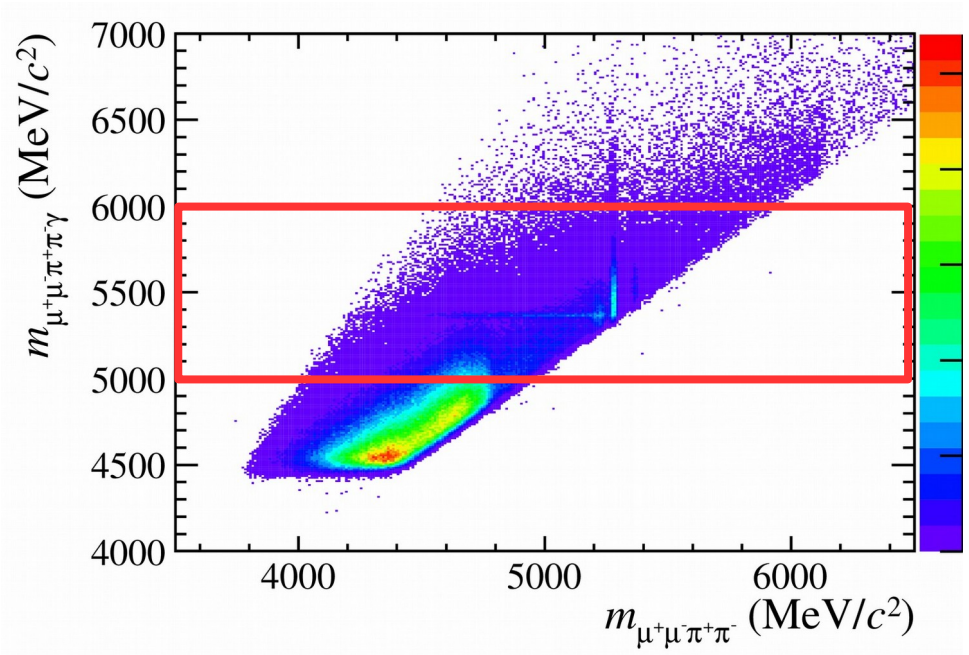
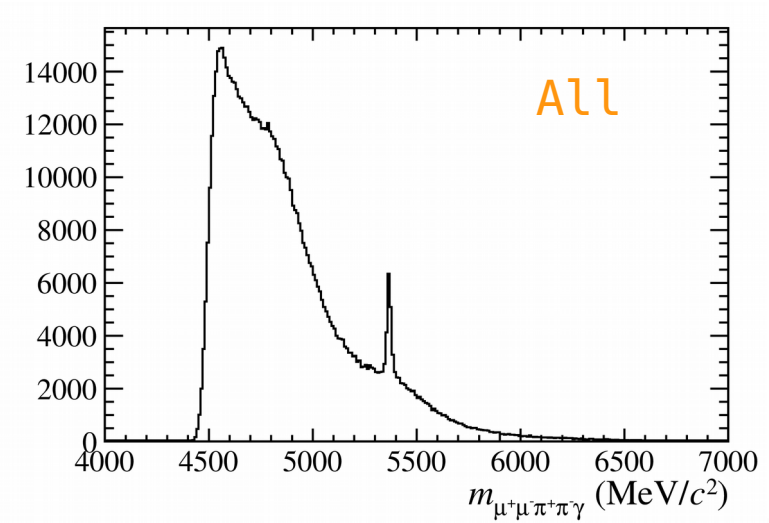
JpsiEtap fit model

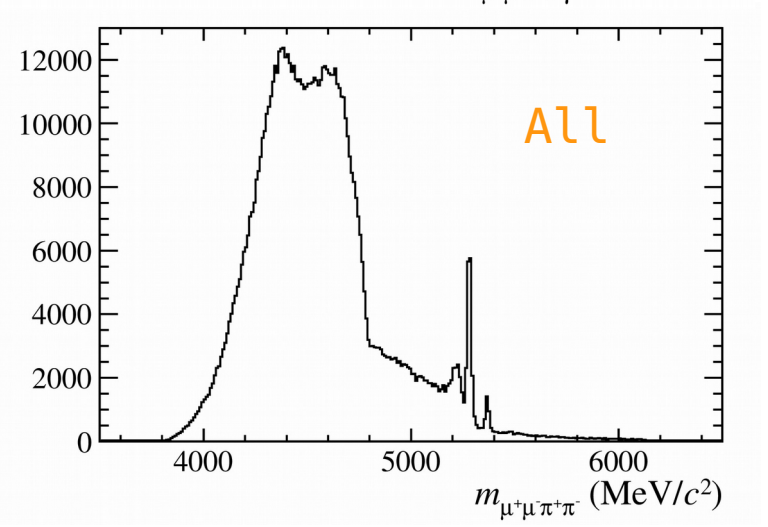
June 17th 2019, Annecy/Edinburgh meeting, M. Chefdeville

Outline

- Look at JpsiEtap and JpsiPiPi masses, both calculated from DTF-4v.
  For JpsiPiPi, require 5 GeV/c^2 < m(JpsiEtap) < 6 GeV/c^2 (as this will be the JpsiEtap fit range)







Outline

- Look at JpsiEtap and JpsiPiPi masses, both calculated from DTF-4v.
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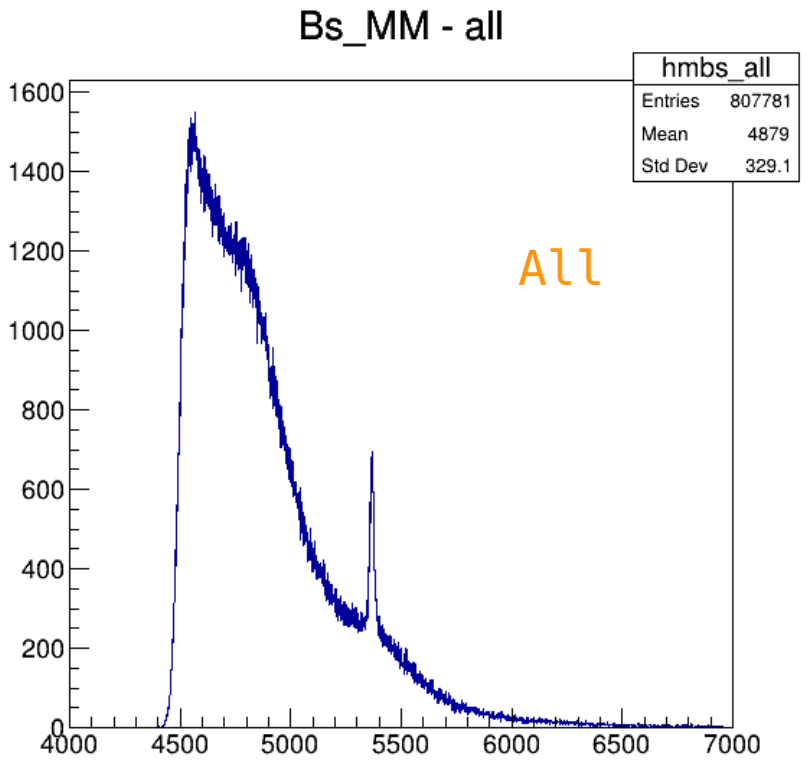
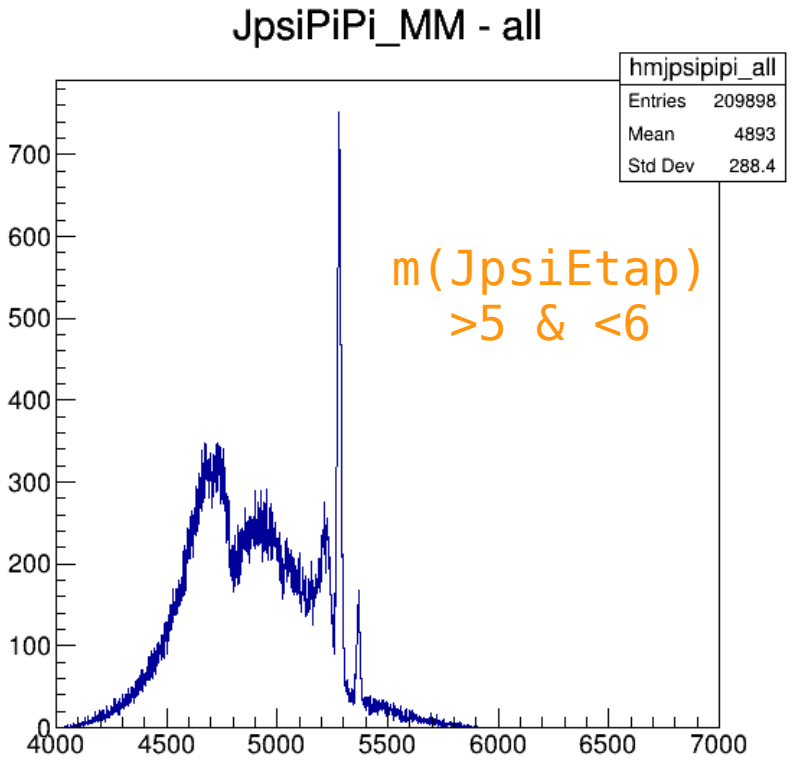




Outline

- Look at JpsiEtap and JpsiPiPi masses, both calculated from DTF-4v.
  For JpsiPiPi, require 5 GeV/c^2 < m(JpsiEtap) < 6 GeV/c^2
- Consider the following decays:
  - Signal, all truth-matched
  - Signal, all but photon truth-matched
  - B(s,d) $\rightarrow$ JpsiPiPi
  - Bs $\rightarrow$ Jpsi Phi[PiPiPi0]
  - Bs $\rightarrow$ Jpsi Phi[KK]
  - B0 $\rightarrow$ Jpsi K*[Kpi]
  - B+ $\rightarrow$ Jpsi Kpipi
  - ?
- Use loose cuts (as in previous talks):
  - PID>0.4 & BDT>0 & Δm(Jpsi)=30 MeV/c^2, Δm(etap)=30 MeV/c^2

Signal

- MC sample 2016 Up-Dw (decfile, generator level cuts):
  - /MC/2016/Beam6500GeV-2016-MagUp-Nu1.6-25ns-Pythia8/Sim09e/Trig0x6139160F/Reco16/Turbo03/Stripping28r1NoPrescalingFlagged/13144203/ALLSTREAMS.DST
- Truth-matched cut:

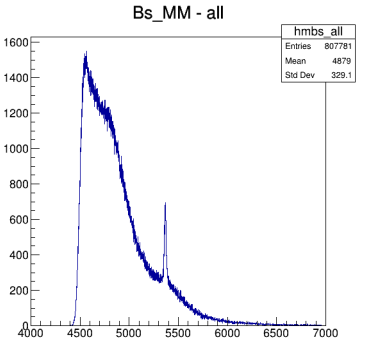
TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==531 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

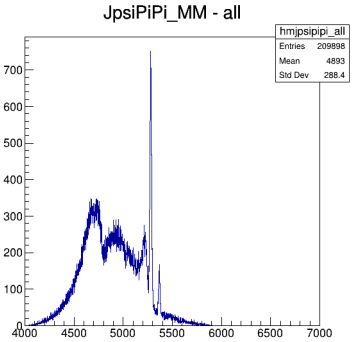
TCut **mygamma** = "gamma_TRUEID==22 && abs(gamma_MC_MOTHER_ID)==331 && abs(gamma_MC_GD_MOTHER_ID) =531"

