Title: PSI 2018/2019 - Beyond Standard Model - Lecture 14

Speakers: Latham Boyle

Collection: PSI 2018/2019 - Beyond Standard Model (Boyle)

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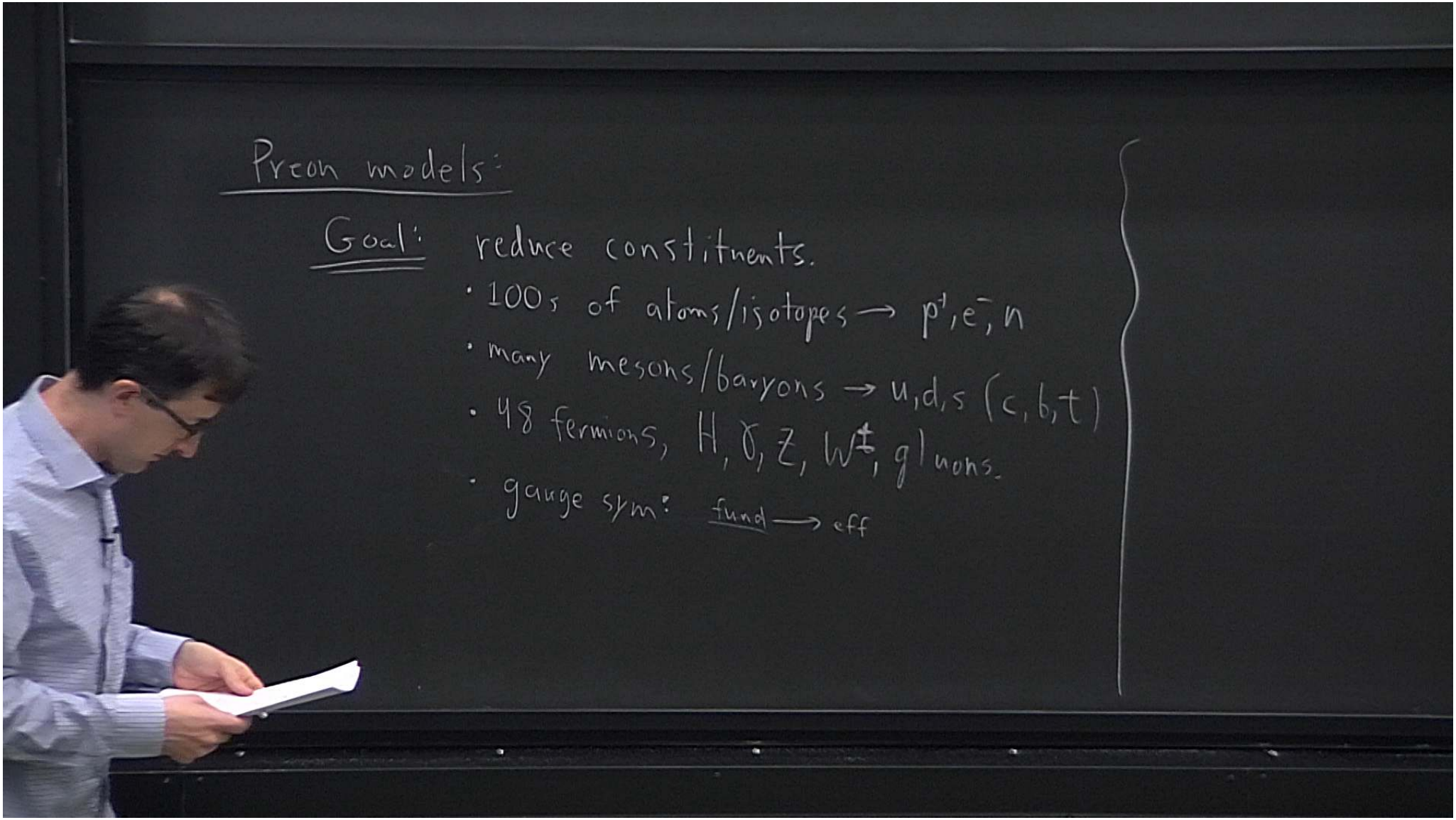
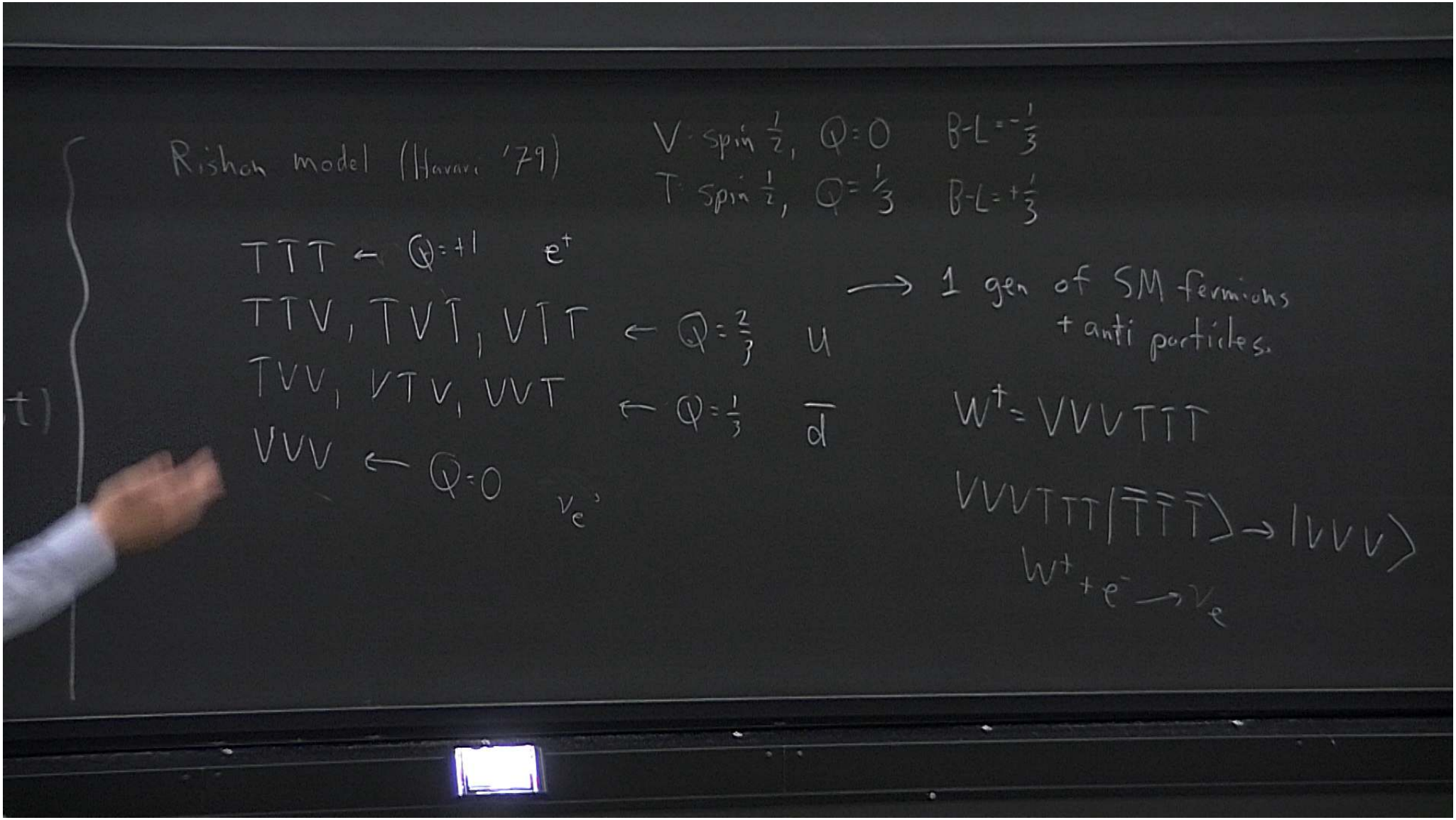
URL: http://pirsa.org/19040030


