

Title: Charges from Attractors

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Abstract: We describe how to recover the quantum numbers of extremal black holes from their near horizon geometries. This is achieved by constructing the gravitational Noether-Wald charges which can be used for non-extremal black holes as well. These charges are shown to be equivalent to the $U(1)$ charges of appropriately dimensionally reduced solutions. Explicit derivations are provided for 10 dimensional type IIB supergravity and 5 dimensional minimal gauged supergravity, with illustrative examples for various black hole solutions. We further discuss how to derive the thermodynamic quantities and their relations explicitly in the extremal limit, from the point of view of the near-horizon geometry. We relate our results to the entropy function formalism.

- ex. $B + I$.
- charges



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- ex. B + 1
- charges



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1. ex. B + 1.
 - chairs
2. Noether-Walk cl.

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1. ex. B + I.
• charges

2. ... Walk Cl.

3. ... Producti. → Cl.



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1. ex. B + I.
 - chairs

2. Noether-Walk Ch.

2. Dim. Producti. \rightarrow Ch.

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1. • ex. $B+1$.
• chairs

2. Noether-Wald Ch.

3. Dim. Products \rightarrow Ch.

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1.
 - ex. $B+1$
 - charges

2. Noether-Wahl Ch.

3. Dim. Produkt. \rightarrow Ch.

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1.
 - ex. B + I.
 - charges
2. Hochw-Wald Cl.
3. Dim. Producti. → Cl.
4. Endkopff.

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1.
 - ex. B + I.
 - charges

2. Hochw-Wert Cl.

3. D.m. Producti. → Cl.

4. Enkop
 - def
 - 1st
 - QSR

- courses
2. Noether-Wald ch.
 3. Dim. Reduct. \rightarrow ch.
 4. Endo 7.
 - def
 - 1st law
 - QSR

o Susan



o Susy
→ on legs count-



- S_{n-1}
→ an hegen counti-
→ NHG



• S_{234}
→ on these counts -

→ NHG

$\mathcal{R} = \emptyset$

o Susy
→ an legs commi-
→ NHG

$$\mathcal{L} = 0 = T$$



→ on these combi-

→ NHG

$\mathcal{X} = \mathcal{O} = \mathcal{T}$

$M(\mathcal{O}, \mathcal{T})$
M

→ on legs combi-

→ NHG

$\mathcal{R} = 0 = T$

M(Q, M)

M-Q

o In 54
→ on legs count

→ NHG

$\mathcal{L} = 0 = T$ $M(Q, \eta)$
 $M-Q$

• Supply
→ an inverse demand

→ NHG : $AD_{S_2} \times ()^{D-1}$

$\mathcal{L} = 0 = T$

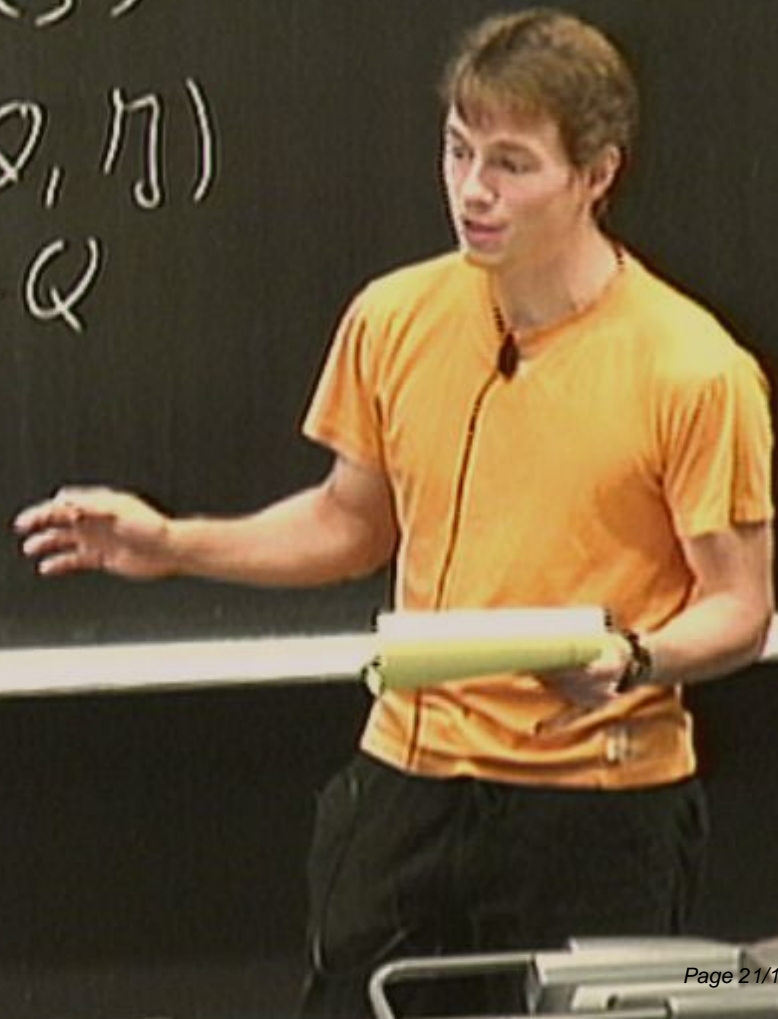
$M(Q, \eta)$

$M = Q$

• S_{154}
→ an large count.

