News ATLAS/CMS results from Moriond 2023

FH particle physics discussion

L.I Estevez Banos

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

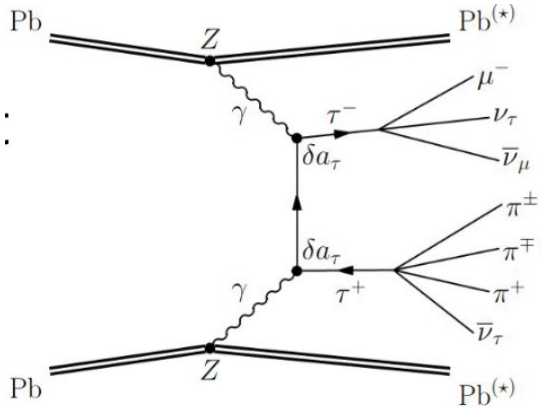
Heavy Ion

Ultraperipheral LHC – Large pHoton Collider

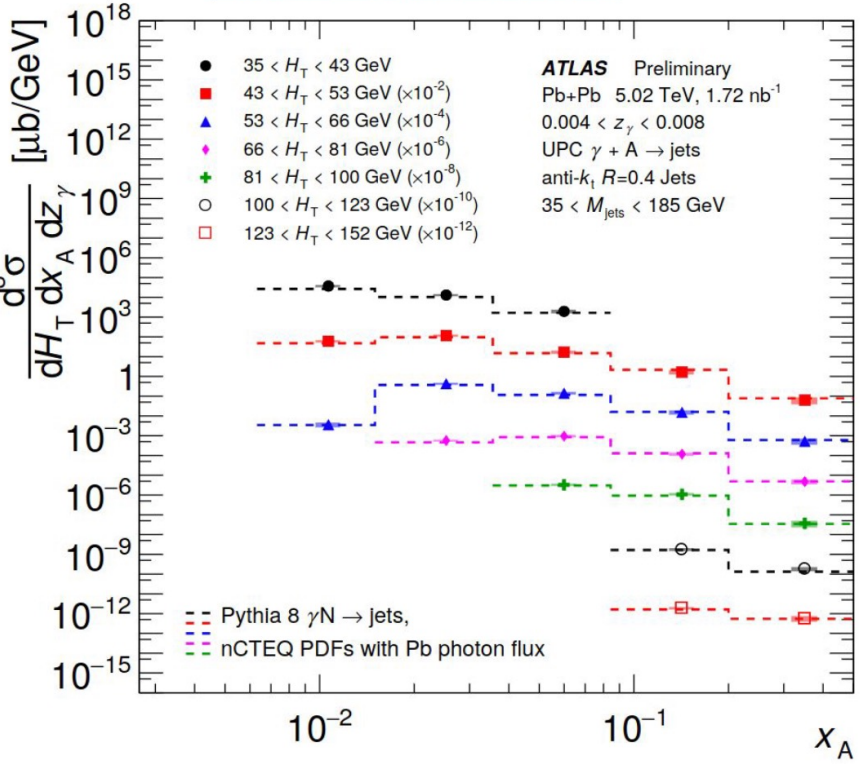
Ragoni **Baldenegro**

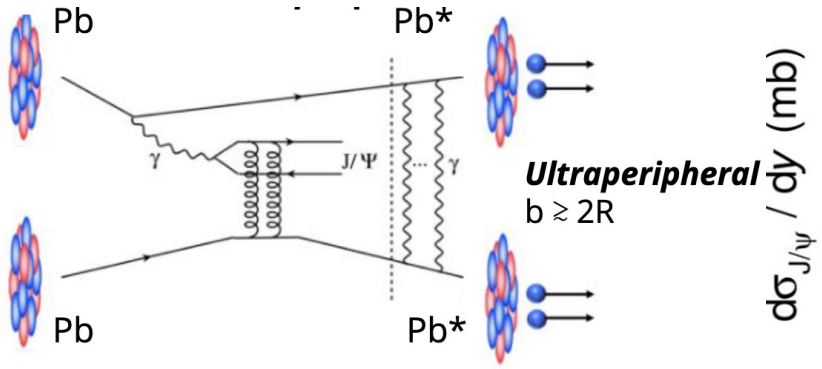
Rare decays and B-physics

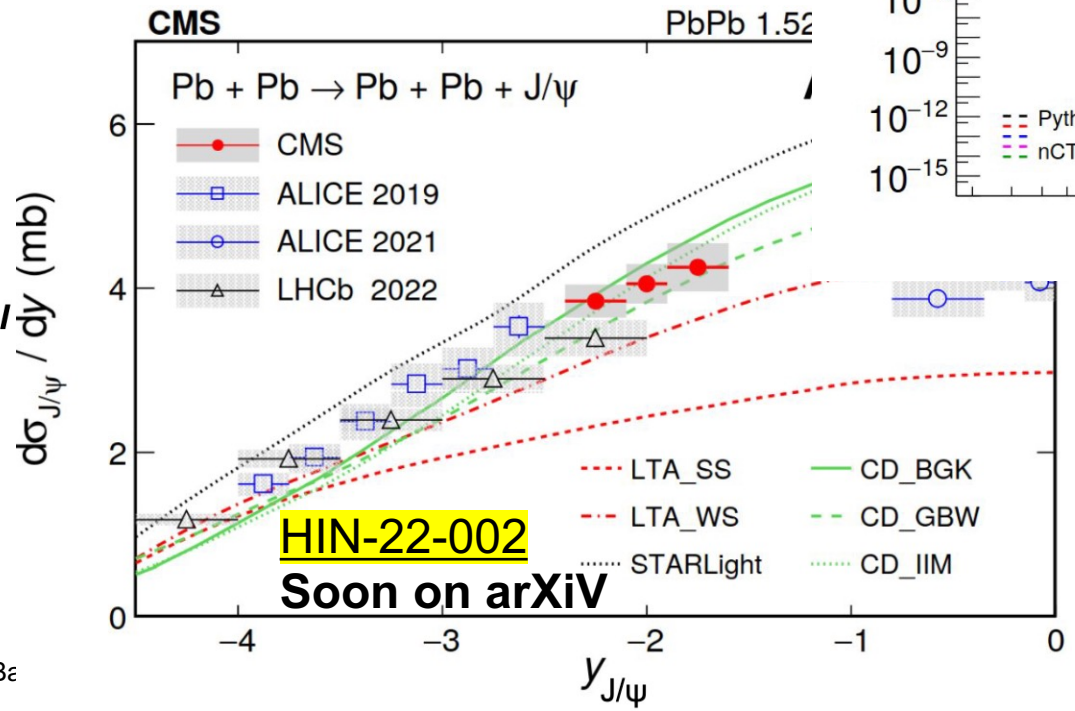
- ATLAS and CMS observed γγ→ τ+τ- in PbPb at the LHC as probe of τ's g-2
- CMS studied J/Psi production in γN
- ATLAS studied γPb →dijet + X



