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Introduction to

# Higher Gauge Theory

via Differential Nonabelian Cohomology  
in Cohesive Homotopy Theory

based in parts on joint work with:

P. Banerjee, D. Fiorenza, G. Giotopoulos, H. Sati, S. Voronov  
(later this week) (later this week)

## Monographs:

*The Character Map in Nonabelian Cohomology*, World Scientific (2023)

*Equivariant Principal  $\infty$ -Bundles*, Cambridge Univ. Press (2026)

*Geometric Orbifold Cohomology*, CRC Press (2026)

## Expositions:

*Higher Topos Theory in Physics*, Encyclopedia Math. Phys. (2025)

*Flux Quantization*, Encyclopedia Math. Phys. (2025)

*Complete Top. Quantization  
of Higher Gauge Fields*, SciPost Phys. Lect. Notes (2026)

## Manuscript:

[ncatlab.org/schreiber/show/Zagreb+2026](https://ncatlab.org/schreiber/show/Zagreb+2026)

NB:

There are *two different* approaches to higher gauge theory:

	<b>principal</b>	<b>cohomological</b>
specified $L_\infty$ -algebra	coefficient of gauge potentials (connections)	coefficient of flux densities (curvatures)
flatness / closure	non-generic	Gauß law / Bianchi identity
examples	heterotic SuGra / B-field on T-folds	type I/II SuGra / 11D SuGra

I started out principal, 20 years ago.  
But I think we need cohomological.

## Higher Maxwell-type Equations of Motion:

higher fluxes:  $\vec{F} := \{F^{(i)} \in \Omega_{\text{dR}}^{\text{deg } i}(X^{1,d})\}_{i \in I}$

higher Bianchis:  $d F^{(i)} = P^{(i)}(\vec{F})$  (polynomials, integrable)

higher duality:  $\star F^{(i)} = \mu^{(i)}(\vec{F})$  (linear iso)

## Examples:

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vacuum Maxwell:	$dF_2 = 0$ $dG_2 = 0$	$\star F_2 = G_2$
5D MCS/SuGra	$dH_3 = \frac{1}{2}F_2 \wedge F_2$ $dF_2 = 0$	$\star F_2 = F_3$
massive type IIA NS/RR-flux ignoring $H_7$ Bianchi	$dF_{2\bullet} = H_3 \wedge F_{2\bullet-2}$ $dH_7 = 0$ $dH_3 = 0$	$\star F_{2\bullet} = F_{10-2\bullet}$ $\star H_3 = H_7$
11D MCS/SuGra	$dG_7 = \frac{1}{2}G_4 \wedge G_4$ $dG_4 = 0$	$\star G_4 = G_7$

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**Prop.** The set of germs of solutions on globally hyperbolic spacetime  $X^{1,d} \simeq \mathbb{R}^{1,0} \times X^d$  around a Cauchy surface  $\{0\} \times X^d$  is

$$\begin{aligned} \text{Sol} &\simeq \left\{ B^{(i)} \in \Omega_{\text{dR}}^{\text{deg } i}(X^d) \mid \underset{\text{Gauß law}}{\text{d}} B^{(i)} = P^{(i)}(\vec{B}) \right\} \\ &\simeq \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) \end{aligned}$$

where  $\mathfrak{b} \in L_\infty \text{Alg}_{\mathbb{R}}$  with

$$\text{CE}(\mathfrak{b}) \simeq \mathbb{R}_{\text{d}}[\vec{b}] / (\text{d} b^{(i)} = P^{(i)}(\vec{b}))_{i \in I}$$

Hence the *smooth moduli set* of germs of solutions is (boldface for smooth/stacky refinement):

$$\begin{aligned} \mathbf{Sol} &\simeq \mathbf{\Omega}_{\text{cl}}^1(X^d; \mathfrak{b}) \in \text{SmthSet} \hookrightarrow \text{SmthGrpd}_\infty \\ &\quad \mathbf{\Omega}_{\text{cl}}^1(X^d; \mathfrak{b}) : U \mapsto \Omega_{\text{cl}}^1(U \times X^d; \mathfrak{b}) \end{aligned}$$

$$\text{so: } \mathbf{\Omega}_{\text{cl}}^1(X^d; \mathfrak{b}) \simeq \mathbf{Map}(X^d, \mathbf{\Omega}_{\text{cl}}^1(*; \mathfrak{b}))$$

