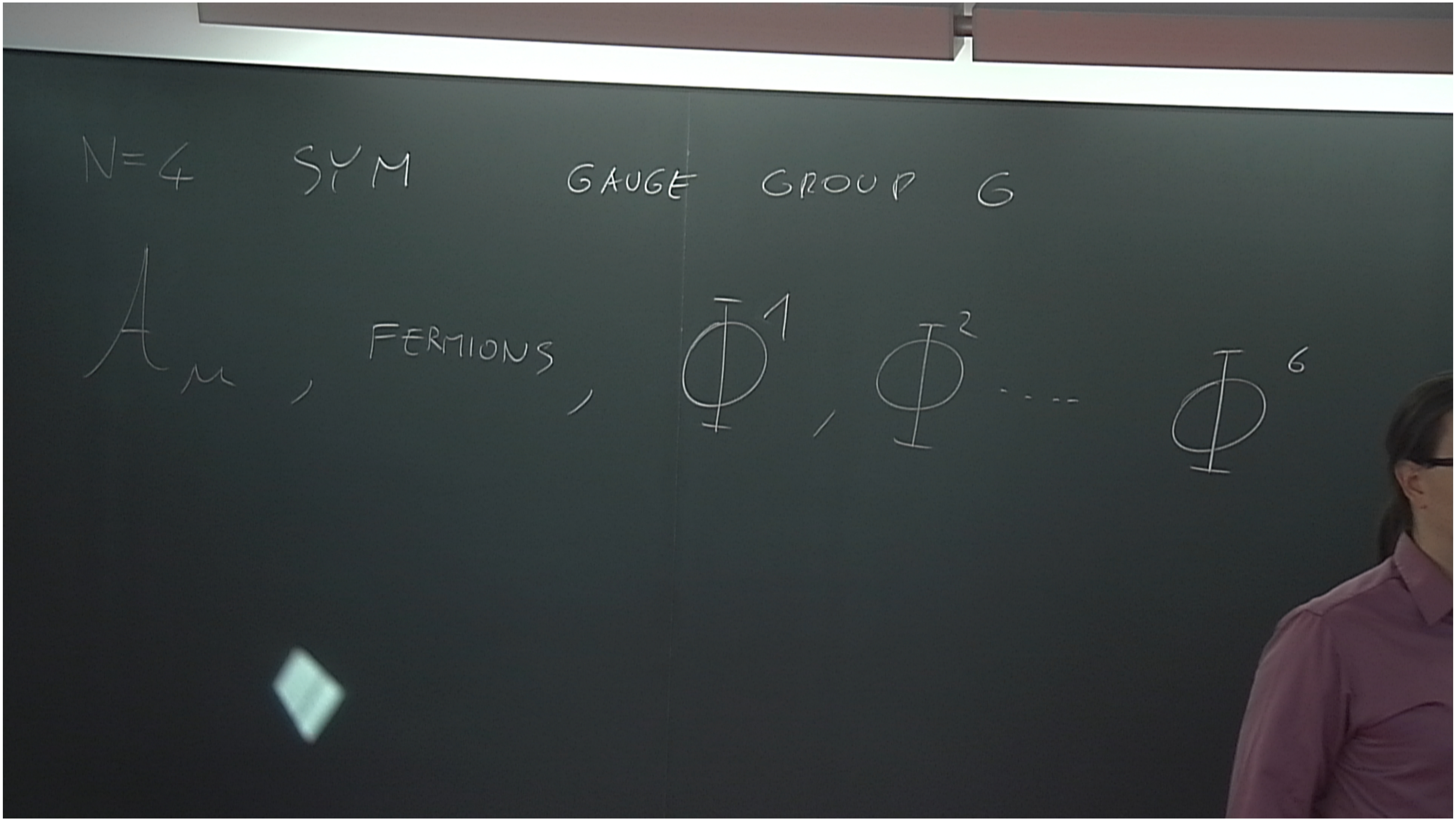
Title: Strings Group Meeting

Date: Oct 07, 2016 10:00 AM

URL: http://pirsa.org/16100055

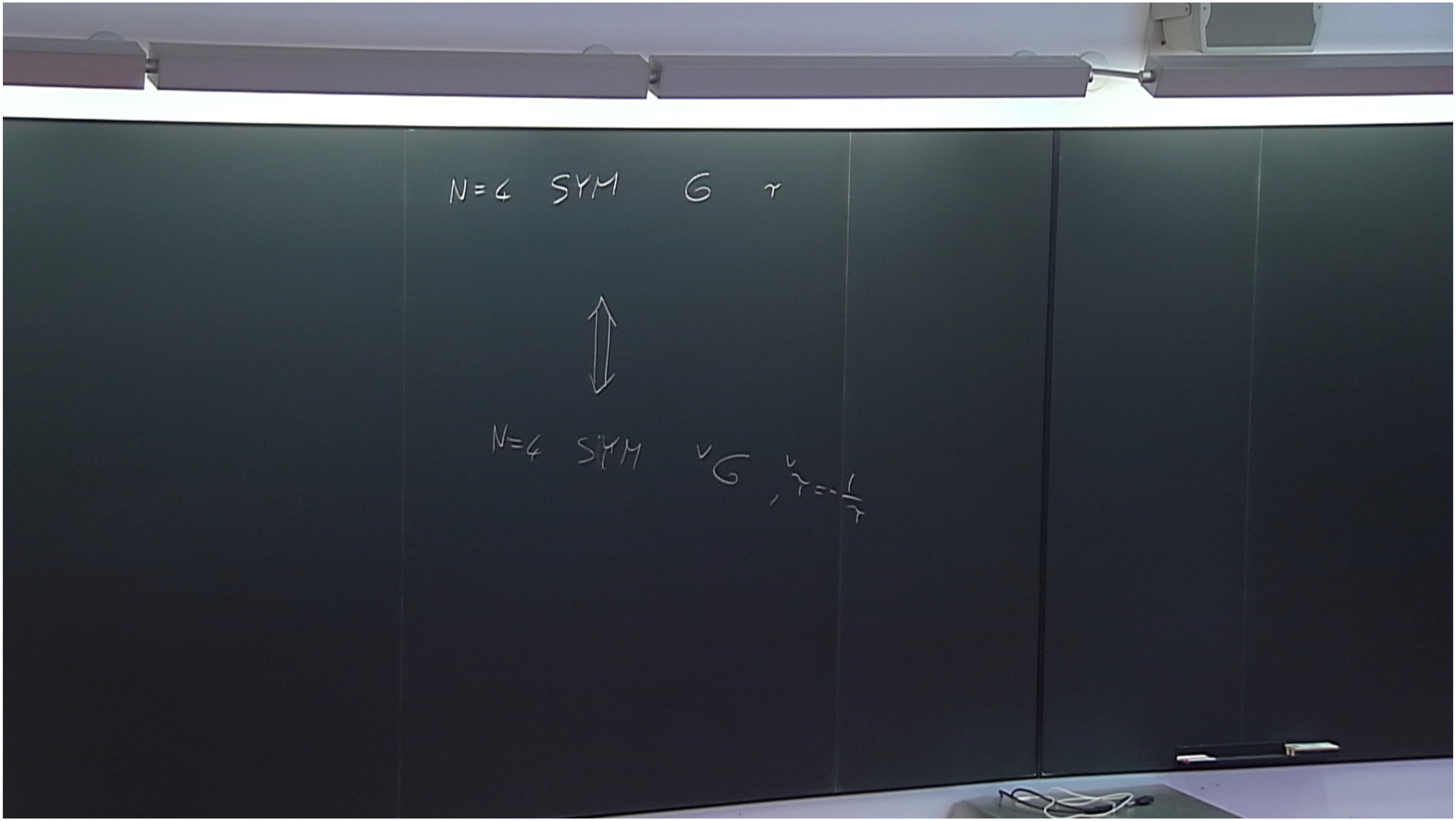
Abstract:

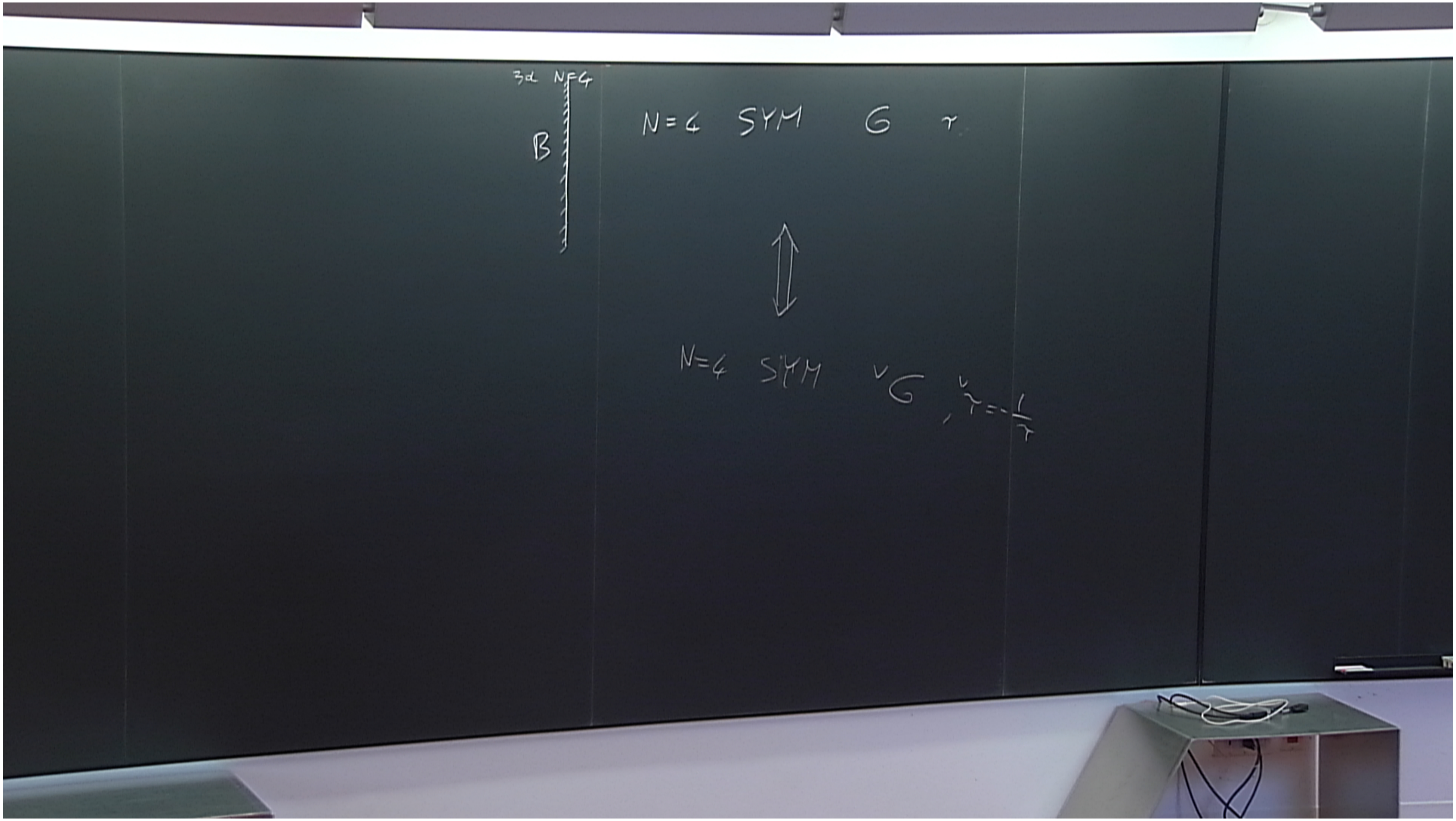

N=4 SYM GAUGE GROUP G
A_μ , FERMIONS , Φ^1 , Φ^2 .... Φ^6

$$\mathrm{Tr}\left[F_{\mu\nu}^2 + (D_\mu \Phi^i)^2 + [\Phi^i, \Phi^j]^2 + \text{FERMIONS} + \frac{\theta}{2\pi} F \wedge F \right]$$

