Title: Asymptotic entanglement and celestial holography

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Series: Quantum Fields and Strings

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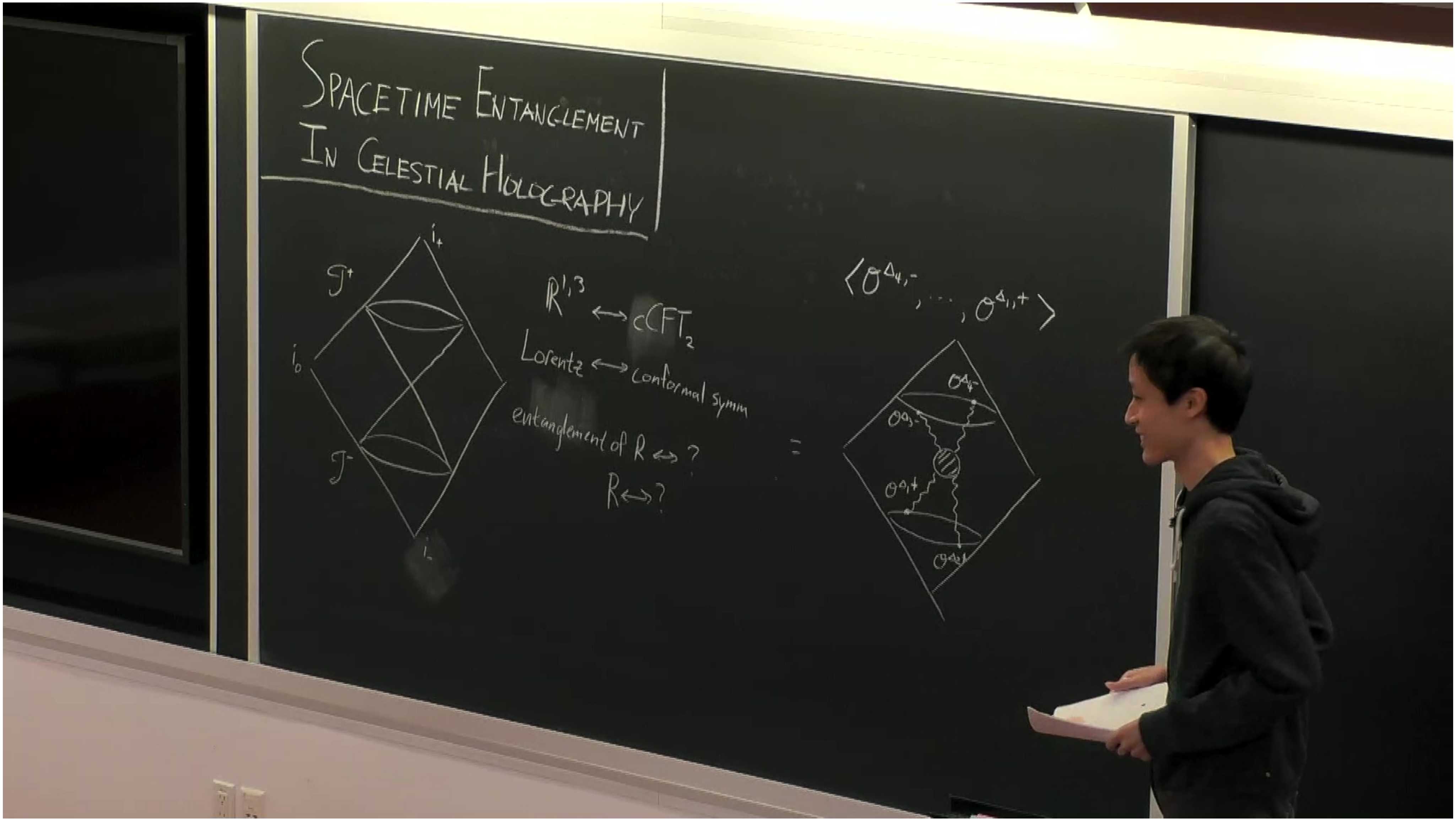
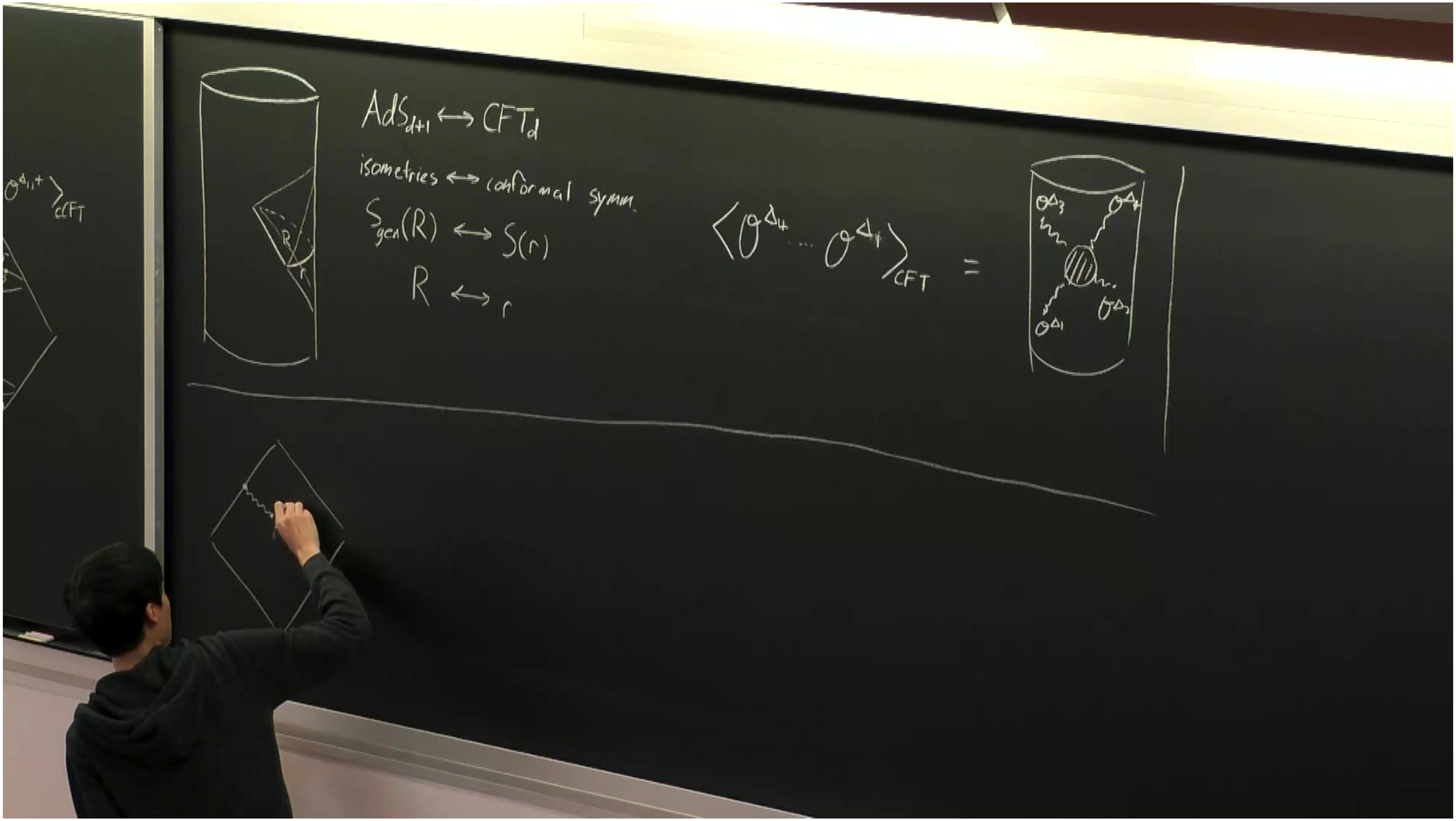
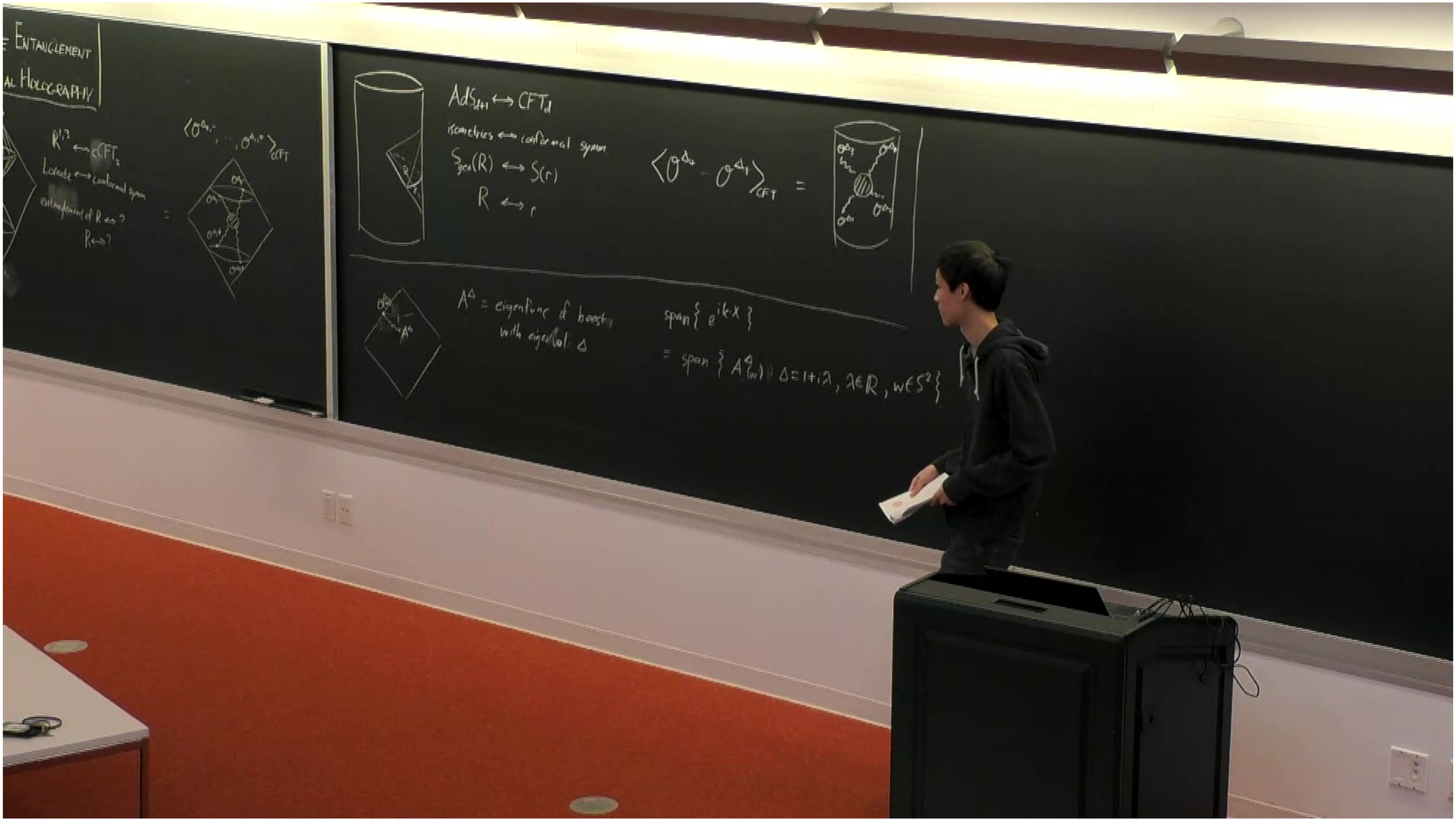
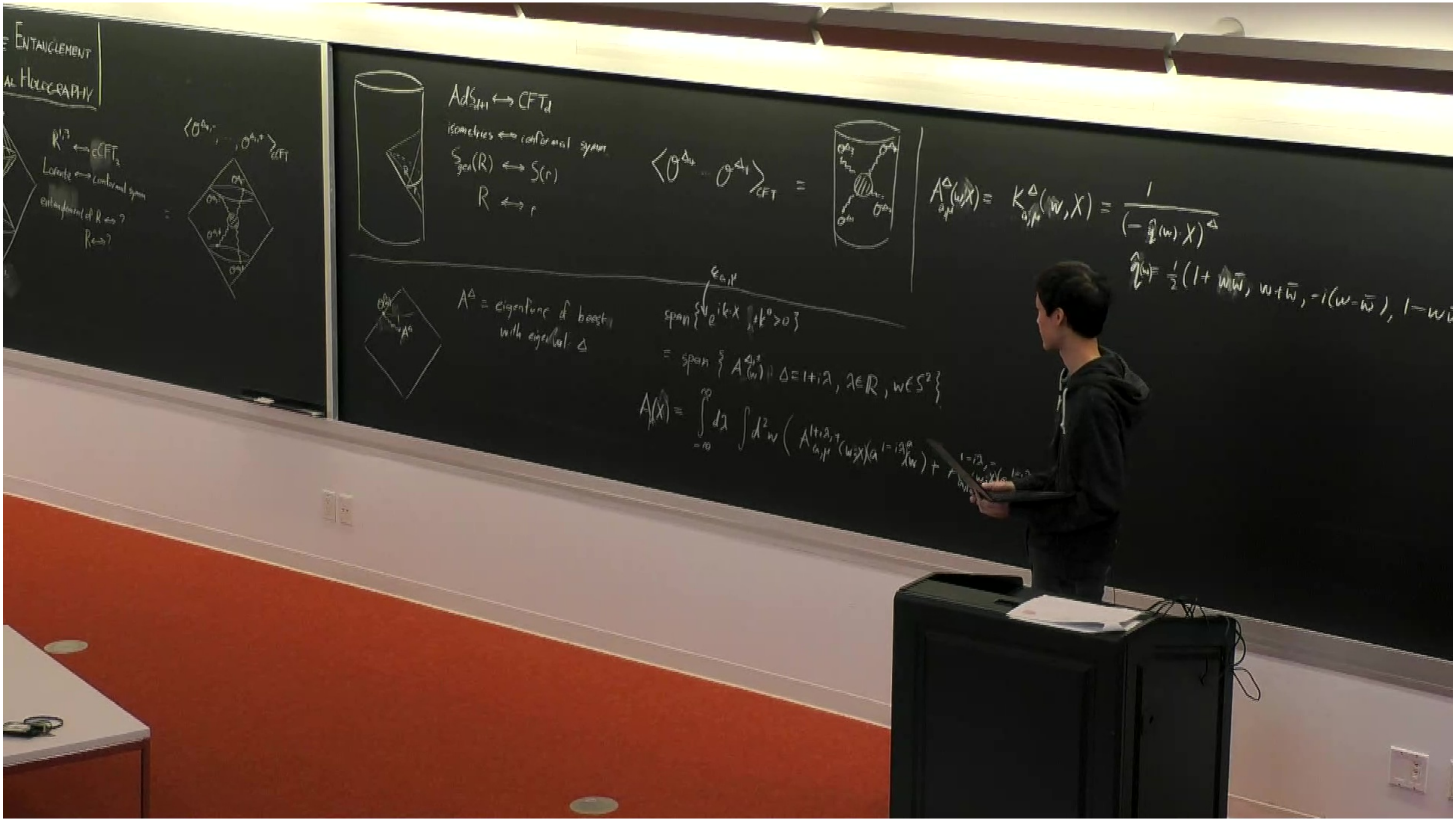
Abstract: While entanglement has been examined extensively in AdS/CFT, it has avoided significant attention in the study of celestial holography and asymptotic symmetries relevant to asymptotically flat spacetime. I will present work that considers the entanglement of a Milne patch for Maxwell theory in Minkowski spacetime from the perspective of celestial holography. In the Minkowski vacuum, we find that the Milne patch is thermally entangled. We interpret the thermal entangling operator that builds the Minkowski vacuum from the Milne vacuum as an interaction term in the celestial CFT. We further examine the edge modes of the Milne patch, assigning them a physical interpretation as fluctuations in Milne asymptotic charge. Interestingly, we find that the constraint governing these edge modes includes sources that avoid the Minkowski interior. Altogether, by studying entanglement along the extra holographic direction present in celestial holography but absent in AdS/CFT, our work bridges a critical gap between our understanding of entanglement in the latter and the physically relevant setting of asymptotically flat spacetime.

