Title: Wilson lines in AdS3 gravity

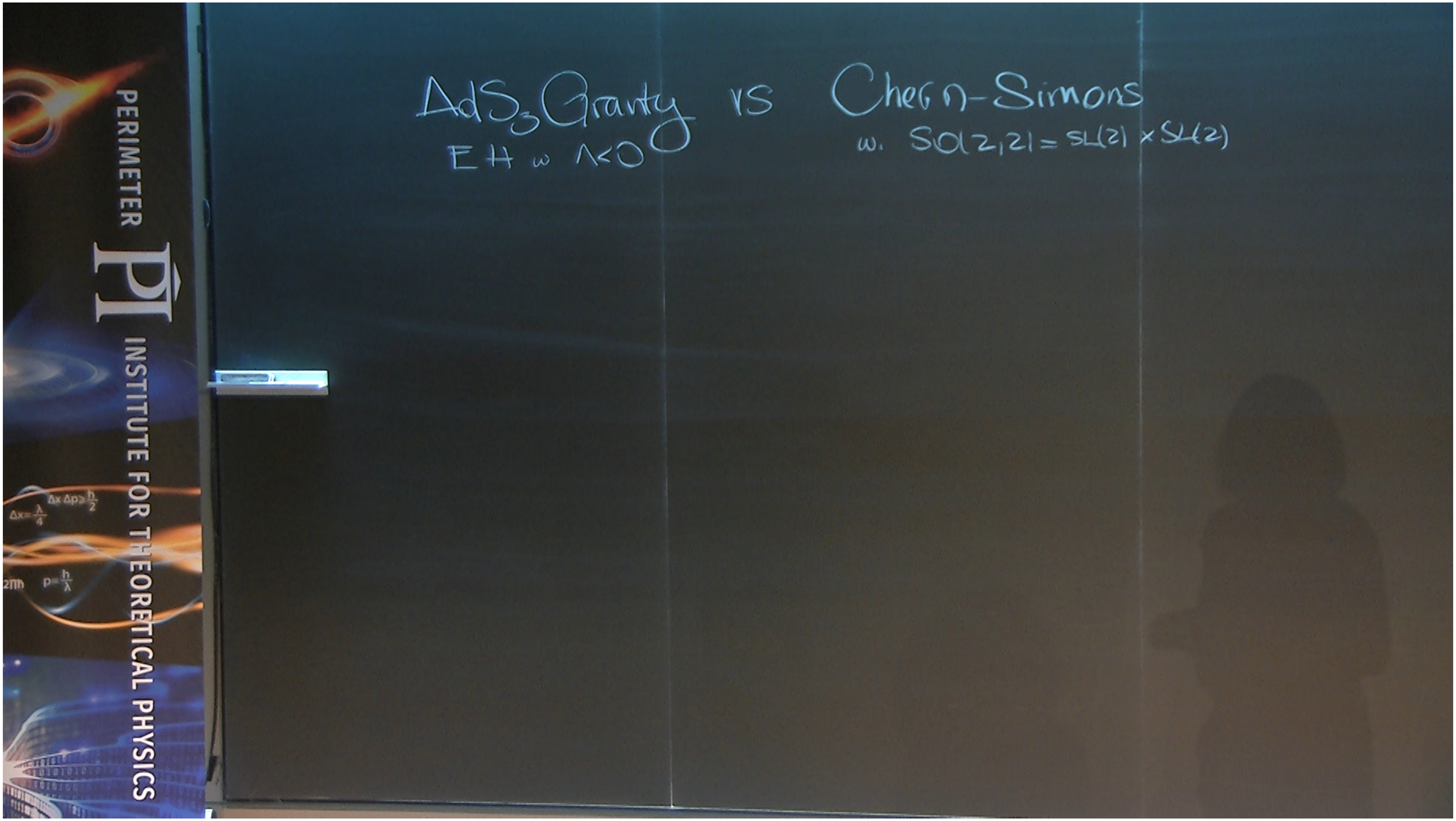
Speakers: Alejandra Castro

