

Measurements of Gluon Fusion and Vector Boson Fusion Production of the Higgs Boson in $H \rightarrow WW^* \rightarrow e\nu\mu\nu$ Decays with the ATLAS Detector

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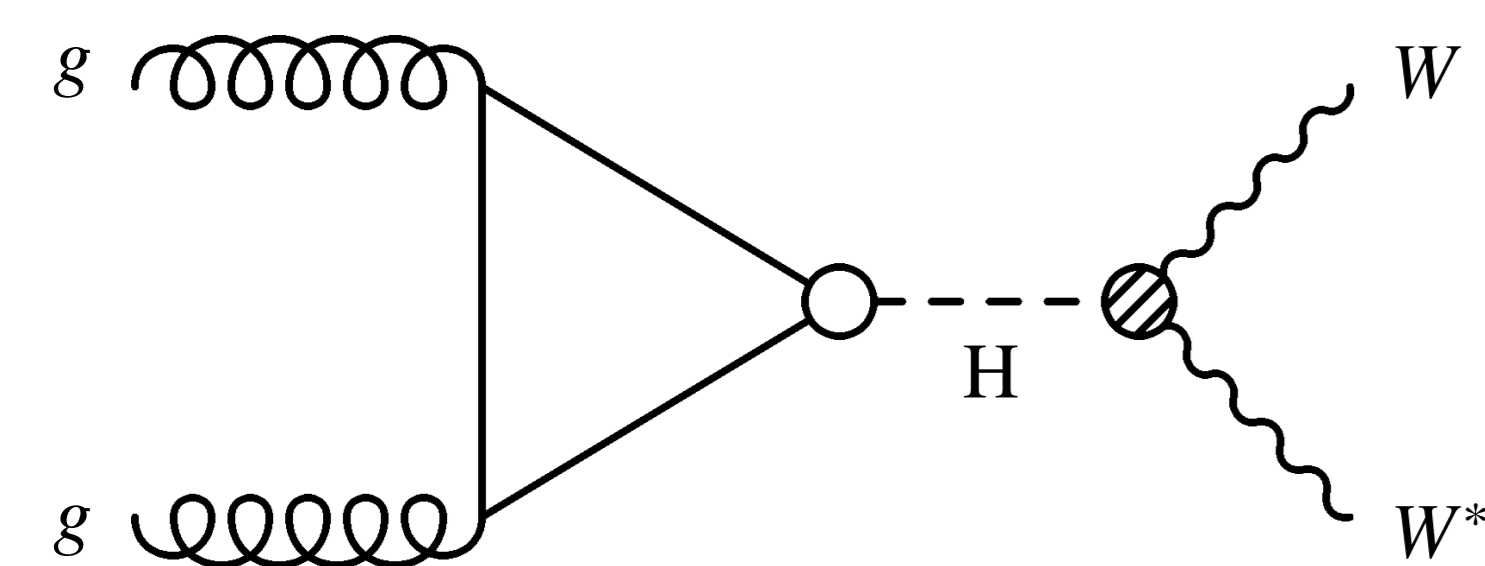
Higgs Physics at the LHC

Measurements of the Higgs boson's couplings to other particles probe for discrepancies with the Standard Model.