ATLAS-CONF-2022-021





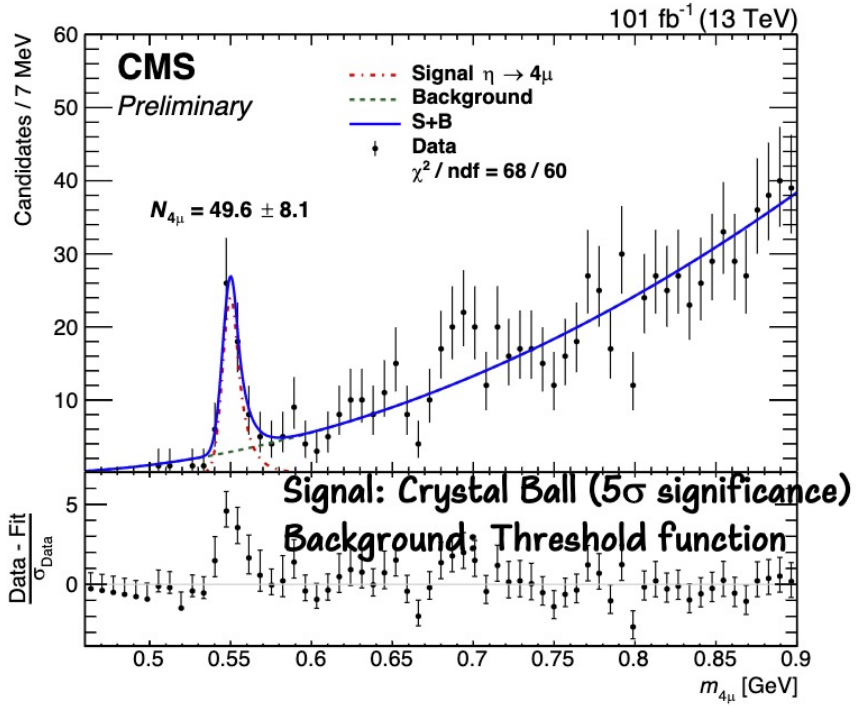


Sanjay K Swain

B-Physics in ATLAS and CMS

Rare decays and B-physics

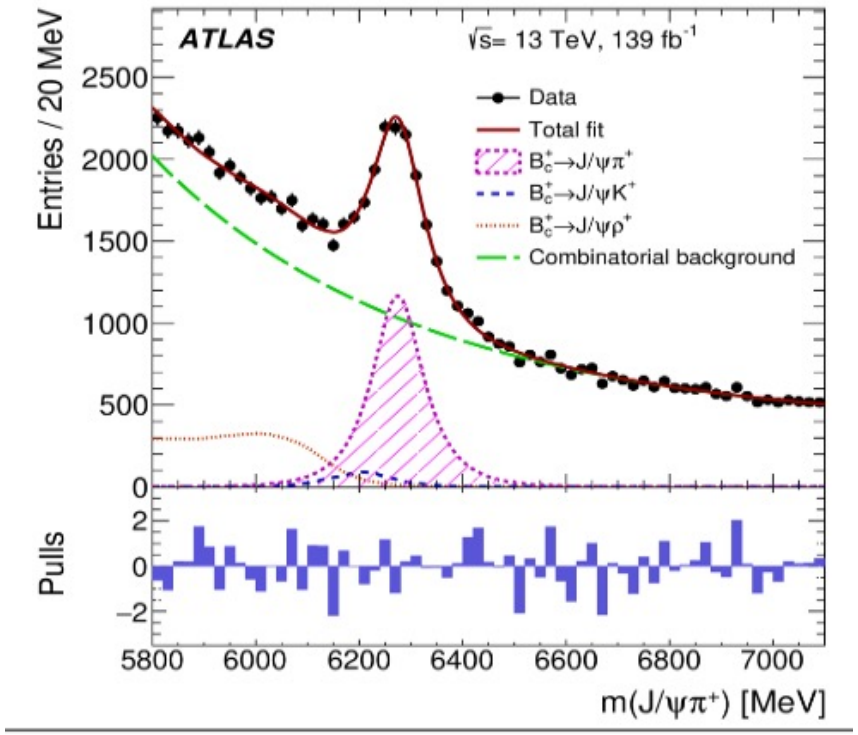
Observation of $\eta \to 4\mu$ narrow resonance Mass of 548 MeV (using high rate **low threshold triggers**)



$$\mathcal{B}(\eta \to 4\mu) = (5.0 \pm 0.8\,(\text{stat}) \pm 0.7\,(\text{syst}) \pm 0.7\,(\mathcal{B})) \times 10^{-9}$$

In agreement with SM: $(3.98 \pm 0.15) \times 10^{-9}$

$B_c^+ \longrightarrow J/\psi D_s^{(*)+}$ decay with ATLAS data



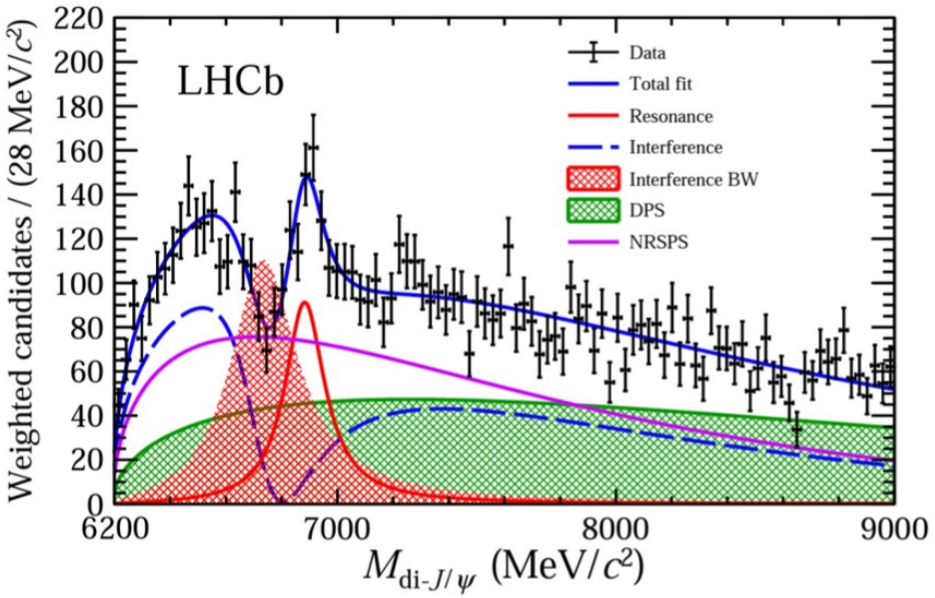
The decay of $B_c^+ \longrightarrow J/\psi D_s^{(*)+}$ is reported and compared with different theoretical calculations.

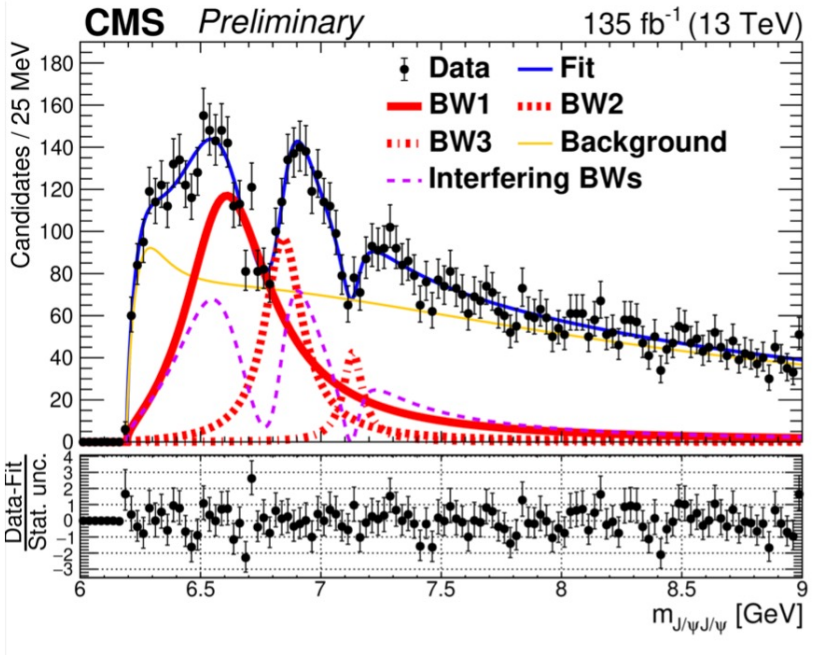
Sanjay K Swain

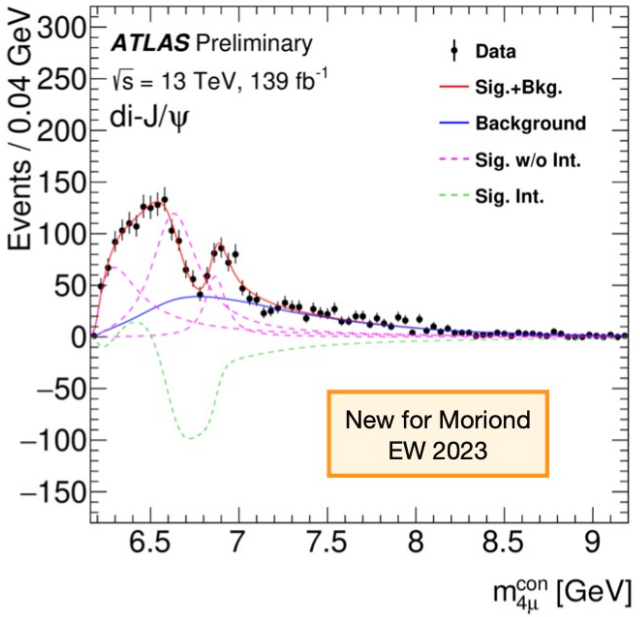
Di-charmonium State studies at ATLAS and CMS

