

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

Status Update

Method

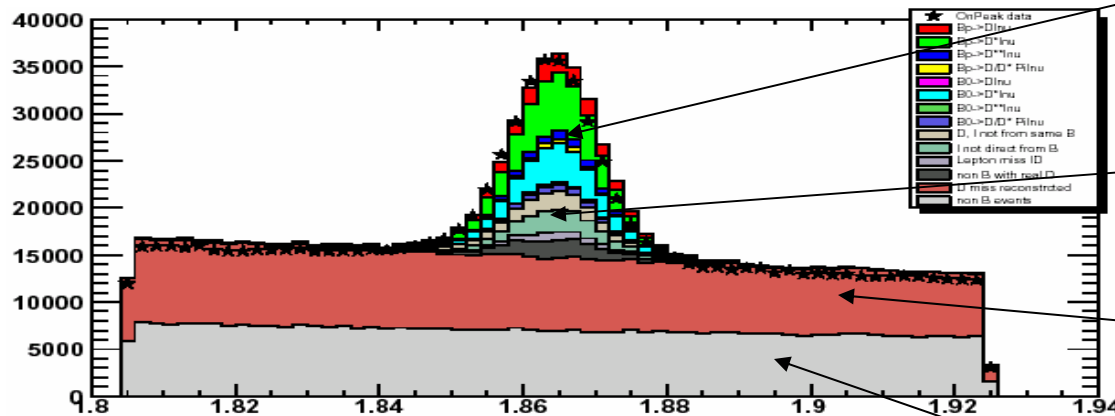
- Reconstruct only D^0 l and $D^+ l$.
- Fit to $B \rightarrow D l \nu$ events.
- Bin events in 3-D : D momentum, Lepton momentum and $\cos\theta_{B-Dl}$.
- Determine branching fractions of
 - $B \rightarrow D l \nu$
 - $B \rightarrow D^* l \nu$
 - $B \rightarrow D^{**} l \nu$?
 - $B \rightarrow D \pi l \nu$?
- Fit is sensitive to FF parameters.
 - $B \rightarrow D$ FF slope
 - $B \rightarrow D^*$ FF parameters ?

Event Selection

- BToDlnu skim
- Bhabha veto
- kaon selection : KMicroNotPion
- Use only D0->KPi and D+->KPiPi modes.
- D and D-l vertexing by TrxFitter :
 probab > 0.01 for both vertex
- Thrust cut : $|\cos(Dl\text{-non}Dl)| < 0.88$

D mass plot after all selection

D0 mass (KPi mode)

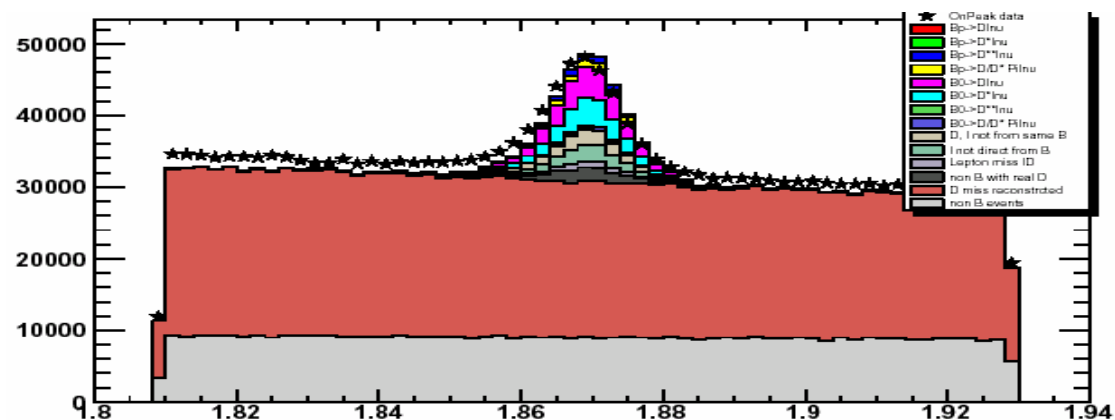


Signals

Peaking backgrounds
from B and D

Combinatorial
background
from B

D+ mass (KPiPi mode)



