

BELLE—CONF—0010
BELLE—CONF—0011
BELLE—CONF—0013

**Studies of
B Meson Decays to
Charmed Final States
with Belle**



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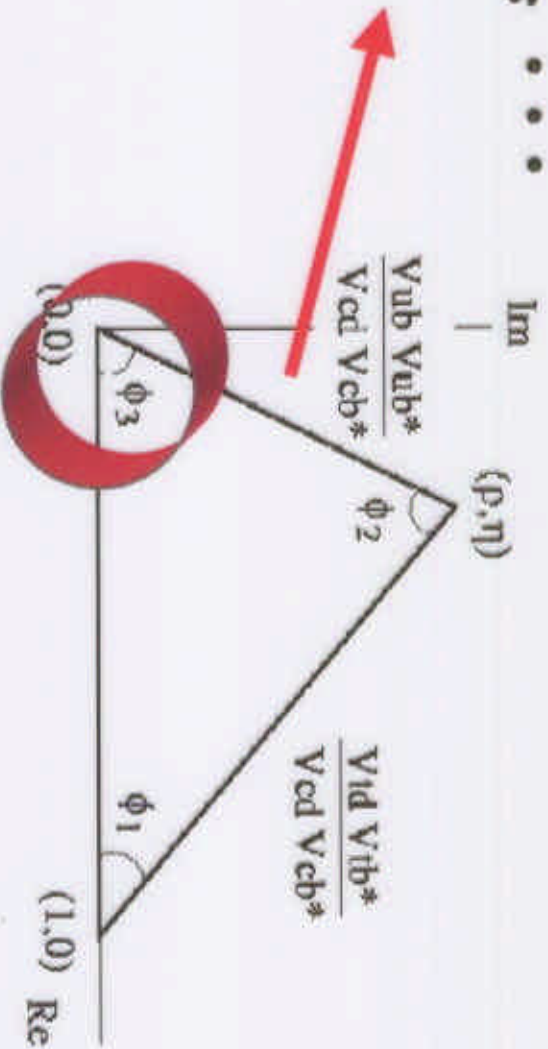
For the Belle Collaboration



What can we learn?

- Charmed Meson in Final State

$D, D^*, D_s \dots$



- $(B \rightarrow DK) / (B \rightarrow D\pi) \quad (\phi_3, \quad V_{us} / V_{ud})$
- $B \rightarrow D_s \pi \quad (b \rightarrow uW, V_{ub})$
- $B \rightarrow D^{(*)} \rho \quad (b \rightarrow cW, V_{cb})$



$B^- \rightarrow D^{(*)}0K^-$

- Feasibility for ϕ_3 measurement



- Naive Model

$$R = \text{Br}(B^- \rightarrow D^0 K^-) / \text{Br}(B^- \rightarrow D^0 \pi^-) \\ = (f_K / f_\pi)^2 |V_{us} / V_{ud}|^2 \approx 0.074$$

- Results with 5.5 M BB events
- New modes
- $B^- \rightarrow D^{*0} K^-$, $\overline{B^0} \rightarrow D^{*+} K^-$



