



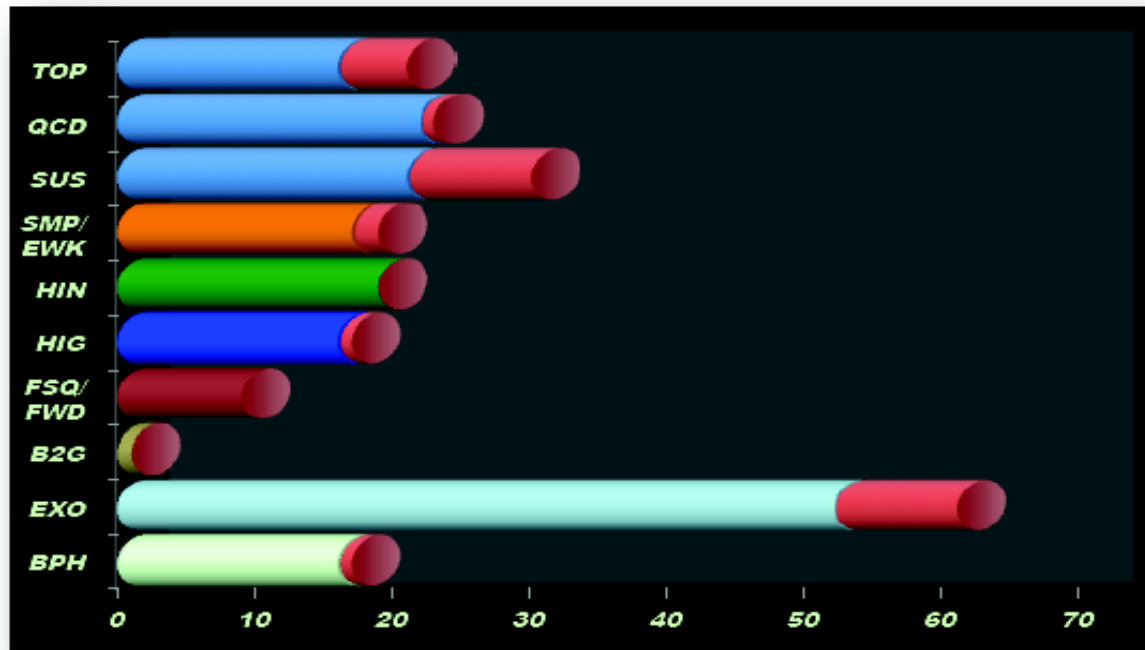
CMS results on searches for physics beyond the standard model

Wolfgang Waltenberger (HEPHY Vienna) on
behalf of the CMS collaboration



CMS publications on LHC data

219 Published + submitted + submitting (30)



**Remaining (planned)
pubs with 2011 data**

Pub Plan	Planned
B2G	10
BPH	18
SMP	22
EXO	1
FWD/FSQ	15
HIG	5
HIN	2
SUS	0
TOP	7
	70

+ 6 detector performance papers
+19 CRAFT papers

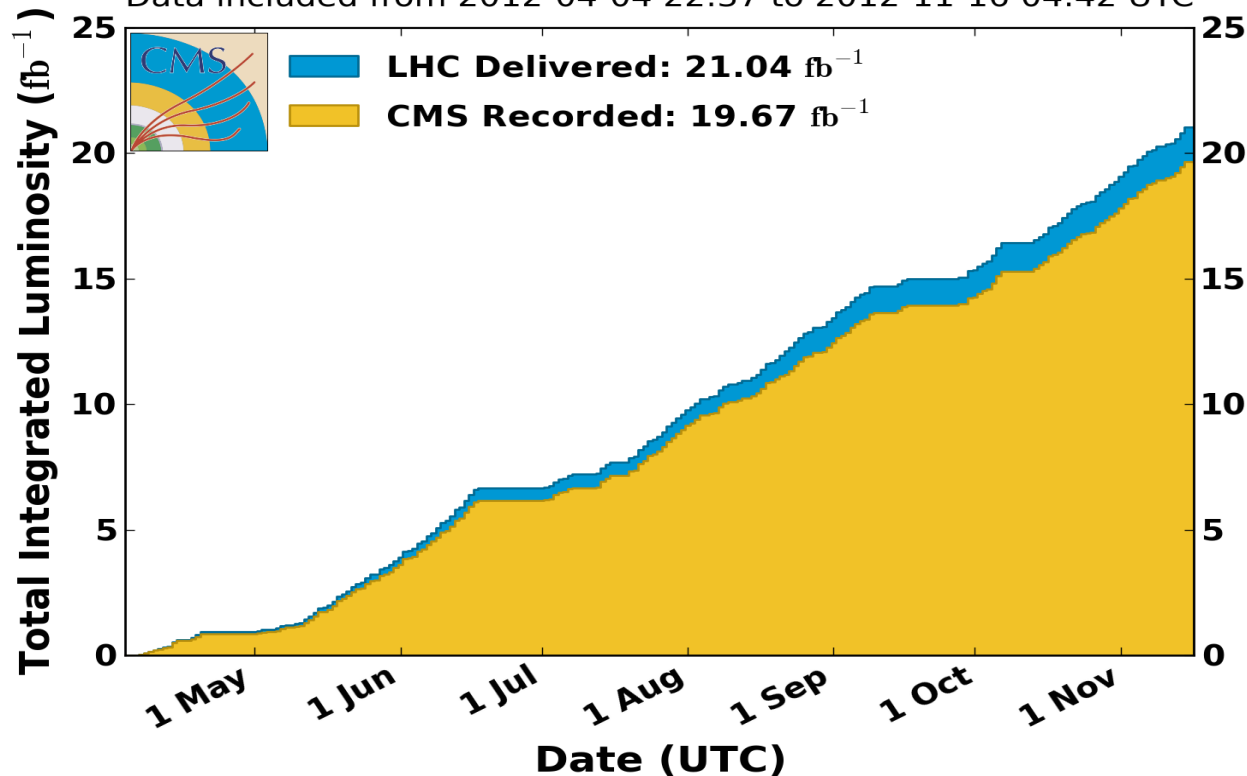
Plan for 2012 data:
~25 mid-year



Status of CMS

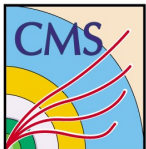
CMS Integrated Luminosity, pp, 2012, $\sqrt{s} = 8$ TeV

Data included from 2012-04-04 22:37 to 2012-11-16 04:42 UTC

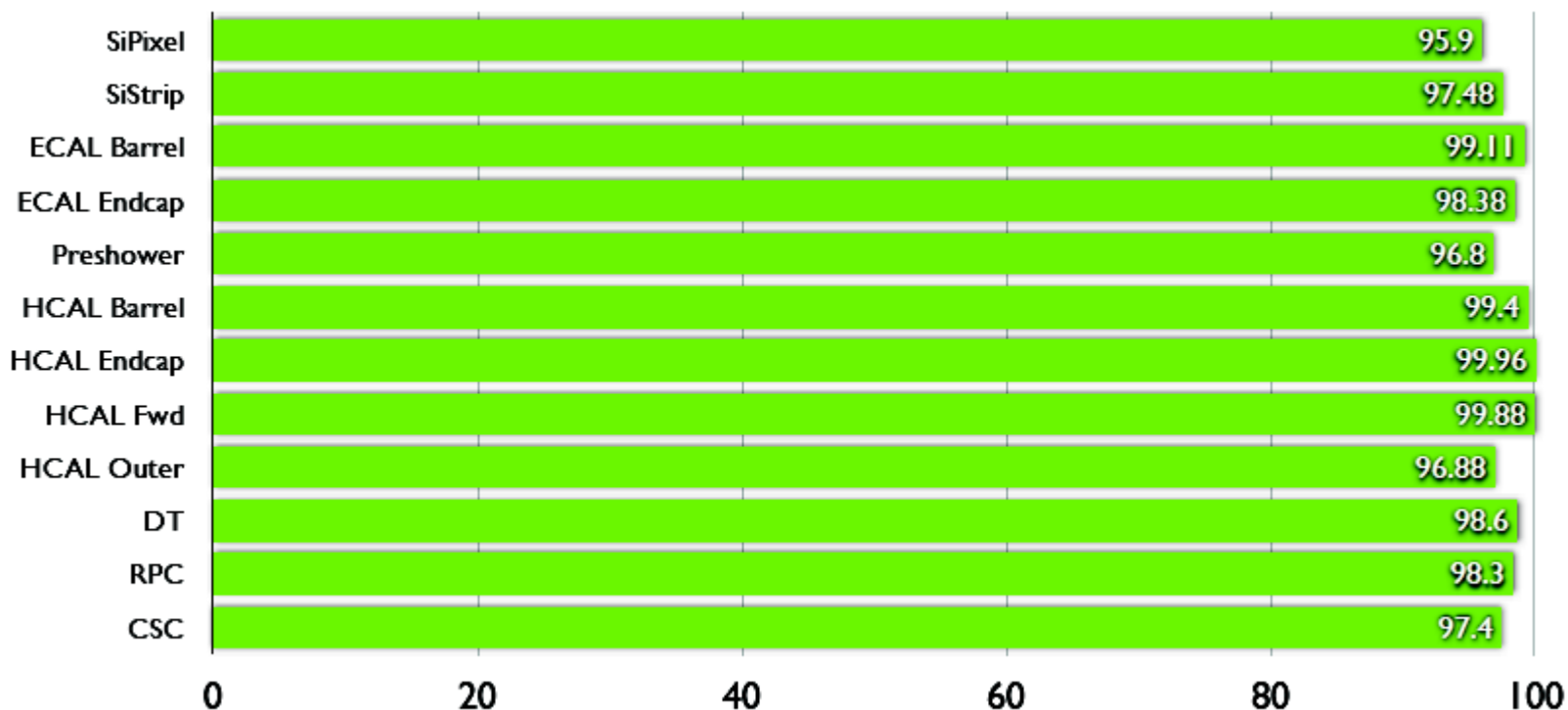
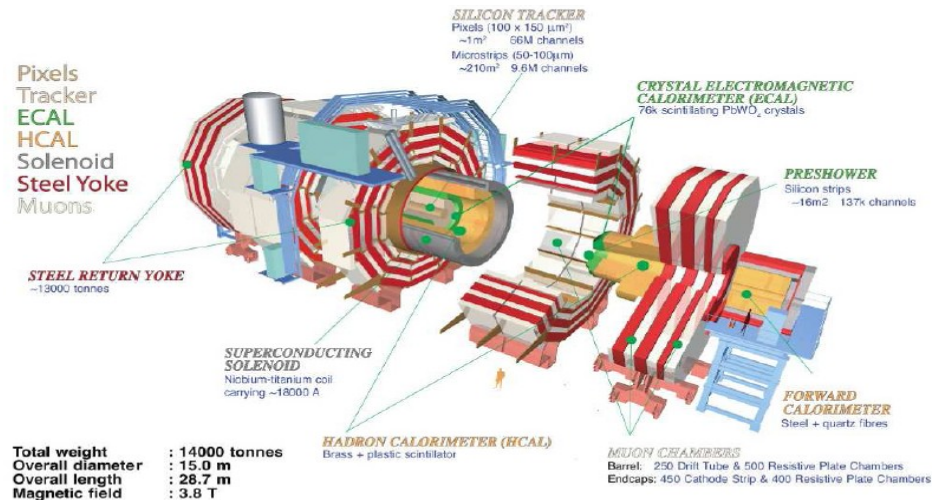


About 20 fb^{-1} of data

For the shutdown 2013 we have “parked data” selected with low- p_T lepton and jet thresholds to be analyzed next year.



