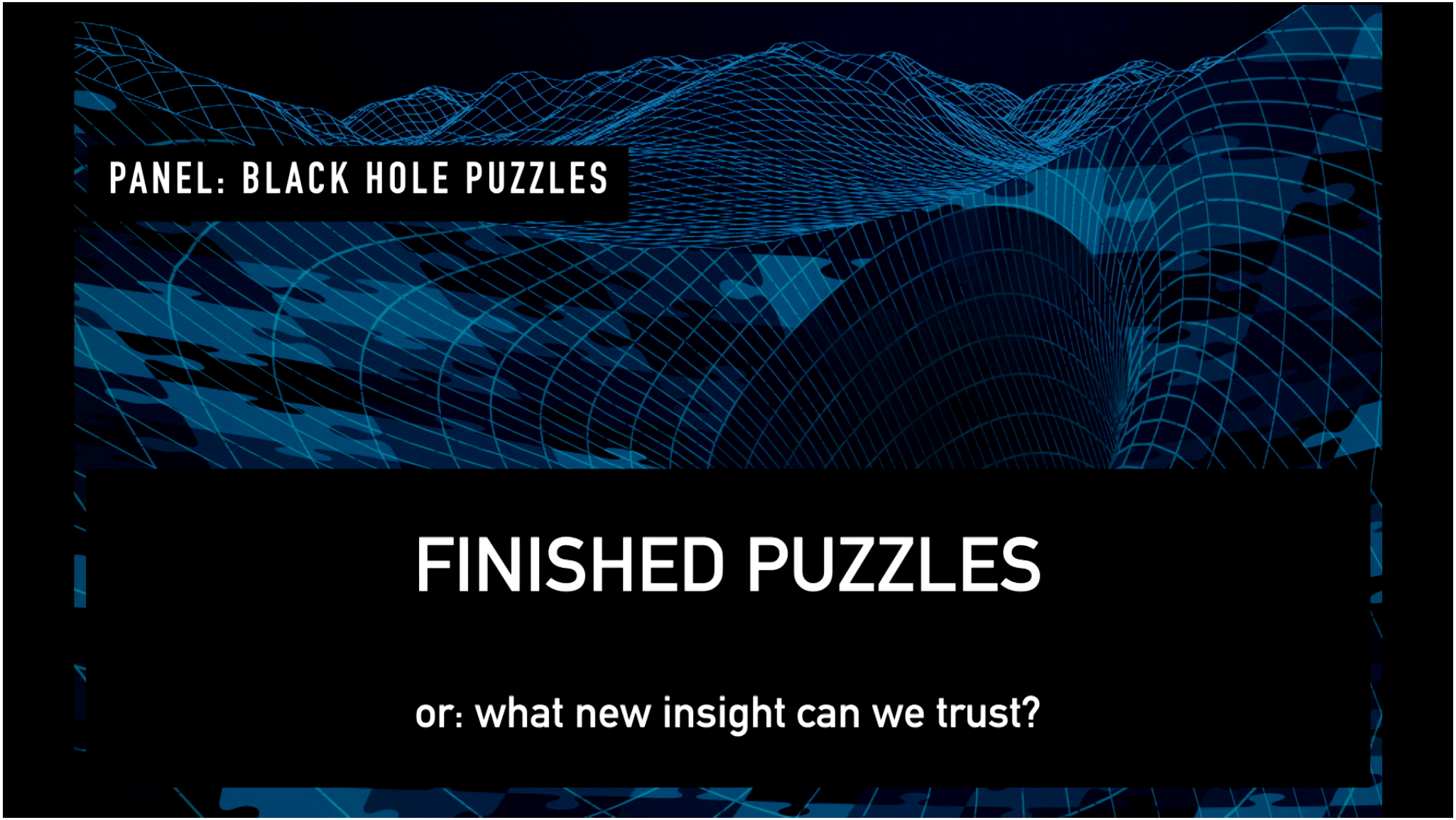
Viewpoints from different approaches

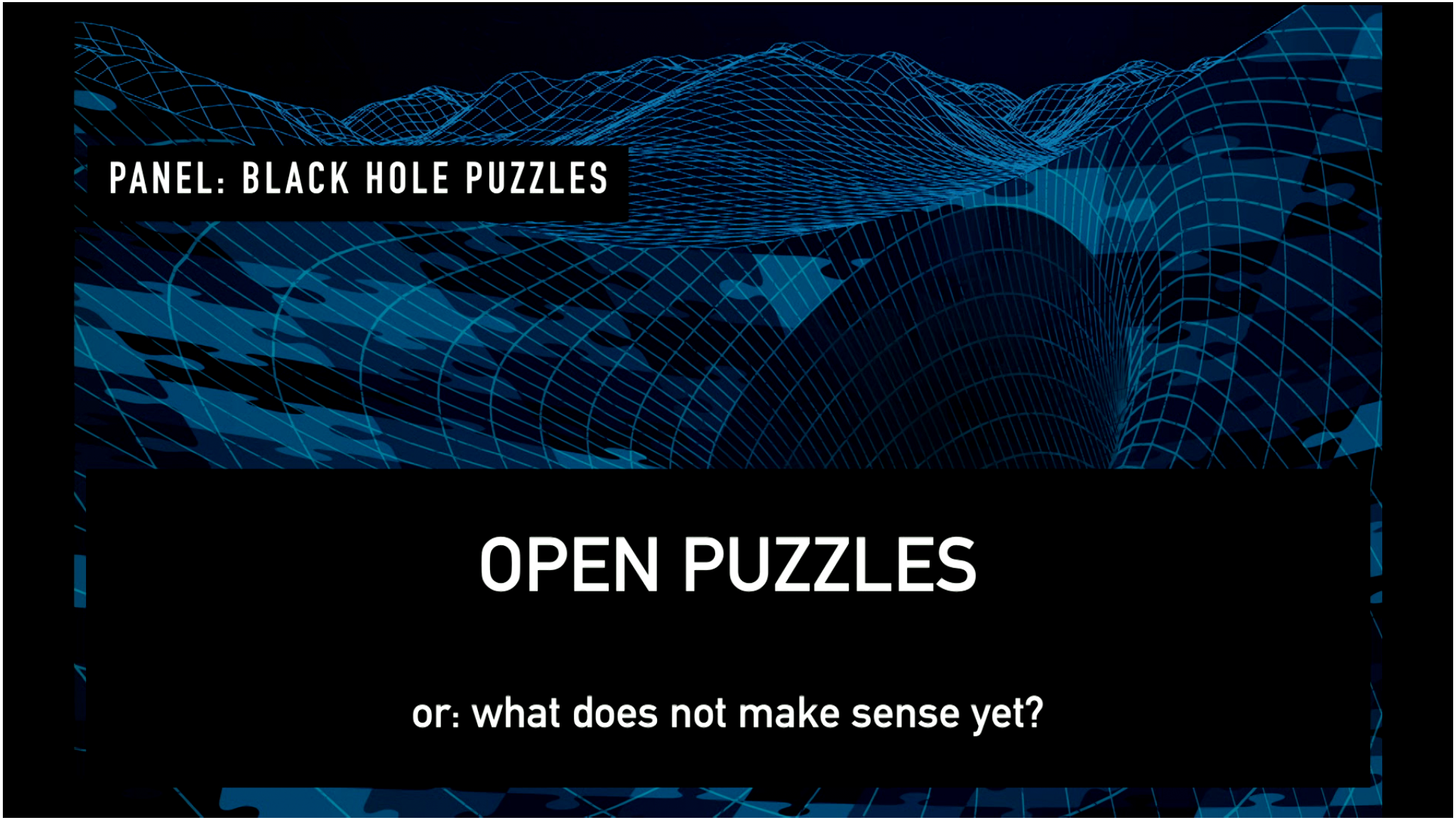
PANEL: BLACK HOLE PUZZLES

Panelists: Francesco Di Filippo, Ruth Gregory, Bob Holdon, Rob Myers, Kelly Stelle

Moderator: Francesca Vidotto


PANEL: BLACK HOLE PUZZLES
* singularity resolution
* information loss paradox
* observational signatures from quantum black holes
* quantum instabilities at the horizon
* the physics of the end of evaporation
* how quantum effects modify classical black hole physics in general
* compact object replacing black holes
* quantum aspects of primordial black hole formation
* the interplay between black hole physics and cosmology…


PANEL: BLACK HOLE PUZZLES
FINISHED PUZZLES
or: what new insight can we trust?


PANEL: BLACK HOLE PUZZLES
OPEN PUZZLES
or: what does not make sense yet?

can a UV completion to gravity produce a black hole replacement?

- are there states much larger than the small distance cutoff of a EFT that cannot be described by the EFT?
- QCD example — quark matter stars cannot be described by the low energy EFT (the chiral Lagrangian)
- quadratic gravity (a QFT) might be a UV completion of gravity
- quadratic gravity has arbitrarily large, horizonless, classical solutions not present in Einstein gravity

2-2-hole and its entropy

- gravitationally bound ball of relativistic gas
- compactness essentially the same as a black hole
- integrate the entropy density of the gas to get the total entropy S_{22}

$$T_\infty S_{22} = T_{\rm BH} S_{\rm BH} = \frac{M}{2}$$

$$\frac{S_{22}}{S_{\rm BH}} = 0.7548 N^{\frac{1}{4}} \left(\frac{m_G}{m_{\rm Pl}}\right)^{\frac{1}{2}} \gtrsim 1$$

- N is number of particle species, and $S_{22} \propto N^{\frac{1}{4}}$ avoids the "species problem" of the black hole