

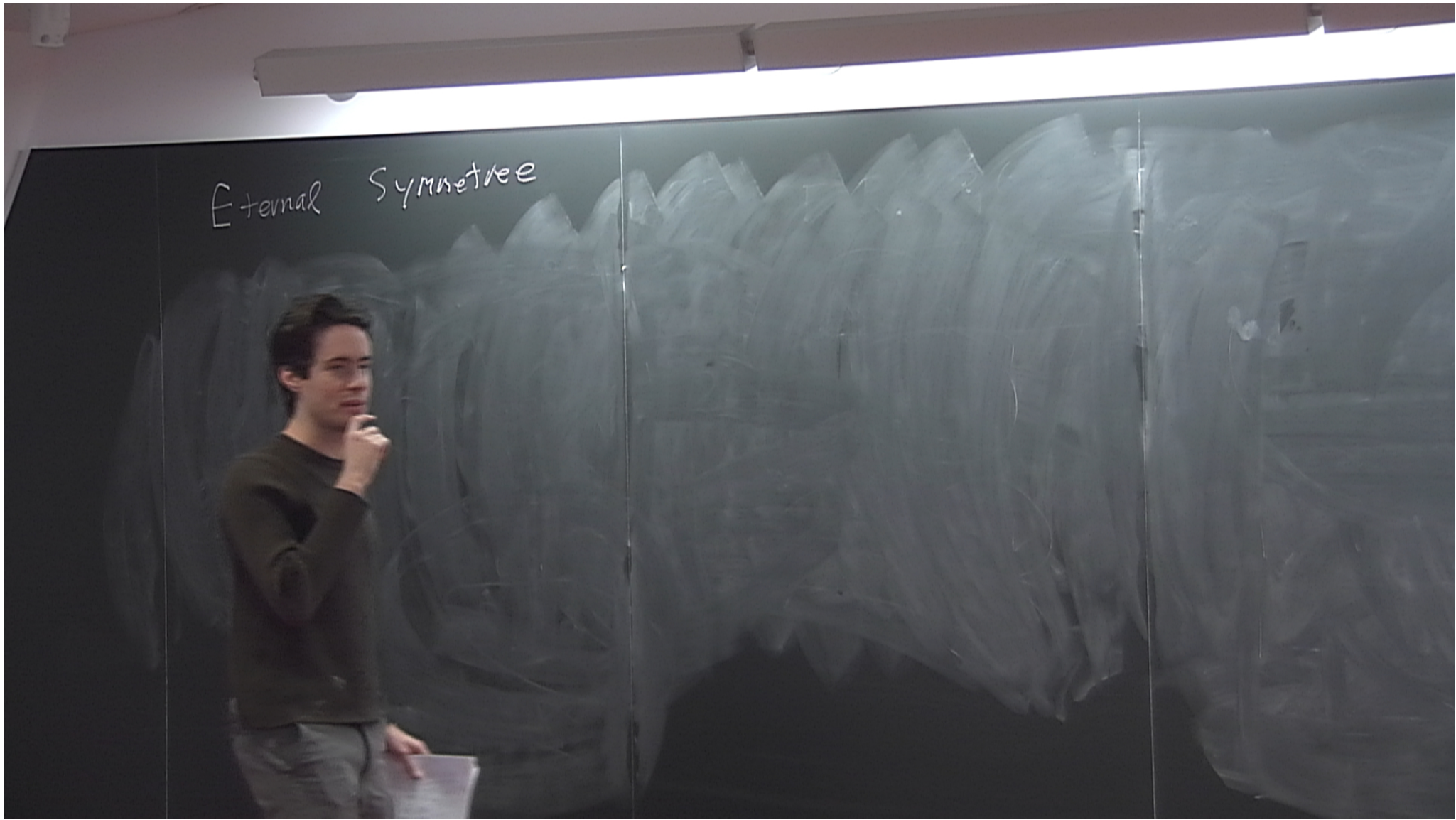
Title: Eternal Symmetree

Date: Dec 08, 2011 04:00 PM

URL: <http://pirsa.org/11120059>

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

Eternal Symmetry



# Eternal Symmetree

1) Exponential Exp.

2)

# Eternal Symmetry

1) Exponential Exp.

2) Multiple Vacua related by decays

3) "

## Eternal Symmetrie

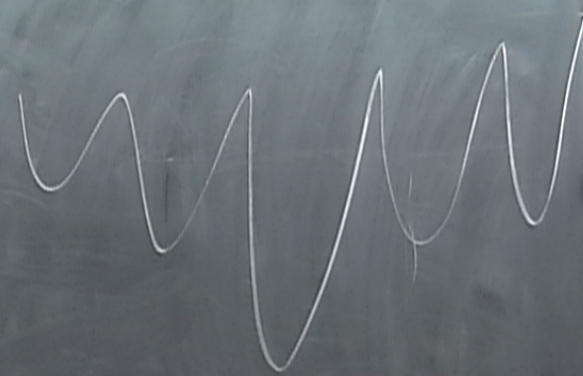
- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$

# Eternal Symmetry

1) Exponential Exp.

2) Multiple states related by decays

3) "Central Theory" at

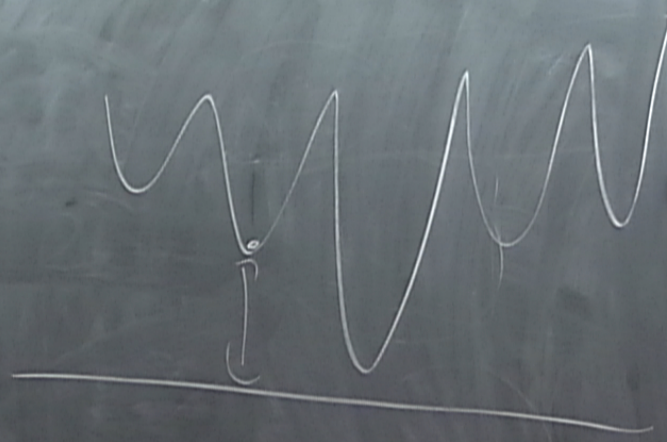


# Eternal Symmetry

1) Exponential Exp.

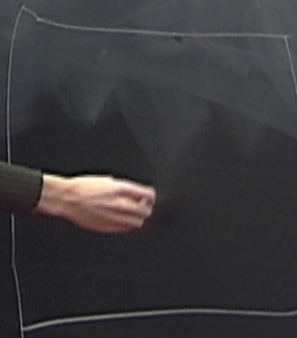
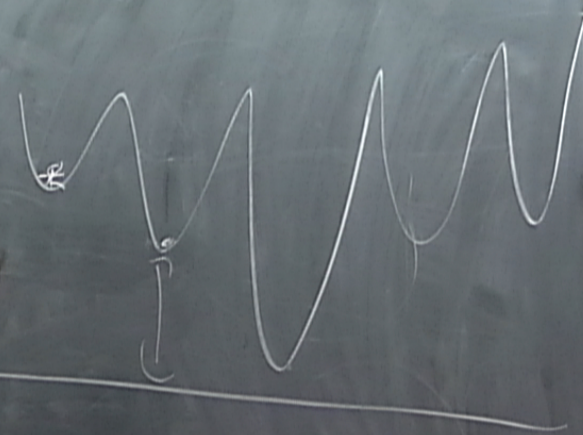
2) can relate by decays

3) formal Theory, at  
 $t \rightarrow \infty$



# Eternal Symmetry

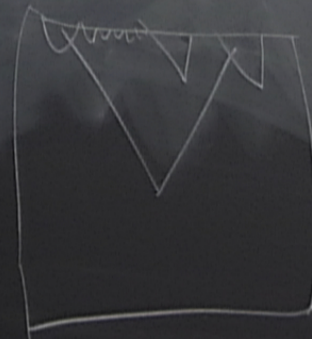
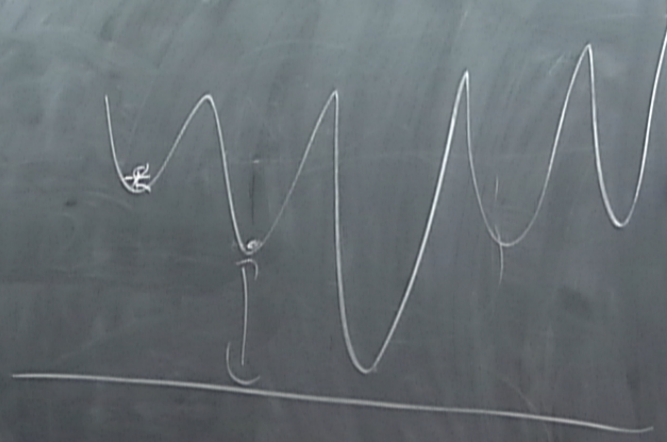
- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theorem" future  $\infty$





# Eternal Symmetry

- 1) Exponential Exp.
- 2) Multiple Vacua → decays
- 3) "Contour" → at future

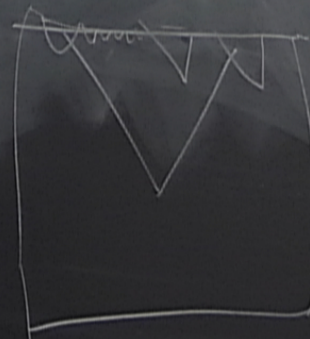
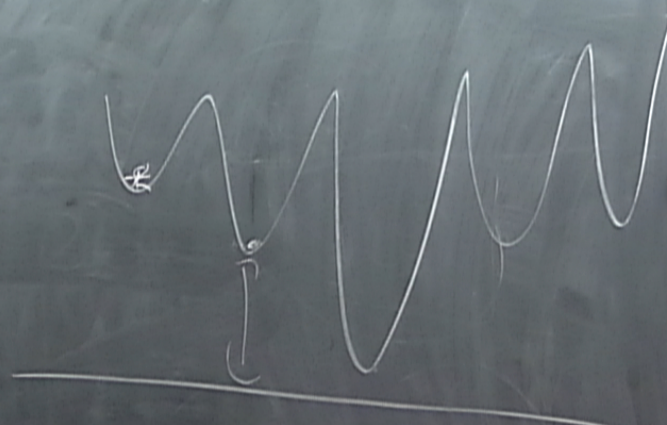


# Eternal Symmetry

1) Exponential Exp.

2) Multiple Vacua  $\rightarrow$  decays

3) "Confined" at future

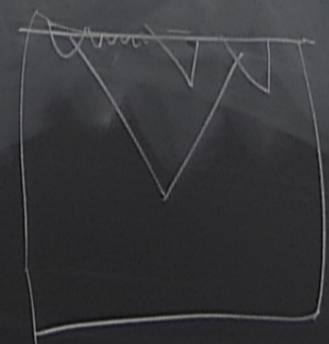
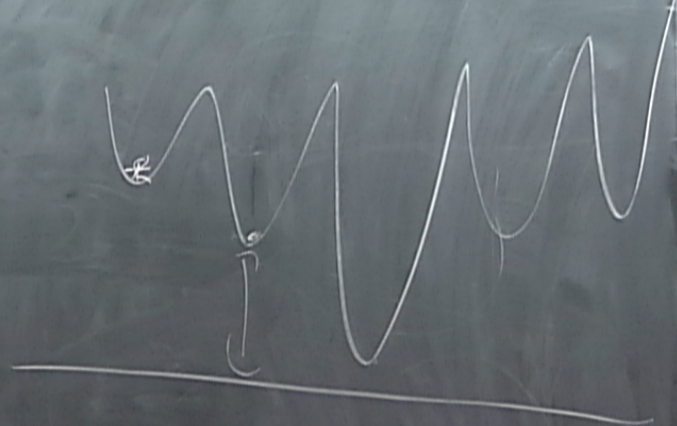


# Eternal Symmetry

1) Exponential Exp.

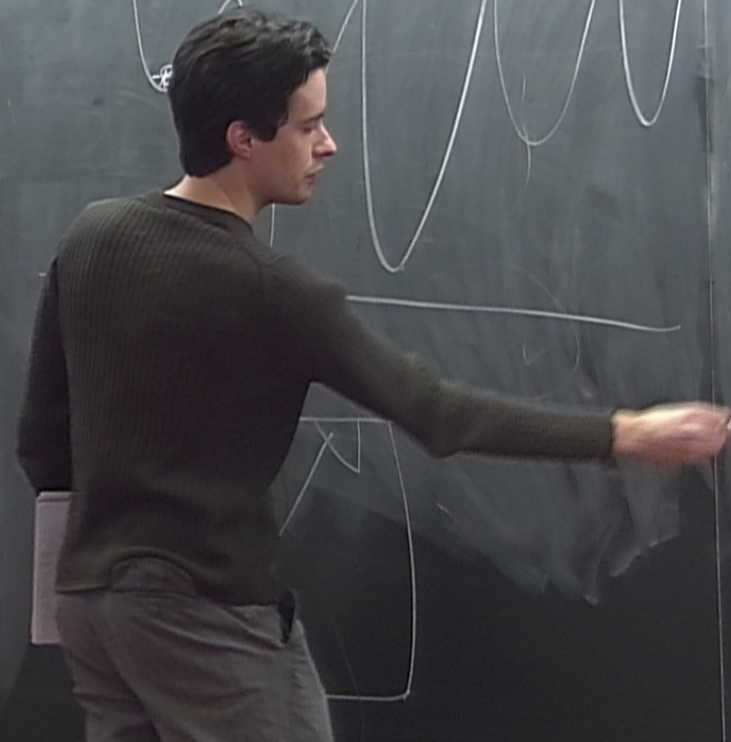
2)  $M$  can relate by decays

3) formal Theory at  $t \rightarrow \infty$



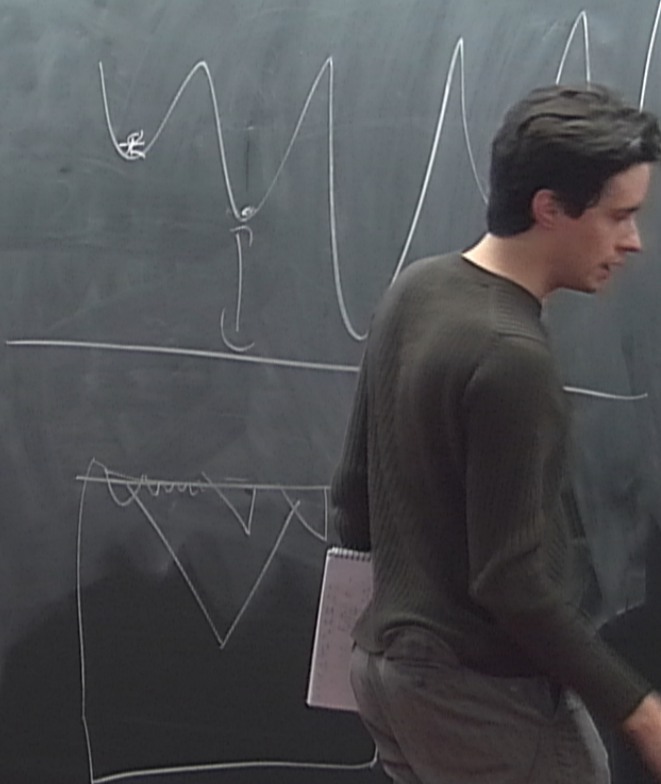
# Eternal Symmetrie

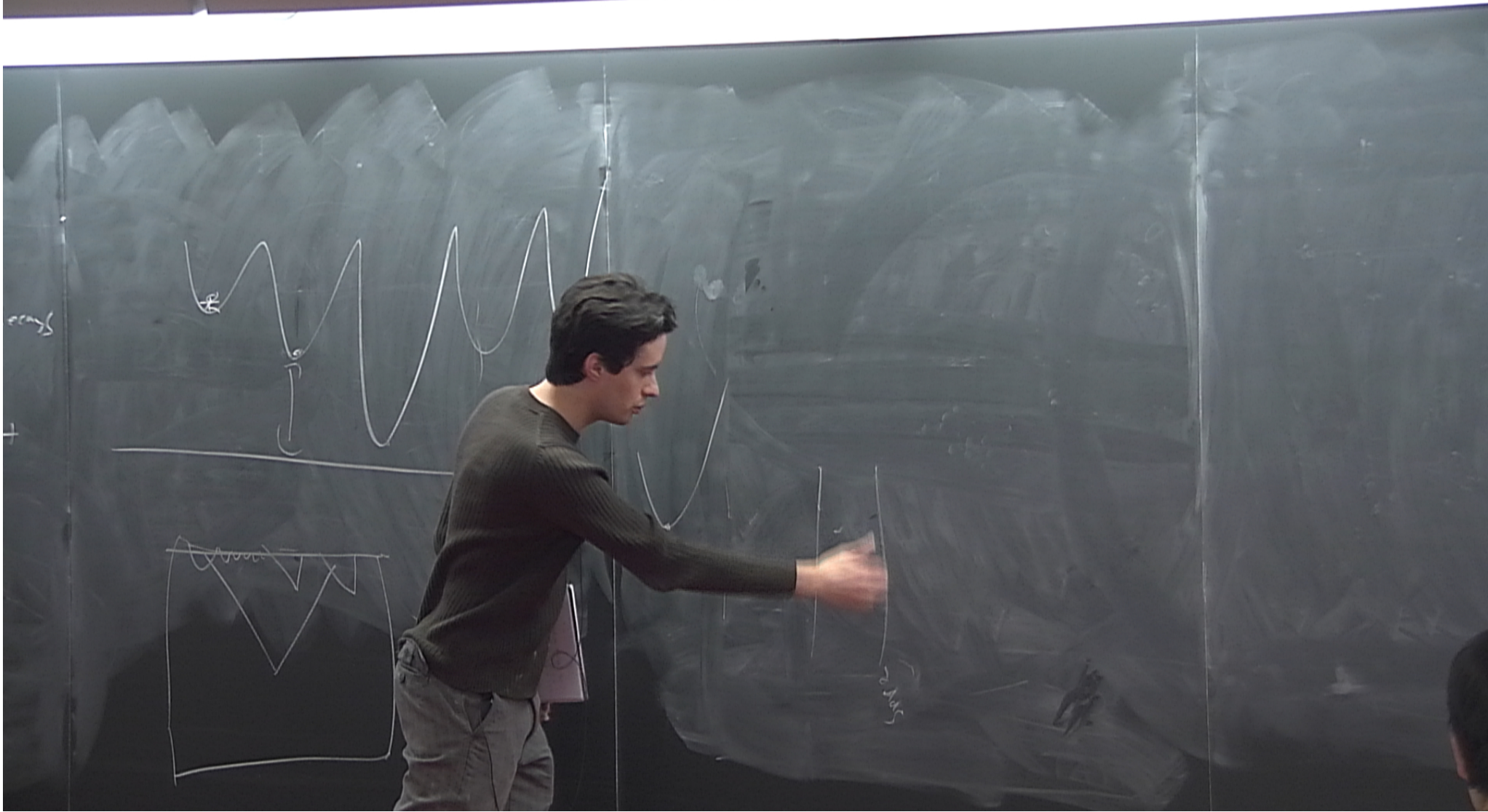
- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$

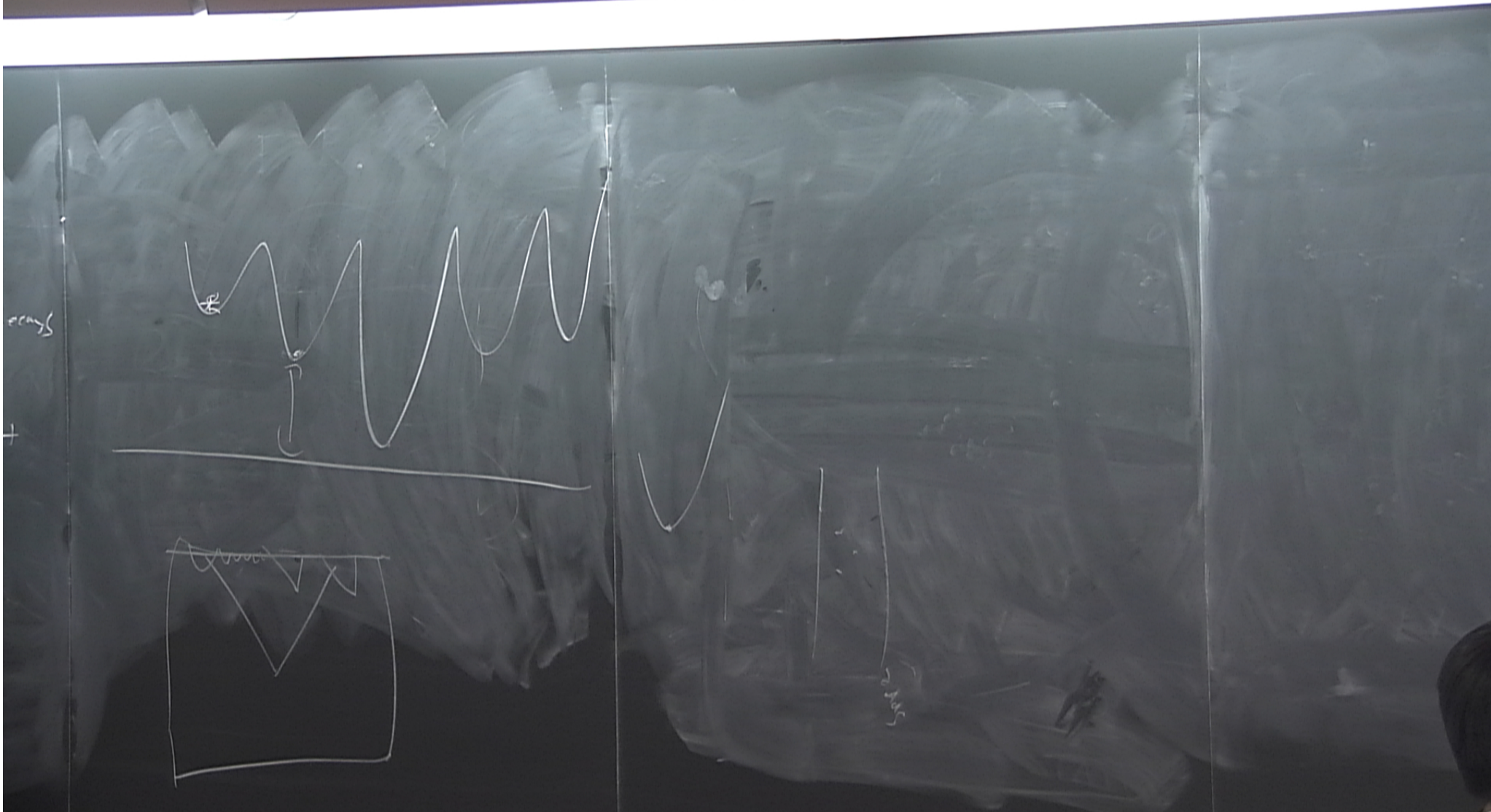


# Eternal Symmetrie

- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$





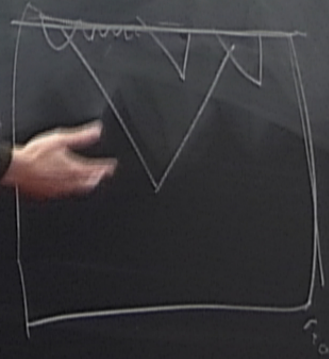
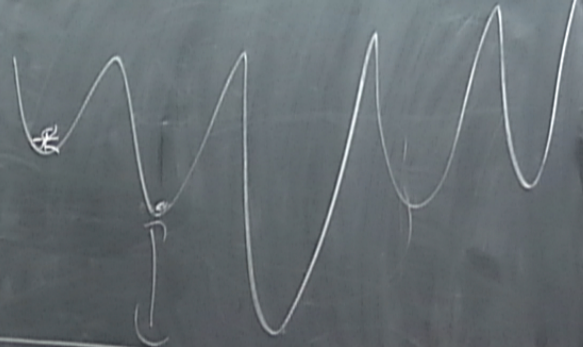


# Eternal Symmetry

1) Exponential Exp.

2) Multiple Vacua related by d.o.f.

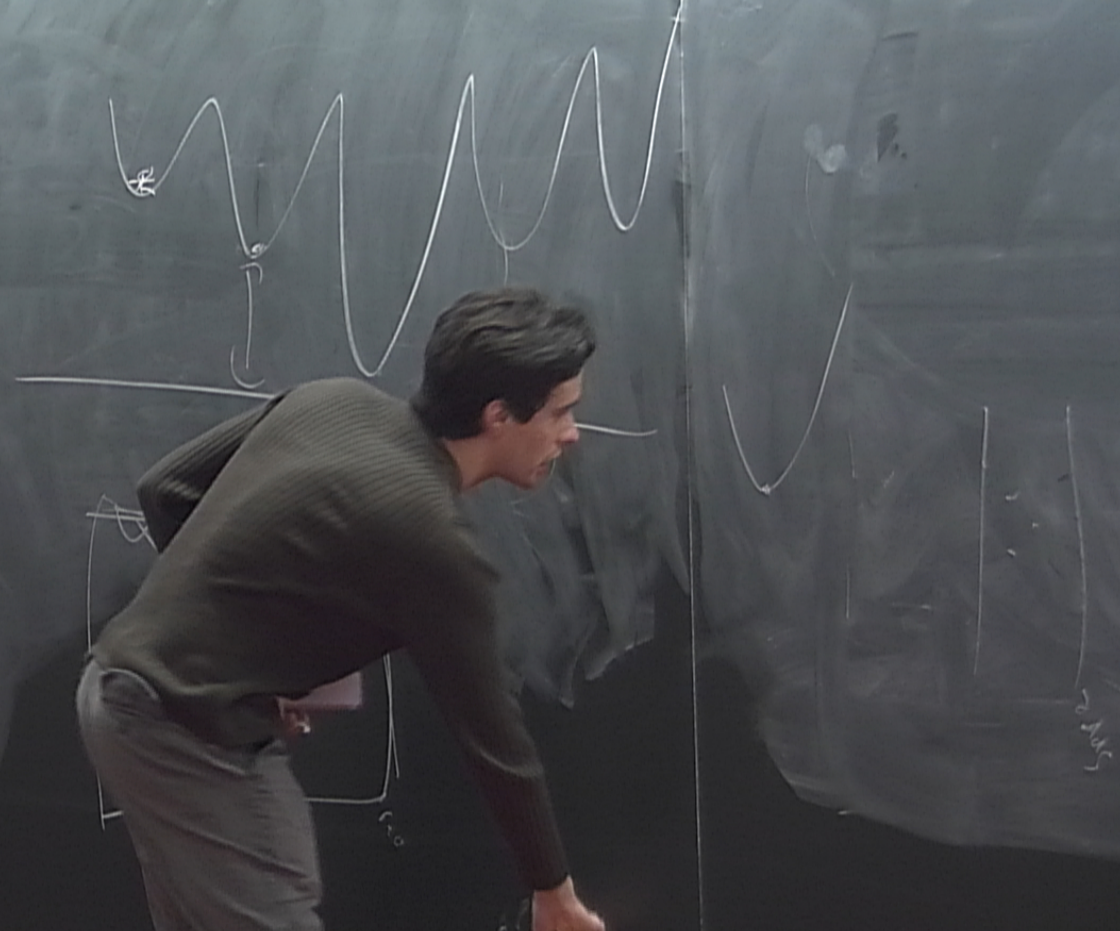
3) "Conformal Theory"  
future  $\infty$





# Eternal Symmetry

- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$

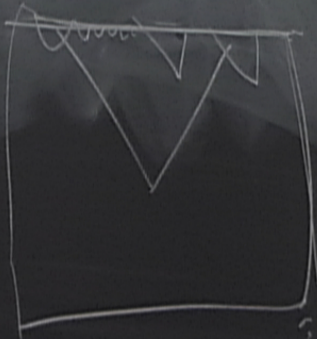
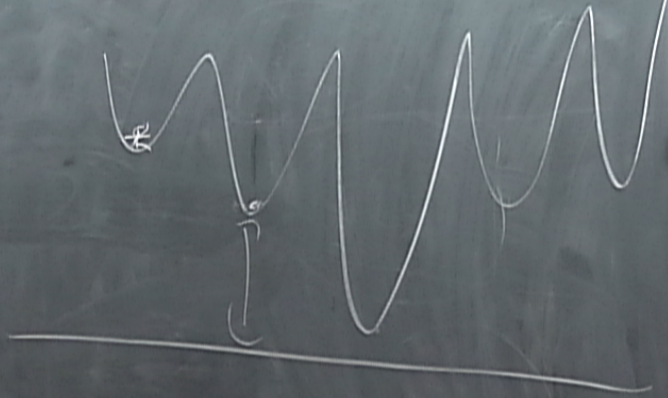


Symmetrie

Exp.

data by decay

at



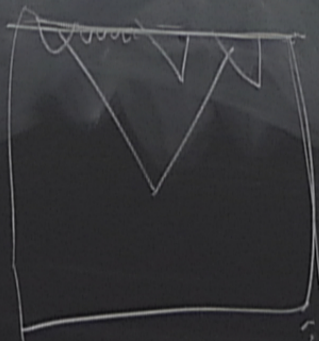
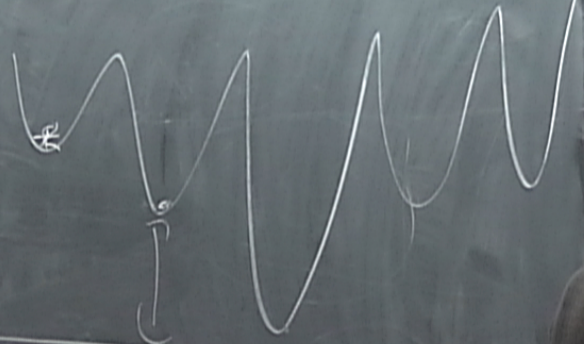
Symmetrie

Exp.

relation related by decay

Therory at

$\infty$



Blue

Calculus  $\equiv$  Values

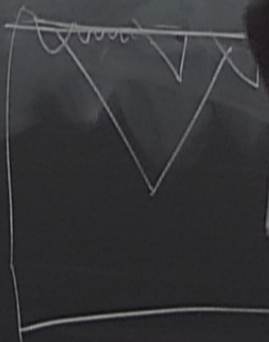
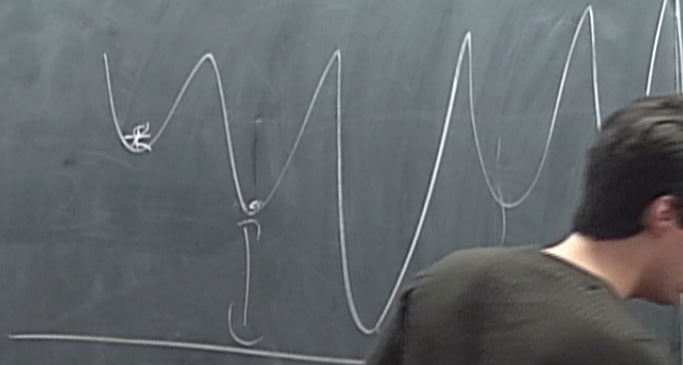
Symmetrie

Exp.

relation related by decay

Thesis at

$\infty$



Blue

Calculus  $\equiv$  Values  
Nc

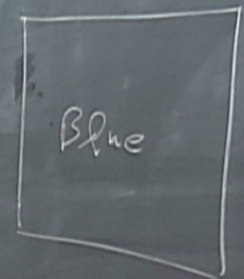
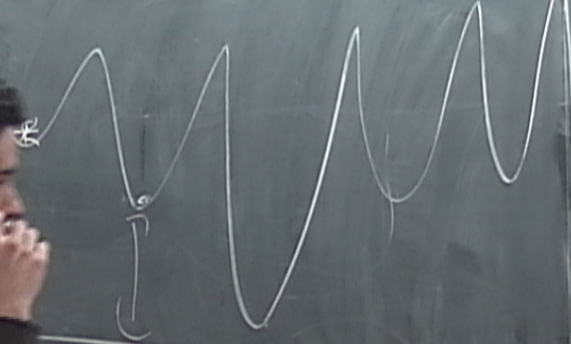
Symmetrie

Exp.

