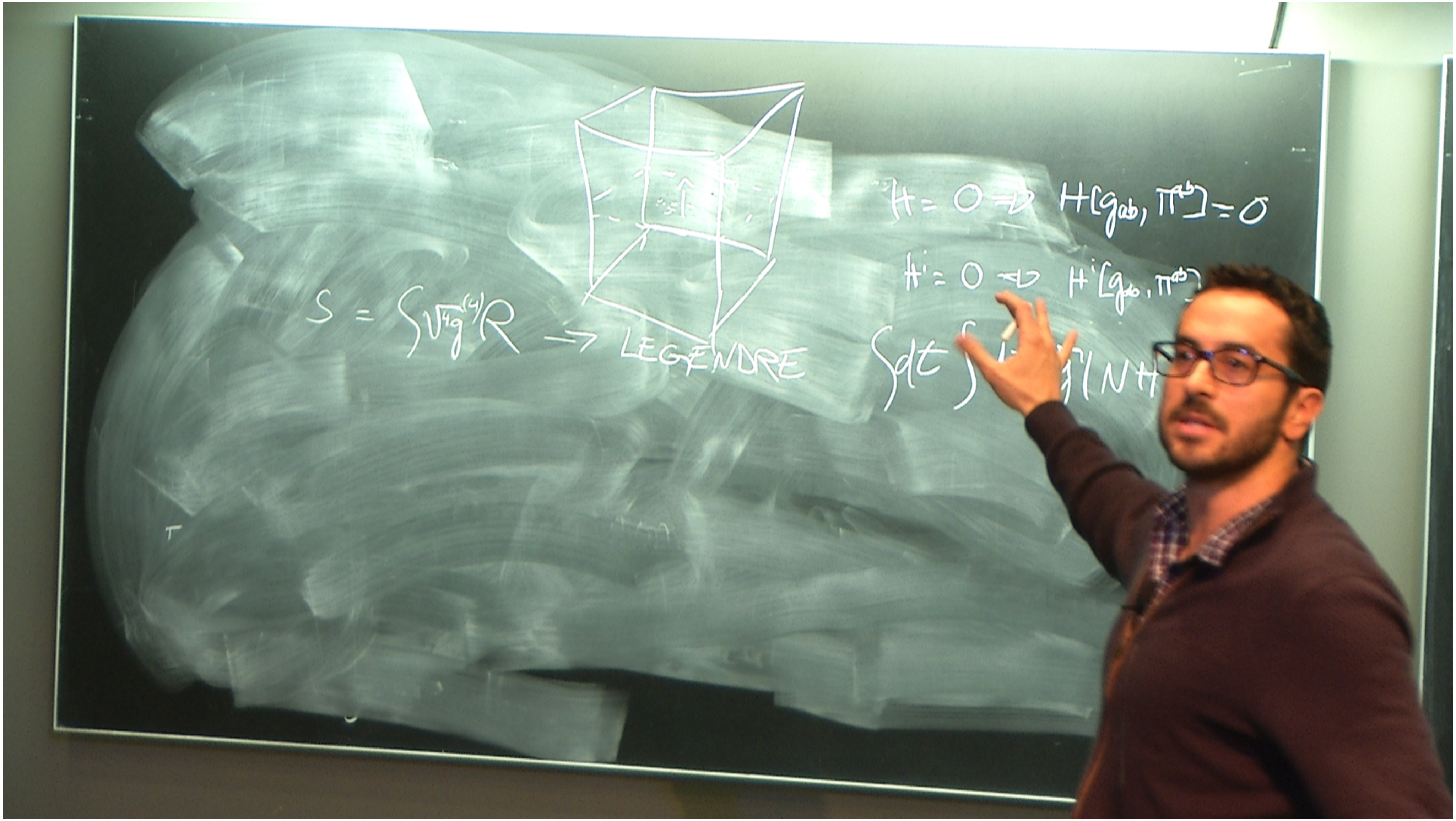
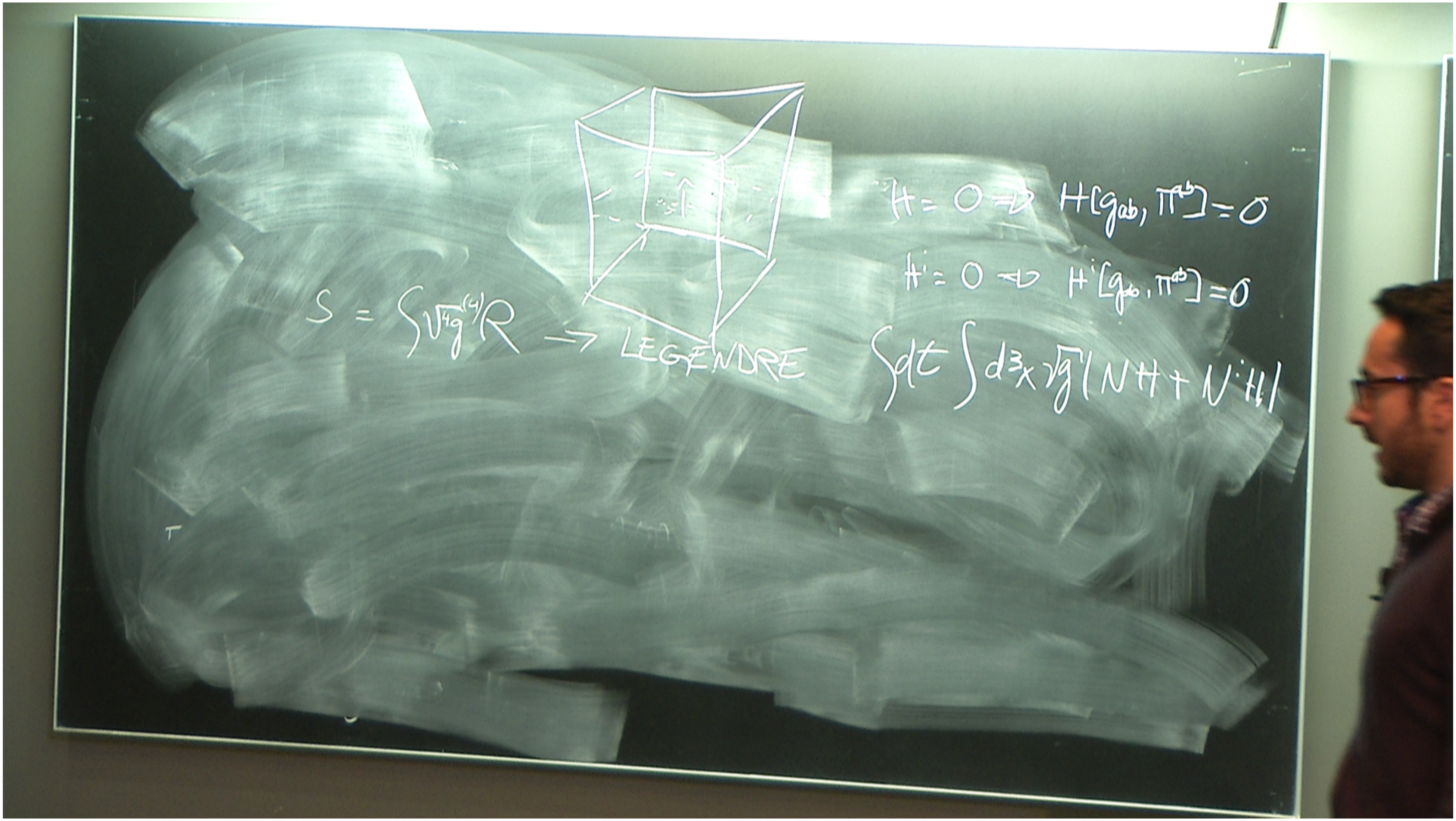
Title: Discussion

