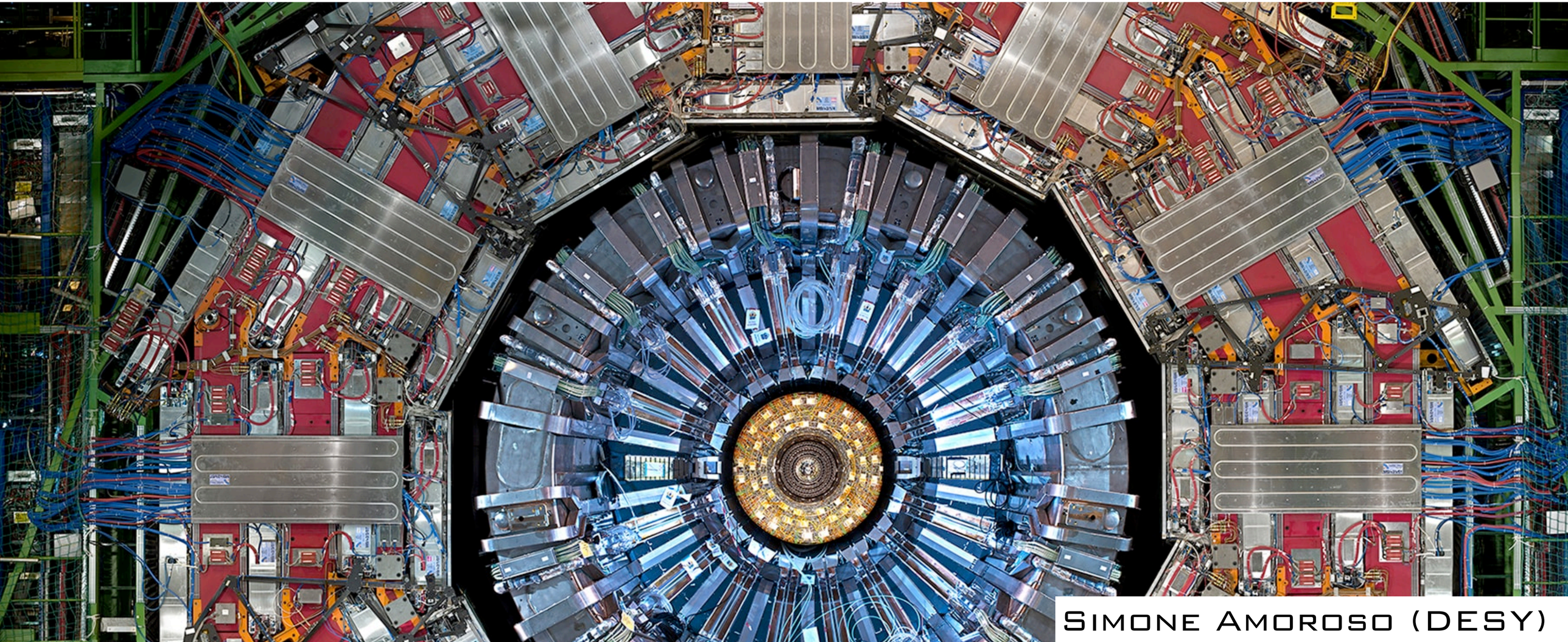
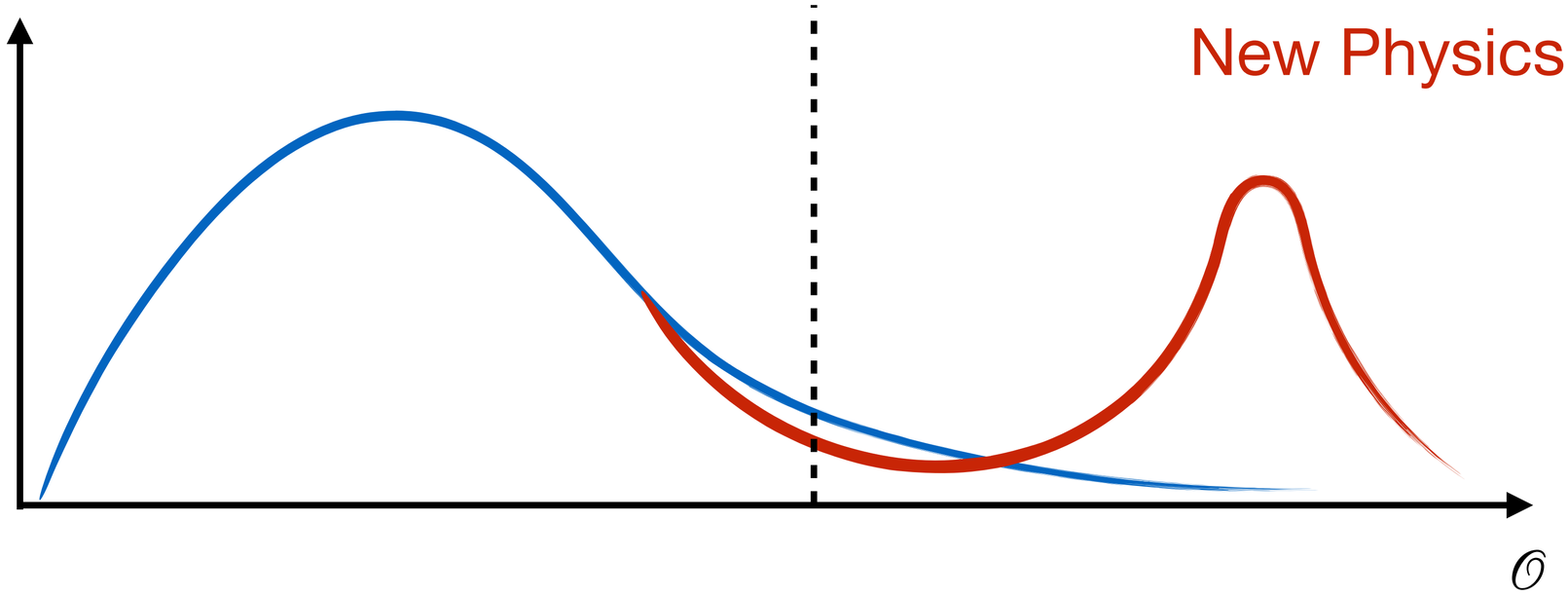
# From the precision frontier to physics beyond the Standard Model

