

Higgs Mass Measurement...

Why measure m_H ?

- Crucial input parameter in SM
- Related to SM vacuum stability
- Required for precision EW calculation
- Important parameter for coupling structure of Higgs

Why HZZ^* channel?

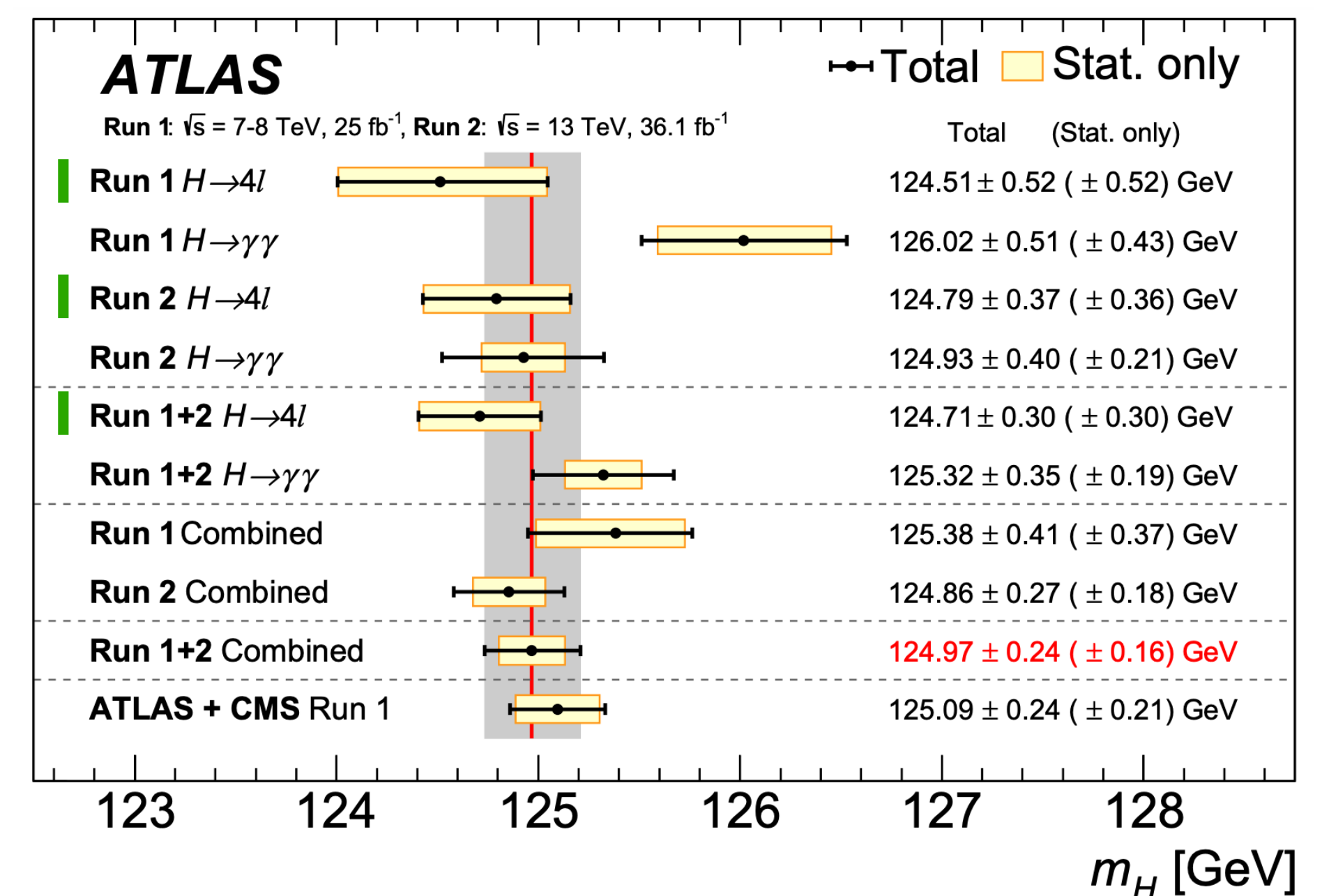
- $H \rightarrow ZZ^* \rightarrow 4l(e, \mu)$: Fully reconstructable final state
- Excellent mass resolution and S/B ratio

How did we improve?

