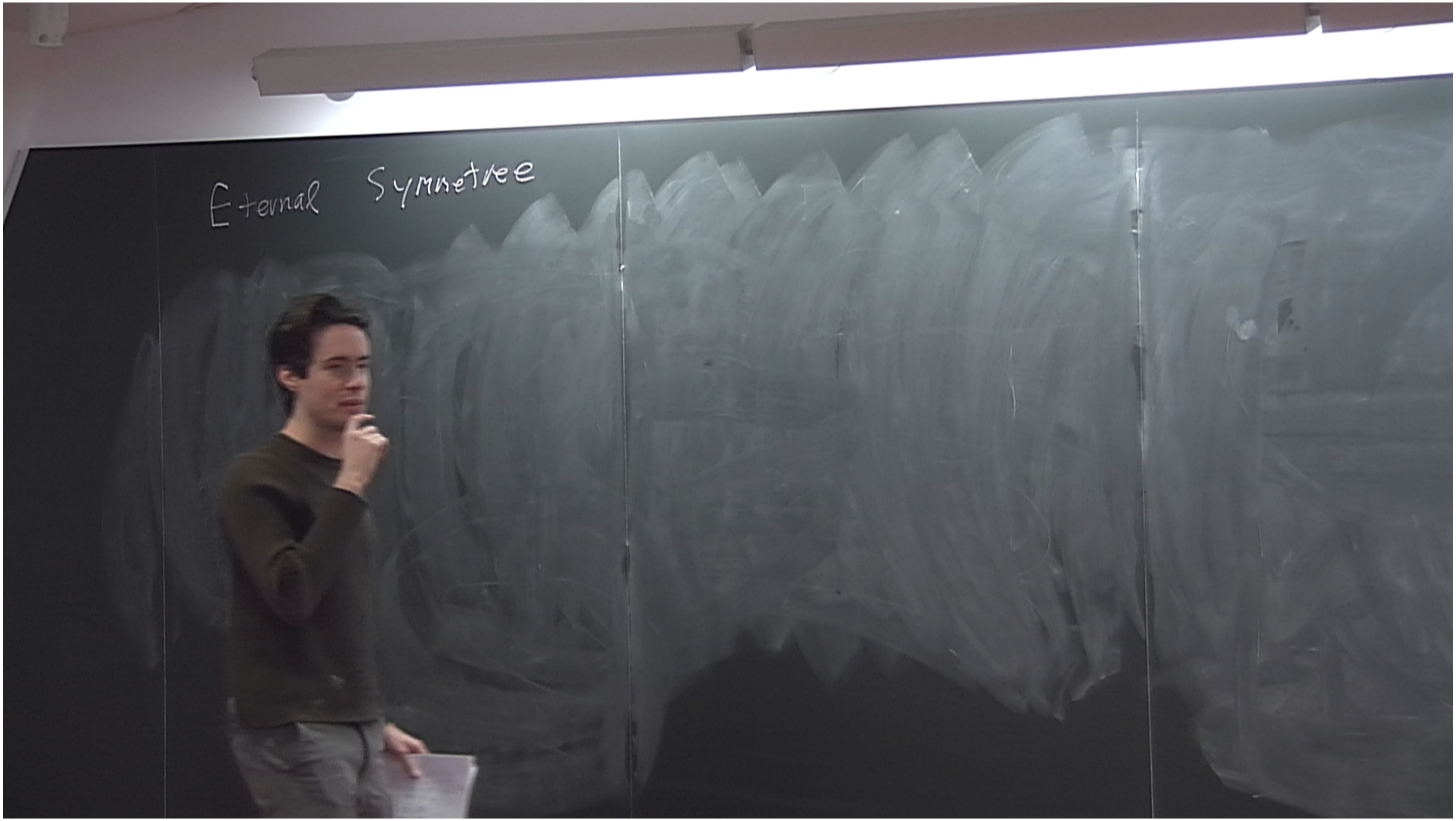
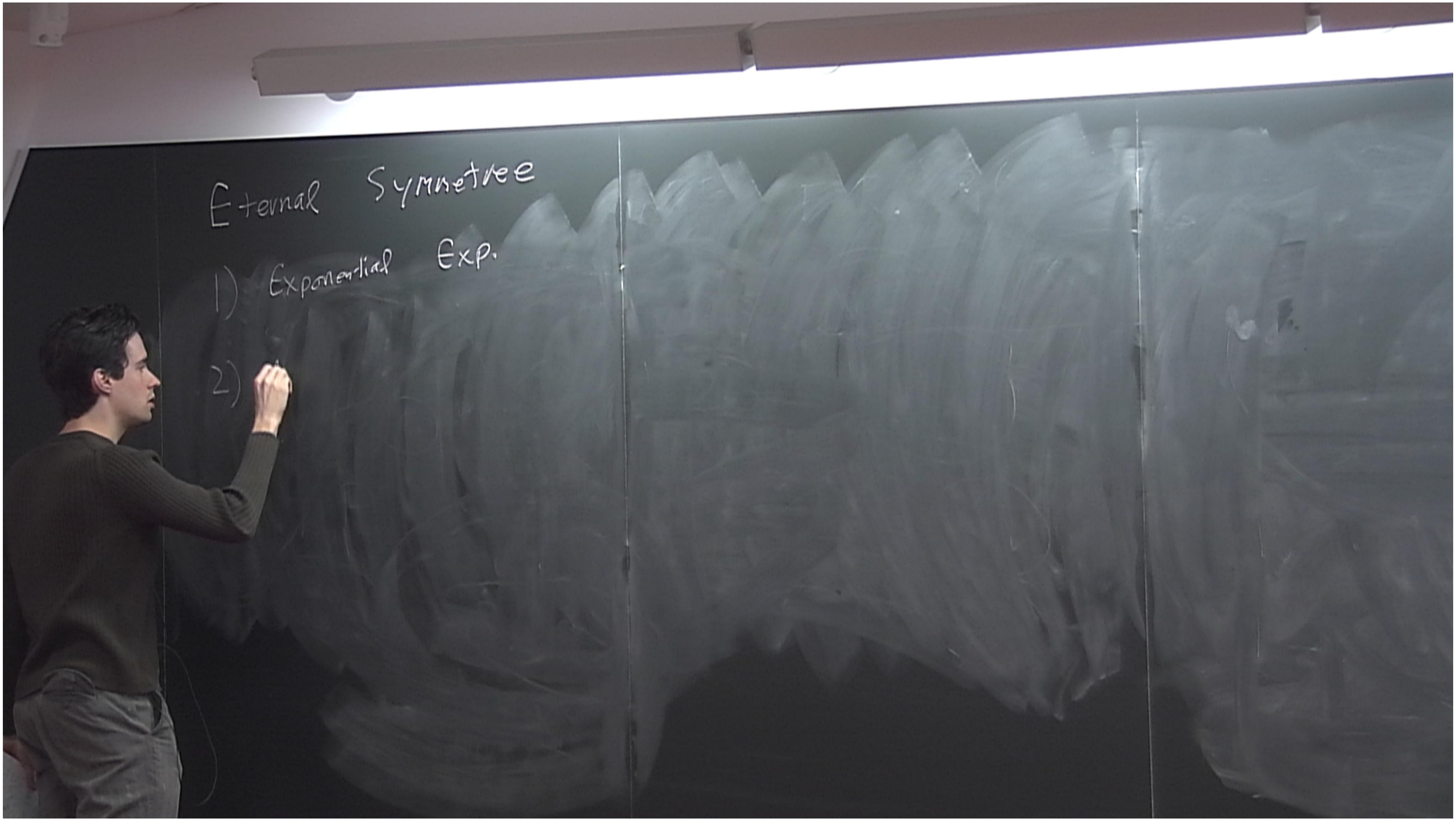
Title: Eternal Symmetree

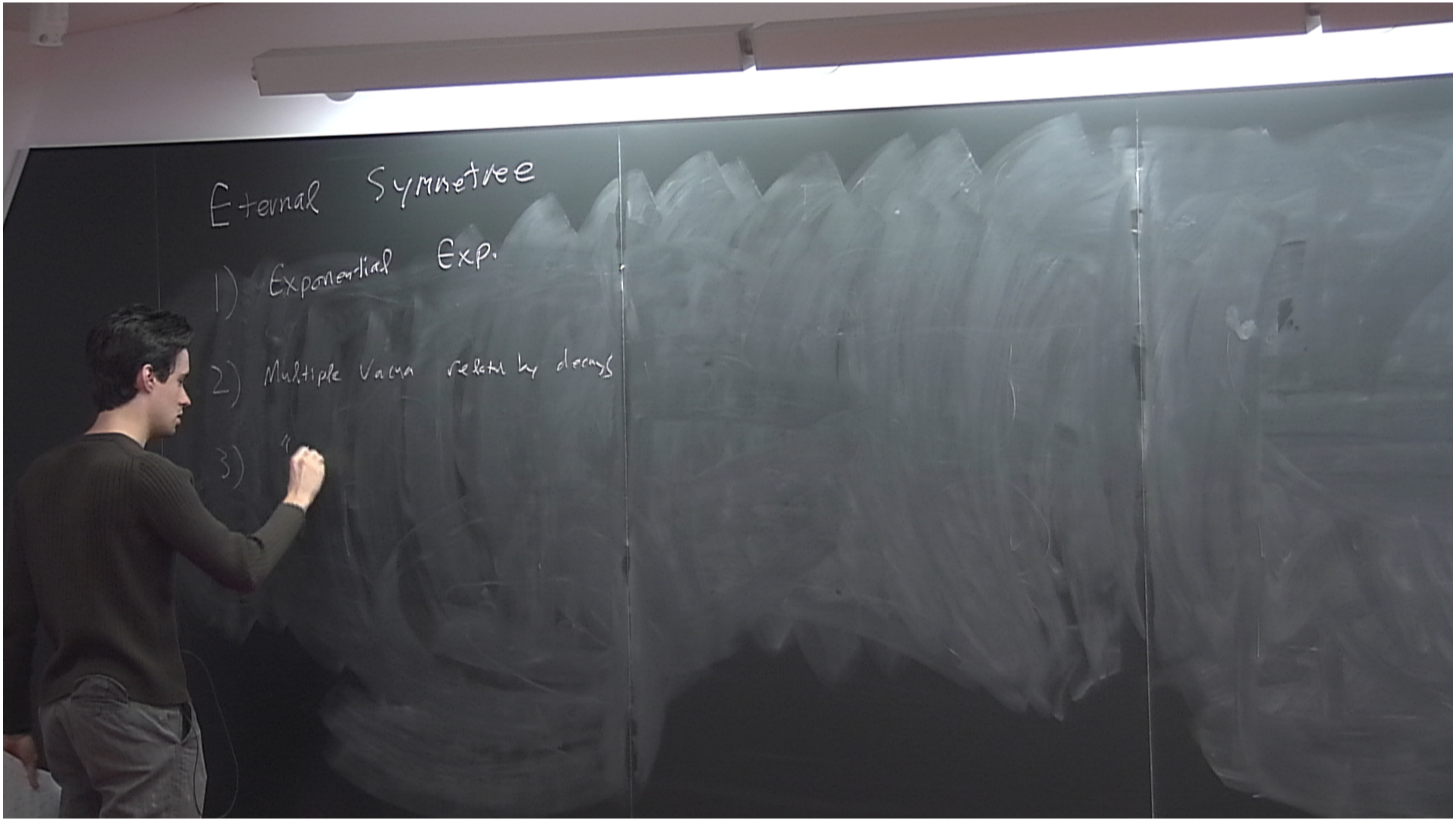
Date: Dec 08, 2011 04:00 PM

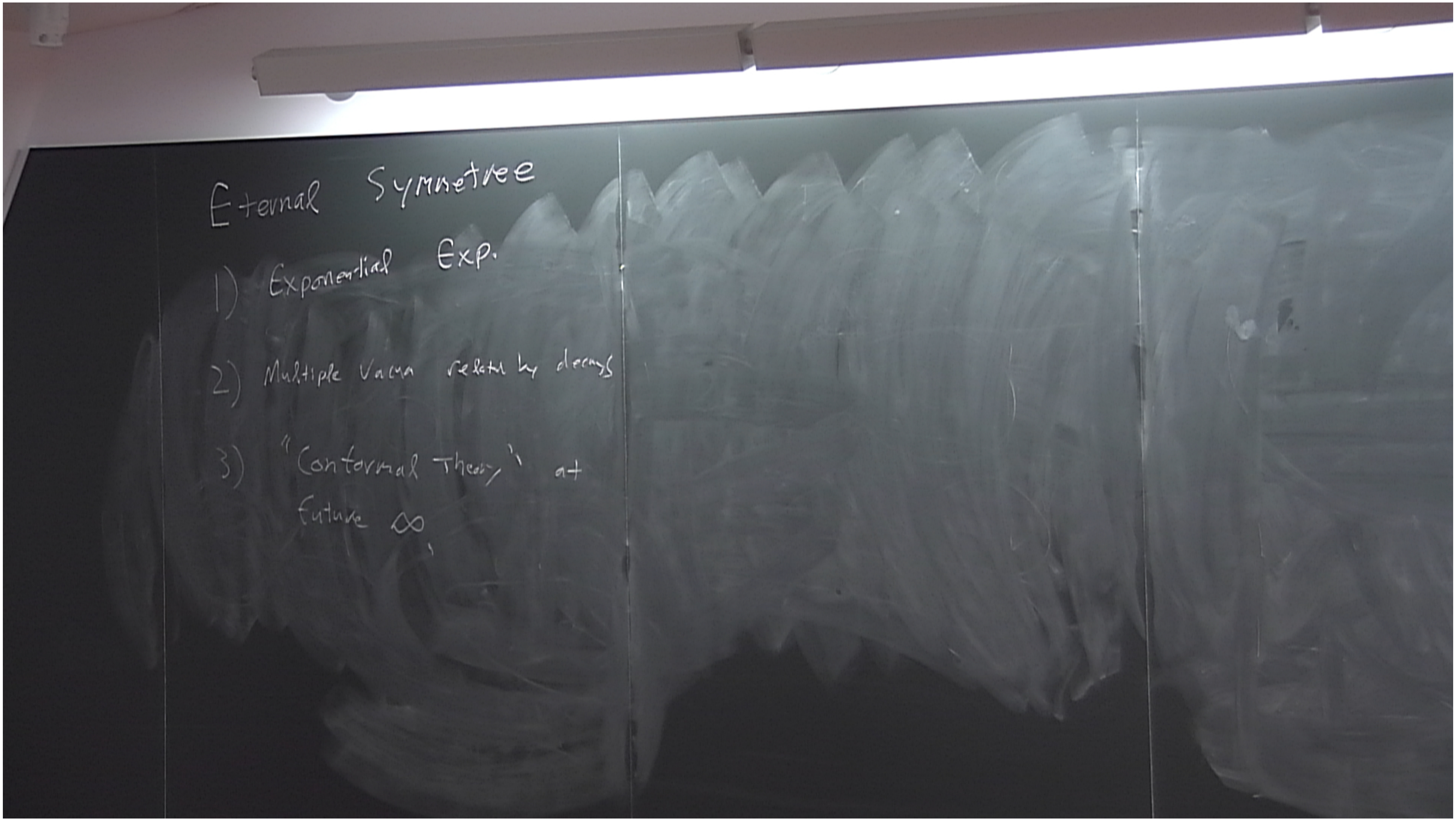
URL: http://pirsa.org/11120059

Abstract: I present a simple exactly solveable model of eternal inflation. The correlation functions have a discrete analogue of conformal symmetry, which can be compactly expressed using the machinery of p-adic numbers. I comment on the implications for actual cosmology, and in particular for holographic descriptions of eternal inflation.


Eternal Symmetree


Eternal Symmetree
1) Exponential Exp.
2)


Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3)


Eternal Symmetree
1) Exponential Exp.
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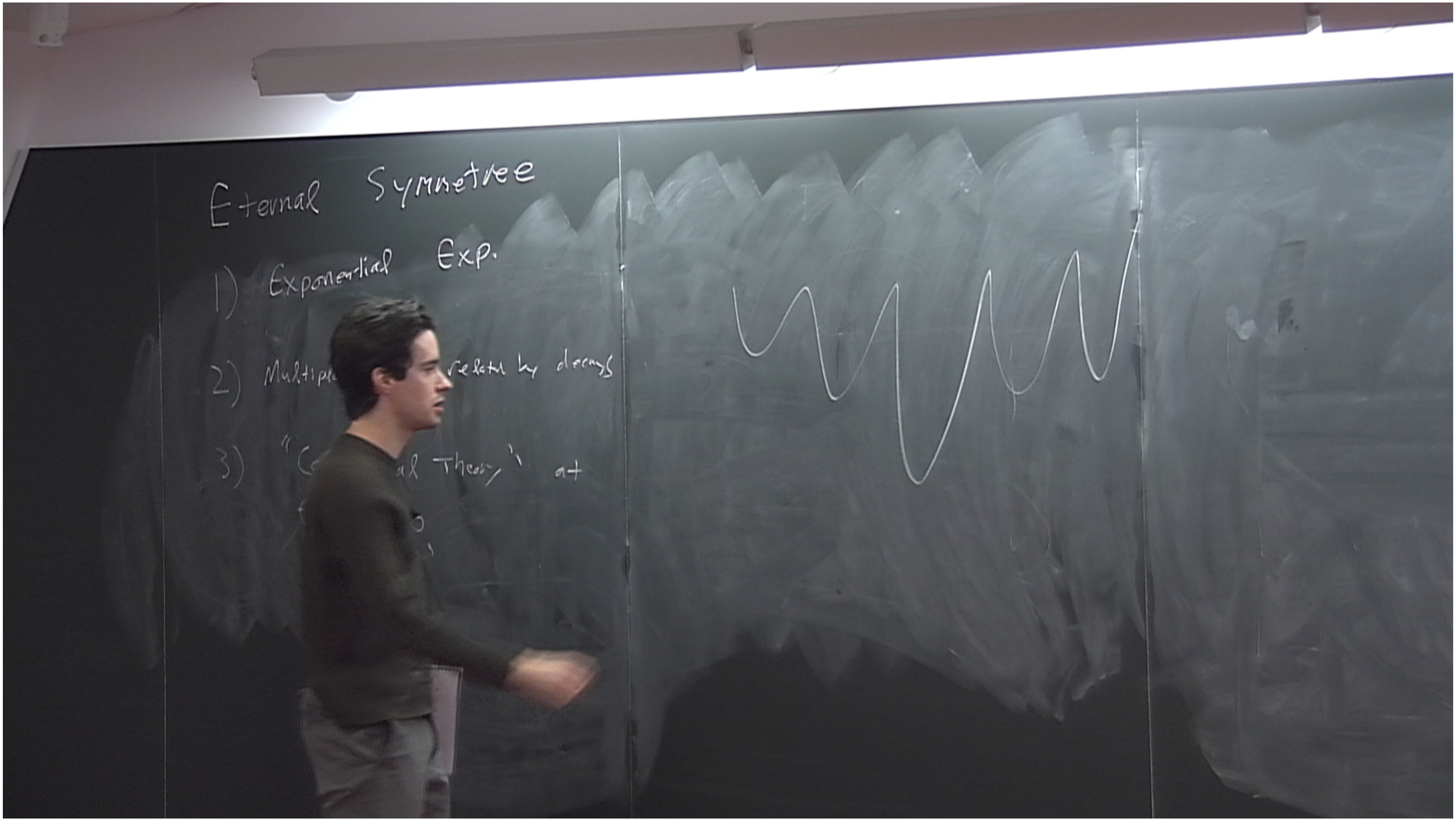
3) "Conformal Theory" at
future ∞


Eternal Symmetree
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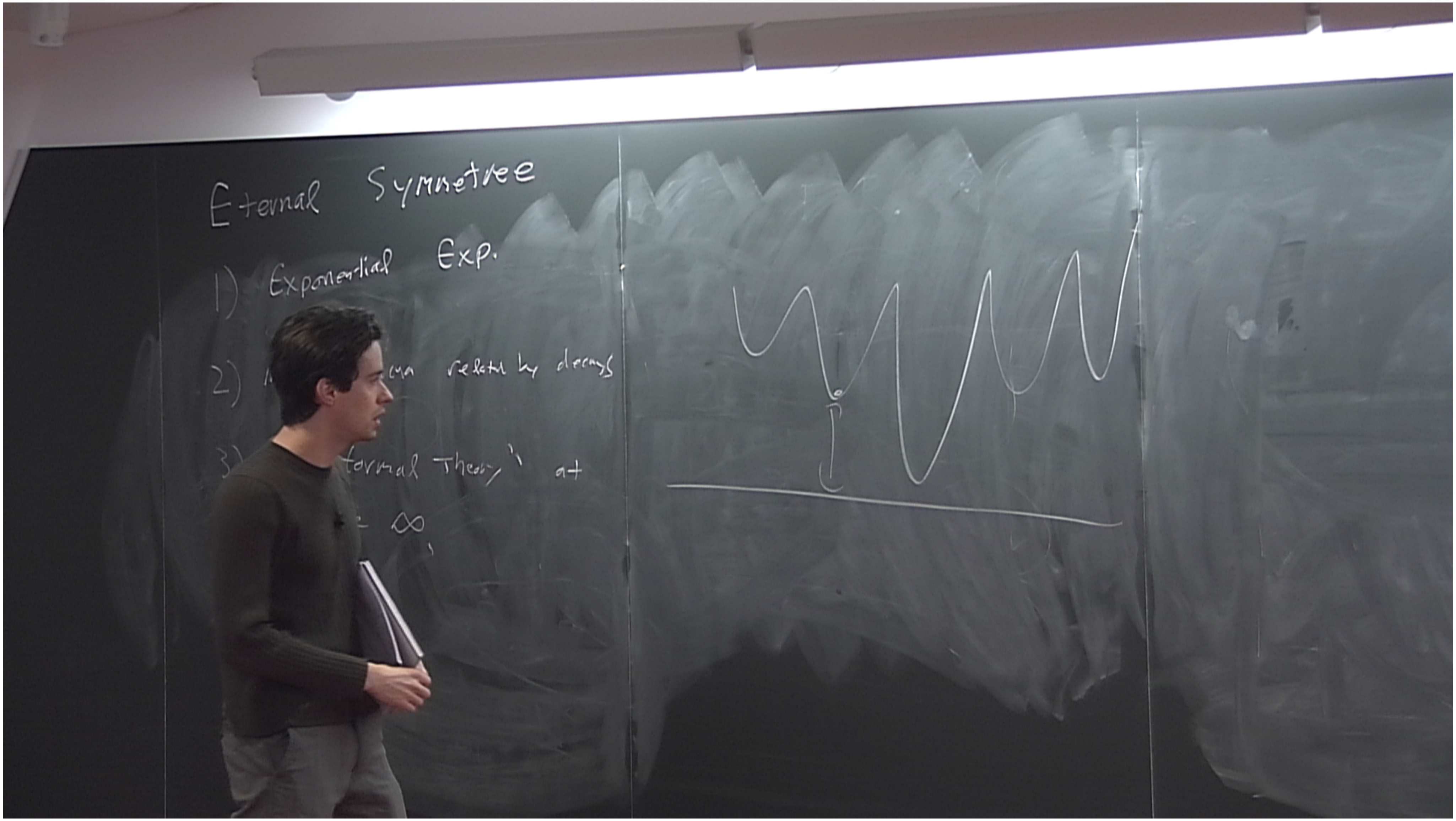
3) Theory" at


Eternal Symmetree
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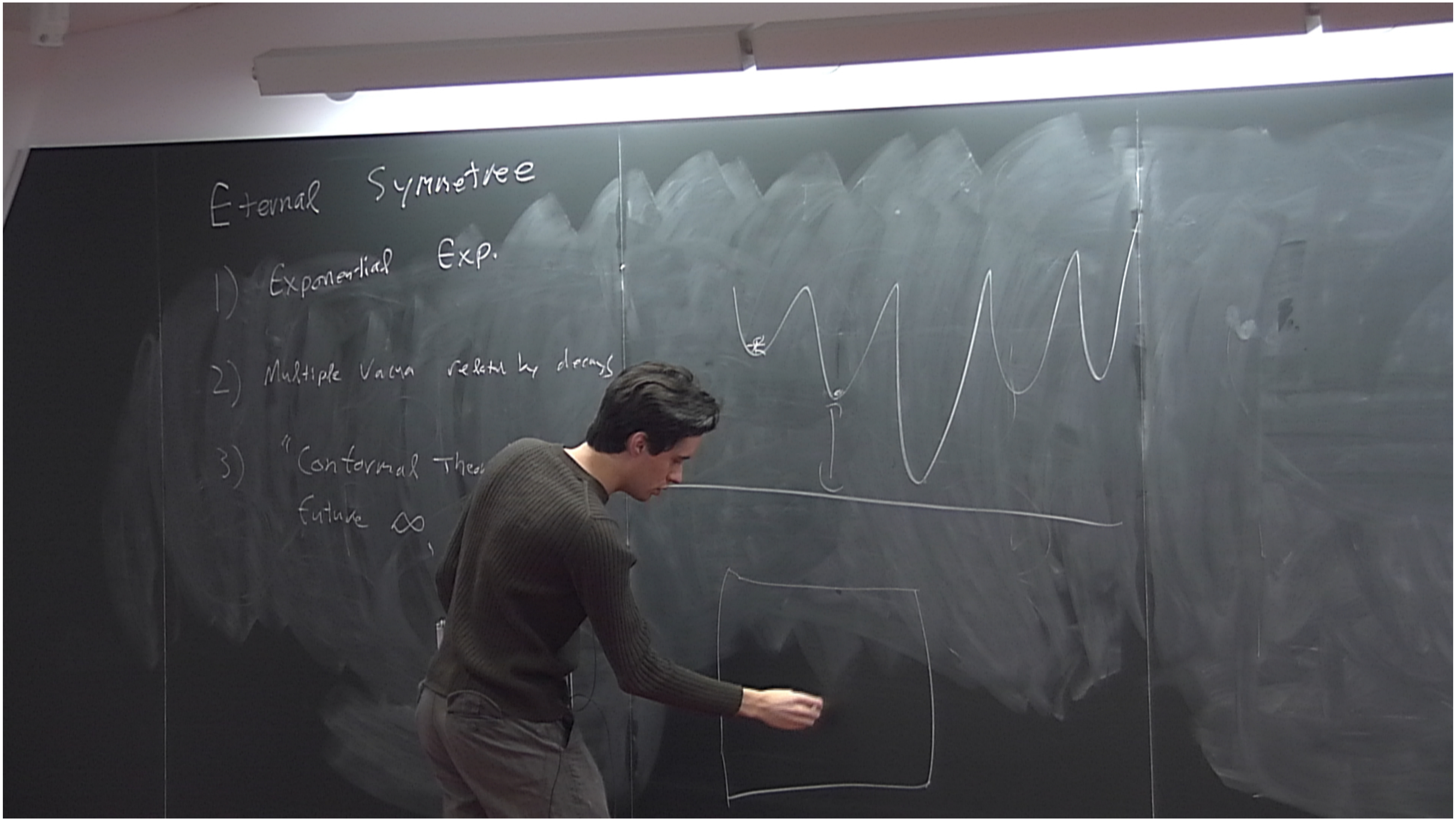
∞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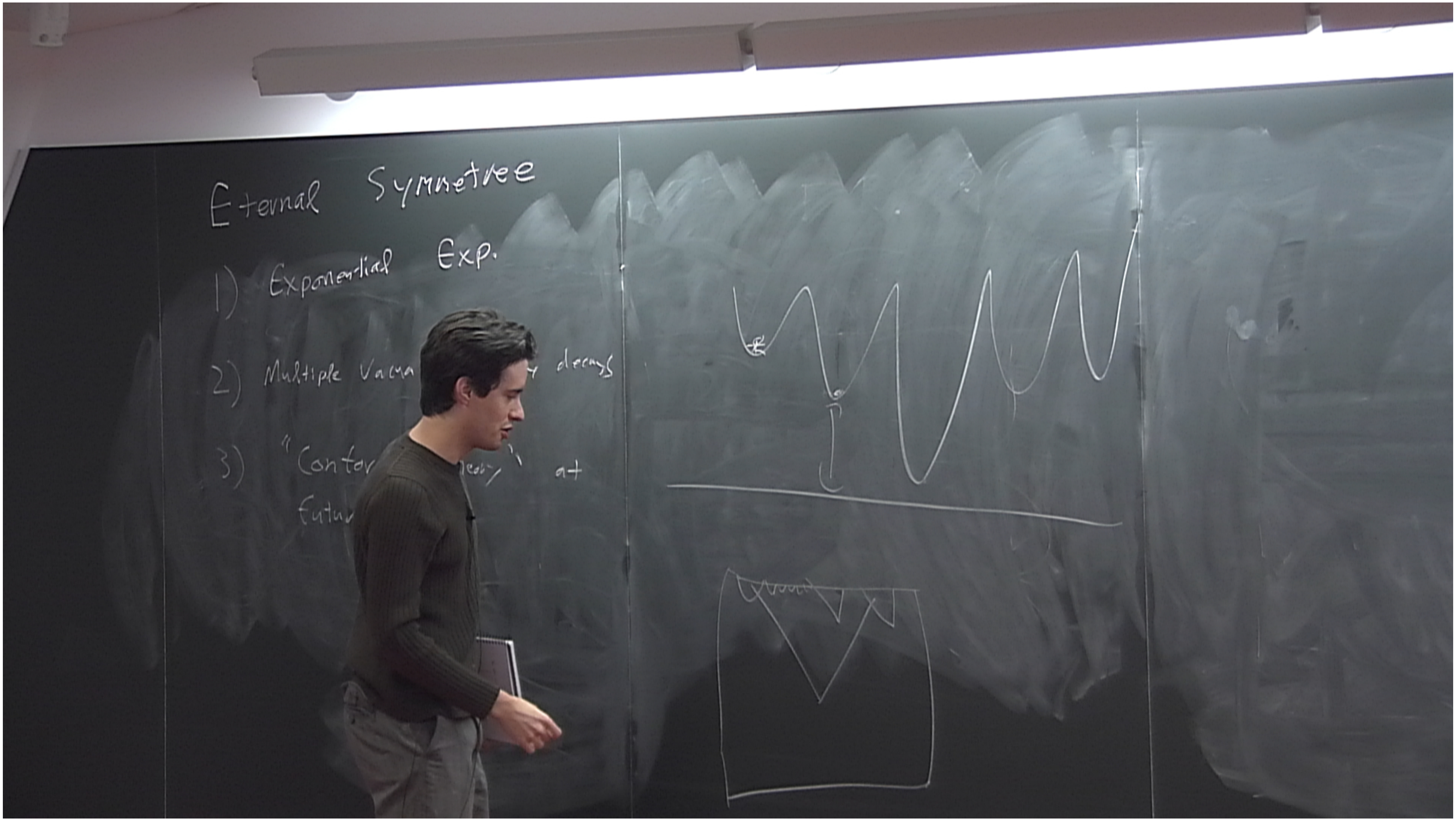

Eternal Symmetree
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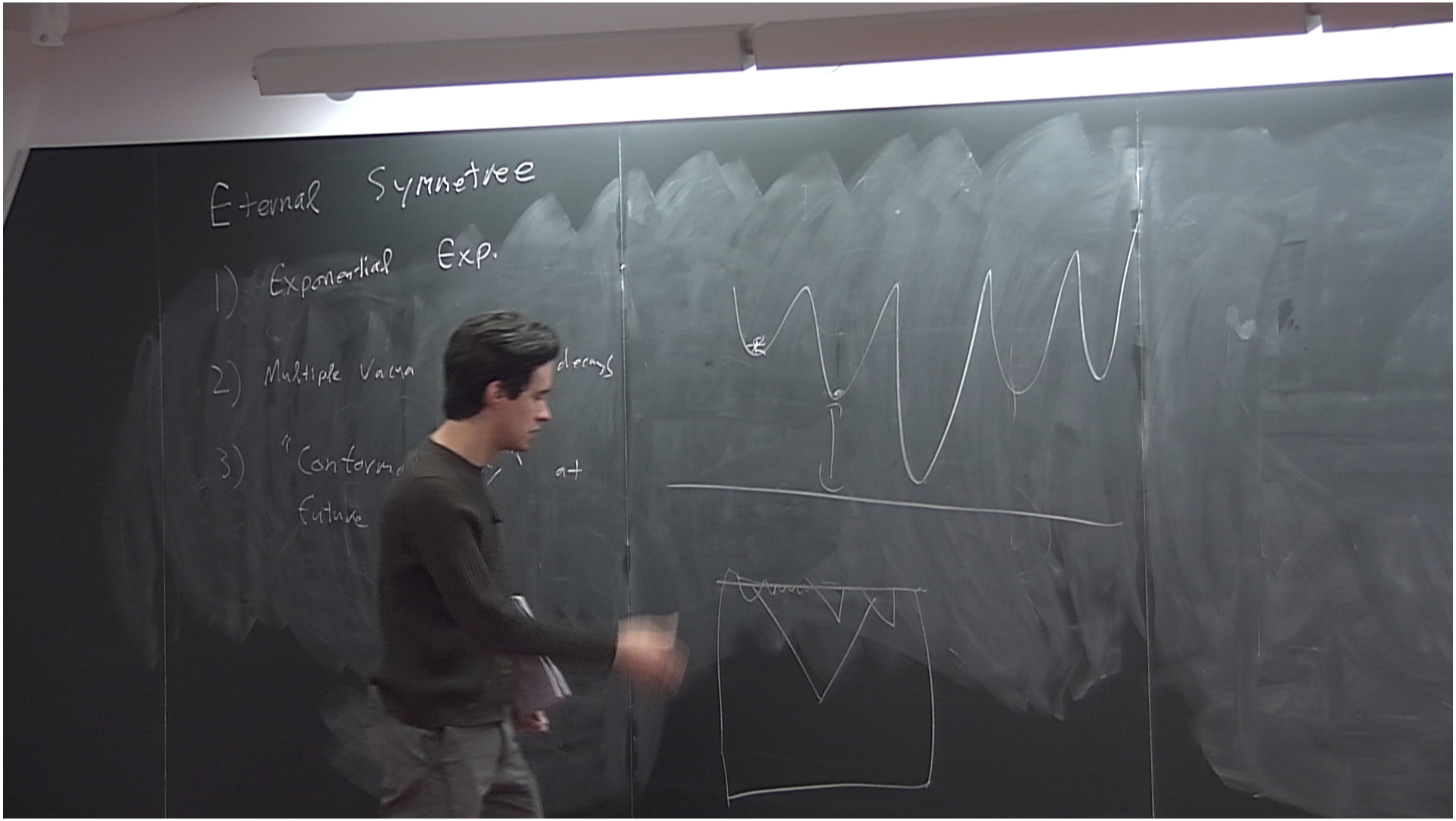
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at
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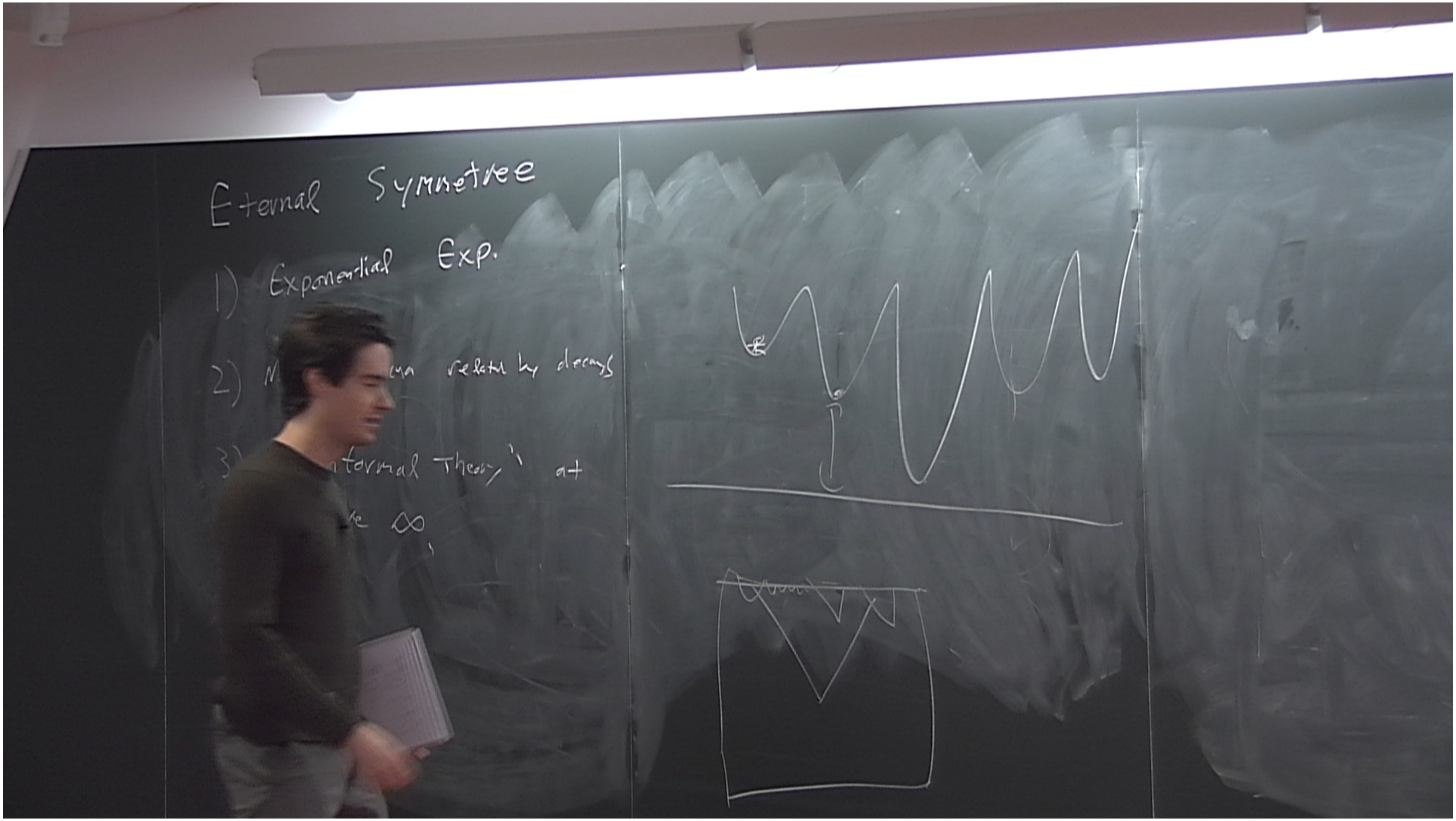
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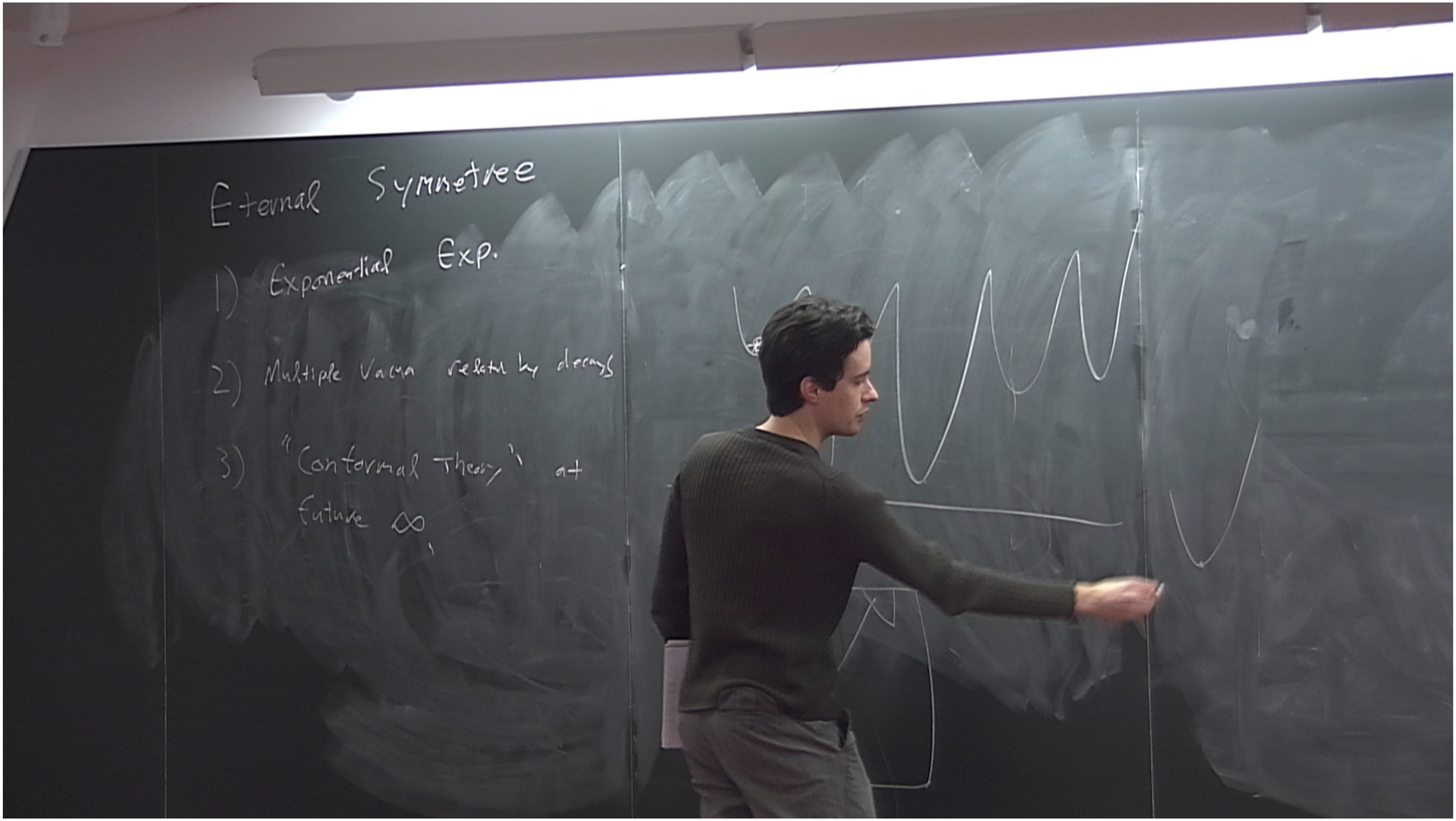
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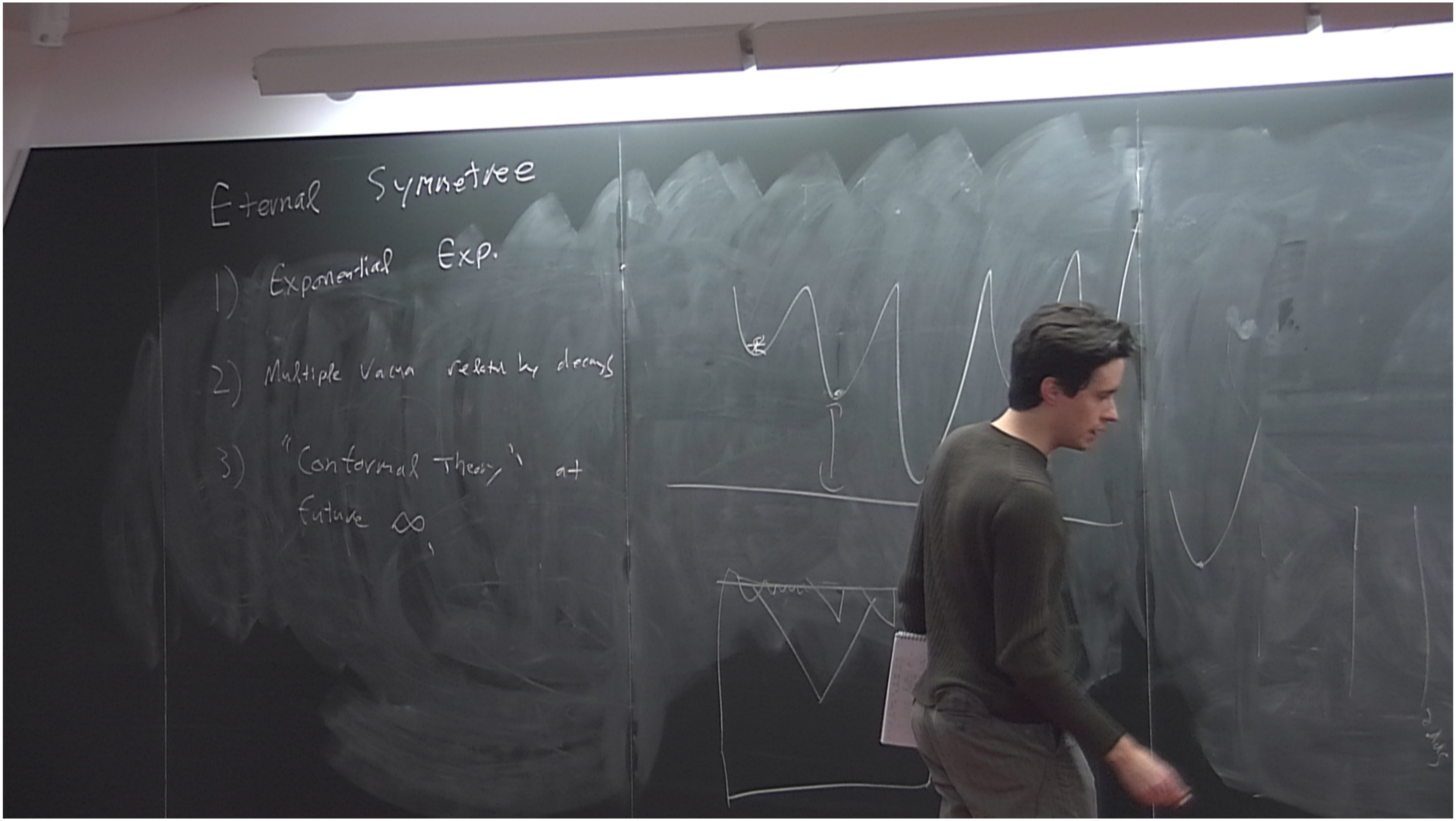
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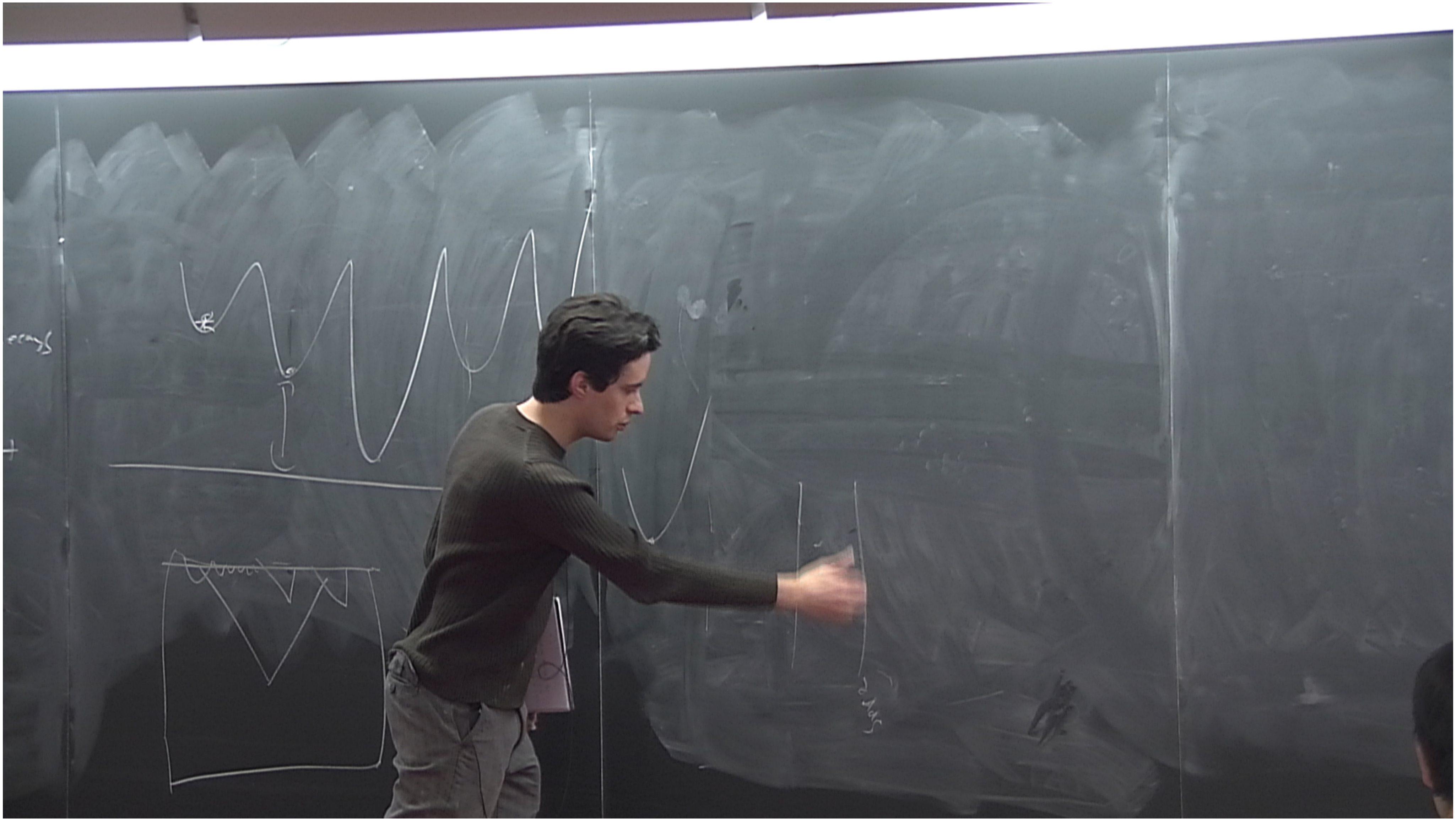