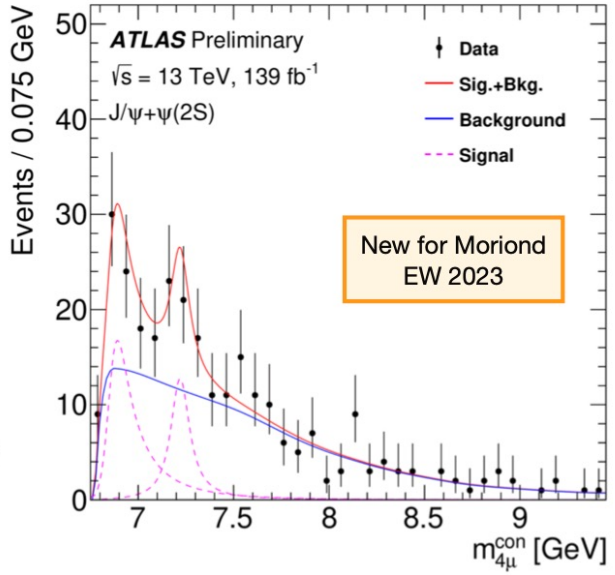
Complex states studies

- Di-charmonium ($J/\psi J\psi$, $J/\psi\psi 2s$) mass spectrum studied by CMS and ATLAS (following observation by LHCb).







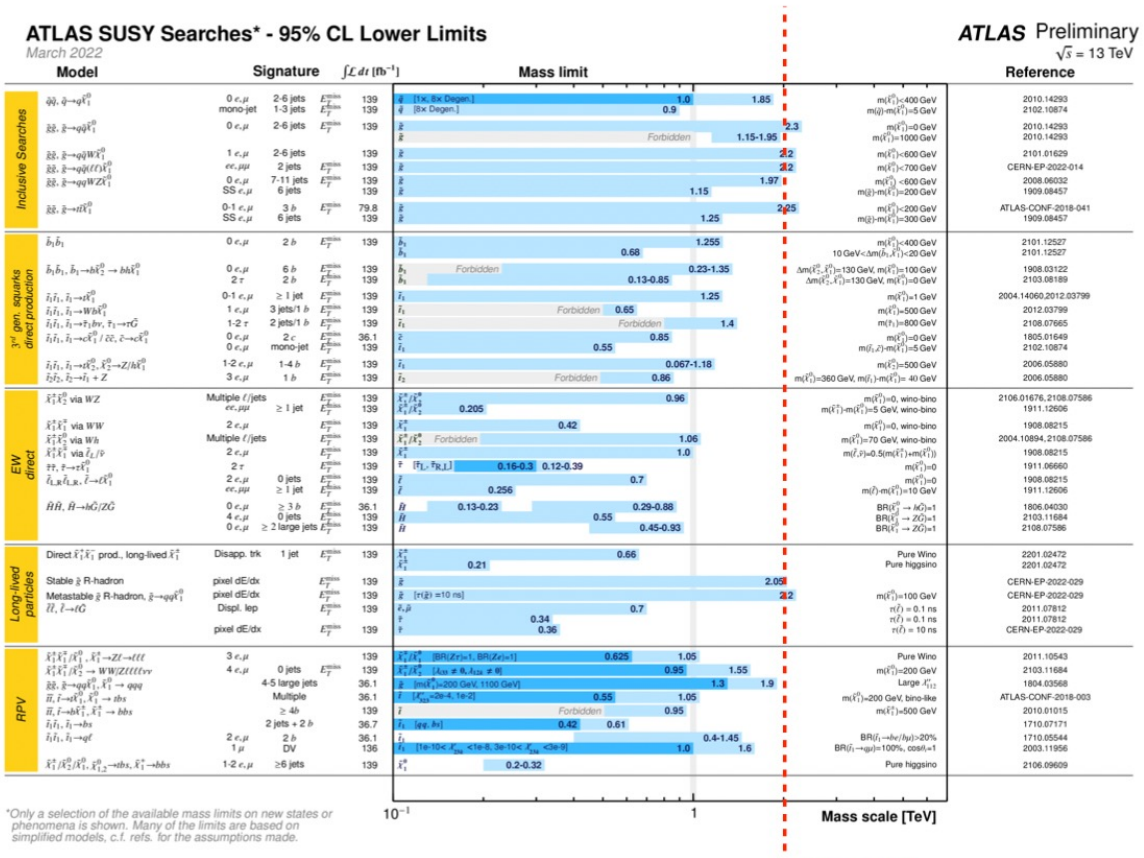


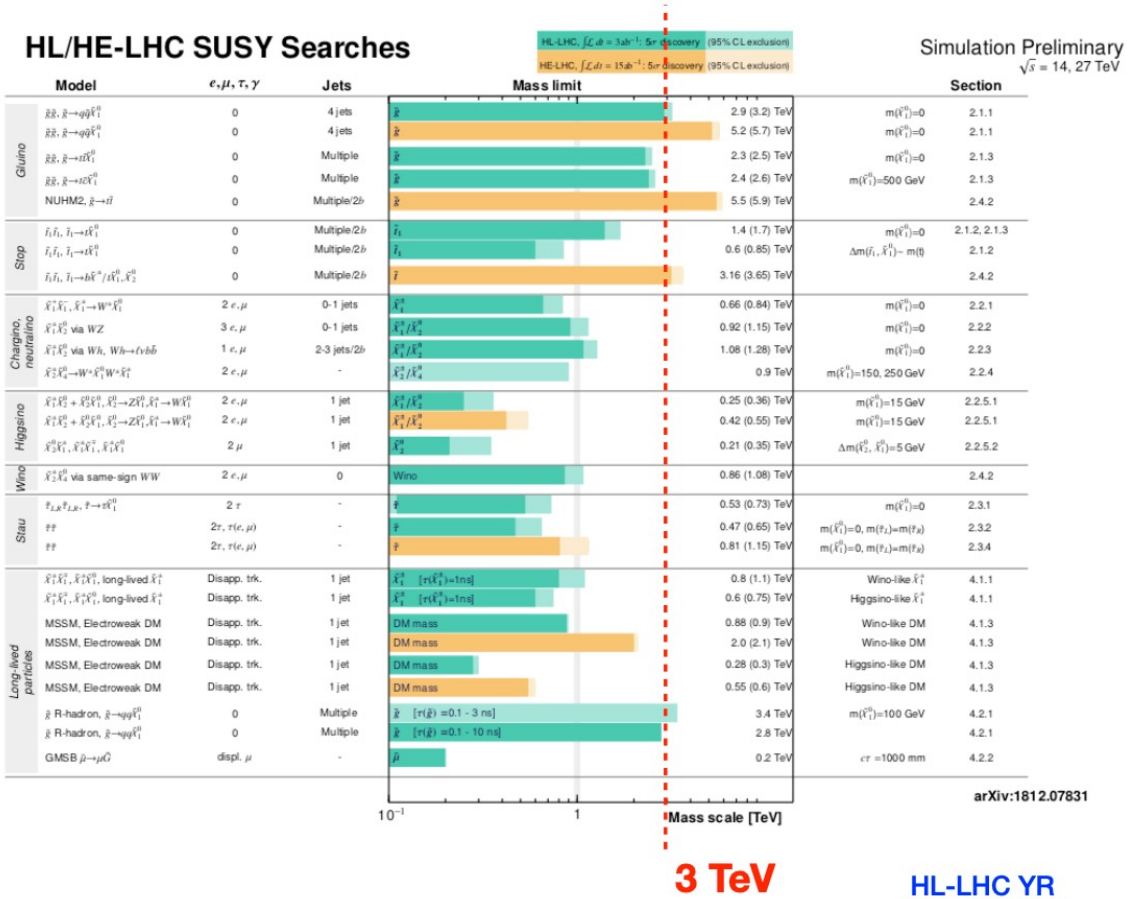
The detailed interpretation of the structures still have to be confirmed (four charm tetra quark?)

