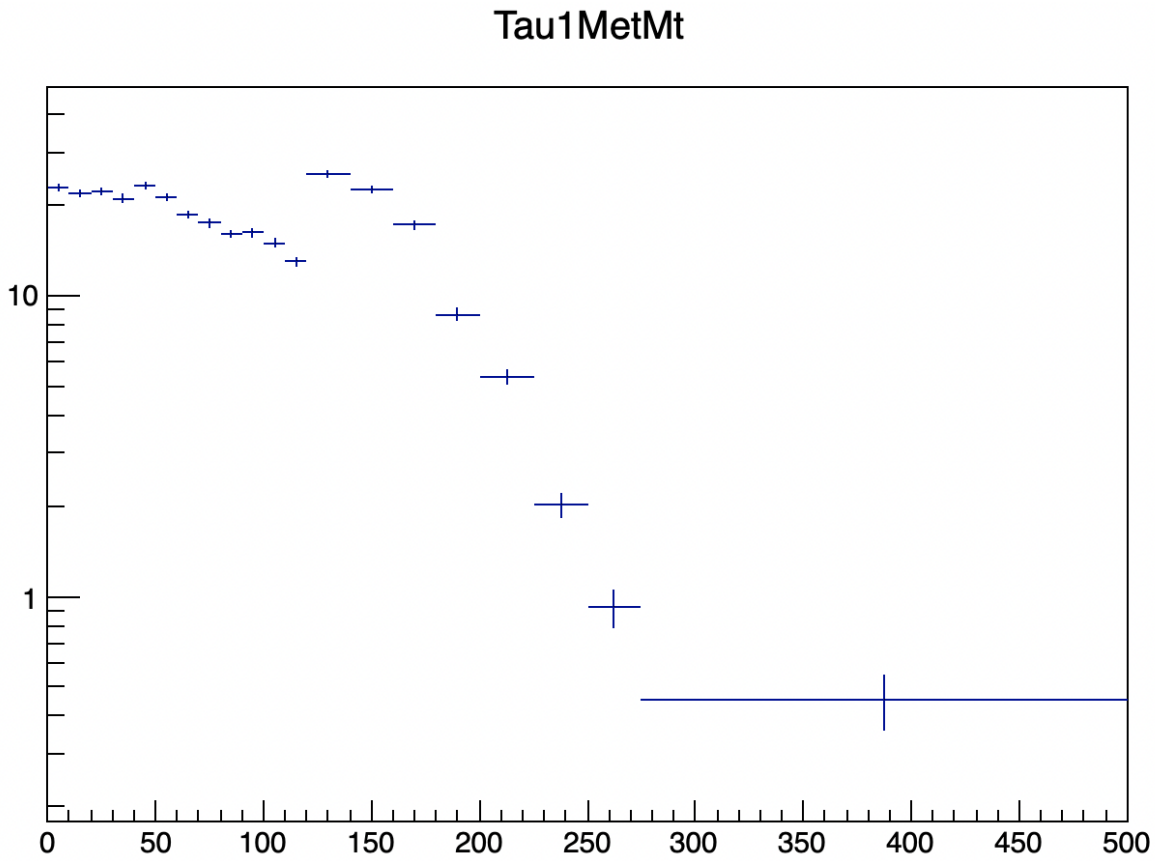
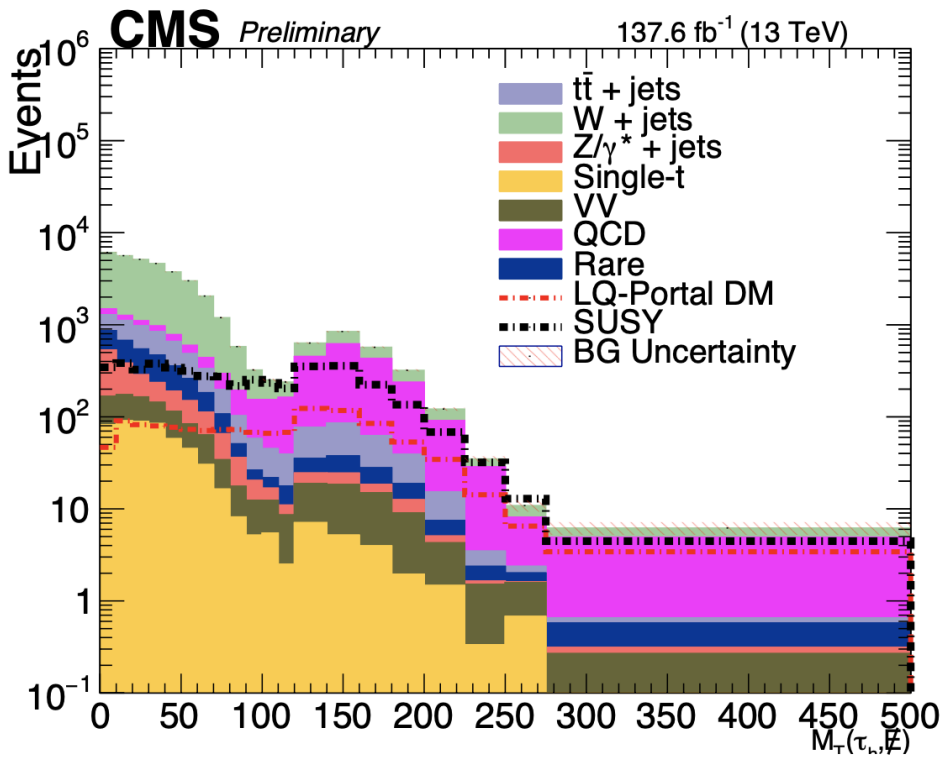
ISR Stau Signal Processing