Preon models:
Goal: reduce constituents.
• 100s of atoms/isotopes → p+, e−, n
• many mesons/baryons → u, d, s (c, b, t)
• 48 fermions, H, γ, Z, W±, gluons.
• gauge sym: fund → eff


Rishon model (Harari '79)
V: spin 1/2, Q=0 B-L=-1/3
T: spin 1/2, Q=1/3 B-L=+1/3
TTT ← Q=+1 e+
TTV, TVT, VTT ← Q=2/3 u
TVV, VTV, VVT ← Q=1/3 d̄
VVV ← Q=0 νe
→ 1 gen of SM fermions + anti particles.
W+ = VVVTTT
VVVTTT/T̄T̄T̄⟩ → |VVV⟩
W+ + e- → νe

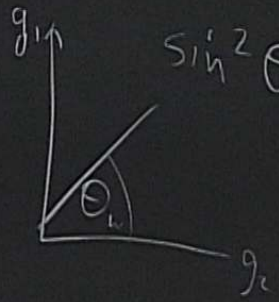
$SU(3)_C \times SU(3)_H$ $\quad g_c < g_H$

$T = (3,3)_{Q=\frac{1}{3}}$

$V = (\bar{3},3)_{Q=0}$

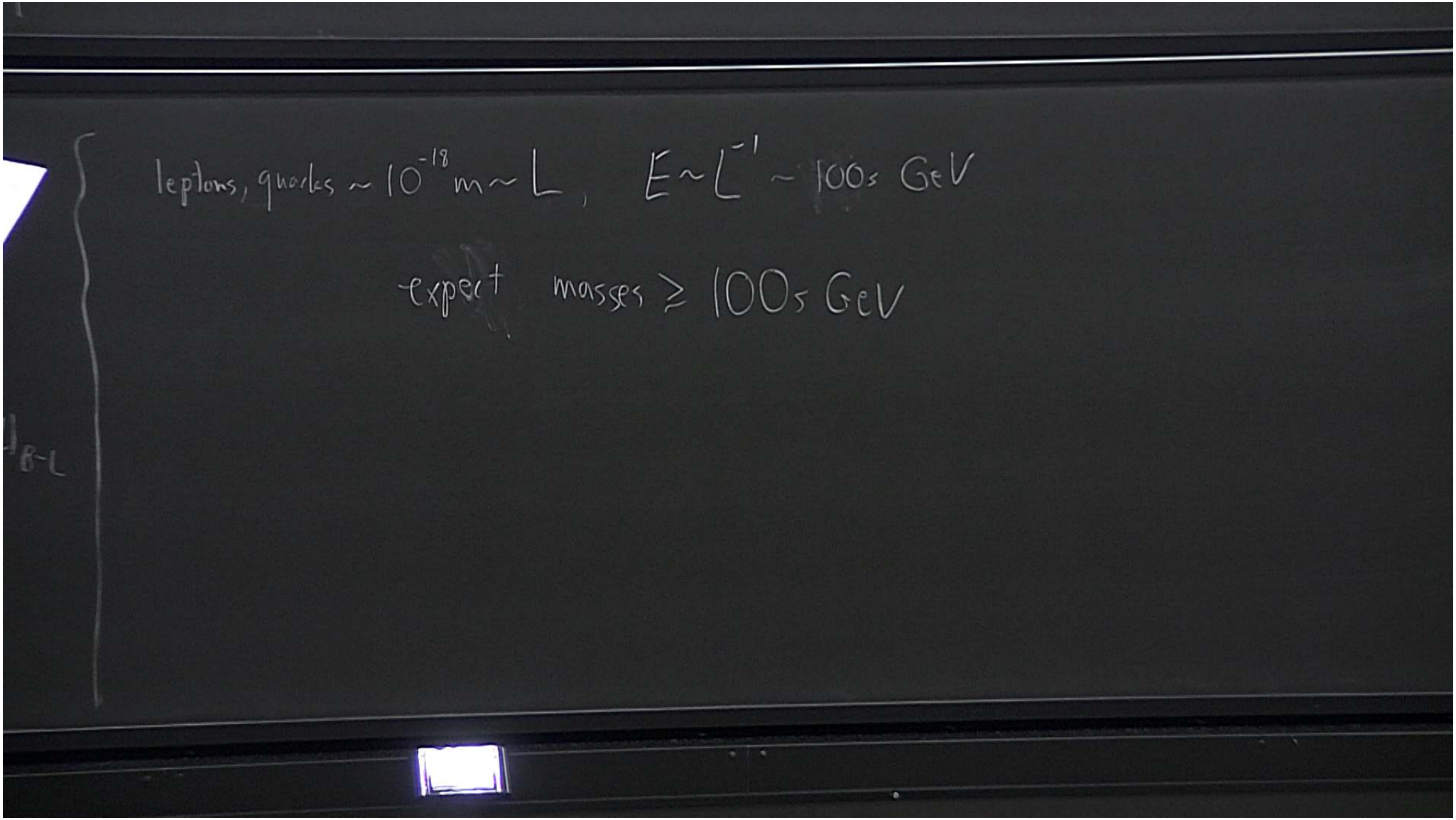
$\bar{T} \not{D} T + \bar{V} \not{D} V$

$\hookrightarrow SU(3)_c \times SU(2)_L \times SU(2)_R \times U(1)_{B-L}$



$\sin^2\theta_W = \frac{1}{4} \approx 0.23$

leptons, qu


leptons, quarks $\sim 10^{-18}$ m $\sim L$, $E \sim L^{-1} \sim$ 100s GeV
expect masses $\gtrsim$ 100s GeV
B-L

- leptons, quarks $\sim 10^{-18}\,m \sim L$, $E \sim L^{-1} \sim$ 100s GeV

expect masses $\gtrsim$ 100s GeV

- arXiv:1808.... Dubois-Violette, Todorov $J_3(\mathbb{O})$

