Title: Lecture - Canonical a

Speakers:

Collection: Celestial Holography Summer School 2024

Date: July 22, 2024 - 10:00 AM

URL: https://pirsa.org/24070003

$$\left\{ C_{AB}(u,x),\ \gamma_{AB}(x),\ M(u_0,x),\ N_A(u_0,x),\ T_{AB}(u_0,x),\ \ldots \right\}$$

$ds^2 = e^{\ldots}\frac{V}{r}du^2 - 2\ldots$

$+\, g_{AB}\ldots$

curvature

$\frac{V}{r} = -\frac{\bar{R}}{2} + \frac{2M}{r} + \ldots$

$\beta = \frac{1}{r^2}\left(-\frac{1}{32} C\ldots\right.$

$U^A = -\frac{1}{2r^2} D_B C\ldots$

$V,\ g_{AB},\ U^A$ ar…

$g_{AB} = r^2\gamma_{AB} + \ldots$

$$\frac{\partial \mathcal{L}}{\partial \dot{\phi}(\vec{x})} \equiv \Pi(\vec{y})$$

$$\{ C_{AB}(u,x) , C_{CD}(u$$

$$\{ \phi(\vec{x}) , \Pi(\vec{y}) \} = i\hbar\, \delta(\vec{x} - \vec{y})$$

Phase Space

$(\mu = 1, \ldots, 2n)$

(q^i, p_j) $\qquad q^\mu$

$\{q^i, p_j\} = \delta^i_j$

$\otimes \quad \exists \quad \Omega = \frac{1}{2} \Omega_{\mu\nu} \, \delta x^\mu \wedge \delta x^\nu$

