



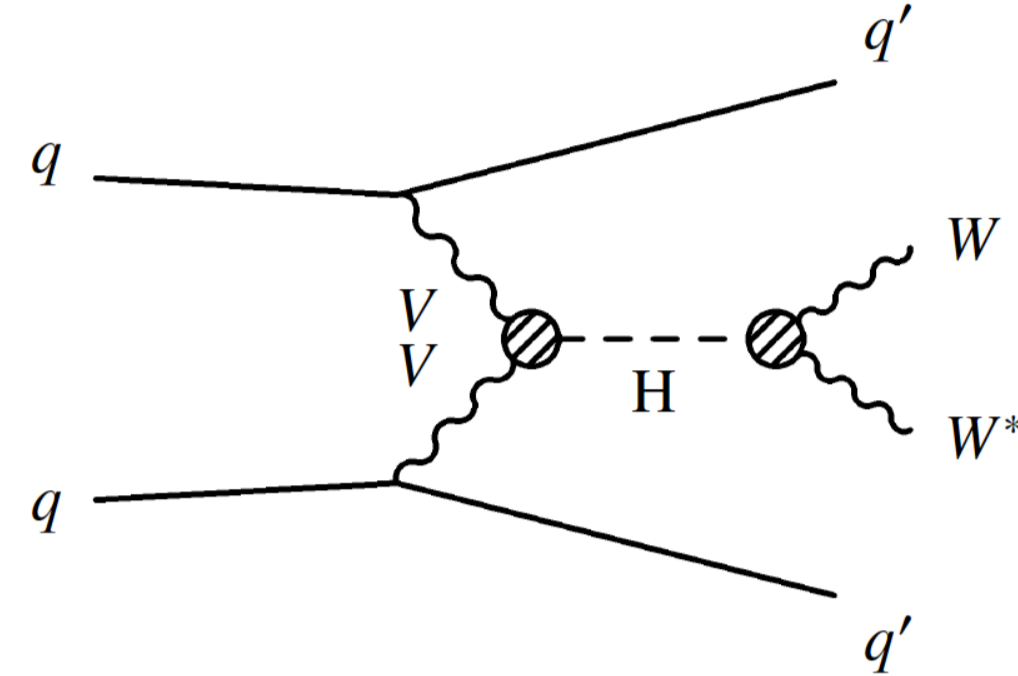
Fiducial cross-section measurements of the Higgs boson production in the $H \rightarrow WW^* \rightarrow e\nu\mu\nu$ decay channel with the ATLAS detector

156th LHCC Meeting | CERN – 27 November, 2023

Overview

- In the Standard Model, H - V couplings are predicted at tree level post Electroweak Symmetry Breaking (EWSB)

- Probing processes with H - V couplings tests the **structure of EWSB**
- Vector Boson Fusion** production of the Higgs boson in the WW^* decay channel is doubly sensitive to this coupling
- Measurements are reported in the **fiducial phase space** to remove acceptance effects and model dependence for robust **interpretations**
- Differential** cross-sections probe different corners of the phase space to look for new physics

