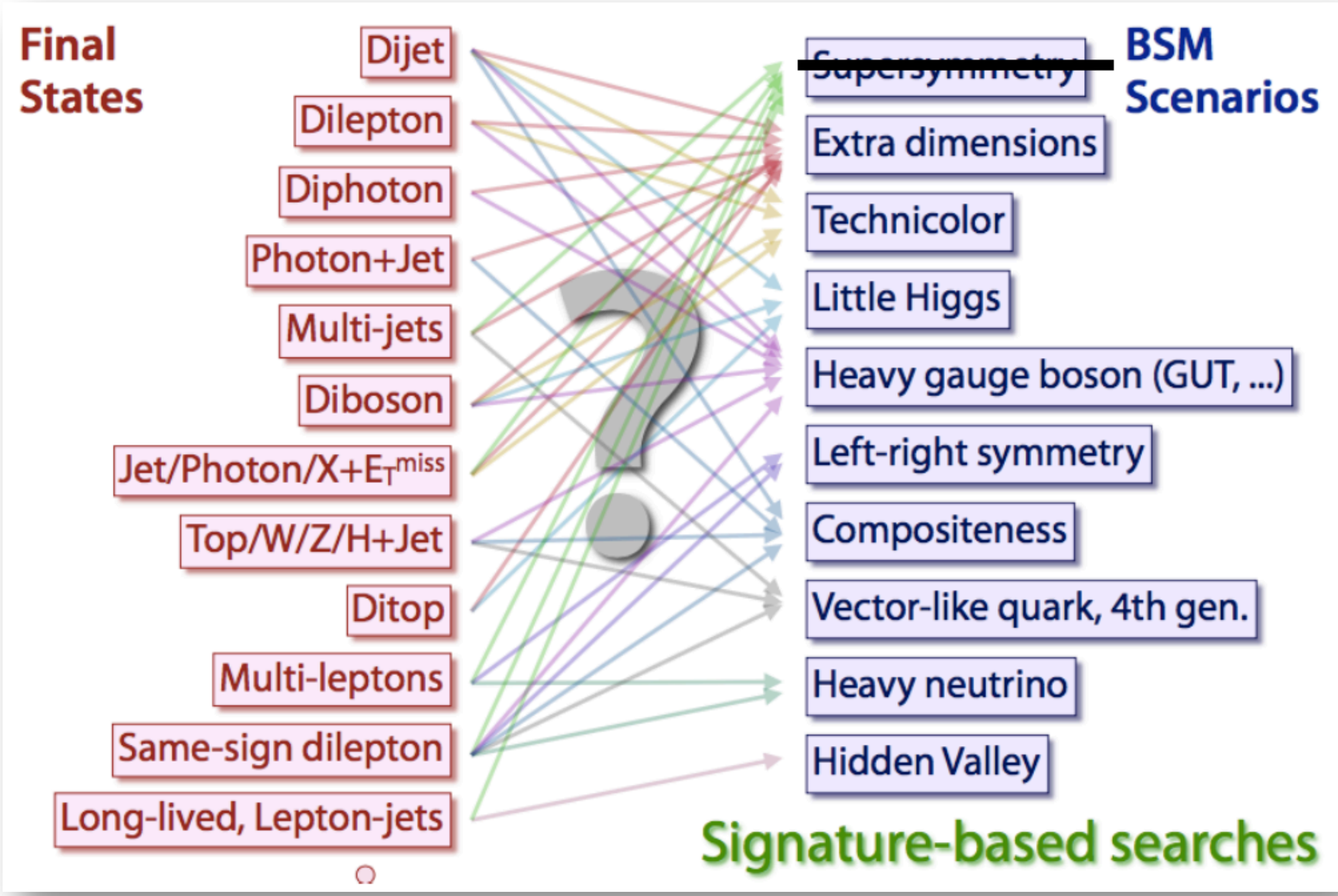
Interpretation Of Results Within Different Models

Keti Kaadze
Kansas State University

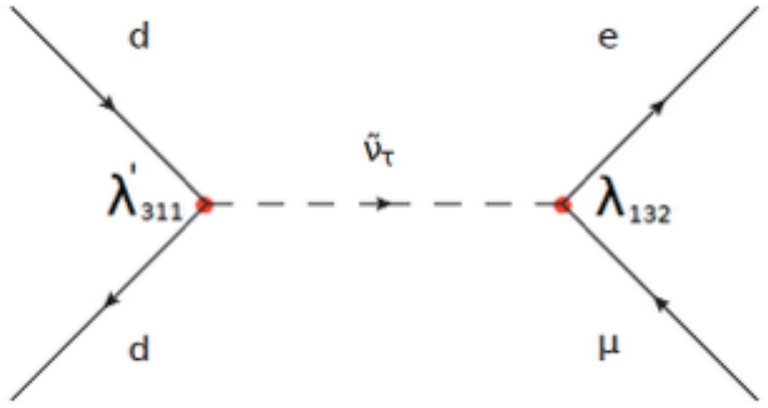
New Physics Interpretations at the LHC
May 2-4, 2016

Search for BSM Physics



$e\mu$ Resonances

- Search for Lepton Flavor Violation decays in heavy states
  - RPV production and decay of τ sneutrino
    - Single production is allowed and production via λ'_{311} is the largest
    - It is the lightest supersymmetric particle (LSP)
    - Coupling λ_{123} is assumed to be dominant

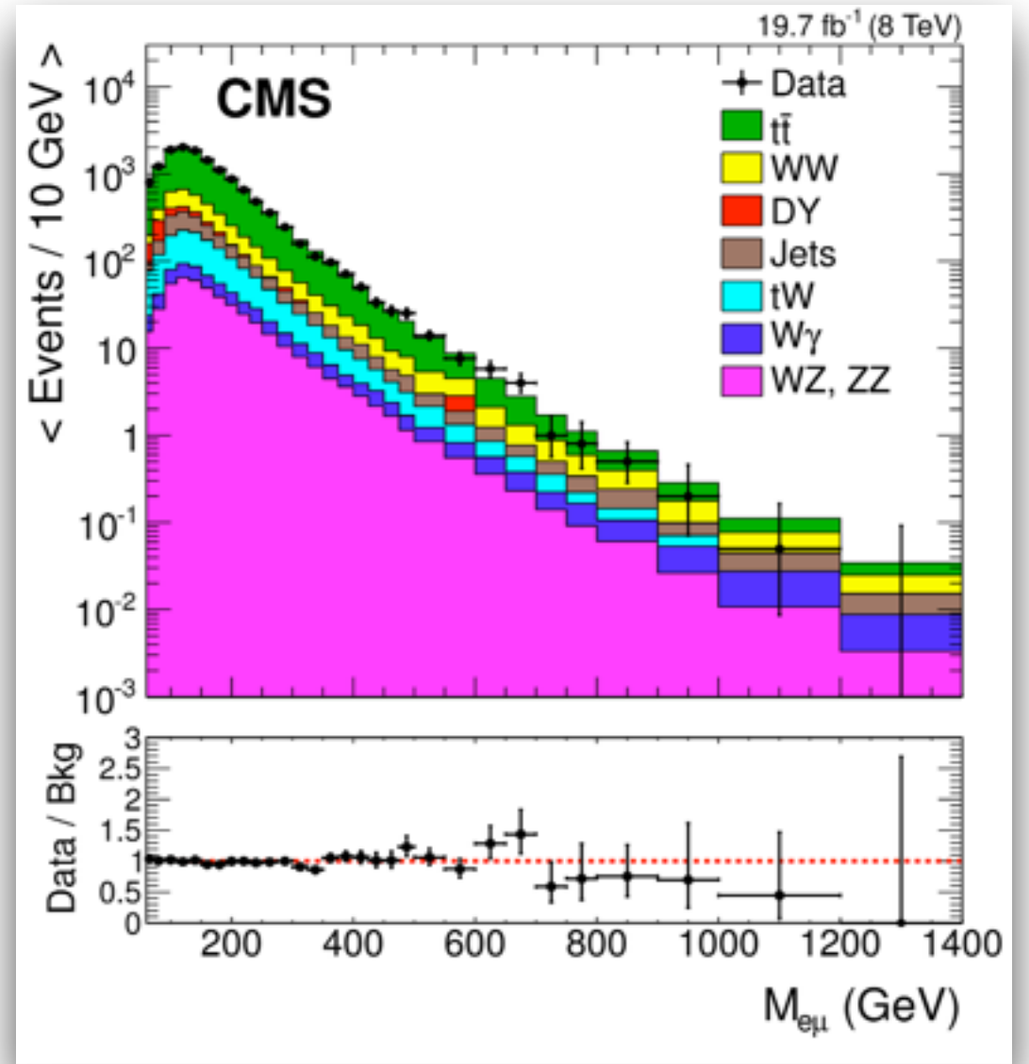


  - Heavy vector resonances from models with extra dimensions
    - LFV Z′: $d + \bar{s} \rightarrow Z'/\gamma' \rightarrow e + \bar{\mu}$
    - Characterized by $M_{Z'}$ and coupling modifier

  - Quantum Black Holes
    - Production depends on threshold mass and number of extra dimension
    - Can produce LFV decay

Analysis Details

- Search is performed in events with high P_T $e\mu$ pair
  - No opposite charge is required
  - Leptons are isolated
  - Electrons produced from muon bremsstrahlung are rejected



Narrow resonances:
τ sneutrino — generic spin-0 resonance
LFV Z′ — specific scenario of interference
Wide resonance: QBH

