Susy search with dileptonic final states in CMS

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December 2^{nd} 2010

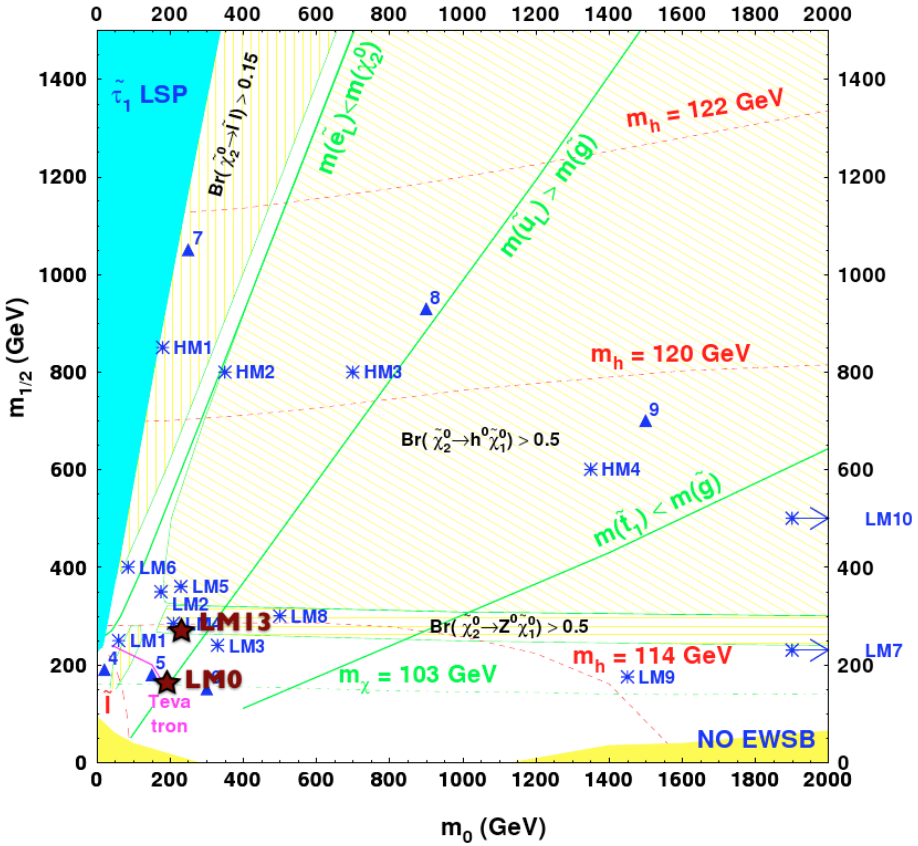
Contents

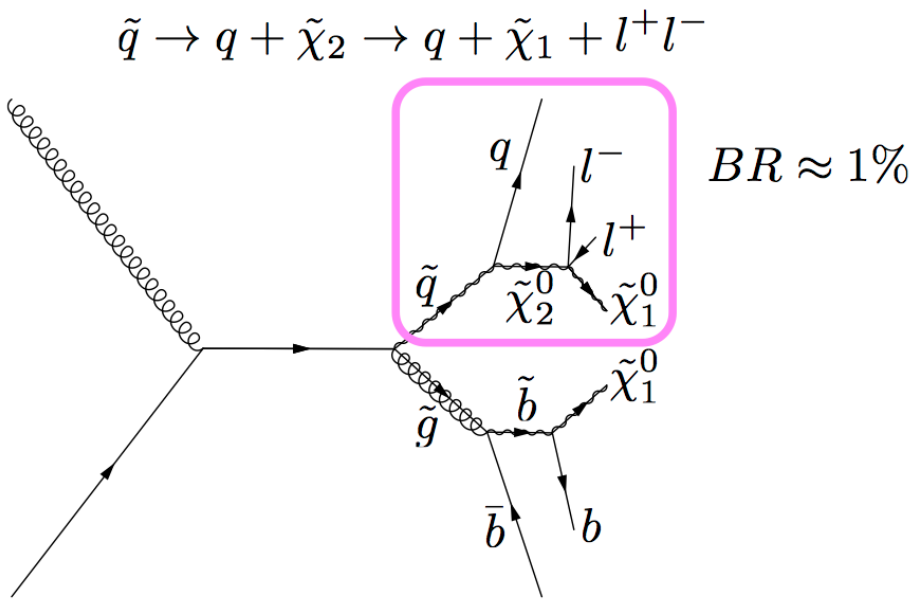
Disclaimer

- Many studies are ongoing to analyze the full pp collision sample of 2010
- Will show only public results with data

