

Global Fit for BF and FF in $B \rightarrow D \ell \nu$ decay

Current status

B $\rightarrow$ D l ν decays

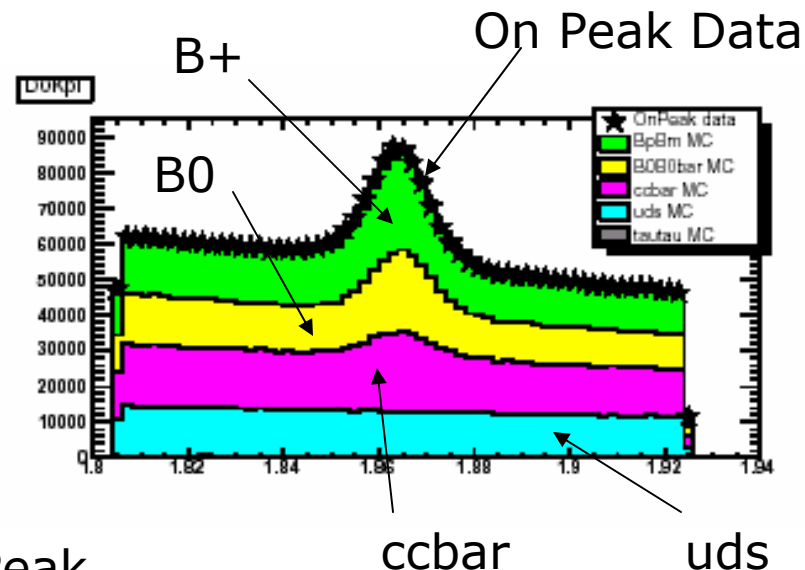
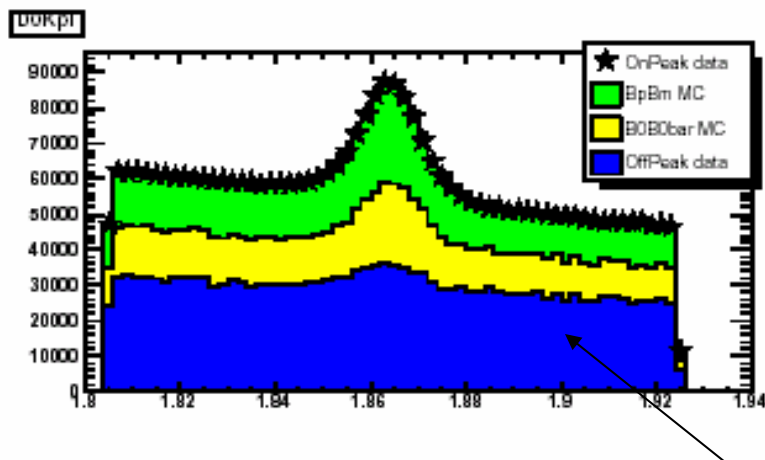
- Possible decay modes
- $B^0 \rightarrow D^- l^+ \nu$
 - $\rightarrow D^{*-} l^+ \nu$
 - $\rightarrow D^{** -} l^+ \nu$
 - $\rightarrow D/D^* \pi^0 l^+ \nu$
 - $\rightarrow D/D^{*0} \bar{\pi}^- l^+ \nu$
- $B_p \rightarrow D^0 \bar{l}^+ \nu$
 - $\rightarrow D^{*0} \bar{l}^+ \nu$
 - $\rightarrow D^{**0} \bar{l}^+ \nu$
 - $\rightarrow D/D^{*0} \bar{\pi}^- l^+ \nu$
 - $\rightarrow D/D^* \pi^0 l^+ \nu$
- $D^*/D^{** -} \rightarrow D^- \pi^0/\gamma$
 - $\rightarrow D^0 \bar{\pi}^-$
- $D^*/D^{**0} \bar{l} \rightarrow D^0 \bar{l} \pi^0/\gamma$

