

Title: Quantum Gravity and Causal Structures

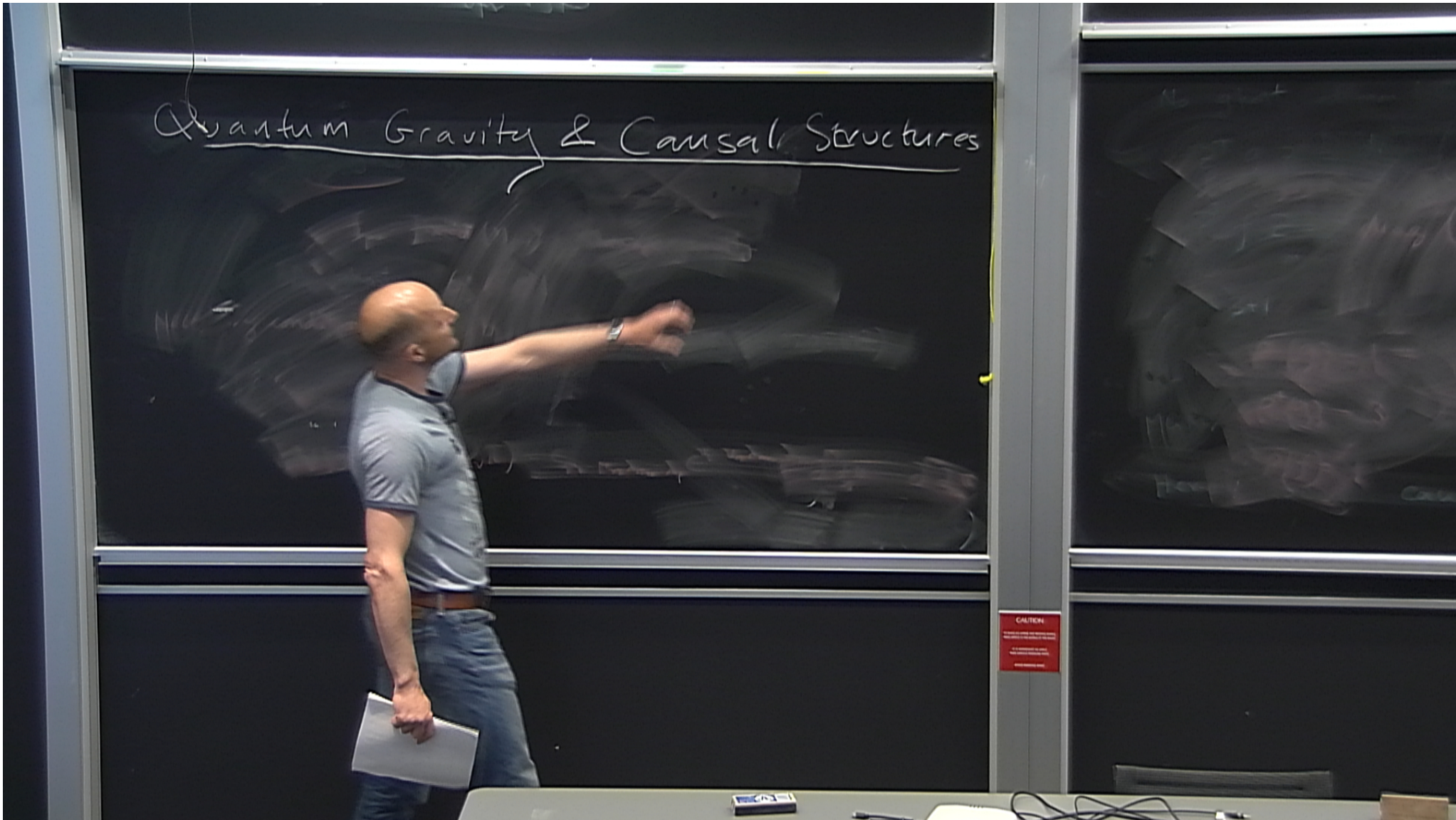
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URL: <http://pirsa.org/15040114>

Abstract:



# Quantum Gravity & Causal Structures



# Quantum Gravity & Causal Structures

$$S = \text{tr} \int \left( \frac{1}{2} A \right)$$

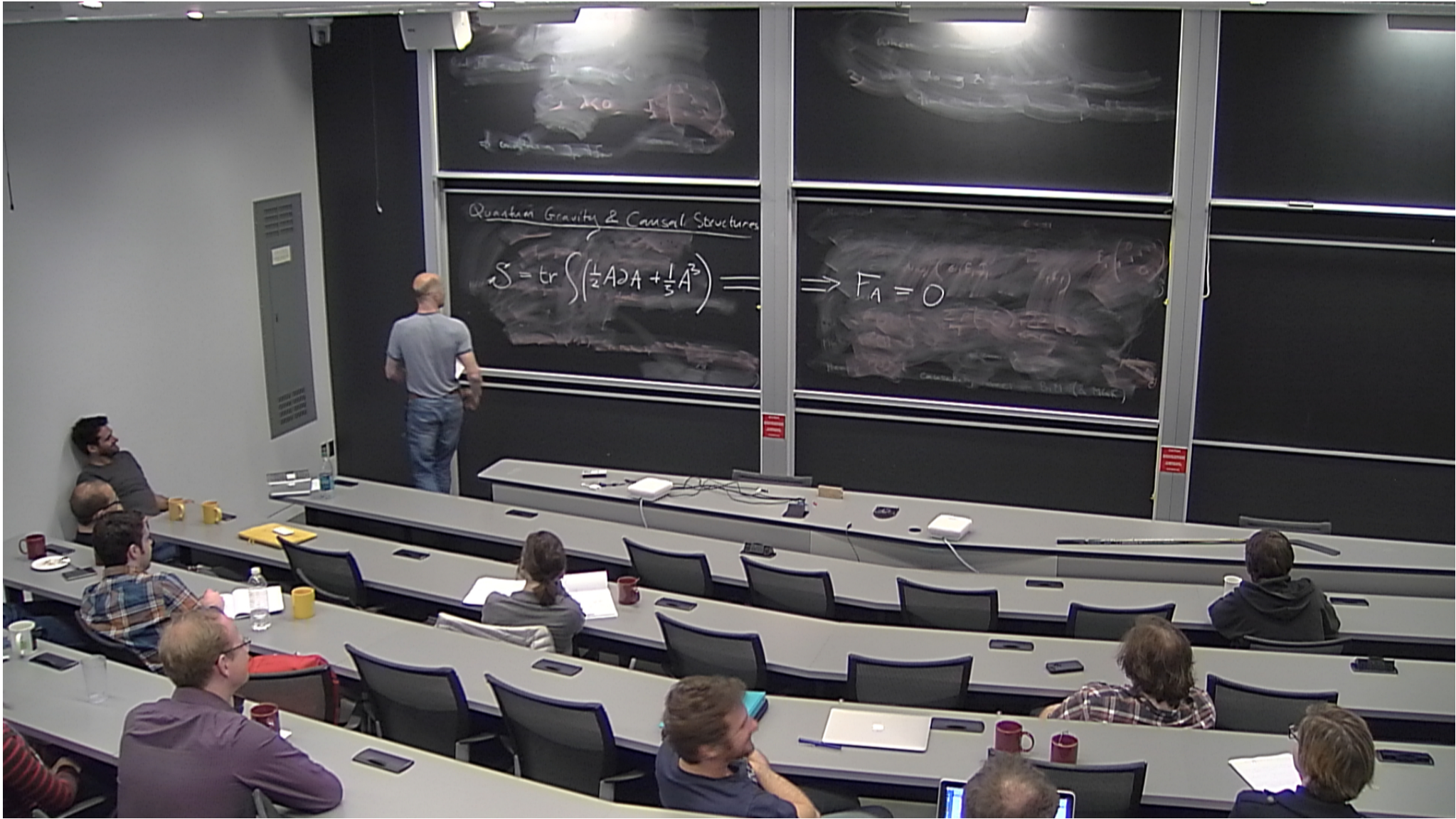
causes

No plot

$\Rightarrow F_A = 0$

causality does = BIM (& MGR)

CAUTION



Quantum Gravity & Causal Structures

$$S = \text{tr} \int \left( \frac{1}{2} A \partial A + \frac{1}{3} A^3 \right) =$$

nilpotent  
BRST

$$\Rightarrow F_A = 0$$

Quantum Gravity & Causal Structures

$$S = \text{tr} \int_H \left( \frac{1}{2} A \partial A + \frac{1}{3} A^3 \right) =$$

$\epsilon A$  → nilpotent  
BRST  
BV  
AKSZ

$$\Rightarrow F_A = 0$$



Local Structures

$$\left(\frac{1}{3}A^3\right) =$$

potential  
PST

Z

Plan - GJMS & Dirac Cone  
- EINSTEIN & THE FUGU

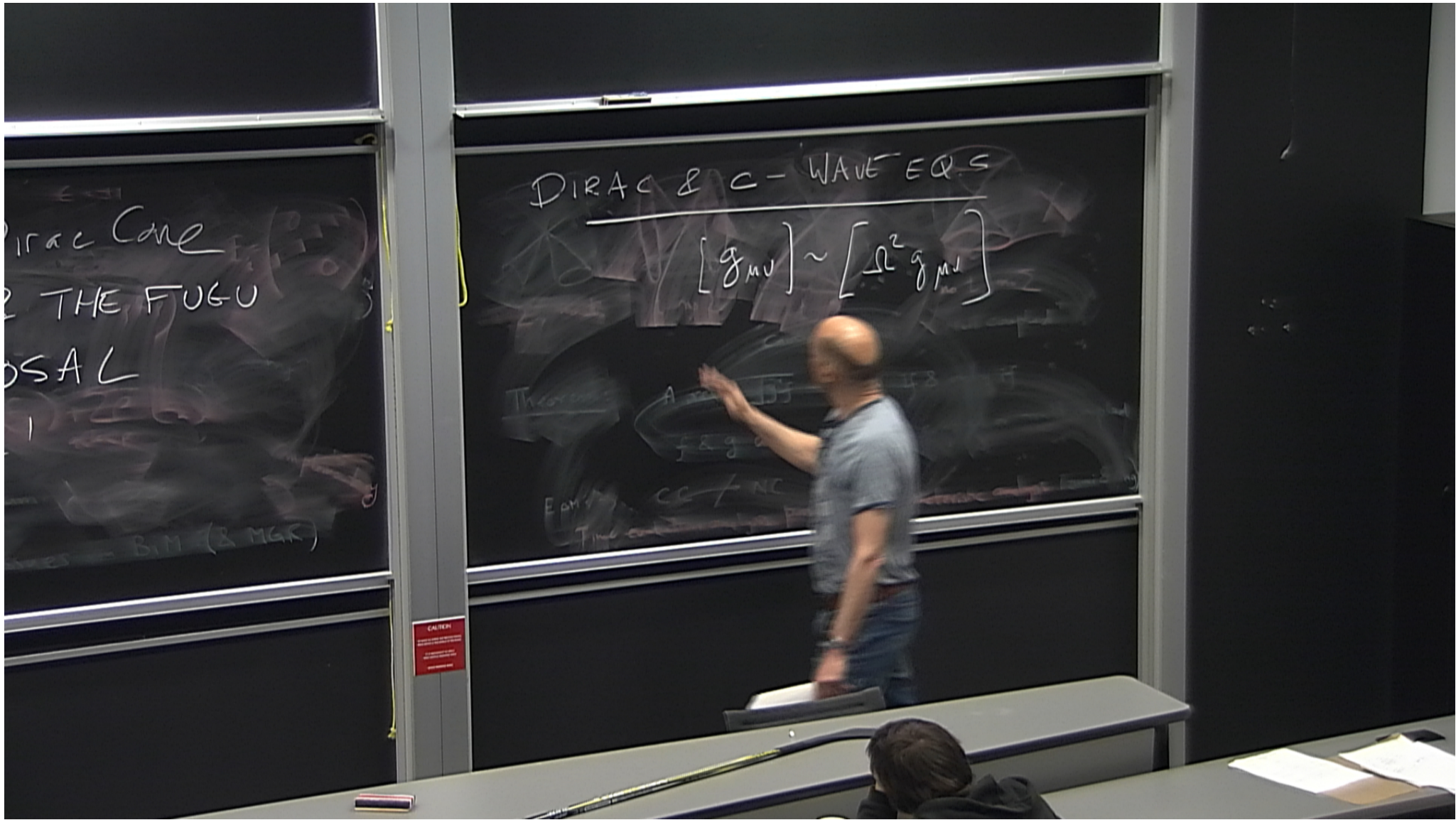
causality issues in BIM (B. MGR)