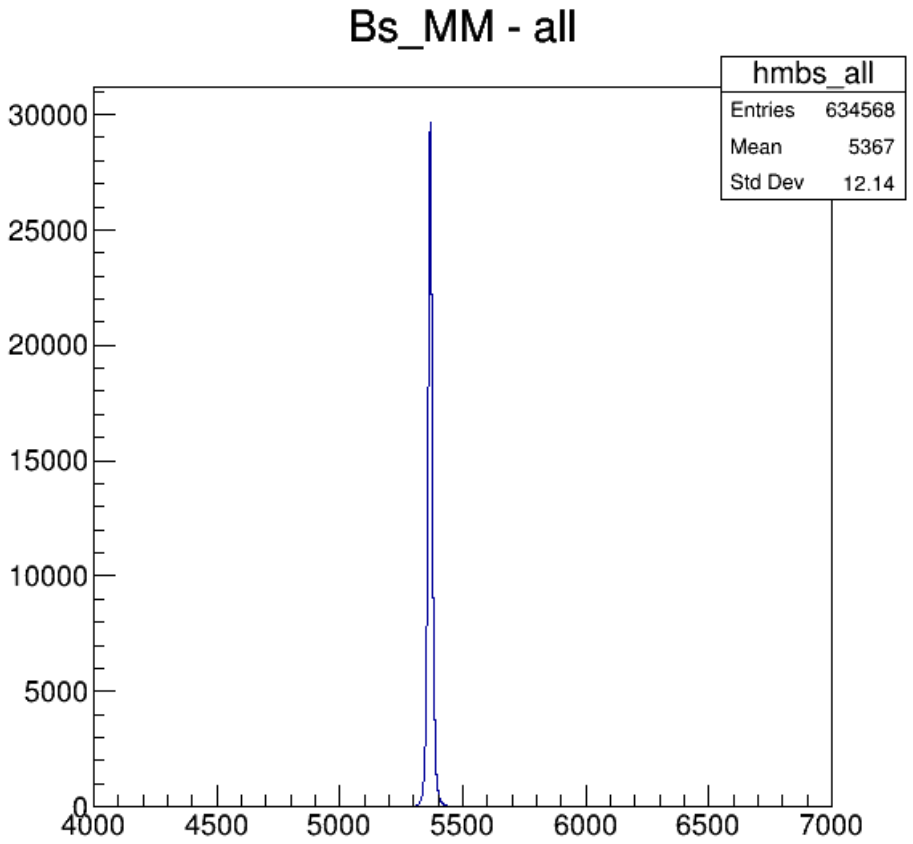
TCut **mypions** = "abs(pi_plus_TRUEID)==211 && abs(pi_minus_TRUEID)==211 && pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==113 && abs(pi_plus_MC_GD_MOTHER_ID)==331 && abs(pi_plus_MC_GD_GD_MOTHER_ID)==531 && pi_plus_MC_GD_MOTHER_KEY==gamma_MC_MOTHER_KEY"

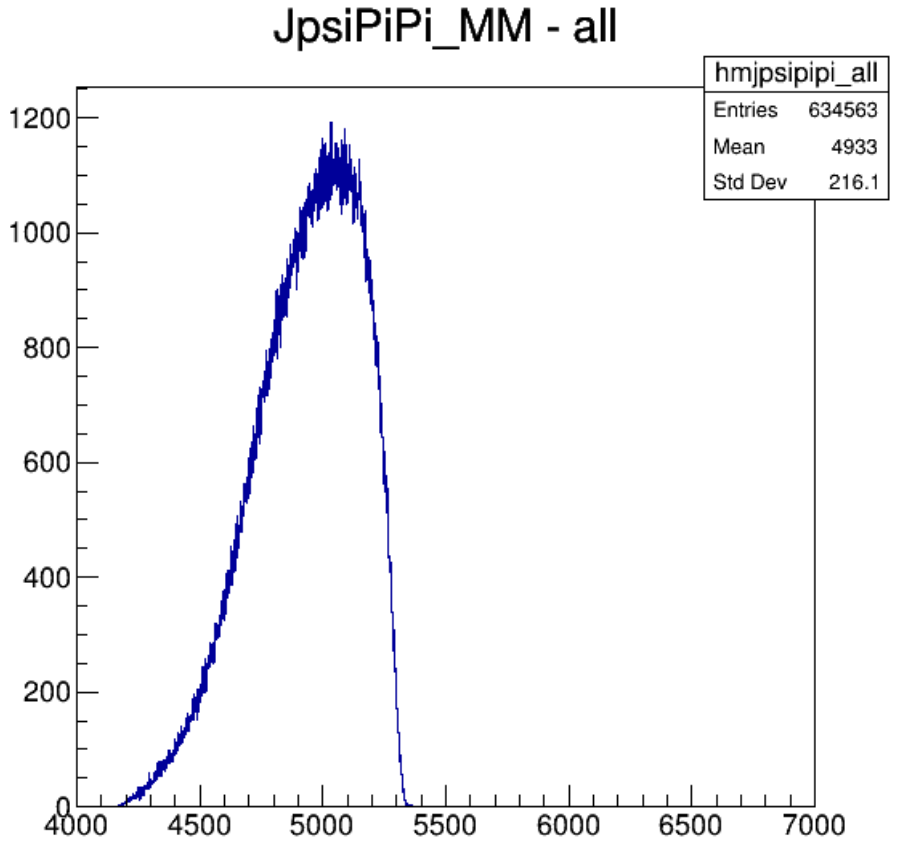
- Efficiency: reco'ed after cuts / DV_processed = 634568 / 7962271 = 8.0%
- Branching: $3.3(0.4) \times 10^{-4}$. 29.1% = 0.96×10^{-4}

Signal

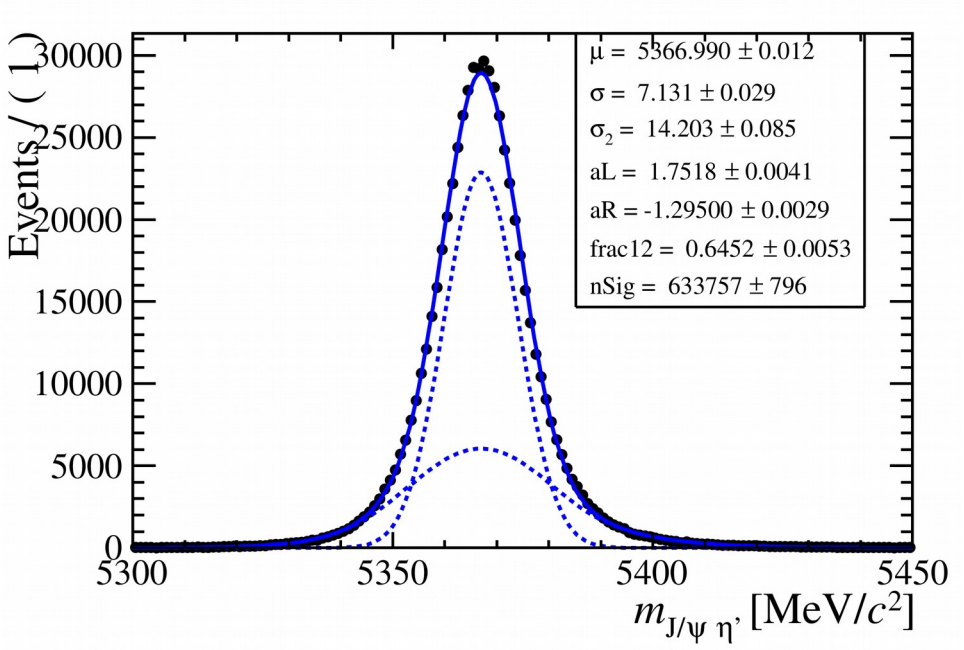

Bs_MM - all
hmbs_all
Entries 807781
Mean 4879
Std Dev 329.1

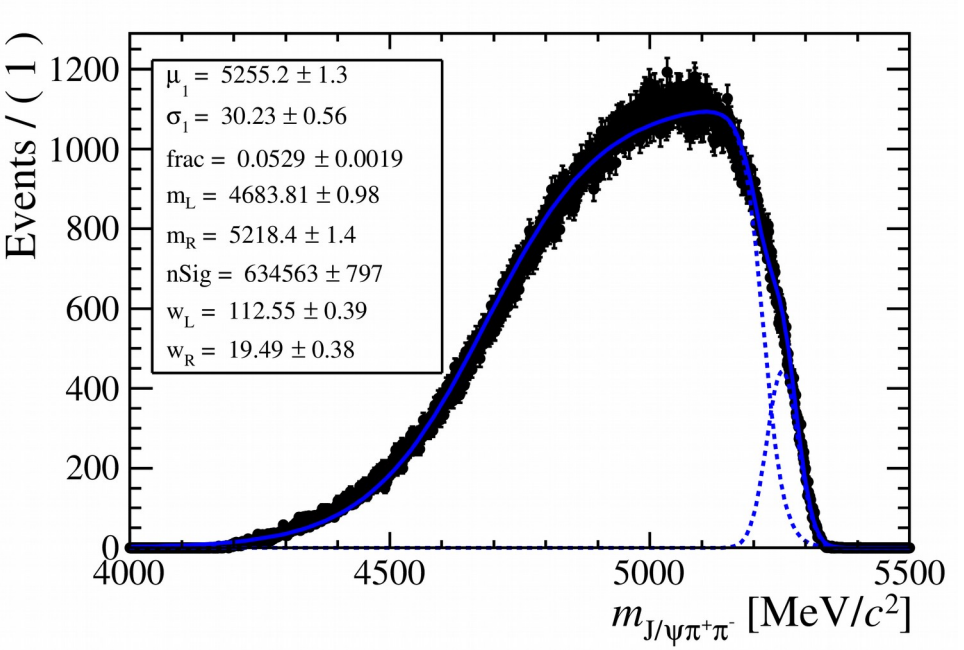

JpsiPiPi_MM - all
hmjpsipipi_all
Entries 209898
Mean 4893
Std Dev 288.4


Bs_MM - all
hmbs_all
Entries 634568
Mean 5367
Std Dev 12.14

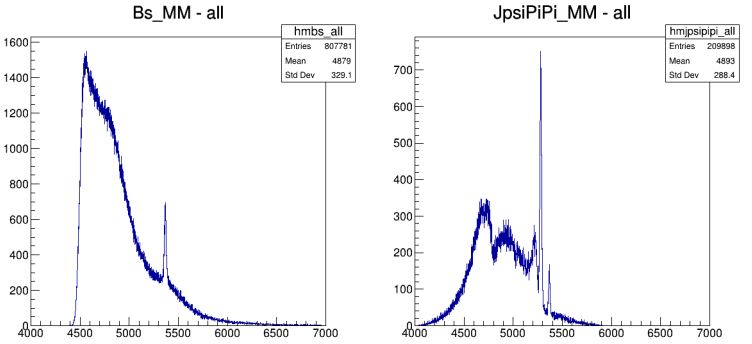

JpsiPiPi_MM - all
hmjpsipipi_all
Entries 634563
Mean 4933
Std Dev 216.1

Signal

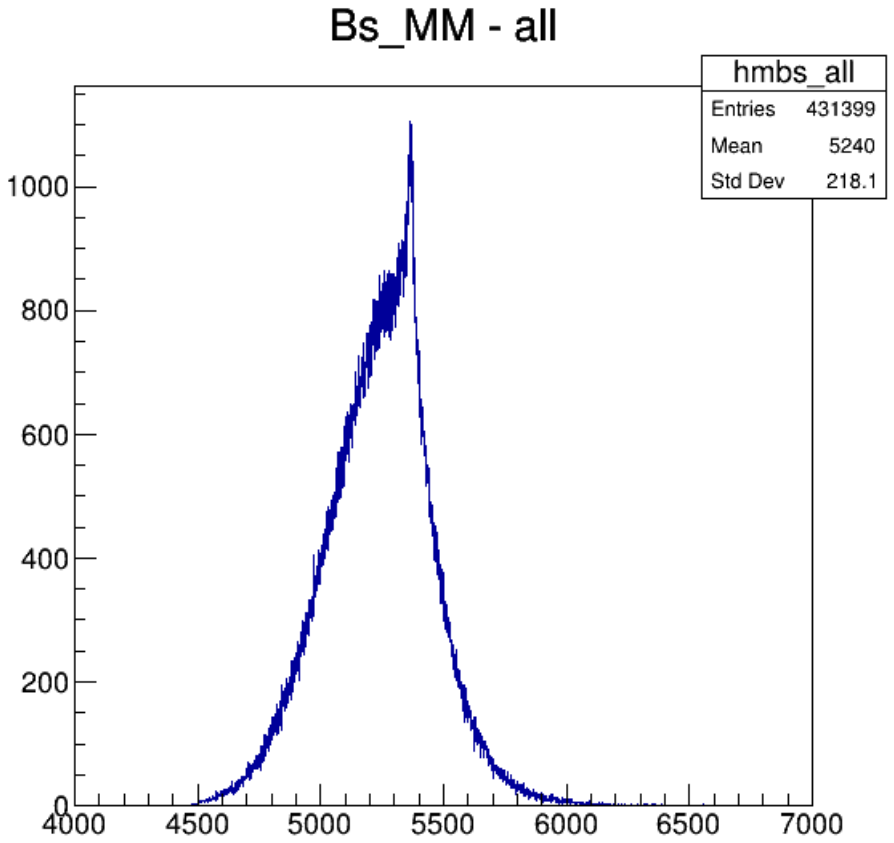

μ = 5366.990 ± 0.012
σ = 7.131 ± 0.029
σ2 = 14.203 ± 0.085
aL = 1.7518 ± 0.0041
aR = -1.29500 ± 0.0029
frac12 = 0.6452 ± 0.0053
nSig = 633757 ± 796
Events / (1)
30000
25000
20000
15000
10000
5000
0
5300
5350
5400
5450
$m_{J/\psi\ \eta'}$ [MeV/c^2]

