Title: BMS Field Theories with u(1) Symmetry

Speakers: Max Riegler

Series: Quantum Gravity

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URL: https://pirsa.org/23050000

Abstract:

Quantum field theories in two dimensions (2d) with an underlying Bondi-van der Burg-Metzner-Sachs (BMS) symmetry augmented by u(1) currents are expected to holographically capture features of charged versions of cosmological solutions in asymptotically flat 3d spacetimes called Flat Space Cosmologies (FSCs). I will present a study of the modular properties of these field theories and the corresponding partition function. Furthermore, I will derive the density of (primary) states and find the entropy and asymptotic values of the structure constants exploiting the modular properties of the partition function and the torus one-point function. The expression for the asymptotic structure constants shows shifts in the weights and one of the central terms and an extra phase compared to earlier results in the literature for BMS invariant theories without u(1) currents present. The field theory results for the structure constants can be reproduced holographically by a bulk computation involving a scalar probe in the background of a charged FSC.

Zoom Link: https://pitp.zoom.us/j/99205444635?pwd=Tk02UlgvcjJCU3JSWWphY1JQSlhFQT09

BMS Field Theories with $U(1)$ Symmetry

2209.06832

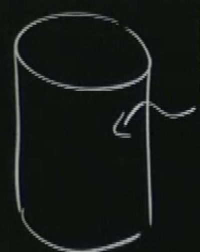
symmetry 2209.06832

AdS/CFT

·) Strong/Weak duality

·) AdS/CFT

3d Gravity AdS$_3$/CFT$_2$



$\boxed{\text{Brown-Henneaux BC's} \quad \text{Vir} \oplus \text{Vir} \quad c = \bar{c} = \frac{3\ell}{2G}}$

BMS Field Theories with $U(1)$ Symmetry

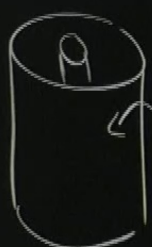
2209.06832

AdS/CFT

- Strong/Weak duality
- AdS/CFT

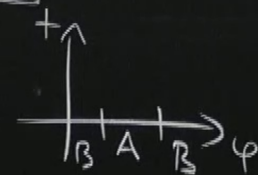
3d Gravity

AdS_3/CFT_2



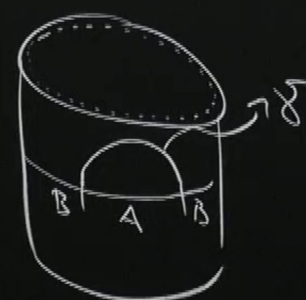
$\boxed{\begin{array}{l}\text{Brown-Henneaux BC's} \\ Vir \oplus Vir \quad c = \bar{c} = \frac{3\ell}{2G}\end{array}}$

EE:

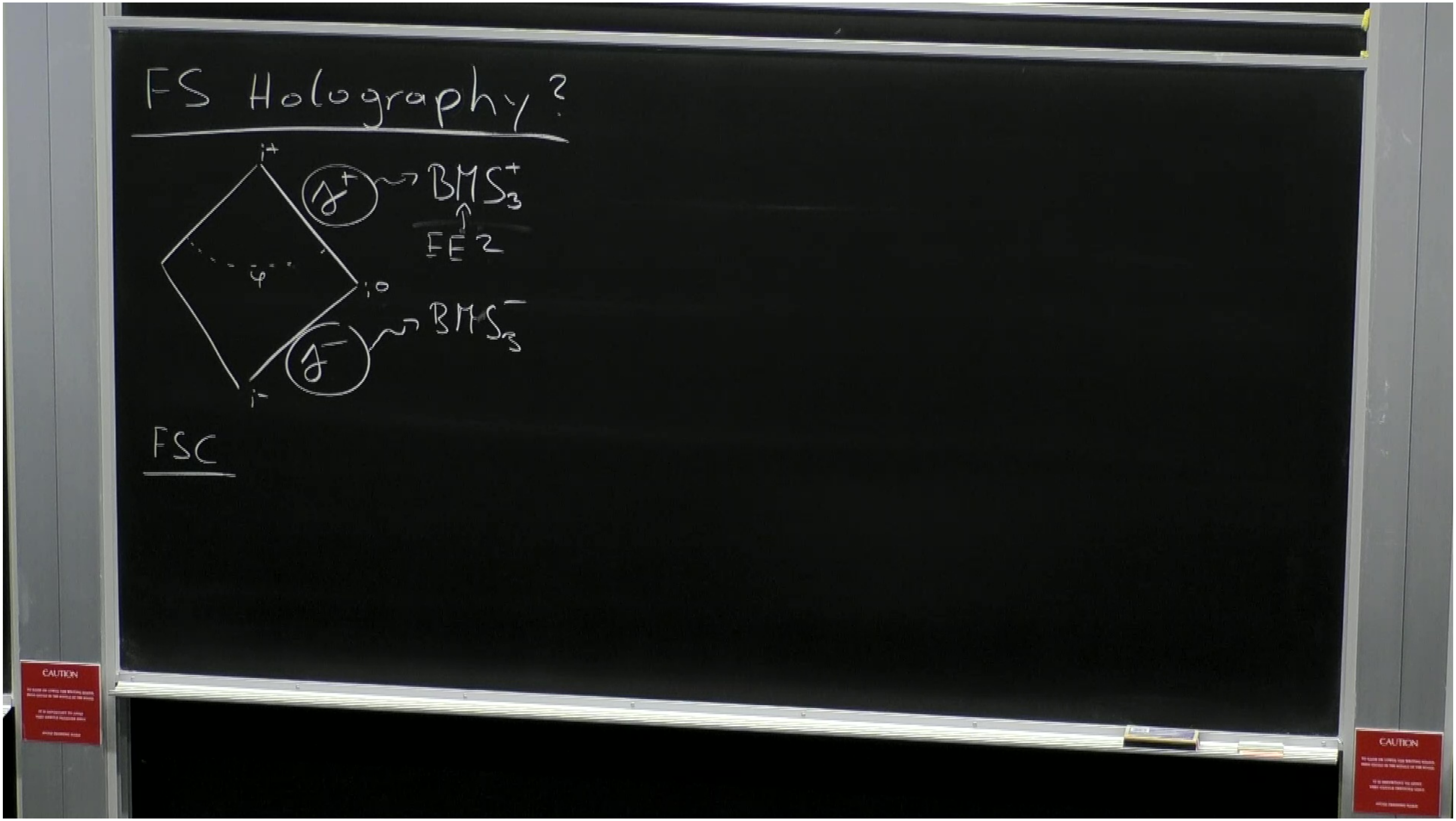


$$S_{EE} = -\mathrm{tr}_A(\rho_A \ln \rho_A)$$

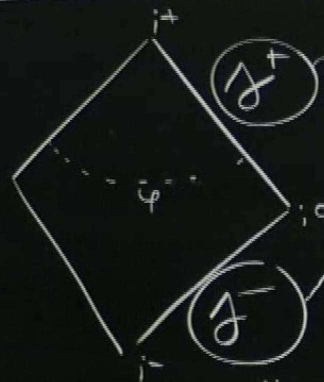
$$\rho_A = \mathrm{Tr}_B\, \rho$$



$$S_{EE} = \frac{L_\gamma}{4}$$


FS Holography?
i^+
$\mathcal{J}^+ \rightsquigarrow BMS_3^+$
φ
i^0
$\mathcal{J}^- \rightsquigarrow BMS_3^-$
i^-
FSC

FS Holography?