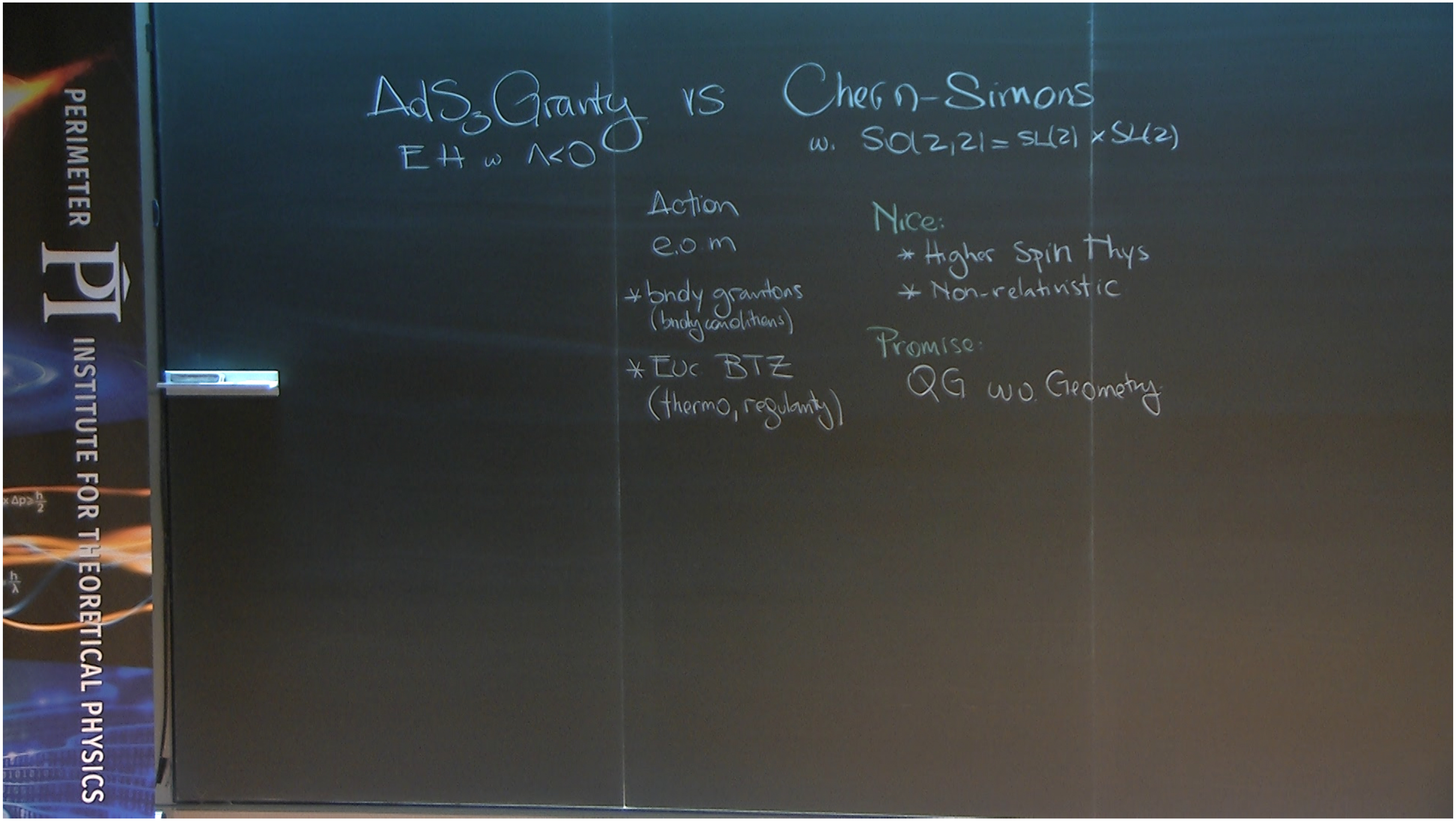
Collection: Boundaries and Defects in Quantum Field Theory

