Global Fit for Branching Fractions and Form Factor Slope of $B->D^{(*)}l\nu$ Decays

- Bug fixed result
- Effect of $D\pi\pi l\nu$

New Nominal Fit Result (Run2 only)

- B0->D1lν selection bug fix
- Lepton candidate problem fix -> cosBY changed for electron.

Before bug fix

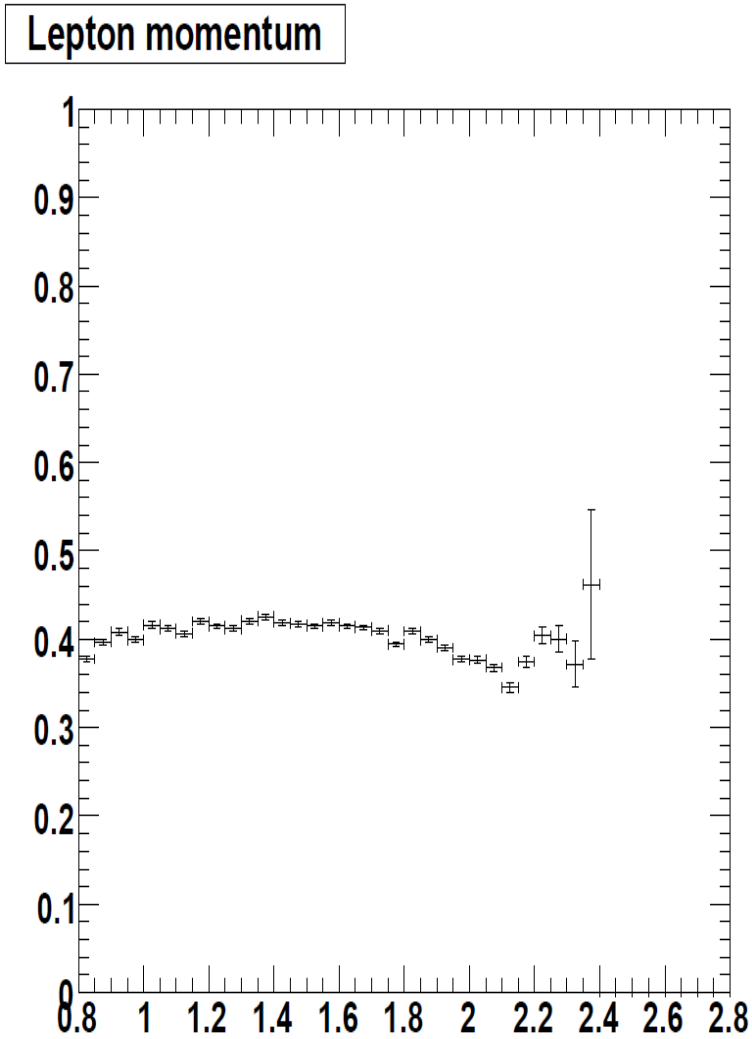
$Dl\nu$ FF slope	1.346 ± 0.067 (1.354)
$D^*l\nu$ FF slope	1.353 ± 0.076 (1.338)
R_1	1.405 ± 0.109 (1.443)
R_2	0.668 ± 0.099 (0.680)
BF(B^+->$Dl\nu$)	0.02525 ± 0.00063 (0.02522)
BF(B^+->$D^*l\nu$)	0.05291 ± 0.00082 (0.05156)
BF(B^+->$D^{**}/D^{(*)}\pi\, l\nu$)	0.01961 ± 0.00090 (0.02197)

