Stringy Horizons and UV/IR mixing

Based on:

1502.03633 with Amit Giveon and David Kutasov

1506.07323 with Roy Ben-Israel, Amit Giveon and Lior Liram

And work to appear

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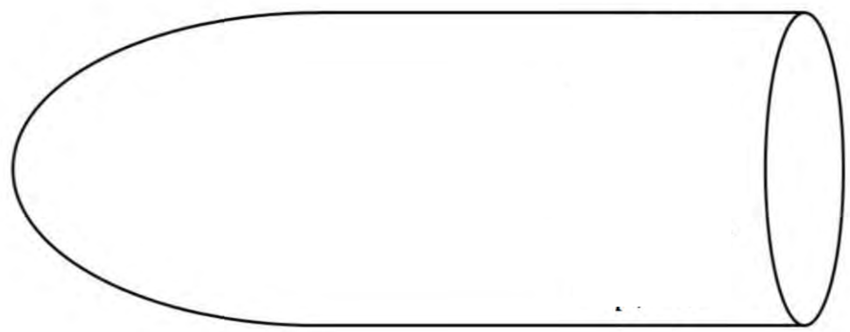
Goal of the talk: show that non-perturbative stringy corrections are far from being trivial.

We consider the exact CFT $SL(2,\mathbb{R})_k/U(1)$ whose sigma model corresponds to the cigar geometry



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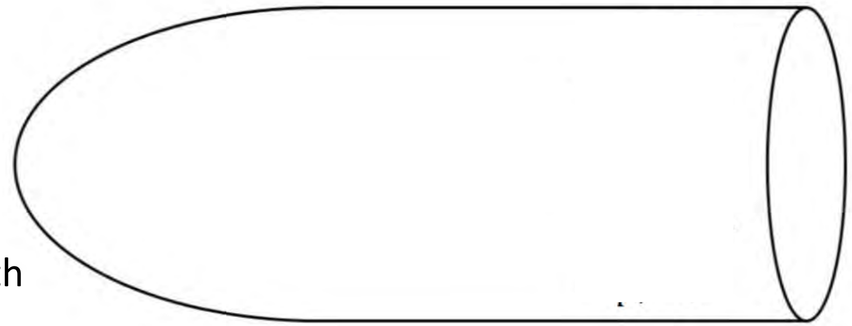

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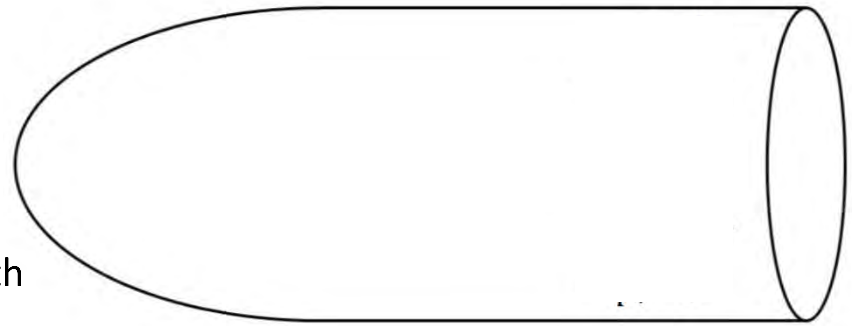

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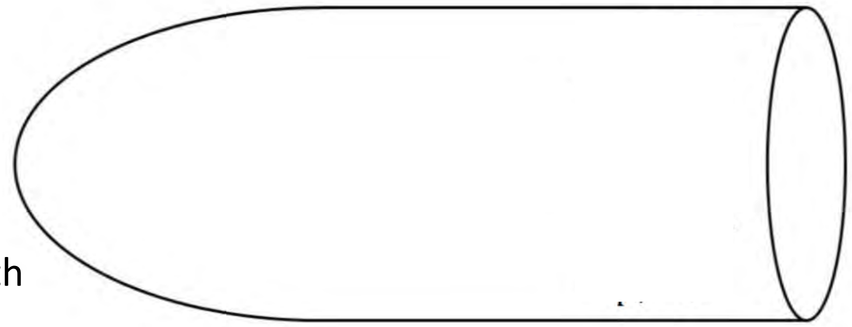

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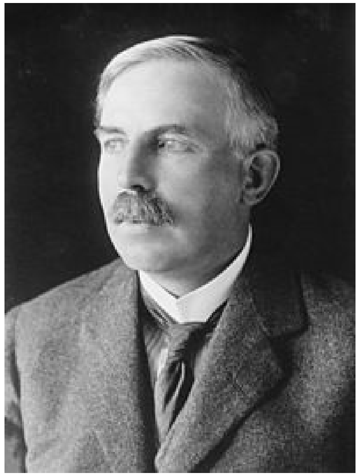
We do so is by following this guy



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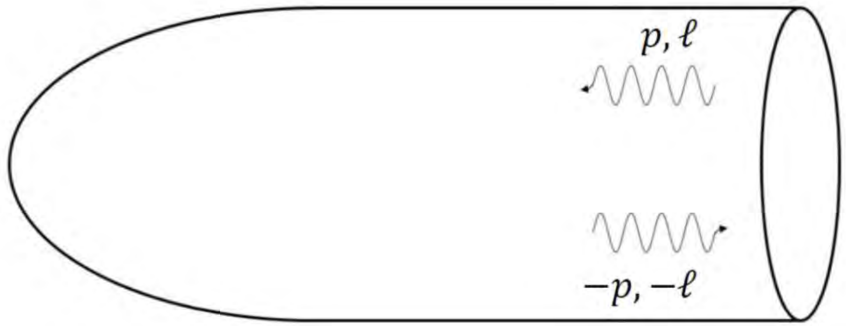

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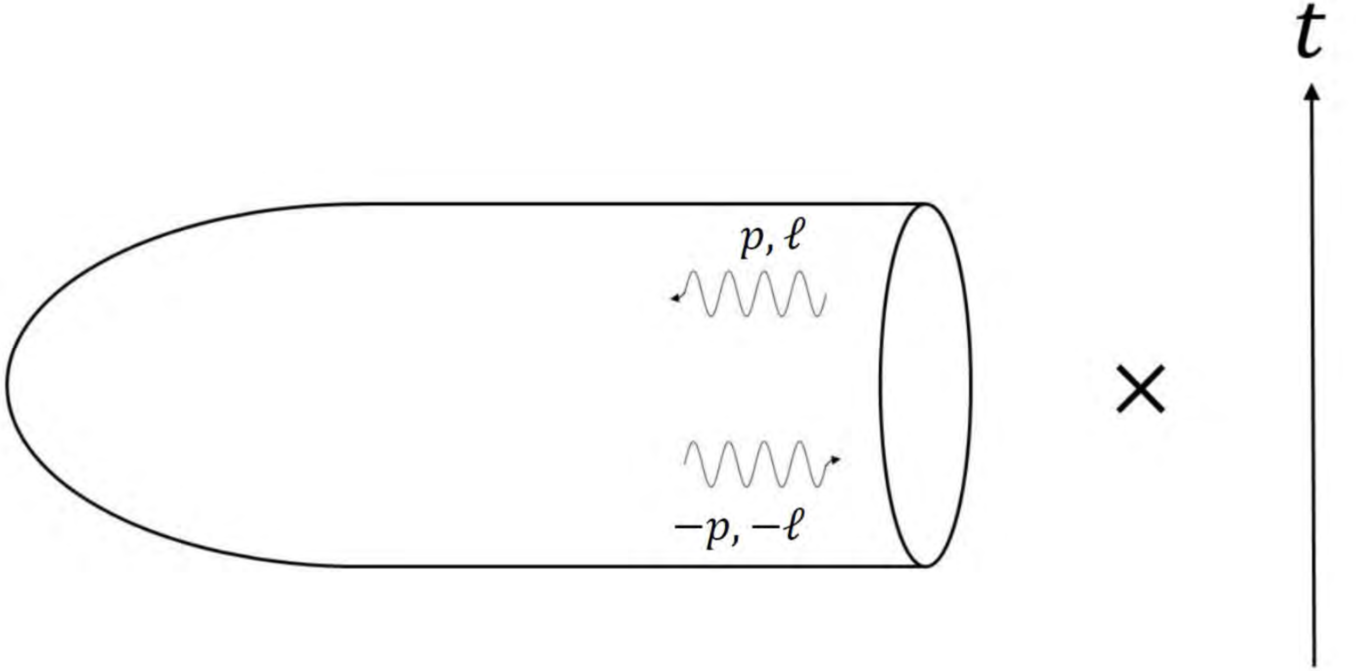

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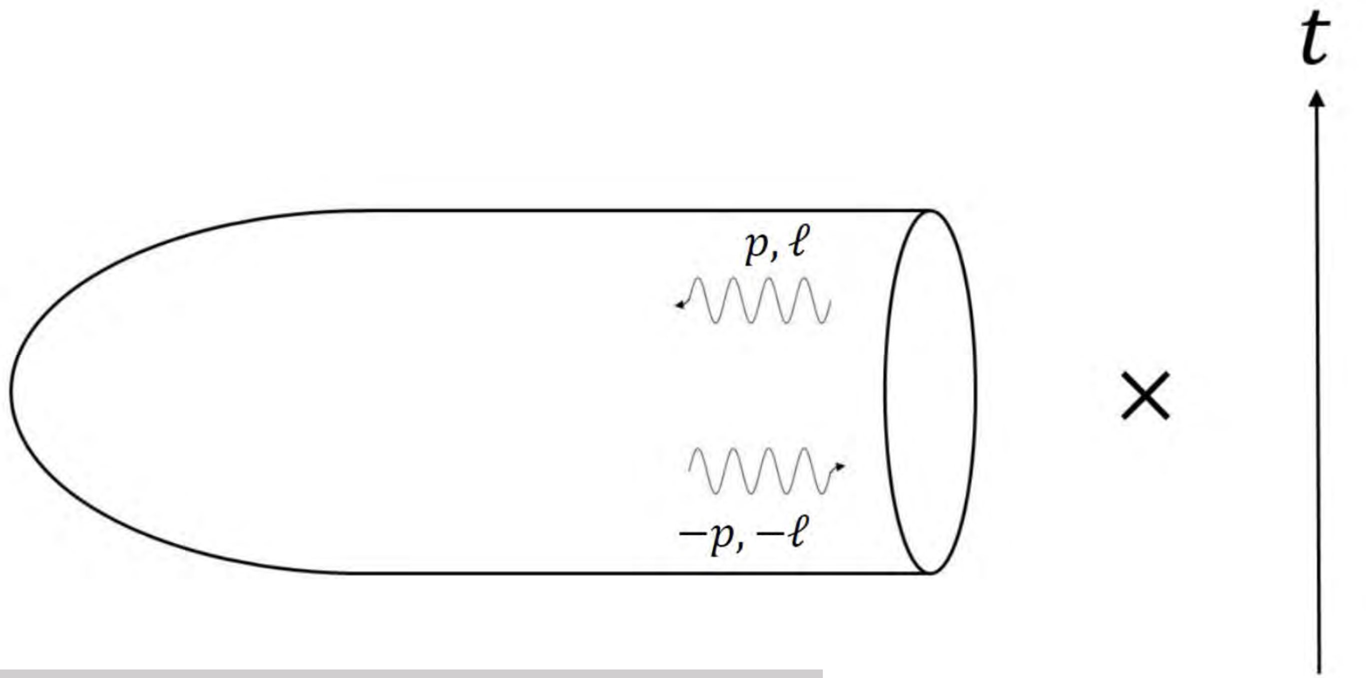