## Smooth sets.

A kind of space  $\mathbf{X}$  which may be

*probed* by *plotting* out smooth manifolds  $U$ :

$$U \longmapsto \text{Plt}(U, \mathbf{X}) \in \text{Set}$$

where only the germs of plots matter.

$$\begin{aligned} \Rightarrow \text{SmthSet} &:= \text{Func}(\text{SmthMfd}^{\text{op}}, \text{Set})^{\text{localized at}}_{\text{local isos}} \\ &\simeq \text{Sh}(\text{SmthMfd}) \end{aligned}$$

## Gauged Smooth Sets = Smooth $\infty$ -Groupoids.

$\mathbf{X}$  with higher gauge transformations between plots

probed by abstract  $k$ -transformations  $\Delta[k]$ :

$$(U, \Delta[k]) \longmapsto \text{Plt}(U \times \Delta^k, \mathbf{X}) \in \text{Set}$$

where only germs of plots up to w homotopy equivalence matter:

$$\begin{aligned} \text{SmthGrpd}_{\infty} &:= \text{Func}((\text{SmthMfd} \times \Delta)^{\text{op}}, \text{Set})^{\text{localized at}}_{\text{local weak hom. equiv.}} \\ &\simeq \text{Sh}_{\infty}(\text{SmthMfd}) \end{aligned}$$

## The shape modality

$$\int : \text{SmthGrpd}_\infty \xrightarrow{\text{Shp}} \text{Grpd}_\infty \xleftarrow{\text{Dsc}} \text{SmthGrpd}_\infty$$

where  $\text{Shp} \dashv \text{Dsc}$

*Differential cohomology in a cohesvive  $\infty$ -topos (2013)*

**Prop. Shape as smooth path  $\infty$ -groupoid:**

$$\int \mathbf{X} \simeq \varinjlim_n \mathbf{Map}(\Delta^n, \mathbf{X}) \simeq \varinjlim_n \mathbf{X}(\Delta^n)$$

**Prop. Smooth Oka principle:**

$$X \in \text{SmthMfd} \hookrightarrow \text{SmthGrpd}_\infty \quad \Rightarrow$$

$$\begin{aligned} \int \mathbf{Map}(X, \mathbf{Y}) &\simeq \mathbf{Map}(X, \int \mathbf{Y}) \\ &\simeq \mathbf{Map}(\int X, \int \mathbf{Y}) \end{aligned}$$

(Pavlov et al. 2014-2024, cf. *Equivariant Principal  $\infty$ -Bundles* §4.3.2 )

## Shape of higher flux solutions and Rational homotopy

$$\int \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) \simeq \mathbf{Map}(X^d, \int \Omega_{\text{cl}}^1(*, \mathfrak{b})) \quad (\text{by smooth Oka})$$

