

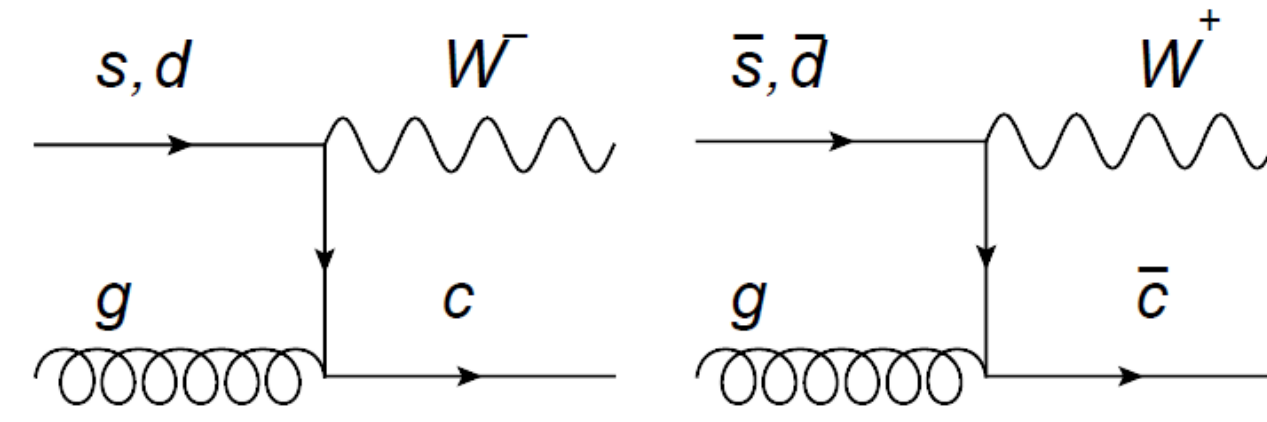
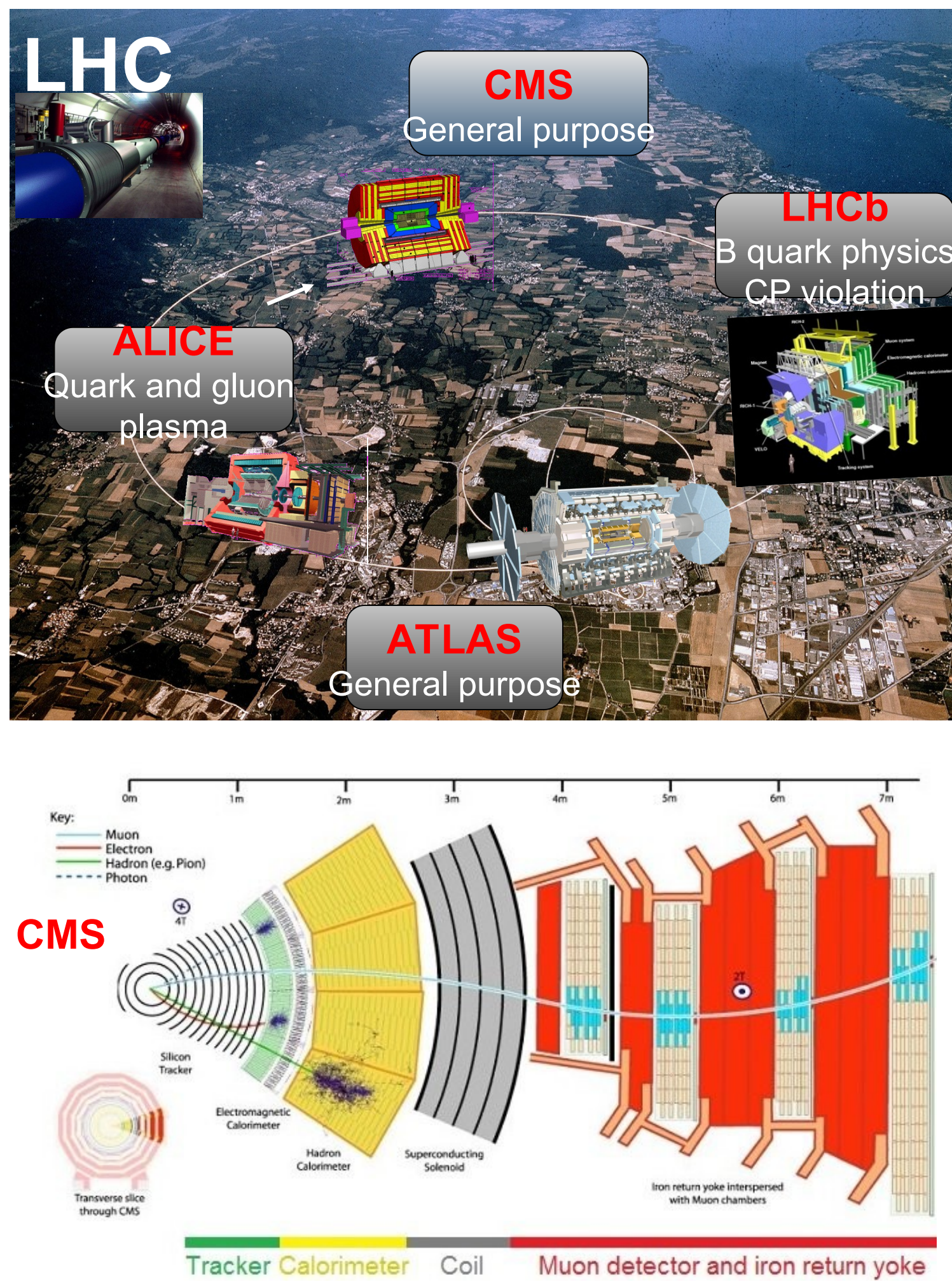
Measurement of the associated production of a W boson and a charm quark at $\sqrt{s} = 13$ TeV at the CMS detector of the LHC



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- A measurement of the associated production of a **W** boson and a charm (**c**) quark in proton-proton collisions at a centre-of-mass energy (\sqrt{s}) of 13 TeV is reported.
- The analysis uses a data sample corresponding to a total integrated luminosity (\mathcal{L}) of 137 fb^{-1} collected by the CMS detector at the LHC during Run II of data taking.
- W bosons are identified through their leptonic decays to an **electron** or a **muon**, and a neutrino.
- Charm jets are tagged by the presence of a muon (**SL**) or a secondary vertex (**SV**) inside the jet.

Experimental setup



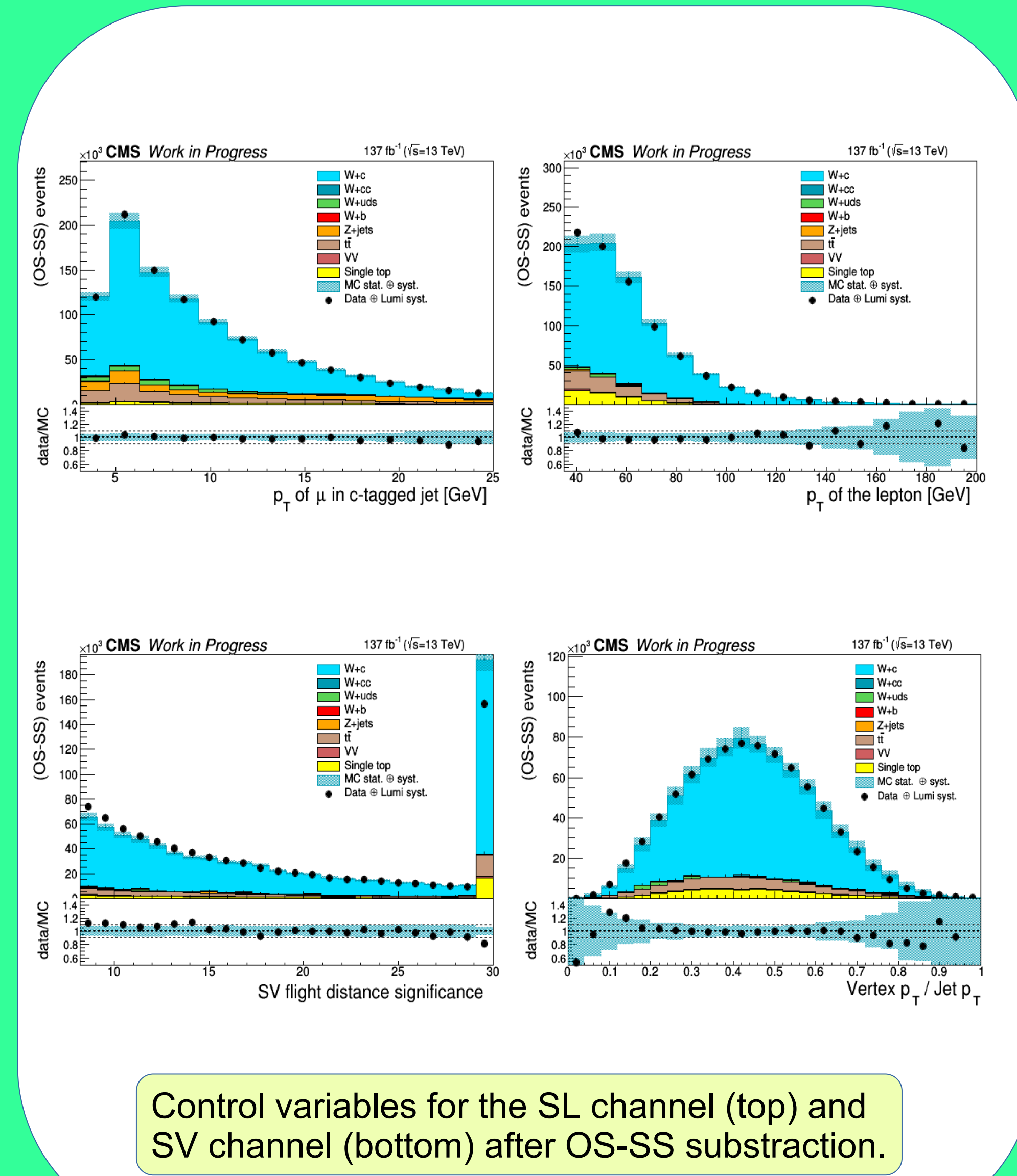
Opposite Sign minus Same Sign subtraction. (**OS-SS**).

Key ingredient for a clean signal region.

- The electric charge of the W boson is opposite to the charge of the c quark.
- In most backgrounds, the final state presents a charm quark or antiquark with equal probability and identical kinematics.
- Statistical subtraction of events leads to an effective removal of charge-symmetric backgrounds.

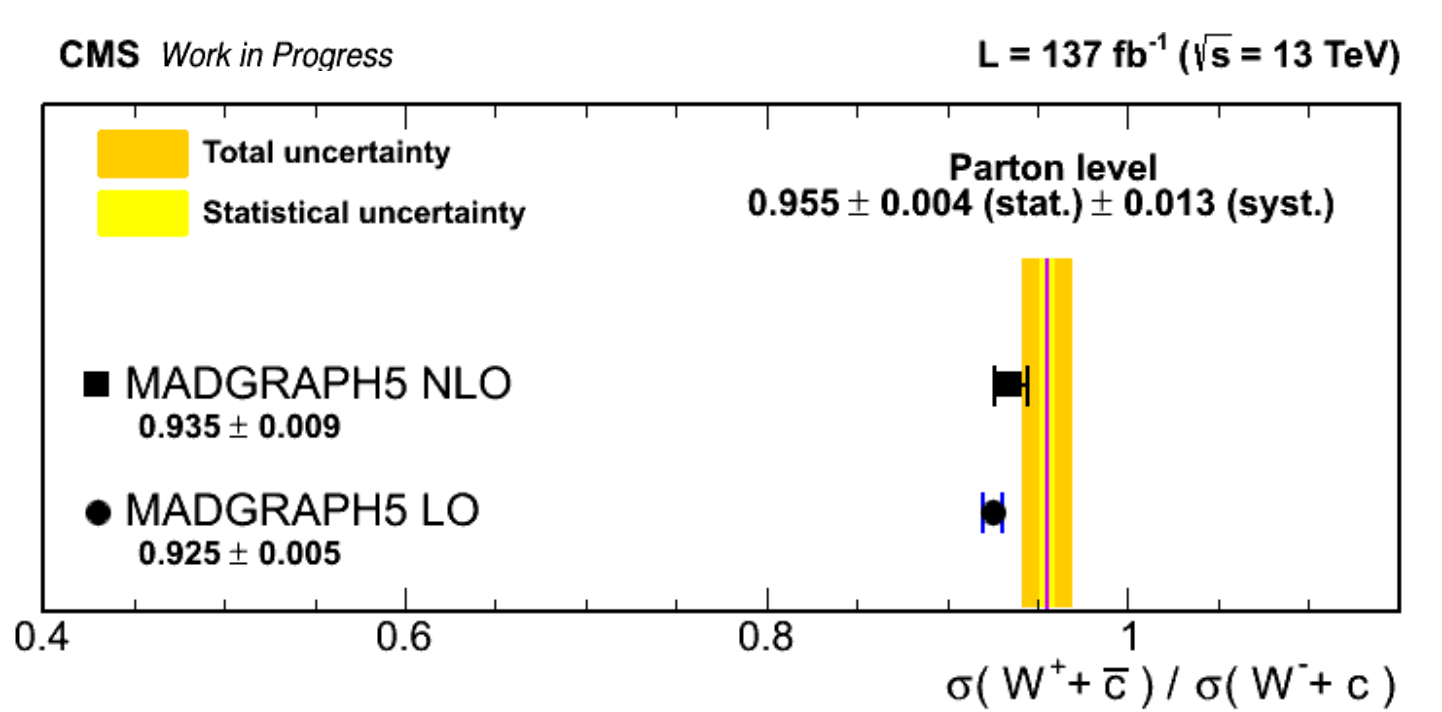
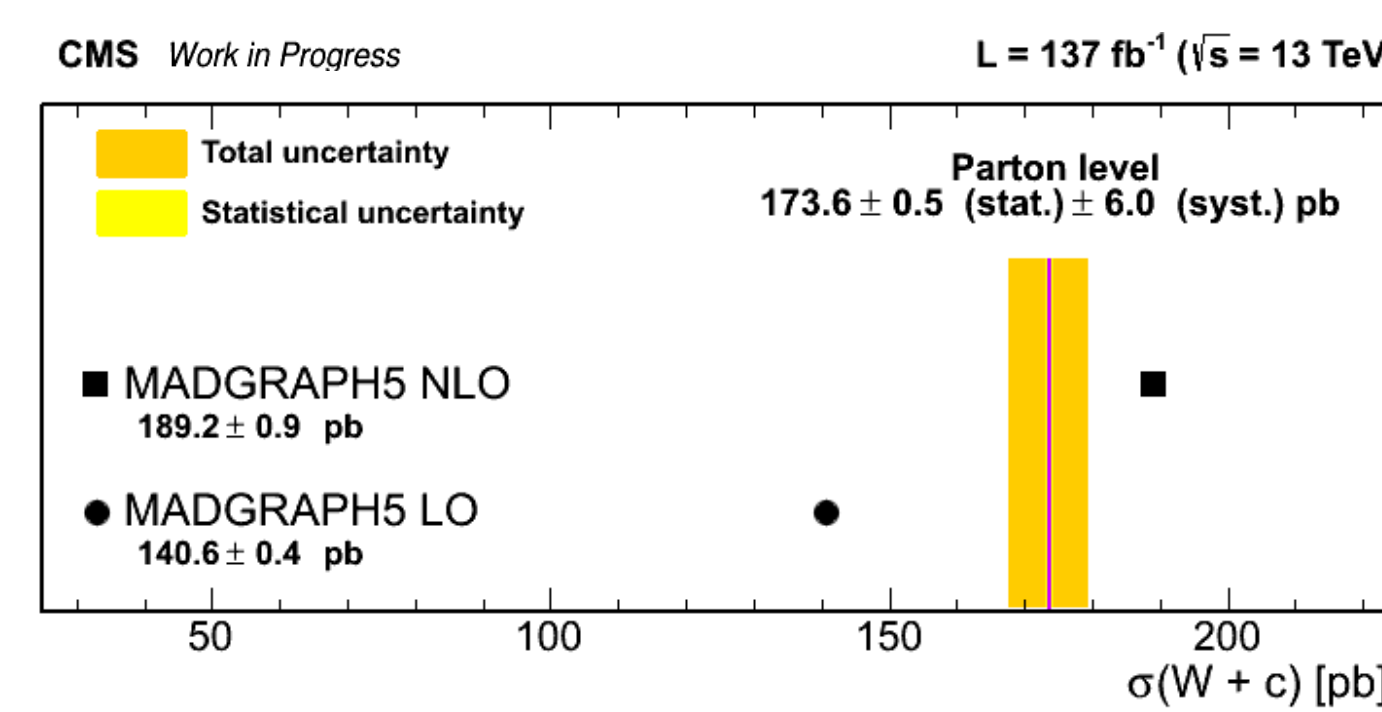
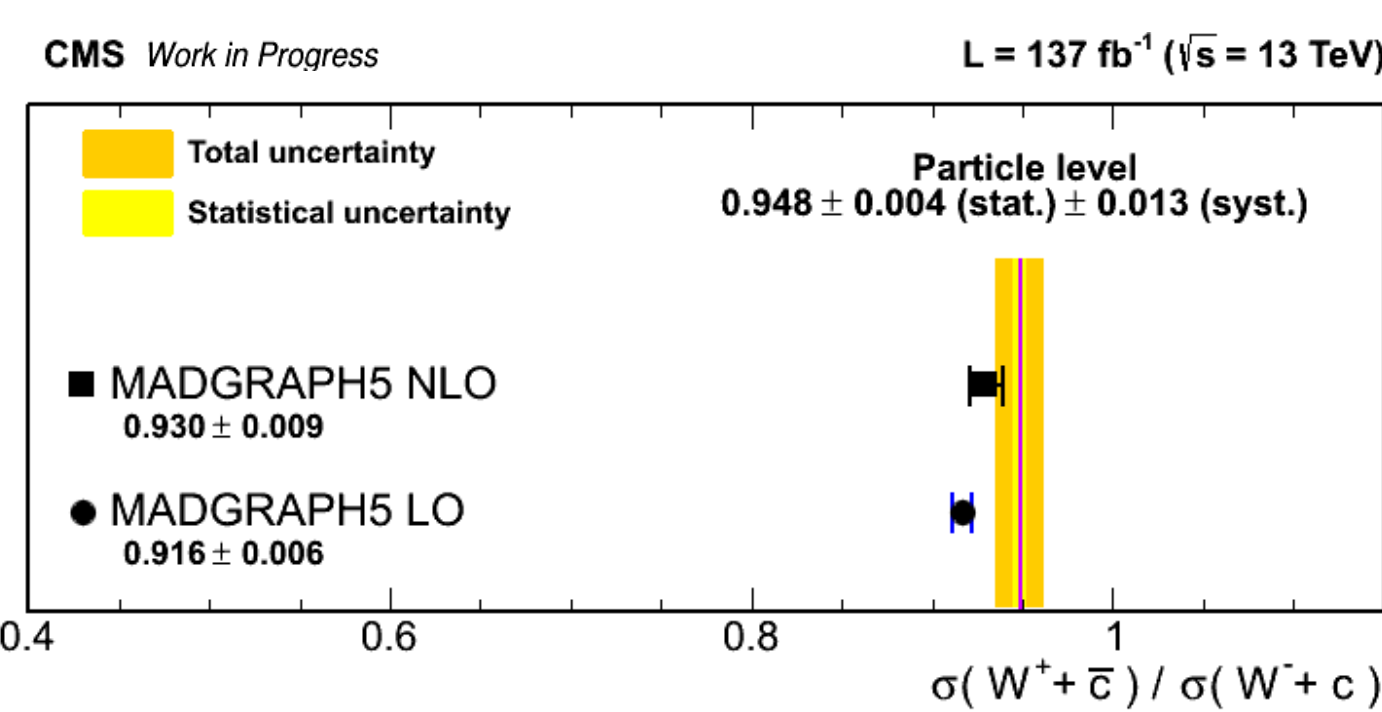
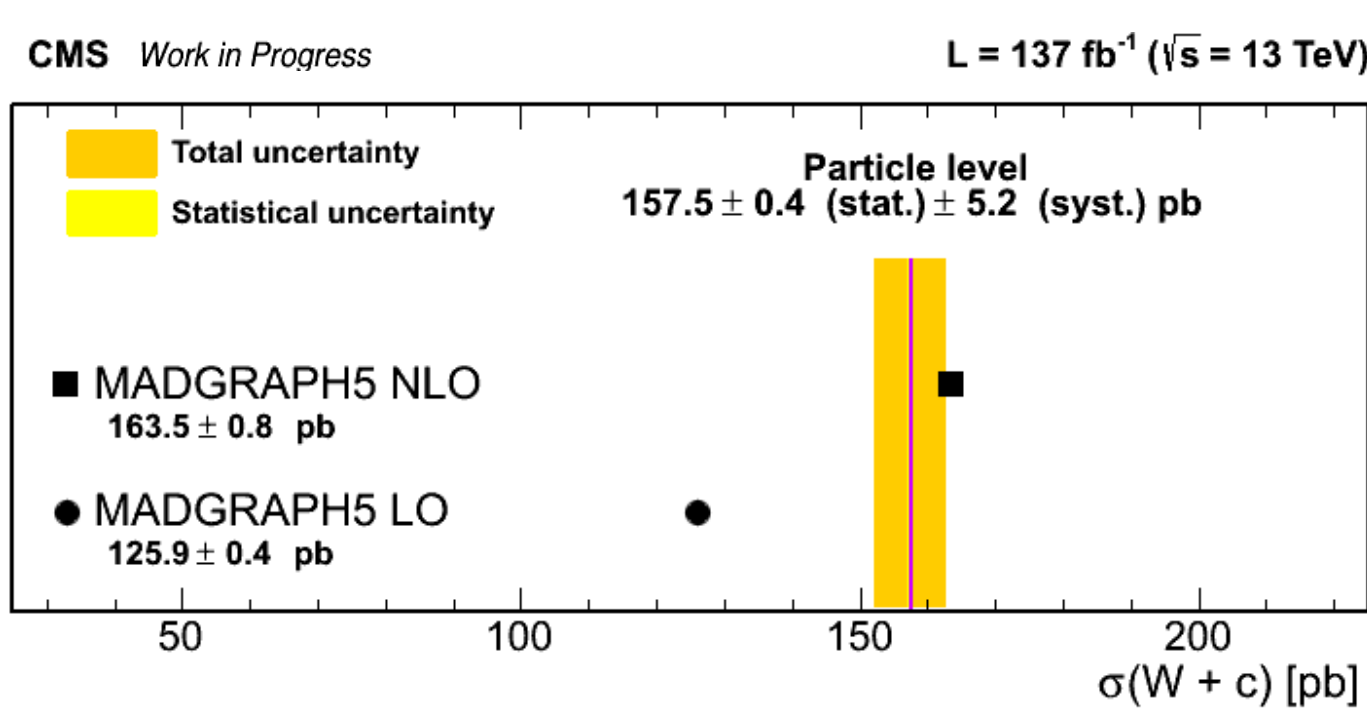
Systematical and statistical uncertainties are considered.

$$\sigma(W+c) = \frac{N_{\text{sel}}(1 - f_{\text{bkg}})}{\mathcal{L}}$$

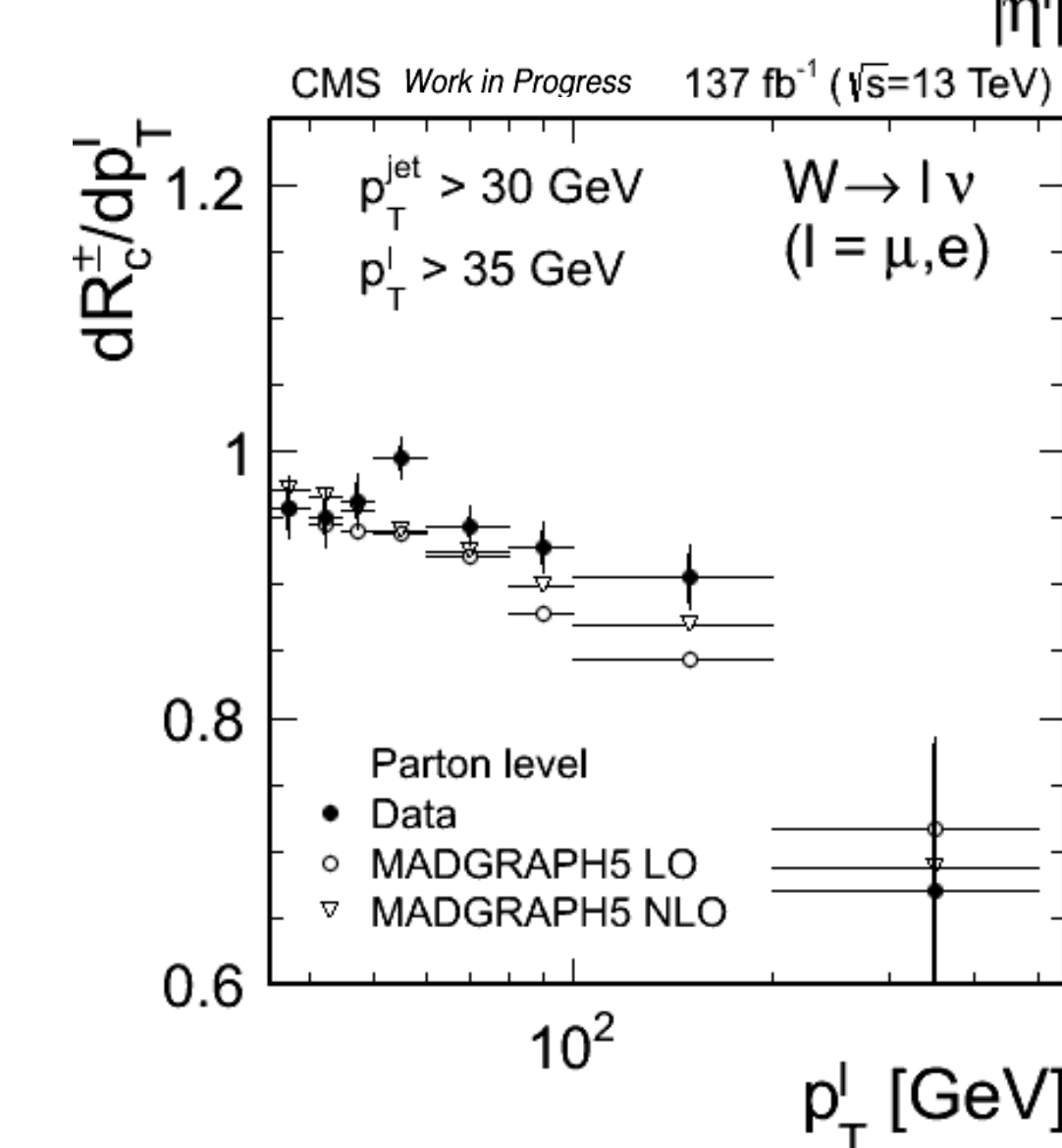