$$m(\chi_1^{\pm}) = 300, \Delta m(\chi_1^{\pm}, \chi_1^0) = 50\ GeV$$





- Apparent lower yields than SUS-19-002

SUS-19-002

m_T	2016 $m_{\tilde{\chi}_1^\pm} = 300$	2017 $m_{\tilde{\chi}_1^\pm} = 300$
0-10	18 ± 1	20 ± 4
10-20	20 ± 1	26 ± 4
20-30	17 ± 1	21 ± 4
30-40	20 ± 1	25 ± 4
40-50	18 ± 1	22 ± 4
50-60	17 ± 1	20 ± 4
60-70	14 ± 1	18 ± 4
70-80	14 ± 1	18 ± 4
80-90	11 ± 1	14 ± 3
90-100	13 ± 1	18 ± 3
100-110	12 ± 1	14 ± 3
110-120	11 ± 1	13 ± 3
120-140	19 ± 1	23 ± 4
140-160	19 ± 1	22 ± 3
160-180	12 ± 1	15 ± 3
180-200	7 ± 1	8 ± 2
200+	6 ± 1	7 ± 2

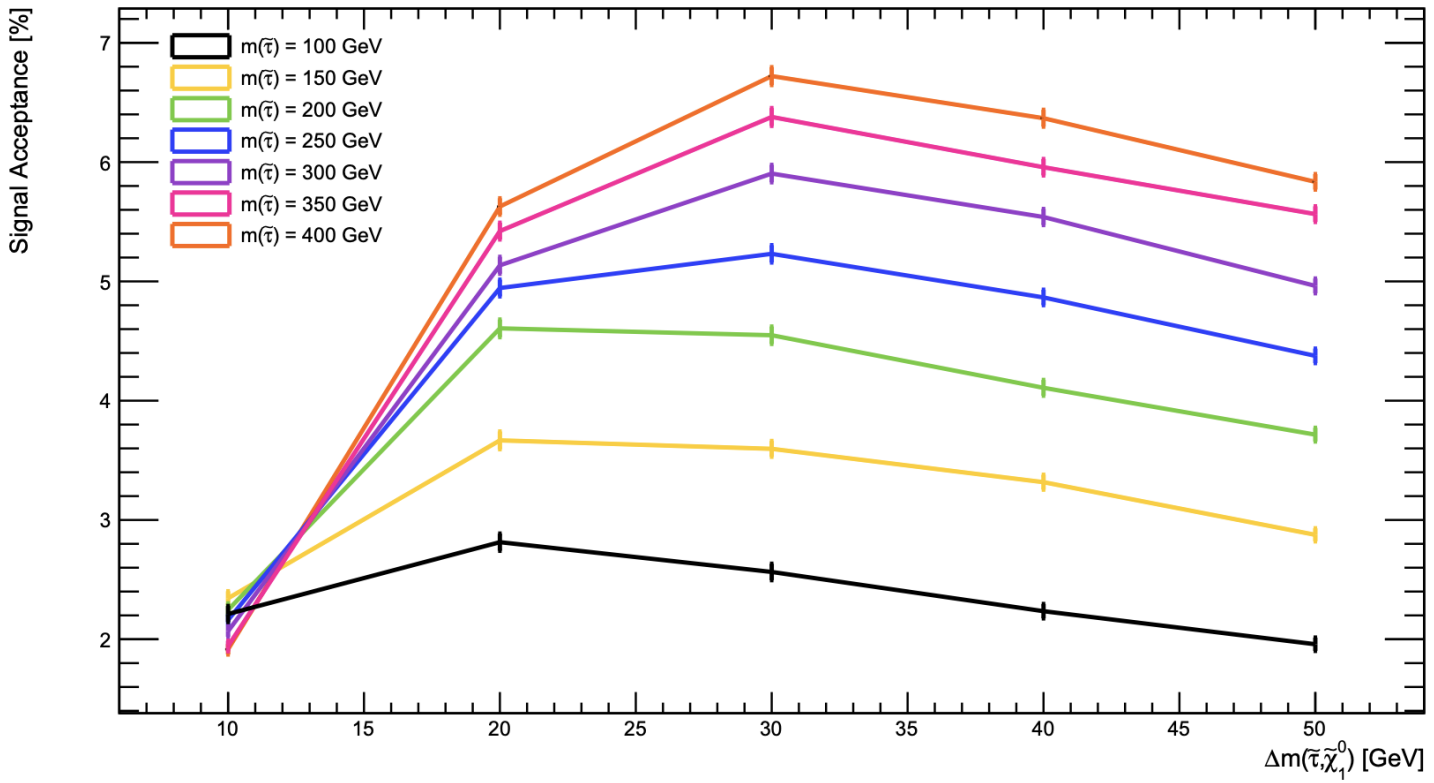
Current Iteration

	2016	2017	2018
Bin 1:	5.92402	7.14191	9.84221
Bin 2:	5.61847	6.77353	9.33456
Bin 3:	5.7408	6.92101	9.5378
Bin 4:	5.44328	6.56233	9.0435
Bin 5:	6.02979	7.26941	10.0179
