BLACK HOLES RADIATION IS TURNED OF BY INFALLING STUFF

arXiv:1408.0778

arXiv:1407.3577.

The case is made that in the case of astrophysical black holes, Hawking radiation is emitted in the vicinity of marginally trapped surfaces, which are locally defined, rather than the event horizon, which is globally defined, and is not unique when $\Lambda>0$.

Consequently as long radiation such as the CBR falls in, as most of the Hawking radiation is trapped, and so the black hole does not evaporate [arXiv:1408.0778]

Actually it seems it does not emit any radiation to be trapped … until the CBR dies away to zero. Then it is unclear what happens [arXiv:1407.3577].

Figure 1: Astrophysical Black Holes in classical theory

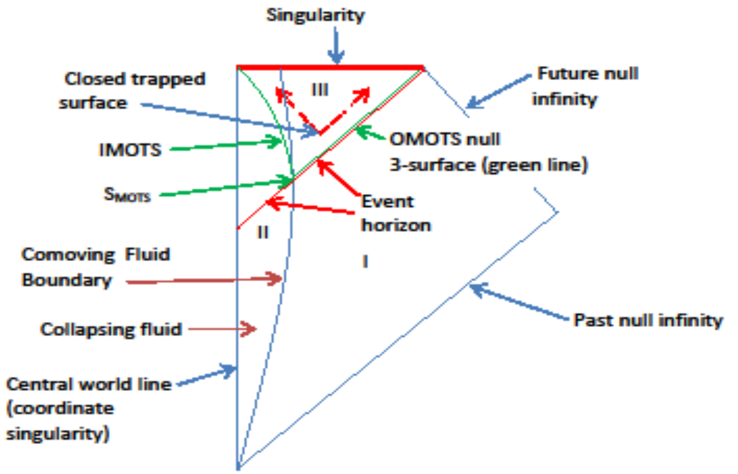

FIGURE 1: Classical black hole formation. The event horizon continues to the centre, the OMOTS and IMOTS surfaces both start at the S_{MOTS} 2-surface.

Figure 4: Astrophysical Black Holesin semi-classical theory, standard view

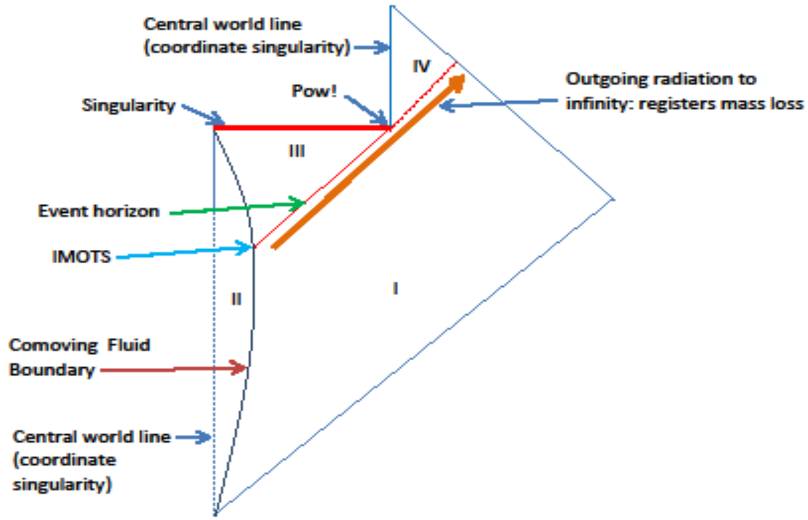

FIGURE 4: The semi classical view: effect of Hawking radiation

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Standard view is based on applying energy conservation to singularity

- Negative energy reduces mass of singularity

But why should singularity obey energy conservation?

- It's outside of space time
- There are no laws for its behaviour
- There are no open neighbourhoods where one can definer the laws that should apply

Major unproven and untestable assumption.

I don't believe it! – take the singularity seriously
It's the end of space, time, and physics (Wheeler)

1st key issue: is there really a singularity?

If it emits positive and negative radiation

-ve in, +ve out

– can it eat the fluid away so that there actually is no singularity?

