# Semi-tauonic Meeting

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# Signal selection:

- $B_{tag}$ cuts:
  - Mbc>5.27 GeV/$c^2$
  - -0.1<DeltaE<0.1 GeV,
  - signalProbability>0.001

D cuts:

- **pi+:95eff** , pionID>0.232 and $p_T$>0.1
- **K+:85eff** , kaonID > 0.517 and $p_T$>0.1
- $\pi^0 \rightarrow \gamma\gamma$
  - $E_\gamma$>50 MeV
  - E1E9>0.8
  - clusterTiming<clusterTimingError
  - 0.124 <InvM<0.140 GeV/$c^2$
- $K_s^0 \rightarrow \pi^+\pi^-$
  - 0.45<InvM<0.55 GeV/$c^2$
  - Flight distance >0.5 cm
- **D candidates:**
  - 1.7<M<2.1GeV/$c^2$
  - $p_{CMS}$<3.0 GeV/

| # | Decay | BF |
|---|---|---|
| 1 | $D^+ \rightarrow K^-\pi^+\pi^+$ | 8.98 +/- 0.28% |
| 2 | $D^+ \rightarrow K^-\pi^+\pi^+\pi^0$ | 5.98 +/- 0.23 % |
| 3 | $D^+ \rightarrow K_s^0\pi^+$ | 1.47 +/- 0.08 % |
| 4 | $D^+ \rightarrow K_s^0\pi^+\pi^-\pi^+$ | 2.97 +/- 0.11 % |
| 5 | $D^+ \rightarrow K_s^0\pi^+\pi^0$ | 7.05 +/- 0.27 % |
| 6 | $D^+ \rightarrow K_s^0K^+$ | 1.05% |
| 7 | $D^0 \rightarrow K^-\pi^+$ | 3.89 +/- 0.04 % |
| 8 | $D^0 \rightarrow K_s^0\pi^0$ | 1.19 +/- 0.04 % |
| 9 | $D^0 \rightarrow K^-\pi^+\pi^0$ | 14.2 +/- 0.5 % |
| 10 | $D^0 \rightarrow K^-\pi^+\pi^-\pi^+$ | 8.11 +/- 0.15 % |
| 11 | $D^0 \rightarrow K_s^0\pi^+\pi^-$ | 2.75 +/- 0.18% |
| 12 | $D^0 \rightarrow K_s^0\pi^+\pi^-\pi^0$ | 5.1 +/- 0.6% |

# Signal Selection:

| Mode | Decay | BF |
|---|---|---|
| 1 | $D^{*+} \rightarrow D^0\pi^+$ | 67.7±0.5 % |
| 2 | $D^{*+} \rightarrow D+\pi^0$ | 30.7±0.5 % |

$60 < p_\pi < 250$ MeV
$0.139 < M_{D^*} - M_D < 0.160$ GeV

- ROE tracks: $p_T > 50$ MeV and $-2 < dr < 2$ and $-4.0 < dz < 4.0$
- ROE clusters: abs(clusterTiming)<clusterErrorTiming and E> 75 MeV
- ROE charge==0 , # of ROE tracks==0, $Q^2 > 4$ GeV$^2/c^2$
- Choose candidate with lowest $E_{extra}$ and highest $B_{tag}$ signal probability.

Tuples skimmed with this signal selection are available at:

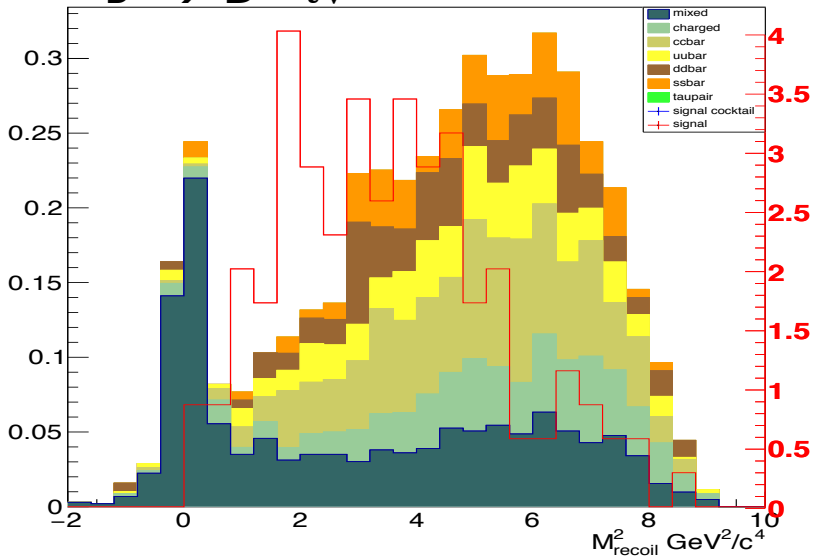
/ghi/fs01/belle2/bdata/group/physics/semitauonic/release-00-09-01/DB00000276/MC9/

