$B \to D^{(*,**)0}\rho(\pi)$ reconstruction with missing mass method

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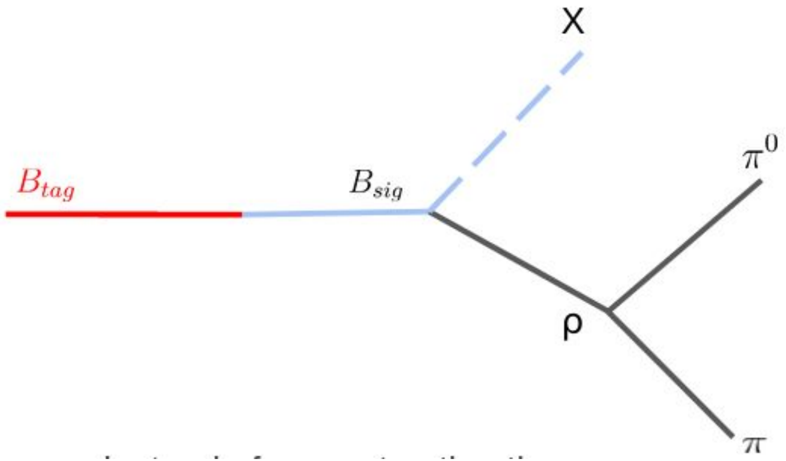
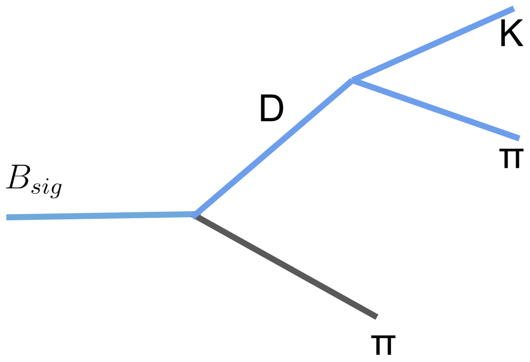


Swarna Prabha Maharana, Vidya Sagar Vobbilisetti, Saurabh Sandilya, Karim Trabelsi

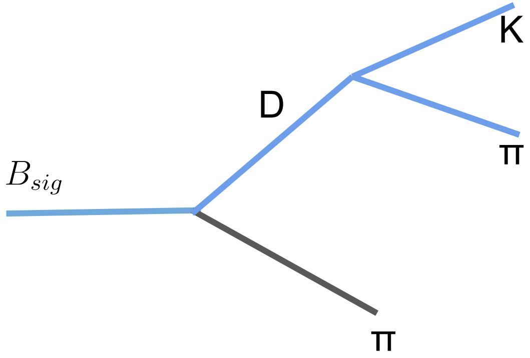
Why Partial Reconstruction?



Reconstruct all the final state particles from the B

Eff = BR($B \to D^0 \pi$) x BR($D^0 \to K\pi$) x ϵ_K x ϵ_π x ϵ_π

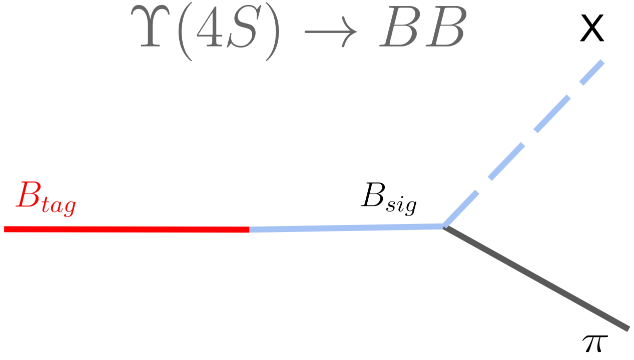
Why Partial Reconstruction?



Reconstruct all the final state particles from the B

Eff = BR(B→D^0π) x BR(D^0→Kπ) x ϵ_K x ϵ_π x ϵ_π

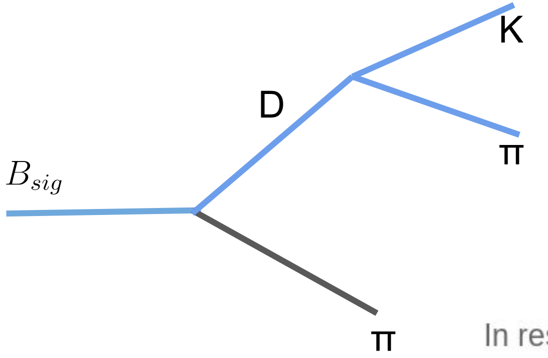
$\Upsilon(4S) \to B\bar{B}$



- Instead of reconstructing the D exclusively, one could reconstruct the other B
- Look for the D in the recoil mass.

Eff = ϵ_{Btag}x ϵ_π

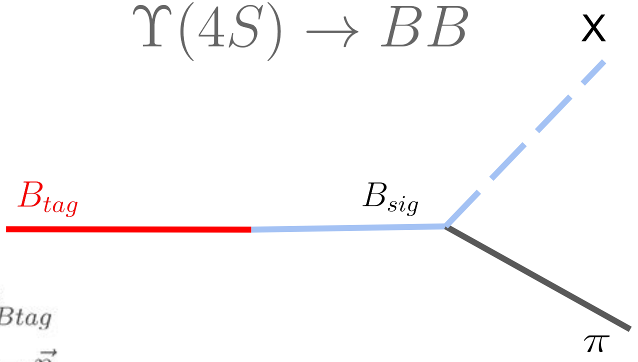
Why Partial Reconstruction?



Reconstruct all the final state particles from the B

Eff = BR(B→D^0π) x BR(D^0→Kπ) x ϵ_K x ϵ_π x ϵ_π

$$\Upsilon(4S) \rightarrow B\bar{B}$$



In rest frame of Υ(4S) : $\vec{p}_{Bsig} = -\vec{p}_{Btag}$

$$\vec{p}_X = \vec{p}_{Bsig} - \vec{p}_\pi$$
$$E_X = E_{beam} - E_\pi$$
$$M_X = \sqrt{E_X^2 - \vec{p}_X^2}$$