→ NHG : $ALS_2 \times (S)^{D-2}$

$\mathcal{L} = 0 = T$ $M(Q, \eta)$
 $M = Q$



• In 3D
→ on large number

$$\rightarrow NHG : A \lambda S_2 \times (S)^{D-2}$$

$$\mathcal{L} = \mathcal{O} = T$$

$$M(Q, \eta)$$

$$M = Q$$

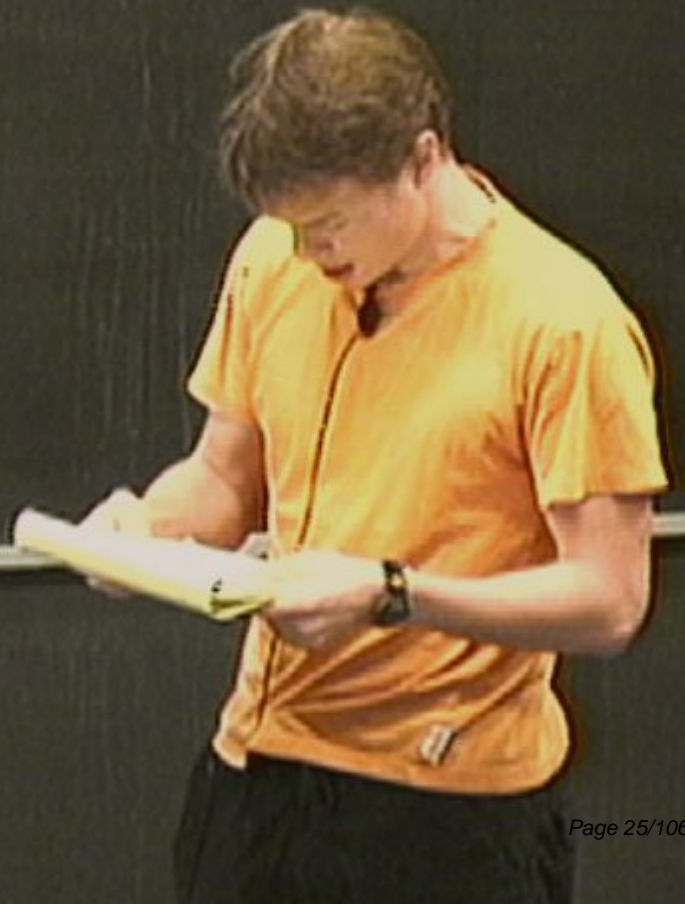
M, Q, Y



(M), Q, Y



(M), (Q), (Y), (S)



$$\int_{\mathbb{R}^n} \delta(x) dx = 1$$

$(M), (\omega), (\gamma), (S)$



$$\begin{aligned}
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \textcircled{M}, \omega, \gamma, (S) \\
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \int_{-\infty}^{\infty} \delta(x) dx
 \end{aligned}$$



$$\begin{aligned}
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S} \\
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \int_{-\infty}^{\infty} \delta(x) dx
 \end{aligned}$$



$$\begin{aligned}
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S} \\
 & \int_{-\infty}^{\infty} \delta(x) dx \\
 & \int_{-\infty}^{\infty} \delta(x) dx
 \end{aligned}$$



$$\begin{aligned}
 & \int_{\infty}^{\infty} \alpha \, d\vec{\xi}_0 \\
 & \textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S} \\
 & \int_{\infty}^{\infty} \alpha \, d\vec{\xi}_0 \\
 & \int_{\infty}^{\infty} \alpha \, d\vec{\xi}_0
 \end{aligned}$$

$$\begin{array}{l}
 \int_{-\infty}^{\infty} \delta(x) dx \\
 \textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S} \\
 \int_{-\infty}^{\infty} \delta(x) dx \\
 \int_{-\infty}^{\infty} \delta(x) dx
 \end{array}
 \rightarrow \int_{-\infty}^{\infty} \delta(x) dx$$



$$\begin{aligned}
 & \int_{\infty}^{\infty} \delta \alpha d\vec{\xi}_0 \\
 & \textcircled{M}, \textcircled{Q}, \textcircled{M}_0, (S) \\
 & \int_{\infty}^{\infty} \delta \alpha d\vec{\xi}_\varphi \\
 & \int_{\infty}^{\infty} \delta \alpha d\vec{\xi}_\varphi
 \end{aligned}$$

$$\int_{\infty}^{\infty} Q_{\xi_i} = \frac{2\ell}{\pi} S$$

$$\begin{aligned}
 & \left(\frac{2\pi}{23} \right)_{\infty} \times d\vec{\zeta}_0 \\
 & \textcircled{M}, \omega, \mu_0, (S) \\
 & \quad \downarrow \int_{\infty} \times F \\
 & \quad \downarrow \int_{\infty} \sigma_i d\vec{\zeta}_i \\
 & \int_{\infty} Q_{\zeta_i} = \frac{2e}{4\pi} S
 \end{aligned}$$

$$\begin{aligned}
 & \int_{\infty}^{\infty} \chi d\vec{\xi}_c \\
 & \textcircled{M}, \omega, \gamma_{d_0}, (S) \\
 & \int_{\infty}^{\infty} \chi \times F \\
 & \int_{\infty}^{\infty} \chi d\vec{\xi}_\varphi
 \end{aligned}$$

