

Title: On Symmetries and Asymmetries at Hadron Colliders

Date: Apr 08, 2011 01:00 PM

URL: <http://pirsa.org/11040104>

Abstract: TBA

Syms. and Asyms. at Hadron Colliders

- Intro

- Tevatron AFB

- $A_{FB}^{t\bar{t}}$

- $A_{FB}^{b\bar{b}, c\bar{c}}$

- Models

Models for $A_{FB}^{t\bar{t}}$

Syms. and Asyms. at Hadron Colliders

- Intro

- Tevatron A_{FB}

- $A_{FB}^{t\bar{t}}$

- $A_{FB}^{b\bar{b}, c\bar{c}}$ - Models for $A_{FB}^{t\bar{t}}$

- excluding models w/ $A_{FB}^{t\bar{t}}$ at LHC

- LHC A_{FB}

Syms. and Asyms. at Hadron Colliders

- Intro

- Tevatron AFB

- A_{FB}^{ll}

- $A_{FB}^{l\bar{l}, c\bar{c}}$

- A_{FB}^{bb}

- Models for A_{FB}^{ll}

- excluding models w/ $A_{FB}^{c\bar{c}}$ etc.

- LHC A_{FB}

Feynman

PP

CP, CP

LHC

PP

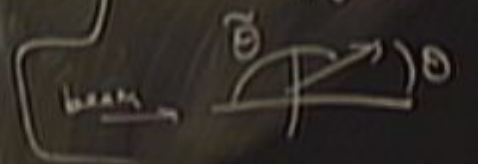
CP, P, P

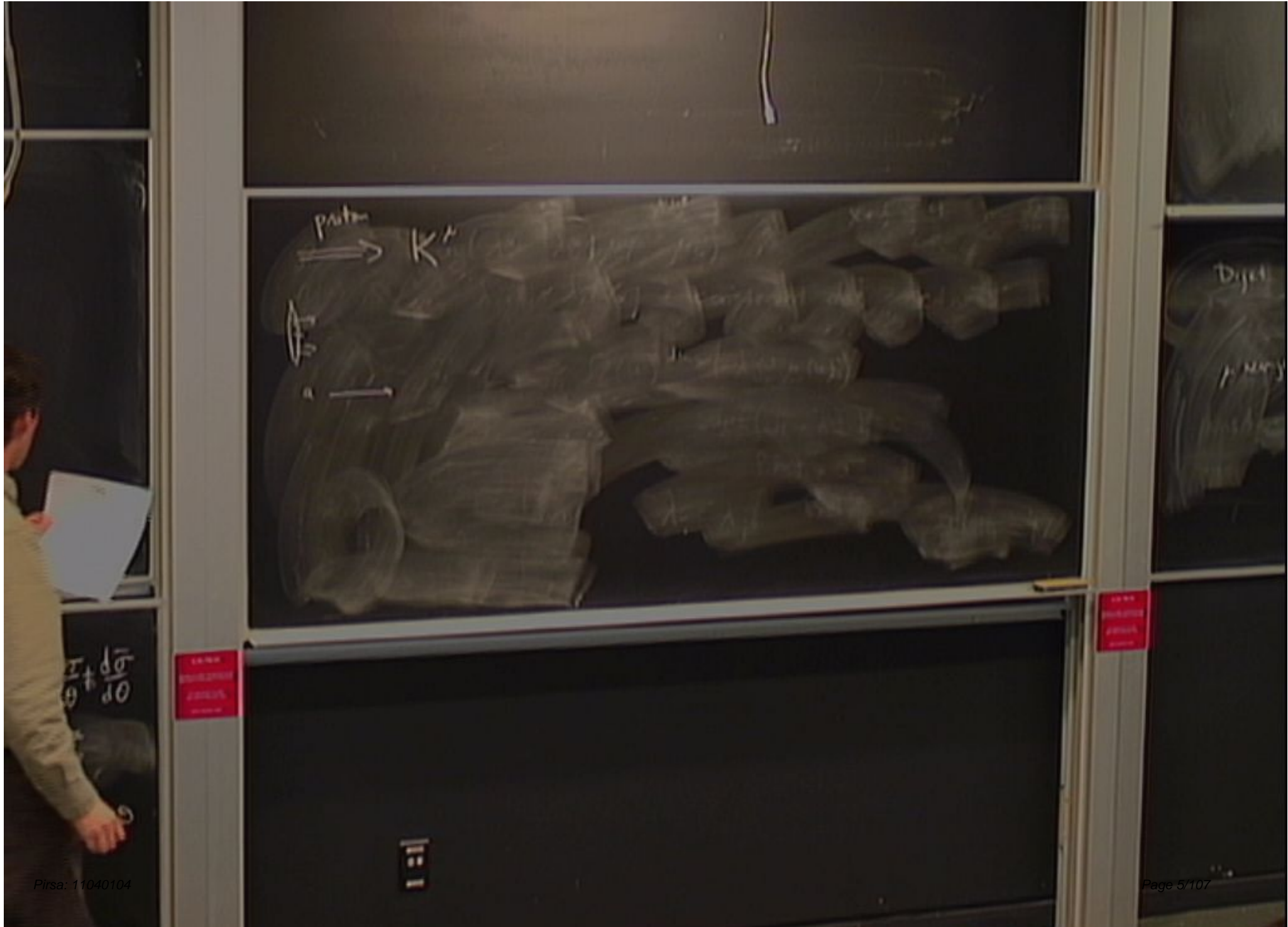
$$\sigma = \bar{\sigma}$$

$$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\bar{\theta}}$$

$$= d\bar{\sigma}$$

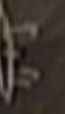
$$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\bar{\theta}}$$





prata

K_z



i

Dijet

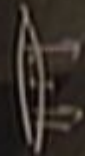
p. 123

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111

proton



$$a \xrightarrow{x} K^a = x K^a$$

$f_a(x)$ prob to find
proton of type a
w/ mom frac x
 $0 < x < 1$



proton



K^+

$a \xrightarrow{x}$

$$K^+ - x K^+$$

$f_a(x)$

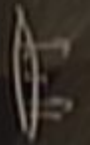
prob to find
proton of type a
w/ max force x

$$0 < x < 1$$



S_1
 S_2
 S_3

proton \rightarrow K^+



$a \xrightarrow{x} K^+ - x K^+$

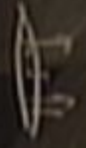
$f_a(x)$

prob to find
proton of type a
w/ max force x

$0 < x < 1$



proton



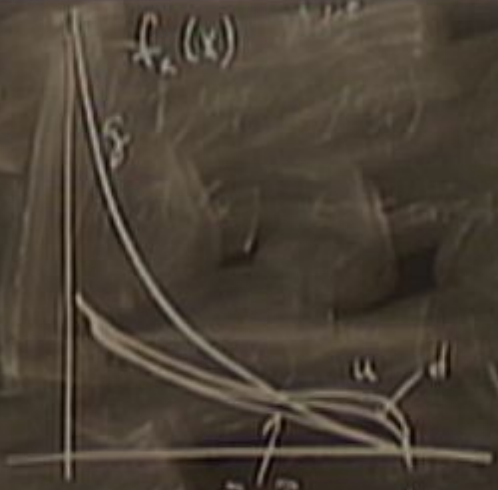
$a \xrightarrow{x}$

$$K^+ = x K^+$$

$f_a(x)$

prob to find
proton of type a
w/ max force x

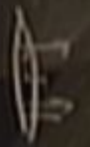
$$0 < x < 1$$



$f_a(x)$

s_1
 s_2
 s_3

proton \Rightarrow K^+



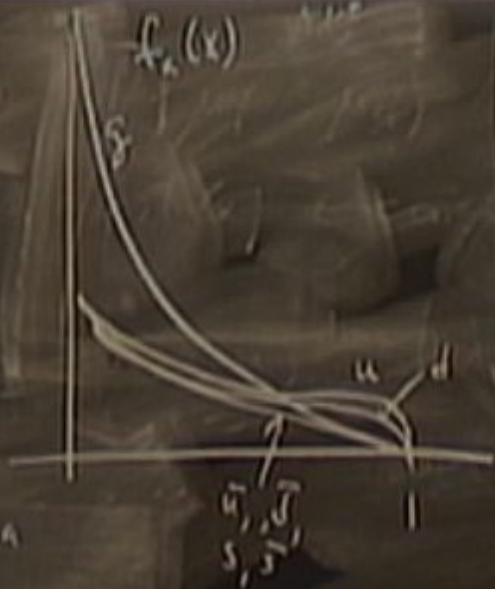
$a \xrightarrow{x} K^+ - x K^+$

$f_a(x)$

prob to find
proton of type a
w/ mom frac x

$0 < x < 1$

$f_a(x)$



proton-proton Luminosity

proton \Rightarrow K^+



$a \xrightarrow{x} K^+ - x K^+$

$f_a(x)$

prob to find
parton of type a
w/ mom frac x

$0 < x < 1$

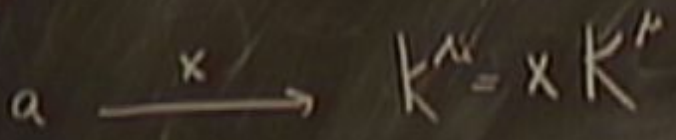
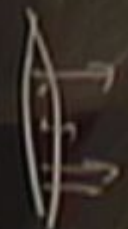
$f_2(x)$



parton-parton Luminosity

$x \xrightarrow{x_1} \xleftarrow{x_2} b$

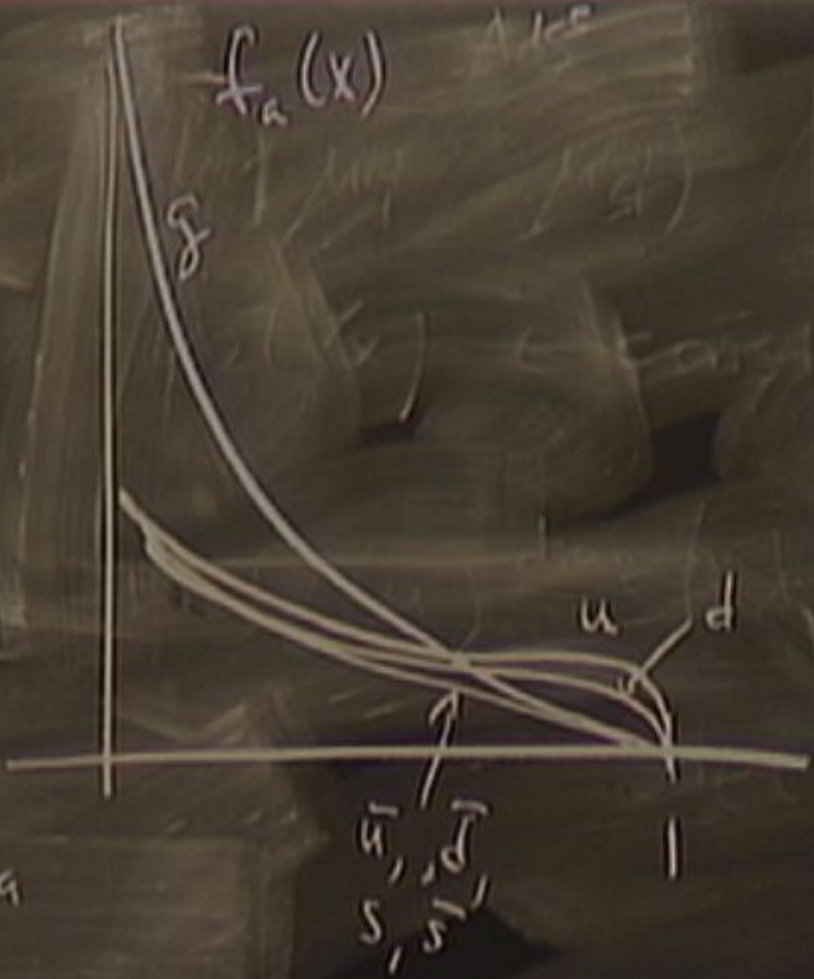
$E^{p, coll} \rightarrow E^{coll} \sqrt{x_1 x_2}$



$f_a(x)$

prob to find
parton of type a
w/ mom frac x

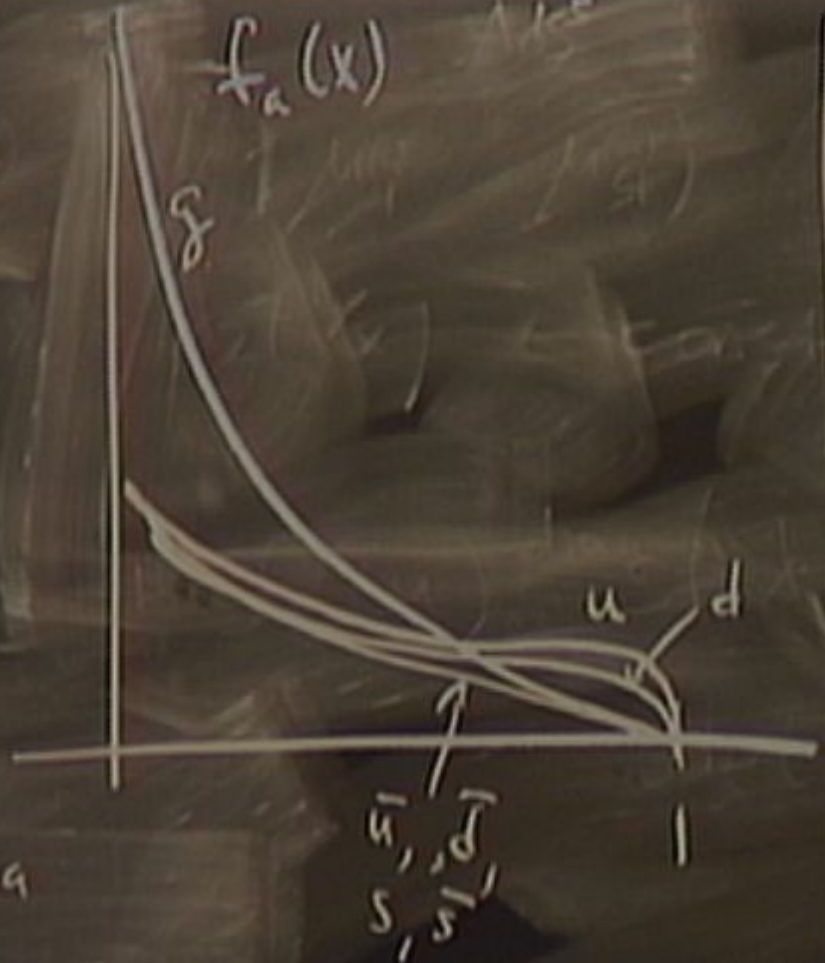
$0 < x < 1$



parton-parton

x_1

$f_a(x)$

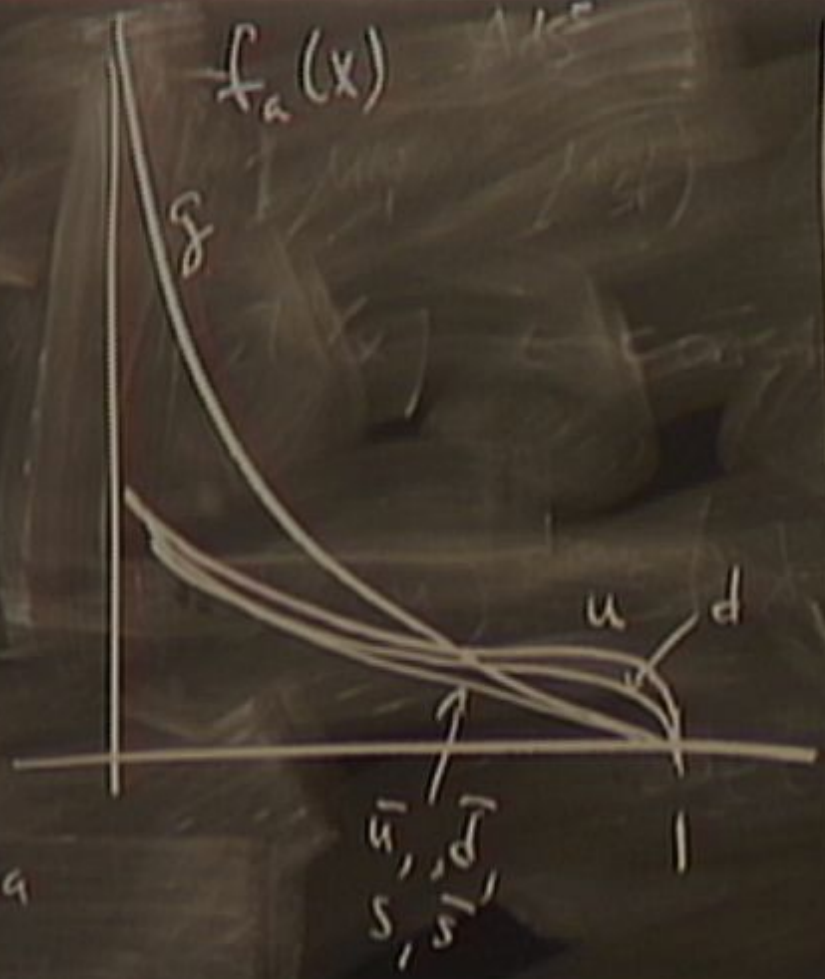


parton-parton Luminosity



$$E^{P.C.D.M} = E^{C.C.O.N} \sqrt{x_1 x_2}$$

$f_a(x)$



parton-parton Luminosity



$$E_{P.C.M.} = E_{C.M.} \sqrt{x_1 x_2}$$

\mathcal{L}_{ab}^{pp}
 $\bar{u} \bar{u}$

$f_a(x)$

g

u d

s_1
 s_2
 s_3

parton-parton Luminosity



$$E_{p.c.o.m.} = E_{c.o.m.} \sqrt{x_1 x_2}$$

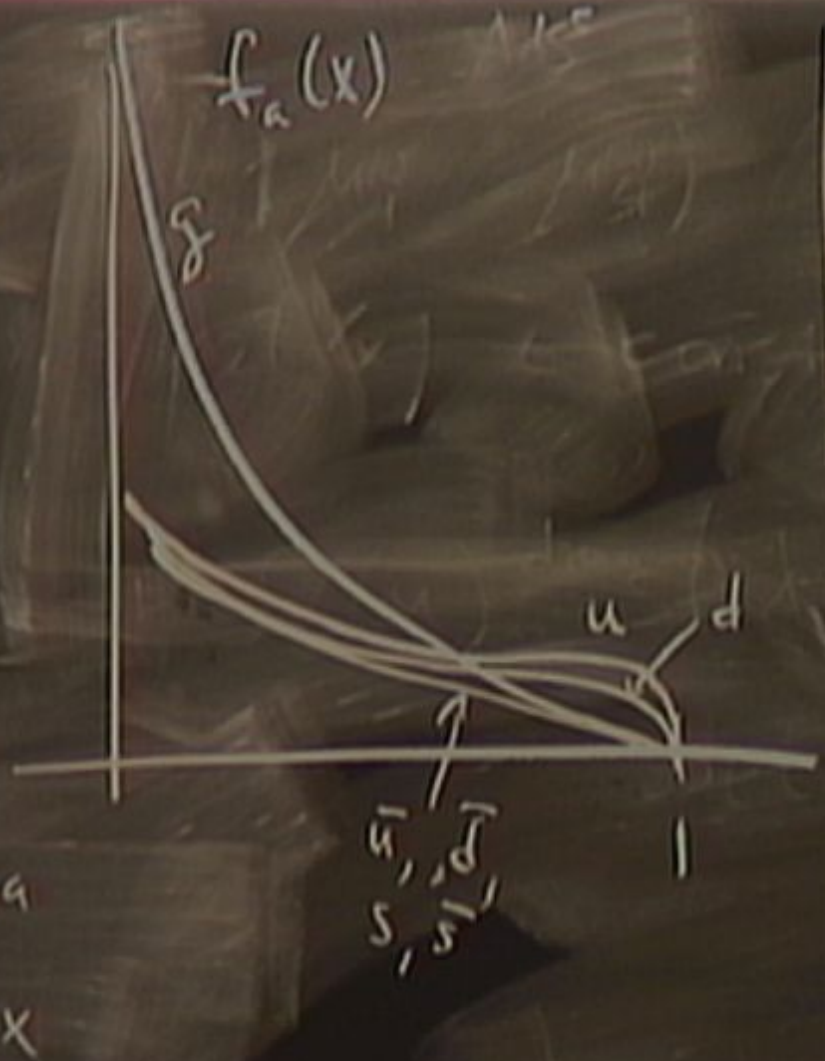
\mathcal{L}_{ab}^{pp}

$$u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$$

$(u, d)g$

gg

$q\bar{q}, q\bar{q}$



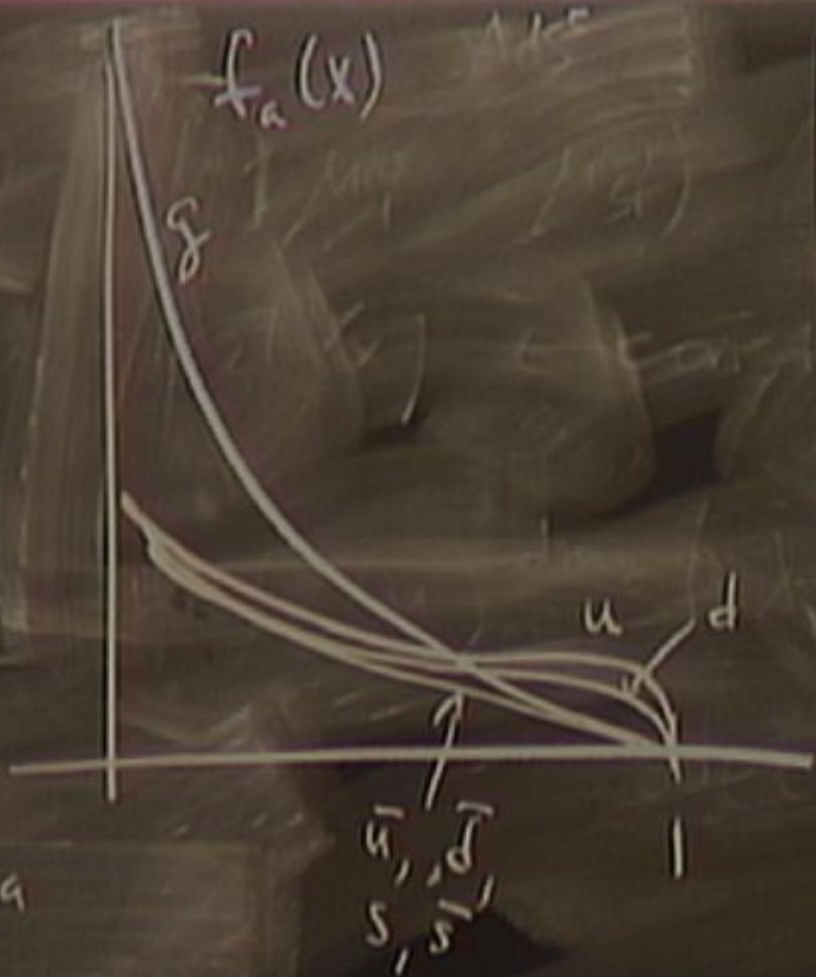
parton-parton Luminosity



$$E_{p.c.o.m} = E^{c.o.m} \sqrt{x_1 x_2}$$

- \mathcal{L}_{ab}^{pp}
- $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
- $(u, d)g$
- gg
- $\pi\pi, \pi\bar{\pi}$