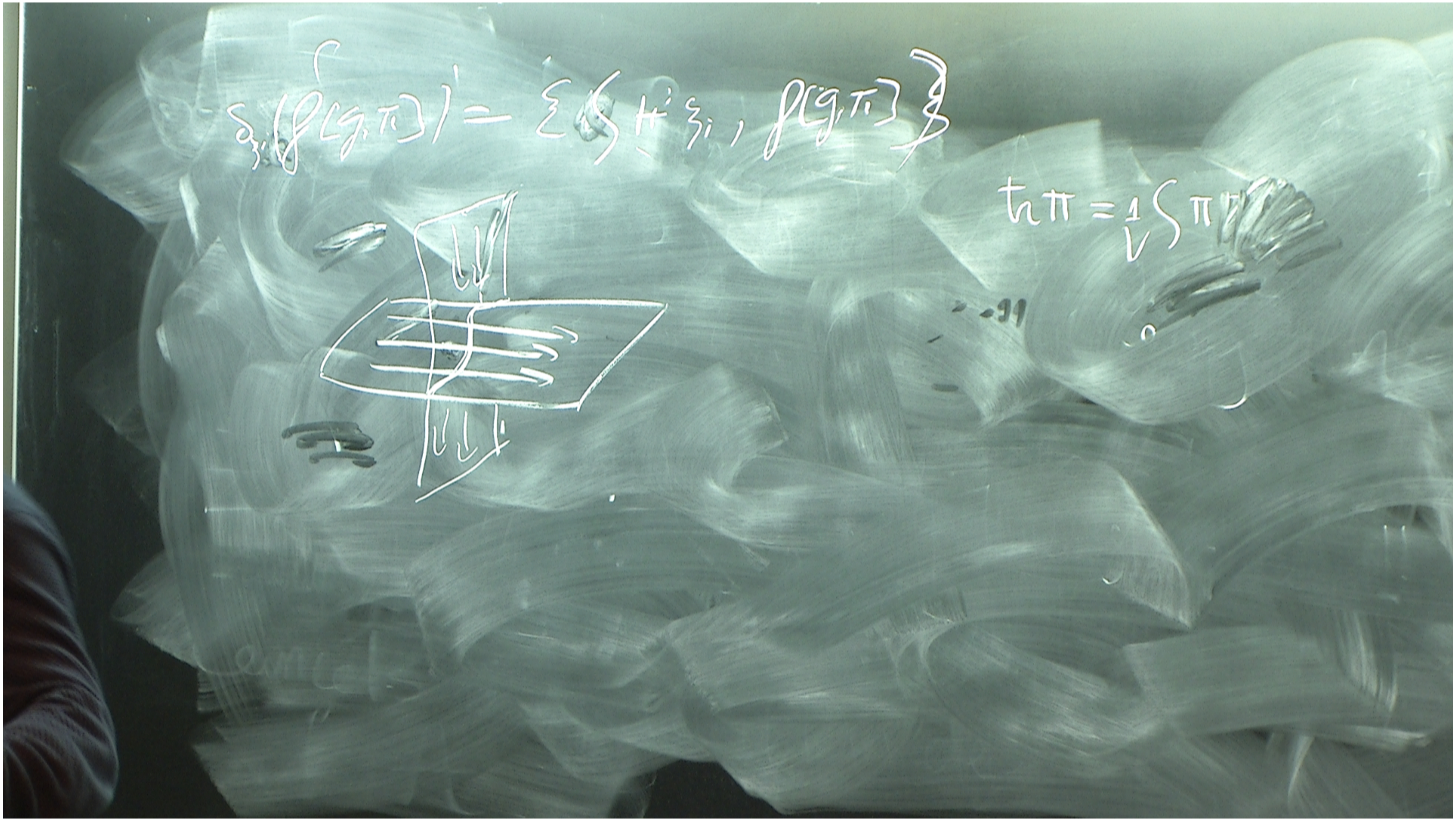
Date: Oct 22, 2014 05:15 PM

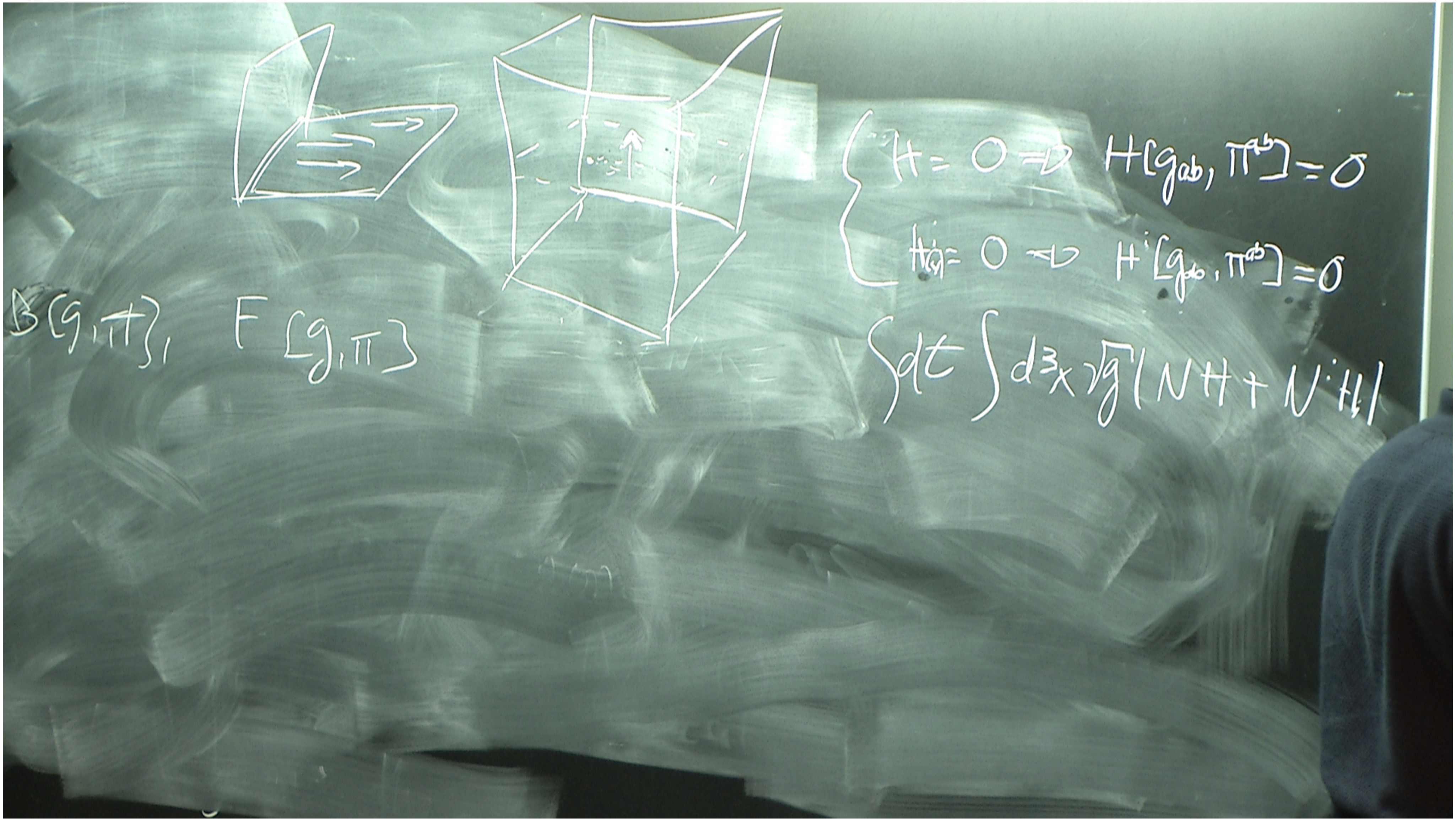
URL: http://pirsa.org/14100117

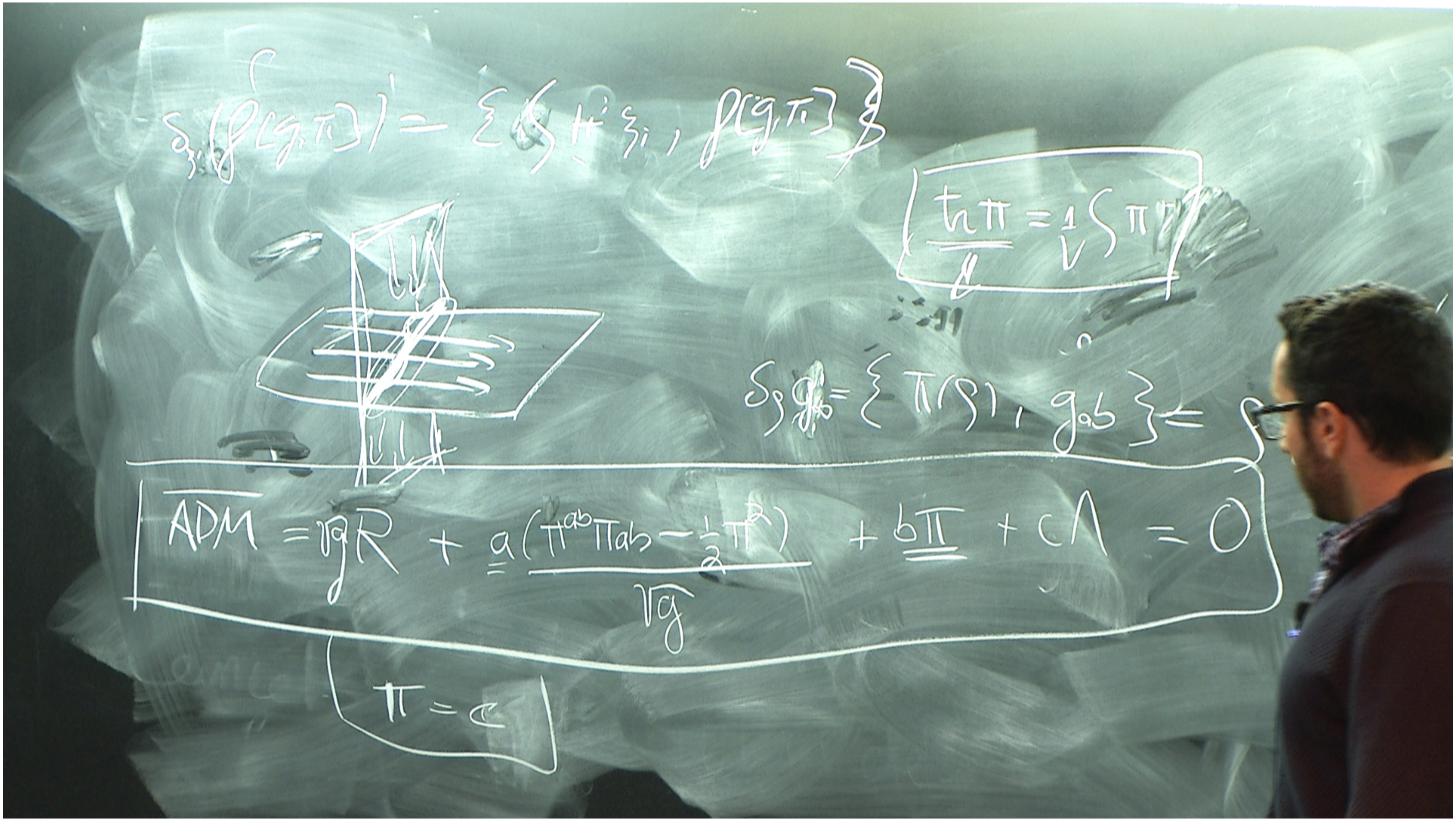
Abstract:

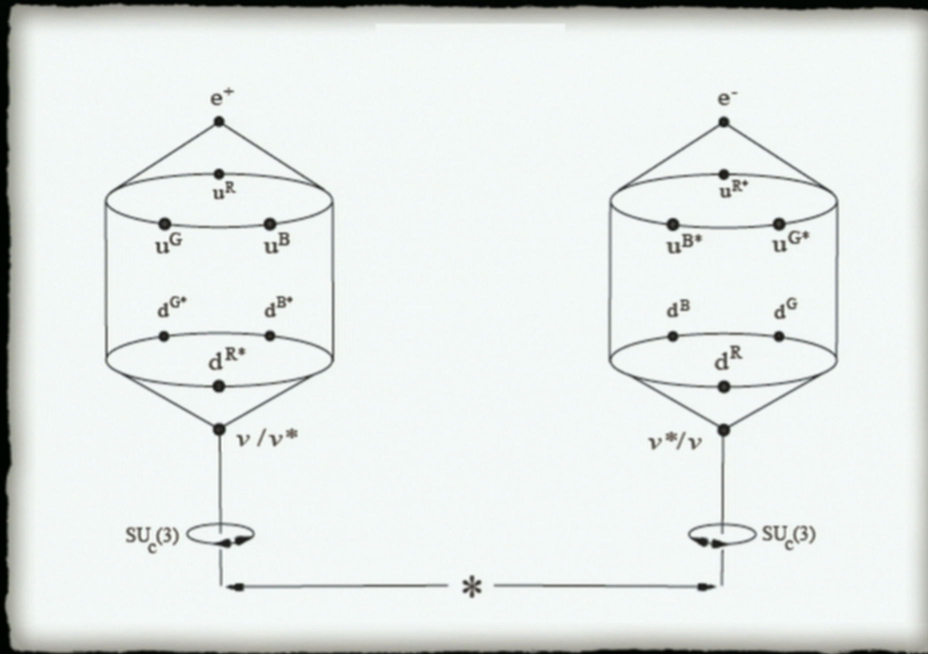

S = ∫√⁽⁴⁾g ⁽⁴⁾R → LEGENDRE
H = 0 ⇒ H[g_ab, π^ab] = 0
H^i = 0 ⇒ H^i[g_ab, π^ab]
∫dt ∫


