Top & Higgs physics from hadron machines

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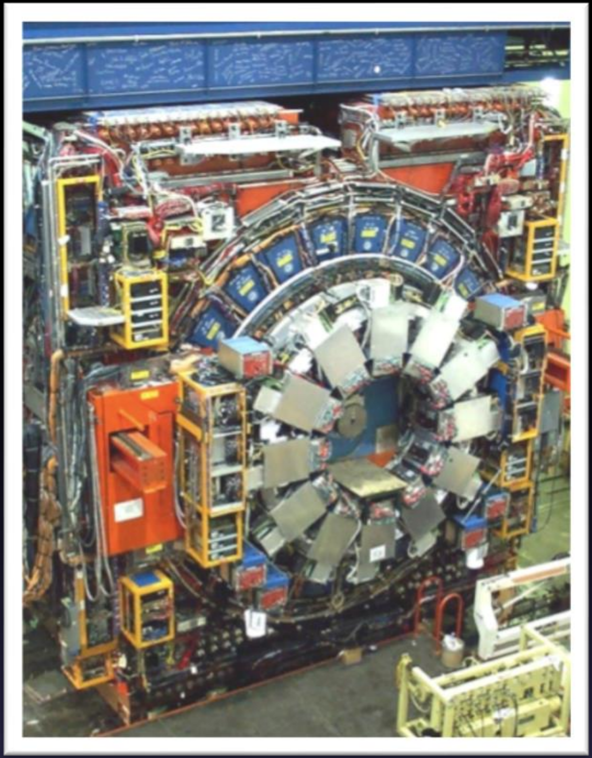
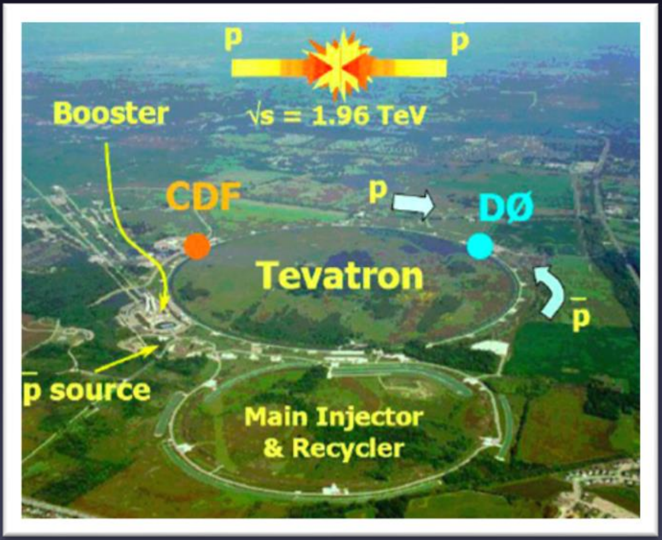
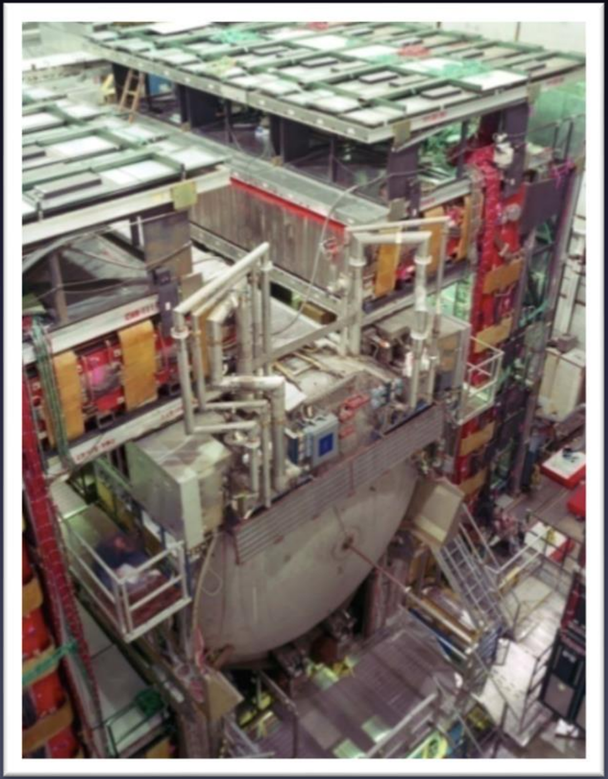
Tevatron

- p-p collisions at $\sqrt{s}$ = 1.96 TeV)
  - 12 fb^{-1} for analysis by end of Run
- After 25 years, closed at the end of 2011

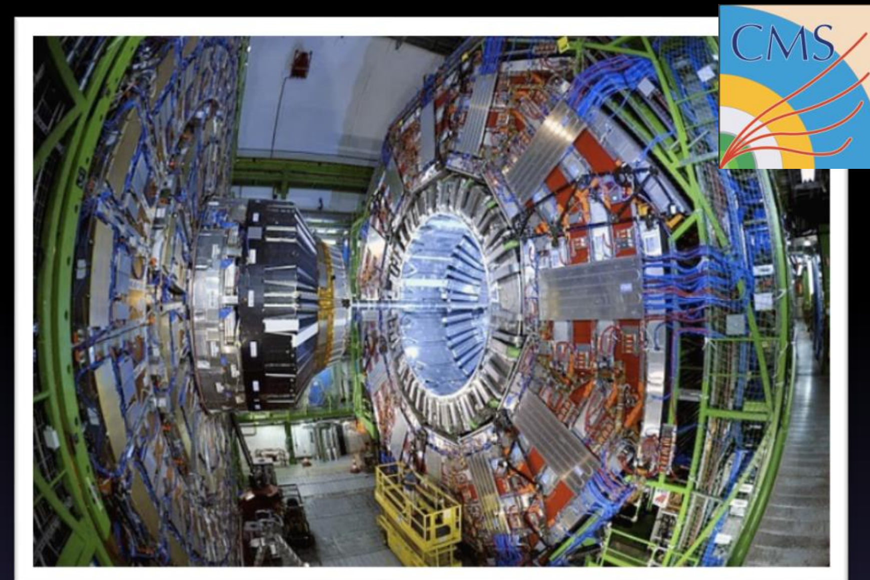


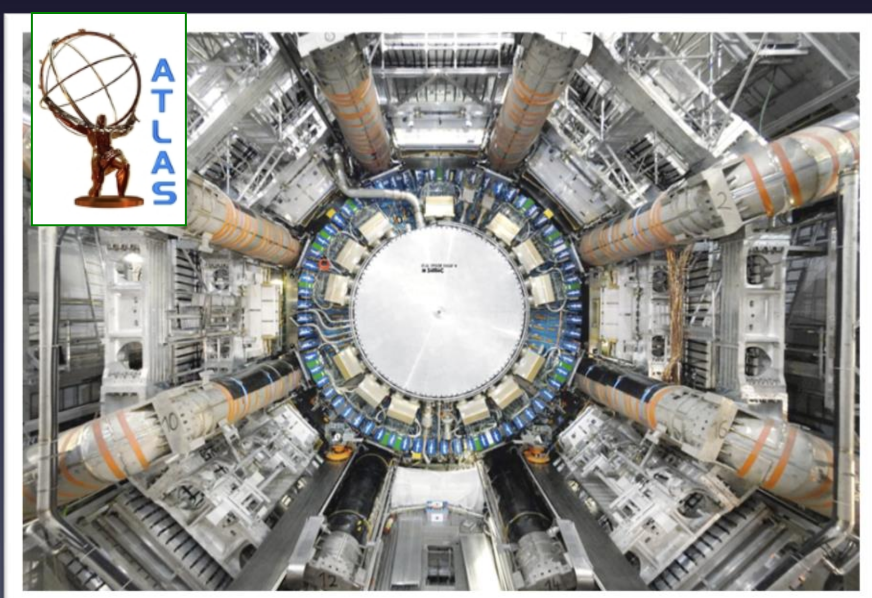


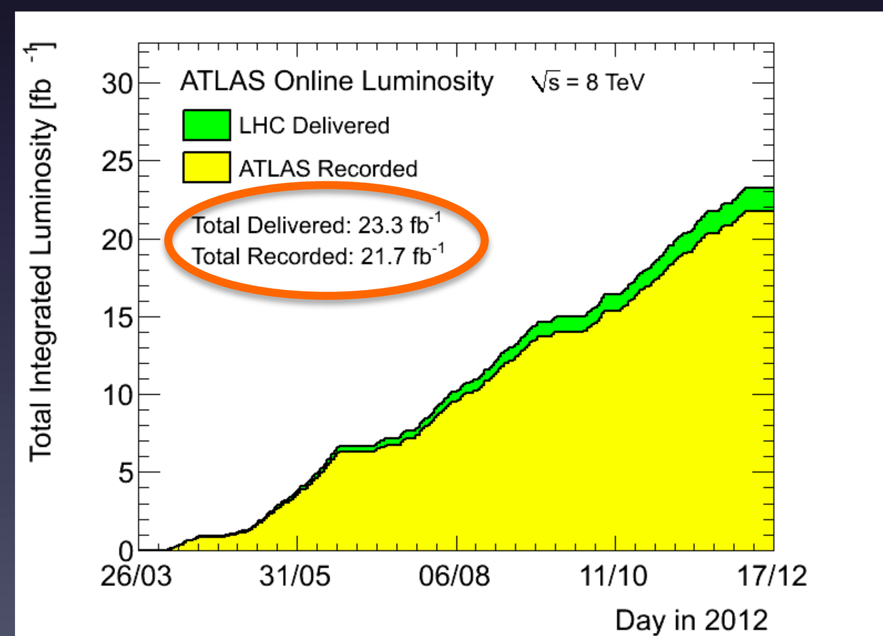


LHC data taking

- pp collisions at 7 and 8 TeV
- Peak luminosity : 7.7×10^{33} $cm^{-2}s^{-1}$
  - Up to >40 overlaid collisions at highest luminosity
  - Challenging environment - $\mathcal{O}(1000)$ tracks – demonstrating marvelous tracker performance
- ≈25 fb^{-1} collected by experiment

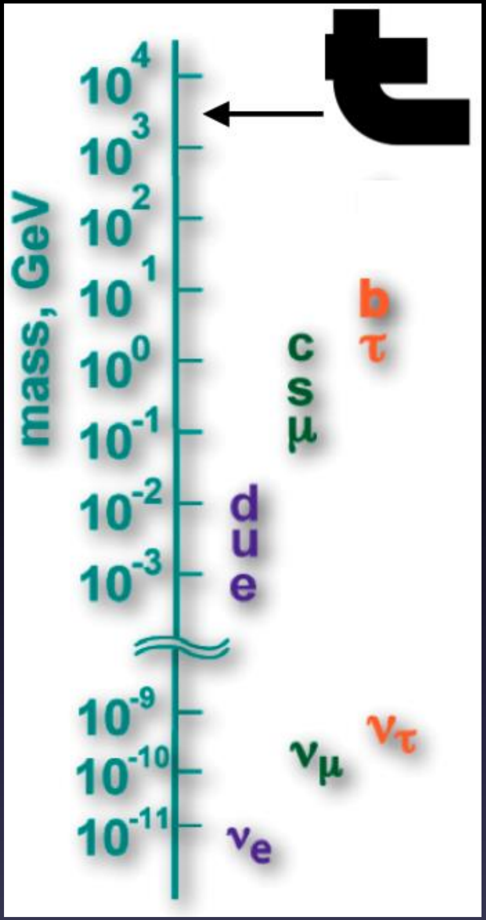






The Top quark is special

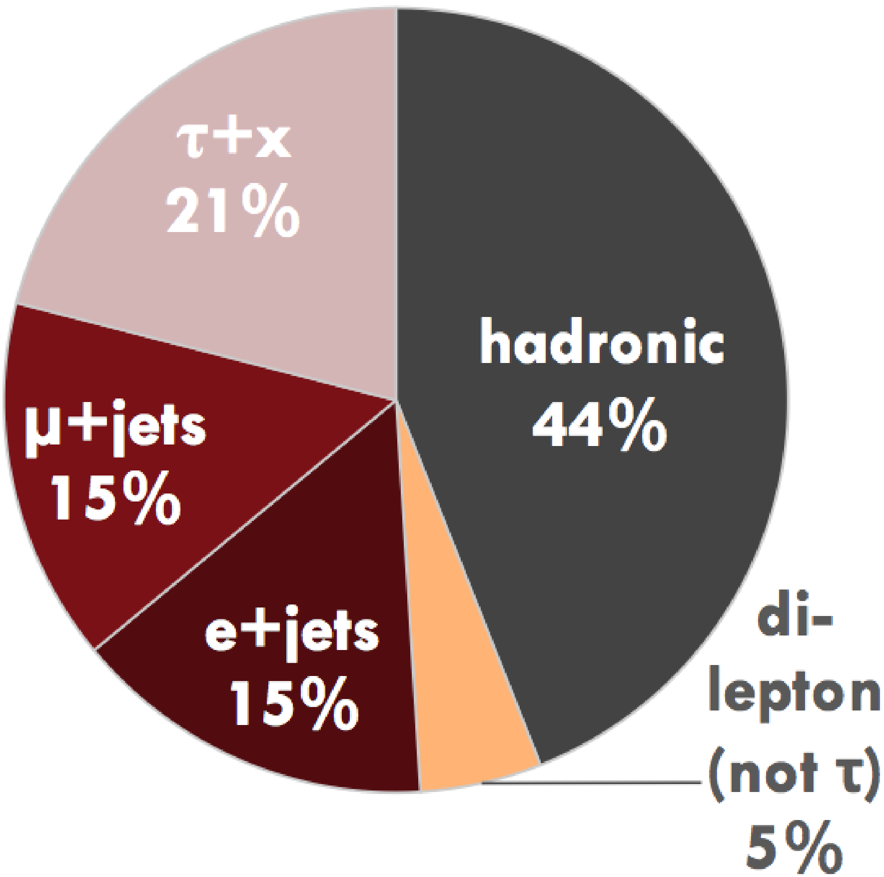
- Top discovered at Fermilab in 1995
- Its mass much larger than any other fermion
- Only quark with large coupling to Higgs
- Lifetime shorter than hadronization time
- Most physics beyond the SM will show up as excess of events above the SM including 6 quarks
- Top studies may be the best testing ground for NLO and NNLO calculations

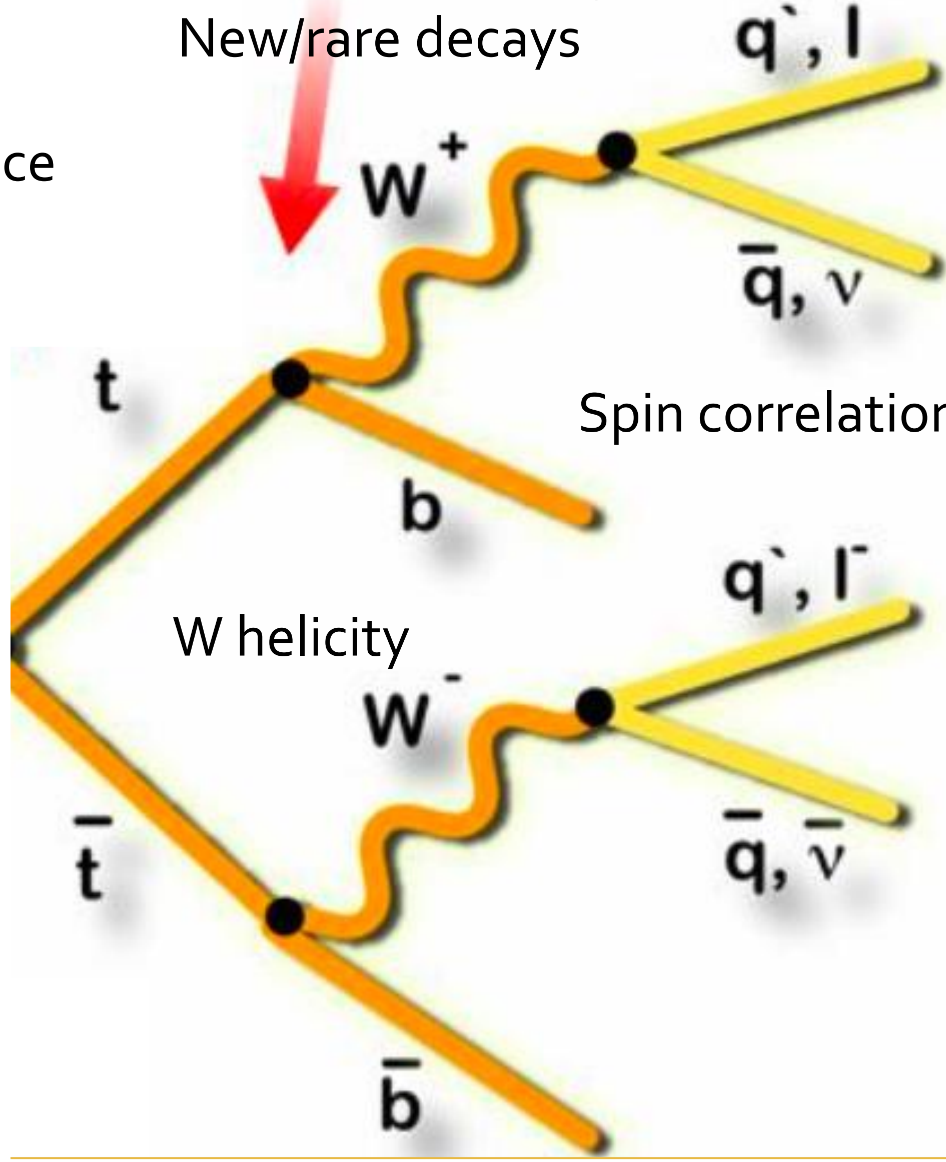


Recently lots of progresses - Czakon and Mitov finished qq and qg NNLO -arXiv:1210.6832, gg – soon, may explain the ttbar charge asymmetry puzzle)

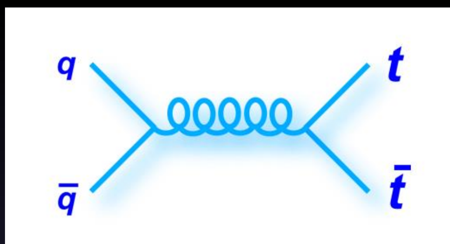
Top width
Lifetime
Top mass
tt mass difference
Top charge