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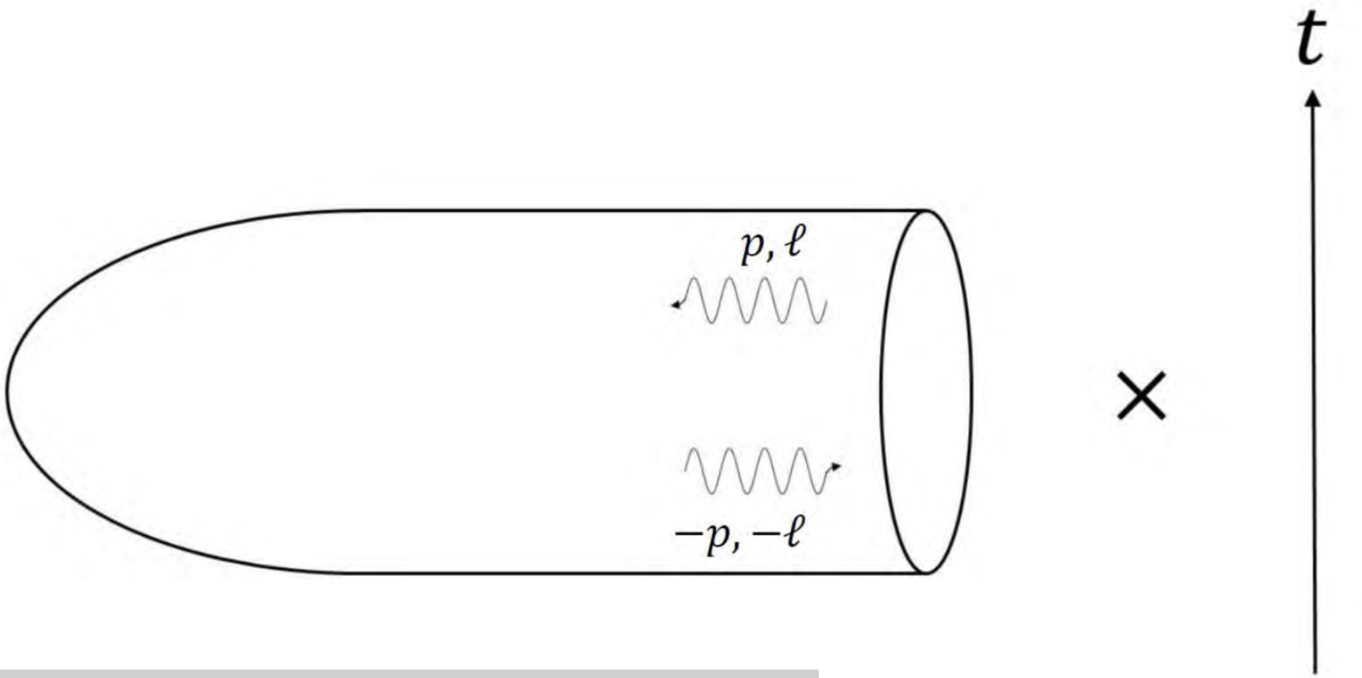

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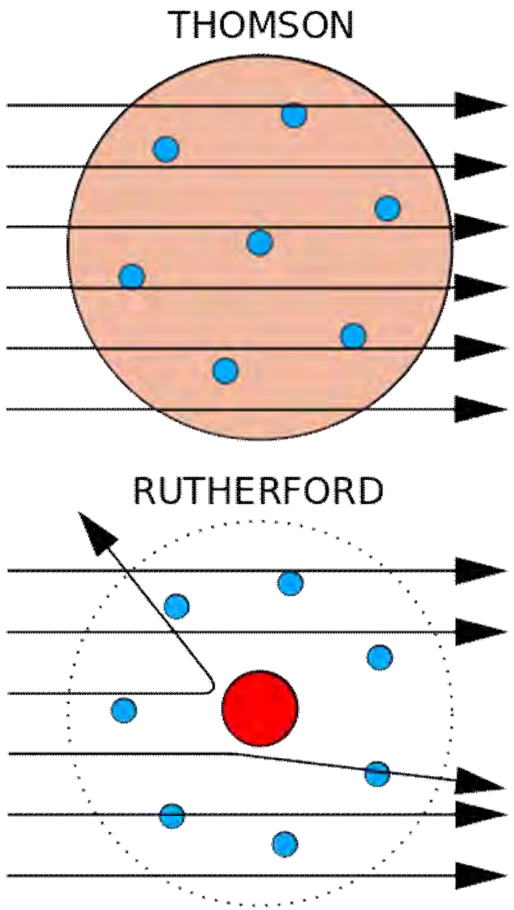
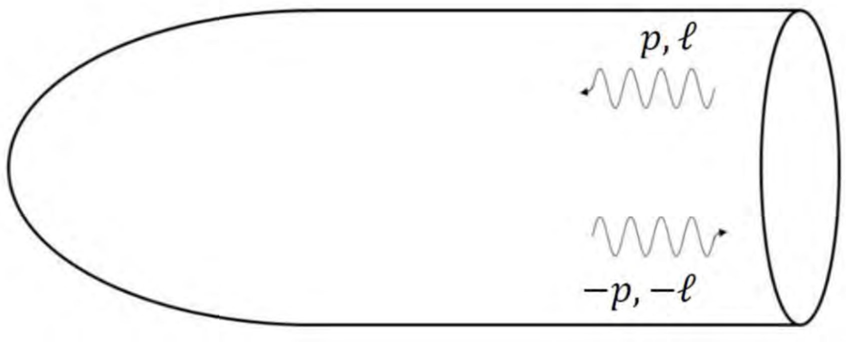
Our job is data analysis:

translate the CFT results into target-space info.

Just like in Rutherford's case, there are two options





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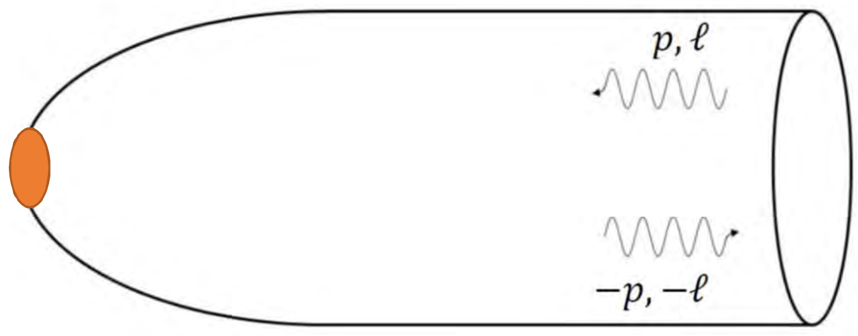

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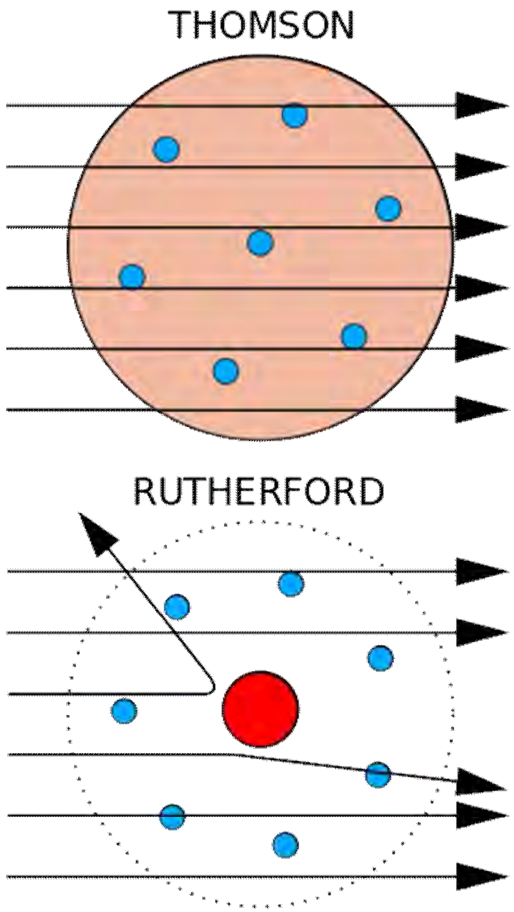

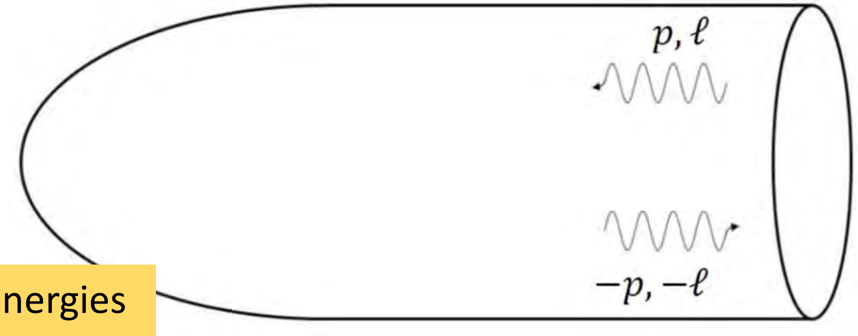

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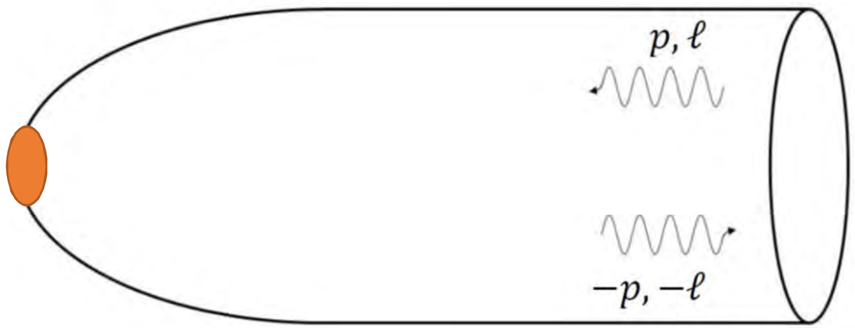
Going to high energies

was and is the key.



