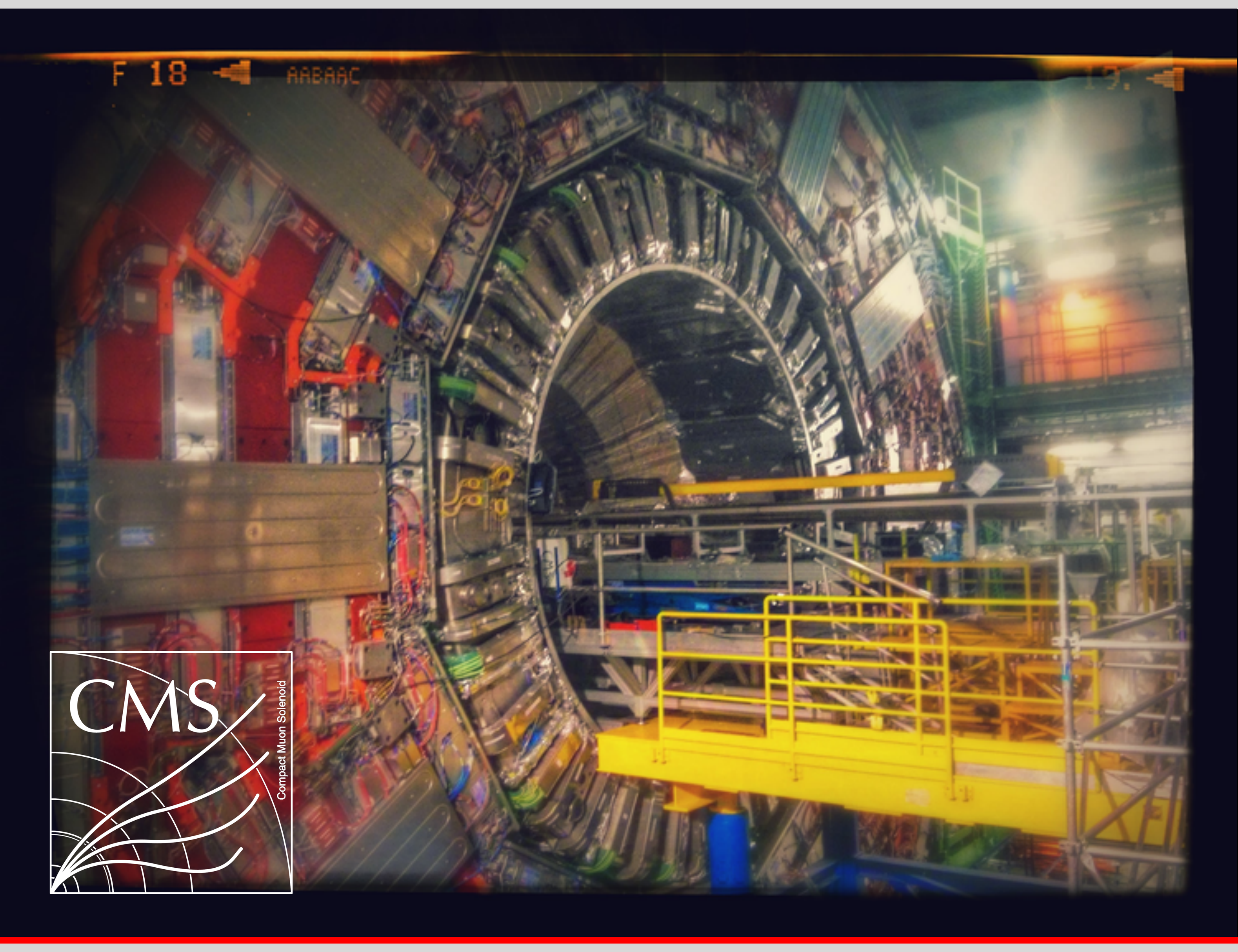


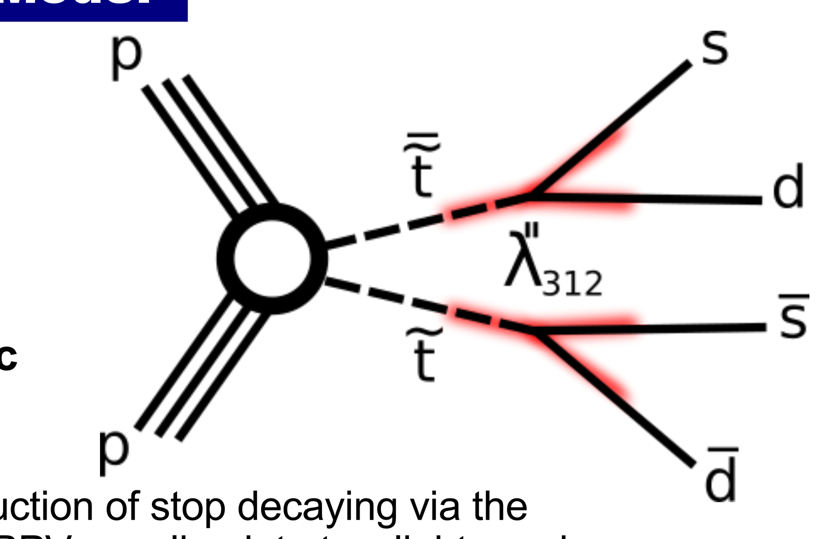
Search for low-mass pair-produced dijet resonances using jet substructure techniques in proton-proton collisions at 13 TeV

CMS-PAS-EXO-16-029

Alejandro Gomez Espinosa (@alefisico)
on behalf of the CMS Collaboration

Rutgers, The State University of New Jersey

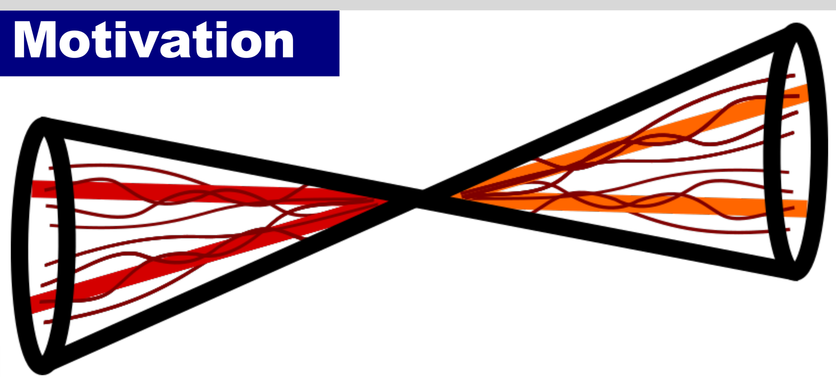
Theory Model



Hadronic RPV SUSY

Pair production of stop decaying via the UDD312 RPV coupling into two light quarks

Physics Motivation



Boosted topologies

Exploit current LHC energy to study this boosted signature and probe lower BSM particle masses.

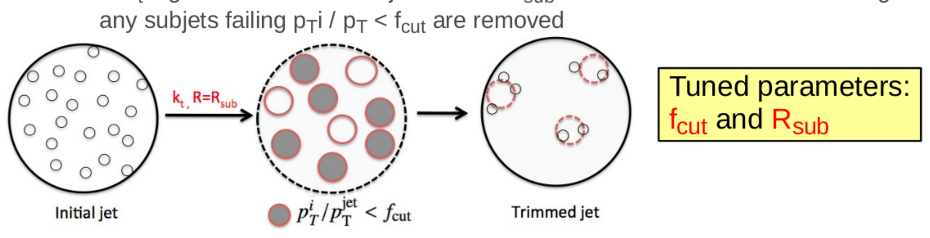
Analysis Strategy

Search for 2 AK8 jets with high pt and substructure

The average jet mass distribution of the two leading jets using anti-kt jets with cone size R=0.8 is investigated for evidence of a signal consistent with localized deviations from the estimated SM backgrounds.