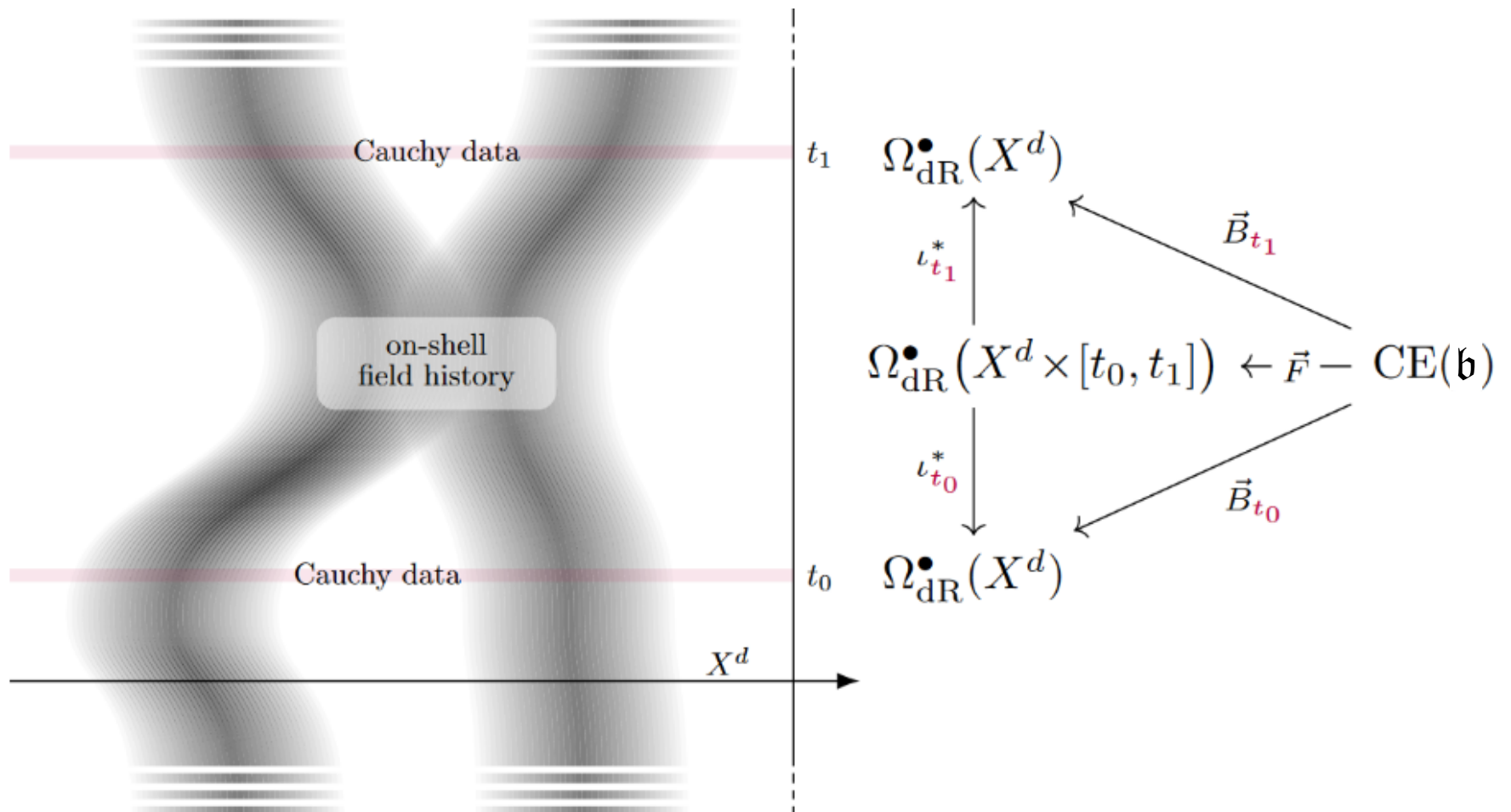
$$\int \Omega_{\text{cl}}^1(*; \mathfrak{b}) \simeq \mathbb{R}\text{-rational space with Whitehead } L_\infty\text{-algebra } \mathfrak{b}$$

For  $\mathcal{B} \in \text{Grpd}_\infty$  (simply connected with fin-dim rational cohomology),  
write  $\mathfrak{B} \in L_\infty\text{Alg}_\mathbb{R}$  for the real Whitehead brackets  
hence with  $\text{CE}(\mathfrak{B})$  the minimal Sullivan model of  $\mathcal{B}$

then:  $\boxed{\int \Omega_{\text{cl}}^1(*; \mathfrak{B}) \simeq L^\mathbb{R}\mathcal{B}}$  is the  $\mathbb{R}$ -rationalization of  $\mathcal{B}$

**Total flux** on  $X^d$  is in **nonabelian de Rham cohomology**:

$$[\vec{F}] \in H_{\text{dR}}^1(X^d; \mathfrak{b}) := \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) / \text{concordance} \\ \simeq \pi_0(\int \Omega_{\text{cl}}^1(X^d; \mathfrak{b}))$$



# The nonabelian character map.

$$\begin{array}{ccc}
 & \text{ch} & \\
 & \longmapsto & \\
 \mathcal{B} & \xrightarrow{\eta^{\mathbb{R}}} & L^{\mathbb{R}}\mathcal{B} \xrightarrow{\sim} \int \Omega_{\text{cl}}^1(*, \mathcal{B}) \\
 \\
 \pi_0 \text{Map}(\int X, \mathcal{B}) & \xrightarrow{\text{ch}_*} & \pi_0 \text{Map}(\int X, \int \Omega_{\text{cl}}^1(*, \mathcal{B})) \\
 \Downarrow & & \Downarrow \\
 H^1(X; \Omega\mathcal{B}) & \xrightarrow{\text{ch}} & H_{\text{dR}}^1(X; \mathcal{B}) \\
 \text{nonabelian} & \text{character map} & \text{nonabelian} \\
 \text{cohomology} & & \text{de Rham} \\
 & & \text{cohomology}
 \end{array}$$

