Title: Gravitational Observatories

Speakers: Dionysios Anninos

Series: Quantum Gravity

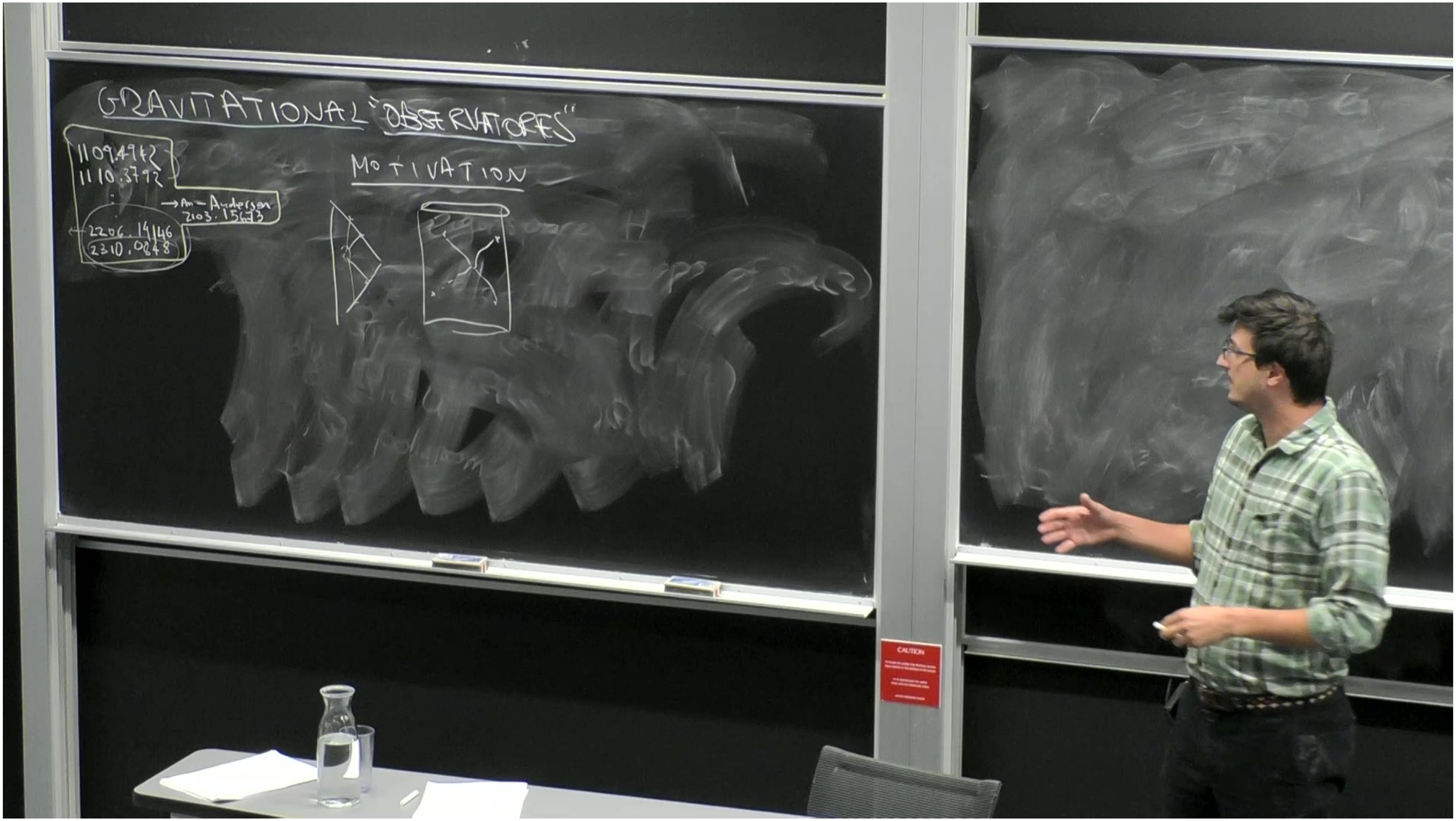
Date: October 19, 2023 - 2:30 PM

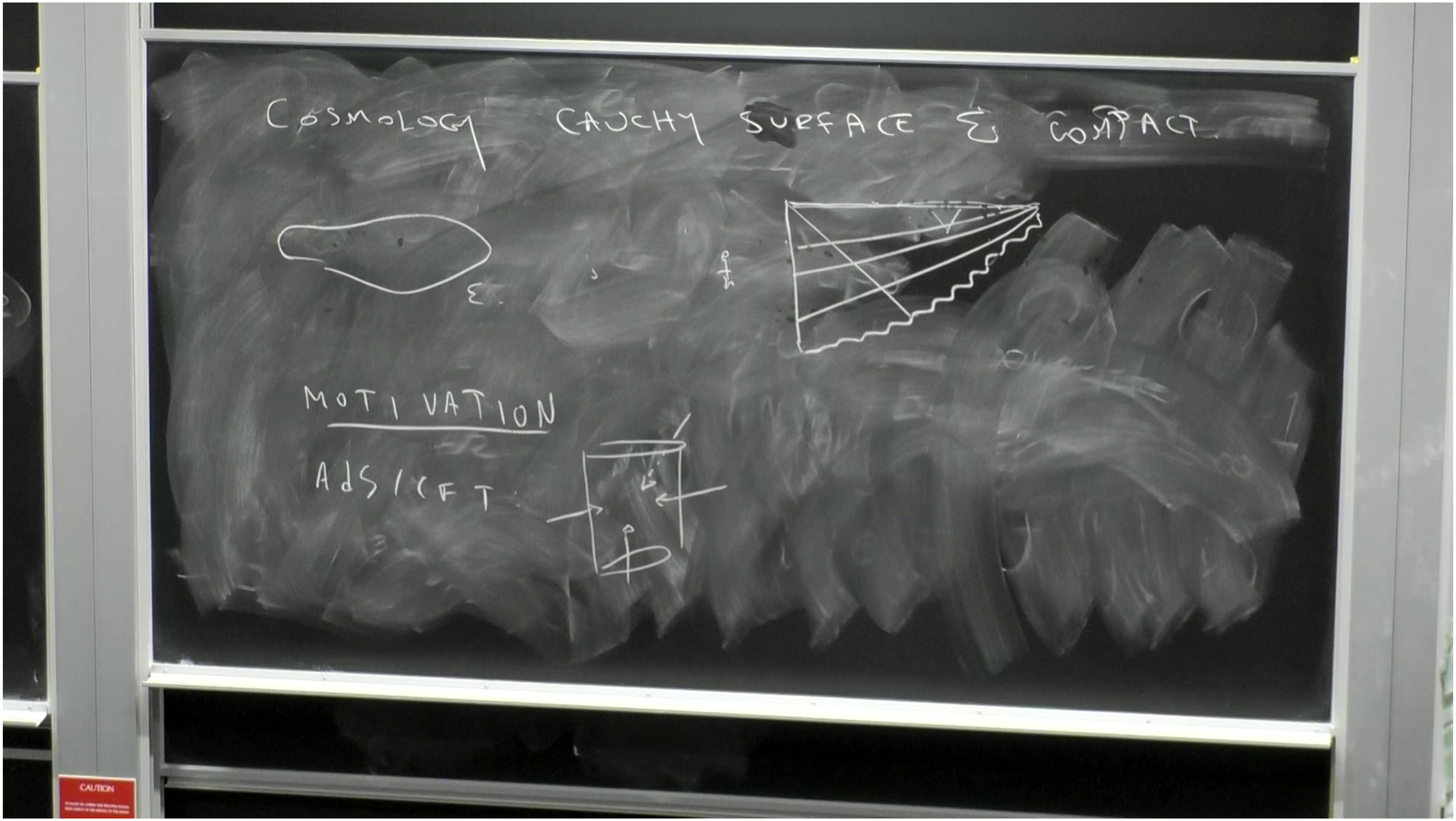
URL: https://pirsa.org/23100104

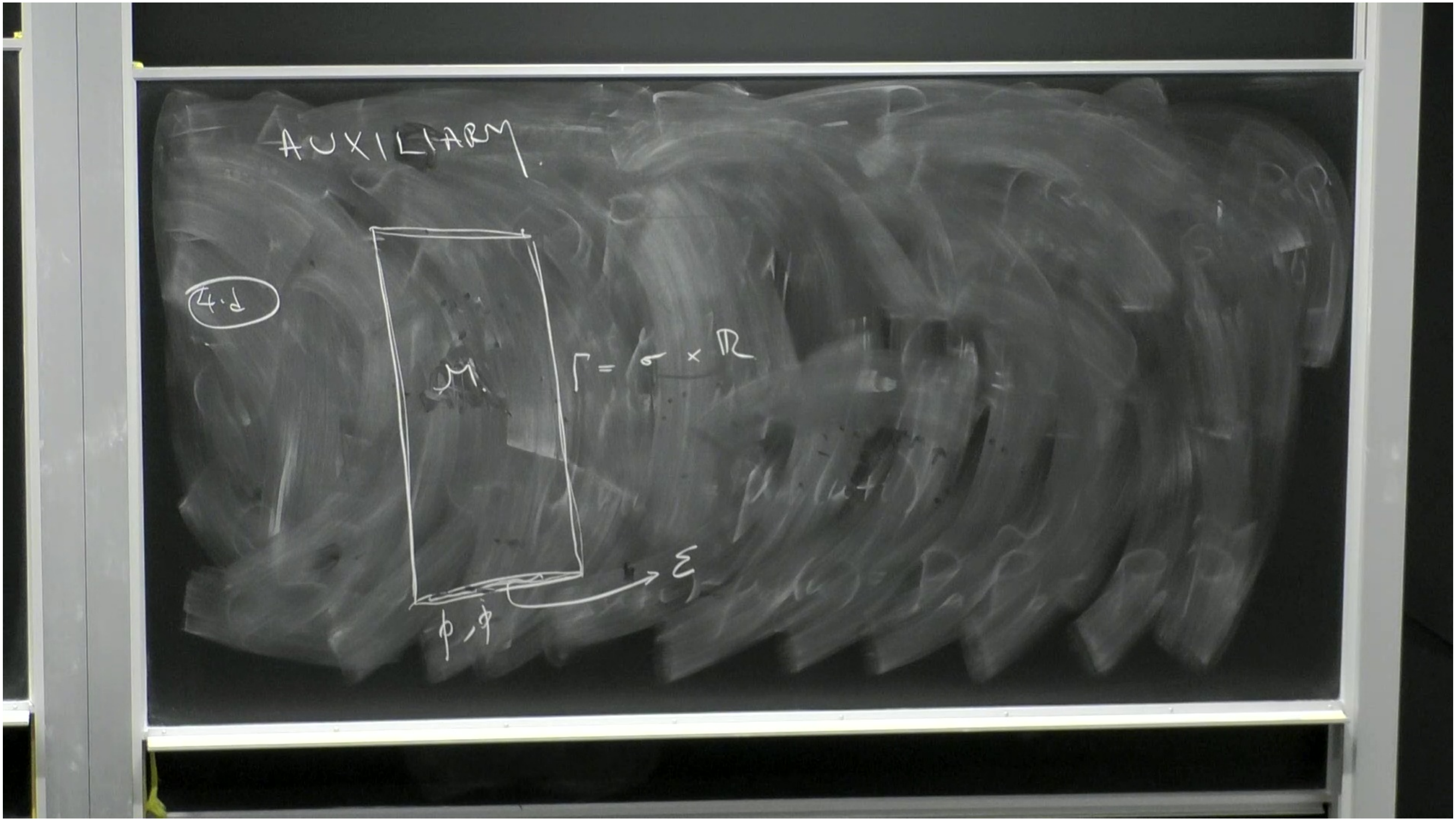
Abstract:

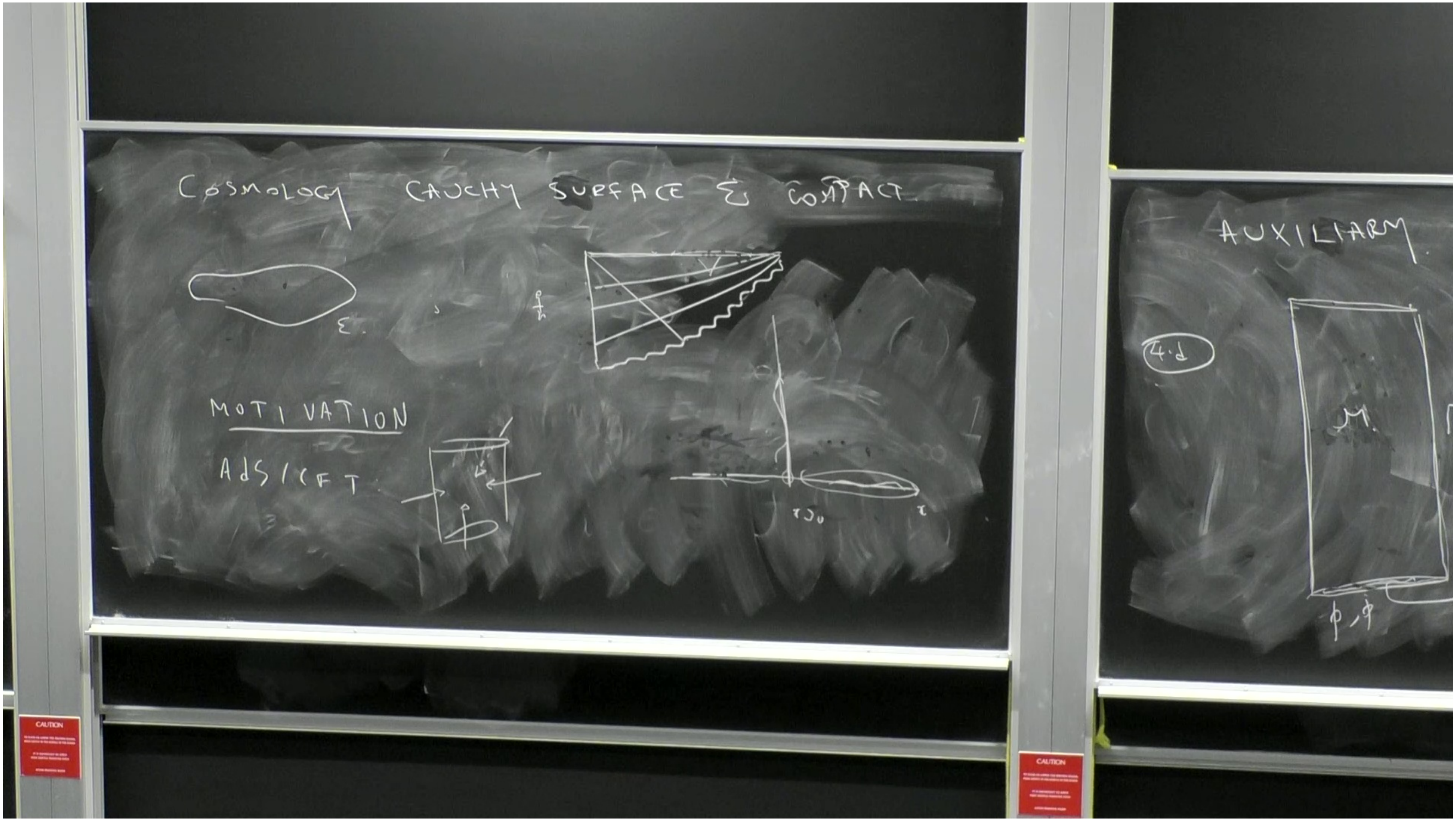
Motivated by the static patch of de Sitter space, we discuss timelike surfaces in general relativity and the initial boundary value problem. We consider the Dirichlet problem and a conformal version thereof. Time permitting we discuss some ideas in lower dimensions.

