

Mass and Width Experimental status

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Introduction

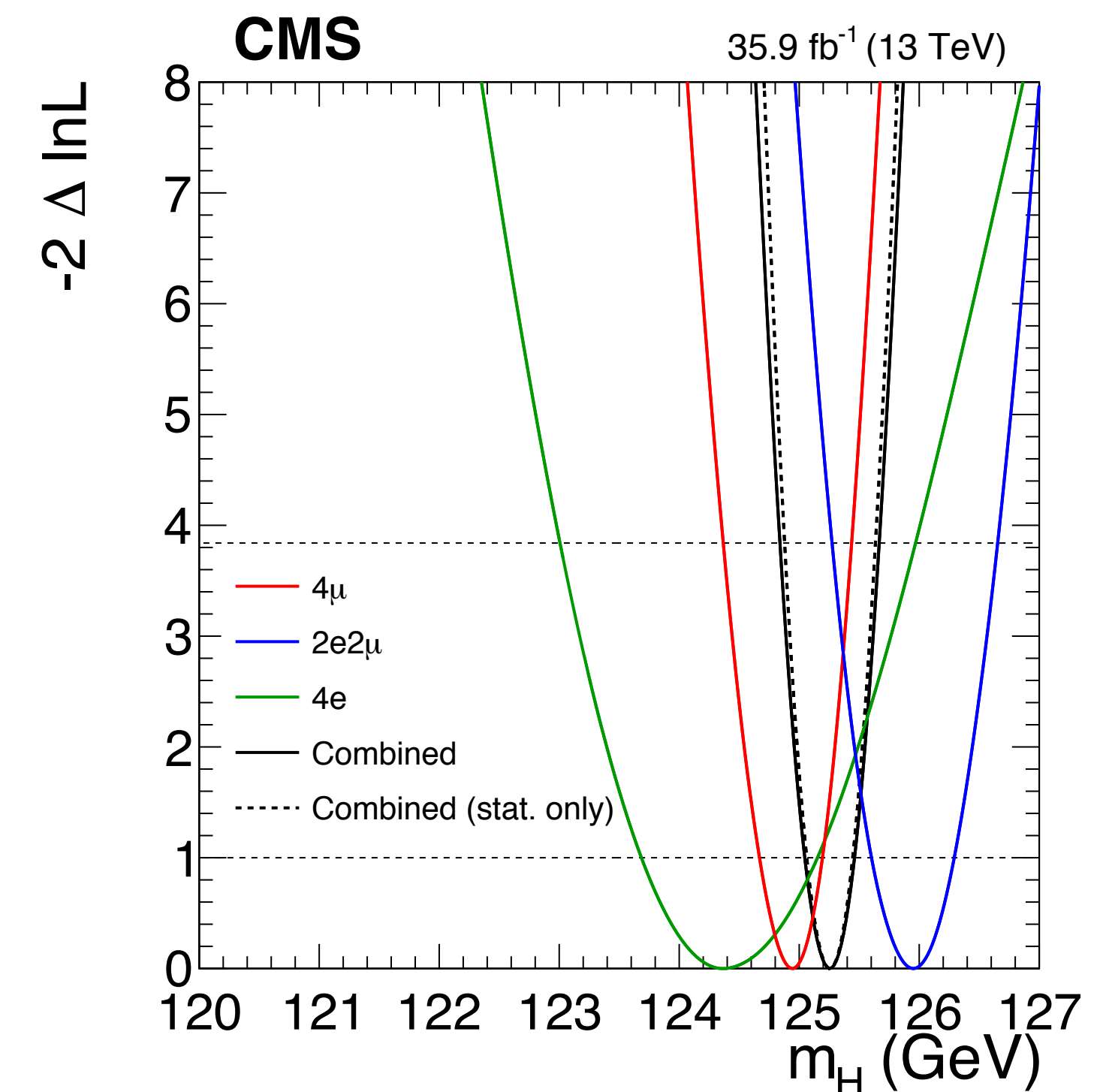
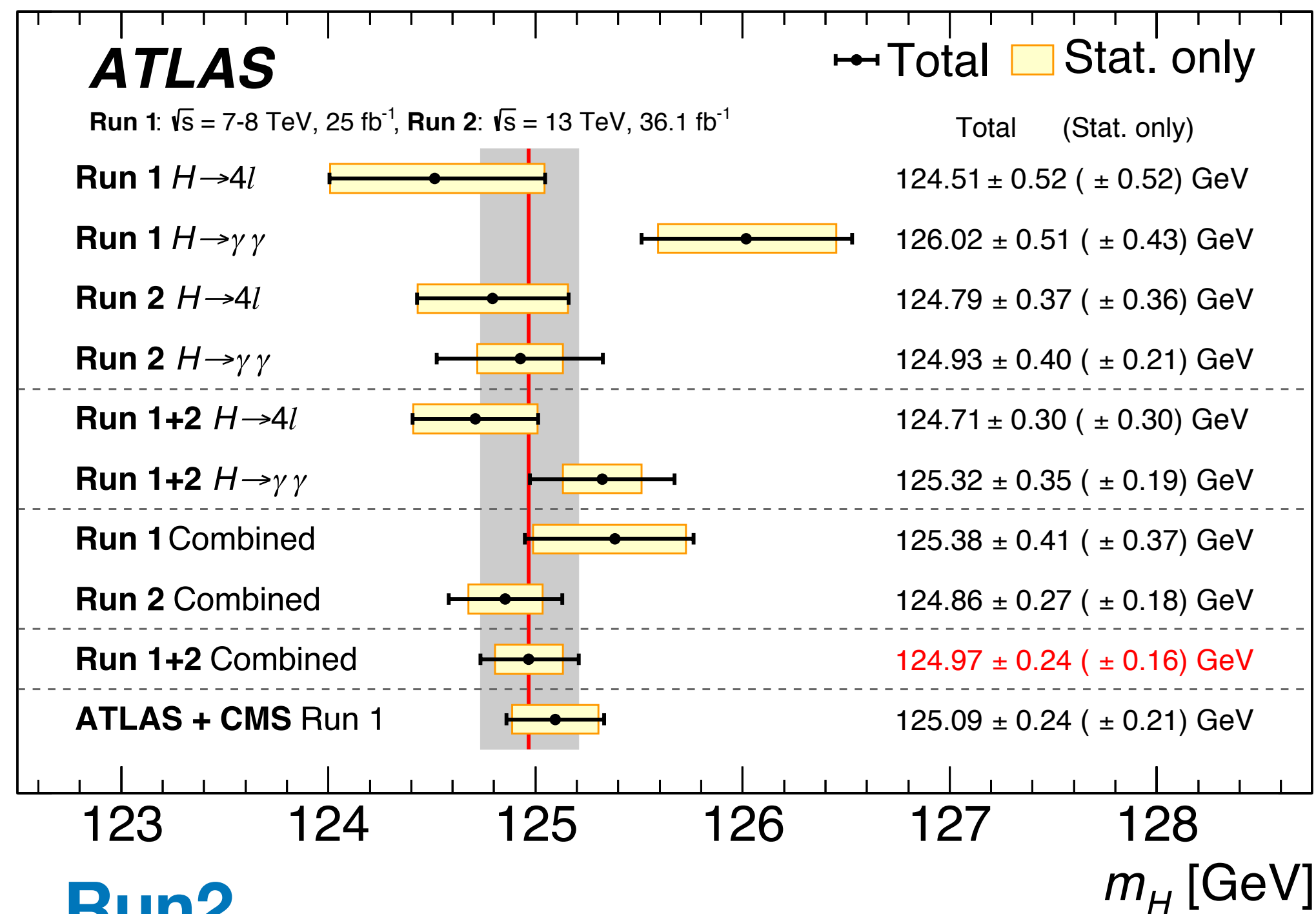
- Mass: $ZZ, \gamma\gamma$
- Width upper bound
 - on-shell: $ZZ, \gamma\gamma$
 - off-shell: ZZ, WW
- Width lower bound: ZZ

Mass

Direct measurement from the mass shape

- Limiting factor: detector resolution
 - HL projection depends on the detector description
- Is the precision good enough for TH studies for YR?