① $d\Omega = 0$

② $\Omega^{\mu\nu}$ exists

Phase Space

$$(q^i, p_j)$$

$$\{q^i, p_j\} = \delta^i_j$$

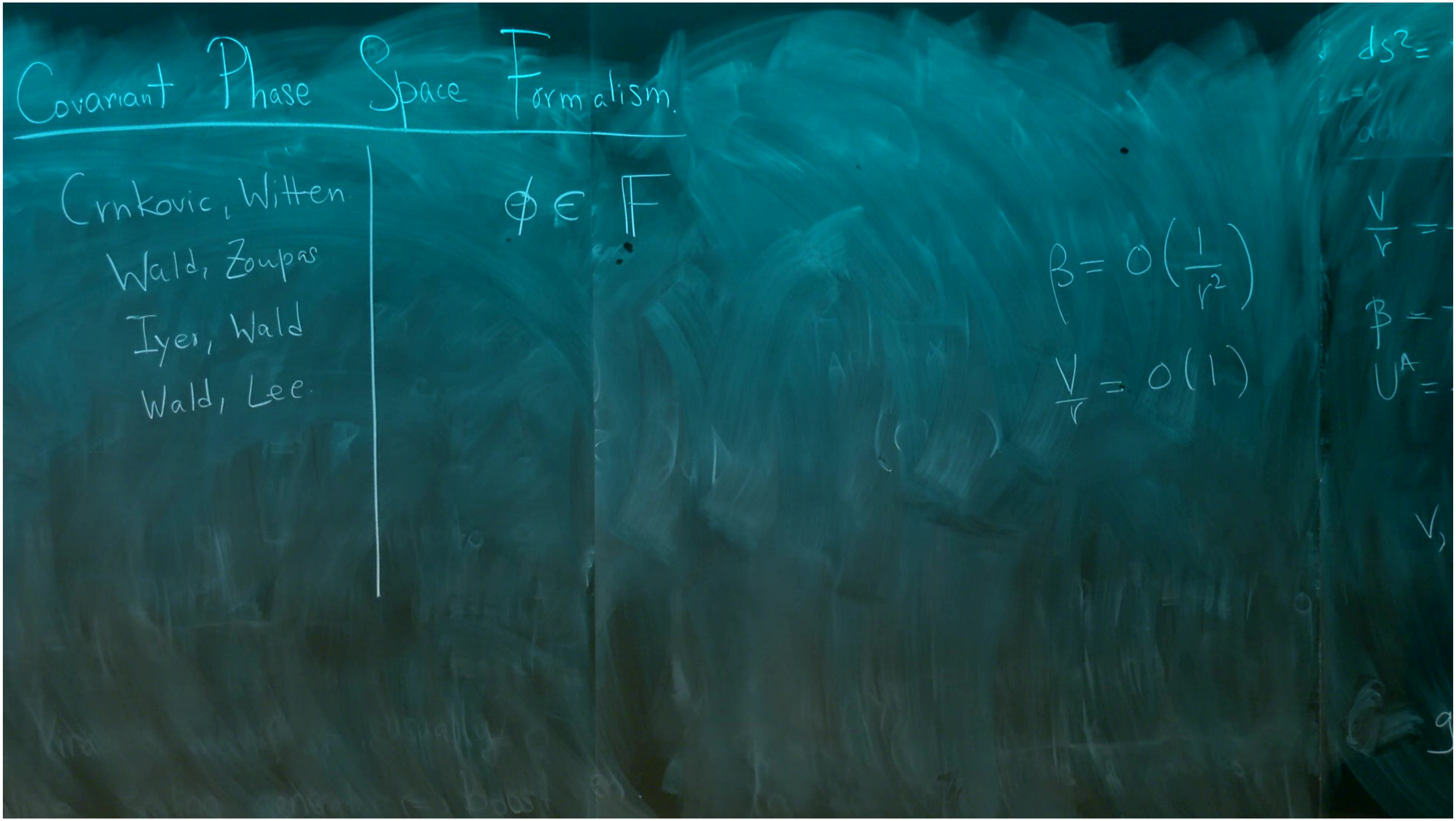
$(\mu = 1, \dots, 2n)$

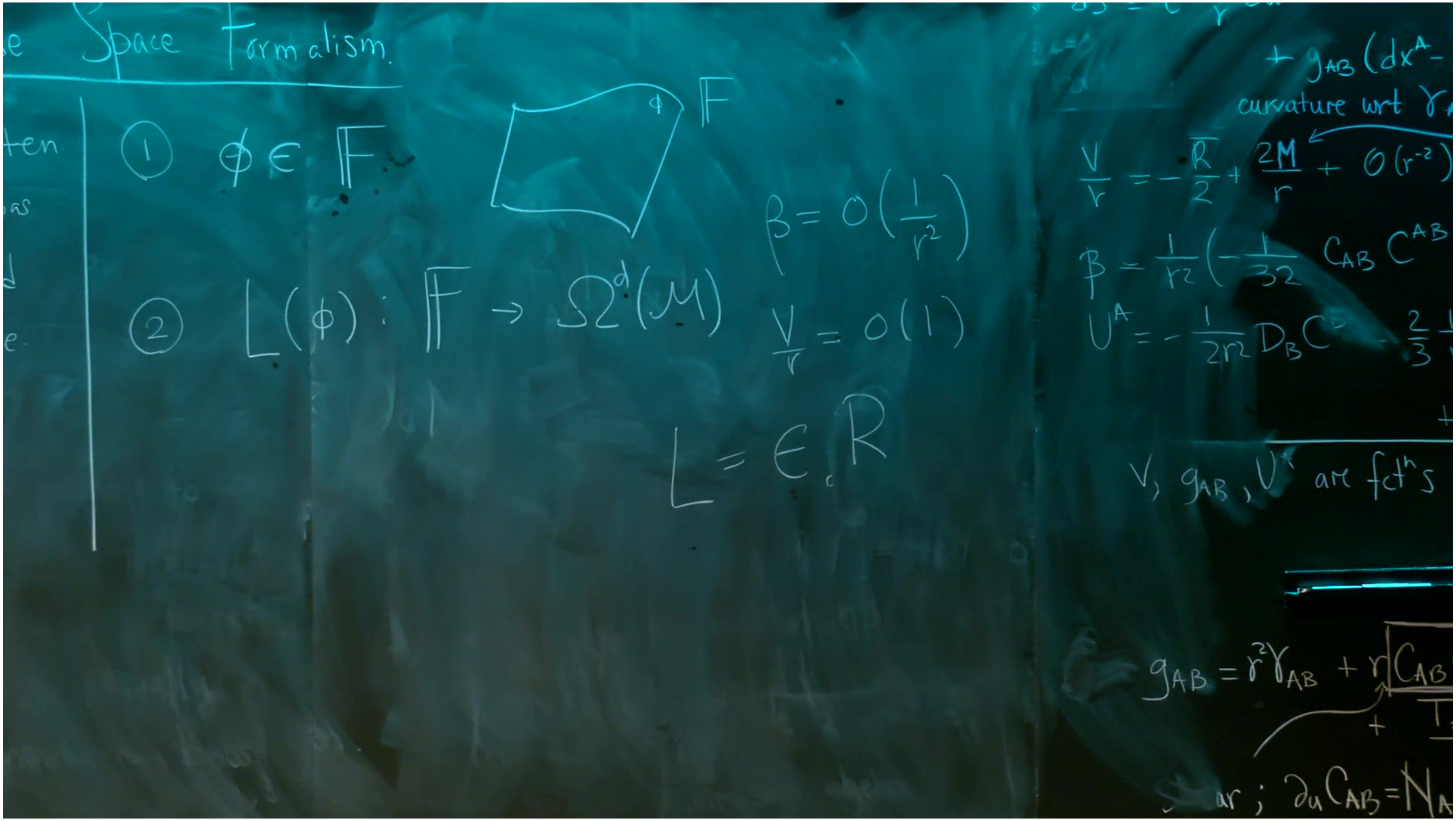
$$\{f(q), g(q)\} = \Omega^{\mu\nu}\,\partial_\mu f\,\partial_\nu g$$