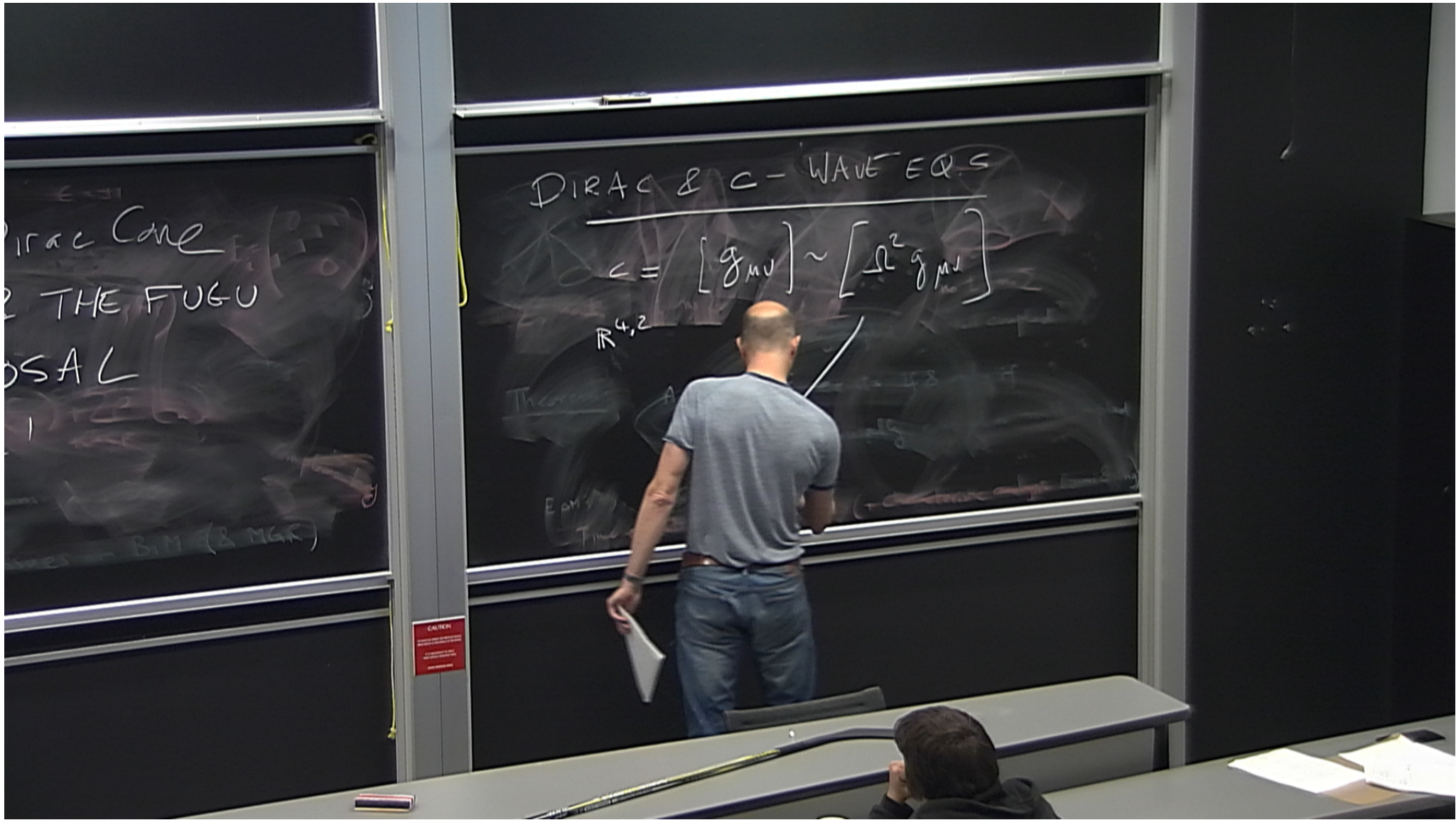
Local Structures

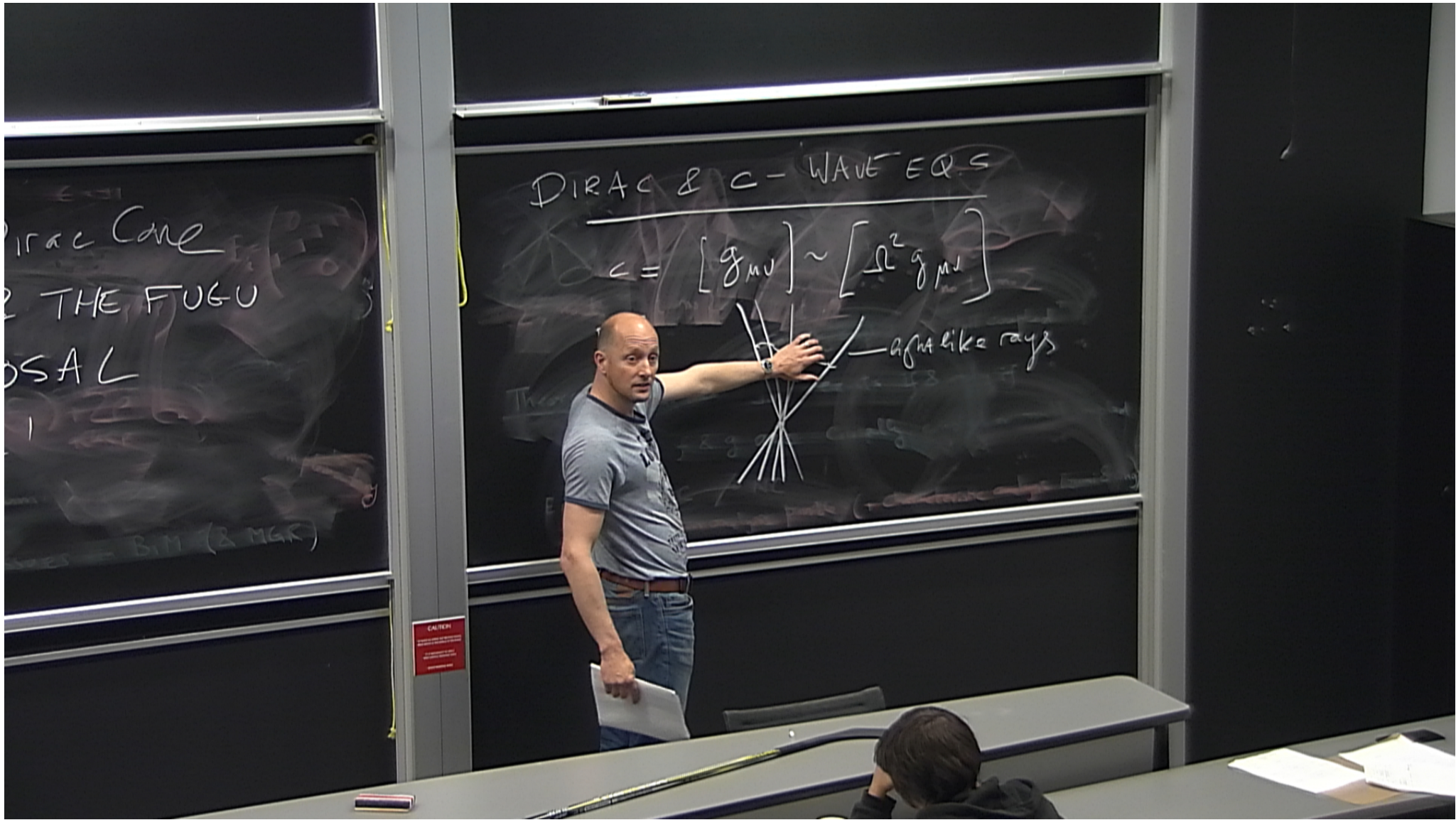
$$\left(\frac{1}{3}A^3\right) =$$

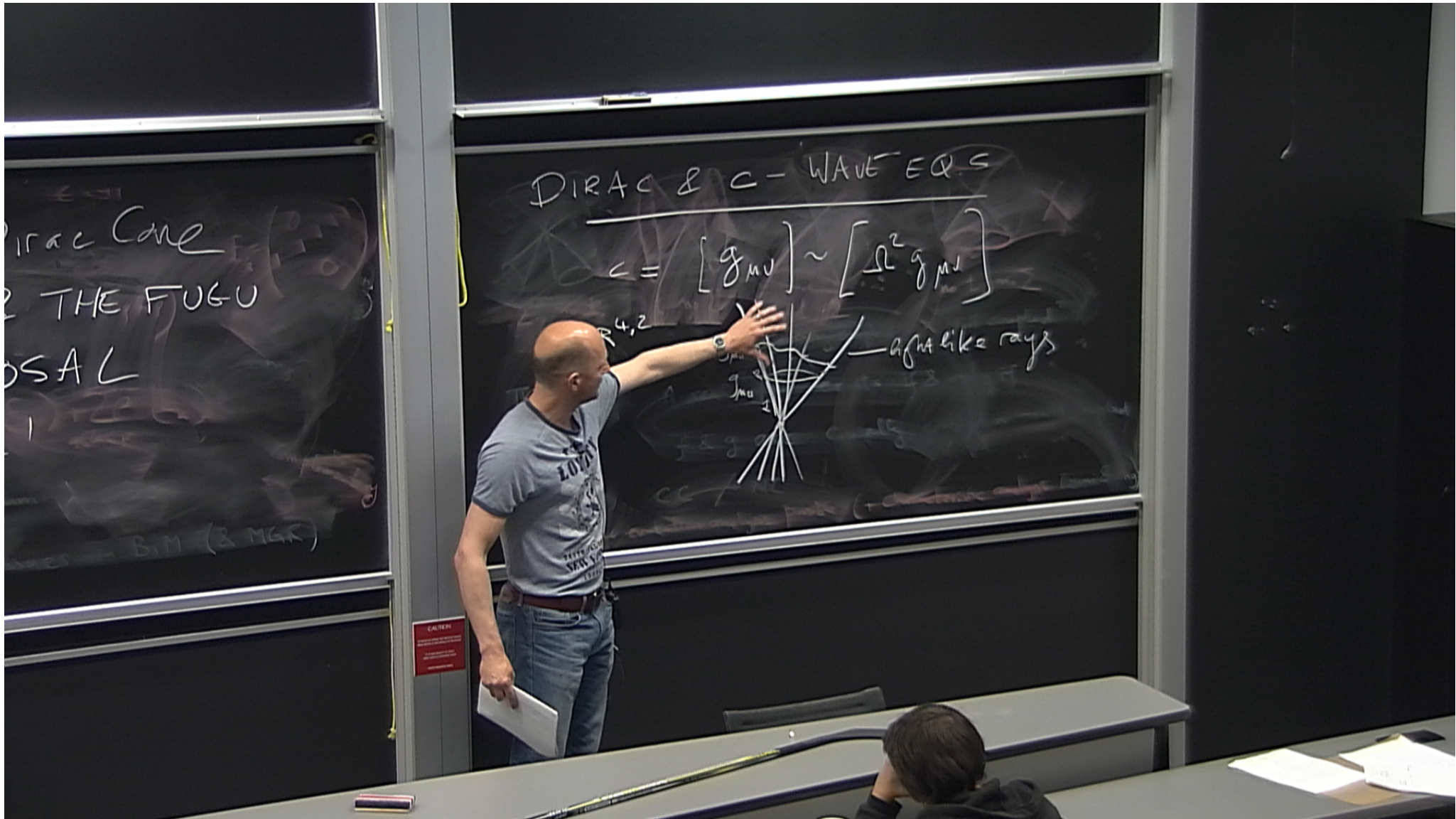
