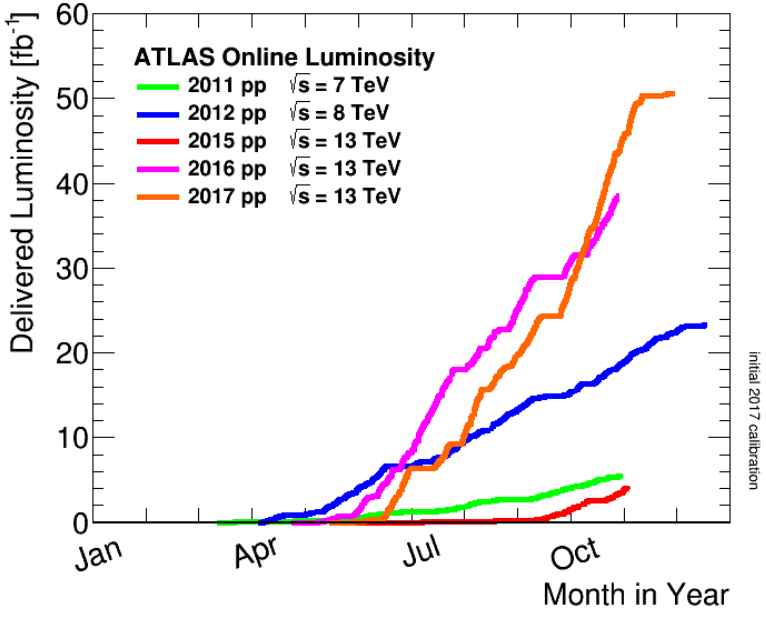
Status of the ATLAS experiment

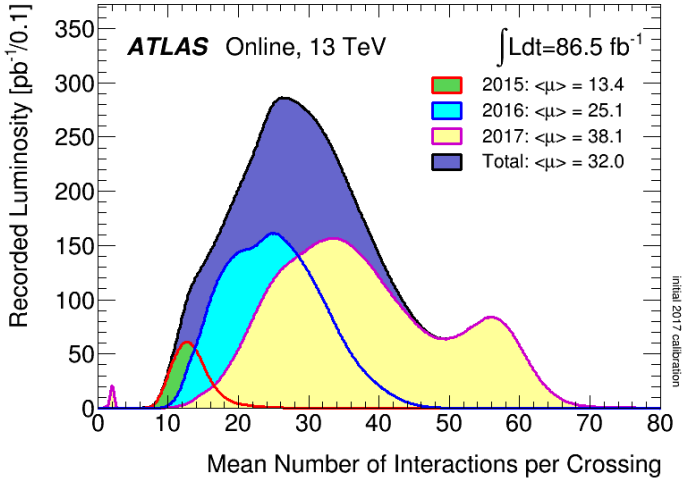
Малеев В.П.

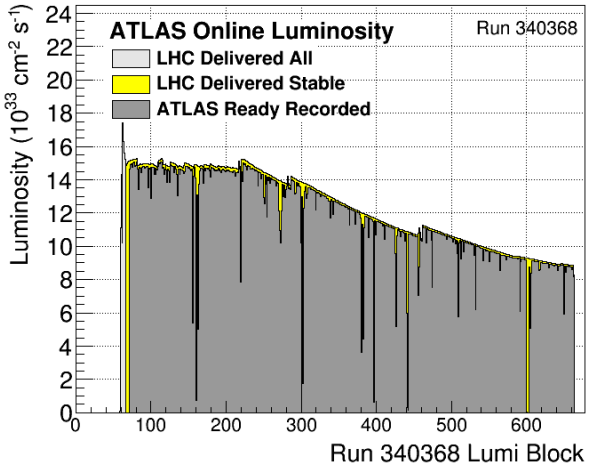
Сессия Учёного совета ОФВЭ
26.12.2017

2017 data

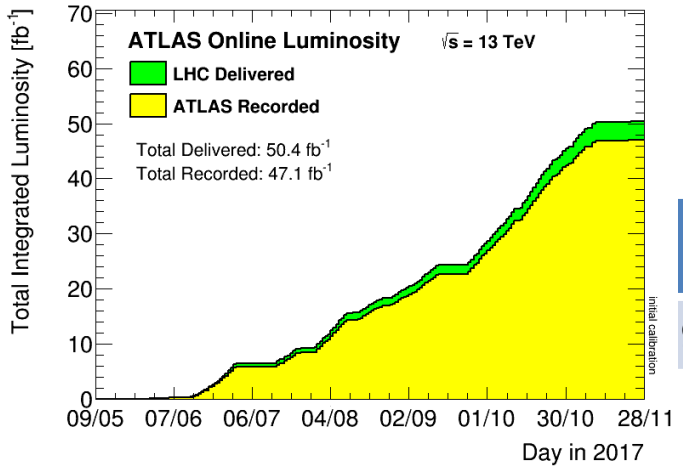


- Thanks LHC and accelerator team for 50 fb^{-1} of data
- Challenging conditions: Luminosity up to 2 x 10^{34} $cm^{-2}s^{-1}$, μ up to 80
- ATLAS requested levelling on 29th of September
- ATLAS can handle $\mu \sim 60$ for trigger optimized for 1.7 x 10^{34} $cm^{-2}s^{-1}$ and 80 kHz L1-rate (limitation are due to HL Trigger CPUs)



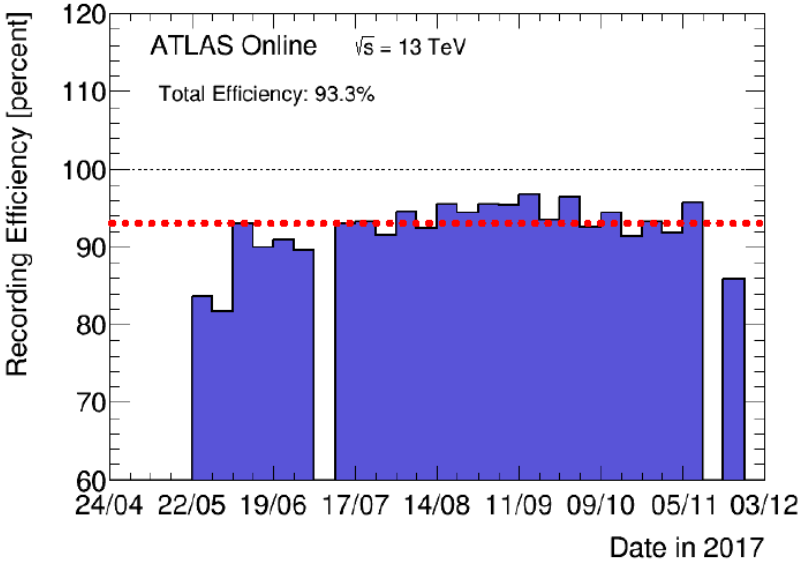


Data taking



Data taking efficiencies by subsystem

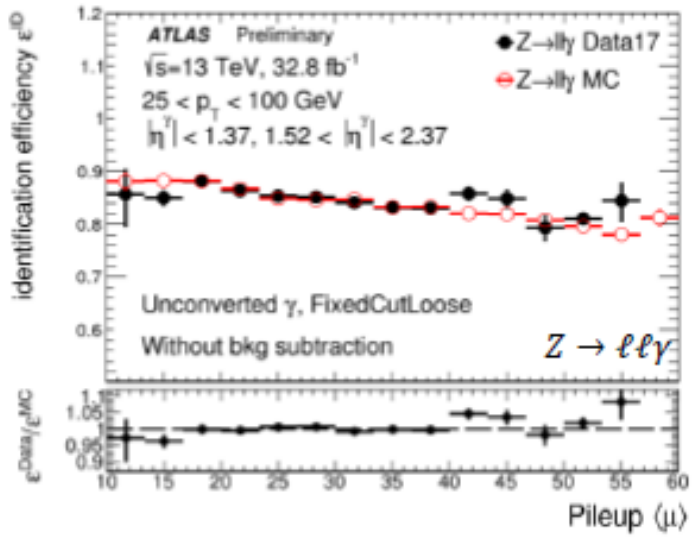
Pixel	SCT	TRT	LAr	Tile	MDT	CSC	RPC	TGC
97.8%	98.7%	97.2%	100%	99.9%	99.7%	96.1%	94.4%	99.5%