	ATLAS	CMS
Run2	124.86 ± 0.27 (4l+ $\gamma\gamma$)	125.26 ± 0.21 (4l)



Run2
CMS 4l
JHEP 11 (2017) 047

Run2
ATLAS 4l+ $\gamma\gamma$
arXiv:1806.00242

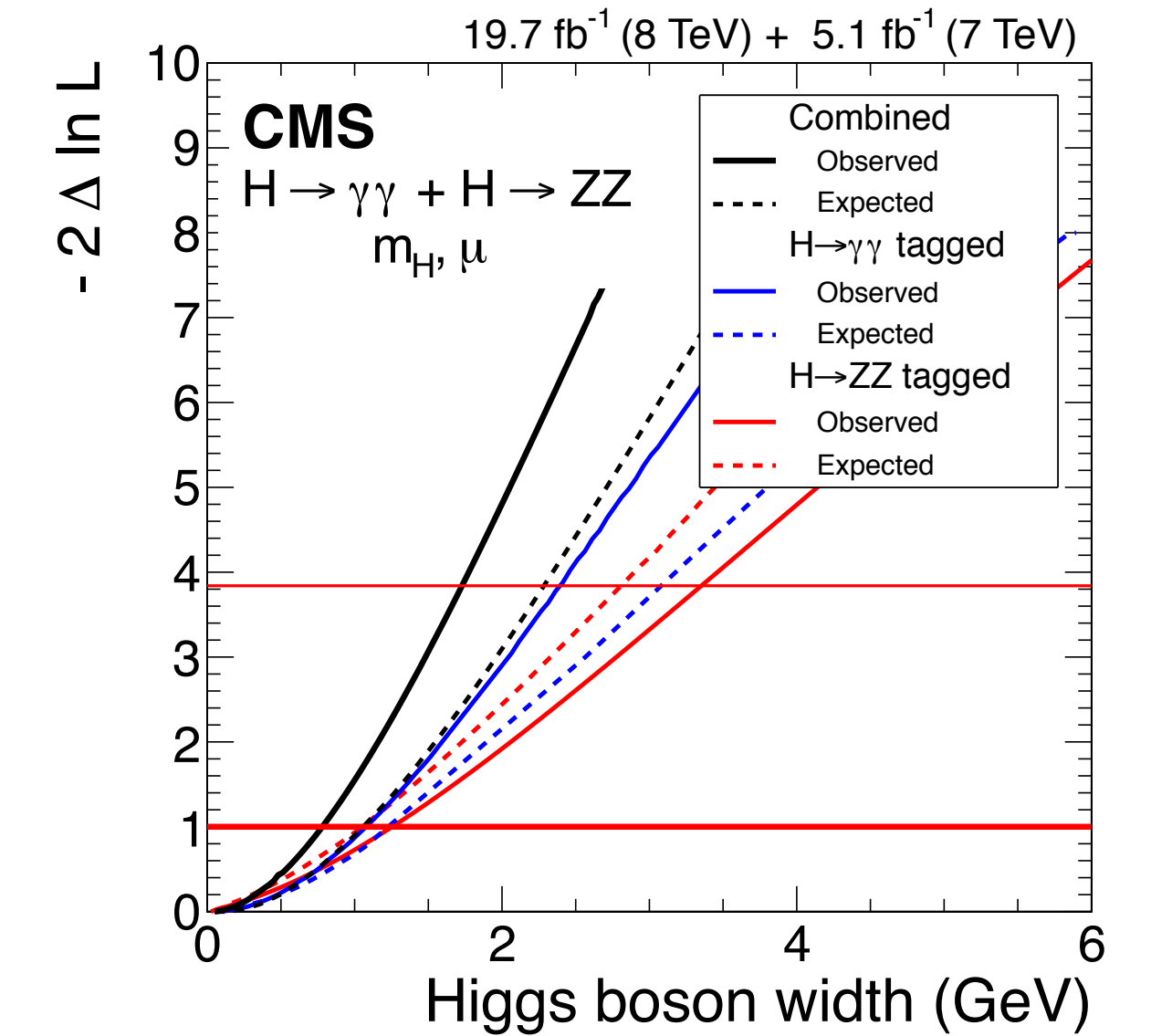
Width from on-shell

Eur. Phys. J. C 75 (2015) 212

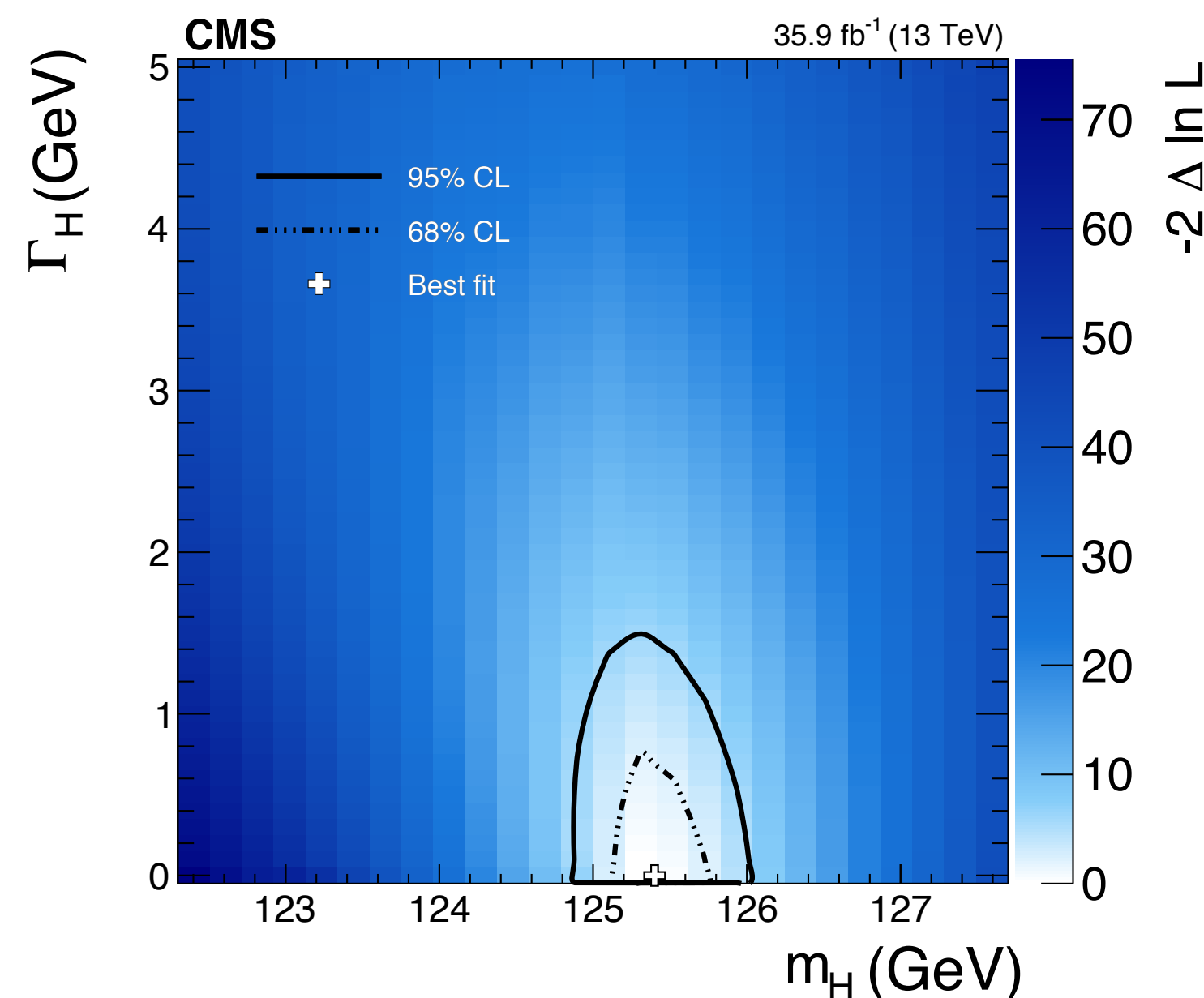
Direct measurement from the mass shape

- Limiting factor: detector resolution
- HL projection depends on the detector description