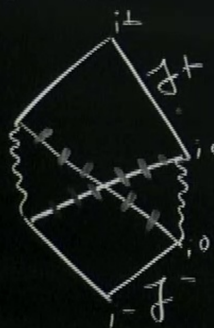
$\mathcal{J}^+ \rightsquigarrow BMS_3^+$

$\uparrow$

FE 2

$\mathcal{J}^- \rightsquigarrow BMS_3^-$

FSC



1) Central charge(s)

2) Spectrum of Primaries

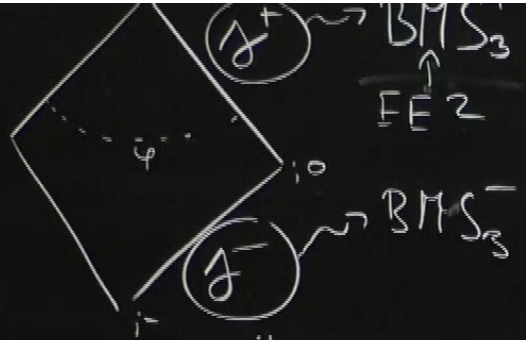
$\boxed{\text{3) Structure constants}}$

$$[L_n, L_m] = (n-m) L_{n+m} + \frac{c_L}{12} n(n^2-1)\delta_{n+m,0}$$

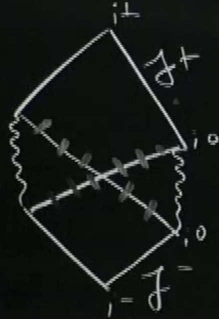
$$[L_n, M_m] = (n-m) M_{n+m} + \frac{c_M}{12} n(n^2-1)\delta_{n+m,0}$$

