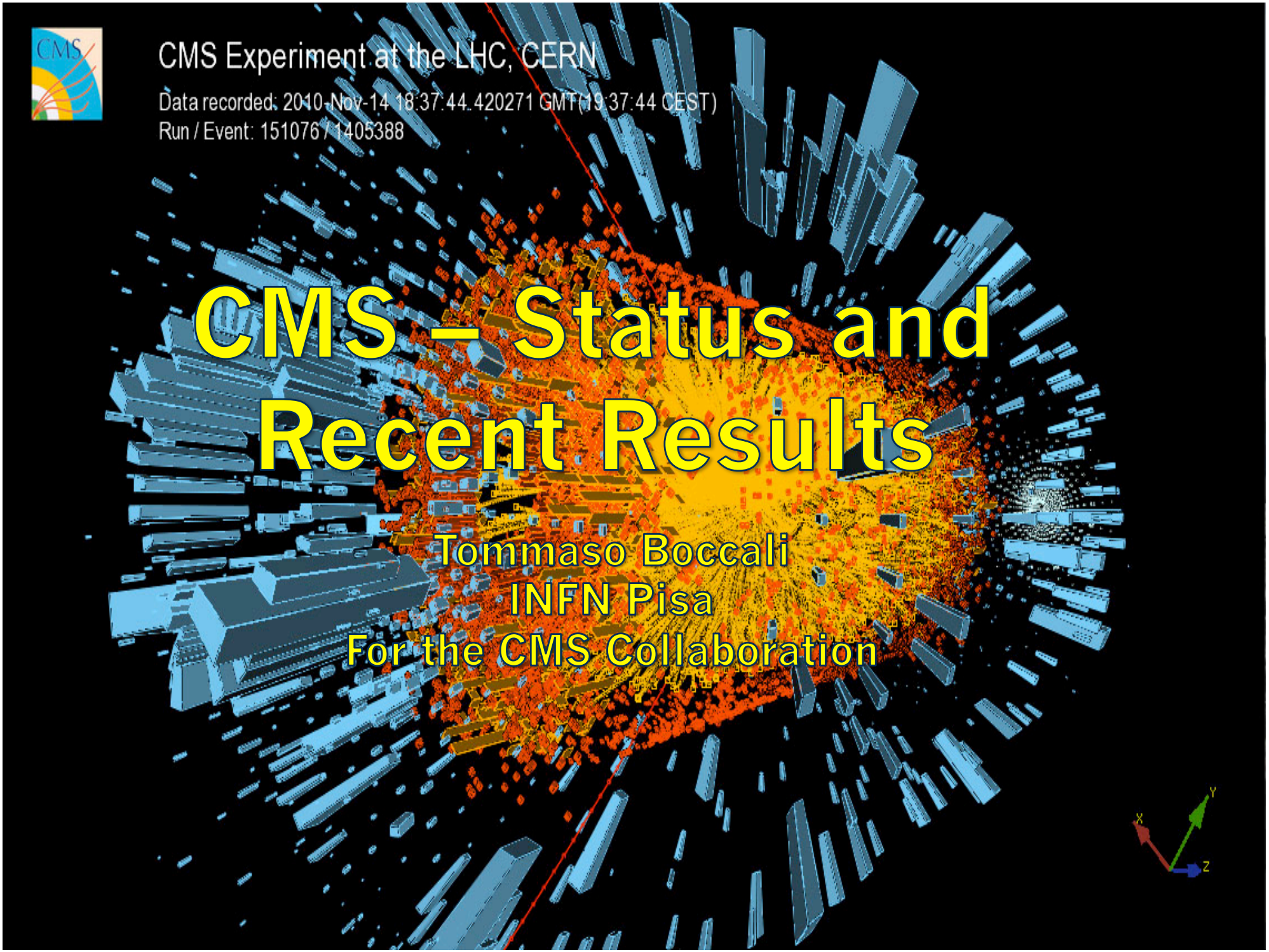
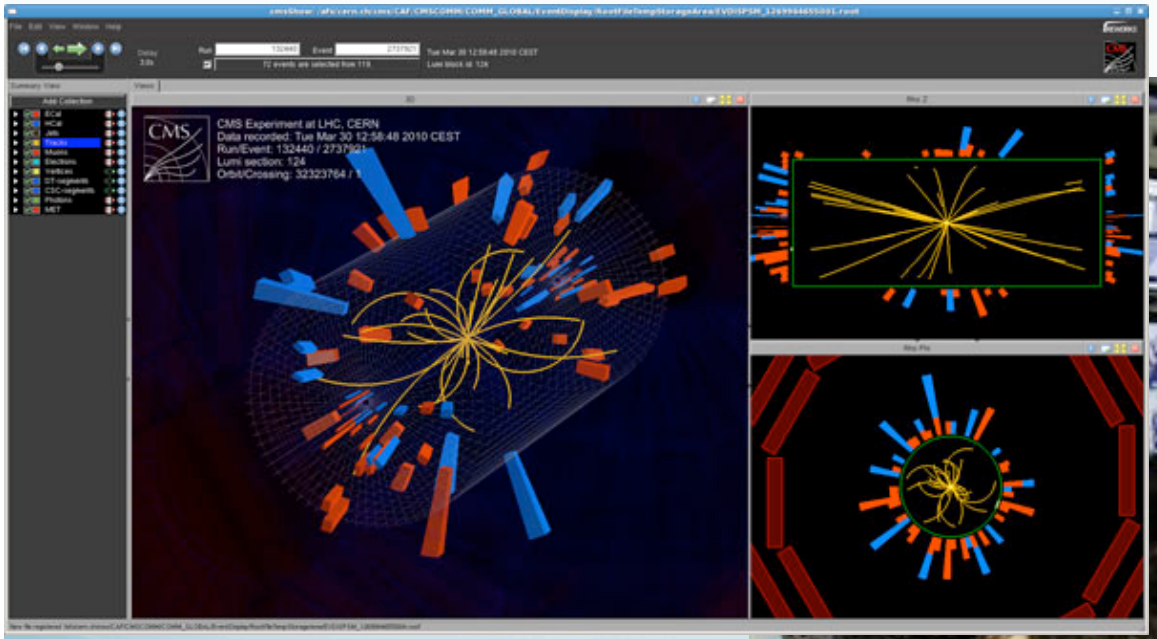
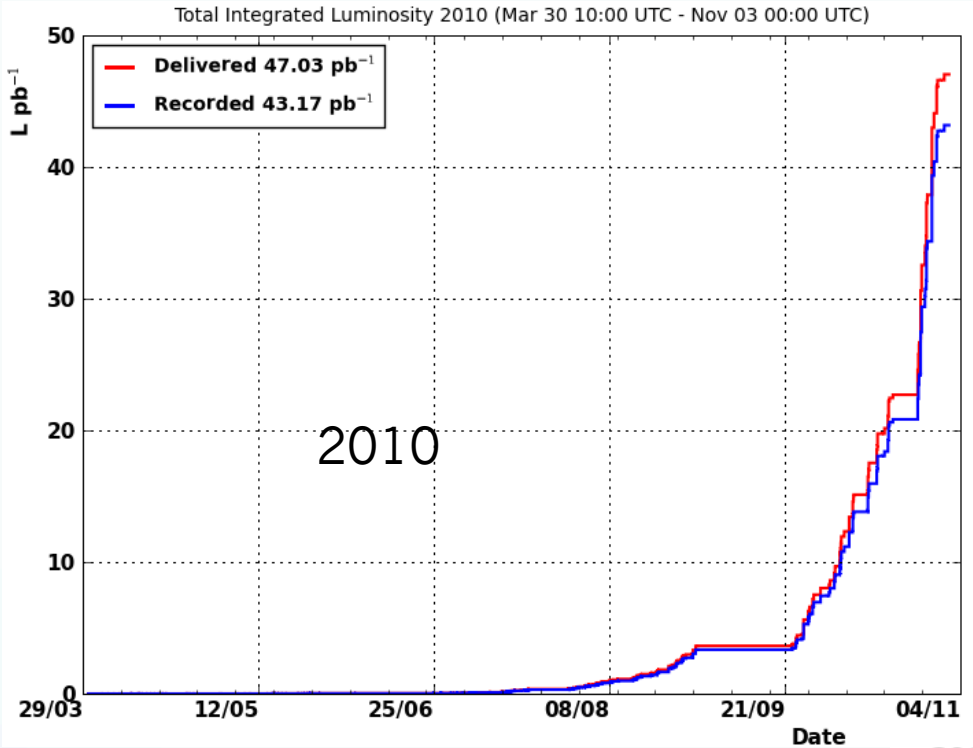

CMS Experiment at the LHC, CERN
Data recorded: 2010-Nov-14 18:37:44.420271 GMT(19:37:44 CEST)
Run / Event: 151076 / 1405388
CMS – Status and Recent Results
Tommaso Boccali
INFN Pisa
For the CMS Collaboration
Y
X
Z

History so far

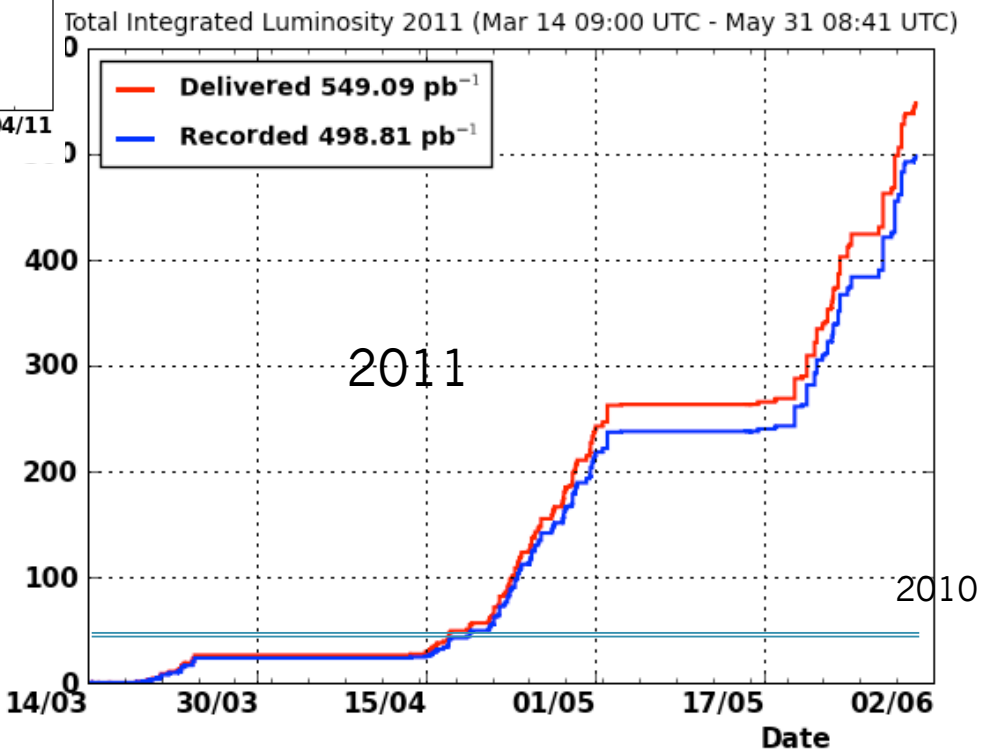
- March 30th 2010 @ 12:58
- … and less than 5 months later: > 30 results @ ICHEP10



2010-2011: LHC



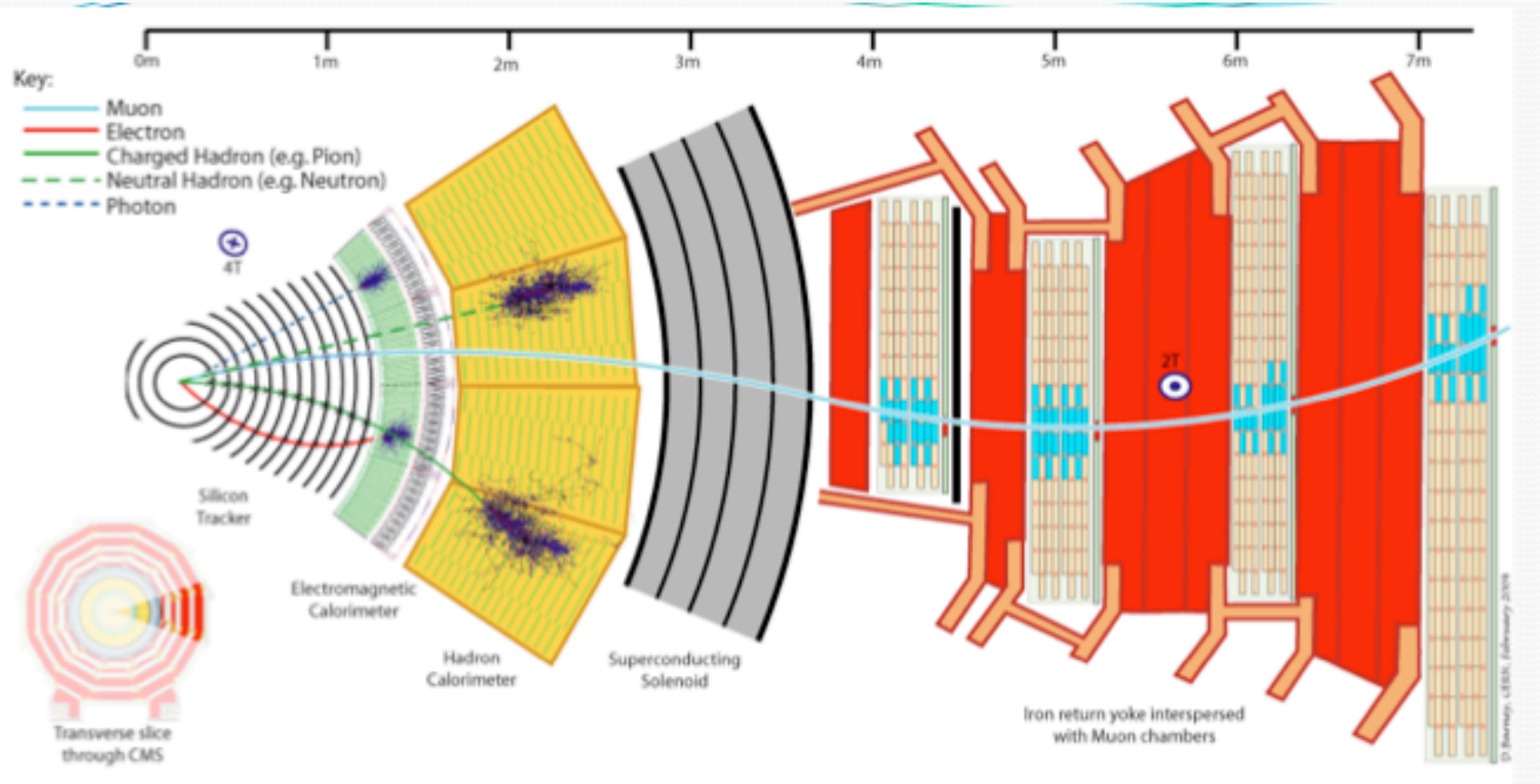
Instantaneous Lumi from 10^{27} to >$2x10^{32}$ $cm^{-2}s^{-1}$ (x2 the target)
More than 40/pb collected and usable for analysis
Up to 368 bunches colliding
150 ns minimum bunch spaces
All results presented here are using this data



Instantaneous lumi broke the record of $1.27x10^{33}$ last week
Up to 1404 (now 1092) bunches with 50 ns bunch spacing (which means LHC is full!)
Expected an integrated lumi somewhere in the 1-3/fb
In these days we collect around 2010 equivalent lumi in one (good) day

2010

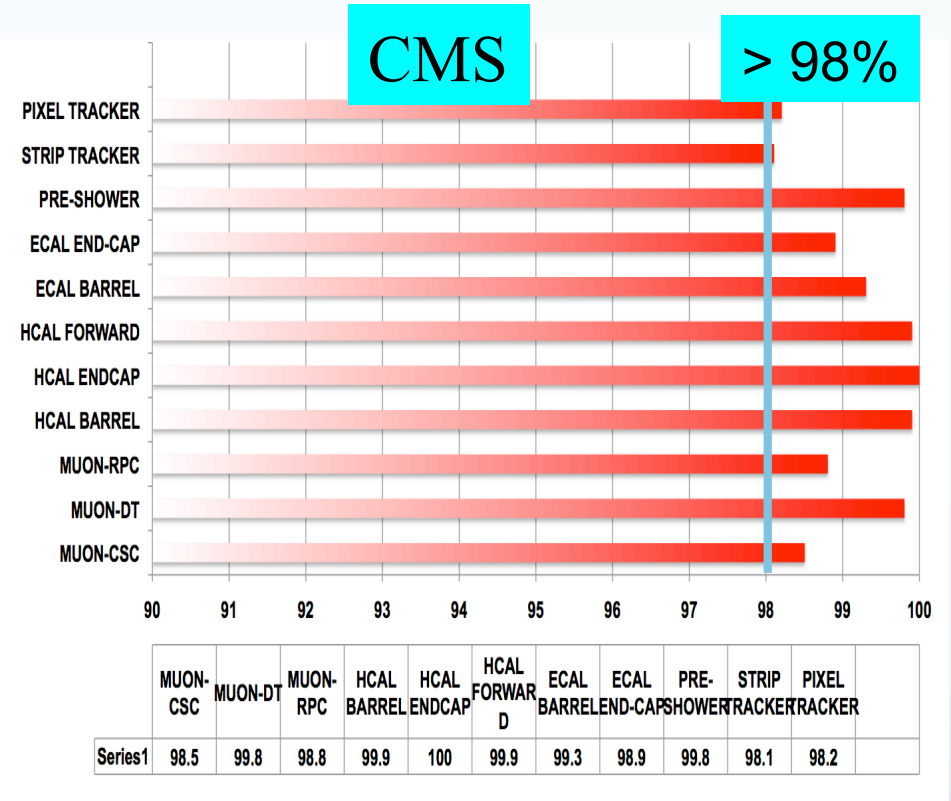
CMS detector



- All silicon tracker design (pixel + strip)
- High resolution electromagnetic calorimeter with 0.5% resolution @ Et=50 GeV
- Hadronic calorimeter for jets and hadrons
- Muon system with gaseous detectors to efficiently trigger and reconstruct muons

CMS - operations

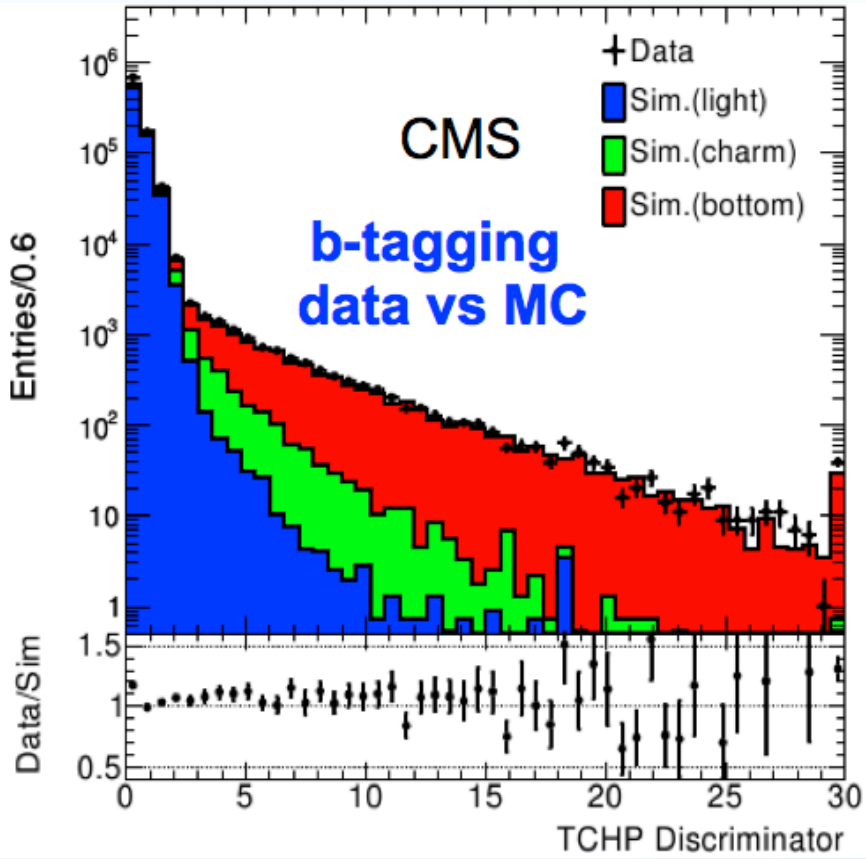
- CMS has overall ~ 100 M electronic channels
- While CMS design is redundant and would allow for high quality physics even with problematic subdetectors ...
- ... the status of CMS, also after ~1 year of operations, is really good
- Current data could be compared with IDEAL detector simulations without issues
  - ...but of course, we are also simulating the percent level issues



