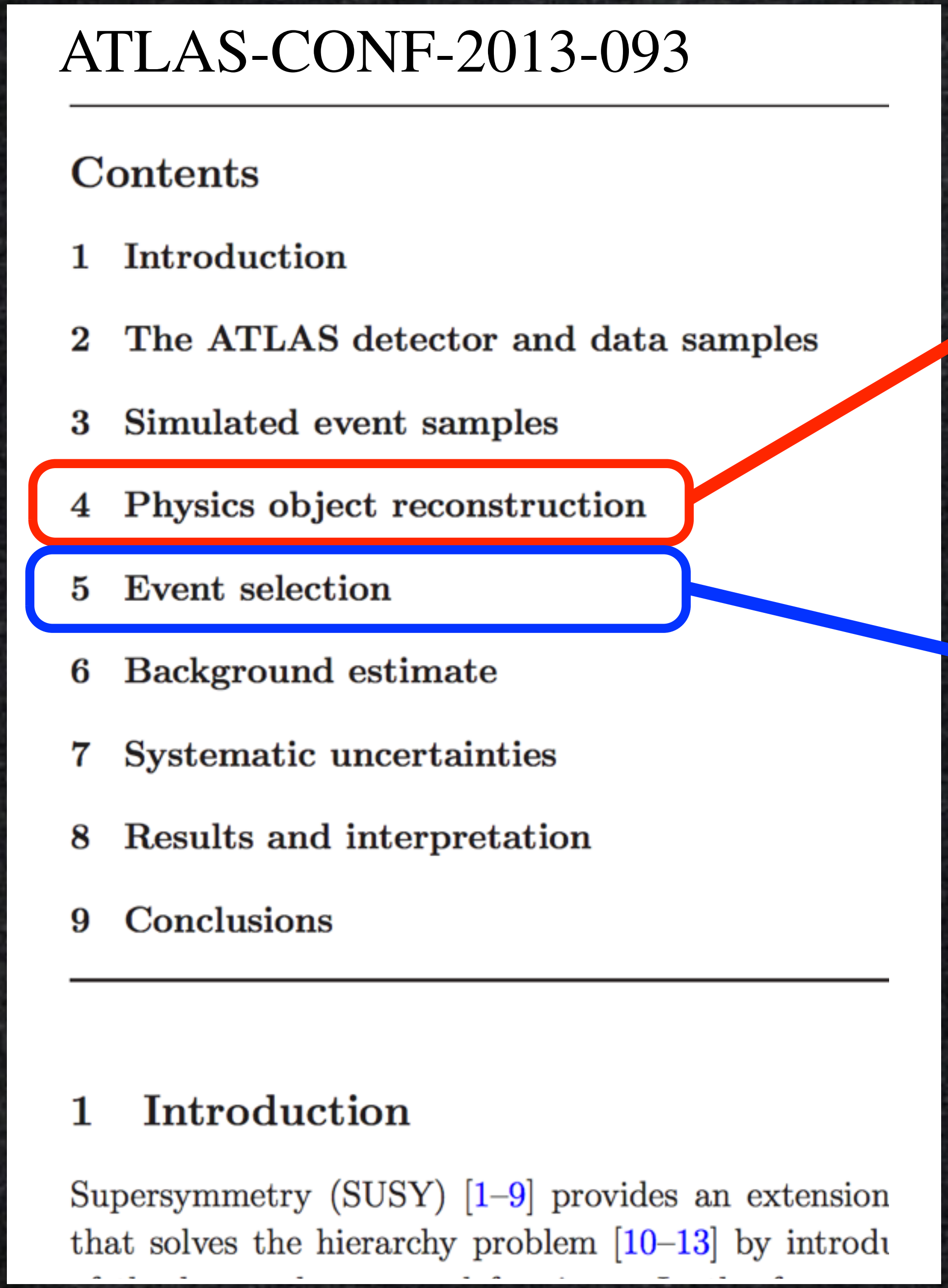
ATOM: Validation

Coding in Atom



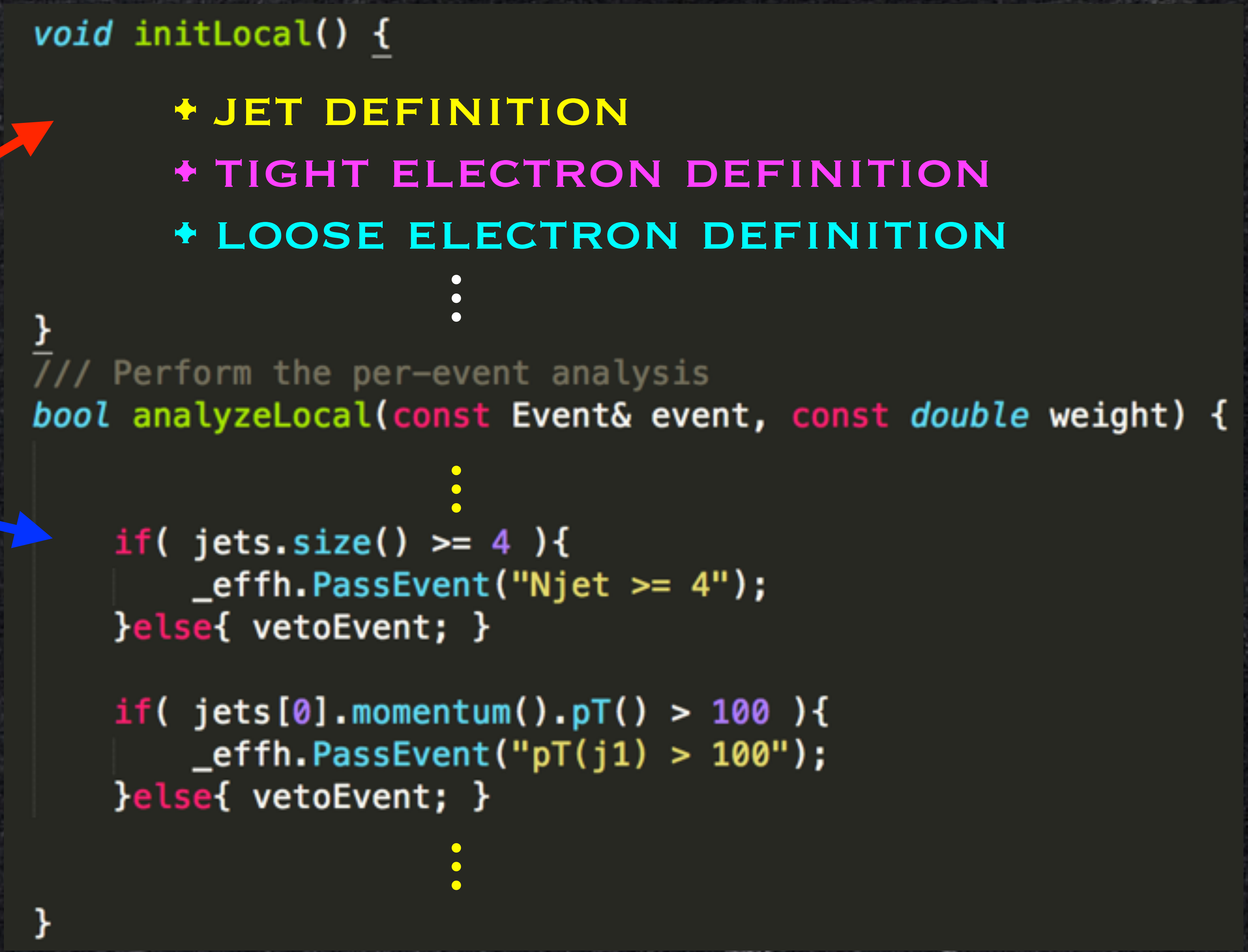
ATLAS-CONF-2013-093

Contents

1 Introduction

Supersymmetry (SUSY) [1–9] provides an extension that solves the hierarchy problem [10–13] by introdu

ATLAS_CONF_2013_093.cc

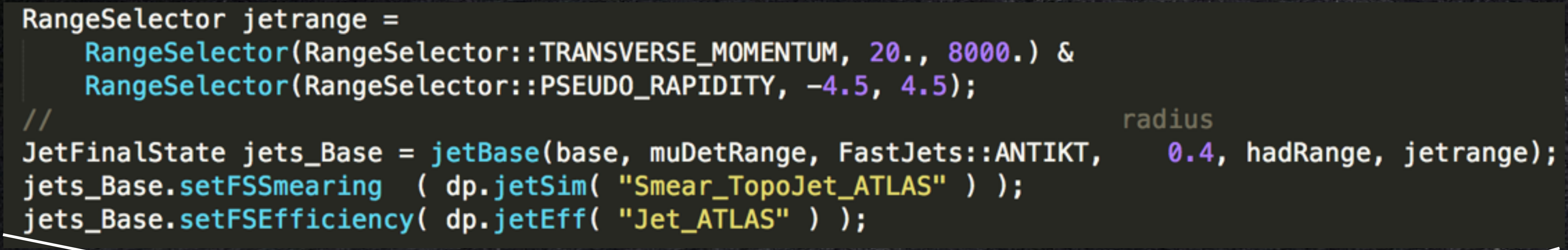


```
void initLocal() {
        ✦ JET DEFINITION
        ✦ TIGHT ELECTRON DEFINITION
        ✦ LOOSE ELECTRON DEFINITION
                      ⋮
}
/// Perform the per-event analysis
bool analyzeLocal(const Event& event, const double weight) {
                      ⋮

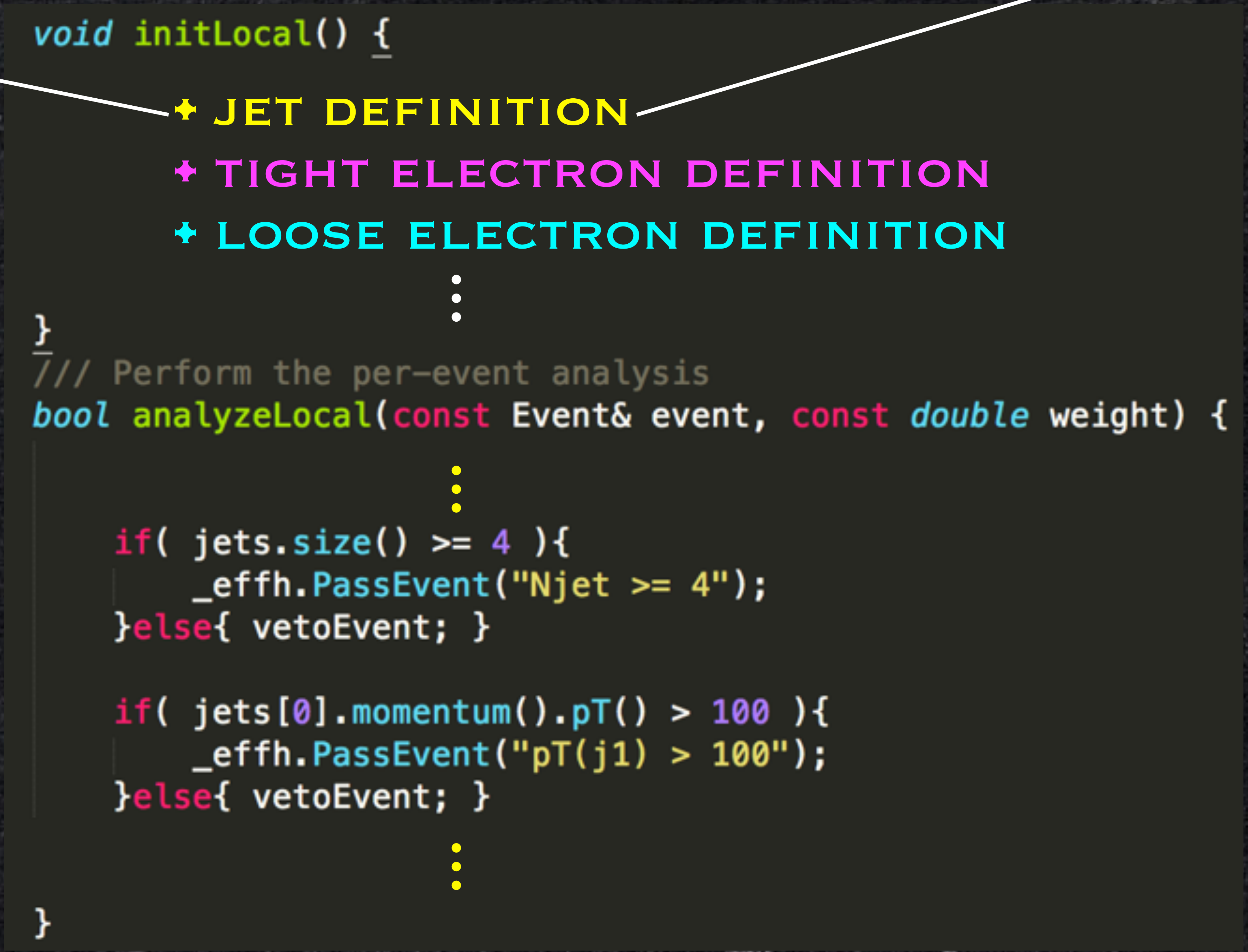
    if( jets.size() >= 4 ){
        _effh.PassEvent("Njet >= 4");
    }else{ vetoEvent; }

    if( jets[0].momentum().pT() > 100 ){
        _effh.PassEvent("pT(j1) > 100");
    }else{ vetoEvent; }
                      ⋮
}
```

✦ JET DEFINITION



```
RangeSelector jetrange =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 20., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -4.5, 4.5);
//                                                            radius
JetFinalState jets_Base = jetBase(base, muDetRange, FastJets::ANTIKT,    0.4, hadRange, jetrange);
jets_Base.setFSSmearing  ( dp.jetSim( "Smear_TopoJet_ATLAS" ) );
jets_Base.setFSEfficiency( dp.jetEff( "Jet_ATLAS" ) );
```



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void initLocal() {

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      ✦ TIGHT ELECTRON DEFINITION
      ✦ LOOSE ELECTRON DEFINITION
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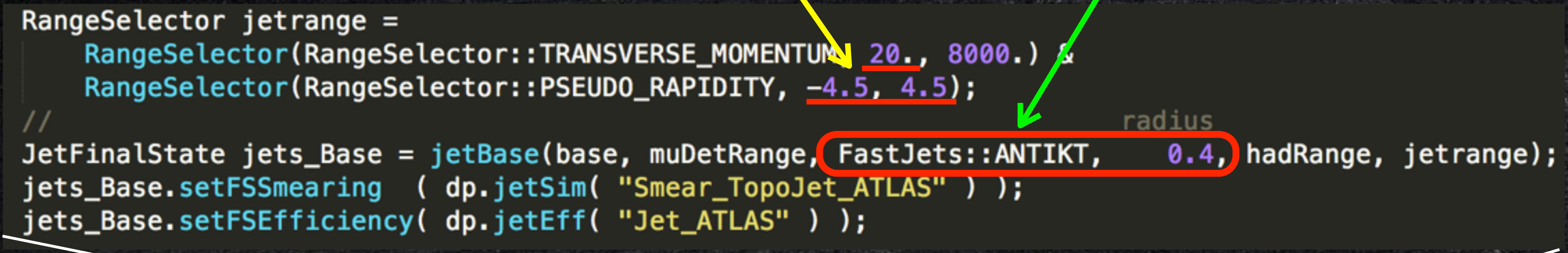
    }else{ vetoEvent; }
                        ⋮
}
```

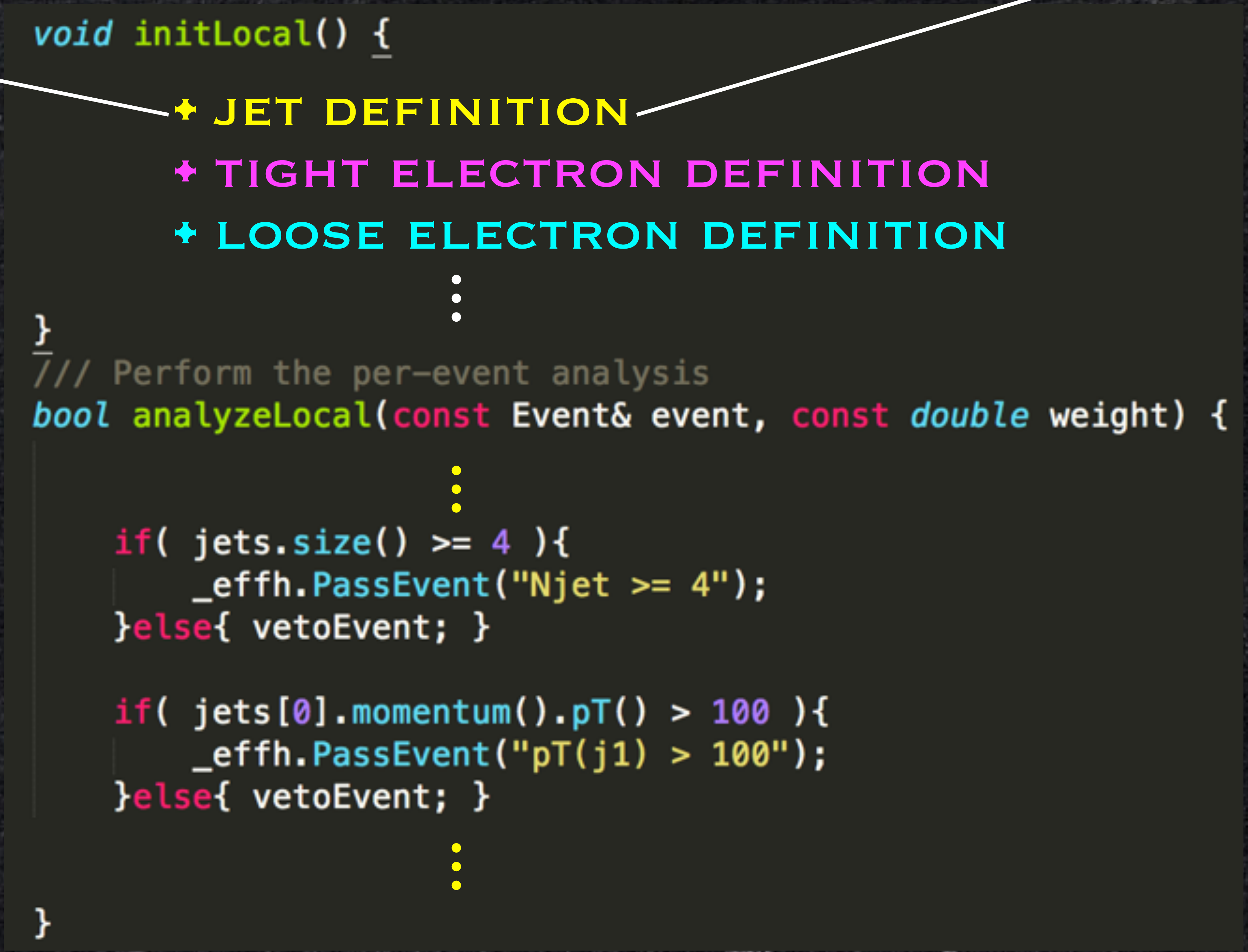
✦ JET DEFINITION

$p_T > 20\,\mathrm{GeV},\ |\eta| < 4.5$

anti-kT, ΔR=0.4 (by Fastjet)



```
RangeSelector jetrange =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 20., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -4.5, 4.5);
//                                                              radius
JetFinalState jets_Base = jetBase(base, muDetRange, FastJets::ANTIKT,     0.4, hadRange, jetrange);
jets_Base.setFSSmearing  ( dp.jetSim( "Smear_TopoJet_ATLAS" ) );
jets_Base.setFSEfficiency( dp.jetEff( "Jet_ATLAS" ) );
```



```
void initLocal() {

        ✦ JET DEFINITION
        ✦ TIGHT ELECTRON DEFINITION
        ✦ LOOSE ELECTRON DEFINITION
                    ⋮
}
/// Perform the per-event analysis
bool analyzeLocal(const Event& event, const double weight) {
                    ⋮
    if( jets.size() >= 4 ){
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    if( jets[0].momentum().pT() > 100 ){
        _effh.PassEvent("pT(j1) > 100");
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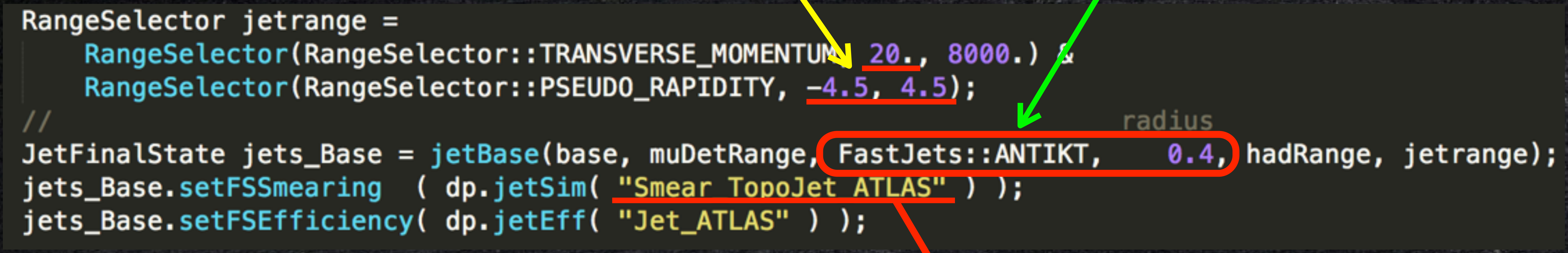
                    ⋮
}
```

✦ JET DEFINITION

$p_T > 20\,\mathrm{GeV},\ |\eta| < 4.5$

anti-kT, ΔR=0.4 (by Fastjet)



```
RangeSelector jetrange =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 20., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -4.5, 4.5);
//                                                         radius
JetFinalState jets_Base = jetBase(base, muDetRange, FastJets::ANTIKT,     0.4, hadRange, jetrange);
jets_Base.setFSSmearing  ( dp.jetSim( "Smear_TopoJet_ATLAS" ) );
jets_Base.setFSEfficiency( dp.jetEff( "Jet_ATLAS" ) );
```

ATLAS-CONF-2013-004

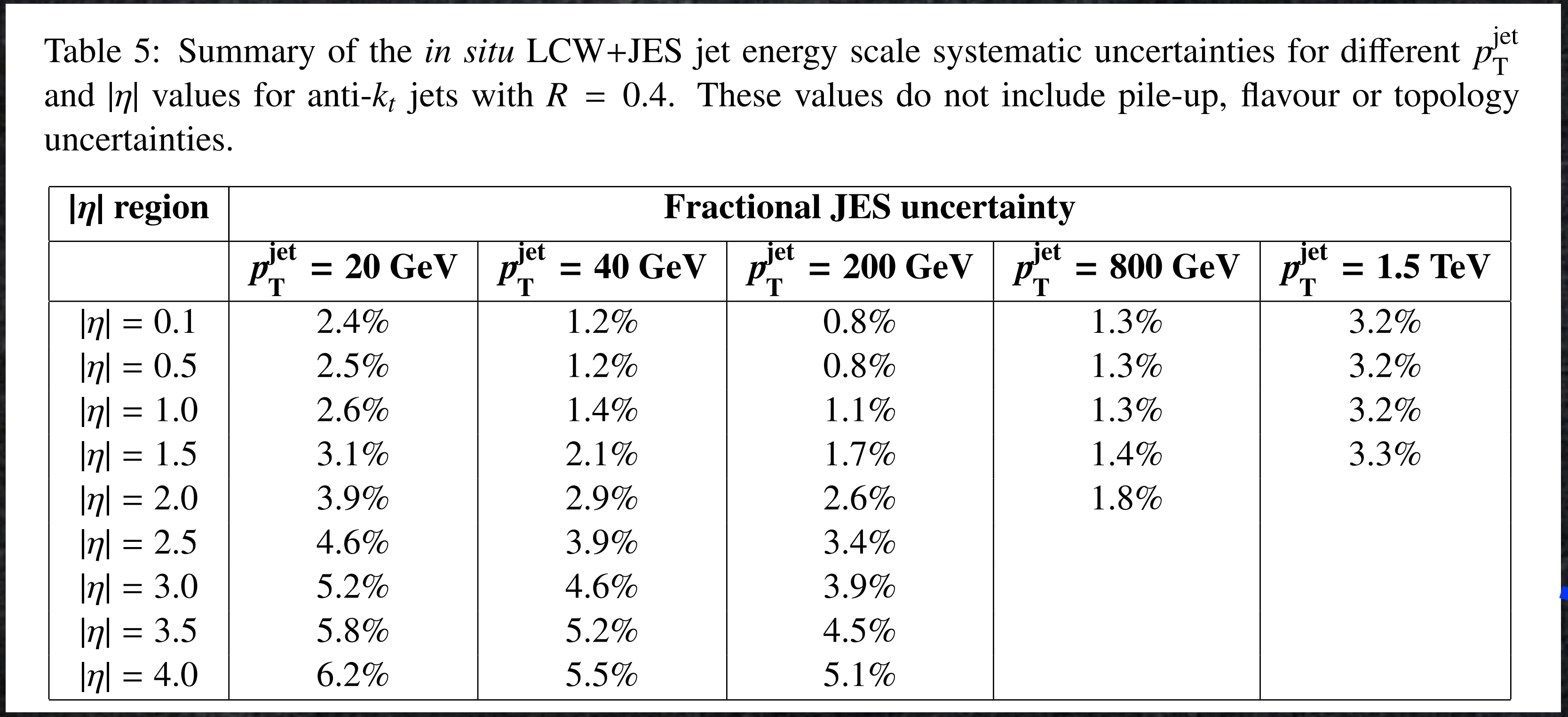
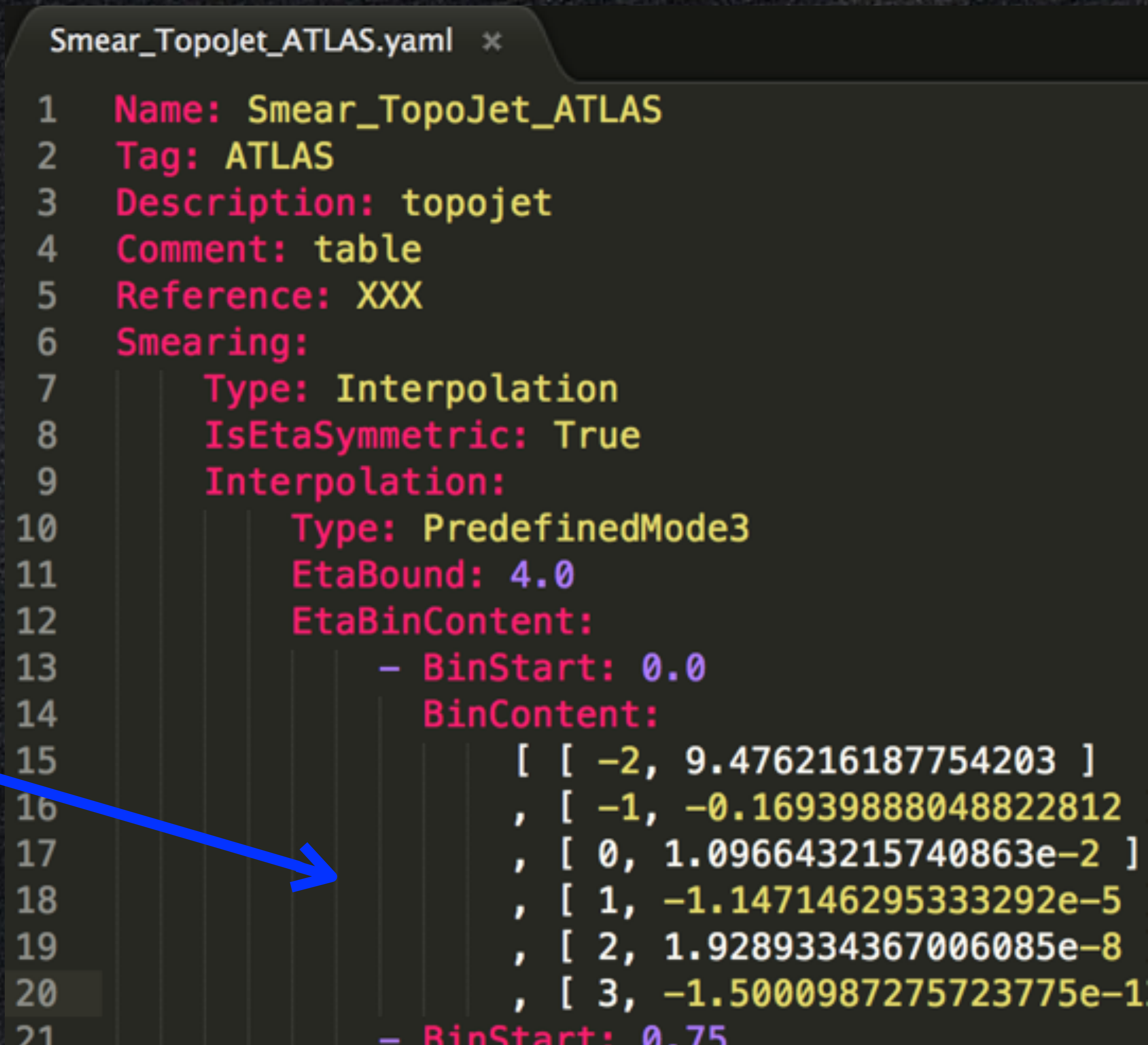


Table 5: Summary of the *in situ* LCW+JES jet energy scale systematic uncertainties for different p_T^{jet} and $|\eta|$ values for anti-k_t jets with $R = 0.4$. These values do not include pile-up, flavour or topology uncertainties.

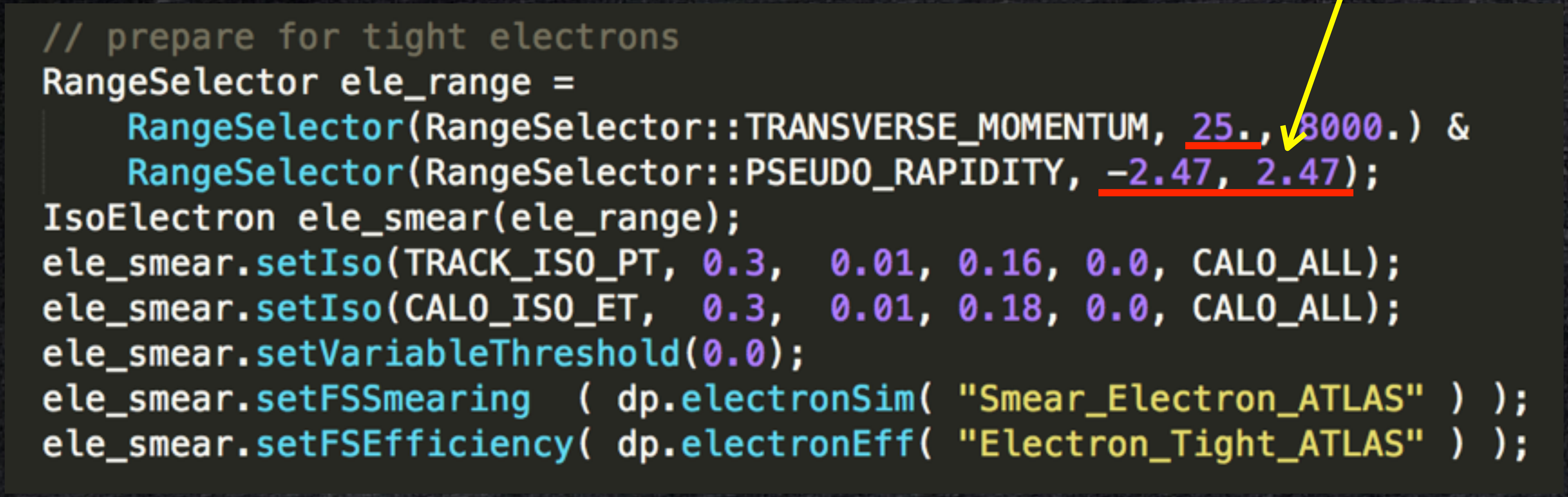
$\|\eta\|$ region	**Fractional JES uncertainty**				
	p_T^{jet} = 20 GeV	**p_T^{jet} = 40 GeV**	**p_T^{jet} = 200 GeV**	**p_T^{jet} = 800 GeV**	**p_T^{jet} = 1.5 TeV**
$\|\eta\| = 0.1$	2.4%	1.2%	0.8%	1.3%	3.2%
$\|\eta\| = 0.5$	2.5%	1.2%	0.8%	1.3%	3.2%
$\|\eta\| = 1.0$	2.6%	1.4%	1.1%	1.3%	3.2%
$\|\eta\| = 1.5$	3.1%	2.1%	1.7%	1.4%	3.3%
$\|\eta\| = 2.0$	3.9%	2.9%	2.6%	1.8%	
$\|\eta\| = 2.5$	4.6%	3.9%	3.4%		
$\|\eta\| = 3.0$	5.2%	4.6%	3.9%		
$\|\eta\| = 3.5$	5.8%	5.2%	4.5%		
$\|\eta\| = 4.0$	6.2%	5.5%	5.1%		