$B^- \rightarrow D^0 K^-$

- **Reconstruction**

For $B^- \rightarrow D^0 h^-$

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

For $B^- \rightarrow D^{*0} h^-$

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

For $\bar{B}^0 \rightarrow D^{*+} h^-$

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

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

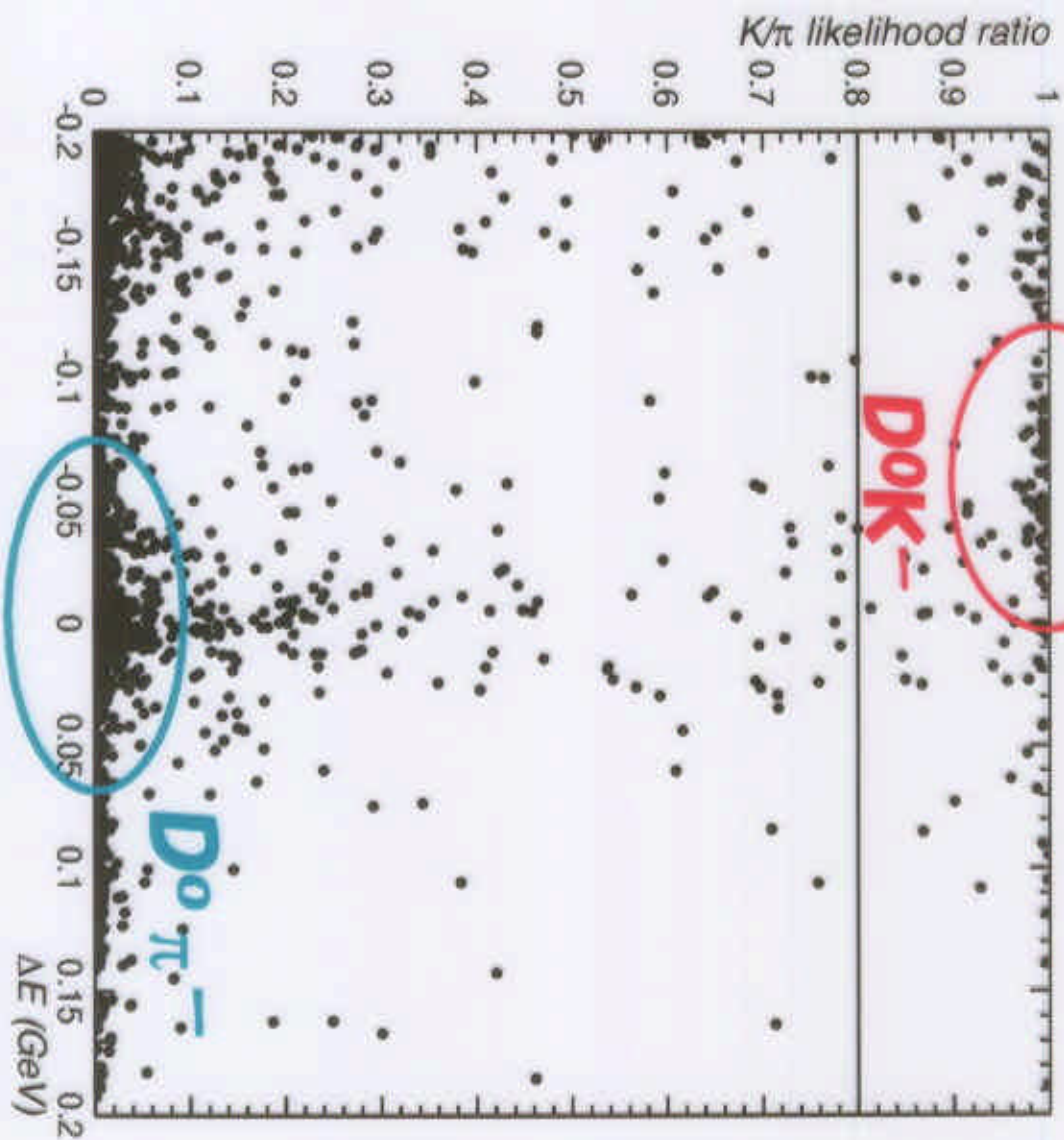
- $D^{(*)} \pi^-$ **assumption in B recon.**

- K/π **separation > 2.5 sigma**

- **Good Tracking**



$B^- \rightarrow D_0 K^-$



- PID Efficiency**
K: $72.5 \pm 1.2\%$
 π : $3.68 \pm 0.54\%$
(2.5 sigma Separation Only from PID)

Clear

Separation ! !