Reconstruction of Dlnu

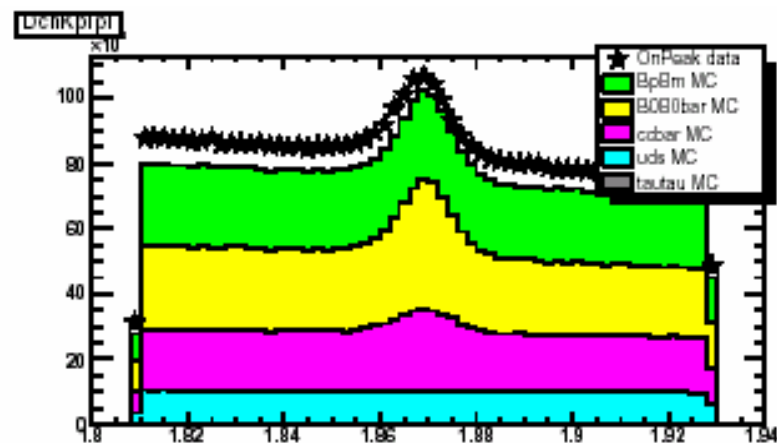
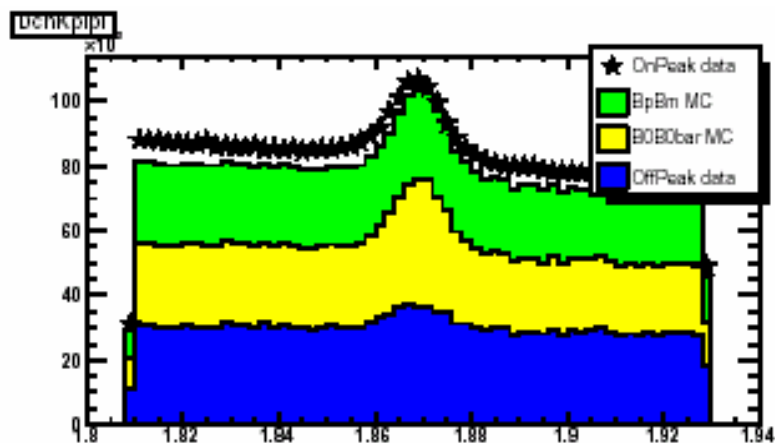
- Reconstruction of D0
- 4 modes : $K^+ \pi^-$ <- I used only this mode
 - $K^+ \pi^+ \pi^- \pi^-$
 - $K^+ \pi^- \pi^0$
 - $K_S^0 \pi^+ \pi^-$
- Reconstruction of D+
- 2 modes : $K^+ \pi^+ \pi^-$ <- I used only this mode
 - $K_S^0 \pi^+$
- Reconstruction of Dl
- Miss-reconstruction = background
 - D, l not from same B
 - Combination of D and "l from another D"
 -etc

D Mass Plot (after Bhabha veto)

D0 mass (KPi mode)



D+ mass (KPiPi mode)



Motivation (1)

- B $\rightarrow$ Dlnu Branching Fraction (BF)/Branching Ratio (BR)
 - B0 $\rightarrow$ D*- l nu problem : a lot of variation
 - 0.0459 $\pm$ 0.0063 (BELLE 2002)
 - 0.0490 $\pm$ 0.0042 (Babar 2005)
 - 0.0590 $\pm$ 0.0072 (DELPHI 2004)
 - 0.0609 $\pm$ 0.0059 (CLEO2 2003)
 - Inclusive and exclusive discrepancy
 - Inclusive B0 $\rightarrow$ X l nu : 0.105 $\pm$ 0.008 (PDG)
 - Exclusive B0 $\rightarrow$ D- l nu : 0.0213 $\pm$ 0.0018
 - $\rightarrow$ D*- l nu : 0.0520 $\pm$ 0.0024
 - $\rightarrow$ Others are small < 0.01
 - Does not add up to inclusive BR
- Form Factor (FF) parameters
 - B $\rightarrow$ Dlnu FF is not well measured.

Motivation (2)

- Determine BF's of all $B \rightarrow D \ell \nu$ decay modes at once by fitting
- Using 3-D fit by
 - D momentum
 - Lepton momentum
 - $\cos\theta_Y$
- Do not have to reconstruct D^*/D^{**} explicitly.
 - Do not have to worry about slow π or π^0
 - $D^* \rightarrow D$
- Can be sensitive to FF parameters.
- D^+ have never been used in this kind of analysis.