```
Name: Smear_TopoJet_ATLAS
Tag: ATLAS
Description: topojet
Comment: table
Reference: XXX
Smearing:
    Type: Interpolation
    IsEtaSymmetric: True
    Interpolation:
        Type: PredefinedMode3
        EtaBound: 4.0
        EtaBinContent:
            - BinStart: 0.0
              BinContent:
                  [ [ -2, 9.47621618775420з ]
                  , [ -1, -0.1693988804882281
                  , [ 0, 1.096643215740863e-2 ]
                  , [ 1, -1.147146295333292e-5
                  , [ 2, 1.928933436700608 5e-8
                  , [ 3, -1.500098727572377 5e-1
            - BinStart: 0.75
```

✦ TIGHT ELECTRONS

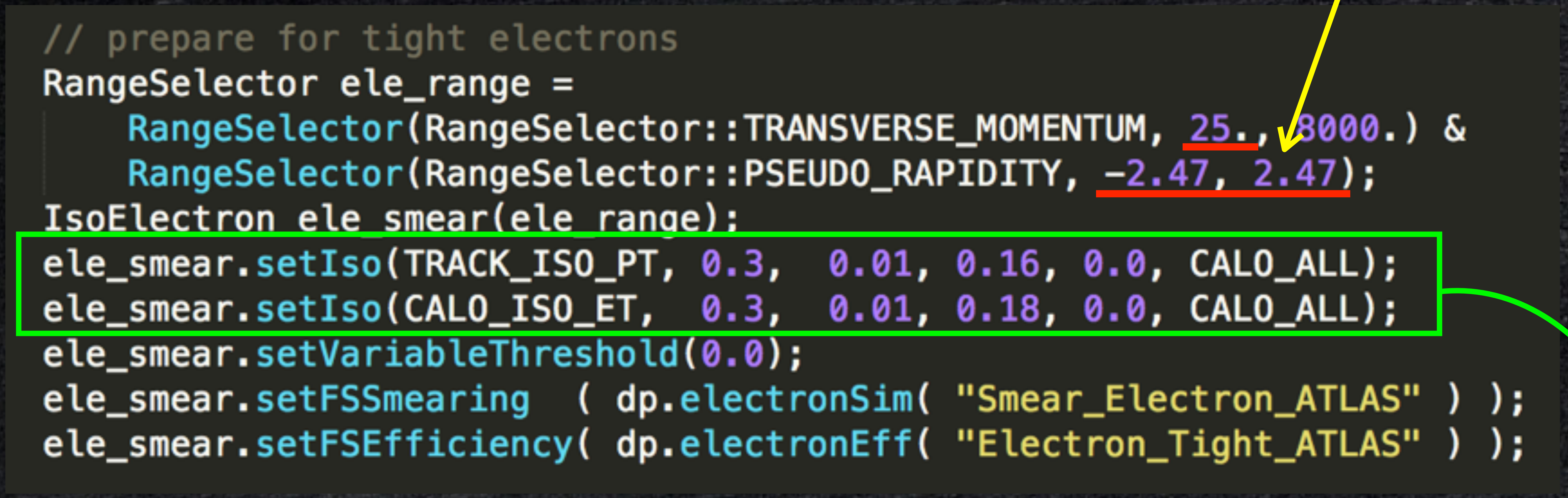
$p_T > 25\,\mathrm{GeV}, \quad |\eta| < 2.47$



```
// prepare for tight electrons
RangeSelector ele_range =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 25., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -2.47, 2.47);
IsoElectron ele_smear(ele_range);
ele_smear.setIso(TRACK_ISO_PT, 0.3,  0.01, 0.16, 0.0, CALO_ALL);
ele_smear.setIso(CALO_ISO_ET,  0.3,  0.01, 0.18, 0.0, CALO_ALL);
ele_smear.setVariableThreshold(0.0);
ele_smear.setFSSmearing  ( dp.electronSim( "Smear_Electron_ATLAS" ) );
ele_smear.setFSEfficiency( dp.electronEff( "Electron_Tight_ATLAS" ) );
```

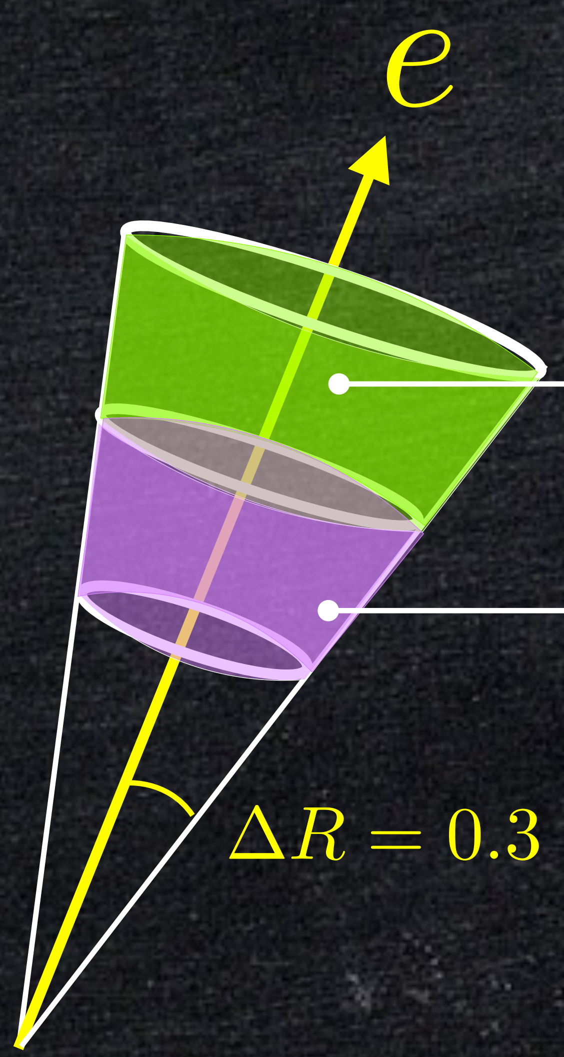
✦ TIGHT ELECTRONS

$p_T > 25\,\mathrm{GeV}, \;\; |\eta| < 2.47$



```
// prepare for tight electrons
RangeSelector ele_range =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 25., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -2.47, 2.47);
IsoElectron ele_smear(ele_range);
ele_smear.setIso(TRACK_ISO_PT, 0.3,  0.01, 0.16, 0.0, CALO_ALL);
ele_smear.setIso(CALO_ISO_ET,  0.3,  0.01, 0.18, 0.0, CALO_ALL);
ele_smear.setVariableThreshold(0.0);
ele_smear.setFSSmearing  ( dp.electronSim( "Smear_Electron_ATLAS" ) );
ele_smear.setFSEfficiency( dp.electronEff( "Electron_Tight_ATLAS" ) );
```

track calorimeter isolation



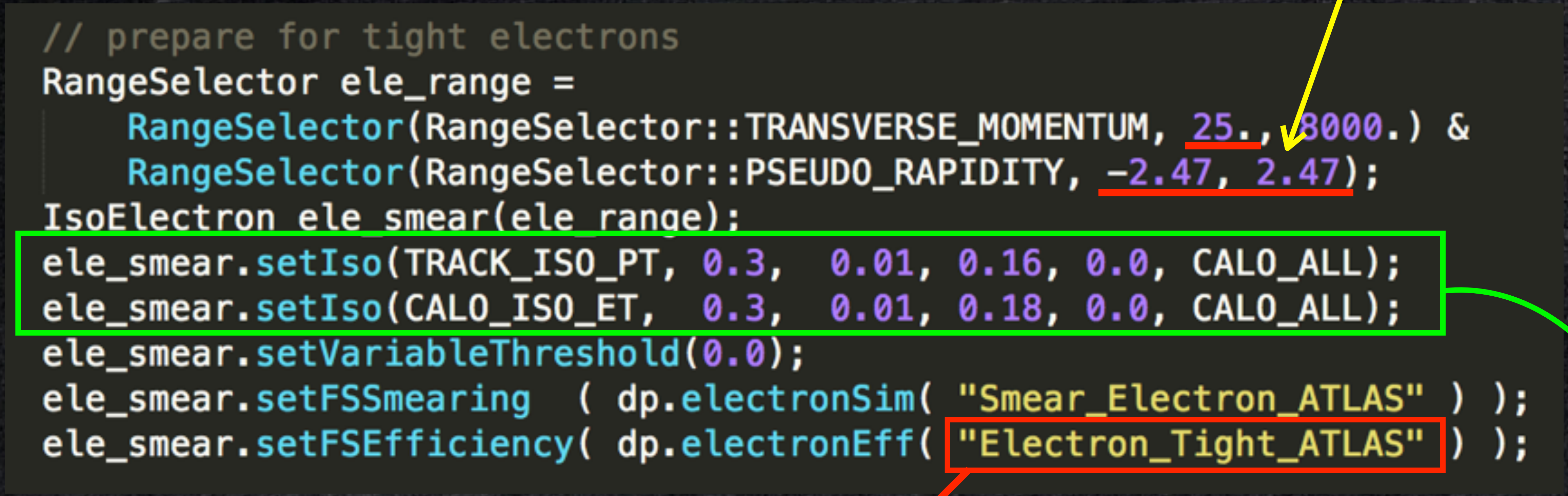
$$\sum_{i}^{\mathrm{CAL}} E_T^i < 0.18 \cdot p_T^e$$

$$\sum_{i}^{\mathrm{track}} p_T^i < 0.16 \cdot p_T^e$$

$\Delta R = 0.3$

✦ TIGHT ELECTRONS

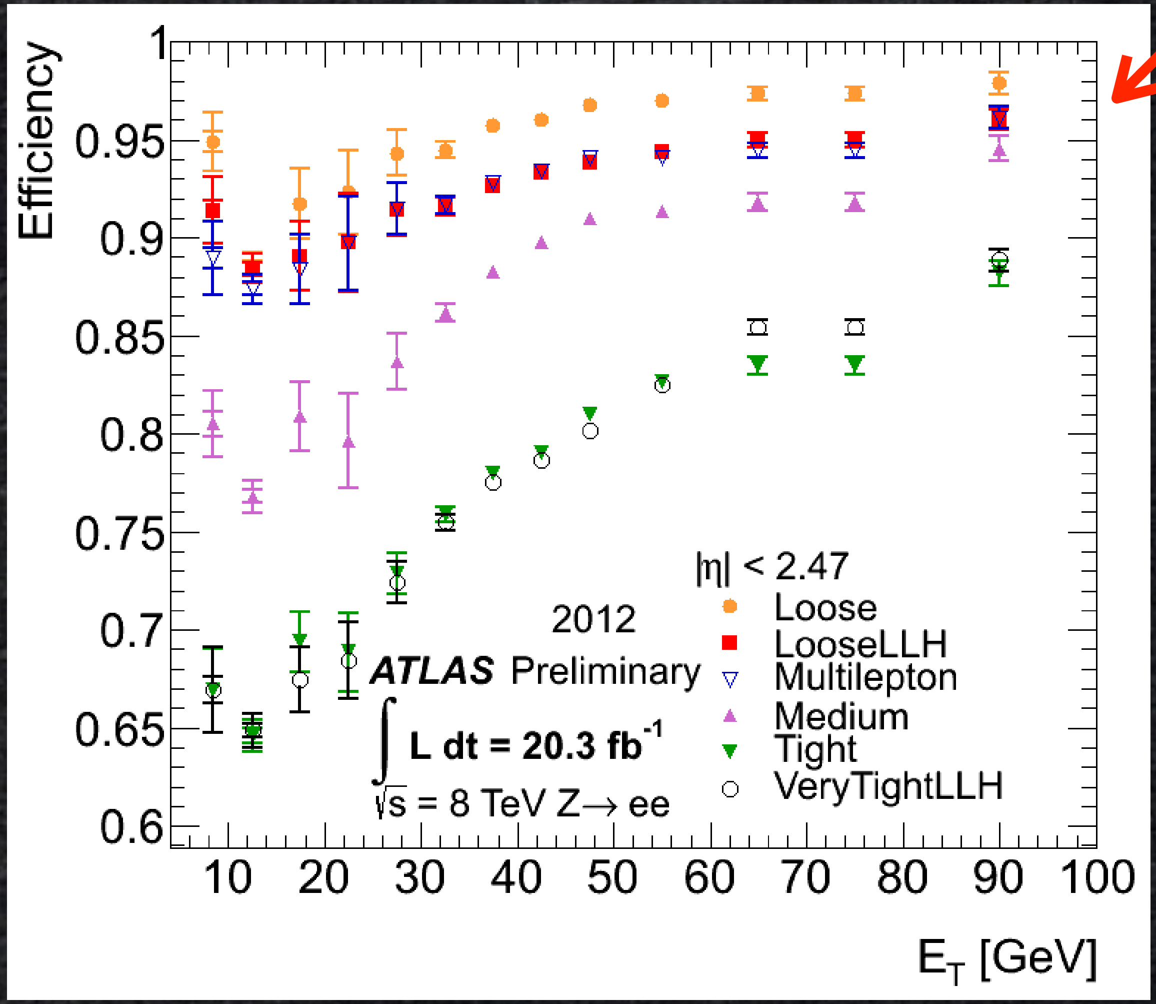
$p_T > 25\,\mathrm{GeV},\ \ |\eta| < 2.47$

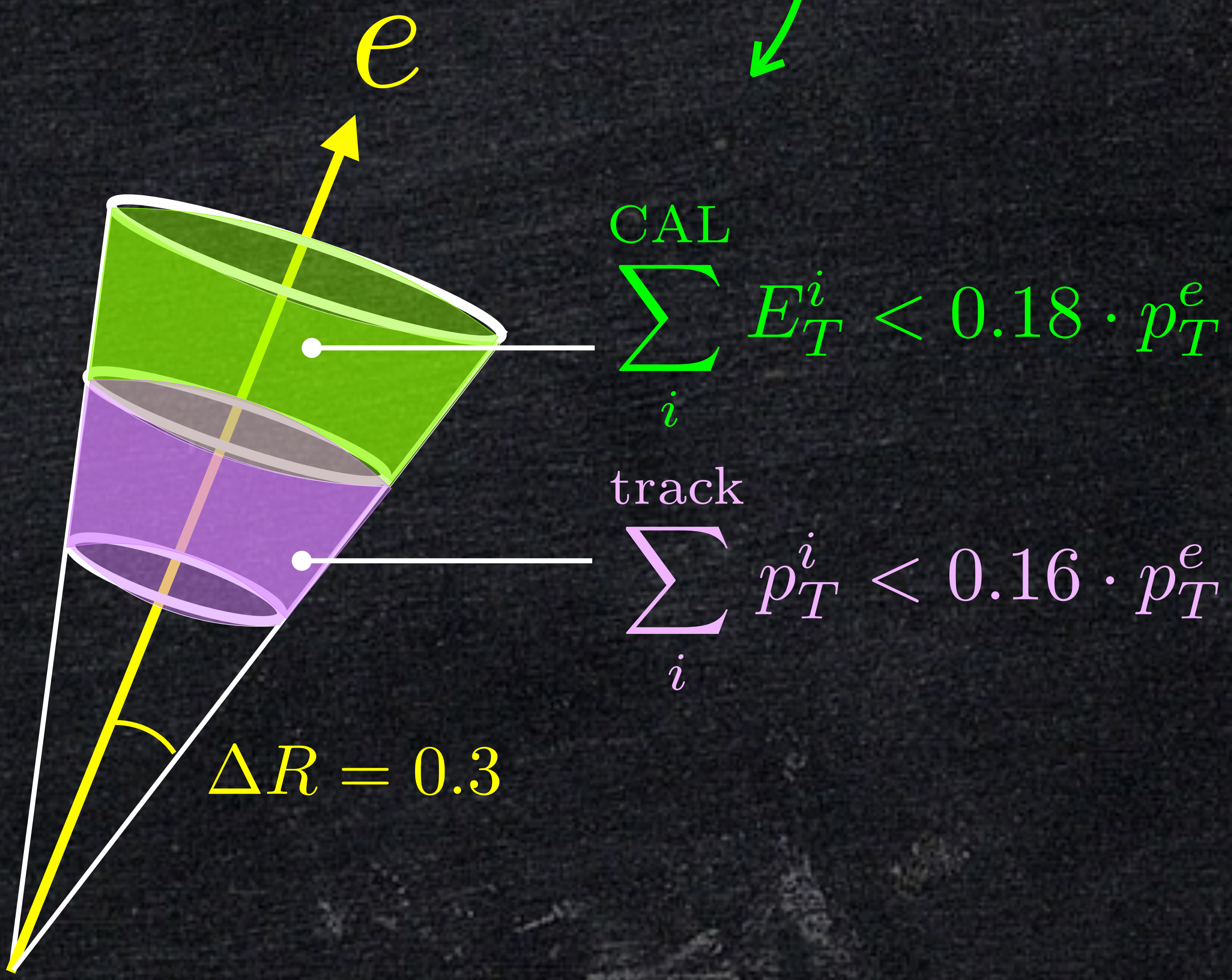


```
// prepare for tight electrons
RangeSelector ele_range =
    RangeSelector(RangeSelector::TRANSVERSE_MOMENTUM, 25., 8000.) &
    RangeSelector(RangeSelector::PSEUDO_RAPIDITY, -2.47, 2.47);
IsoElectron ele_smear(ele_range);
ele_smear.setIso(TRACK_ISO_PT, 0.3,  0.01, 0.16, 0.0, CALO_ALL);
ele_smear.setIso(CALO_ISO_ET,  0.3,  0.01, 0.18, 0.0, CALO_ALL);
ele_smear.setVariableThreshold(0.0);
ele_smear.setFSSmearing  ( dp.electronSim( "Smear_Electron_ATLAS" ) );
ele_smear.setFSEfficiency( dp.electronEff( "Electron_Tight_ATLAS" ) );
```

track calorimeter isolation

reconstruction efficiencies

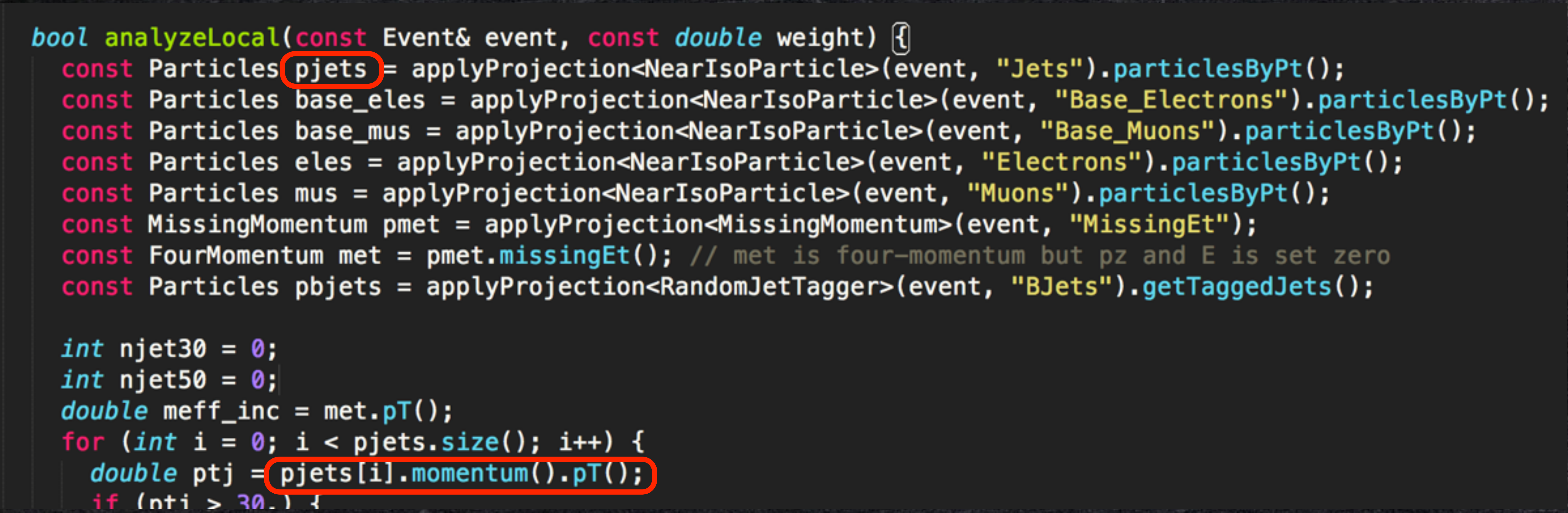




$$\sum_i^{\mathrm{CAL}} E_T^i < 0.18 \cdot p_T^e$$

$$\sum_i^{\mathrm{track}} p_T^i < 0.16 \cdot p_T^e$$

- The objects defined and projected in initLocal can be retrieved and used in analyzeLocal.



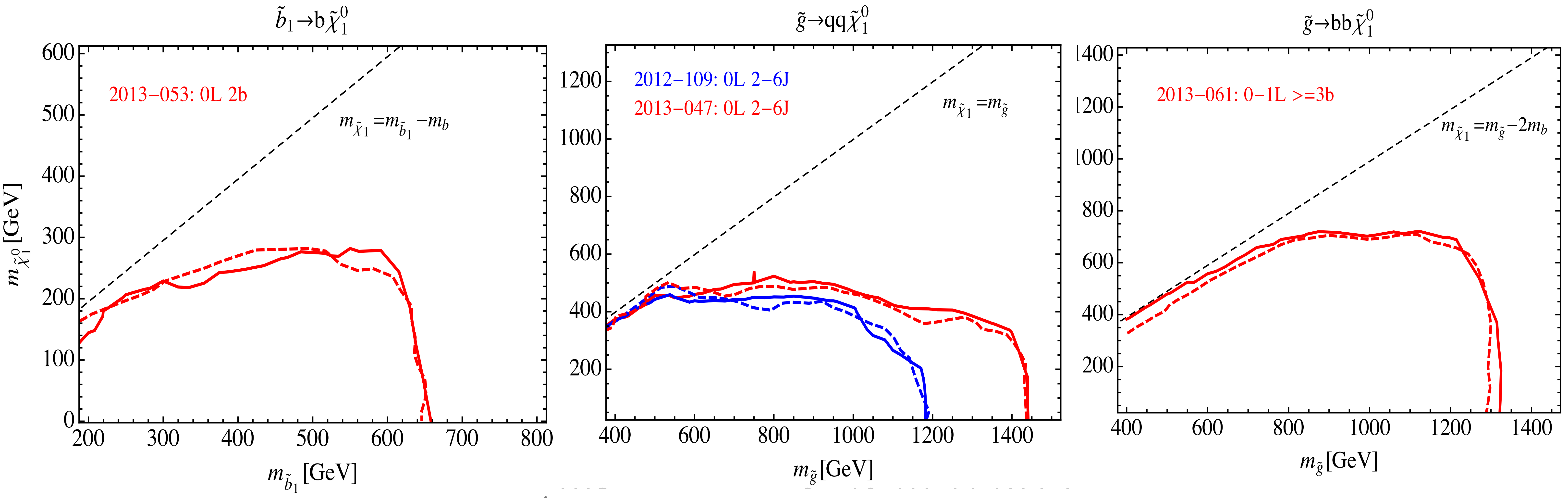
```cpp
bool analyzeLocal(const Event& event, const double weight) {
  const Particles pjets = applyProjection<NearIsoParticle>(event, "Jets").particlesByPt();
  const Particles base_eles = applyProjection<NearIsoParticle>(event, "Base_Electrons").particlesByPt();
  const Particles base_mus = applyProjection<NearIsoParticle>(event, "Base_Muons").particlesByPt();
  const Particles eles = applyProjection<NearIsoParticle>(event, "Electrons").particlesByPt();
  const Particles mus = applyProjection<NearIsoParticle>(event, "Muons").particlesByPt();
  const MissingMomentum pmet = applyProjection<MissingMomentum>(event, "MissingEt");
  const FourMomentum met = pmet.missingEt(); // met is four-momentum but pz and E is set zero
  const Particles pbjets = applyProjection<RandomJetTagger>(event, "BJets").getTaggedJets();