Bin 6:	5.48896	6.61741	9.1194
Bin 7:	4.82421	5.81599	8.01498
Bin 8:	4.50495	5.4311	7.48455
Bin 9:	4.14655	4.99901	6.8891
Bin 10:	4.17837	5.03738	6.94198
Bin 11:	3.86747	4.66256	6.42544
Bin 12:	3.3605	4.05137	5.58316
Bin 13:	6.54333	7.88854	10.8711
Bin 14:	5.82534	7.02294	9.67826
Bin 15:	4.44466	5.35841	7.38438
Bin 16:	2.23713	2.69705	3.71679
Bin 17:	1.38859	1.67407	2.30702
Bin 18:	0.521373	0.628559	0.866212
Bin 19:	0.238061	0.287003	0.395516
Bin 20:	0.116931	0.14097	0.19427

- Efficiencies seem lower than SUS-19-002

	$\Delta m(\chi_1^{\pm}, \chi_1^0) = 50\ GeV$	$\Delta m(\chi_1^{\pm}, \chi_1^0) = 100\ GeV$
2016	$\varepsilon = 1.7\%$	$\varepsilon = 1.5\%$
2017	$\varepsilon = 1.8\%$	$\varepsilon = 1.5\%$
2018	$\varepsilon = 1.7\%$	$\varepsilon = 1.5\%$

