Processing of Run II dimuon data

Feb. 13th 2019, Annecy/Edinburgh meeting, M. Chefdeville

Introduction

- Foressen Run I & II restripping:
  - New lines: Jpsi pi0[R,M], K^{*+}[R,M], K, eta[gg, pipipi0R-M, pipigamma], eta'[rhogamma, etapipi]
    Will allow for full calo reprocessing if neeeded
  - In parallel: prepare Ntuples with same selections using available stripped data $\rightarrow$ BR(B0 $\rightarrow$ JpsiPi0)

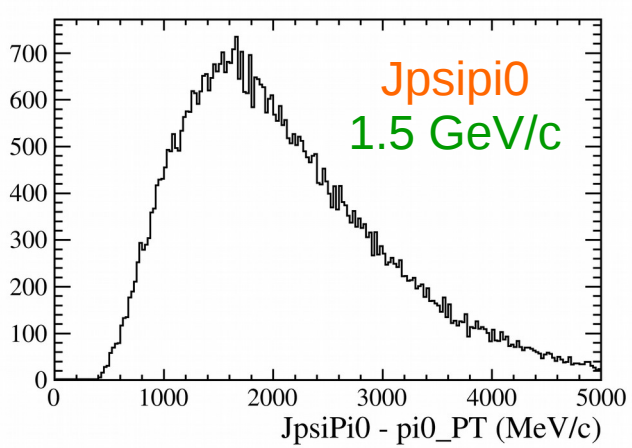
- Processing of DiMuon stream:
  - Start from FullDSTDiMuonJpsi2MuMuDetachedLine candidates
  - Combine with neutrals, use "lowest" PT cut
  - Apply loose vertex cuts: B: DIRA>0.9995 & IP<0.2 & IPCHI2<20 & VCHI2PDOF<10
  - Add a Fisher discriminant if combinatorics too large (JpsiPi0[gg], JpsiK^{*+}, JpsiEta[gg])

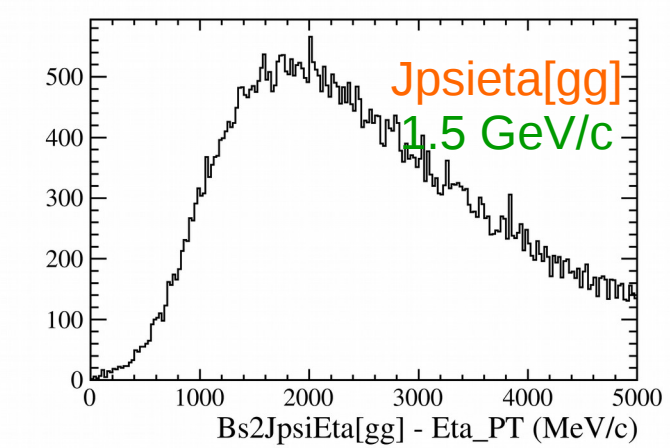
- Ntuples split by mode-year-magnet, being made available on /eos

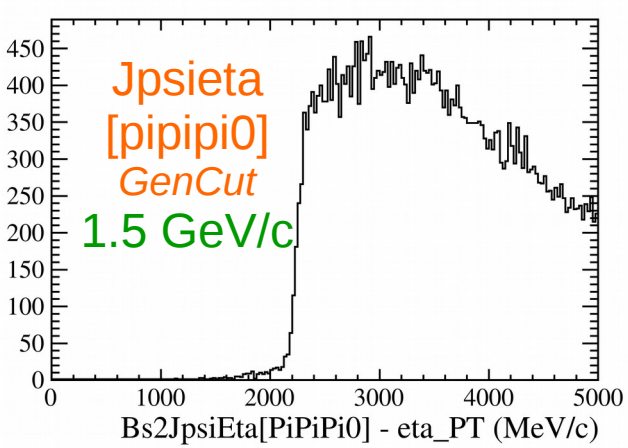
- DaVinci Tupling script:
  - Save DTF-kinematics, Vertex isolation, Photon isol. (cone) & quality (CL, trk-match, converted...)
  - To me made available on git

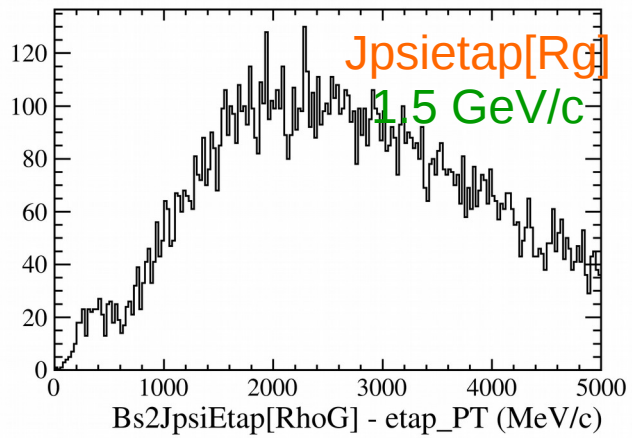
X^0 (P_T,M) cuts

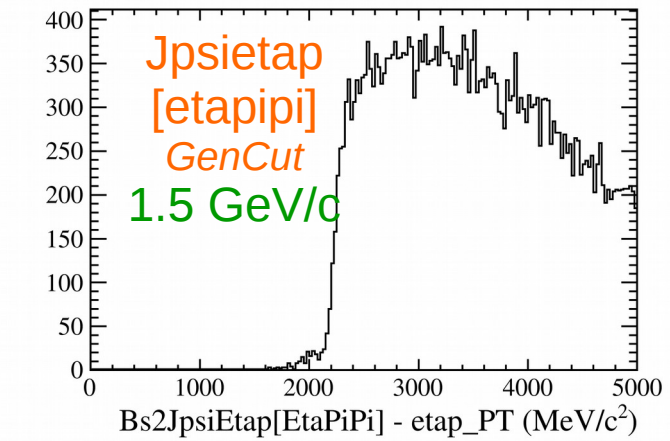
- Look at Run I MC-truth distributions of reco'ed X^0 (= direct B daugther)
  - P_T: 200 MeV/c for photons and no cut for DiPhotons
  - Mode with 2 tracks are high-rate → choose cut as distrib. max @ 1.5 GeV/c
  - Modes with 4 tracks are lower rate → keep 1.5 GeV/c (check later on data if worth it)