Observation of $B^- \rightarrow D^0 K^-$

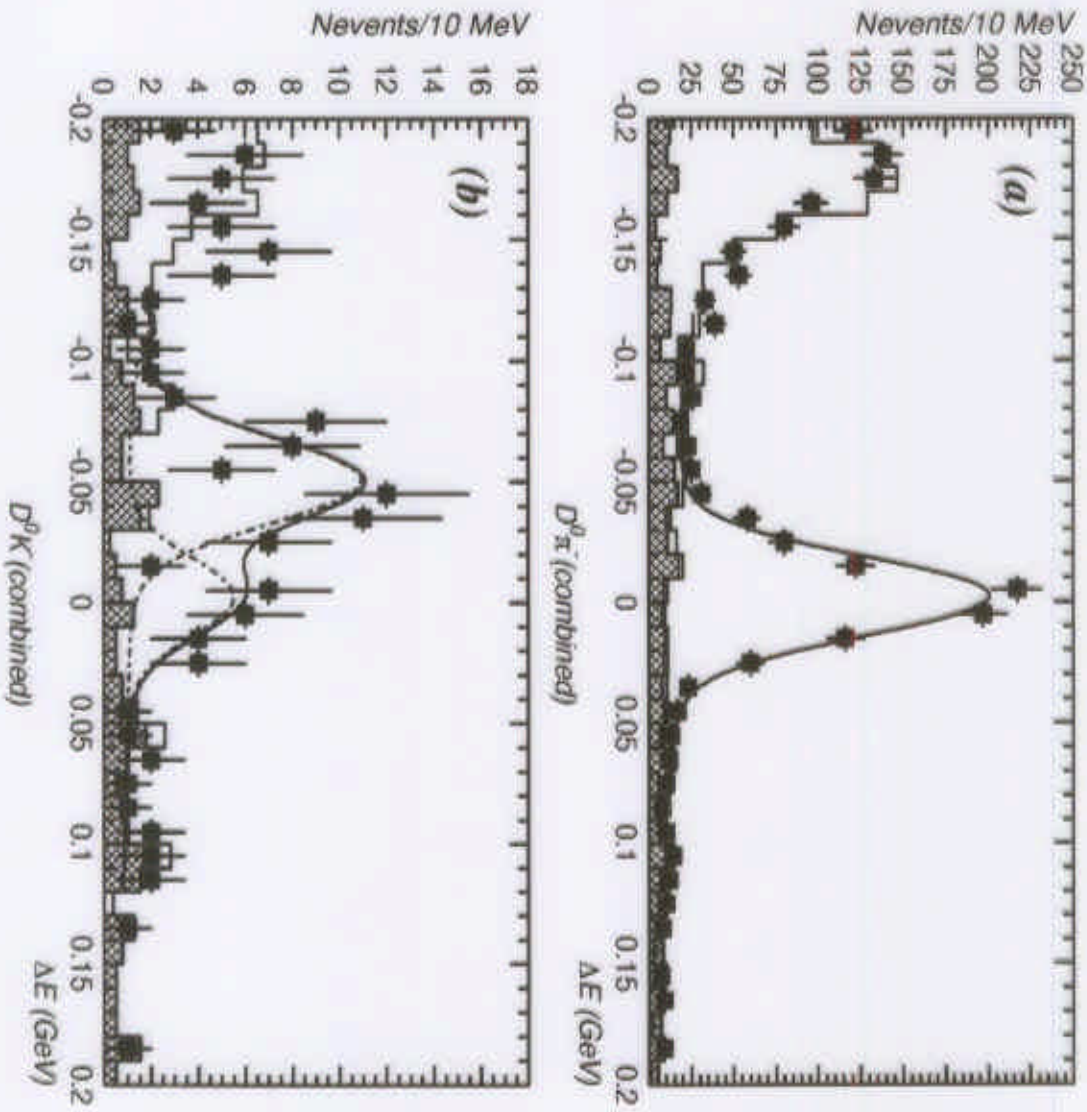
- $N(D^0 K^-) = 48.7 \pm 8.4$
- $N(D^0 \pi^-) = 832 \pm 34$

$$R = \frac{Br(B^- \rightarrow D^0 K^-)}{Br(B^- \rightarrow D^0 \pi^-)} = 0.081 \pm 0.014 \pm 0.011$$

c. f.