g_{YM}

$$\frac{i}{g_{YM}^2} + \frac{\theta}{2\pi} = \tau$$

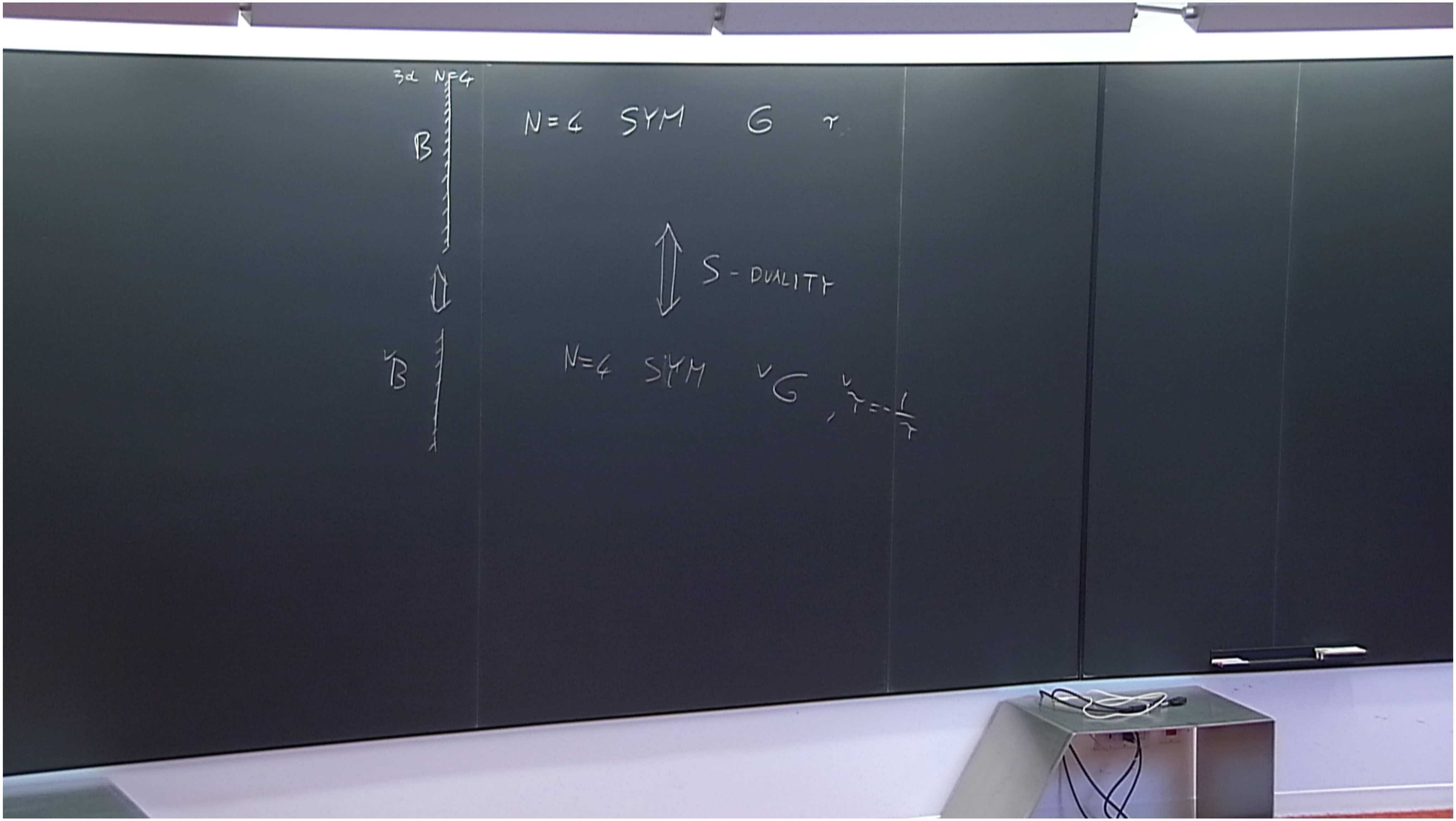

N=4 SYM G τ
N=4 SYM ᴸG , ᴸτ = -1/τ


3d N=4
B
N=4 SYM G τ
N=4 SYM ᵛG ᵛτ = -1/τ

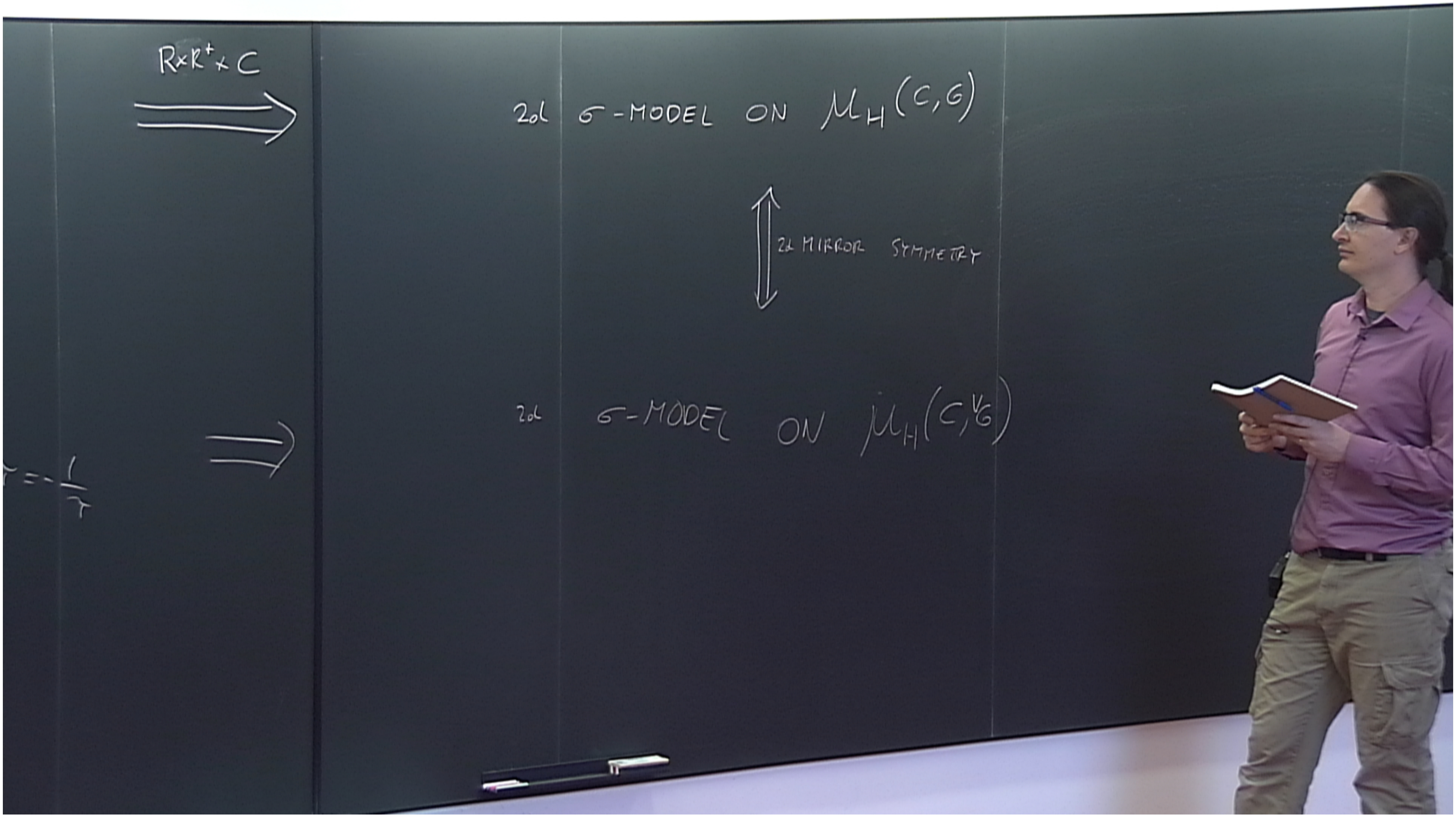
$$\mathrm{Tr}\left[F_{\mu\nu}^2 + (D_\mu \Phi^i)^2 + [\Phi^i, \Phi^j]^2 + \text{FERMIONS} + \frac{\theta}{2\pi} F \wedge F \right]$$

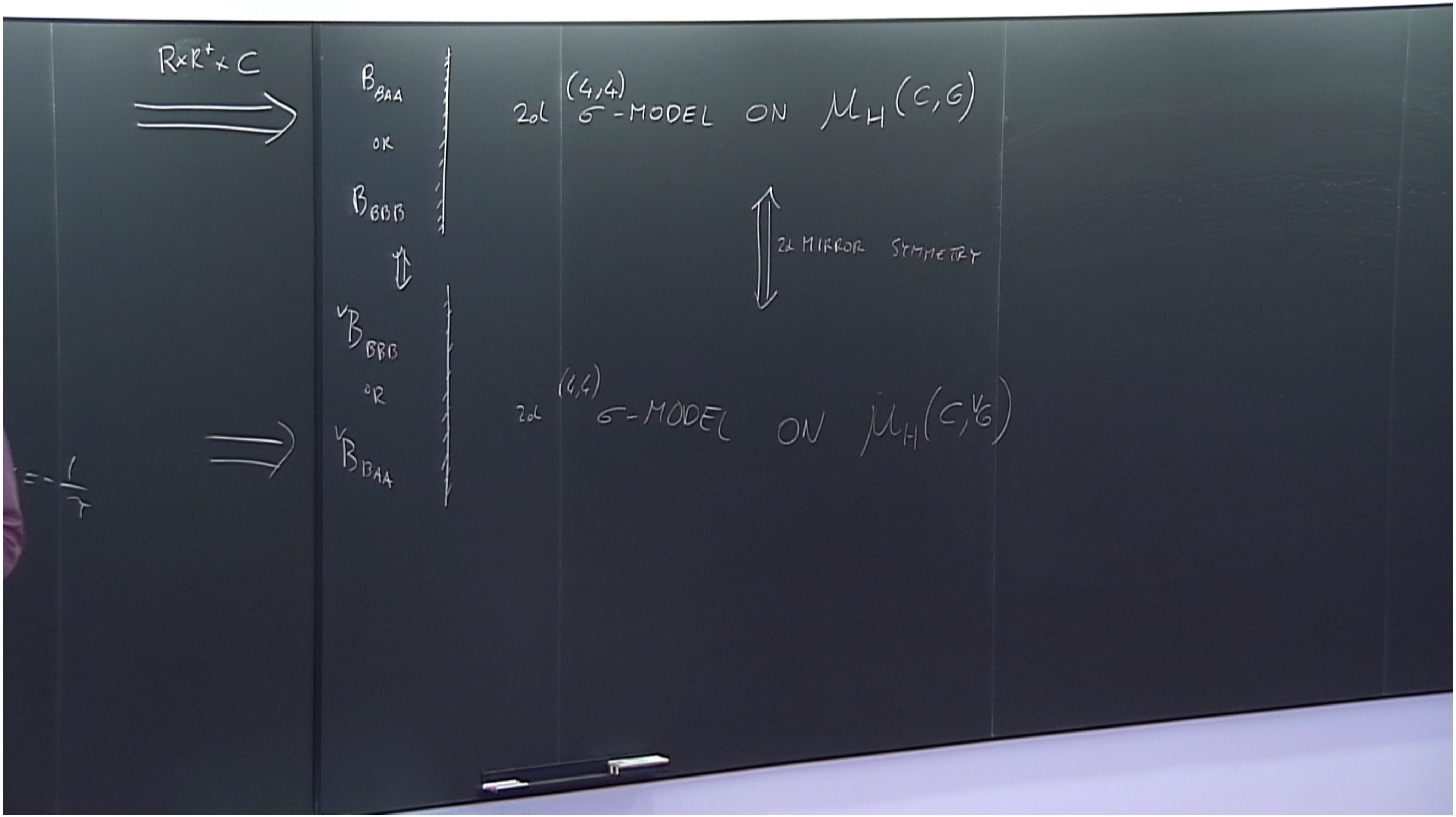
g_{YM} $\qquad \frac{i}{g_{YM}^2} + \frac{\theta}{2\pi} = \tau$