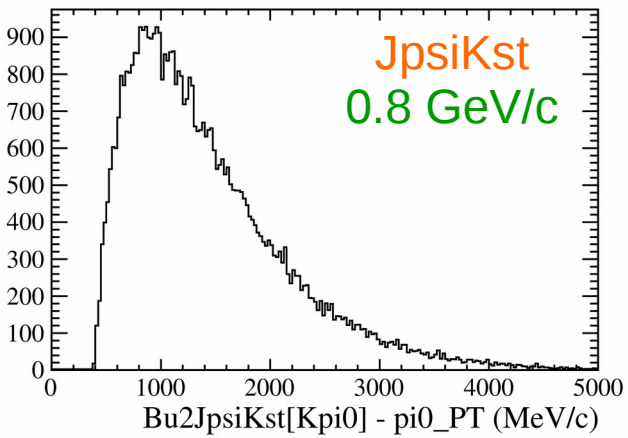






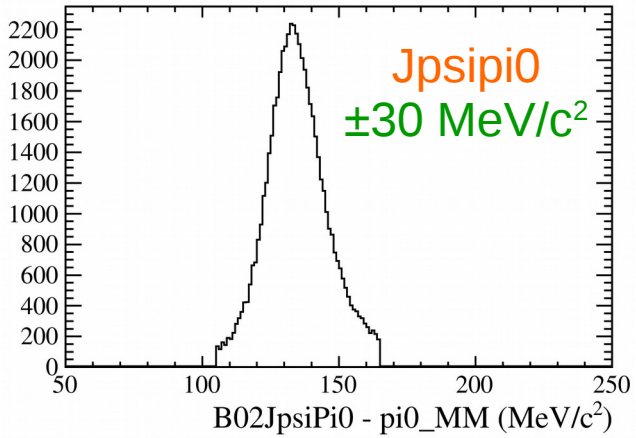


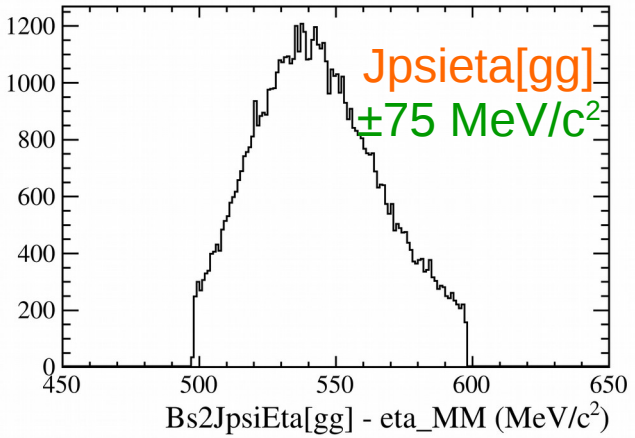


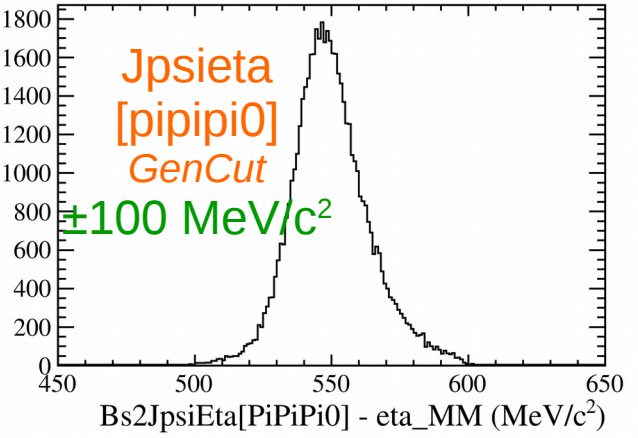


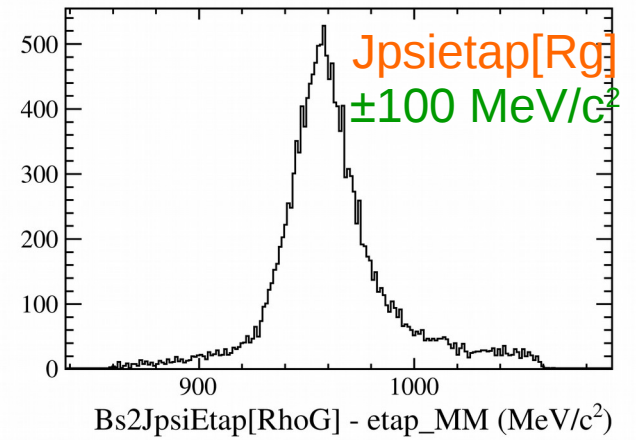
X^0 (P_T,M) cuts

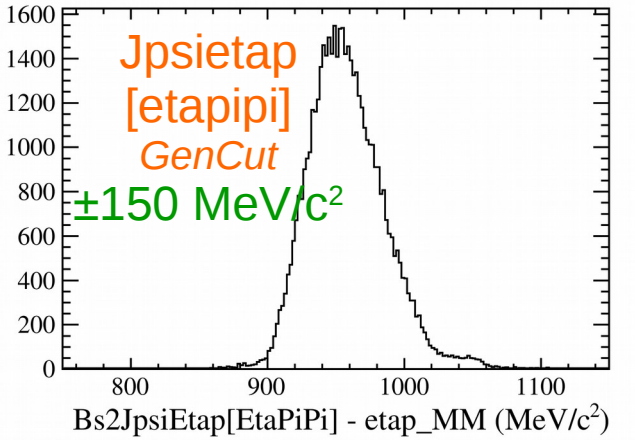
- Look at Run I MC-truth distributions of reco'ed X^0 (= direct B daugther)
  - M: do we need some sidebands? Default window rather small → inlarge a bit
  - For di-photons: ±30 and 75 MeV/c^2 for pi0 and eta respectively
  - For di-tracks+neutral: 150 MeV/c^2 (except Etap[RG]: tighter by mistake)