We are enjoying stable data-taking conditions



(taken from Luigi's talk on tuesday)



Searches for supersymmetry



8 new SUSY search results made public recently

- Search for SUSY with **taus** using **Razor** with **7 TeV** data: SUS-11-029
- Search for **direct stop** production in the **all hadronic** channel with **7 TeV** data: SUS-11-030
- Search for EWK production of **charginos, neutralinos and sleptons** with **8 TeV** data: SUS-12-022
- Search for **direct stop** production in the **single lepton** channel with **8 TeV** data: SUS-12-023
- Search for SUSY in inclusive **multilepton** signatures with **8 TeV** data: SUS-12-026
- Search for **RPV SUSY** with 3 or more leptons and b-tags with **8 TeV** data: SUS-12-027
- Search for SUSY in events with MET and 0, 1, 2, 3 and ≥ 4 or more b-jets using **alphaT** with **8 TeV** data: SUS-12-028
- Search for SUSY in **same sign dilepton** events and b-tags with **8 TeV** data: SUS-12-029



natural SUSY

- In 2012 natural (= not fine-tuned) SUSY has moved into our focus

– searches for **scalar top and sbottom** quarks $< 400 - 1000$ GeV

– **gluinos** below $1300 - \dots$ GeV (approximately)

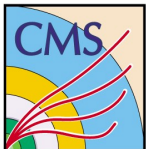
Cumulative Natural SUSY

1300 \downarrow \tilde{g}

400 \downarrow $\tilde{t}_{L,R}, \tilde{b}_L$

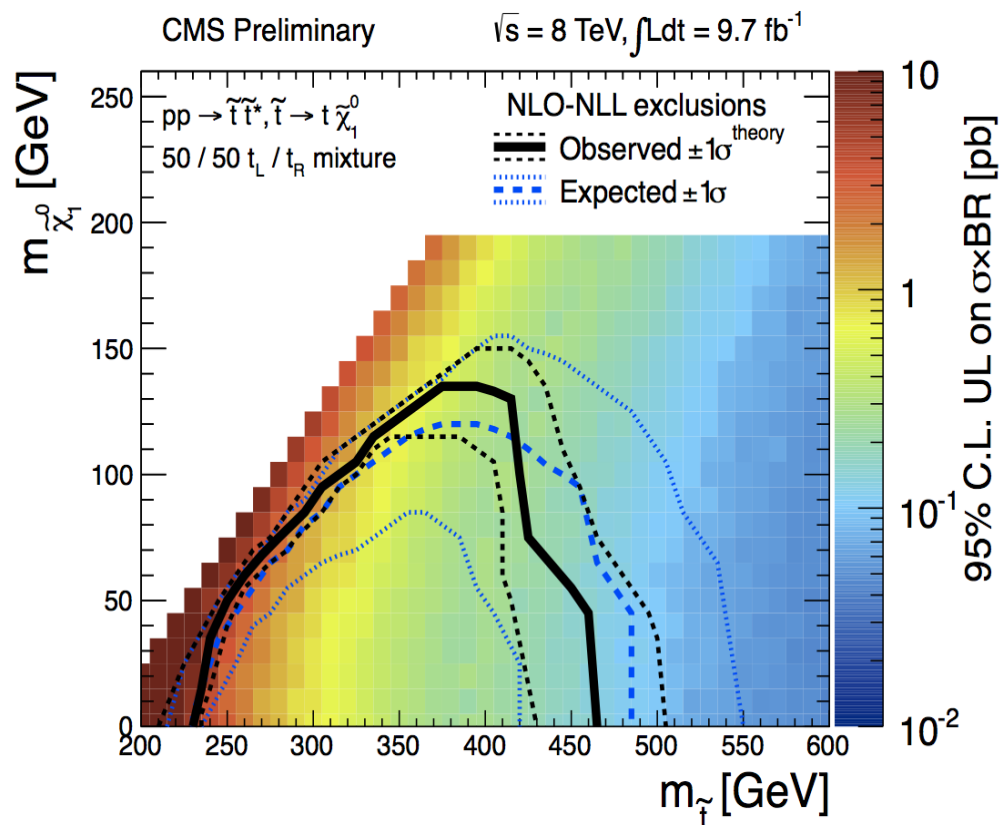
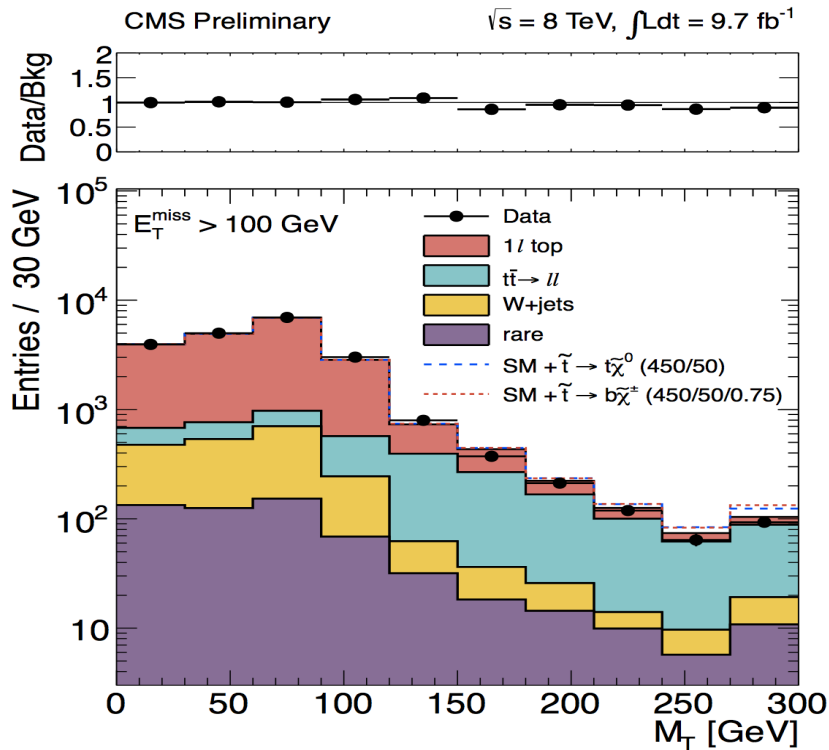
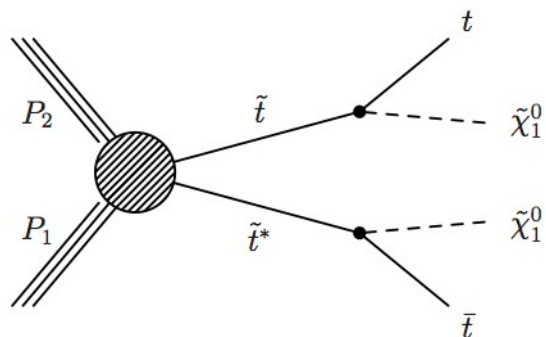
120 \downarrow h

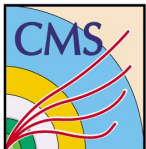
Unavoidable tunings: $\left(\frac{400}{m_{\tilde{t}}}\right)^2, \left(\frac{4m_{\tilde{t}}}{M_{\tilde{g}}}\right)^2$