New Phenomena Searches

Searches (SUSY) for new physics (ATLAS/CMS)

Large variety of topologies and models for searches



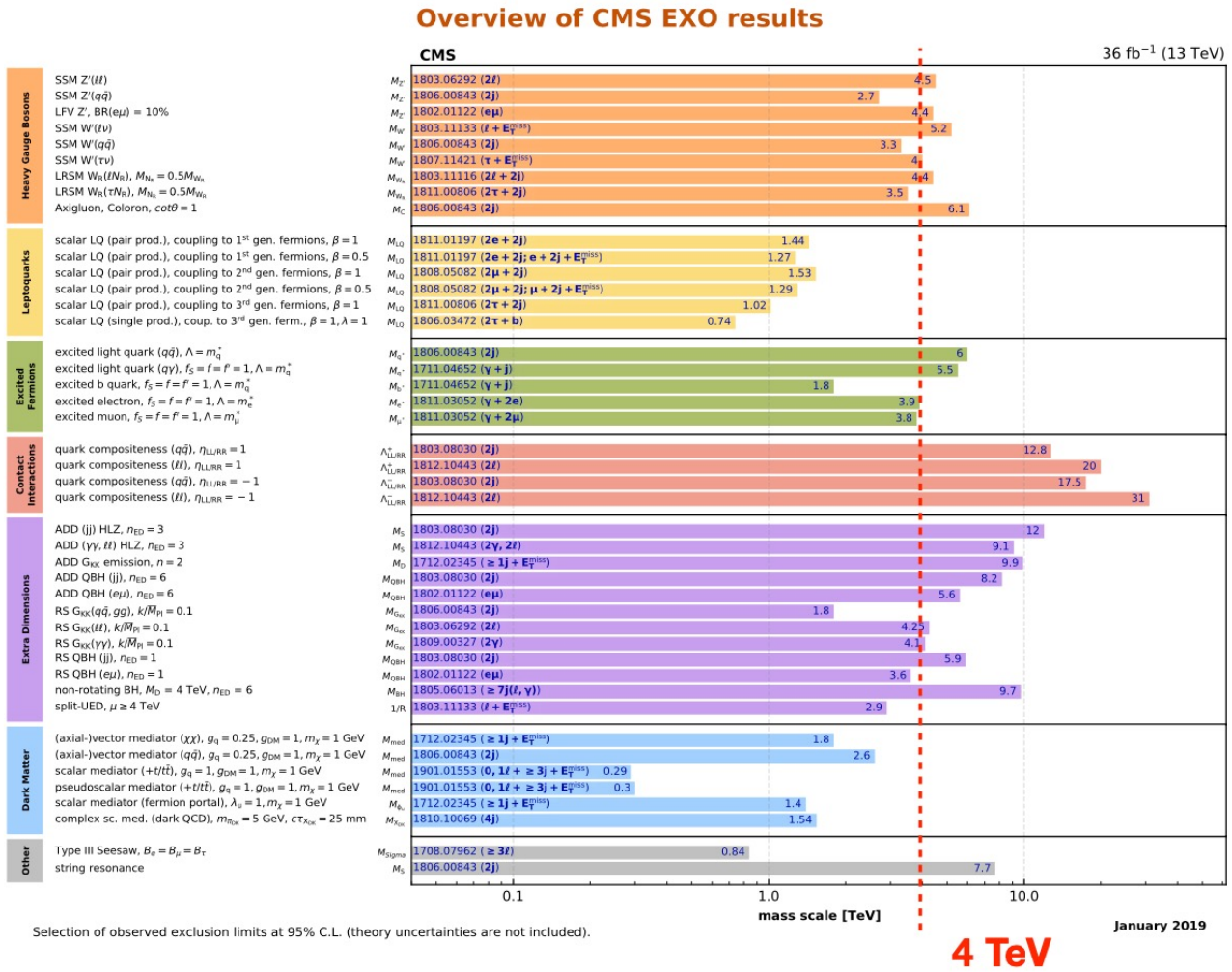


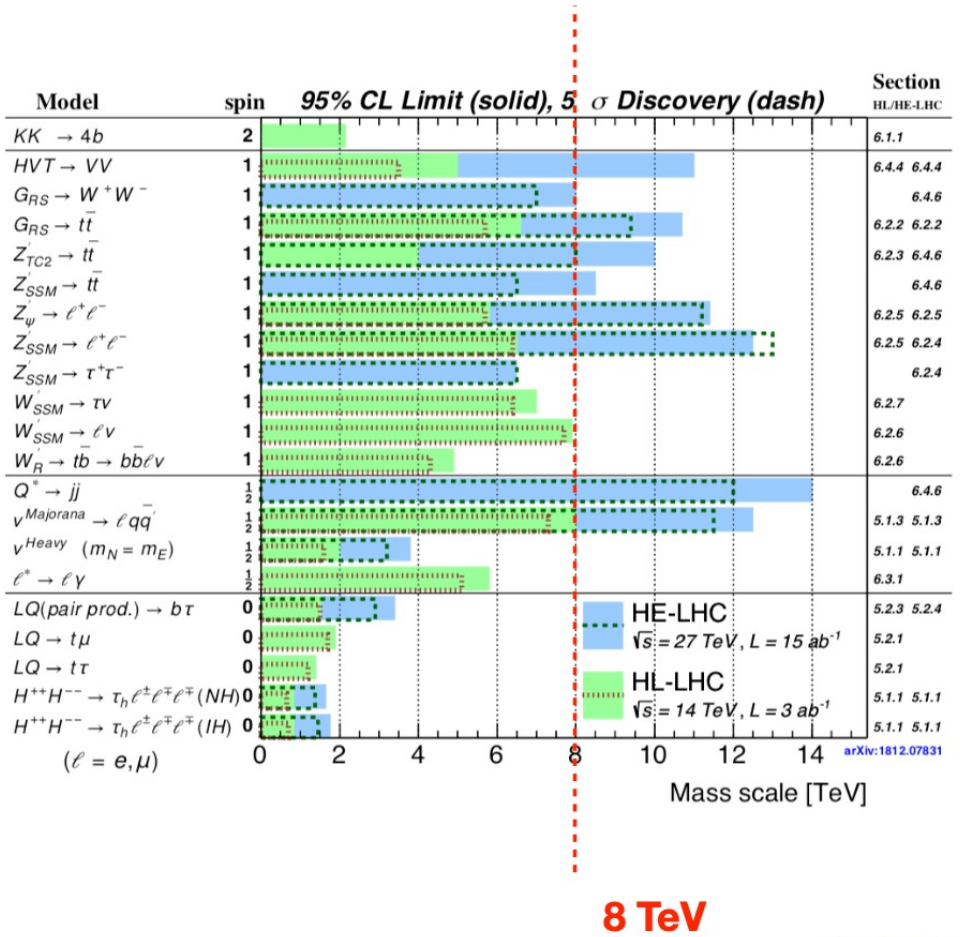
HL-LHC YR
1812.07831

Example from ATLAS (similar for CMS)

Searches (EXO) for new physics (ATLAS/CMS)

Large variety of topologies and models for searches





HL-LHC YR
1812.07831

Example from CMS (similar for ATLAS) - latest plot in the backup!