Top branching ratios
Anomalous couplings
New/rare decays

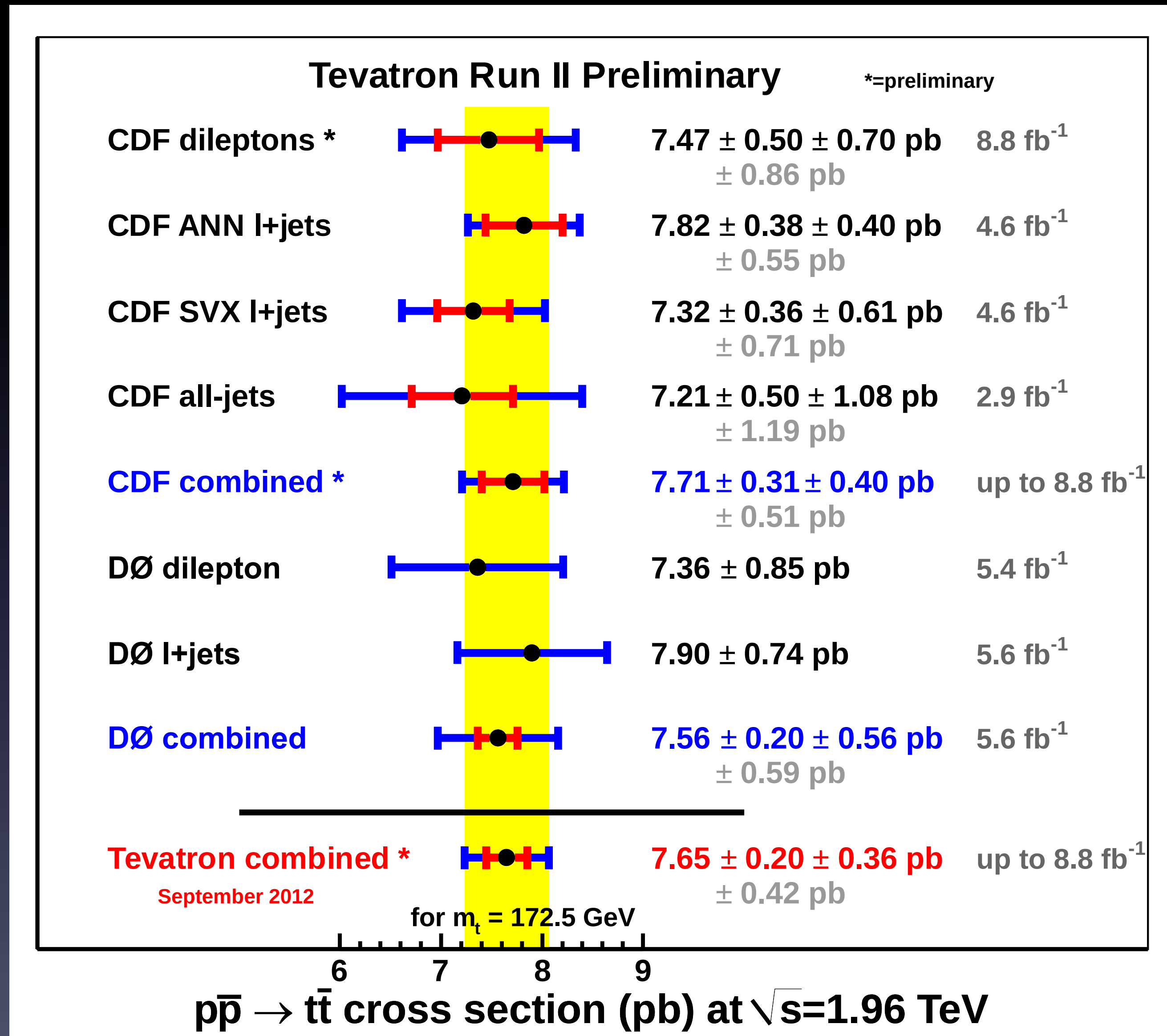




σ_{tt} @ Tevatron

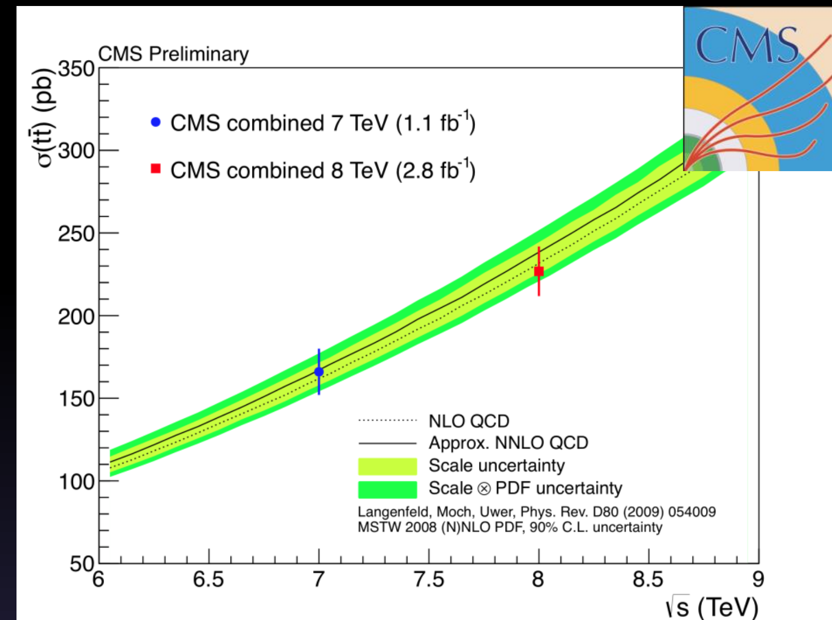


70000 tt pairs



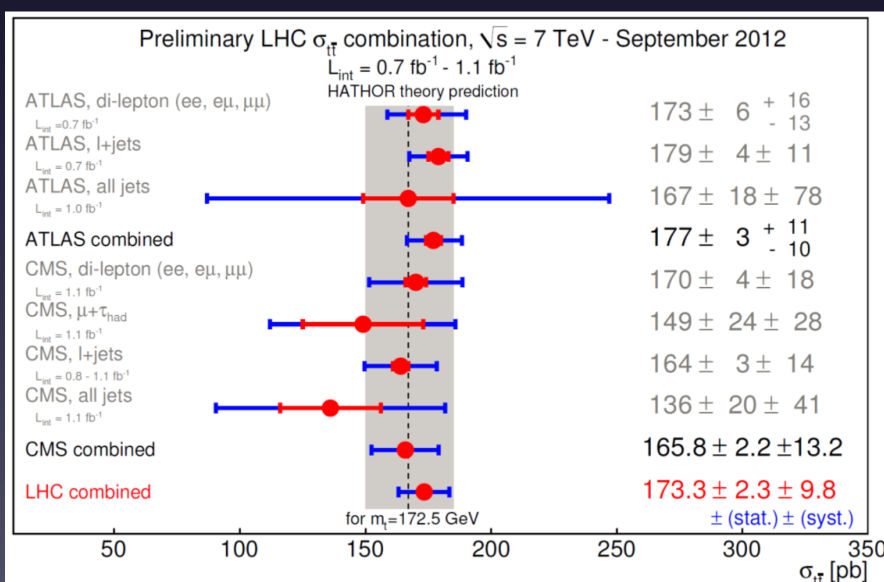
σ_{tt} @ LHC

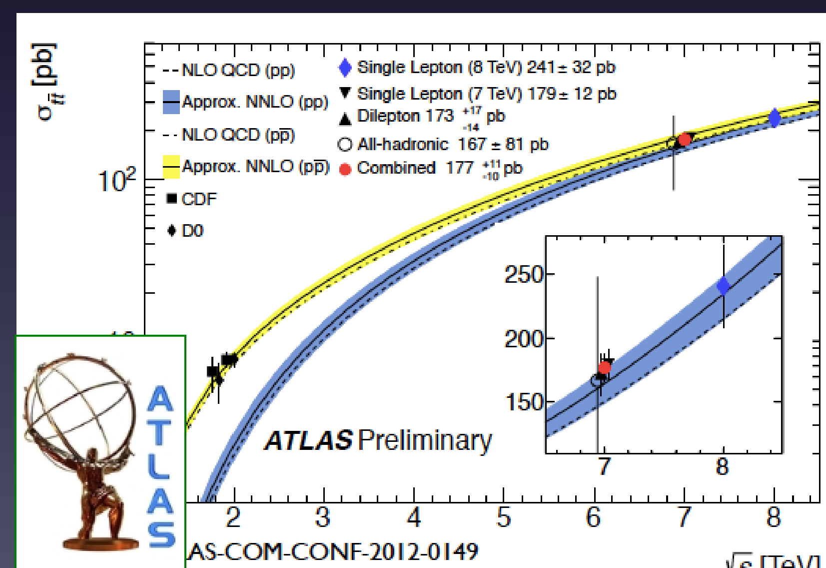
- 5.600.000 tt pairs
- Evolution 7 to 8 TeV as expected
- Uncertainties at 8 TeV 7 - 13 % so far



First LHC combination

- 7% gain v.s. most precise measurement
- New results not included yet





$t\bar{t}$ +W,Z,γ,$b\bar{b}$

Associated production of tt with vector bosons or bb, also observed

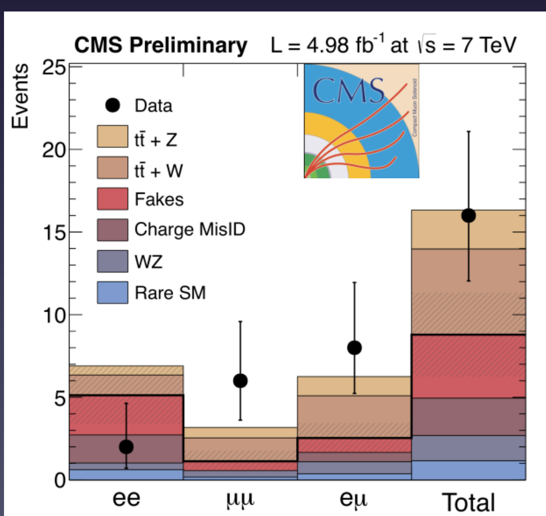
- tt+W/Z, SS dilepton, trilepton [CMS PAS TOP-12-014]:

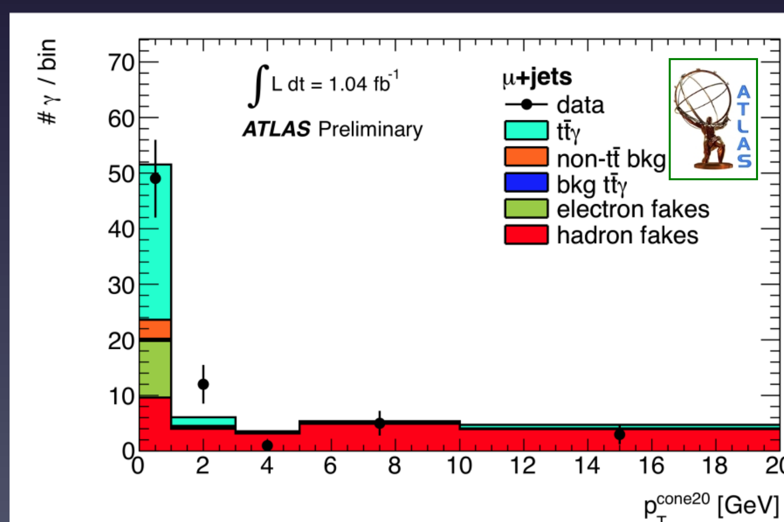
  σ_{ttV} = 0.51 ± 0.14(stat) ± 0.05(syst) pb (Theory: ≈0.3 pb)

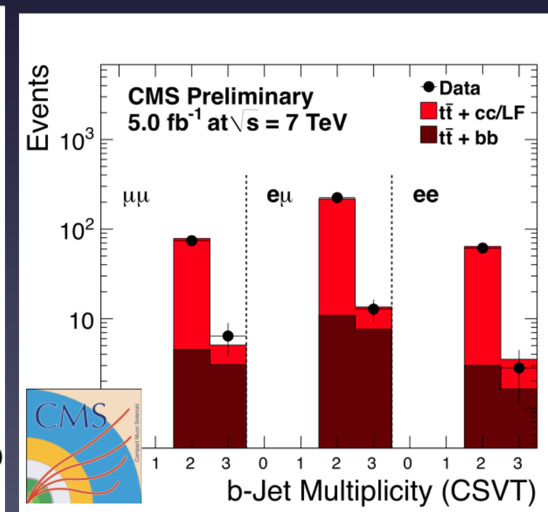
- tt+ γ [ATLAS-CONF-2010-153]

  $\sigma_{tt\gamma}$ = 2.0 ± 0.5(stat) ± 0:7(syst) ± 0:8(lumi) pb (Theory: 2.1 ± 0.4 pb)

- ttbb [CMS PAS TOP-12-024] = σ(ttbb)/σ(ttjj) = 3.6± 1:1(stat)± 0.9(syst)%

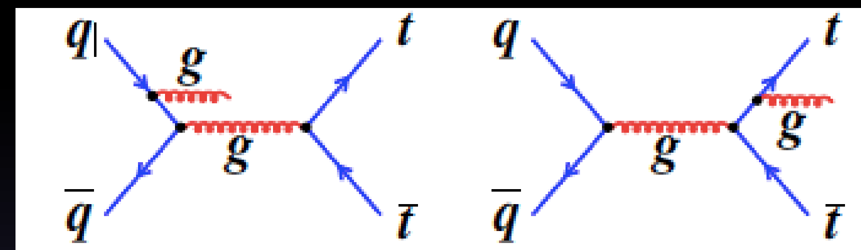




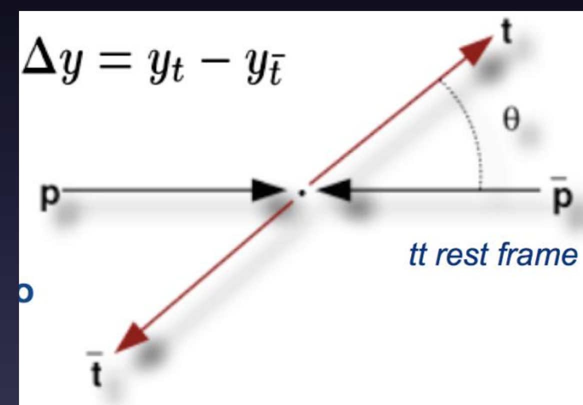


$t\bar{t}$ charge asymmetry@ Tevatron

- @ LO QCD, top production symmetric
- NLO QCD predicts small asymmetry
  - A_{FB} about 5%



- New physics can give rise to a larger asymmetry (Z′, W′, Axigluons, Technicolours…)
- Focus on best measured objects from top decay: leptons



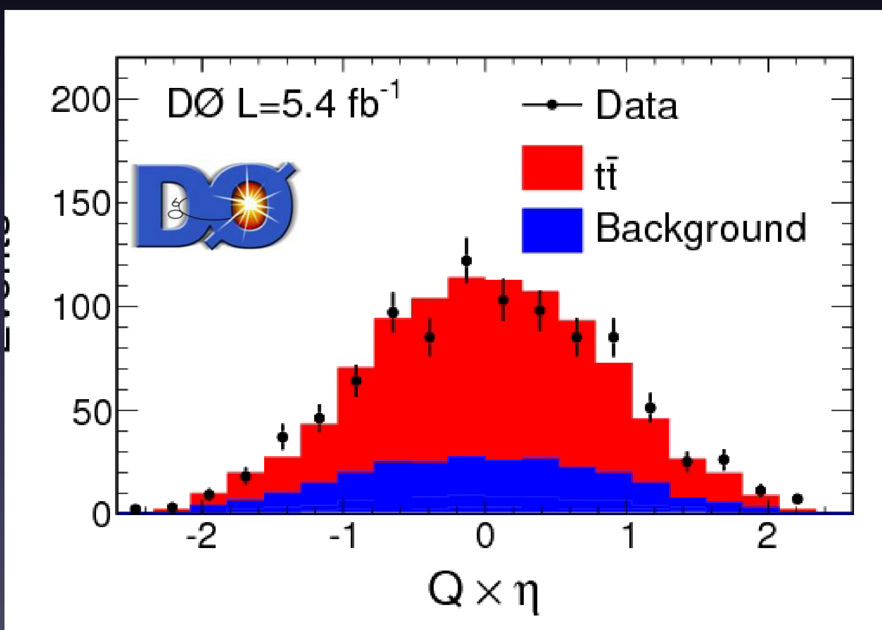
$$A^{l}_{FB} = \frac{N(q_l y_l > 0) - N(q_l y_l < 0)}{N(q_l y_l > 0) + N(q_l y_l < 0)}$$

$$A^{ll} = \frac{N(\Delta\eta > 0) - N(\Delta\eta < 0)}{N(\Delta\eta > 0) + N(\Delta\eta < 0)}, \text{ where } \Delta\eta = \eta_{l^+} - \eta_{l^-}$$

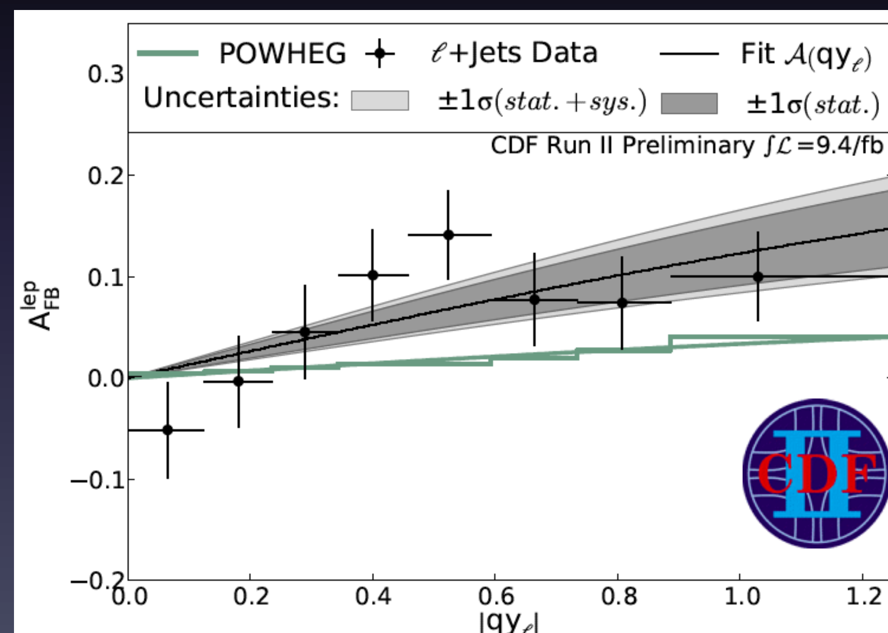
$t\bar{t}$ charge asymmetry@ Tevatron

- 5.4 fb-1 dilepton channel
- A^{l}_{FB} = (5.8 ±5.1(stat) ±1.3(syst))%
- A^{ll} = (5.3±7:9(stat)±2.9(syst))%
- Agreement with MC simulation

- 9.4 fb-1 , l+jets channel
- A^{l}_{FB} = (5.8 ±5.1(stat) ±1.3(syst))%
- Deviation of ≈ 2 σ

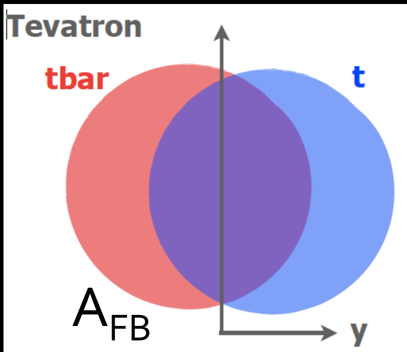


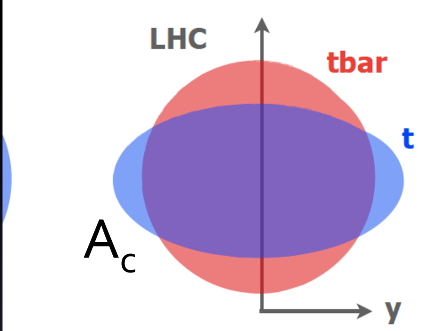
Phys. Rev. D 87, 011103(R) (2012)



CDF conf. note 10975 (2013)

$t\bar{t}$ charge asymmetry@ LHC





- @LHC tops tend to be "more forward" than antitops!

Reconstructing $t\bar{t}$: $\Delta|y| = |y_t| - |y_{\bar{t}}|$

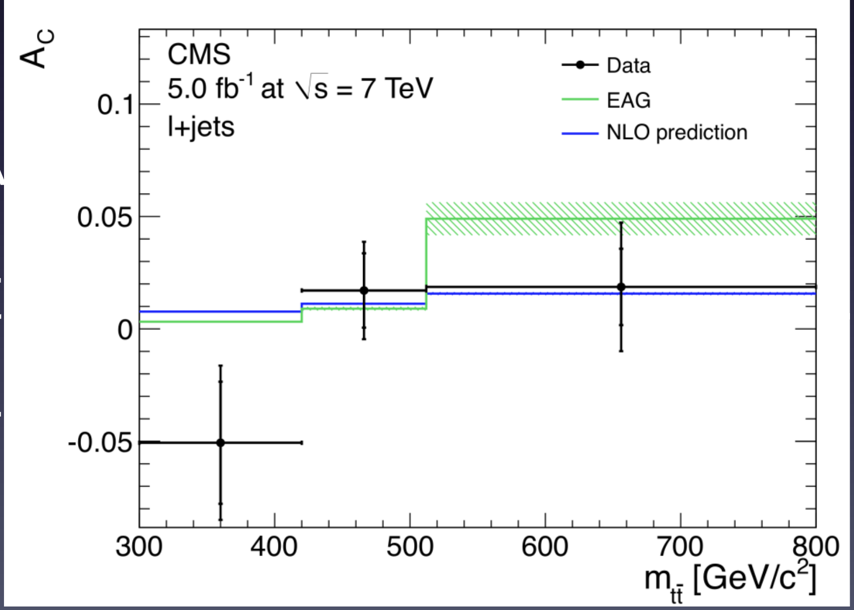
$$A_C = \frac{N(\Delta|y|>0) - N(\Delta|y|<0)}{N(\Delta|y|>0) + N(\Delta|y|<0)}$$

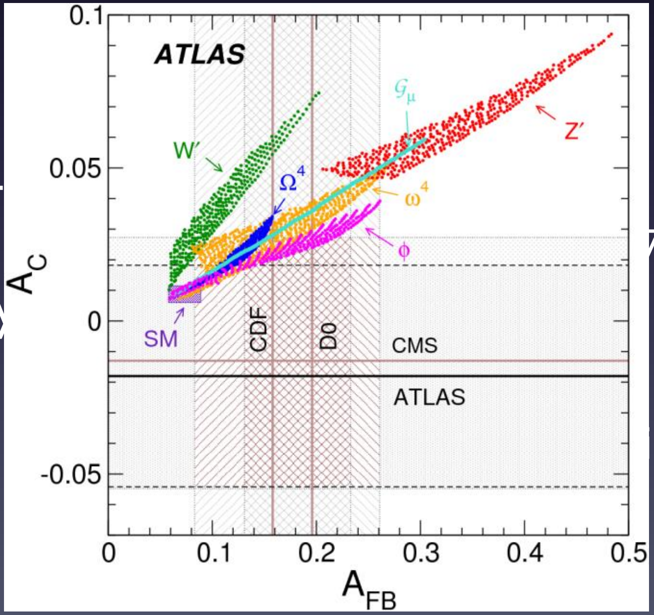
- $A_C \neq A_{FB}$ but related in a model dependent way
- Measured in l+jets and dilepton channel

A … 0.014 … 2039

C … 011(sy … 7]

