

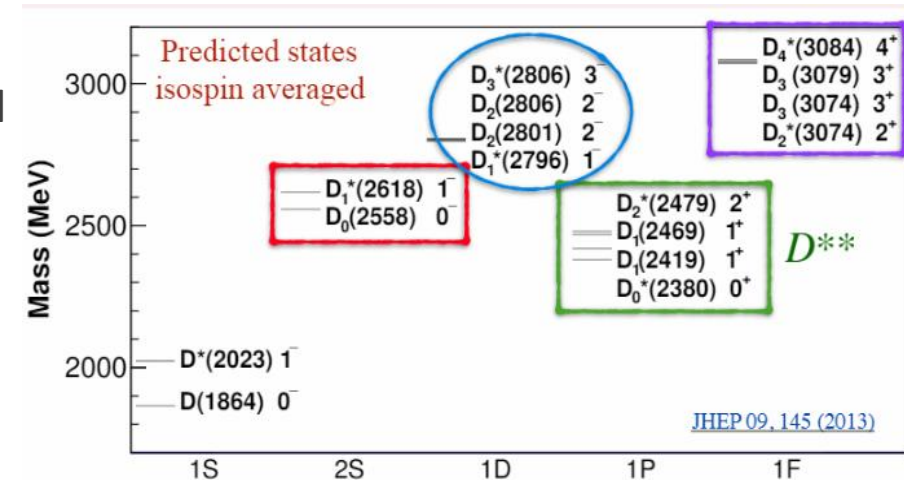
# Run 2 $R(D^{(*)})$ Progress 8-21-20

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# Run 2 Monte Carlo Request

- Overall, keep the same relative sample ratios as Run 1
- A few small differences for  $D^{**}$ 
  - Increase strange  $D_s^{**}$  stats to achieve 4x more MC than data for all channels
    - May already be fine, but just to be sure
  - Run 1 requested two  $D^{**}$  samples:  $D^0$  ( $D^{**} \rightarrow D^{*+}, D^{*0}, D^0$ ) and  $D^{*+}$  ( $D^{**} \rightarrow D^{*+}$  only) to increase  $D^{*+}$  stats
    - Run 2 will only request  $D^0$  and **adjust BF as needed** for comparable  $D^{*+}$  stats for each  $D^{**}$  (actually, just  $D_1, D_1', D_2^*$ , as  $D_0^* \rightarrow D$  only)...next slide
    - Run 2 will reduce 3-body decays of  $D_2^*$  to 5%, not eliminate
    - Run 2 will change some BF ratios for  $D_2^*$ 
      - $\Gamma(D^{*0}\pi)/\Gamma(D^{*+}\pi) = 2/1$  (isospin)
      - $\Gamma(D\pi)/\Gamma(D^*\pi) = 1/1$
    - Run 2 will also reduce 3-body decays of  $D_0^*$  to 5%



Three body  $D^{**}$  decays (from PDG & others):

$D_0^* \rightarrow D\pi\pi$	not seen	$D_0^* \rightarrow D^*\pi\pi$	not seen
$D_1 \rightarrow D\pi\pi$	seen	$D_1 \rightarrow D^*\pi\pi$	not seen
$D_1' \rightarrow D\pi\pi$	not seen	$D_1' \rightarrow D^*\pi\pi$	not seen
$D_2^* \rightarrow D\pi\pi$	not seen	$D_2^* \rightarrow D^*\pi\pi$	not seen

# Stats for $D_1'$ (okay), $D_2^*$ (too low)

**11873010 - Bd\_Dststmunu-D0 (8.9M events)**

$$8.9 \times 0.3069 \times 0.2189 = \underline{598k} B^0 \rightarrow D_1'^- (\rightarrow D^{*-} \pi^0) \mu^+ \nu$$

$$8.9 \times 0.1188 \times 0.0887 = \underline{94k} B^0 \rightarrow D_2^{*-} (\rightarrow D^{*-} \pi^0) \mu^+ \nu$$

```
Decay B0sig
0.3069 MyD'_1- mu+ nu_mu PHOTOS ISGW2
0.2970 MyD_0*- mu+ nu_mu PHOTOS ISGW2
0.2772 MyD_1- mu+ nu_mu PHOTOS ISGW2
0.1188 MyD_2*- mu+ nu_mu PHOTOS ISGW2
Decay MyD'_1+
0.6466 MyD*0 pi+ PHOTOS VVS_PWAVE [1.0, 0.0, 0.0, 0.0, 0.0, 0.0]
0.2189 MyD*+ pi0 PHOTOS VVS_PWAVE [1.0, 0.0, 0.0, 0.0, 0.0, 0.0]
0.1345 MyD0 pi+ pi0 PHOTOS PHSP
Decay MyD_2*+
0.4028 MyD0 pi+ PHOTOS TSS
0.2613 MyD*0 pi+ PHOTOS TVS_PWAVE [0.0, 0.0, 1.0, 0.0, 0.0, 0.0]
0.0977 MyD_0*0 pi+ PHOTOS PHSP
0.0887 MyD*+ pi0 PHOTOS TVS_PWAVE [0.0, 0.0, 1.0, 0.0, 0.0, 0.0]
0.0769 MyD_0*+ pi0 PHOTOS PHSP
0.0483 MyD0 pi+ pi0 PHOTOS PHSP
0.0121 MyD*0 pi+ pi0 PHOTOS PHSP
0.0082 MyD*+ pi+ pi- PHOTOS PHSP
0.0041 MyD*+ pi0 pi0 PHOTOS PHSP
```