- \mathcal{L}_{ab}^{pp}
- $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
- $(u, d)g$
- gg



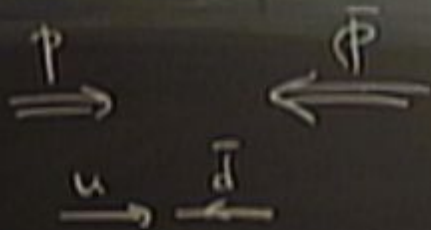
parton-parton Luminosity



$$E_{p.c.o.m.} = E^{c.o.m.} \sqrt{x_1 x_2}$$

\mathcal{L}_{ab}^{pp}
 $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
 $(u, d)g$
 gg
 $q\bar{q}, q\bar{q}$

\mathcal{L}_{ab}^{pp}
 $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
 $(u, d)g$
 gg
 $q\bar{q}$



Symms. and Asymms at Hadron Colliders

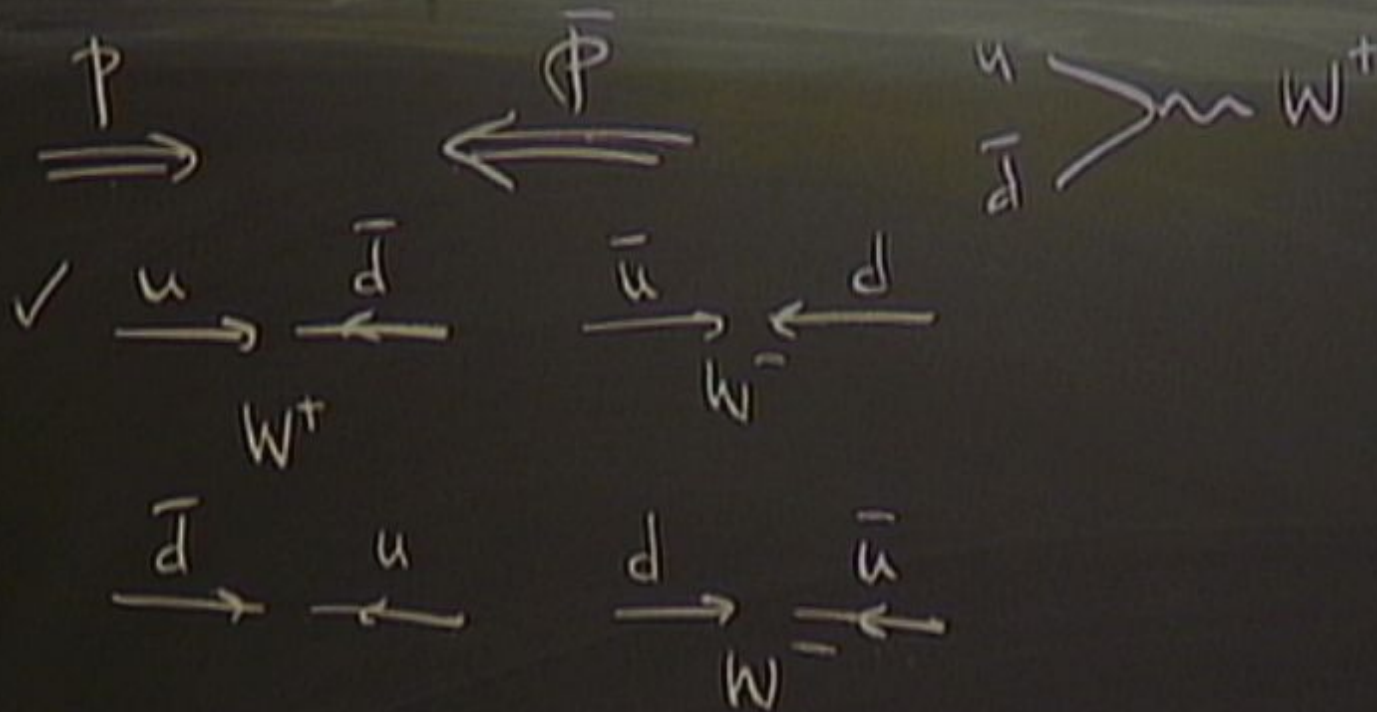
- Intro
- Tevatron Asym

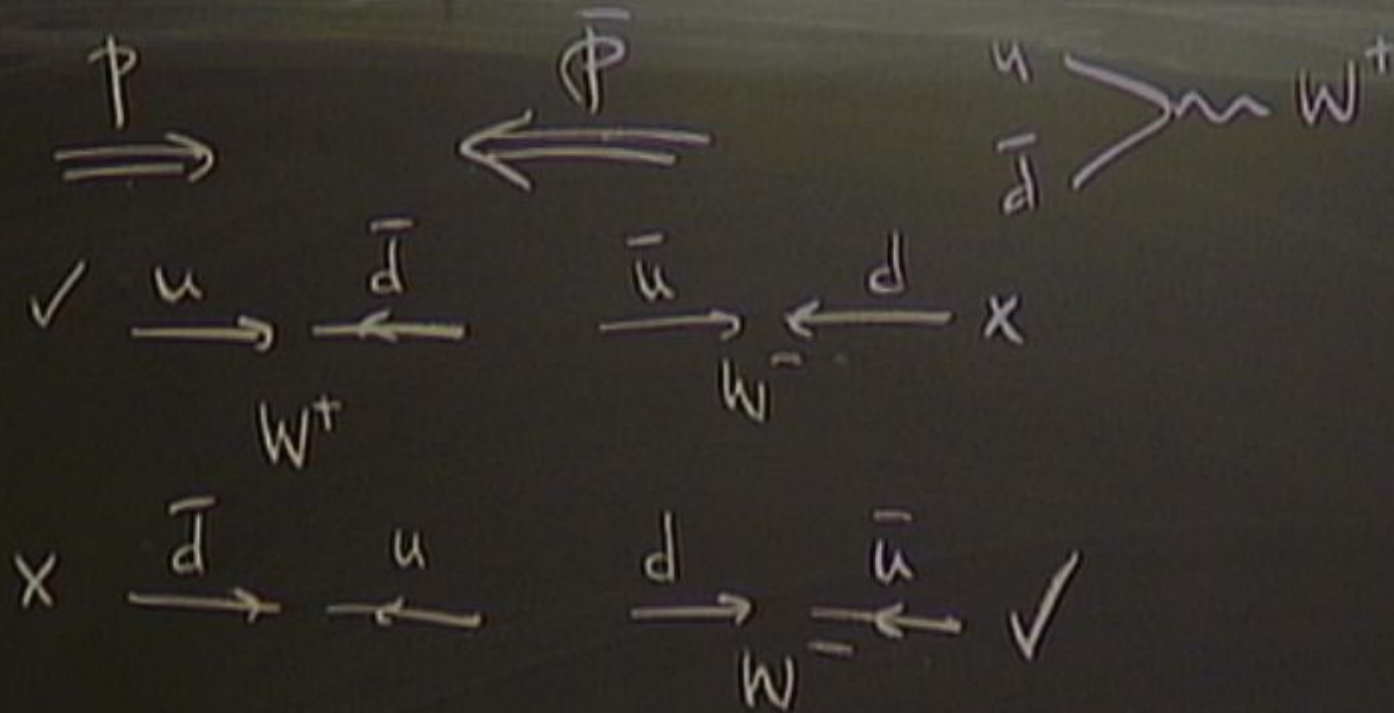
Λ_{QCD}
 Λ_{QCD}
 Λ_{QCD} Models for Λ_{QCD}

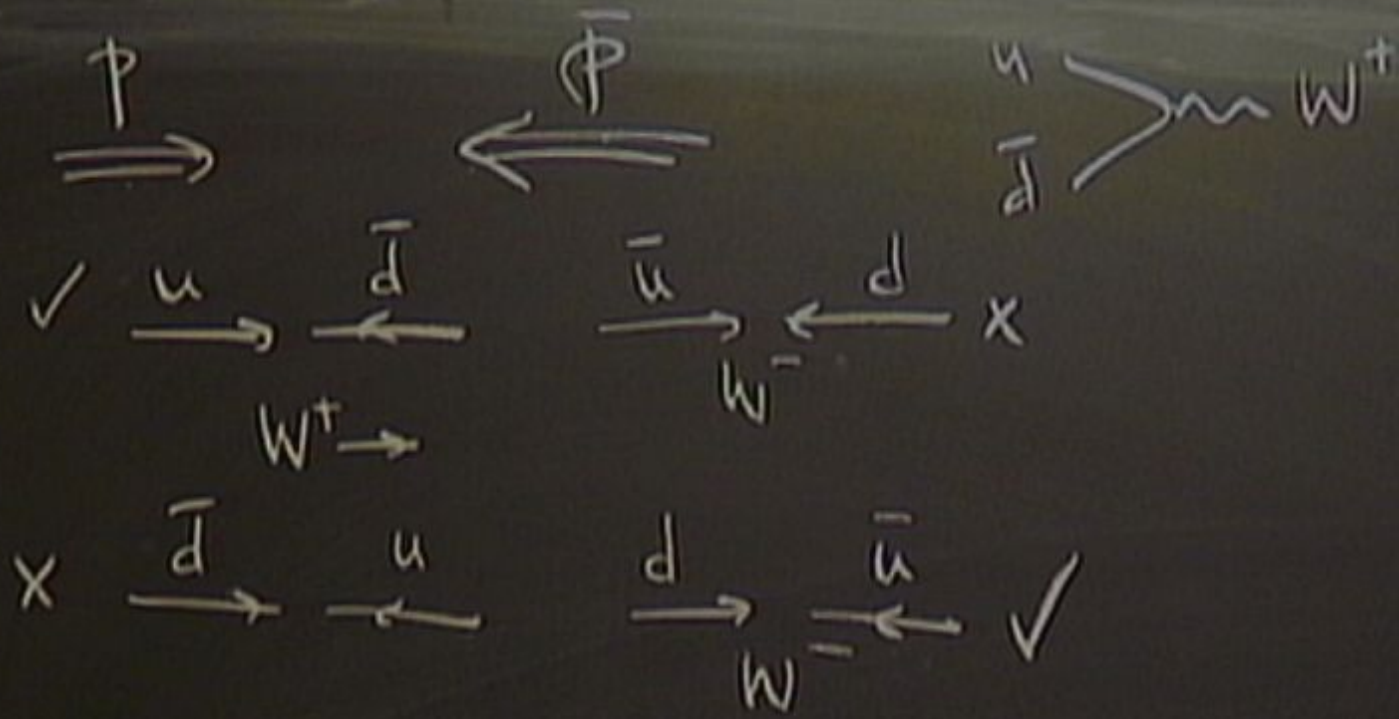
- excluding models w/ Λ_c at LHC

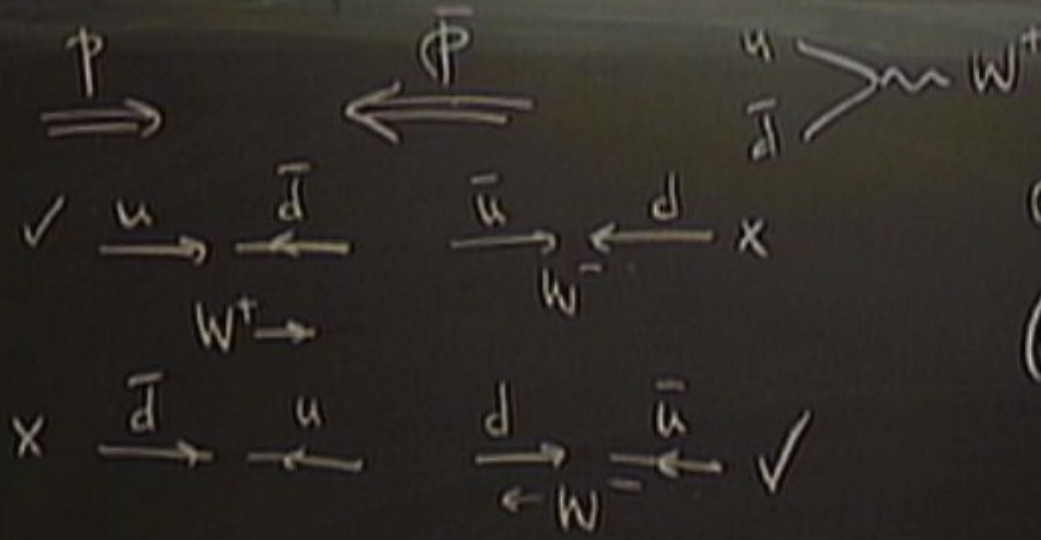
<u>Feynman</u>	CP, CP	$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$
LHC	CP, CP, P	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \bar{\sigma}$		
$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\theta}$		
$\sigma \neq \bar{\sigma}$		

beam \rightarrow









$$\sigma_{W^+} = \sigma_{W^-}$$

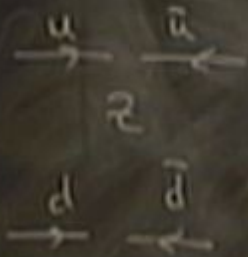
$$(\sigma_{W^+}^{\rightarrow} + \sigma_{W^+}^{\leftarrow}) + (\sigma_{W^-}^{\rightarrow} + \sigma_{W^-}^{\leftarrow})$$

Syms. and Asyms. at Hadron Colliders

- Intro
- Tevatron AEC

- Feynman
- PP
- LHC

$$= \sigma_0, \frac{d\sigma}{d\theta} \neq \frac{d\sigma}{d\theta}$$



Symms. and Asymms. at Hadron Colliders

- Intro
- Tevatron AFB
- A_{FB}^{ll}
- $A_{FB}^{bb,cc}$ - Models for A_{FB}^{ll}
- A_{FB}^{ll}
- excluding models w/ A_C^{ll} at LHC

Feynman

PP

CP, CP

$$\sigma = \overline{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\overline{\sigma}}{d\theta}$$

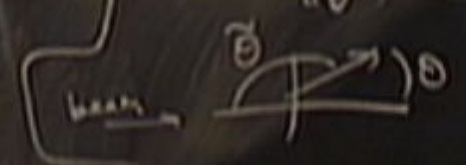
LHC

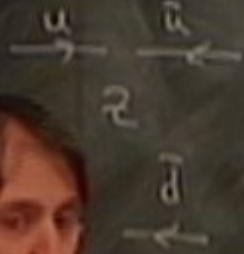
PP

CP, CP, P

$$\sigma \neq \overline{\sigma}$$

$$\frac{d\sigma}{d\theta} = \frac{d\overline{\sigma}}{d\theta}$$





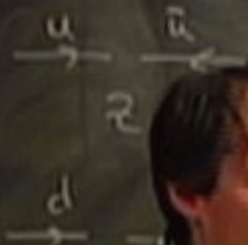
$$q\bar{q} \rightarrow e^+e^- \rightarrow \mu\mu$$

and Asym at Hadron Colliders

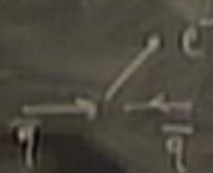
- Intro
- Tevatron Asym
- $A_{FB}^{t\bar{t}}$
- $A_{FB}^{b\bar{b}, c\bar{c}}$ - Models for $A_{FB}^{t\bar{t}}$
- $A_{FB}^{c\bar{c}}$
- excluding models w/ $A_c^{t\bar{t}}$ at LHC

Tevatron	CP, CP	$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$
LHC	CP, CP, P	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \bar{\sigma}$		
$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\bar{\theta}}$		
$d\sigma \neq d\bar{\sigma}$		

beam \rightarrow



$$q\bar{q} \rightarrow e \rightarrow \ell\bar{\ell}$$



Symmetries at Hadron Colliders

Feynman

PP

CP, CP

$$\sigma > \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$

from Arg

LHC

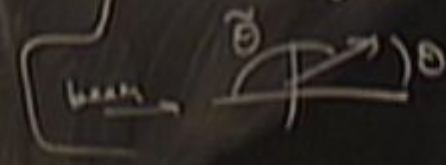
PP

CP, P, T

$$\frac{d\sigma}{d\theta}$$

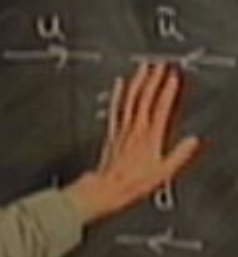
Models for A_{FB}

$$\sigma \neq \bar{\sigma}$$

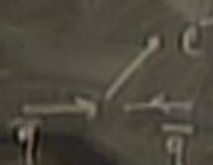


$$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\bar{\theta}}$$

models of A_{FB} at LHC



$$q\bar{q} \rightarrow e^+e^- \rightarrow \mu^+\mu^-$$



Units and Asym at Hadron Colliders

- Intro
- Tevatron Ang
- Λ_{QCD}
- $\Lambda_{QCD}^{b,c}$ - Models for Λ_{QCD}
- Λ_{QCD}
- excluding models w/ Λ_c at LHC

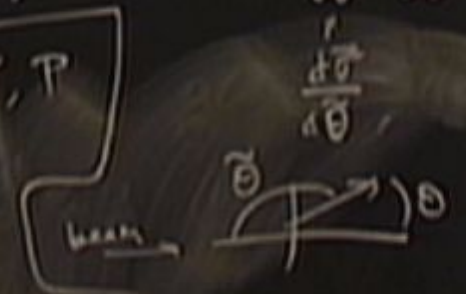
Feynman

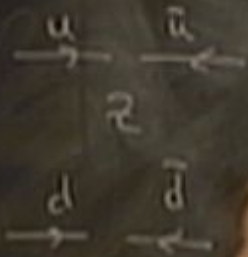
PP	CP, CP
LHC PP	CP, P, T

$$\sigma \neq \bar{\sigma}$$

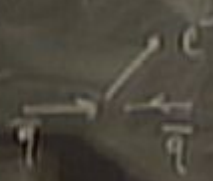
$$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\bar{\theta}}$$

$$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\bar{\theta}}$$





$$q\bar{q} \rightarrow \gamma \rightarrow \ell\ell$$



Asym at Hadron Colliders

- Intro
- Tevatron Asym
- A_{FB}^{ℓ}
- $A_{FB}^{b,c}$ Models for A_{FB}^{ℓ}
- A_{FB}^{ℓ}
- excluding models w/ A_C^{ℓ} at LHC

Tevatron	CP, CP	$\sigma > \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$
LHC	CP, P	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \bar{\sigma}$		
$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\theta}$		
$d\sigma \neq d\bar{\sigma}$		

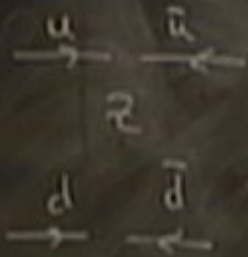
beam \rightarrow



Symms. and Asymms at Hadron

- Intro
- Tevatron AFB
- A_{FB}^{ll}
- $A_{FB}^{bb, cc}$ - Models for A_{FB}^{ll}
- A_{FB}^{cc}
- excluding models w/ A_c at LHC

$\sigma = \overline{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\sigma}{d\theta}$
 $\frac{d\sigma}{d\theta}$



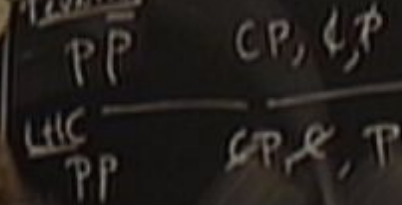
$$q\bar{q} \rightarrow e^+e^- \rightarrow \mu\mu^-$$



Symms. and Asymms

- Intro
- Tevatron A_s
- A_{FB}^{ll}
- $A_{FB}^{b\bar{b}, c\bar{c}}$ - Models for A_{FB}
- excluding models w/ A_s