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The reflection coefficient takes the form

$$R(p,l) = R_{per}(p,l)R_{non-per}(p)$$

Obtained by solving the KG equation in the Sigma-Model back

Relevant energy scale is set by the curvature $1/\sqrt{k}$

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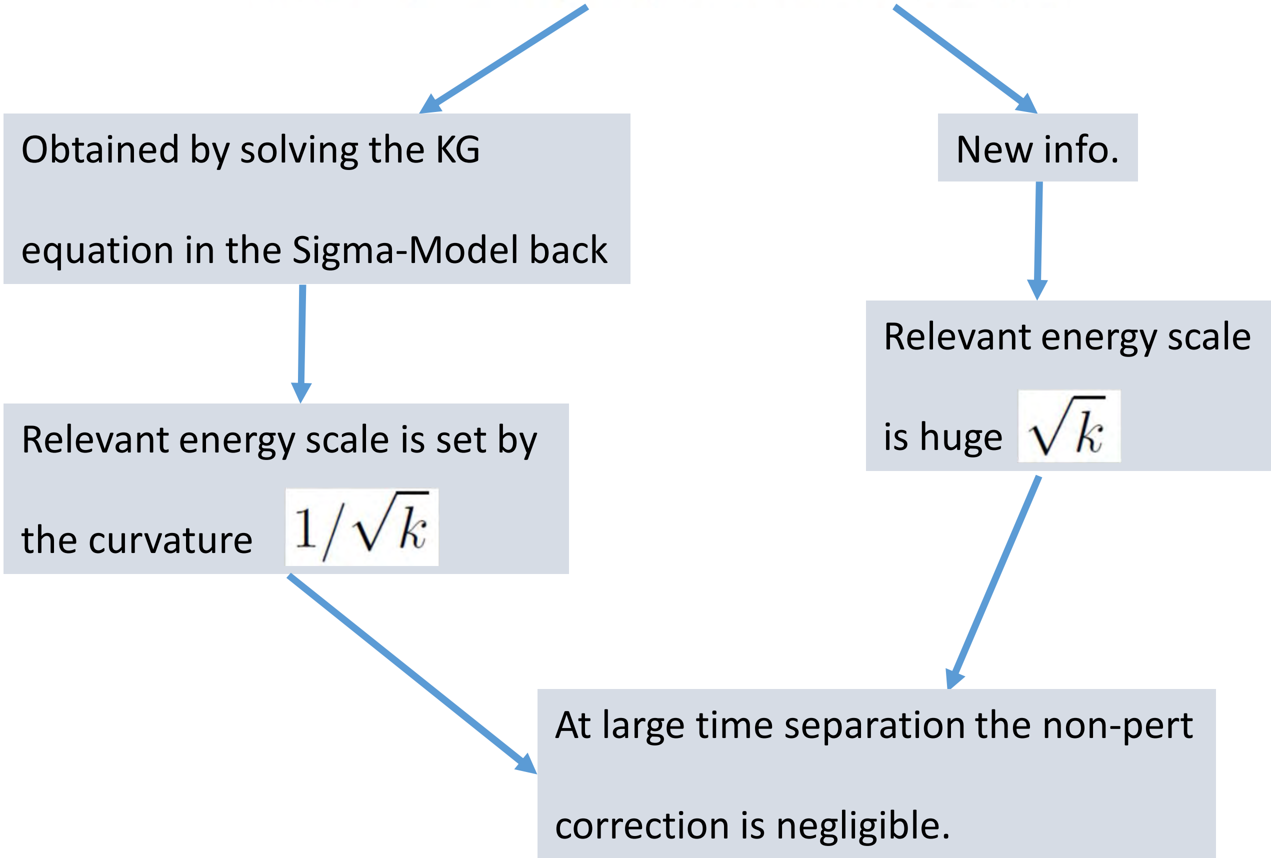

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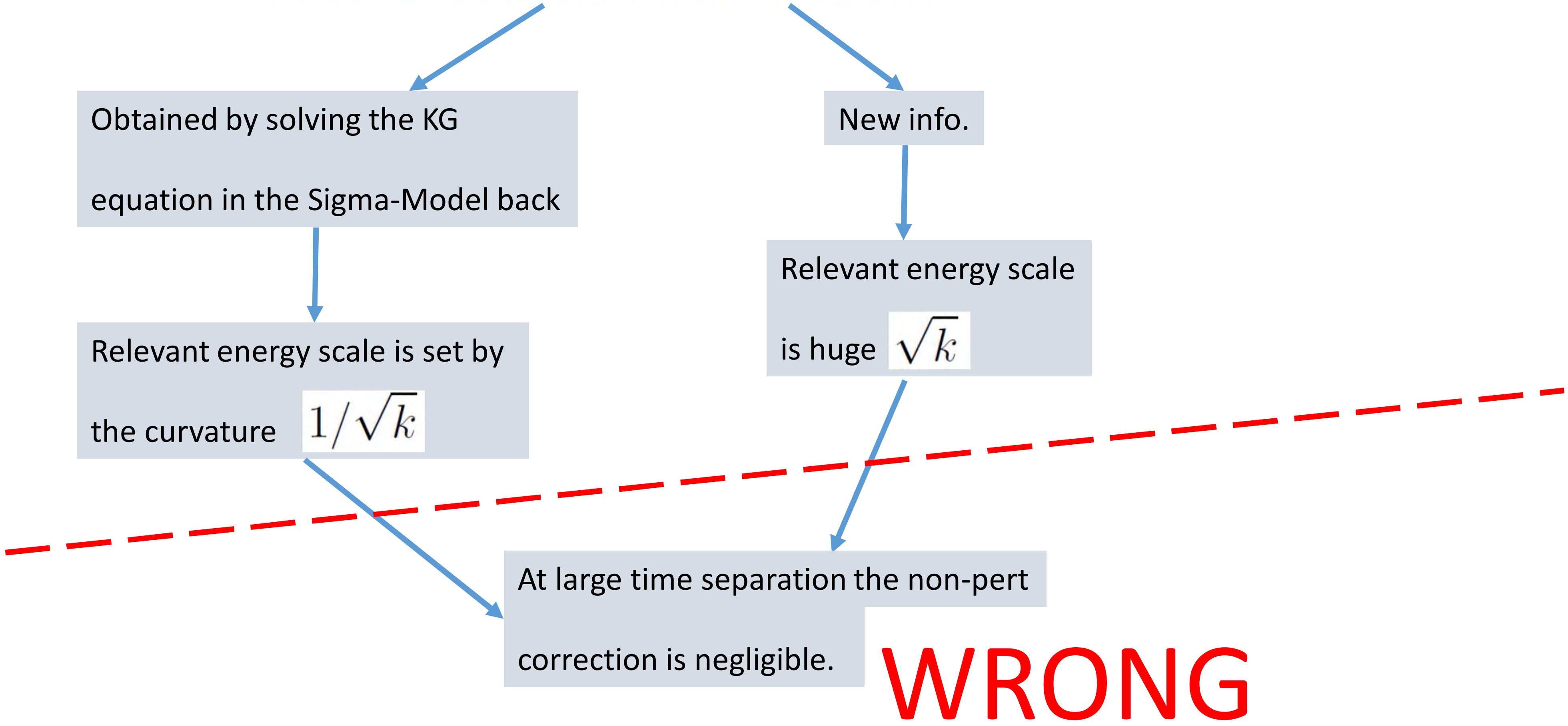

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UV/IR mixing

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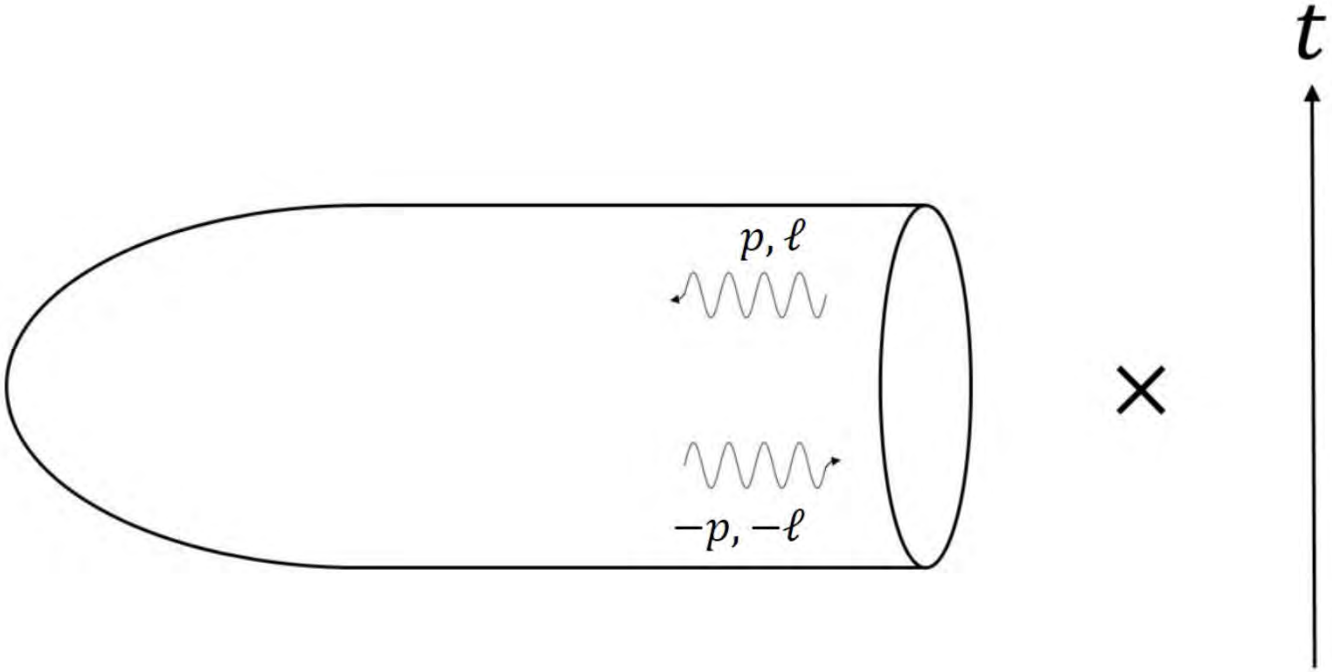
At large time separation the non-pert correction is negligible.

WRONG

A bit more details: For simplicity we take l=0 and the on-shell condition E=p



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Then we have the reflection coefficient as a function of E.