H = 0 ⇒ H[gab, π^ab] = 0
H^i = 0 ⇒ H^i[gab, π^ab] = 0
S = ∫√(4)g (4)R → LEGENDRE
∫dt ∫d³x √g (N H + N^i H_i)


trπ = 1/V ∫ π


H = 0 ⇒ H[g_ab, π^ab] = 0
H_i = 0 ⇒ H^i[g_ab, π^ab] = 0
∫dt ∫d³x √g (NH + N^i H_i)
B[g, π], F[g, π]


ADM
π = c



Charge Quantization from a Number Operator

Cohl Furey
Perimeter Institute for Theoretical Physics

R C H O

R → everywhere

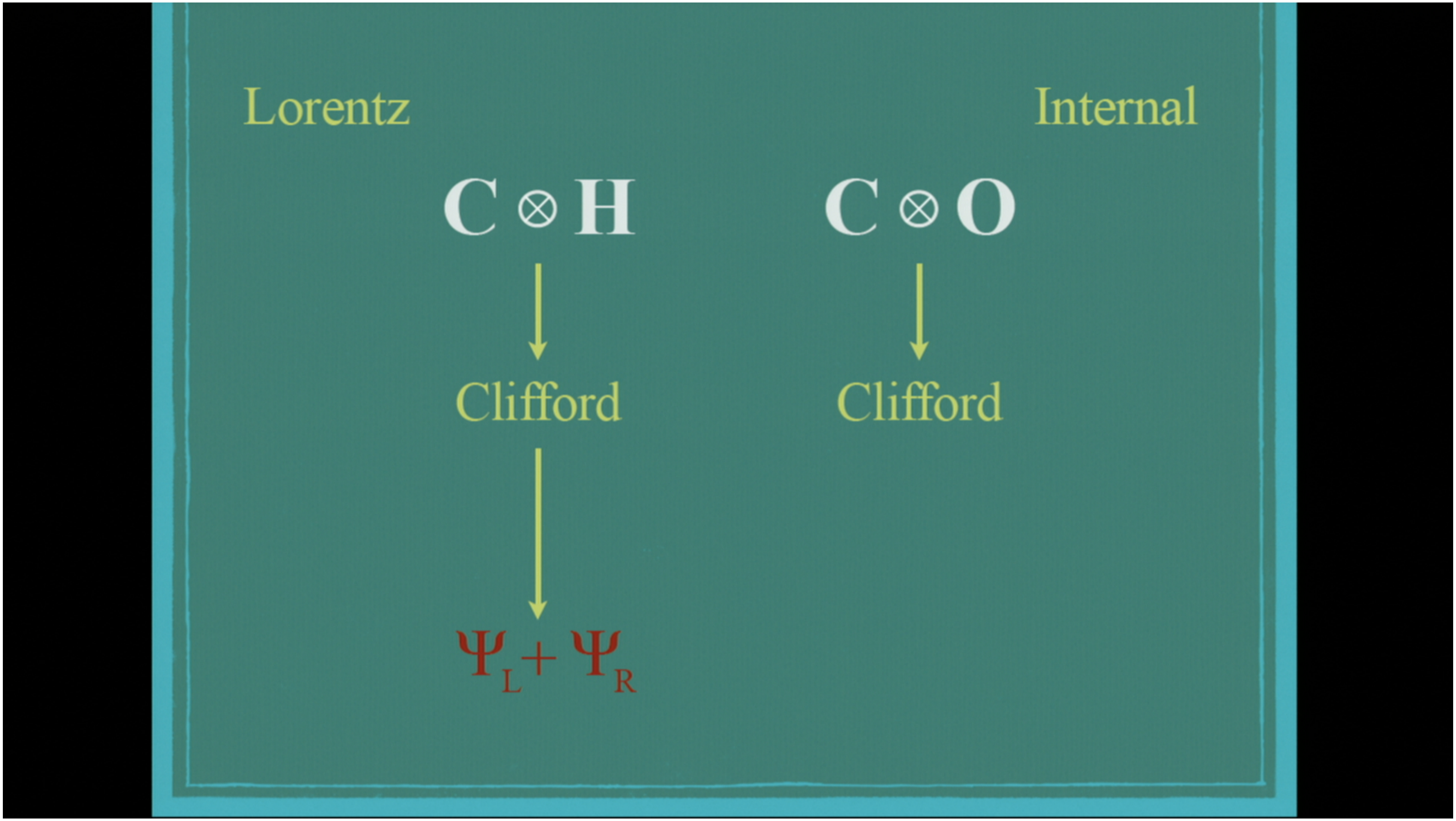
C → quantum

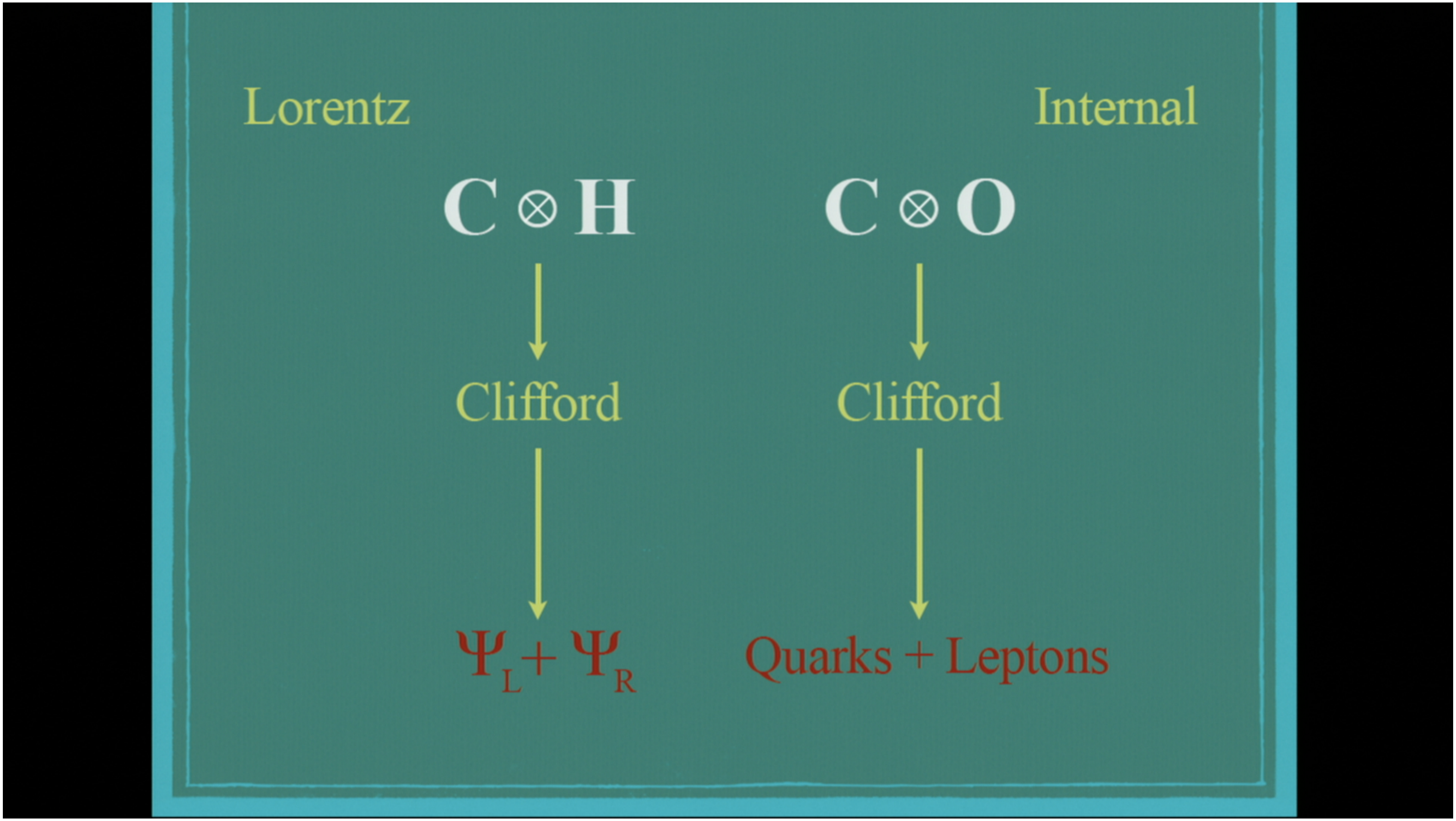
H → lorentz

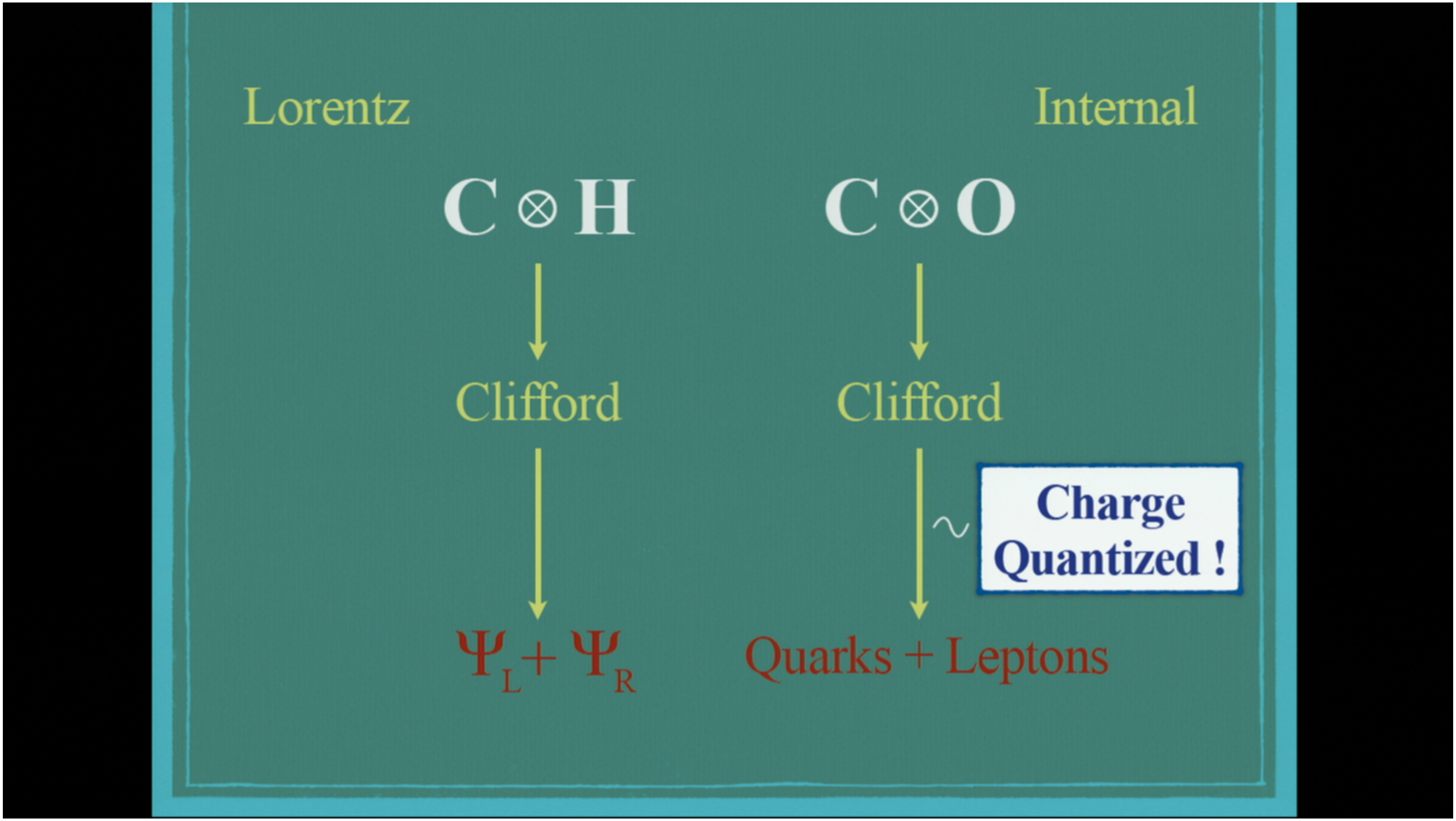
O → ?