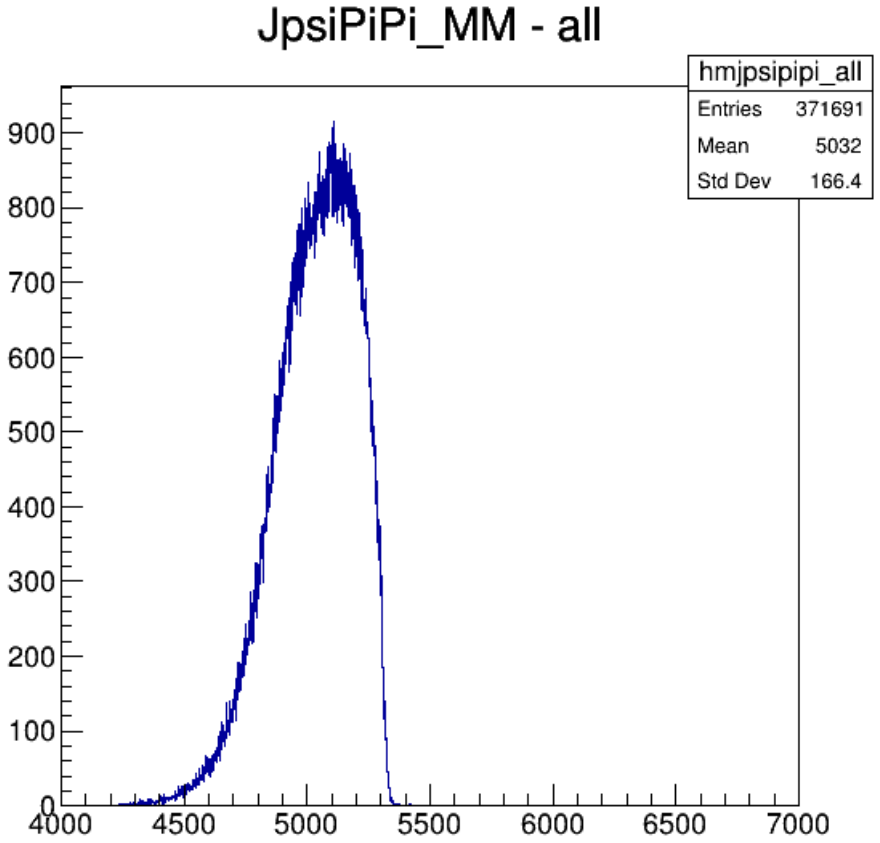

μ1 = 5255.2 ± 1.3
σ1 = 30.23 ± 0.56
frac = 0.0529 ± 0.0019
mL = 4683.81 ± 0.98
mR = 5218.4 ± 1.4
nSig = 634563 ± 797
wL = 112.55 ± 0.39
wR = 19.49 ± 0.38
Events / (1)
1200
1000
800
600
400
200
0
4000
4500
5000
5500
$m_{J/\psi\pi^+\pi^-}$ [MeV/c^2]

Signal + random photon



- Drop photon cut (still, sharp peak @ Bmass)
- Efficiency: reco'ed after cuts / DV_processed = 371691 / 7962271 = 4.7%





Bs → Jpsi PiPi

- MC sample 2015-16 Up-Dw (decfile, PHSP decay):
  - /MC/2016/Beam6500GeV-2016-MagUp-Nu1.6-25ns-Pythia8/Sim09b/Trig0x6138160F/Reco16/Turbo03/Stripping26NoPrescalingFlagged/13144031/ALLSTREAMS.DST
- Truth-matched cut:

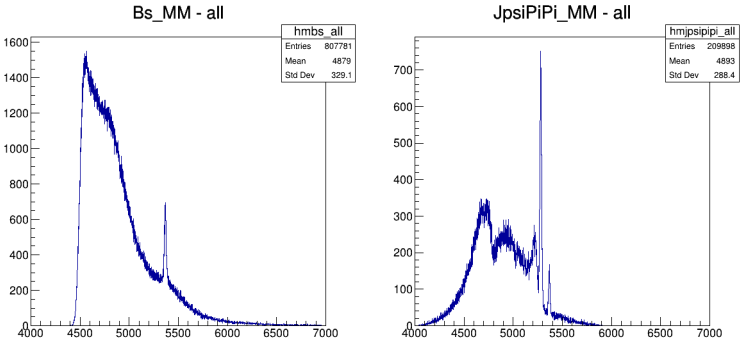
  TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==531 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

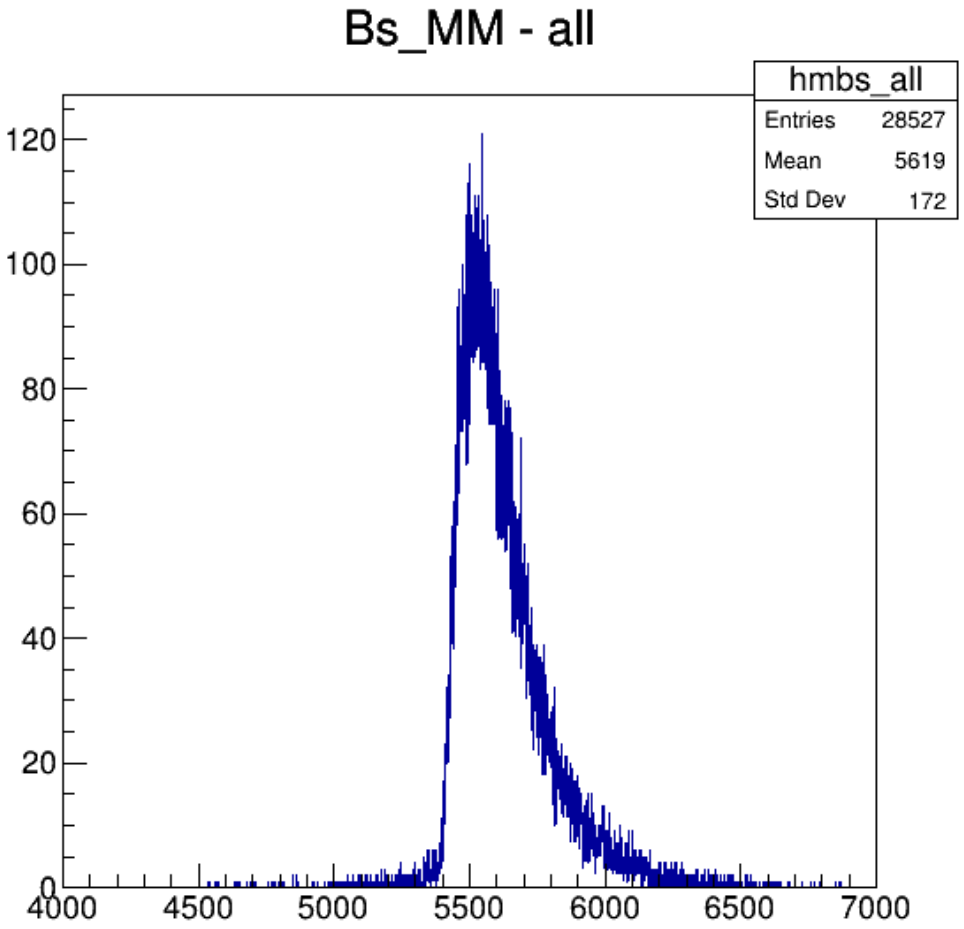
  TCut **mypions** = "abs(pi_plus_TRUEID)==211 && abs(pi_minus_TRUEID)==211 && pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==531"

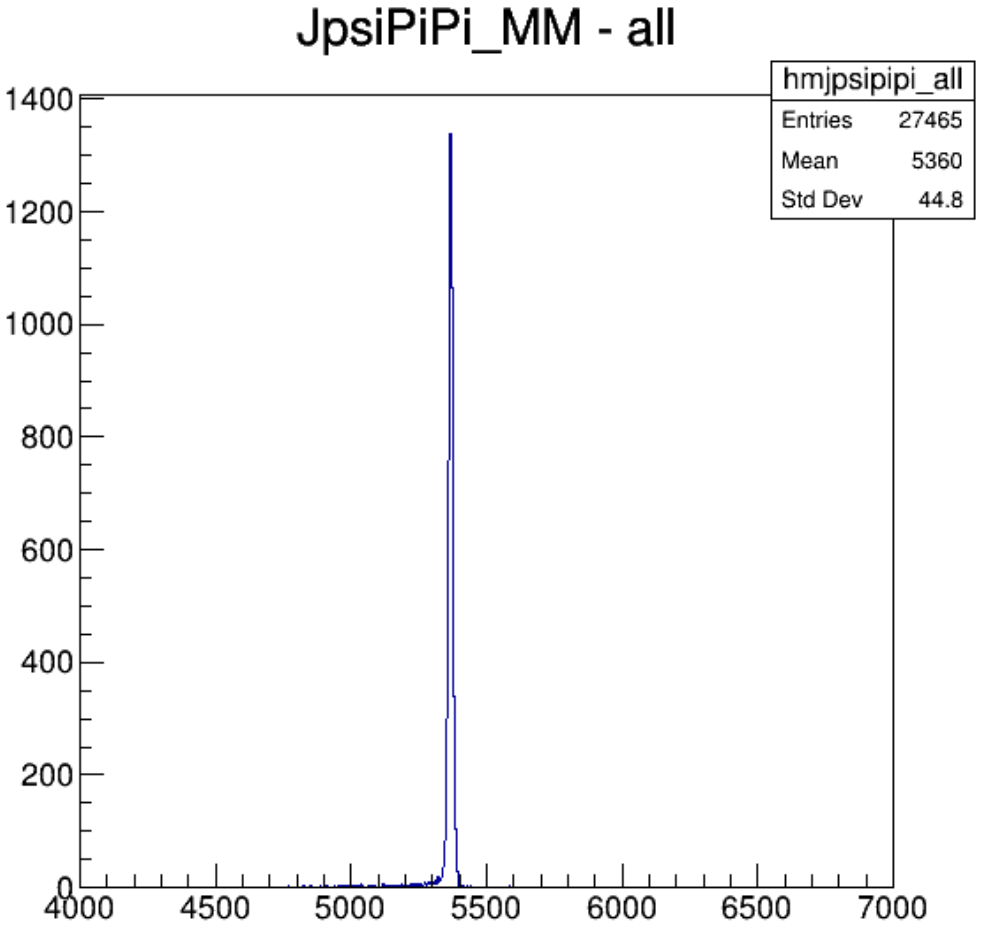
- Efficiency: reco'ed after cuts / DV_processed = 28527 / 6155369 = 0.46%
- Branching: $2.13(0.18) \times 10^{-4}$