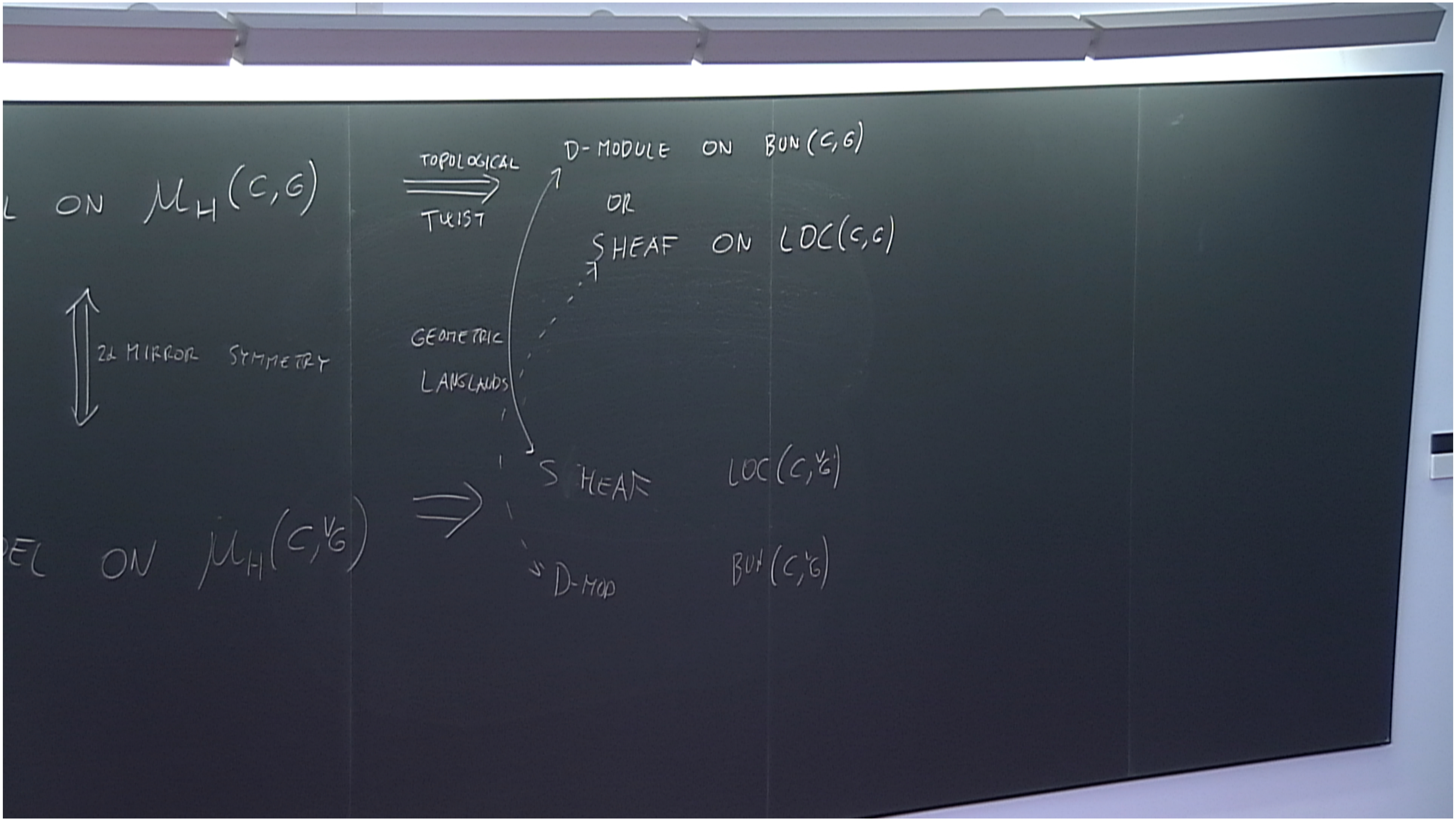
$$\{Q^i, Q_j\} = C_{\cdot} P^{\cdot}$$

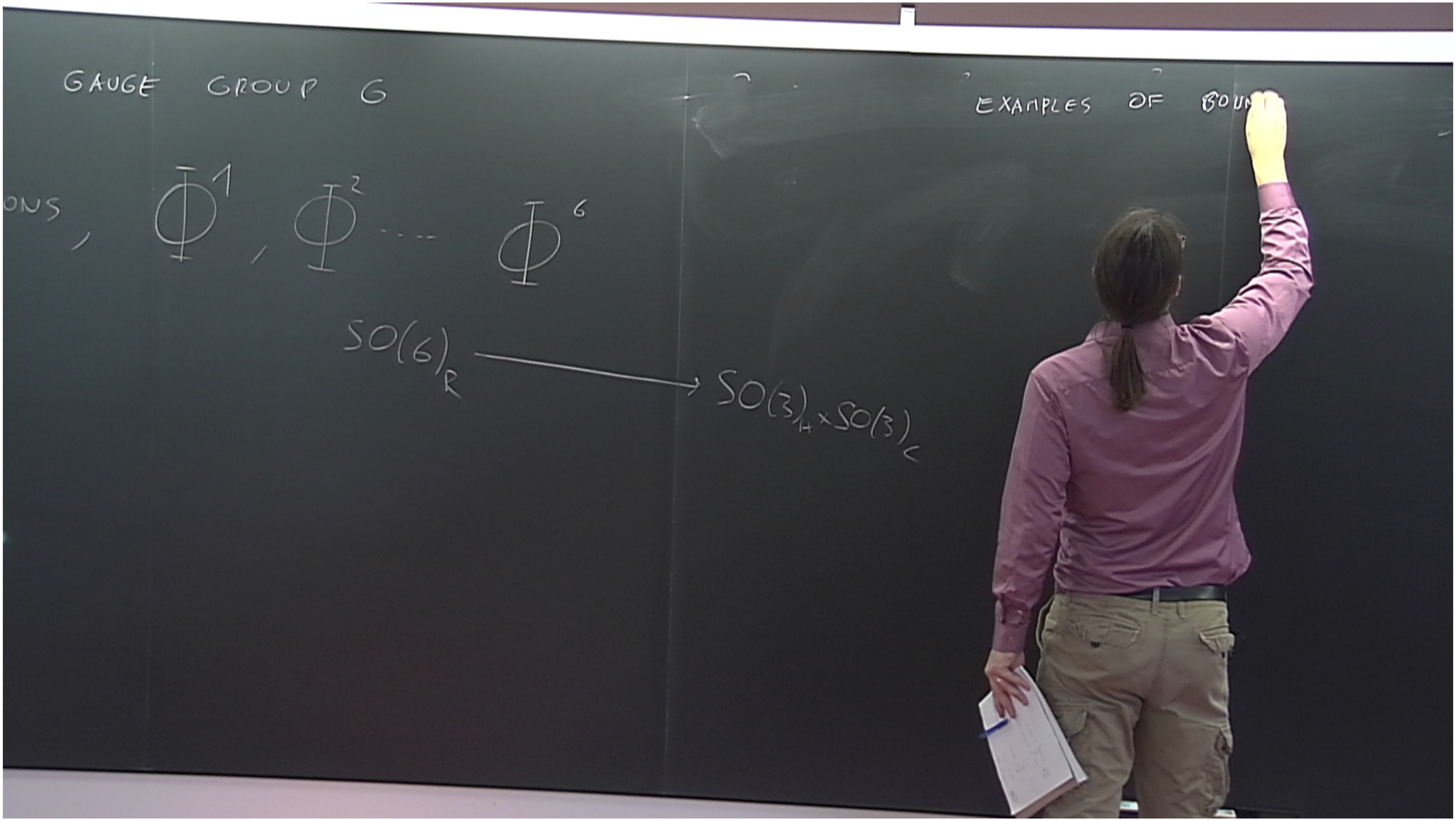

3d N=4
B
ᵛB
N=4 SYM G τ
S - DUALITY
N=4 SYM ᵛG , ᵛτ = -1/τ


$R \times R^+ \times C$
DUALITY
G τ
${}^\vee G$ ${}^\vee\tau = -\frac{1}{\tau}$


$R \times R^+ \times C$
2d σ-MODEL ON $\mathcal{M}_H(C,G)$
2d MIRROR SYMMETRY
2d σ-MODEL ON $\mathcal{M}_H(C,{}^LG)$
$\tau = -\frac{1}{\tau}$


$\mathbb{R} \times \mathbb{R}^+ \times C$
B_{BAA}
OR
B_{BBB}
${}^{\vee}B_{BBB}$
OR
${}^{\vee}B_{BAA}$
2d $(4,4)$ σ-MODEL ON $\mathcal{M}_H(C, G)$
2d MIRROR SYMMETRY
2d $(4,4)$ σ-MODEL ON $\mathcal{M}_H(C, {}^{\vee}G)$
$= -\frac{1}{\tau}$


L ON $\mathcal{M}_H(C,G)$
TOPOLOGICAL
TWIST
D-MODULE ON BUN(C,G)
OR
SHEAF ON LOC(C,G)
2d MIRROR SYMMETRY
GEOMETRIC
LANGLANDS
SHEAF LOC(C,$^\vee G$)
EL ON $\mathcal{M}_H(C,{}^\vee G)$
D-MOD BUN(C,$^\vee G$)

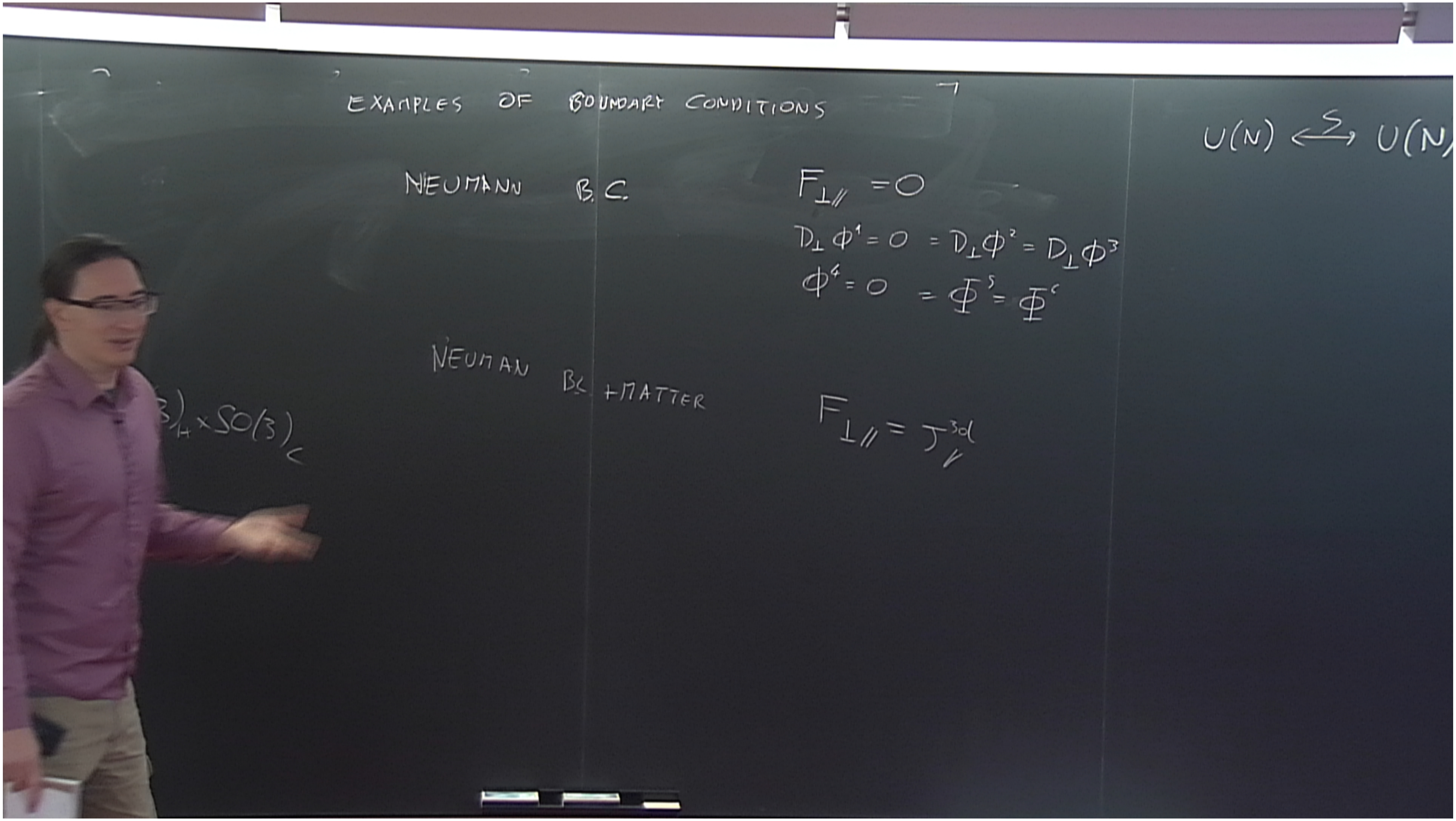

GAUGE GROUP G
EXAMPLES OF BOU
ONS , Φ^1 , Φ^2 .... Φ^6
$SO(6)_R \longrightarrow SO(3)_H \times SO(3)_C$

EXAMPLES OF BOUNDARY CONDITIONS

$U(N) \xleftrightarrow{S} U(N$

NEUMANN B.C. $F_{\perp /\!/} = 0$

$\rightarrow SO(3)_H \times SO(3)_C$


EXAMPLES OF BOUNDARY CONDITIONS
$U(N) \xleftrightarrow{S} U(N)$
NEUMANN B.C.
$F_{\perp\parallel} = 0$
$D_\perp \Phi^1 = 0 = D_\perp \Phi^2 = D_\perp \Phi^3$
$\Phi^4 = 0 = \Phi^5 = \Phi^6$
NEUMAN B.C. + MATTER
$F_{\perp\parallel} = J^{3d}_{\parallel}$
$3)_H \times SO(3)_C$

EXAMPLES OF BOUNDARY CONDITIONS

$U(N) \xleftrightarrow{S} U(N)$

NEUMANN B.C.

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$\rightarrow SO(3)_H \times SO(3)_C$

NEUMAN B.C. + MATTER

$F_{\perp /\!/} = J^{3d}_{/\!/}$

$\Phi^4 = \mu_1^{3d}$ $\Phi^5 = \mu_2^{3d}$ $\Phi^6 = \mu_3^{3d}$

EXAMPLES OF BOUNDARY CONDITIONS

$U(N) \xleftrightarrow{S} U(N$

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$D_\perp \Phi^1 = 0 = D_\perp \Phi^2 = D_\perp \Phi^3$

$\Phi^4 = 0 = \Phi^5 = \Phi^6$

$\longrightarrow SO(3)_H \times SO(3)_C$

NEUMAN BC + MATTER

$F_{\perp /\!/} = J^{3d}_{/\!/}$

$\Phi^4 = \mu_1^{3d} \quad \Phi^5 = \mu_2^{3d} \quad \Phi^6 = \mu_3^{3d}$

DIRICHLET

$A_{/\!/} = 0$

$\Phi^1 = \Phi^2 = \Phi^3 = 0$

$D_\perp \Phi^4 = D_\perp \Phi^5 = D_\perp \Phi^6 = 0$

EXAMPLES OF BOUNDARY CONDITIONS

$U(N) \xleftrightarrow{S} U(N)$

NEUMANN B.C.

$F_{\perp /\!/} = 0$

$D_\perp \Phi^1 = 0 = D_\perp \Phi^2 = D_\perp \Phi^3$

$\Phi^4 = 0 = \Phi^5 = \Phi^6$

NEUMAN BC + MATTER

$\longrightarrow SO(3)_H \times SO(3)_C$

$F_{\perp /\!/} = J^{3d}_{/\!/}$

$\Phi^4 = \mu_1^{3d} \quad \Phi^5 = \mu_2^{3d} \quad \Phi^6 = \mu_3^{3d}$

DIRICHLET

(G SYMMETRY)

$A_{/\!/} = a^{3d}_{/\!/}$

$\Phi^1 = \Phi^2 = \Phi^3 = \varphi^{3d}_{i}$

$D_\perp \Phi^4 = D_\perp \Phi^5 = D_\perp \Phi^6 = 0$

EXAMPLES OF BOUNDARY CONDITIONS

$SO(6) \to SO(3) \times SO(3)$

$U(N) \xleftrightarrow{S} U$

NEUMANN B.C.

