

Black Holes and Quantum Info, Fall 2021

Problem Set 1

Due: in lecture Tuesday, Sep. 14

Reading. Reading for each lecture is posted on the website. In addition, read sections 9.4-9.5 of Carroll *Spacetime and Geometry*, working carefully through all the details of section 9.5.

Problems

1. Do the exercise “Finite-temperature correlators in a 2d CFT” in QGBH section 4.
2. Do the exercise “Rindler time translations are Minkowski boosts” in QGBH section 3.
3. Do the exercise “Entanglement warm-up” in QGBH section 5.
4. (Do this after working carefully through the details of Carroll section 9.5, and use Carroll’s notation.) Write a formula for the operator ρ_{Rindler} , i.e. the reduced density matrix of Rindler spacetime, in terms of field creation and annihilation operators. Confirm Carroll eqn (9.163) using the definition for an expectation value in a mixed state,

$$\langle \hat{n}_R^{(1)}(k) \rangle = \text{Tr } \rho_{\text{Rindler}} \hat{n}_R^{(1)}(k) . \quad (0.1)$$