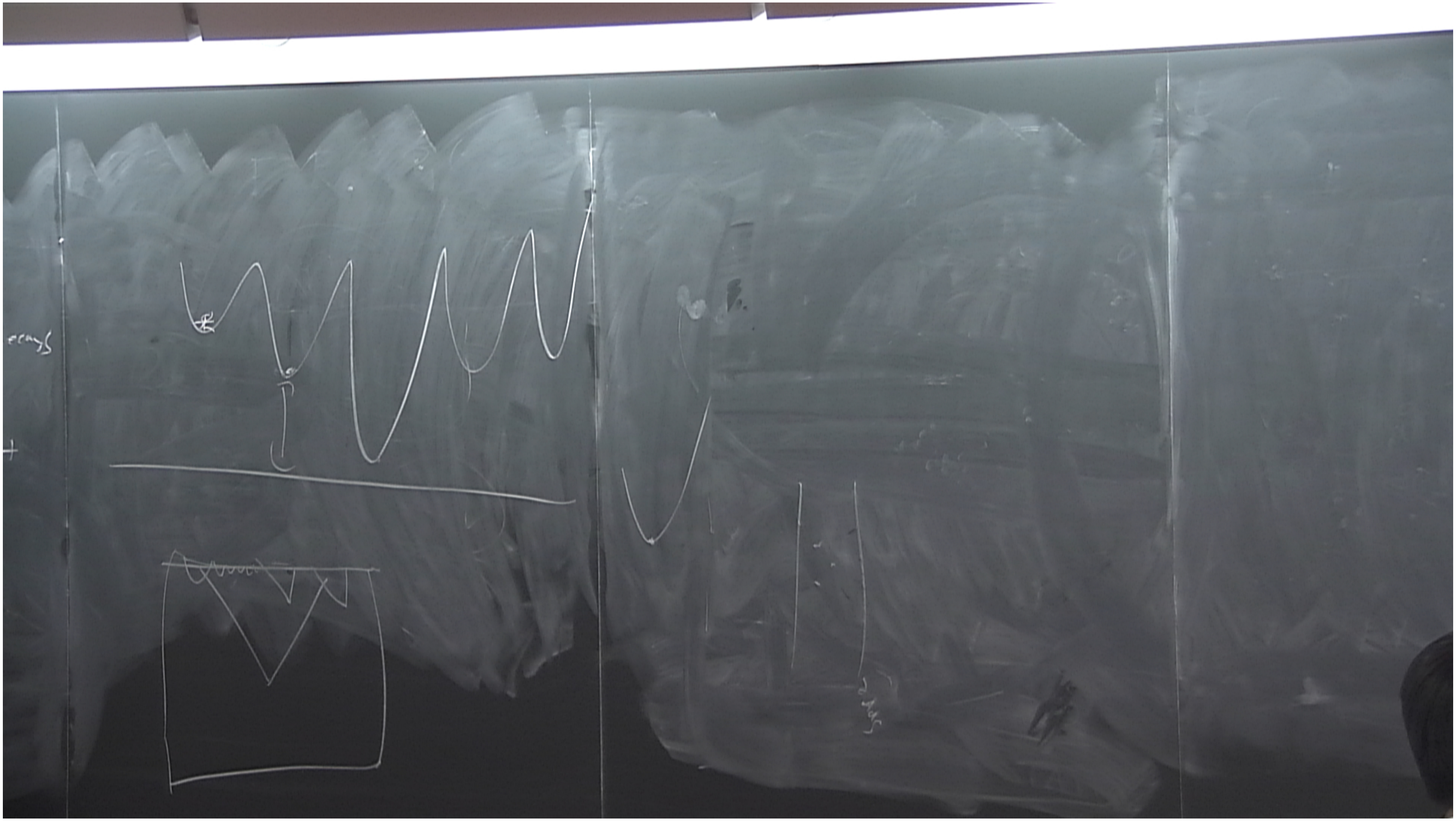

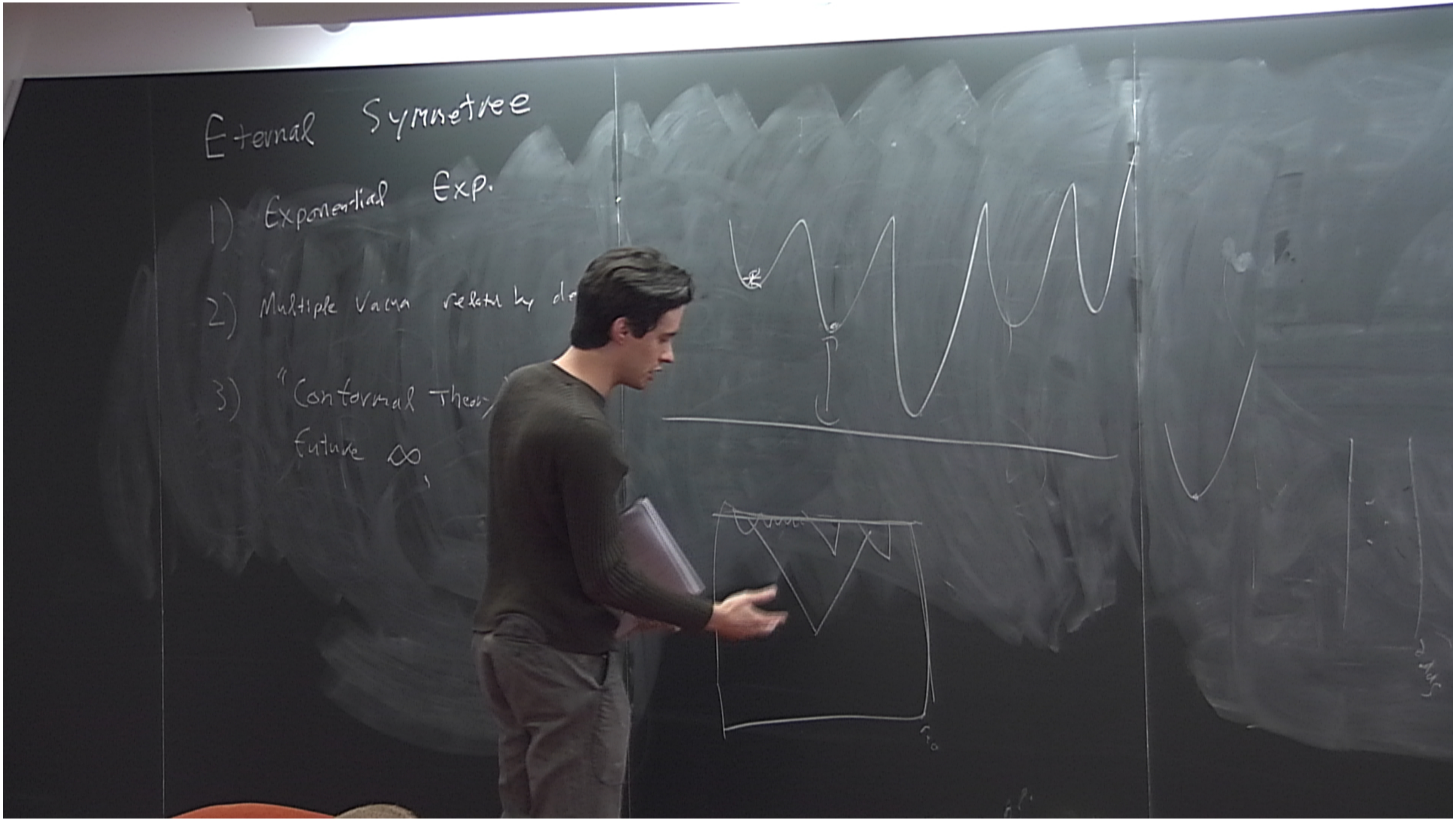
Eternal Symmetree
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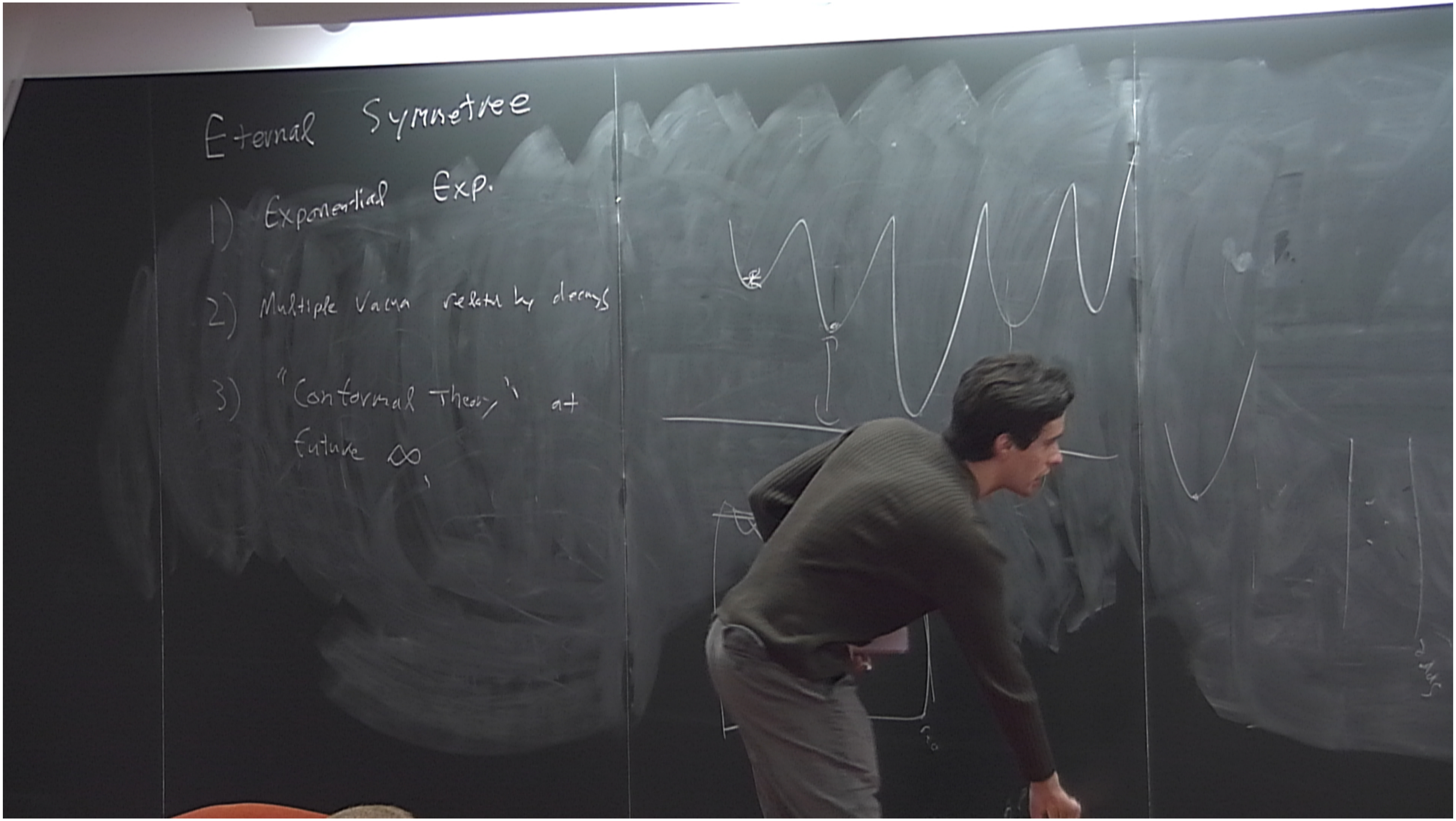
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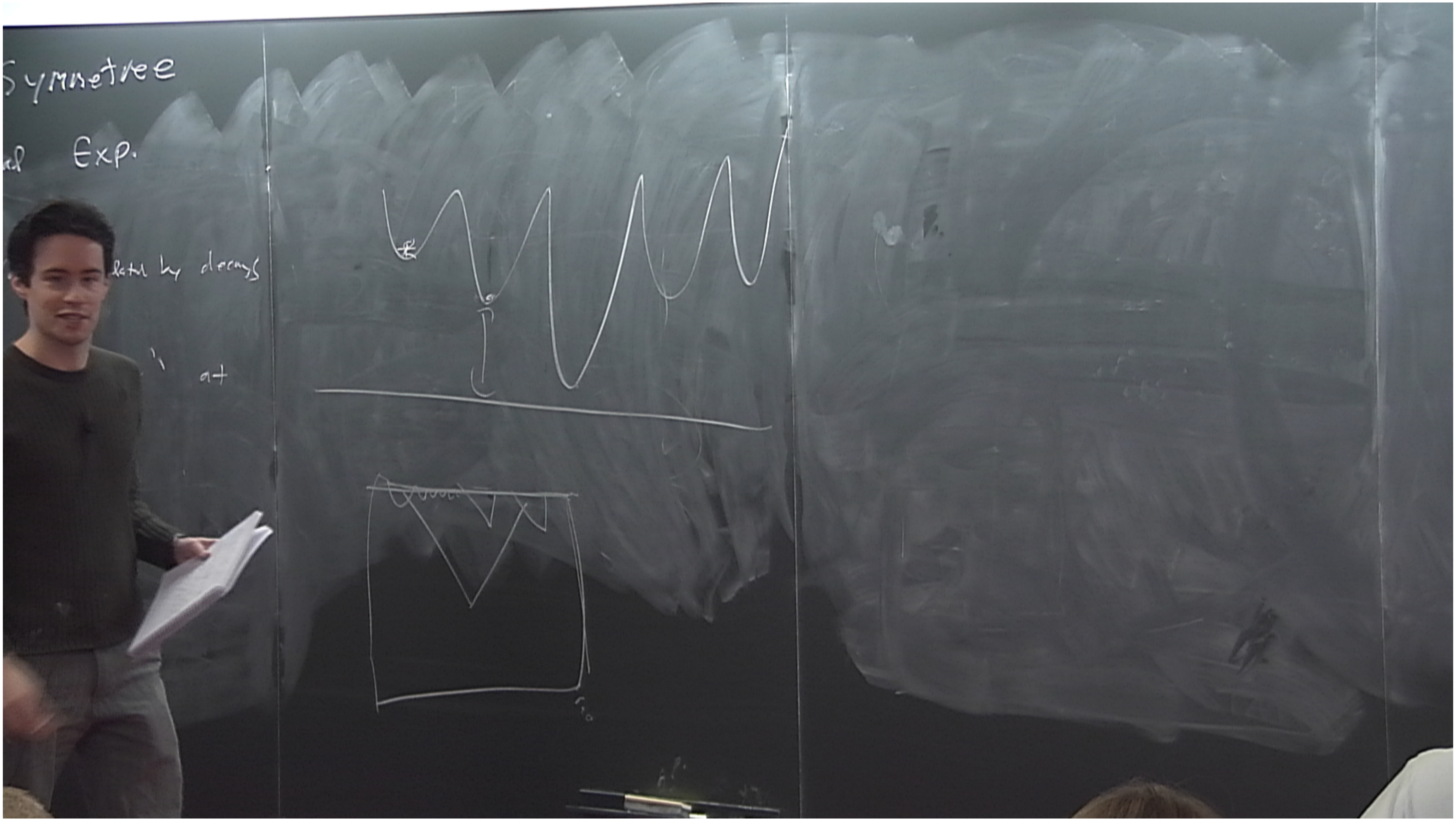
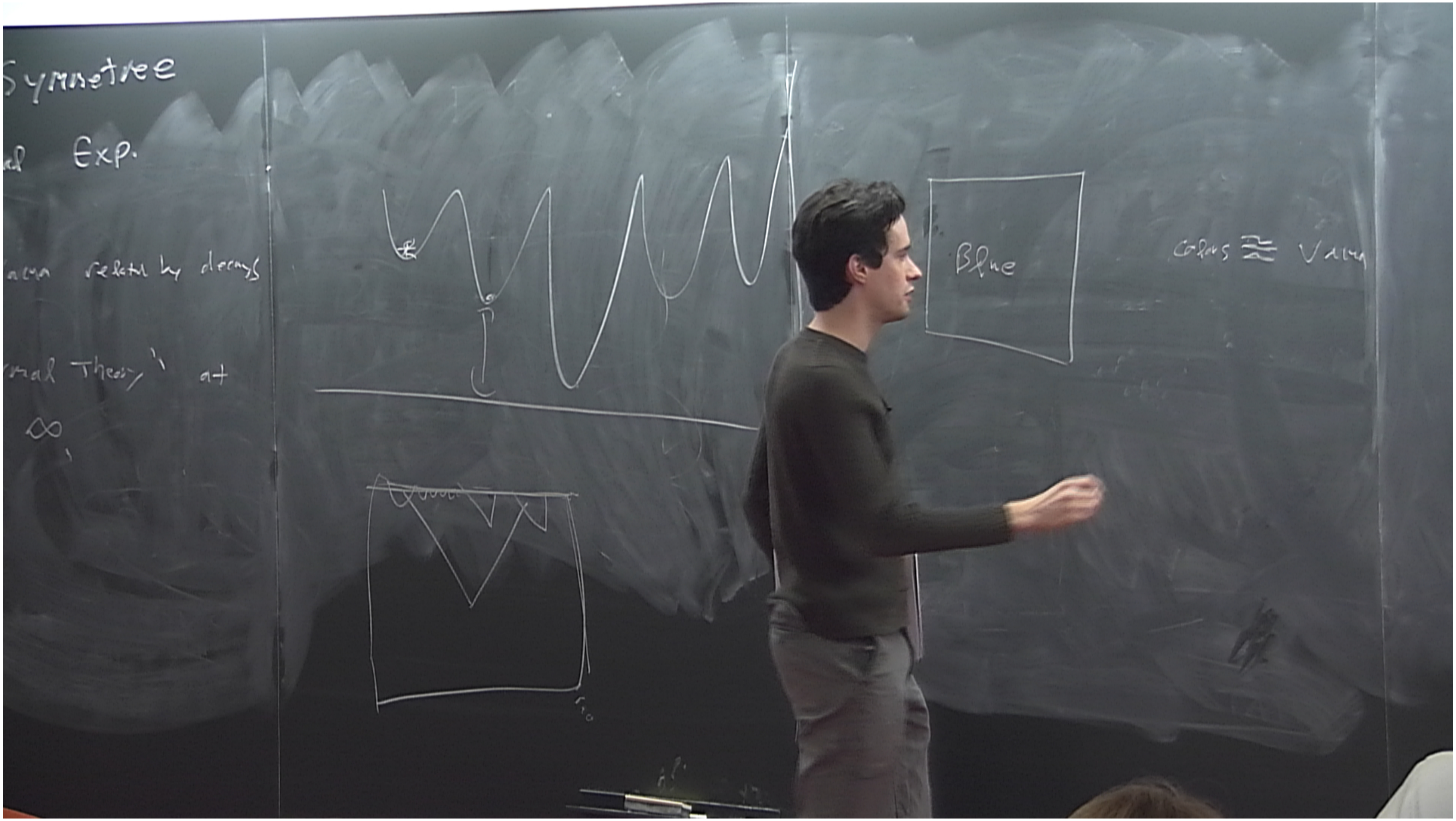
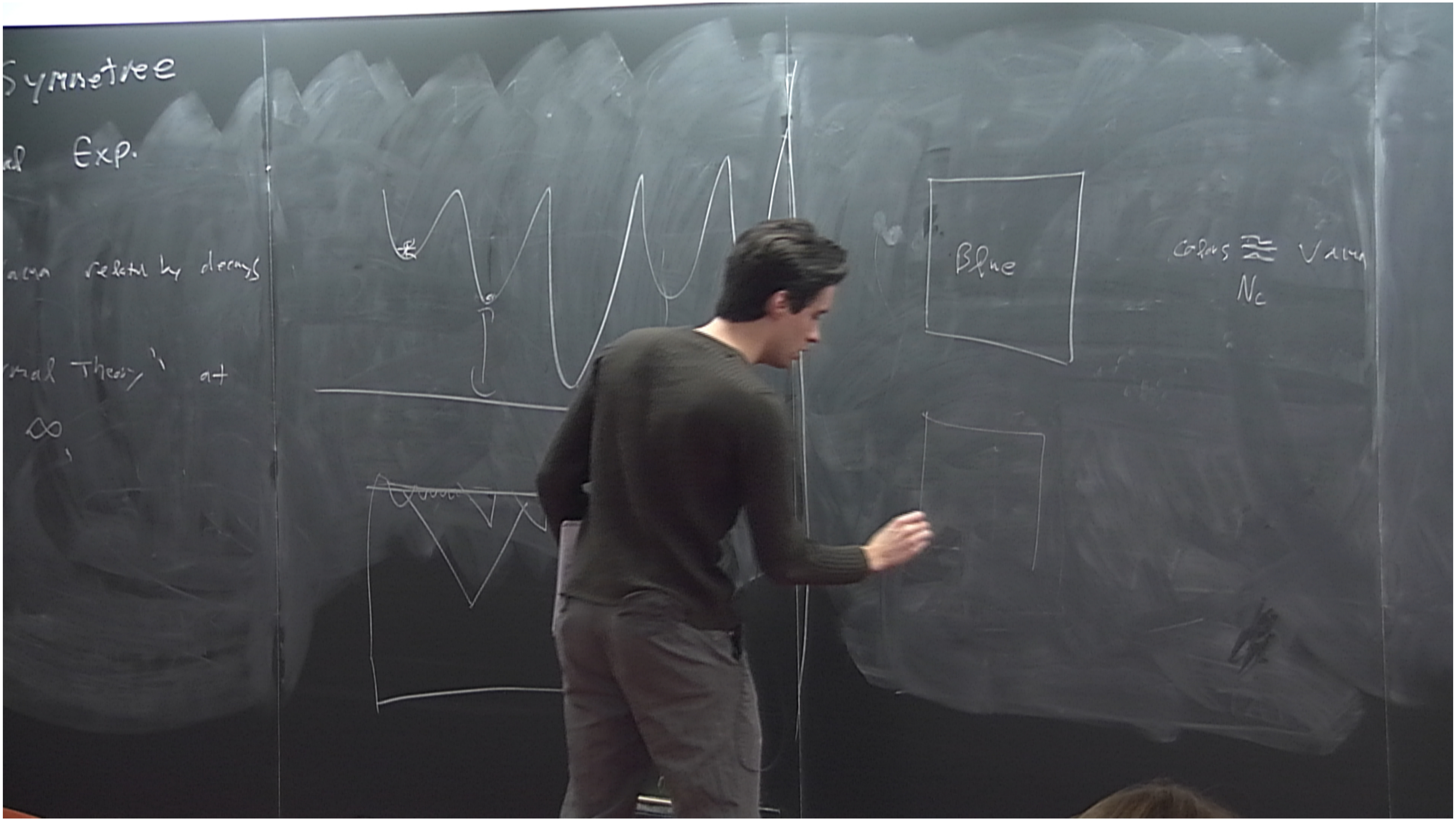
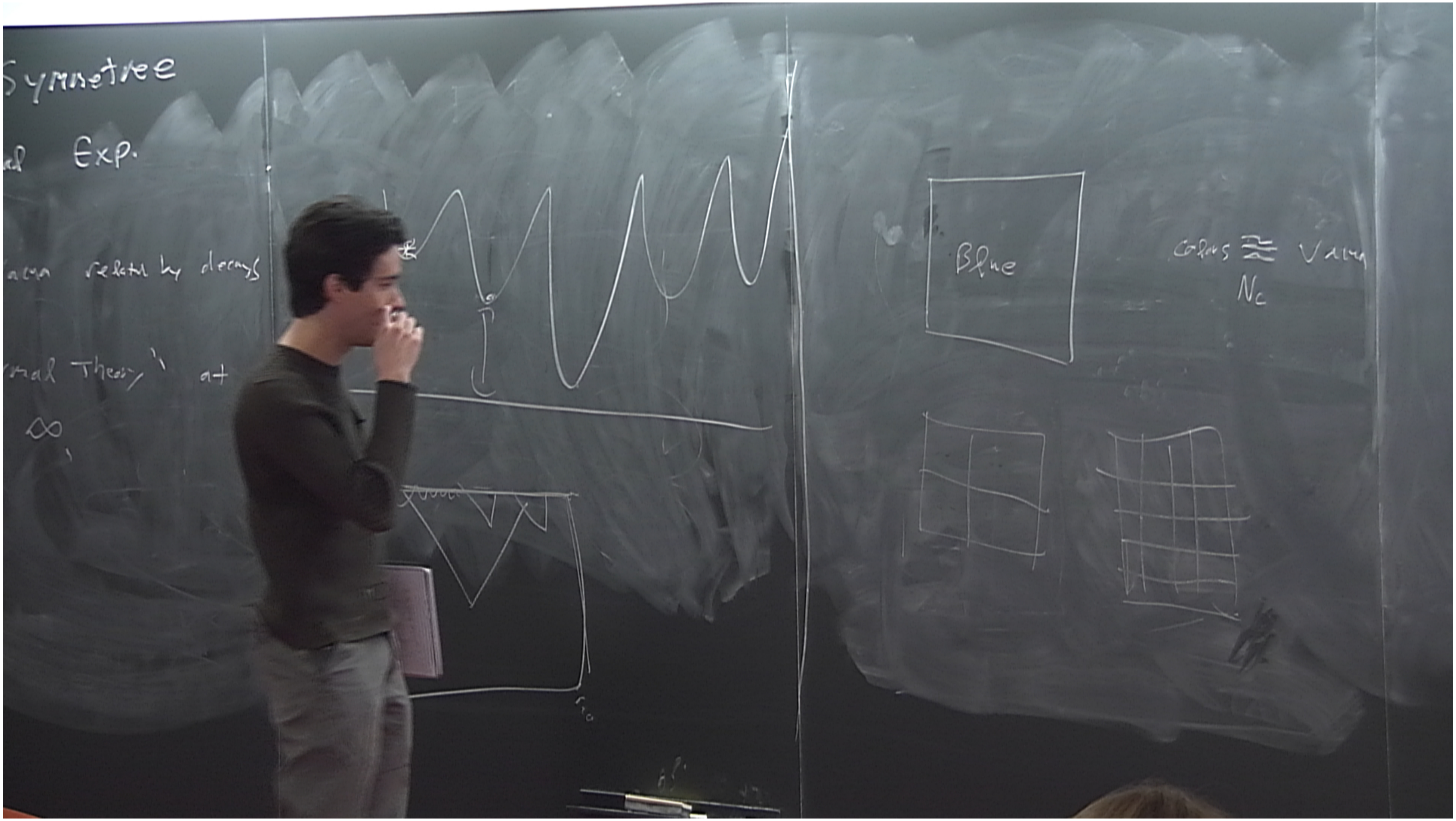

Symmetree
Exp.


Symmetree
Exp.
Blue


Exp.
related by decays
Theory
at
Blue
Colors
N_c


Symmetree
Exp.
Blue
Colors
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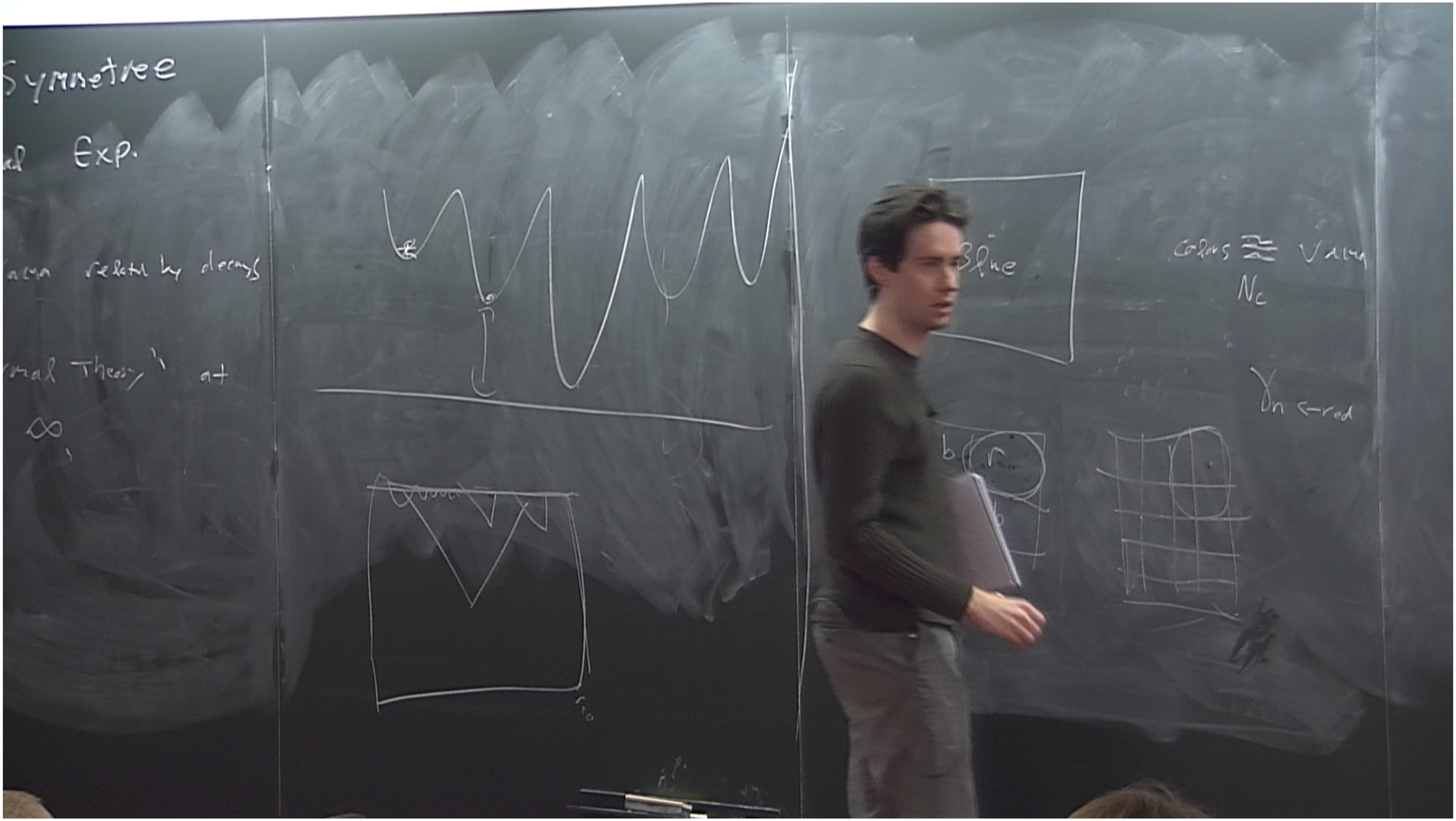
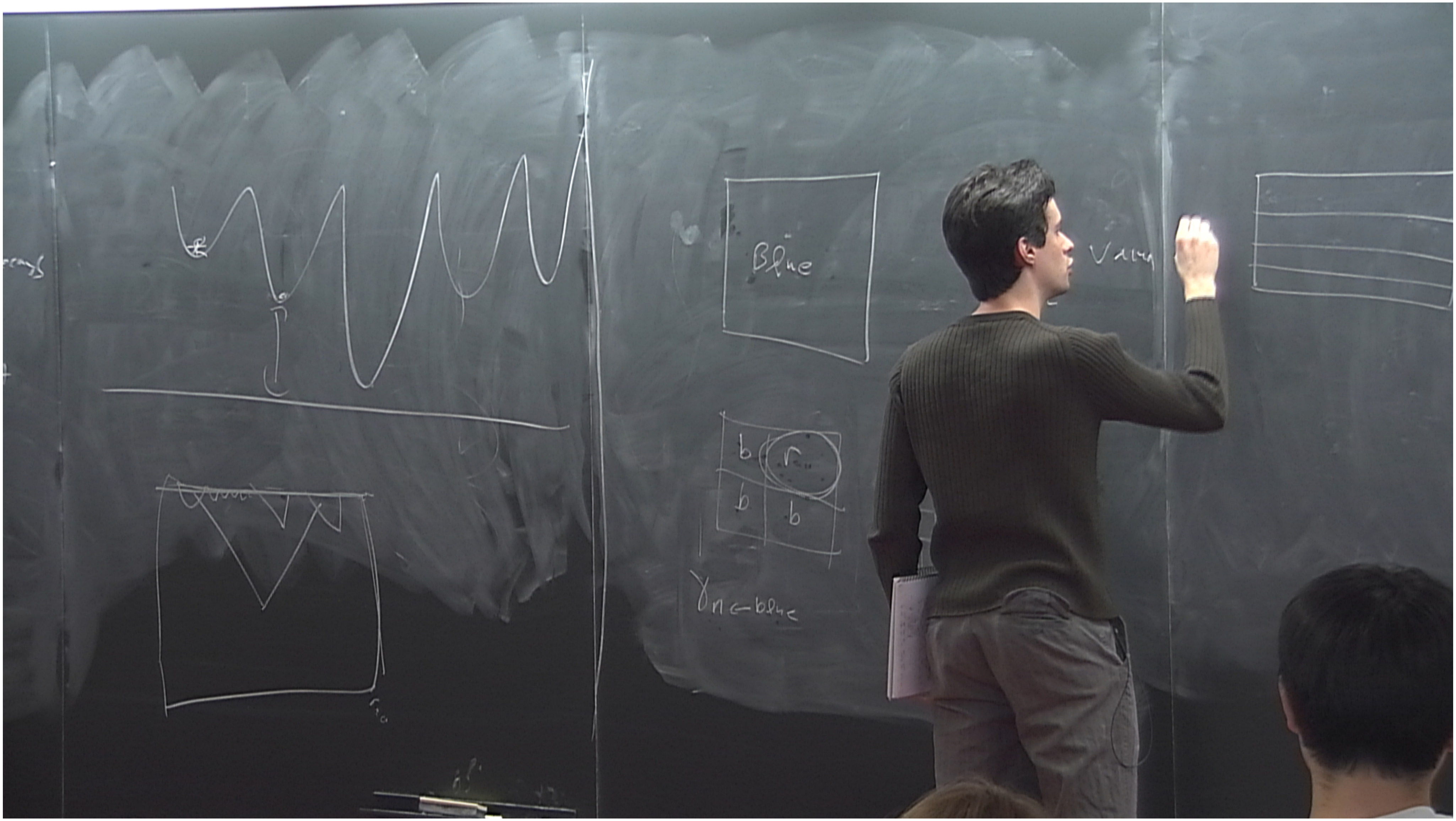
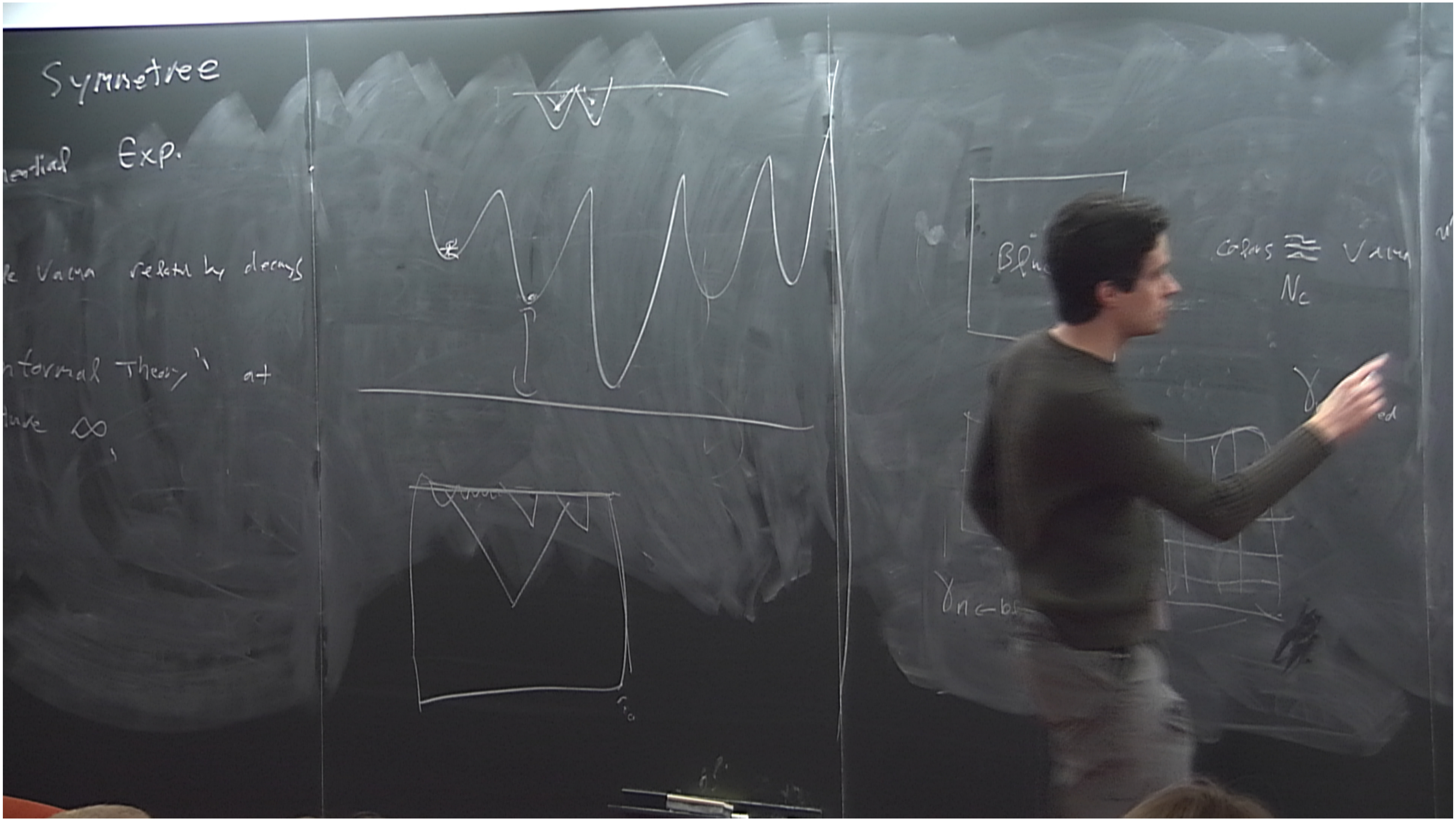
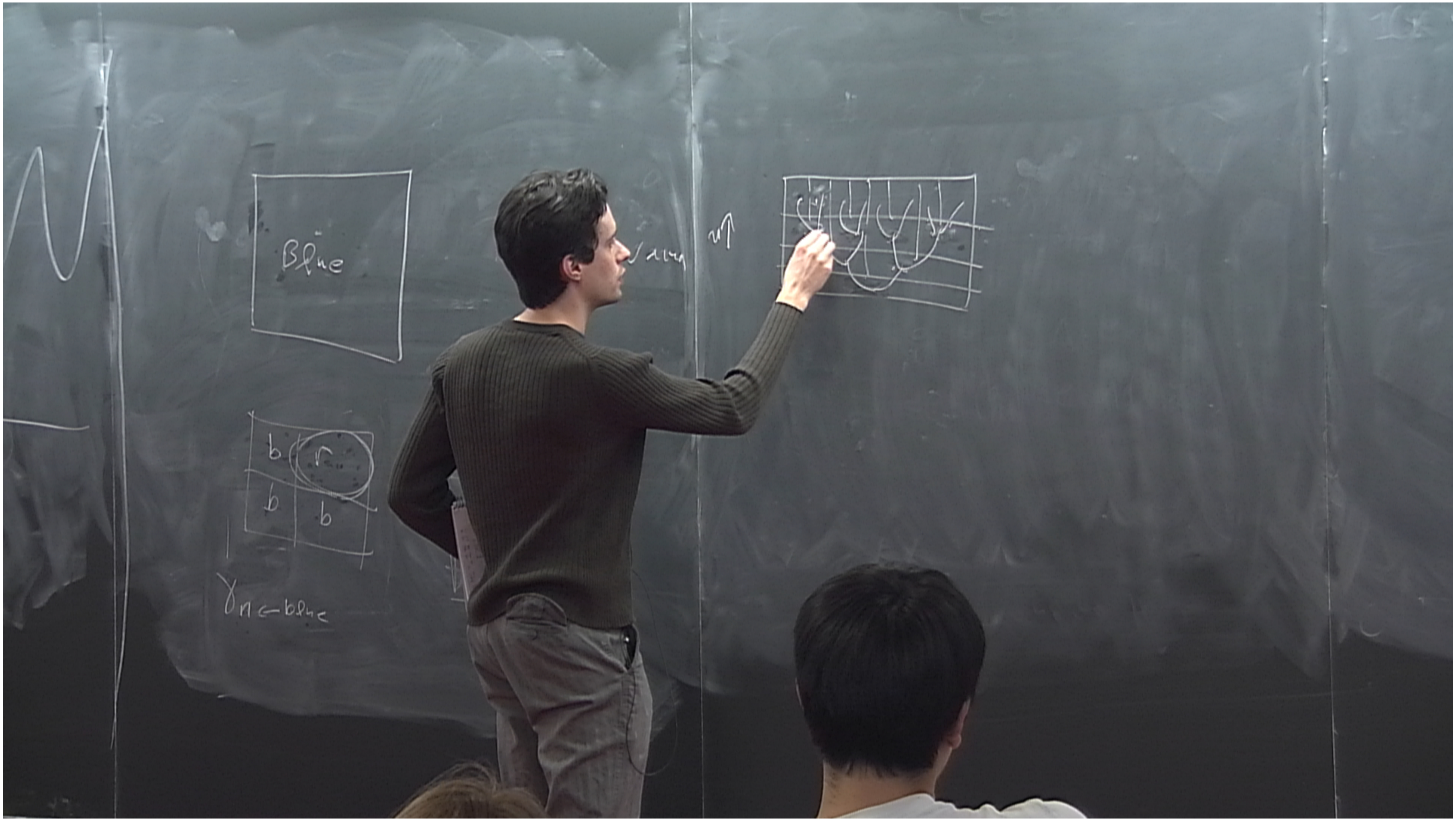
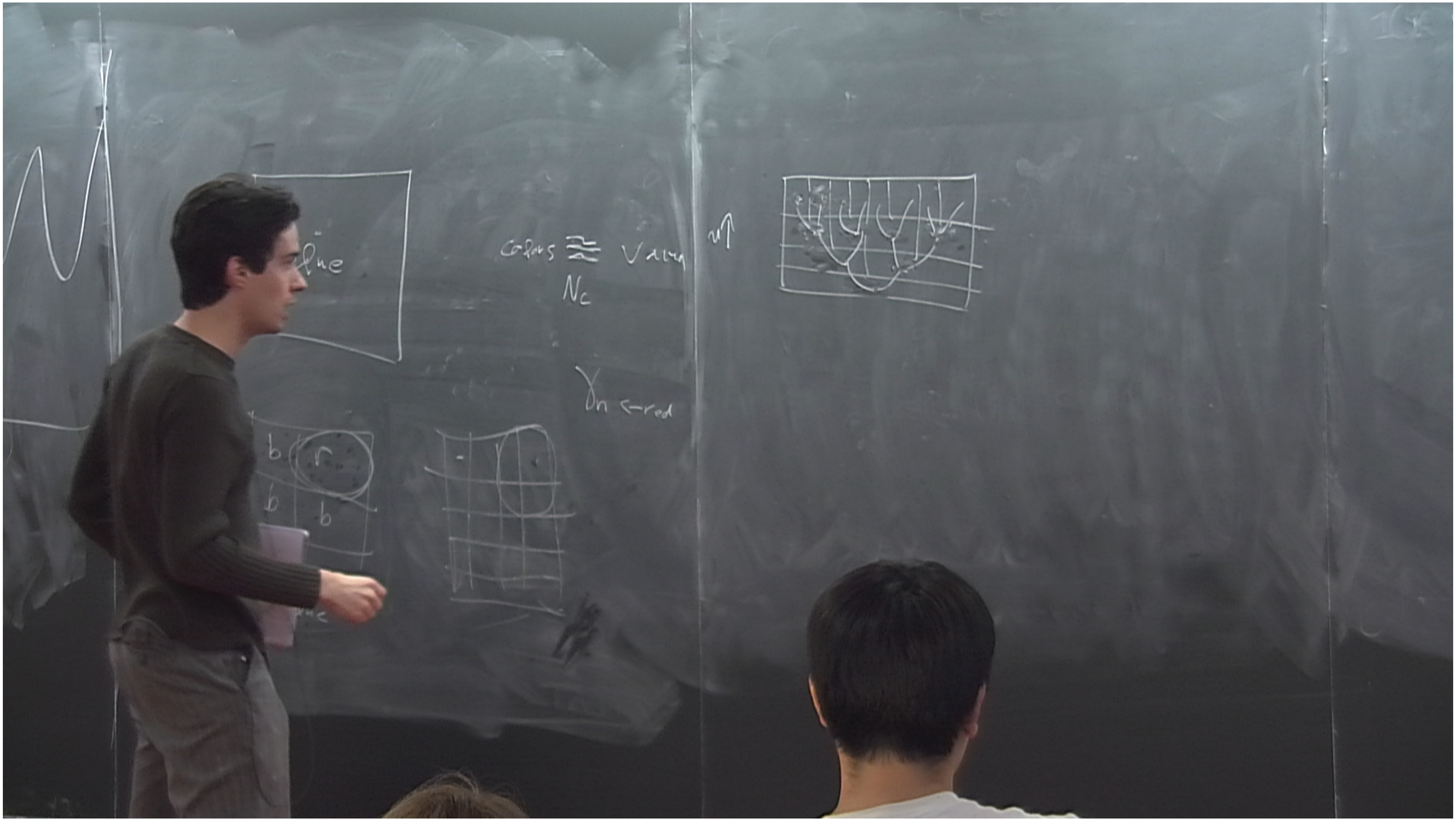
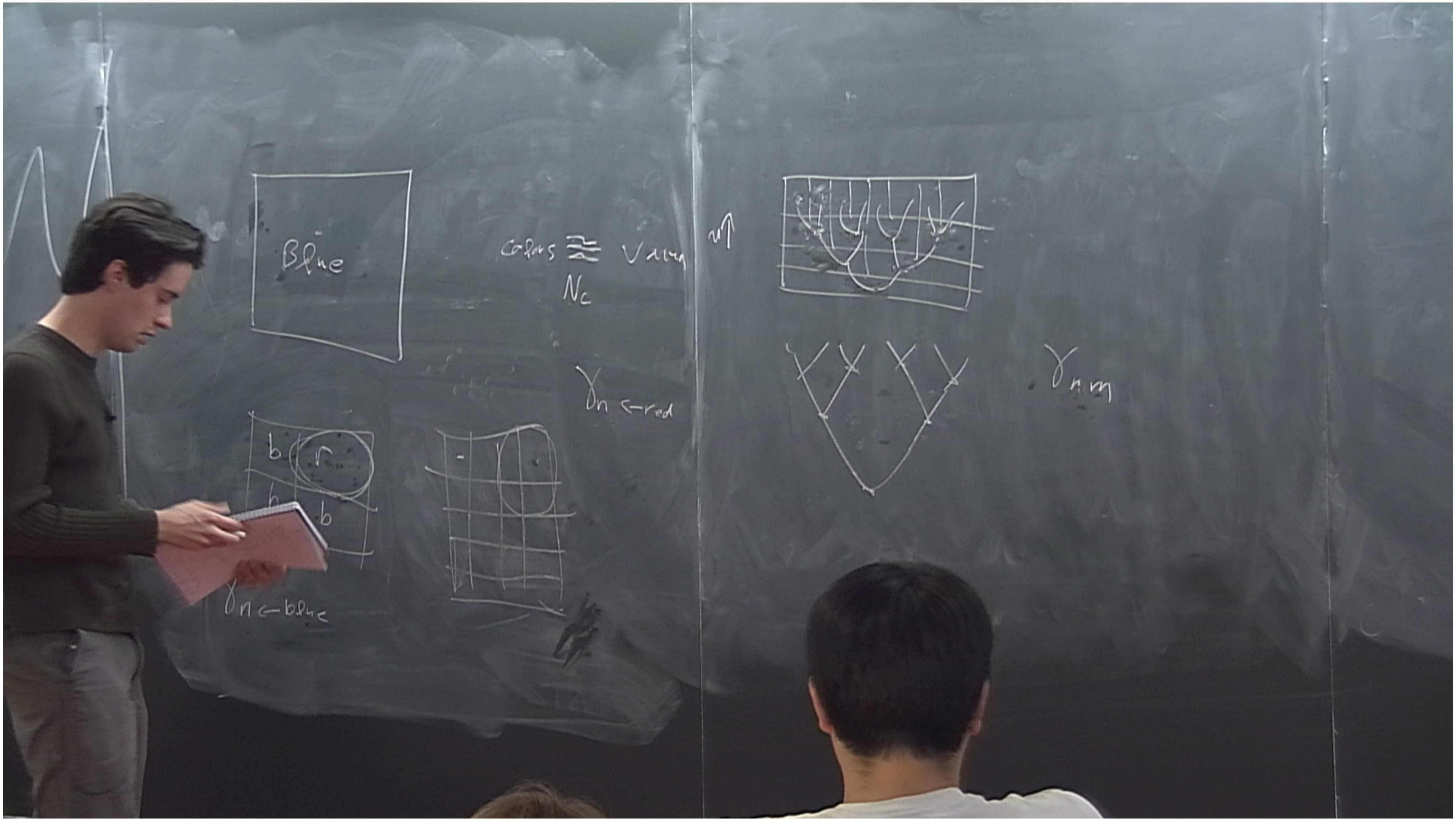