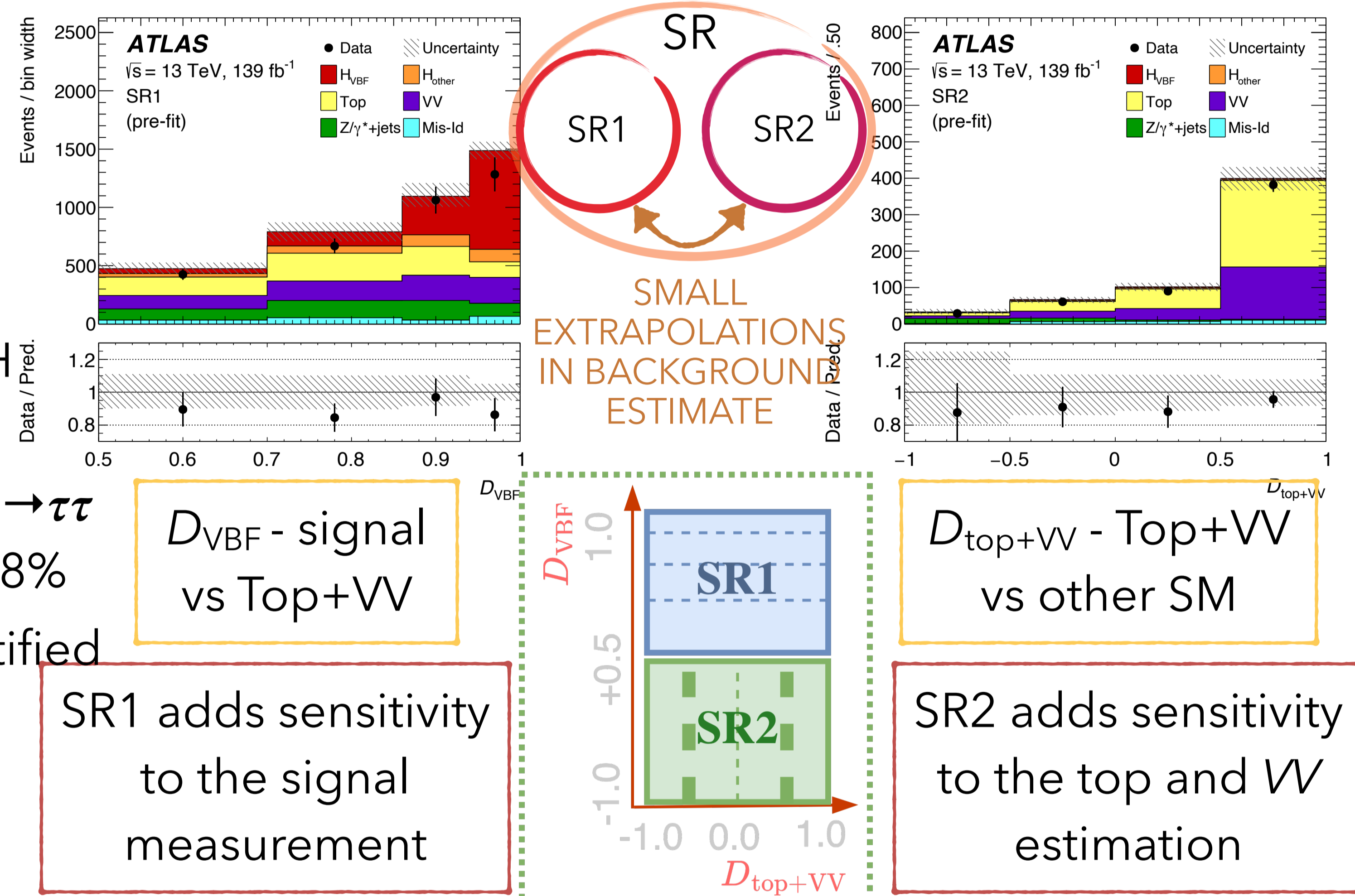
