

Measurement of A_c with Charmed Mesons

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Update since Winter-2000:

- 1. $b \rightarrow D$ asymmetry**
- 2. Using the latest $P_e A_e$ values**
- 3. QCD correction**
- 4. QED correction**

In this measurement, We use

1. Exclusive D^*/D reconstruction
2. Inclusive soft-pion

to tag c-quark

1) Exclusive D^*/D reconstruction

We use 6 decay modes:

$$D^{*+} \rightarrow D^0 \pi^+ \quad (D^0 \rightarrow K^- \pi^+)$$

$$D^{*+} \rightarrow D^0 \pi^+ \quad (D^0 \rightarrow K^- \pi^+ \pi^0)$$

$$D^{*+} \rightarrow D^0 \pi^+ \quad (D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-)$$

$$D^{*+} \rightarrow D^0 \pi^+ \quad (D^0 \rightarrow K^- l^+ \nu)$$

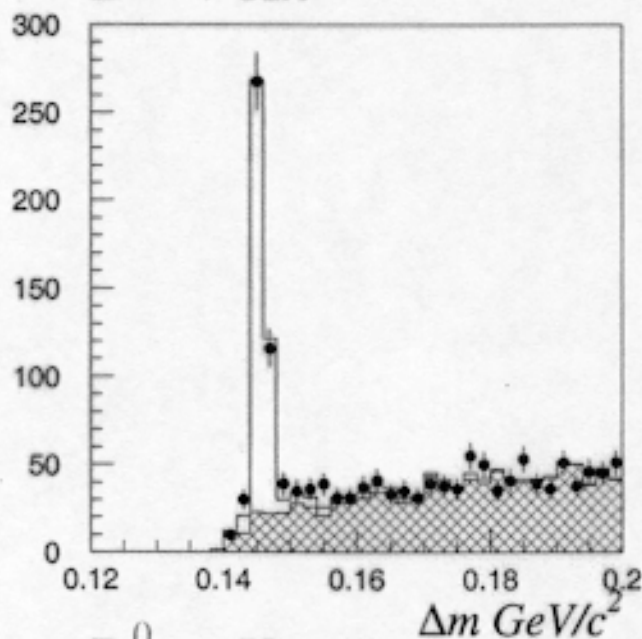
$$D^+ \rightarrow K^- \pi^+ \pi^-$$

$$D^0 \rightarrow K^- \pi^+$$

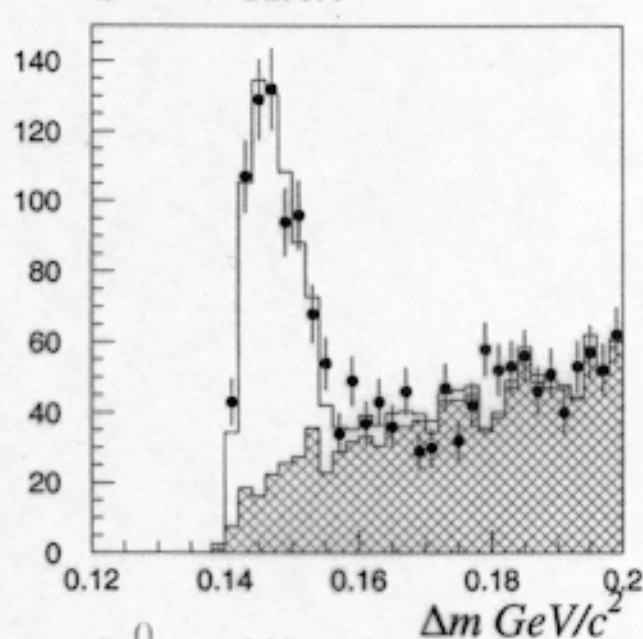
$A_c(\text{Exclusive } D^*/D \text{ reconstruction})$