  For B0 mode: 4 (fd/fs) . $4.03(0.18) \times 10^{-5} = 1.61 \times 10^{-4}$

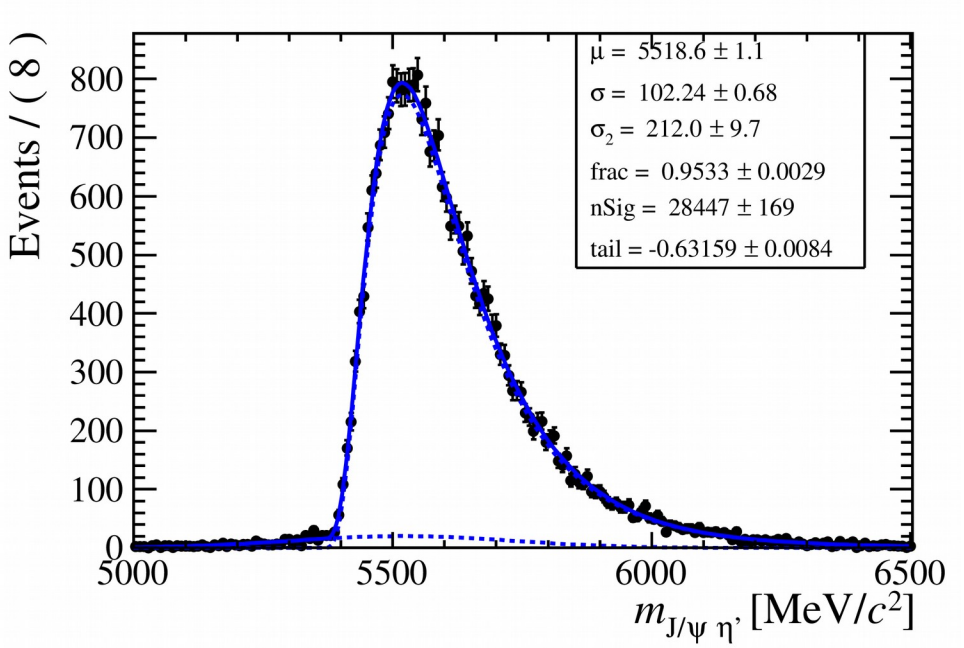
Bs → Jpsi PiPi

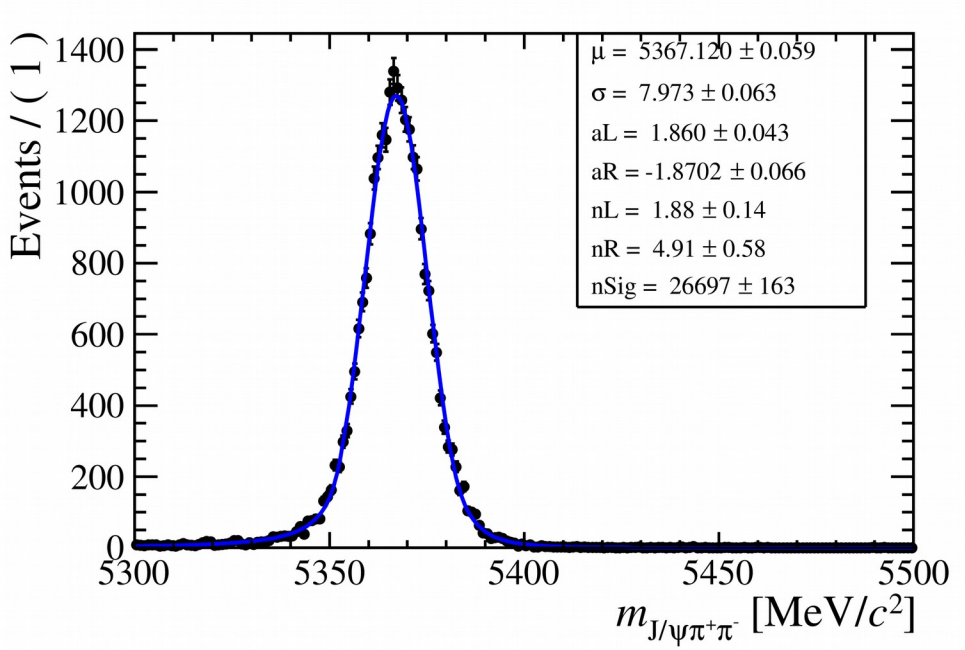

Bs_MM - all
hmbs_all
Entries 807781
Mean 4879
Std Dev 329.1
JpsiPiPi_MM - all
hmjpsipipi_all
Entries 209898
Mean 4893
Std Dev 288.4


Bs_MM - all
hmbs_all
Entries 28527
Mean 5619
Std Dev 172


JpsiPiPi_MM - all
hmjpsipipi_all
Entries 27465
Mean 5360
Std Dev 44.8

Bs → Jpsi PiPi


μ = 5518.6 ± 1.1
σ = 102.24 ± 0.68
σ2 = 212.0 ± 9.7
frac = 0.9533 ± 0.0029
nSig = 28447 ± 169
tail = -0.63159 ± 0.0084
Events / (8)
m J/ψ η' [MeV/c2]


μ = 5367.120 ± 0.059
σ = 7.973 ± 0.063
aL = 1.860 ± 0.043
aR = -1.8702 ± 0.066
nL = 1.88 ± 0.14
nR = 4.91 ± 0.58
nSig = 26697 ± 163
Events / (1)
m J/ψπ+π- [MeV/c2]

Bs → Jpsi Phi[KK]

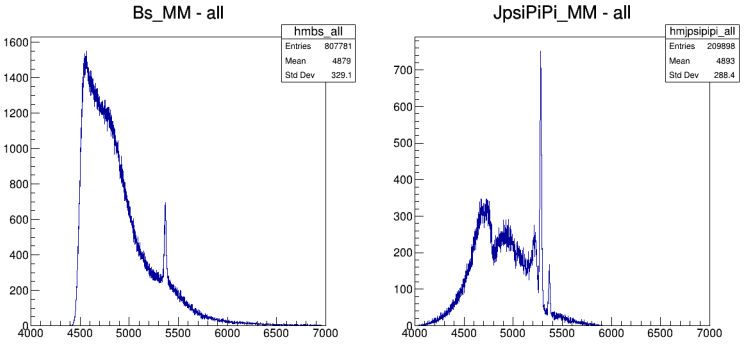
- MC sample 2011-12 Up-Dw (Run I only, decfile, cocktail pipipi0/KK (1/3)):
  - /MC/2012/Beam4000GeV-2012-MagUp-Nu2.5-Pythia8/Sim08a/Digi13/Trig0x409f0045/Reco14a/Stripping20NoPrescalingFlagged/13344002/ALLSTREAMS.DST
- Truth-matched cut:

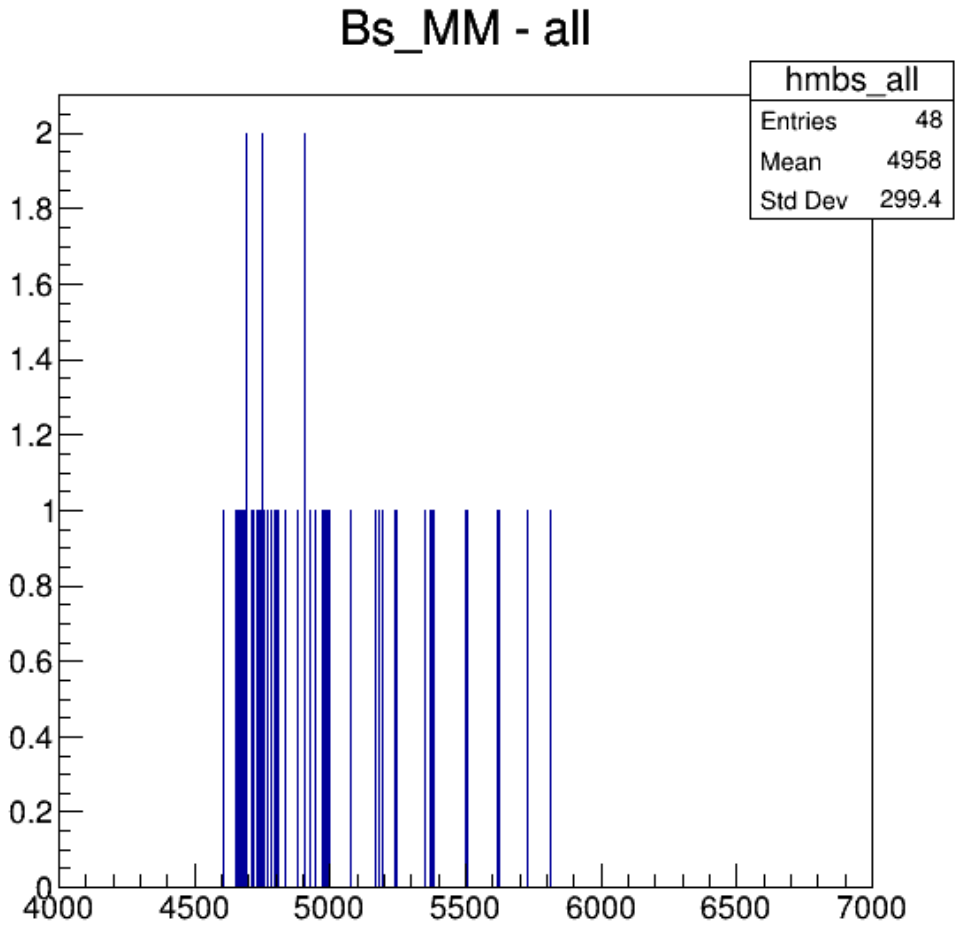
TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==531 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

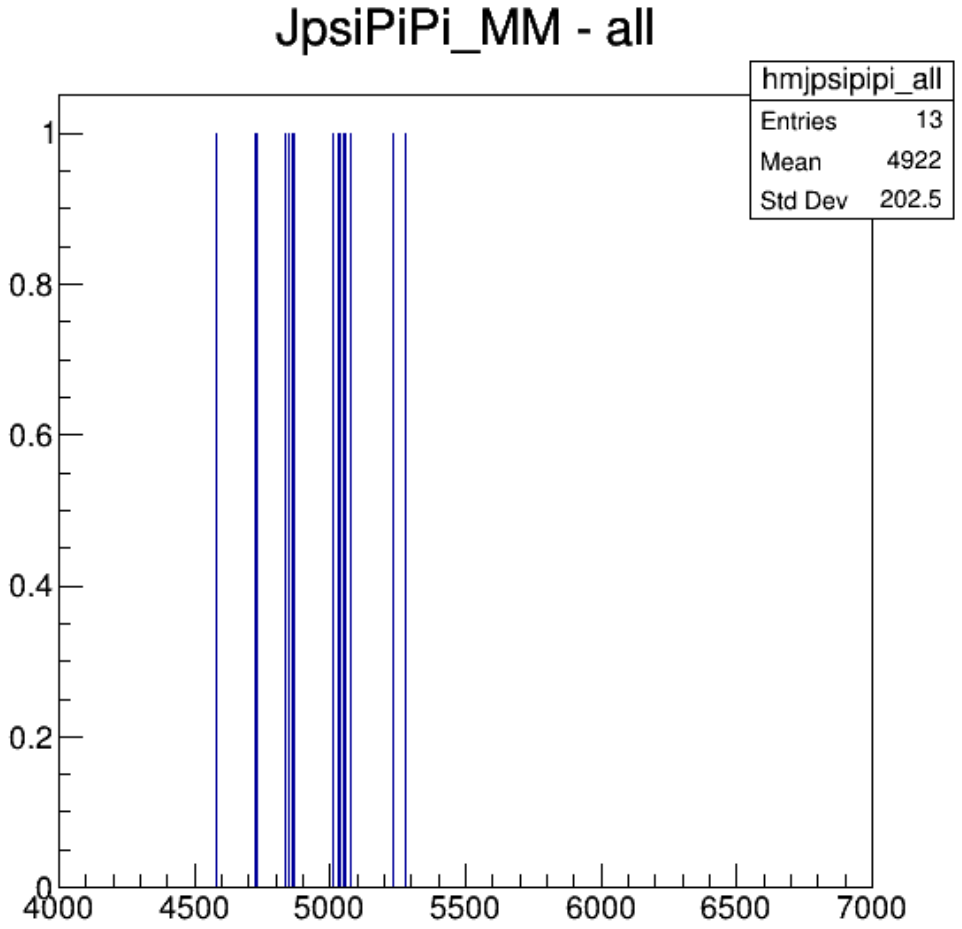
TCut **mykk** = "(abs(pi_plus_TRUEID)==321 && abs(pi_plus_MC_MOTHER_ID)==333 && abs(pi_plus_MC_GD_MOTHER_ID)==531) || (abs(pi_minus_TRUEID)==321 && abs(pi_minus_MC_MOTHER_ID)==333 && abs(pi_minus_MC_GD_MOTHER_ID)==531)";

- Efficiency: reco'ed after cuts / DV_processed = 13 / 1616882 = 0.001%
- Branching: $1.07(0.08) \times 10^{-3}$. 48.9% = 5.2×10^{-4}