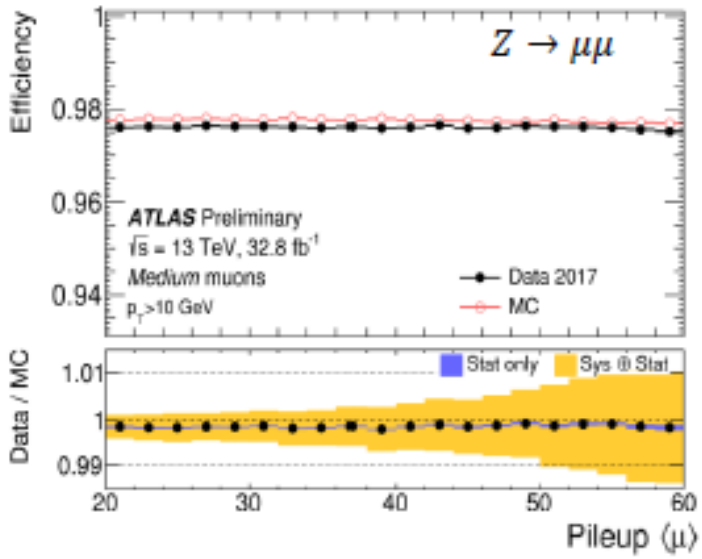
- ATLAS data taking efficiency 93.3%
- TRT data taking efficiency 97.2%
  - μ =66: at 97 kHz L1 rate, TRT use ~92% of S-Link bandwidth
  - Expected improvement of ~10% by optimizing lossless data compression table with high data (former optimization with μ = 40 data)
  - More aggressive readout compression on the way to be ready to run at μ = 80

