

$$B^0 \rightarrow K^* \mu^- \mu^+$$

Update



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February 14, 2017

The need for MC

⇒ New analysis will need new/Run2 MC. Already in progress:

■	34950	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MU - Marcin (Kotm...)	Beam6500GeV-2016-MagUp-Nu1...	Sim09b/Tng0e6138160FReco16/T...	11114014	24,000,000	5,387,917	22
■	34947	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MD - Marcin (Kotm...)	Beam6500GeV-2016-MagDown-N...	Sim09b/Tng0e6138160FReco16/T...	11114014	24,000,000	5,402,480	22
▣	34942	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MU - Marcin (Kotm...)	Beam6500GeV-2016-MagUp-Nu1...	Sim09b/Tng0e6138160FReco16/T...		750,000	49,561	6
■	34941	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MD - Marcin (Kotm...)	Beam6500GeV-2016-MagDown-N...	Sim09b/Tng0e6138160FReco16/T...		750,000	24,566	3
▣	34935	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MU - Marcin (L.Terrin)	Beam6500GeV-2016-MagUp-Nu1...	Sim09b/Tng0e6138160FReco16/T...		300,000	49,187	16
▣	34934	Simulation	Active	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MD - Marcin (L.Terrin)	Beam6500GeV-2016-MagDown-N...	Sim09b/Tng0e6138160FReco16/T...		300,000	27,820	9
■	34933	Simulation	PPG OK	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MU - Marcin (ghmm)	Beam6500GeV-2016-MagUp-Nu1...	Sim09b/Tng0e6138160FReco16/T...	13114002	150,000	0	0
■	34932	Simulation	PPG OK	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MD - Marcin (ghmm)	Beam6500GeV-2016-MagDown-N...	Sim09b/Tng0e6138160FReco16/T...	13114002	150,000	0	0
■	34927	Simulation	Done	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MU - Marcin (Kotm)	Beam6500GeV-2016-MagUp-Nu1...	Sim09b/Tng0e6138160FReco16/T...	12113001	250,000	361,848	144
■	34923	Simulation	Done	2a	RDWG - Reconstructible Filtered - Sim09b 2016 - MD - Marcin (Kotm)	Beam6500GeV-2016-MagDown-N...	Sim09b/Tng0e6138160FReco16/T...	12113001	250,000	361,997	144

Selection

⇒ Re-examine the selection:

- $m_{K\pi\mu\mu} > 4960$ && $m_{K\pi\mu\mu} < 6000$
- $q^2 < 19.5$
- $K_PIDK > -5$ && $Pi_PIDK < 25$ &&
 $mu_minus_PIDmu > -3$ && $mu_plus_PIDmu > -3$
- Muons: isMuon
- $m_{K\pi} > 630$ && $m_{K\pi} < 1530$

Trigger Run1

⇒ There is the standard:

- L0Muon
- B0_Hlt1TrackAllL0 || B0_Hlt1TrackMuon
- B0_Hlt2TopoMu(2,3,4)BodyBBDT ||
B0_Hlt2Topo(2,3,4)BodyBBDT || B0_Hlt2DiMuonDetached ||
B0_Hlt2DiMuon

⇒ All required to be TOS.

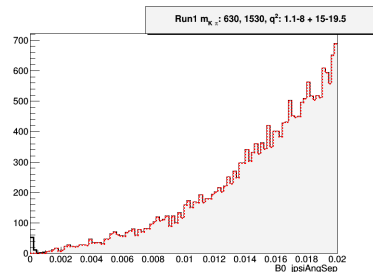
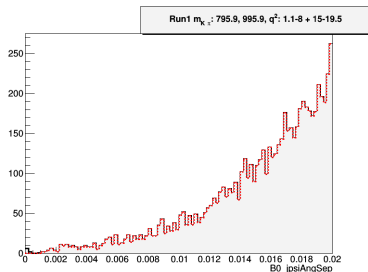
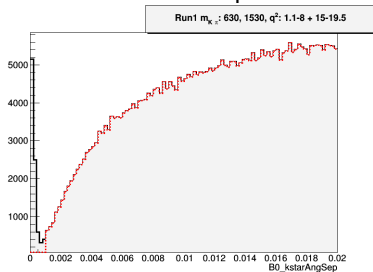
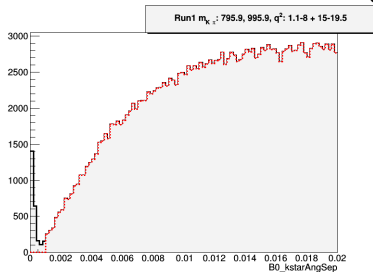
Trigger Run2