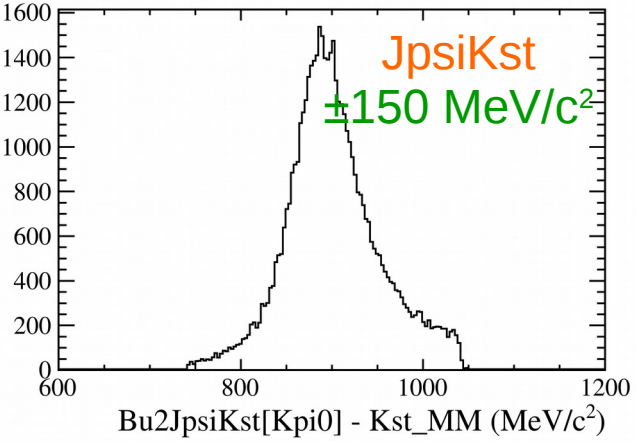






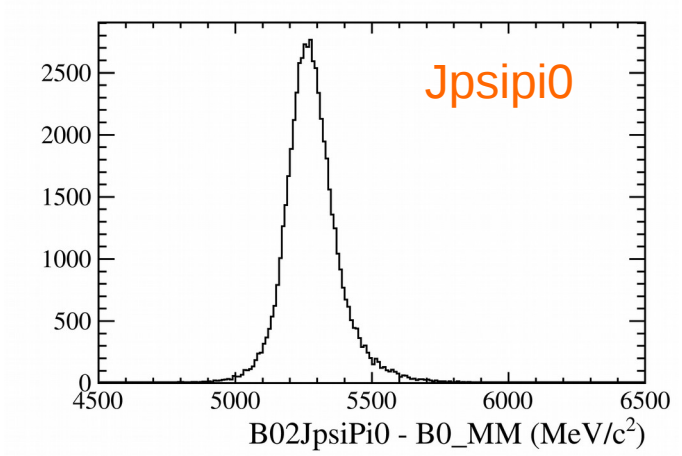


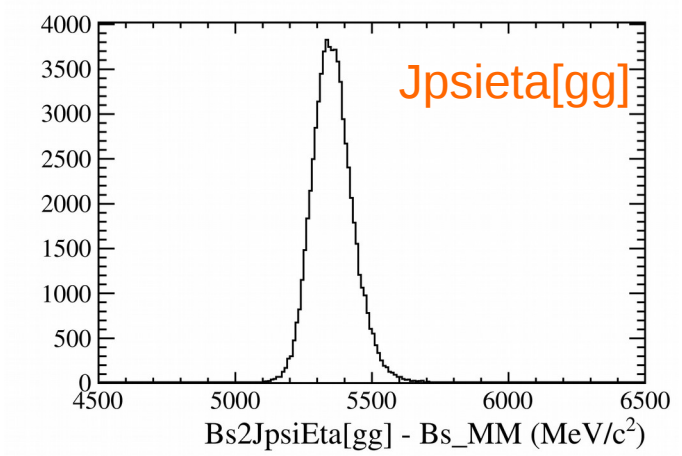


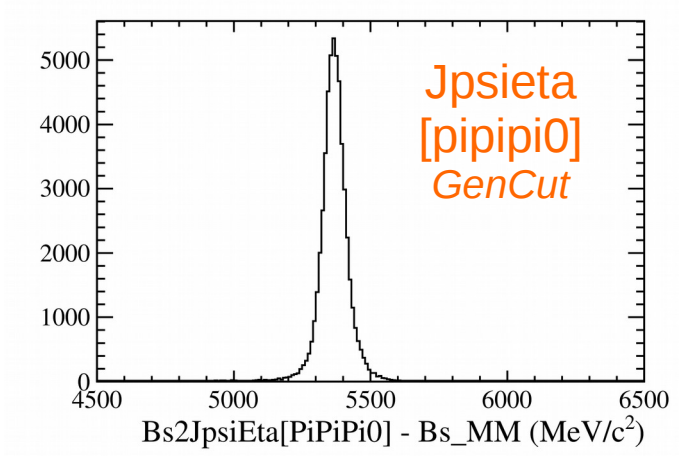


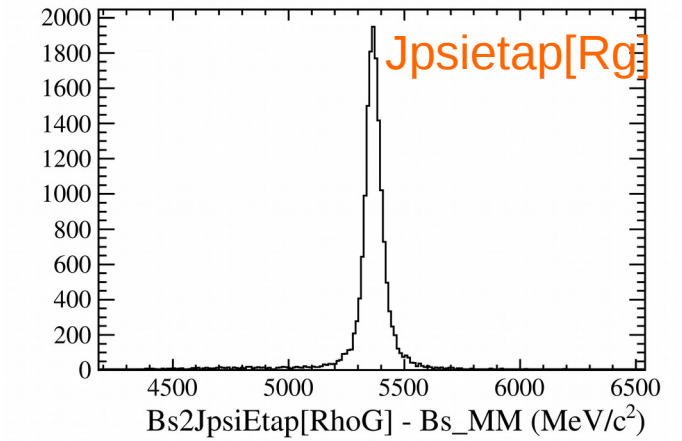
Bmass resolution

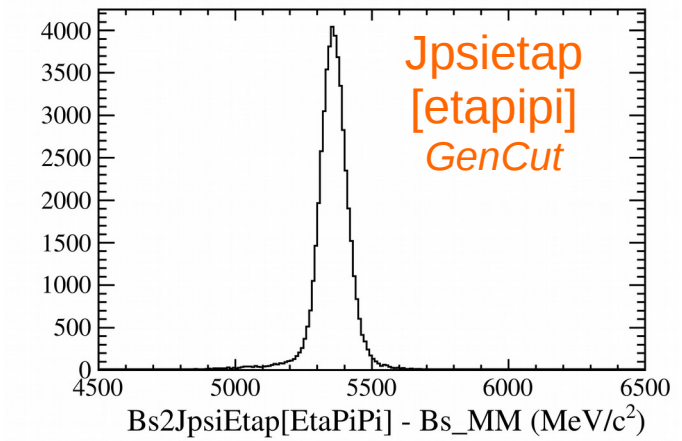
- No mass constrains used to make these plots

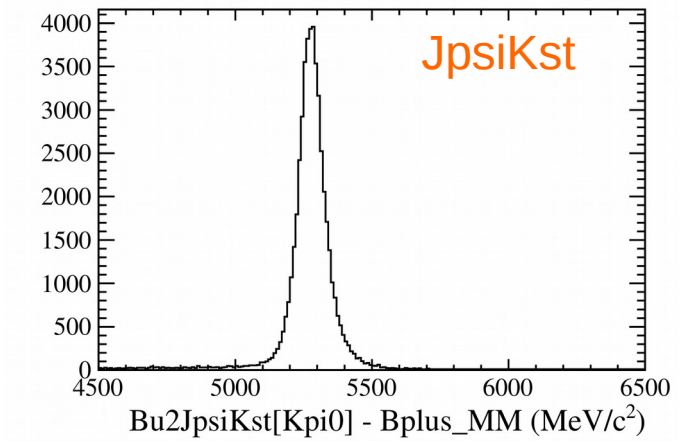










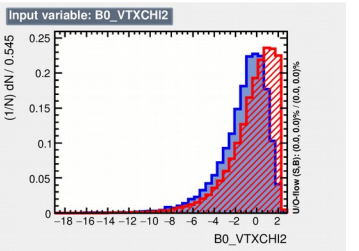


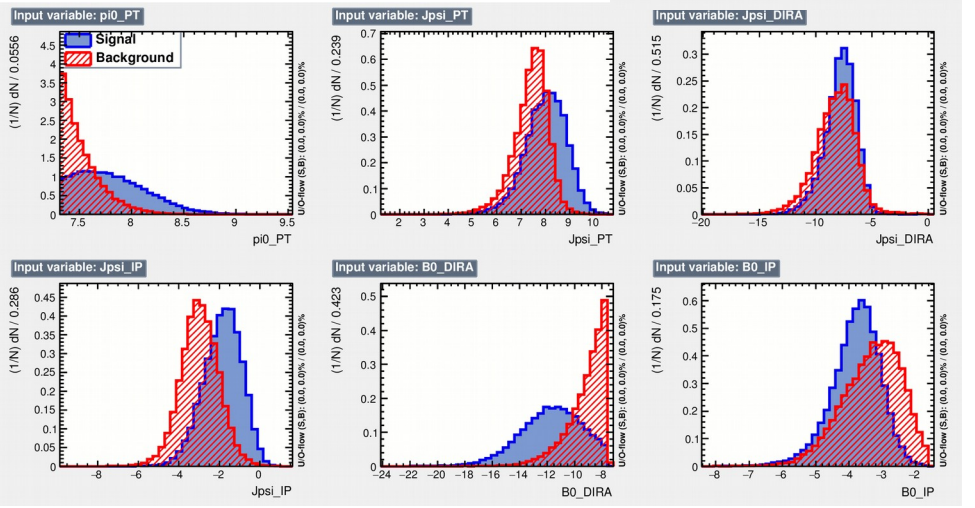
Fisher discriminant

- Cut at DV level for high-rate modes (also in stripping)
  - MC-truth VS data Jpsi mass sidebands
  - Kinematic & vertex -only variables

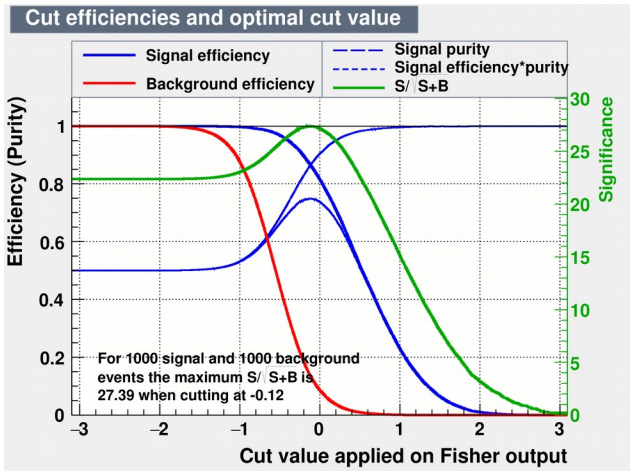
    Jpsi_DIRA, Jpsi_IP, Jpsi_PT, pi0_PT

    B_DIRA, B_IP, B_VtxChi2
- Cut such as to remove 50% of bkg (few % effect on signal)