- Largest collected dataset (139 fb^{-1})
- Significant improvement in lepton resolution
- muon p_T scale error: factor of 4 reduction!
- Better theory modelling

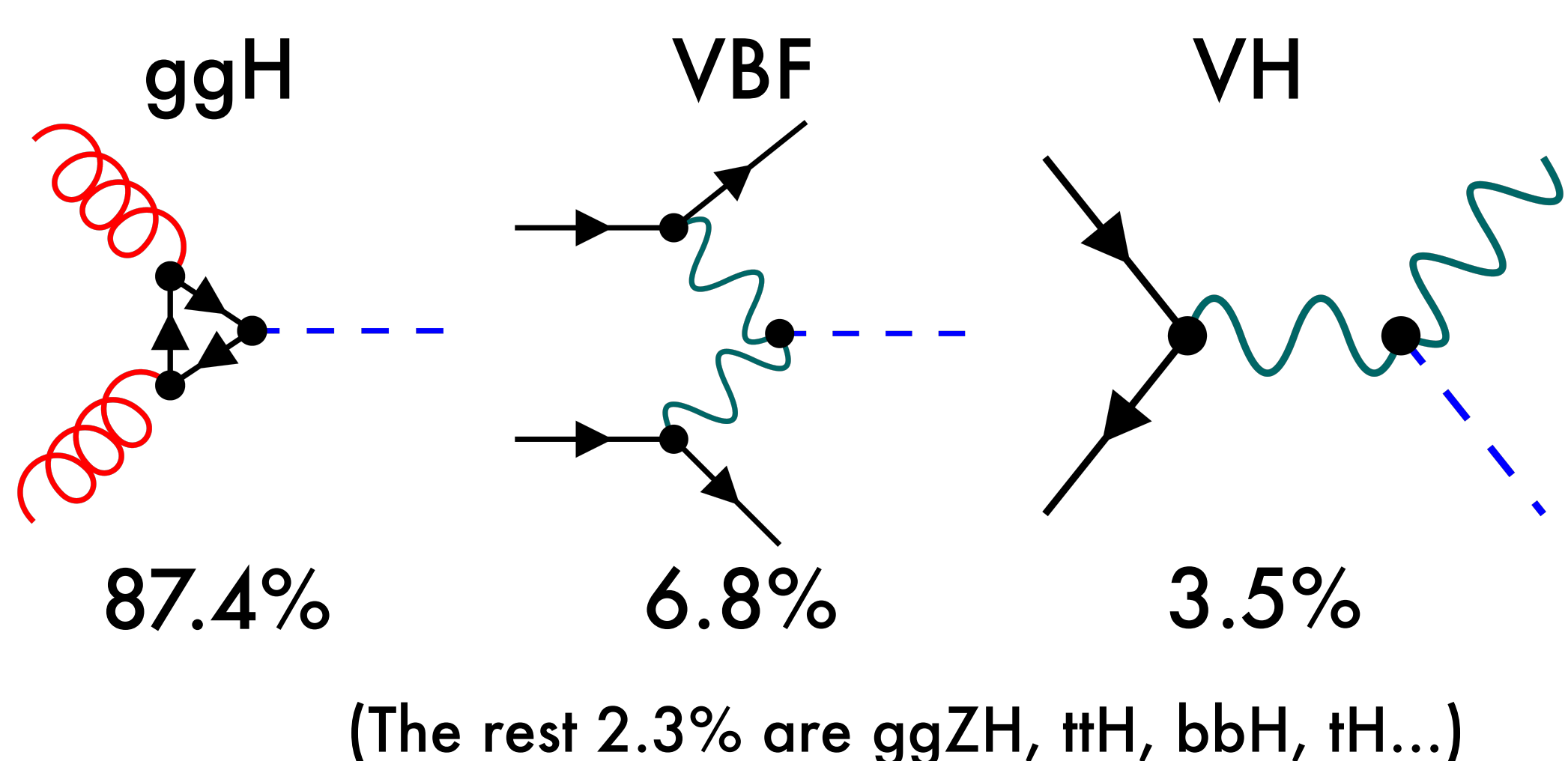
What was done before?