Fourier transform

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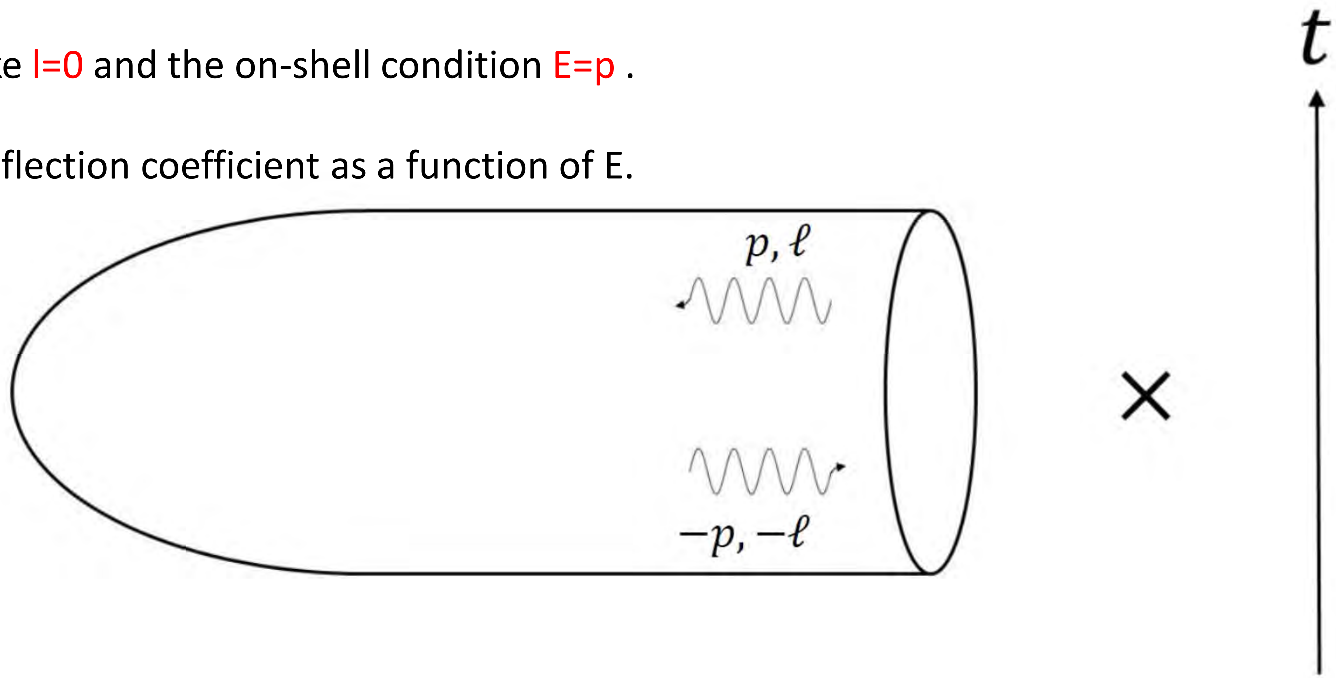

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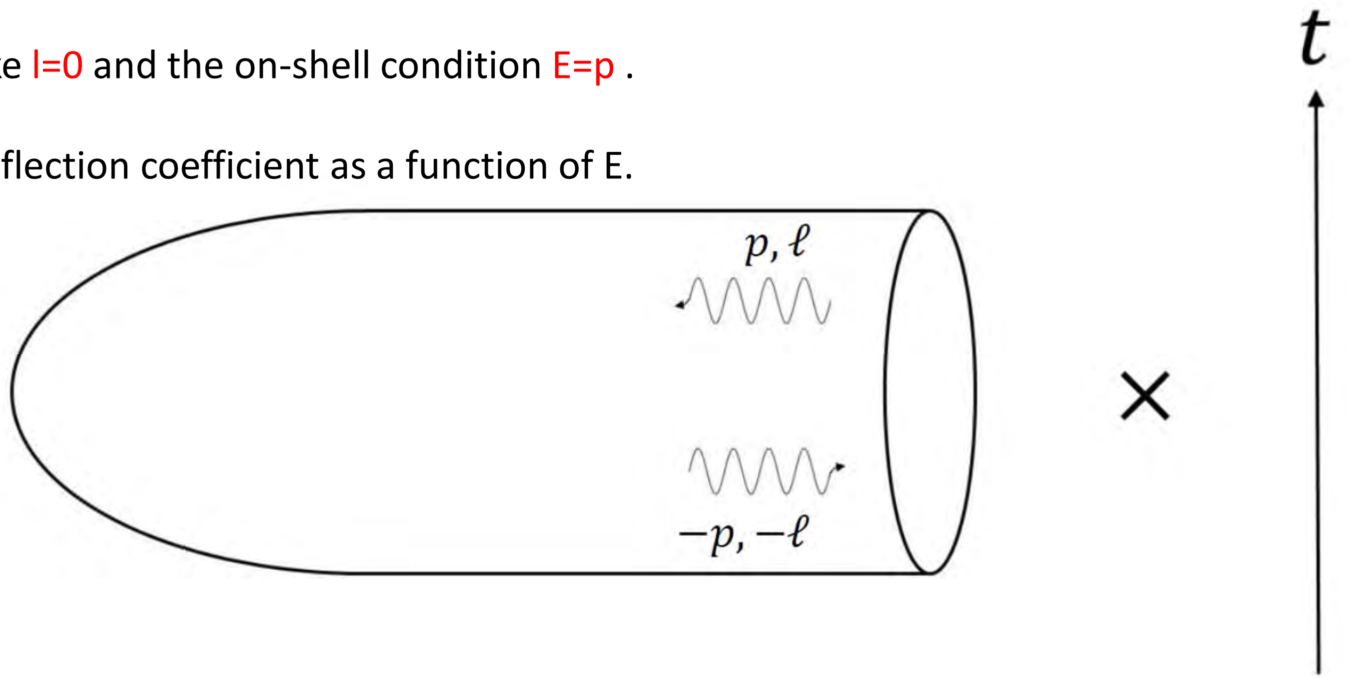

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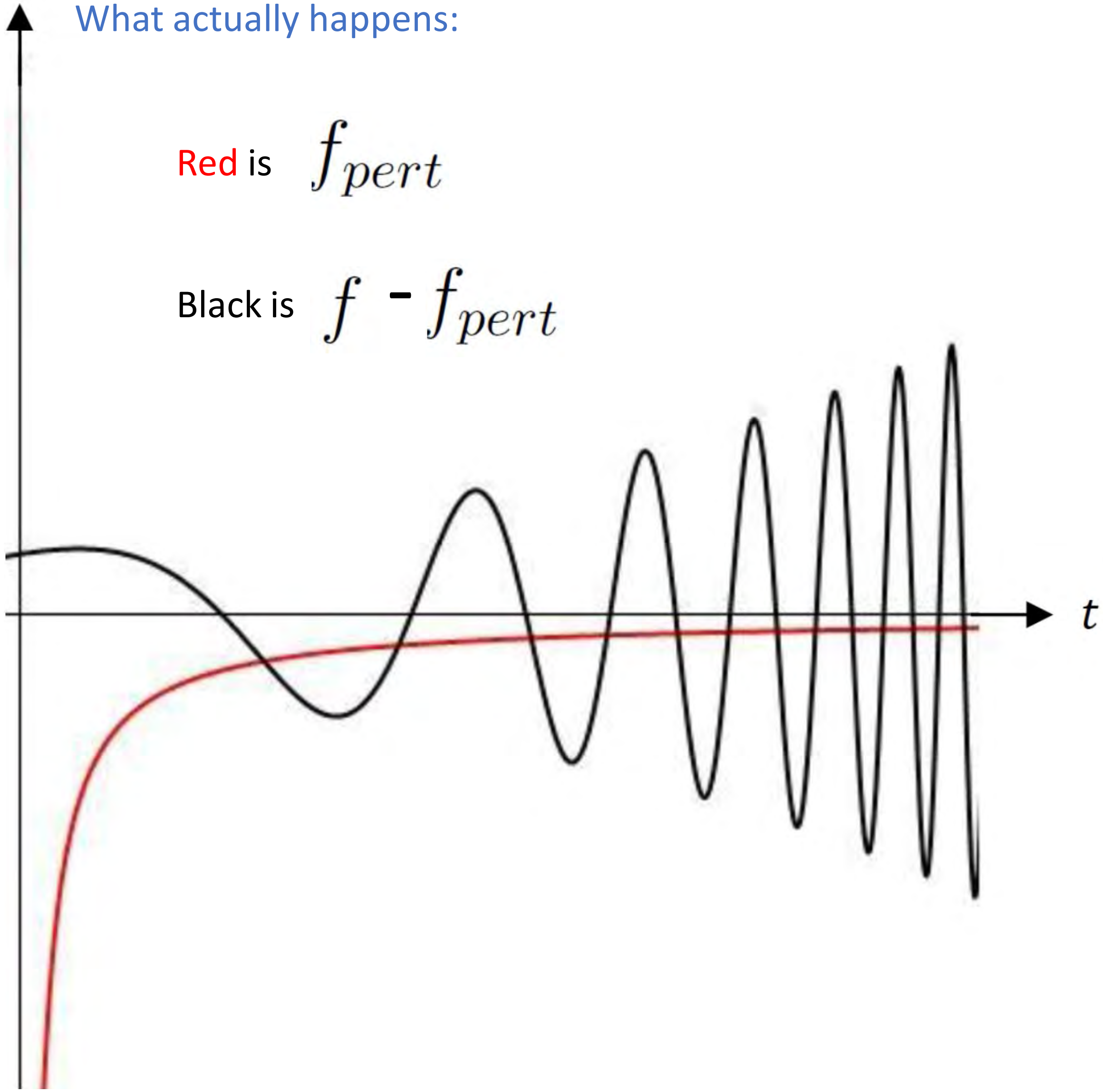
What actually happens:

Red is f_{pert}

Black is $f - f_{pert}$



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Rest of the talk:

1. How come?
2. Why this is relevant to the BH information puzzle?

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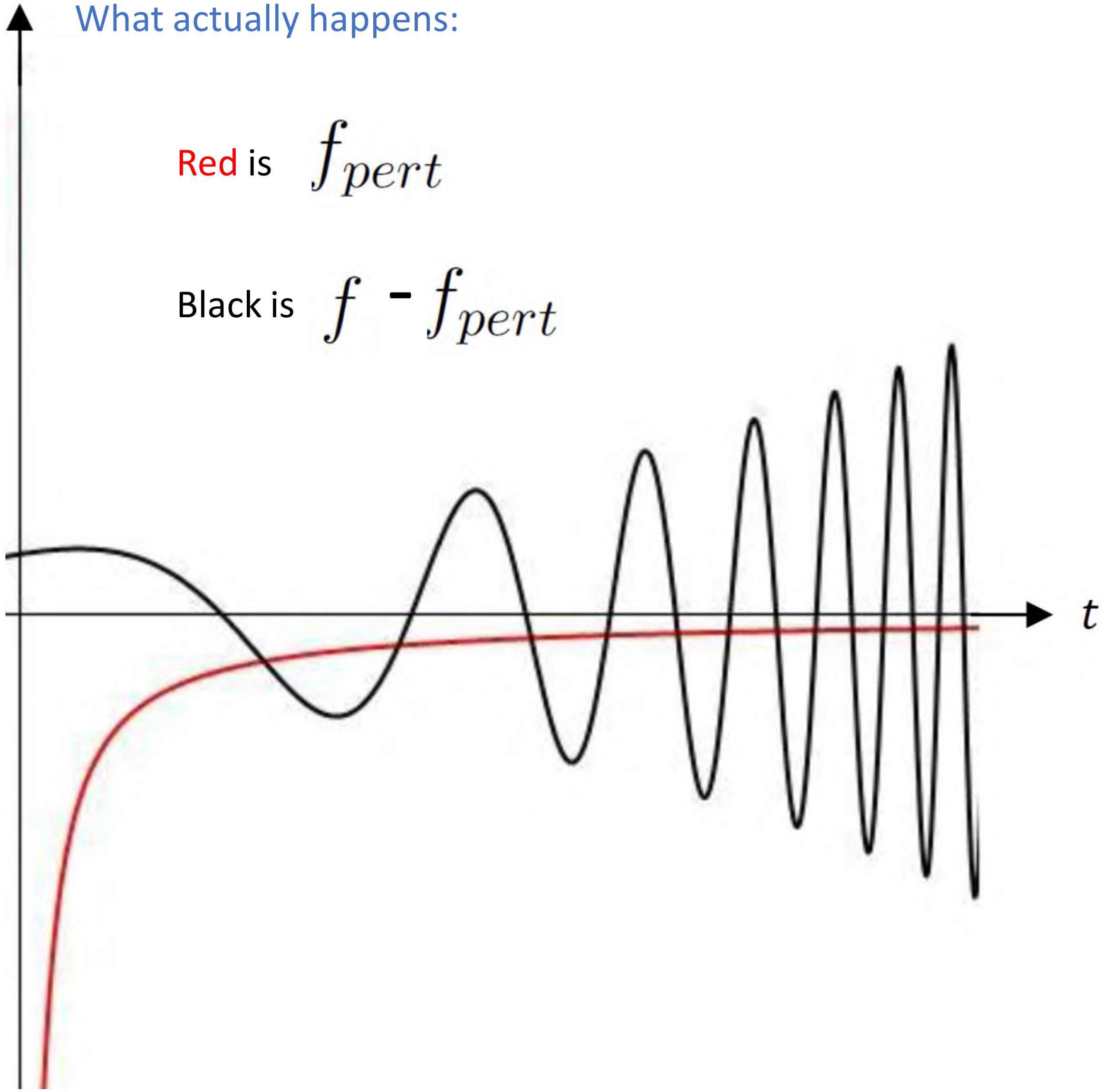