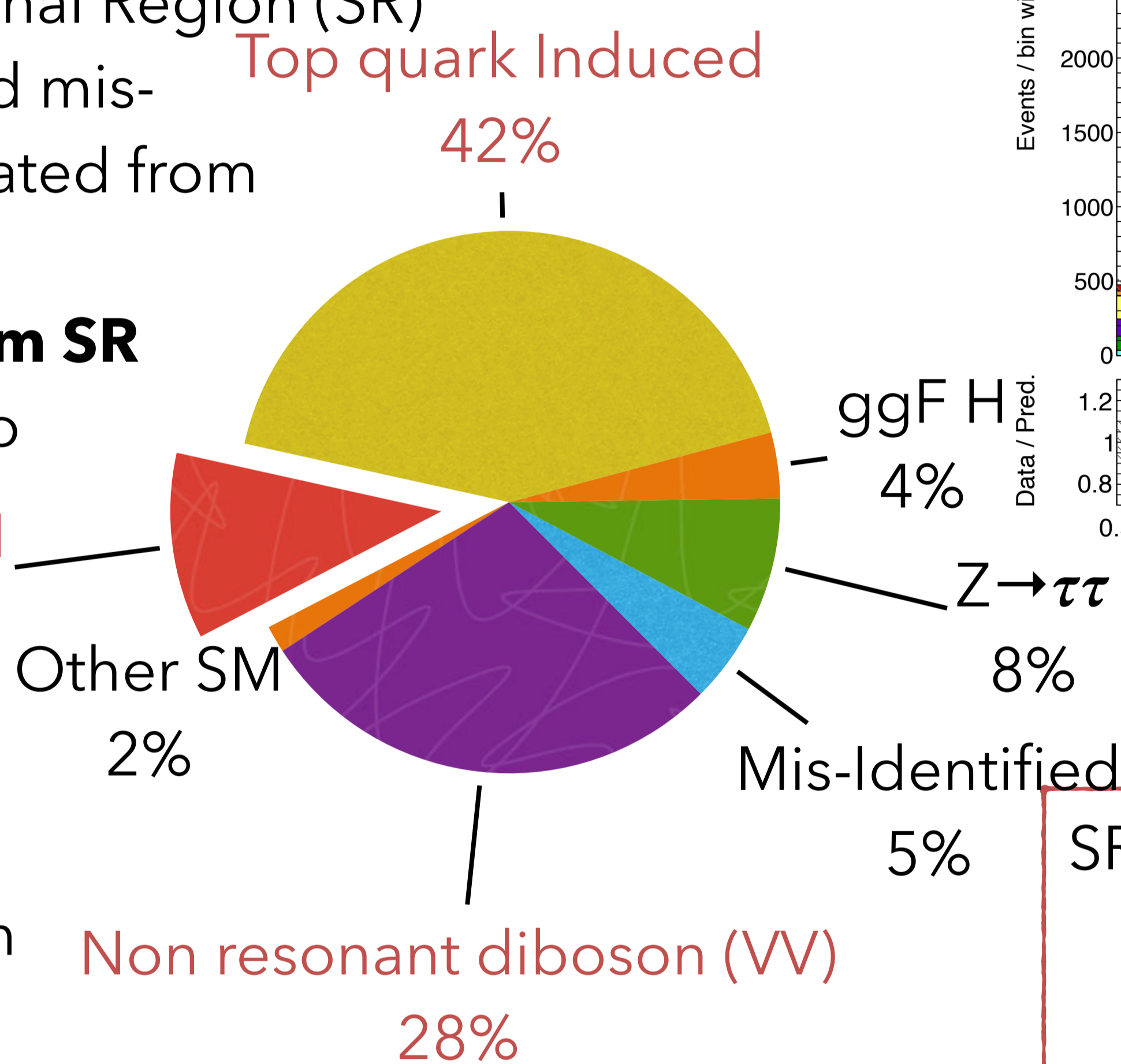