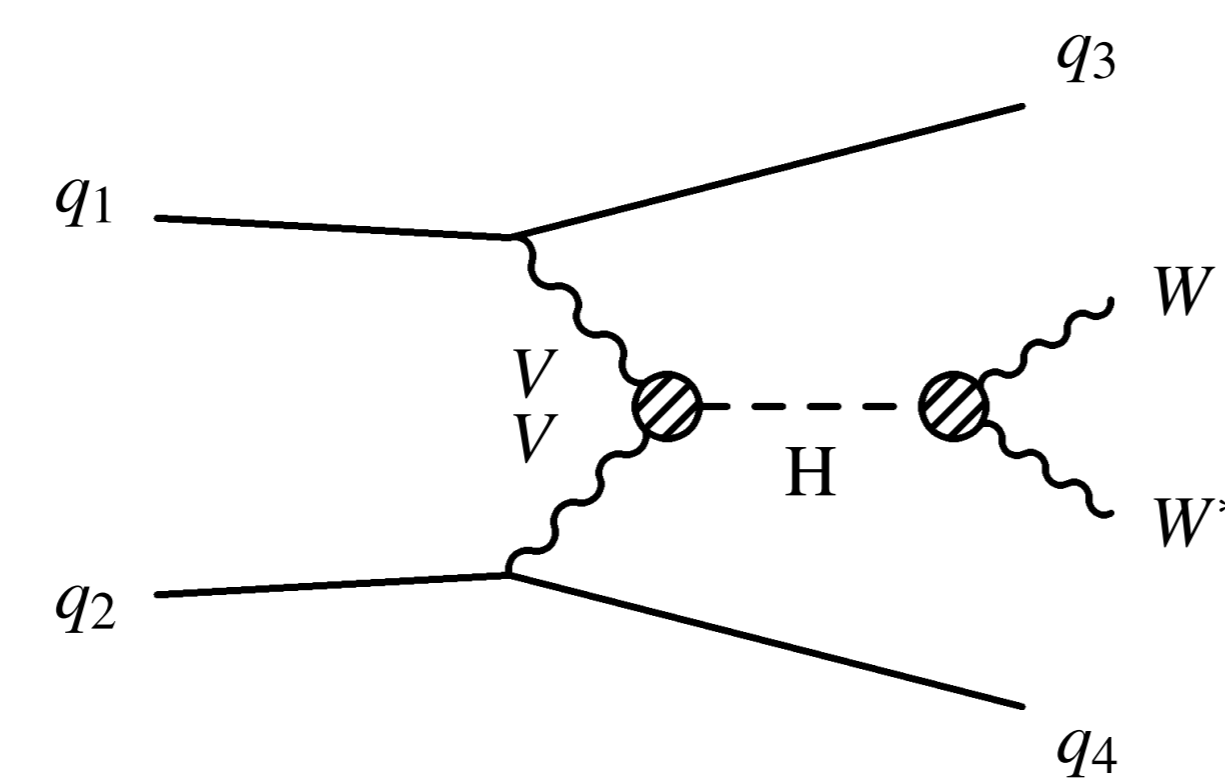
The coupling of the Higgs to W bosons has been studied here with data from proton-proton collisions at the Large Hadron Collider (LHC) collected with the ATLAS detector between 2015 and 2018.