$$D^{*+} \rightarrow D^0 \pi^+ S$$

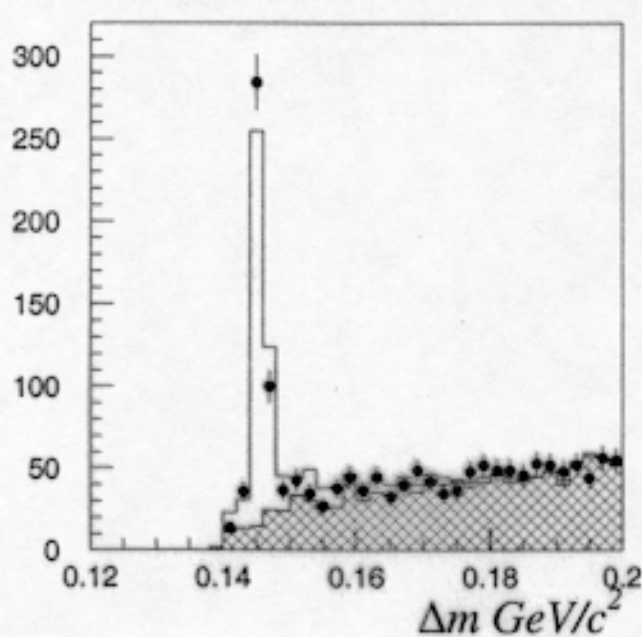
$$D^0 \rightarrow K \pi$$



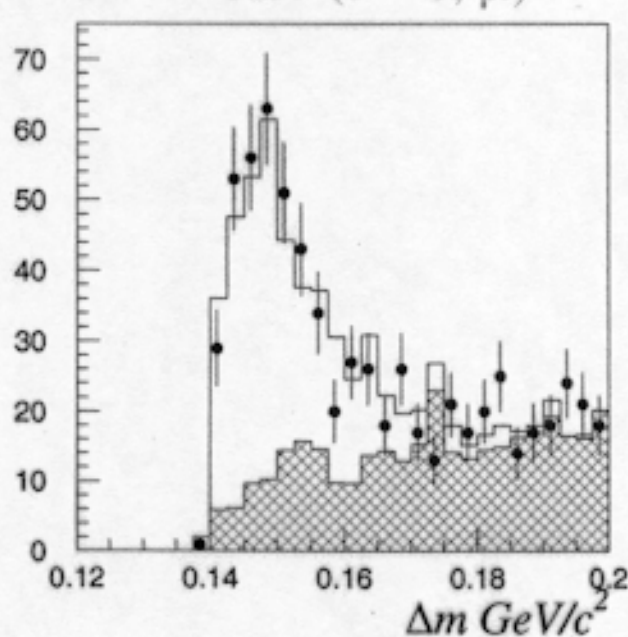
$$D^0 \rightarrow K \pi \pi^0$$

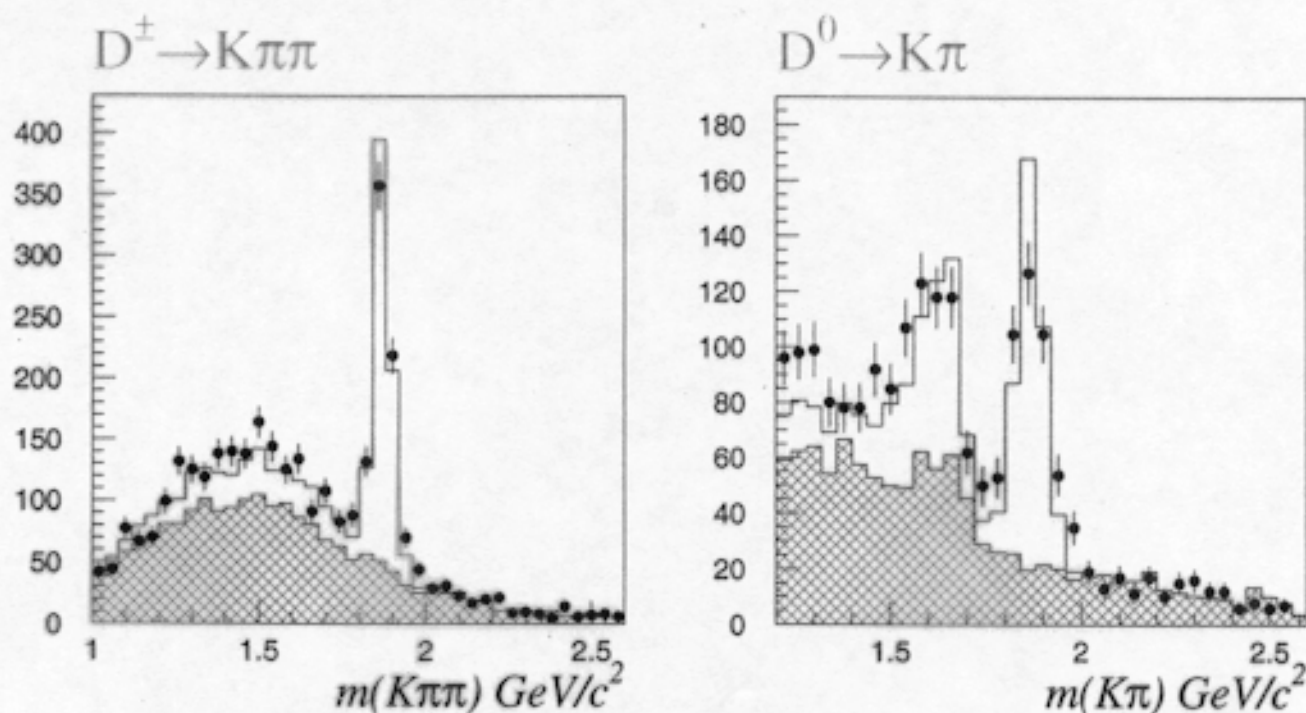


