Search for new physics in same-sign di-lepton events at CMS

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Introduction:

We search for **new physics** in events with two equally charged, isolated leptons, hadronic activity and missing transverse energy in the final state.

The analysis is performed in the full **2011 dataset recorded by CMS**, corresponding to an integrated luminosity of **4.98 fb^{-1}** produced in proton-proton collisions at a **center-of-mass energy of 7 TeV**. The observations agree well with predictions from the standard model (SM) and thus **no evidence for new physics** is found.

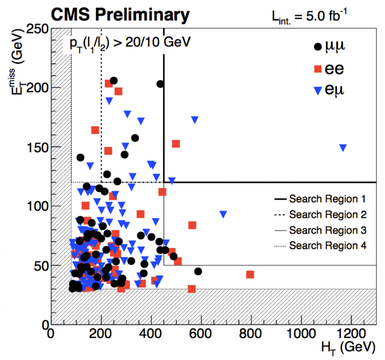
Object and event selection:

- two same-sign leptons (e or μ)
  - --> **p_T > 20/10 GeV**
  - --> well **isolated**
- varying requirements on hadronic activity
  - --> **H_T := scalar sum of jet-p_Ts**
- different cuts on missing transverse (ME_T)
  - --> **ME_T := negative vectorial sum of all p_Ts**
- motivated by trigger thresholds and new physics models (SUSY)

Search regions and yields:

binned in H_T and ME_T --> 228 events passing baseline selection

	$H_T > 80$ $E_T^{miss} > 30$	$H_T > 80$ $E_T^{miss} > 120$	$H_T > 200$ $E_T^{miss} > 120$	$H_T > 450$ $E_T^{miss} > 50$	$H_T > 450$ $E_T^{miss} > 120$
Double Fakes	35.7 ± 17.9	-0.1 ± 0.1	0.0 ± 0.1	0.2 ± 0.2	0.0 ± 0.1
Single Fakes	215.8 ± 108.3	18.5 ± 9.5	13.4 ± 7.0	6.1 ± 3.5	1.4 ± 1.2
Charge MisID	12.9 ± 1.4	0.7 ± 0.1	0.4 ± 0.1	0.3 ± 0.0	0.1 ± 0.0
Rare SM	80.7 ± 40.4	13.1 ± 6.7	10.6 ± 5.5	6.8 ± 3.7	3.2 ± 2.2
Total Bkg	**345.0 ± 132.3**	**32.1 ± 11.5**	**24.3 ± 8.8**	**13.5 ± 5.1**	**4.7 ± 2.5**
Observed	**228**	**24**	**21**	**11**	**4**



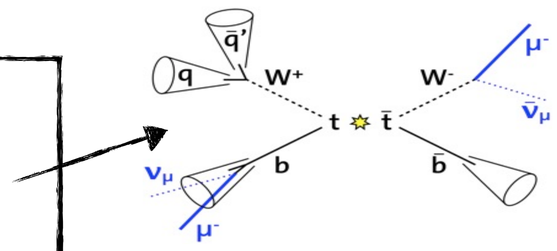
Backgrounds:

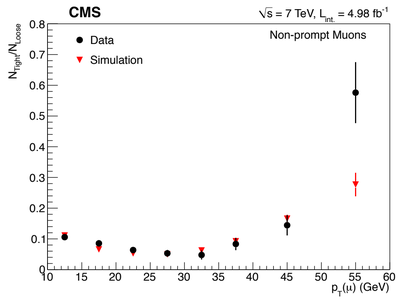
Fake leptons:

- e.g. **b-quark decays**, mis-reconstructed **jets**, etc.
- notoriously hard to model in simulation
  - --> **estimate** by **fully data-driven technique**
- extrapolation in isolation
  - --> from **sidebands to signal selection**
- **estimate** fractions of **prompt/non-prompt** events **from tight/loose** yields
- measure **f/p-ratios in data**
- employ algebraic equations:

$$N_{pf} = \frac{1}{(p-f)^2}\left[-2fpN_{ll} + [f(1-p)+p(1-f)]\,N_{tl} - 2(1-p)(1-f)N_{tt}\right]$$

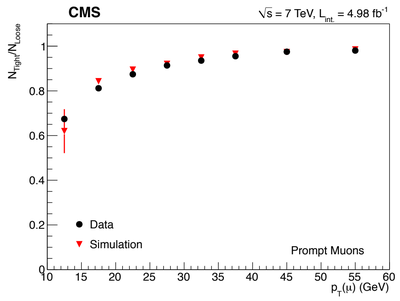
$$N_{ff} = \frac{1}{(p-f)^2}\left[p^2N_{ll} - p(1-p)N_{tl} + (1-p)^2N_{tt}\right]$$





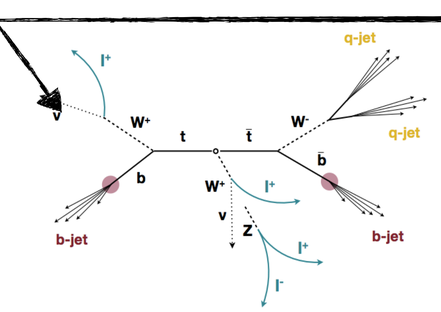
Charge mis-ID:

- negligible for muons
- **probability about 10^{-3} and 10^{-4}** for electrons
  - --> depending on detector region
- measured in **Z -> ee** events
- fully data-driven



SM processes:

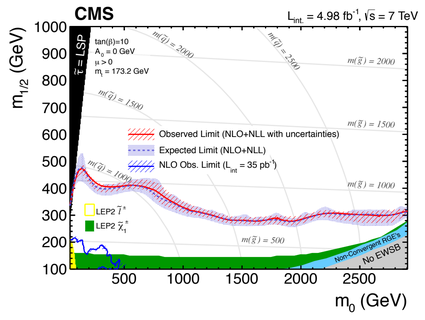
- **very rare**, but no longer insignificant
- most common: WZ production
  - --> $W^{\pm}W^{\pm}$
  - --> ttW / ttZ
  - --> ZZ, tri-boson production etc.
- taken from Monte Carlo simulation



Interpretation:

- **no excess** observed
  - --> **upper limits** are set
- **common effort** with other participating groups
- done in **cMSSM** model

- results are public, **accepted by PRL**
  - -->more details: **http://arxiv.org/abs/1205.6615**



Results: