

Introduction

Towards Understanding  
Subregion  
Duality

A Simple  
Geometrical  
Criterion

Applications  
and  
Comments

# Reconstructing the Hologram: Towards Subregion Dualities in AdS/CFT

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Introduction

Towards Understanding  
Subregion DualityA Simple Geometrical  
CriterionApplications and  
Comments

## Things we know about AdS/CFT

- All degrees of freedom in the bulk are mapped to degrees of freedom on the boundary
- Given the "whole boundary" we (should) know everything about the bulk
- But what if we have access only to part of the boundary?

→ Is a CFT restricted to a subset of the full AdS boundary dual to a geometric subset of the AdS bulk?

Motivation: Holographic entanglement entropy

Based on R. Bousso et. al. 1209.4641v1

Introduction

Towards Understanding  
Subregion  
Duality

A Simple  
Geometrical  
Criterion

Applications  
and  
Comments

**Global AdS/CFT:** In the classical limit, bulk fields can be reconstructed from CFT one–point functions.

**Subregion AdS/CFT:** The same must hold if a subregion duality exists.

- Construct *continuous* maps between data on a subregion of the boundary and the dual bulk fields in the corresponding bulk subregion, in the classical limit.
  - Non–standard Cauchy problem

When does a continuous map exist?  $\left\{ \begin{array}{ll} \text{Global AdS} & \text{YES} \\ \text{Poincaré Patch} & \text{YES} \\ \text{AdS–Rindler} & \text{NO} \end{array} \right.$

## Proposed Criterion for Continuous Reconstruction

### Statement

Continuous reconstruction of a bulk subregion is only possible if every null geodesic in that subregion reaches the asymptotic boundary of that subregion

### Motivation

- Mathematical theorems related to the analogous problem in flat spacetime (*Bardos et. al.* )
- The physical interpretation of why the reconstruction fails in the case of the Rindler wedge
- Questions about unique continuation of bulk solutions further into the bulk

The proposed diagnostic criterion can be applied to familiar situations to test its implications:

- *AdS Black Hole formed in collapse*

Every null geodesic reaches the boundary

⇒ Continuous reconstruction is possible

- *Eternal AdS Black Hole*

Some null geodesics go from the past singularity to the future singularity and never reach the boundary

⇒ Continuous reconstruction possible only down to the unstable circular orbit

- *Black Branes*

For every value of  $r$  there are null geodesics that never reach the boundary

⇒ No continuous reconstruction

Introduction

Towards Understanding  
Subregion  
DualityA Simple  
Geometrical  
CriterionApplications  
and  
Comments

*Does the failure of the diagnostic test imply the death of a AdS–Rindler subregion duality?*

**No: Non–local operators might play a role in bulk reconstruction even at the classical level**

Thank you for listening