$$D^0 \rightarrow K \pi \pi \pi$$



$$D^0 \rightarrow K l \nu \quad (l = e, \mu)$$





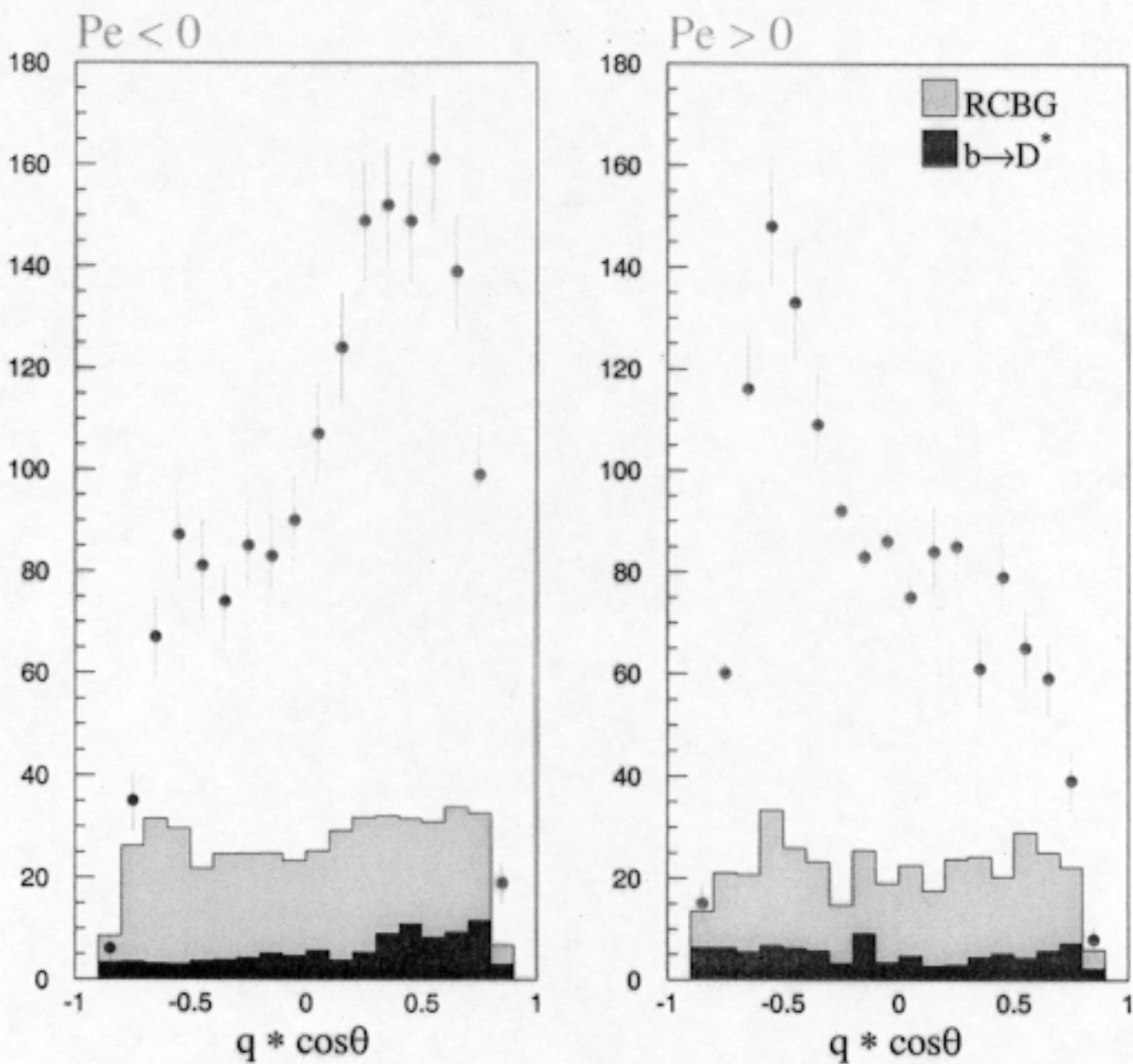
From 1993-98 We get 3967 candidates

$c \rightarrow D$ 2829 (71%)