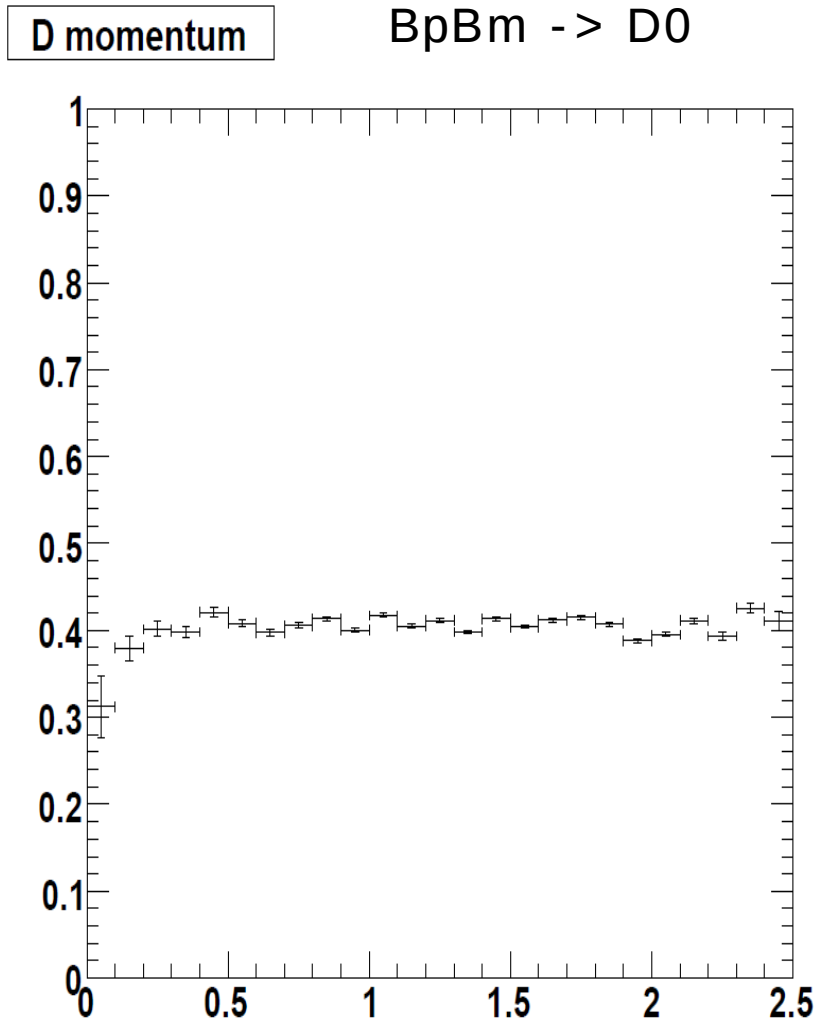
- f_+0 = 1.080 ± 0.030 (before bug fix : 1.100)
- Chi-square/ndof (P-value) = 240/217 (0.13)

Effect of $B->D^{(*)}\pi\pi l\nu$ (method)

