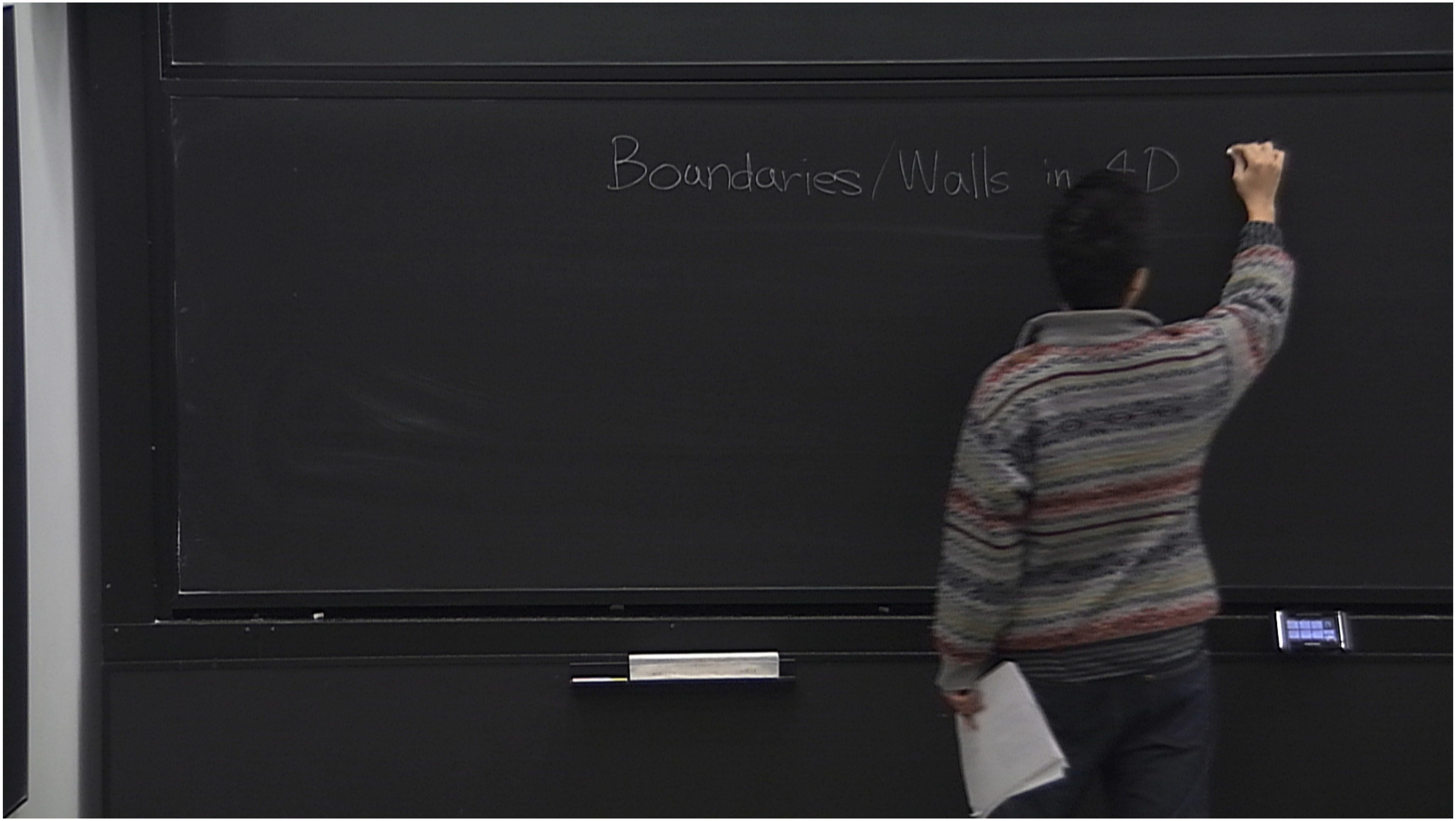
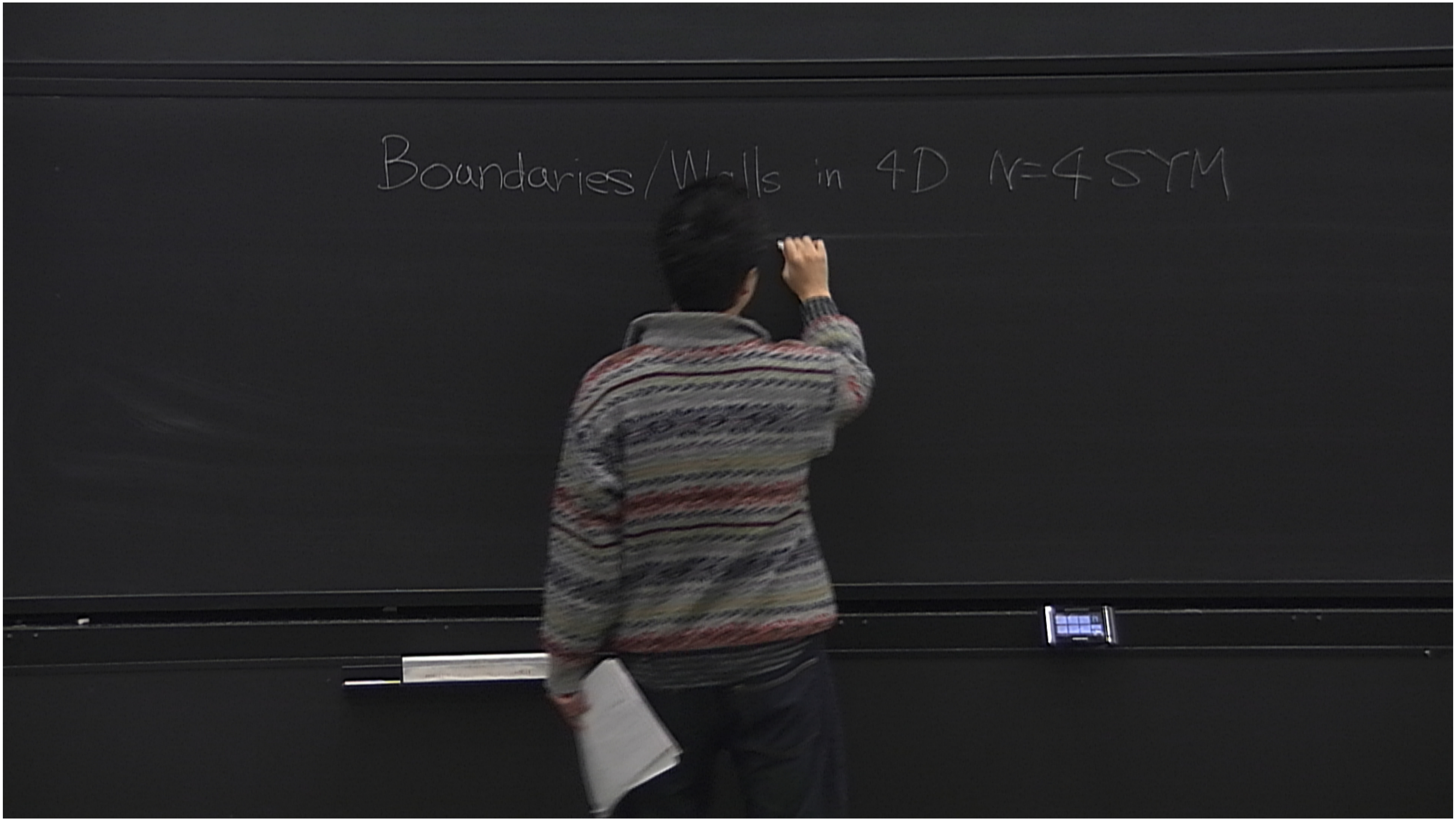
Title: Boundaries and Defects in 4d N=4 SYM

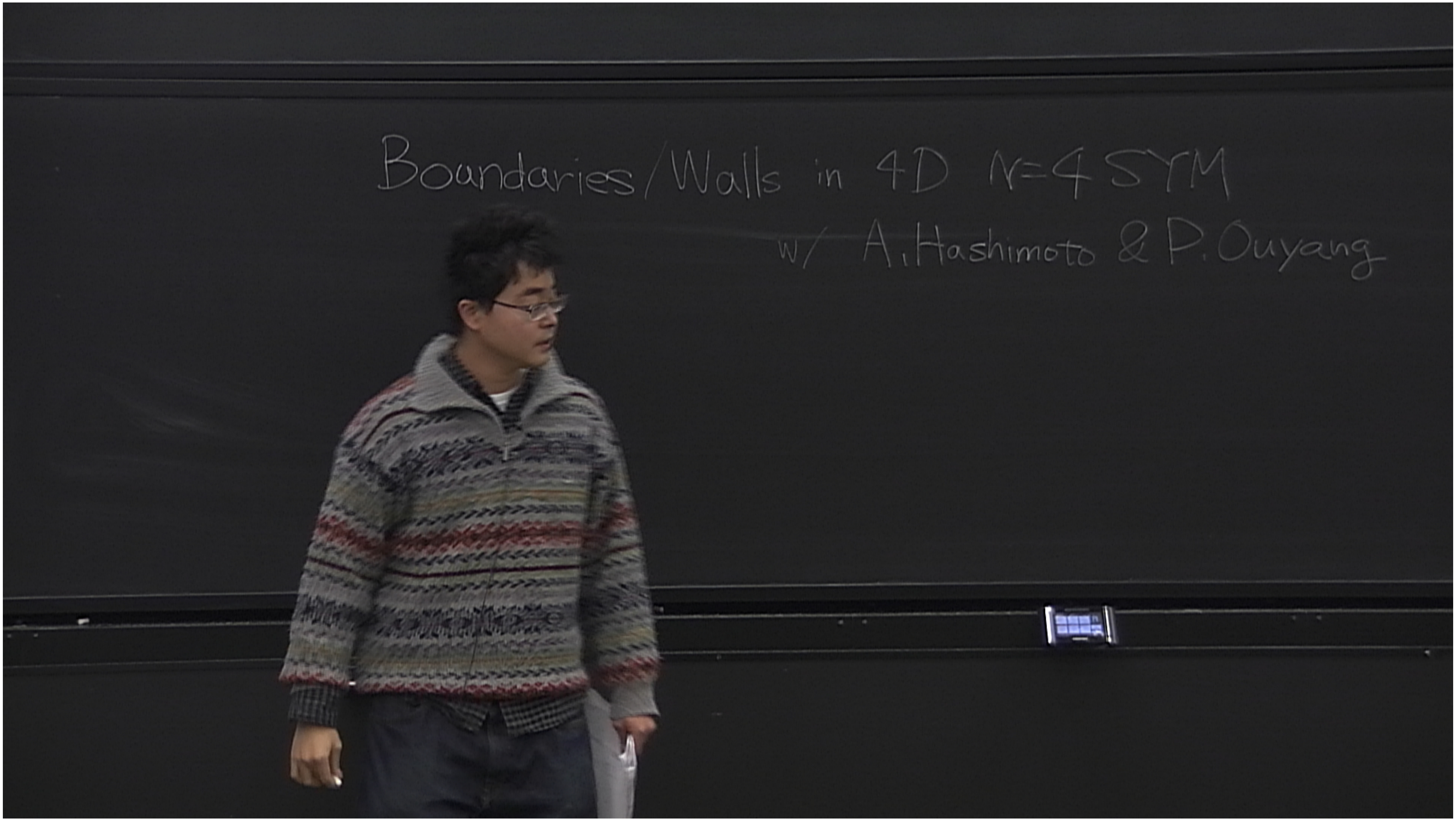
Date: Jan 21, 2014 02:00 PM

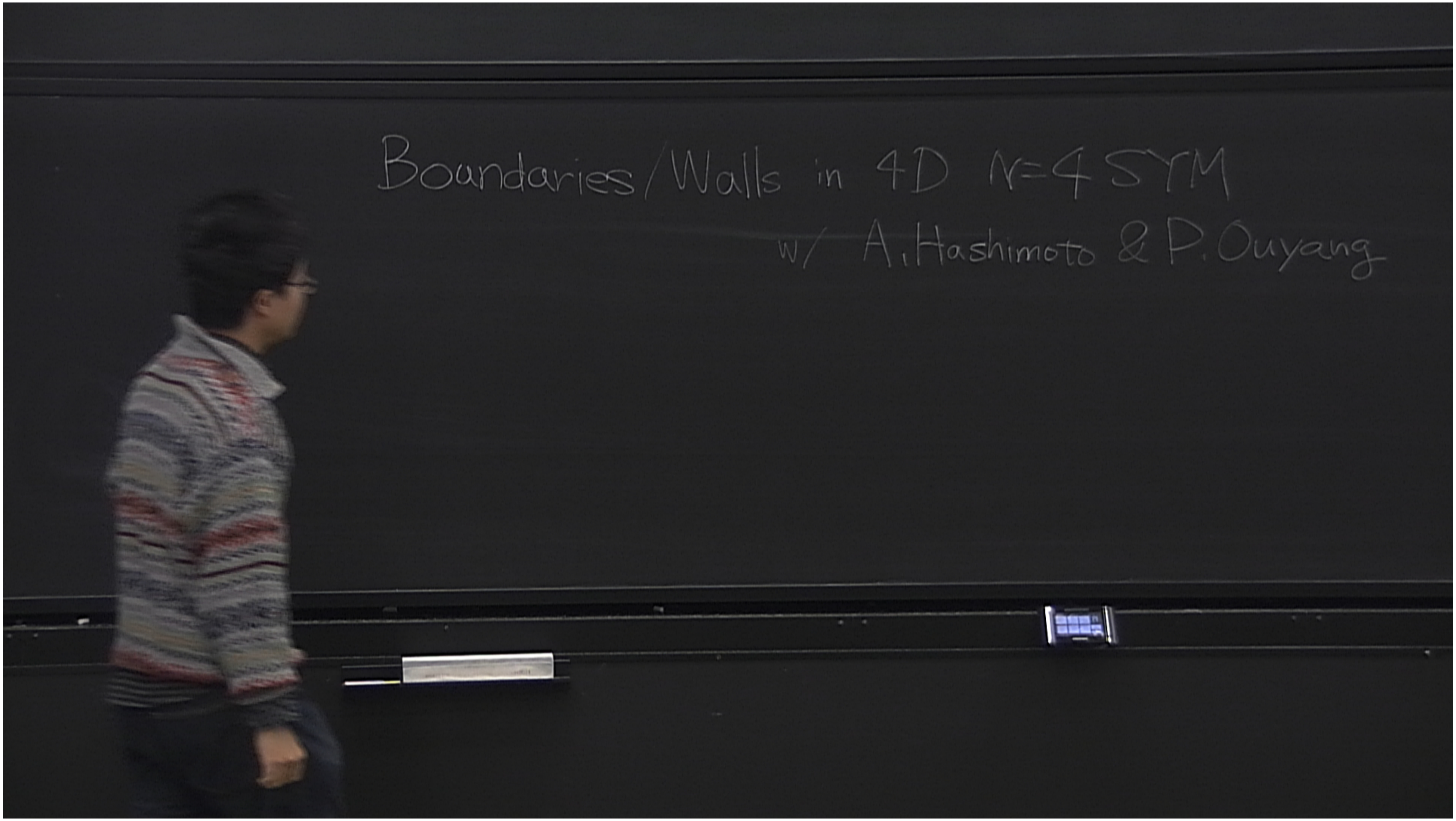
URL: http://pirsa.org/14010086

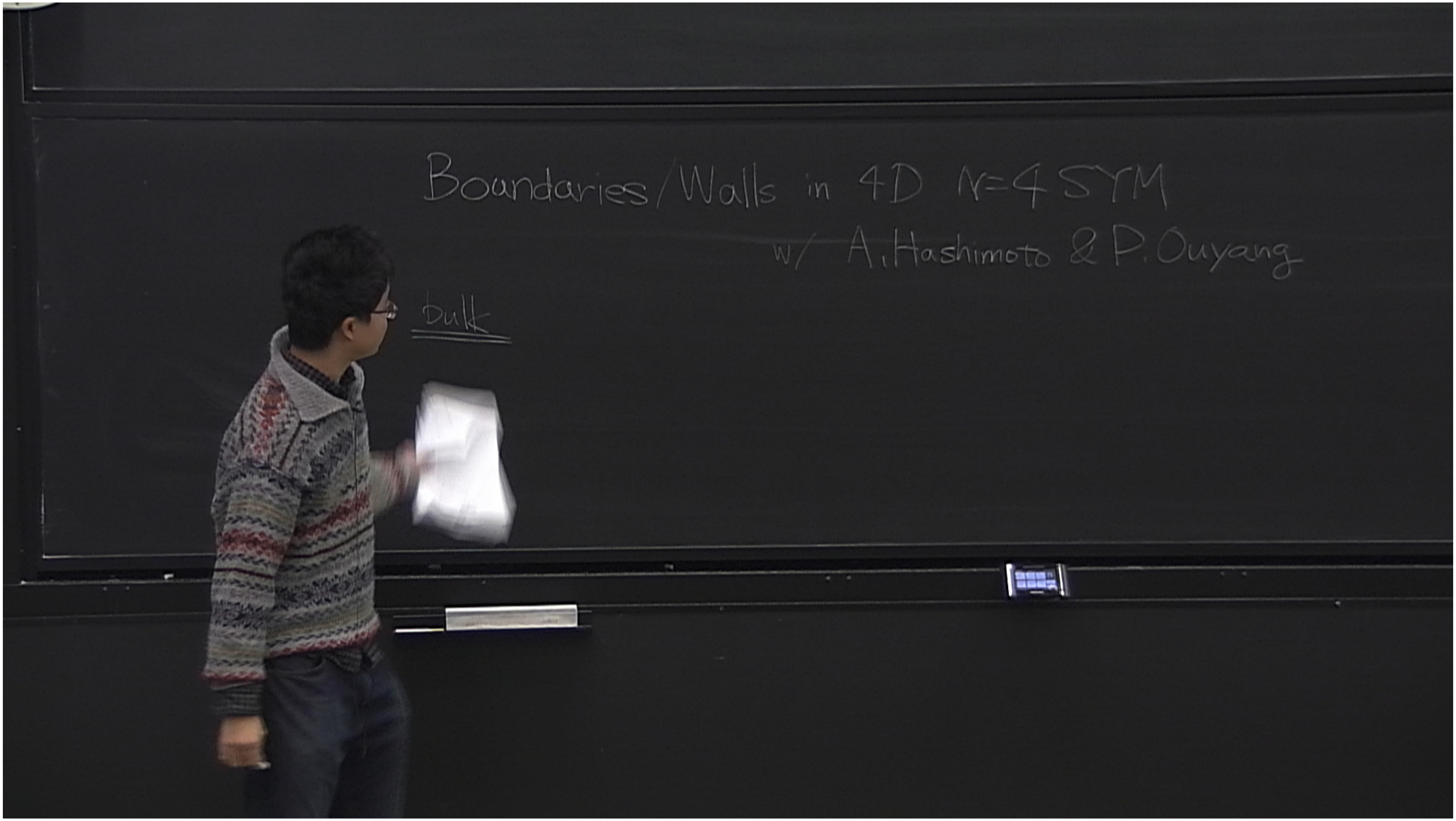
Abstract: We discuss boundary conditions and domain walls in 4d N=4 SYM, focusing on those preserving 4 supercharges. Along the way we revisit the old problem of the quantum-corrected moduli space of 3d N=2 theories.