Contents

Some mSUGRA Benchmark points

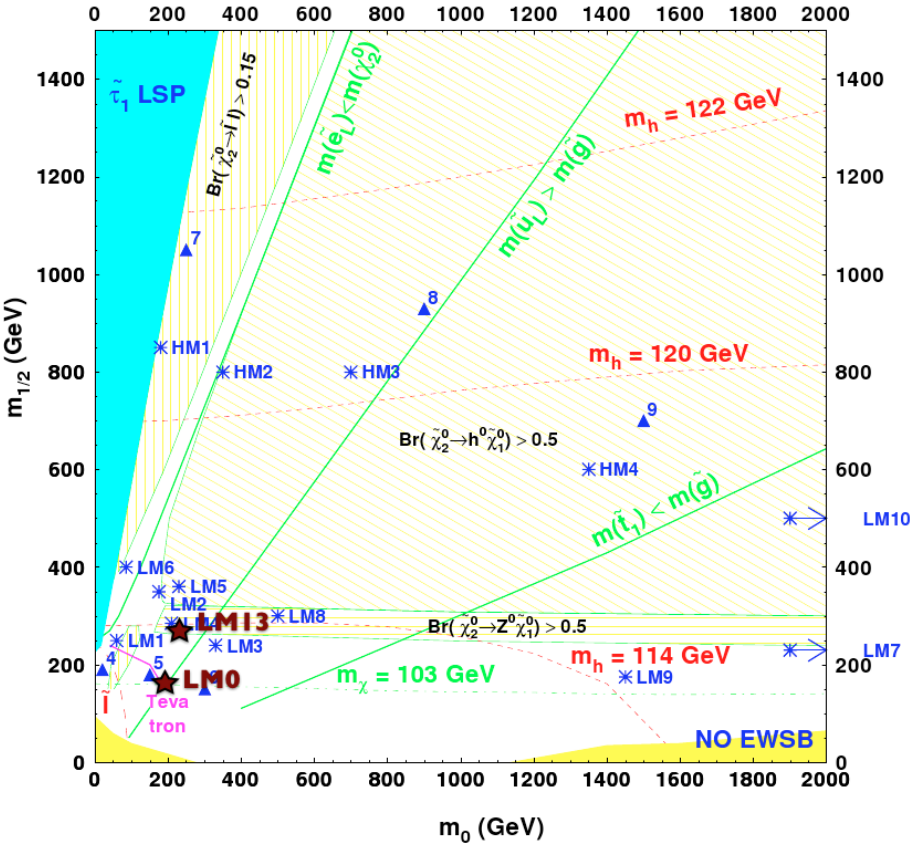


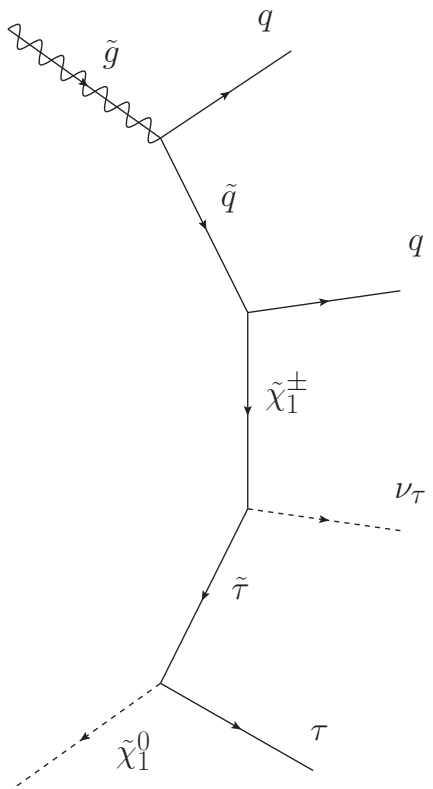


SUSY cascade to opposite-sign final state

- Benchmark points are chosen to cover a large range of signatures
- Mostly $tan(\beta) = 10$
  Exceptions: LM2 ($tan(\beta) = 35$), LM11 (35), LM12 (47.6) and LM13 (40)

Some mSUGRA Benchmark points

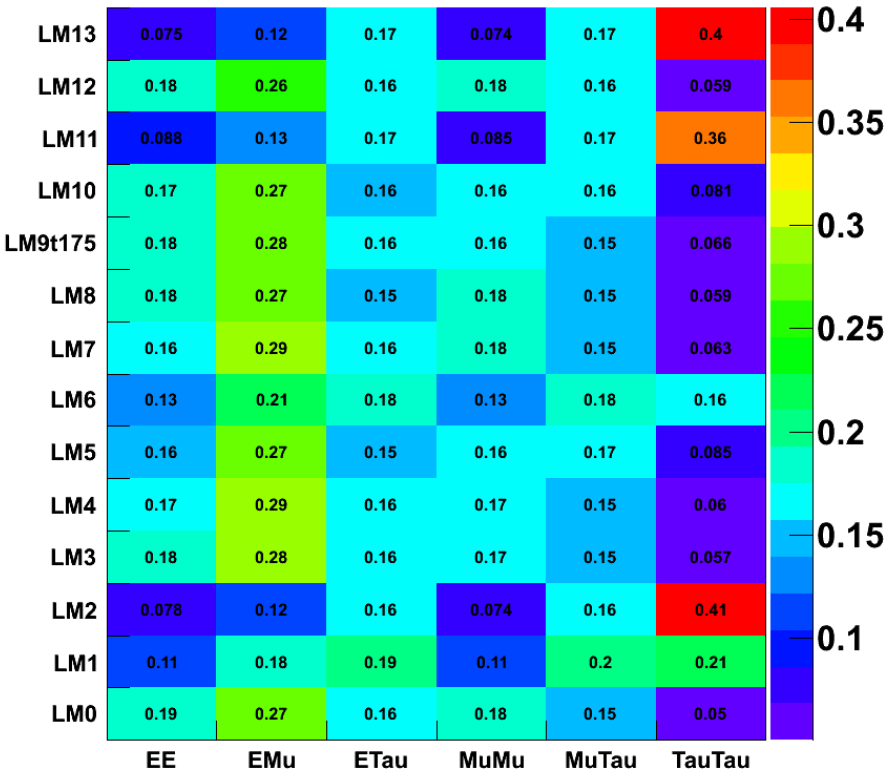




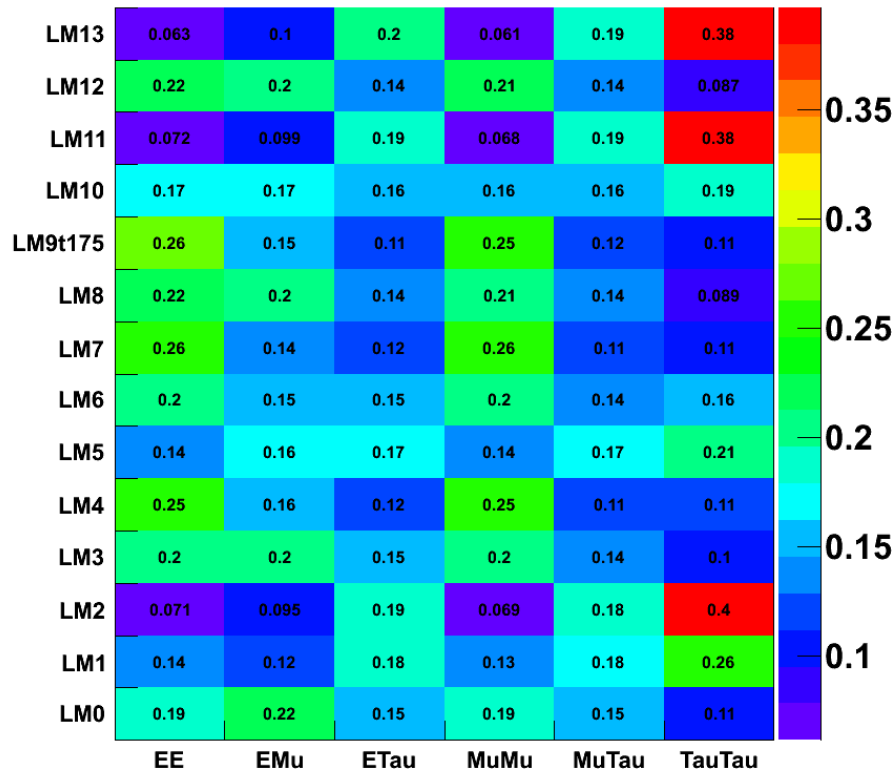
Part of a SUSY cascade of a possible same-sign final state