Searches for new physics (ATLAS/CMS)

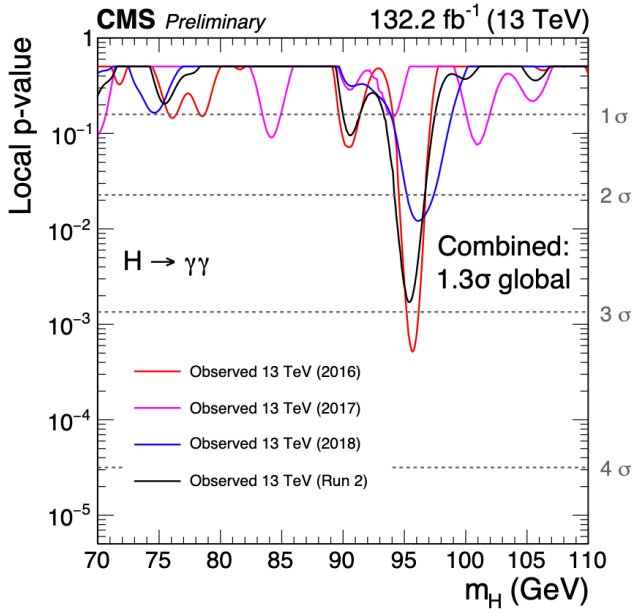
Some take home messages from searches at the LHC

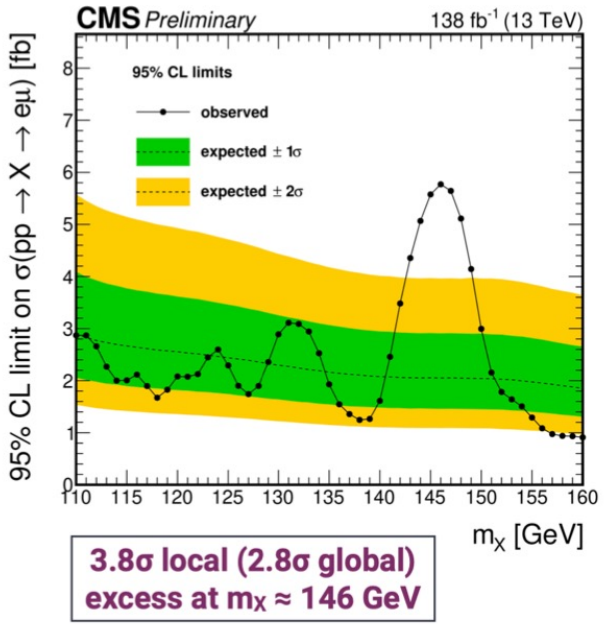
SUSY searches potential for HL-LHC

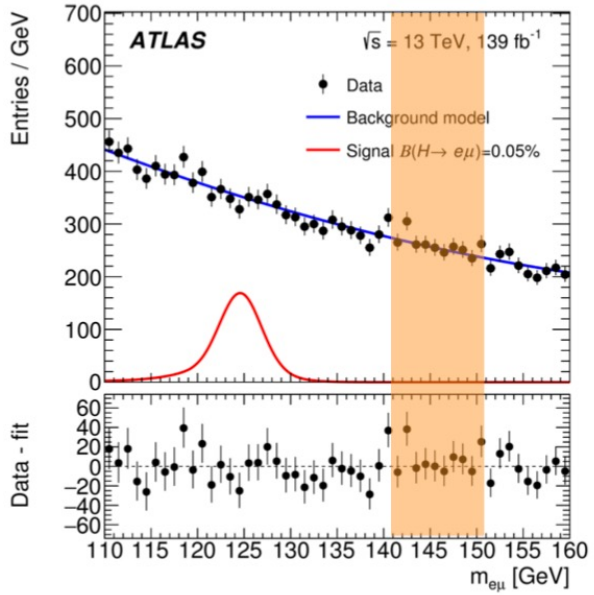
- Discovery potential of gluinos up to O(2-3 TeV)
- Discovery potential of stops up to O(1.5 TeV)
- Discovery potential of EW SUSY up to O(1 TeV)

EXO searches potential for HL-LHC

- Z'and W' up to 6 TeV and 8 TeV
- Leptoquarks (1.5-2 TeV)







Low energy anomalies can be immediately checked at the energy frontier at the LHC

Searches for new physics (ATLAS/CMS)

Gonzalo

What to do next ? Should we continue searches model by model ?

New tool using ML in development for global searches

GAMBIT: The Global And Modular BSM Inference Tool

gambit.hepforge.org. github.com/GambitBSM EPJC 77 (2017) 784 arXiv:1705.07908

- Extensive model database, beyond SUSY
- Fast definition of new datasets, theories
- Extensive observable/data libraries
- Plug&play scanning/physics/likelihood packages
- Various statistical options