Detector performance in 2017

Photons

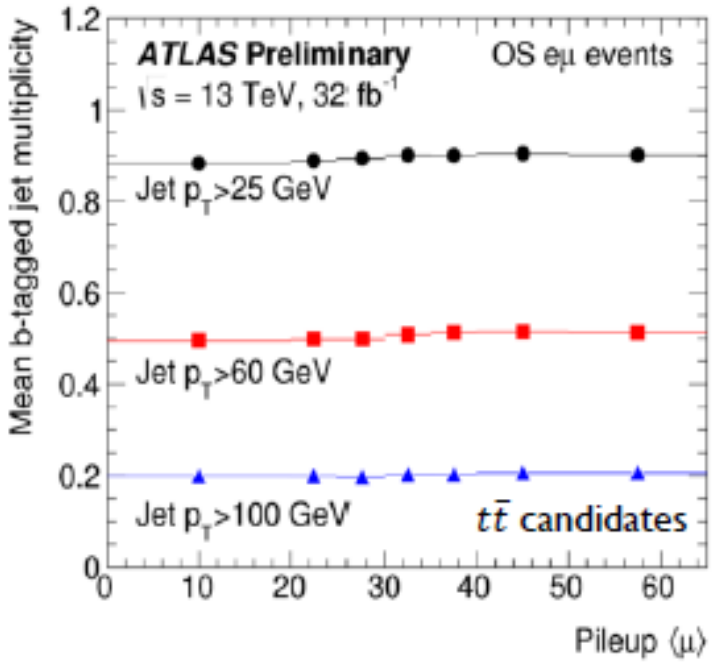


Muons

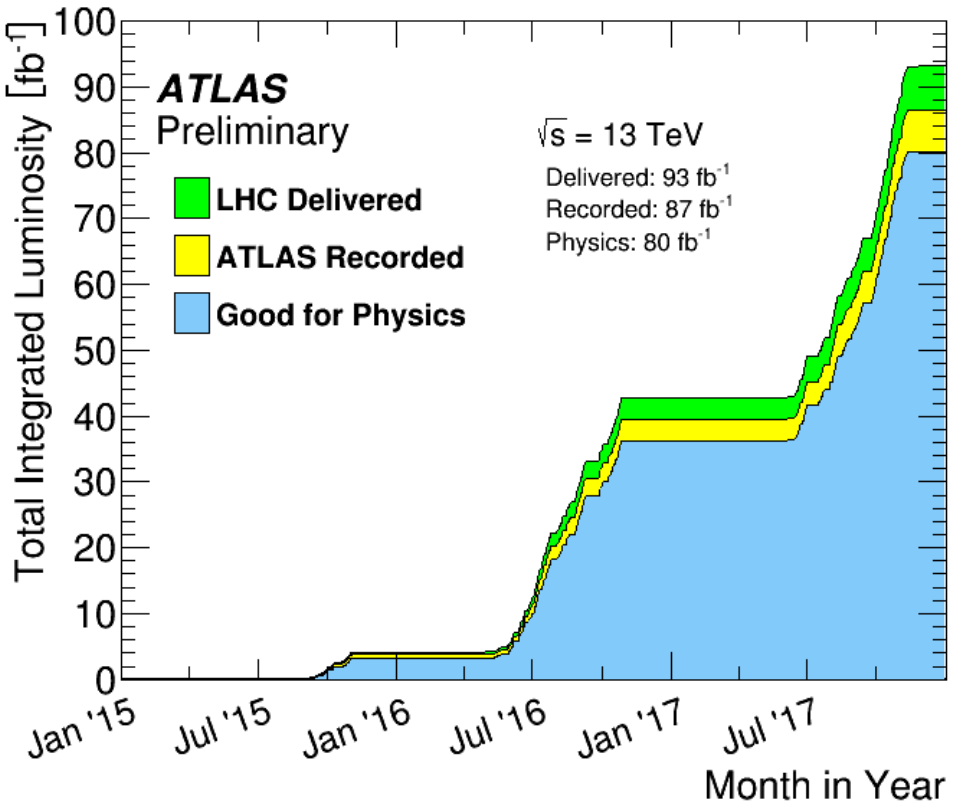


Detector shows stable identification ability in hard environment

b-tagged jets



Run II data

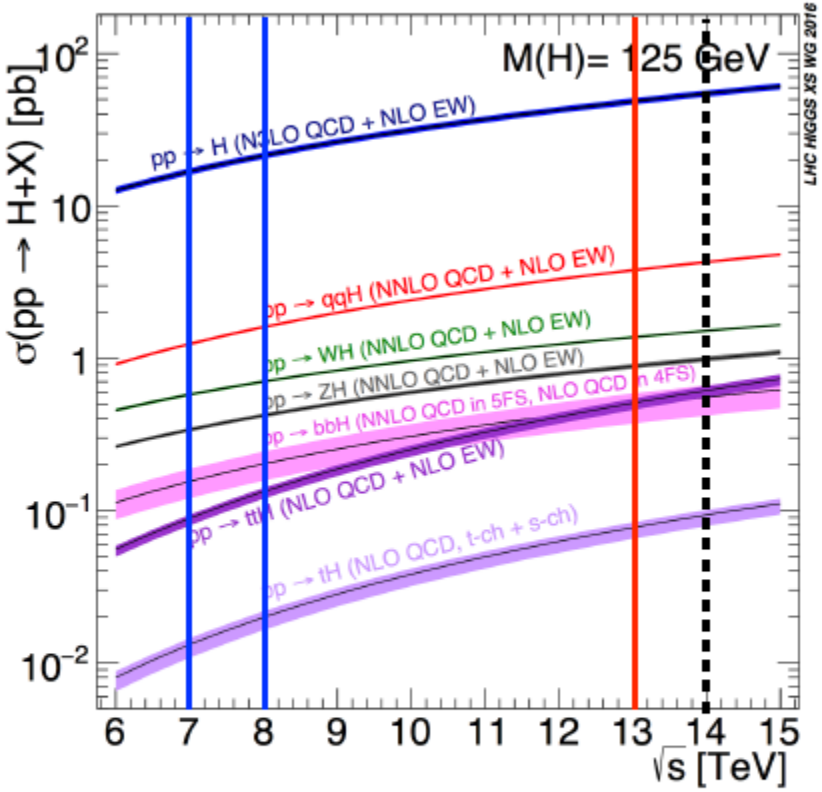


Good for Physics

- 2015-2016 data: 36.1 fb^{-1}
- 2017 data 43.9 fb^{-1}
- Run II 80 fb^{-1}

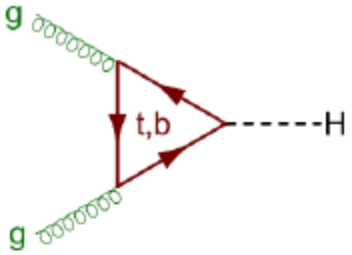
Results presented below are based on 2015-2016 data mostly

Higgs production modes



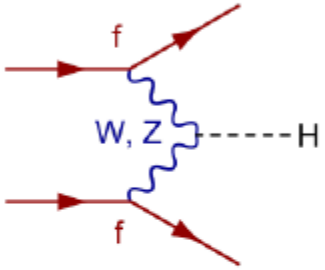
@ 13 TeV

ggF



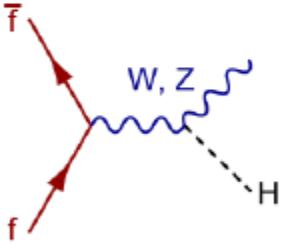
87%

VBF



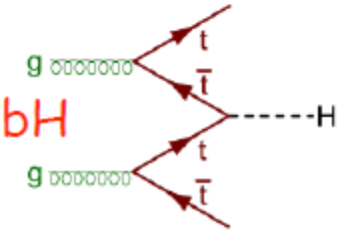
6.8%

VH



4.0%

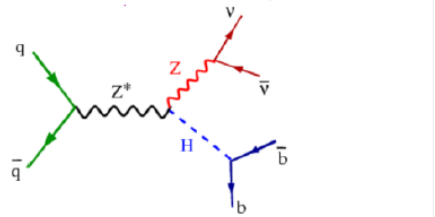
ttH, bbH



0.9% each

Evidence of H->bb (VH)

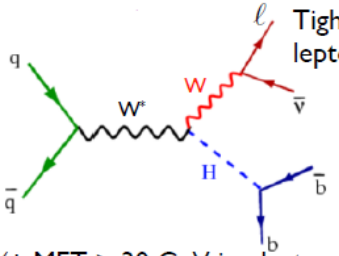
MET > 150 GeV



(+ additional criteria to suppress multi-jet)

$p_T(\ell\nu) > 150$ GeV

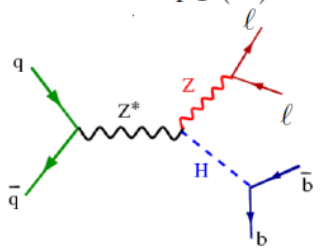
Tightly isolated lepton

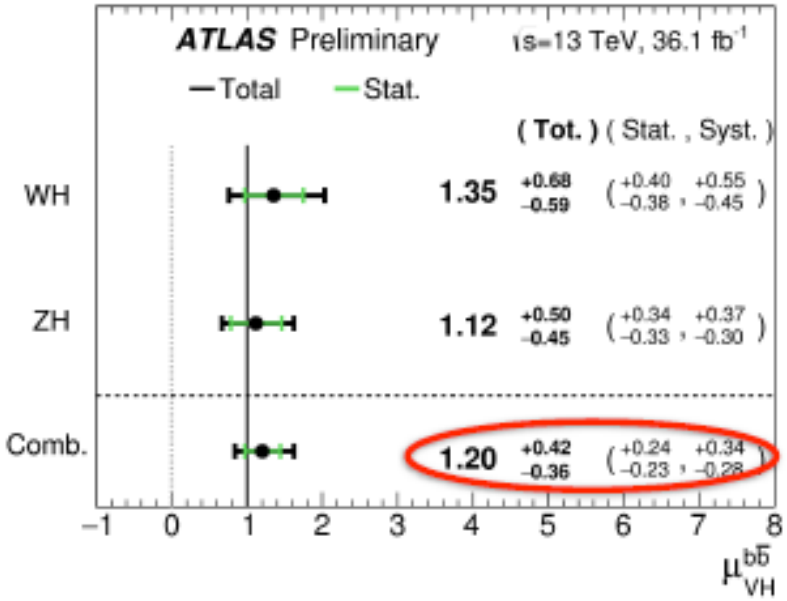


(+ MET > 30 GeV in electron channel)

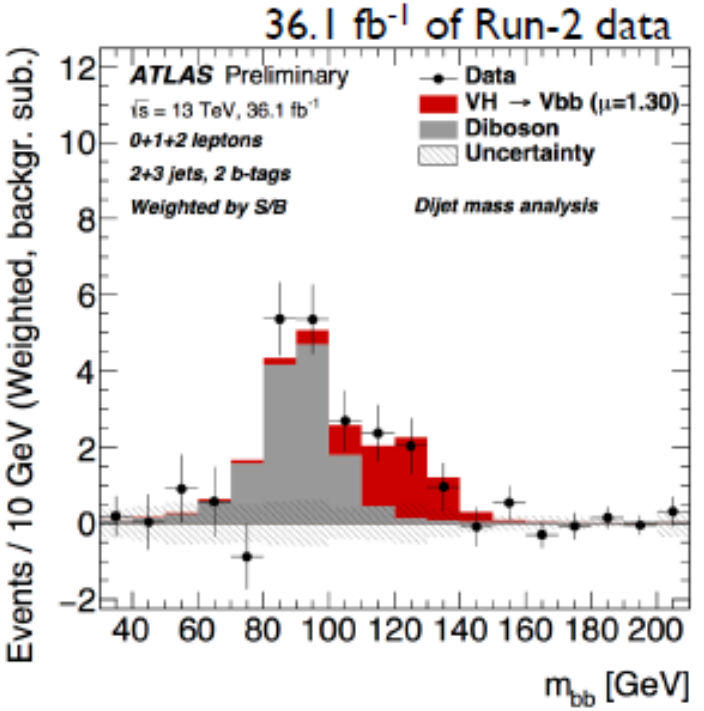
$|m_{\ell\ell} - 91\ \text{GeV}| < 10$ GeV