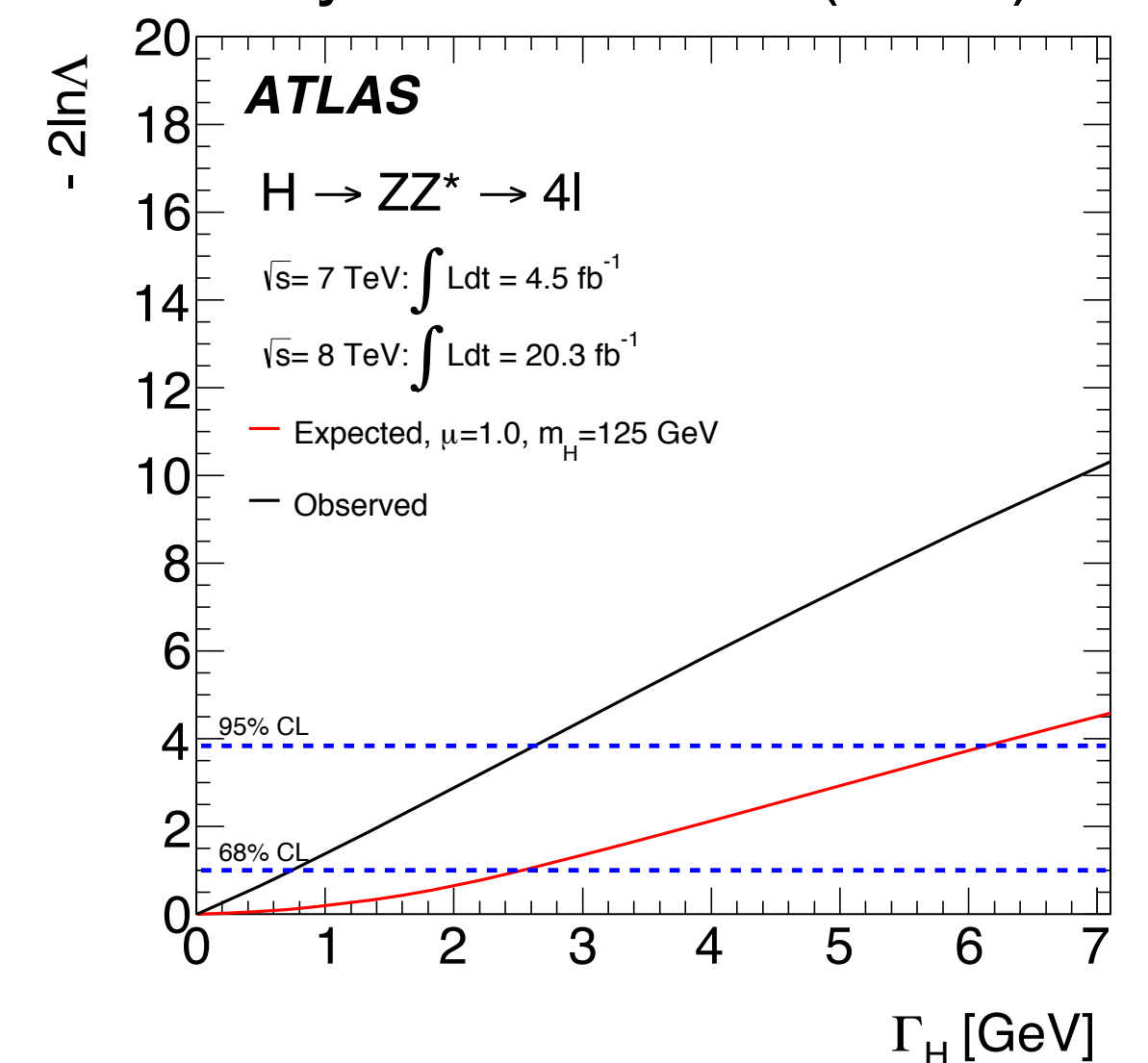
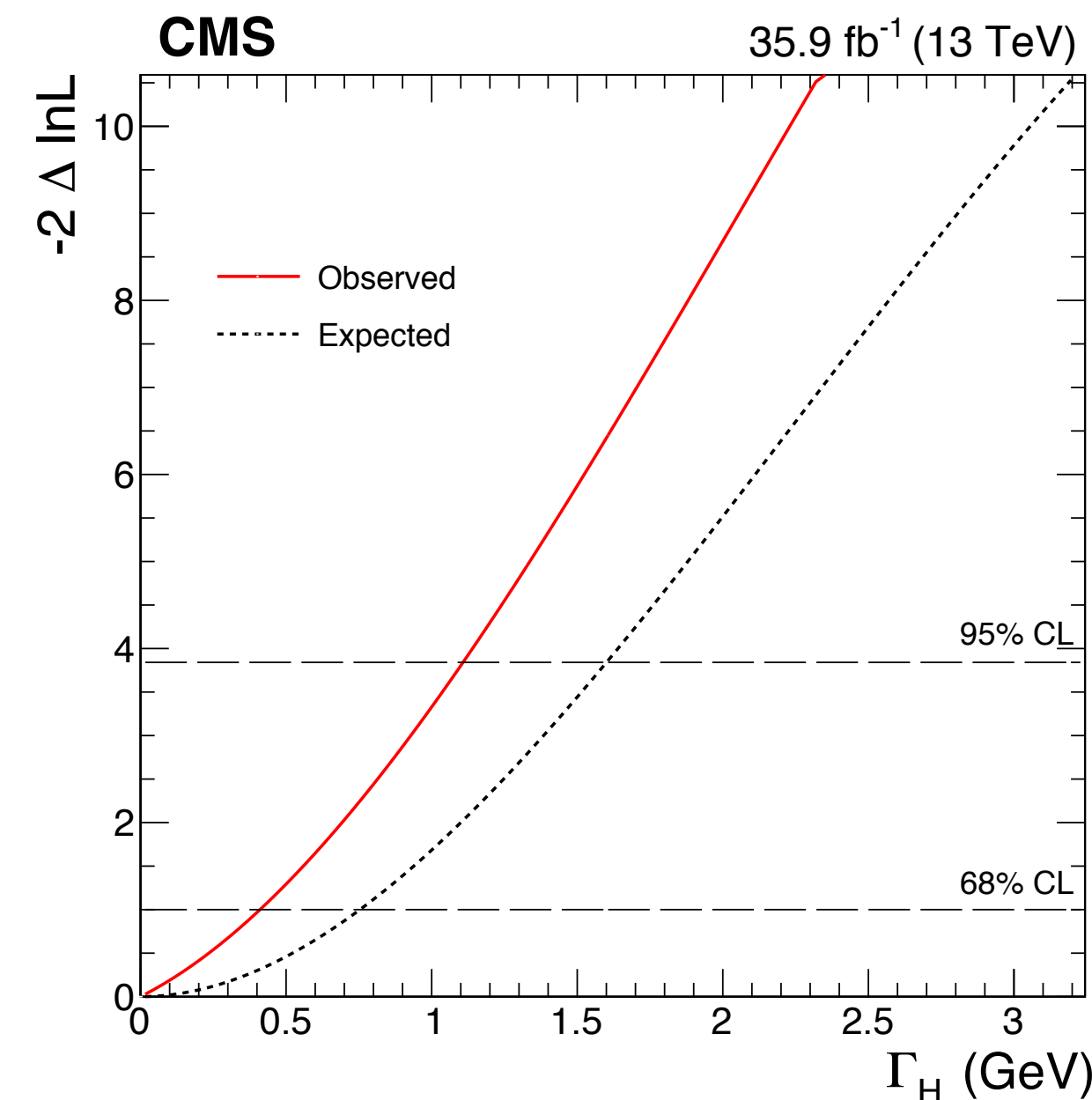
	ATLAS	CMS
Run1	<2.6 GeV (ZZ)	<1.7 GeV (ZZ+ $\gamma\gamma$)
Run2	-	<1.1 GeV (ZZ)