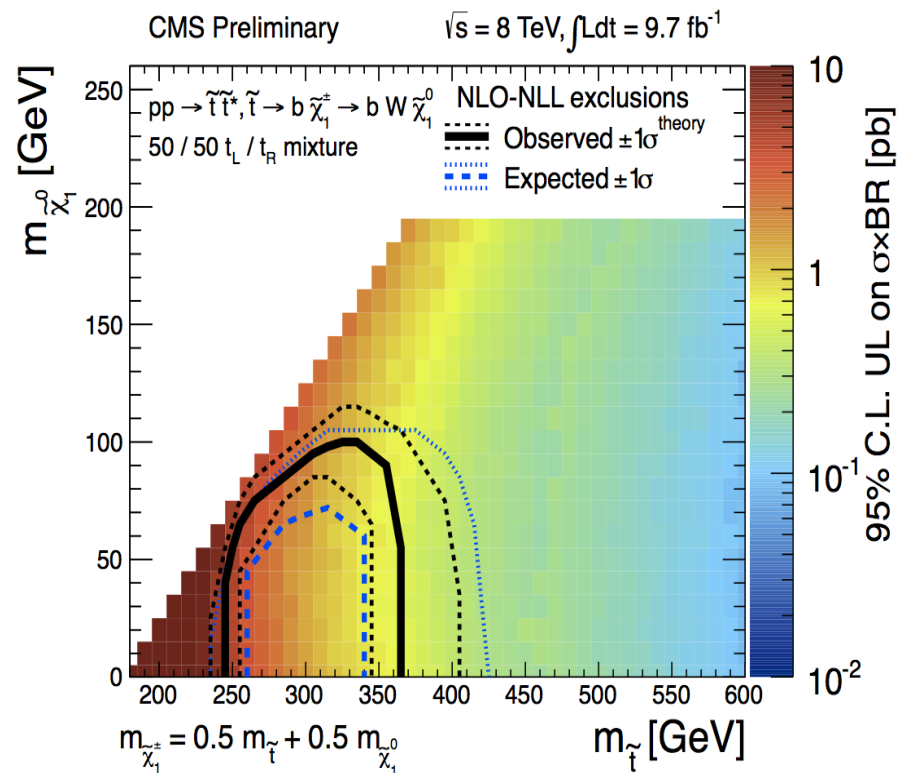
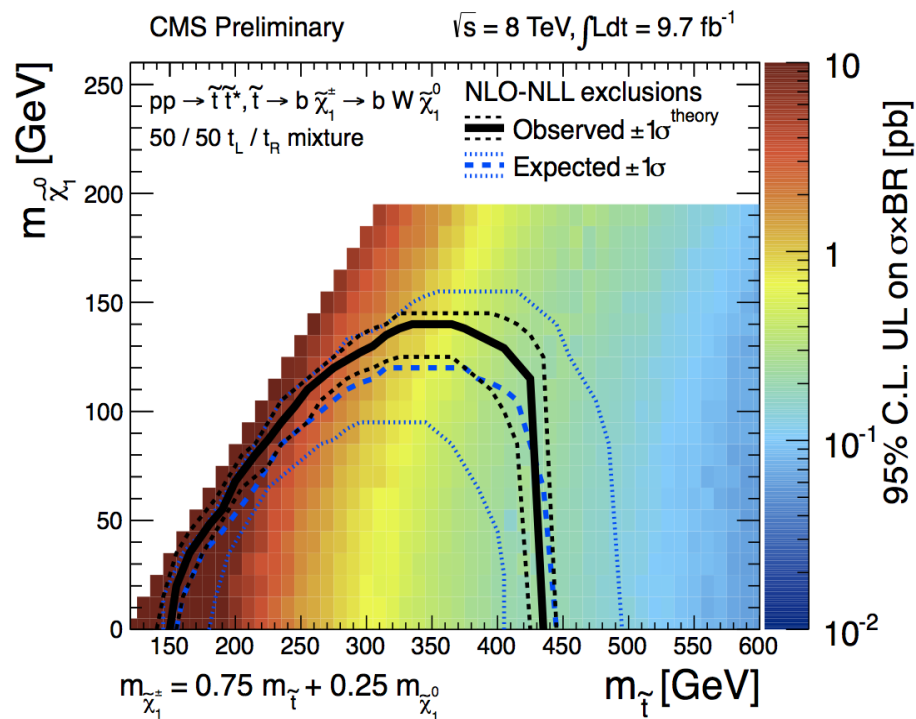
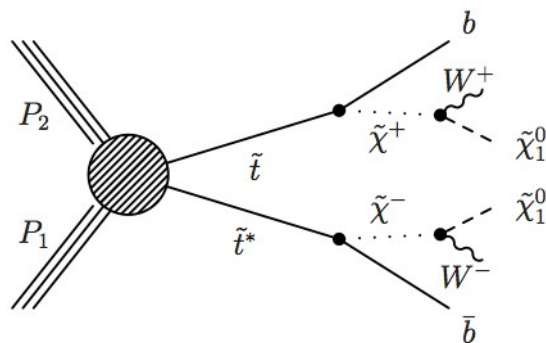
Example: single-lepton search for stop (SUS-12-023)

require b-tag, cut on **transverse mass** and **missing energy**

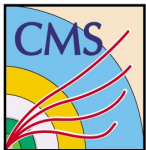




SUS-12-023

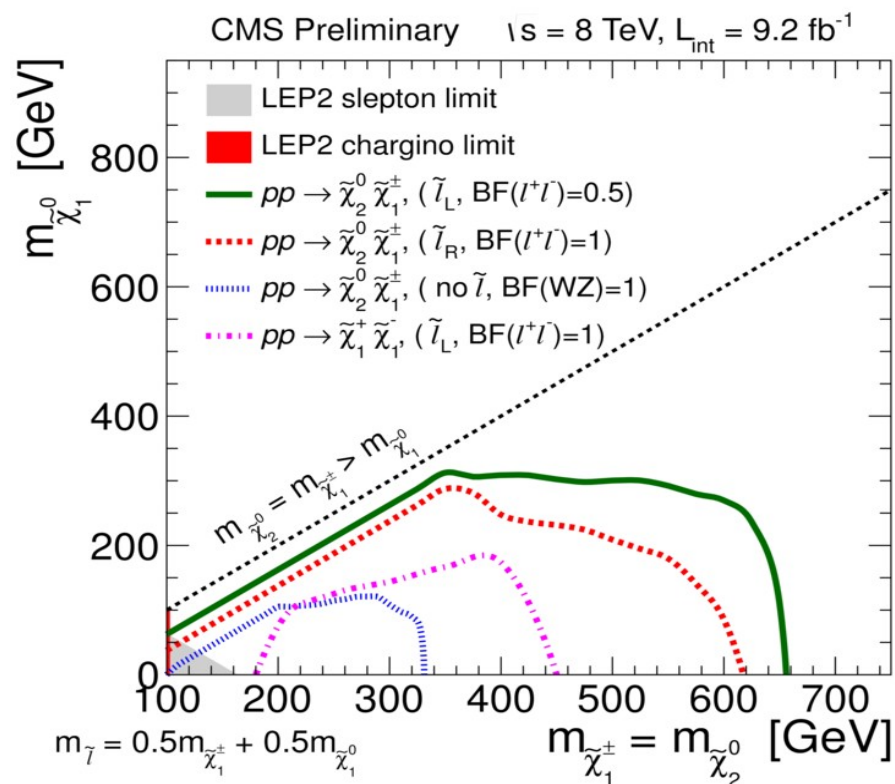
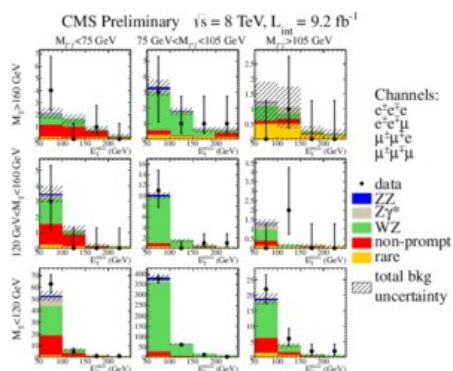
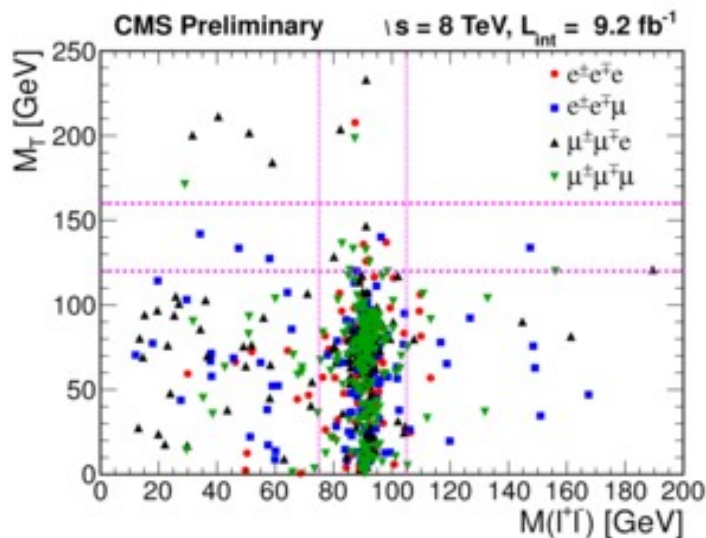


Result reinterpreted in
different simplified models,
with different chargino masses.

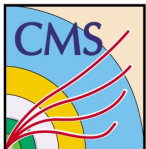


Example: search for weakinos (SUS-12-022)