  int njet30 = 0;
  int njet50 = 0;
  double meff_inc = met.pT();
  for (int i = 0; i < pjets.size(); i++) {
    double ptj = pjets[i].momentum().pT();
    if (ptj > 30.) {
```

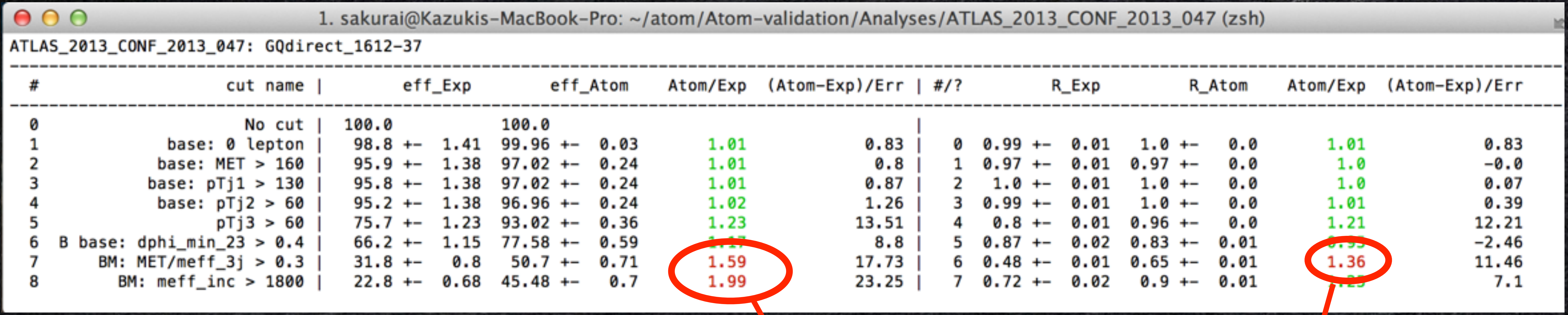
ATOM: Validation

Some info on Validation

- We use cut-flow tables whenever they are available.
- Otherwise we use exclusion plots or some distribution plots for validation.

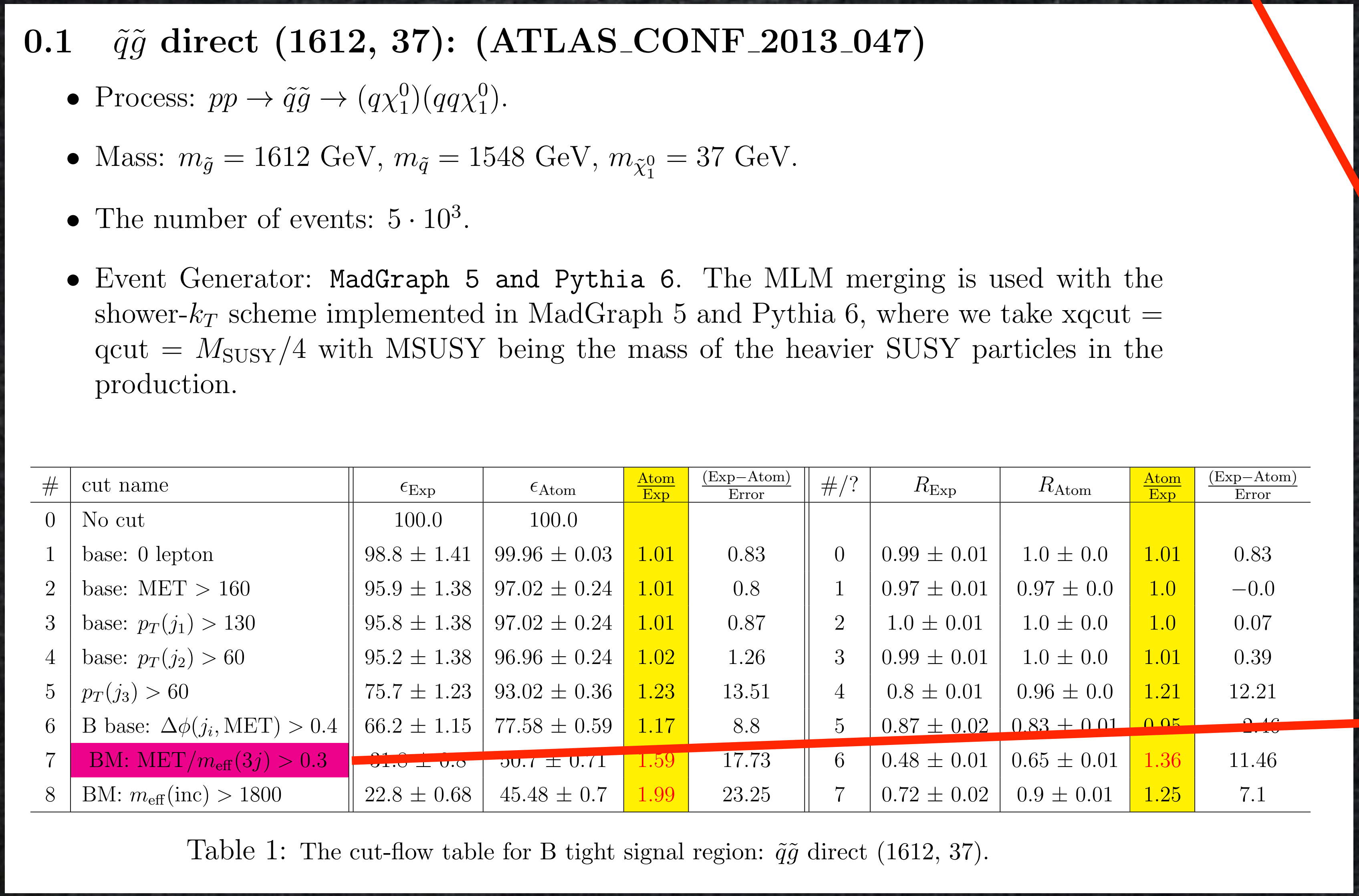


Automated Validation



1. sakurai@Kazukis-MacBook-Pro: ~/atom/Atom-validation/Analyses/ATLAS_2013_CONF_2013_047 (zsh)

