Semileptonic D Decays from CLEO and BELLE

Yongsheng Gao

Southern Methodist University

(CLEO Collaboration)

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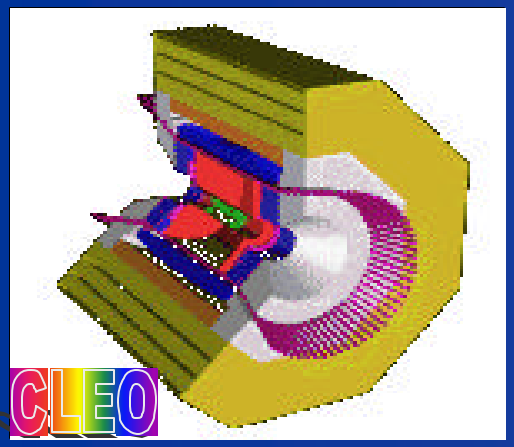
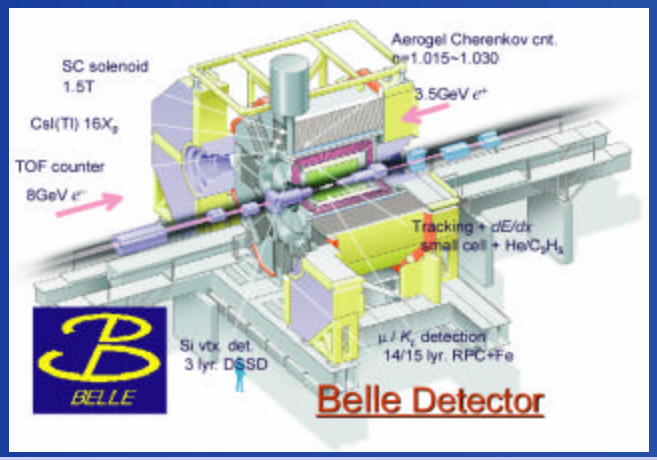
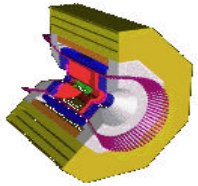






ICHEP Abstract / Paper

CLEO-III Exclusive D^0 semileptonic Decays

(ICHEP ABS11-0780, CLEO CONF 04-14)

First CLEO-c Inclusive D^0,D^+ semileptonic Decays

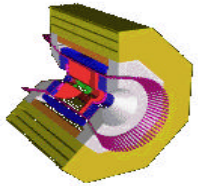
(ICHEP ABS11-0777, CLEO CONF 04-12)

First CLEO-c Exclusive D^0 semileptonic Decays

(ICHEP ABS8-0781, CLEO CONF 04-3)

BELLE Exclusive D^0 semileptonic Decays

(ICHEP ABS11-0706, BELLE CONF 0457)



Outline

Introduction

CLEO-III Semileptonic D Decay Results

- **Exclusive $D^0 \to K^- l^+ n$, $p^- l^+ n$**
  (ICHEP ABS11-0780, CLEO CONF 04-14, Submitted to PRL)

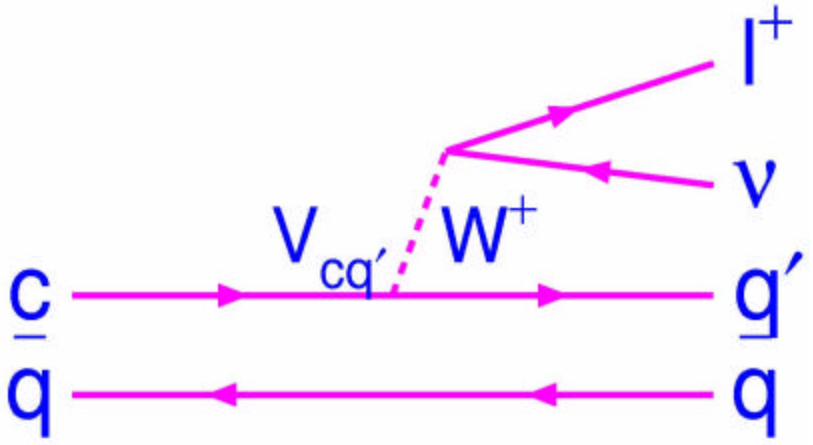
First CLEO-c Semileptonic D Decay Results

- **Inclusive $D^0 \to X e^+ n$, $D^+ \to X e^+ n$**
  (ICHEP ABS11-0777)
- **Exclusive $D^0 \to K^- e^+ n$, $p^- e^+ n$, $K^{*-} e^+ n$, $?^- e^+ n$**
  (ICHEP ABS8-0781, CLEO CONF 04-3)

Future Outlook

Why Semileptonic D Decay?

$$\mathbf{V}_{CKM} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix}$$



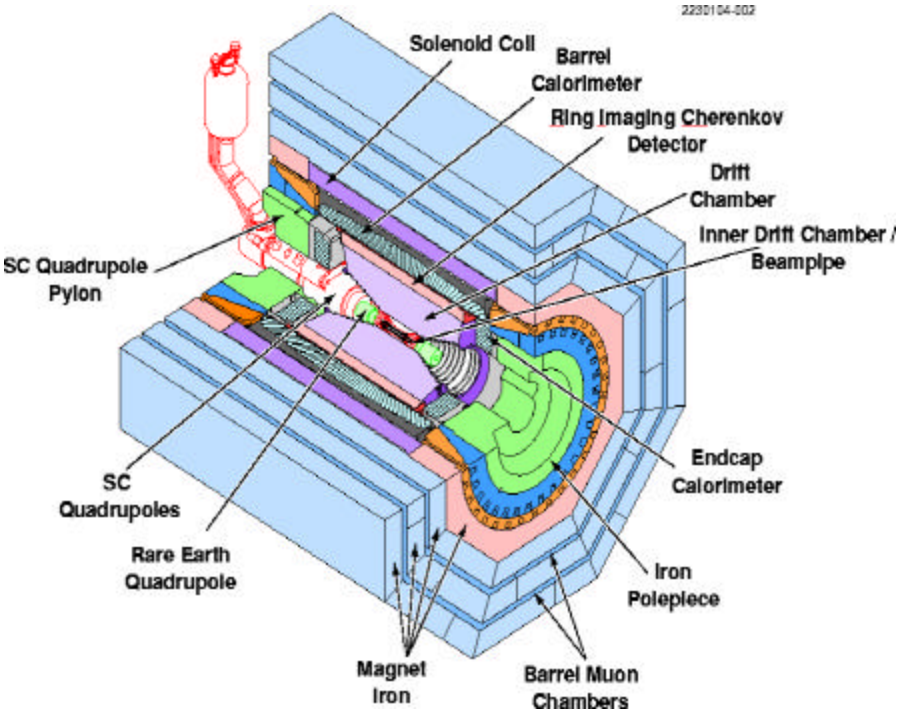
$D^0 \to Xe^+n$ and $D^+ \to Xe^+n$:

- **Inclusive semileptonic BR and spectrum**

$D^0 \to K^-e^+n$, p^-e^+n etc: $\frac{d\Gamma}{dq^2} = \frac{G_F^2}{24\pi^3} |V_{cq'}|^2 p_P^3 \left| f_+(q^2) \right|^2$