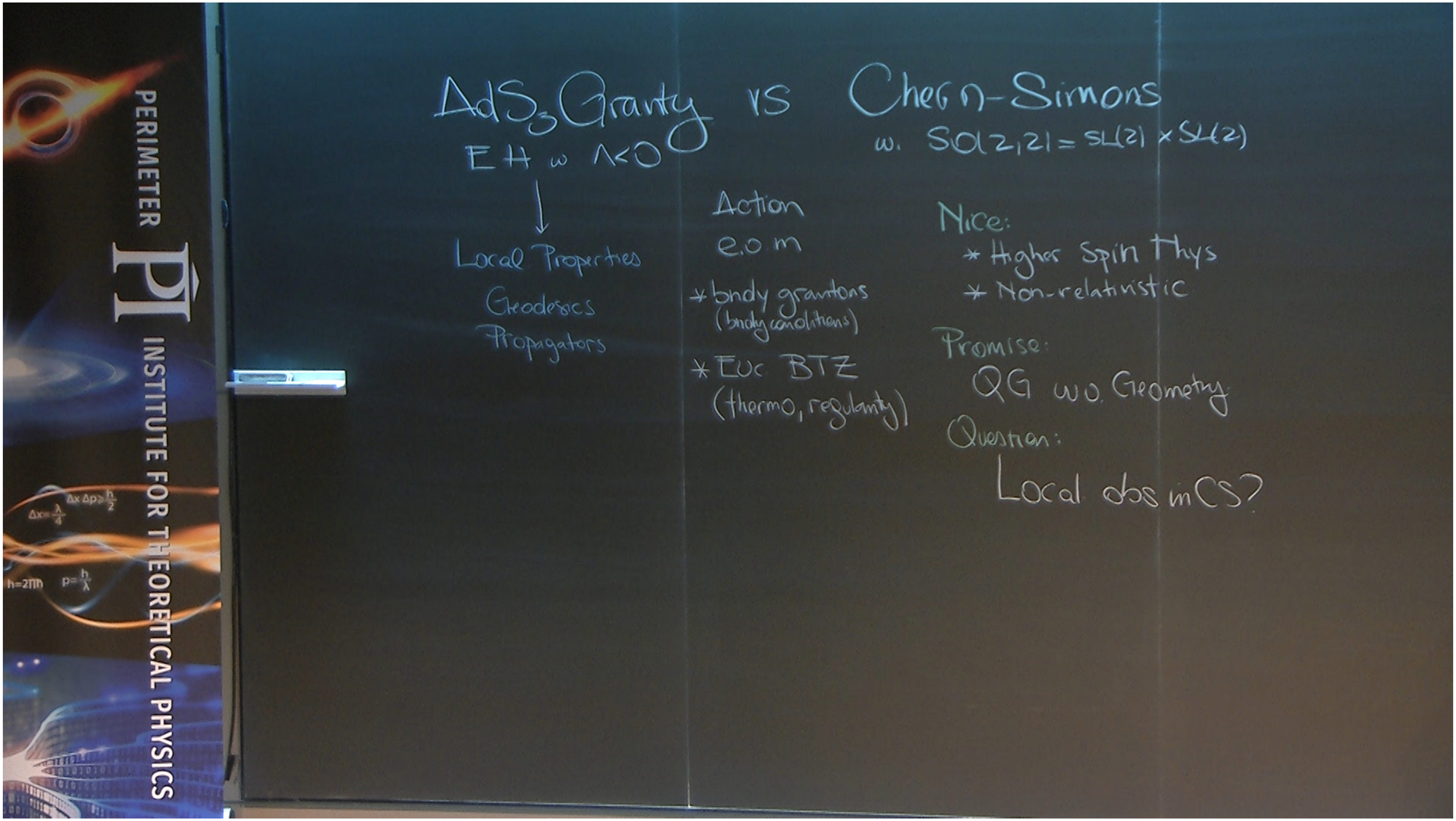
Date: August 07, 2019 - 2:45 PM

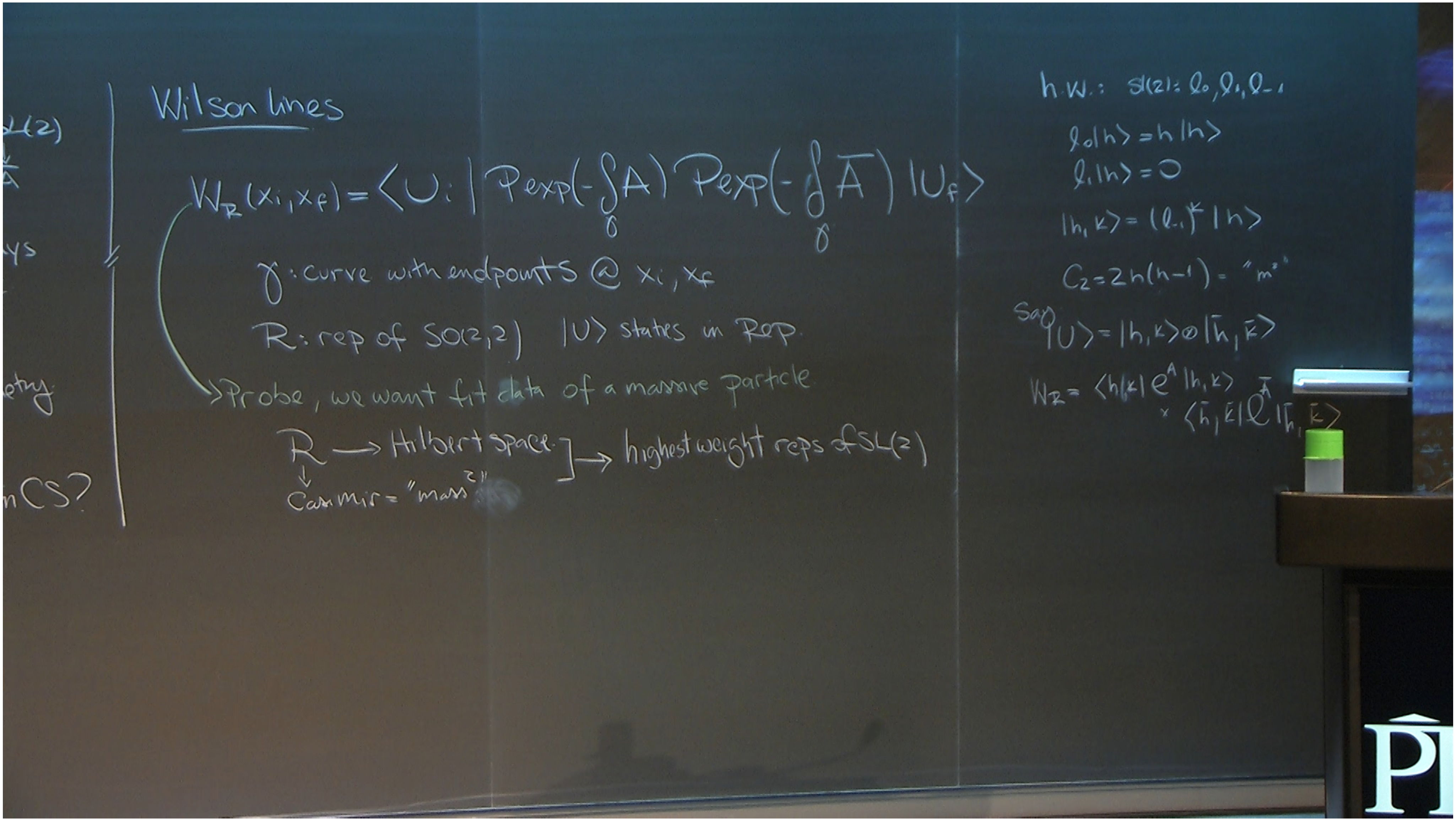
URL: http://pirsa.org/19080062

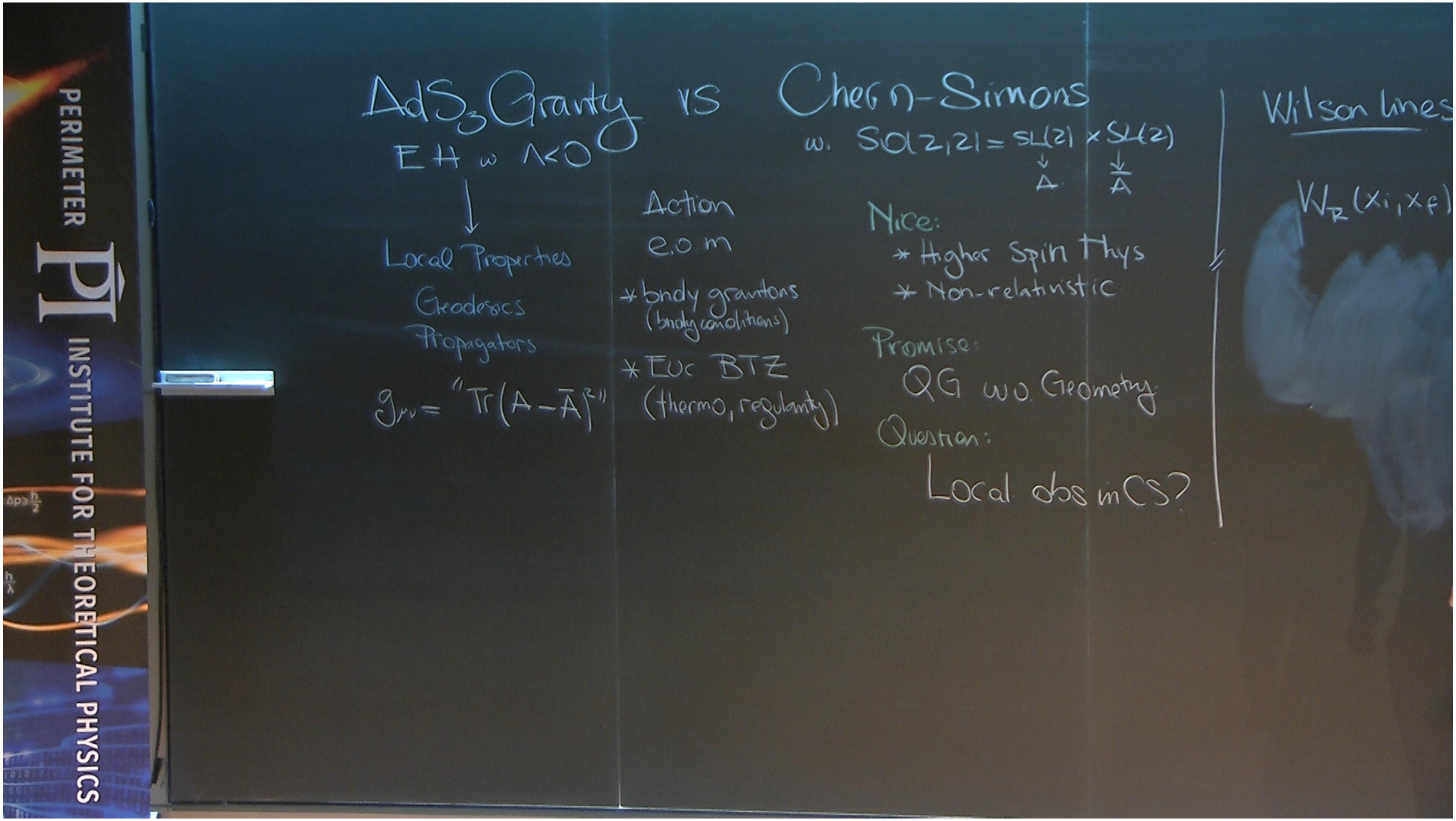
Abstract: The partnership between 3D gravity and Chern-Simons theory is well-known and powerful, but many aspects of this relation are unclear. In this talk I'll discuss Wilson lines in Chern-Simons theory and their role in AdS3 gravity. Wilson lines are interesting objects to explore locality in Chern-Simons theory, and how they affect the partnership at the quantum level.