Producing a Higgs

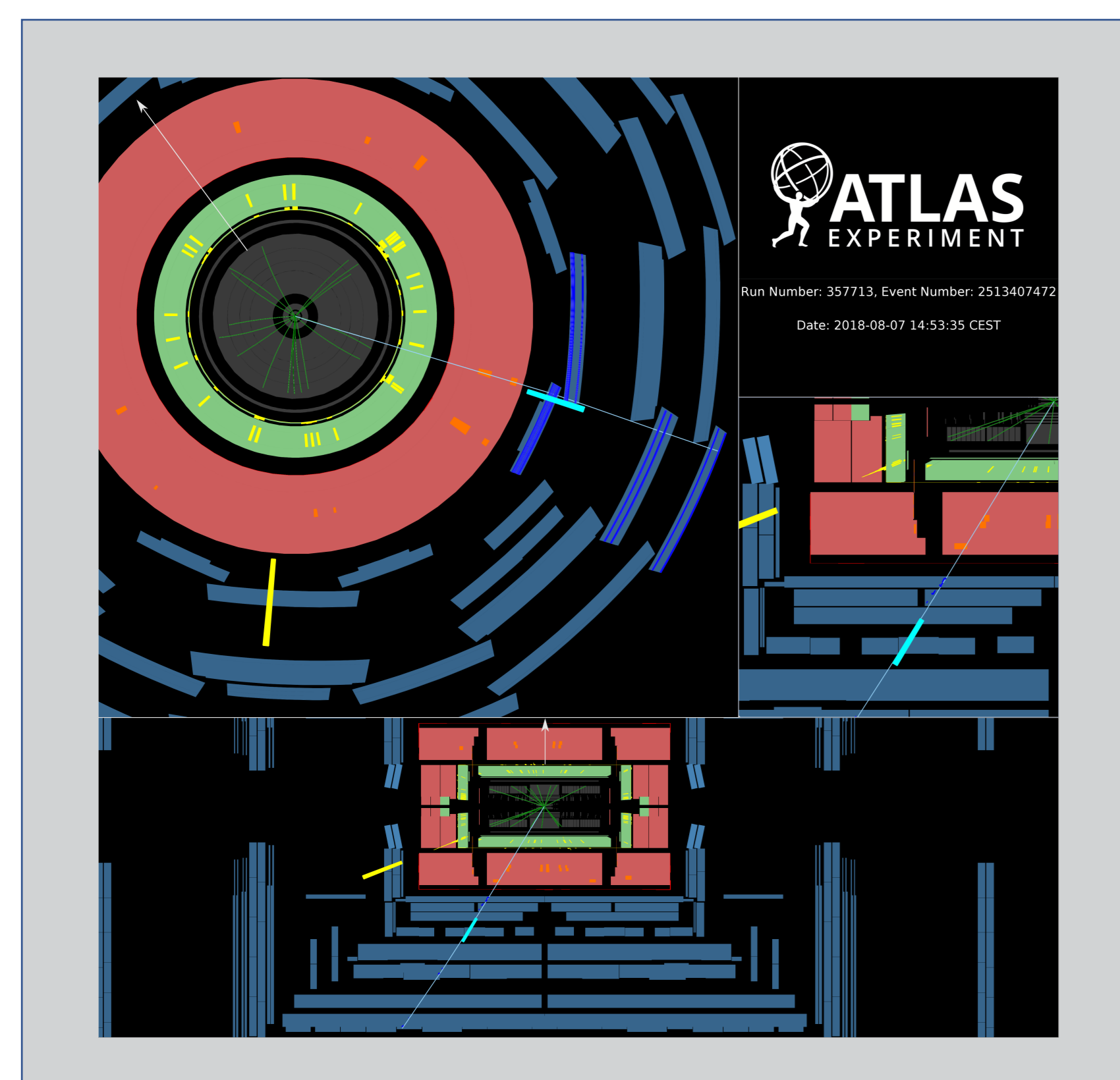
Higgs bosons can be produced in the gluon fusion (ggF) and vector boson fusion (VBF) channels.