- **Form Factors, V_{cd}, V_{cs} and V_{ub}**

CESR and CLEO

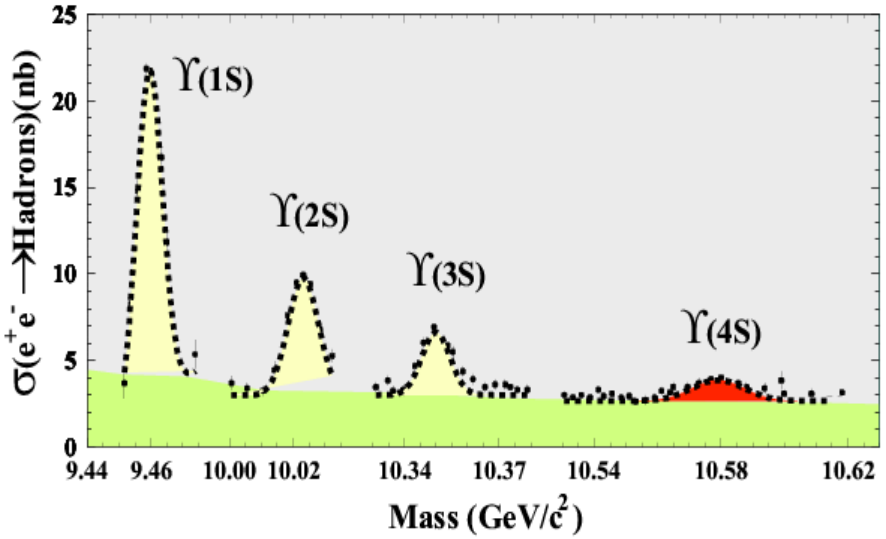


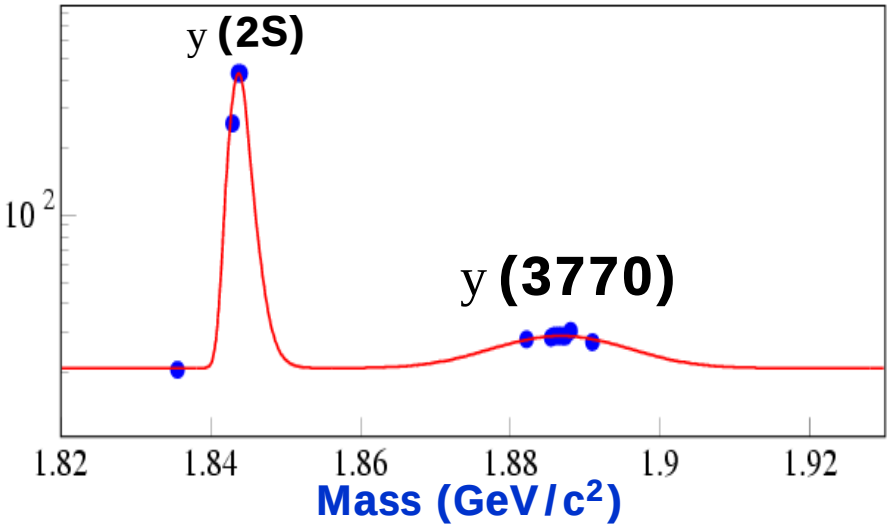
Tracking: Drift Chambers

Electron ID: CsI Cal.

Hadron ID: RICH

CLEO Data Samples





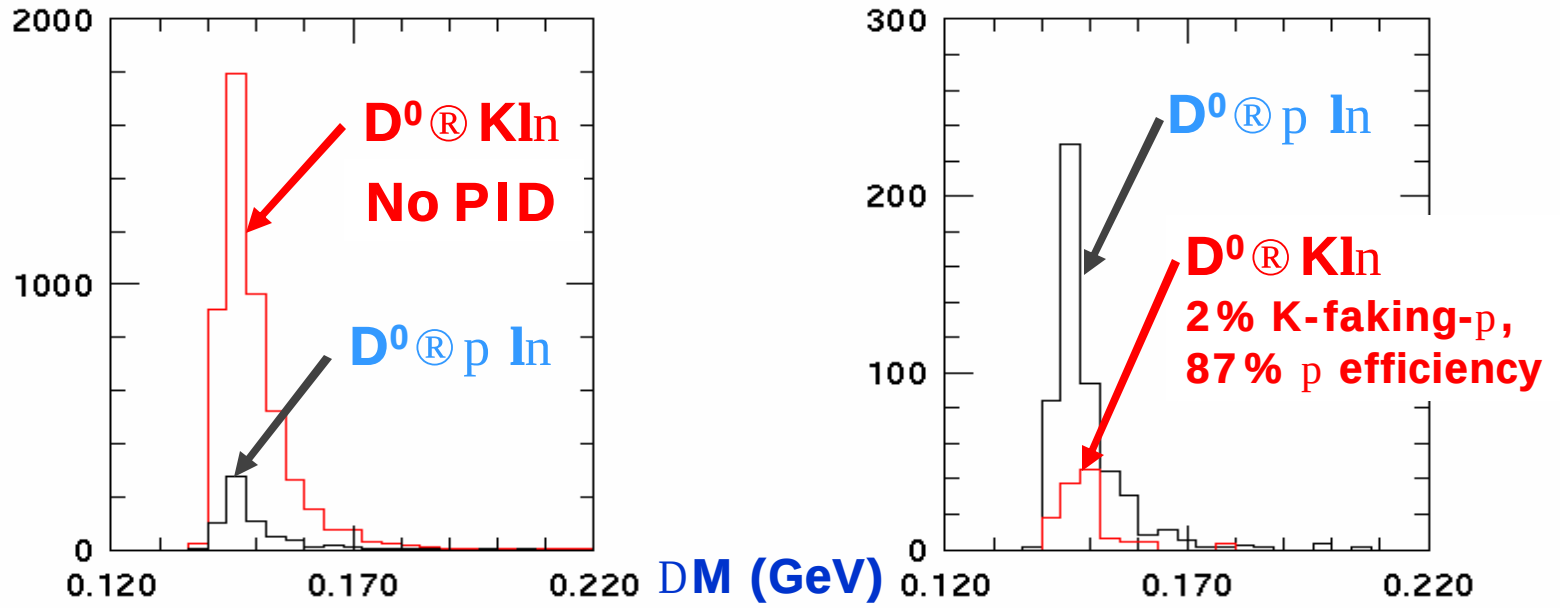
	Resonance	Integrated Luminosity
CLEO III	~ ¡(4S)	9.2 fb^{-1}
CLEO-c	y(3770)	60 pb^{-1}

CLEO III $D^0 \to K^- l^+ n / p^- l^+ n$

~7 fb^{-1} of CLEO-III data near $\Upsilon(4S)$

Event Reconstruction: $D^{*+} \to p^+_{slow} D^0$, $D^0 \to p(K)\, l\, n$

Observable: $\Delta M = M_{D^*} - M_{D^0}$



K/p Separation Capability Essential!

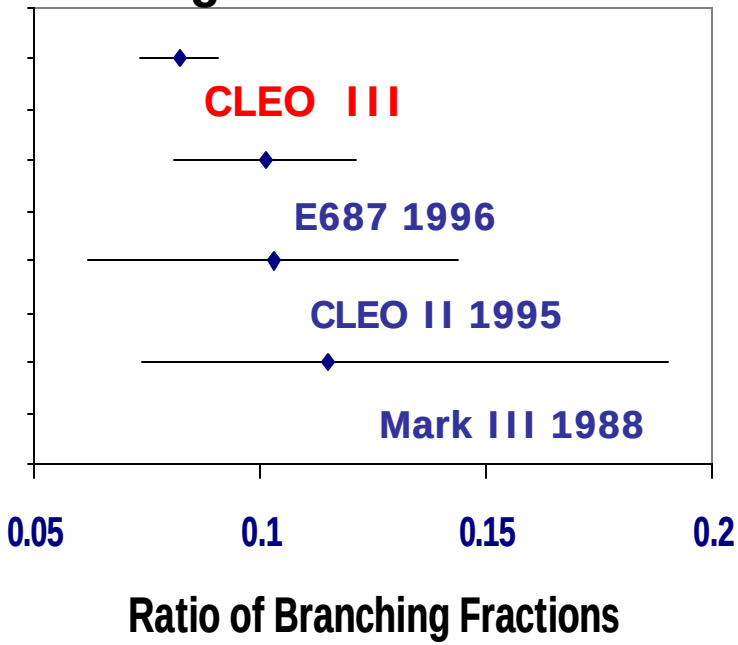
CLEO III $D^0 \to K^- l^+ n / p^- l^+ n$

~7 fb^{-1} CLEO III data near ¡(4S)

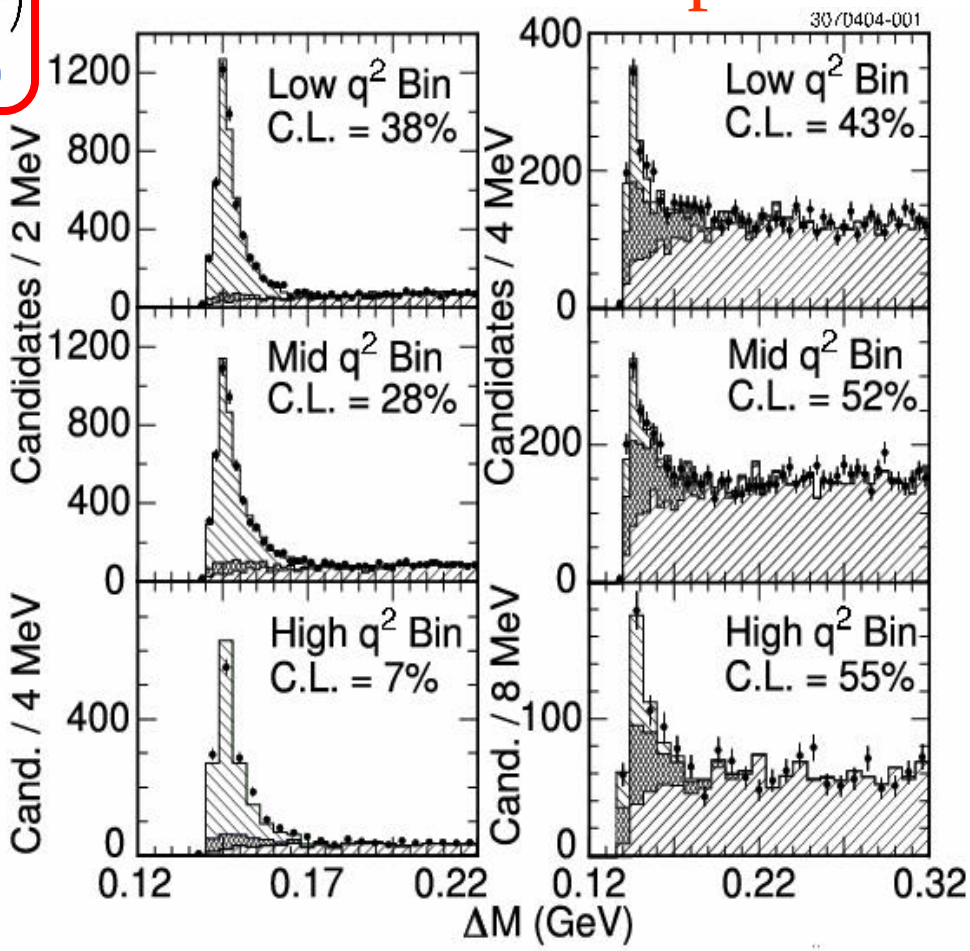
$$R_0 \equiv \mathcal{B}(D^0 \to \pi^- e^+ \nu)/\mathcal{B}(D^0 \to K^- e^+ \nu)$$
$$= 0.082 \pm 0.006(\text{stat}) \pm 0.005(\text{sys})$$