- B0ToDstarPlusTauNu
- B0ToDplusTauNu
- BplusToD0TauNu
- BplusToDstar0TauNu

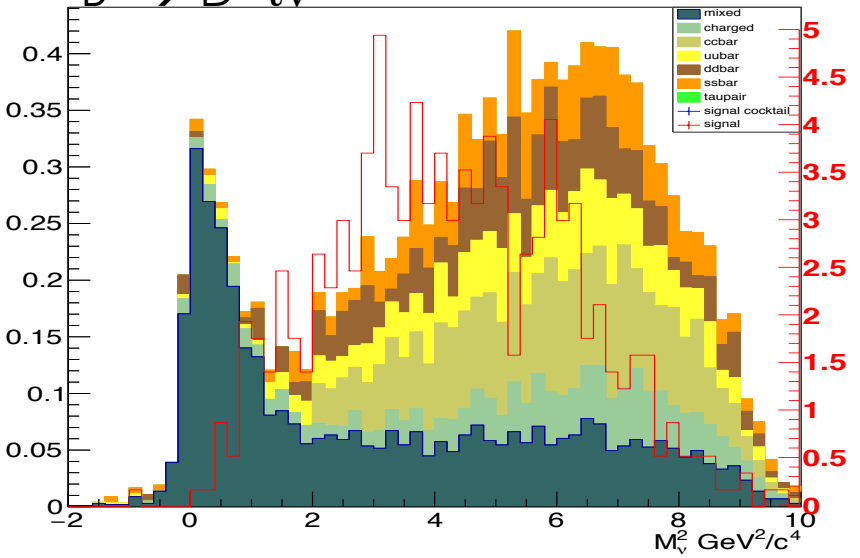
JuneB2GM2018/

# $B \rightarrow D \tau\nu$:

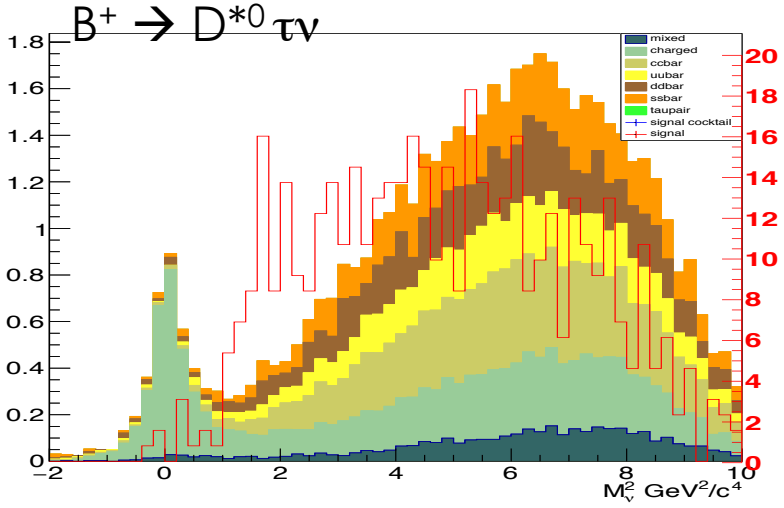
$B^0 \rightarrow D^{*+} \tau\nu$



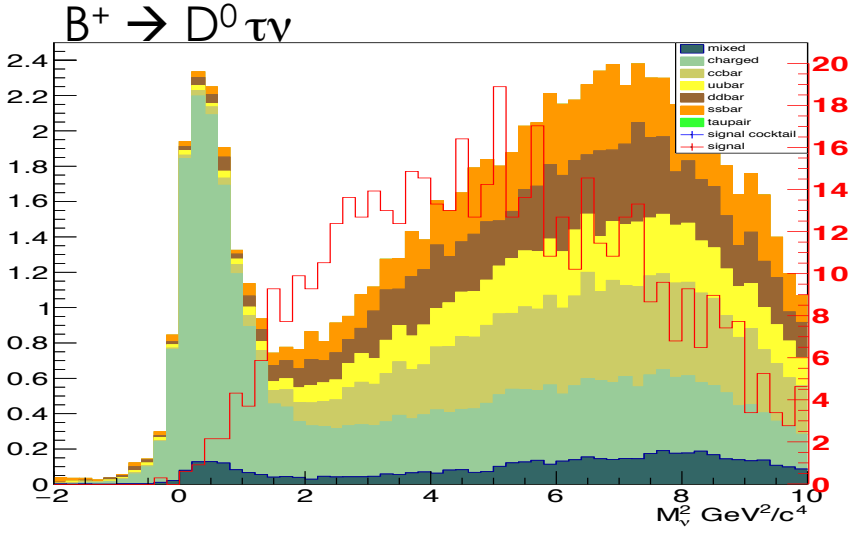

$B^0 \rightarrow D^{+} \tau\nu$




$B^+ \rightarrow D^{*0} \tau\nu$

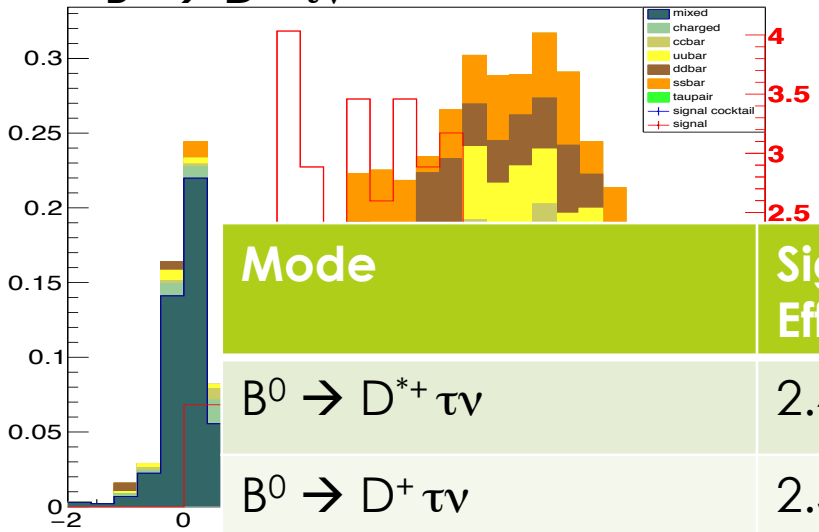



$B^+ \rightarrow D^{0} \tau\nu$

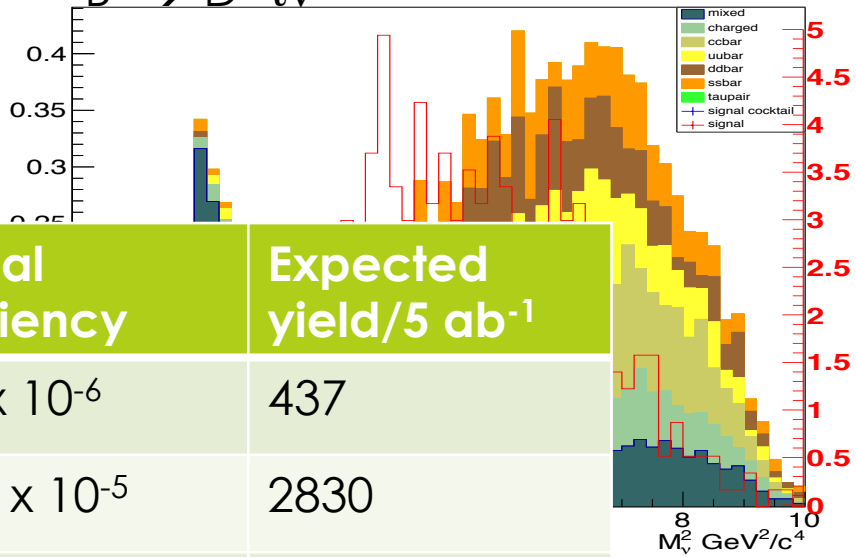


# $B \rightarrow D \tau\nu$

$B^0 \rightarrow D^{*+} \tau\nu$

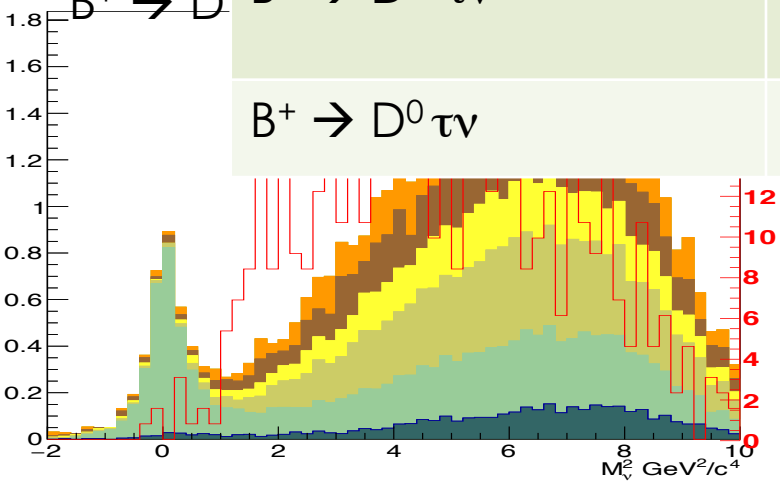


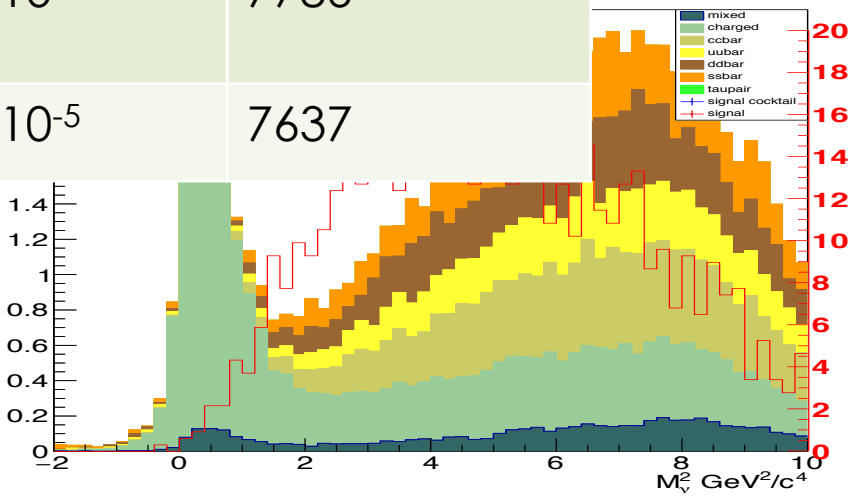

$B^0 \rightarrow D^{+} \tau\nu$




| Mode | Signal Efficiency | Expected yield/5 ab$^{-1}$ |
|---|---|---|
| $B^0 \rightarrow D^{*+} \tau\nu$ | 2.4 x $10^{-6}$ | 437 |
| $B^0 \rightarrow D^{+} \tau\nu$ | 2.52 x $10^{-5}$ | 2830 |
| $B^+ \rightarrow D^{*0} \tau\nu$ | 3.8 x $10^{-5}$ | 7786 |
| $B^+ \rightarrow D^{0} \tau\nu$ | 9.1 x $10^{-5}$ | 7637 |

$B^+ \rightarrow D$



# Changes with release-02:

- Global PID used now.
- Standard lists: K+:good, e+:good, mu+:good.
- Use pi+:90eff : we want the 95eff (pionID>0.002)→ the :95 eff will be fixed in the new patch release.
- K_S0 merged list.
- Pi0 lists are based on gamma:tight with
- Build both $B_{tag}$ and Y4S ROE. The former will be used for the normalization mode.
- Added continuum suppression variables.
- Applied Q2>0 cut only.. Left all Y4S candidates in.