$$F_{\perp /\!/} = 0$$

$$D_\perp \Phi^1 = 0 = D_\perp \Phi^2 = D_\perp \Phi^3$$

$$\Phi^4 = 0 = \Phi^5 = \Phi^6$$

NEUMAN BC + MATTER

$$F_{\perp /\!/} = J^{3d}_{/\!/}$$

$$\Phi^4 = \mu^{3d}_1 \qquad \Phi^5 = \mu^{3d}_2 \qquad \Phi^6 = \mu^{3d}_3$$

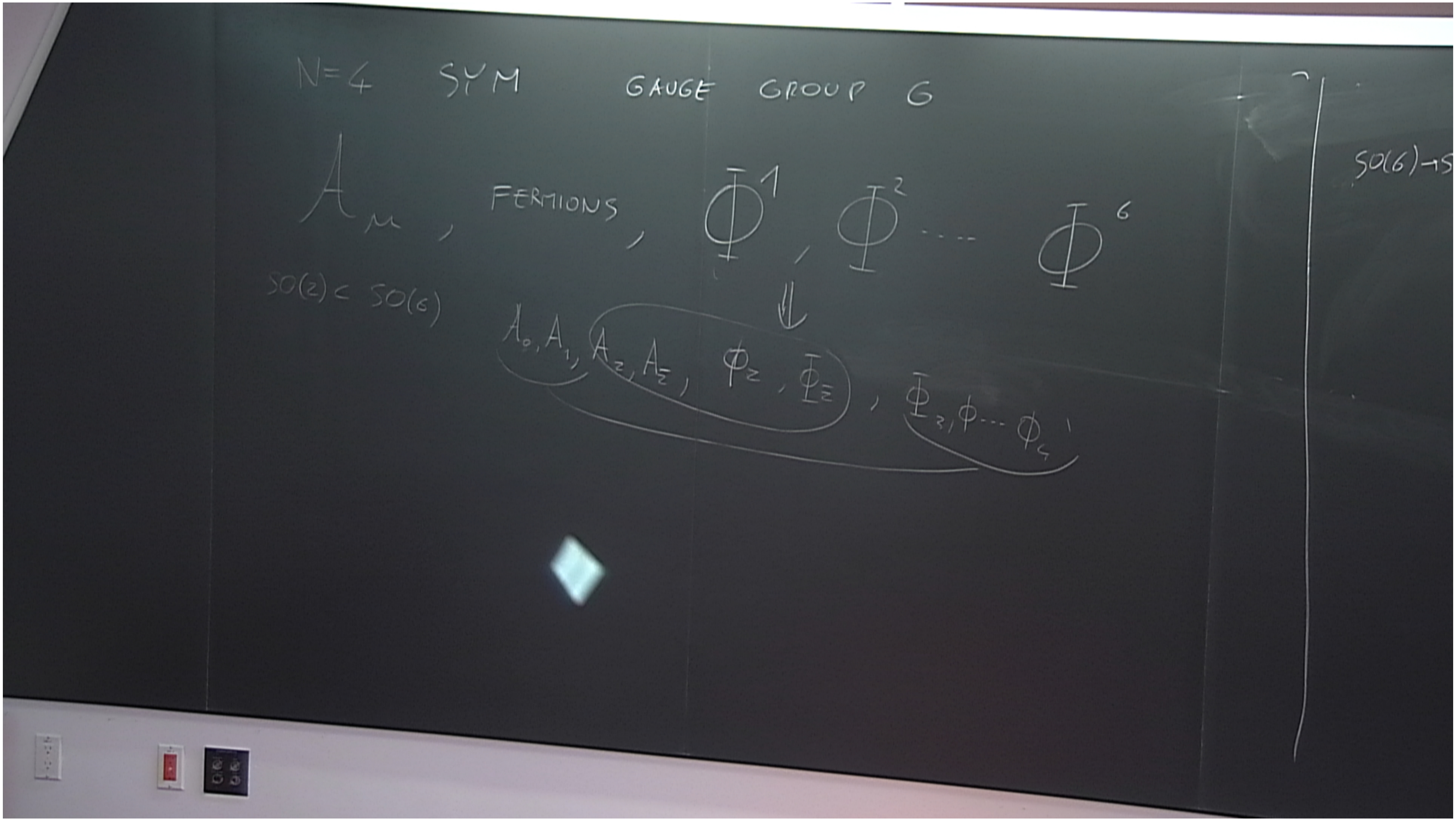
DIRICHLET

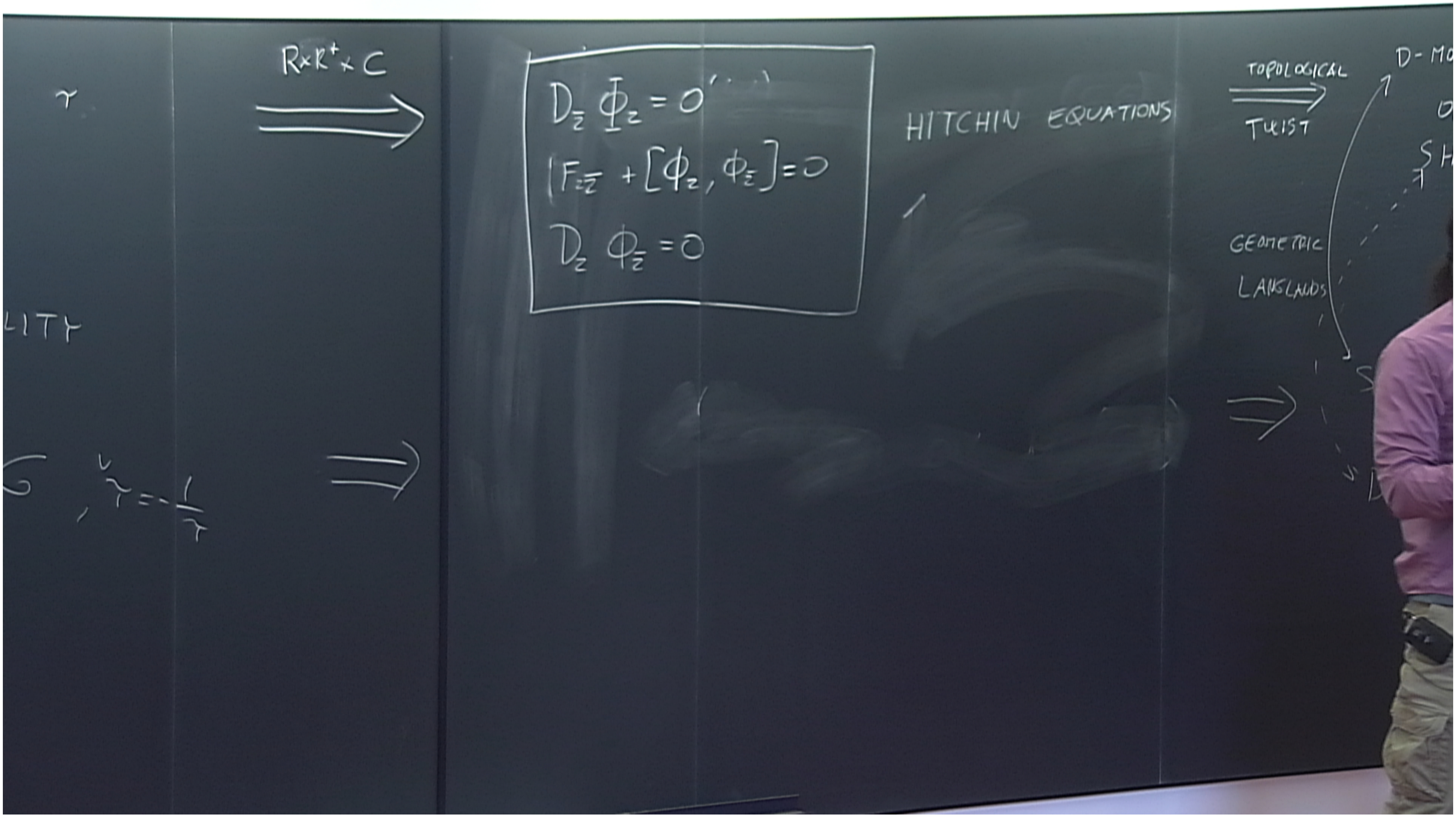
(G SYMMETRY!)

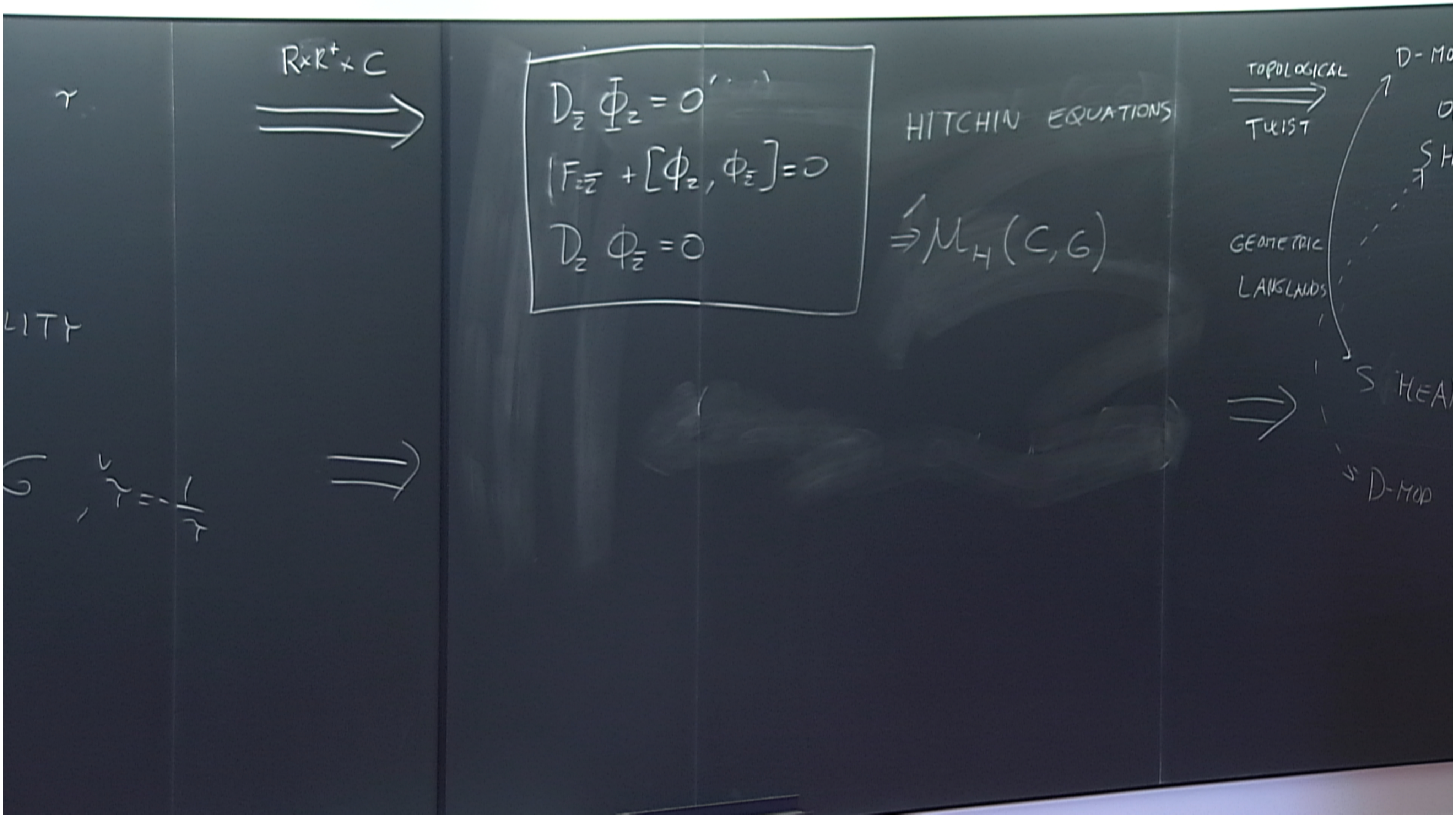
$$A_{/\!/} = a^{3d}_{/\!/}$$

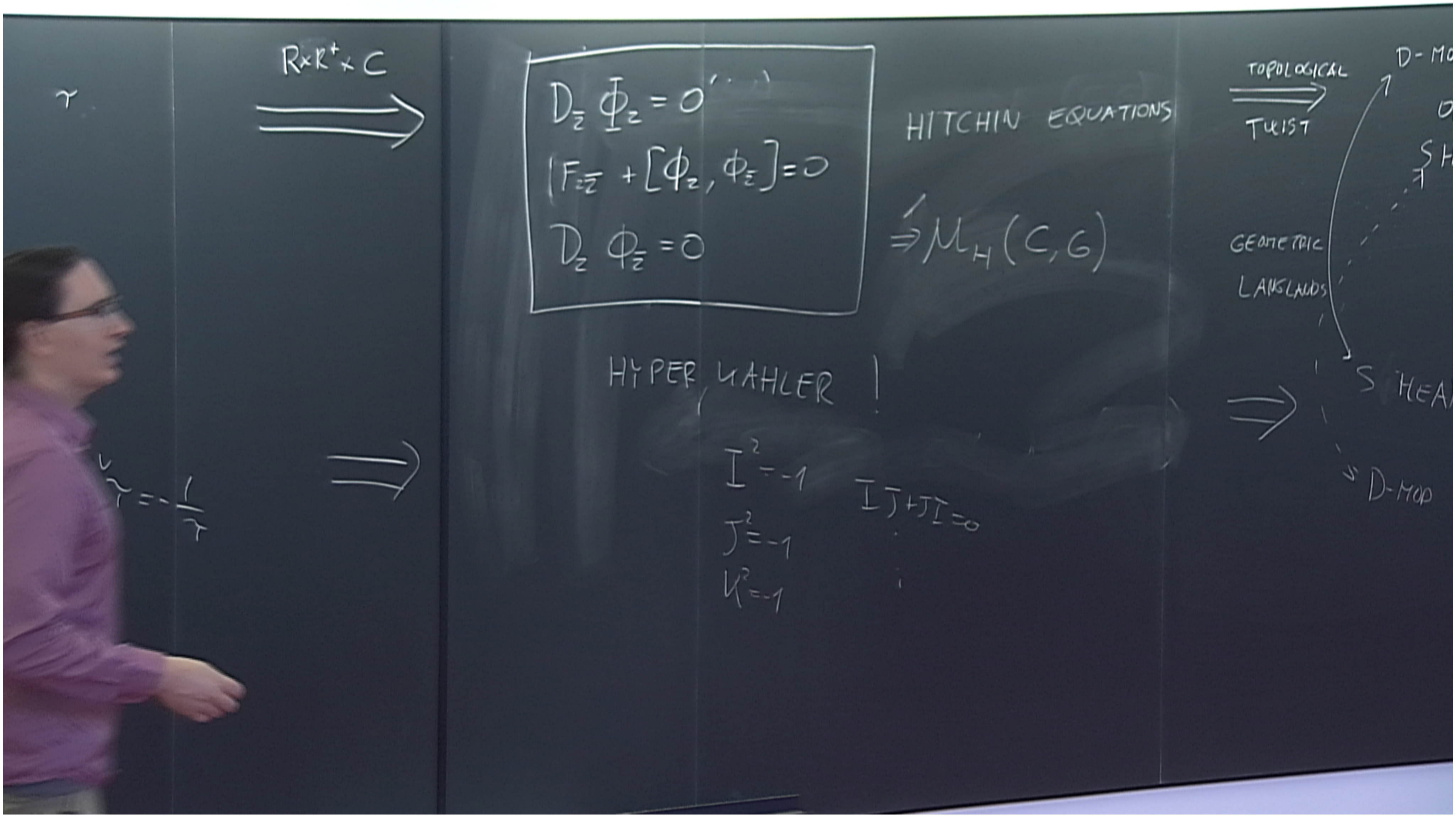
$$\Phi^1 = \Phi^2 = \Phi^3 = \varphi^{1,2,3}_{3d}$$

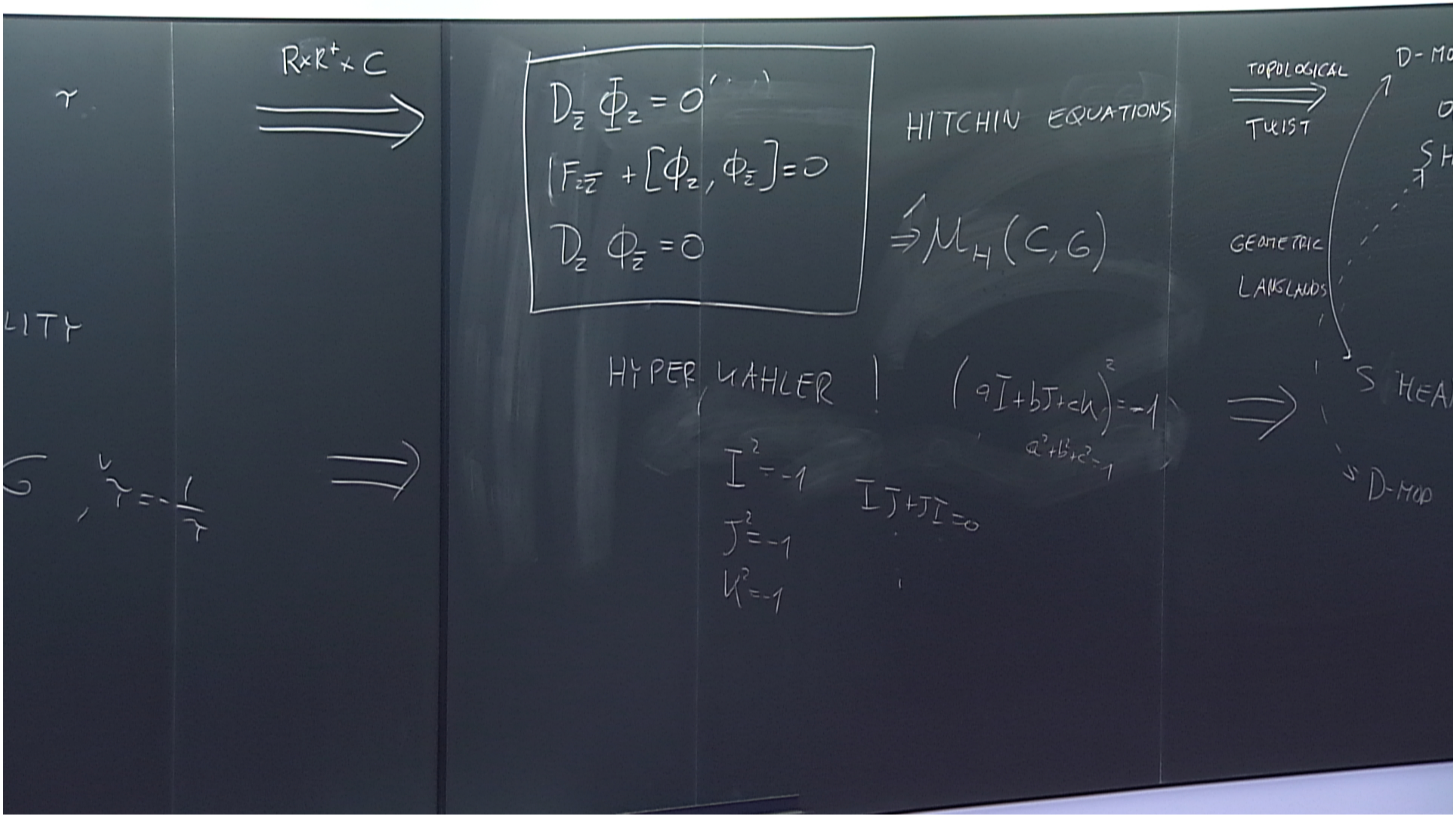
$$D_\perp \Phi^4 = D_\perp \Phi^5 = D_\perp \Phi^6 = 0$$