Higgs mass measurement with 36 fb^{-1} with ATLAS detector [1]



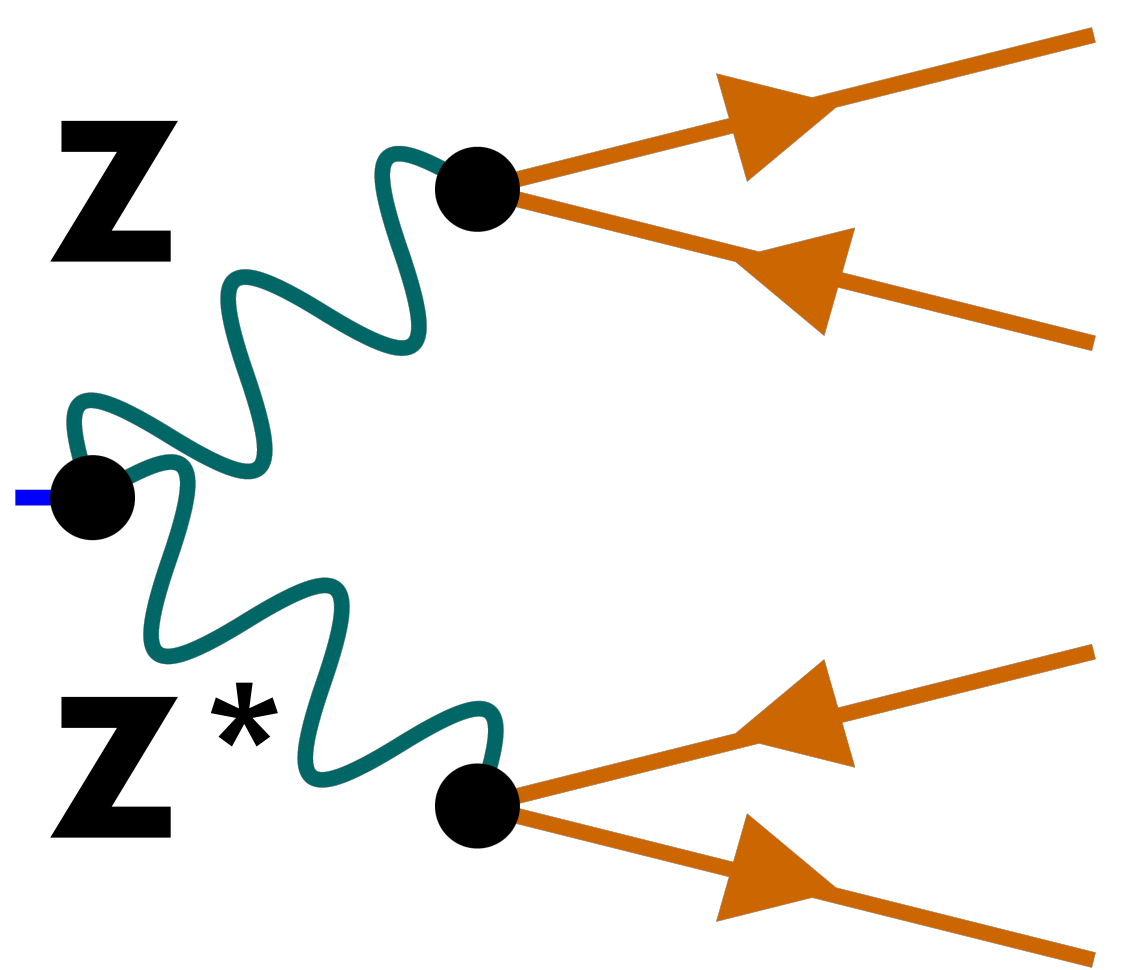
...in $H \rightarrow ZZ^* \rightarrow 4l$...