- Benchmark points are chosen to cover a large range of signatures
- Mostly $tan(\beta) = 10$
  Exceptions: LM2 ($tan(\beta) = 35$), LM11 (35), LM12 (47.6) and LM13 (40)

Dileptonic Final States



Same Sign



Opposite Sign

- Six possible channels per charge combination
- Classify only hadronic τ decays in τ channels (about 65%)
- Leptonic decays are counted directly as e/μ final States

  $\Rightarrow$ possibility to combine all 9 channels studied so far

Event Selection

Basic

Trigger	Hadronically ($H_T = \sum p_T^{Jet}$) (or separately leptonically)
Entire event	$H_T > 350 GeV$ ($\rightarrow$trigger) $\not{E}_T > 80$GeV (SS light), $\not{E}_T > 150$GeV (SS τ, OS light),
Light Leptons	$p_T > 5$ GeV, $\lvert\eta\rvert < 2.4$ comb. rel. isolation < 0.25
τ Leptons	$p_T > 15$ GeV, $\lvert\eta\rvert < 2.4$ 1% Fakerate NN classifier

Using particle flow reconstruction method for all objects

Muon

ID	Tracker and muon system
Track fit	quality cuts
vertex	from primary

Electron

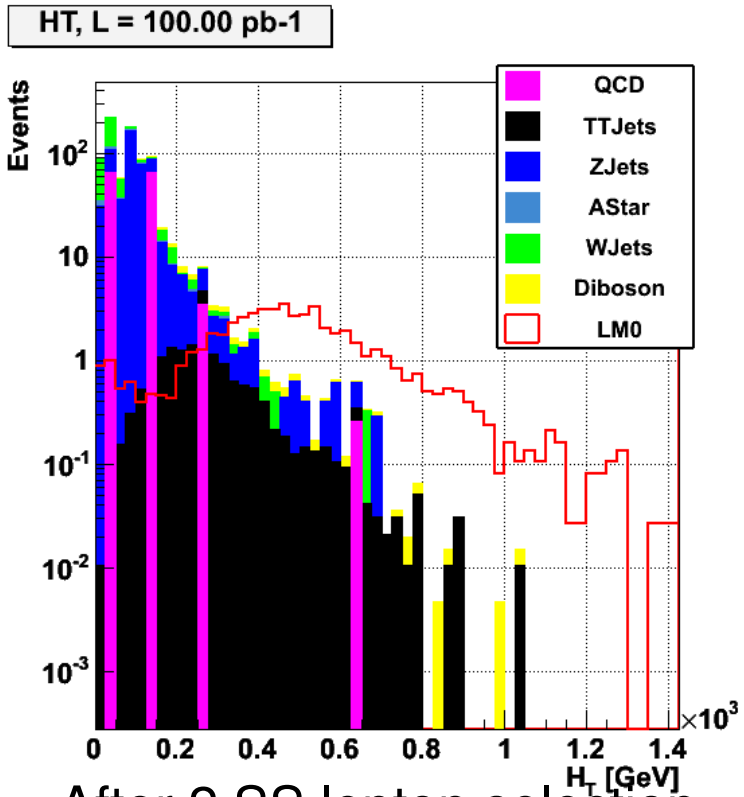
ID	Multivariate discriminator
vertex	From primary
conversions	Reject by tracking

Tau

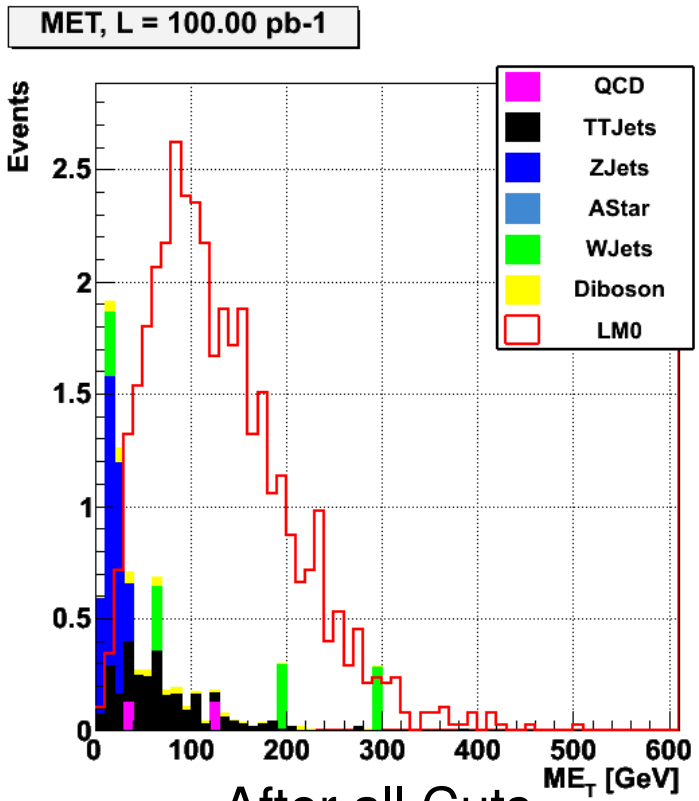
e, μ	rejection
|charge|	= 1

Contents

Same-Sign Light Lepton Study (D. Sprenger)