MU DAYS 2022 Oct. 21st, 2022



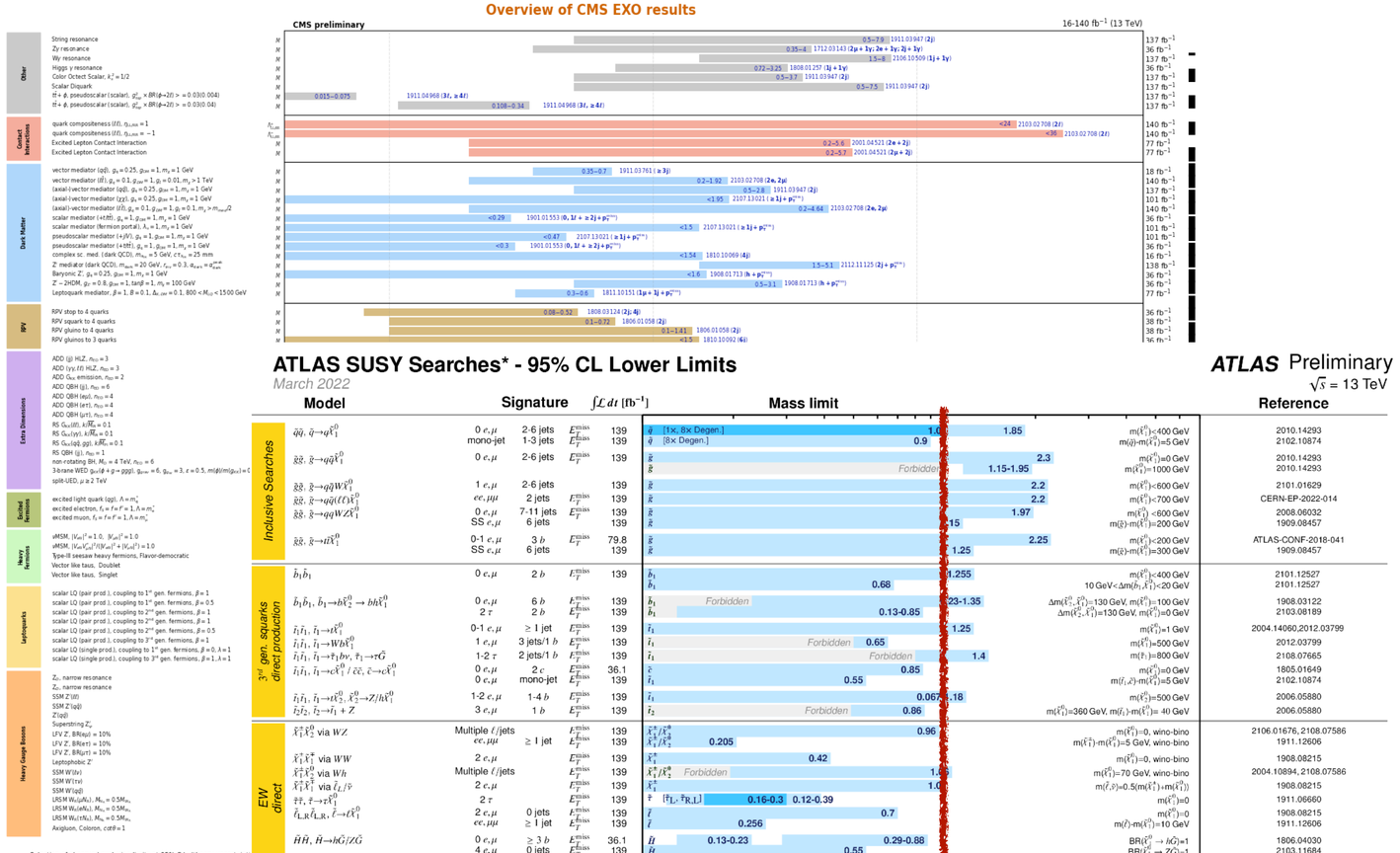
Simone Amoroso (DESY)