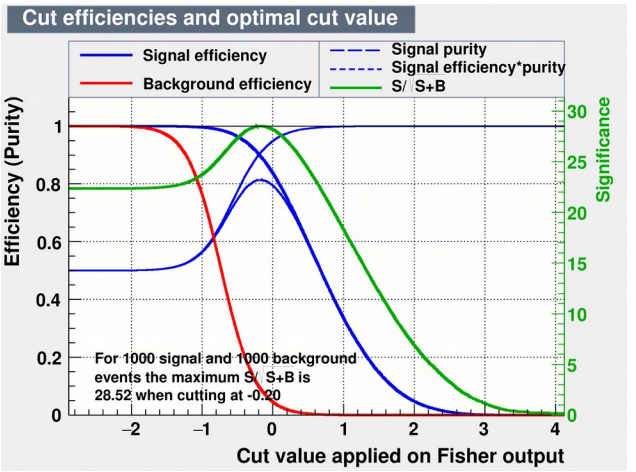




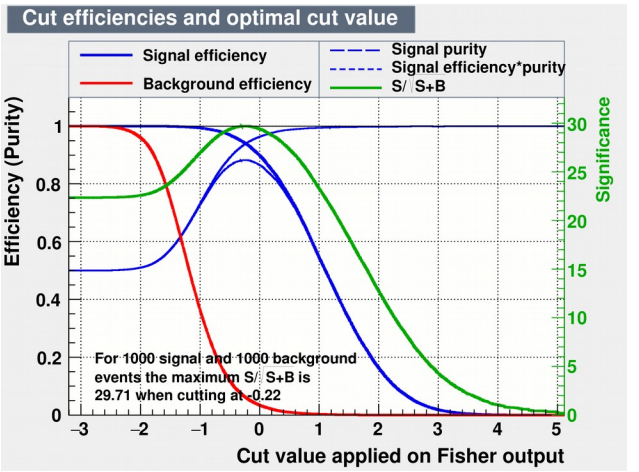
Jpsipi0



Jpsieta[gg]



JpsiKst

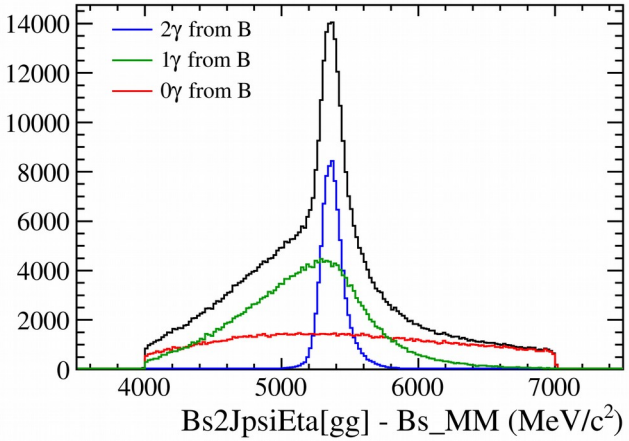


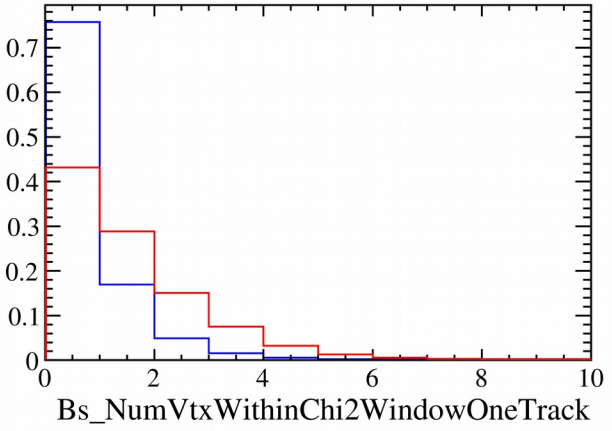
Variables for MVA

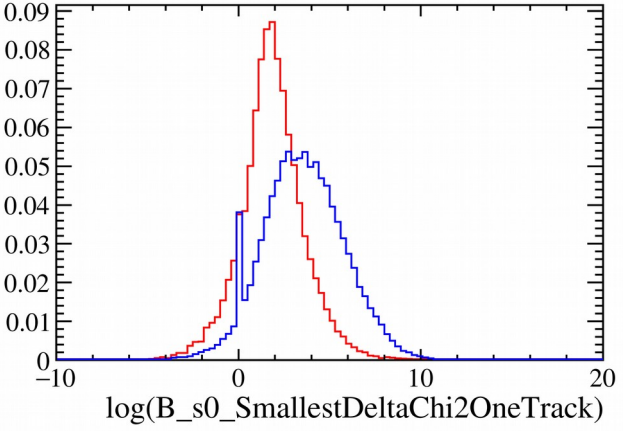
- Next step: MVA selections for all modes
  - Kin & vtx: re-use Fisher variables
  - **Vertex isolation** (TupleToolVtxIsoln to B branch) against part-reco
  - Photon isolation (TupleToolConeIsolation, $\Delta R=0.4$) against pile-up
  - Photon variables (TupleToolPhotonInfo, TupleToolProtoPData) against pile-up

    TupleToolProtoPData.DataList =
    ["CaloNeutralID","CaloNeutralSpd","IsNotH","IsNotE","IsPhoton"]

Jpsieta[gg] MC 2016







Variables for MVA

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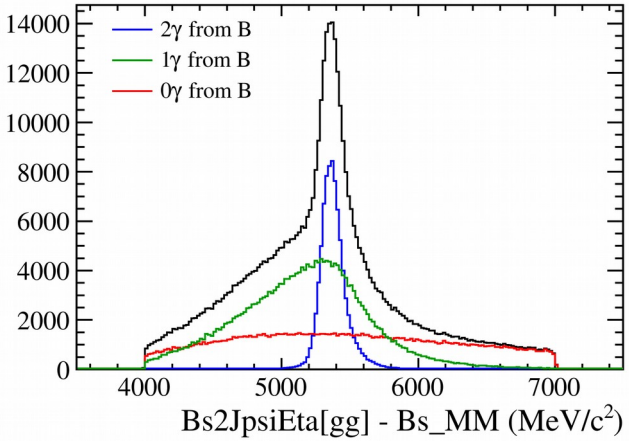
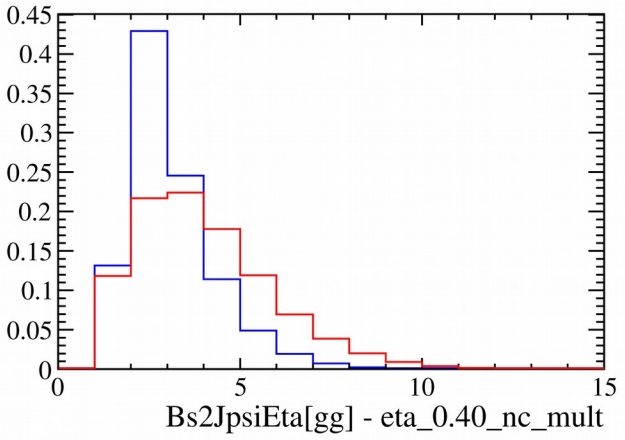
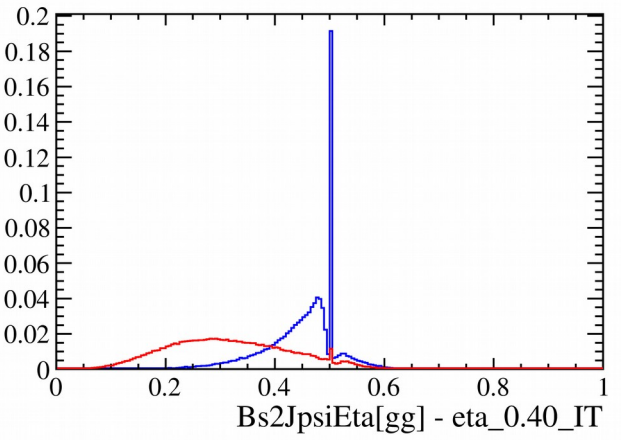
Jpsieta[gg] MC 2016