Submitted to PRL

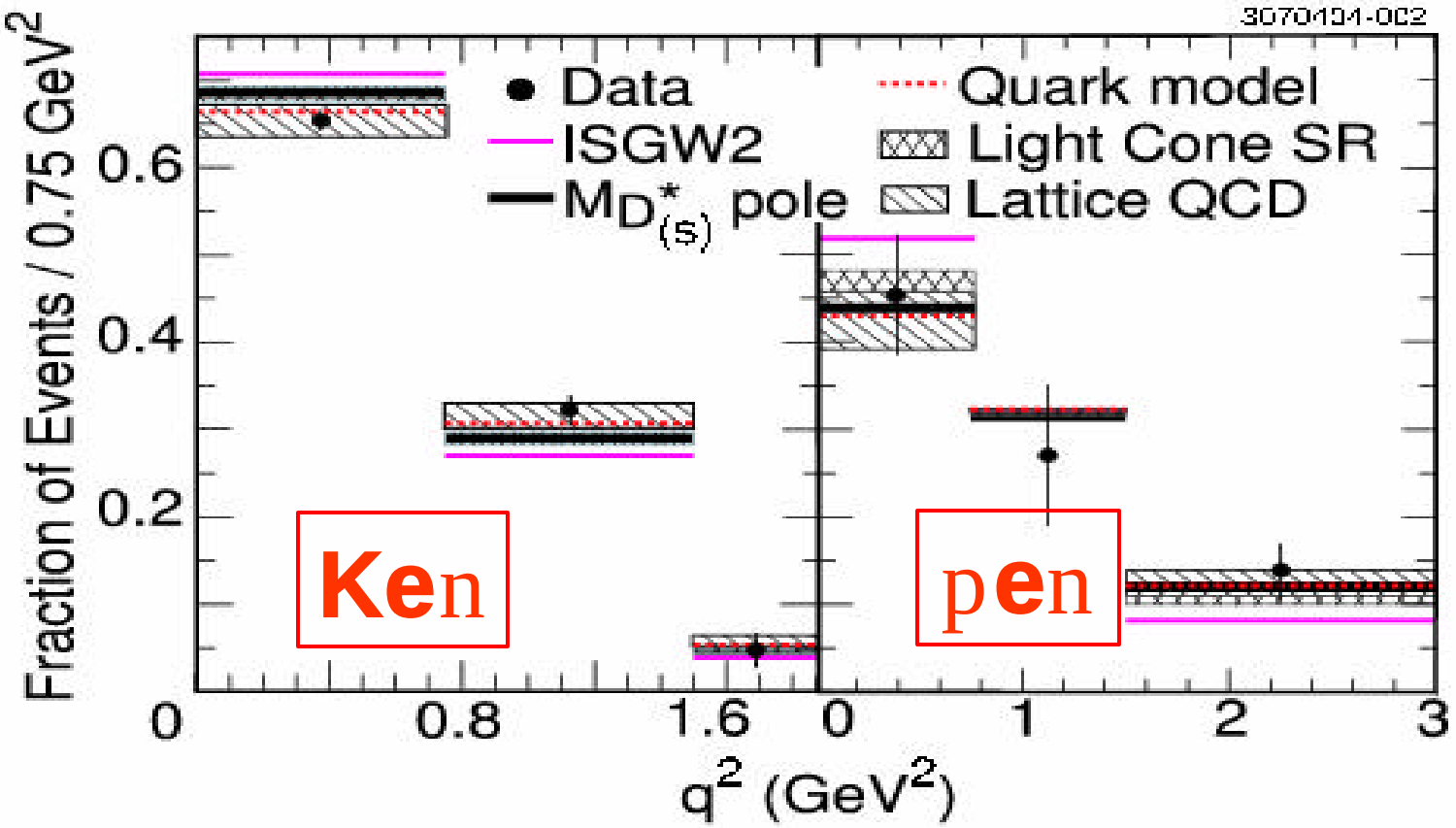
Existing Measurements:



Kln **pln**



CLEO III $D^0 \to K^- l^+ n / p^- l^+ n$



Submitted to PRL

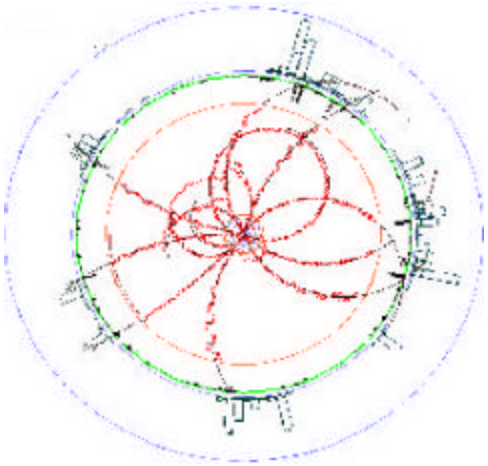
First Measurement

$$\frac{|f_+^\pi(0)|^2|V_{cd}|^2}{|f_+^K(0)|^2|V_{cs}|^2} = 0.038^{+0.006+0.005}_{-0.007-0.003}$$

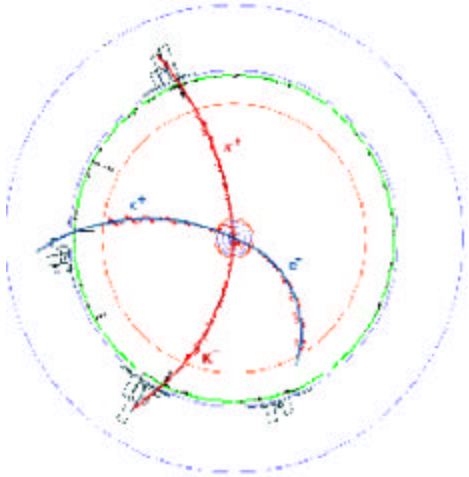
$$|f_+^\pi(0)|/|f_+^K(0)| = 0.86 \pm 0.07^{+0.06}_{-0.04} \pm 0.01$$

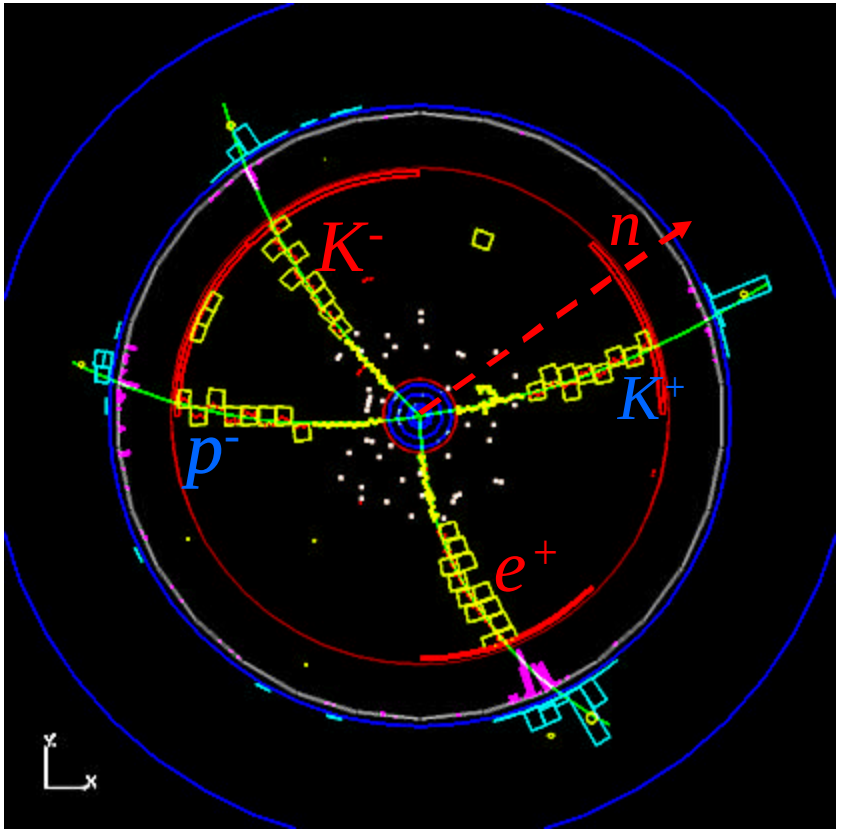
Charm at Υ(3770) vs ~¡(4S)