Event Selection

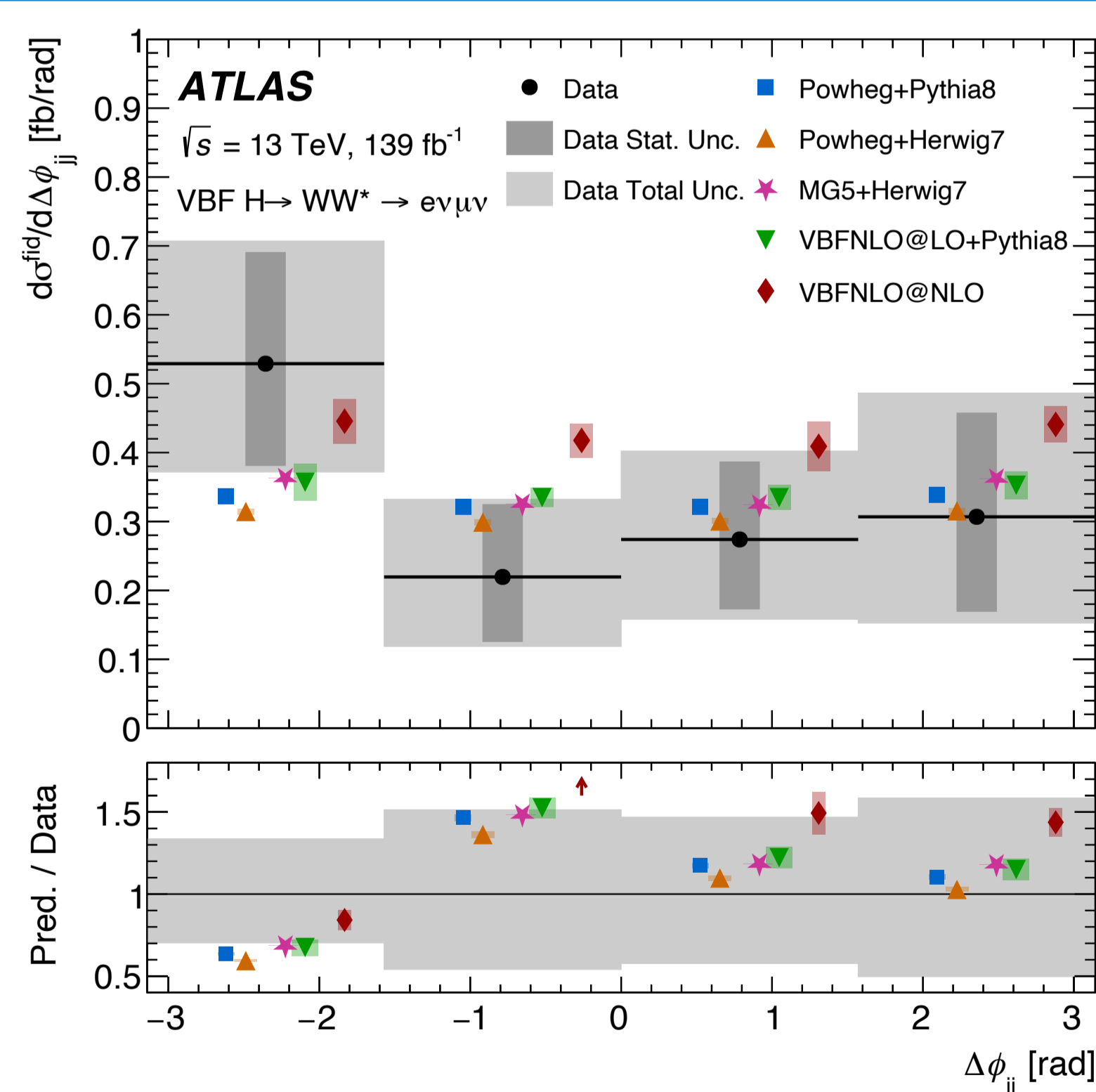
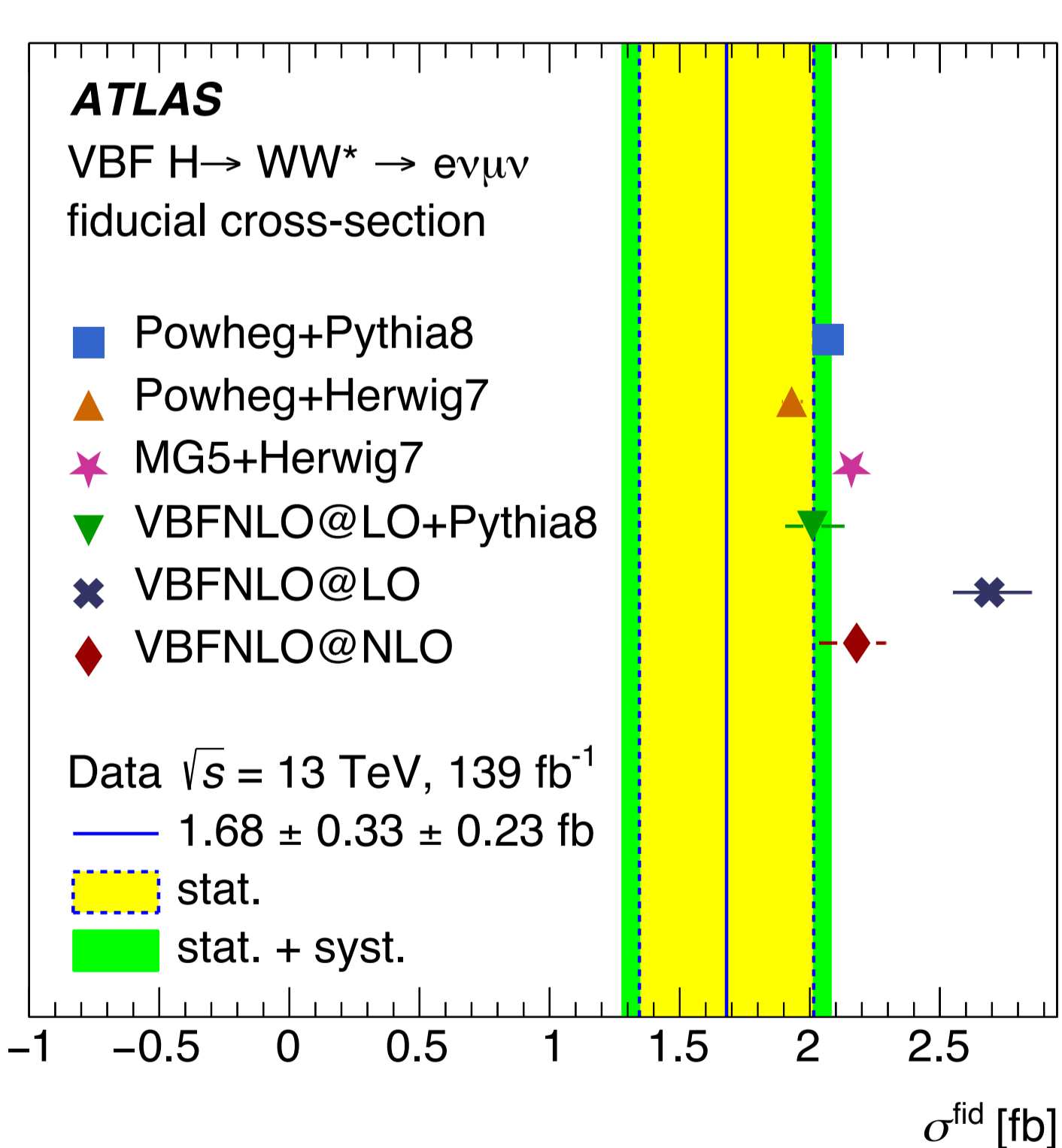
- $e^+\mu^-$ or $e^-\mu^+$ final state
 - p_T lead (sub) > 22 (15) GeV
 - $m_{e\mu} > 10$ GeV
 - $m_{\tau\tau^*} < m_Z - 25$ GeV
 - $|\Delta\phi_{e\mu}| < 1.4$ rad
 - No leptons outside rapidity space b/w jets
 - Leading jet
 - Sub-leading jet
 - soft hadronic activity
 - Muon
 - Electron
 - ≥ 2 jets
 - b-jet veto
 - $m_{jj} > 450$ GeV
 - $|\Delta y_{jj}| > 2.1$
 - No third jet (> 20 GeV) between two leading jets
- *based on the $e\mu$ pair with a collinear approximation