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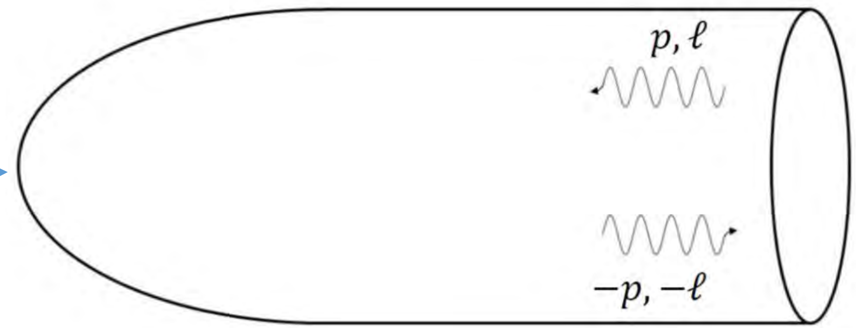

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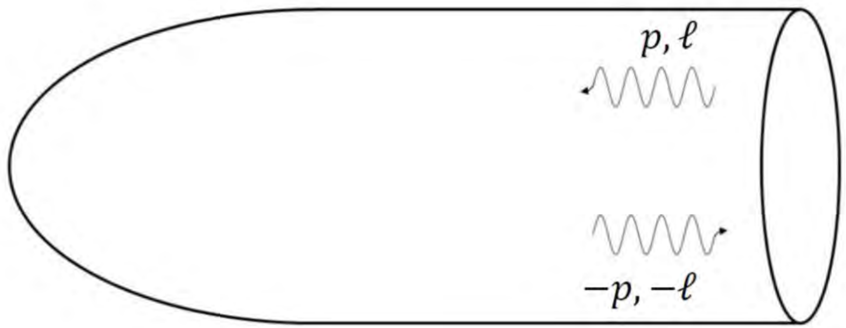

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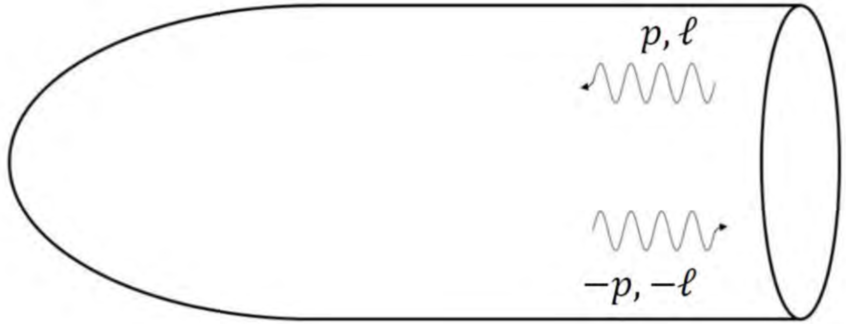

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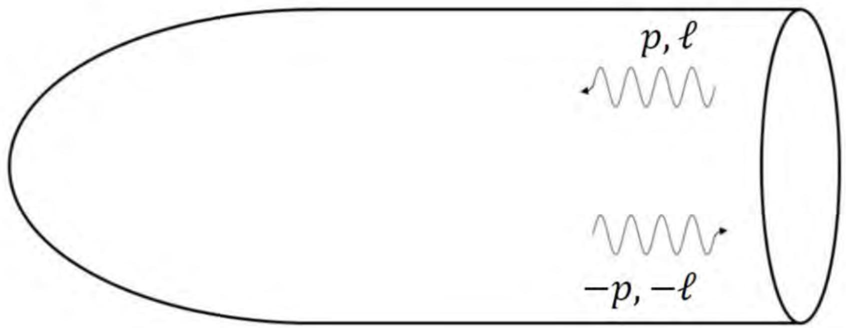

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We see that in fact at large k we have:

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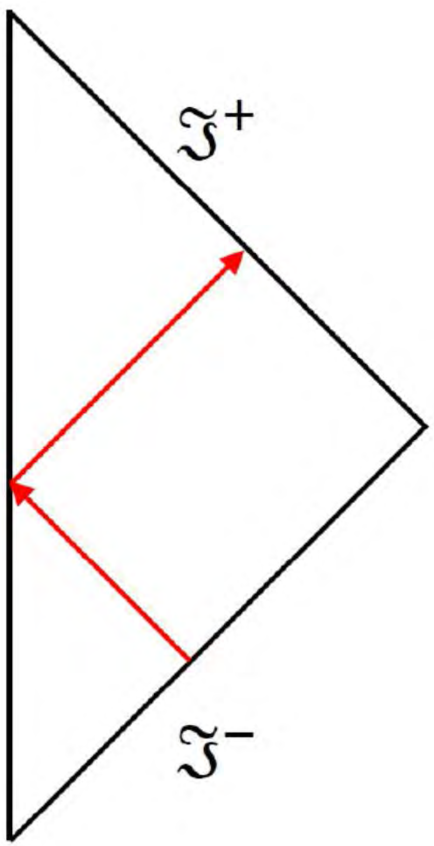

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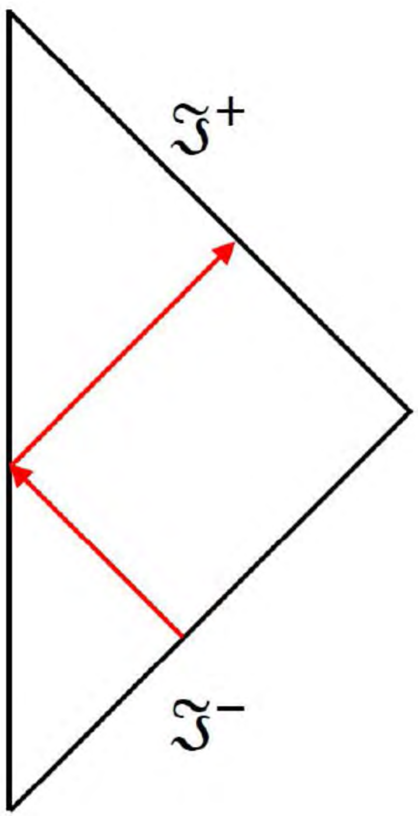

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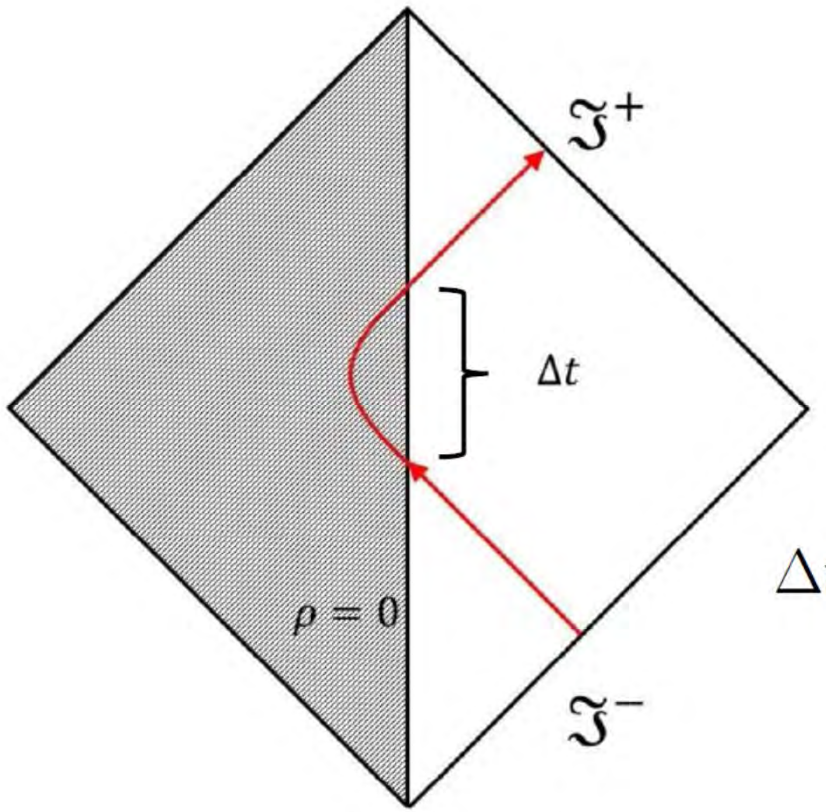

$$\Delta t \sim \frac{1}{\sqrt{k}} \log(E)$$

UV/IR mixing

Coarse graining

Suppose that we have an uncertainty in the time separation δt

then because the frequency blows up faster than the amplitude

if we coarse grain

$$f_{\delta t}^{coarse-grain}(t) \equiv \frac{1}{\delta t}\int_t^{t+\delta t} f(t')dt'.$$

we get that for $\delta t \gg e^{-\frac{1}{2}\sqrt{\frac{k}{2}}\,t}$

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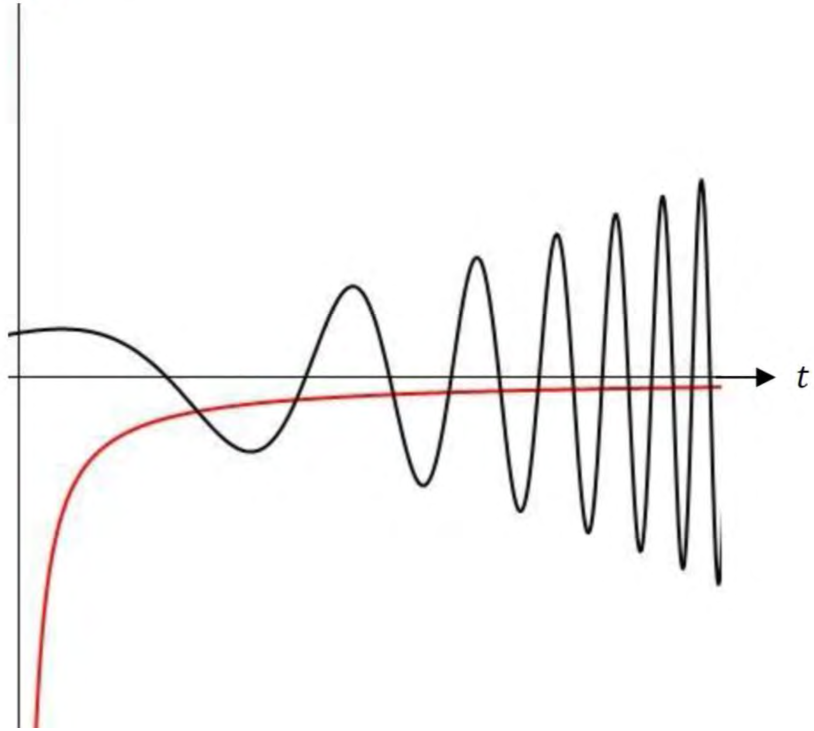