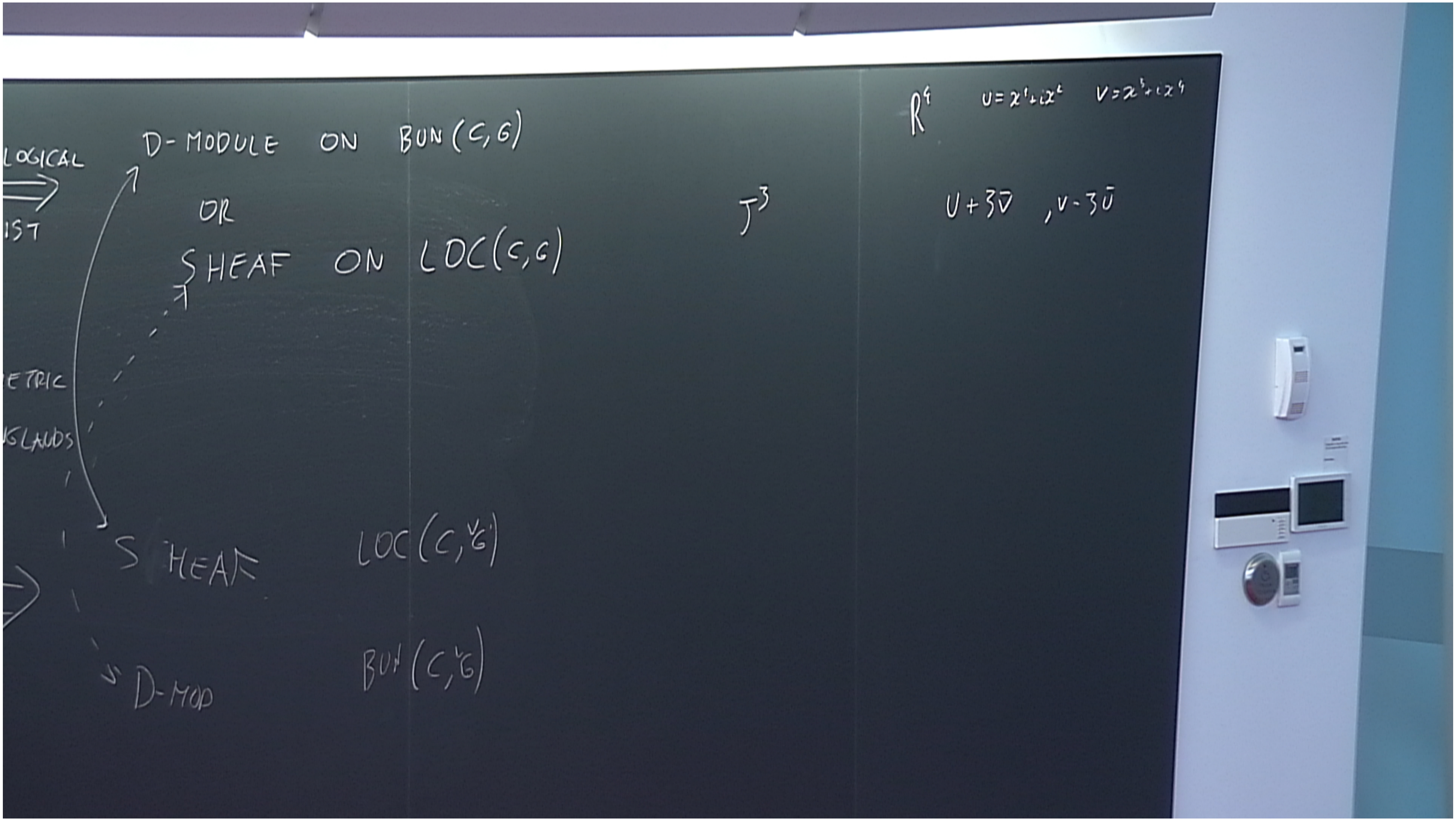

N=4 SYM GAUGE GROUP G
A_μ, FERMIONS, Φ^1, Φ^2 .... Φ^6
SO(2) < SO(6)
$A_0, A_1, A_z, A_{\bar z}, \phi_z, \Phi_{\bar z}, \Phi_3, \phi \dots \phi_6$
SO(6)→S

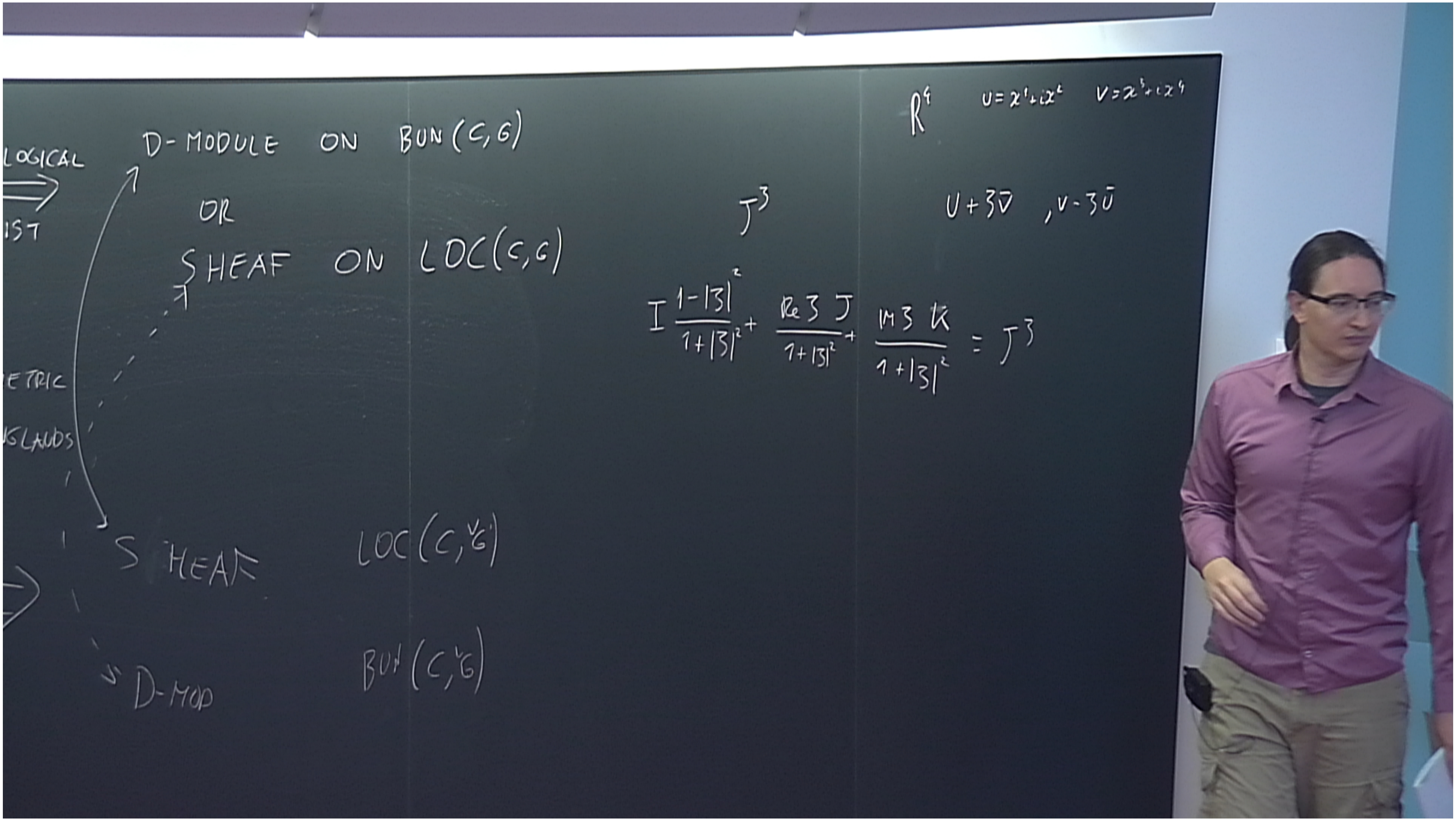

$R \times R^+ \times C$
$D_{\bar{z}} \Phi_z = 0$
$F_{z\bar{z}} + [\Phi_z, \Phi_{\bar{z}}] = 0$
$D_z \Phi_{\bar{z}} = 0$
HITCHIN EQUATIONS
TOPOLOGICAL
TWIST
GEOMETRIC
LANGLANDS

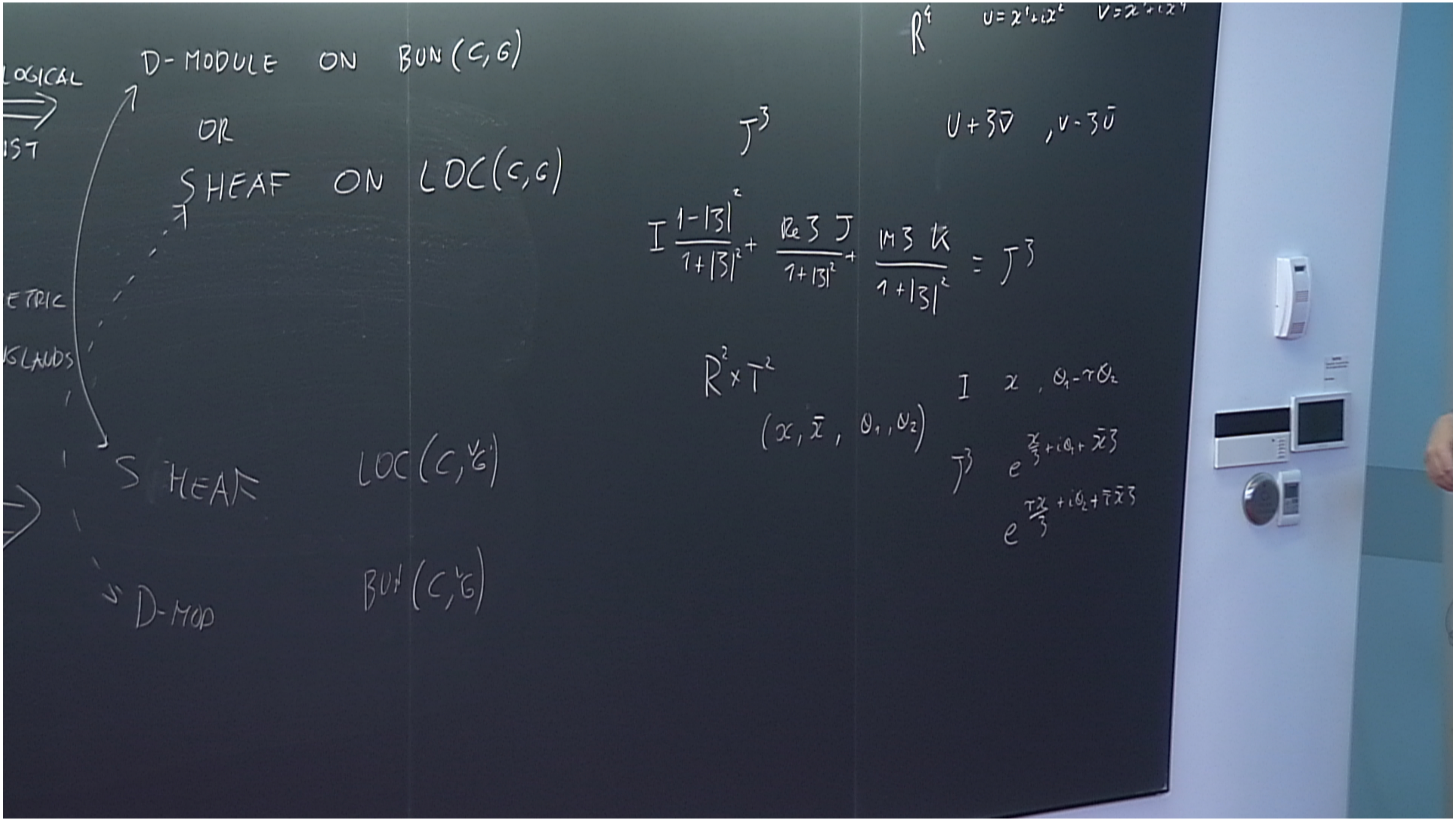

R×R⁺×C
D_z̄ Φ_z = 0
F_zz̄ + [Φ_z, Φ_z̄] = 0
D_z Φ_z̄ = 0
HITCHIN EQUATIONS
⇒ M_H (C, G)
TOPOLOGICAL
TWIST
GEOMETRIC
LANGLANDS
LITY
D-MOD