Selection efficiencies

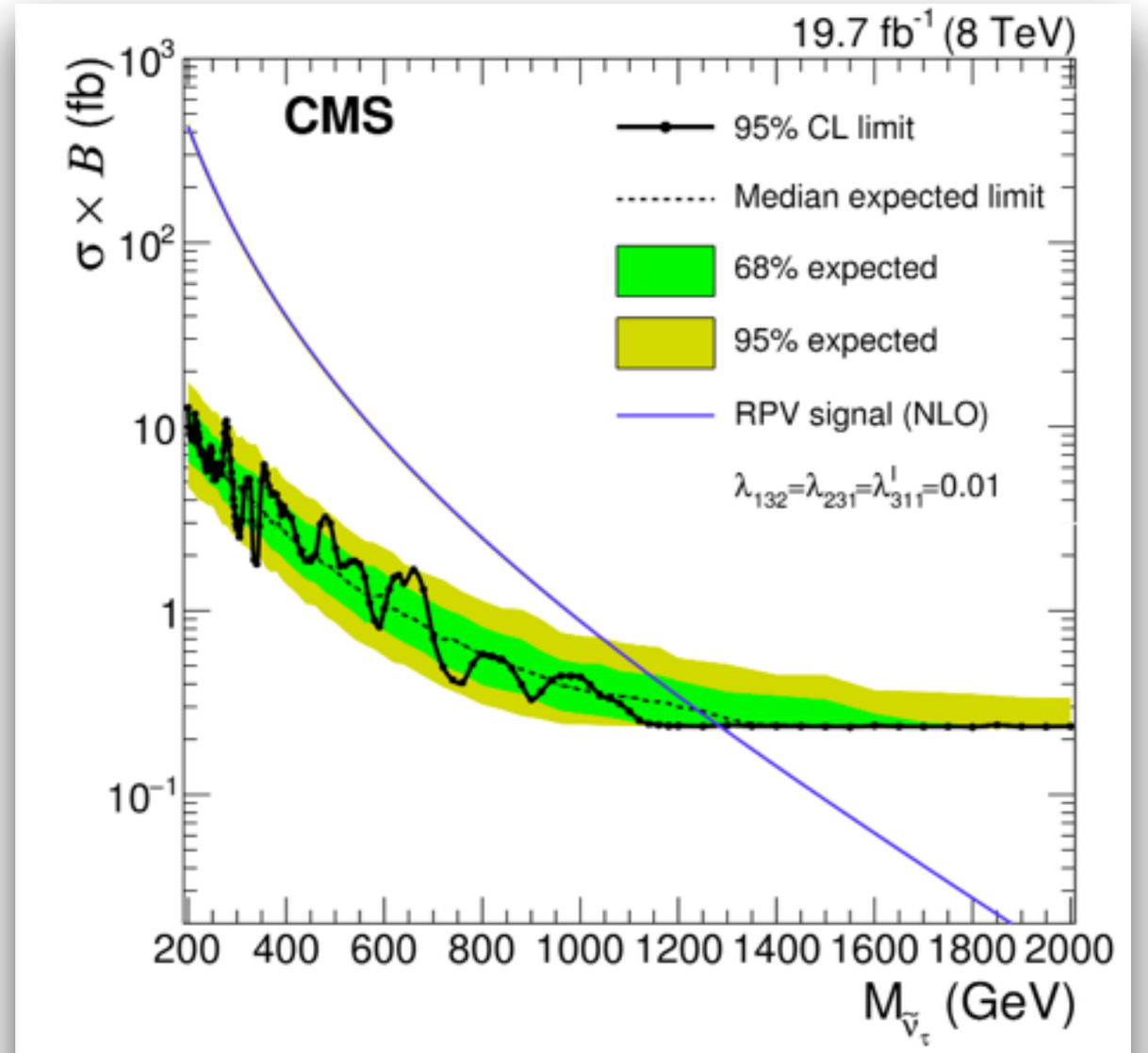
$M_{\tilde{\nu}_\tau}$ (TeV)	A	$A\epsilon$	$M_{Z'}$ (TeV)	A	$A\epsilon$
0.2	0.59	0.42	0.25	0.57	0.39
0.5	0.80	0.58	0.5	0.72	0.51
1.0	0.89	0.64	1.0	0.83	0.59
1.5	0.91	0.65	1.5	0.87	0.61
2.0	0.92	0.65	2.0	0.89	0.62

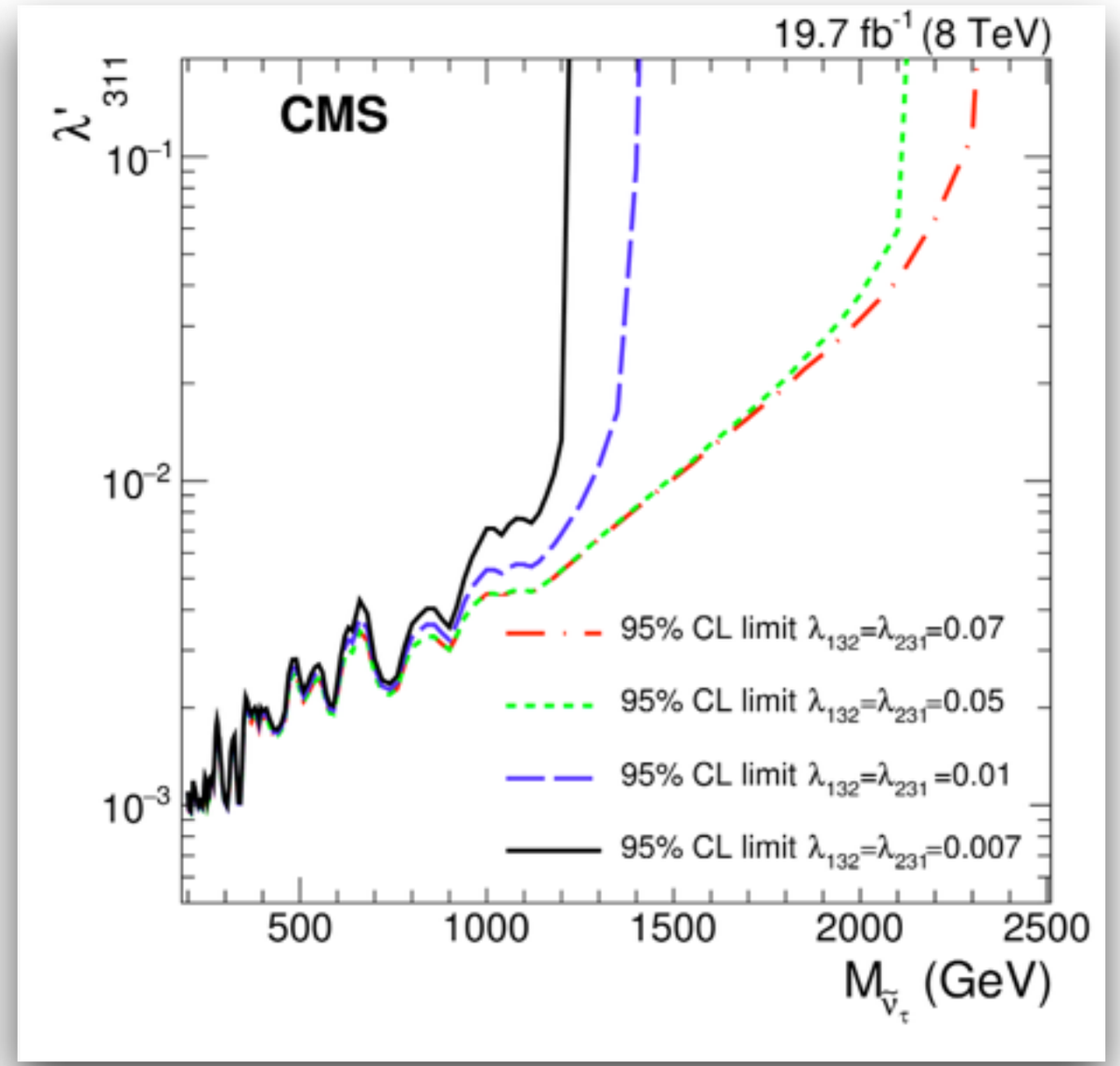
$n = 0$			$n = 6$		
M_{th} (TeV)	A	$A\epsilon$	M_{th} (TeV)	A	$A\epsilon$
0.5	0.85	0.61	0.5	0.82	0.60
1.0	0.90	0.63	1.0	0.89	0.64
2.0	0.93	0.64	2.0	0.93	0.65
3.0	0.94	0.63	3.0	0.94	0.64
4.0	0.94	0.62	4.0	0.94	0.63