⇒ There is the standard:

- LOMuon
- B0_Hlt1TrackMVADecision B0_Hlt1TrackMuonDecision
B0_Hlt1DiMuonHighMassDecision
B0_Hlt1DiMuonLowMassDecision
B0_Hlt1SingleMuonHighPTDecision
- B0_Hlt2TopoMuMu(2,3,4)BodyBBDT ||
B0_Hlt2TopoMu(2,3,4)BodyBBDT ||
B0_Hlt2Topo(2,3,4)BodyBBDT || B0_Hlt2DiMuonDetached ||
B0_Hlt2SingleMuon || B0_Hlt2SingleMuonHighPT ||
B0_Hlt2SingleMuonLowPT || B0_Hlt2SingleMuonRare

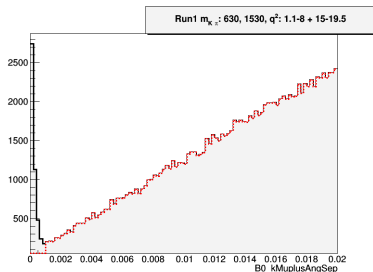
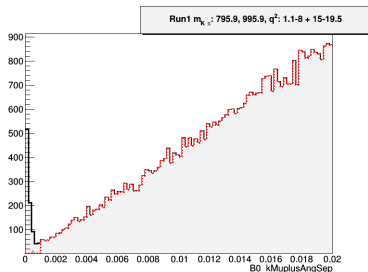
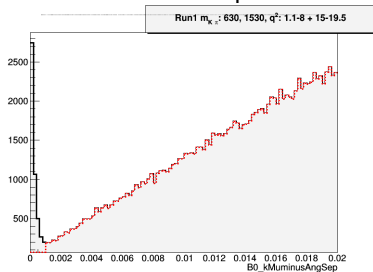
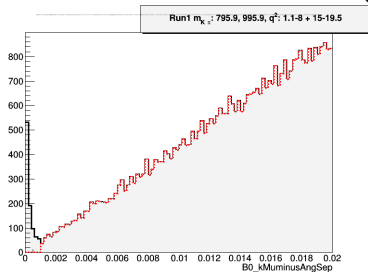
Angles peak

⇒ Remove events where angles between two particles is small:



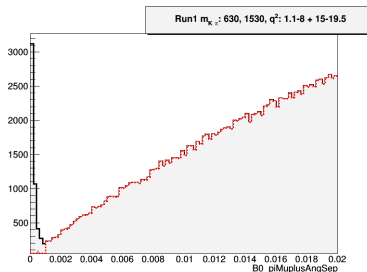
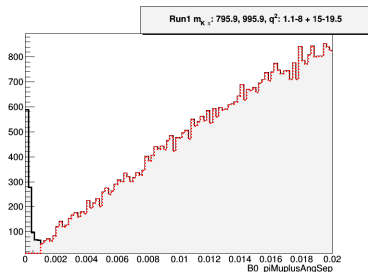
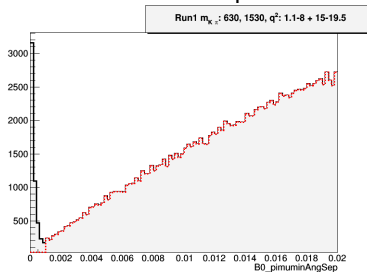
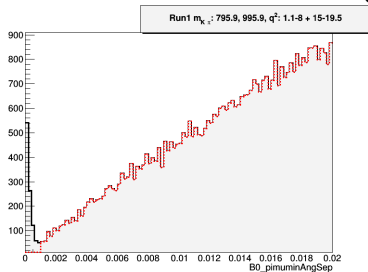
Angles peak

