Discussion on Correspondence

Initial slides:

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Reformulation of questions

What regime?
(correspondence)

What properties
should it have?

How/what does
it predict?

How does it
explain black holes?

What is the underlying dynamics
("Nonlocal mechanics")

Is it strings?
"AdS/CFT"

How does it
explain cosmology,
inflation, etc.

Are there observational
consequences?

Does it predict
a landscape?

One possible set of limitations:

"locality bound:"

2 part Fock sp.: $\phi_{x,p}\phi_{y,q}|0\rangle$

good description for $|x-y|^{D-3} > G|p+q|$

Observation:

If "observing" degrees of freedom must be accounted for (relational observables), then expect limit on observation

Suggestion:

"Resum" pert thy, giving partial QFT description inside black hole, away from singularity, and for

$$t < R_S S_{BH}$$

good for many quantities,
but no complete local quantum description?

N-particle generalization:

$$\phi_{x_1,p_1} \cdots \phi_{x_N,p_N} |0\rangle$$

not good for $\mathrm{Max}|x_i - x_j|^{D-3} < G|\sum_i P_i|$

Likewise, expected to constrain observation

One example: "Ultimate detector"

(S.G, Marolf, Hartle hep-th/0512200)

Try to instrument a region of space of size R with a state capable of making measurements at resolution r

Requires exciting fields with momenta 1/r in each "cell" of size r. Total energy:

$$E \sim \frac{1}{r}\left(\frac{R}{r}\right)^3$$

Condition for small grav. backreaction:

$$R \gtrsim \frac{1}{M_P^2}\frac{1}{r}\left(\frac{R}{r}\right)^3$$

→ Strong ~holographic constraint:

$$N(R) \sim (M_P R)^{3/2}$$

(c.f. 't Hooft; Cohen, Kaplan, Nelson)

(Possibly get $N(R) \sim (M_P R)^2$, accounting for grav DOF (or different eq. of state??))

Plausible viewpoint: degrees of freedom that can't in principle be observed don't exist

These are suggestions for the "correspondence limit."
(Similar suggestions exist for dS)

1) Are there others ?

2) To what extent should they be taken seriously in formulating fundamental theory?