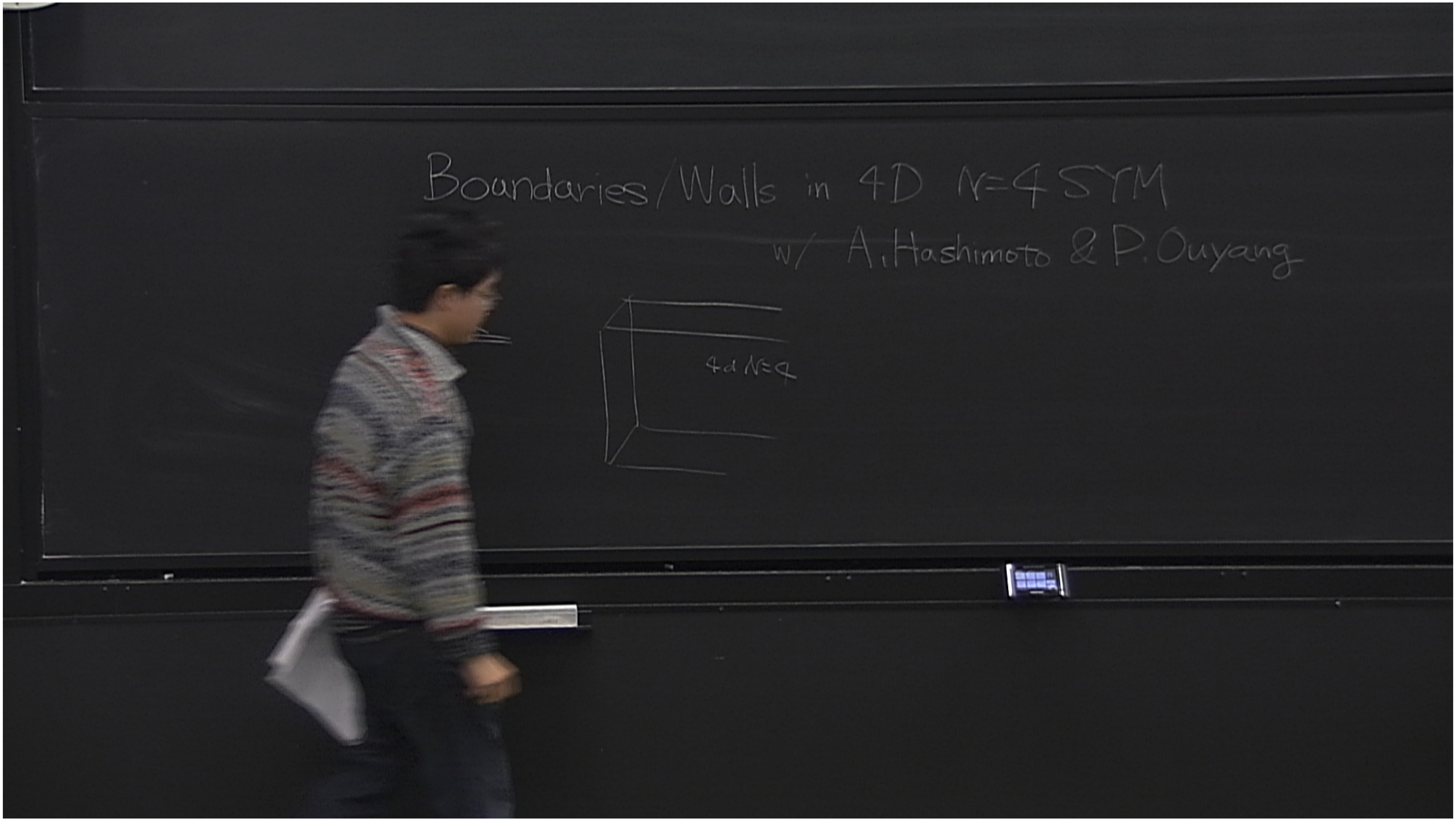

Boundaries/Walls in 4D

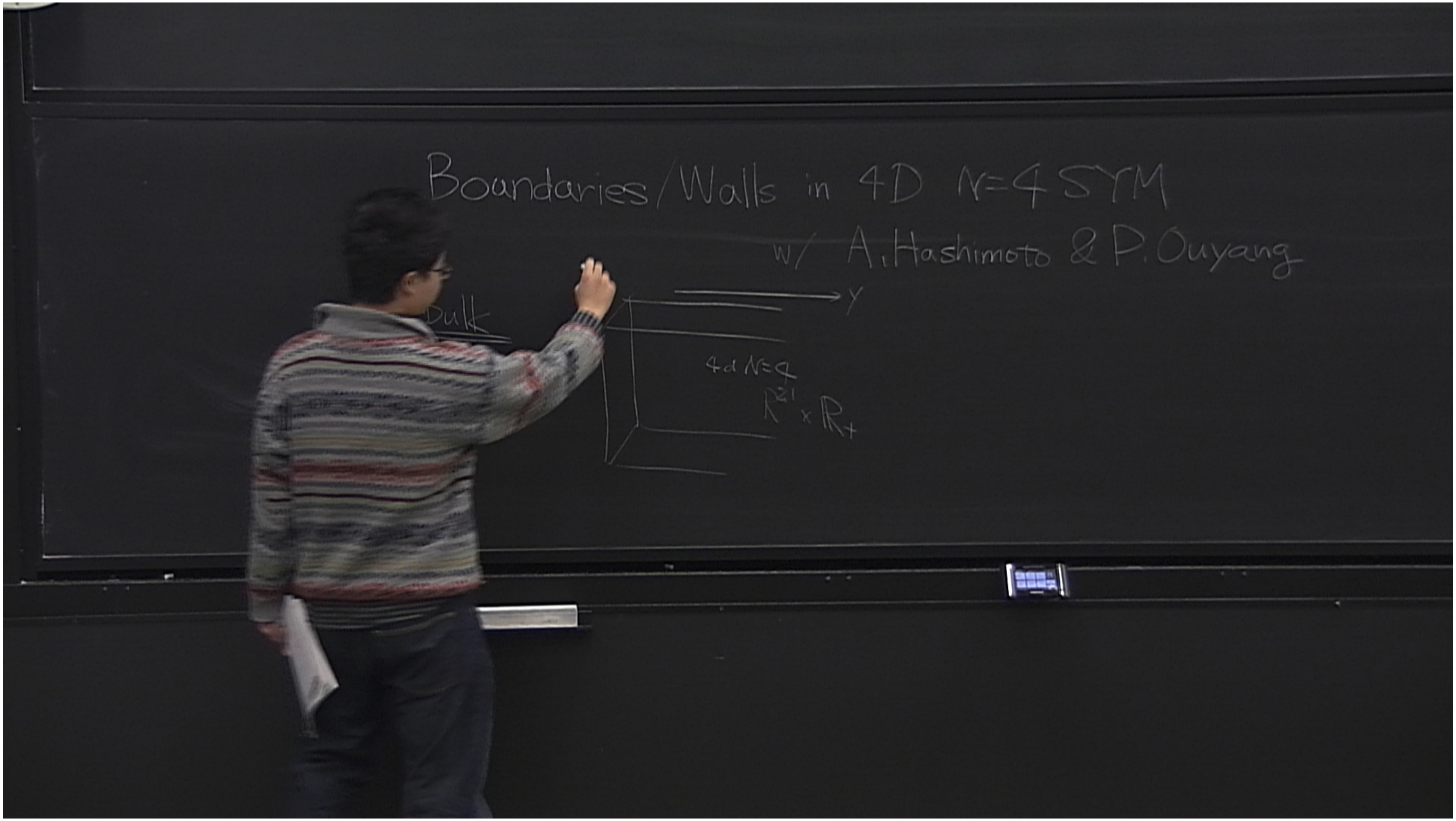

Boundaries/Walls in 4D N=4 SYM


Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang

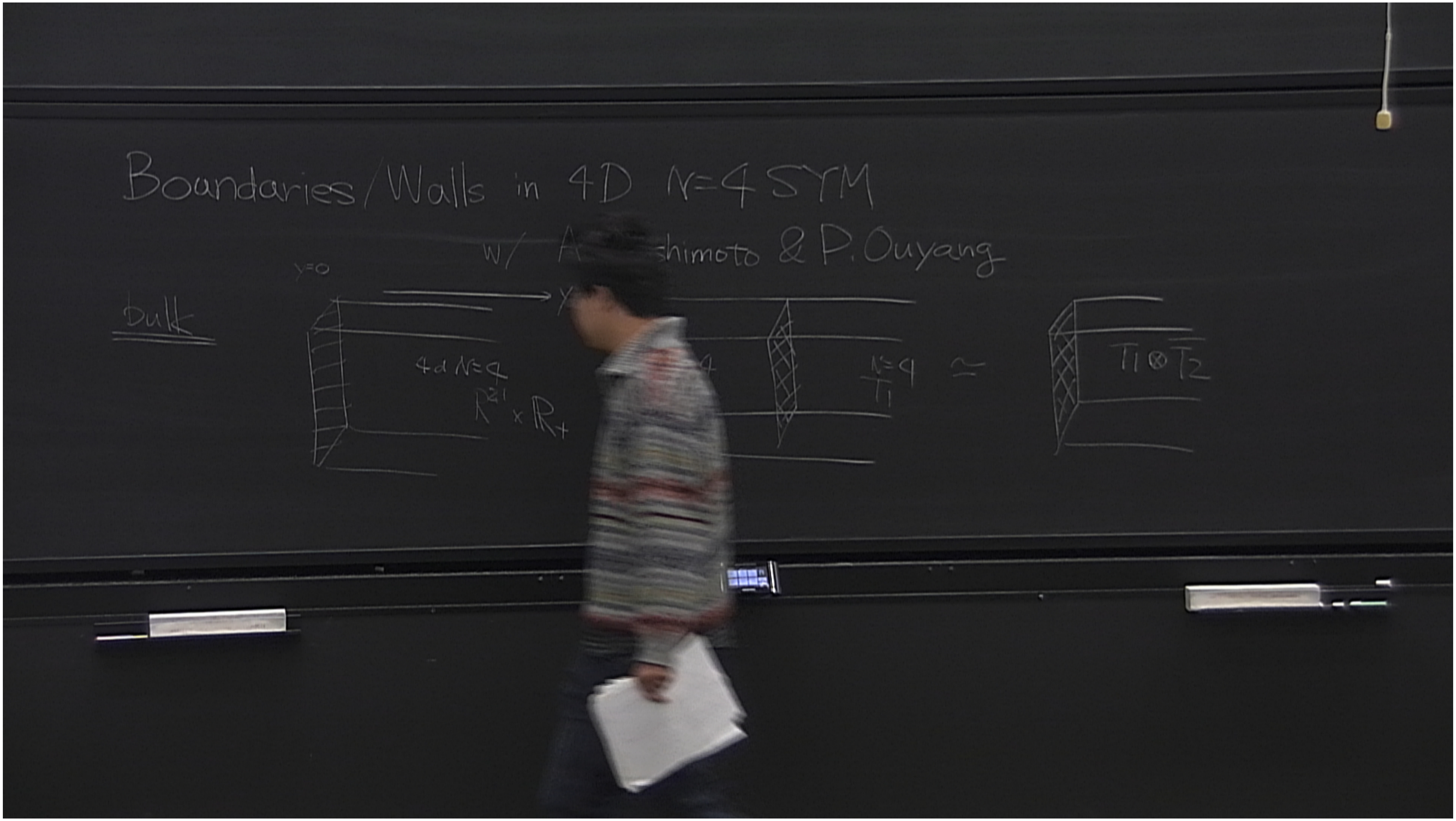

Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang

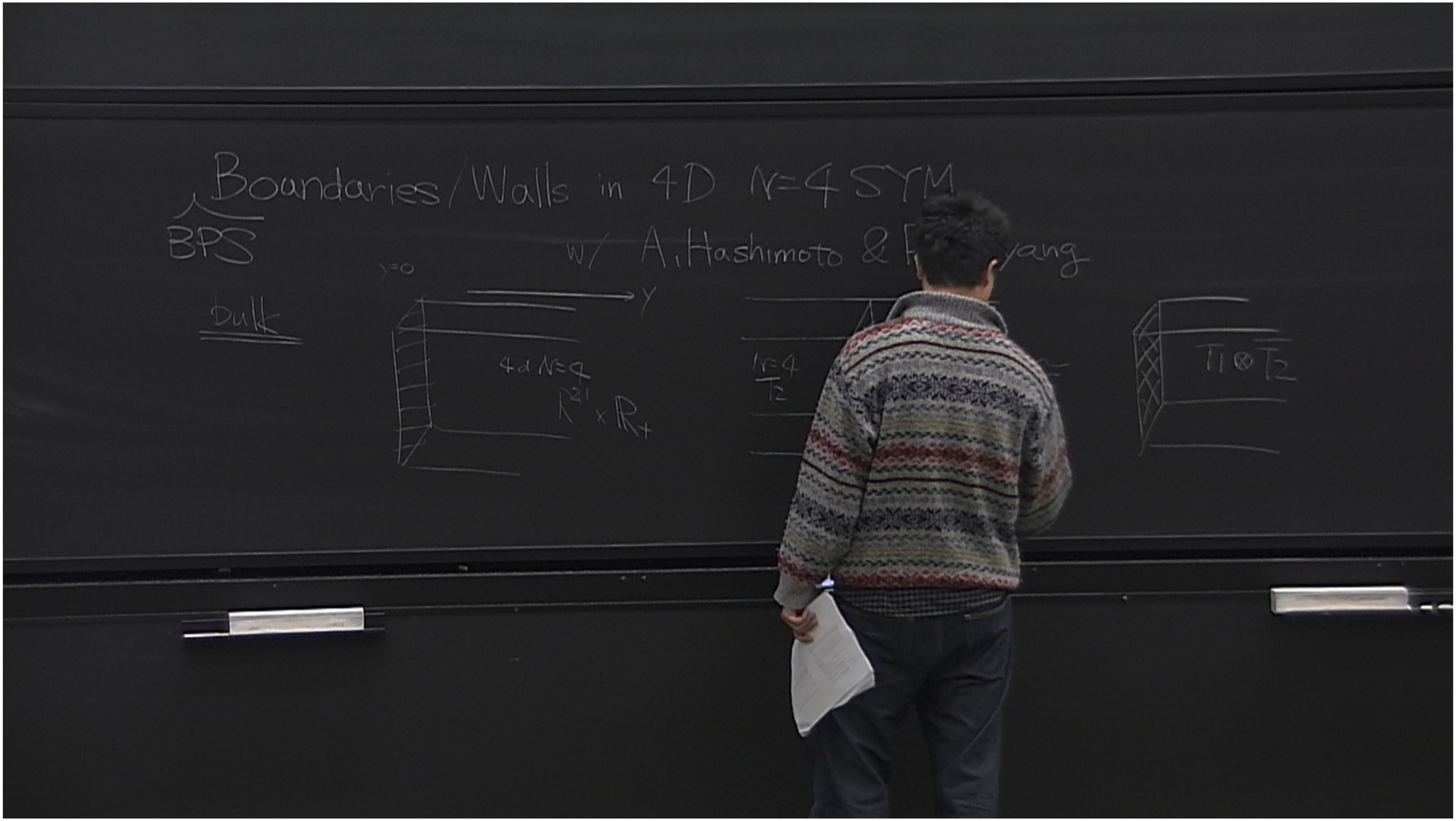

Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang
bulk

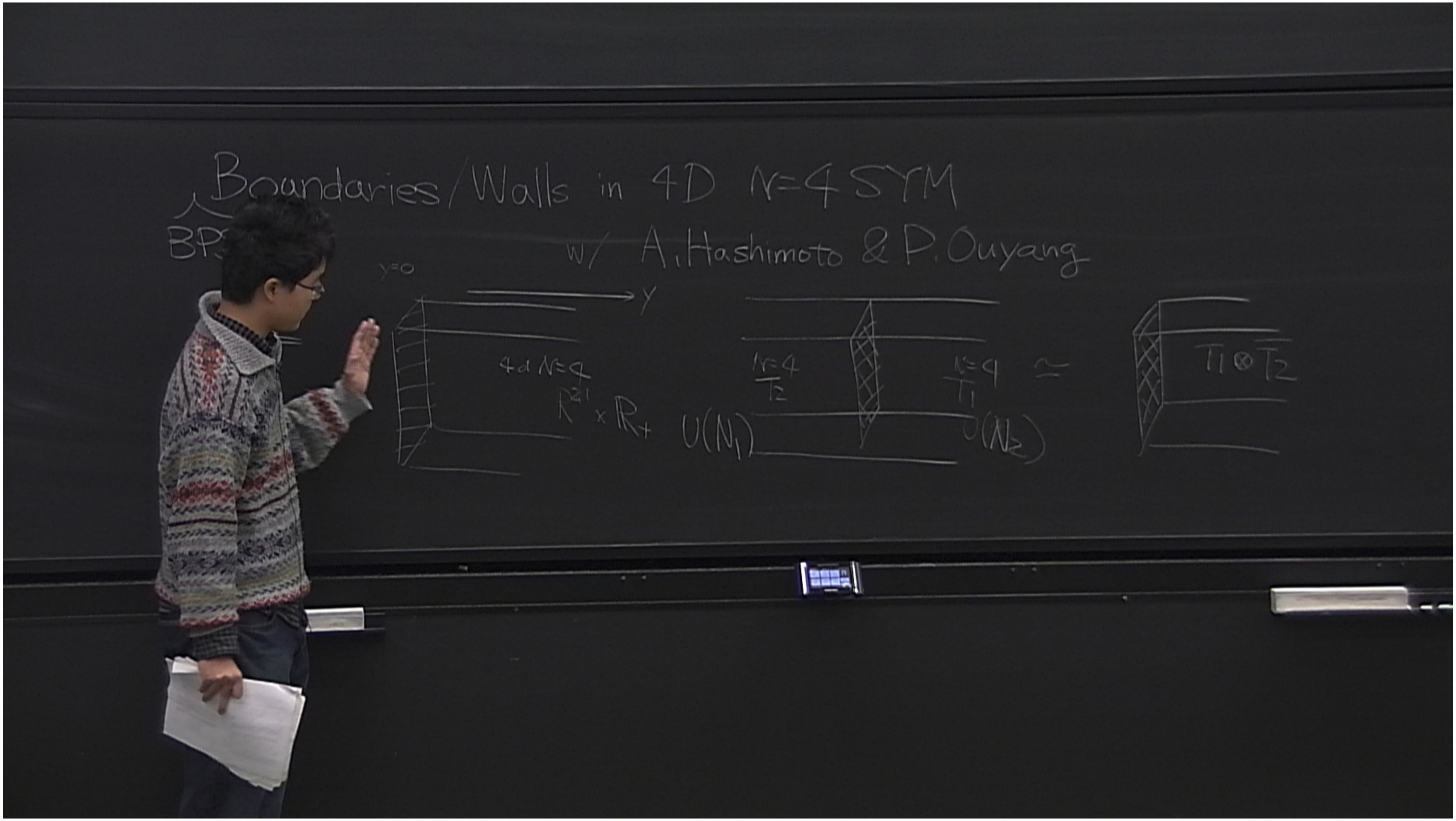

Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang
4d N=4



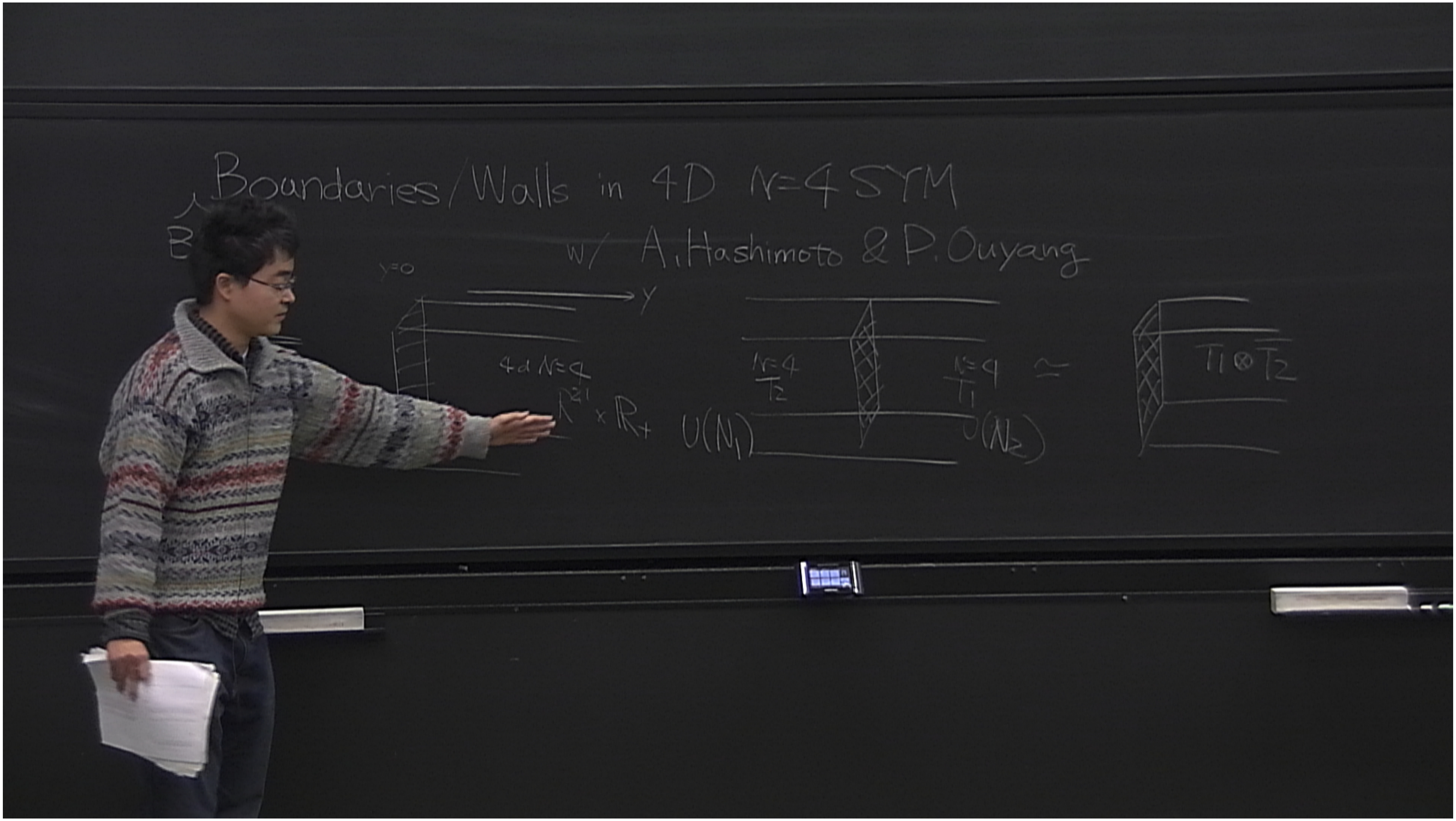
Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang
y
bulk
4d N=4
R^{2,1} x R_+


Boundaries/Walls in 4D N=4 SYM
w/ A. ...shimoto & P. Ouyang
bulk
y=0
4d N=4
N=4
T1
T1 ⊗ T2

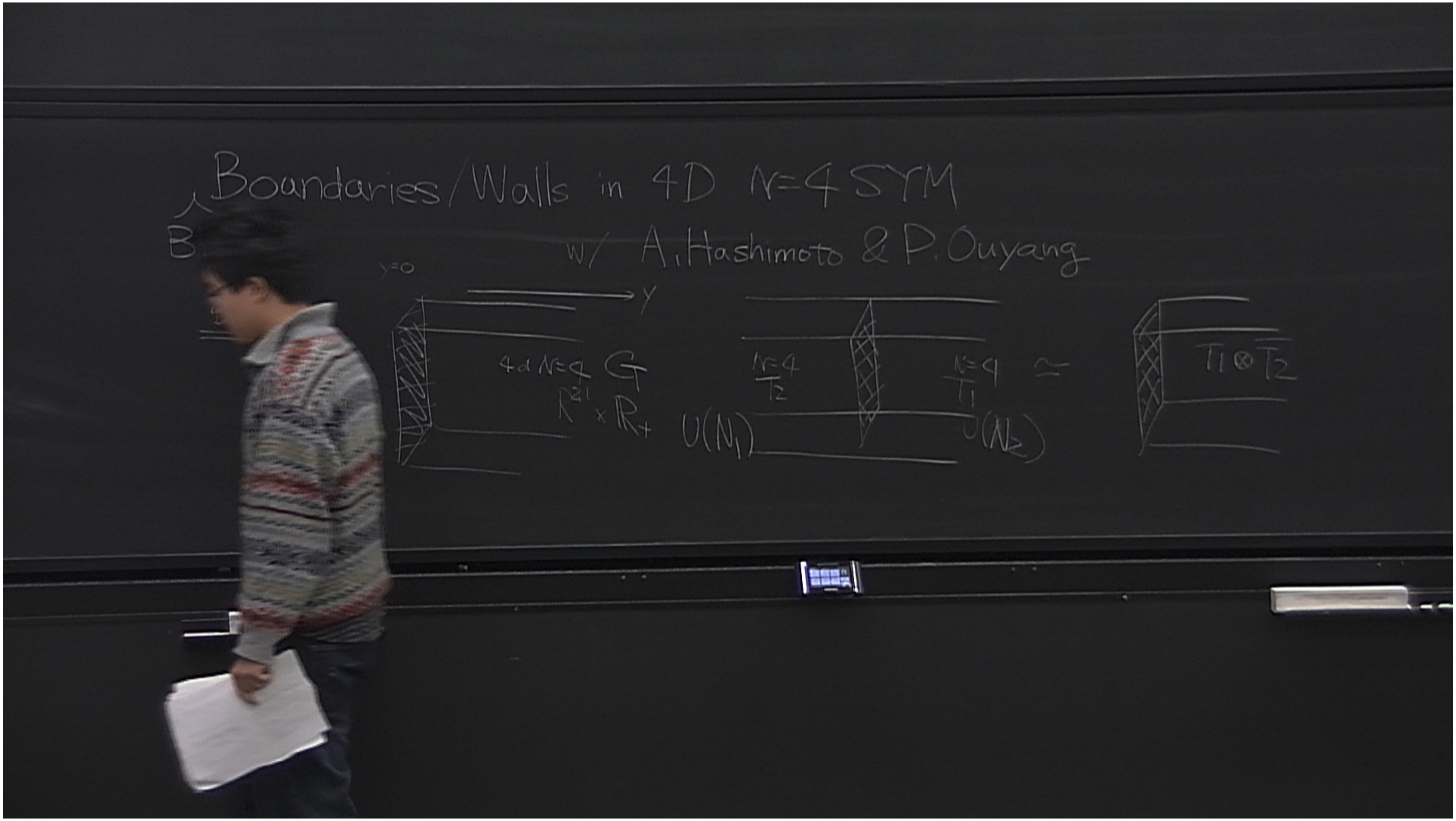

Boundaries/Walls in 4D N=4 SYM
BPS
w/ A. Hashimoto &
yang
bulk
y=0
y
4d N=4
R^{2,1} x R_+
N=4
T_2
T_1 ⊗ T_2