~¡(4S)



Υ(3770)





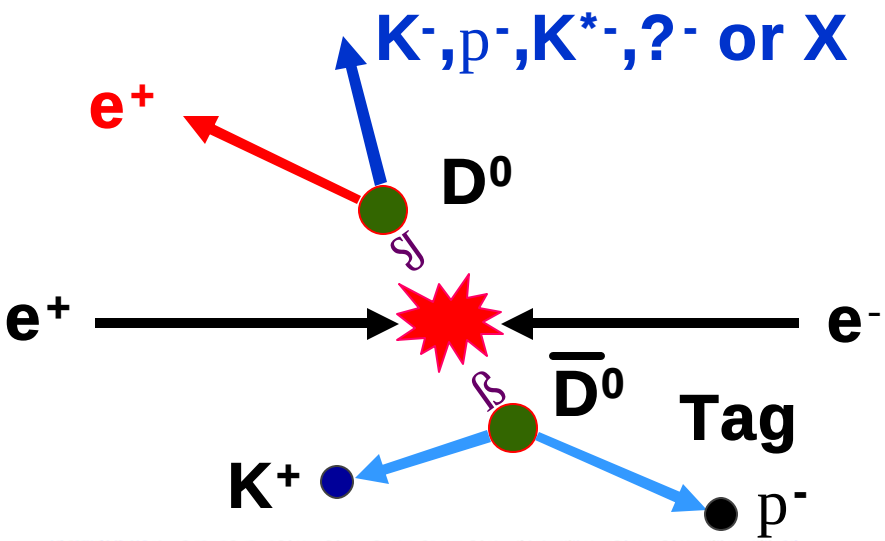
- Large Cross-Section
- Low Multiplicity
- NO Fragmentation
- Kinematics Variables:
- "Background Free"