	MUON-CSC	MUON-DT	MUON-RPC	HCAL BARREL	HCAL ENDCAP	HCAL FORWARD	ECAL BARREL	ECAL END-CAP	PRE-SHOWER	STRIP TRACKER	PIXEL TRACKER
Series1	98.5	99.8	98.8	99.9	100	99.9	99.3	98.9	99.8	98.1	98.2

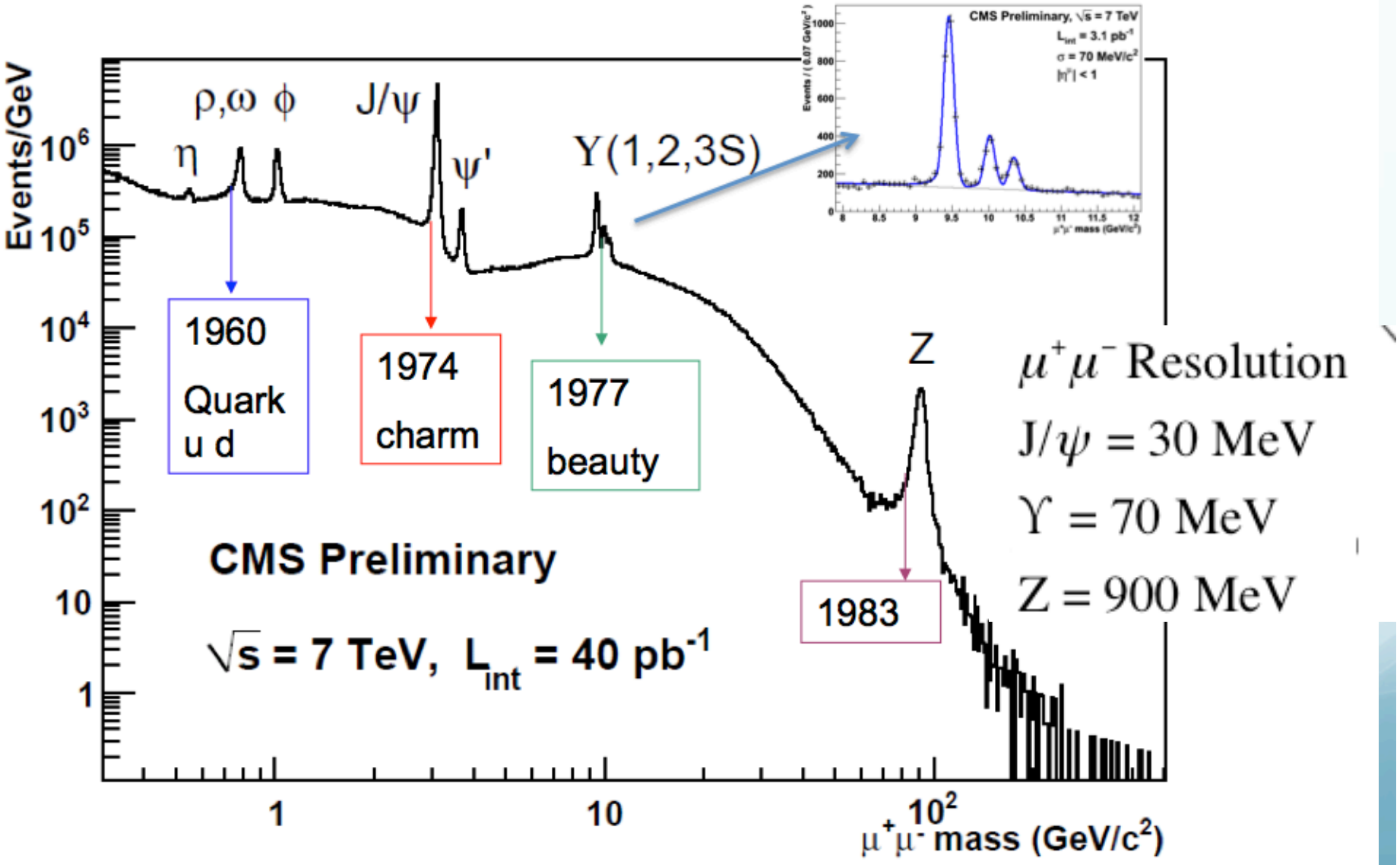
Detector understanding

- The understanding of the physics objects has been spectacular practically since the beginning
  - Data driven estimates on efficiencies, resolutions and performance have shown from the start very similar to our simulated startup scenarios
  - Calibration with data has already reached design precision for most of the objects
  - Just an example: out-of-the-box-btagging using out of the box tracking, vertexing, jet reconstruction

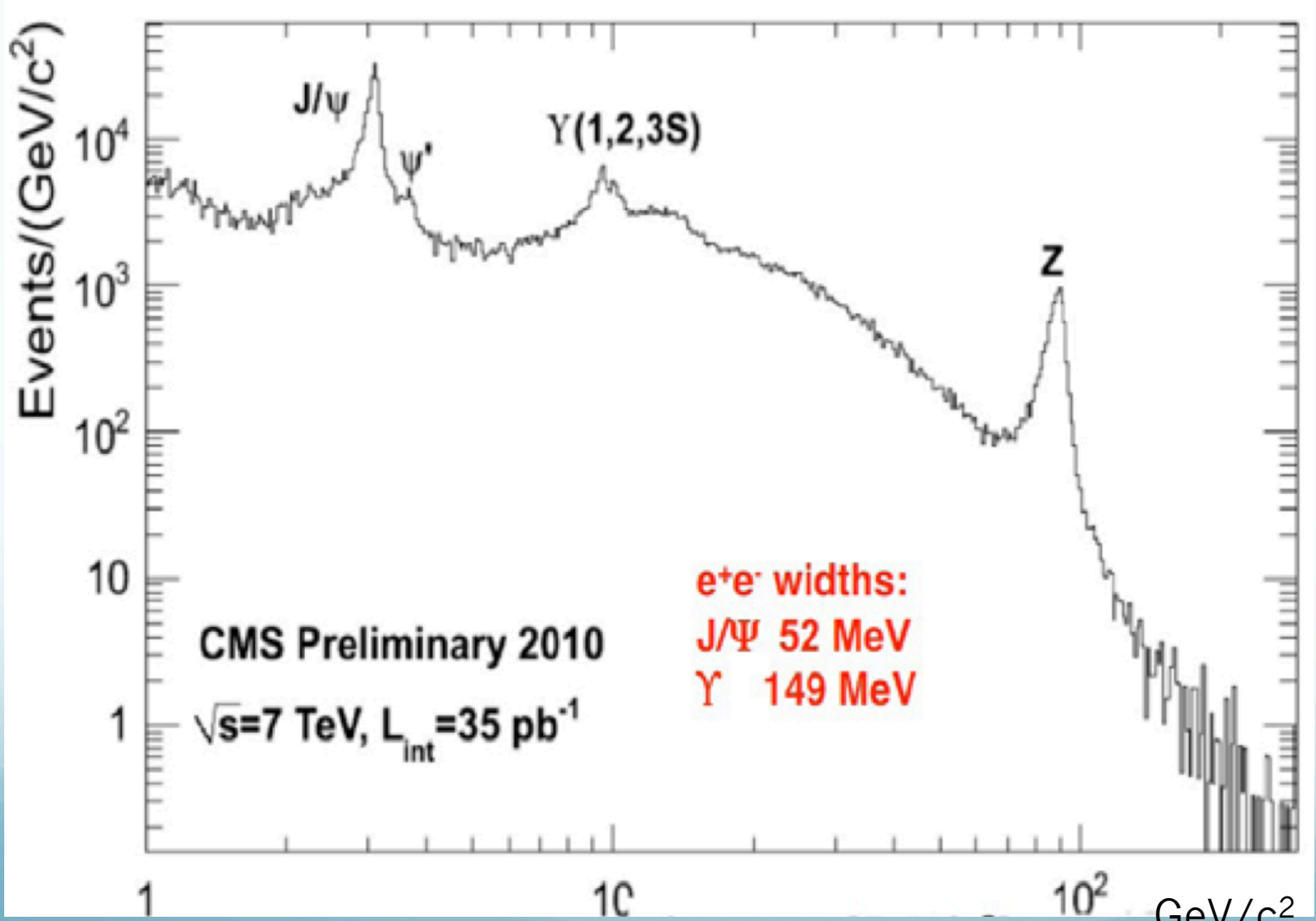


Uncalibrated btagging at startup
Comparable with simulations spanning 6 orders of magnitude (Y) and 30 sigmas (X)
TCHP ~ IP/σ(IP)

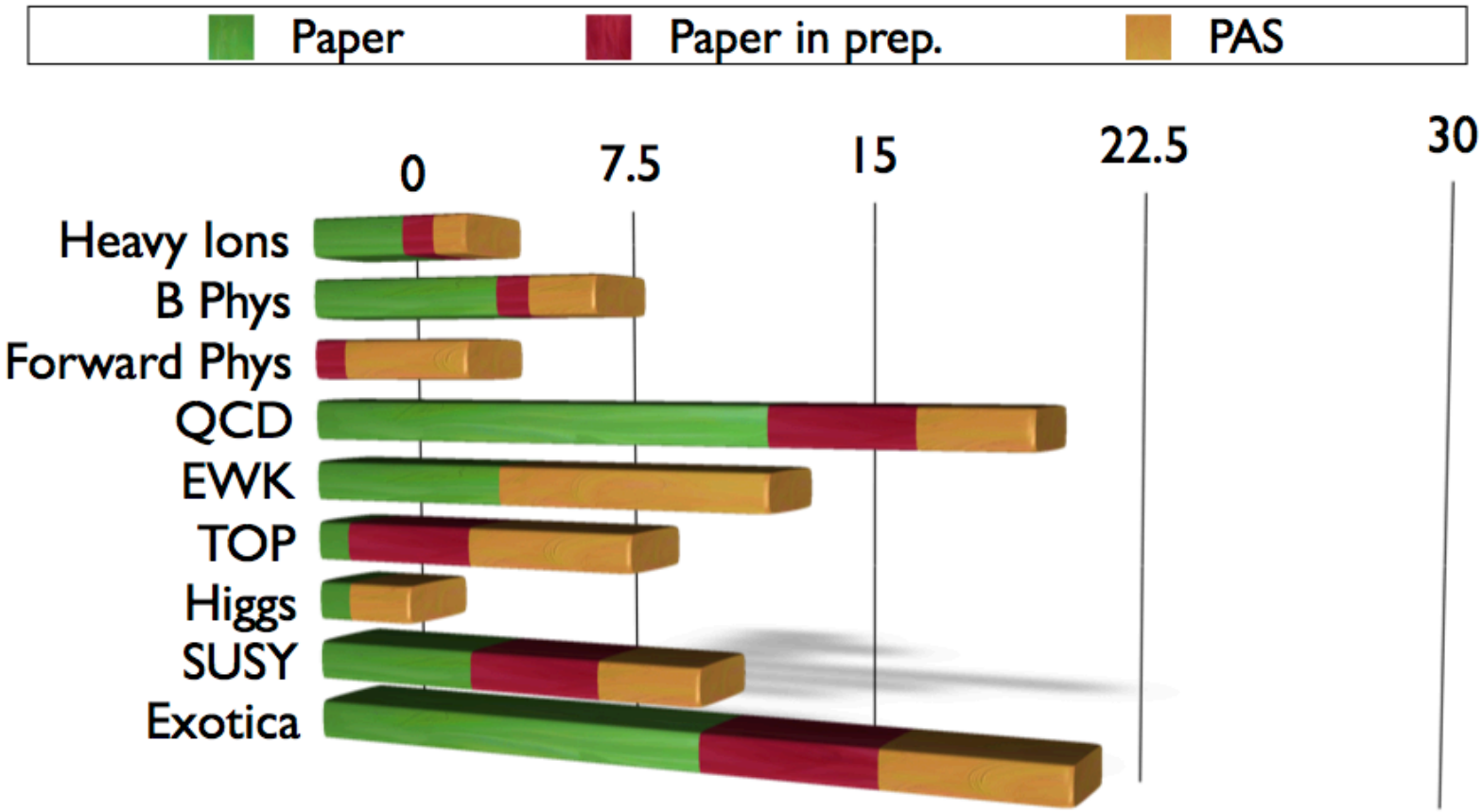
The ‘M’ in CMS


Events/GeV
10^6
10^5
10^4
10^3
10^2
10
1
ρ,ω φ
η
J/ψ
ψ'
Υ(1,2,3S)
Z
1960
Quark
u d
1974
charm
1977
beauty
1983
CMS Preliminary
$\sqrt{s}$ = 7 TeV, L_{int} = 40 pb^{-1}
1
10
10^2
$\mu^+\mu^-$ mass (GeV/c^2)
CMS Preliminary, $\sqrt{s}$ = 7 TeV
L_{int} = 3.1 pb^{-1}
σ = 70 MeV/c^2
$|\eta^\mu|$ < 1
$\mu^+\mu^-$ Resolution
J/ψ = 30 MeV
Υ = 70 MeV
Z = 900 MeV

The ‘E’ is missing in the name, but …



Results (as of some weeks ago)



In total : **99** physics analyses approved so far
48 papers completed (published, accepted, or submitted)
19 papers close to submission
32 analyses with a Public Analysis Summary

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

(and expect many more for Summer Conferences, on 2011 data)

What can I show here?

- Some selected results on:
  - Standard model rediscovery
    - Electroweak, QCD, B physics…
  - Top physics
    - From signal to background…
  - Higgs searches
    - Results + prospects on 2011 data …
  - New physics – searches
    - Current SUSY + some Exotica limits …
  - No time for HI, sorry
    - *but* please note these would be worth a talk on their own!

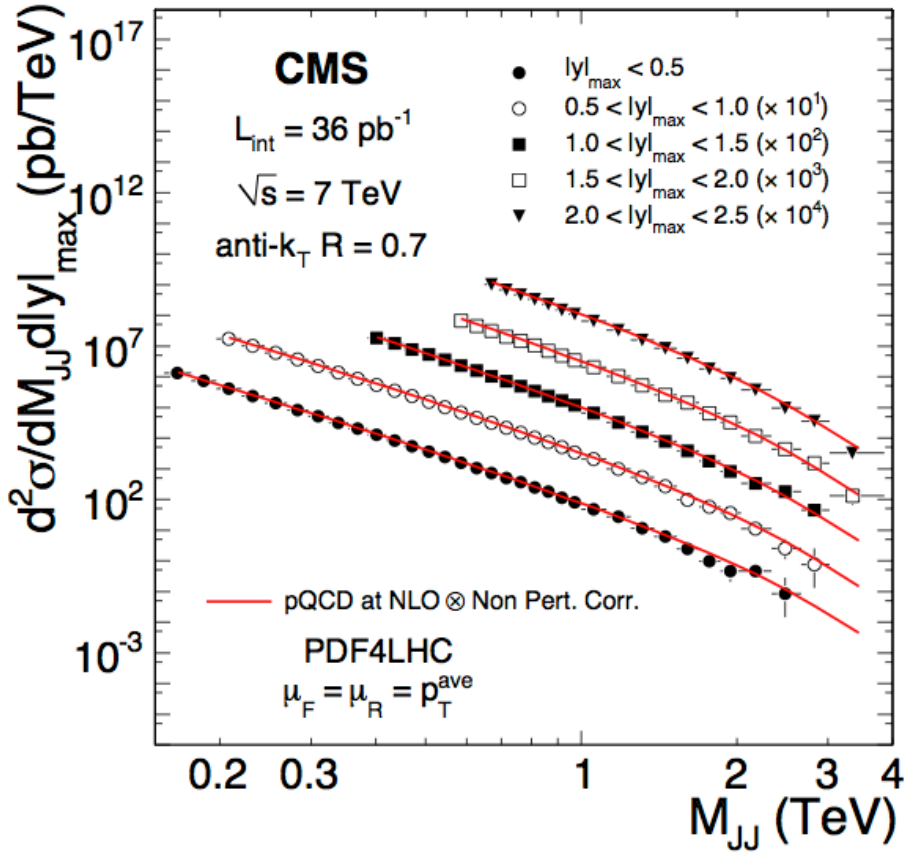
QCD and Jets

- Will show just
  - Dijet mass

- Full list of public results:
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsQCD
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsJME

Dijet mass

- Dijet mass in doubly differential form (Pt and eta)
  - Ranging from 200 GeV to 3.5 TeV
  - Both a QCD check and an unbiased look for dijet resonances
- **Important measurement which can be done, for the low mass range, just in the first LHC phase when jet triggers are (were) low**
- Overall excellent understanding of jet production



Minimum jet p_T (GeV)	30	50	70	100	140
$\mathcal{L}_{eff}$(pb^{-1})	0.32	3.2	8.6	19	36

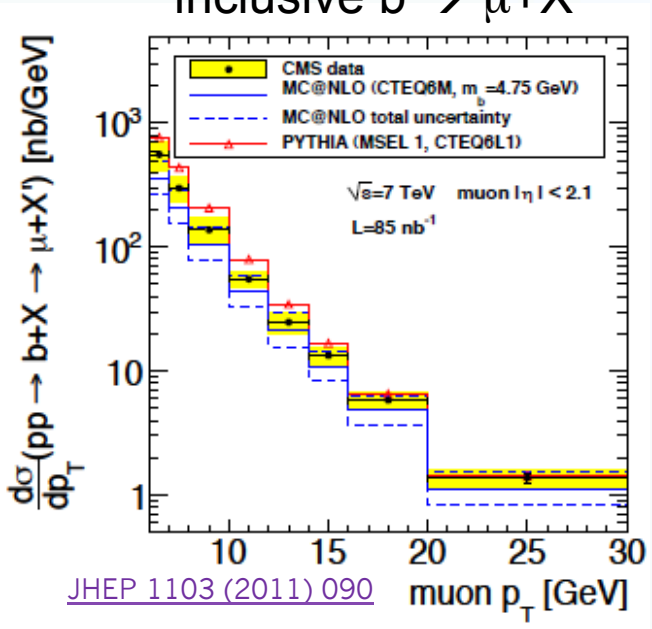
Physics Letters B
Volume 700, Issues 3-4,
13 June 2011, Pages 187-206

B physics

- b/B differential cross sections
  - Full list of results:
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsBPH

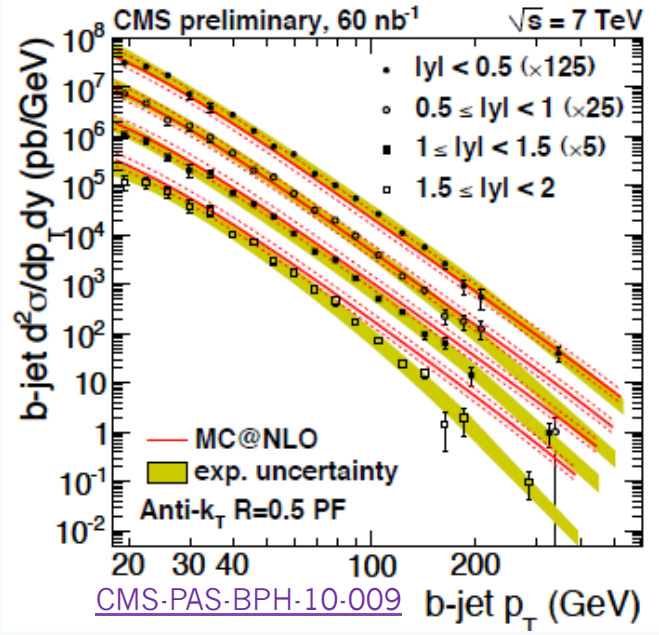
B quark/meson cross sections

inclusive b → μ+X



JHEP 1103 (2011) 090

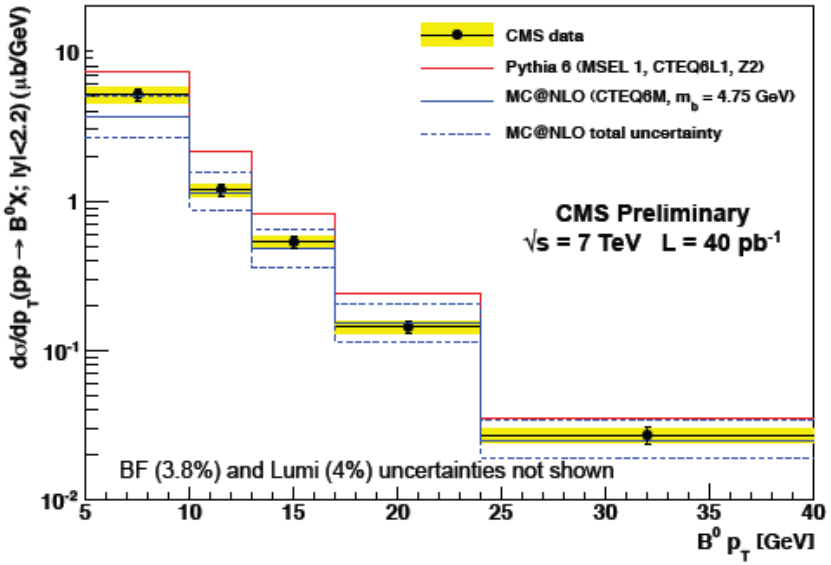
inclusive b jets (with btag)