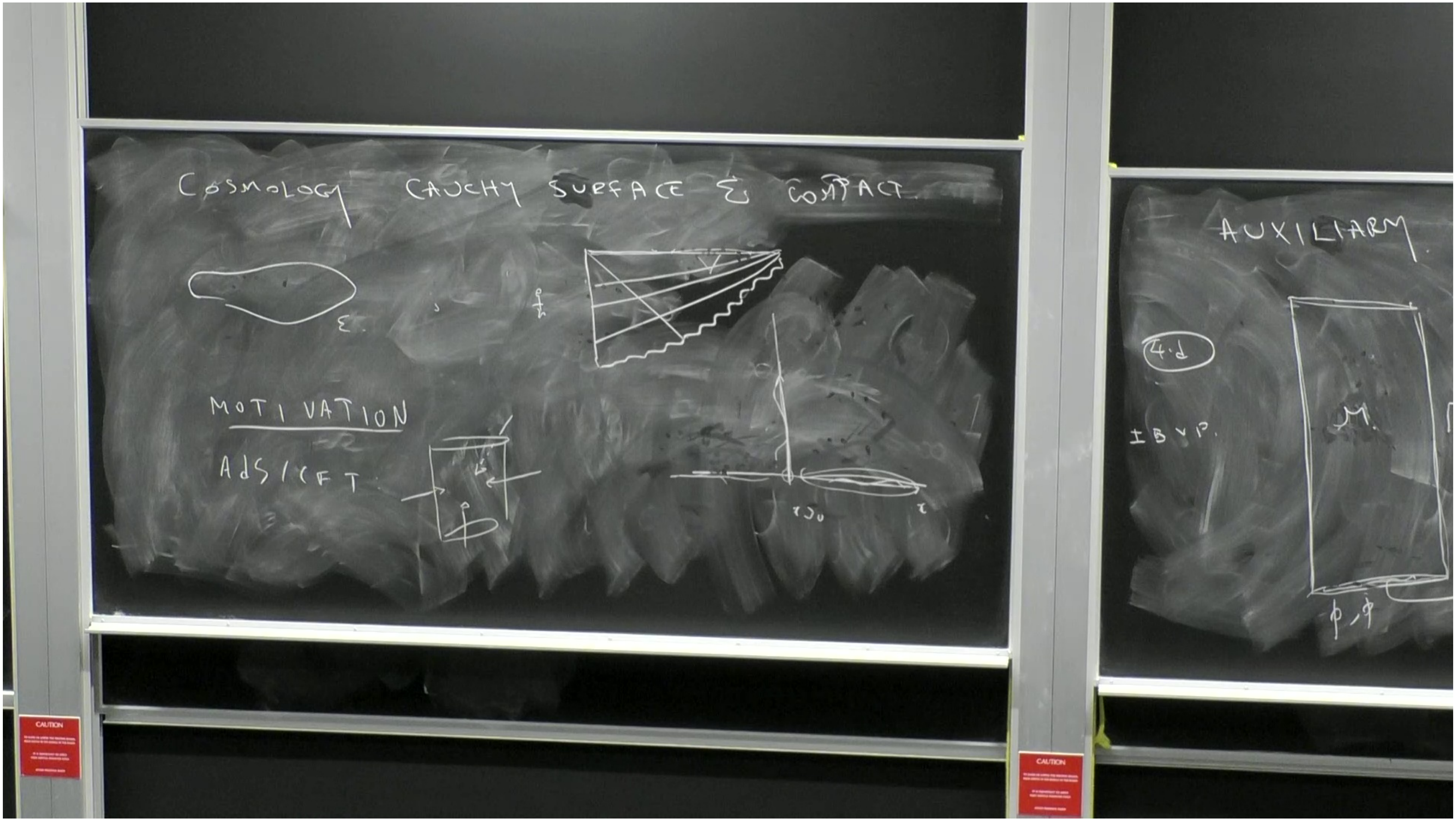
Zoom link https://pitp.zoom.us/j/98357788662?pwd=b3lHS3Q3T2xkNm53SkR3QVVvTGJMdz09