Searches in many lepton/jet combinations

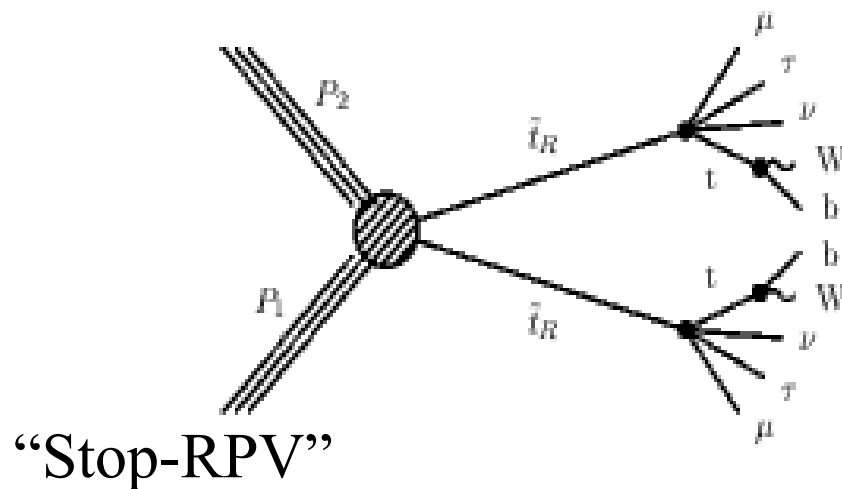


interpretation in many different
“weakino” simplified models

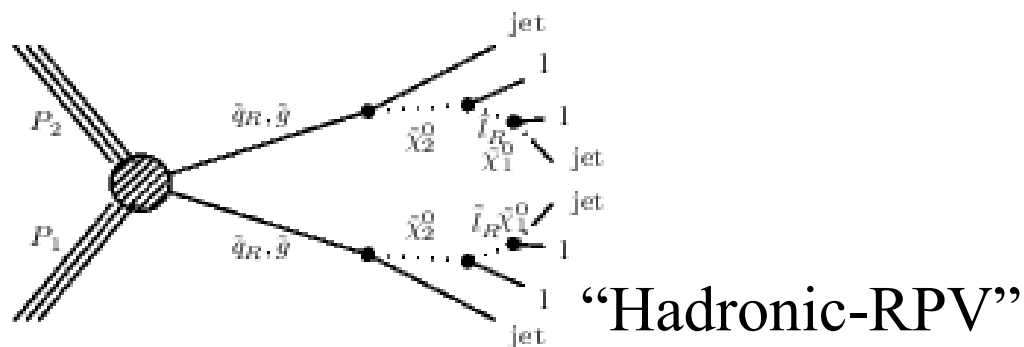
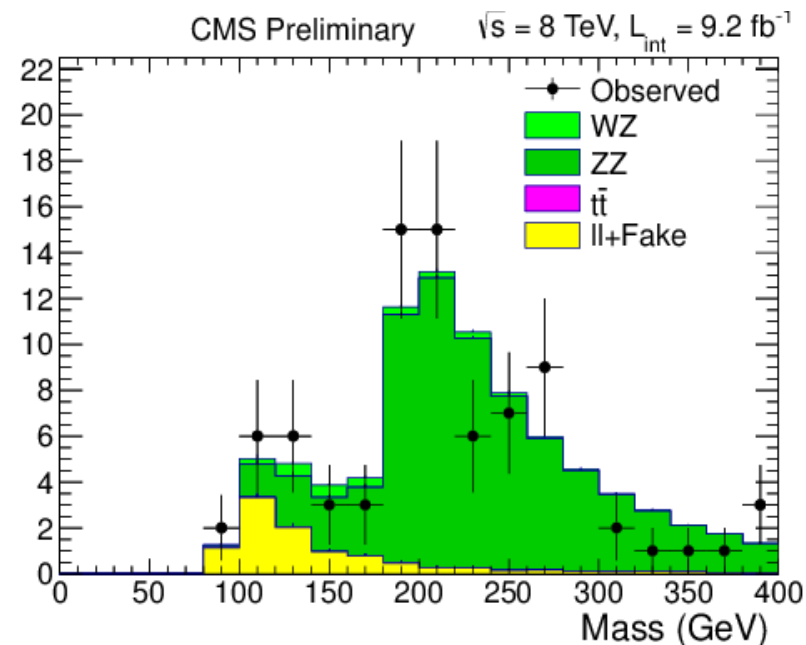


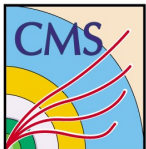
Example: search for RPV SUSY (SUS-12-027)

three or more leptons, no missing energy

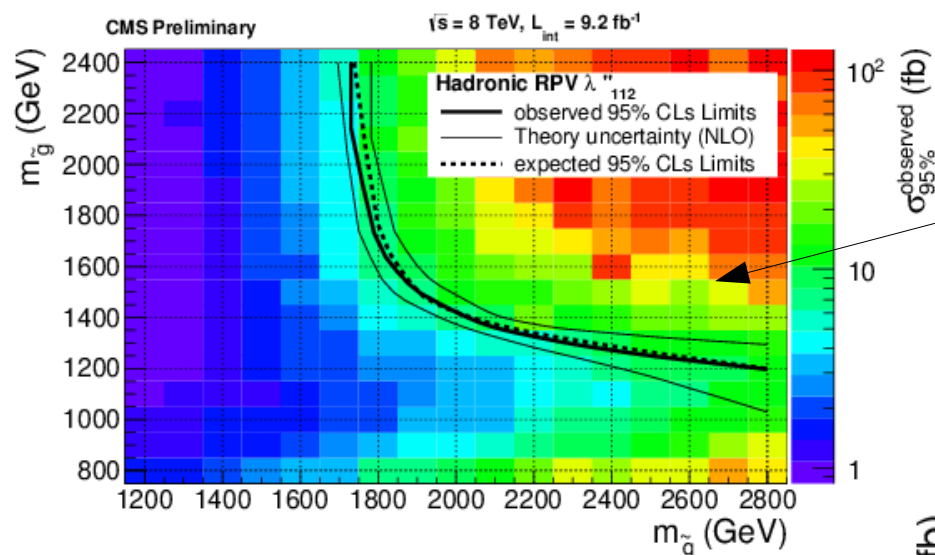


events



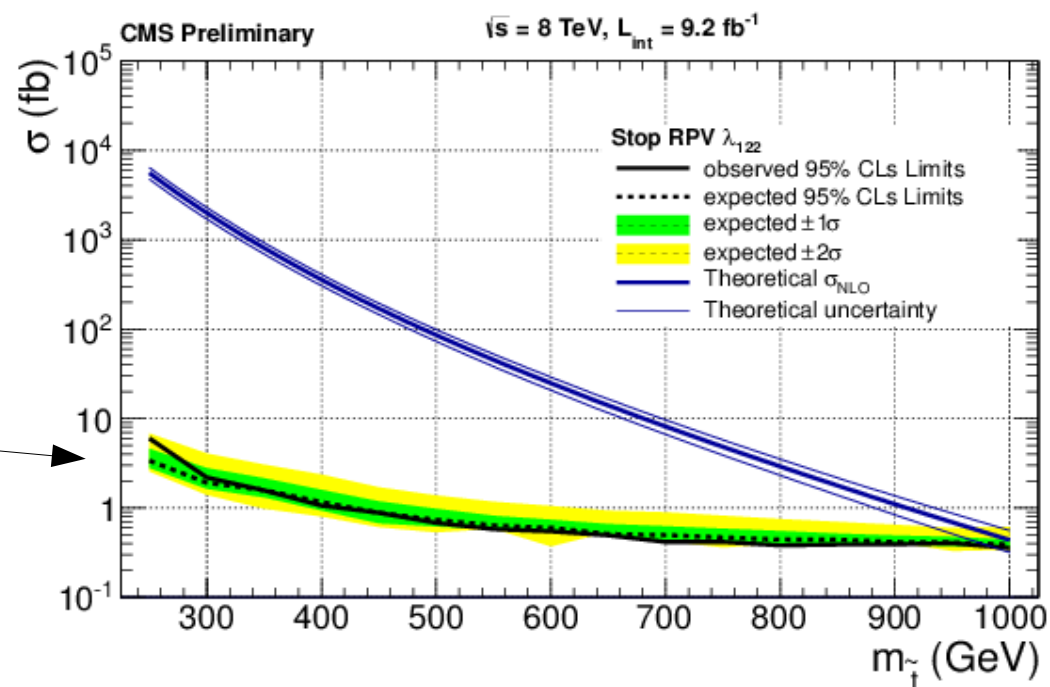


Example: search for RPV SUSY (SUS-12-027)