## Examples:

de Rham map  $\simeq$   $\text{ch}^{B^n\mathbb{Z}}$

Chern-Dold character  $\simeq$   $\text{ch}^{E_n}$  (stage in a spectrum)

Chern-character  $\simeq$   $\text{ch}^{\text{KU}}$

cohomotopy character  $\simeq$   $\text{ch}^{S^n}$

## Admissible classifying spaces $\mathcal{B}$ for given Gauß law $\mathfrak{b}$

satisfy:  $\boxed{\mathcal{B} \simeq \mathfrak{b}}$

### Examples:

For Maxwell,                      admissible is  $\mathcal{B} \equiv B^2\mathbb{Z}^2$

for 5D MCS/SuGra,              admissible is  $\mathcal{B} \equiv \int S^2$

for NS/RR-flux,                  admissible is  $\mathcal{B} \equiv (KU_0 // BU(1))$

for 11D MCS/SuGra,              admissible is  $\mathcal{B} \equiv \int S^4$

But there is in each case an infinity of admissible choices.

This choice of  $\mathcal{B}$  is a *global completion* of higher flux theory  $\mathfrak{b}$ .

## Coarse flux quantization:

total flux must be in the image of the character map,

for  $\mathcal{B}$  admissible,  $\mathfrak{l}\mathcal{B} \simeq \mathfrak{b}$ :

$$\begin{array}{ccc}
 * & \xrightarrow[\text{charge}]{[\chi]} & H^1(X^d; \Omega\mathcal{B}) \\
 & \searrow[\vec{B}] & \downarrow \text{ch} \\
 & \xrightarrow[\text{flux}]{} & \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) \xrightarrow{[-]} H_{\text{dR}}^1(X^d; \mathfrak{b})
 \end{array}$$

**Example:**  $\mathcal{B} \equiv B^n\mathbb{Z}$ : forces  $n$ -forms to be integral

**NB:** Quantizing not just magnetic but also electric fluxes.

**Proper flux quantization** is local  $\Rightarrow$  gauge potentials!

$$\begin{array}{ccc}
 * & \xrightarrow{\text{charge}} & \mathbf{Map}(X^d; \mathcal{B}) \\
 & \searrow \vec{B} & \downarrow \mathbf{ch}_* \\
 & \xrightarrow{\text{flux}} & \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) \xrightarrow{\eta^f} \int \Omega_{\text{cl}}^1(X^d; \mathfrak{b})
 \end{array}$$

$\chi$   
 $\hat{A}$  gauge potential

in nonabelian differential cohomology:

$$\begin{array}{ccc}
 * & \xrightarrow{(\chi, \hat{A})} & \mathbf{Map}(X^d, \mathcal{B}_{\text{dff}}) \xrightarrow{\eta^f} \mathbf{Map}(X^d; \mathcal{B}) \\
 & \searrow \vec{B} & \downarrow \lrcorner \\
 & \xrightarrow{\text{flux}} & \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) \xrightarrow{\eta^f} \int \Omega_{\text{cl}}^1(X^d; \mathfrak{b})
 \end{array}$$

$\downarrow \mathbf{ch}_*$

$$H_{\text{dff}}^1(X^d, \Omega\mathcal{B}) := \pi_0(\mathfrak{b}\mathbf{Map}(X^d, \mathcal{B}_{\text{dff}}))$$

## Example: Recovering abelian generalized diff. cohomology.

For  $\mathcal{B} \equiv E_n$  a stage in a spectrum, this reproduces canonical Hopkins-Singer type differential cohomology, e.g., differential K-theory for  $\mathcal{B} \equiv \text{KU}_n$ .