Symmetree
Exp.
Colors
Blue
N_c

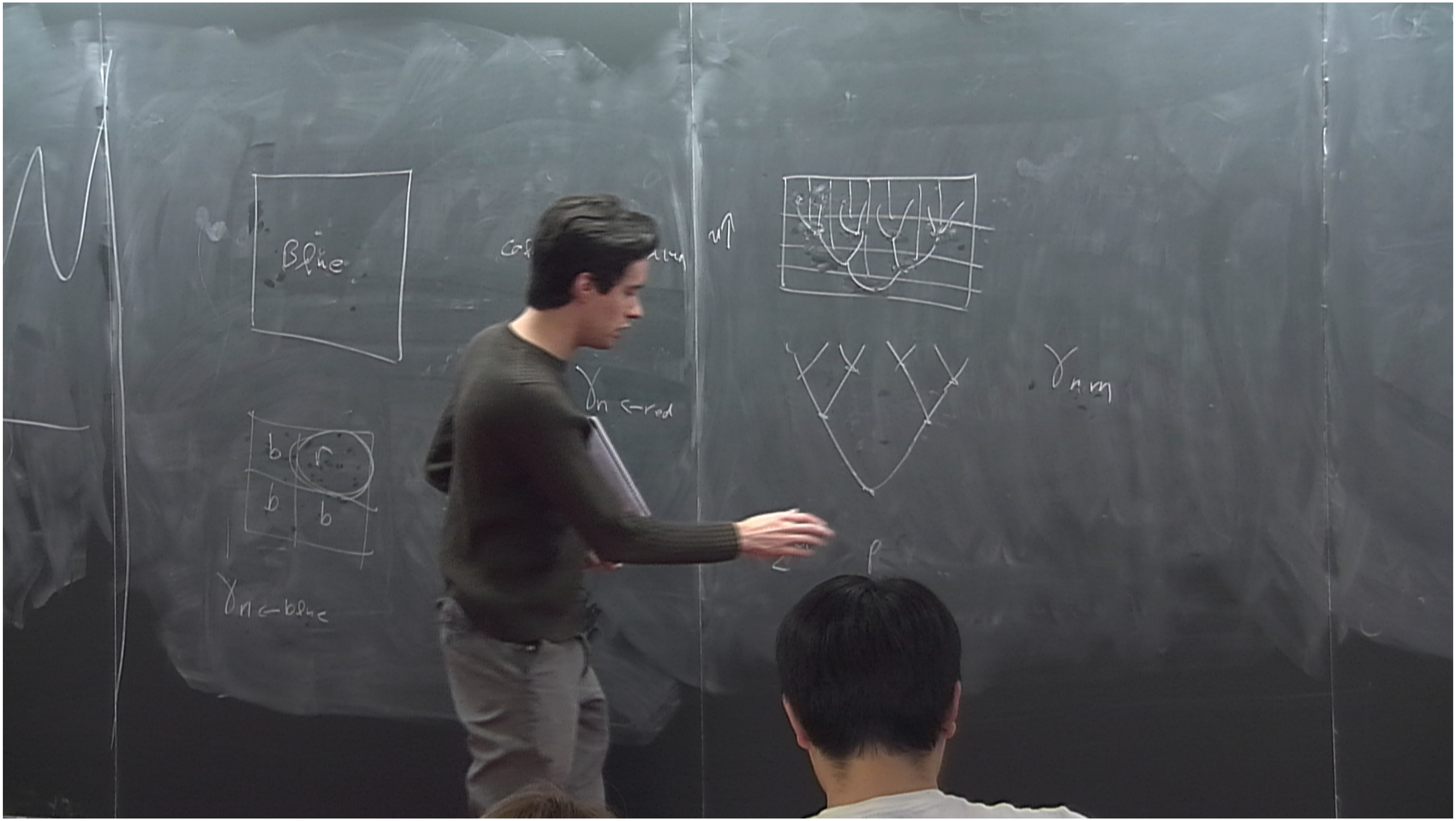


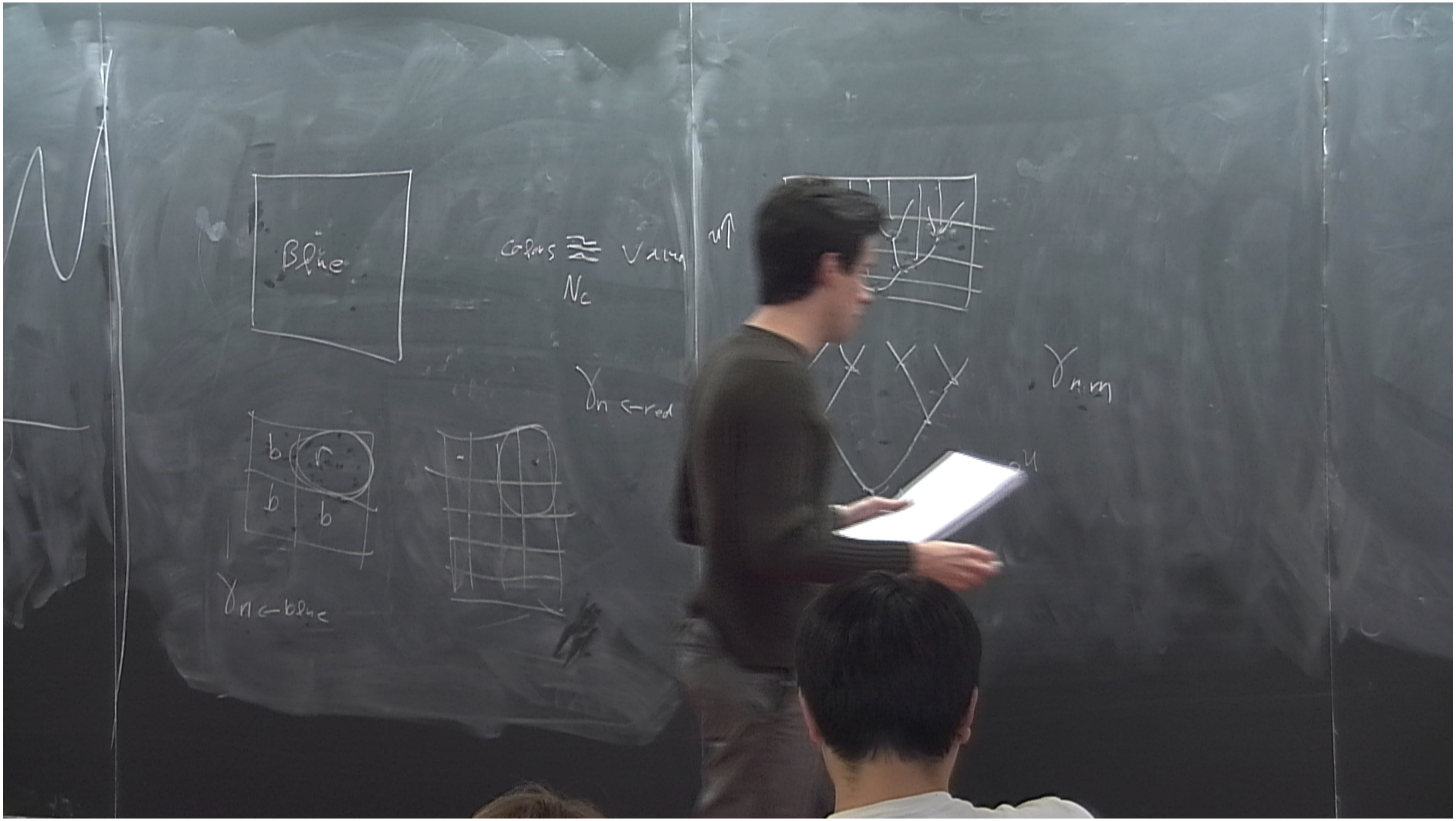

Symmetree
Exp.
Vacua related by decays
Theory
at
∞
Colors
Vacua
Nc

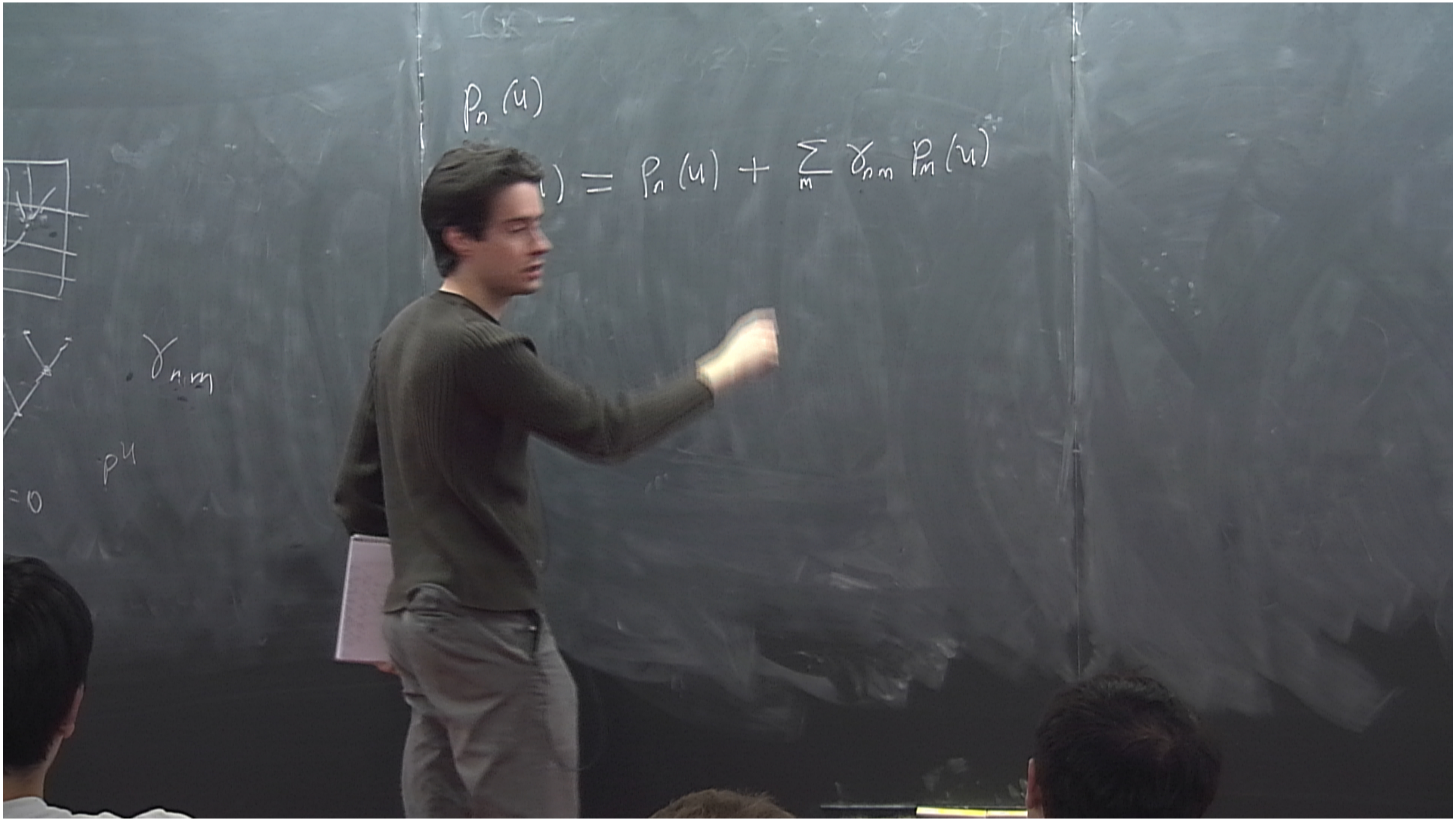


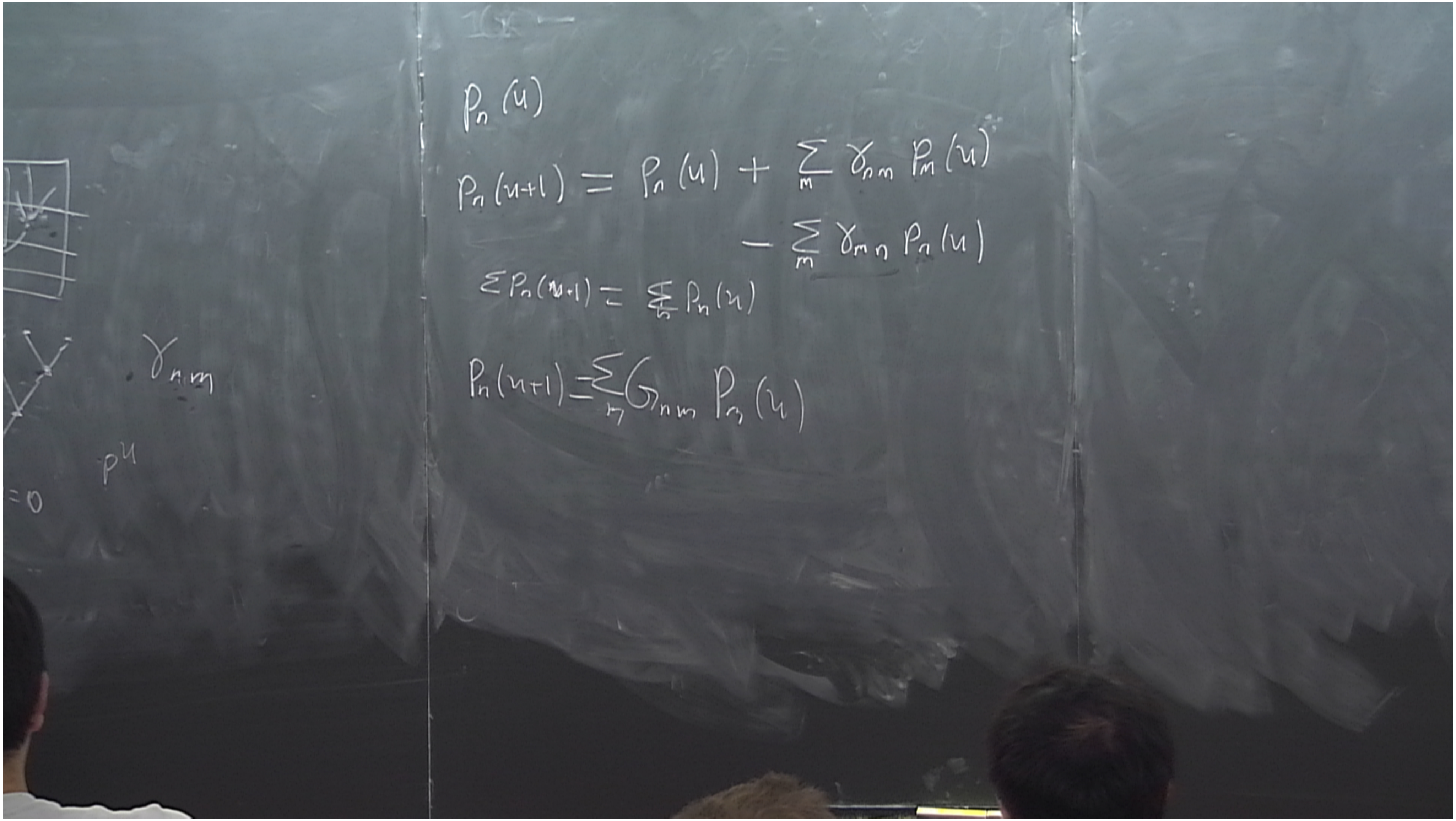


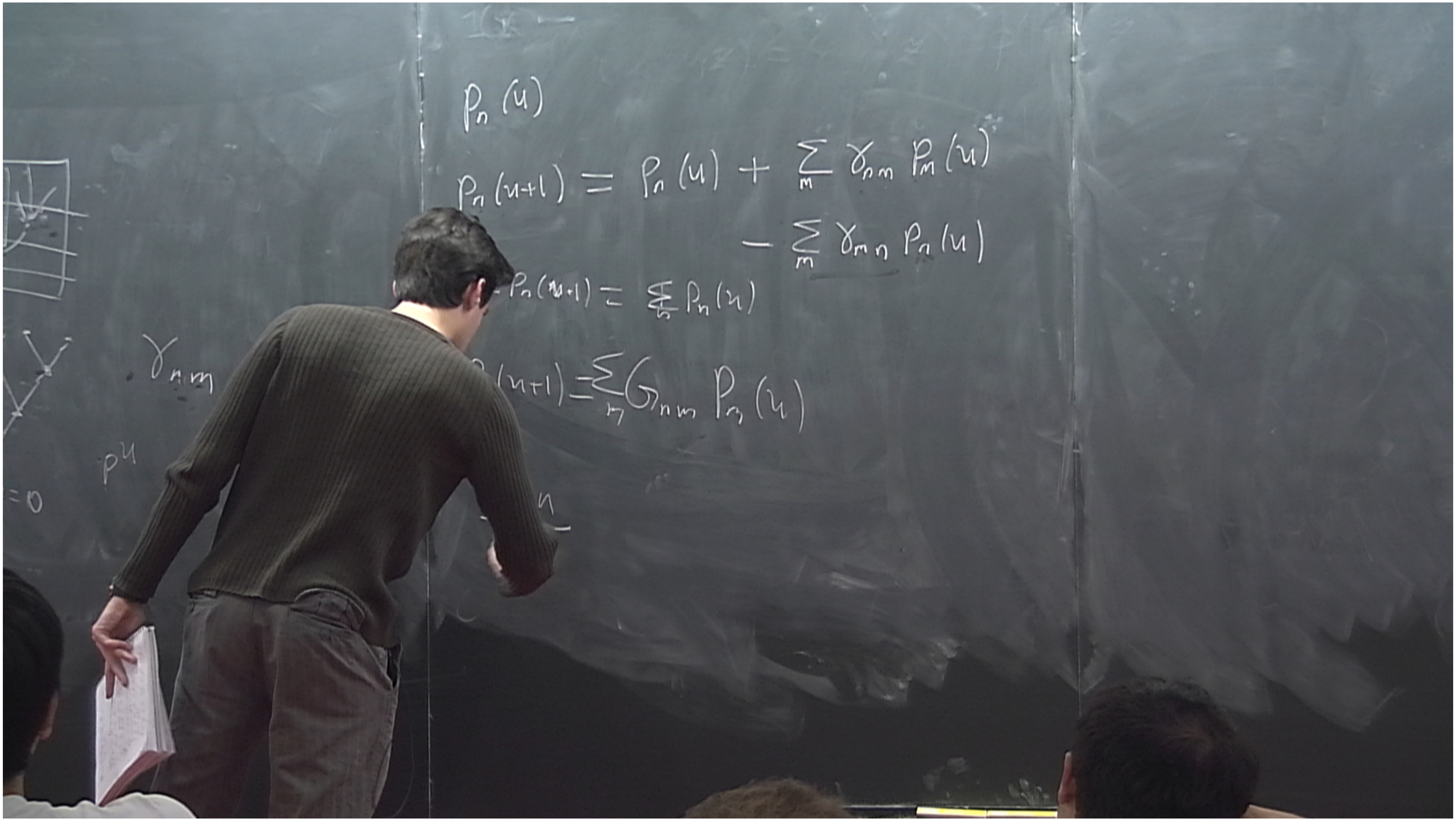

Blue
Nc
b
r
b
b

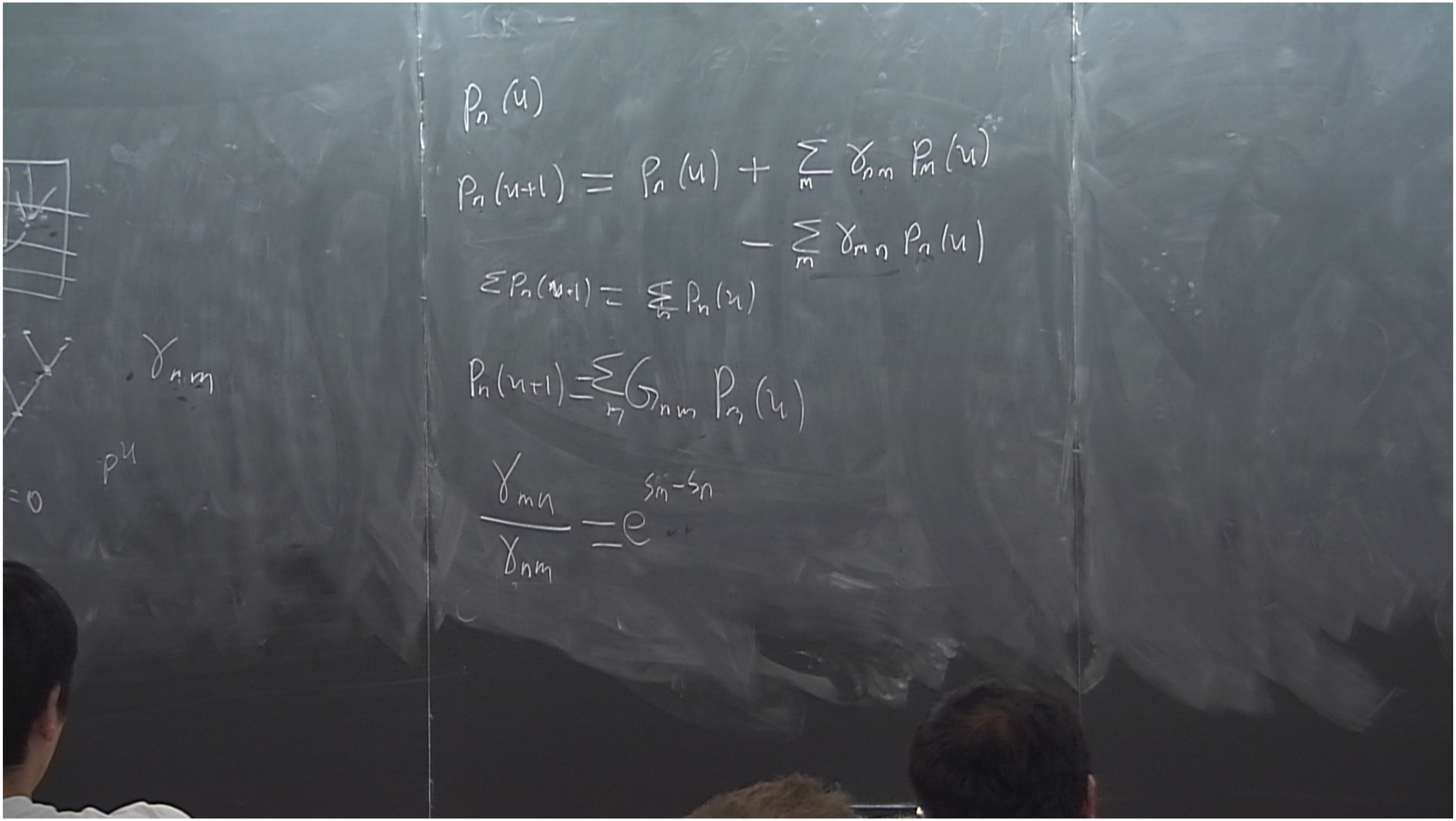

Blue
$\gamma_{n\leftarrow red}$
$\gamma_{n\leftarrow blue}$
$\gamma_{n,m}$




$P_n(u)$
$= P_n(u) + \sum_m \gamma_{nm} P_m(u)$
$\gamma_{n,m}$
p^4


$P_n(u)$
$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$
$\sum P_n(u+1) = \sum_n P_n(u)$
$P_n(u+1) = \sum_m G_{nm} P_m(u)$
$\gamma_{n,m}$
p^u
$=0$


Pn (u)
Pn (u+1) = Pn (u) + Σm γnm Pm (u)
− Σm γmn Pn (u)
γn m



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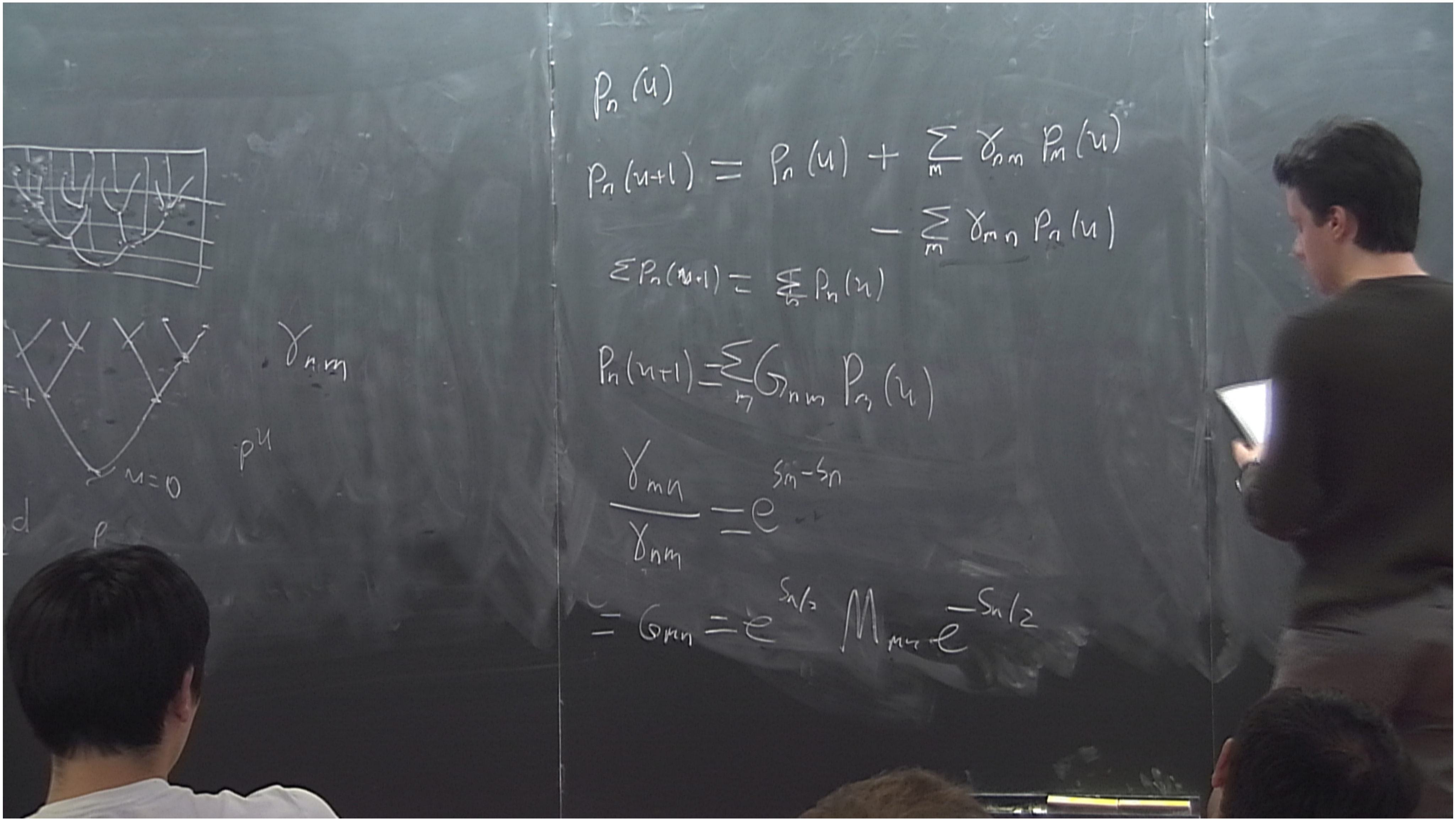
$P_n(u+1) = \sum_m G_{nm} P_m(u)$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
γ_{nm}
P^u
$= 0$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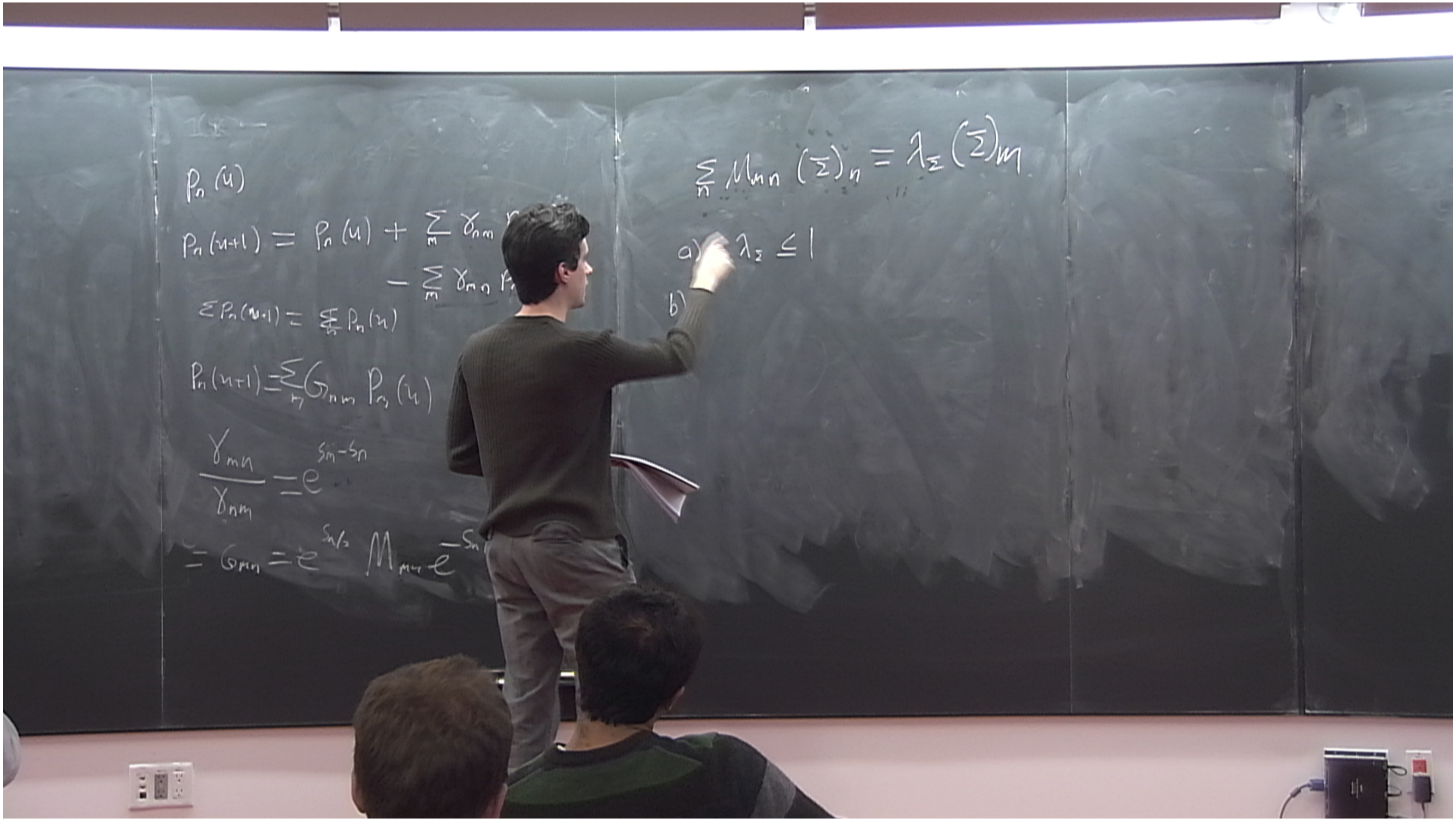
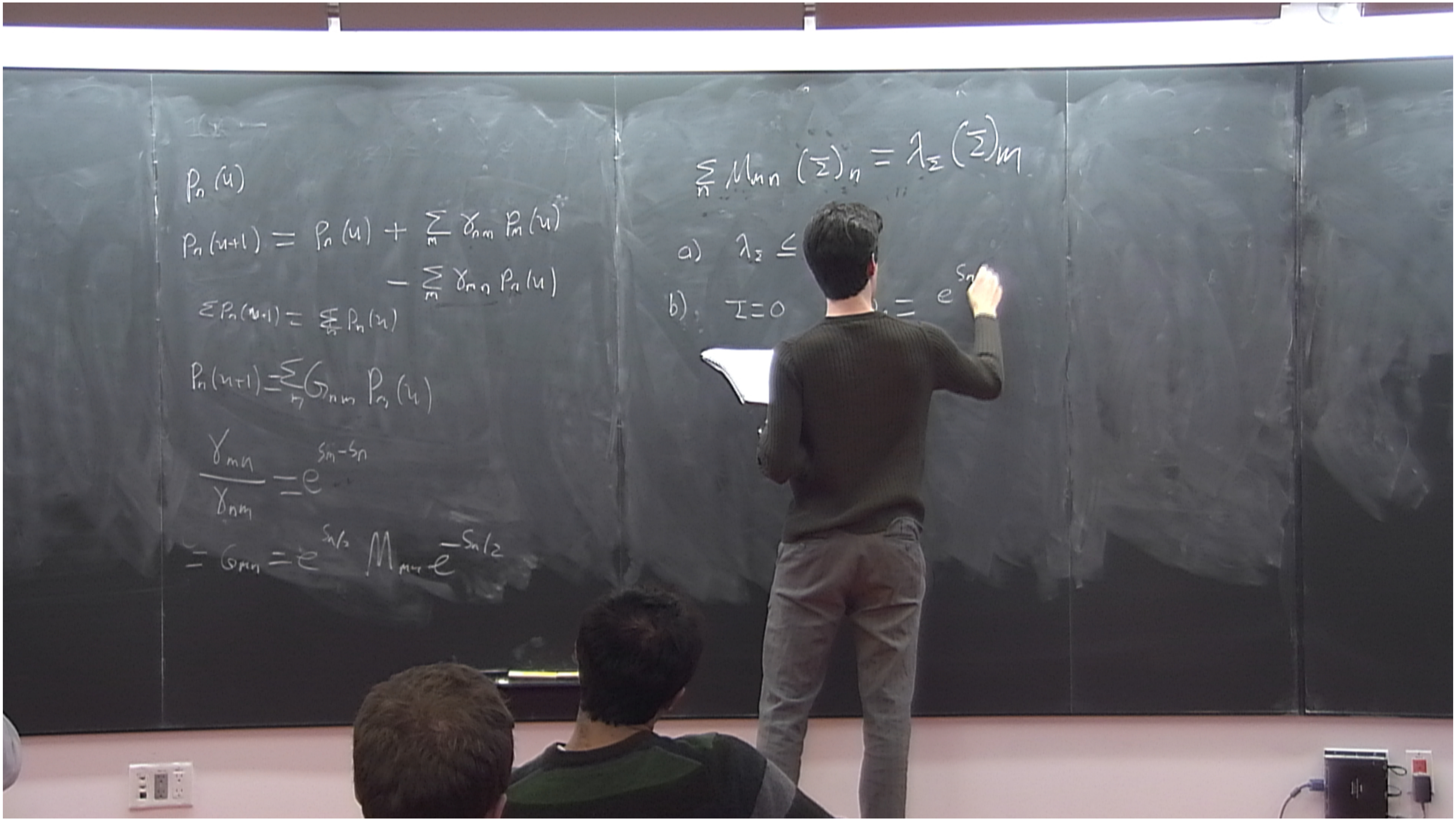
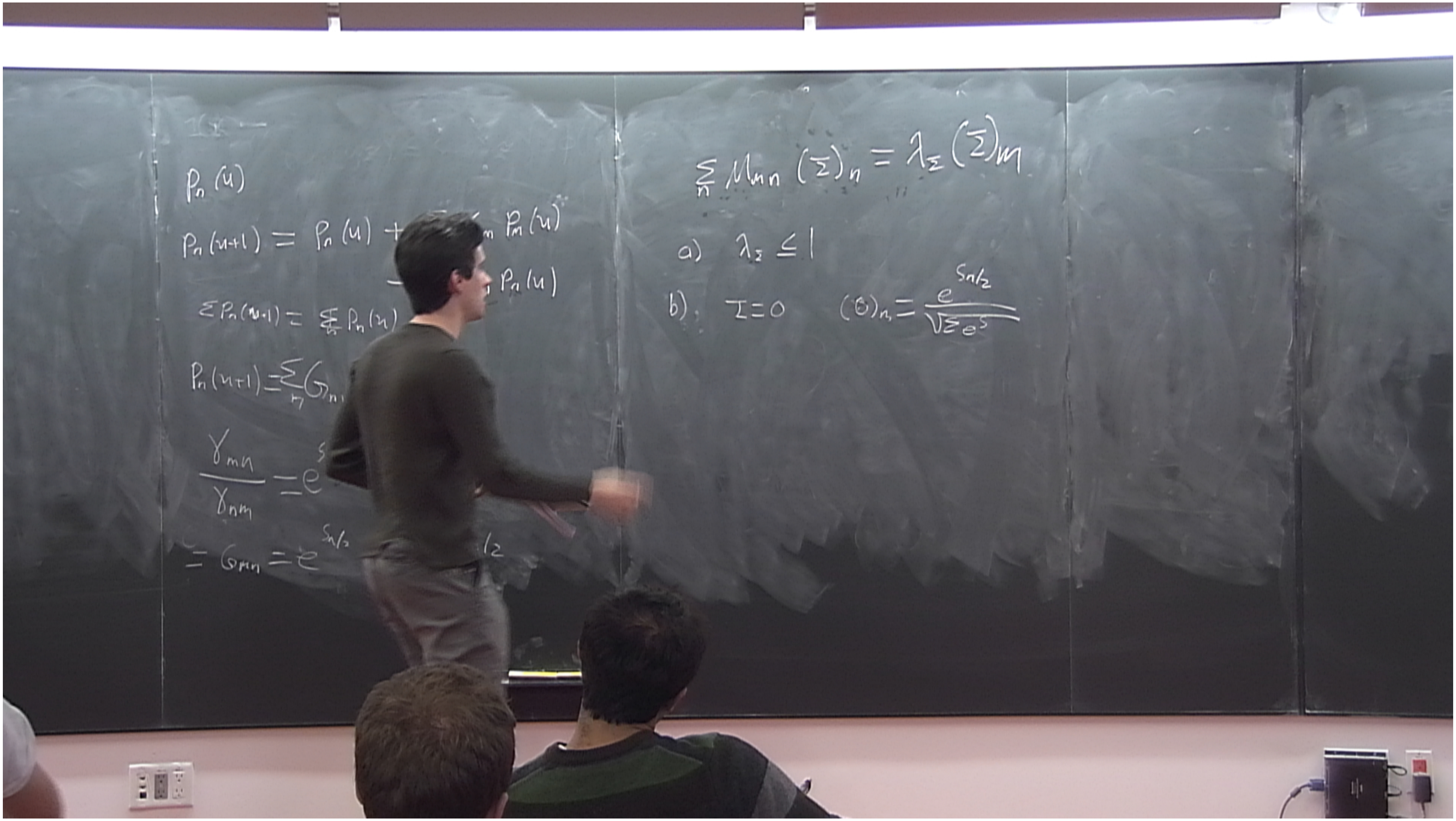
$P_n(u+1) = \sum_m G_{nm} P_m(u)$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
$G_{mn} = e^{S_n/2} M_{mn} e^{-S_n/2}$
γ_{nm}
P^u
$u=0$


$P_n(u)$
$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm}$
$- \sum_m \gamma_{mn}$
$\sum P_n(u+1) = \sum_n P_n(u)$
$P_n(u+1) = \sum_m G_{nm} P_m(u)$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
$= G_{mn} = e^{S_n/2} M_{mn} e^{-S_n}$
$\sum_n M_{mn} (\Sigma)_n = \lambda_\Sigma (\Sigma)_m$
a) $\lambda_\Sigma \leq 1$
b)



Pn (u)
Pn (u+1) = Pn (u) + Σm γnm Pm (u)
− Σm γmn Pn (u)
Σ Pn (u+1) = Σ Pn (u)
Pn (u+1) = Σm Gnm Pm (u)
γmn / γnm = e^(Sm−Sn)
= Gmn = e^(Sn/2) Mmn e^(−Sn/2)
Σn Mmn (Σ)n = λΣ (Σ)m
a) λΣ ≤
b) Σ = 0
= e^Sn