Results

- Results on τ sneutrino search

arXiv:1604.05239

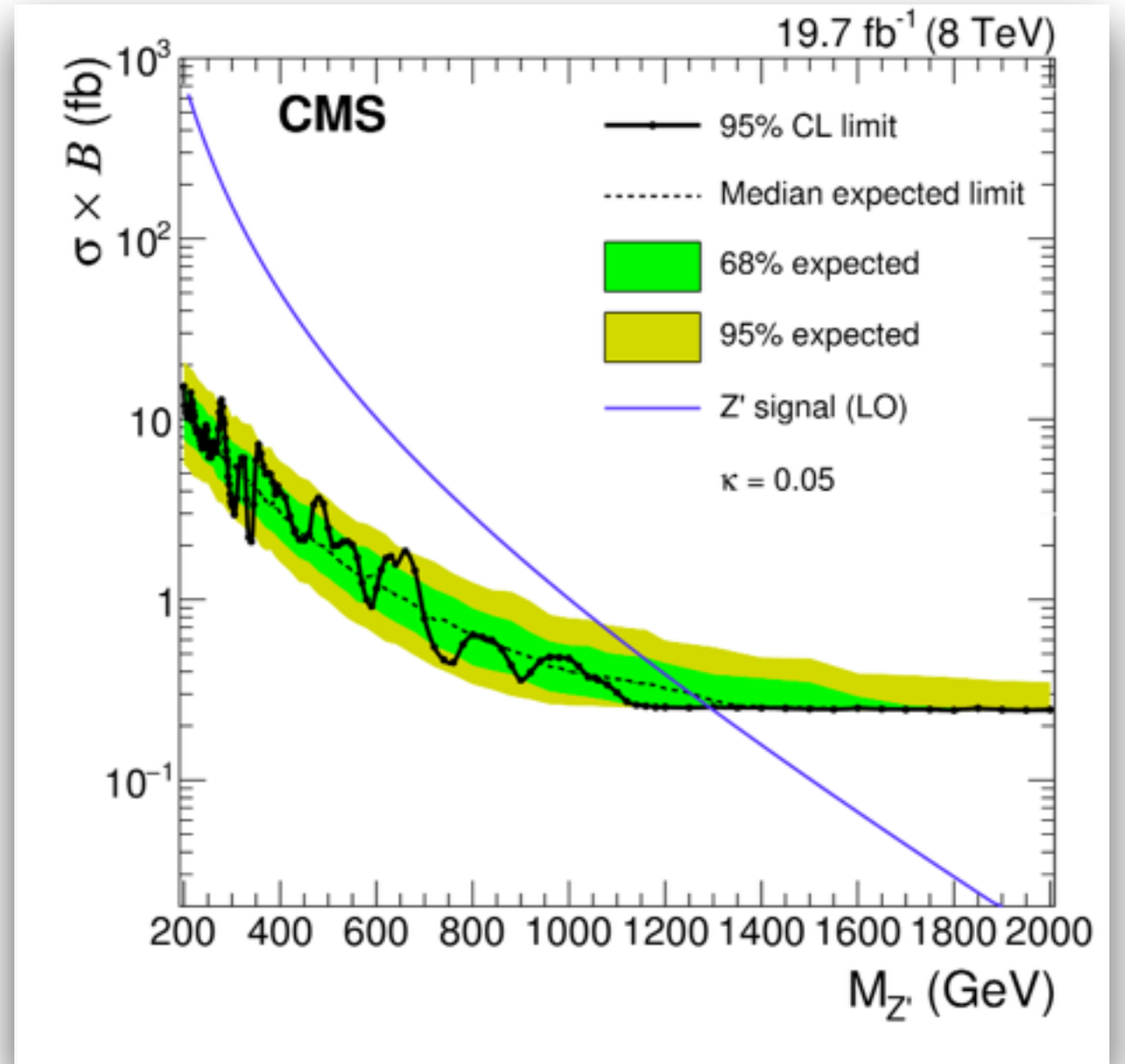


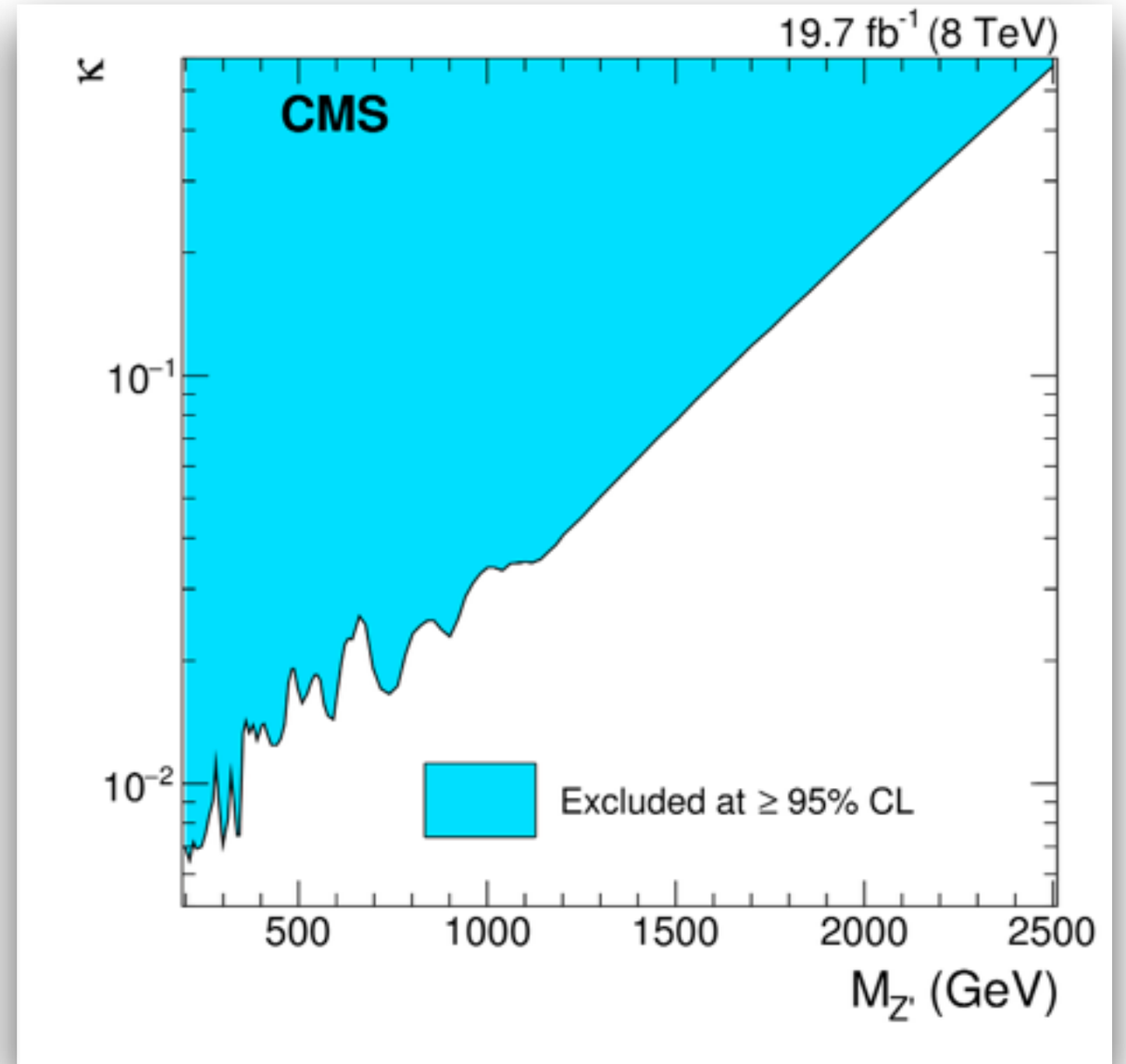


Results

- Results on LFV Z′ search

arXiv:1604.05239

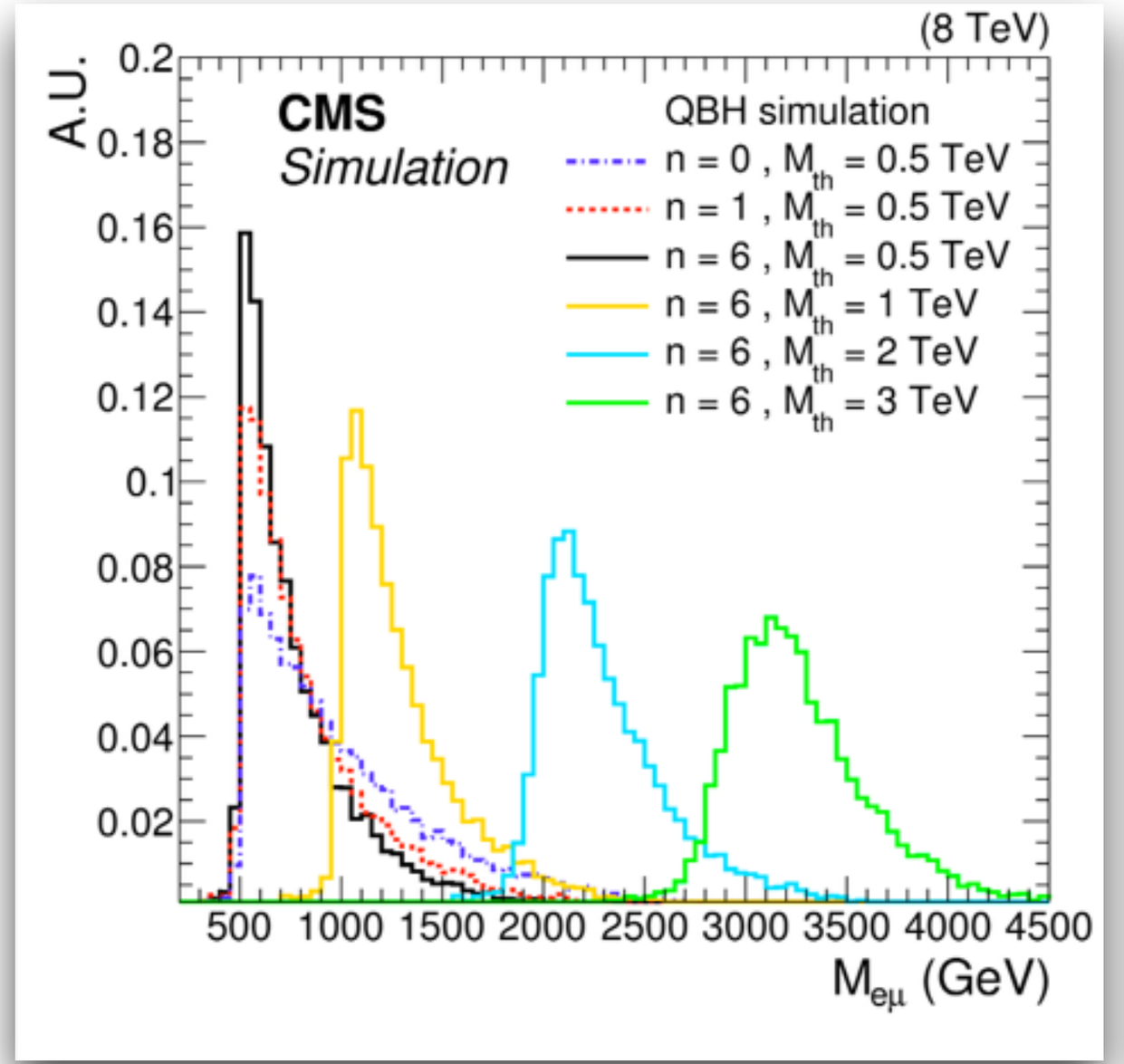


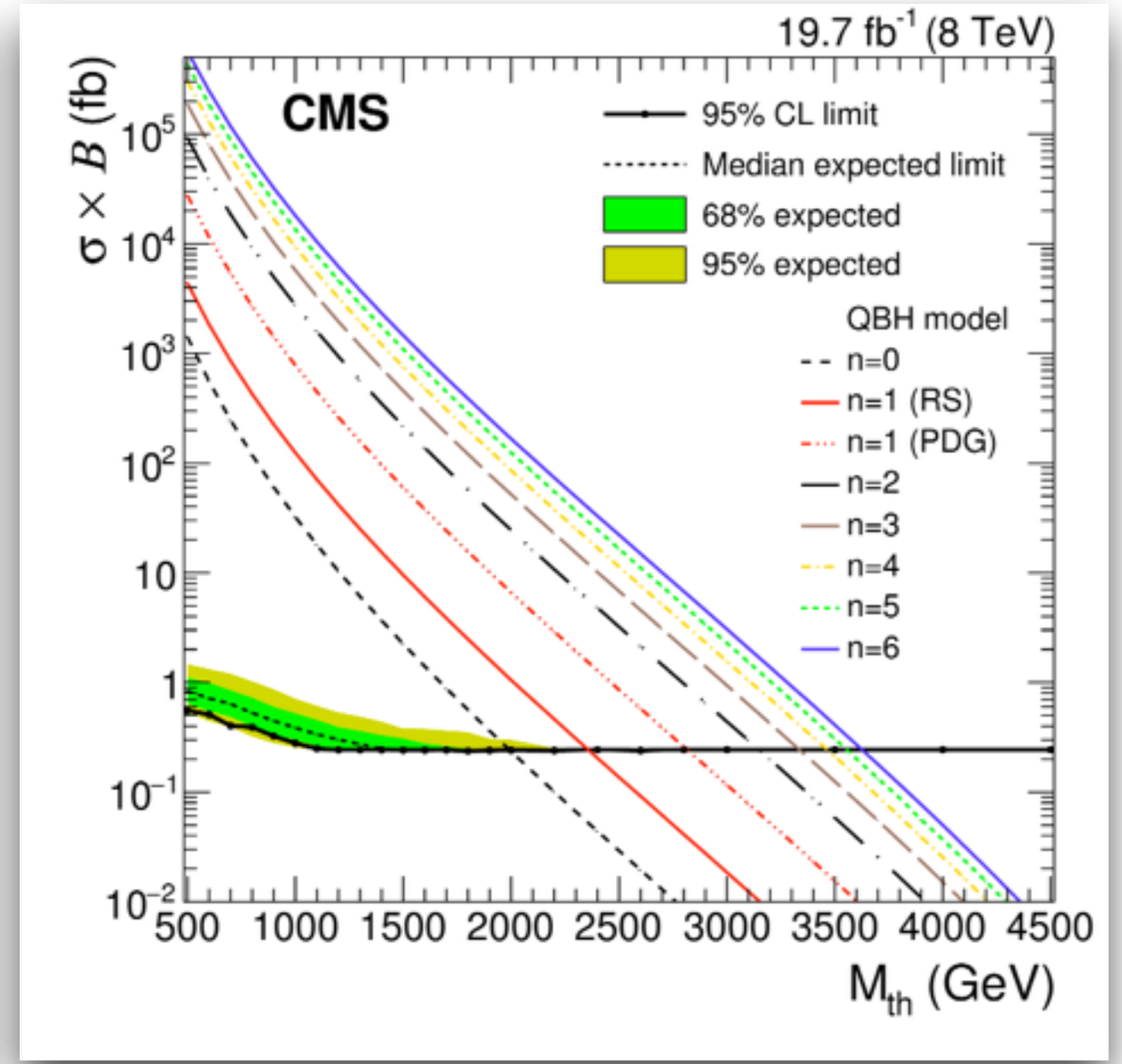


Results

- Results on QBH search

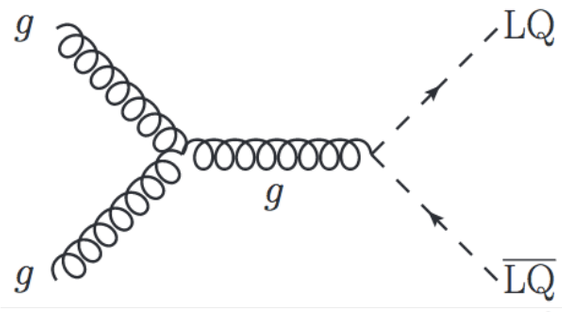
arXiv:1604.05239

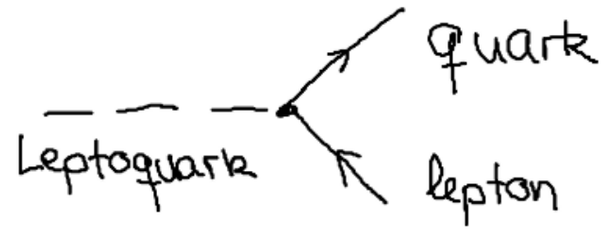




Leptons+Jets Signatures

- Conventional LQ searches
  - For masses ≲1500 GeV pair-production is dominant