$$[L_n, J_m] = -m J_{n+m} \qquad [L_n, P_m] = -m P_{n+m} \qquad [M_n, J_m] = -m P_{n+m}$$

$$[J_n, J_m] = K_J n \delta_{n+m,0} \qquad [J_n, P_m] = K_P n \delta_{n+m,0}$$



FSC



3) Structure constants

$$[L_n, L_m] = (n-m) L_{n+m} + \frac{c_L}{12} n(n^2-1)\delta_{n+m,0}$$

$$[L_n, M_m] = (n-m) M_{n+m} + \frac{c_M}{12} n(n^2-1)\delta_{n+m,0}$$

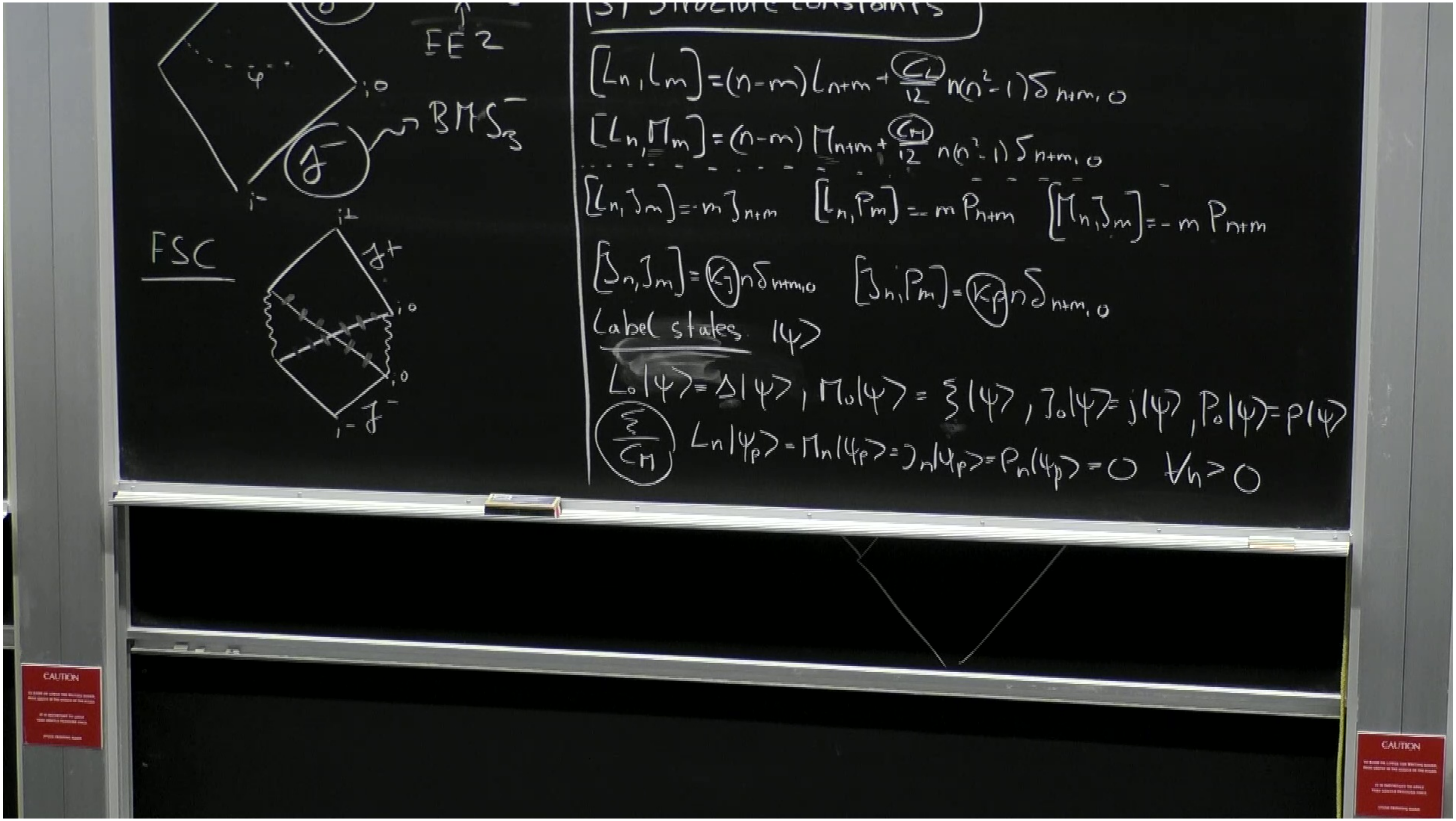
$$[L_n, J_m] = -m J_{n+m} \qquad [L_n, P_m] = -m P_{n+m} \qquad [M_n, J_m] = -m P_{n+m}$$