(x) $\exists\ \Omega = \frac{1}{2}\Omega_{\mu\nu}\,\delta x^\mu \wedge \delta x^\nu$

(1) $\delta\Omega = 0$

(2) $\Omega^{\mu\nu}$ exists


Covariant Phase Space Formalism
Crnkovic, Witten
Wald, Zoupas
Iyer, Wald
Wald, Lee
$\phi \in \mathbb{F}$
$\beta = O\left(\frac{1}{r^2}\right)$
$\frac{V}{r} = O(1)$


Space Formalism
ten
① $\phi \in \mathbb{F}$
② $L(\phi) : \mathbb{F} \to \Omega^d(\mathcal{M})$
ϕ $\mathbb{F}$
$\beta = O\left(\frac{1}{r^2}\right)$
$\frac{V}{r} = O(1)$
$L = \in \mathbb{R}$
$+ g_{AB}(dx^A -$
curvature wrt γ
$\frac{V}{r} = -\frac{R}{2} + \frac{2M}{r} + O(r^{-2})$
$\beta = \frac{1}{r^2}\left(-\frac{1}{32} C_{AB} C^{AB}\right.$
$U^A = -\frac{1}{2r^2} D_B C$
V, g_{AB}, U^A are fct^{n}s
$g_{AB} = r^2 \gamma_{AB} + r\, C_{AB}$
$\partial_u C_{AB} = N_A$

Covariant Phase Space

I. $\delta L(\phi) = E(\phi)\,\delta\phi + d\,\Theta$

II. $\mathcal{S} : \quad E(\phi) = 0$

III. $\omega \equiv \delta\Theta$

$L(\phi) : (d, 0)$

$\Theta : (d-1, 1)$

$\omega : (d-1, 2)$

$\tilde{\Omega} : (0, 2)$

IV. $\tilde{\Omega} = \int_{\Sigma} \omega$

1

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Covariant Phase Space Formalism

① $\phi \in \mathbb{F}$

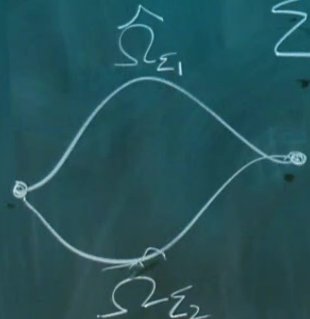
IV. $\hat{\Omega} = \int_{\Sigma} \omega$

② $L(\phi) : \mathbb{F} \to \Omega^{d}(\mathcal{M})$

$\beta = O\left(\frac{1}{r^2}\right)$

$\frac{V}{r} = O(1)$

Ex:

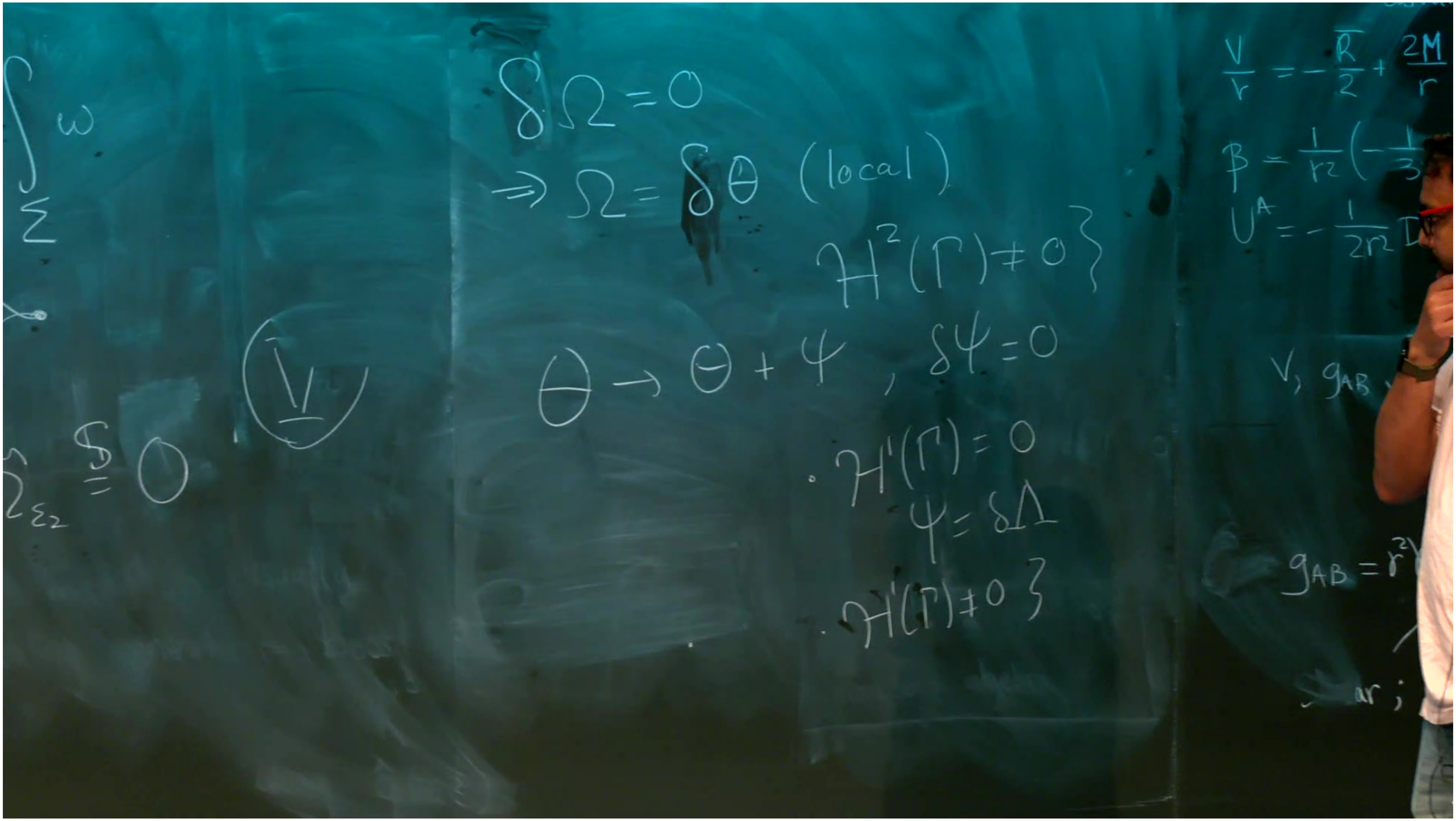


$$\hat{\Omega}_{\Sigma_1} - \hat{\Omega}_{\Sigma_2} \overset{\mathbb{S}}{=} 0$$

V. $\delta \hat{\Omega} = 0$

$L = \epsilon R$

$$\Gamma \equiv \frac{\mathbb{S}}{\mathrm{Ker}\, \hat{\Omega}}$$


$\int_\Sigma \omega$
$\delta\Omega = 0$
$\Rightarrow \Omega = \delta\Theta$ (local)
$\mathcal{H}^2(\Gamma) \neq 0$
$\Theta \to \Theta + \Psi, \ \delta\Psi = 0$
$\mathcal{H}^1(\Gamma) = 0$
$\Psi = \delta\Lambda$
$\mathcal{H}^1(\Gamma) \neq 0$
$\frac{V}{r} = -\frac{\bar{R}}{2} + \frac{2M}{r}$
V, g_{AB}
$g_{AB} = r^2$

$$\delta L(\phi) = E(\phi)\,\delta\phi + d\Theta$$

I. $S : \quad E(\phi) = 0$

II. $\omega \equiv \delta\Theta$

$L(\phi) : (d, 0)$

$\Theta : (d-1, 1)$

$\omega : (d-1, 2)$

$\Omega : (0, 2)$

Covariant Phase Space Formal

$$\Theta \mapsto \Theta + dY$$

$$\Omega \to \Omega + \oint_{\partial\Sigma} \delta Y$$

Covariant Phase Space Formal

$$\delta L(\phi) = E(\phi)\,\delta\phi + d\Theta$$

I. $\mathcal{S}: \quad E(\phi) = 0$

II. $\omega \equiv \delta\Theta$

$L(\phi): (d, 0)$

$\Theta: (d-1, 1)$

$\omega: (d-1, 2)$

$\Omega: (0, 2)$

$$\Theta \mapsto \Theta + dY$$

$$\Omega \to \Omega + \oint_{(\partial\Sigma)} \delta Y$$