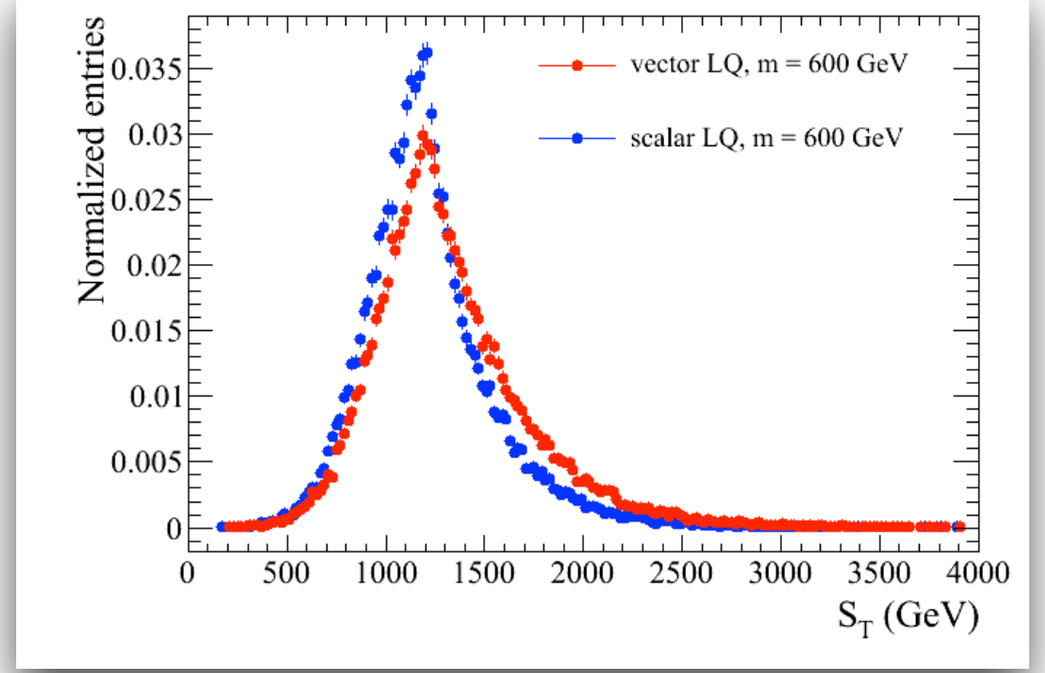


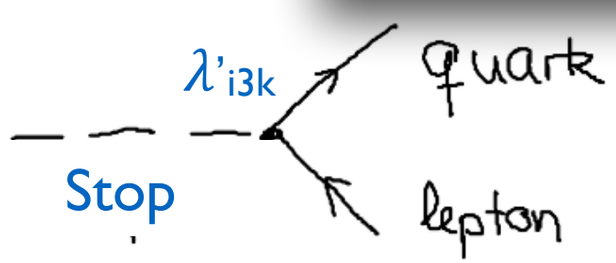


Signatures:

- Two charged leptons & at least two jets
- One charged lepton, at least two jets, & large E_T^{miss}
- Large E_T^{miss} & at least two jets

  - Vector LQ
    - Kinematic difference between vector and scalar LQ is negligible for given selections
  - In decoupling limit, top squarks can be produced with very similar cross sections
    - In R-Parity Violating (RPV) scenario top squark decays the SM particles