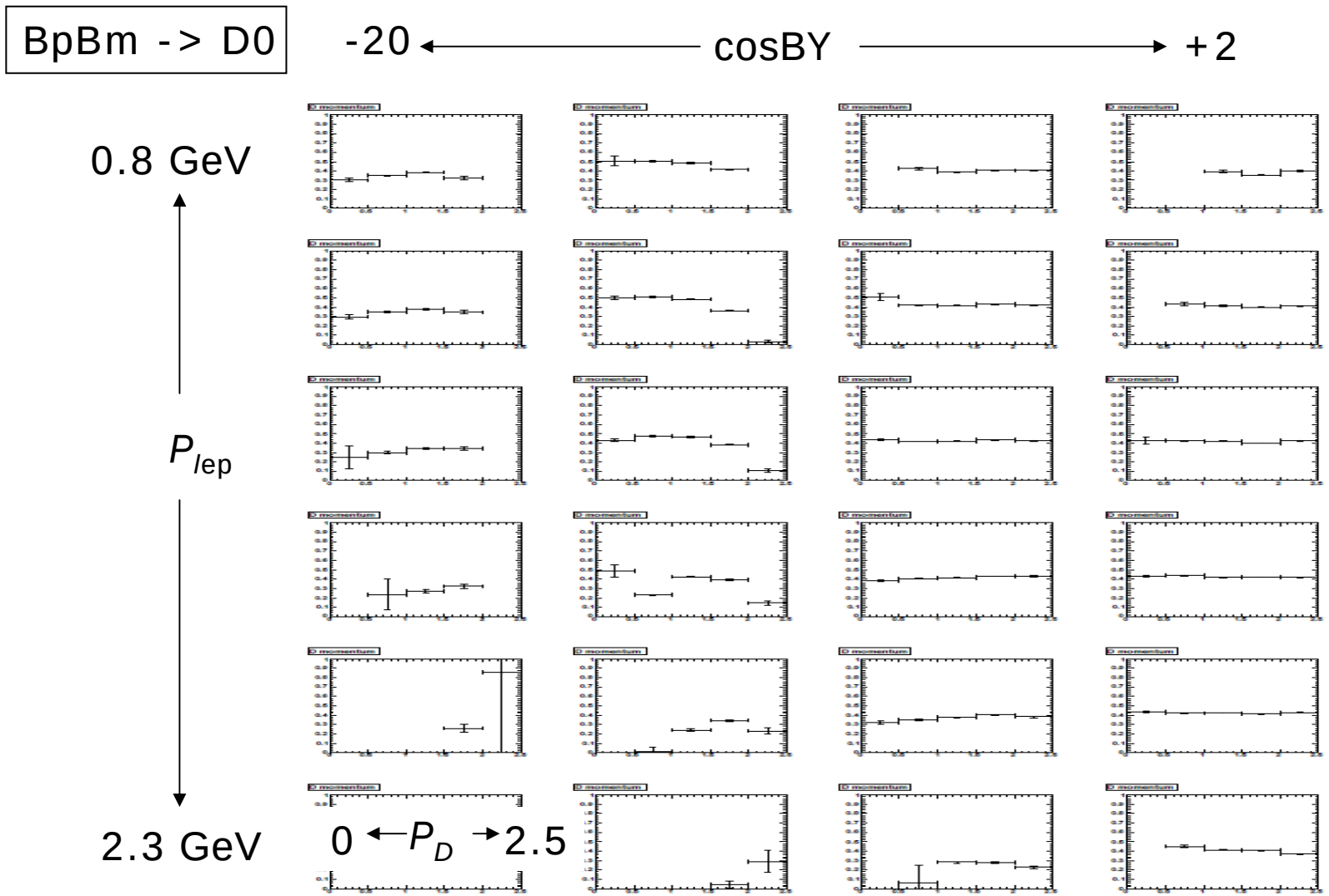
- We generate 4 different types of decays :
  - $B->Xl\nu$, $B->X^*l\nu$, $B->Yl\nu$, $B->Y^*l\nu$
  - X and Y are scalar and X^* and Y^* are vector particles.
  - X and X^*
    - Mass = 2.61 GeV (just above $D^*\pi\pi$ threshold)
    - Decays to $D^{(*)}\pi\pi$
  - Y and Y^*
    - Mass = 2.87 GeV (just above $D^*\rho$ threshold)
    - Decays to $D^{(*)}\rho(\pi\pi)$
- The numbers shown are for sum of the 4 modes in the case where each mode has the same BF.
- We use 3D efficiency matrix to convert generated histograms to reconstructed one.

3D Efficiency matrix - projections





3D Efficiency matrix – all bins



Effect of $B->D\pi\pi l\nu$ (result 1)

Fit results (this systematic error, total systematic error)

$Dl\nu$ FF slope	1.331 ± 0.068 (1.12, 3.12 %)
$D^*l\nu$ FF slope	1.373 ± 0.075 (1.50, 4.20 %)
R_1	1.419 ± 0.107 (0.99, 6.55 %)
R_2	0.632 ± 0.099 (5.37, 9.16 %)
BF($B^+->Dl\nu$)	0.02511 ± 0.00063 (0.55, 4.33 %)
BF($B^+->D^*l\nu$)	0.05434 ± 0.00099 (2.69, 5.52 %)
f_+0	1.061 ± 0.030 (1.76, 4.40 %)