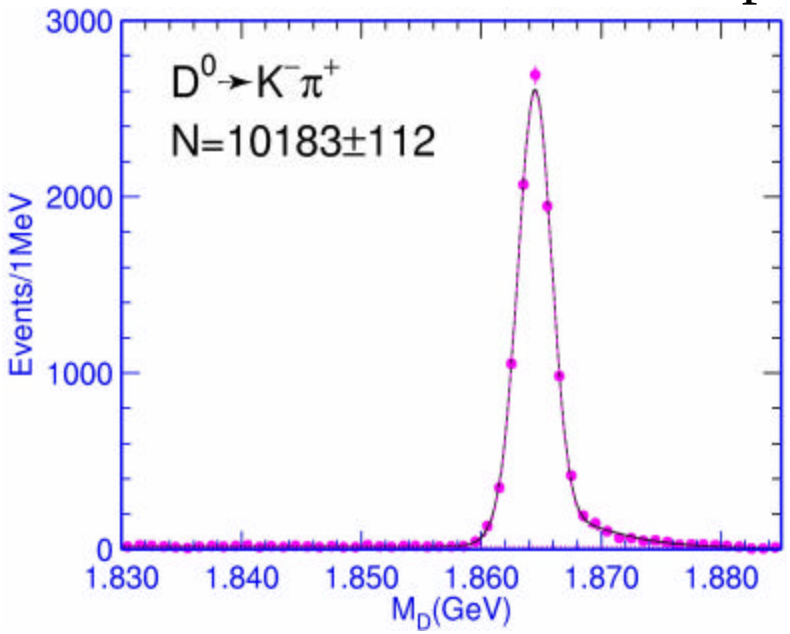
$$M_D \equiv \sqrt{E_b^2 - |p_D|^2}$$

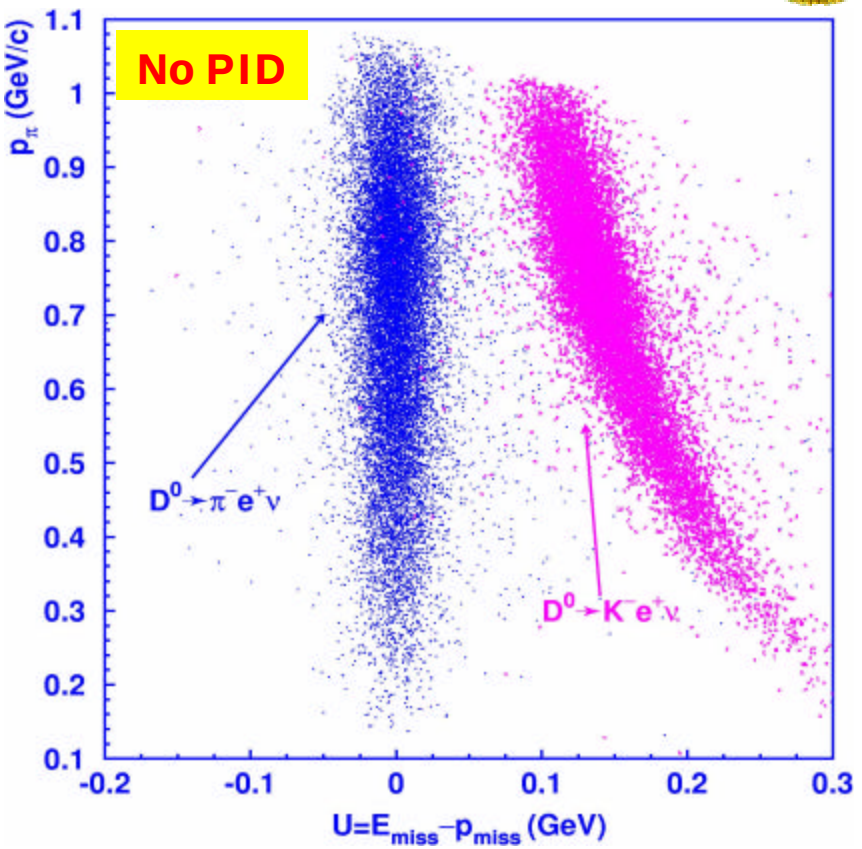
?E = E_b - E_D

U = E_{miss} - P_{miss}

Unique Kinematics at $\Upsilon(3770)$



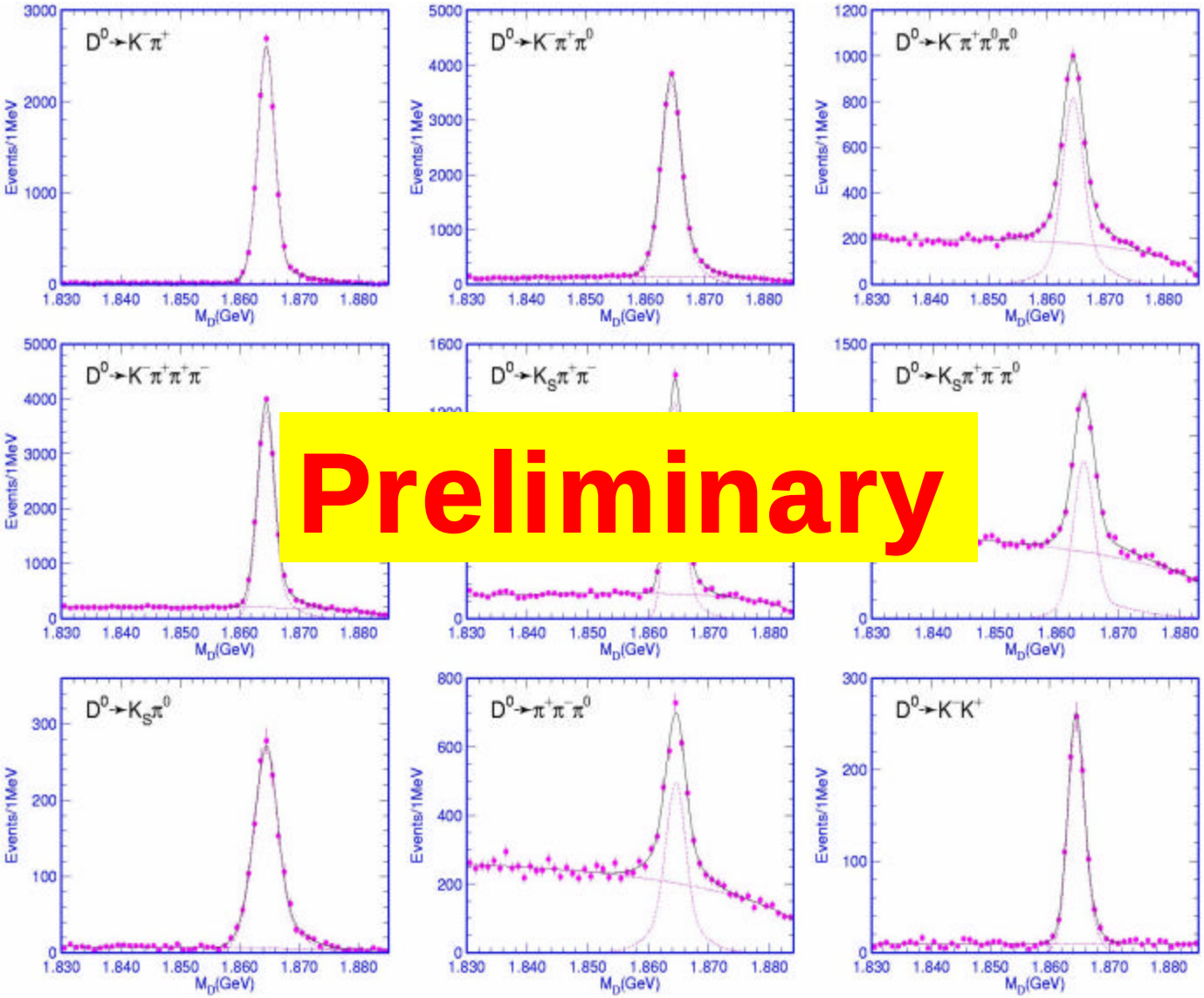




$$\mathcal{B} = \frac{N_{\rm signal}/\epsilon_{\rm signal}}{N_{\rm tag}/\epsilon_{\rm tag}}$$

Fully Reconstructed D^0 (Tag)