Bs → Jpsi Phi[KK]







Bs → Jpsi Phi[PiPiPi0]

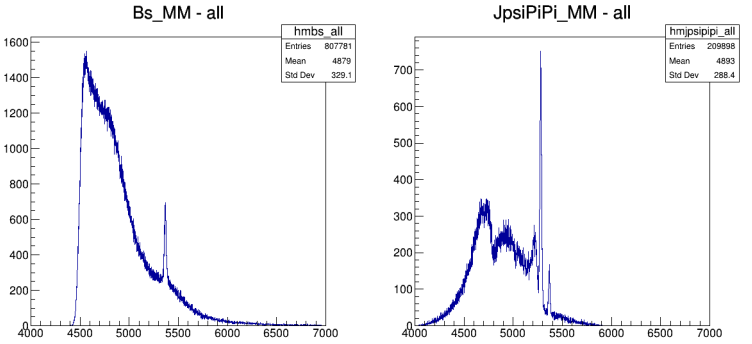
- MC sample 2011-12 Up-Dw (Run I only, decfile, cocktail pipipi0/KK (1/3)):
  - /MC/2012/Beam4000GeV-2012-MagUp-Nu2.5-Pythia8/Sim08a/Digi13/Trig0x409f0045/Reco14a/Stripping20NoPrescalingFlagged/13344002/ALLSTREAMS.DST
- Truth-matched cut:

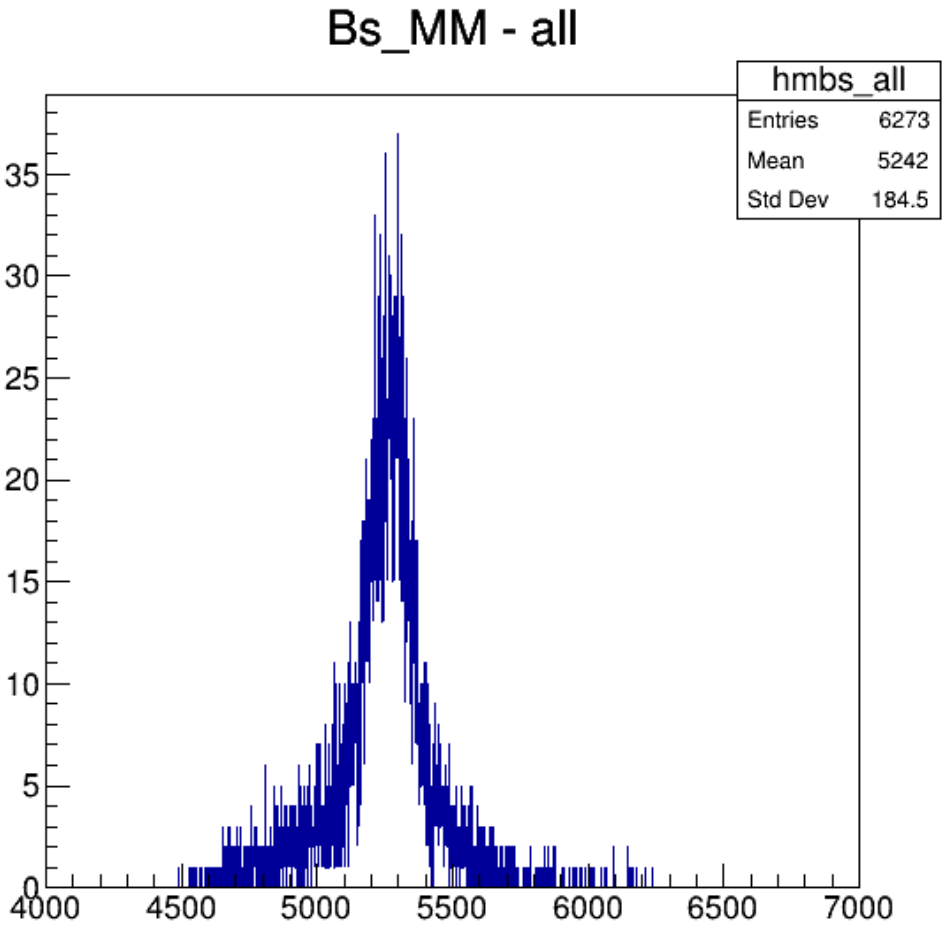
  TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==531 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

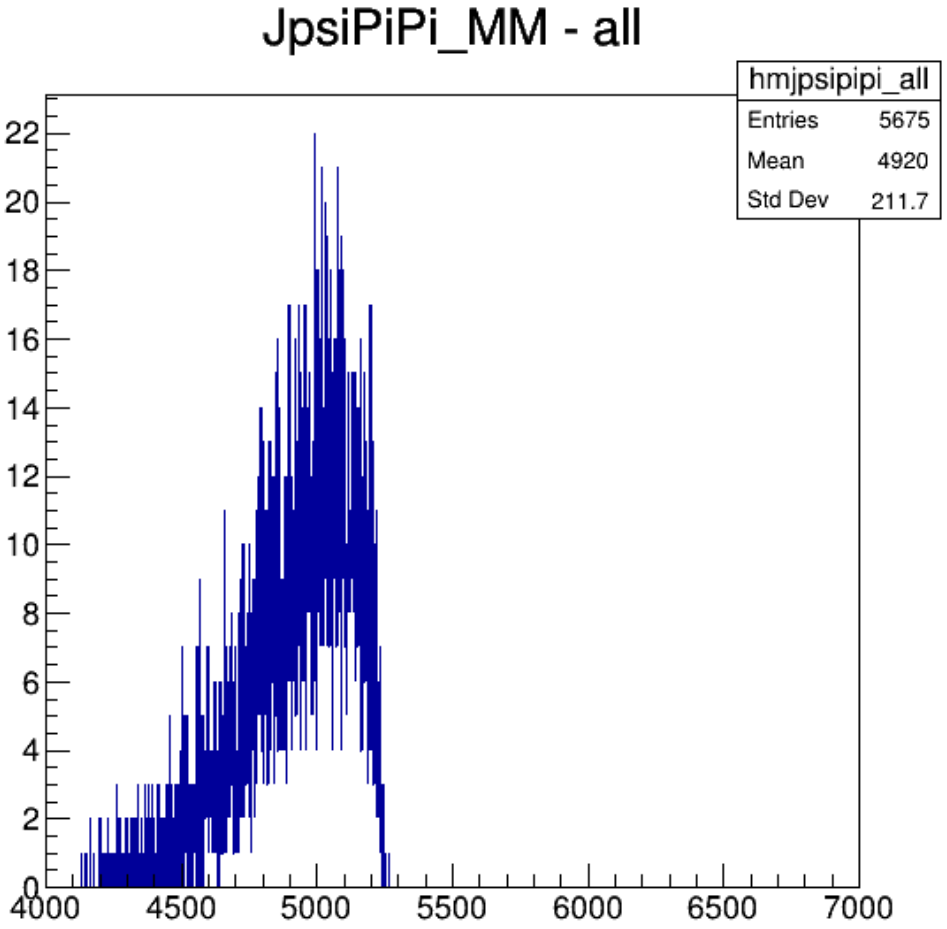
  TCut **mypipipi0** = "pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==333 && abs(pi_plus_MC_GD_MOTHER_ID)==531 && abs(pi_plus_TRUEID)==abs(pi_minus_TRUEID) && abs(pi_plus_TRUEID)==211"

- Efficiency: reco'ed after cuts / DV_processed = 5675 / 515363 = 1.10%
- Branching: $1.07(0.08) \times 10^{-3}$. 15.3% = 1.6×10^{-4}

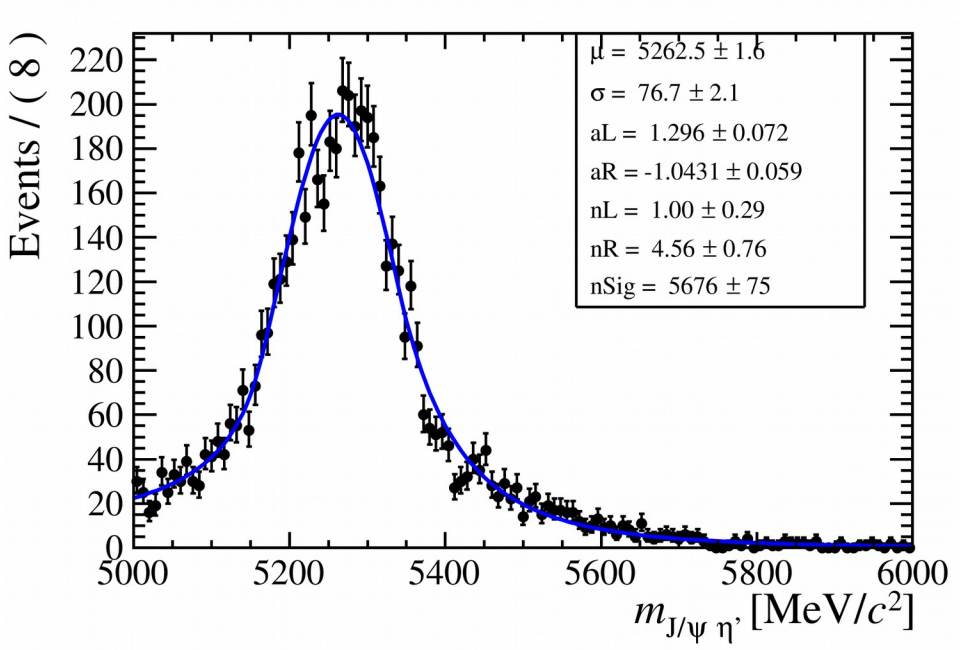
Bs → Jpsi Phi[PiPiPi0]

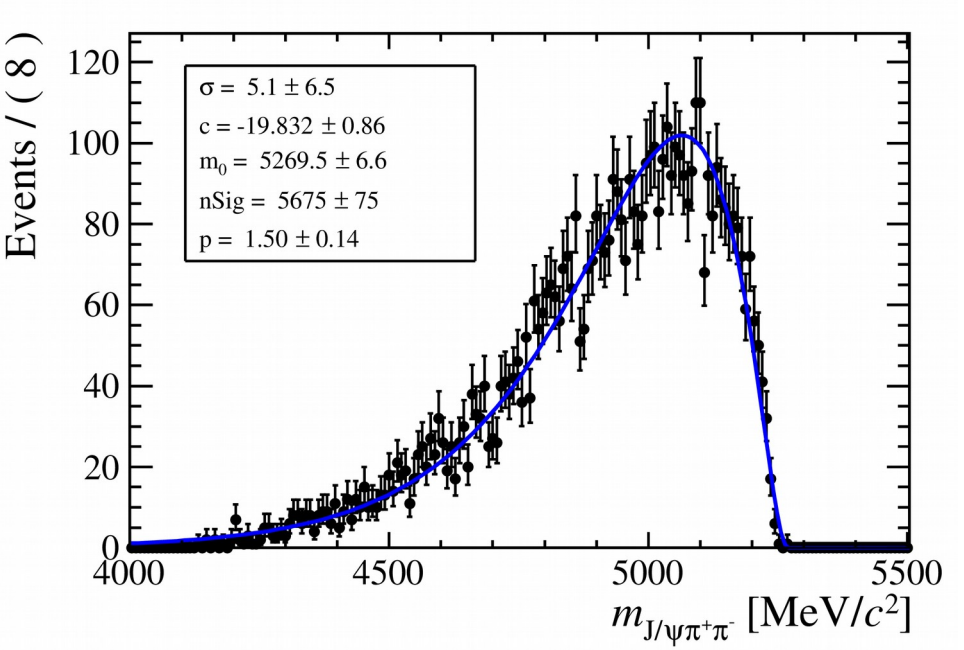






Bs → Jpsi Phi[PiPiPi0]