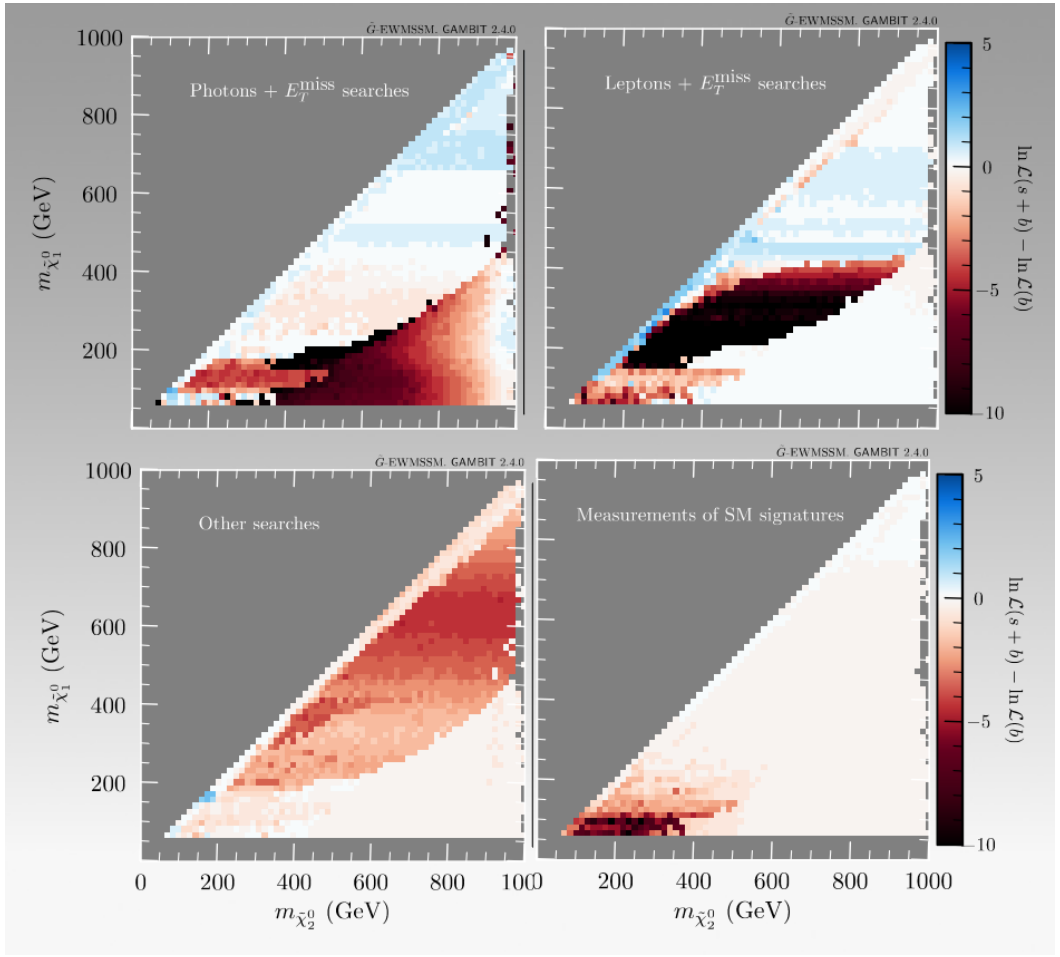
Impact of searches and measurements

→ Photon searches exclude low mass binos

→ Lepton searches exclude low mass winos

→ Boosted boson searches exclude high mass winos

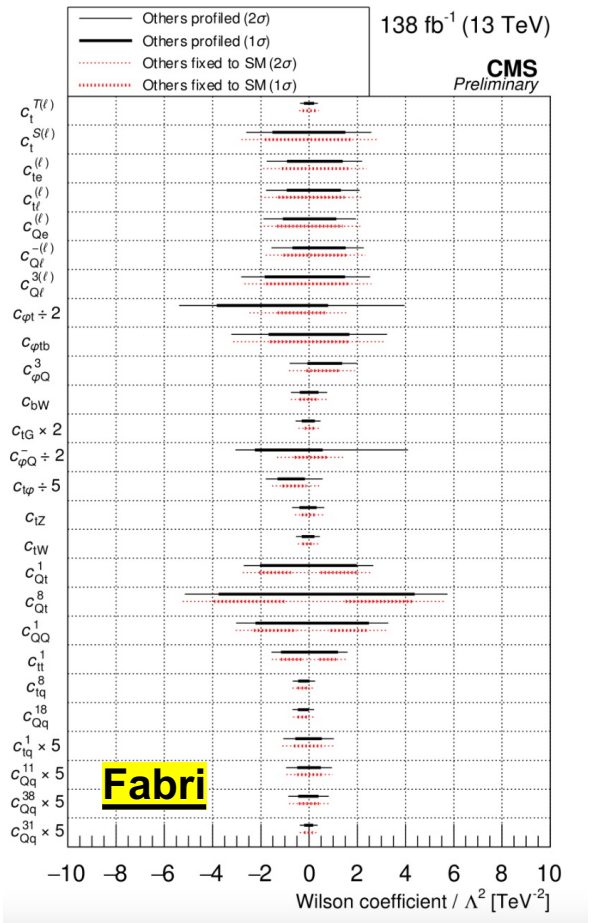
→ Measurements exclude low mass Higgsino and winos

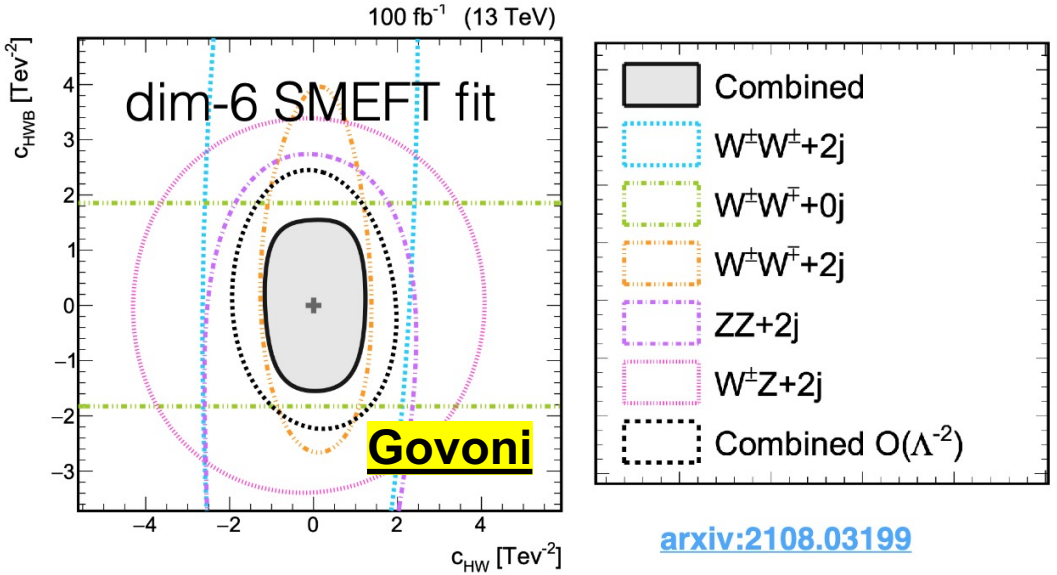


Searches for new physics (ATLAS/CMS)

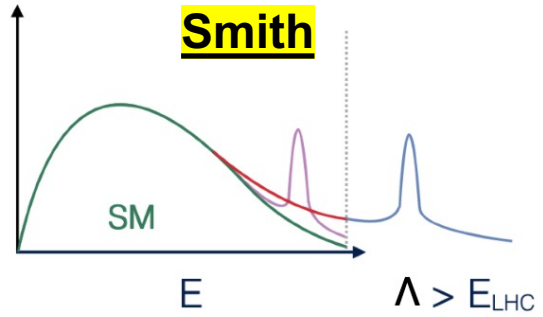
What to do next ? Should we continue searches model by model ?

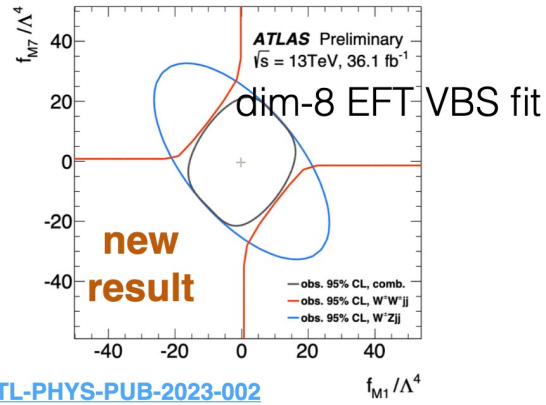
EFT instead of going model by model





arxiv:2108.03199





ATL-PHYS-PUB-2023-002

$$\mathscr{L} = \mathscr{L}_{SM} + \sum_i^1 \frac{c_i}{\Lambda}\mathcal{O}_i^{(5)} + \sum_i^{2499} \frac{c_i}{\Lambda^2}\mathcal{O}_i^{(6)} + \cdots$$