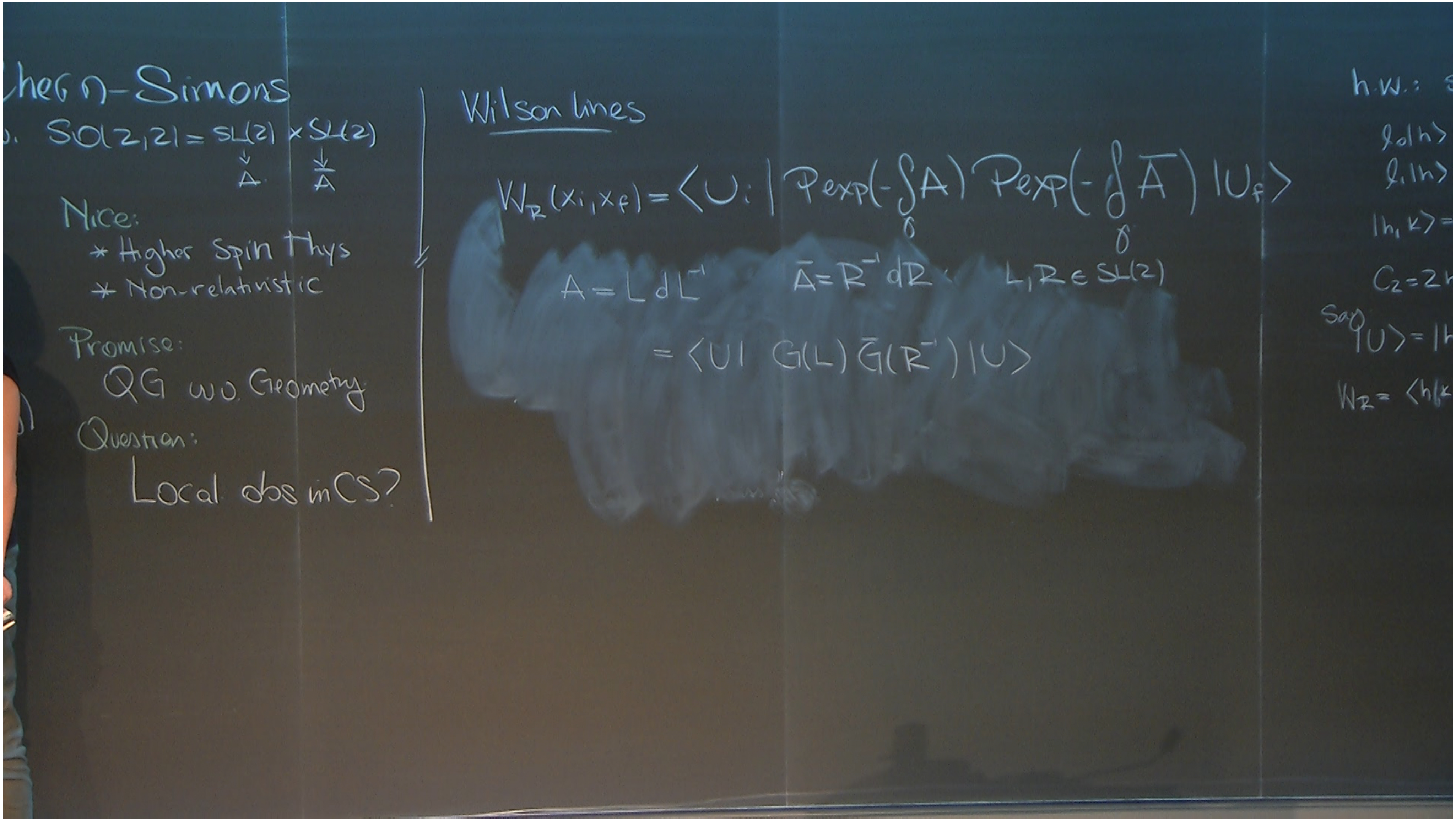

AdS$_3$ Gravity vs Chern-Simons
EH w $\Lambda<0$
w. $SO(2,2) = SL(2) \times SL(2)$
PERIMETER
PI
INSTITUTE FOR THEORETICAL PHYSICS

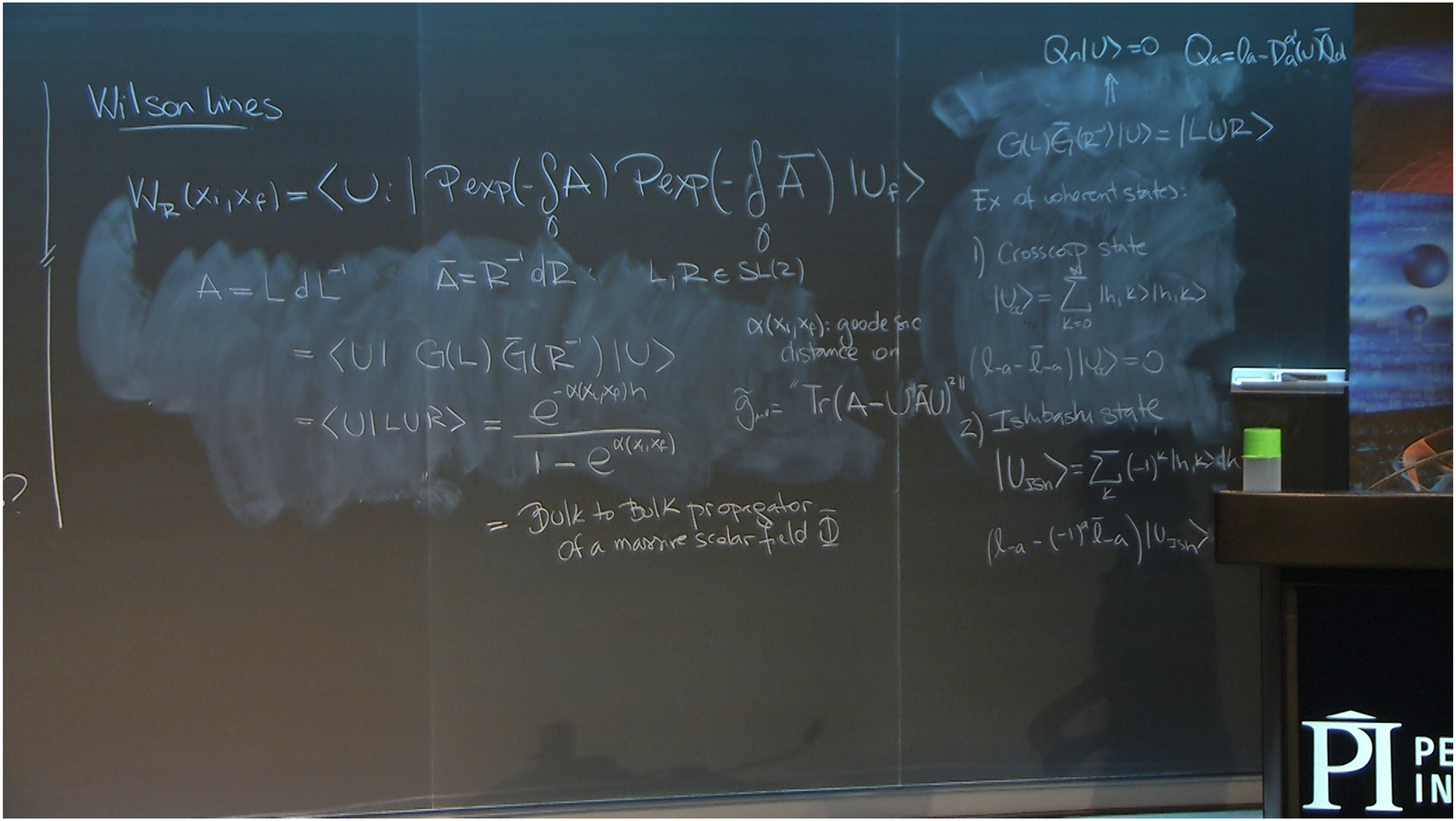

PERIMETER
PI
INSTITUTE FOR THEORETICAL PHYSICS
AdS3 Gravity vs Chern-Simons
EH w Λ<0
w. SO(2,2) = SL(2) × SL(2)
Action
e.o.m
* bndy gravitons
(bndy conditions)
* Euc BTZ
(thermo, regularity)
Nice:
* Higher Spin Thys
* Non-relativistic
Promise:
QG w.o. Geometry