Jordan algs classified by Wigner, Von Neumann, + Jordan

($J_n(\mathbb{R})$, $J_n(\mathbb{C})$, $J_n(\mathbb{H})$ $J_3(\mathbb{O})$

↳ Clifford symmetrized

NCG/NAG:

i) CM→QM: · coordinates q,p promoted to non-commutative (Heisenberg) algebra: $[q,p]=i\hbar$

· coordinates on manifold of observables → non-associative (Jordan) algebra: Lie: $[A,$

H,H

NCG/NAG:

i) CM → QM: • coordinates q, p promoted to non-commutative (Heisenberg) algebra: $[q,p] = i\hbar$

• coordinates on manifold of observables → non-associative (Jordan) algebra:

• spacetime manifold?

Lie: $[A_1, A_2] = A_3$

$\{H_1, H_2\} = H_3$

•

$A = C_\infty(M, \mathbb{R}) \rightarrow Aut(A) = Diff(M) \rightarrow$ symmetries of GR

$A = C_\infty(M, A_F) \rightarrow Aut(A) = \underbrace{Diff(M) \ltimes Gauge(Aut(A_F))}_{Diff(M)}$

ii) $\psi_A(x)$ $A = 1, \ldots 48$ ↳ instead of 48 spinors on M

↳ 1 spinor on $(M \times F)$

M: 4d manifold; F: finite/discrete.

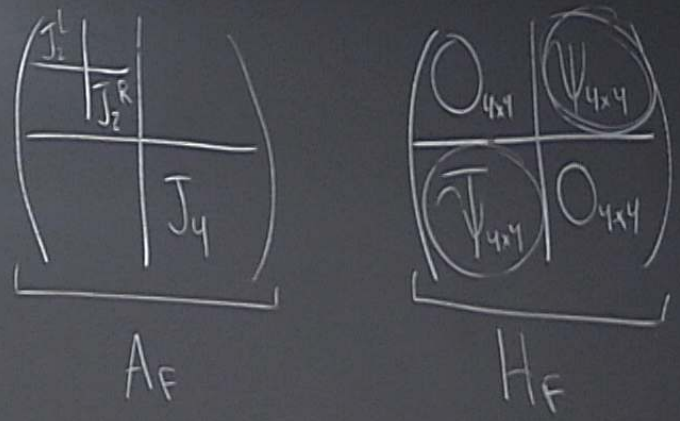
iii) Can we reformulate: massless?

$$\bar{\psi}^i (i\not{\partial} - m)\psi^i \to \psi \not{D} \psi$$

Pati-Salam:

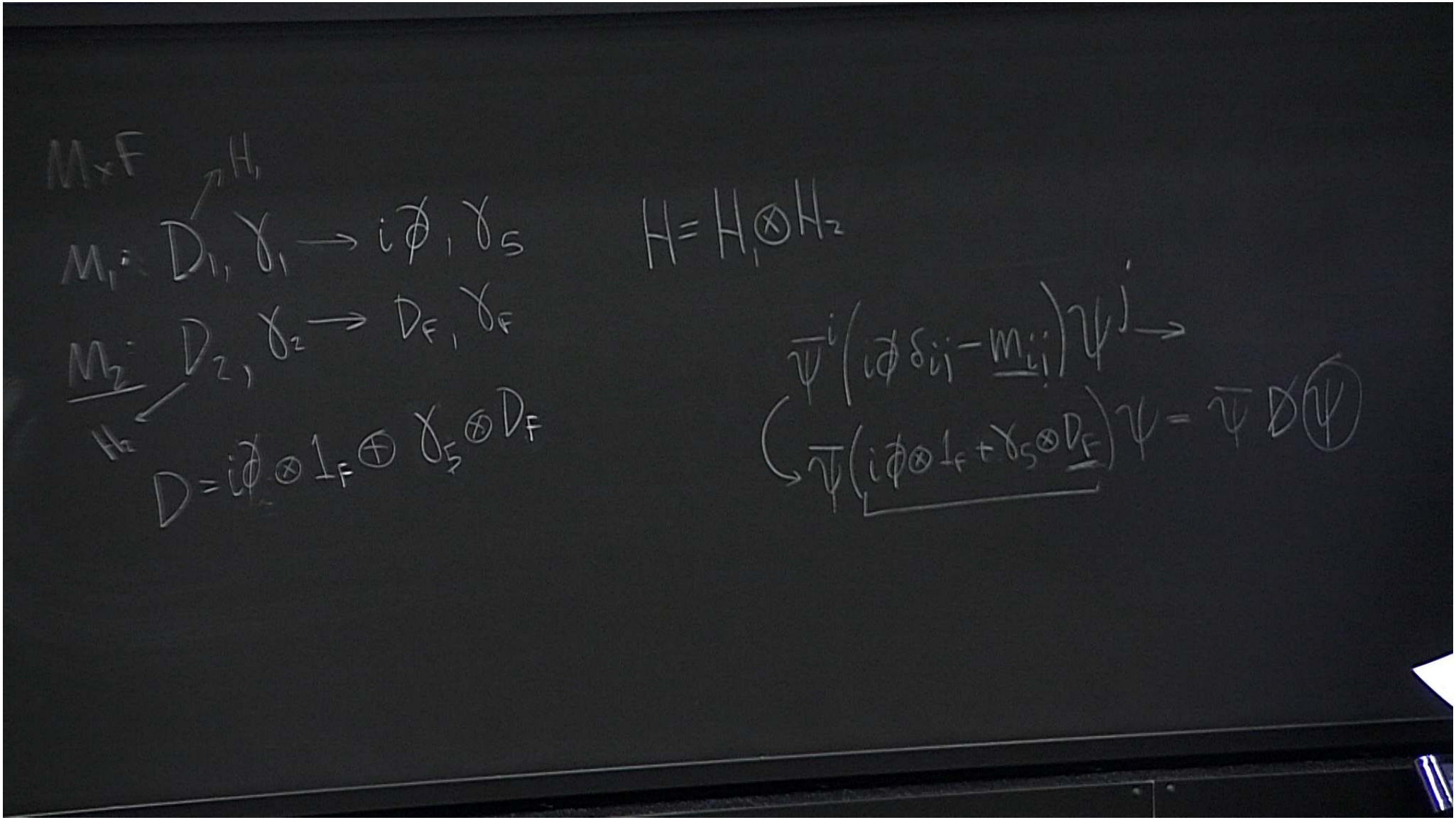
$$A_F = J_4(\mathbb{C}) \oplus J_2^L(\mathbb{C}) \oplus J_2^R(\mathbb{C}) \longrightarrow$$