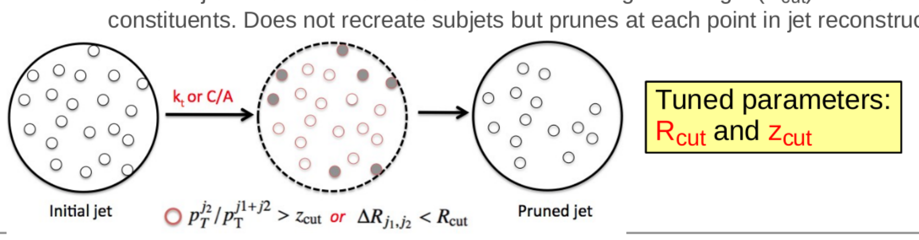
Substructure Techniques

- **"Trimming"** http://arxiv.org/abs/0912.1342 (D. Krohn, J. Thaler, L. Wang)
  - uses k_t algorithm to create subjets of size R_{sub} from the constituents of the large-R jet: any subjets failing $p_{T}i / p_T < f_{cut}$ are removed



Tuned parameters: f_{cut} and R_{sub}

- **"Pruning"** http://arxiv.org/abs/0912.0033 (S. Ellis, C. Vermilion, J. Walsh)
  - Recombine jet constituents with C/A or kt while vetoing wide angle (R_{cut}) and softer (z_{cut}) constituents. Does not recreate subjets but prunes at each point in jet reconstruction



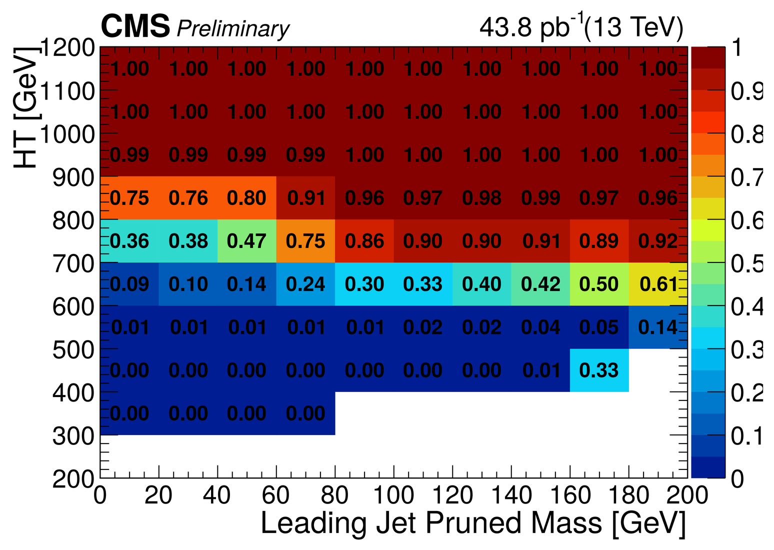
Tuned parameters: R_{cut} and z_{cut}

"N-subjetiness" http://arxiv.org/abs/1108.2701 (J. Thaler, K. Van Tilburg)

Creates N subjet axes within a jet and sums angular distances of jet consituents to their nearest subjet axis. This variable is a jet shape designed to identify boosted hadronic objects.

High Level Trigger (HLT)

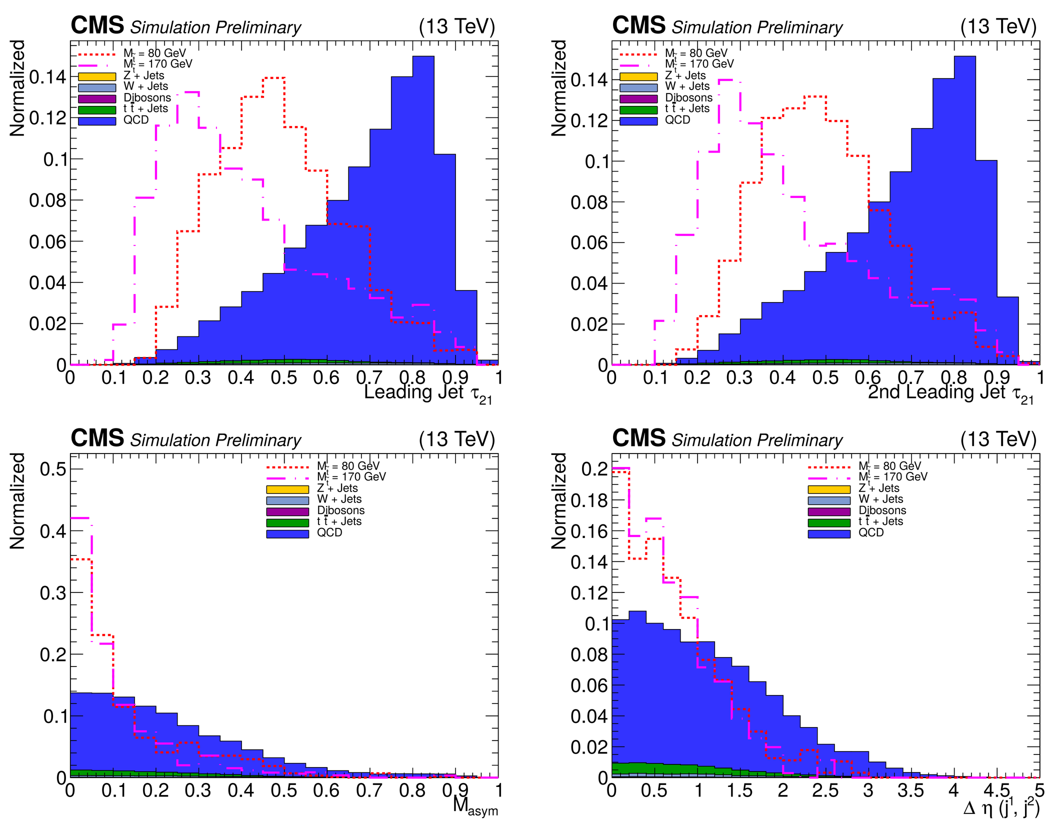
We developed an HLT trigger for this search using the p_T sum of AK8 jets (HT) and grooming techniques.



