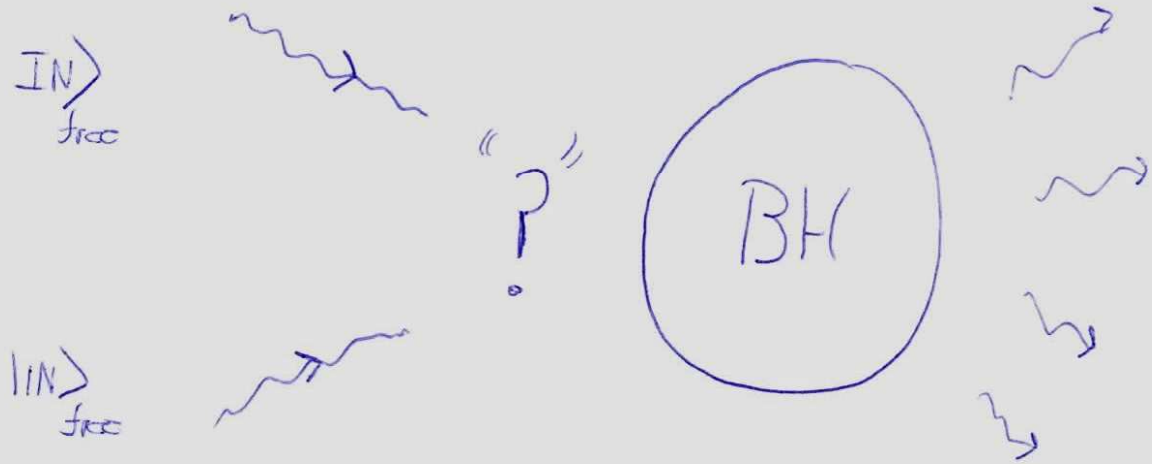
Asymptotic Darkness
in
Hořava-Lifshitz Gravity

(P.S & E. Elizalde.
arXiv 1110.0036)

Iberian Strings
2012.

(4)

G.R + Cov. L.I. modf.



Thermal.

GR is not

Renormal

Pe

Deep UV ≈ BH dominate

S ∝ Area

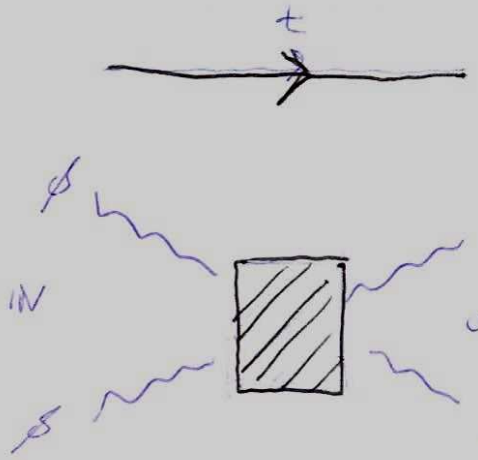
⇕

Not F.T.

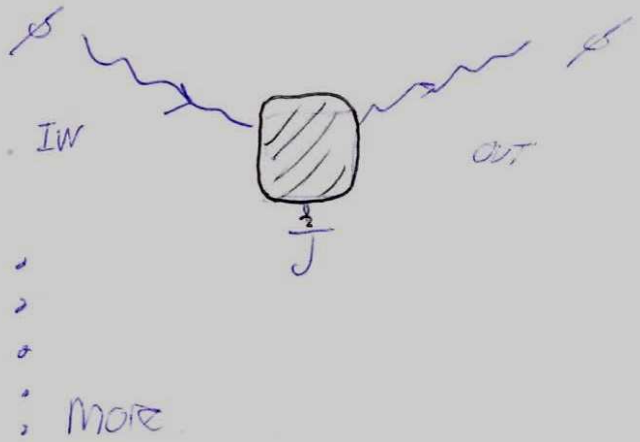
[Asymptotic Dar

Scattering....

ϕ_{in} ; ϕ_{out} : J_{source}.