Local horizon forms but then goes away

- No event horizon ever forms

- Ellis and Perry?? => probably no
- Hawking: ???
- Bardeen: unphysical matter , holography
- Mersini-Houghton: wrong vacuum (need Unruh)

Figure 5: Black Hole Evaporation Processes

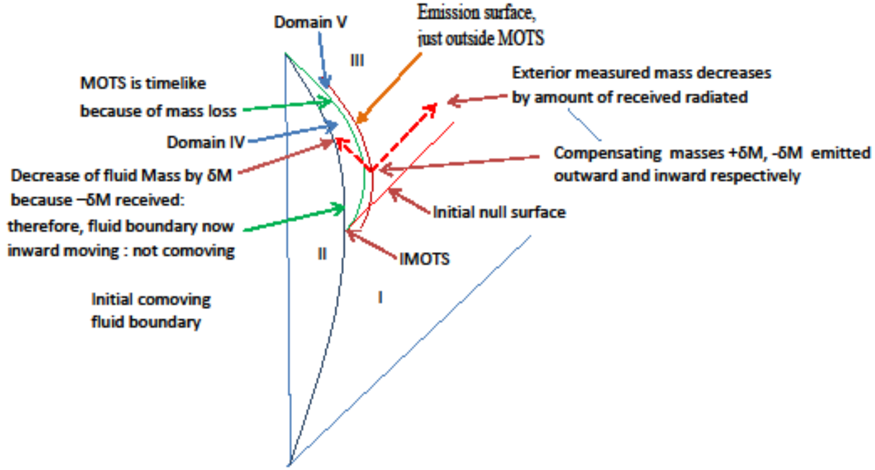


FIGURE 5: Backreaction effect of Hawking radiation on spacetime: the basic compensated processes.

Figure 4

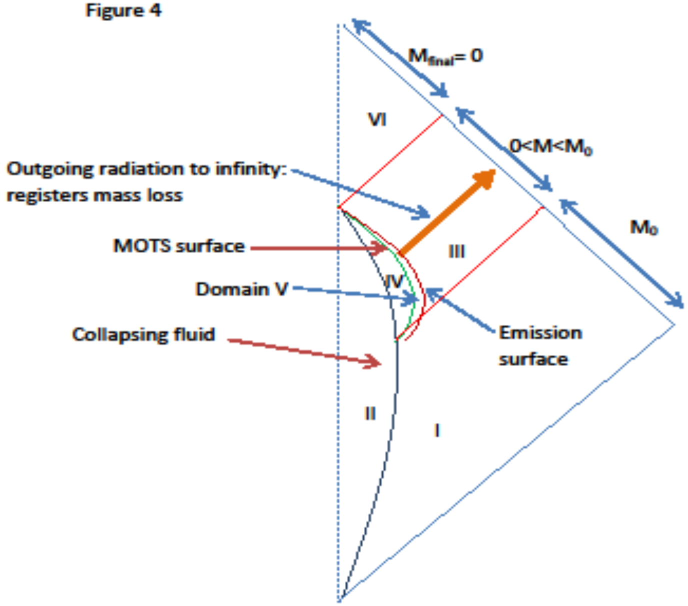


FIGURE 4: No singularity occurs.

2nd key issue:

Is Hawking radiation determined

- by a global event horizon?
- by a local apparent horizon?

Global: Don Page, Roger Penrose, Stephen Hawking (?), …
Local: Parikh and Wilczek, Matt Visser, Tim Clifton, Alex Nielsen, Paranjape and Padmanabhan, …

In former case: don't know where event horizon is:

- wont' be determined till end of universe
- e.g. Galaxy BH merge with Andromeda BH
- So how does the local physics know when/where to emit radiation?

Don Page says the difference is very little today. Is it?

2nd key issue:

- by a local apparent horizon?

If so which one:

The outer one (OMOTS)?

Or the inner one (IMOTS)?

OMOTS is spacelike in realistic case: suggests no
- Particle pair trapped, tunnelling, S-matrix all depend on timelike surface

IMOTS is timelike in realistic case: suggests yes

Figure 2: Astrophysical Black Hole trapping properties

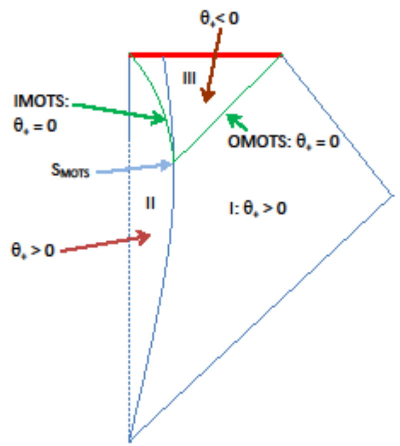


FIGURE 2: Astrophysical black hole trapping properties: the sign of the divergence θ_+ of the outgoing null geodesics in different domains. The MOTS surfaces separate domains where it has opposite signs.