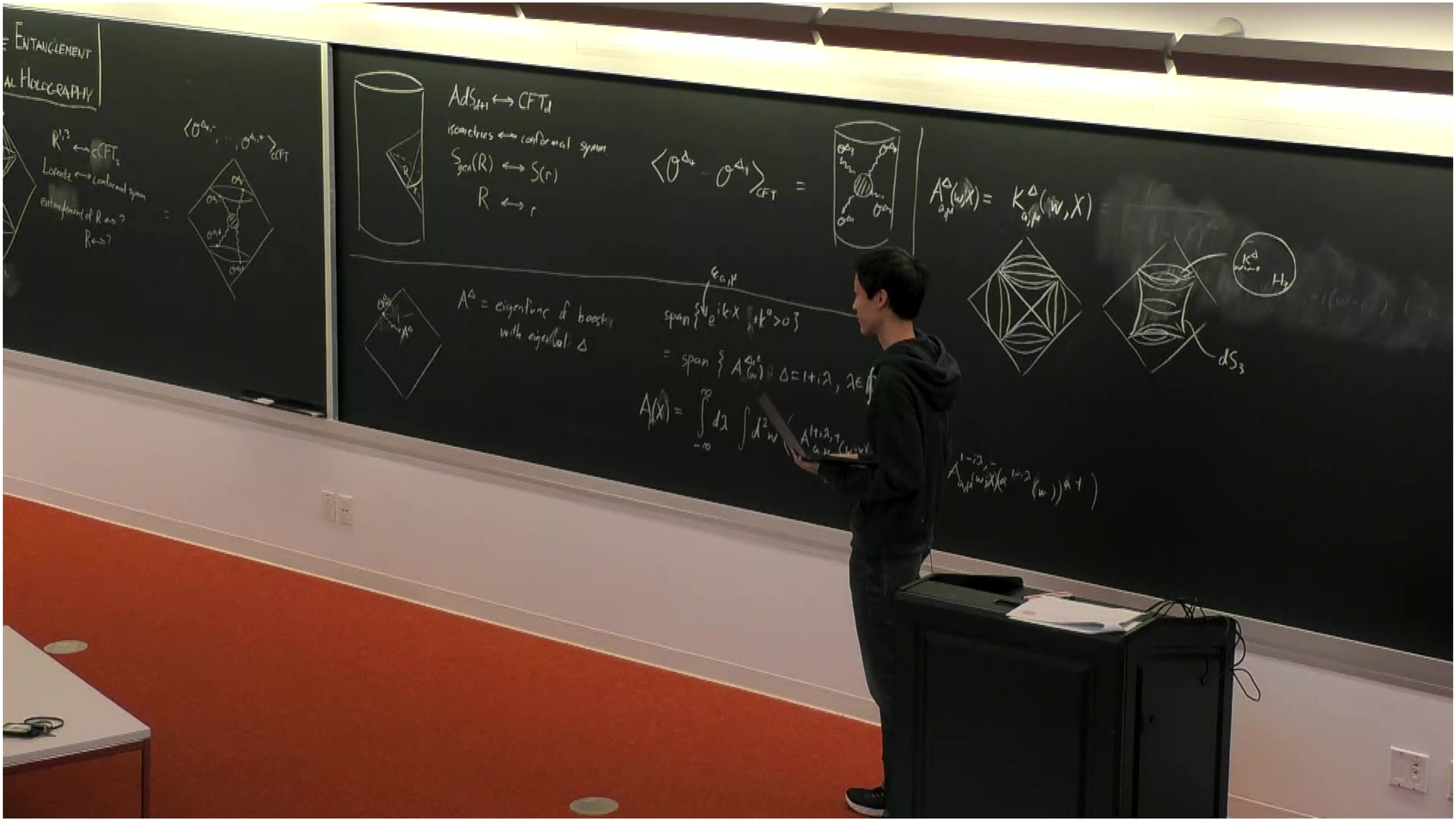
Zoom Link: TBD

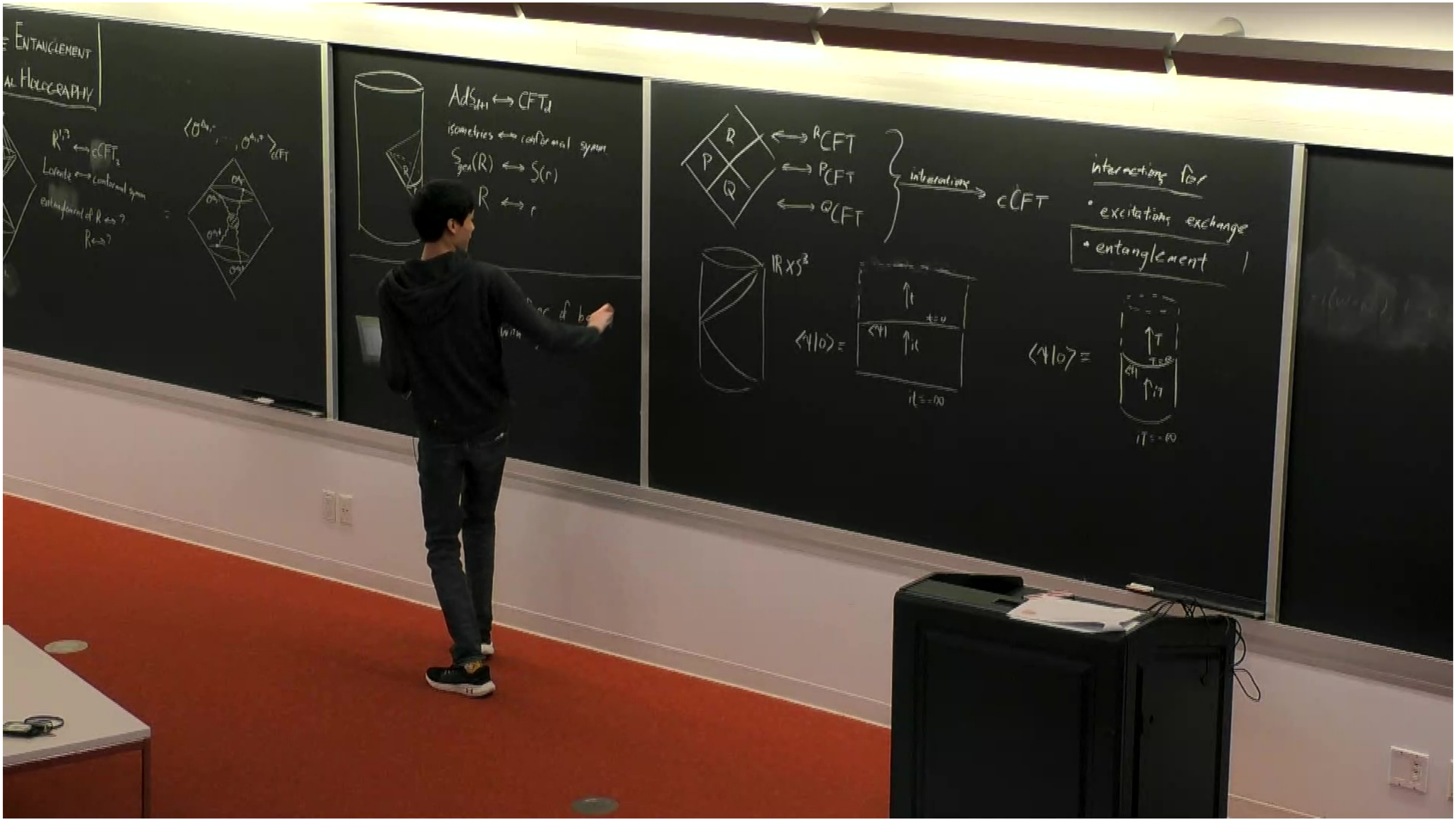

SPACETIME ENTANGLEMENT
IN CELESTIAL HOLOGRAPHY
R^{1,3} ⟷ cCFT_2
Lorentz ⟷ conformal symm
entanglement of R ⟷ ?
R ⟷ ?