Here we show the trigger efficiency in HT vs Leading Jet pruned mass for a logical OR between that trigger and the nominal HT hadronic trigger.

Event Selection

Variable	Selection
NumberofAK8jets	2leading p_T jets
jet p_T	> 150GeV
jet $\|\eta\|$	< 2.5
H_T	> 900GeV
M_{asym}	< 0.1
$\|\eta_{j1} - \eta_{j2}\|$	< 1.5
1stand2ndjet τ_{21}	< 0.45



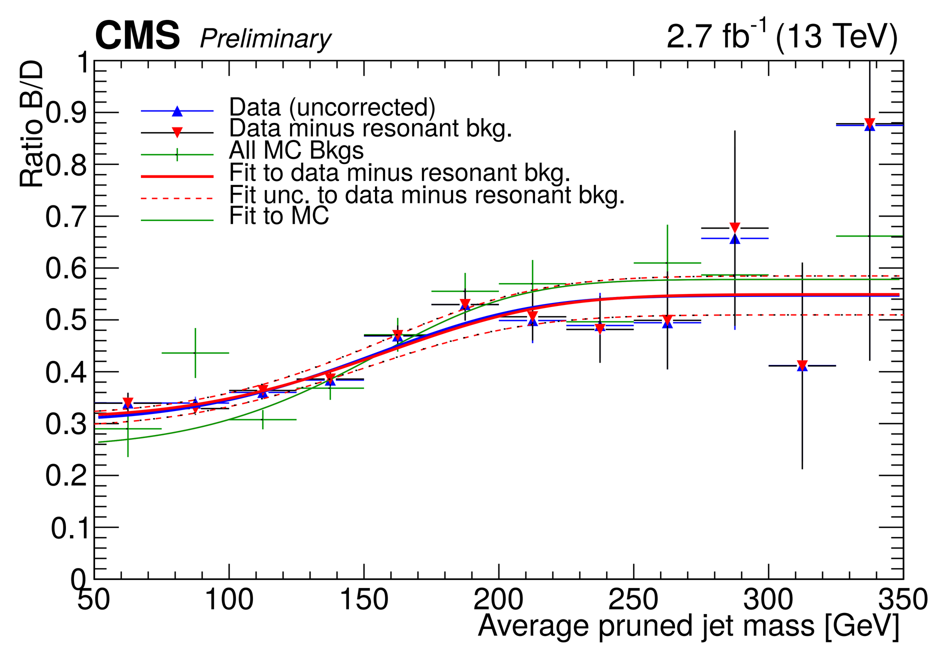
Each variable is plotted with all selection criteria apart from that on the variable being shown.
The distributions are normalized to unit area.

Background Estimation

Non-resonant backgrounds (QCD):

ABCD method: use background enriched sidebands to estimate the background in the signal region.