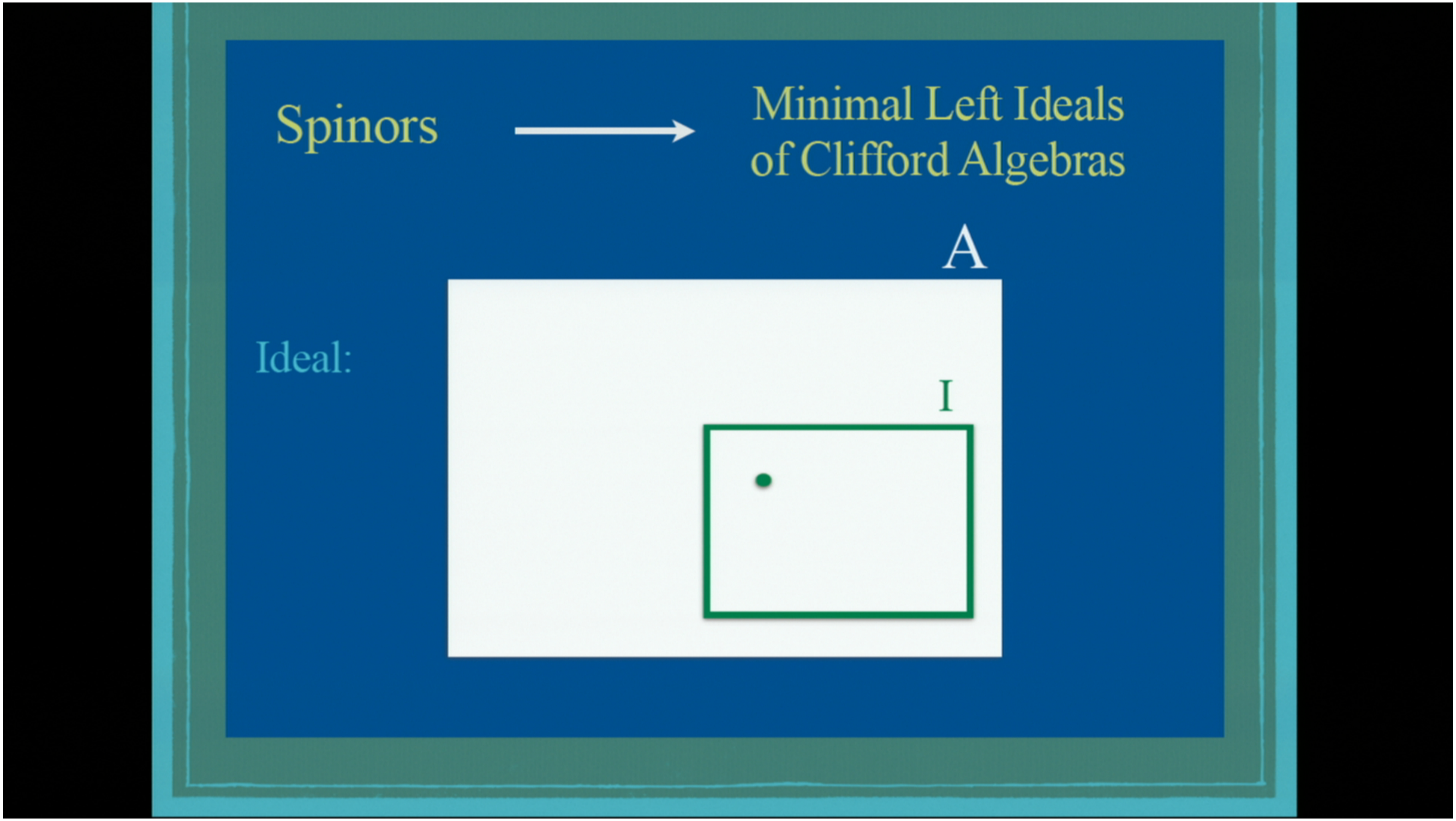
Lorentz

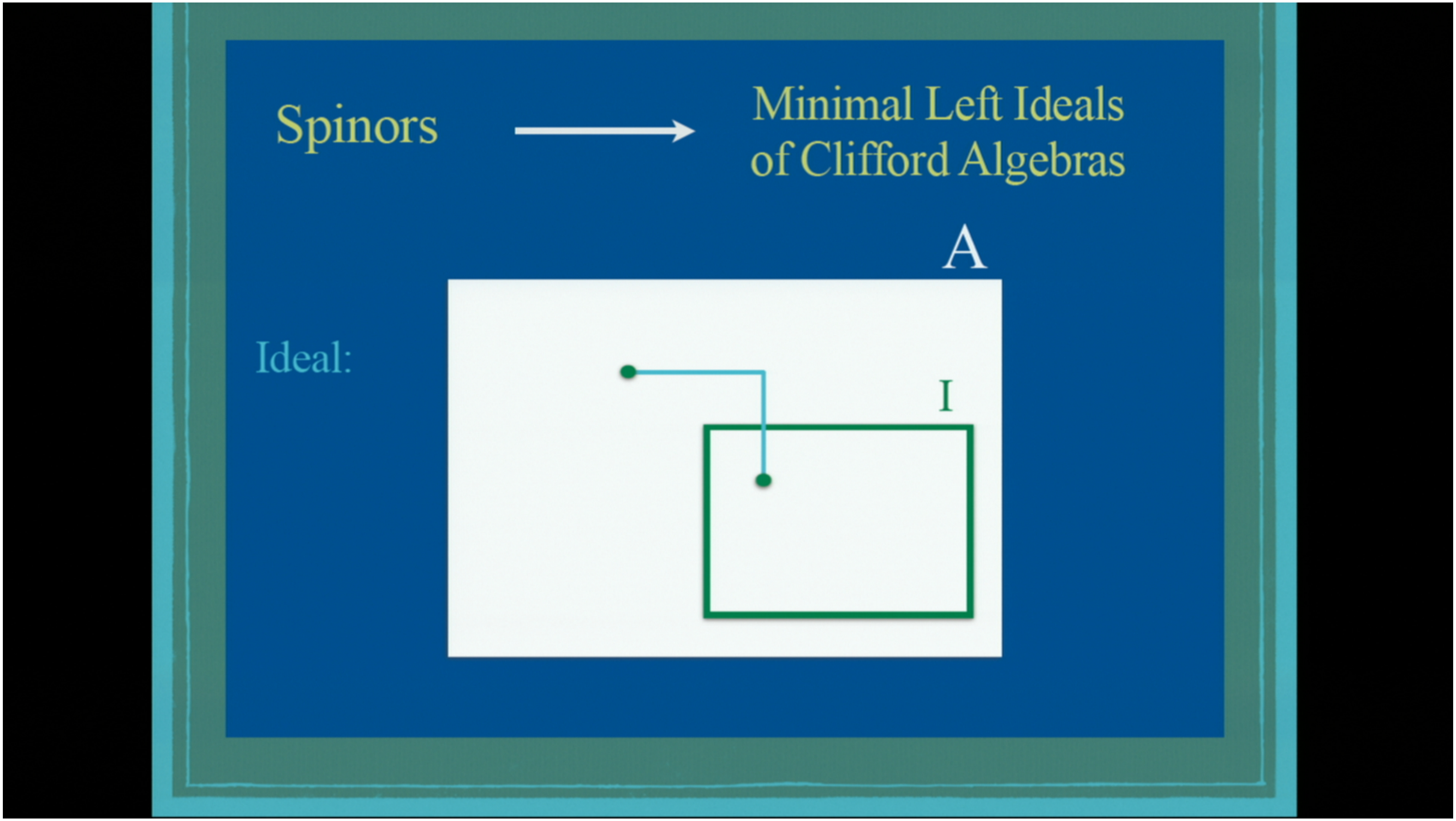
$$\mathbb{C} \otimes \mathbb{H}$$


Lorentz
Internal
$\mathbb{C} \otimes \mathbb{H}$
$\mathbb{C} \otimes \mathbb{O}$
Clifford
Clifford
$\Psi_L + \Psi_R$


Lorentz
Internal
$\mathbb{C} \otimes \mathbb{H}$
$\mathbb{C} \otimes \mathbb{O}$
Clifford
Clifford
$\Psi_L + \Psi_R$
Quarks + Leptons


Lorentz
Internal
C ⊗ H
C ⊗ O
Clifford
Clifford
Charge Quantized !
$\Psi_L + \Psi_R$
Quarks + Leptons