$$\int_{\infty}^{\infty} Q_{\xi} = \frac{2\ell}{4\pi} S$$

$$D_{\xi} \xi = \chi \xi$$

$$\begin{aligned} & \left(\frac{2 \cdot 7}{2 \cdot 3} \right) \int_{\infty}^{\infty} \chi d\vec{\xi}_0 \\ \textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S} & \\ & \int_{\infty}^{\infty} \chi d\vec{\xi}_0 \\ & \int_{\infty}^{\infty} \chi d\vec{\xi}_0 \end{aligned}$$

$$\int_{\infty}^{\infty} Q_{\xi} = \frac{2\ell}{4\pi} S$$

$$D_{\xi} \xi = \chi \xi$$



$$\left(\frac{2\pi}{\hbar} \right) \int_{\infty}^{\infty} \delta \alpha \hat{\xi}_0$$

$$\textcircled{M}, \textcircled{Q}, \textcircled{M}, \textcircled{S}$$

$$\int_{\infty}^{\infty} \delta \alpha \hat{\xi}_0$$

$$\int_B Q_{\xi} = \frac{2\ell}{4\pi} S$$

$$D_{\xi} \xi = -2\ell$$

BH



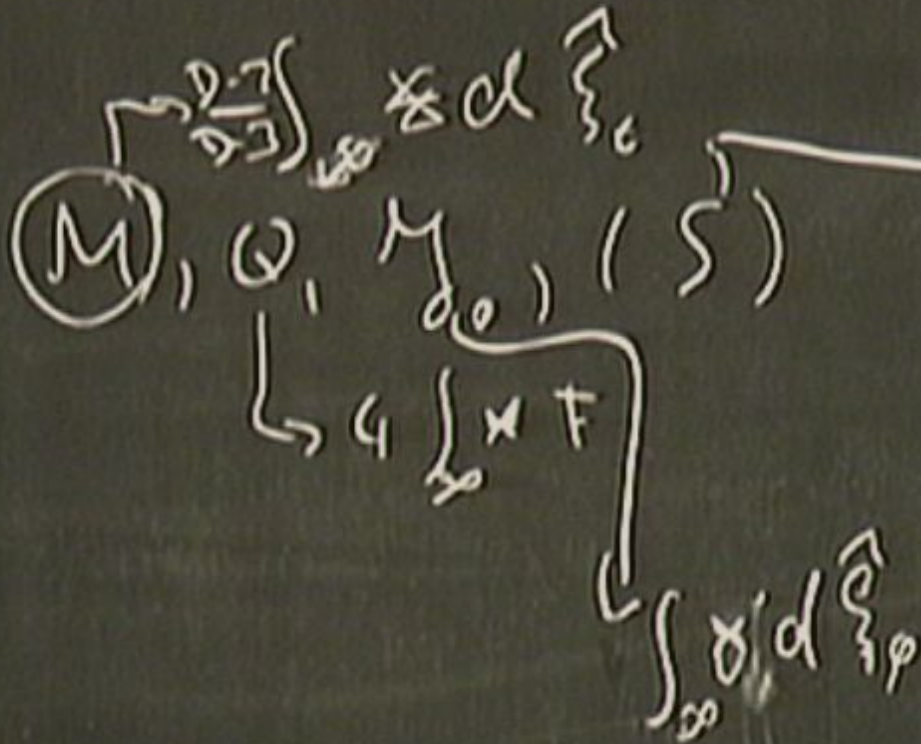
$\left(\frac{D \cdot 7}{23} \right) \times \alpha \xi_0$
 $(M), (Q), (J_0), (S)$
 $\hookrightarrow 4 \int \times F$

$$\int_{\mathcal{B}} Q_{\xi_i} = \frac{2\ell}{4\pi} S$$

$$D_{\xi} \xi = \chi \xi$$

$$\int_{\infty} \delta_i d\xi_{ip}$$

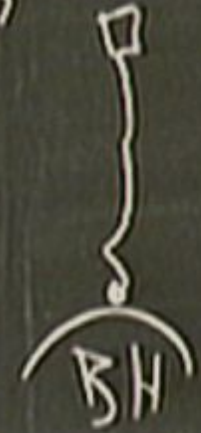
$\mathcal{H}_{1,1571}$
 BH



$$\int_B Q_{\xi_i} = \frac{2\ell}{4\pi} S$$

$$D_{\xi} \xi = \alpha \xi$$

$$\alpha_{\xi_2} - \alpha_{\xi_1, \delta \xi_1}$$



N-W Charges:

$$i) \delta_9 \mathcal{L} = E_i$$



N-W Charges:

$$i) \delta_g L = E_i \delta_g \Phi_i$$

N-W Charges:

$$i) \delta_g L = E_i \delta_g \Phi^i + d(\theta(\delta_g \Phi))$$

N-W charges:

$$i) \delta_3 \mathcal{L} = E_i \delta_3 \Phi^i + d(\theta(\delta_3 \Phi))$$

$$ii) \delta_3 \mathcal{L} = d(\xi \cdot L)$$

N-W Charges:

$$i) \delta_g L = E_i \delta_g \Phi^i + d(\theta(\delta_g \Phi))$$

$$ii) \delta_\xi L = d(\xi \cdot L)$$

N-W Changes:

$$i) \delta_g L = E_i \delta_g \Phi_i + d(\theta(\delta_g \Phi))$$

$$ii) \delta_g L = d(\xi \cdot L)$$

$$M = \theta(\xi \cdot L)$$

N-W charges:

$$i) \delta_q L = E_i \delta_q \Phi_i + d(\theta(\delta_q \Phi))$$

$$ii) \delta_\xi L = d(\xi \cdot L)$$

$$\gamma = \theta(\xi \cdot L) \stackrel{E_i=0}{\Rightarrow} d\alpha = 0$$

$$\gamma = dQ$$

N-W Charges:

$$i) \delta_g L = E_i \delta_g \Phi^i + d(\theta(\delta_g \Phi))$$

$$ii) \delta_\xi L = d(\xi \cdot L)$$

$$\gamma = \theta(\xi \cdot L) \stackrel{E_i=0}{\Rightarrow} d\gamma = 0$$

$$\gamma = dQ$$

$$1) \quad \gamma = 0$$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$1) \quad \Gamma = 0$$

$$L = 0$$

§ A. U. m.

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

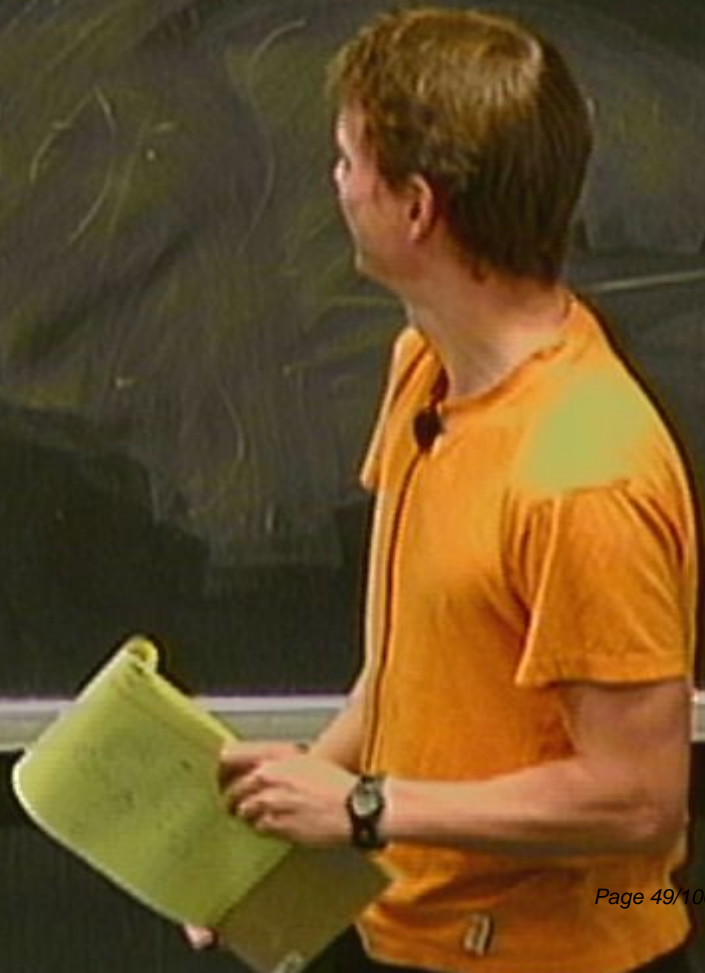
$$1) \quad J = 0$$

$$L = 0$$

ξ A. U. m.

$$\int_{\xi_1} Q - \int_{\xi_2} Q = 0$$

$$\int_{\xi} J = 0$$



$$i) \quad \gamma = 0$$

$$L = 0$$

ξ A: U.M.

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\gamma = 0$$

ii) ξ periodic



$$i) \quad \mathcal{I} = 0$$

$L: \partial$
 $\xi: A: U: \text{un}$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\int_{\xi} \mathcal{I} = 0$$

ii) ξ periodic, killings



$$i) \quad J = 0$$

$$L = 0$$

{ A: U. m. r.

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$J_{\xi} g = 0$$

ii) { periodic, killings

$$i) \quad \mathcal{I} = 0$$

$$L = 0$$

$\{ A: U_{\text{sym}}$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\mathcal{I}_{\xi} \mathcal{I} = 0$$

ii) $\{$ periodic, killings

$$i) \quad \Gamma = 0$$

$L = 0$
 $\{ A: U_{\text{sym}}$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\int_{\Sigma} \Gamma = 0$$

ii) $\{$ periodic, killings

$$\int_{\Sigma} \cdot L$$

$$i) \quad \int_0^L q = 0$$

$$L: 0$$

$$\{ A: \text{U.} \}$$

$$\int_{\xi_1}^{\xi_2} Q - \int_{\xi_2}^{\xi_1} Q = 0$$

$$\int_{\xi} \int_{\xi} q = 0$$

ii) $\{ \text{periodic, killions} \}$



$L: \partial$
 $\xi \in \mathcal{U}_m$

$$\int_{\xi} g = 0$$

ii) ξ periodic, killings

$$\mathcal{Y} = \mathcal{A}Q + E; \quad \mathcal{Y}$$

$\int_{\xi} \cdot L$

$L: \partial$
 $\{A: U_{\text{max}}$

$\int_{\xi} \eta = 0$

ii) $\{ \text{periodic, killions} \}$

$\mathcal{M} \quad Q + E: \mathcal{Y}^i$



$L: \partial$
 $\{A: U_{\text{top}}$

$$\mathcal{L}_\xi \mathcal{L}_\eta = 0$$

ii) $\{$ periodic, killings

$$\mathcal{L}_\xi = \mathcal{L}_Q + E; \quad \mathcal{L}_\eta$$



$$Y = \alpha Q + \epsilon; \quad \begin{matrix} \downarrow \\ \epsilon \end{matrix} \quad \begin{matrix} \downarrow \\ \epsilon \end{matrix}$$