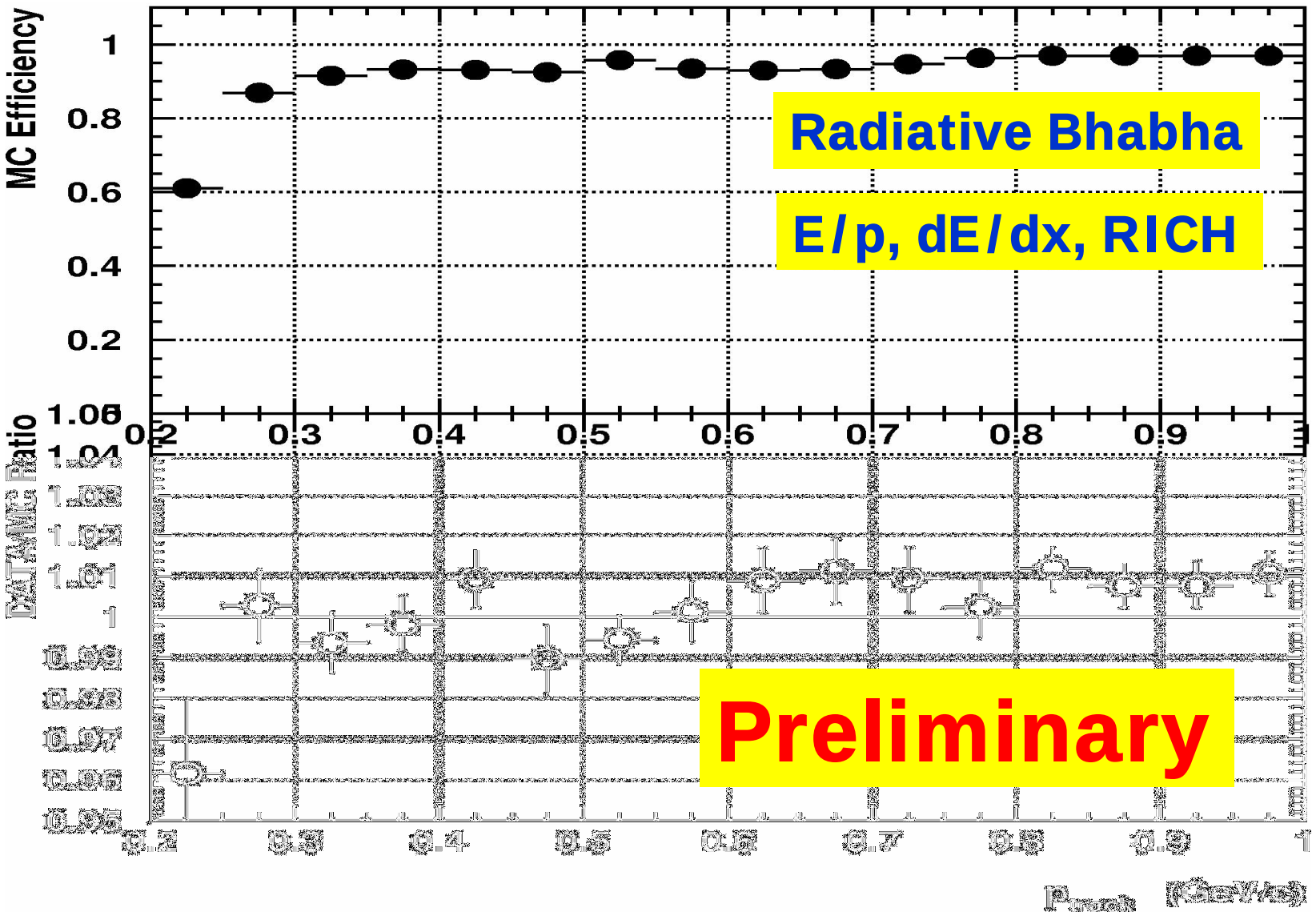
From 60 pb-1 at $\Upsilon(3770)$



Preliminary

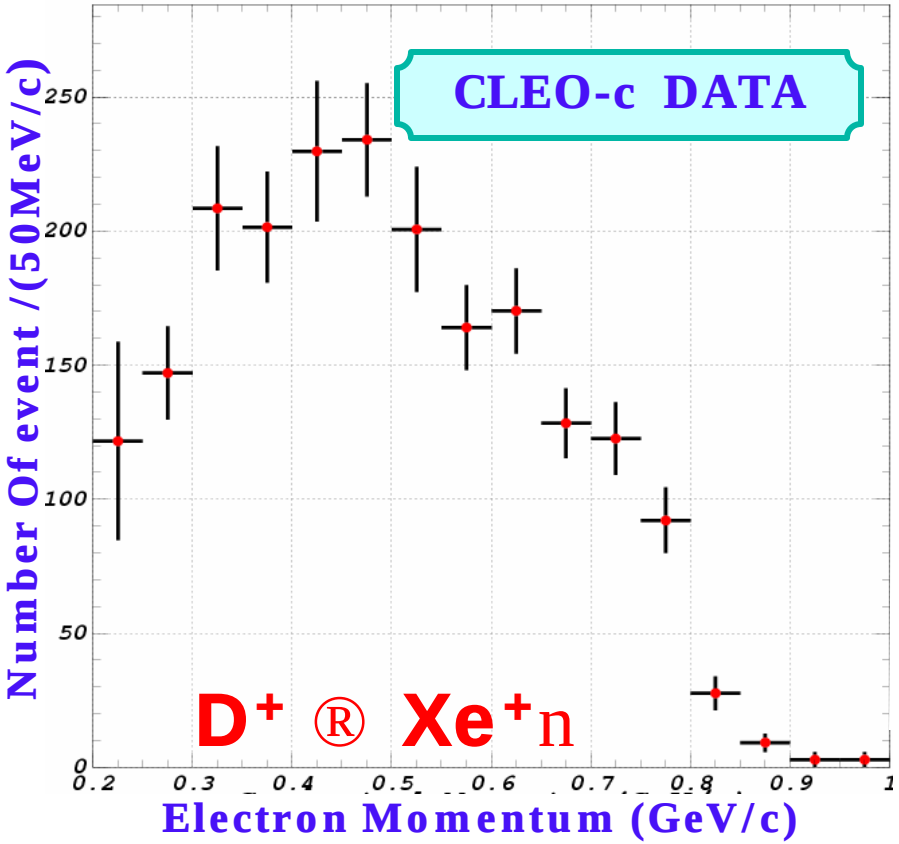
60K fully reconstructed D^0

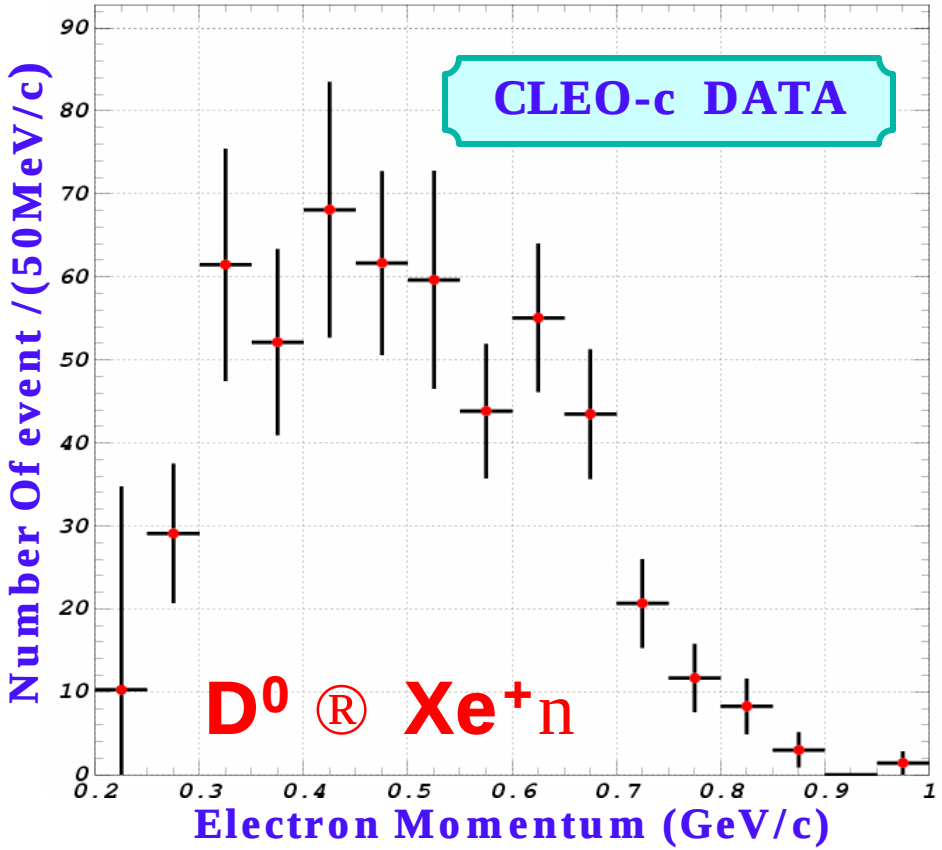
Electron Identification



Corrected Electron Spectra

From 60 pb^{-1} of first CLEO-c data: Preliminary





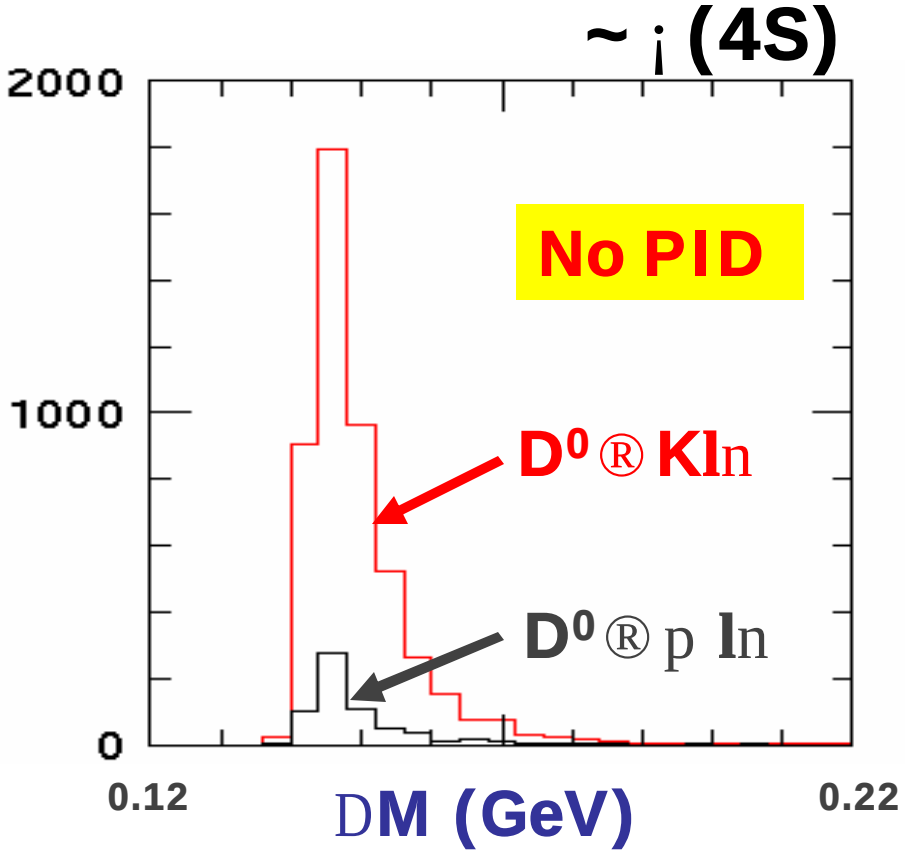
Stat. Uncertainty ~ 0.6%
PDG: BR = (17.2±1.9)%

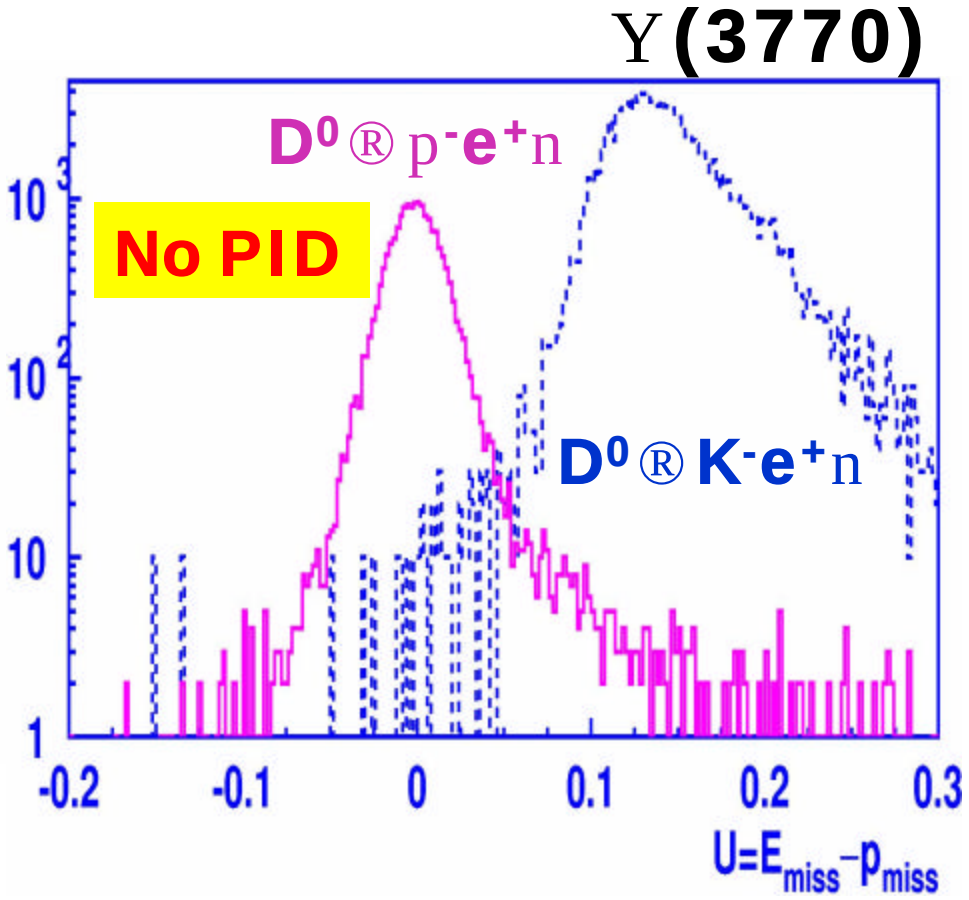
Stat. Uncertainty ~0.5%
PDG: BR = (6.75±0.29)%

Crossfeed bw $D^0 \to K^- e^+ n$, $p^- e^+ n$

~¡(4S): NO separation in ?M

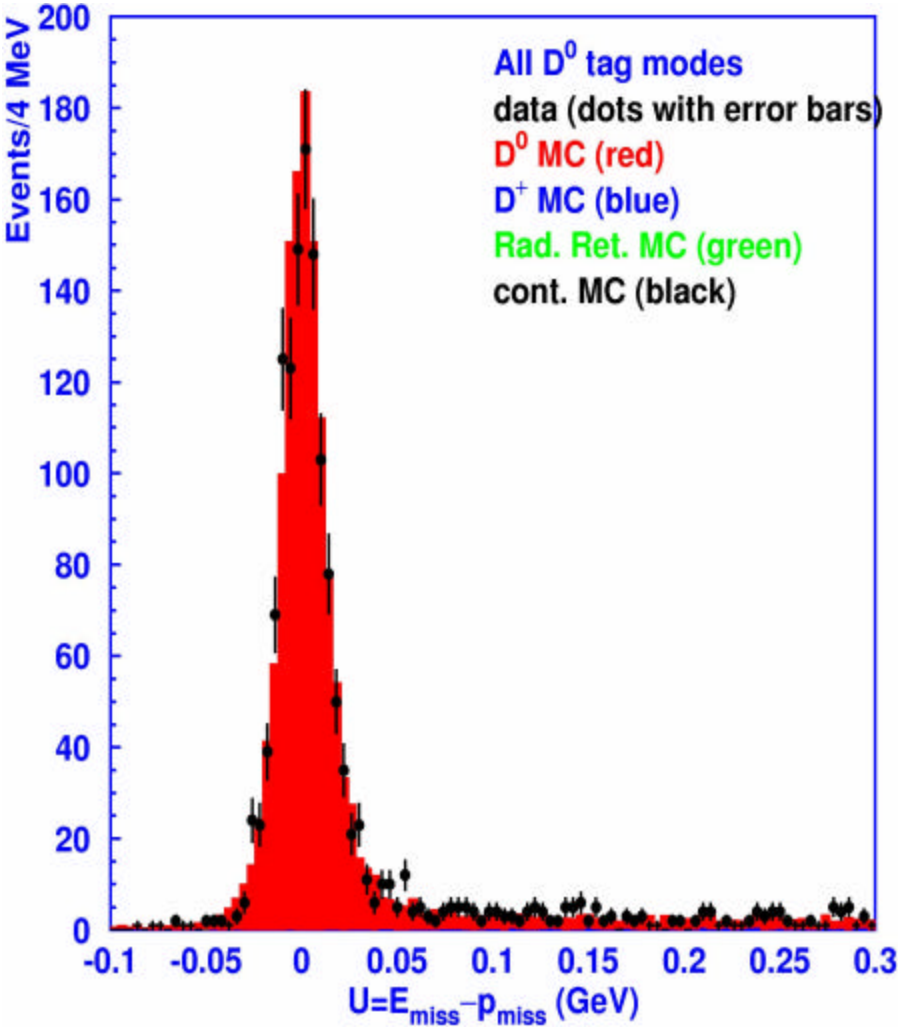
Y(3770): WELL separated in U

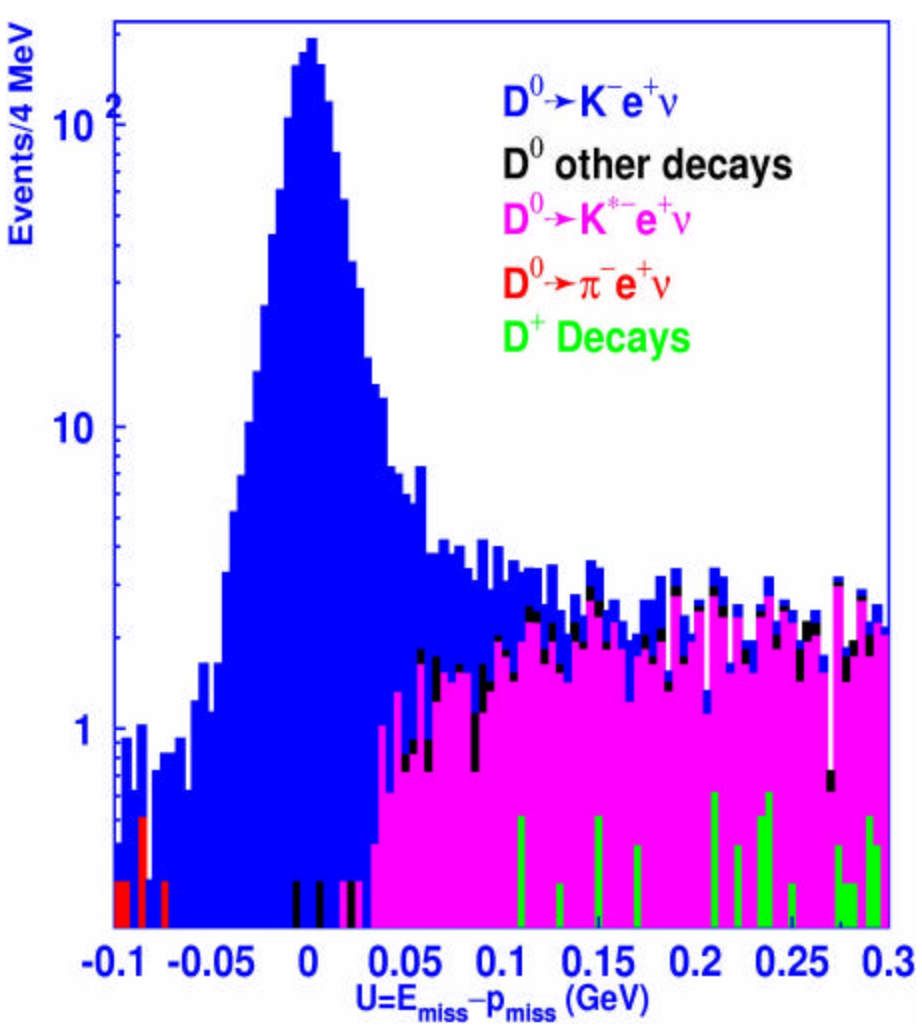




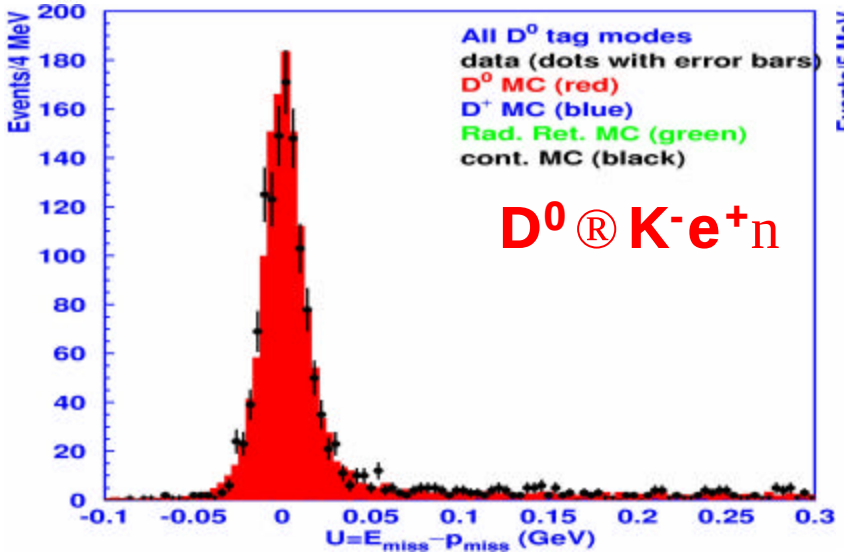
CLEO-c: $D^0 \to K^- e^+ \nu$ Results

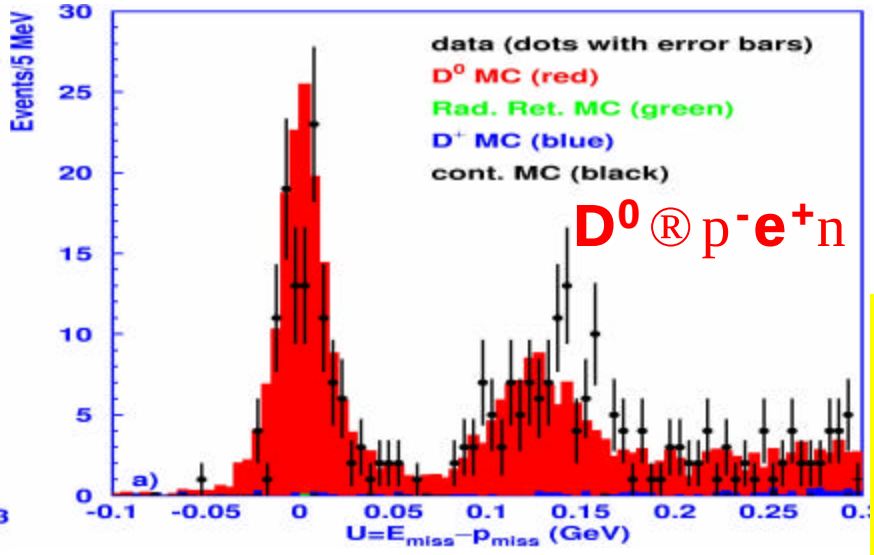
From 60 pb^{-1} CLEO-c data: Preliminary