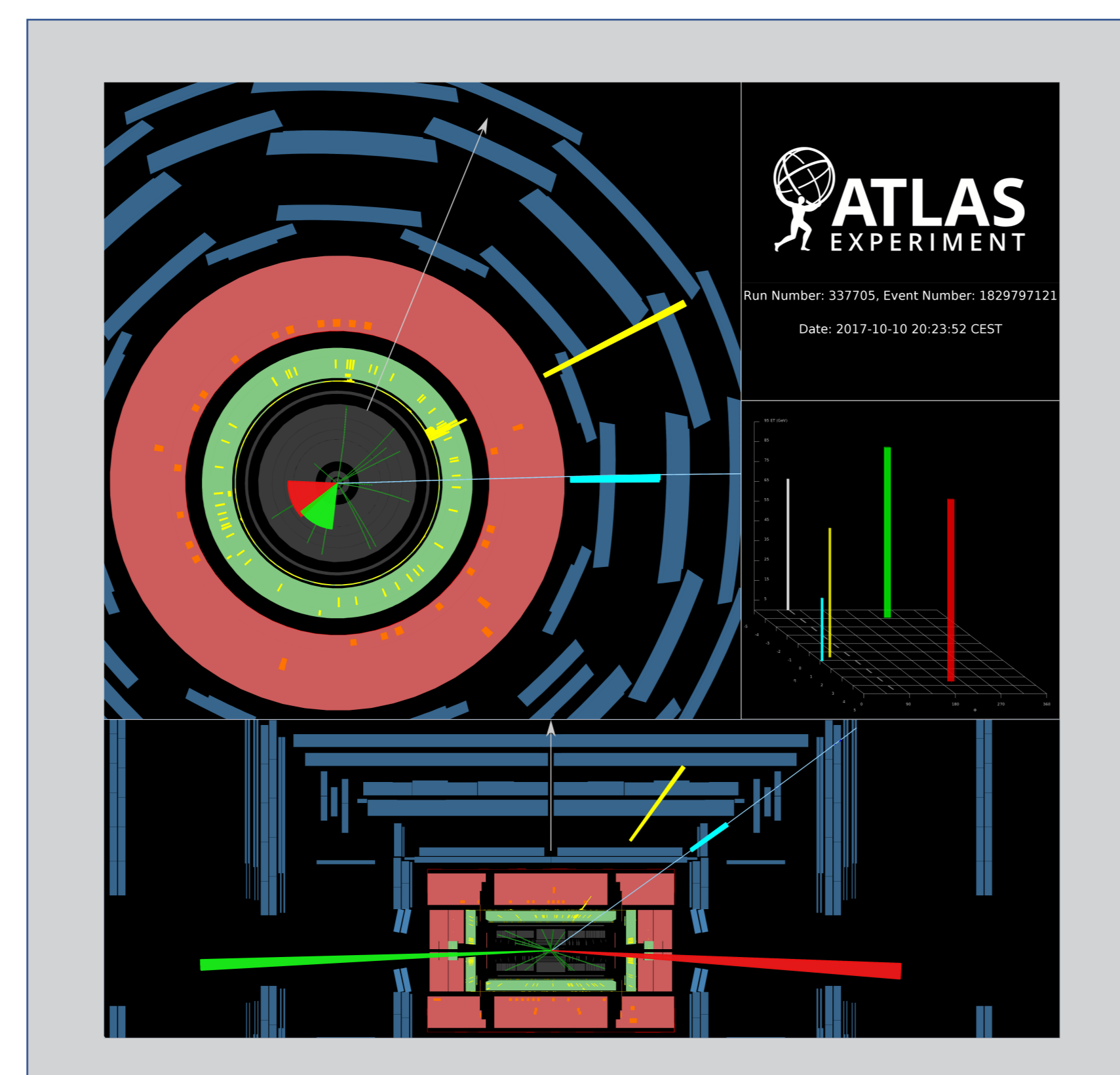
a) ggF production



b) VBF production



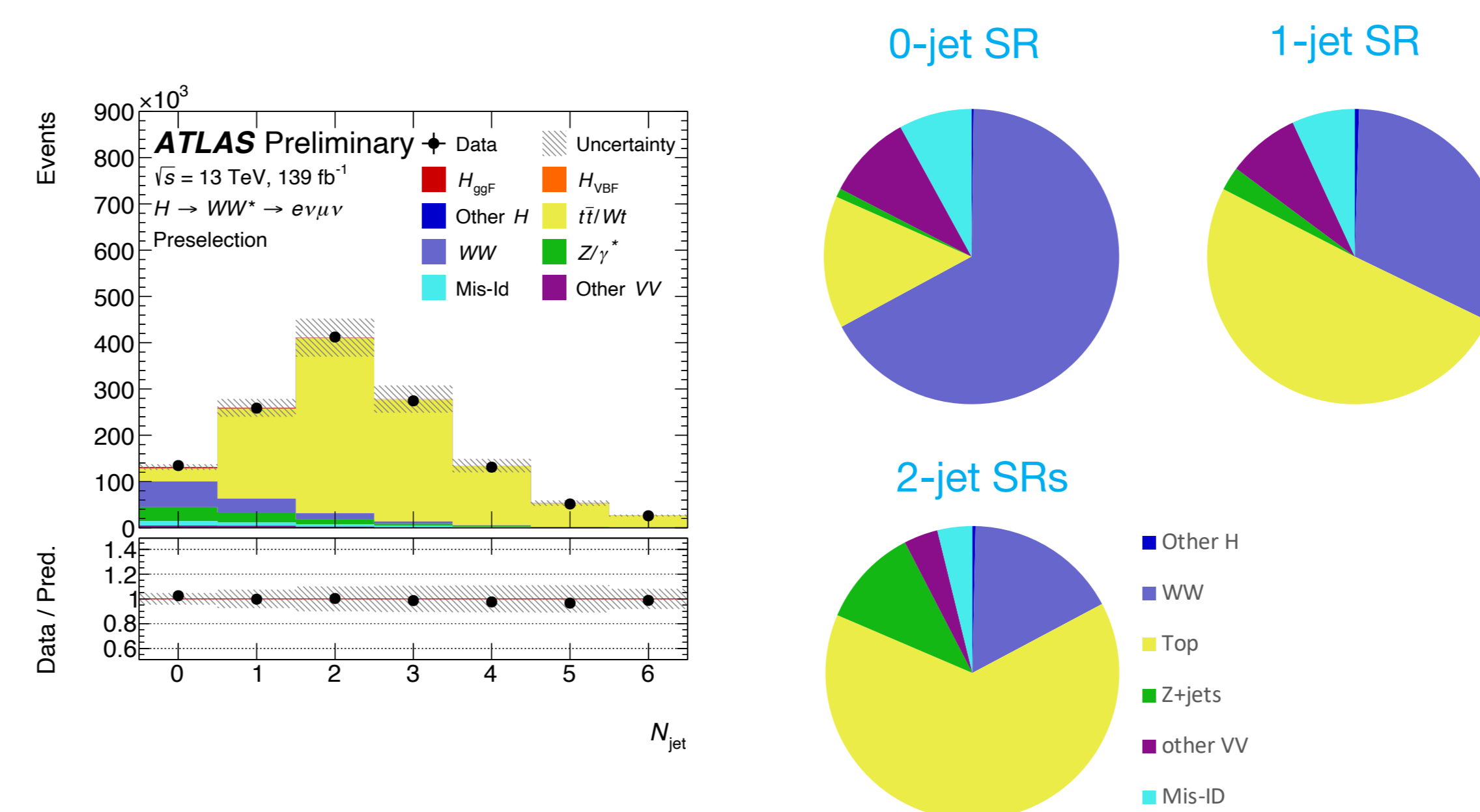
Candidate event display for a Higgs boson produced through the ggF production mode.



Candidate event display for a Higgs boson produced through the VBF production mode.