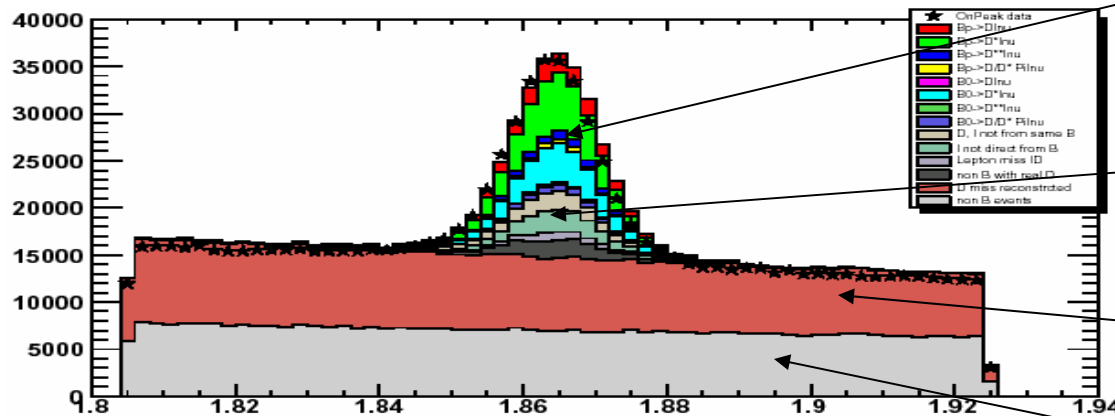
Event Selection (1)

- BToDInu skim
 - Select events including $B \rightarrow D/D^* \text{Inu}$ candidates.
- Bhabha veto
 - Reject radiative Bhabha events.
- Tighter kaon selection
 - In reconstruction of D^0 , there was no kaon selection.
 - I applied a kaon selector (KMicroNotPionGTL) to reduce background
- Vertexing (by TreeFitter)
 - D vertexing
 - B vertexing

Event Selection (2)

- Thrust cut
 - Thrust axis = axis of sum of 3-momentum of tracks.
 - $\cos\theta_{\text{DInonDI}}$ = cosine of the angle between the thrust axis of DI tracks and non DI tracks.
 - B decay : isotropic.
 - > If DI tracks come from one B and non DI tracks come from the other B, $\cos\theta_{\text{DInonDI}}$ is flat.
 - $c\bar{c}$, $u\bar{d}s$: forward backward dominant
 - > $\cos\theta_{\text{DInonDI}}$ has peaks at 1 and -1.
 - Applied $|\cos\theta_{\text{DInonDI}}| < 0.88$

D0 mass (KPi mode)