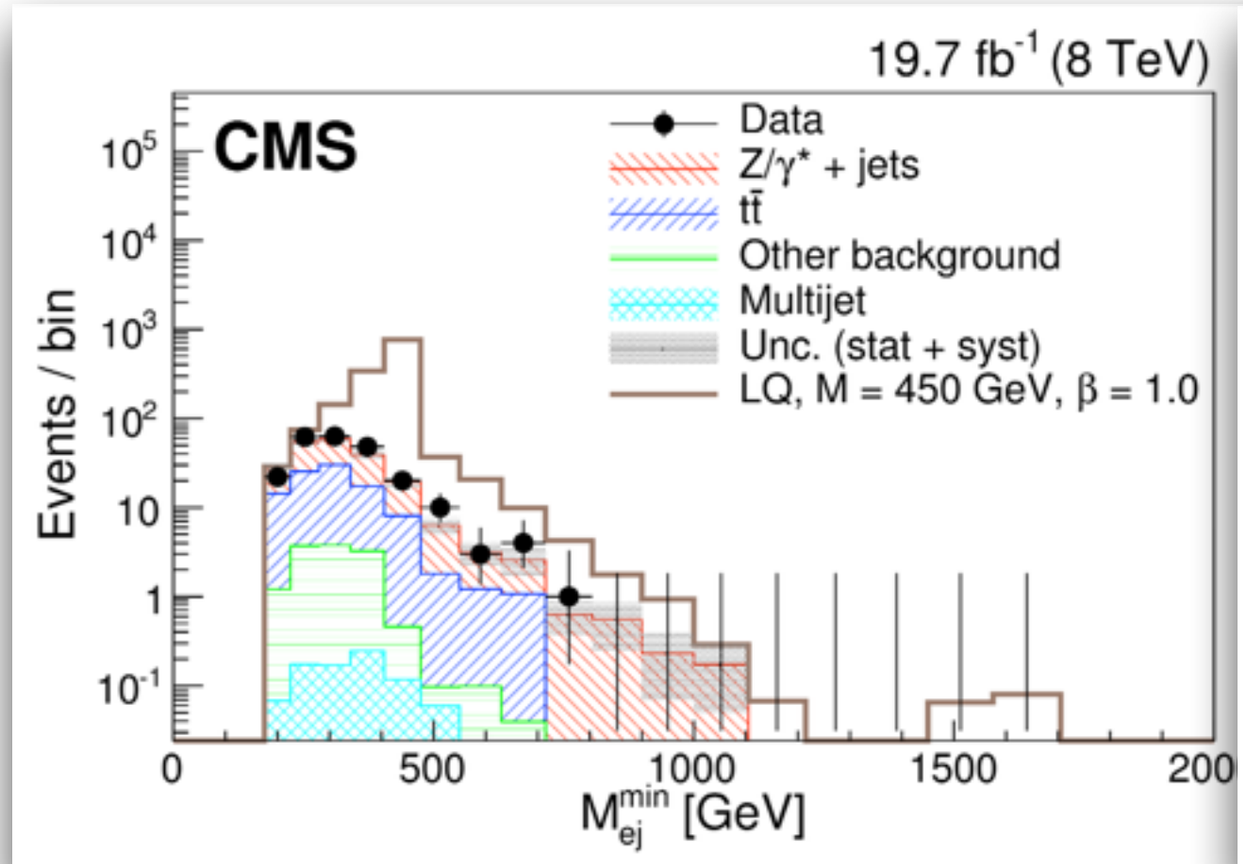


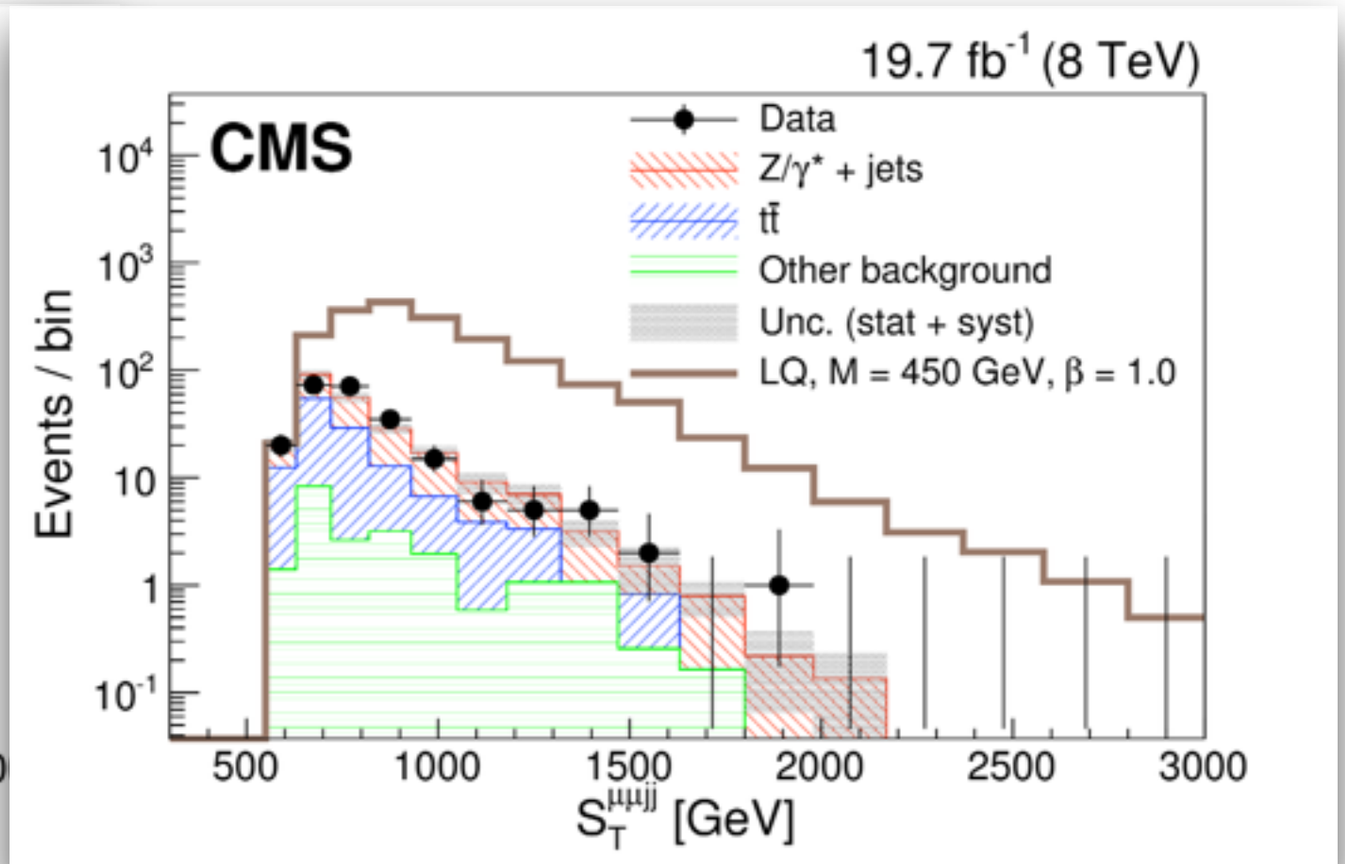


Signature: identical to that from LQ

LQ1/2 Analysis Details

- Searches are performed in $\ell\ell$+jj or $\ell\nu$+jj final states
  - High P_T final state objects are selected
  - Optimized selection criteria on S_T, $M_{\ell j}$, $M_{\ell\ell}$ or S_T, $M_{\ell j}$, M_T, E_T^{miss}