$p_T(\ell\ell) > 75$ GeV



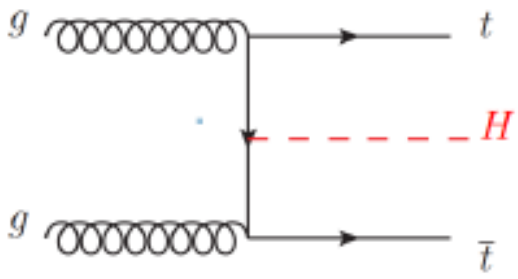


Significance:
3.5σ observed
3.0σ expected

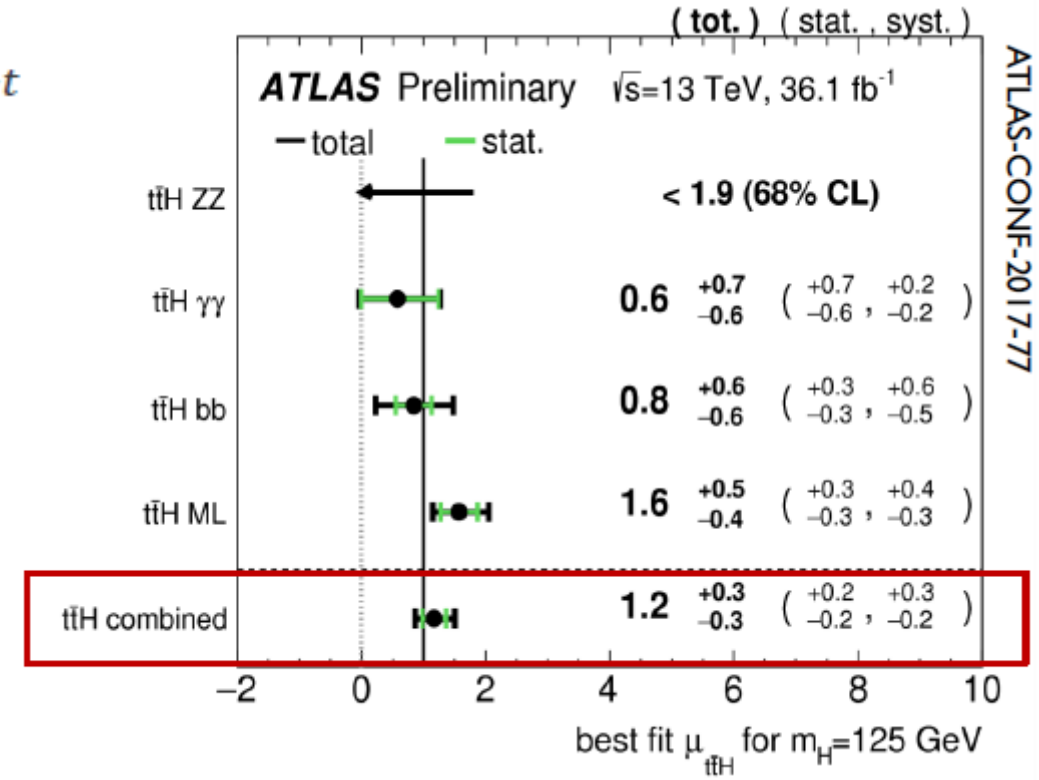


ttH

$t\bar{t}H$ is best direct way to measure λ_t



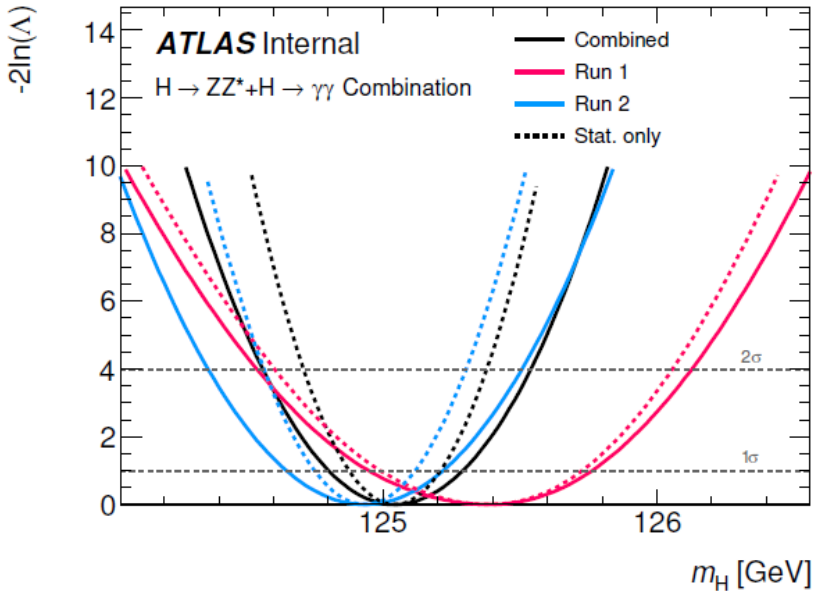
Channel	Significance	
	Observed	Expected
Multilepton	4.1σ	2.8σ
$H \to b\bar{b}$	1.4σ	1.6σ
$H \to \gamma\gamma$	0.9σ	1.7σ
$H \to 4\ell$	—	0.6σ
Combined	4.2σ	3.8σ

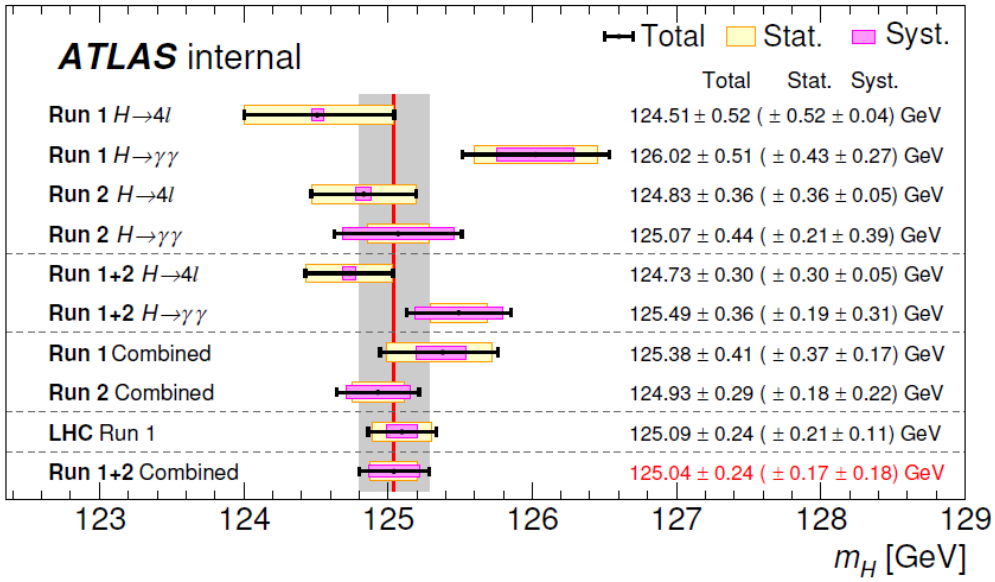


EVIDENCE of $t\bar{t}H$ production!