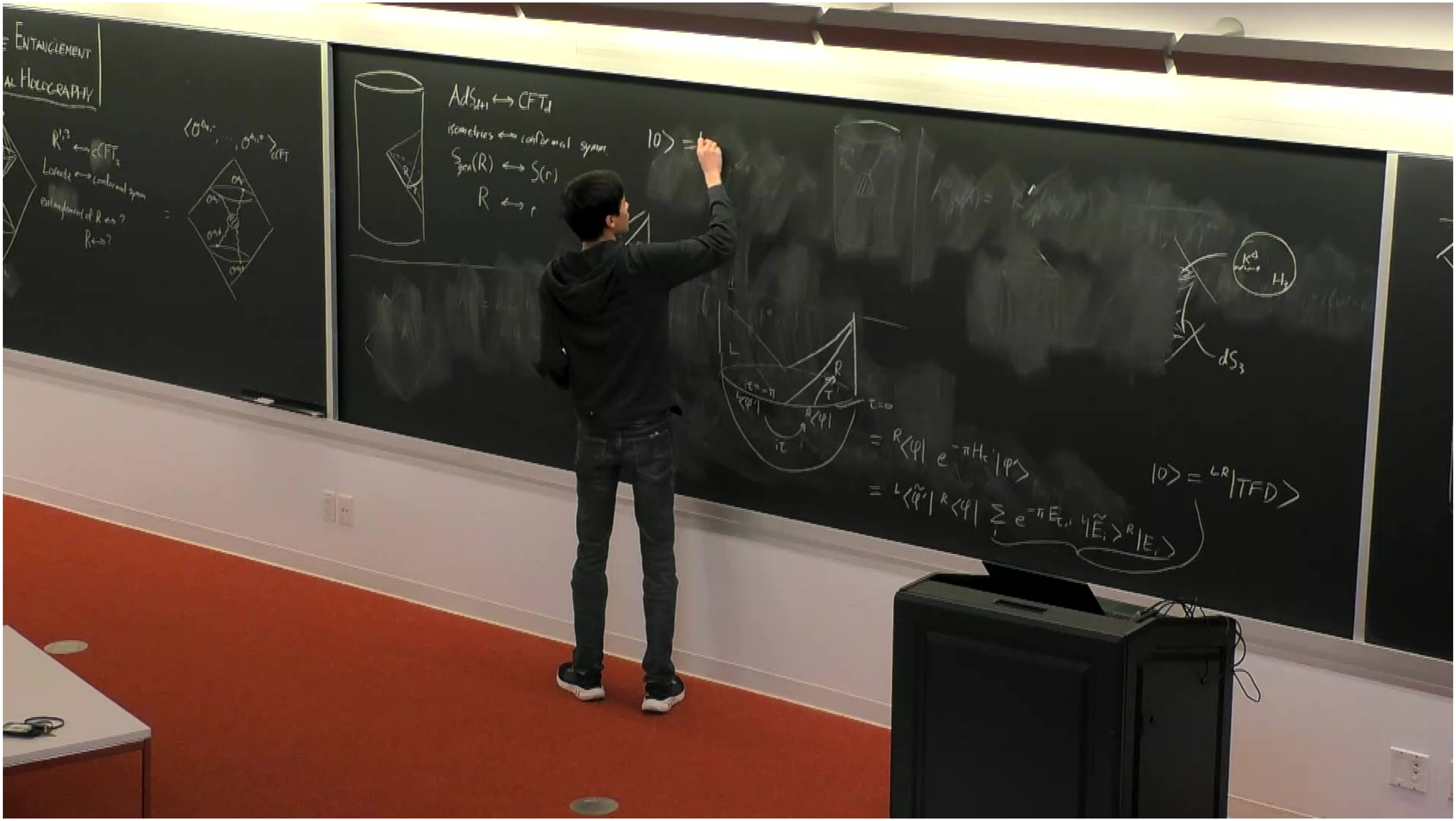

AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm.
S_gen(R) ⟷ S(r)
R ⟷ r
⟨O^{Δ4} ... O^{Δ1}⟩_CFT =