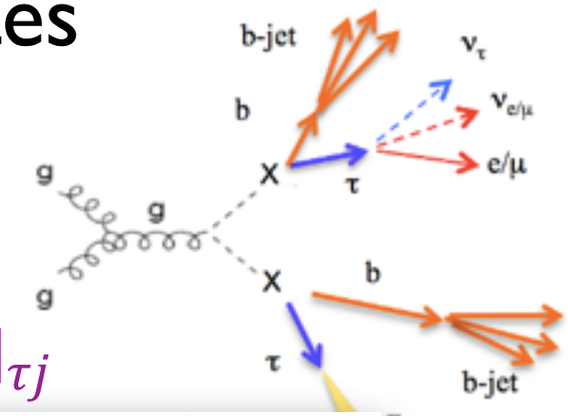


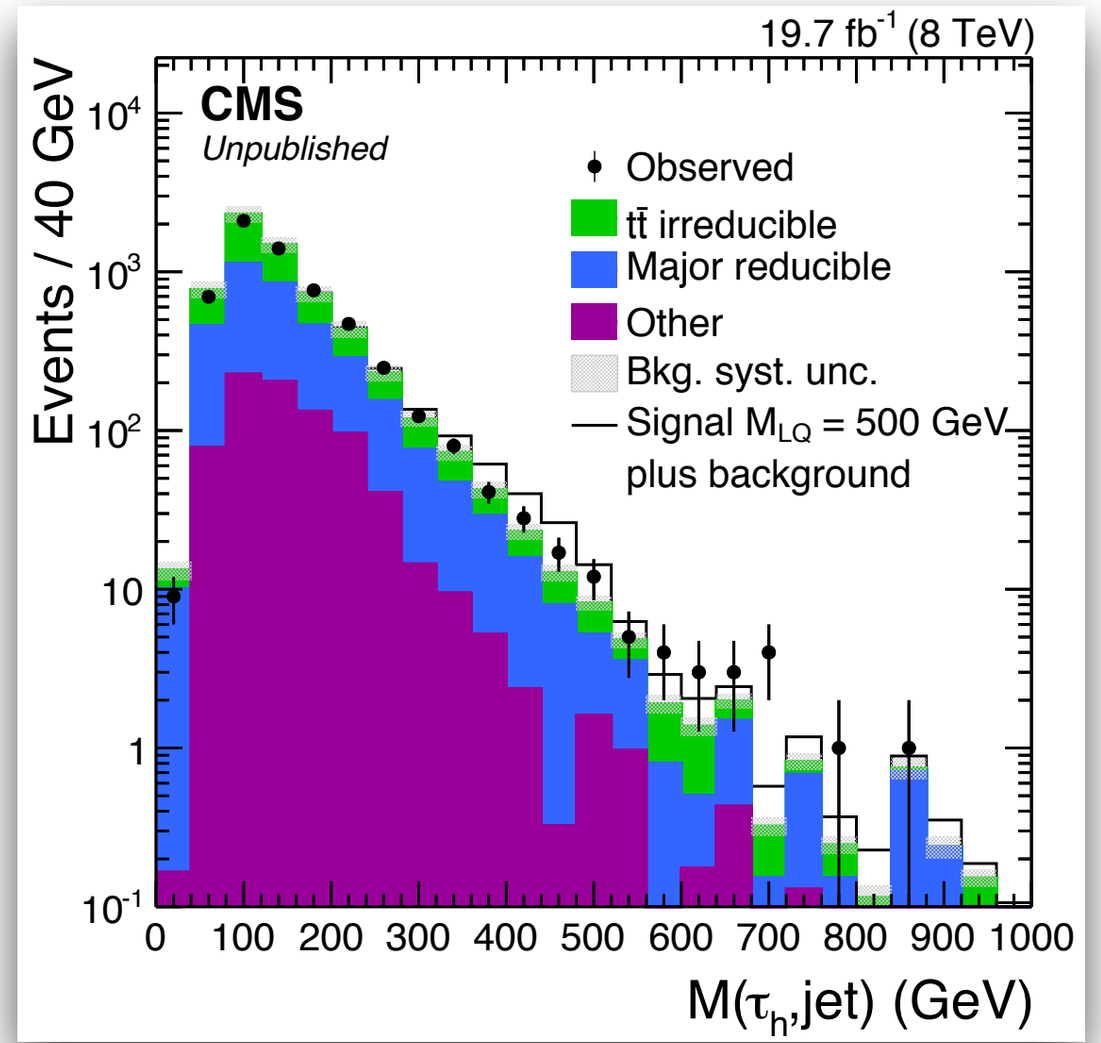


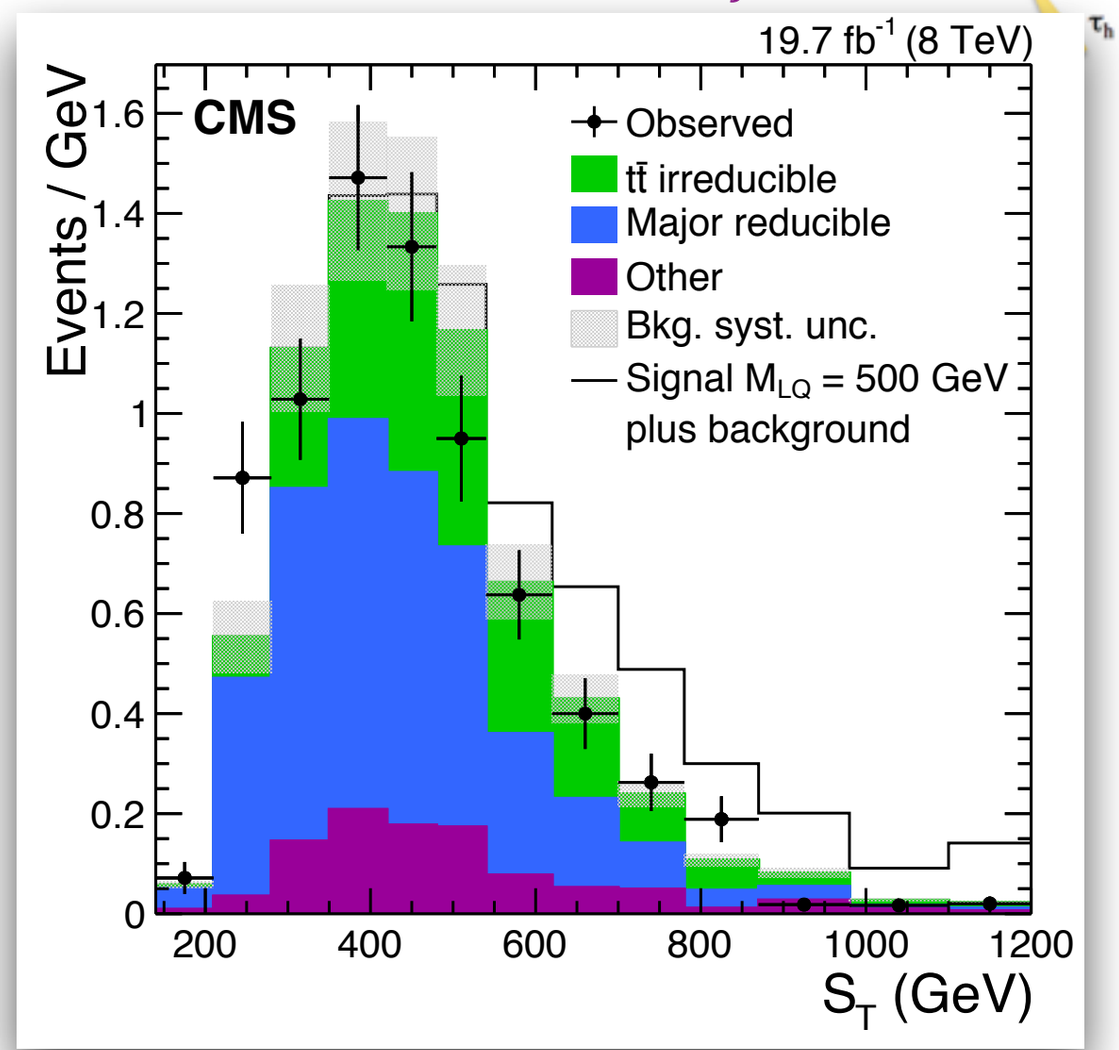
	LQ mass [GeV]														
	300	350	400	450	500	550	600	650	700	750	800	850	900	950	≥ 1000
S_T [GeV]	380	460	540	615	685	755	820	880	935	990	1040	1090	1135	1175	1210
$M_{\mu\mu}$ [GeV]	100	115	125	140	150	165	175	185	195	205	215	220	230	235	245
$M_{\mu j}^{min}$ [GeV]	115	115	120	135	155	180	210	250	295	345	400	465	535	610	690

LQ3 Analysis Details

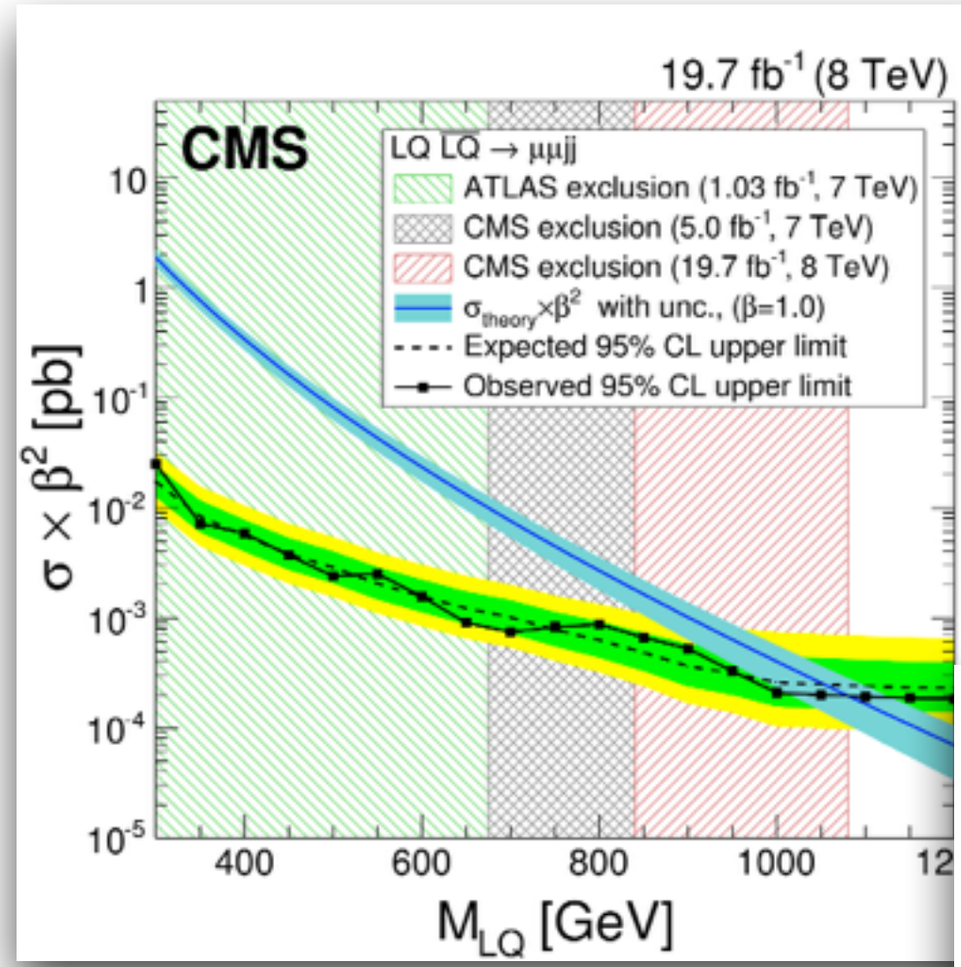
- Search is performed in $e\tau$+jj or $\mu\tau$+jj final states
  - At least one jet is identified as a b-jet
  - High P_T final state objects
  - Background is rejected by minimum threshold on $M_{\tau j}$