	$M_{asym} < 0.1$	$M_{asym} > 0.1$
$\|\eta_{j1} - \eta_{j2}\| > 1.5$	RegionB	RegionD
$\|\eta_{j1} - \eta_{j2}\| < 1.5$	RegionA	RegionC

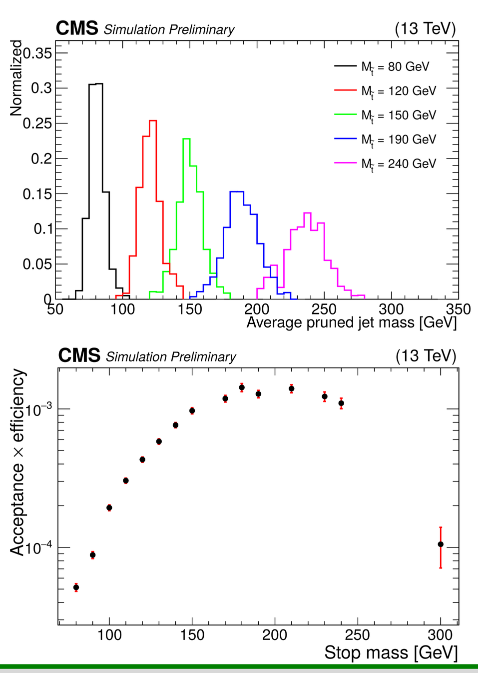


Resonant backgrounds:

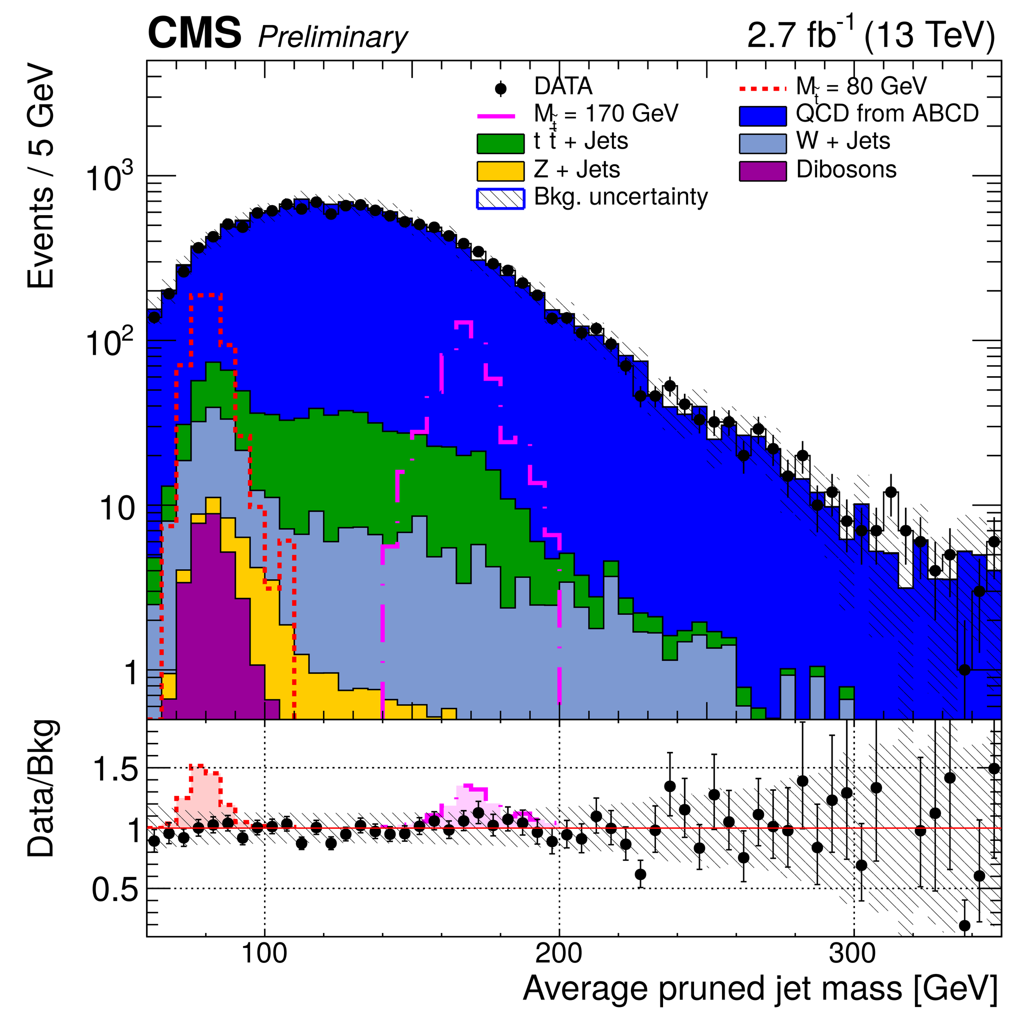
5% of total background: ttbar, Wjets, Zjets, dibosons.
Use MC samples, properly validated.