# PHYSICS AT THE LARGE HADRON COLLIDER




Standard Model (SM)

# A DEDICATED SEARCH PROGRAM

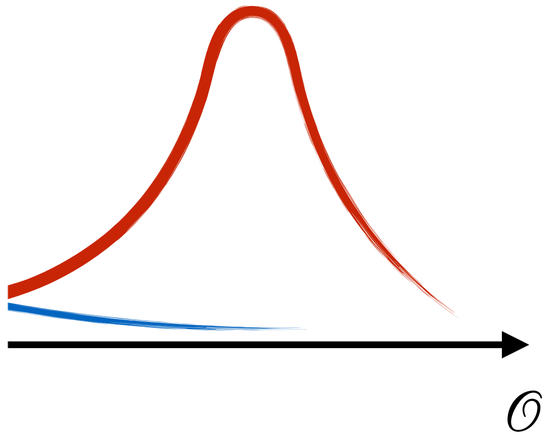






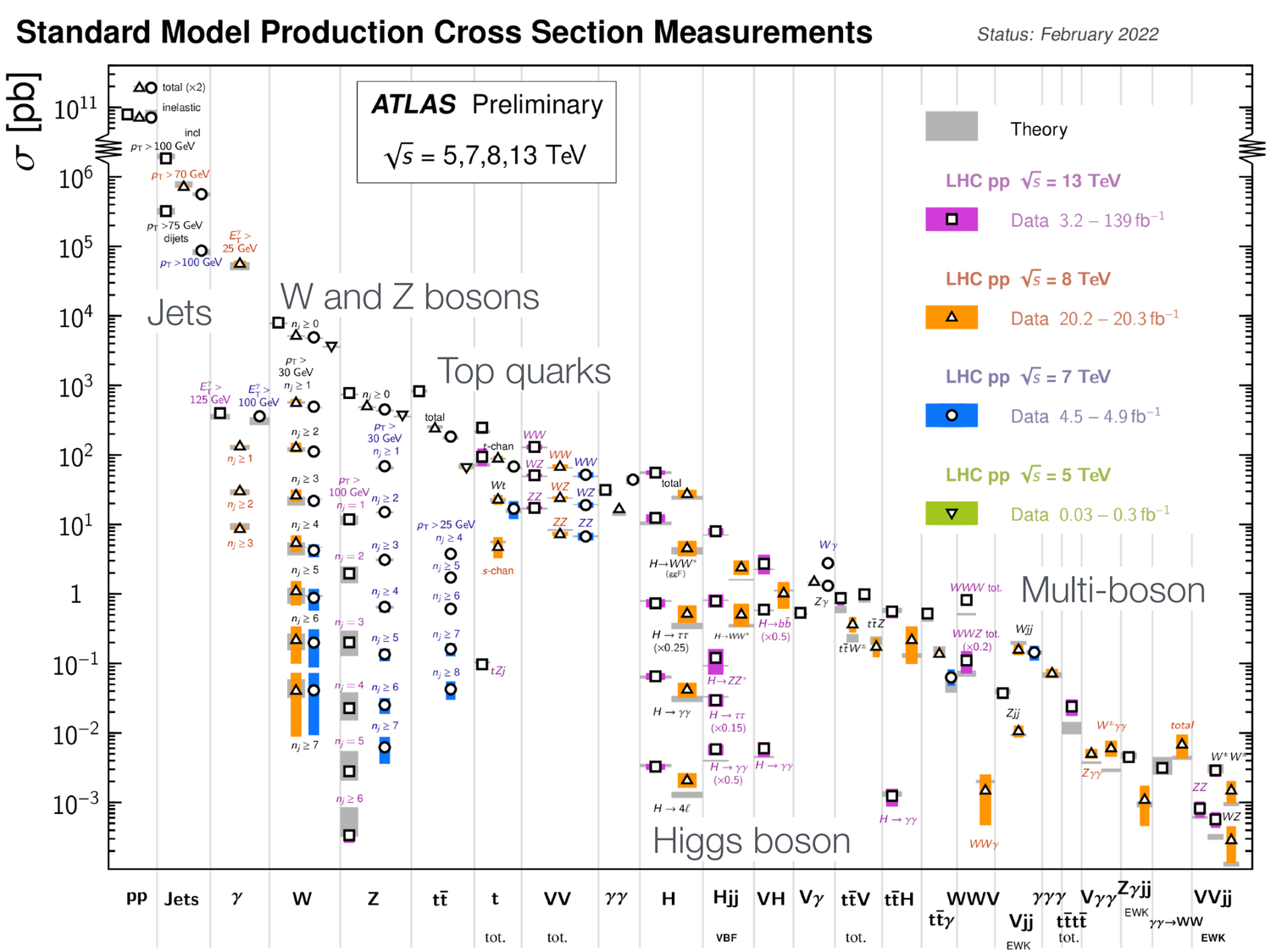
*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

## New Physics

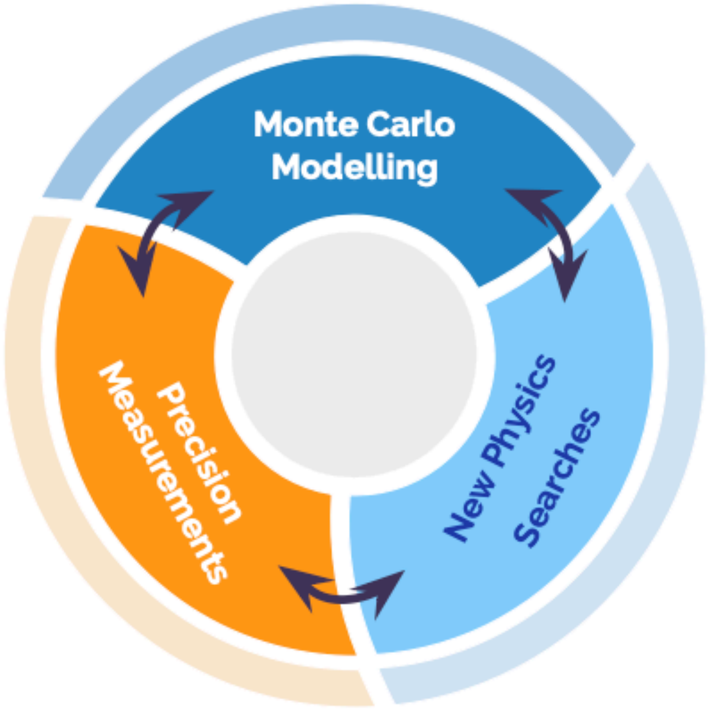


- Extensive (~1000 results)
- Signature/model driven
- Fast ➜ detector level

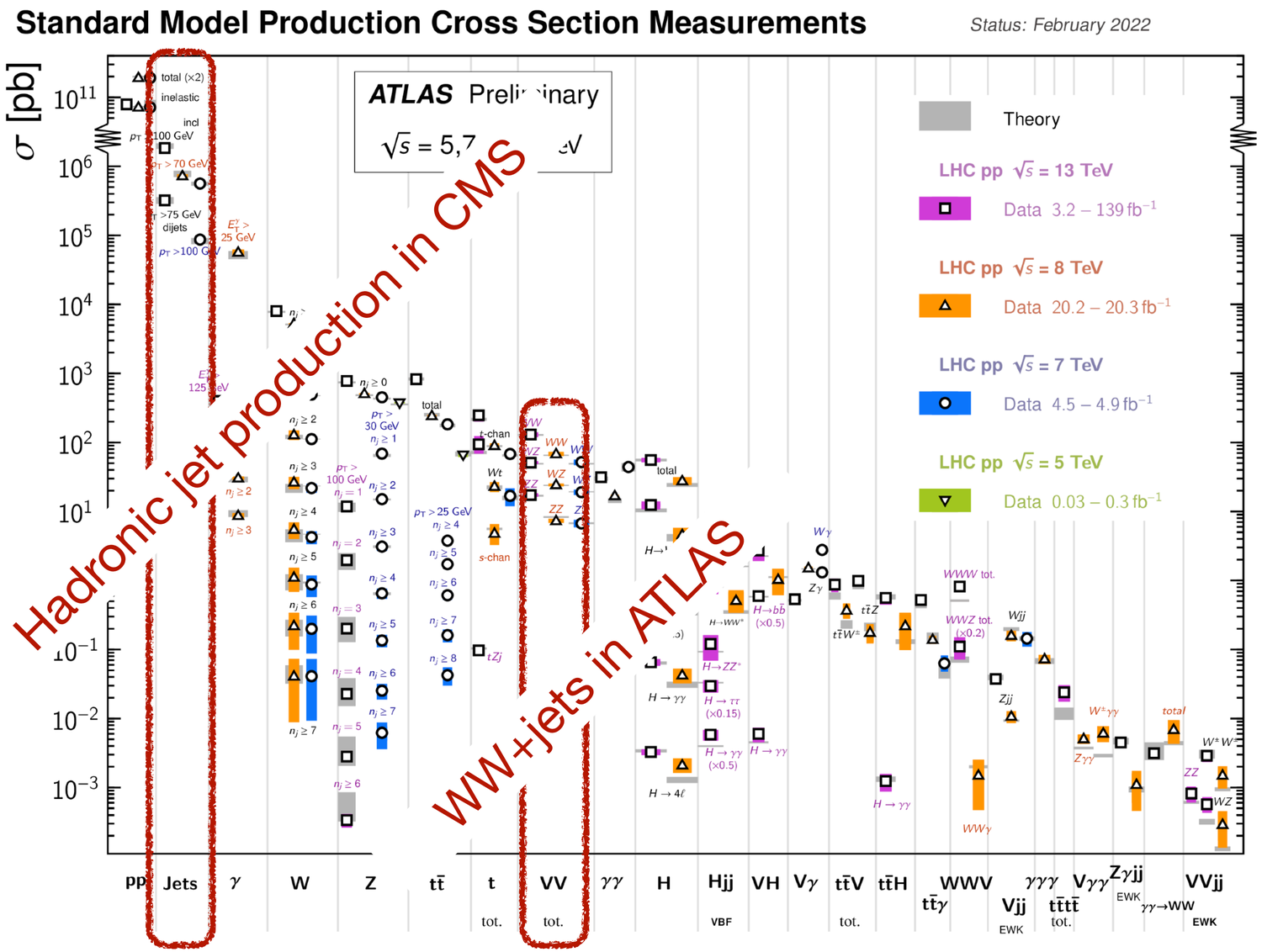
# How do Standard Model measurements differ ?




- SM process driven