Continuum background
from ccbar, uds and tau

Do **sideband subtraction**
to remove non-peaking
background

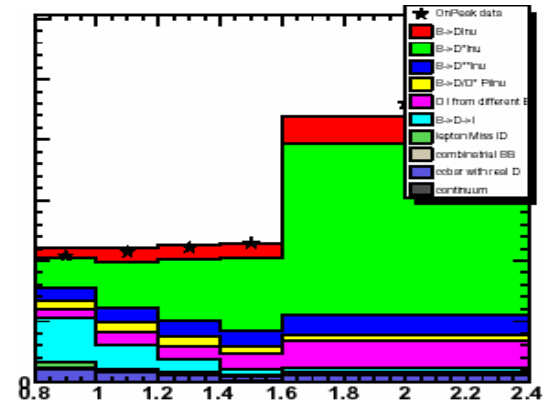
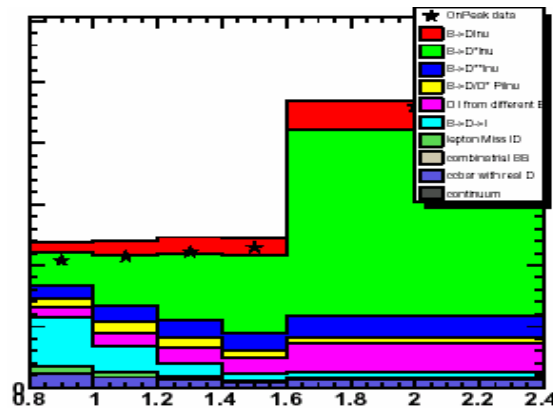
Tracking and PID correction

Lepton momentum

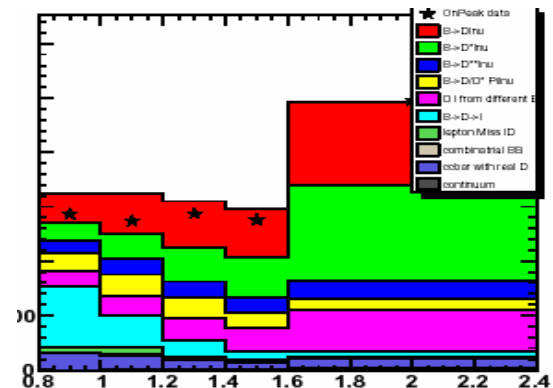
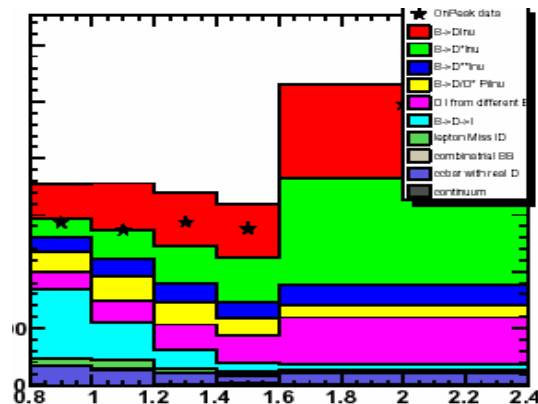
Before correction