Spinors
Minimal Left Ideals of Clifford Algebras
A
Ideal:
I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Minimal Left Ideals of Clifford Algebras
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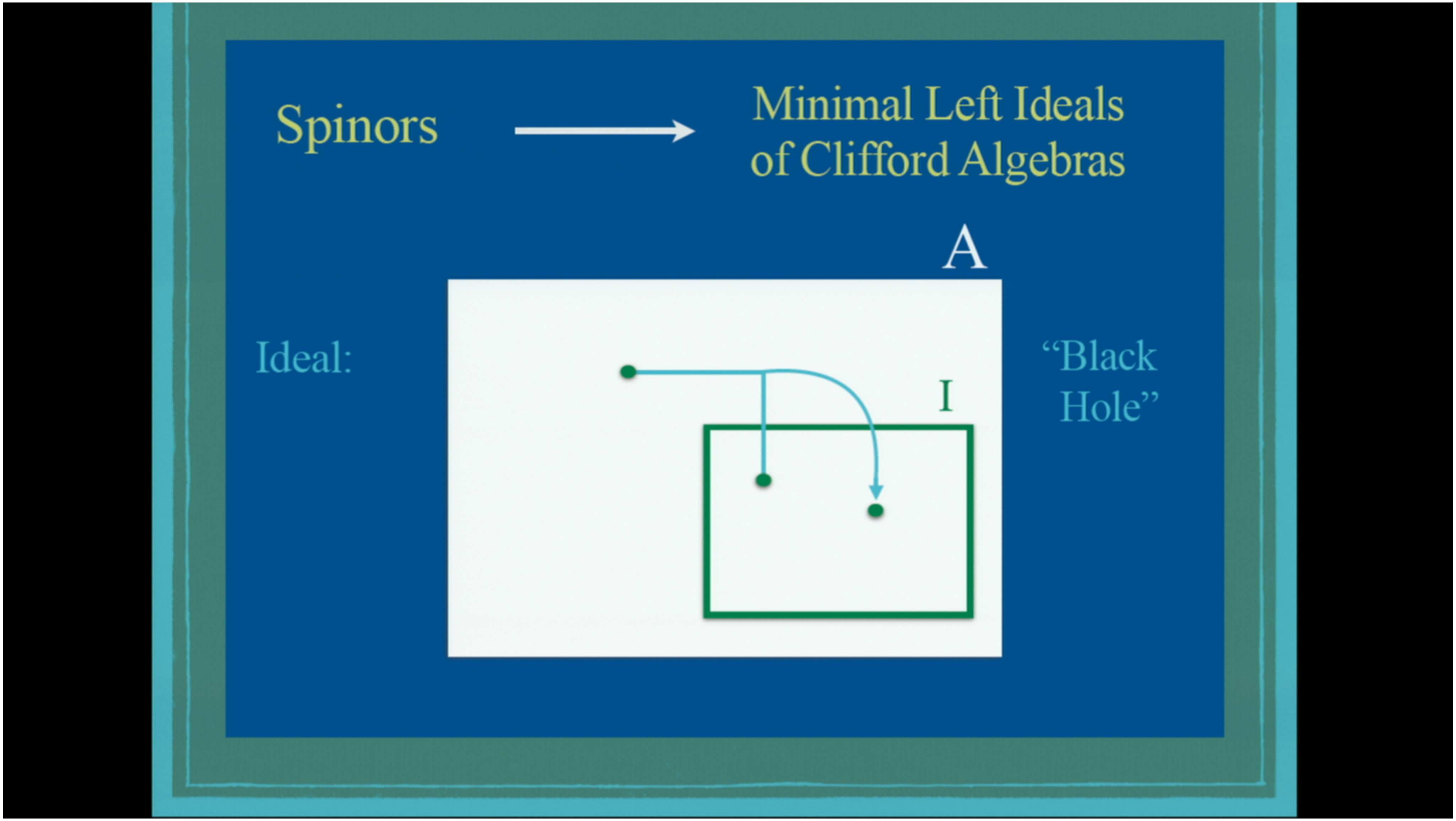
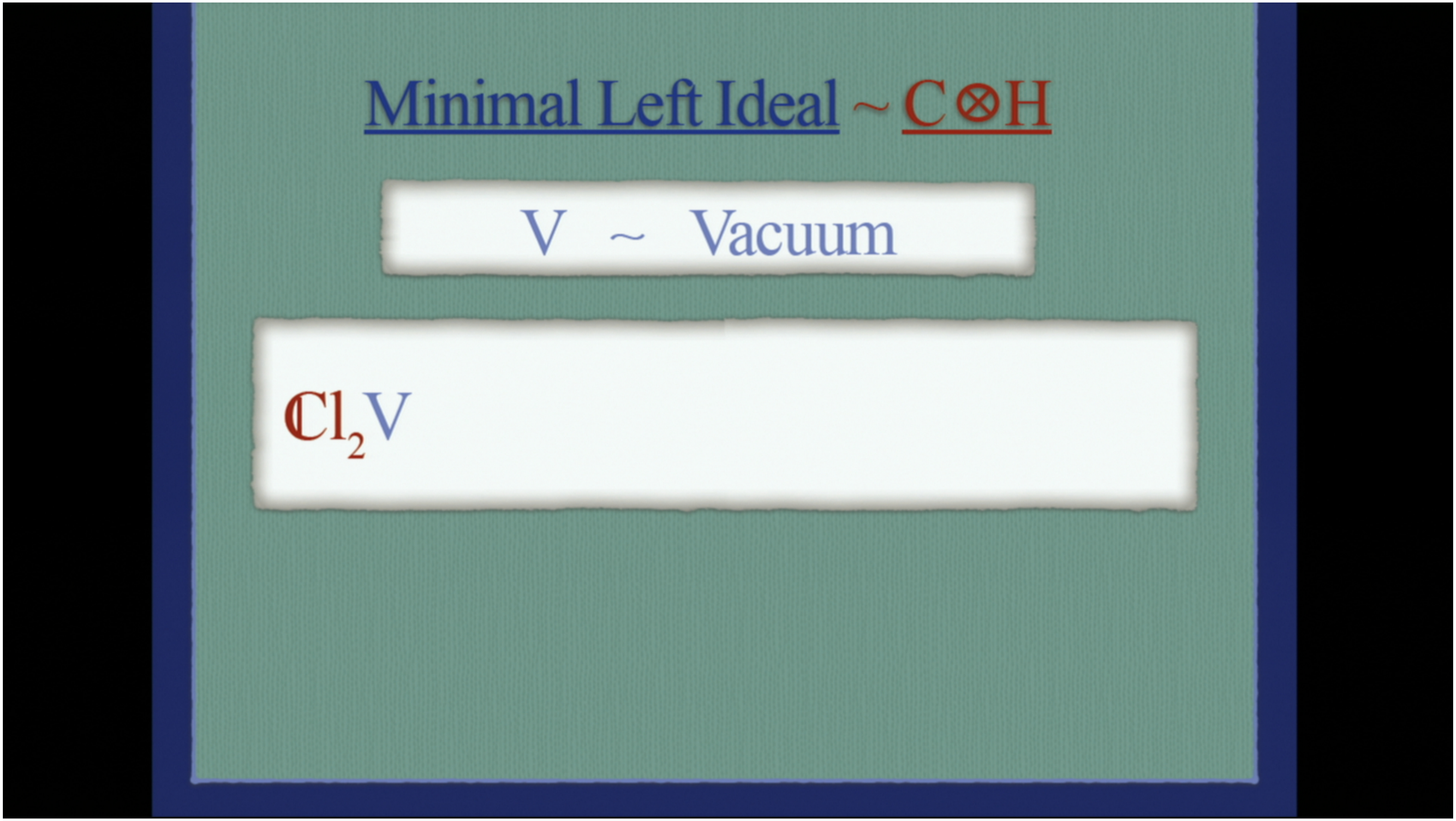

Spinors
Minimal Left Ideals
of Clifford Algebras
A
Ideal:
I
"Black
Hole"

Minimal Left Ideal ~ $C \otimes H$

V ~ Vacuum



Minimal Left Ideal ~ C⊗H
V ~ Vacuum
$\mathbb{C}l_2 V$

Minimal Left Ideal ~ $\mathbb{C} \otimes \mathbb{H}$

$V \sim$ Vacuum

$$\mathbb{C}l_2 V = \psi_L^{\uparrow} V + \psi_L^{\downarrow} \alpha^{\dagger} V = \Psi_L$$

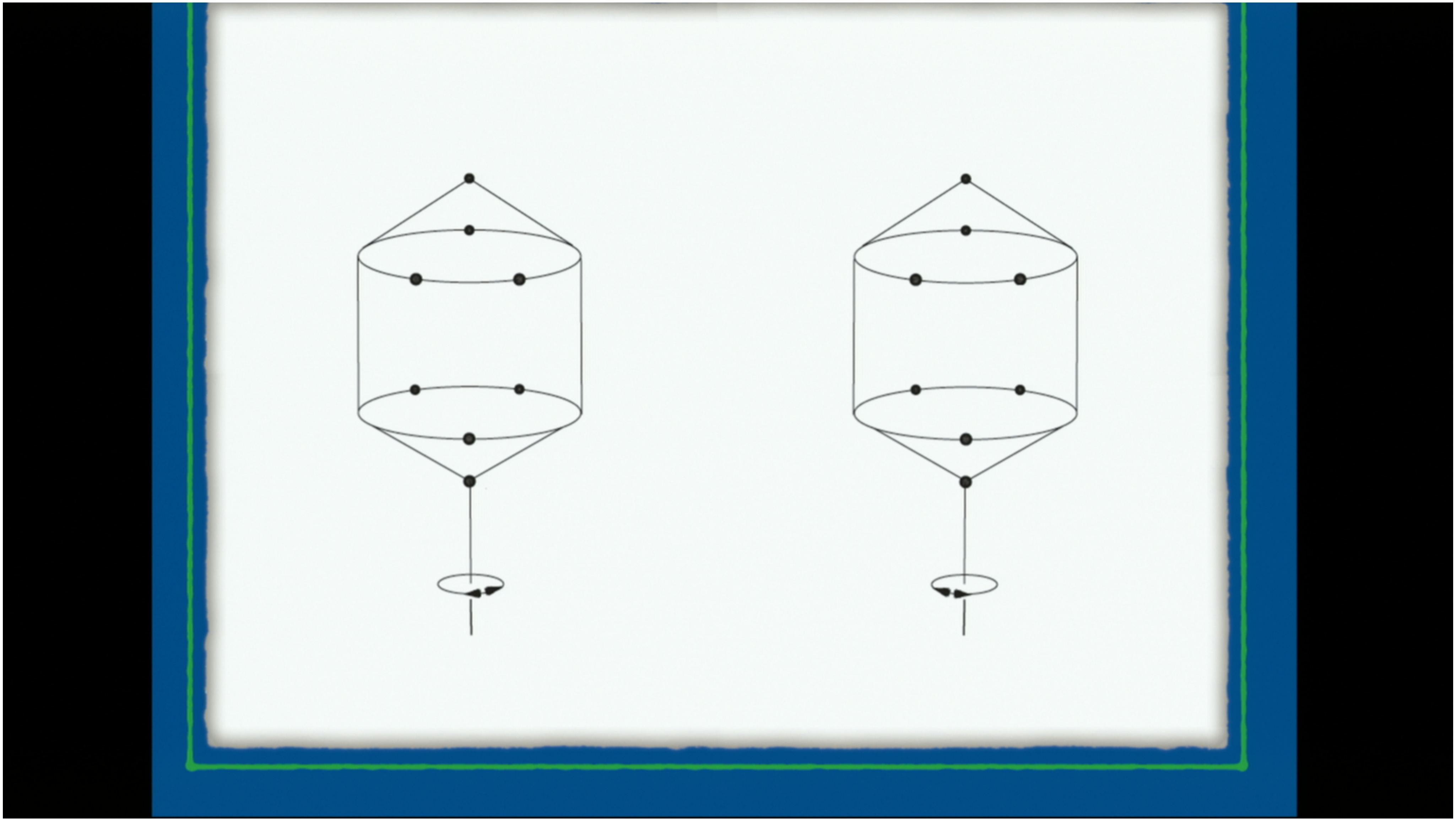
$$\mathbb{C}l_2 V^* = \psi_R^{\downarrow} V^* + \psi_R^{\uparrow} \alpha V^* = \Psi_R$$