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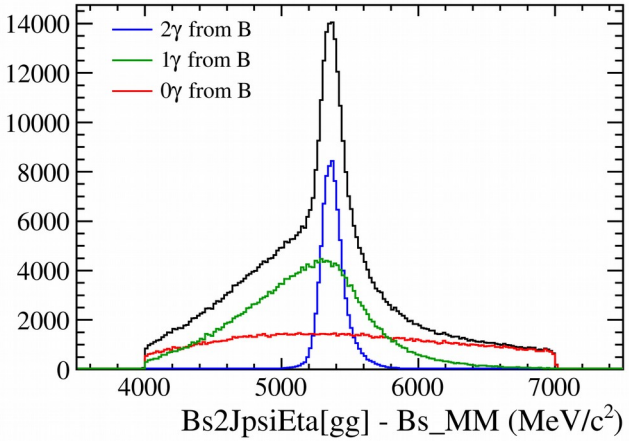
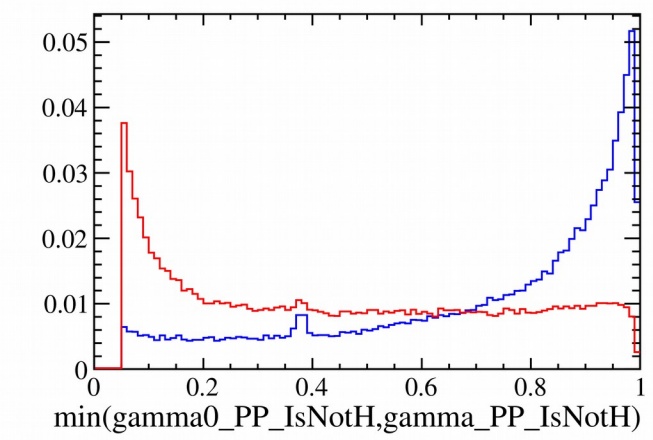
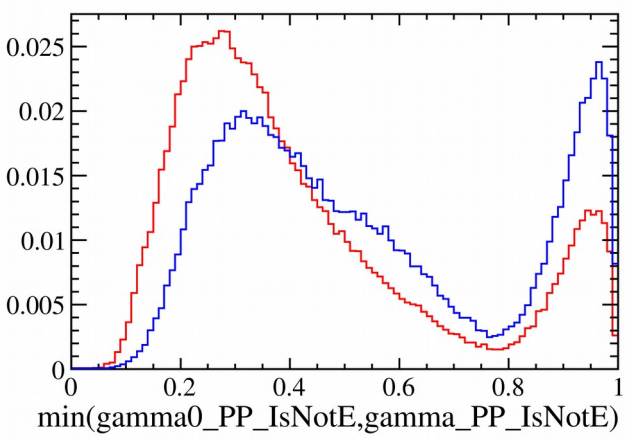
Jpsieta[gg] MC 2016







Variables for MVA

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  - Kin & vtx: re-use Fisher variables
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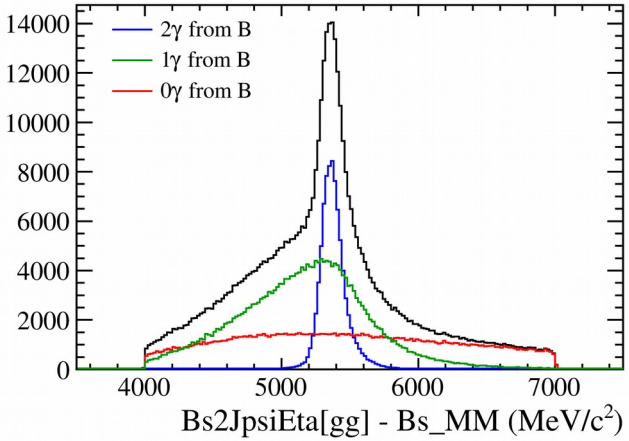
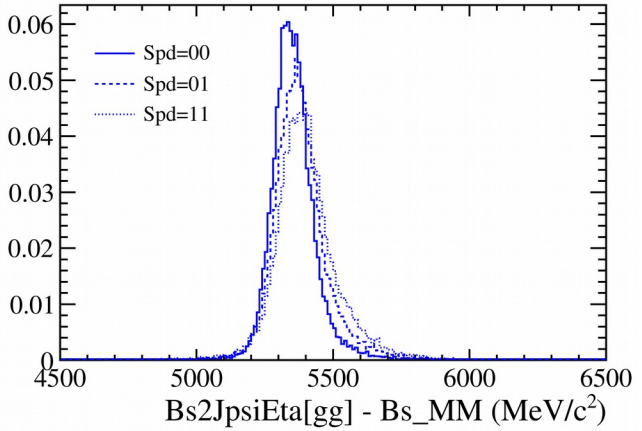
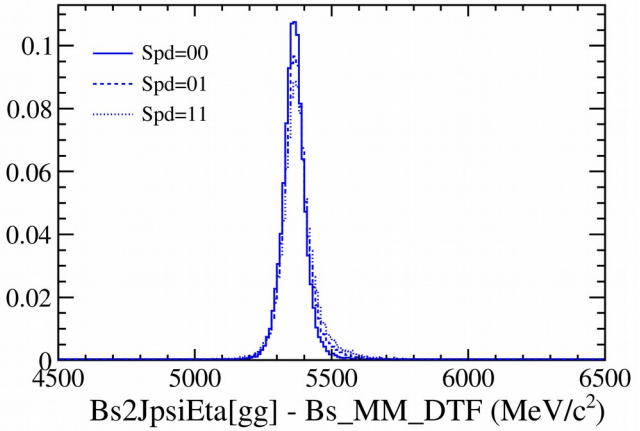
Jpsieta[gg] MC 2016