After Correction

D0



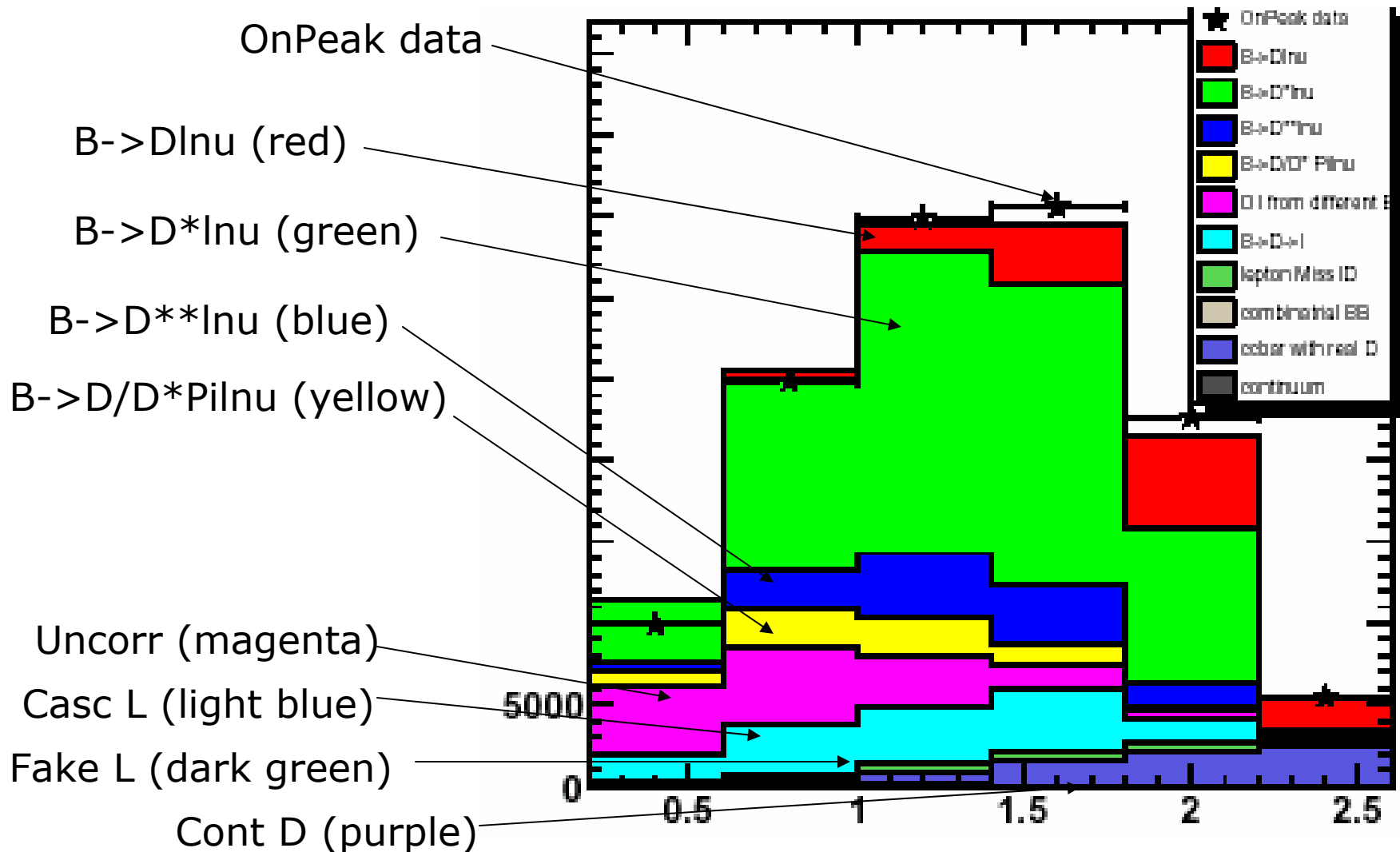
D+



New Binning

- Lepton momentum bin (4bins):
 - 0.8, 1.2, 1.6, 2.0, 2.4 GeV
- D momentum bin (6 bins):
 - 0.2, 0.6, 1.0, 1.4, 1.8, 2.2, 2.6 GeV
- cosBY bin (5 bins):
 - -10, -2.5, -1.1, 0.0, 1.1, 5
- Total $120 * 2$ (D+ and D0) = 240 bins
 - Use #evt > 25 bins -> ~190 bins are used
- Run 3 data (30.6 fb⁻¹)
and MC (~100 fb⁻¹ of BBbar and ~50 fb⁻¹ of others)
was used.