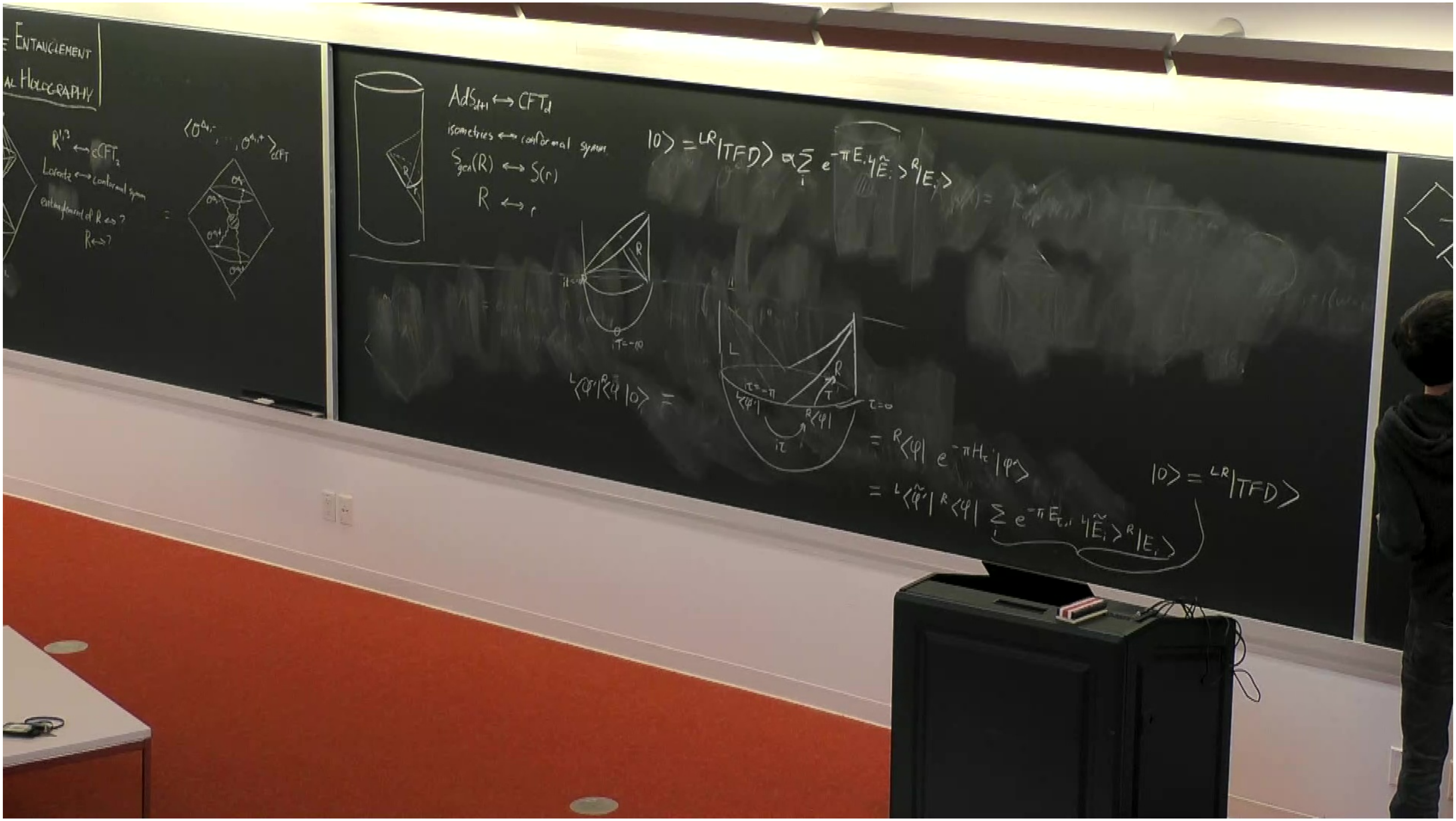

ENTANGLEMENT
HOLOGRAPHY
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm
S_gen(R) ⟷ S(r)
R ⟷ r
A^Δ = eigenfunc of boosts with eigenval Δ
span{ e^{ik·x} }
= span { A^Δ(w) | Δ = 1+iλ, λ∈R, w∈S² }


Entanglement
Holography
AdS ⟷ CFT
isometries ⟷ conformal symm
R ⟷ r
A^Δ = eigenfunc of boosts
with eigenval. Δ
span

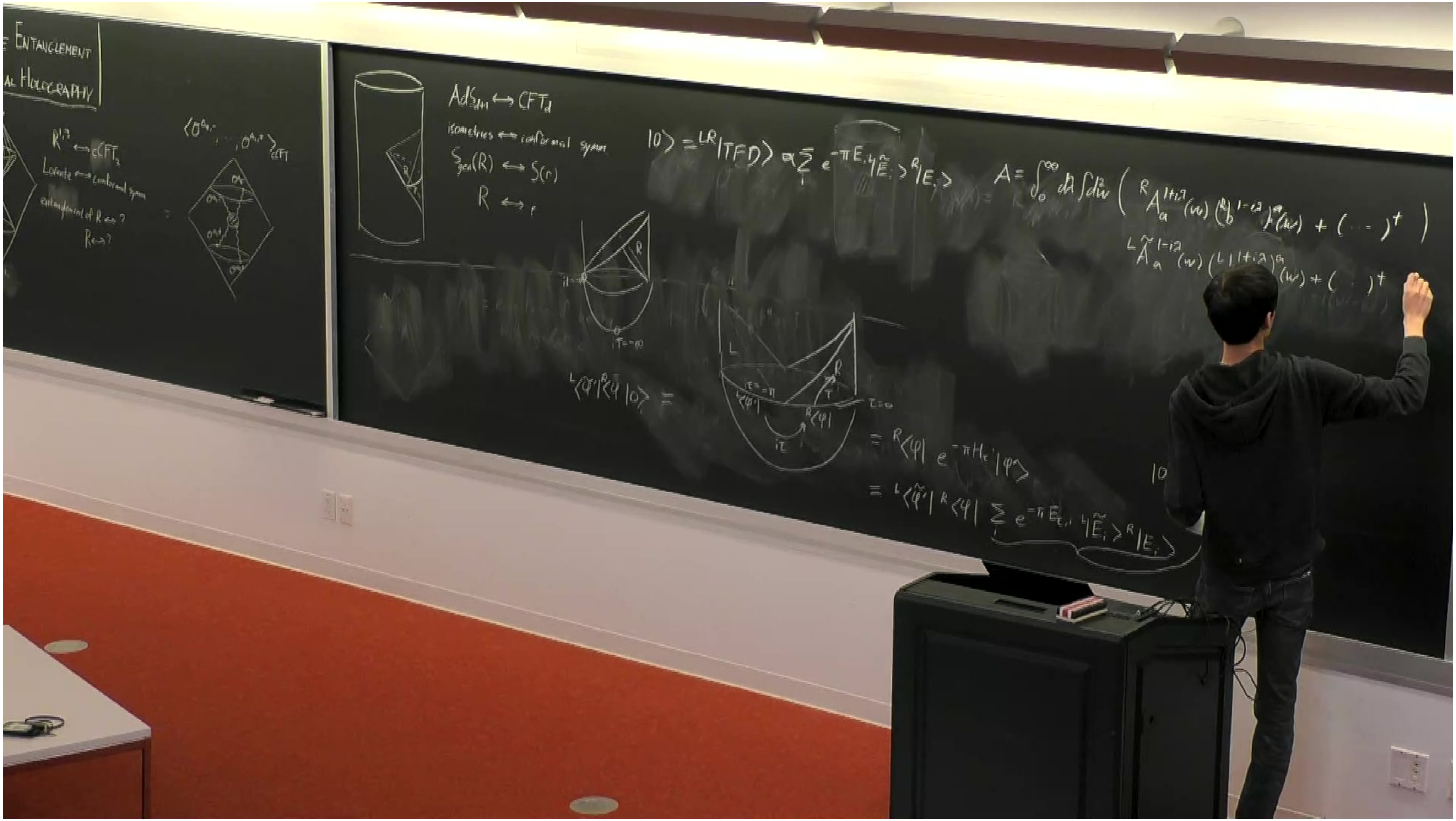

ENTANGLEMENT
AL HOLOGRAPHY
Lorentz ⟷ conformal symm
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm
R ⟷ r
A^Δ = eigenfunc of boosts
with eigenval. Δ
dS_3