SUS-19-002 →



- We are adding across years of raw MC events per mass/Δm to increase stats, then normalize to corresponding $\varepsilon, \sigma, \mathcal{L}$.

```
double lumi2016 = 36.33;
double lumi2017 = 41.480;
double lumi2018 = 59.830;

double xSec = 129.9;
```

```
// vector of chargino1 masses (n1 = c2 here)
Double_t Graph0_fx1007[5] = {
100,
200,
300,
400,
500};

// cross section in femtobarn
Double_t Graph0_fy1007[5] = {
3913.17,
558.28,
129.9,
48.4118,
20.12};
```

```
TFile *f1 = new TFile("ISR_stau_2016_signalYields/ISR_SUS_2016_mC1_300_dm_50_finalBinning.root");
TH1D *TauMetMtBase = Tau1MetMt;
TH1D *EventsCp16 = Events;
TFile *f2 = new TFile("ISR_stau_2017_signalYields/ISR_SUS_2017_mC1_300_dm_50_finalBinning.root");
TH1D *TauMetMt17 = Tau1MetMt;
TH1D *EventsCp17 = Events;
TFile *f3 = new TFile("ISR_stau_2018_signalYields/ISR_SUS_2018_mC1_300_dm_50_finalBinning.root");
TH1D *TauMetMt18 = Tau1MetMt;
TH1D *EventsCp18 = Events;

TauMetMtBase->Add(TauMetMt17);
TauMetMtBase->Add(TauMetMt18);
```

Code to calculate efficiencies, extract and scale histograms:

```
  TFile *f1 = new TFile("ISR_stau_2016_signalYields/ISR_SUS_2016_mC1_300_dm_50_finalBinning.root");
  TH1D *TauMetMtBase = Tau1MetMt;
  TH1D *EventsCp16 = Events;
  TFile *f2 = new TFile("ISR_stau_2017_signalYields/ISR_SUS_2017_mC1_300_dm_50_finalBinning.root");
  TH1D *TauMetMt17 = Tau1MetMt;
  TH1D *EventsCp17 = Events;
  TFile *f3 = new TFile("ISR_stau_2018_signalYields/ISR_SUS_2018_mC1_300_dm_50_finalBinning.root");
  TH1D *TauMetMt18 = Tau1MetMt;
  TH1D *EventsCp18 = Events;

  TauMetMtBase->Add(TauMetMt17);
  TauMetMtBase->Add(TauMetMt18);

//for dm=50
  double eff16 = EventsCp16->GetBinContent(2)/103373.62;
  double eff17 = EventsCp17->GetBinContent(2)/95070.66;
  double eff18 = EventsCp18->GetBinContent(2)/93484.64;
```

- Samples contain mix of mass/Δm events, so *Events* histo. bin 1 is not reflective of the number of the number of events “processed” we use in efficiency denominator.
- Instead, we use Events histo. bin 2 from NRecoVertex cut level as denominator.

```
TH1D *TauMetMt2018 = (TH1D*)TauMetMtBase->Clone();
TauMetMt2018->Scale((eff18 * lumi2018 * xSec)/TauMetMt2018->Integral(1,21));

TH1D *TauMetMt2017 = (TH1D*)TauMetMtBase->Clone();
TauMetMt2017->Scale((eff17 * lumi2017 * xSec)/TauMetMt2017->Integral(1,21));

TH1D *TauMetMt2016 = (TH1D*)TauMetMtBase->Clone();
TauMetMt2016->Scale((eff16 * lumi2016 * xSec)/TauMetMt2016->Integral(1,21));
```

Full Status Report on 9/20

- Aside from general comments, the main point of discussion may be the ongoing conversation about the simultaneous fit vs. scale factor background estimation method:
  - I will upload the cards (and AN) today, as the conveners have requested.

- Other points of discussion per most recent convener email:
  - “Please document how you apply the btag scale factors (mention the method from BTV and include efficiency maps if relevant) ”
    - We currently use ”Event Reweighting Using Scale Factors Only” from the BTV POG Twiki at [1]
    - It seems this is not one of the recommended approaches
    - Should be acceptable given that we only apply a b-jet veto with very efficiencies, though we will have to make this case.
- Expected limits:
  - Though the cards are in place, the issues mentioned previously may need more studies.
  - Additional question: Usage of combineCards.py for a large number of cards?

[1]:https://twiki.cern.ch/twiki/bin/view/CMS/BTagSFMethods