```
ATLAS_2013_CONF_2013_047: GQdirect_1612-37
---------------------------------------------------------------------------------------------------------------------------------------------------------------
 #                  cut name |      eff_Exp        eff_Atom     Atom/Exp   (Atom-Exp)/Err  | #/?        R_Exp        R_Atom      Atom/Exp   (Atom-Exp)/Err
---------------------------------------------------------------------------------------------------------------------------------------------------------------
 0                    No cut |  100.0          100.0                                       |
 1           base: 0 lepton  |   98.8 +-  1.41  99.96 +-  0.03        1.01            0.83 |  0  0.99 +-  0.01   1.0 +-   0.0       1.01            0.83
 2           base: MET > 160 |   95.9 +-  1.38  97.02 +-  0.24        1.01             0.8 |  1  0.97 +-  0.01  0.97 +-   0.0        1.0            -0.0
 3          base: pTj1 > 130 |   95.8 +-  1.38  97.02 +-  0.24        1.01            0.87 |  2   1.0 +-  0.01   1.0 +-   0.0        1.0            0.07
 4           base: pTj2 > 60 |   95.2 +-  1.38  96.96 +-  0.24        1.02            1.26 |  3  0.99 +-  0.01   1.0 +-   0.0       1.01            0.39
 5                 pTj3 > 60 |   75.7 +-  1.23  93.02 +-  0.36        1.23           13.51 |  4   0.8 +-  0.01  0.96 +-   0.0       1.21           12.21
 6  B base: dphi_min_23 > 0.4 |   66.2 +-  1.15  77.58 +-  0.59        1.17             8.8 |  5  0.87 +-  0.02  0.83 +-  0.01       0.95           -2.46
 7      BM: MET/meff_3j > 0.3 |   31.8 +-   0.8   50.7 +-  0.71        1.59           17.73 |  6  0.48 +-  0.01  0.65 +-  0.01       1.36           11.46
 8        BM: meff_inc > 1800 |   22.8 +-  0.68  45.48 +-   0.7        1.99           23.25 |  7  0.72 +-  0.02   0.9 +-  0.01       1.25             7.1
```



0.1 $\tilde{q}\tilde{g}$ direct (1612, 37): (ATLAS_CONF_2013_047)

- Process: $pp \to \tilde{q}\tilde{g} \to (q\chi^0_1)(qq\chi^0_1)$.
- Mass: $m_{\tilde{g}} = 1612$ GeV, $m_{\tilde{q}} = 1548$ GeV, $m_{\tilde{\chi}^0_1} = 37$ GeV.
- The number of events: $5 \cdot 10^3$.
- Event Generator: `MadGraph 5 and Pythia 6`. The MLM merging is used with the shower-k_T scheme implemented in MadGraph 5 and Pythia 6, where we take xqcut = qcut = $M_{\rm SUSY}/4$ with MSUSY being the mass of the heavier SUSY particles in the production.

#	cut name	$\epsilon_{\rm Exp}$	$\epsilon_{\rm Atom}$	Atom Exp	(Exp−Atom) Error	#/?	$R_{\rm Exp}$	$R_{\rm Atom}$	Atom Exp	(Exp−Atom) Error
0	No cut	100.0	100.0							
1	base: 0 lepton	98.8 ± 1.41	99.96 ± 0.03	1.01	0.83	0	0.99 ± 0.01	1.0 ± 0.0	1.01	0.83
2	base: MET > 160	95.9 ± 1.38	97.02 ± 0.24	1.01	0.8	1	0.97 ± 0.01	0.97 ± 0.0	1.0	−0.0
3	base: $p_T(j_1) > 130$	95.8 ± 1.38	97.02 ± 0.24	1.01	0.87	2	1.0 ± 0.01	1.0 ± 0.0	1.0	0.07
4	base: $p_T(j_2) > 60$	95.2 ± 1.38	96.96 ± 0.24	1.02	1.26	3	0.99 ± 0.01	1.0 ± 0.0	1.01	0.39
5	$p_T(j_3) > 60$	75.7 ± 1.23	93.02 ± 0.36	1.23	13.51	4	0.8 ± 0.01	0.96 ± 0.0	1.21	12.21
6	B base: $\Delta\phi(j_i, {\rm MET}) > 0.4$	66.2 ± 1.15	77.58 ± 0.59	1.17	8.8	5	0.87 ± 0.02	0.83 ± 0.01	0.95	−2.46
7	BM: ${\rm MET}/m_{\rm eff}(3j) > 0.3$	31.8 ± 0.8	50.7 ± 0.71	1.59	17.73	6	0.48 ± 0.01	0.65 ± 0.01	1.36	11.46
8	BM: $m_{\rm eff}({\rm inc}) > 1800$	22.8 ± 0.68	45.48 ± 0.7	1.99	23.25	7	0.72 ± 0.02	0.9 ± 0.01	1.25	7.1

Table 1: The cut-flow table for B tight signal region: $\tilde{q}\tilde{g}$ direct (1612, 37).

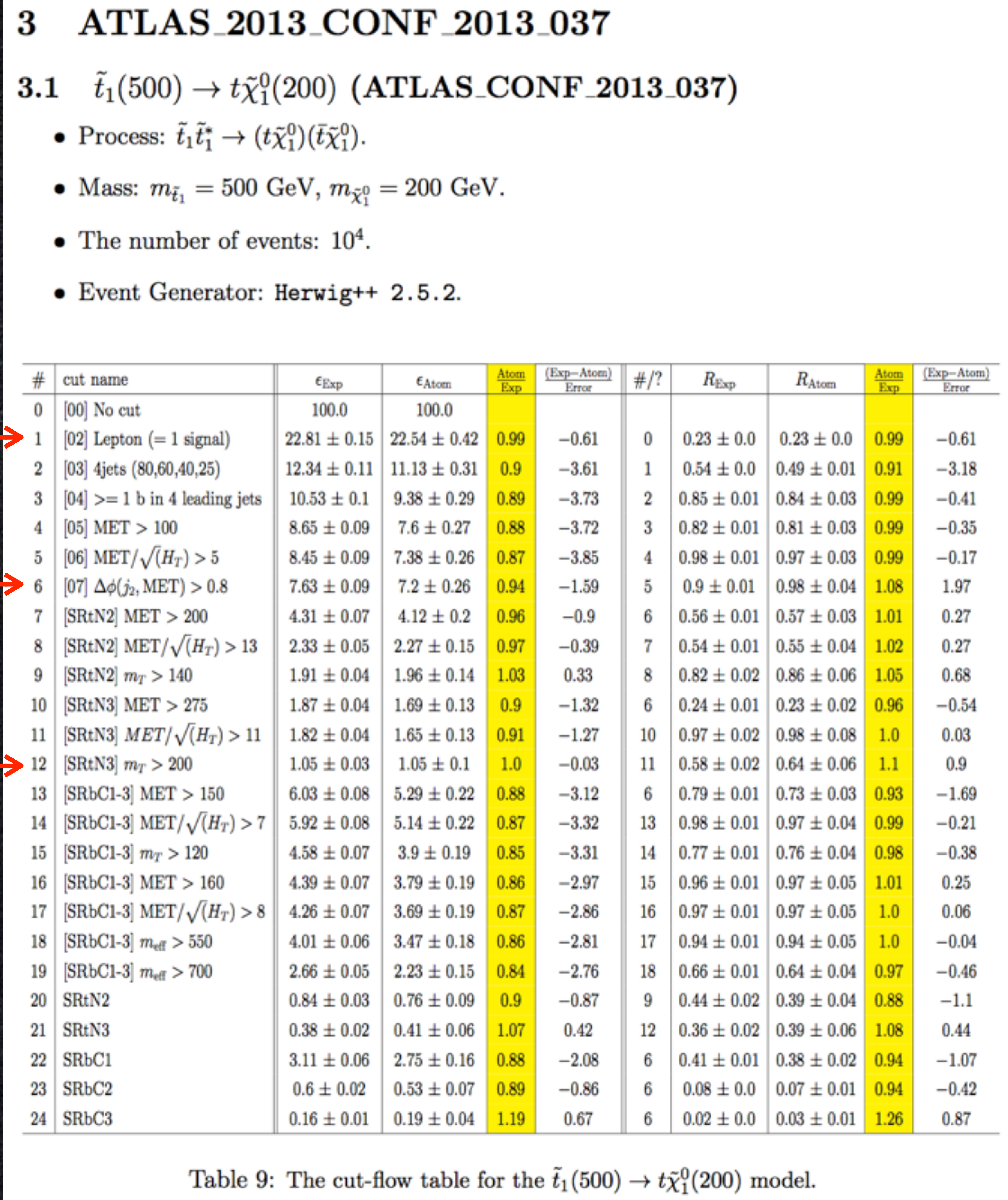
- ATOM automatically generates cut-flow tables and checks the efficiencies between ATOM and experimental collaborations.
- If significant deviation is found, it provides warnings.

anomaly can be easily caught

lepton efficiency

ISR
jet, MET smearing

lepton, MET
smearing



3 ATLAS_2013_CONF_2013_037

3.1 $\tilde{t}_1(500) \to t\tilde{\chi}_1^0(200)$ (ATLAS_CONF_2013_037)

- Process: $\tilde{t}_1\tilde{t}_1^* \to (t\tilde{\chi}_1^0)(\bar{t}\tilde{\chi}_1^0)$.
- Mass: $m_{\tilde{t}_1} = 500$ GeV, $m_{\tilde{\chi}_1^0} = 200$ GeV.
- The number of events: 10^4.
- Event Generator: `Herwig++ 2.5.2`.

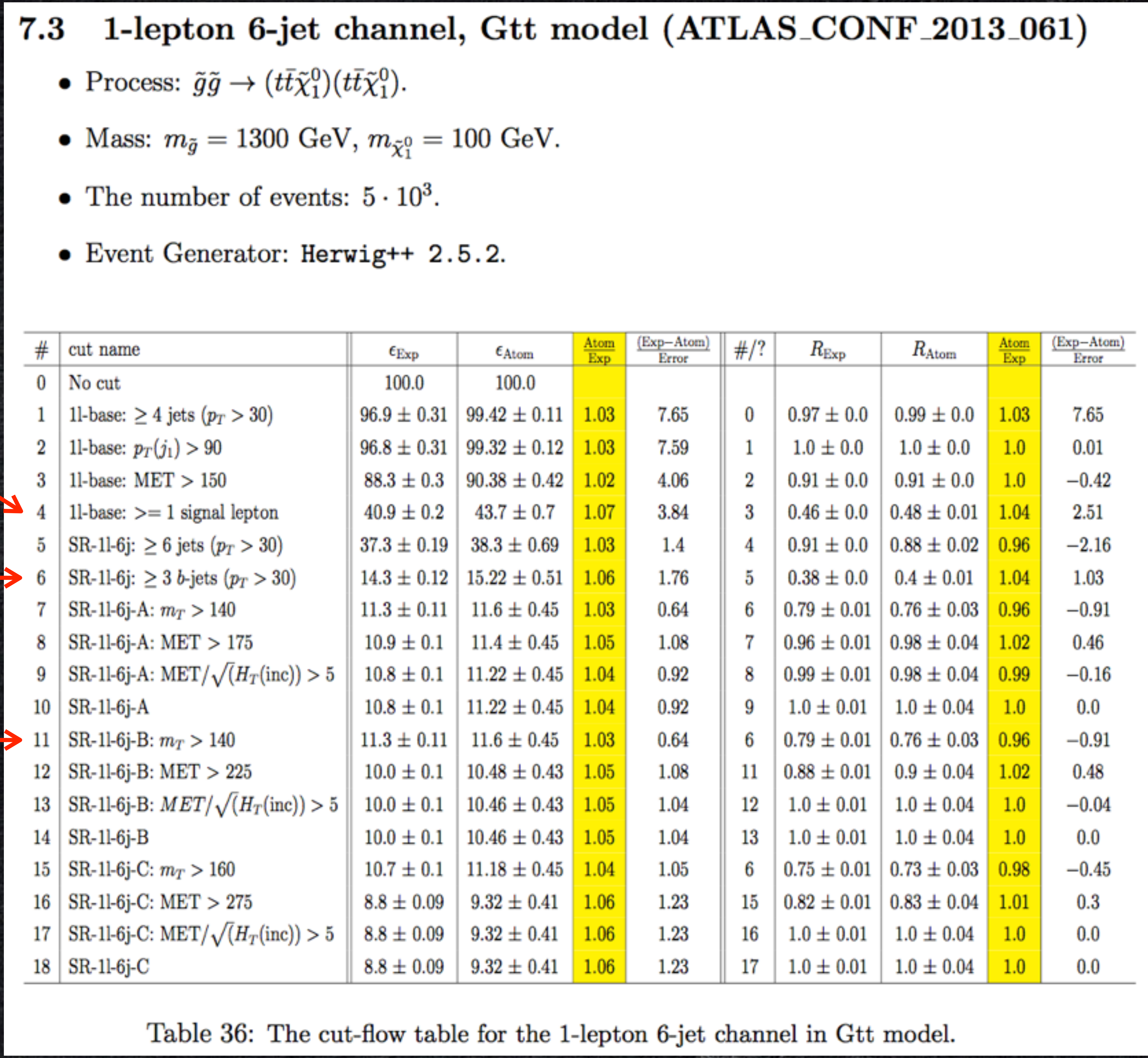
#	cut name	$\epsilon_{\rm Exp}$	$\epsilon_{\rm Atom}$	$\frac{\rm Atom}{\rm Exp}$	$\frac{\rm (Exp-Atom)}{\rm Error}$	#/?	$R_{\rm Exp}$	$R_{\rm Atom}$	$\frac{\rm Atom}{\rm Exp}$	$\frac{\rm (Exp-Atom)}{\rm Error}$
0	[00] No cut	100.0	100.0							
1	[02] Lepton (= 1 signal)	22.81 ± 0.15	22.54 ± 0.42	0.99	−0.61	0	0.23 ± 0.0	0.23 ± 0.0	0.99	−0.61
2	[03] 4jets (80,60,40,25)	12.34 ± 0.11	11.13 ± 0.31	0.9	−3.61	1	0.54 ± 0.0	0.49 ± 0.01	0.91	−3.18
3	[04] >= 1 b in 4 leading jets	10.53 ± 0.1	9.38 ± 0.29	0.89	−3.73	2	0.85 ± 0.01	0.84 ± 0.03	0.99	−0.41
4	[05] MET > 100	8.65 ± 0.09	7.6 ± 0.27	0.88	−3.72	3	0.82 ± 0.01	0.81 ± 0.03	0.99	−0.35
5	[06] MET/$\sqrt{(H_T)} > 5$	8.45 ± 0.09	7.38 ± 0.26	0.87	−3.85	4	0.98 ± 0.01	0.97 ± 0.03	0.99	−0.17
6	[07] $\Delta\phi(j_2,$ MET$) > 0.8$	7.63 ± 0.09	7.2 ± 0.26	0.94	−1.59	5	0.9 ± 0.01	0.98 ± 0.04	1.08	1.97
7	[SRtN2] MET > 200	4.31 ± 0.07	4.12 ± 0.2	0.96	−0.9	6	0.56 ± 0.01	0.57 ± 0.03	1.01	0.27
8	[SRtN2] MET/$\sqrt{(H_T)} > 13$	2.33 ± 0.05	2.27 ± 0.15	0.97	−0.39	7	0.54 ± 0.01	0.55 ± 0.04	1.02	0.27
9	[SRtN2] $m_T > 140$	1.91 ± 0.04	1.96 ± 0.14	1.03	0.33	8	0.82 ± 0.02	0.86 ± 0.06	1.05	0.68
10	[SRtN3] MET > 275	1.87 ± 0.04	1.69 ± 0.13	0.9	−1.32	6	0.24 ± 0.01	0.23 ± 0.02	0.96	−0.54
11	[SRtN3] $MET/\sqrt{(H_T)} > 11$	1.82 ± 0.04	1.65 ± 0.13	0.91	−1.27	10	0.97 ± 0.02	0.98 ± 0.08	1.0	0.03
12	[SRtN3] $m_T > 200$	1.05 ± 0.03	1.05 ± 0.1	1.0	−0.03	11	0.58 ± 0.02	0.64 ± 0.06	1.1	0.9
13	[SRbC1-3] MET > 150	6.03 ± 0.08	5.29 ± 0.22	0.88	−3.12	6	0.79 ± 0.01	0.73 ± 0.03	0.93	−1.69
14	[SRbC1-3] MET/$\sqrt{(H_T)} > 7$	5.92 ± 0.08	5.14 ± 0.22	0.87	−3.32	13	0.98 ± 0.01	0.97 ± 0.04	0.99	−0.21
15	[SRbC1-3] $m_T > 120$	4.58 ± 0.07	3.9 ± 0.19	0.85	−3.31	14	0.77 ± 0.01	0.76 ± 0.04	0.98	−0.38
16	[SRbC1-3] MET > 160	4.39 ± 0.07	3.79 ± 0.19	0.86	−2.97	15	0.96 ± 0.01	0.97 ± 0.05	1.01	0.25
17	[SRbC1-3] MET/$\sqrt{(H_T)} > 8$	4.26 ± 0.07	3.69 ± 0.19	0.87	−2.86	16	0.97 ± 0.01	0.97 ± 0.05	1.0	0.06
18	[SRbC1-3] $m_{\rm eff} > 550$	4.01 ± 0.06	3.47 ± 0.18	0.86	−2.81	17	0.94 ± 0.01	0.94 ± 0.05	1.0	−0.04
19	[SRbC1-3] $m_{\rm eff} > 700$	2.66 ± 0.05	2.23 ± 0.15	0.84	−2.76	18	0.66 ± 0.01	0.64 ± 0.04	0.97	−0.46
20	SRtN2	0.84 ± 0.03	0.76 ± 0.09	0.9	−0.87	9	0.44 ± 0.02	0.39 ± 0.04	0.88	−1.1