Targeting Signal, Rejecting Background

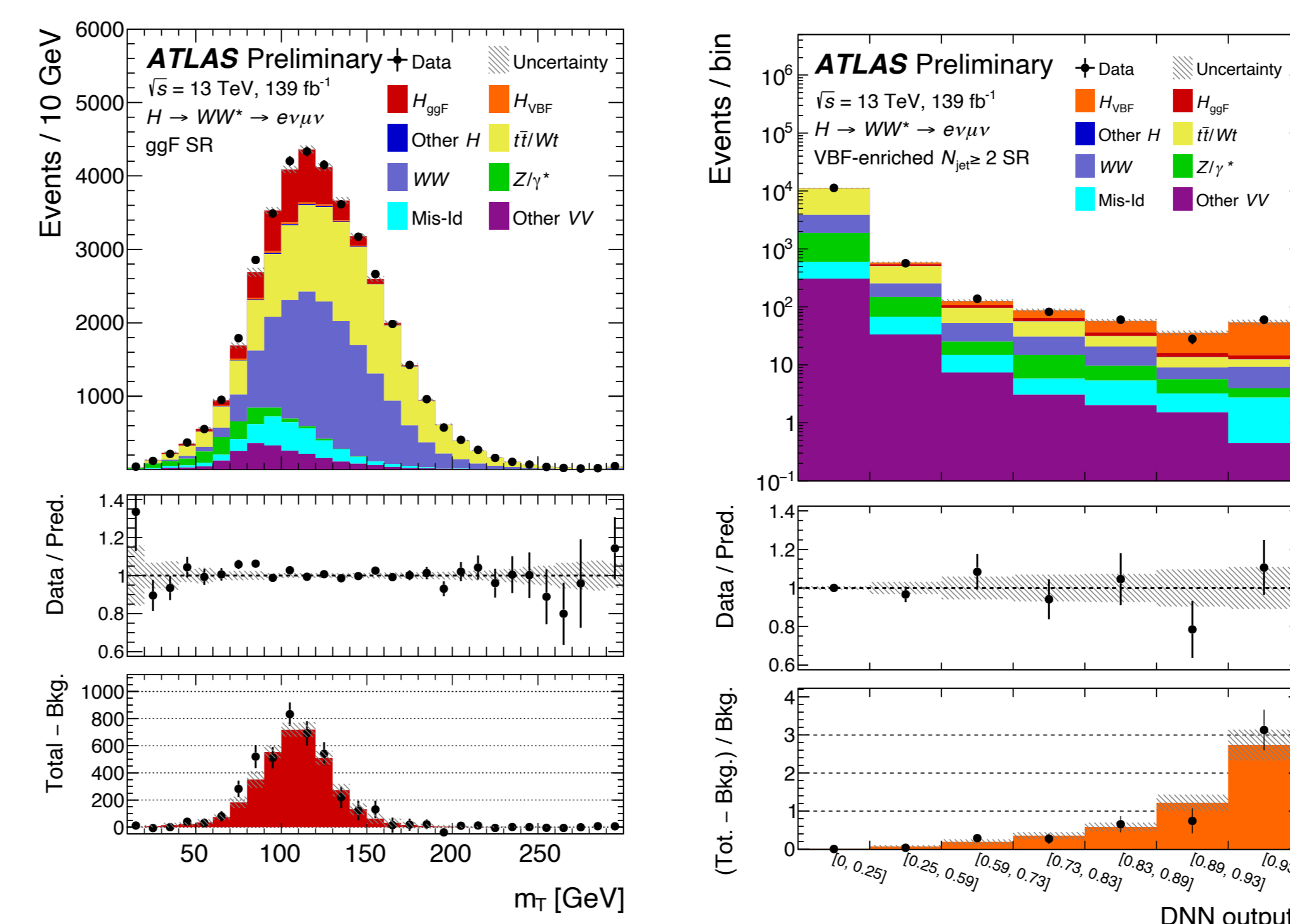
Some common preselection is first applied to target Higgs decay to $WW \rightarrow e\nu\mu\nu$, and then events are separated by number of jets, since the main background contributions vary with jet multiplicity.



Jet multiplicity distributions after applying preselection criteria.