B0 → Jpsi K*

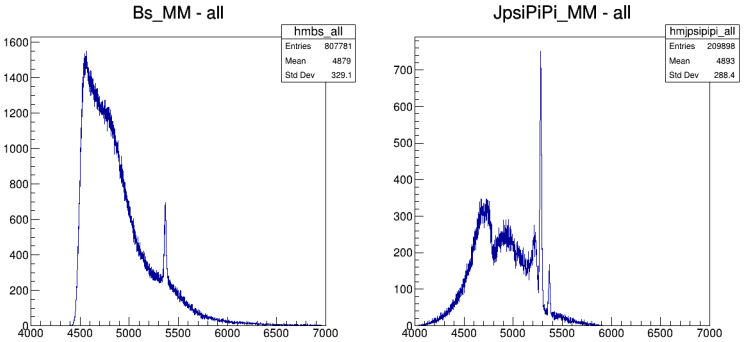
- MC sample 2015-16 Up-Dw (decfile, PHSP decay). Only processed sub-stat:
  - /MC/2016/Beam6500GeV-2016-MagUp-Nu1.6-25ns-Pythia8/Sim09b/Trig0x6138160F/Reco16/Turbo03/Stripping26NoPrescalingFlagged/11144001/ALLSTREAMS.LDST
- Truth-matched cut:

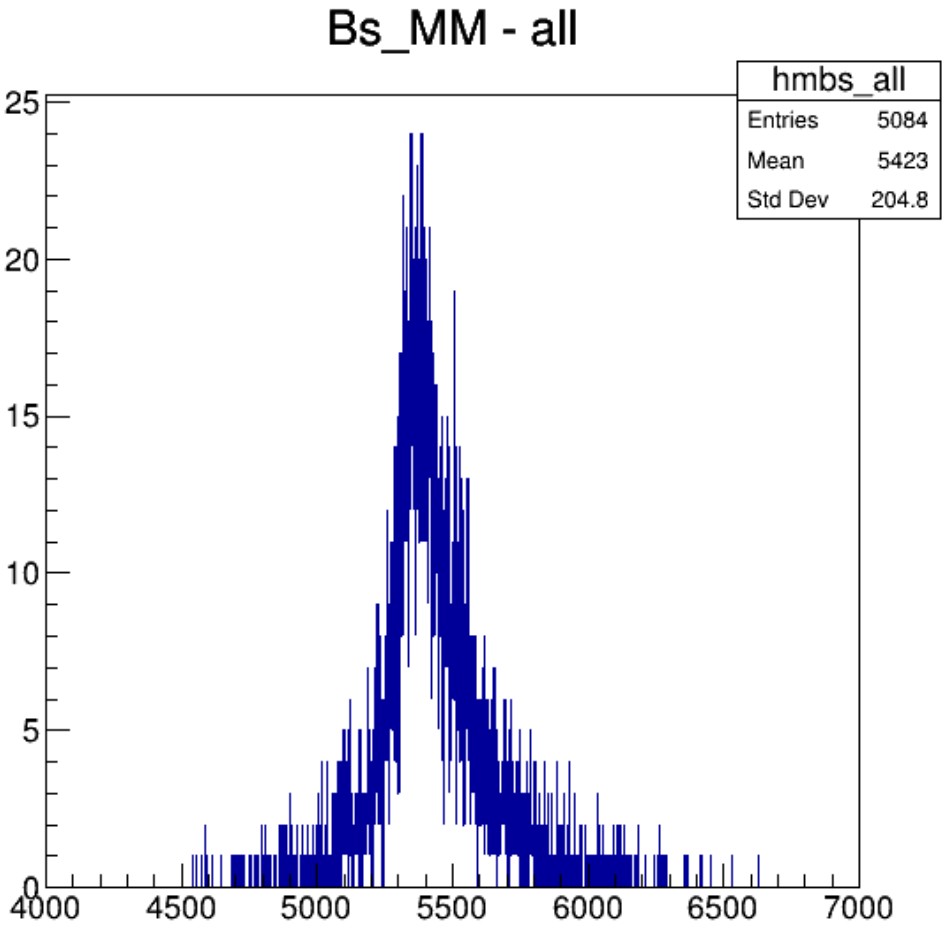
TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==511 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

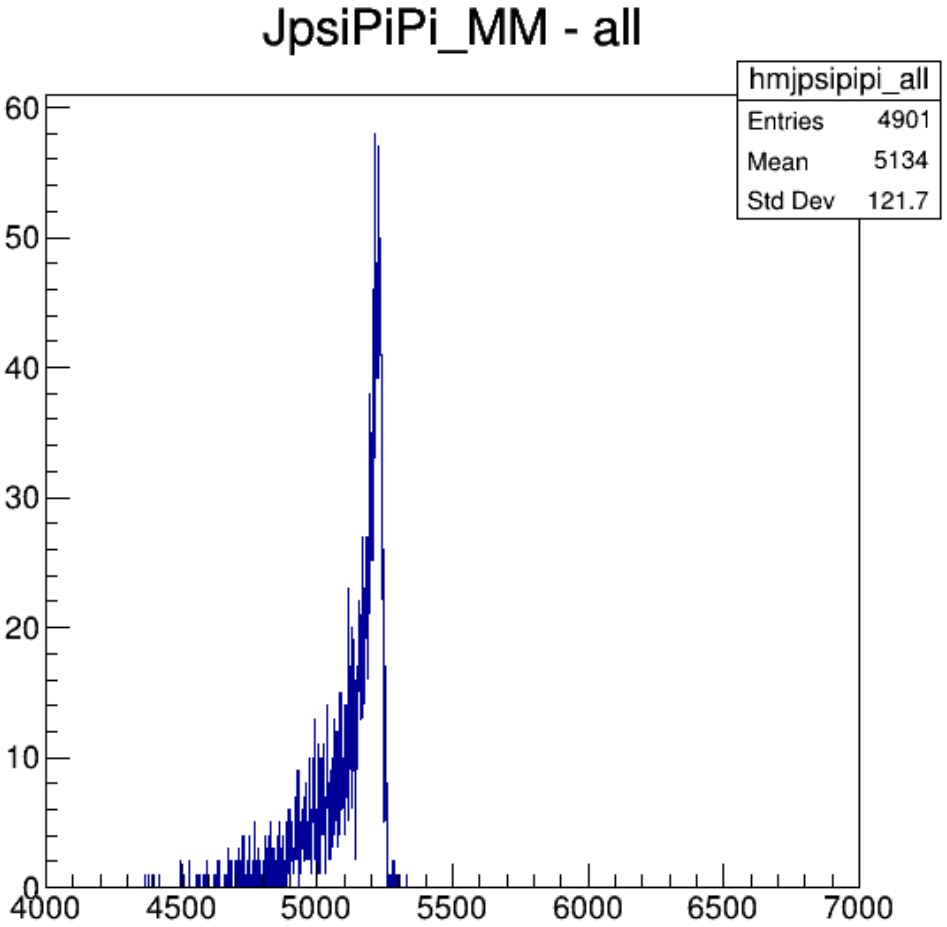
TCut **mypions** = "((abs(pi_plus_TRUEID)==211 && abs(pi_minus_TRUEID)==321) || (abs(pi_plus_TRUEID)==321 && abs(pi_minus_TRUEID)==211)) && pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==313 && abs(pi_plus_MC_GD_MOTHER_ID)==511 && pi_plus_MC_GD_MOTHER_KEY==Jpsi_MC_MOTHER_KEY"

- Efficiency: reco'ed after cuts / DV_processed = 4901 / 6780003 = 0.07%
- Branching: 4 (fd/ds) . 1.28(0.05) x 10^{-3} = 5.12 x 10^{-3}

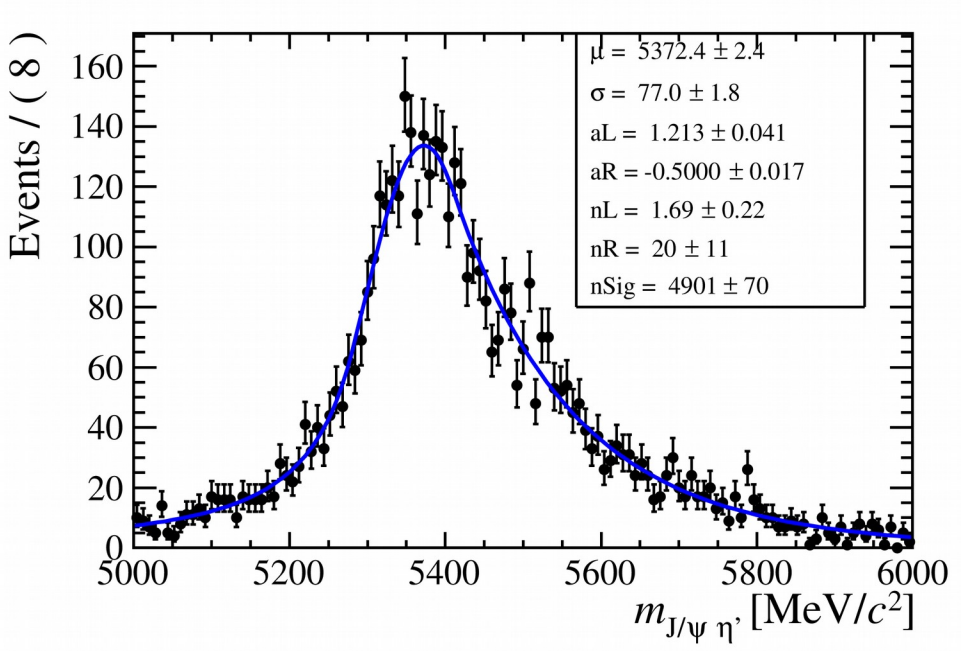
B0 → Jpsi K*

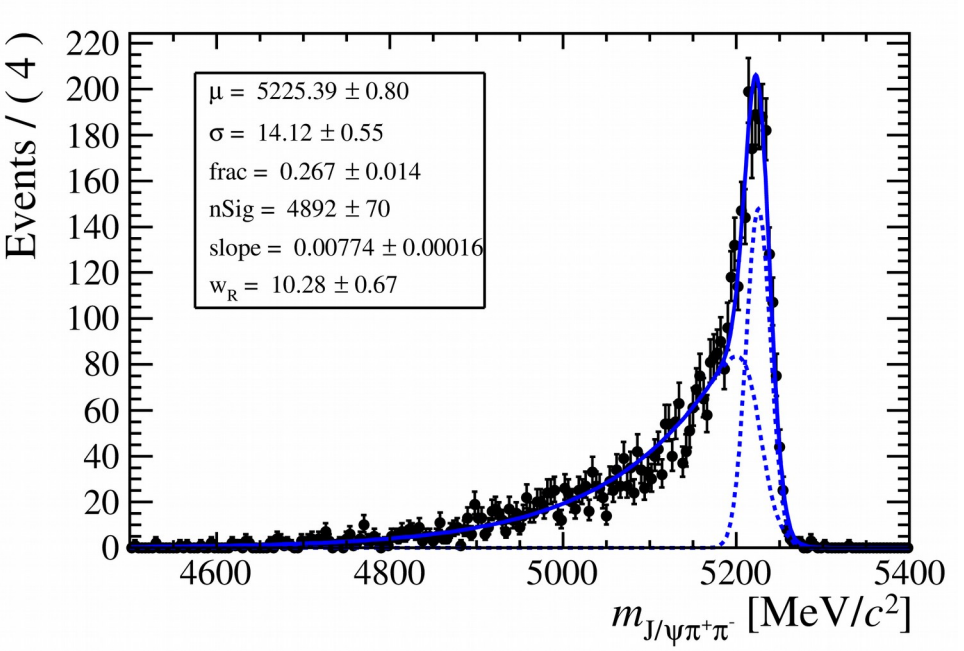

Bs_MM - all
hmbs_all
Entries 807781
Mean 4879
Std Dev 329.1
JpsiPiPi_MM - all
hmjpsipipi_all
Entries 209898
Mean 4893
Std Dev 288.4


Bs_MM - all
hmbs_all
Entries 5084
Mean 5423
Std Dev 204.8


JpsiPiPi_MM - all
hmjpsipipi_all
Entries 4901
Mean 5134
Std Dev 121.7

B0 → Jpsi K*


μ = 5372.4 ± 2.4
σ = 77.0 ± 1.8
aL = 1.213 ± 0.041
aR = -0.5000 ± 0.017
nL = 1.69 ± 0.22
nR = 20 ± 11
nSig = 4901 ± 70
Events / (8)
$m_{J/\psi\ \eta'}$ [MeV/c^2]


μ = 5225.39 ± 0.80
σ = 14.12 ± 0.55
frac = 0.267 ± 0.014
nSig = 4892 ± 70
slope = 0.00774 ± 0.00016
w_R = 10.28 ± 0.67
Events / (4)
$m_{J/\psi\pi^+\pi^-}$ [MeV/c^2]