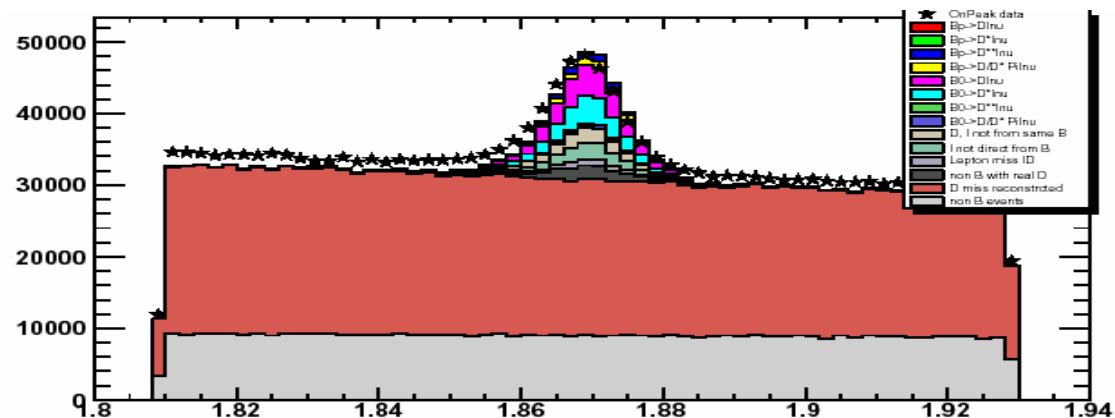
Signals

Peaking backgrounds from B and D

Continuum background from B

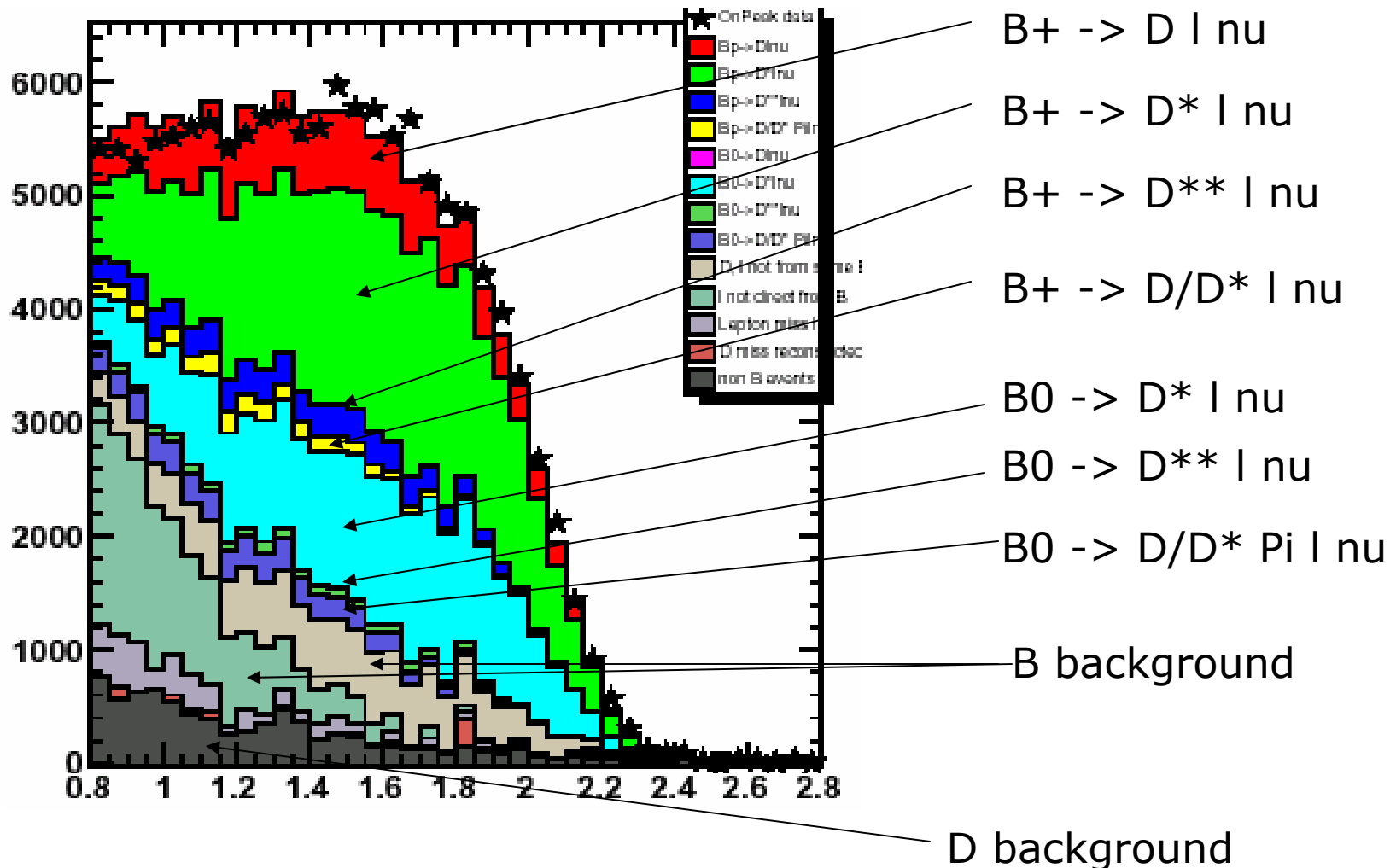
Continuum background from $c\bar{c}$, $u\bar{d}s$ and τ

D+ mass (KPiPi mode)