**NEED TO MOVE NtupleTools TO VariablesToNtuple → Volunteers?**

# Updated tuples:

Update BGx1 tuples for all generic MC samples are available on the GRID :
/belle/user/rachac/gbasf2/MC9/

**B0ToDstarPlusTauNu/**
**B0ToDplusTauNu/**
**BplusToDstar0TauNu/**
**BplusToD0tauNu/**

**sampleType**BGx1/sub03

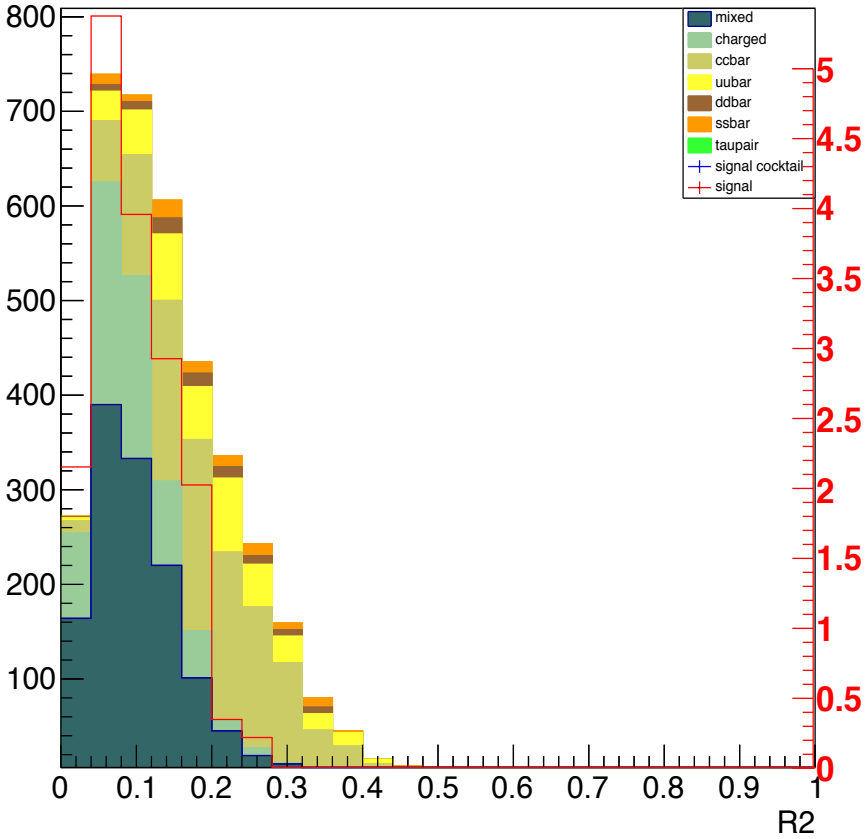
Where sampleType is mixed, charged, ccbar, uubar, ddbar, ssbar, taupair.