Pn (u)
Pn (u+1) = Pn (u) +
a) λΣ ≤ 1
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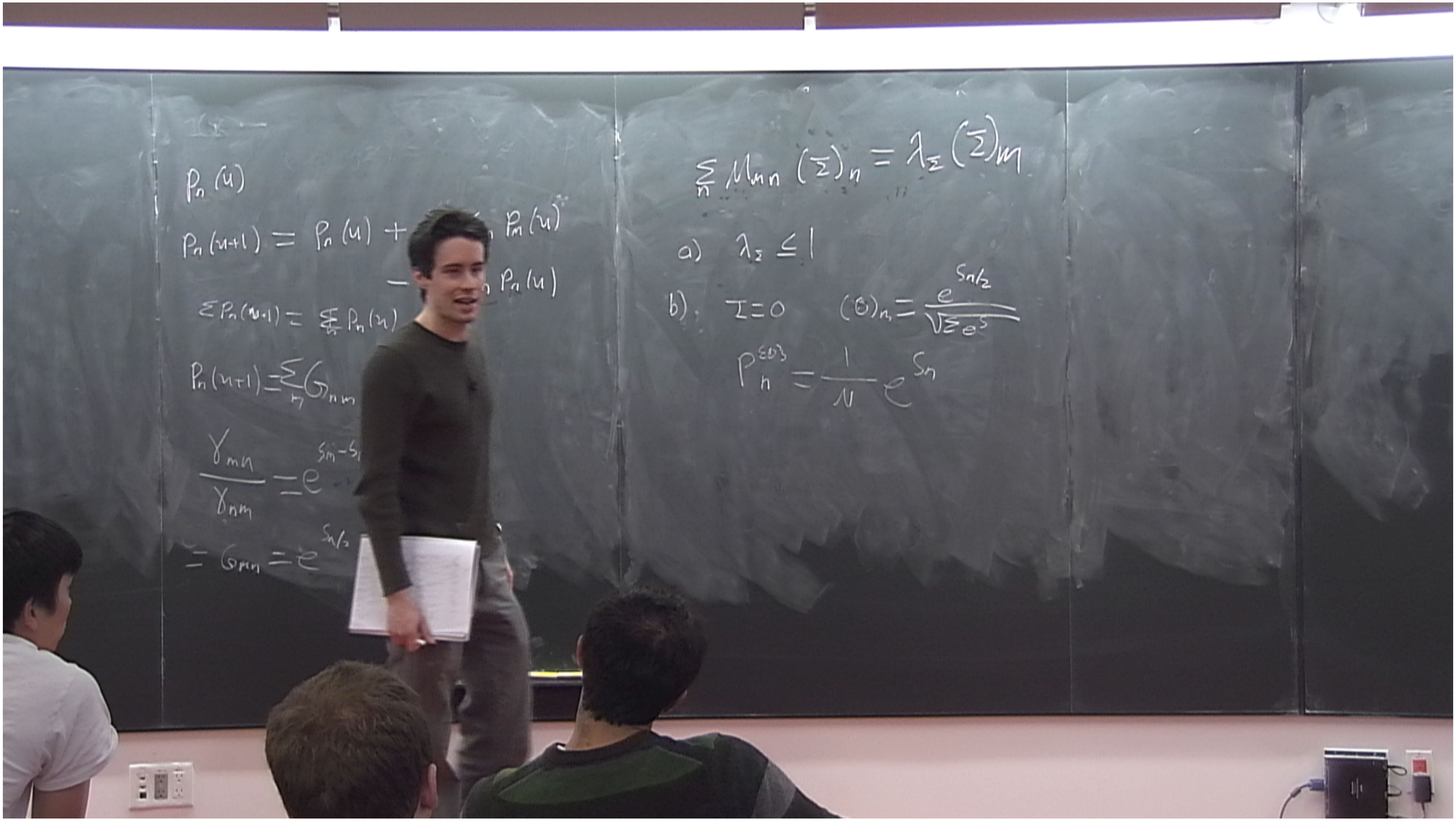
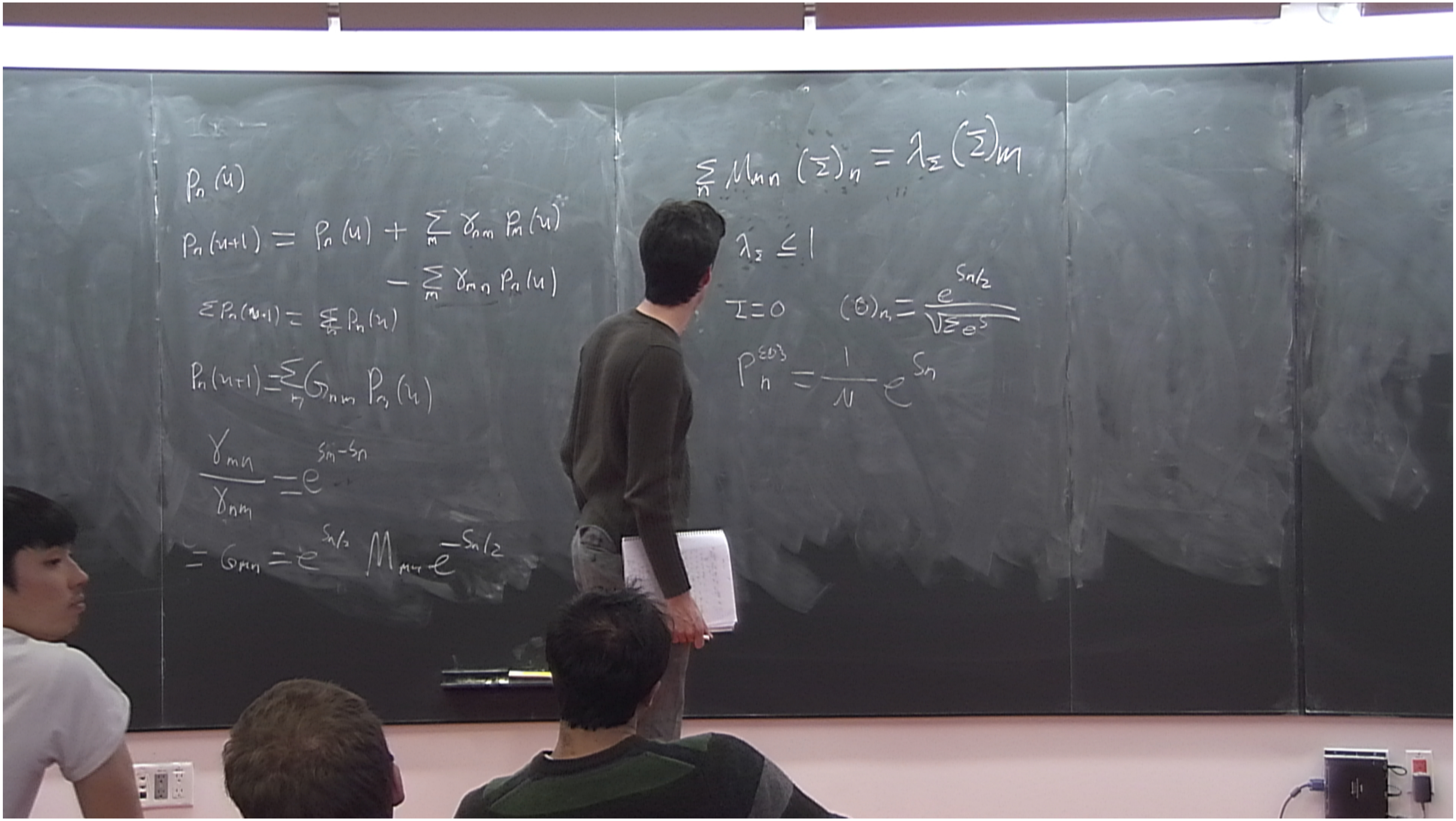
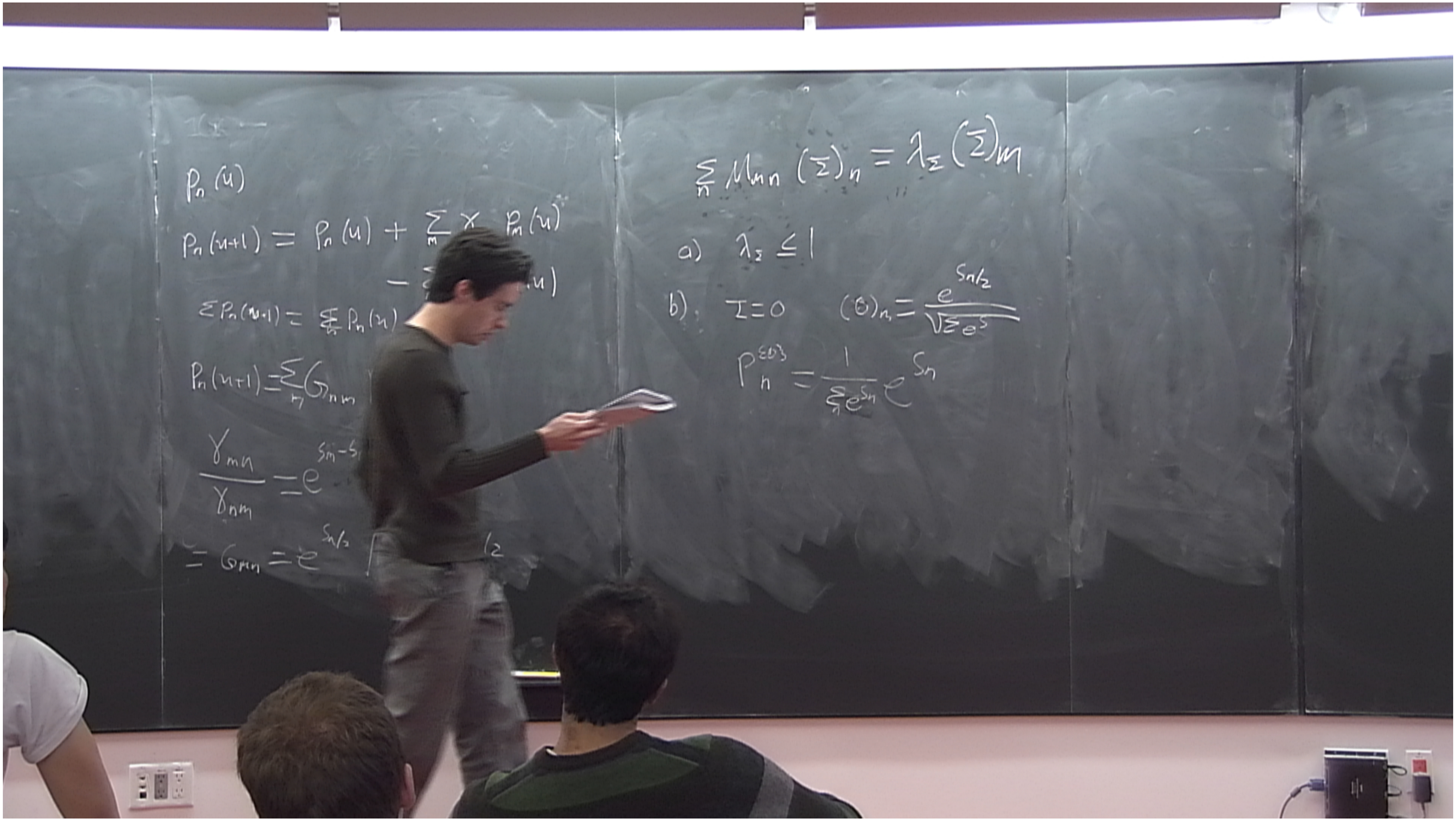
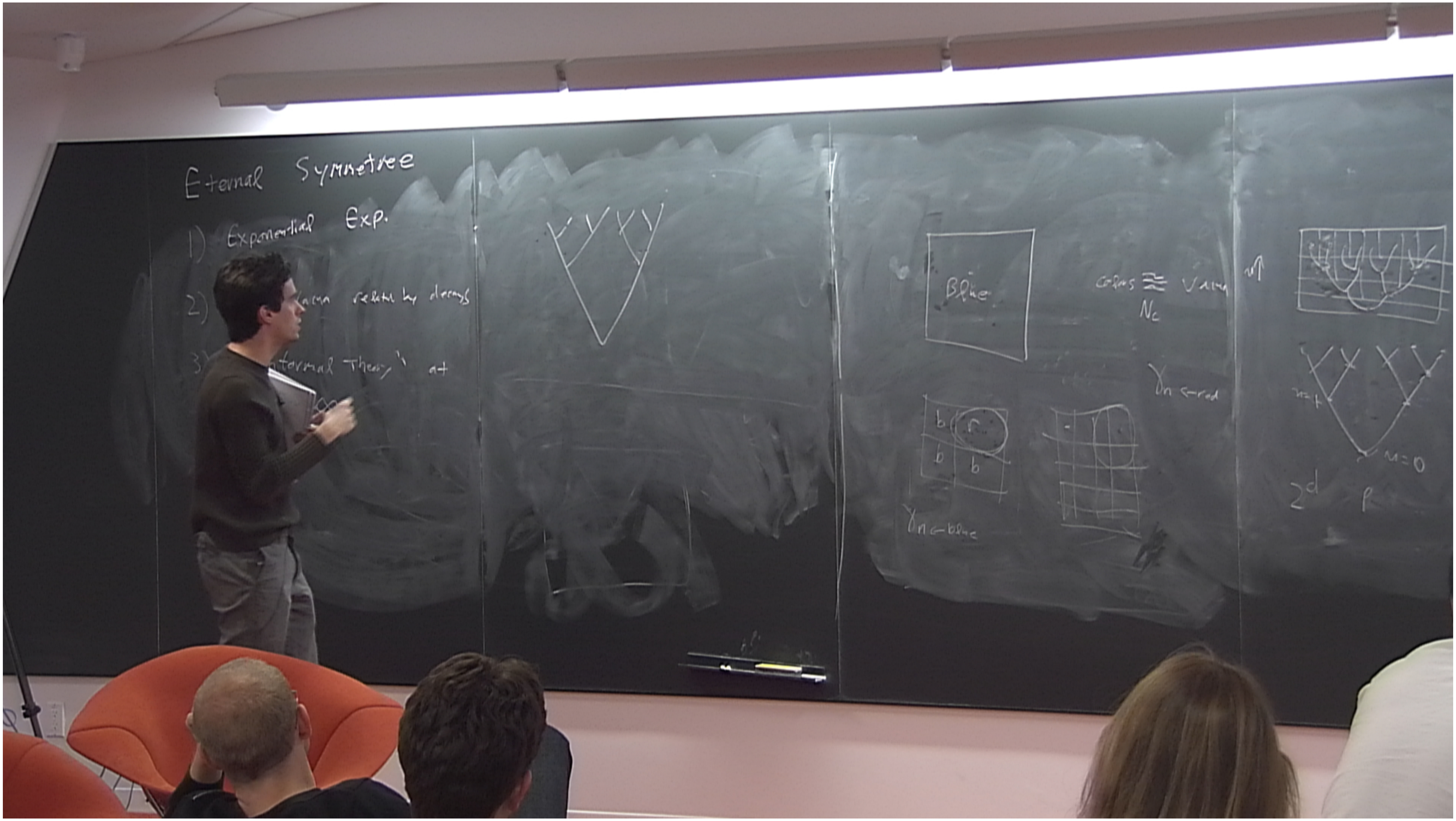


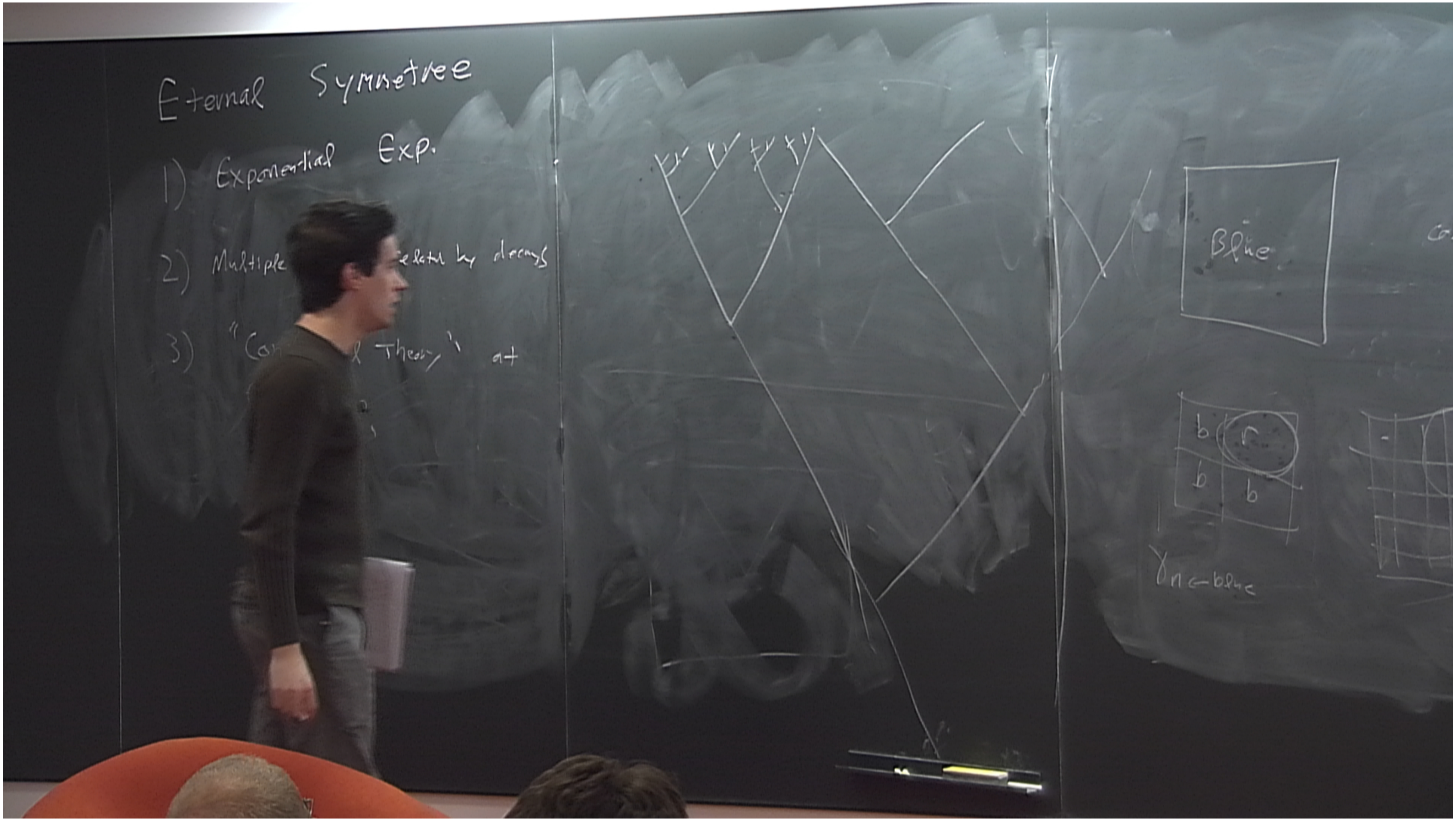

P_n(u)
P_n(u+1) = P_n(u) + Σ_m γ_nm P_m(u) − Σ_m γ_mn P_n(u)
Σ P_n(u+1) = Σ P_n(u)
P_n(u+1) = Σ_m G_nm P_m(u)
γ_mn / γ_nm = e^{S_m − S_n}
G_mn = e^{S_n/2} M_mn e^{−S_n/2}
Σ_n M_mn (Σ)_n = λ_Σ (Σ)_m
λ_Σ ≤ 1
Σ = 0
(0)_n = e^{S_n/2} / √(Σ e^S)
P_n^{(0)} = (1/N) e^{S_n}


Pn(u)
a) λΣ ≤ 1
b) Σ=0



Eternal Symmetree
1) Exponential Exp.
2)
3)
Blue

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua
3) "Conformal
Future ∞
Blue
b
b
b


Eternal Symmetree
1) Exponential Exp.
2) Multiple
relate by decays
3) "Co l Theory" at
Blue
b
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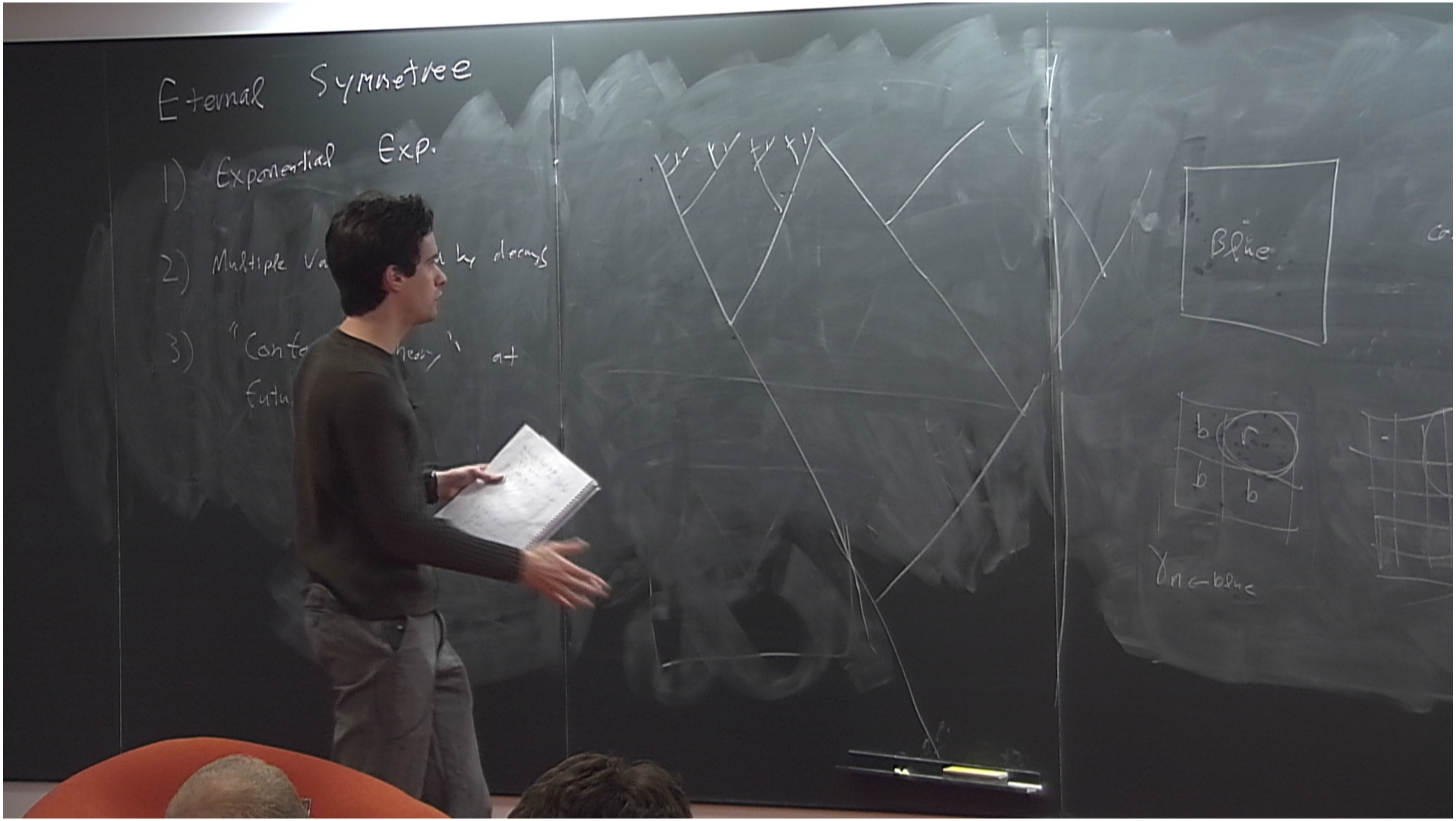
b
r
$\gamma_{r \leftarrow blue}$


Eternal Symmetree
1) Exponential Exp.
2) Multiple Va... by decays
3) "Conf... ...heory" at
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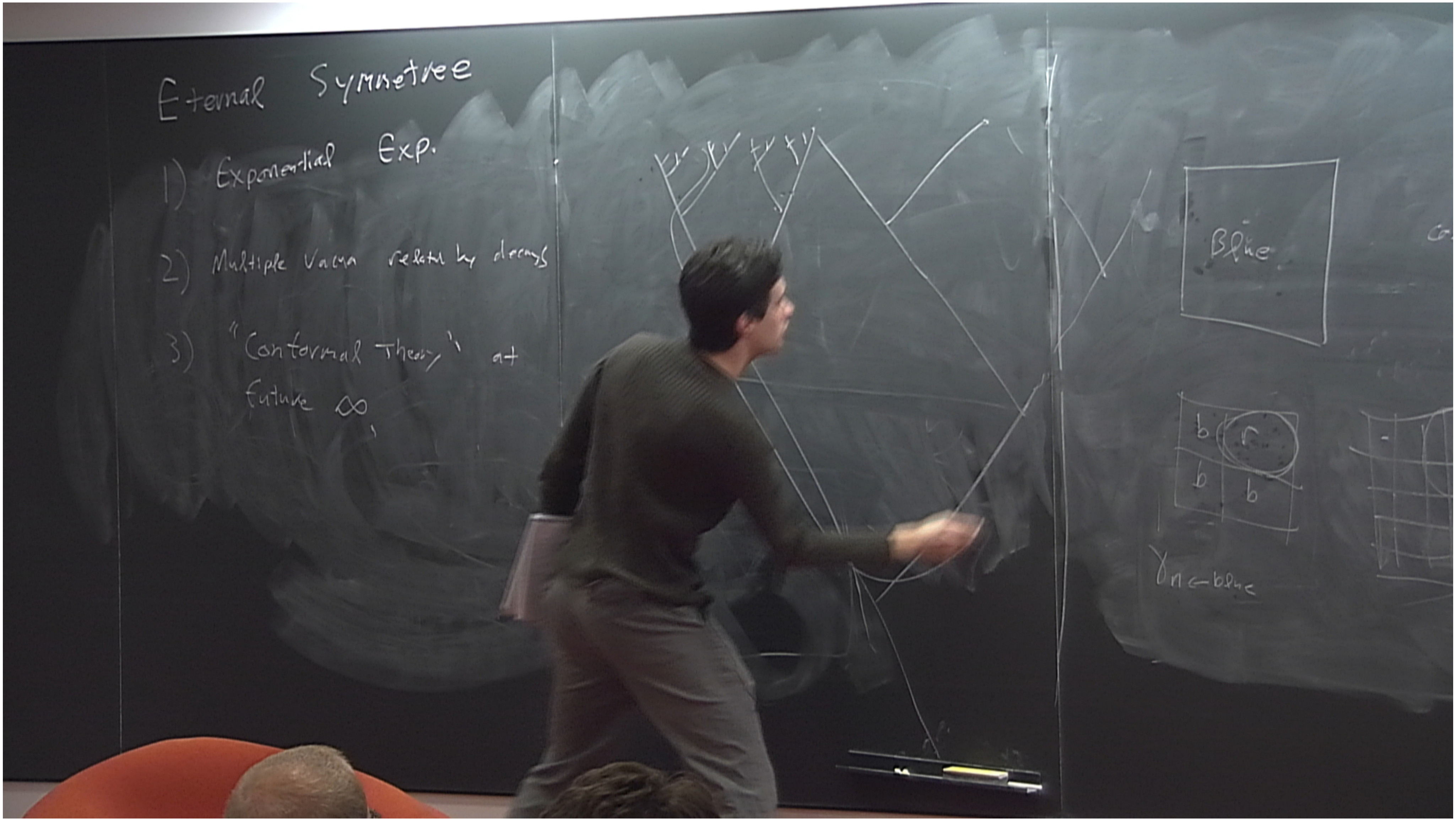

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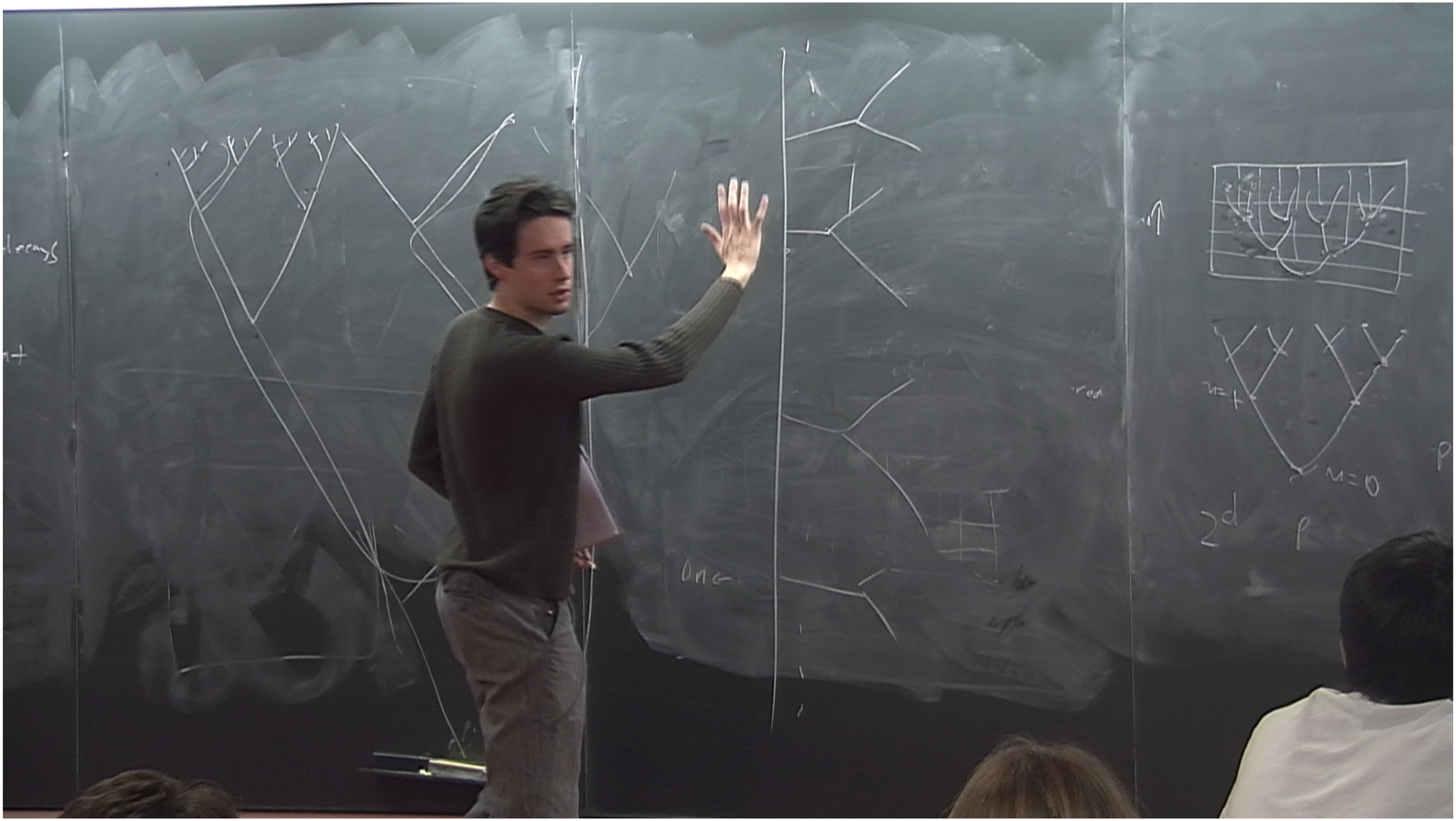
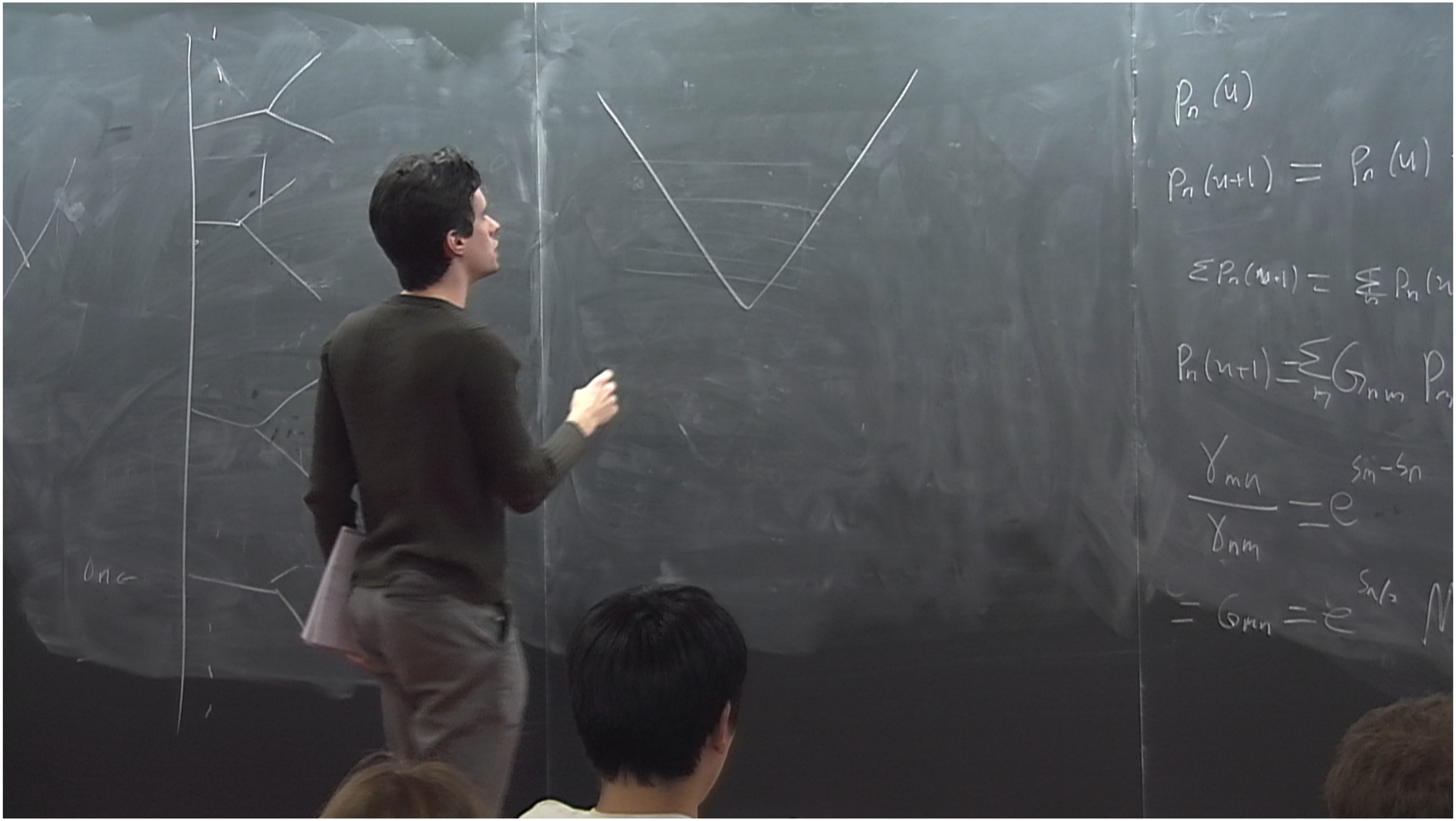
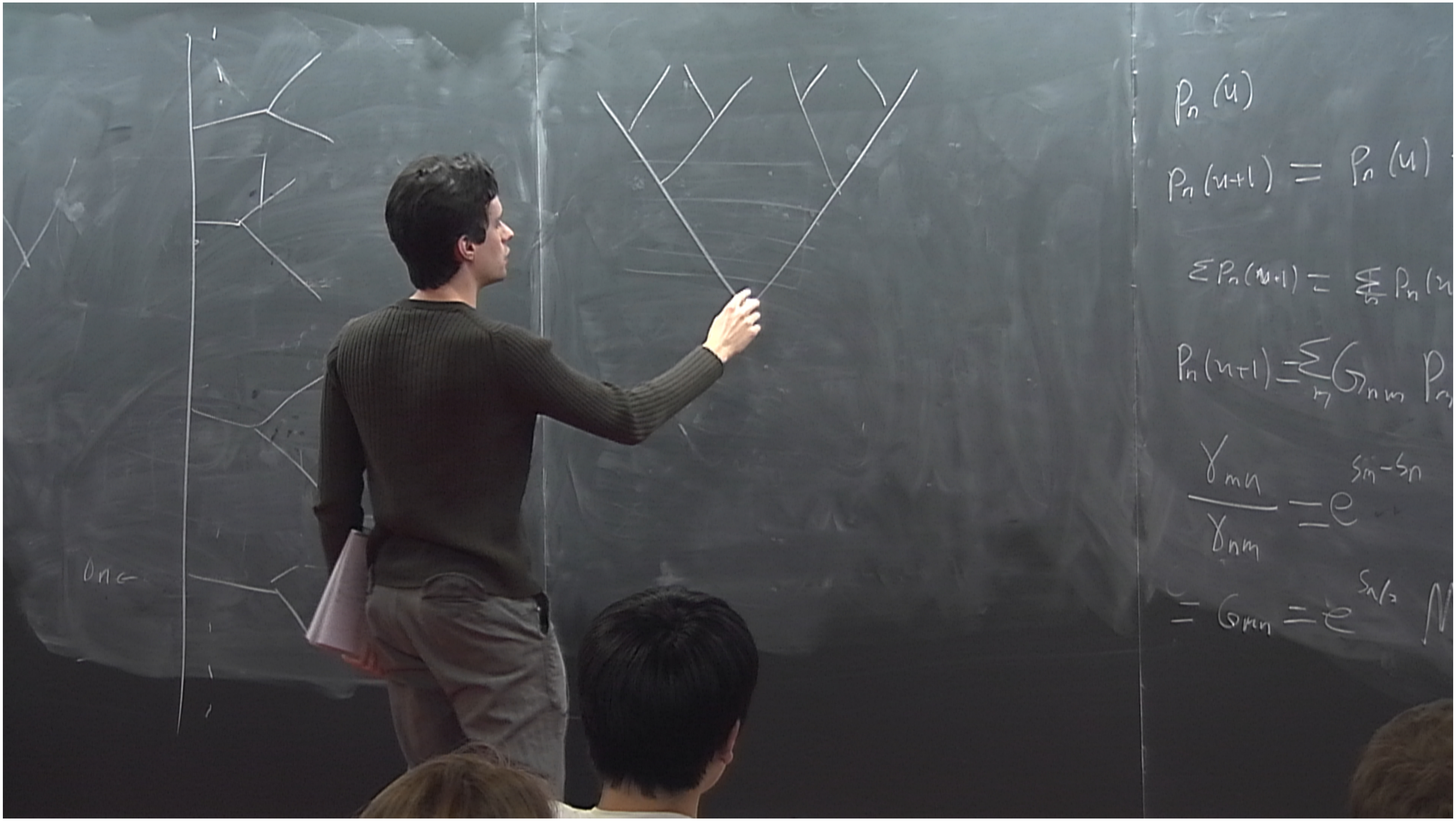
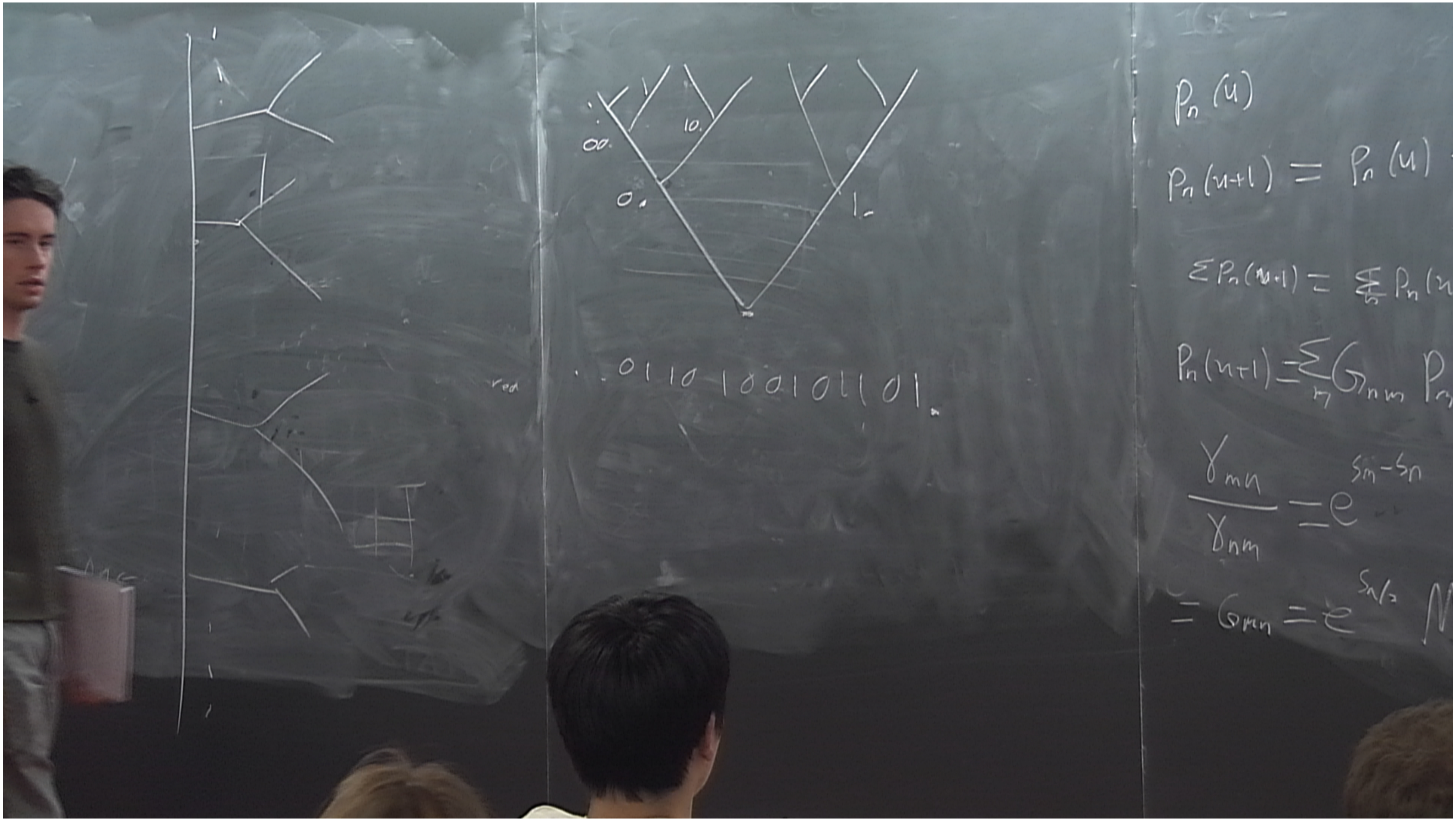