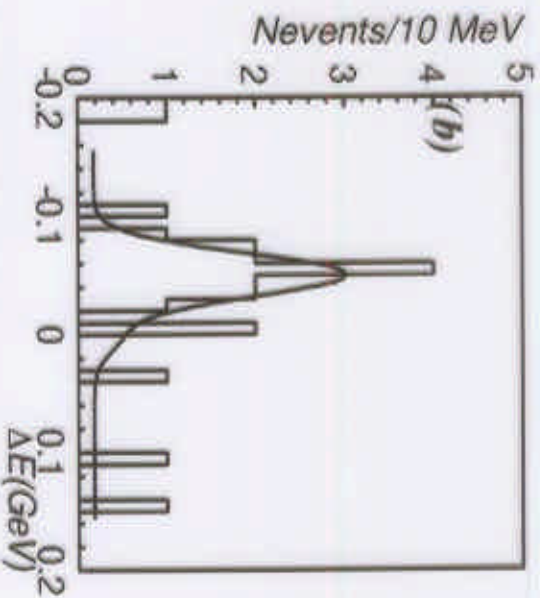
$$R = 0.055 \pm 0.014 \pm 0.011$$

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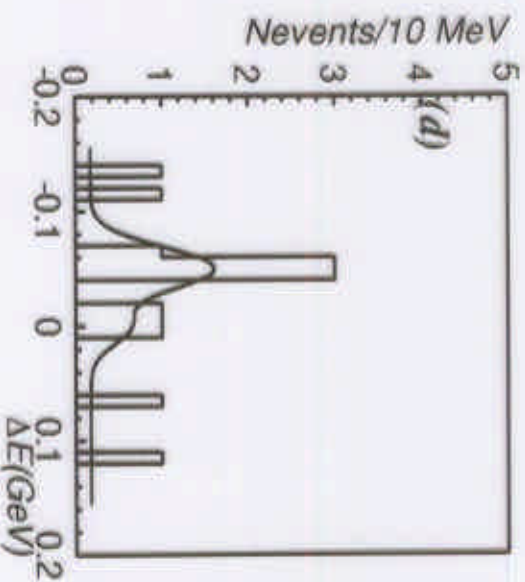
Evidence of $B \rightarrow D^*K^-$



$$N(D^*0K^-) =$$

$$13.3 + 4.3 / -3.6$$

$$\text{Significance} = 4.5\sigma$$



$$N(D^*+K^-) =$$

$$6.7 + 3.2 / -2.5$$

$$\text{Significance} = 3\sigma$$

First Measurement

$$\begin{aligned}
 \text{Br}(\overline{B^-} \rightarrow D^*0K^-) / \text{Br}(\overline{B^-} \rightarrow D^*0\pi^-) &= 0.134 \pm 0.045 / -0.038 \pm 0.015 \\
 \text{Br}(\overline{B^0} \rightarrow D^*+K^-) / \text{Br}(\overline{B^0} \rightarrow D^*+\pi^-) &= 0.062 \pm 0.030 / -0.024 \pm 0.013
 \end{aligned}$$