**11874060 - Bd\_Dststmunu-Dst+ (2.0M events)**

$$2 \times 0.4058 = \underline{812k} B^0 \rightarrow D_1'^- (\rightarrow D^{*-} \pi^0) \mu^+ \nu$$

$$2 \times 0.1449 \times 0.728 = \underline{311k} B^0 \rightarrow D_2^{*-} (\rightarrow D^{*-} \pi^0) \mu^+ \nu$$

```
Decay B0sig
0.4493 MyD_1- mu+ nu_mu PHOTOS ISGW2
0.4058 MyD'_1- mu+ nu_mu PHOTOS ISGW2
0.1449 MyD_2*- mu+ nu_mu PHOTOS ISGW2
Decay MyD'_1+
1.0000 MyD*+ pi0 PHOTOS VVS_PWAVE [1.0, 0.0, 0.0, 0.0, 0.0, 0.0]
Decay MyD_2*+
0.7280 MyD*+ pi0 PHOTOS TVS_PWAVE [0.0, 0.0, 1.0, 0.0, 0.0, 0.0]
0.0979 MyD_0*0 pi+ PHOTOS PHSP
0.0736 MyD_0*+ pi0 PHOTOS PHSP
0.0669 MyD*+ pi+ pi- PHOTOS PHSP
0.0335 MyD*+ pi0 pi0 PHOTOS PHSP
```

Keeping the same ratio as in Run 1 request, we would get **26% fewer  $D^{*+}$  events for  $D_1'$** , but **almost 3 times less for  $D_2^*$** . We can reduce the 3-body decays, and adjust the B branching fractions to get enough  $D_2^*$

# Run 2 Monte Carlo Request (cont'd)

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- Other differences (already discussed)

- Generator level cuts `tightCut.Cuts =`

```
'[pi+]cc': "abs(GPX/GPZ) < 0.38 & abs(GPY/GPZ) < 0.28 & (GPT > 250*MeV)",  
'[K-]cc': "abs(GPX/GPZ) < 0.38 & abs(GPY/GPZ) < 0.28 & (GPT > 250*MeV)",  
'[mu+]cc': "abs(GPX/GPZ) < 0.38 & abs(GPY/GPZ) < 0.28 & (GP > 2950*MeV)",  
'[D0]cc': "(piKP>15000*MeV) & (piKPT>2450*MeV)"
```

- Stripping cuts

- What was decided for this? No  $p_T$  stripping and loosened other stripping cuts?

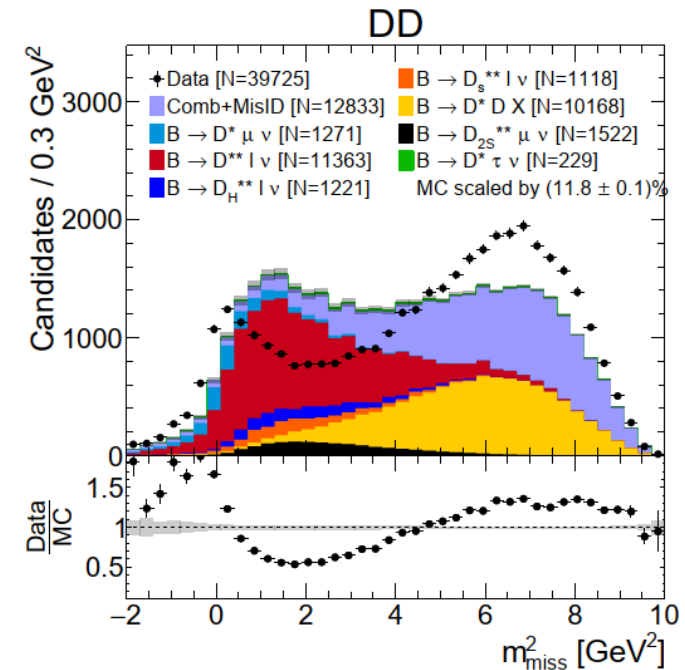
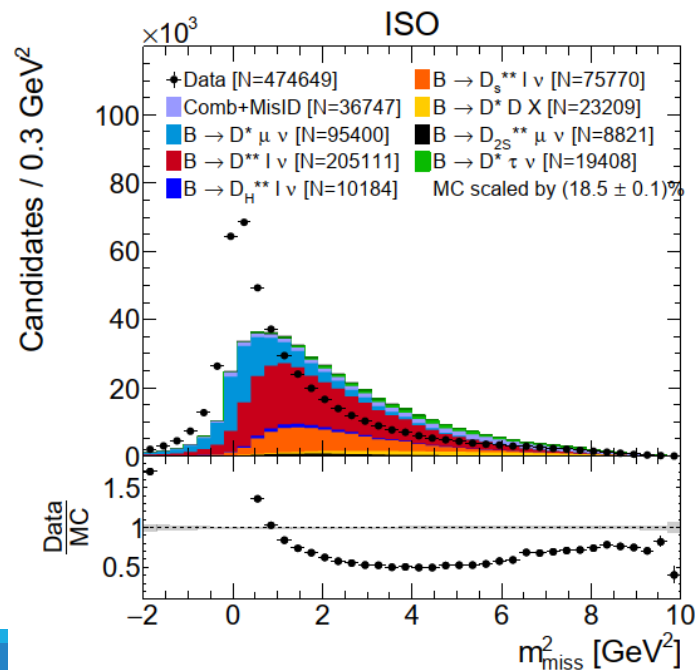
# Run 2 Monte Carlo Request (to-do)