21	SRtN3	0.38 ± 0.02	0.41 ± 0.06	1.07	0.42	12	0.36 ± 0.02	0.39 ± 0.06	1.08	0.44
22	SRbC1	3.11 ± 0.06	2.75 ± 0.16	0.88	−2.08	6	0.41 ± 0.01	0.38 ± 0.02	0.94	−1.07
23	SRbC2	0.6 ± 0.02	0.53 ± 0.07	0.89	−0.86	6	0.08 ± 0.0	0.07 ± 0.01	0.94	−0.42
24	SRbC3	0.16 ± 0.01	0.19 ± 0.04	1.19	0.67	6	0.02 ± 0.0	0.03 ± 0.01	1.26	0.87

Table 9: The cut-flow table for the $\tilde{t}_1(500) \to t\tilde{\chi}_1^0(200)$ model.

lepton efficiency

b-tag efficiency

lepton, MET
smearing



7.3 1-lepton 6-jet channel, Gtt model (ATLAS_CONF_2013_061)

- Process: $\tilde{g}\tilde{g} \to (t\bar{t}\tilde{\chi}_1^0)(t\bar{t}\tilde{\chi}_1^0)$.
- Mass: $m_{\tilde{g}} = 1300$ GeV, $m_{\tilde{\chi}_1^0} = 100$ GeV.
- The number of events: $5 \cdot 10^3$.
- Event Generator: `Herwig++ 2.5.2`.

#	cut name	ϵ_{Exp}	ϵ_{Atom}	Atom / Exp	(Exp−Atom) / Error	#/?	R_{Exp}	R_{Atom}	Atom / Exp	(Exp−Atom) / Error
0	No cut	100.0	100.0							
1	1l-base: ≥ 4 jets ($p_T > 30$)	96.9 ± 0.31	99.42 ± 0.11	1.03	7.65	0	0.97 ± 0.0	0.99 ± 0.0	1.03	7.65
2	1l-base: $p_T(j_1) > 90$	96.8 ± 0.31	99.32 ± 0.12	1.03	7.59	1	1.0 ± 0.0	1.0 ± 0.0	1.0	0.01
3	1l-base: MET > 150	88.3 ± 0.3	90.38 ± 0.42	1.02	4.06	2	0.91 ± 0.0	0.91 ± 0.0	1.0	−0.42
4	1l-base: >= 1 signal lepton	40.9 ± 0.2	43.7 ± 0.7	1.07	3.84	3	0.46 ± 0.0	0.48 ± 0.01	1.04	2.51
5	SR-1l-6j: ≥ 6 jets ($p_T > 30$)	37.3 ± 0.19	38.3 ± 0.69	1.03	1.4	4	0.91 ± 0.0	0.88 ± 0.02	0.96	−2.16
6	SR-1l-6j: ≥ 3 b-jets ($p_T > 30$)	14.3 ± 0.12	15.22 ± 0.51	1.06	1.76	5	0.38 ± 0.0	0.4 ± 0.01	1.04	1.03
7	SR-1l-6j-A: $m_T > 140$	11.3 ± 0.11	11.6 ± 0.45	1.03	0.64	6	0.79 ± 0.01	0.76 ± 0.03	0.96	−0.91
8	SR-1l-6j-A: MET > 175	10.9 ± 0.1	11.4 ± 0.45	1.05	1.08	7	0.96 ± 0.01	0.98 ± 0.04	1.02	0.46
9	SR-1l-6j-A: MET$/\sqrt(H_T(\text{inc})) > 5$	10.8 ± 0.1	11.22 ± 0.45	1.04	0.92	8	0.99 ± 0.01	0.98 ± 0.04	0.99	−0.16
10	SR-1l-6j-A	10.8 ± 0.1	11.22 ± 0.45	1.04	0.92	9	1.0 ± 0.01	1.0 ± 0.04	1.0	0.0
11	SR-1l-6j-B: $m_T > 140$	11.3 ± 0.11	11.6 ± 0.45	1.03	0.64	6	0.79 ± 0.01	0.76 ± 0.03	0.96	−0.91
12	SR-1l-6j-B: MET > 225	10.0 ± 0.1	10.48 ± 0.43	1.05	1.08	11	0.88 ± 0.01	0.9 ± 0.04	1.02	0.48
13	SR-1l-6j-B: $MET/\sqrt(H_T(\text{inc})) > 5$	10.0 ± 0.1	10.46 ± 0.43	1.05	1.04	12	1.0 ± 0.01	1.0 ± 0.04	1.0	−0.04
14	SR-1l-6j-B	10.0 ± 0.1	10.46 ± 0.43	1.05	1.04	13	1.0 ± 0.01	1.0 ± 0.04	1.0	0.0
15	SR-1l-6j-C: $m_T > 160$	10.7 ± 0.1	11.18 ± 0.45	1.04	1.05	6	0.75 ± 0.01	0.73 ± 0.03	0.98	−0.45
16	SR-1l-6j-C: MET > 275	8.8 ± 0.09	9.32 ± 0.41	1.06	1.23	15	0.82 ± 0.01	0.83 ± 0.04	1.01	0.3
17	SR-1l-6j-C: MET$/\sqrt(H_T(\text{inc})) > 5$	8.8 ± 0.09	9.32 ± 0.41	1.06	1.23	16	1.0 ± 0.01	1.0 ± 0.04	1.0	0.0
18	SR-1l-6j-C	8.8 ± 0.09	9.32 ± 0.41	1.06	1.23	17	1.0 ± 0.01	1.0 ± 0.04	1.0	0.0

Table 36: The cut-flow table for the 1-lepton 6-jet channel in Gtt model.

Fastlim

Motivation

- For many occasions, we want a quick model testing method.
- The standard approach (CheckMATE, MA5, ATOM) requiring event generation and detector simulation is too time consuming for some cases.
- How can we speed up?

Factorisation

- Factorise the problem in parts and parametrise them by the dominant dependency with some approximation.

Factorisation

- Factorise the problem in parts and parametrise them by the dominant dependency with some approximation.

Example: fast detector simulation

Full simulation → **Object ID** X **Smearing** X **Cuts**

Factorisation

- Factorise the problem in parts and parametrise them by the dominant dependency with some approximation.

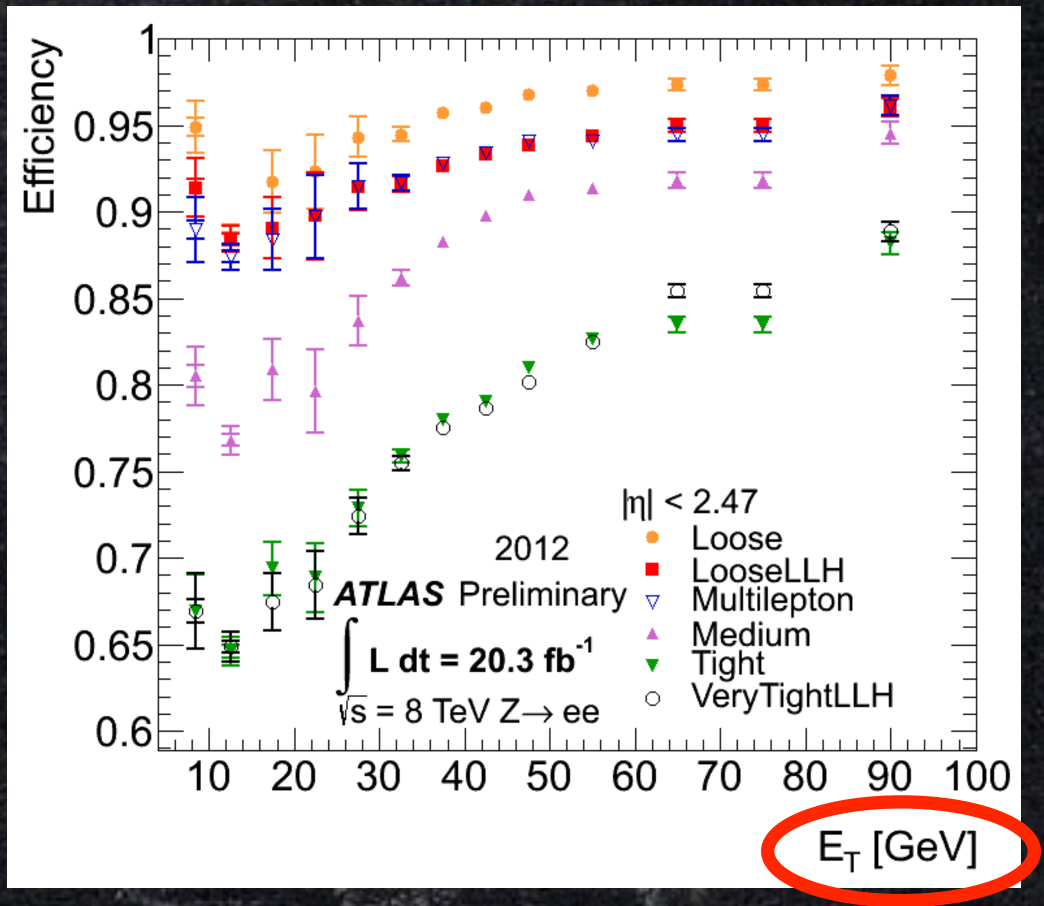
Example: fast detector simulation

Full simulation → **Object ID** x **Smearing** x **Cuts**

Electron ID

- shower shape
- track quality
- HCAL/ECAL ratio
- …

→



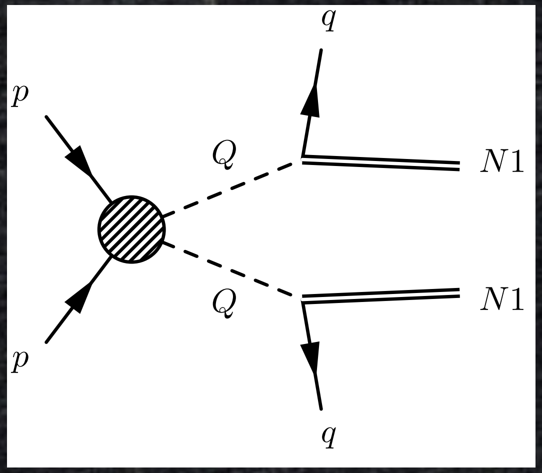
Event factorisation

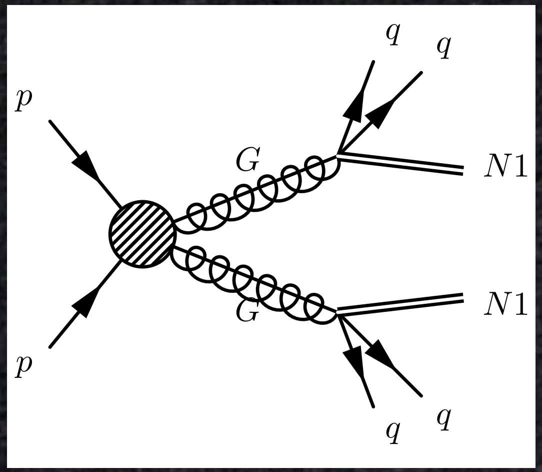
$\mathrm{Q} = \tilde{q}$

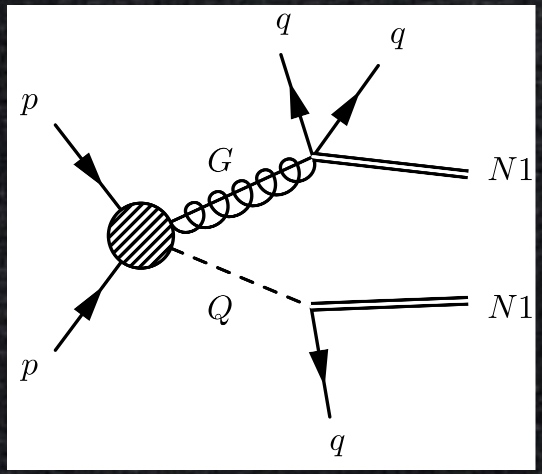
$\mathrm{G} = \tilde{g}$

$\mathrm{N1} = \tilde{\chi}_1^0$

$$N_{\mathrm{BSM}}^{(a)} = \left\{ \begin{array}{c} N^{(a)}_{\mathrm{QqN1:QqN1}} \\ + \\ N^{(a)}_{\mathrm{GqqN1:GqqN1}} \\ + \\ N^{(a)}_{\mathrm{GqqN1:QqN1}} \\ \vdots \end{array} \right.$$







Event factorisation

$\mathrm{Q} = \tilde{q}$
$\mathrm{G} = \tilde{g}$
$\mathrm{N1} = \tilde{\chi}_1^0$

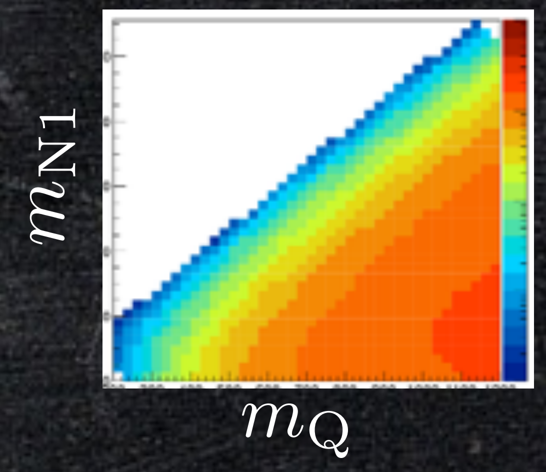
dominantly depends on BSM particle masses

$$N_{\mathrm{BSM}}^{(a)} = \left\{ \begin{array}{l} N_{\mathrm{QqN1:QqN1}}^{(a)} = \epsilon_{\mathrm{QqN1:QqN1}}^{(a)}(m_{\mathrm{Q}}, m_{\mathrm{N1}}) \cdot \sigma_{\mathrm{QQ}} \cdot BR \cdot \mathcal{L} \\ \quad + \\ N_{\mathrm{GqqN1:GqqN1}}^{(a)} = \epsilon_{\mathrm{GqqN1:GqqN1}}^{(a)}(m_{\mathrm{G}}, m_{\mathrm{N1}}) \cdot \sigma_{\mathrm{GG}} \cdot BR \cdot \mathcal{L} \\ \quad + \\ N_{\mathrm{GqqN1:QqN1}}^{(a)} = \epsilon_{\mathrm{GqqN1:QqN1}}^{(a)}(m_{\mathrm{G}}, m_{\mathrm{Q}}, m_{\mathrm{N1}}) \cdot \sigma_{\mathrm{GQ}} \cdot BR \cdot \mathcal{L} \\ \quad \vdots \end{array} \right.$$

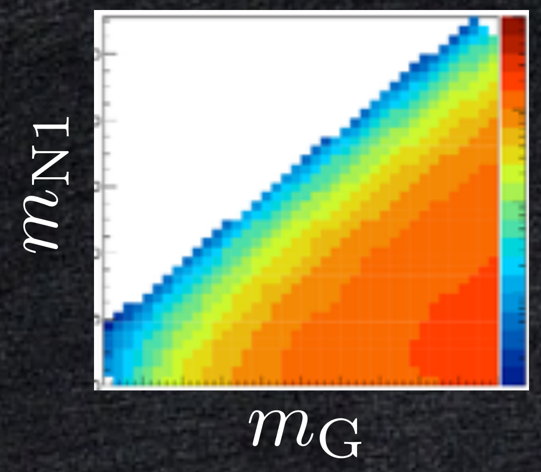
Event factorisation

$\mathrm{Q} = \tilde{q}$
$\mathrm{G} = \tilde{g}$
$\mathrm{N1} = \tilde{\chi}_1^0$

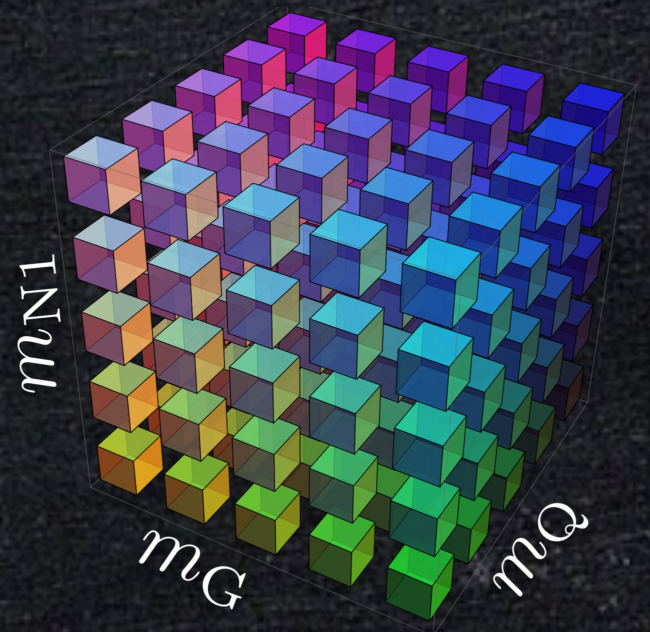
$$N^{(a)}_{\mathrm{BSM}} = \left\{ \begin{array}{l} N^{(a)}_{\mathrm{QqN1:QqN1}} = \\ + \\ N^{(a)}_{\mathrm{GqqN1:GqqN1}} = \\ + \\ N^{(a)}_{\mathrm{GqqN1:QqN1}} = \\ \vdots \end{array} \right.$$



$$\sigma_{\mathrm{QQ}} \cdot BR \cdot \mathcal{L}$$



$$\sigma_{\mathrm{GG}} \cdot BR \cdot \mathcal{L}$$



$$\sigma_{\mathrm{GQ}} \cdot BR \cdot \mathcal{L}$$

Approximation

$$N_{\mathrm{BSM}} \simeq \sum_{i}^{\text{topologies}} N_i$$

topology =
on-shell production
and decay

- Neglecting interference: ⇒ Good for weakly coupled BSM

Approximation

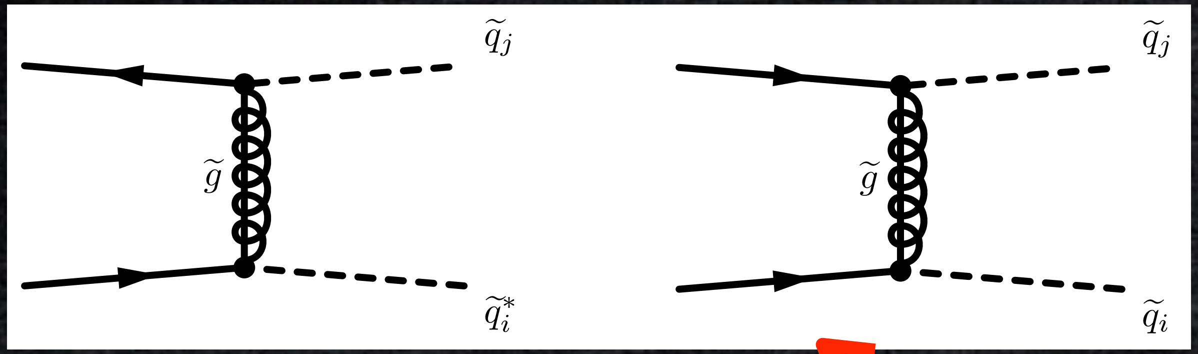
$$N_{\mathrm{BSM}} \simeq \sum_{i}^{\text{topologies}} N_i$$

topology =
on-shell production
and decay

- Neglecting interference: ⇒ Good for weakly coupled BSM

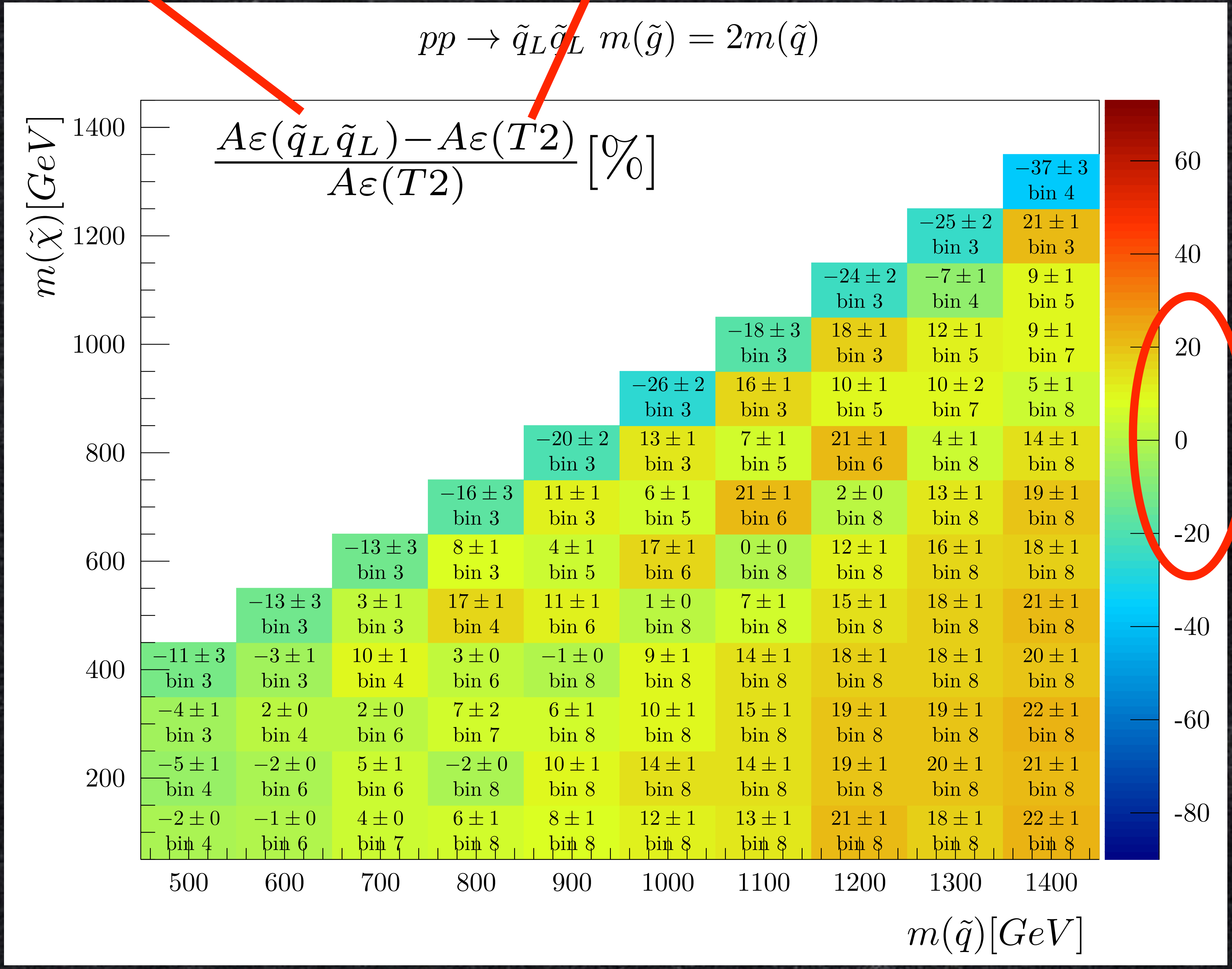
$$\epsilon_i \simeq \epsilon_i(\{m_{\mathrm{BSM}}\})$$

- Neglecting
  - width: ⇒ Good for weakly coupled BSM
  - production mechanism
  - coupling (chirality) structure



$m_{\tilde{g}} = 10^5$ GeV (decoupled)

CMS α_T analysis
(CMS-SUS-12-028)

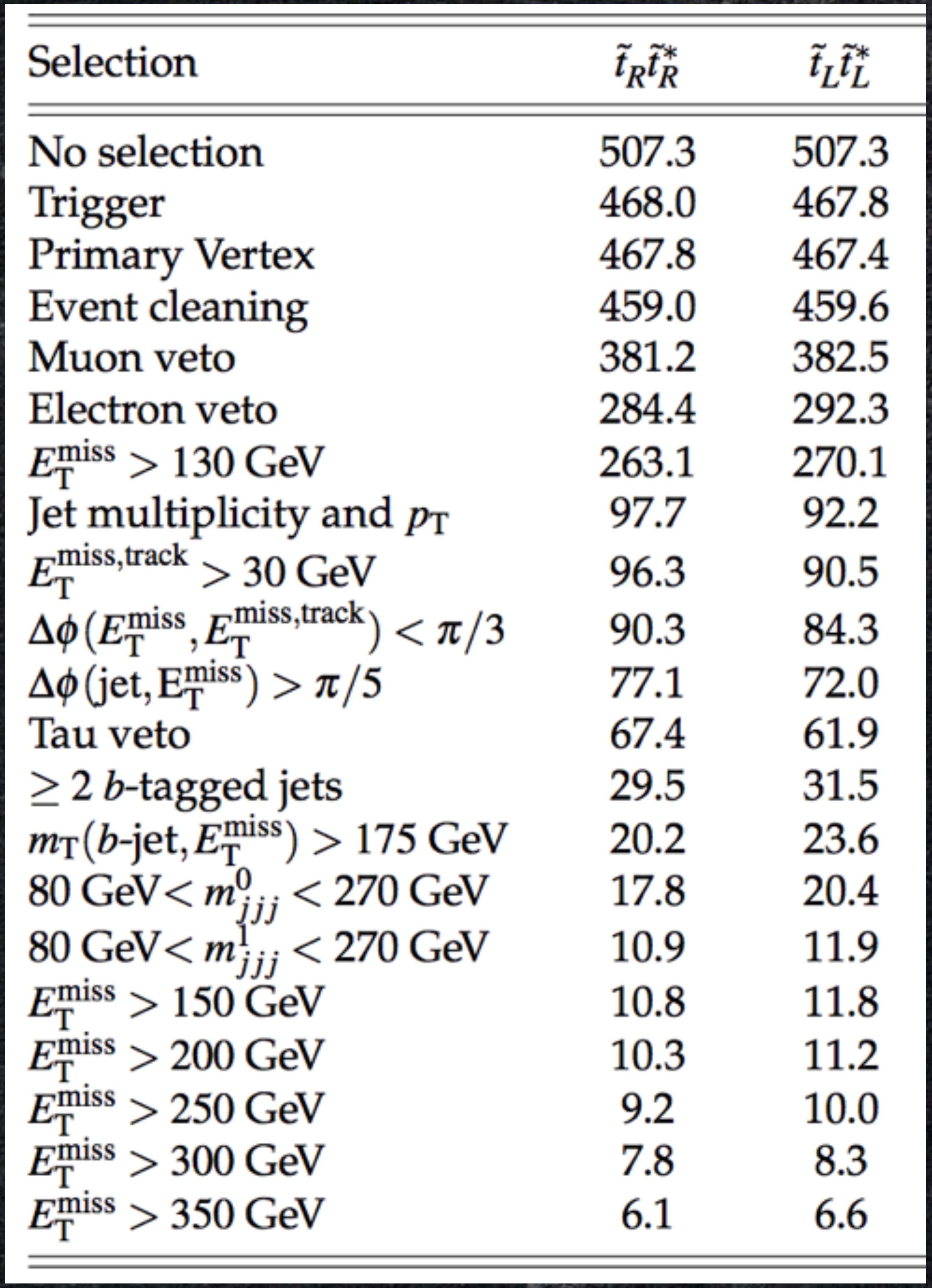


500	600	700	800	900	1000	1100	1200	1300	1400
									-37 ± 3 bin 4
								-25 ± 2 bin 3	21 ± 1 bin 3
							-24 ± 2 bin 3	-7 ± 1 bin 4	9 ± 1 bin 5