Signal Extraction and Background Estimation Strategy

- 11% signal purity** in the Signal Region (SR)
- gluon fusion H , Drell-Yan, and mis-identified lepton bkg estimated from dedicated Control Regions
- Biggest **bkgs estimated from SR**
- Analysis strategy designed to **minimize systematic error** at the cost of small increase in stat error
- Simultaneous fit with **in-likelihood unfolding** to extract signal cross-section in the fiducial phase space



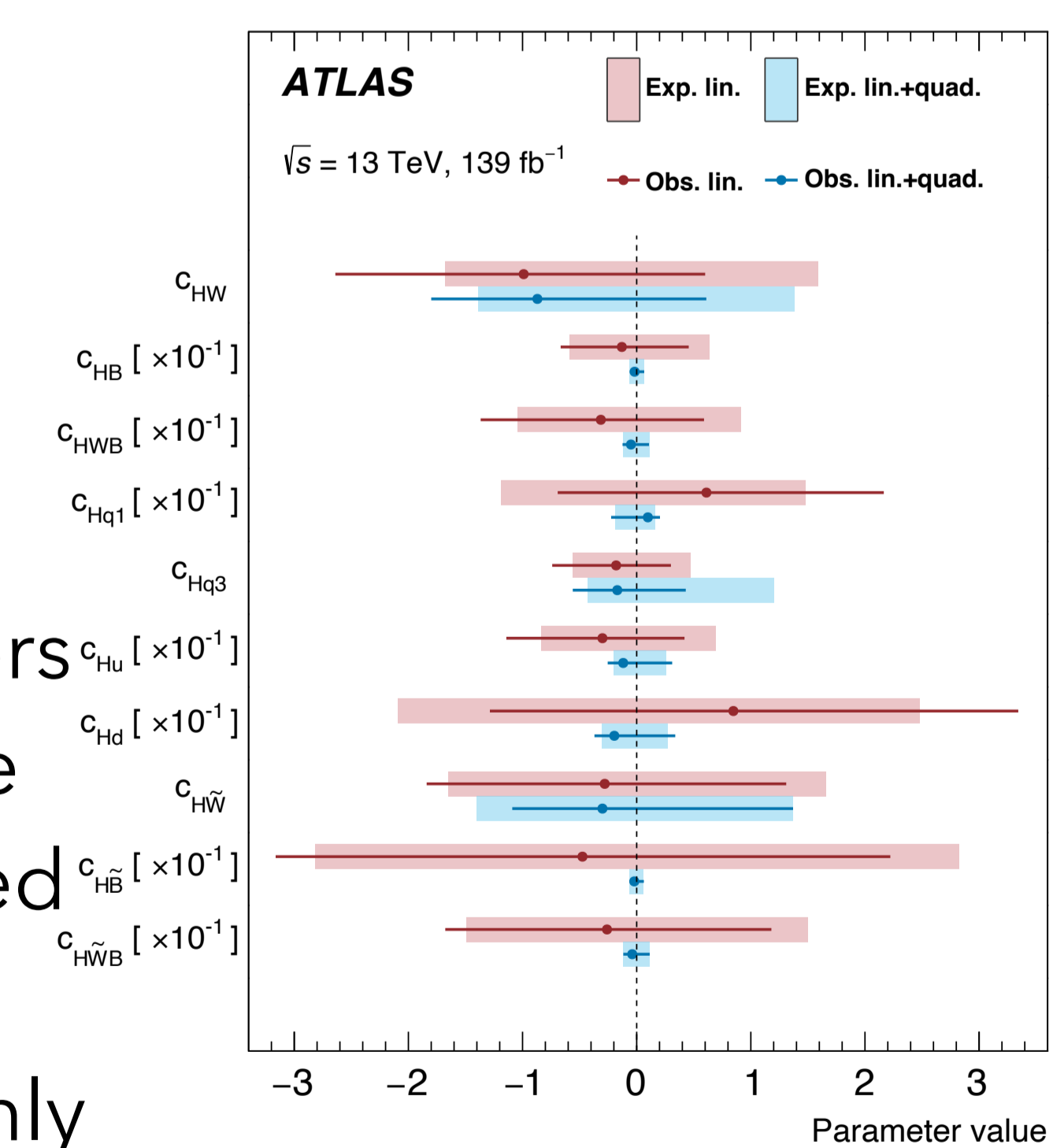
Cross section measurements



- First fully fiducial measurement isolating the VBF produced H
- Measurement compatible with the SM prediction
- 13 differential cross-sections** measured - lepton and jet like
- Measurements **limited by statistical uncertainty** (13%)
- Signal (5%) and background **modeling** (8%) **subleading**
- Correlations** (statistical and **systematic** (new!)) obtained between pairwise differential cross-sections via **bootstrapping**

Effective Field Theory Interpretation

- Differential XS used to put constraints on **anomalous couplings of the Higgs boson** in the EFT formalism
- Consider both **CP-even** and **CP-odd** mass dim-6 operators
- Some Wilson coefficients are significantly more constrained with a linear+quadratic parameterization vs linear only
- Shows potential sensitivity to the linear term of dim-8 EFT operators not considered in this parameterization



ATLAS Collaboration. **Integrated and differential fiducial cross-section measurements for the vector-boson-fusion production of the Higgs boson in the $H \rightarrow WW^* \rightarrow e\nu\mu\nu$ decay channel at 13 TeV with the ATLAS detector**, Phys. Rev. D **108**, 072003, arXiv:2304.03053 [hep-ex].