⇒ Remove events where angles between two particles is small:



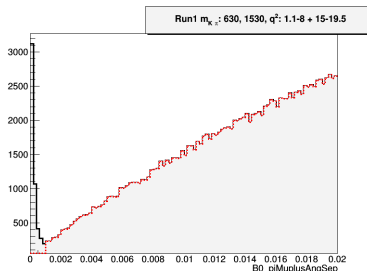
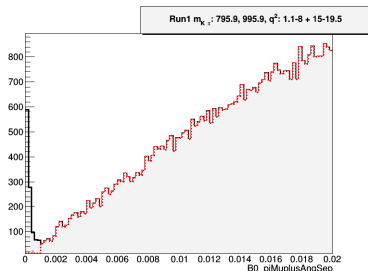
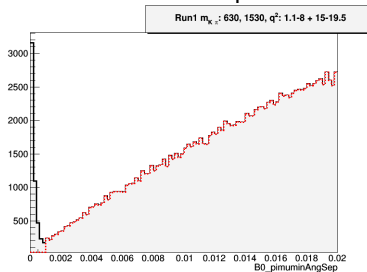
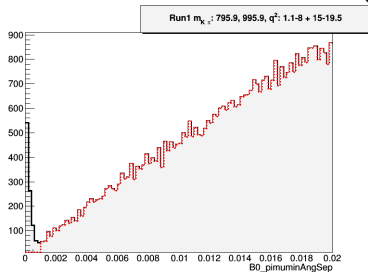
Angles peak

⇒ Remove events where angles between two particles is small:



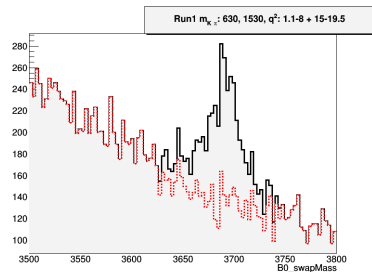
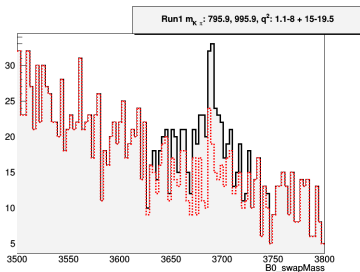
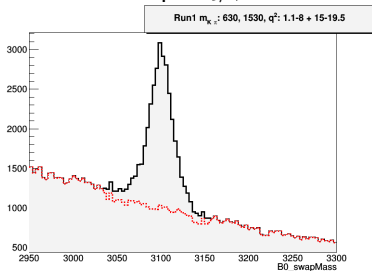
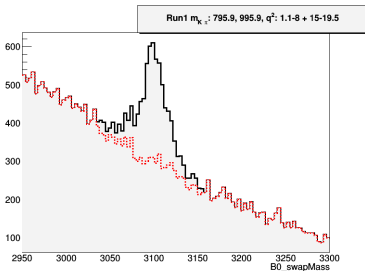
Angles peak

⇒ Remove events where angles between two particles is small:



$\mu \leftrightarrow \pi$ swaps

\Rightarrow Remove events where we swap J/ψ and $\Psi(2S)$.