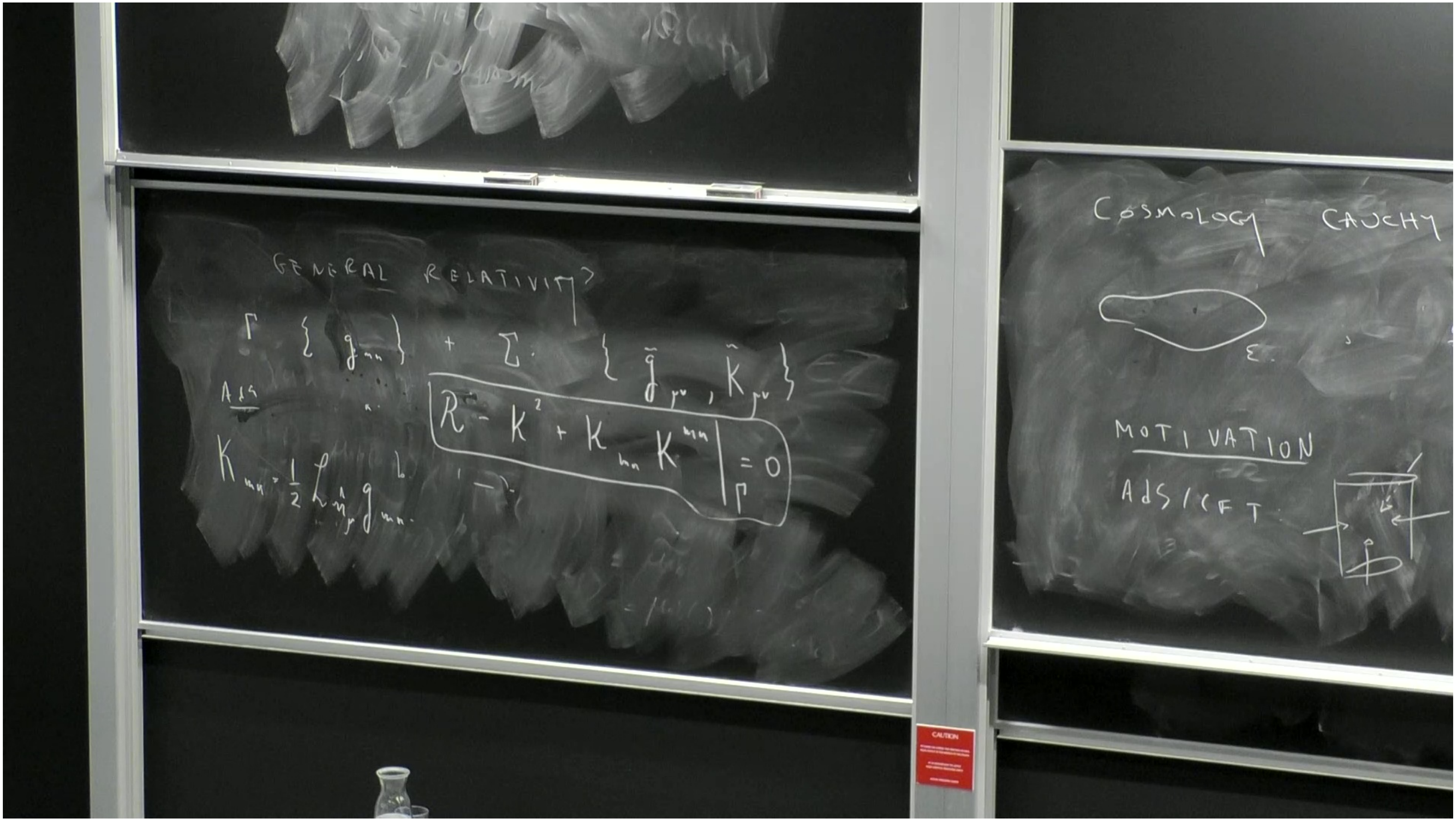

GRAVITATIONAL "OBSERVATORIES"
1109.4942
1110.3792
→ An - Anderson
2103.15673
2206.14146
2310.0848
MOTIVATION
CAUTION

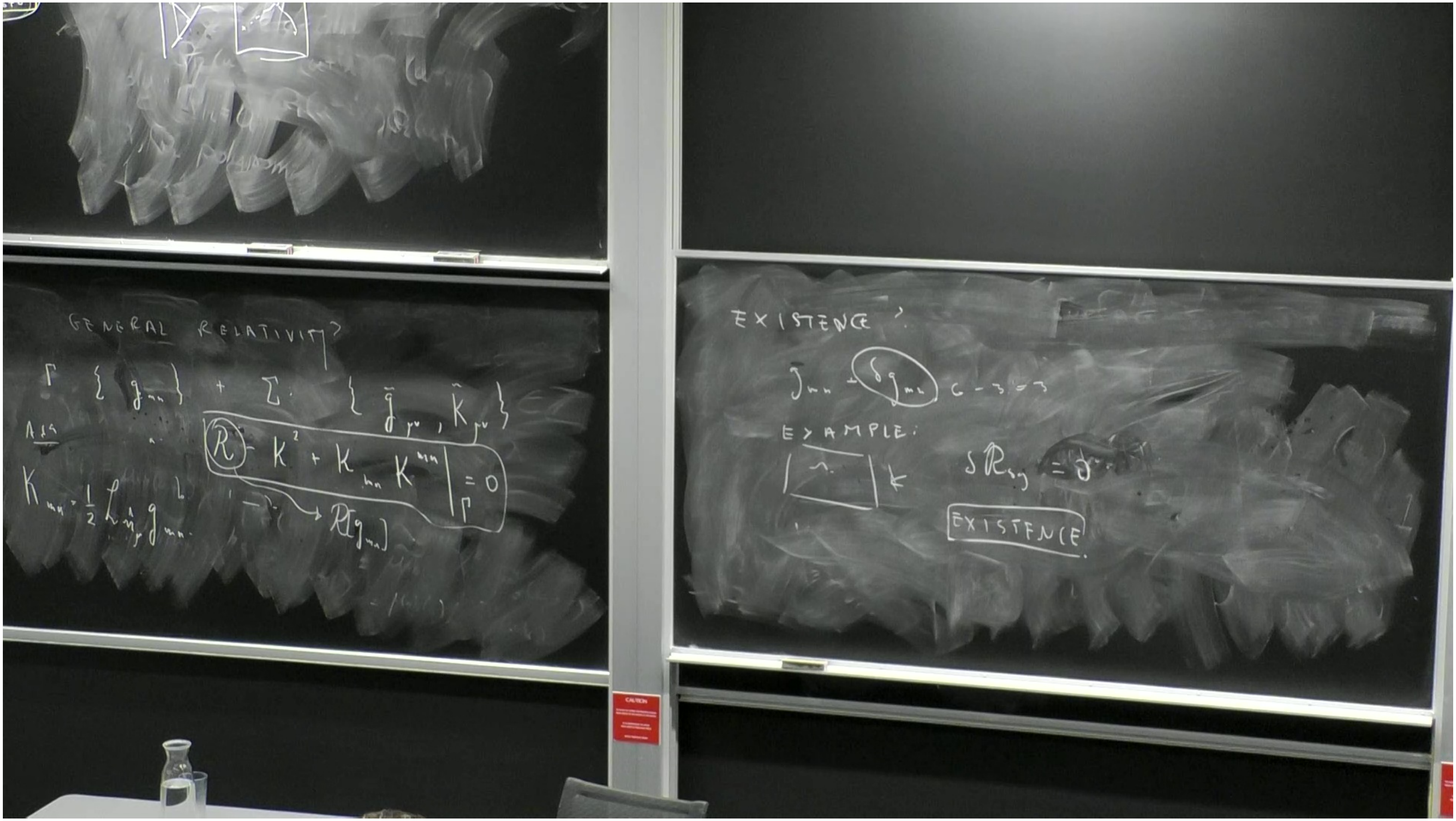

COSMOLOGY CAUCHY SURFACE & COMPACT.
Σ
MOTIVATION
AdS/CFT

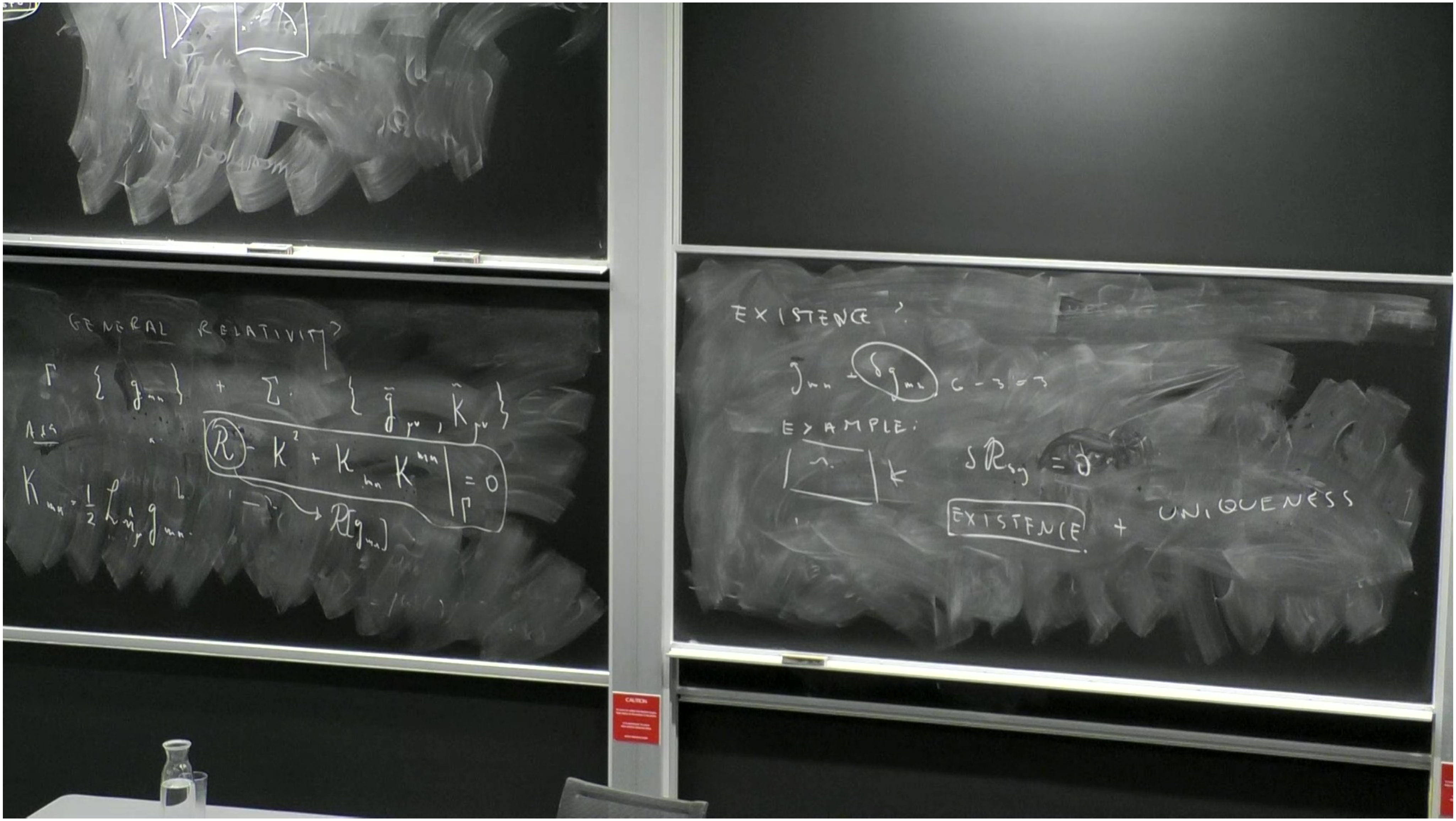

AUXILIARY.
4d
M
$\Gamma = \sigma \times \mathbb{R}$
$\phi, \bar{\phi}$
Σ

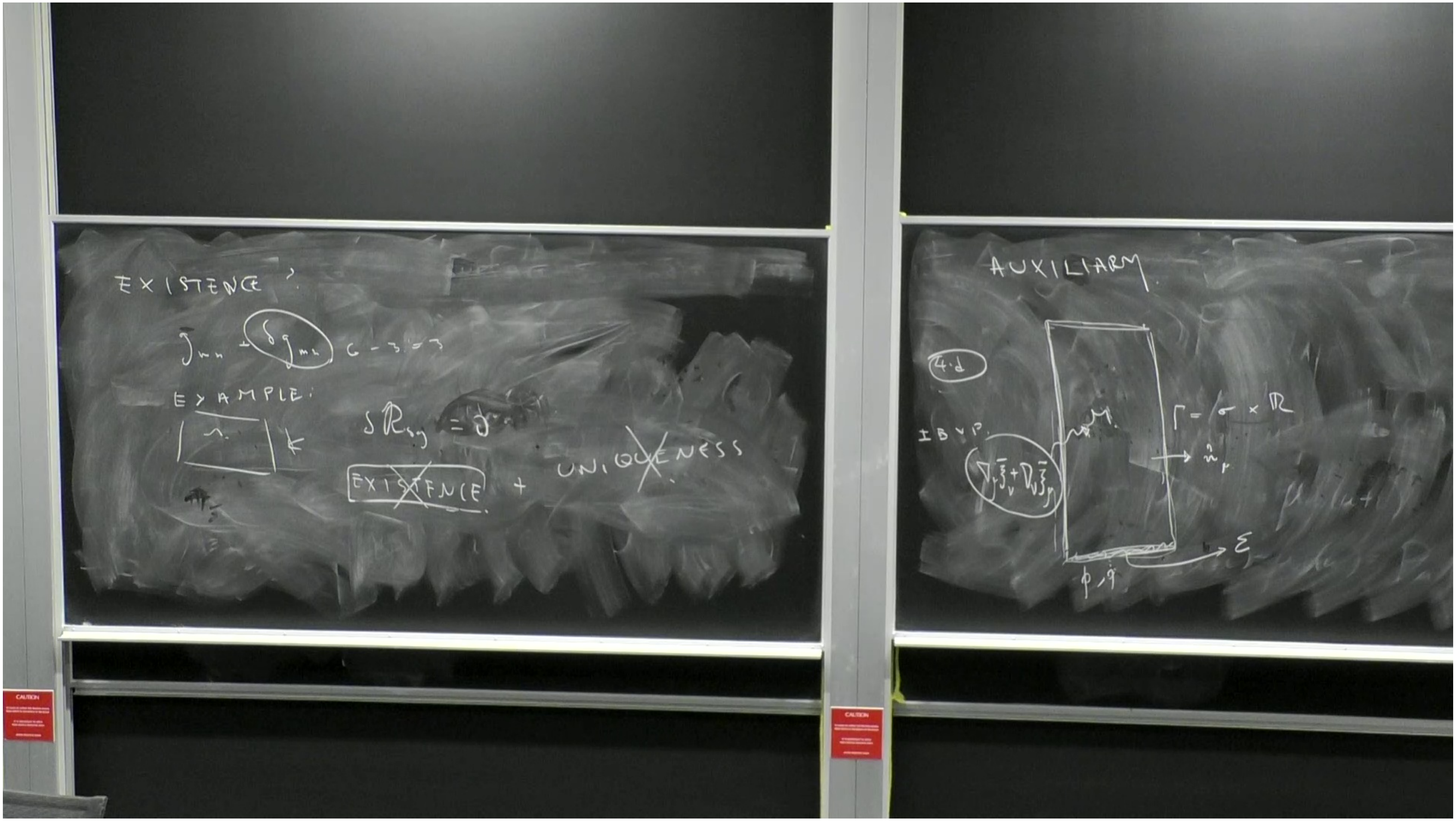

COSMOLOGY
CAUCHY SURFACE Σ COMPACT
Σ
MOTIVATION
AdS/CFT
AUXILIARY
4-d
M
ϕ, ϕ