Higgs mass

ATLAS-CONF-2017-046





2015-2016 data

$$m_H^{ZZ^*} = 124.84 \pm 0.36\ (\text{stat}) \pm 0.05\ (\text{syst})\ \text{GeV} = 124.84 \pm 0.36\ \text{GeV},$$

$$m_H^{\gamma\gamma} = 125.07 \pm 0.21\ (\text{stat}) \pm 0.39\ (\text{syst})\ \text{GeV} = 125.07 \pm 0.44\ \text{GeV}.$$

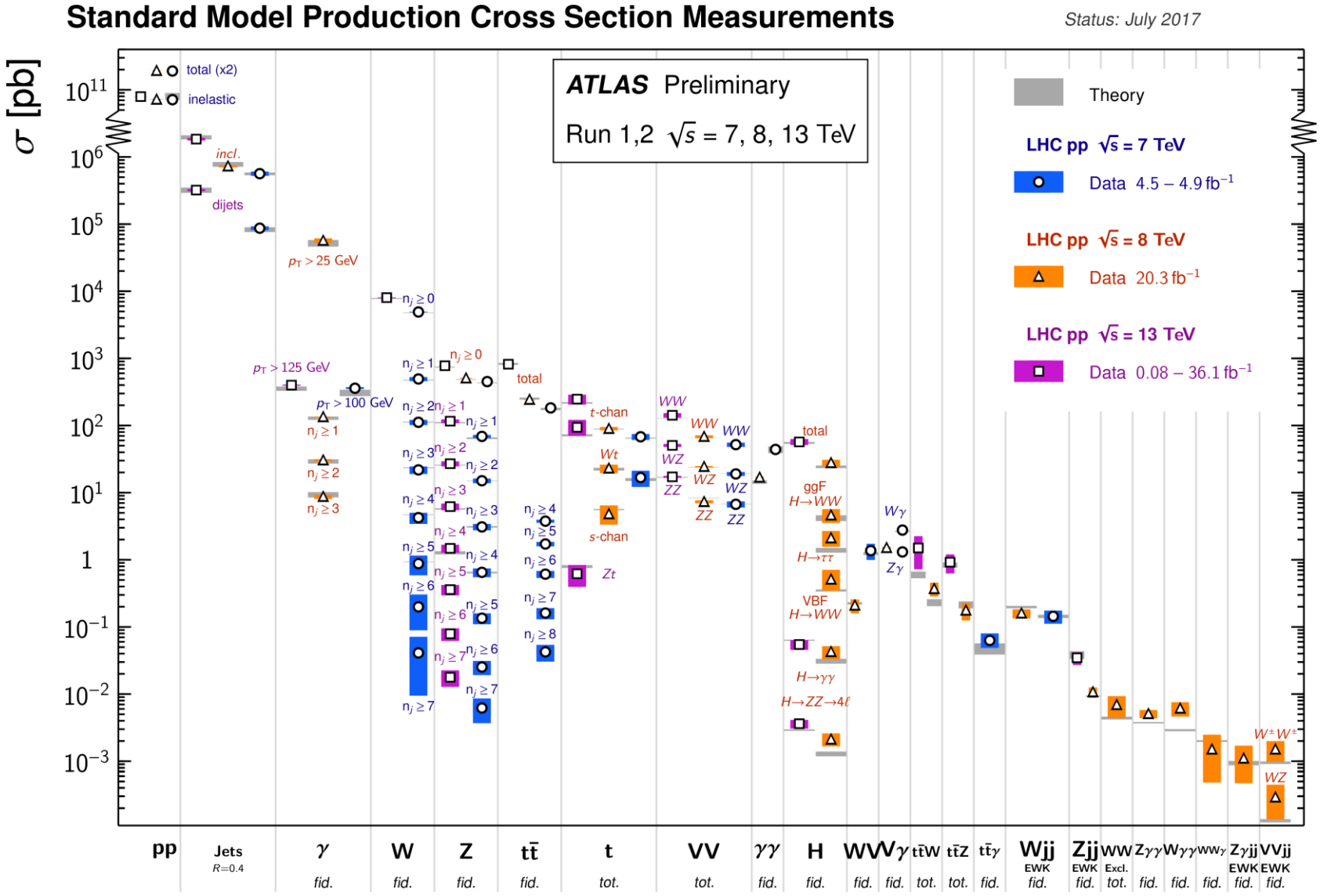
Run 2 combination

$$m_H = 124.93 \pm 0.18\ (\text{stat}) \pm 0.22\ (\text{syst})\ \text{GeV} = 124.93 \pm 0.29\ \text{GeV}.$$

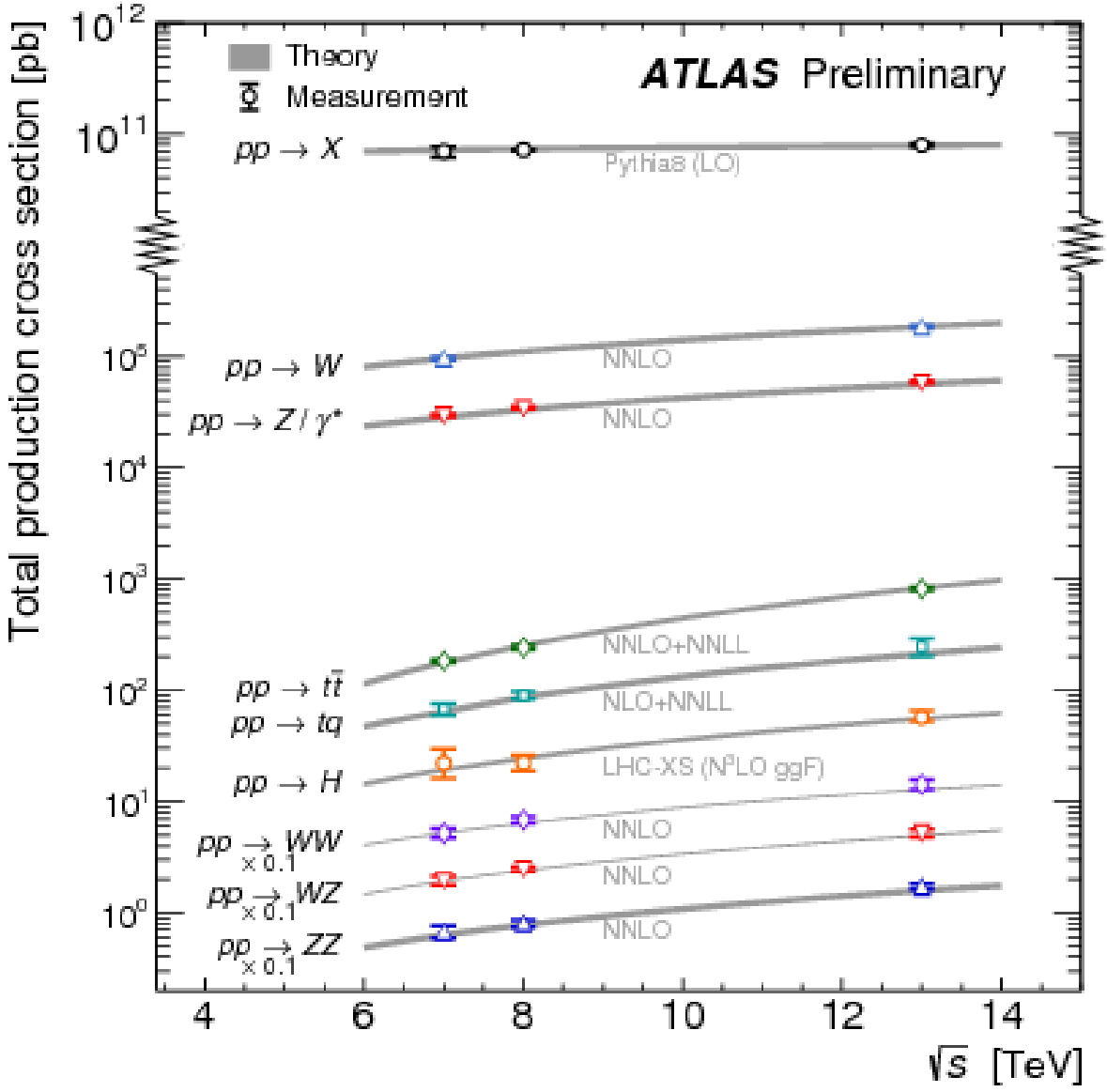
Run 1 + Run 2 combination

$$m_H = 125.09 \pm 0.21\ (\text{stat}) \pm 0.11\ (\text{syst})\ \text{GeV} = 125.09 \pm 0.24\ \text{GeV}$$