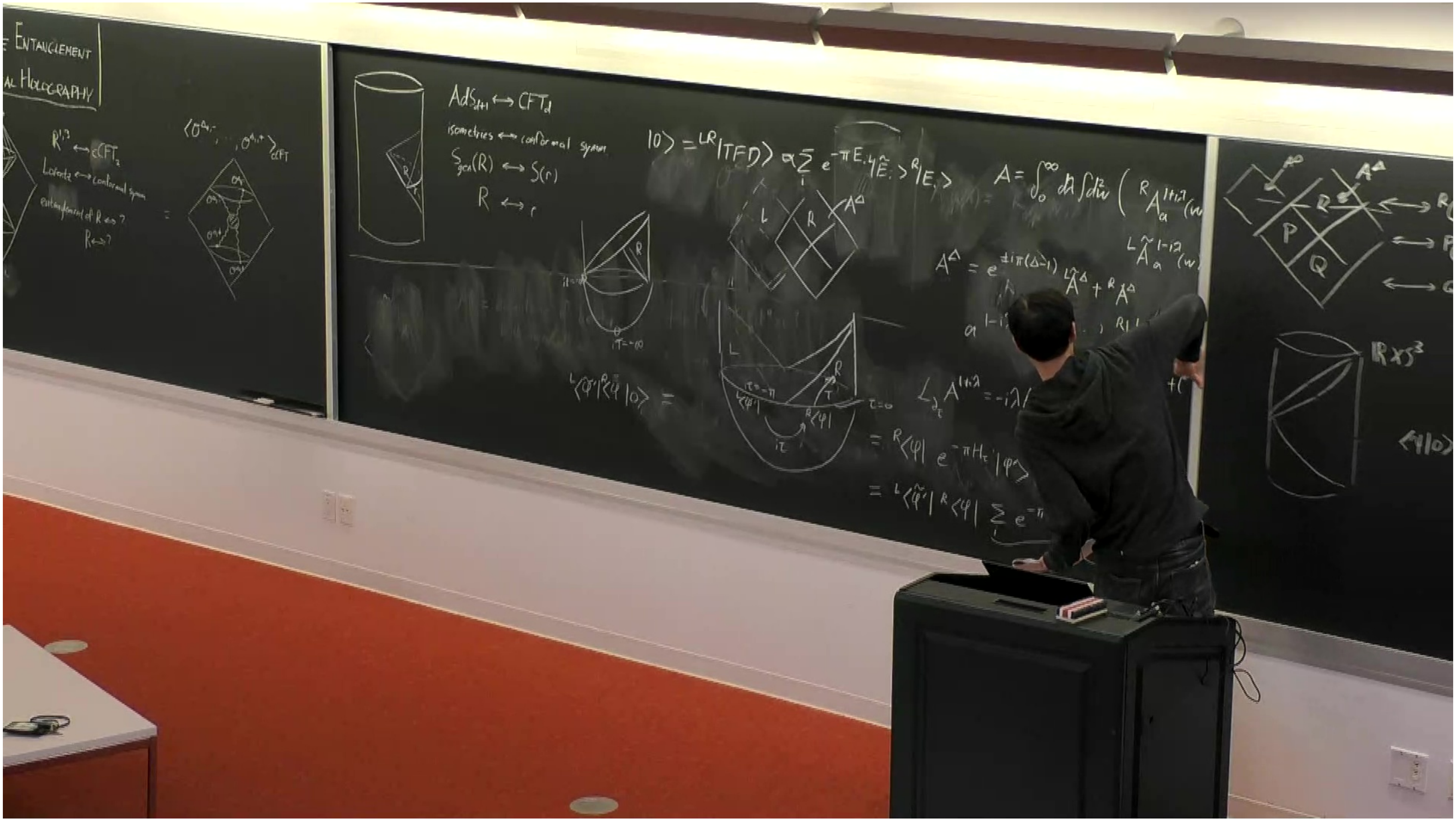

AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm
S_gen(R) ⟷ S(r)
RCFT
PCFT
QCFT
interactions
cCFT
interacting for
• excitations exchange
• entanglement
ℝ×S³
⟨ψ|0⟩ =
⟨ψ|0⟩ =


ENTANGLEMENT
HOLOGRAPHY
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal sym
S_gen(R) ⟷ S(r)
R ⟷ r
Lorentz ⟷ conformal sym
|0⟩ = ^{LR}|TFD⟩
dS_3