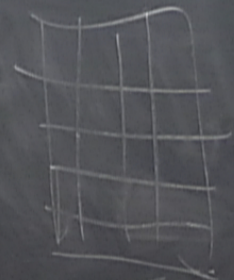
relation related by decays

Therory at

$\infty$



Calculus  $\equiv$  Values  
Nc

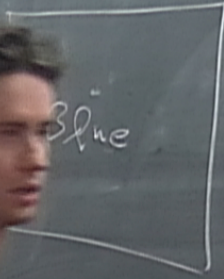
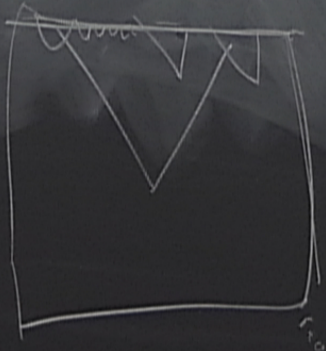
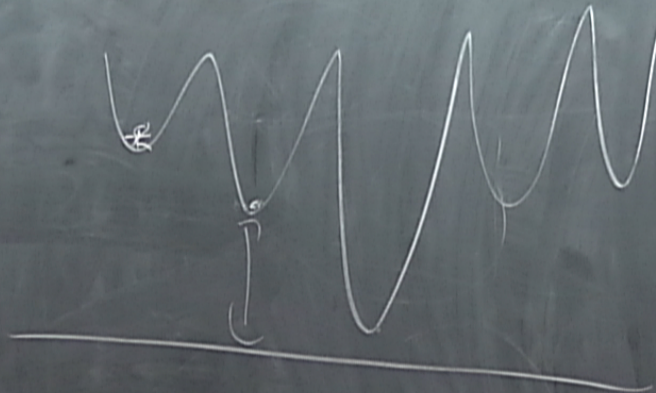


Symmetrie

Exp.

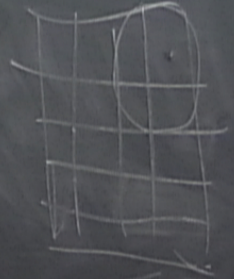
relates by decays

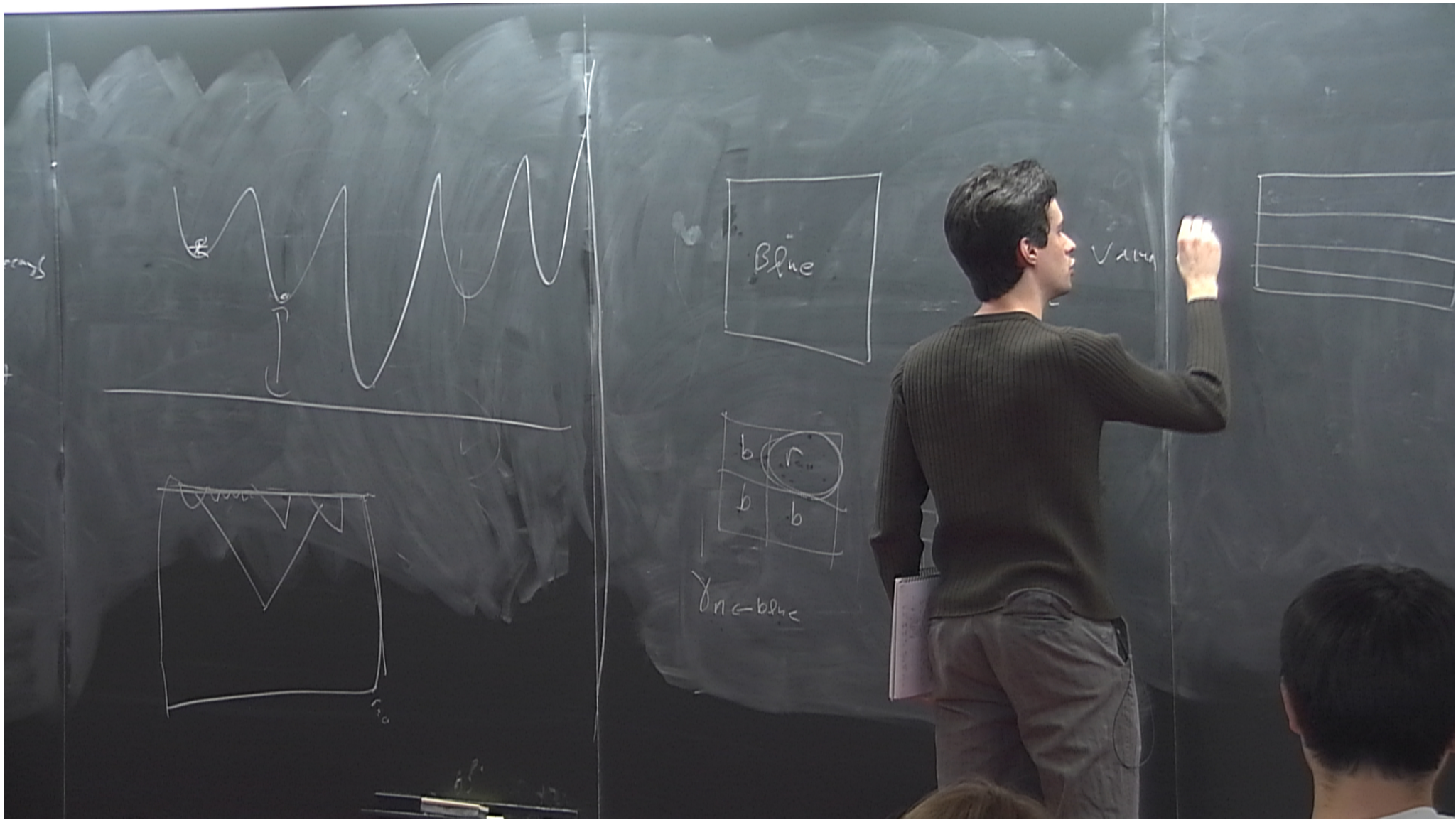
Theory at



Colours  $\equiv$  Values  
 $N_c$

$\gamma_n \leftarrow$  red





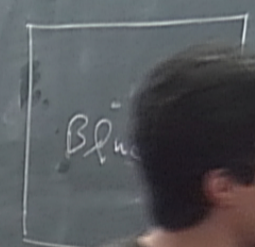
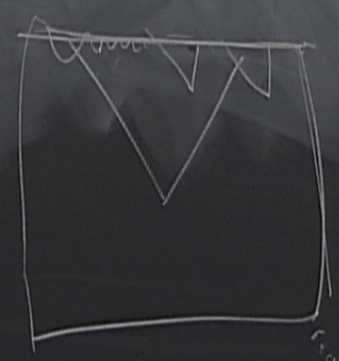
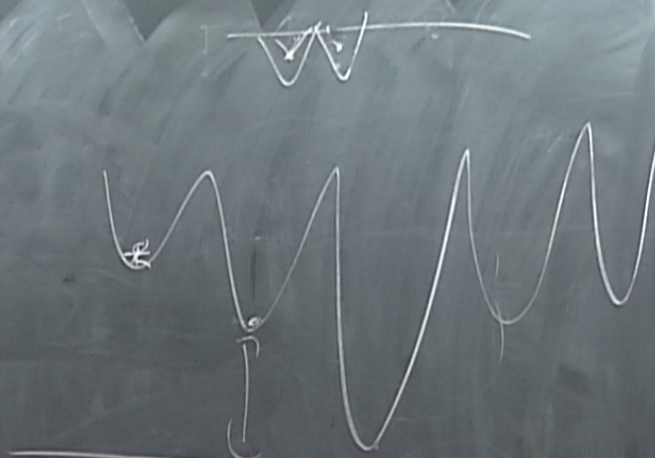
# Symmetrie

herdial Exp.