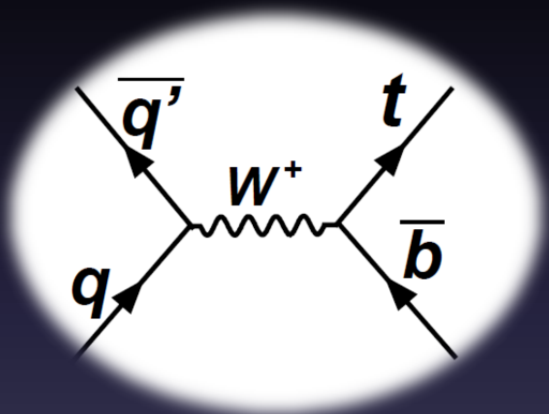
T … go,





Single Top Production

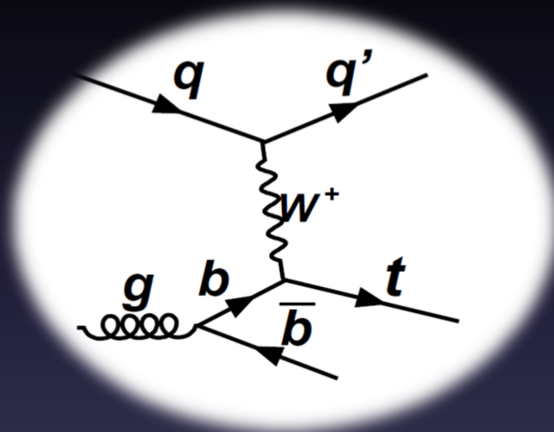
- Electroweak production (first observed in 2009 at the Tevatron)
- Sensitive to new phyisics anomalous couplings
- Direct measurement of |Vtb|



s-channel

TeV: 1.04±0.06 pb

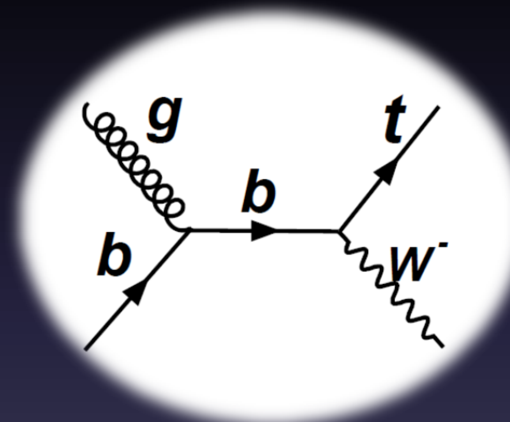
LHC8: 5.6±0.2pb



t-channel

2.1±0.1 pb

87±3 pb



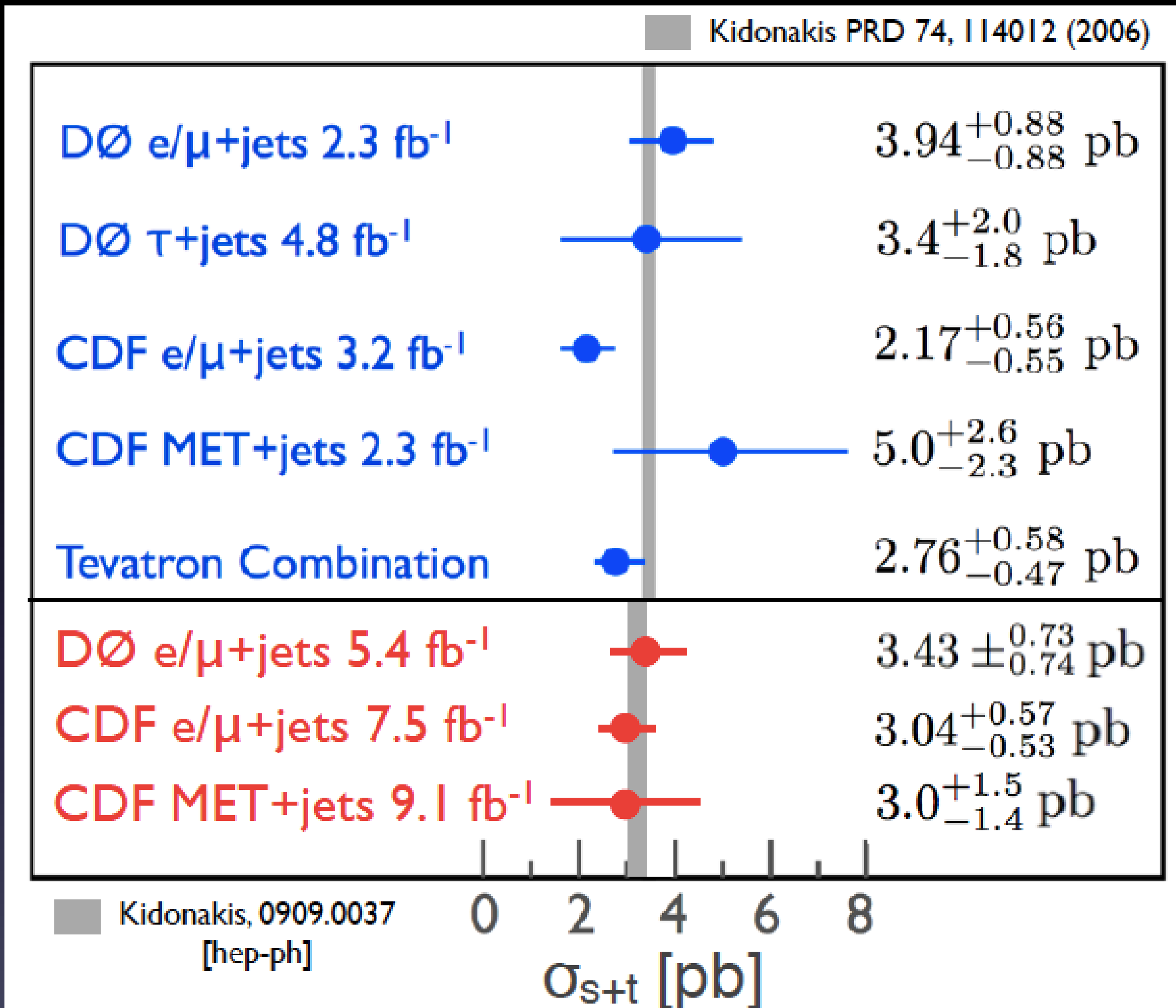
Wt-channel

0.1 pb

22±2 pb

Kidonakis, MSTW2008, NNLO approximation, for mt=173 GeV

s+t-channel @ Tevatron



CDF and Do in 2009

Extraction of V_{tb}

Main systematics:

- B-tagging
- W+jets normalization
- Jet energy scale

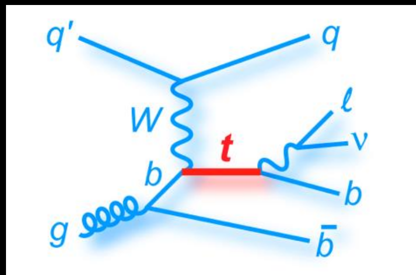
$|V_{tb}| = 0.88 \pm 0.07$ $\pm 8\%$

$|V_{tb}| = 0.92^{+0.10}_{-0.11}$

$|V_{tb}| = 0.92 \pm 0.10$

Good agreement with SM

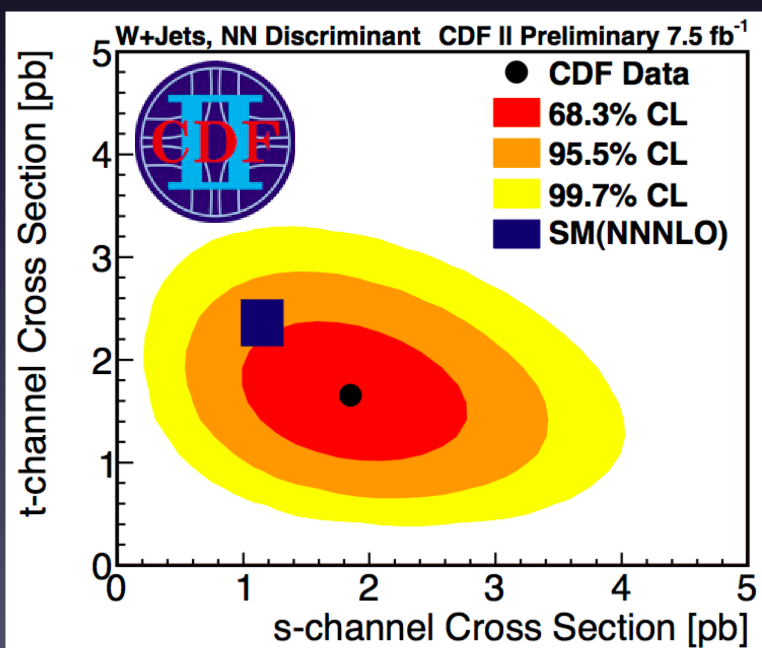
t-channel @ Tevatron

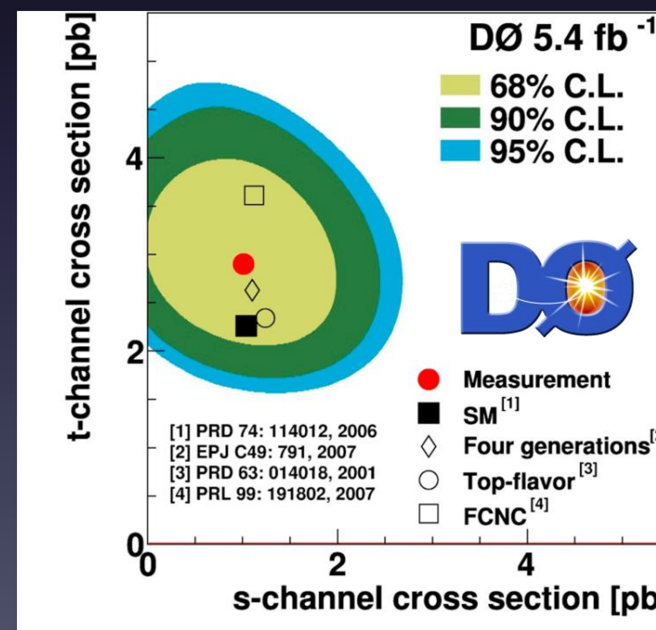


- Remove s/t channel constraint (could be changed by new physics)
- Train multivariate analysis for t-channel
- Measure s- and t-channel simultaneously

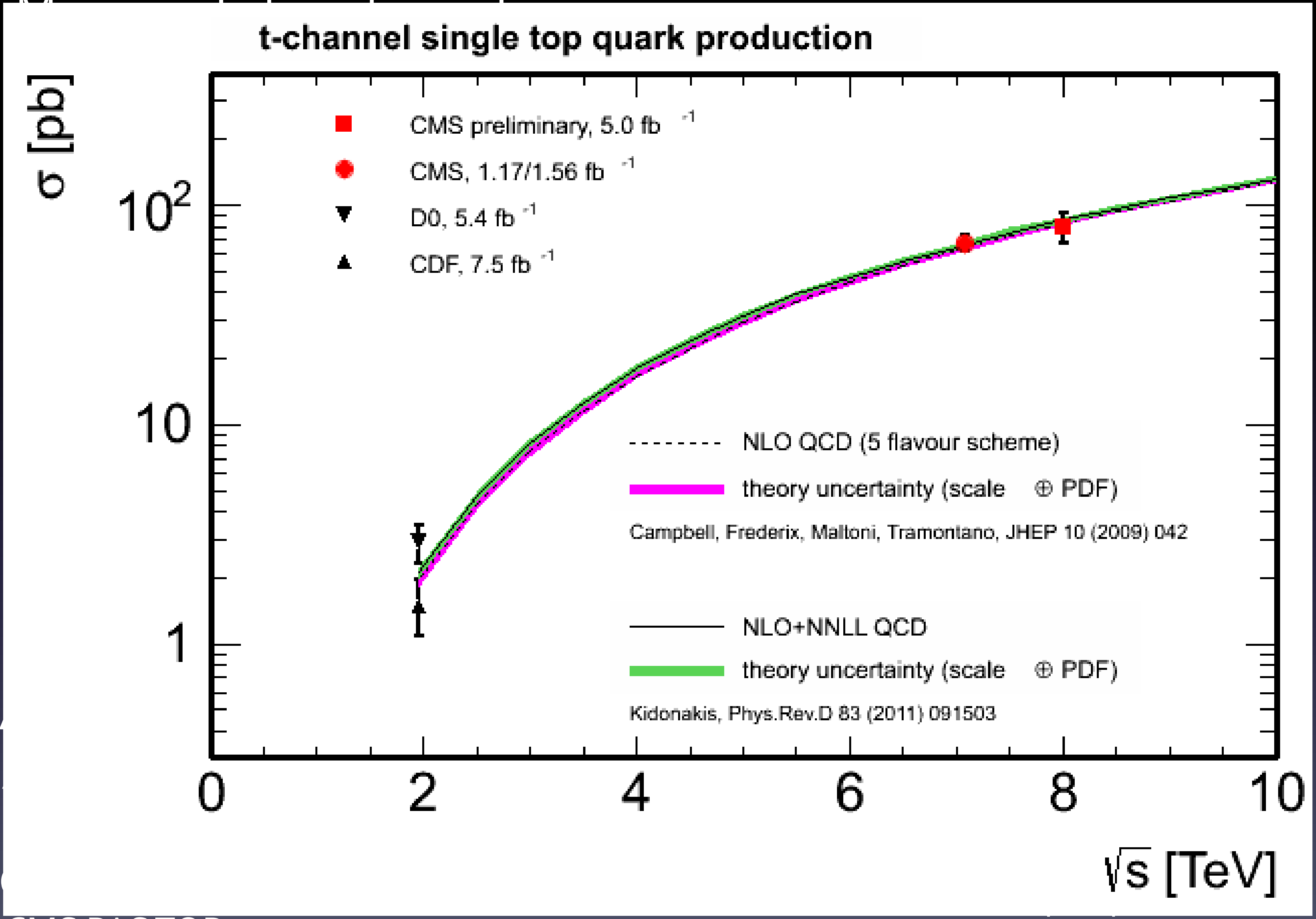
$$\sigma(\text{t-channel}) = 2.90 \pm 0.59 \text{ pb}$$ ± 20%

Observation wth 5.5 σ



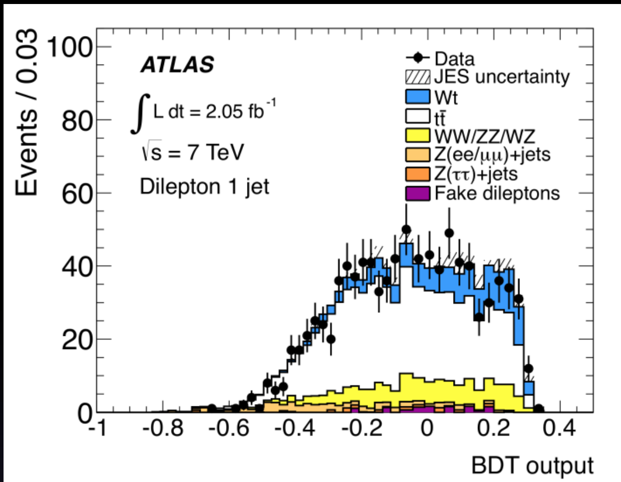


t-channel @ LHC



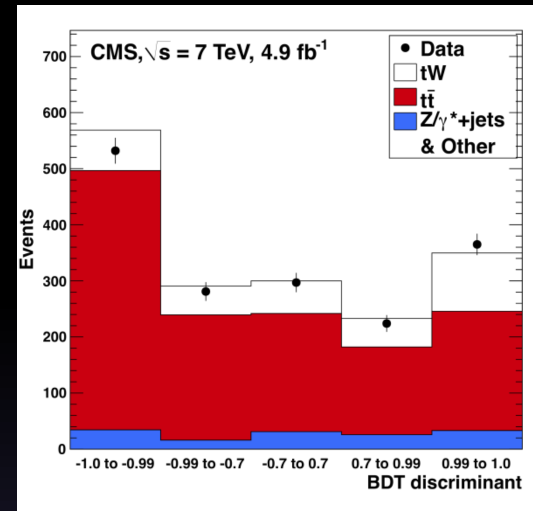
CMS PAS TOP-12-011

Wt and s-channel @ LHC



Wt-channel:

- Dilepton selection
- MVA discriminants

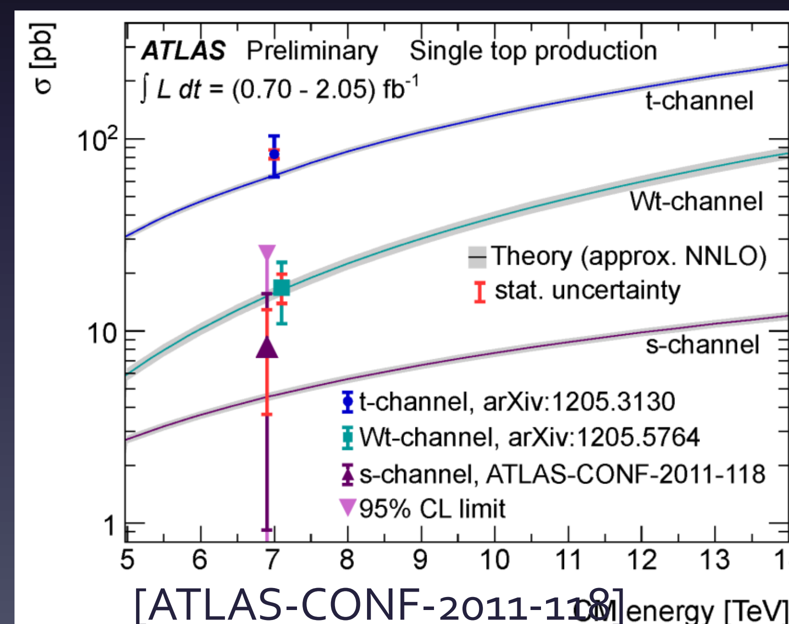


ATLAS σ_{Wt} = 16.8 ± 2.9(stat) ± 4.9(syst) pb

[PLB716(2012)142])

CMS $\sigma_{Wt} = 16^{+5}_{-4}$ pb

[Phys. Rev. Lett. 110, 022003 (2013)])



[ATLAS-CONF-2011-118]

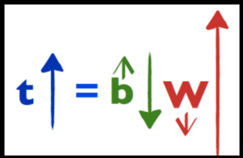
s-channel:

- No evidence yet
- 5.8 x SM excluded @ 95% C.L.

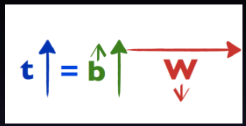
W helicity @ Tevatron

V-A coupling predicts:

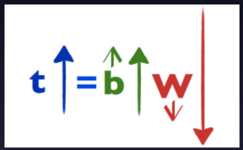
$$\frac{1}{\sigma}\frac{d\sigma}{d\cos\theta^*} = \frac{3}{4}(1-\cos^2\theta^*)F_0 + \frac{3}{8}(1-\cos\theta^*)^2 F_L + \frac{3}{8}(1+\cos\theta^*)^2 F_R$$



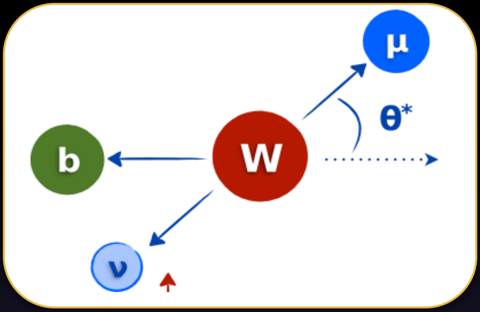
$f_L \approx 0.311$

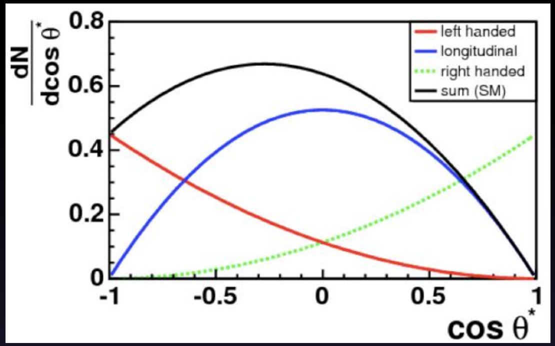


$f_0 \approx 0.687$



$f_R \approx 0.001$

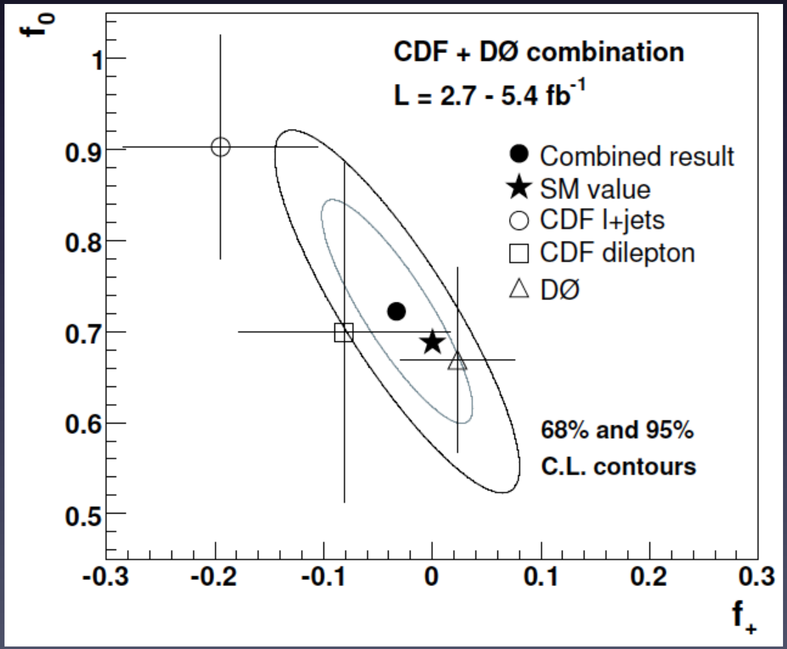




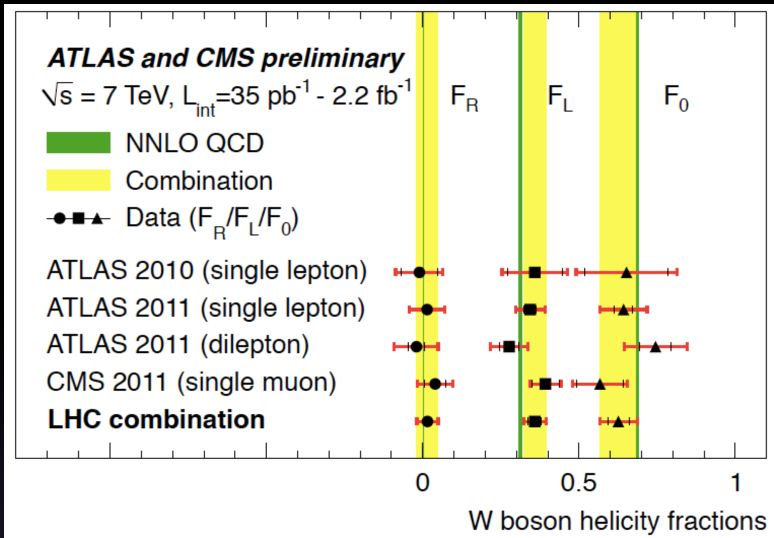
Combined CDF+D0

f_R=-0.033±0.0462
f_0=0.722±0.081

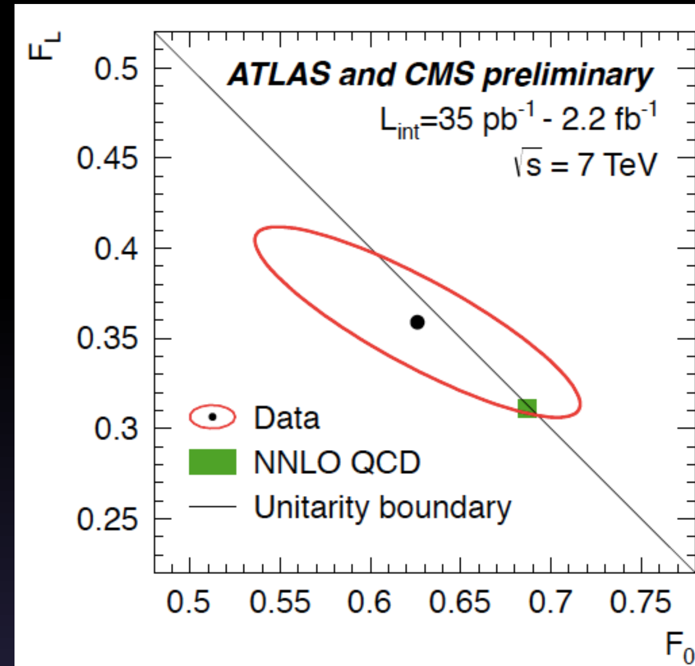
PRD 85 , 091104 (2012)