Figure 3: Domains when CBR effects are taken into account

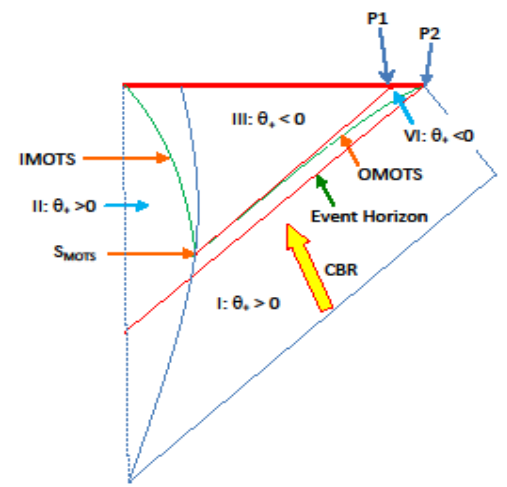


FIGURE 3: Domains and the signs of the outward null divergence θ_+ when CBR is taken into account, represented as radiation streaming in from infinity. The null event horizon now lies outside the spacelike OMOTS surface.

Figure 4: Domains when CBR effects and cosmological constant are taken into account

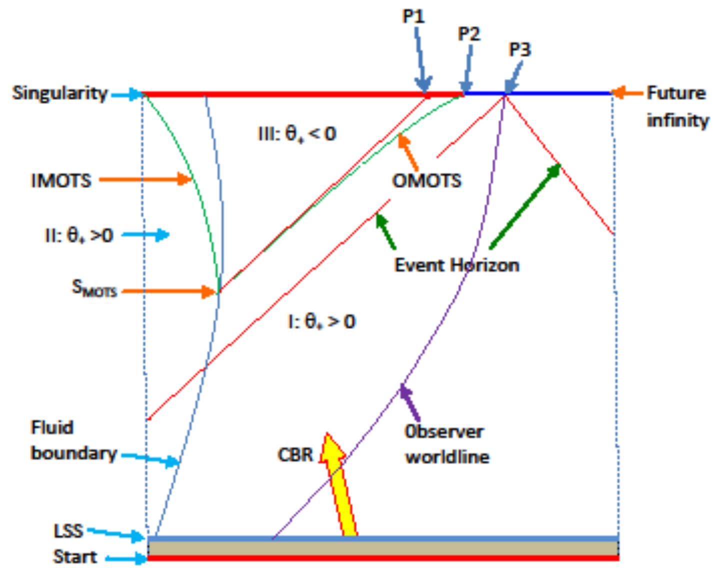


FIGURE 4: Effect of CBR and cosmological constant taken together. The CBR is emitted from the last scattering surface (LSS). Future infinity (blue) is now spacelike (as the universe is asymptotically de Sitter). Consequently the event horizon of a generic observer (the past null cone of P3) is unrelated to the black hole singularity (red at top) and its OMOTS surface.

Astrophysical Black Hole horizons in a cosmological context: Nature and possible consequences on Hawking Radiation

George F R Ellis, Rituparno Goswami, Aymen I. M. Hamid, Sunil D. Maharaj

This paper considers the nature of apparent horizons for astrophysical black hole situated in a realistic cosmological context.

Using semi-tetrad covariant methods we study the local evolutions of the boundaries of the trapped region in the spacetime..

For a collapsing massive star immersed in a cosmology with Cosmic Background Radiation (CBR), we show that the initial 2 dimensional marginally trapped surface bifurcates into inner and outer horizons

The inner horizon is timelike while the continuous CBR influx into the black hole makes the outer horizon spacelike.