## Example: Induced gauge potentials in nonabelian case

	on chart	on double-intersections
for $\mathfrak{a} = \mathfrak{so}(4)$	$d C_3 = G_4$	$d \gamma_2 = C'_3 - C_3$
	$d C_6 = G_7 - \frac{1}{2} C_3 \wedge G_4$	$d \gamma_5 = C'_6 - C_6 - \frac{1}{2} C'_3 \wedge C_3$
	as expected in 11D SuGra literature	
for $\mathfrak{a} = \mathfrak{so}(3)$	$d A_1 = F_2$	$d \alpha_0 = A'_1 - A_1$
	$d B_2 = H_3 - \frac{1}{2} A_1 \wedge F_2$	$d \beta_1 = B'_2 - B_2 - \frac{1}{2} A'_1 \wedge A_1$

Abelian Chern-Simons term! More in a moment.

**Phase space stack of flux-quantized higher gauge fields:**

$$\mathbf{PhsSpc} \equiv \mathbf{Map}(X^d; \mathcal{B}_{\text{dff}})$$

**Observables:**  $\mathbf{PhsSpc} \xrightarrow{\mathcal{O}} \mathbb{C}$

**Topological observables:**  $\mathbf{PhsSpc} \xrightarrow{\eta^{\int}} \int \mathbf{PhsSpc} \dashrightarrow \mathbb{C}$

**Prop:**  $\int \mathbf{Map}(X^d; \mathcal{B}_{\text{dff}}) \simeq \mathbf{Map}(X^d, \mathcal{B})$

$\Leftrightarrow$  “Topological observables are entirely determined by choice of flux quantization  $\mathcal{B}$ ”.

*Flux Quantization on Phase Space, AHP 26 (2025)*

*Quantum Observables of Quantized Fluxes, AHP 26 (2025)*

# Higher Maxwell-*Chern-Simons* EoMs

More generally, we may pick a morphism  $\mathfrak{b}' \xrightarrow{\iota} \mathfrak{b}$  and consider the further pullback:

$$\begin{array}{ccccc}
 \text{CS constrained} & & \text{phase space} & & \\
 \mathbf{Map}(X^d, \mathcal{B}_{\text{dff}'}) & \rightarrow & \mathbf{Map}(X^d, \mathcal{B}_{\text{dff}}) & \xrightarrow{\eta^f} & \mathbf{Map}(X^d; \mathcal{B}) \\
 \downarrow & \lrcorner & \downarrow & \lrcorner & \downarrow \mathbf{ch}_* \\
 \Omega_{\text{cl}}^1(X^d; \mathfrak{b}') & \xrightarrow{\iota_*} & \Omega_{\text{cl}}^1(X^d; \mathfrak{b}) & \xrightarrow{\eta^f} & \int \Omega_{\text{cl}}^1(X^d; \mathfrak{b})
 \end{array}$$

This corresponds to imposing CS-like EoMs,  $F^{(i)} = 0$  on those fluxes  $F^{(i)}$  not in the image of  $\iota_*$ .

**Example:** The Hopf fibration  $\iota \equiv \mathfrak{h}_{\mathbb{C}} : \mathfrak{S}^3 \longrightarrow \mathfrak{S}^2$   
implies ordinary abelian CS EoM:  $F_2 = 0$

## Higher Maxwell EoMs with background fields.

Consider now an inclusion of domains  $\begin{array}{c} \Sigma^p \\ \downarrow \phi \\ X^d \end{array}$

with “background” flux densities  $\vec{B} \in \Omega_{\text{cl}}^1(X^d, \mathfrak{b})$  as before,

then higher Maxwell-type theory *relative* to  $\phi$  is

$$\left\{ \vec{B}'^{(j)} \in \Omega_{\text{dR}}^{\text{deg } j}(\Sigma^p) \mid dB'^{(j)} = P^{(j)}(\vec{B}', \phi^* \vec{B}) \right\}$$

$$\simeq \left\{ \begin{array}{ccc} \Sigma^p & \xrightarrow{\vec{B}'} & \Omega_{\text{cl}}^1(*; \mathfrak{a}) \\ \downarrow \phi & & \downarrow \\ X^d & \xrightarrow{\vec{B}} & \Omega_{\text{cl}}^1(*; \mathfrak{b}) \end{array} \right\}$$