After 2 SS lepton selection

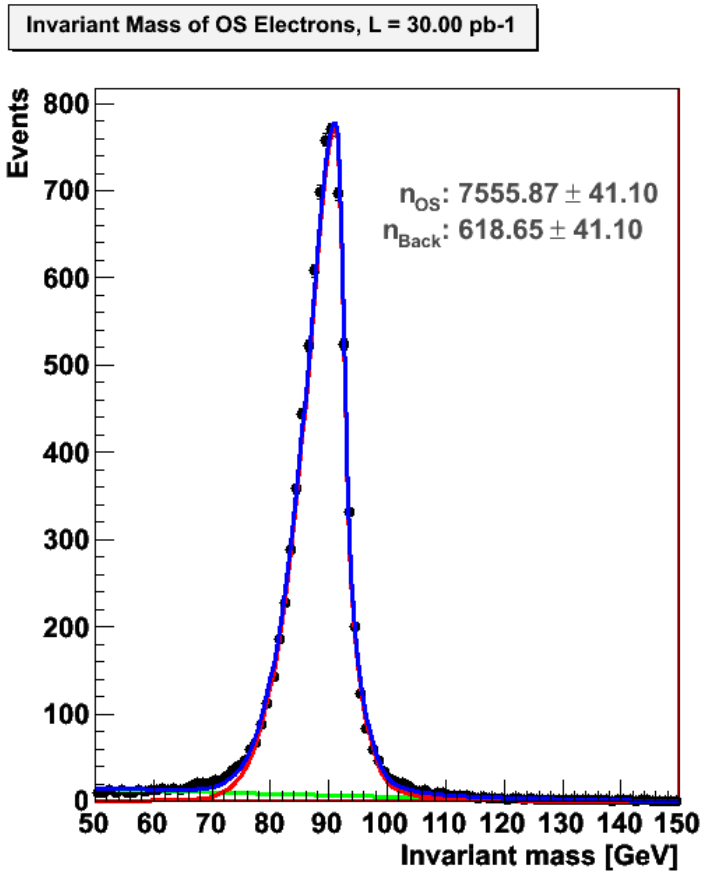


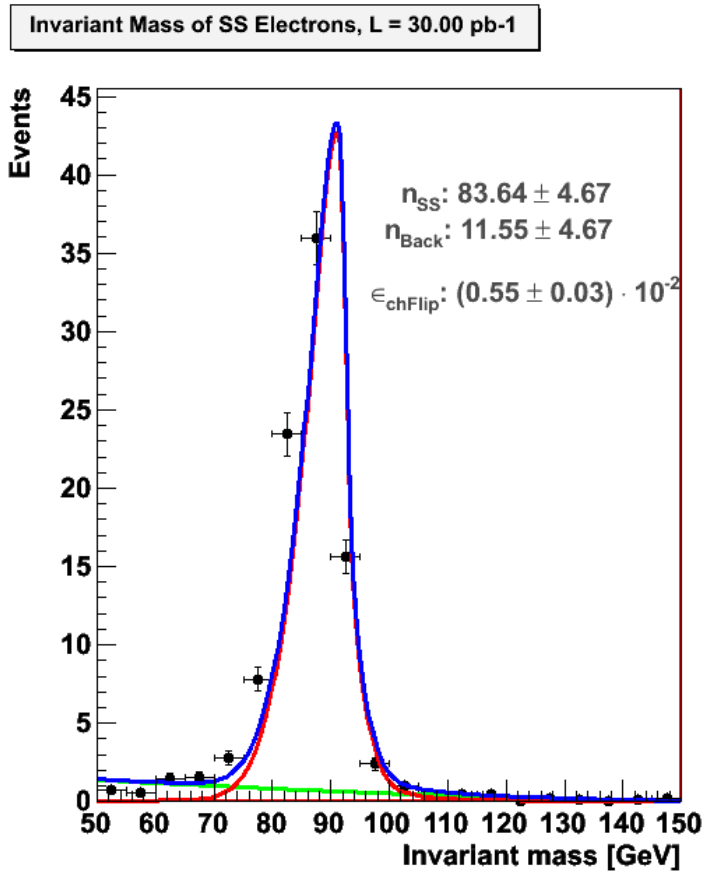
After all Cuts

- HT and $\not{E}_T$ selection provides good discrimination in light same-sign di-lepton channels
- Very little relevant background at $\not{E}_T > 80$ GeV