SM Physics


Standard Model Production Cross Section Measurements
Status: July 2017
ATLAS Preliminary
Run 1,2 √s = 7, 8, 13 TeV
Theory
LHC pp √s = 7 TeV
Data 4.5 – 4.9 fb⁻¹
LHC pp √s = 8 TeV
Data 20.3 fb⁻¹
LHC pp √s = 13 TeV
Data 0.08 – 36.1 fb⁻¹
σ [pb]
pp
Jets
γ
W
Z
tt̄
t
VV
γγ
H
WWγ
tt̄W
tt̄Z
tt̄γ
Wjj
Zjj
WW
Zγγ
Wγγ
WWγ
Zγjj
VVjj

SM physics



$pp \to X$
7 TeV, 20 μb^{-1}, Nat. Commun. 2, 463 (2011)
8 TeV, 500 μb^{-1}, Phys.Lett. B761 158 (2016)
13 TeV, 60 μb^{-1}, Phys. Rev. Lett. 117 182002 (2

$pp \to W$ $pp \to Z/\gamma^*$
7 TeV, 4.6 fb^{-1}, arXiv:1612.03016 (for Z/W) 8 TeV, 20.2 fb^{-1}, JHEP 02, 117 (2017) (for Z)
13 TeV, 81 pb^{-1}, PLB 759 (2016) 601 (for W)
13 TeV, 3.2 fb^{-1}, JHEP 02, 117 (2017) (for Z)

$pp \to t\bar{t}$
7 TeV, 4.6 fb^{-1}, Eur. Phys. J. C 74:3109 (2014)
8 TeV, 20.3 fb^{-1}, Eur. Phys. J. C 74:3109 (2014)
13 TeV, 3.2 fb^{-1}, arXiv:1606.02699

$pp \to tq$
7 TeV, 4.6 fb^{-1}, PRD 90, 112006 (2014)
8 TeV, 20.3 fb^{-1}, arXiv:1702.02859
13 TeV, 3.2 fb^{-1}, arXiv:1609.03920

$pp \to H$
7 TeV, 4.5 fb^{-1}, Eur. Phys. J. C76 (2016) 6
8 TeV, 20.3 fb^{-1}, Eur. Phys. J. C76 (2016) 6
13 TeV, 36.1 fb^{-1}, ATLAS-CONF-2017-047

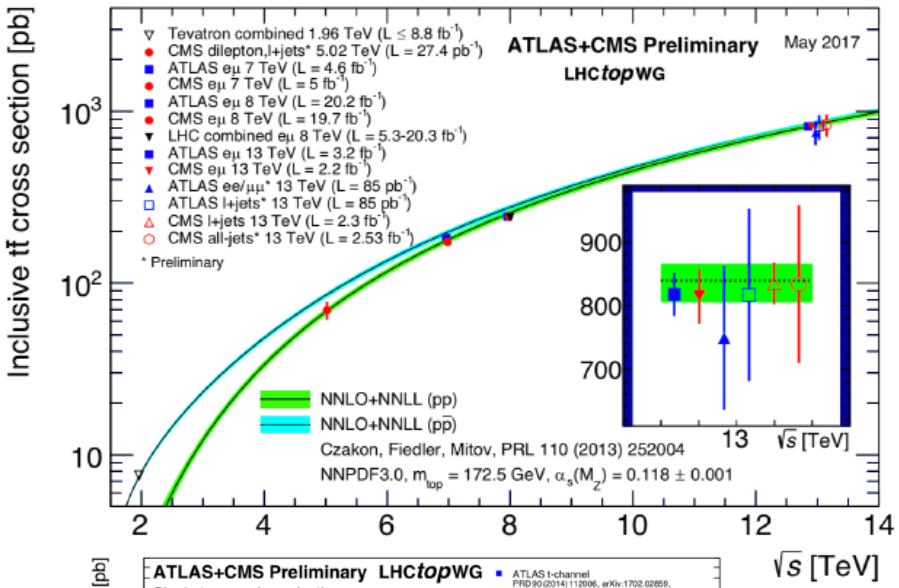
$pp \to WW$
7 TeV, 4.6 fb^{-1}, PRD 87, 112001 (2013)
8 TeV, 20.3 fb^{-1}, JHEP 09 029 (2016)
13 TeV, 3.2 fb^{-1}, arXiv:1702.04519

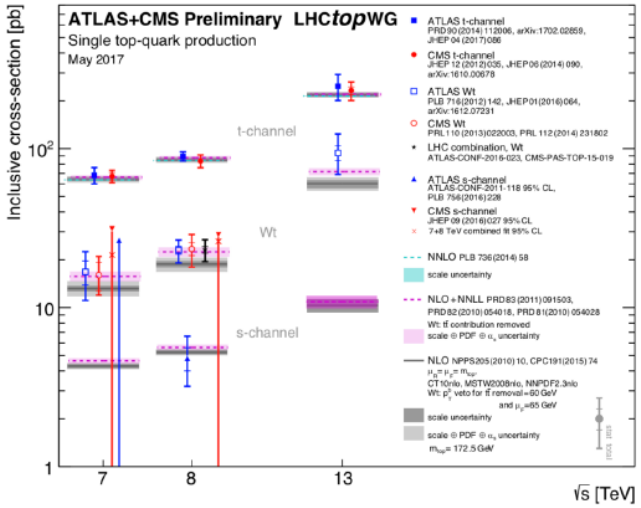
$pp \to WZ$
7 TeV, 4.6 fb^{-1}, Eur. Phys. J. C (2012) 72:2173
8 TeV, 20.3 fb^{-1}, PRD 93, 092004 (2016)
13 TeV, 3.2 fb^{-1}, Phys. Lett. B 762 (2016)

$pp \to ZZ$
7 TeV, 4.6 fb^{-1}, JHEP 03, 128 (2013)
8 TeV, 20.3 fb^{-1}, JHEP 01, 099 (2017)
13 TeV, 36.1 fb^{-1}, ATLAS-CONF-2017-031