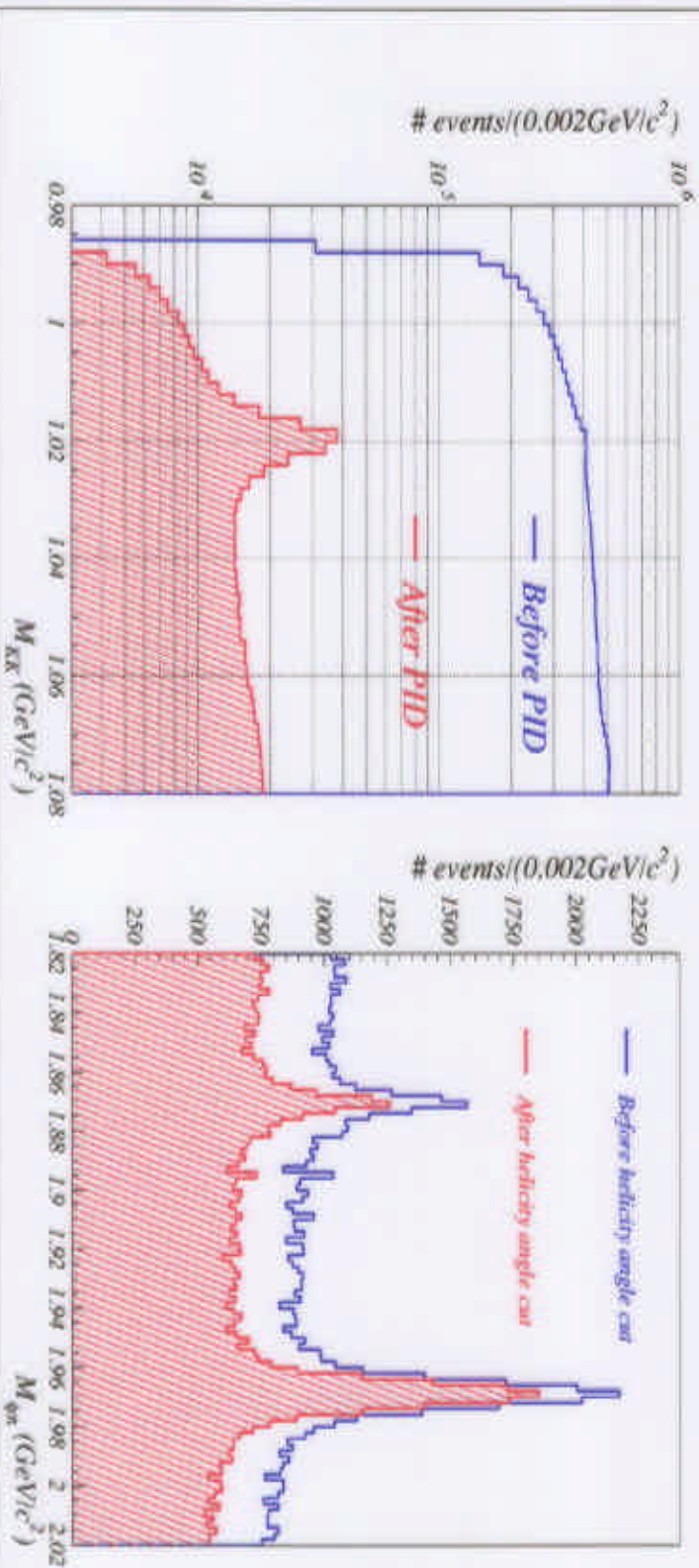
$B \rightarrow D_s \pi$ Search

- Dominated by tree diagram
 $b \rightarrow uW$, $W \rightarrow cs$ transition
 → possibility to study V_{ub}
- Naive expect. by $|V_{cb}/V_{ub}|$
 $Br(B \rightarrow D_s \pi) = (5.1 \pm 2.3) \times 10^{-5}$
- CLEO's published result
 $Br(B \rightarrow D_s \pi) < 2.7 \times 10^{-4}$ (90%CL)
- $D_s \rightarrow \phi \pi$, $\phi \rightarrow KK$ mode is used.



$B \rightarrow D_s \pi$ Search(2)

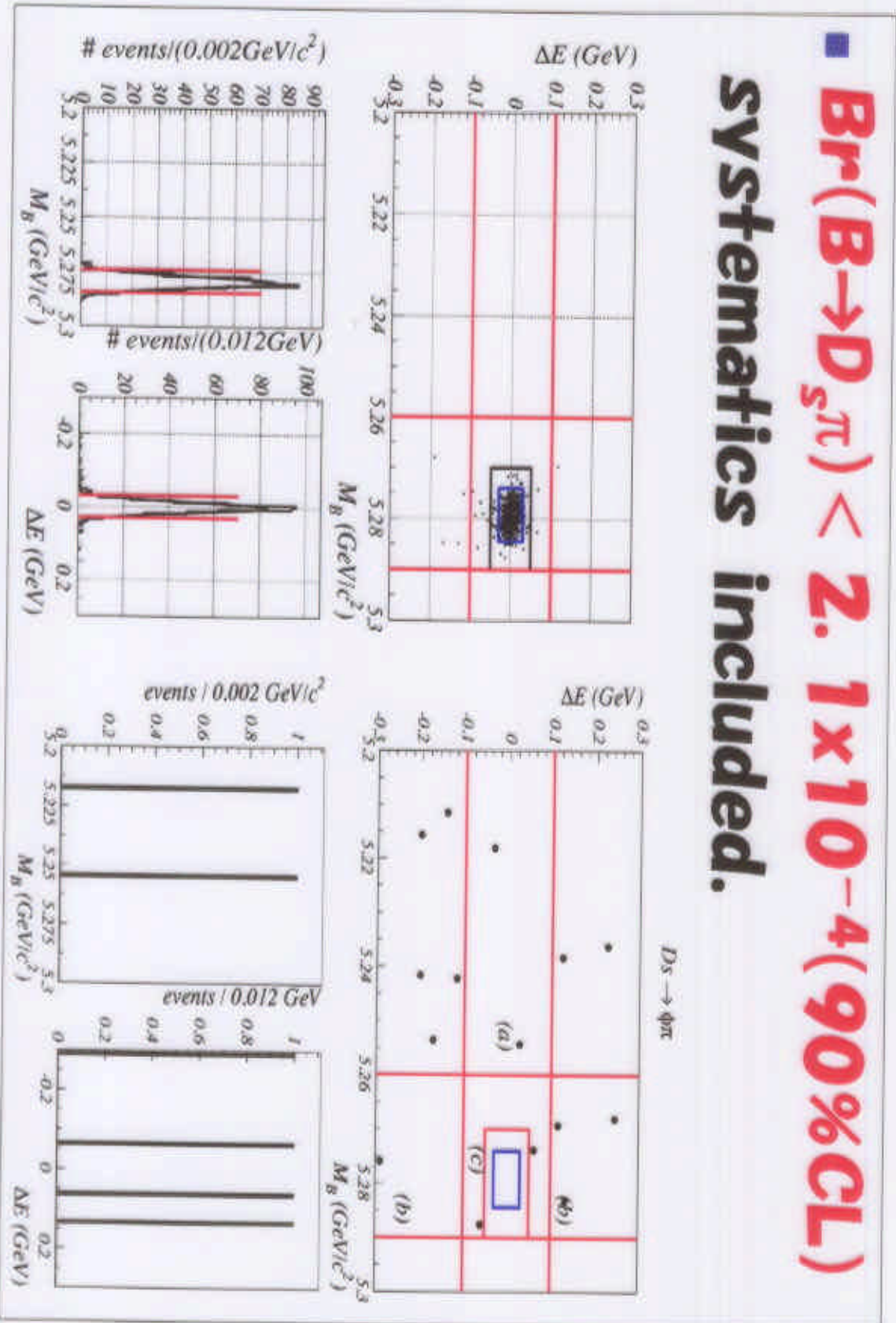
- Reconstruction of particles.
- PID performance and momentum resolution (5MeV).