Signal	28 (NLO)
Background	1.7
$Z_{Bi}^{25\%}$	9.1σ

Electron Charge Mismeasurement using Z→ee events

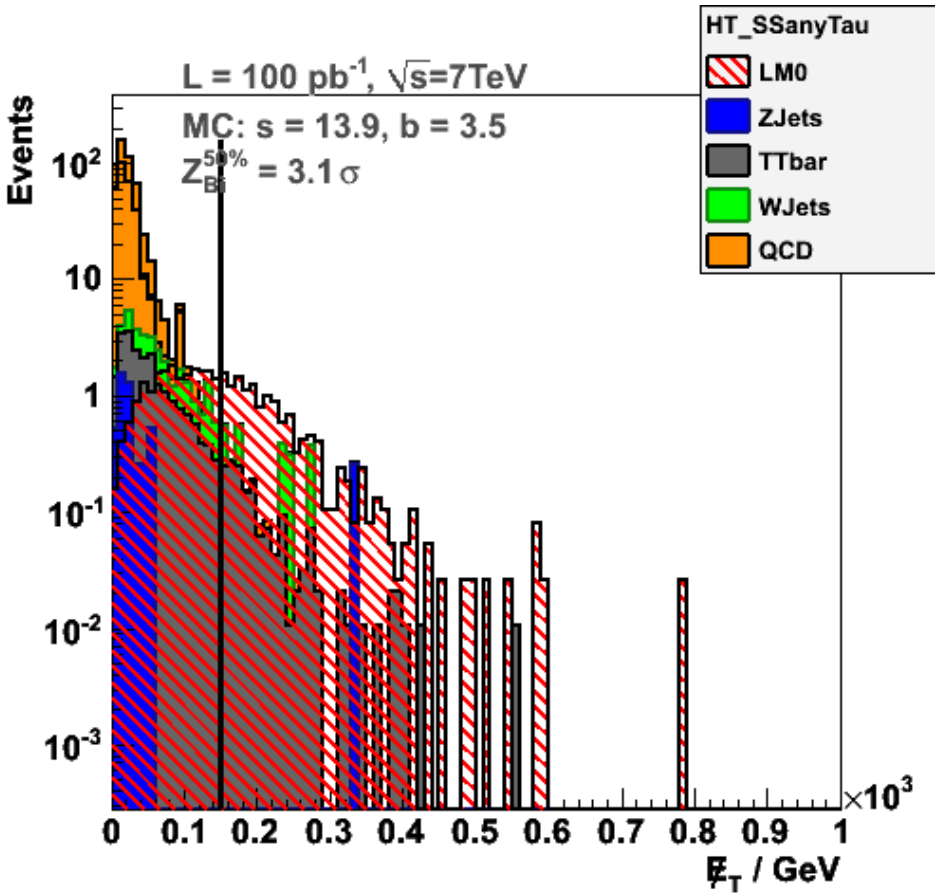


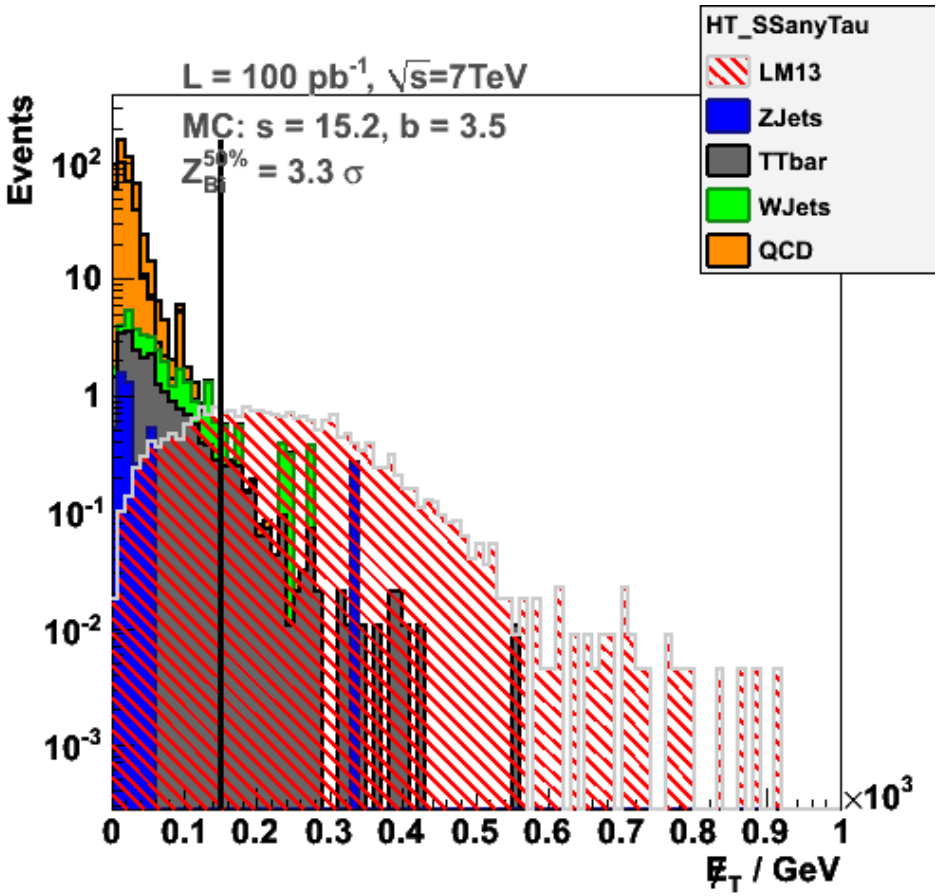


- Important effect to estimate SM background especially at low $\not{E}_T$
- Simultaneously fit m_{ee} for opposite sign (all parameters) and same sign (just normalisation) case

$$\Rightarrow \varepsilon_{misID} = \frac{n_{SS}}{2 \cdot n_{total}} = (0.55 \pm 0.03) \cdot 10^{-2}$$

Same Sign τ Study (M. Edelhoff)



