ATLAS PUB Note

ATL-PHYS-PUB-2019-024

11th July 2019
Minor revision: 28th November 2019

Standard Model Summary Plots Summer 2019

The ATLAS Collaboration

This note presents cross section summary plots for measurements in the ATLAS Standard Model group as of Summer 2019.

Updated in November 2019 with the following changes from the previous version (July 2019): (i) Fig. 25 updated with corrected integrated luminosity, (ii) Figures with final references where available.

1 Introduction

This document collects the Standard Model summary plots with the inputs available at 05/07/2019. The scripts for the creation of these plots are available at [1].

2 Updates since Spring 2019

Since the last publication of these summary plots[2], the following results have been updated:

- WW 13 TeV
- $ZZ \to \ell\ell\nu\nu$ 13 TeV
- $WVjj$+$ZVjj$ EW 13 TeV
- several updated references

and the following measurements have been added:

- W and Z 2.76 TeV
- W 8 TeV.

A new plot has been added showing subset of the cross section measurements as a function of centre-of-mass energy $\sqrt{s}$ with linear scale (see Fig. 25).

Only Figures 1, 2, 3, 5, 6, 8, 9, 11, 17, 18, 21, 22, 24 and 25 are affected by the afforementioned updates.

3 Total cross section overview plots

Figures 1 and 2 summarize several Standard Model total production cross section measurements, corrected for branching fractions, compare to the corresponding theoretical expectations. All theoretical expectations were calculated at NLO or higher. The luminosity used for each measurement is indicated close to the data point. Some measurements have been extrapolated using branching ratios as predicted by the Standard Model for the Higgs boson. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. They were not always evaluated using the same prescriptions for PDFs and scales. Not all measurements are statistically significant yet.

4 Fiducial cross section overview plots

Figures 3, 4, 5, 6, 7, 8, 9, 10 and 11 summarize several Standard Model total and fiducial production cross section measurements, corrected for branching fractions, compared to the corresponding theoretical expectations. All theoretical expectations were calculated at NLO or higher. Some measurements have been extrapolated using branching ratios as predicted by the Standard Model for the Higgs boson. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. They were not always evaluated using the same prescriptions for PDFs and scales. Not all measurements are statistically significant yet.

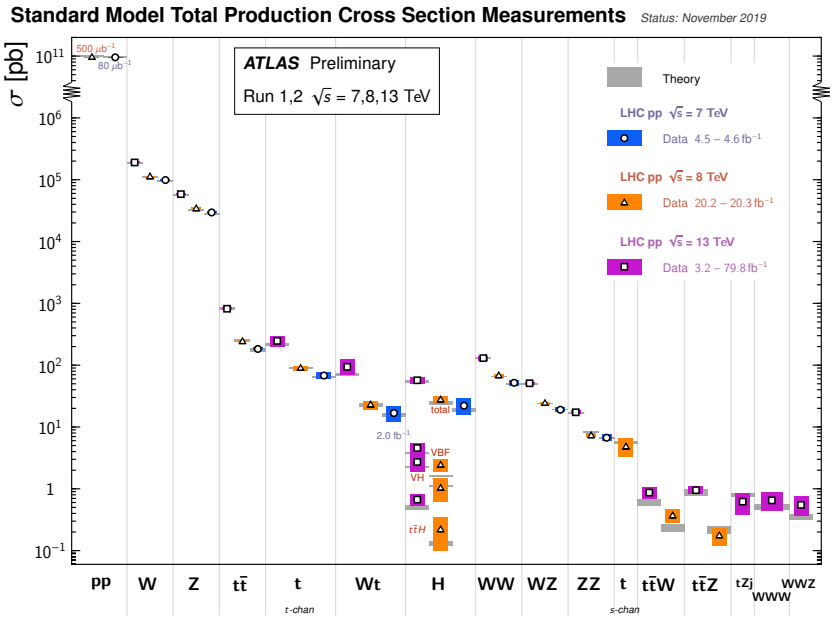

Figure 1: Summary of several Standard Model total production cross section measurements, corrected for branching fractions, compared to the corresponding theoretical expectations.

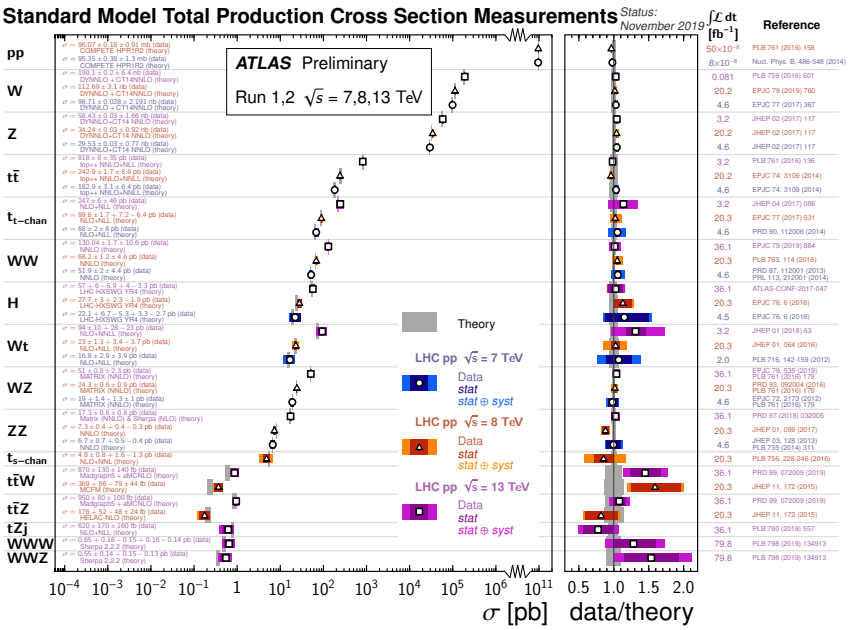

Figure 2: Summary of several Standard Model total production cross section measurements, corrected for branching fractions, compared to the corresponding theoretical expectations and ratio with respect to best theory.

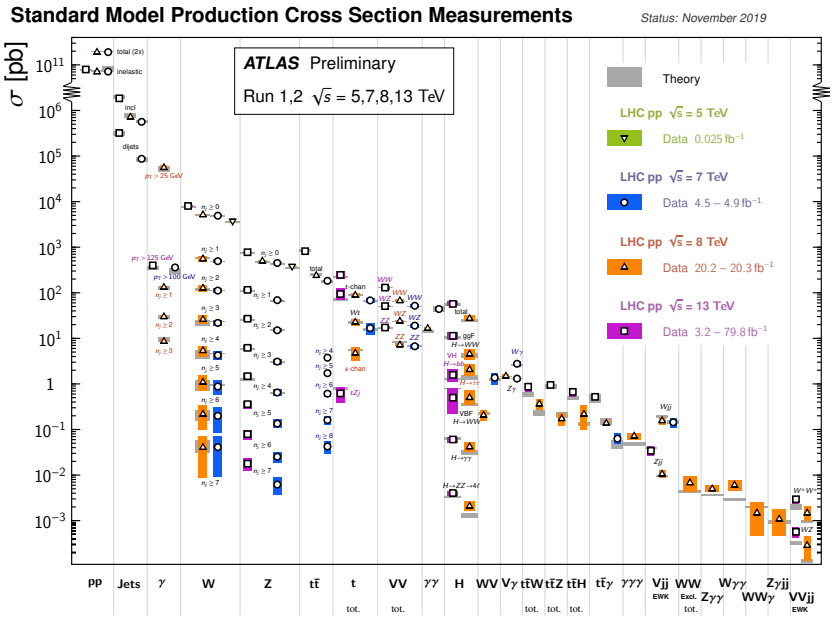

Figure 3: Summary of several Standard Model total and fiducial production cross section measurements, corrected for branching fractions, compared to the corresponding theoretical expectations

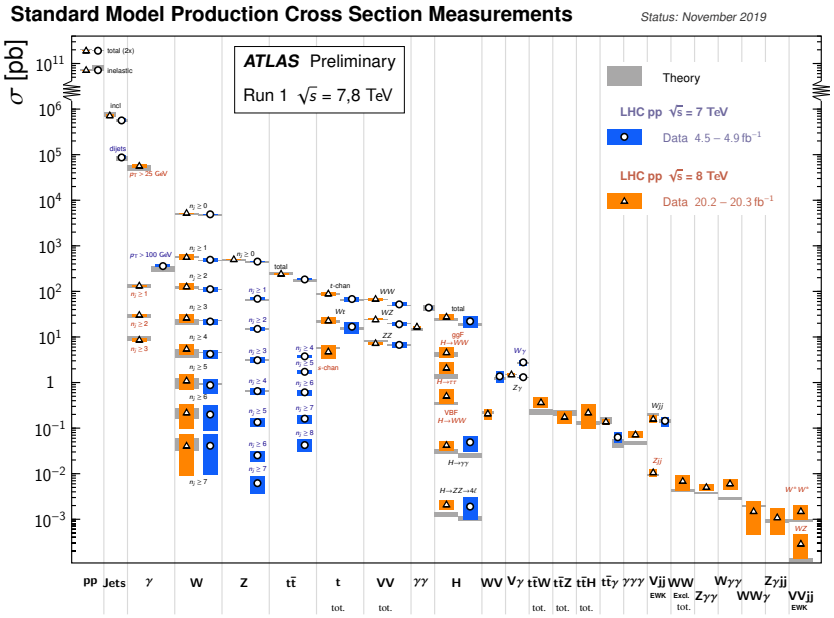

Figure 4: Summary of several Standard Model total and fiducial production cross section measurements from Run 1, corrected for branching fractions, compared to the corresponding theoretical expectations

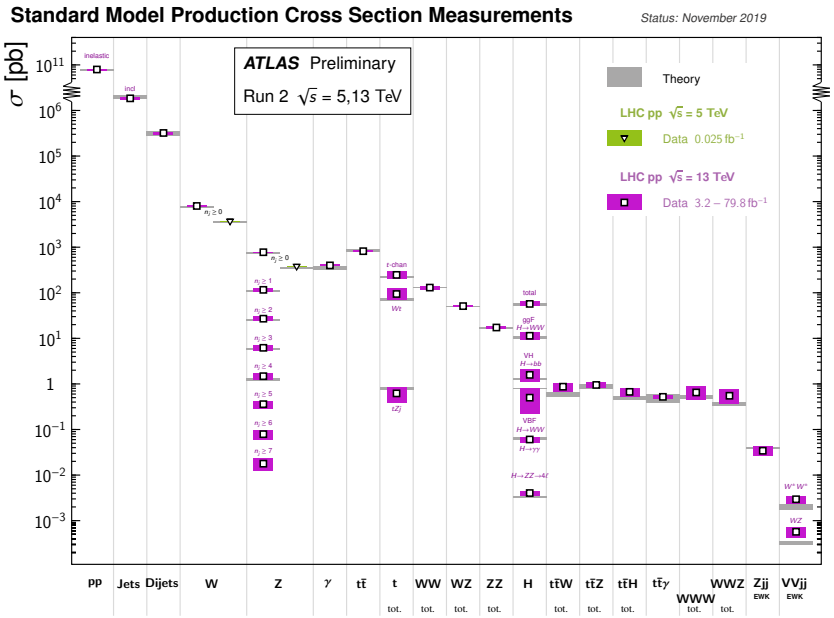

Figure 5: Summary of several Standard Model total and fiducial production cross section measurements from Run 2, corrected for branching fractions, compared to the corresponding theoretical expectations

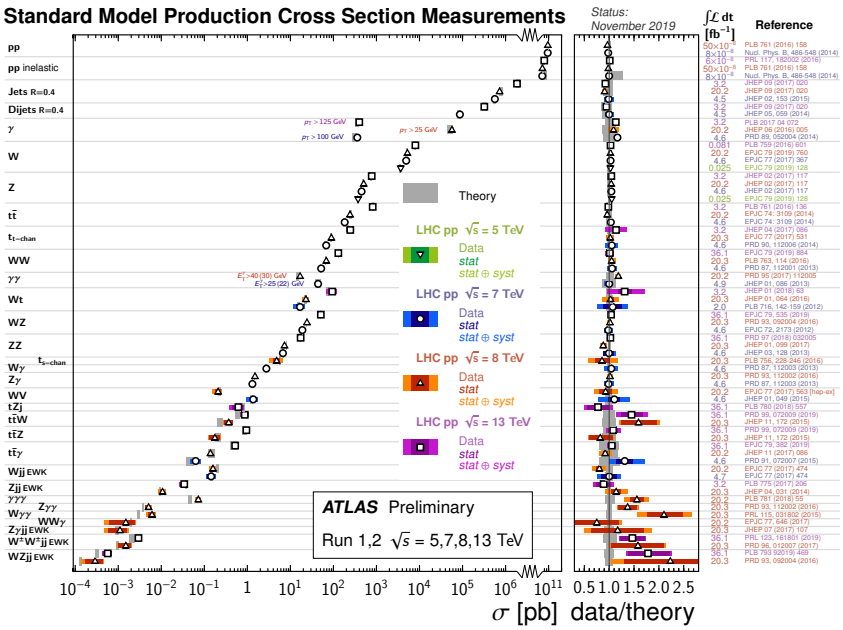

Figure 6: Summary of several Standard Model total and fiducial production cross section measurements, corrected for branching fractions, compared to the corresponding theoretical expectations and ratio with respect to best theory.

