



Department of  
Theoretical Physics

# THE QUANTUM SPACETIME SEMINAR SERIES

## Emergent times in holography

(Zoom Seminar)

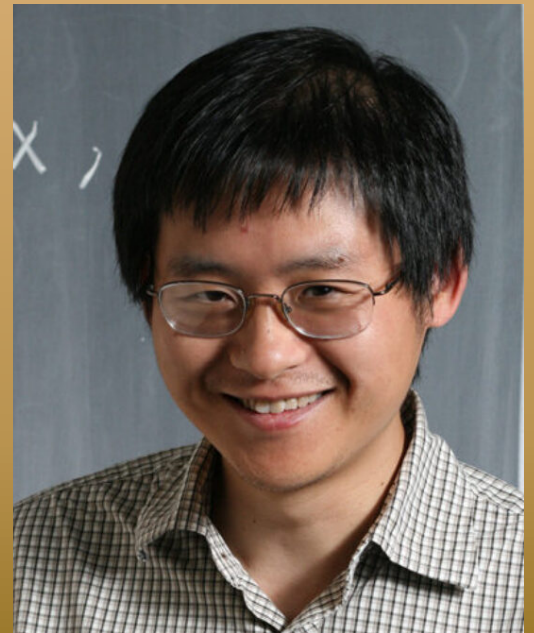
**Hong Liu**

(MIT)

**Date:** March 7, 2022

**Time:** 9 AM IST

Zoom link shall be shared separately



In holographic duality an eternal AdS black hole is described by two copies of the boundary CFT in the thermal field double state. We provide explicit constructions in the boundary theory of infalling time evolutions which can take bulk observers behind the horizon. The constructions also help to illuminate the boundary emergence of the black hole horizons, the interiors, and the associated causal structure. A key element is the emergence, in the large  $N$  limit of the boundary theory, of a type III<sub>1</sub> von Neumann algebraic structure and the half-sided modular translation structure associated with it.