- Detector-corrected
- Focus on precision/longevity



# How do Standard Model measurements differ ?

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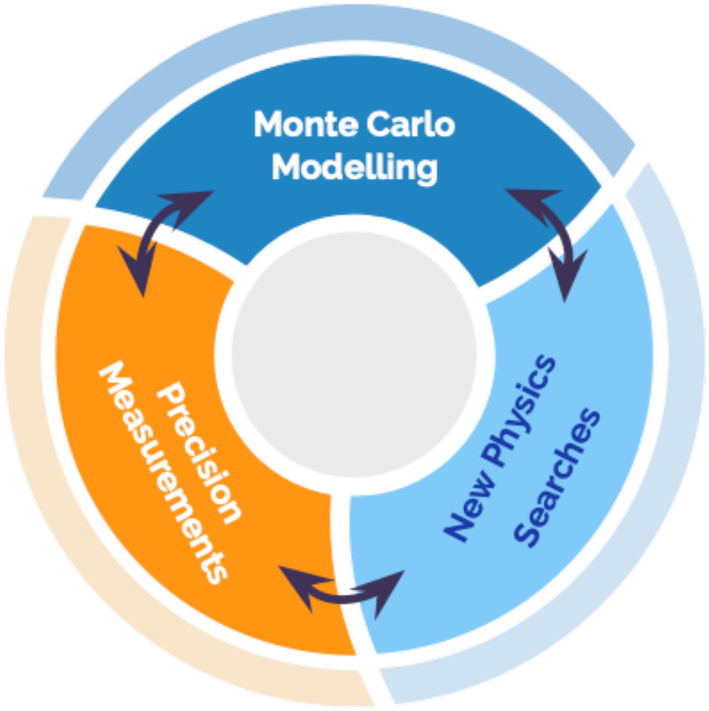
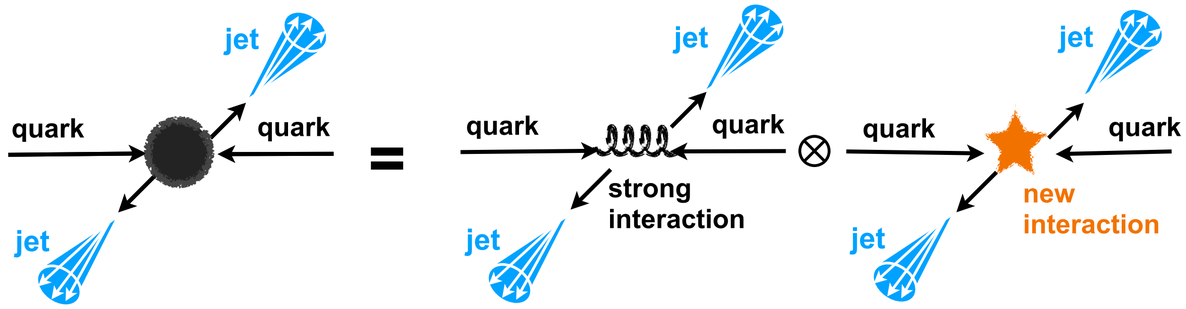