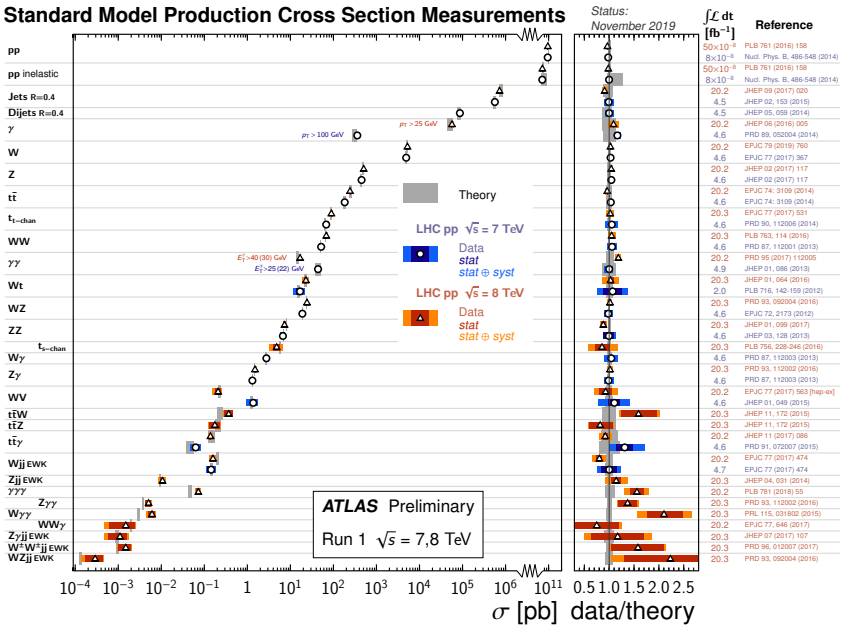

Figure 7: Summary of several Standard Model total and fiducial production cross section measurements from Run 1, corrected for branching fractions, compared to the corresponding theoretical expectations and ratio with respect to best theory.

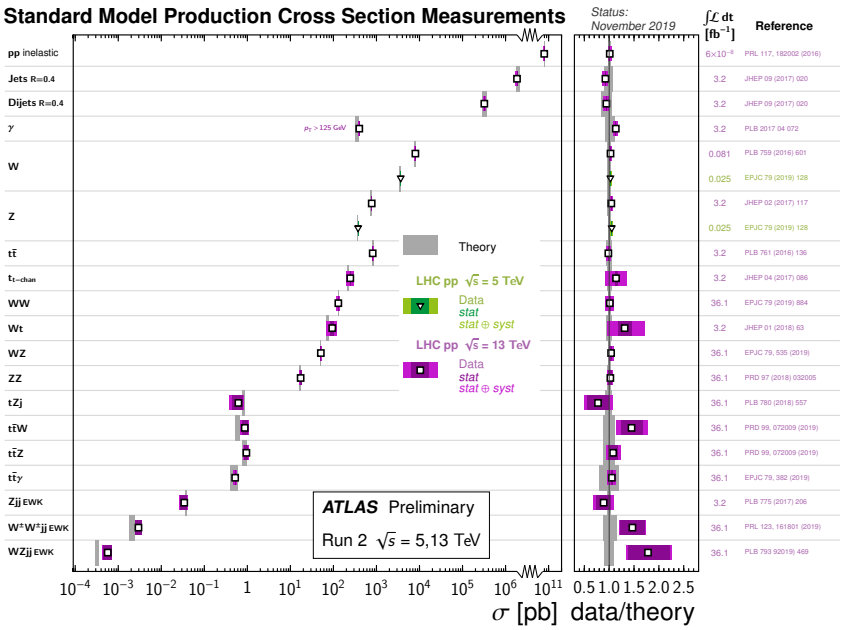

Figure 8: Summary of several Standard Model total and fiducial production cross section measurements from Run 2, corrected for branching fractions, compared to the corresponding theoretical expectations and ratio with respect to best theory.

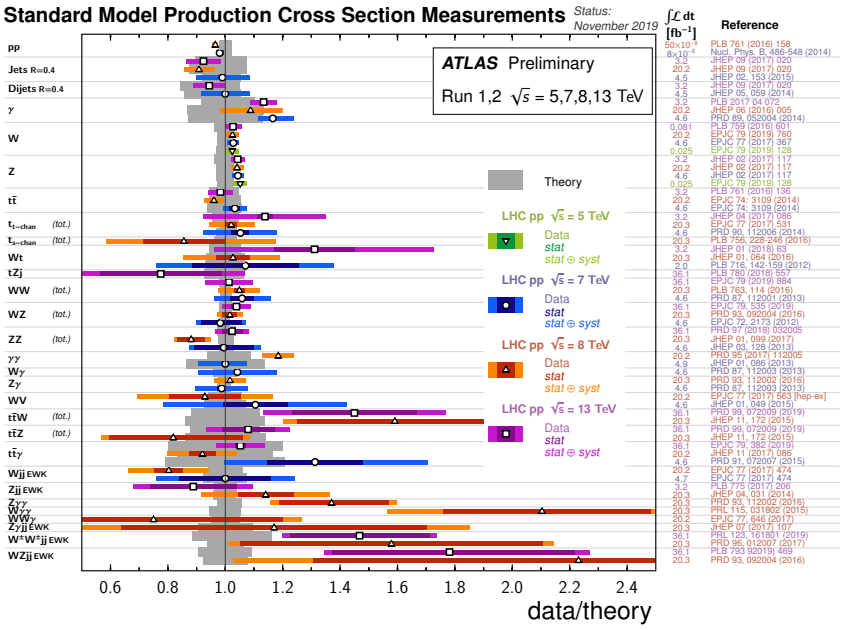

Figure 9: Summary of ratios with respect to best theory for several Standard Model total and fiducial production cross section measurements, corrected for branching fractions.