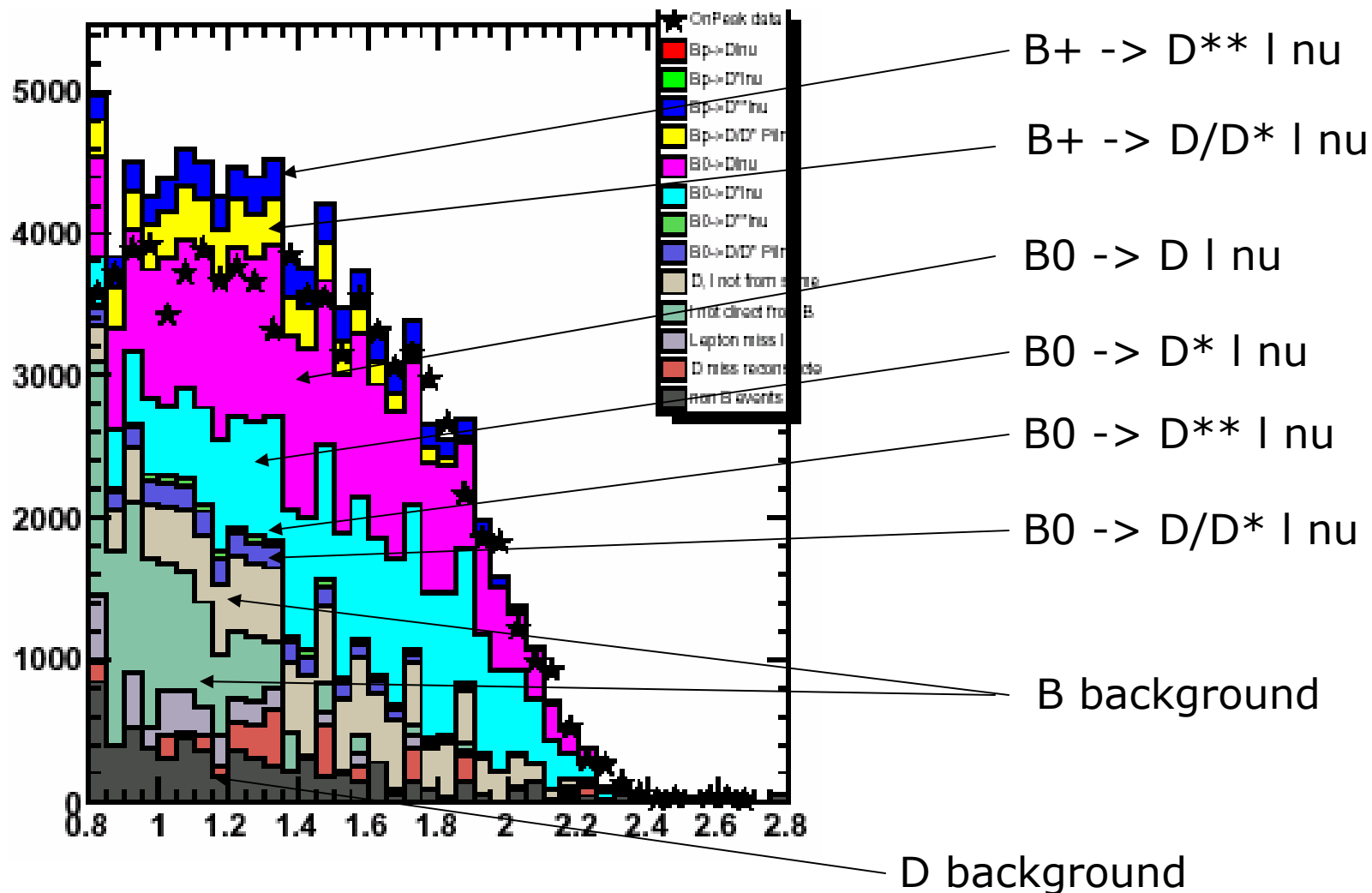


Do **sideband subtraction** to remove continuum background

Lepton momentum ($D^0 \rightarrow K\pi$)