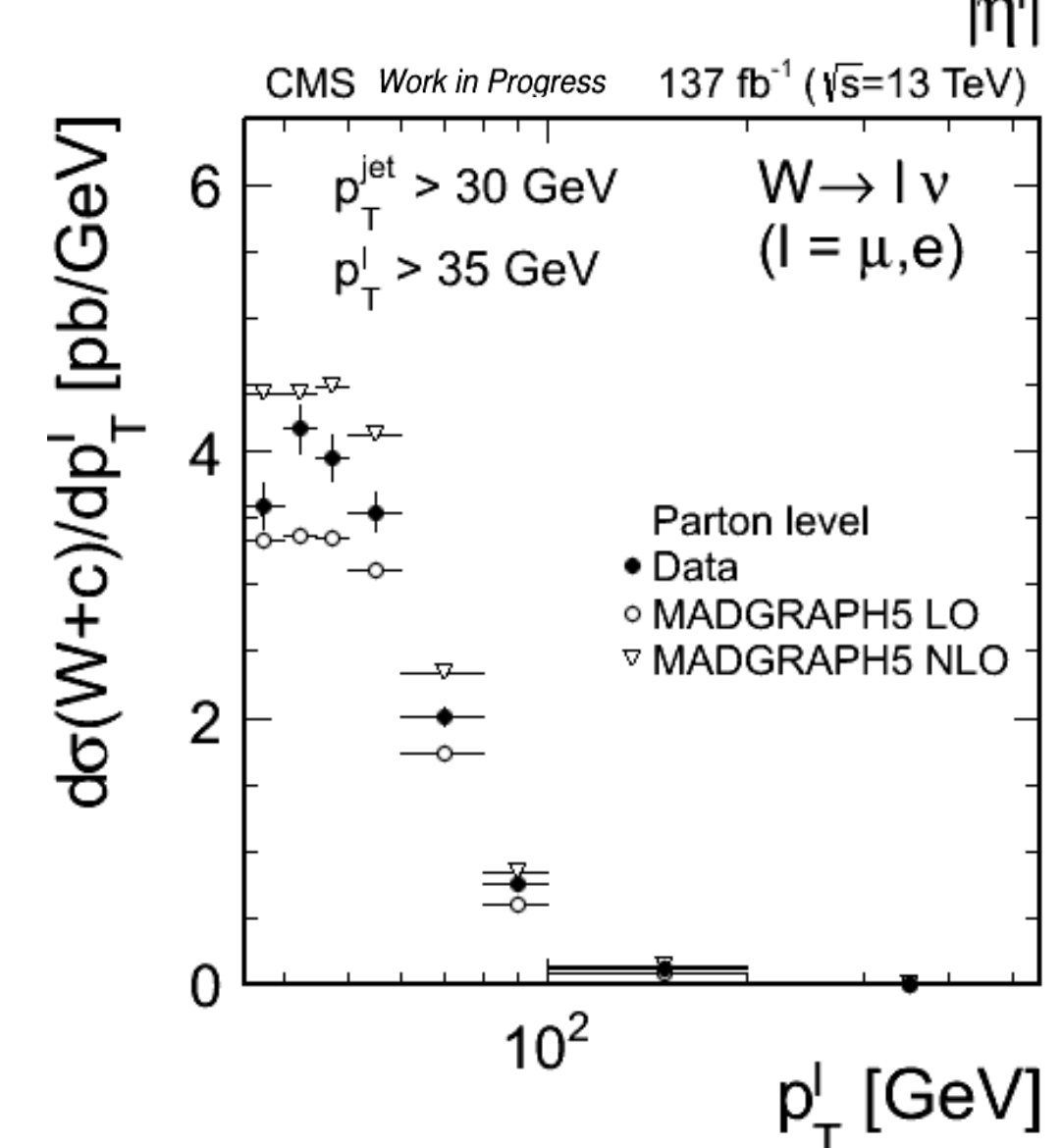
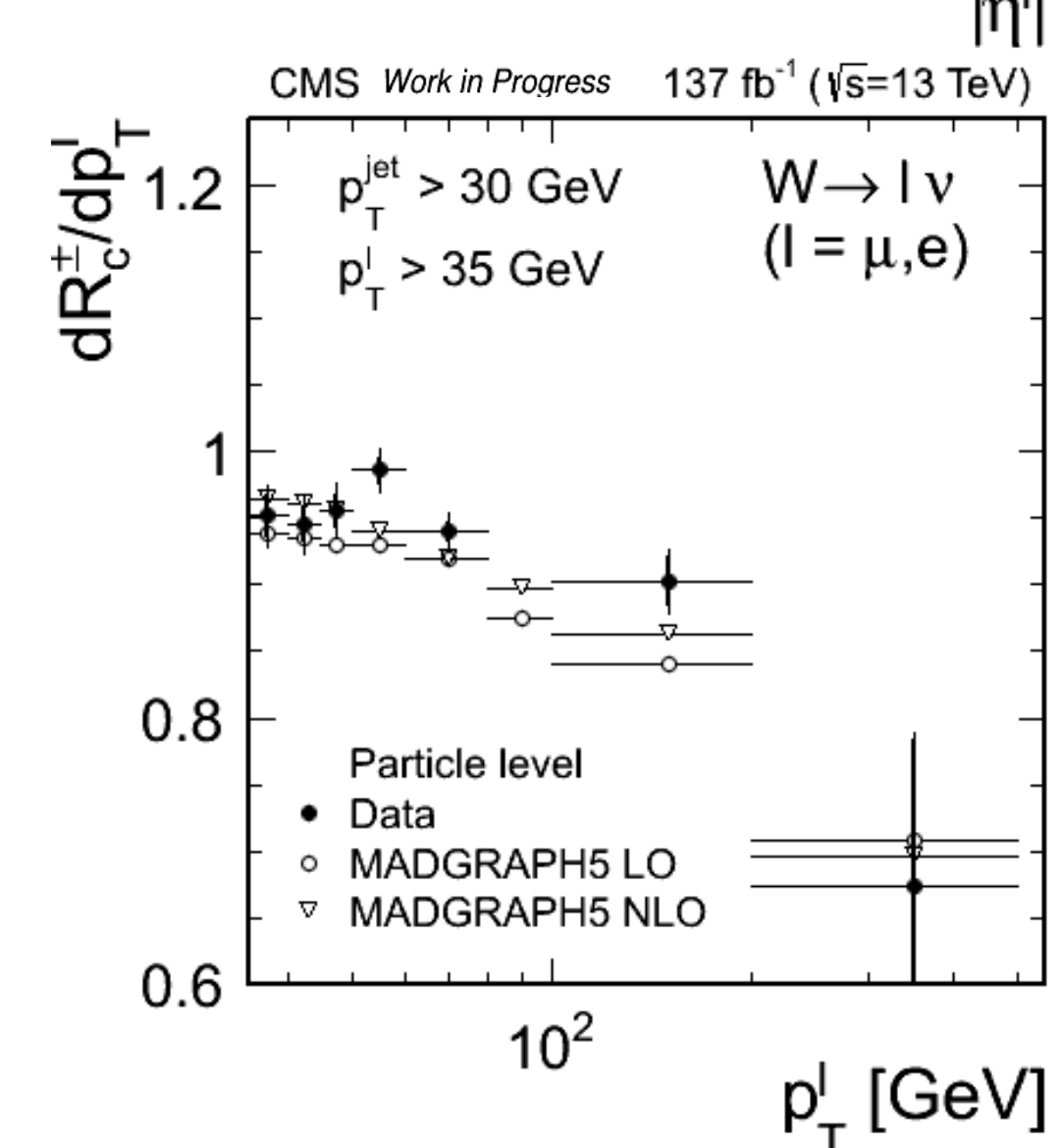
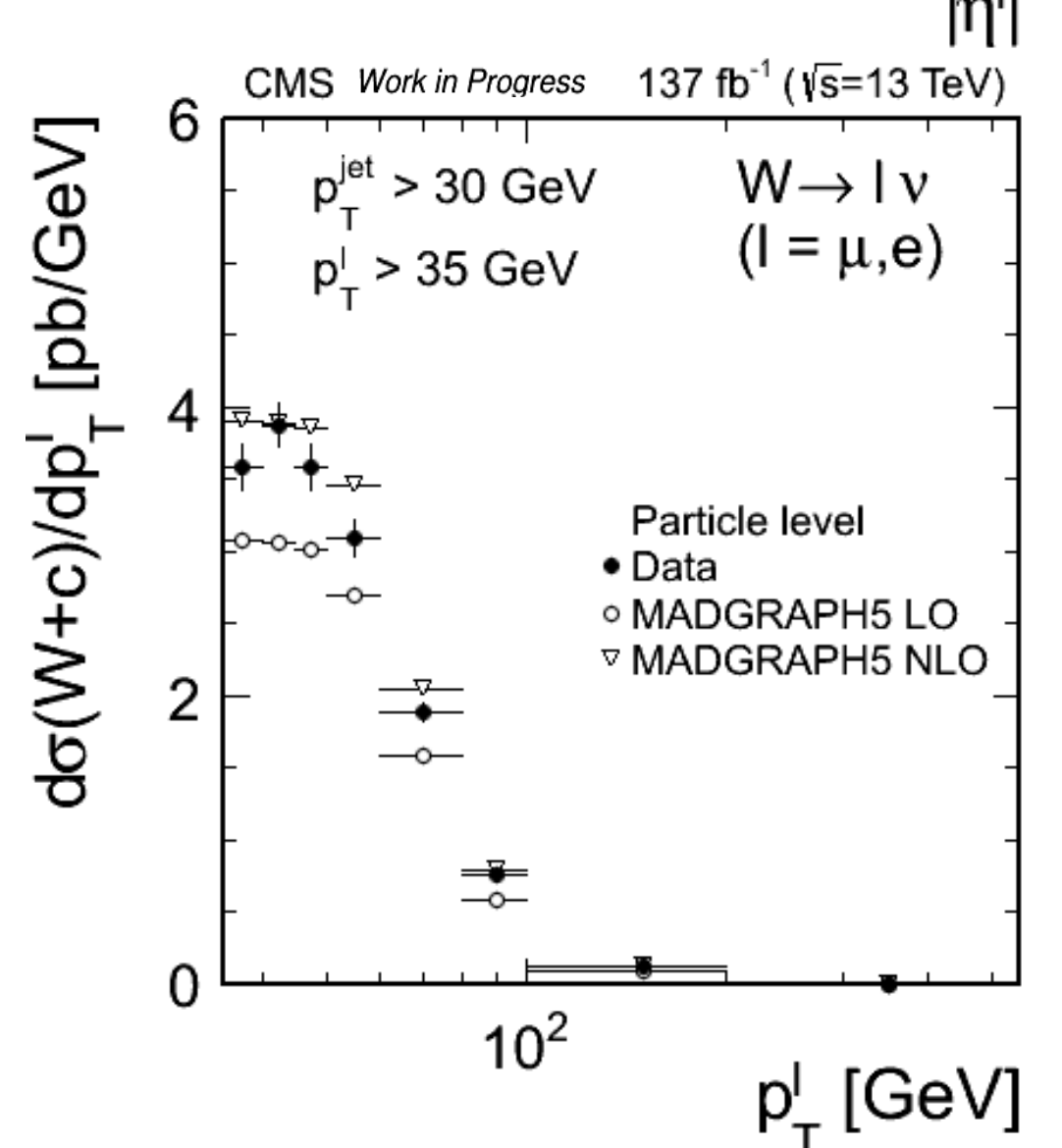
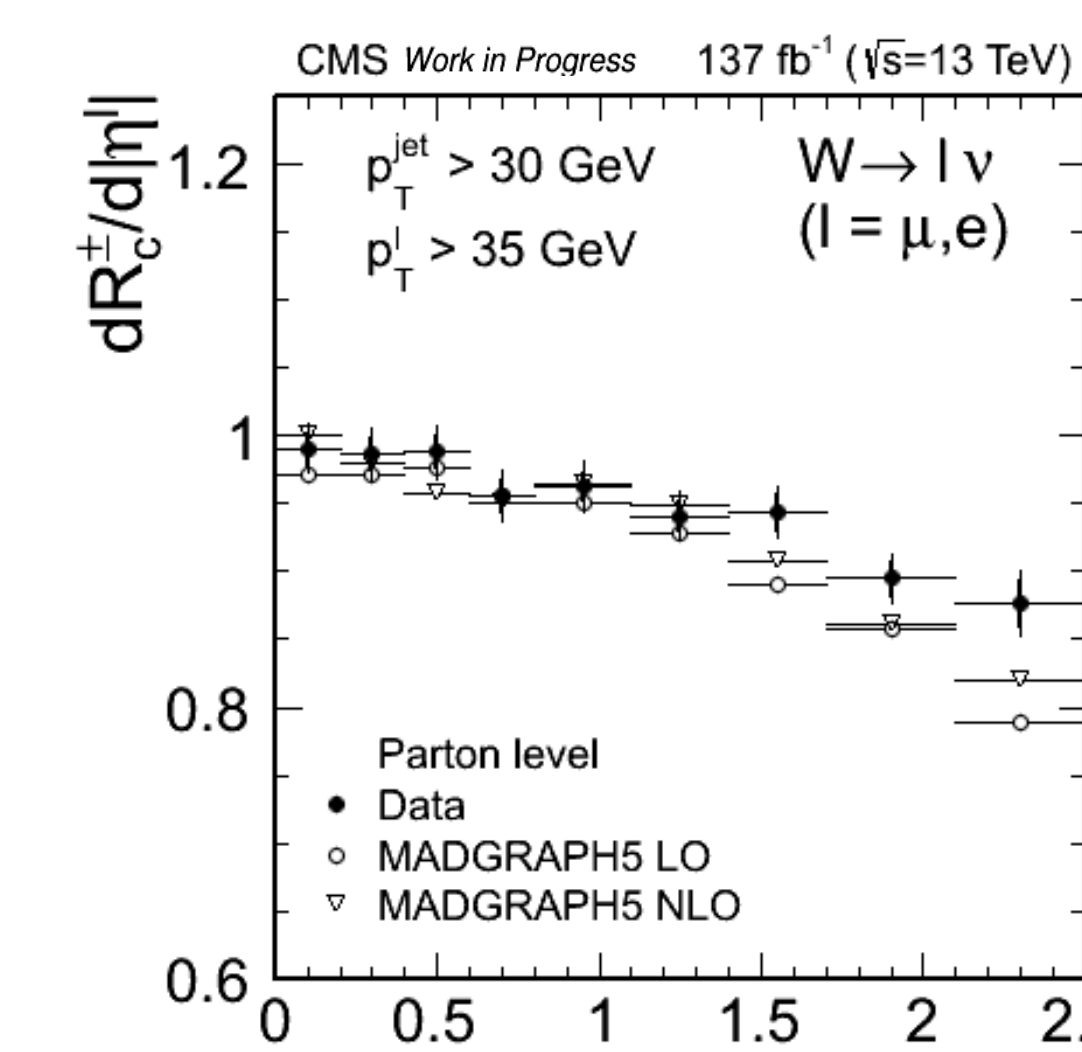
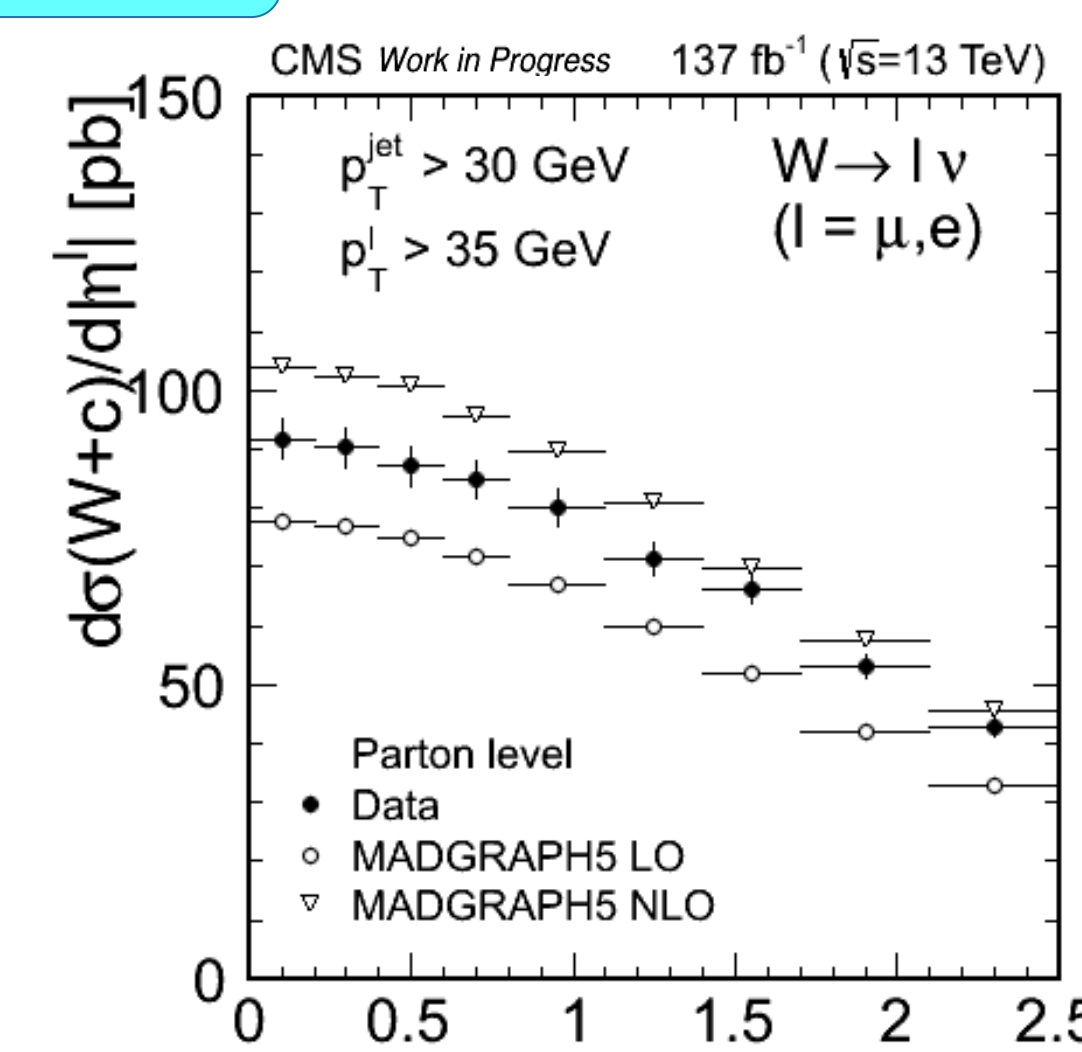
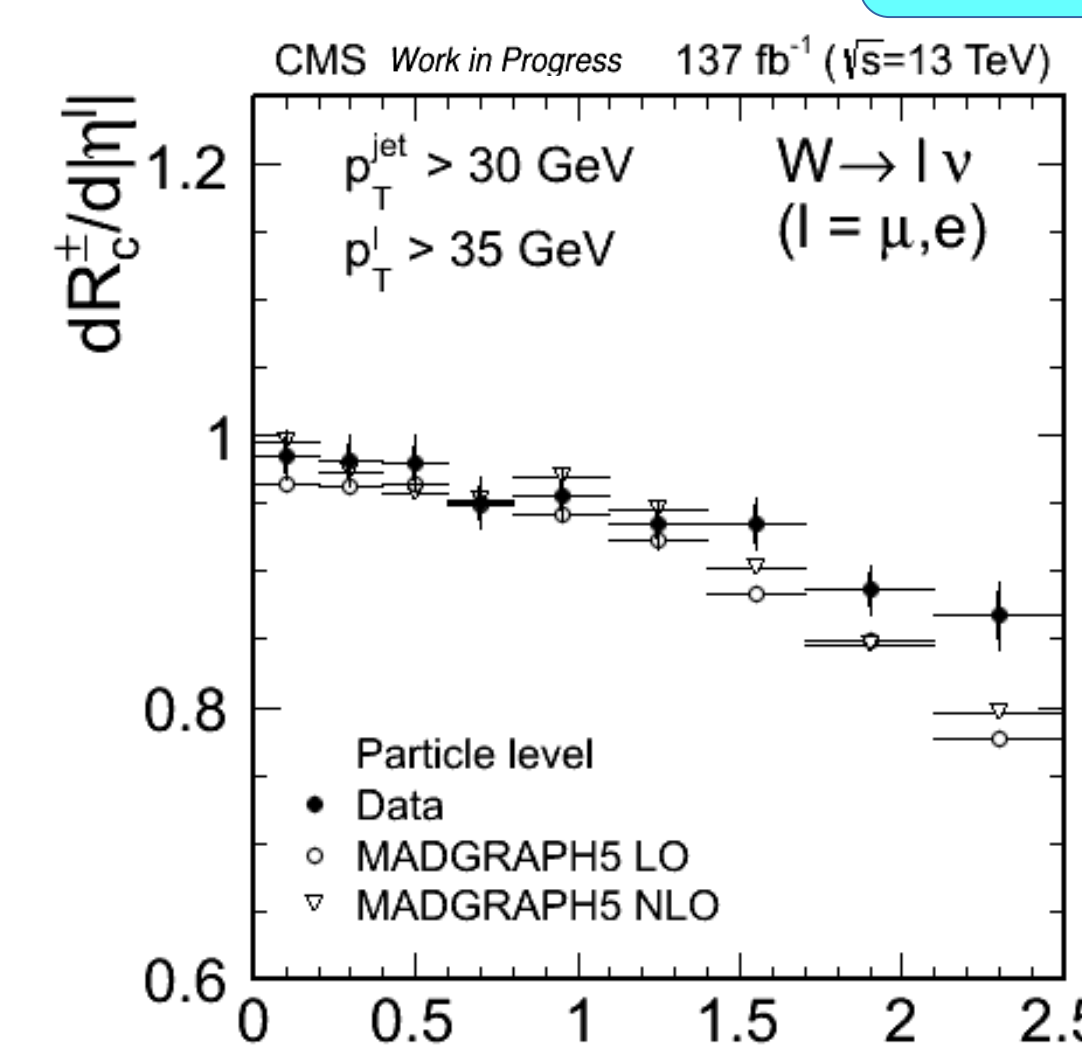
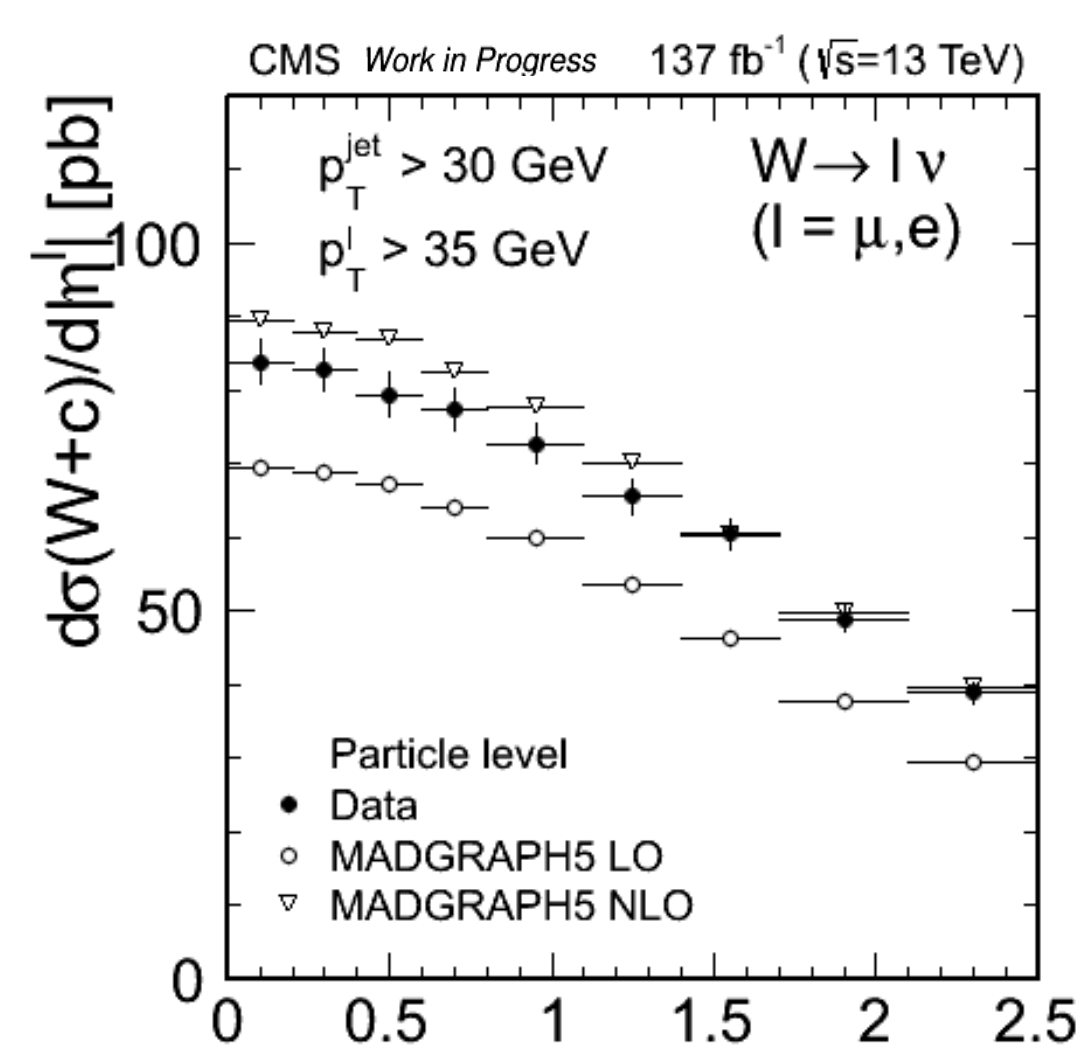


Control variables for the SL channel (top) and SV channel (bottom) after OS-SS subtraction.

Inclusive cross section



Differential cross section



- The $W+c$ production **cross section** and the **cross section ratio** $\sigma(W+ + \bar{c})/\sigma(W- + c)$ are measured **inclusively** in a fiducial region of phase space, and **differentially** as a function of the transverse momentum (p_T) and the absolute value of the pseudorapidity ($|\eta|$) of the lepton from the W boson decay.
- Measurements are performed at the **particle** and **parton** levels defined through the acceptance-times efficiency (\mathcal{C}), and are compared to **Monte Carlo** generators that implement calculations to leading order (LO) and next-to-leading order (NLO) in perturbative QCD interfaced with parton showering.