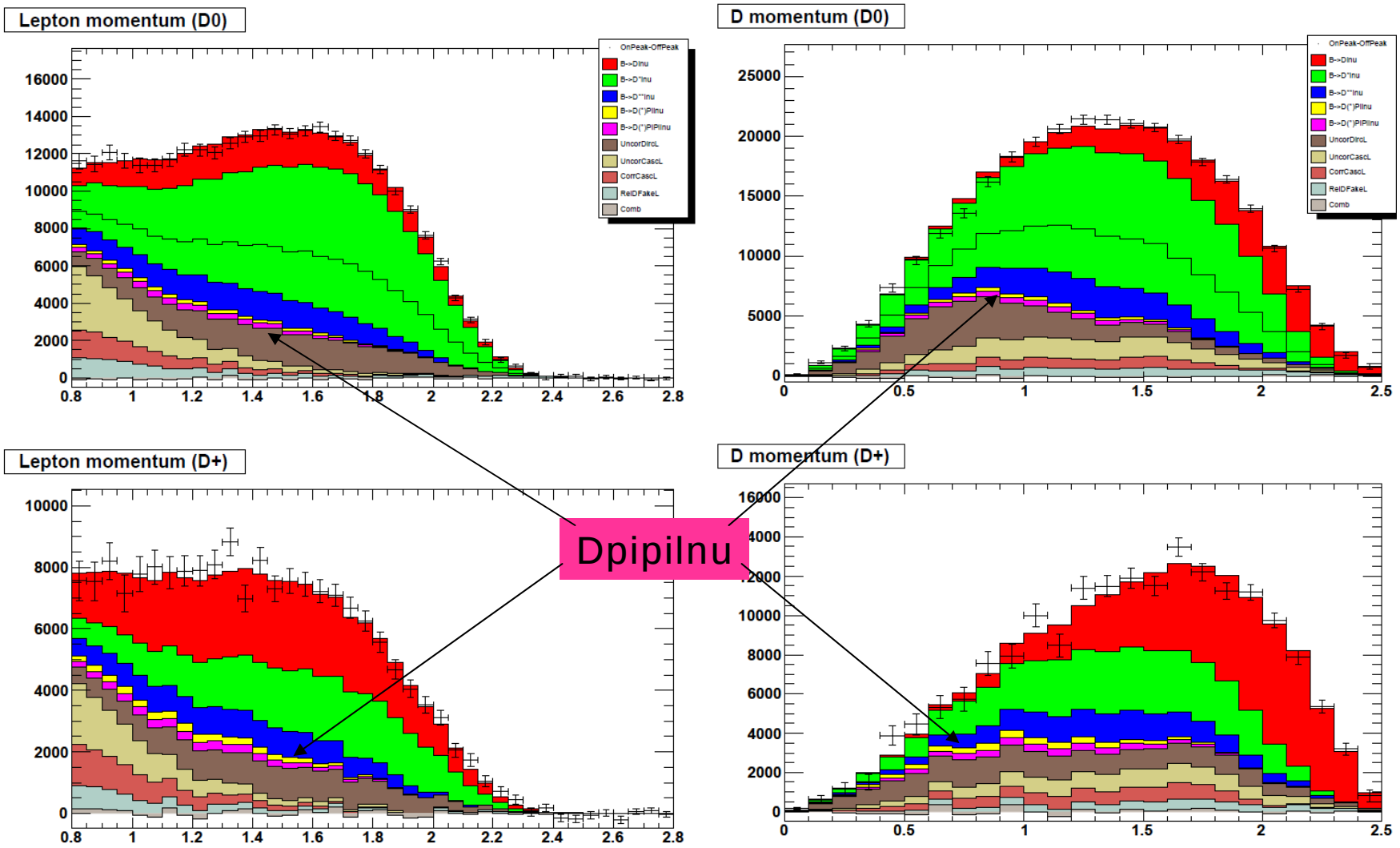
- BF($B^+->D^{**}/D^{(*)}\pi l\nu$) = 0.0169 ± 0.0014
- BF($B^+->D\pi\pi l\nu$) = 0.0048 ± 0.0019
- Chi-square/ndof (P-value) = 234/217 (0.20)
- When only one model (X only, Y^* only etc.) is used, results does not change much.