QCD

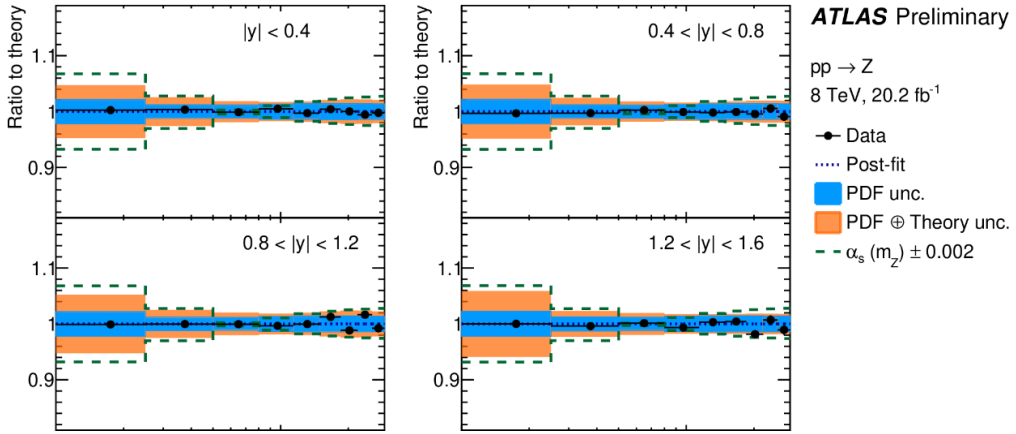
Precise determination of α_S

Most precise determination in hadron colliders

$$\alpha_S(m_Z) = 0.1183 \pm 0.0009$$

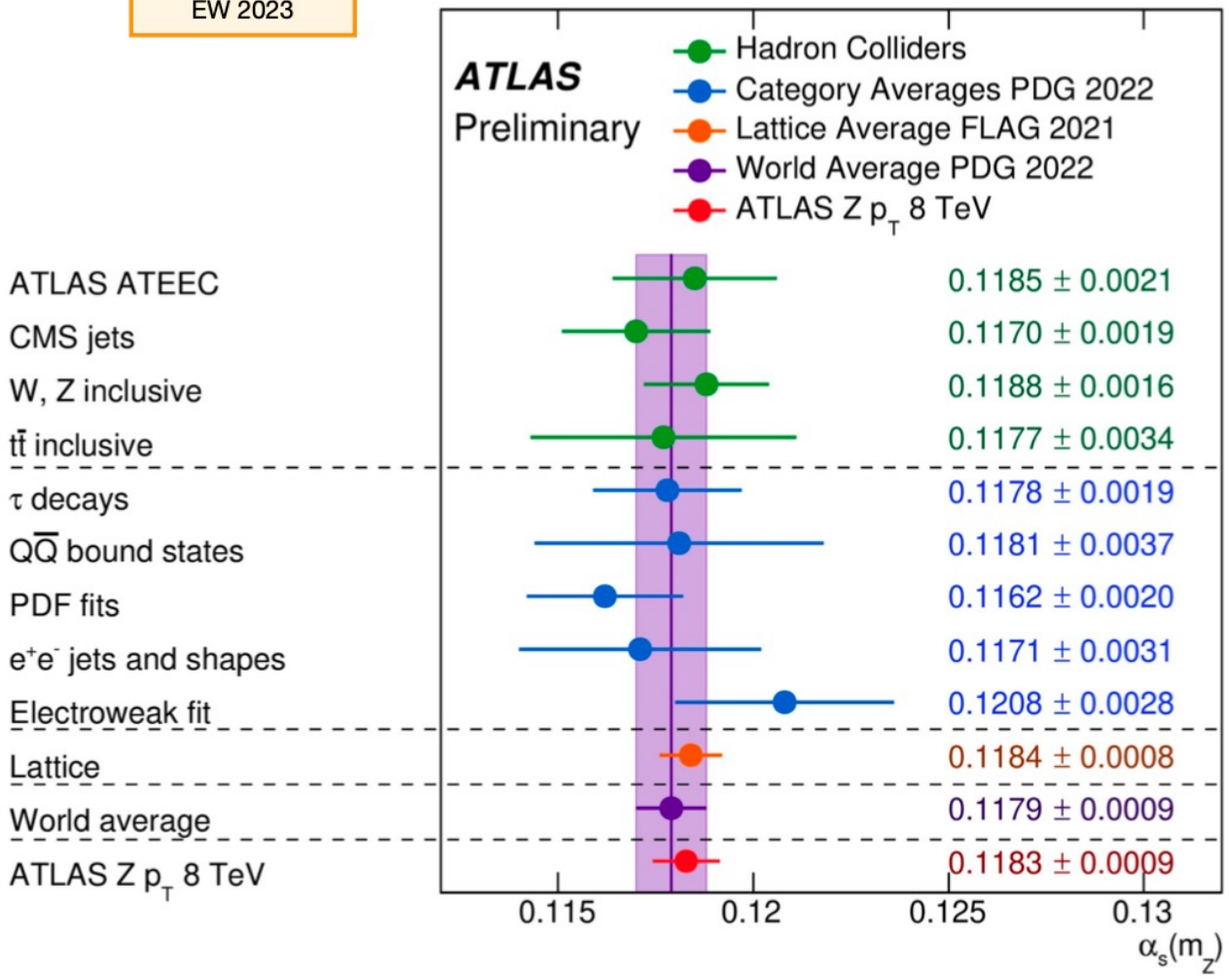
Kivernyk

- Very precise measurement of α_S in ATLAS
  - Derived from Z boson p T in 8 TeV data



Experimental uncertainty	+0.00044	-0.00044
PDF uncertainty	+0.00051	-0.00051
Scale variations uncertainties	+0.00042	-0.00042
Matching to fixed order	0	-0.00008
Non-perturbative model	+0.00012	-0.00020
Flavour model	+0.00021	-0.00029
QED ISR	+0.00014	-0.00014
N4LL approximation	+0.00004	-0.00004
Total	+0.00084	-0.00088

New for Moriond EW 2023



W mass measurement from ATLAS

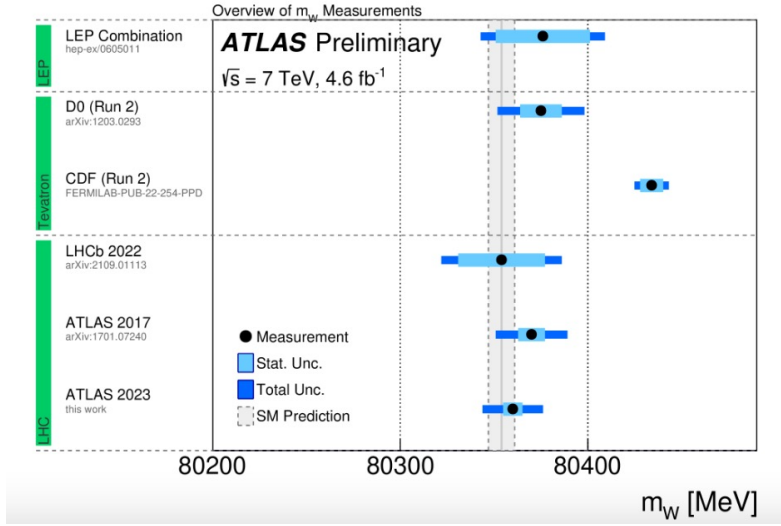
Kivernyk

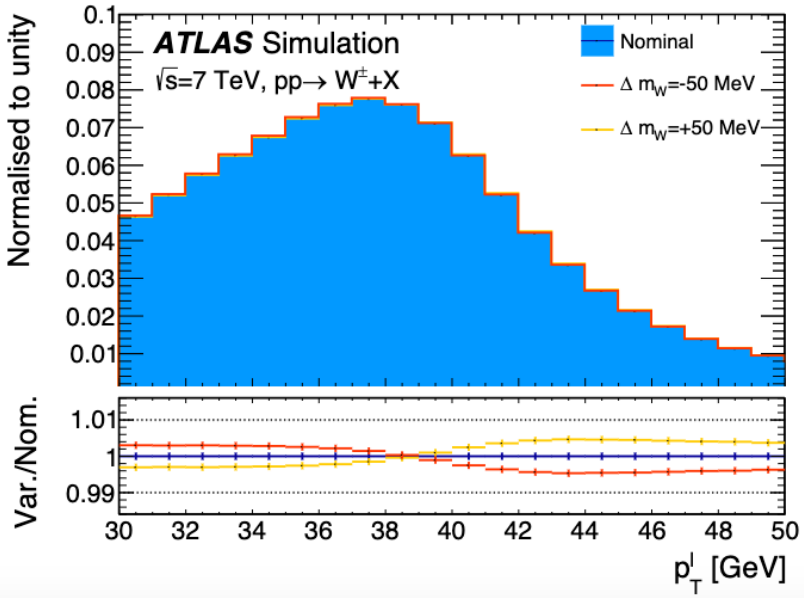
Most precise determination in hadron colliders