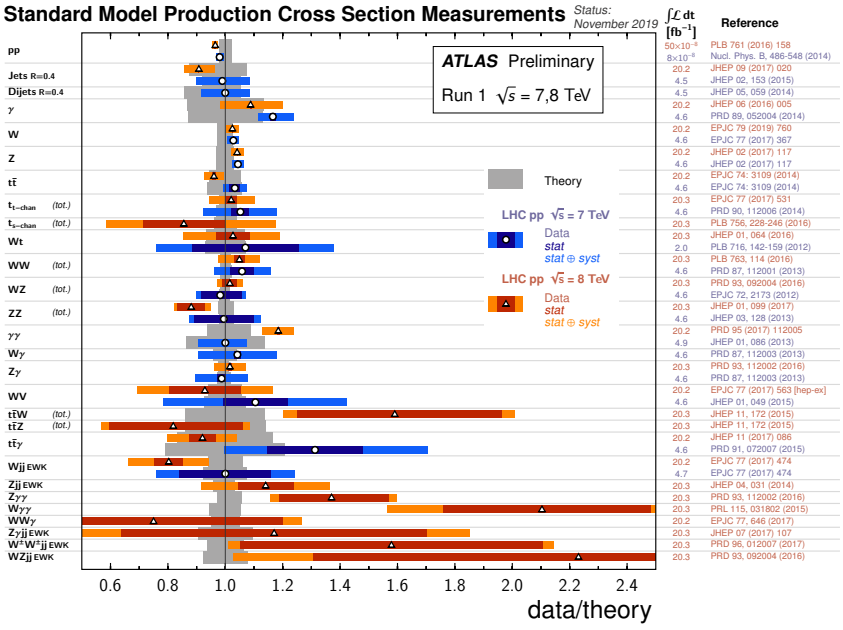

Figure 10: Summary of ratios with respect to best theory for several Standard Model total and fiducial production cross section measurements from Run 1, corrected for branching fractions.

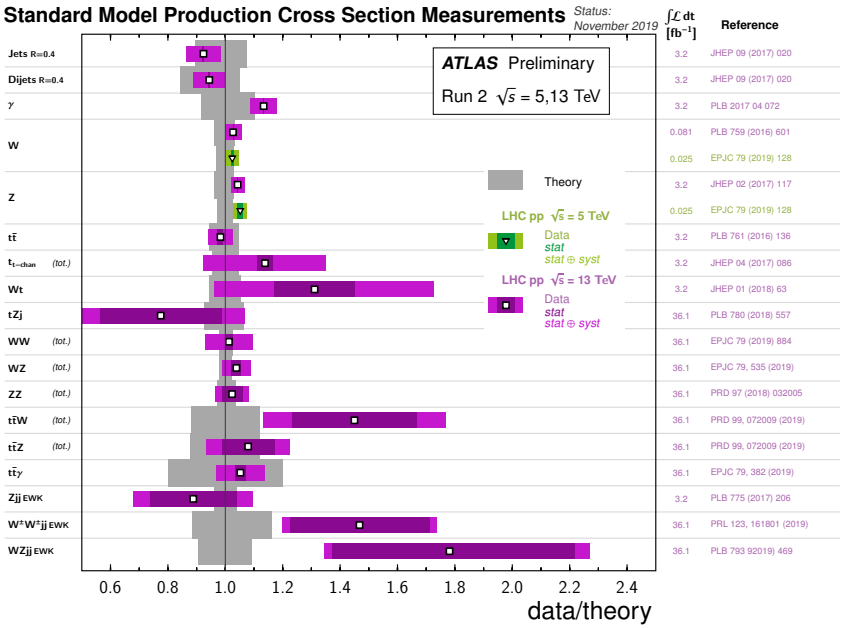

Figure 11: Summary of ratios with respect to best theory for several Standard Model total and fiducial production cross section measurements from Run 2, corrected for branching fractions.

5 Overview plots for inclusive measurements

Figures 12, 13, 14 show the data/theory ratio for several inclusive jet fiducial production cross section measurements. All theoretical expectations were calculated at NLO or higher. The dark-color error bar represents the statistical uncertainty. The lighter-color error bar represents the full uncertainty, including systematics and luminosity uncertainties. The luminosity used and reference for each measurement are also shown. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers.

6 Overview plots for single boson measurements

Figures 15 and 16 show the data/theory ratio for several single-boson fiducial production cross section measurements, corrected for branching fractions. All theoretical expectations were calculated at NLO or higher. The dark-color error bar represents the statistical uncertainly. The lighter-color error bar represents the full uncertainty, including systematics and luminosity uncertainties. The luminosity used and reference for each measurement are also shown. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. They were not always evaluated using the same prescriptions for PDFs and scales.

7 Overview plots for diboson measurements

Figures 17 and 18 show the ratio for several diboson total and fiducial production cross section measurements over best available theory prediction, corrected for branching fractions. All theoretical expectations are

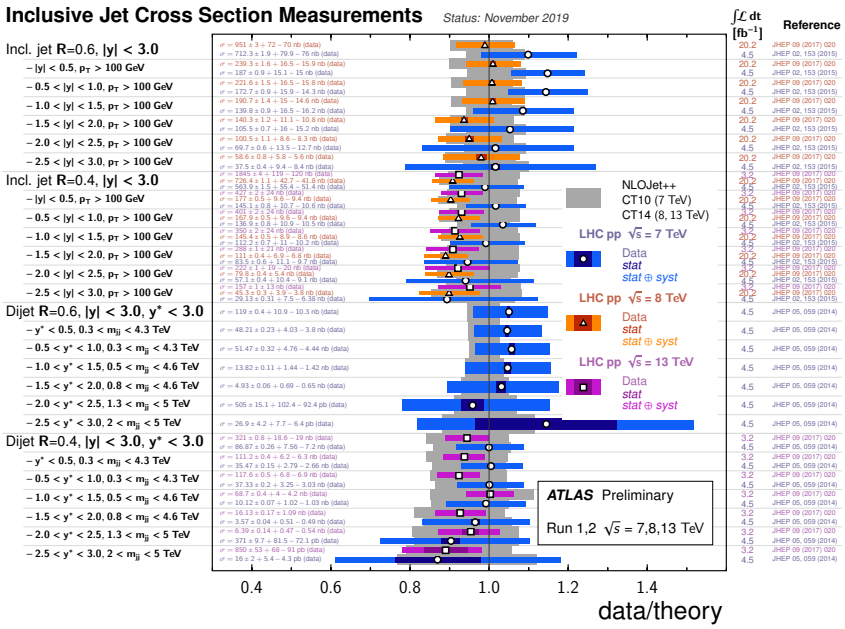

Figure 12: The data/theory ratio for several inclusive jet fiducial production cross section measurements.