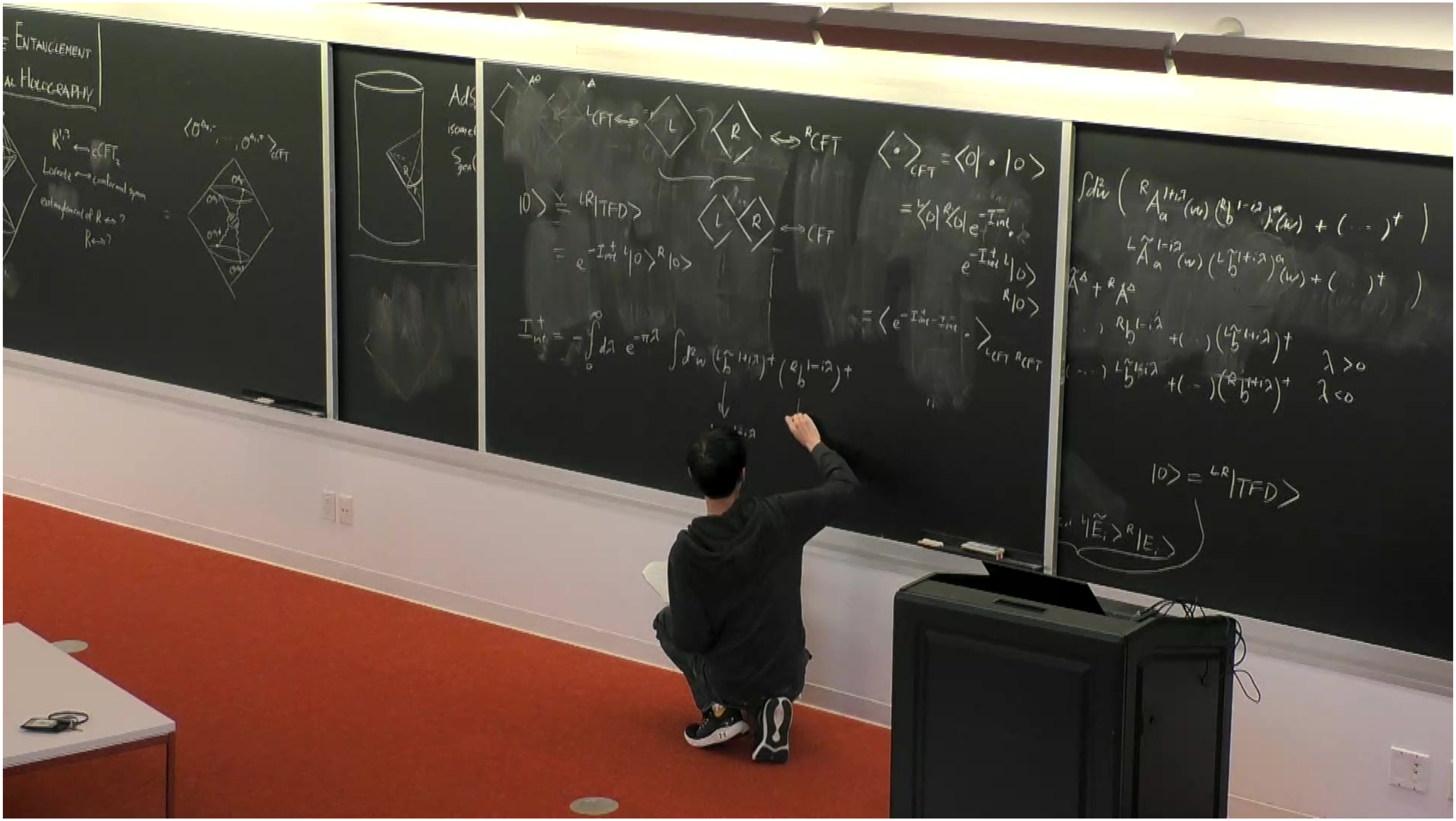


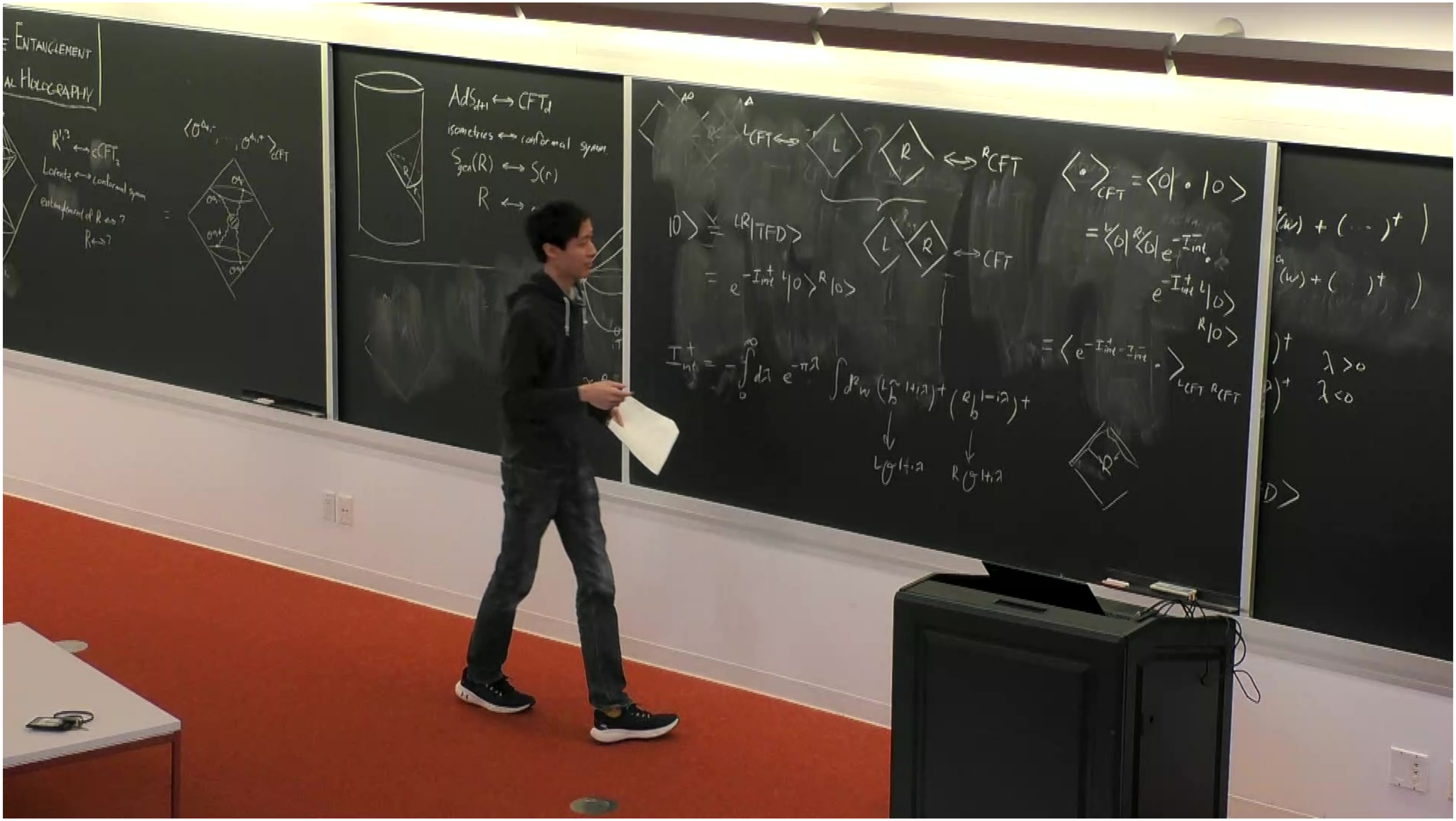
ENTANGLEMENT
HOLOGRAPHY
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm.
S_gen(R) ⟷ S(r)
R ⟷ r
|0⟩ = ^{LR}|TFD⟩
|0⟩ = ^{LR}|TFD⟩ ∝ Σ_i e^{-πE_i} ^L|Ẽ_i⟩ ^R|E_i⟩
^L⟨φ'| ^R⟨φ| |0⟩ =
= ^R⟨φ| e^{-πH_τ} |φ'⟩
= ^L⟨φ̃'| ^R⟨φ| Σ_i e^{-πE_{τ,i}} ^L|Ẽ_i⟩ ^R|E_i⟩
τ=0
τ=-π


ENTANGLEMENT
AL HOLOGRAPHY
Lorentz ⟷ conformal sym
isometries ⟷ conformal sym
R ⟷ r


ENTANGLEMENT
HOLOGRAPHY
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm
R ⟷ r
R×S^3


ENTANGLEMENT
HOLOGRAPHY
AdS ⟷ CFT
isometries ⟷ conformal symm
R ⟷ r
CFT
interactions
cCFT
interactions for
• excitations exchange
• entanglement


ENTANGLEMENT
HOLOGRAPHY
|0> = LR|TFD>


ENTANGLEMENT
HOLOGRAPHY
Lorentz ⟷ conformal symm
AdS_{d+1} ⟷ CFT_d
isometries ⟷ conformal symm
S_gen(R) ⟷ S(r)
^L CFT
^R CFT
⟷ CFT
|0⟩ = LR|TFD⟩
λ > 0
λ < 0