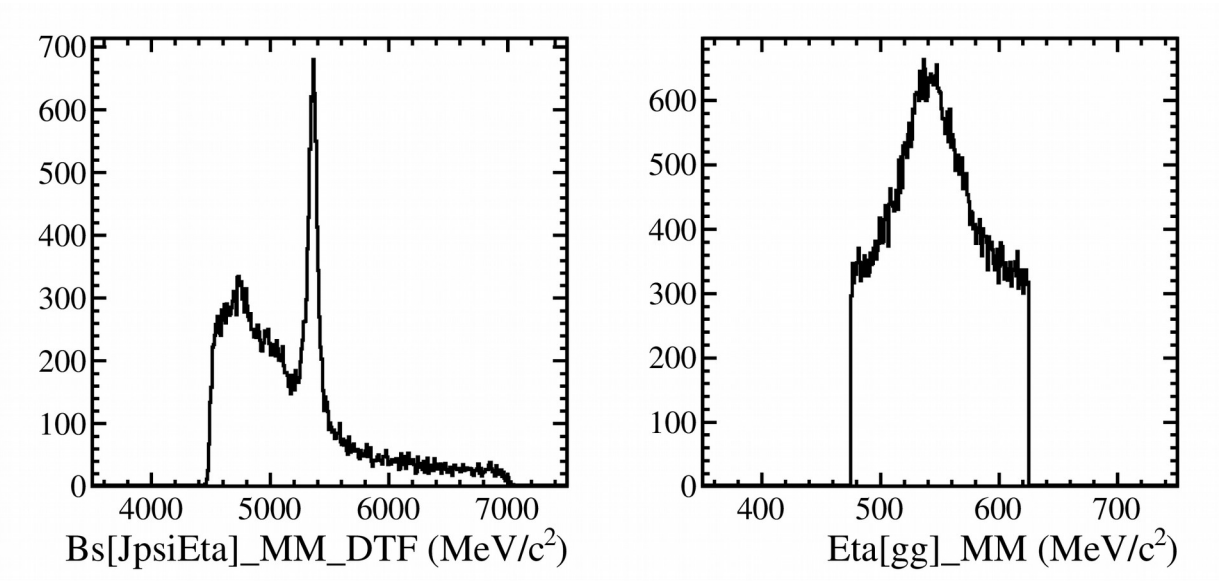






JpsiEta signals

Eta → gamma gamma

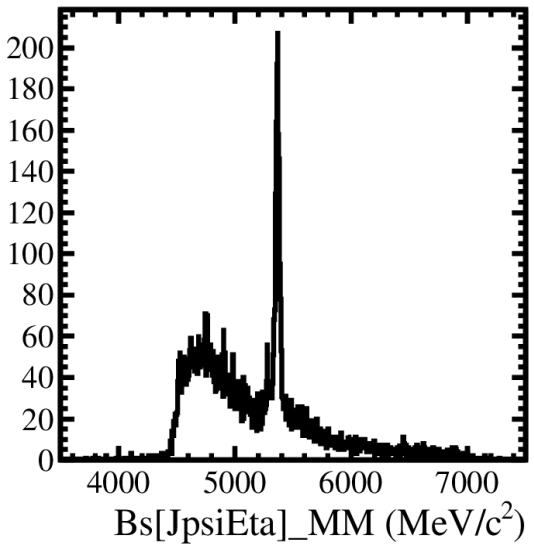


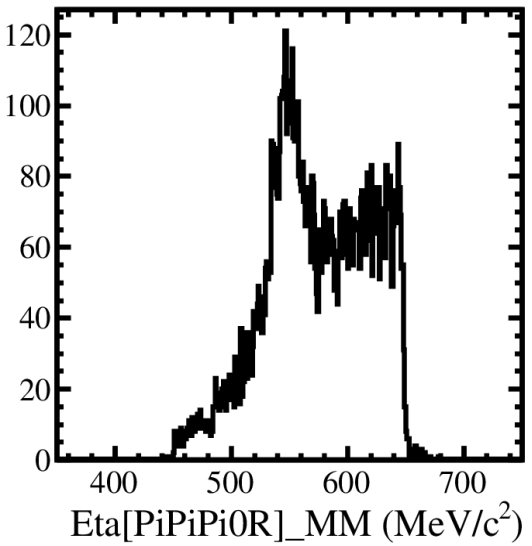
TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<10 && Bs_NumVtxWithinChi2WindowOneTrack==0 && eta_0.40_IT>0.35 && min(gamma0_PP_IsNotH,gamma_PP_IsNotH)>0.6 && Bs_FISHERBs>0.25";

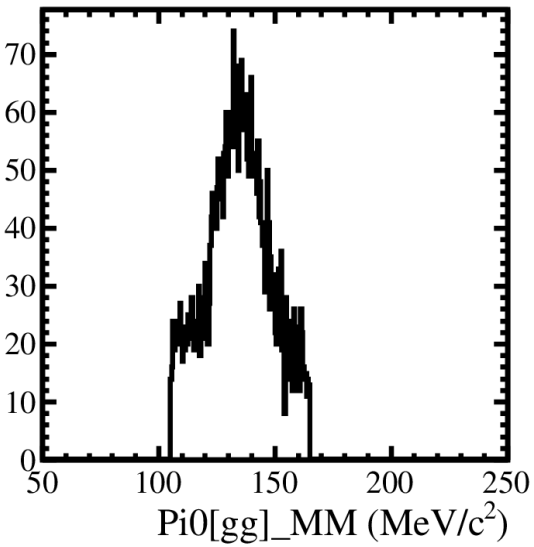
TCut cut_eta = "abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0 && eta_0.40_IT>0.35 && min(gamma0_PP_IsNotH,gamma_PP_IsNotH)>0.6 && Bs_FISHERBs>0.25";

JpsiEta signals

Eta → pipi pi0_resolved







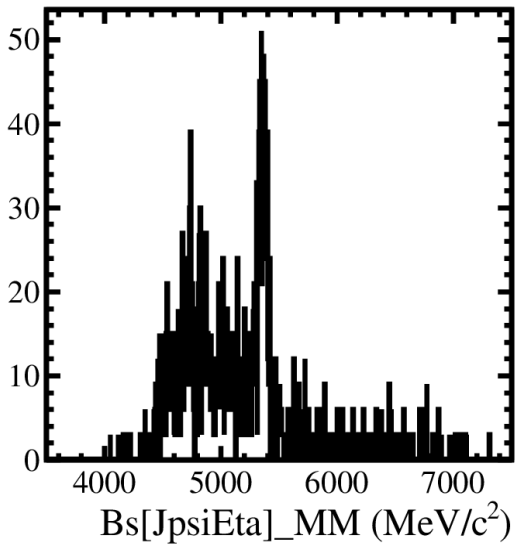
TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<20 && abs(pi0_MM-135)<20 && Bs_NumVtxWithinChi2WindowOneTrack==0 && min(gamma0_PP_IsNotH,gamma_PP_IsNotH)>0.6 && pi0_0.40_IT>0.35";

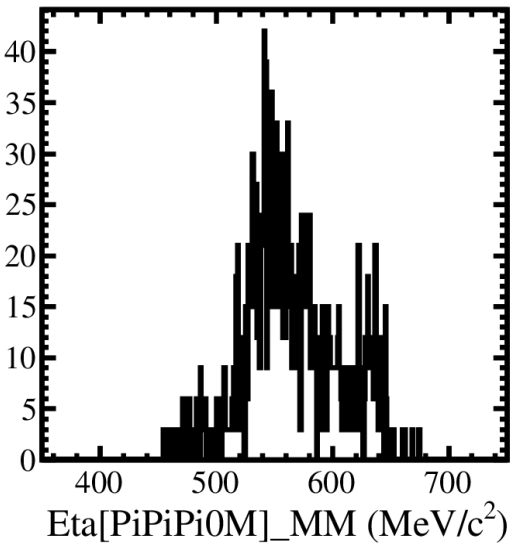
TCut cut_eta = "abs(Bs_Jpsi_MM-3100)<30 && abs(Bs_DTF_M[0]-5366)<200 && abs(pi0_MM-135)<20 && Bs_NumVtxWithinChi2WindowOneTrack==0 && min(gamma0_PP_IsNotH,gamma_PP_IsNotH)>0.6 && pi0_0.40_IT>0.35";

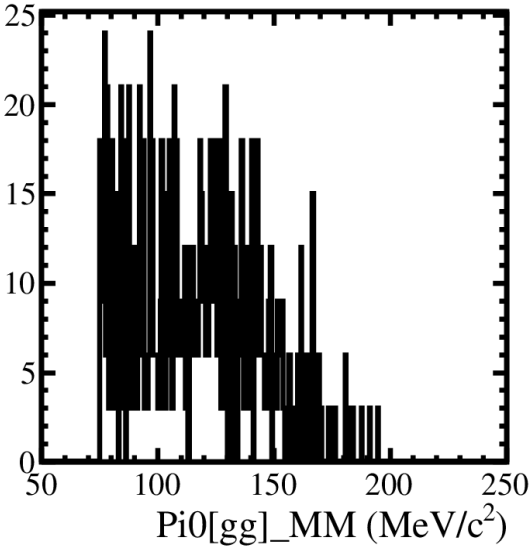
TCut cut_pi0 = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<20 && abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0 && min(gamma0_PP_IsNotH,gamma_PP_IsNotH)>0.6 && pi0_0.40_IT>0.35";