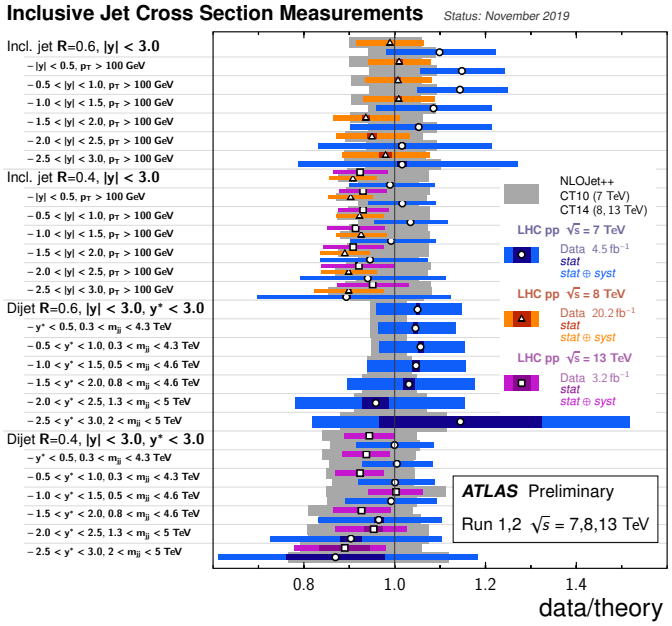

Figure 13: The data/theory ratio for several inclusive jet fiducial production cross section measurements.

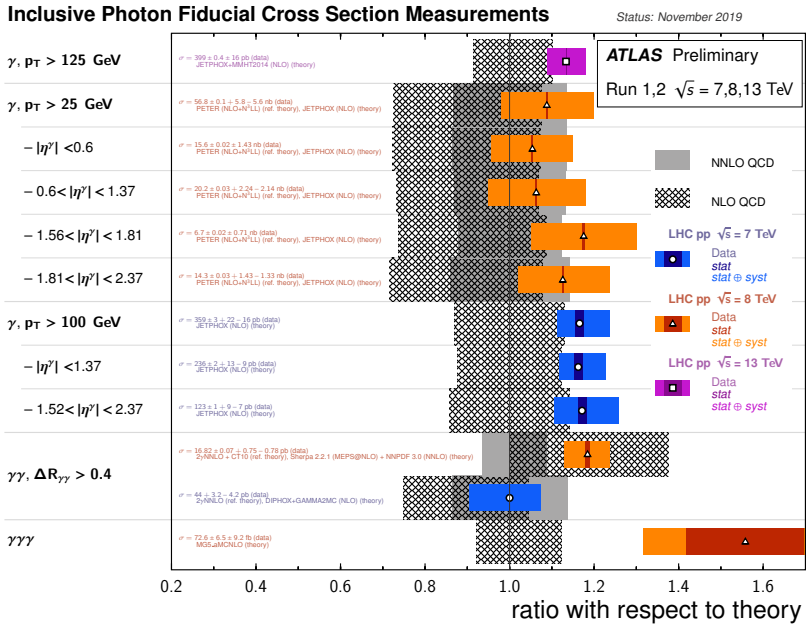

Figure 14: The ratio for several inclusive photon fiducial production cross section measurements over best available theory prediction. All theoretical expectations are shown using gray bars, hatched for NLO calculations and full for NNLO predictions.

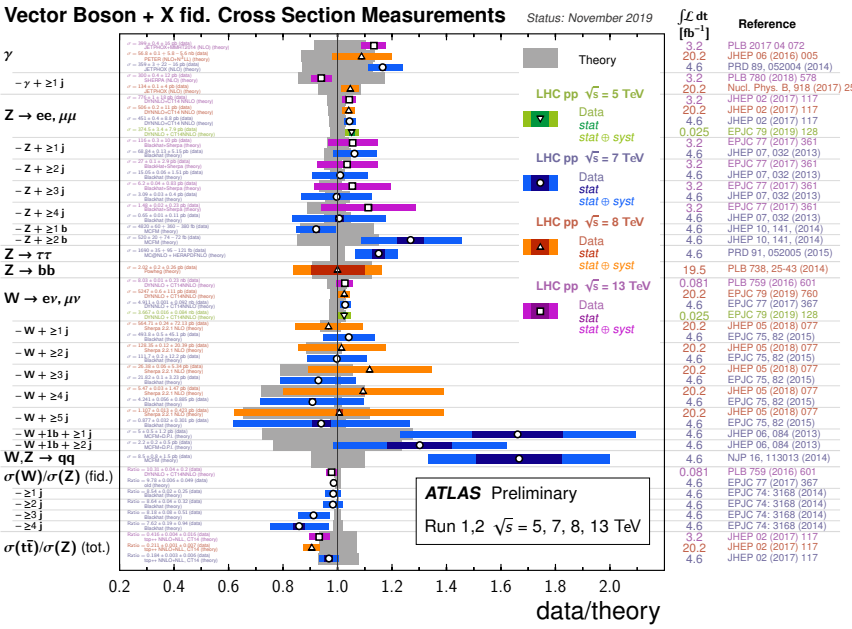

Figure 15: The data/theory ratio for several single-boson fiducial production cross section measurements, corrected for branching fractions.