D momentum plot (D0)



Binned chi-square fitting

$$\chi^2 = \sum_{i=\text{bin}}^{D^0} \frac{(N_i^{\text{data}} - \sum_j C_j^{MCBkgd} N_{ij}^{MCBkgd} - \sum_j C_j^{D^0} N_{ij}^{MC})^2}{(\sigma_i^{\text{data}})^2 + \sum_j (C_j^{MCBkgd} \sigma_{ij}^{MCBkgd})^2 + \sum_j (C_j^{D^0} \sigma_{ij}^{MC})^2} \\ + \sum_{i=\text{bin}}^{D^+} \frac{(N_i^{\text{data}} - \sum_j C_j^{MCBkgd} N_{ij}^{MCBkgd} - \sum_j C_j^{D^+} N_{ij}^{MC})^2}{(\sigma_i^{\text{data}})^2 + \sum_j (C_j^{MCBkgd} \sigma_{ij}^{MCBkgd})^2 + \sum_j (C_j^{D^+} \sigma_{ij}^{MC})^2}$$

- Predicted number of events ($N^{\{MC\}}$)
 - Tracking efficiency and PID corrected.
 - Luminosity normalised.
 - Form factor (FF) re-weighted.
- Coefficients (C) include
 - Branching fractions (BF)
 - Ratios like
 $f_{+0} = f_{+-}/f_{00}$, $f_{0+} = t_{00}/t_{+-}$ (life time)
 efficiency to reconstruct $D^+/D^0 = c_{D+0}$
- Isospin symmetry is assumed for $B \rightarrow D \ell \nu_X$ decays (not for $D^{*-} \rightarrow D$).
- Use TMINUIT.

First results of fitting – FF fixed

- Constraints on $D^{**} \text{Inu}$ BF and $D\text{PiInu}$ BF
 - $\text{BF}(D0^{*} \text{Inu}) = \text{BF}(D1 \text{Inu}) * 20/56$
 - $\text{BF}(D1' \text{Inu}) = \text{BF}(D2^{*} \text{Inu}) = \text{BF}(D1 \text{Inu}) * 37/56$
 - These ratios 20/56 and 37/56 are based on SP5/SP6 value.
 - $\text{BF}(D^{*} \text{Pi Inu}) = \text{BF}(D \text{Pi Inu}) * 67/54$
 - This ratio 67/54 is based on BELLE measurement.
- Float background components
- Gaussian constraints on f_{+0} and c_{D+0}