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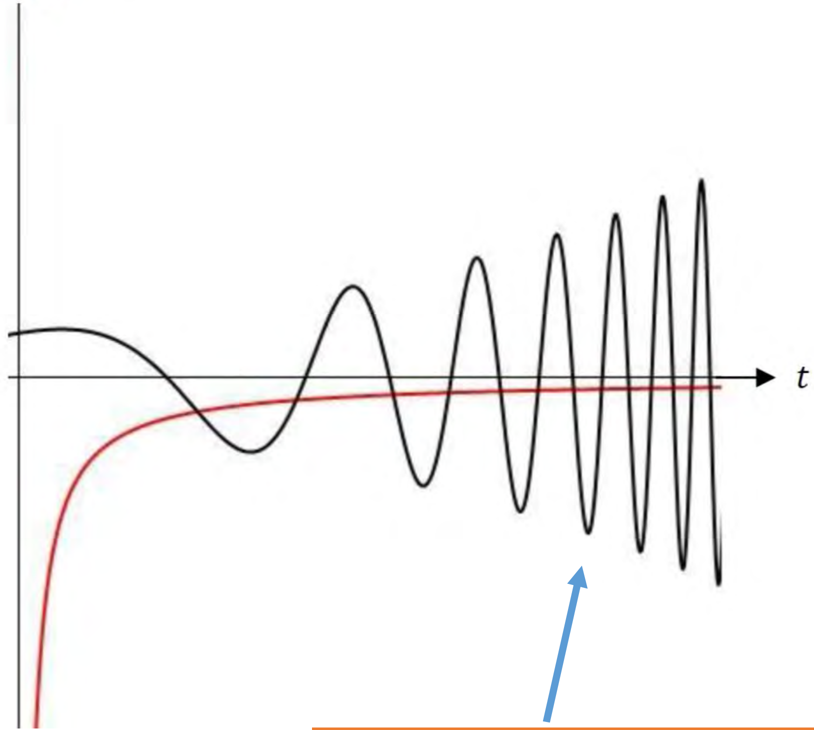

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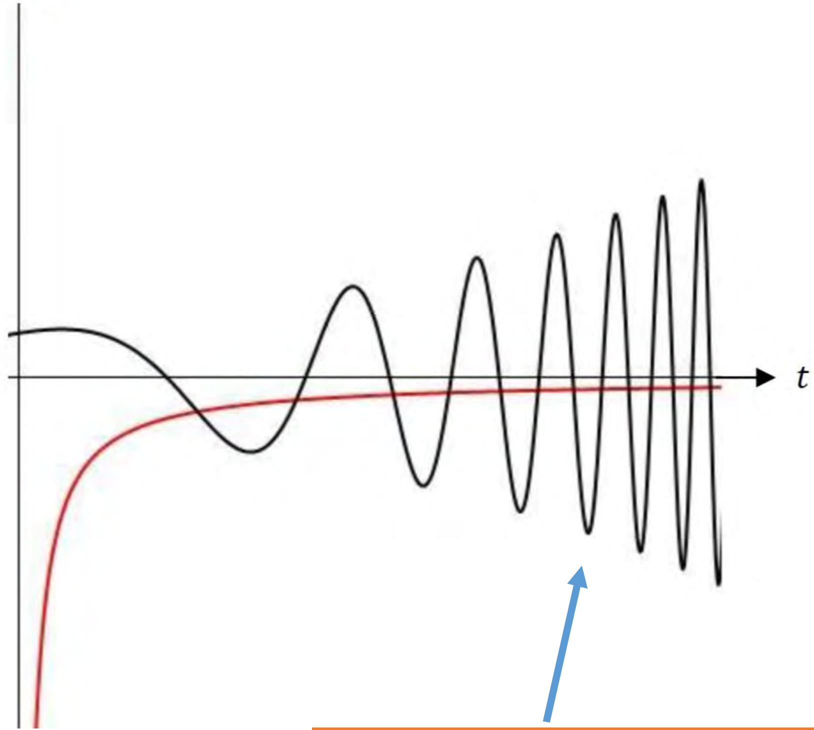

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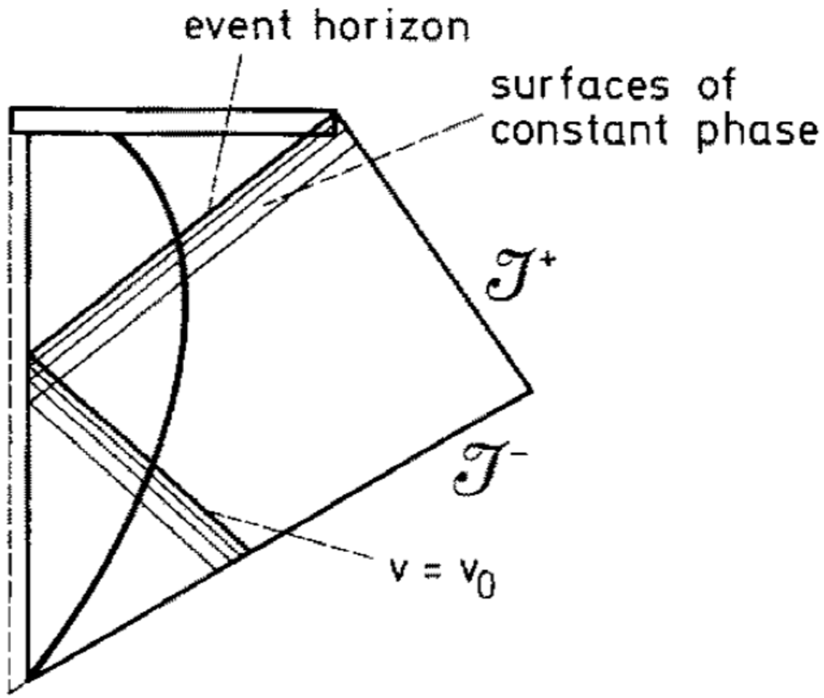
This suggest an analogy with BH hair.

Can be made rather precise.

Black Holes Information Puzzle

Hawking calculation in GR (figure from Hawking's paper)



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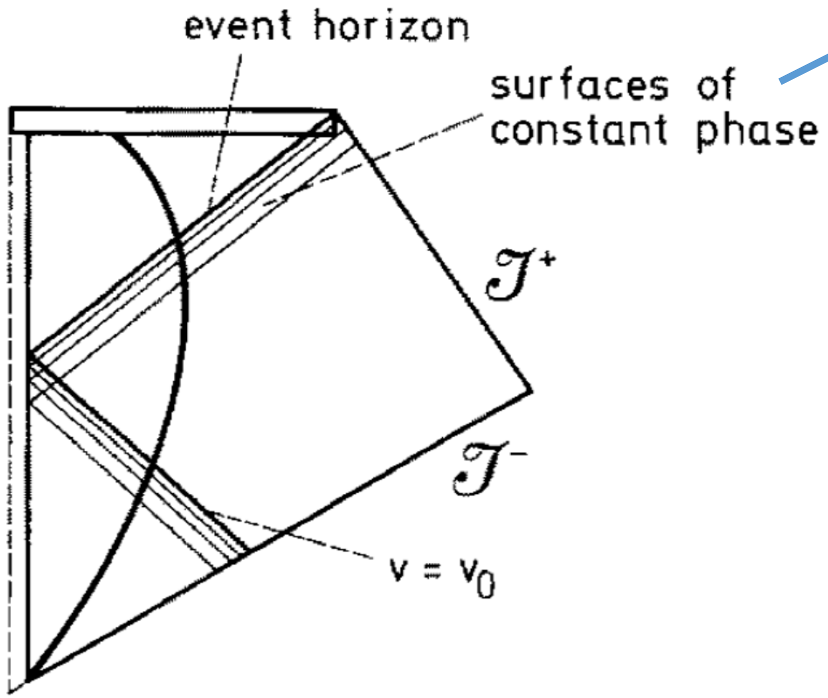

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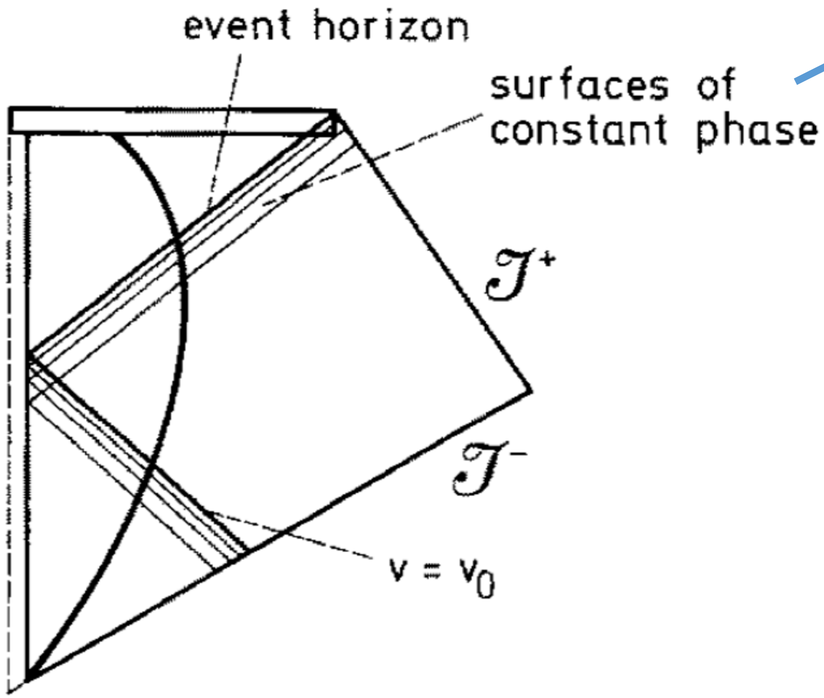