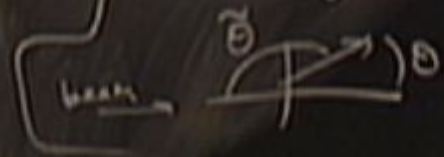
Hidden
Tevatron



$$\sigma > \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$

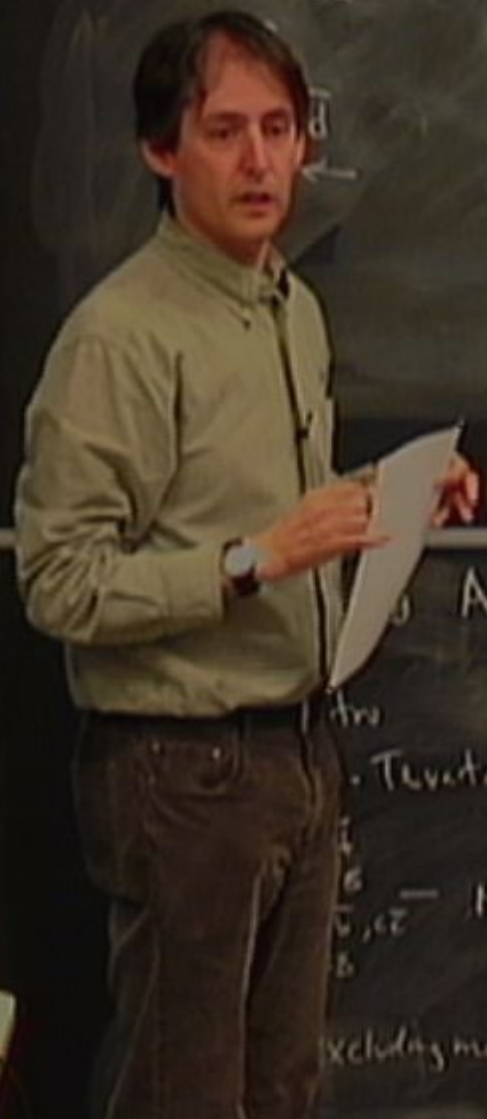
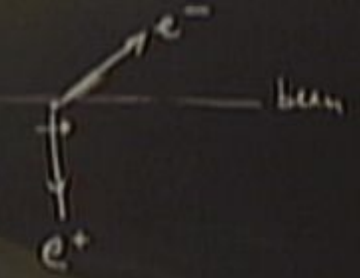
$$\sigma \neq \bar{\sigma}$$

$$\frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$





$$q\bar{q} \rightarrow e^- \rightarrow \mu\mu^-$$



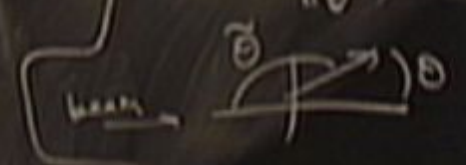
Asym at Hadron Colliders

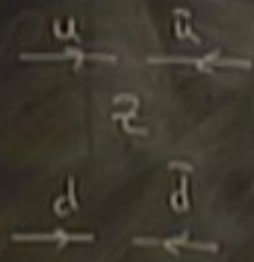
Tevatron Asym

Models for A_c

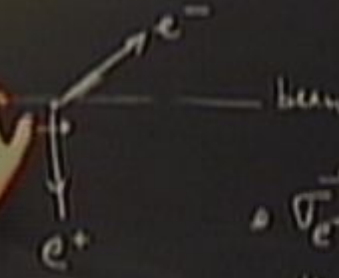
excluding models w/ A_c at LHC

Tevatron	CP, CP	$\sigma > \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$
LHC	CP, CP, P	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \bar{\sigma}$		
$\frac{d\sigma}{d\theta} = \frac{d\bar{\sigma}}{d\theta}$		
$\sigma \neq \bar{\sigma}$		





$$q\bar{q} \rightarrow e^+e^- \rightarrow \mu\mu$$



$$\sigma_{e^+e^-} \neq \sigma_{e^-e^+}$$

in Z frame

Symms. and Asymms at H

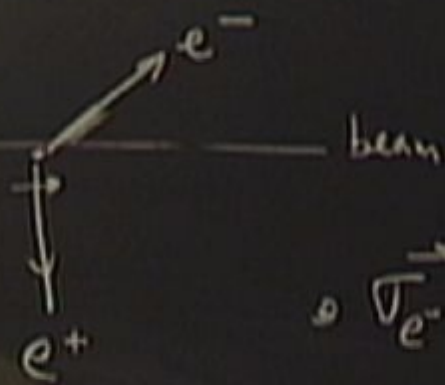
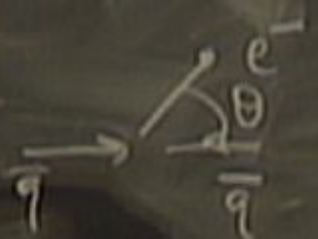
- Intro
- Tevatron AFB
- $A_{FB}^{t\bar{t}}$
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- $A_{FB}^{e^+e^-}$
- excluding models w/ A_C at LHC

CP, CP, CP, P

$$\sigma = \overline{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\sigma}{d\theta}$$



$$q\bar{q} \rightarrow Z \rightarrow \ell\bar{\ell}$$



• $\sigma_{e^+e^-}^{\rightarrow} \text{ vs } \sigma_{e^-e^+}^{\leftarrow}$
in Z frame

• $\sigma_{e^+e^-}^{\rightarrow} \text{ vs } \sigma_{e^-e^+}^{\leftarrow}$
in lab frame

Asyms. of Hadron Colliders

in AFIS

Fevatron

PP

CP, CP

LHC

PP

CP, CP, P

$\sigma \neq \bar{\sigma}$

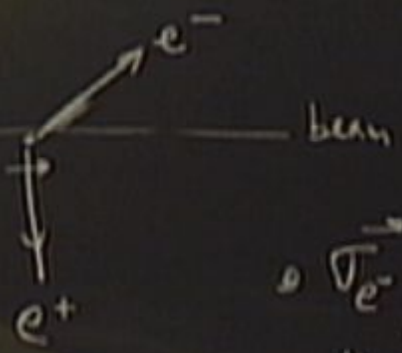
$$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$

$$\frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$



$\bar{p} \rightarrow z \rightarrow \ell \ell^-$

amplitude



$\sigma_{e^+}^{\rightarrow} \text{ vs } \sigma_{e^-}^{\leftarrow}$
in z frame

$\sigma_{e^+ \rightarrow z}^{\rightarrow} \text{ vs } \sigma_{e^+ \rightarrow z}^{\leftarrow}$
in lab frame

iders
Feynman
PP

CP, CP

$$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$$

HC
PP

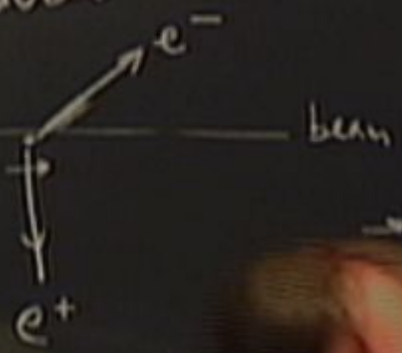
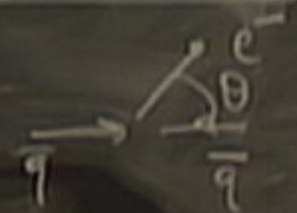
CP, P, T



$$q\bar{q} \rightarrow Z \rightarrow \ell\bar{\ell}$$

amplitude - induced

Δ_{FB}



vs σ_{e^-}
 frame
 vs σ_{e^+}
 frame

at Hadron Colliders

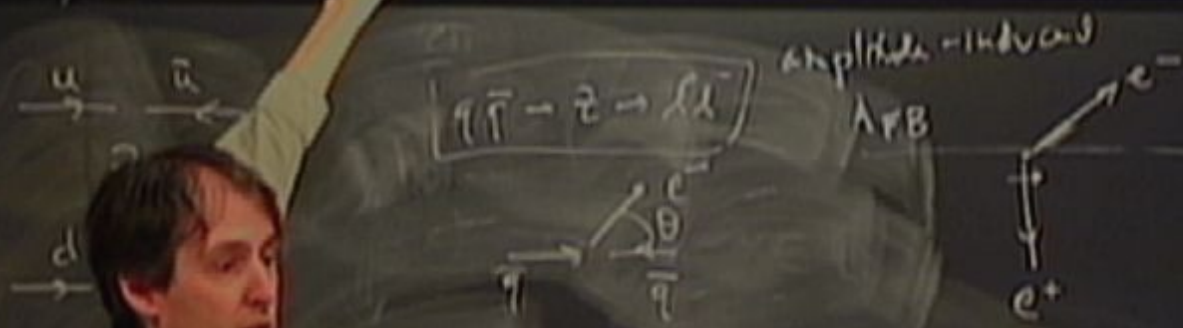
Feynman

PP

LHC

PP

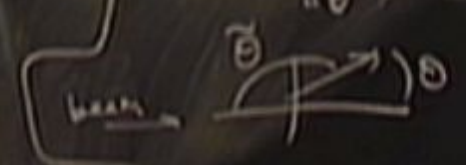


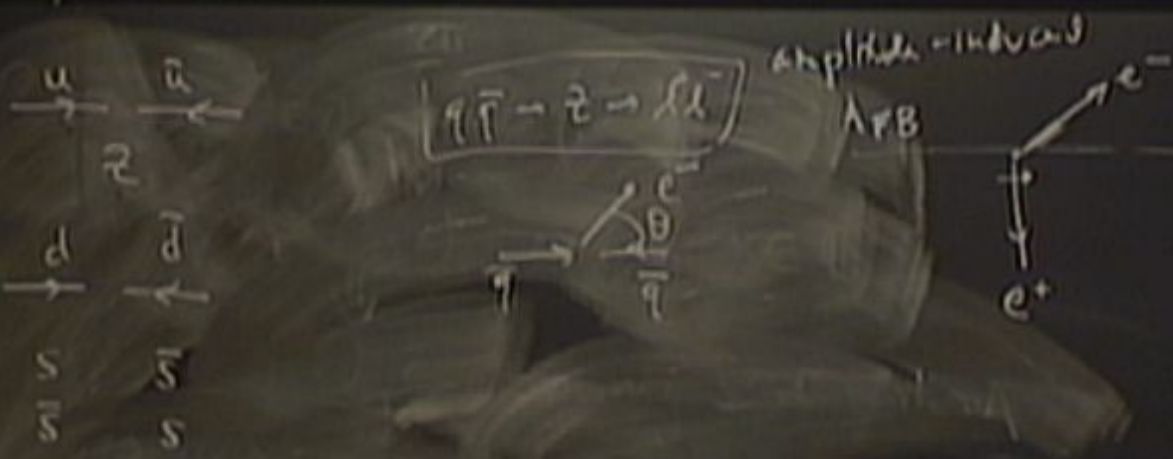


- $\sigma_{e^-}^{\rightarrow} \neq \sigma_{e^-}^{\leftarrow}$ in Z frame
- $\sigma_{e^-e^+}^{\rightarrow} \neq \sigma_{e^-e^+}^{\leftarrow}$ in lab frame

Symmetries of Hadron Colliders

Feynman	CP, CP	$\sigma = \overline{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\overline{\sigma}}{d\theta}$
LHC	CP, P, T	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \overline{\sigma}$		
$\frac{d\sigma}{d\theta} = \frac{d\overline{\sigma}}{d\overline{\theta}}$		

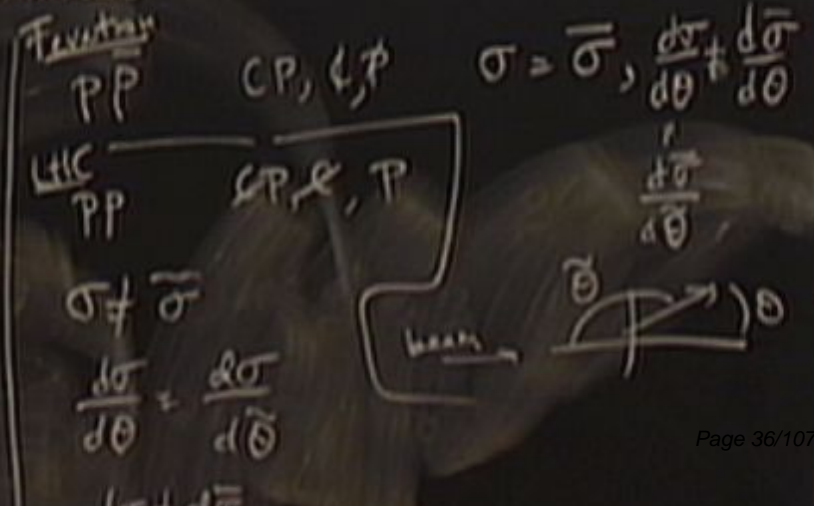


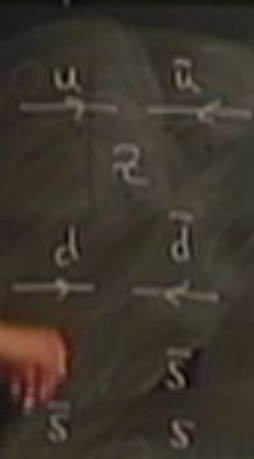


$\sigma_{e^+e^-}^{\rightarrow} \text{ vs } \sigma_{e^+e^-}^{\leftarrow}$
 in Z frame
 $\sigma_{e^+e^-}^{\rightarrow} \text{ vs } \sigma_{e^+e^-}^{\leftarrow}$
 in lab frame

Symms. and Asymms at Hadron Colliders

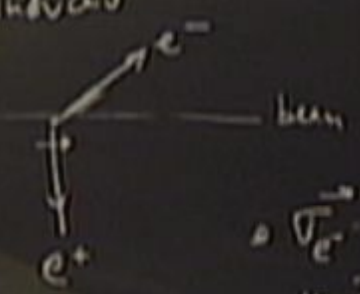
- Intro
- Tevatron AFB
- A_{FB}^{ll}
- $A_{FB}^{bb, cc}$ - Models for A_{FB}^{ll}
- A_{FB}^{ll}
- excluding models w/ A_C at LHC





$$\gamma\gamma \rightarrow e^+e^- \rightarrow \mu\mu$$

amplitude-induced
AFB

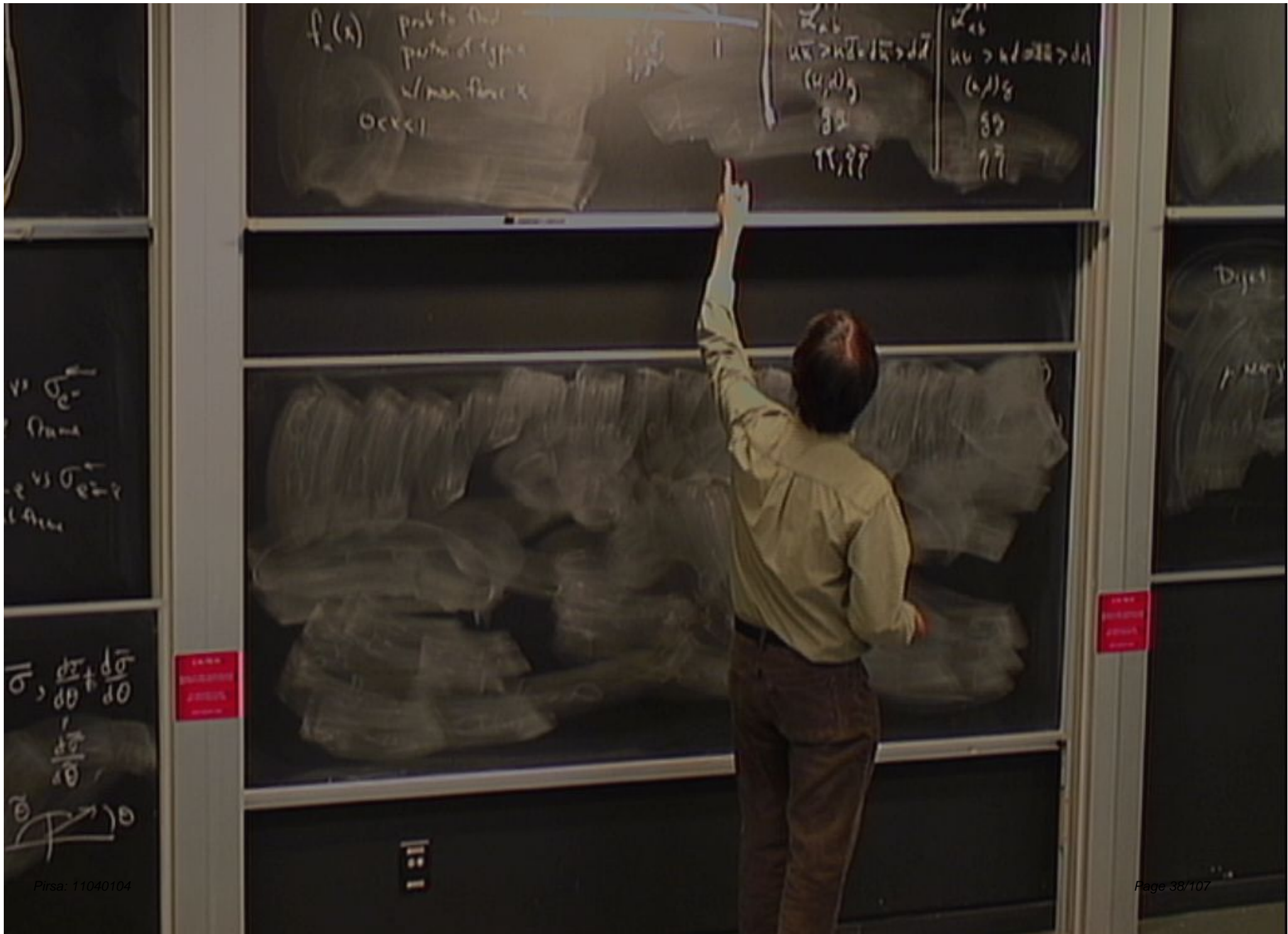


- $\sigma_{e^+e^-}^{\rightarrow} \neq \sigma_{e^+e^-}^{\leftarrow}$ in Σ frame
- $\sigma_{e^+e^-}^{\rightarrow} \neq \sigma_{e^+e^-}^{\leftarrow}$ in lab frame

Symms. and Asymms w/ Hadron Colliders

- Intro
- Tevatron AFB
- $A_{FB}^{t\bar{t}}$
- $A_{FB}^{b\bar{b}, c\bar{c}}$ - Models for $A_{FB}^{t\bar{t}}$
- $A_{FB}^{s\bar{s}}$
- excluding models w/ $A_C^{t\bar{t}}$ at LHC

<u>Feynman</u>	CP, CP	$\sigma = \bar{\sigma}, \frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$
PP		
LHC	CP, CP, P	$\frac{d\sigma}{d\theta}$
PP		
$\sigma \neq \bar{\sigma}$		
$\frac{d\sigma}{d\theta} \neq \frac{d\bar{\sigma}}{d\theta}$		



$f_n(x)$ prob to find
part of type
w/ max force x
 $0 < x < 1$

\mathcal{L}_{ab}
 $u > w > d > d > d$
 $(u, d)g$
 gg
 gg, gg

\mathcal{L}_{ab}
 $u > w > d > d > d$
 $(u, d)g$
 gg
 gg

$v \sigma_c$
 σ_{max}
 $v \sigma_c$
 $(A)_{max}$

$\frac{1}{10}, \frac{1}{10}, \frac{1}{10}$
 $\frac{1}{10}, \frac{1}{10}, \frac{1}{10}$
 $\frac{1}{10}, \frac{1}{10}, \frac{1}{10}$
 $\frac{1}{10}, \frac{1}{10}, \frac{1}{10}$
 $\frac{1}{10}, \frac{1}{10}, \frac{1}{10}$

Dijet
p. 127

$f_2(x)$ part to find
part of type
w/ max force x
0 < x < 1

1/2

Σ_{ab}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
 $(u,d)g$
 gg
 $tt, \bar{t}\bar{t}$

Σ_{cb}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
 $(c,s)g$
 gg
 tt

$v^+ \sigma_c^-$
 σ_{ann}
 $v^+ \sigma_{e^+e^-}$
 σ_{ann}

$\frac{1}{10}, \frac{1}{20}, \frac{1}{30}, \frac{1}{40}$
 $\frac{1}{20}, \frac{1}{30}, \frac{1}{40}$
 $\frac{1}{20}, \frac{1}{30}, \frac{1}{40}$

Transition $t\bar{t}$
 $gg \rightarrow t\bar{t}$
 $gg \rightarrow t\bar{t}$
 $gg \rightarrow t\bar{t}$

$gg \rightarrow t\bar{t}$ \rightarrow g g

Dijet
 p, \bar{p}

RESEARCH
 UNIVERSITY
 LIBRARY

RESEARCH
 UNIVERSITY
 LIBRARY

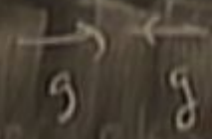
111

Traction $t\bar{t}$

$$q\bar{q} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$



$$q\bar{q} \rightarrow t\bar{t}$$

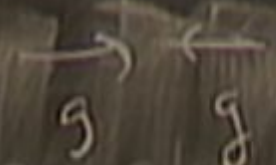
Teuclon $t\bar{t}$

$$q\bar{q} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$

$$q\bar{q} \rightarrow t\bar{t}$$



$f_2(x)$ part to the
part of type
w/ non force x
0 < x < 1

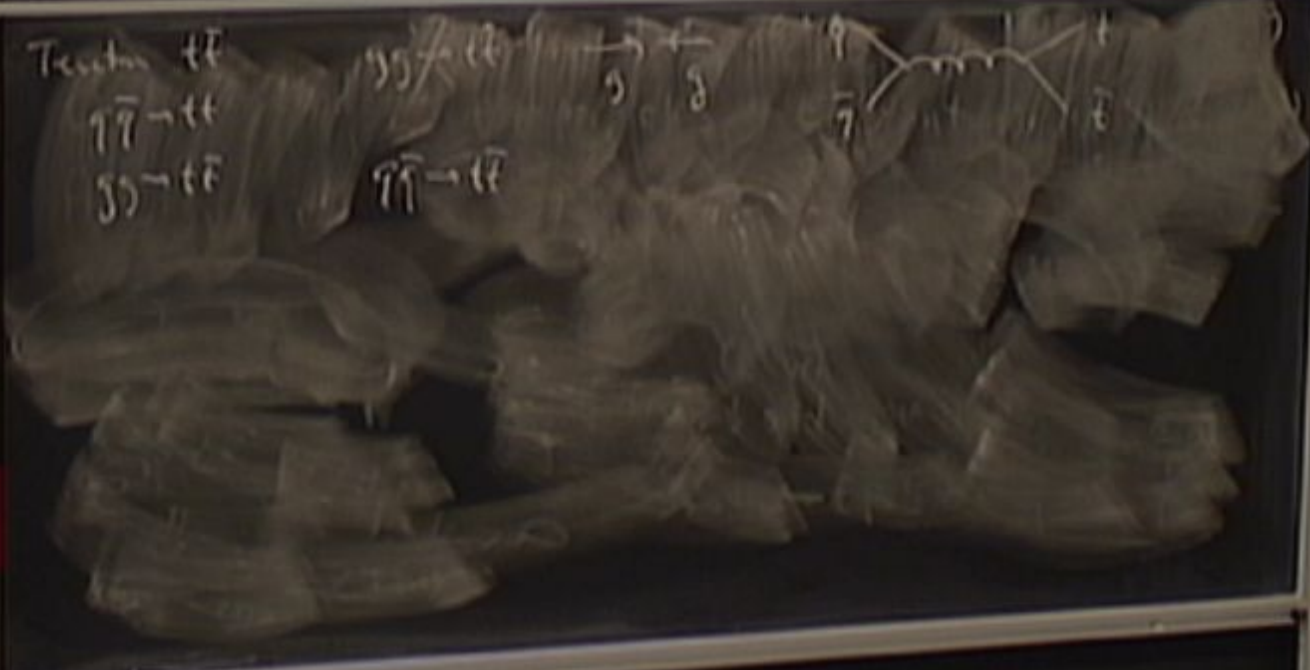
part
type

α_{ab}
 $ku > kd > dd$
(u,d)g
gg
gg, gg

α_{ab}
 $ku > kd > dd$
(u,d)g
gg
gg

$v \sigma_c$
Dura
 $v \sigma_c$
Ame

$\frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 σ

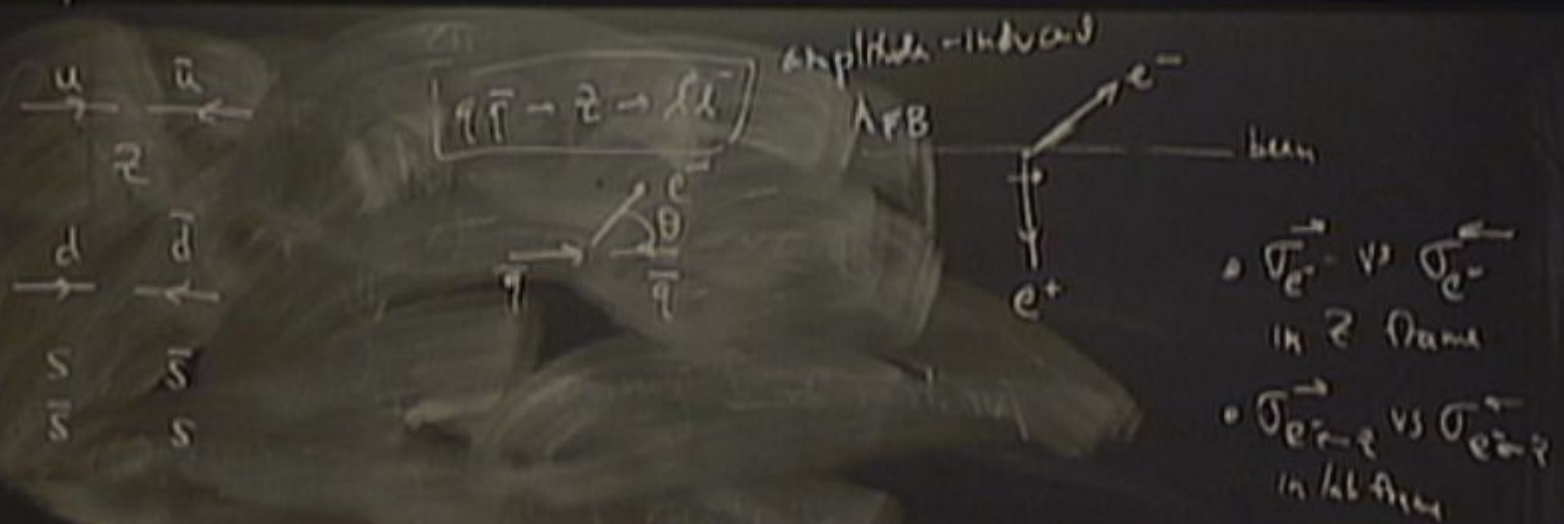


Dijet
muon

Small red sticker with illegible text.