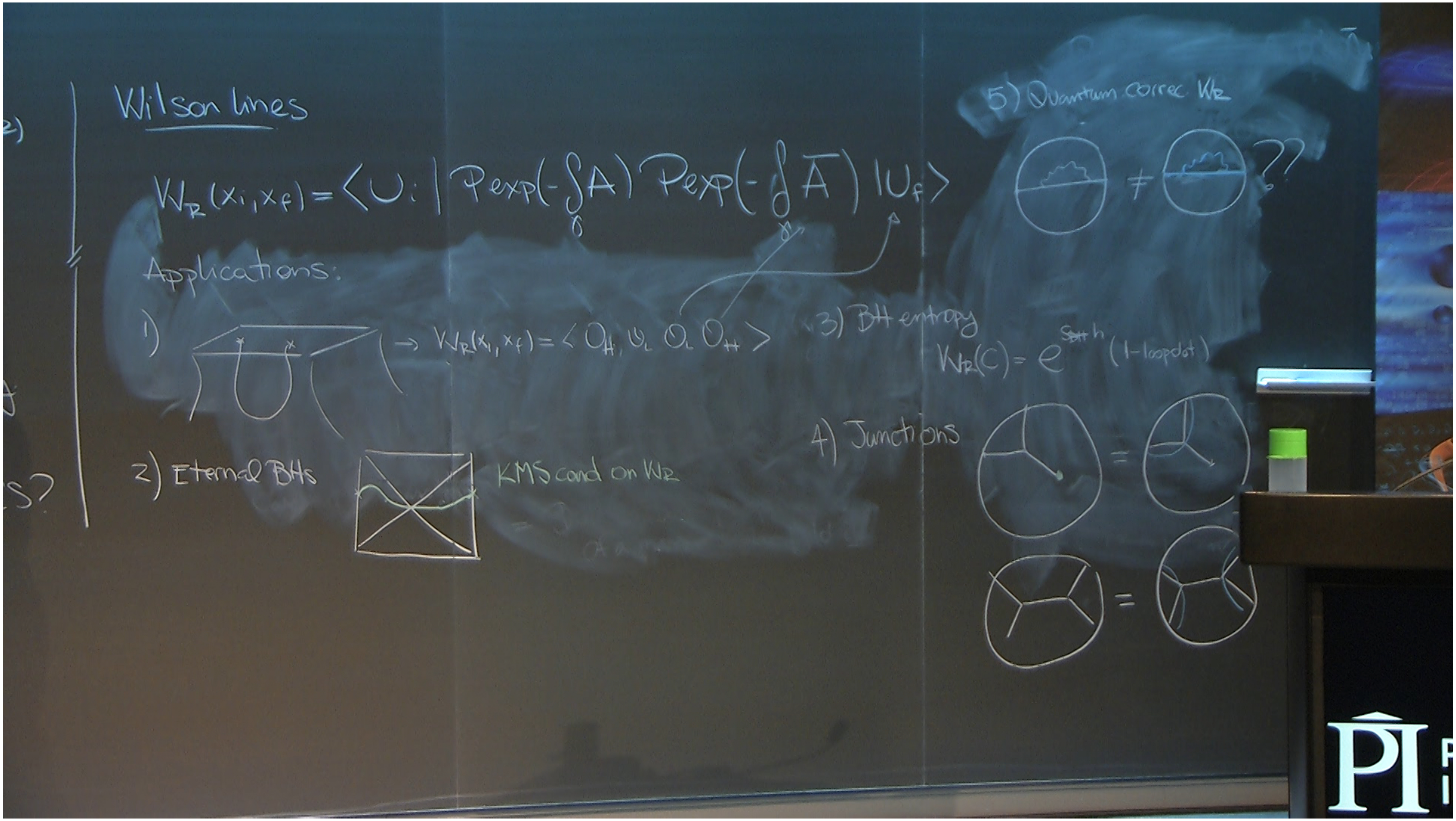

PERIMETER PI INSTITUTE FOR THEORETICAL PHYSICS
AdS_3 Gravity vs Chern-Simons
EH w $\Lambda<0$
w. $SO(2,2) = SL(2) \times SL(2)$
Local Properties
Geodesics
Propagators
Action
e.o.m
* bndy gravitons
(bndy conditions)
* Euc BTZ
(thermo, regularity)
Nice:
* Higher Spin Thys
* Non-relativistic
Promise:
QG w.o. Geometry
Question:
Local obs in CS?