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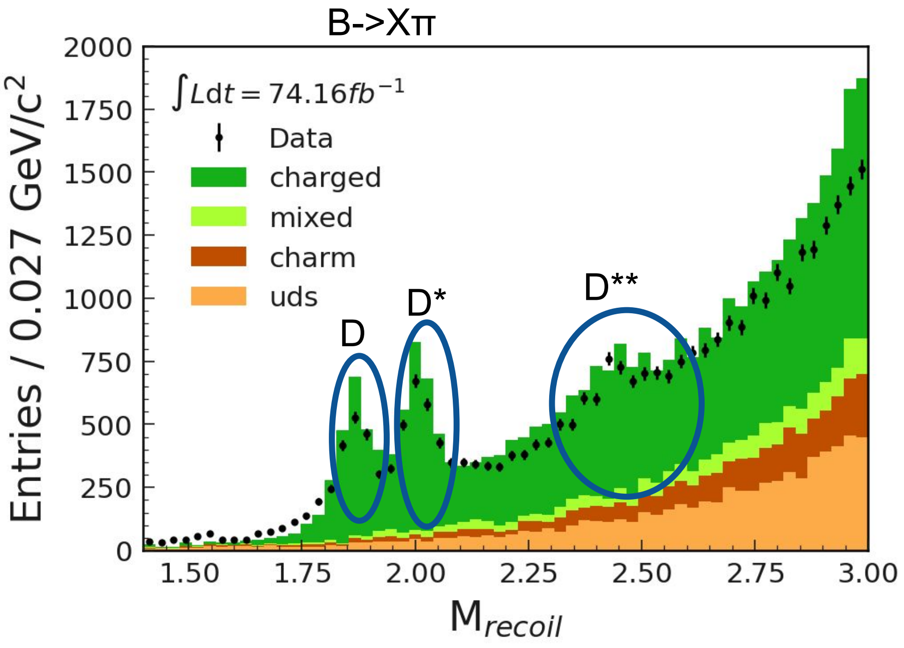
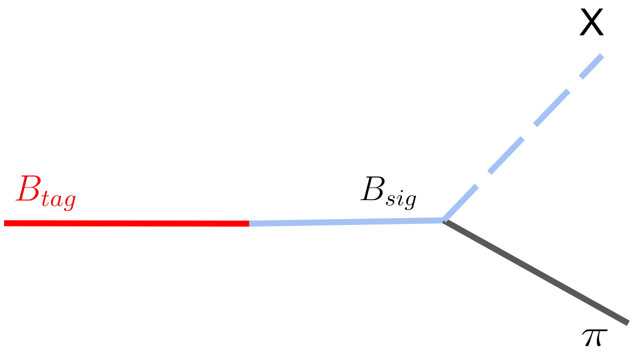
Eff = ϵ_{Btag} x ϵ_π

Why Partial Reconstruction?



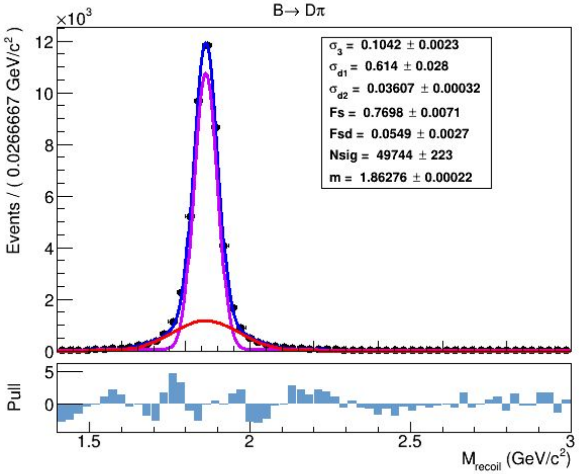
D,D*,D with same efficiency**

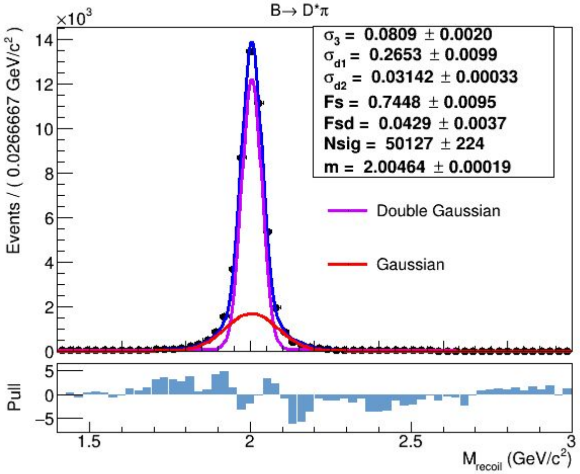


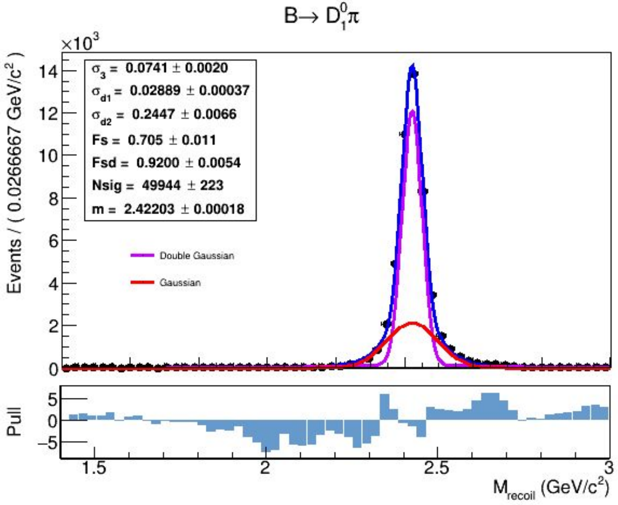
- Instead of reconstructing the D exclusively, one could reconstruct the other B
- Look for the D in the recoil mass.