nilpotent  
BRST  
BV  
AKSZ

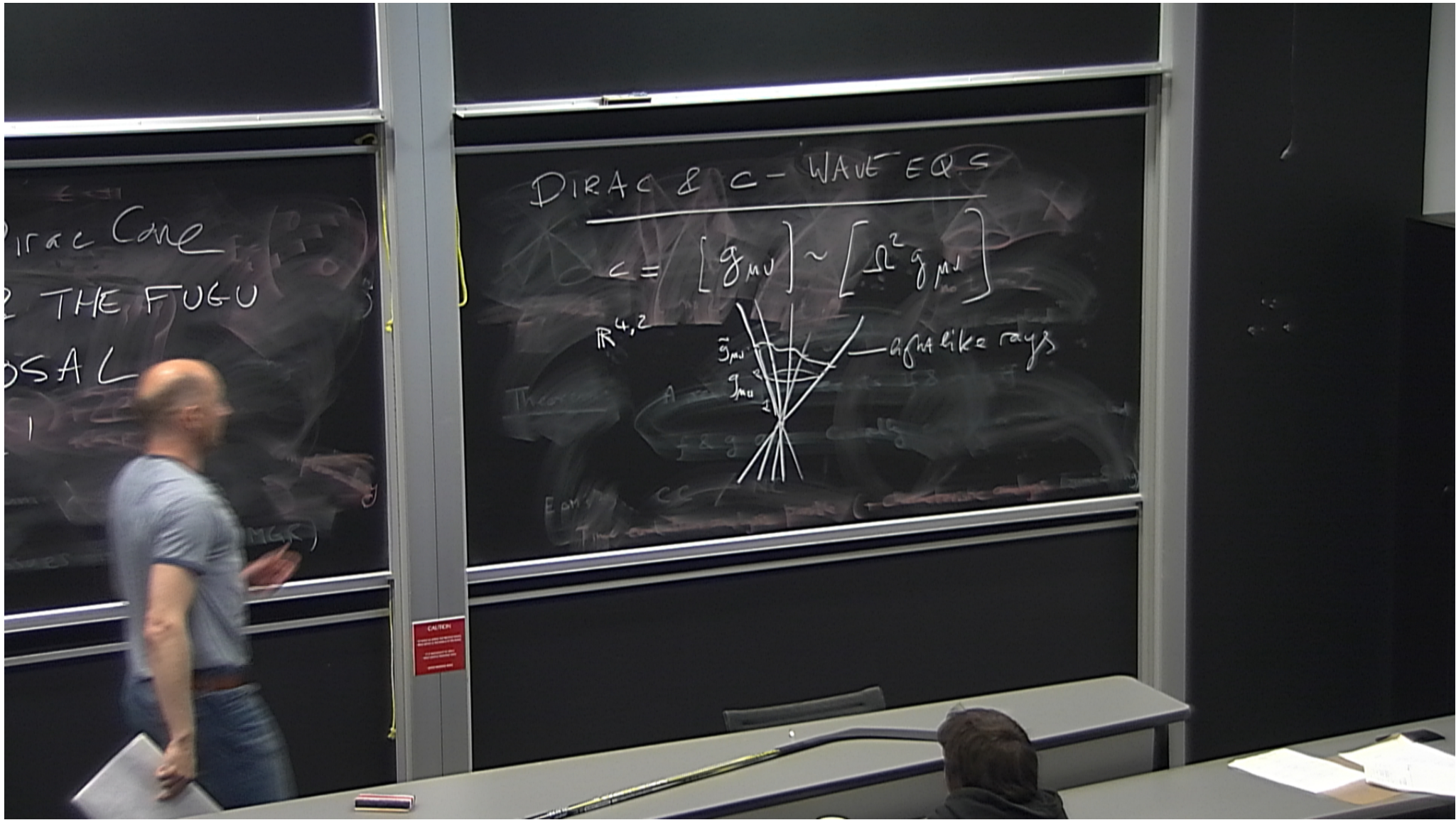
- Plan - GJMS & Dirac Cone
- EINSTEIN & THE FUGU
- 2T PROPOSAL
- The mode!