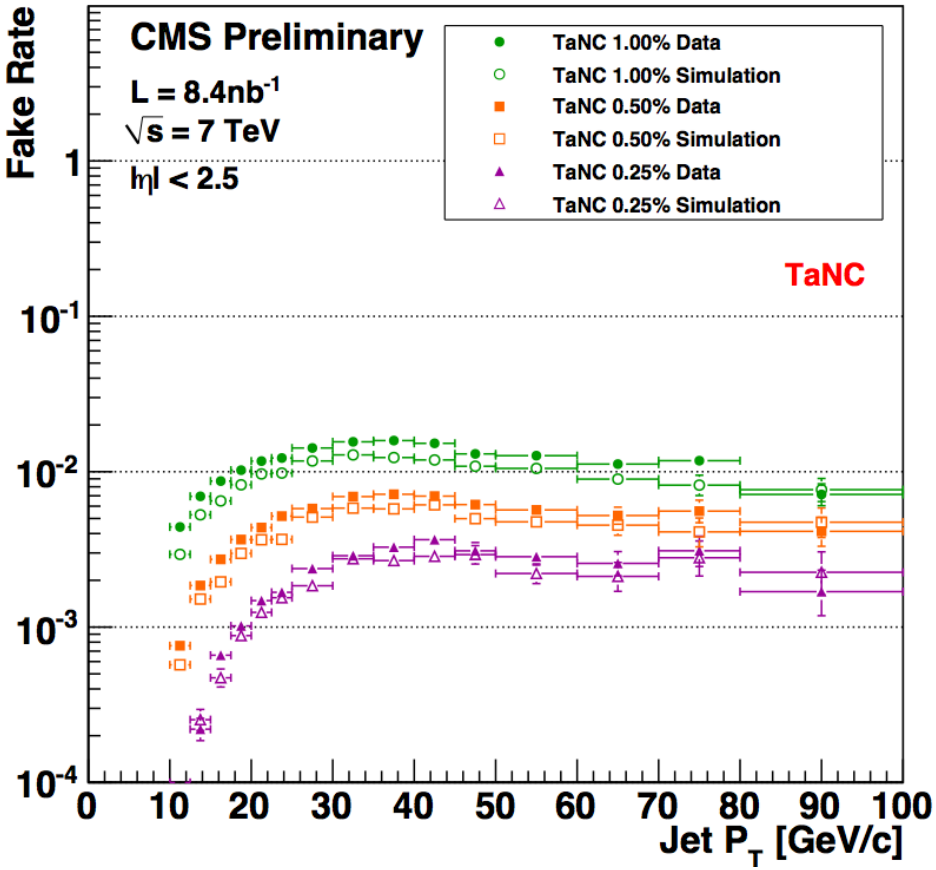


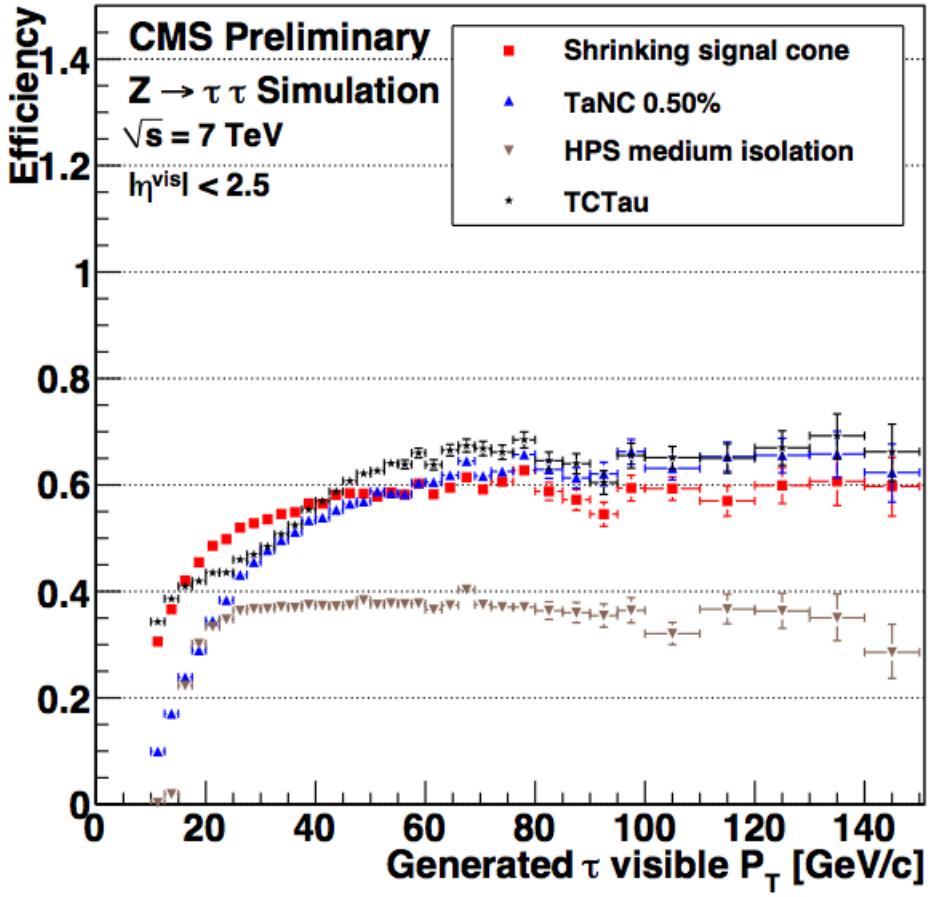
After all other Cuts

- Higher $\not\!\!E_T$ threshold necessary due to higher τ fake rate
- At LM0-like points in phase space viable way to extend reach
- With increased statistics high $tan(\beta)$ regions like LM13 can be studied

Tau Fake Rate

CMS PAS PFT-10-004

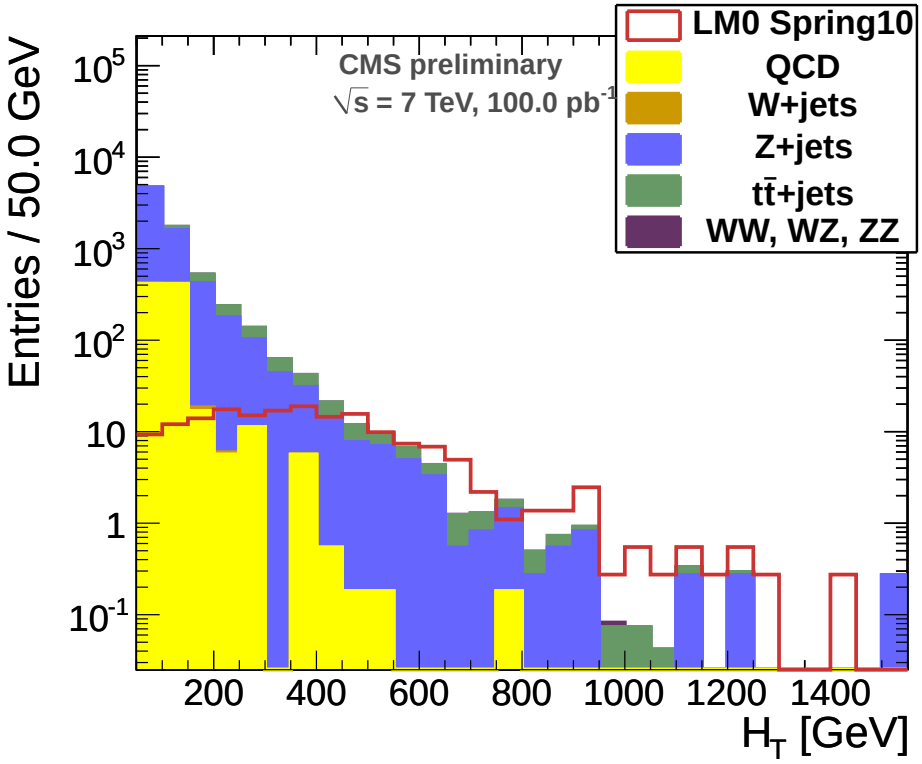




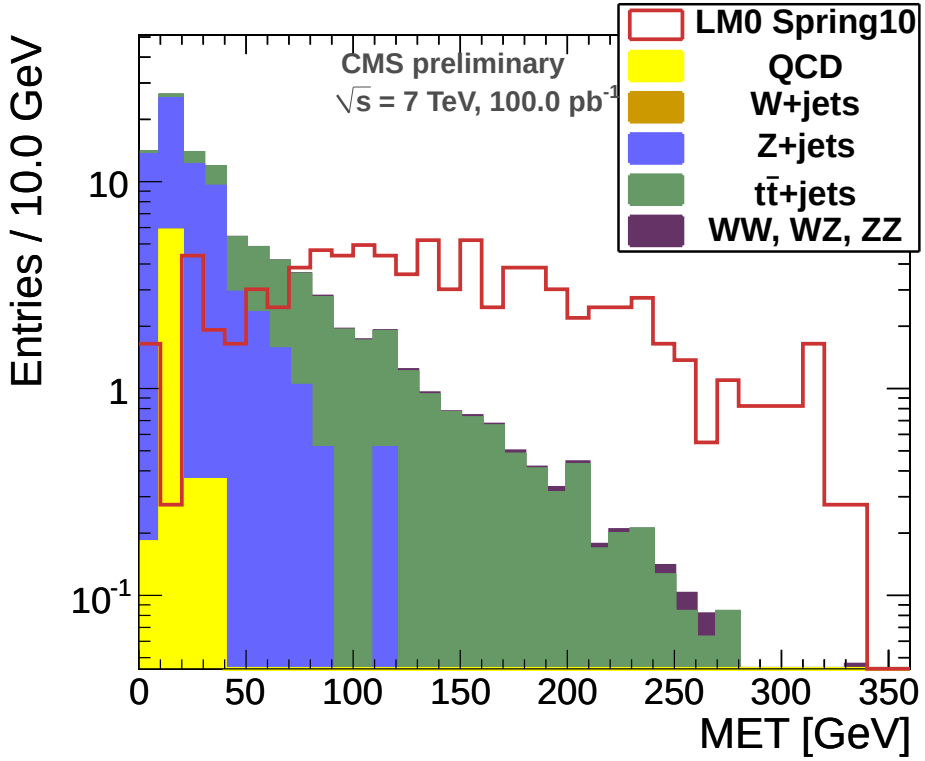
- $P_{fr}(bin) = \frac{N_{Jets}(bin)_{passing\tau ID}}{N_{Jets}(bin)}$
- Fake rate not statistics limited even at L$= 8.4nb^{-1}$
- Efficiency measurement from data limited by available Luminosity

Contents

Opposite Sign Light Lepton Study (N. Mohr)



After 2 OS lepton selection



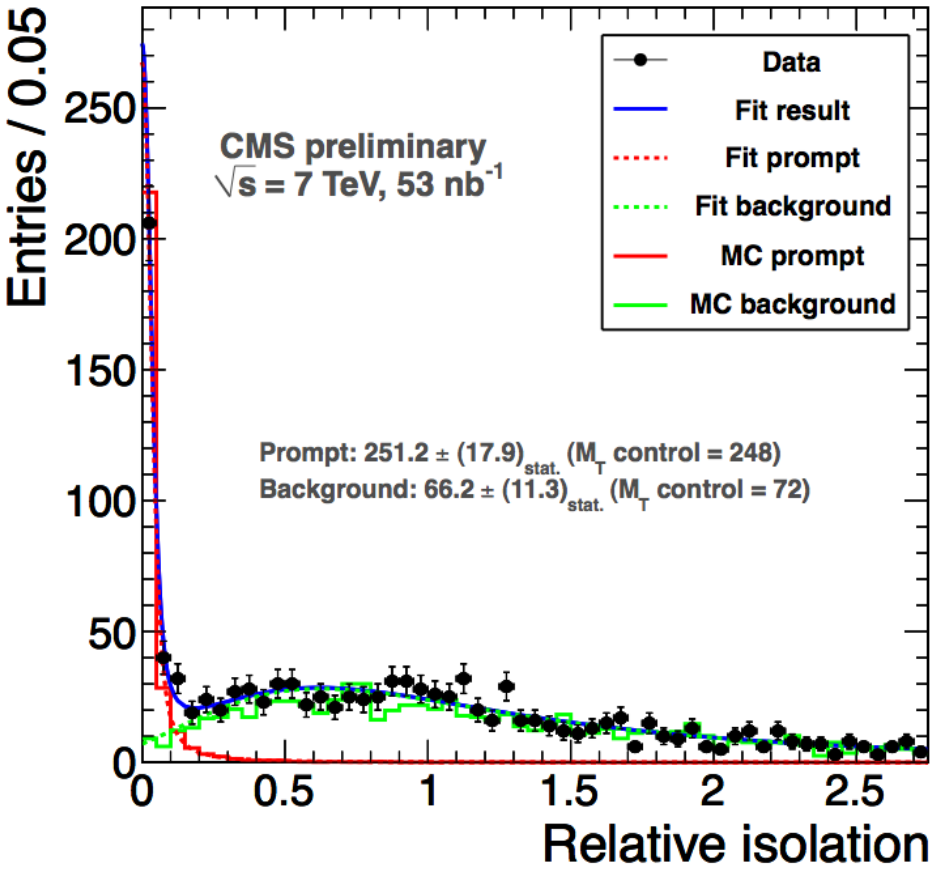
After all Cuts

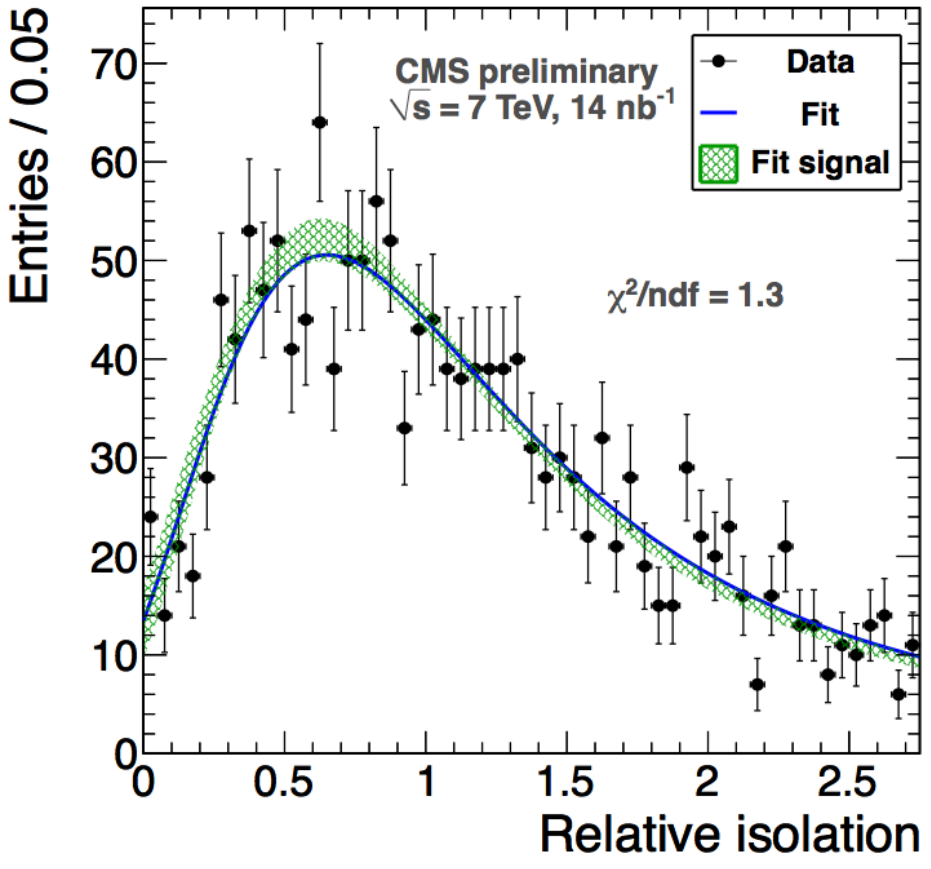
- Larger background from $t\bar{t} \Rightarrow$ higher $\not{E}_T$ threshold
- Can use opposite flavour subtraction to reduce this effect