B → D_sπ Search (3)

- $Br(B \rightarrow D_s \pi) < 2.1 \times 10^{-4}$ (90%CL)
 systematics included.

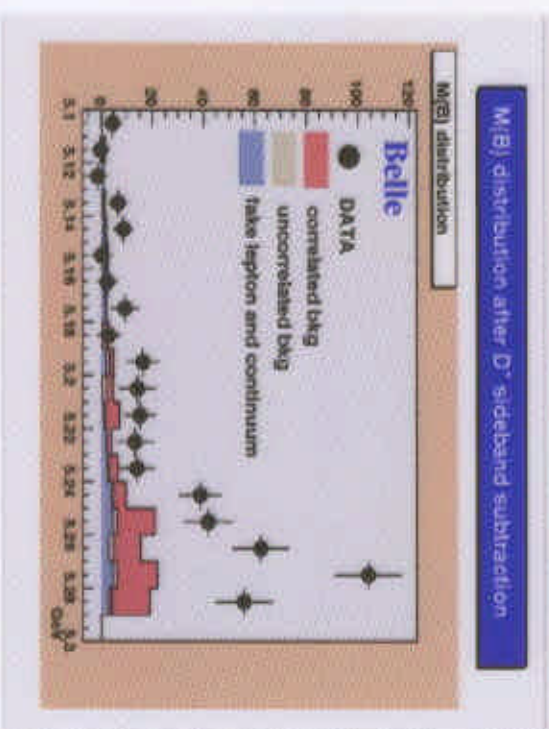
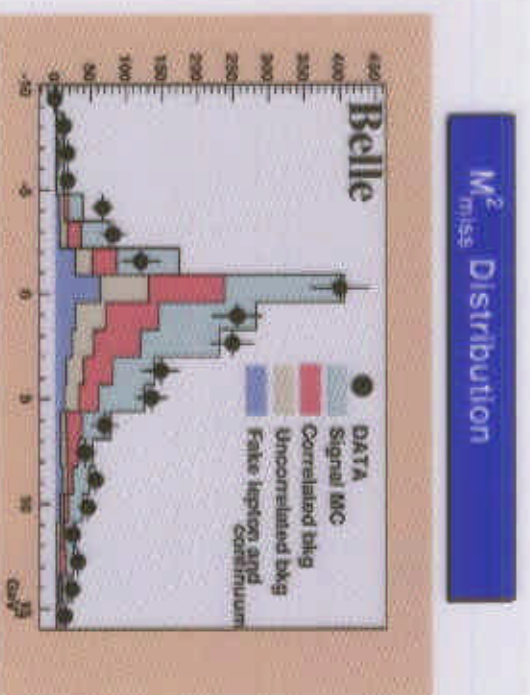