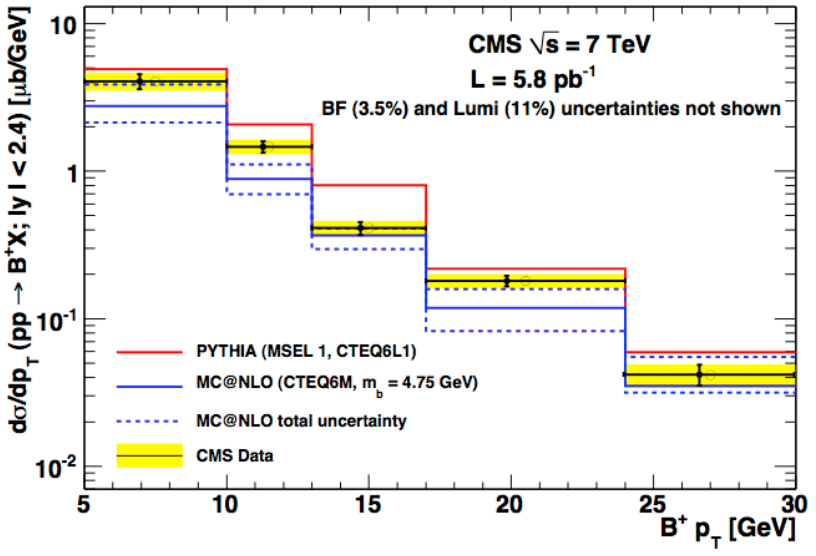
CMS-PAS-BPH-10-009

Results generally between Pythia and MC@NLO

$B^0 \rightarrow J/\Psi K_s$ arXiv:1104.2892



$B^+ \rightarrow J/\Psi K^+$ Phys. Rev. Lett. 106, 112001 (2011)

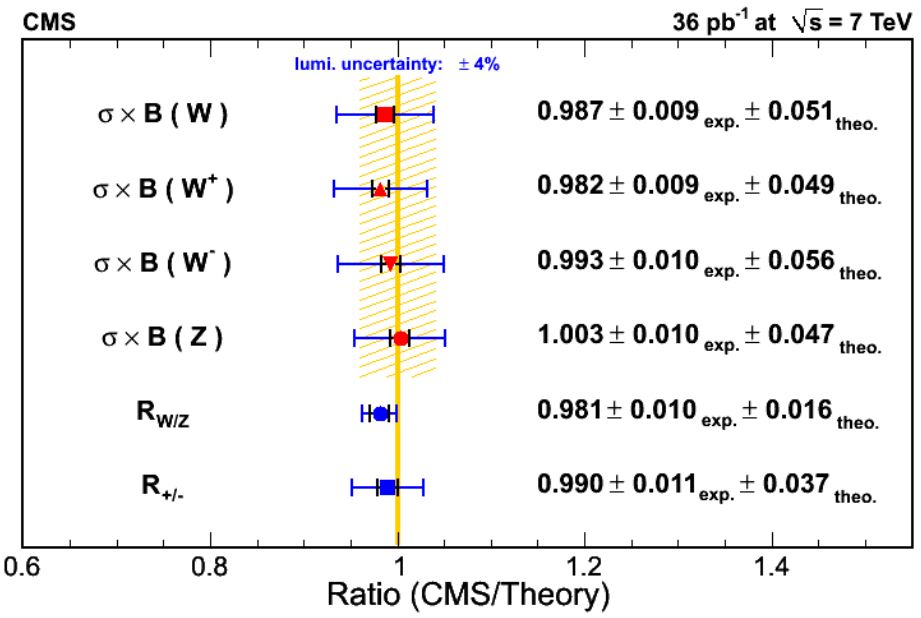


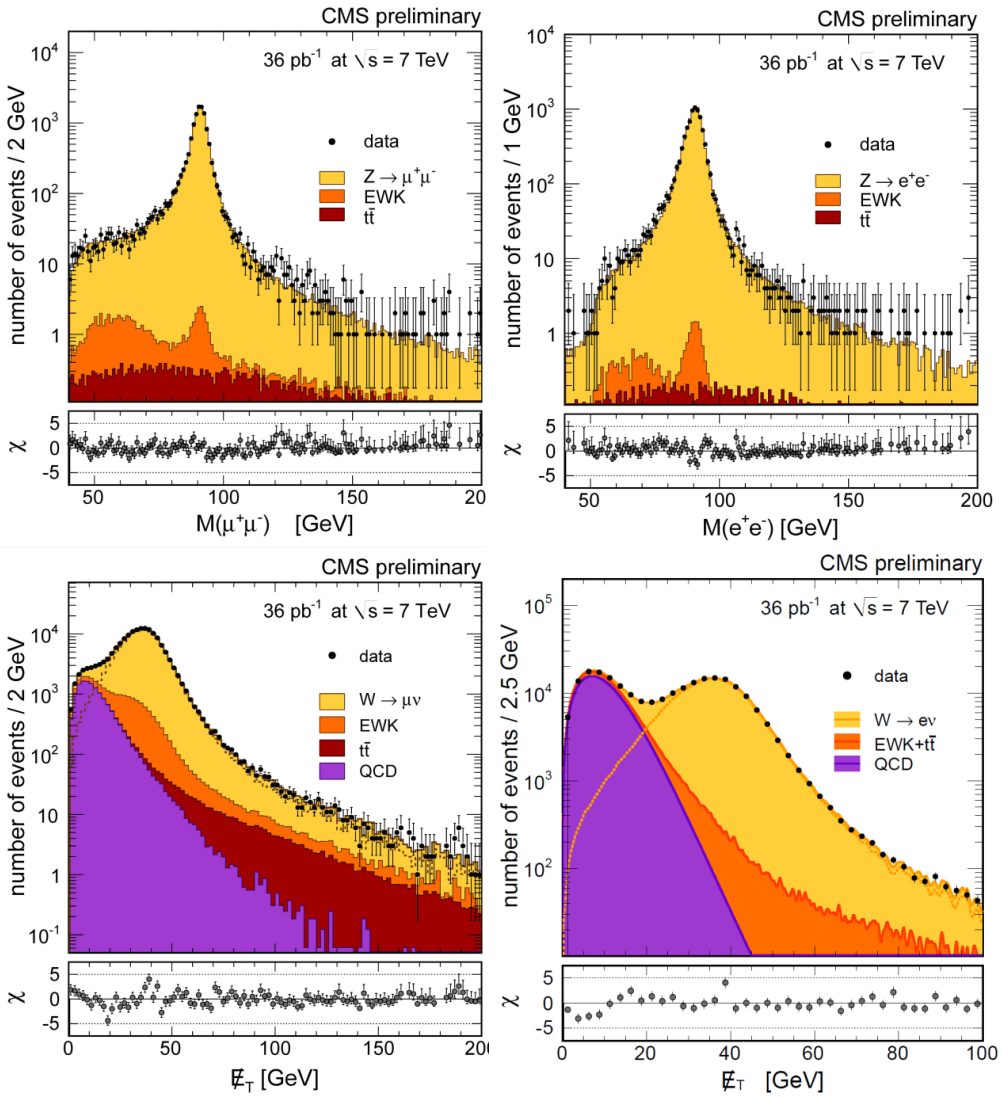
ElectroWeak Physics

- Just showing:
  - W and Z production
  - W/Z plus jets
  - WW cross section
  - Full list of results
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEWK

W and Z production

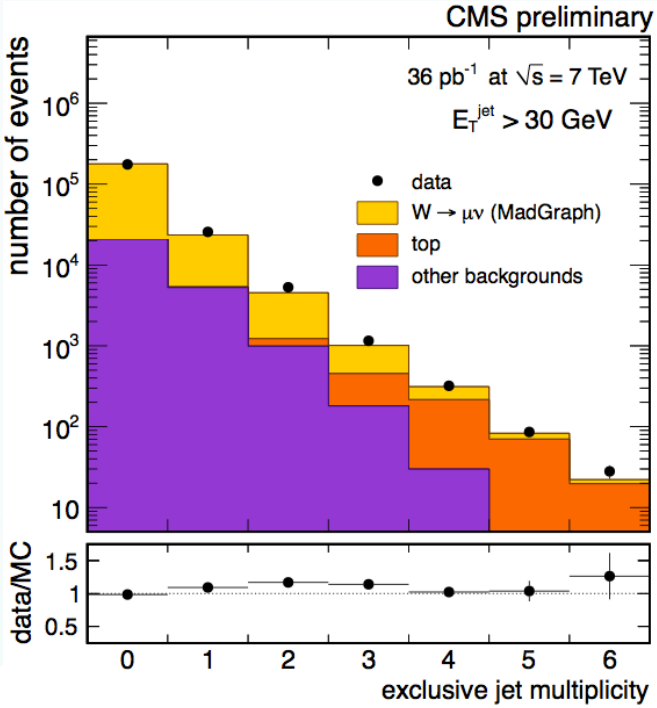
- Z: peak from dileptons
- W: due to the presence of a neutrino, fit MET
  - QCD fully modeled from data
- Good agreement with NNLO+PDF theory predictions
  - Already constraining theory given the 1% experimental precision

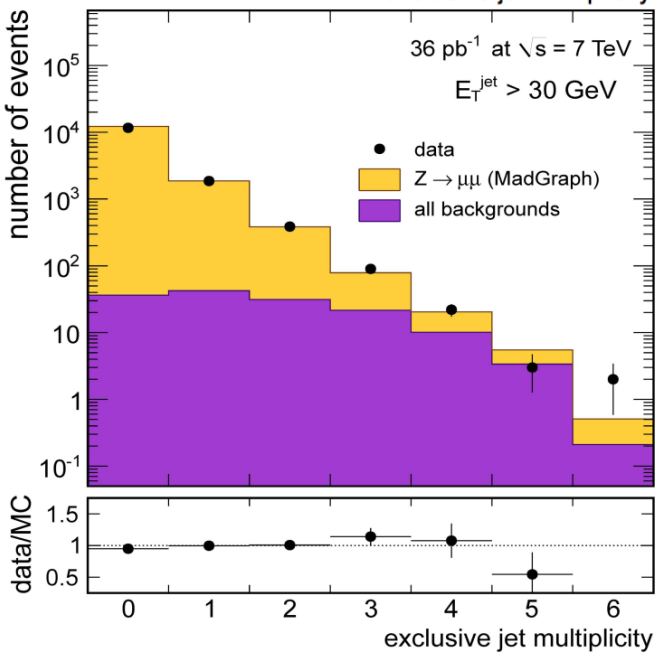


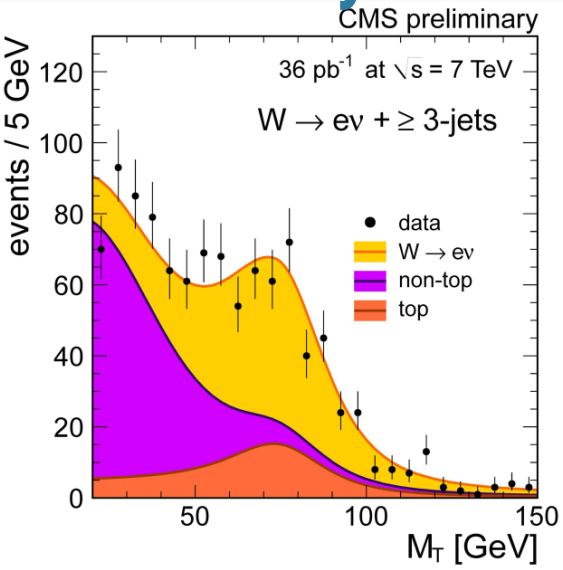


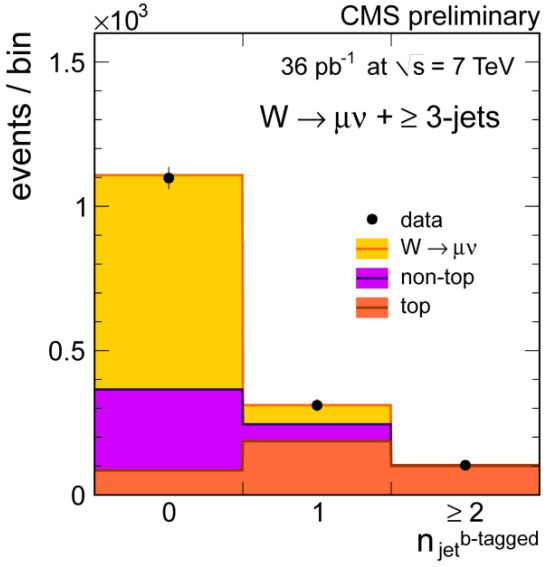
CMS-PAS-EWK-10-005

W/Z + jets







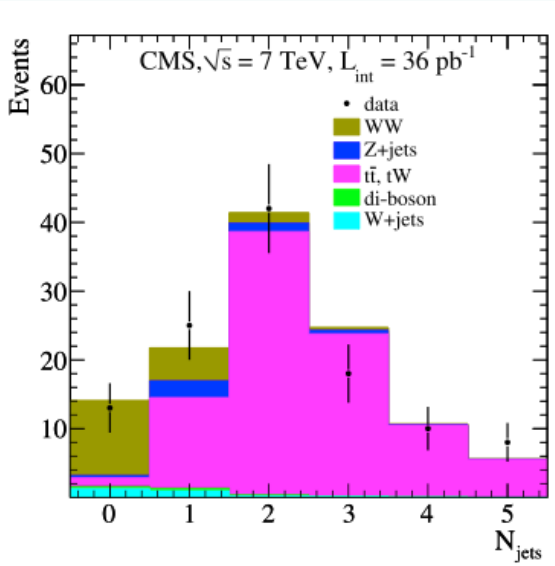


- Important as preparatory work for top analyses, and test of perturbative QCD V+n jets
  - Predictions are for n up to 4 for W, up to 3 for Z
- Search for leptonic decays of W and Z; use btagging to disentangle ttbar component in W sample
  - 2D fit to M_T^W vs $N_{b\text{-jet}}$ distributions
- VB production in excellent agreement with ME + PS matched Monte Carlo model; also first test of Berends-Giele scaling

CMS PAS EWK-10-012

WW, Wγ, Zγ

- WW: important background to H to WW
- Select different sign ee, mumu, mue samples
- Use MET to kill DY background, and a Z veto
- ttbar bkg has higher jet multiplicity

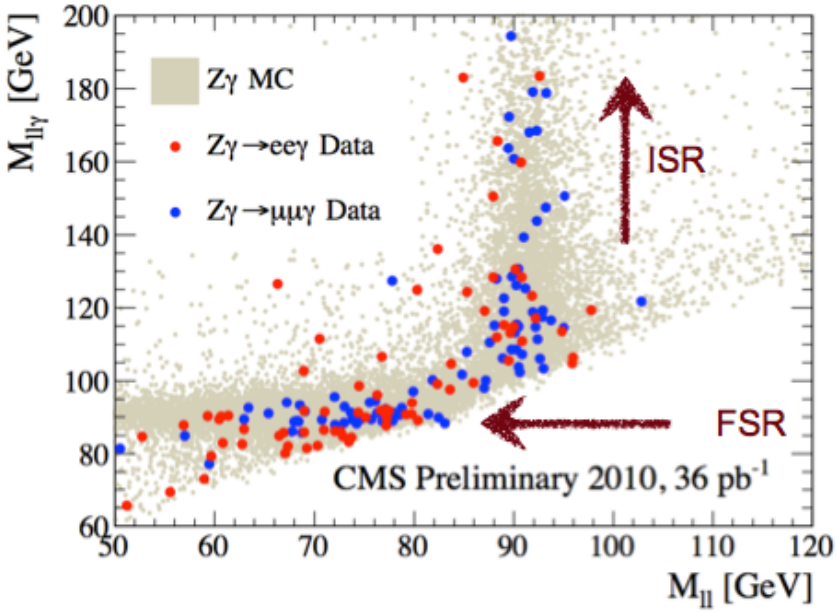


Physics Letters B 699 (2011) 25–47

$$\sigma_{W^+W^-} = 41.1 \pm 15.3\,(\text{stat}) \pm 5.8\,(\text{syst}) \pm 4.5\,(\text{lumi})\ \text{pb}.$$

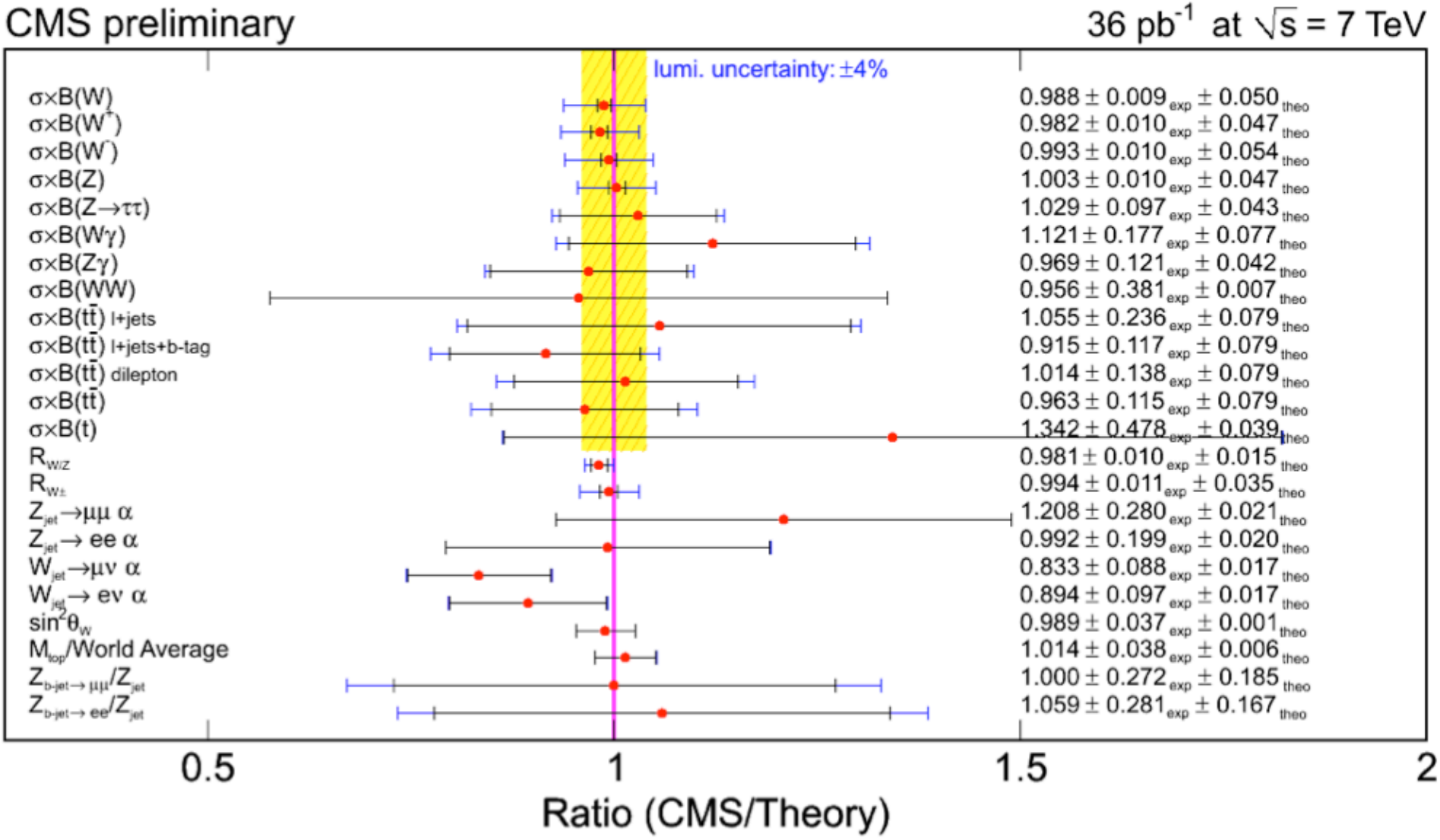
$$\frac{\sigma_{WW}}{\sigma_W} = (4.46 \pm 1.66 \pm 0.64) \cdot 10^{-4}$$