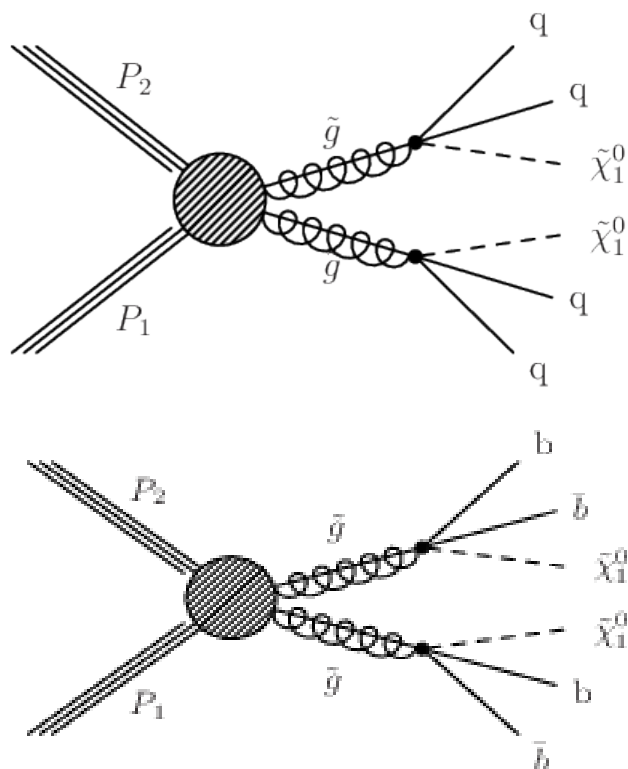
Interpretation in Hadronic RPV

Interpretation in Stop-RPV

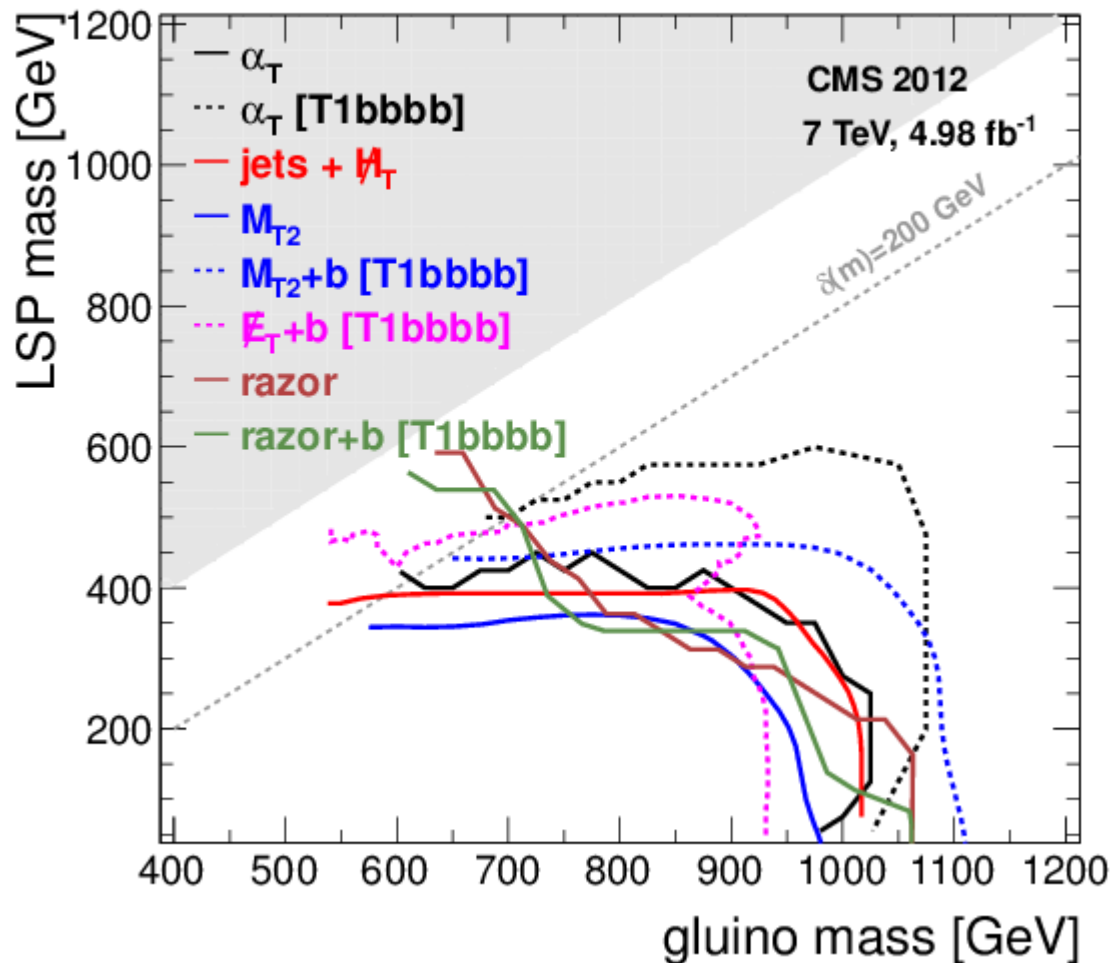




Summary – gluino production



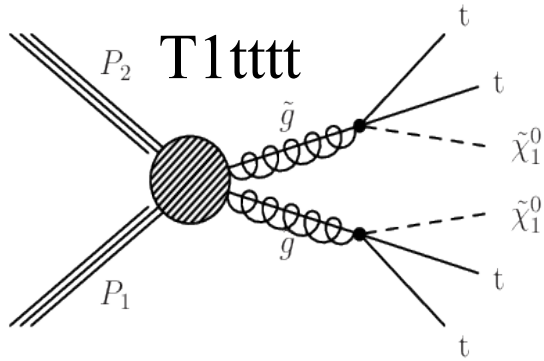
95% exclusion limits for $\tilde{g} \rightarrow q q \tilde{\chi}_1^0$; $m(\tilde{q}) \gg m(\tilde{g})$



<https://twiki.cern.ch/twiki/bin/view/CMSPublic/>



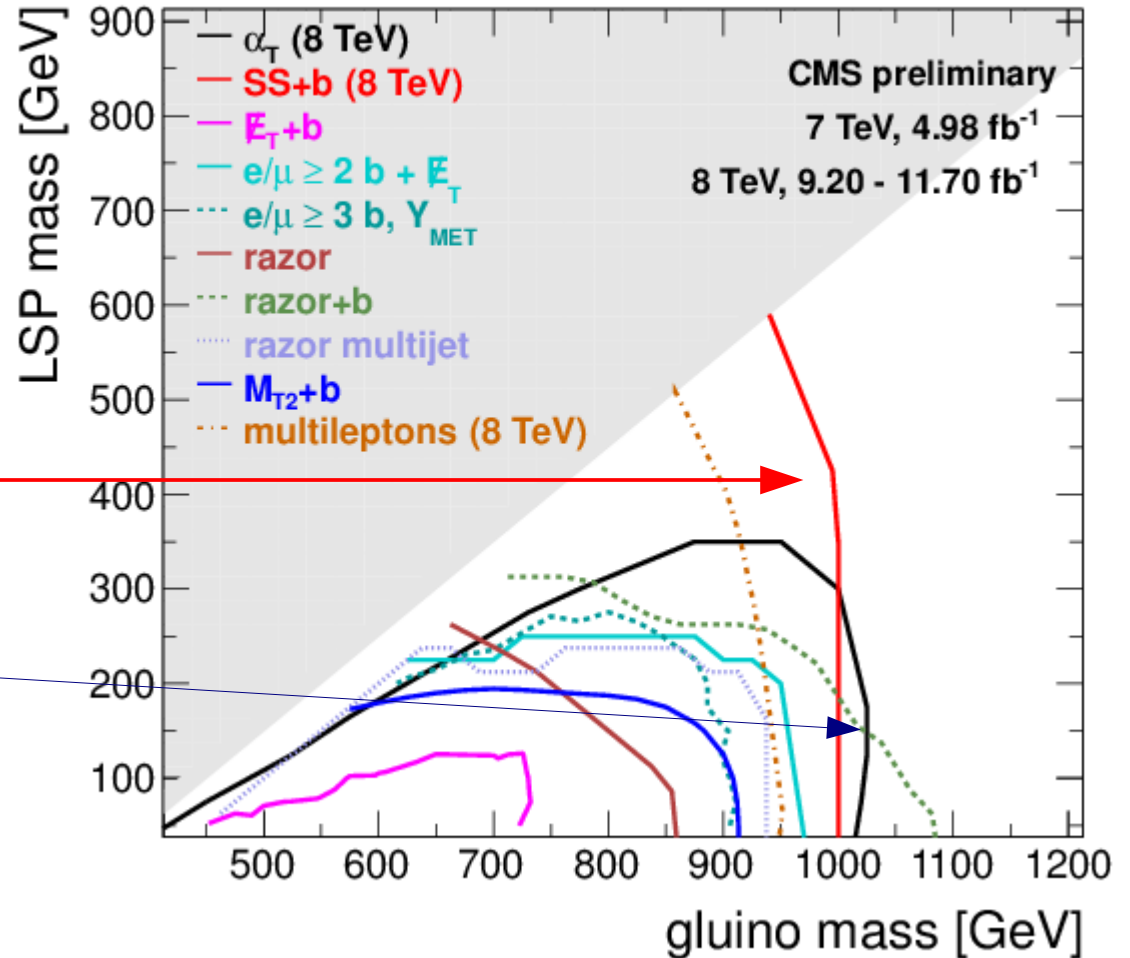
Summary – T1tttt (gluino \rightarrow tt LSP)

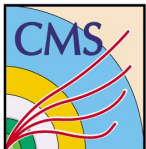


Di-leptons and multileptons searches can typically probe lower mass splittings.

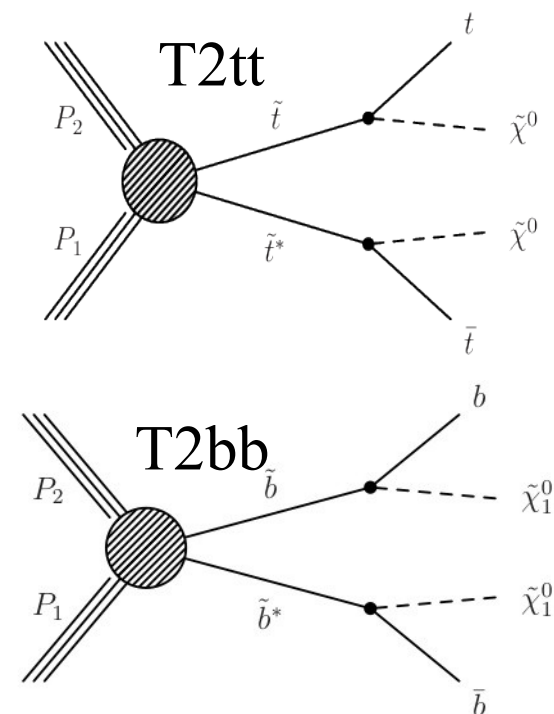
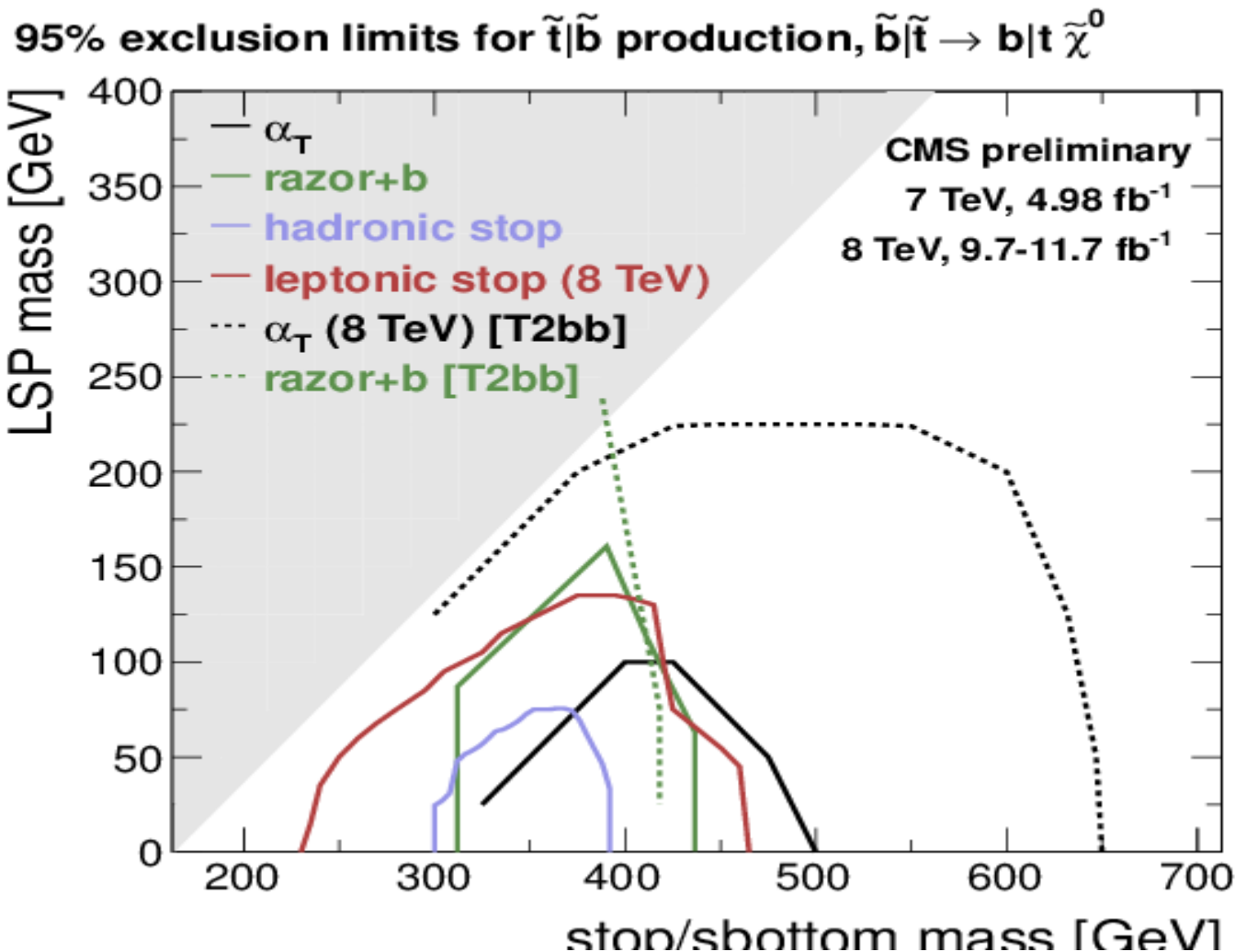
Hadronic analyses usually need large mass splittings