Phys. Rev. D. 90 (2014) 052004



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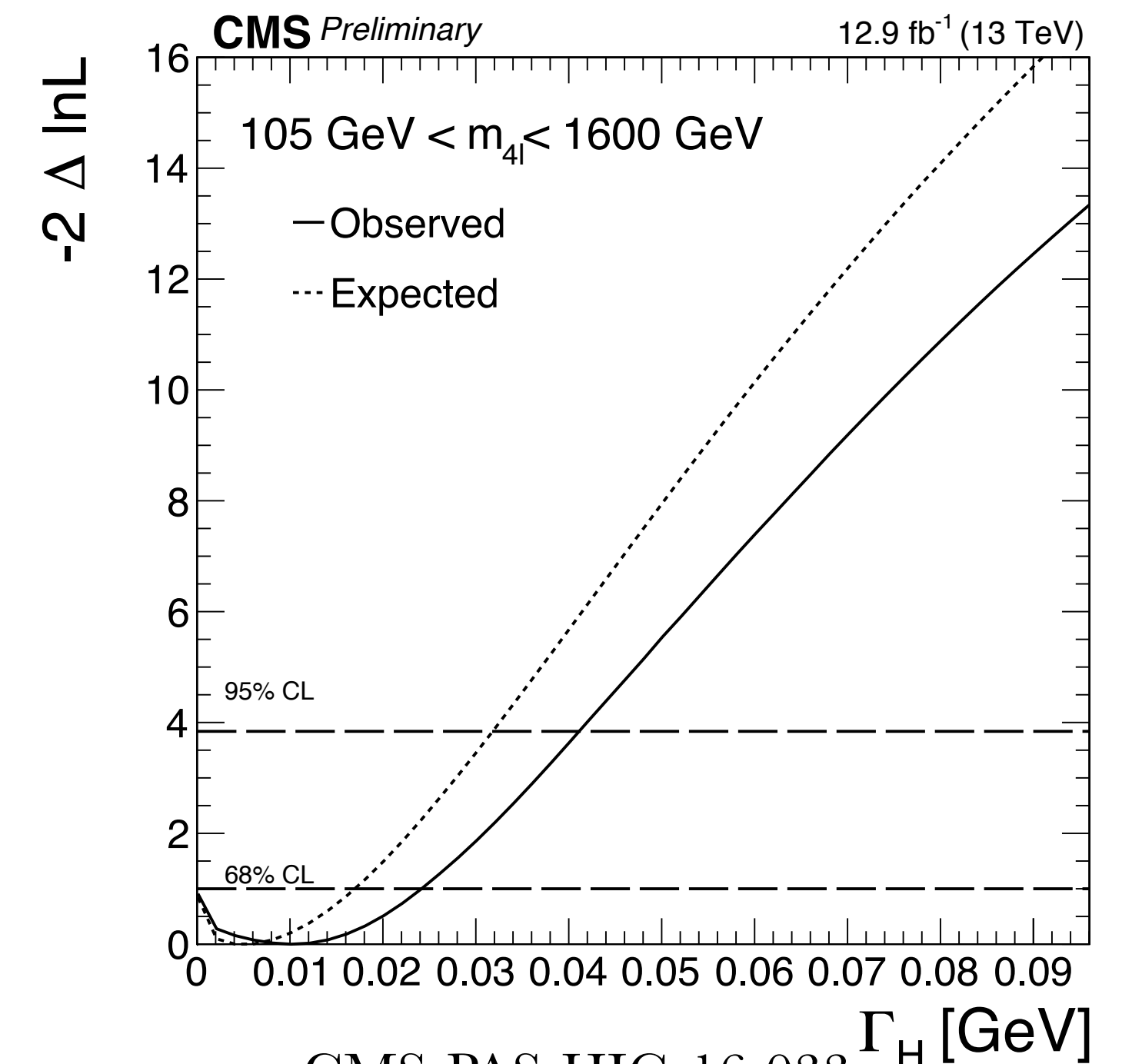
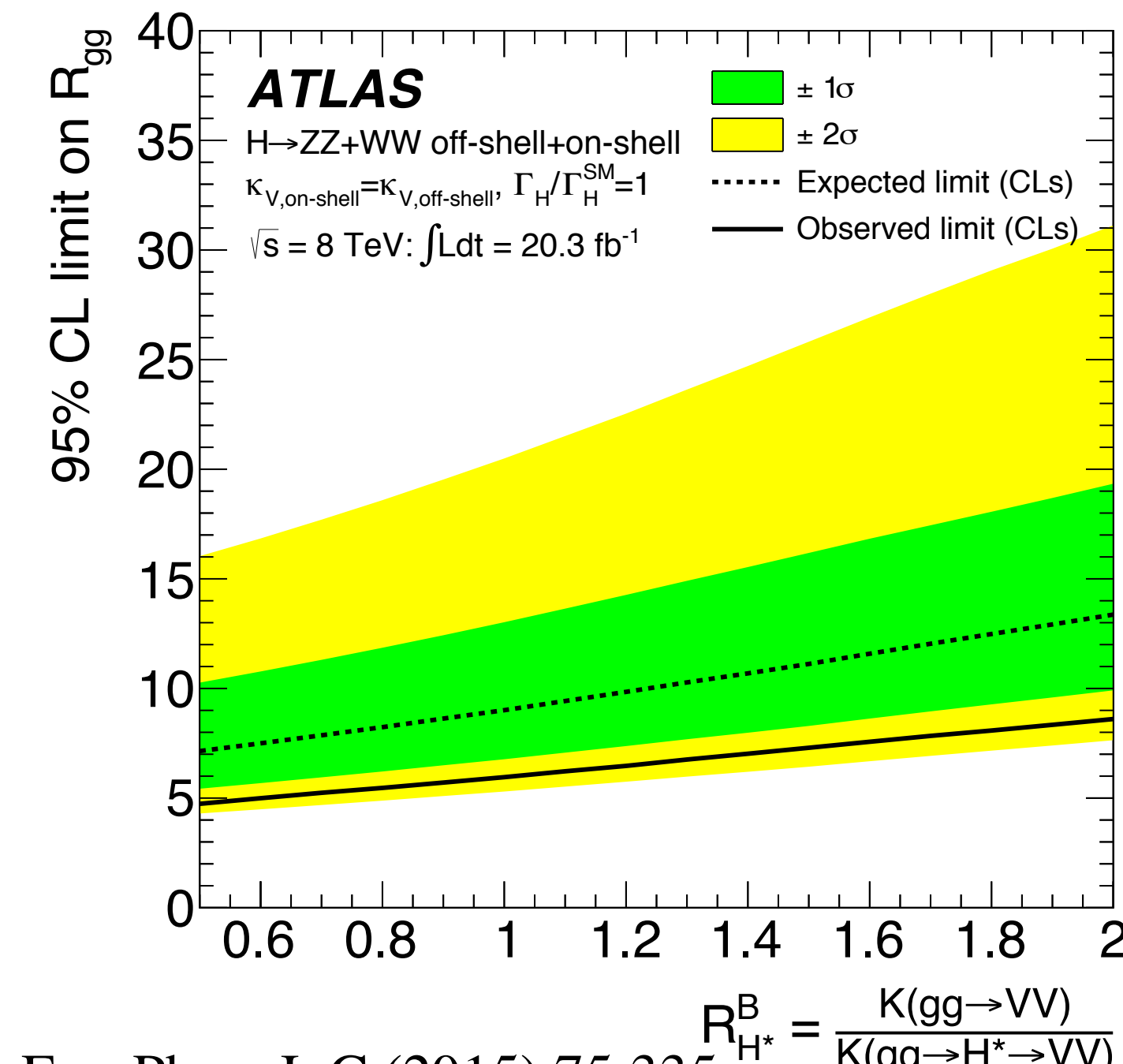
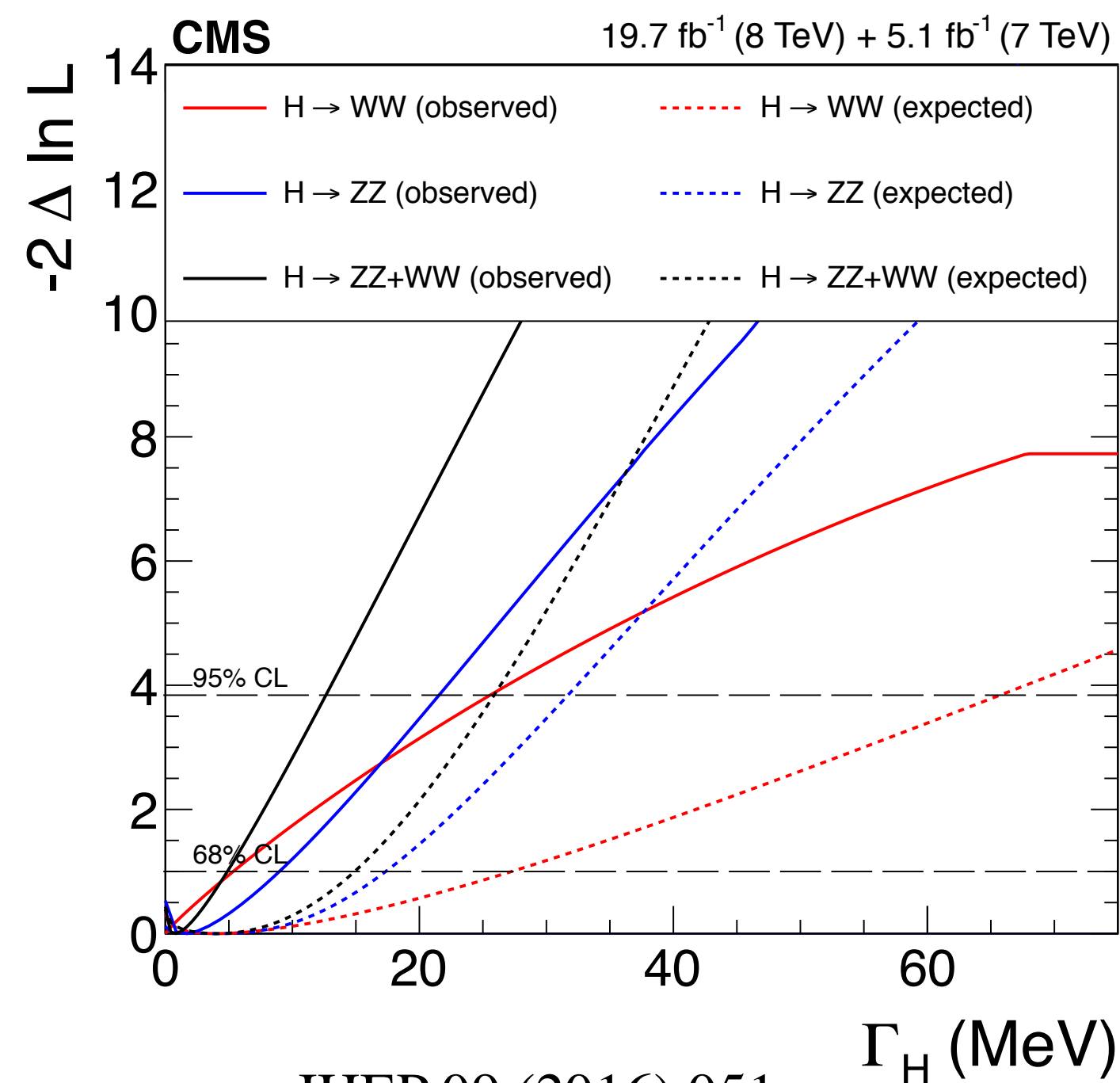