Eff = ϵ_{Btag} x ϵ_{π}

Signal MC







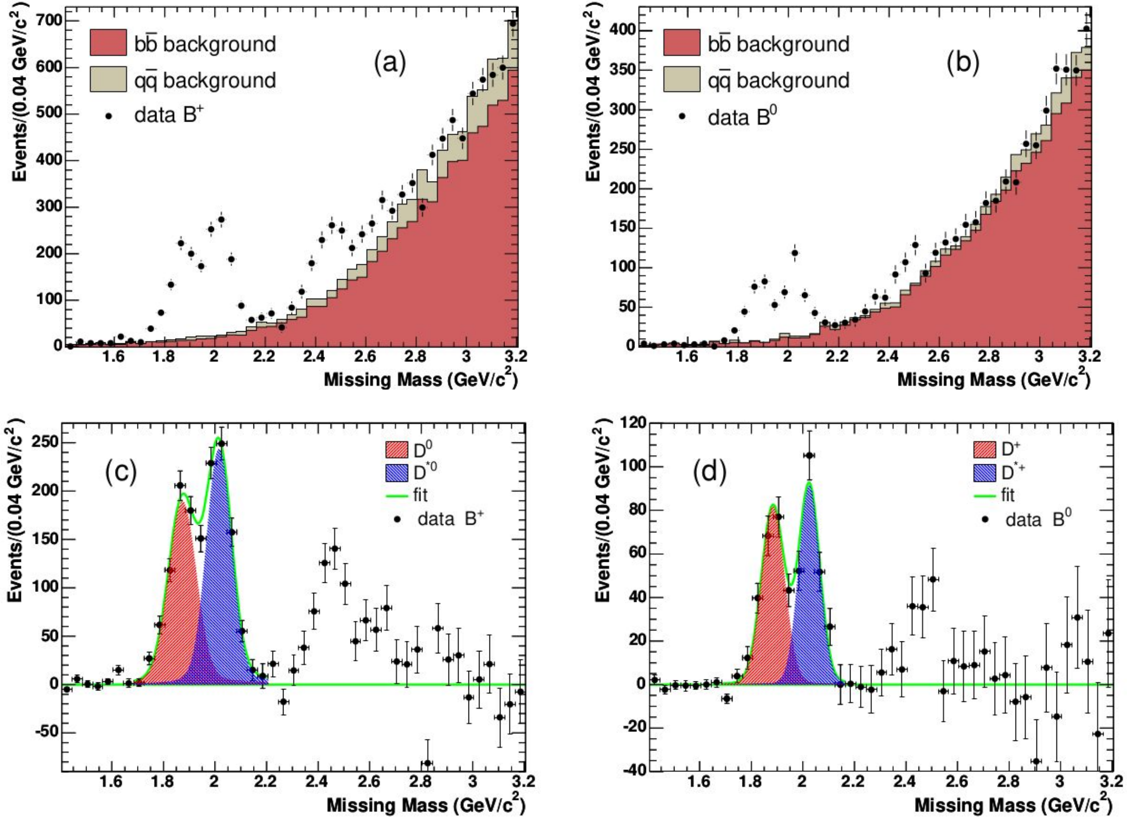
Mode	Efficiency(x 10^{-3})
B->Dπ	4.97±0.02
B->D*π	5.01±0.02
B->D_1^0π	4.99±0.02

Approach 1.0

- $B^+ \rightarrow D^{(*)0}\pi^+$, $D^{(*)0}\rho^+$, $D^{(*)0}a_1^+$
- $B^0 \rightarrow D^{(*)-}\pi^+$, $D^{(*)-}\rho^+$, $D^{(*)-}a_1^+$

The D** yields are defined as the excess of candidates in the missing mass range 2.2 − 2.8 GeV/c2 , and the B→D** π⁻ branching fractions refer to the contributions of all non-strange charm meson states in the same region.

Decay mode	Yield	Efficiency	$\mathcal{B}(10^{-3})$
$B^- \rightarrow D^0\pi^-$	677 ± 32		4.49±0.21±0.23
$B^- \rightarrow D^{*0}\pi^-$	774 ± 33	0.796±0.007	5.13±0.22±0.28
$B^- \rightarrow D^{**0}\pi^-$	829 ± 78		5.50±0.52±1.04
$\overline{B}^0 \rightarrow D^+\pi^-$	248 ± 19		3.03±0.23±0.23
$\overline{B}^0 \rightarrow D^{*+}\pi^-$	245 ± 19	0.793±0.007	2.99±0.23±0.24
$\overline{B}^0 \rightarrow D^{**+}\pi^-$	192 ± 54		2.34±0.65±0.88



B. Aubert *et al.* (BABAR Collaboration),Phys. Rev. D 74, 111102(R)

Selection

We start with B to Xπ

Tag side B selection:

- M_{bc} > 5.27 GeV/c^2
- |ΔE| < 0.05 GeV
- FEI Signal Probability > 0.01

Select a π with:

- |d0| < 1 and |z0| < 3
- L[K/π] < 0.9 and μ-id < 0.9 and e-id < 0.9

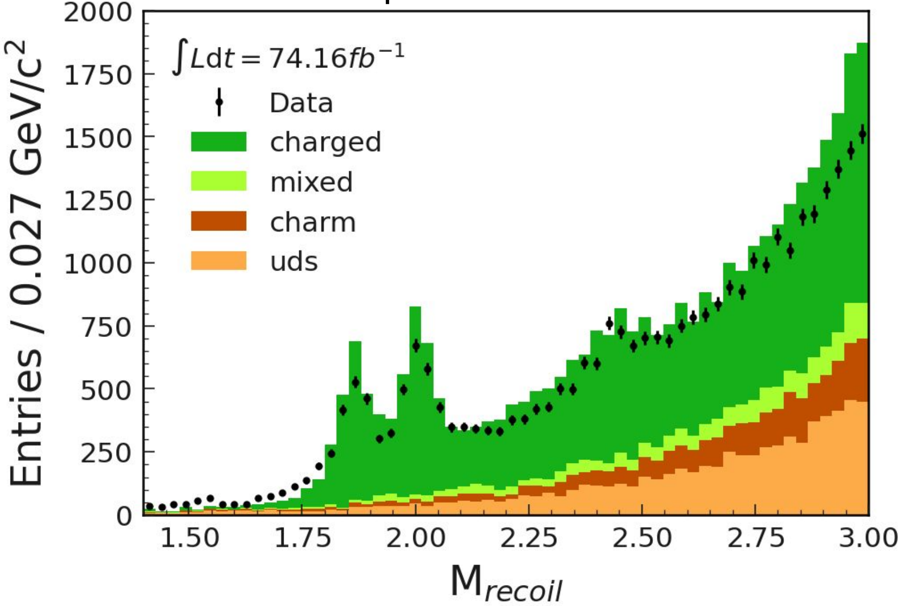
continuum suppression:

- Event sphericity > 0.2
- B tag 's cosTBTO < 0.9

BCS: Event with highest FEI signal probability and highest π momentum in CMS

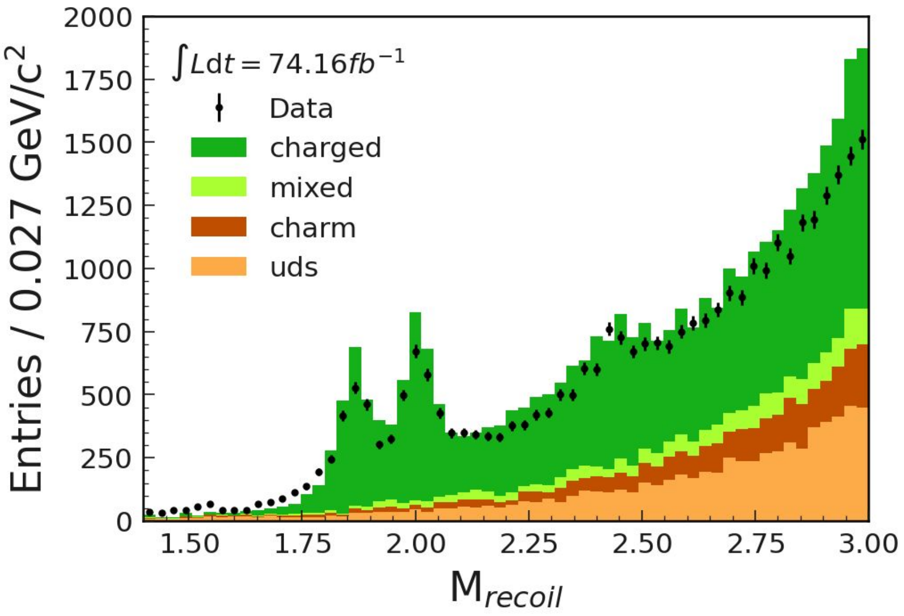
B⟶Xπ

Exp 55

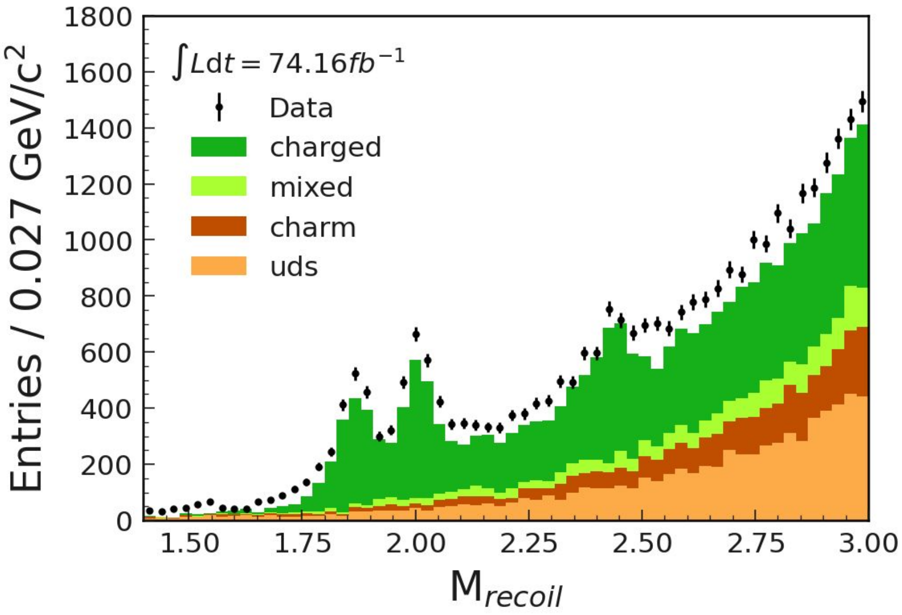


$\int L dt = 74.16 fb^{-1}$
Data
charged
mixed
charm
uds
Entries / 0.027 GeV/c^2
M$_{recoil}$
0
250
500
750
1000
1250
1500
1750
2000
1.50
1.75
2.00
2.25
2.50
2.75
3.00