le Valua relate by decays

ntormal Theory' at

time  $\infty$

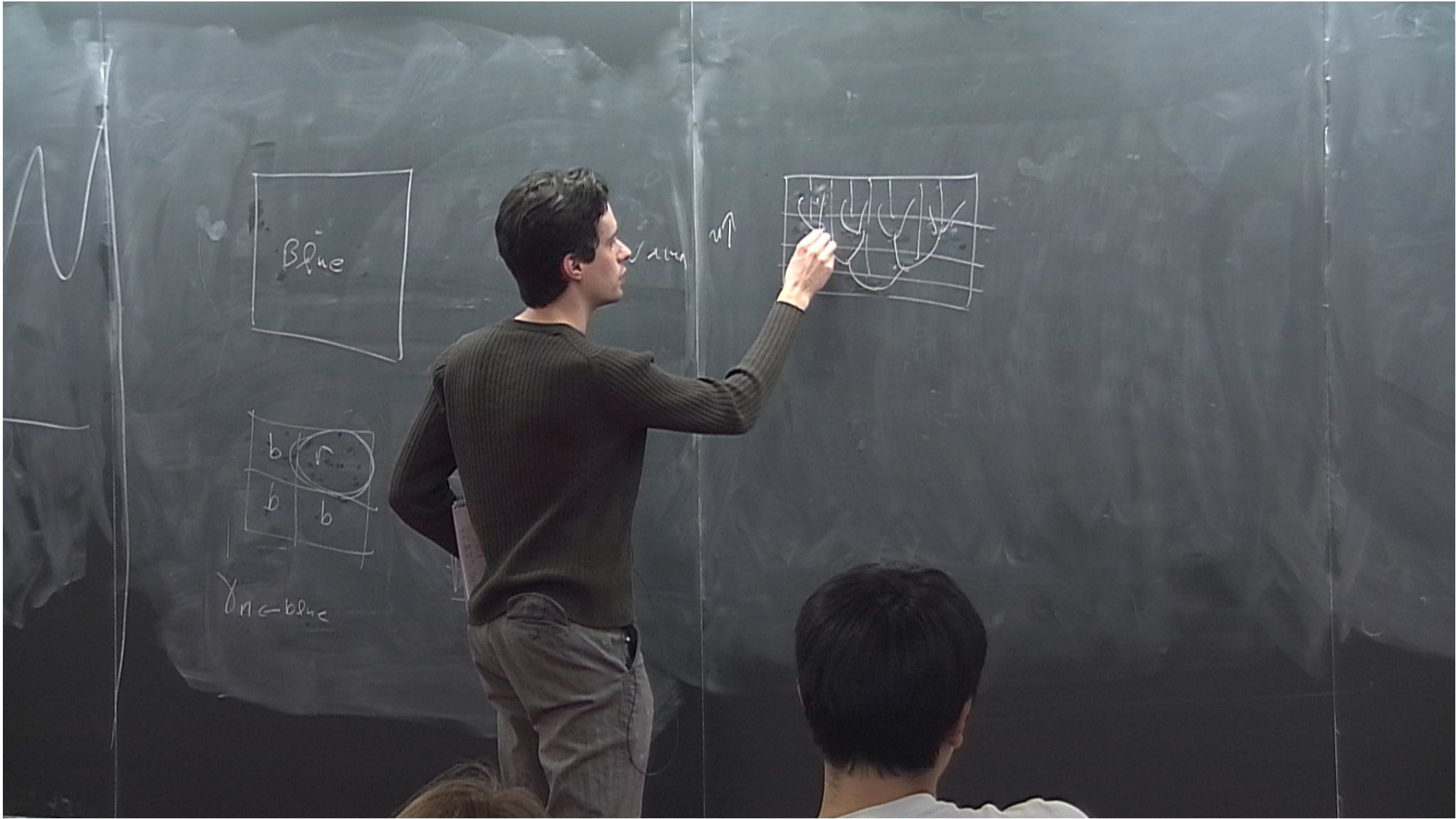


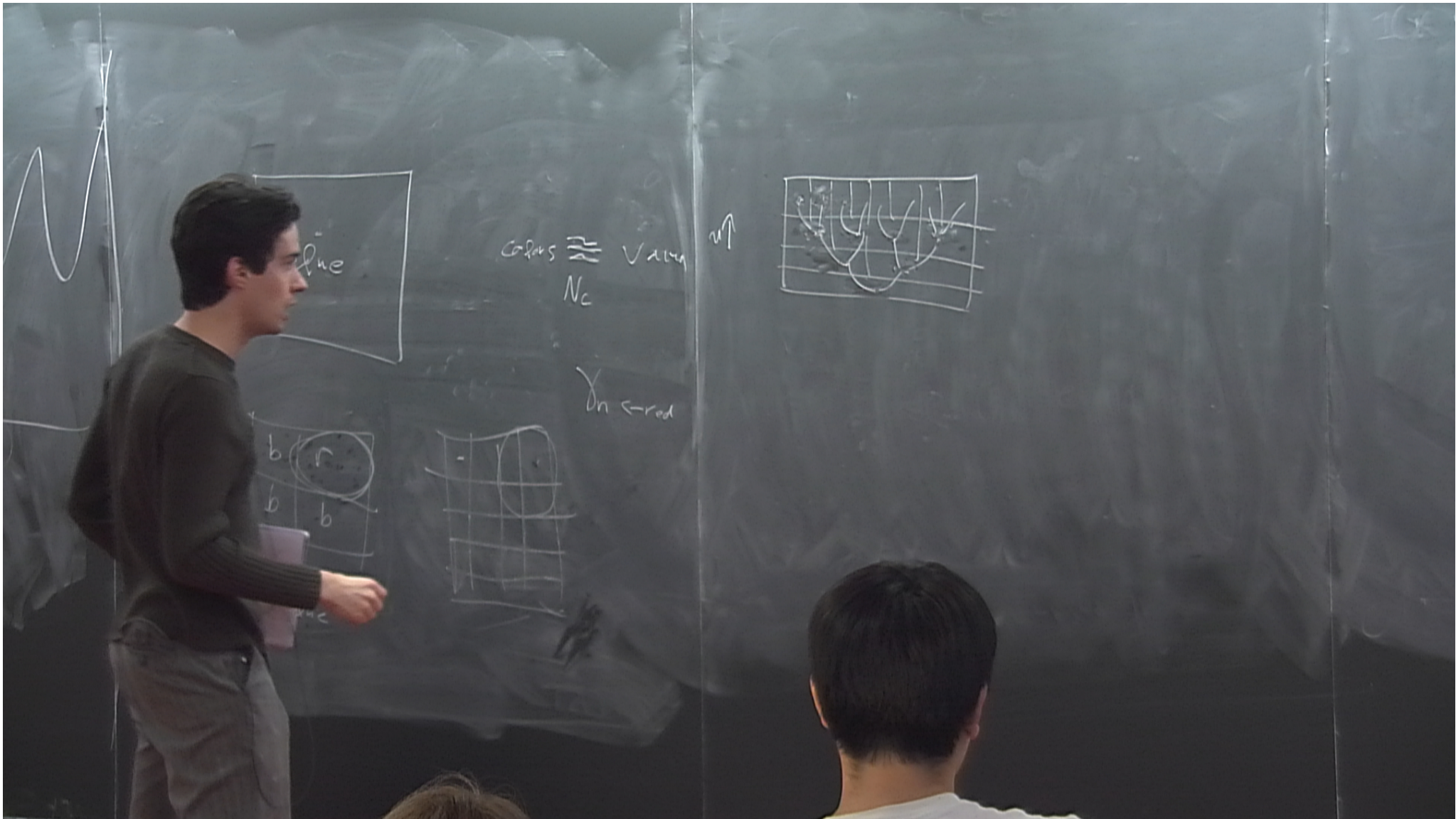
Calus  $\approx$  Valua  
 $N_c$

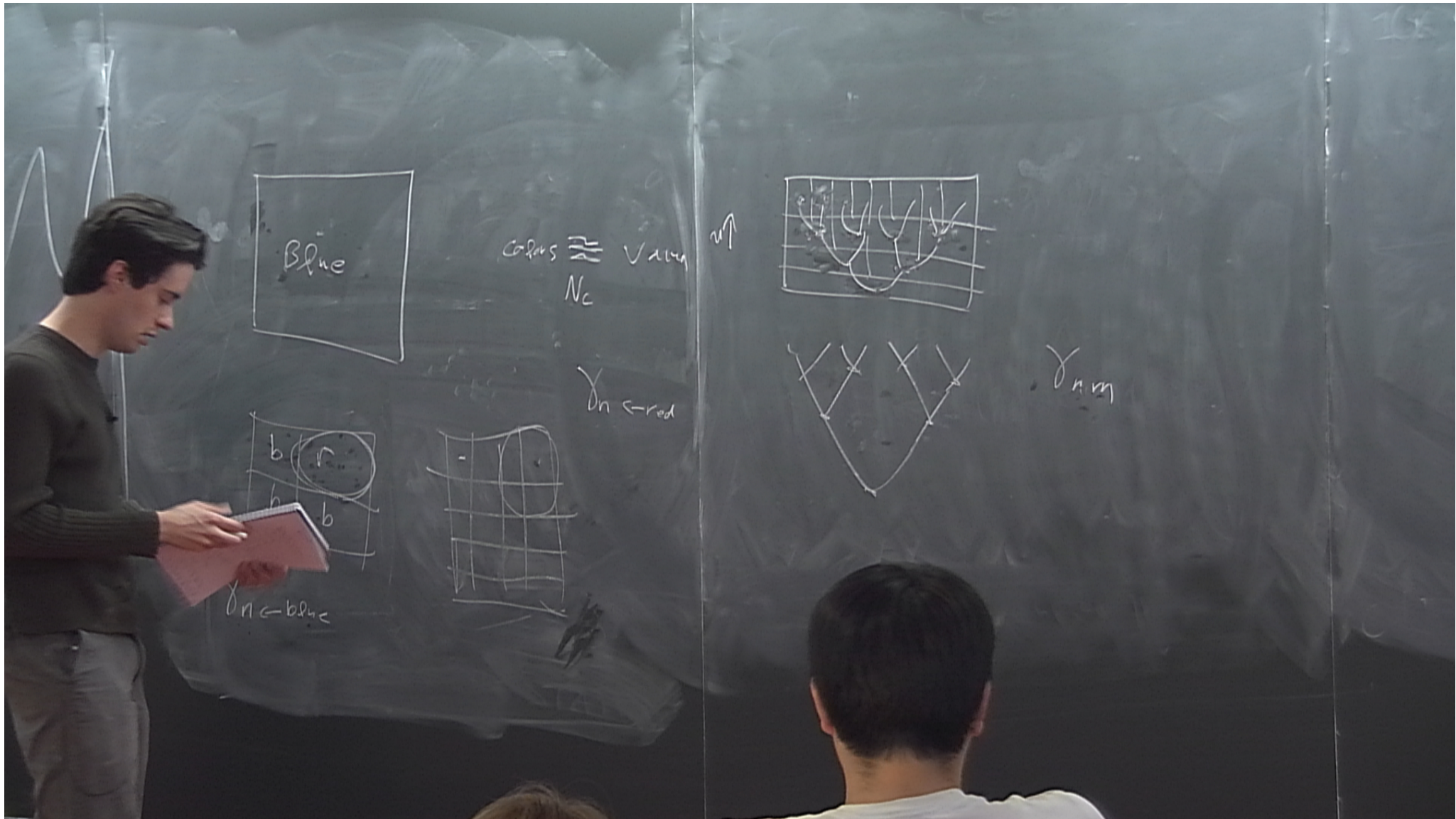
$\gamma_{n \leftarrow b}$

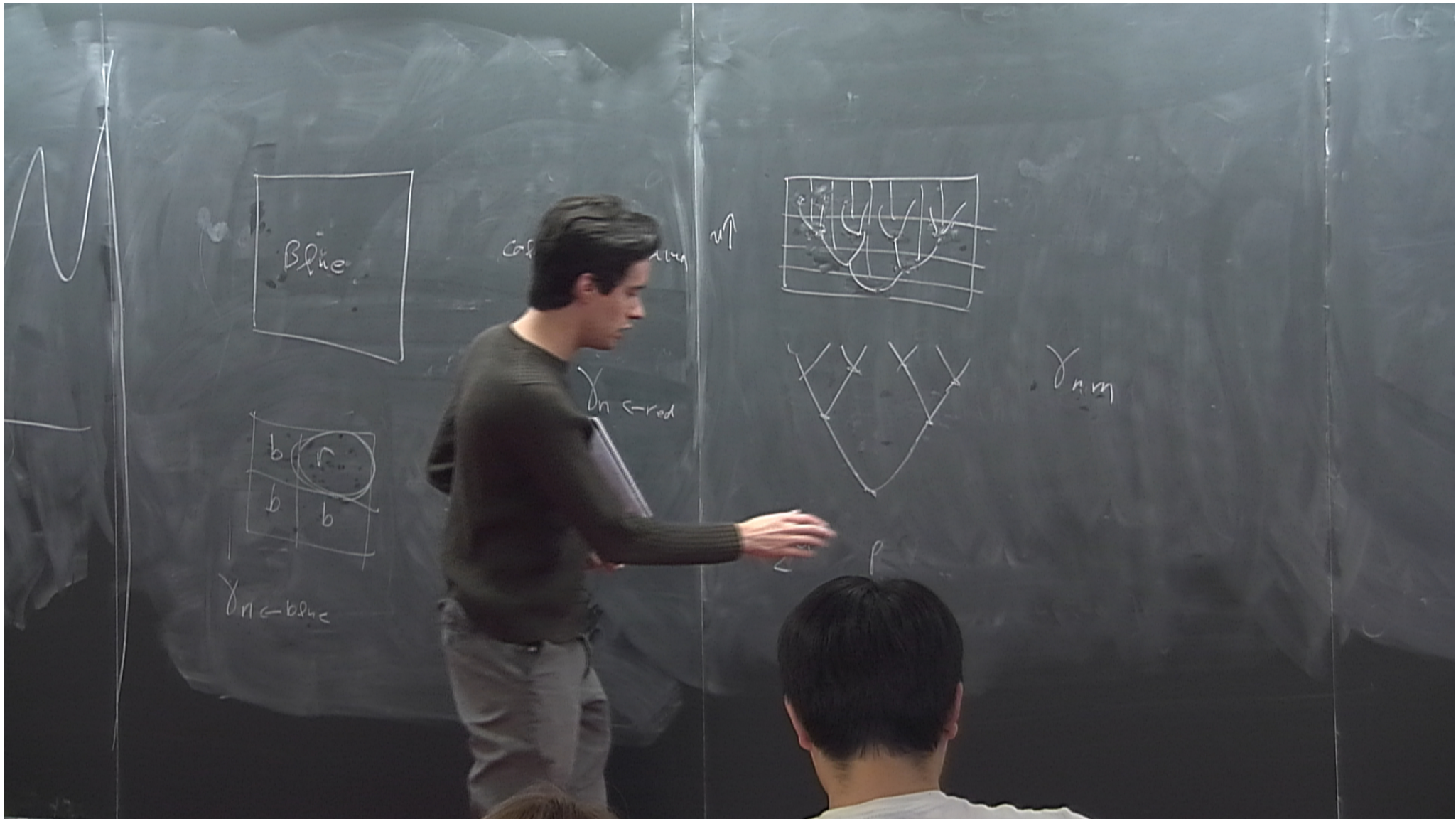


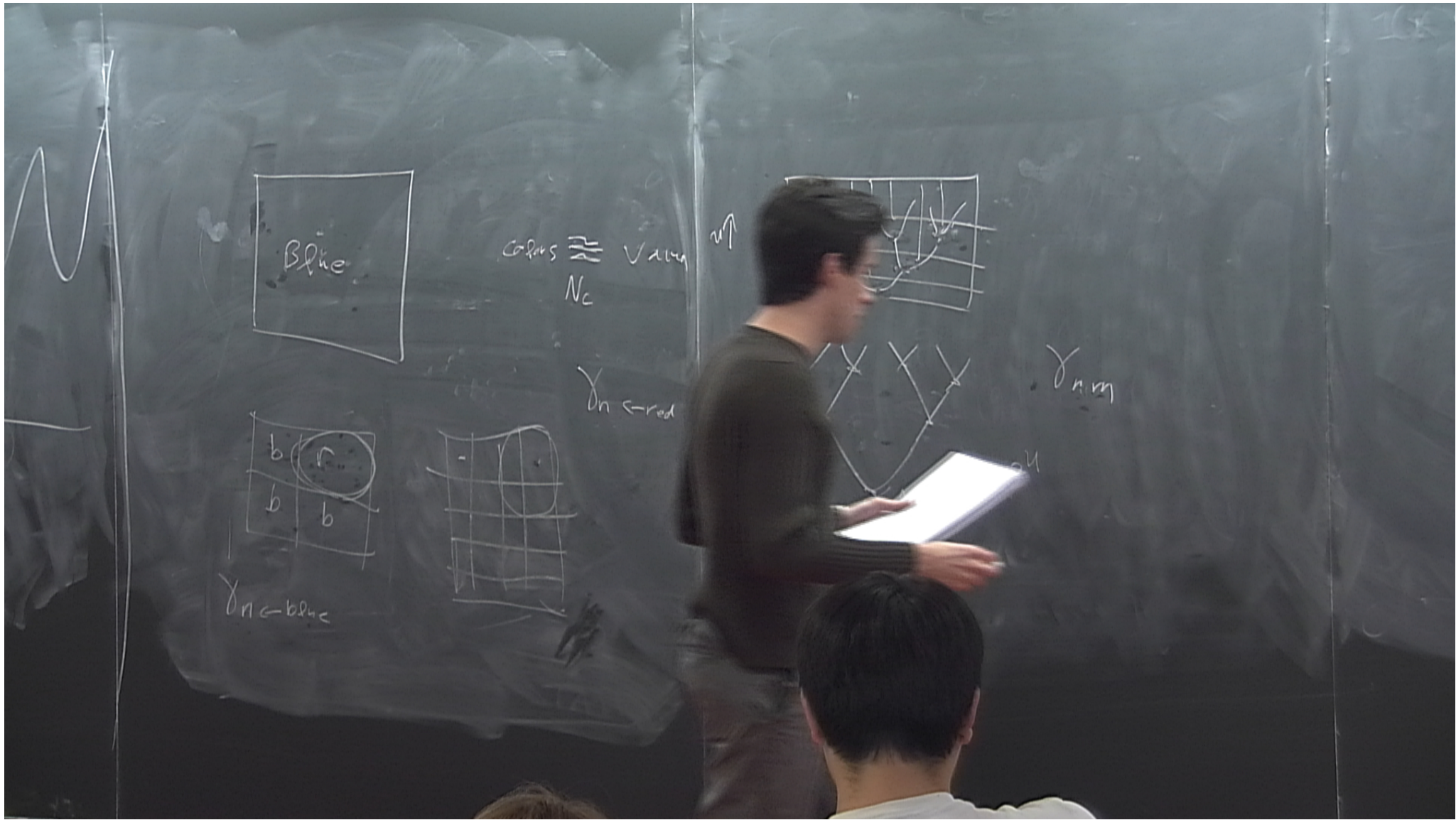


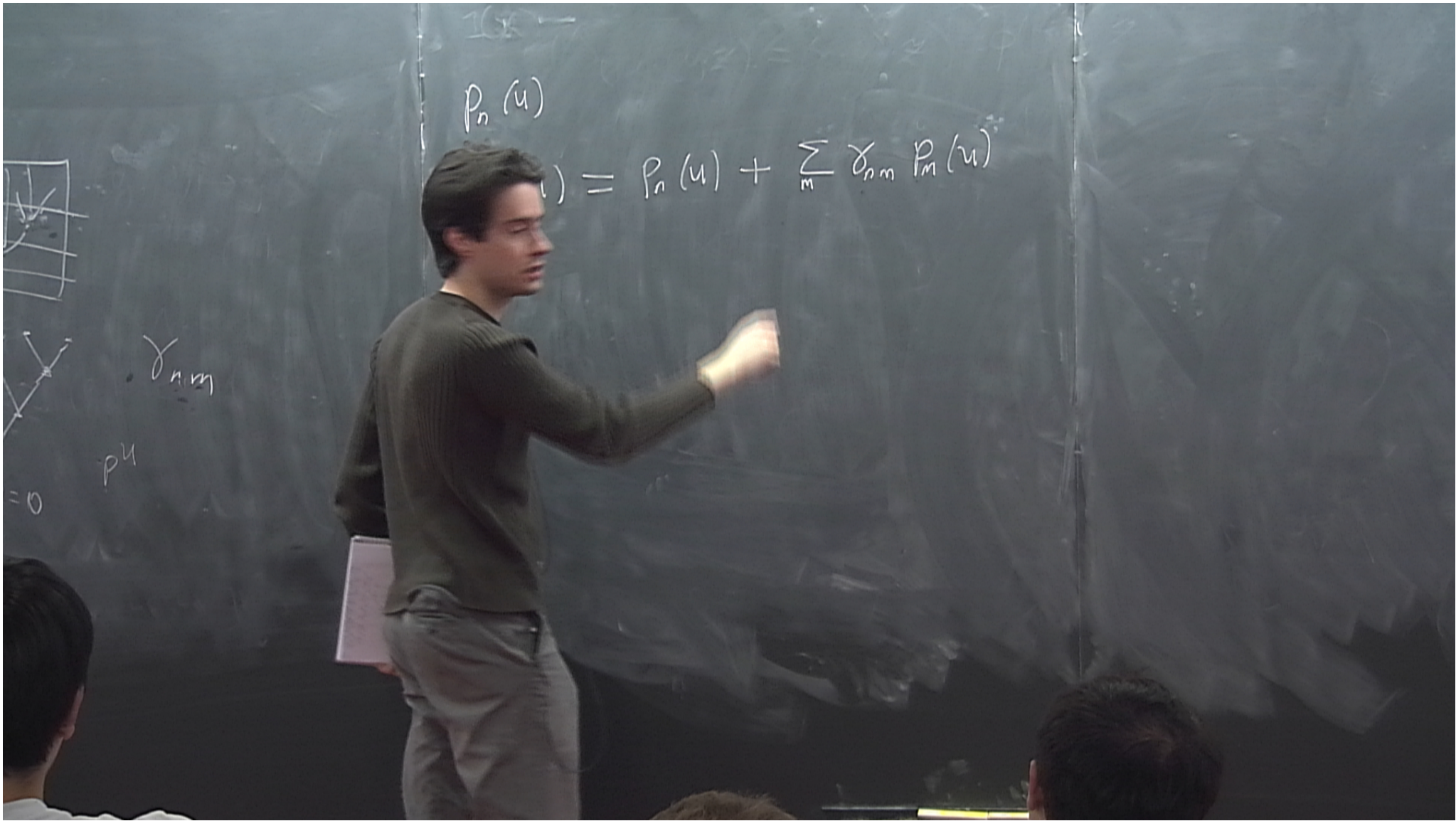












$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

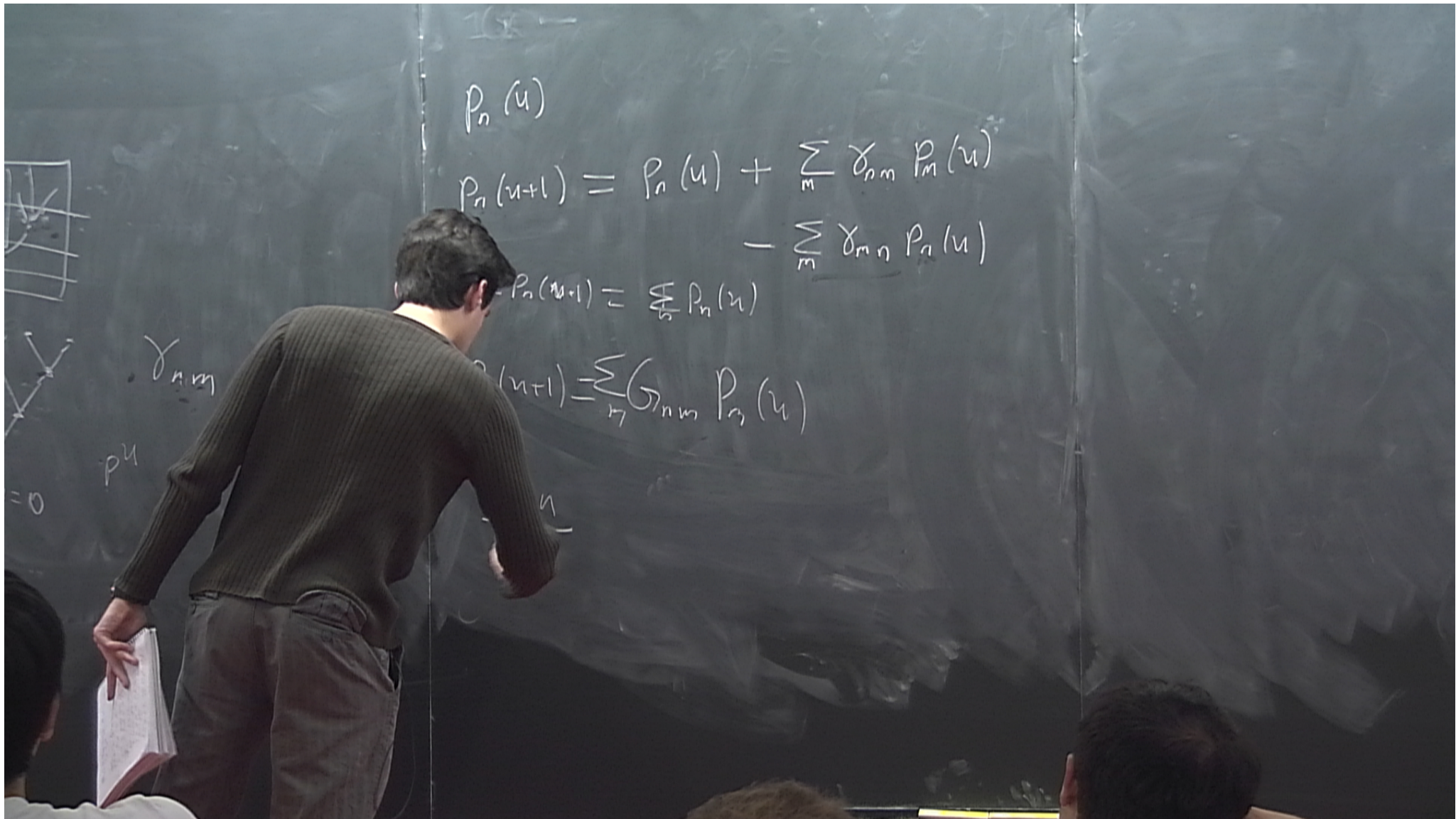
$$\sum P_n(u+1) = \sum P_n(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$\gamma_{nm}$

$p_n$

$= 0$



$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$G_{nm} = \gamma_{nm} + \delta_{nm} - \sum_m \gamma_{mn}$$

$\gamma_{nm}$

$P_n$



$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$\sum P_n(u+1) = \sum P_n(u)$$

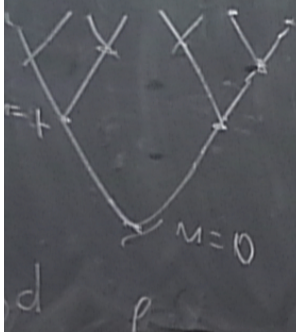
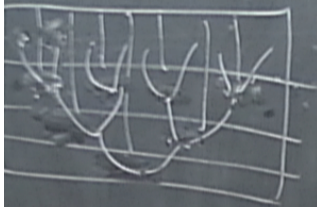
$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$\gamma_{nm}$

$p^4$

$= 0$



$\gamma_{nm}$

$p_u$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$\mathbb{E} P_n(u+1) = \sum_m P_n(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{nm} = e^{s_n/2} M_{nm} e^{-s_n/2}$$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$E P_n(u+1) = \sum_m P_m(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{mn} = e^{s_m/2} M_{mn} e^{-s_n/2}$$

$$\sum_n M_{nn} (\Sigma)_n = \lambda_\Sigma (\Sigma)_n$$

a)  $\lambda_\Sigma \leq 1$

b)

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$\varepsilon P_n(u+1) = \sum_m \varepsilon P_m(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{nm} = e^{s_n/2} M_{nm} e^{-s_n/2}$$

$$\sum_n M_{nn} (\Sigma)_n = \lambda_\Sigma (\Sigma)_m$$

a)  $\lambda_\Sigma \leq$

b)  $\Sigma = 0 \Rightarrow e^{s_n}$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m P_m(u)$$

$$\varepsilon P_n(u+1) = \sum_m P_m(u)$$

$$P_n(u+1) = \sum_m G_{nm}$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^s$$

$$G_{mn} = e^{s/2}$$

$$\sum_n M_{nn}(\Sigma)_n = \lambda_\Sigma(\Sigma)_M$$

a)  $\lambda_\Sigma \leq 1$

b)  $\Sigma = 0 \quad (\Theta)_n = \frac{e^{s/2}}{\sqrt{\sum e^s}}$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m P_m(u)$$

$$E P_n(u+1) = \sum_m P_m(u)$$

$$P_n(u+1) = \sum_m G_{nm}$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{nm} = e^{s_n/2}$$

$$\sum_n M_{nn}(\Sigma)_n = \lambda_\Sigma(\Sigma)_M$$

a)  $\lambda_\Sigma \leq 1$

b)  $\Sigma = 0 \quad (0)_n = \frac{e^{s_n/2}}{\sqrt{\sum e^{s_n}}}$

$$P_n^{(0)} = \frac{1}{N} e^{s_n}$$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \gamma_{nm} P_m(u) - \sum_m \gamma_{mn} P_n(u)$$

$$\varepsilon P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{mn} = e^{s_n/2} M_{mn} e^{-s_n/2}$$

$$\sum_n M_{nn} (\Sigma)_n = \lambda_\Sigma (\Sigma)_n$$

$$\lambda_\Sigma \leq 1$$

$$\Sigma = 0 \quad (\Theta)_n = \frac{e^{s_n/2}}{\sqrt{\sum e^{s_n}}}$$

$$P_n^{eq} = \frac{1}{N} e^{s_n}$$

$$P_n(u)$$

$$P_n(u+1) = P_n(u) + \sum_m \lambda_{nm} P_m(u) - \sum_m \lambda_{mn} P_n(u)$$

$$\sum_n P_n(u+1) = \sum_n P_n(u)$$

$$P_n(u+1) = \sum_m G_{nm} P_m(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$G_{nm} = e^{s_n/2} \quad (2)$$

$$\sum_n M_{nn}(\Sigma)_n = \lambda_\Sigma(\Sigma)_M$$

a)  $\lambda_\Sigma \leq 1$

b)  $\Sigma = 0 \quad (\theta)_n = \frac{e^{s_n/2}}{\sqrt{\sum e^{s_n}}}$

$$P_n^{(0)} = \frac{1}{\sum e^{s_n}} e^{s_n}$$

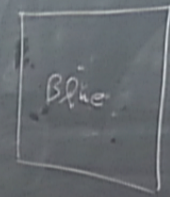
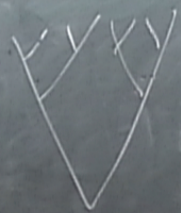


# Eternal Symmetry

1) Exponential Exp.

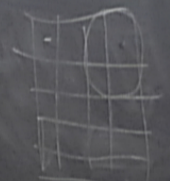
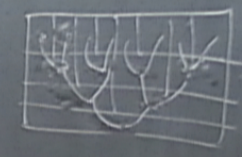
2) ... relate by always

3) ... eternal theo, at

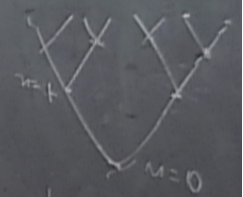


Colors  $\cong$  Value  
 $N_c$

$\uparrow$



$\ln \leftarrow \text{rad}$



$\sum d$

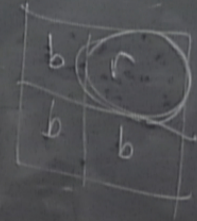
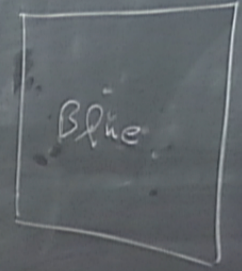
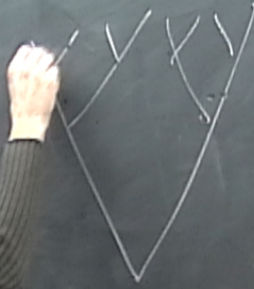
$\ln \leftarrow \text{blue}$

# Eternal Symmetree

1) Exponential Exp.

2) Multiple Vacua

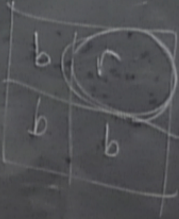
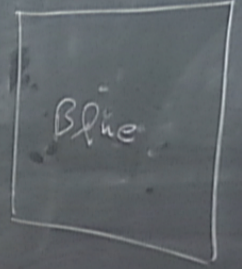
3) "Conformal  
Future  $\infty$ "



$\gamma_{nc-blue}$

# External Symmetrie

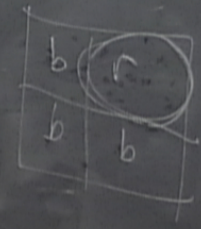
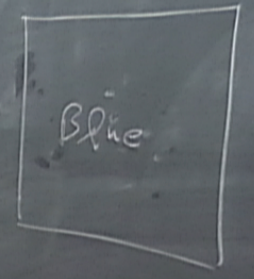
- 1) Exponential Exp.
- 2) Multiple  $\rightarrow$  related by decays
- 3) "Control Theory" at



$\gamma_{n-c-blue}$

# Eternal Symmetree

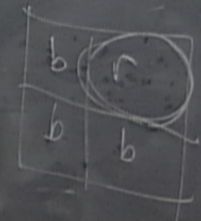
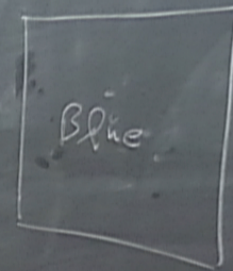
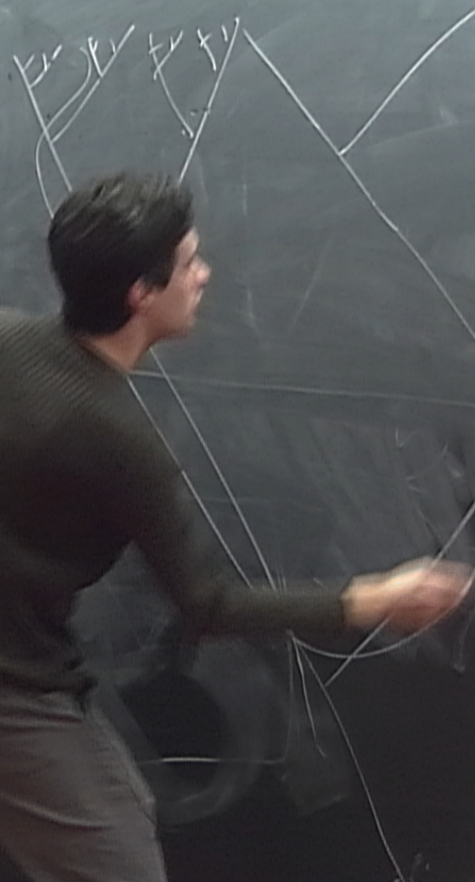
- 1) Exponential Exp.
- 2) Multiple variables by decays
- 3) "Contour theory" at future



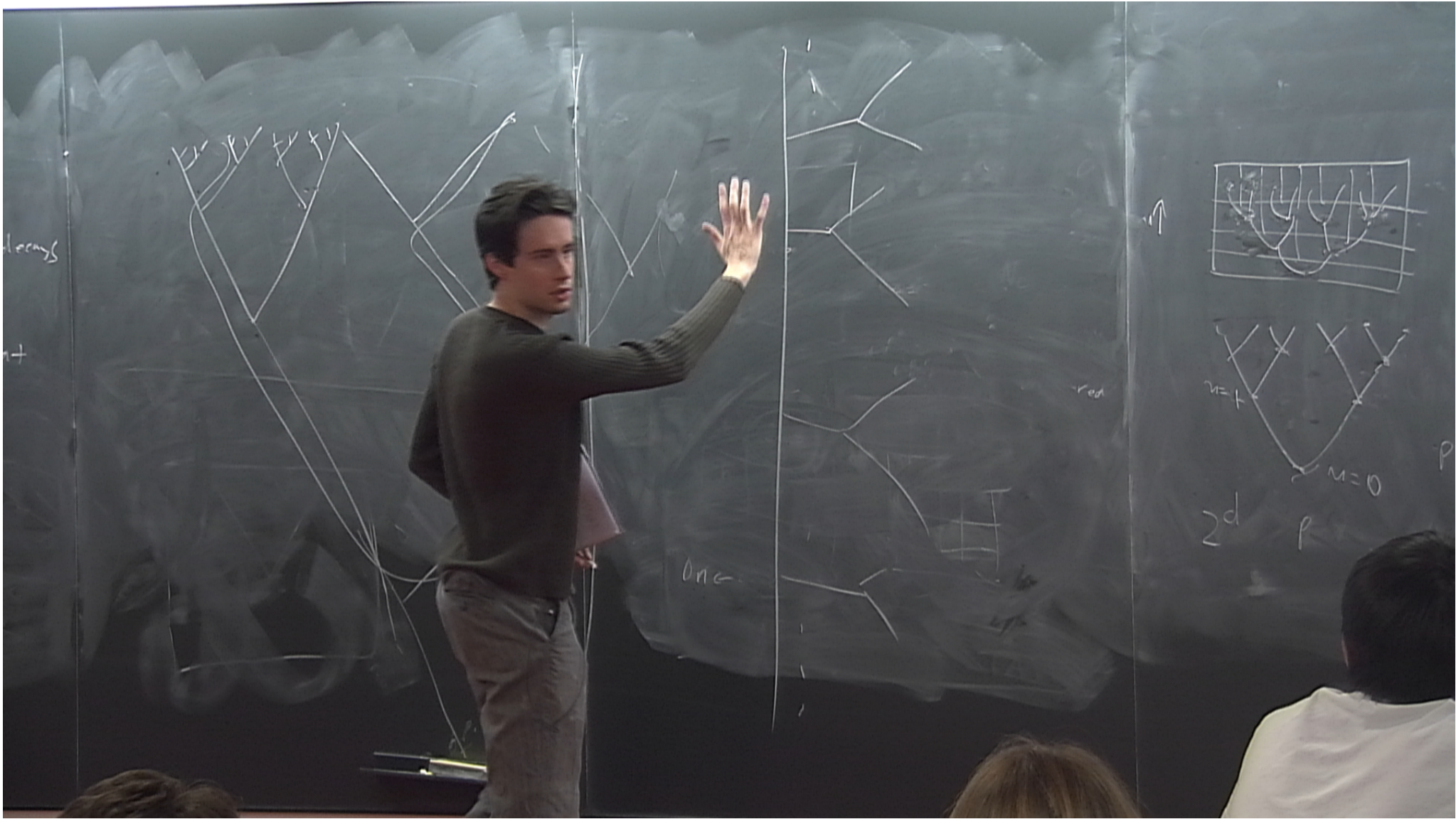
$\gamma_{nc-blue}$

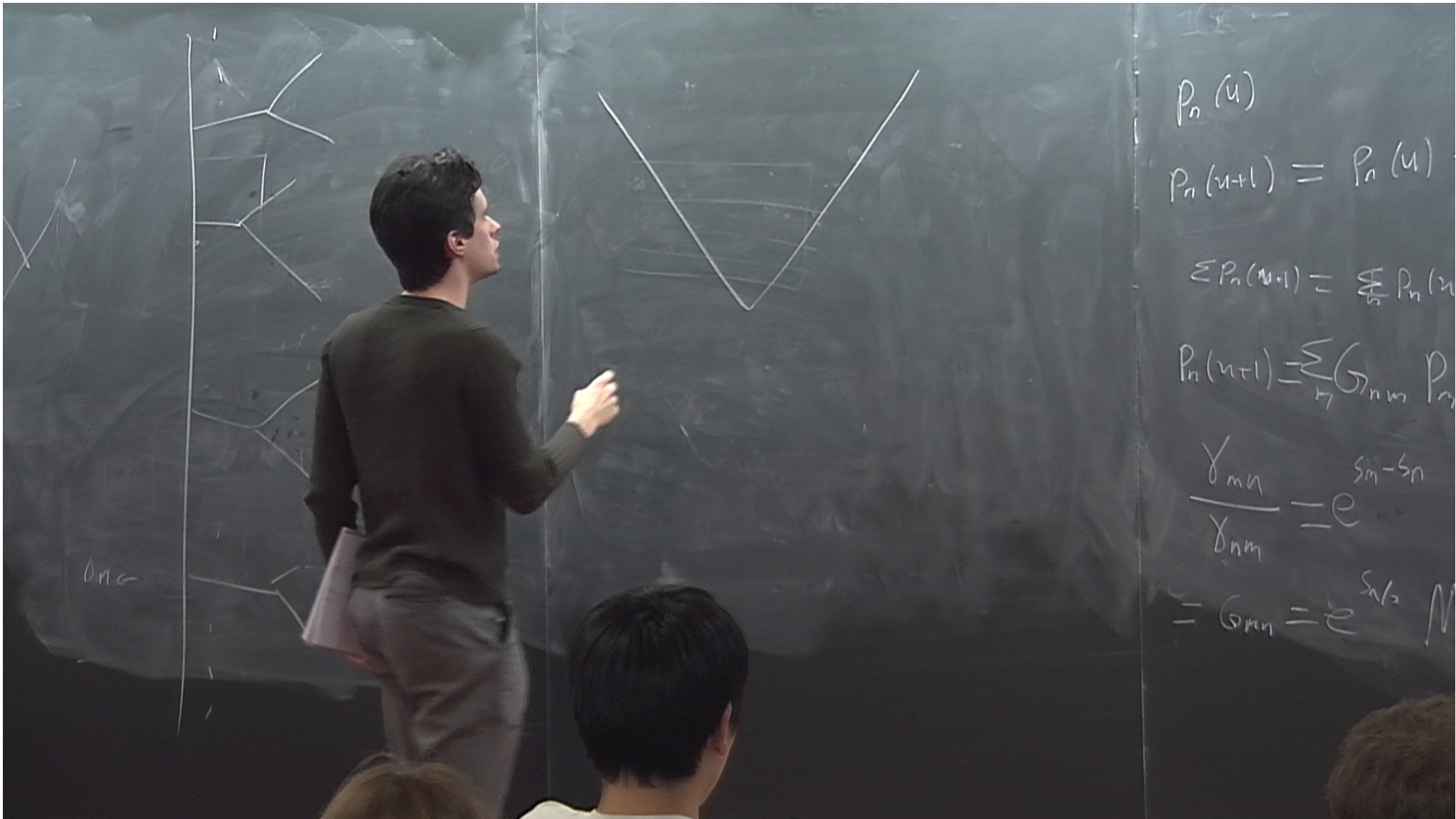
# Eternal Symmetree

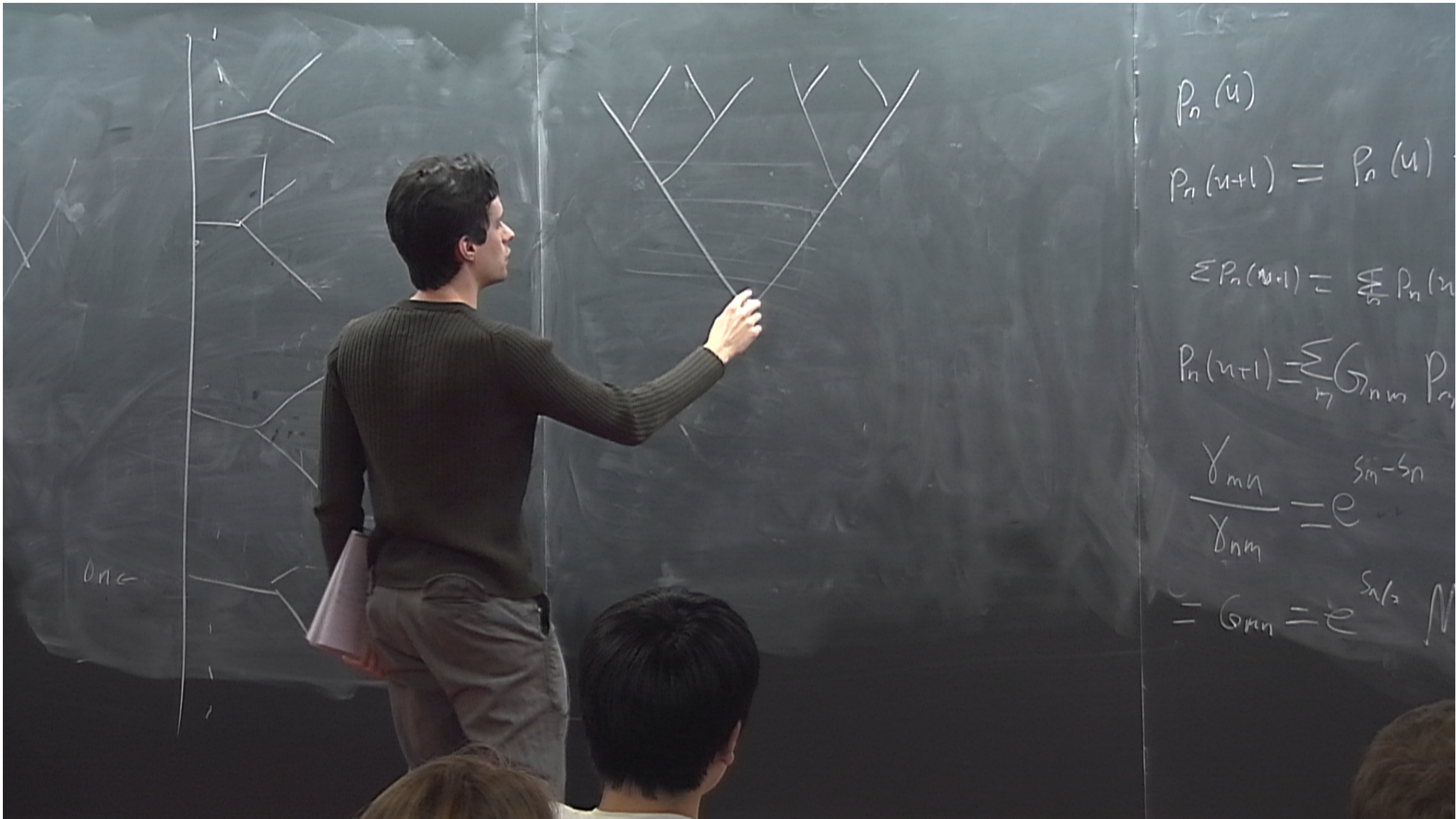
- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$