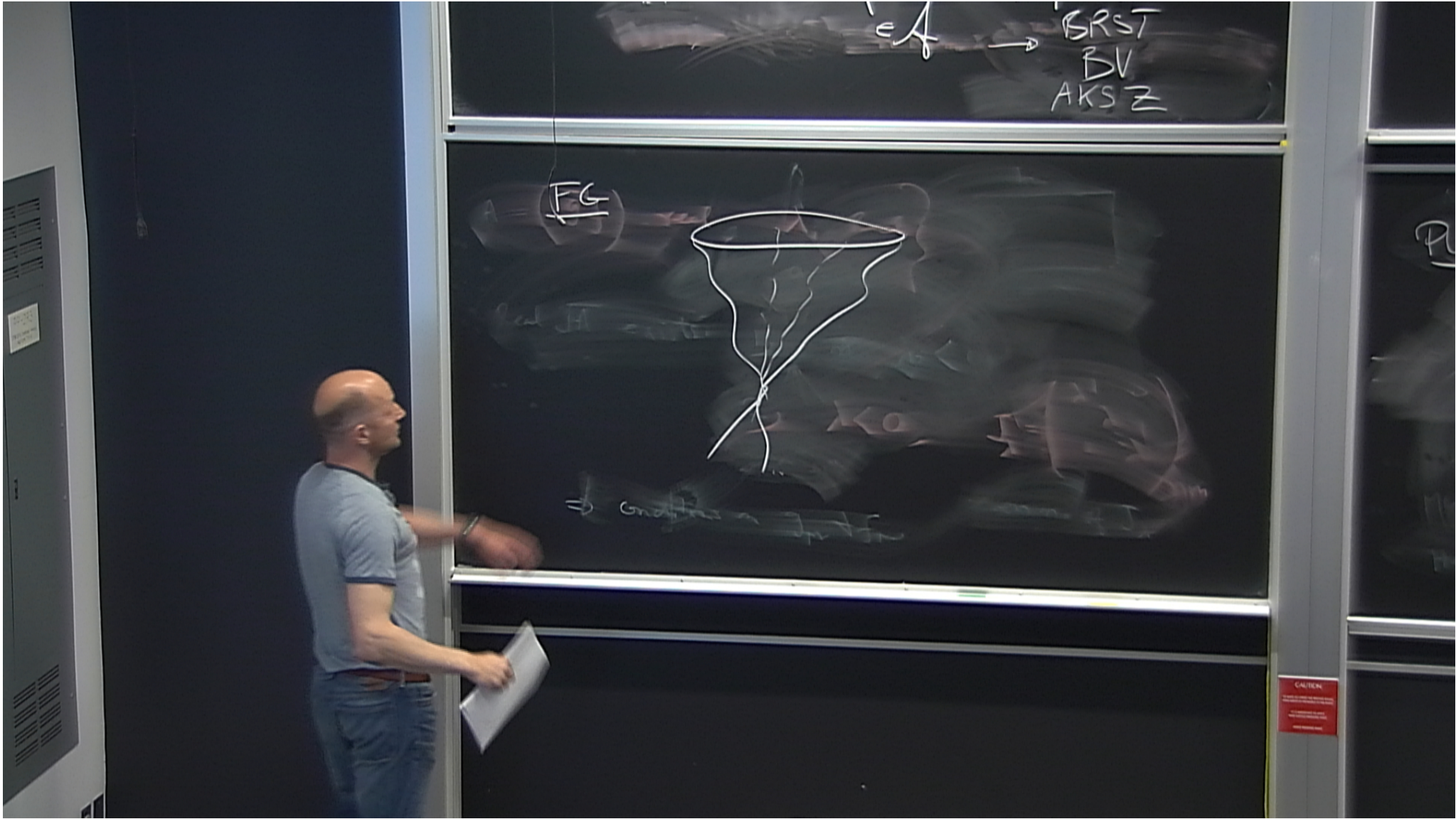




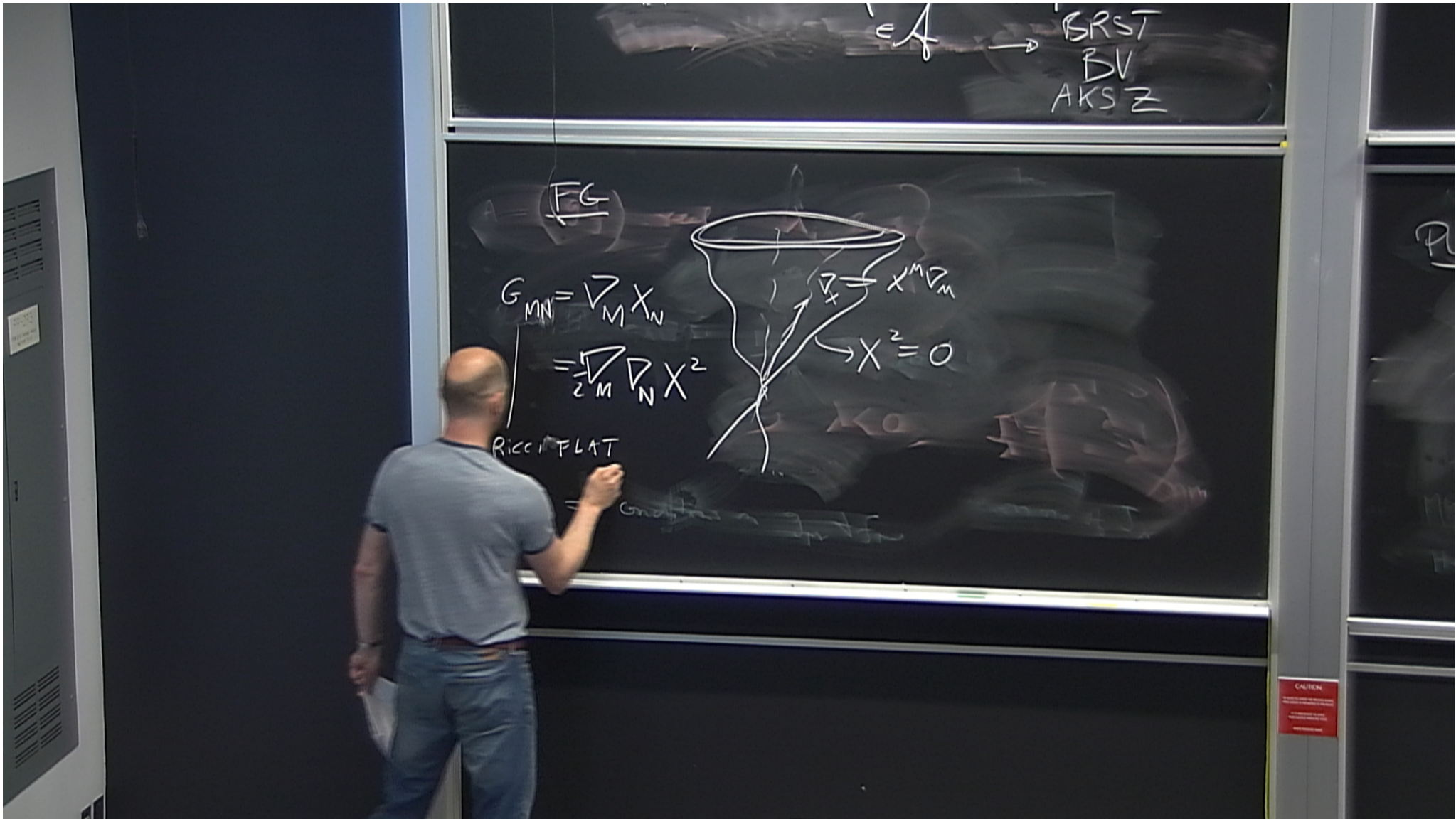


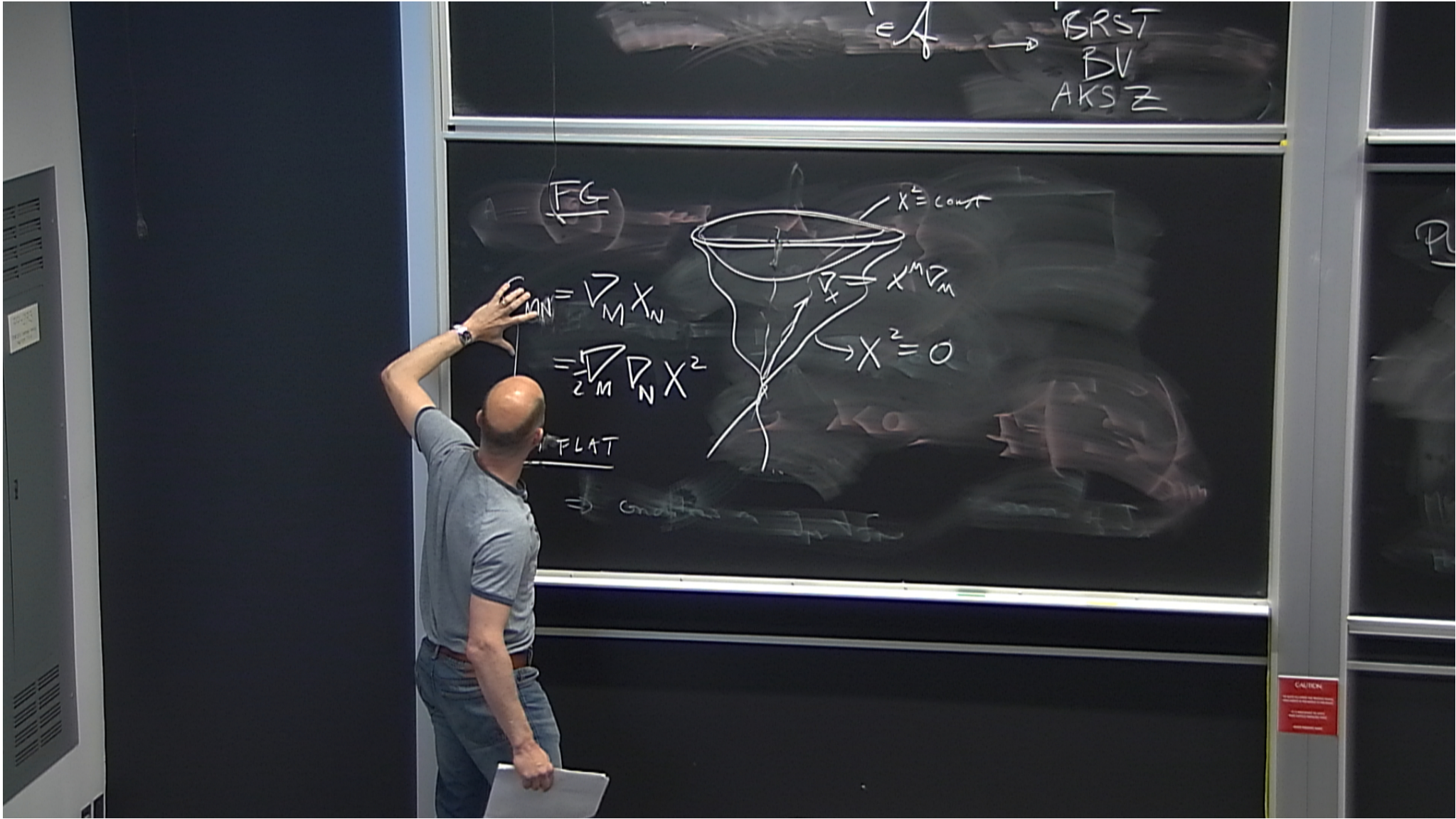












(SRS)  
BV  
AKSZ

GJMS TRACTORS  
Ambient fields

where  $\mathbb{I} \sim \Phi^2 + X^2 \mathbb{I}$

classify by weight

$$\Delta_X \Phi = w \Phi$$

GJ

DIRAC  
 $\Delta =$   
 $\mathbb{R}^{4,2}$

(SRS)  
BV  
AKSZ

GJMS TRACTORS  
Ambient fields

$$\mathbb{I} \sim \Phi^2 + X^2 \mathbb{I}$$

classify by weight