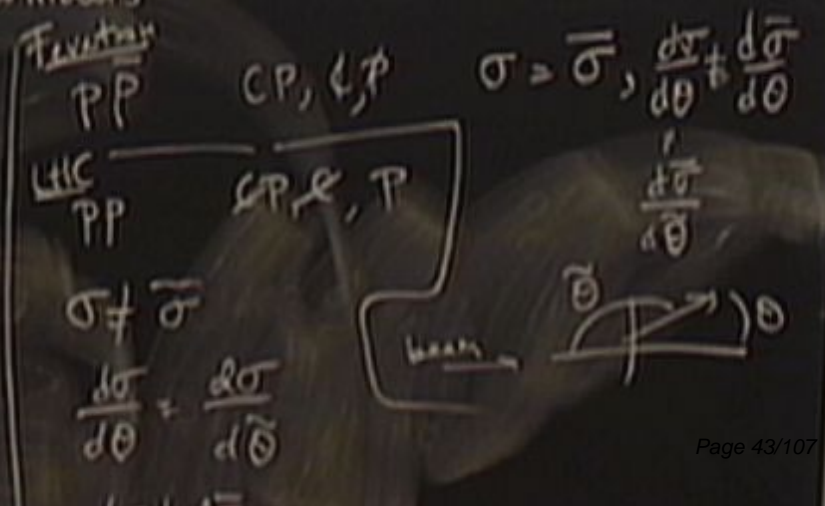
Small red sticker with illegible text.

Small black sticker with the number '111'.



Symms. and Asymms of Hadron Colliders

- Intro
- Tevatron AFB
- Λ_{FB}^{ll}
- $\Lambda_{FB}^{bb,cc}$ - Models for Λ_{FB}^{ll}
- Λ_{FB}^{ss}
- excluding models w/ A_c at LHC



$f_n(x)$ prob to find
 partition of type n
 w/ max force x
 $0 < x < 1$

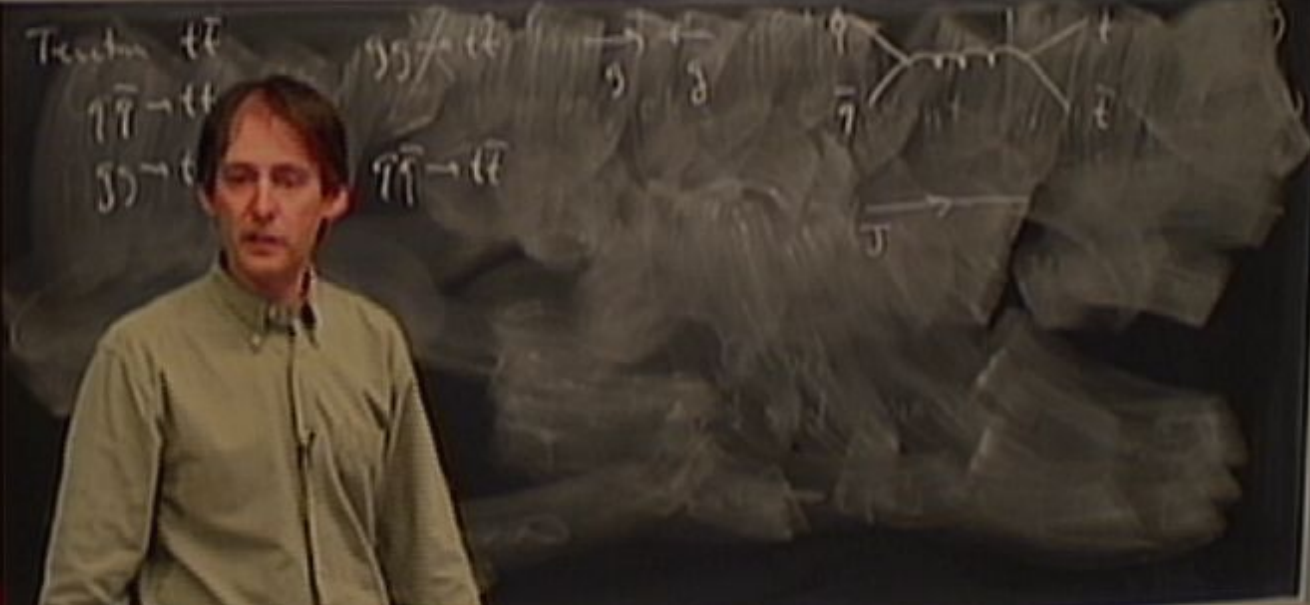
$g(x)$
 $1/2$

z_{ab}
 $u > u' > d > d'$
 $(u, d)g$
 gg
 gg, gg'

z'_{ab}
 $u > u' > d > d'$
 $(u, d)g$
 gg
 gg'

$v \sigma_c^-$
 ρ_{max}
 $v \sigma_{e^-}$
 (A_{max})

$\frac{d}{dt}, \frac{d^2}{dt^2} + \frac{d}{dt}$
 $\frac{d^2}{dt^2} - \frac{d}{dt}$
 \vec{v}



Dijet
 p, p'

NO NO
 PROHIBITED
 ENTRY

NO NO
 PROHIBITED
 ENTRY

$f_n(x)$ part to find
part of type
w/ non force x
0 < x < 1

\mathcal{L}_{ab}
 $u > w > d > d$
(u,d)g
gg
gg,gg

\mathcal{L}_{ab}
 $u > w > d > d$
(u,d)g
gg
gg

Transition
gg → tt
gg → tt

gg → tt



$v = \sigma_c$
Puma
 $v = \sigma_{c-}$
Lama

$\frac{d}{dt} \frac{d}{dt} + \frac{d}{dt}$
 $\frac{d}{dt} - \frac{d}{dt}$
 $\frac{d}{dt}$

SAFARI
UNIVERSITY
LIBRARY

111

$\pi, \bar{\pi}$

$\eta, \bar{\eta}$

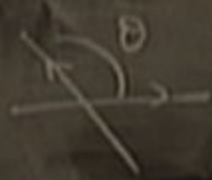
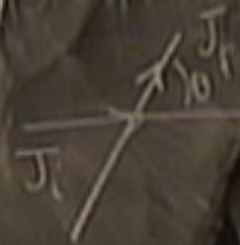
Transition $t\bar{t}$

$$q\bar{q} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$

$$g\bar{g} \rightarrow t\bar{t}$$

$$q\bar{q} \rightarrow t\bar{t}$$



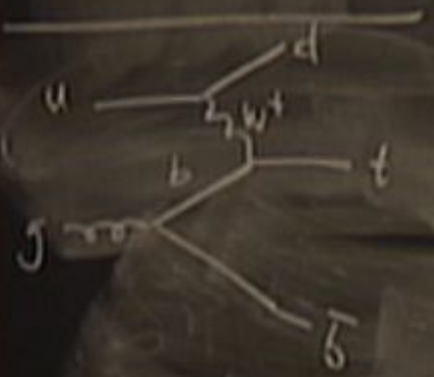
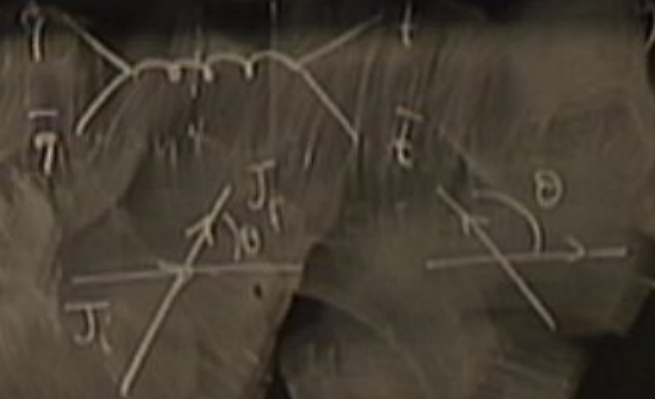
π, η

η

Reaction $t\bar{t}$
 $q\bar{q} \rightarrow t\bar{t}$
 $gg \rightarrow t\bar{t}$

~~$gg \rightarrow t\bar{t}$~~
 $q\bar{q} \rightarrow t\bar{t}$

$g \quad g$
no asym at
tree level



$\pi, \bar{\pi}$

η

Reaction $t\bar{t}$

$q\bar{q} \rightarrow t\bar{t}$

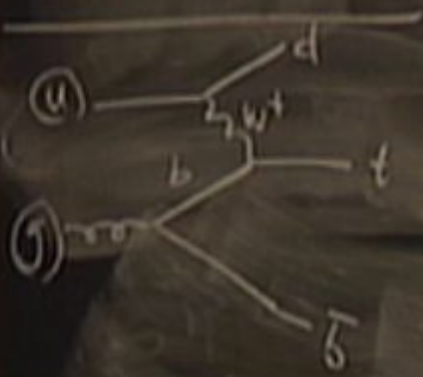
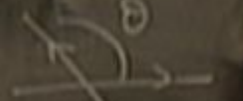
$gg \rightarrow t\bar{t}$

$gg \rightarrow t\bar{t}$

$q\bar{q} \rightarrow t\bar{t}$

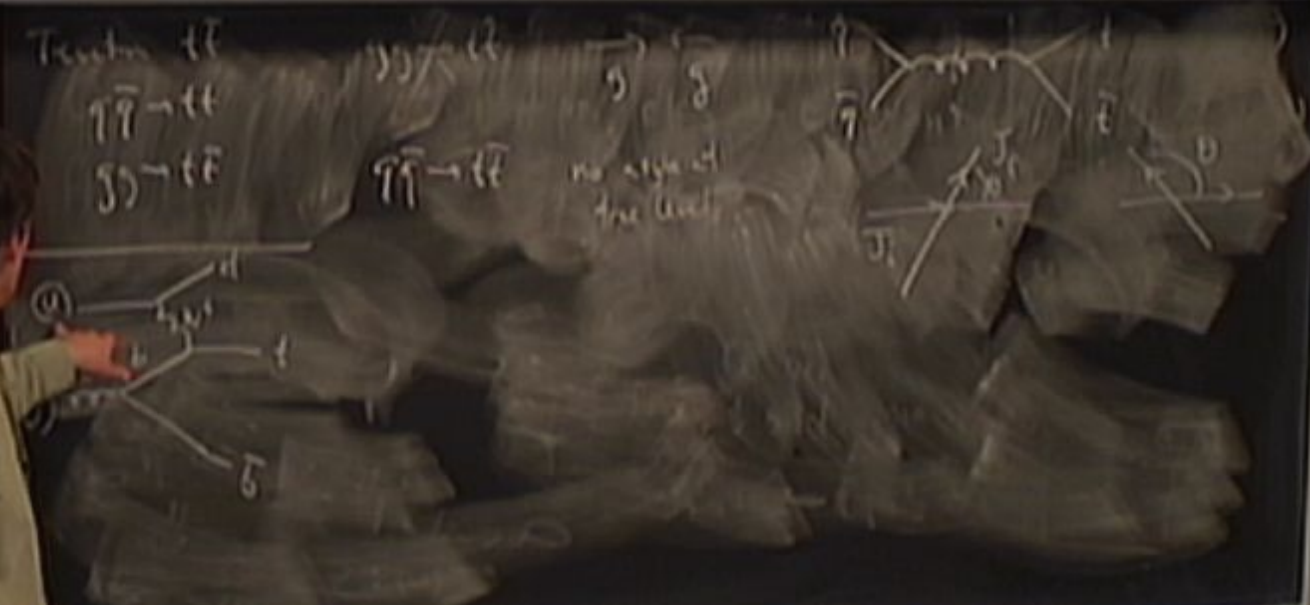


no asym at tree level



$f_2(x)$ part to the part of type x w/ max force x
 $0 < x < 1$

$u > u > d > d$	$u > u > d > d$
$(u, d)_{\bar{q}}$	$(u, d)_{\bar{q}}$
$\bar{q} \bar{q}$	$\bar{q} \bar{q}$
$q \bar{q}$	$q \bar{q}$



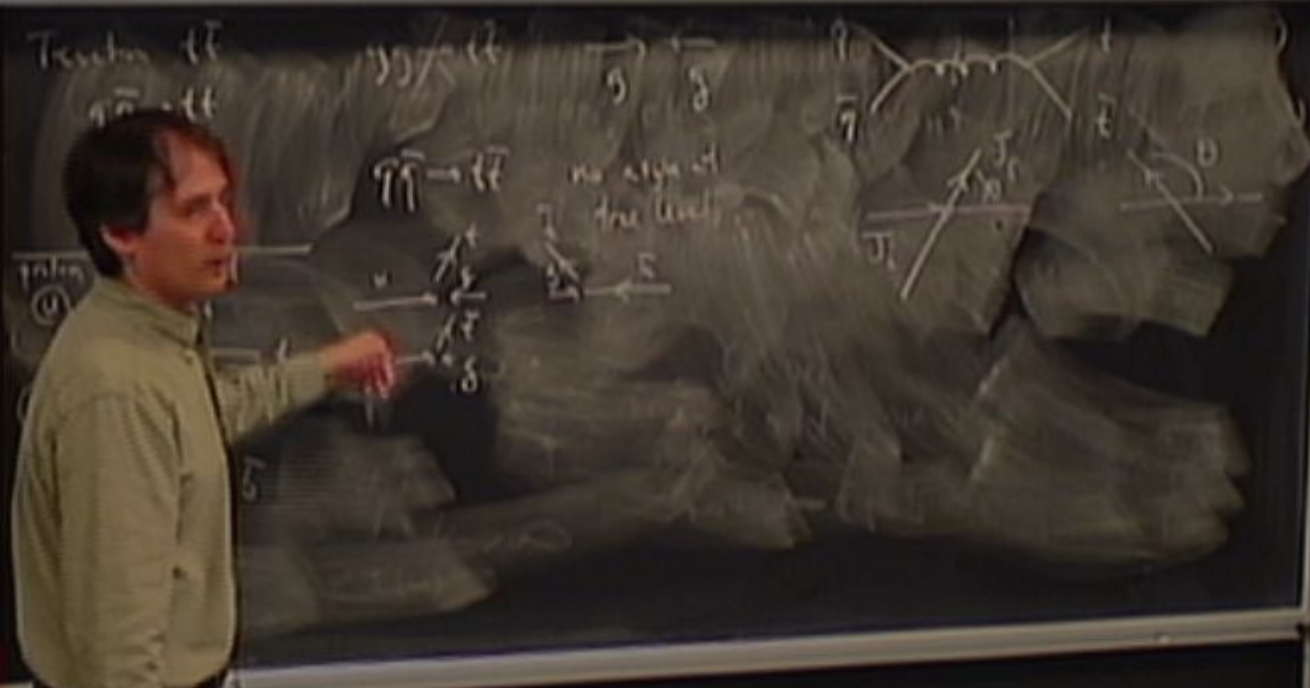
$v \rightarrow \sigma_c^-$
 σ_{max}
 $v \rightarrow \sigma_{e^+}$
 σ_{max}

$\frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega} - \frac{d\sigma}{d\Omega}$

no fire
 prohibited
 smoking
 area

$f_n(x)$ part to the part of type x w/ max force x
 $0 < x < 1$

$u_1 > u_2 > d_1 > d_2$	$u_1 > u_2 > d_1 > d_2$
$(u, d)_1$	$(u, d)_2$
δ_1	δ_2
π_1, π_2	π_1



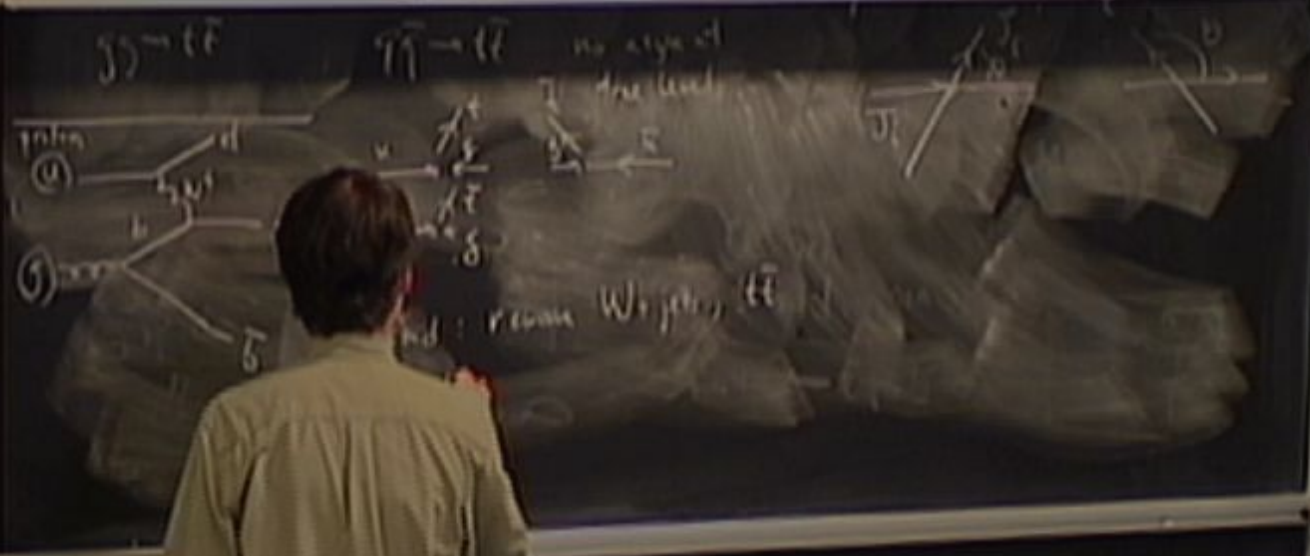
$v \rightarrow \sigma_c$
 Puma
 $v \rightarrow \sigma_{e^+}$
 Lame

$\frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$

Dijet
 primary

$f_2(x)$ part to find
part of type
w/mon form x
 $0 < x < 1$

$u_1 > u_2 > d_1 > d_2$	$u_1 > u_2 > d_1 > d_2$
$(u, d)_1$	$(u, d)_2$
u_1	u_2
d_1, d_2	d_1



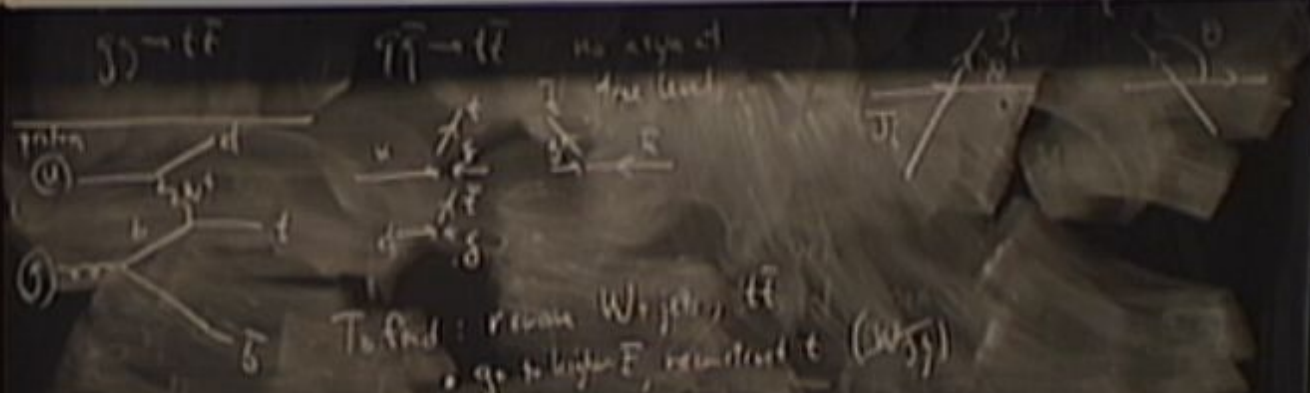
$v_1 \sigma_c^-$
 σ_{ma}
 $v_2 \sigma_c^-$
 σ_{ma}

$\frac{dV}{dt} + \frac{dV}{dS}$
 $\frac{dV}{dS}$
 $\frac{dV}{dS}$

no one
particular
person
knows

$f_2(x)$ part to find
part of type
w/ max force x
 $0 < x < 1$

z_{ab} $u < u' < u'' < u''' < u''''$ (u, d)g gg gg, gg	z_{cb} $u < u' < u'' < u''' < u''''$ (u, d)g gg gg
--	--



To find: reverse Weierstrass, ff
• go to higher F , reinsert t (W/ gg)

