

Title: Lecture - Canonical a

Speakers:

Collection: Celestial Holography Summer School 2024

Date: July 22, 2024 - 10:00 AM

URL: <https://pirsa.org/24070003>

$$\left\{ \begin{array}{l} C_{AB}(u, x), \gamma_{AB}(x), \\ M(u_0, x), N_A(u_0, x), \\ T_{AB}(u_0, x), \end{array} \right\}$$

$$ds^2 = e^{2\beta} \frac{1}{r} du - 2$$

$$+ g_{AB} \text{ curvature}$$

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

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

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

$$V, g_{AB}, U^A \text{ and}$$

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

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

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

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

Phase Space

$$(q^i, p_j)$$

$$\{q^i, p_j\} = \delta_j^i$$

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

$$g^{\mu}$$

⊗

∫

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

① $d\Omega = 0$

② $\Omega^{\mu\nu}$ exists

Phase Space

$$(q^i, P_j)$$

$$\{q^i, P_j\} = \delta_j^i$$

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

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

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

$$\textcircled{1} \quad \delta \Omega = 0$$

$$\textcircled{2} \quad \Omega^{\mu\nu} \text{ exists}$$

Covariant Phase Space Formalism.

Crnkovic, Witten

Wald, Zoupas

Iyer, Wald

Wald, Lee.

$$\phi \in \mathbb{F}$$

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

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

$$ds^2 =$$

$$\frac{V}{r} =$$

$$\beta =$$

$$U^A =$$

$$V,$$

Space Formalism

① $\phi \in \mathbb{F}$



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

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

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

$L = \epsilon \cdot R$

+ $g_{AB} (dx^A -$
curvature wrt γ

$\frac{V}{r} = -\frac{R}{2} + \frac{2M}{r} + O(r^{-2})$

$\beta = \frac{1}{r^2} \left(-\frac{1}{32} C_{AB} C^{AB} \right)$

$U^A = -\frac{1}{2r^2} D_B C^B - \frac{2}{3}$

V, g_{AB}, U^A are fctⁿs

$g_{AB} = r^2 \gamma_{AB} + r \left[C_{AB} \right]$

$\partial_u C_{AB} = N_{AB}$

$$\textcircled{\text{I}} \quad \delta L(\phi) = E(\phi) \delta \phi + d\theta$$

$$\textcircled{\text{II}} \quad \int : E(\phi) = 0$$

$$\textcircled{\text{III}} \quad \omega \equiv \delta \theta$$

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

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

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

$$\int \omega : (0, 2)$$

Covariant Phase Space

$$\textcircled{\text{IV}} \quad \int \omega = \int_M \omega$$

①

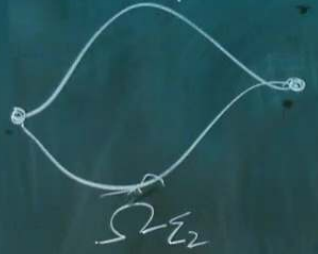
②

Covariant Phase Space Formalism.

IV

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

Ex:



$$\tilde{\Omega}_{\epsilon_1} - \tilde{\Omega}_{\epsilon_2} \stackrel{\$}{=} 0$$

① $\phi \in F$



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

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

$$\frac{1}{r} = o(1)$$

V

$$\delta \tilde{\Omega} = 0$$

$$L = \epsilon \cdot R$$

$$\Gamma \equiv \frac{\$}{\text{Ker } \tilde{\Omega}}$$

$\int \omega$
 \sum

$\int \omega$
 \sum

$\int \omega$
 \sum

$$\delta \Omega = 0$$

$$\Rightarrow \Omega = \delta \Theta \text{ (local)}$$

$$\mathcal{H}^2(\Gamma) \neq 0 \}$$

$$\Theta \rightarrow \Theta + \psi, \delta \psi = 0$$

$$\mathcal{H}^1(\Gamma) = 0$$

$$\psi = \delta \Lambda$$

$$\mathcal{H}^1(\Gamma) \neq 0 \}$$

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

$$\beta = \frac{1}{r^2} \left(-\frac{1}{3} \right)$$

$$U^A = -\frac{1}{2r^2} \Gamma^A$$

v, g_{AB}

$$g_{AB} = r^2$$

$ar;$

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

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

$$\omega \equiv \delta \Theta$$

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

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

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

$$\Omega : (0, 2)$$

Covariant Phase Space Formalism

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

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

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

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

$$\omega \equiv \delta \Theta$$

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

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

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

$$\Omega : (0, 2)$$

Covariant Phase Space Formalism

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

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