B→Xπ

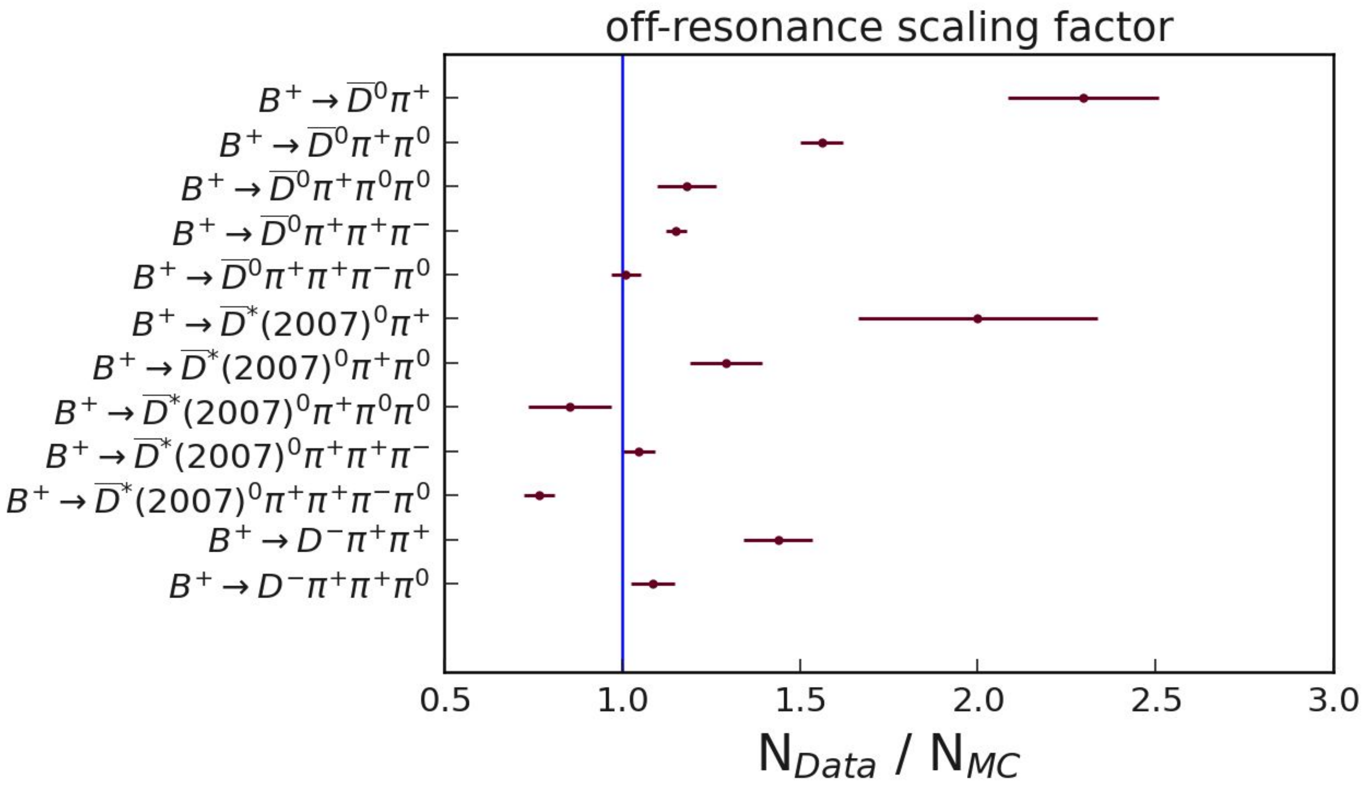


With new MC



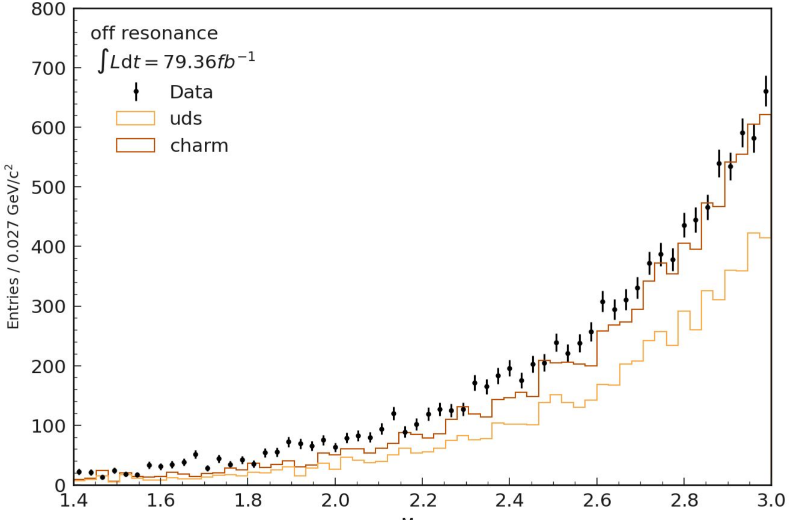
Scaling factor from continuum?