B+ → Jpsi Kpipi

- MC sample 2011-12 Up-Dw (Run I only DST, decfile, PHSP decay):
  - /MC/2012/Beam4000GeV-2012-MagUp-Nu2.5-Pythia8/Sim08e/Digi13/Trig0x409f0045/Reco14a/Stripping20NoPrescalingFlagged/12145070/ALLSTREAMS.DST
- Truth-matched cut:

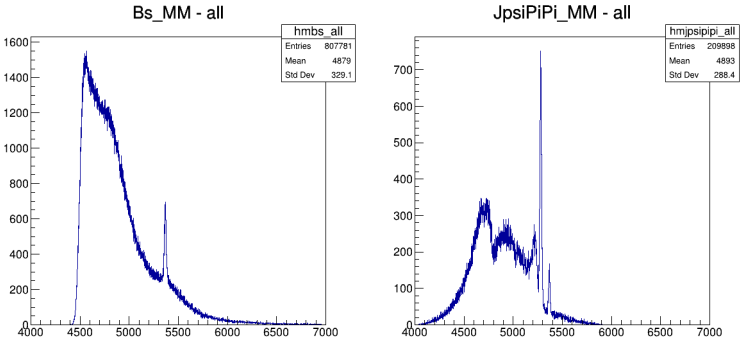
TCut **myjpsi** = "mu_plus_MC_MOTHER_KEY==mu_minus_MC_MOTHER_KEY && abs(mu_plus_MC_MOTHER_ID)==443 && abs(mu_plus_MC_GD_MOTHER_ID)==521 && abs(mu_plus_TRUEID)==13 && abs(mu_minus_TRUEID)==13"

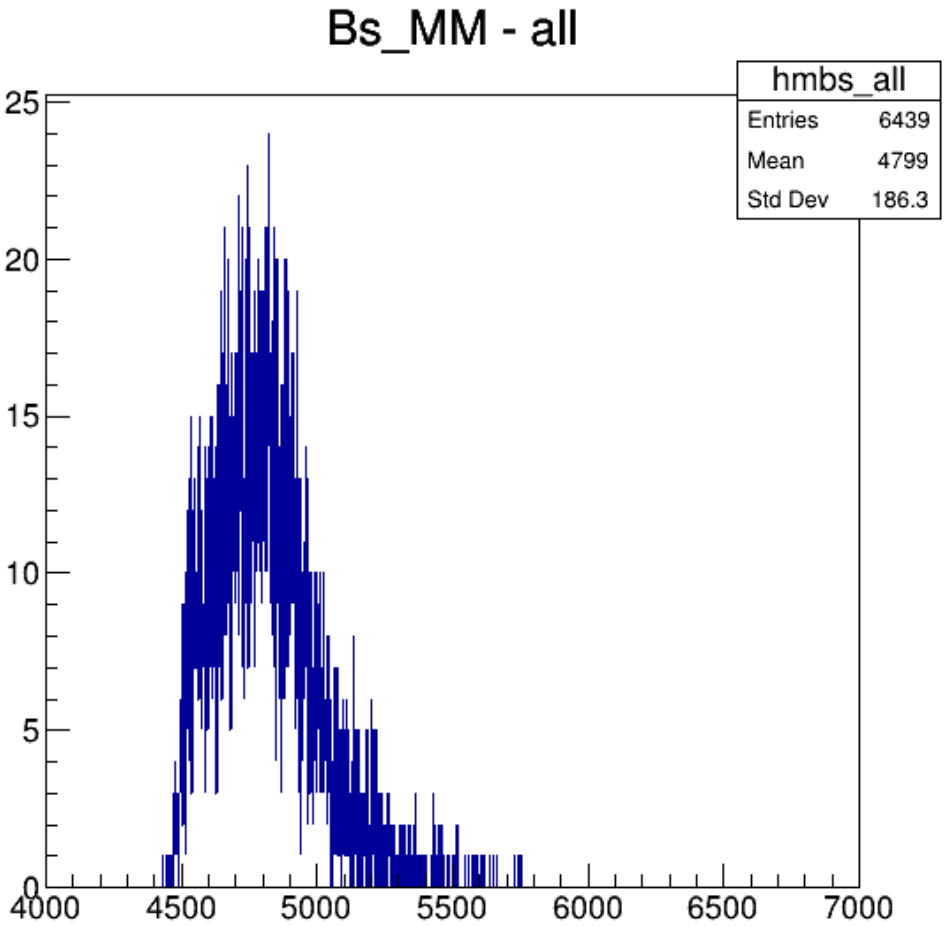
TCut **mypions** = "abs(pi_plus_TRUEID)==211 && abs(pi_minus_TRUEID)==211 && pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==521"

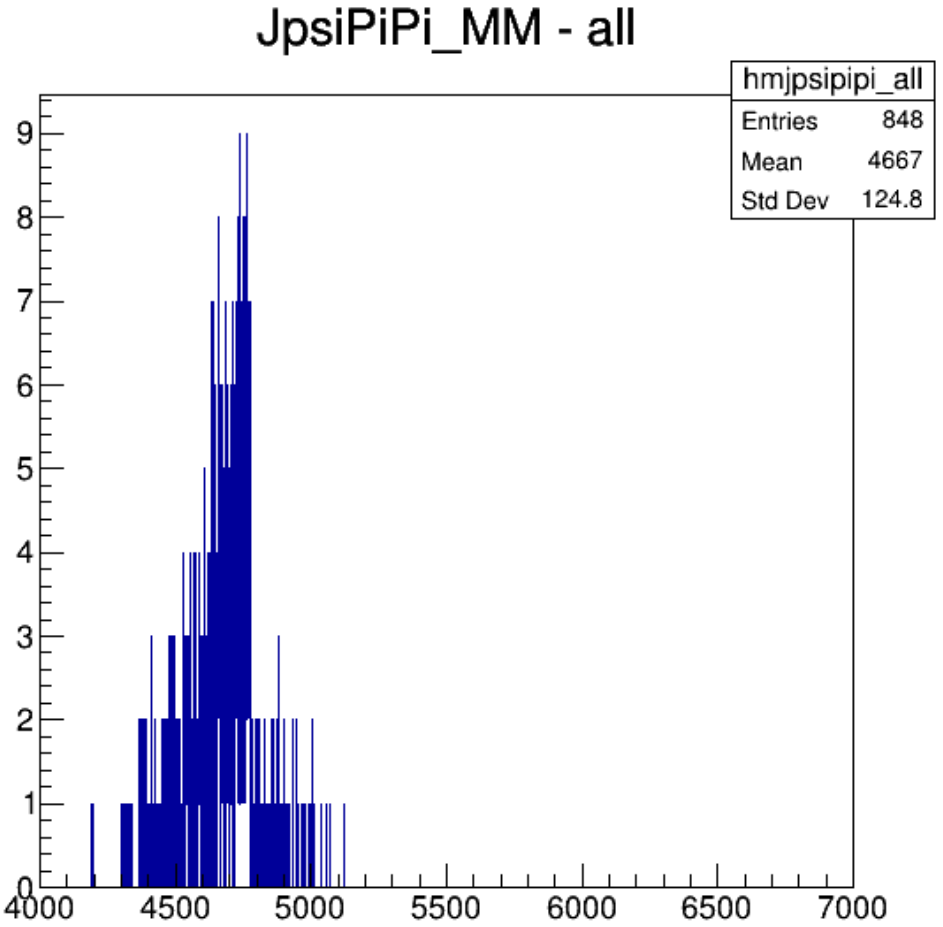
TCut **mytracks && !mypions** = "pi_plus_MC_MOTHER_KEY==pi_minus_MC_MOTHER_KEY && abs(pi_plus_MC_MOTHER_ID)==521" && mypions;

- Efficiency: reco'ed after cuts / DV_processed = 848 / 2940094 = 0.03%
- Branching: 4 (fd/ds) . 8.1(1.3) x 10^{-4} = 3.24 x 10^{-3}

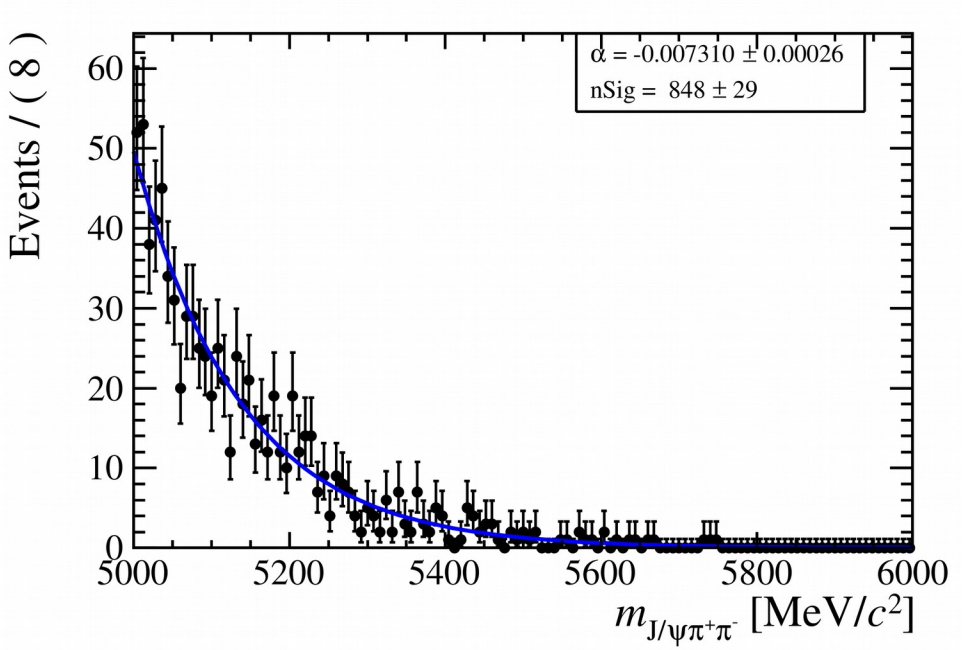
B+ → Jpsi Kpipi

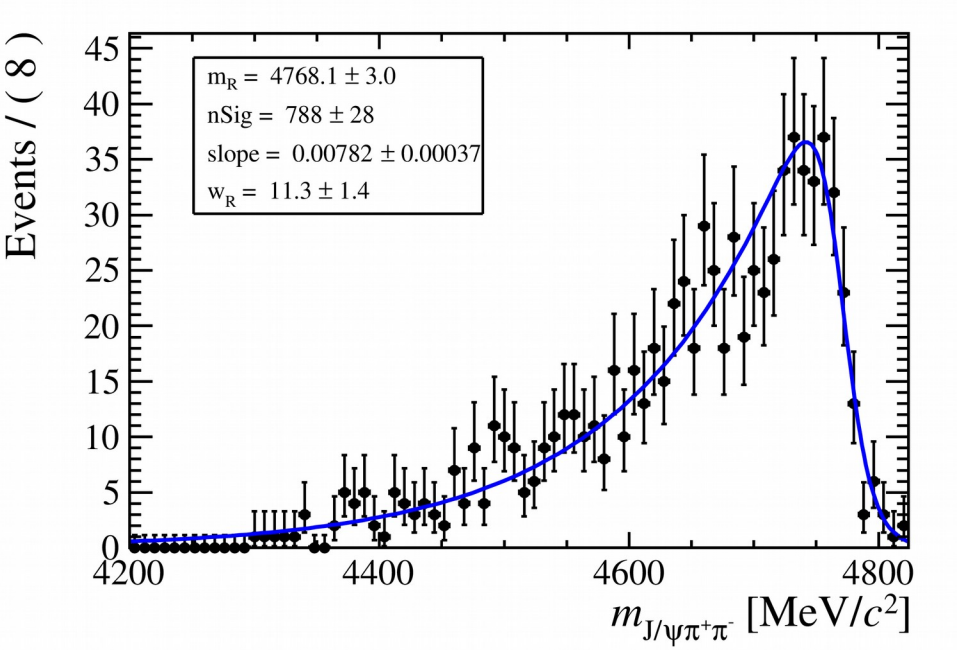

Bs_MM - all
hmbs_all
Entries 807781
Mean 4879
Std Dev 329.1
JpsiPiPi_MM - all
hmjpsipipi_all
Entries 209898
Mean 4893
Std Dev 288.4