Wilson lines
$W_R(x_i,x_f) = \langle U_i | P\exp(-\int_\gamma A)\, P\exp(-\int_\gamma \bar{A}) | U_f \rangle$
γ: curve with endpoints @ x_i, x_f
R: rep of SO(2,2) $|U\rangle$ states in Rep.
Probe, we want fit data of a massive particle
R ⟶ Hilbert space ⟶ highest weight reps of SL(2)
Casimir = "mass^2"
h.w.: sl(2): l_0, l_1, l_{-1}
$l_0|h\rangle = h|h\rangle$
$l_1|h\rangle = 0$
$|h,k\rangle = (l_{-1})^k|h\rangle$
$C_2 = 2h(h-1) = $ "m^2"
Say $|U\rangle = |h,k\rangle \otimes |\bar{h},\bar{k}\rangle$
$W_R = \langle h,k| e^A |h,k\rangle \times \langle \bar{h},\bar{k}| e^{\bar{A}} |\bar{h},\bar{k}\rangle$
nCS?


PERIMETER
PI
INSTITUTE FOR THEORETICAL PHYSICS
AdS_3 Gravity vs Chern-Simons
EH w $\Lambda<0$
Local Properties
Geodesics
Propagators
$g_{\mu\nu} =$ "$\mathrm{Tr}(A-\bar{A})^2$"
Action
e.o.m
* bndy gravitons
(bndy conditions)
* Euc BTZ
(thermo, regularity)
w. $SO(2,2) = SL(2) \times SL(2)$
A $\bar{A}$
Nice:
* Higher Spin Phys
* Non-relativistic
Promise:
QG w.o. Geometry
Question:
Local obs in CS?
Wilson lines
$W_R(x_i, x_f)$


hern-Simons
$SO(2,2) = SL(2) \times SL(2)$
$A \quad \bar{A}$
Nice:
* Higher Spin Thys
* Non-relativistic
Promise:
QG w.o. Geometry
Question:
Local obs in CS?
Wilson lines
$W_R(x_i, x_f) = \langle U_i | P\exp(-\int_\gamma A) \, P\exp(-\int_\gamma \bar{A}) | U_f \rangle$
$A = L\, dL^{-1} \quad \bar{A} = R^{-1} dR \quad L, R \in SL(2)$
$= \langle U | G(L) \bar{G}(R^{-1}) | U \rangle$
h.w.:
$\ell_0 |h\rangle$
$\ell_1 |h\rangle$
$|h, k\rangle =$
$C_2 = 2h$
Say $|U\rangle = |h$
$W_R = \langle h|k$


Wilson lines
$W_R(x_i,x_f) = \langle U_i | P\exp(-\int_\gamma A)\, P\exp(-\int_\gamma \bar{A}) | U_f \rangle$
$A = L\,dL^{-1}$ $\bar{A} = R^{-1}dR$ $L, R \in SL(2)$
$= \langle U | G(L)\bar{G}(R^{-1}) | U \rangle$
$= \langle U | LUR \rangle = \dfrac{e^{-\alpha(x_i,x_f)h}}{1-e^{\alpha(x_i,x_f)}}$
$\alpha(x_i,x_f)$: geodesic distance on
$\tilde{g}_{\mu\nu} =$ "$\mathrm{Tr}(A - U^{-1}\bar{A}U)^2$"
= Bulk to Bulk propagator of a massive scalar field Φ
$Q_n|U\rangle = 0$ $Q_a = l_a - D_a^{\bar{a}}(U)\bar{l}_{\bar{a}}$
$G(L)\bar{G}(R^{-1})|U\rangle = |LUR\rangle$
Ex of coherent states:
1) Crosscap state
$|U_{cc}\rangle = \sum_{k=0} |h,k\rangle|h,k\rangle$
$(l_{-a} - \bar{l}_{-a})|U_{cc}\rangle = 0$
2) Ishibashi state
$|U_{Ish}\rangle = \sum_k (-1)^k |h,k\rangle|h$
$(l_{-a} - (-1)^a \bar{l}_{-a})|U_{Ish}\rangle$


Wilson lines
W_R(x_i, x_f) = ⟨U_i | P exp(-∫A) P exp(-∫Ā) | U_f⟩
Applications:
1)
→ W_R(x_i, x_f) = ⟨O_H, U_L O_L O_H⟩
2) Eternal BHs
KMS cond on W_R
3) BH entropy
W_R(C) = e^(S_BH h) (1-loop det)
4) Junctions
5) Quantum correc. W_R
??