$\mu \leftrightarrow \pi$ swaps

⇒ Cuts J/ψ :

```
(B0_swapMass>3036)&&(B0_swapMass<3156)  
&&(Pi_PIDmu>5||Pi_isMuon==1
```

⇒ Cuts J/ψ double swap:

```
(B0_kmuswapMass>3036)&&(B0_kmuswapMass<3156)  
&&(K_PIDmu>5||K_isMuon==1))
```

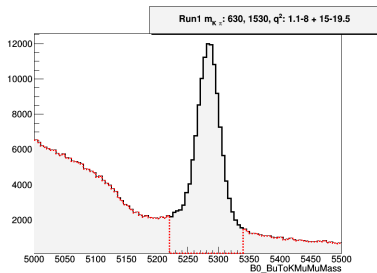
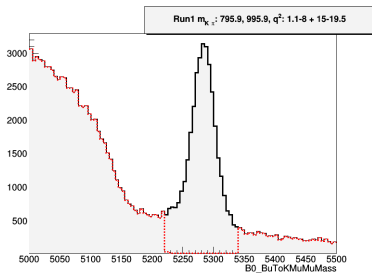
⇒ Cuts $\Psi(2S)$:

```
(B0_swapMass>3626)&&(B0_swapMass<3746)  
&&(Pi_PIDmu>5||Pi_isMuon==1
```

⇒ Cuts $\Psi(2S)$ double swap:

```
(B0_kmuswapMass>3626)&&(B0_kmuswapMass<3746)  
&&(K_PIDmu>5||K_isMuon==1))
```

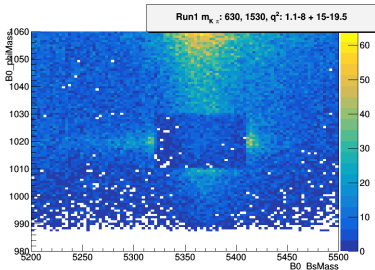
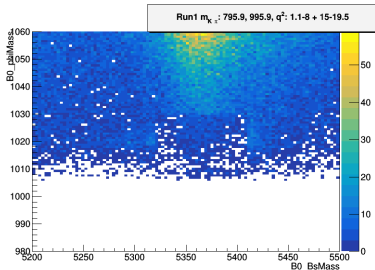
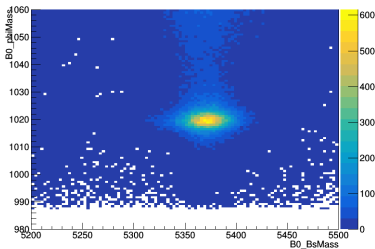
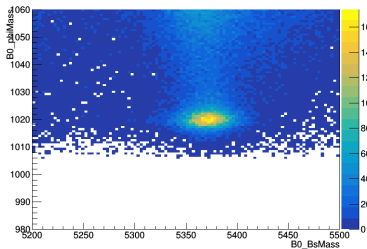
$B \rightarrow K\mu\mu$ with a pion



⇒ Cut:

$(B0_M > 5380 \&\& B0_BuToKMuMuMass > 5220 \&\& B0_BuToKMuMuMass < 5340)$

$$B_s^0 \rightarrow \Phi \mu \mu$$



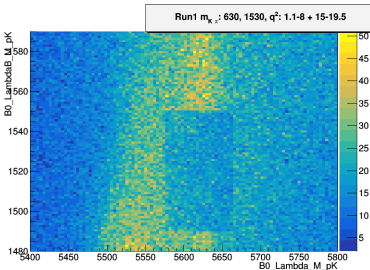
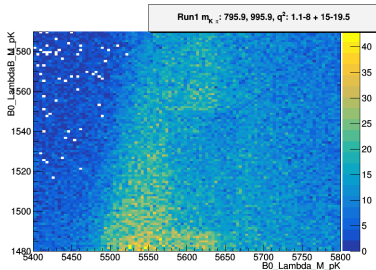
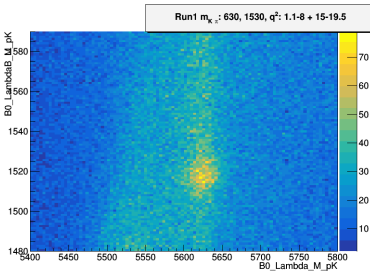
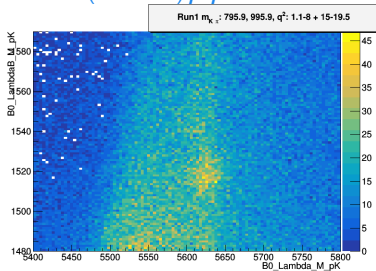
$$B_s^0 \rightarrow \Phi \mu \mu$$

⇒ Cut:

(B0_phiMass>1010&& B0_phiMass<1030 && B0_BsMass>5321&&
B0_BsMass<5411&&Pi_PIDK>-10.