						-18 ± 3 bin 3	18 ± 1 bin 3	12 ± 1 bin 5	9 ± 1 bin 7
					-26 ± 2 bin 3	16 ± 1 bin 3	10 ± 1 bin 5	10 ± 2 bin 7	5 ± 1 bin 8
				-20 ± 2 bin 3	13 ± 1 bin 3	7 ± 1 bin 5	21 ± 1 bin 6	4 ± 1 bin 8	14 ± 1 bin 8
			-16 ± 3 bin 3	11 ± 1 bin 3	6 ± 1 bin 5	21 ± 1 bin 6	2 ± 0 bin 8	13 ± 1 bin 8	19 ± 1 bin 8
		-13 ± 3 bin 3	8 ± 1 bin 3	4 ± 1 bin 5	17 ± 1 bin 6	0 ± 0 bin 8	12 ± 1 bin 8	16 ± 1 bin 8	18 ± 1 bin 8
	-13 ± 3 bin 3	3 ± 1 bin 3	17 ± 1 bin 4	11 ± 1 bin 6	1 ± 0 bin 8	7 ± 1 bin 8	15 ± 1 bin 8	18 ± 1 bin 8	21 ± 1 bin 8
-11 ± 3 bin 3	-3 ± 1 bin 3	10 ± 1 bin 4	3 ± 0 bin 6	-1 ± 0 bin 8	9 ± 1 bin 8	14 ± 1 bin 8	18 ± 1 bin 8	18 ± 1 bin 8	20 ± 1 bin 8
-4 ± 1 bin 3	2 ± 0 bin 4	2 ± 0 bin 6	7 ± 2 bin 7	6 ± 1 bin 8	10 ± 1 bin 8	15 ± 1 bin 8	19 ± 1 bin 8	19 ± 1 bin 8	22 ± 1 bin 8
-5 ± 1 bin 4	-2 ± 0 bin 6	5 ± 1 bin 6	-2 ± 0 bin 8	10 ± 1 bin 8	14 ± 1 bin 8	14 ± 1 bin 8	19 ± 1 bin 8	20 ± 1 bin 8	21 ± 1 bin 8
-2 ± 0 bin 4	-1 ± 0 bin 6	4 ± 0 bin 7	6 ± 1 bin 8	8 ± 1 bin 8	12 ± 1 bin 8	13 ± 1 bin 8	21 ± 1 bin 8	18 ± 1 bin 8	22 ± 1 bin 8

Taken from a talk by J.Sonneveld at SUSY2014

ATLAS-CONF-2013-024 (stop → t, neut1)

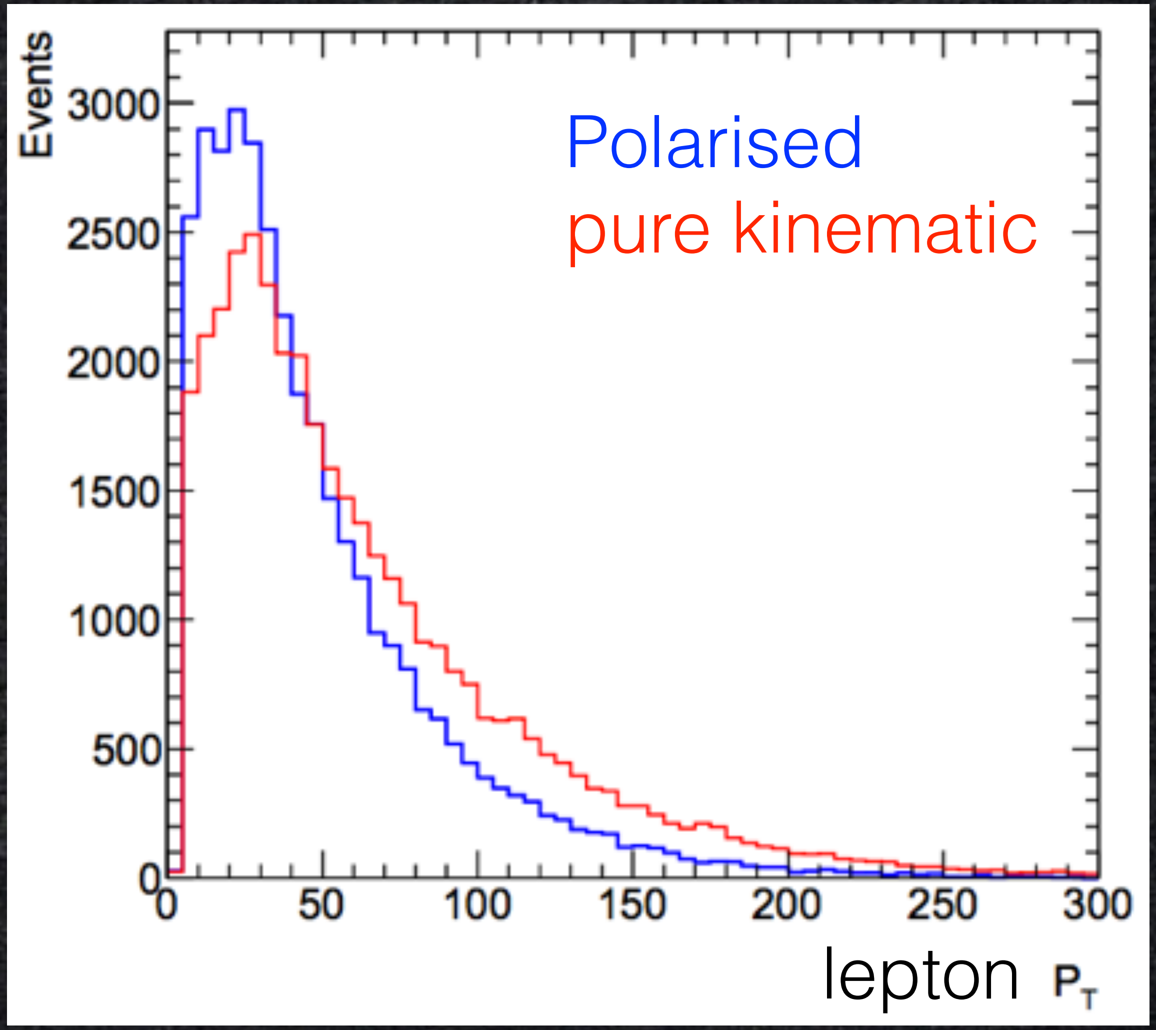
- What is the impact of the stop chirality in BSM search?



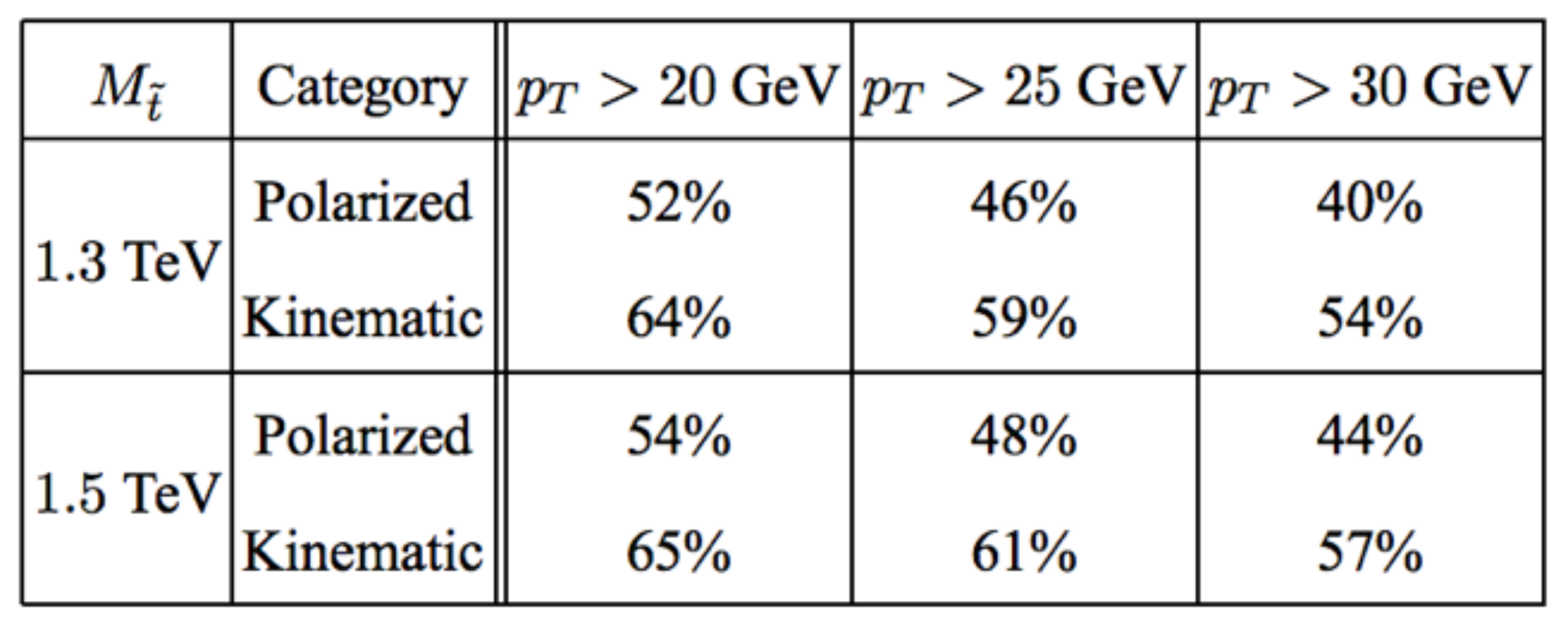
Selection	$\tilde{t}_R\tilde{t}_R^*$	$\tilde{t}_L\tilde{t}_L^*$
No selection	507.3	507.3
Trigger	468.0	467.8
Primary Vertex	467.8	467.4
Event cleaning	459.0	459.6
Muon veto	381.2	382.5
Electron veto	284.4	292.3
$E_{\mathrm{T}}^{\mathrm{miss}} > 130$ GeV	263.1	270.1
Jet multiplicity and p_{T}	97.7	92.2
$E_{\mathrm{T}}^{\mathrm{miss,track}} > 30$ GeV	96.3	90.5
$\Delta\phi(E_{\mathrm{T}}^{\mathrm{miss}}, E_{\mathrm{T}}^{\mathrm{miss,track}}) < \pi/3$	90.3	84.3
$\Delta\phi(\mathrm{jet}, \mathrm{E}_{\mathrm{T}}^{\mathrm{miss}}) > \pi/5$	77.1	72.0
Tau veto	67.4	61.9
≥ 2 b-tagged jets	29.5	31.5
$m_{\mathrm{T}}(b\text{-jet}, E_{\mathrm{T}}^{\mathrm{miss}}) > 175$ GeV	20.2	23.6
80 GeV$< m_{jjj}^{0} <$ 270 GeV	17.8	20.4
80 GeV$< m_{jjj}^{1} <$ 270 GeV	10.9	11.9
$E_{\mathrm{T}}^{\mathrm{miss}} > 150$ GeV	10.8	11.8
$E_{\mathrm{T}}^{\mathrm{miss}} > 200$ GeV	10.3	11.2
$E_{\mathrm{T}}^{\mathrm{miss}} > 250$ GeV	9.2	10.0
$E_{\mathrm{T}}^{\mathrm{miss}} > 300$ GeV	7.8	8.3
$E_{\mathrm{T}}^{\mathrm{miss}} > 350$ GeV	6.1	6.6

- What is the impact of the stop chirality in BSM search?

- Polarised stop vs. pure kinematic decay: $\tilde{t} \to b\tilde{\chi}_1^{\pm} \to b\ell\nu\tilde{\chi}_1^0$



K.Wang, L.Wang, T.Xu, L.Zhang, 2013



$M_{\tilde{t}}$	Category	$p_T > 20$ GeV	$p_T > 25$ GeV	$p_T > 30$ GeV
1.3 TeV	Polarized	52%	46%	40%
	Kinematic	64%	59%	54%
1.5 TeV	Polarized	54%	48%	44%
	Kinematic	65%	61%	57%

- What is the impact of the stop chirality in BSM search?

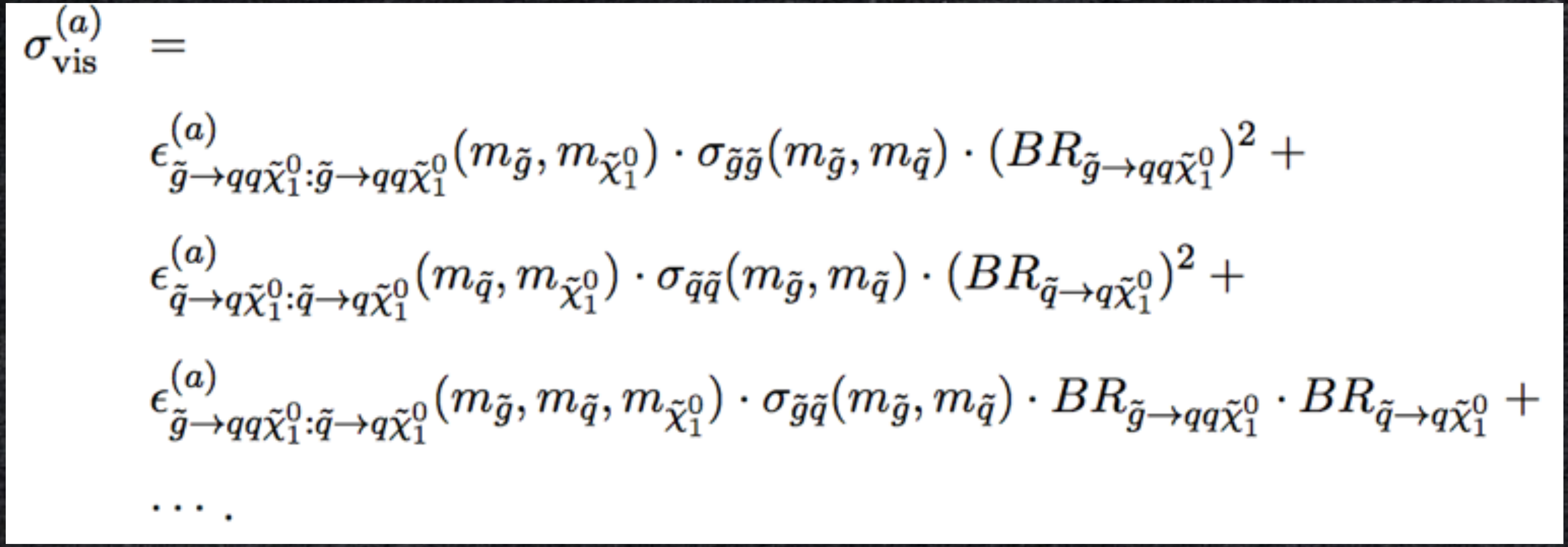
- The effect can be factorable by the R and L contributions.

weight (analytical)

$$\epsilon(\theta_{eff}) = \underset{\uparrow}{\epsilon_{\tilde{t}_R}} \cdot \overset{\downarrow}{\cos\theta_{eff}} + \underset{\uparrow}{\epsilon_{\tilde{t}_L}} \cdot \overset{\downarrow}{\sin\theta_{eff}}$$

efficiency maps for R and L

Other limitation

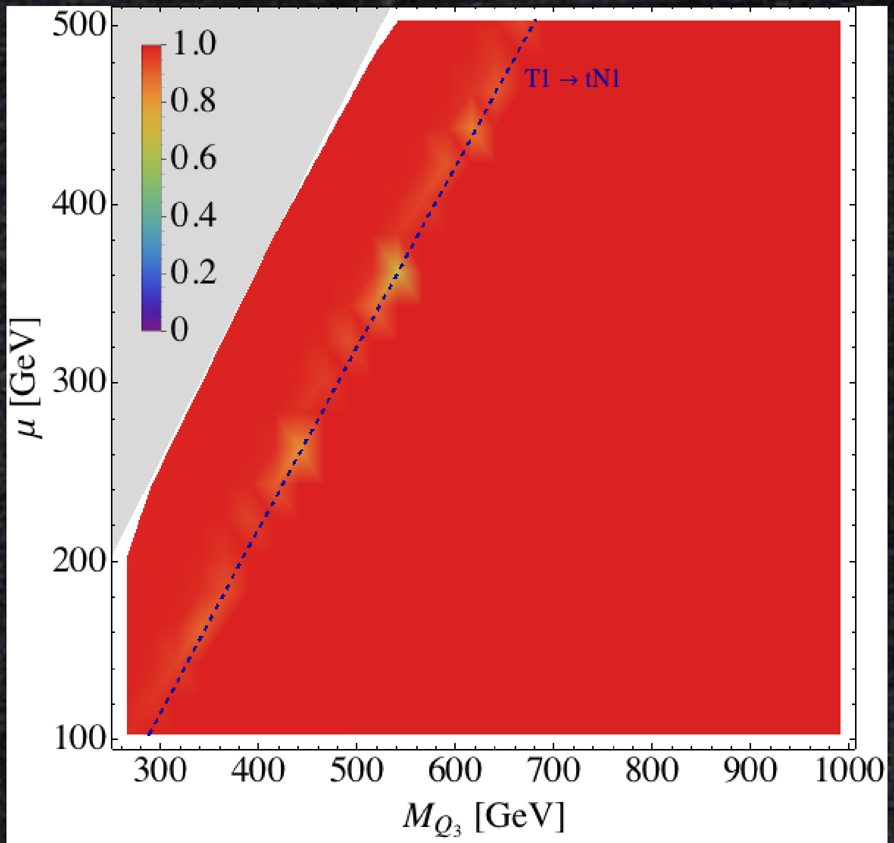


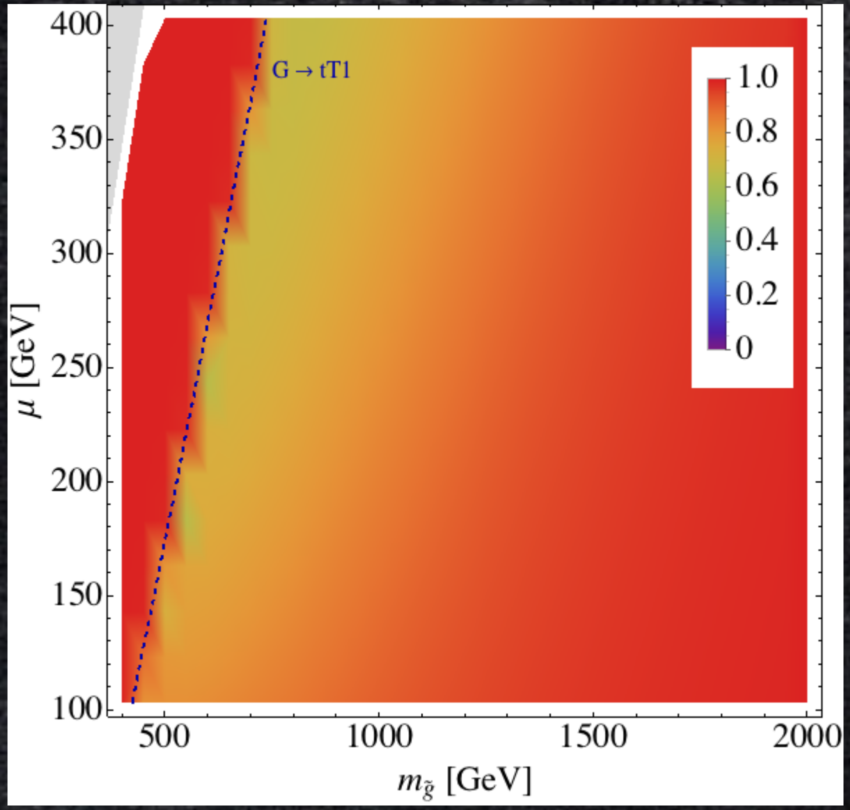
$$\begin{aligned}\sigma^{(a)}_{\mathrm{vis}} = \; & \\ & \epsilon^{(a)}_{\tilde{g}\to qq\tilde{\chi}^0_1:\tilde{g}\to qq\tilde{\chi}^0_1}(m_{\tilde{g}}, m_{\tilde{\chi}^0_1}) \cdot \sigma_{\tilde{g}\tilde{g}}(m_{\tilde{g}}, m_{\tilde{q}}) \cdot (BR_{\tilde{g}\to qq\tilde{\chi}^0_1})^2 + \\ & \epsilon^{(a)}_{\tilde{q}\to q\tilde{\chi}^0_1:\tilde{q}\to q\tilde{\chi}^0_1}(m_{\tilde{q}}, m_{\tilde{\chi}^0_1}) \cdot \sigma_{\tilde{q}\tilde{q}}(m_{\tilde{g}}, m_{\tilde{q}}) \cdot (BR_{\tilde{q}\to q\tilde{\chi}^0_1})^2 + \\ & \epsilon^{(a)}_{\tilde{g}\to qq\tilde{\chi}^0_1:\tilde{q}\to q\tilde{\chi}^0_1}(m_{\tilde{g}}, m_{\tilde{q}}, m_{\tilde{\chi}^0_1}) \cdot \sigma_{\tilde{g}\tilde{q}}(m_{\tilde{g}}, m_{\tilde{q}}) \cdot BR_{\tilde{g}\to qq\tilde{\chi}^0_1} \cdot BR_{\tilde{q}\to q\tilde{\chi}^0_1} + \\ & \dots .\end{aligned}$$

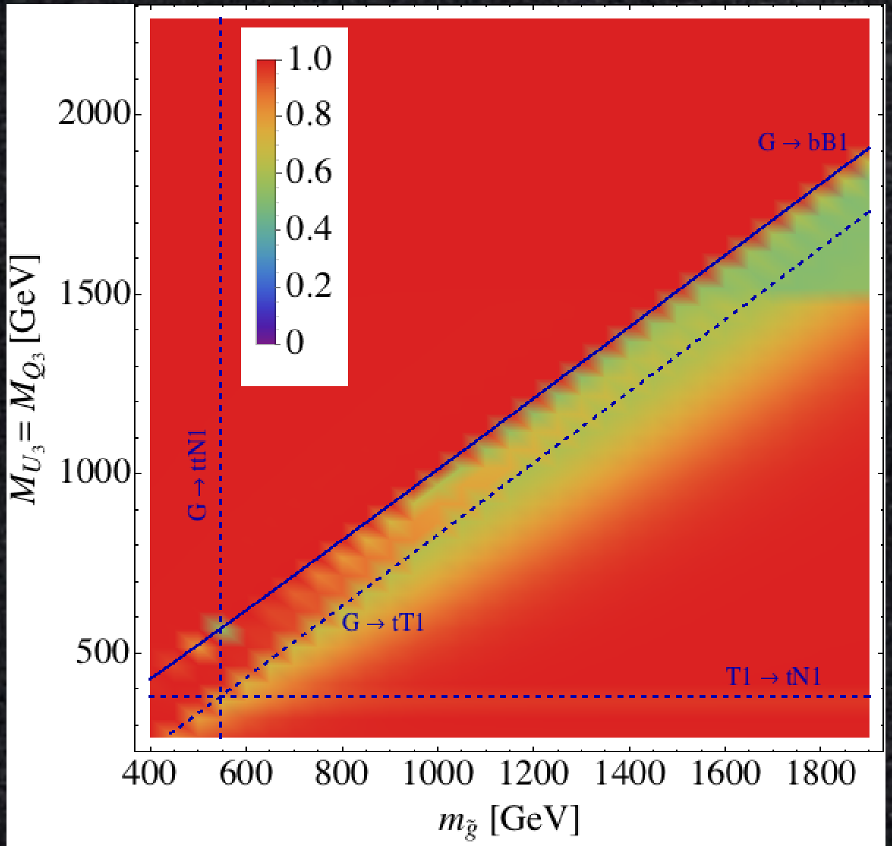
- difficult to cover all the topologies
- for the topology with long decay chain, the efficiency depends on 3 or more BSM masses => difficult to generate the efficiency maps
- However, the limit is always conservative.

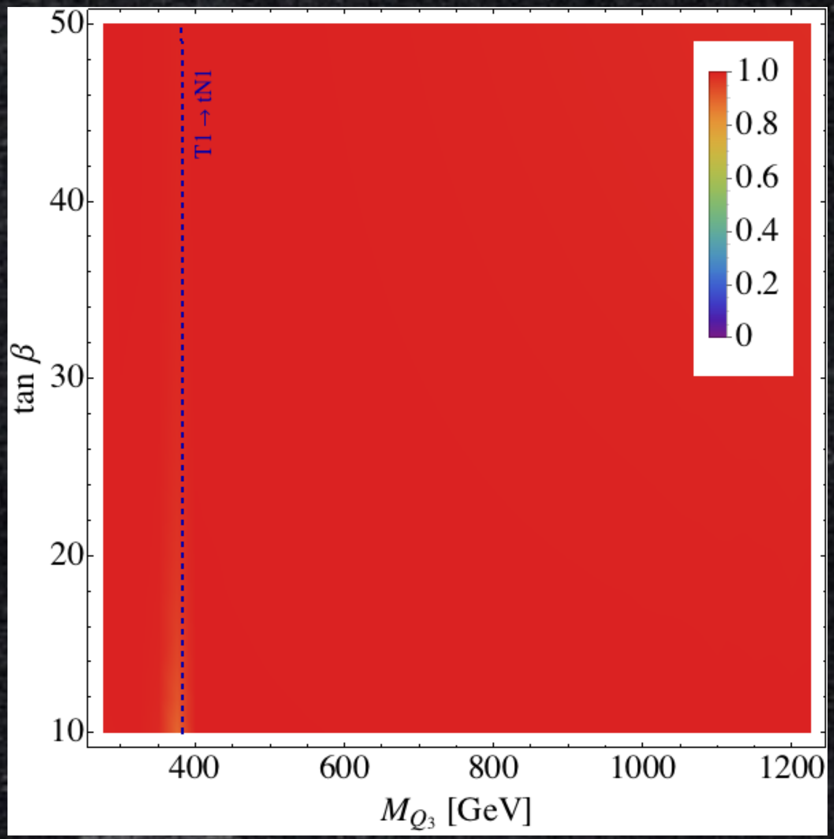
Coverage for Natural SUSY

$$\text{coverage} = \frac{\sigma^{\text{implimented}}}{\sigma_{\text{tot}}}$$



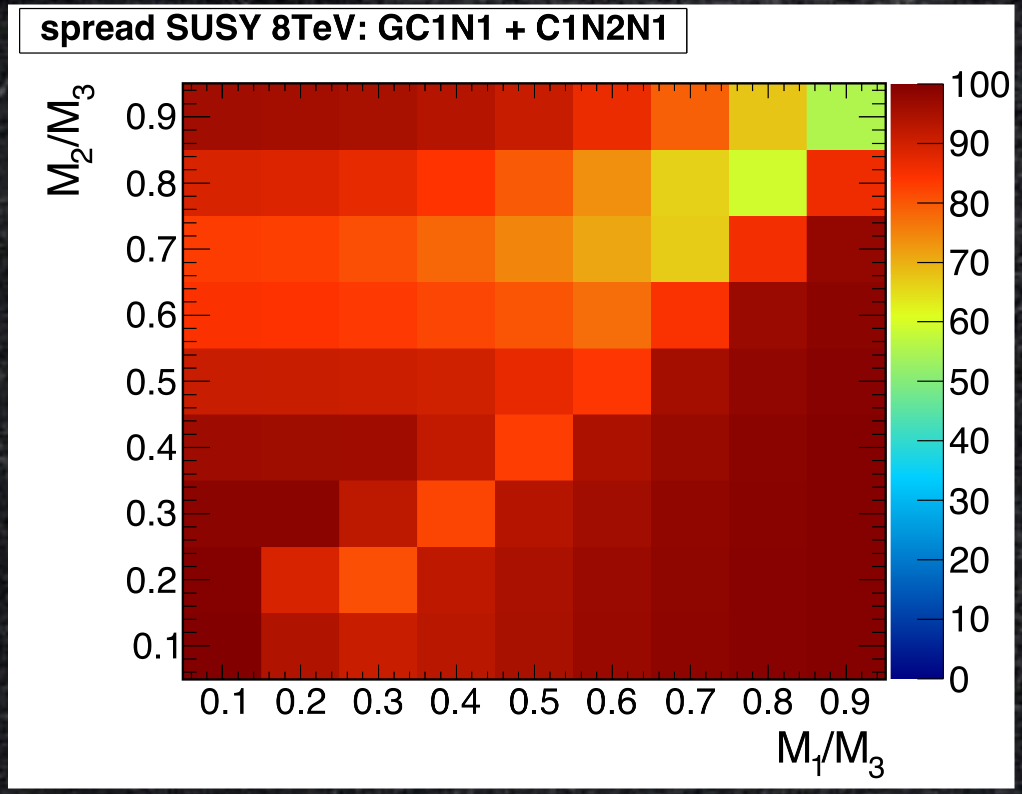




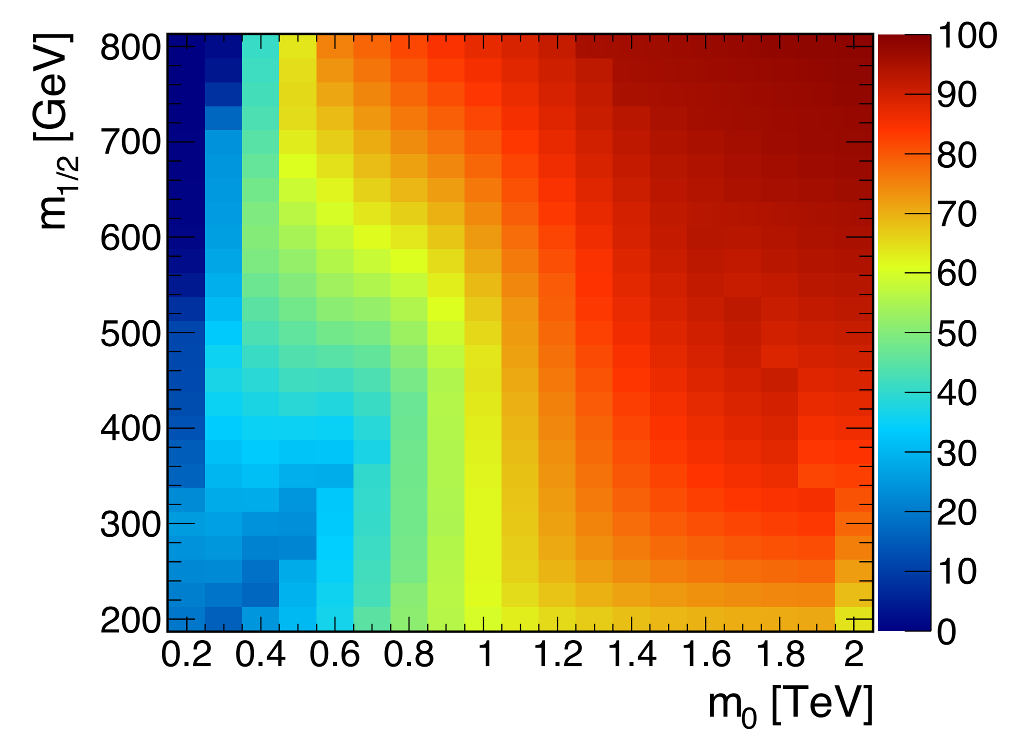


With some 3- or 4-D efficiency maps popular models can have good coverage.

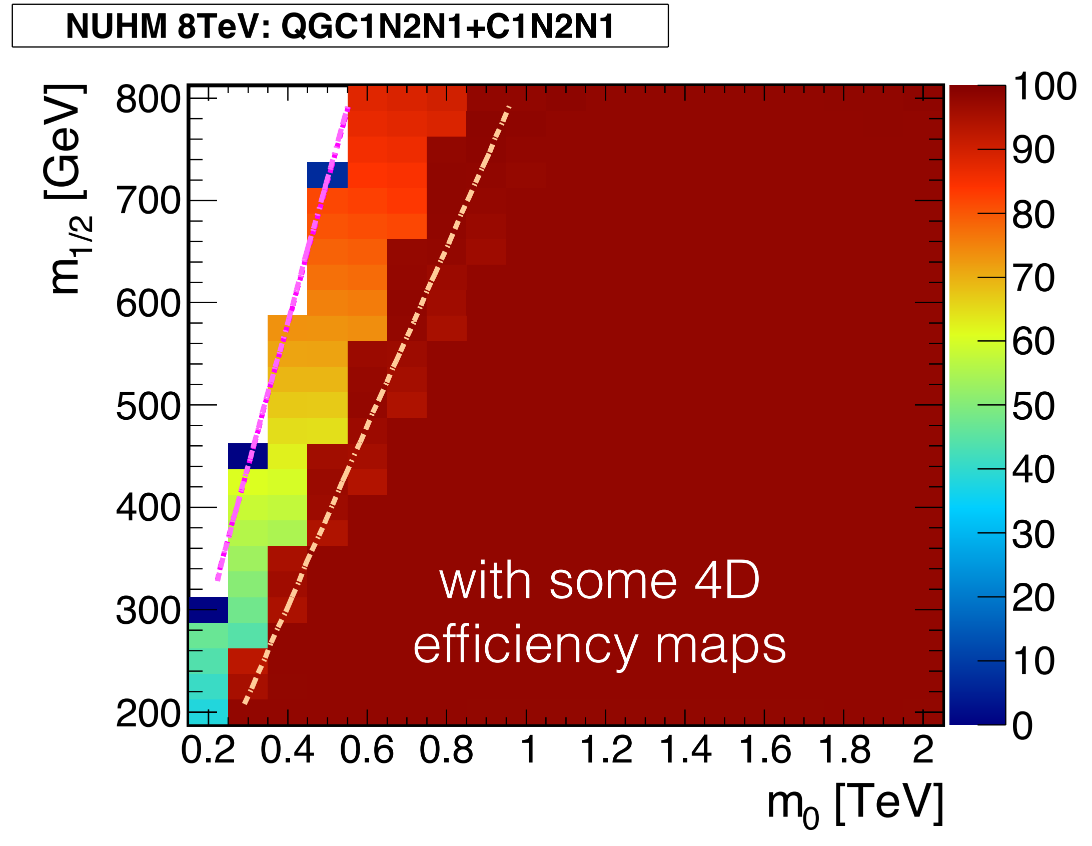
Split SUSY



CMSSM



NUHM

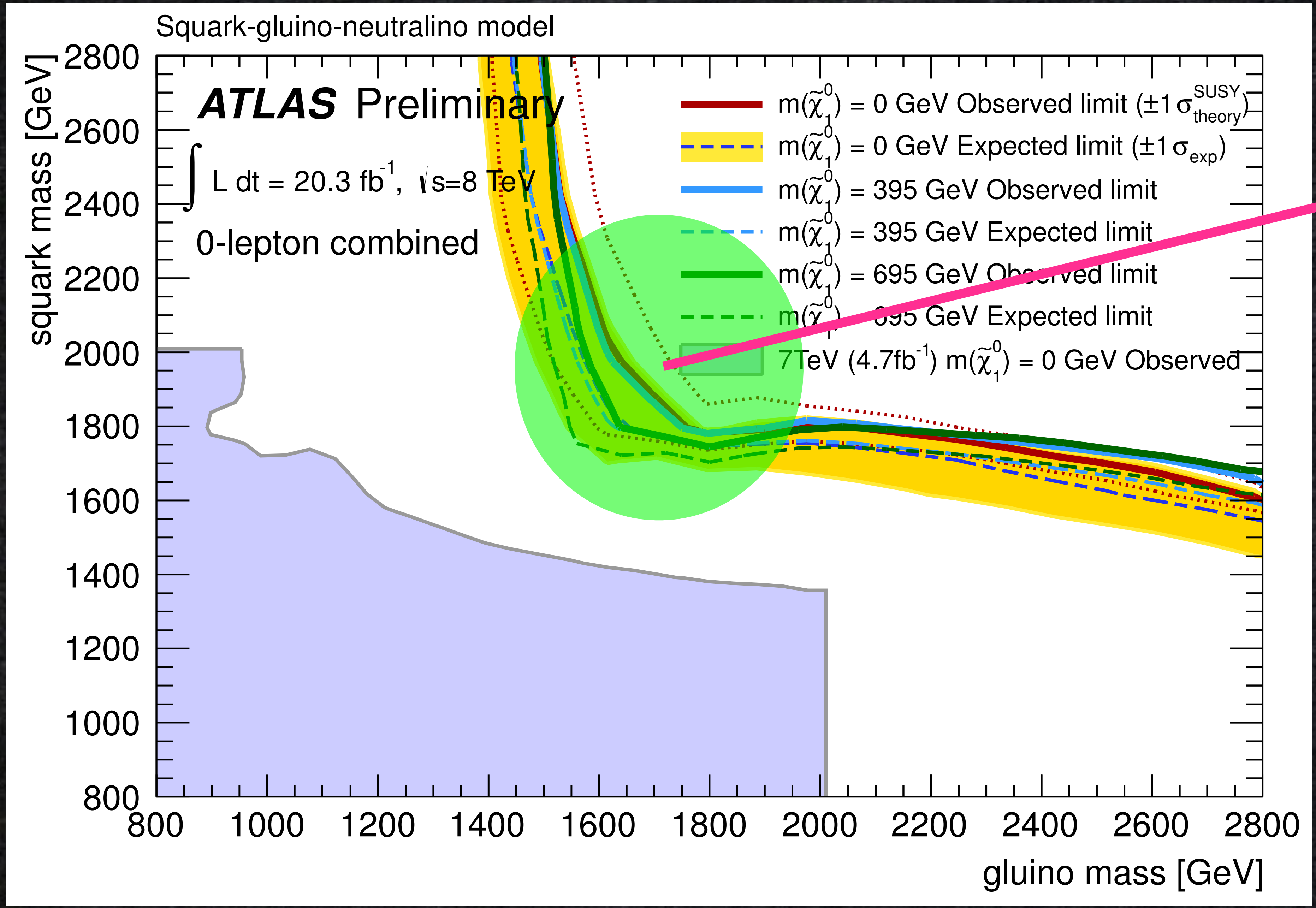


with some 4D efficiency maps

Topologies vs Simplified Models

[Gluino-Squark-Neutralino model]

$$\mathcal{L} = \mathcal{L}_{kin} + \tilde{g}^A \tilde{q} T^A \bar{q} + \tilde{q}\bar{q}\tilde{\chi}_1^0 + \frac{1}{\Lambda^2}\tilde{g}^A q T^A \bar{q}\tilde{\chi}_1^0 + m_{\tilde{g}}\tilde{g}\tilde{g} + m_{\tilde{q}}^2\tilde{q}\tilde{q} + m_{\tilde{\chi}}\tilde{\chi}_1^0\tilde{\chi}_1^0$$



production

decay

$$\boxed{\begin{array}{l} pp \to \tilde{q}\tilde{q} \\ pp \to \tilde{g}\tilde{g} \\ pp \to \tilde{g}\tilde{q} \end{array}} \otimes \boxed{\begin{array}{l} \tilde{g} \to \tilde{q}\bar{q} \\ \tilde{g} \to q\bar{q}\tilde{\chi}_1^0 \\ \tilde{q} \to q\tilde{g} \\ \tilde{q} \to q\tilde{\chi}_1^0 \end{array}}$$

⇒ mixture of various topologies

The rate of topologies is easily violated with (e.g.)

$$\tilde{g} \to t\bar{t}\tilde{\chi}_1^0$$

and the limit cannot be used.

http://fastlim.web.cern.ch/fastlim/

Fastlim

Papucci, KS, Weiler,
Zeune 1402.0492

cross section tables

m_Q	m_G	σ
300	300	87.94
300	350	34.98
...		

efficiency tables

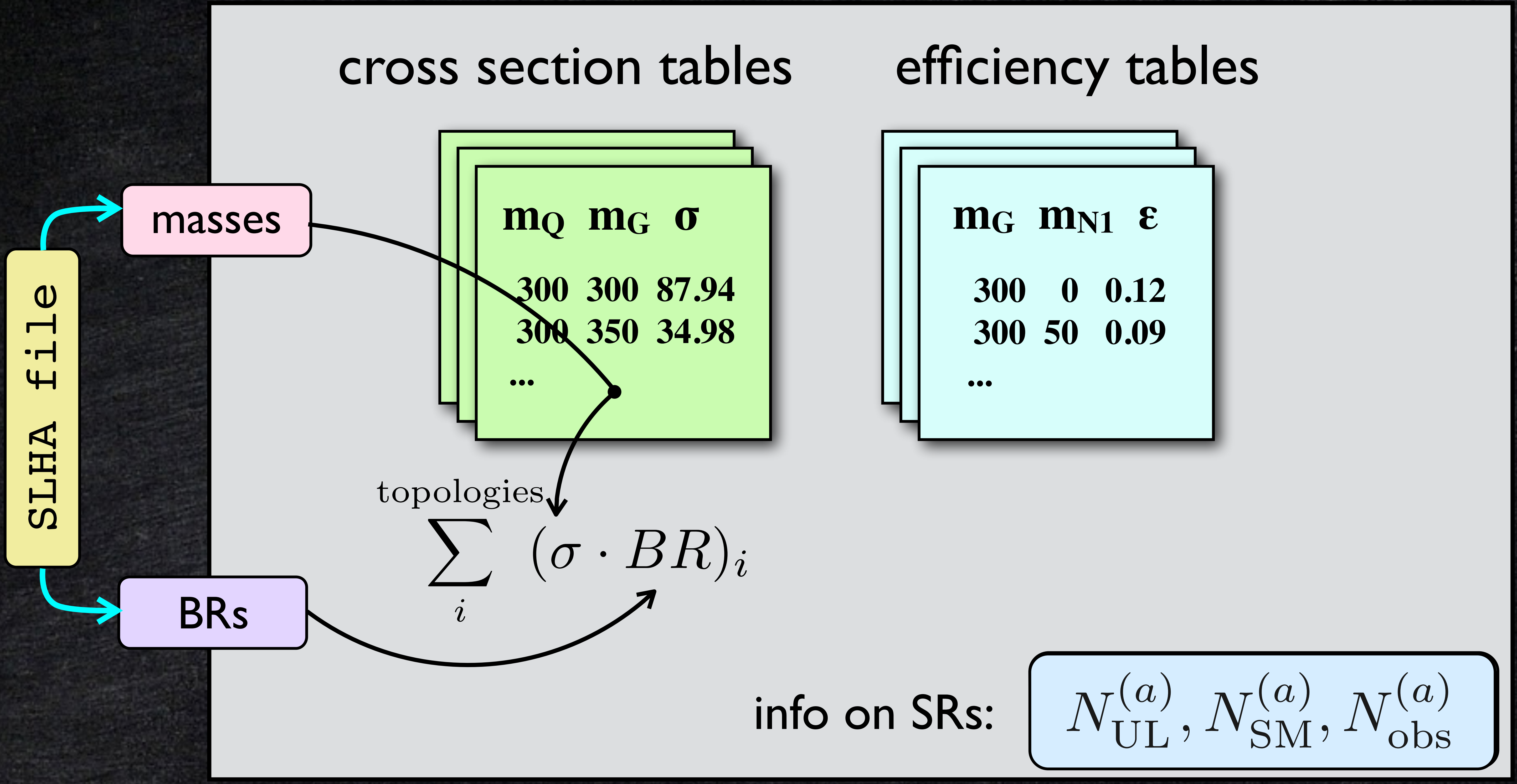
m_G	m_{N1}	ε
300	0	0.12
300	50	0.09
...		

info on SRs: $N_{\rm UL}^{(a)}, N_{\rm SM}^{(a)}, N_{\rm obs}^{(a)}$

http://fastlim.web.cern.ch/fastlim/

Fastlim

Papucci, KS, Weiler,
Zeune 1402.0492



SLHA file

masses

BRs

cross section tables

m_Q	m_G	σ
300	300	87.94
300	350	34.98
...		

efficiency tables

m_G	m_{N1}	ε
300	0	0.12
300	50	0.09
...		

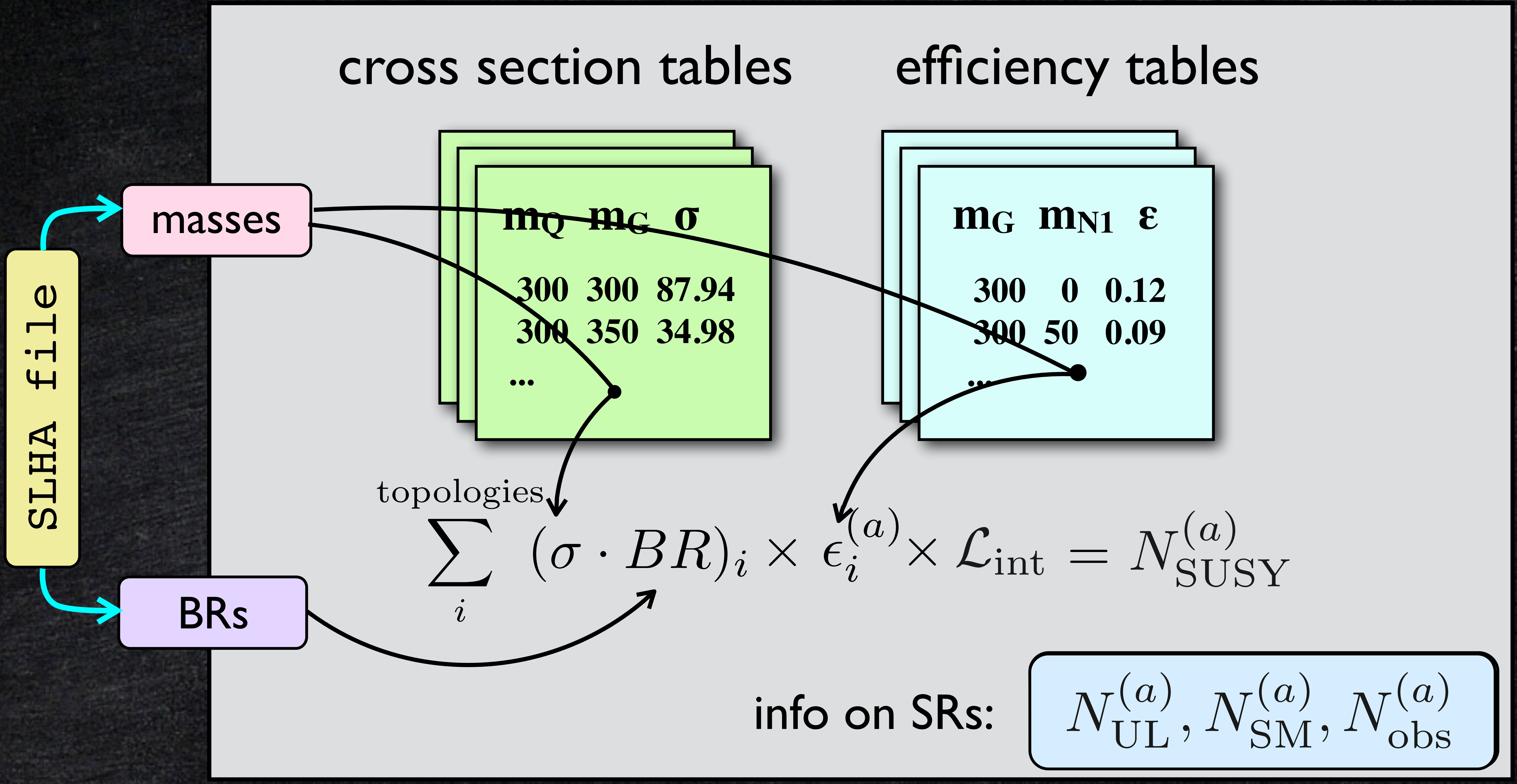
$$\sum_{i}^{\text{topologies}} (\sigma \cdot BR)_i$$

info on SRs: $N^{(a)}_{\mathrm{UL}}, N^{(a)}_{\mathrm{SM}}, N^{(a)}_{\mathrm{obs}}$