## Relative Whitehead $L_\infty$ -algebras

fibration  
of spaces

fibration  
of  $L_\infty$ -algs

relative minimal  
Sullivan model

$$\begin{array}{ccccc}
 \mathcal{A} & & \mathfrak{l}_{\mathcal{B}}\mathcal{A} & & \mathrm{CE}(\mathfrak{l}_{\mathcal{B}}\mathcal{A}) \\
 \downarrow \wr_{\varphi} & \dashrightarrow & \downarrow \wr_{\varphi} & \dashleftarrow & \uparrow \mathrm{CE}(\wr_{\varphi}) \\
 \mathcal{B} & & \mathfrak{l}\mathcal{B} & & \mathrm{CE}(\mathfrak{l}\mathcal{B})
 \end{array}$$

## Examples:

Maxwell  
with source

$$\begin{array}{ccc}
 X^d & \xrightarrow{G_2} & \Omega_{\text{cl}}^1(*; \mathfrak{l}_{B^3\mathbb{Z}} EB^2\mathbb{Z}) \\
 \downarrow \iota & & \downarrow \\
 X_{\cup\{\infty\}}^d & \xrightarrow{J_3} & \Omega_{\text{cl}}^1(*; \mathfrak{l}B^3\mathbb{Z})
 \end{array}
 \quad \begin{array}{l}
 d G_2 = \iota^* J_3 \\
 d J_3 = 0
 \end{array}$$


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NS/RR-flux

$$\begin{array}{ccc}
 X^d & \xrightarrow{F_{2\bullet}} & \Omega_{\text{cl}}^1(*; \mathfrak{l}_{B^3\mathbb{Z}} \text{KU} // B^2\mathbb{Z}) \\
 \downarrow \iota & & \downarrow \\
 X_{\cup\{\infty\}}^d & \xrightarrow{H_3} & \Omega_{\text{cl}}^1(*; \mathfrak{l}B^3\mathbb{Z})
 \end{array}
 \quad \begin{array}{l}
 d F_{2\bullet} = F_{2\bullet-2} \wedge \iota^* H_3 \\
 d H_3 = 0
 \end{array}$$


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flux on  
M5-brane  
in 11D

$$\begin{array}{ccc}
 \Sigma^5 & \xrightarrow{H_3} & \Omega_{\text{cl}}^1(*; \mathfrak{l}_{S^4} S^7) \\
 \downarrow \phi & & \downarrow \mathfrak{l}(h_{\mathbb{H}})_* \\
 X^{10} & \xrightarrow{(G_4, G_7)} & \Omega_{\text{cl}}^1(*; \mathfrak{l}S^4)
 \end{array}
 \quad \begin{array}{l}
 d H_3 = \phi^* G_4 \\
 d G_7 = \frac{1}{2} G_4 \wedge G_4 \\
 d G_4 = 0
 \end{array}$$

## Twisted relative cohomology.

$$\mathbf{Map}(\phi, \wp) := \mathbf{Map}(\Sigma, \mathcal{A}) \times_{\mathbf{Map}(\Sigma, \mathcal{B})} \mathbf{Map}(X, \mathcal{B})$$

$$= \left\{ \begin{array}{ccc} \Sigma & \dashrightarrow & \mathcal{A} \\ \downarrow \phi & & \downarrow \wp \\ X & \dashrightarrow & \mathcal{B} \end{array} \right\}$$

etc.

Then the  $\wp$ -twisted  $\phi$ -relative differential cohomology is:

$$\begin{array}{ccccc} \mathbf{Map}(\phi, \wp_{\text{dff}}) & \longrightarrow & \mathbf{Map}(\phi, \wp_{\text{dff}'}) & \longrightarrow & \mathbf{Map}(\phi, \wp) \\ \downarrow & \lrcorner & \downarrow & \lrcorner & \downarrow \mathbf{ch} \\ \Omega_{\text{cl}}^1(\phi, \mathfrak{l}_{\wp'}) & \xrightarrow{!_*} & \Omega_{\text{cl}}^1(\phi, \mathfrak{l}_{\wp}) & \xrightarrow{\eta^f} & \int \Omega_{\text{cl}}^1(\phi, \mathfrak{l}_{\wp}) \end{array}$$