$$R \rightarrow - \alpha d \xi$$

gause

$$Y = \alpha Q + E; \quad Y_i$$

$\frac{1}{2}$ } $\cdot L$

[Faded chalkboard text, possibly "MILK PRODUCTION"]

$$R \rightarrow - \alpha d \xi$$

gause

$$\begin{matrix} F \wedge R F \\ A \wedge E \wedge F \end{matrix}$$

\rightarrow

$$R \rightarrow - \frac{d\Phi}{dt}$$

gause $\begin{matrix} \mathbf{F} \wedge \mathbf{r} \\ A \wedge \mathbf{F} \end{matrix} \rightarrow i \int A \frac{\delta L}{\delta \mathbf{A}}$

$$R \rightarrow - \frac{d\Phi}{dt}$$

gause

$$\begin{matrix} \mathbf{F} \wedge \mathbf{r} \\ A \wedge \mathbf{F} \end{matrix}$$

\rightarrow

$$i \int A \frac{\delta L}{\delta \dot{A}}$$

$$R \rightarrow -x d \vec{e}_z$$

gause

$$\begin{matrix} \vec{r} \wedge \vec{r} F \\ A \wedge F \wedge F \end{matrix}$$

\rightarrow

$$i_0 A \frac{\delta L}{\delta d A}$$

$$i) \quad \int = 0$$

$$L = 0$$

$$\int A \cdot U \cdot \mu$$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\int_{\Sigma} q = 0$$