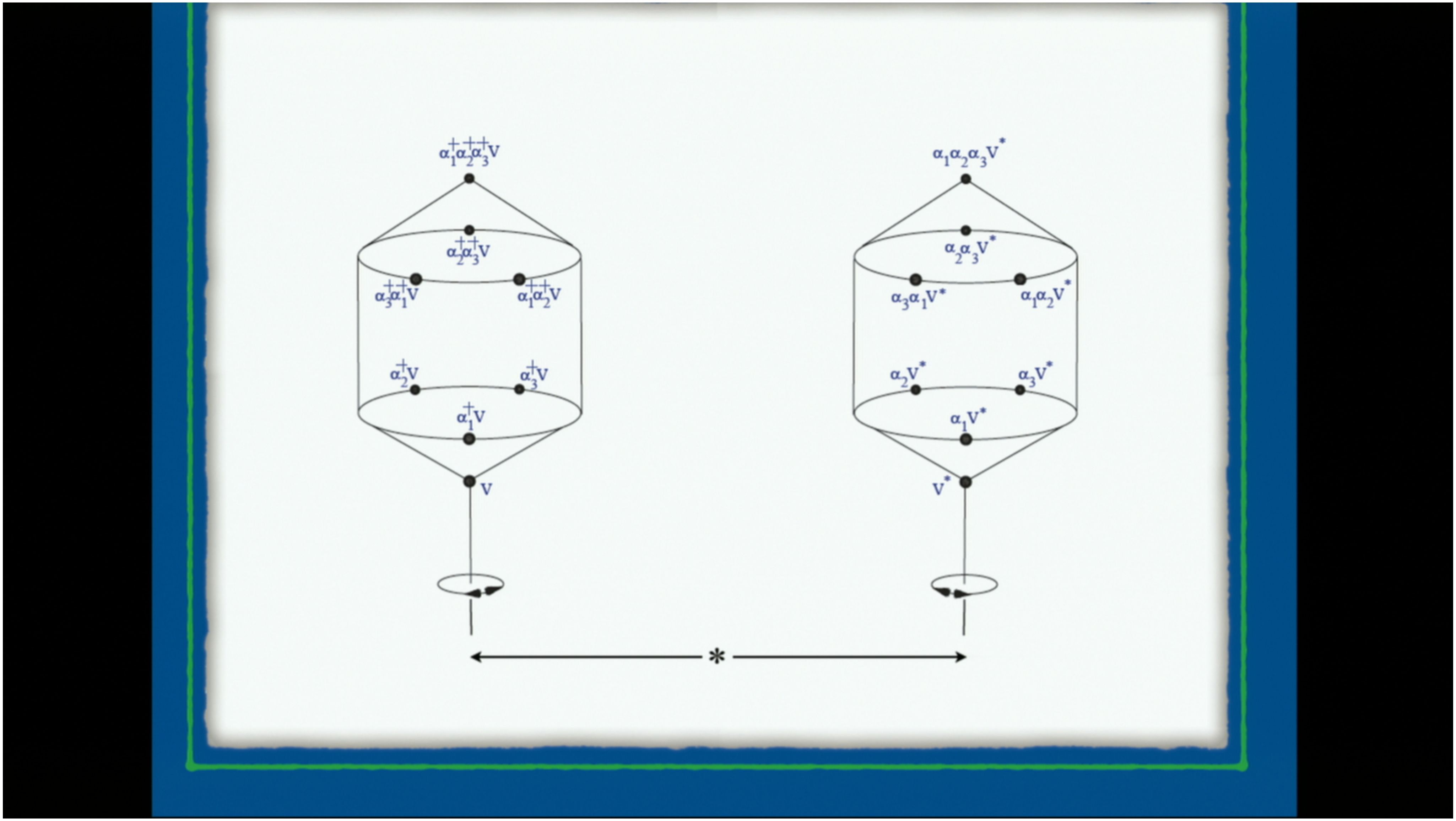
Minimal Left Ideal ~ $\mathbb{C} \otimes \mathbb{O}$

V ~ Vacuum

$\mathbb{C}l_6 V \;=\; 8\,\mathbb{C}$ Fock Space

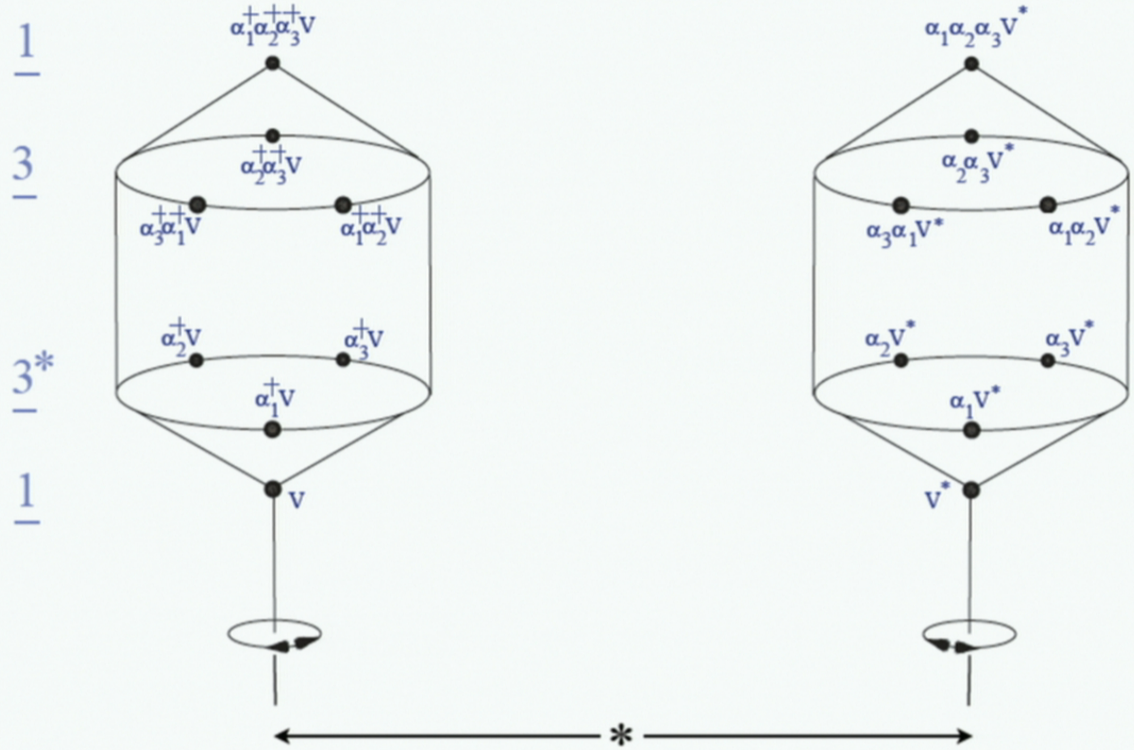
$\mathbb{C}l_6 V^{*} \;=\; 8\,\mathbb{C}$ Fock Space

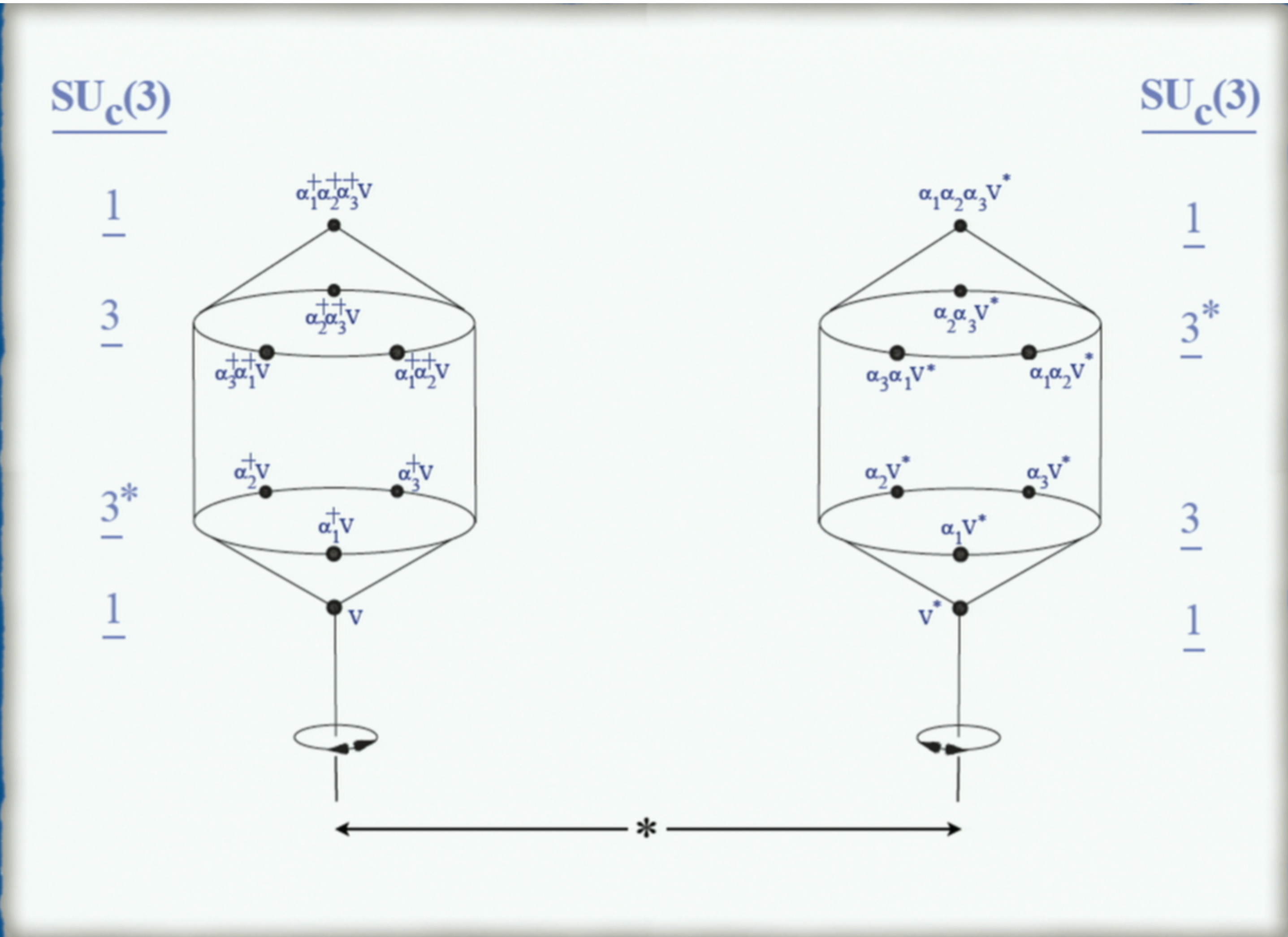




$\alpha_1^\dagger\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_3^\dagger\alpha_1^\dagger V$
$\alpha_1^\dagger\alpha_2^\dagger V$
$\alpha_2^\dagger V$
$\alpha_3^\dagger V$
$\alpha_1^\dagger V$
V
$\alpha_1\alpha_2\alpha_3 V^*$
$\alpha_2\alpha_3 V^*$
$\alpha_3\alpha_1 V^*$
$\alpha_1\alpha_2 V^*$
$\alpha_2 V^*$
$\alpha_3 V^*$
$\alpha_1 V^*$
V^*
*