Pn (u)
Pn (u+1) = Pn (u)
γmn / γnm = e^{Sm-Sn}
= Gmn = e^{Sn/2}


$P_n(u)$
$P_n(u+1) = P_n(u)$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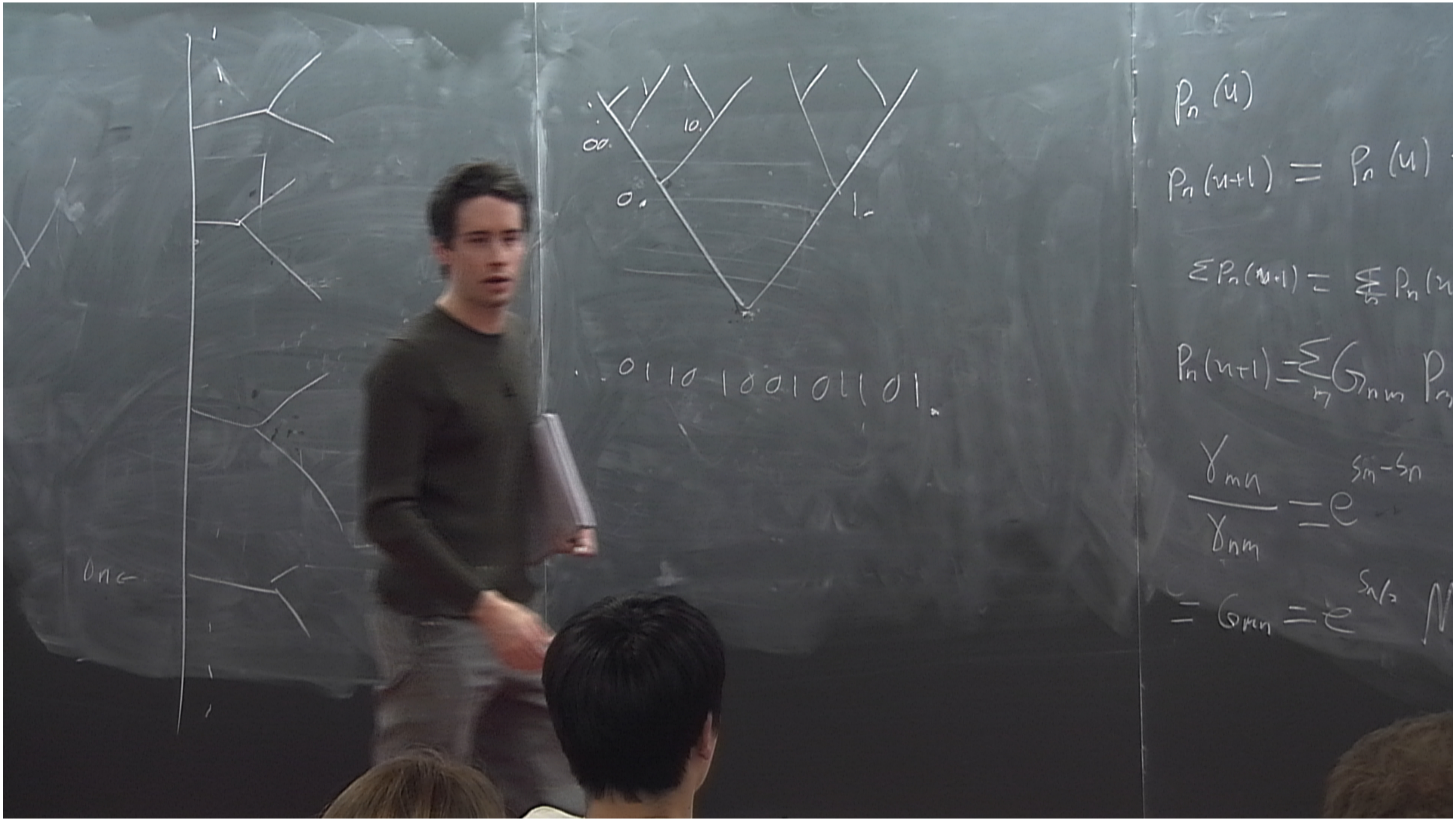
$P_n(u)$
$P_n(u+1) = P_n(u)$
$\Sigma P_n(u+1) = \sum_n P_n(u$
$P_n(u+1) = \sum_m G_{nm} P_m$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
$G_{mn} = e^{S_n/2}$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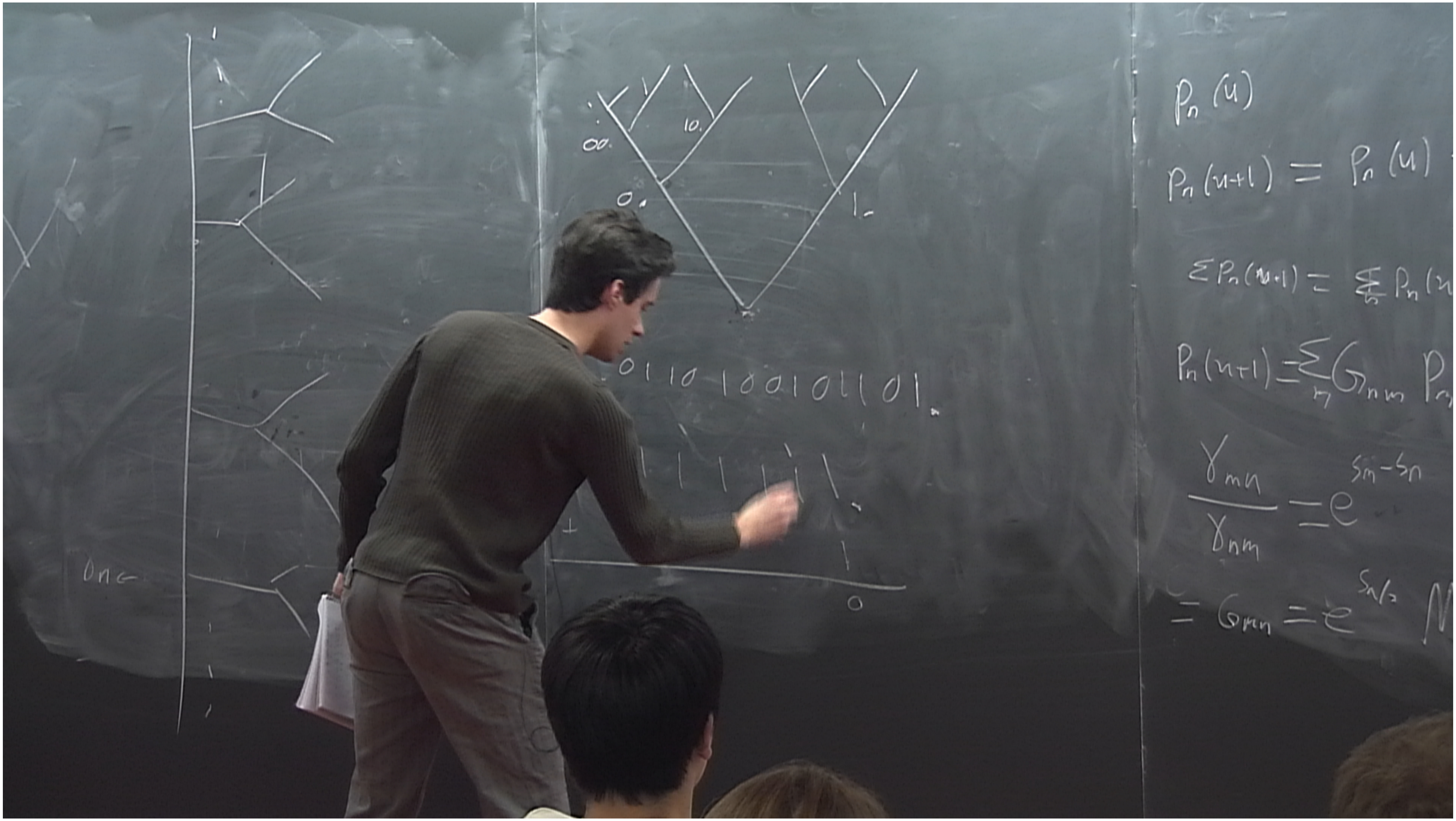
$P_n(u)$
$P_n(u+1) = P_n(u)$
$\sum P_n(u+1) = \sum_n P_n(u$
$P_n(u+1) = \sum_m G_{nm} P_m$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
$= G_{mn} = e^{S_n/2}$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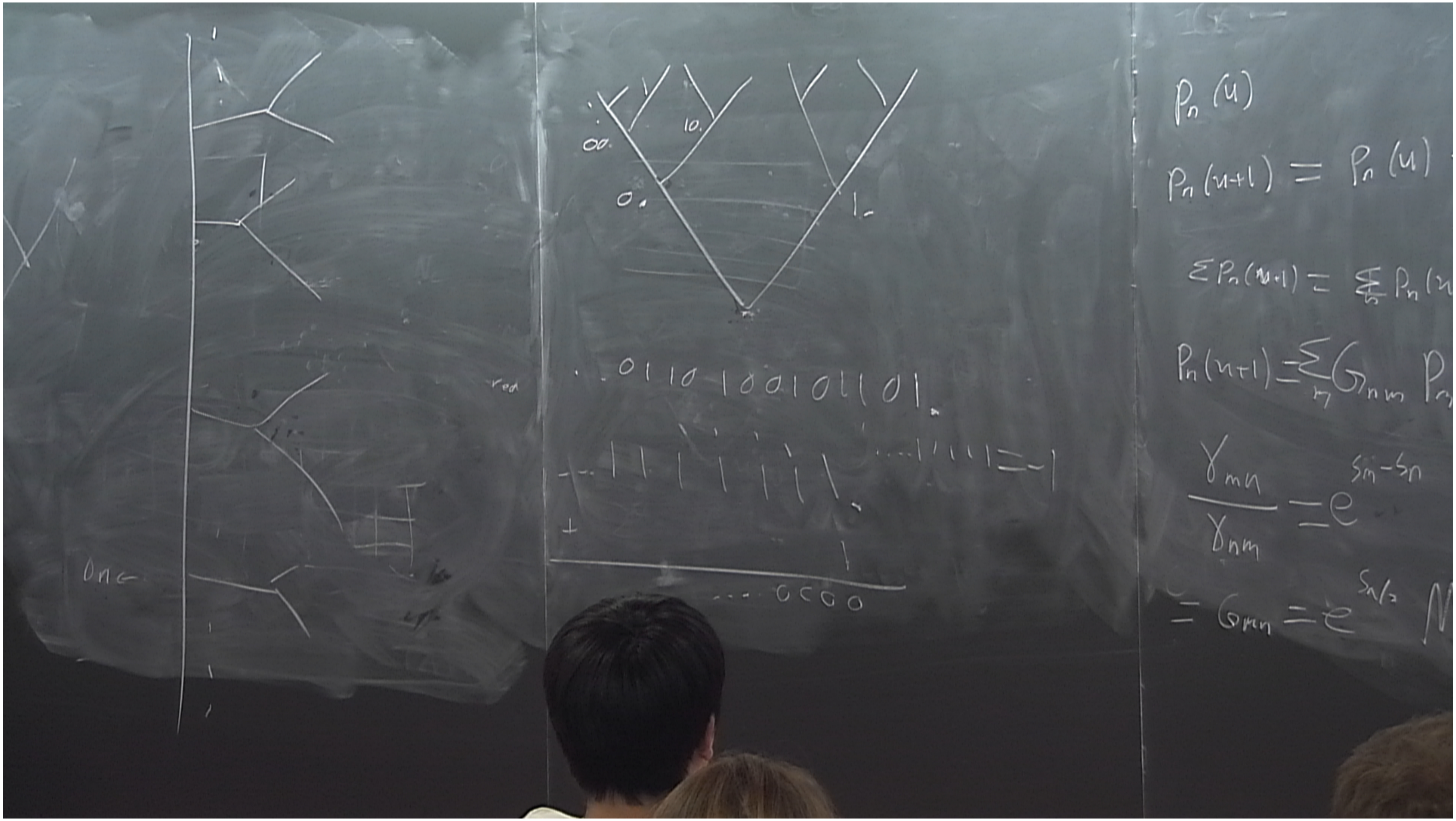
$P_n(u)$
$P_n(u+1) = P_n(u)$
$\Sigma P_n(u+1) = \sum_n P_n(u$
$P_n(u+1) = \sum_m G_{nm} P_m$
$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{S_m - S_n}$
$G_{mn} = e^{S_n/2}$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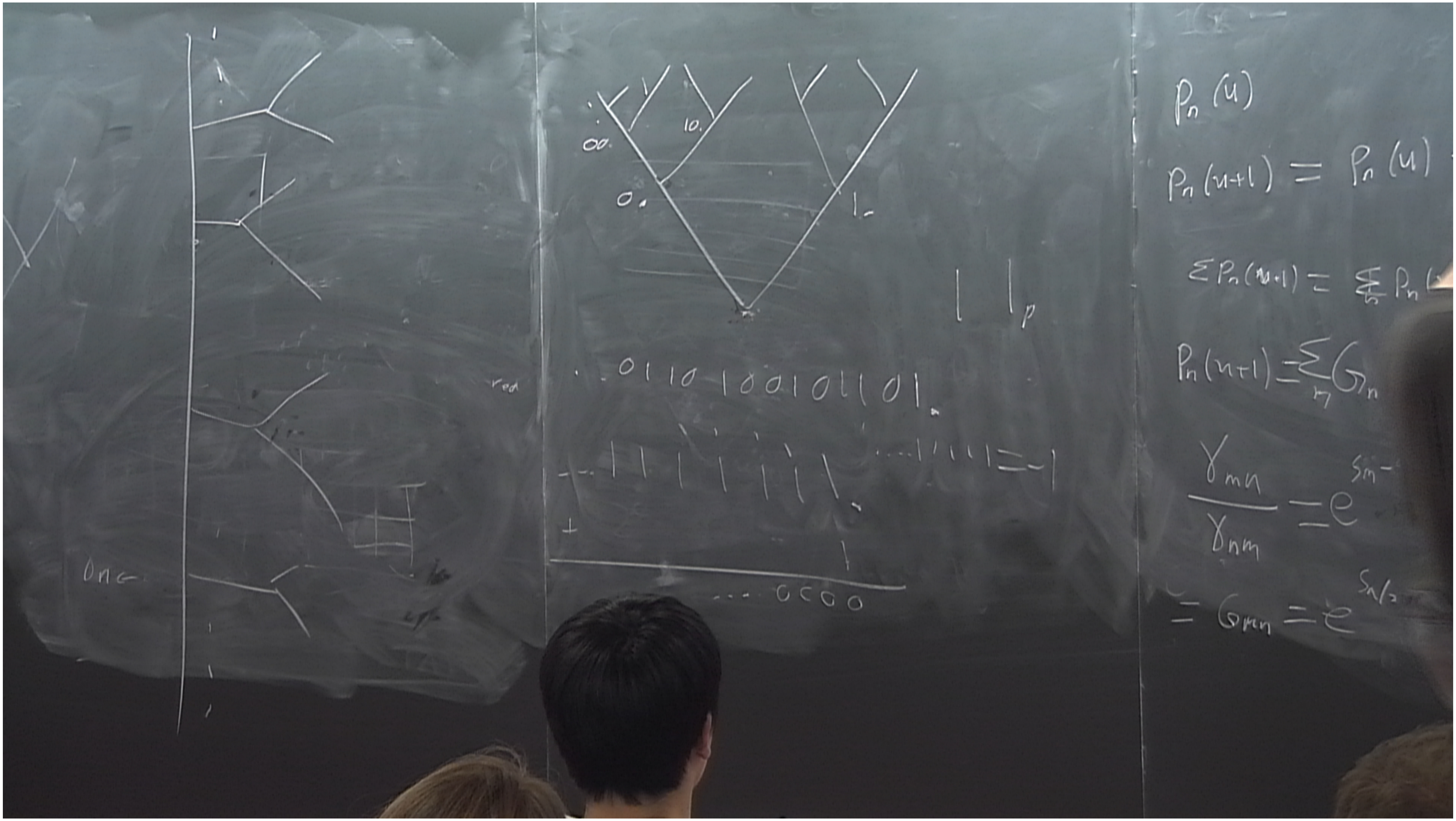
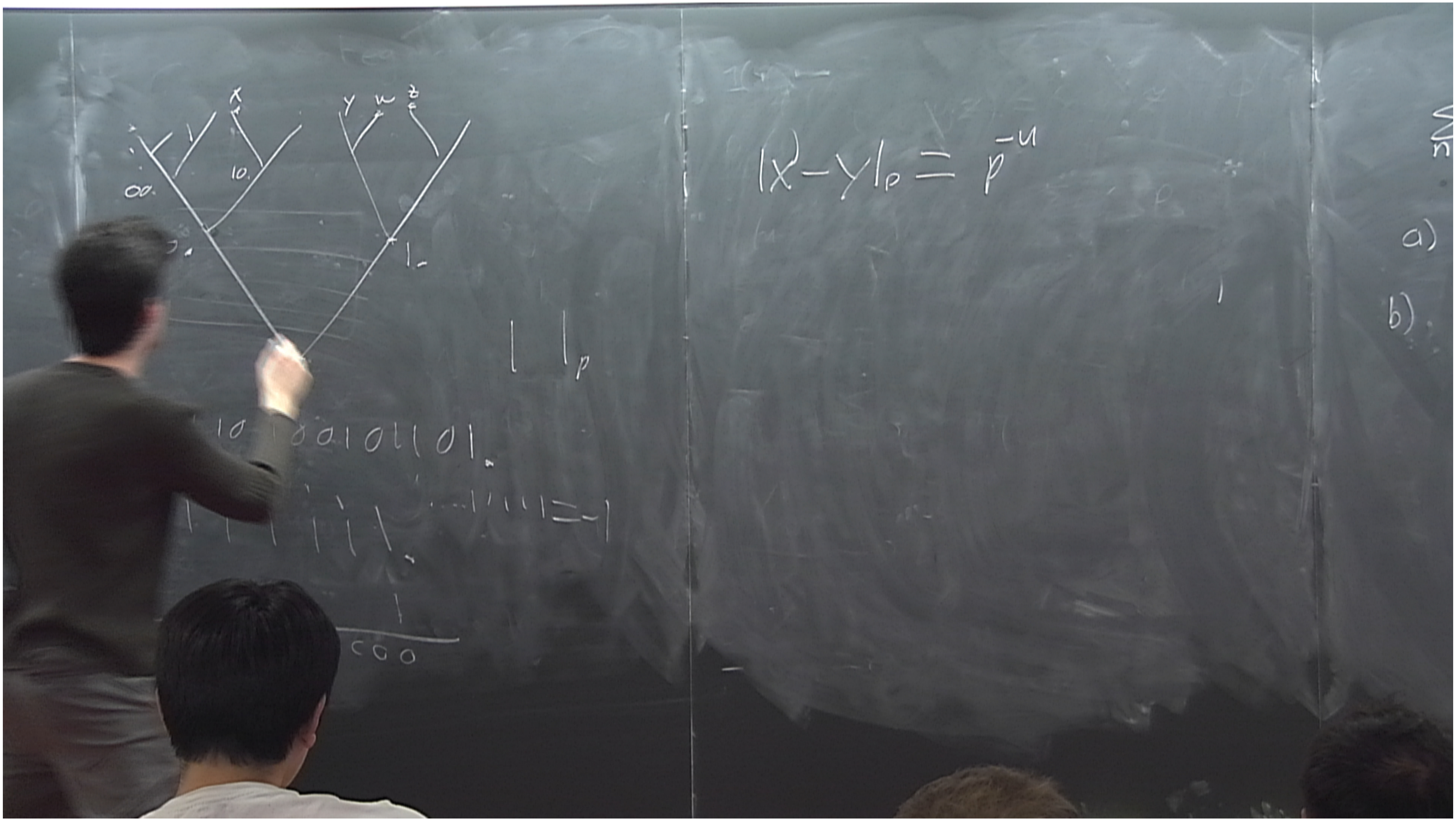
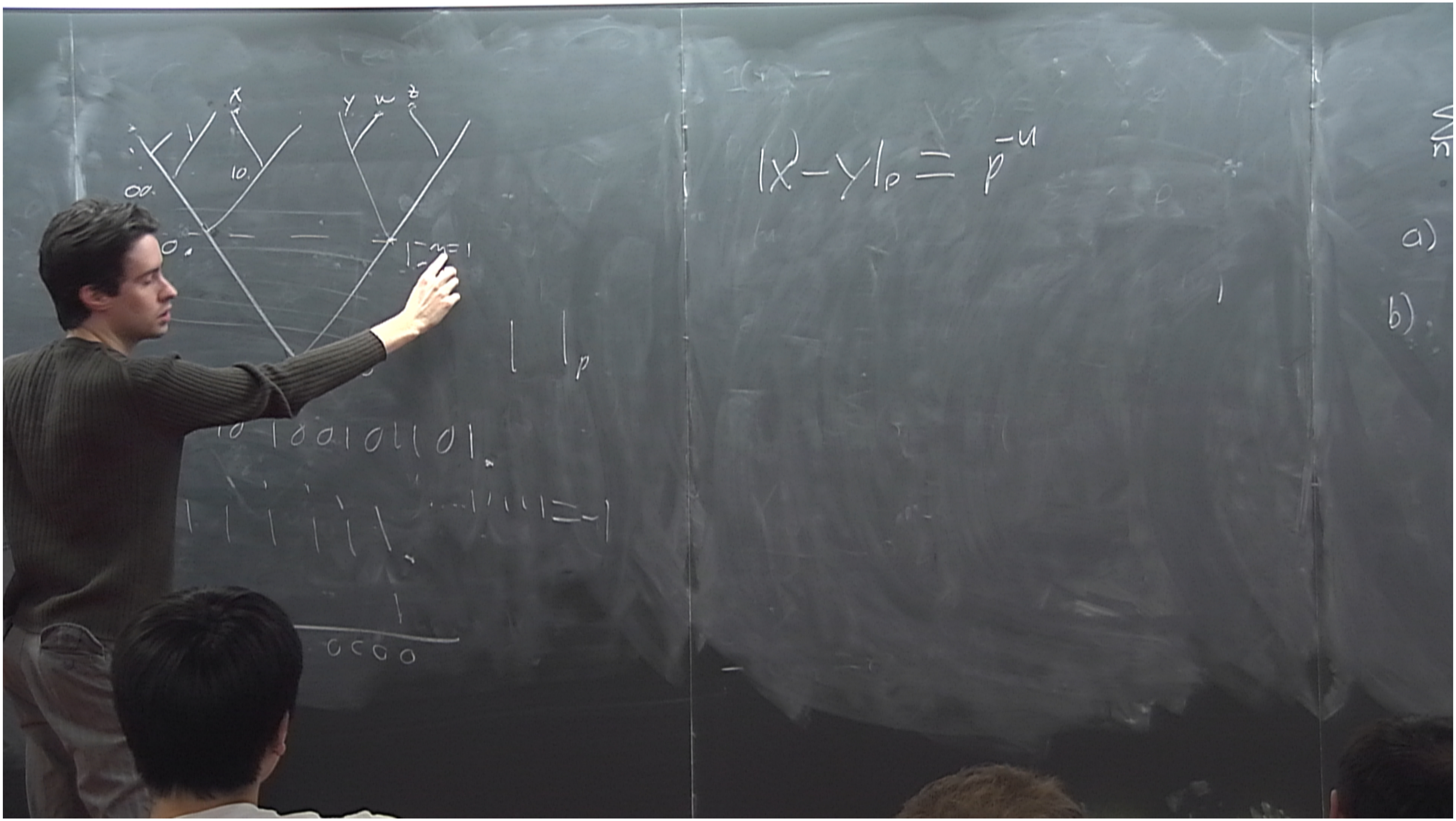
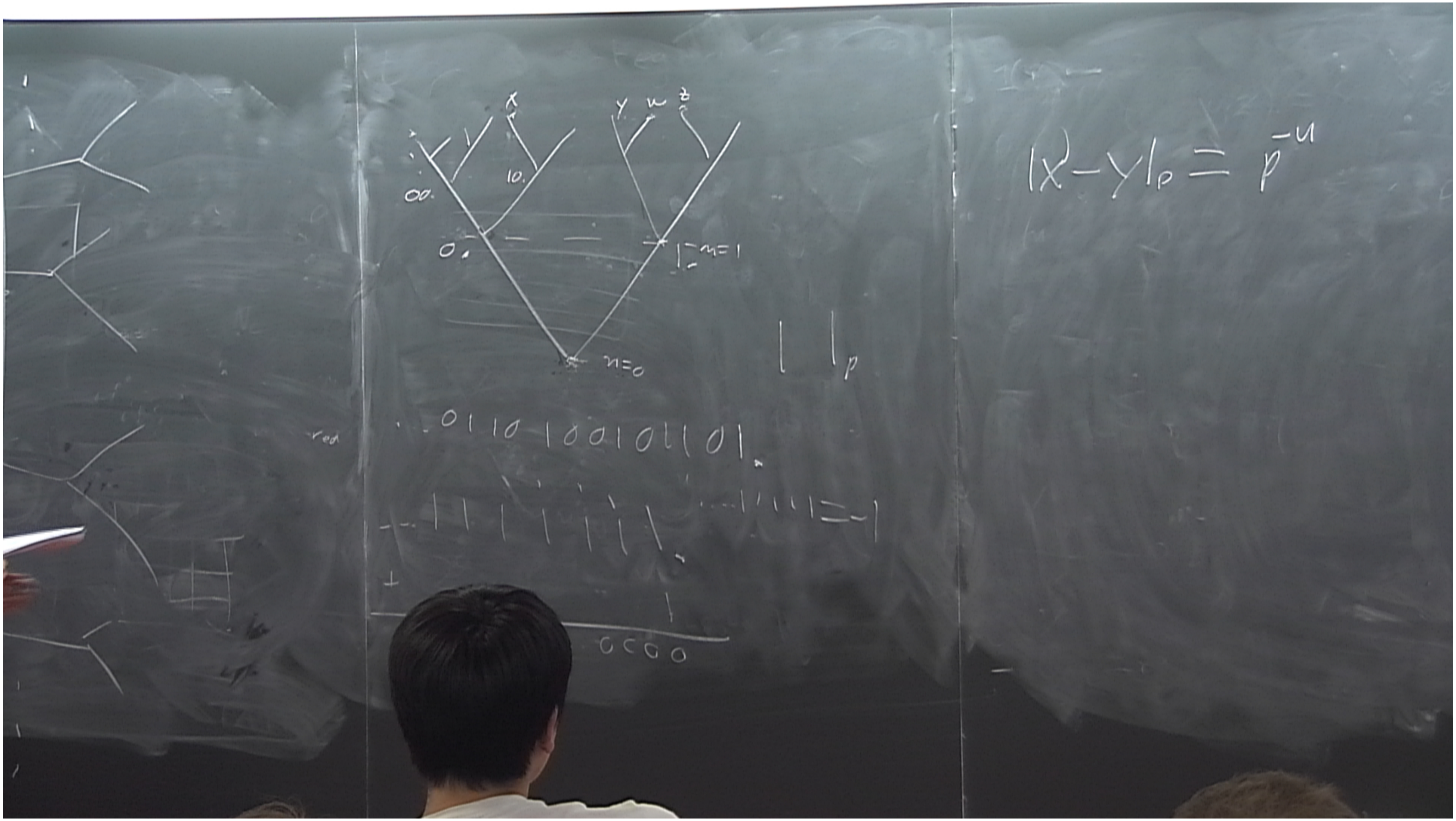
Pn (u)
Pn (u+1) = Pn (u)
Pn (u+1) = Σ Gnm Pm
γmn / γnm = e^(Sm-Sn)
= Gmn = e^(Sn/2)

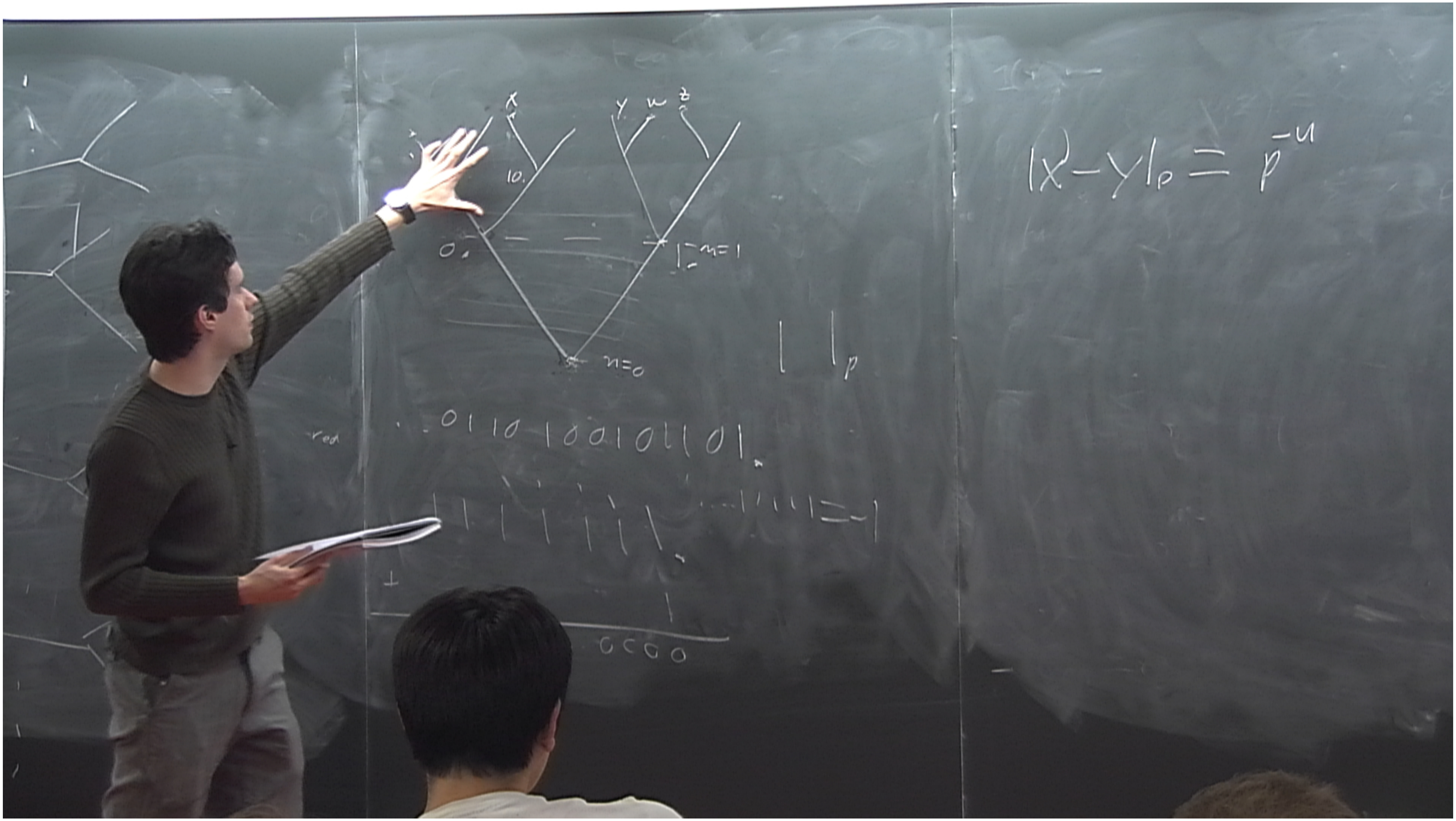


Pn (u)
Pn (u+1) = Pn (u)
Pn (u+1) = Σ Gmn
γmn / γnm = e
= Gmn = e

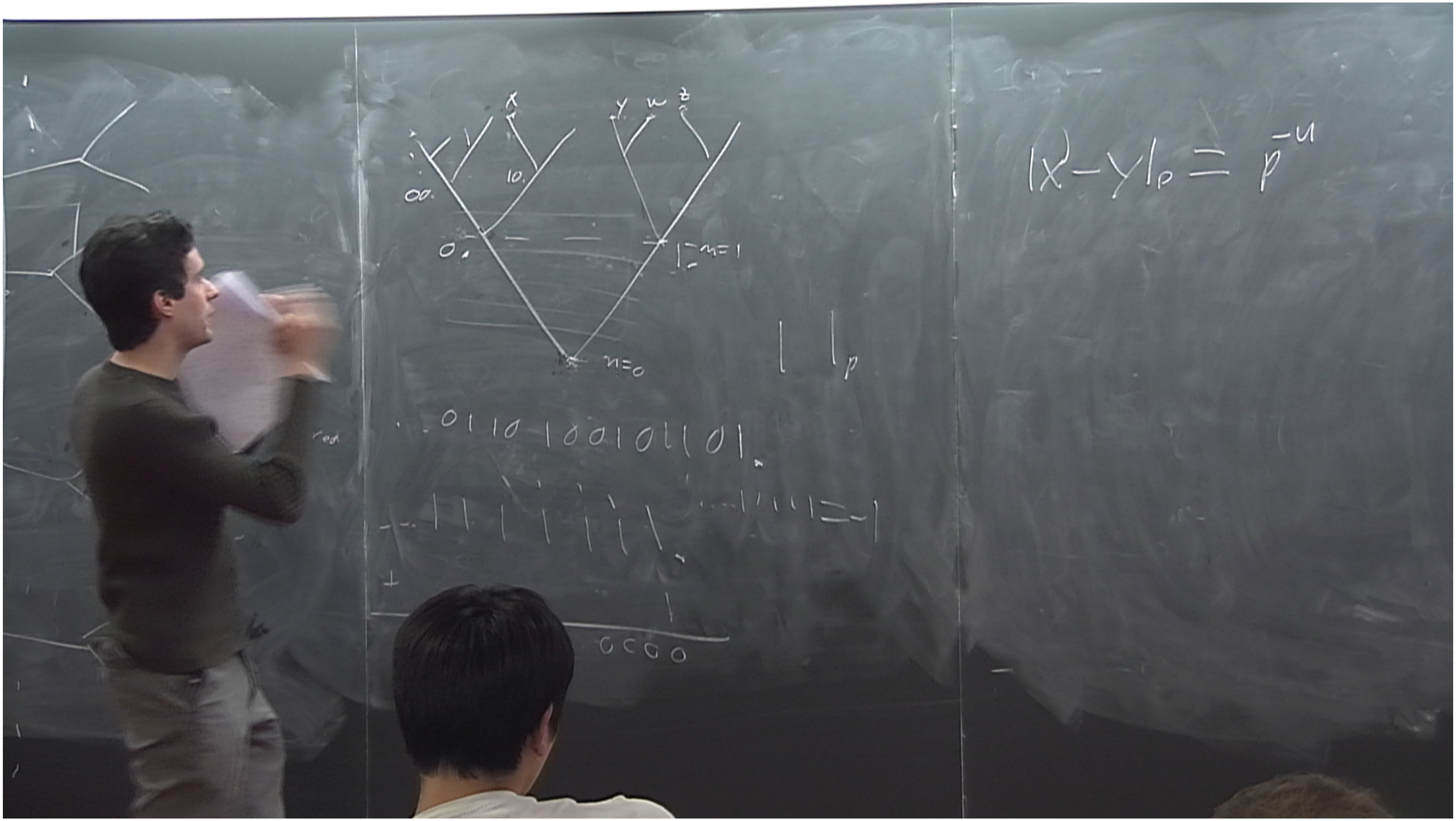

x
y w z
00.
10.
1.
| |p
|x−y|p = p−u
a)
b)

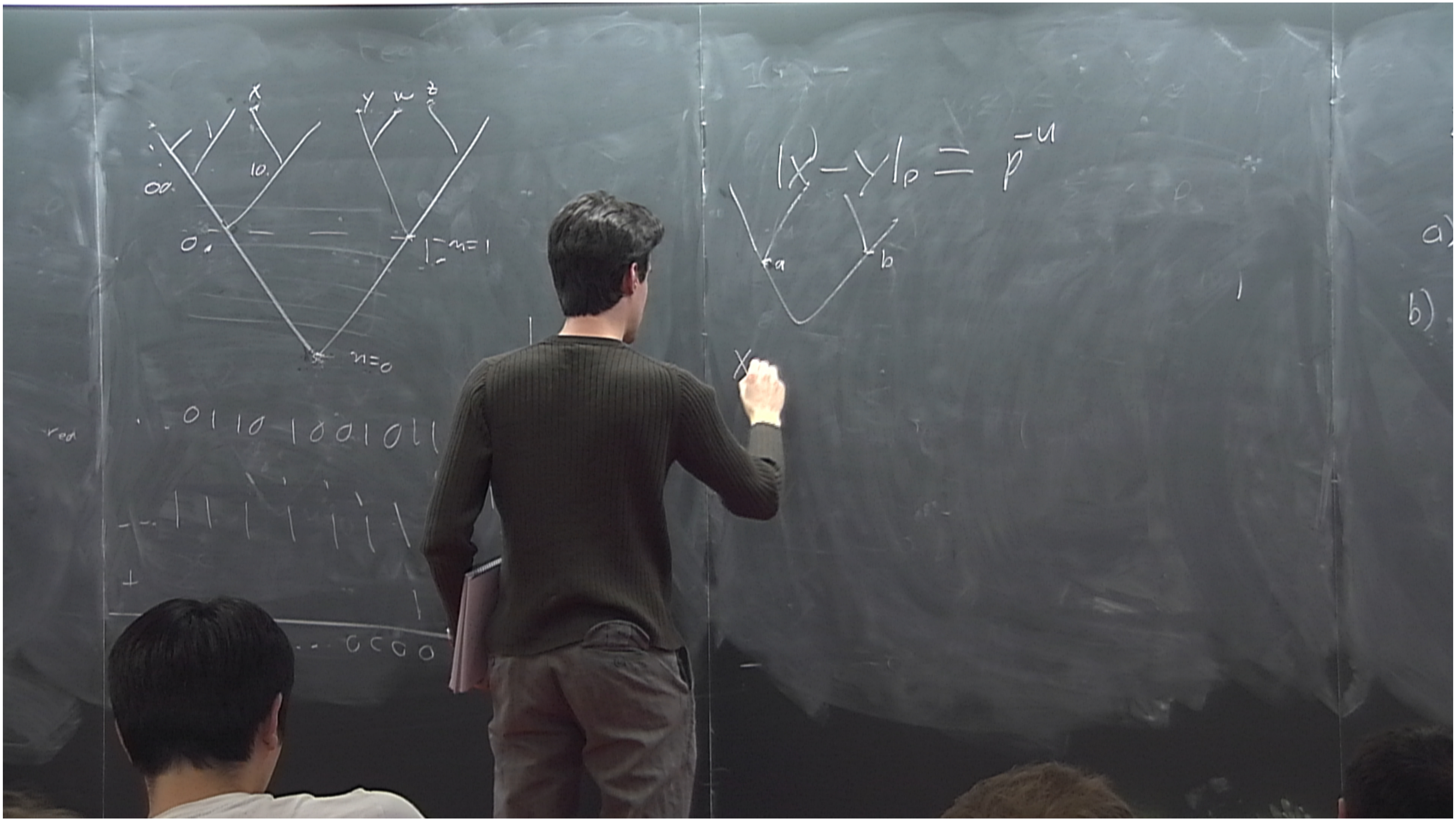

|x−y|p = p^−u
a)
b)


x
y w z
00.
10.
0.
n=1
n=0
| |p
red
...0110 1001010 1101
|x−y|p = p^−n

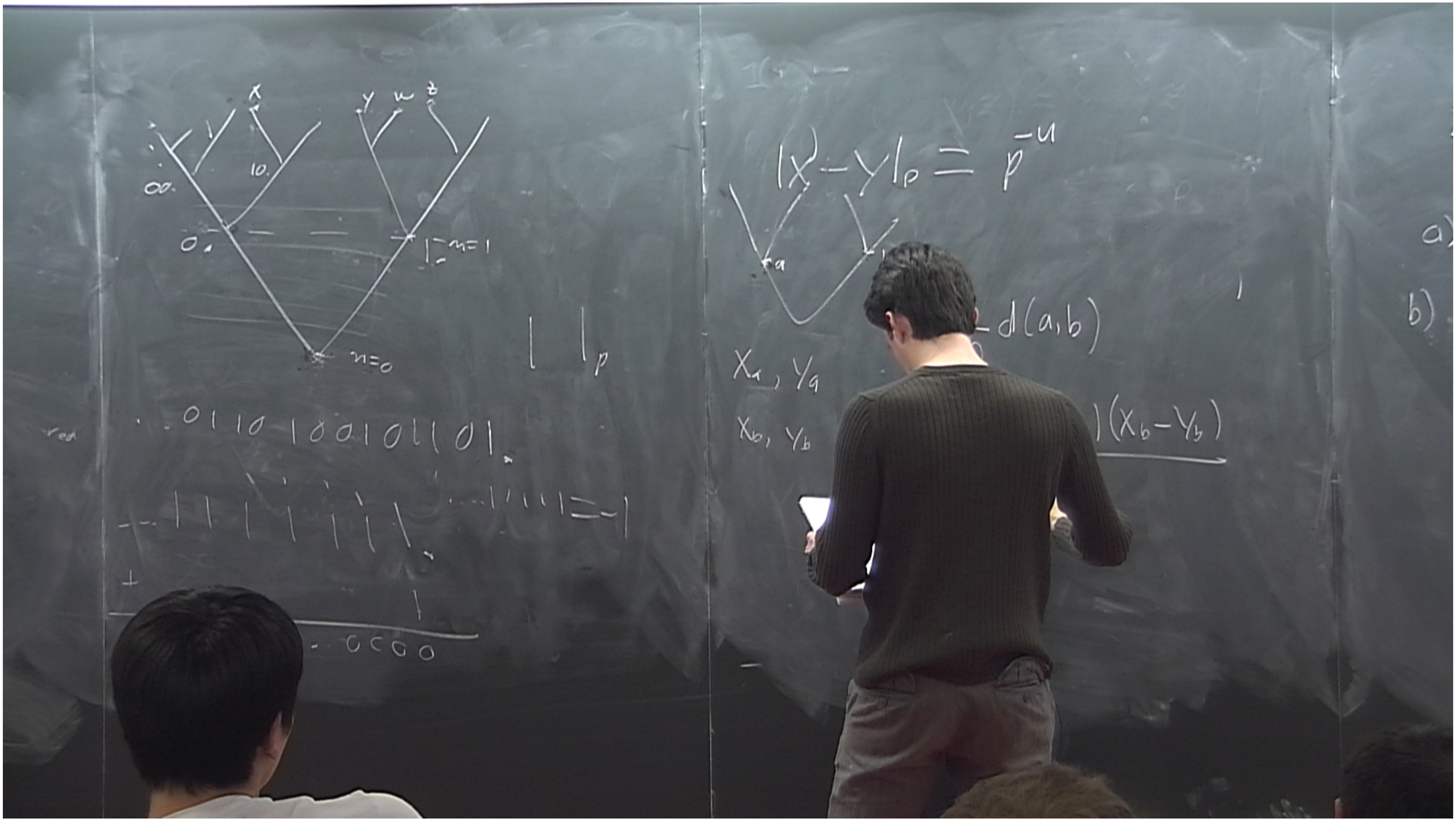


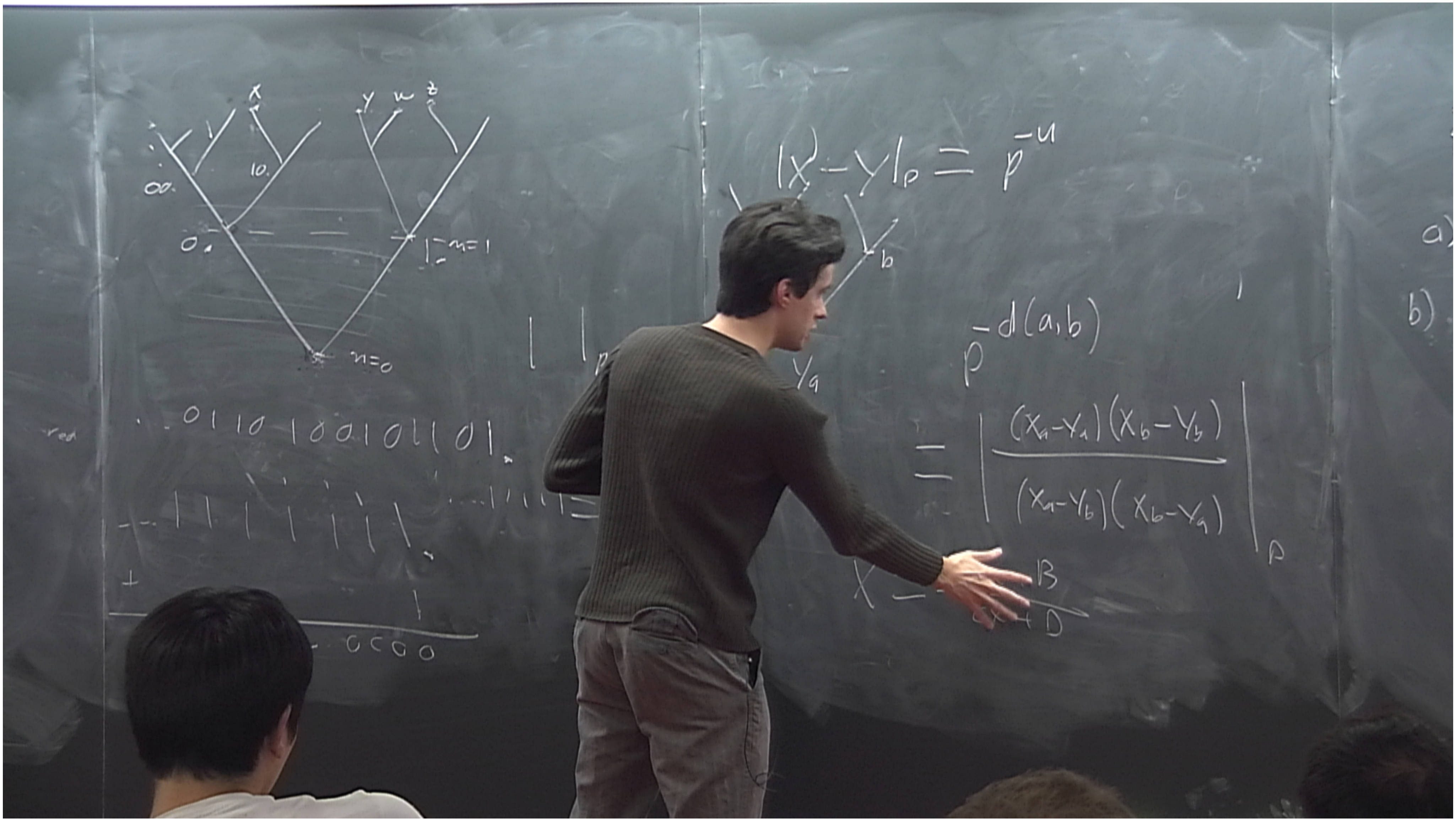
x
y
w
z
10.
0.
1
n=1
n=0
$|x-y|_p = p^{-n}$
| |p
0110 1001011101
=-1

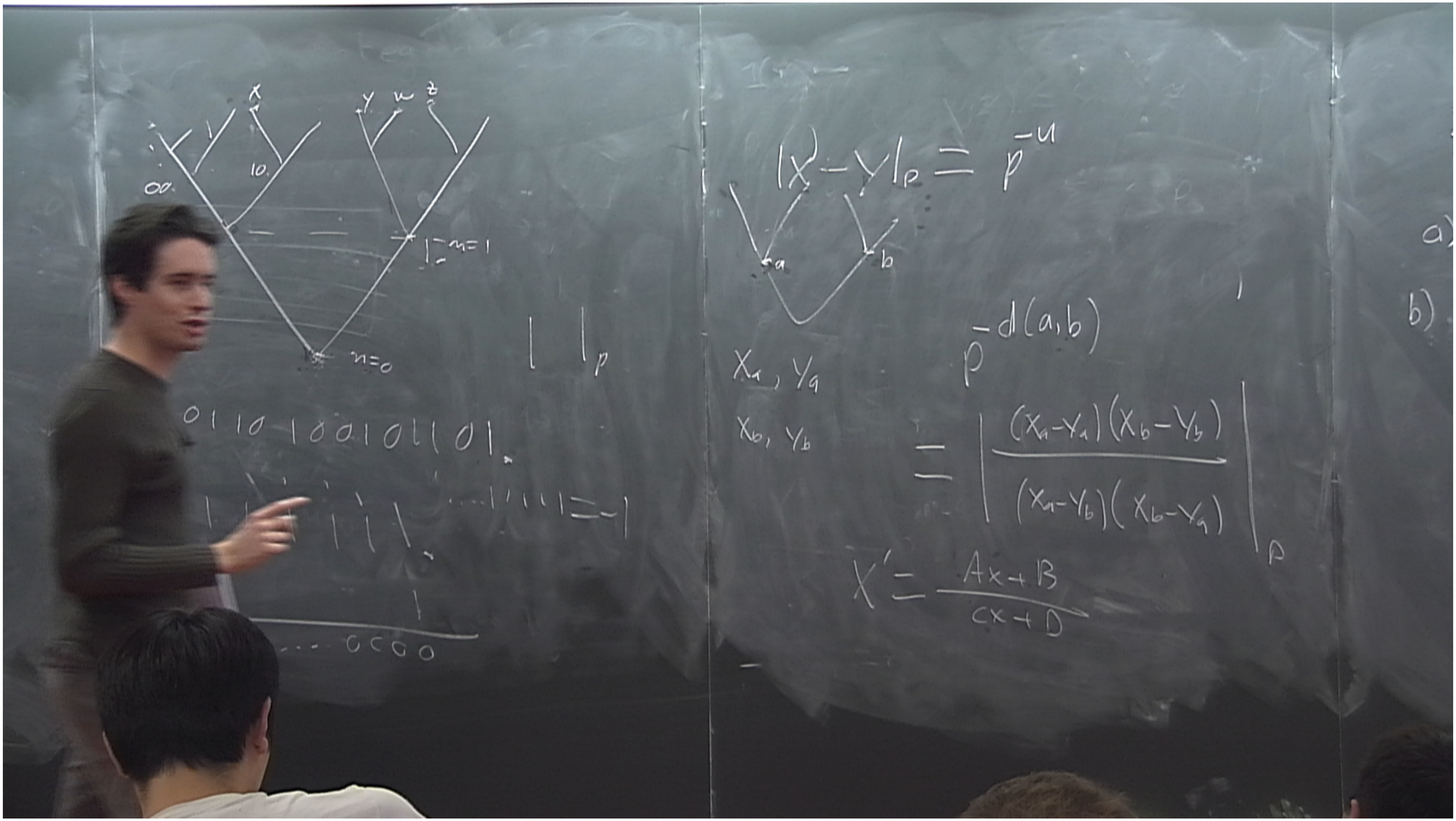

x
y w z
00.
10.
0.
1 n=1
n=0
| |p
...01101001011101
...1111111111=-1
0000
$|x-y|_p = p^{-n}$

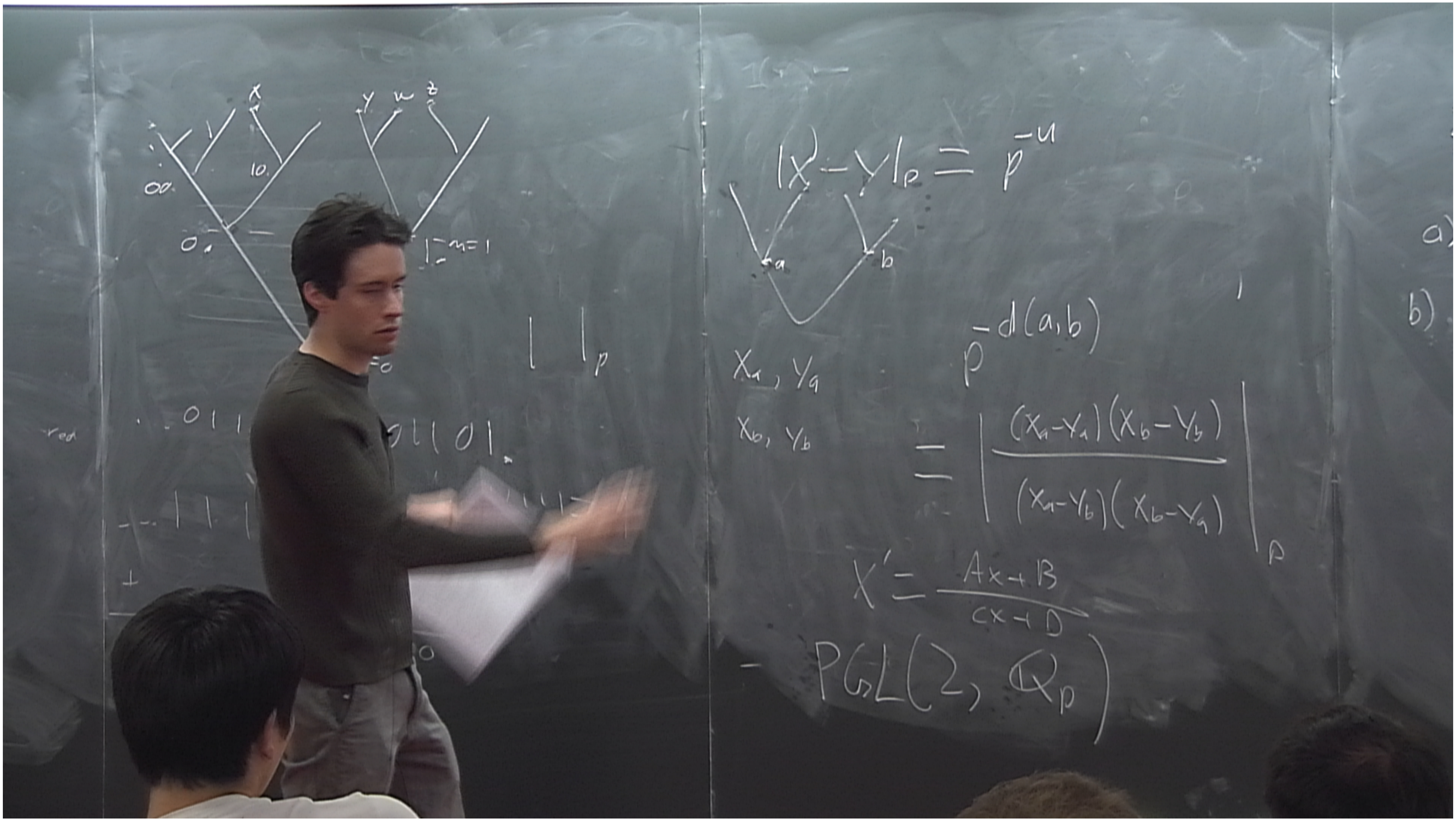


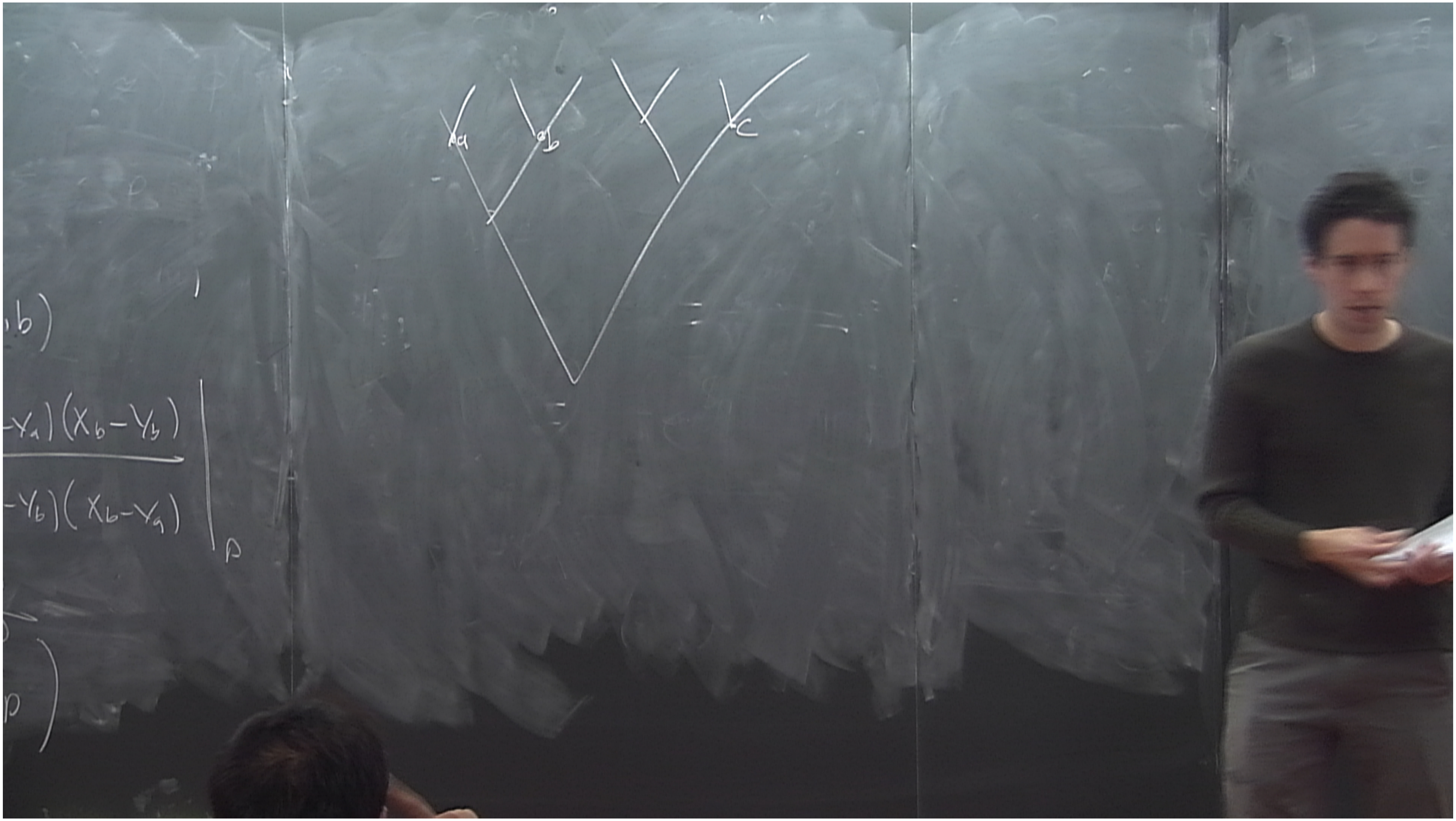
$|x-y|_p = p^{-n}$
n=0
n=1


x
y w z
10.
n=0
n=1
| |p
|x−y|p = p^−u
d(a,b)
Xa , Ya
Xb , Yb
(Xb − Yb)
a)
b)