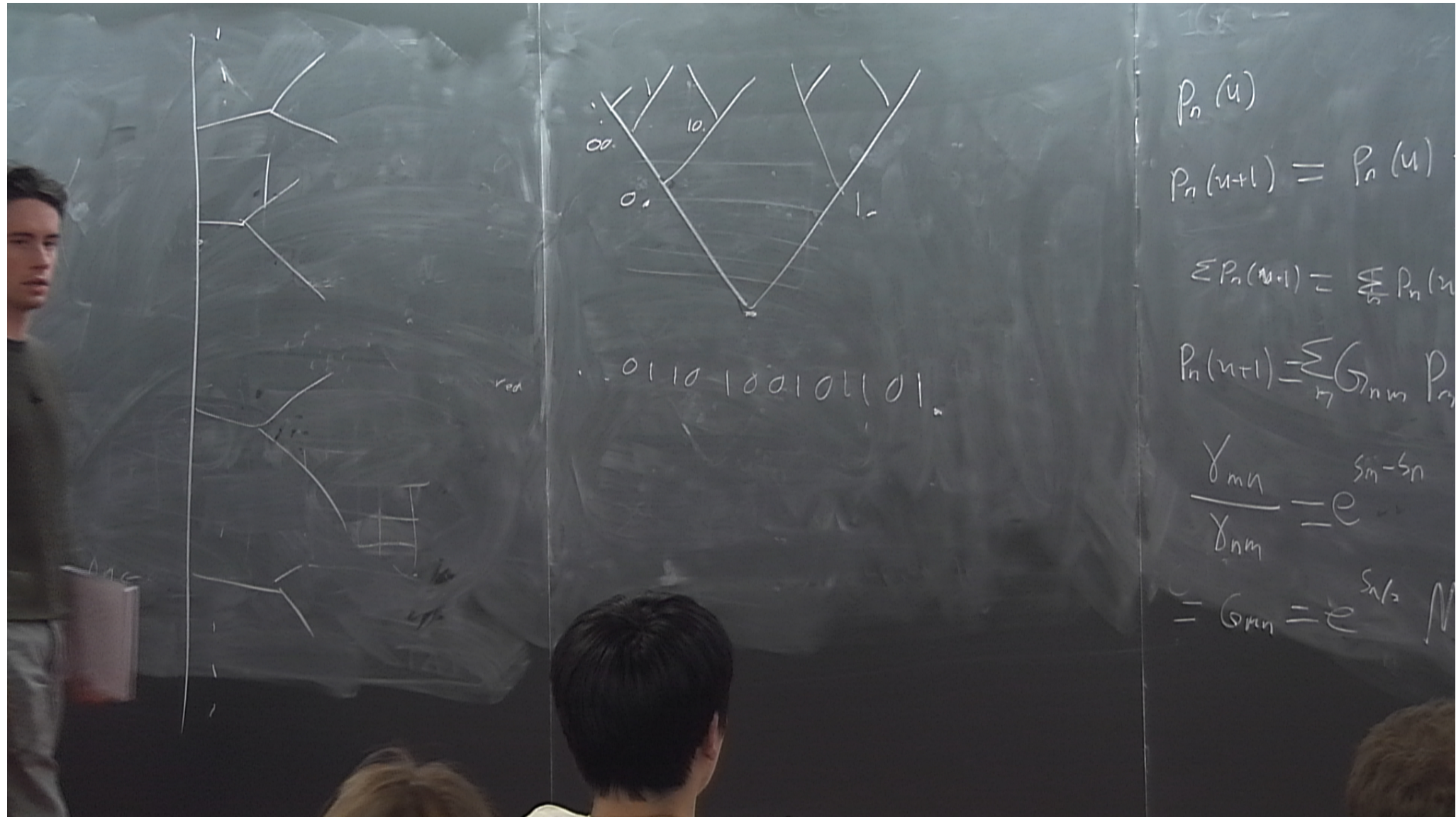
$\gamma_{n-c} = b_{n-c}$

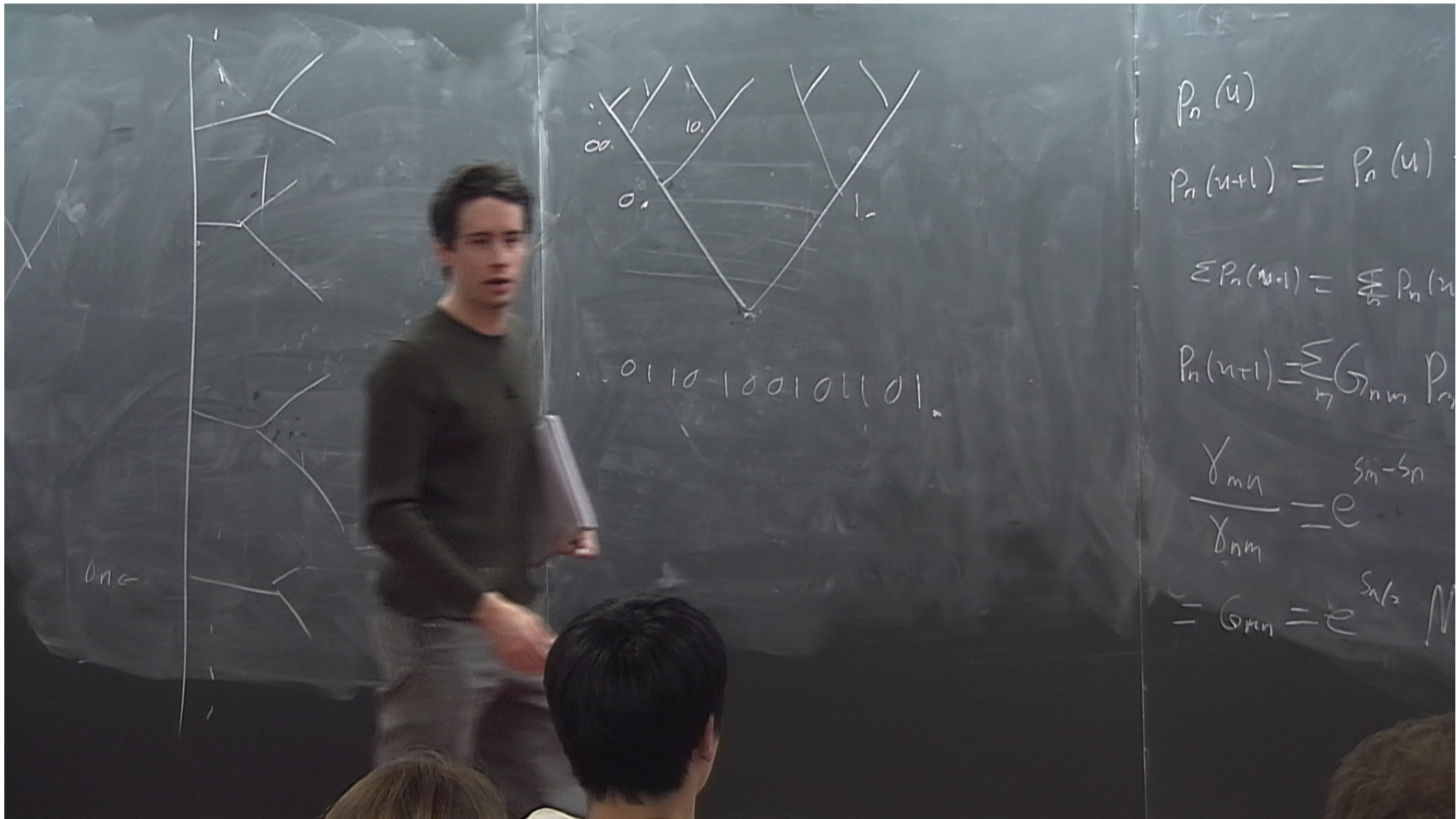


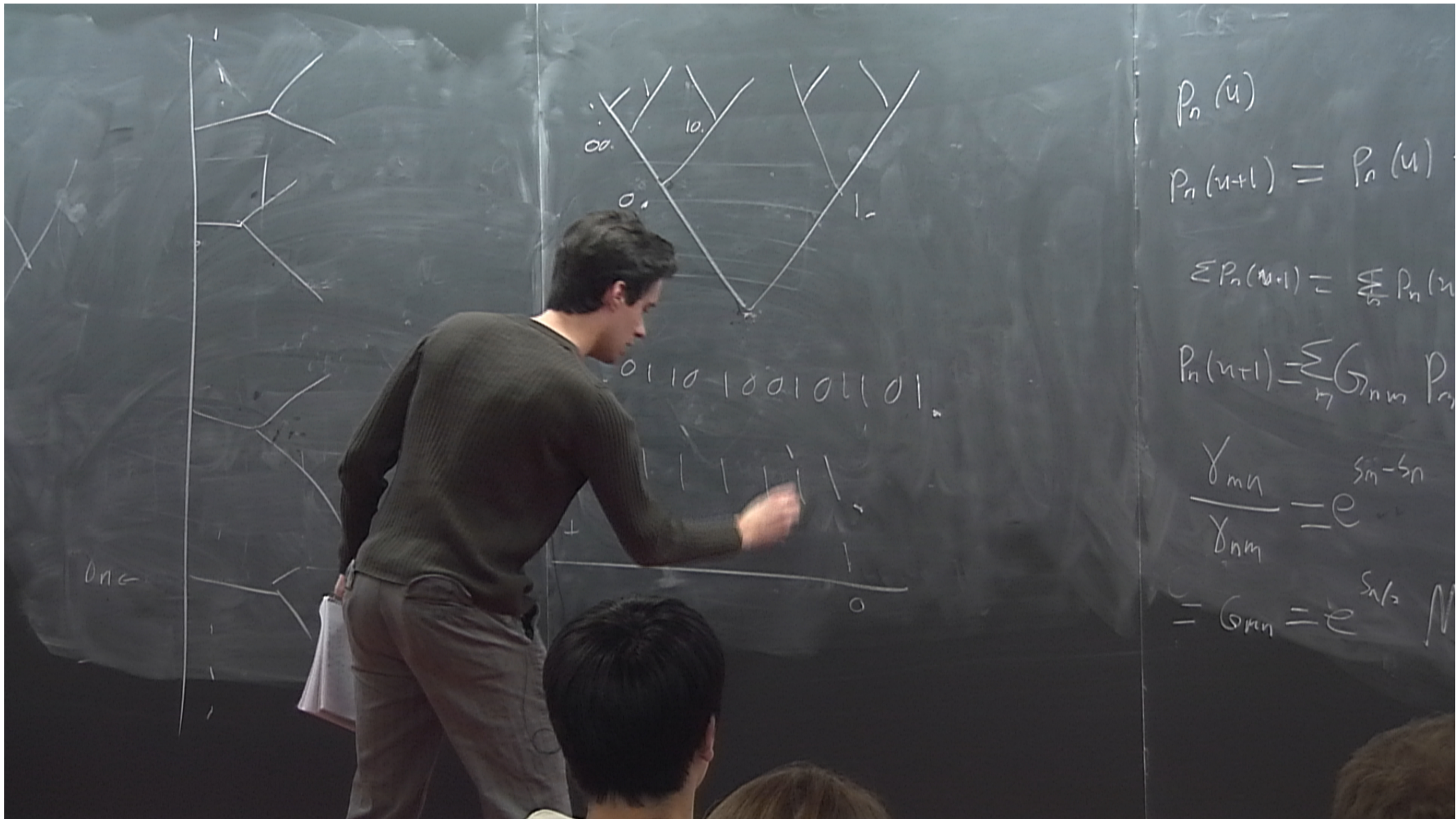


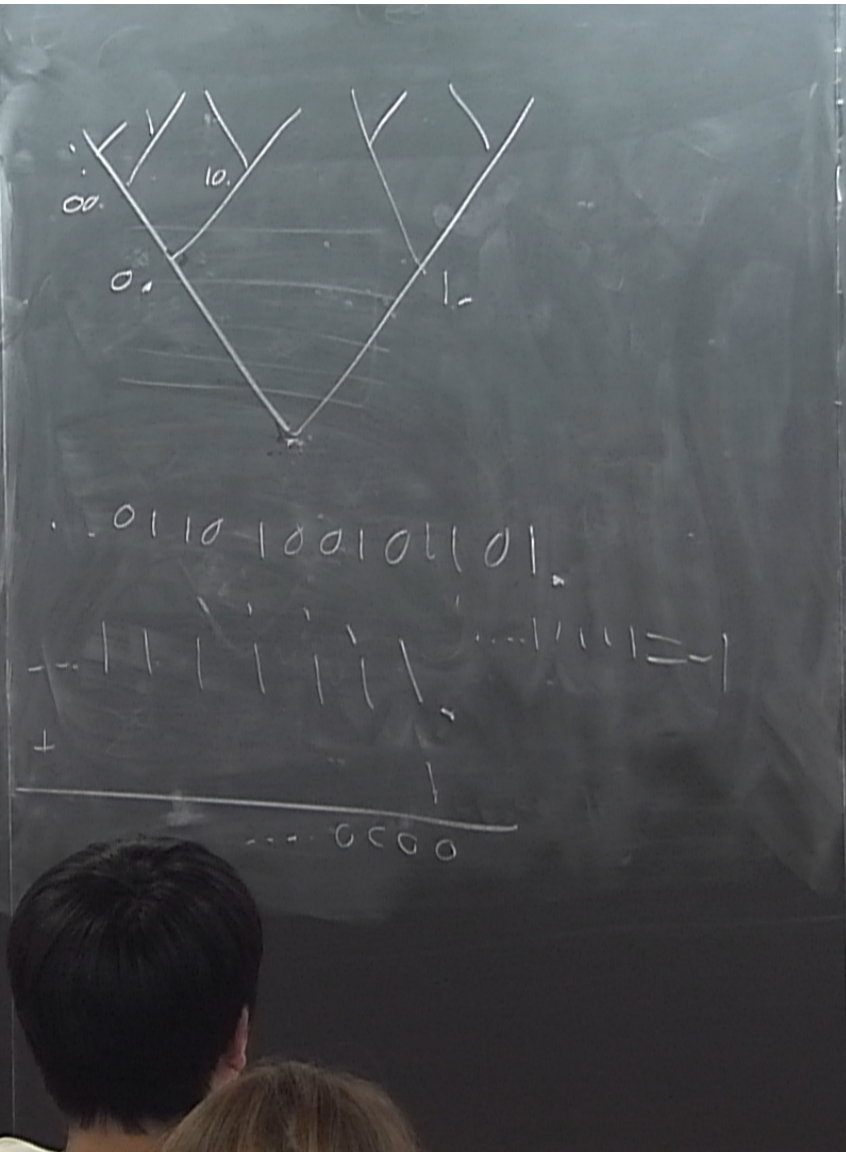












$$P_n(u)$$

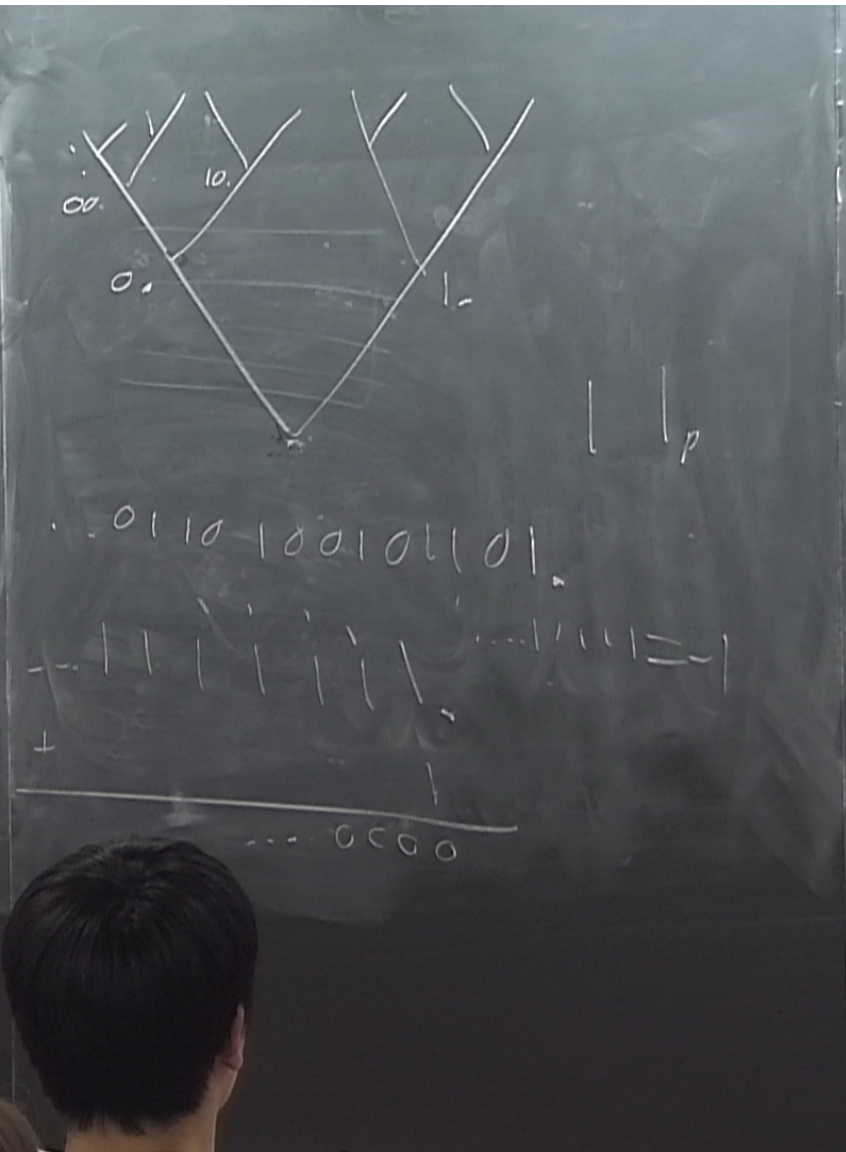
$$P_n(u+1) = P_n(u)$$

$$\sum P_n(u+1) = \sum_{\frac{1}{2}} P_n(u)$$

$$P_n(u+1) = \sum_{\frac{1}{2}} G_{nm} P_n(u)$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{s_m - s_n}$$

$$= G_{nm} = e^{s_n/2} M$$



$$P_n(u)$$

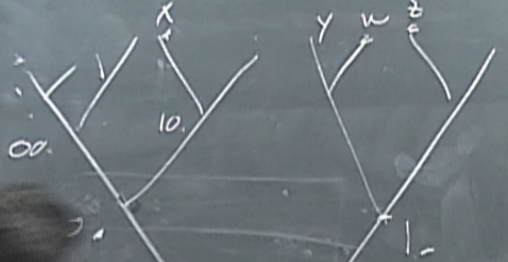
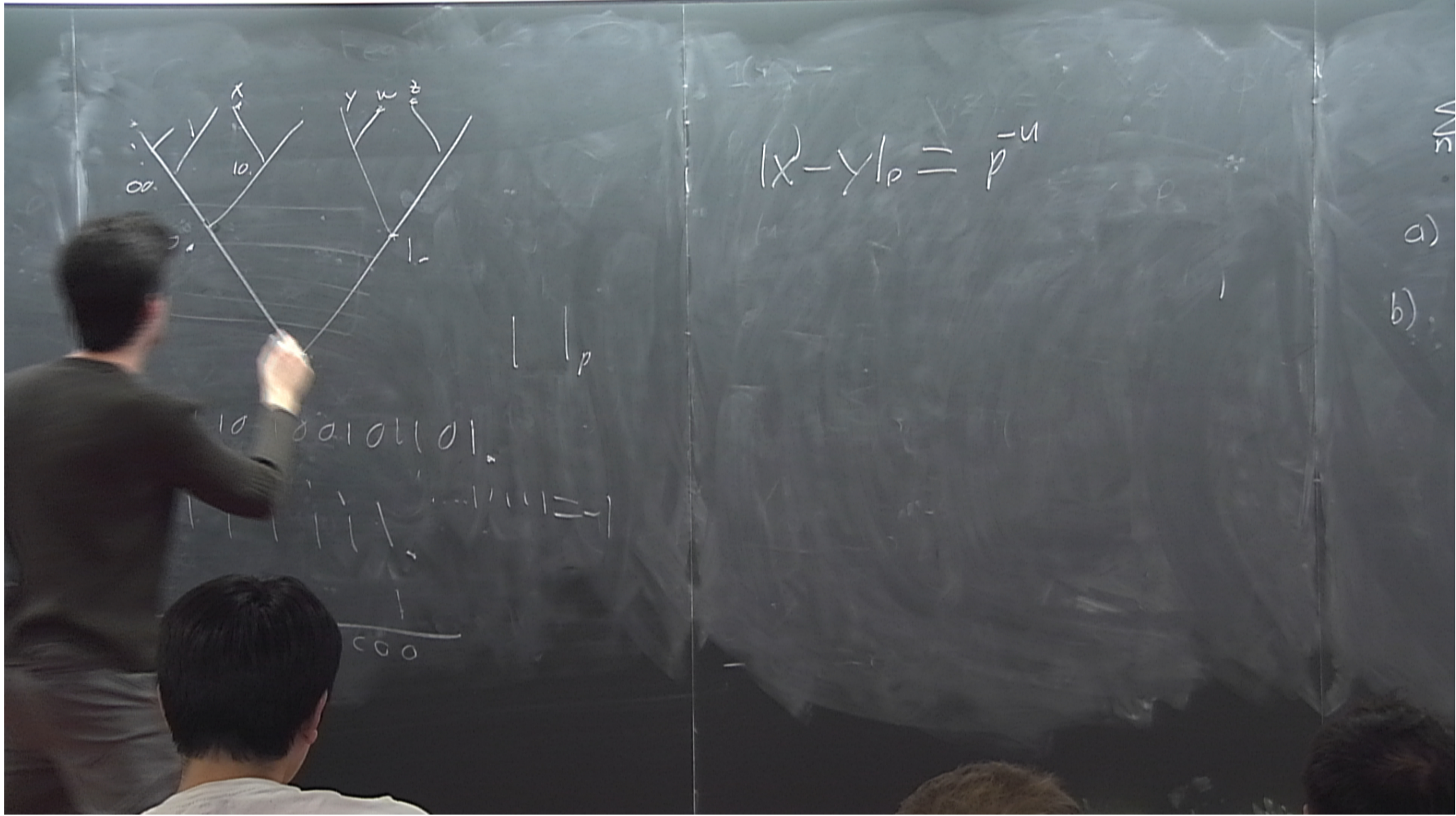
$$P_n(u+1) = P_n(u)$$