$b \rightarrow D$ 281 (7%)

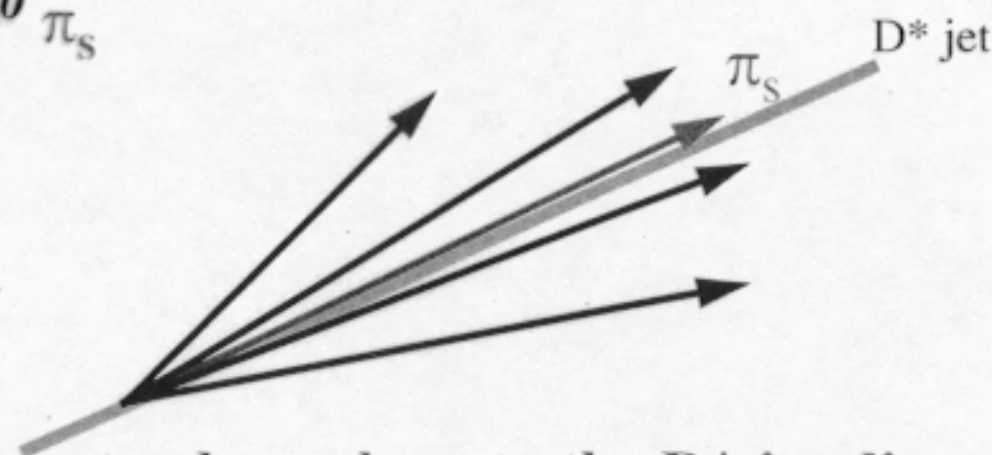
RCBG 857 (22%)

$A_c(\text{Exclusive } D^*/D \text{ reconstruction})$



Inclusive Soft-pion

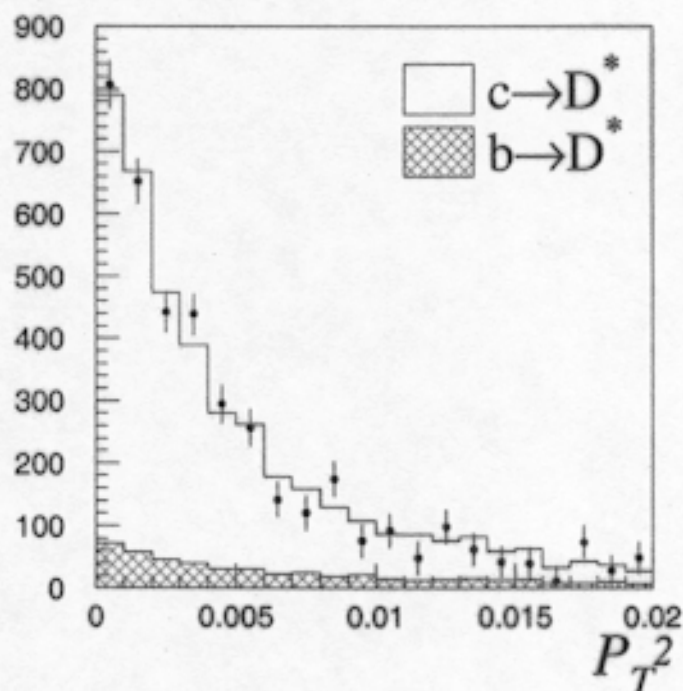
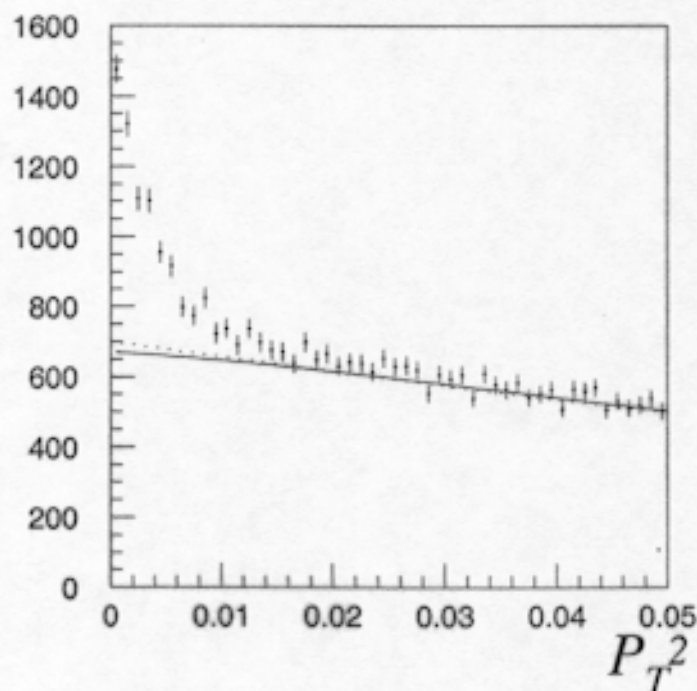
$$D^{*+} \rightarrow D^0 \pi_S$$



π_S : produce along to the D^* jet direction

Signal... $P_T^2 \sim 0$

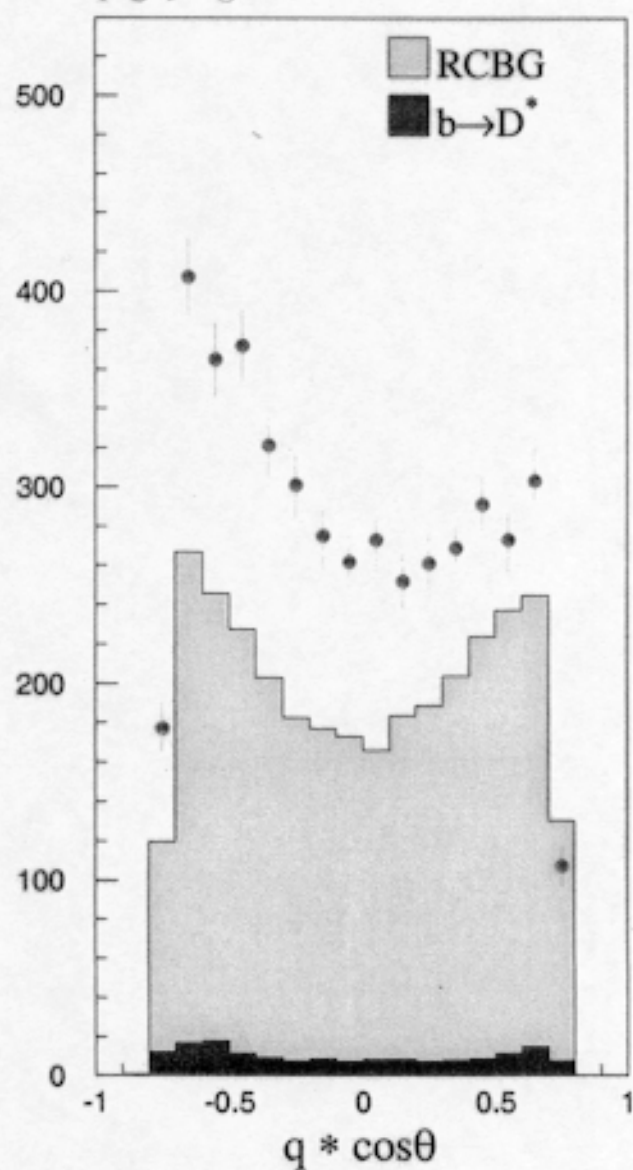
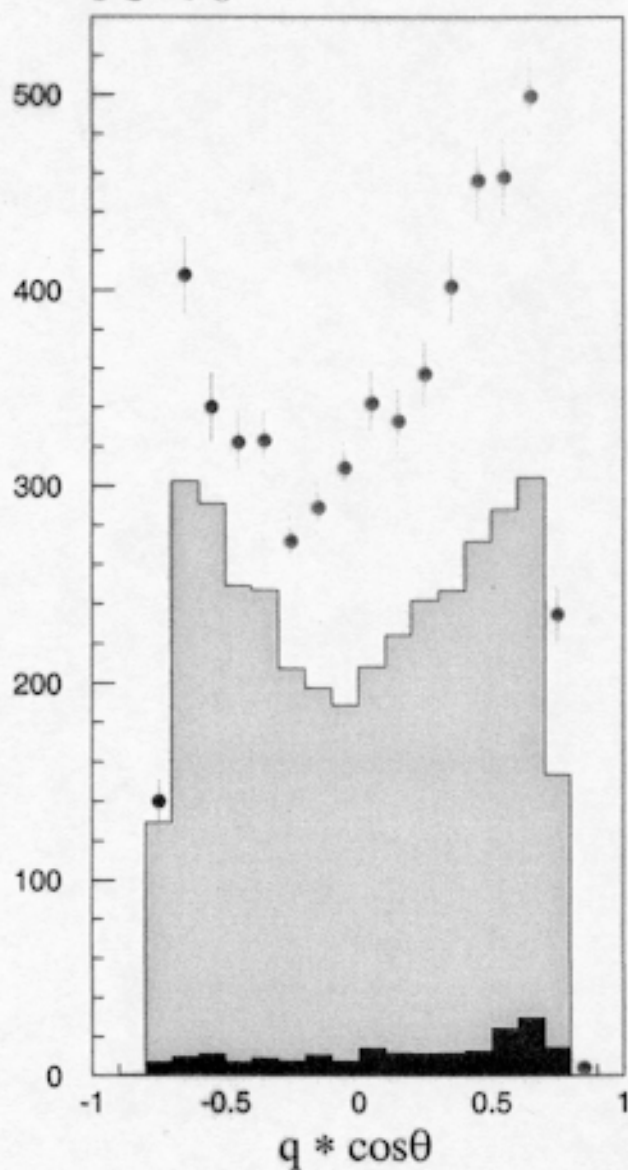
--> BG subtract