Effect of $B->D\pi\pi l\nu$ (result 2)

	Nominal fit	
BF($B^+->Dl\nu$)	0.0252	0.0251 ± 0.0006
BF($B^+->D^*l\nu$)	0.0529	0.0543 ± 0.0010
BF($B^+->D^{**}/D^{(*)}\pi l\nu$)	0.0196	0.0169 ± 0.0014
BF($B^+->D\pi\pi l\nu$)	0	0.0049 ± 0.0019
Bkgd (D0)		
UncorrDL	0.968	0.932 ± 0.052
UncorrCL	0.859	0.874 ± 0.063
Cascade	0.762	0.671 ± 0.098
Bkgd (D+)		
UncorrDL	1.092	1.053 ± 0.126
UncorrCL	0.859	0.838 ± 0.135
Cascade	1.377	1.168 ± 0.234

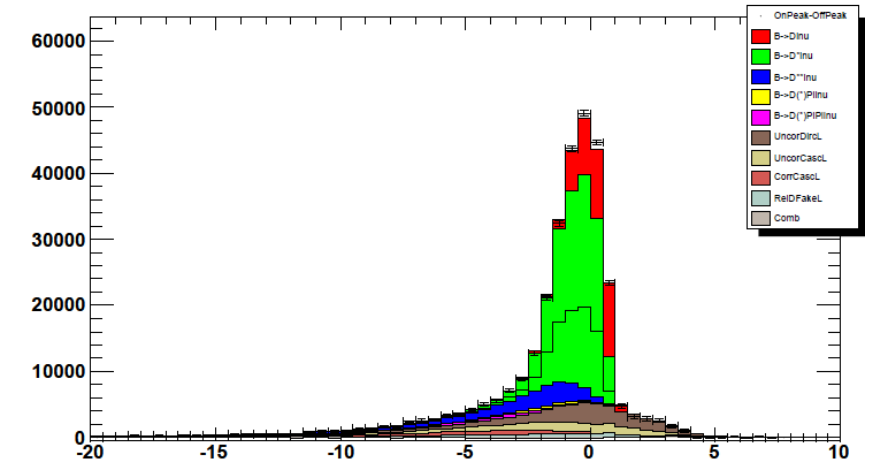
$B->D\pi\pi l\nu$ eats $B->D^{**}/D(*)\pi l\nu$ and cascade backgrounds.

Effect of $B->D\pi\pi l\nu$ (plots 1)

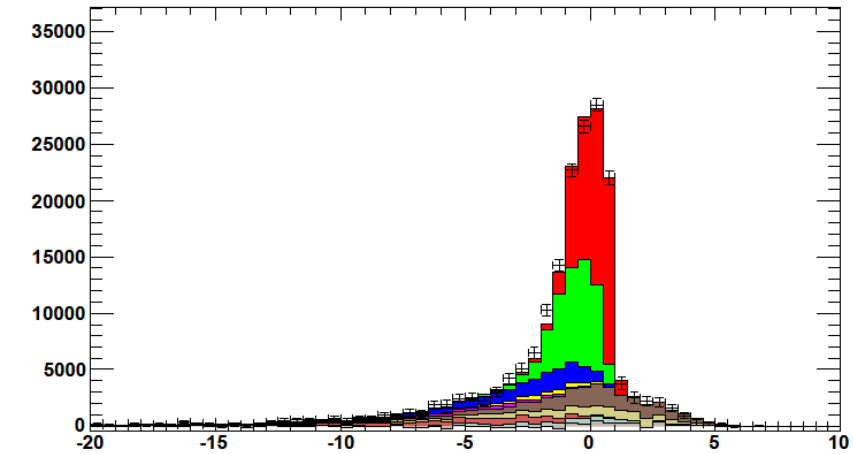


Effect of $B->D\pi\pi l\nu$ (plots 2)

cosBY (D0)



cosBY (D+)