We discuss the possible consequences of these features for Hawking radiation in realistic astrophysical contexts.

arXiv:1407.3577 [gr-qc]

3rd Key point:

Particle or field

- Particle picture gives 100% off if spacelike

Field picture allows fuzzier limits

Actually: need energy momentum tensor to check what is happening (Davies, Perry)

In the meantime: can use the eikonal approximaton

NB: not static spacetime can't rely on Killing vectors and associated properties

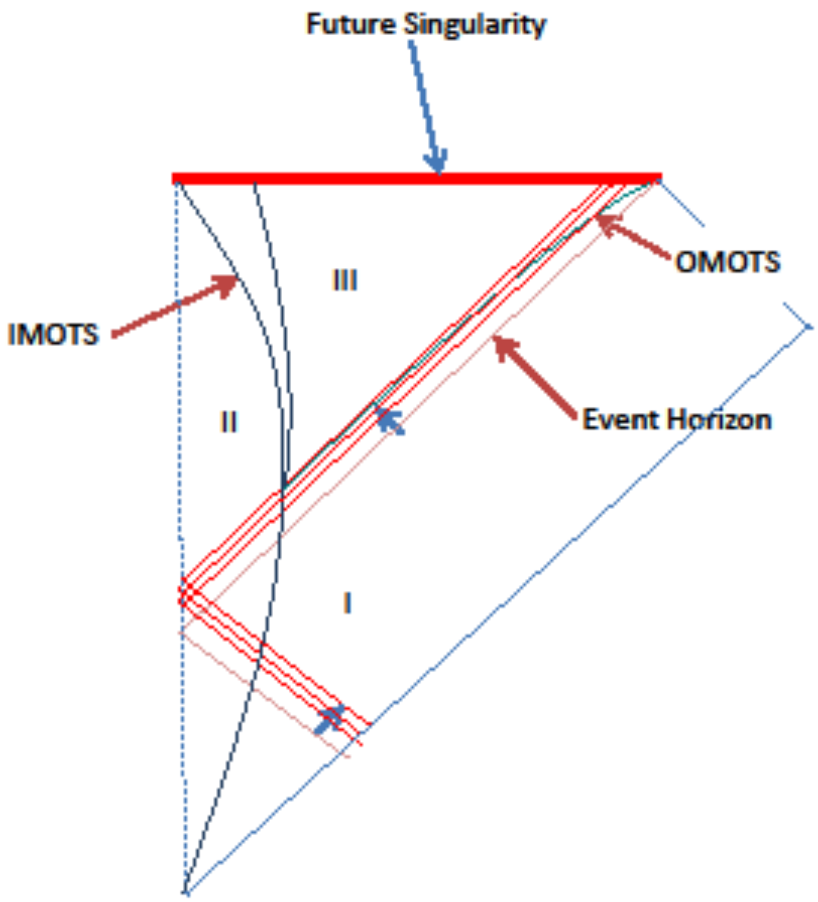
Cosmic Matter Flux May Turn Hawking Radiation Off
Javad T. Firouzjaee, George F. R. Ellis [arXiv:1407.3577]

An astrophysical (cosmological) black hole forming in a cosmological context will be subject to a flux of infalling matter and radiation, which will cause the outer apparent horizon (a marginal trapping surface) to be spacelike. As a consequence the radiation emitted close to the apparent horizon no longer arrives at infinity with a diverging redshift.

Standard calculations of the emission of Hawking radiation then indicate that no blackbody radiation is emitted to infinity by the black hole in these circumstances, hence there will also then be no black hole evaporation process due to emission of such radiation as long as the matter flux is significant.

The essential adiabatic condition (eikonal approximation) for black hole radiation gives a strong limit to the black holes that can emit Hawking radiation.

We give the mass range for the black holes that can radiate, according to their cosmological redshift, for the special case of the cosmic blackbody radiation (CBR) influx (which exists everywhere in the universe).


Future Singularity
OMOTS
III
IMOTS
II
Event Horizon
I

Key point:

Does it happen in the vacuum or in the fluid?