- Wγ, Zγ, with W and Z in lν and ll, with gamma's Et> 10 GeV and lepton/gamma separation> 0.7 in (eta,phi)
- Agreement with SM found, and first lomit on WWγ, ZZγ and Zγγ aTCG @ 7 TeV



arXiv:1105.2758,

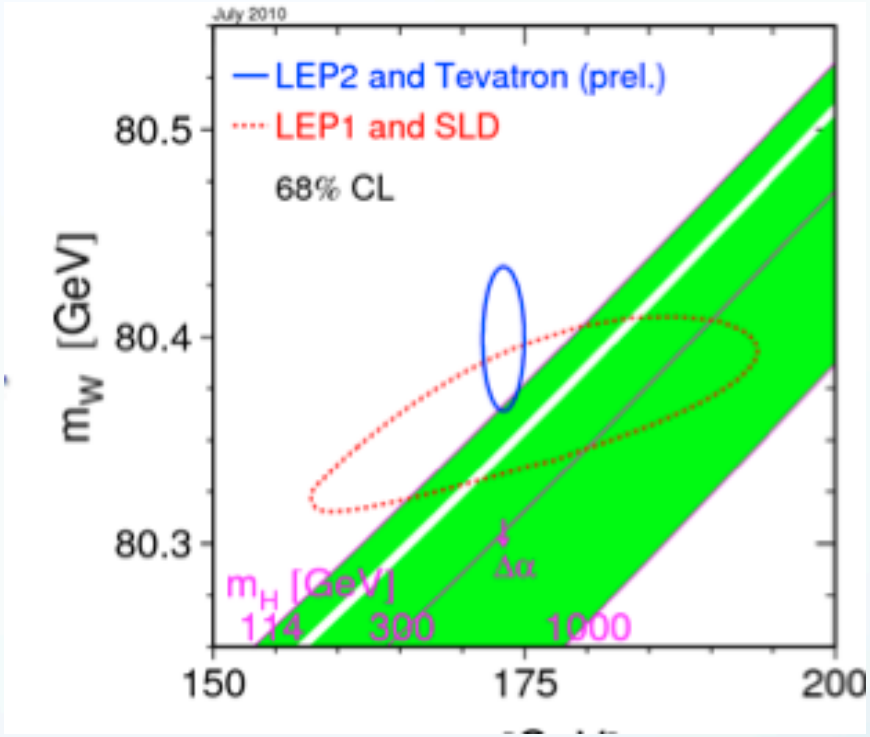
The standard model @ CMS (2010 data)



from P.C.Harris, Moriond EWK 2011

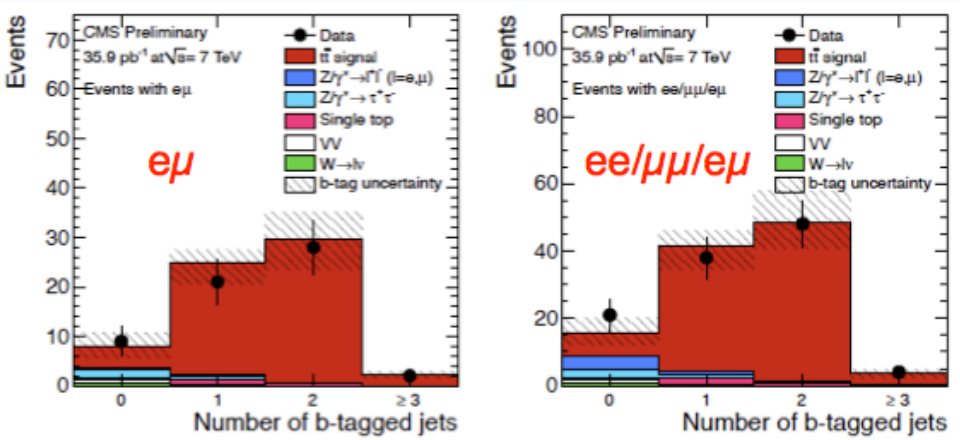
Top

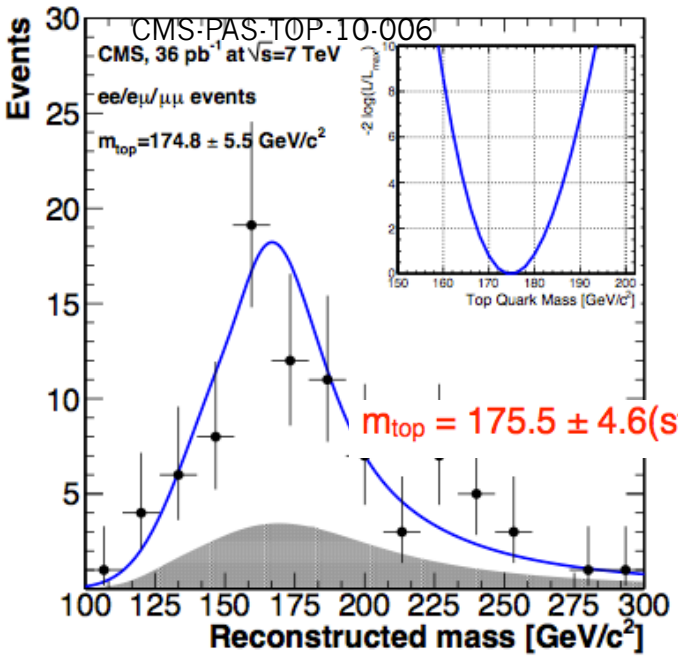
- Why is it interesting?
  - Heaviest particle known up to date
  - Only quark which decays before hadronizing
  - Its mass is one of the parameters which constrain more the EW fit
- Two highlights here
  - Top rediscovery (with mass/xsec measurements)
  - Single top
- Full list of results:
- https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsTOP



The top mass and xsection

- Mass: Search for di-leptonic ttbar decays
- Xsection low, but less background; mostly from lepton misidentification
  - Events with 2 isolated leptons, not compatible with a Z decay; with two or more jets pt>30
  - With sizeable (> 30 GeV) missing Et accounting for the neutrinos
- Xsection:
  - With dileptons
  - With l+jets with and without btagging

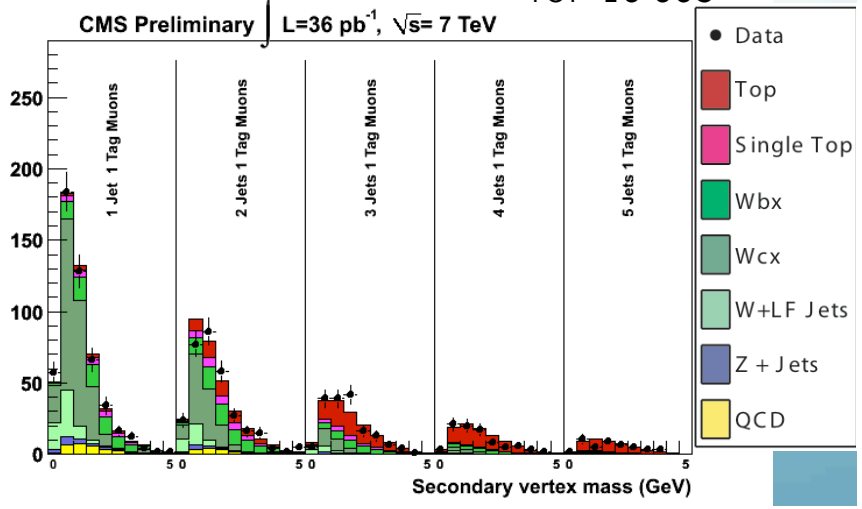




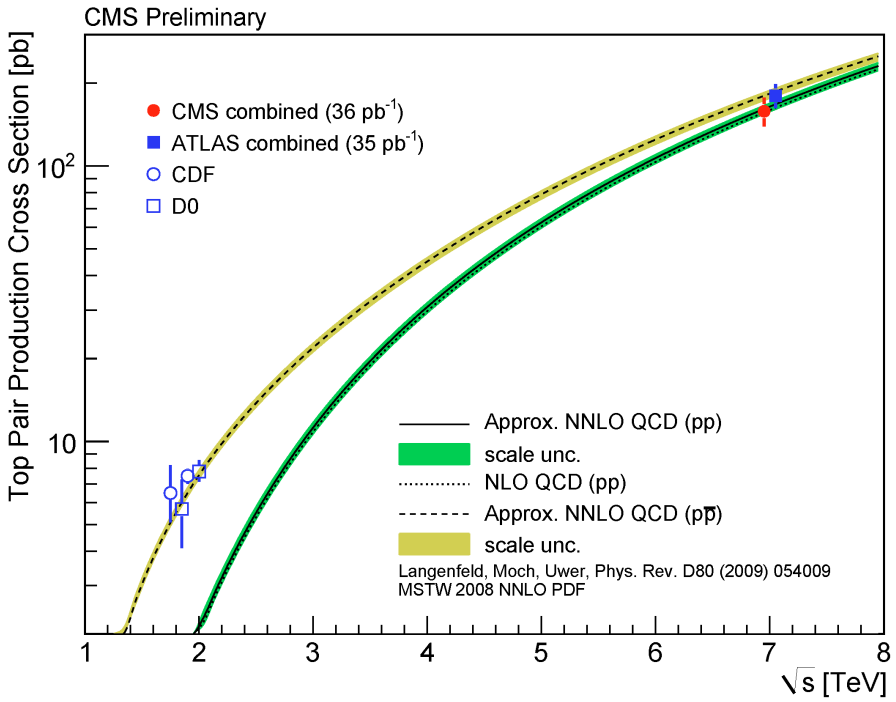
arXiv:1105:5661

m_{top} = 175.5 ± 4.6(stat) ± 4.6(syst) GeV/c²

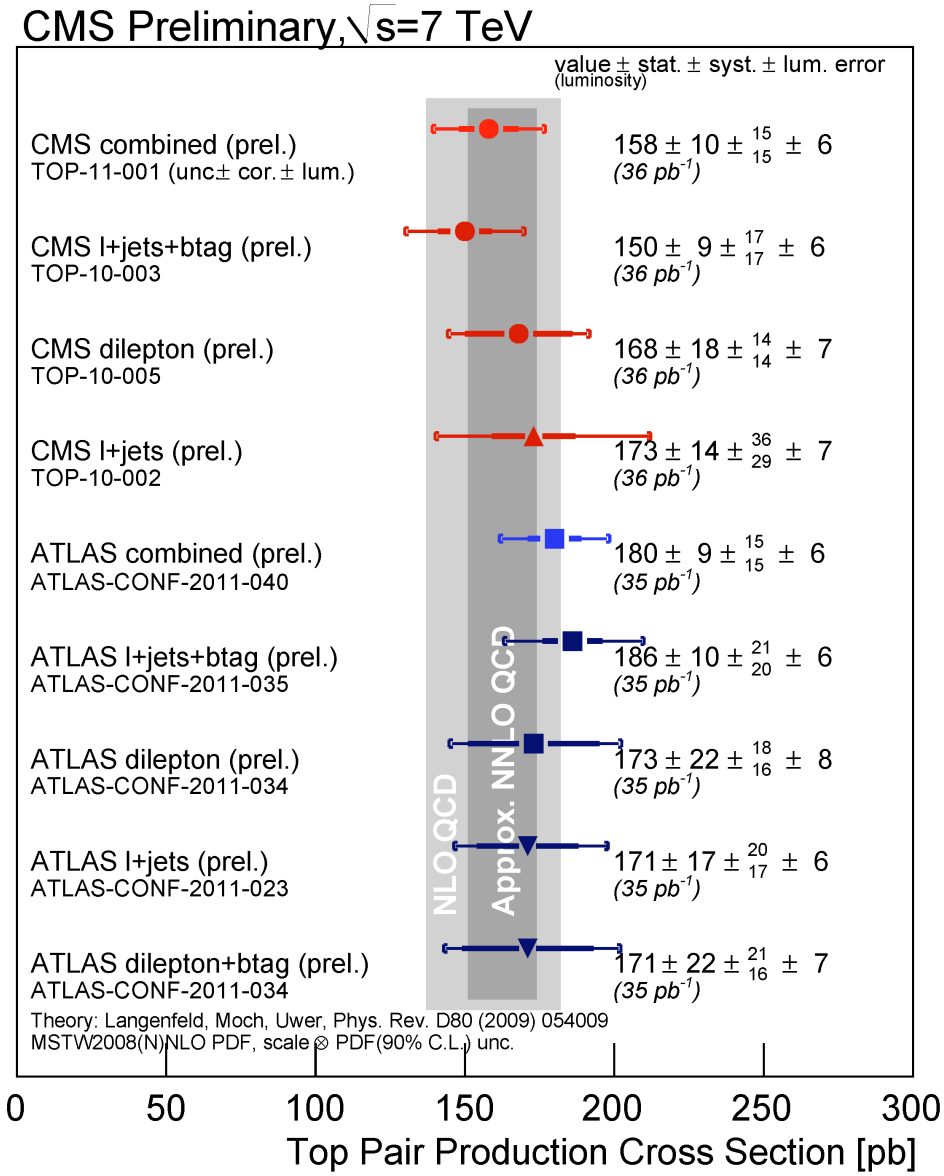
TOP-10-003



Top xsection



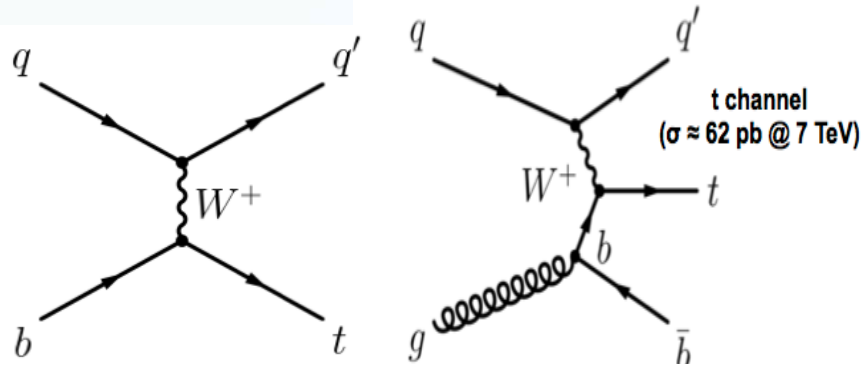
CMS PAS TOP-11-001

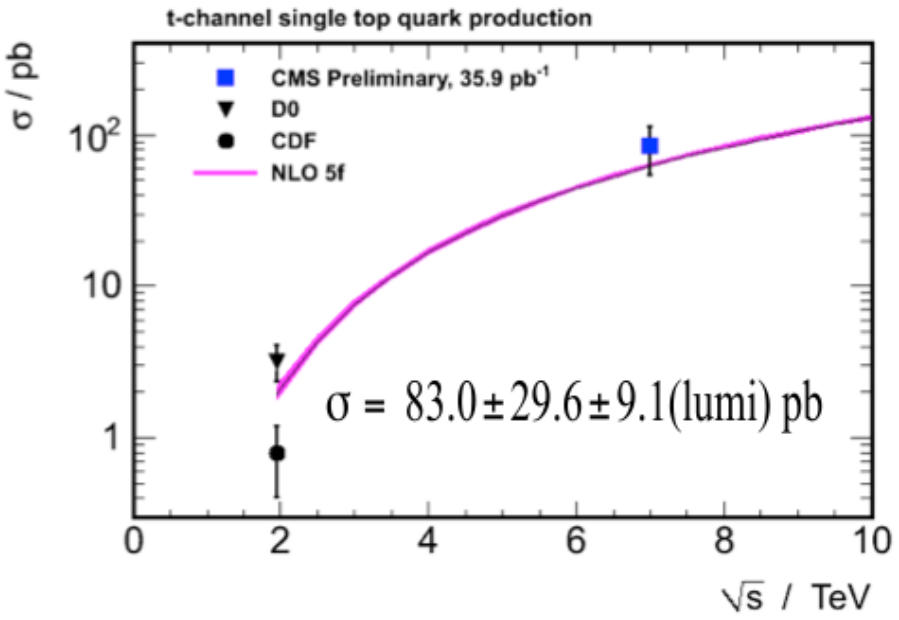


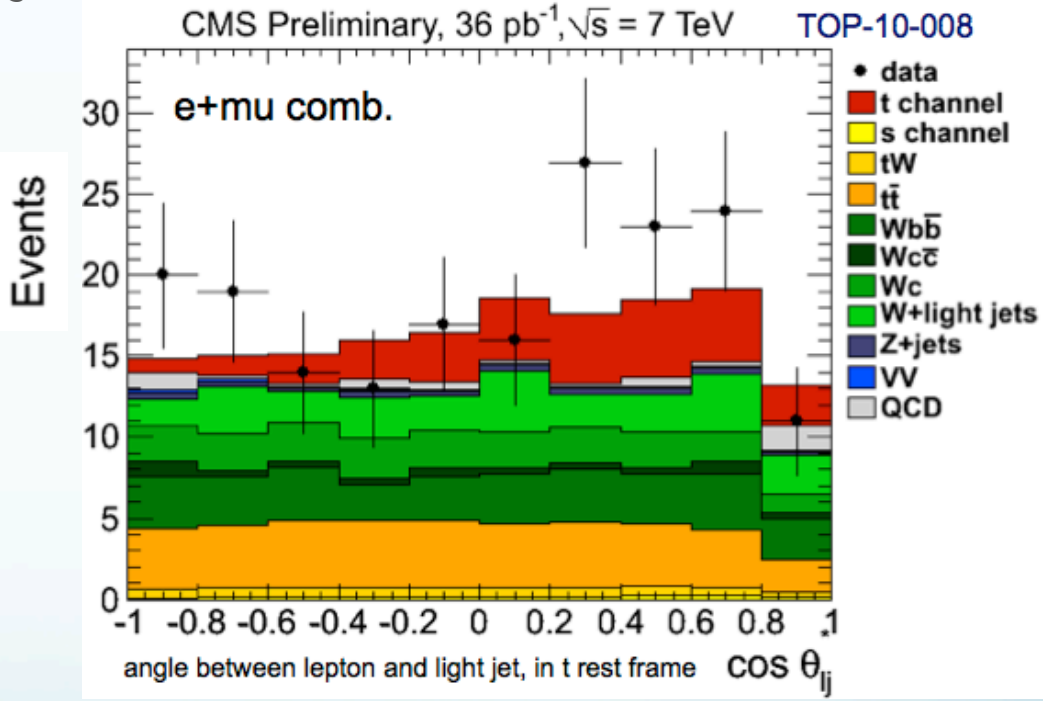
Single Top cross section

- Two different analysis using leptonic W decays
  - Cut based, using angular info + 1 btagged jet
  - BDT, based on kinematic observables

$$\frac{1}{\Gamma}\frac{d\Gamma}{d\cos\theta^*_{lj}} = \frac{1}{2}(1 + A\cos\theta^*_{lj})$$