ii) \int periodic, billions

$$\int = dQ + E; \quad \int$$



$$i) \quad \mathcal{J} = 0$$

$$L = 0$$

$$\{ \text{A. U. m.} \}$$

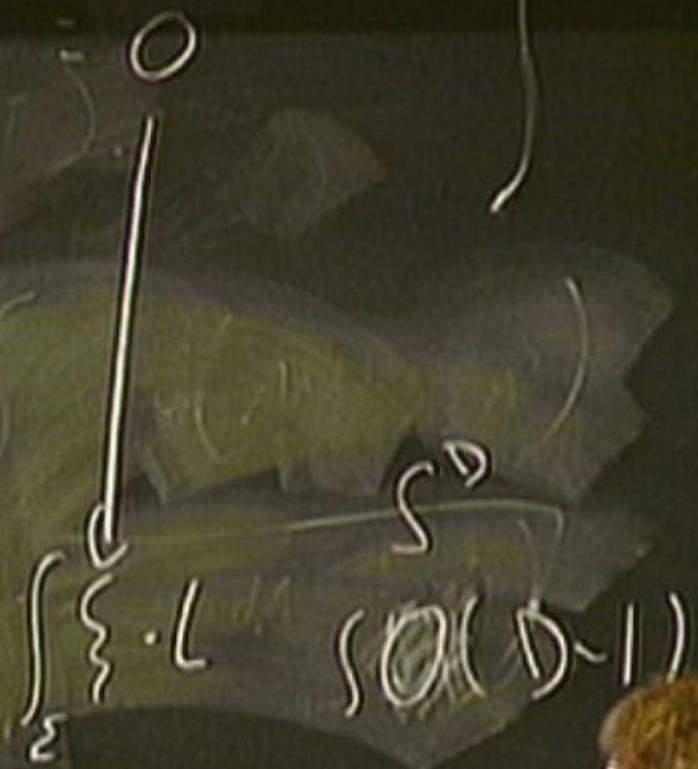
$$\int_{\Sigma_1} Q$$

$$\int_{\Sigma_2} Q$$

$$\mathcal{J}, \mathcal{J} = 0$$

ii) $\{ \text{periodic, killings} \}$

$$\mathcal{M} = dQ + E; \quad \mathcal{F}^i$$



$$i) \quad \int = 0$$

$$L = 0$$

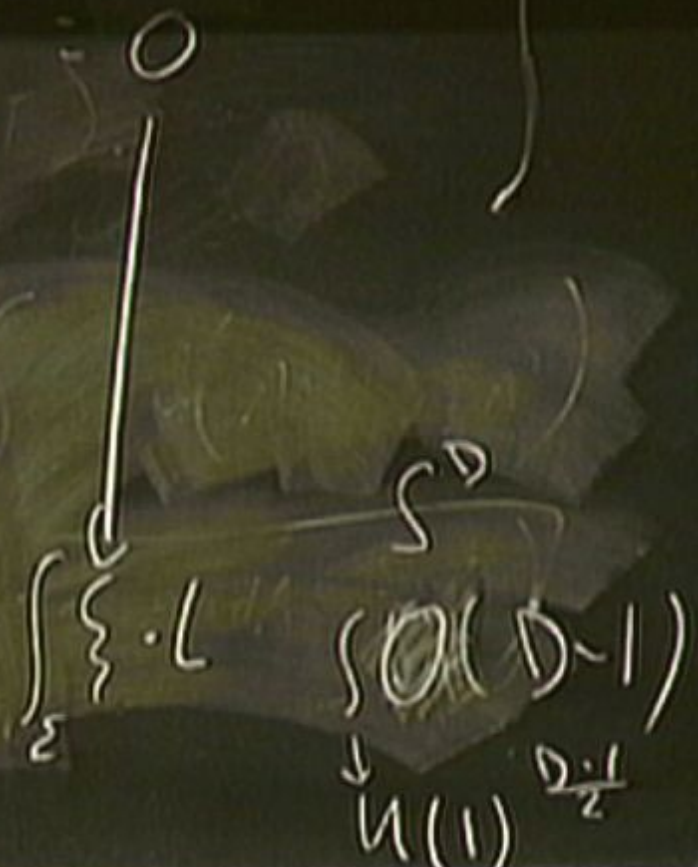
$$\{ A: U_{\text{max}}$$

$$\int_{\Sigma_1} Q - \int_{\Sigma_2} Q = 0$$

$$\int_{\Sigma} q = 0$$

ii) $\{$ periodic, killings

$$M = Q + E; \quad \mathbb{Z}^i$$



$Q_{max} = (q_{max} + B.L.B \text{ Bahan})$
 Q_{max}

$$G_{m,n} = (\gamma_{m,n} + B L \cdot B \quad B^a \text{ h a n })$$

$$A_m^{(5)} = \phi_m \cdot \text{h a n}$$

$$G_{mn} = (g_{mn} + B_L \cdot B \quad B^a \text{ h an})$$

$$A_m^{(5)} = \phi_m \quad A_M^a = A_M^3 \quad \phi \text{ h an}$$

$$A_M^a = A_M^3 + \phi_m B_M^m$$

$$A_m^{(5)} = \phi_m$$

$$A_M^n = A_M^B + \phi_m B_M^m$$

$$\left[\frac{D-2}{2} \right]$$

$$A_m^{(5)} = \phi_m$$

$$A_M^n = A_M^3 + \phi_m B_M^m$$

$$Q_{Si} = y_i = \int_{\epsilon} Q_{\epsilon i}$$

$$\left[\frac{D-2}{2} \right]$$

no A



no A

$$Q \sim \delta \bar{A}$$



NO

A

$Q \sim$

δL

$\delta \int A$

$\int A \wedge F \wedge F$



no

A

$Q \sim$

SL

$\delta \bar{A}$

$\neg F$

$\delta A \wedge \neg A$

$\delta A \wedge ()$

no

A

$Q \sim$

SL

$\delta \bar{A}$

$A \wedge F$

$\delta A \wedge A$

$\delta A ())$



no

A

$Q \sim$

SL

$\overline{\delta} \delta A$

$A \wedge F \wedge F$

$\delta A \wedge \delta A$

$d(\text{tr } \dots)$

$$g_{mn} = (\delta_{mn} + B_L \cdot B \quad B_m^a \quad h_{mn})$$

$$A_m^{(5)} = \phi_m \cdot A_m^a = A_m^b + \phi_m B_m^m$$

$$\psi_i = \gamma_i = \int \frac{Q_i}{r_i}$$

$$\left[\frac{D-2}{2} \right]$$



$$A \wedge F \wedge F$$

$$\overline{\delta \vee A} \quad \delta \vee A$$
$$\delta \vee A \wedge \delta \vee A$$

$$d(A \wedge (F))$$



$R - r_{f,t} + \frac{1}{n} A$ $\delta \Delta A$
 $\delta A A \Delta 1$
 δL $d(A, \Phi)$





$$\mathbb{F} + \frac{1}{2} A \wedge \mathbb{F} \wedge \mathbb{F}$$

↳ Anderson

$$\delta \bar{A} \quad \delta A \wedge \mathbb{F}$$

$$d(\wedge(\Phi))$$

$$\delta L \sim \Phi$$

$$\begin{aligned}
 R - \frac{1}{2} \eta_{\mu\nu} F^{\mu\nu} + \frac{1}{4} A_{\mu\nu} \wedge F^{\mu\nu} & \quad \delta A \\
 \downarrow \text{And } \delta \omega & \quad \delta A \wedge \omega \\
 \downarrow \text{And } \delta \omega & \quad \delta A \wedge \omega \\
 \delta L \sim \int \mathbb{R}^4 & \quad \delta A \wedge \omega
 \end{aligned}$$

o $S_{\mu\nu}$
→ on these commut.

$$Q_{\xi} \sim \alpha d\xi + Q \xi \cdot A - \int \xi \cdot B$$

\circ S_{inst}
 \rightarrow on legs combi.

$$Q_{\text{inst}} \sim \alpha d\xi + Q\xi \cdot A - g\xi \cdot B$$

$$\alpha S = \int$$

• S_{EH}
 \rightarrow on these counts.

$$Q_{\xi} \sim \int_{\Sigma} d^3x \left(\xi^i \pi_i + Q \xi^i A_i - g \xi^i B_i \right)$$

$$\delta S = \int_{\Sigma_H} Q_{\xi}$$

• S_{EH}
 \rightarrow on these counts

$$Q_{\text{EH}} \sim \oint_{\Sigma} \vec{\xi} \cdot \vec{D} + Q \int_{\Sigma} \vec{A} \cdot \vec{D} - \int_{\Sigma} \vec{\xi} \cdot \vec{D}$$