W helicity @ LHC



ATLAS-CONF-2013-033
CMS-PAS-TOP-12-025

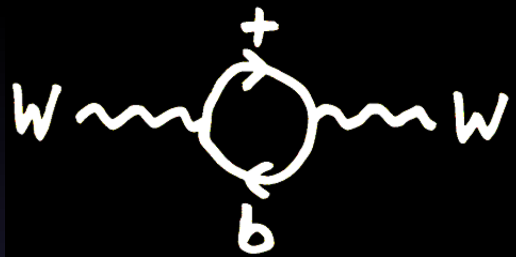


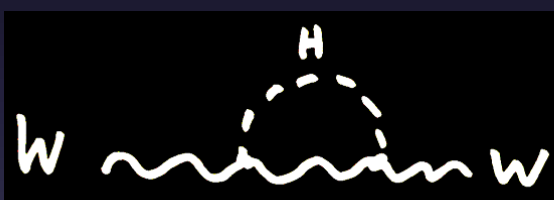
- Unitarity constraint: $F_0+F_L+F_R=1$ in each measurement and in the combination

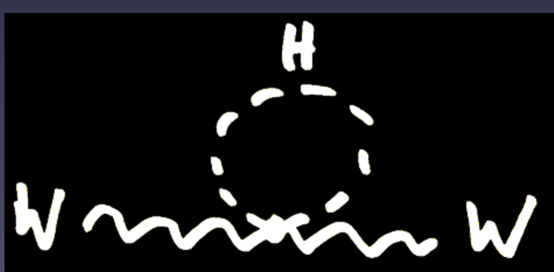
$$F_0 = 0.626 \pm 0.034(stat) \pm 0.048(syst)$$
$$F_L = 0.359 \pm 0.021(stat) \pm 0.028(syst)$$
$$F_R = 0.015 \pm 0.034(stat + syst)$$

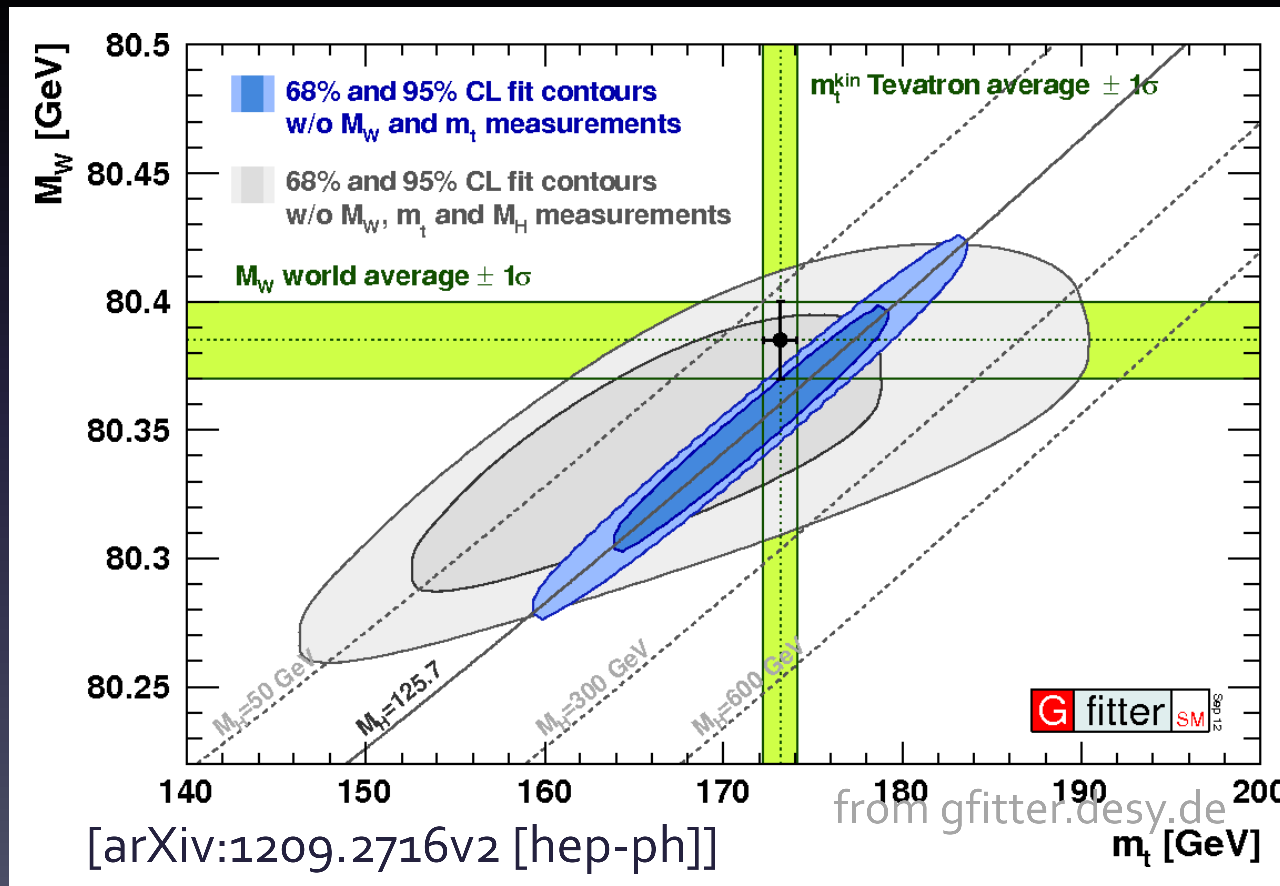
Importance of M_{top} measurement

- Precision needed to test Electroweak theory given a Higgs boson at 125 GeV









[arXiv:1209.2716v2 [hep-ph]]

M_{top} @ Tevatron: combination

- Using Best Linear Unbiased Estimator
- Requires the knowledge of the correlation of uncertainties between measurements -> lot of care in defining systematic uncertainties
- Systematic distributions assumed (symmetric) gaussian

In selecting the measurements among the 50 that the collaborations published, the focus is on precision and independence

12 results from the two experiments are combined:

Mass measurements from Tevatron: March 2013 combination

$$m_t = 173.20 \pm 0.51\ (stat.) \pm 0.71\ (syst.)\ \mathrm{GeV}/c^2$$
$$= 173.20 \pm 0.87\ \mathrm{GeV}/c^2 \qquad (rel.\ 0.50\%)$$

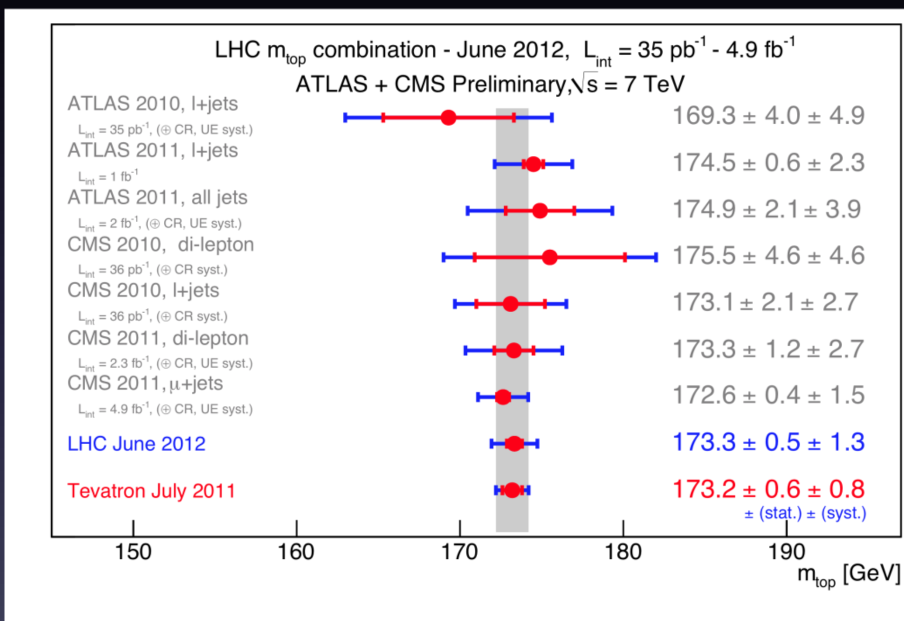
Dominant uncertainties: Jet Energy Scale and Signal Modelling

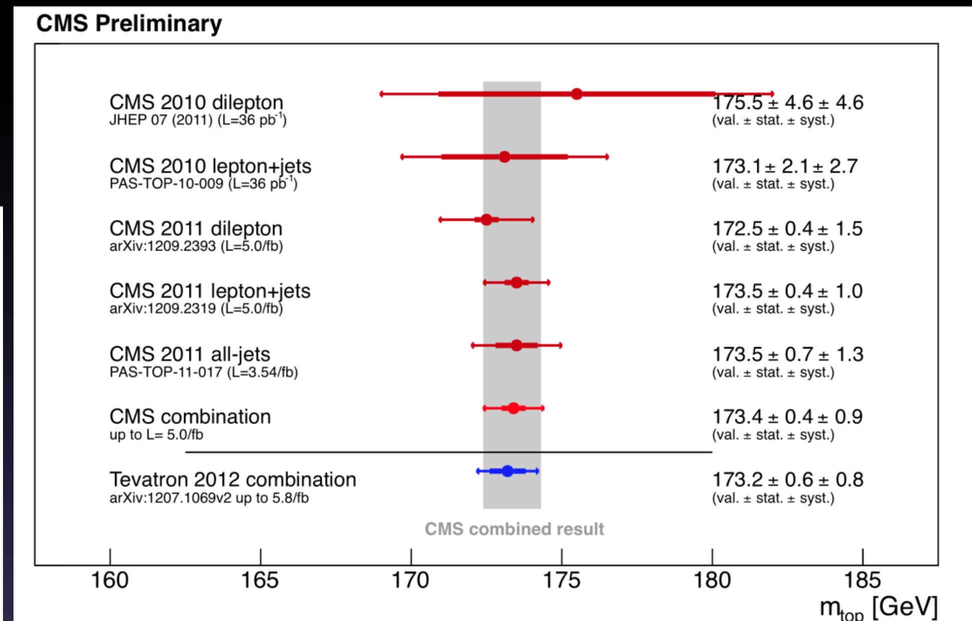
M_{top} @ LHC

First LHC combination

CMS—PAS-TOP-11-018

- Important exercise but outdated
- LHC precision: 0.8%





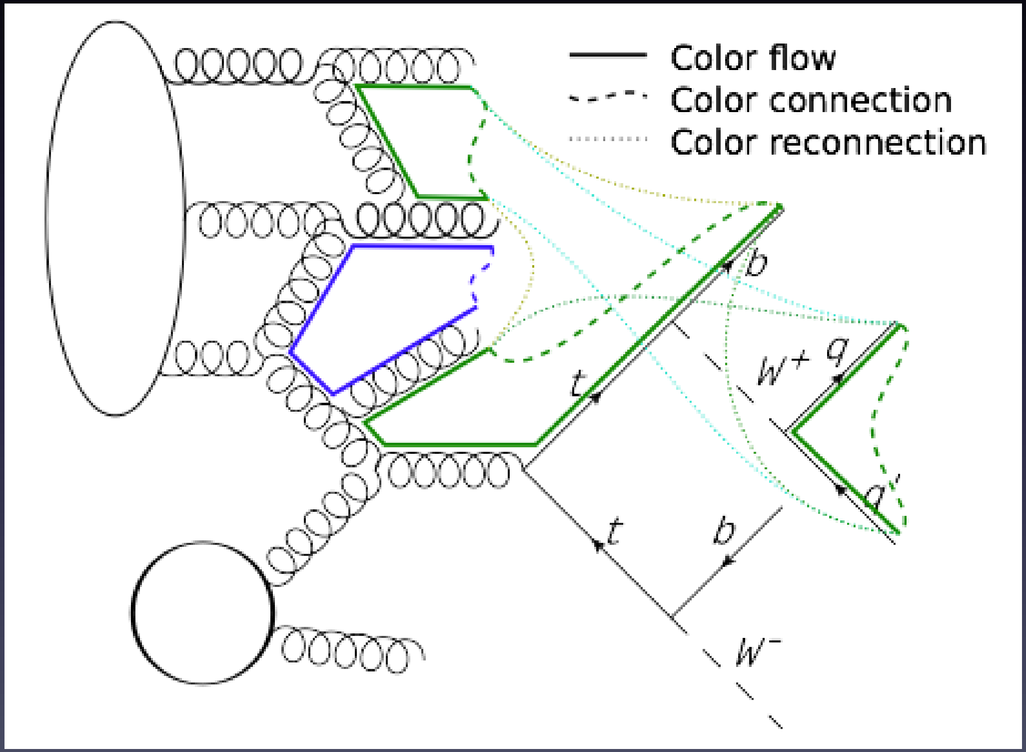
- Most precise single mesurement
- Reaching Tevatron Precision
- Perfect agreement with Tevatron

CMS PAS TOP-12-001
ATLAS-CONF-2012-095]

M_{top} vs event kinematics @ LHC

- M_{top} measurements reached a remarkable precision
- M_{top} interpretation is not straightforward for δm~< 1 GeV~Γt.

  Difficult to define a pole mass for unstable and colored particles



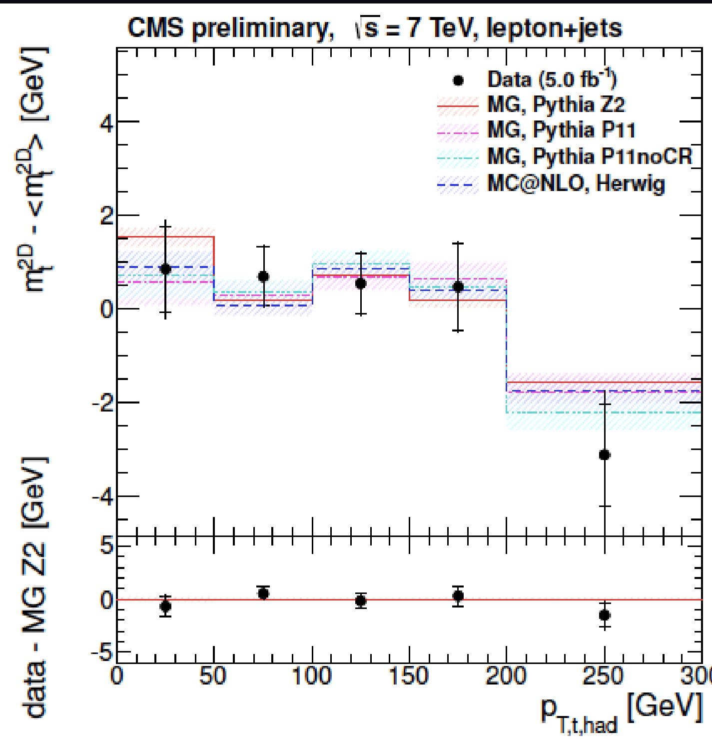
Since top decays before hadronizing to have a colorless final state, additional quarks are needed.

M_{top} exp ≠ M_{to}p pole and event dependent.

M_{top} vs event kinematics @ LHC

- First M_{top} measurement binned in kinematic observables
- Relation contains (non)perturbative corrections, expected to depend on event kinematics
- Is this kinematic dependence properly modelled by MC?
- With the current precision no mismodelling effects

	Fig.	Observable
color recon.	1	$\Delta R_{q\bar{q}}$
	2	$\Delta\phi_{q\bar{q}}$
	3	$p_{T,t,had}$
	4	$\lvert\eta_{t,had}\rvert$
ISR/FSR	5	H_T
	6	$m_{t\bar{t}}$
	7	$p_{T,t\bar{t}}$
	8	Jet multiplicity
b-quark kin.	9	$p_{T,b,had}$
	10	$\lvert\eta_{b,had}\rvert$
	11	$\Delta R_{b\bar{b}}$
	12	$\Delta\phi_{b\bar{b}}$

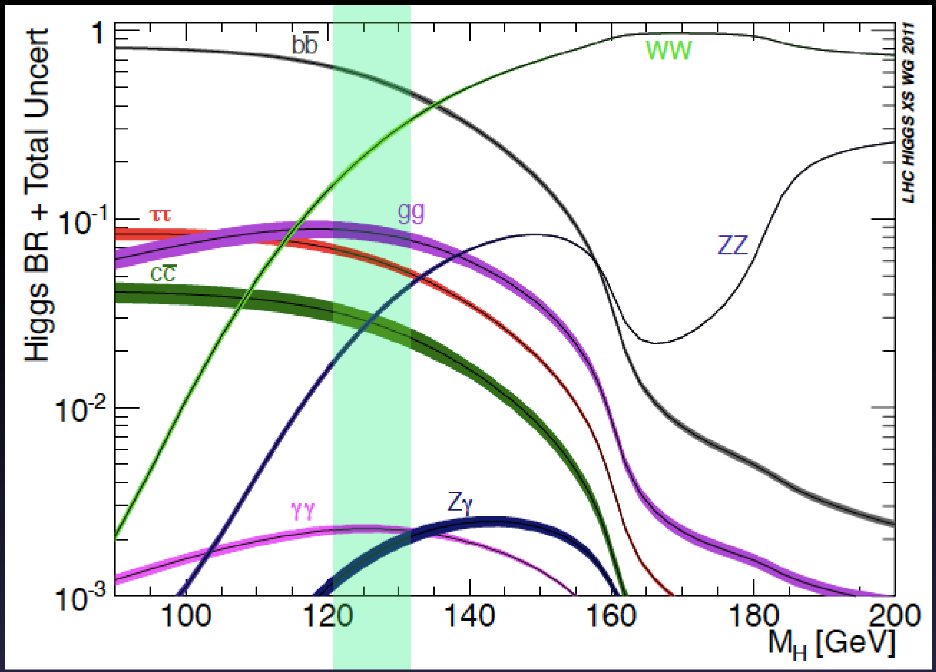


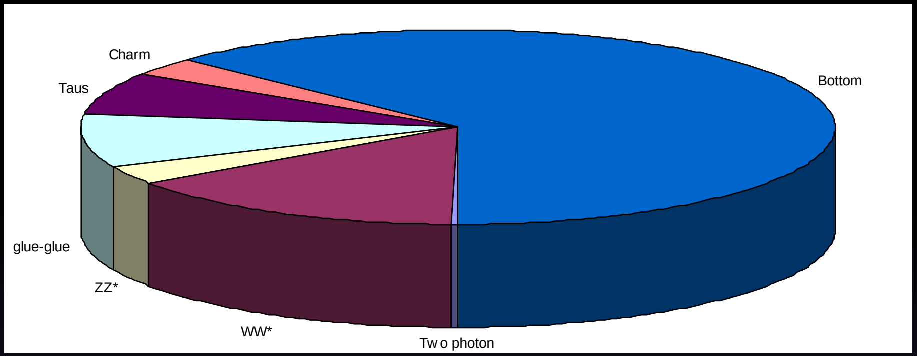
CMS-PAS-TOP-12-029

Top Conclusions

- 18 years after discovery top quark still a fascinating topic in HEP
- High precision measurements at LHC start to be on par (e.g. mass), or better (e.g. limits on |Vtb|) than the ones performed at Tevatron
- Large statistics @LHC allows to perform more detailed studies
- Many published analyses still based on 7 TeV datasets. More (even better) results expected before LHC starts back
- Other measurements not reported here, including:
  - Tt cross-section: all-hadronic, nal states with , Higgs searches: ttH, tH+, FCNC in t decay, Top mass: dilepton, all-ahdronic, mass from tt

Higgs Decays





By coincidence, MH= 125 GeV is one of the best places to find Higgs and study its properties (from the experimental point of view) – many channels with relatively large branching fractions !