Bs_MM - all
hmbs_all
Entries 6439
Mean 4799
Std Dev 186.3


JpsiPiPi_MM - all
hmjpsipipi_all
Entries 848
Mean 4667
Std Dev 124.8

B+ → Jpsi Kpipi


α = -0.007310 ± 0.00026
nSig = 848 ± 29
Events / (8)
$m_{J/\psi\pi^+\pi^-}$ [MeV/c^2]


m_R = 4768.1 ± 3.0
nSig = 788 ± 28
slope = 0.00782 ± 0.00037
w_R = 11.3 ± 1.4
Events / (8)
$m_{J/\psi\pi^+\pi^-}$ [MeV/c^2]

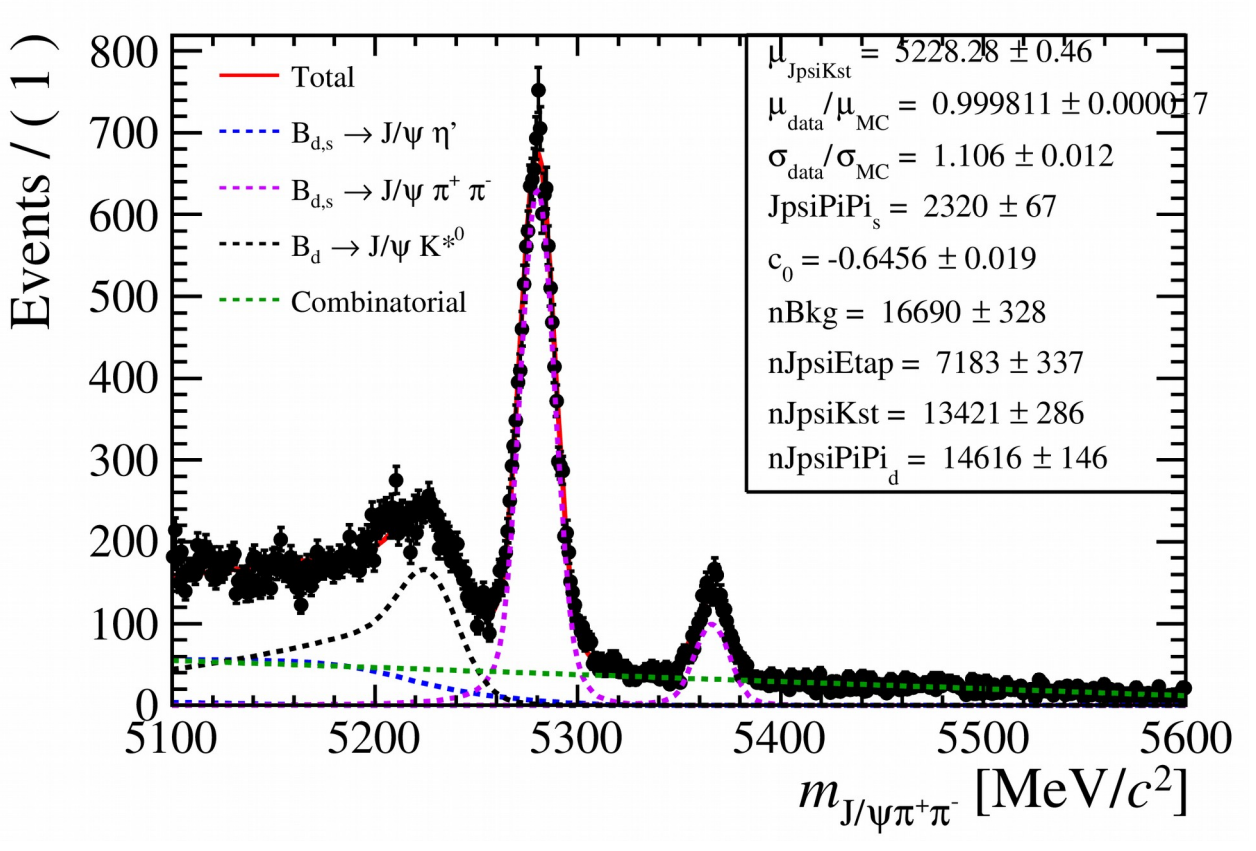
Summary

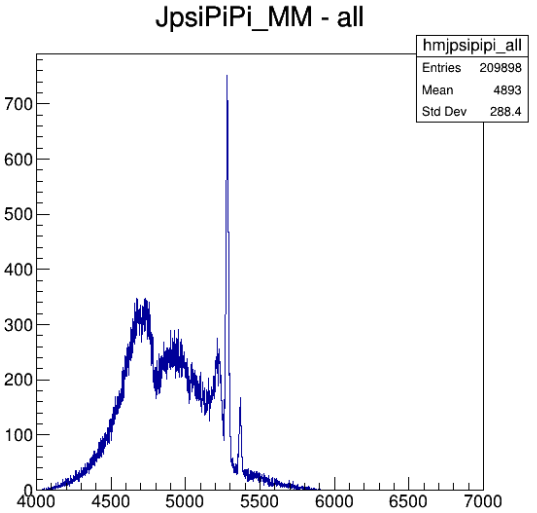
- Signal efficiency to pass JpsiPiPi selections (include 5<JpsiEtap<6 GeV/c^2)
  - Need to know the efficiency of the generator-level cuts (Gauss logs?)
- Background yields relative to each other

Mode	Bs → JpsiPiPi	B0 → JpsiPiPi	Bs → JpsiPhi Phi[KK]	Bs → JpsiPhi Phi[pipipi0]	B0 → JpsiK*	B+ → JpsiKpipi	Signal
eff (%)	0.46	Assume same as Bs mode	0.001	1.10	0.07	0.03	Assume 1% for now
BR	2.13×10^{-4}	1.61×10^{-4}	5.2×10^{-4}	1.6×10^{-4}	5.12×10^{-3}	3.24×10^{-3}	0.96×10^{-4}
eff.BR$\times10^6$	0.98	0.74	0.004	1.76	3.58	0.97	0.96

First JpsiPiPi fit

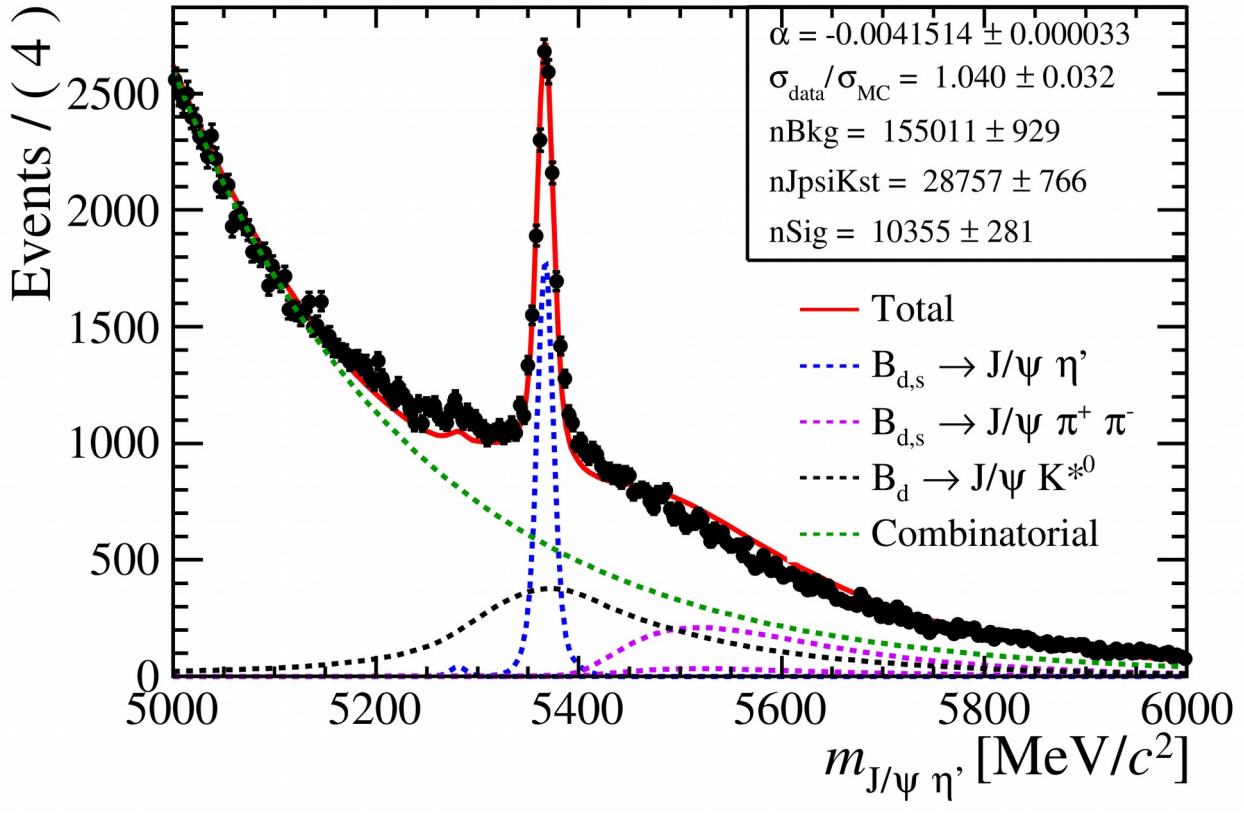
- Model: fit subrange of mass ($\rightarrow$ ignore JpsiKpipi)
- Floating: yields & combinatorial shape & mean of JpsiKst & data/MC ratios
  - B(s,d)2JpsiPiPi yields are quite different (?)

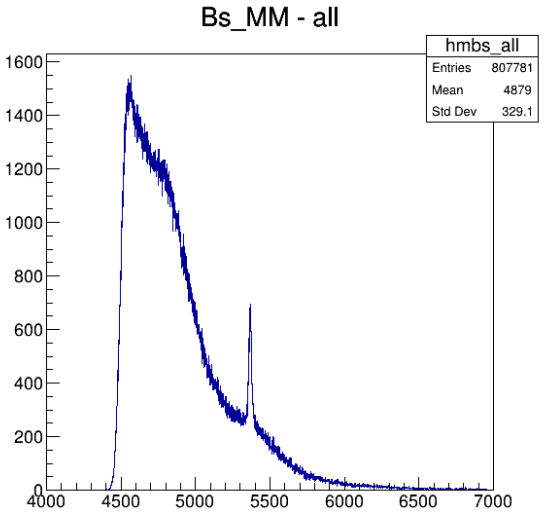




First JpsiEtap fit

- Model: fix JpsiPiPi yields, ignore JpsiKpipi (as in previous)
- Floating: other yields & combinatorial shape & data/MC sigma ratio
  - Signal still around 10^4
  - Need to fix JpsiKst and take JpsiKpipi in ($\rightarrow$ fit JpsiPiPi down to lower mass)





Outlook

- The fits, to-do:
  - Check relative efficencies of various backgrounds (need new signal MC)
  - Fit JpsiPiPi to lower mass (to better constrain JpsiK* & JpsiKpipi)
  - Include Signal + random photon
  - Try to cut tigher on the BDT (better purity)
  - Look at Etap and PiPi masses (useful structures?)
  - Other backgrounds?

MC requests

- JpsiEtap analysis (Stefano)
  - (B02JpsiPiPi: 11144061, decfile, Run II MC available, 5M evt)
  - **Bs2JpsiPhi[PiPiPi0]**, 13344002, decfile is a cocktail (1/3), Run I data only

    Modify decfile to remove Phi[KK]? New request Run II:

    6M = 2M fullsim + 4M redecay, split 2015/2016 Up/Down equally
  - Signal **Bs2JpsiEtap**: use 13144201 instead of 13144203 (i.e. decfile instead of this one) to avoid generator-level cuts (Run I DST & Run II MDST available). Or modify decfile to keep other useful generator-level cuts?
  - Same story for **Bs2JpsiEta2PiPiPi0**: use 13144401 instead of 13144403.
  - **Bu2JpsiKpipi** (PHSP): 12145070 decfile, 3M Run I DST, (Run II MDST)
- JpsiPi0 & JpsiEta analysis (Max)
  - **JpsiEta[pipigamma] Run II**
  - **JpsiK0sh[pi0pi0] Run II**
  - **JpsiK1[K*pi0]** Run II