JpsiEta signals

Eta → pipi pi0_merged







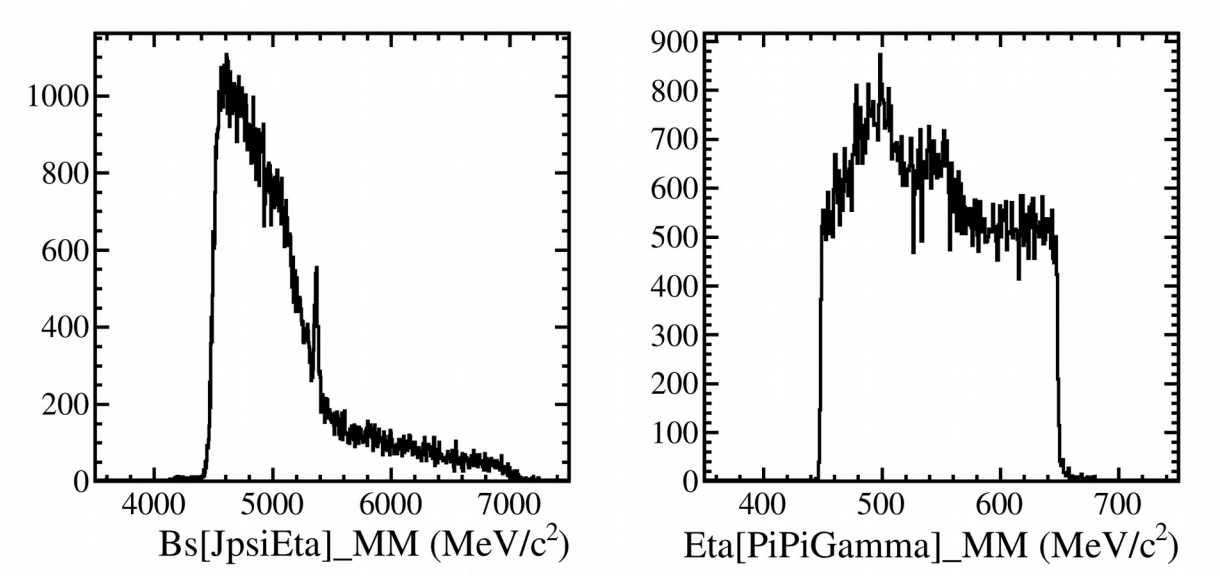
TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<30 && abs(pi0_MM-135)<40 && Bs_NumVtxWithinChi2WindowOneTrack==0";

TCut cut_eta = "abs(Bs_Jpsi_MM-3100)<30 && abs(Bs_DTF_M[0]-5366)<200 && abs(pi0_MM-135)<40 && Bs_NumVtxWithinChi2WindowOneTrack==0";

TCut cut_pi0 = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<30 && abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0";

JpsiEta signals

Eta → pipi gamma



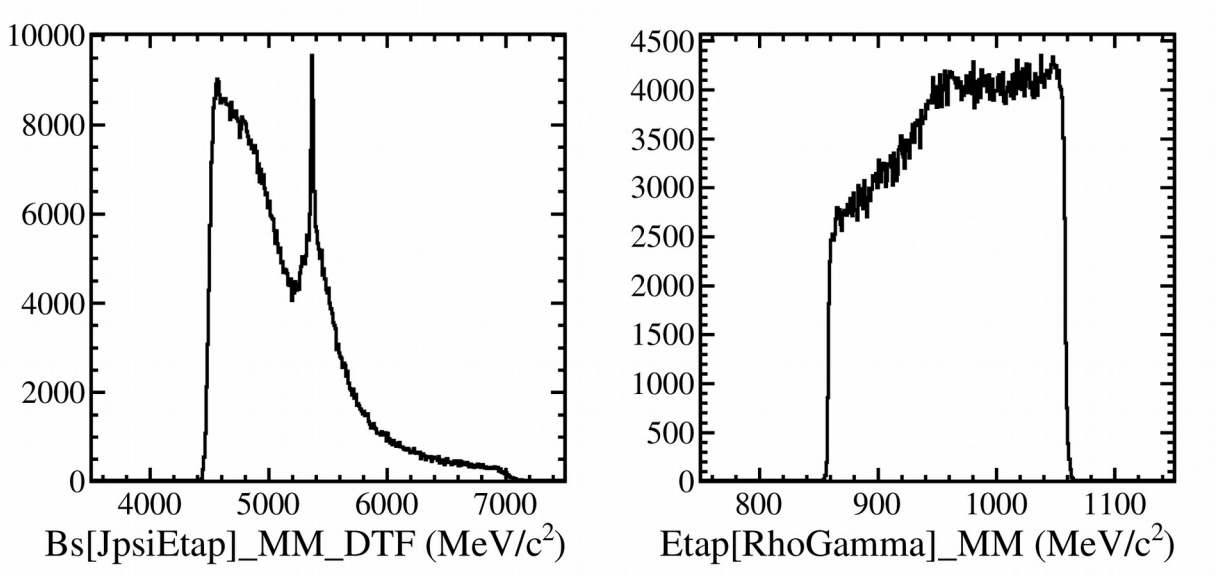
TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(eta_MM-550)<20 && Bs_NumVtxWithinChi2WindowOneTrack==0 && gamma_PP_IsNotH>0.6 && gamma_0.40_IT>0.35 && (Bs_JpsiPiPi_MM<5000 || Bs_JpsiPiPi_MM>5250)";*

TCut cut_eta = "abs(Bs_Jpsi_MM-3100)<30 && abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0 && gamma_PP_IsNotH>0.6 && gamma_0.40_IT>0.35 && (Bs_JpsiPiPi_MM<5000 || Bs_JpsiPiPi_MM>5250)";*

**: veto JpsiPiPi region around B^0 mass → see slide 17*

JpsiEta' signals

Eta' → rho0 gamma

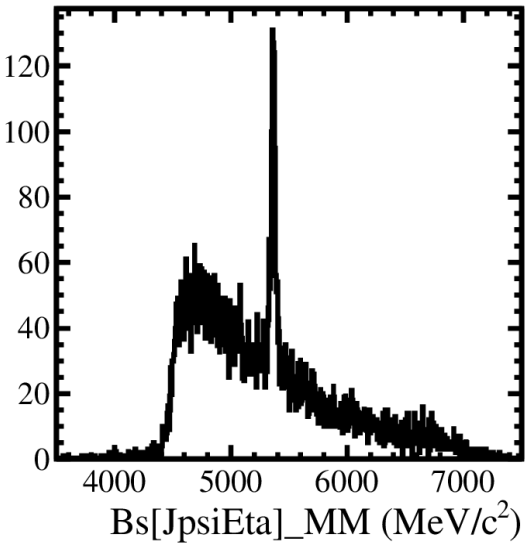


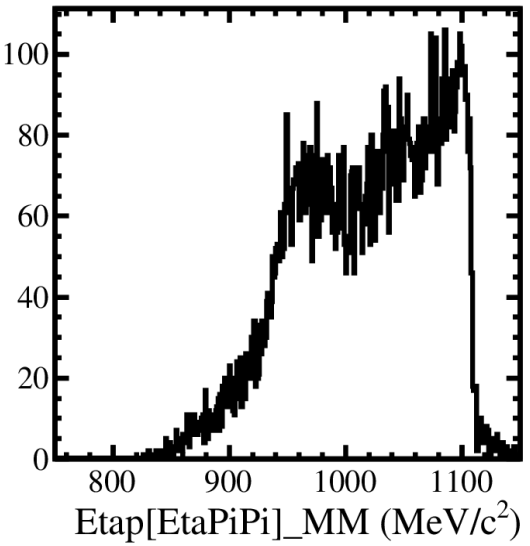
TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(etap_MM-960)<25 && Bs_NumVtxWithinChi2WindowOneTrack==0 && gamma_PP_IsNotH>0.6 && gamma_0.40_IT>0.35";