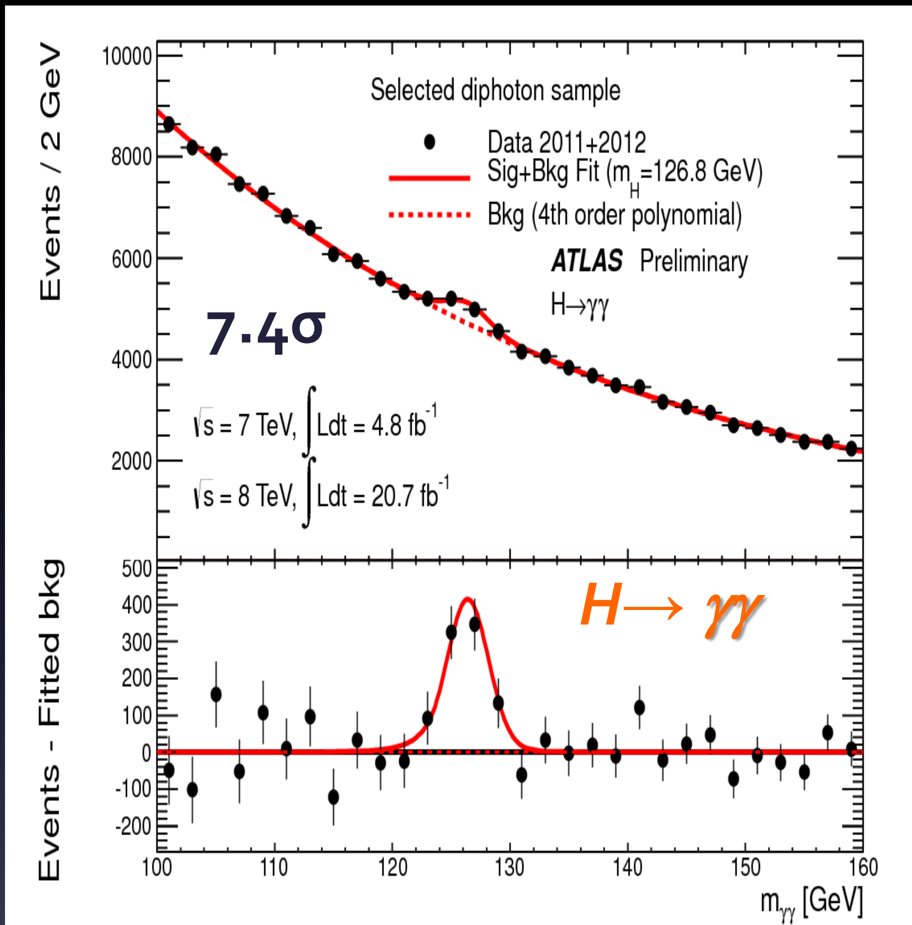
	BR	b:s
bb	60%	10^4
WW	15%	10
ZZ	4%	10
gg	10%	10^6
$\tau\tau$	8%	10^5
cc	6%	10^4
$\gamma\gamma$	0.2%	10

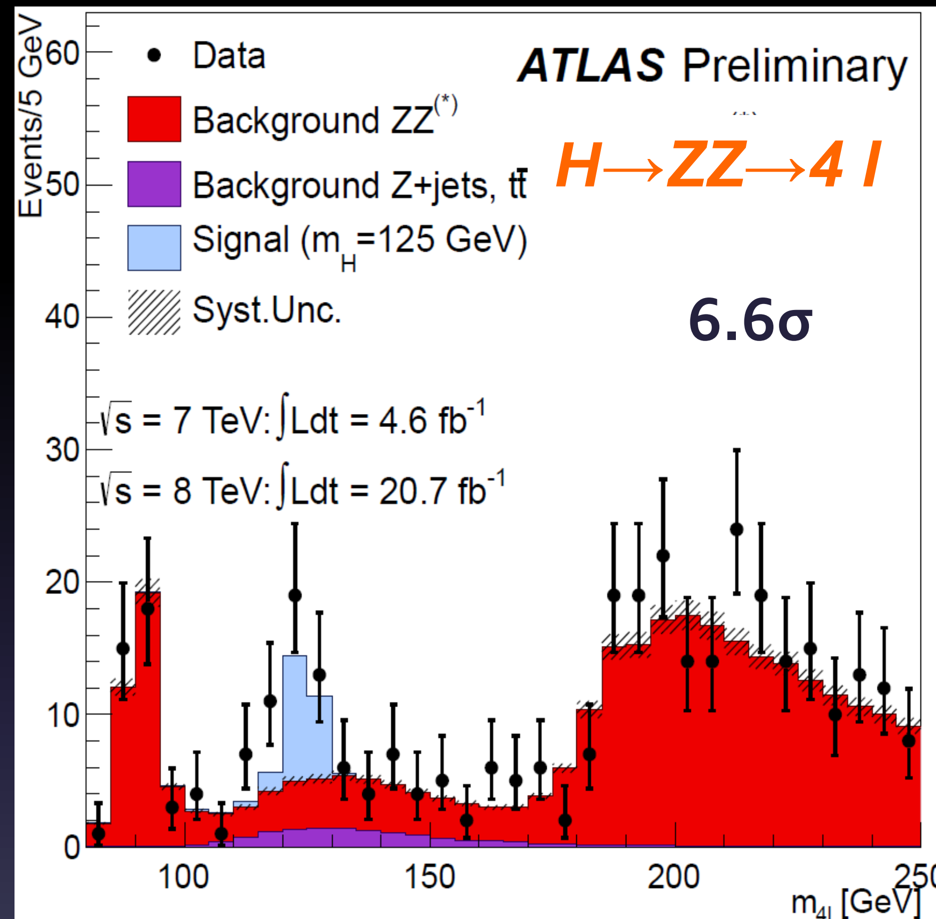
Questions & Answers

Question	Done?	How
Statistically significant?	yes	Estimate p-value on combination
Is it a boson?	yes	It decays in $\gamma\gamma$
Mass?	yes (improving)	Use $\gamma\gamma$ and ZZ channels

@ 125GeV	signature	S/B	Mass Resol.	N events in $20fb^{-1}$	Good For
$H \rightarrow bb$	two b-jets, Z or W, bb inv. mass	low O(0.1)	10%	$\sim 10^5$ ~50 (sel)	couplings to fermions
$H \rightarrow \tau\tau$	had tau, leptons, MET	low O(0.1)	10 %	$\sim 10^4$ ~40 (sel)	couplings to fermions
$H \rightarrow WW$	two leptons with opposite charge MET	medium O(1)	20 %	$\sim 10^3$ ~120 (sel)	cross section, BR, couplings to V
$H \rightarrow \gamma\gamma$	two photons peak in inv. mass	low O(0.1)	1-2%	800 ~400 (sel)	H mass, couplings $K_V K_F$, discovery
$H \rightarrow ZZ$	four leptons with right charge peaks in inv. mass (Z_1 and Higgs)	high >1	1-2%	40 ~12 (sel)	H mass, discovery

ATLAS New results (Moriond EW 2013)





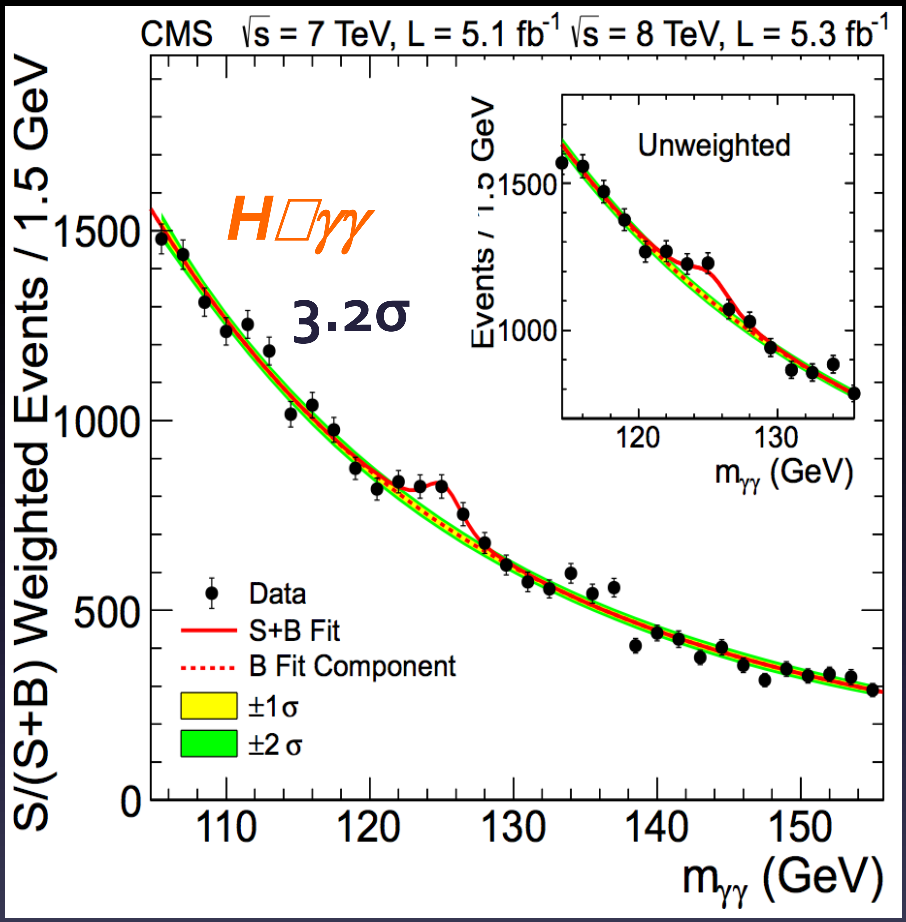
m_H= 126.8±0.2(stat) ±0.7(syst) GeV

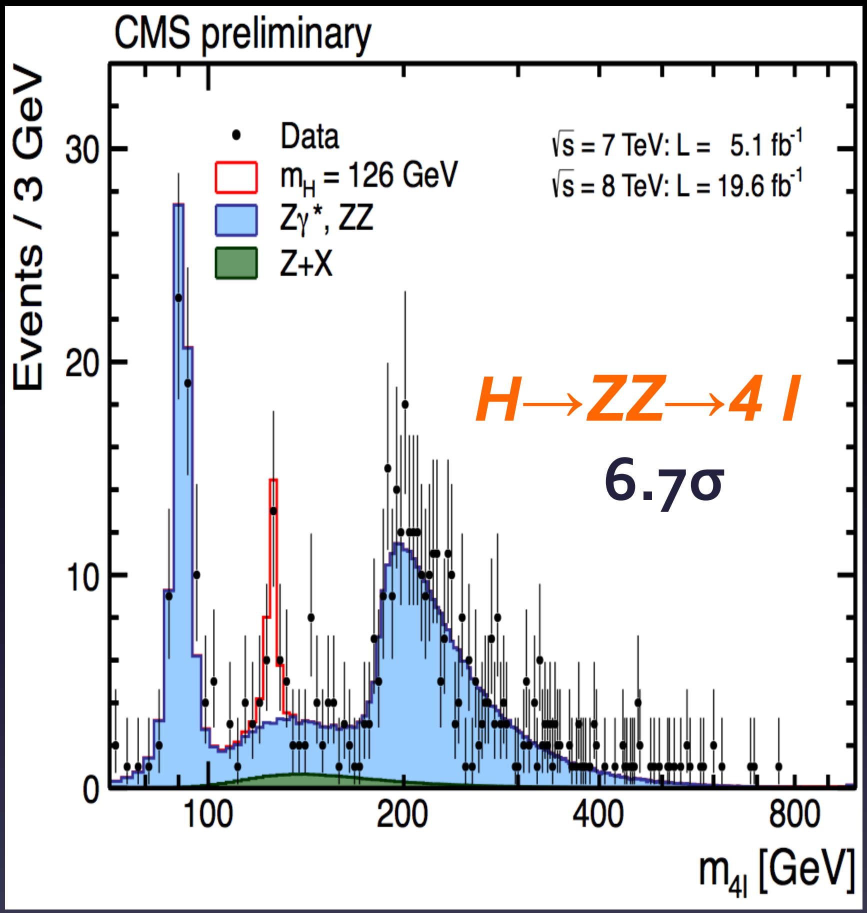
m_H= 124.3 $^{+0.6}_{-0.5}$(stat) $^{+0.5}_{-0.3}$(syst) GeV

Combined : 125.5 ± 0.2 (stat)± 0.6 (sys) GeV
ΔM = 2.3+0.6-0.7(stat) ±0.6(syst) GeV

ΔM_H=0 disfavoured by:
1.5%(2.4 σ)- MC ensembles;
8%- rectangular pdfs

CMS New results (Moriond EW 2013)





m_H =125± 0.3(stat) ±0.6 (syst)GeV

m_H =125.8±0.5(stat)±0.2(syst) GeV

Combined : 125.7 ± 0.4 GeV

Signal strenght

- Most of the measurements based on the number of signal observed

category/channel   detector acceptance   decay final state

$$n^k_{\text{signal}} = \left(\sum_i \mu_i \sigma_{i,\text{SM}} \times A^k_{if} \times \varepsilon^k_{if} \right) \times \mu_f \times B_{f,\text{SM}} \times \mathcal{L}^k$$

- The strenght parameter is simply the comparison of the observed signal yield with the SM prediction