## Example.

$$\text{Consider } \left\{ \begin{array}{l} \wp \equiv h_{\mathbb{C}} : S^3 \rightarrow S^2 \\ \prime \equiv \mathfrak{l}(\text{id}, h) : \begin{array}{ccc} \mathfrak{l}S^3 & \rightarrow & \mathfrak{l}S^3 \\ \parallel & & \downarrow \mathfrak{l}h_{\mathbb{C}} \\ \mathfrak{l}S^3 & \rightarrow & \mathfrak{l}S^2 \end{array} \end{array} \right.$$

$$\begin{array}{ccc} & \text{EoMs} & \text{gauge} \\ & & \text{potentials} \\ \text{then:} & F_2 = 0 & d\lambda = \phi^* A_1 \\ & dH_3 = F_2 \wedge F_2 & dA_1 = 0 \end{array}$$

This is as in abelian CS with FJ/WZW boundary!

**Claim:** Topological observables on phase space stack reproduce in fine detail those of abelian CS with boundary:

- renormalized Wilson loop observables
- Heisenberg observables on torus
- modular functor
- bulk/edge correspondence

# Twisted relative cohomology forms bulk-boundary LESs:

$$\begin{array}{c}
 \text{near bndry} \\
 \text{unwindings} \\
 \tilde{H}^{-2}(\Sigma; \mathcal{A}) \\
 \left. \vphantom{\tilde{H}^{-2}(\Sigma; \mathcal{A})} \right\} \\
 \text{deep bulk orders unwinding near bndry} \\
 \partial_1^{\text{uw}} \\
 \begin{array}{ccc}
 \tilde{H}^{-1}(\bar{X}; \mathcal{B}) & \xrightarrow{i_{\text{blk}}} & \tilde{H}^{-1}(\phi; \wp) & \xrightarrow{r_{\text{bdr}}} & \tilde{H}^{-1}(\Sigma; \mathcal{A}) \\
 \text{deep bulk} & \text{among} & \text{total system} & \text{restrict to} & \text{near bndry} \\
 \text{top. orders} & & \text{top. orders} & & \text{top. orders}
 \end{array}
 \end{array}$$

**Claim:** For the above choice  $\wp \equiv h_{\mathbb{C}}$  and  $\iota \equiv \mathbb{1}(\text{id}, h_{\mathbb{C}})$  this reproduces physical expectations for FQH systems ...

# Engineering FQH anyons on M2/M5-branes:

$$\begin{array}{rcccl}
 \text{M2-brane} & \mathbb{R}^{1,1} \times \Sigma^1 & \dashrightarrow & S^7 & \curvearrowright G \\
 & \downarrow \phi & & \downarrow h_{\mathbb{C}} & \curvearrowright G \\
 \text{M5-brane} & \mathbb{R}^{1,1} \times X^2 \times \mathbb{C} & \dashrightarrow & \mathbb{C}P^3 & \curvearrowright G \\
 & \downarrow \Phi & & \downarrow t_{\mathbb{C}} & \curvearrowright G \\
 \text{11D bulk} & \mathbb{R}^{1,1} \times \mathbb{R}^5 \times \underbrace{\mathbb{C} \times \mathbb{C}}_{A_1\text{-orbifold}} & \dashrightarrow & S^4 & \curvearrowright G
 \end{array}$$

reduces to the orbi-singularity:

$$\begin{array}{rcccl}
 \text{M2-brane} & \mathbb{R}^{1,1} \times \Sigma^1 & \dashrightarrow & S^3 & \\
 & \downarrow \phi & & \downarrow h_{\mathbb{C}} & \\
 \text{M5-brane} & \mathbb{R}^{1,1} \times X^2 & \dashrightarrow & S^2 & \text{and hence to} \\
 \text{singularity} & & & & \text{CS/WZW} \\
 & \downarrow \Phi & & \downarrow & \\
 \text{7D } A_1\text{-} & \mathbb{R}^{1,1} \times \mathbb{R}^5 & \dashrightarrow & * & \\
 \text{singularity} & & & & 
 \end{array}$$

*Flux Quantization on M5-Branes*, JHEP 140 (2024)

*Anyons on M5-Probes of Seifert 3-Orbifolds*, LMP **115** (2025)

*Engineering of Anyons on M5-Probes*, SciPost Phys. Lec. Notes **107** (2025)

*Flux Quantization on M-Strings* (2026)

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