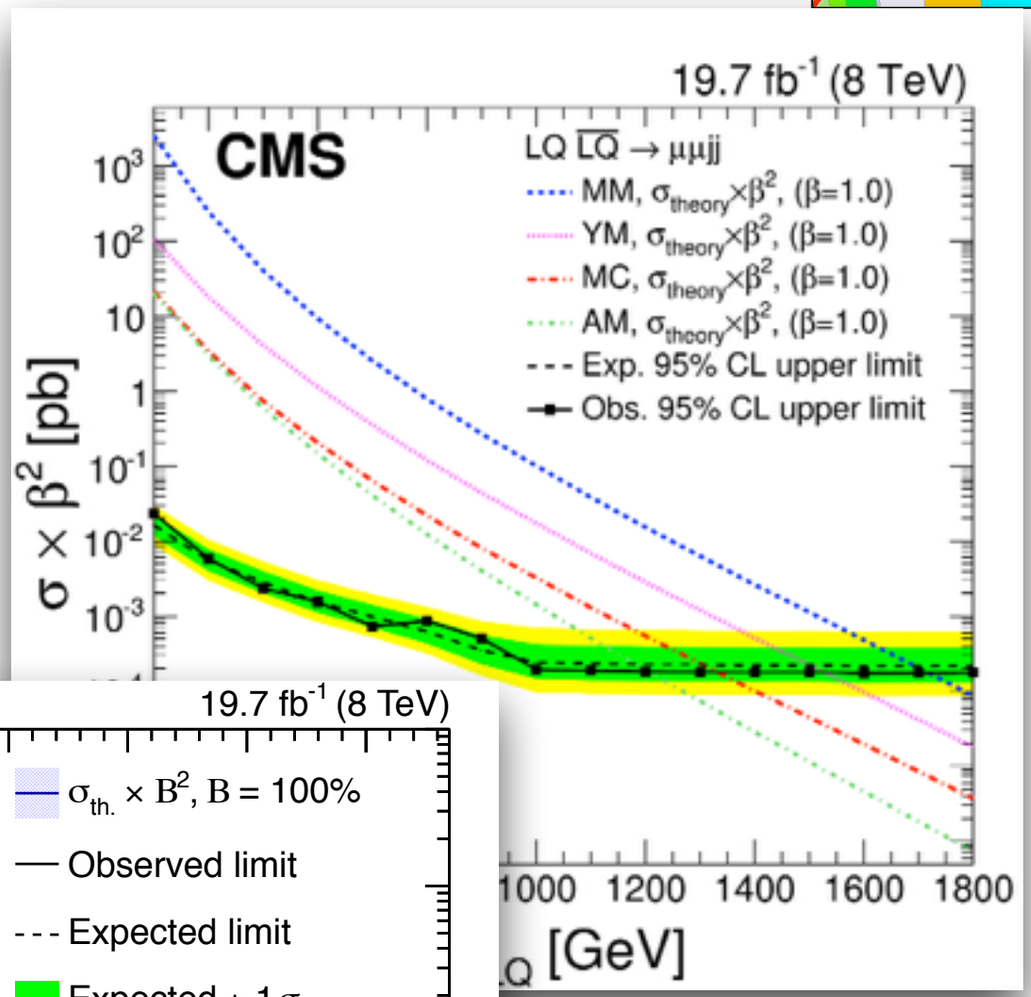


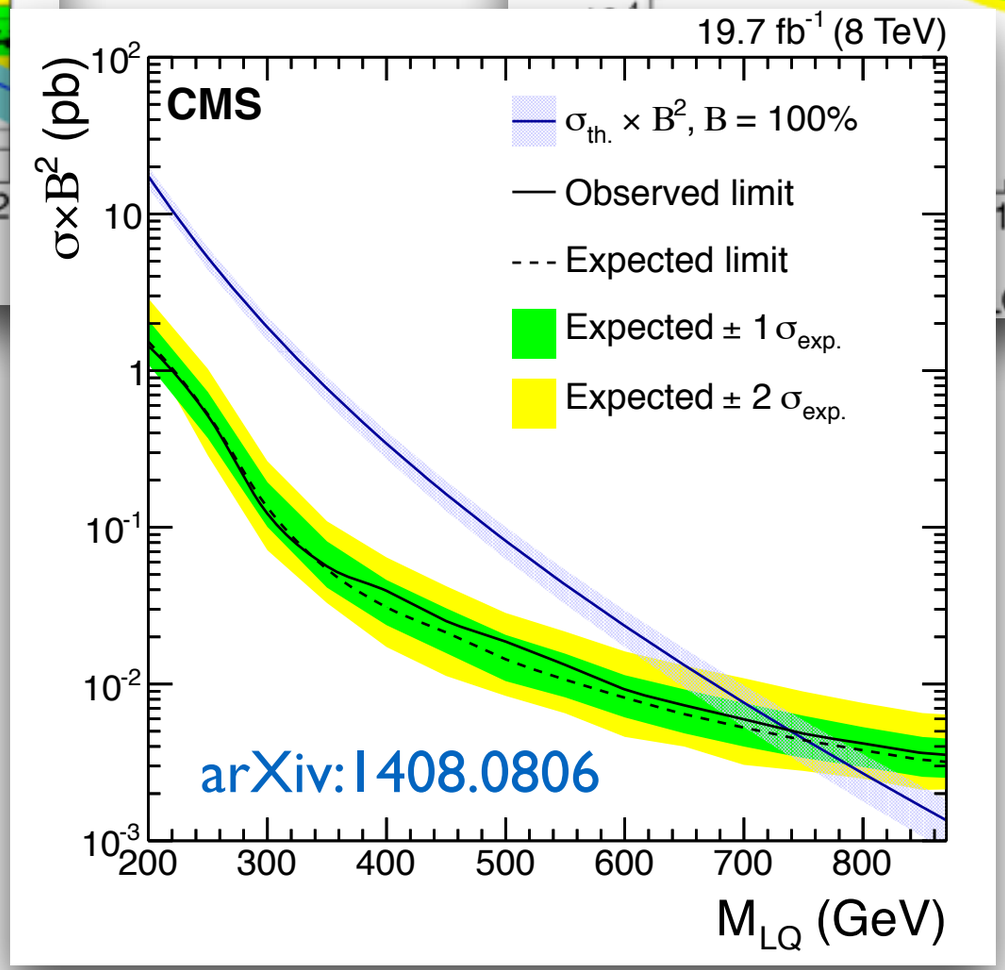


Very Simple Interpretations

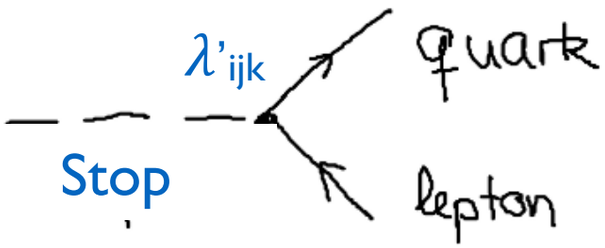


arXiv:1509.03744



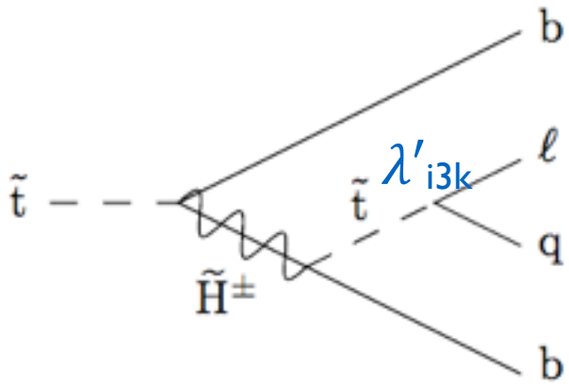


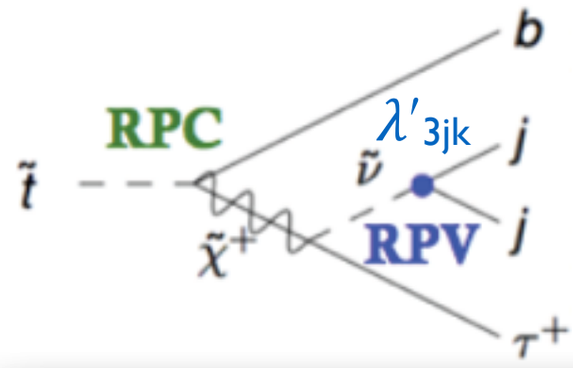
λ'_{132}, λ'_{232}, λ'_{333} are directly constrained



More Interpretations

- Top squark can decay via RPC-RPV interactions
  - Top squark decay is mediated by a Higgsino $M_{\tilde{H}} = M_{\tilde{t}} - 100\ GeV$

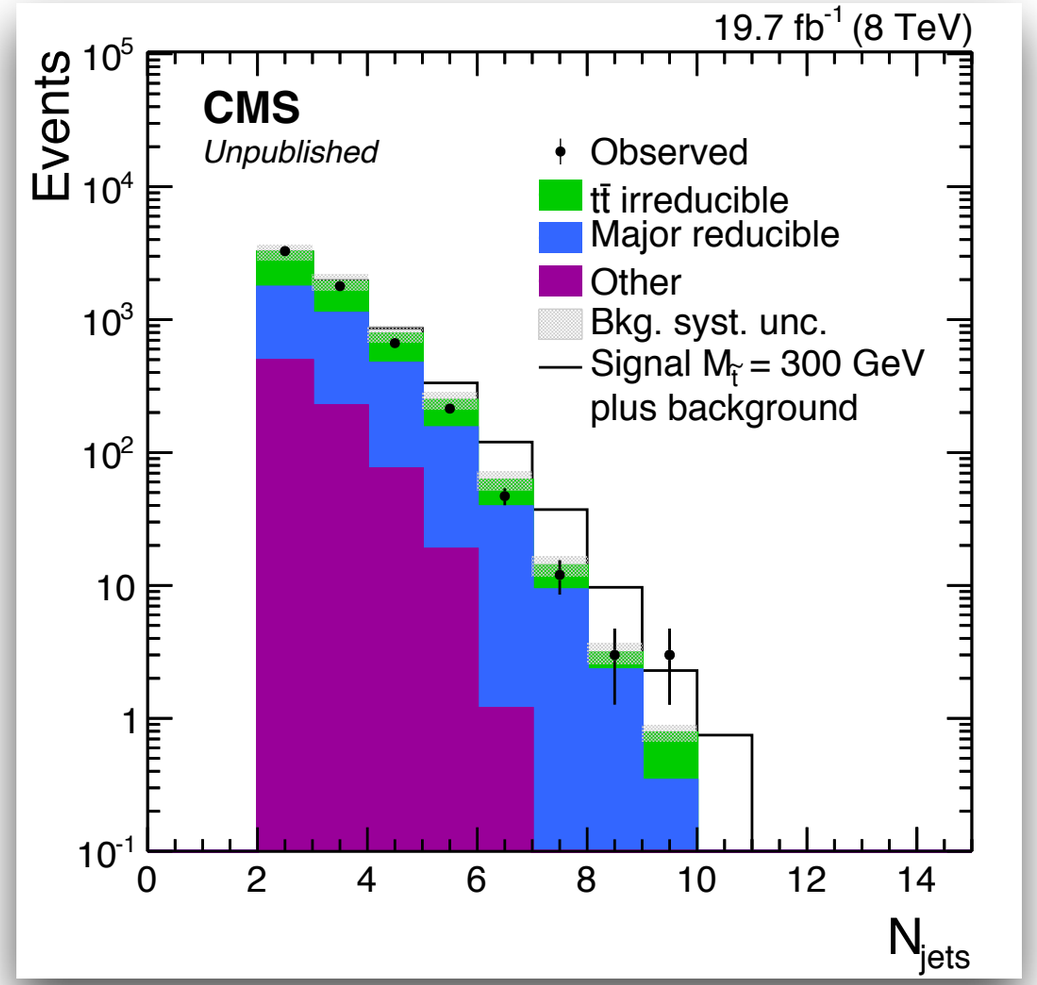




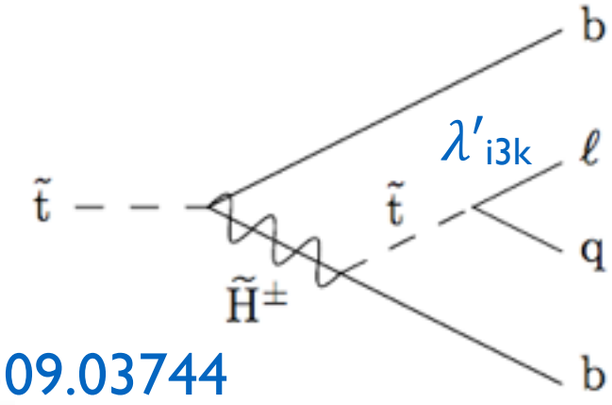
J.A. Evans & Y. Kats
arXiv:1311.0890
arXiv:1209.0764