$$\nabla_X \Phi = w \Phi$$

GJMS algebra  $\{\Delta, \nabla_X, X^2\} = \mathfrak{sl}(2)$

DIRAC

$\mathbb{R}^{4,2}$

(SRS)  
BV  
AKSZ

GJMS TRACTORS  
Ambient fields

$$\mathbb{I} \sim \Phi^2 + X^2 \mathbb{I}$$

classify by weight

GJ  $X \mathbb{I} = w \mathbb{I}$

$$\{\Delta, \nabla_X, X^2\} = \mathfrak{sl}(2)$$

DIRAC

$\mathbb{R}^{4,2}$

FACTORS

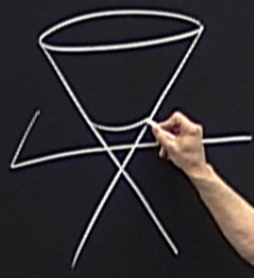
nt fields

$$\sim \Phi^2 + X^2 \Psi$$

by weight

$$\Phi = \Psi \rightarrow \text{conformally invariant}$$
$$\{\Delta, \nabla_X, X^2\} = \mathfrak{sl}(2)$$

EINSTEIN & THE FUGU



FACTORS

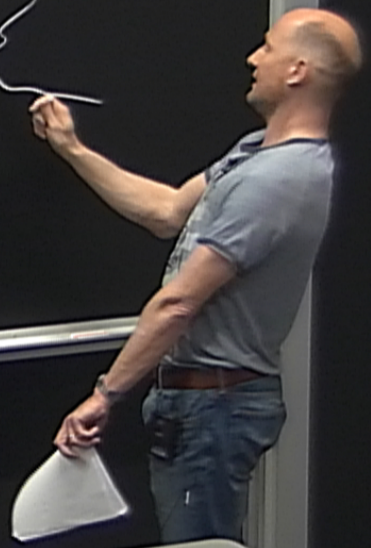
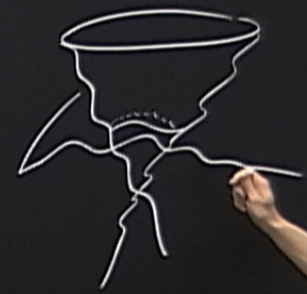
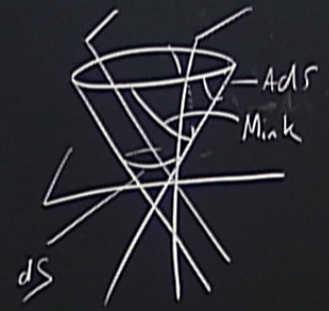
nt fields

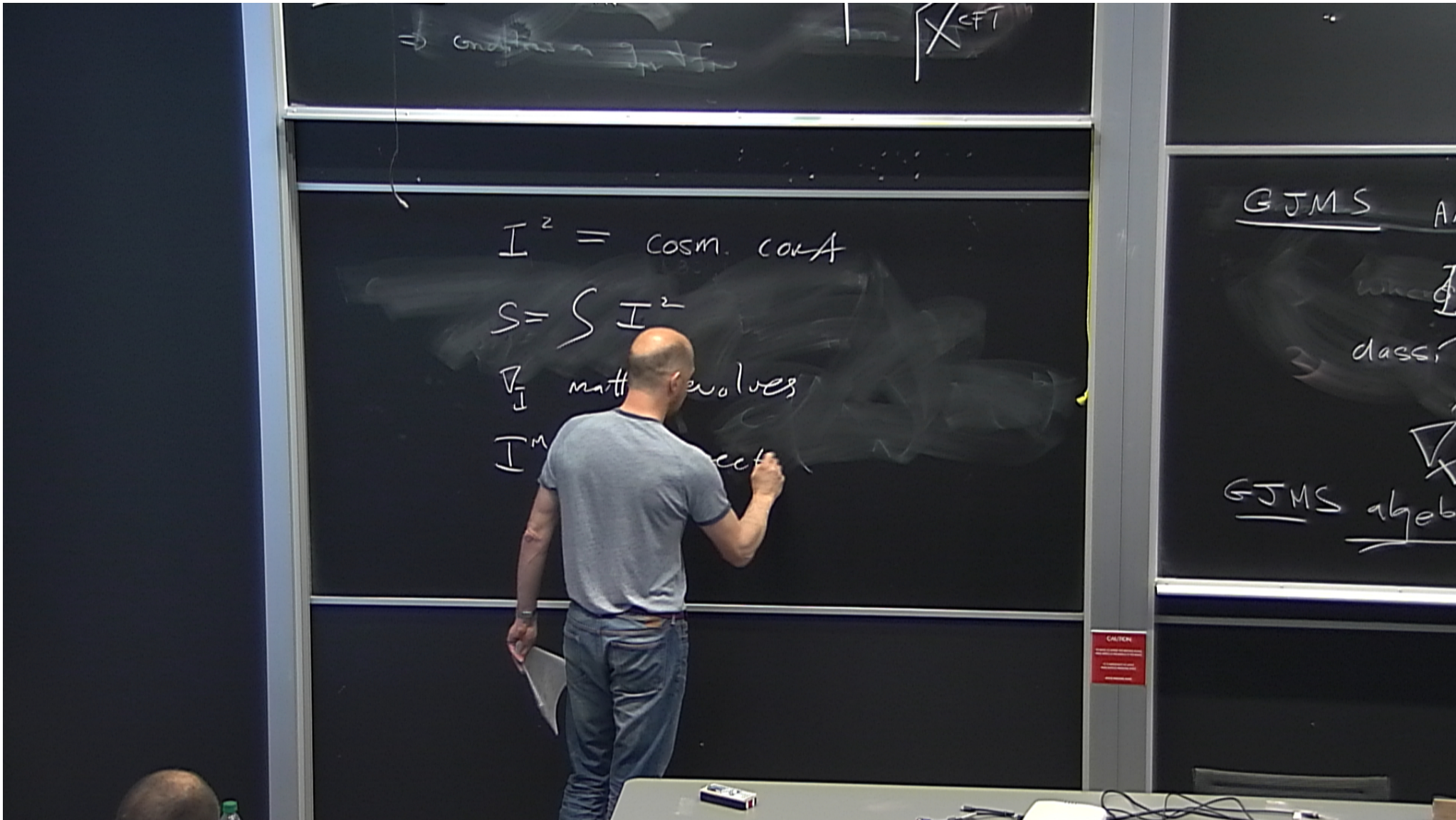
$$\sim \Phi^2 + X^2 \Psi$$

by weight

$$\Phi = \Psi \rightarrow \text{conformally invariant}$$
$$\{\Delta, \nabla_X, X^2\} = \mathfrak{sl}(2)$$