# Hadronic jets as probe of the strong force

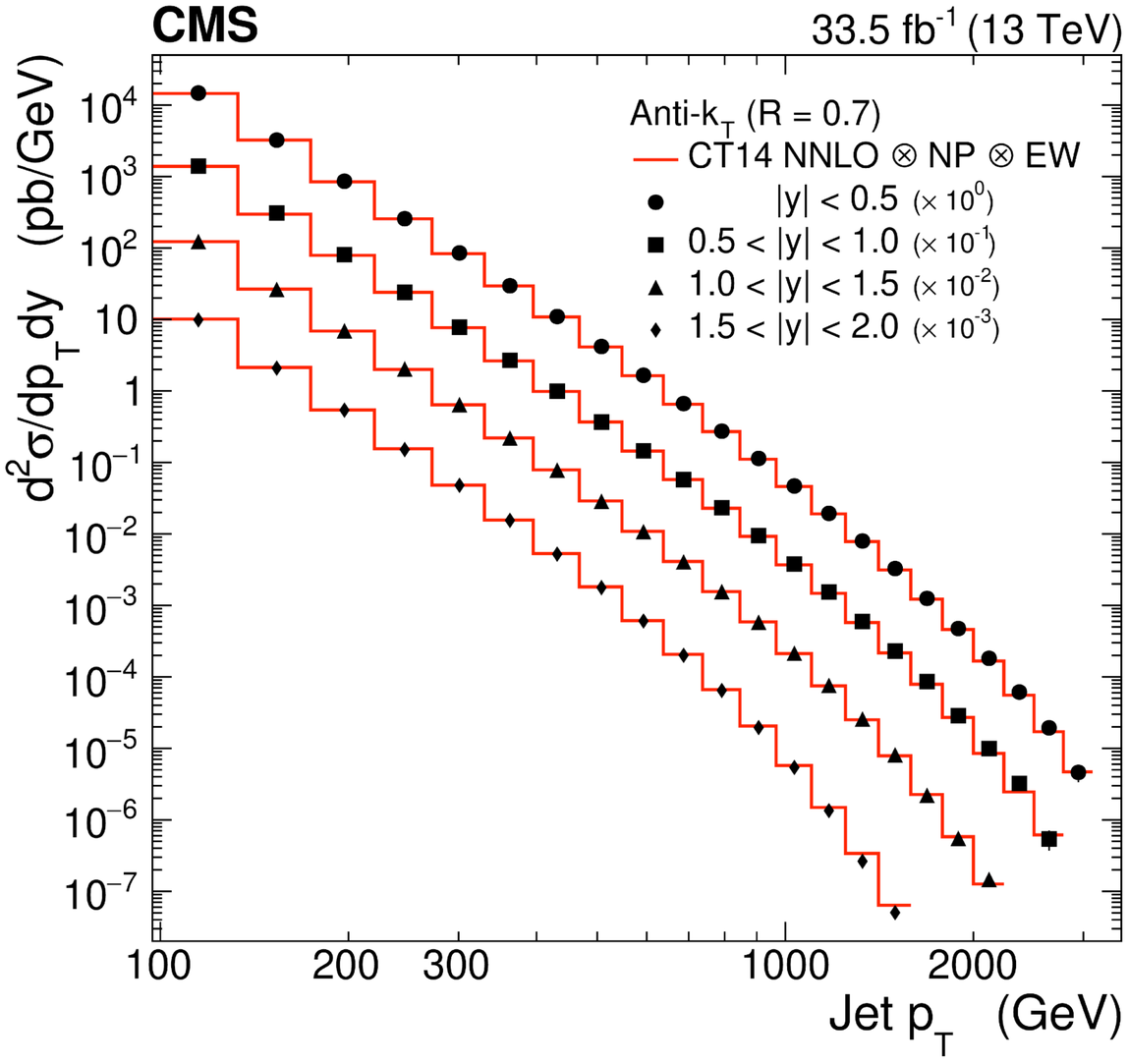



- Test of the strong force at the highest collision energies
  - Sensitive to the **proton structure** (PDFs)
  - Extract **strong coupling** $\alpha_S(m_Z)$, least well known fundamental constant

$$\alpha_S(m_Z) = 0.1170 \pm 0.0017$$

Most precise $\alpha_S(m_Z)$ from collider experiment

- Probe **physics beyond the SM** (i.e. contact-interactions)
  - For vector-like couplings new physics scale $\Lambda > 32$ TeV