$\phi_{out} = \phi_{in} + \delta\phi$



$\delta\phi \ll \phi_{in}$

perturbation t.

Solve → find.

$\left.\frac{\delta\phi}{\phi}\right|_{r_*} \propto I$ ← "Region where Interactions are

but

$r_* \propto (\sqrt{s})^{\Delta}$ → <0 ≠ G.R or QF

→ >0 ← GR

for $\Delta > 0 \Rightarrow$ $r_* \propto$ "Energy input"

↓

Grows in U.V.

- $|in\rangle$ ← Quantum
- $|out\rangle$ → Classical configuration.

↓

In GR ϕ_{class} precursor of BH.!!

Quantum gravity.....

Horava gravity.

- Breake Lorentz. inv.

- $\tilde{x}(\tilde{x},t)$; $\tilde{t}(t)$

  $x \to b^{-1}x$ $\quad t \to b^{-3}t$

$$S = \frac{1}{\alpha K^2}\int dt\, d^3x\, N\sqrt{h}\left(K_{ij}K^{ij} - \lambda K^2 + \xi R^{(3)} + \alpha a_i a^i + \dots - V(a, \nabla^3, R^{(3)}) \right)$$

$K_{ij}K^{ij}$ → Extrinsic Curvature

$R^{(3)}$ → 3-Curvature

$a_i a^i$ → $(\partial_i \ln N)$

$(N\ h_{ij}, N_i)$

$\Downarrow$

2 dof + matter

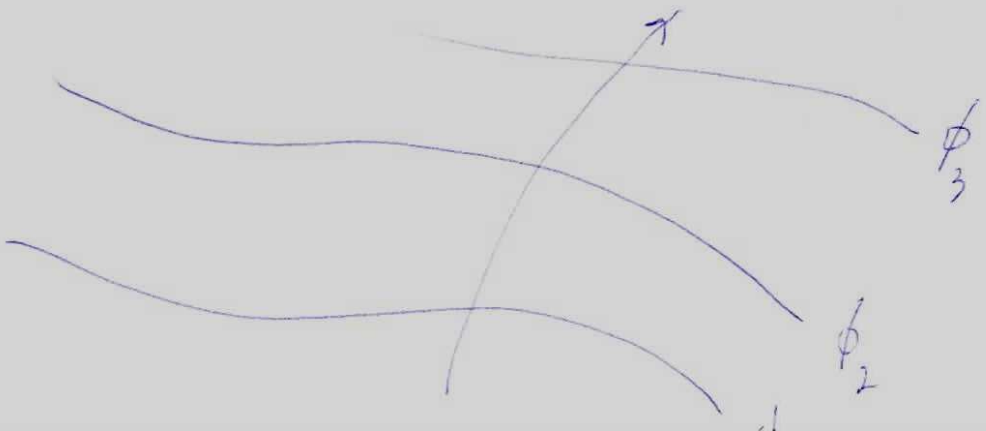
Nice:

- L.I is recovered at IR.
- Naive-renormalizable.

- Dispersion relations: $c(\vec{p}) \longmapsto \infty$
  $\downarrow \infty$
- There is a Covariant formulation