&& (B0_phiMass>1030&& B0_phiMass<1075 && B0_BsMass>5321
&& B0_BsMass<5411&& Pi_PIDK>10.)) ⇒ Make it a bit larger?

$\Lambda_b \rightarrow \Lambda(1520)\mu\mu$



$\Lambda_b \rightarrow \Lambda(1520)\mu\mu$

```
!(B0_Lambda_M_pK > (1520.-30.) && B0_Lambda_M_pK <
(1520.+30.) && B0_LambdaB_M_pK > (5620.-45) &&
B0_LambdaB_M_pK < (5620.+45.) && Pi_PIDp > 0 )
&& !(B0_Lambda_M_pK2 > (1520.-30.) && B0_Lambda_M_pK2
< (1520.+30.) && B0_LambdaB_M_pK2 > (5620.-45) &&
B0_LambdaB_M_pK2 < (5620.+45.) && Pi_PIDK > 0. )
```

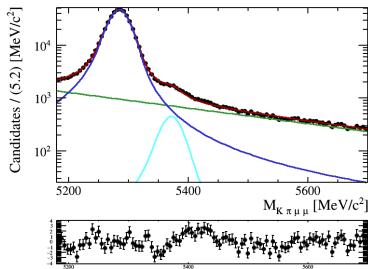
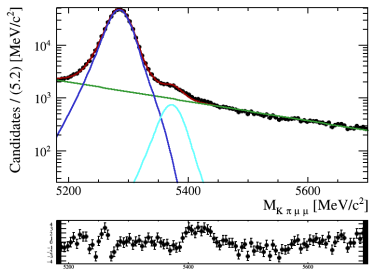
⇒ Make it smaller?

Other cuts

⇒ $K \leftrightarrow \pi$ swaps:

```
!(B0_kpisswapMass>792&&B0_kpisswapMass<992  
&&(K_PIDK+10<Pi_PIDK))
```

Mass fits

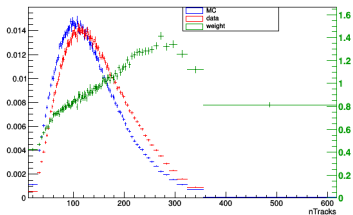


⇒ lpathia doesn't work...

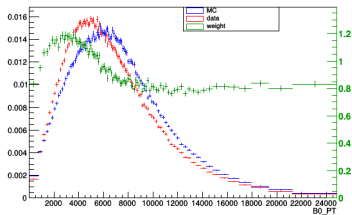
⇒ We need to add the remaining Λ_b pdf to the fit.

Data MC reweighting

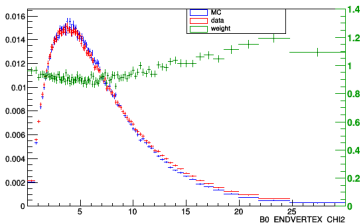
MC_nTracks



target_B0_PT

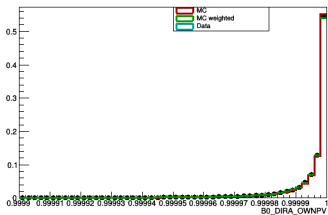
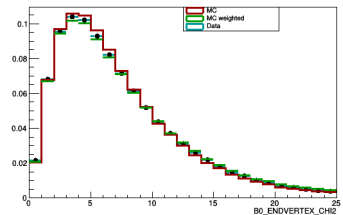
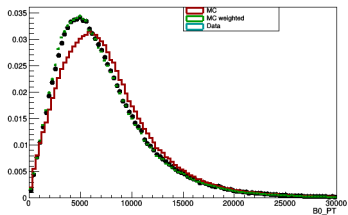
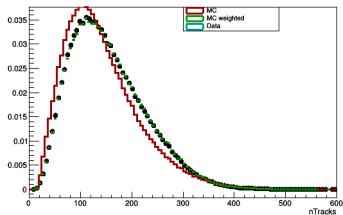