$$\mu_i = \sigma_i / \sigma_{i,\text{SM}}$$

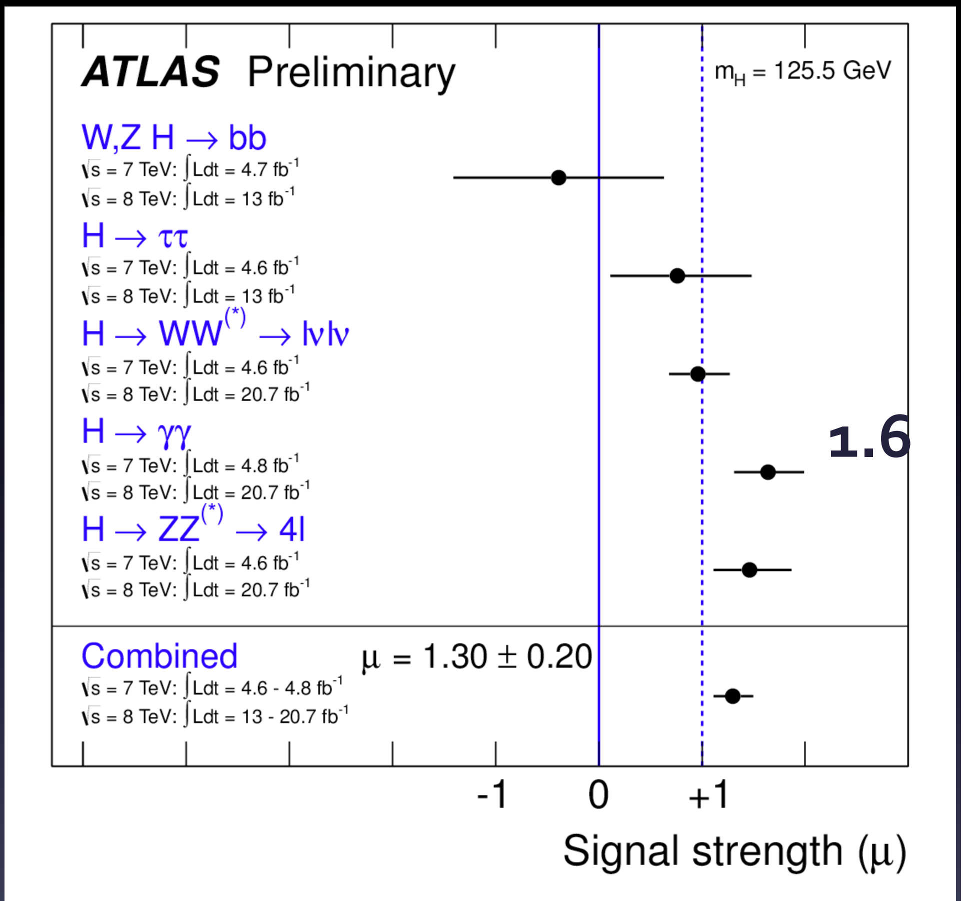
$$\mu_f = B_f / B_{f,\text{SM}}$$

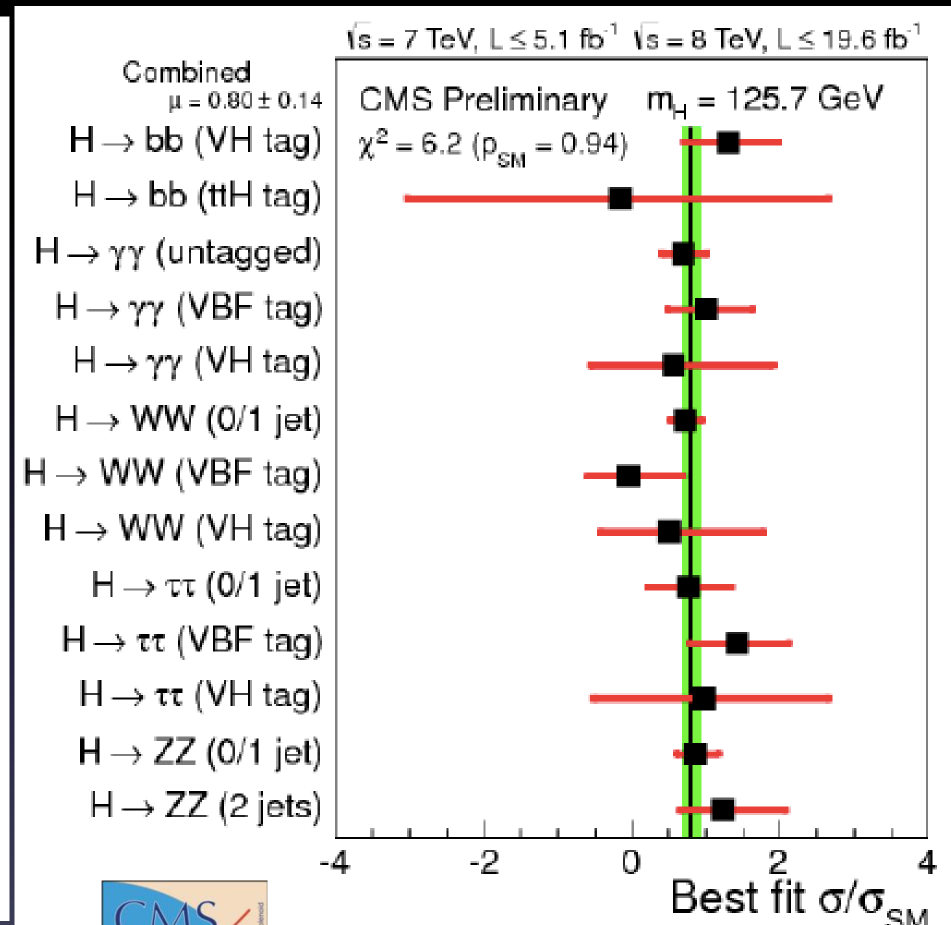
$$\mu = \mu_i . \mu_f$$

global signal strength

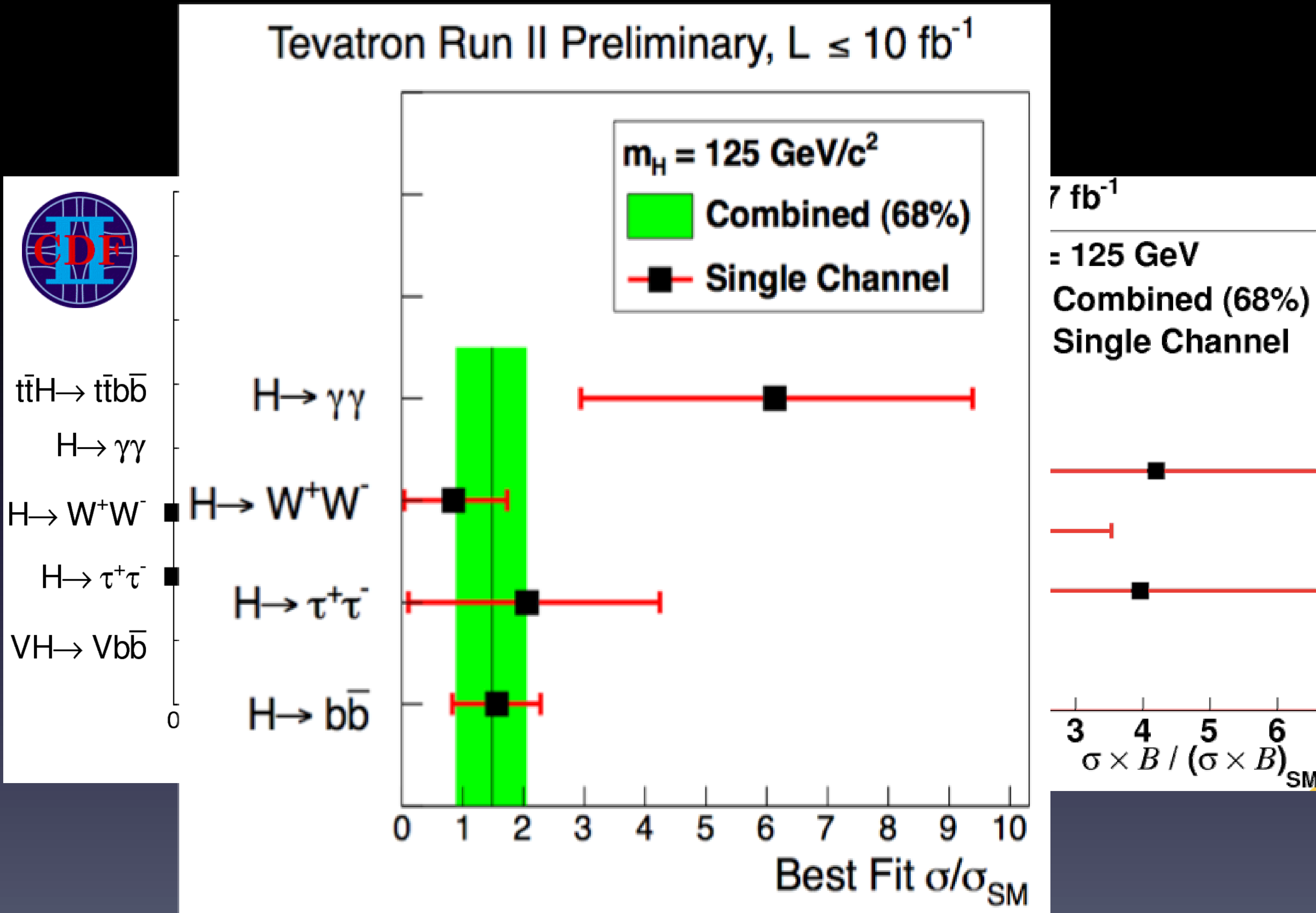
Signal strenght @ LHC

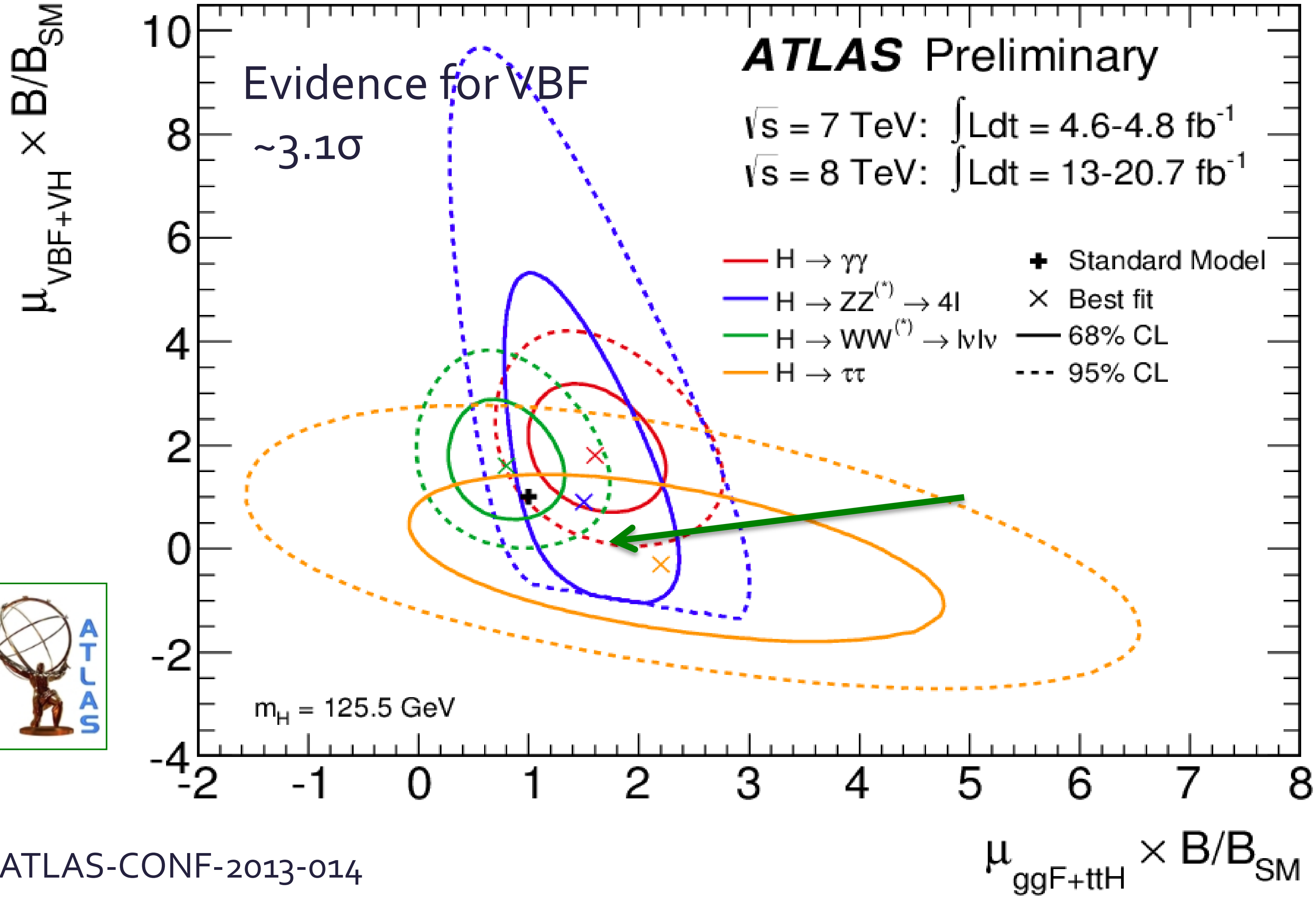
ATLAS-CONF-2013-014





Signal strenght @ Tevatron





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- Fermion mediated (ggH and ttH process): $\mu_{ggH+ttH}$
- Boson mediated (VBF and VH process): μ_{VBF}, μ_{VH}, μ_{VBF+VH}

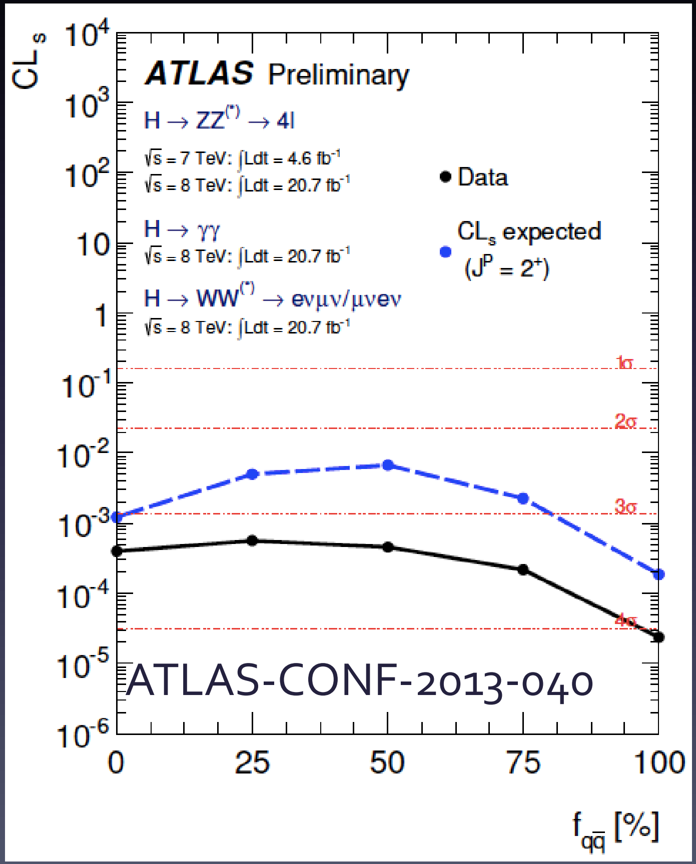
Questions & Answers

Question	Done?	How
Statistically significant?	yes	Estimate p-value on combination
Is it a boson?	yes	It decays in $\gamma\gamma$
Mass?	yes (improving)	Use $\gamma\gamma$ and ZZ channels
Spin?	yes (improving)	Use kinematics of decay products
Parity?	yes (improving)	Use kinematics of decay products

Spin @ LHC

- Test compatibility of data with distinct models
- 20.7 fb^{-1} (8 TeV)
  + 4.8 fb^{-1}(7 TeV) for H−>4l
- Spin from particle kinematics

J^P	Description
0^-	CP-odd scalar
0_h+	CP-even w/ HD operators
1^+	Axial-vector
1^-	Vector
2_m^+ (gg)	gg -> min coupling grav
2_m^+(qq)	qq->min coupling grav



- H−>γγ, H−>4l , H−>WW*
- The observed exclusion of the $J^P = 2^+$ state in favour of the SM $J^P = 0^+$ hypothesis exceeds 99.9% CL for all values of f_{qq}

Spin @ LHC

HZZ

fitted μ separation						
J^P	production	comment	expect (μ=1)	obs. 0+	Obs. J^P	CL_s
0-	gg→X	Pseudoscalar	2.6σ (2.8σ)	0.5σ	3.3σ	0.16%
0h+	gg→X	Higher dim operators	1.7σ (1.8σ)	0.0σ	1.7σ	8.1%
2m+	gg→X	Minimal couplings	1.8σ (1.9σ)	0.8σ	2.7σ	1.5%
2m+	qq→X	Minimal couplings	1.7σ (1.9σ)	1.8σ	4.0σ	<0.1%
1-	qq→X	Exotic vector	2.8σ (3.1σ)	1.4σ	>4.0σ	<0.1%
1+	qq→X	Exotic axial-vector	2.3σ (2.6σ)	1.7σ	>4.0σ	<0.1%

HWW

fitted μ separation						
J^P	production	comment	expect (μ=1)	obs. 0+	Obs. J^P	CL_s
2m+	gg→X	Minimal couplings	1.8σ (2.4σ)	0.5σ	1.3σ	14%

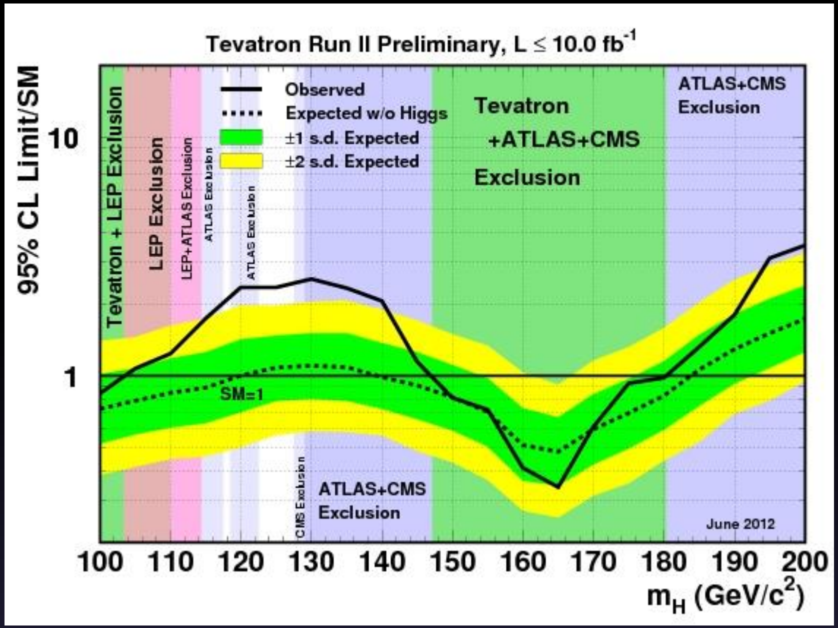
Data disfavors all alternative models tested thus far at 2σCL except 0+

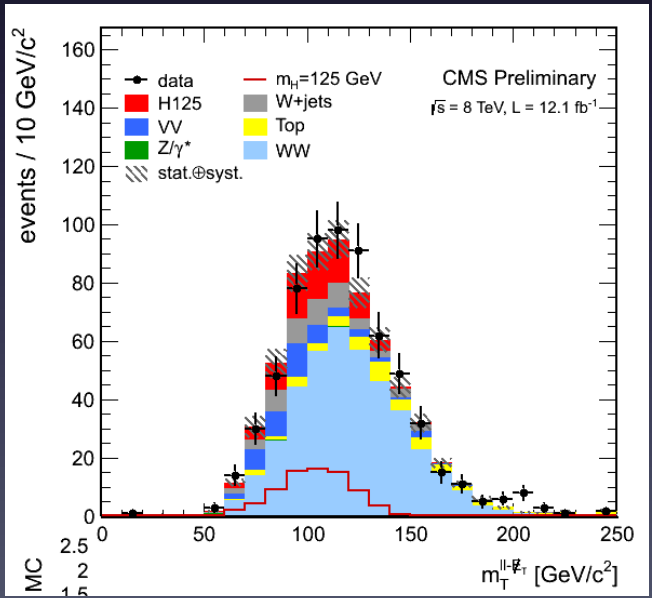
Questions & Answers

Question	Done?	How
Statistically significant?	yes	Estimate p-value on combination
Is it a boson?	yes	It decays in $\gamma\gamma$
Mass?	yes (improving)	Use $\gamma\gamma$ and ZZ channels
Spin?	yes (improving)	Use kinematics of decay products
Parity?	yes (improving)	Use kinematics of decay products
Is it “the” Higgs boson?	progressing	Measure BRs and couplings

Higgs Couplings

- Coupling to fermions
  - CMS significance for H→bb (ττ) is 2.0 (2.8)σ
  - Tevatron sees >2σ excess, mainly from pp →WH/ZH, H →bb
- Must couple to W and Z bosons
  - it decays to ZZ→4ℓ
  - there is evidence for WW→ℓνℓ′ν′





Couplings

- Number of signal measured

$$N(XX \to H \to YY) \sim \sigma(XX \to H).BR(H \to YY) \sim \frac{\Gamma_{XX}.\Gamma_{YY}}{\Gamma_{tot}}$$

with:

$$\Gamma_{tot} = \sum \Gamma_i + \Gamma_{BSM}$$

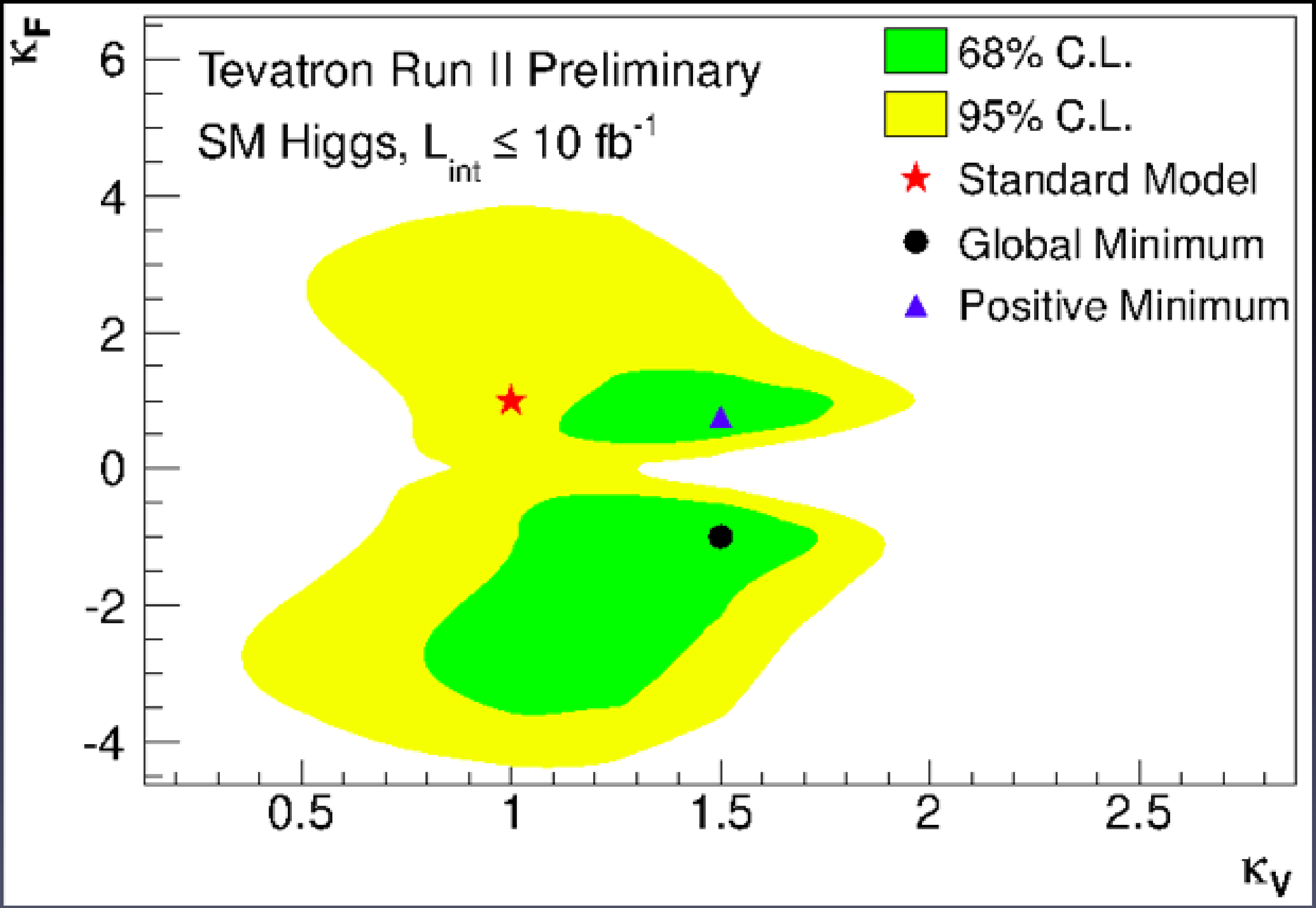
Define effective Higgs boson couplings:

production decay

$$\kappa_i^2 \sim \frac{\Gamma_i}{\Gamma_{i(SM)}} \qquad \kappa_H^2 \sim \frac{\Gamma_{tot}}{\Gamma_{tot(SM)}} \quad \Rightarrow \quad n_{signal} \sim \frac{\kappa_{XX}^2 \cdot \kappa_{YY}^2}{\kappa_H^2}$$

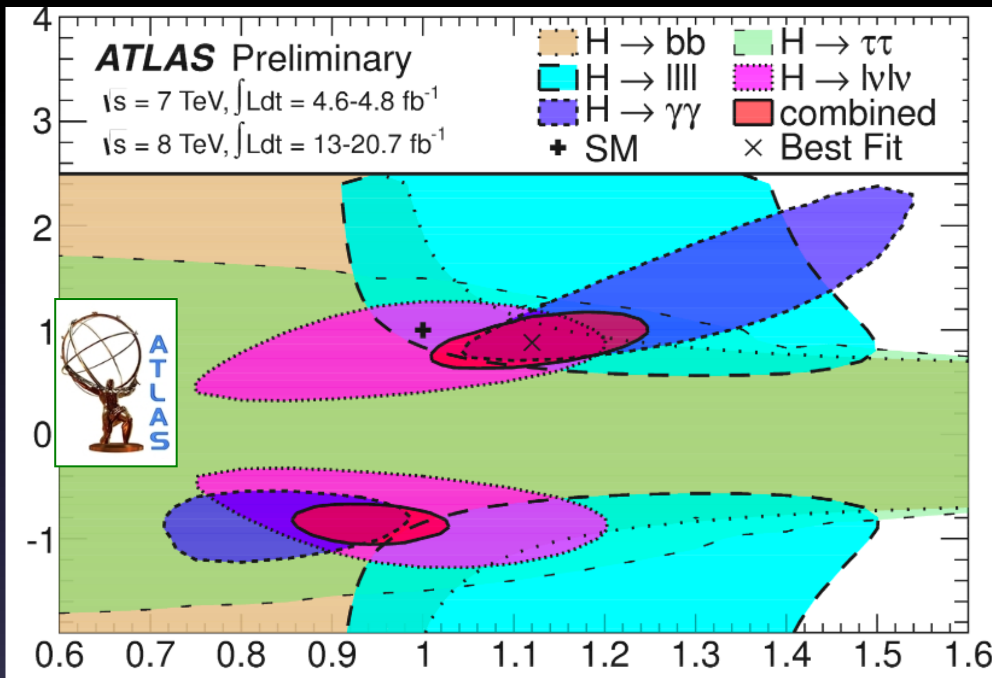
They can be extracted from the different