$$\sum P_n(u+1) = \sum P_n(u)$$

$$P_n(u+1) = \sum G_n$$

$$\frac{\gamma_{mn}}{\gamma_{nm}} = e^{\frac{s_m - s_n}{2}}$$

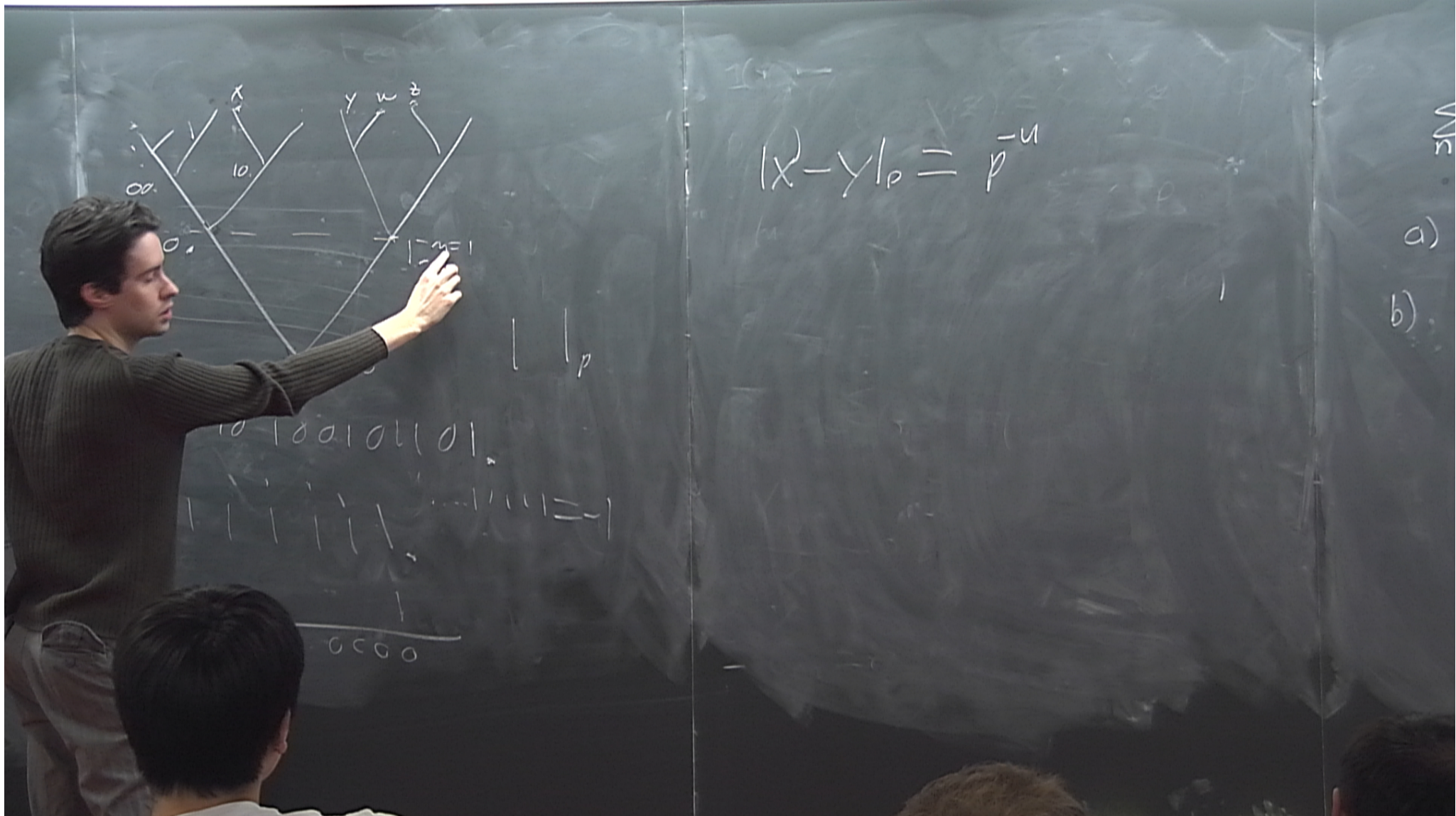
$$= G_{mn} = e^{\frac{s_m - s_n}{2}}$$

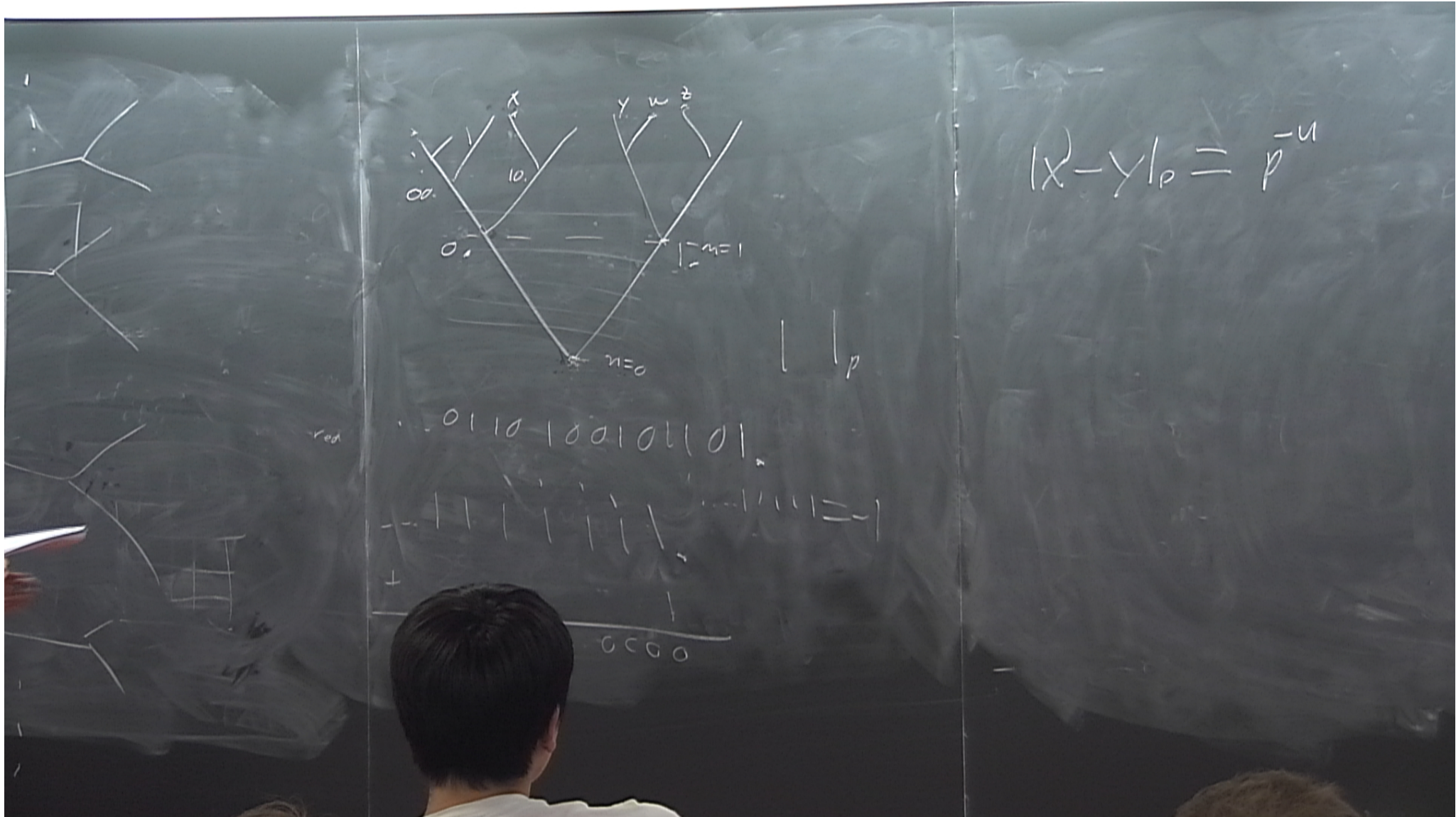


$$|x-y|_p = p^{-u}$$

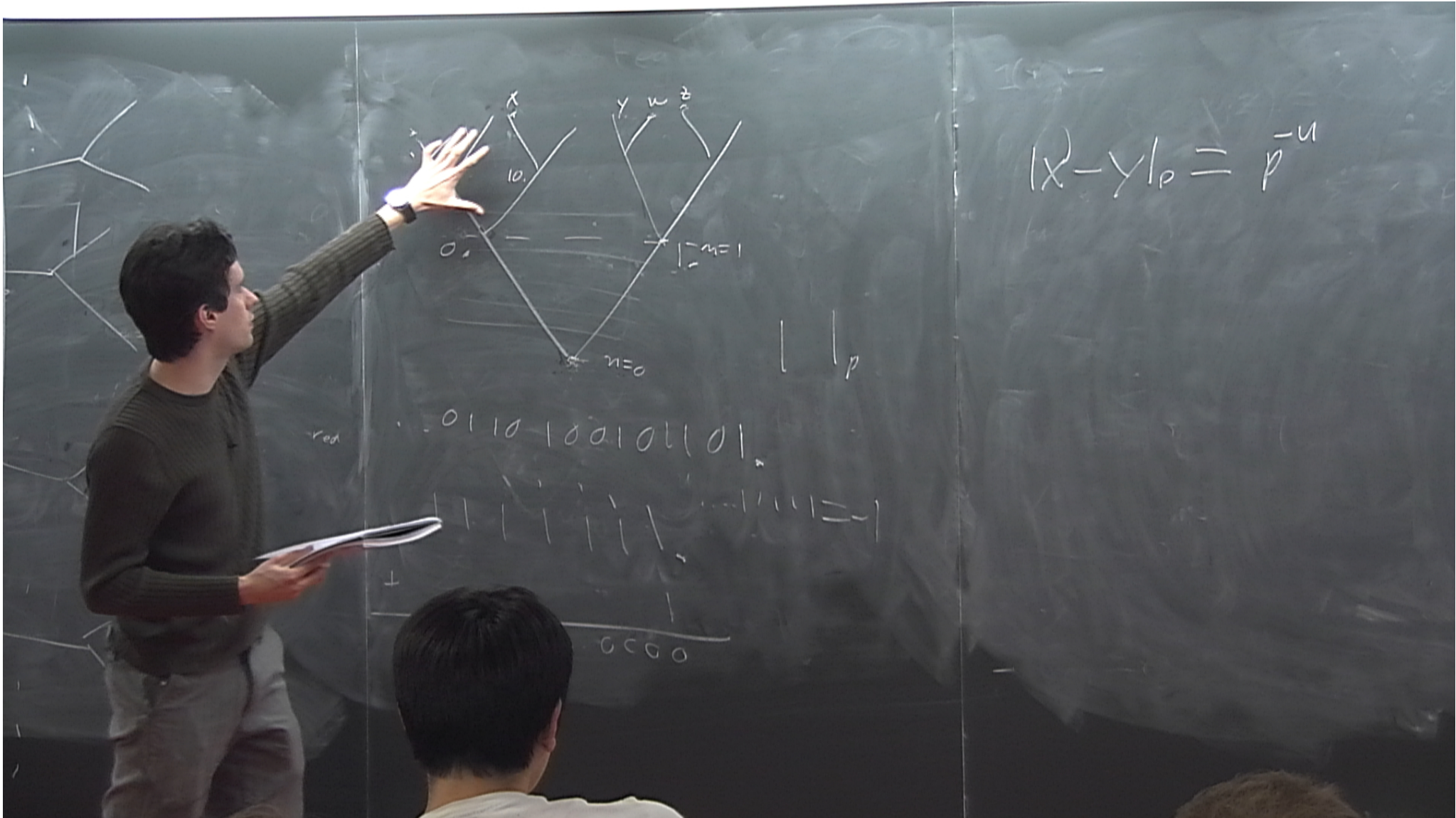
10 10 10 10 10 10 10 10

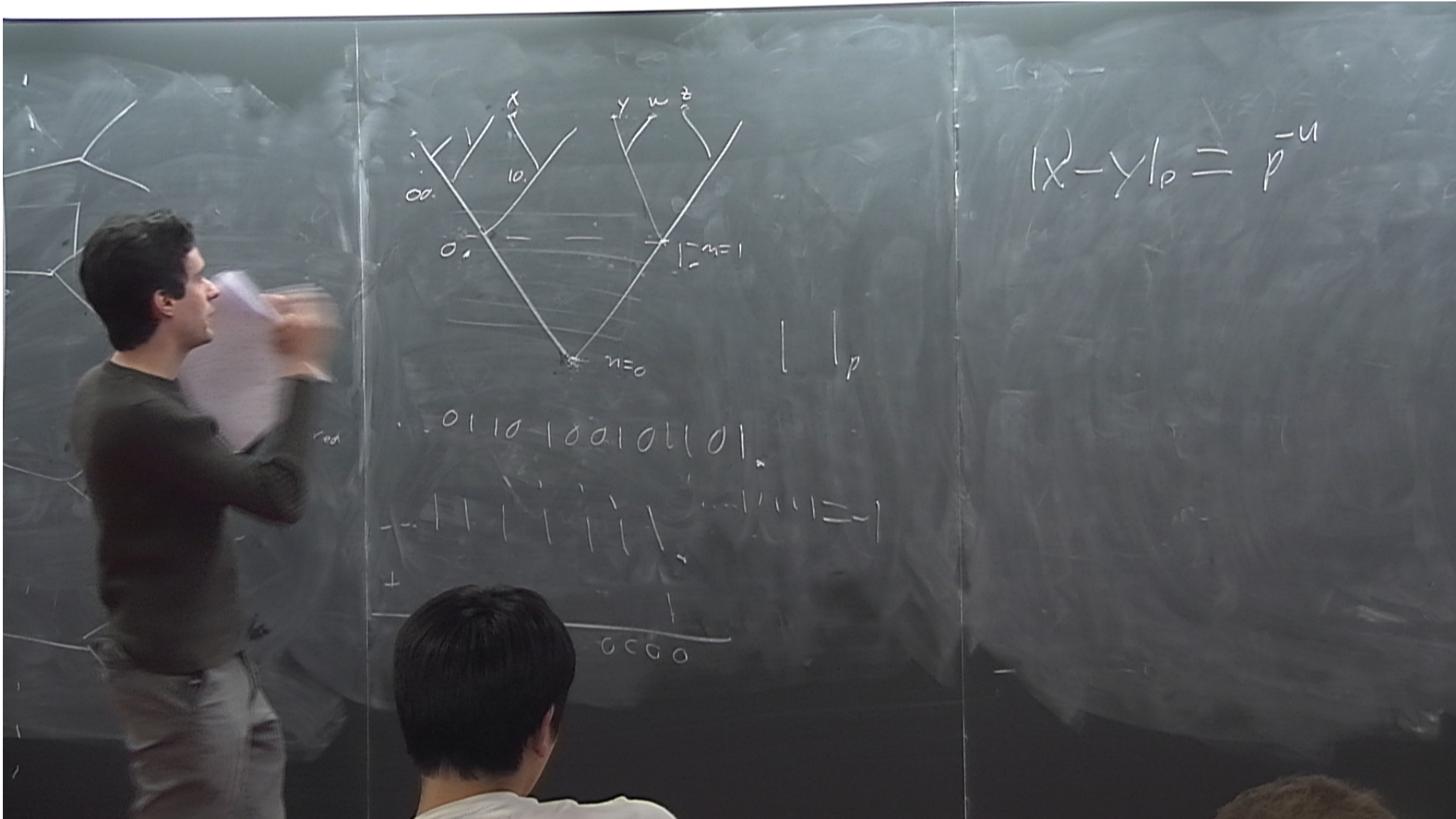
- a)
- b)

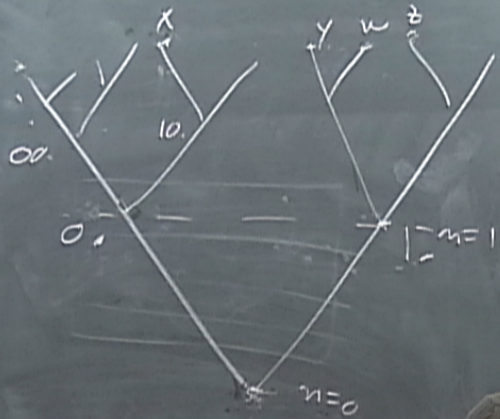












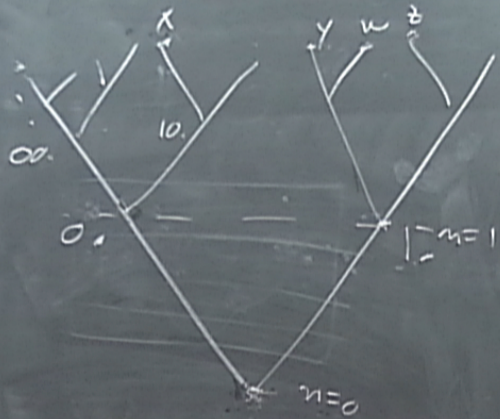
$$(x - y) / p = p^{-u}$$

x

red ... 01101001011

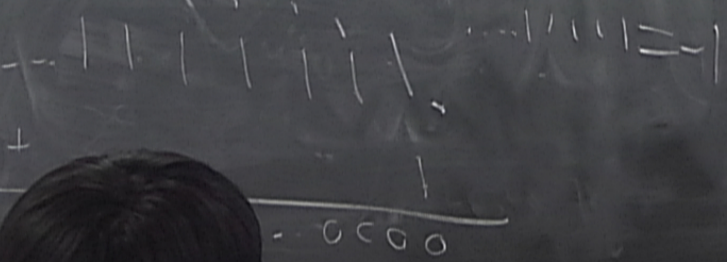


... 0000



$| \quad | \quad p$

red  $\dots 0110100101101$



$$(x - y) / p = p^{-u}$$

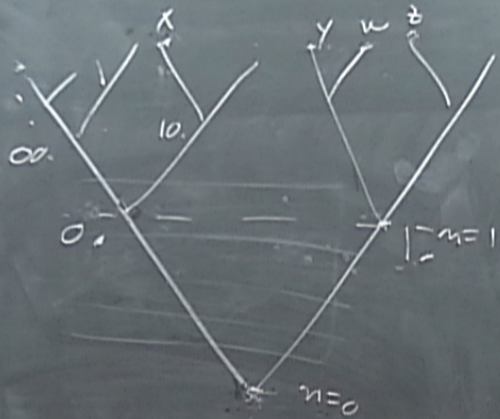


$d(a, b)$

$x_a, y_a$

$x_b, y_b$

$$\frac{(x_b - y_b)}{p}$$



red

0110 100101101

|||||

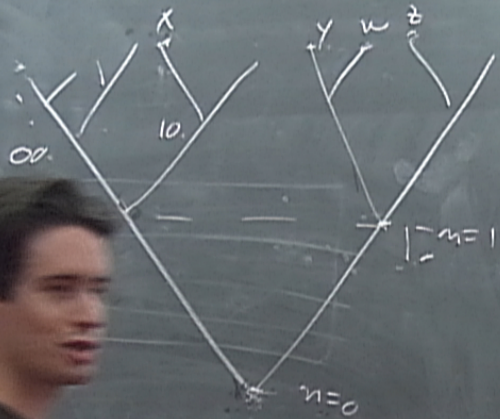
0000

$$(X - Y)_p = p^{-u}$$

$$p^{-d(a,b)}$$

$$= \left| \frac{(X_a - Y_a)(X_b - Y_b)}{(X_a - Y_b)(X_b - Y_a)} \right|_p$$

$$X - \frac{B}{A+D}$$



$| \quad |$   
 $p$

0 1 1 0 1 0 0 1 0 1 1 0 1



... 0 0 0 0

$$(X) - Y | p = p^{-u}$$

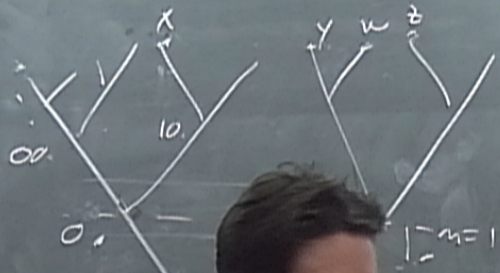
$X_a, Y_a$

$X_b, Y_b$

$p = d(a, b)$

$$= \left| \frac{(X_a - Y_a)(X_b - Y_b)}{(X_a - Y_b)(X_b - Y_a)} \right| p$$

$$X' = \frac{Ax + B}{Cx + D}$$



$$(x - y)_p = p^{-u}$$

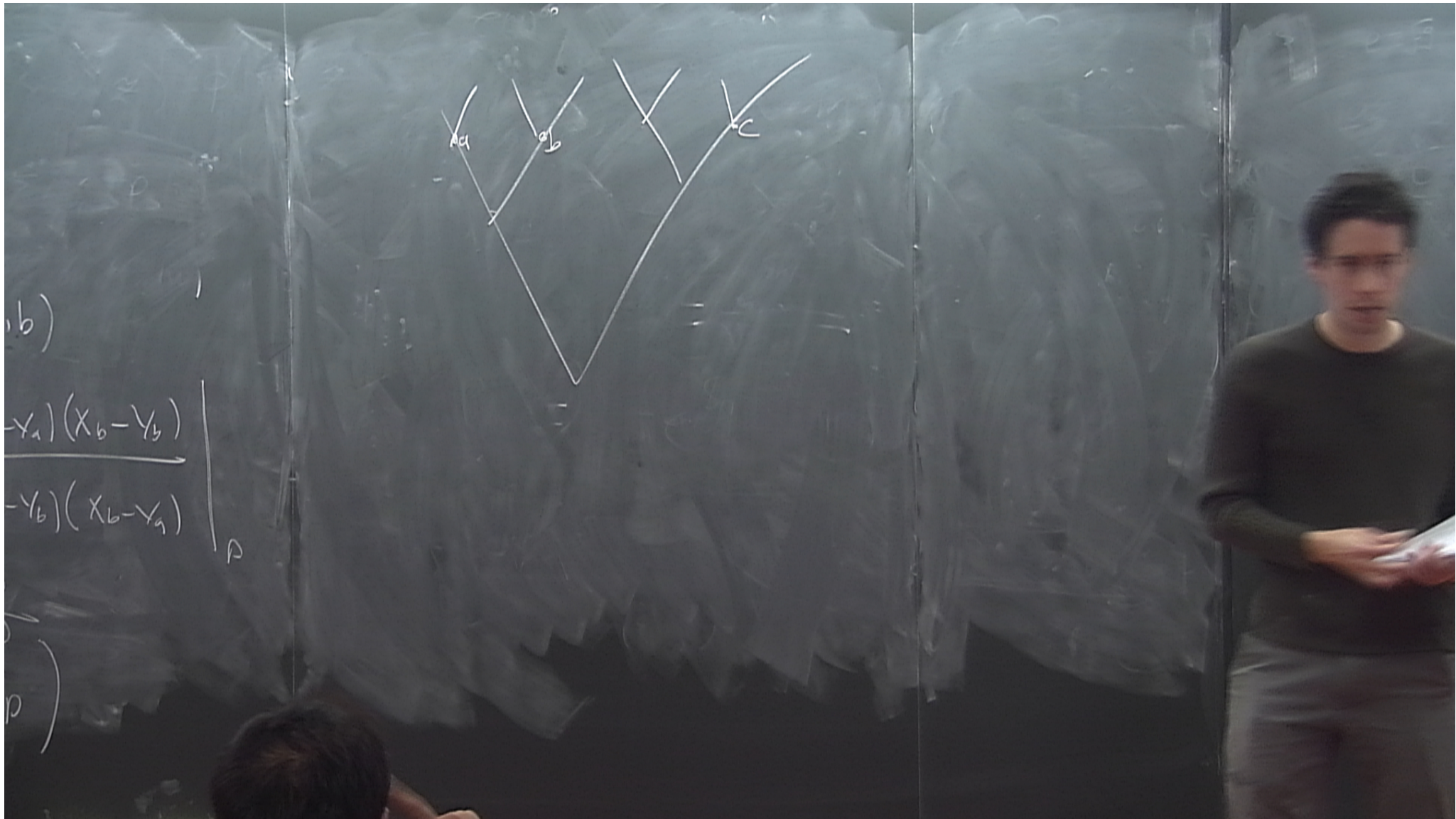
$x_a, y_a$   
 $x_b, y_b$

$$p^{-d(a,b)}$$

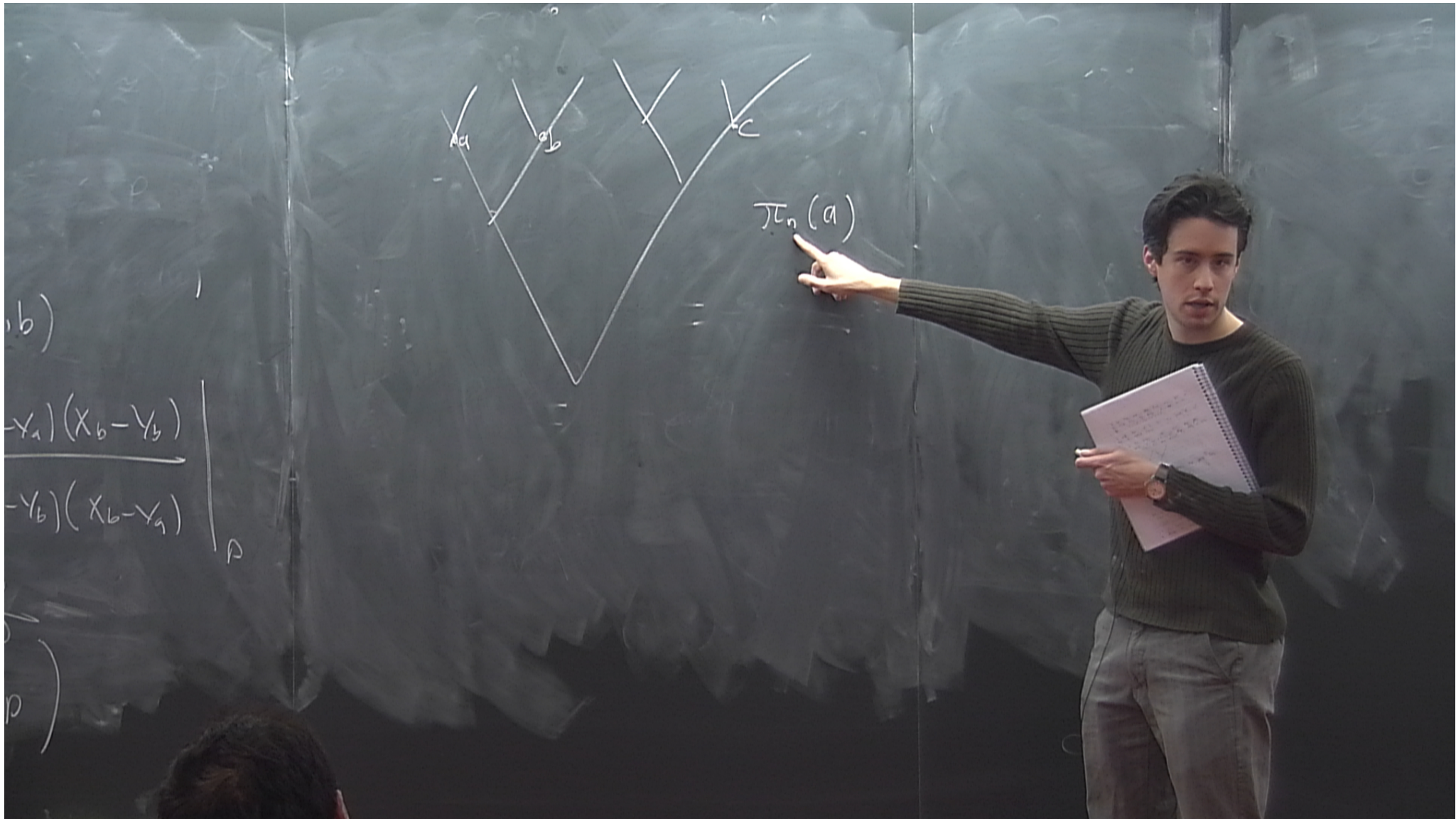
$$= \left| \frac{(x_a - y_a)(x_b - y_b)}{(x_a - y_b)(x_b - y_a)} \right|_p$$