95% exclusion limits for $\tilde{g} \rightarrow t t \tilde{\chi}^0$; $m(\tilde{q}) \gg m(\tilde{g})$





Summary – stop/sbottom production

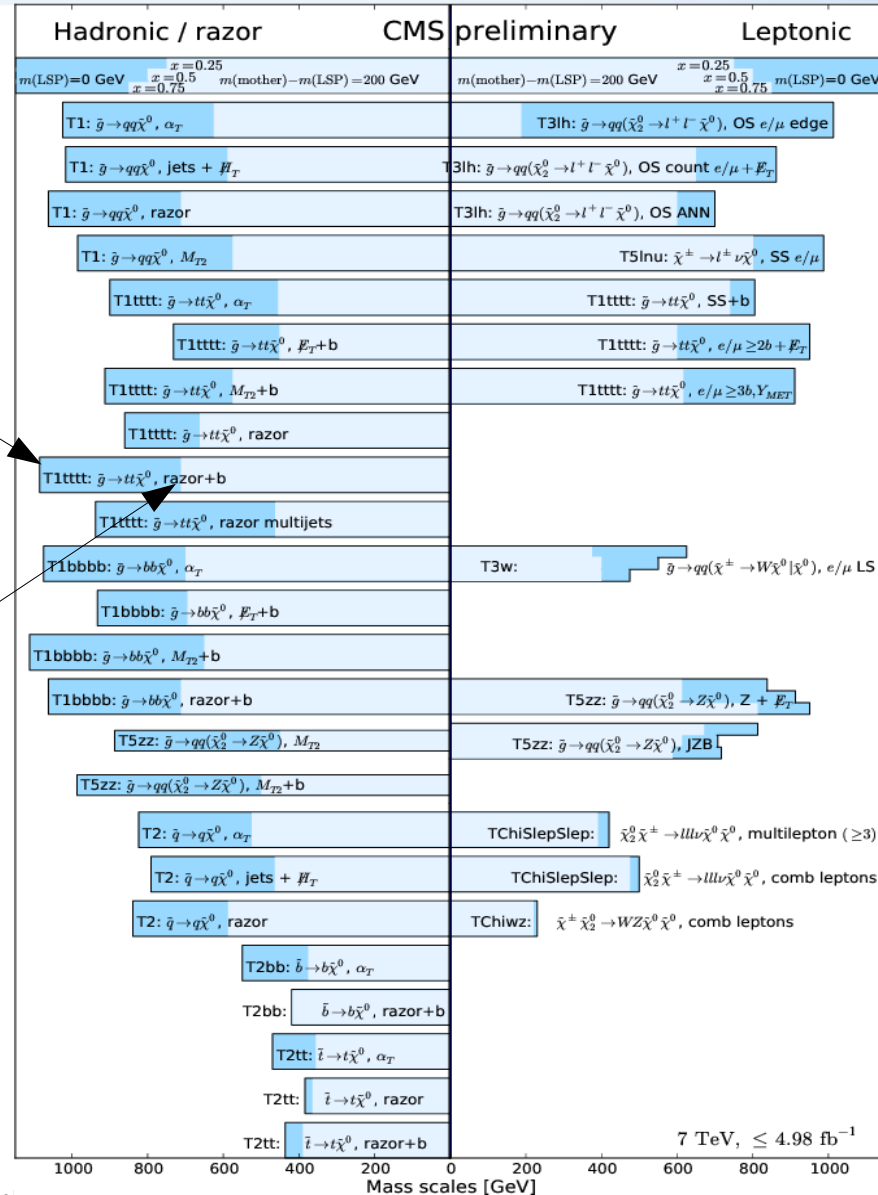




CMS summary: all SMS results

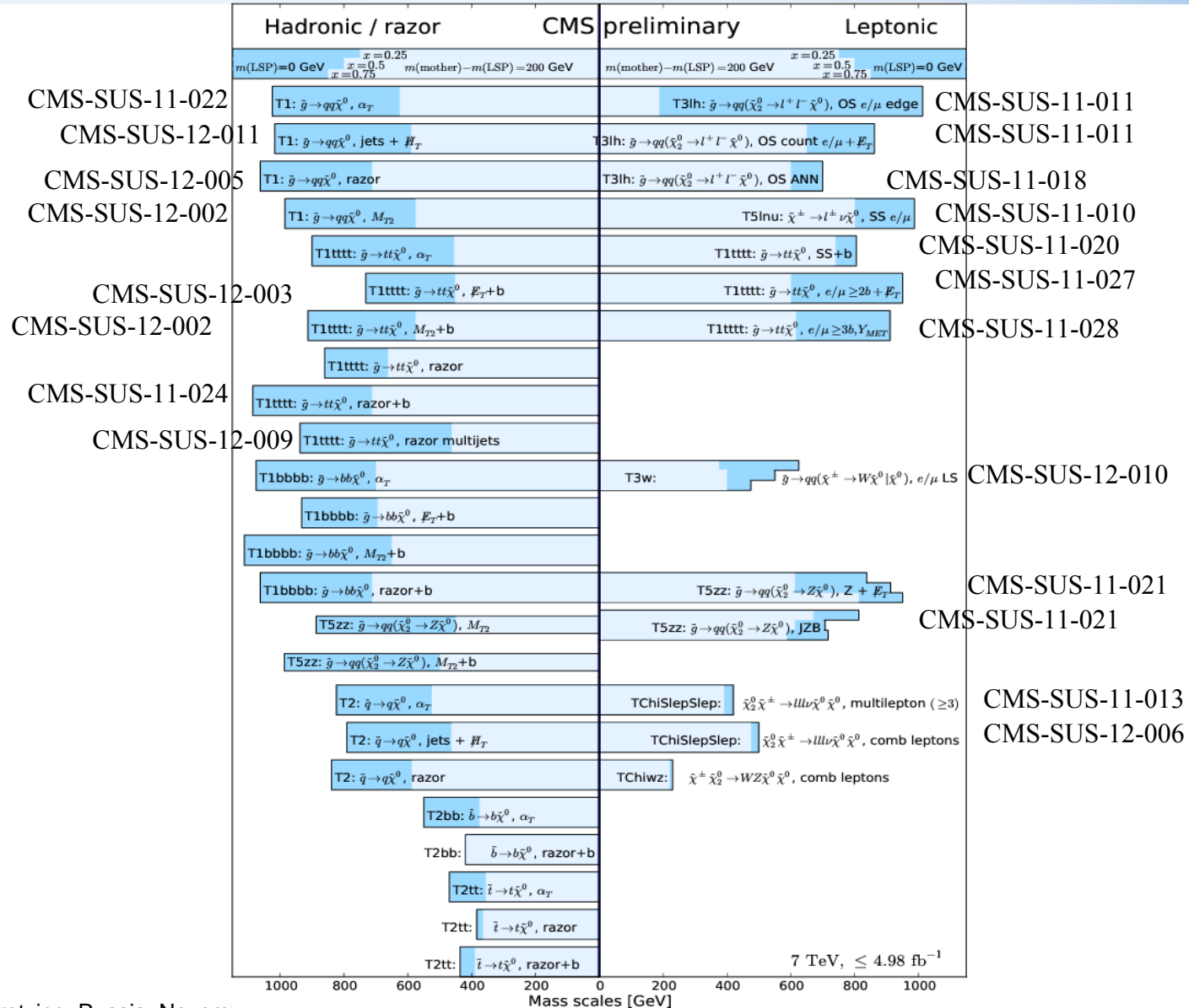
limit for LSP mass ~ 0
(and BR=1)

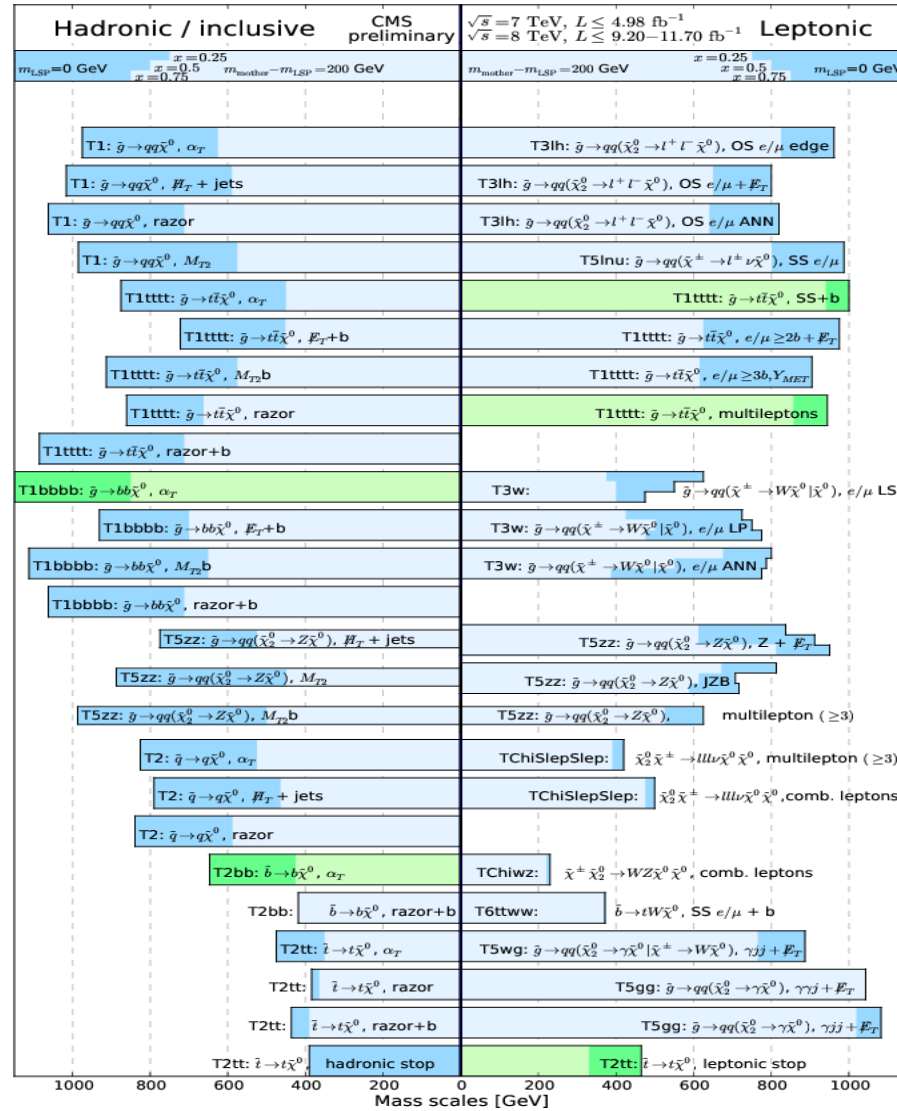
limit for LSP mass =
mass of mother – 200
GeV (and BR=1)