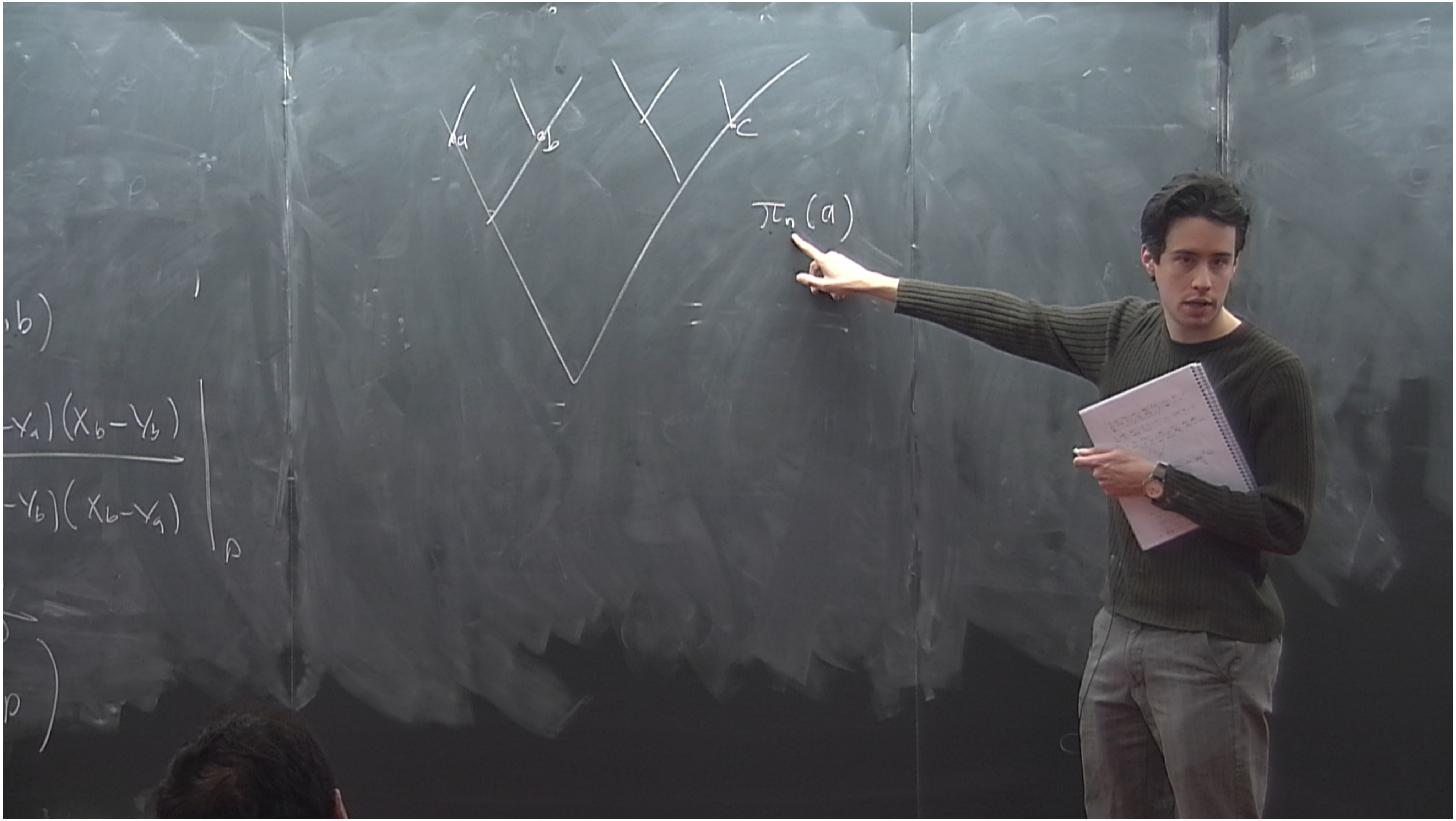

x
y w z
10.
00.
0.
1
n=1
n=0
$|x-y|_p = p^{-u}$
b
$p^{-d(a,b)}$
$= \left| \frac{(x_a-y_a)(x_b-y_b)}{(x_a-y_b)(x_b-y_a)} \right|_p$
...0110100101101
a)
b)

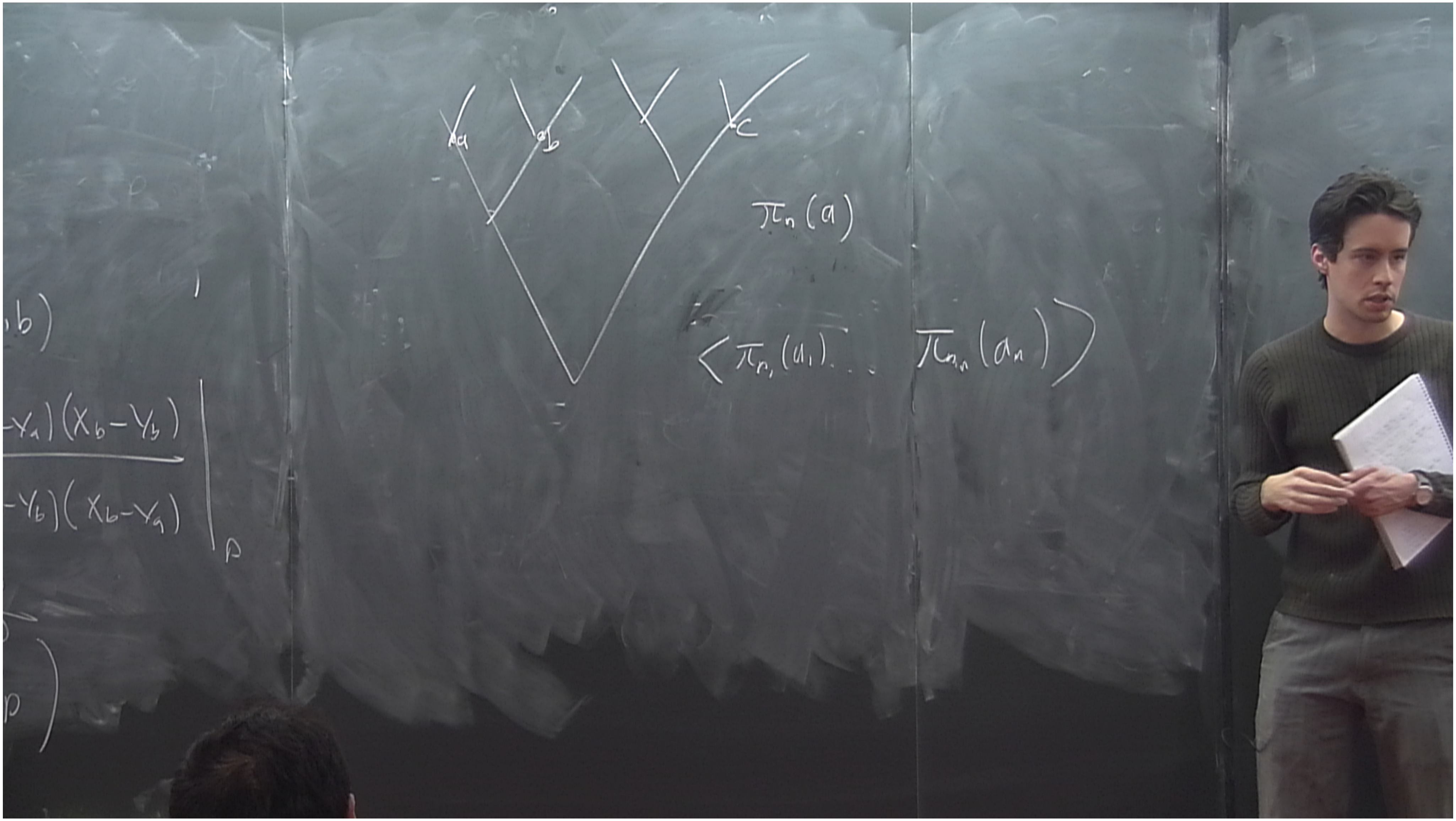

x y w z
00
10
n=1
n=0
| |p
|x − y|p = p^−u
a b
p^−d(a,b)
Xa , Ya
Xb , Yb
= | (Xa−Ya)(Xb−Yb) / (Xa−Yb)(Xb−Ya) |p
X' = Ax + B / Cx + D
a)
b)

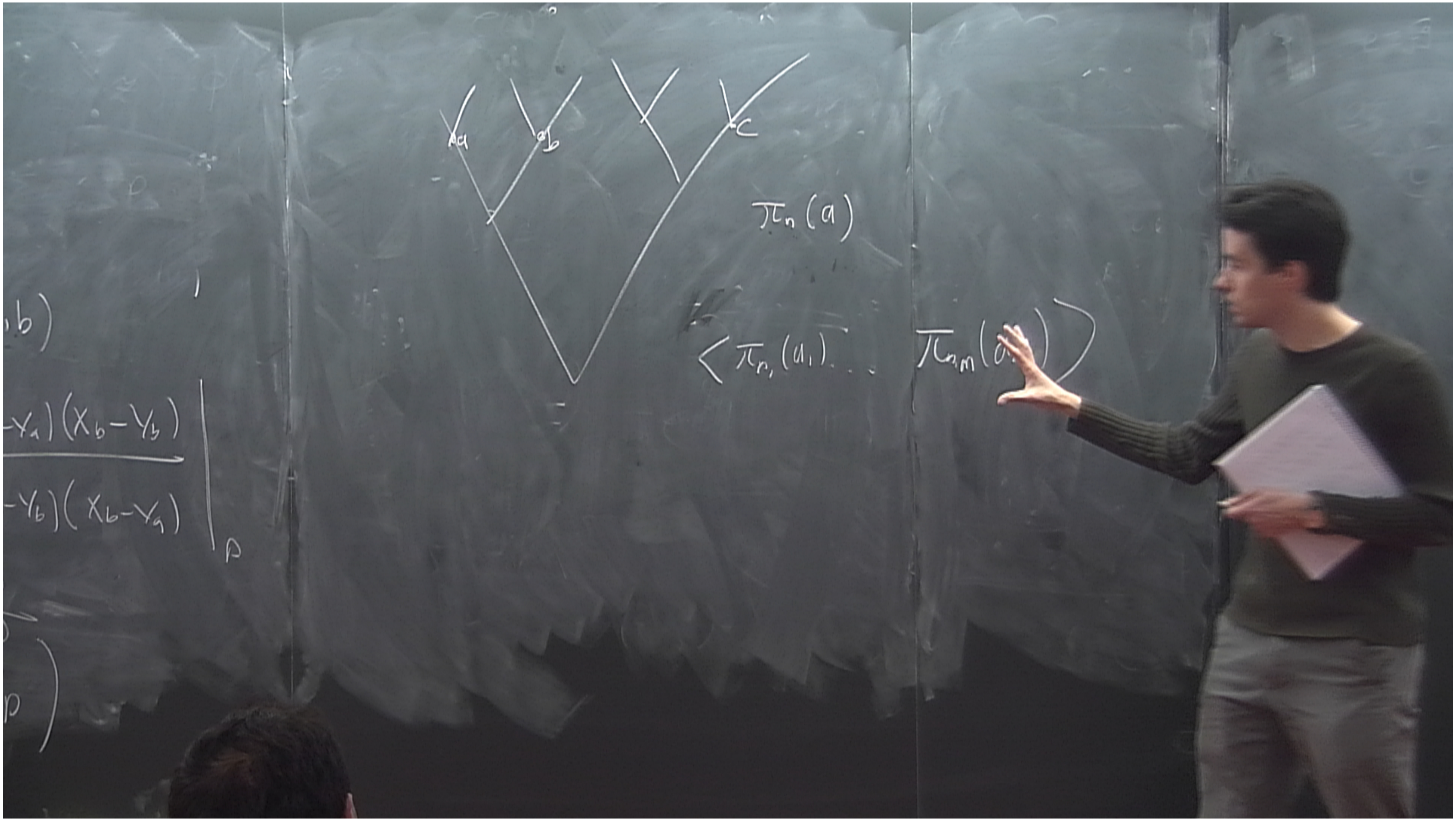

$|x - y|_p = p^{-u}$
x_a, y_a
x_b, y_b
$p^{-d(a,b)}$
$= \left| \frac{(x_a - y_a)(x_b - y_b)}{(x_a - y_b)(x_b - y_a)} \right|_p$
$x' = \frac{Ax + B}{Cx + D}$
$PGL(2, \mathbb{Q}_p)$



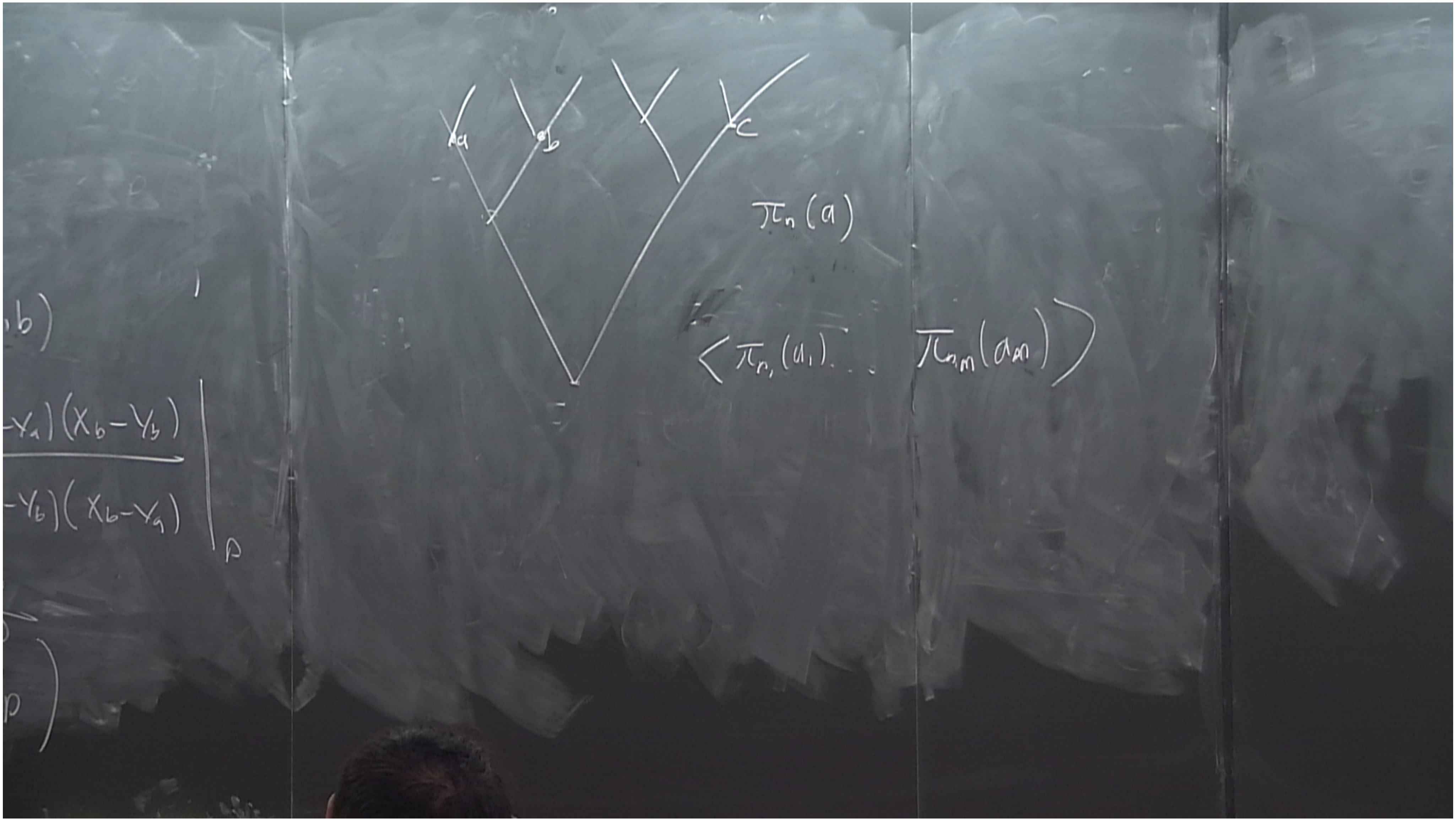
a
b
c

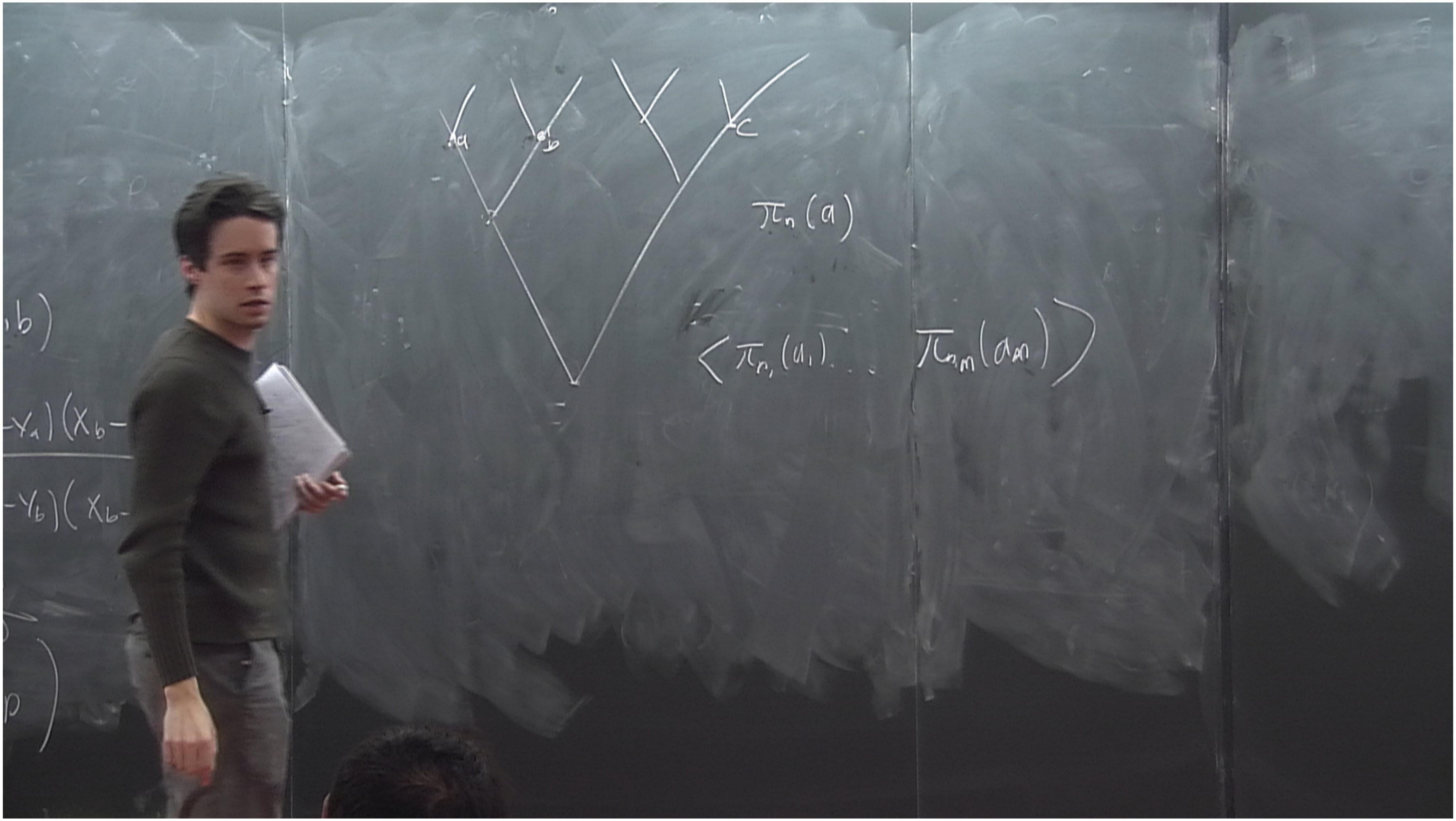

a
b
c
$\pi_n(a)$


a
b
c
πn (a)
⟨πn1 (a1) ... πnn (an)⟩

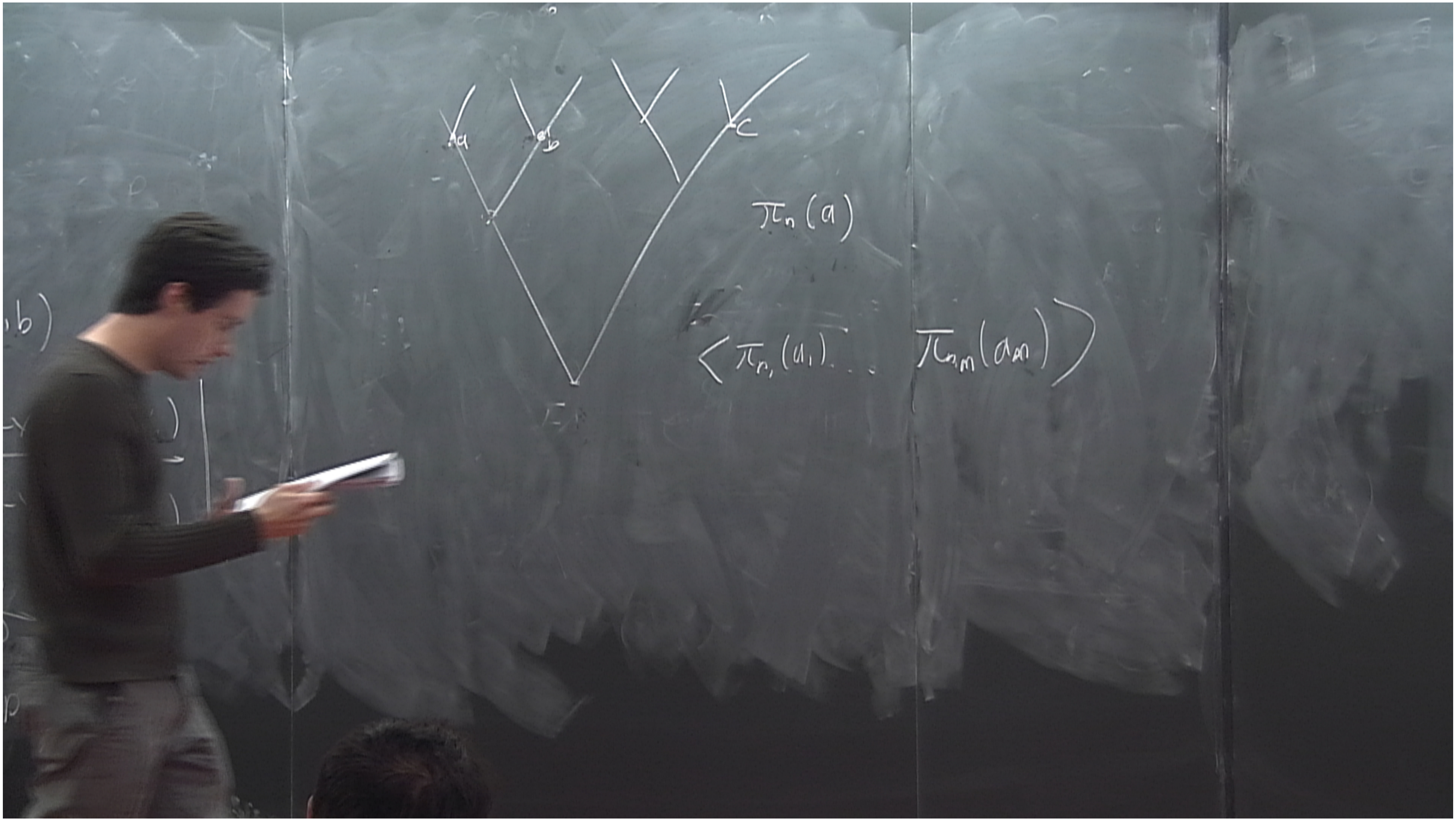


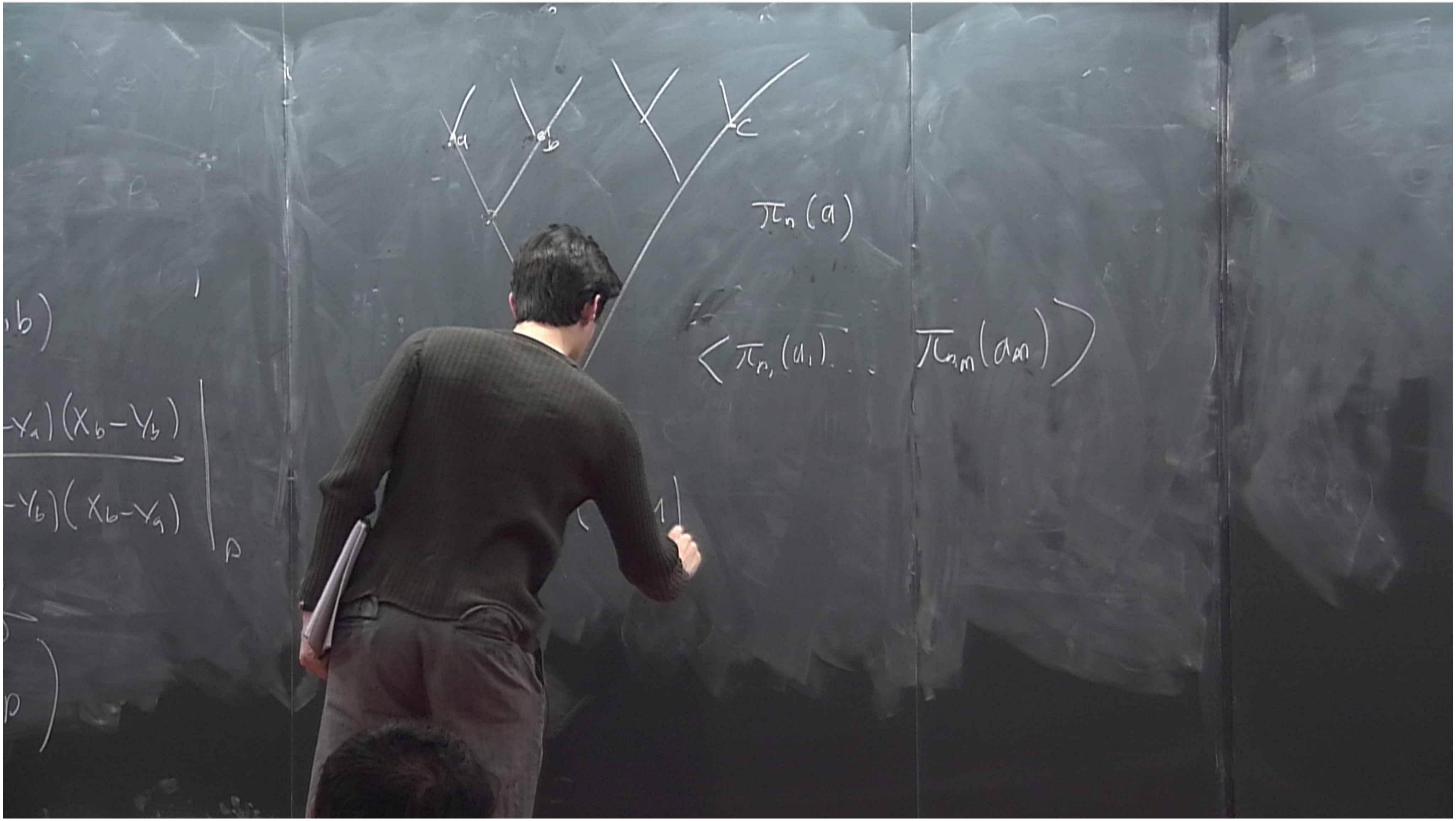
a
b
c
πn (a)
< πn1 (a1) . . . πnm (a

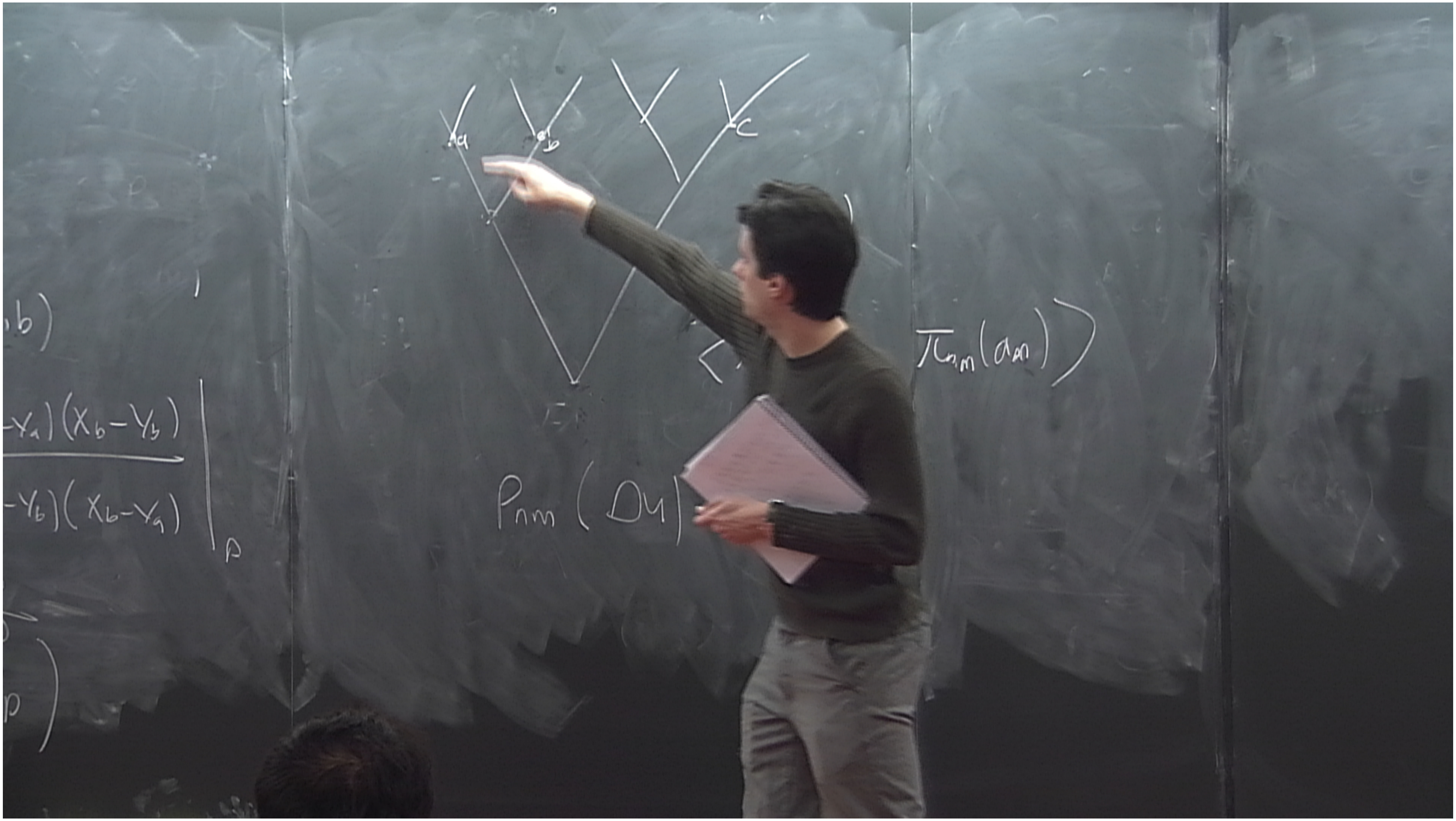

a
b
c
πn (a)
< πn1 (a1) . . . πnm (am) >

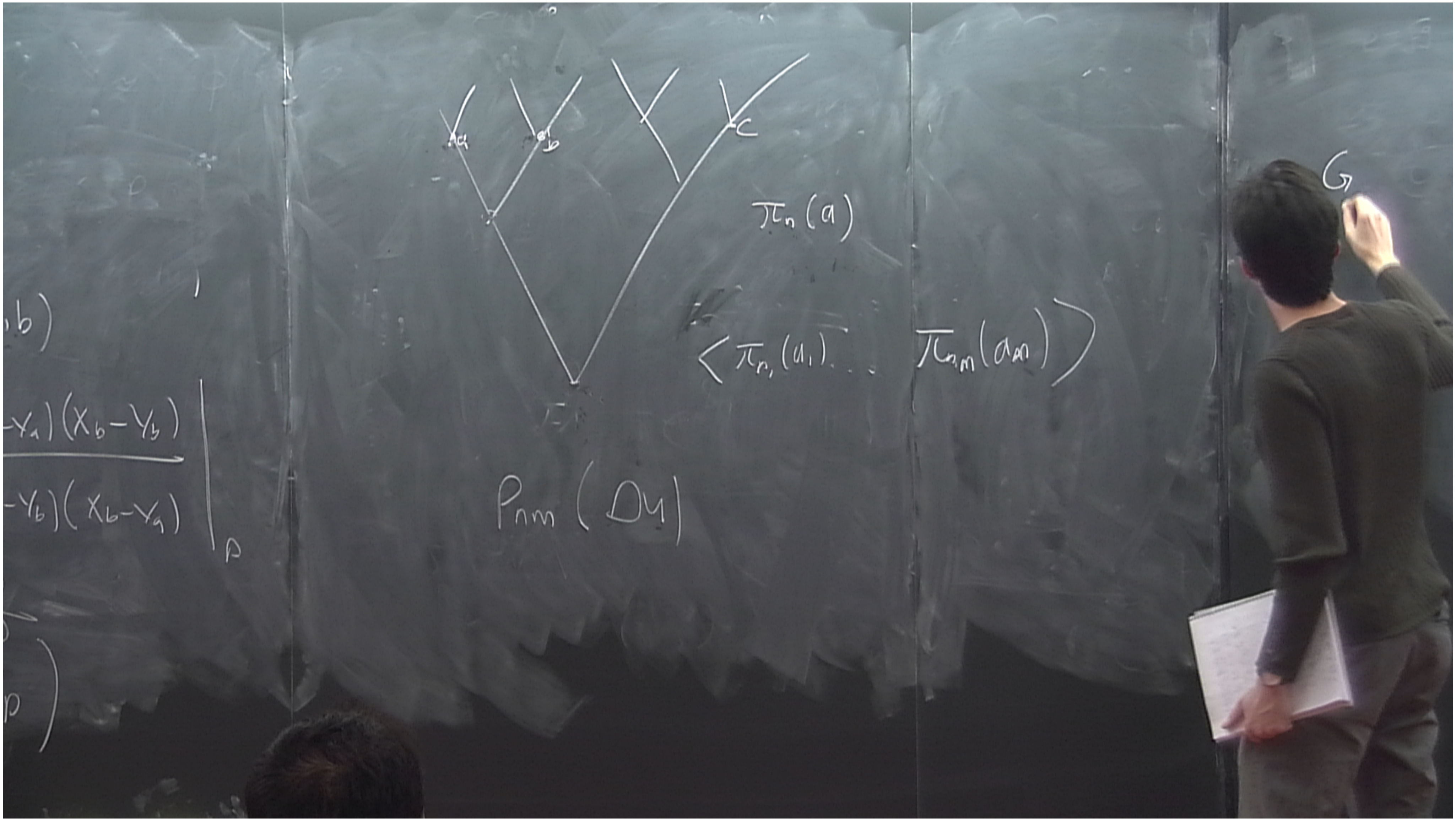


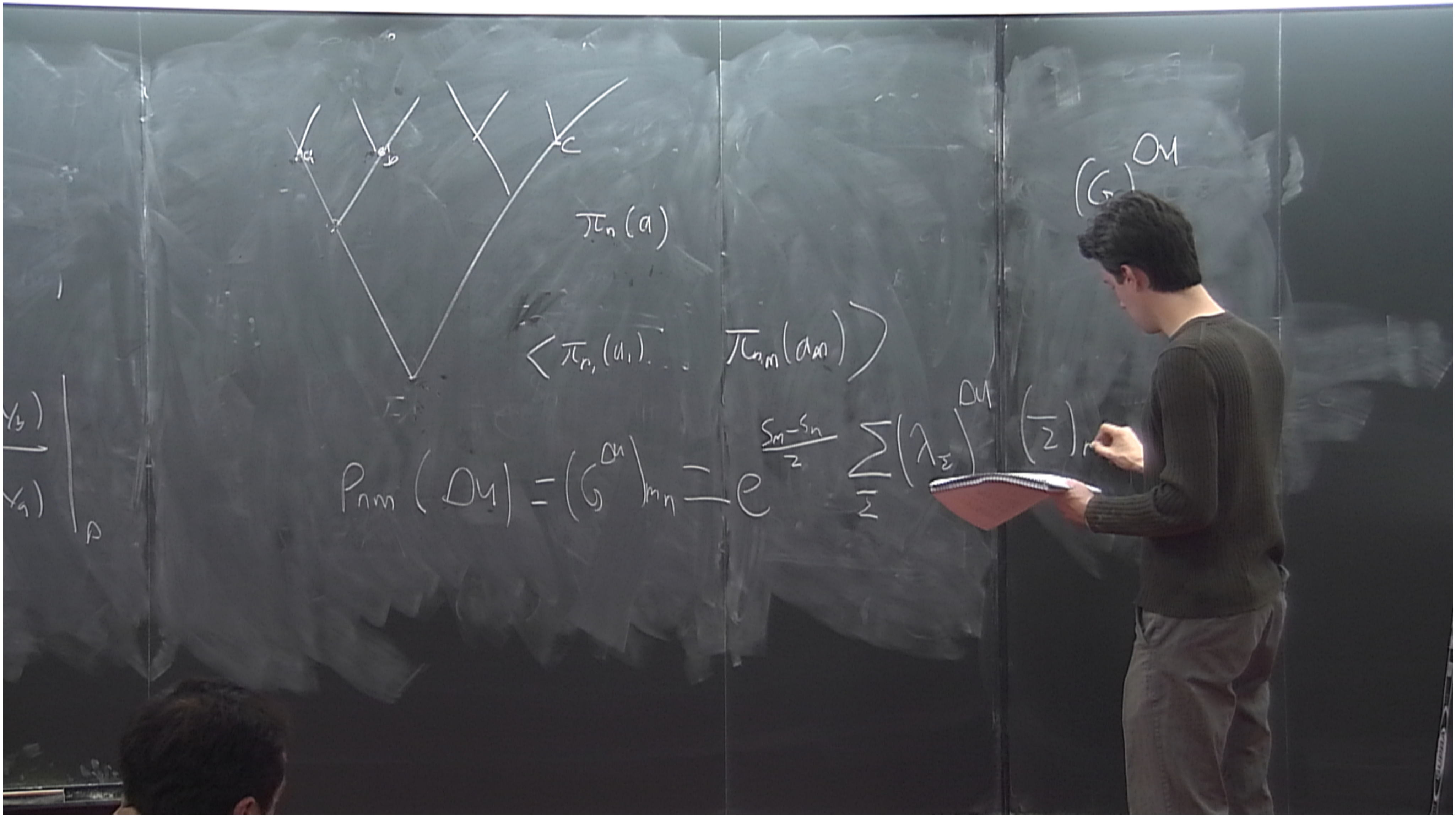
a
b
c
πn (a)
< πn1 (a1) . . . πnm (am) >

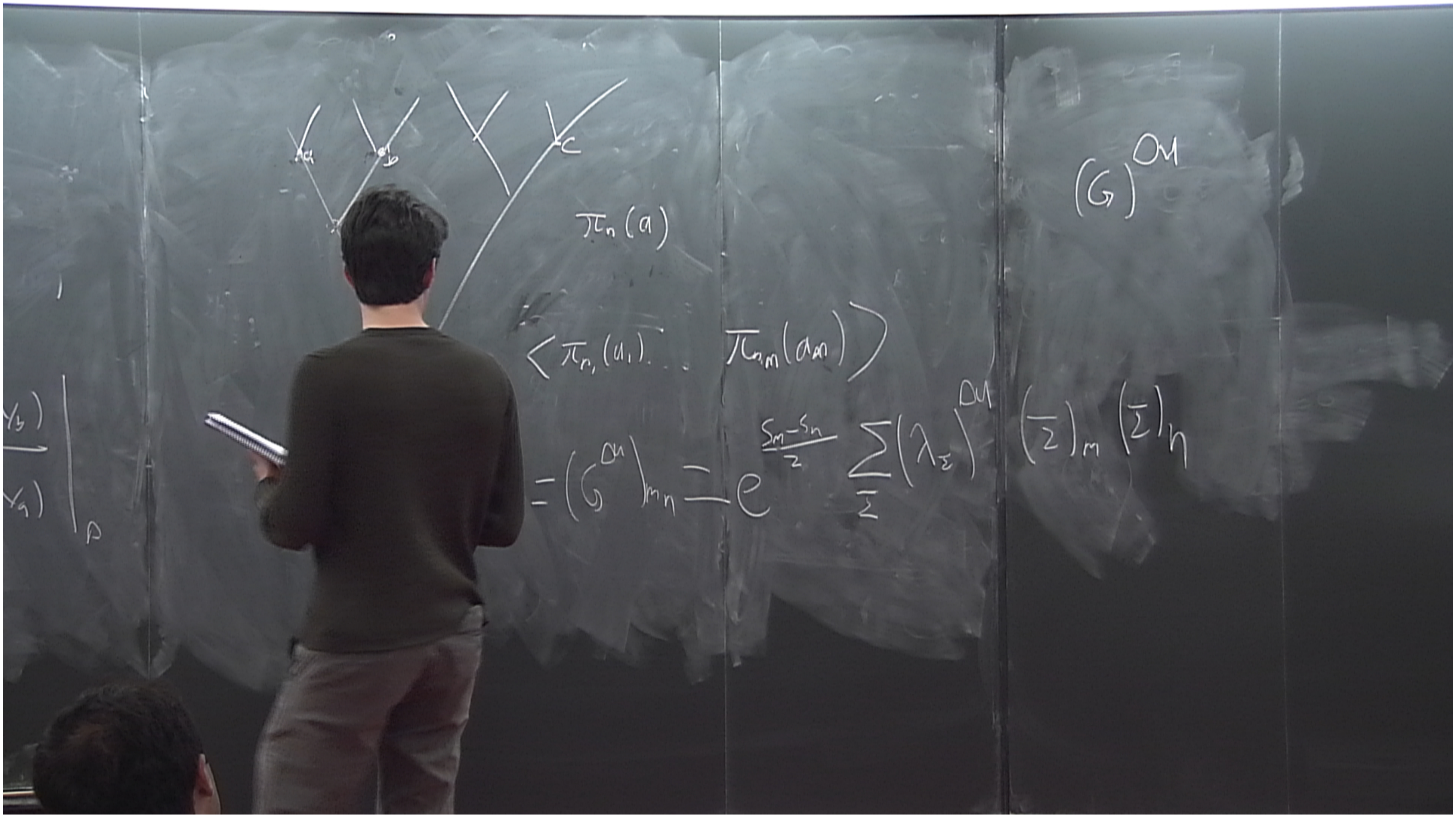

a
b
c
πn (a)

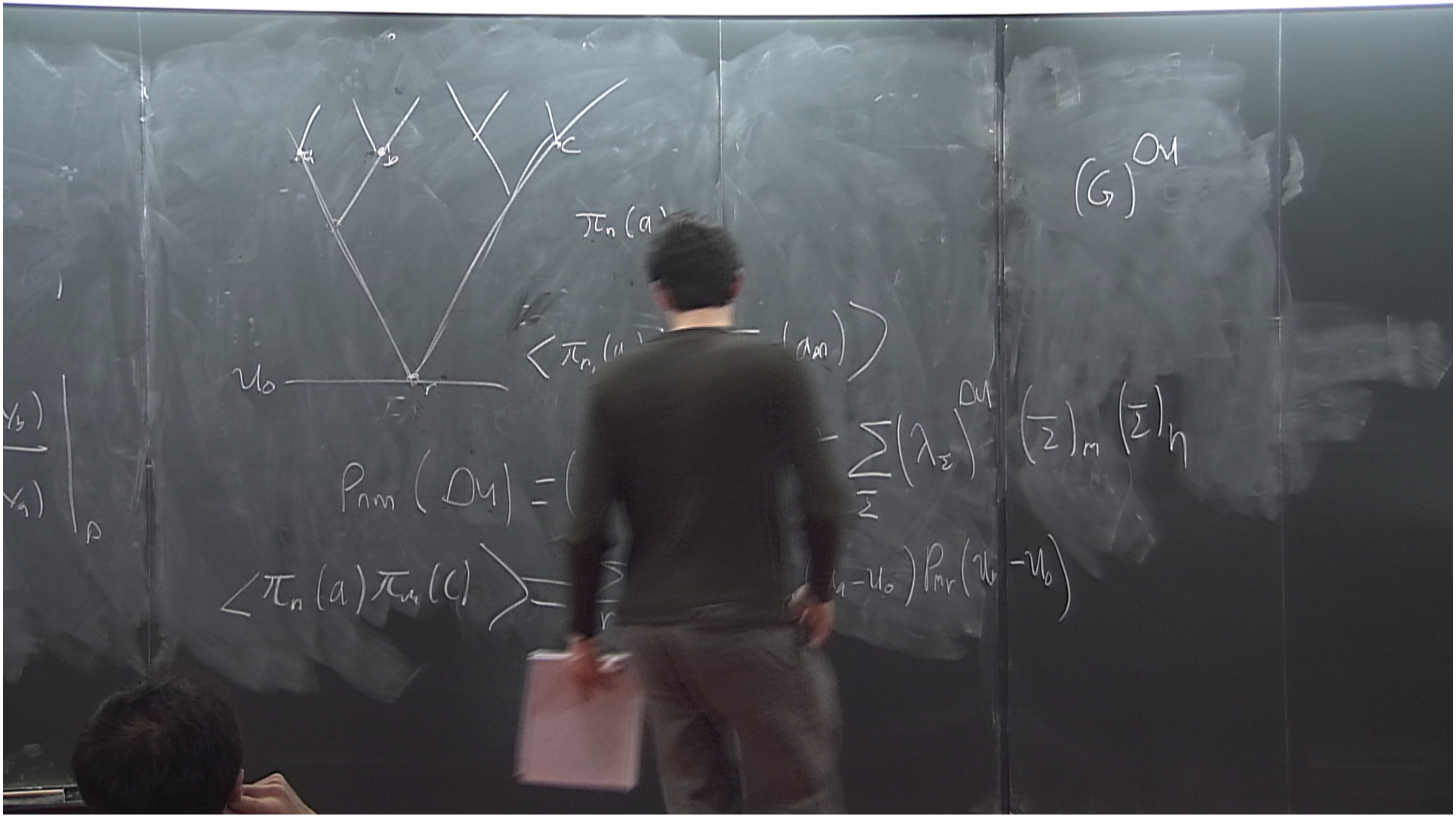

a
b
c
πn (a)
< πn1 (a1) . . . πnm (am) >
(Xb − Yb)
(Xb − Ya)