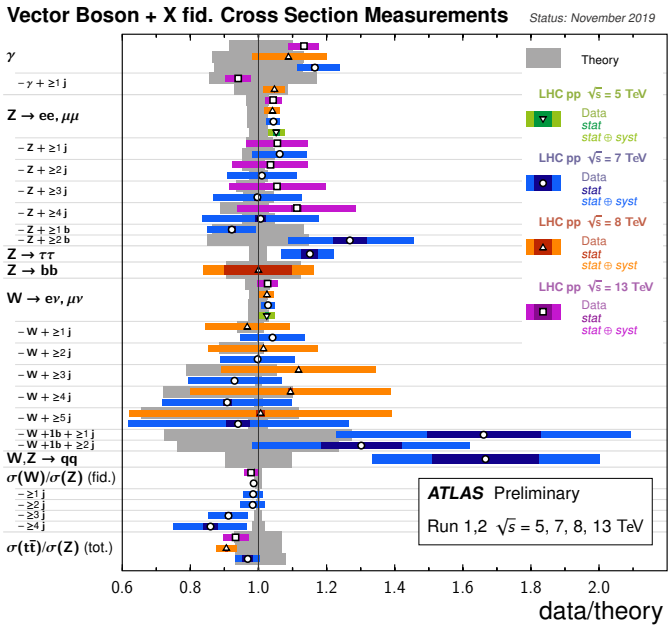

Figure 16: The data/theory ratio for several single-boson fiducial production cross section measurements, corrected for branching fractions.

shown using gray bars, hatched for NLO calculations and full for NNLO predictions. The dark-color error bar represents the statistical uncertainly. The lighter-color error bar represents the full uncertainty, including systematics and luminosity uncertainties. The luminosity used and reference for each measurement are also shown. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. Not all measurements are statistically significant yet.

8 Overview plots for VBF, VBS and triboson measurements

Figures 19 and 20 show the data/theory ratio for several vector boson fusion, vector boson scattering, and triboson fiducial cross section measurements. All theoretical expectations were calculated at NLO. The dark-color error bar represents the statistical uncertainty. The lighter-color error bar represents the full uncertainty, including systematics and luminosity uncertainties. The luminosity used and reference for each measurement are also shown. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. They were not always evaluated using the same prescriptions for PDFs and scales. Not all measurements are statistically significant yet.

9 Used values

Figures 21, 22, and 23 present tables of used results. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers. They were not always evaluated using the same prescriptions for PDFs and scales.

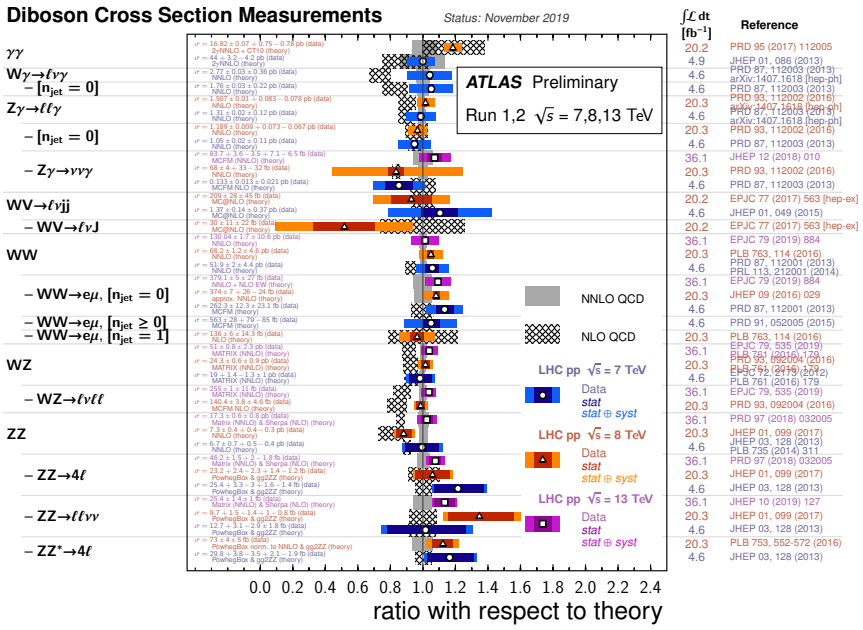

Figure 17: The data/theory ratio for several diboson fiducial production cross section measurements, corrected for branching fractions.

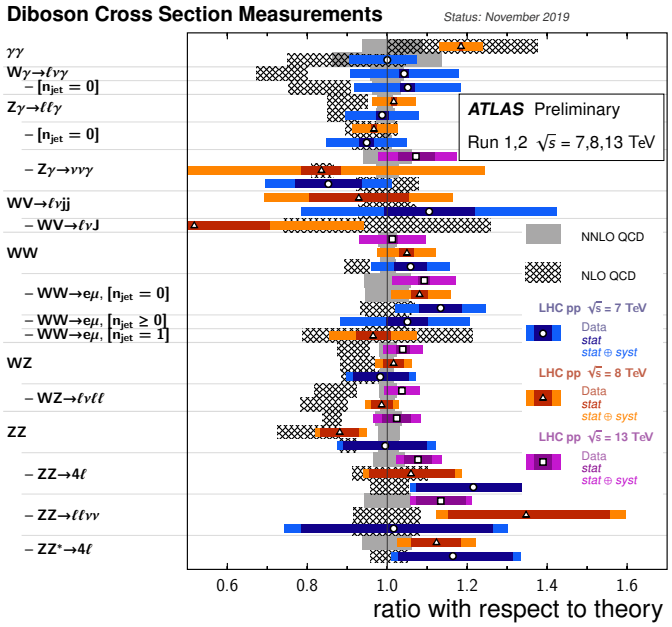

Figure 18: The data/theory ratio for several diboson fiducial production cross section measurements, corrected for branching fractions.