CMS summary: all SMS results





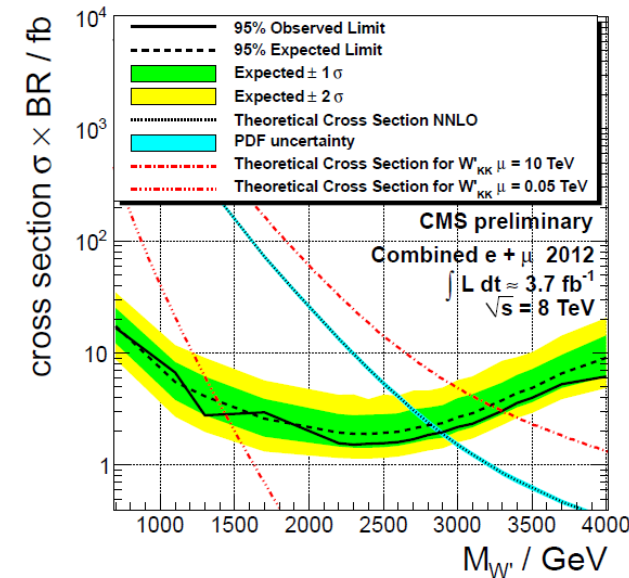
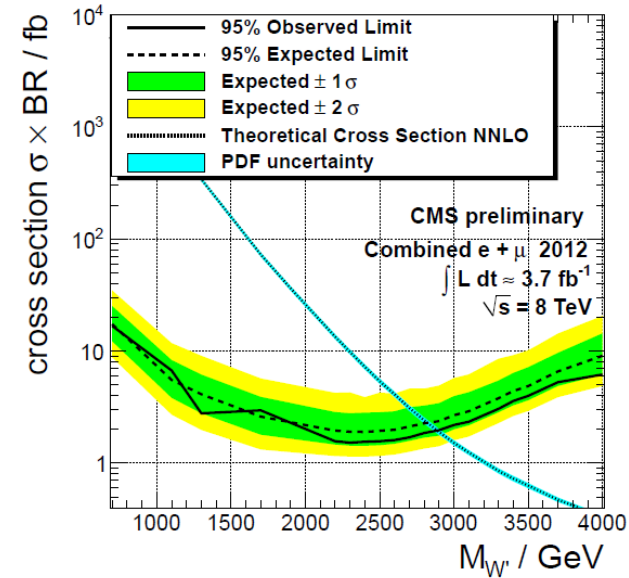
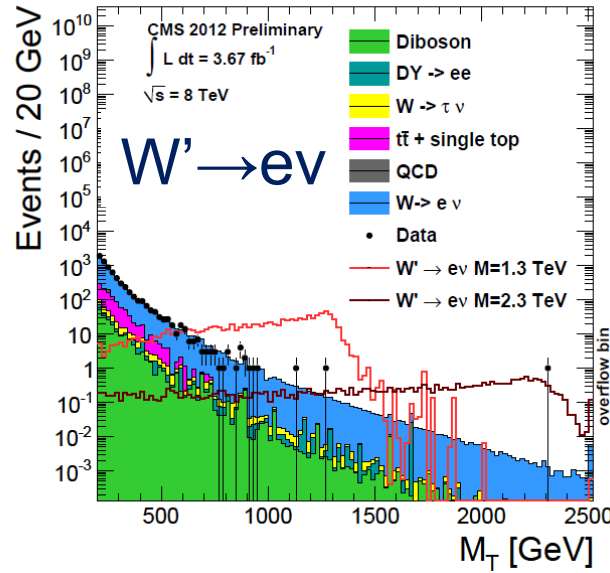
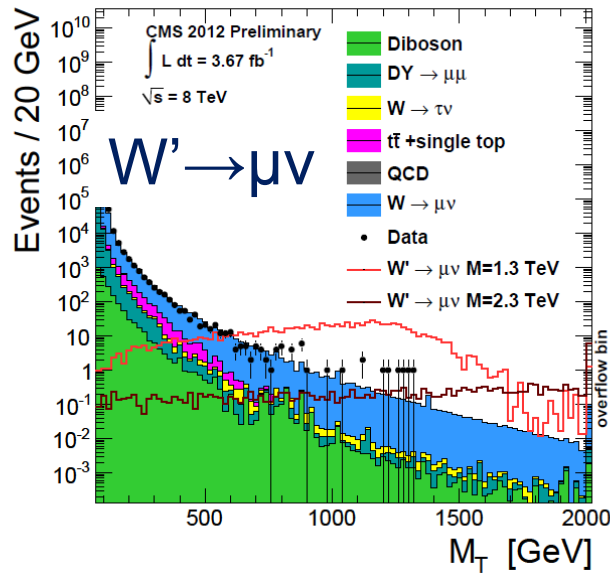


Exotic searches



Search for leptonic decays of W' bosons

EXO-12-010



Uses the **transverse mass** of the lepton/neutrino(=MET) pair to constrain the production of **heavy W' bosons**

Exclusions limits for several W' models:

- **sequential standard model** ($m_{W'} > 2.85 \text{ TeV}$)
- Kaluza-Klein W_{KK}' states ($n=2$) in split **universal extra dimensions** framework with bulk mass fermions (μ), e.g.: $\mu=10 \text{ TeV} \rightarrow m_{W'} > 1.4 \text{ TeV}$
- **preon** binding energy scale $> 8.7 \text{ TeV}$



Search for black holes

EXO-12-009

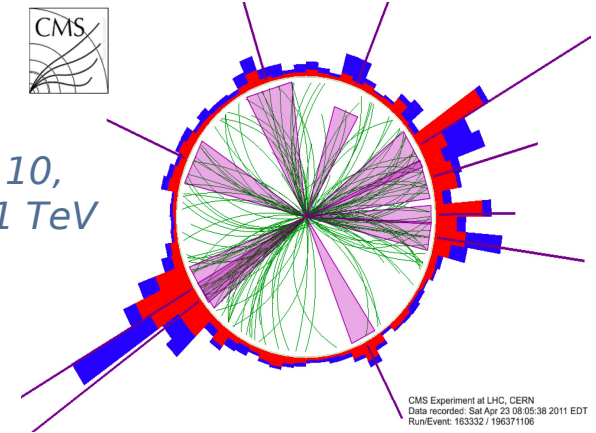
Microscopic black holes decay democratically and isotropically into SM particles.

Signature: Events with large **transverse energy sum ST** , and a high multiplicity of jets, leptons and photons.

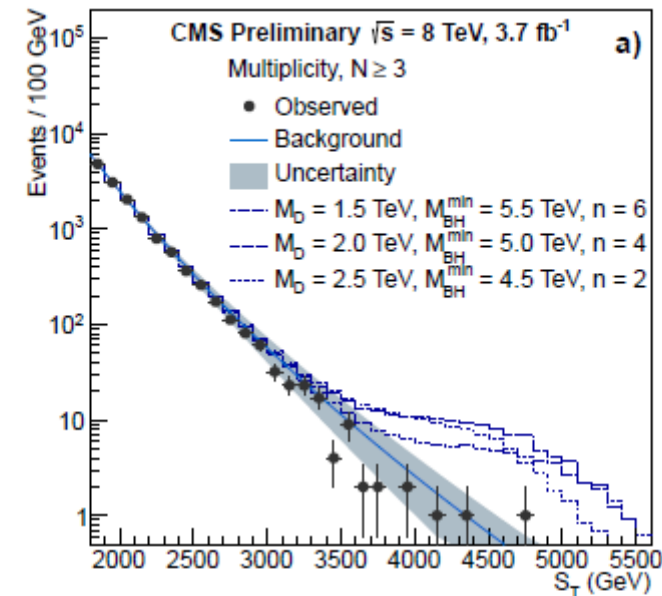
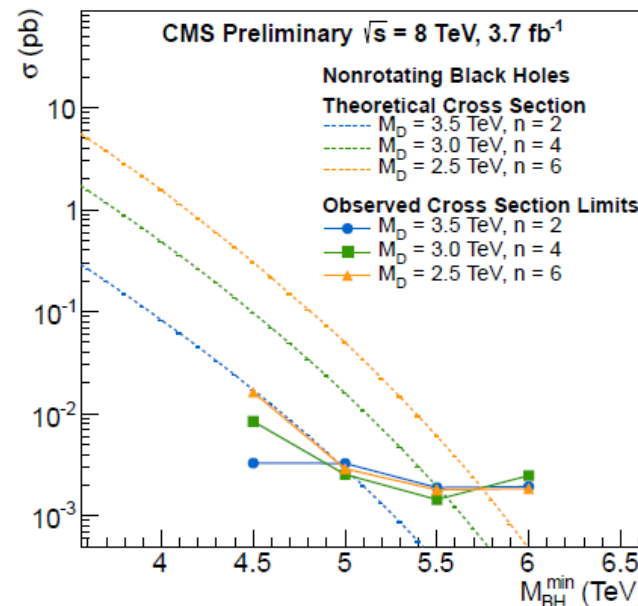
The search is performed in bins of final state multiplicities and limits are obtained in the range $M_{BH} \sim 4.1 - 6.1$ TeV which are the **most restrictive** limits to date.