Single top at 3 sigma level in both analyses

CMS PAS TOP-10-008

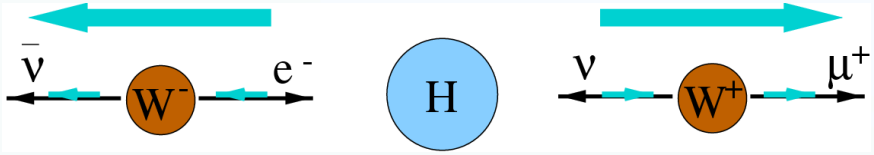
Higgs

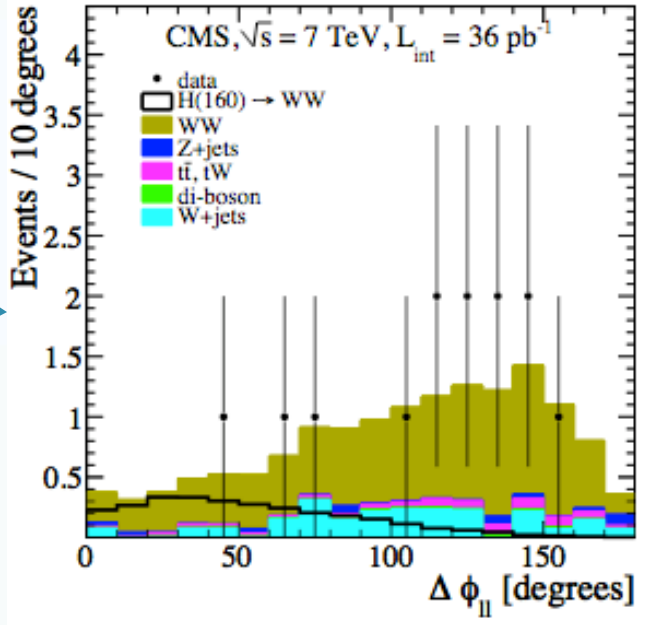
- Some published results:
  - H to WW
  - H(mssm) to tau tau
- Some prospects for LHC/TeVatron

- Full list of results
- https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsHIG

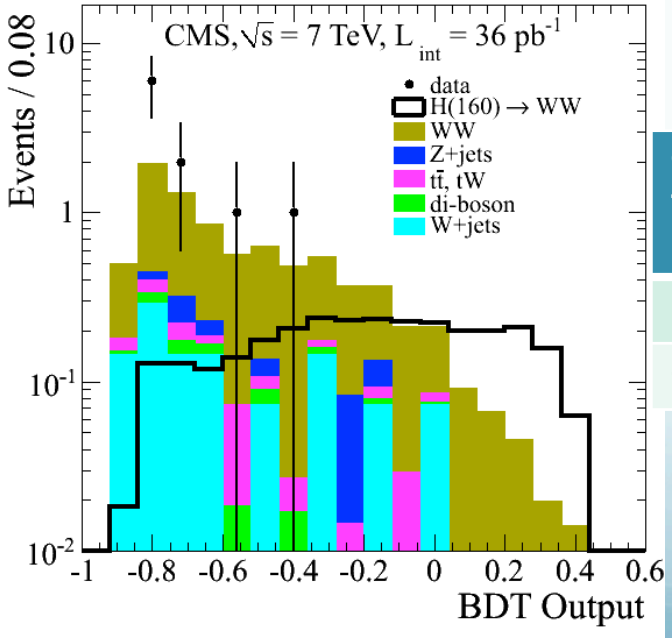
H→WW→2l2ν @ CMS

Direct WW production is irreducible background
Main handle is Helicity conservation:
spin 1 (Z*→WW) vs. spin 0 (H→WW)
For H, charged leptons tend to go in the same direction



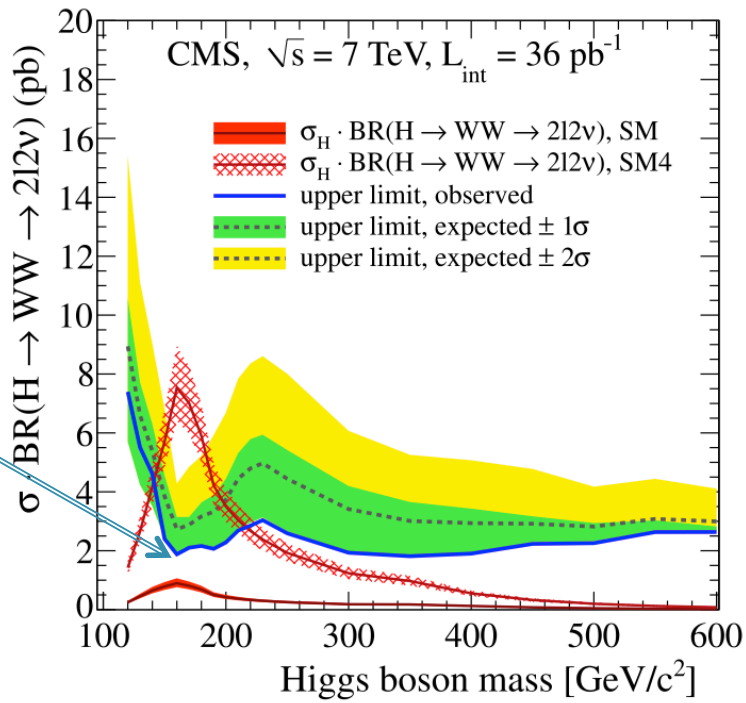


Same pre-selection as WW analysis
S/B poor: rely on MVA techniques (BDT)



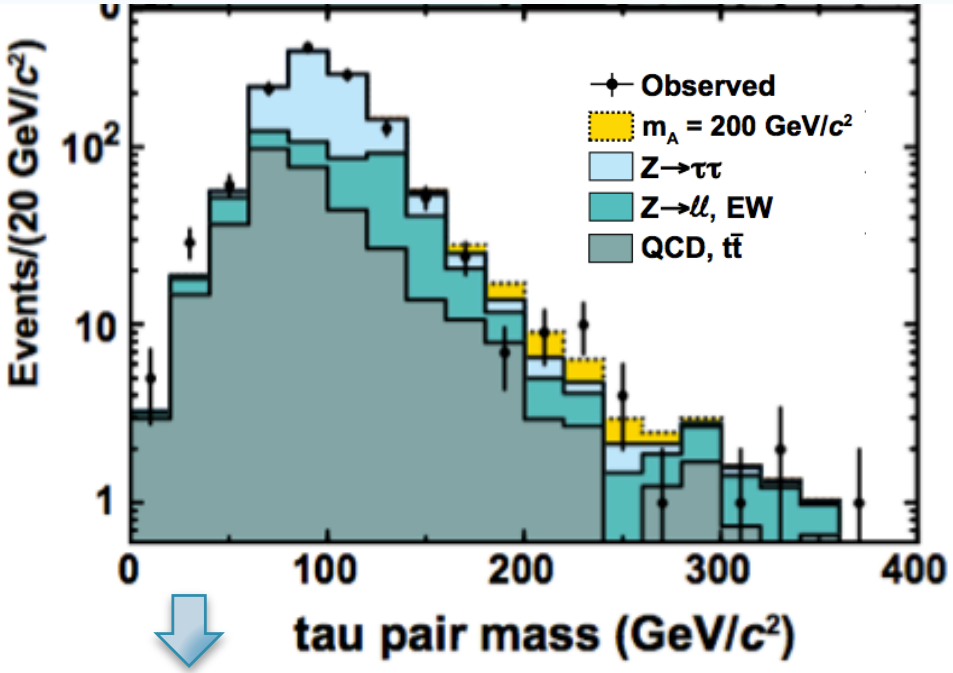
95 % CL Limit for M_H = 160 GeV	CMS (Bayesian)
Expected	3.0 x SM
Observed	2.1 x SM

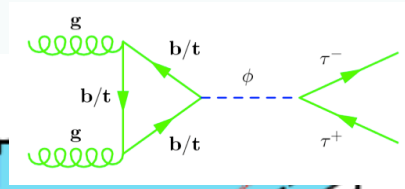
Physics Letters B 699 (2011) 25–47

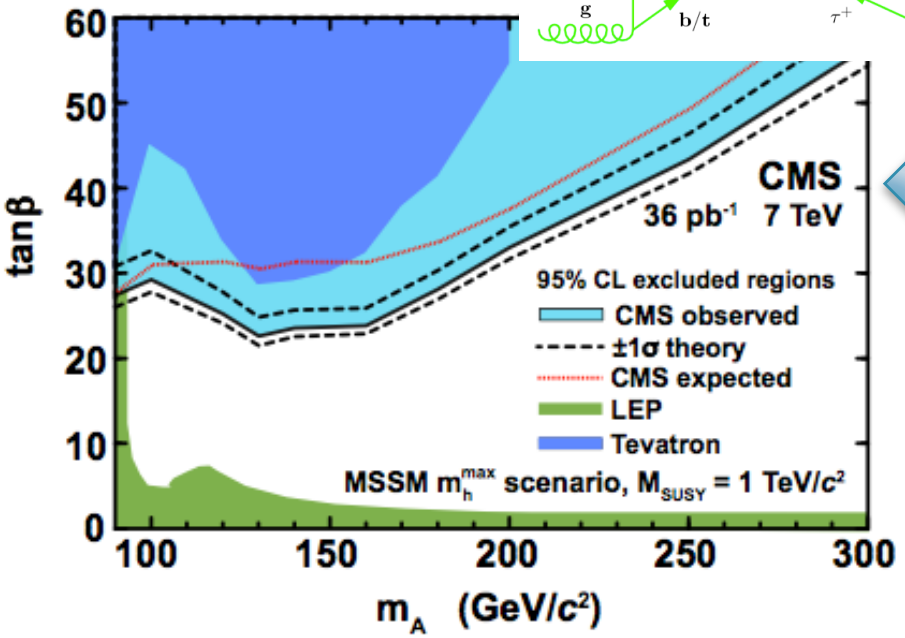


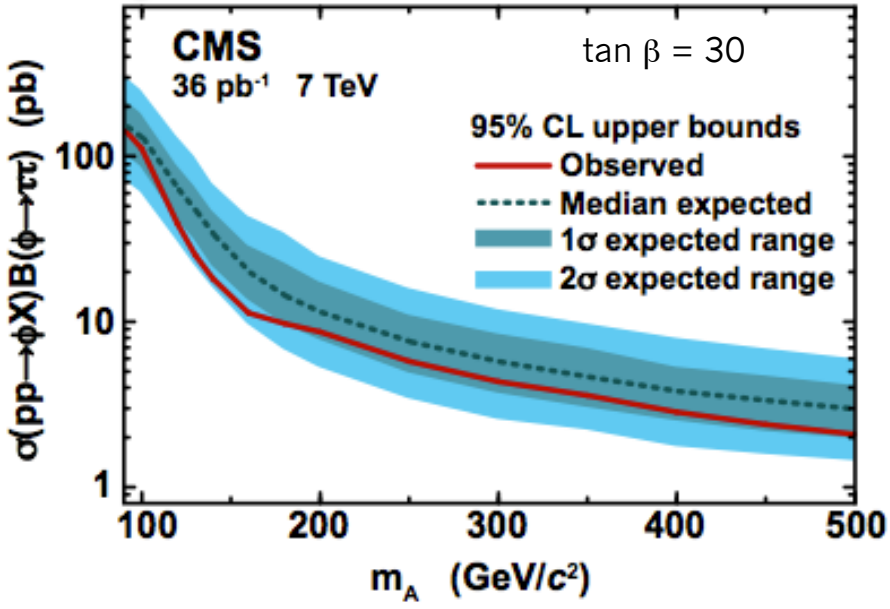
(mssm) H to tautau

- Channels used: e-mu, e-had, mu-had
- improved mass reconstruction (better resolution) using likelihood, based on tau decay kinematics of visible decay products and Et(miss)
- Limits on MSSM Higgs production, **already improving on the Tevatron results**



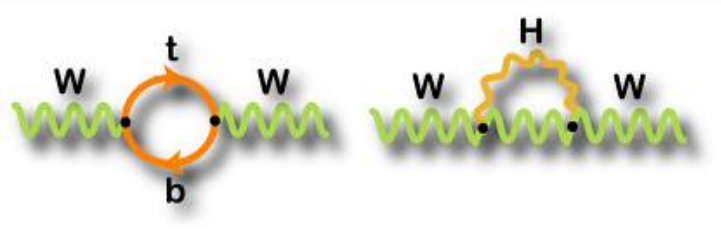






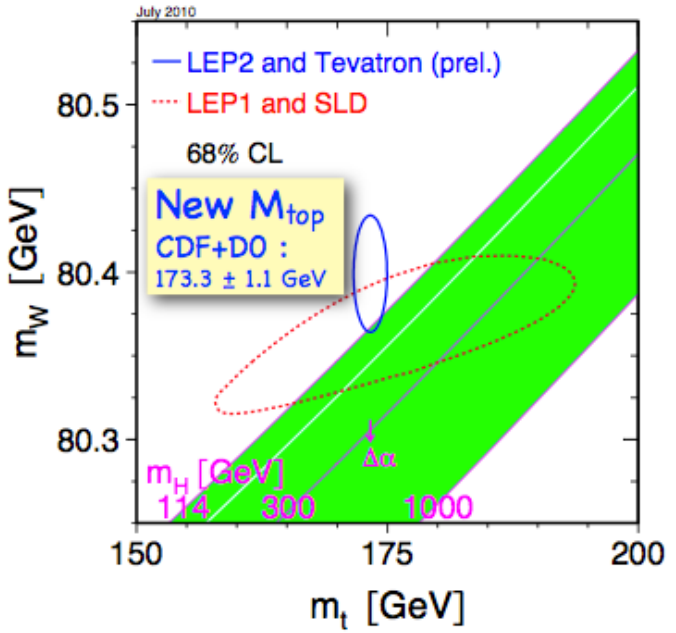
Constrains on Higgs Mass

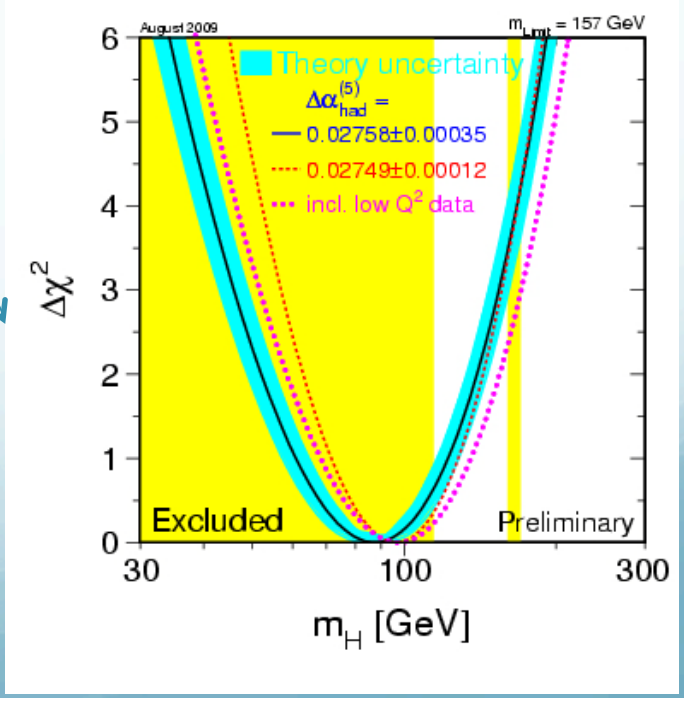
- M_H free parameter in SM
  - Indirect measurements:
    - From EWK precision data through radiative corrections

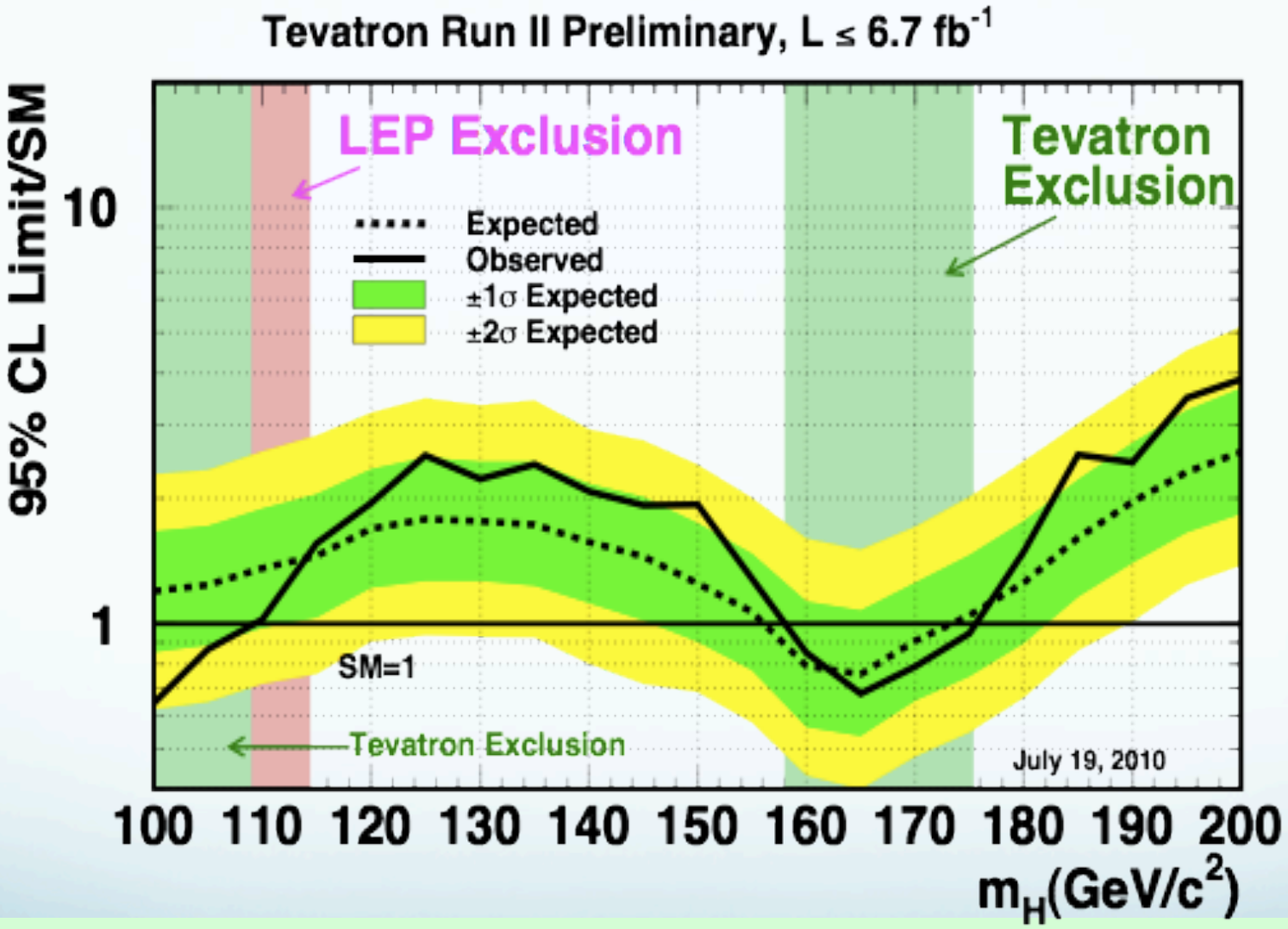


$M_H = 89.0^{+35}_{-26}$ GeV
Excluded M_H>158 GeV (@95%)

  - From direct searches at LEP
    - M_H>114.4 GeV/c^2 @ 95% C.L.
  - From direct searches at Tevatron
  - **Now: from direct searches at LHC**