$\vec{A} = 0$

$$\mathcal{L} S = \int_{\Sigma_H} Q_{\text{EH}}$$

\circ S_{EH}
 \rightarrow on large number

$$Q_{\text{EH}} \sim \int_{\Sigma} d^3\xi \left(\vec{\xi} \cdot \vec{A} - \gamma \vec{\xi} \cdot \vec{B} \right)$$

$\vec{A} = 0$ $\vec{B} = 0$

$$\mathcal{L} S = \int_{\Sigma_H} Q_{\text{EH}}$$

\circ S_{stat}
 \rightarrow on loop comb.

$$Q_{\text{stat}} \sim \int d\vec{\xi} + Q \int_{\vec{A}=0}^{\vec{B}=0} \xi \cdot \vec{A} - \int \xi \cdot \vec{B}$$

$$\mathcal{Z}(S) = \int_{\mathcal{E}_M} Q_{\text{stat}}^{e_i(\cdot)} \quad S = \frac{\int Q_{\text{stat}}}{x} \Big|_{x=0}$$

o S_{ext}
 \rightarrow on legs comb.

$$Q_{\text{ext}} \sim \int_{\Sigma} d^3\xi \cdot \vec{Q} + Q \int_{\Sigma} \vec{A} - \int_{\Sigma} \vec{B}$$

$\downarrow \vec{A} = 0$
 $\downarrow \vec{B} = 0$

$$\chi(S) = \int_{\Sigma} Q_{\text{ext}}(\xi)$$

$$S = \int_{\Sigma} \frac{1}{\sqrt{h}} \sqrt{-\det g} \mathcal{L} \Big|_{T=0}$$

- S_{ext}
 \rightarrow on legs combi.

$$Q_{\text{ext}} \sim \int_{\partial V} \vec{A} \cdot d\vec{S} + Q \int_V \vec{A} \cdot \vec{\omega} - \int_V \rho$$

$$\mathcal{L}(S) = \int_{\Sigma} Q_{\text{ext}}(\cdot)$$

$$S \frac{\delta Q_{\text{ext}}}{\delta \rho}$$

\circ S_{in}
 \rightarrow on legs count.

$$Q_{in} \sim \underbrace{\int_{S_{in}} \vec{A} \cdot d\vec{S}} + Q \underbrace{\int_{S_{out}} \vec{A} \cdot d\vec{S}} - \underbrace{\int_{S_{out}} \vec{B} \cdot d\vec{S}}$$

$$\oint_{\partial V} \vec{A} \cdot d\vec{S} = \int_V \nabla \cdot \vec{A} \, dV$$

\circ S_{EH}
 \rightarrow on legs combi.

$$Q_{\text{EH}} \sim \int_{\Sigma_{\text{EH}}} \dots$$

$$Q_{\text{EH}} \sim \int_{\Sigma_{\text{EH}}} \dots$$

$$\Phi_H = 0$$

$$\Omega_H$$

$$S_{\text{EH}} = \int_{\Sigma_{\text{EH}}} Q_{\text{EH}}(\dots)$$

$$S = 0$$

$$0 \neq 0$$

δQ_{ext}
 \rightarrow on these counts.

$$\delta Q_{\text{ext}} \sim \int_{\Sigma_{\text{ext}}} \vec{E} \cdot d\vec{A} + Q \left(\int_{\Sigma_{\text{ext}}} \vec{A} - \int_{\Sigma_{\text{ext}}} \vec{B} \right)$$

$$\delta S = \int_{\Sigma_{\text{ext}}} Q_{\text{ext}}(\cdot) \quad S = \int_{\Sigma_{\text{ext}}} \frac{\delta Q_{\text{ext}}}{T} \Big|_{T=0}$$

$$\left(\frac{d}{dt} \int_{\mathcal{V}} \rho \, d\tau \right) + \int_{\mathcal{V}} \rho \, \nabla \cdot \mathbf{v} \, d\tau = 0$$

$(M), (Q), (M), (S)$
 $\int_{\mathcal{V}} \rho \, \nabla \cdot \mathbf{v} \, d\tau$

$$\int_H \delta Q_3 - \int_{\infty} \delta Q_3 = \neq 1$$

$\frac{d}{dt} \int_{\mathcal{V}} \rho \, d\tau$
 $(M), (Q), (M), (S)$
 $\int_{\mathcal{V}} \rho \, d\tau$