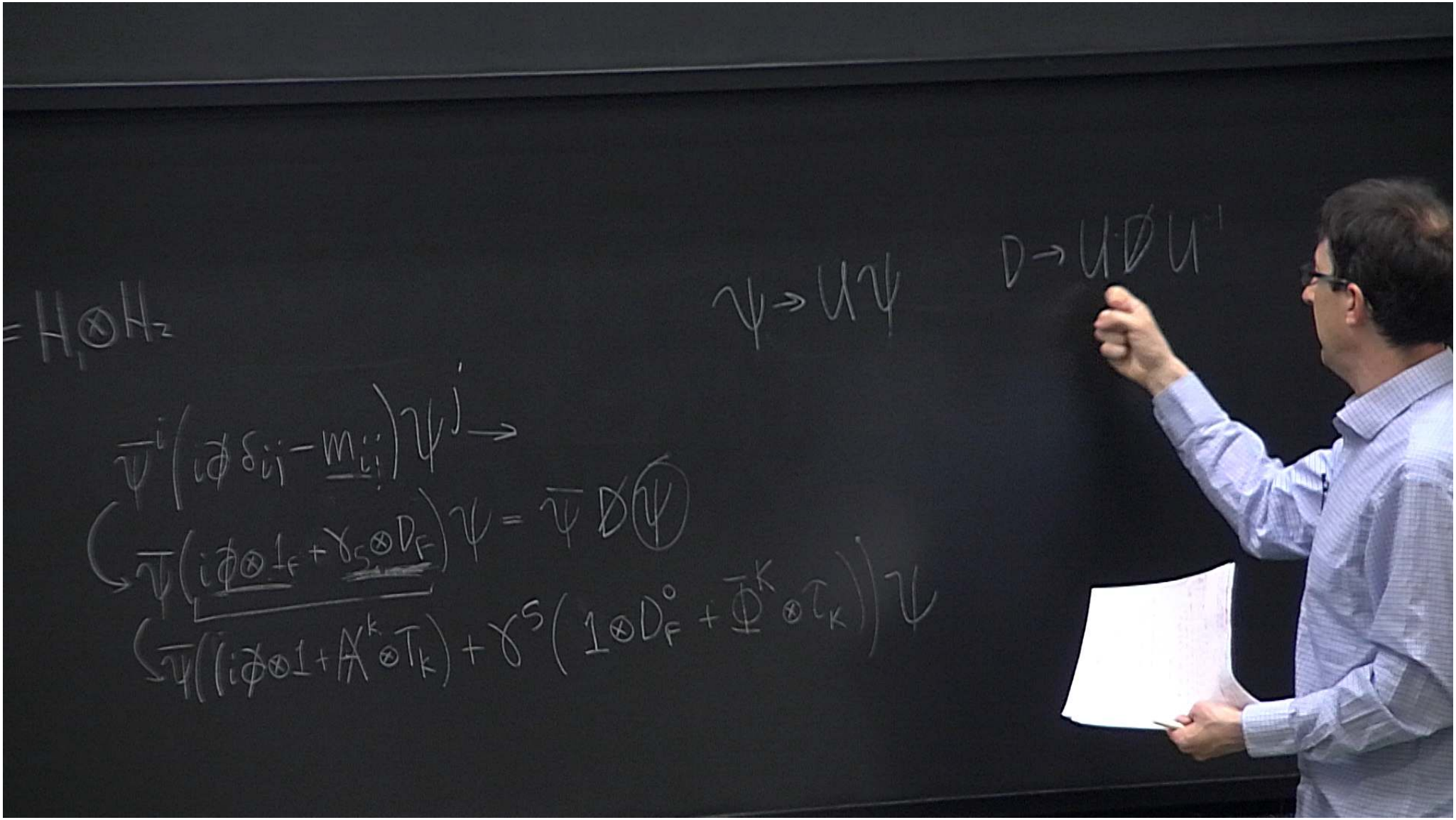
$$SU(4) \times SU(2)_L \times SU(2)_R$$

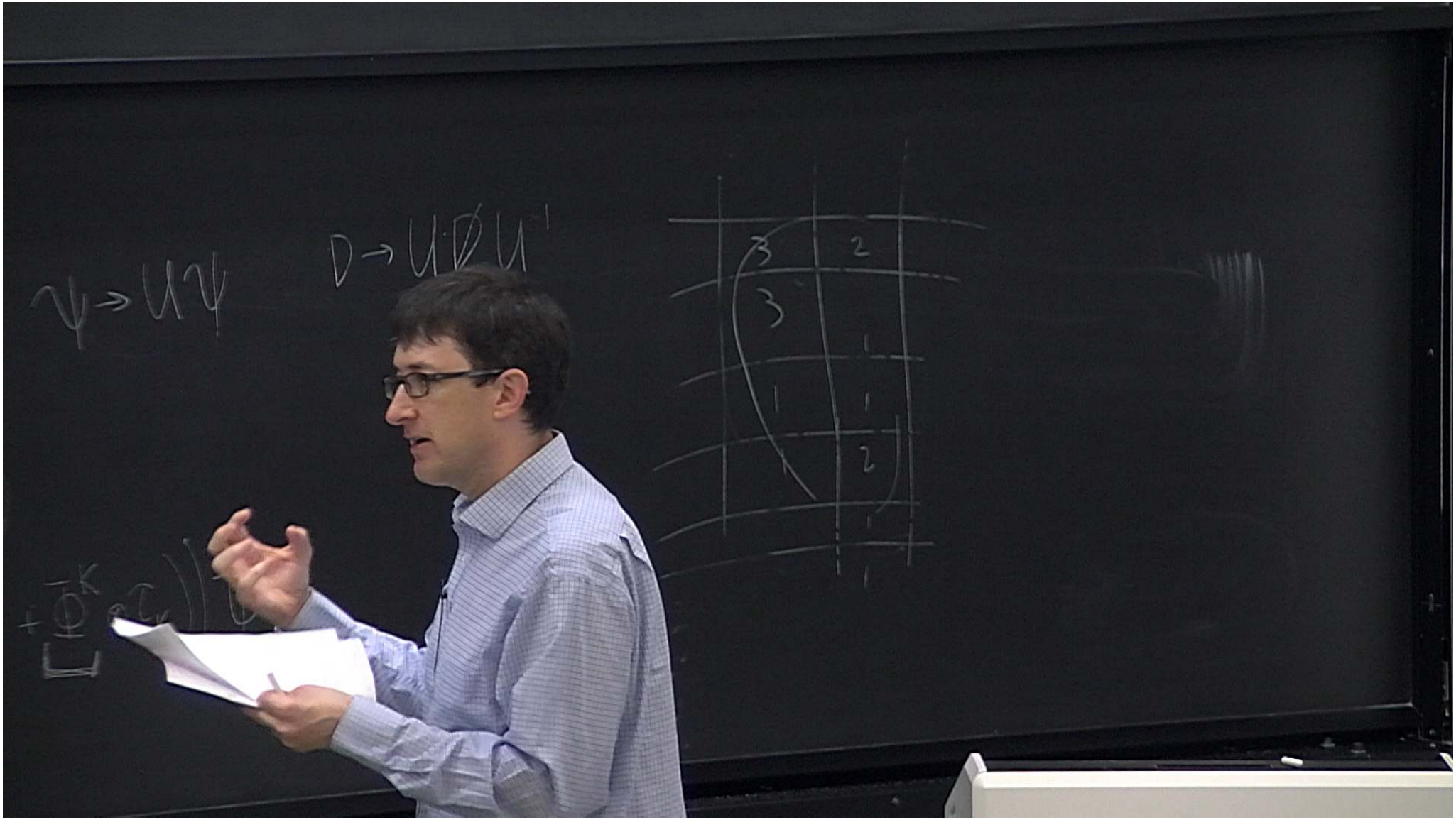


A_F $\qquad$ H_F

$$B_F = A_F \oplus H_F$$


M × F
M₁ : D₁, γ₁ → iϕ, γ₅
M₂ : D₂, γ₂ → D_F, γ_F
H₁
H₂
D = iϕ ⊗ 1_F ⊕ γ₅ ⊗ D_F
H = H₁ ⊗ H₂
ψ̄^i (iϕ δ_ij − m_ij) ψ^j →
↳ ψ̄ (iϕ ⊗ 1_F + γ₅ ⊗ D_F) ψ = ψ̄ D ψ


$= H_1 \otimes H_2$
$\psi \to U\psi$
$D \to UDU^\dagger$
$\bar{\psi}^i (i\partial \delta_{ij} - m_{ij}) \psi^j \to$
$\bar{\psi} (i\partial \otimes 1_F + \gamma_5 \otimes D_F) \psi = \bar{\psi} D \psi$
$\bar{\psi} ((i\partial \otimes 1 + A^k \otimes \tau_k) + \gamma^5 (1 \otimes D_F^0 + \bar{\Phi}^k \otimes \tau_k)) \psi$


ψ → Uψ
D → UDU'