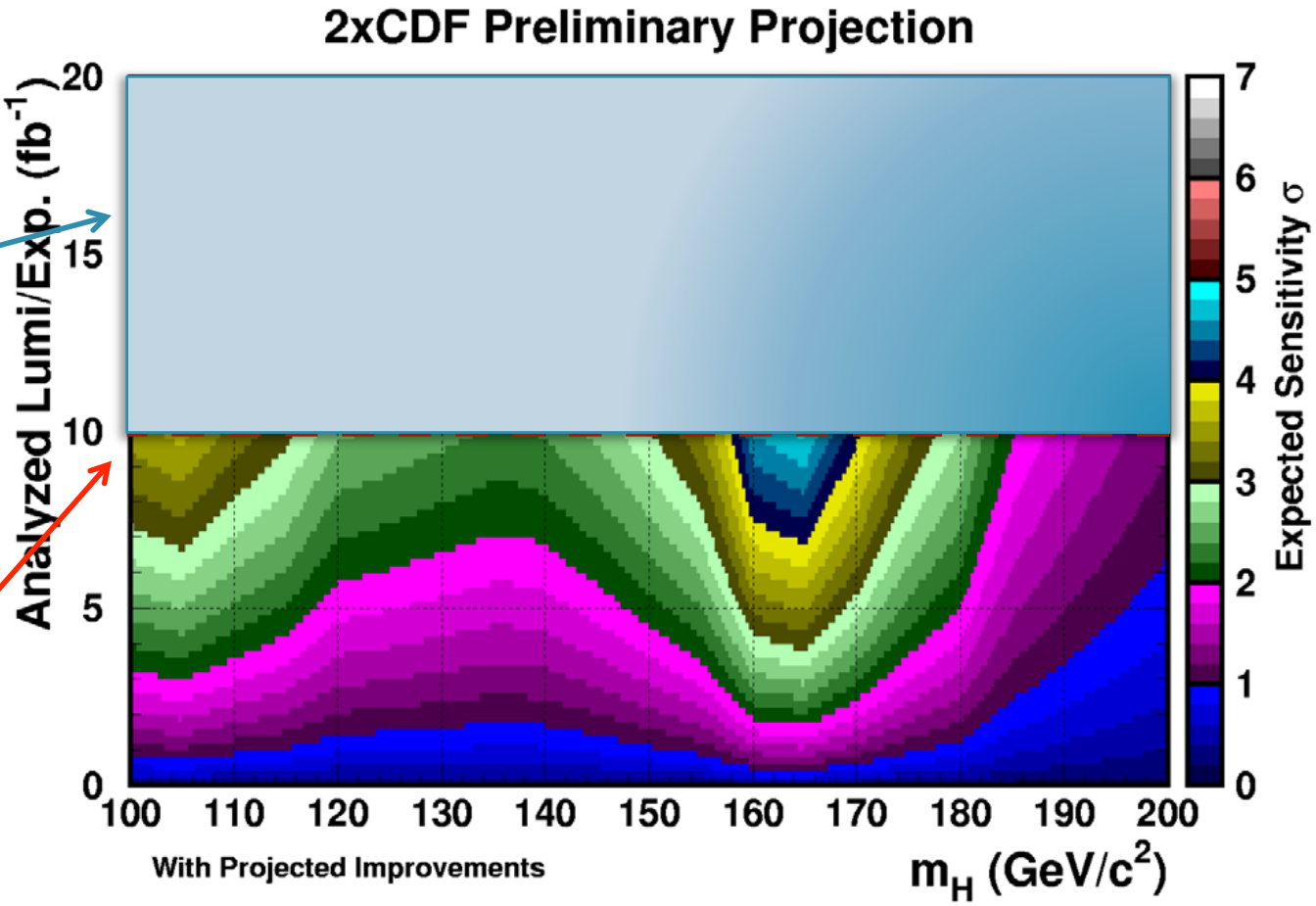


When we add TeVatron we can also exclude (85% CL)

$158 < M_H < 175$

Tevatron discovery projections

"would have been" if extension to Tevatron was granted



Tevatron @ end of 2011:

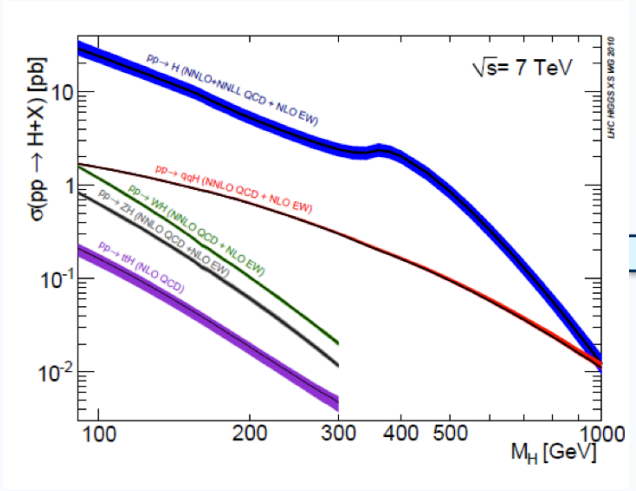
- up to 10/fb/experiment
- ~3 σ exclusion from 100 – 115 GeV/c^2 and 150 – 180GeV/c^2
- 5 "discovery" σ hard to reach anywhere
- (considering SM σ)

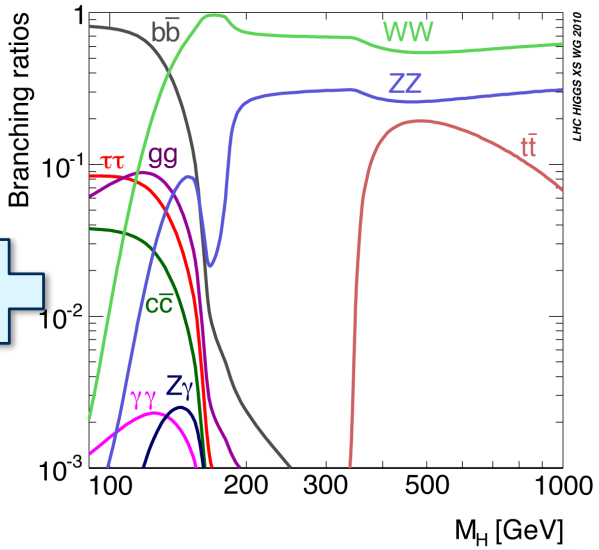
95% CL Excluded Mass range

LEP + Tevatron

Tevatron

158 175





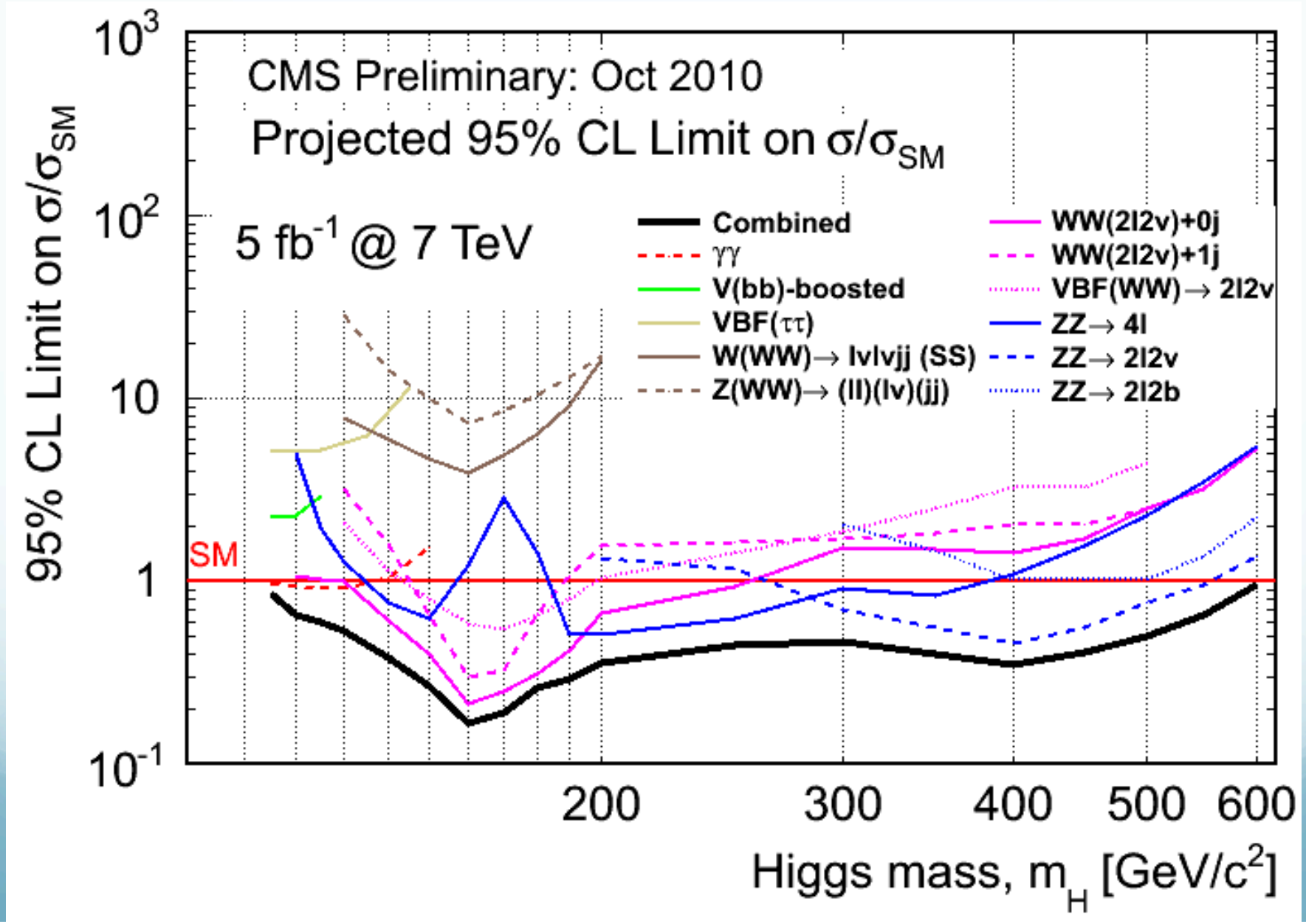
0 100 114 200 300 400 500 600

Low Mass
($M_H \approx <$ 120 GeV)
H→γγ
H → WW
qqH→ττ
V+ H→bb
qqH→bb
V+ H→WW

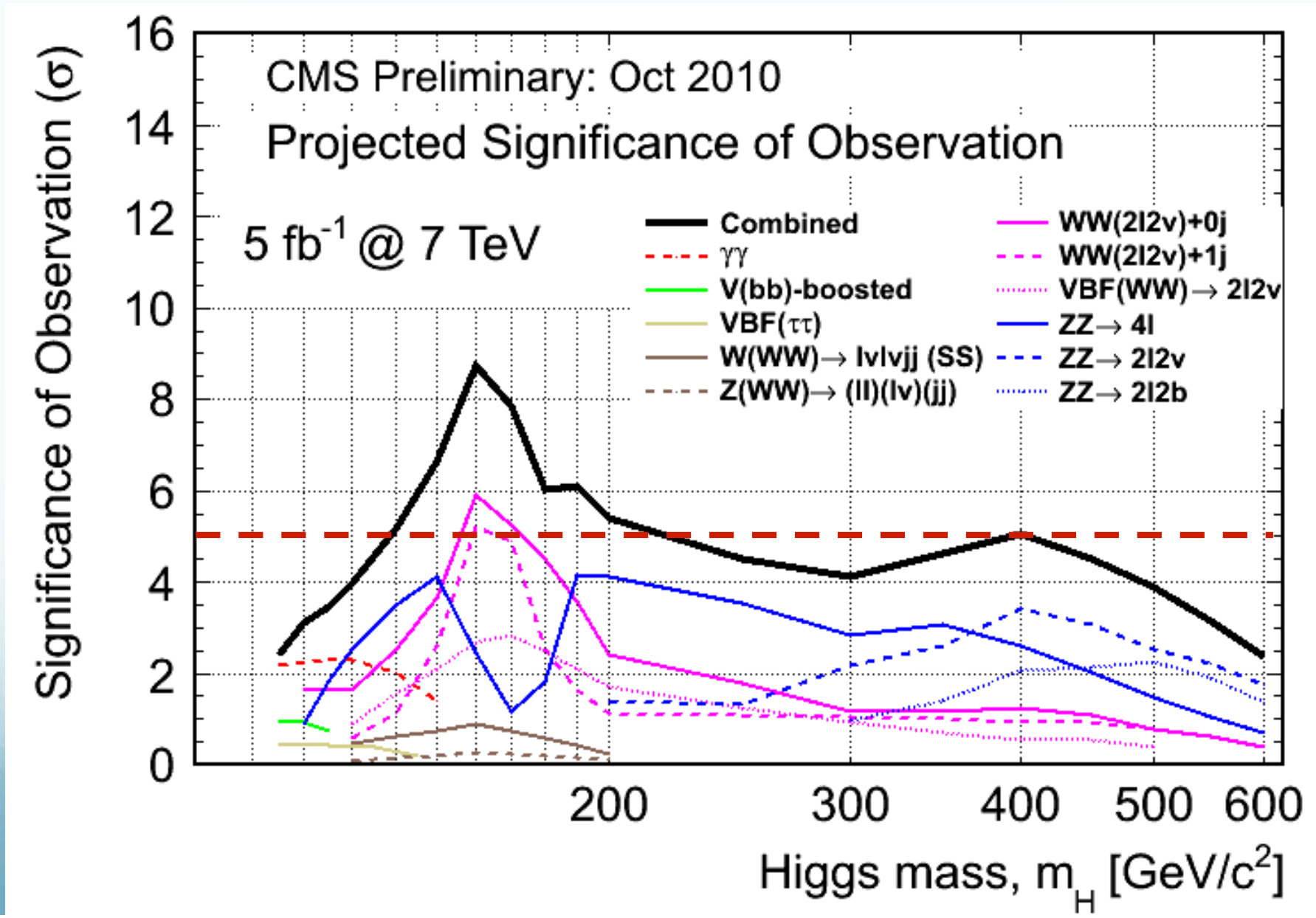
Mid Mass
($M_H \approx$ 160 GeV)
H→WW
H→ZZ

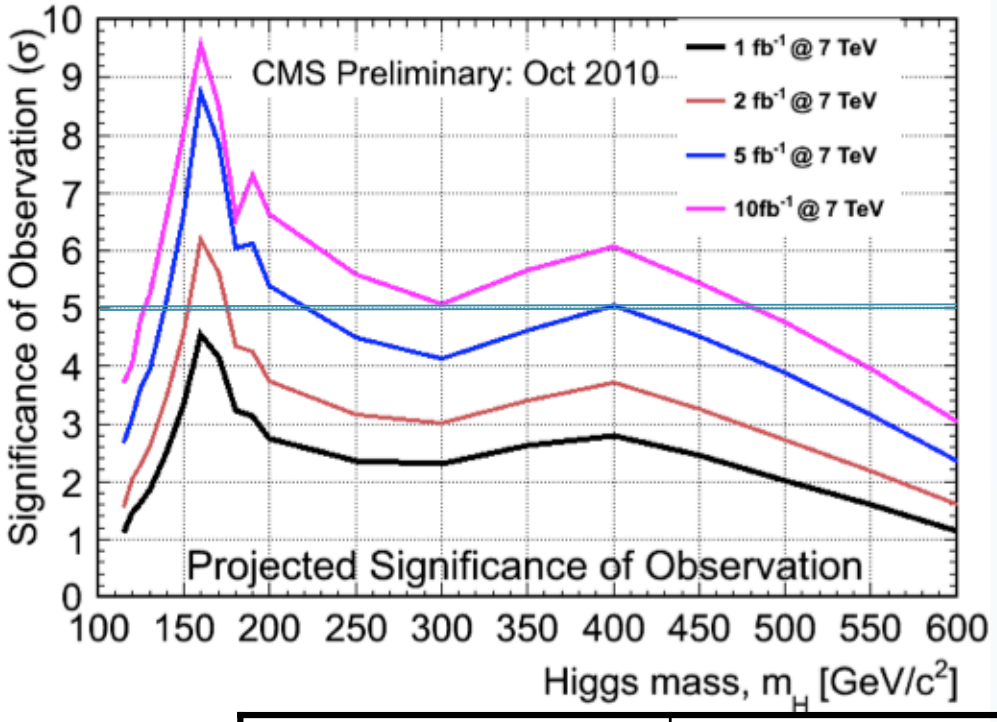
High Mass
($M_H \approx >$ 400 GeV)
H→ZZ
H→WW

CMS Sensitivity Projections @ 5 fb^{-1}



CMS Significance of Obs. @ 5 fb^{-1}





ATLAS + CMS ≈ 2 x CMS	95% CL exclusion	3σ sensitivity	5σ sensitivity
1 fb^{-1}	120 - 530	135 - 475	152 - 175
2 fb^{-1}	114 - 585	120 - 545	140 - 200
5 fb^{-1}	114 - 600	114 - 600	128 - 482
10 fb^{-1}	114 - 600	114 - 600	117 - 535

SUSY Search Strategy

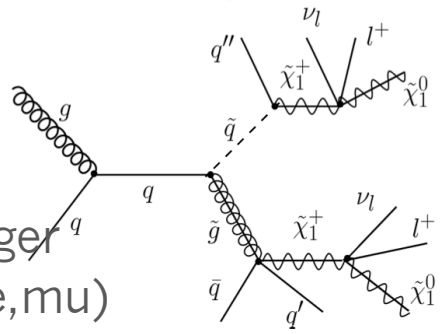
0-leptons	1-lepton	OSDL	SSDL	≥3 leptons	2-photons	γ+lepton
Jets + MET	Single lepton + Jets + MET	Opposite-sign di-lepton + jets + MET	Same-sign di-lepton + jets + MET	Multi-lepton	Di-photon + jet + MET	Photon + lepton + MET

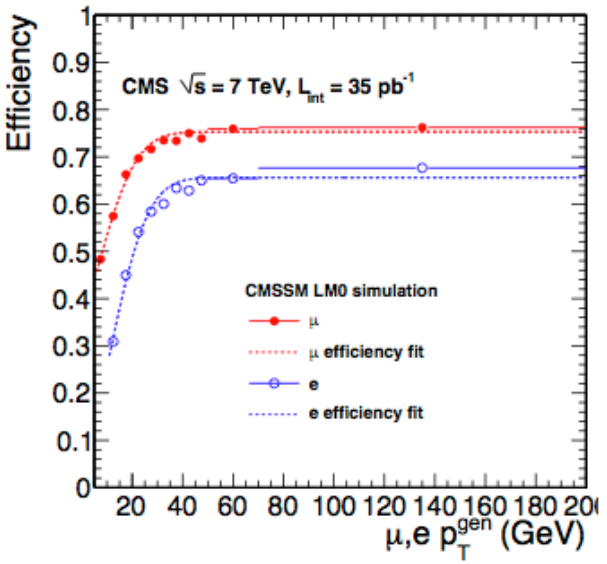
- **Basic analysis strategy:**
- **Focus on topology using different kinematic observables**
  - **So that types of SM bkgs and detector strong assets drive the searches**
- use well understood CMS 'objects'
  - Leptons, photons, jets, MET; Particle Flow to increase sensitivity everywhere
- Use data driven background whenever possible
- 2011: setting the best limits is important, but we should also be prepared for discovery scenarios
- Some examples follow… Full results at https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS

Analysis	Approved Plots	CDS Entry	Luminosity	Comment
Search for Physics Beyond the Standard Model in Z + MET + Jets events at the LHC	SUS10010	PAS-SUS-10-010	34/pb	
Inclusive search for new physics at CMS with the jets and missing momentum signature	SUS10005	PAS-SUS-10-005	36/pb	
Further interpretation of the search for SUSY based on αT	SUS11001	PAS-SUS-11-001	35/pb	
Inclusive search for squarks and gluinos at √s = 7 TeV	SUS10009	PAS-SUS-10-009	35/pb	
Search for New Physics in pp Collisions at √s = 7 TeV in Events with a Single Lepton, Jets, and Missing Transverse Momentum	SUS10006		36/pb	
Search for Supersymmetry in pp Collisions at √s = 7 TeV in Events with A Lepton, Photon, and Missing Transverse Energy	SUS11002	CERN-PH-EP-2011-058	35/pb	arxiv:1105.3152
Search for Physics Beyond the Standard Model Using Multilepton Signatures in √s = 7 TeV pp Collisions with the CMS Detector at the LHC	SUS10008		35/pb	
Search for new physics with same-sign isolated di-lepton events with jets and missing transverse energy at the LHC	SUS10004	CERN-PH-EP-2011-033	35/pb	arxiv:1104.3168
A Search for New Physics in b-tagged dijet and multi-jet events with Missing Energy in pp collisions at √s=7 TeV	SUS10011	PAS-SUS-10-011	35/pb	
Search for Physics Beyond the Standard Model in Opposite-Sign Dilepton Events in pp Collisions at √s = 7 TeV	SUS10007	CERN-PH-EP-2011-016	34/pb	arxiv:1103.1348
A Search for Supersymmetry in pp Collisions at 7 TeV Using Events with Two Photons and Large Missing Transverse Energy	SUS10002	CERN-PH-EP-2011-007	36/pb	arxiv:1103.0953
Search for Supersymmetry in pp Collisions at 7 TeV in Events with Jets and Missing Transverse Energy	SUS10003	CERN-PH-EP-2010-084	35/pb	arXiv:1101.1628
Performance of Methods for Data-Driven Background Estimation in SUSY Searches	SUS10001	PAS SUS-10-001	11-76/nb	