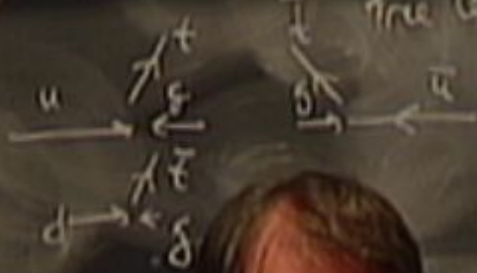
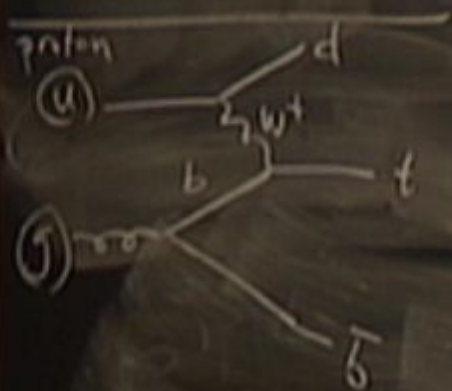
$v < v' < v'' < v''' < v''''$
 $u < u' < u'' < u''' < u''''$

Dijet
p. 111

$$gg \rightarrow t\bar{t}$$

$$q\bar{q} \rightarrow t\bar{t}$$

no asym at tree level



To find:

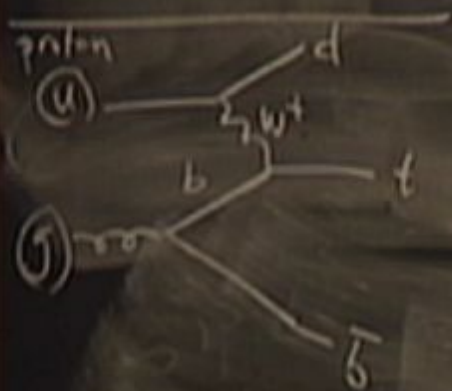
$$g \rightarrow$$

jets, $t\bar{t}$
 \bar{t} , reconstruct t (Wjj)

$$gg \rightarrow t\bar{t}$$

$$q\bar{q} \rightarrow t\bar{t}$$

no asym at tree level

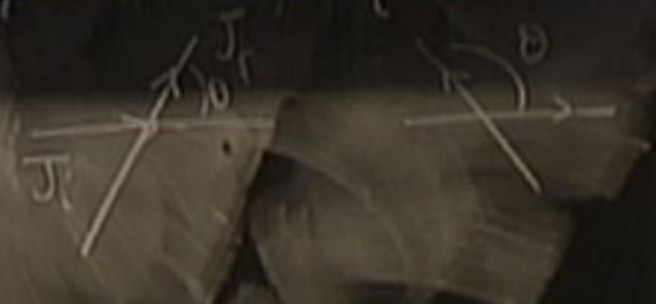
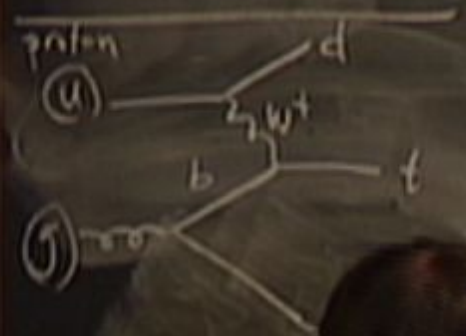


To find: remove $W + jets, t\bar{t}$
 • go to higher E , reconstruct t ($W + jets$)

$$gg \rightarrow t\bar{t}$$

$$q\bar{q} \rightarrow t\bar{t}$$

no asym at tree level



- find: remove $W + jets, t\bar{t}$
- go to higher E , reconstruct t ($W\gamma\gamma$)
- use $A_{FB} \sim (\frac{d\sigma}{d\cos\theta})$

11,99 1 77

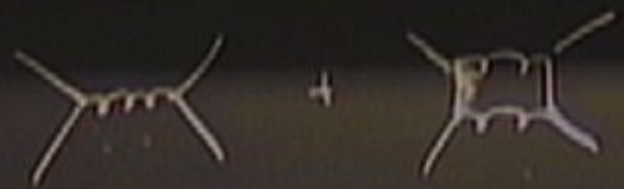
$\frac{A}{FB}$



ALLEN
and
...

77, 77

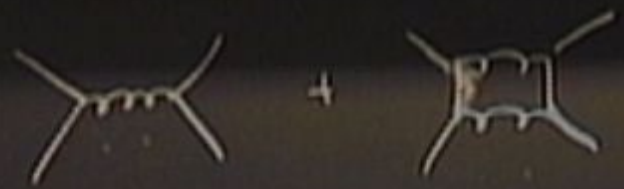
A ^{tī}
FB



ALLEN
THE UNIVERSITY
OF TEXAS
AT AUSTIN

77, 77

A $t\bar{t}$
FB



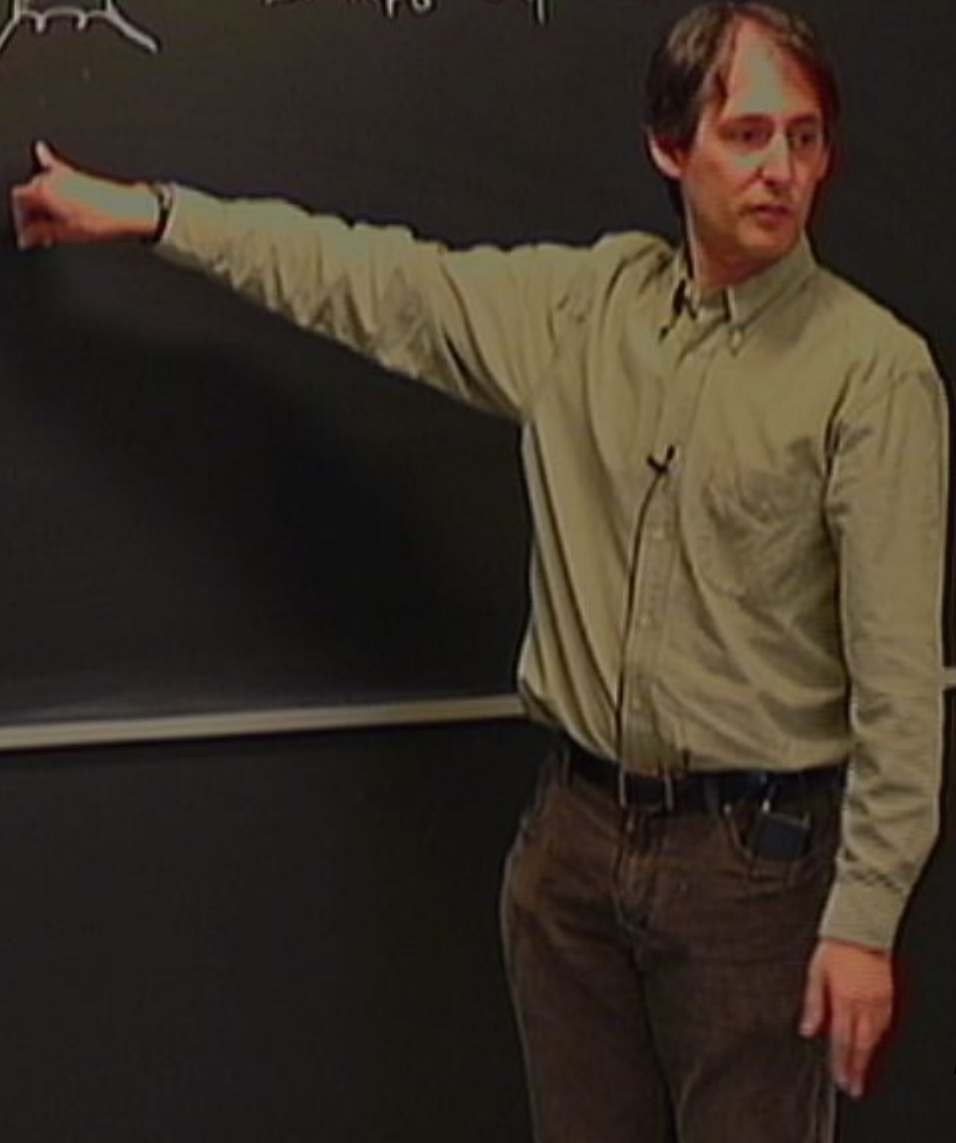
\Rightarrow AFB Asymptote induced

$A_{FB}^{t\bar{t}}$



+

$\Rightarrow A_{FB}^{t\bar{t}}$ amplitude induced



$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}^{t\bar{t}}$ Amplitude induced



R date

$A_{FB}^{t\bar{t}}$



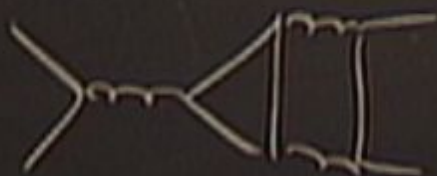
$\Rightarrow A_{FB}^{t\bar{t}}$ amplitude induced



$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}^{t\bar{t}}$ amplitude induced



& date

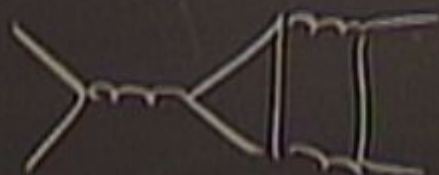
$t\bar{t}$ frame

SM $A_{FB}^{t\bar{t}}$ 8%-7%

$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}^{t\bar{t}}$ amplitude induced



α date

$t\bar{t}$ frame
SM $A_{FB}^{t\bar{t}}$ 8% - 7%

Twitter, Lab France

$f_-(x)$ part to find
part of type
w/ non zero x
 $0 < x < 1$

Σ_{ab} $u\bar{u} \rightarrow u\bar{d} + d\bar{u} \rightarrow d\bar{d}$ (4,1) _g gg gg, $\bar{q}q$	Σ_{ab} $u\bar{u} \rightarrow u\bar{d} + d\bar{u} \rightarrow d\bar{d}$ (4,1) _g gg gg
--	--

$\frac{d\Gamma}{d\Omega}$



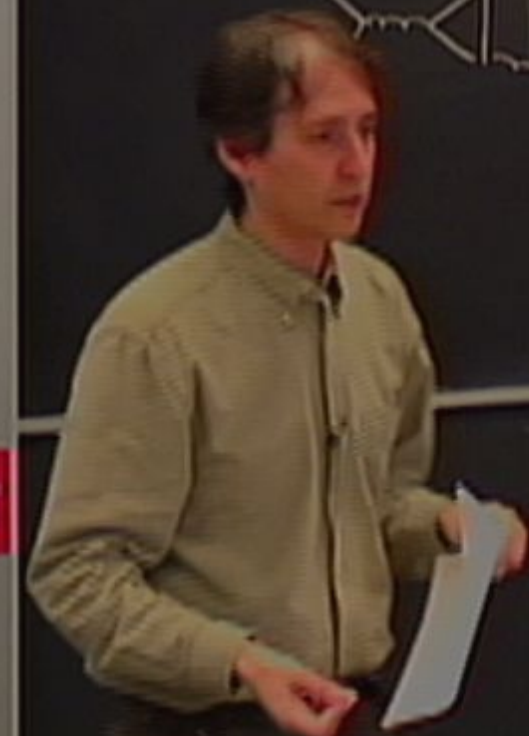
\Rightarrow AFB Asymptotic in had



$\propto d^2x$

$\frac{d\Gamma}{d\Omega}$ 8% - 7%

Theory, 1st order ~ 5%



$v \rightarrow \sigma_{e^-}$
 Ω_{had}
 $e^+ \nu \sigma_{e^-}$
 Ω_{had}

$\frac{d\Gamma}{d\Omega}, \frac{d\Gamma}{d\Omega} + \frac{d\Gamma}{d\Omega}$
 $\frac{d\Gamma}{d\Omega}$
 $\vec{p} \rightarrow \vec{p}$

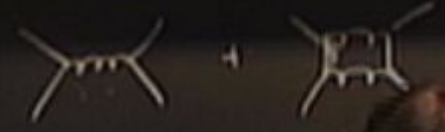
no one
participated
without
... ..

$f_2(x)$ part to find
part of type
w/ non zero x
 $0 < x < 1$

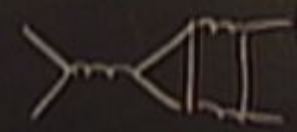
α_{ab}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
(4,1)₃
33
11, 33

α'_{ab}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
(6,1)₃
33
11

$\frac{1}{\Lambda_{FB}}$



$\Rightarrow \Lambda_{FB}$ amplitude induced



$\frac{1}{\Lambda_{FB}}$ from

Theory, 1/6 from

SM Λ_{FB} 8% - 7%
CDF
DO

~ 5%

$v \sigma_{e^-}$
 σ_{ann}
 $v \sigma_{e^+}$
 σ_{ann}

$\frac{d\sigma}{d\Omega} \frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 \vec{p}

Dijet
primary

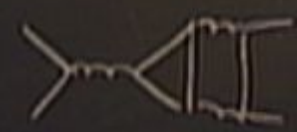
$f_2(x)$ part to the part of type w/ non force x $0 < x < 1$

α_{ab}	α_{ab}
$u_1 > u_2 > d_1 > d_2$	$u_1 > u_2 > d_1 > d_2$
(4,1)g	(4,1)g
gg	gg
gg, gg	gg

$\frac{d^2}{d\theta^2}$



\Rightarrow AFD amplitude induced



\approx d'ok Expt

$\frac{d^2}{d\theta^2}$ from
 SM $A_{FB}^{H^0}$ $8\% - 7\%$
 CDF $2\% \pm 14\%$
 D0

Theory, 1b from $\sim 5\%$
 high energy error

$v \rightarrow \sigma_{e^-}$
 σ_{anna}
 $v \rightarrow \sigma_{e^+}$
 σ_{anna}

$\sigma_1, \frac{d\sigma_1}{d\theta} + \frac{d\sigma_2}{d\theta}$
 $\frac{d\sigma_1}{d\theta}$

|||

$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}$ Amplitude induced



α data
Expt

$\frac{t\bar{t}}{\text{from}}$
SM $A_{FB}^{t\bar{t}}$ 8% - 7%
CDF $24 \pm 14\%$
DO high

lab frame
?

$\pm 8\% ?$

CAUTION
DO NOT TOUCH THE BOARD
OR THE EQUIPMENT
IF YOU HAVE ANY
QUESTIONS
PLEASE ASK THE
LECTURER

$t\bar{t}$
AFB



\Rightarrow AFB Amplitude induced



α data
Expt

$t\bar{t}$ from
SM AFB 8% - 7%
CDF $24 \pm 14\%$
DO higher, by 20%

TeVton, lab frame
~ 5%

$17 \pm 8\%$

$t\bar{t}$
AFB



\Rightarrow AFB Amplitude induced



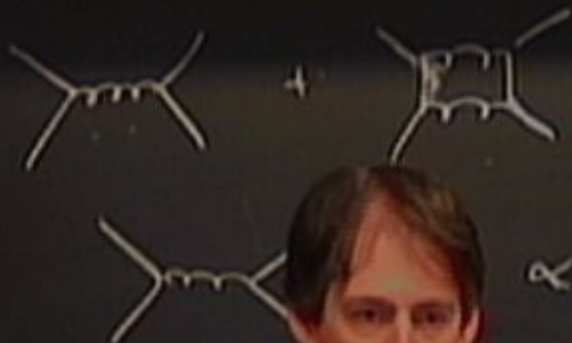
α data
Expt

$t\bar{t}$ from
SM $A_{FB}^{t\bar{t}}$ 8% - 7%
CDF $24 \pm 14\%$
DO higher, by 50%
CDF

TeVton, lab frame
 $\sim 5\%$

$17 \pm 8\%$?

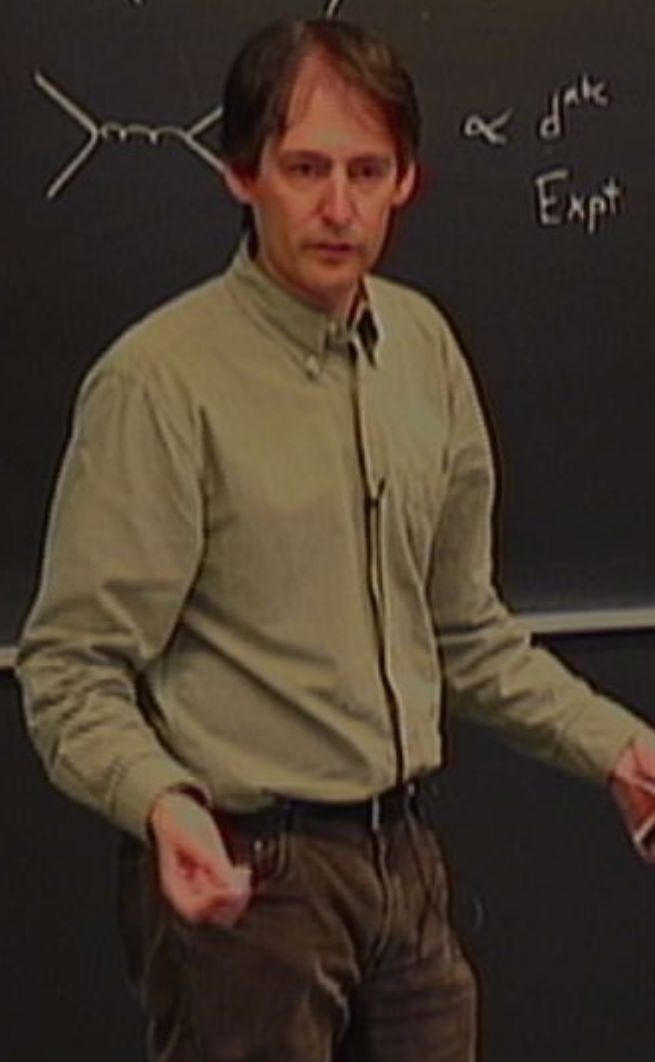
$t\bar{t}$
AFB



\Rightarrow AFB Amplitude induced

α data
Expt

	$t\bar{t}$ from	<u>TeVton, lab frame</u>
SM $A_{FB}^{t\bar{t}}$	8% - 7%	~ 5%
CDF	$24 \pm 14\%$	$17 \pm 8\% ?$
DO	high, low energy	
CDF $M_{t\bar{t}}$		

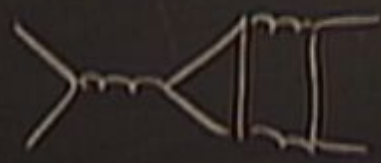


CAUTION
DO NOT TOUCH THE BOARD
OR THE EQUIPMENT
WHILE THE LECTURE IS IN PROGRESS

$t\bar{t}$
AFB



\Rightarrow AFB Amplitude induced



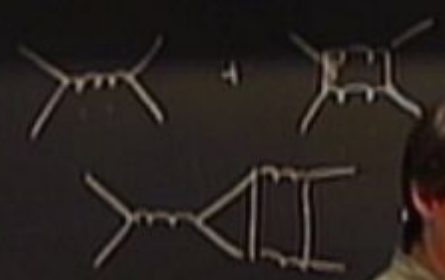
α d'Alc
Expt

	<u>$t\bar{t}$ from</u>	<u>TeVton, lab frame</u>
SM $A_{FB}^{t\bar{t}}$	8% - 7%	~ 5%
CDF	$24 \pm 14\%$	$17 \pm 8\%$?
DO	higher, by a factor	
CDF $M_{t\bar{t}}$	$\rightarrow 450$ 47.5	
	GeV $\pm 11.8\%$	
vs		$27.8 \pm 2.1\%$

$f_-(x)$ prob to find
particle of type a
w/ mass m_a &
 $0 < x < 1$

\mathcal{L}_{ab} $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$ (u,d)g gg gg, gg	\mathcal{L}'_{ab} $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$ (u,d)g gg gg
---	--

$\frac{\Gamma}{\Lambda_{FB}}$



$\Rightarrow \Lambda_{FB}$ Asymptotically induced

	$\frac{\Gamma}{\Lambda_{FB}}$ from	Theory, 1-loop
SM Λ_{FB}	87% - 7%	~ 5%
CDF	2% ± 14%	17% ± 8%
DO	higher, higher	
CDF M, 2450	47.5	
vs	11.4%	
	0.28 ± 0.12%	



$v \rightarrow \sigma_{e^-}$
sigma
 $v \rightarrow \sigma_{e^+}$
sigma

$\frac{d\sigma}{d\Omega}, \frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 σ



⇒ AFB Amplitude induced



α d^{abc}
Expt

t \bar{t} frame

Tevatron, lab frame

SM AFB^{t \bar{t}} 8% - 7%

~ 5%

CDF 24 ± 14%

17 ± 8% ?

DO higher, large error

CDF M_{t \bar{t}} > 450 GeV 47.5 ± 11.4%

VS

22.8 ± 9.0%



$\Rightarrow A_{FB}$ Amplitude induced

$\propto d^{abc}$
Expt

$t\bar{t}$ frame
SM $A_{FB}^{t\bar{t}}$ 8% - 7%

TeVton, lab frame

~ 5%

CDF $24 \pm 14\%$

$17 \pm 8\%$

DO high, large errors

CDF $M_{t\bar{t}} > 450$ 47.5
GeV $\pm 11.4\%$

VS

$33.8 \pm 13\%$

$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}$ amplitude induced



$\propto d_{tbc}$
Expt

$t\bar{t}$ frame

TeVton, lab-frame

SM $A_{FB}^{t\bar{t}}$ 8% - 7%

~ 5%

CDF $24 \pm 14\%$

$17 \pm 8\%$

DO higher, large errors

CDF $M_{t\bar{t}} > 450$ GeV 47.5 $\pm 11.4\%$

VS

$28 \pm 13\%$



$A_{FB}^{t\bar{t}}$



$\Rightarrow A_{FB}^{t\bar{t}}$ amplitude induced



α data
Expt



$t\bar{t}$ frame

TeVton, lab-frame

SM $A_{FB}^{t\bar{t}}$ 8% - 7%

~ 5%

CDF $24 \pm 14\%$

$17 \pm 8\%$

DO higher, large error

CDF $M_{t\bar{t}} > 450$ GeV 47.5 $\pm 11.4\%$

VS

$28 \pm 13\%$

$A_{FB}^{t\bar{t}}$

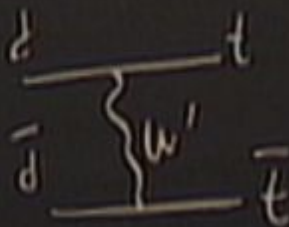


$\Rightarrow A_{FB}$ amplitude induced



$\propto d^{abc}$
Expt

$u \bar{d} \rightarrow t \bar{t}$
 $\bar{u} d \rightarrow t \bar{t}$



$t\bar{t}$ frame

TeVton, lab-frame

SM $A_{FB}^{t\bar{t}}$ 8% - 7%

~ 5%

CDF $24 \pm 14\%$

$17 \pm 8\%$

DO higher, large errors

CDF $M_{t\bar{t}} > 450$ GeV 47.5 $\pm 11.4\%$

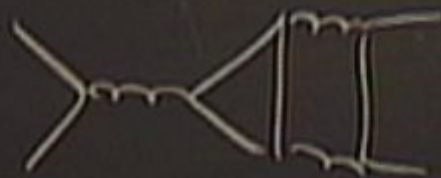
VS

$28 \pm 13\%$

$A_{FB}^{t\bar{t}}$

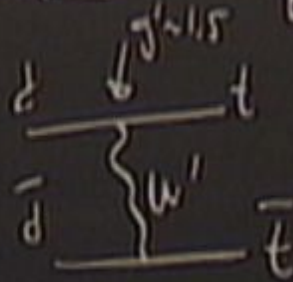
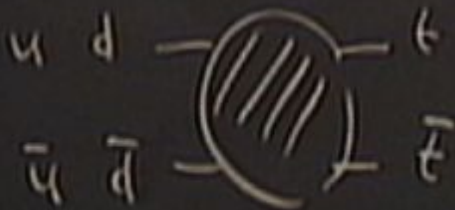


$\Rightarrow A_{FB}$ amplitude induced



$\propto d^{abc}$

Expt



$M_{W'} \sim 600 \text{ GeV}$

$t\bar{t}$ frame

TeVton, lab-frame

SM $A_{FB}^{t\bar{t}}$ 8% - 7%

~ 5%

CDF $24 \pm 14\%$

$17 \pm 8\%$

DO higher, large error

CDF $M_{t\bar{t}} > 450 \text{ GeV}$ 47.5 $\pm 11.4\%$

VS

$28.5 \pm 9.1\%$

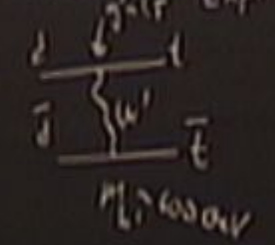
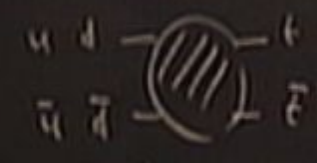
$f_2(x)$ part to find
part of type
w/ non zero x
 $0 < x < 1$

\sum_{ab}	\sum_{cb}
$u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$	$u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
(u,d)g	(u,d)g
gg	gg
gg,gg	gg

$\frac{d\sigma}{d\Omega}$



\Rightarrow AFB Asymptotic in had



$\frac{d\sigma}{d\Omega}$ from
 Theor, 1st Gen
 ~ 5%
 CDF 2% = 14%
 17 = 8% ?
 DO high, by 1000
 CDF M₂ 450 475
 vs 11.4%
 vs 0.78, 0.81, 0.82

$v \sigma_{e^-}$
 $\sigma_{\mu\mu}$
 $v \sigma_{e^+}$
 $\sigma_{\mu\mu}$

$\frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 \rightarrow

$f_2(x)$ part to find
 part of $f_2(x)$
 w/ non zero x
 $0 < x < 1$

α_{ab}	α_{ab}
$u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$	$u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
(4,1) ₃	(4,1) ₃
33	33
11, 33	11

beam
 $\sigma_{e^-} \rightarrow \nu_e$ vs $\sigma_{e^-} \rightarrow \nu_e$
 in Z frame
 $\sigma_{e^-} \rightarrow \nu_e$ vs $\sigma_{e^-} \rightarrow \nu_e$
 in lab frame

$\Lambda_{FB}^{t\bar{t}}$

$\Rightarrow \Lambda_{FB}^{t\bar{t}}$ Amplitude induced

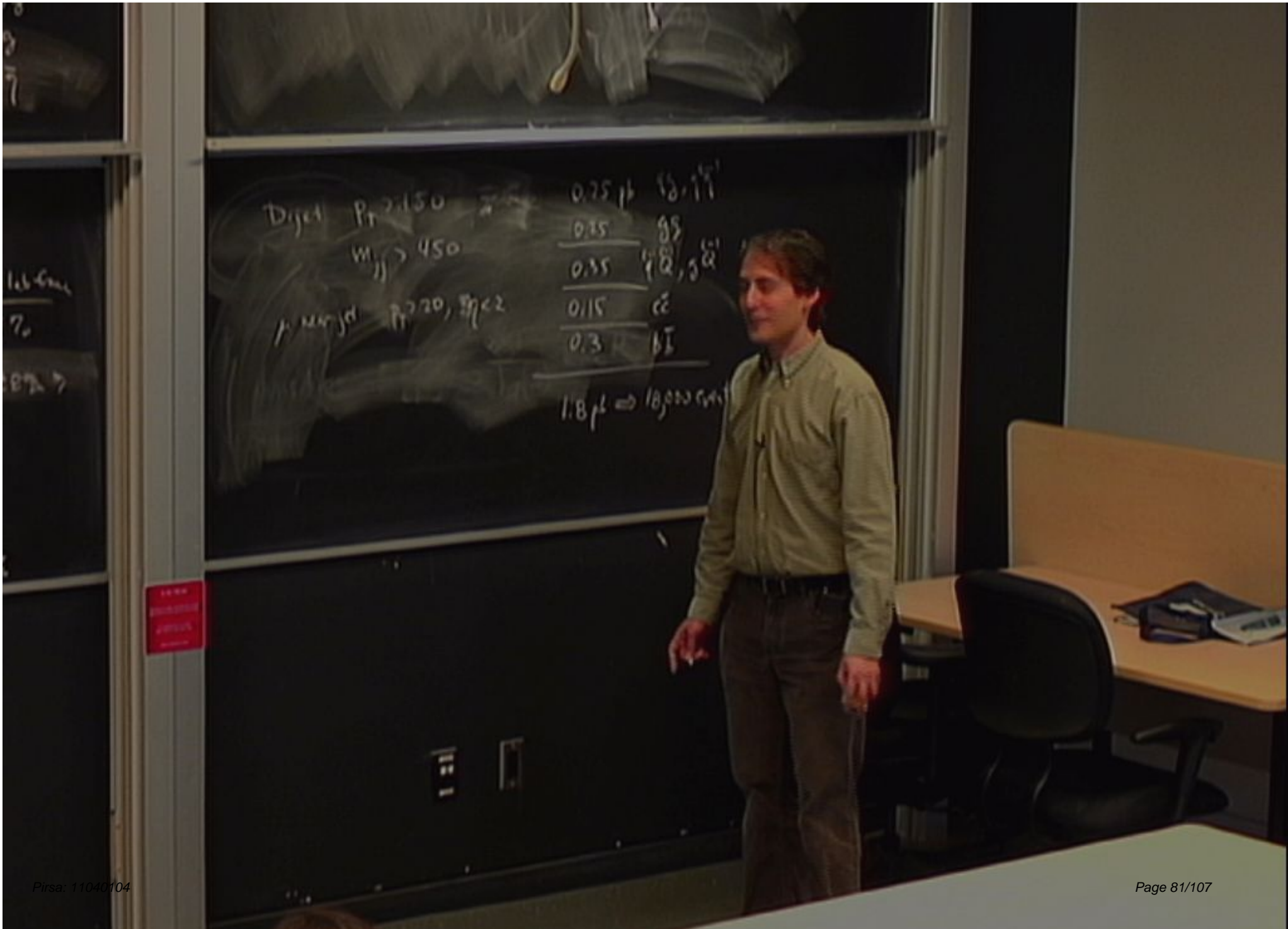
$\propto d^{\text{max}}$

" d t
 $\bar{u} \bar{d}$ \bar{t}
 u t
 u t

\bar{d} \bar{t}
 \bar{t}
 $M_W > 100 \text{ GeV}$

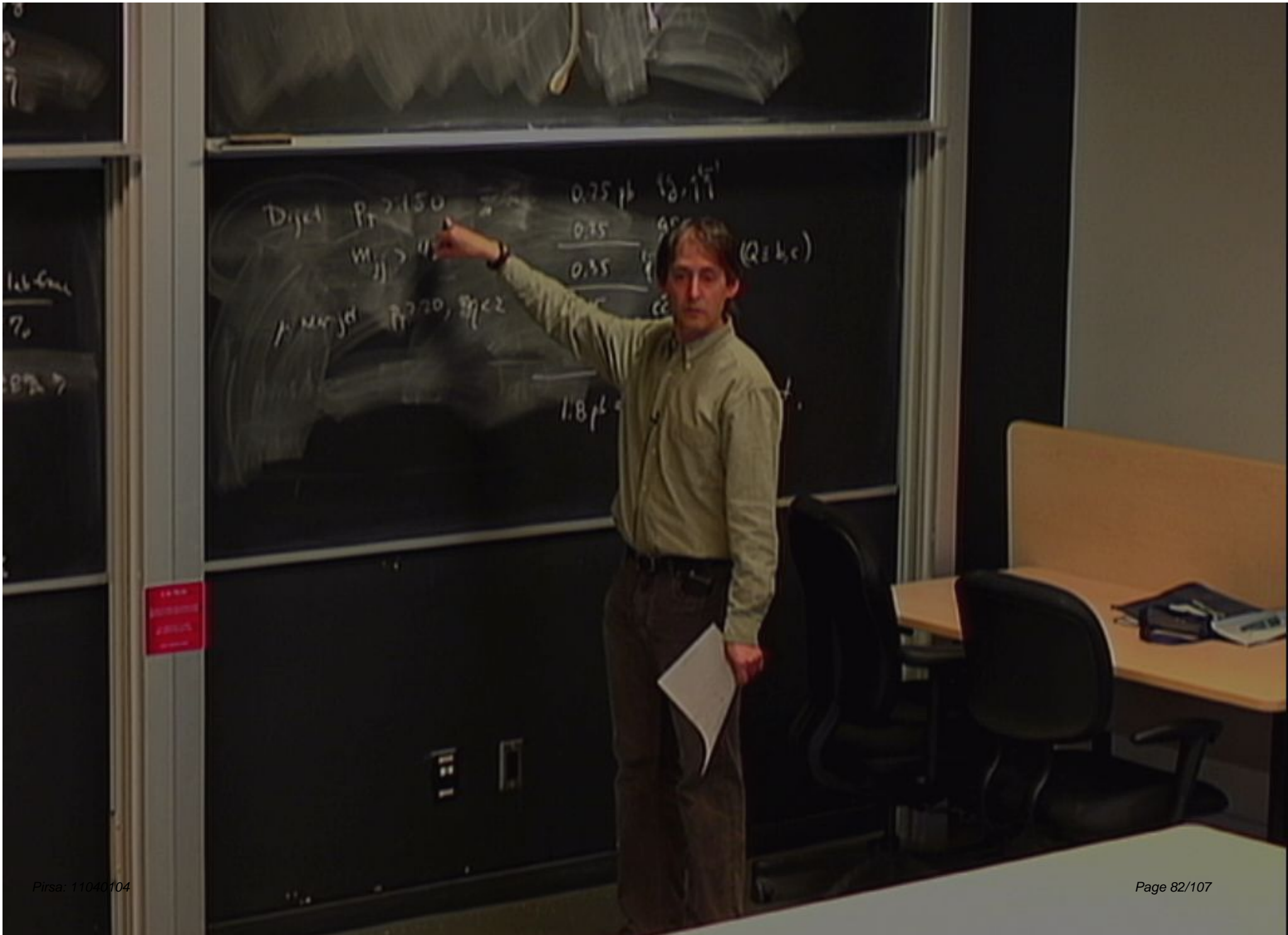
	$\bar{t}\bar{t}$ from	Theory, 16 GeV
SM $\Lambda_{FB}^{t\bar{t}}$	8% - 7%	~ 5%
CDF	28 ± 14%	17 ± 8% ?
DO	higher, higher	
CDF $M_W > 100 \text{ GeV}$	47.5	
vs	114%	

$\sigma = \sigma_0 \left(\frac{E}{E_0} \right)^2 + \frac{d\sigma}{dE}$
 $\sigma = \sigma_0 \left(\frac{E}{E_0} \right)^2 + \frac{d\sigma}{dE}$
 $\sigma = \sigma_0 \left(\frac{E}{E_0} \right)^2 + \frac{d\sigma}{dE}$



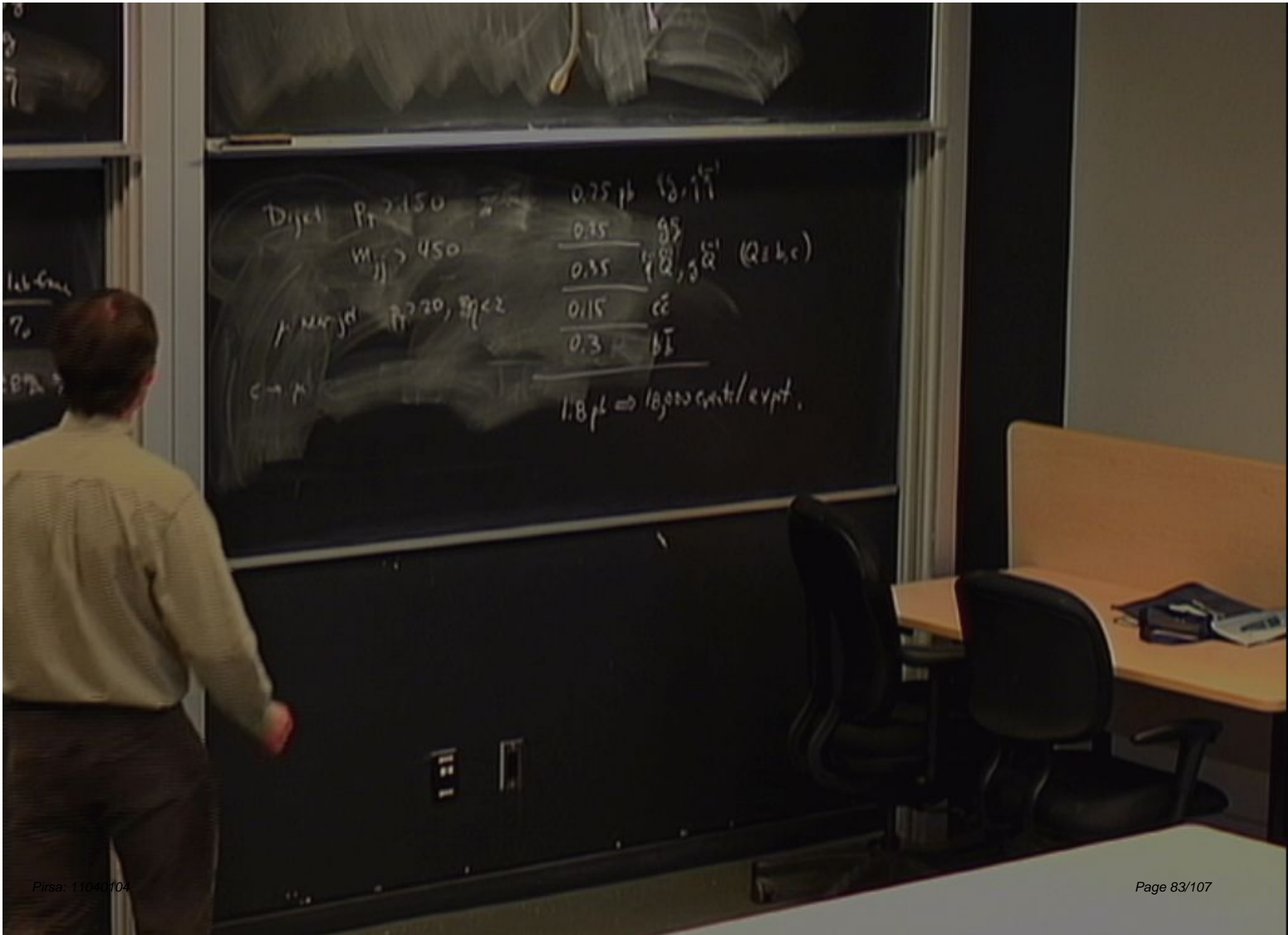
Dijet Pt 2150
M₁₁ > 450
P. Max jet Pt 220, 37 < 2
1.8 pt => 18,000 c. 4.1

0.25	85
0.25	85
0.35	80, 50
0.15	c
0.3	b



Dijet Pt 2150
 $M_{jj} > 4$
A. M. J. Pt 220, 222
0.75 pt 18.15
0.75
0.35
1.8 pt
(2 ± 4c)

CAUTION
ELECTRICAL
EQUIPMENT



Dijet Pt 2150
 Mj > 450
 P. margin Pt 20, 22
 c - p

0.75	18
0.35	95
0.35	100
0.15	100
0.3	100

1.8 pt => 18,000 cent/evpt.

Dijet $P_T > 150$

$m_{jj} > 450$

μ New jet $P_T > 20, \eta < 2$

$c \rightarrow \mu^+$

$\bar{c} \rightarrow \mu^-$

0.75 pb (g, \bar{g})

0.25 gg

0.35 $(gQ, g\bar{Q})$ ($Q = b, c$)

0.15 $c\bar{c}$

0.3 $b\bar{b}$

1.8 pb \Rightarrow 18,000 events/expt.

Dijet $P_T > 150$

$m_{jj} > 450$

$\mu_{\text{new jet}} P_T > 2$

$c \rightarrow \mu^+$
 $\bar{c} \rightarrow \mu^-$

0.75 pb (g, \bar{g})

0.25 gg

0.35 $(gQ, g\bar{Q})$ ($Q = b, c$)

0.15 $c\bar{c}$

0.3 $b\bar{b}$

1.8 pb \Rightarrow 18,000 events/expt.

Dijet $P_T > 150$

m_{jet}

$\mu_{\text{new jet}}$

$\eta < 2$

$c \rightarrow \mu^+$

$\bar{c} \rightarrow \mu^-$

0.75 pb (g, \bar{g})

0.25 gg

0.35 $(g\bar{Q}, \bar{g}Q)$ ($Q = b, c$)

0.15 $c\bar{c}$

0.3 $b\bar{b}$

1.8 pb \Rightarrow 18,000 events/expt.

Dijet $P_T > 150$

$m_{jj} > 450$

μ new jet $P_T > 20, \eta < 2$

$c \rightarrow \mu^+$ $b \rightarrow \mu^-, b \rightarrow c \rightarrow \mu^+$
 $\bar{c} \rightarrow \mu^-$ \bar{b}

$B^0 \rightarrow \bar{B}^0$

0.75 pb (g, \bar{g})

0.25 gg

0.35 $(gQ, g\bar{Q})$ ($Q \equiv b, c$)

0.15 $c\bar{c}$

0.3 $b\bar{b}$

1.8 pb \Rightarrow 18,000 events/expt.

Dijet $P_T > 150$

$m_{jj} > 450$

μ new jet $P_T > 20, \eta < 2$

$c \rightarrow \mu^+$ $b \rightarrow \mu^-, b \rightarrow c \rightarrow \mu^+$
 $\bar{c} \rightarrow \mu^-$ \bar{b}

$B^0 \rightarrow \bar{B}^0$ $b \leftrightarrow \bar{b}$

0.75 pb (g, \bar{g})

0.25 gg

0.35 $(g\bar{Q}, g\bar{Q})$ ($Q = b, c$)

0.15 $c\bar{c}$

0.3 $b\bar{b}$

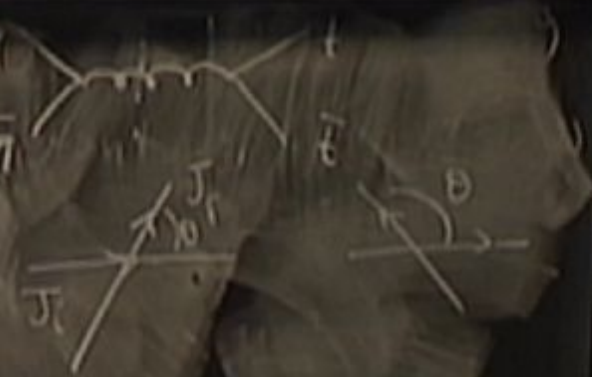
1.8 pb \Rightarrow 18,000 events

0 < x < 1

98
11, 97

88
77

$$A_{FB}^{j \rightarrow j} = A_{FB}^{cc \rightarrow \gamma} - \frac{1}{3} A_{FB}^{bb \rightarrow \gamma}$$

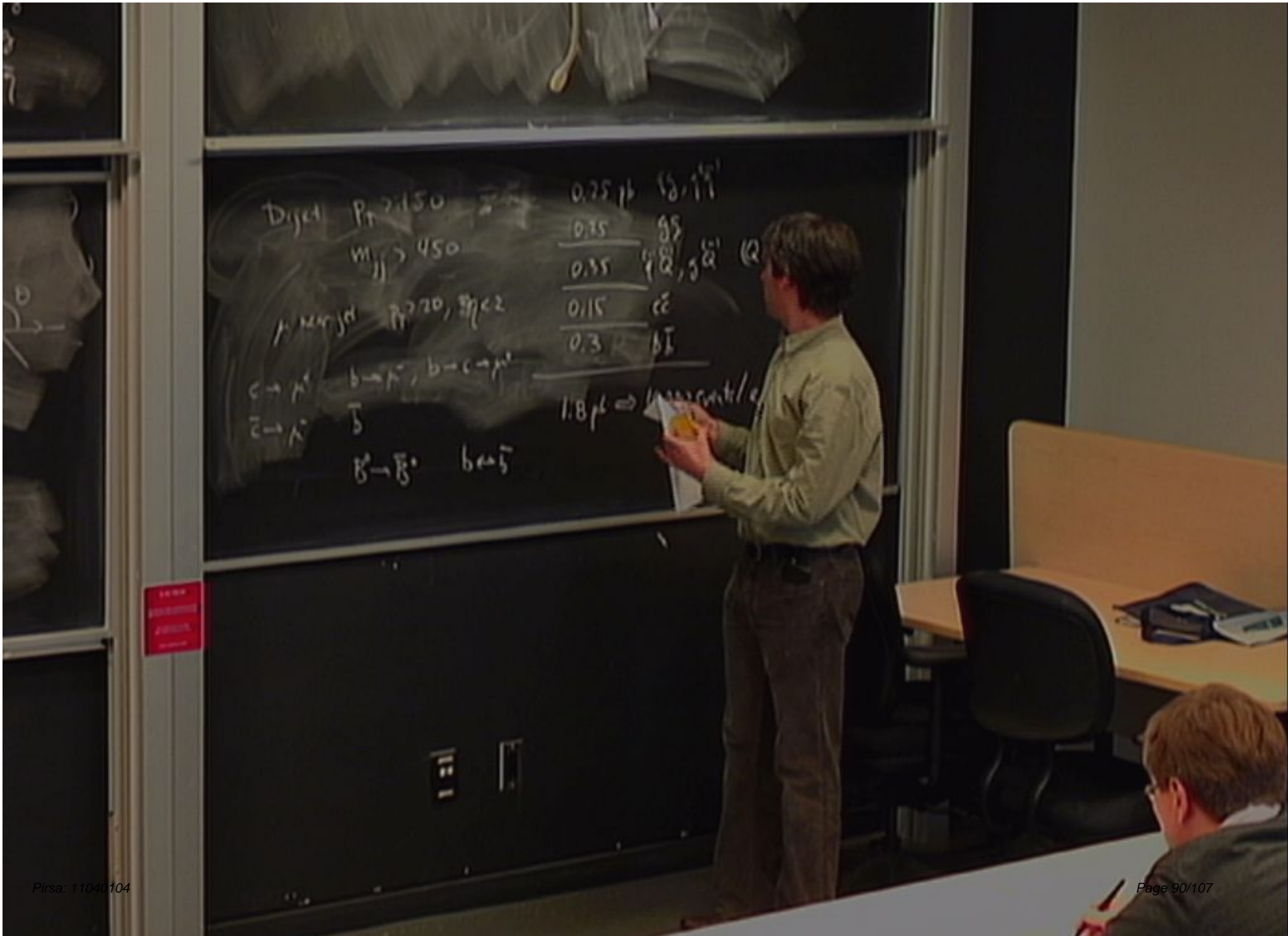


To find: ν from W jets, $t\bar{t}$

- go to higher E , reconstruct t (W jets)
- use $A_{FB}^{j \rightarrow j}$ ($t\bar{t}$)
- use forward jet