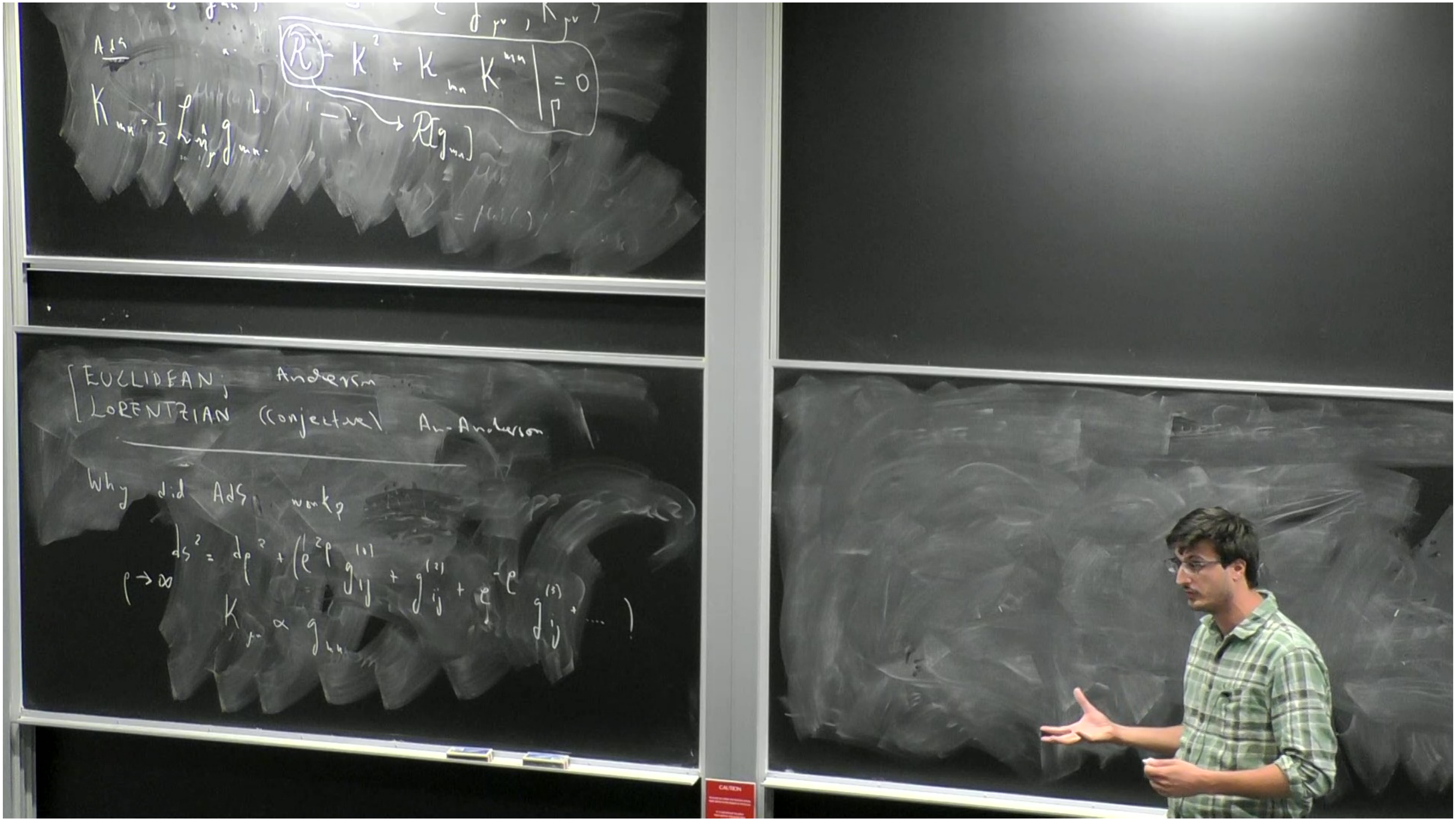

COSMOLOGY CAUCHY SURFACE Σ COMPACT
Σ
MOTIVATION
AdS/CFT
AUXILIARY
4-d
IBVP.
M
φ, φ̇

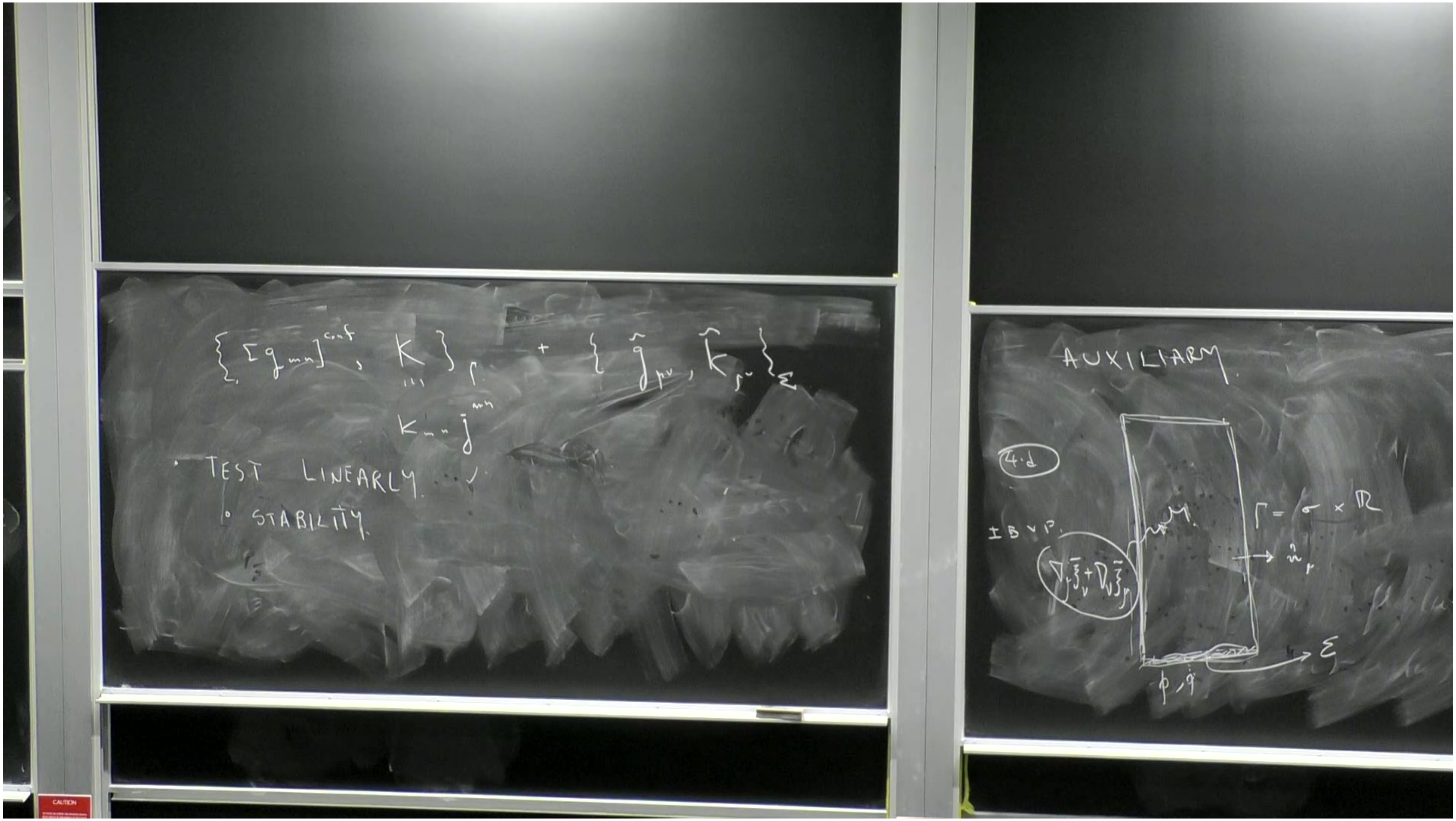

GENERAL RELATIVITY
$R - K^2 + K_{mn} K^{mn} \big|_{\Gamma} = 0$
COSMOLOGY
CAUCHY
MOTIVATION
AdS/CFT
CAUTION

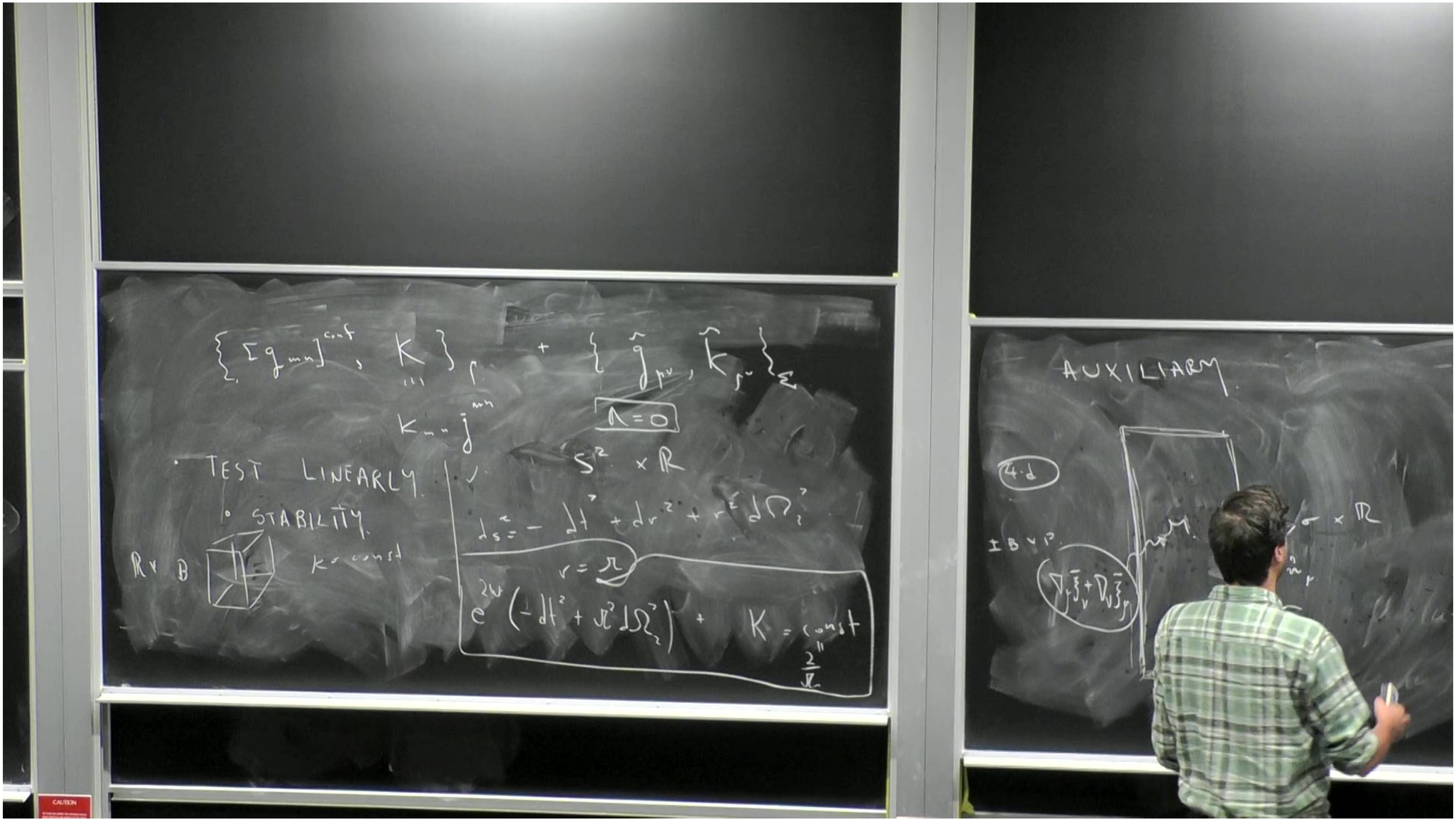

GENERAL RELATIVITY
EXISTENCE?
EXAMPLE:
EXISTENCE


GENERAL RELATIVITY?
EXISTENCE?
EXAMPLE:
EXISTENCE + UNIQUENESS


EXISTENCE ?
EXAMPLE:
EXISTENCE + UNIQUENESS
AUXILIARY
4-d
IBVP


EUCLIDEAN; Anderson
