Does AdS/CFT coarse grain?

\[ M : \mathcal{H}_B \rightarrow \mathcal{H}_\partial \]

\[ \text{1-1, unitary, onto?} \]

If so:

\[ U_B = M^\dagger U M \]

QG √

Alternatives: e.g. many

coarse graining suggested/explored:

Tests: ~local bulk observables

flat S-matrix

hep-th/9907129
hep-th/0103231 w/ Lippert
work w/ M. Gary
E.g.

\[ \psi_{\text{in}} \rightarrow S_B \rightarrow \psi_{\text{out}} \]

\[ \sim \text{LSZ for AdS} \]

Would give $S$ (need basis of scatt. states)
Describing scattering states:
- Trivial in the non-interacting theory
- Difficulties w/interactions

1) Normalizable construction:
   - Even for $g << 1$:
     - $\infty$ interactions
     - BHs!

2) Non-normalizable:
   - $\int \psi_{NN} \psi_{NN} G_B$
   - Other contrib.
3) Boundary compact:

- can’t get arbitrary wavepackets
  limits on sharpness/tails
- e.g. op. at point spreads
- challenge to get arbitrary multipart. states
Possible alternative:

Full fine-grained $\mathcal{H}_B$ not described by $\mathcal{H}_\theta$

Other, subsequent, indications for coarse-graining Marolf/Wall; also, AMPS??
How to settle?

(How) Does the gauge theory describe bulk physics in AdS/CFT?

What are necess/suff conditions for extracting $S_B \approx S_{QFT}$?

Concretely: what is a general, precise prescription

$$\langle \Omega \Omega \Omega \cdots \rangle \rightarrow S_{\psi_1 \psi_2 \cdots} \psi_3 \cdots$$

Do we have a suitable construction of \textasciitilde local bulk observables? (KLL, etc.)

or, possible issues (similar?)