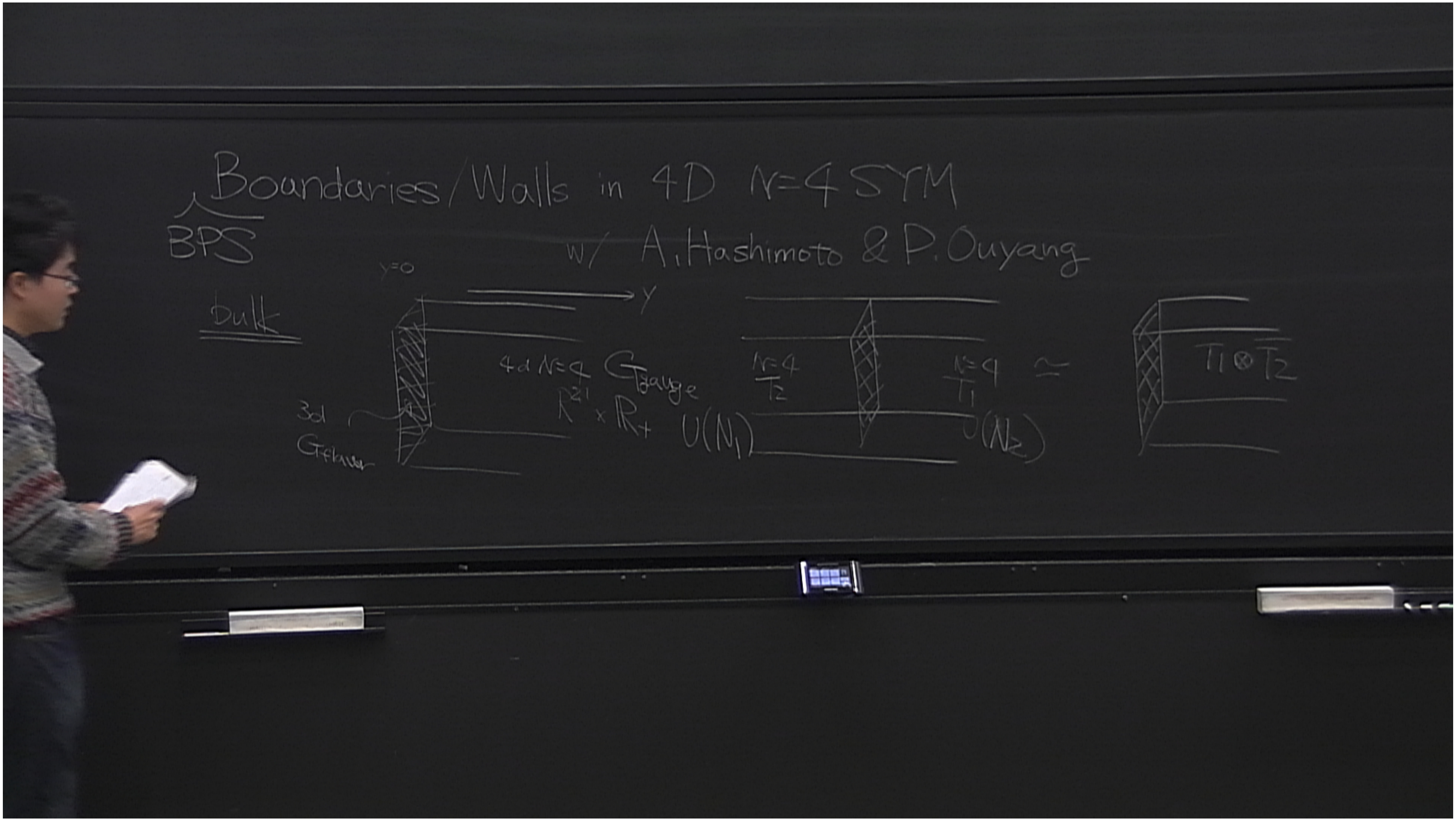
Boundaries/Walls in 4D N=4 SYM
BPS
w/ A. Hashimoto & P. Ouyang
y=0
y
4d N=4
U(N1)
U(N2)
T1 ⊗ T2



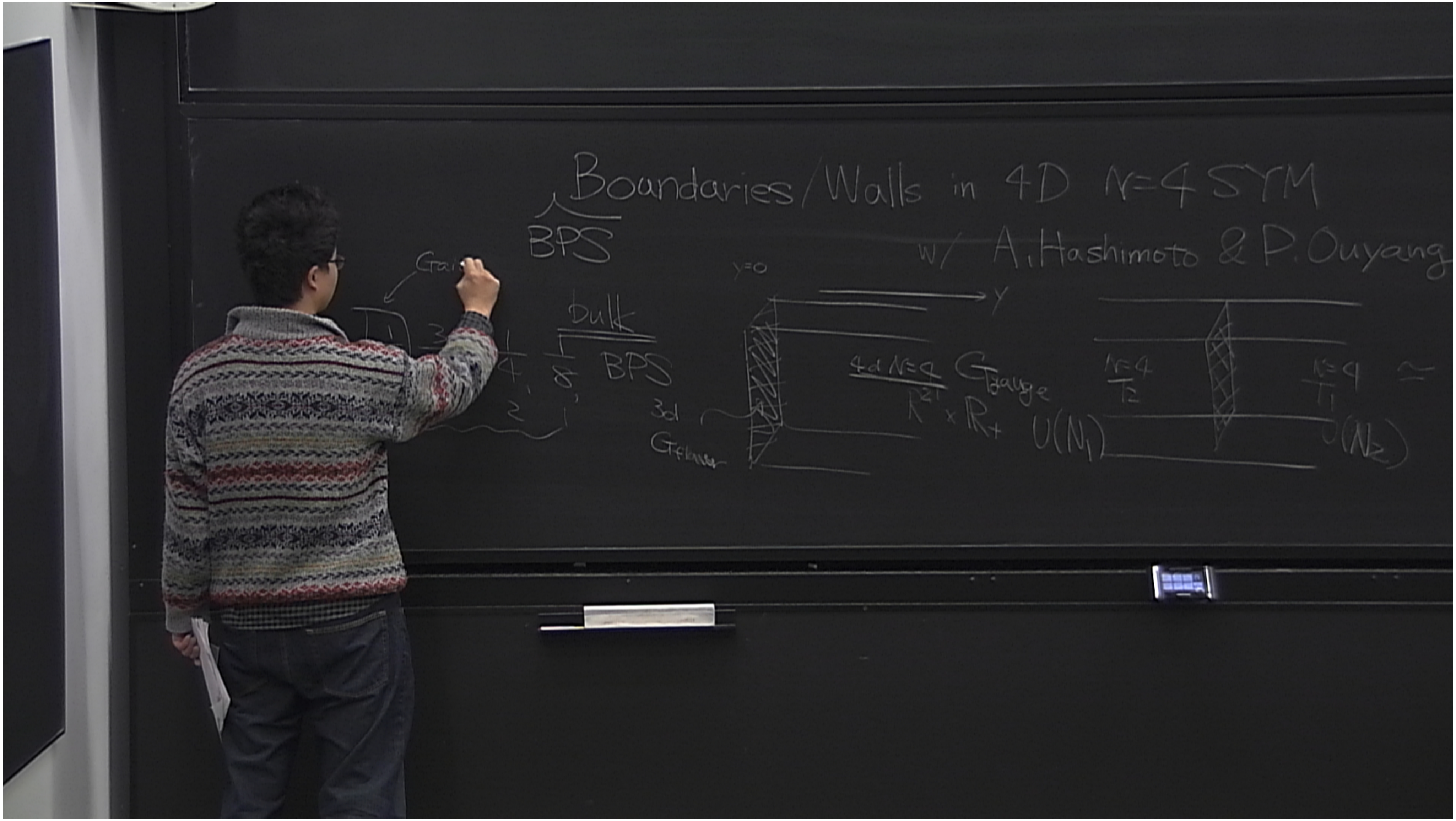
Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang
y=0
y
4d N=4
U(N1)
U(N2)
T1⊗T2

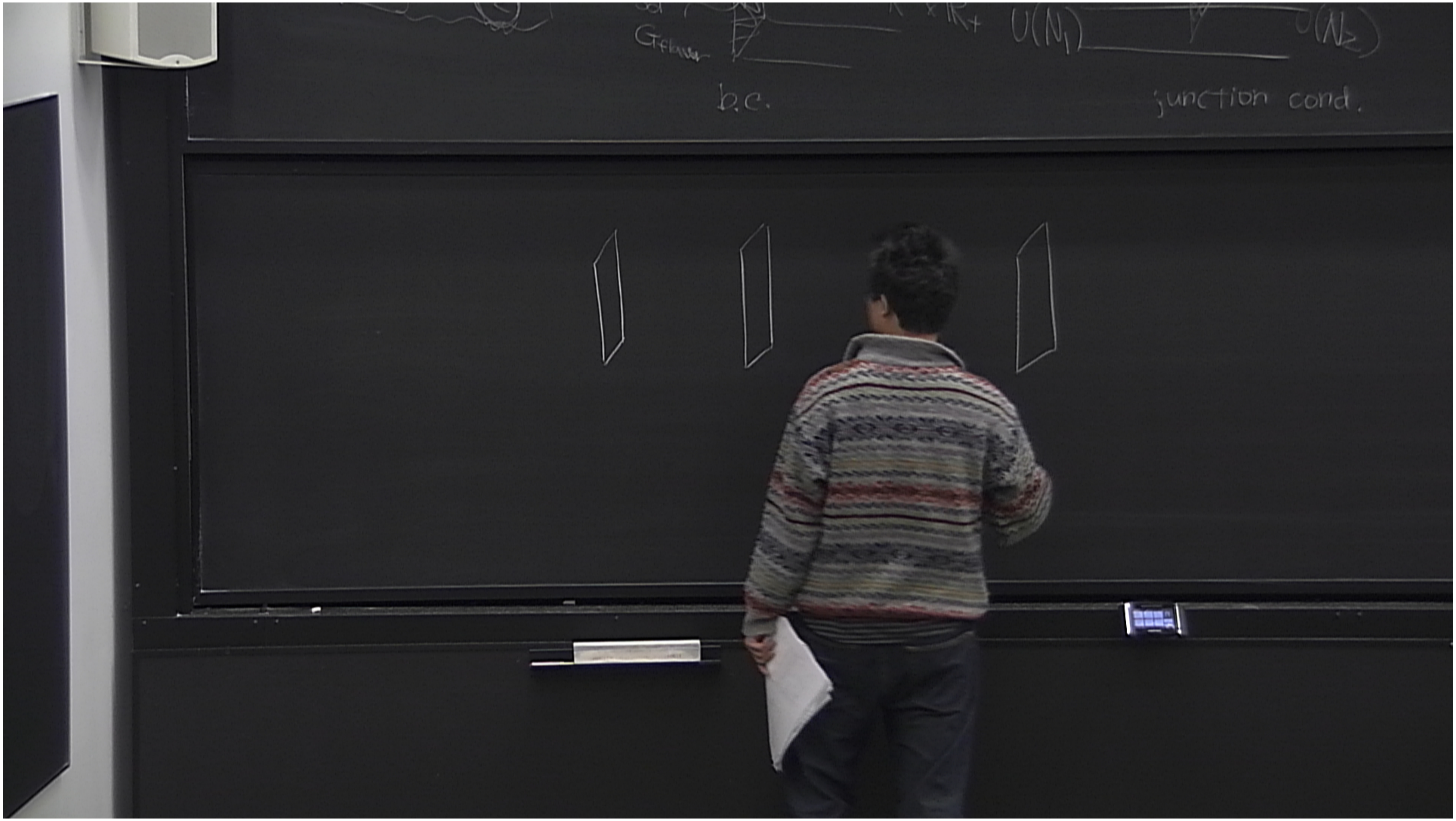


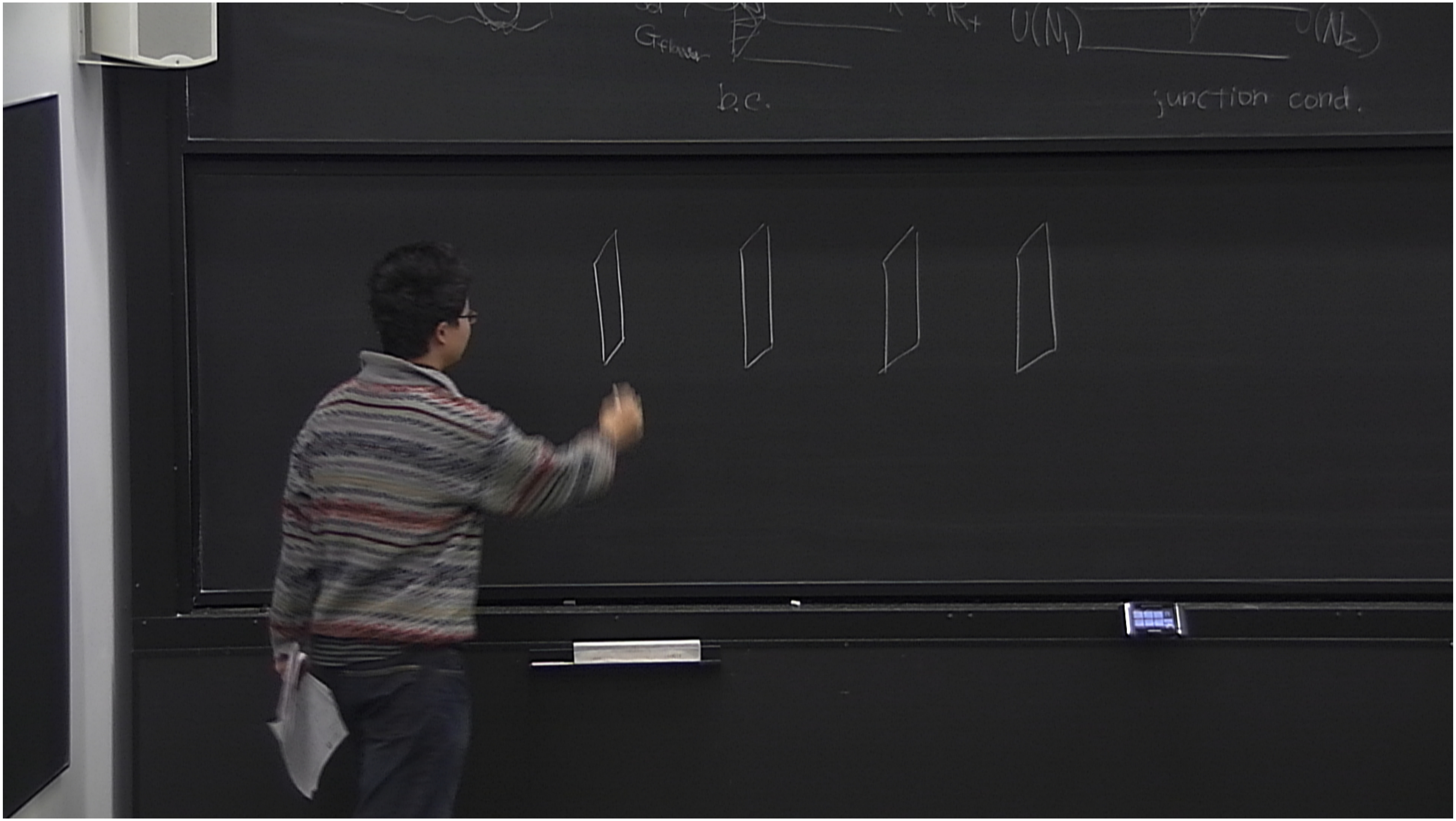
Boundaries/Walls in 4D N=4 SYM
w/ A. Hashimoto & P. Ouyang
y=0
y
4d N=4 G
R^{2,1} × R_+
N=4
T_2
N=4
T_1
U(N_1)
U(N_2)
≃
T_1 ⊗ T_2

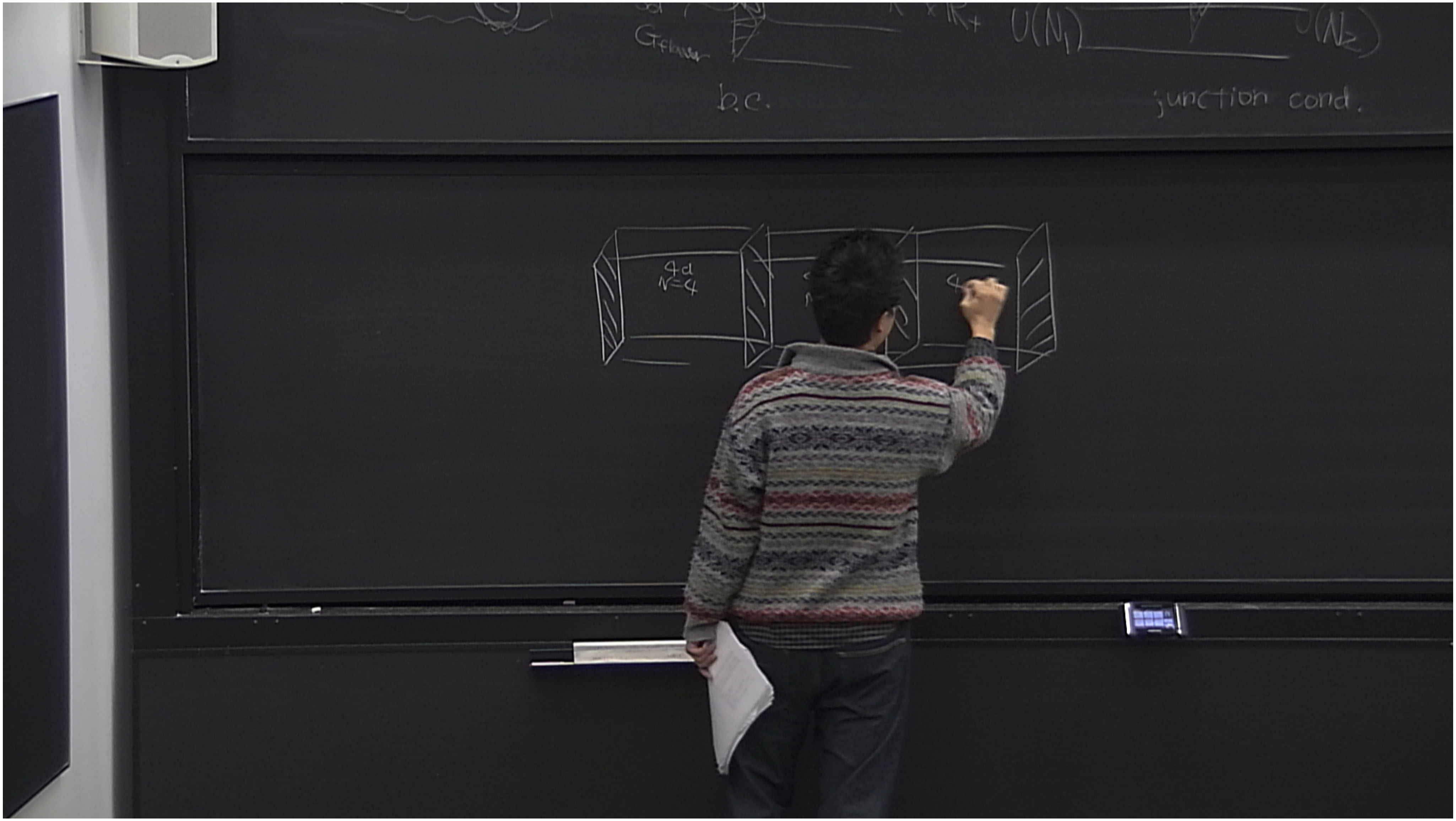


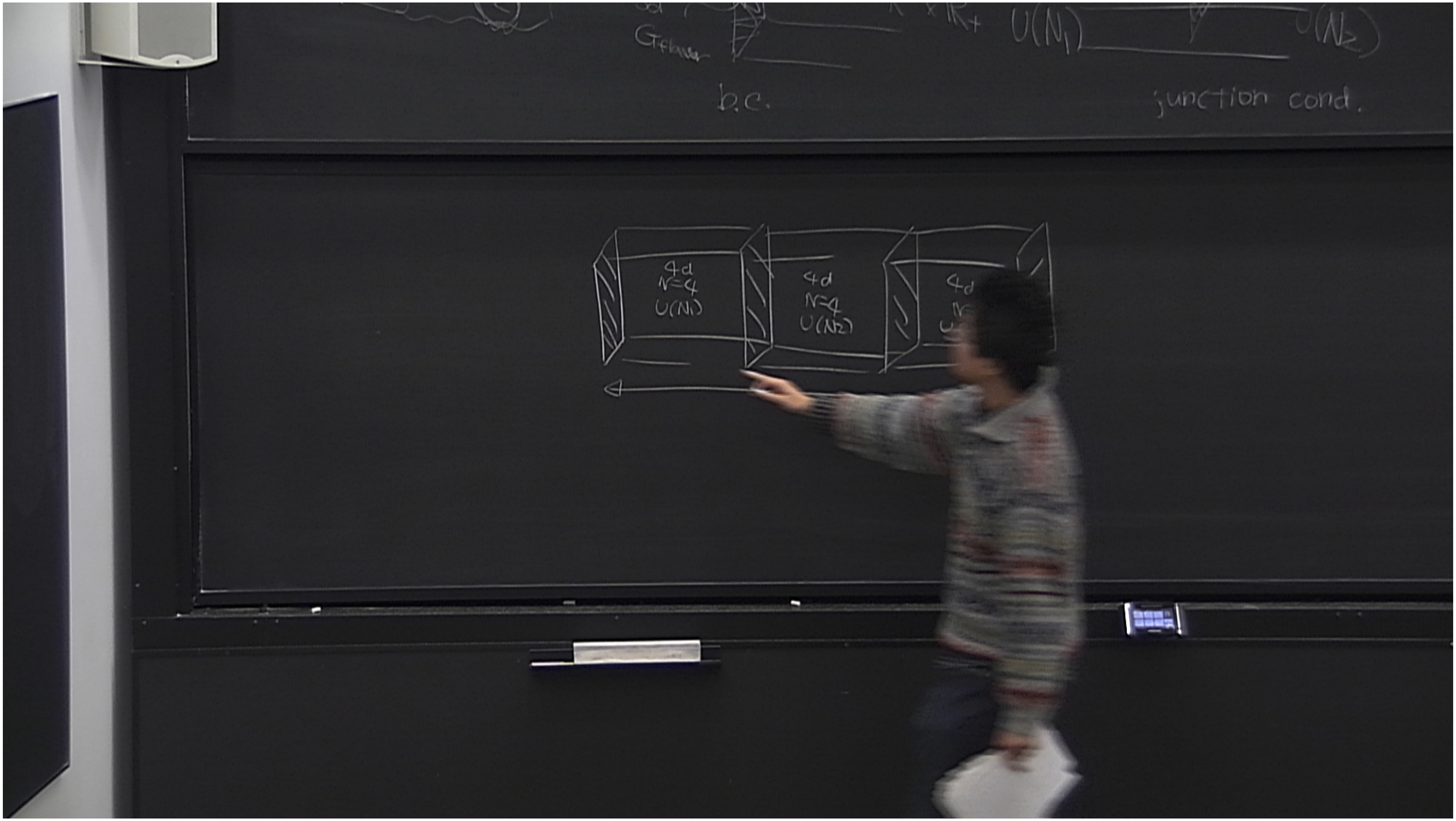
Boundaries/Walls in 4D N=4 SYM
BPS
w/ A. Hashimoto & P. Ouyang
bulk
y=0
y
4d N=4 G_gauge
R^{2,1} x R_+
3d
G_flavor
N=4
T_2
U(N_1)
N=4
T_1
U(N_2)
≃
T_1 ⊗ T_2


Boundaries/Walls in 4D N=4 SYM
BPS
w/ A. Hashimoto & P. Ouyang
bulk
BPS
y=0
y
4d N=4
Ggauge
3d
Gflavor
U(N1)
U(N2)

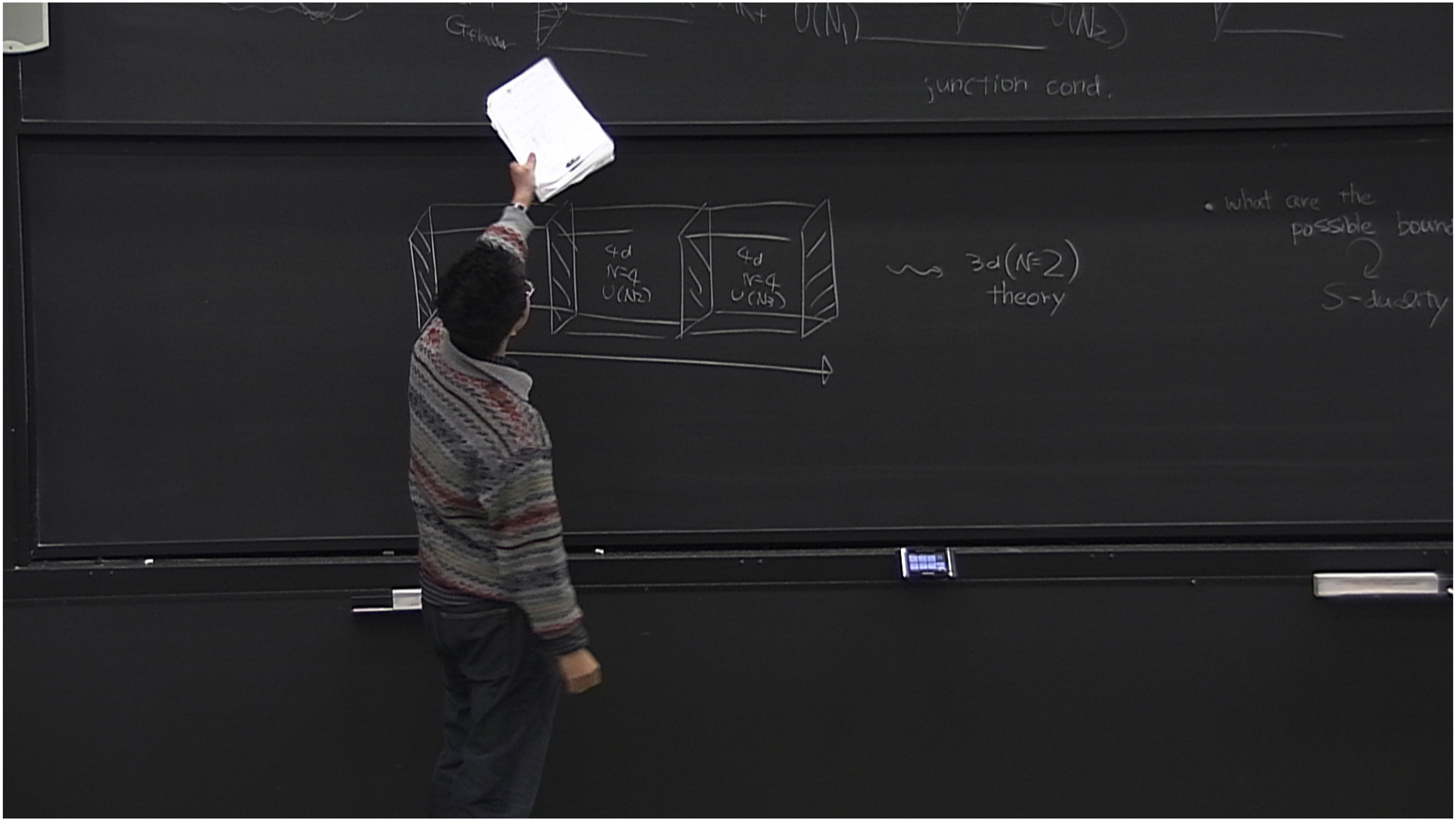

U(N1)
U(N2)
b.c.
junction cond.