LORENTZIAN (conjecture) An-Anderson
Why did AdS work?


TEST LINEARLY
STABILITY
AUXILIARY
4·d
IBVP.
Γ = σ × ℝ


AUXILIARY
TEST LINEARLY
STABILITY
4-d
IBVP
Λ=0
K = const

$\{ \dots, K \}_{\Gamma} + \{ \tilde{g}_{\mu\nu}, \tilde{K}_{\mu\nu} \}_{\Sigma}$

$K_{mn} j^{mn}$ $\boxed{\Lambda = 0}$

$S^2 \times \mathbb{R}$

NEARLY

TY.

const

$ds^2 = -dt^2 + dr^2 + r^2 d\Omega_2^2$

$r = \mathcal{R}$

$e^{2\psi}(-dt^2 + \mathcal{R}^2 d\Omega_2^2) + K = \text{const} = \frac{2}{\mathcal{R}}$

KODAMA - ISHIBASHI

$h^{(V)}_{\mu\nu} + h^{(S)}_{\mu\nu}$

$-\nabla^2_{S^2} S = L(L+1)$

$D_i V^i = 0$

algebraic conditions at $r = \mathcal{R}$

$\sum_{L,m} \int_{\omega} e^{-i\omega t} Y_{Lm}(\theta, \varphi) f_{\omega L m}(r)$ +

$t = 0$

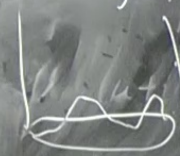
KODAMA-ISHIBASHI

$h^{(V)}_{\mu\nu} + h^{(S)}_{\mu\nu}$

$D_i V^i = 0 \qquad -\nabla^2_{S^2} S = L(L+1)S$

$\sum_{L,m,\omega}\int e^{-i\omega t}\, Y_{Lm}(\theta,\varphi)\, f_{\omega L m}(r)$ + algebraic conditions at $r=\mathcal{R}$