$$[J_n, J_m] = k_J\, n\, \delta_{n+m,0} \qquad [J_n, P_m] = k_P\, n\, \delta_{n+m,0}$$

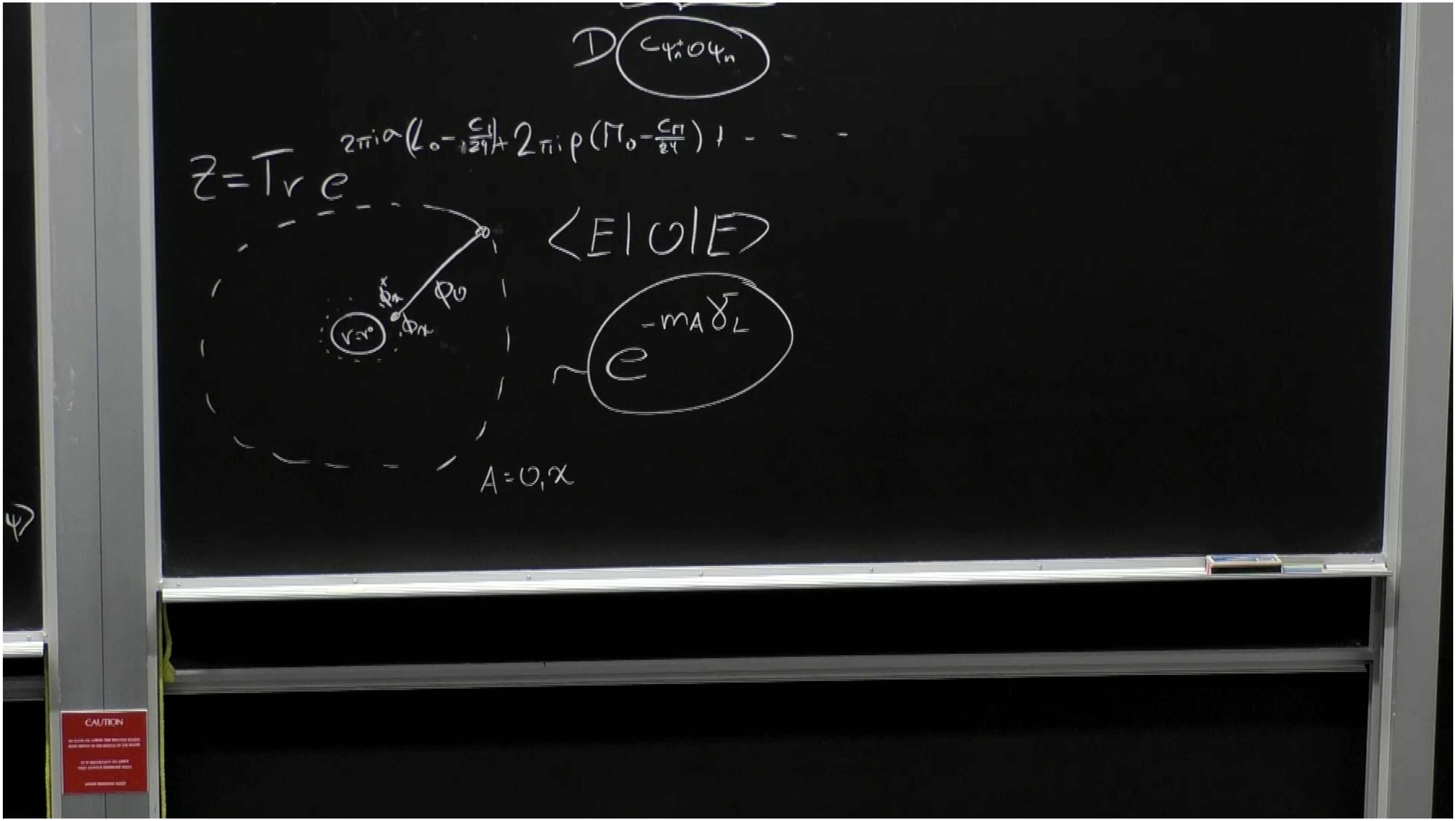
Label states $|\psi\rangle$

$$L_0|\psi\rangle = \Delta|\psi\rangle,\ M_0|\psi\rangle = \xi|\psi\rangle,\ J_0|\psi\rangle = j|\psi\rangle,\ P_0|\psi\rangle = p|\psi\rangle$$

$$\frac{\xi}{c_M}$$


FE2
ψ
i^0
$\mathcal{J}^- \rightsquigarrow BMS_3^-$
i^-
FSC
i^+
$\mathcal{J}^+$
i^0
i^0
$i^- \ \mathcal{J}^-$
3) Structure constants
$[L_n, L_m] = (n-m) L_{n+m} + \frac{c_L}{12} n(n^2-1) \delta_{n+m,0}$
$[L_n, M_m] = (n-m) M_{n+m} + \frac{c_M}{12} n(n^2-1) \delta_{n+m,0}$
$[L_n, J_m] = -m J_{n+m}$ $[L_n, P_m] = -m P_{n+m}$ $[M_n, J_m] = -m P_{n+m}$
$[J_n, J_m] = K_J n \delta_{n+m,0}$ $[J_n, P_m] = K_P n \delta_{n+m,0}$
Label states $|\psi\rangle$
$L_0|\psi\rangle = \Delta|\psi\rangle, M_0|\psi\rangle = \xi|\psi\rangle, J_0|\psi\rangle = j|\psi\rangle, P_0|\psi\rangle = p|\psi\rangle$
$\frac{\xi}{c_M}$ $L_n|\psi_p\rangle = M_n|\psi_p\rangle = J_n|\psi_p\rangle = P_n|\psi_p\rangle = 0 \ \forall n > 0$
CAUTION
CAUTION

$$\langle O \rangle = \mathrm{Tr}(O\, Z) = \sum_n \underbrace{\langle \psi_n | O | \psi_n \rangle}_{D} Z$$


D ⟨ψ_n* O ψ_n⟩
Z = Tr e^{2πia(L_0 − c_L/24) + 2πip(M_0 − c_M/24) + ...}
⟨E|O|E⟩
~ e^{−m_A γ_L}
A = O, x
r = r_0
φ_O
φ_n