First results of fitting – FF fixed

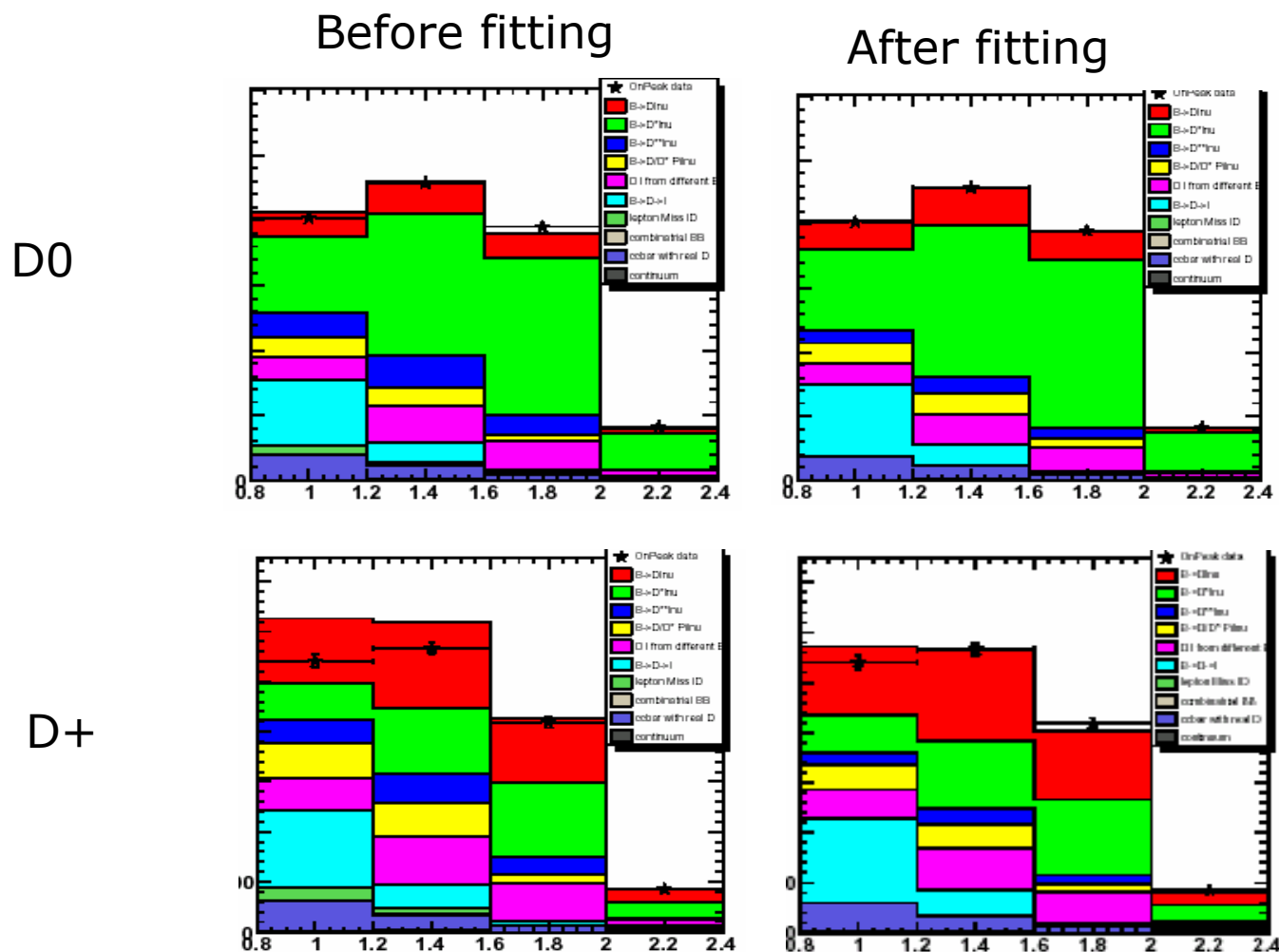
192 bins	SP5/SP6	Fitted value	New BF
Chi-square	936.735	406.595	
B->Dl _{nu}	0.0210	0.02449 +- 1.6%	0.0236
B->D*l _{nu}	0.0560	0.06271 +- 1.1%	0.0604
B->D0*l _{nu}	0.0020	(0.00112)	0.0011
B->D1'l _{nu}	0.0037	(0.00208)	0.0020
B->D1l _{nu}	0.0056	0.00315 +- 13%	0.0030
B->D2*l _{nu}	0.0037	(0.00208)	0.0020
B->DPil _{nu}	0.0060	0.00367 +- 14%	0.0035
B->D*Pil _{nu}	0.0020	(0.00455)	0.0044
Sum	0.1000	0.10385	0.100
Uncorr	1	0.877 +- 5.0%	
Casc L	1	1.119 +- 4.6%	
Cont D	1	0.968 +- 5.0%	
f_+0	1	1.0061 +- 0.8%	
c_D+0	1	0.9931 +- 0.7%	

Correlation

	D	D*	D1	D Pi	Uncr	Casc	Cont	f+0	D+0
D	1								
D*	-0.28	1							
D1	-0.08	-0.41	1						
D Pi	0.08	0.08	-0.77	1					
Uncr	-0.06	0.27	0.31	-0.36	1				
Casc	0.04	0.18	0.14	-0.47	-0.17	1			
Cont	-0.32	0.11	-0.22	0.23	0.03	-0.33	1		
f+0	0.13	-0.49	0.17	-0.01	-0.01	-0.18	0.01	1	
D+0	-0.29	0.08	0.02	0.01	-0.08	-0.04	0.02	-0.10	1

Fitted Plots (1)