Effect of $B->D\pi\pi l\nu$ - comparison

BF	X only	X^*	Y	Y^*	D1($D\pi\pi$)
D	2.50±0.06	2.52±0.06	2.51±0.06	2.52±0.06	2.52±0.06
D^*	5.45±0.10	5.44±0.10	5.40±0.09	5.37±0.09	5.33±0.10
D^{**} $D\pi$	1.61±0.16	1.60±0.18	1.82±0.11	1.84±0.11	1.84±0.17
$D\pi\pi$	0.61±0.23	0.50±0.21	0.41±0.16	0.21±0.12	0.14±0.16
Chi2/ ndf	234/217	235/217	235/217	238/217	240/216
P-value	0.21	0.19	0.19	0.16	0.13

Effect of $B->D\pi\pi l\nu$ – Fix to 1.0%

Fix $D\pi\pi$ BF to 1.0 %

BF	Mix of 4	X only	X^*	Y	Y^*
D	2.50±0.06	2.49±0.06	2.51±0.06	2.49±0.06	2.50±0.06
D^*	5.58±0.08	5.56±0.08	5.60±0.08	5.54±0.08	5.63±0.08
D^{**} $D\pi$	1.41±0.09	1.38±0.09	1.21±0.09	1.62±0.09	1.42±0.09
$D\pi\pi$	1.0 (Fix)	1.0 (Fix)	1.0 (Fix)	1.0 (Fix)	1.0 (Fix)
Chi2/ ndf	264/219	237/218	281/220	264/219	344/216
P-value	0.02	0.18	0.003	0.02	6e-8

Summed BF (%)

	BAD1889	Our result (stat err only) Nominal / Dpipi included
BF($B^+ \to D l \nu$)	2.33 ± 0.13	2.53 ± 0.06 / 2.51 ± 0.06
BF($B^+ \to D^* l \nu$)	5.83 ± 0.34	5.29 ± 0.08 / 5.43 ± 0.10
BF($B^+ \to D \pi l \nu$) BF($B^+ \to D^* \pi l \nu$) BF($B^+ \to D^{(*)} \pi^0 l \nu$)	0.42 ± 0.07 0.59 ± 0.06 0.505 ?	 1.96 ± 0.09 / 1.69 ± 0.14
Sum	9.675 ± 0.38	9.78 ± 0.13 / 9.63 ± 0.18
BF($B^+ \to D \pi \pi l \nu$)		/ 0.49 ± 0.19
Sum		/ 10.12 ± 0.26

Electron vs Muon

	Electron	Muon	Pull / Difference %
D slope	1.29 ± 0.09	1.42 ± 0.10	+0.97 / +9.2%
*D** slope	1.39 ± 0.10	1.28 ± 0.11	-0.74 / -8.6%
R1	1.53 ± 0.16	1.27 ± 0.14	-1.2 / -20.5%
R2	0.66 ± 0.13	0.71 ± 0.13	+0.27 / +7.0%
BF(*D*)	2.61 ± 0.08 %	2.44 ± 0.10 %	-1.3 / -7.0%
BF(*D**)	5.31 ± 0.11 %	5.22 ± 0.12 %	-0.55 / -1.7%
Chi2/ndf (P-Value)	214/204 (0.30)	210/206 (0.40)	

D^0 vs D^+ (f_{+0} fixed)

	D^0	D^+	Pull / %
D slope	1.47 ± 0.09	1.19 ± 0.12	-1.9 / -23.5%
D^* slope	1.32 ± 0.08	1.46 ± 0.30	+0.45 / +9.6 %
R1	1.37 ± 0.11	1.58 ± 0.45	+0.45 / +13.3%
R2	0.70 ± 0.10	0.62 ± 0.40	-0.2 / -12.9%
BF(D)	2.63 ± 0.09 %	2.41 ± 0.09 %	-1.7 / -9.1%
BF(D^*)	5.30 ± 0.08 %	4.93 ± 0.40 %	-0.9 / -7.5%
Chi2/ndf (P-Value)	137/108 (0.03)	90/103 (0.81)	
BF sum	9.80 ± 0.16	10.03 ± 0.49	