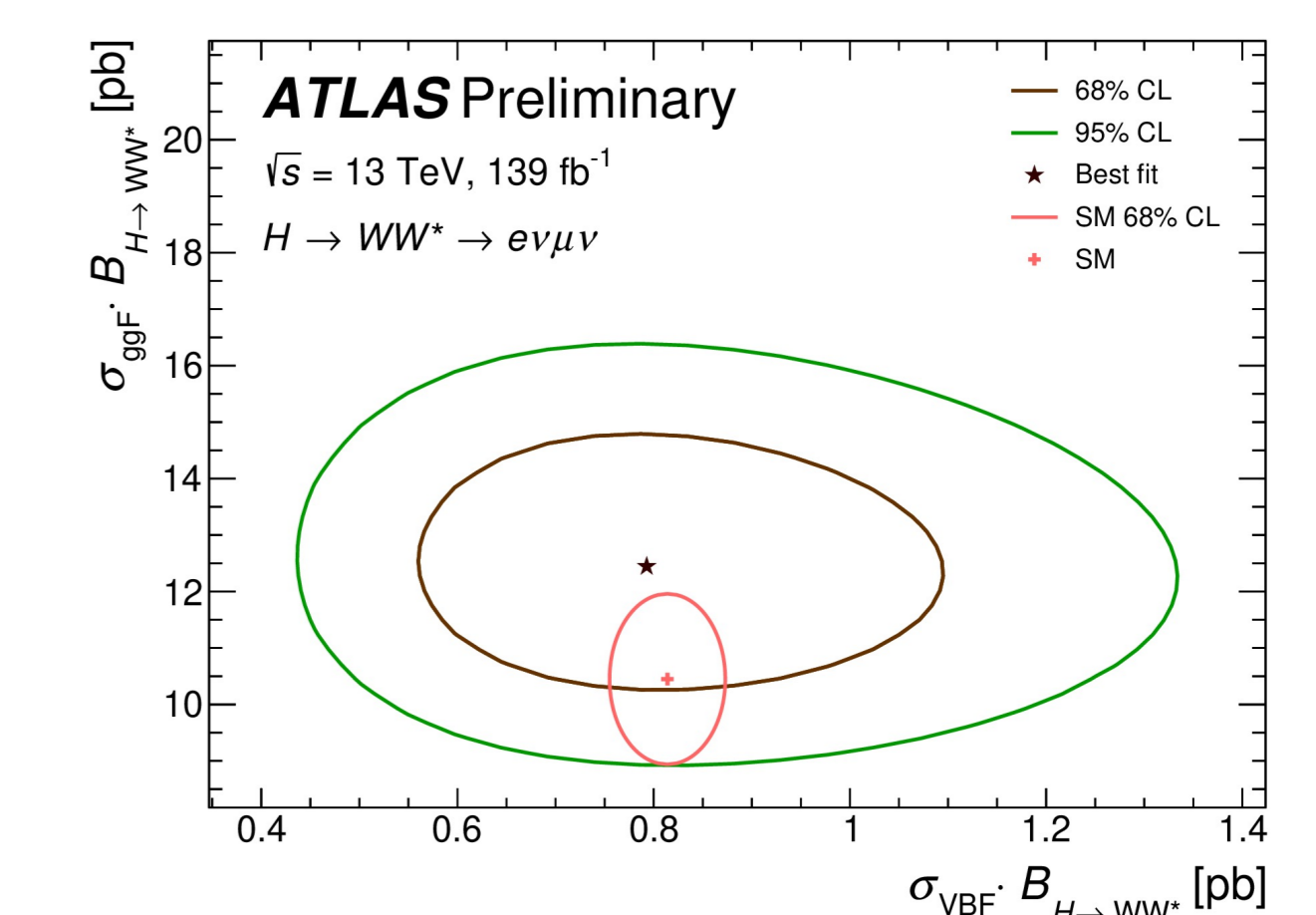
Background composition for signal regions (SR) split by jet multiplicity.

Further cuts that target typical Higgs production and decay characteristics are applied. For VBF Higgs production, a deep neural network is also used to separate signal from background, to produce signal regions enriched in ggF and VBF $H \rightarrow WW \rightarrow e\nu\mu\nu$ events.