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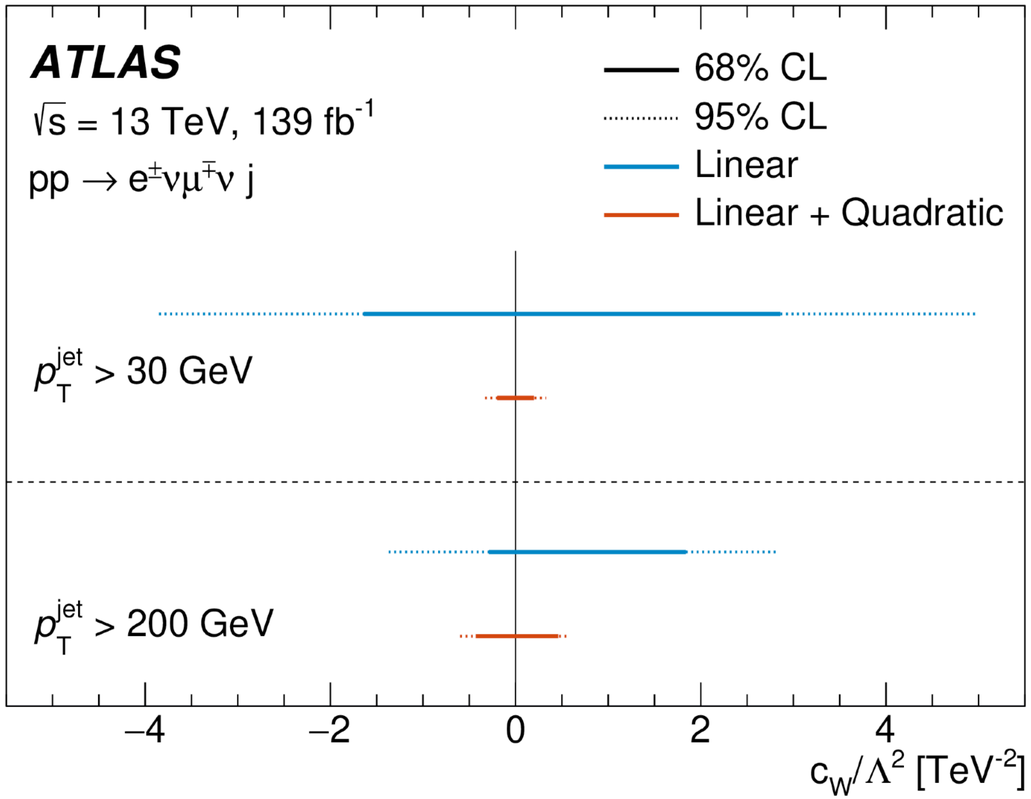
# Electroweak interactions in WW+jets

- ATLAS precise measurement of $pp \rightarrow e^{\pm}\nu\mu^{\pm}\nu j$
  - Sensitive to electroweak boson self-interactions and higher orders in the strong coupling