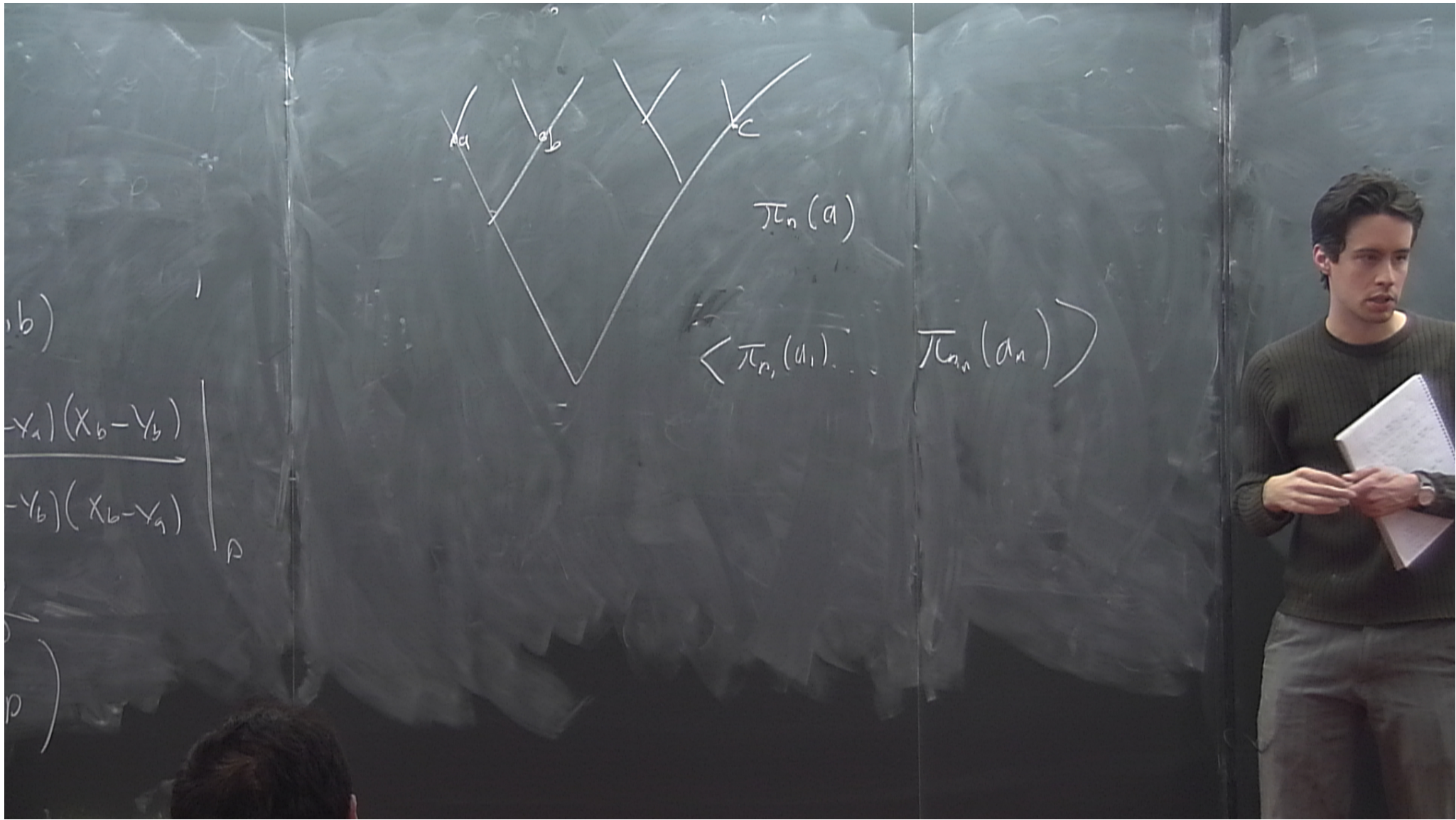
$$X' = \frac{Ax + B}{cx + D}$$

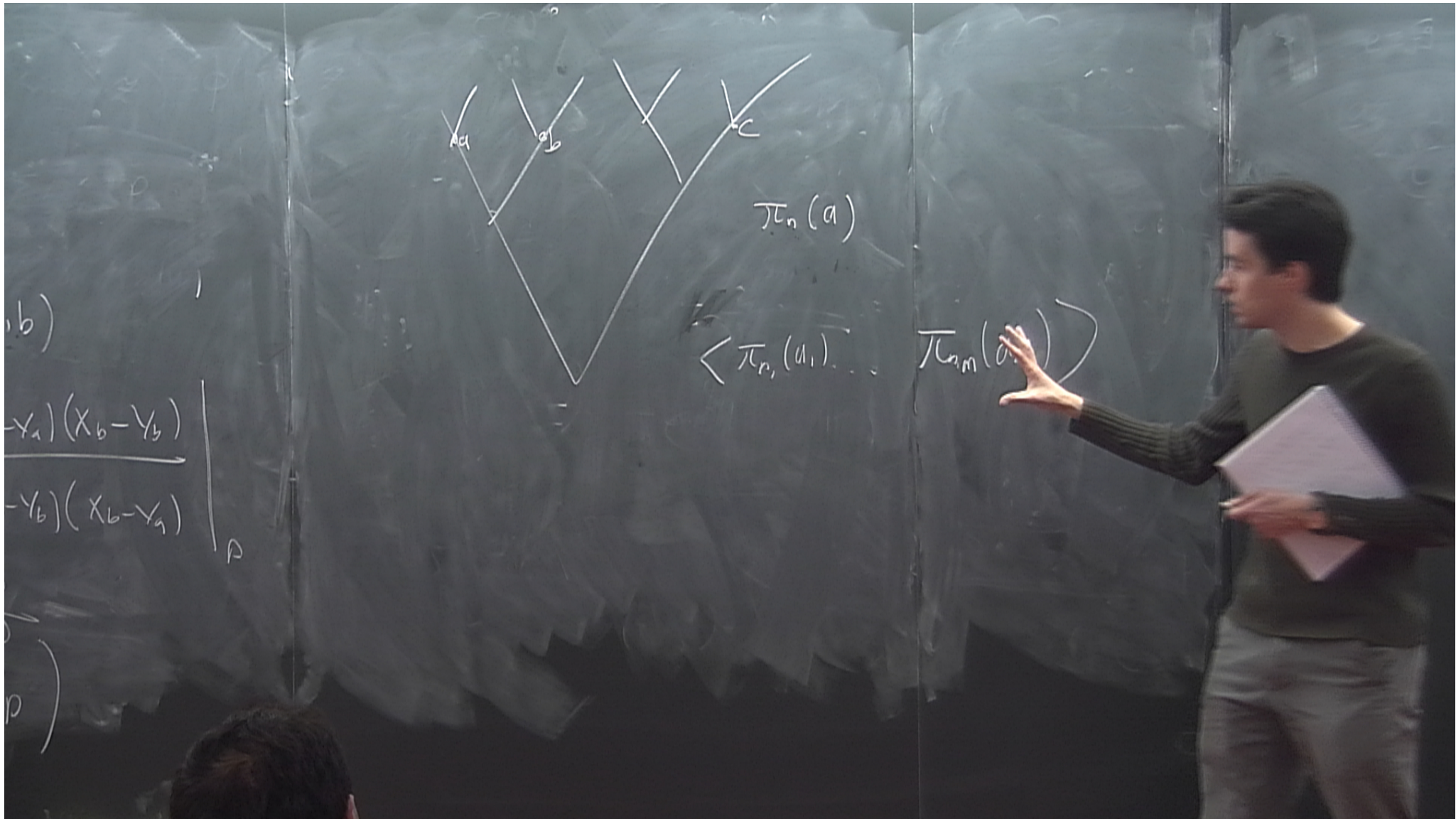
$- PGL(2, \mathbb{Q}_p)$



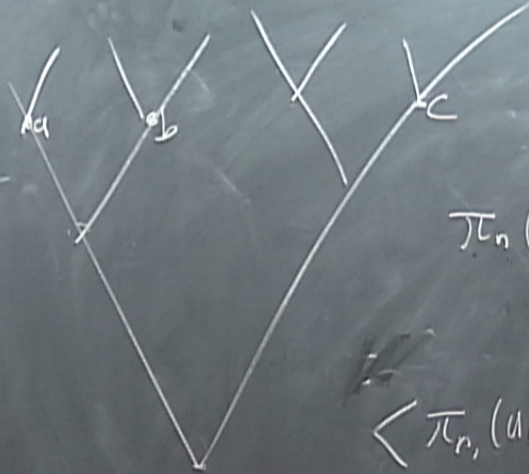






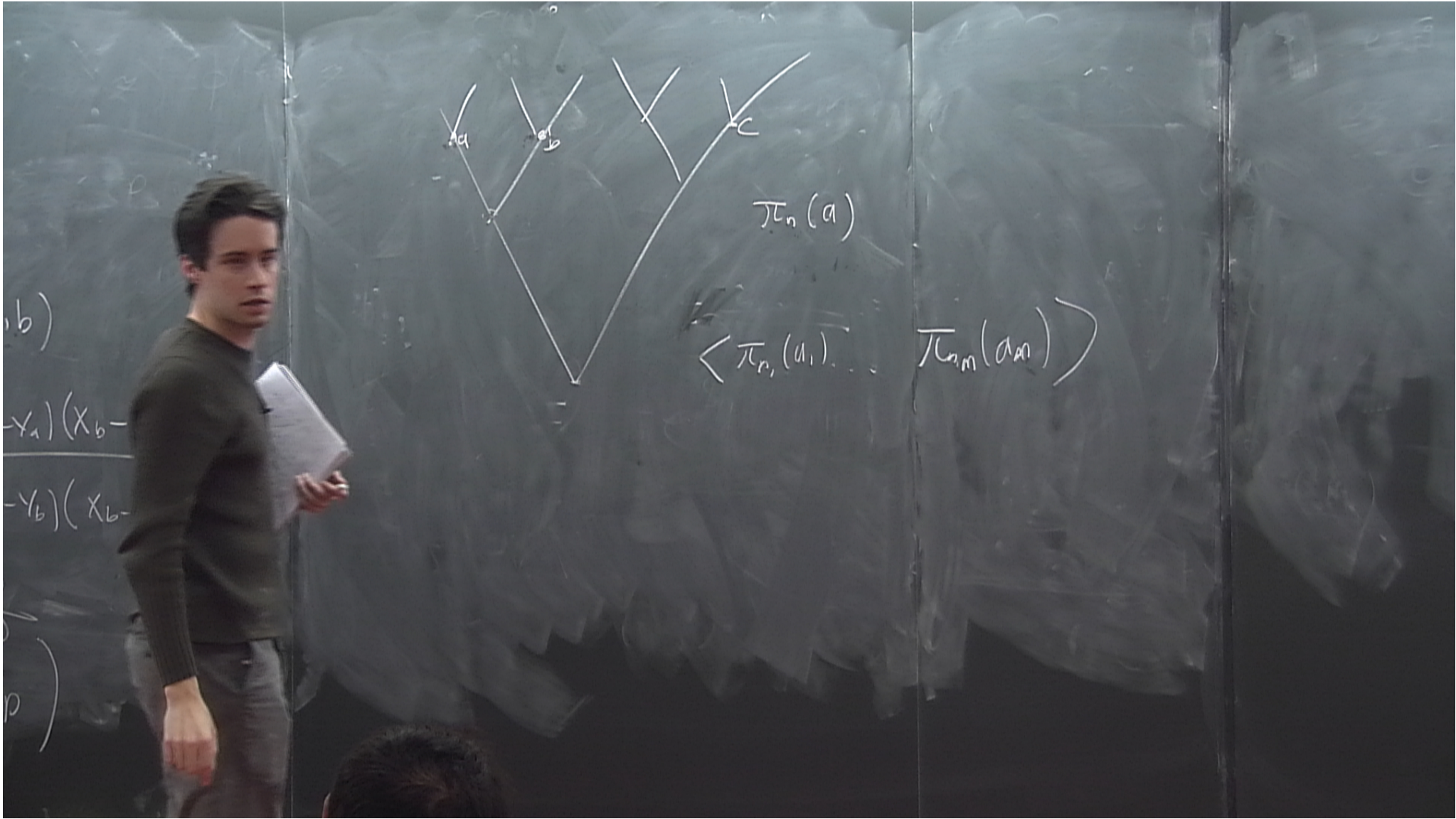


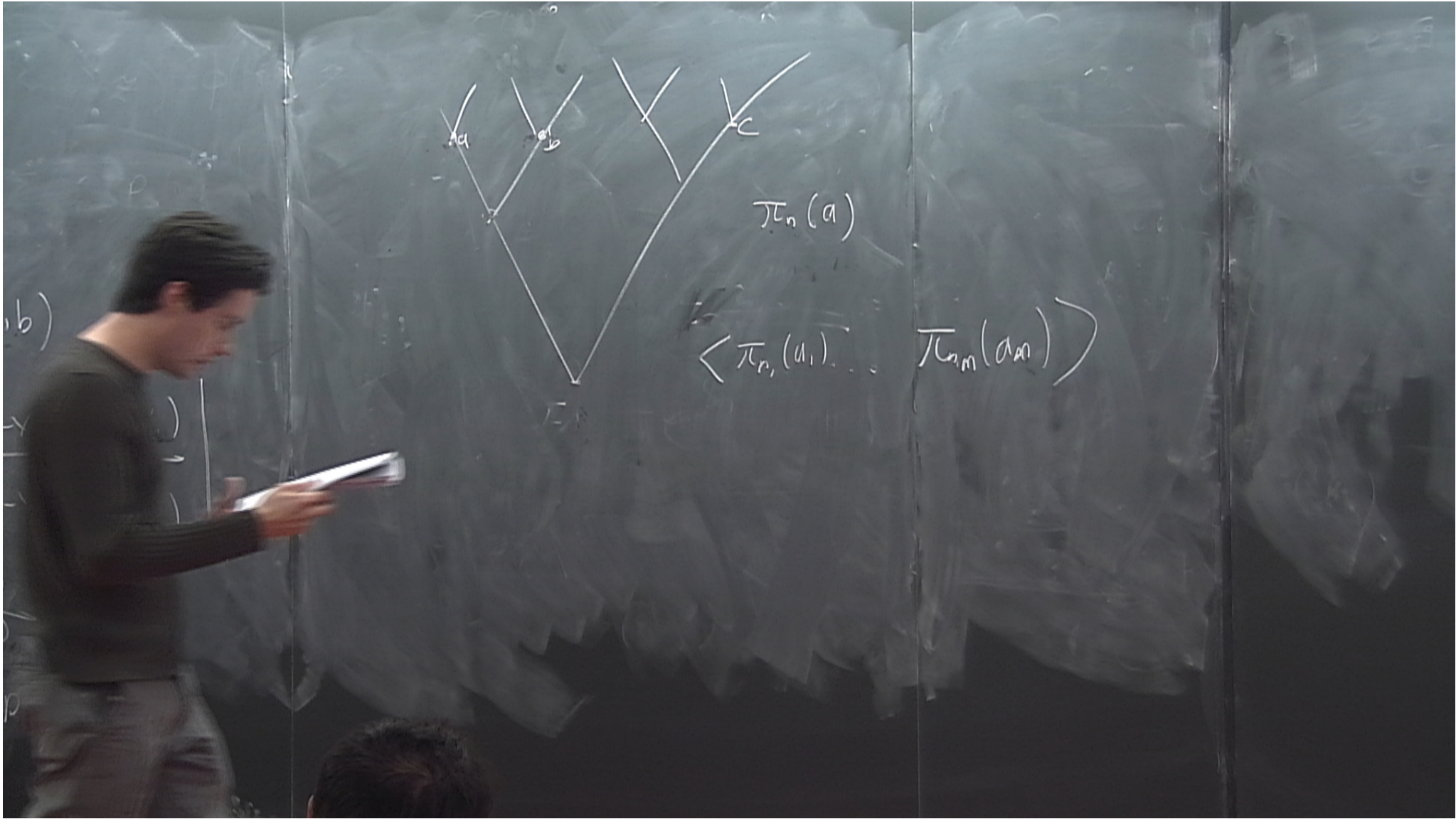
$$b) \frac{-y_a(x_b - y_b)}{-y_b(x_b - y_a)}$$

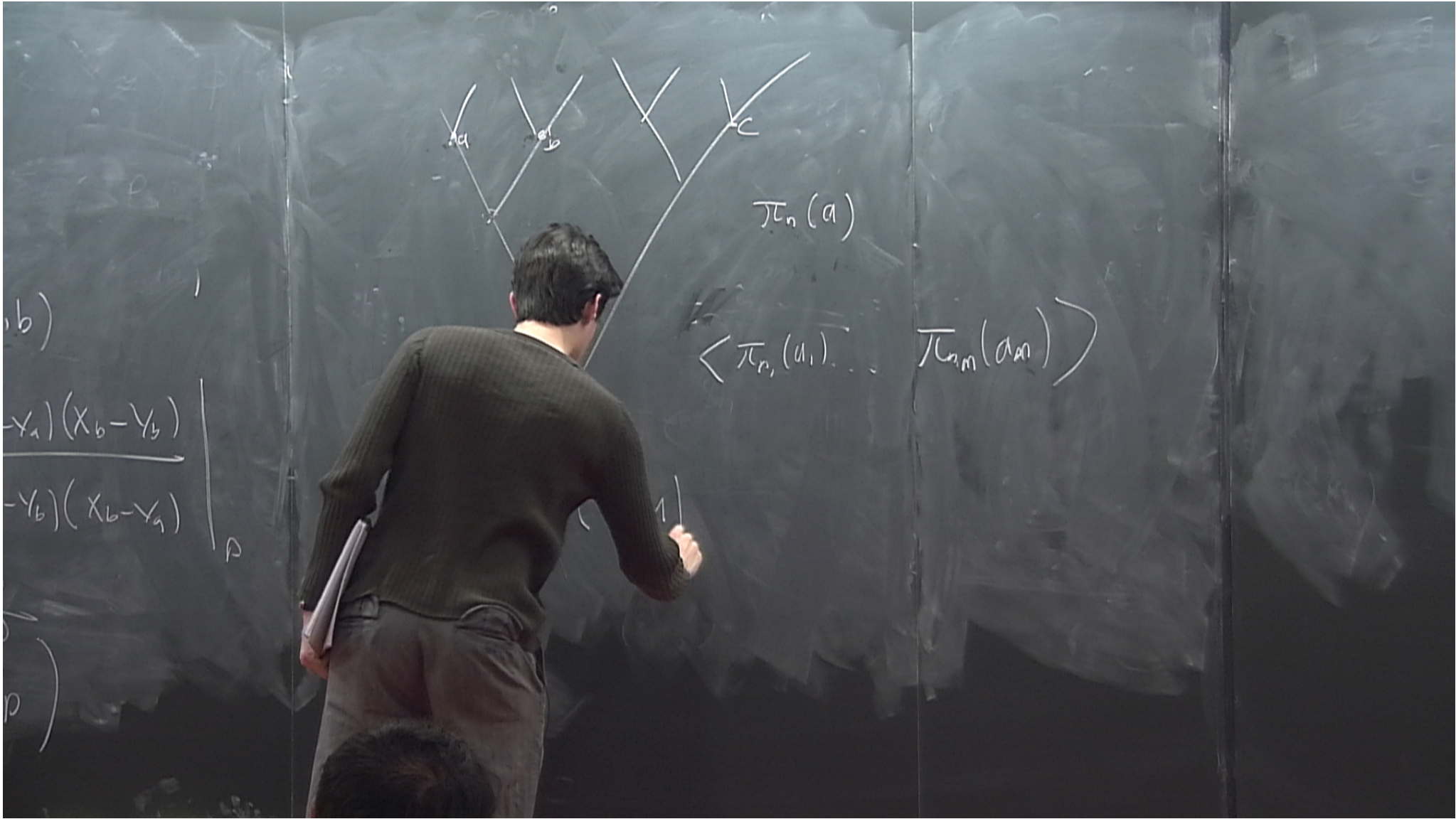


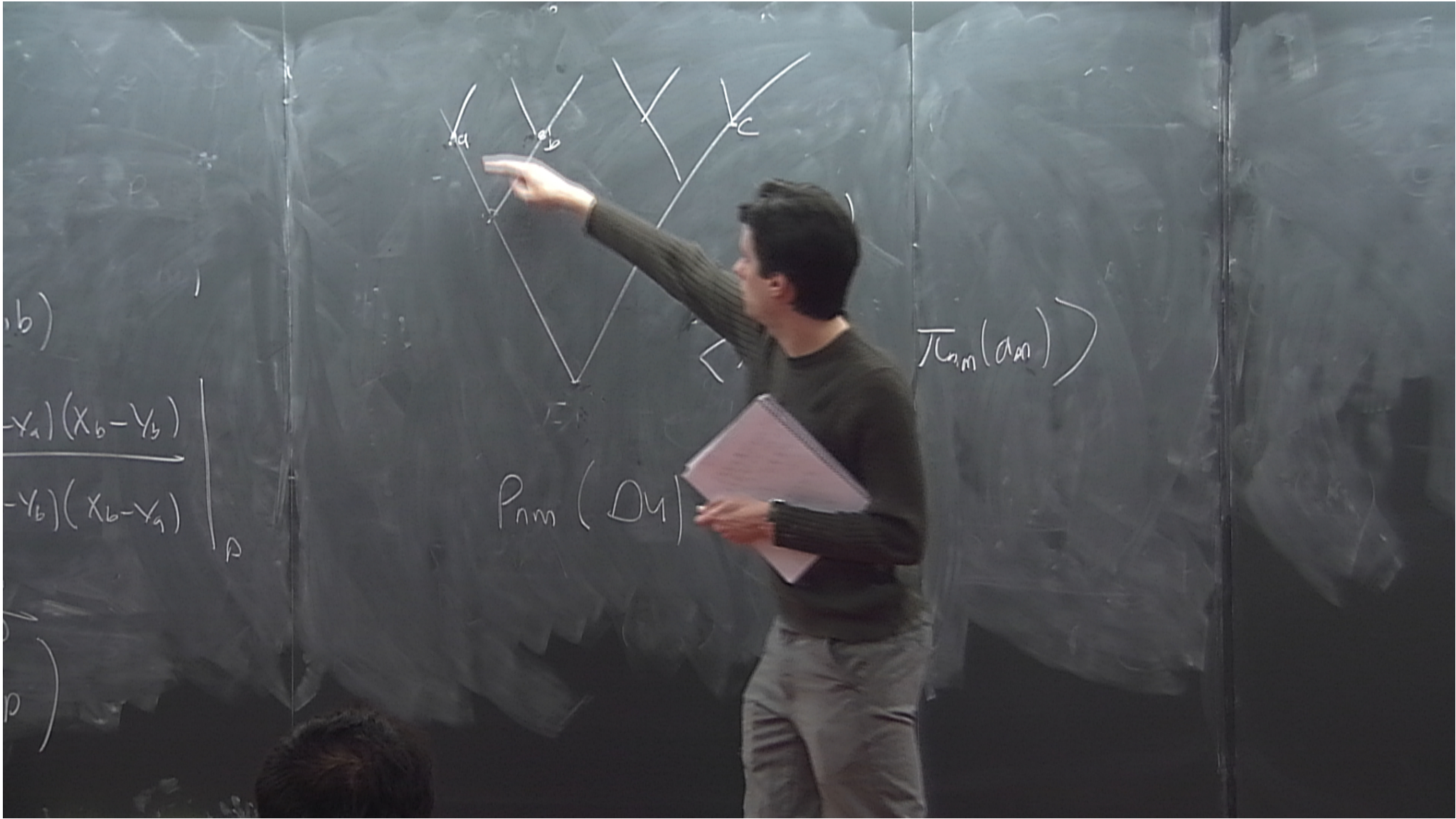
$\pi_n(a)$

$\langle \pi_{n_1}(a_1) \dots \pi_{n_m}(a_m) \rangle$



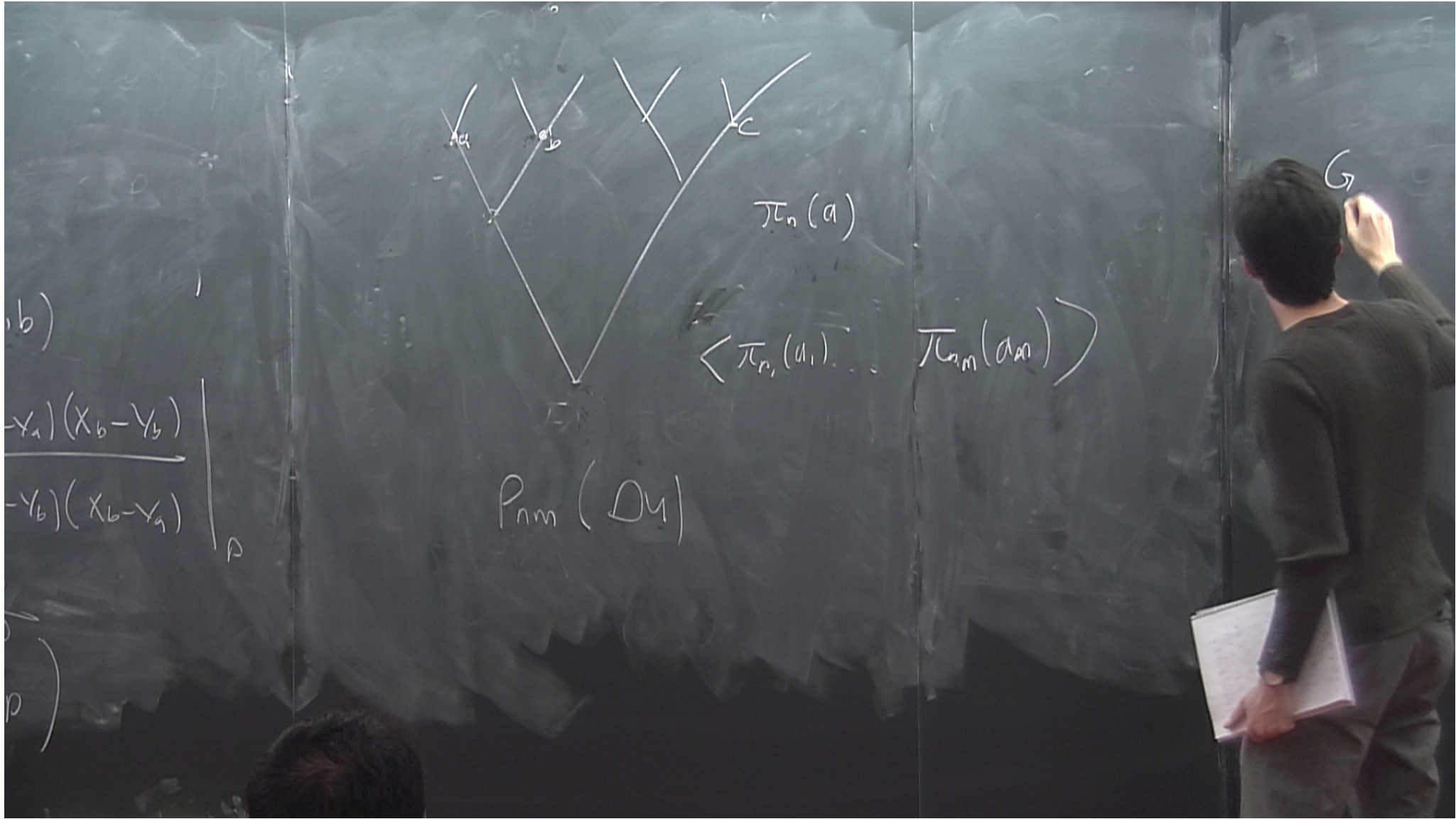


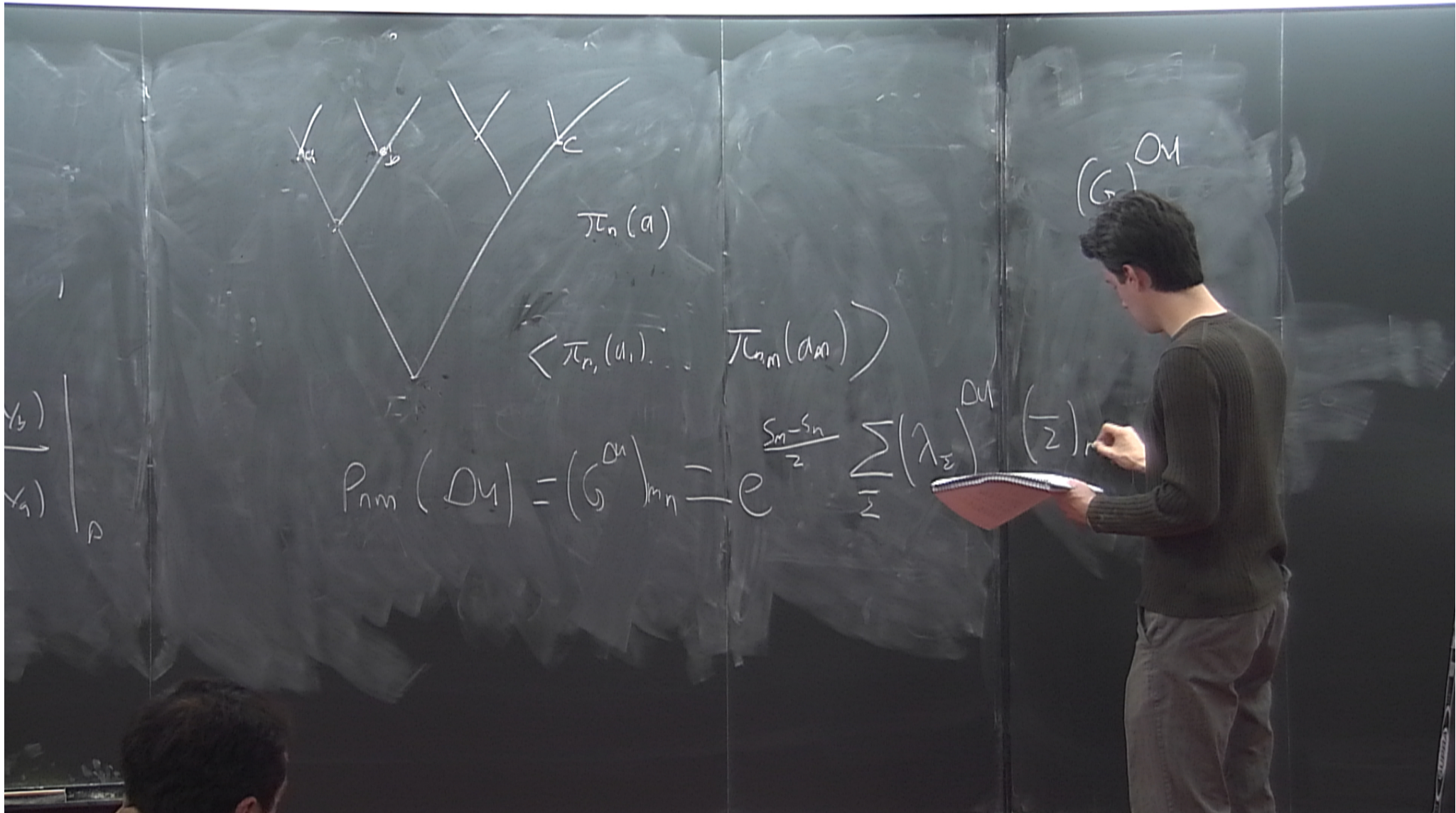




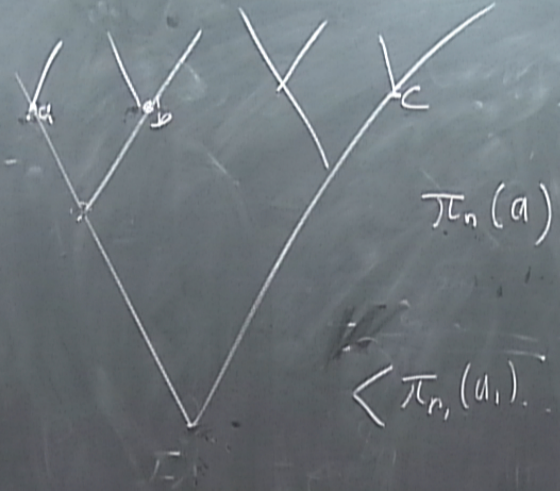








$y_b)$   
 $y_a)$  |  $P$

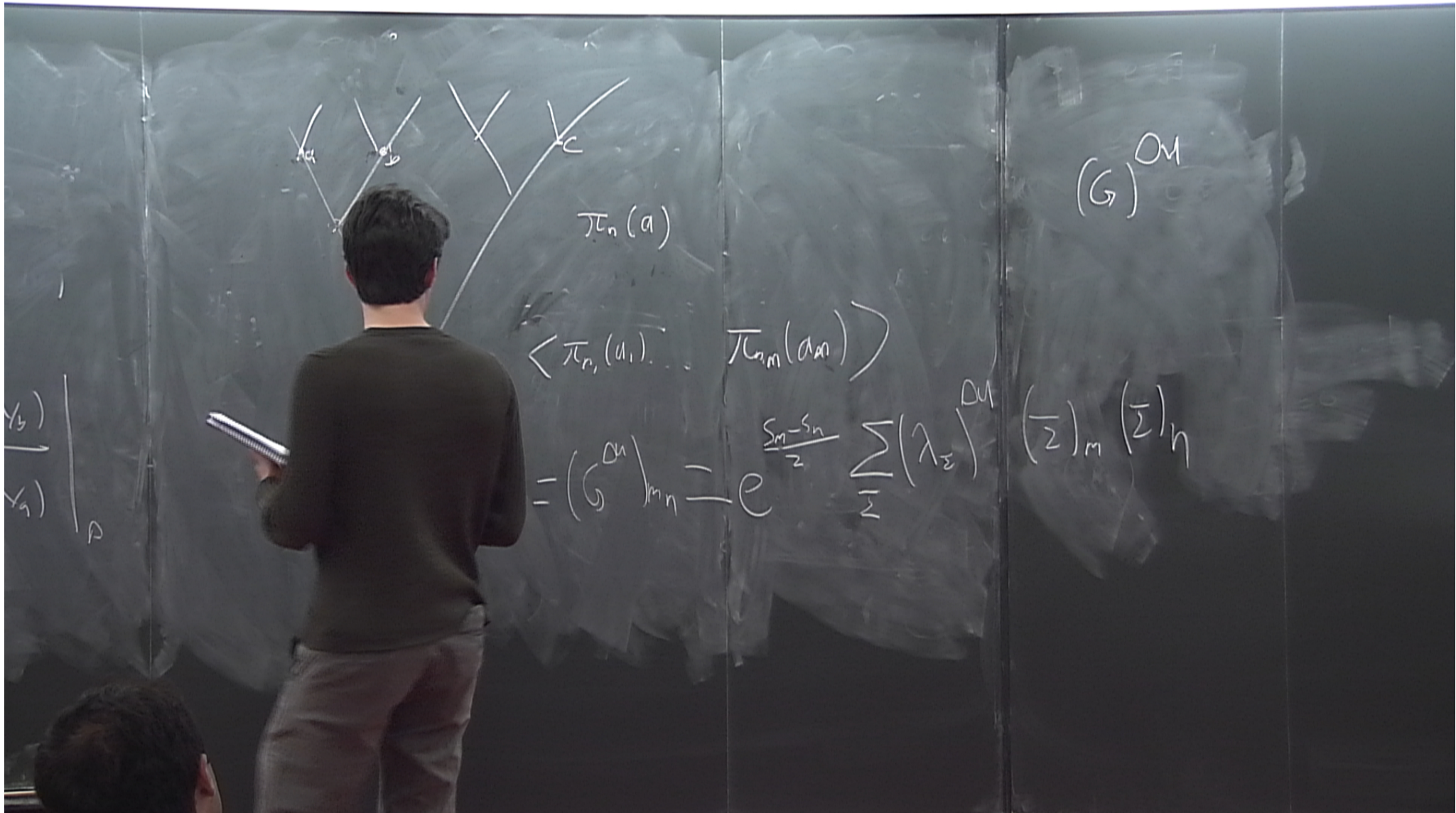


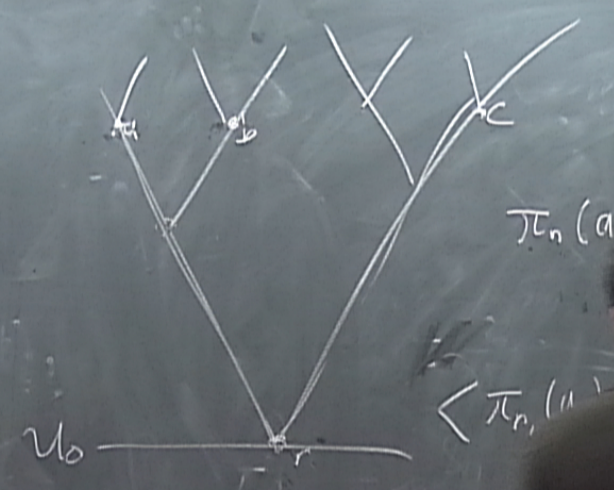
$\pi_n(a)$

$\langle \pi_n(a_i), \pi_{n,m}(a_m) \rangle$

$(G)^{DM}$

$$P_{nm}(DM) = (G^{DM})_{mn} = e^{\frac{s_m - s_n}{2}} \sum_{\Sigma} (\lambda_{\Sigma})^{DM} (\frac{z}{\Sigma})_n$$