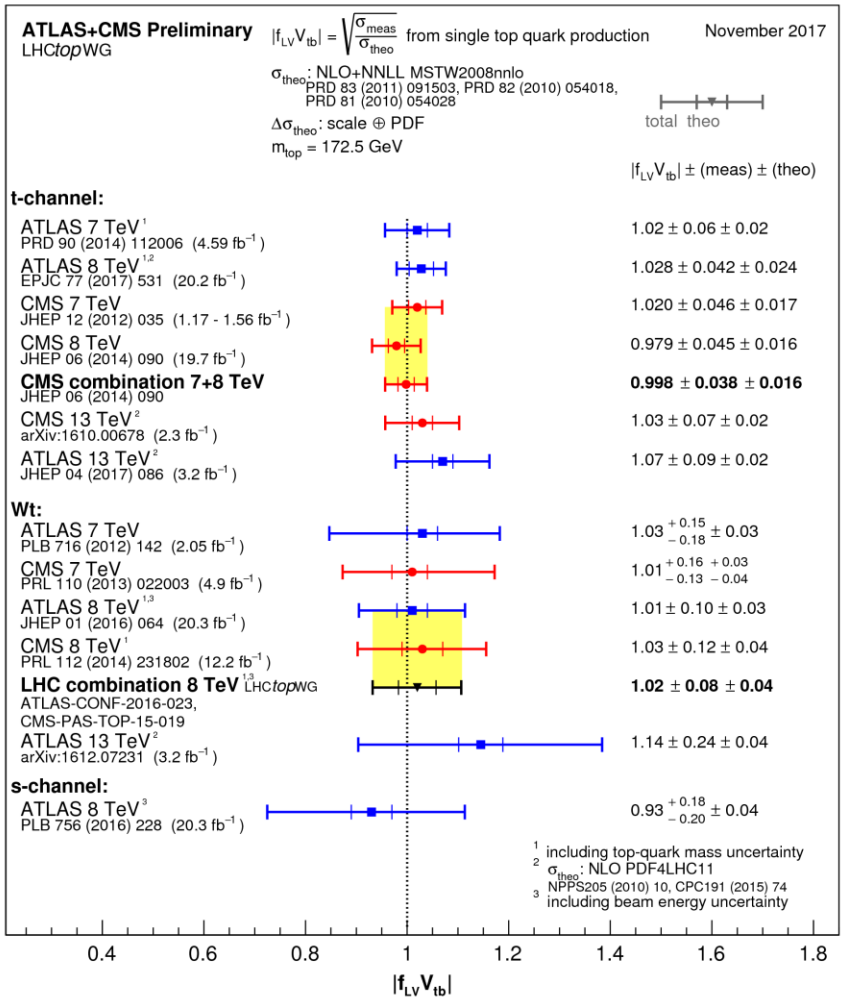
t-quark physics

Summary plot, ATLAS in blue, CMS in Red



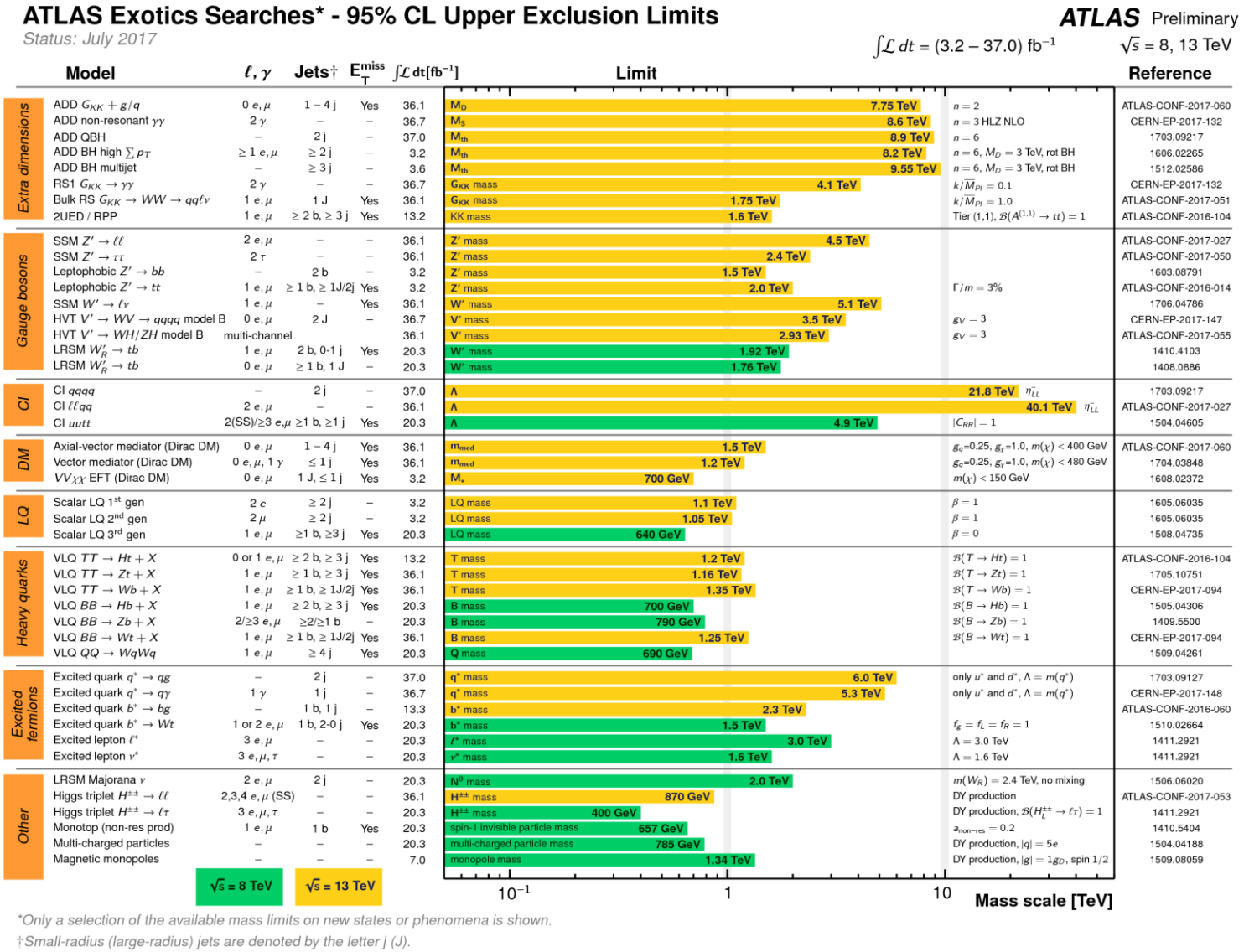


Cross-sections of single t-quark production for t-channel, Wt and s-channel



Cross-sections agrees with SM predictions, $|V_{tb}|$ consistent with 1

Exotics

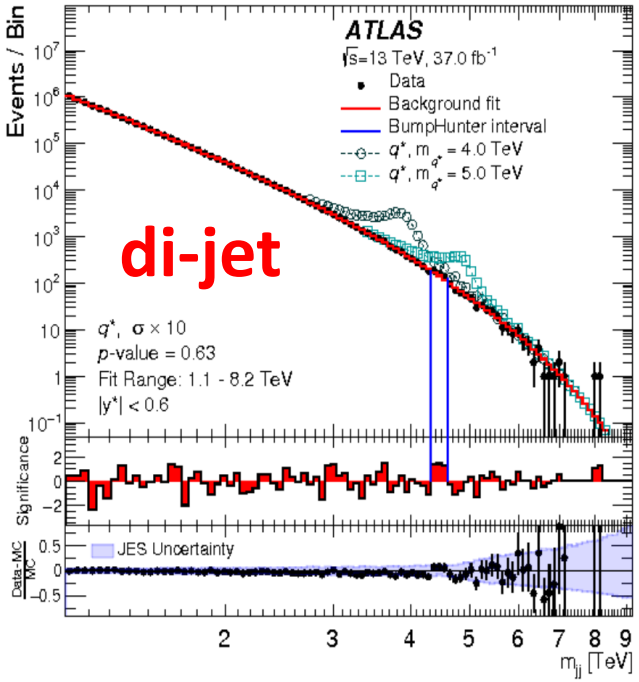


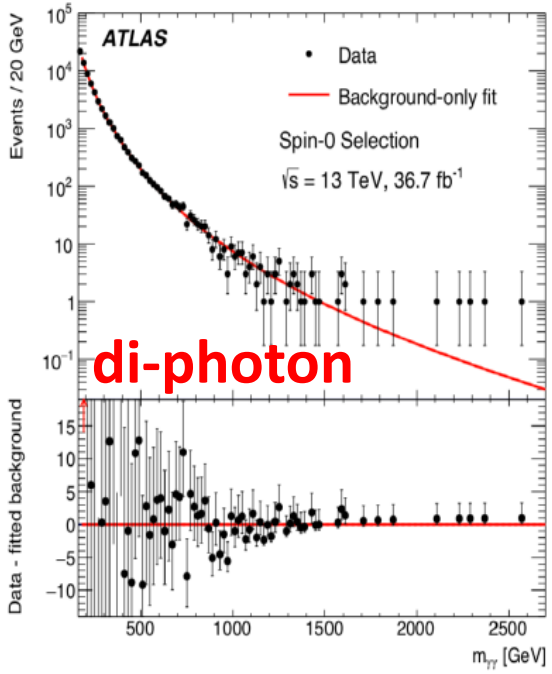
*Only a selection of the available mass limits on new states or phenomena is shown.