http://fastlim.web.cern.ch/fastlim/

Fastlim

Papucci, KS, Weiler,
Zeune 1402.0492



cross section tables

m_Q	m_G	σ
300	300	87.94
300	350	34.98
...		

efficiency tables

m_G	m_{N1}	ε
300	0	0.12
300	50	0.09
...		

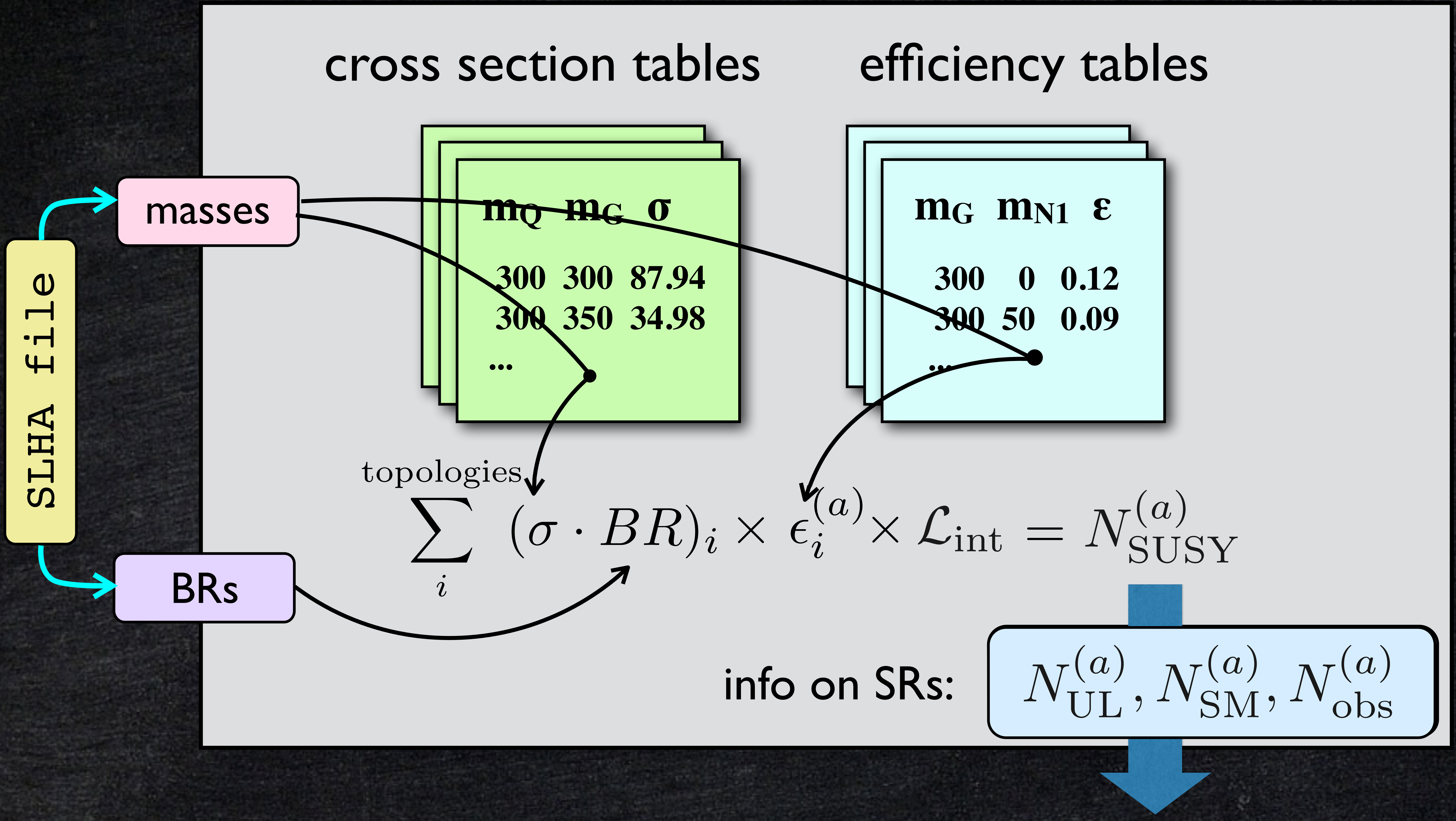
$$\sum_{i}^{\text{topologies}} (\sigma \cdot BR)_i \times \epsilon_i^{(a)} \times \mathcal{L}_{\text{int}} = N_{\text{SUSY}}^{(a)}$$

info on SRs: $N_{\text{UL}}^{(a)}, N_{\text{SM}}^{(a)}, N_{\text{obs}}^{(a)}$

http://fastlim.web.cern.ch/fastlim/

Fastlim

Papucci, KS, Weiler, Zeune 1402.0492



cross section tables

m_Q	m_G	σ
300	300	87.94
300	350	34.98
...		

efficiency tables

m_G	m_{N1}	ε
300	0	0.12
300	50	0.09
...		

$$\sum_{i}^{\text{topologies}} (\sigma \cdot BR)_i \times \epsilon_i^{(a)} \times \mathcal{L}_{\rm int} = N^{(a)}_{\rm SUSY}$$

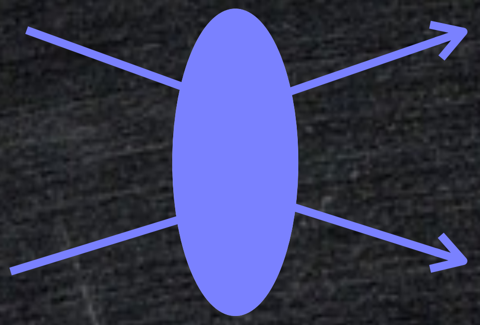
info on SRs: $N^{(a)}_{\rm UL}, N^{(a)}_{\rm SM}, N^{(a)}_{\rm obs}$

No MC sim. required

output: $N^{(a)}_{\rm SUSY}/N^{(a)}_{\rm UL}, CL^{(a)}_s$

Definition of topology

- If R-parity is (approximately) conserved, the SUSY events can be identified by tracing the two decay chains:

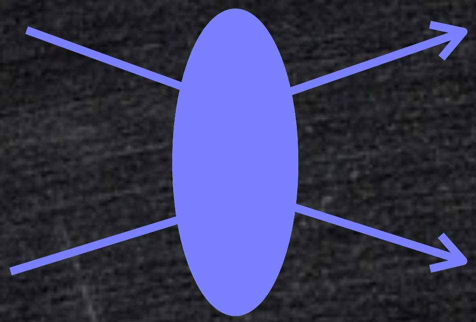


sparticle A1 → sparticle A2 → …

sparticle B1 → sparticle B2 → …

Definition of topology

- If R-parity is (approximately) conserved, the SUSY events can be identified by tracing the two decay chains:



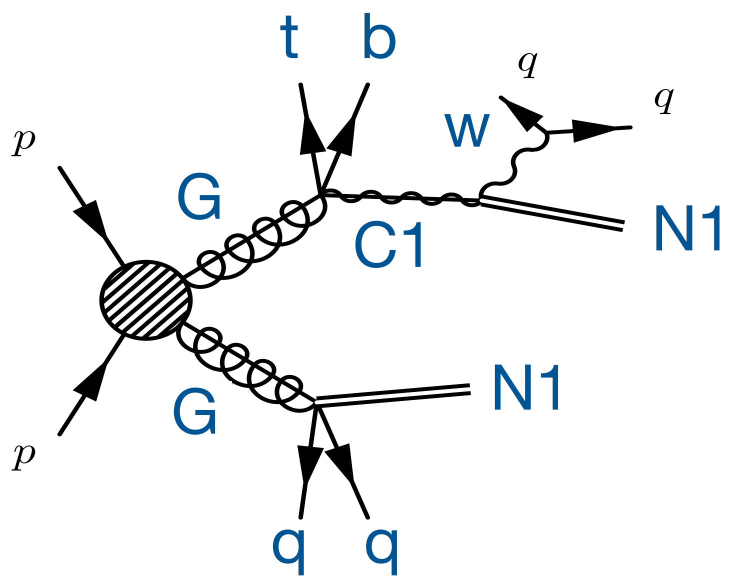
sparticle A1 → sparticle A2 → …

sparticle B1 → sparticle B2 → …

- It is convenient to introduce the particle names that manifestly distinguishes R-odd and R-even states.

R even	g	gam, z, w, h	q	t	b	e, m, ta	n
R odd	G	N1,…,N4, C1,C2	Q	T1, T2	B1, B2	E, M, TAU	NU, NUT

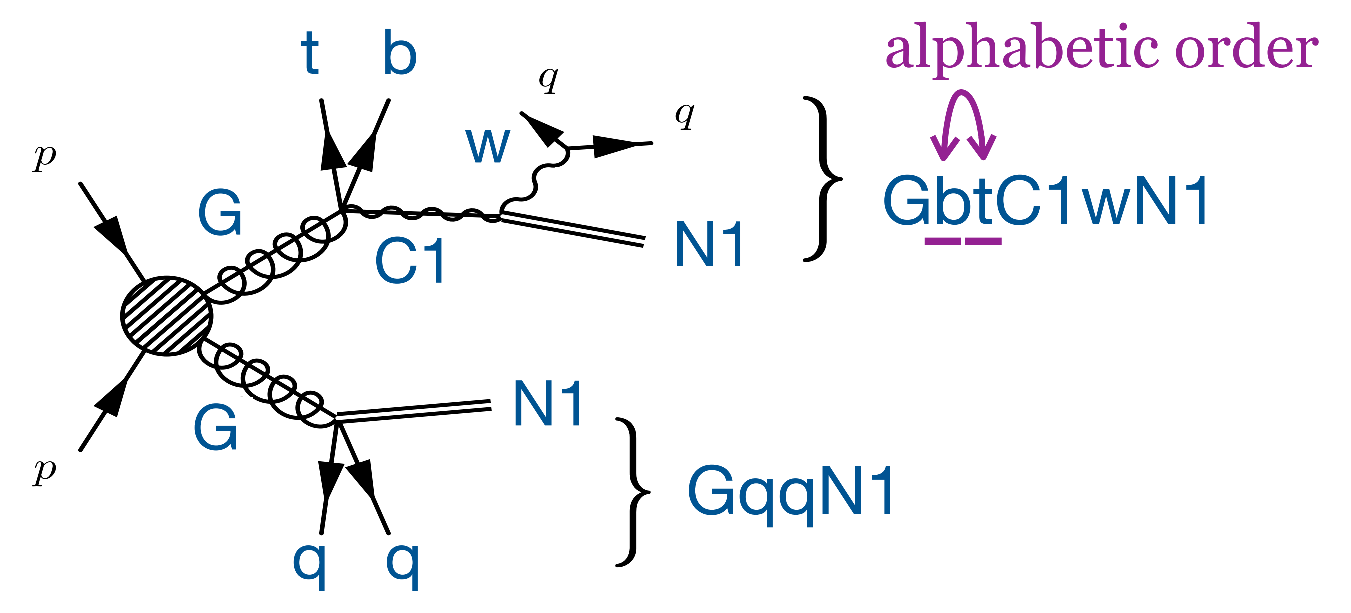
Definition of topology



- It is convenient to introduce the particle names that manifestly distinguishes R-odd and R-even states.

R even	g	gam, z, w, h	q	t	b	e, m, ta	n
R odd	G	N1,…,N4, C1,C2	Q	T1, T2	B1, B2	E, M, TAU	NU, NUT

Definition of topology



- It is convenient to introduce the particle names that manifestly distinguishes R-odd and R-even states.

R even	g	gam, z, w, h	q	t	b	e, m, ta	n
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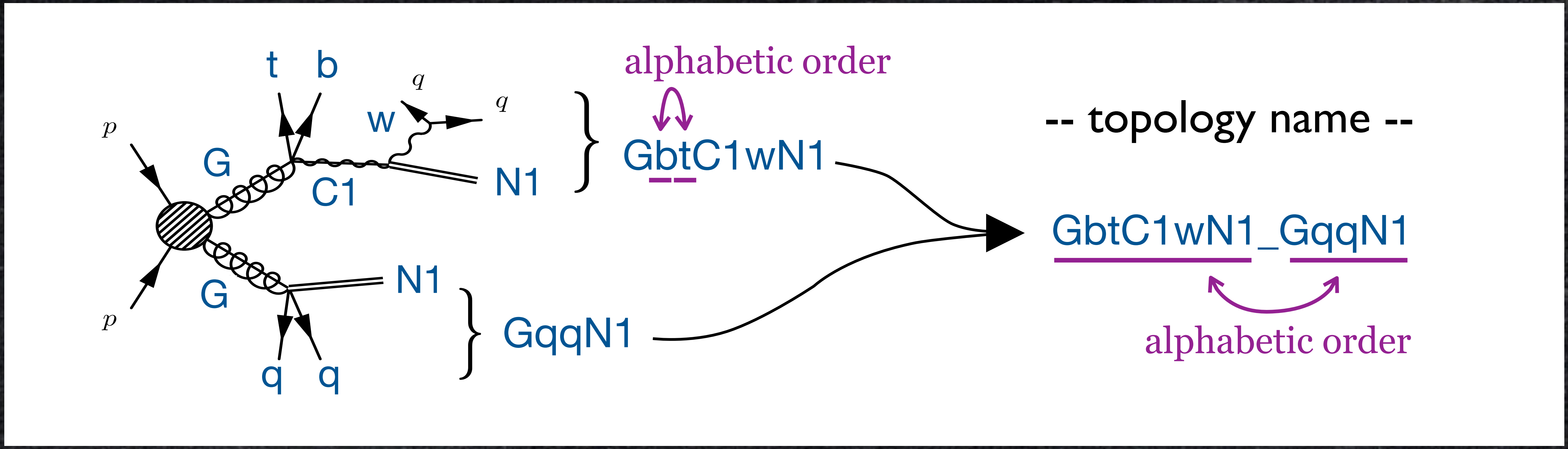
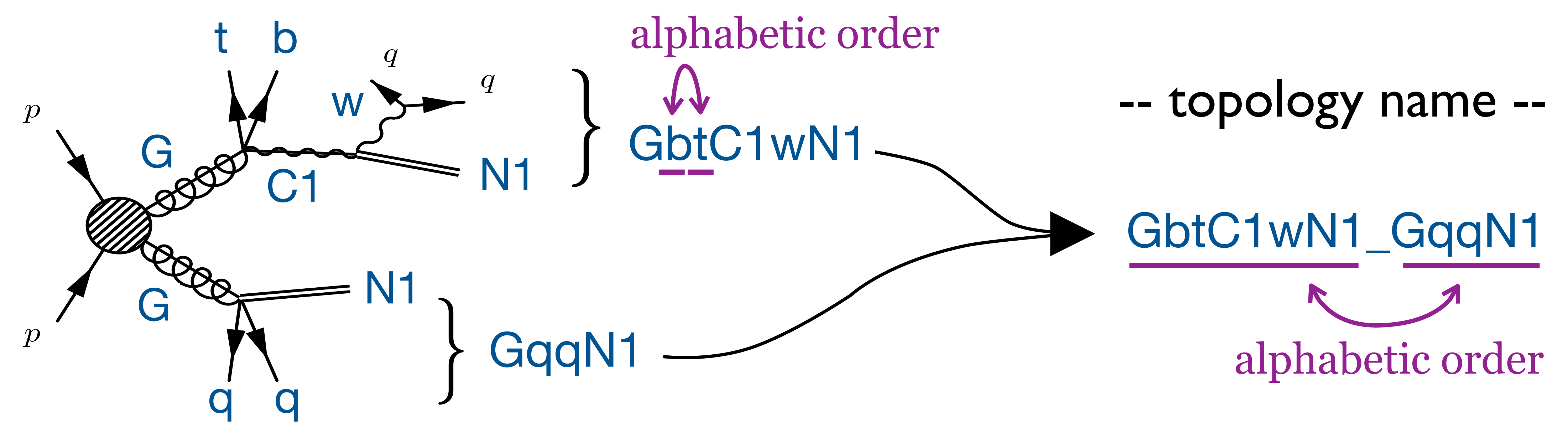
Definition of topology



- It is convenient to introduce the particle names that manifestly distinguishes R-odd and R-even states.

R even	g	gam, z, w, h	q	t	b	e, m, ta	n
R odd	G	N1,…,N4, C1,C2	Q	T1, T2	B1, B2	E, M, TAU	NU, NUT

Definition of topology

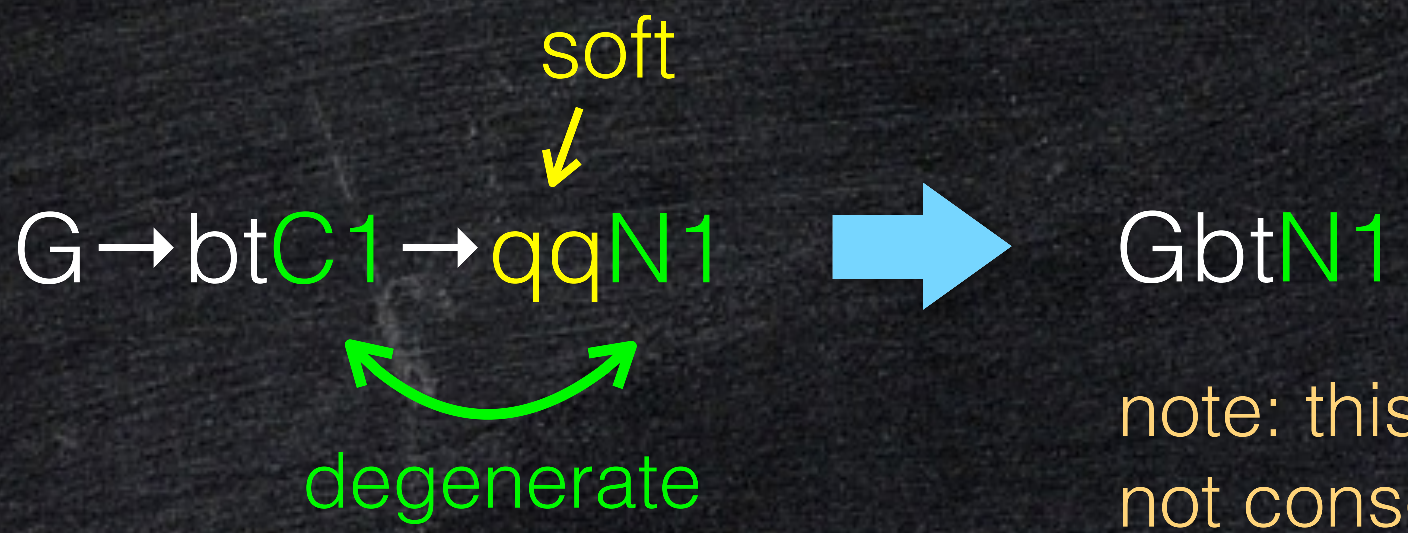


From the minimality requirement

- We do not specify the decay of SM particles. SM decays are fixed and model independent.
- We do not specify the charge (or particle <-> anti-particle). The event ratio between a process and its CP conjugated process is model independent as long as CP is conserved.

Truncation of soft decays

- If there are two BSM particles with similar masses, the decays involving these particles produce very low pT SM particles, which do not have impact on the SR efficiency. In this case, such decays can be truncated and the topology can be redefined as a shorter topology.

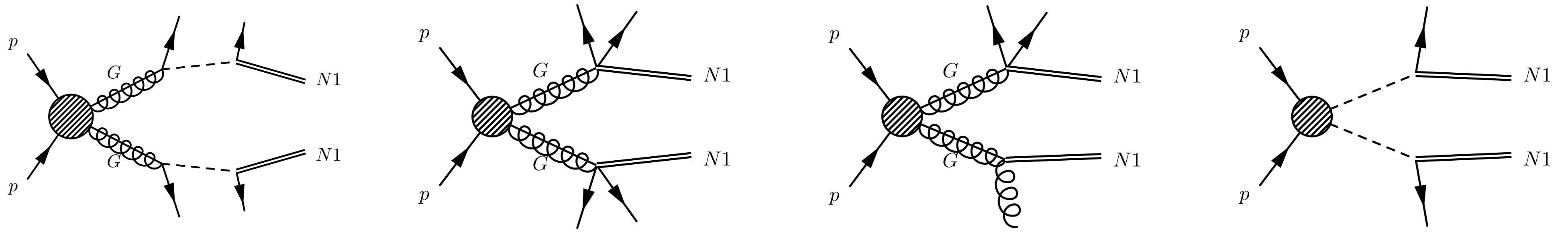


note: this introduces topologies as if EM charge is not conserved.

- This technique is particularly useful for the wino or higgsino LSP cases.

Fastlim 1.0

topologies in Fastlim 1.0



GbB1bN1_GbB1bN1
GbB1bN1_GbB1tN1
GbB1tN1_GbB1tN1
GtT1bN1_GtT1bN1
GtT1bN1_GtT1tN1
GtT1tN1_GtT1tN1
(GbB2bN1_GbB2bN1)
(GbB2bN1_GbB2tN1)
(GbB2tN1_GbB2tN1)
(GtT2bN1_GtT2bN1)
(GtT2bN1_GtT2tN1)
(GtT2tN1_GtT2tN1)
[GbB1bN1_GbB2bN1]
[GbB1bN1_GbB2tN1]
[GbB1tN1_GbB2bN1]
[GbB1tN1_GbB2tN1]
[GtT1bN1_GtT2bN1]
[GtT1bN1_GtT2tN1]
[GtT1tN1_GtT2bN1]
[GtT1tN1_GtT2tN1]

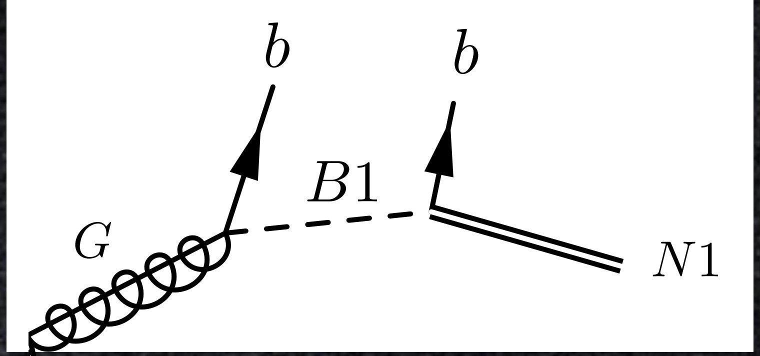
GbbN1_GbbN1
GbbN1_GbtN1
GbbN1_GttN1
GbbN1_GqqN1
GbtN1_GbtN1
GbtN1_GttN1
GbtN1_GqqN1
GttN1_GttN1
GttN1_GqqN1
GqqN1_GqqN1

GbbN1_GgN1
GbtN1_GgN1
GgN1_GgN1
GgN1_GttN1
GgN1_GqqN1

T1bN1_T1bN1
T1bN1_T1tN1
T1tN1_T1tN1
(B1bN1_B1bN1)
(B1bN1_B1tN1)
(B1tN1_B1tN1)
(B2bN1_B2bN1)
(B2bN1_B2tN1)
(B2tN1_B2tN1)
(T2bN1_T2bN1)
(T2bN1_T2tN1)
(T2tN1_T2tN1)

GbB1bN1

$\tilde{g} \to b\tilde{b}_1$ $\tilde{b}_1 \to b\tilde{\chi}_1^0$



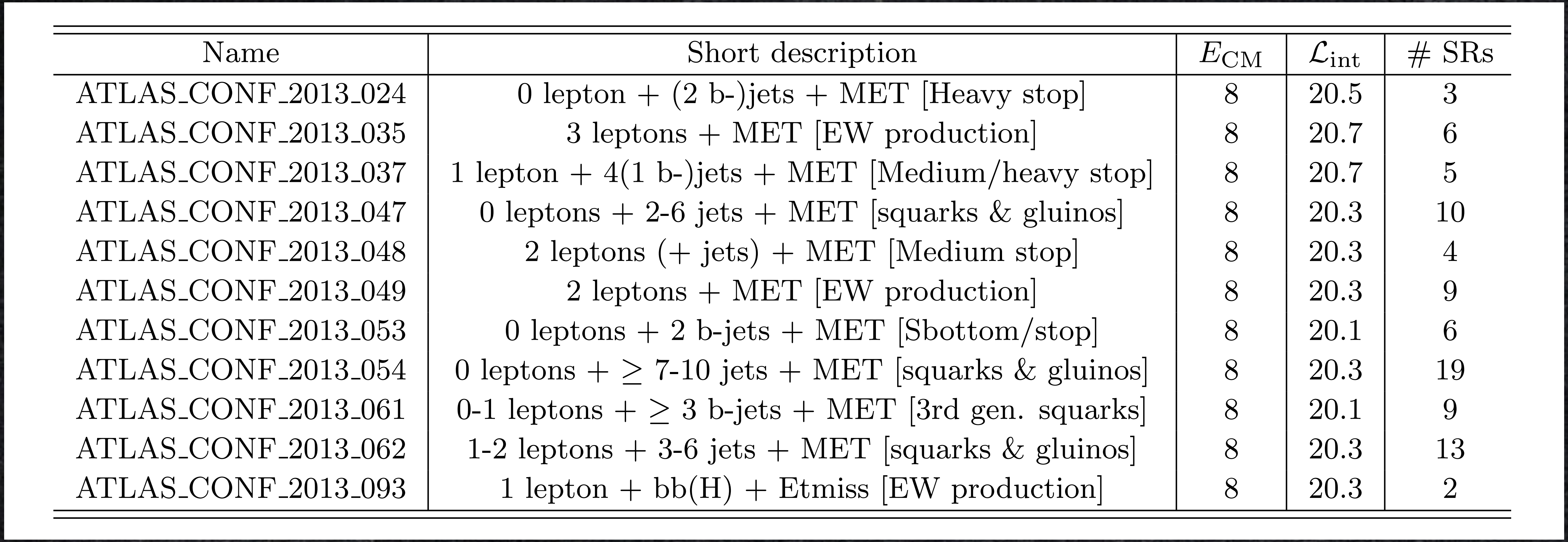
not all topologies are implemented

↓

the result may be underestimated but at least conservative

Fastlim 1.0

available analyses



Name	Short description	E_{CM}	$\mathcal{L}_{\mathrm{int}}$	# SRs
ATLAS_CONF_2013_024	0 lepton + (2 b-)jets + MET [Heavy stop]	8	20.5	3
ATLAS_CONF_2013_035	3 leptons + MET [EW production]	8	20.7	6
ATLAS_CONF_2013_037	1 lepton + 4(1 b-)jets + MET [Medium/heavy stop]	8	20.7	5
ATLAS_CONF_2013_047	0 leptons + 2-6 jets + MET [squarks & gluinos]	8	20.3	10
ATLAS_CONF_2013_048	2 leptons (+ jets) + MET [Medium stop]	8	20.3	4
ATLAS_CONF_2013_049	2 leptons + MET [EW production]	8	20.3	9
ATLAS_CONF_2013_053	0 leptons + 2 b-jets + MET [Sbottom/stop]	8	20.1	6
ATLAS_CONF_2013_054	0 leptons + $\geq$ 7-10 jets + MET [squarks & gluinos]	8	20.3	19
ATLAS_CONF_2013_061	0-1 leptons + $\geq$ 3 b-jets + MET [3rd gen. squarks]	8	20.1	9
ATLAS_CONF_2013_062	1-2 leptons + 3-6 jets + MET [squarks & gluinos]	8	20.3	13
ATLAS_CONF_2013_093	1 lepton + bb(H) + Etmiss [EW production]	8	20.3	2

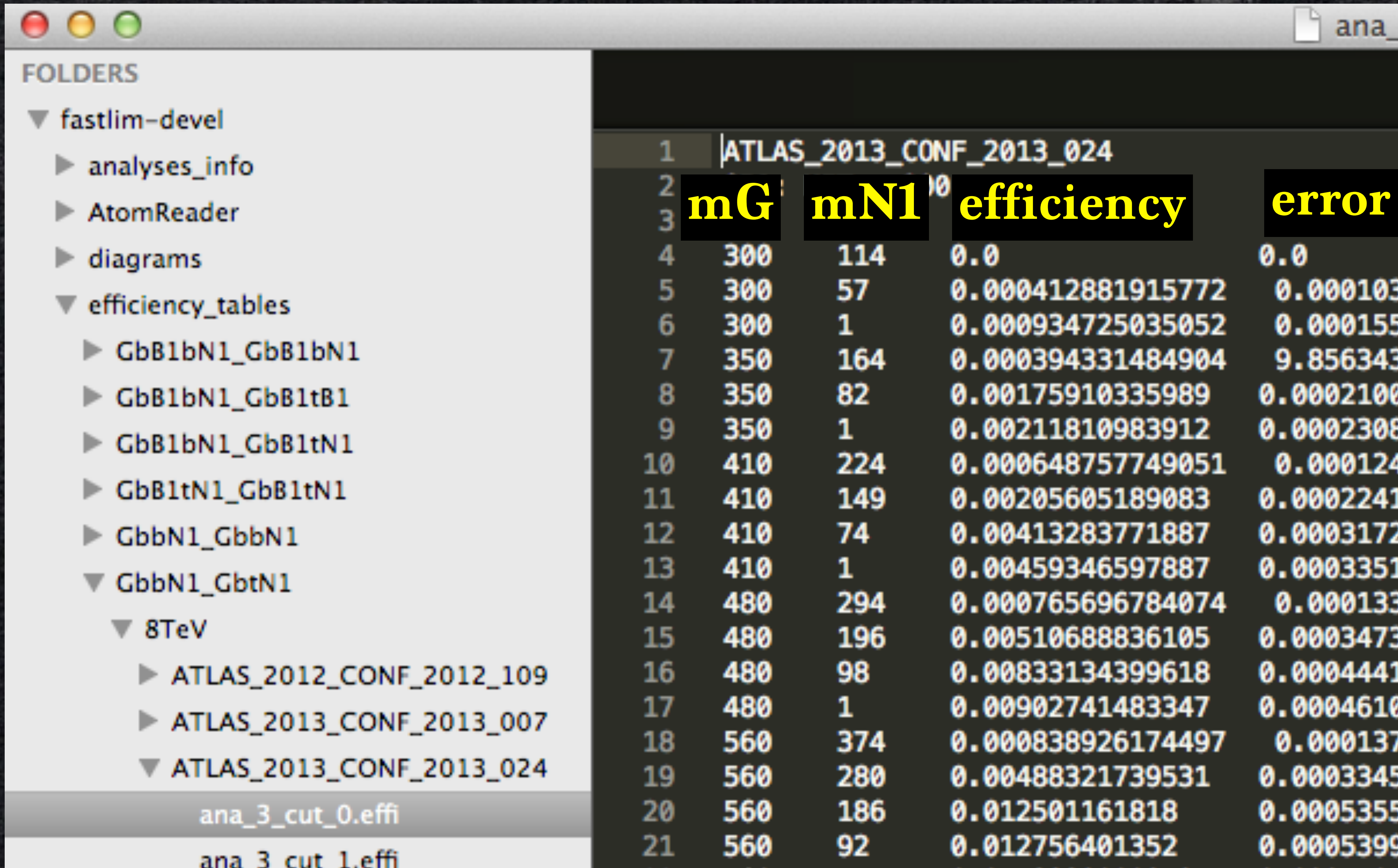
- Most 2013 ATLAS analyses are implemented (CMS analyses will be implemented soon).
- Event generation was done using MadGraph 5. The sample include up to extra 1 parton emission at ME level, matched to parton shower using MLM scheme.
- ATOM is used for efficiency estimation.

Efficiency Tables

- efficiency tables are standard text file.
- should be given for each signal region and each topology
- any 3rd party's efficiency tables can be easily incorporated.

global coordinating effort to generate efficiency maps and share

https://indico.cern.ch/event/272303/



- fastlim-devel
  - analyses_info
  - AtomReader
  - diagrams
  - efficiency_tables
    - GbB1bN1_GbB1bN1
    - GbB1bN1_GbB1tB1
    - GbB1bN1_GbB1tN1
    - GbB1tN1_GbB1tN1
    - GbbN1_GbbN1
    - GbbN1_GbtN1
      - 8TeV
        - ATLAS_2012_CONF_2012_109
        - ATLAS_2013_CONF_2013_007
        - ATLAS_2013_CONF_2013_024
          - ana_3_cut_0.effi
          - ana_3_cut_1.effi

mG **mN1** **efficiency** **error**