Signal	40 (NLO)
Background	4.5
$Z_{Bi}^{25\%}$	8.5σ

Muon Background Prediction with Isolation Fits

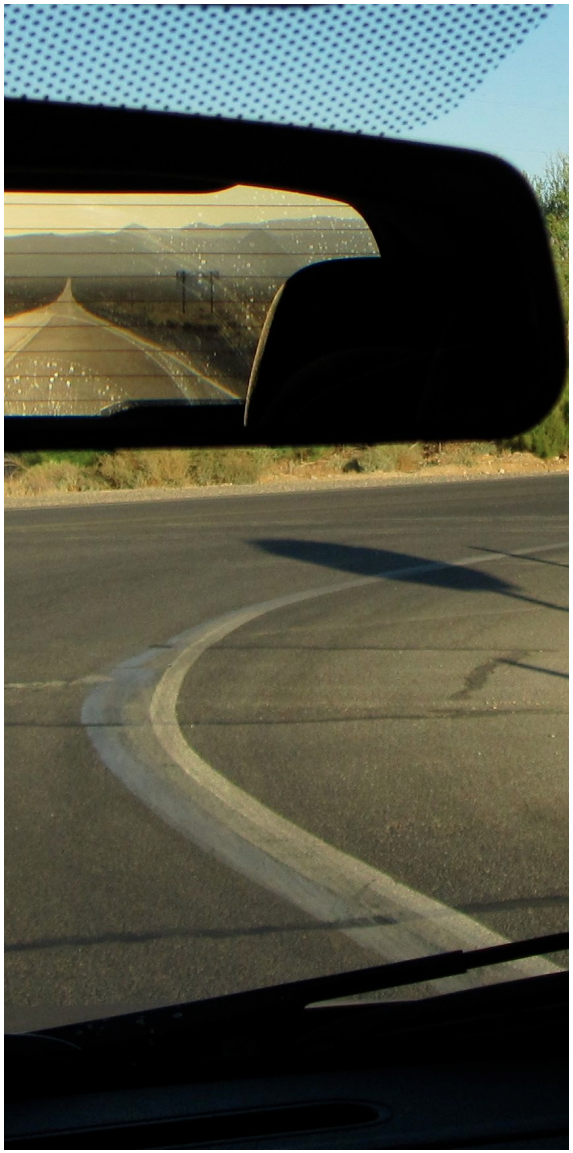
CMS PAS SUS-10-001 (Proof of concept using $12.37 nb^{-1}$)





- Simultaneously fit signal (shape from MC) and Background (in final analysis from QCD selection) to isolation distribution with all other cuts
- Extrapolate background to isolated region (rel. iso < 0.25)

Conclusion



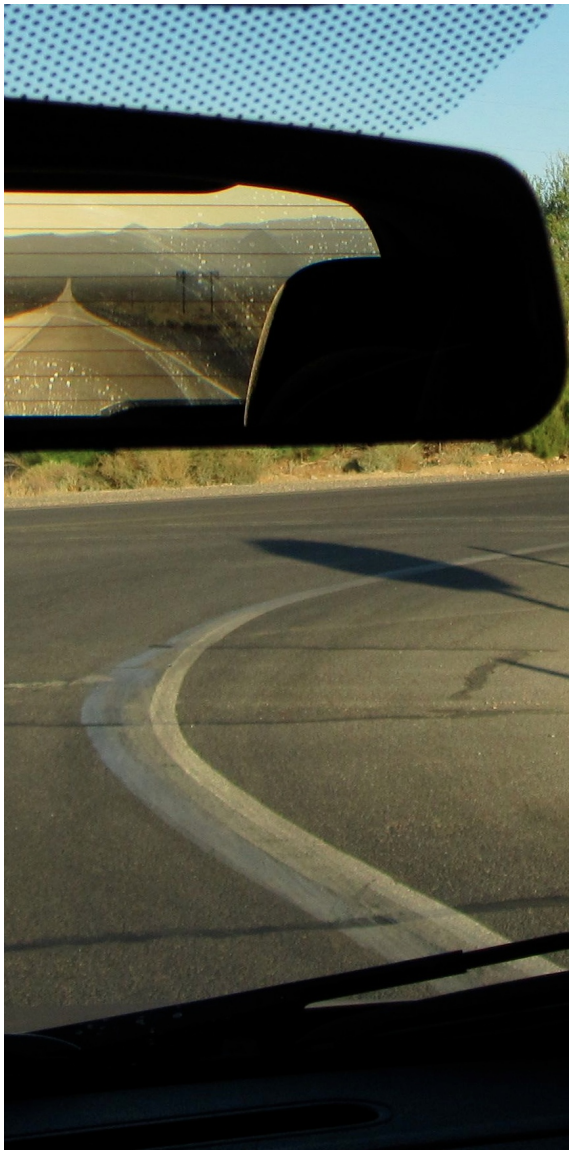
CMS Dilepton SUSY searches by the Aachen group

- Cover both same and opposite sign channels
- Use hadronic τ decay reconstruction to extend reach
- Use data-driven methods to estimate background and efficiencies where ever possible (could not show all here)

Ongoing work

- Looking at full 2010 pp-collision sample, but no public results, yet.
- Correct combination of the 9 channels is nontrivial
- Preparing for 2011 data

Conclusion



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Lepton analysis started by the DESY group

- Work in progress, results to be expected next year
- Same-sign e and μ analysis: Matthias Stein
- Opposite-sign e and μ analysis: Hannes Schettler
- Single e and μ analysis: Niklas Pietsch

The End

CMS Low Mass Benchmark-Points

Benchmark	m0	m1/2	A0	tanb	sgn(mu)
LM0	200	160	-400	10	1
LM1	60	250	0	10	+
LM2	185	350	0	35	+
LM2mhf360	185	360	0	35	+
LM3	330	240	0	20	+
LM4	210	285	0	10	+
LM5	230	360	0	10	+
LM6	85	400	0	10	+
LM7	3000	230	0	10	+
LM8	500	300	-300	10	+
LM9	1450	175	0	50	+
LM9p	1450	230	0	10	+
LM9t175	1450	175	0	50	+
LM10	3000	500	0	10	+
LM11	250	325	0	35	+
LM12	2544.58	246.564	-865.752	47.5897	+
LM13	270	218	-553	40	+