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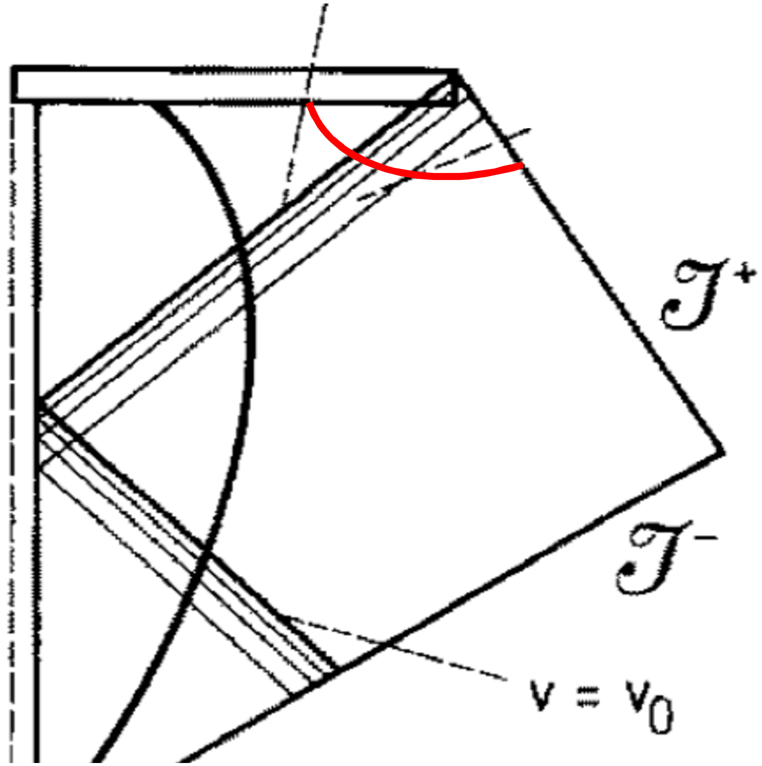

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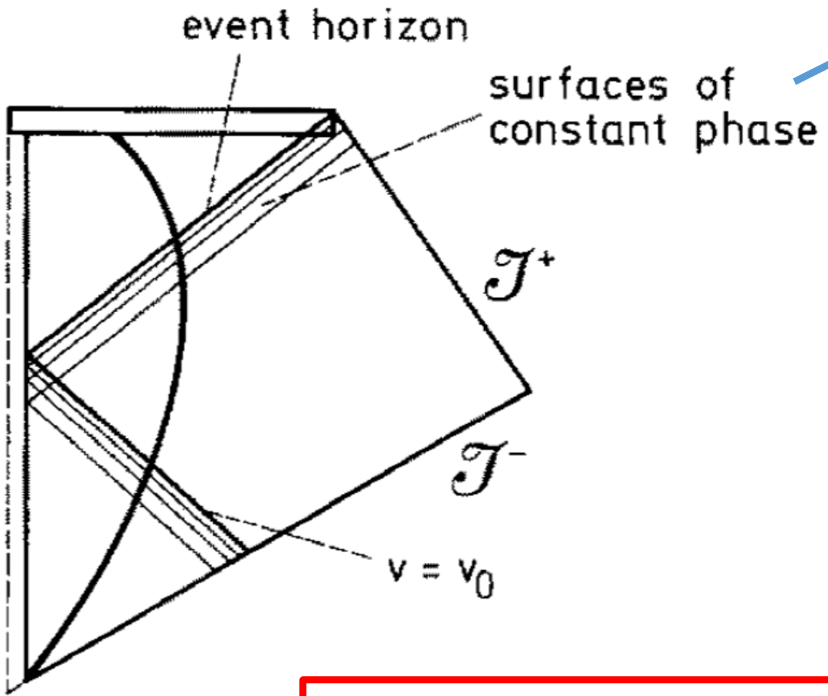

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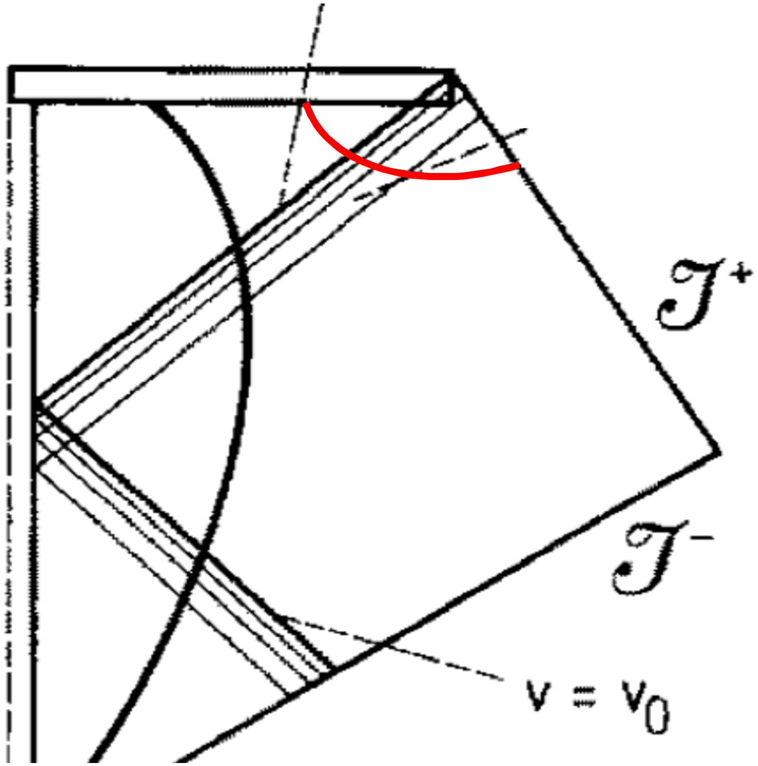

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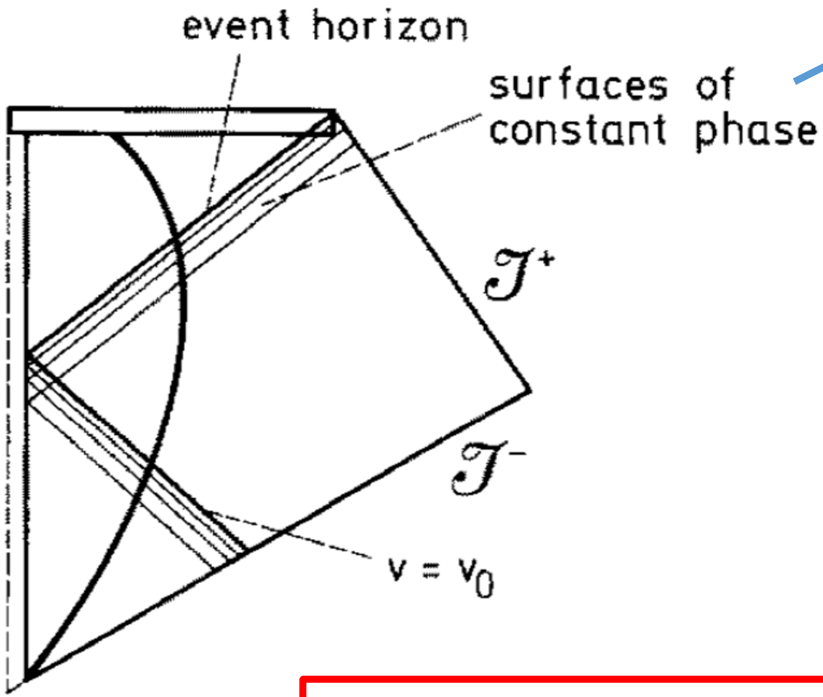

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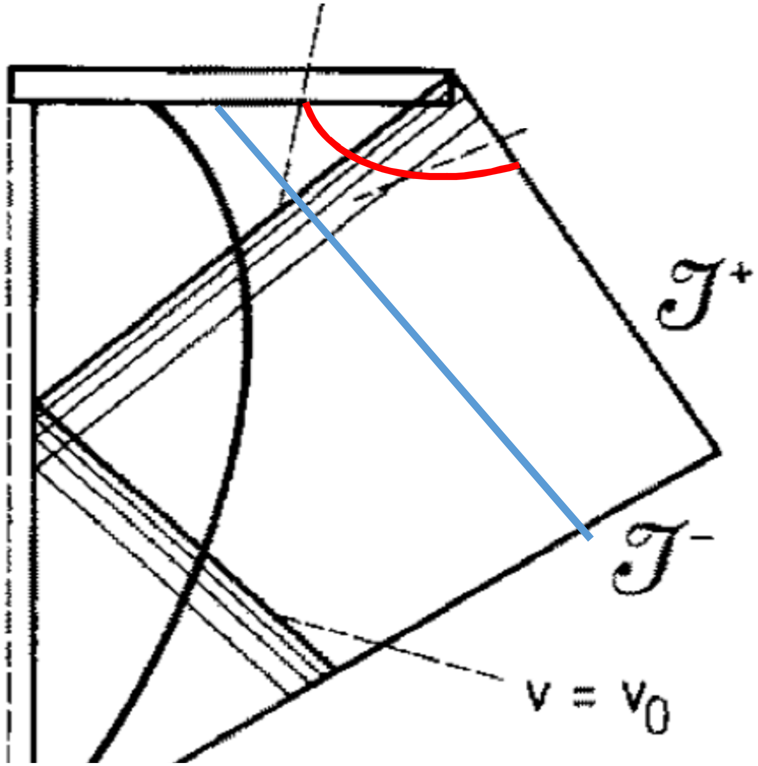

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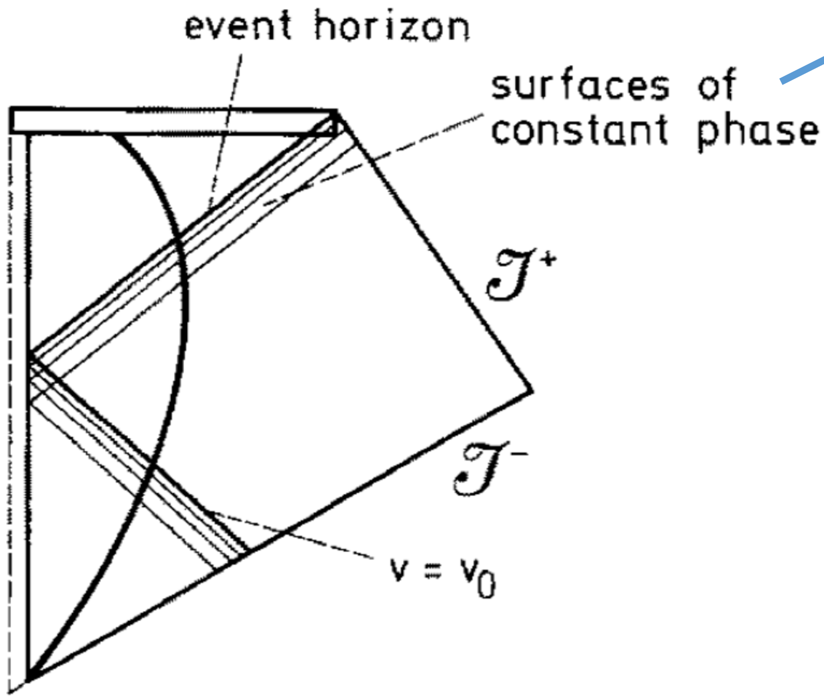
Hawking calculation including non-pert stringy effects