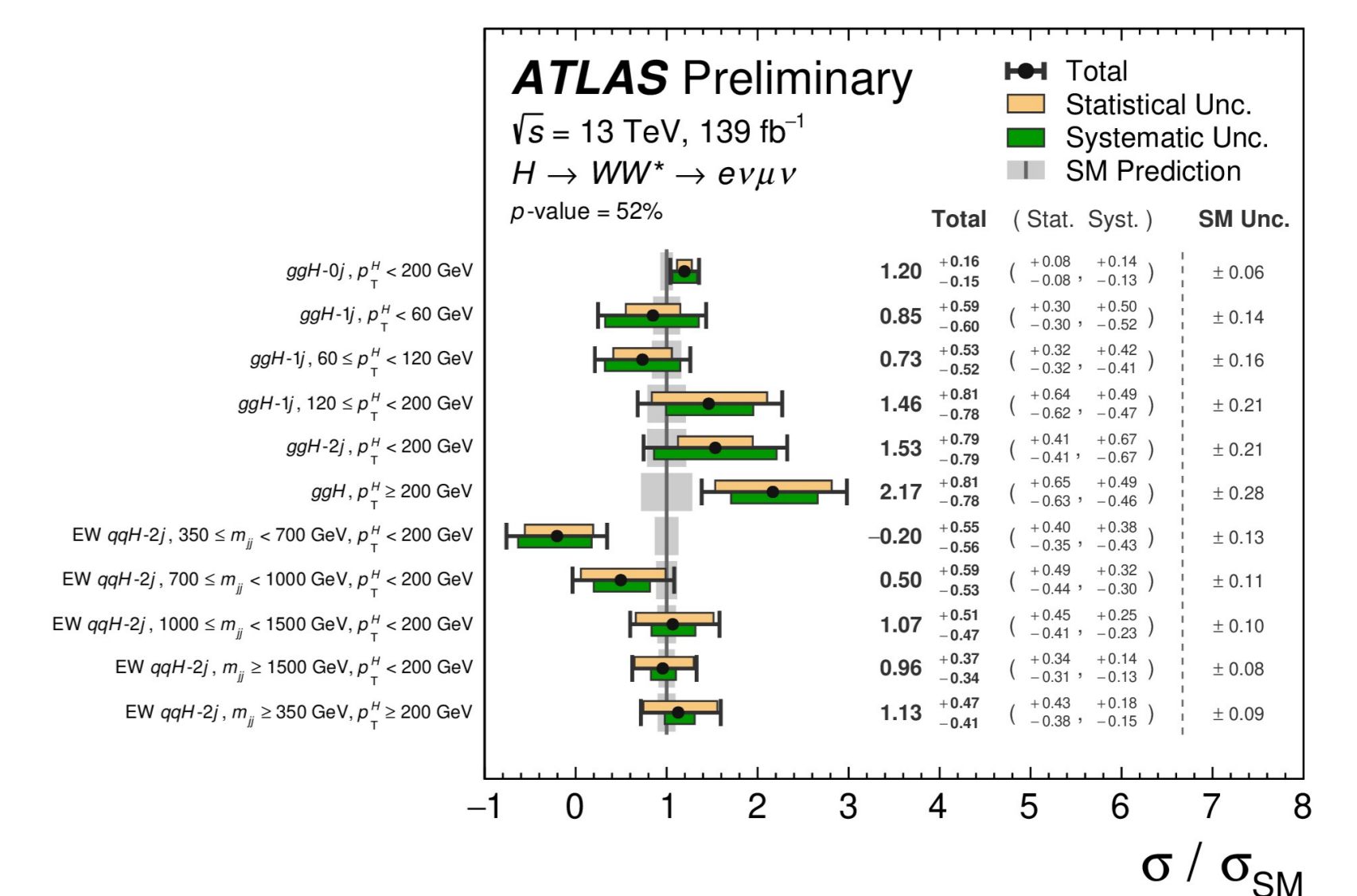


Cross-Sections

This data allows the combined ggF and VBF Higgs cross-sections to be measured, both inclusively and in kinematic bins. All measurements are compatible with the SM.



2D likelihood contours of $\sigma_{VBF} \cdot B_{H \rightarrow WW}$ and $\sigma_{ggF} \cdot B_{H \rightarrow WW}$, compared to the SM prediction.



Best-fit values and uncertainties for cross-sections measured in kinematic categories.

Conclusions

This is the first observation of $H \rightarrow WW$ decay in the VBF channel, and provides precise measurements of Higgs cross-sections and couplings that will allow theories of physics beyond the Standard Model to be further constrained.