

# Celestial and Carrollian holography

[vision / discussion session]

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Laura DONNAY

AdS/CFT meets Carrollian & Celestial holography

ICMS, Bayes Centre, Edinburgh

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# Celestial / Carrollian holography

**Goal :** establish a holographic correspondence between

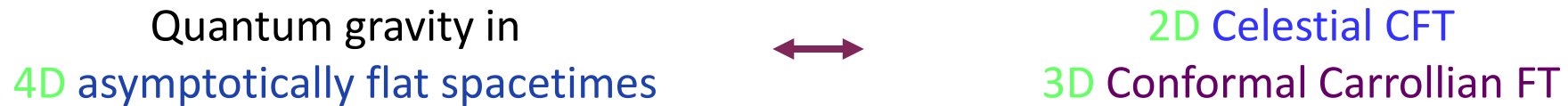
Quantum gravity in  
4D asymptotically flat spacetimes



2D Celestial CFT  
3D Conformal Carrollian FT

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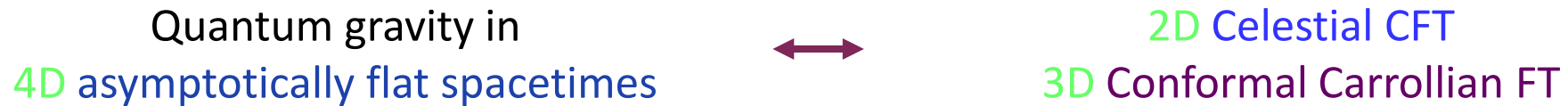
Both celestial and Carrollian programs have been driven by the presence of an infinite-dimensional asymptotic symmetry group

$\text{BMS}_4$  + extensions\*

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$\text{BMS}_4$  + extensions\*

→ deep relation with infrared effects in QFT, provide a stress tensor, current algebras, ...

\* you name it

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**Seminal paper** [Strominger '14]

ON BMS INVARIANCE OF GRAVITATIONAL  
SCATTERING

Andrew Strominger

*Center for the Fundamental Laws of Nature, Harvard University,  
Cambridge, MA 02138, USA*

→ **The S-matrix is BMS invariant**

Provided a (new) starting point for  
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It's been more than 10 years now...

## Question

How fundamental do we think **BMS\*** symmetries are ?

\* and/or their gauge theory analogues

# AdS / CFT correspondence

is a statement about the  
equivalence of 2 quantum theories

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In flat space holography

What **Hilbert space** are we trying to map ??

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→ **QED**: need to **depart** from the Hilbert space of the usual Fock representation  
[Chung '65][Kibble '68] (see also [Ashtekar '84])

Faddeev-Kulish (FK) dressed states  $\in$  enlarged Hilbert space  $\mathcal{H}_{\text{FK}}$

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→ *Modern revisit*:  
IR divergences arise, for conventional states, as a necessity to **respect BMS conservation laws**.  
[Kapec, Perry, Raclariu, Strominger '17][Akhoury, Choi '17]

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- $\text{BMS}_3$  particles introduced in [Barnich, Oblak '14 '15]  
(g)BMS reps also studied in [Bagchi, Basu, Kakkar, Mehra '16][Freidel, Moosavian, Pranzetti '24]
- $\text{BMS}_4$  UIRs classified in a series of papers by Mc Carthy (+ Girardello, Parravicini) in 1970's

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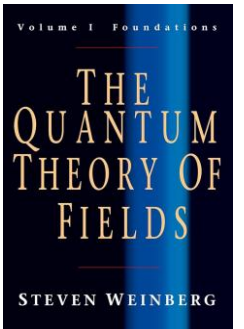
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supermomentum eigenstate



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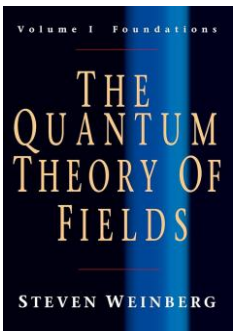
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