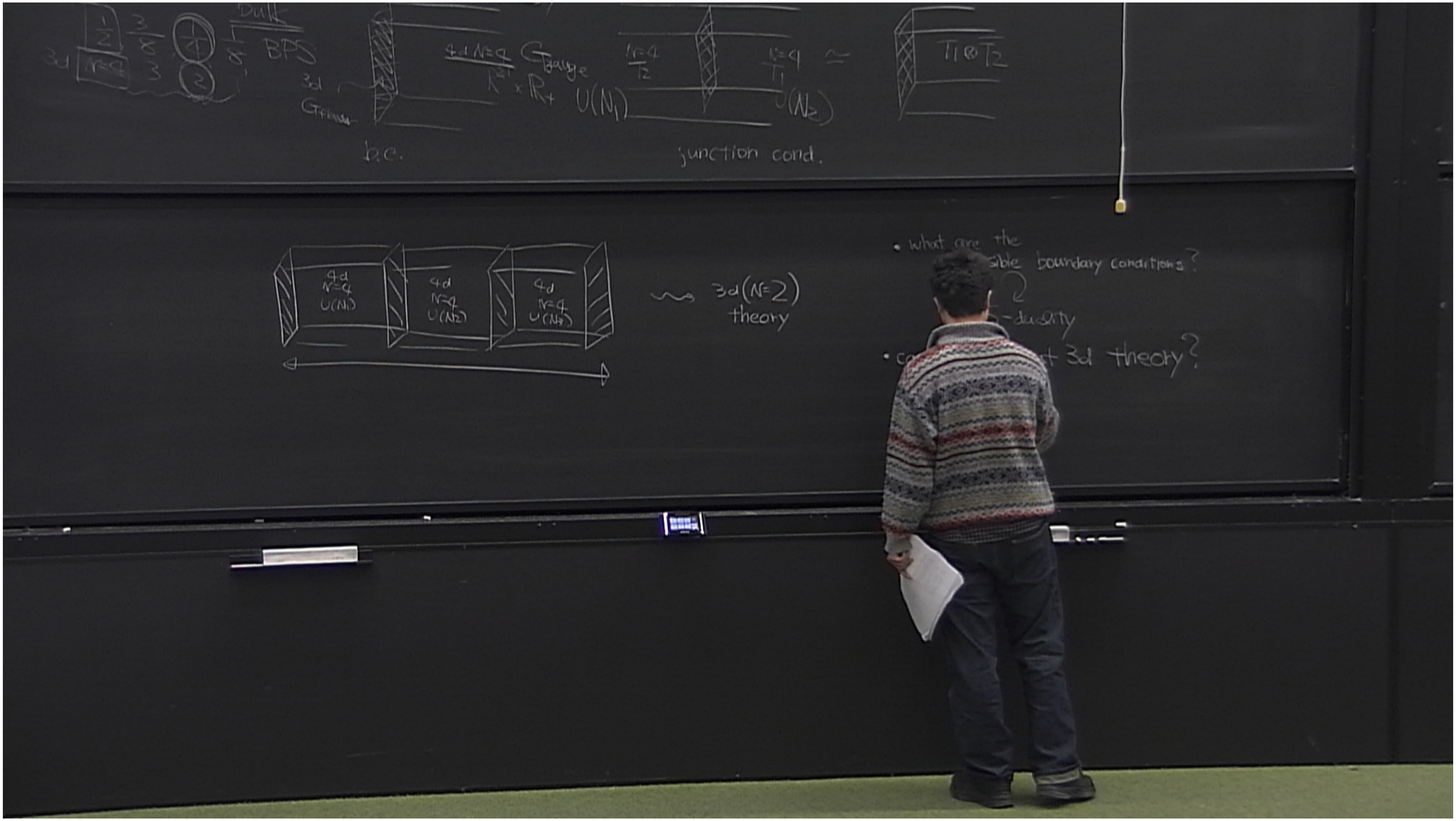

b.c.
junction cond.

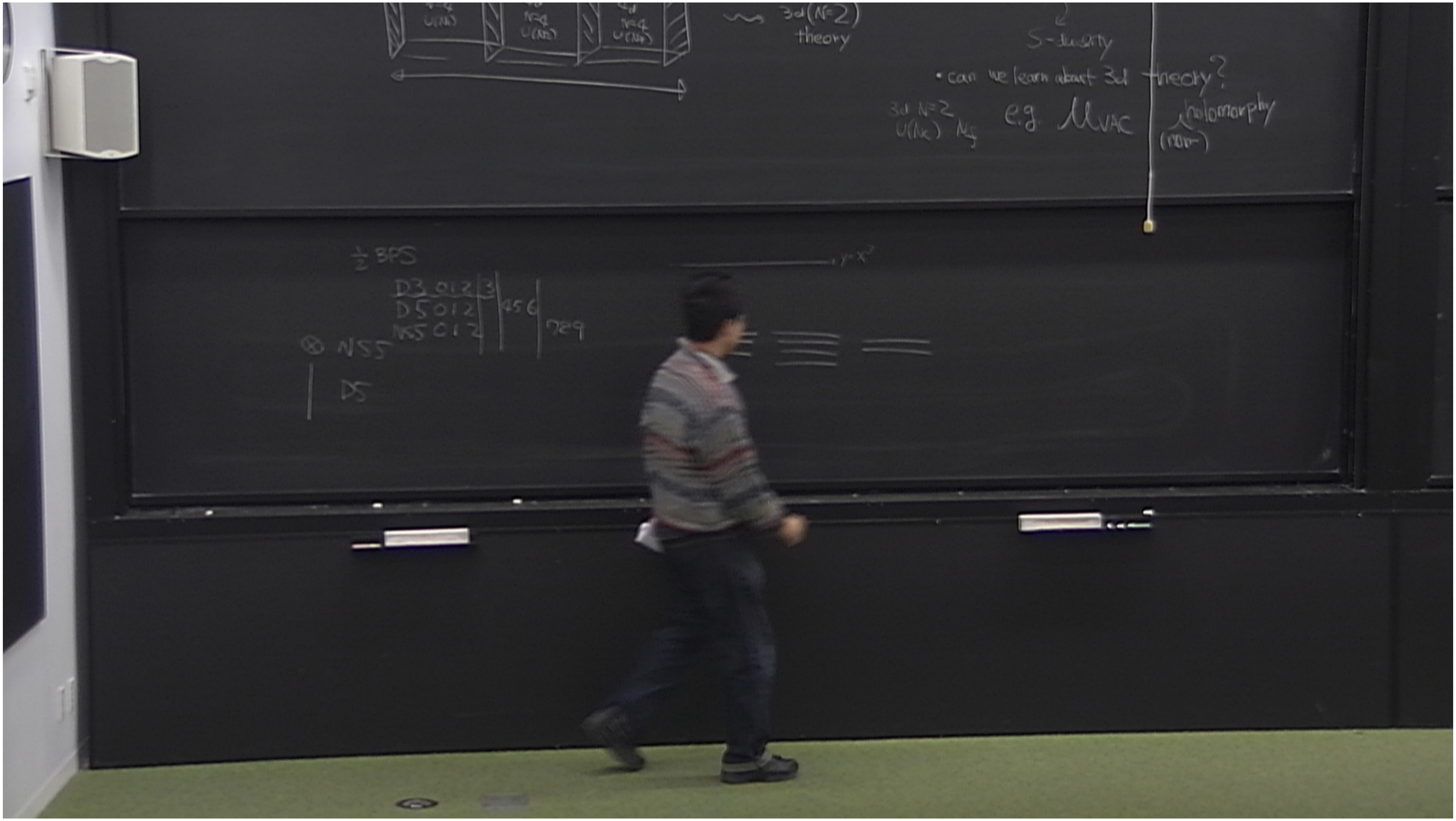

U(N1)
U(N2)
b.c.
junction cond.
4d
N=4

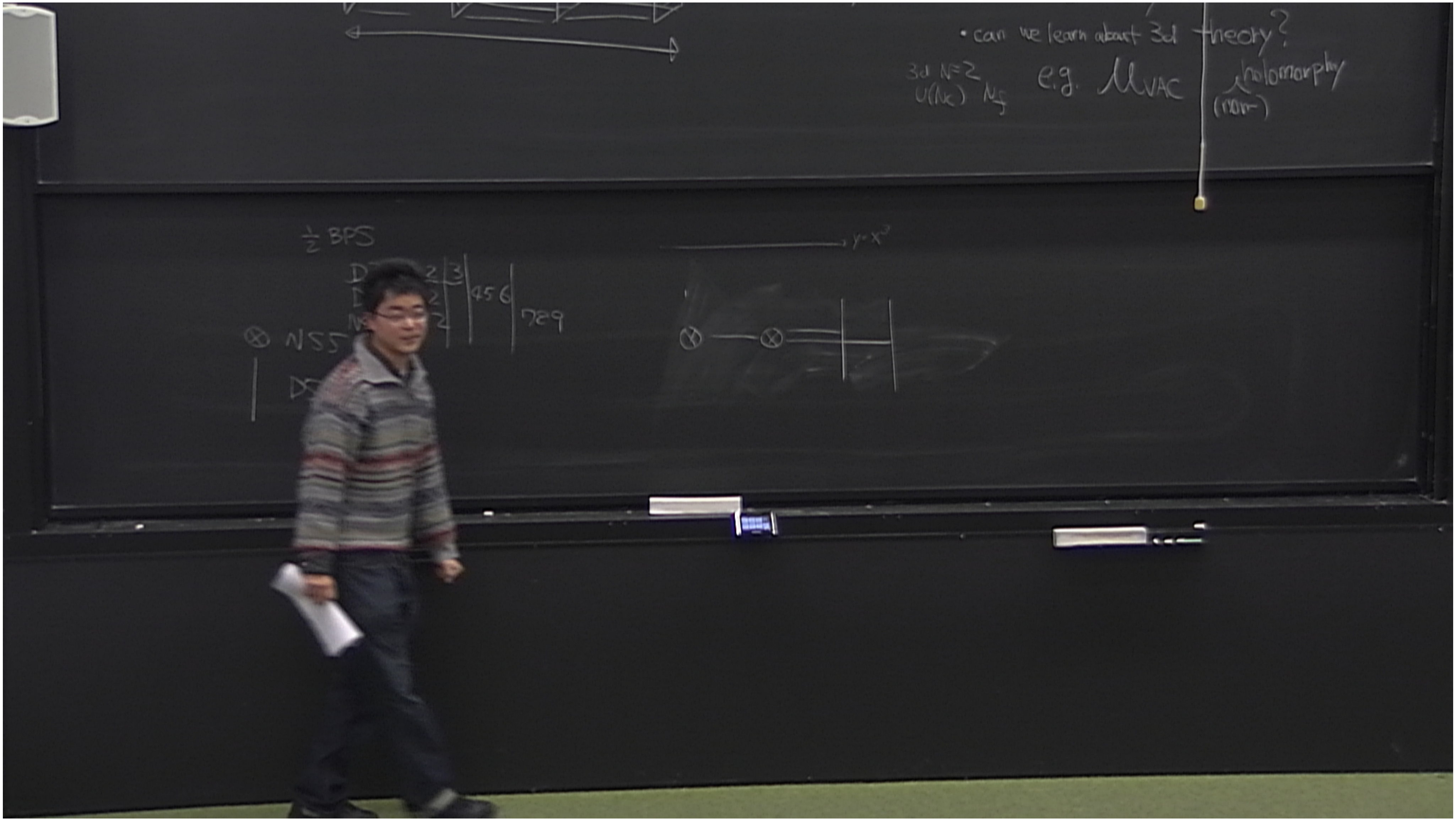


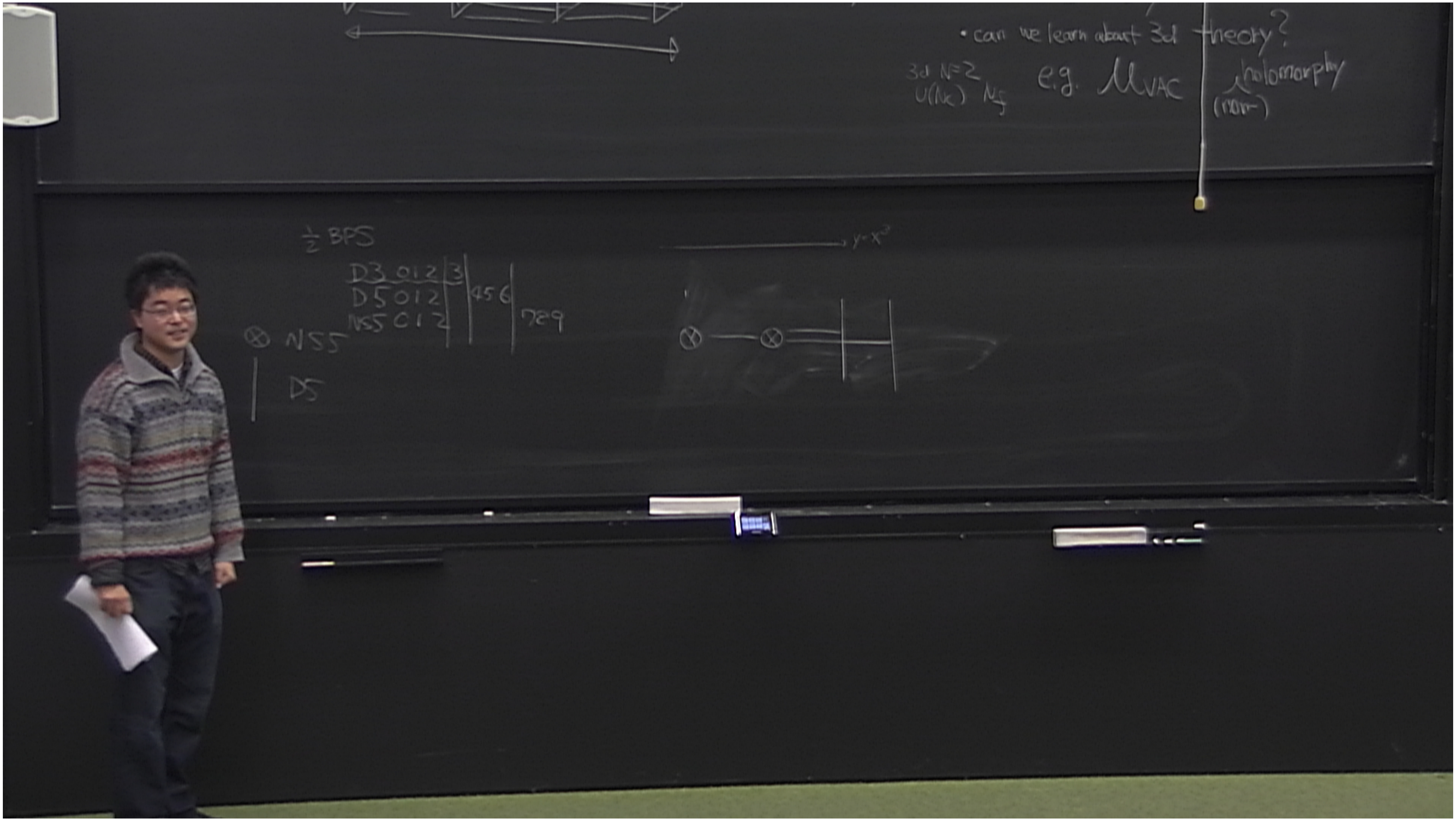
U(N1)
U(N2)
b.c.
junction cond.
4d
N=4
U(N1)
4d
N=4
U(N2)

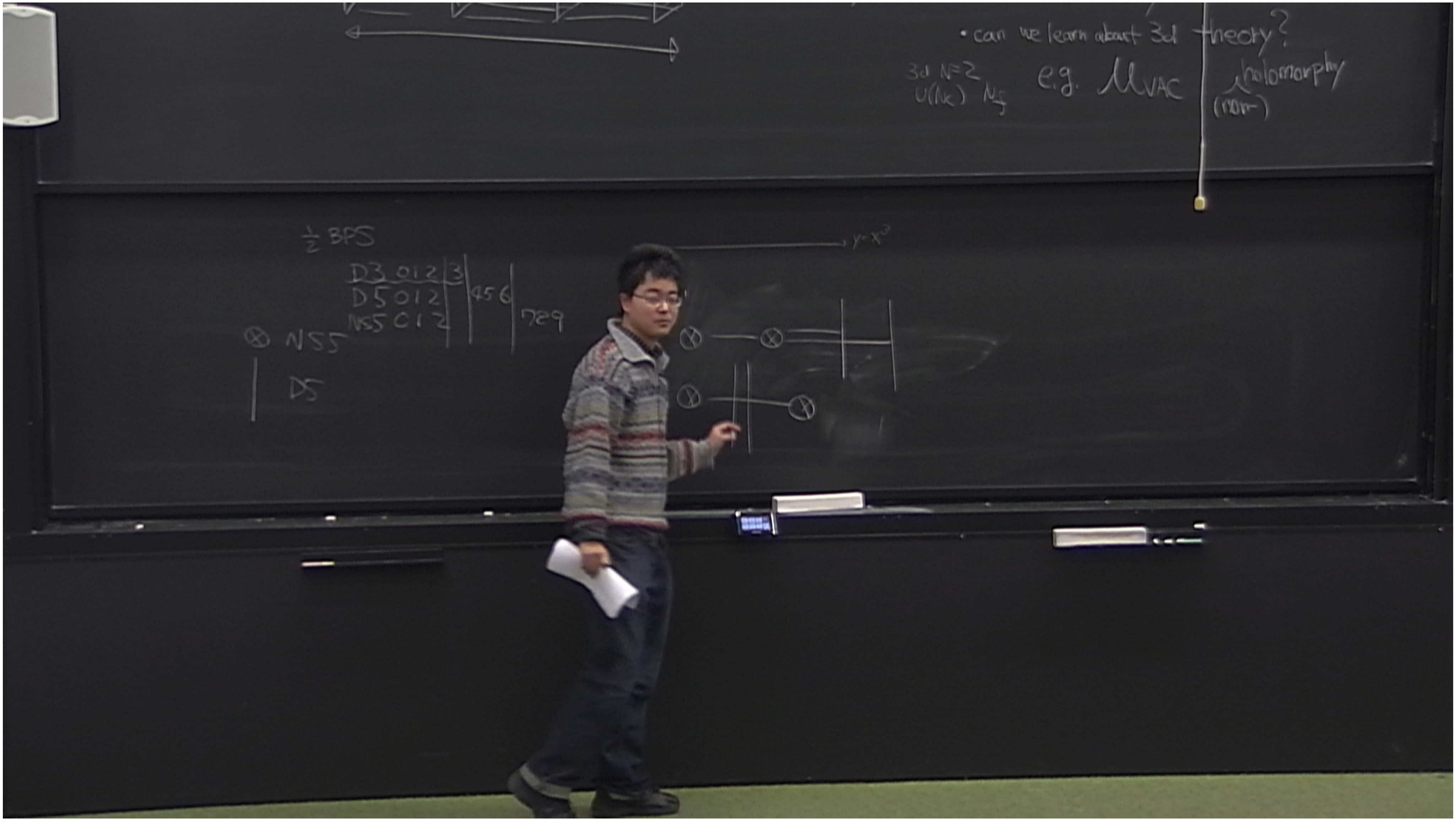

junction cond.
4d
N=4
U(N2)
4d
N=4
U(N3)
3d (N=2)
theory
• what are the
possible
S-duality

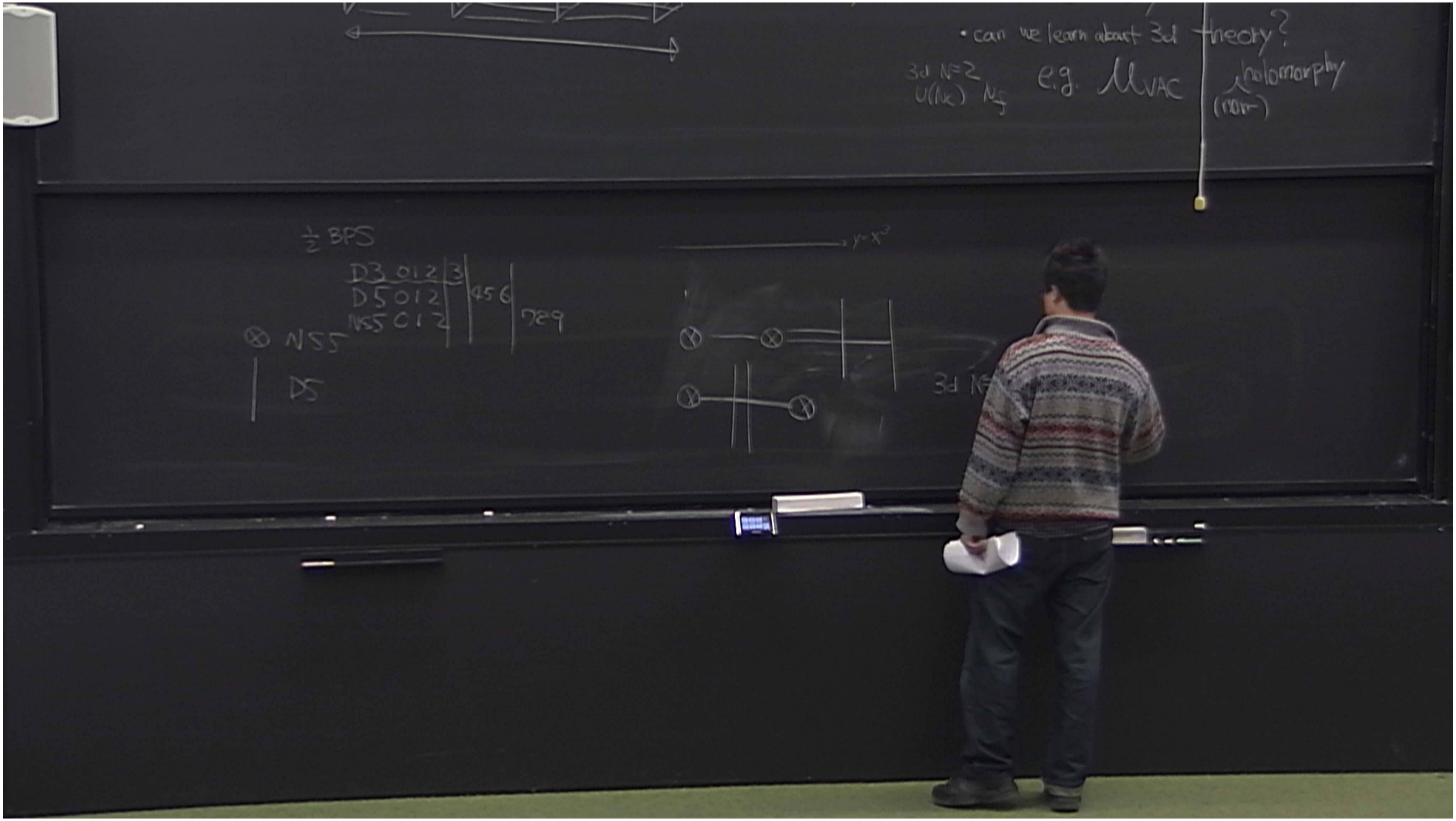

BPS
$U(N_1)$
$U(N_2)$
$T_1 \otimes T_2$
b.c.
junction cond.
$3d(N=2)$
theory
what are the
boundary conditions?
theory?