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- Svende will circulate slides (today?), we'll discuss feedback on Tuesday, and then make presentation at SL meeting Wednesday
- Request 200M FullSim and 200M tracker-only
  - May reduce to 100M if significant pushback or will take too long

# Other things

- Yipeng and Alex working on finalizing ntuple production by carefully going through Phoebe's code for run 1
  - Yipeng looking at step 1-to-2 cuts, Alex at step 2-to-fit
  - Good agreement in plots between data/MC isn't expected for now (because there's no fit, weights aren't fully implemented from Phoebe's analysis...and for these two plots, Alex absolutely has some bugs).



# Backup

Stats for  $D_1$

**11873010 - Bd\_Dststmunu-D0 (8.9M events)**  
 $8.9 \times 0.2772 \times 0.1829 = \underline{451k} B^0 \rightarrow D_1^- (\rightarrow D^{*-} \pi^0) \mu^+ \nu$

Decay B0sig					
0.3069	MyD'_1-	mu+	nu_mu	PHOTOS	ISGW2
0.2970	MyD_0*-	mu+	nu_mu	PHOTOS	ISGW2
0.2772	MyD_1-	mu+	nu_mu	PHOTOS	ISGW2
0.1188	MyD_2*-	mu+	nu_mu	PHOTOS	ISGW2
Decay MyD_0*+					
0.7677	MyD0	pi+		PHOTOS	PHSP
0.1152	MyD*0	pi+	pi0	PHOTOS	PHSP
0.0781	MyD*+	pi+	pi-	PHOTOS	PHSP
0.0390	MyD*+	pi0	pi0	PHOTOS	PHSP
Decay MyD_0*0					
0.6052	MyD0	pi0		PHSP	
0.1813	MyD*0	pi+	pi-	PHOTOS	PHSP
0.1228	MyD*+	pi-	pi0	PHOTOS	PHSP
0.0907	MyD*0	pi0	pi0	PHOTOS	PHSP
Decay MyD_1+					
0.5403	MyD*0	pi+		PHOTOS	VVS_PWAVE [0.0, 0.0, 0.0, 0.0, 1.0, 0.0]
0.1829	MyD*+	pi0		PHOTOS	VVS_PWAVE [0.0, 0.0, 0.0, 0.0, 1.0, 0.0]
0.1548	MyD_0*0	pi+		PHOTOS	PHSP
0.1220	MyD_0*+	pi0		PHOTOS	PHSP

**11874060 - Bd\_Dststmunu-Dst+ (2.0M events)**  
 $2 \times 0.4493 \times 0.846 = \underline{760k} B^0 \rightarrow D_1^- (\rightarrow D^{*-} \pi^0) \mu^+ \nu$

Decay B0sig					
0.4493	MyD_1-	mu+	nu_mu	PHOTOS	ISGW2
0.4058	MyD'_1-	mu+	nu_mu	PHOTOS	ISGW2
0.1449	MyD_2*-	mu+	nu_mu	PHOTOS	ISGW2
Decay MyD_0*+					
0.6667	MyD*+	pi+	pi-	PHOTOS	PHSP
0.3333	MyD*+	pi0	pi0	PHOTOS	PHSP
Decay MyD_0*0					
1.0000	MyD*+	pi-	pi0	PHOTOS	PHSP
Decay MyD_1+					
0.8460	MyD*+	pi0		PHOTOS	VVS_PWAVE [0.0, 0.0, 0.0, 0.0, 1.0, 0.0]
0.0880	MyD_0*0	pi+		PHOTOS	PHSP
0.0660	MyD_0*+	pi0		PHOTOS	PHSP

Keeping the same ratio as in Run 1 request, we would get 40% fewer  $D^{*+}$  events with the  $D^0$  sample.  
 Could reduce  $D_1^- \rightarrow D_0^* \pi$  BF, and keep the same 8.9M/2M ratio