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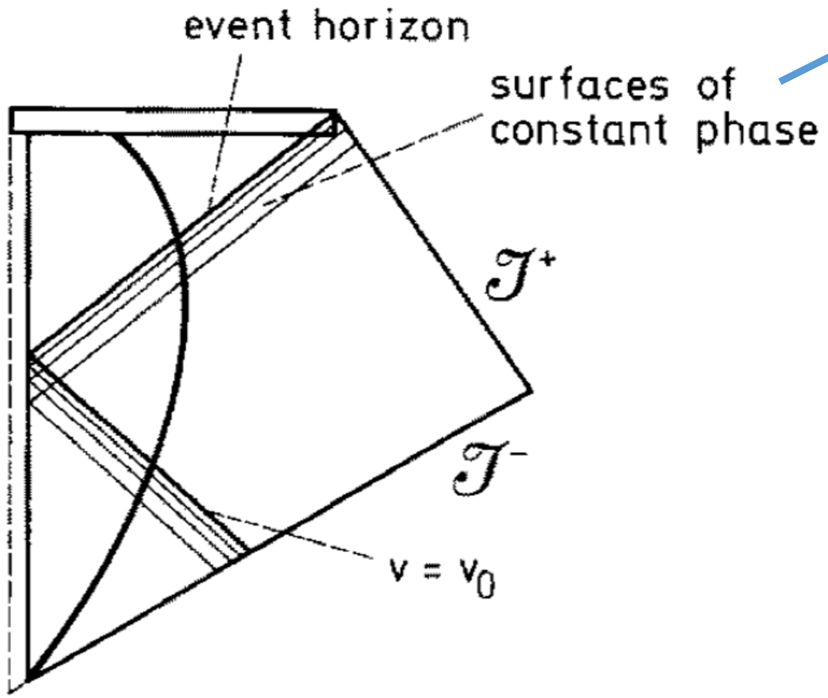

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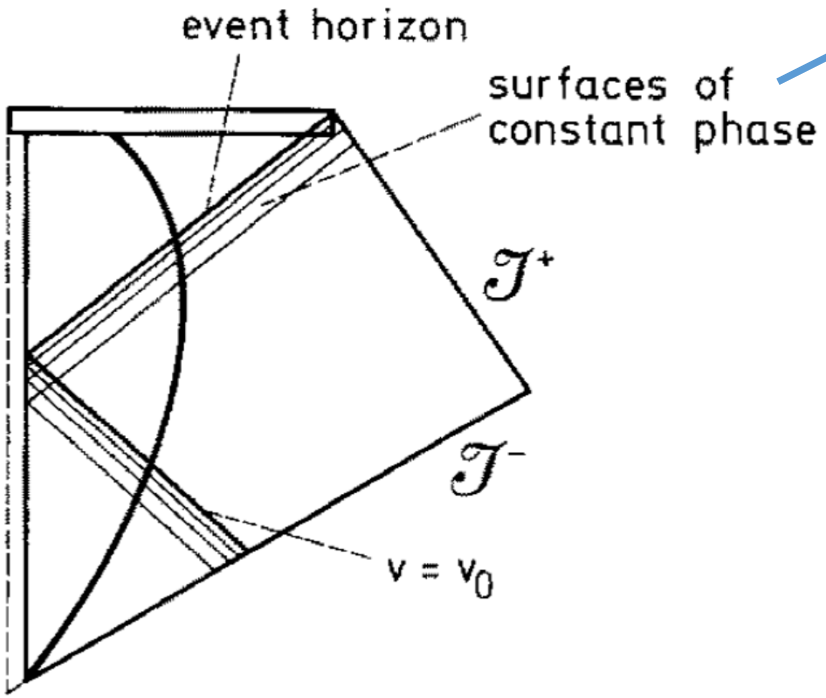

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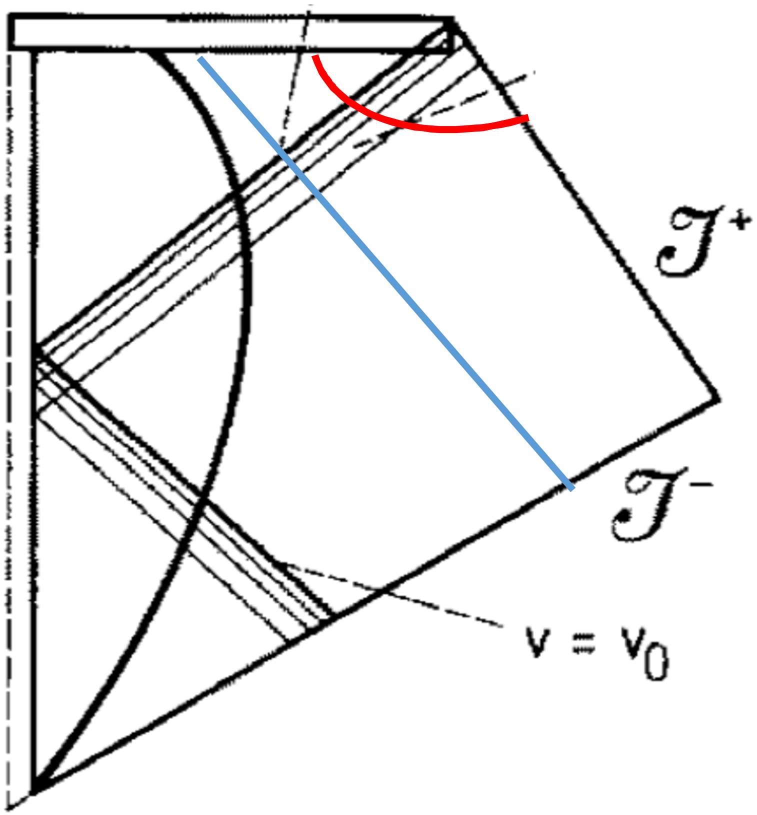

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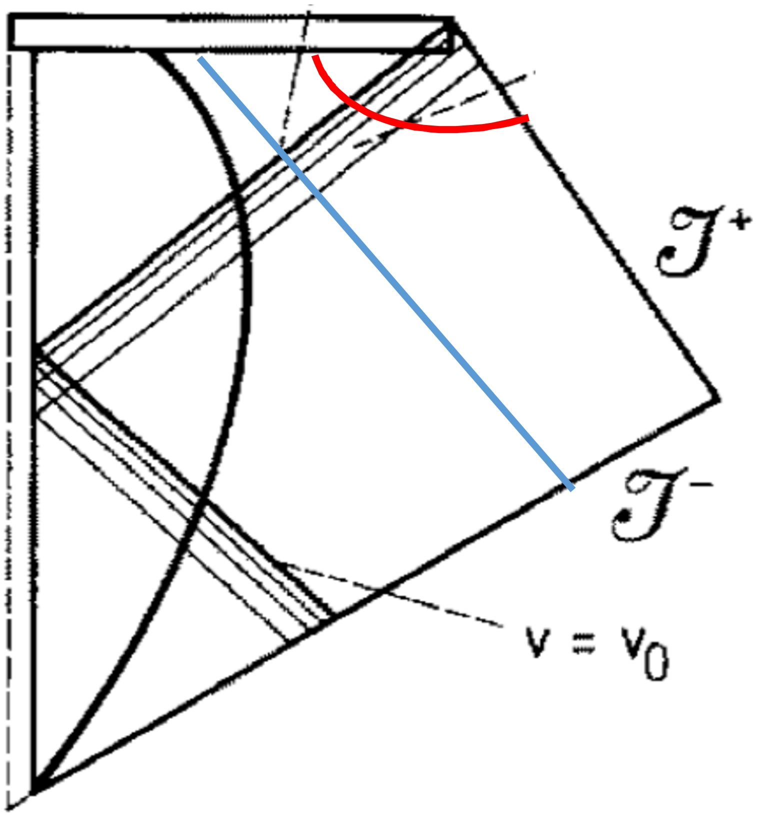
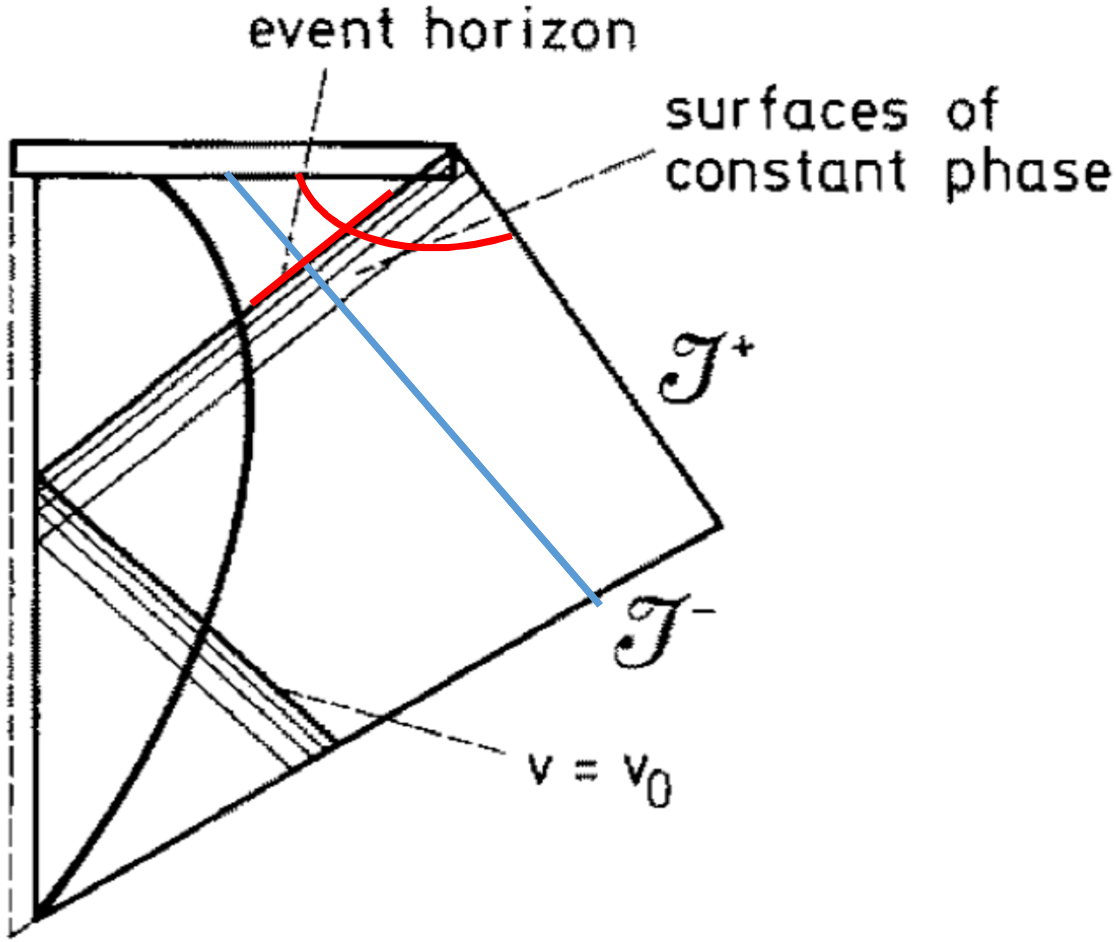


we have



Summary:

1. Illustrated UV/IR mixing at the cigar geometry.

2. Argued it should play important role in BH info. puzzle.

3. Very much relevant for LST theory that Kutasov will discuss next.