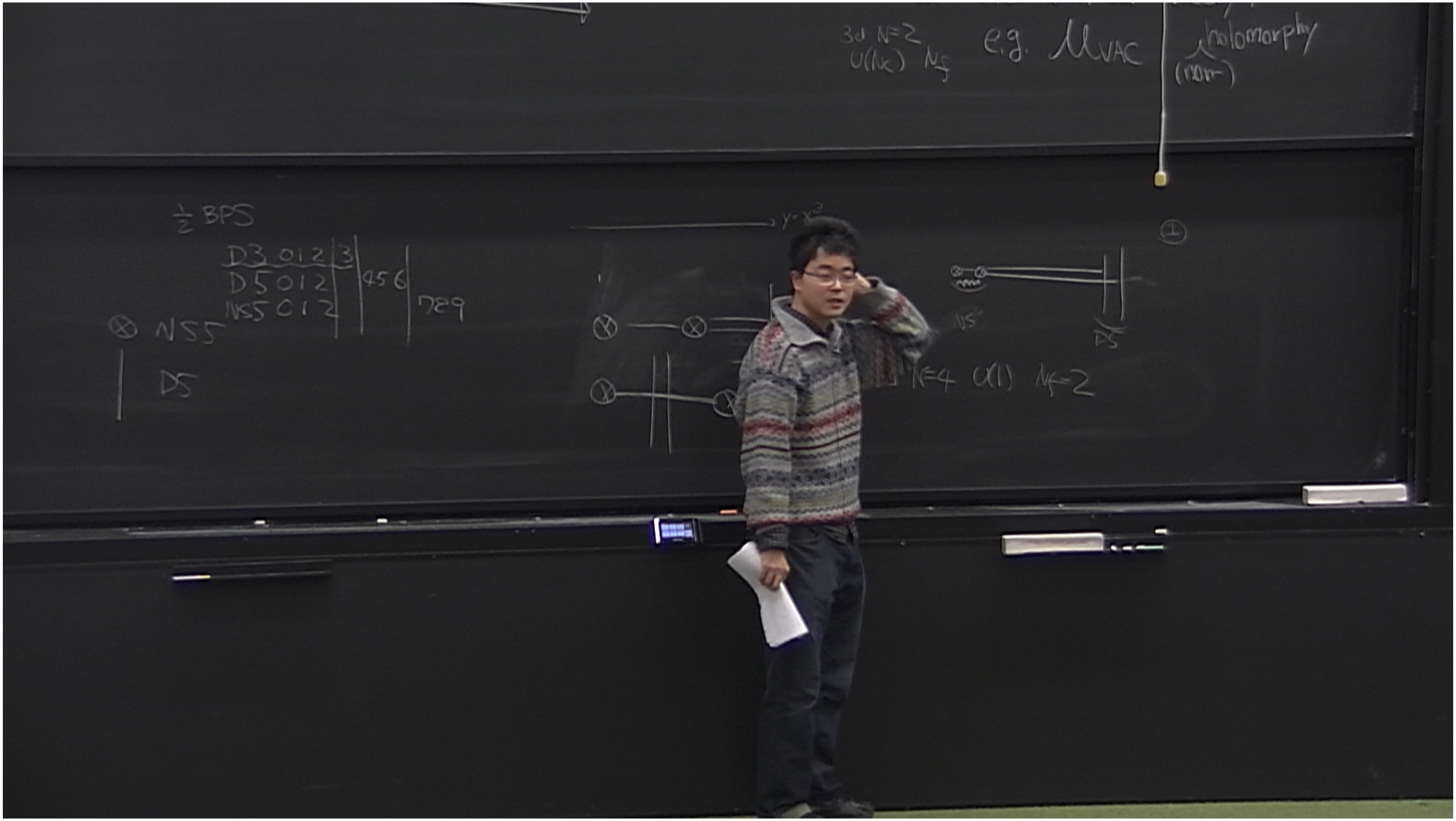

3d (N=2)
theory
S-duality
• can we learn about 3d theory?
e.g.
holomorphy
1/2 BPS
D3 0 1 2 3
D5 0 1 2 4 5 6
NS5 0 1 2 7 8 9
NS5
D5


• can we learn about 3d theory?
3d N=2
U(Nc) Nf
e.g. M VAC
holomorphy
(non-)
½ BPS
NS5
D5
y=x^2

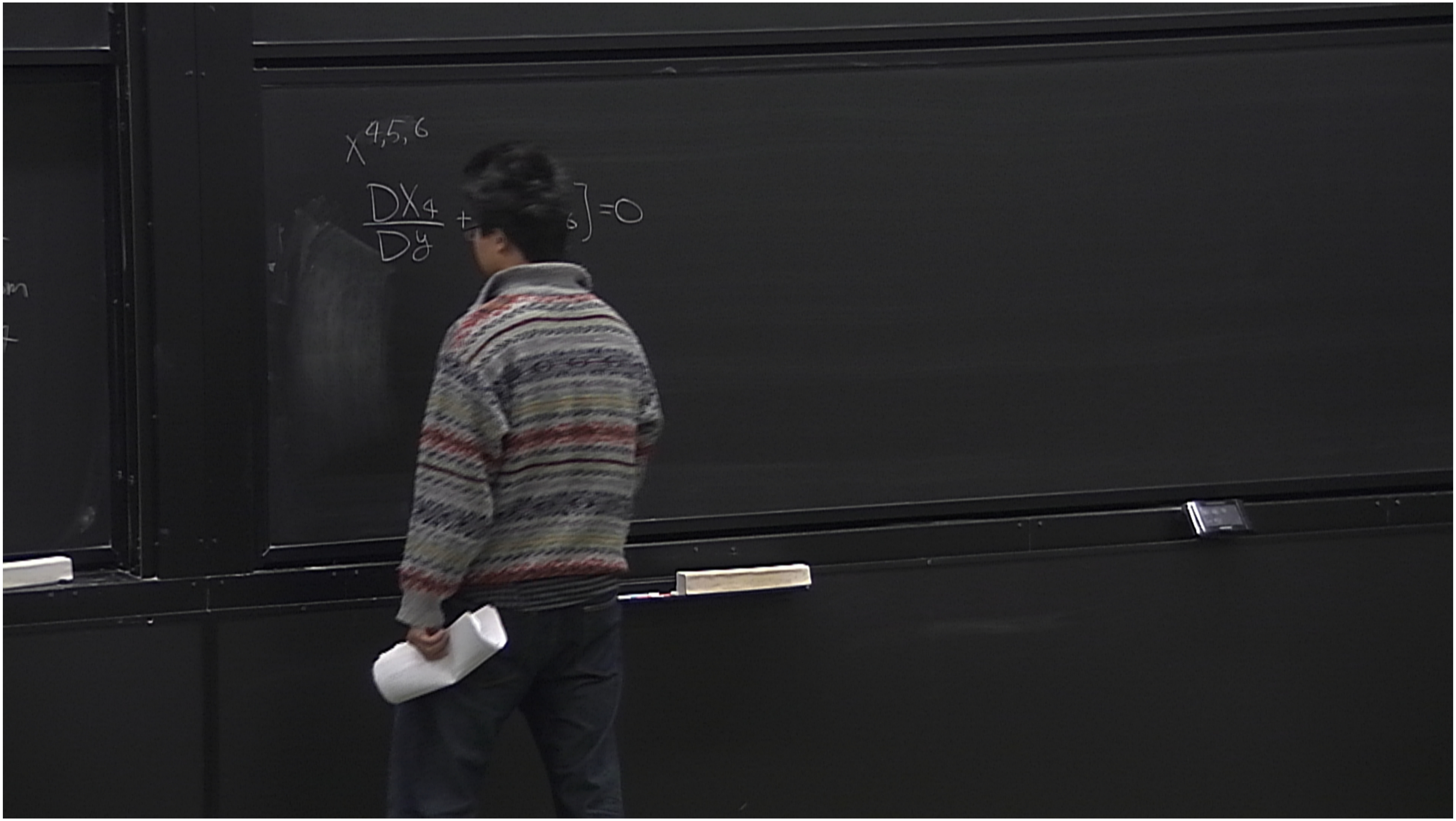

• can we learn about 3d theory?
3d N=2
U(Nc) Nf
e.g.
holomorphy
(non-)
1/2 BPS
D3 012 3
D5 012 456
NS5 012 789
NS5
D5

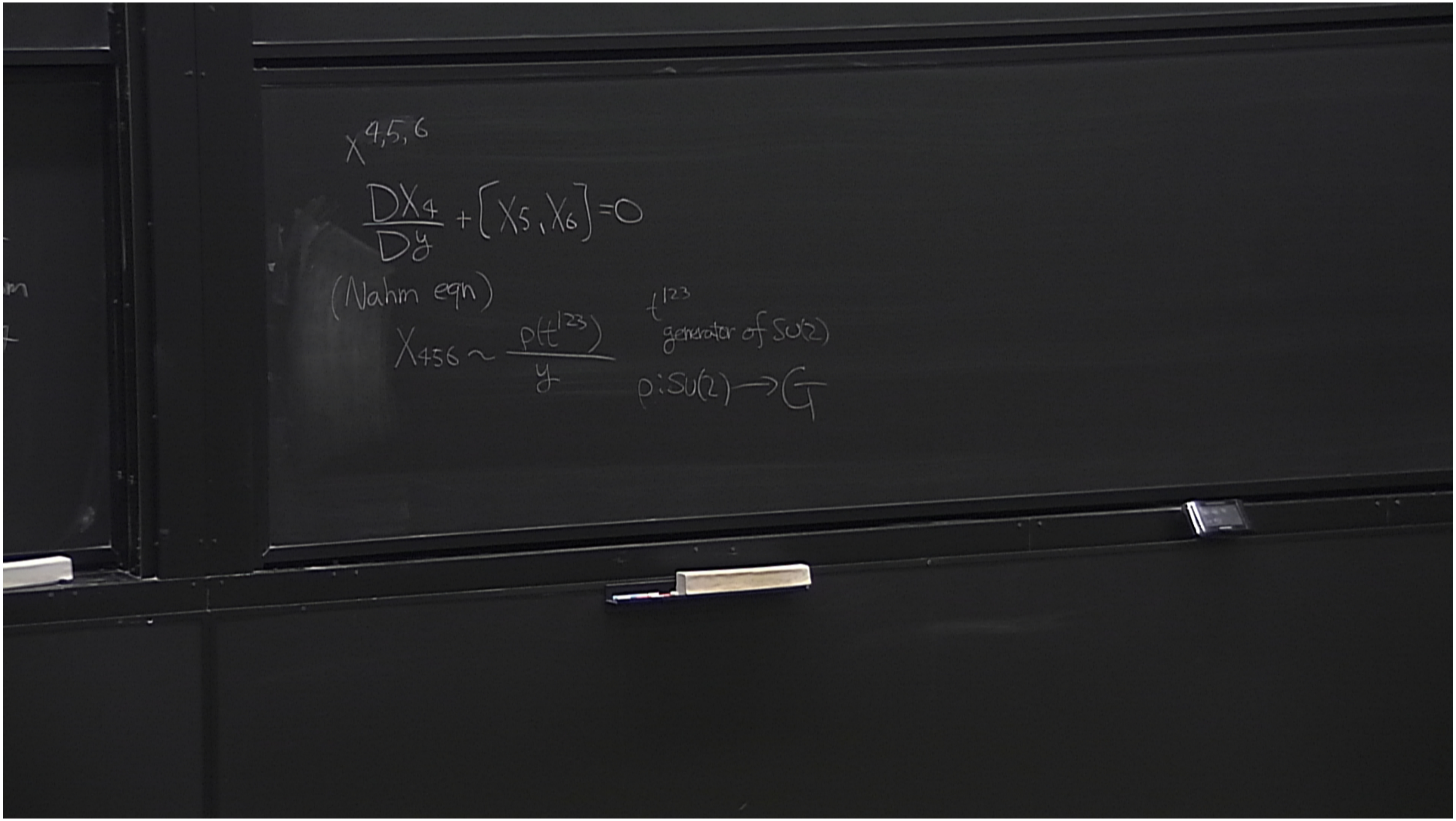

• can we learn about 3d theory?
3d N=2
U(Nc) Nf
e.g. M VAC
holomorphy
(non-)
½ BPS
D3 012 3
D5 012 456
NS5 012 789
⊗ NS5
| D5

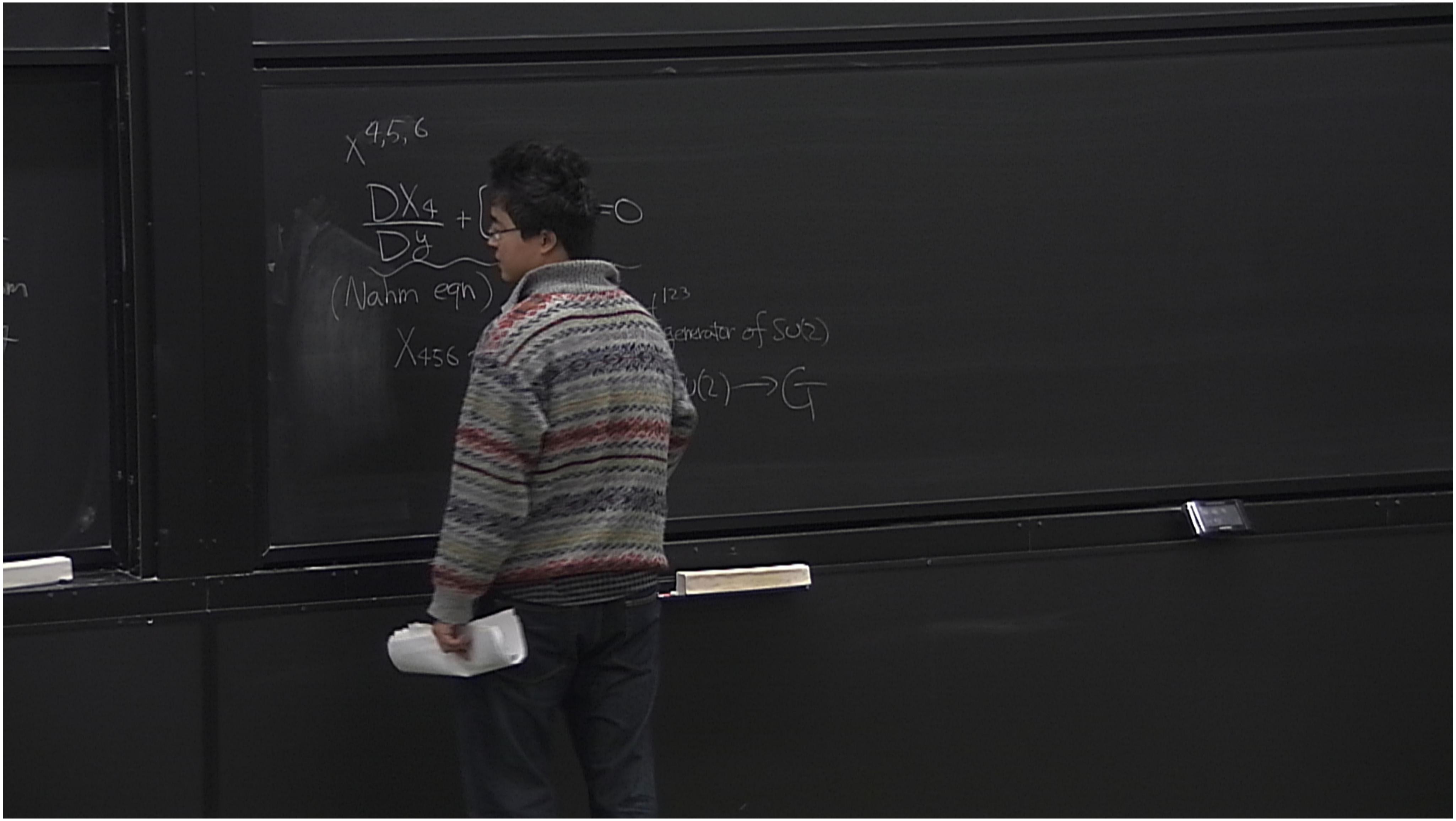

• can we learn about 3d theory?
3d N=2
U(Nc) Nf
e.g. M VAC
holomorphy
(non-)
½ BPS
D3 0 1 2 3
D5 0 1 2 4 5 6
NS5 0 1 2 7 8 9
NS5
D5

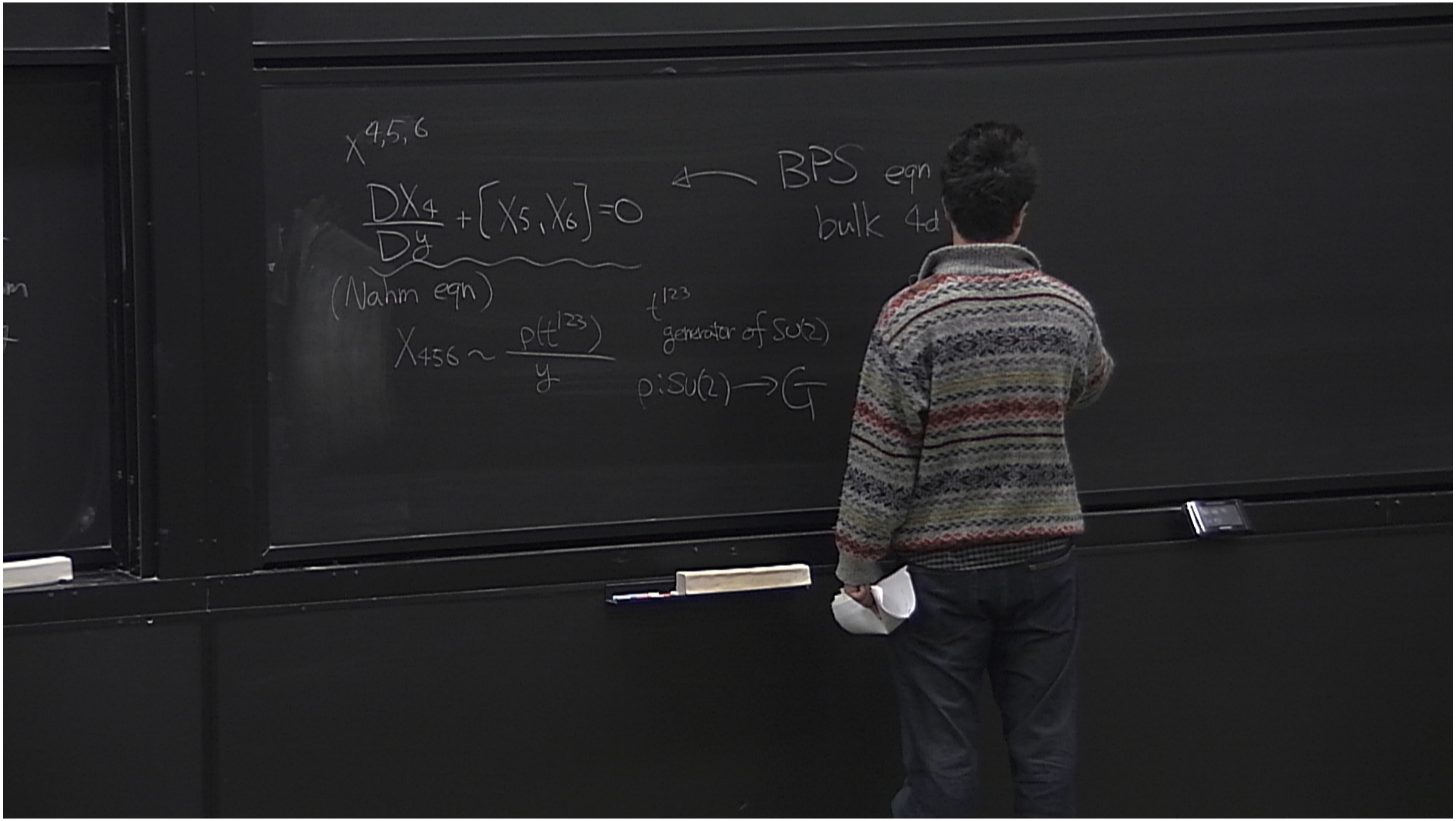


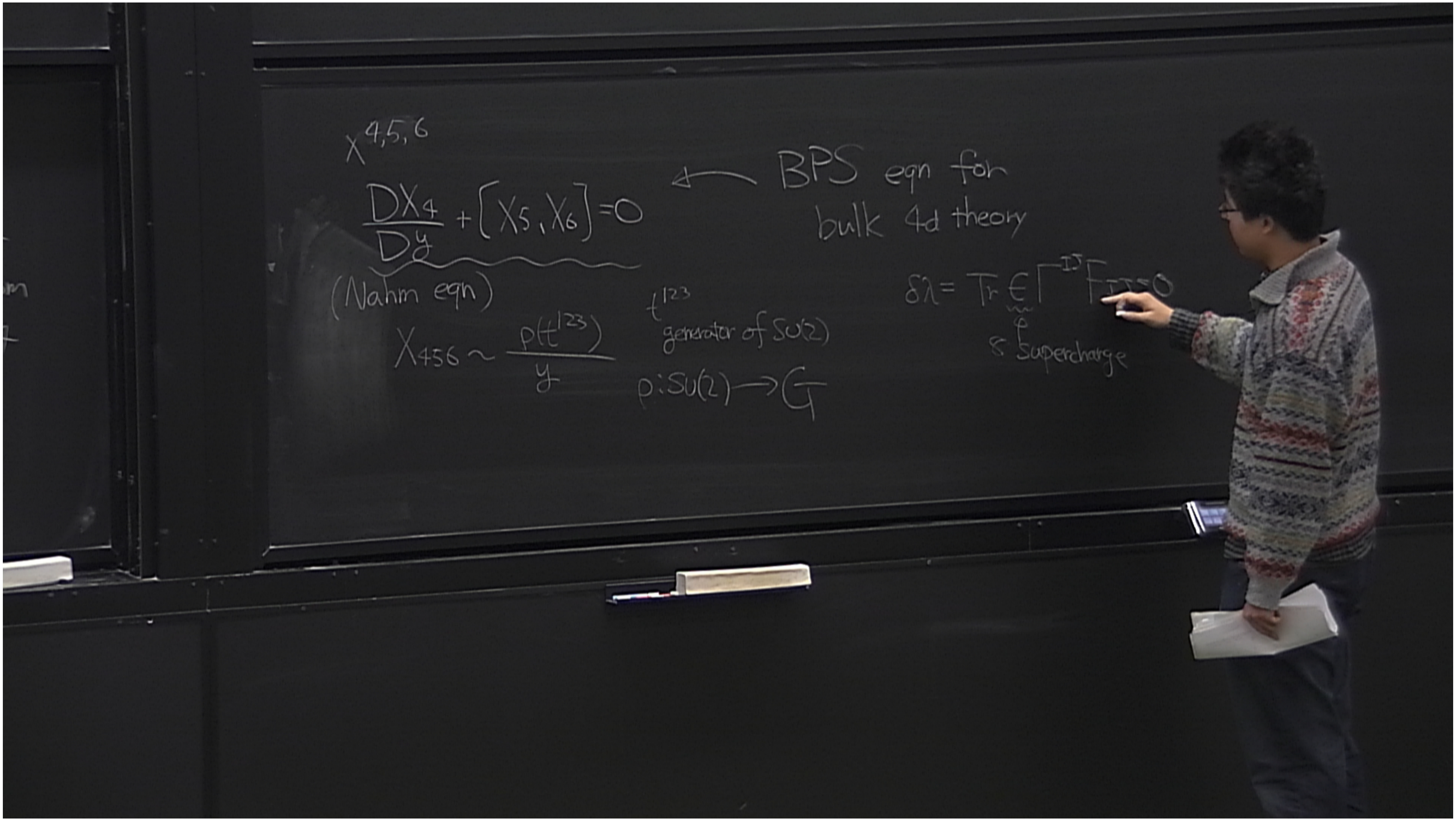
3d N=2
U(Nc) Nf
e.g. M VAC
holomorphy
(non-)
½ BPS
D3 012 3
D5 012 456
NS5 012 789
NS5
D5
y - x³
NS
D5
N=4 U(1) Nf=2

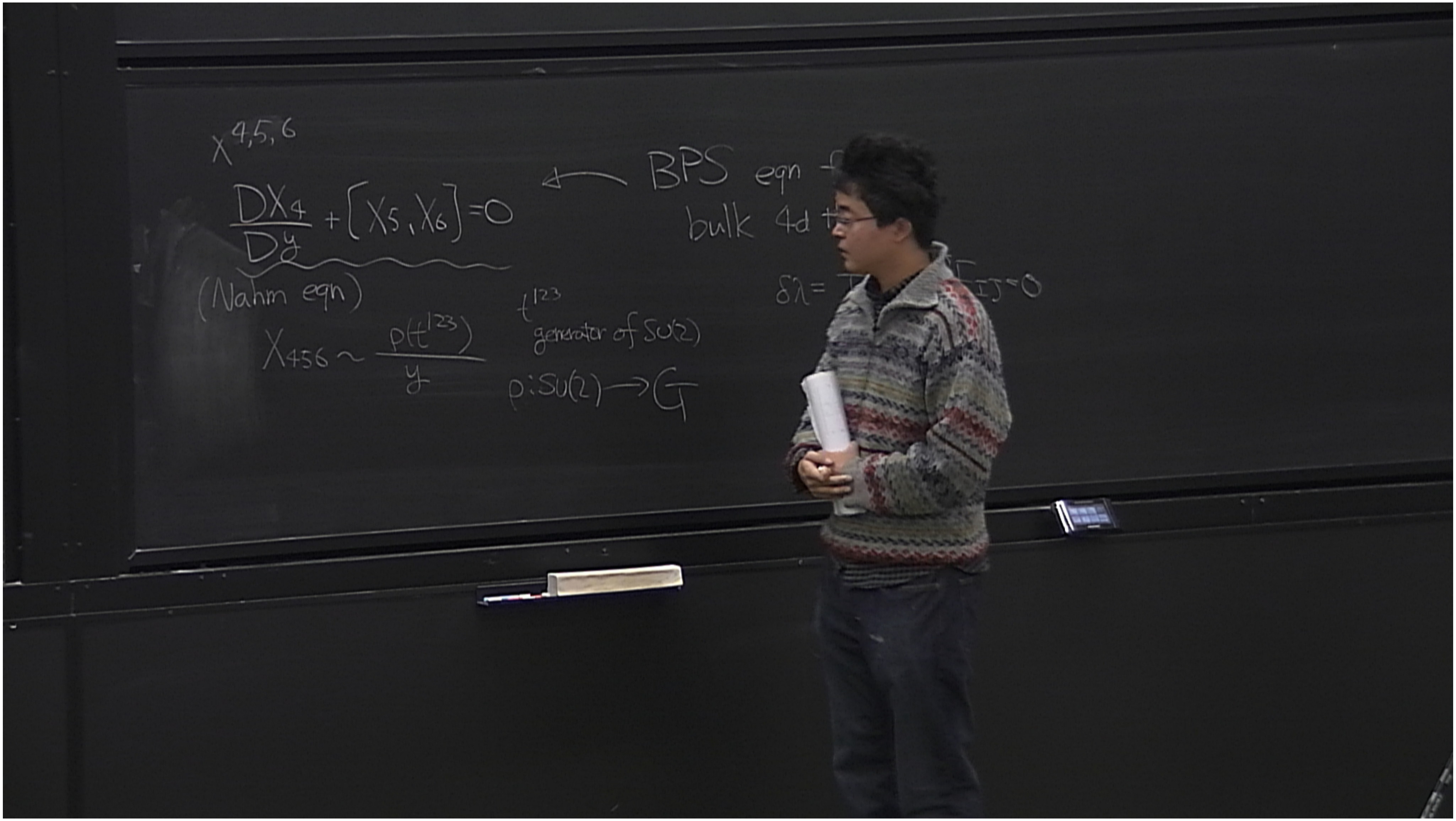

$X^{4,5,6}$
$\frac{DX_4}{Dy}$ +
] = 0

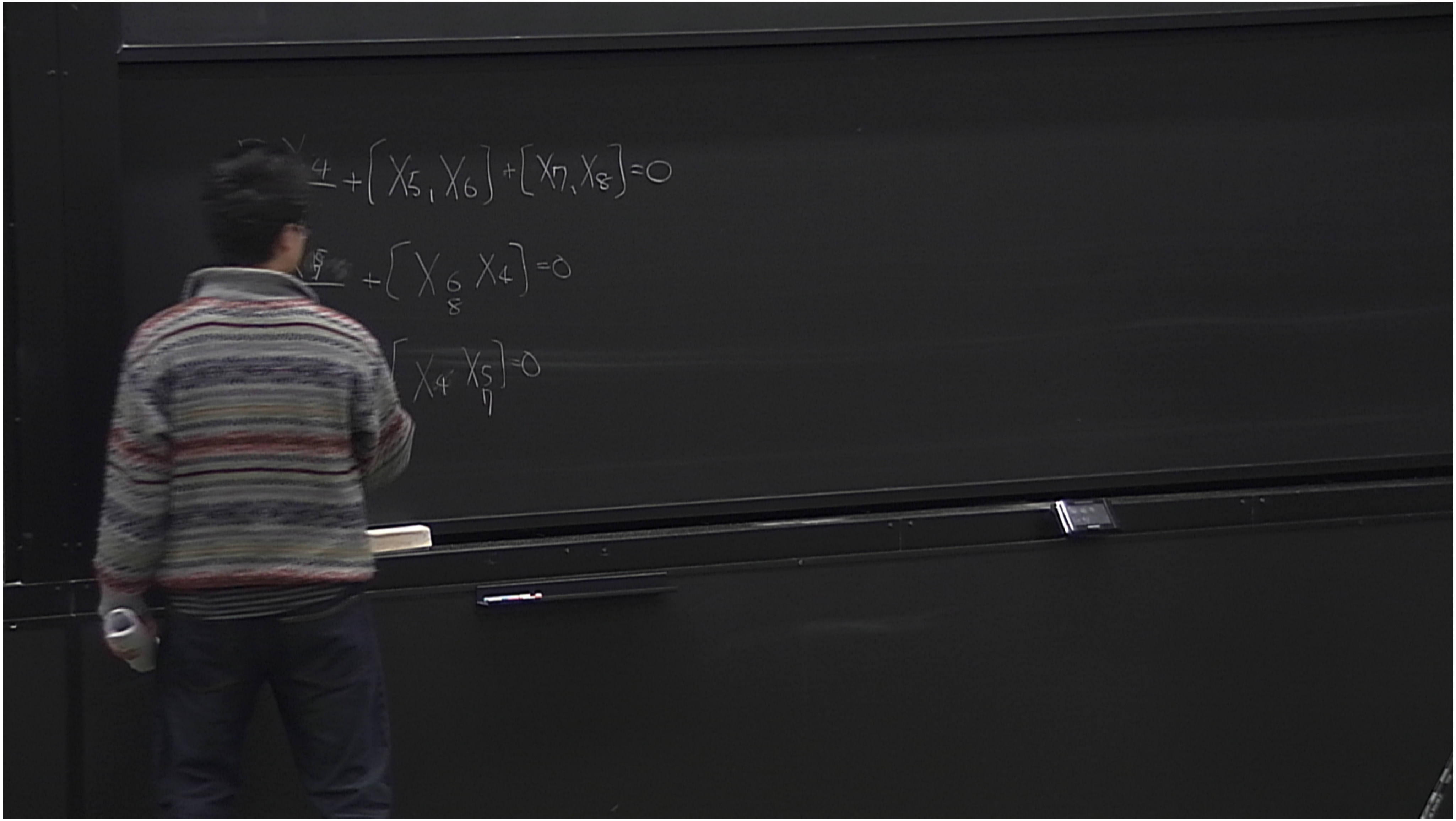

$X^{4,5,6}$
$\frac{DX_4}{Dy} + [X_5, X_6] = 0$
(Nahm eqn)
$X_{456} \sim \frac{\rho(t^{123})}{y}$
t^{123}
generator of SU(2)
$\rho : SU(2) \to G$

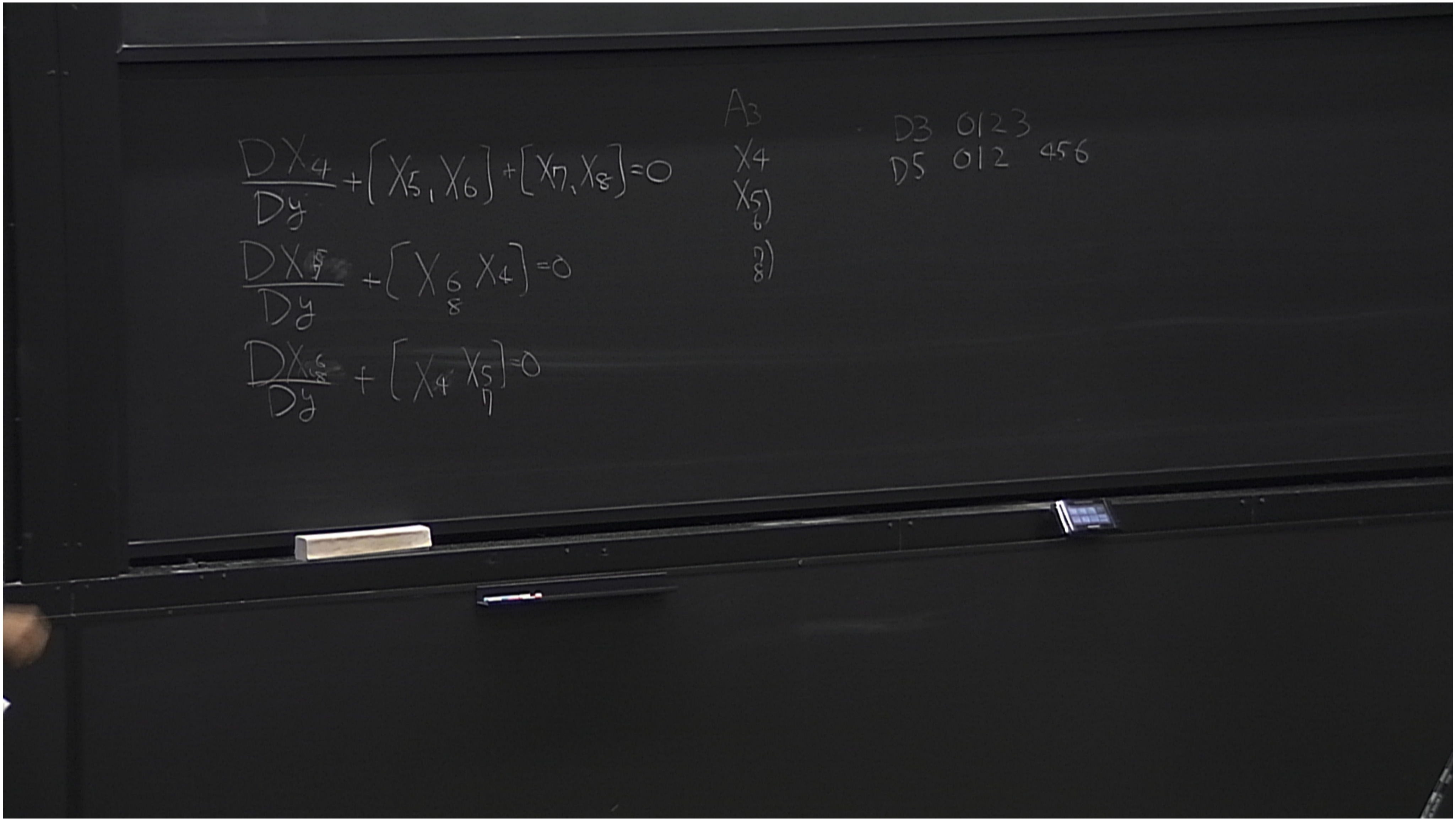

X 4,5,6
DX4
Dy
=0
(Nahm eqn)
123
generator of SU(2)
X456
→G

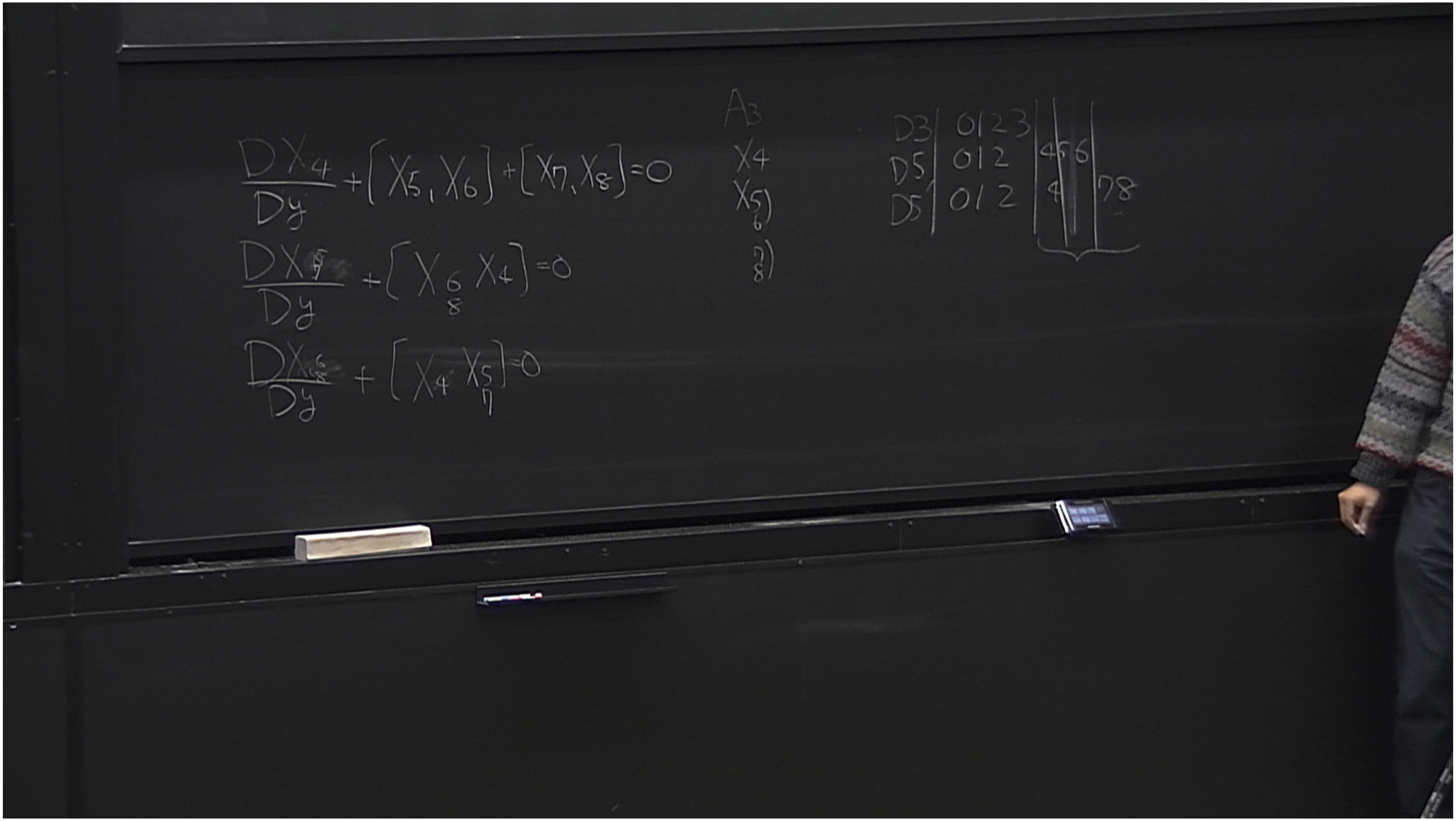

X^{4,5,6}
DX4/Dy + [X5, X6] = 0
BPS eqn
bulk 4d
(Nahm eqn)
t^{123}
generator of SU(2)
X456 ~ ρ(t^{123})/y
ρ: SU(2) → G


X^{4,5,6}
DX4/Dy + [X5, X6] = 0
BPS eqn for bulk 4d theory
(Nahm eqn)
X456 ~ ρ(t^{123})/y
t^{123} generator of SU(2)
ρ: SU(2) → G
δλ = Tr ε Γ^{IJ} F_{IJ} = 0
ε supercharge

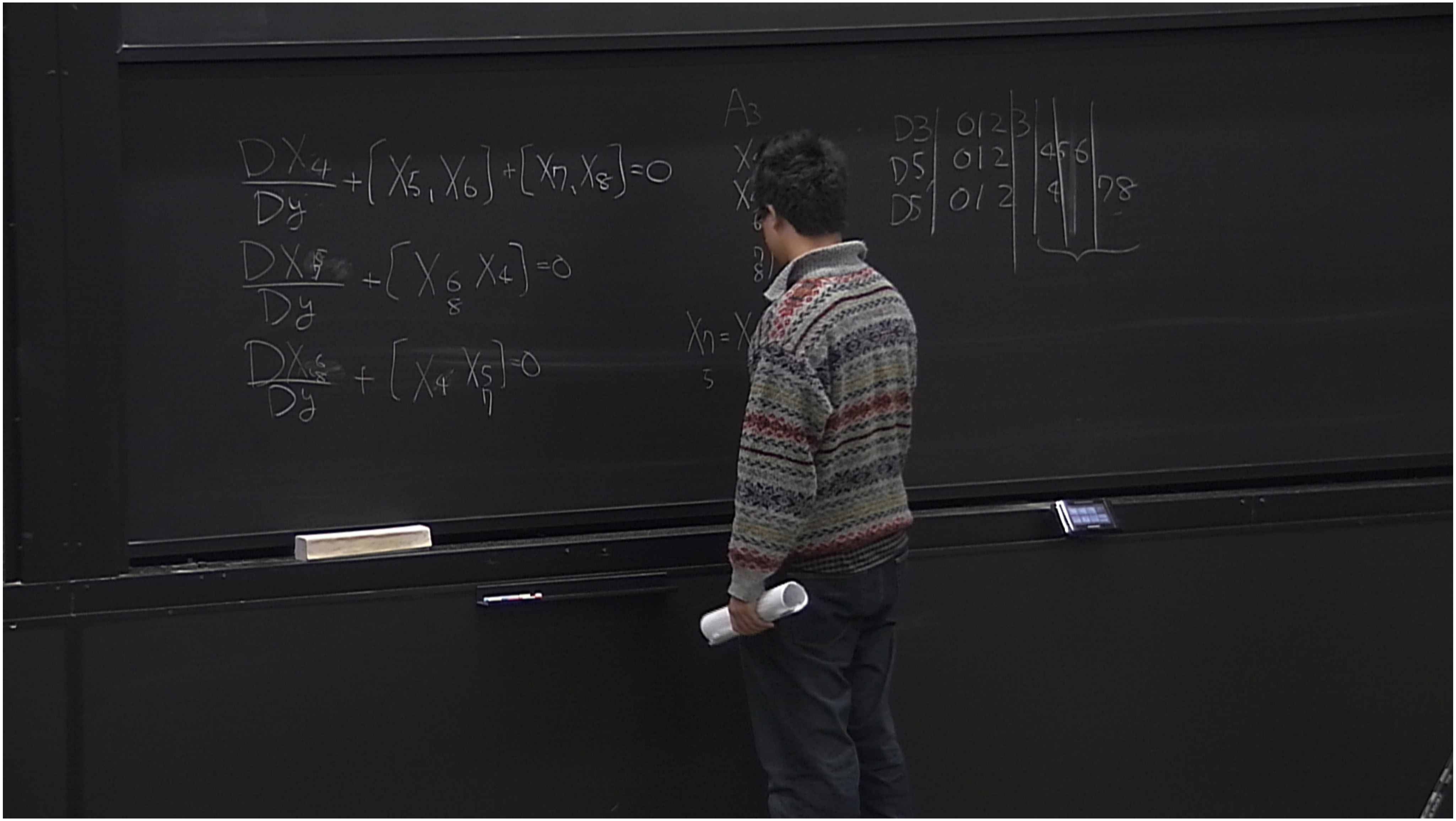

X 4,5,6
DX4/Dy + [X5, X6] = 0
BPS eqn
bulk 4d
(Nahm eqn)
X456 ~ ρ(t123)/y
t123
generator of SU(2)
ρ: SU(2) → G
δλ =