$\pi_n(a)$

$\langle \pi_n(a) \pi_n(c) \rangle$

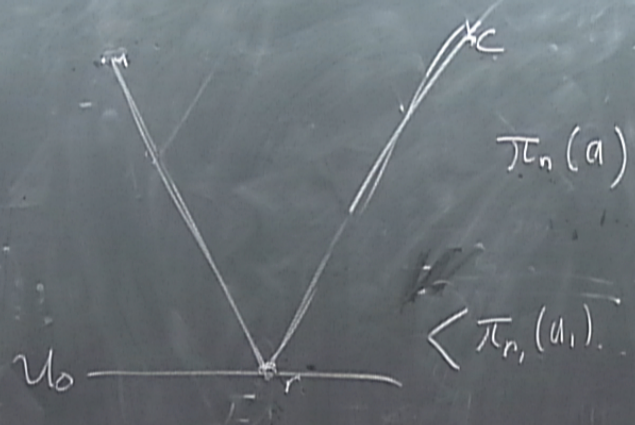
$$P_{nm}(DU) =$$

$$\sum_{\Sigma} (\lambda_{\Sigma})^{DU} (\Sigma)_m (\Sigma)_n$$

$\langle \pi_n(a) \pi_m(c) \rangle =$

$$\sum_{\Sigma} (\lambda_{\Sigma})^{DU} P_{nr}(\Sigma - u_0)$$

$(G)^{DU}$

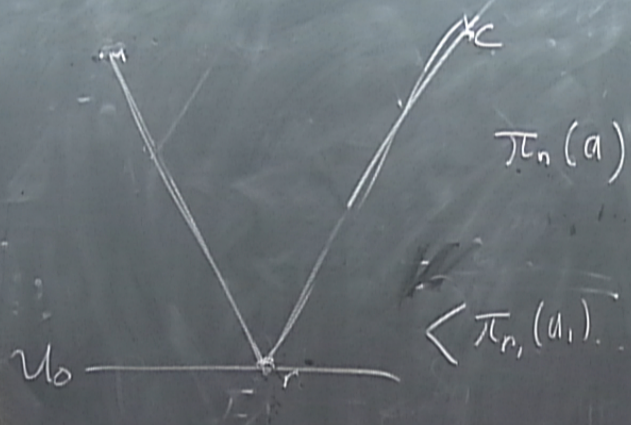


$$\langle \pi_n(a), \pi_m(b) \rangle$$

$$(G)^{DN}$$

$$P_{nm}(DN) = (G^{DN})_{mn} = e^{\frac{s_m - s_n}{2}} \sum (\lambda_\varepsilon)$$

$$\langle \pi_n(a), \pi_m(c) \rangle = \sum_r P_r^{s_0} P_{nr}(u_1 - u_0)$$



$\langle \pi_r(u_1) \dots \pi_{n,m}(a_n) \rangle$

$(G)^{DN}$

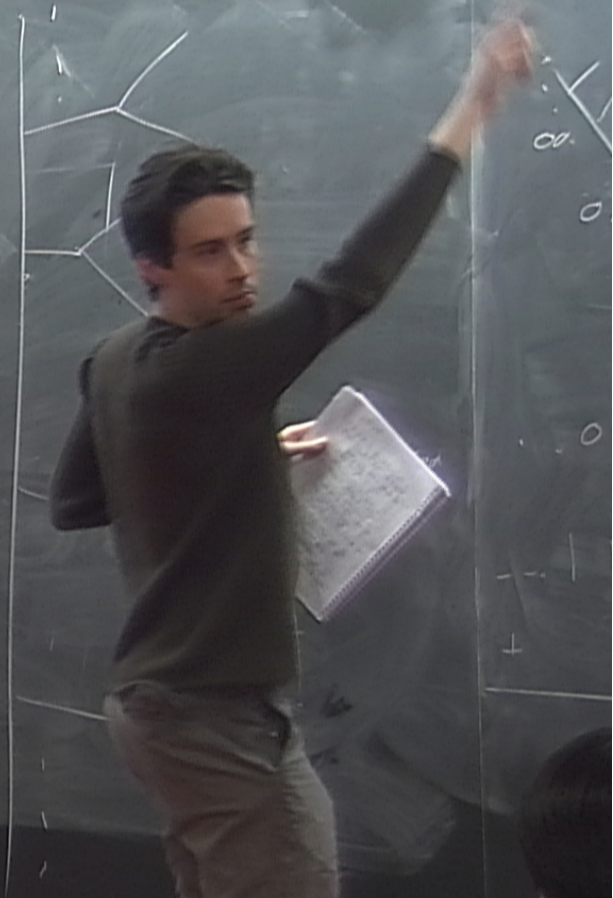
$$P_{nm}(DN) = (G)^{DN}_{mn} = e^{\frac{s_m - s_n}{2} \sum (\lambda_\Sigma)^{DN}} (\bar{z})_m (\bar{z})_n$$

$$\pi_n(a) \pi_m(c) \rangle = \sum_r \frac{e^{s_r}}{N} P_{nr}(u_1 - u_0) P_{nr}(u_2 - u_0)$$

# Extended Symmetry

- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$

$$\Theta_2(x) = \lim_{a \rightarrow x \in D}$$

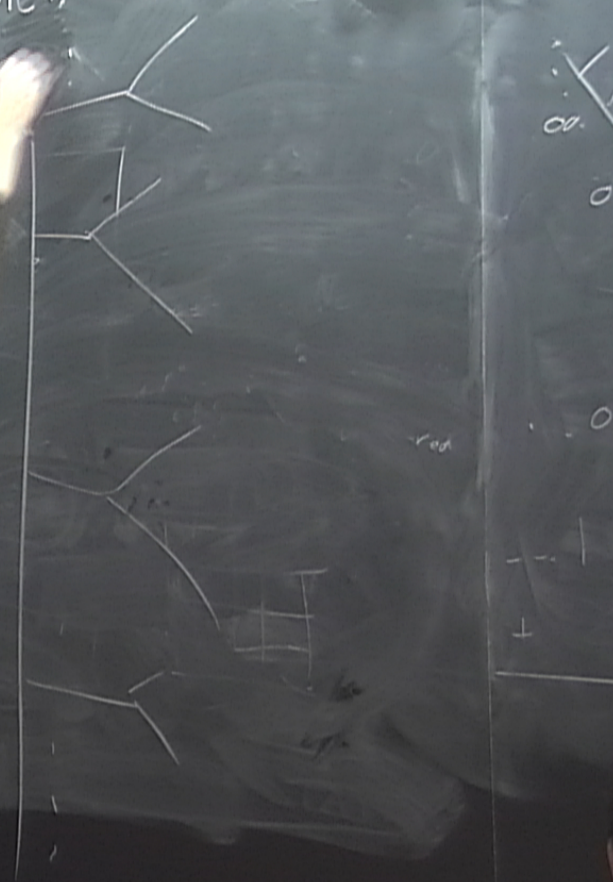




# Eternal Symmetry

- 1) Exponential Exp.
- 2) Multiple vacua related by decays
- 3) "Conformal Theory" at future  $\infty$

$$\Theta_Z(X) = \text{Lim}_{a \rightarrow \infty} \underbrace{(A_Z)^{-u(a)}}_{\text{Extrapolate}} \underbrace{\sum_n e^{-S_n/2} (Z_n)^{K_n(a)}}_{\text{WF Renorm}}$$



# Extended Symmetries

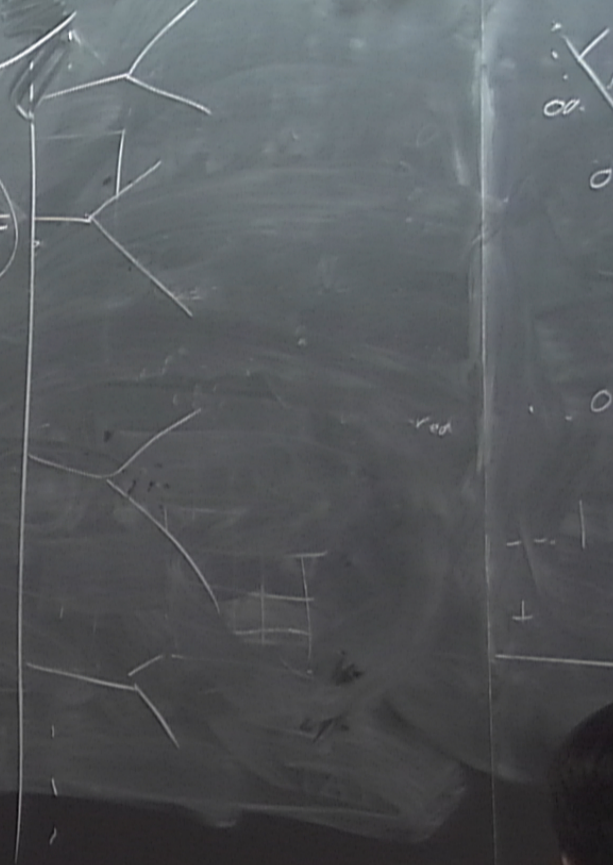
- 1) Exponential Exp.
- 2) Multiple vacua related by duality
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{O}_z(x) = \text{Lim}_{a \rightarrow x \in \mathbb{D}} \underbrace{(A_z)}_{\substack{\text{WF} \\ \text{Renormalized}}} \sum_n e^{-S_n(z)} \underbrace{\pi_n(a)}_{\sim \sqrt{N}}$$

$$\langle \mathcal{O}_z(y) \rangle = \frac{\delta \Sigma J}{p - 2\Delta \Delta}$$

Eigen basis

$$\lambda_z = p^{-\Delta}$$



# Eternal Symmetrie

- 1) Exponential Exp.
- 2) Multiple Vacua relate by decays
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{Q}_Z(X) = \text{Lim}_{a \rightarrow \infty} (A_Z)^{-u(a)} \sum_n e^{-Sn/2} (2\pi)^{K_n(a)} \sqrt{\pi}$$

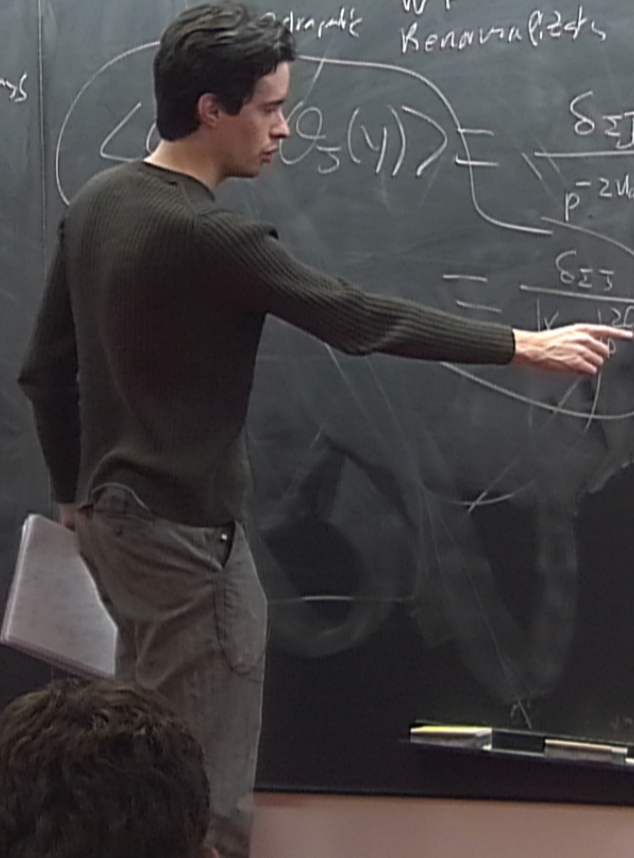
WF Renormalizats

Eigen basis

$$\lambda_Z = p^{-D_Z}$$

$$\langle \mathcal{Q}_Z(Y) \rangle = \frac{\delta \Sigma_J}{p^{-2u_D \Delta_Z}}$$

$$= \frac{\delta \Sigma_J}{\sqrt{1 - 2u_D \Delta_Z}}$$



# Extended Symmetrie

- 1) Exponential Exp.
- 2) Multiple vacua related by duality
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{O}_z(x) = \text{Lim}_{a \rightarrow x \in \mathbb{D}_0} (A_z)^{-u(a)} \sum_n e^{-Sn/2} (z)^n \pi_n(a) \sqrt{\pi}$$

Extrapolate WF  
 Renormalization

$$\langle \mathcal{O}_z(x) \mathcal{O}_w(y) \rangle = \frac{\delta_{z,w}}{p^{-2u} \Delta_z}$$

$$= \frac{\delta_{z,w}}{|x-y|_D^{2\Delta_z}}$$

Eigen basis

$$\lambda_z = p^{-\Delta_z}$$



# Eternal Symmetry

## 1) Exponential Exp.

2) Vacuum related by decay

on formal Theory, at

$$\mathcal{O}_Z(X) = \lim_{a \rightarrow \infty} \underbrace{(\Lambda_Z)}_{\text{WF Renormalization}}^{-u(a)} \sum_n e^{-Sn/2} \underbrace{(\sum_n \pi_n(a))}_{\sqrt{N}}$$

WF Renormalization

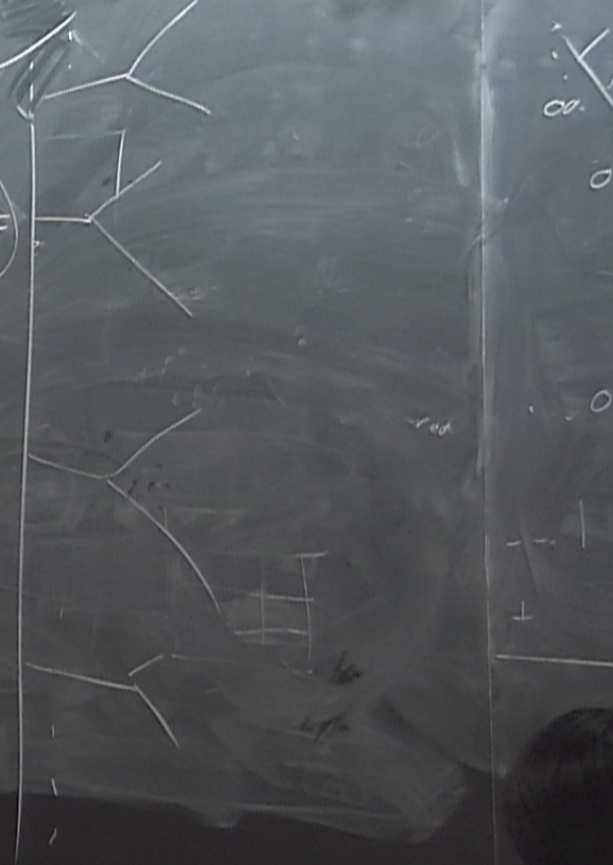
Eigen basis

$$\lambda_Z = p^{-\Delta_Z}$$

$$\langle \mathcal{O}_Z(X) \mathcal{O}_Z(Y) \rangle = \frac{\delta_{\Sigma J}}{p^{-2\Delta_Z}}$$

$$= \frac{\delta_{\Sigma J}}{|X-Y|_p^{2\Delta_Z}}$$

1) diagonally, needed detailed balance



# Eternal Symmetrie

- 1) Exponential Exp.
- 2) Multiple Vacua relate by decays
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{O}_Z(X) = \text{Lim}_{a \rightarrow X \in \mathbb{D}_0} (A_Z)^{-u(a)} \sum_n e^{-Sn/2} (2n) \pi_n(a) \sqrt{\pi}$$

Extrakt
WF  
Renormalizats

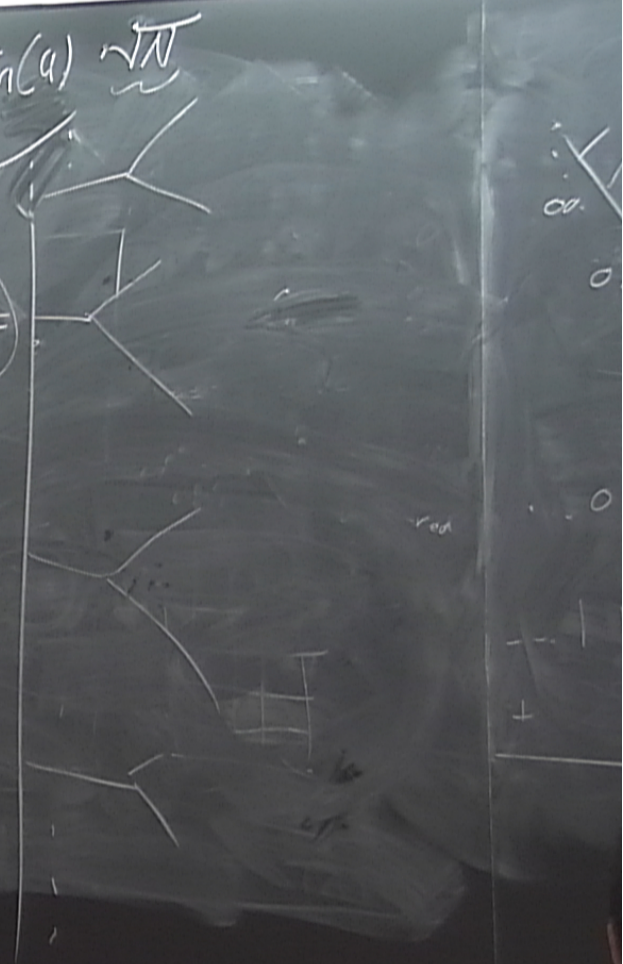
$$\langle \mathcal{O}_Z(X) \mathcal{O}_Z(Y) \rangle = \frac{\delta_{\Sigma J}}{p^{-2u_0} \Delta_\Sigma}$$

$$= \frac{\delta_{\Sigma J}}{|X-Y|_p^{2\Delta_\Sigma}}$$

- 1) diagonally, needed
- 2) detailed, balance

Eigen basis

$$\lambda_Z = p^{-\Delta_\Sigma}$$



# Extended Symmetry

- 1) Exponential Exp.
- 2) Multiple vacua related by duality
- 3) "Conformal Theory" future  $\infty$

$$\mathcal{Q}_Z(X) = \text{Lim}_{a \rightarrow \infty} \left( \lambda_Z \right)^{-u(a)} \sum_n e^{-S_n/2} \left( \sum_n \lambda_n(a) \right)^{\sqrt{N}}$$

Extrapolate WF Renormalization

Eigen basis

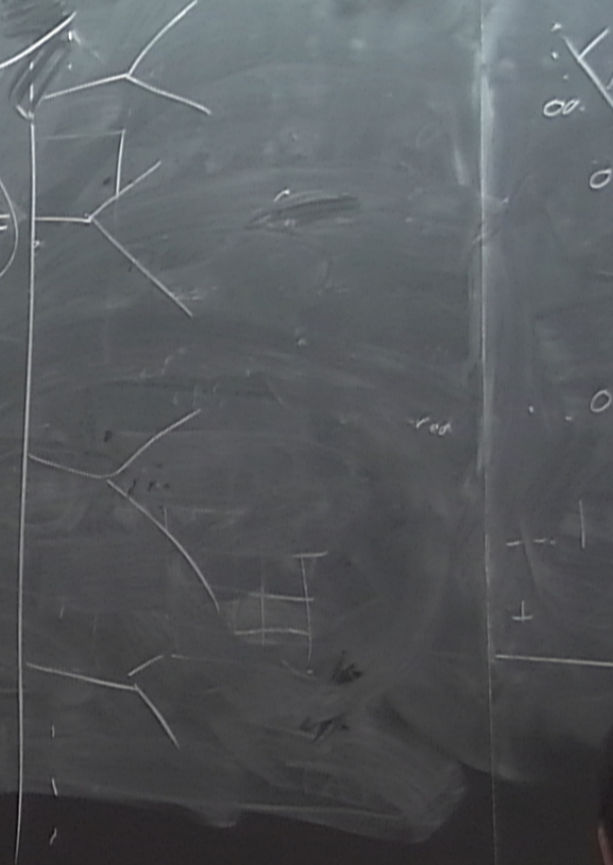
$$\lambda_Z = p^{-D_Z}$$

$$\langle \mathcal{Q}_Z(y) \rangle = \frac{\delta \Sigma_J}{p^{-2\Delta} \Delta}$$

$$= \frac{\delta \Sigma_J}{|x-y|^{2\Delta}}$$

really needed  
dual balance

$$\Rightarrow \mathcal{O}_Z = \mathcal{Q}(y)$$



# External Symmetrie

- 1) Exponential Exp.
- 2) Multiple Vacua relate by decays
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{O}_Z(X) = \text{Lim}_{a \rightarrow \infty} (A_Z)^{-u(a)} \sum_n e^{-S_n/2} (Z_n) \pi_n(a) \sqrt{\pi}$$

Extractable WF Renormalizats Eigen basis  
 $\bar{z} = p$

$$\langle \mathcal{O}_Z(X) \mathcal{O}_{\bar{Z}}(Y) \rangle = \frac{\delta_{Z\bar{Z}}}{P}$$

- 1) diagonally, needed detailed balance
- 2)  $G = 1 + O(\delta)$   
 $\Rightarrow \mathcal{O}_Z = \mathcal{O}(X)$



# External Symmetries

1) Exponential Exp.

2) Multiple Vacua

3) "Conformal future"

$$\mathcal{O}_Z(X) = \text{Lim}_{a \rightarrow \infty} (A_Z)^{-u(a)} \sum_n e^{-Sn/2} (2n)^{K_n(a)} \sqrt{N}$$

Extrapolate WF Renormalization

Eigen basis

$$\lambda_Z = p^{-D_Z}$$

$$\langle \mathcal{O}_Z(X) \mathcal{O}_Y(Y) \rangle = \frac{\delta_{Z\bar{Y}}}{p^{-2u\Delta_Z}}$$

$$= \frac{\delta_{Z\bar{Y}}}{|X-Y|_p^{2\Delta_Z}}$$

1) diagonally, needed detailed balance

$$2) G = 1 + \mathcal{O}(\delta)$$

$$\Rightarrow \mathcal{O}_Z = \mathcal{O}(X)$$

# Eternal Symmetry

- 1) Exponential Exp.
- 2) Multiple vacua related by duality
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{G}_Z(X) = \text{Lim}_{a \rightarrow \infty} (A_Z)^{-u(a)} \sum_n e^{-Sn/2} (Z^n \chi_n(a)) \sqrt{\pi}$$

Extrapolate WF Renormalization

$$\langle \mathcal{G}_Z(y) \rangle = \frac{\delta \Sigma J}{p - 2u_0 \Delta}$$

$$= \frac{\delta \Sigma J}{|x-y|_D^{2\Delta}}$$

needed balance  
 $= 1 + \mathcal{O}(\delta)$   
 $= \mathcal{G}(x)$

Eigen basis

$$\lambda_Z = p^{-\Delta}$$

3) follows from PGL(2, C)

# Eternal Symmetrie

- 1) Exponential Exp.
- 2) Multiple Vacua related by duality
- 3) "Conformal Theory" at future  $\infty$

$$\mathcal{O}_Z(X) = \text{Lim}_{a \rightarrow \infty} (A_Z)^{-u(a)} \sum_n e^{-Sn/2} (Z_n) \pi_n(a) \sqrt{\pi}$$

WF Renormalizats
Eigen basis

$$\langle \mathcal{O}_Z(X) \mathcal{O}_Y(Y) \rangle = \delta_{Z,Y}$$

$Z = P^{-1}$   
 3) follows from  $PGL(2, \mathbb{C})$   
 $X \rightarrow f(X)$   
 $\sigma(X) =$   
 $0 \leftarrow$

1) diagonally, need detailed basis

$$Z) G = 1 + \delta$$

$$\Rightarrow \mathcal{O}_Z =$$

# Extended Symmetries

- 1) Exponential Exp.
- 2) Multiple vacua related by duality
- 3) "Conformal Theory" at future  $\infty$

$$\Theta_z(x) = \text{Lim}_{a \rightarrow \infty} \underbrace{(\Lambda_z)}_{\text{WF Renormalization}}^{-u(a)} \sum_n e^{-Sn/2} (z^n \pi_n(a)) \sqrt{\pi}$$

$$\langle \Theta_z(x) \Theta_w(y) \rangle = \frac{\delta_{z\bar{w}}}{|x-y|_D^{2\Delta}} = \frac{\delta_{z\bar{w}}}{|x-y|_D^{2\Delta}}$$

deduced by

$$1 + \Theta(x) = \Theta(x)$$

Eigen basis

$$\lambda_z = p^{-\Delta_z}$$

3) follows from PGL(2, C)

$$x' = f(x)$$

$$\Theta'_z(x) = \left( \frac{dx}{dx'} \right)^{-\Delta_z} \Theta_z(x)$$

one

$$u(x) = \sum_n e^{-Sn/2} \left( \sum_n \pi_n(a) \right) \sqrt{\pi}$$

Eigen basis

$$\lambda_{\Sigma} = \frac{-D_{\Sigma}}{p}$$

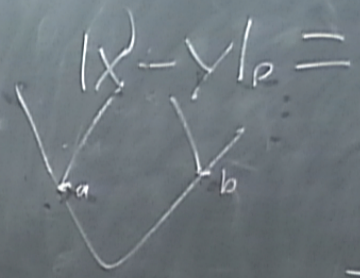
3) follows from  $PGL(2, \mathbb{C})$

$$X' = f(X)$$

$$\frac{d(X)}{dz} = \left( \frac{df}{dx} \right)^{-1} D_{\Sigma} \theta(X)$$

one

$$\theta_{\Sigma}(X) = \theta_{\Sigma}(Y) = \sum_k \frac{1}{k} |X - Y|$$



$$X_a, Y_a$$

$$X_b, Y_b$$

$$X' = \frac{A}{C}$$

$$PGL(2, \mathbb{C})$$

$$u(x) = \sum_n e^{-Sn/z} \left( \sum_n \pi_n(a) \right) \sqrt{\pi}$$

Eigen basis

$$\lambda_z = \frac{-D_z}{p}$$

3) follows from  $PGL(2, \mathbb{Q}_p)$

$$x' = f(x)$$

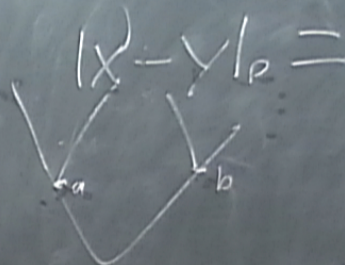
$$\frac{d(x)}{z} = \left( \frac{df}{dx} \right)^{-D_z} \theta(x)$$

one

$$\theta_z(x) \cdot \theta_5(y)$$

$$= \sum_k c_{zjk} |x-y|_p^{D_k - D_z - D_5}$$

$$\theta_c(y)$$

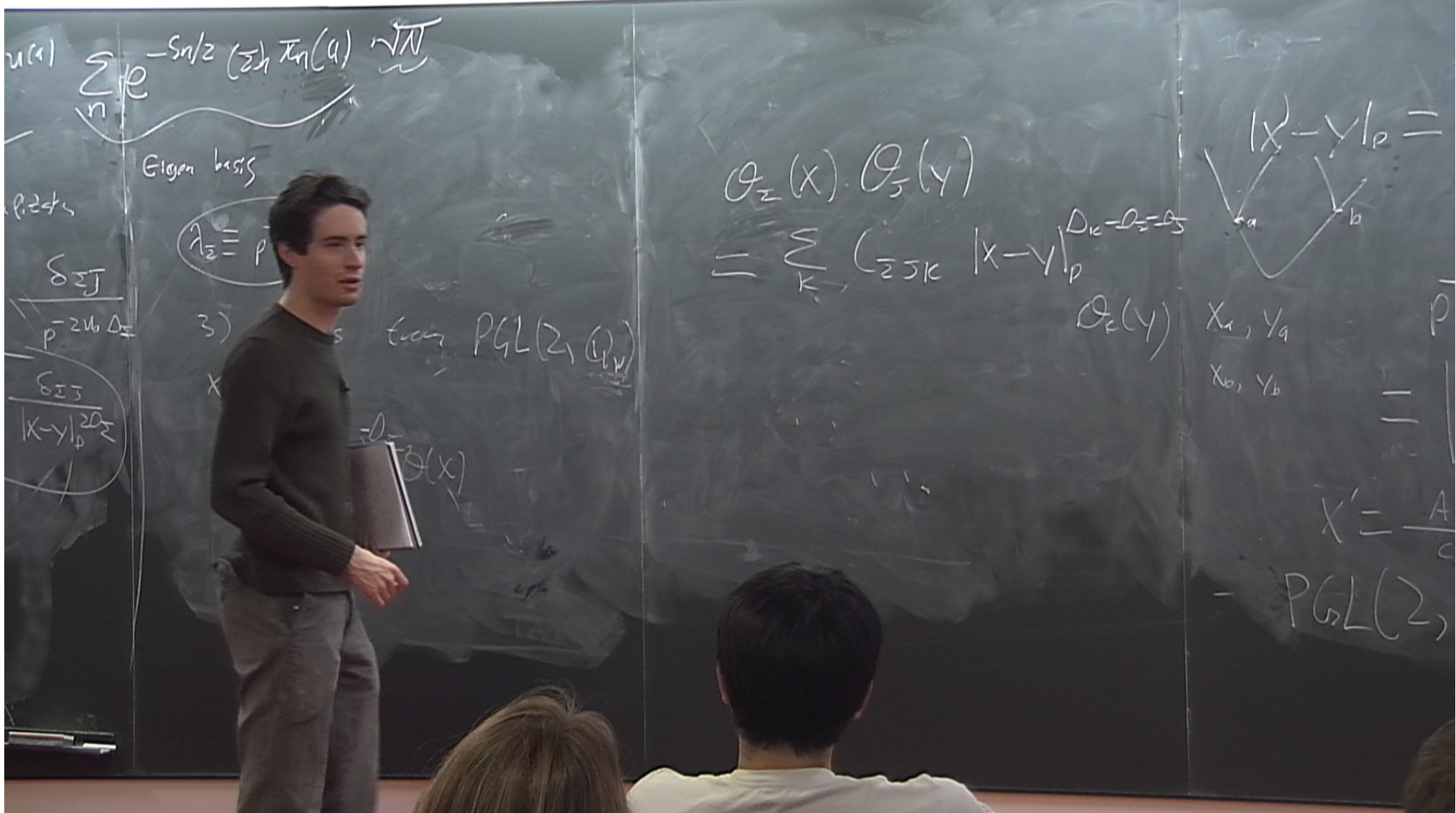


$$x_a, y_a$$

$$x_b, y_b$$

$$x' = \frac{A}{c}$$

$$PGL(2, \mathbb{Q}_p)$$



$$u(x) = \sum_n e^{-Sn/2} \left( \sum_n \pi_n(a) \right) \sqrt{\pi}$$

Eigen basis

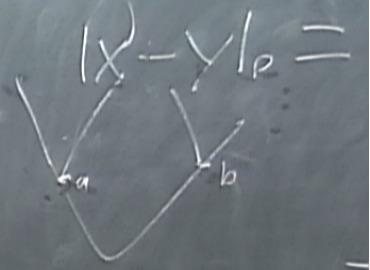
$$\lambda_{\pm} = p$$

$$\frac{\delta_{\Sigma J}}{p - 2u_0 \Delta}$$

$$\frac{\delta_{\Sigma J}}{|x-y|_p^{2\Delta}}$$

3)  $PGL(2, \mathbb{C})$

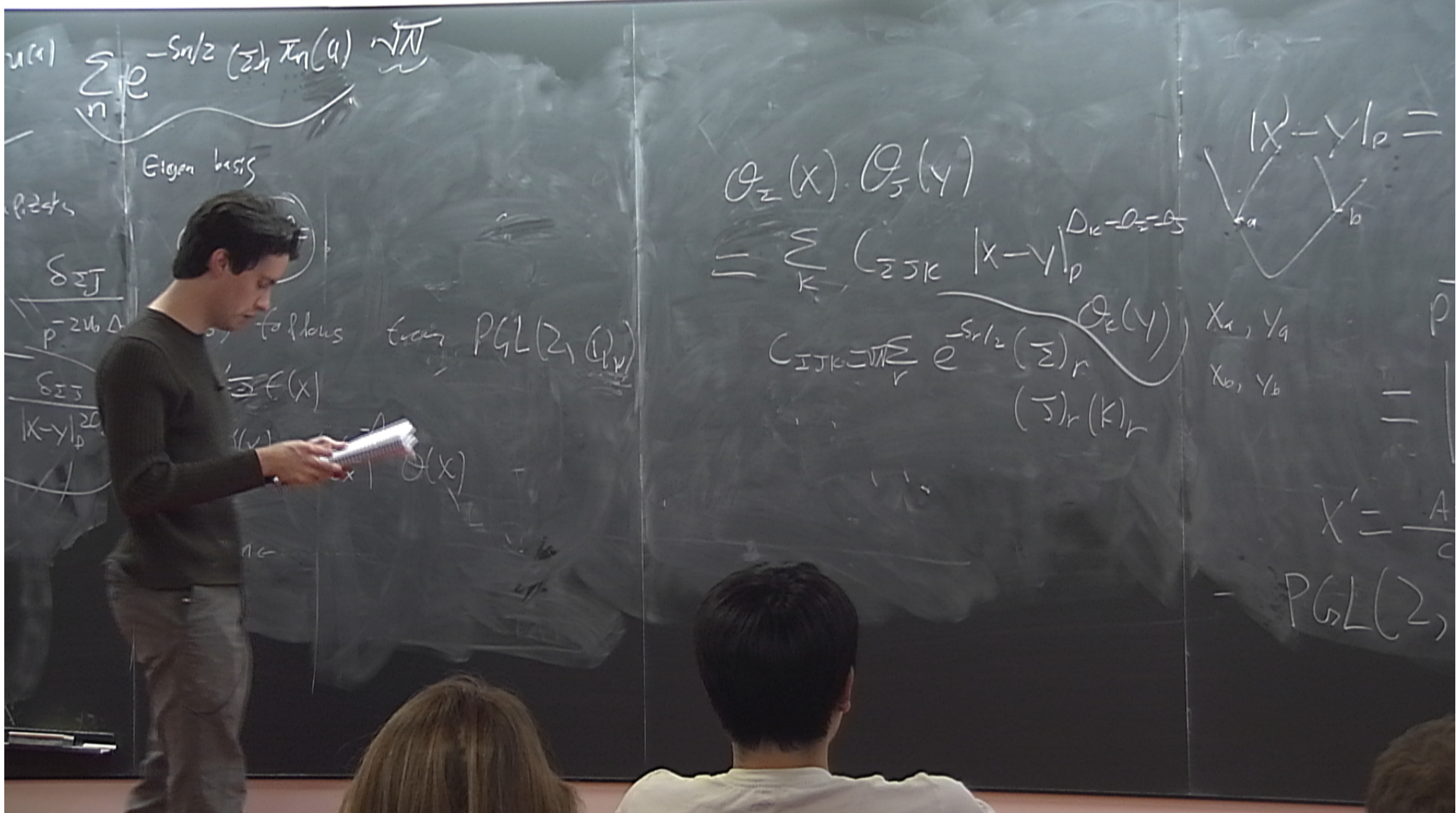
$$\mathcal{O}_2(x) \cdot \mathcal{O}_3(y) = \sum_K C_{2JK} |x-y|_p^{D_K - D_J - D_S} \mathcal{O}_K(y)$$