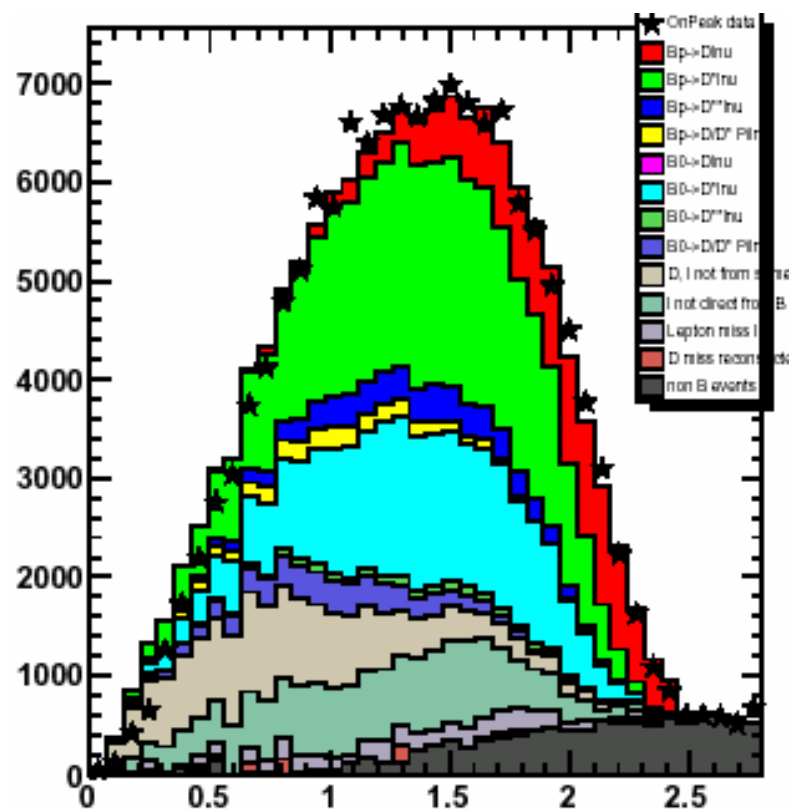


Lepton Momentum ($D^+ \rightarrow K\pi\pi$)

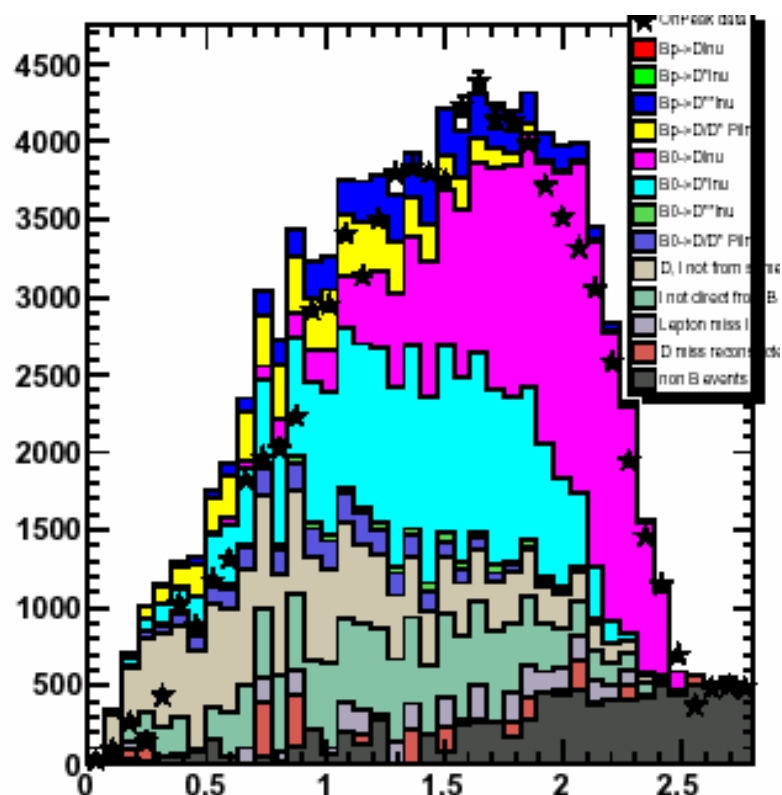


D momentum

D0



D+



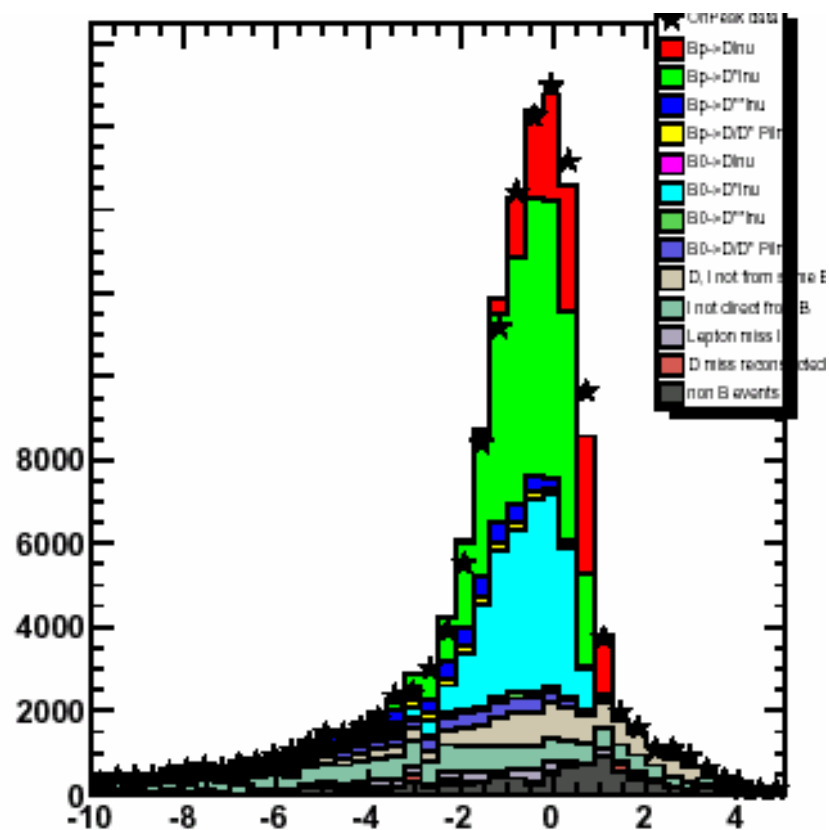
What is cosBY ?