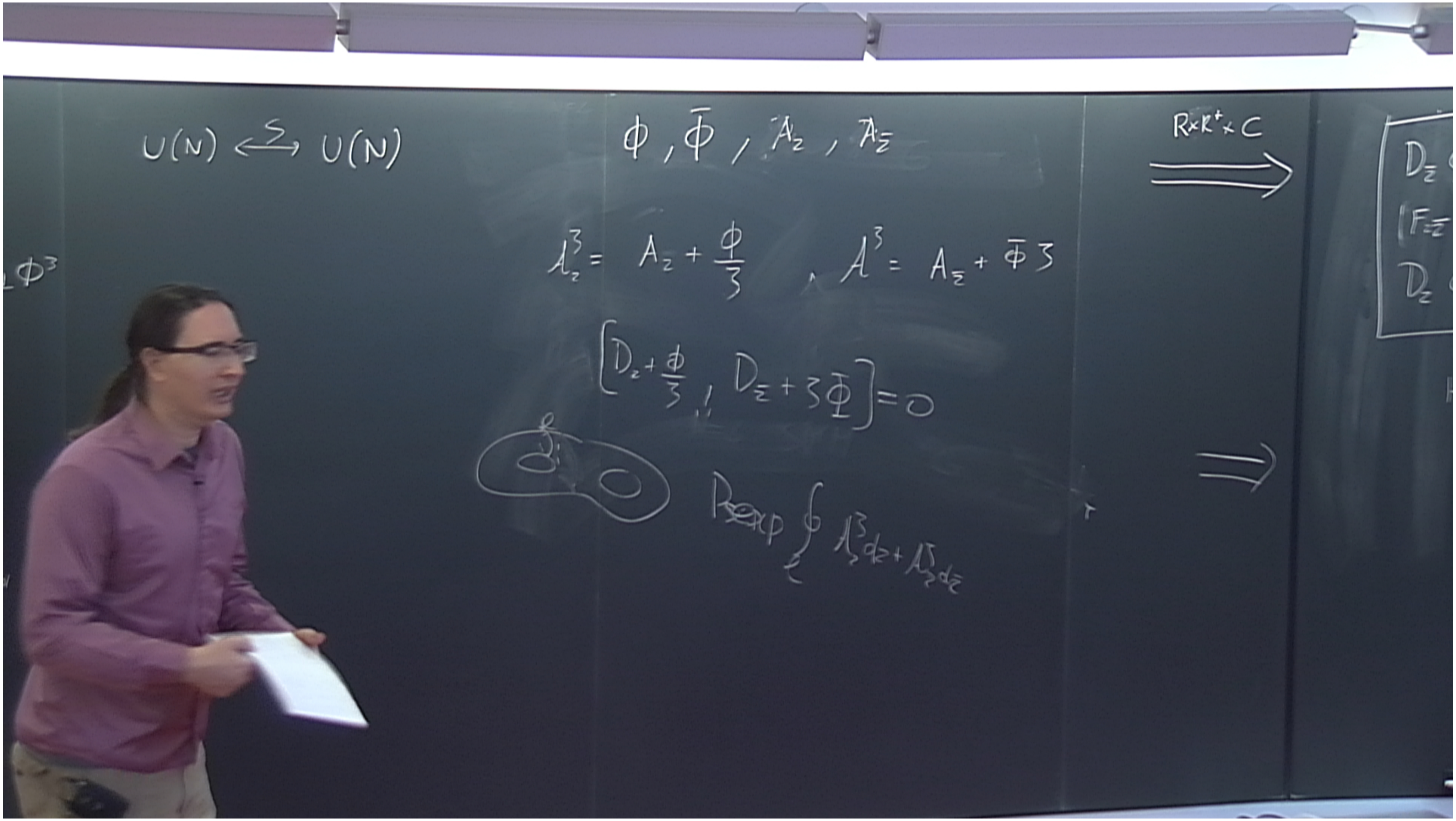

$R \times R^+ \times C$
τ
$D_{\bar z} \Phi_z = 0$
$F_{z\bar z} + [\Phi_z, \Phi_{\bar z}] = 0$
$D_z \Phi_{\bar z} = 0$
HITCHIN EQUATIONS
$\Rightarrow \mathcal{M}_H(C, G)$
HYPER KAHLER !
$I^2 = -1$
$J^2 = -1$
$K^2 = -1$
$IJ + JI = 0$
$\tilde\tau = -\frac{1}{\tau}$
TOPOLOGICAL
TWIST
GEOMETRIC
LANGLANDS
D-MOD
SHEA


R×R⁺×C
τ
LITY
D_z̄ Φ_z = 0
F_zz̄ + [Φ_z, Φ_z̄] = 0
D_z Φ_z̄ = 0
HITCHIN EQUATIONS
⇒ M_H (C, G)
TOPOLOGICAL
TWIST
GEOMETRIC
LANGLANDS
D-MO
SH
HYPER KAHLER !
(aI+bJ+cK)² = -1
a²+b²+c²=1
I² = -1
J² = -1
K² = -1
IJ+JI=0
S HEA
D-MOD


LOGICAL
IST
ETRIC
GLANDS
D-MODULE ON BUN(C,G)
OR
SHEAF ON LOC(C,G)
SHEAF LOC(C,ᴸG)
D-MOD BUN(C,ᴸG)
J³
R⁴ U=x¹+ix² V=x³+ix⁴
U+3V̄ , V-3Ū


LOGICAL
IST
D-MODULE ON BUN(C,G)
OR
SHEAF ON LOC(C,G)
ETRIC
GLANDS
SHEAF
LOC(C,ᴸG)
D-MOD
BUN(C,ᴸG)
J³
I (1-|ζ|²)/(1+|ζ|²) + (Re ζ J)/(1+|ζ|²) + (Im ζ K)/(1+|ζ|²) = J³
R⁴
U = x¹+ix²
V = x³+ix⁴
U+ζV̄ , V-ζŪ


D-MODULE ON BUN(C,G)
OR
SHEAF ON LOC(C,G)
SHEAF
LOC(C,ᴸG)
D-MOD
BUN(C,ᴸG)
T^3
R^4
$U+3\bar{V}$, $V-3\bar{U}$
$I\frac{1-|3|^2}{1+|3|^2}+\frac{\mathrm{Re}\,3\,J}{1+|3|^2}+\frac{\mathrm{Im}\,3\,K}{1+|3|^2}=T^3$
$R^2\times T^2$
$(x,\bar{x},\theta_1,\theta_2)$
I x , $\theta_1-\tau\theta_2$


$U(N) \xleftrightarrow{S} U(N)$
$\phi, \bar{\Phi}, A_z, A_{\bar{z}}$
$R \times R^{+} \times C$
$\mathcal{A}^3_z = A_z + \frac{\phi}{3}, \quad \mathcal{A}^3 = A_{\bar{z}} + \bar{\Phi} 3$
$\left[D_z + \frac{\phi}{3}, D_{\bar{z}} + 3\bar{\Phi}\right] = 0$
$P\exp \oint_{\ell} \mathcal{A}^3_z dz + \mathcal{A}^3_{\bar{z}} d\bar{z}$

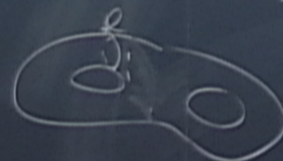
$U(N) \xleftrightarrow{S} U(N)$

$\phi, \bar{\Phi}, A_z, A_{\bar{z}}$

$\xRightarrow{R \times R^+ \times C}$

$\mathcal{A}^3_z = A_z + \frac{\phi}{3}$, $\mathcal{A}^3 = A_{\bar{z}} + \bar{\Phi}\, 3$

$\mathcal{M}^3_H = LOC(C, G)$ $\quad \left[D_z + \frac{\phi}{3}, D_{\bar{z}} + 3\bar{\Phi} \right] = 0$