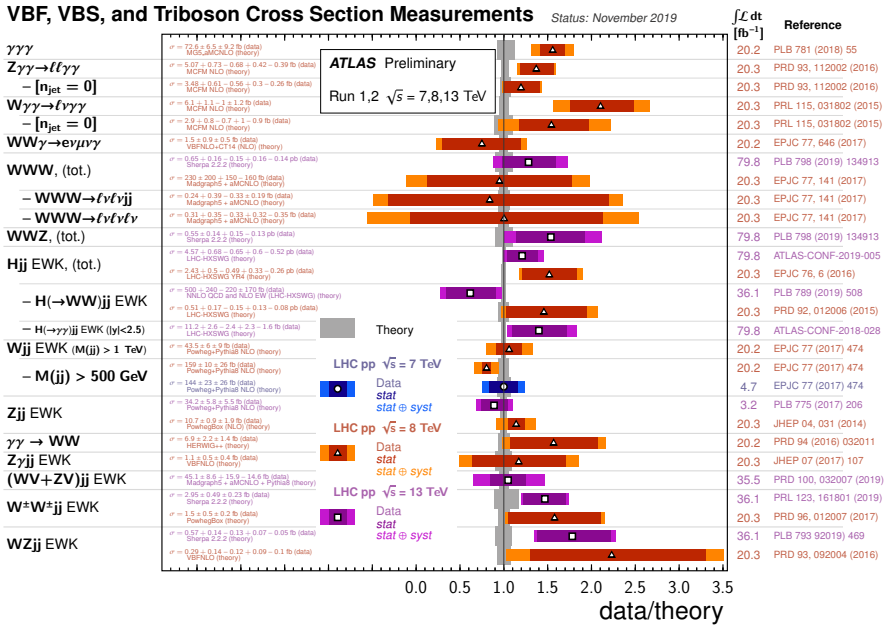

Figure 19: The data/theory ratio for several vector boson fusion, vector boson scattering, and triboson fiducial production cross section measurements.

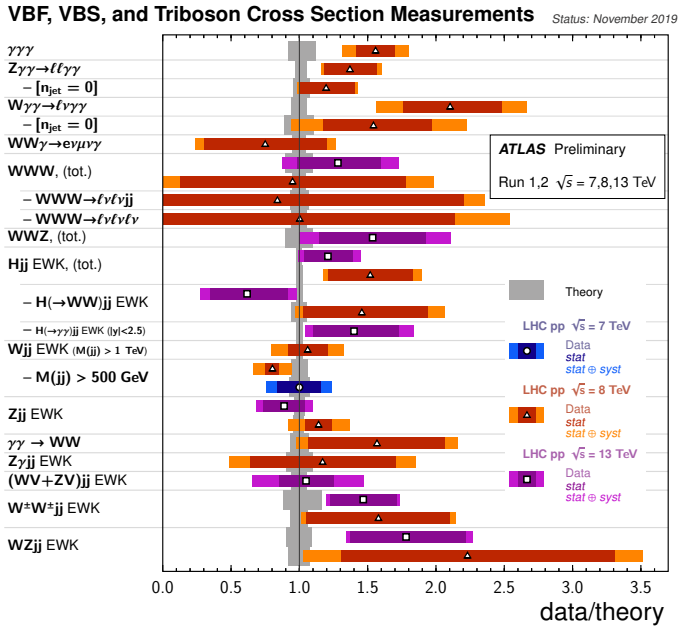

Figure 20: The data/theory ratio for several vector boson fusion, vector boson scattering, and triboson fiducial production cross section measurements.

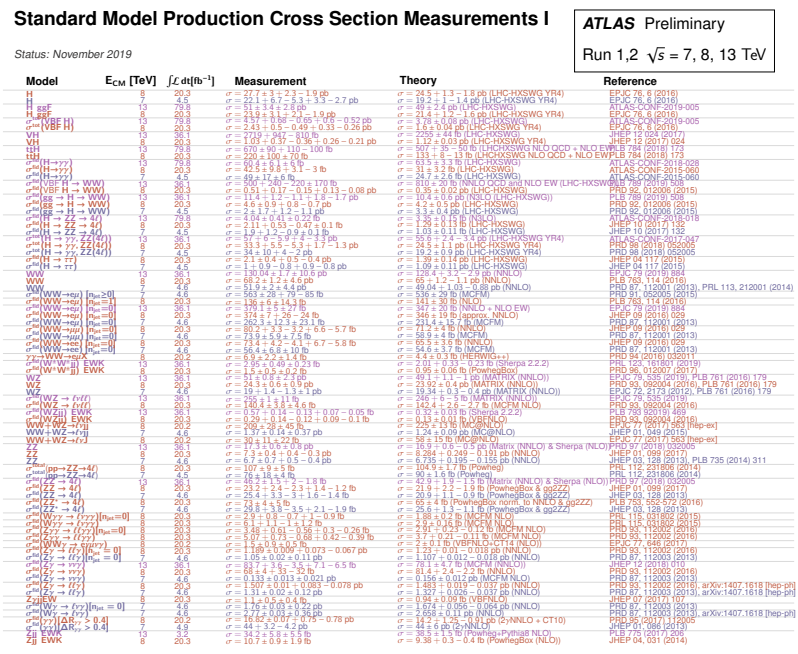

Figure 21: Table of used results. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers.

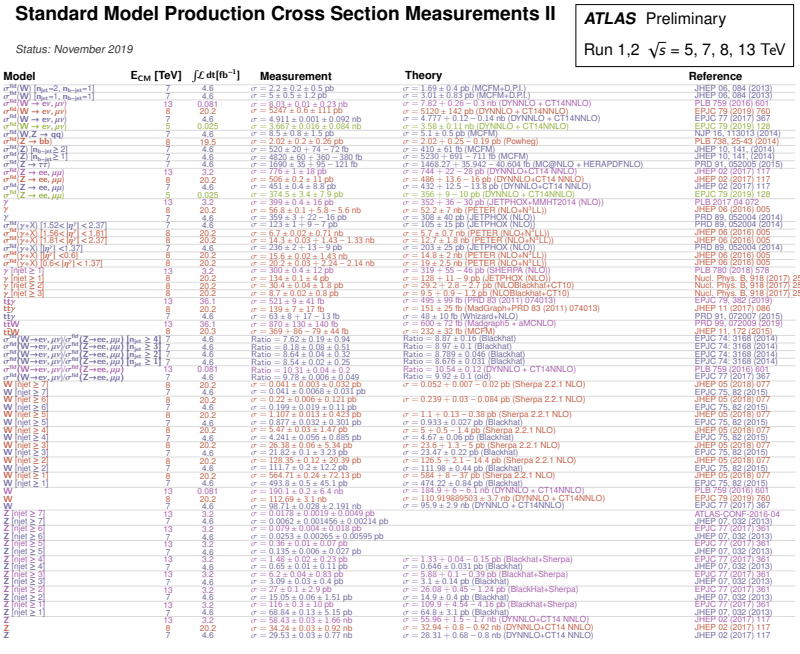

Figure 22: Table of used results. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers.