MC_B0_ENDVERTEX_CHI2

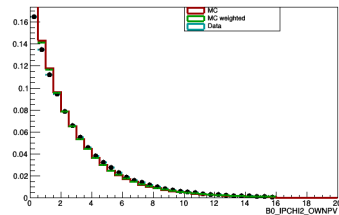
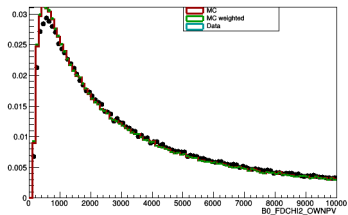
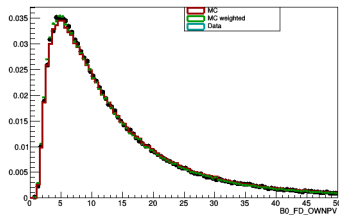
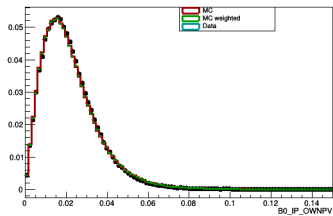


- ⇒ For this time we started with simple 1D adaptive reweighting.
- ⇒ Works quite nicely, we will try the BDT reweighting next.

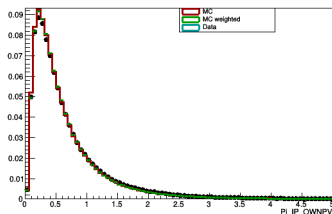
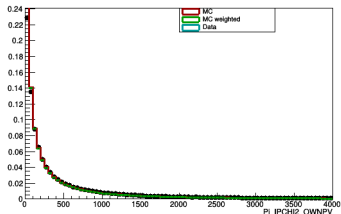
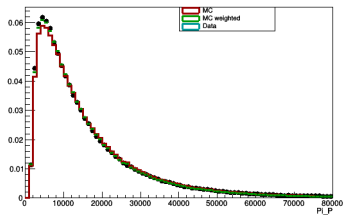
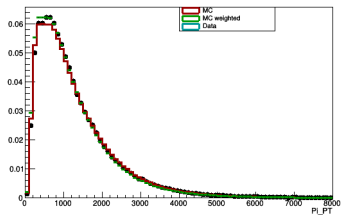
Data MC reweighting



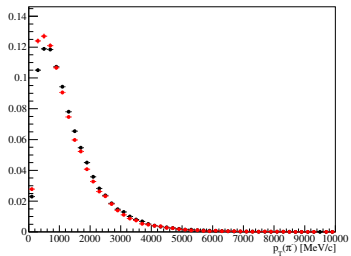
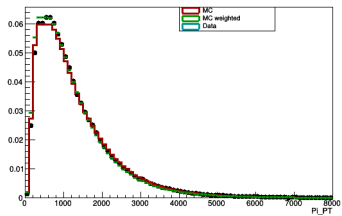
Data MC reweighting



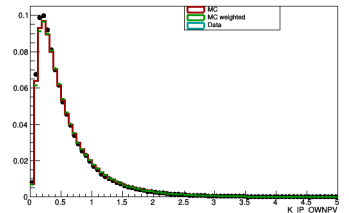
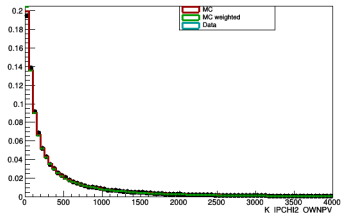
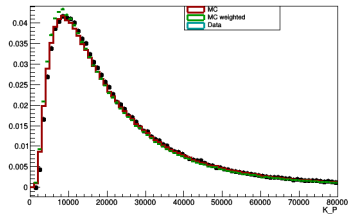
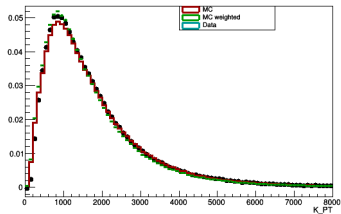
Data MC reweighting