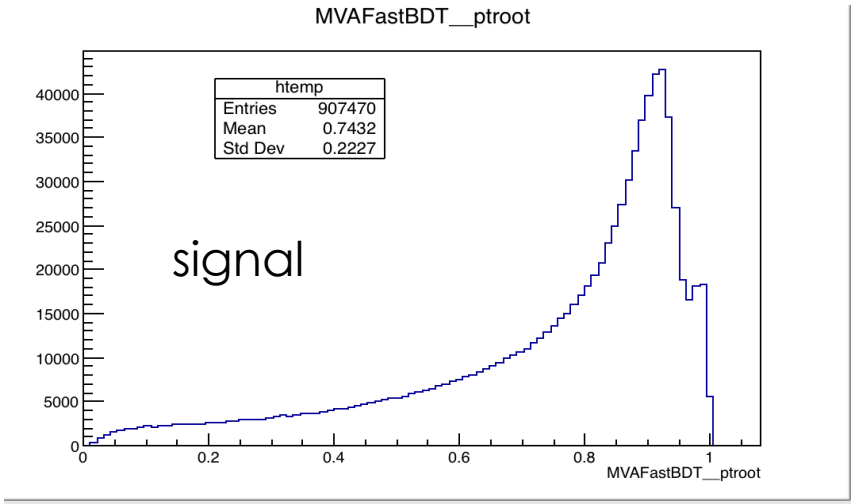
Updated signal MC9 tuples:
/ghi/fs01/belle2/bdata/group/physics/semitauonic/release-02-00-00/DB00000411/MC9/signal
BGx0 samples will be made soon. All will be transferred to kekcc.

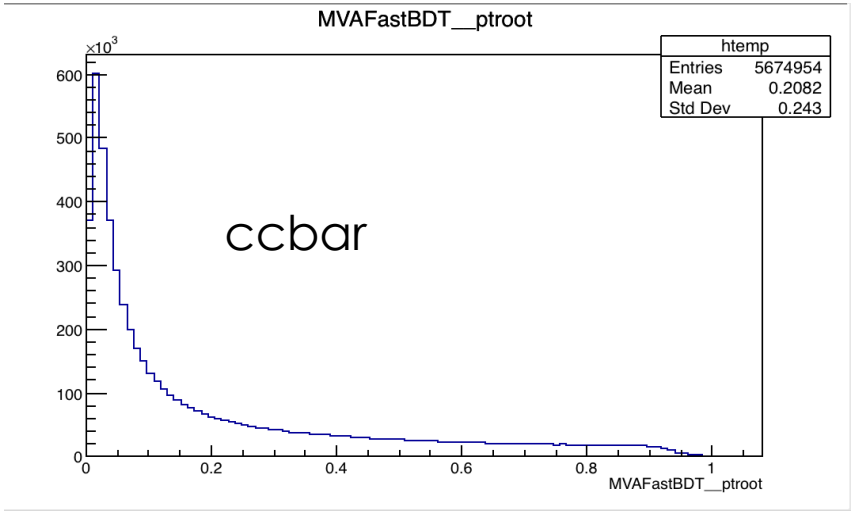
MC10 signal MC samples are being skimmed with FEI as we speak!!

# Continuum Suppression

- Previous continuum suppression relied on a R2 cut.