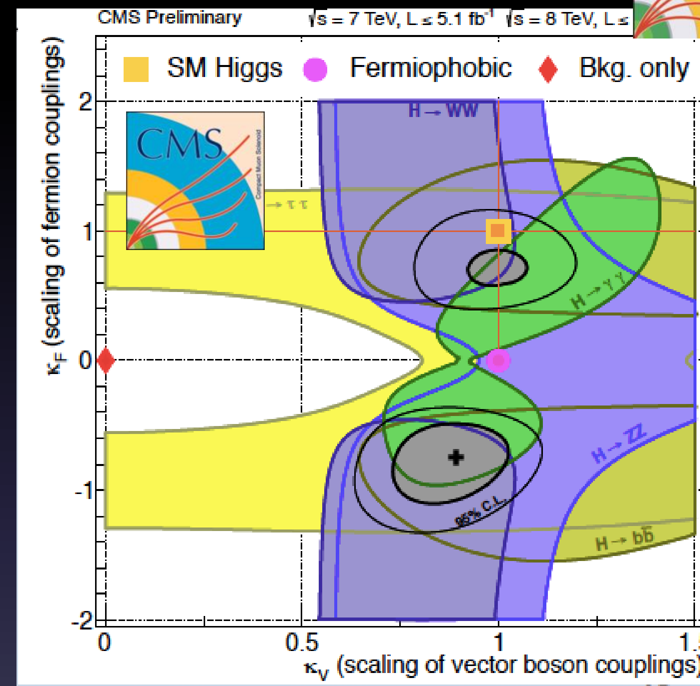
Higgs Couplings at Tevatron



Fermion vs vector couplings

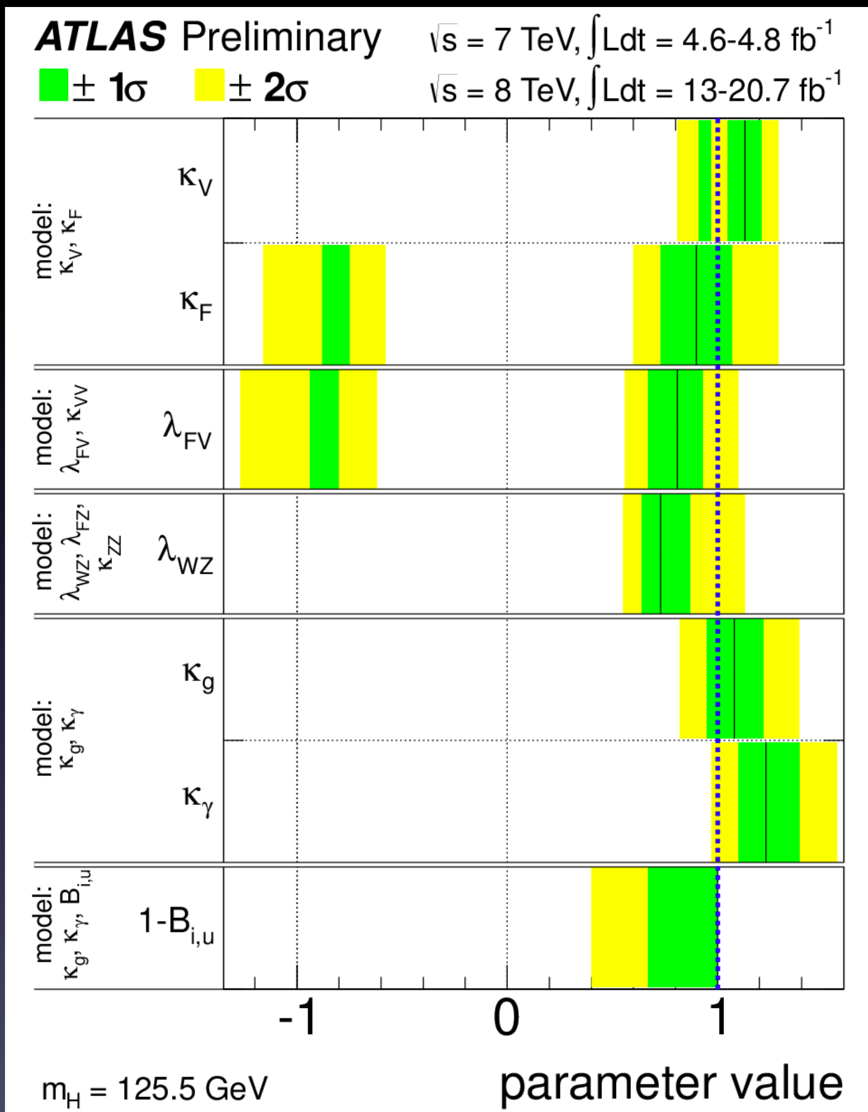
- Couplings to fermions (κ_F) and bosons (κ_V)
- All channels consistent with SM Higgs expectation





- 2-parameter benchmark model, group fermion and vector couplings together
- Here: assume only SM particles contribute to κg (gg→H) and κγ (H→γγ)
- One overall not observable sign, choose κV > 0. Some sensitivity to κF sign from interference between top and W in H → γγ
- 2D compatibility with the SM: 8%

Couplings @ LHC



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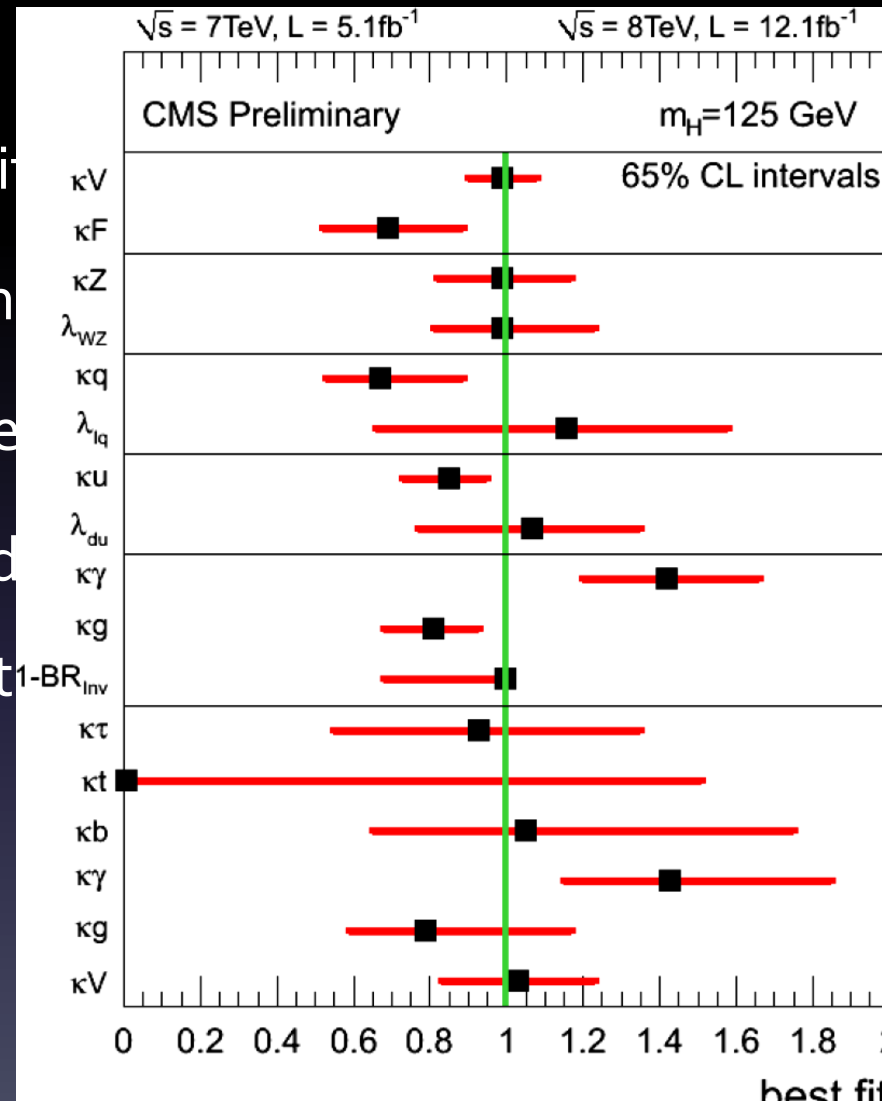
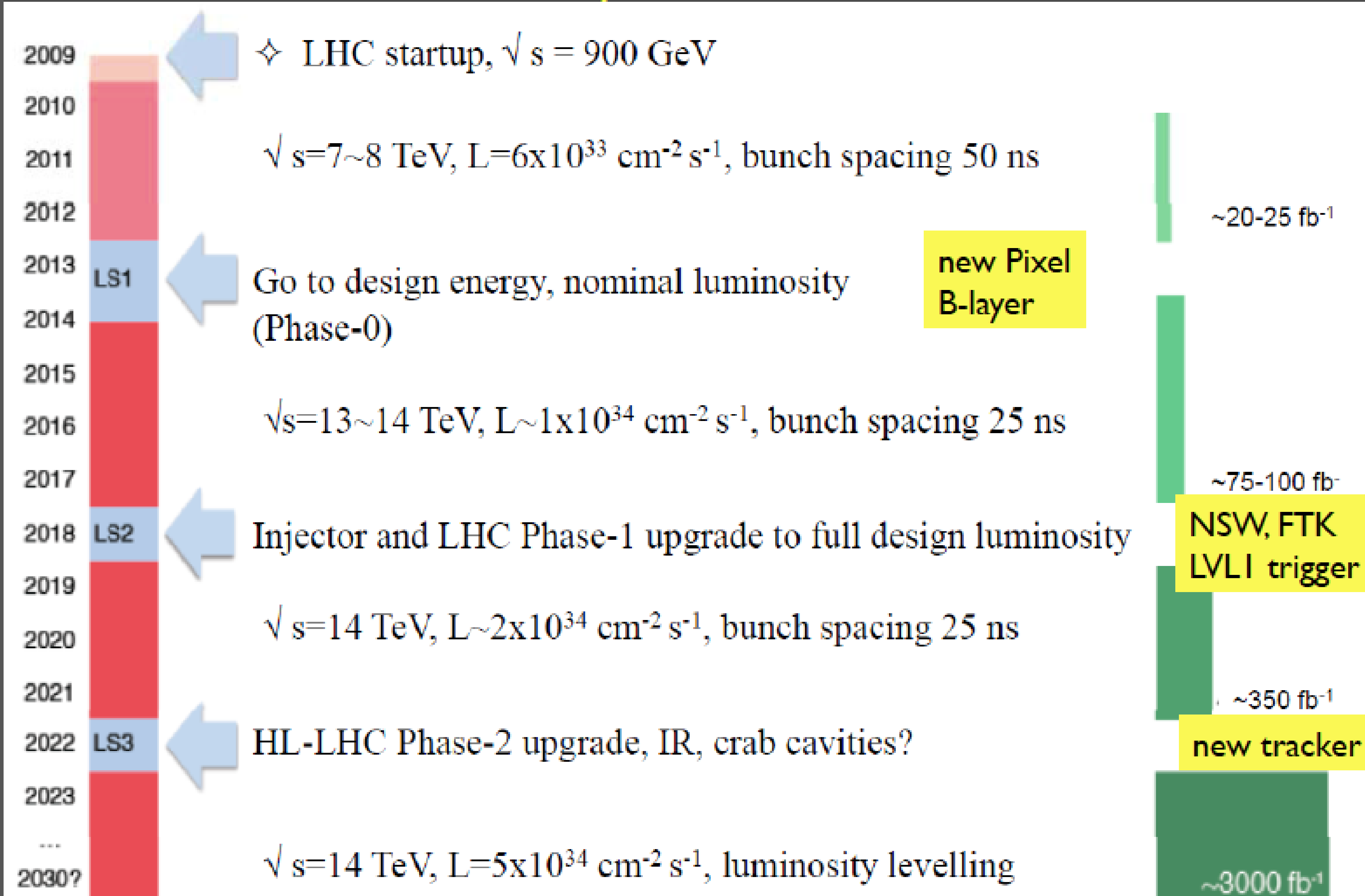


The future: present LHC schedule



Higgs properties: the future

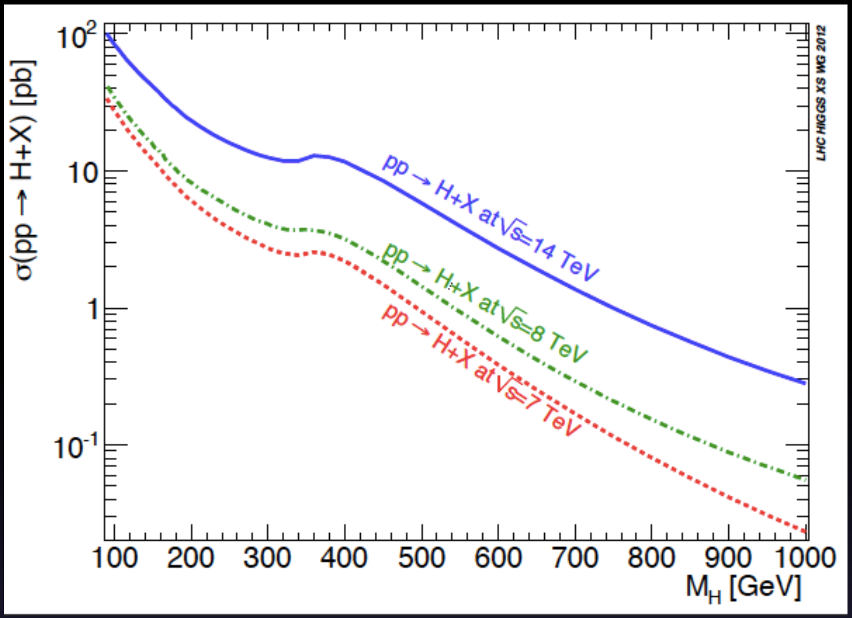
Known mass of the new boson, the MSM couplings are calculable, and will be compared with the data

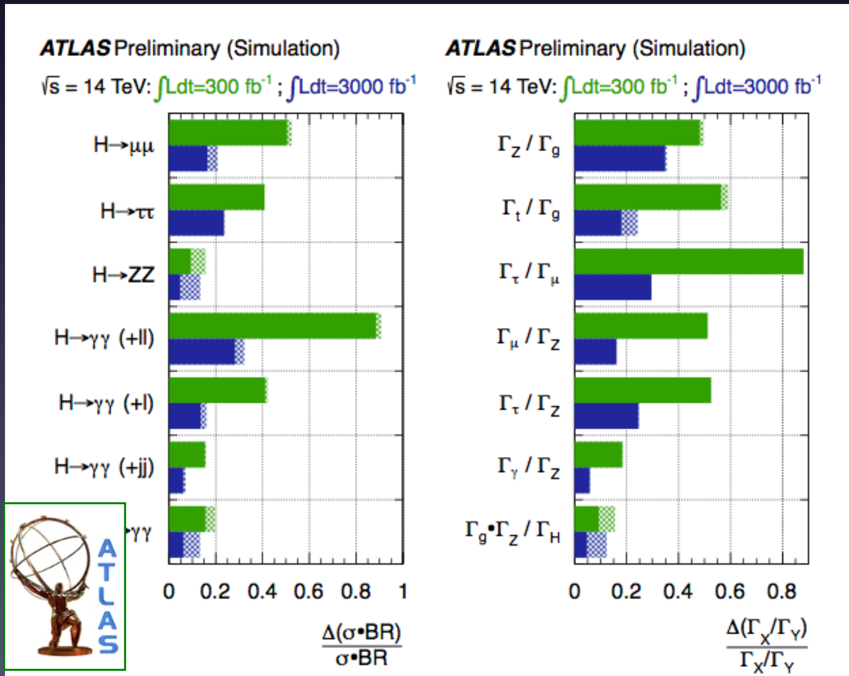
With ~300 fb^{-1} after Phase-I upgrade - the ratios of couplings will be known to within 30-50%

Spin and parity will be known at ~5σ level

HHH couplings – maybe with 3000/fb

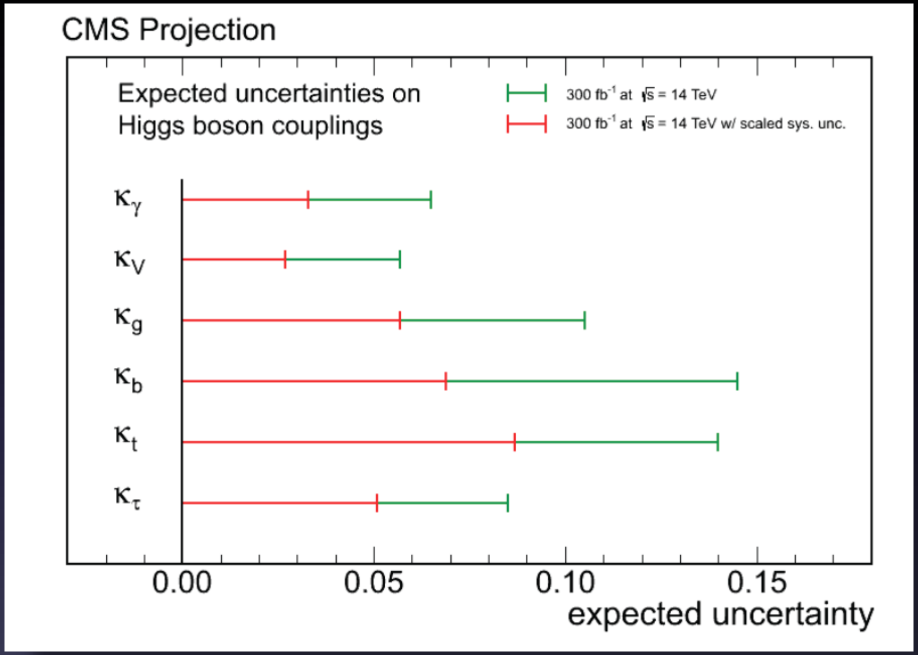
HHHH – perhaps not at LHC





Measure properties precisely

- Higgs couplings with 300 fb^{-1} @14 TeV ⇒2015 onwards
- Higgs couplings with 3000 fb^{-1} at HL-LHC⇒2020 onwards



coupling	fractional uncertainty
κ_γ	1.5%
κ_V	1.0%
κ_g	2.7%
κ_b	2.7%
κ_t	3.9%
κ_τ	2.0%

- observe H→μμ with significance of 5 sigma
  – Measure κ_μ to ≈10%.

Higgs factories: near and far future

- The fun is just beginning!
- LHC as a Higgs factory:
  - premium in increasing √s close to 14 TeV
  - High-Luminosity LHC with a factor of 200 more data
    - Good prospects for precision measurements, discovering additional Higgs, and other new particles needed
- Future plans beyond the LHC:

Higgs Factory proposals include

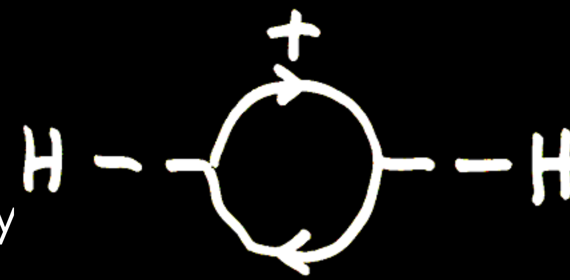
- Linear Collider start @ 250 GeV
- LEP3: e+e- ring in the LHC tunnel @240 GeV
- TLEP: a new 80 km ring @350 GeV

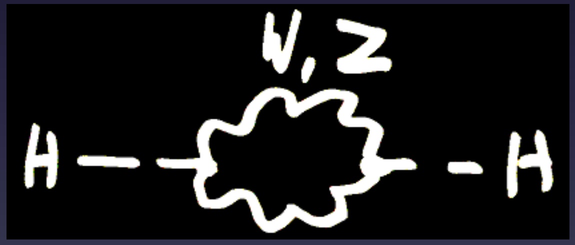
Higgs Conclusions

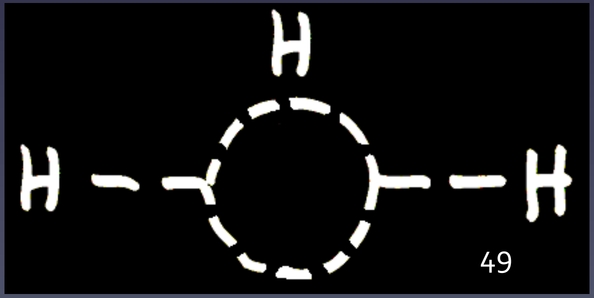
- Moving towards precision Higgs Physics
  - Evidence for VBF production
  - Correct ratio of W/Z couplings
  - No strong hints of new physics, neither in the loop, nor in the decay
- The observed state is consistent with SM spin/CP
- Active search for rare decays and additional states of the EWSB sector (not shown in this talk..)

What are the implications?

- there must be new physics at the TeV scale
  - loop corrections to Higgs mass diverge with energy
  - if the SM were valid at all energies the Higgs boson would naturally be very massive
  - then why is its mass 125 GeV?
  - there must be a physical principle that keeps the Higgs light
  - biggest contribution from top quark loop
  - need new particles to cancel divergence
    - SUSY: stop squarks
    - little Higgs: vectorlike quarks
    - cannot be too massive else cancellation doesn't work
- can we find them at the LHC?