S:N ~ 1:2

We get 12,992 candidates (c->D 3791 b->D 500 RCBG 8701)

$A_c(\text{Inclusive soft-pion})$

 $P_e < 0$
 $P_e > 0$


Using these event samples (93-98 SLD data), We measured

$$A_c = 0.690 \pm 0.042 \text{ (stat)} \pm 0.022 \text{ (sys)} \quad \text{Exclusive } D^*/D$$

$$A_c = 0.690^{+0.03}_{-0.04} \pm 0.052 \text{ (stat)} \pm 0.050 \text{ (sys)} \quad \text{Inclusive soft-pion}$$

for Winter 2000

Update

1) $b \rightarrow D$ asymmetry

b asymmetry is diluted by

i) $B^0 - \bar{B}^0$ mixing

ii) Wrong-sign D production via $W^- \rightarrow \bar{c}s$

Then effective b -asymmetry can be written as

$$A_b^P = A_b \times (1 - 2\chi_{\text{mixing}}) \times (1 - 2\chi_{W \rightarrow cs})$$

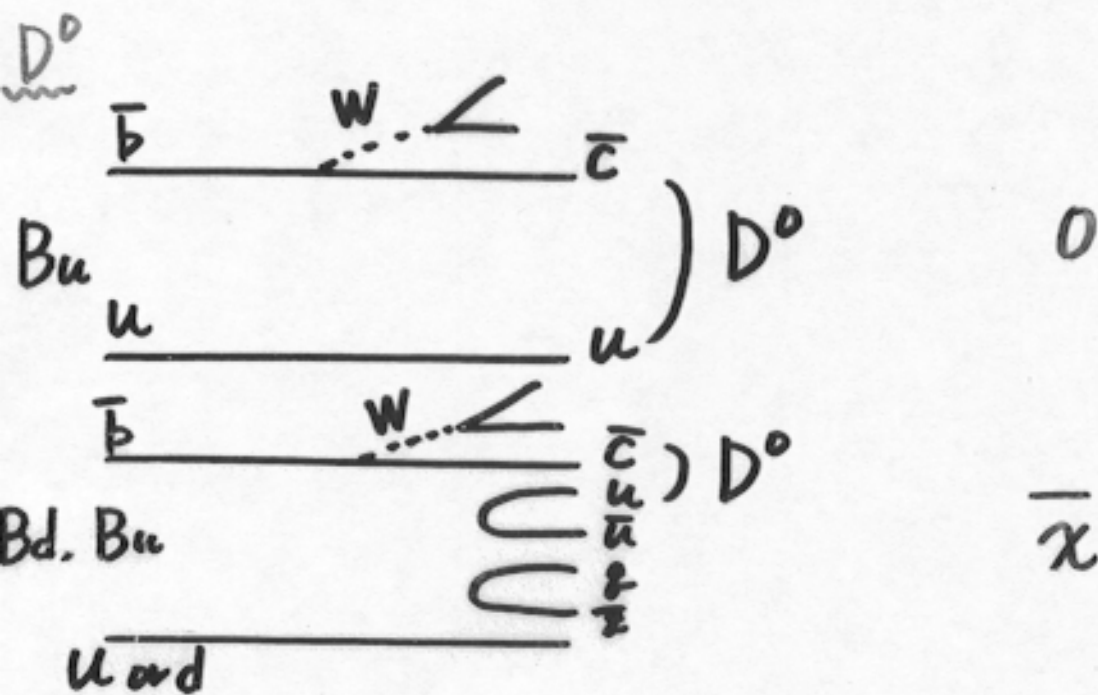