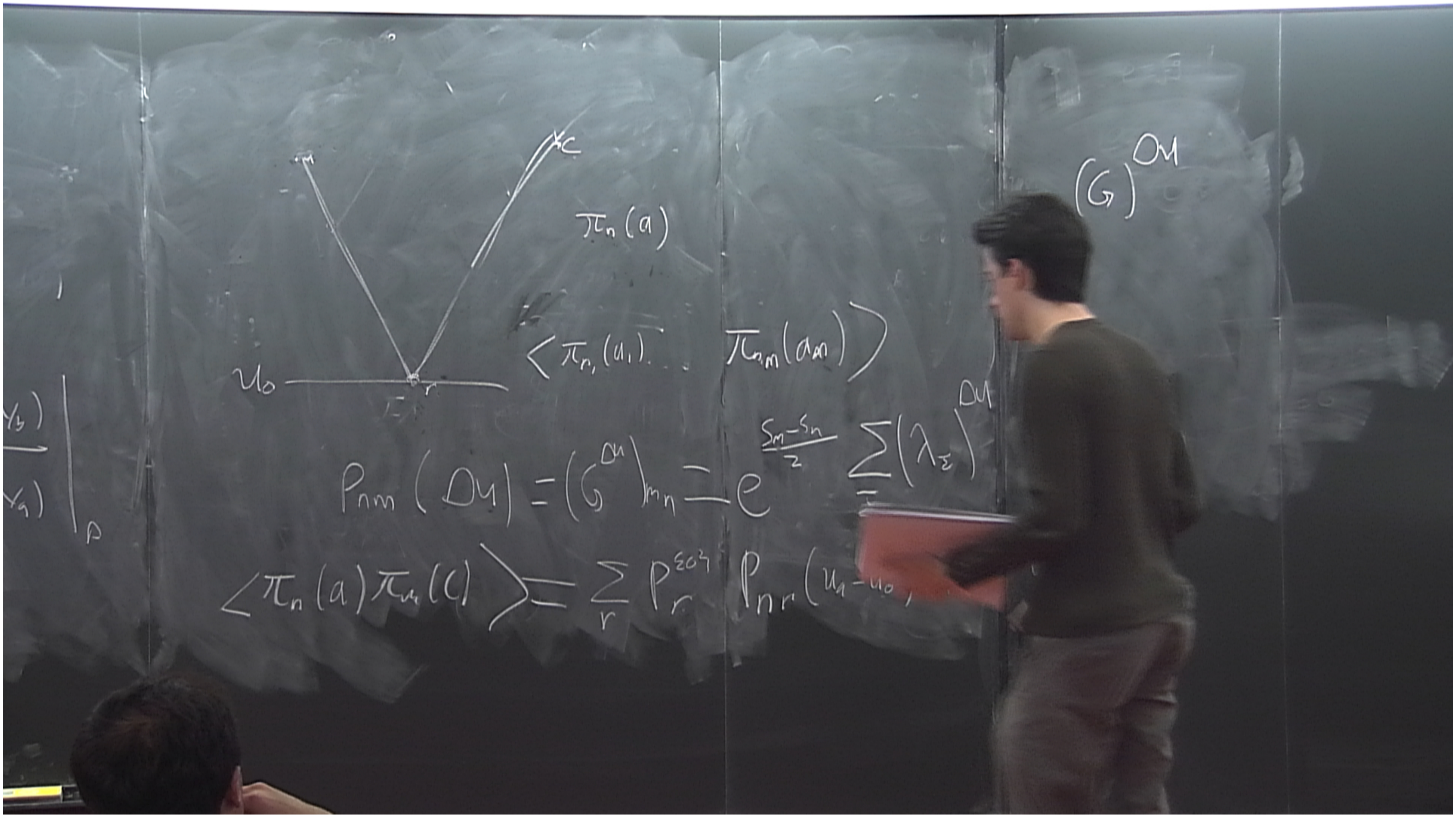

πn (a)
< πn1 (a1) . . . πnm (anm) >
Pnm (Δu)
G

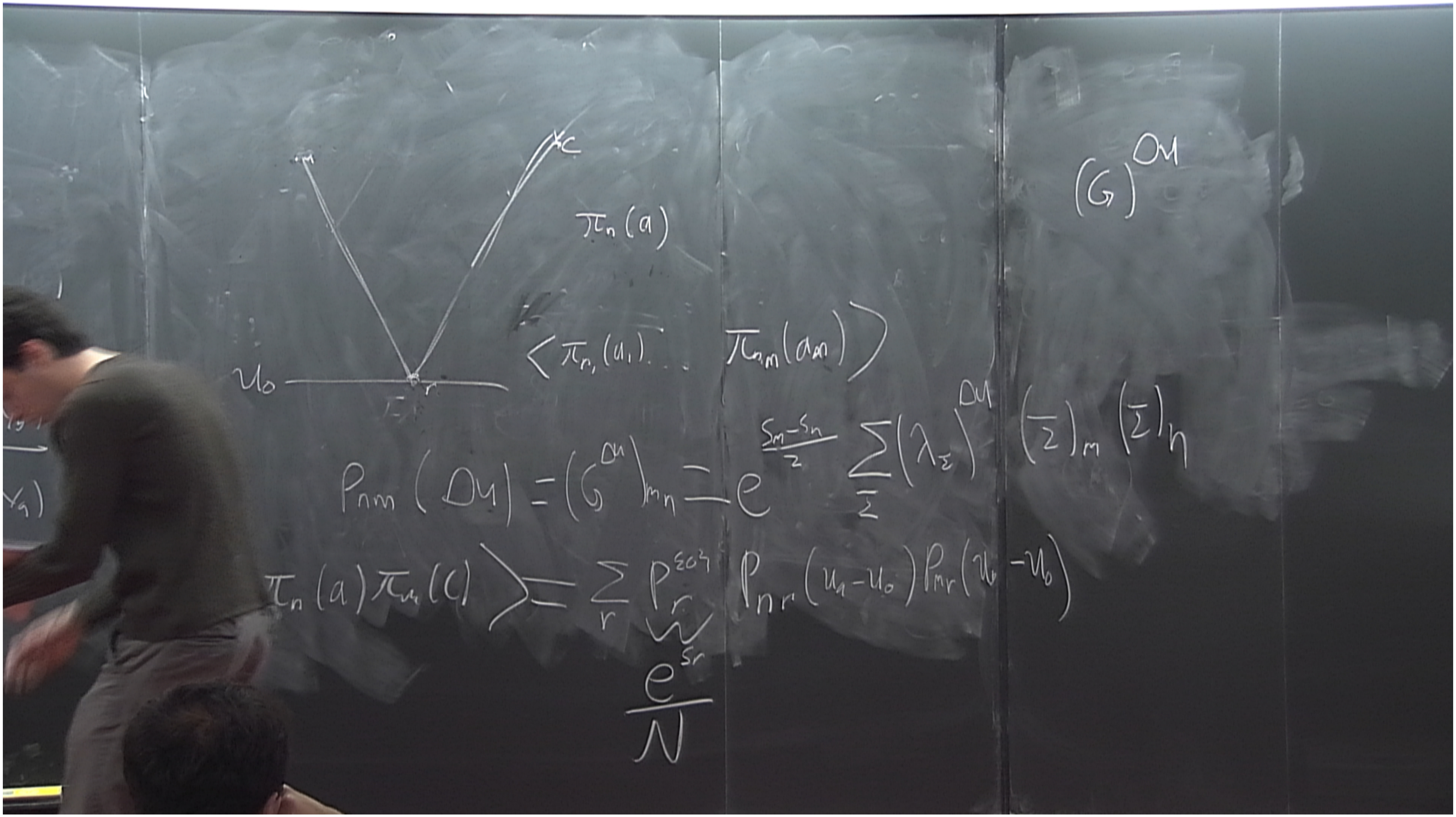


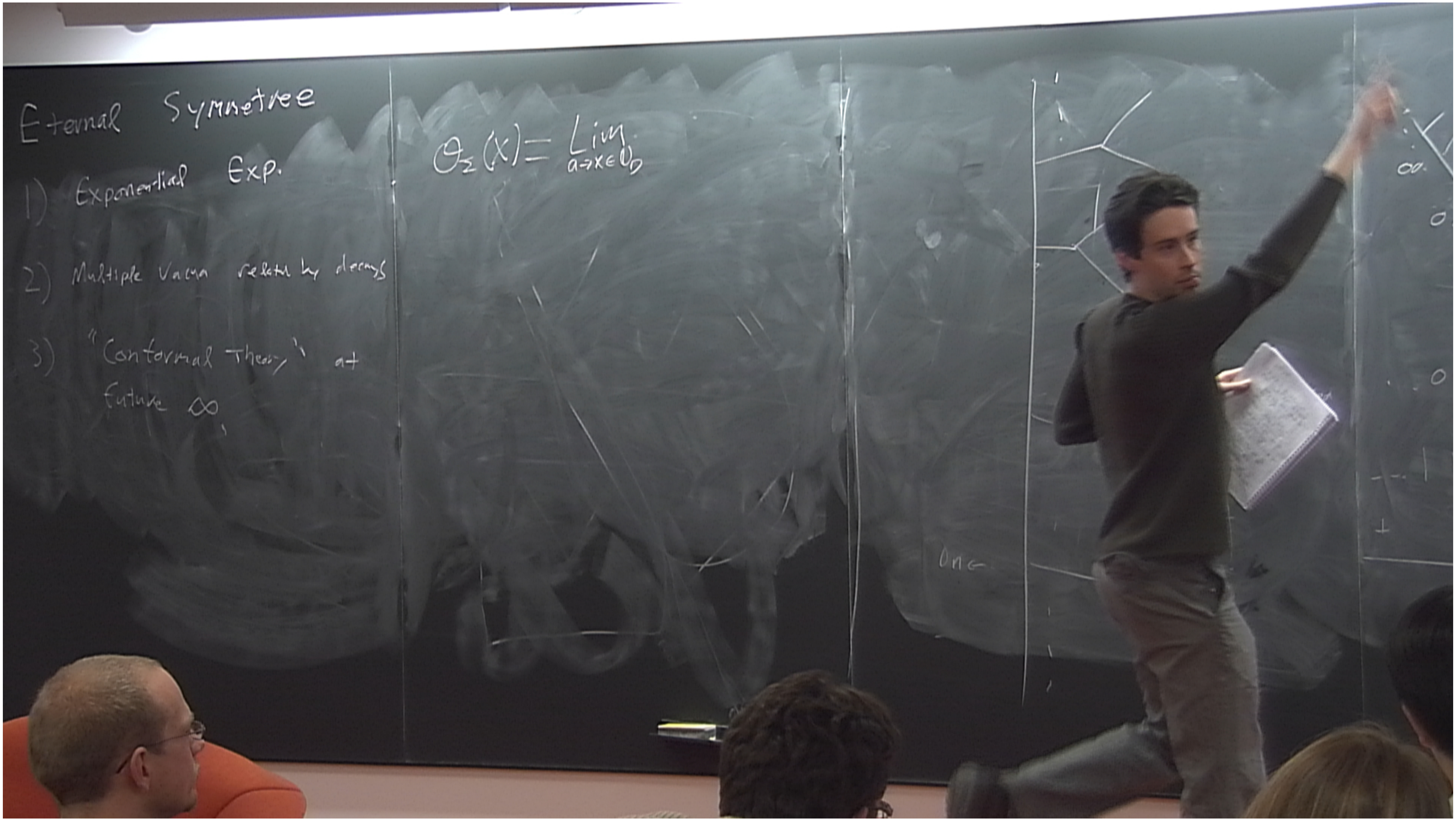

a
b
c
πn(a)
(G)Ou
<πn1(a1) ... πnm(am)>
= (GOu)mn = e(Sm−Sn)/2 ΣΣ(λΣ)Ou (Σ)m (Σ)n

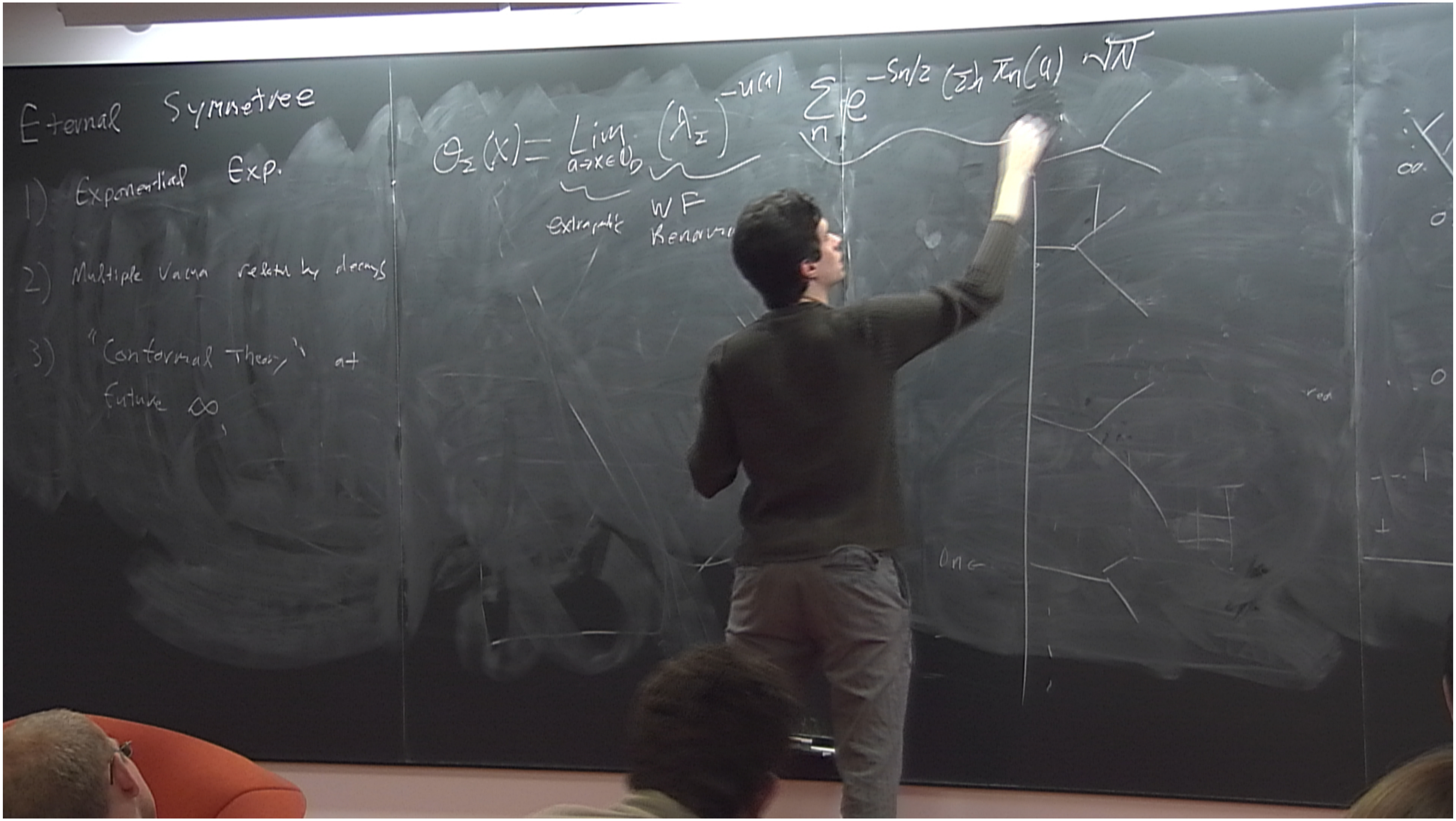


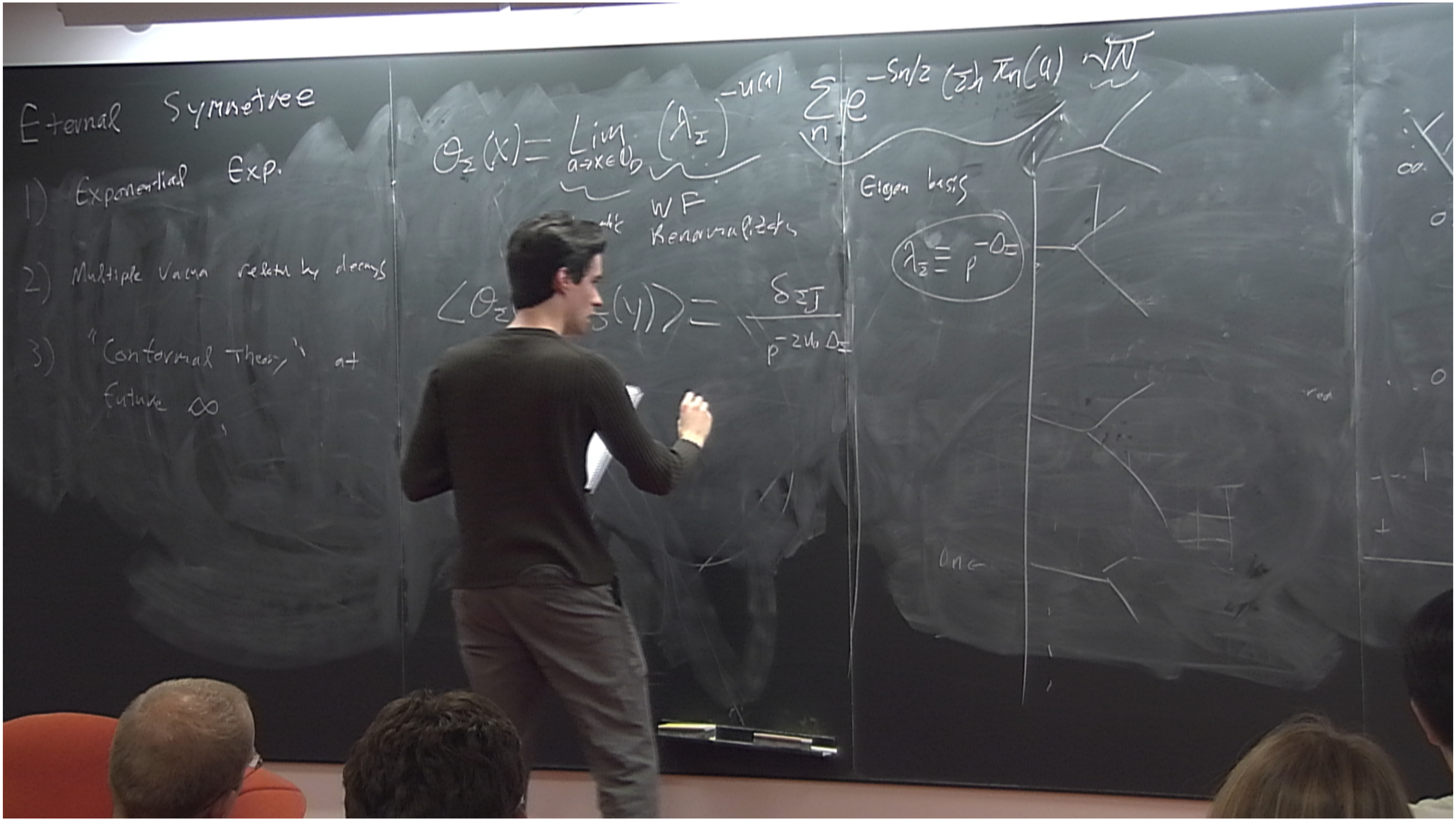
$\pi_n(a)$
u_0
$(G)^{\Delta u}$
$P_{nm}(\Delta u) =$
$\sum_{\Sigma} (\lambda_\Sigma)^{\Delta u} (\Sigma)_m (\Sigma)_n$
$\langle \pi_n(a) \pi_m(c) \rangle =$

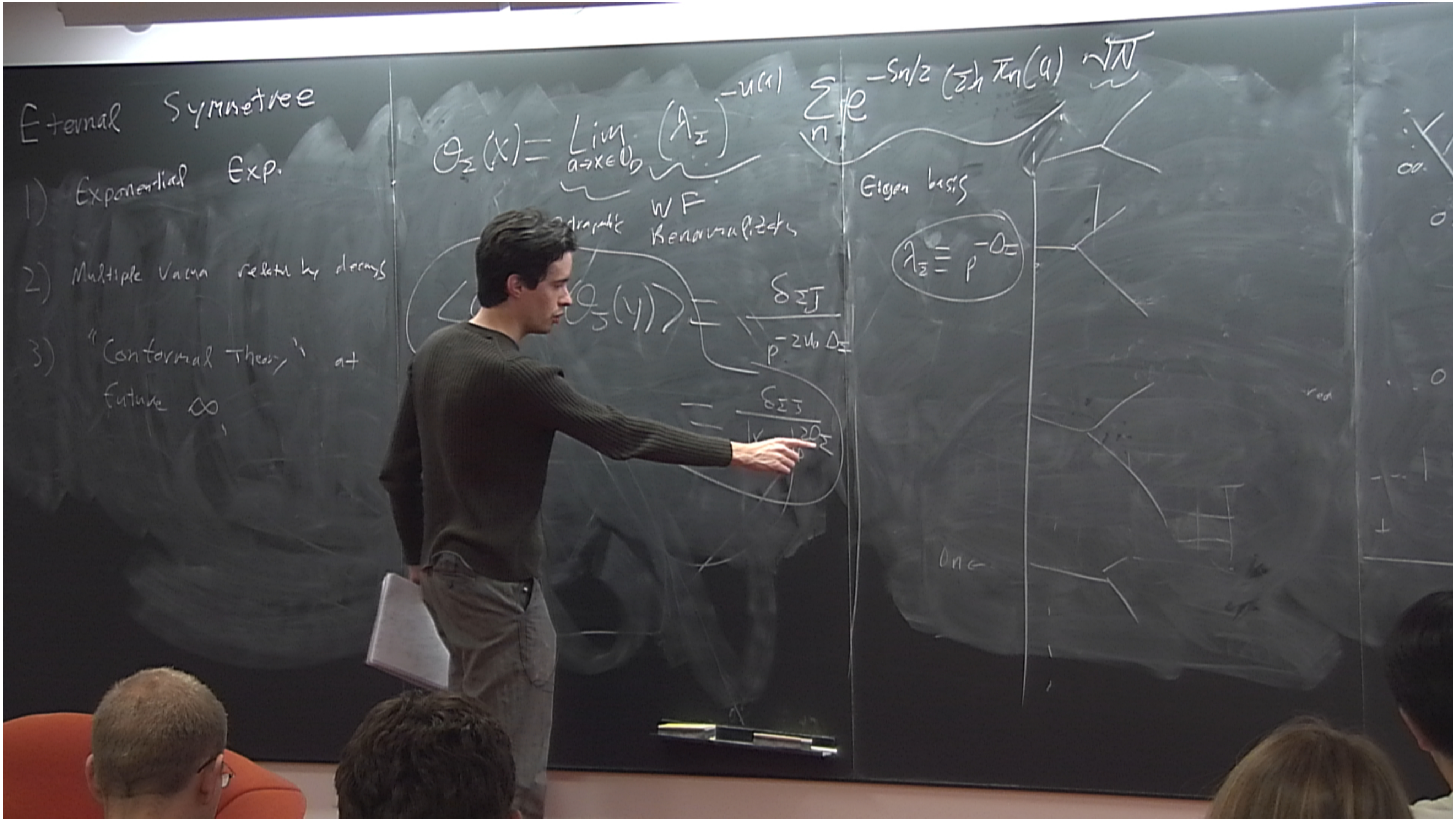

$\pi_n(a)$
$\langle \pi_{n_1}(a_1) \ldots \pi_{n_m}(a_m) \rangle$
$(G)^{\Delta u}$
u_0
$P_{nm}(\Delta u) = (G^{\Delta u})_{mn} = e^{\frac{S_m - S_n}{2}} \sum (\lambda_\Sigma)^{\Delta u}$
$\langle \pi_n(a) \pi_m(c) \rangle = \sum_r P_r^{\Sigma 0} P_{nr}(u_1 - u_0)$

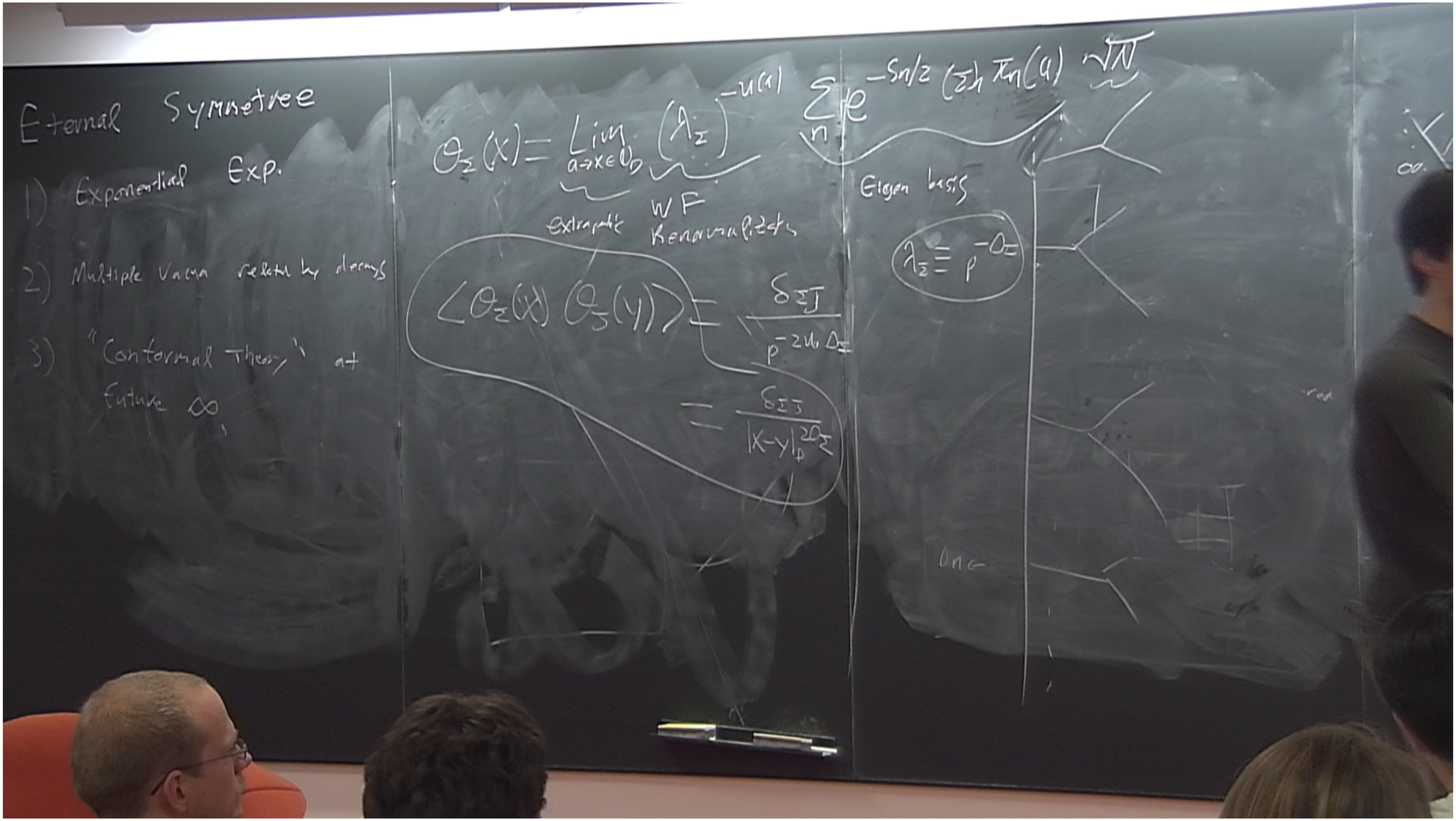

$(G)^{\Delta u}$
$\pi_n(a)$
$\langle \pi_{n_1}(a_1) \ldots \pi_{n_m}(a_m) \rangle$
u_0
$P_{nm}(\Delta u) = (G^{\Delta u})_{mn} = e^{\frac{s_m - s_n}{2}} \sum_{\Sigma} (\lambda_\Sigma)^{\Delta u} (\Sigma)_m (\Sigma)_n$
$\langle \pi_n(a) \pi_m(c) \rangle = \sum_r P_r^{\{0\}} P_{nr}(u_1 - u_0) P_{mr}(u_1 - u_0)$
$\frac{e^{s_r}}{N}$

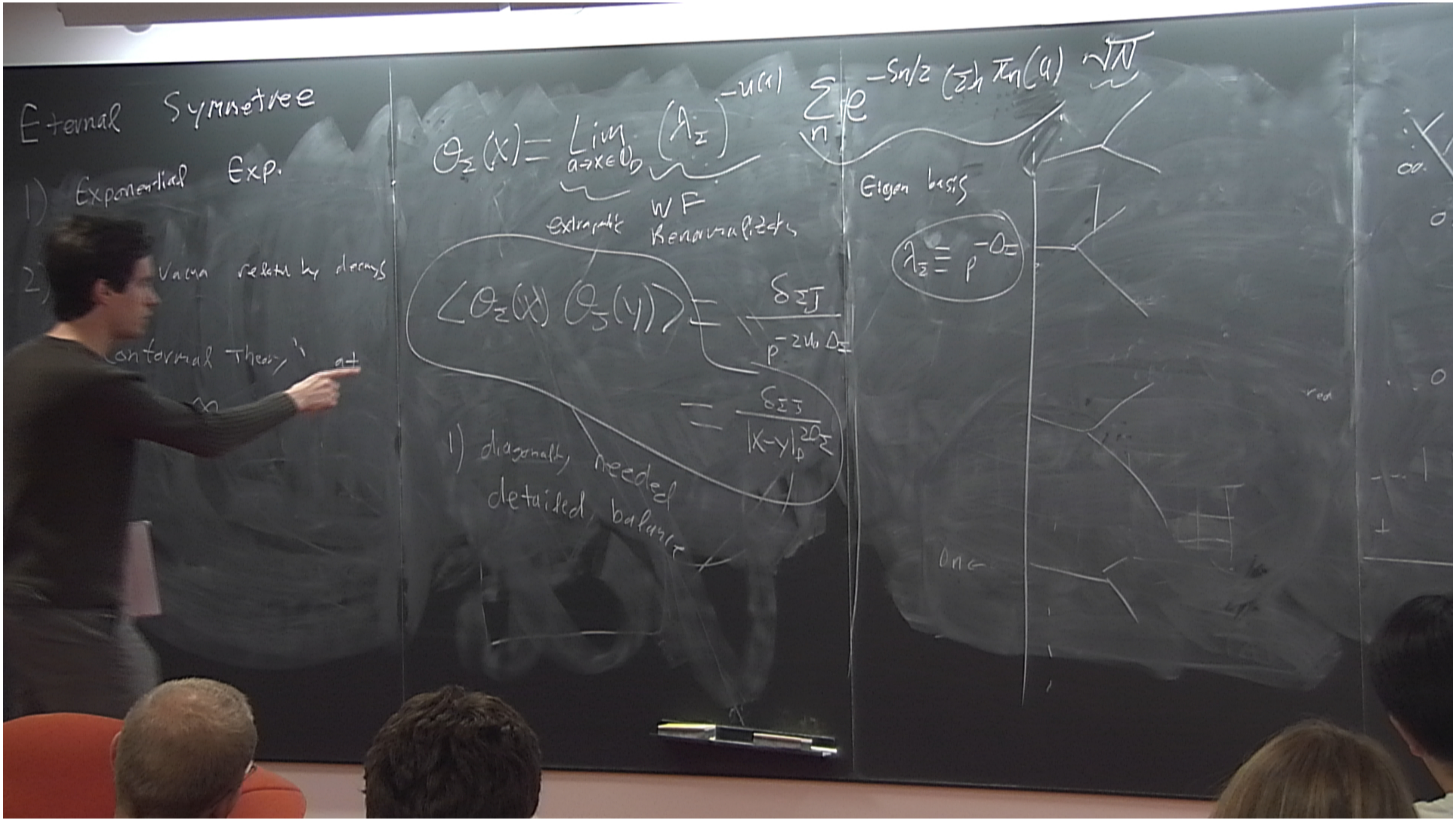

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
$\mathcal{O}_\Sigma(x) = \lim_{a \to x \in \mathcal{O}_D}$

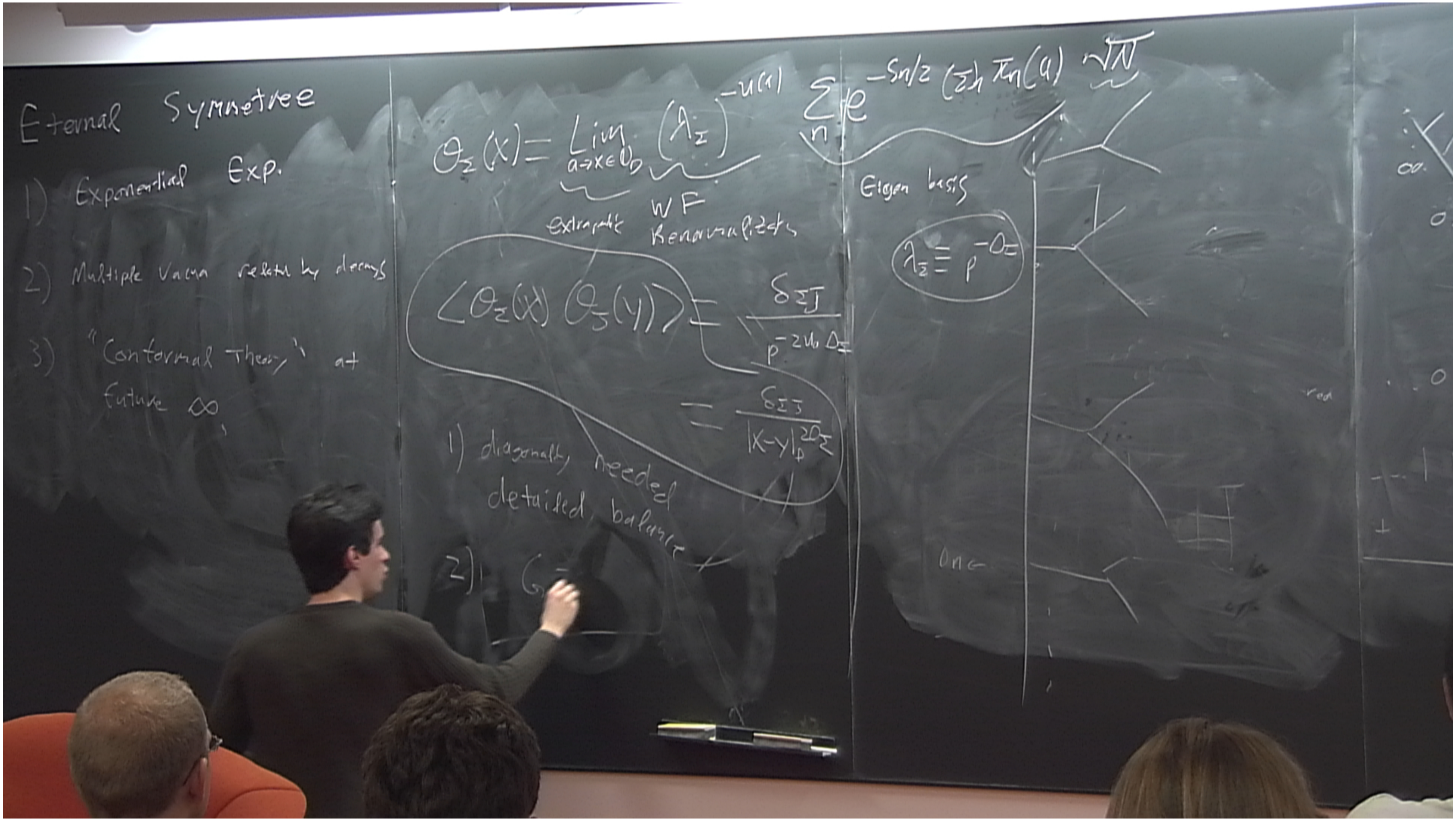

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
WF


Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
WF
Renormalization
Eigen basis

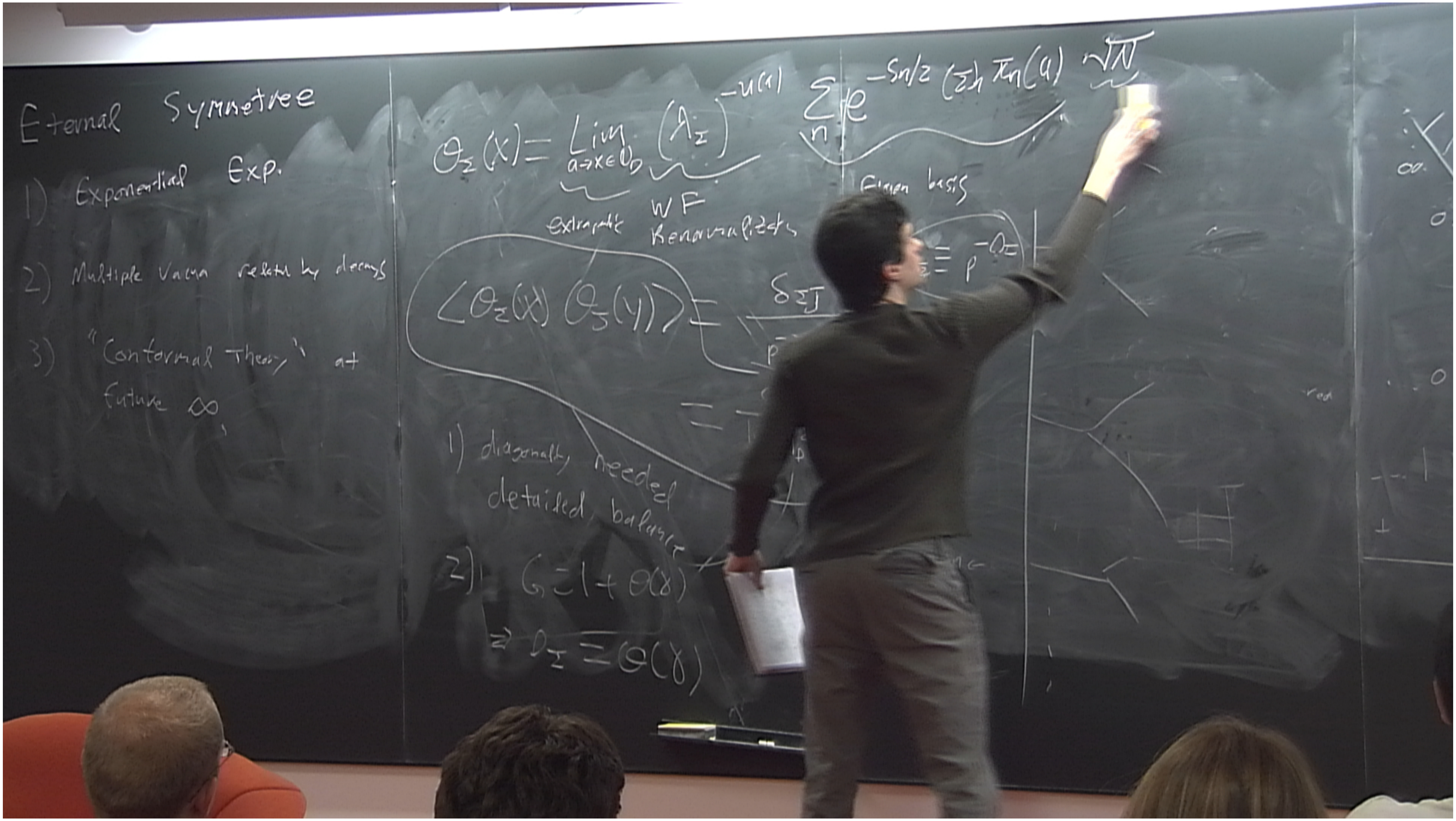

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
Eigen basis
WF
Renormalization

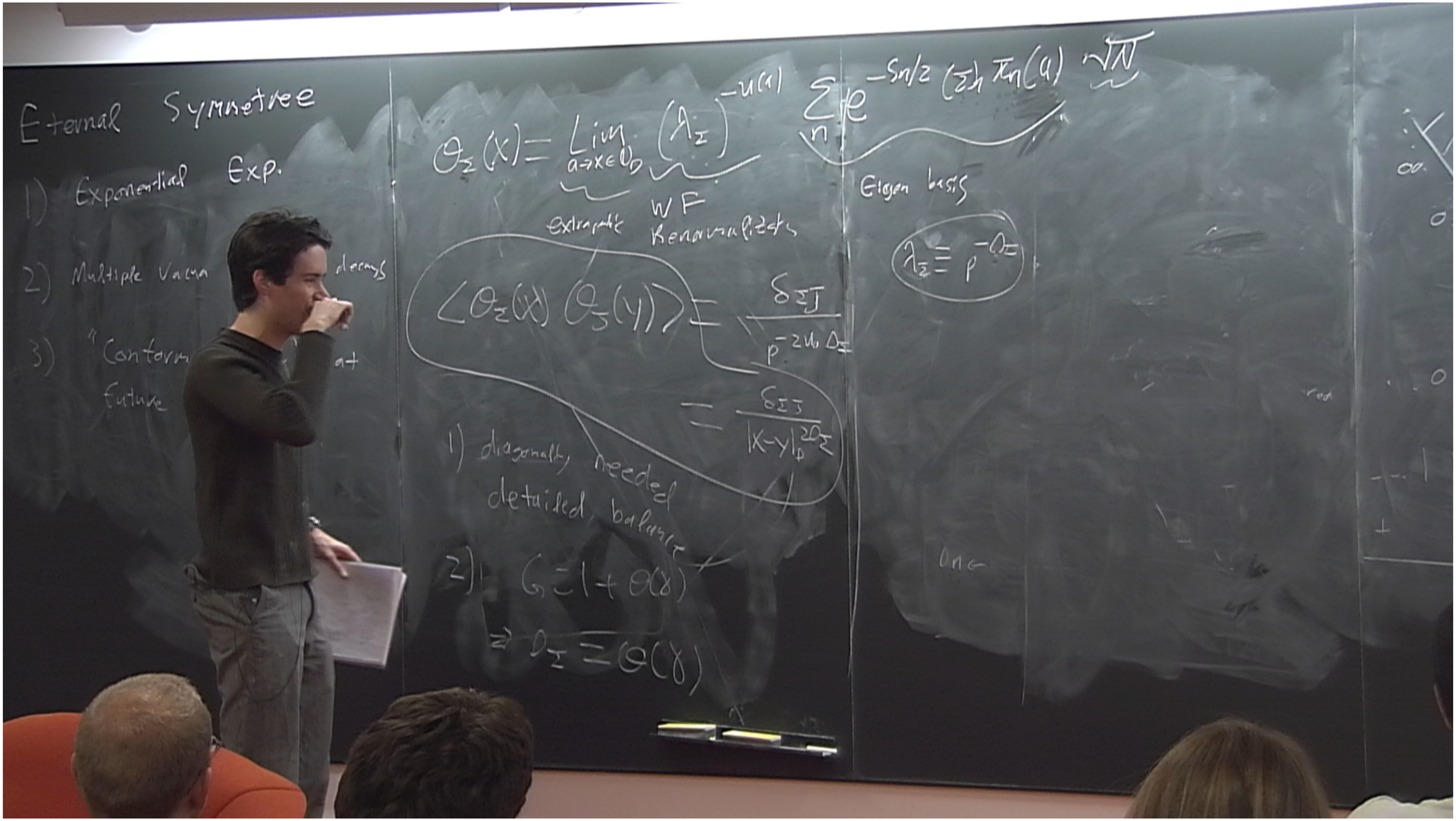

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at
future ∞
WF
Renormalization
Eigen basis

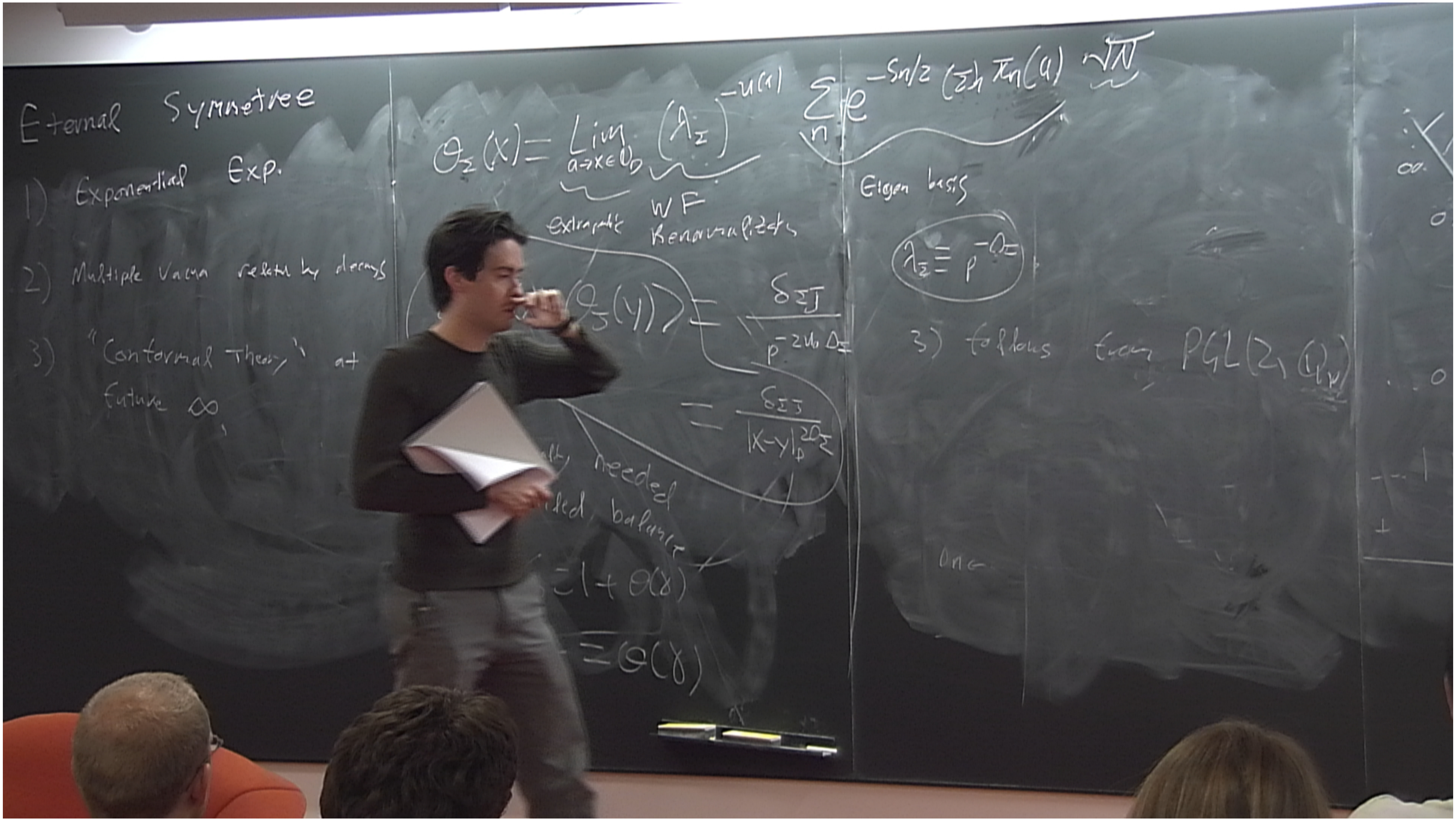

Eternal Symmetree
1) Exponential Exp.
Conformal Theory
WF
Eigen basis
1) diagonal, needed
detailed balance