Width from off-shell

Indirect measurement from the on-shell + off-shell mass

- Off-shell/on-shell ratio => width (couplings the same)
- High precision
- Not depend on the detector too much

	ATLAS	CMS
Run1	<22.7 MeV (ZZ+WW)	<13 MeV (ZZ+WW)
Run2	-	<41 MeV (4l, 1/3 full data)



Width projection from off-shell

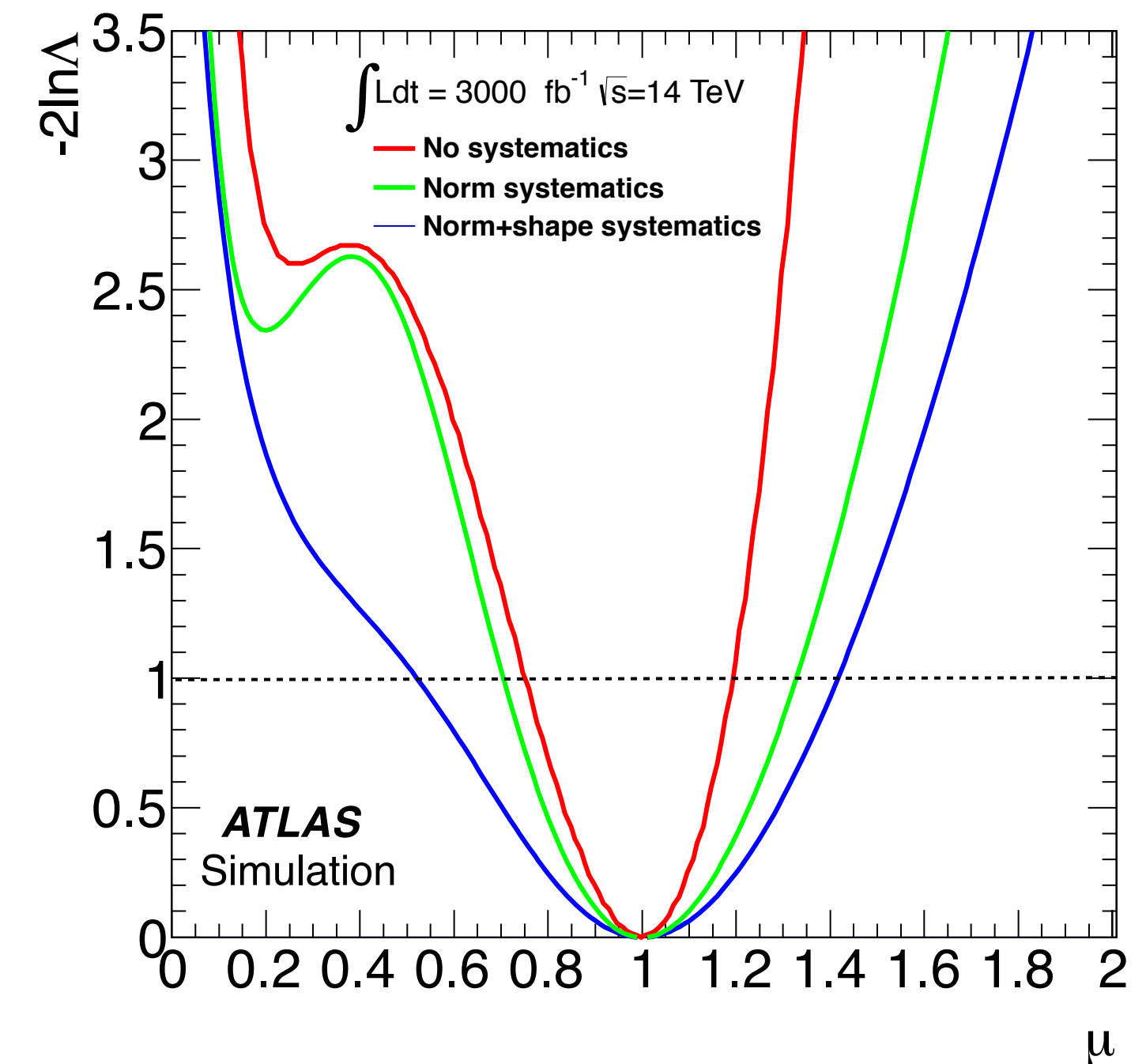
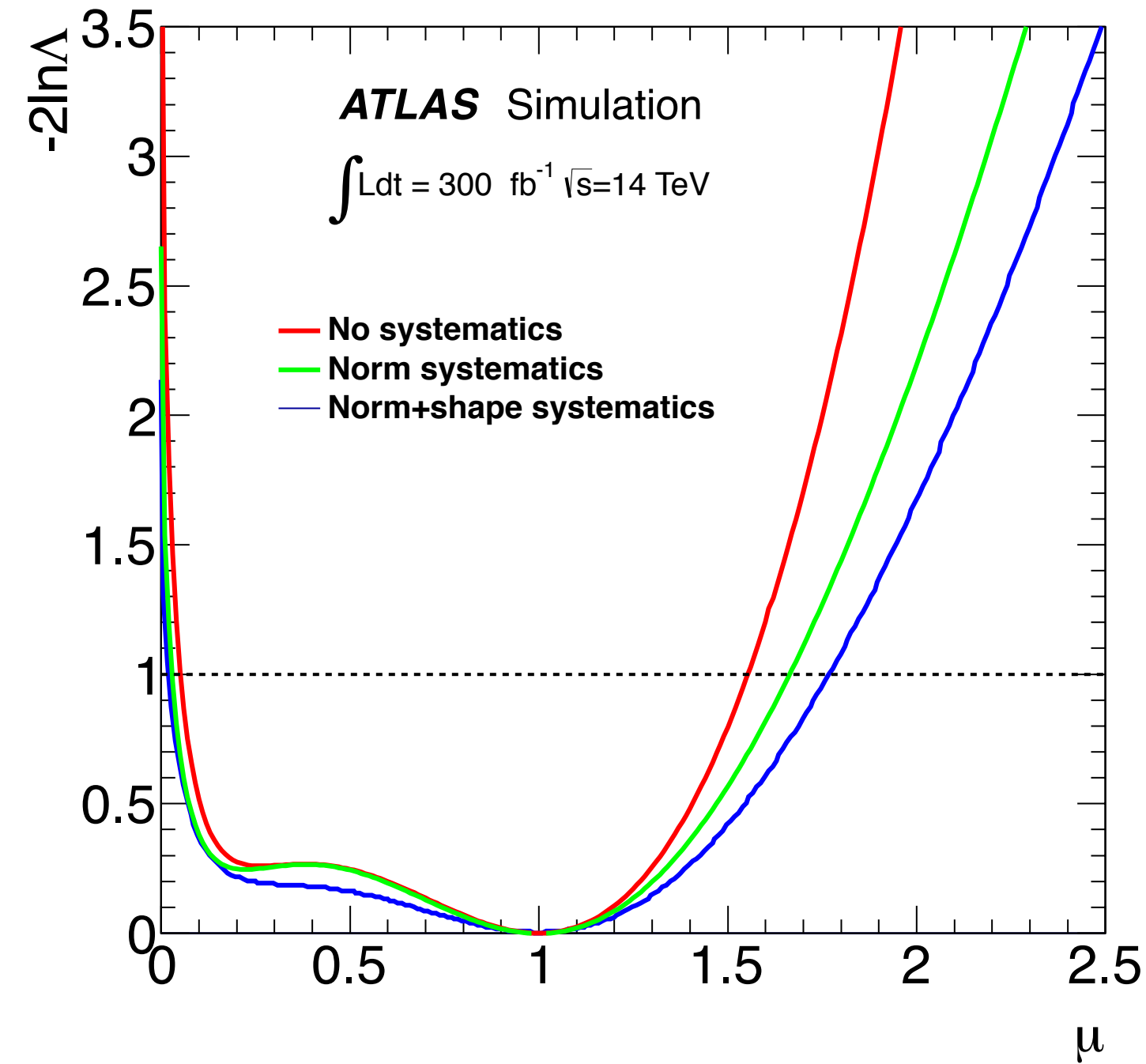
ATL-PHYS-PUB-2015-024