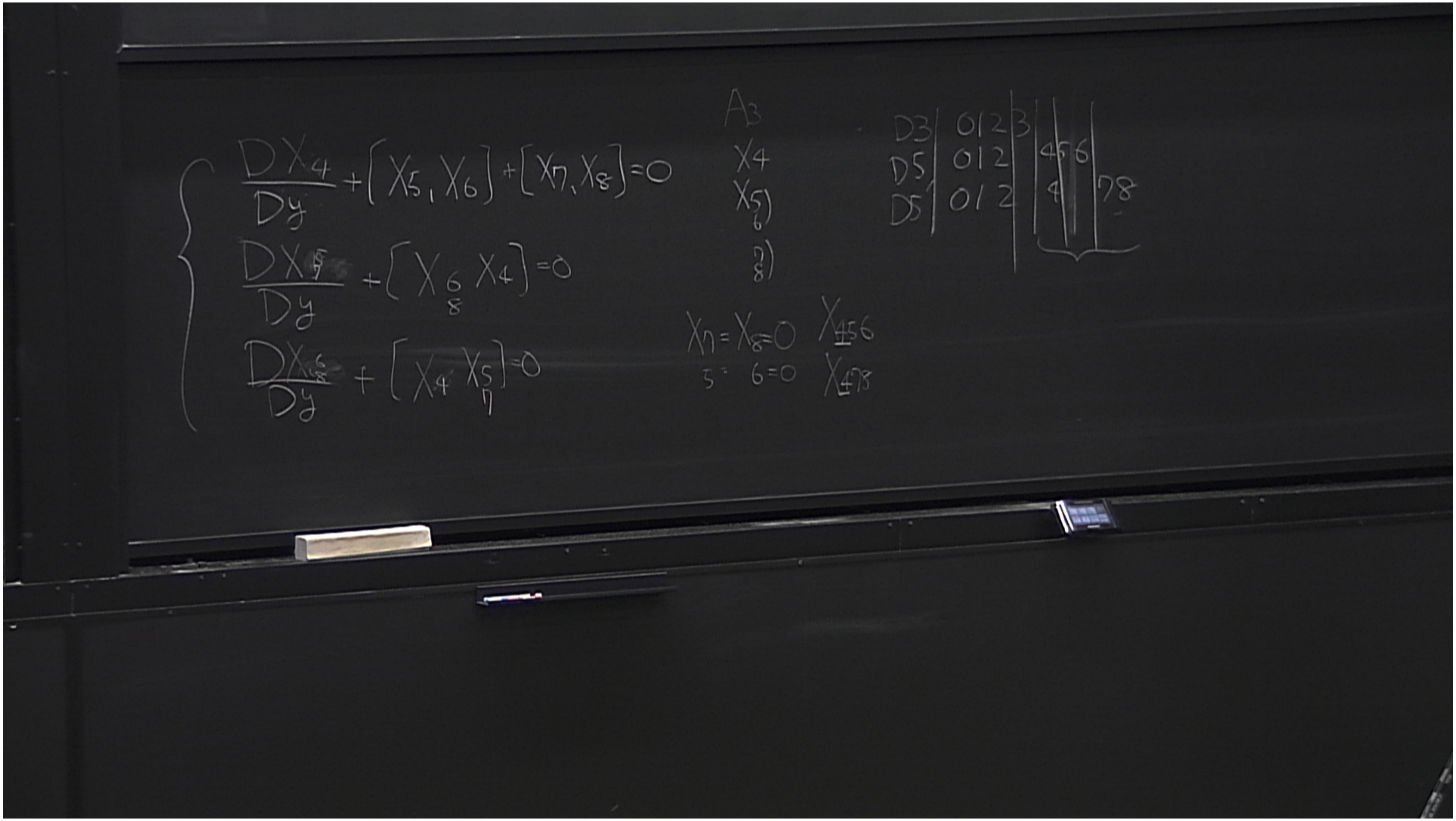

+ [X5, X6] + [X7, X8] = 0

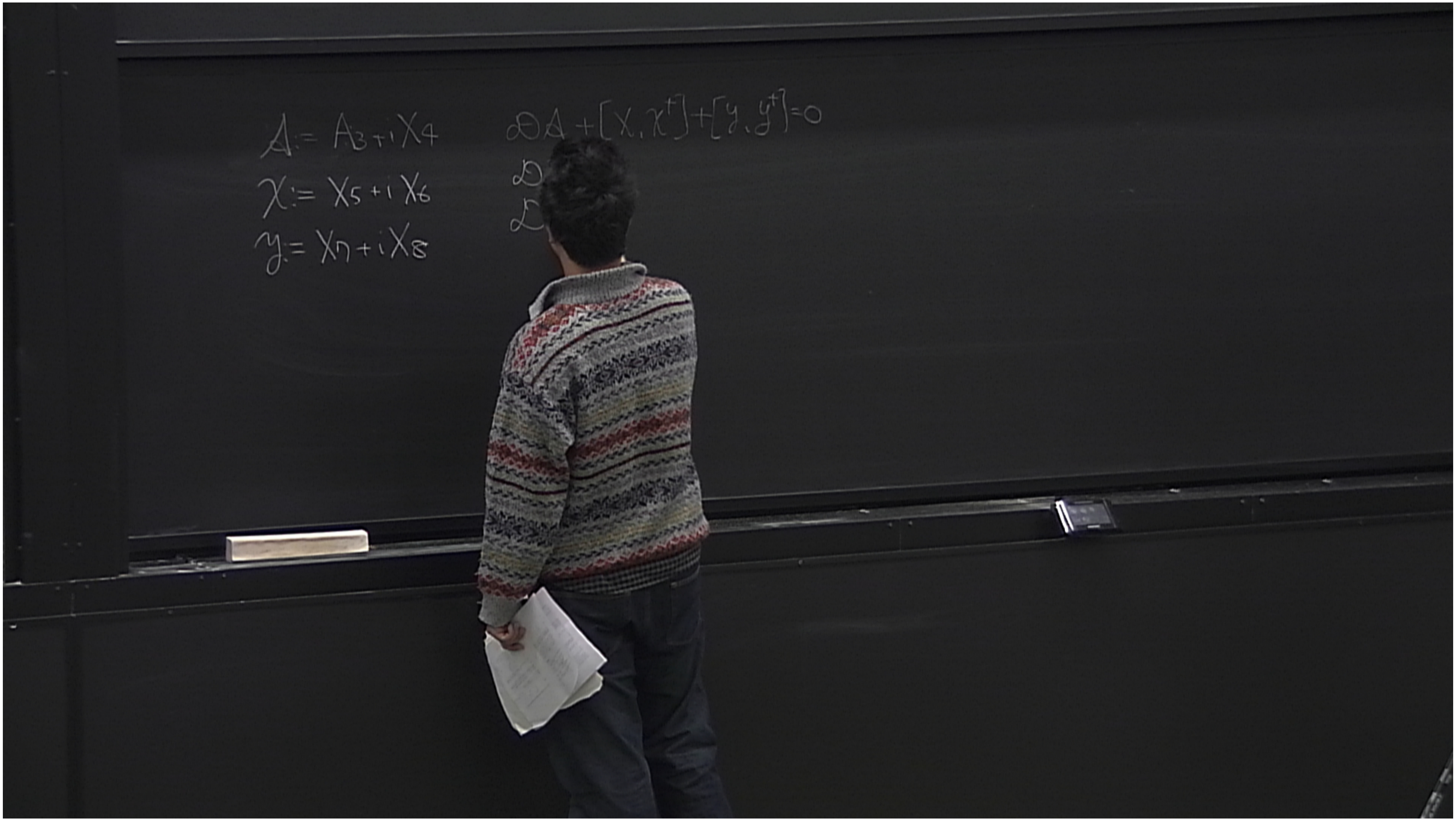

DX4/Dy + [X5, X6] + [X7, X8] = 0
DX5/Dy + [X6 X4] = 0
DX6/Dy + [X4 X5] = 0
A3
X4
X5)
6
7)
8)
D3 0123
D5 012 456

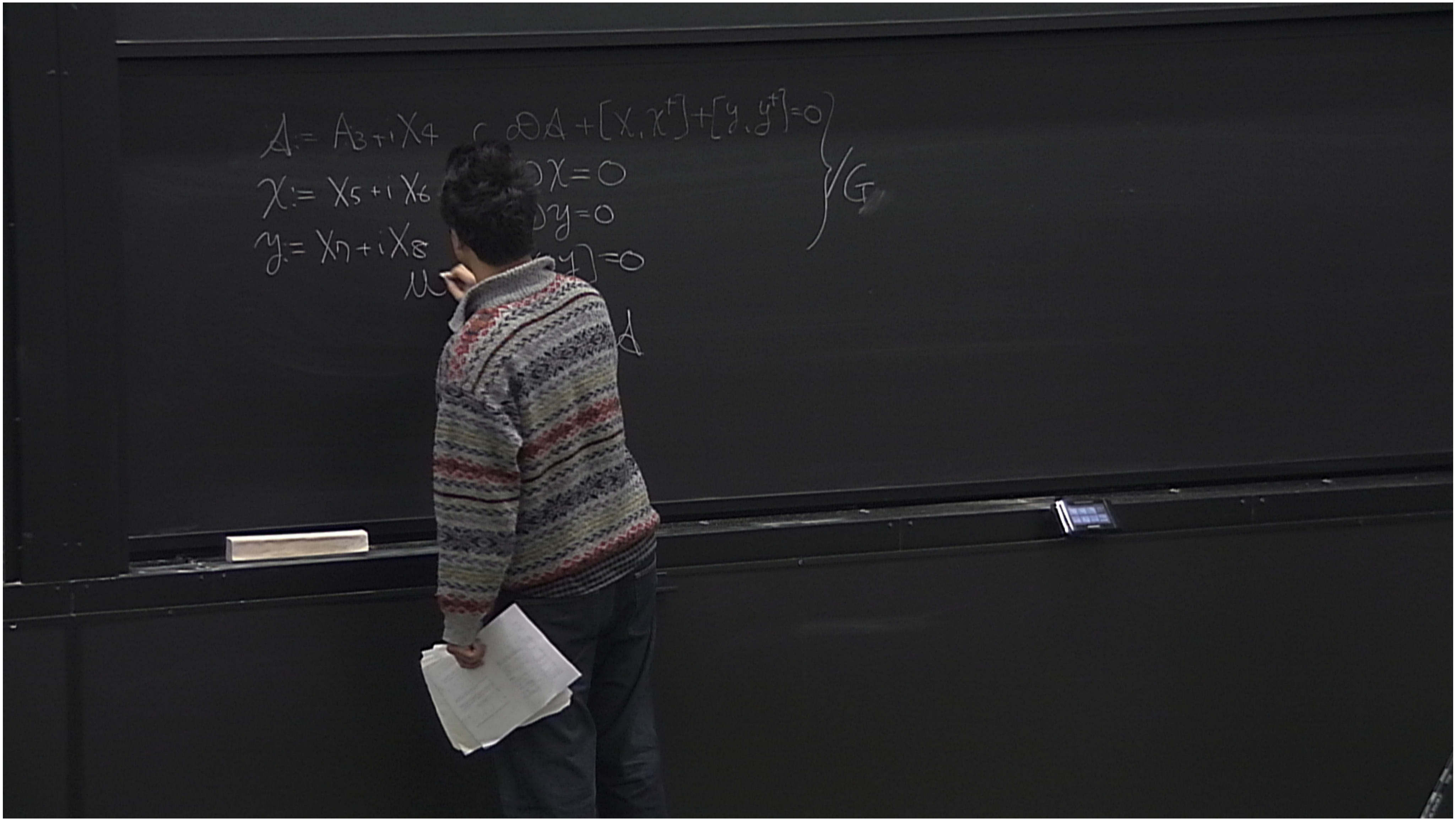


DX4/Dy + [X5, X6] + [X7, X8] = 0
DX5/Dy + [X6, X4] = 0
DX6/Dy + [X4, X5] = 0
A3
X4
X5
D3 0123
D5 012 456
D5 012 4 78

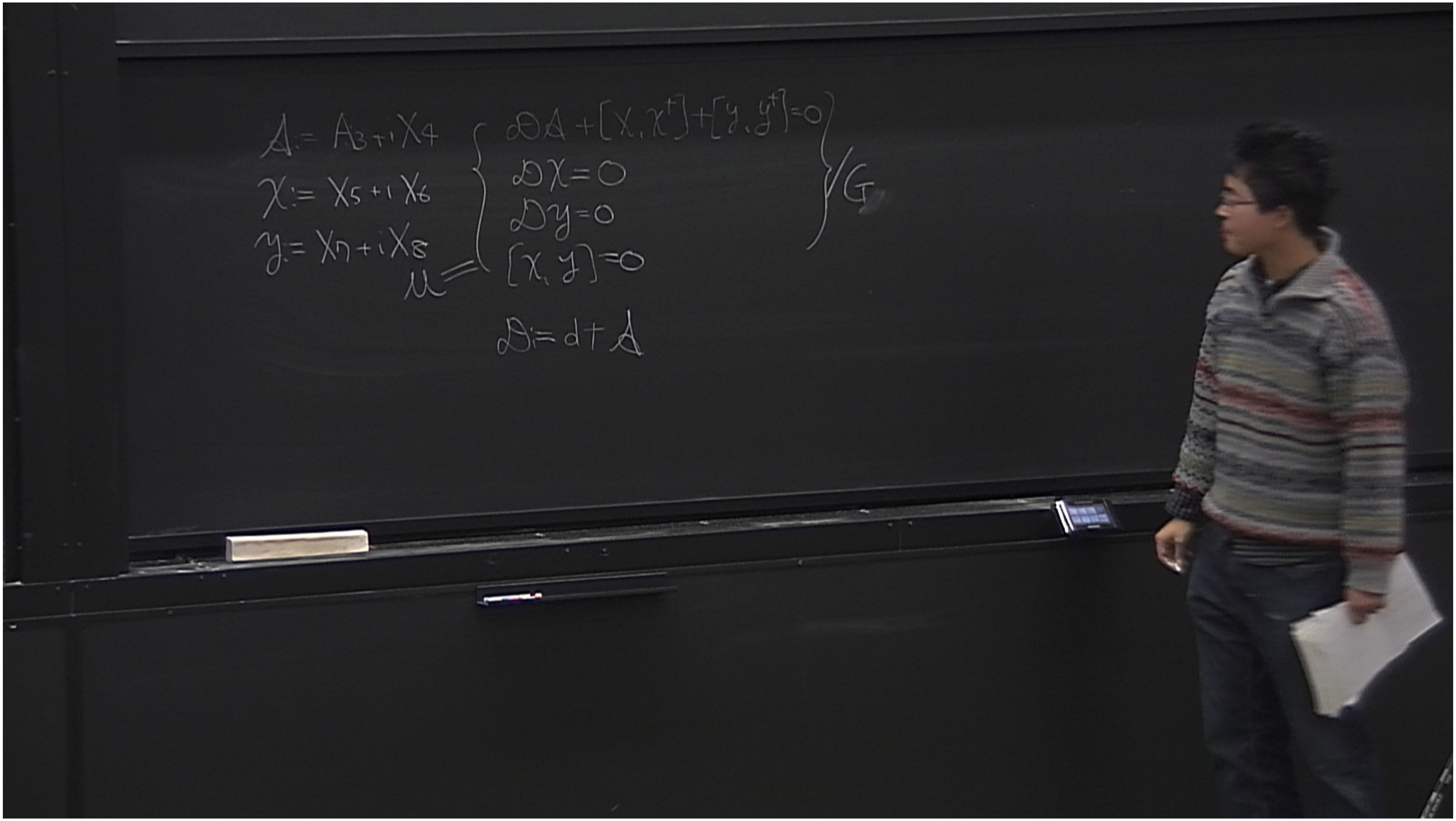

DX4/Dy + [X5, X6] + [X7, X8] = 0
A3
D3 0 1 2 3
D5 0 1 2
D5 0 1 2


DX4/Dy + [X5, X6] + [X7, X8] = 0
DX5/Dy + [X6 X4] = 0
DX6/Dy + [X4 X5] = 0
A3
X4
X5
X7 = X8 = 0
5 = 6 = 0
X456
X478
D3 | 0 1 2 3
D5 | 0 1 2 | 4 5 6
D5 | 0 1 2 | 4 | 7 8

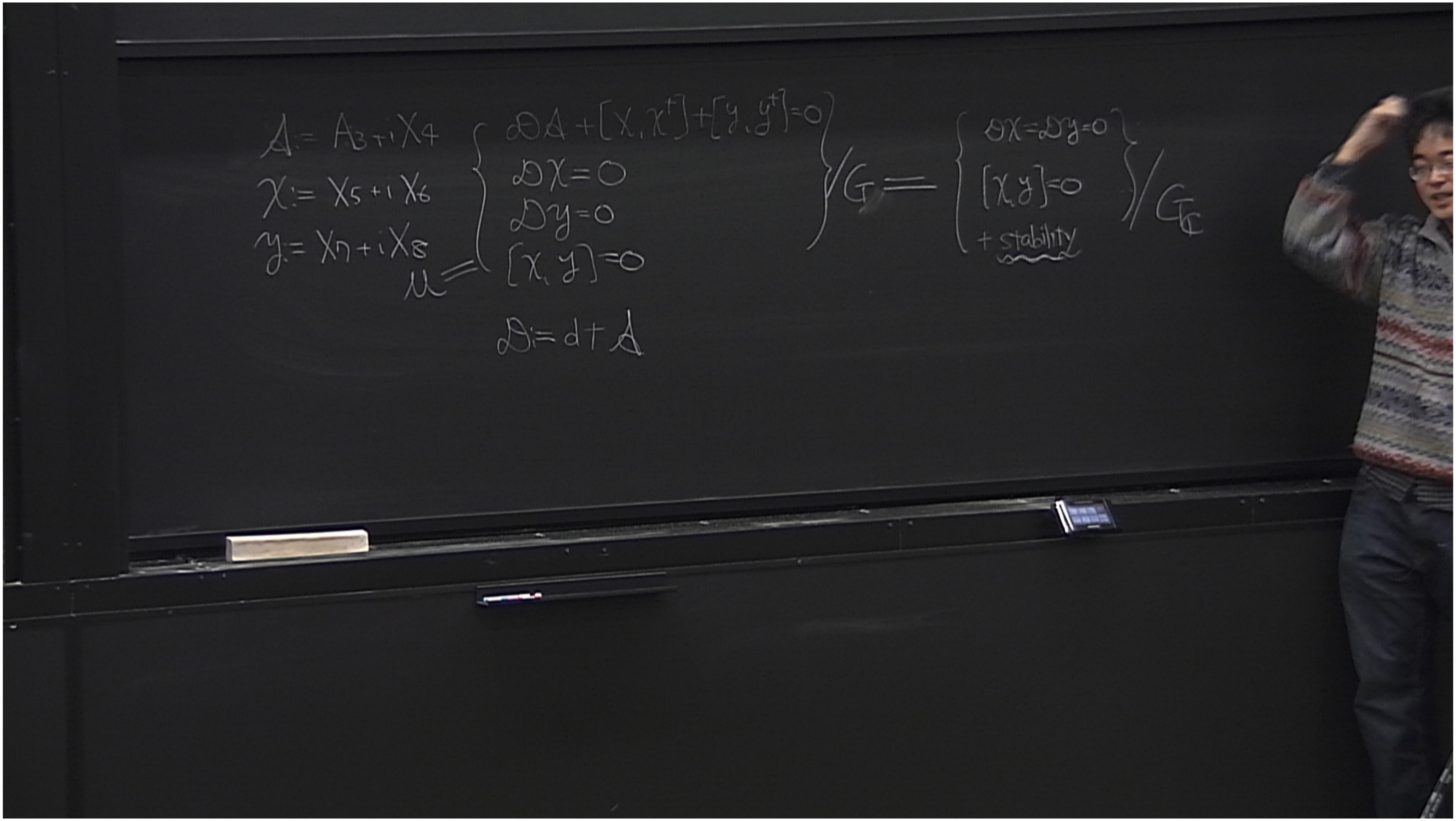

A := A3 + i X4
X := X5 + i X6
Y := X7 + i X8
DA + [X, X†] + [Y, Y†] = 0



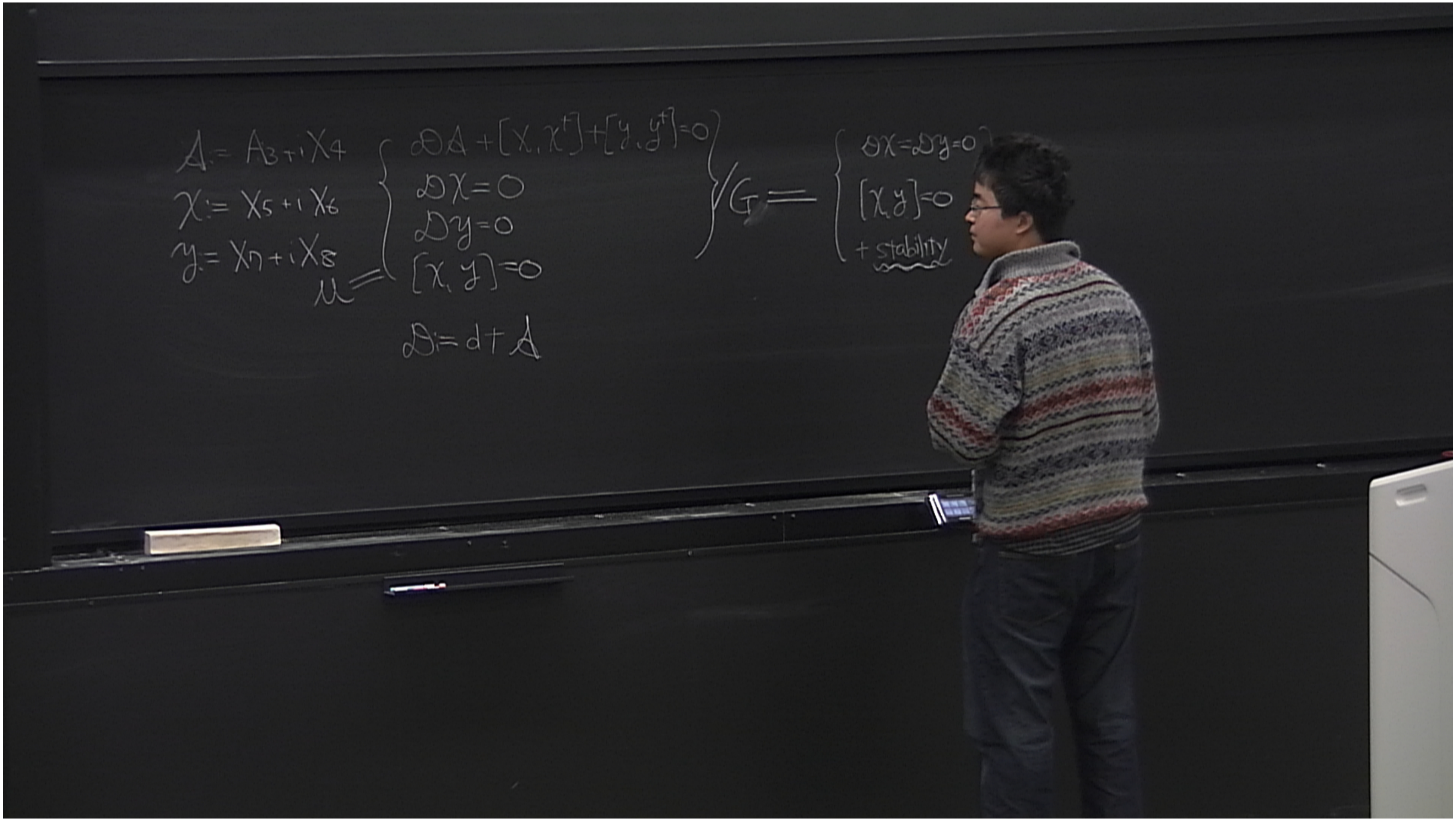
A := A3 + i X4
X := X5 + i X6
y := X7 + i X8
/G

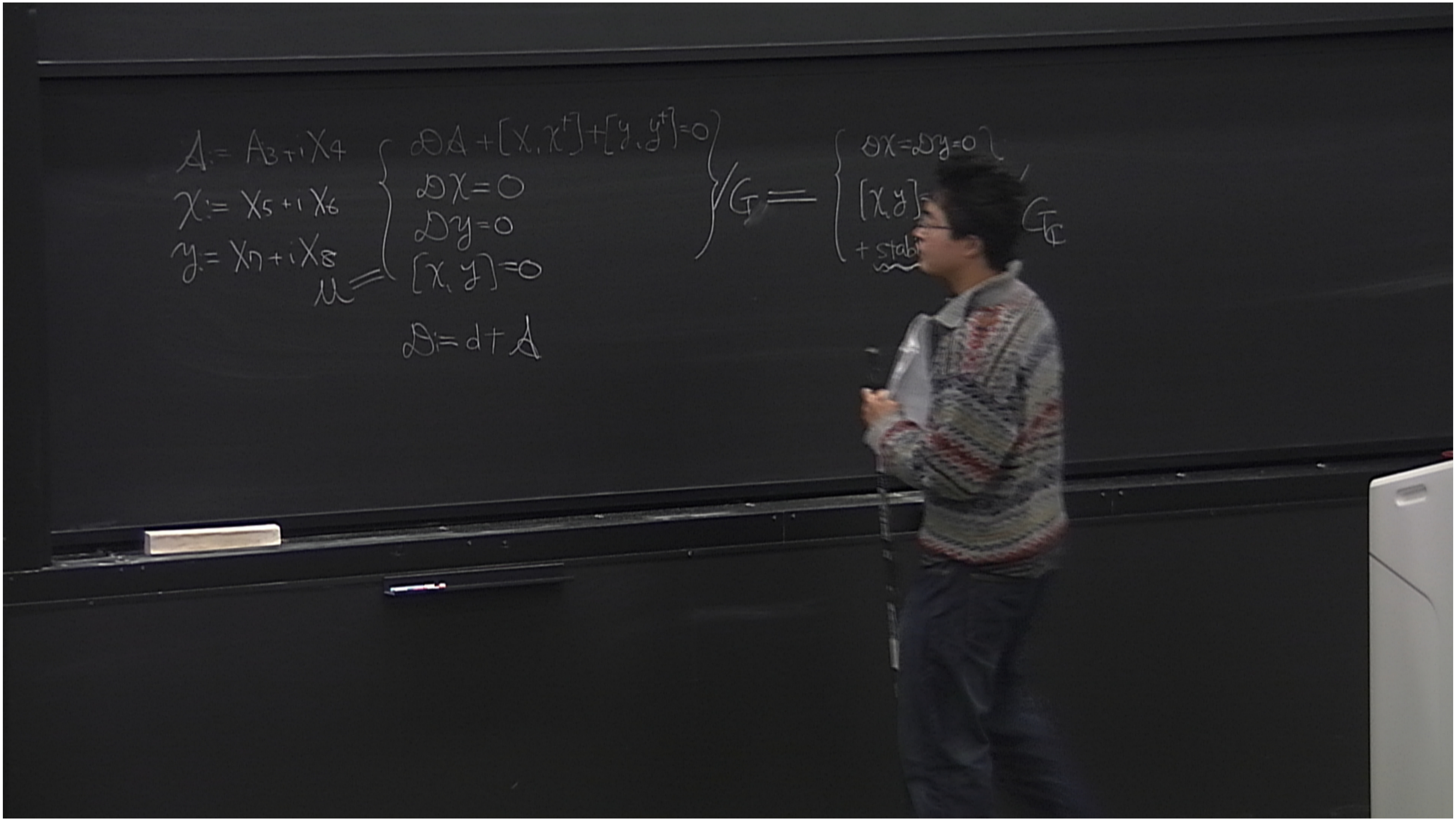


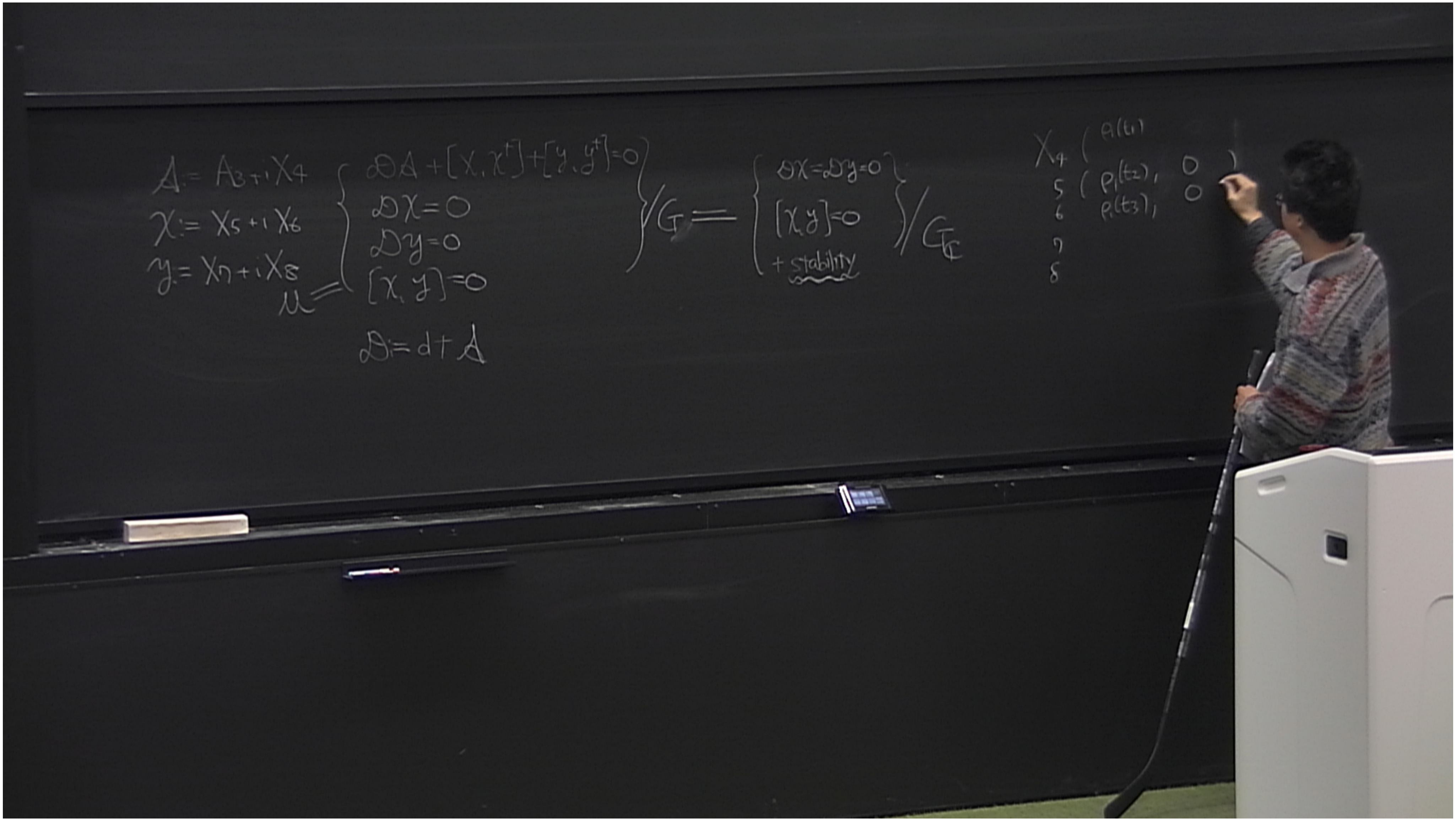
A := A3 + iX4
X := X5 + iX6
Y := X7 + iX8
M = { DA + [X, X†] + [Y, Y†] = 0
DX = 0
DY = 0
[X, Y] = 0 } / G
D := d + A

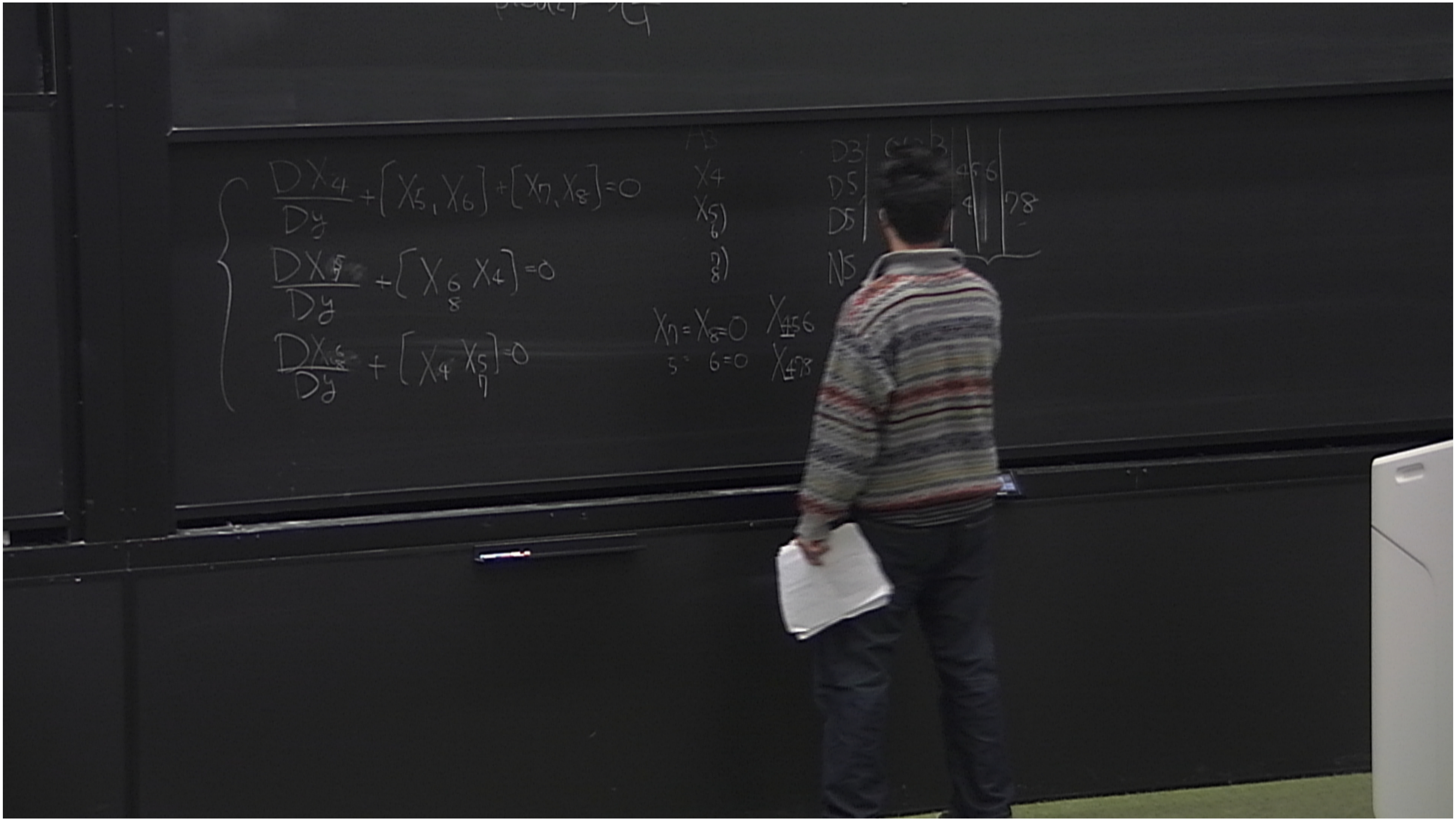


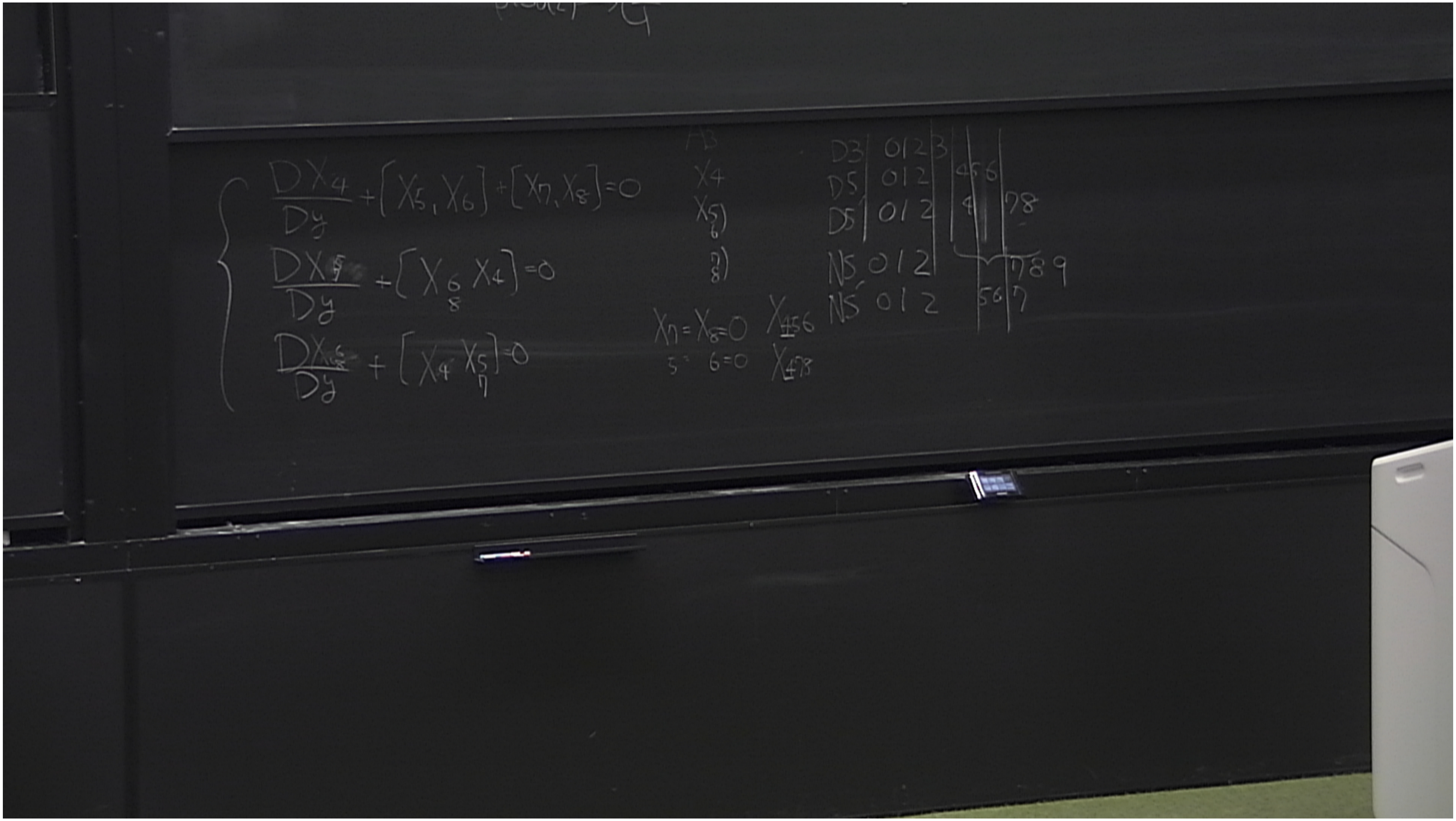
$\mathcal{A} := A_3 + i X_4$
$\mathcal{X} := X_5 + i X_6$
$\mathcal{Y} := X_7 + i X_8$
$\mathcal{M} = \left\{ \mathcal{D}\mathcal{A} + [\mathcal{X}, \mathcal{X}^\dagger] + [\mathcal{Y}, \mathcal{Y}^\dagger] = 0,\ \mathcal{D}\mathcal{X} = 0,\ \mathcal{D}\mathcal{Y} = 0,\ [\mathcal{X}, \mathcal{Y}] = 0 \right\} / G = \left\{ \mathcal{D}\mathcal{X} = \mathcal{D}\mathcal{Y} = 0,\ [\mathcal{X}, \mathcal{Y}] = 0 \right.$ + stability $\left. \right\} / G_{\mathbb{C}}$
$\mathcal{D} := d + \mathcal{A}$

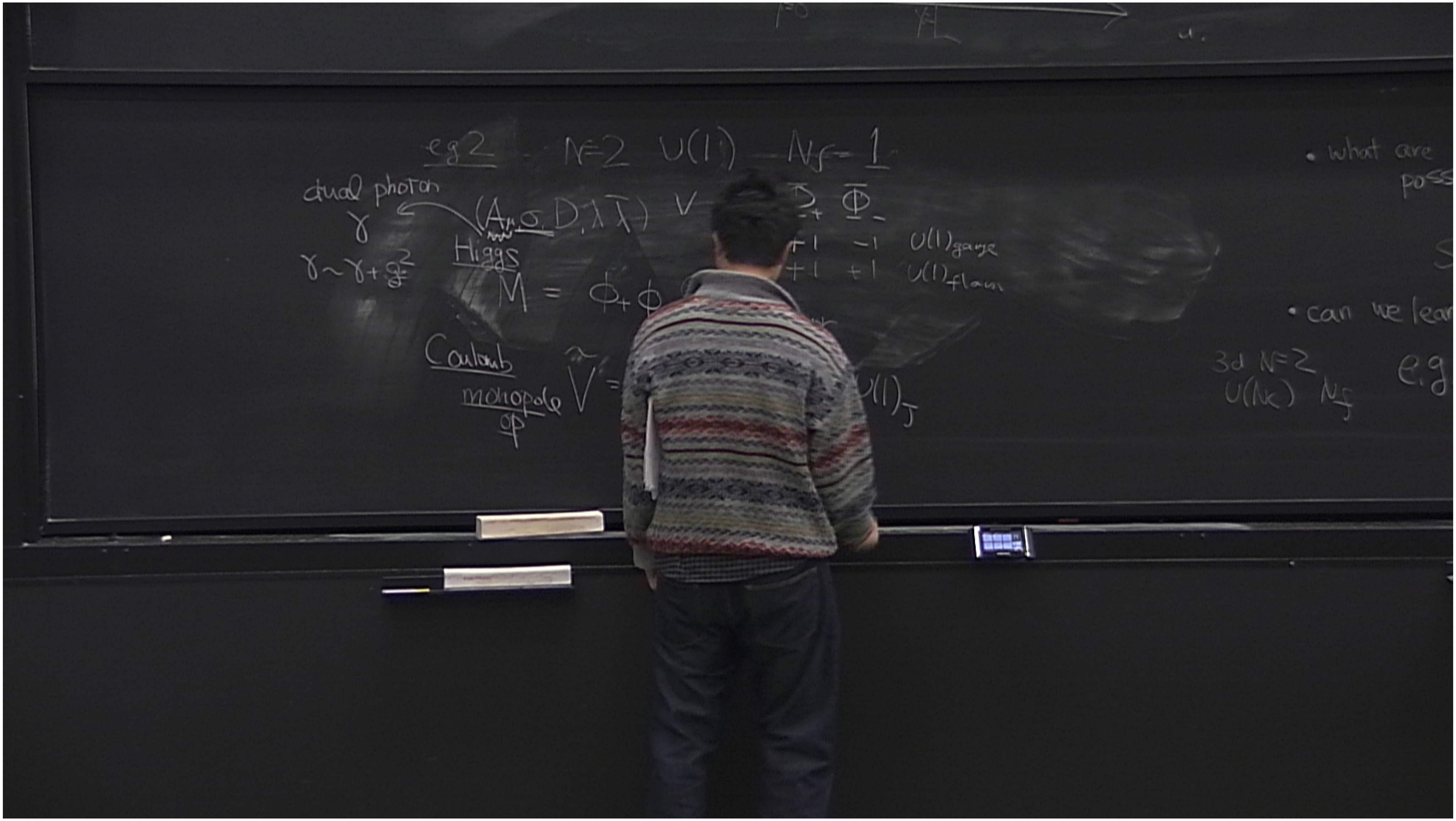

A := A3 + i X4
X := X5 + i X6
y := X7 + i X8
DA + [X, X†] + [y, y†] = 0
DX = 0
Dy = 0
[X, y] = 0
M =
/G =
DX = Dy = 0
[X, y] = 0
+ stability
D := d + A

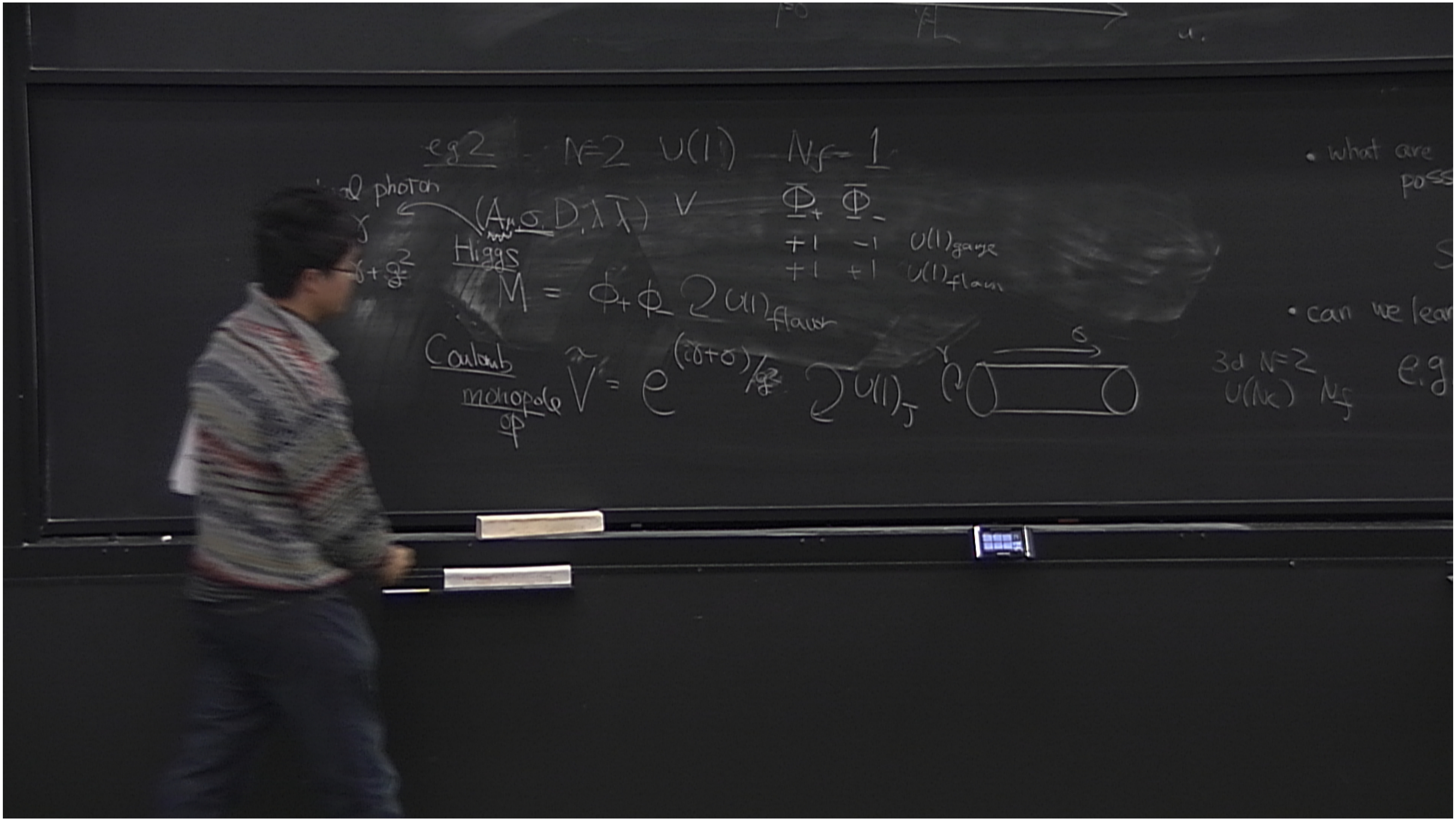

A := A3 + i X4
X := X5 + i X6
Y := X7 + i X8
DA + [X, X†] + [Y, Y†] = 0
DX = 0
DY = 0
[X, Y] = 0
D := d + A
DX = DY = 0


A := A3 + i X4
X := X5 + i X6
y := X7 + i X8
DA + [X, X†] + [y, y†] = 0
DX = 0
Dy = 0
[X, y] = 0
D := d + A
DX = Dy = 0
[X, y] = 0
+ stability


DX4/Dy + [X5, X6] + [X7, X8] = 0
X4
D3
D5
D5
NS
X7 = X8 = 0
X456
X478


DX4/Dy + [X5, X6] + [X7, X8] = 0
DX5/Dy + [X6 X4] = 0
DX6/Dy + [X4 X5] = 0
X7 = X8 = 0
D3 0 1 2 3
D5 0 1 2
D5 0 1 2
NS 0 1 2
NS 0 1 2


eg2 N=2 U(1) Nf=1
dual photon
(Aμ σ, D, λ λ̄) V
Higgs
M =
U(1)gauge
U(1)flavor
Coulomb
monopole op
U(1)J
• what are
• can we lear
3d N=2
U(Nc) Nf
e.g.


eg2 N=2 U(1) Nf=1
photon
Higgs
U(1)gauge
Coulomb
monopole op
• what are
3d N=2
U(Nc) Nf