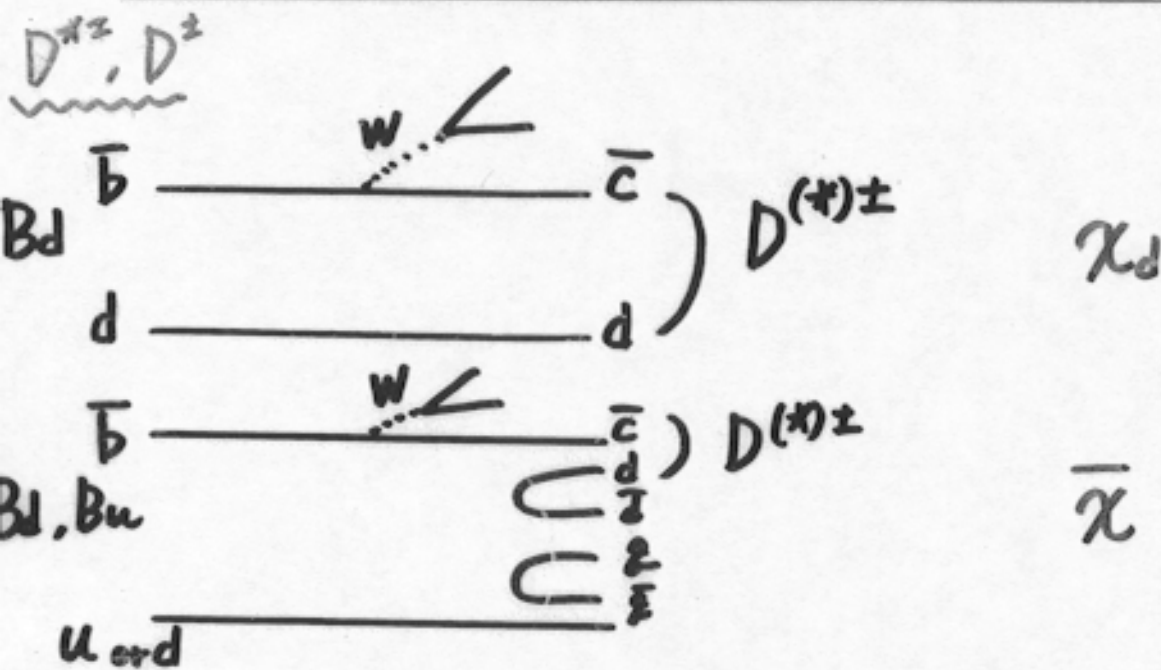
$$A_b^D = A_b \times (1 - 2\chi_{\text{mixing}}) \times (1 - 2\chi_{W \rightarrow cs})$$

OLD	New
$A_b = 0.935 \pm 0.105$ $\chi_d = 0.16 \pm 0.025$ (CLEO '89) $\bar{\chi} = 0.12 \pm 0.01$ (LEP '94) $\chi_{W \rightarrow cs} = 0.025 \pm 0.025$ (OPAL '93)	$0.935 \pm \underline{\underline{0.025}}$ (LEP $\downarrow$) SLD 2000 0.156 ± 0.024 (PDG '98) 0.119 ± 0.004 (LEP 2000) (0.023 ± 0.006 $D^{\pm}, D^{\pm}, D^0$ Av. 0.021 ± 0.006 D^{π} only)
$A_b^D = 0.64 \pm 0.11$	$\left\{ \begin{array}{ll} 0.657 \pm 0.025 & D^{\pi} \\ 0.655 \pm 0.026 & D^{\pm} \\ 0.762 \pm 0.023 & D^0 \end{array} \right.$

To obtain χ_{mixing} , so far we assumed

$$\chi_{\text{mixing}} = 0.5 \chi_d + 0.5 \bar{\chi}$$

$\rightarrow$ is this correct?