$t=0$



$K\}_{\Gamma} + \{\tilde{g}_{\mu\nu}, \tilde{K}_{\mu\nu}\}_{\Sigma}$

$K_{mn}\tilde{g}^{mn}$ $\qquad \boxed{\Lambda = 0}$

$S^2 \times \mathbb{R}$

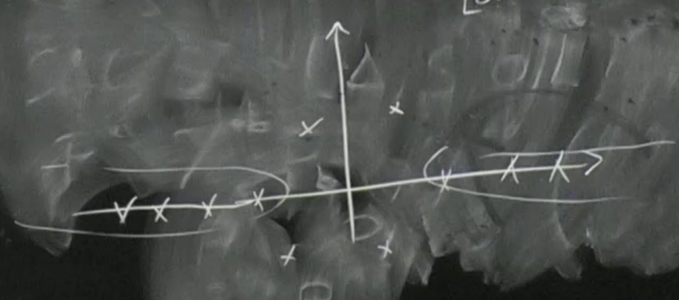
RLY

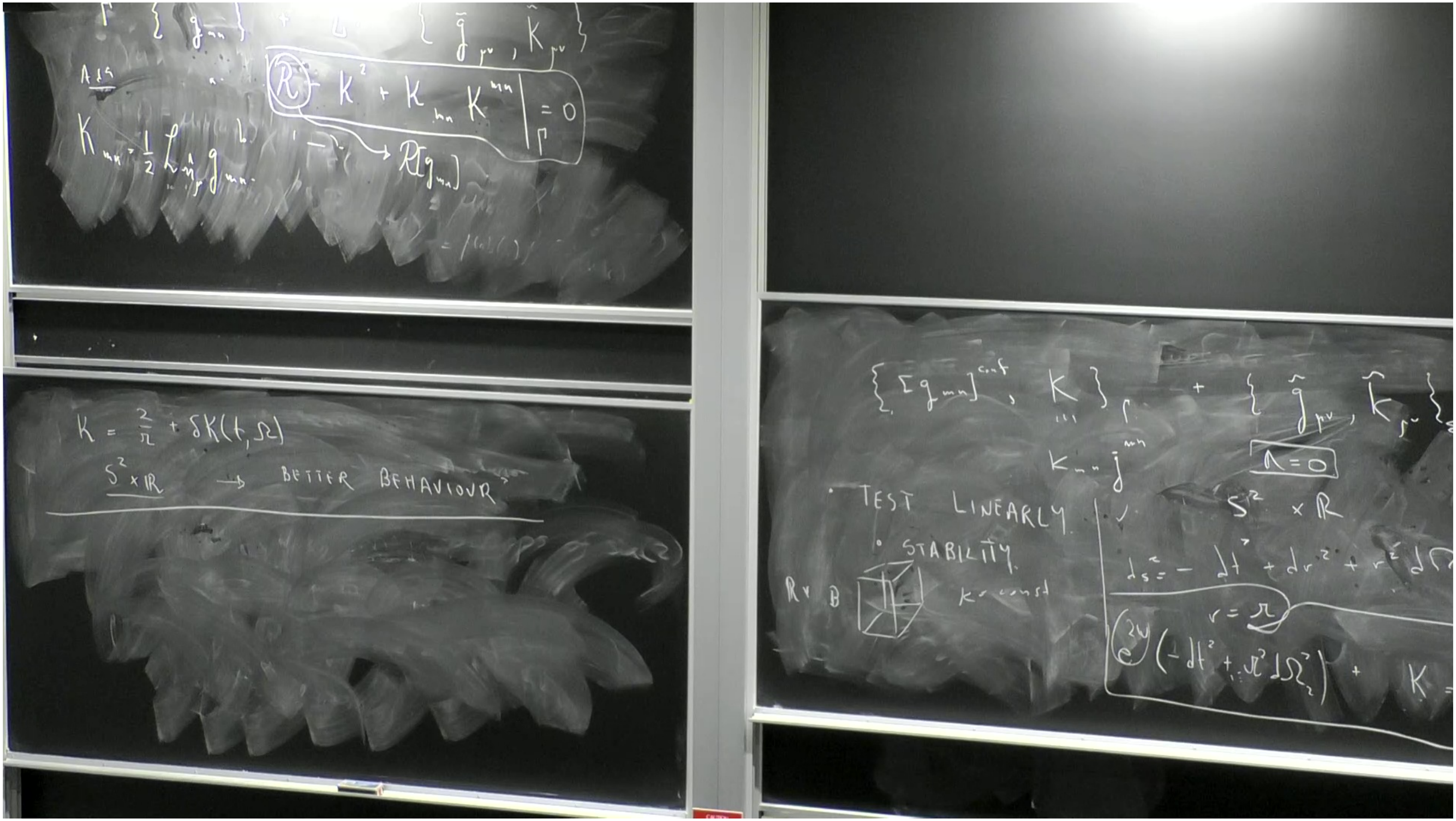
$ds^2 = -dt^2 + dr^2 + r^2 d\Omega_2^2$

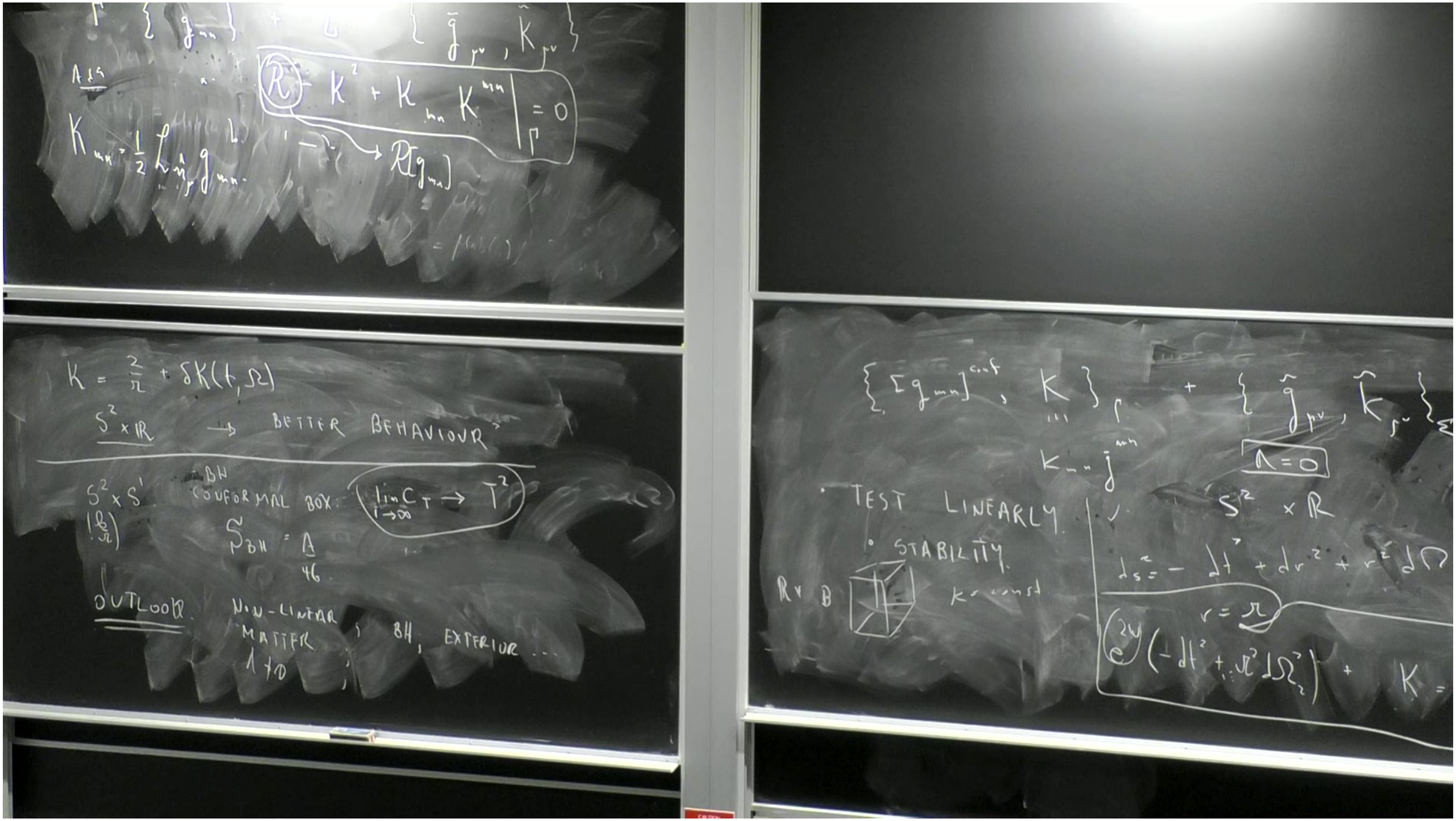
$r = \mathcal{R}$

$$\boxed{e^{2\psi}\left(-dt^2 + \mathcal{R}^2 d\Omega_2^2\right) + K = \text{const} = \frac{2}{\mathcal{R}}}$$

$dr^2 + r^2 d\Omega_2^2 \qquad r\in(0,\mathcal{R})$




AdS
$R - K^2 + K_{mn}K^{mn}\big|_\Gamma = 0$
$K_{mn} = \frac{1}{2}\mathcal{L}_{\hat n}\, g_{mn}$
$R[g_{mn}]$
$K = \frac{2}{\Omega} + \delta K(t, \Omega)$
$S^2 \times \mathbb{R}$ → BETTER BEHAVIOUR
$\{[g_{mn}]^{conf}, K\}_\Gamma + \{\tilde g_{\mu\nu}, \tilde K_{\mu\nu}\}$
$K_{mn}\, j^{mn}$
$\Lambda = 0$
TEST LINEARLY
STABILITY
$S^2 \times \mathbb{R}$
$ds^2 = -dt^2 + dr^2 + r^2 d\Omega$
$r = \Omega$
$\mathbb{R} \times B$
$K \sim const$
$e^{2\omega}(-dt^2 + \Omega^2 d\Omega_2^2) + K =$


K = 2/r + δK(t, Ω)
S² × R → BETTER BEHAVIOUR?
S² × S¹
CONFORMAL BOX
S_BH = A/4G
OUTLOOK
NON-LINEAR
MATTER
BH, EXTERIOR ...
Λ ≠ 0
TEST LINEARLY
STABILITY
Λ = 0
S² × R
ds² = − dt² + dr² + r² dΩ
r = r
e^{2ω} (−dt² + r² dΩ²)