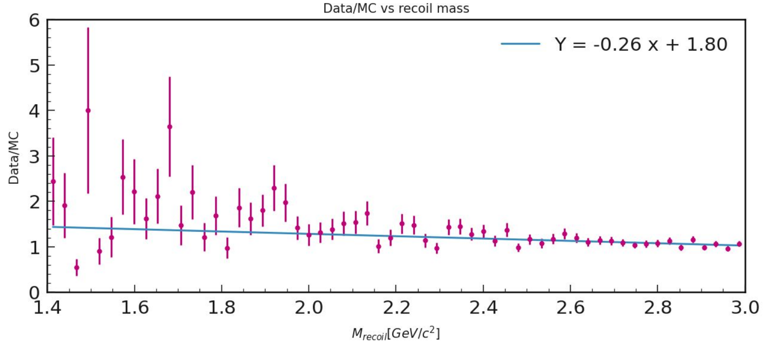
Scaling factor Vs tag mode

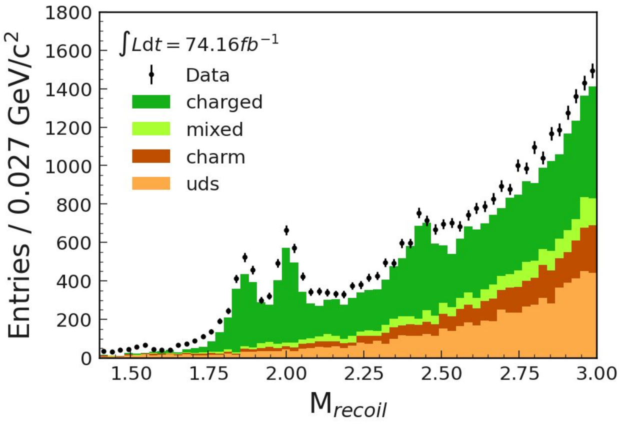


M_{recoil}

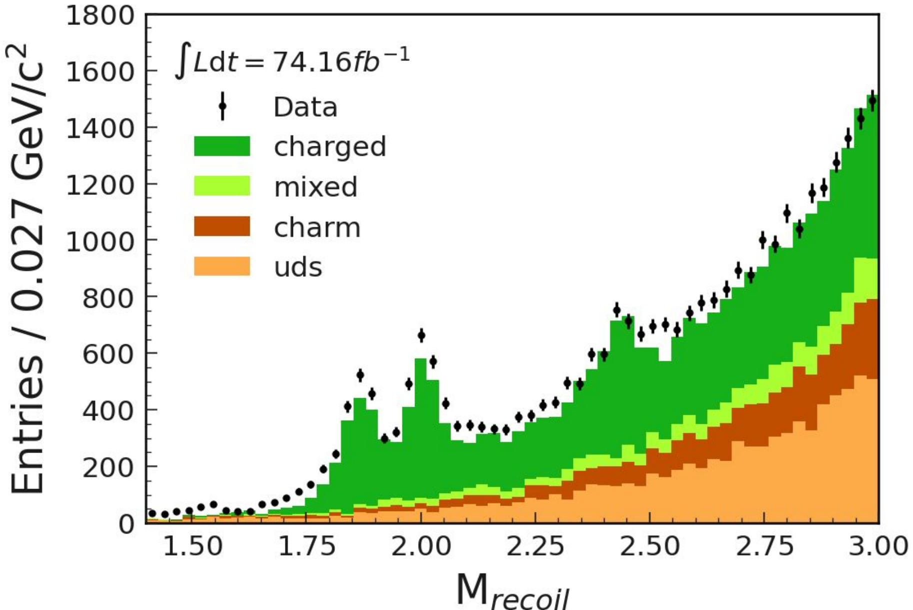
Overall Data/MC~1.15 from off-resonance



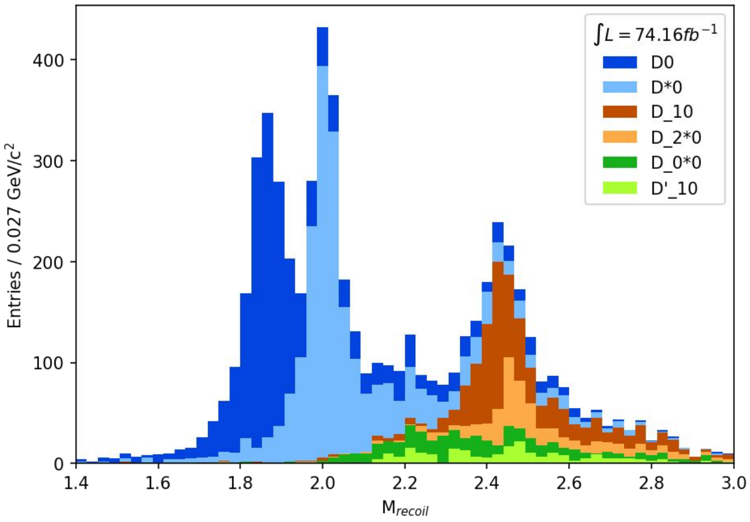




Scale continuum

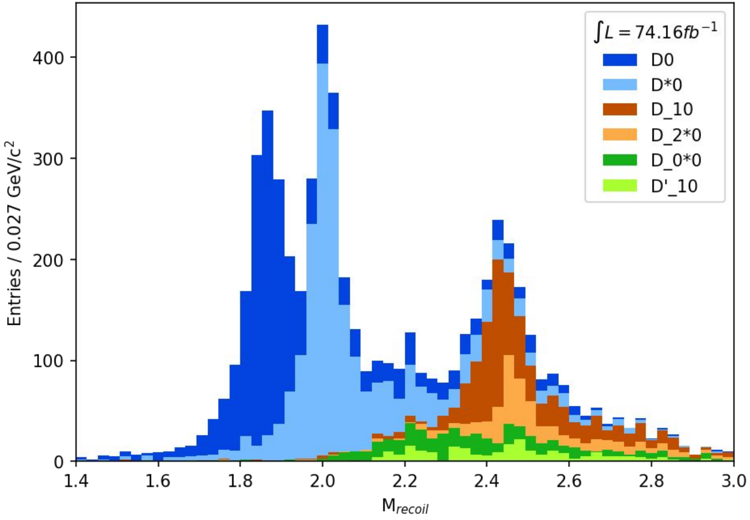


Background subtracted data



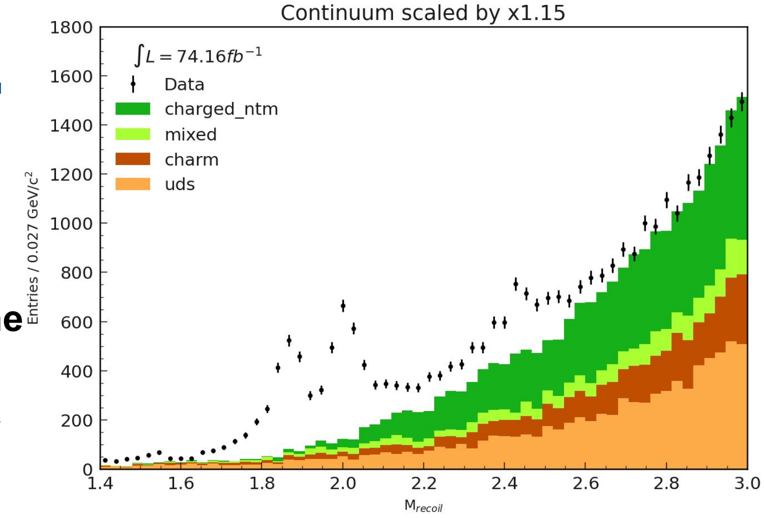
Signal modes

Background subtracted data

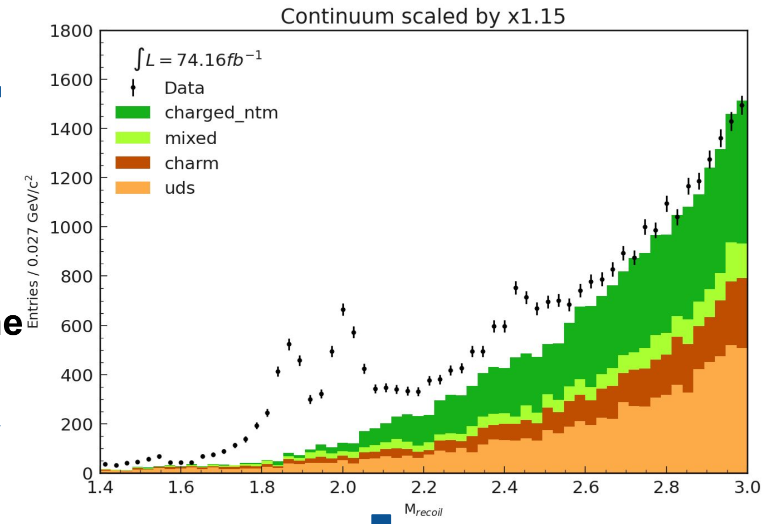


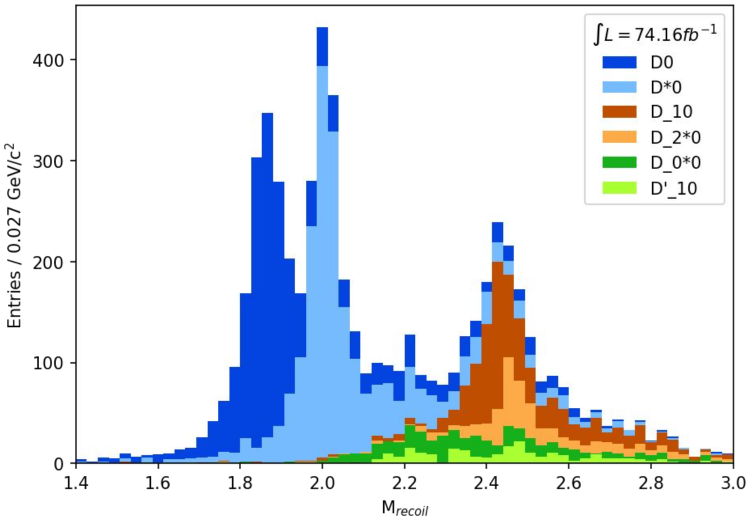
Signal modes

Remove all the signal modes



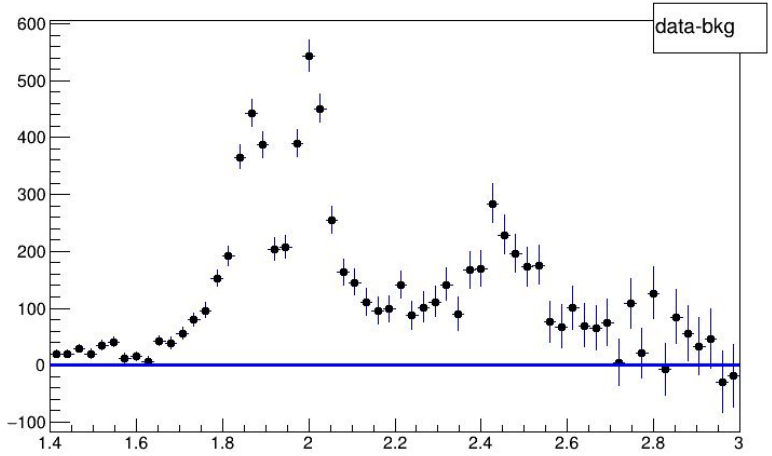
Background subtracted data



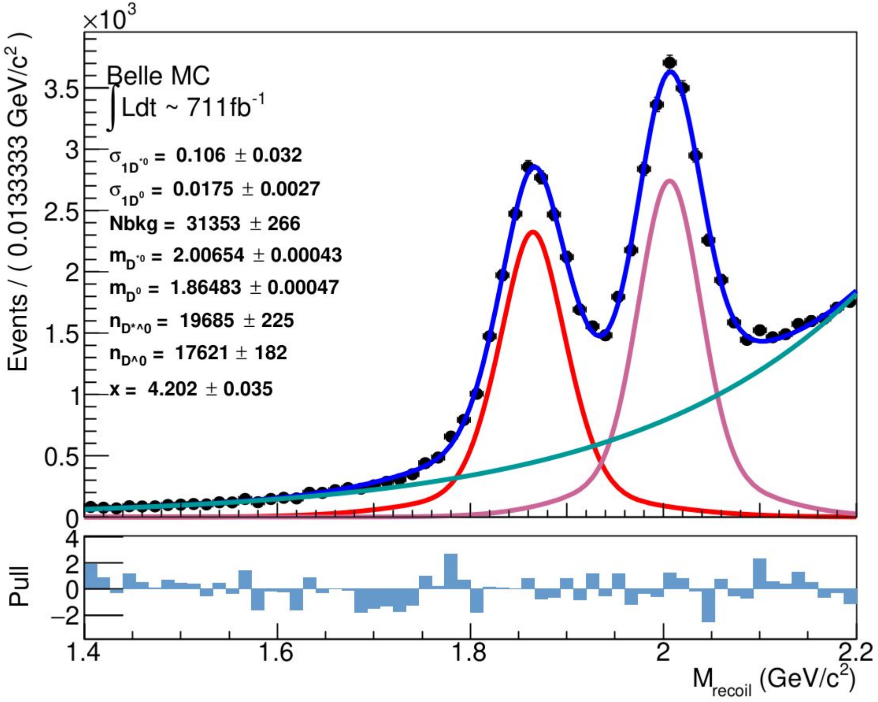


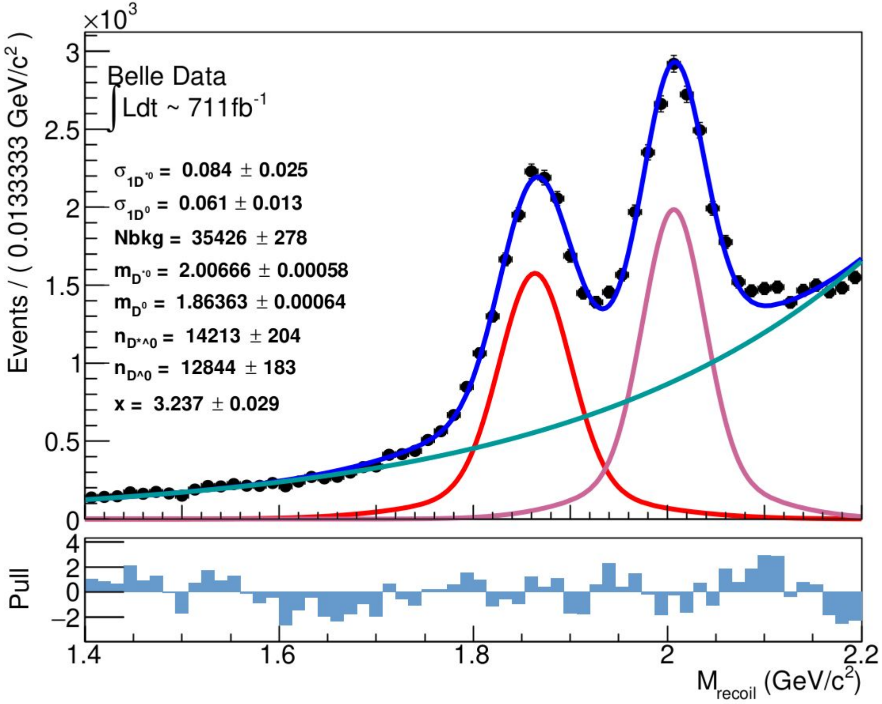
Signal modes

Remove all the signal modes