$P\exp \oint_{\ell} \mathcal{A}^3_z dz + \mathcal{A}^3_{\bar{z}} d\bar{z}$

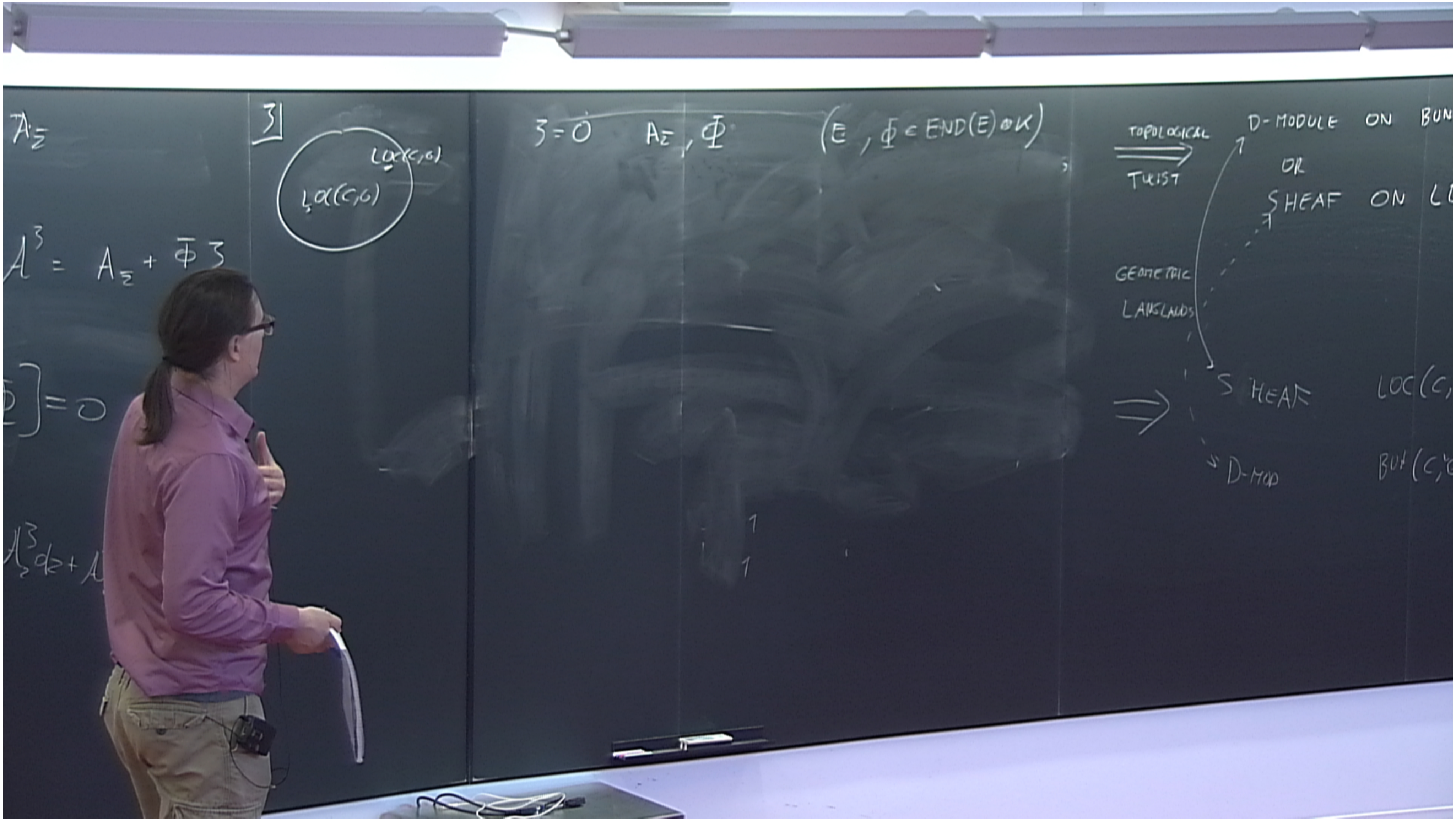
$\Longrightarrow$

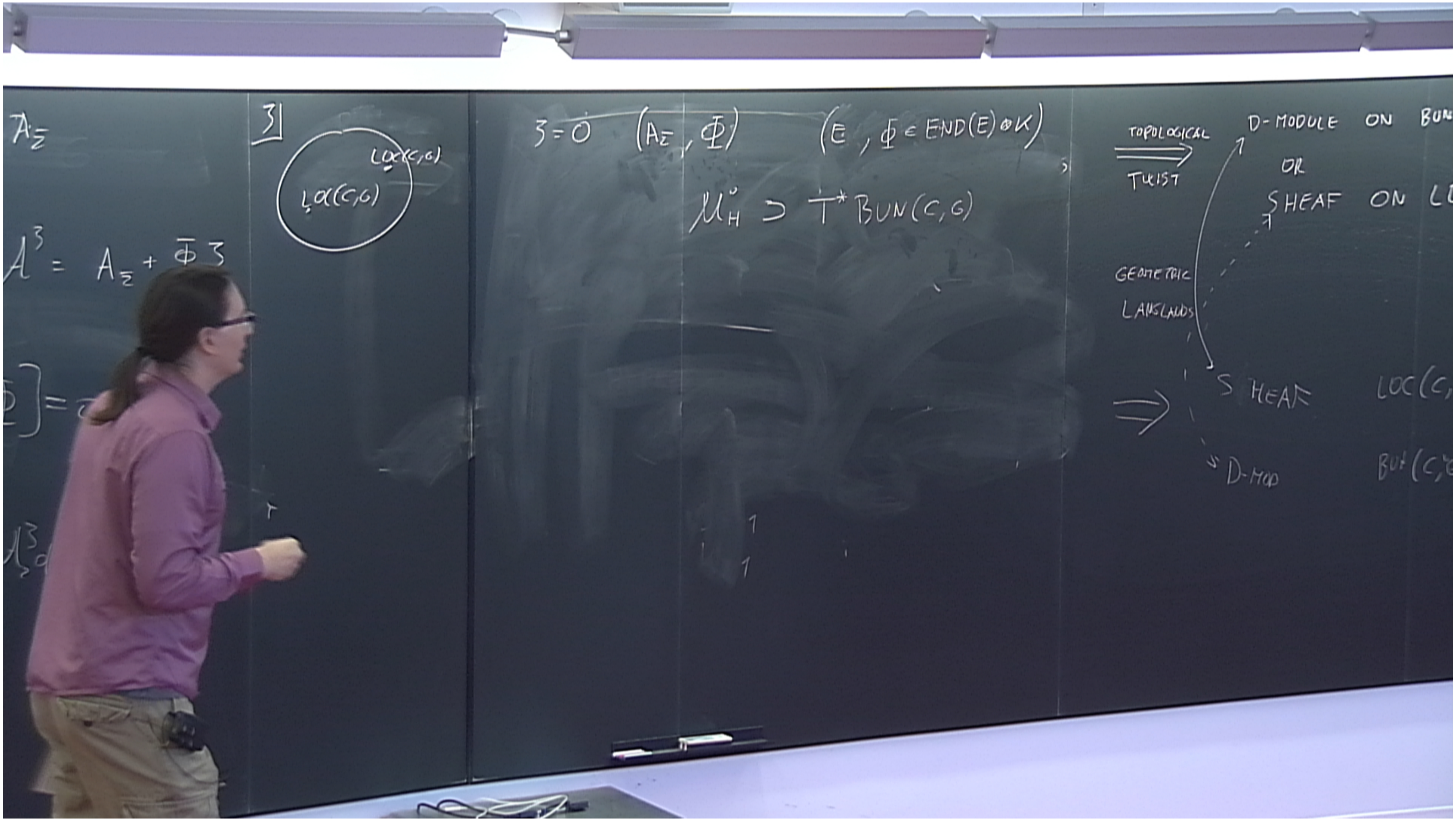
$D_{\bar{z}}$

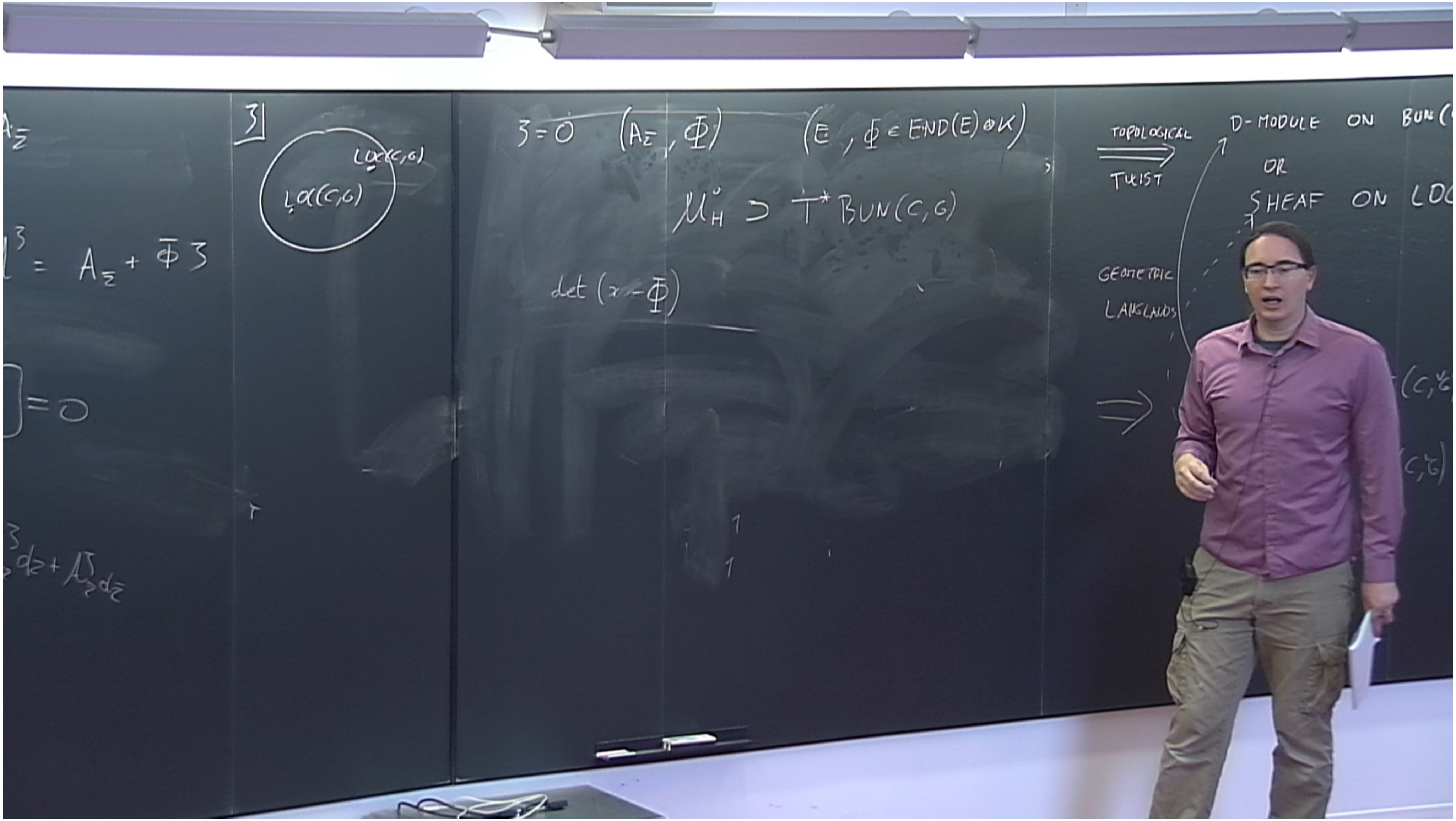
$F_{z\bar{z}}$

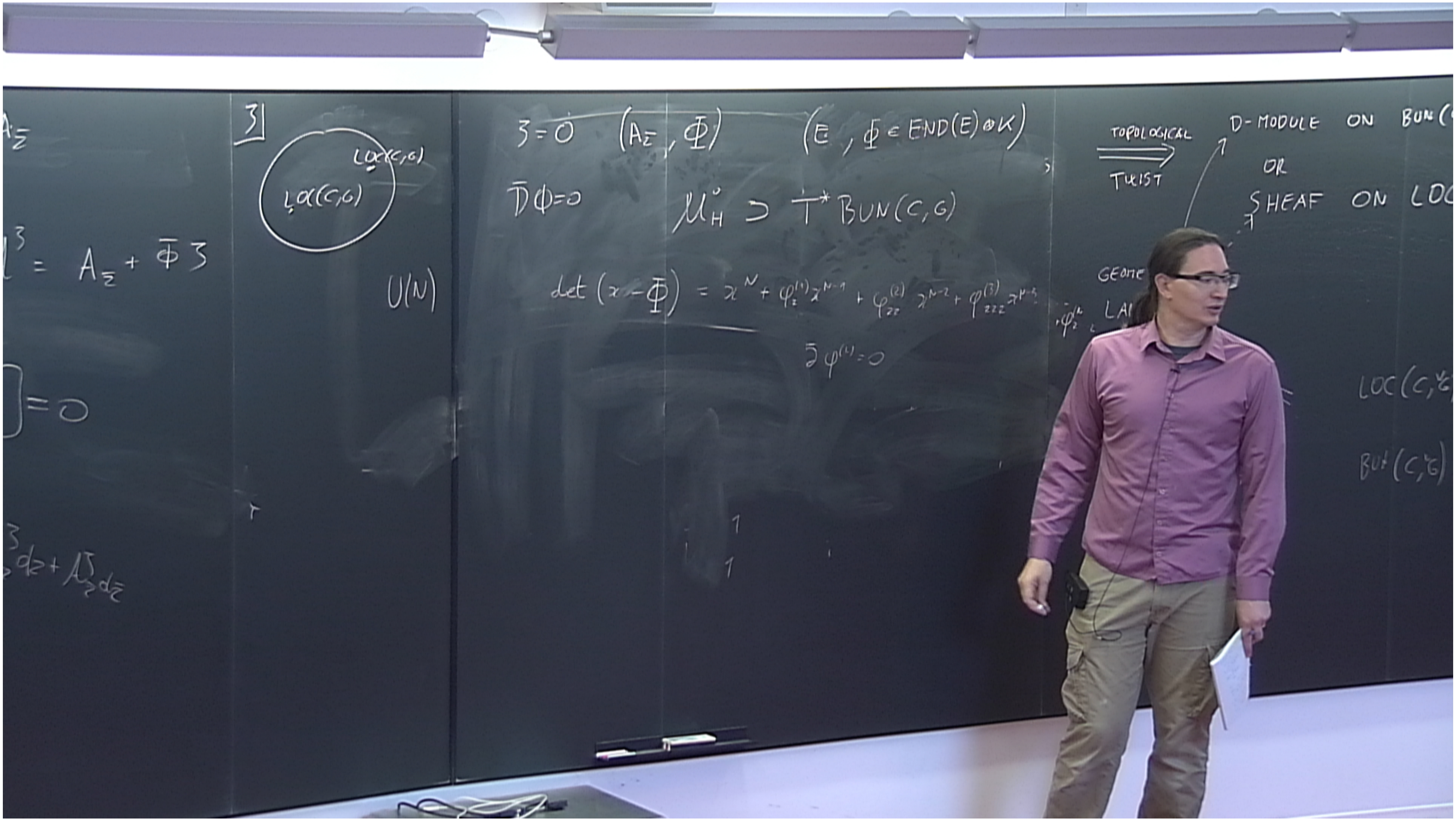
D_z

Φ^3

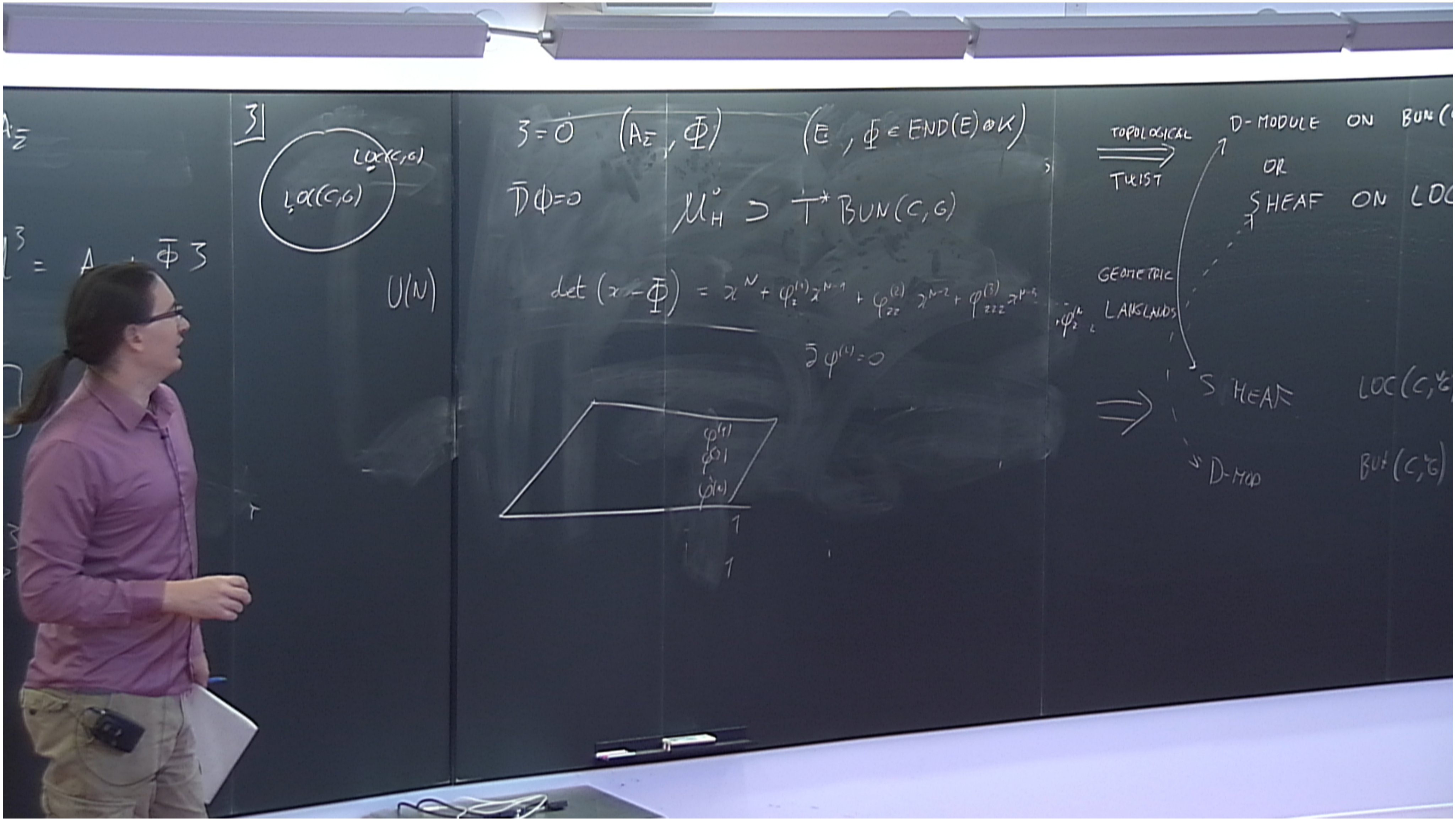

TOPOLOGICAL
TWIST
D-MODULE ON BUN
OR
SHEAF ON L
GEOMETRIC
LANGLANDS
SHEAF
D-MOD

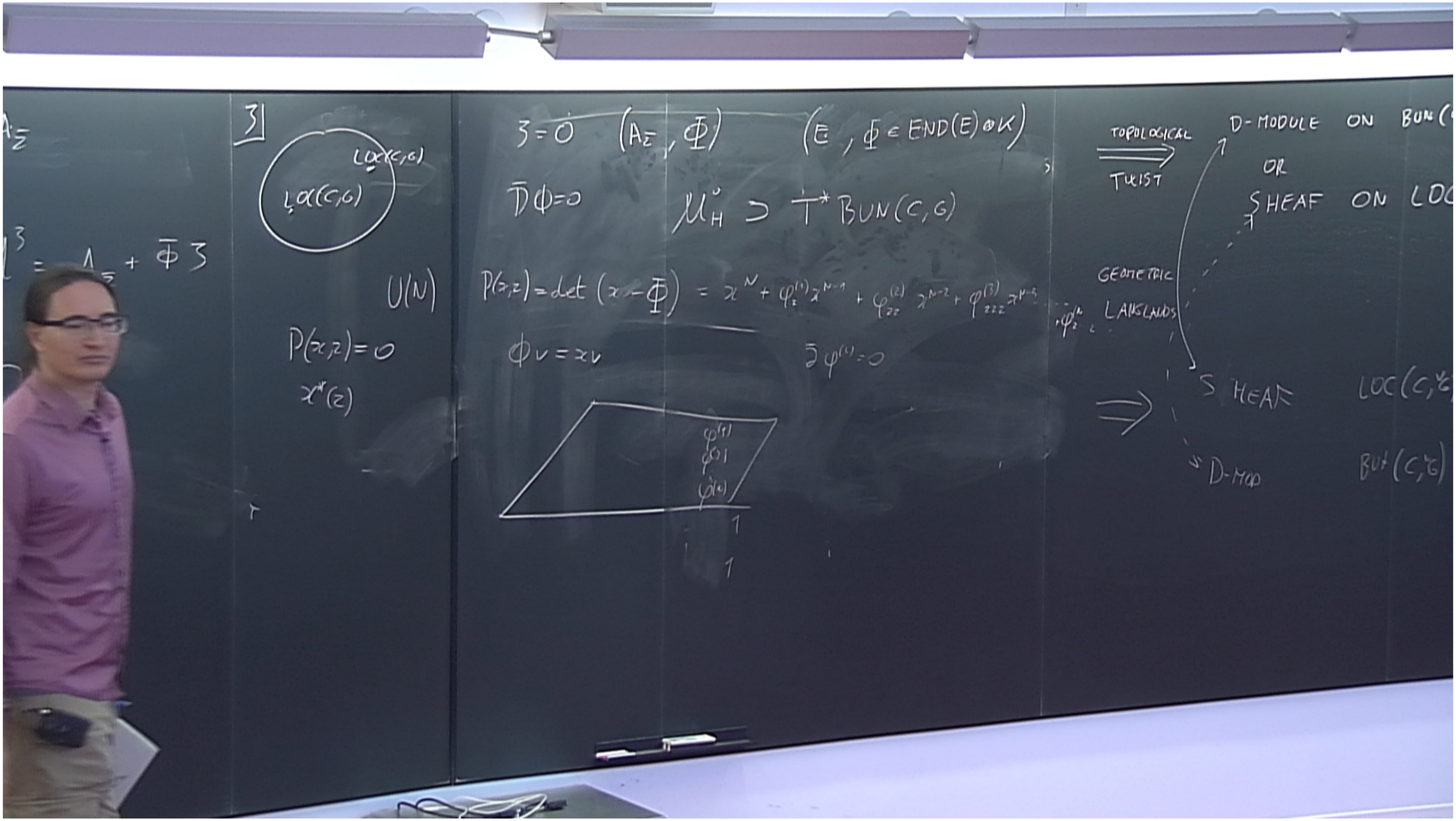

Loc(C,G)
Loc(C,G)
3 = O (A_Z̄ , Φ) (E , Φ ∈ END(E) ⊗ K)
M_H ⊃ T* BUN(C,G)
TOPOLOGICAL
TWIST
D-MODULE ON BUN
OR
SHEAF ON L
GEOMETRIC
LANGLANDS
SHEAF
LOC(C,
D-MOD
BUN(C,