$x_a, y_a$   
 $x_b, y_b$

$$x' = \frac{A}{c}$$

$PGL(2, \mathbb{C})$



$$u(x) = \sum_n e^{-Sn/2} (\sum_r \pi_n(a)) \sqrt{\pi}$$

Eigen basis

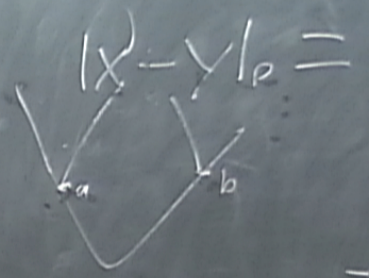
$$\frac{\delta \Sigma J}{p - 2ub \Delta}$$

$$\frac{\delta \Sigma J}{|x-y|_p}$$

follows from  $PGL(2, \mathbb{C})$

$$\theta_2(x) \theta_3(y) = \sum_K C_{2JK} |x-y|_p^{D_K - D_2 - D_3}$$

$$C_{JK} = \int_r e^{-Sr/2} (\sum_r \theta_2(y)) (\sum_r (K)_r)$$

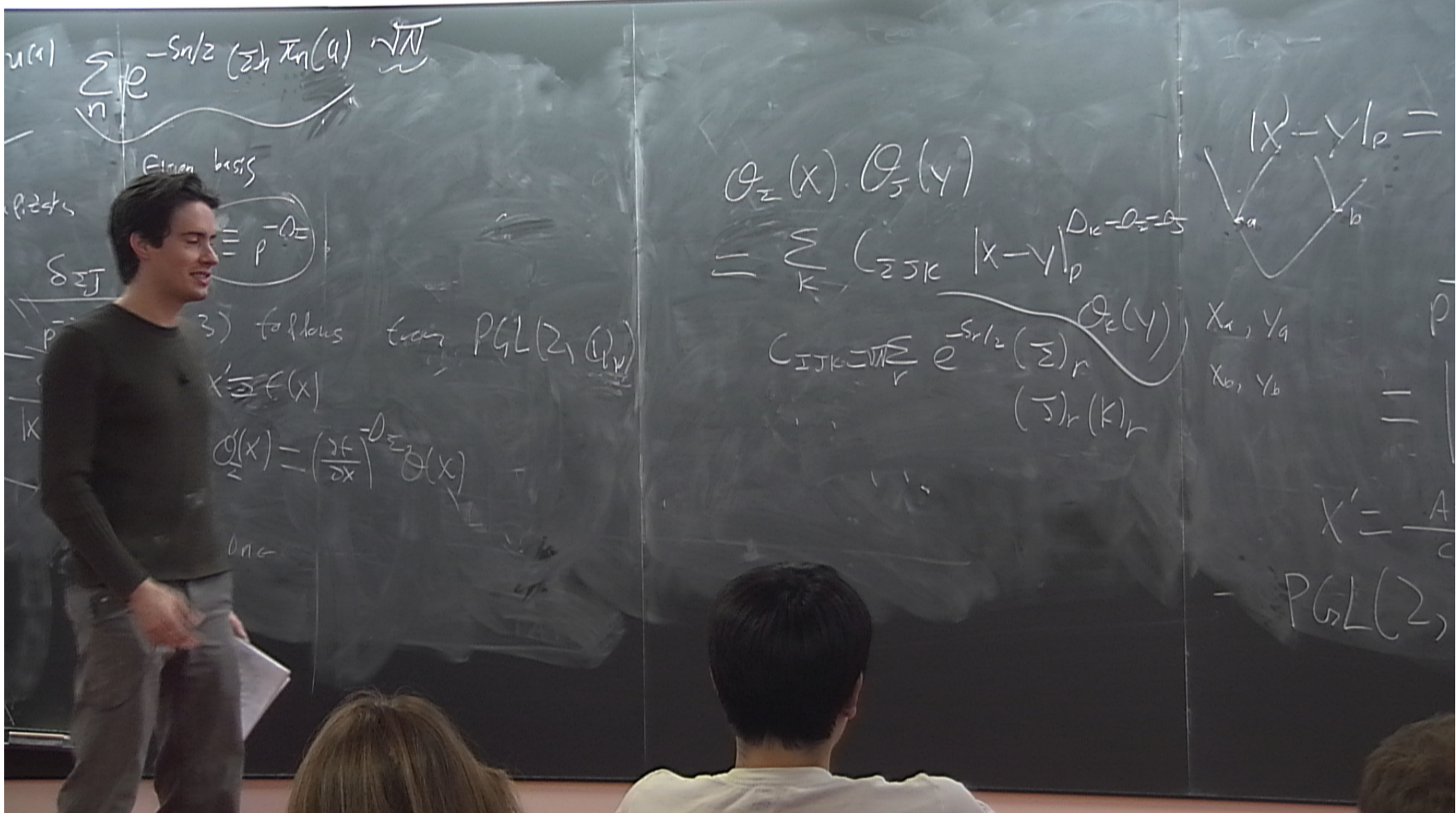


$x_a, y_a$   
 $x_b, y_b$

$$x' = \frac{A}{c}$$

$PGL(2, \mathbb{C})$





$$\sum_n e^{-S_n/2} (\sum_n \pi_n(a)) \sqrt{\pi}$$

Eigen basis

$$\delta_{\Sigma J} \equiv \frac{-D_{\Sigma}}{p}$$

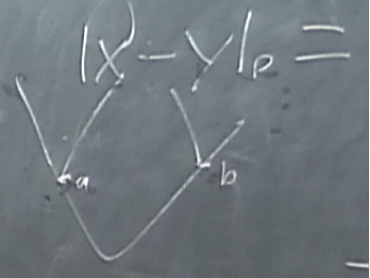
3) follows from  $PGL(2, \mathbb{C})$

$$x' = f(x)$$

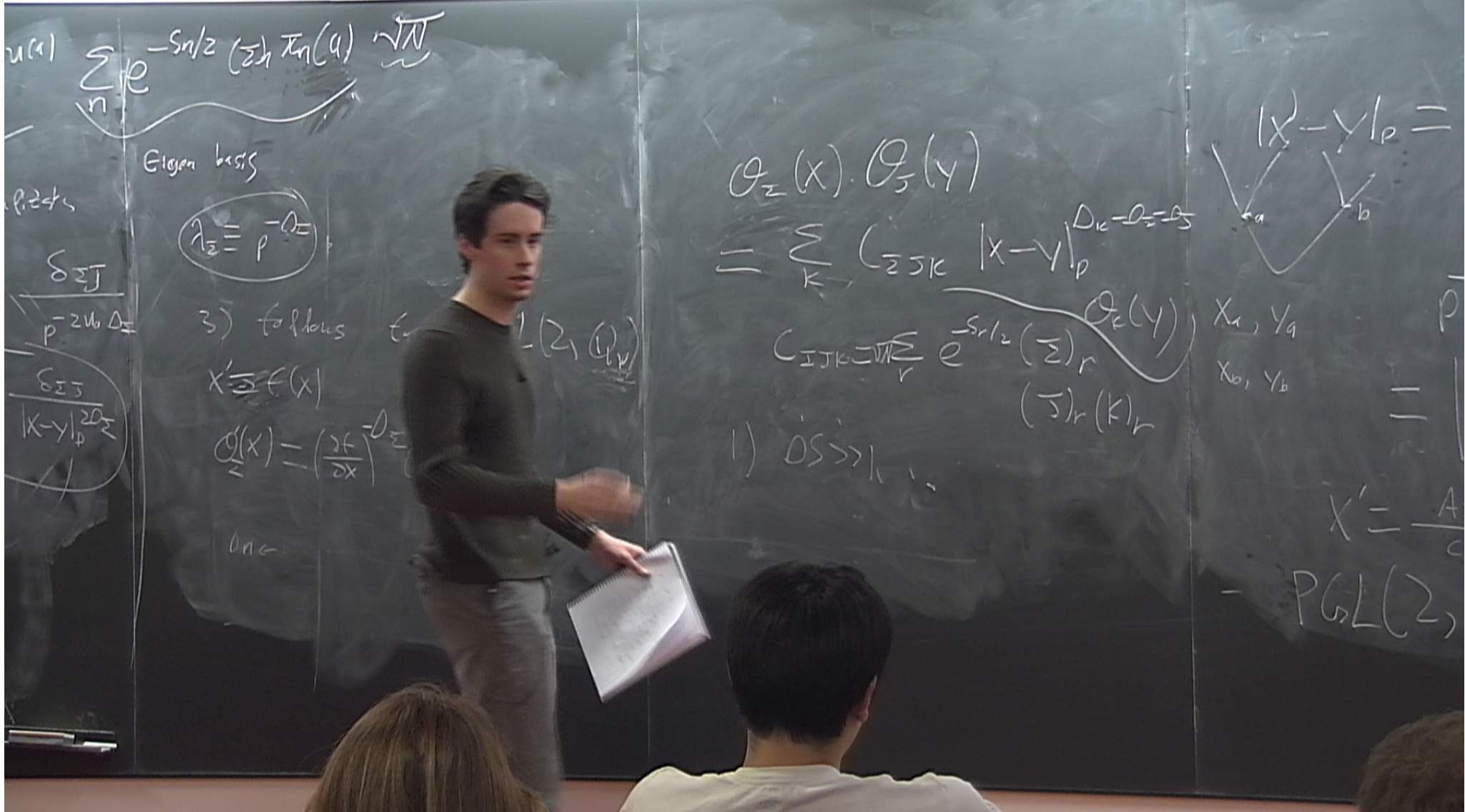
$$\frac{d(x)}{z} = \left(\frac{\partial f}{\partial x}\right)^{-1} \frac{d(x)}{z}$$

one

$$\begin{aligned} & \mathcal{O}_Z(X) \cdot \mathcal{O}_Y(Y) \\ &= \sum_K C_{\Sigma JK} |X - Y|_p^{D_K - D_{\Sigma} - D_Y} \\ & C_{\Sigma JK} = \sum_r e^{-S_r/2} (\sum_r \pi_r(a)) \sqrt{\pi} \end{aligned}$$



$$\begin{aligned} & X_a, Y_a \\ & X_b, Y_b \\ & X' = \frac{A}{c} \\ & PGL(2, \mathbb{C}) \end{aligned}$$



$$u(x) = \sum_n e^{-Sn/2} \left( \sum_r \pi_n(a) \right) \sqrt{\pi}$$

Eigen basis

$$\lambda_{\Sigma} = \frac{-D_{\Sigma}}{p}$$

3) follows

$$X' = F(X)$$

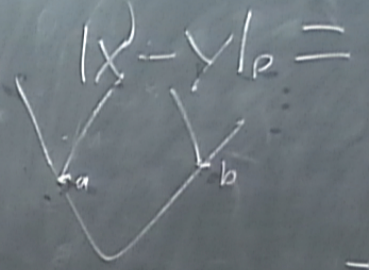
$$\frac{d(X)}{d(\Sigma)} = \left( \frac{\partial F}{\partial X} \right)^{-1} D_{\Sigma}$$

one

$$\begin{aligned} & \mathcal{O}_{\Sigma}(X) \cdot \mathcal{O}_{\Sigma}(Y) \\ &= \sum_K C_{\Sigma JK} |X - Y|_p \end{aligned}$$

$$C_{\Sigma JK} = \sum_r e^{-Sr/2} \left( \sum_r \pi_r(a) \right) \left( \sum_r \pi_r(b) \right)$$

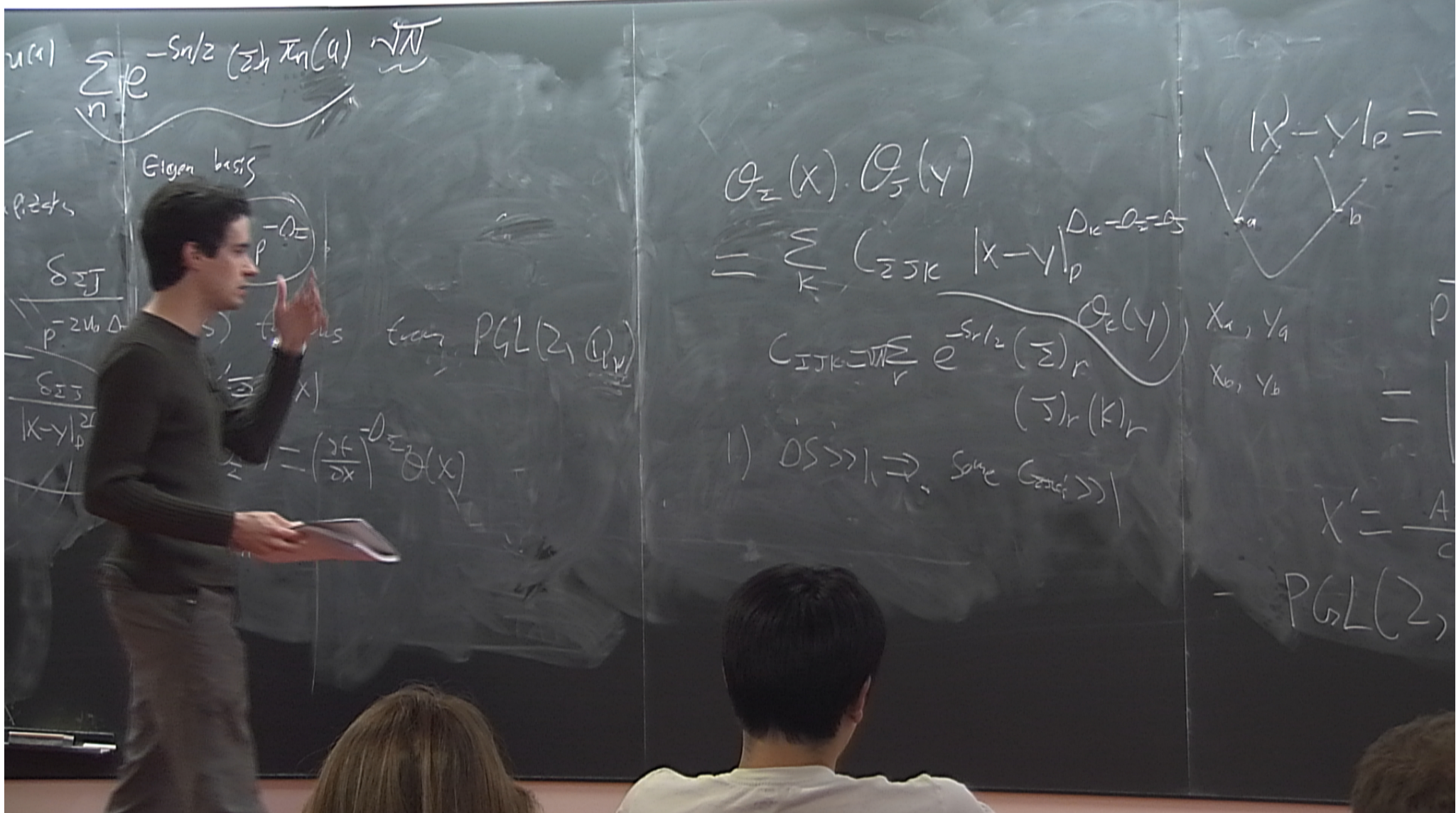
1)  $D_{\Sigma} \gg 1$



$X_a, Y_a$   
 $X_b, Y_b$

$$X' = \frac{A}{c}$$

$PGL(2, \mathbb{C})$



$$u(x) = \sum_n e^{-Sn/2} \frac{\pi_n(a)}{\sqrt{\pi}}$$

Eigen basis

$$\frac{\delta_{zj}}{p} = \frac{\delta_{zj}}{p} \left( \frac{\partial}{\partial z} \right)^j$$

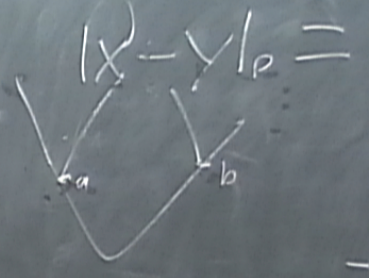
from  $PGL(2, \mathbb{C})$

$$\frac{\partial}{\partial z} = \left( \frac{\partial x}{\partial z} \right)^{-1} \frac{\partial}{\partial x}$$

$$\mathcal{O}_z(x) \cdot \mathcal{O}_y(y) = \sum_K C_{zJK} |x-y|_p^{D_K - D_z - D_y}$$

$$C_{JK} = \int_r e^{-S_r/2} \mathcal{O}_z(x) \mathcal{O}_y(y) \frac{dx dy}{(J)_r (K)_r}$$

1)  $D_S \gg 1 \Rightarrow$  some  $G_{zJK}$



$$x_a, y_a$$

$$x_b, y_b$$

$$x' = \frac{A}{c}$$

$$PGL(2, \mathbb{C})$$

$$u(x) = \sum_n e^{-Sn/2} \left( \frac{z}{2} \right)^n \pi_n(a) \sqrt{\pi}$$

Eigen basis

$$\lambda_z = \frac{-D_z}{p}$$

3) follows from  $PGL(2, \mathbb{C})$

$$x' = f(x)$$

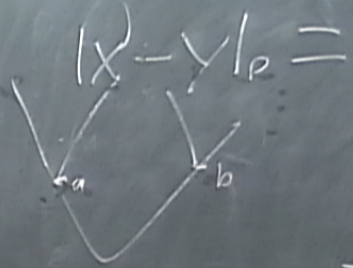
$$\frac{d(x)}{dz} = \left( \frac{df}{dx} \right)^{-1} \theta(x)$$

one

$$\theta_z(x) \cdot \theta_s(y) = \sum_k C_{zsk} |x-y|_p^{D_k - D_z - D_s}$$

$$C_{IJK} = \int \sum_r e^{-Sr/2} \left( \frac{z}{2} \right)^r \theta_r(y) \left( \frac{z}{2} \right)^r (K)_r$$

- 1)  $D_S \gg 1 \Rightarrow$  Same Genus
- 2) No Descendants!



$x_a, y_a$   
 $x_b, y_b$

$x' = \frac{A}{c}$   
 $PGL(2, \mathbb{C})$

$$u(x) = \sum_n e^{-Sn/2} \left( \frac{z}{2} \right)^n \chi_n(a) \sqrt{\pi}$$

Eigen basis

$$\lambda_{\frac{z}{2}} = \frac{-D_z}{p}$$

follows from  $PGL(2, \mathbb{C})$

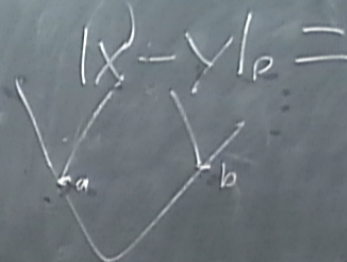
$$\frac{d}{dz} \theta(x) = \left( \frac{\partial}{\partial x} \right)^{-D_z} \theta(x)$$

one

$$\theta_z(x) \cdot \theta_s(y) = \sum_K C_{zJK} |x-y|_p^{D_K - D_z - D_s}$$

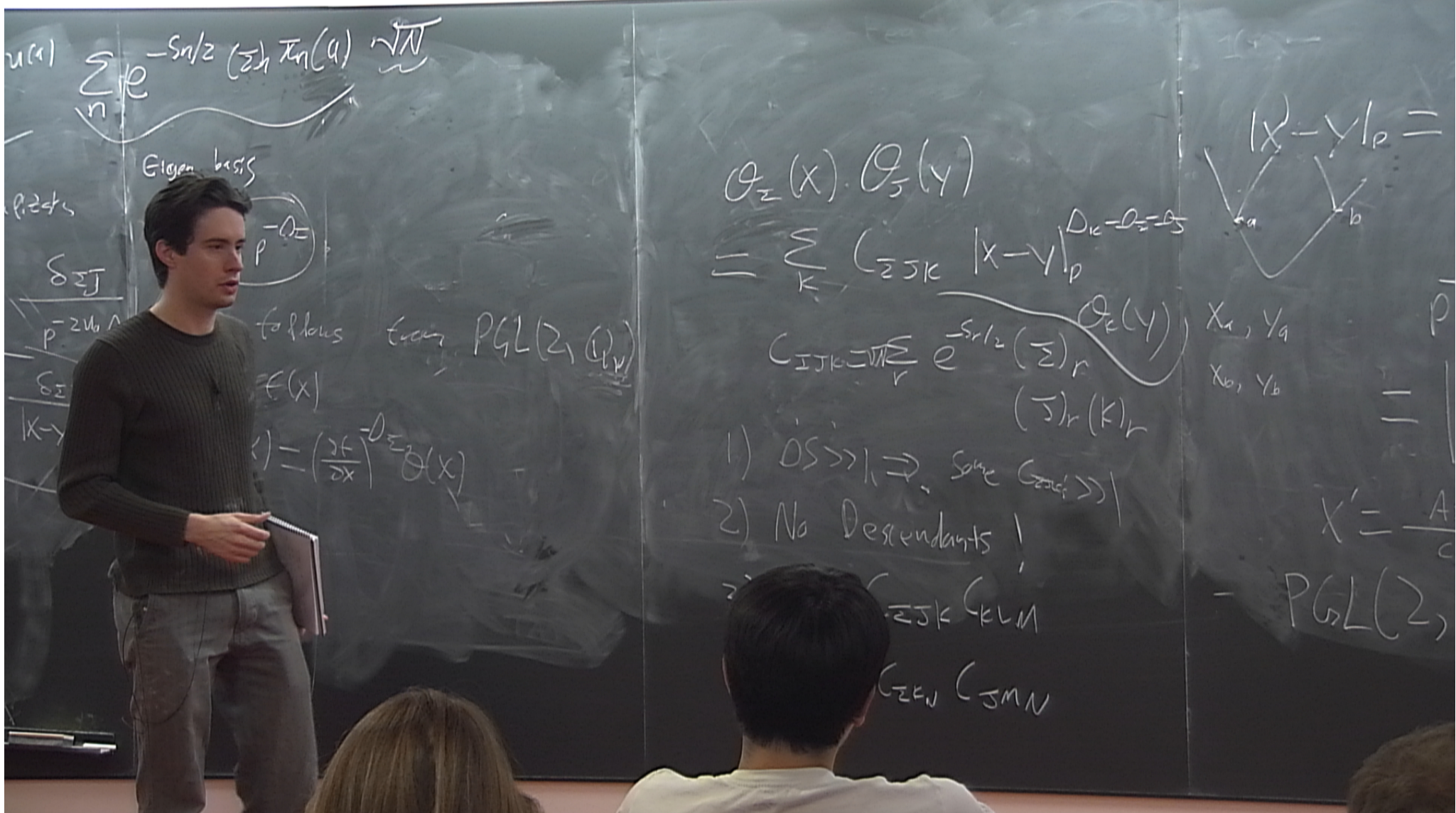
$$C_{JK} = \int \frac{e^{-S/2} \left( \frac{z}{2} \right)^r \theta_r(y)}{\left( \frac{z}{2} \right)^r (K)_r}$$

- 1)  $D_S \gg 1 \Rightarrow$  Same Genus
- 2) No Descendants!



$x_a, y_a$   
 $x_b, y_b$

$PGL(2, \mathbb{C})$



$$u(x) = \sum_n e^{-Sn/2} (\bar{z})^n \bar{\chi}_n(a) \sqrt{\pi}$$

Eigen basis

$$\frac{\delta_{\Sigma J}}{p^{-2\Delta} \Lambda}$$

follows from  $PGL(2, \mathbb{C})$   
 $\mathbb{C}(x)$

$$\langle \cdot \rangle = \left( \frac{\partial f}{\partial x} \right)^{-D_{\Sigma}} \theta(x)$$

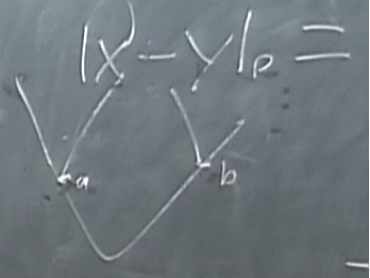
$$\theta_{\Sigma}(x) \cdot \theta_{\Sigma}(y) = \sum_K C_{\Sigma JK} |x-y|_p^{D_K - D_{\Sigma} - D_{\Sigma}}$$

$$C_{IJK} = \int_{\Sigma} e^{-S/2} (\bar{z})^r \theta_K(y) (\bar{z})^r (K)_r$$

- 1)  $D_S \gg 1 \Rightarrow$  some  $G_{\text{desc}} \gg 1$
- 2) No Descendants!

$$C_{\Sigma JK} C_{KLM}$$

$$C_{\Sigma KN} C_{JMN}$$



$x_a, y_a$   
 $x_b, y_b$

$$x' = \frac{A}{c}$$

$PGL(2, \mathbb{C})$

$$\sum_n e^{-S_n/2} (\bar{z})^n \pi_n(a) \sqrt{\pi}$$

Eigen basis

$$\begin{pmatrix} -D_z \\ p \end{pmatrix}$$

3) follows from  $PGL(2, \mathbb{C})$

$$X' = F(X)$$

$$d(Y) = \left( \frac{\partial F}{\partial X} \right)^{-1} dX$$

one

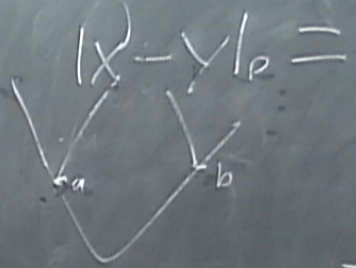
$$\begin{aligned} & \theta_z(X) \cdot \theta_{\bar{z}}(Y) \\ &= \sum_K C_{zJK} |X-Y|_p^{D_K - D_z - D_{\bar{z}}} \end{aligned}$$

$$C_{IJK} = \int_r e^{-S_r/2} (\bar{z})^r \theta_r(Y) (\bar{z})^r (K)_r$$

- 1)  $D_S \gg 1 \Rightarrow$  same  $G_{z\bar{z}} \gg 1$
- 2) No Descendants!

$$C_{zJK} C_{KLM}$$

$$C_{zKN} C_{JMN}$$



$X_a, Y_a$   
 $X_b, Y_b$

$$X' = \frac{A}{C}$$

$PGL(2, \mathbb{C})$