$$\int_{\mathcal{V}} \delta Q_+ - \int_{\mathcal{V}} \delta Q_- \neq 1$$

$$\delta M(t) = \rho(t) \delta S + \phi(t) \delta Q + \psi(t) \delta Z$$

COMPARING MOVE D

$$\int_{\Sigma} Q_{\text{ext}} = \int_{\Sigma} Q + \#$$



LINEAR ALGEBRA MOVE D

$$\int_{\mathbb{R}^n} Q_{\text{new}} = \int_{\mathbb{R}^n} Q + \# \#$$

M - Move



COMPARING MOVED

$$\int_{\Sigma} Q_{\text{new}} = \int_{\Sigma} Q + \#$$

M - Index



SIMILARITY MOVED

$$\int_{\mathbb{R}^n} Q_{\text{new}} = \int_{\mathbb{R}^n} Q + \# + \#$$

M - \rightarrow MCQ



STARK'S MOVE

$$\int_{\mathbb{S}^1} Q_{2n} = \int_{\mathbb{R}^2} Q + \mathbb{H}$$

$$\mathcal{M} \rightarrow \mathcal{M}(Q, \gamma)$$

$$S = -2\pi(E)$$



SEMI-MARKOV MOVED

$$\int_{\mathcal{S}_n} Q_{n+1} = \int_{\mathcal{P}} Q + \mathbb{H}$$

$$E \sim \frac{\phi(x)}{\mathcal{Q}(x)}$$

$$M \rightarrow M(Q, \gamma)$$

$$S \sim 2\pi(E)$$

COMPARING HAS MOVED

$$\int_{S_+} Q_{\text{ext}} = \int_{\mathcal{P}} Q + \mathbb{H}$$

$$E \sim \frac{\phi(\epsilon)}{2\epsilon(\epsilon)}$$

$$\mathbb{H} = M$$

$$| - | = d B$$

$$S = -2\pi (E_{\text{ext}} Q + \dots)$$



STARKER MOVE P

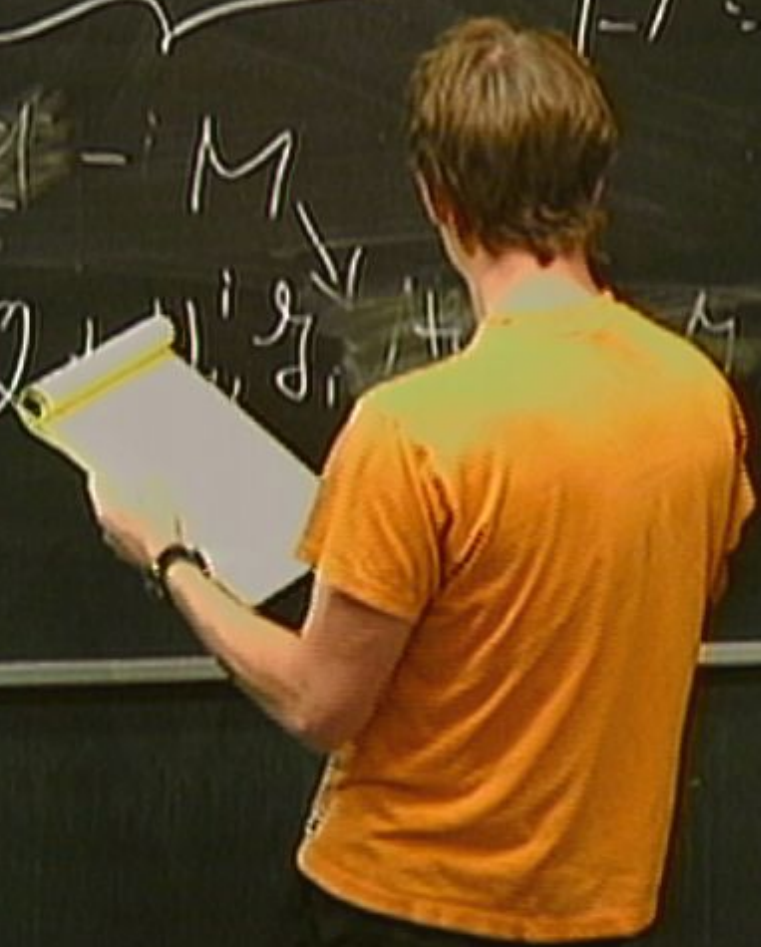
$$\int_{\Sigma} Q_{\text{new}} = \int_{\Sigma} Q + \mathbb{H}$$

$$E \sim \frac{\phi(x)}{2(x)}$$

$$2\pi |M| - M$$

$$|M| = d\mathcal{B}$$

$$S = -2\pi (E_{\text{new}} Q + \dots + \mathbb{H} + M)$$



STARK IN MOVE P

$$\int_{\Sigma} Q_{\mu\nu} = \int_{\mathcal{P}} Q + \mathbb{H}$$

$$E \sim \frac{\Phi(\cdot)}{2Q(\cdot)}$$

$$2\mathbb{H} - M$$

$$| \cdot | = \alpha \beta$$

$$S = -2\pi (E_{\mu\nu} Q + H_{\mu\nu}^i g_i + H_{\mu\nu}^* \int_{\Sigma} M)$$



SMARIA MOVED

$$\int_{\Sigma} Q_{\Sigma} = \int_{\mathbb{R}^3} Q + H$$

$$H = d\mathcal{B}$$

$$E \sim \frac{\phi(\cdot)}{r(\cdot)} \quad \mathcal{H}^2 - M$$

$$S = -2\pi (E_{\Sigma} Q + H_{\Sigma} \int_{\Sigma} H^* \mathcal{L}(\gamma))$$

MARKING MOVED

$$\int_{\Sigma} Q_{\text{ext}} = \int_{\mathbb{R}^3} Q + H$$

$$H = d\mathcal{B}$$

$$E \sim \frac{\phi(x)}{r(x)} \quad \text{where } M$$

$$S = -2\pi (E_{\text{ext}} Q + H_{\text{ext}}^i \delta_i^j H_{\text{ext}}^* \int_{\Sigma_H} \mathcal{L})$$