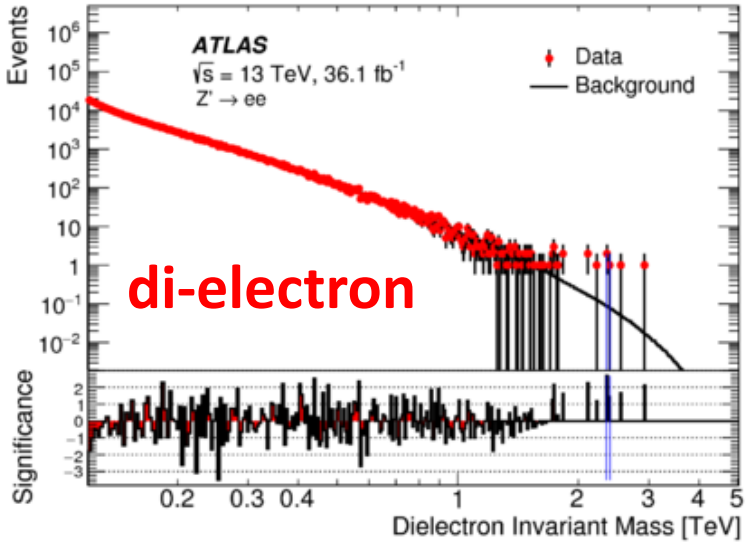
†Small-radius (large-radius) jets are denoted by the letter j (J).

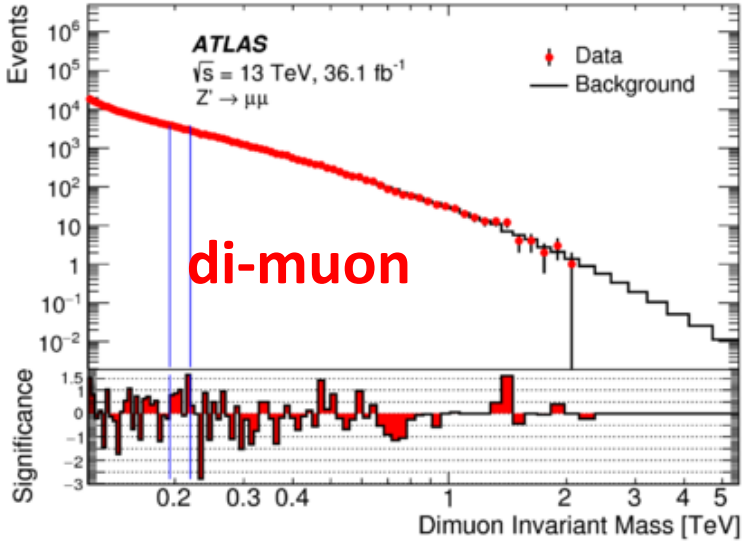
These and more results on
https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults

High-mass resonances



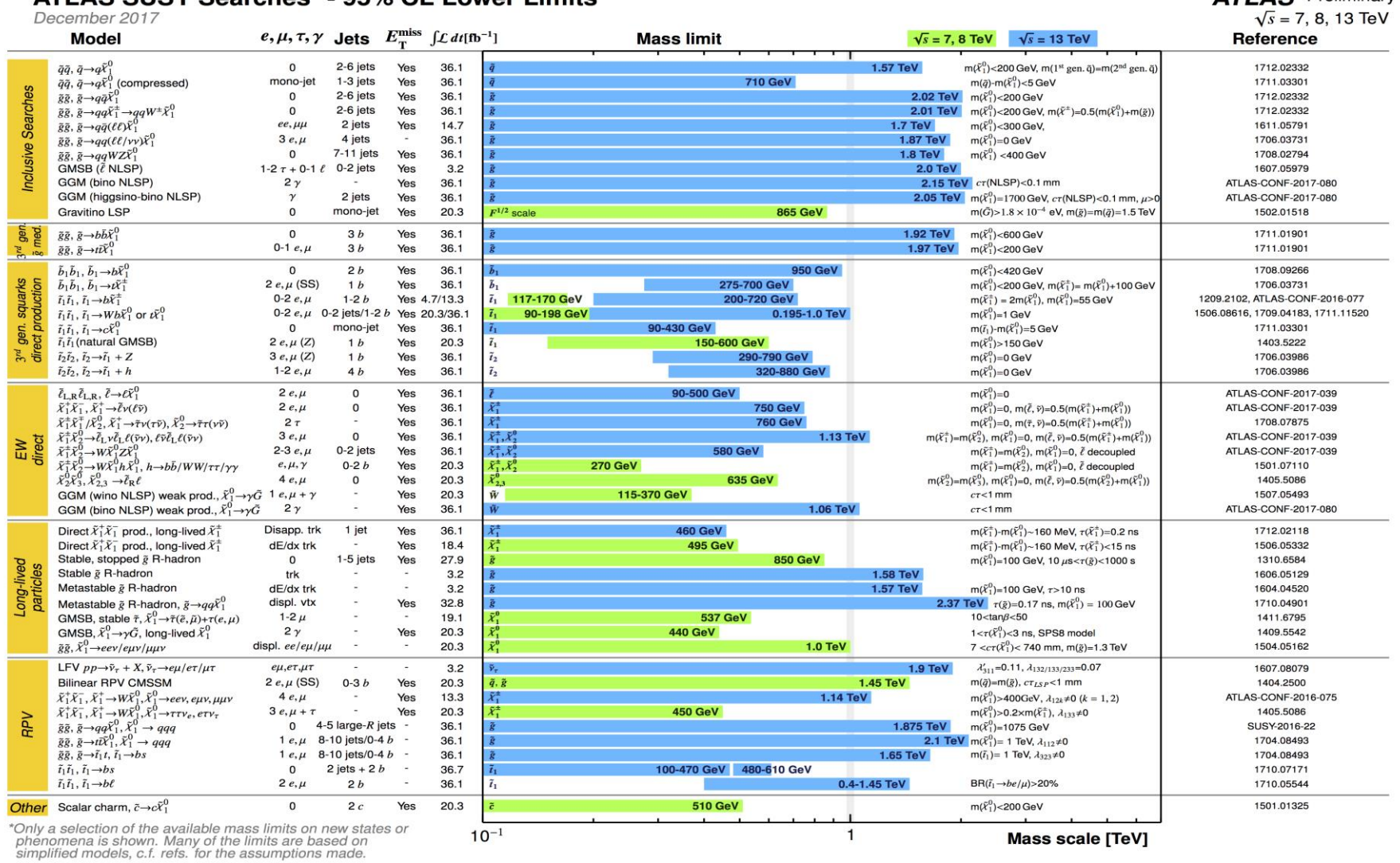






No data excess observed ☹

SUSY



*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

These and more results on
https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults

Summary

- 43.9 fb^{-1} were collected in 2017
- Total in 2015-2017 80 fb^{-1}
- ATLAS has shown high performance despite the hard environment
- 84 papers have been published in 2017 (+60 submitted)

СПАСИБО
и
С Новым Годом !