$SU_c(3)$


$\underline{1}$
$\underline{3}$
$\underline{3^*}$
$\underline{1}$
$\alpha_1^\dagger\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_3^\dagger\alpha_1^\dagger V$
$\alpha_1^\dagger\alpha_2^\dagger V$
$\alpha_2^\dagger V$
$\alpha_3^\dagger V$
$\alpha_1^\dagger V$
V
$\alpha_1\alpha_2\alpha_3 V^*$
$\alpha_2\alpha_3 V^*$
$\alpha_3\alpha_1 V^*$
$\alpha_1\alpha_2 V^*$
$\alpha_2 V^*$
$\alpha_3 V^*$
$\alpha_1 V^*$
V^*
*



$SU_c(3)$
$\underline{1}$
$\underline{3}$
$\underline{3}^*$
$\underline{1}$
$\alpha_1^\dagger\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_2^\dagger\alpha_3^\dagger V$
$\alpha_3^\dagger\alpha_1^\dagger V$
$\alpha_1^\dagger\alpha_2^\dagger V$
$\alpha_2^\dagger V$
$\alpha_3^\dagger V$
$\alpha_1^\dagger V$
V
$SU_c(3)$
$\underline{1}$
$\underline{3}^*$
$\underline{3}$
$\underline{1}$
$\alpha_1\alpha_2\alpha_3 V^*$
$\alpha_2\alpha_3 V^*$
$\alpha_3\alpha_1 V^*$
$\alpha_1\alpha_2 V^*$
$\alpha_2 V^*$
$\alpha_3 V^*$
$\alpha_1 V^*$
V^*
*