CAUTION
DO NOT TOUCH
ELECTRONIC EQUIPMENT
OR INSTRUMENTS
IN THIS AREA

CAUTION
DO NOT TOUCH
ELECTRONIC EQUIPMENT
OR INSTRUMENTS
IN THIS AREA

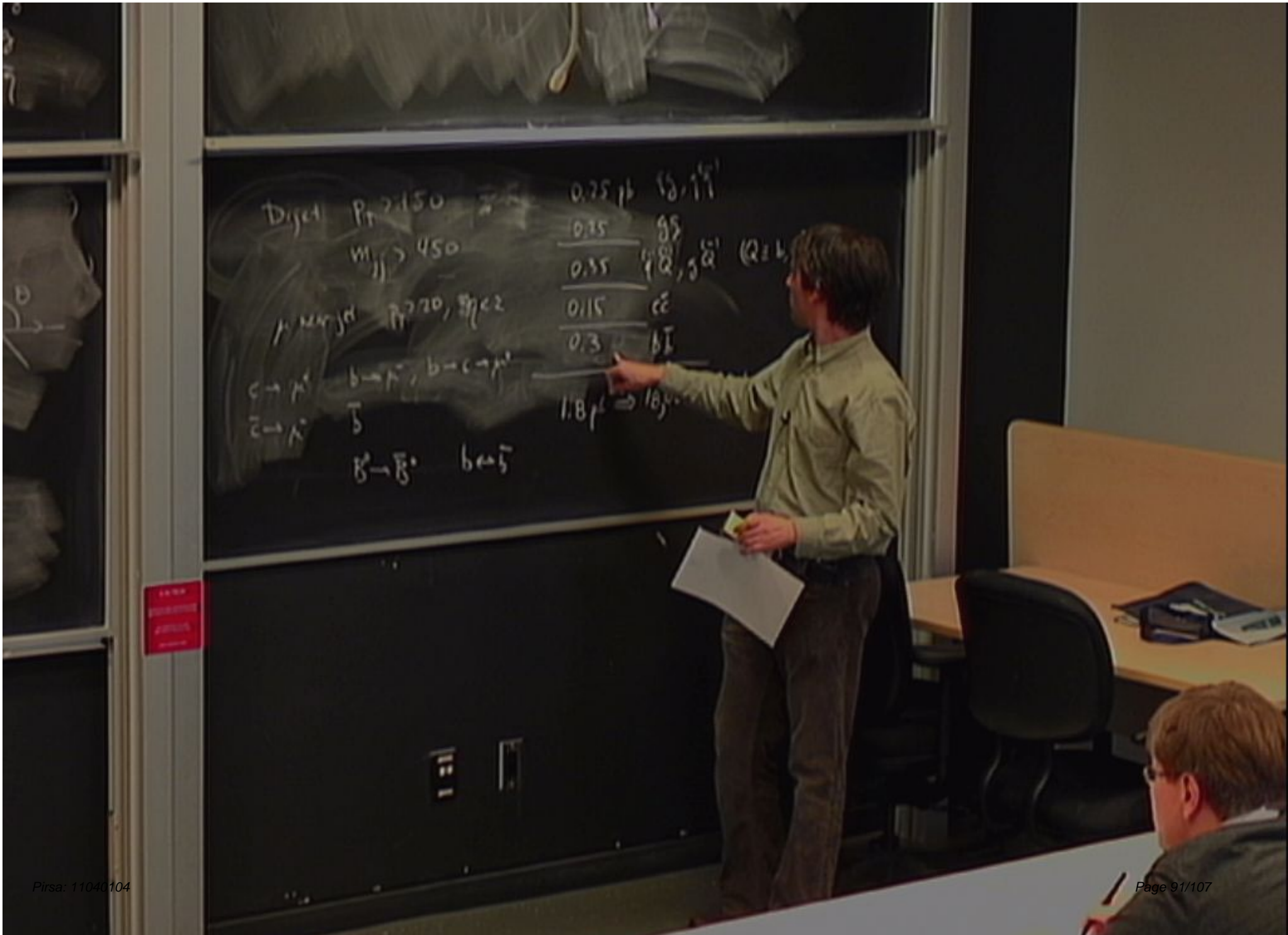


$D_{ij} = P_{ij} \cdot 150$
 $m_{ij} > 450$
 $\mu_{merjor} = 20, \sigma_{\mu} = 2$
 $c \rightarrow \mu^c$
 $\bar{c} \rightarrow \mu^c$
 $b \rightarrow \mu^b, b \rightarrow c \rightarrow \mu^c$
 $\bar{b} \rightarrow \bar{\mu}^b, b \rightarrow \bar{b}$

0.25	10, 11'
0.25	95
0.35	10, 95' (2)
0.15	cē
0.3	bē

$1.8 \mu^c \Rightarrow 1.8 \mu^c / \sigma^c$

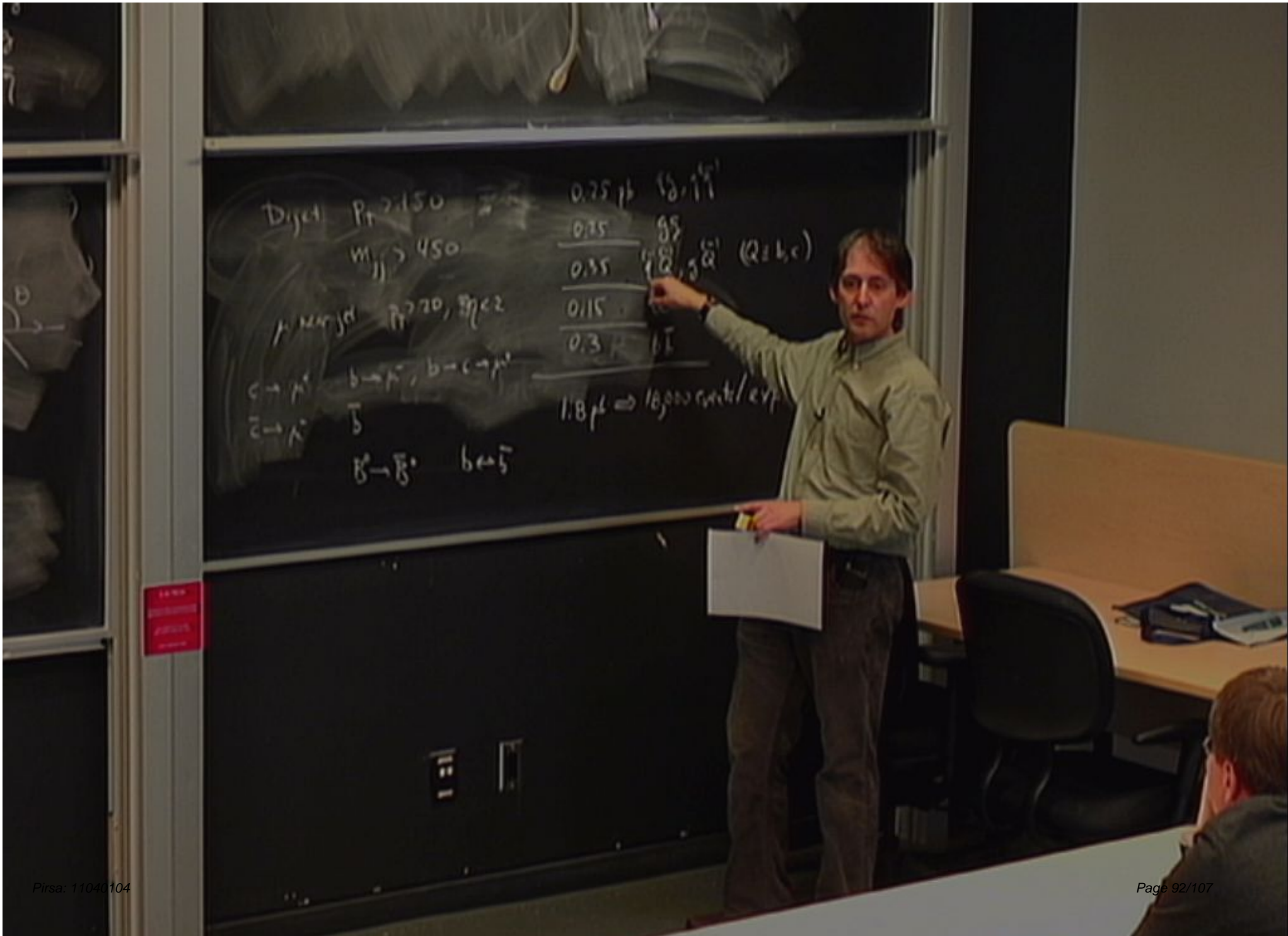
1000
 1000
 1000



Dijet $P_T > 150$
 $M_{jj} > 450$
 $\mu_{merger} P_T > 20, \eta < 2$
 $c \rightarrow \bar{c} \quad b \rightarrow \bar{b}, b \rightarrow c \rightarrow \bar{c}$
 $\bar{c} \rightarrow c$
 $b \rightarrow \bar{b} \quad b \rightarrow \bar{c}$

0.25	b, \bar{b}
0.25	c, \bar{c}
0.35	\bar{c}, c, \bar{b}, b ($Q \geq b$)
0.15	c, \bar{c}
0.3	b, \bar{b}

$1.8 p^c \Rightarrow 1.8 p^b$

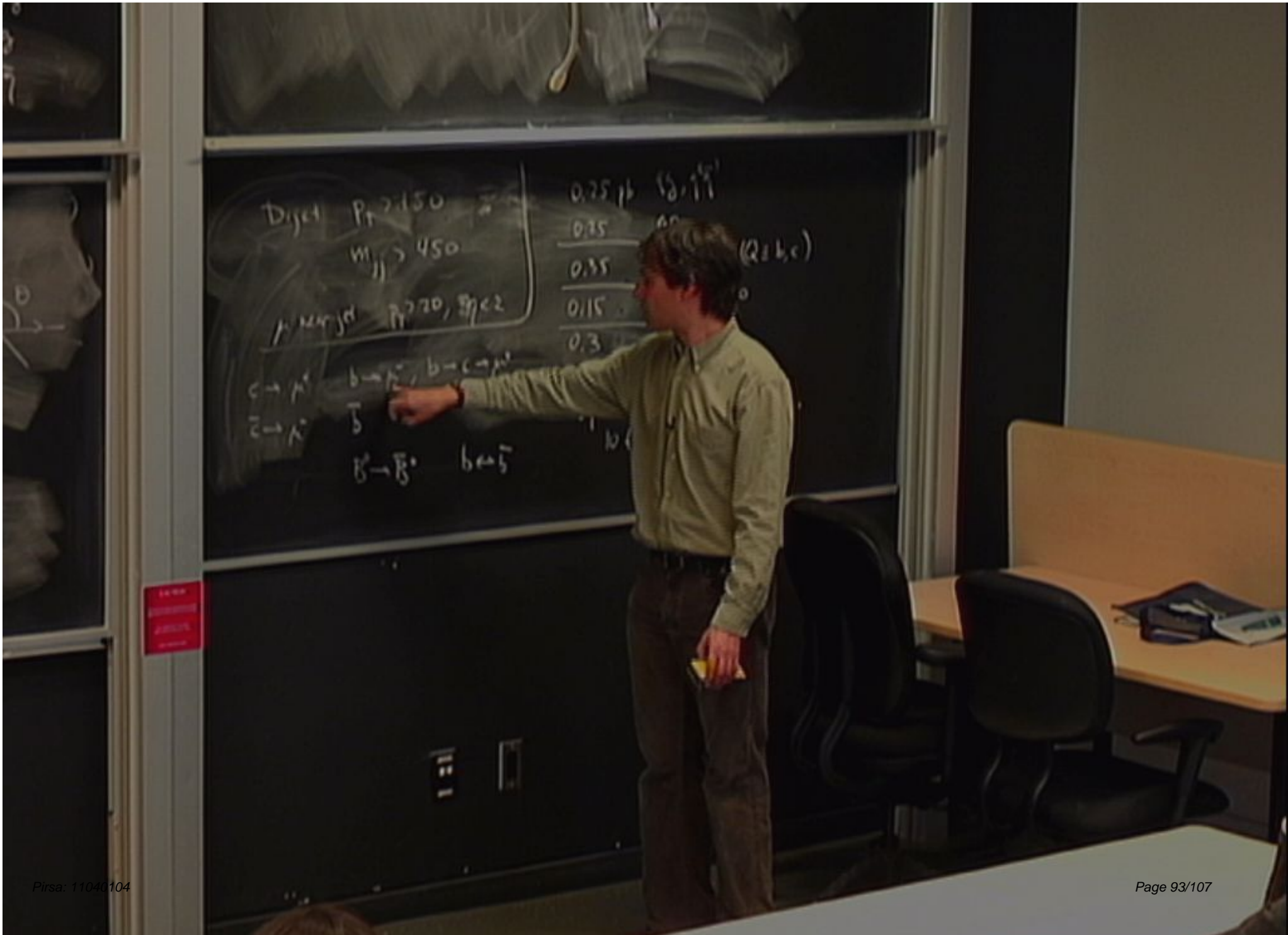


Dijet $P_T > 150$
 $m_{jj} > 450$
 μ $m_{jj} > 20, \eta \in 2$
 $c \rightarrow \mu^+$ $b \rightarrow \mu^+, b \rightarrow c \rightarrow \mu^+$
 $\bar{c} \rightarrow \mu^-$ \bar{b}
 $B^0 \rightarrow \bar{D}^0$ $b \rightarrow \bar{D}^0$

0.25	μ^+
0.25	μ^-
0.35	μ^+, μ^-
0.15	
0.3	μ^+

$1.8 \mu^+ \Rightarrow 18,000 \text{ events/yr}$

10 No
 10/10/10
 10/10/10



0.25	16	16.15
0.25		
0.35		
0.15		
0.3		

(2, b, c)

Dijet $P_T > 150$
 $M_{jj} > 450$

$P_{\text{merged}} P_T > 20, \eta < 2$

$c \rightarrow \bar{c}$
 $\bar{c} \rightarrow c$

$b \rightarrow \bar{b}, b \rightarrow c \rightarrow \mu$
 $\bar{b} \rightarrow \bar{c}$
 $\bar{b} \rightarrow \bar{c}, b \rightarrow \bar{b}$

$f_-(x)$ part to find
part of type
w/ man force &
 $0 < x < 1$

α_{ab}
 $u > v > w > d > d$
(u,v)g
gg
gg,gg

α_{ab}
 $u > v > w > d > d$
(u,v)g
gg
gg

$A_{FB} \rightarrow$ $A_{FB}^{cc} \rightarrow \frac{1}{3} A_{FB}^{bb} \rightarrow$

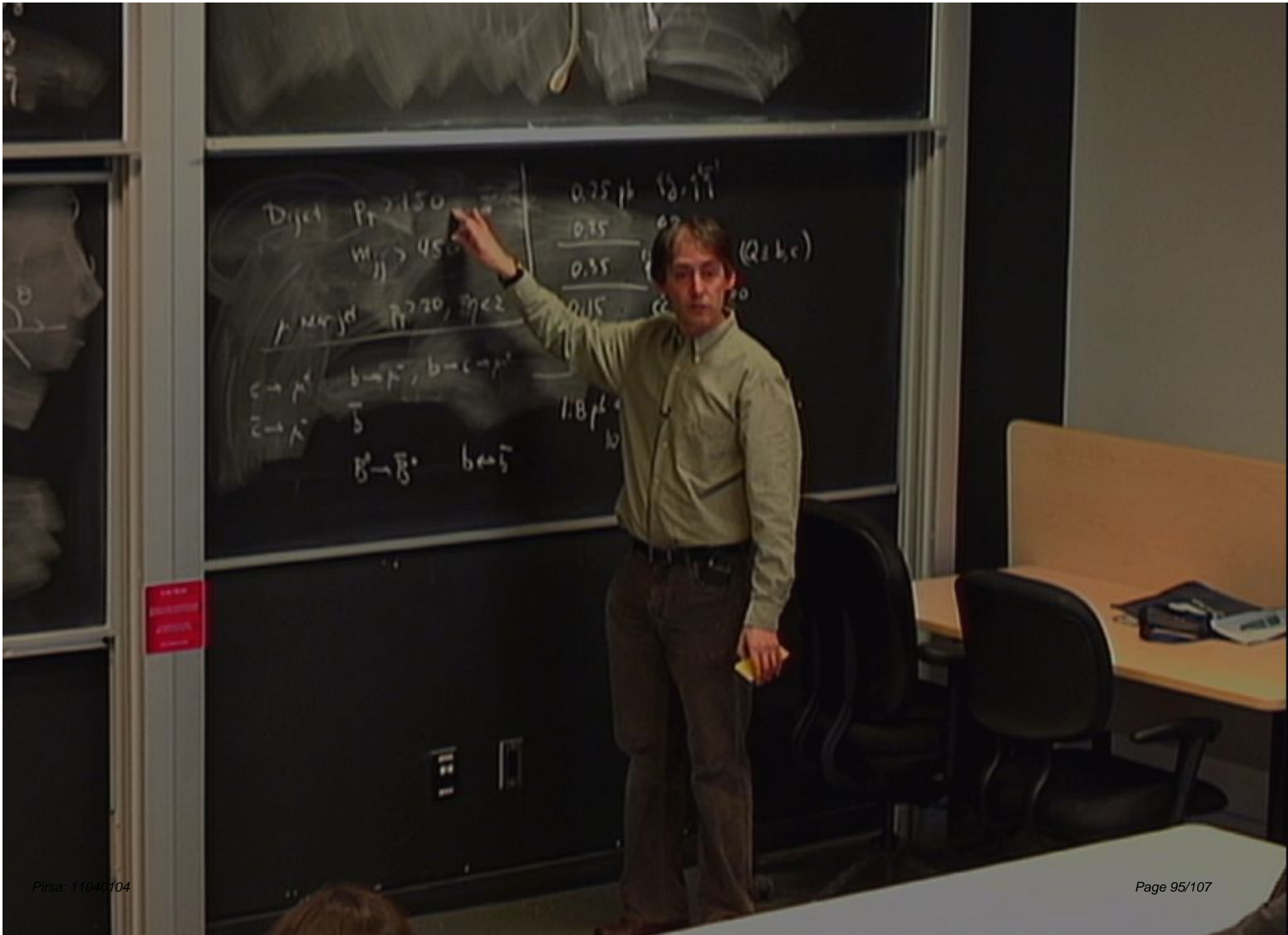
To find: reason W_{jet} , tE

- go to higher E \rightarrow tE
- use A_{FB} \rightarrow (J, K)
- Use Parquet jet

$v \rightarrow \vec{e}_c$
Frame
 $v \rightarrow \vec{e}_c$
Frame

$\frac{d\sigma}{d\Omega} \frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 $\vec{P} \rightarrow$

Dijet
 μ_{jet}
 \vec{e}_c
 \vec{e}_c



$D_{ij} = P_{ij} > 150$
 $w_{ij} > 45$
 $P_{ij} > 20, \eta < 2$
 $c \rightarrow p^c, b \rightarrow p^b, b \rightarrow c \rightarrow p^c$
 $\bar{c} \rightarrow p^c, \bar{b}$
 $B^c \rightarrow \bar{B}^c, b \rightarrow \bar{b}$

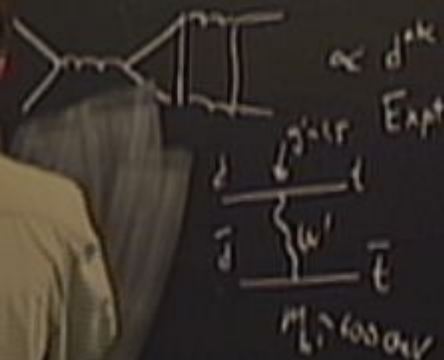
0.25	$\frac{1}{2}, \frac{1}{2}$
0.35	$\frac{1}{2}$
0.35	$\frac{1}{2}$ (2, b, c)
0.15	$\frac{1}{2}$

$1.8 p^c$
 b

$f_2(x)$ prob to find
partic of type x
w/ mean force x
 $0 < x < 1$

α_{ab} $u < u' < d < d' < d'$	α'_{ab} $u < u' < d < d' < d'$
(4,1)g	(4,1)g
gg	gg
gg,gg	gg

- Use μ_{FD}
- Use forward jet



	μ_{FD} Case	Thick, 1st Case
SI μ_{FD}	8% - 7%	~ 5%
CDF	28% - 14%	17% - 8%
DO	high, higher	
CDF μ_{FD}	47.5	
vs	21.4%	
	vs	27.8% - 21.4%

$v \sigma_c$
Frame
 $v \sigma_{e^+e^-}$
Frame

$\frac{d\sigma}{d\Omega} + \frac{d\sigma'}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
 $\frac{d\sigma'}{d\Omega}$