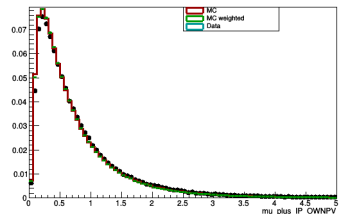
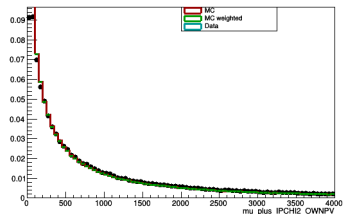
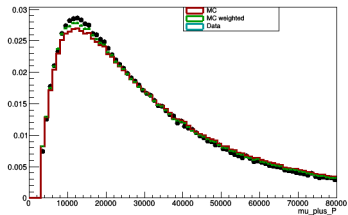
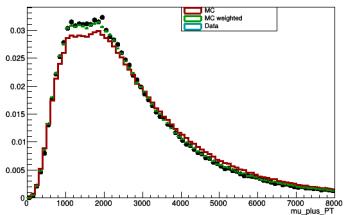
Pion PT



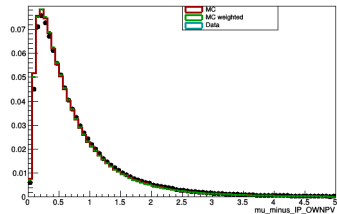
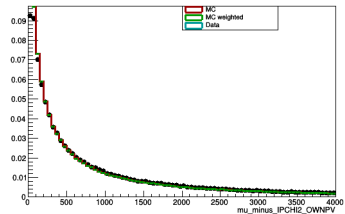
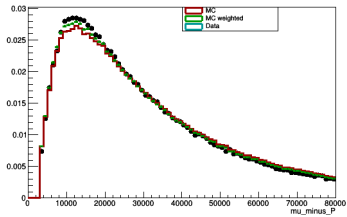
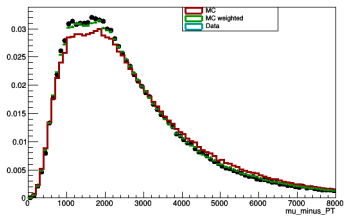
Data MC reweighting



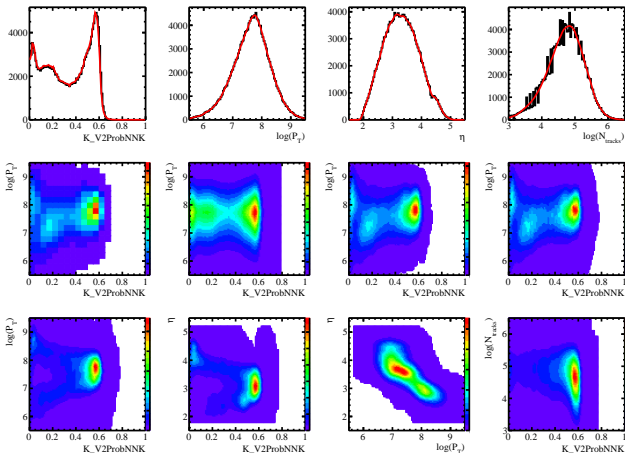
Data MC reweighting



Data MC reweighting



PID resampling



Conclusions

- ⇒ We will update the fit with Λ_b pdf. Ipatia becomes a standard so if that works we would propose to stick to it.
- ⇒ The peaking background section is done. We efficiencies will be evaluated on MC, the PID resampling is ongoing.
- ⇒ Starting to train the BDT with variables that have good data/mc agreement.
- ⇒ The π PT is being investigated.