$$N = \Sigma\, \alpha_i^{\dagger} \alpha_i$$

$$NS = \#\, S$$

$$\{\, 0, 1, 1, 1, 2, 2, 2, 3 \,\}$$

$$N = \Sigma\, \alpha_i^{\dagger} \alpha_i$$

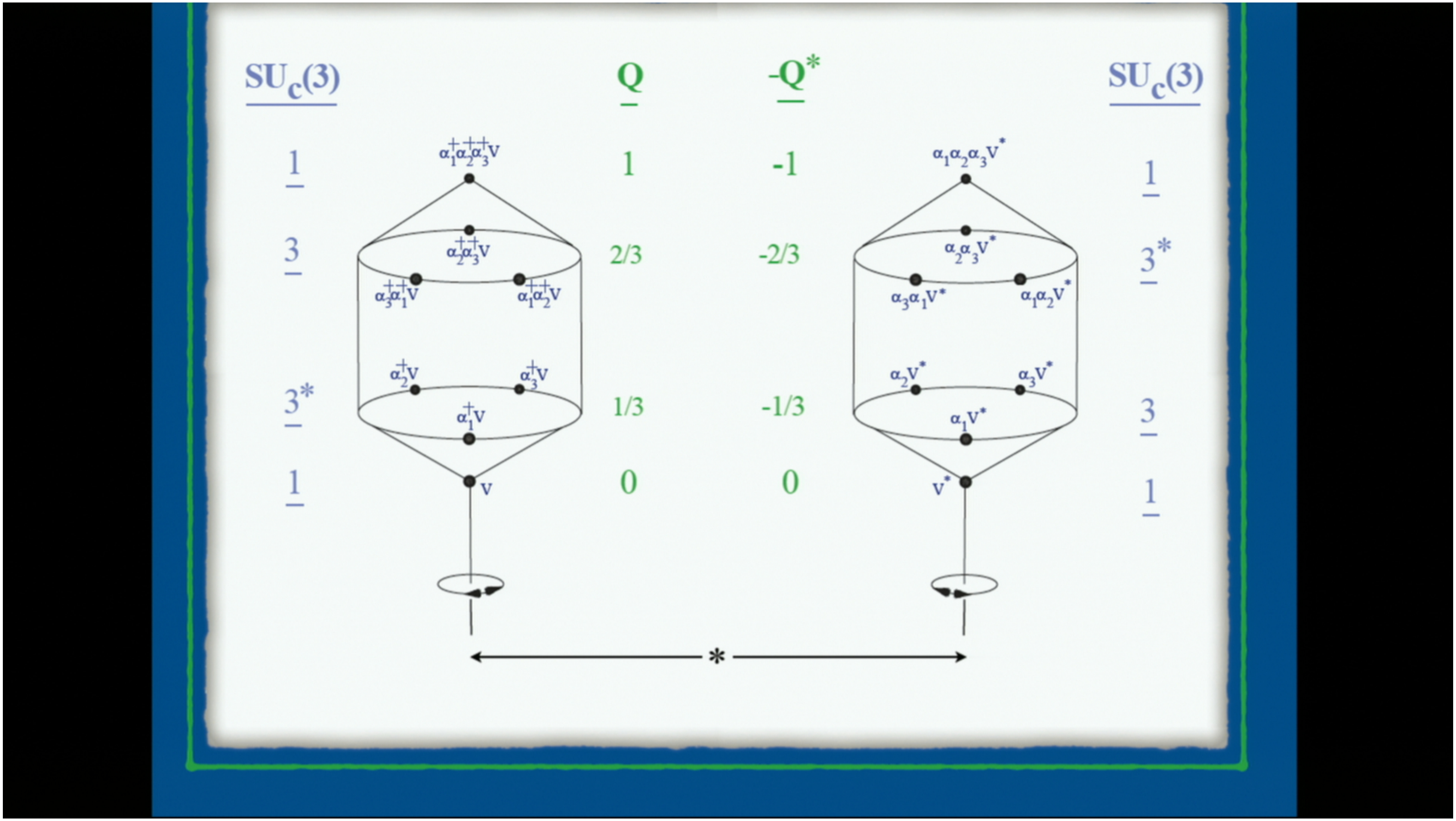
$$NS = \# S$$

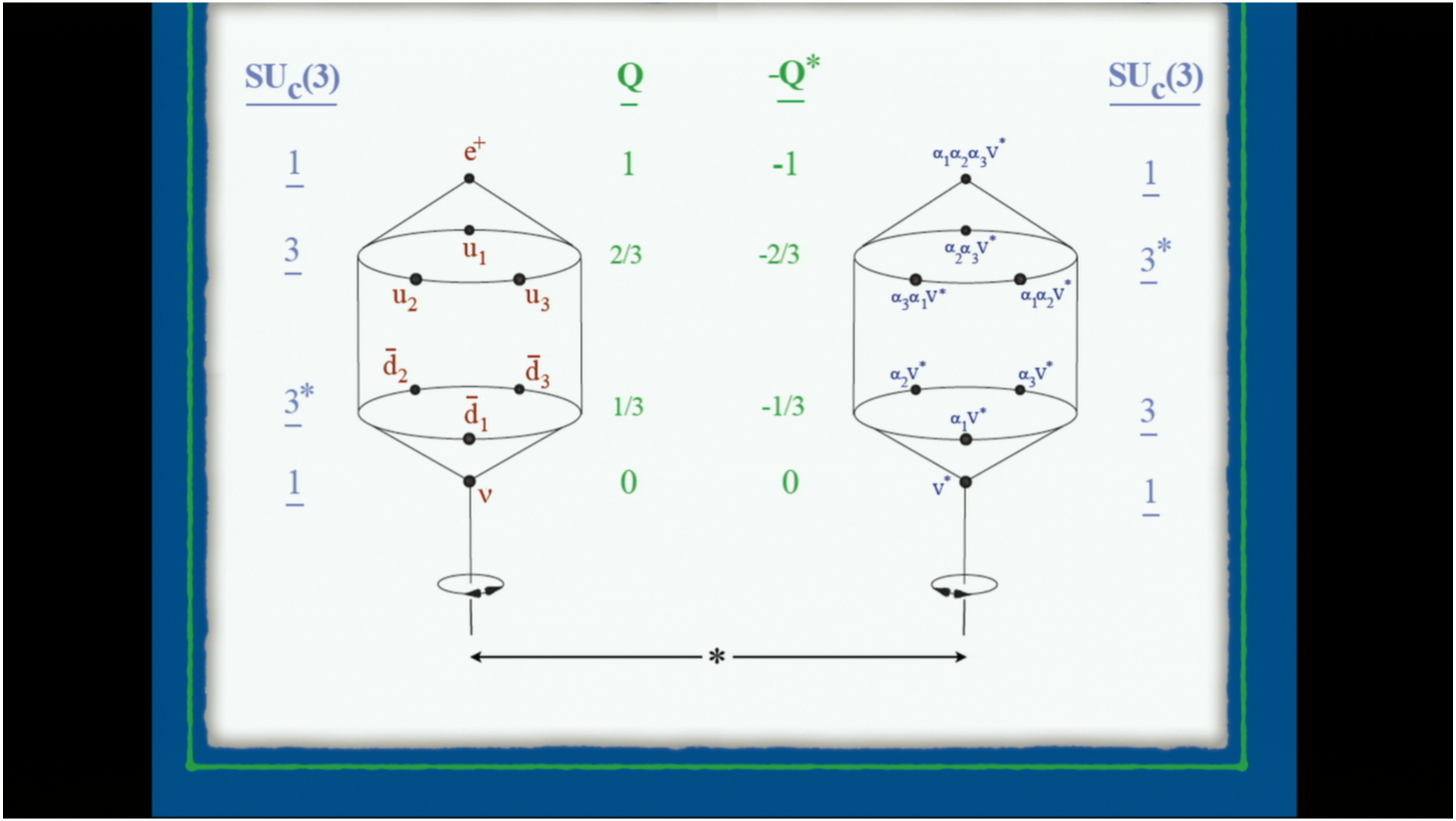
↓

$$\{\, 0, 1, 1, 1, 2, 2, 2, 3 \,\}$$

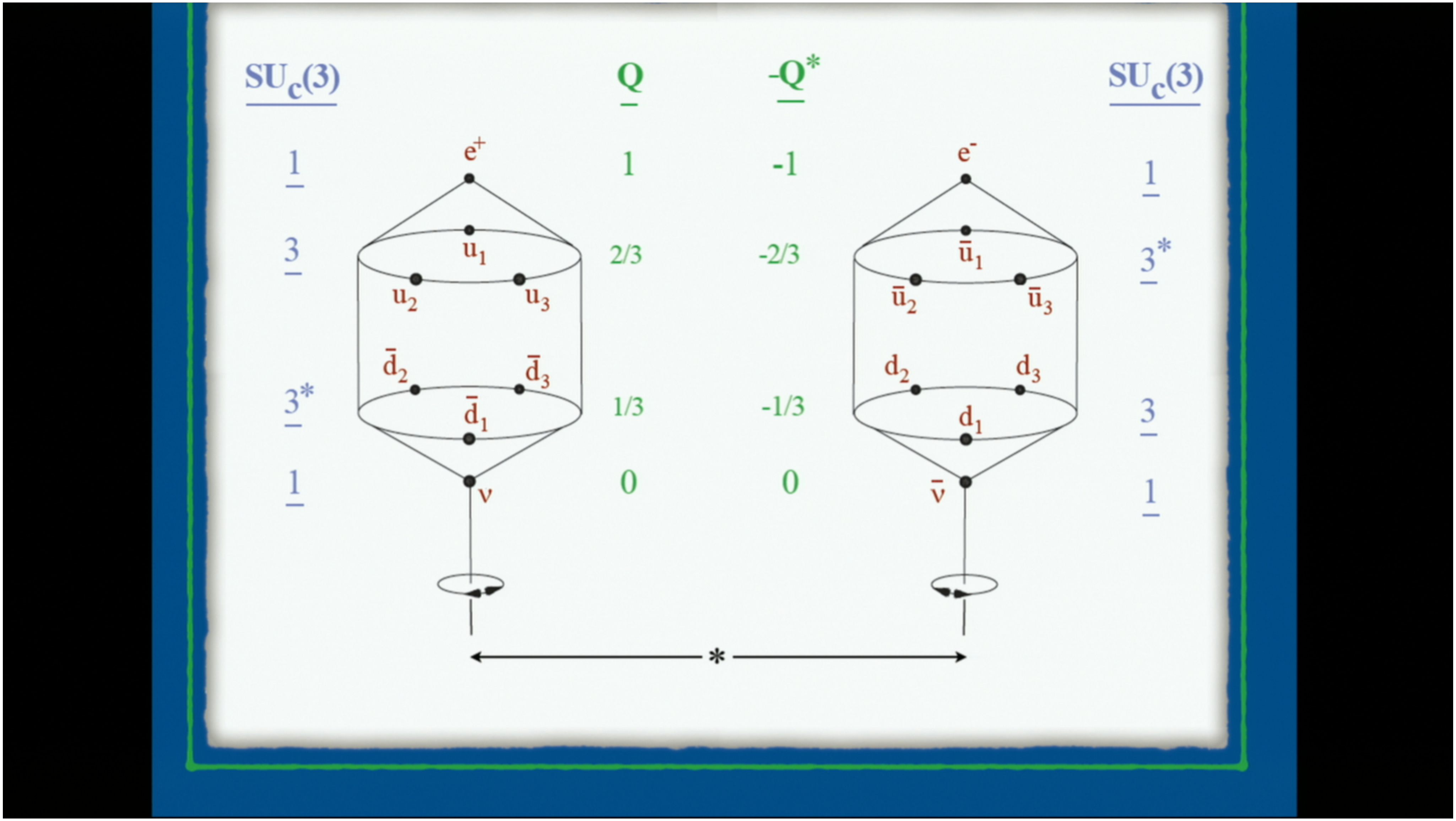
↓

$$\left\{\ 0,\ \ \frac{1}{3},\ \ \frac{1}{3},\ \ \frac{1}{3},\ \ \frac{2}{3},\ \ \frac{2}{3},\ \ \frac{2}{3},\ \ 1\ \right\}$$


SU_c(3)
Q
-Q*
SU_c(3)
1
1
-1
1
3
2/3
-2/3
3*
3*
1/3
-1/3
3
1
0
0
1
*



SU_c(3)
Q
-Q*
SU_c(3)
1
e+
1
-1
α1α2α3V*
1
3
u1
2/3
-2/3
α2α3V*
3*
u2
u3
α3α1V*
α1α2V*
d̄2
d̄3
α2V*
α3V*
3*
d̄1
1/3
-1/3
α1V*
3
1
ν
0
0
V*
1
*


SUc(3)
Q
-Q*
SUc(3)
1
e+
1
-1
e-
1
3
u1
2/3
-2/3
ū1
3*
u2
u3
ū2
ū3
d̄2
d̄3
d2
d3
3*
d̄1
1/3
-1/3
d1
3
1
ν
0
0
ν̄
1
*

Results

1. $\Psi_L + \Psi_R$ → enough DOFs ~ generation

Results

1. $\Psi_L + \Psi_R$ ⟶ enough DOFs ~ generation
2. $SU_c(3)$ worked
3. Q ⟶ correct charges

Results

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2. $SU_c(3)$ worked
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   ⟶ fit with $SU_c(3)$
4. Towards SU(2)

Results

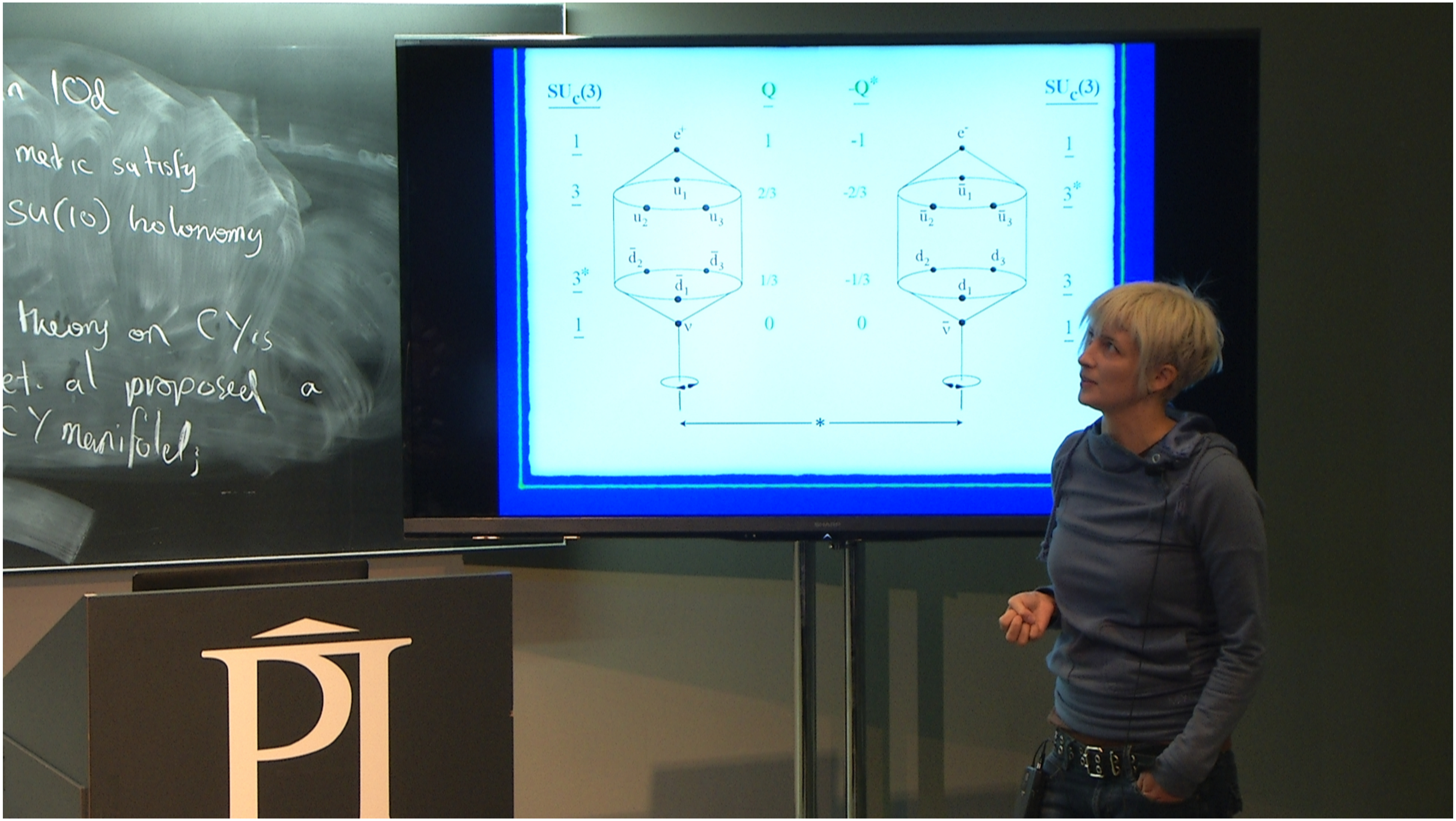
1. $\Psi_L + \Psi_R \longrightarrow$ enough DOFs ~ generation
2. $SU_c(3)$ worked
3. $Q \longrightarrow$ correct charges

   $\longrightarrow$ fit with $SU_c(3)$
4. Towards SU(2)
5. Particle $\overset{*}{\longleftrightarrow}$ Antiparticle

Results

1. $\Psi_L + \Psi_R$ $\longrightarrow$ enough DOFs ~ generation
2. $SU_c(3)$ worked
3. Q $\longrightarrow$ correct charges

   $\longrightarrow$ fit with $SU_c(3)$
4. Towards SU(2)
5. Particle $\overset{*}{\longleftrightarrow}$ Antiparticle
6. $Q = N/3$ $\longrightarrow$ Q Quantized !


SU_c(3)
Q
-Q*
SU_c(3)
1
e+
1
-1
e-
1
3
u1
2/3
-2/3
ū1
3*
u2
u3
ū2
ū3
d̄2
d̄3
d2
d3
3*
d̄1
1/3
-1/3
d1
3
1
ν
0
0
ν̄
1
*
n 10d
metric satisfy
SU(10) holonomy
theory on CY's
et. al proposed a
CY manifold;