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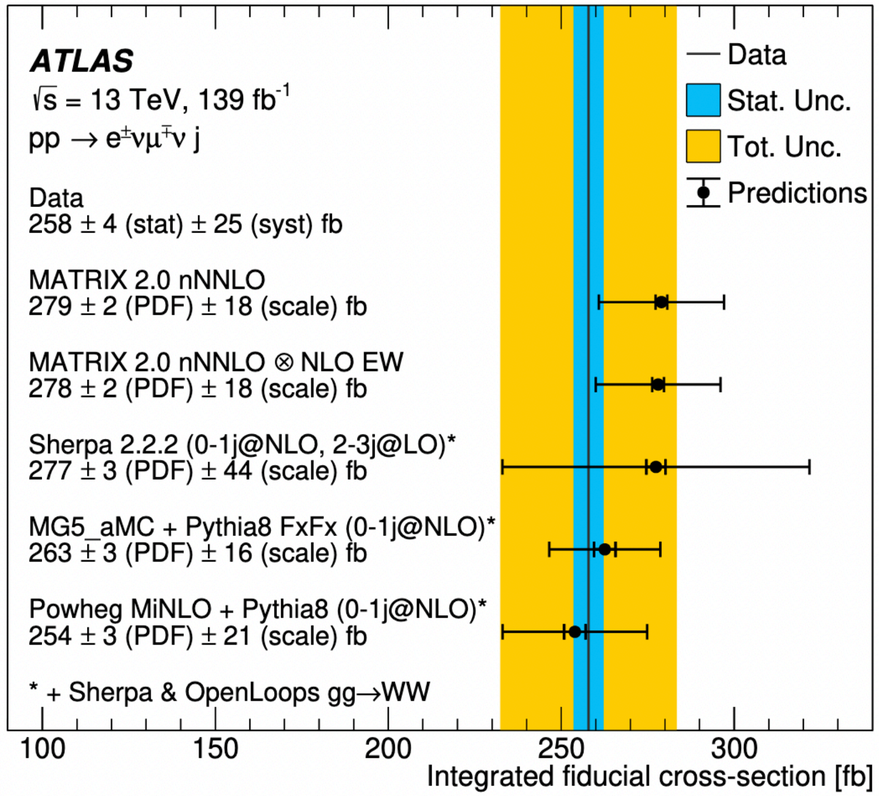
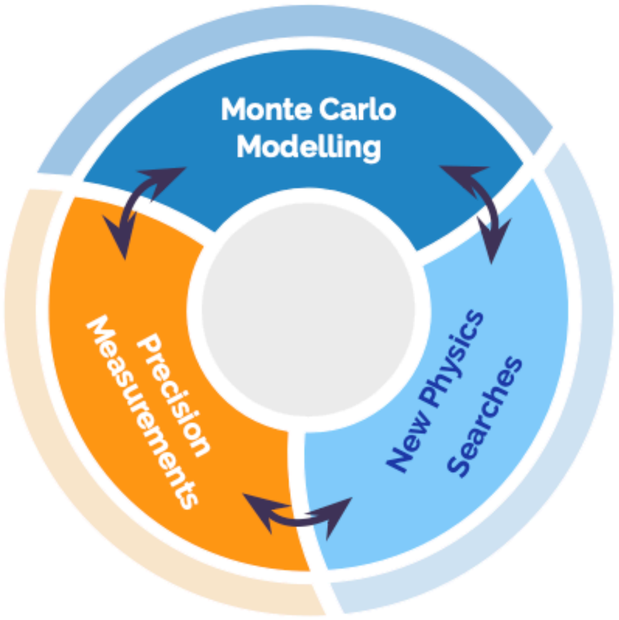


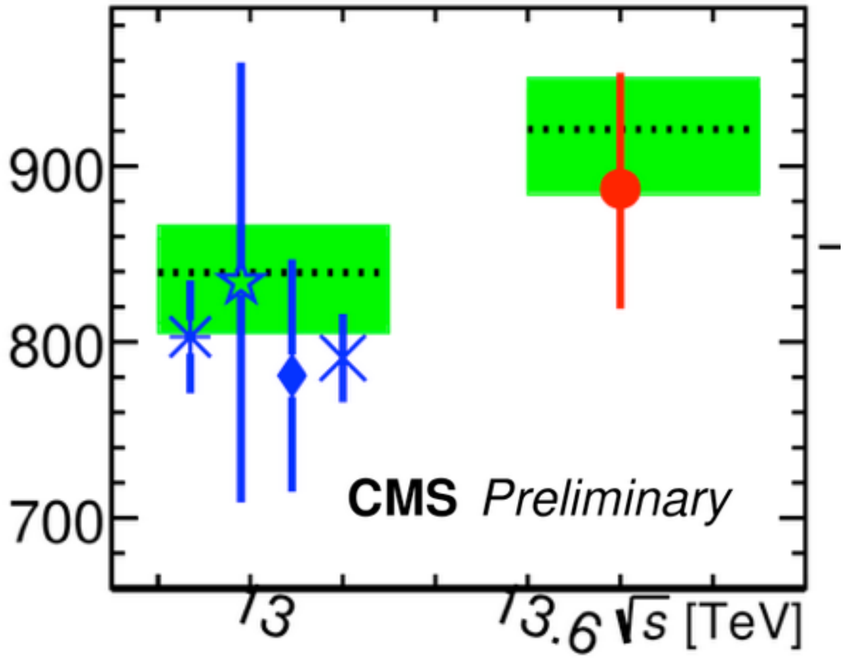

- Compared to state-of-the-art theoretical predictions
- Differential distributions constrain **anomalous couplings**

# Summary

- We have only scraped the surface of the potential of the LHC data




- SM measurements constraint BSM physics beyond the LHC direct reach

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- Only touched upon two 13 TeV results, but Run3 data is already with us