```
ATLAS_2013_CONF_2013_024


300   114   0.0                 0.0
300   57    0.000412881915772    0.000103
300   1     0.000934725035052    0.000155
350   164   0.000394331484904    9.856343
350   82    0.00175910335989    0.0002100
350   1     0.00211810983912    0.0002308
410   224   0.000648757749051    0.000124
410   149   0.00205605189083    0.0002241
410   74    0.00413283771887    0.0003172
410   1     0.00459346597887    0.0003351
480   294   0.000765696784074    0.000133
480   196   0.00510688836105    0.0003473
480   98    0.00833134399618    0.0004441
480   1     0.00902741483347    0.0004610
560   374   0.000838926174497    0.000137
560   280   0.00488321739531    0.0003345
560   186   0.012501161818      0.0005355
560   92    0.012756401352      0.0005399
```

Eff

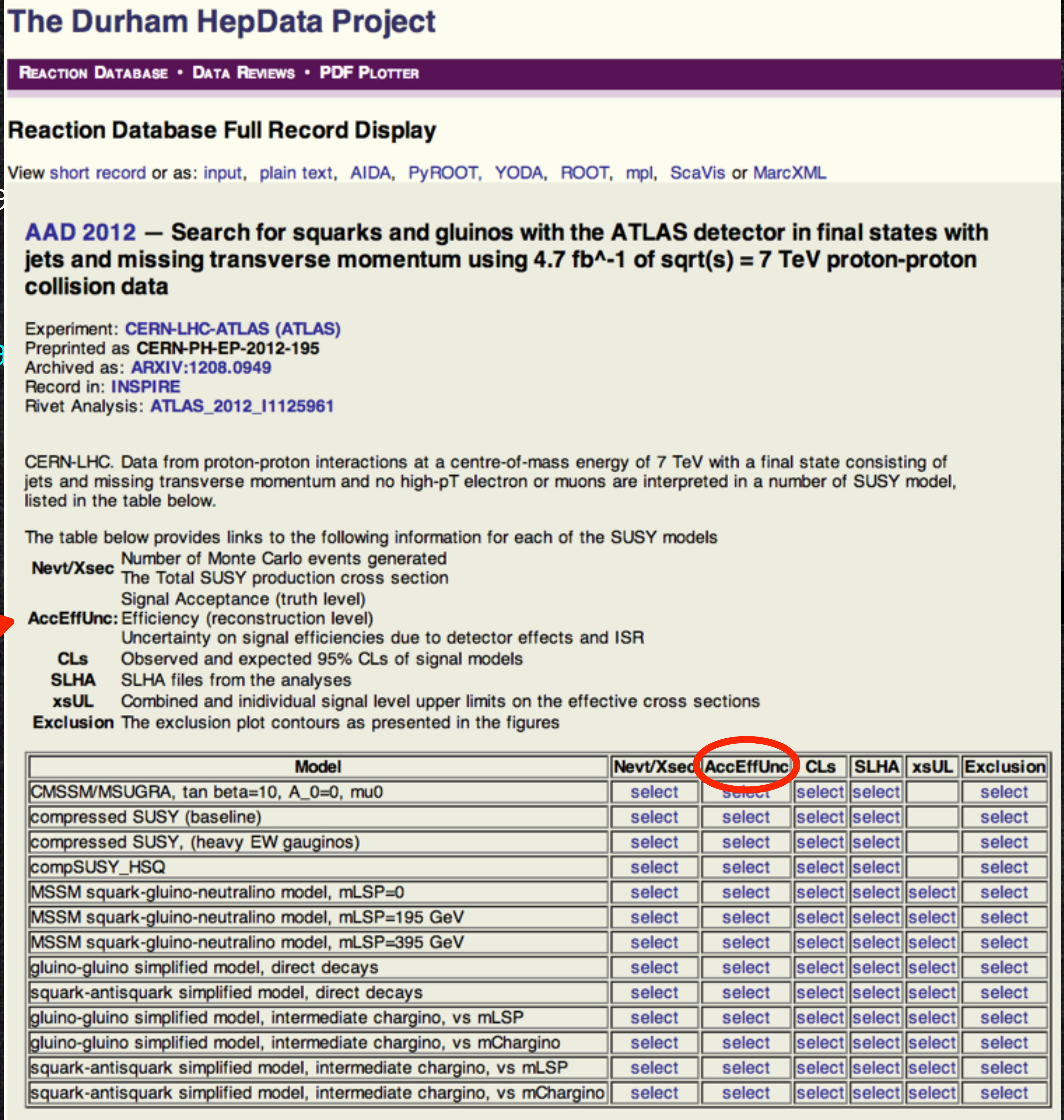
- efficiency tables are standa
- should be given for each si
- any 3rd party's efficiency ta

global coordinating effort to generate efficiency maps and share

https://indico.cern.ch/event/272303/

can include efficiency maps on HepData very easily.

Please provide more maps!



The Durham HepData Project

REACTION DATABASE • DATA REVIEWS • PDF PLOTTER

Reaction Database Full Record Display

View short record or as: input, plain text, AIDA, PyROOT, YODA, ROOT, mpl, ScaVis or MarcXML

AAD 2012 — Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum using 4.7 fb^-1 of sqrt(s) = 7 TeV proton-proton collision data

Experiment: **CERN-LHC-ATLAS (ATLAS)**
Preprinted as **CERN-PH-EP-2012-195**
Archived as: **ARXIV:1208.0949**
Record in: **INSPIRE**
Rivet Analysis: **ATLAS_2012_I1125961**

CERN-LHC. Data from proton-proton interactions at a centre-of-mass energy of 7 TeV with a final state consisting of jets and missing transverse momentum and no high-pT electron or muons are interpreted in a number of SUSY model, listed in the table below.

The table below provides links to the following information for each of the SUSY models

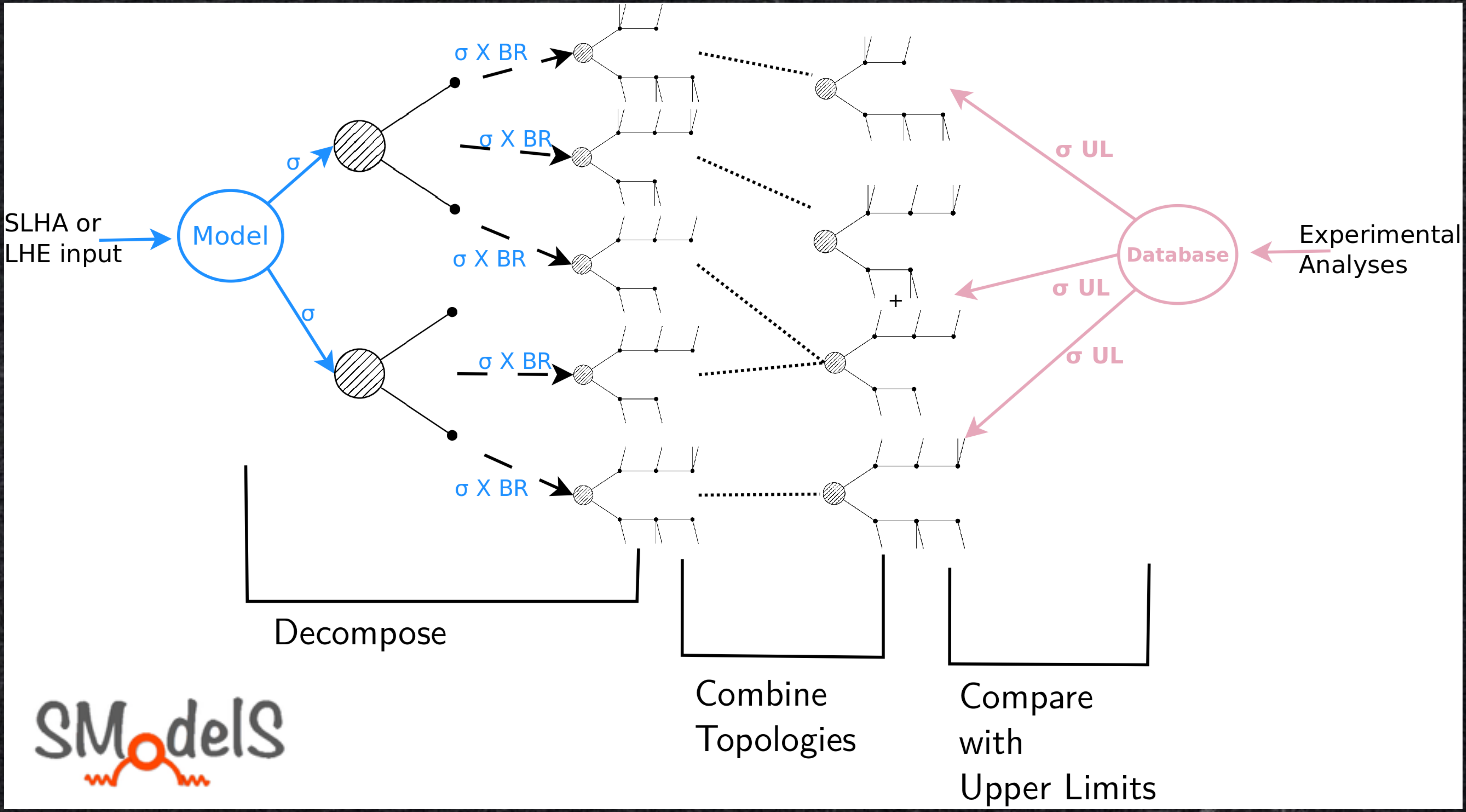
Nevt/Xsec	Number of Monte Carlo events generated The Total SUSY production cross section
AccEffUnc:	Signal Acceptance (truth level) Efficiency (reconstruction level) Uncertainty on signal efficiencies due to detector effects and ISR
CLs	Observed and expected 95% CLs of signal models
SLHA	SLHA files from the analyses
xsUL	Combined and inidividual signal level upper limits on the effective cross sections
Exclusion	The exclusion plot contours as presented in the figures

Model	Nevt/Xsec	AccEffUnc	CLs	SLHA	xsUL	Exclusion
CMSSM/MSUGRA, tan beta=10, A_0=0, mu0	select	select	select	select		select
compressed SUSY (baseline)	select	select	select	select		select
compressed SUSY, (heavy EW gauginos)	select	select	select	select		select
compSUSY_HSQ	select	select	select	select		select
MSSM squark-gluino-neutralino model, mLSP=0	select	select	select	select	select	select
MSSM squark-gluino-neutralino model, mLSP=195 GeV	select	select	select	select	select	select
MSSM squark-gluino-neutralino model, mLSP=395 GeV	select	select	select	select	select	select
gluino-gluino simplified model, direct decays	select	select	select	select	select	select
squark-antisquark simplified model, direct decays	select	select	select	select	select	select
gluino-gluino simplified model, intermediate chargino, vs mLSP	select	select	select	select	select	select
gluino-gluino simplified model, intermediate chargino, vs mChargino	select	select	select	select	select	select
squark-antisquark simplified model, intermediate chargino, vs mLSP	select	select	select	select	select	select
squark-antisquark simplified model, intermediate chargino, vs mChargino	select	select	select	select	select	select

SModelS

Sabine Kraml, *et.al*, 2013

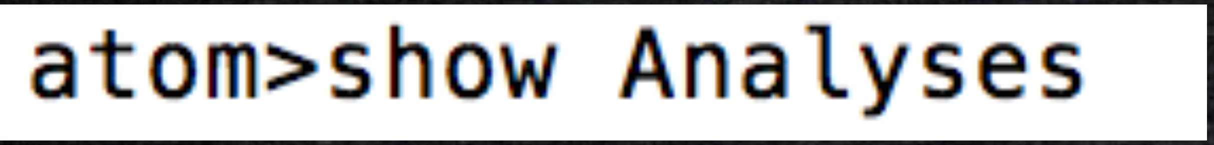
- SModelS is a tool to automatically check the simplified model constraints on a given BSM model.



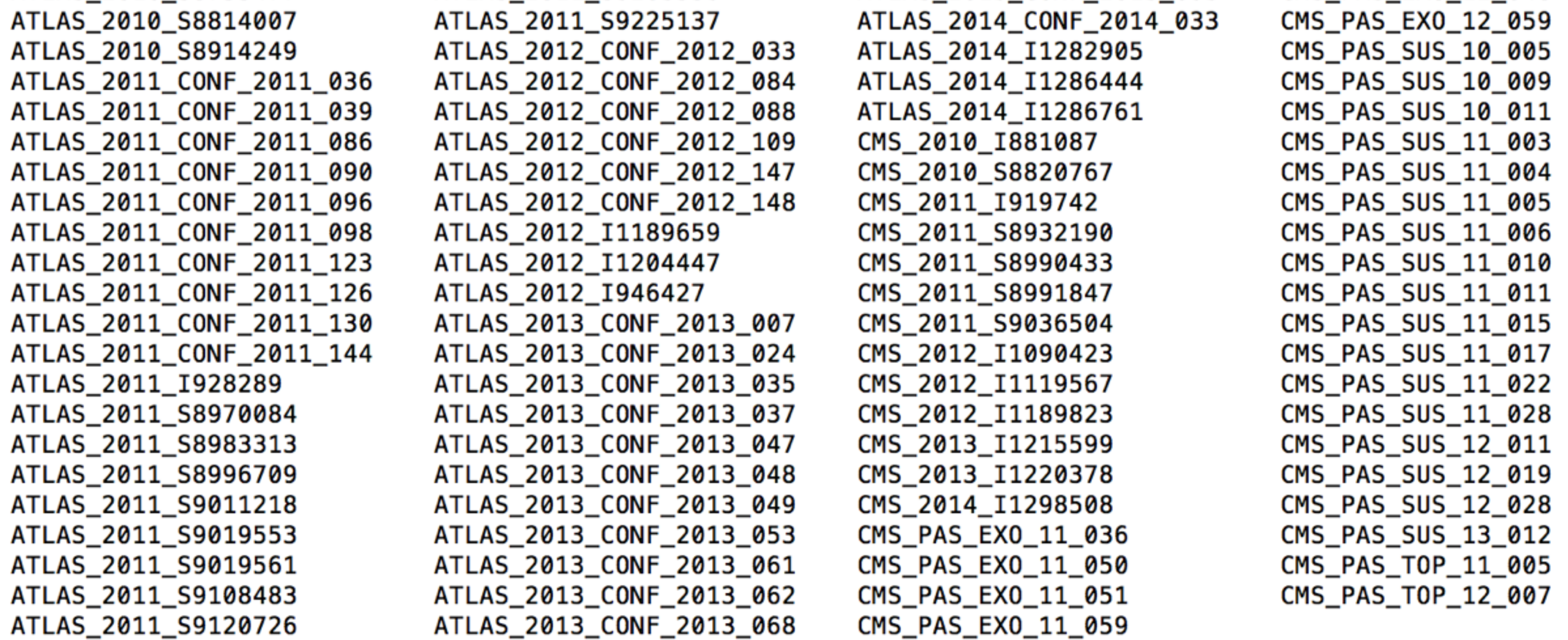
ATOM: Implemented analyses

Some info on Analysis

- Currently we have ~50 ATLAS and ~40 CMS analyses.
- All Rivet analyses can run on Atom: ~200 available analyses.
- ATLAS 2013 SUSY analyses have been systematically implemented for Fastlim project.
- Some of the ATLAS and CMS 2014 analyses have been implemented for different projects.



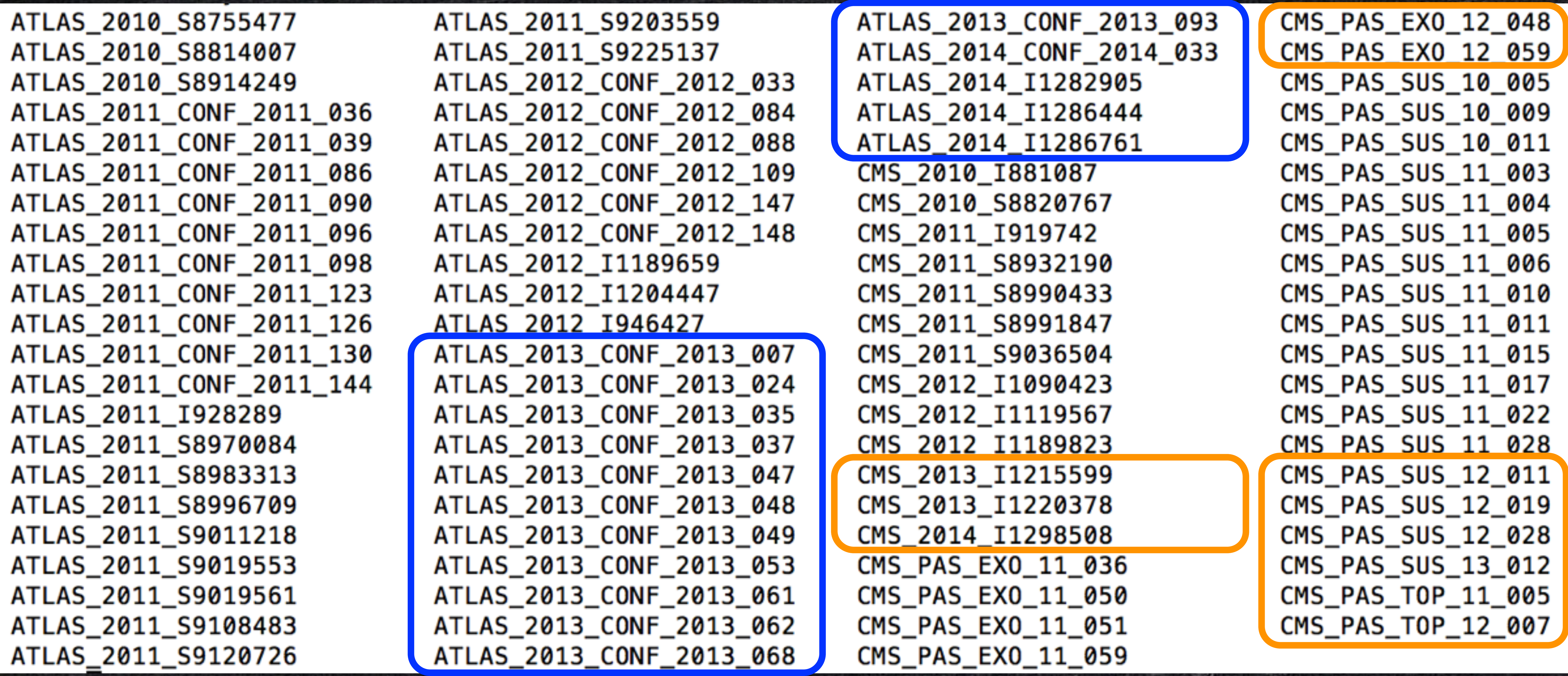
```
atom>show Analyses
```



```
ATLAS_2010_S8755477       ATLAS_2011_S9203559       ATLAS_2013_CONF_2013_093  CMS_PAS_EXO_12_048
ATLAS_2010_S8814007       ATLAS_2011_S9225137       ATLAS_2014_CONF_2014_033  CMS_PAS_EXO_12_059
ATLAS_2010_S8914249       ATLAS_2012_CONF_2012_033  ATLAS_2014_I1282905       CMS_PAS_SUS_10_005
ATLAS_2011_CONF_2011_036  ATLAS_2012_CONF_2012_084  ATLAS_2014_I1286444       CMS_PAS_SUS_10_009
ATLAS_2011_CONF_2011_039  ATLAS_2012_CONF_2012_088  ATLAS_2014_I1286761       CMS_PAS_SUS_10_011
ATLAS_2011_CONF_2011_086  ATLAS_2012_CONF_2012_109  CMS_2010_I881087          CMS_PAS_SUS_11_003
ATLAS_2011_CONF_2011_090  ATLAS_2012_CONF_2012_147  CMS_2010_S8820767         CMS_PAS_SUS_11_004
ATLAS_2011_CONF_2011_096  ATLAS_2012_CONF_2012_148  CMS_2011_I919742          CMS_PAS_SUS_11_005
ATLAS_2011_CONF_2011_098  ATLAS_2012_I1189659       CMS_2011_S8932190         CMS_PAS_SUS_11_006
ATLAS_2011_CONF_2011_123  ATLAS_2012_I1204447       CMS_2011_S8990433         CMS_PAS_SUS_11_010
ATLAS_2011_CONF_2011_126  ATLAS_2012_I946427        CMS_2011_S8991847         CMS_PAS_SUS_11_011
ATLAS_2011_CONF_2011_130  ATLAS_2013_CONF_2013_007  CMS_2011_S9036504         CMS_PAS_SUS_11_015
ATLAS_2011_CONF_2011_144  ATLAS_2013_CONF_2013_024  CMS_2012_I1090423         CMS_PAS_SUS_11_017
ATLAS_2011_I928289        ATLAS_2013_CONF_2013_035  CMS_2012_I1119567         CMS_PAS_SUS_11_022
ATLAS_2011_S8970084       ATLAS_2013_CONF_2013_037  CMS_2012_I1189823         CMS_PAS_SUS_11_028
ATLAS_2011_S8983313       ATLAS_2013_CONF_2013_047  CMS_2013_I1215599         CMS_PAS_SUS_12_011
ATLAS_2011_S8996709       ATLAS_2013_CONF_2013_048  CMS_2013_I1220378         CMS_PAS_SUS_12_019
ATLAS_2011_S9011218       ATLAS_2013_CONF_2013_049  CMS_2014_I1298508         CMS_PAS_SUS_12_028
ATLAS_2011_S9019553       ATLAS_2013_CONF_2013_053  CMS_PAS_EXO_11_036        CMS_PAS_SUS_13_012
ATLAS_2011_S9019561       ATLAS_2013_CONF_2013_061  CMS_PAS_EXO_11_050        CMS_PAS_TOP_11_005
ATLAS_2011_S9108483       ATLAS_2013_CONF_2013_062  CMS_PAS_EXO_11_051        CMS_PAS_TOP_12_007
ATLAS_2011_S9120726       ATLAS_2013_CONF_2013_068  CMS_PAS_EXO_11_059
```

```
atom>show Analyses
```

Recent ATLAS and CMS
analyses are implemented



```
ATLAS_2010_S8755477         ATLAS_2011_S9203559         ATLAS_2013_CONF_2013_093    CMS_PAS_EXO_12_048
ATLAS_2010_S8814007         ATLAS_2011_S9225137         ATLAS_2014_CONF_2014_033    CMS_PAS_EXO_12_059
ATLAS_2010_S8914249         ATLAS_2012_CONF_2012_033    ATLAS_2014_I1282905         CMS_PAS_SUS_10_005
ATLAS_2011_CONF_2011_036    ATLAS_2012_CONF_2012_084    ATLAS_2014_I1286444         CMS_PAS_SUS_10_009
ATLAS_2011_CONF_2011_039    ATLAS_2012_CONF_2012_088    ATLAS_2014_I1286761         CMS_PAS_SUS_10_011
ATLAS_2011_CONF_2011_086    ATLAS_2012_CONF_2012_109    CMS_2010_I881087            CMS_PAS_SUS_11_003
ATLAS_2011_CONF_2011_090    ATLAS_2012_CONF_2012_147    CMS_2010_S8820767           CMS_PAS_SUS_11_004
ATLAS_2011_CONF_2011_096    ATLAS_2012_CONF_2012_148    CMS_2011_I919742            CMS_PAS_SUS_11_005
ATLAS_2011_CONF_2011_098    ATLAS_2012_I1189659         CMS_2011_S8932190           CMS_PAS_SUS_11_006
ATLAS_2011_CONF_2011_123    ATLAS_2012_I1204447         CMS_2011_S8990433           CMS_PAS_SUS_11_010
ATLAS_2011_CONF_2011_126    ATLAS_2012_I946427          CMS_2011_S8991847           CMS_PAS_SUS_11_011
ATLAS_2011_CONF_2011_130    ATLAS_2013_CONF_2013_007    CMS_2011_S9036504           CMS_PAS_SUS_11_015
ATLAS_2011_CONF_2011_144    ATLAS_2013_CONF_2013_024    CMS_2012_I1090423           CMS_PAS_SUS_11_017
ATLAS_2011_I928289          ATLAS_2013_CONF_2013_035    CMS_2012_I1119567           CMS_PAS_SUS_11_022
ATLAS_2011_S8970084         ATLAS_2013_CONF_2013_037    CMS_2012_I1189823           CMS_PAS_SUS_11_028
ATLAS_2011_S8983313         ATLAS_2013_CONF_2013_047    CMS_2013_I1215599           CMS_PAS_SUS_12_011
ATLAS_2011_S8996709         ATLAS_2013_CONF_2013_048    CMS_2013_I1220378           CMS_PAS_SUS_12_019
ATLAS_2011_S9011218         ATLAS_2013_CONF_2013_049    CMS_2014_I1298508           CMS_PAS_SUS_12_028
ATLAS_2011_S9019553         ATLAS_2013_CONF_2013_053    CMS_PAS_EXO_11_036          CMS_PAS_SUS_13_012
ATLAS_2011_S9019561         ATLAS_2013_CONF_2013_061    CMS_PAS_EXO_11_050          CMS_PAS_TOP_11_005
ATLAS_2011_S9108483         ATLAS_2013_CONF_2013_062    CMS_PAS_EXO_11_051          CMS_PAS_TOP_12_007
ATLAS_2011_S9120726         ATLAS_2013_CONF_2013_068    CMS_PAS_EXO_11_059
```

```
atom>show Analyses
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We follow the Rivet convention for the name of analyses code

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ATLAS_2010_S8755477        ATLAS_2011_S9203559        ATLAS_2013_CONF_2013_093   CMS_PAS_EXO_12_048
ATLAS_2010_S8814007        ATLAS_2011_S9225137        ATLAS_2014_CONF_2014_033   CMS_PAS_EXO_12_059
ATLAS_2010_S8914249        ATLAS_2012_CONF_2012_033   ATLAS_2014_I1282905        CMS_PAS_SUS_10_005
ATLAS_2011_CONF_2011_036   ATLAS_2012_CONF_2012_084   ATLAS_2014_I1286444        CMS_PAS_SUS_10_009
ATLAS_2011_CONF_2011_039   ATLAS_2012_CONF_2012_088   ATLAS_2014_I1286761        CMS_PAS_SUS_10_011
ATLAS_2011_CONF_2011_086   ATLAS_2012_CONF_2012_109   CMS_2010_I881087           CMS_PAS_SUS_11_003
ATLAS_2011_CONF_2011_090   ATLAS_2012_CONF_2012_147   CMS_2010_S8820767          CMS_PAS_SUS_11_004
ATLAS_2011_CONF_2011_096   ATLAS_2012_CONF_2012_148   CMS_2011_I919742           CMS_PAS_SUS_11_005
                                                      CMS_2011_S8932190          CMS_PAS_SUS_11_006
                                                      CMS_2011_S8990433          CMS_PAS_SUS_11_010
                                                      CMS_2011_S8991847          CMS_PAS_SUS_11_011
                                                 _007 CMS_2011_S9036504          CMS_PAS_SUS_11_015
                                                 _024 CMS_2012_I1090423          CMS_PAS_SUS_11_017
                                                 _035 CMS_2012_I1119567          CMS_PAS_SUS_11_022
                                                 _037 CMS_2012_I1189823          CMS_PAS_SUS_11_028
                                                 _047 CMS_2013_I1215599          CMS_PAS_SUS_12_011
                                                 _048 CMS_2013_I1220378          CMS_PAS_SUS_12_019
                                                 _049 CMS_2014_I1298508          CMS_PAS_SUS_12_028
                                                 _053 CMS_PAS_EXO_11_036         CMS_PAS_SUS_13_012
                                                 _061 CMS_PAS_EXO_11_050         CMS_PAS_TOP_11_005
                                                 _062 CMS_PAS_EXO_11_051         CMS_PAS_TOP_12_007
                                                 _068 CMS_PAS_EXO_11_059
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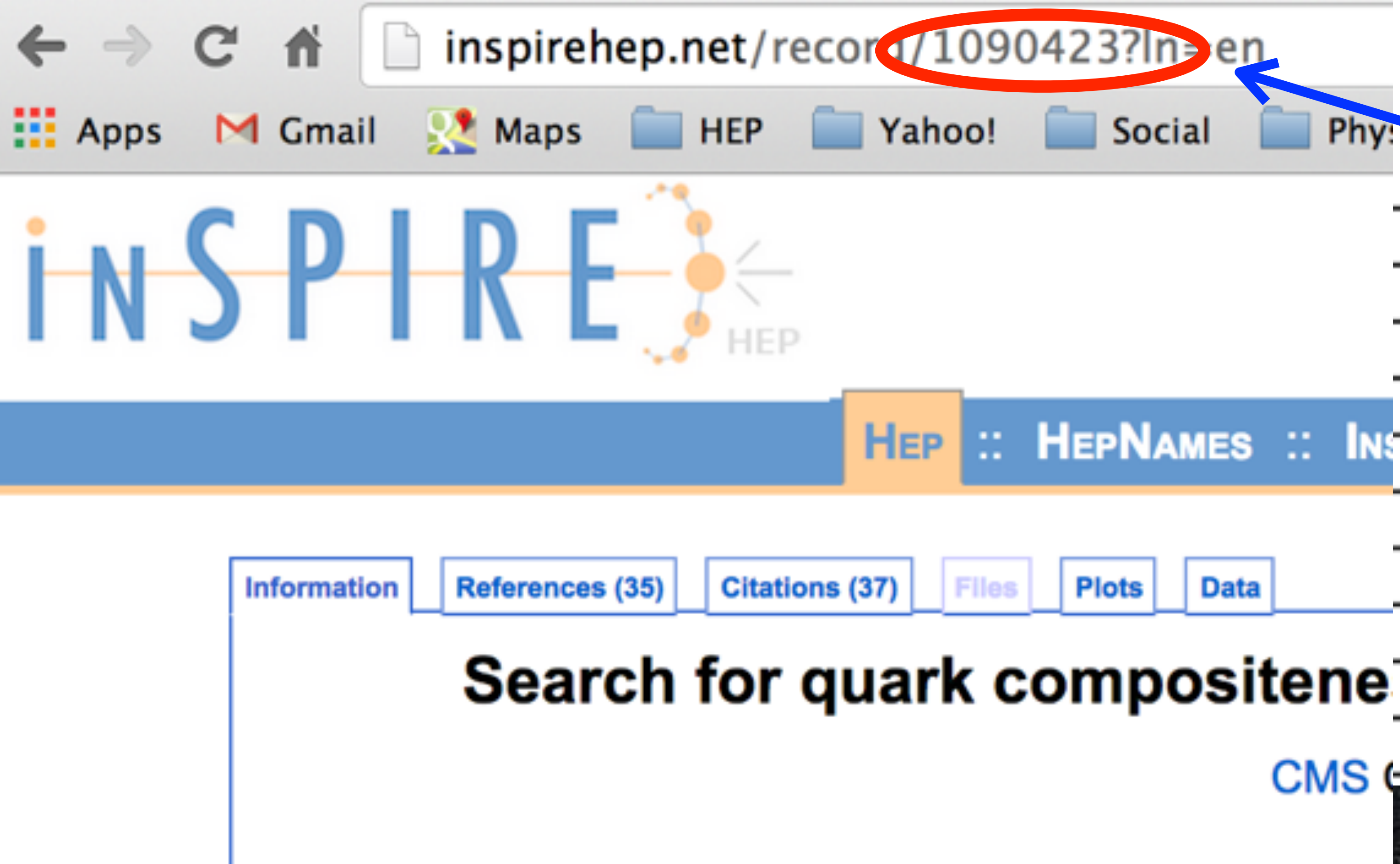
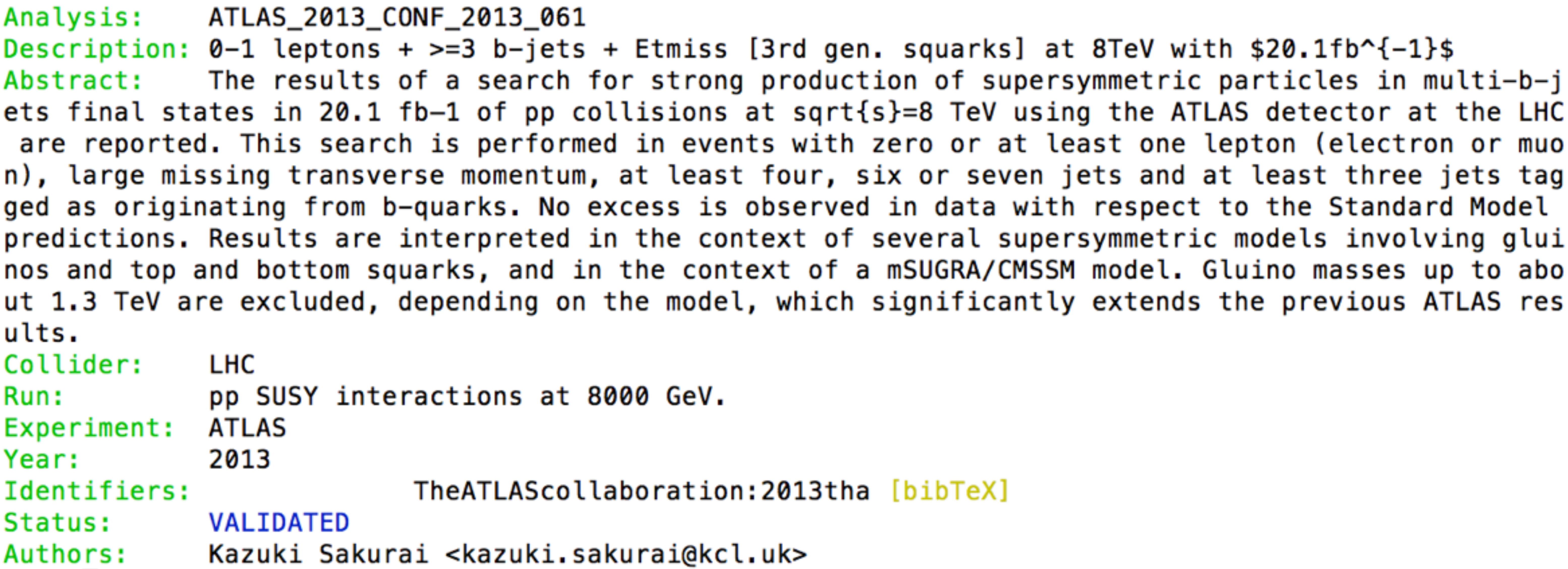


Search for quark compositene

CMS

```
atom>show Analysis ATLAS_2013_CONF_2013_061
```



```
Analysis:    ATLAS_2013_CONF_2013_061
Description: 0-1 leptons + >=3 b-jets + Etmiss [3rd gen. squarks] at 8TeV with $20.1fb^{-1}$
Abstract:    The results of a search for strong production of supersymmetric particles in multi-b-j
ets final states in 20.1 fb-1 of pp collisions at sqrt{s}=8 TeV using the ATLAS detector at the LHC
 are reported. This search is performed in events with zero or at least one lepton (electron or muo
n), large missing transverse momentum, at least four, six or seven jets and at least three jets tag
ged as originating from b-quarks. No excess is observed in data with respect to the Standard Model
predictions. Results are interpreted in the context of several supersymmetric models involving glui
nos and top and bottom squarks, and in the context of a mSUGRA/CMSSM model. Gluino masses up to abo
ut 1.3 TeV are excluded, depending on the model, which significantly extends the previous ATLAS res
ults.
Collider:    LHC
Run:         pp SUSY interactions at 8000 GeV.
Experiment:  ATLAS
Year:        2013
Identifiers:             TheATLAScollaboration:2013tha [bibTeX]
Status:      VALIDATED
Authors:     Kazuki Sakurai <kazuki.sakurai@kcl.uk>
```