- Y is DI combination in this case
- $\cos BY$ = cosine of the angle between
the direction of B
and
the direction of "D-l"
in the Y(4S) rest frame
- $-1 < \cos BY < 1$ is expected, but....

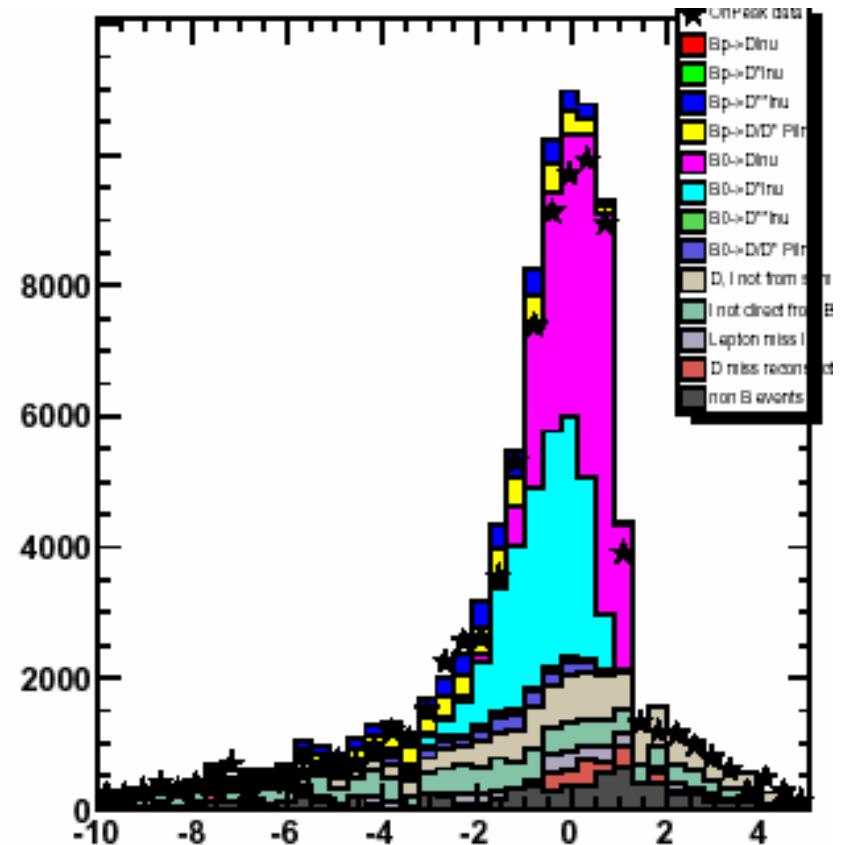
This is not the case because of detector effects, miss-reconstructions, additional pion from higher D mass states or non-resonant $D\pi$ decays, etc.

cosBY plot

D0



D+



Next step

- Perform 3D fit of BToDlnu candidates by lepton momentum, D momentum and cosBY.
- These three variables have a good discrimination power.
- RooFit is a good tool to do this.
- Try to extract BF's of
 - $B \rightarrow D \ell \nu$
 - $B \rightarrow D^* \ell \nu$
 - $B \rightarrow D^{**} \ell \nu$
- And the slope of B- $\rightarrow$ Dlnu FF (Form Factor).