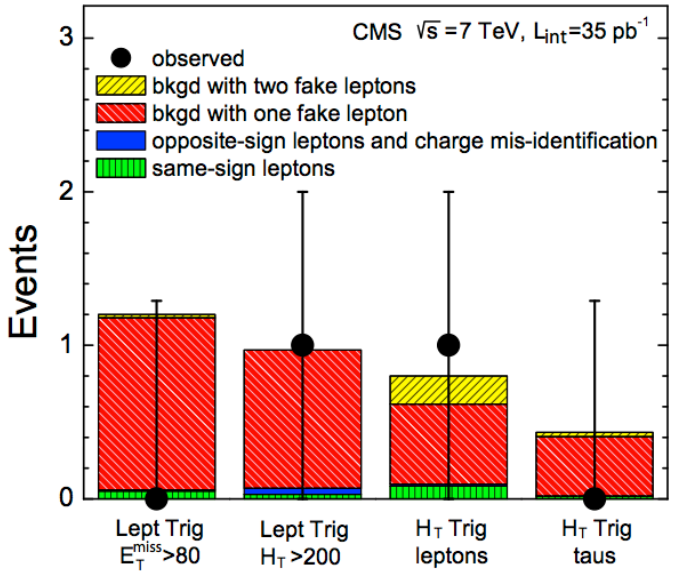
A clear channel: same sign dileptons searches

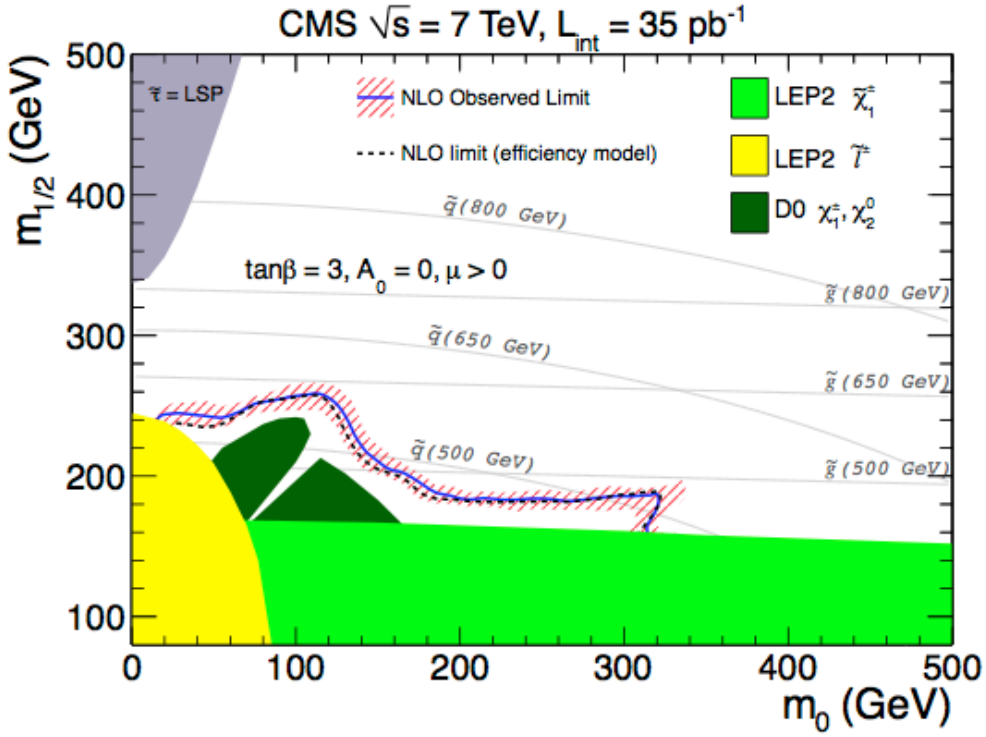
- Easy selection
  - Start from a lepton or HT trigger
  - Ask for 2 same sign leptons (e,mu) with sizeable Pt
  - Ask for at least 2 jets
  - Ask for a sizeable MET
- Bkg mostly from fake leptons and leptons from ttbar (but overall < 1 event expected)



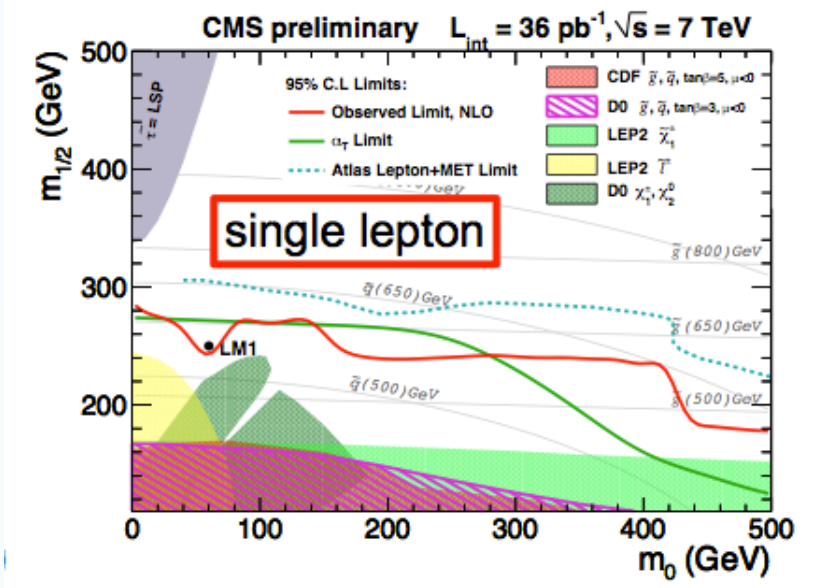


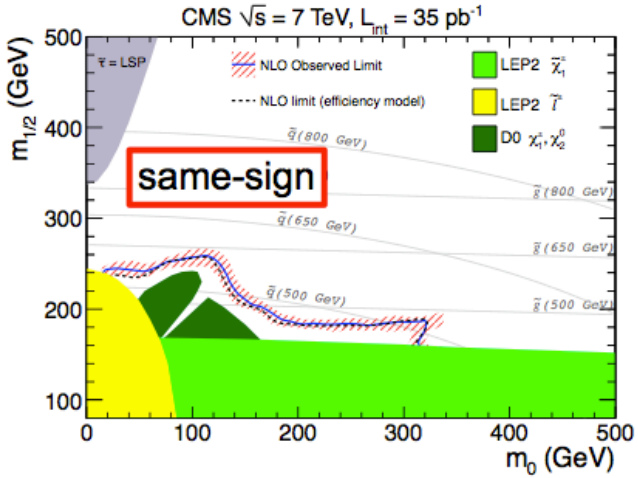
Data driven lepton efficiency arxiv:1104.3168

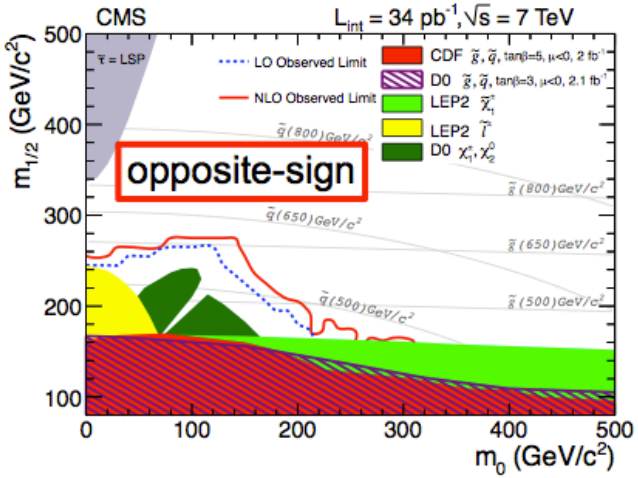


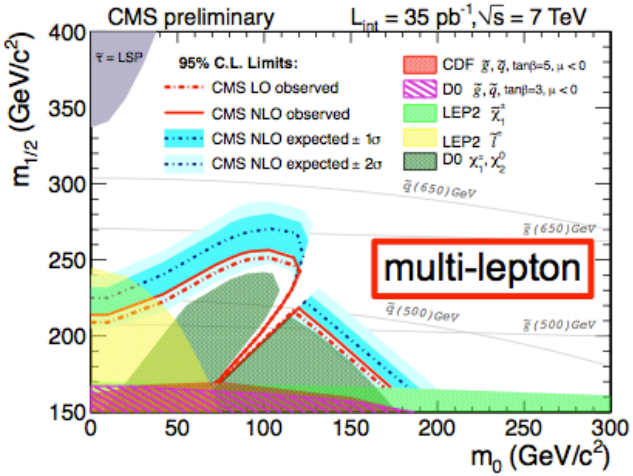


"N" leptons mSUGRA exclusions with $\tan\beta = 3$, $\mu > 0$ and A0= 0



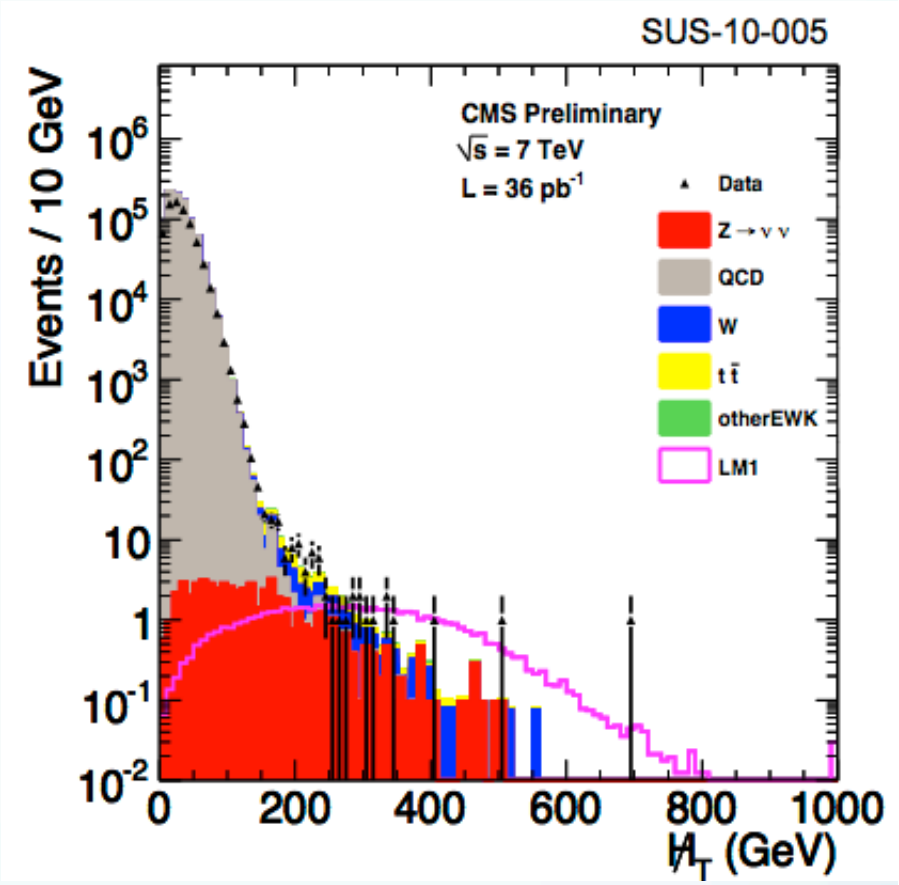






More difficult: Missing Momentum signatures

- You really need to understand your detector in details
  - Particle flow essential here
- Ask for
  - HT triggers
  - At least 3 jets
  - Sizeable HT and Missing momentum
- All bkgs are estimated with data driven techniques

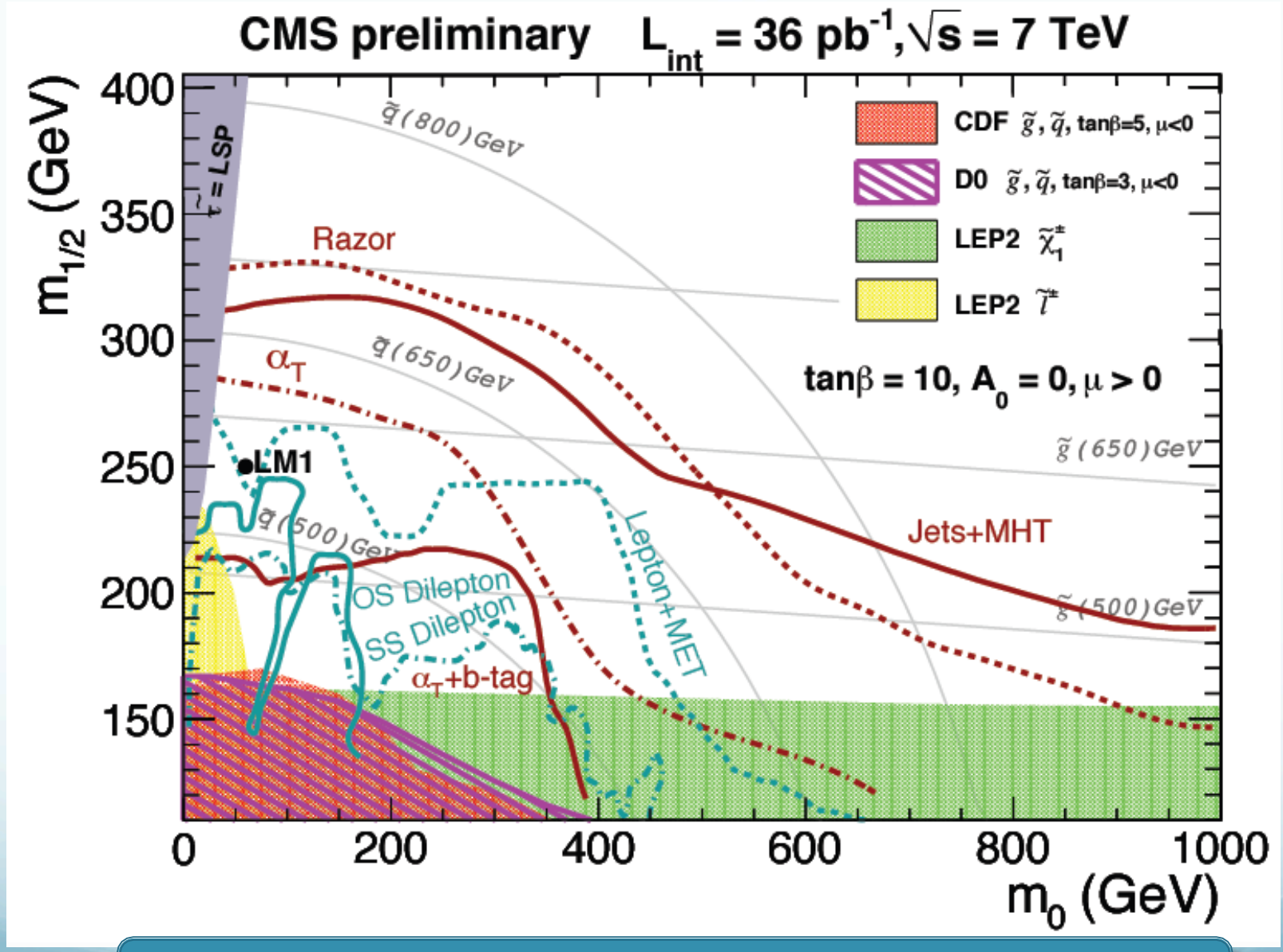


CMS-PAS-SUS-10-005

Method	Baseline selection		High-$\not{H}_T$ selection		High-H_T selection	
$Z \to \nu\bar{\nu}$ from γ+jets	26.3	±4.8	7.1	±2.2	8.4	±2.3
$t\bar{t}/W \to e, \mu$+X lost-lepton method	33.0	±8.1	4.8	±1.9	10.9	±3.4
$t\bar{t}/W \to \tau_{had}$+X method	22.3	±4.6	6.7	±2.1	8.5	±2.5
QCD Rebalance+Smear method	29.7	±15.2	0.16	±0.10	16.0	±7.9
QCD factorization method	25.2	±13.4	0.4	±0.3	17.3	±9.4
Total data-driven background	111.3	±18.5	18.8	±3.5	43.8	±9.2
Observed in 36 pb^{-1} of data	111		15		40	

- CMS LM1:
  - mSUGRA
  - M0=60 GeV
  - M(1/2)=250 GeV
  - A0=0
  - tan(β)=10
  - μ>0

CMS Combined Exclusion Plot



Limits extend well beyond Tevatron reach

Exotica

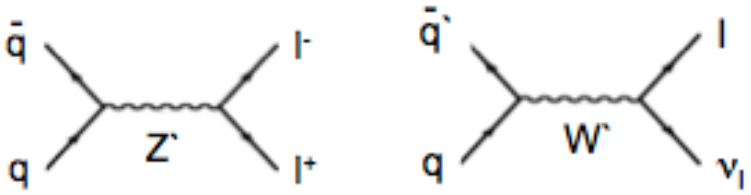
- “generic” Z’, W’
  - Can be extra gauge bosons, KK graviton excitations in RS, etc
- Extra dimensions
- Black Holes

- Full list of results:
- https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO

Analysis	ArXiv Entry	Luminosity	Publication Status	Approved Plots
Search for First Generation Scalar Leptoquarks in the evjj channel in pp collisions at √s = 7 TeV NEW	1105.5237 (hep-ex)	36/pb	Submitted to PLB	EXO10006
Search for Large Extra Dimensions in the Diphoton Final State at the Large Hadron Collider	1103.4279 (hep-ex)	36/pb	Accepted by JHEP	EXO10026
Search for Resonances in the Dilepton Mass Distribution in pp collisions at √s = 7 TeV	1103.0981 (hep-ex)	40/pb	Accepted by JHEP	EXO10013
Search for a W' boson decaying to a muon and a neutrino in pp collisions at √s = 7 TeV	1103.0030 (hep-ex)	36/pb	Submitted to PLB	EXO10015
Search for a Heavy Bottom-like Quark in pp Collisions at √s = 7 TeV	1102.4746 (hep-ex)	34/pb	Accepted by PLB	EXO10018
Measurement of Dijet Angular Distributions and Search for Quark Compositeness in pp Collisions at √s = 7 TeV	1102.2020 (hep-ex)	36/pb	10.1103/PhysRevLett.106.201804	EXO10009
Search for Heavy Stable Charged Particles in pp collisions at √s = 7 TeV	1101.1645 (hep-ex)	3.1/pb	10.1007/JHEP03(2011)024	EXO10011
Search for for a heavy gauge boson W' in the final state with an electron and large missing transverse energy in pp collisions at √s = 7 TeV	1012.4945 (hep-ex)	36/pb	10.1016/j.PhysLetB.2011.02.048	EXO10014
Search for Pair Production of First-Generation Scalar Leptoquarks in pp Collisions at √s = 7 TeV	1012.4031 (hep-ex)	33/pb	10.1103/PhysRevLett.106.201802	EXO10005
Search for Pair Production of Second-Generation Scalar Leptoquarks in pp Collisions at √s = 7 TeV	1012.4033 (hep-ex)	34/pb	10.1103/PhysRevLett.106.201803	EXO10007
Search for Microscopic Black Hole Signatures at the Large Hadron Collider	1012.3375 (hep-ex)	35/pb	10.1016/j.PhysLetB.2011.02.032	EXO10017
Search for Stopped Gluinos in pp Collisions at √s = 7 TeV	1011.5861 (hep-ex)	10/pb	10.1103/PhysRevLett.106.011801	EXO10003
Search for Quark Compositeness with the Dijet Centrality Ratio in pp Collisions at √s = 7 TeV	1010.4439 (hep-ex)	2.9/pb	10.1103/PhysRevLett.105.262001	
Search for Dijet Resonances in 7 TeV pp Collisions at CMS	1010.0203 (hep-ex)	2.9/pb	10.1103/PhysRevLett.105.211801	