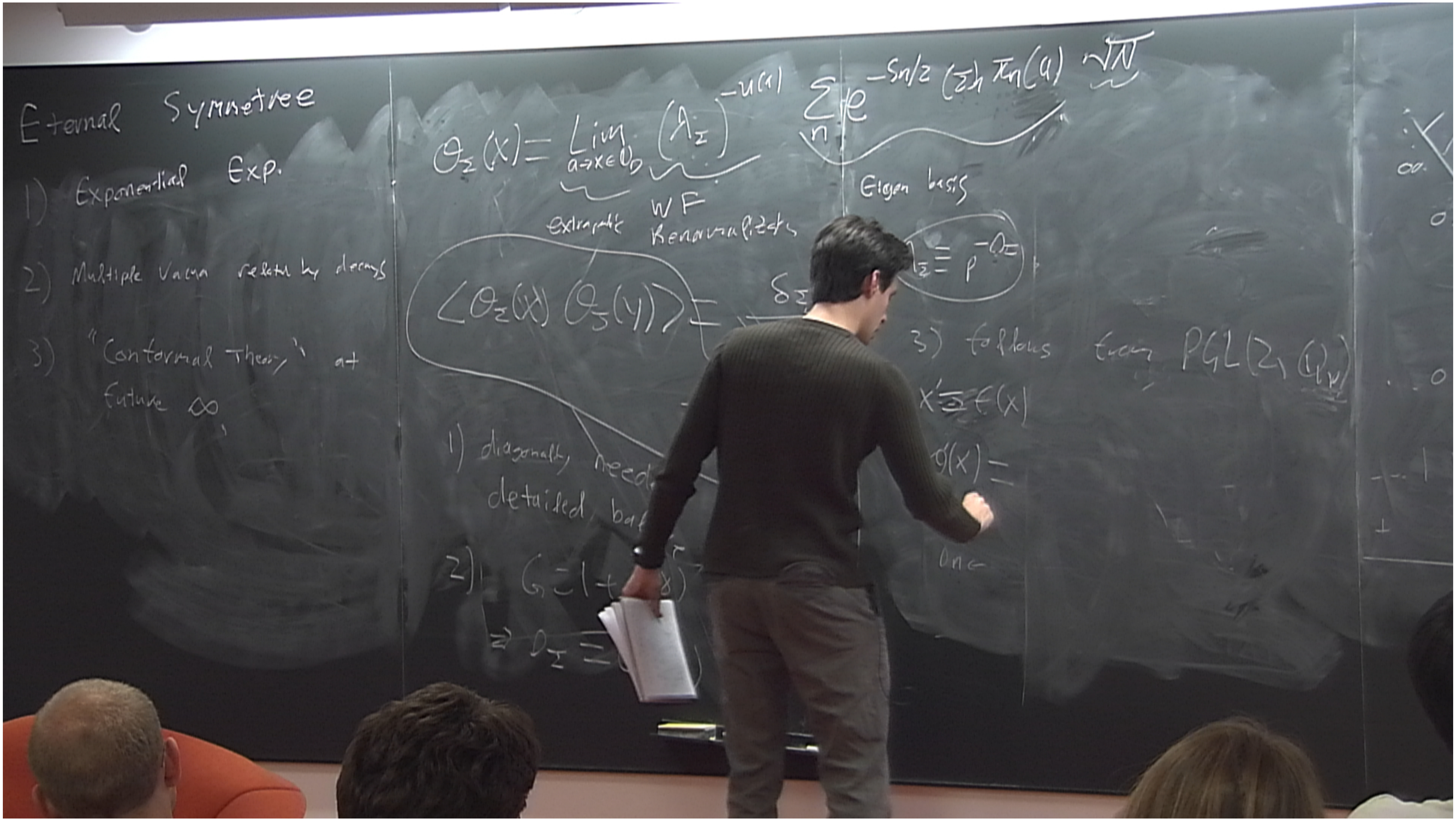

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
Eigen basis
WF
Renormalization
1) diagonality needed
detailed balance

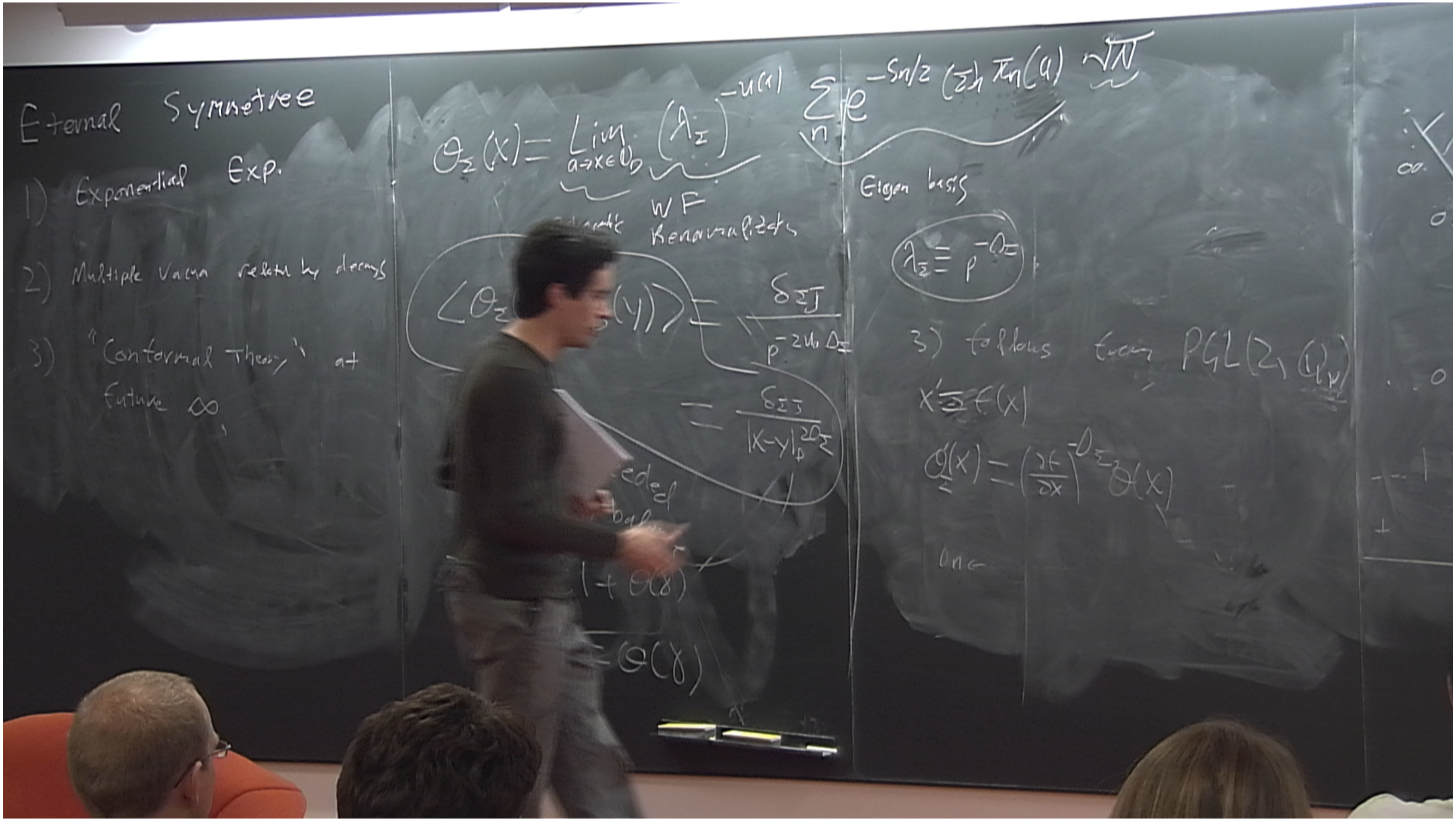

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" future ∞
WF
Eigen basis

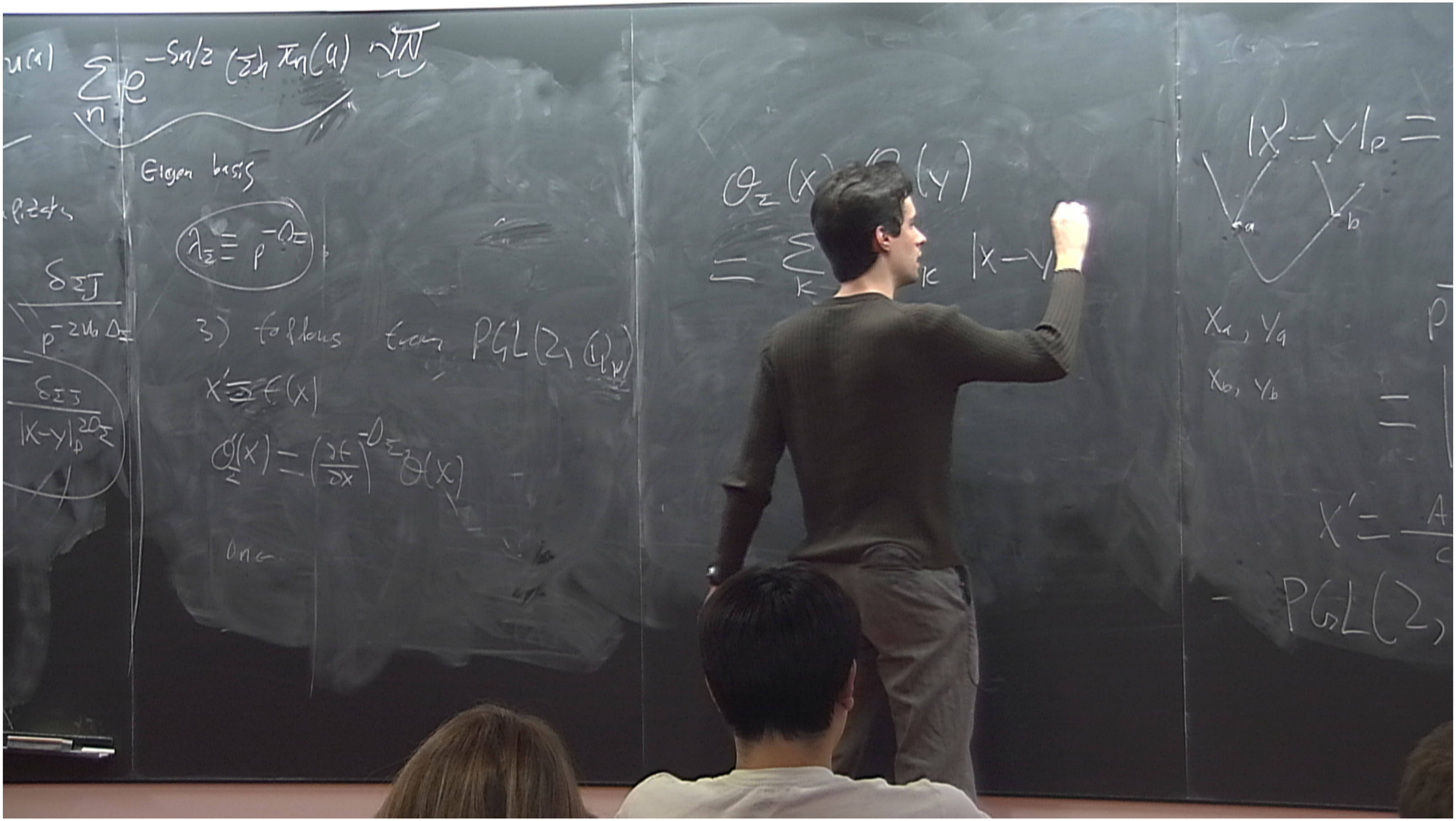

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at
future ∞
WF
Renormalization
Eigen basis
1) diagonality needed
detailed balance

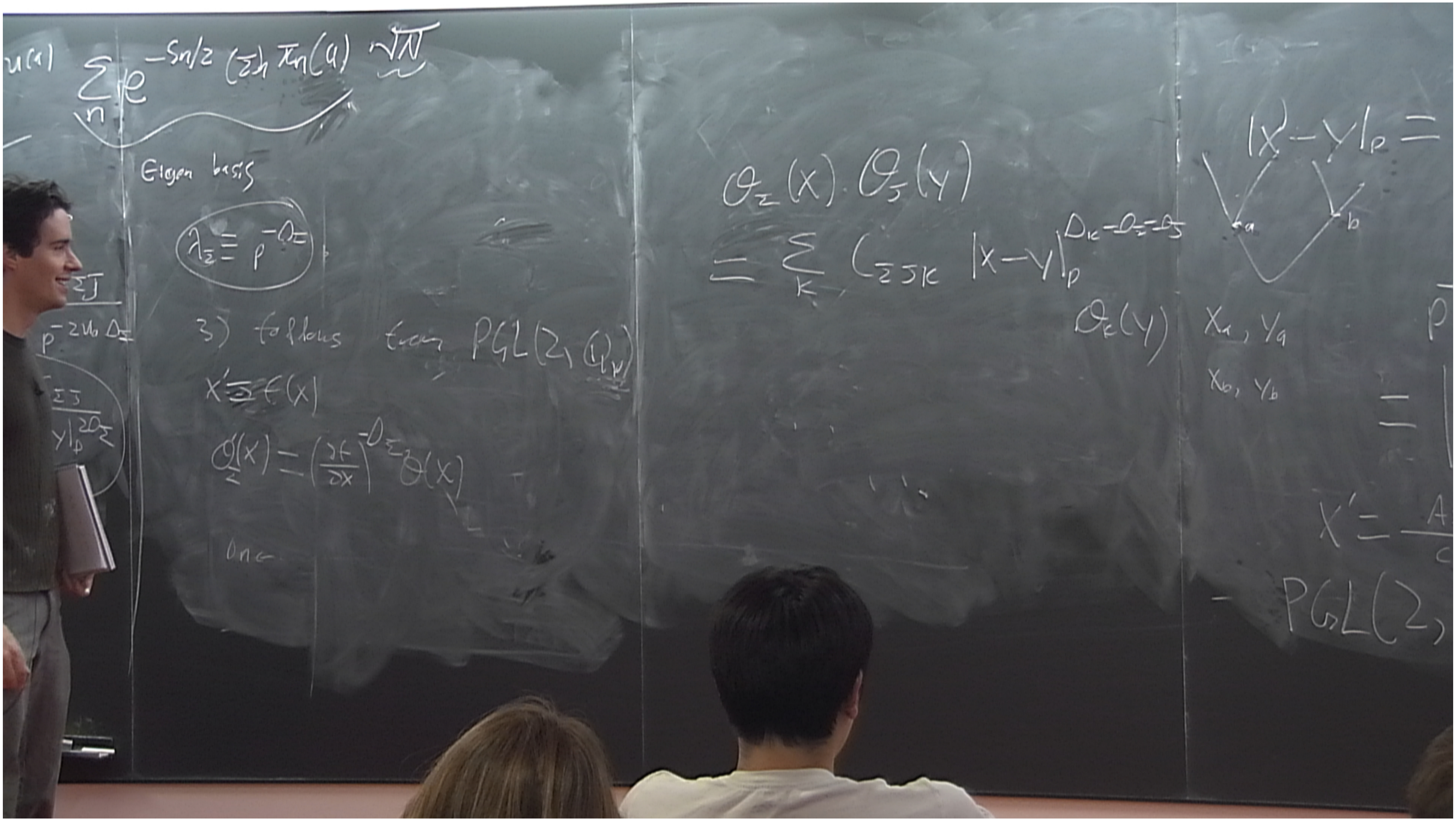

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua
3) "Conform
future
Eigen basis
1) diagonality needed
detailed balance

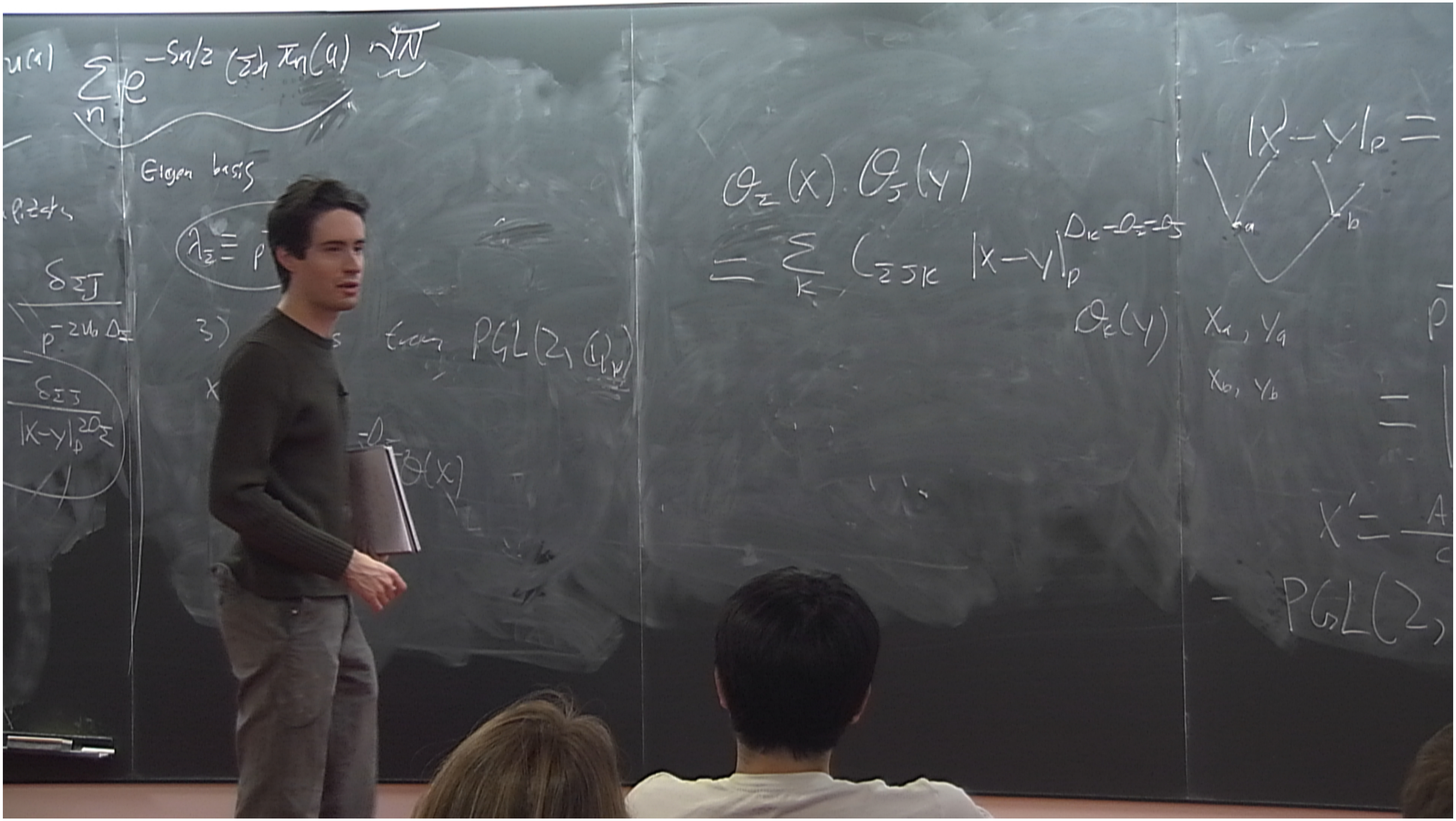

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
WF
Renormalizati
Eigen basis
3) follows from PGL(2, Q_p)

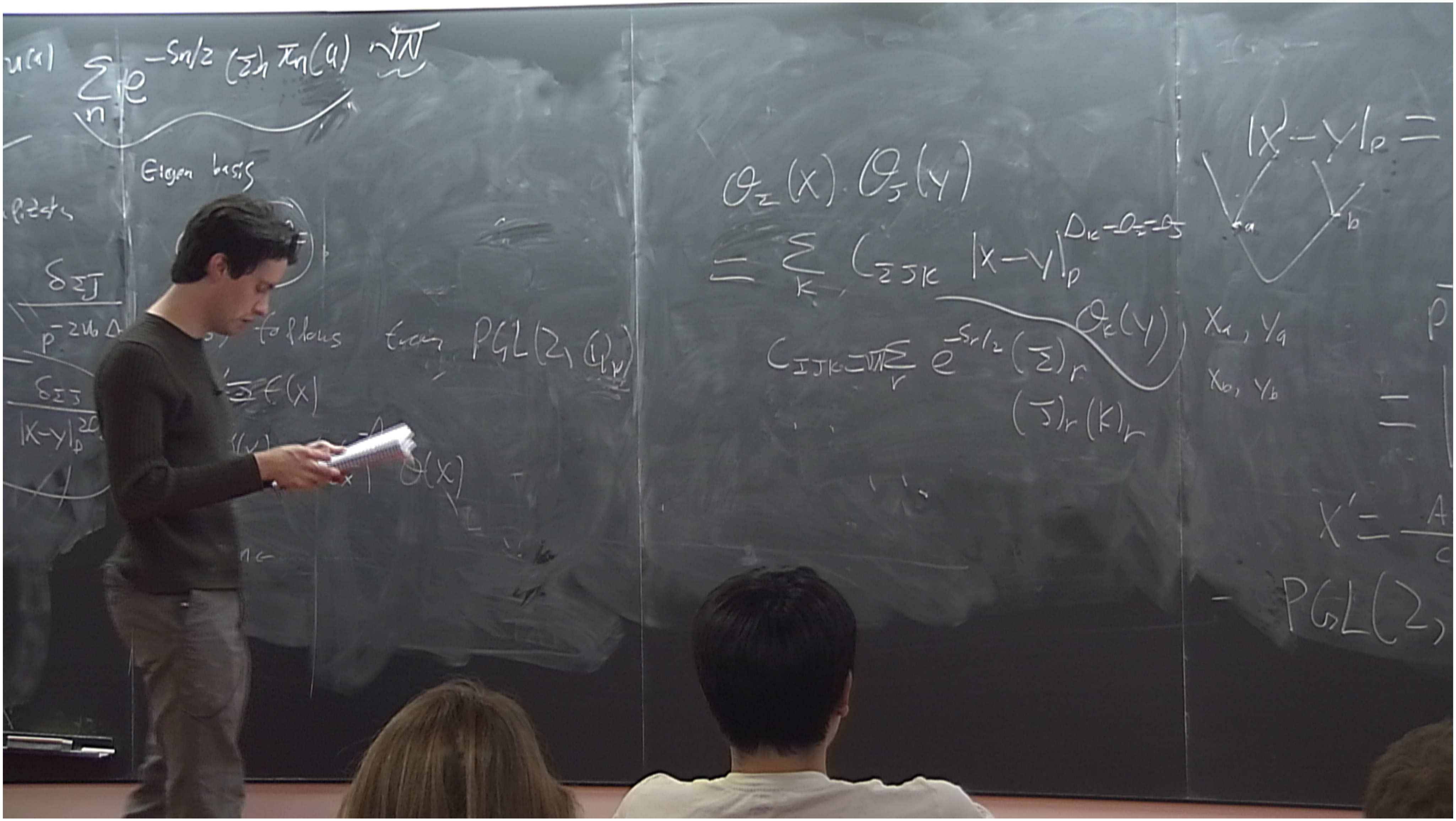

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
Eigen basis
W F
3) follows from PGL(2,

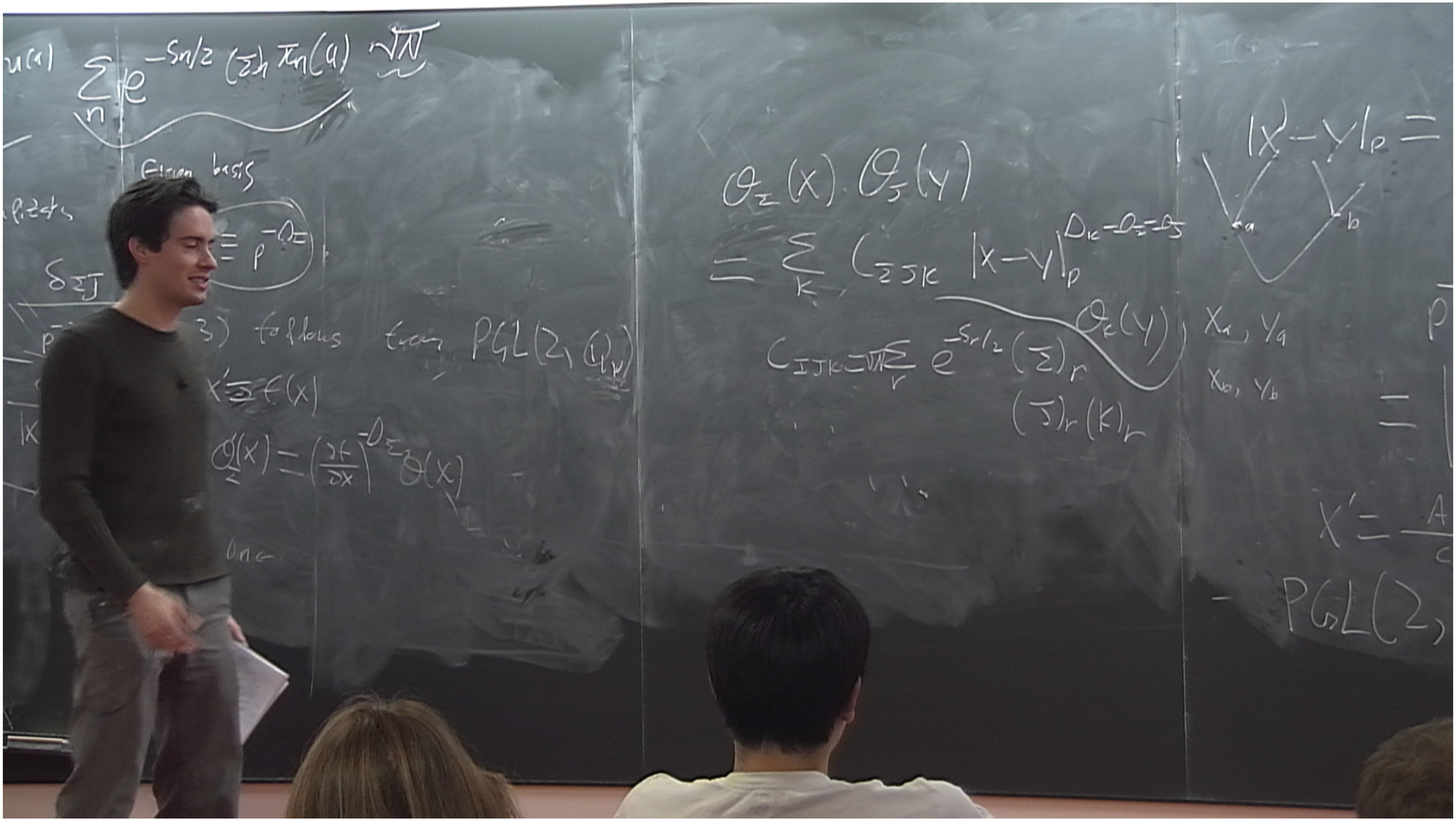

Eternal Symmetree
1) Exponential Exp.
2) Multiple Vacua related by decays
3) "Conformal Theory" at future ∞
WF Renormalization
Eigen basis
3) follows from PGL(2, Q_p)

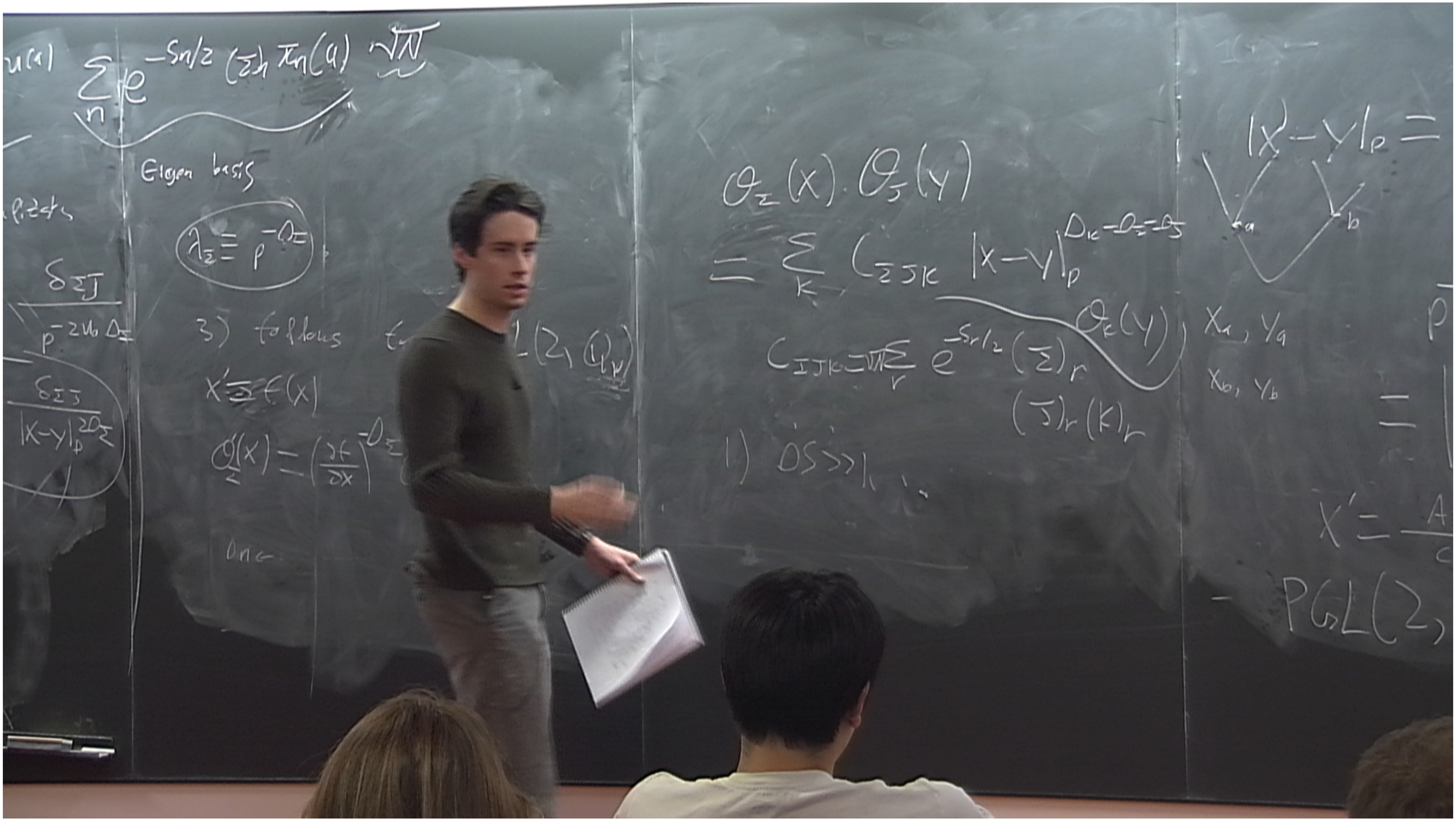

Eigen basis
3) follows from PGL(2,
Xa, Ya
Xb, Yb
PGL(2,

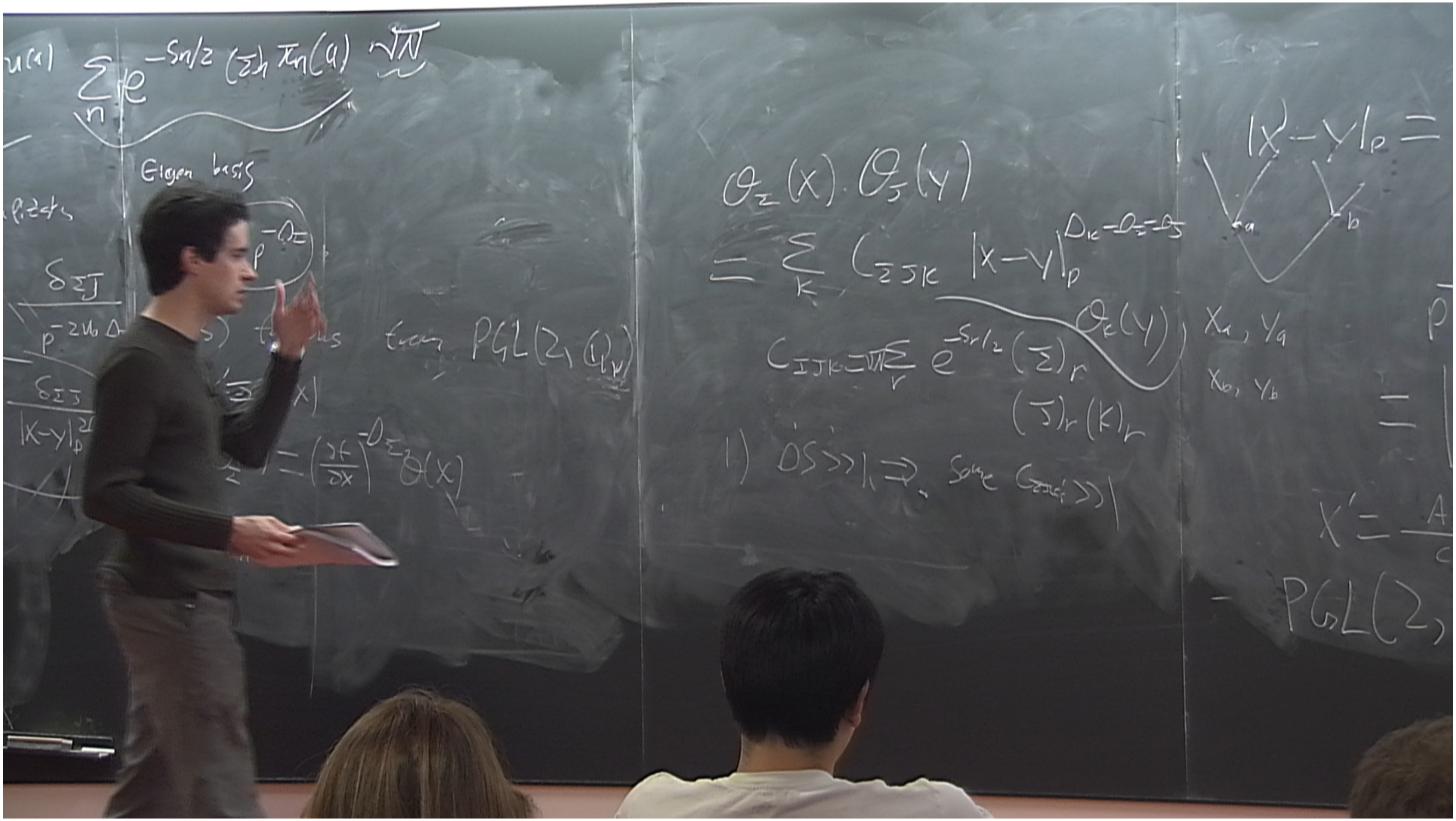

Eigen basis
3) follows from PGL(2,

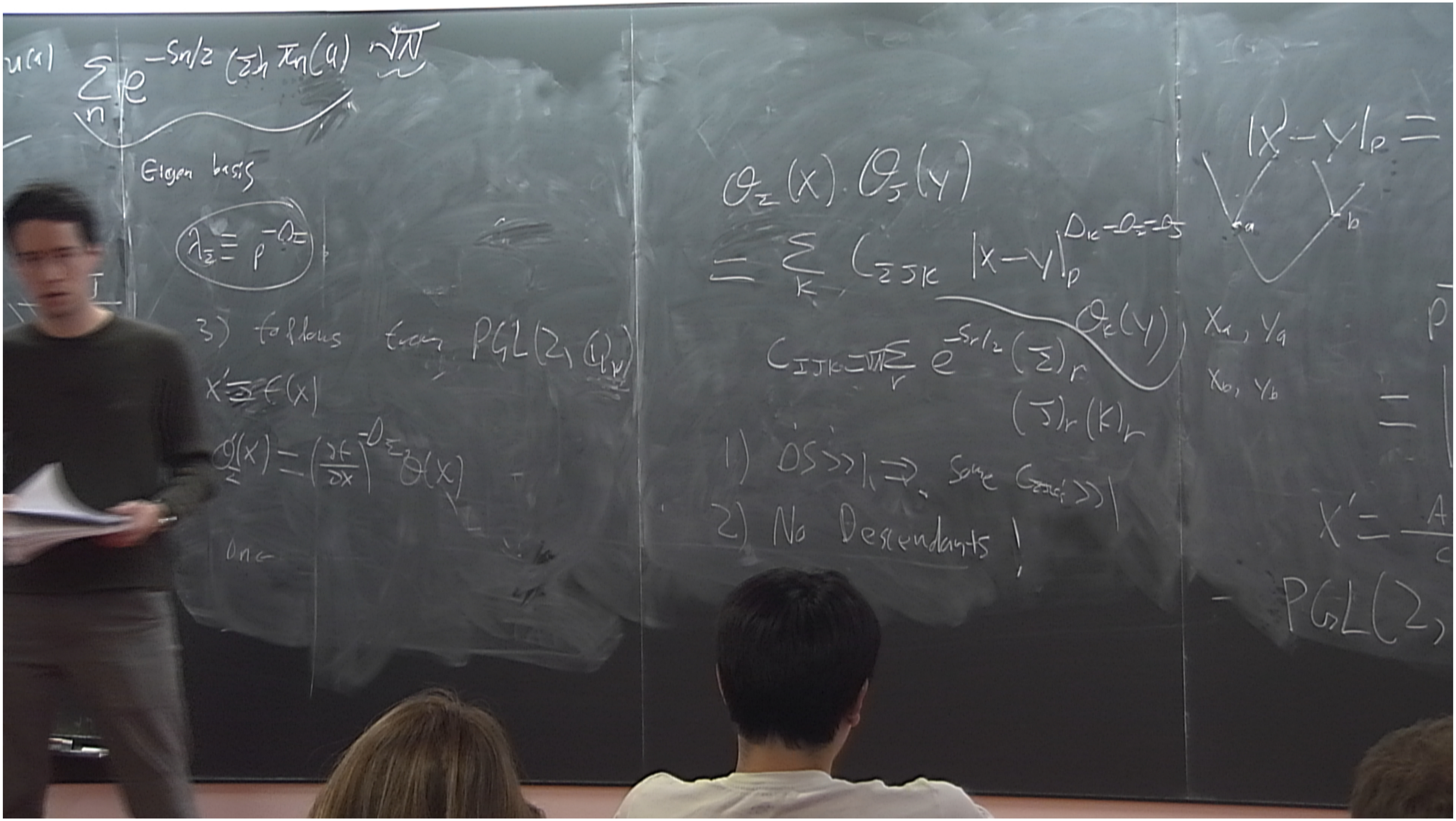

Eigen basis
PGL(2,

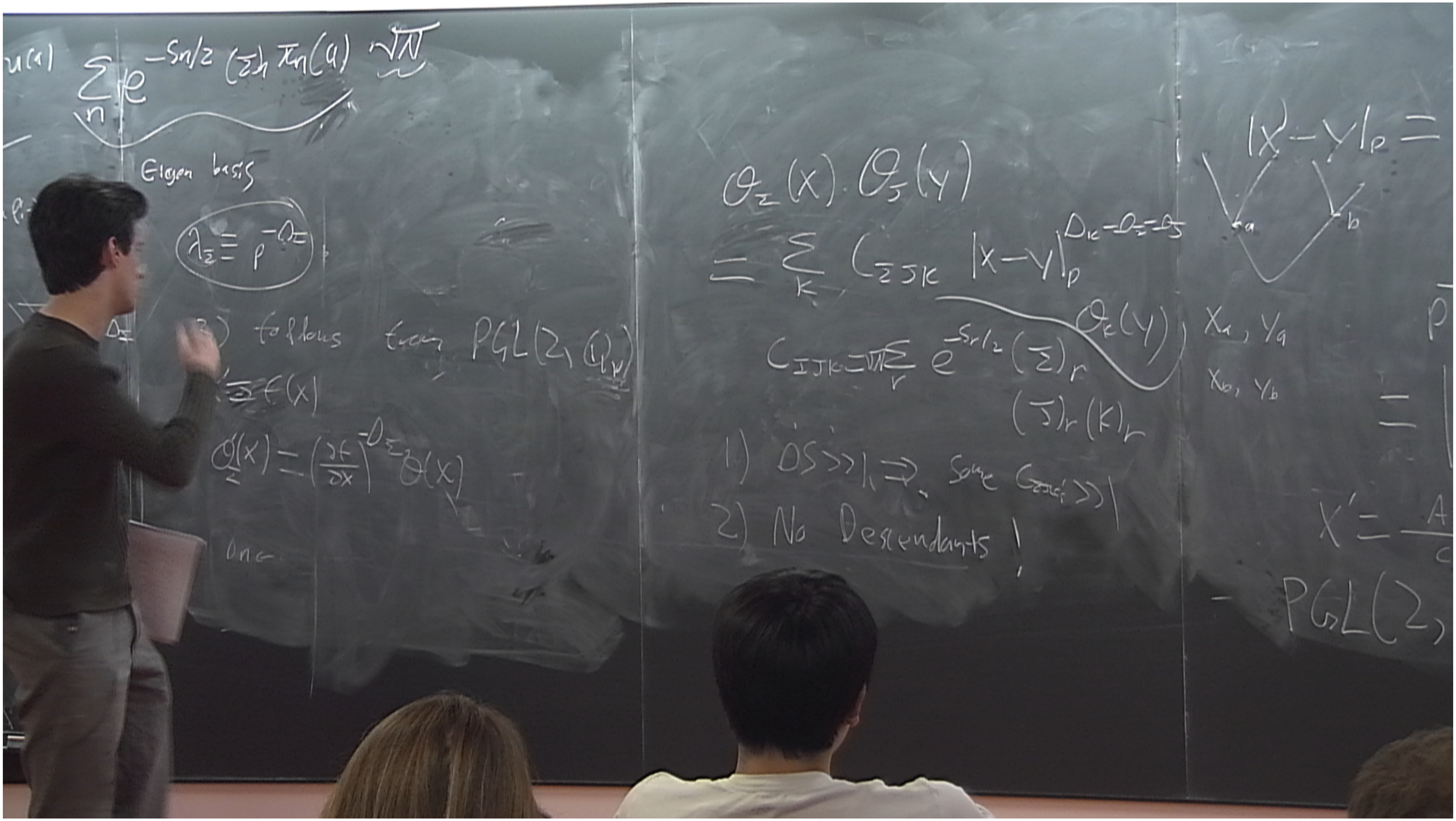

Eigen basis
follows from PGL(2, Q_p)
X_a, Y_a
X_b, Y_b
PGL(2,

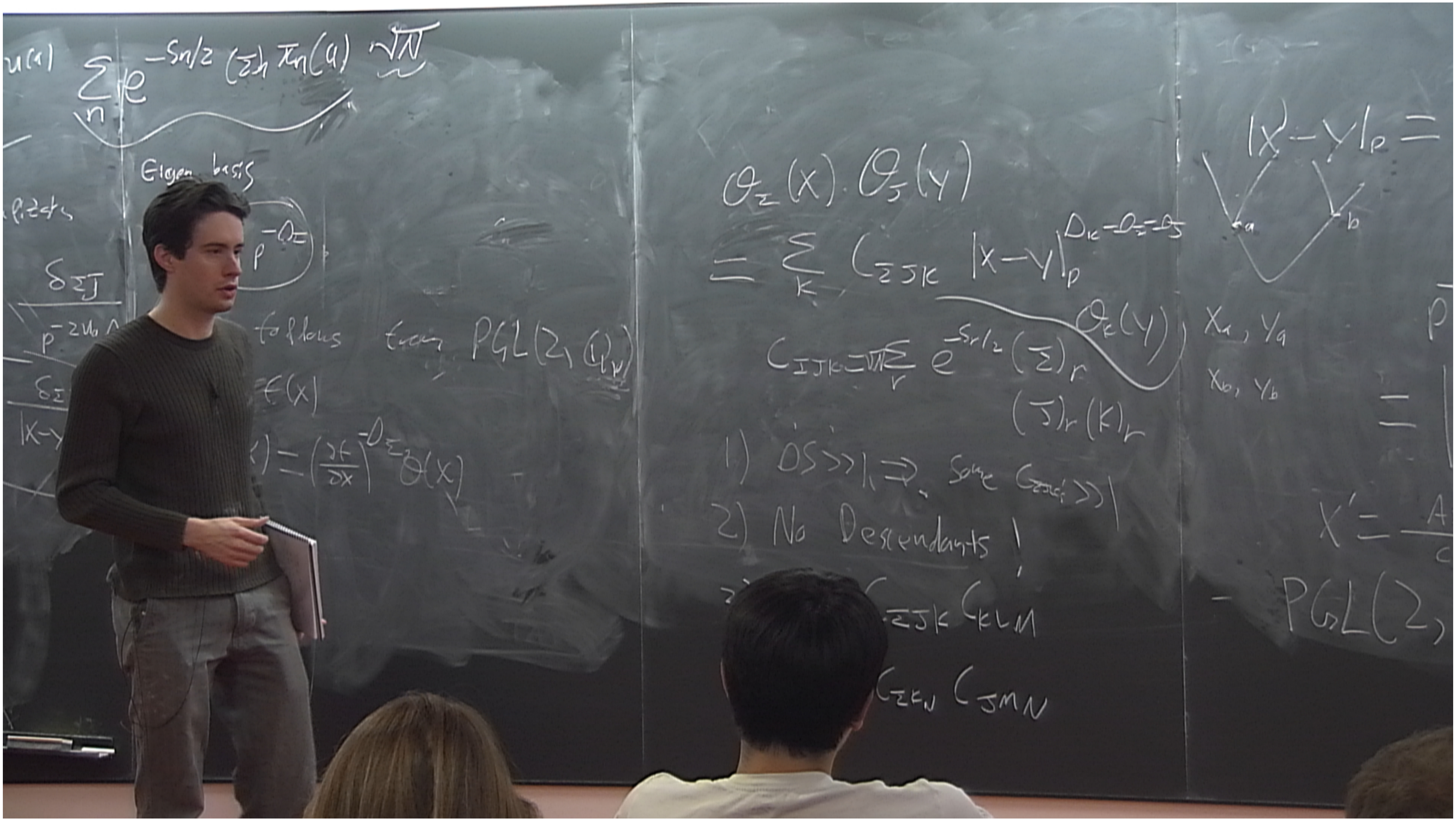



Eigen basis
3) follows
PGL(2,


Eigen basis
from PGL(2, Q_p)
$\theta_I(x)\cdot\theta_J(y)$
$= \sum_K C_{IJK} |x-y|_p^{D_K - D_I - D_J}$
$\theta_K(y)$
$C_{IJK} = \sqrt{N} \sum_r e^{-S_r/2} (I)_r (J)_r (K)_r$
1) $\delta S \gg 1 \Rightarrow$ some $C_{IJK} \gg 1$
$|x-y|_p =$
x_a, y_a
x_b, y_b
PGL(2,


Eigen basis
3) follows from PGL(2,
2) No Descendants !
PGL(2,


Eigen basis
follows from PGL(2, Q_p)
1) ΔS >> 1 ⇒ some C >> 1
2) No Descendants !
X_a, Y_a
X_b, Y_b
PGL(2,


Eigen basis
follows from PGL(2,
2) No Descendants !
PGL(2,