Hawking and Birrell and Davies state it happens in the fluid …

But do the calculation in the external vacuum spacetime

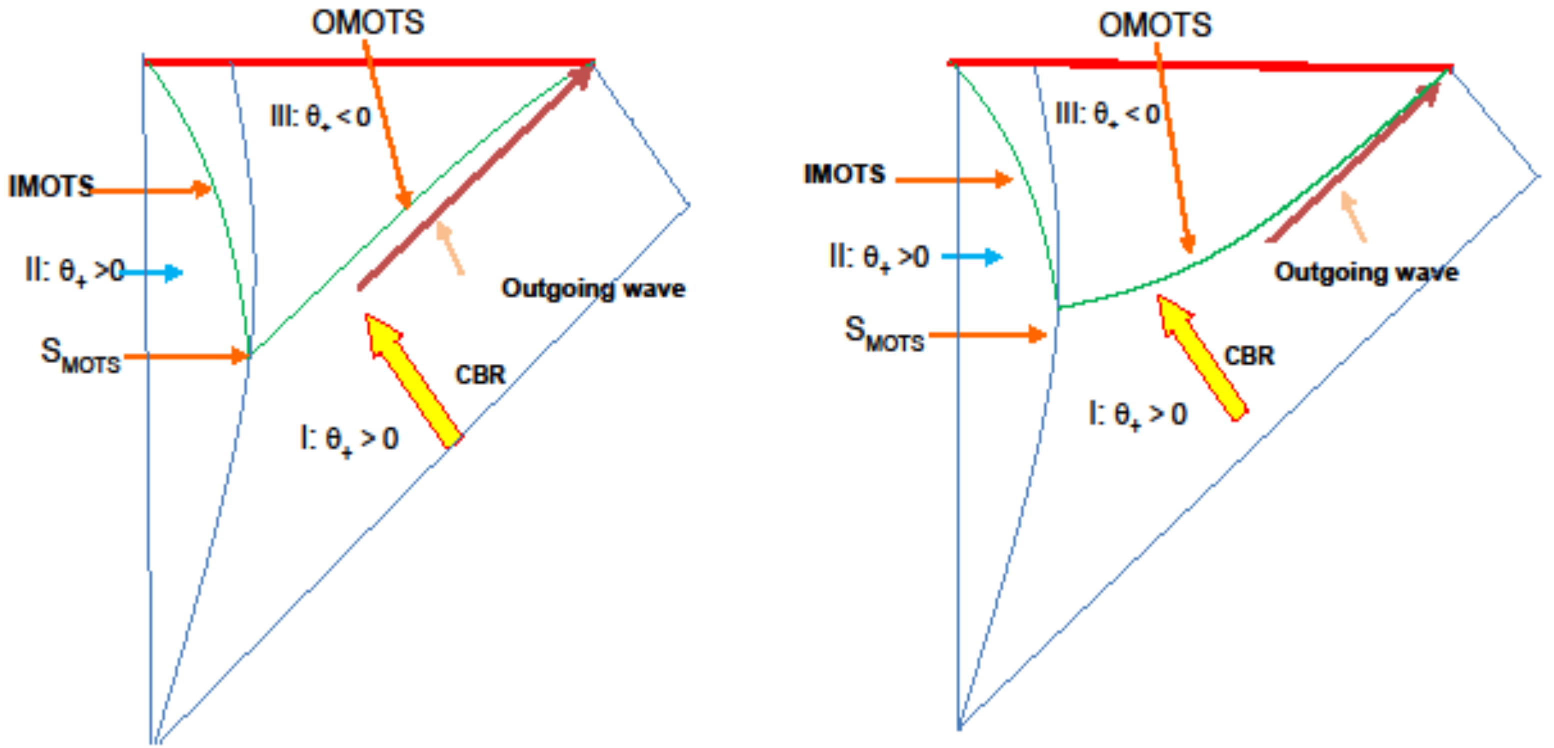
Which is static, by Birkhoff's theorem.

Needs a proper calculation of what is going on in the fluid!

And the energy momentum stress tensor …

At a very late stage of black hole formation when the CBR influx decays away,

- the black hole horizon becomes first a slowly evolving horizon
- and then an isolated horizon;
- at that stage, black hole radiation will start.


OMOTS
III: θ+ < 0
IMOTS
II: θ+ >0
SMOTS
Outgoing wave
CBR
I: θ+ > 0
OMOTS
III: θ+ < 0
IMOTS
II: θ+ >0
SMOTS
Outgoing wave
CBR
I: θ+ > 0

- at that stage, black hole radiation will start.

Then back to square 1!

- Maybe singularity goes away

- Maybe spacetime singularity occurs, matter and information lost

- Maybe quantum bounce to a new universe, matter and information goes through …..

But no black hole explosion!

In the case of eternal black holes, the obvious statement of the black hole evaporation hypothesis in terms of Cauchy data is inconsistent with the symmetry of the maximally extended Kruskal-Schwarzschild solution.

The implication is that in this case too, the black hole does not evaporate: same kind of solution holds

Needs checking: is vacuum in-state invariant under space-time symmetry group? If not why not?

This case is not realistic but serves as test bed for calculations

NB: same kind of issue arises for Unruh radiation;
- it's a global effect and cannot be realised in practice.
- what about De Sitter and Gibbons-Hawking radiation?