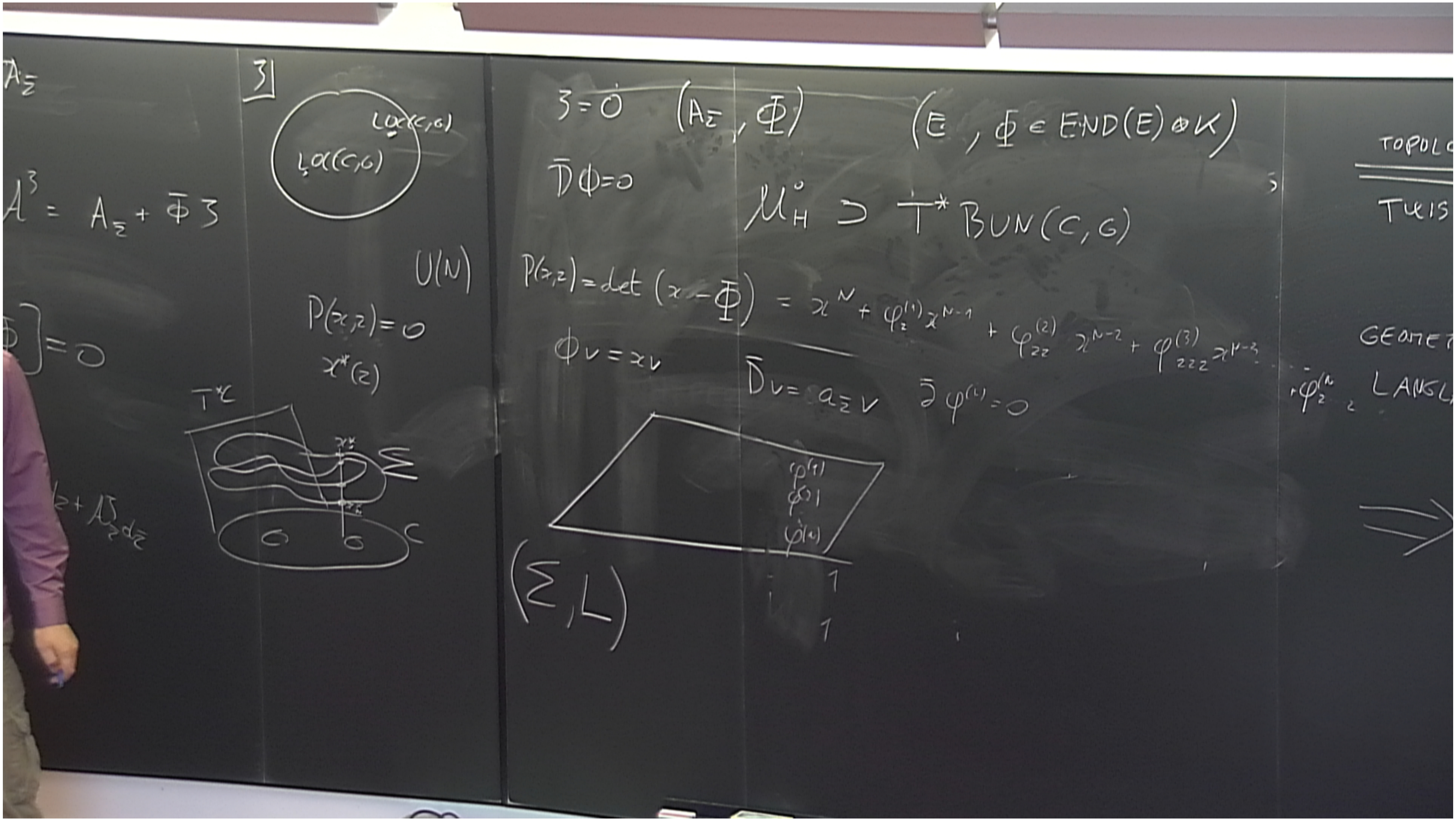

TOPOLOGICAL
TWIST
D-MODULE ON BUN(
OR
SHEAF ON LOC
GEOMETRIC
LANGLANDS
det(x − Φ)



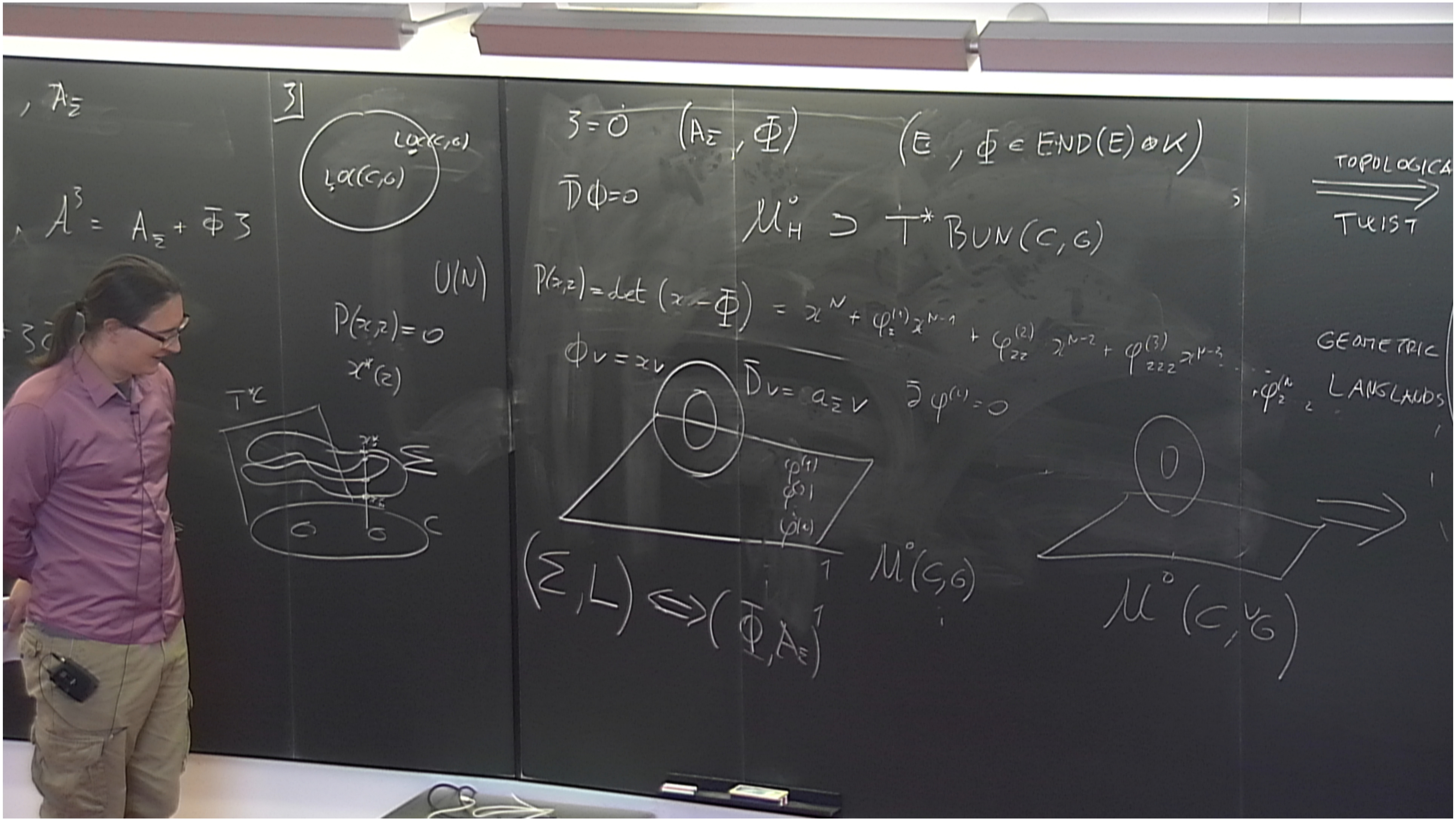
3
U(N)
TOPOLOGICAL
TWIST
D-MODULE ON BUN(
OR
SHEAF ON LOC
END(E)
BUN(C,G)

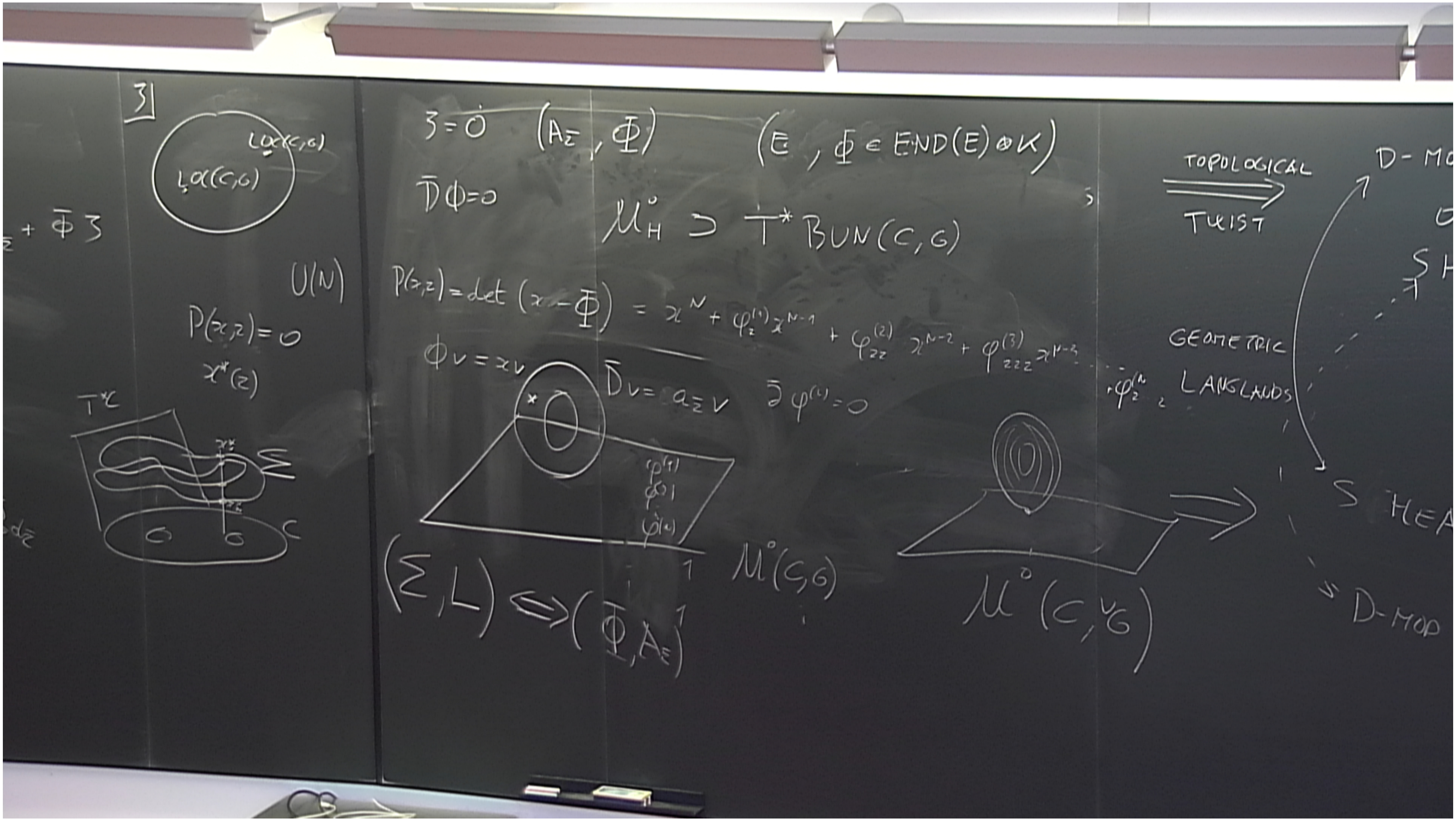

U(N)
TOPOLOGICAL
TWIST
D-MODULE ON BUN
OR
SHEAF ON LOC
GEOMETRIC
LANGLANDS
SHEAF
D-MOD


TOPOLOGICAL
TWIST
D-MODULE ON BUN
OR
SHEAF ON LOC
GEOMETRIC
LANGLANDS
SHEAF
D-MOD
U(N)
P(x,z) = 0



3]
U(N)
P(x,z) = 0
T*C
Σ
C
3 = 0
(A_z̄ , Φ)
(E , Φ ∈ END(E) ⊗ K)
D̄Φ = 0
M_H ⊃ T* BUN(C, G)
P(x,z) = det (x − Φ) = x^N + φ_z^(1) x^(N-1) + φ_zz^(2) x^(N-2) + φ_zzz^(3) x^(N-3)
Φv = xv
D̄v = a_z̄ v
∂̄ φ^(i) = 0
(Σ, L)
TOPOL
TWIS
GEOME
LANGL


TOPOLOGICA
TWIST
GEOMETRIC
LANGLANDS
U(N)



TOPOLOGICAL
TWIST
GEOMETRIC
LANGLANDS
D-MOD
U(N)
END(E)
BUN(C,G)