λ'_{i3k} are probed from ee+jj and $\mu\mu$+jj channels:
For a given top squark mass a selection corresponding to 100 GeV lighter LQ signal is used

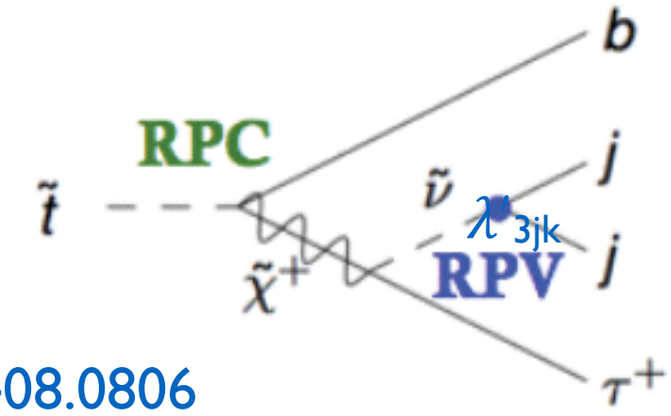
λ'_{3jk} are probed from $e\tau jj$ and $\mu\tau jj$ channels:
Background is rejected by a $N_j \geq 5$ criteria



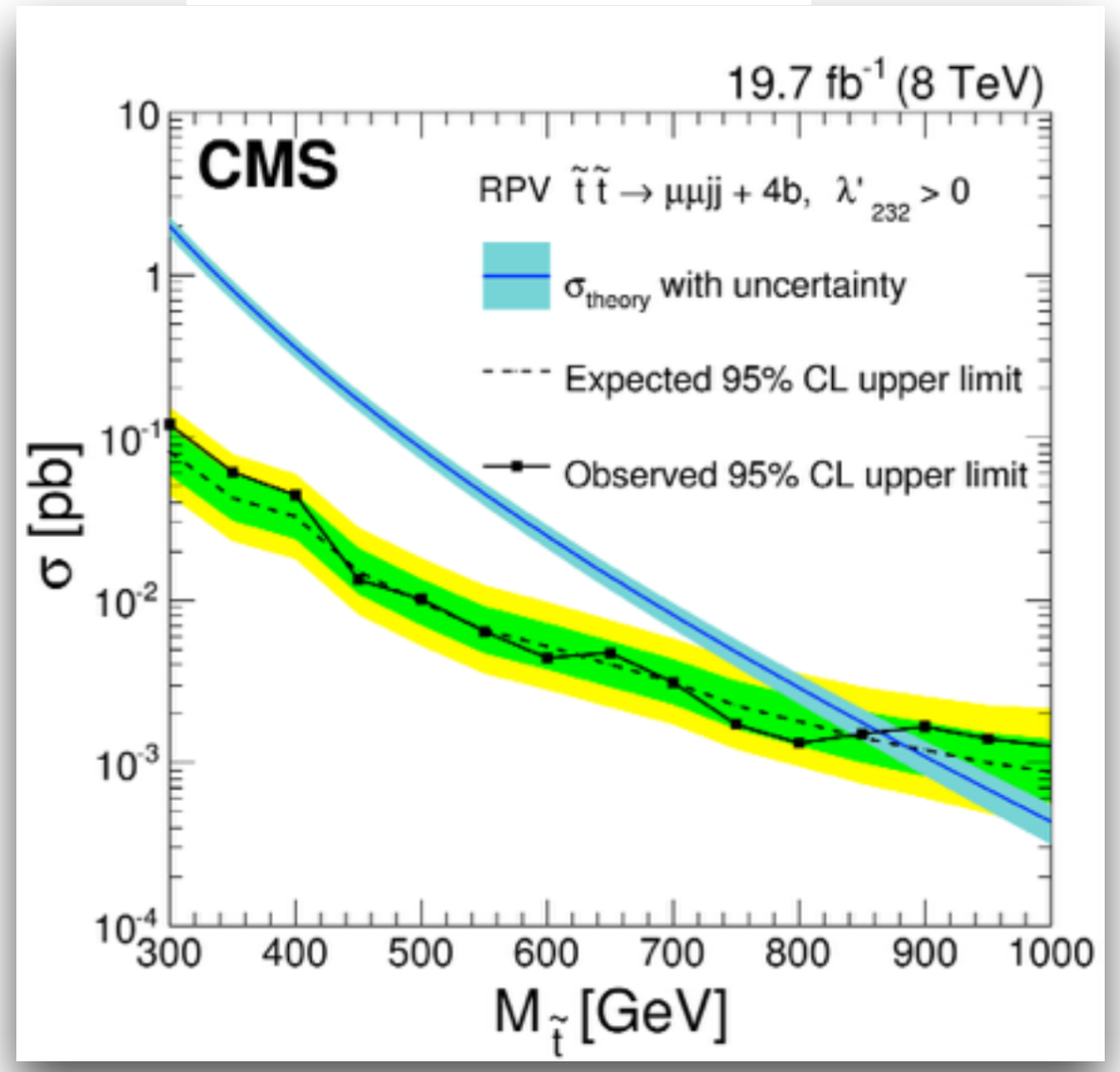
More Interpretation

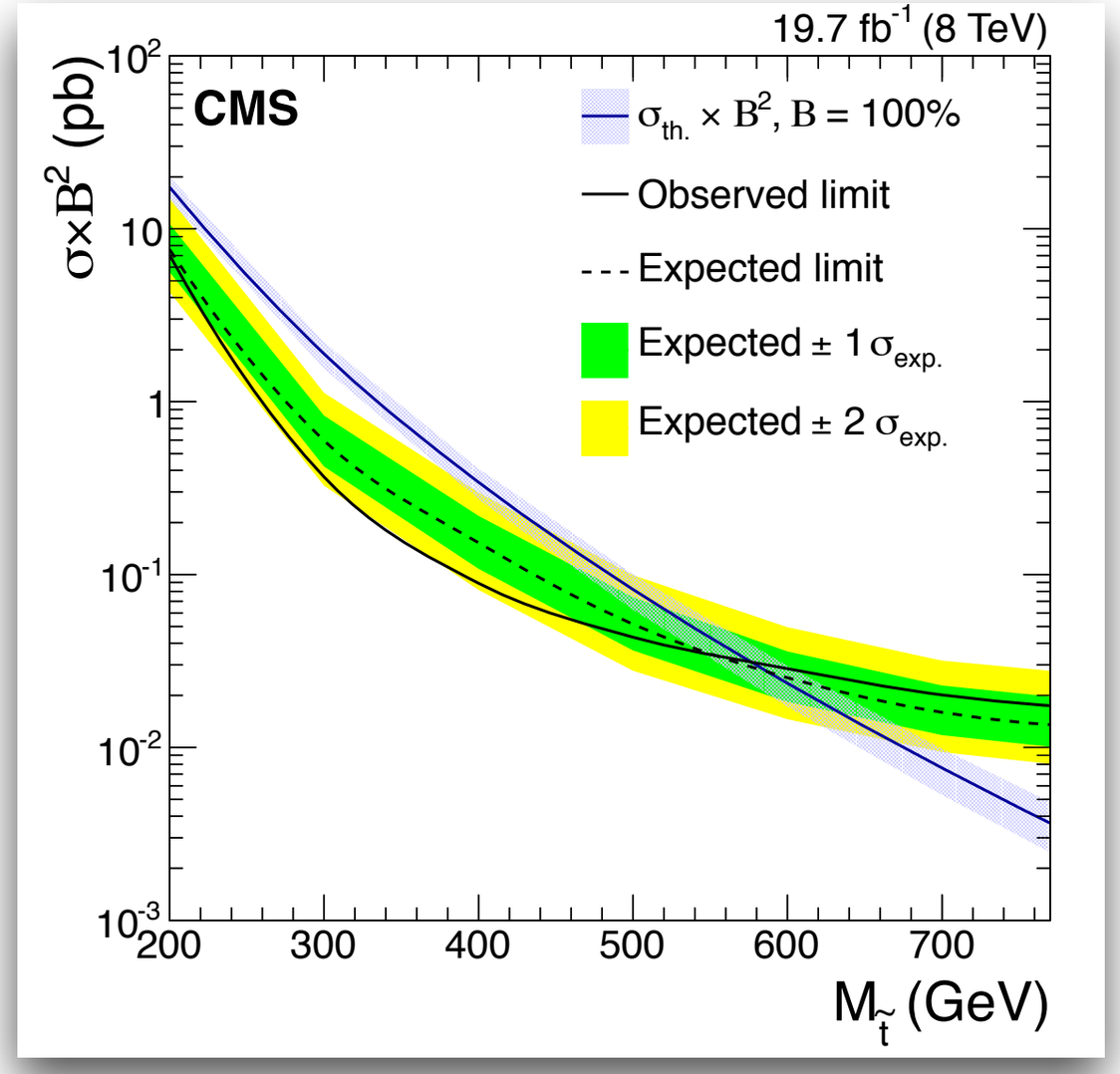


arXiv:1509.03744



arXiv:1408.0806





Conclusion

- Very often a given signature is sensitive to more than one model of new physics
- The search strategy is defined such to be sensitive to different models
  - Core of the analysis stays the same
  - Different BSM models can be probed using various approaches
- Ideas from theorists and phenomenologists are very welcome on
  - What is interesting to probe with a given signature, what are key points of a given BSM model, etc..
  - What is the most interesting form of presentation of a given results, etc..