...With signal:

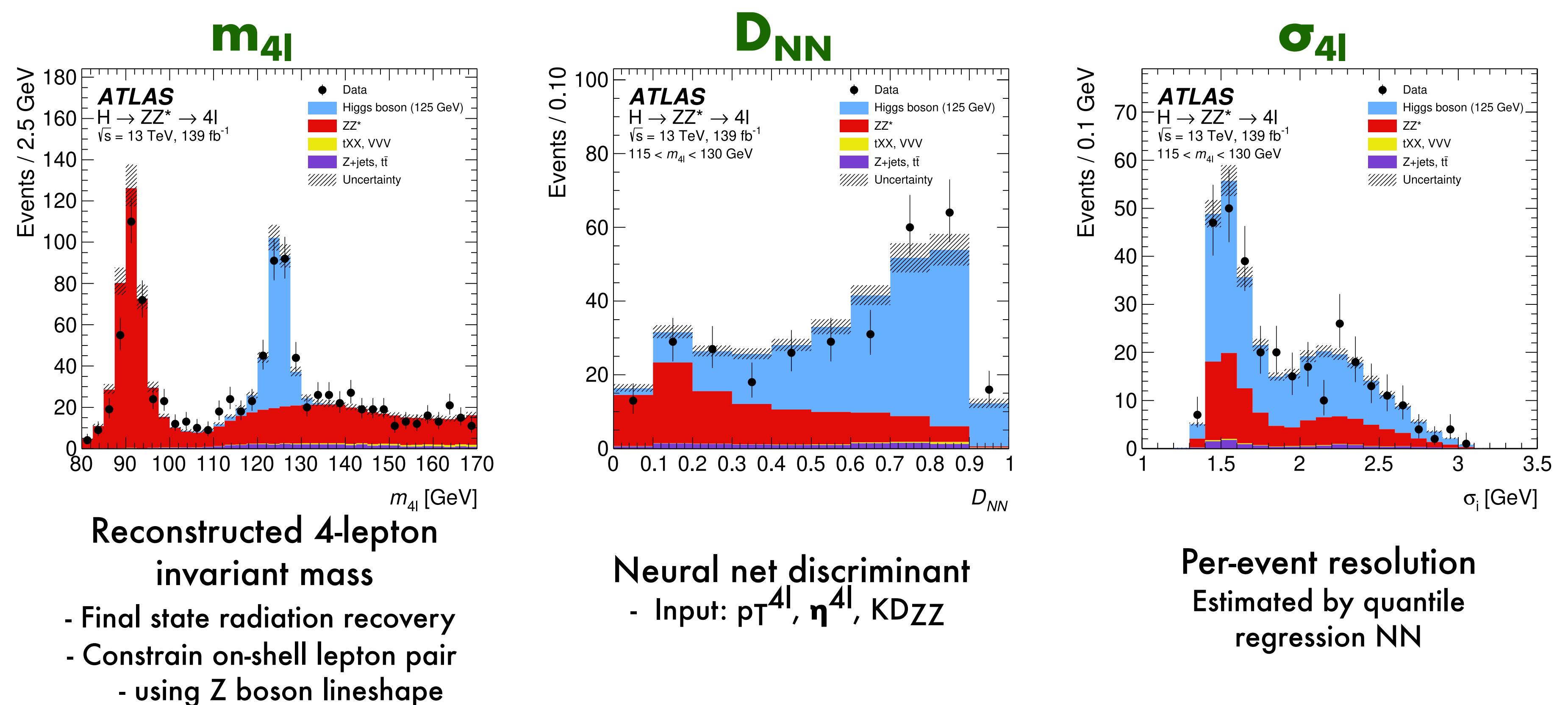


In this final state:

2 pairs of opposite charge, same flavour leptons
 $(p_T > 20, 15, 10, 0 \text{ GeV})$
 $50 < m_Z < 106 \text{ GeV}$
 $12 < m_{Z^*} < 115 \text{ GeV}$ if $m_{4l} < 140 \text{ GeV}$, else
 $50 < m_{Z^*} < 115 \text{ GeV}$
 Jpsi suppression: veto if alternate $m_{ll} < 5 \text{ GeV}$



With these observables:



...with 139 fb^{-1} from the ATLAS detector

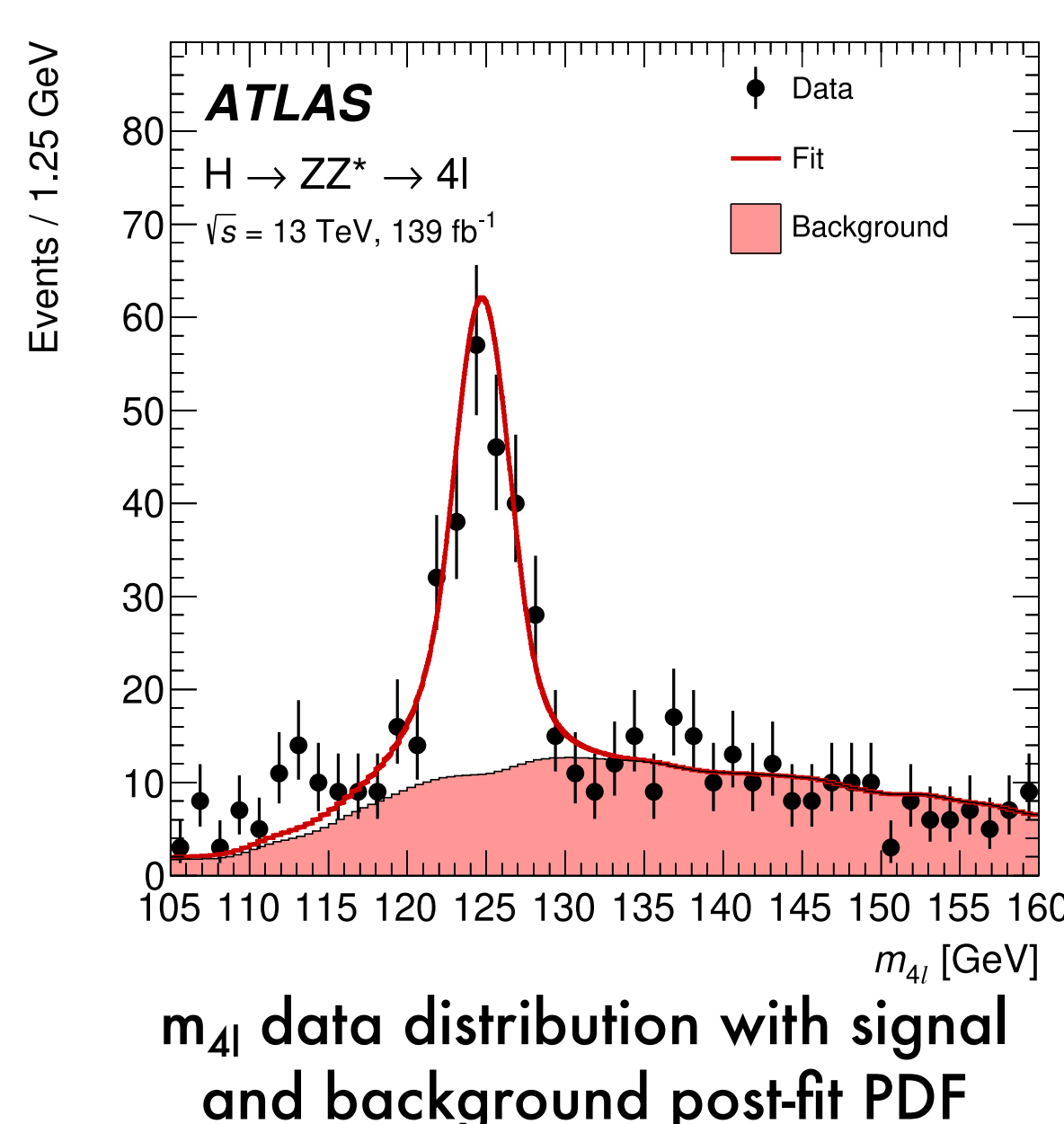
Signal and background modelling

For signal:

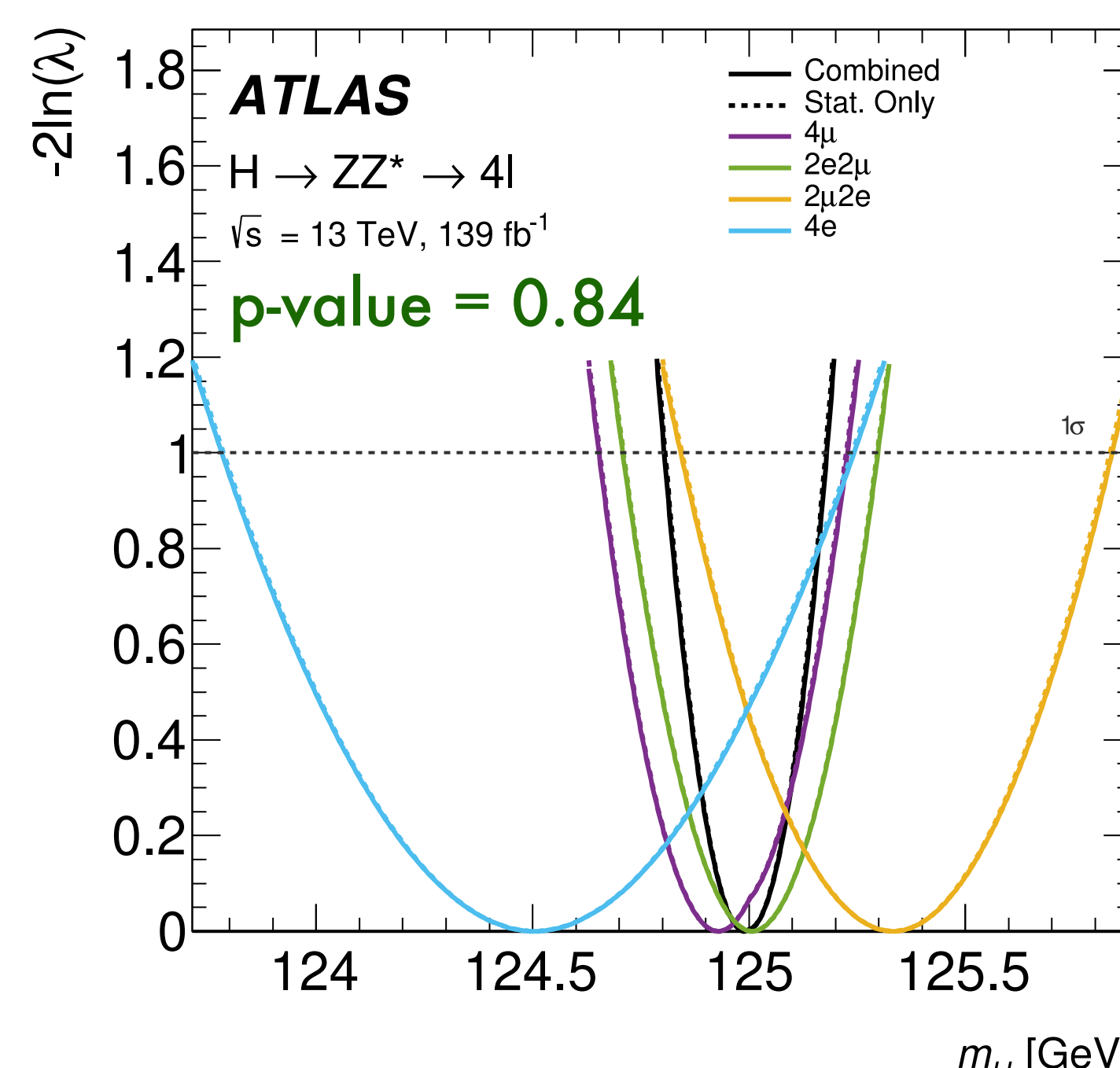
- 3D (m_{4l} , D_{NN} and σ_i) simplified to 2D likelihood
- m_{4l} modelled by double sided crystal ball
- Both m_{4l} and D_{NN} conditional on σ_i
- Remaining m_H dependency parametrised in fit terms

For background:

Construct 2D PDF for m_{4l} and D_{NN}



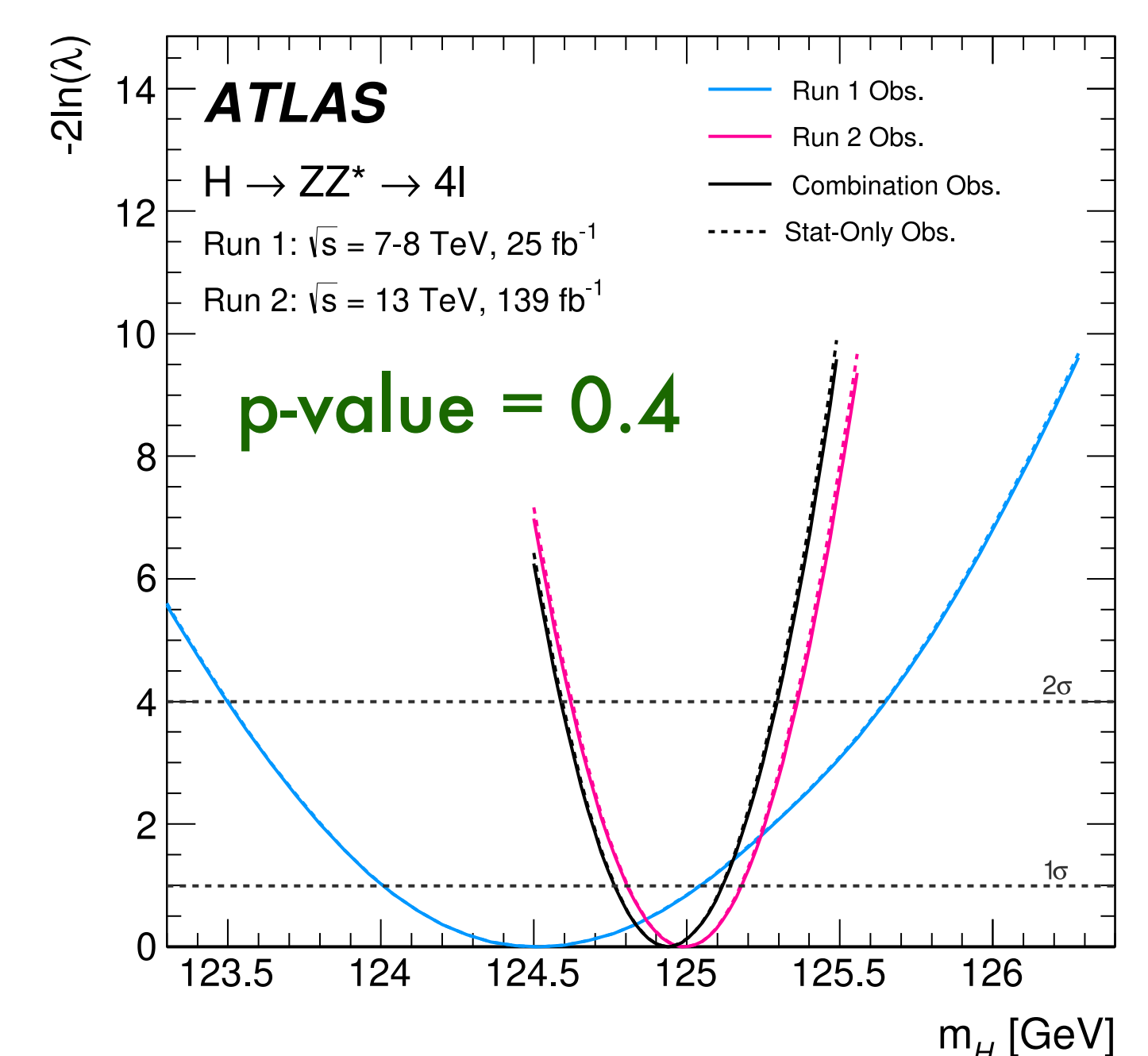
Run 2 result: $m_H = 124.99 \pm 0.18 \text{ (stat)} \pm 0.04 \text{ (sys)} \text{ GeV}$



50% (20%) total (systematic) uncertainty reduction!

Systematic Uncertainty	Contribution [MeV]
Muon momentum scale	± 28
Electron energy scale	± 19
Signal-process theory	± 14

Combining with Run 1



Run 1+2 result: $m_H = 124.94 \pm 0.17 \text{ (stat)} \pm 0.03 \text{ (sys)} \text{ GeV}$

[1] The ATLAS Collaboration, "Measurement of the Higgs boson mass in the $H \rightarrow ZZ^* \rightarrow 4l$ and $H \rightarrow \gamma\gamma$ channels with TeV pp collisions using the ATLAS detector", Physics Letter B, V 784, p 345-366