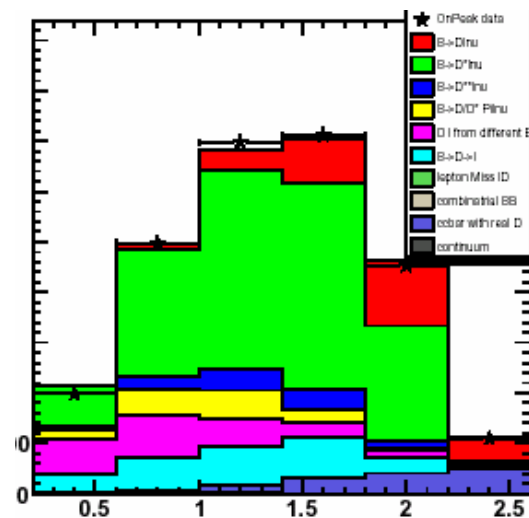
Lepton momentum



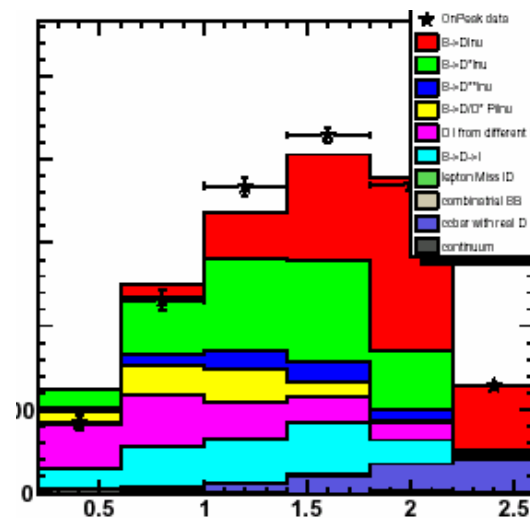
Fitted Plots (2)

D momentum

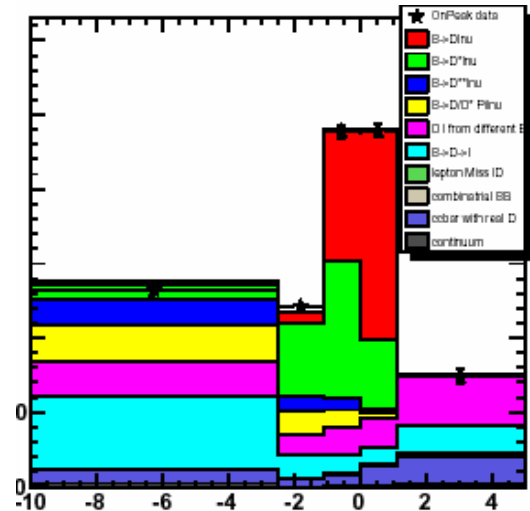
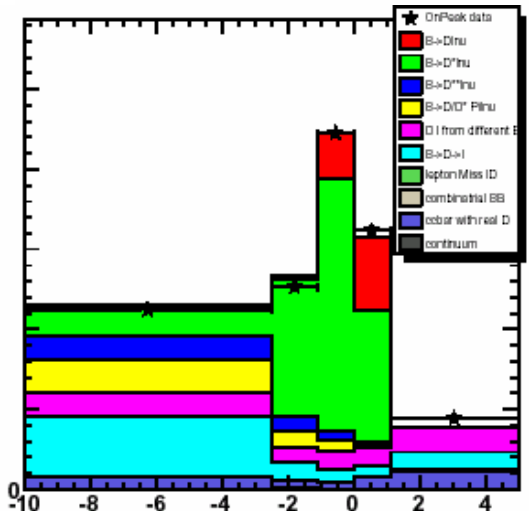
D0



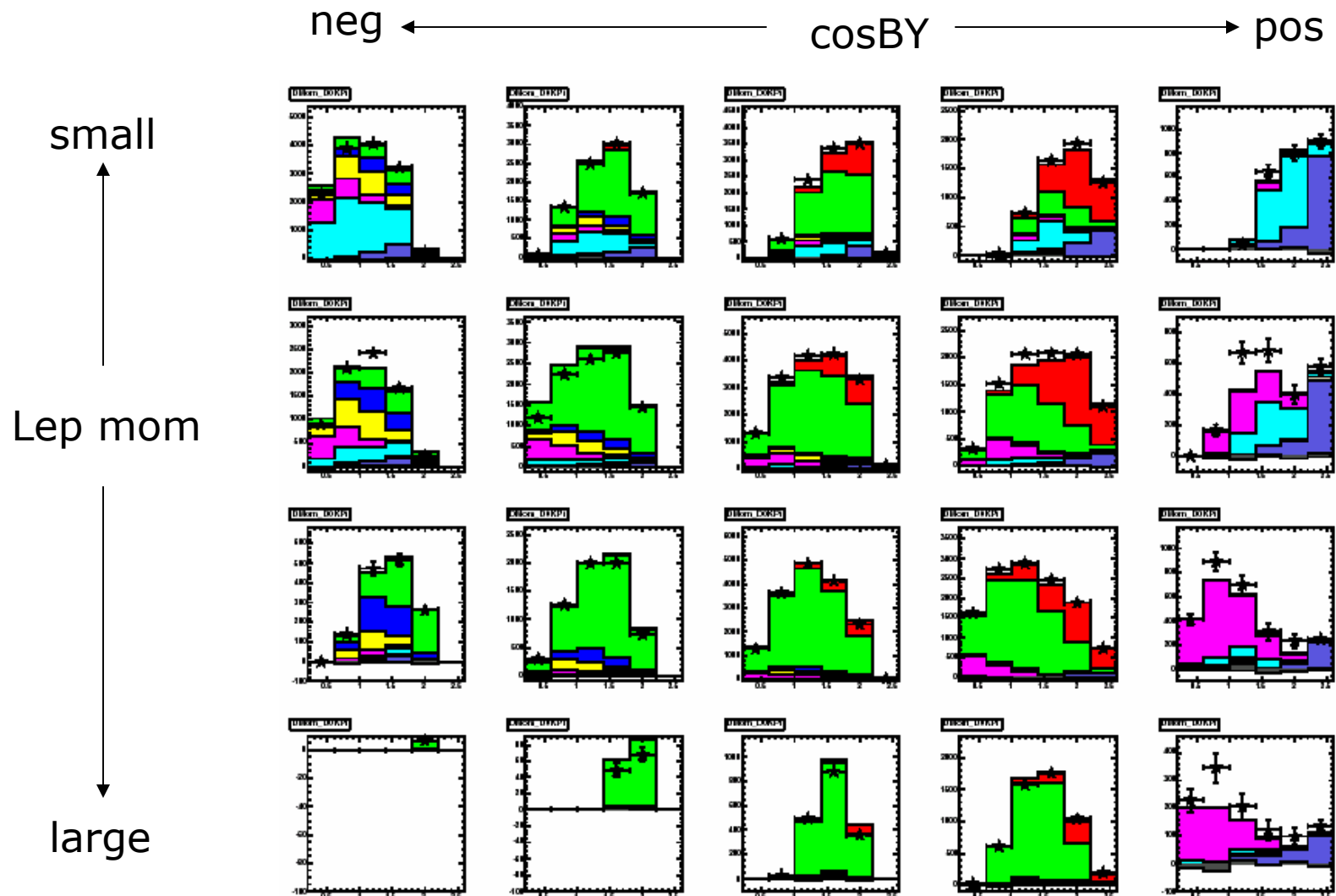
D+



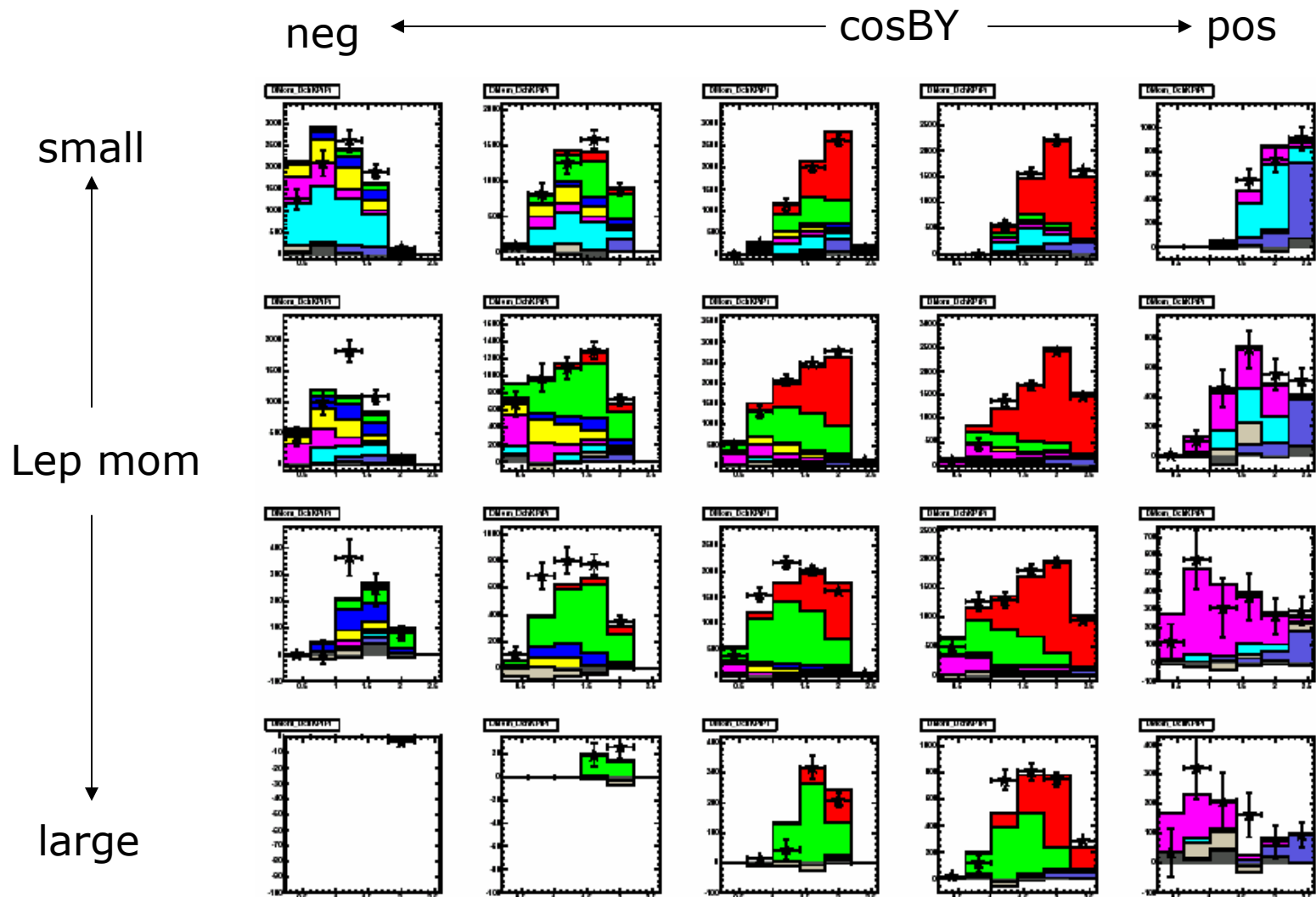
cosBY



Fitted Plots (3) – D0 momentum



Fitted Plots (4) – D+ momentum



Previous next steps

- Apply D* FF parameters to MC. -> Done
- Reconsider
 - Binning -> Done
 - Variables to use : cosBY or cosDI ? -> cosBY
 - We do not want 0 entry bins -> Select #evt > 25
- Perform fit to data.
 - Binned chi-square fit -> Done
- Try to extract BF's of -> On going
 - B -> D l nu
 - B -> D* l nu
 - B -> D** l nu
- And the slope of D FF -> On going

Next steps

- Tune/measure $B \rightarrow D^* \text{ FF}$?
- Reweight $B \rightarrow D^{**} \text{ FF}$
 - ISGW2 $\rightarrow$ LLSW (Leibovich, Ligeti, Stewart and Wise)
- Reweight $B \rightarrow D\text{P}\pi \text{ FF}$
 - Tune parameters of GoityRoberts
- Tuning of fit
 - Constraints on D^{**} and $D\text{P}\pi$.
 - Which parameters to float.
 - Need to make it fast to fit FF slope.
- Systematic study
- Write BAD