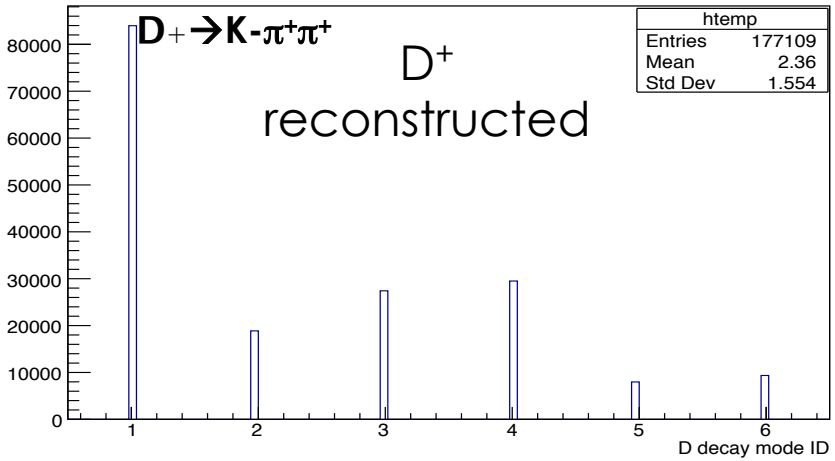


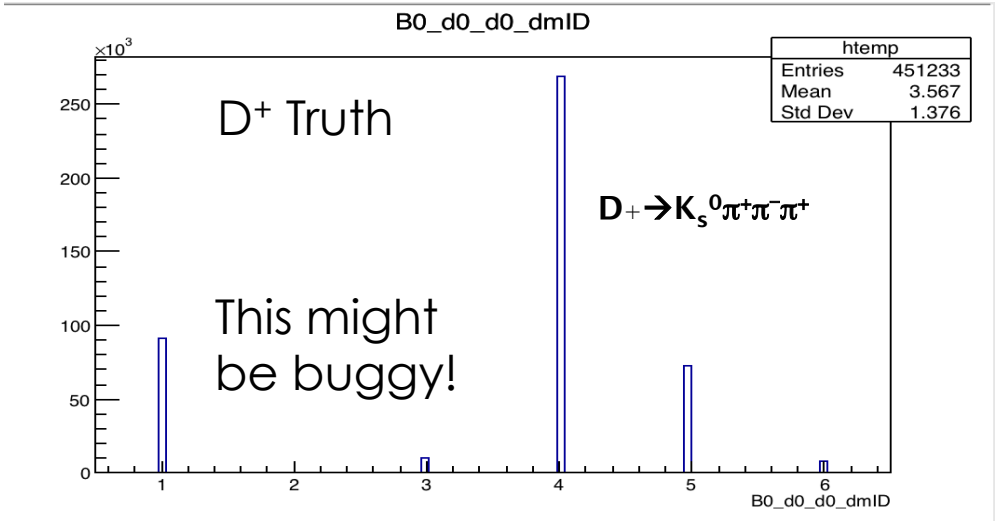



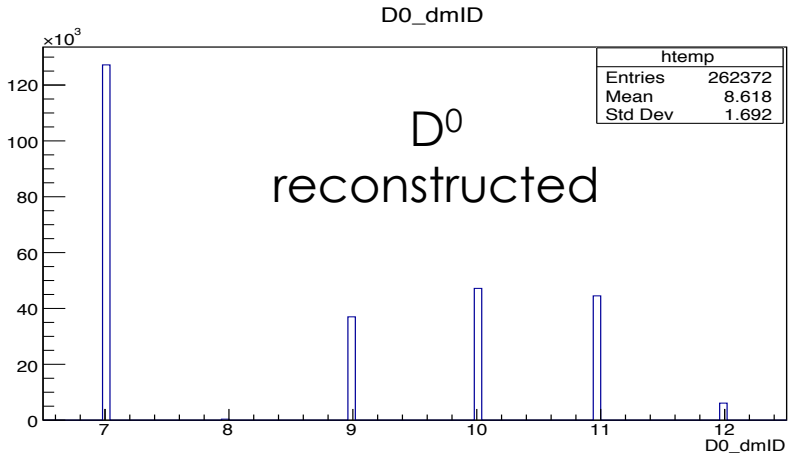



# Truth Information


- Truth Information is important to study D reconstruction, peaking backgrounds, etc..




More work to be done here.
Script is in development.
We need to be able to flag MC events as "signal" or not.

# Preparation for Phase III

- Signal Selection (changes can be easily added or removed).
- Validation scripts update and monitoring.
- FEI calibration, optimization, studies.
- Beam background effects
  - Will produce BGx0 samples in the next week.
- Determine D/D* resolution to optimize D mass selection window.
  - Preliminary script available.
  - Needs to be updated and rerun.
- Train TMVA to suppress continuum (in progress)
  - Add BDT output to ntuple
  - Add weight variable to ntuple. HELP?
- Use truth information to understand D and D* reconstruction efficiency and signal cross-feed.
  - Preliminary script in progress
  - Need to determine signal component in mixed and charged generic MC.

# Preparation for Phase III

- Study main backgrounds.
  - D* l v, D** lv, D* pi lv, other BB, continuum
- Train TMVA to suppress main backgrounds.
- Study and estimate peaking background B to D** (MC10 signal samples are being skimmed now).
- Signal extraction-→ IDEAS?
- Systematic Uncertainties → Not there yet!

# Data Challenge

- We will participate in the data challenge.
- Goal is to have all the tasks above done by the next B2GM.
- I need your help!