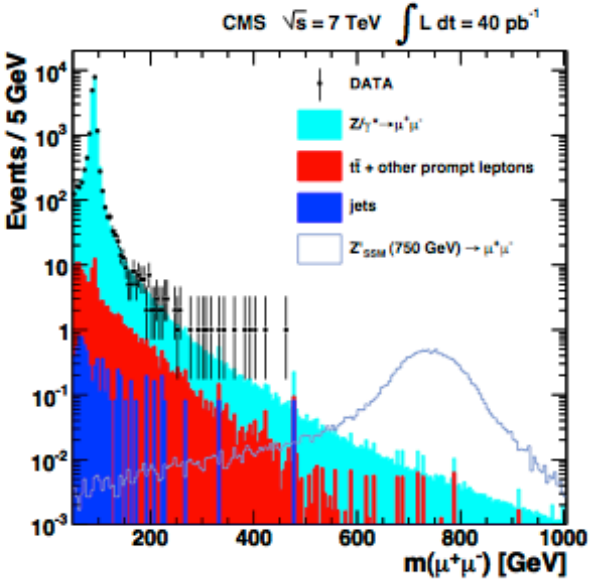
W', Z' to leptons

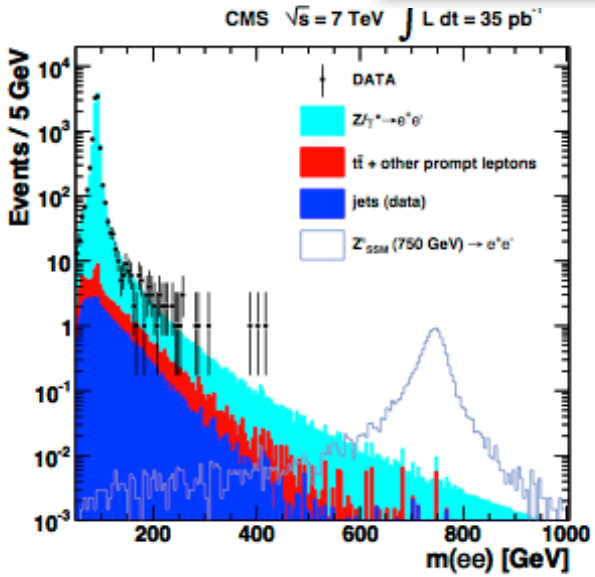
- Z': search for a clear peak mass under DY continuum
- W': search for peaks in the M_T (l,ν) spectrum



Channel	μμ	ee	Combined
Z_{SSM}	1027 GeV	958 GeV	1140 GeV
Z_ψ	792 GeV	731 GeV	887 GeV
G_{KK}, k/M_{Pl} = 0.05	778 GeV	729 GeV	855 GeV
G_{KK}, k/M_{Pl} = 0.10	987 GeV	931 GeV	1079 GeV

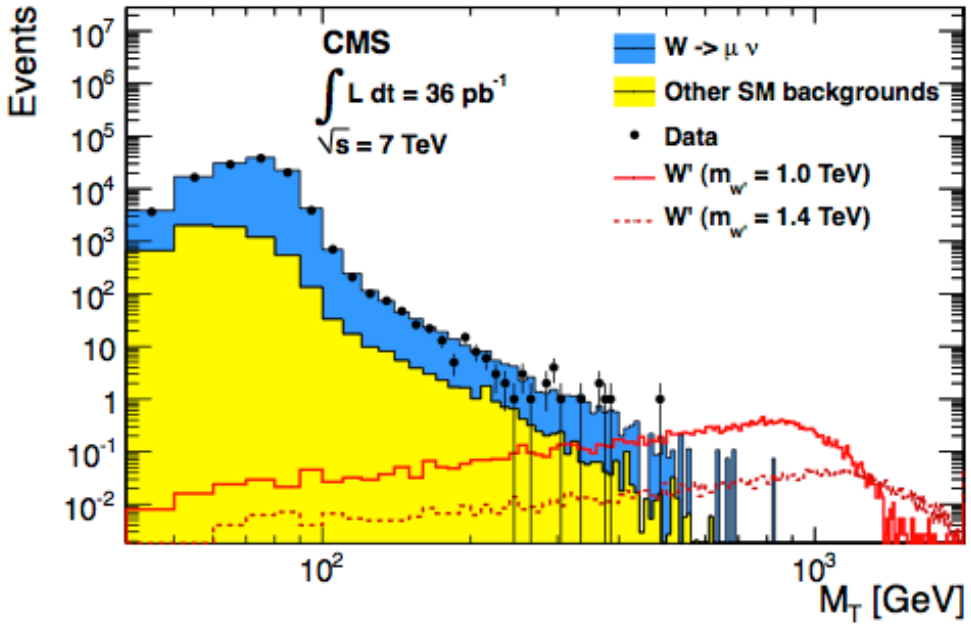
arXiv:1103.0981

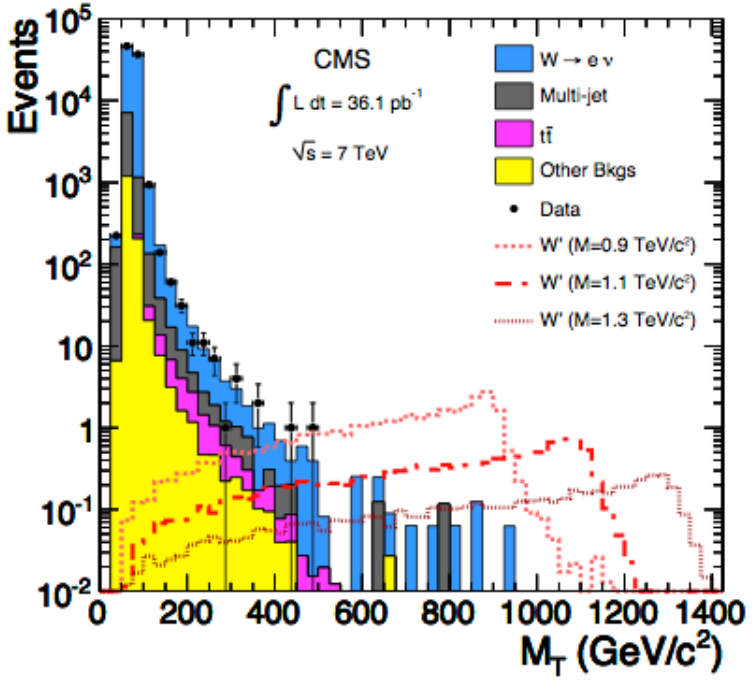




Z': exclusion depends on the model, limits are in the TeV region

W’ to μν,eν



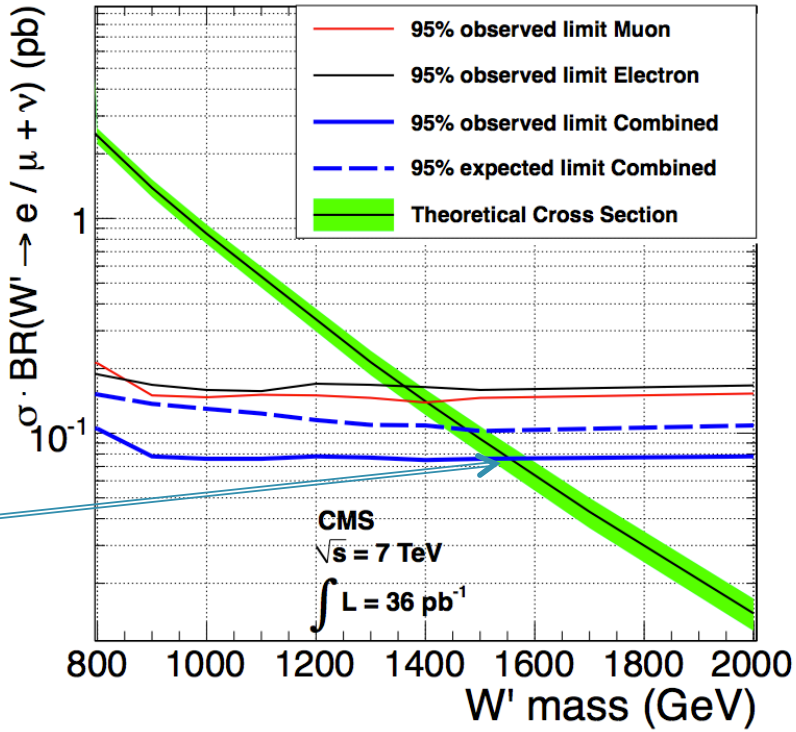


$$M_{\mathrm{T}} = \sqrt{2 \cdot p_{\mathrm{T}} \cdot E_{\mathrm{T}}^{\mathrm{miss}} \cdot (1 - \cos \Delta\phi_{\mu,\nu})}$$

CMS limits (36 pb^{-1})

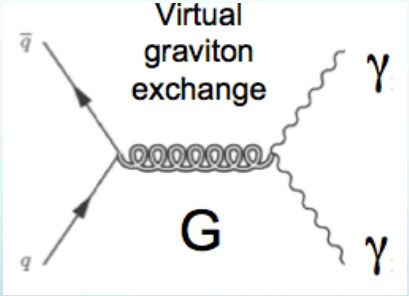
eν	1.36 TeV
μν	1.4 TeV
eν+μν	1.58 TeV

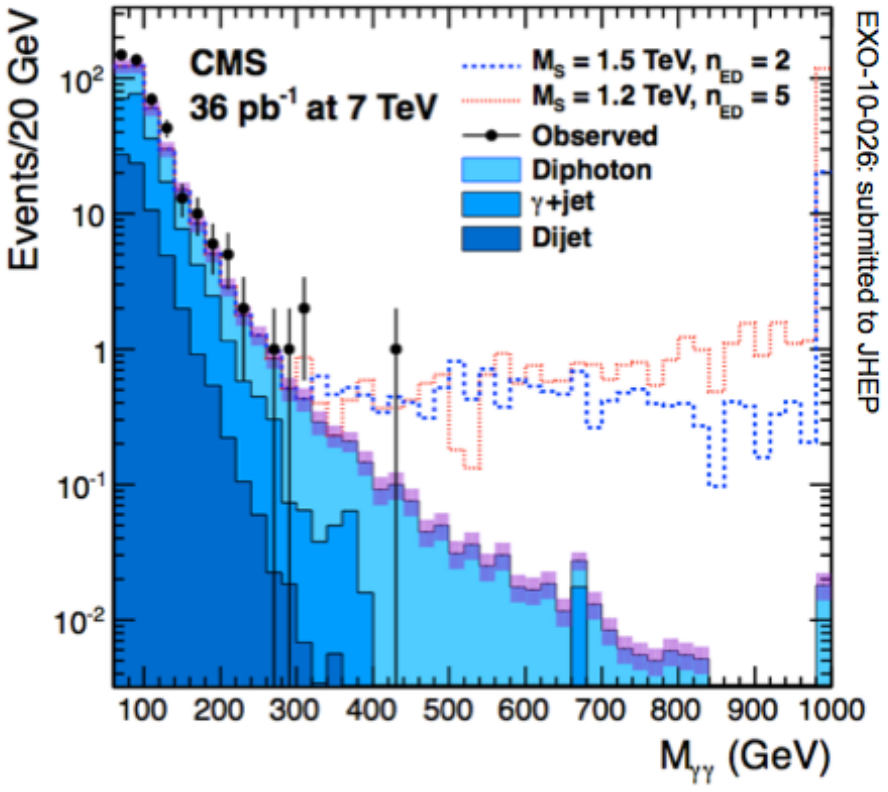
eν arXiv:1012.5945, Accepted by PLB
μν arXiv:1103.0030, Submitted to PLB



Extra dimensions in γγ

- Require two high energy isolated photons, with diphoton mass in excess of 60 GeV
- Use barrel photons only, since they have highest purity
- Divide the spectrum in control, intermediate and signal region, and use control to assess the backgrounds





Process	$60 < M_{\gamma\gamma} < 200$ GeV	$200 < M_{\gamma\gamma} < 500$ GeV	500 GeV$< M_{\gamma\gamma}$
Dijets	70 ± 28	0.5 ± 0.2	0.0009 ± 0.0004
γ + Jets	145 ± 7	2.3 ± 0.3	0.016 ± 0.003
Diphotons	150 ± 35	6.2 ± 1.4	0.29 ± 0.07
Total Backgrounds	365 ± 49	9.0 ± 1.5	0.30 ± 0.07
Observed	428	12	0

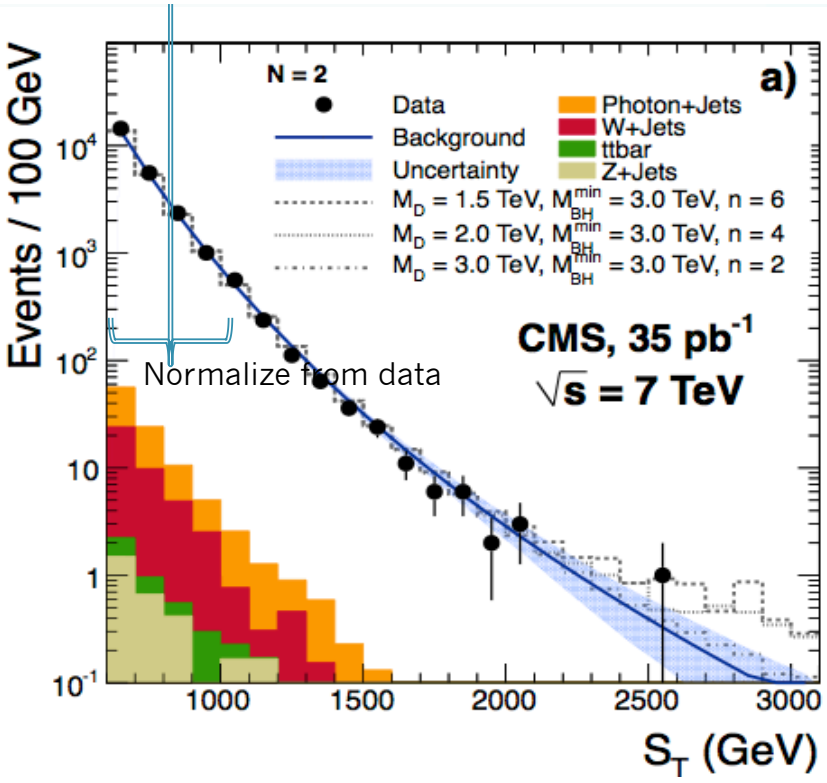
Upper limit on σ x BR < 0.11 pb for Mγγ> 500 GeV
Lower limits on Effective Planck scale in the range 1.6-2.3 TeV (depending on the # of ED)

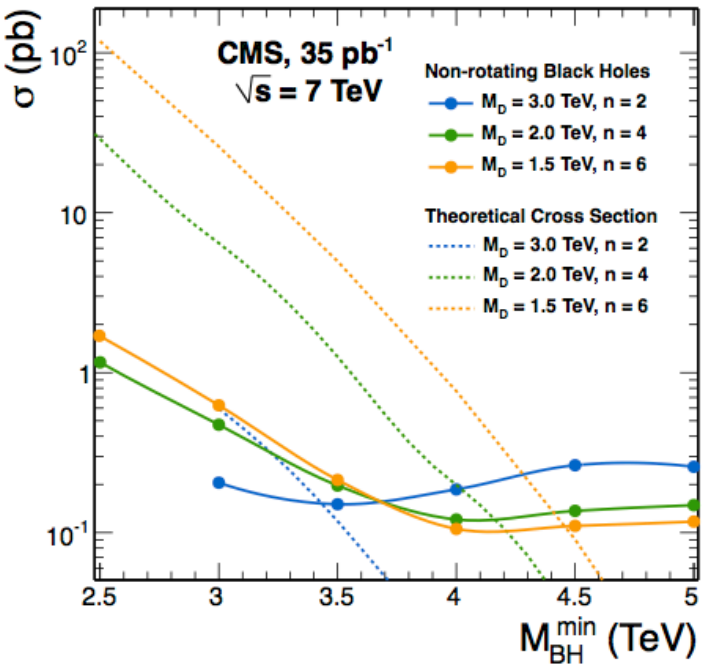
1103.4279 (hep-ex)

Microscopic black holes

- What a signature! BH decays via Hawking radiation "democratically" to SM particles
  - Events with large number of energetic final state particles (quarks and gluons but also leptons, photons…)
- Use HT trigger since lots of hadronic activity expected
- Look for excess in S_T distributions in bins of particle multiplicity N, with S_T defined as the scalar sum of all sizeable (E>50 GeV) 'objects' (jets, leptons, photons, MET)
- Bkg: mostly multijet QCD; from data S_T<1100 GeV

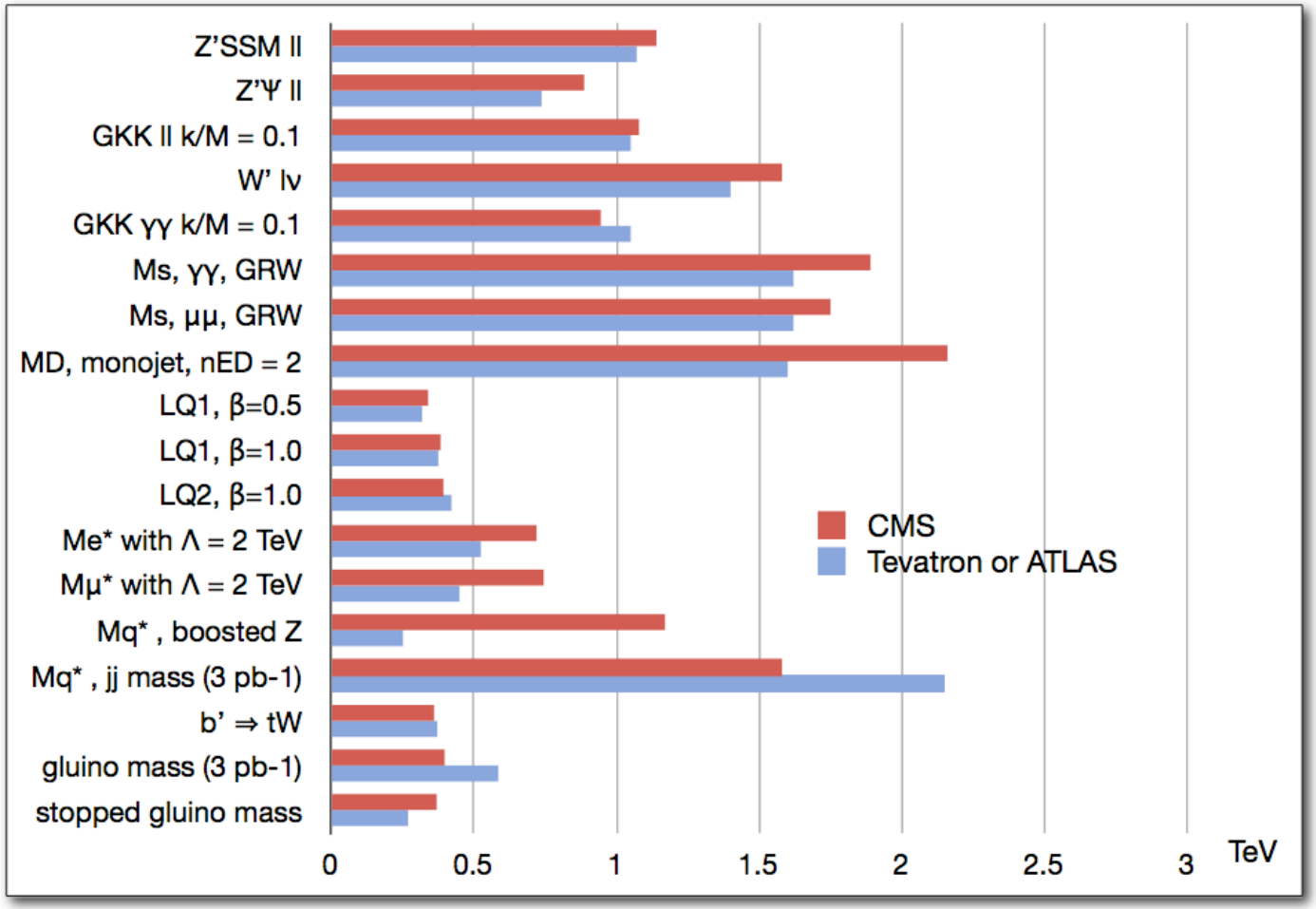
Limits on the black hole mass are set in the range 3.5 – 4.5 TeV (model dependent)





10.1016/j.PhysLetB.2011.02.032

What CMS is doing already with 2010 data...



Mass limits on MSSM/Exo in most cases set world records

Conclusions

- The startup of LHC, after the 2008 facts, has been exceeding all expectations (even if at lower energy, unfortunately)
  - and 2011-2012 run is exceeding initial estimates
- CMS has shown that the years spent on simulation and cosmic data taking were worth the effort
  - Data usable for physics from day 1
  - Detector understanding already matching asymptotic performance
  - Data Analysis environment has proven “analysis friendly”, and this has helped fast turnaround of results
- **Expect a full list of updated + new results for Summer Conferences, using 20x-XXx more data!**

- BACKUP

Susy reach 100/pb vs 1/fb (one example)