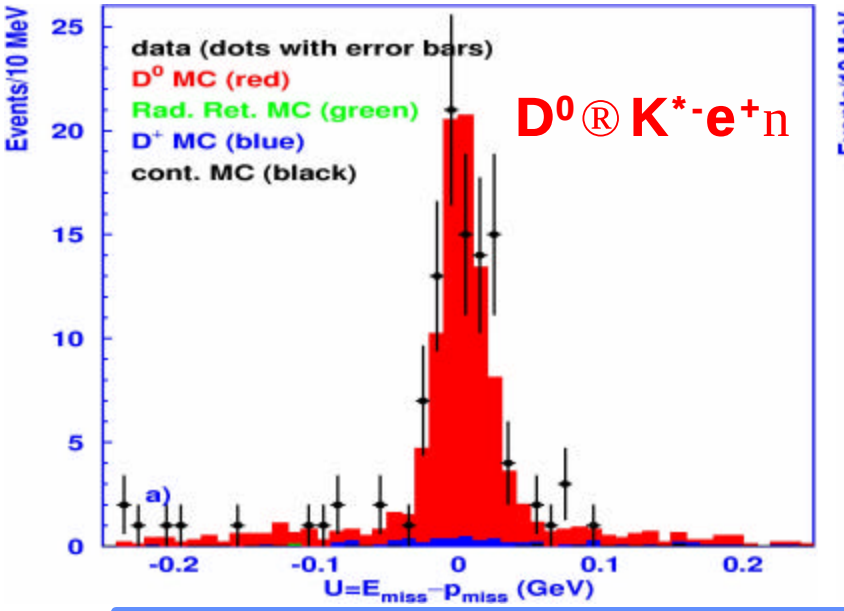


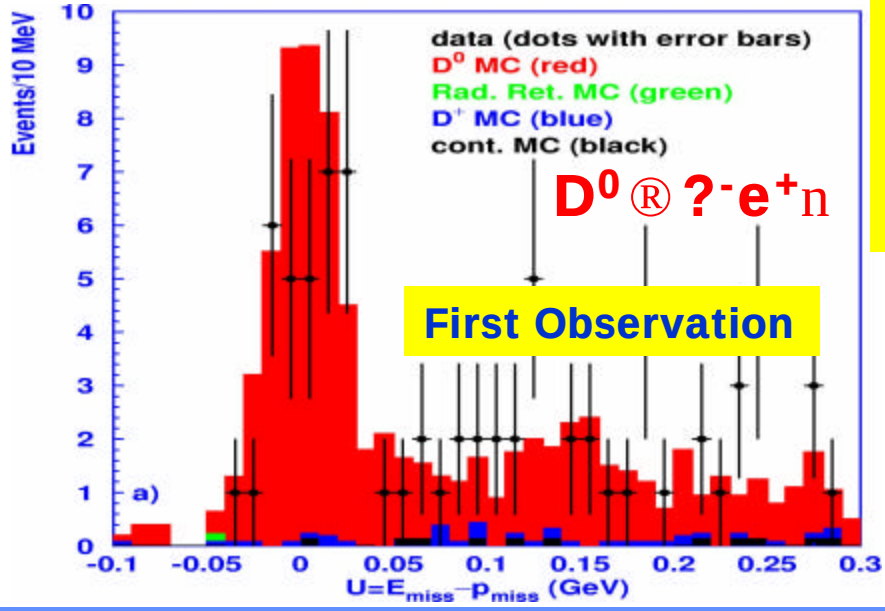


CLEO-c Exclusive D^0 Semileptonic









Preliminary

First CLEO-c Results

Decays	$\mathcal{B}$	PDG
$D^0 \to K^- e^+ \nu$	$(3.52 \pm 0.10 \pm 0.25)\%$	$(3.58 \pm 0.18)\%$
$D^0 \to \pi^- e^+ \nu$	$(0.25 \pm 0.03 \pm 0.02)\%$	$(0.36 \pm 0.06)\%$
$D^0 \to K^{*-} e^+ \nu$	$(2.07 \pm 0.23 \pm 0.18)\%$	$(2.15 \pm 0.35)\%$
$D^0 \to \rho^- e^+ \nu$	$(0.19 \pm 0.04 \pm 0.02)\%$	none
$\frac{\mathcal{B}(D^0 \to \pi^- e^+ \nu)}{\mathcal{B}(D^0 \to K^- e^+ \nu)}$	$(7.0 \pm 0.7 \pm 0.3)\%$	$(10.1 \pm 1.8)\%$
$\frac{\mathcal{B}(D^0 \to \rho^- e^+ \nu)}{\mathcal{B}(D^0 \to K^{*-} e^+ \nu)}$	$(9.2 \pm 2.0 \pm 0.8)\%$	none

Preliminary

Improved measurements of absolute Branching Fractions

First Observation of $D^0 \to ?^- e^+ \nu$

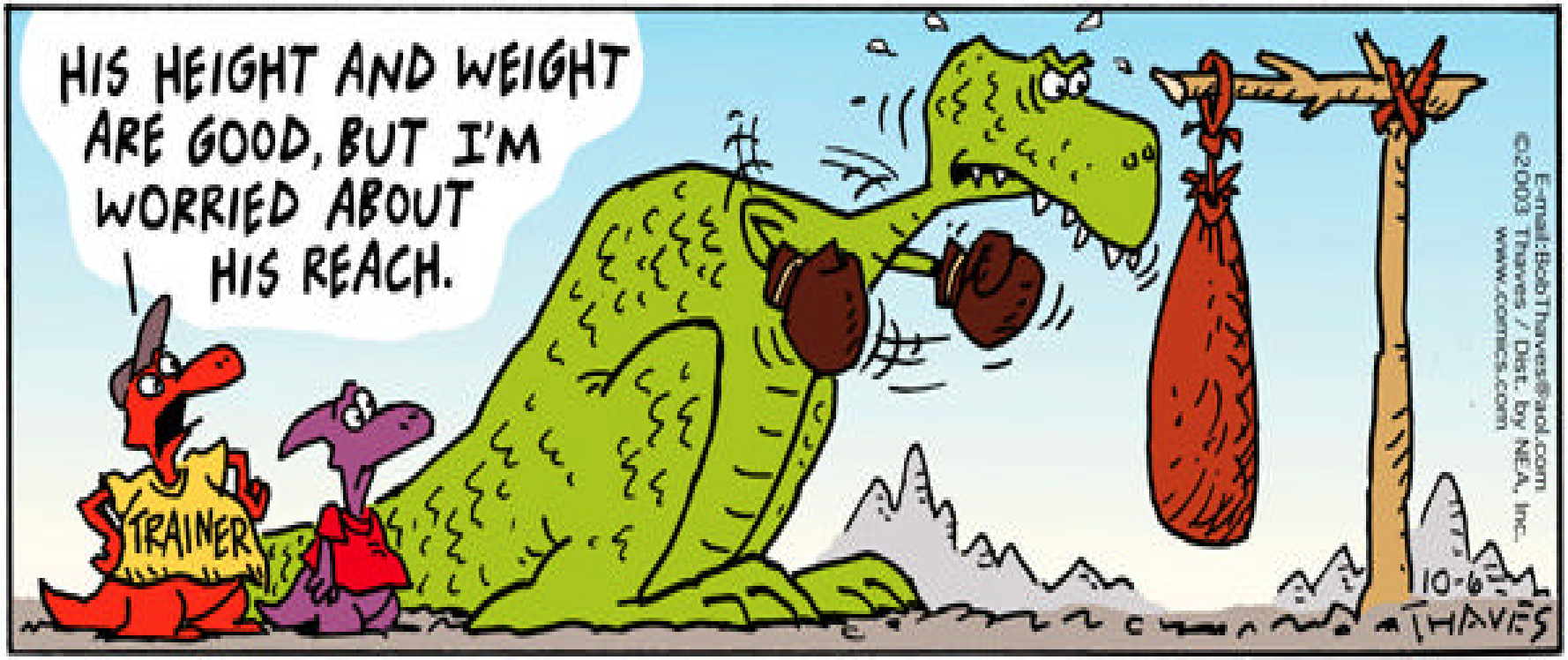
Both Statistic / Systematic errors limited by the 60 pb^{-1} data!

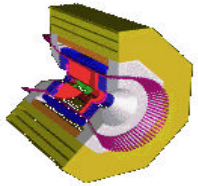
Expect ~3 fb^{-1} of CLEO-c data in one year!

Summary

"Background Free" at $\Upsilon(3770)$

Limiting Factor: 60 pb^{-1} of data sample!





CLEO-c Outlook

2005: $\psi(3770) \sim 3\ fb^{-1}$

18 million DD evts, 3,6 million *tagged* D decays

(150 times MARK III)

2006: $\sqrt{S} \sim 4140$ MeV $\sim 3\ fb^{-1}$

1.5 million D_sD_s evts, 0.3 million *tagged* D_s

(480 times MARK III, 130 times BES)

2007: $\psi(3100)$, $\sim 1\ fb^{-1}$ & $\psi(3686)$

$\sim$ 1 Billion J/ψ decays

(170 times MARK III, 20 times BES II)

CLEO-c

Many very precision charm results:

Form factors, Absolute BR, CKM elements …

CLEO-c Yellow Book, CLNS-01/1742