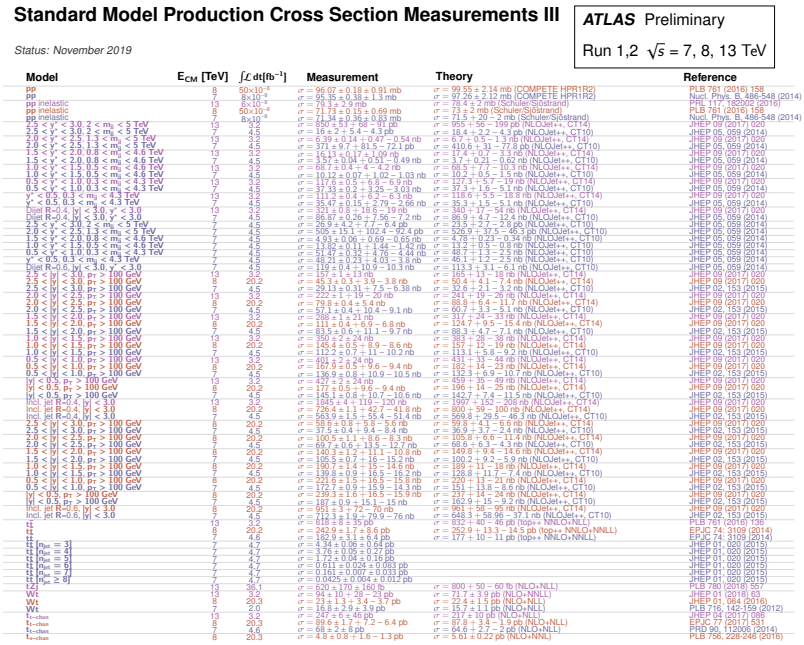

Figure 23: Table of used results. Uncertainties for the theoretical predictions are quoted from the original ATLAS papers.

10 Cross section measurements as a function of centre-of-mass energy $\sqrt{s}$

Summary of total production cross-section measurements by ATLAS presented as a function of centre-of-mass energy from 7 to 13 TeV for a few selected processes. The diboson measurements are scaled by a factor 0.1 to allow a presentation without overlaps.

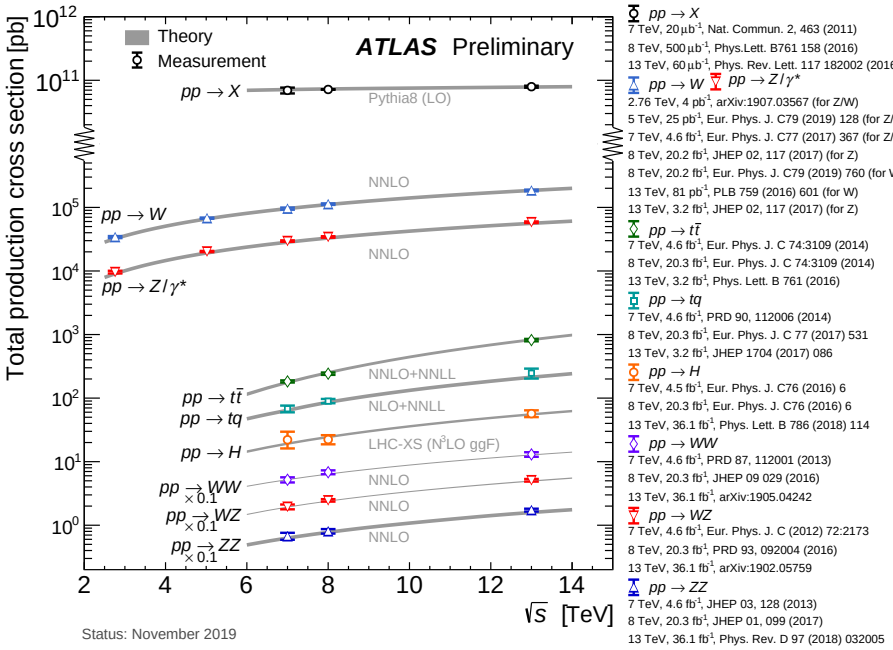

Figure 24: Summary of total production cross-section measurements by ATLAS presented as a function of centre-of-mass energy from 2.76 to 13 TeV for a few selected processes.

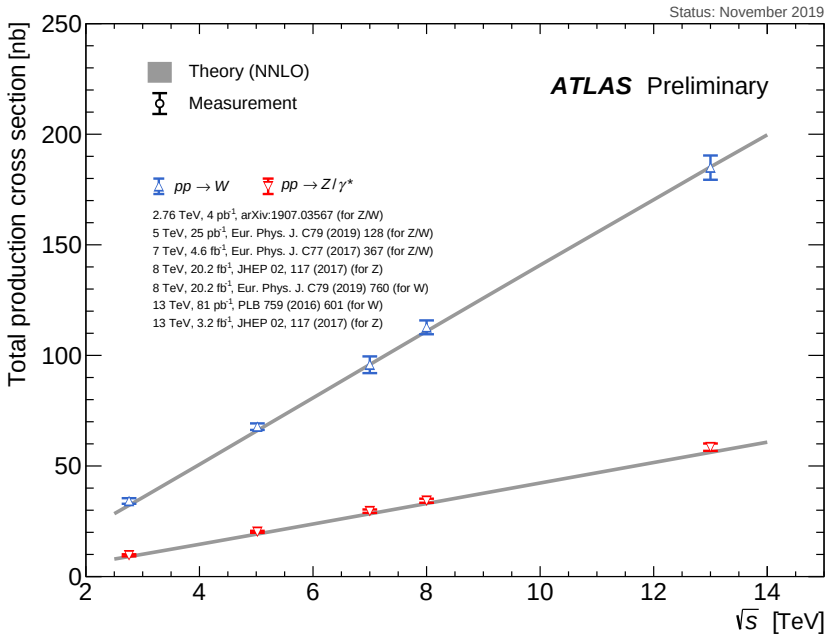

Figure 25: Summary of total production cross-section measurements of electro-weak gauge boson by ATLAS presented as a function of centre-of-mass energy from 2.76 to 13 TeV.

References

[1] ATLAS Collaboration, *Gitlab page for Summary plots*, 2019, URL: https://gitlab.cern.ch/atlas-physics/sm/StandardModelTools_SummaryPlots/SummaryPlots (cit. on p. 2).

[2] ATLAS Collaboration, *Standard Model Summary Plots Spring 2019*, 2019, URL: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PUBNOTES/ATL-PHYS-PUB-2019-010/ (cit. on p. 2).