$g_{\mu\nu} + \phi$

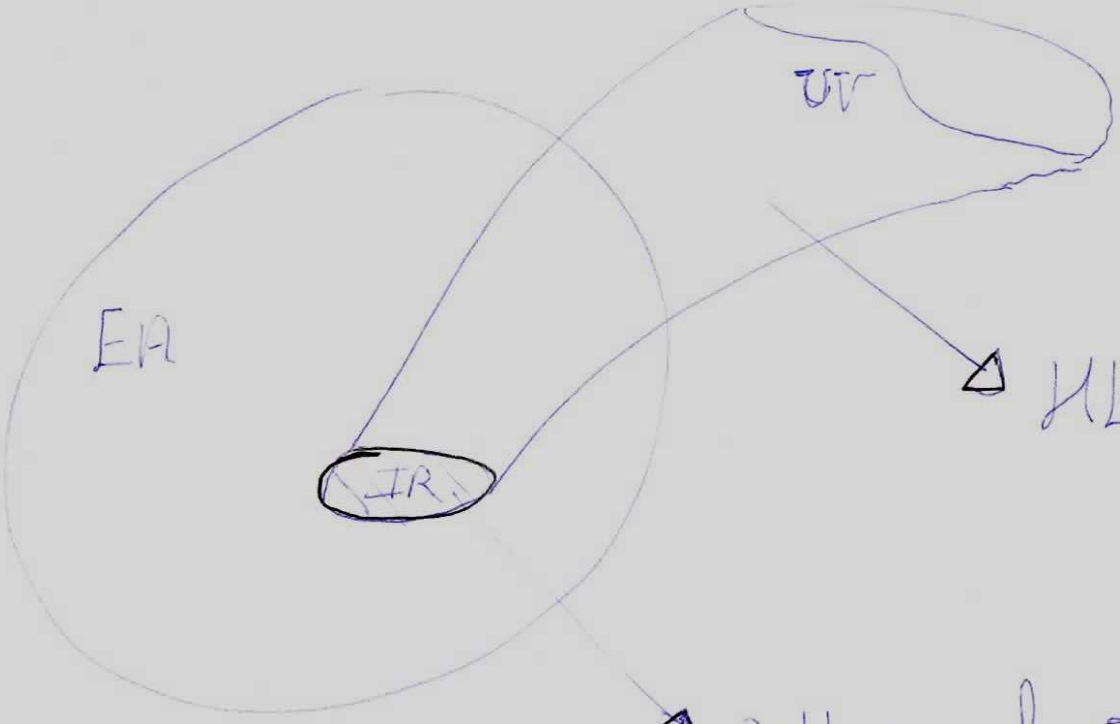
↳ Aether



fact:

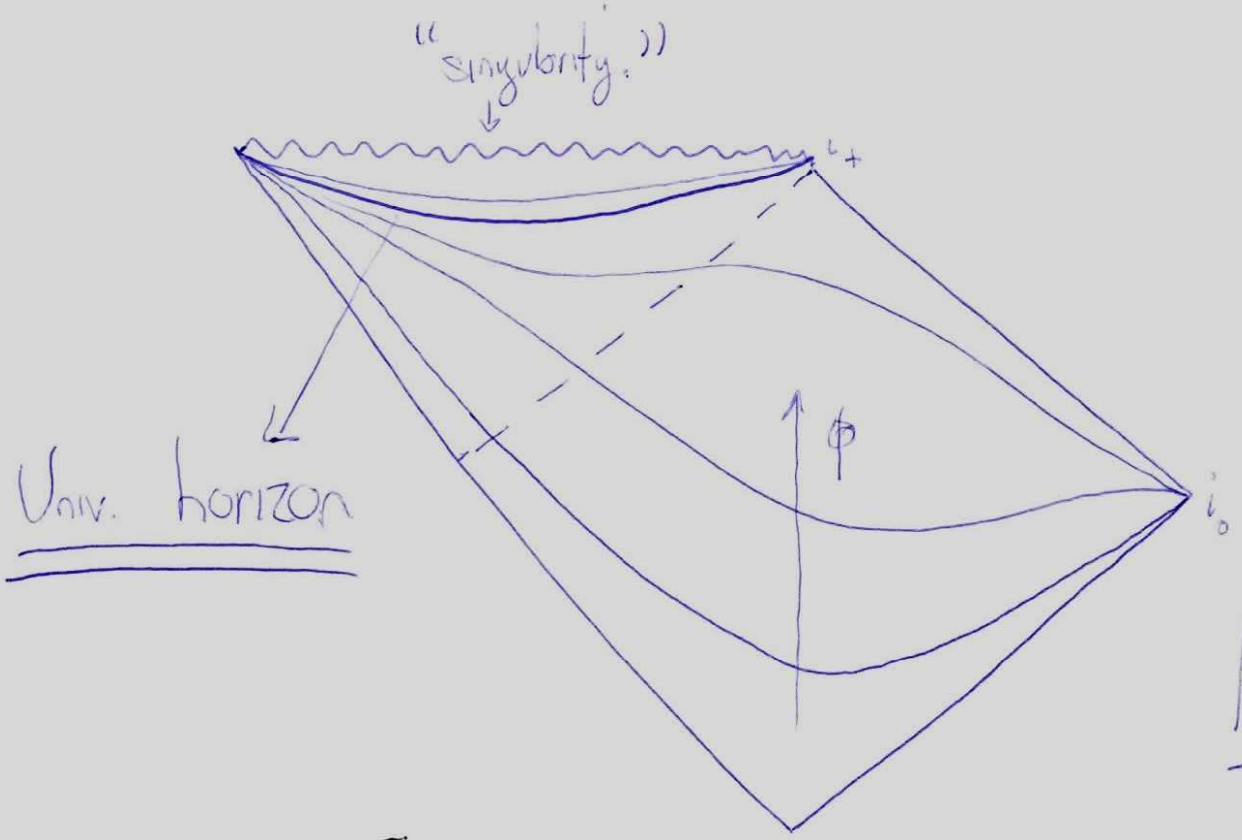
HL refract as Einstein-Aether the

EA



i.e. $EA_{ortho} = HL$

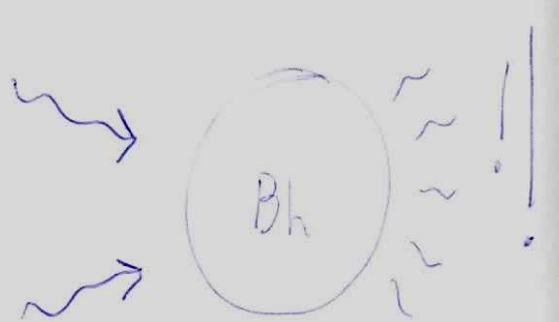
there $\exists$ BH in $EA = KL\big|_{IR.}$



Univ. horizon

- There is Singular
- Univ. horizon. behind met

but



numerical Sol.

- What is this singularity?
- What is the point of $V(a_i, P_i^3, R^3)$ if BH dominate U.V.?
- 2nd Law is Violated* ($\Delta S \geq 0$)
  - ↳ Unitarity problems !!

* EA

Back to Scattering.

(Simplest case) ϕ & external source J. in flat space.

$$\mathcal{L}_{tot} = \mathcal{L}_{EH} + \mathcal{L}_{GF}$$

$$\frac{1}{2\lambda_p}\left(\dot{\psi}^2 - 2\psi\Delta\psi + 1\phi\Delta\psi - \alpha\phi\Delta\phi\right) - \phi m\delta^3(x)$$

$$\frac{1}{2\lambda_p}\left[-f_1(\Delta\psi)^2 - 2f_2\Delta\phi\Delta\psi - f_3(\Delta\phi)^2 - g_1\psi\Delta^3\psi - 2g_2\phi\Delta^3\psi - g_3\phi\Delta^3\phi\right]$$

$$\begin{cases} N = 1+\phi \\ e^i_\mu = \delta^i_\mu - \alpha(\delta^i_\mu - \partial^i\partial_\mu)\psi \end{cases}$$

Hence

In IR. (only 2 derivatives)

- $r_x \sim \frac{m|_p^2}{(1-\alpha)} \propto m$ ← Classicalizat

In UV already 4 derivatives + ...

- $r_* \sim m^{-1}|_p * P(\alpha, f, g)$

$\propto \frac{1}{m}$ ← De-classicalizat

Hence

- there is no precursor of BH. !!

↓

the above BH are an illusion of

low energy theory

" No Asymptotic Darkness "

Notes

- Some destabilization of higher order. in V.
- Resolution of the Singularity.
- Leaking Radiation ?!

* This solve the problem:

There are No Bh. !!!