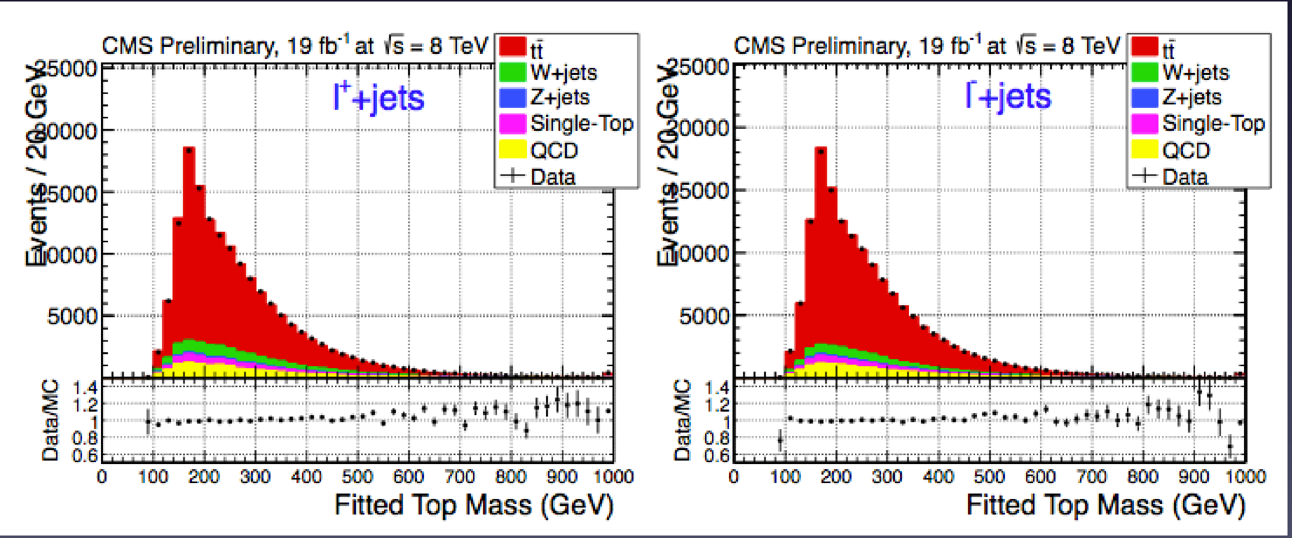


M_{top} and $M_{antitop}$ @ LHC

CMS-PAS-TOP-12-031

- CPT invariance -> Mparticle = Mantiparticle
- Top decays before hadronization -> Mtop and Mantitop can be measured directly
- CMS measurement in l+jets channel using Ideogram method divided into two samples with opposite lepton charge

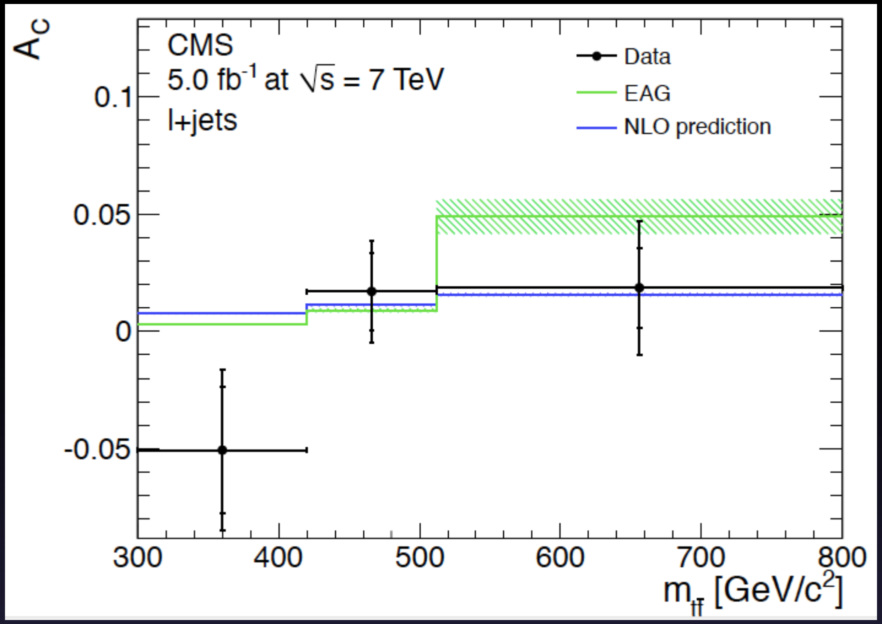
$$\Delta m_t = m_t^{had} - m_{\bar{t}}^{had} = -272 \pm 196\ (stat) \pm 122\ (syst.)\ MeV$$



Dominant systematics:
- b vs b~bar jet response
- background composi2on
- signal frac2on
- b vs b~bar tagging eff.

tt charge asymmetry@ LHC

EFT/EAG: A model featuring an effective axial-vector coupling of the gluon that could describe the AFB vs mtt dependence (PRD 8 (2011) 054017)



EPJ-C 72 (2012) 2039

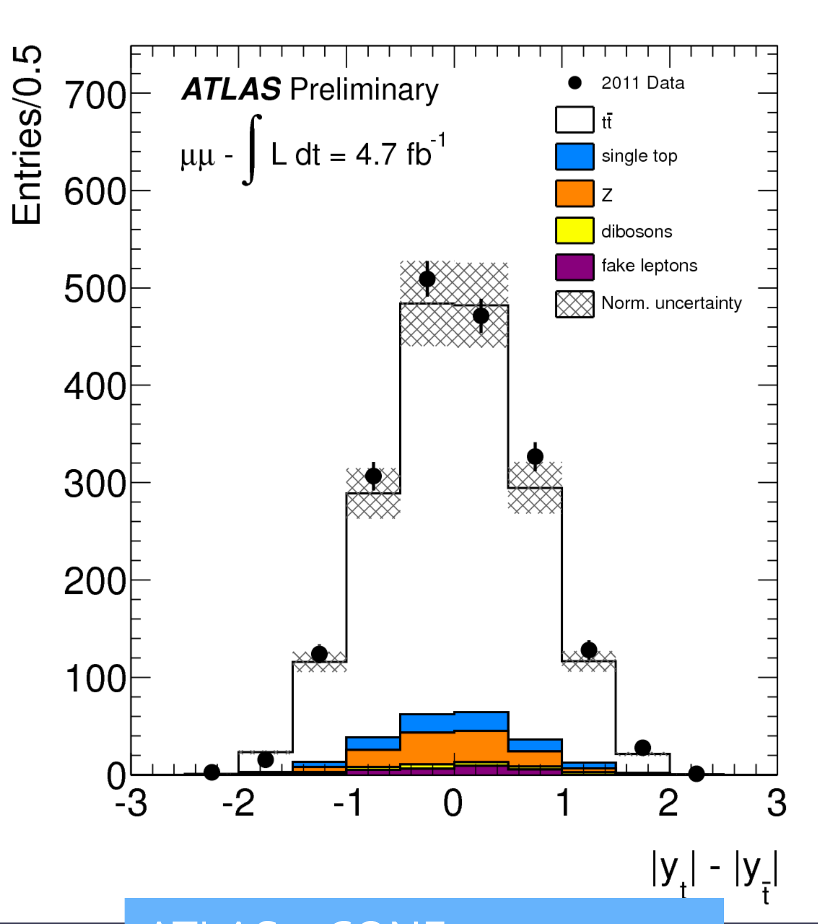
CMS-PAS-TOP-12-010

	lepton+jets	**dileptons**
ATLAS	−0.019 ± 0.028 (stat) ± 0.024 (syst) [1.04 /fb]	0.057 ± 0.024 (stat) ± 0.015 (syst) [4.7 /fb]
ATLAS (lepton rap.)		0.023 ± 0.012 (stat) ± 0.008 (syst) [4.7 /fb]
CMS	0.004 ± 0.010 (stat) ± 0.011 (syst) [5 /fb]	0.050 ± 0.043(stat)$^{+0.010}_{-0.039}$ (syst) [5 /fb]
CMS (lepton rap.)		0.010 ± 0.015(stat)±0.006 (syst) [5 /fb]

PLB 717 (2012) 129

ATLAS-CONF-2012-057

tt charge asymmetry@ LHC



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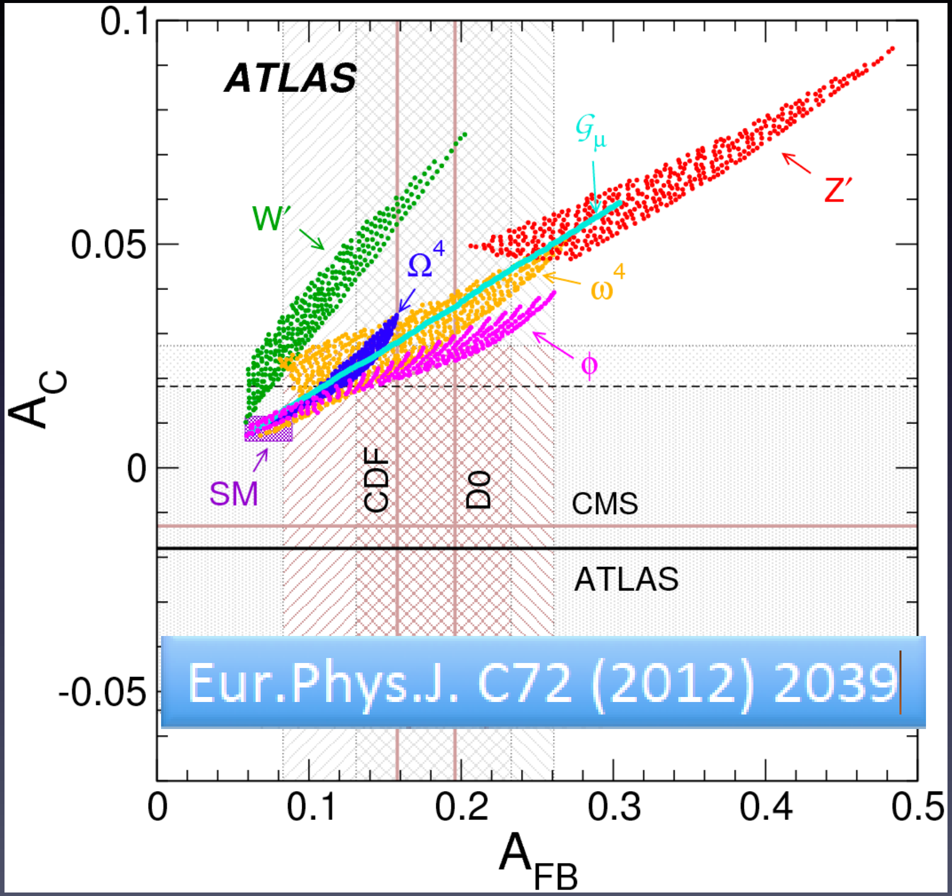
Colored: ranges of predicted values for each model.
Horizontal lines: LHC measurements
Vertical lines: Tevatron measurements

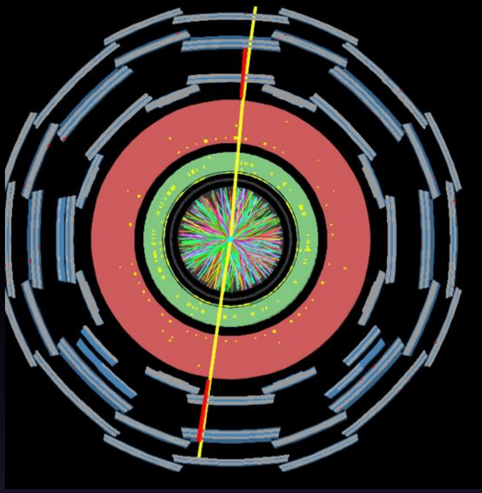


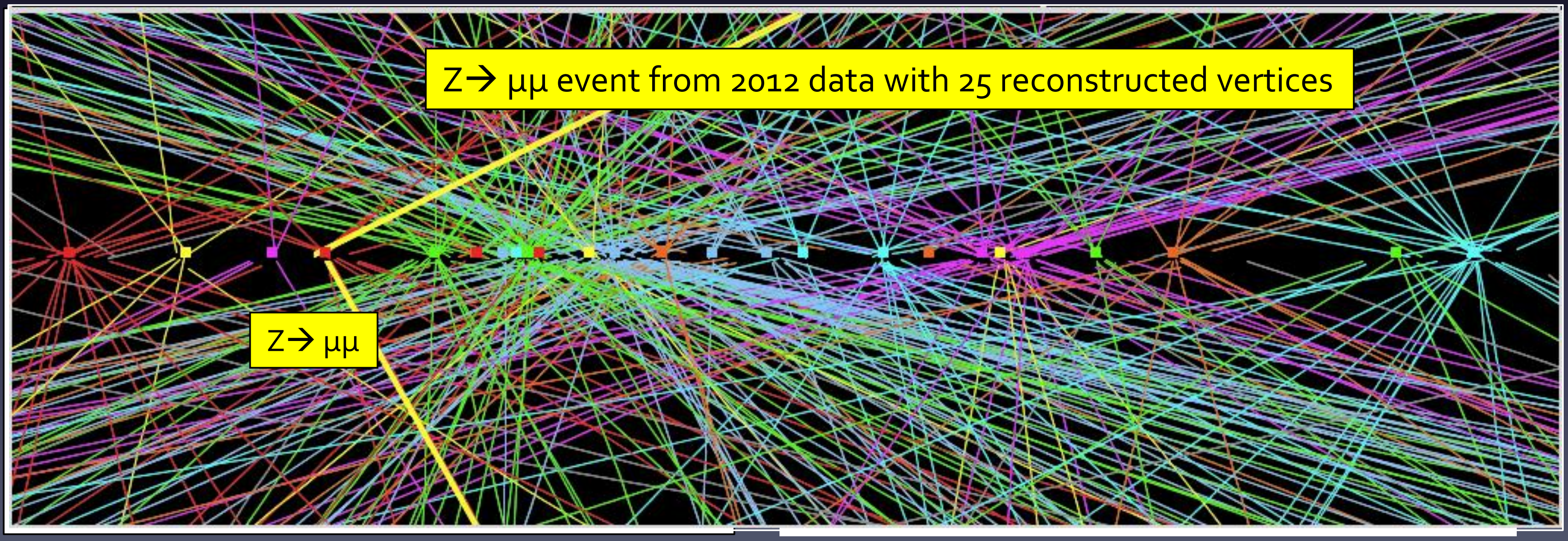
Eur.Phys.J. C72 (2012) 2039

All results consistent with SM

Additional Burden – Pile-Up

- LHC still operates with 50 ns bunch spacing
  - ~1 collision per bunch crossing @ L~2x10^{32} cm^{-2}s^{-1}
  - Up to >40 overlaid collisions at highest luminosity
  - Challenging environment - $\mathcal{O}$(1000) tracks – demonstrating marvelous tracker performance
    - Backgrounds even harder to control





Top Physics

Higgs Physics

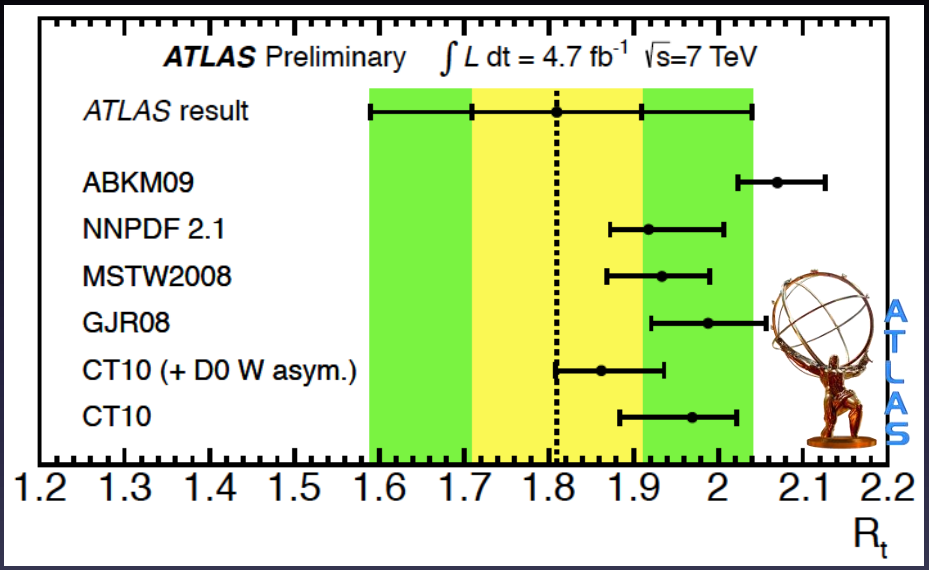
t-channel: $\sigma_t/\sigma_{\bar{t}}$ @ LHC

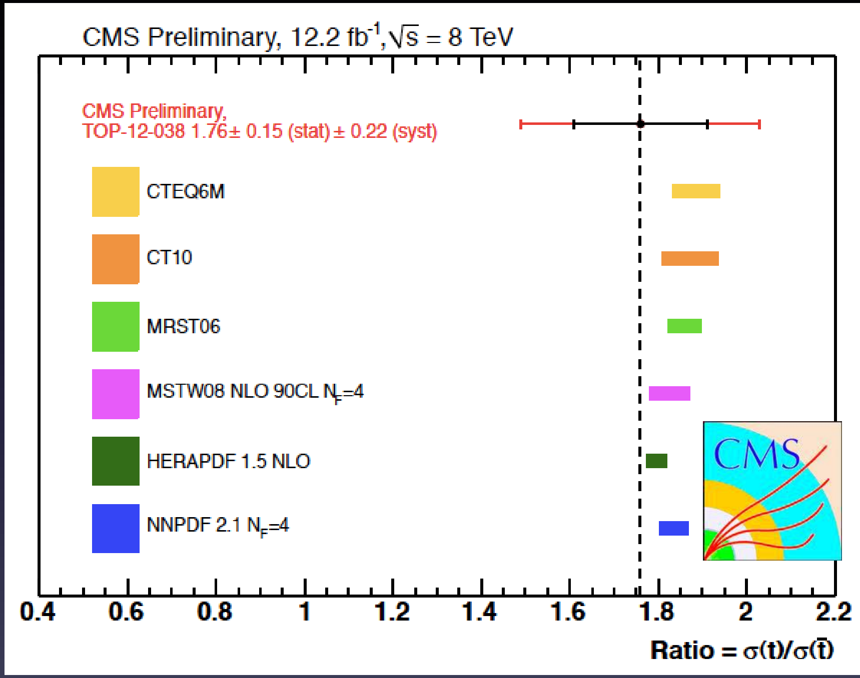
Single top t-channel prod. happens mainly via u(d)-b W exchange

- in pp collisions the u density is almost twice the d density
- σt/σt in t-channel is expected to be larger than 1

PAS TOP-2012-038

ATLAS-CONF-2012-056





performed on l+ 2/3 jet samples
result from fits on NN outputs for l+/l-
Rt = 1.81± 0.10(stat) ±0.20 0.21 (syst)

performed fitting the η distribution of the non b-tagged jet and separating l+ and l-
Rt = 1.76 ± 0.14(stat) ± 0.21(syst)

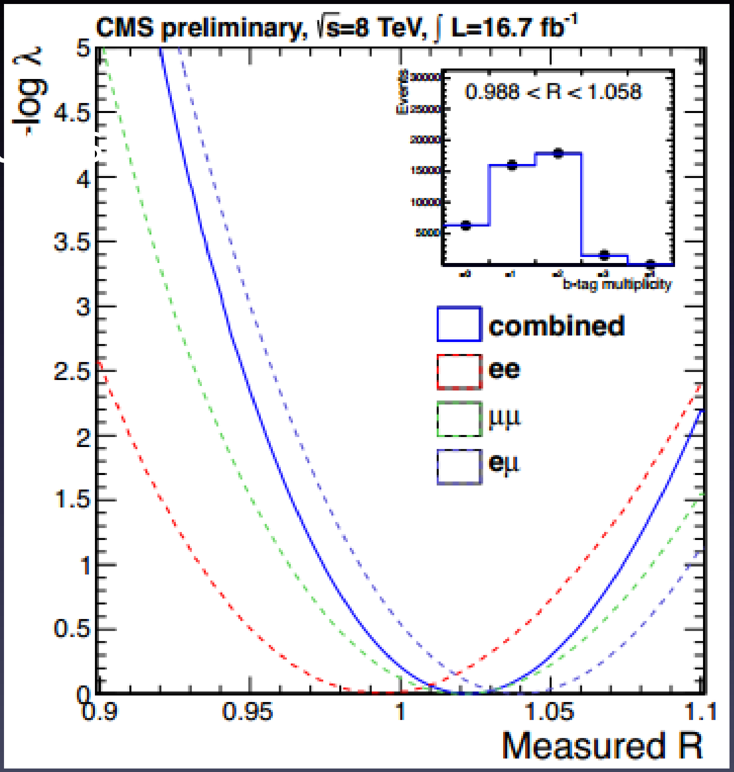
R = BR(tWb)/BR(tWq)

Evaluate branching ratio of tWb w.r.t. branching ratio of tWq:

- Validate the SM prediction of $|V_{tb}| = 0.999146^{+0.000021}_{-0.000046}$
- Can probe new physics (as 4th generation or charged Higgs boson)

Computed in dilepton channel using a likelihood t on b-tag multiplicity that accou

for:



- fraction of tt and single-t in sample
- fraction of evts with correct jet assignment
- b -tagging efficiency and mis-identication

Results :

CMS PAS TOP-12-035

$R = 1.023^{+0.036}_{-0.034}$

$|V_{tb}| = 1.011^{+0.018}_{-0.017} > 0.972$@95%C.L.

World most precise measurement!