Approach 2.0





$$\mathcal{B} = \frac{N_{yield}}{2 \times N_{B\bar{B}} \times f_{00} \times \epsilon_{MC} \times C_{tag} \times C_{\pi}}$$

$$\frac{\mathcal{B}(B \to D^{*0}\pi)}{\mathcal{B}(B \to D^{0}\pi)} = \frac{N_{D^*\pi}}{N_{D\pi}} \times \frac{\epsilon_{D\pi}}{\epsilon_{\mathrm{D}^*\pi}}$$

	Data	MC
Ratio	1.09±0.02	1.10±0.01

Selection for $B \to X\rho$

- $M_{bc} > 5.27$ GeV/c^2
- $|\Delta E| < 0.05$ GeV
- FEI Signal Probability > 0.01

Select a π with:

- $|d0| < 1$ and $|z0| < 3$
- $L[K/\pi] < 0.9$ and μ-id < 0.9 and e-id < 0.9

continuum suppression:

- Event sphericity > 0.2
- Btag 's cosTBTO < 0.9

Select a π^0 with:

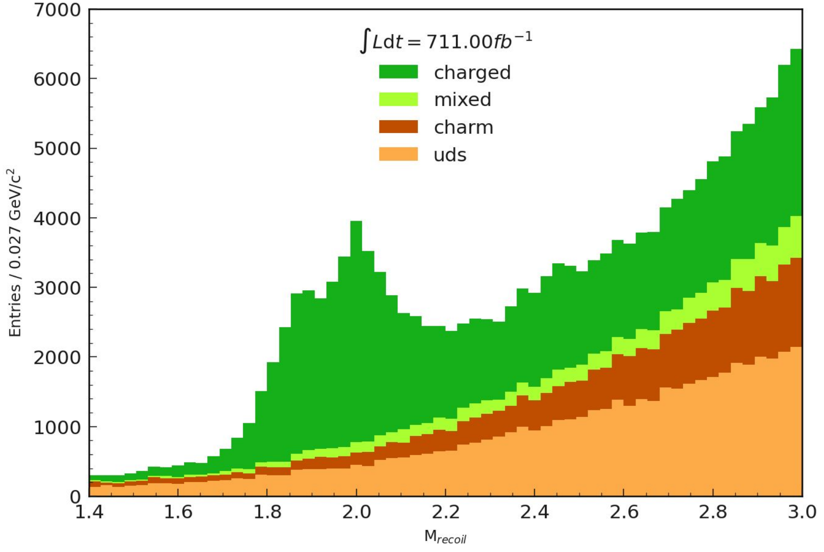
- π^0 : mdst list

Further cuts to reduce background:

- $p[\pi^0] > 150$ MeV
- $M[\pi^0] \in [0.12,0.15]$GeV/c^2
- $M[\rho] \in [0.6,0.9]$GeV/c^2

BCS: Event with highest FEI signal probability and highest ρ momentum in CMS

B→Xρ



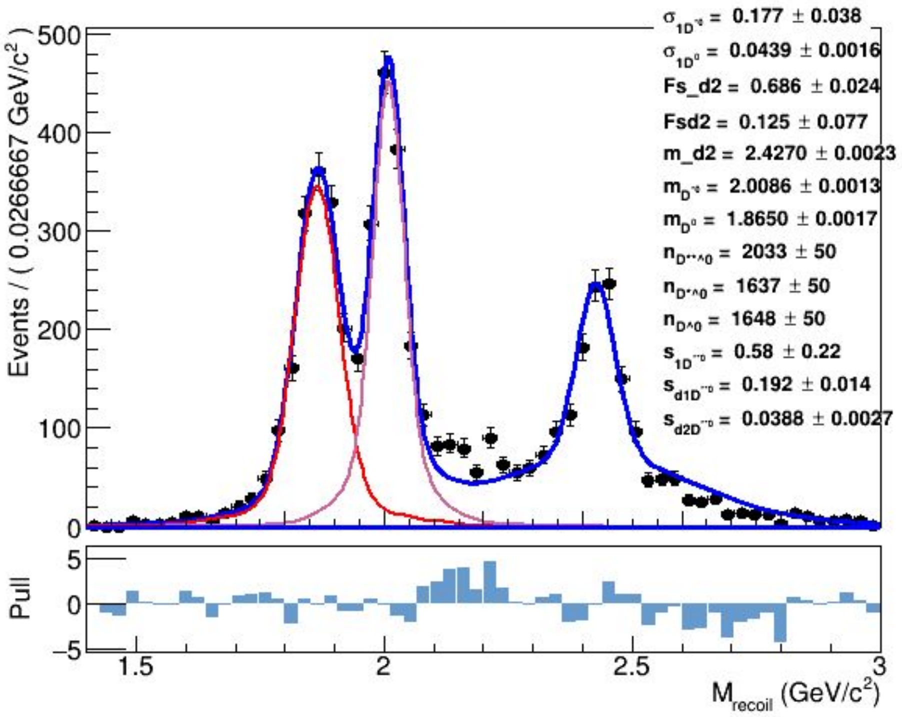
Resolution is worse than B->Xπ
But can still see D, D*, D** peaks.

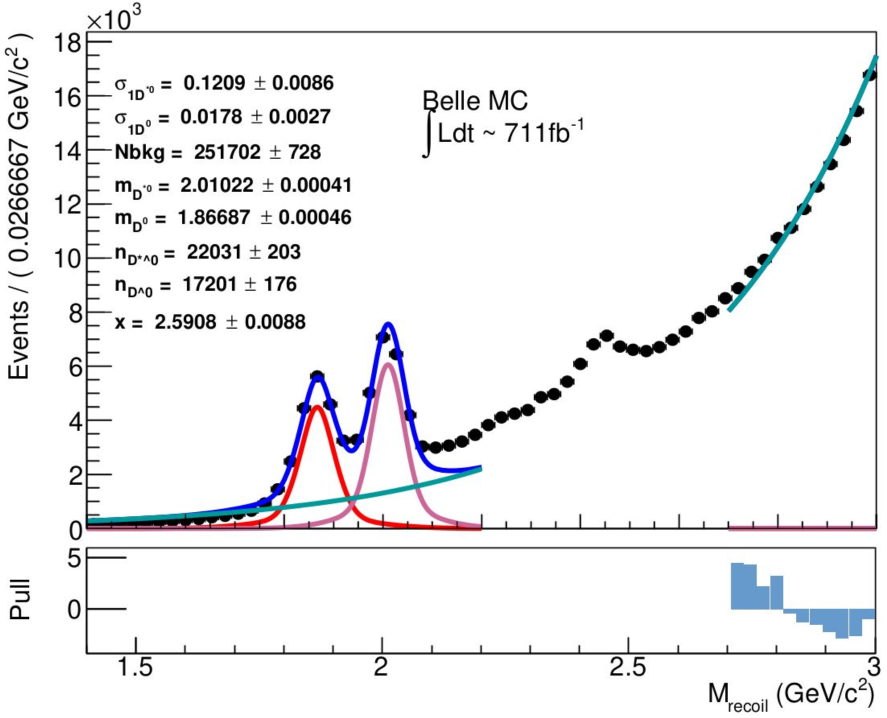
What next?

- Continuum Suppression needs a revisit.
- Some specific B_{tag} modes may be favourable.
- Some selection criteria on the pion invariant may help reducing the background.
- A fit plan for the whole M_{recoil} region(1.4-3 GeV).
- Look if the signal, background pdfs depend on FEI modes.
- Double recoil method for an efficient understanding of D** .

Thank You

Fit in MC


σ_1D*0 = 0.177 ± 0.038
σ_1D0 = 0.0439 ± 0.0016
Fs_d2 = 0.686 ± 0.024
Fsd2 = 0.125 ± 0.077
m_d2 = 2.4270 ± 0.0023
m_D*0 = 2.0086 ± 0.0013
m_D0 = 1.8650 ± 0.0017
n_D**^0 = 2033 ± 50
n_D*^0 = 1637 ± 50
n_D^0 = 1648 ± 50
s_1D**0 = 0.58 ± 0.22
s_d1D**0 = 0.192 ± 0.014
s_d2D**0 = 0.0388 ± 0.0027
Events / (0.0266667 GeV/c^2)
Pull
M_recoil (GeV/c^2)


×10^3
σ_1D*0 = 0.1209 ± 0.0086
σ_1D0 = 0.0178 ± 0.0027
Nbkg = 251702 ± 728
m_D*0 = 2.01022 ± 0.00041
m_D0 = 1.86687 ± 0.00046
n_D*^0 = 22031 ± 203
n_D^0 = 17201 ± 176
x = 2.5908 ± 0.0088
Belle MC
∫Ldt ~ 711fb^-1
Events / (0.0266667 GeV/c^2)
Pull
M_recoil (GeV/c^2)