EINSTEIN & THE FUGU







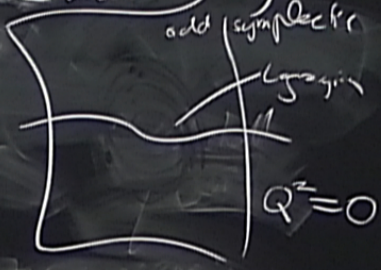
$\Rightarrow$  ~~Grassmann~~  $X_{\text{CFT}}$

GJMS algebra  $\Delta$

Action  $S = \text{tr}_H Q_a Q^b + \frac{2}{3} \epsilon^{abc} Q_a Q_b Q_c$

BV  $A = C + Q_a c^a + Q_{ab}^{*} c^a c^b + \dots$    
 causal structure   
 field   
 add symplectic

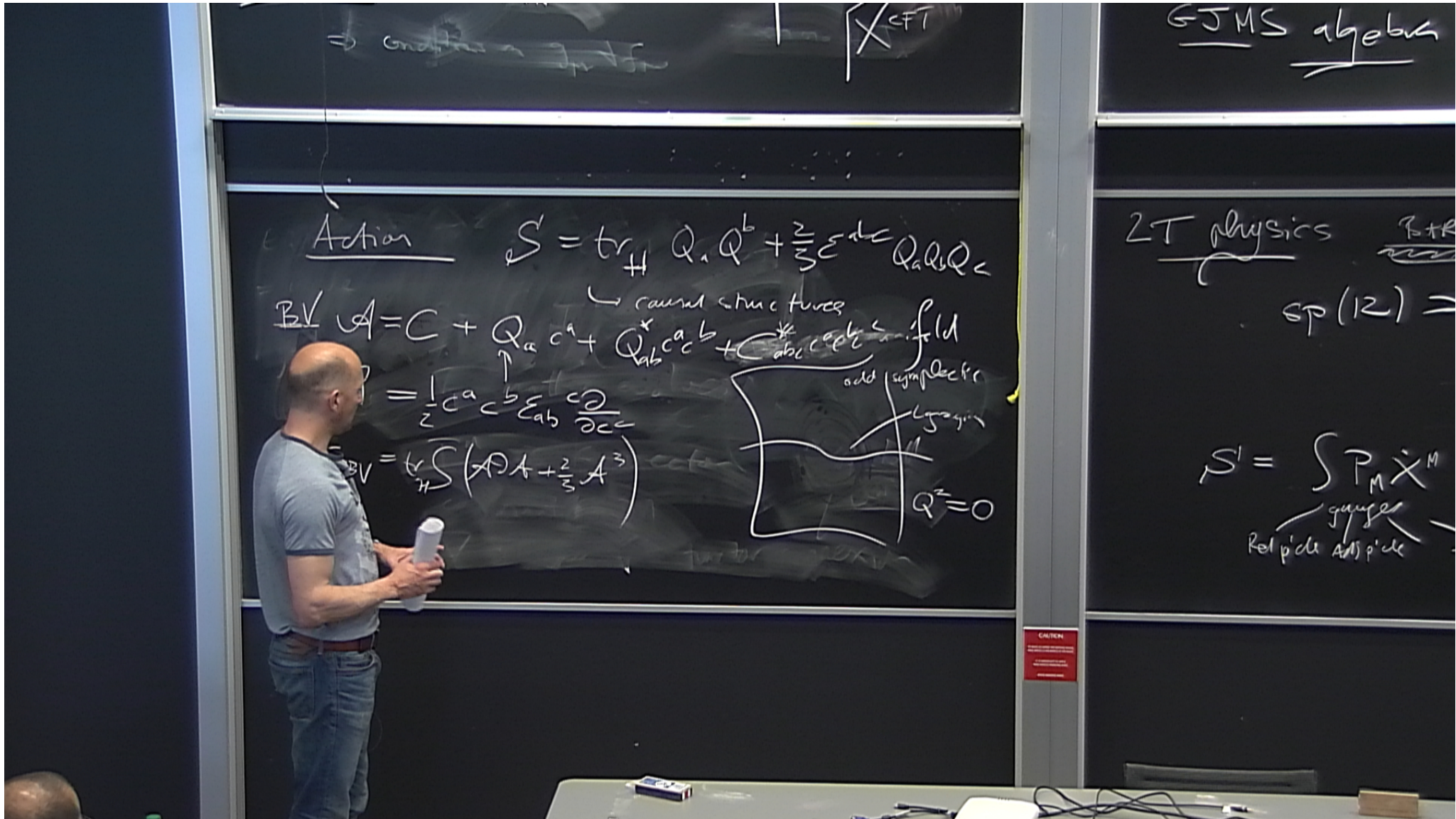
$\vec{A} = \frac{1}{2} \epsilon^{ab} \frac{\partial}{\partial c^c}$    
 $S_{\text{BV}} = \dots + \frac{2}{3} A^3$



2T physics R+RS

$\text{sp}(12) \supset \text{sp}(6)$    
 $112$    
 $50(2)$    
 $11$    
 $50(2)$

$S' = \int P_M \dot{X}^M - [e$    
 gauge   
 Rel p' de  $A^M$  p' de  $\text{Hydrogen}$



$\rightarrow$  ~~another~~  $X_{\text{CFT}}$

GJMS algebra

Action  $S = \text{tr}_H Q_a Q^b + \frac{2}{3} \epsilon^{abc} Q_a Q_b Q_c$

BV  $\mathcal{A} = C + Q_a c^a + Q_{ab}^x c^a c^b + C_{abc}^* c^a c^b c^c$  field

$= \frac{1}{2} c^a c^b \epsilon_{ab} \frac{\partial}{\partial c^c}$

$\text{BV} = \text{tr}_H \left( A \dot{A} + \frac{2}{3} A^3 \right)$

causal structures  
odd symplectic  
Lagrangian  
 $Q^2 = 0$

ZT physics  $\text{sp}(12) =$

$S = \int P_M \dot{X}^M$

gauge  
Red p'ole A's p'ole