ATLAS projection

— Assuming k-factor unc 10%

At 3 ab⁻¹

$\Gamma_H = 4.2^{+1.5}_{-2.1}$ MeV



Width lower bound

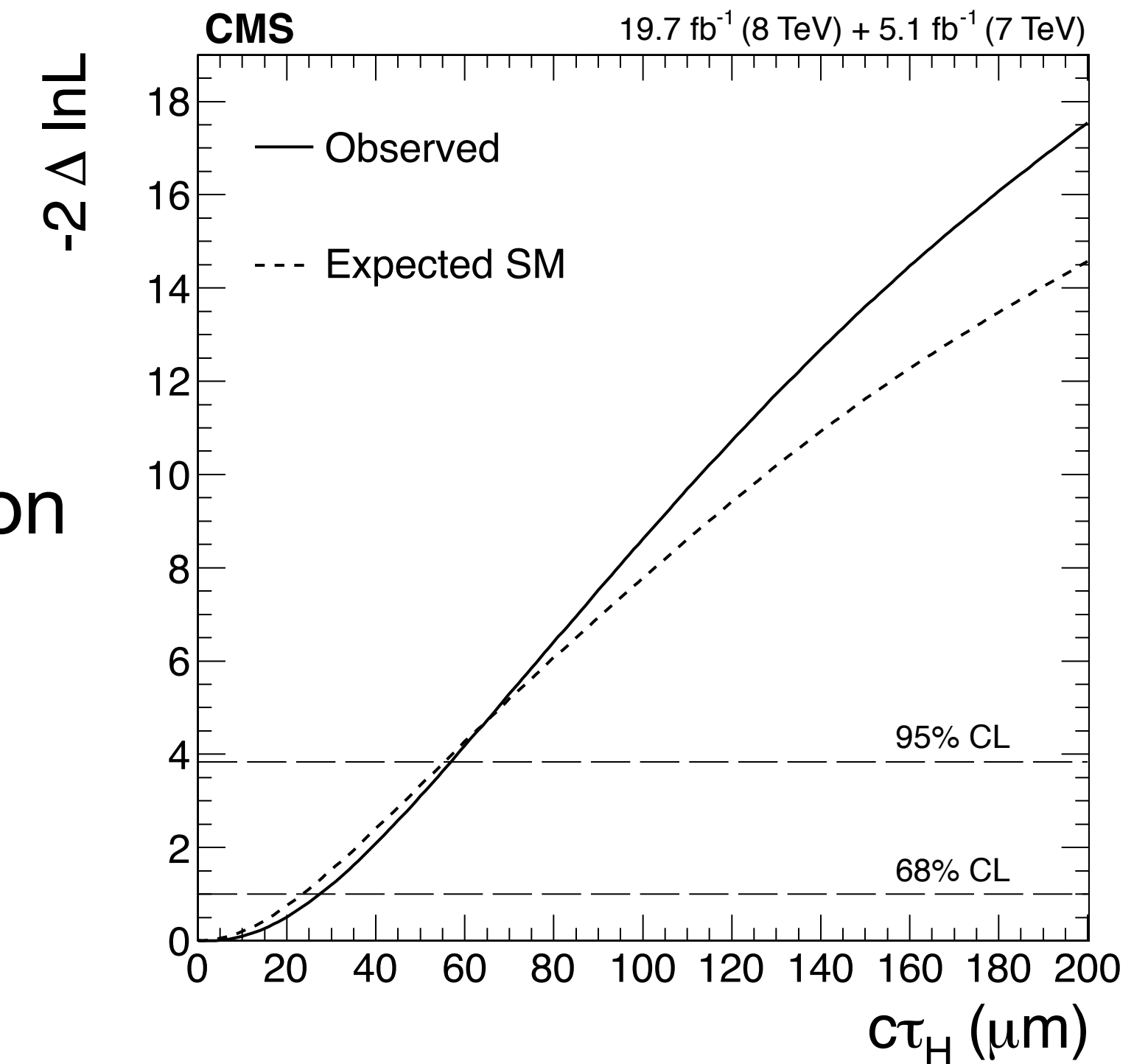
$H \rightarrow ZZ \rightarrow 4l$, flight distance \Rightarrow lifetime

- Limiting factor: detector
- HL projection depends on the detector description
- Low sensitivity, better constraints from off-shell projection
- No plan to perform the projection for HL YR

Run 1 result:

$$c\tau_H < 57 \mu\text{m} \Rightarrow \Gamma_H > 3.5 \times 10^{-9} \text{ MeV}$$