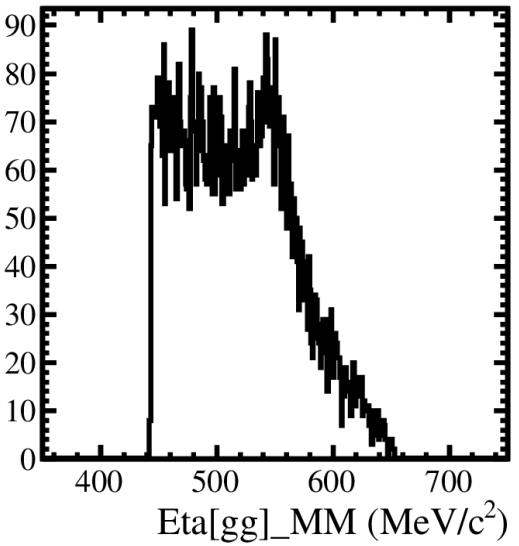
TCut cut_etap = "abs(Bs_Jpsi_MM-3100)<30 && abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0 && gamma_PP_IsNotH>0.6 && gamma_0.40_IT>0.35";

JpsiEta' signals

Eta' → pipi eta[gg]







TCut cut_bs = "abs(Bs_Jpsi_MM-3100)<30 && abs(etap_MM-960)<25 && abs(eta_MM-550)<25 && Bs_NumVtxWithinChi2WindowOneTrack==0";

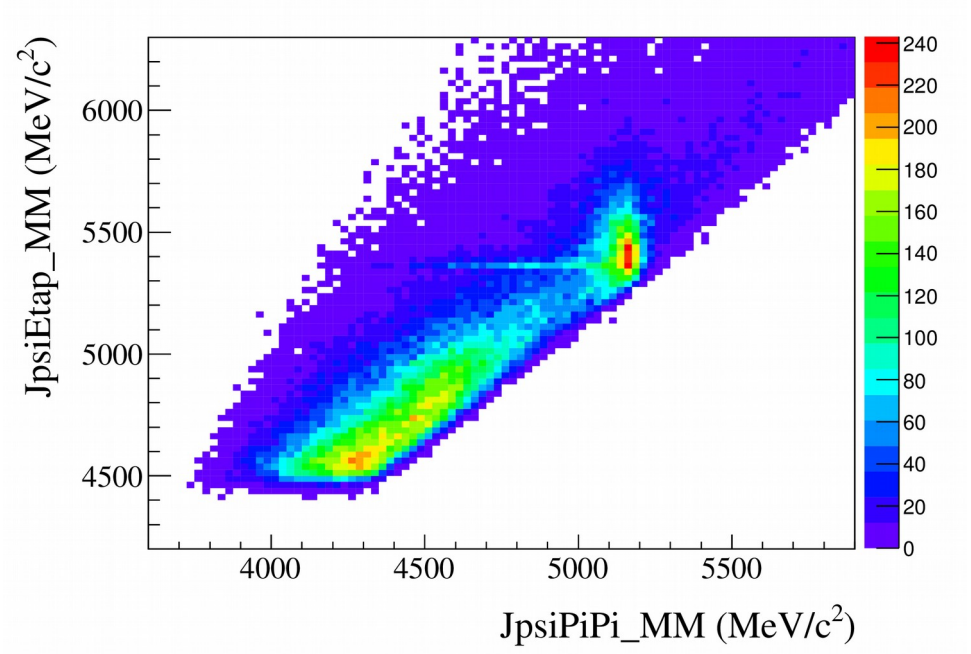
TCut cut_etap = "abs(Bs_Jpsi_MM-3100)<30 && abs(Bs_DTF_M[0]-5366)<200 && abs(eta_MM-550)<25 && Bs_NumVtxWithinChi2WindowOneTrack==0";

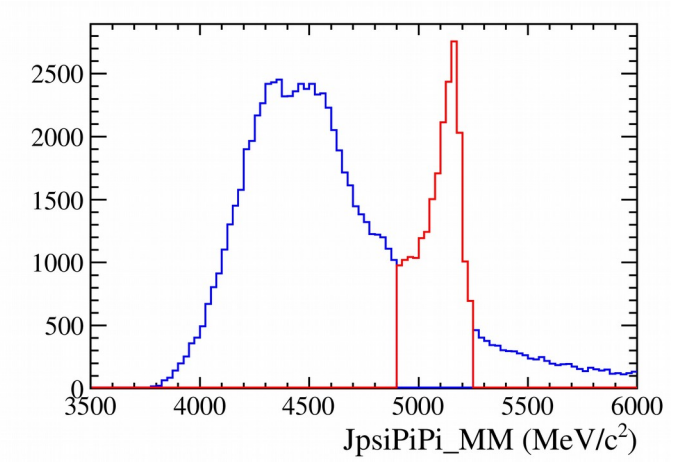
TCut cut_eta = "abs(Bs_Jpsi_MM-3100)<30 && abs(etap_MM-960)<25 && abs(Bs_DTF_M[0]-5366)<200 && Bs_NumVtxWithinChi2WindowOneTrack==0";

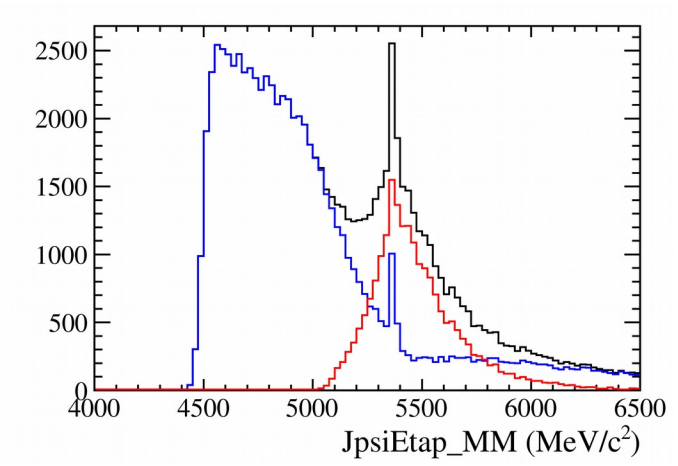
Fit model

- Modes with 4 tracks potentially affected by Bx → JpsiPiPi

Eta' → rho0 gamma (2018)







Outlook

- Loose selections but signals for all modes, lots of room for improvement
  - Selection scripts and data being made available
  - Run1 data processing on-going

- MVA strategy
  - 1 BDT with everything?
  - Training: calo variables always cleaner in MC $\rightarrow$ careful if training with data bkg VS signal MC

- Fit model
  - JpsiPiPi: PT-dependent but absent from Nucl. Phys. B867 (2013) 547.
    $\rightarrow$ Fit in or veto?
  - Part reco list to be defined
    $\rightarrow$ converge on MC request.