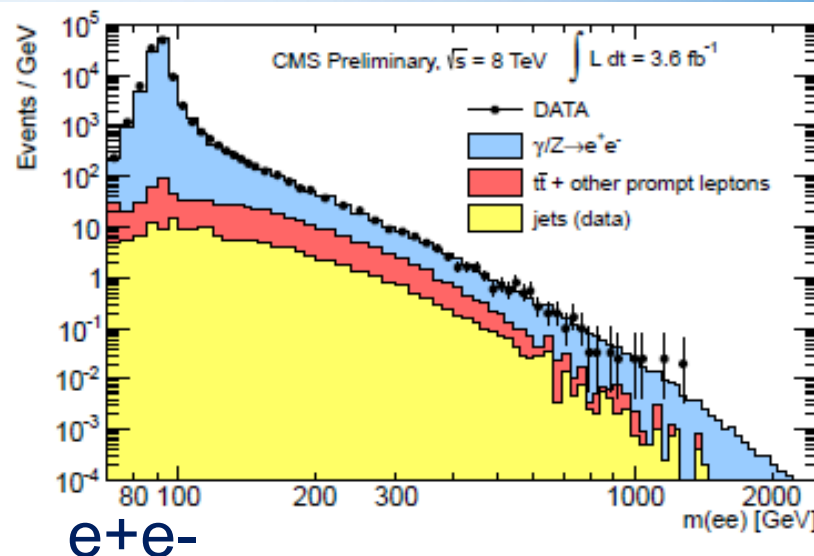
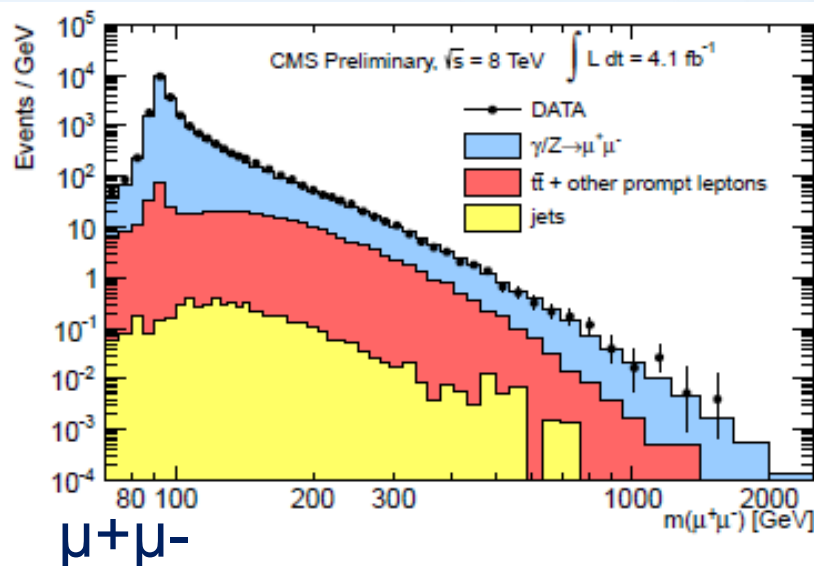
$N_{jets} = 10,$
 $ST = 1.1$ TeV



CMS Experiment at LHC, CERN
Data recorded: Sat Apr 23 08:05:38 2011 EDT
Run/Event: 163332 / 196371106



Search for dilepton resonances



Di-lepton mass bump hunt: Clean signal, small background, good reconstruction performance

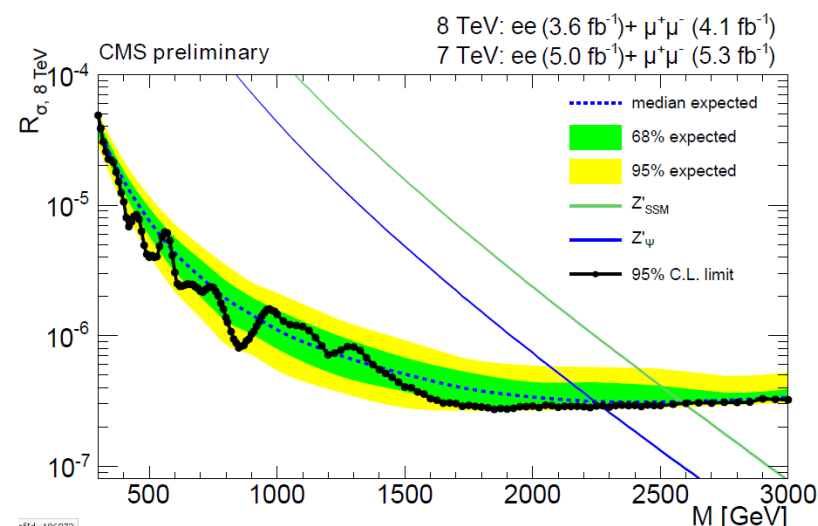
very long list of theory models!

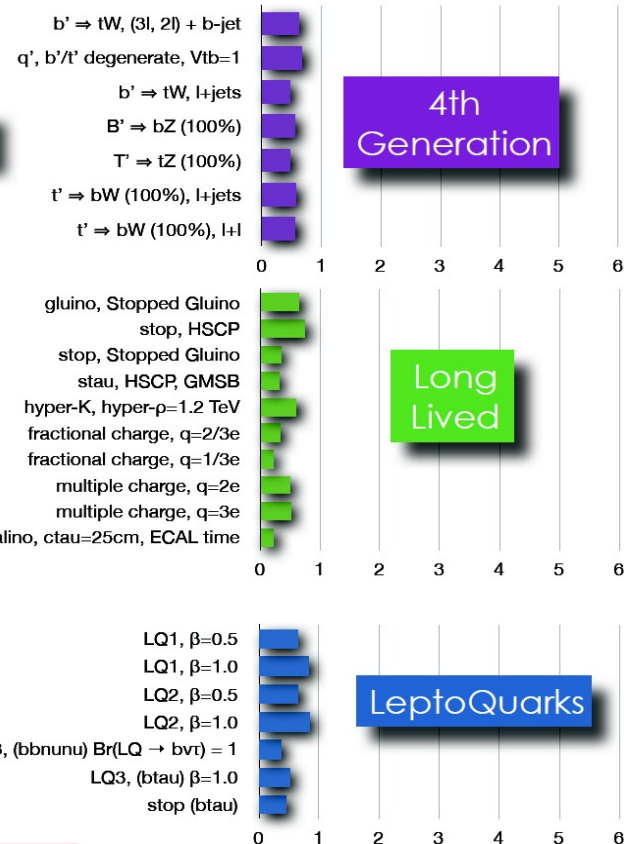
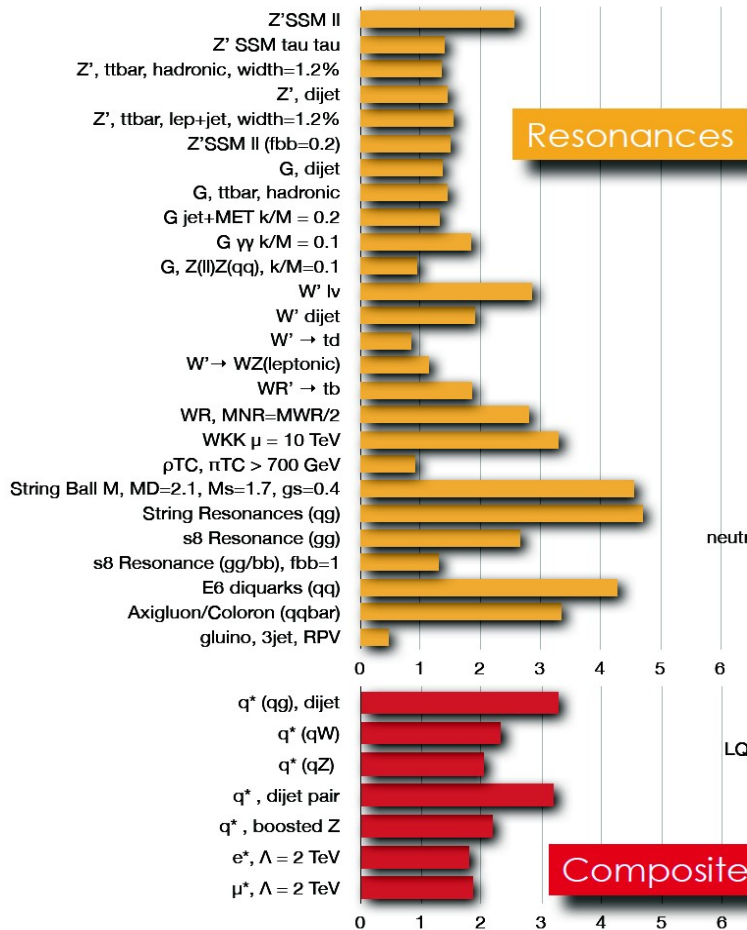
Results: 95% CL limits

2590 GeV for Z' SSM model

2260 GeV for $Z'\psi$ model (superstring inspired E6 model)

Tighter limits than those from previous searches at Tevatron and Lep-II and LHC

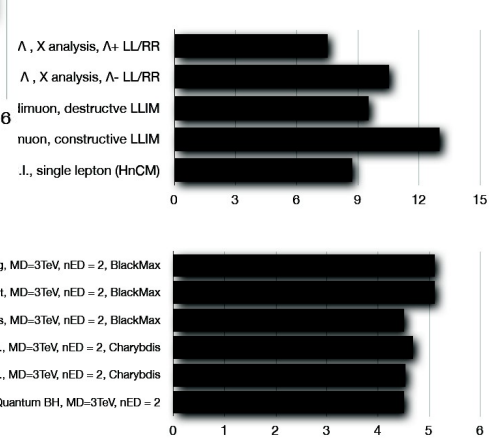




Gave only three examples

Long list of analyses

Long list of models





Summary

LHC and CMS: stable operation.

Search for BSM physics is major goal, now that Higgs-like particle has been found.

Very wide range of signatures are covered by current searches

Large fractions of theory space covered already

No excesses seen so far

Already constraining natural SUSY scenarios



More information can be found here:

<https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResults>

Physics Analyses

Physics Analysis Group	Group page	Publications	Preliminary Results	Monte Carlo studies
Forward and Small-x QCD Physics	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
B Physics and Quarkonia	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Standard Model Physics (Vector Bosons & Jets)	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Top Physics	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Higgs Physics	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Supersymmetry	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Exotica	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Beyond 2 Generations	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries
Heavy-Ion Physics	Plots and Results	Papers	Physics Analysis Summaries	Physics Analysis Summaries



Backup



cMSSM