Using MC (JETSET 7.4 b-quark parton shower
300k events)

We get

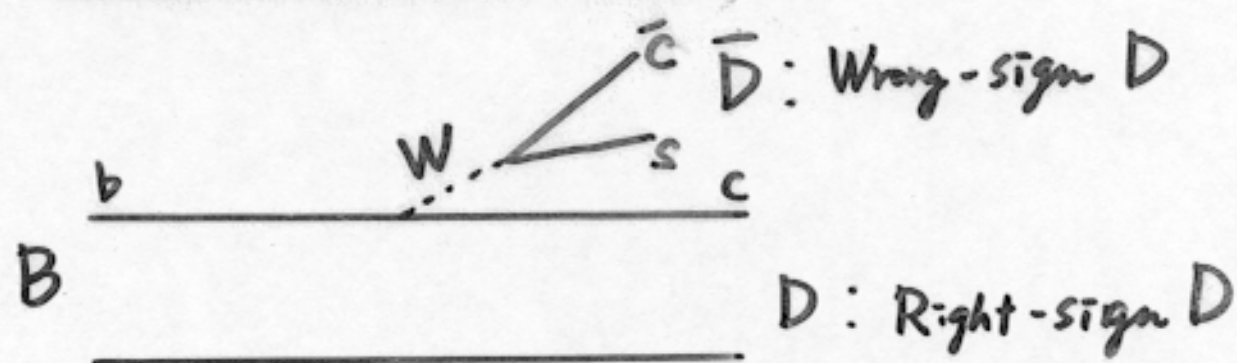
$$D^{*2} : 0.65 \bar{\chi} + 0.35 \chi_d$$

$$D^{\pm} : 0.63 \bar{\chi} + 0.37 \chi_d$$

$$D^0 : 0.61 \bar{\chi}$$

Here we assume $Br(b \rightarrow B_d) = Br(b \rightarrow B_u)$ in $\bar{\chi}$

$\chi_{W \rightarrow cs}$ determination



Using MC, we estimate

$$\chi_{W \rightarrow cs} = 0.023 \pm 0.0007 \pm 0.0064$$

MC stat. Theory

for D^{*+}, D^+, D^0 Av.

$$0.021 \pm 0.0008 \pm 0.0057$$

for D^{*+} only
(for soft-pion anal.)

The theory error is from

$$\text{Br}(b \rightarrow c \bar{c} s) = 22 \pm 6 \%$$

30% error

To check the A_b^D value,

We measured A_b^D with D^{*2} from b-decay

Exp: '96-'98

MC: '97-'98 $\leftarrow$ correct $B \rightarrow D\bar{D}$ value

	MC	Exp.
$x_D > 0.2$	0.483 ± 0.026	0.490 ± 0.074
0.25	0.487 ± 0.030	0.497 ± 0.071
0.3	0.511 ± 0.034	0.572 ± 0.081
0.35	0.500 ± 0.041	0.576 ± 0.104
0.4	0.564 ± 0.047	0.508 ± 0.119

- QCD correction

I had mistakes to calculate the analysis bias factor

$$\Delta_{\text{QCD}} = f \cdot \Delta_{\text{QCD-Theory}}$$

OLD values

Exclusive: $f_c = f_b = 0.29 \pm \text{Big error}$

Inclusive: $f_c = f_b = 0.35 \pm \text{Big error}$

We had Big errors because the statistics of our Full MC is limited...

→ Using generator level MC data

+ efficiency determined by the Full MC

New values

Exclusive: $f_c = 0.27 \pm 0.10$ $f_b = 0.17 \pm 0.07$

Inclusive: $f_c = 0.40 \pm 0.14$ $f_b = 0.19 \pm 0.09$

QED correction

Using ZFITTER (6.23), we estimate
QED correction

- initial + final states radiation
- γ -exchange, γ -Z interference

(Thanks to Morris and Toshi)

$$\Delta A_c = +0.00117 \quad (+0.18\%)$$

$$\left(\Delta A_b = -0.00213 \quad (-0.23\%) \right)$$

Using {

- $b \rightarrow D$ asymmetry
- The latest P_e and A_e values
- QCD correction
- QED correction

We update A_c values as

$$A_c = 0.690 \pm 0.042 \pm 0.019$$

Exclusive D^*/D

$$0.685 \pm 0.052 \pm 0.036$$

inclusive soft-pion

→ combine

$$\underline{0.688 \pm 0.40}$$

I think it is the final value.

Now preparing for the next version draft.