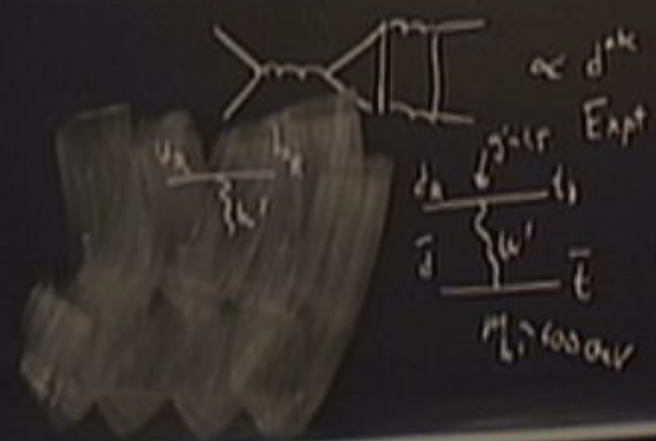
Dijet
 μ_{FD}
 $c \rightarrow p^+$
 $z \rightarrow p^+$

$f_-(x)$ prob to find
particle of type x
w/ mass m &
 $0 < x < l$

α_{ab} $uv > ud > \bar{u}d > d\bar{d}$ (4,1) _g 33 11, 33	α'_{ab} $uv > ud > \bar{u}d > d\bar{d}$ (4,1) _g 33 11
--	---

- Use $\bar{u}d$ jet
- Use forward jet

$v \rightarrow \sigma_c^-$
Frame
 $\sigma_{e^+e^-}$



$\bar{t}t$ cross section
 at $\sqrt{s} = 87.7$ GeV
 CDF $28 \pm 14\%$
 DO higher, by 100%
 CDF $M_{\bar{t}t} = 475$
 vs 211.7
 vs 270 ± 20

Topo. 1st cross section
 $\sim 5\%$
 $17 \pm 8\%$

Dijet
 $p \rightarrow p'$
 $\bar{p} \rightarrow \bar{p}'$

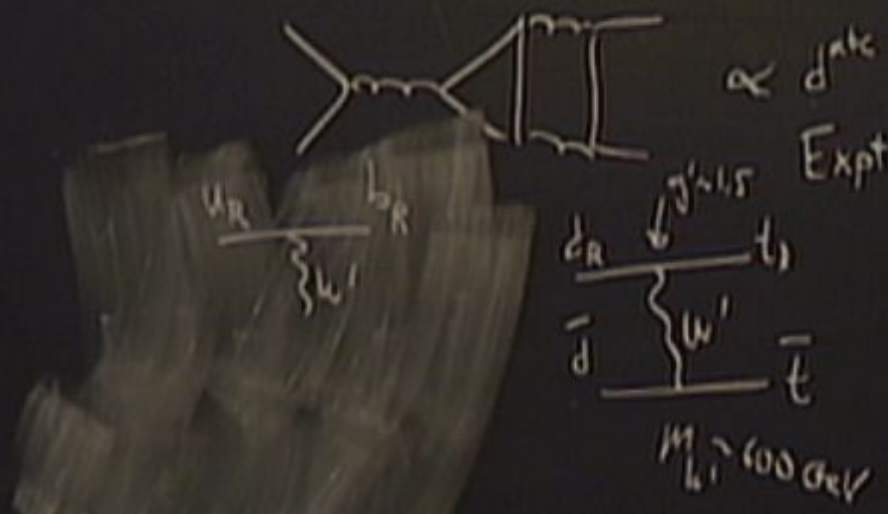
DO NOT
 PROCEED
 WITHOUT
 PERMISSION

DO NOT
 PROCEED
 WITHOUT
 PERMISSION

11, 27

17

- Use AFB
- Use forward jet



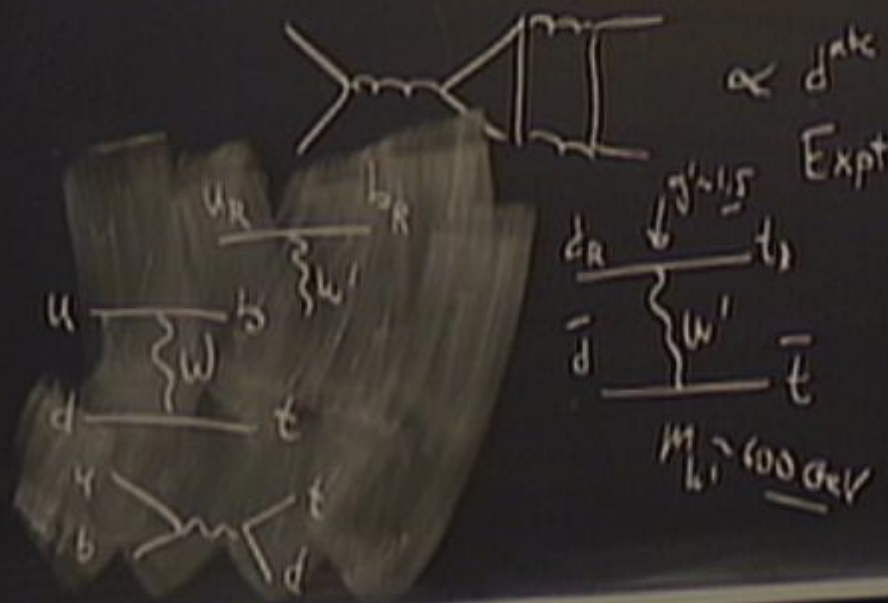
α data
 Expt

	$t\bar{t}$ from	TeVton, lab-frame
SM AFB	8% - 7%	~ 5%
CDF	$24 \pm 14\%$	$17 \pm 8\%$
DO	higher, larger error	
CDF	$M_{t\bar{t}} \rightarrow 450$ $t\bar{t}$ GeV $\pm 11.4\%$	
VS	$27.8 \pm 0.3\%$	

11, 29

17

- Use AFB
- Use forward jet



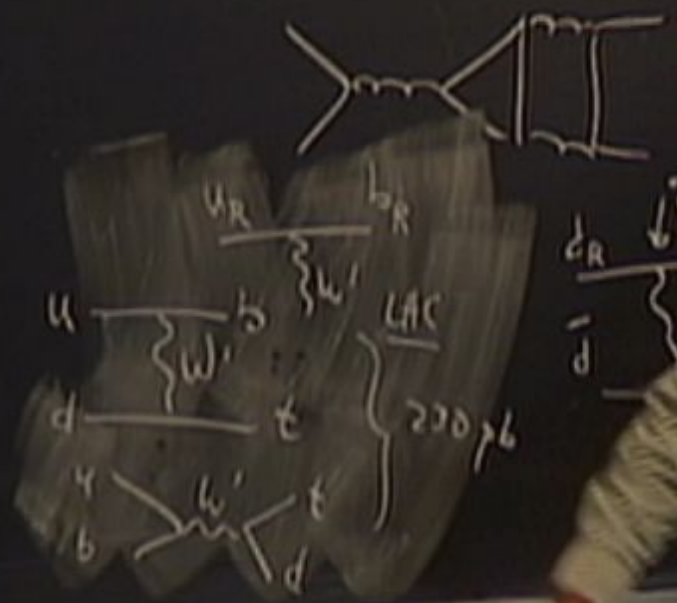
α data
 Expt

	$t\bar{t}$ from	TeVton, lab-frame
SM $A_{FB}^{t\bar{t}}$	8% - 7%	~ 5%
CDF	$24 \pm 14\%$	$17 \pm 8\%$
DO	higher, large error	
CDF $M_{t\bar{t}} \rightarrow 450$	47.5	
$t\bar{t}$ GeV	$\pm 11.4\%$	
VS	$27.8 \pm 0.1\%$	

11, 27

17

- Use NFB
- Use forward jet



α data

Ext

7% - 7%

$24 \pm 14\%$

TeVton, lab-frame

$\sim 5\%$

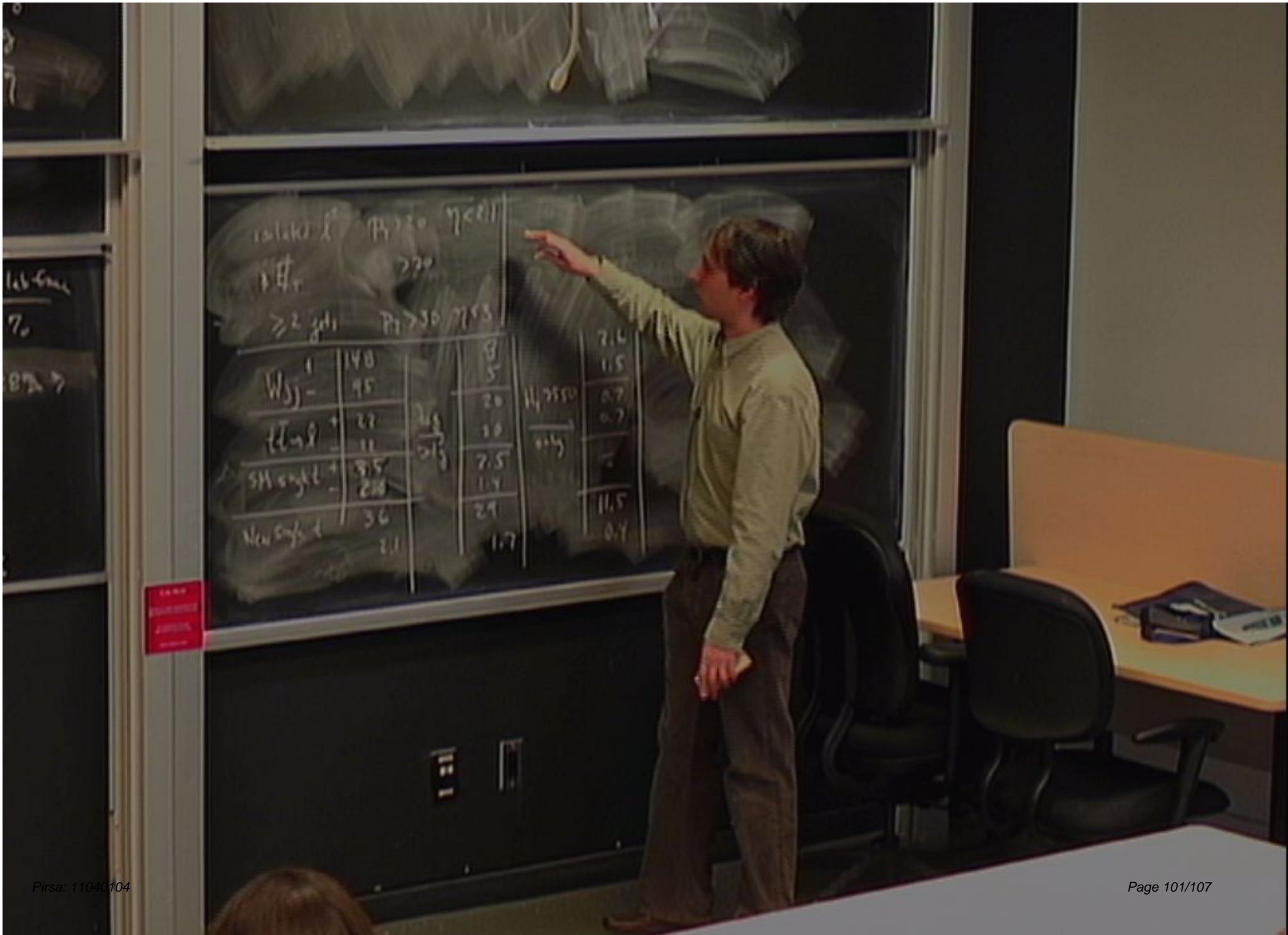
$17 \pm 8\%$

large error

47.5

$\pm 11\%$

$2788 \pm 201\%$



calculus \int $\frac{1}{x^2}$ $\frac{1}{x^2}$

$\frac{1}{x^2}$ $\frac{1}{x^2}$

$\frac{1}{x^2}$ $\frac{1}{x^2}$ $\frac{1}{x^2}$

1	140	8	2.6
Wsj-	45	5	1.5
+	27	20	0.7
-	11	10	0.7
SM engt	35	2.5	-
-	20	1.4	11.5
New engt	36	2.9	0.4
	21	1.7	

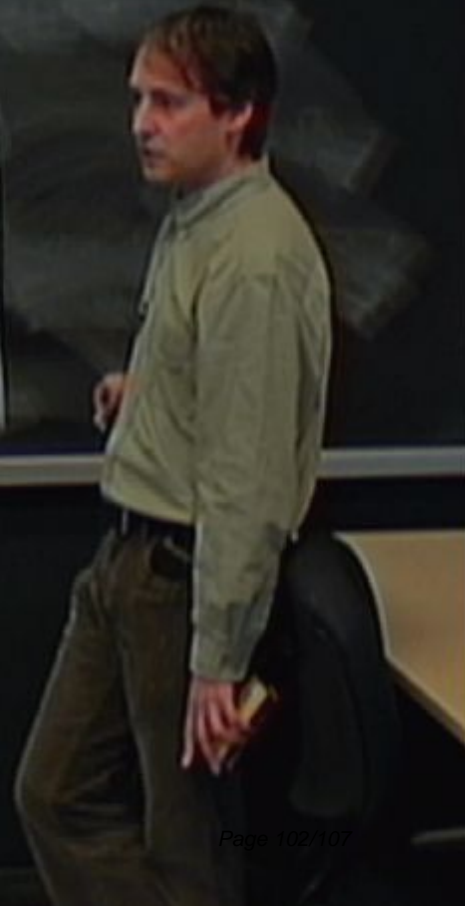
$E[\dots] = E \sqrt{x_i, x_i}$
 $\sum_{ab} \dots$
 $u > u > u > u > u > u$
 $(u, d)g$
 83
 $11, 11$

$\frac{1}{2} \text{ Gross}$ $\text{Ther, 1/6 \text{ Gross}}$
 $81 \text{ Apr } 87\% - 7\%$ $- 5\%$
 $\text{CDF } 29 \pm 14\%$ $17 \pm 8\%$
 DO higher, higher
 $\text{CDF } M_{1,2,3,4} 47.5$
 $\text{vs } 114\%$
 $\text{vs } 0.7, 0.7, 0.7$

~~Handwritten notes, mostly obscured by erasing.~~

$\text{calculate } \dots \eta > 20, \eta < 11$
 $\dots > 20$
 $\geq 2 \text{ yds } P_T > 30, \eta < 3$

WSj	148	8	7.6
	75	5	1.5
	27	20	0.7
	11	20	0.7
SM night	85	2.5	-
	200	1.4	-
New York	36	29	11.5
	2.1	1.7	0.4

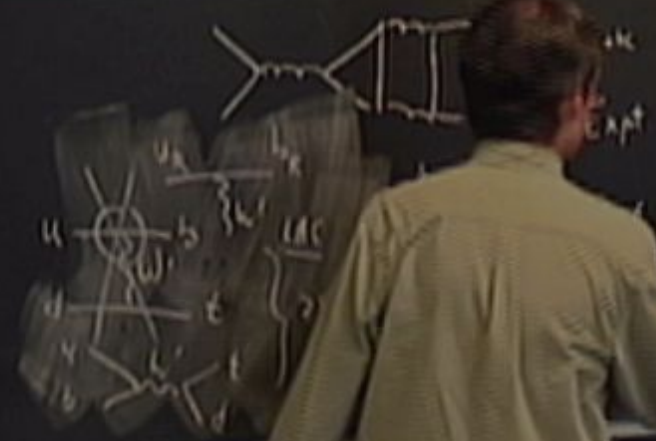


$f_2(x)$ prob to find
part of type
w/ max force x
 $0 < x < 1$

Z_{ab}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
(u,d)g
gg
gg, gg

Z_{cb}
 $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$
(c,d)g
gg
gg

- Use π PB
- Use forward jet



	$\bar{t}\bar{t}$ from	Theror, $\bar{t}\bar{t}$ from
SI A_{FB}	$8\% - 7\%$	$\sim 5\%$
CDF	$28 \pm 14\%$	$17 \pm 8\% ?$
DO	higher, higher	
CDF $M_{\bar{t}\bar{t}}$	475	
vs	214%	
	0.78 ± 0.12	

$v \rightarrow \sigma_c^-$
sigma
 $v \rightarrow \sigma_{e^-}$
sigma

$\frac{d\sigma}{d\theta} + \frac{d\sigma}{d\theta}$
 $\frac{d\sigma}{d\theta}$
 $\frac{d\sigma}{d\theta}$

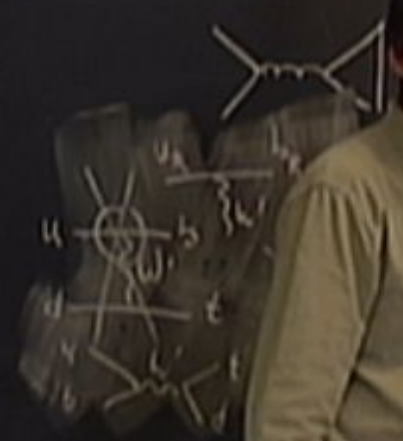
calculated
 $v \rightarrow \sigma$
 ≥ 2 jets
 W_{jj}
 $\bar{t}\bar{t} \rightarrow \bar{t}$
strong
New style

$f_-(x)$ part to find
part of type
w/ non force x
 $0 < x < 1$

\mathcal{L}_{ab}
 $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
(u,d)g
gg
gg, gg

\mathcal{L}_{cb}
 $u\bar{u} > u\bar{d} = d\bar{u} > d\bar{d}$
(u,d)g
gg
gg

- via Higgs
- via forward jet



ac data
Exp

	$\bar{t}\bar{t}$ from	Theory, lib from
at ATLAS	8% - 7%	~ 5%
CDF	2% = 14%	17% = 10% ?
DO	high, by 10%	
CDF	$M_{\bar{t}\bar{t}} = 47.5$	
	$\bar{t}\bar{t} - \bar{c}\bar{c} = 11.7%$	
	vs	0.78% 0.01%

$v \cdot \sigma_c^-$
sigma
 $v \cdot \sigma_{e^2-}$
sigma

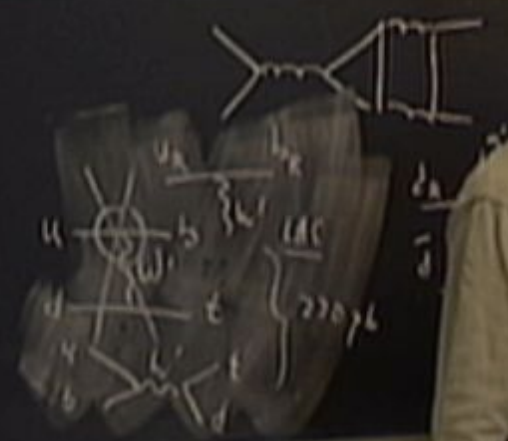
$\frac{d\sigma}{d\Omega} + \frac{d\sigma}{d\Omega}$
 $\frac{d\sigma}{d\Omega}$
Diagram

calculated
 $v \cdot \sigma_c^-$
 ≥ 2 jets
 W_{jj}
 $\bar{t}\bar{t} \rightarrow \bar{t}$
sigma
New style

$f_2(x)$ part to find
part of type
w/ non force x
 $0 < x < 1$

Σ_{ab} $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$ (u,d)g gg gg,gg	Σ_{ab} $u\bar{u} > u\bar{d} > d\bar{u} > d\bar{d}$ (u,d)g gg gg
---	--

- Use HFB
- Use forward jet



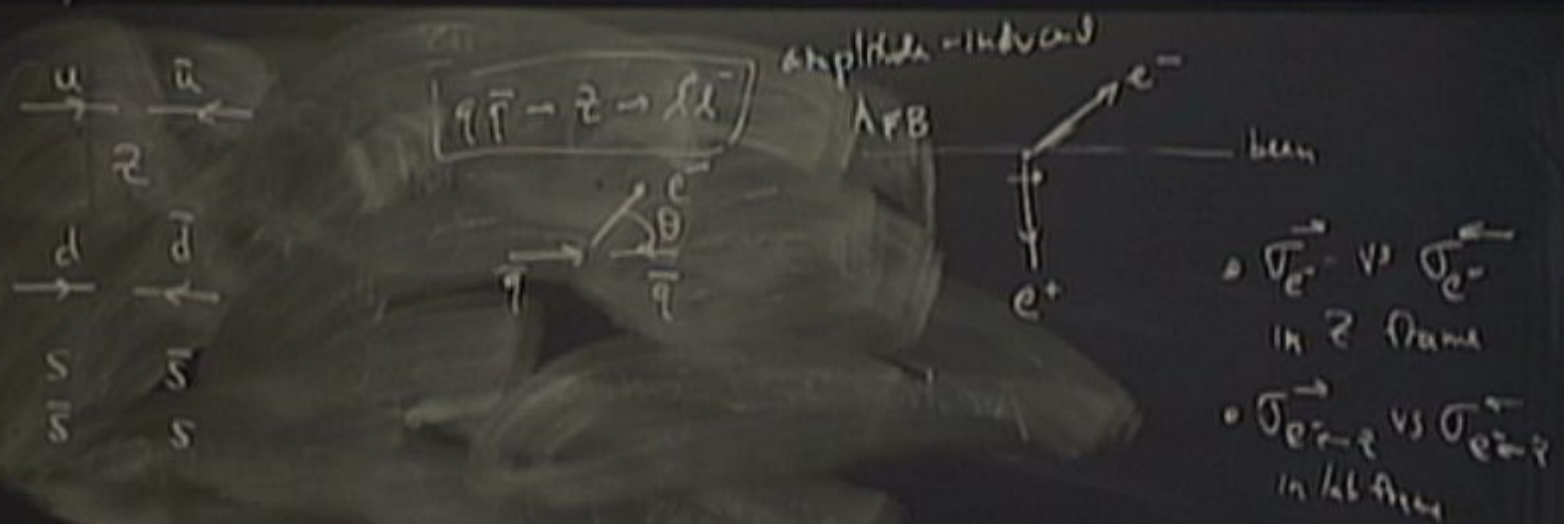
\sqrt{s} from
 at ATLAS 87.7%
 CDF 2% = 147.
 DO high, high
 CDF M₂₄₃₀ 475
 vs
 0.7802 0.012

Thesis, 1/6/04
 ~ 5%
 17.0% ?

$v = \sigma_c^-$
 sigma
 $v = \sigma_{e^2-}$
 LAC

$\frac{d\sigma}{d\theta} + \frac{d\sigma}{d\theta}$
 $\frac{d\sigma}{d\theta}$

calculated
 $v = \sigma_c^-$
 ≥ 2 jets
 W_{jj}
 $\sqrt{s} \rightarrow 2$
 strength
 New York



Symms. and Asymms at Hadron Colliders

- Intro
- Tevatron AFB
- A_{FB}^{ll}
- $A_{FB}^{bb, cc}$ - Models for A_{FB}^{ll}
- A_{FB}^{bb}
- excluding models w/ A_C at LHC