$B \rightarrow D l \nu$

- Full reconstruction by neutrino reconstruction
- $p_{lab} > 0.8 \text{ GeV}$
- $1.0 < p_D < 2.5 \text{ GeV}$

$$Br(B \rightarrow D l \nu) = 2.07 \pm 0.21 \pm 0.31 \%$$

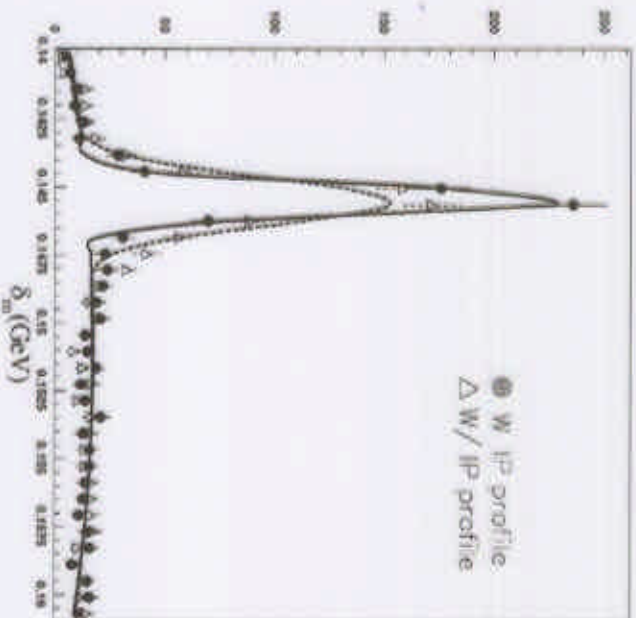




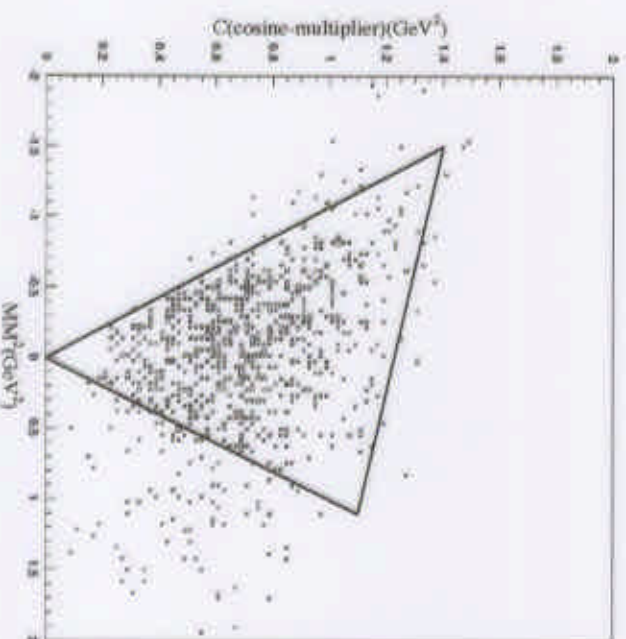
$B \rightarrow D^* l \nu$

Signal:

$D^* + \text{high } p \text{ lepton}$
 $1.0 < p_e^* < 2.45 \text{ GeV}$
 $1.4 < p_\mu^* < 2.45 \text{ GeV}$



$$\text{Br}(B \rightarrow D^* l \nu) = (4.74 \pm 0.25 \pm 0.51)\%$$





Preliminary Result

- $Br(B \rightarrow D^0 K^-) / Br(B \rightarrow D^0 \pi^-)$
 $= 0.081 \pm 0.014 \pm 0.011$
- **First Evidence of $B \rightarrow D^* K^-$**
 $Br(B \rightarrow D^* 0 K^-) / Br(B \rightarrow D^* 0 \pi^-)$
 $= 0.134 + 0.045 / -0.038 \pm 0.015$
 $Br(\overline{B^0} \rightarrow D^{*+} K^-) / Br(\overline{B^0} \rightarrow D^{*+} \pi^-)$
 $= 0.062 + 0.030 / -0.024 \pm 0.013$
- $Br(B \rightarrow D_s \pi) < 2.1 \times 10^{-4}$ (**90%CL**)
- $Br(B \rightarrow D^* l \nu) = (4.74 \pm 0.25 \pm 0.51)\%$
- $Br(B \rightarrow D l \nu) = (2.07 \pm 0.21 \pm 0.31)\%$