Signal MC Simulations

Signal samples were simulated in Madgraph5+Pythia8.
On the right, signal shapes are shown after final selection is applied.
We show the acceptance x efficiency vs. stop mass from the signal MC simulation.



Results



Systematic Uncertainties

Signal:

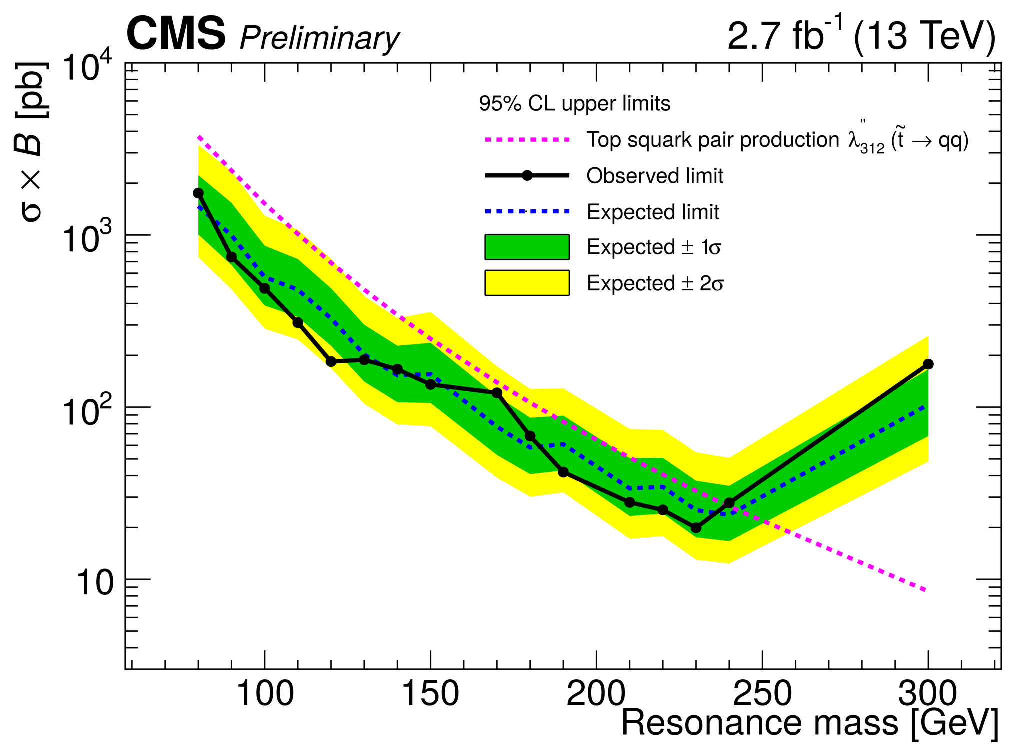
SourceofSystematic	Effect	Value
Luminosity	Yield	2.7%
Trigger	Yield	2%
Pileup	Yield	1.5%
PDF	Yield	12%
Two-prongTaggerScaleFactor	Yield	17%
JetEnergyScale	Yield	0.8%-5%
JetEnergyResolution	Yield	0.6%-3%
MCStatistics	-	bin-by-bin
JetMassScale	ResonanceShape	2%
JetMassResolution	ResonanceShape	11%

Backgrounds:

Background	SourceofSystematic	Effect	Value
QCDABCDmethod:	Closure	Yield	10%
	TransferFactorFitUncertainty	Shape	0.8%-8%
	StatisticsinSidebandRegion(C)	Shape	bin-by-bin
Resonantbackgrounds:	SystematicinMCBackgrounds	Yield	50%
	MCStatistics	Shape	bin-by-bin

Exclusion Limits

Since no excess is observed in data, we set limits on the production cross section (σ) x branching ratio (B) of stops with the RPV coupling UDD312.
We assume 100% B of stops to light quarks.



We exclude masses below 240 GeV.