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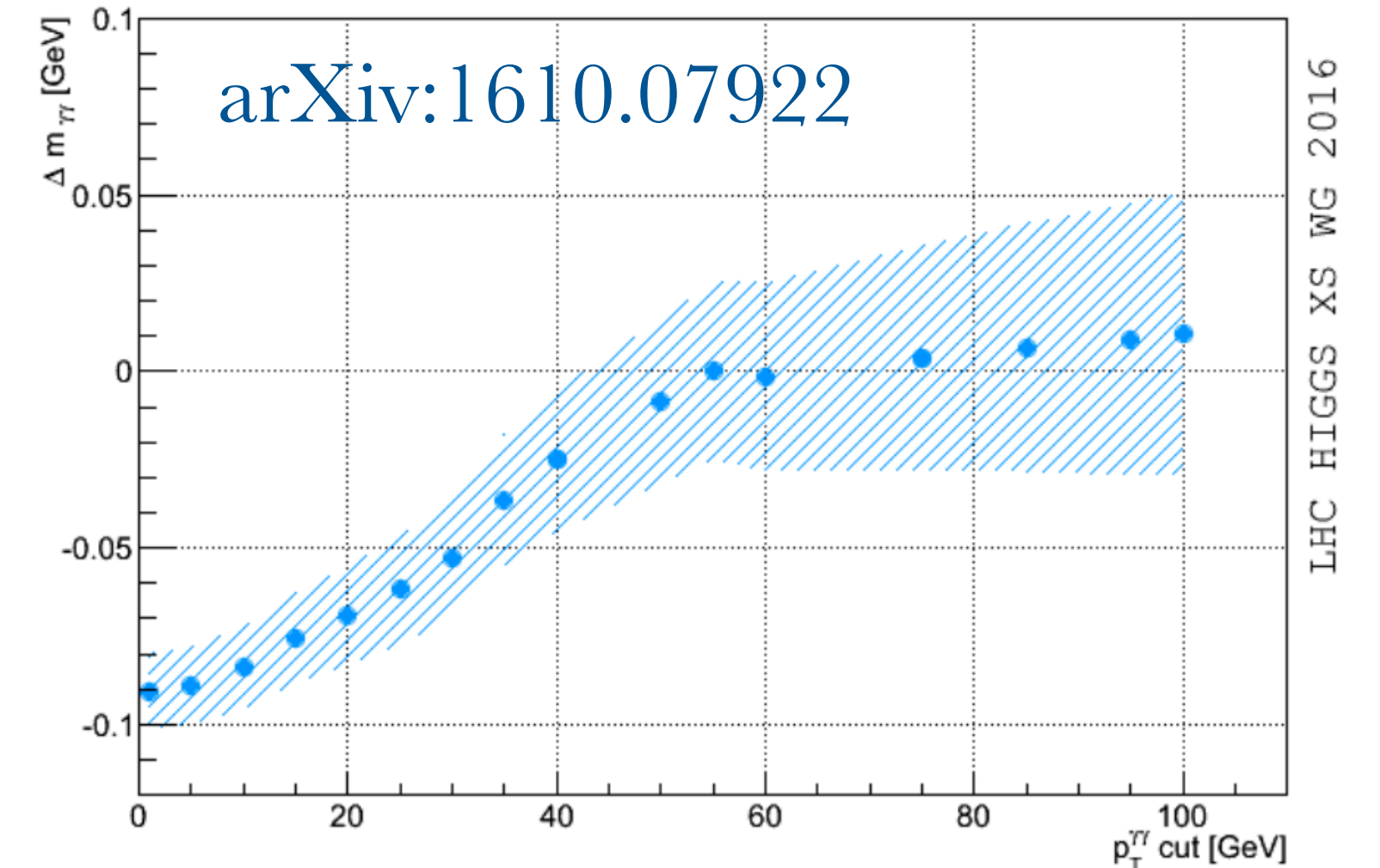
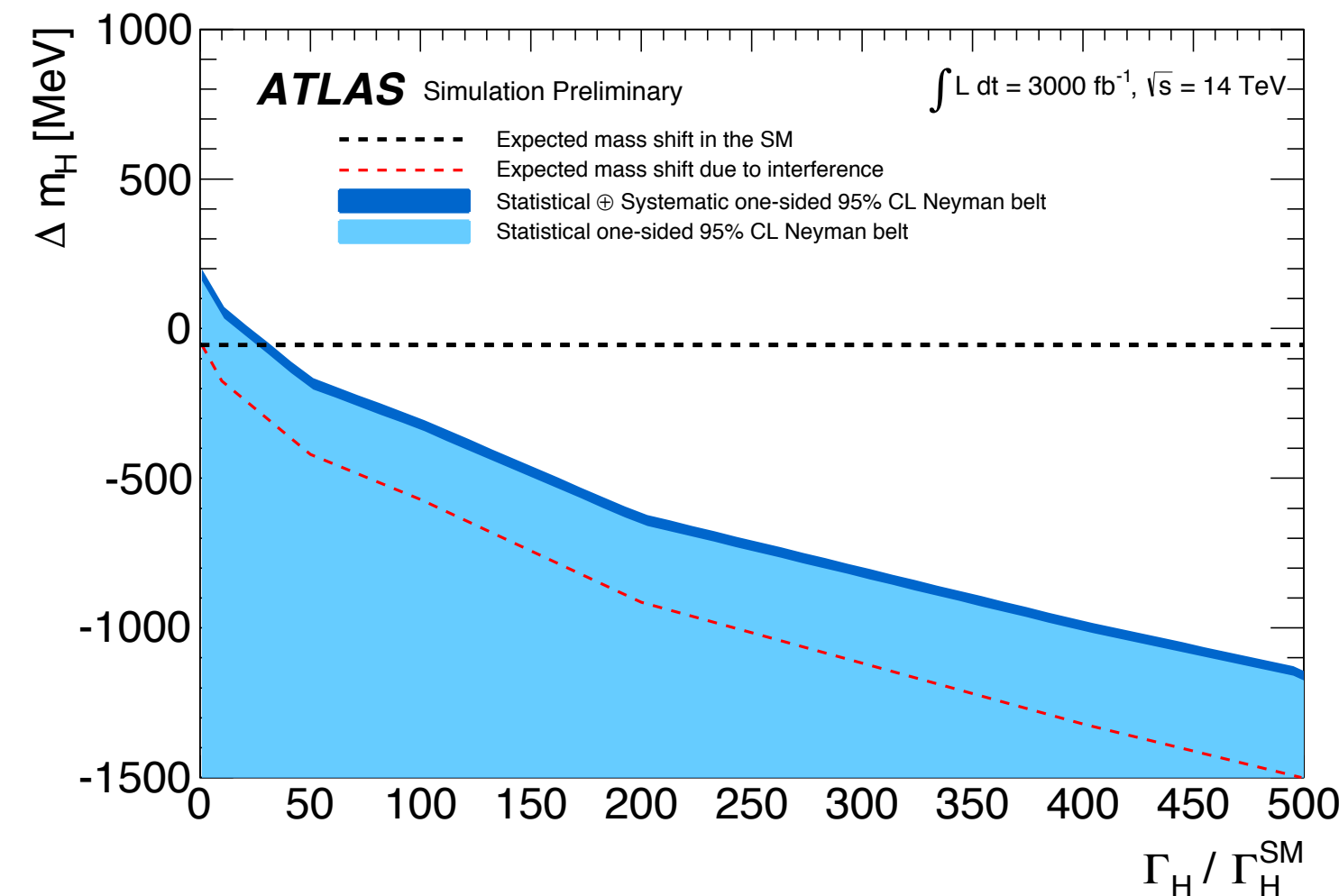
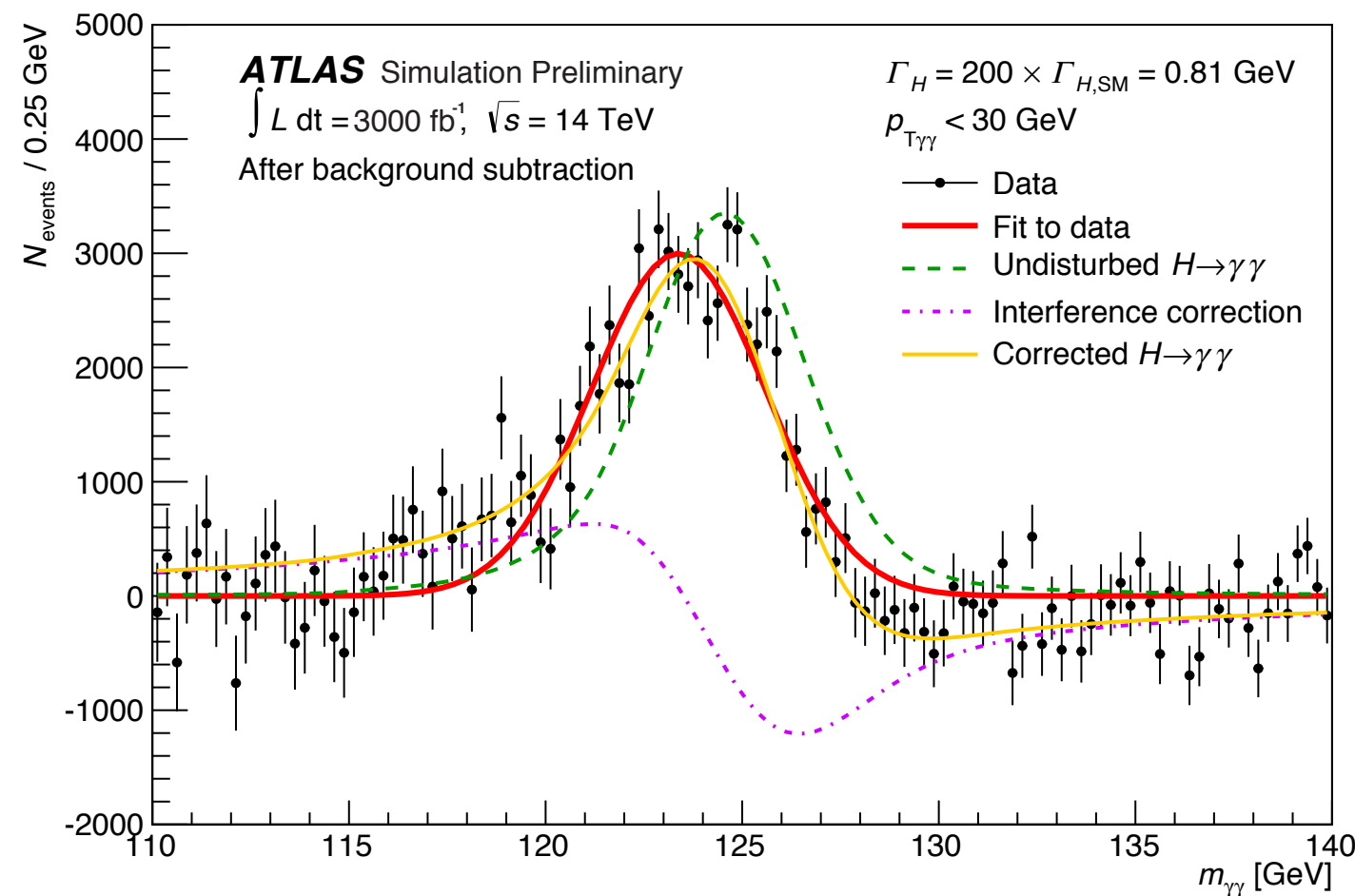
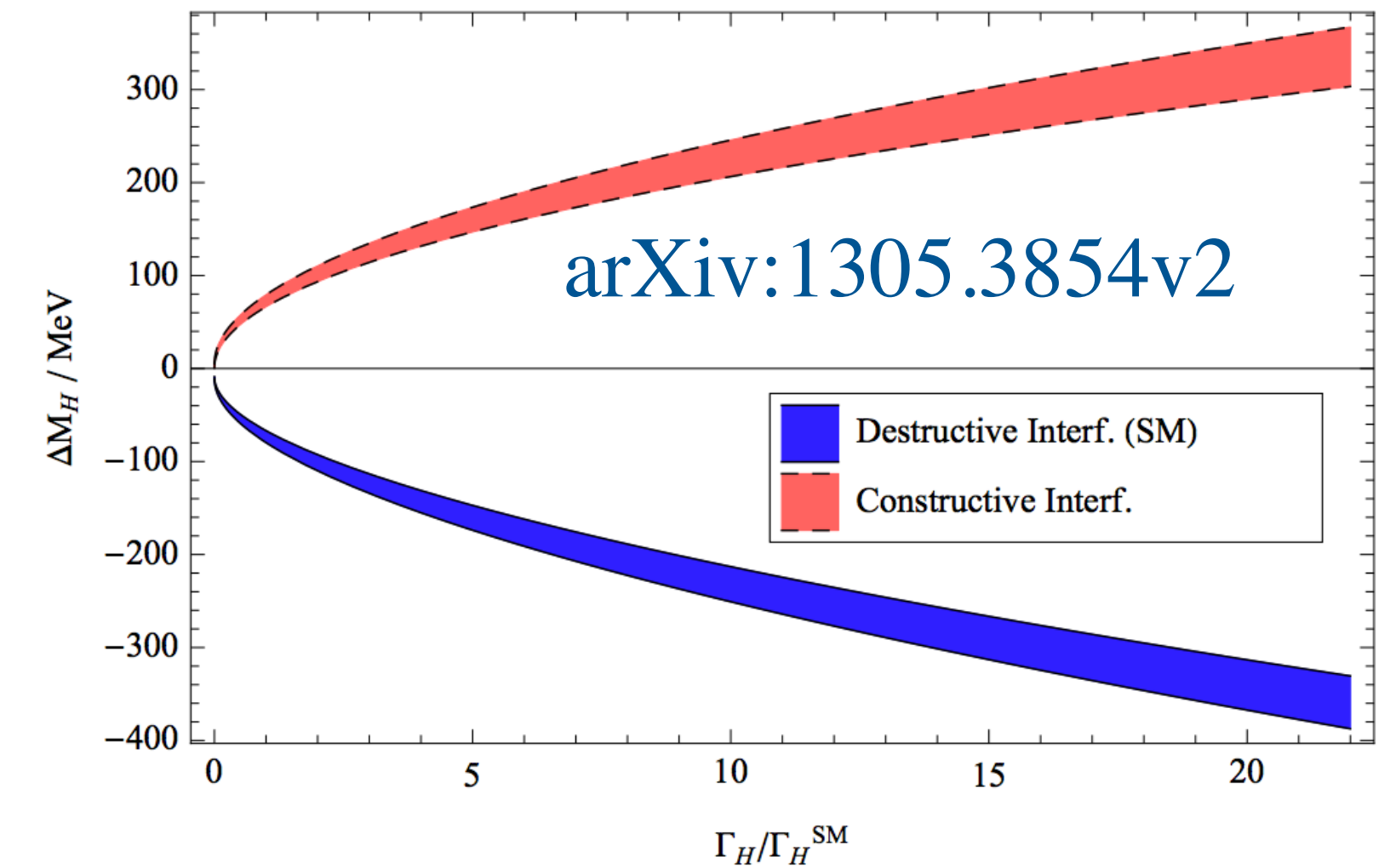
On-shell width: using interference

gg,qq \rightarrow (H) \rightarrow $\gamma\gamma$ interference at NLO
 \Rightarrow mass shift dependent of Γ_H , p_T

Use mass shift in different p_T region to constrain H width
 – Effect most pronounced in low p_T , need careful experimental work

Studies from ATLAS

– Projection with 3 ab⁻¹: $\Delta m = 130$ MeV, $\Gamma_H \sim 40\text{-}50 \Gamma_{SM}$



Summary

- Quite a complete list of mass and width measurements from Run1 and Run2
 - Some with already good precision, some quite far
- Projection of the measurements mostly depends on the detector effects
 - so far no intension to do mass and on-shell width
 - off-shell width projection from ATLAS available