Michal P. Heller (Ghent University)
Title: Temporal Entanglement from Holographic Entanglement Entropy
Abstract: Recently several notions of entanglement in time have emerged as a novel frontier in quantum-many body physics, quantum field theory and gravity. We propose a systematic prescription to characterize temporal entanglement in relativistic quantum field theory in a general state for an arbitrary subregion on a flat constant time slice in flat spacetimes. Our prescription starts with the standard entanglement entropy of a spatial subregion and amounts to transporting the unchanged subregion to boosted time slices all the way across suitably regulated light cone when it becomes in general a complex characterization of the corresponding temporal subregion. For holographic quantum field theories, our prescription amounts to an analytic continuation of all codimension-two bulk extremal surfaces satisfying homology constraint and picking the one with the smallest real value of the area as the leading saddle point. We implement this prescription for the holographic conformal field theories in thermal states on a two-dimensional Lorentzian cylinder and in three-dimensional Minkowski space and show that it leads to results with self-consistent physical properties of temporal entanglement. Based on an upcoming work with Fabio Ori and Alexandre Serantes.

Andreas Blommaert (IAS)
Title: The observer's no-boundary state and the universe's size
Abstract: We will discuss the expectation value of the size of the universe. I will consider sine dilaton gravity, a toy model of 2d quantum cosmology. I will explain how to compute the sphere amplitude in sine dilaton, and the prediction it gives for the size of the universe. Much like the prediction by the no-boundary state in inflationary models, the sphere predicts a universe that is unrealistically small. I will then discuss the no-boundary proposal for closed universes with an observer. The observer's no-boundary state is dominated by a bra-ket wormhole and predicts a large universe, like our own.

Andy Lucas (University of Colorado)
Title: The reconstruction map in JT gravity
Abstract: JT gravity is a (relatively) simple model of quantum gravity in 2 dimensions where there has been significant progress on defining and understanding a non-perturbative theory of quantum gravity. However, many important open questions about quantum gravity have remained challenging to answer, even in JT, because we do not know a reconstruction map, which tells us how to define semiclassical operators (such as wormhole length) in the non-perturbative theory. We postulate a simple reconstruction map based on (1) knowledge of the spectrum of the non-perturbative theory; (2) assuming

that the predictions of semiclassical gravity are accurate at short times. This reconstruction map allows us to make rather quantitative predictions about the quantum dynamics of wormholes in non-perturbative JT gravity at all time scales. We find that the average wormhole length is a non-monotonic function of time, and that quantum fluctuations in wormhole length are extremely small until (almost) the Heisenberg time. Our reconstruction map is based on a clear relationship between wormhole length and a formal notion of quantum ergodicity, which may have interesting implications for the “complexity = volume” conjecture from holography.

Zohar Komargodski (SCGP)

Title: ''Entropic Order''

Abstract: Ordered phases of matter, such as solids, ferromagnets, superfluids, or quantum topological order, typically only exist at low temperatures. Relatedly, large Black Holes have no hair. We present explicit local models in which order exists at arbitrarily high temperature. The physical mechanism is that order in one degree of freedom can enable many more to freely fluctuate, leading to “entropic order”, whereby typical high energy states are ordered! Interacting bosons can lead to entropic order at any temperature, avoiding existing no-go theorems on long-range order or entanglement at high temperature. We also show how we can obtain superconductors at very high temperature using these ideas.

Giuseppe Policastro (ENS)

Energy transport in 2D holographic conformal and non-conformal interfaces"

Defects and interfaces are the subjects of intense study in different contexts, as they provide useful probes quantum field theory and condensed-matter systems. In the case of two-dimensional conformal interfaces, universal properties are encoded in the flux of energy transmitted and reflected for an excitation scattering with the interface. I will discuss the study of energy trasport across interfaces in the holographic setup, using the minimal holographic model of a brane in AdS3, and extended brane configurations that can mimic top-down smooth gravity solutions, and the extension to a class of non-conformal defects obtained by turning on a TTbar-deformation of the CFT.