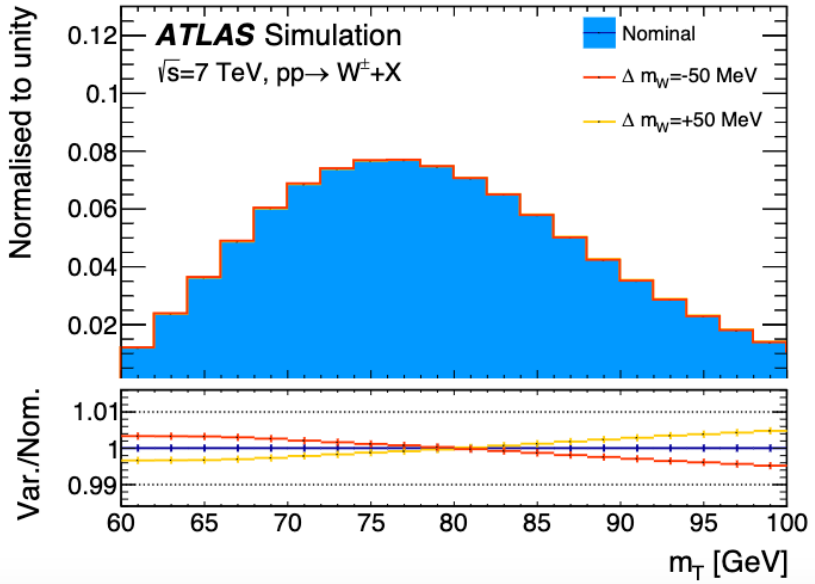
- Crucial parameter for testing self-consistency of the SM
  - 2017 ATLAS result at 7 TeV (80370 ± 19 MeV)
  - Measurement is based on the Template-Fit to p_T^l, and m_T^W distributions by χ^2 minimization

Improvement of W mass measurement at 7 TeV

$$80360 \pm 5(stat) \pm 15(syst) = 80360 \pm 16 \text{ MeV}$$





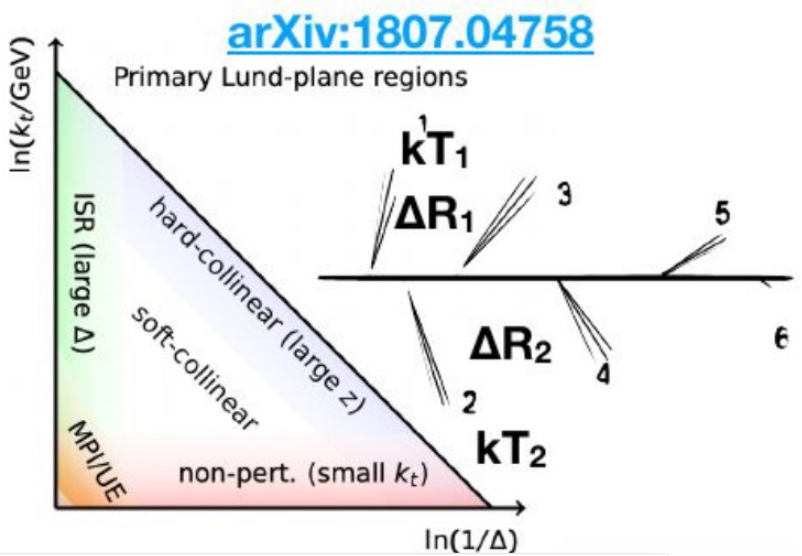


Lund jet plane density measurement

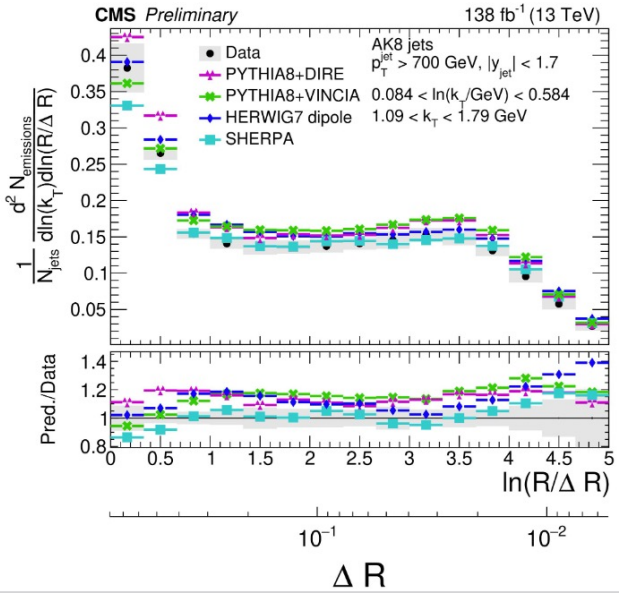
Negro

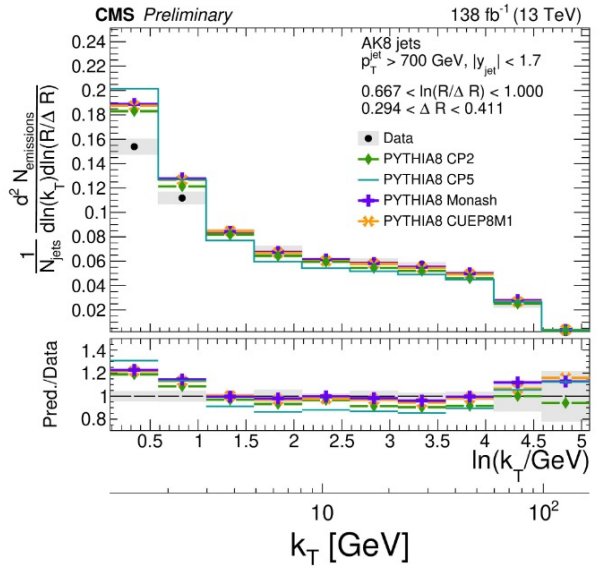
Precision measurement

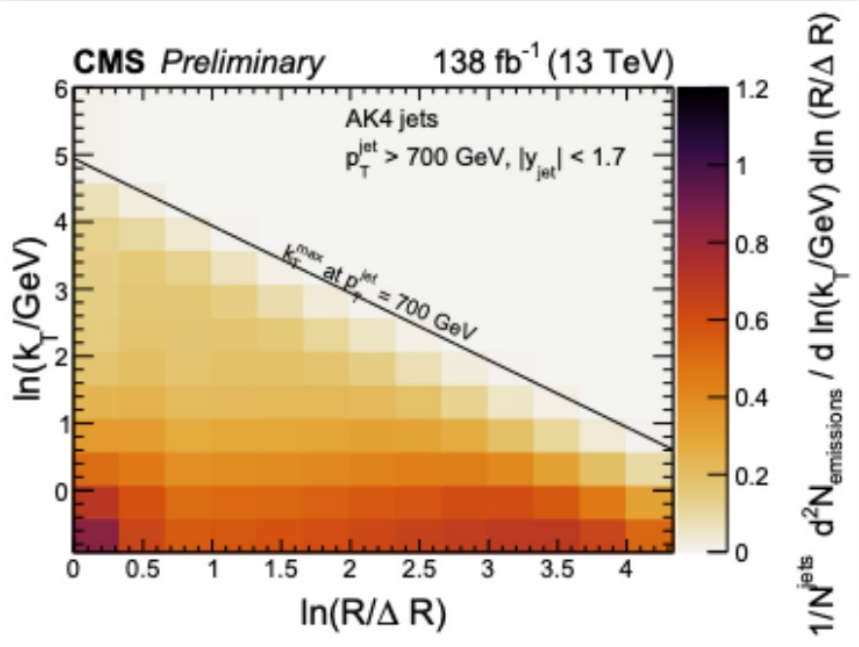
- Study the emission of radiation in jets
- Jet pT > 700 GeV
- Measured for AK4 and AK8 jets



$$\Delta R = \sqrt{(y_{\text{soft}} - y_{\text{hard}})^2 + (\phi_{\text{soft}} - \phi_{\text{hard}})^2} \qquad k_{\text{T}} = p_{\text{T}} \Delta R$$







Top physics

Four tops finally observed

Fabri

Extremely rare process in SM

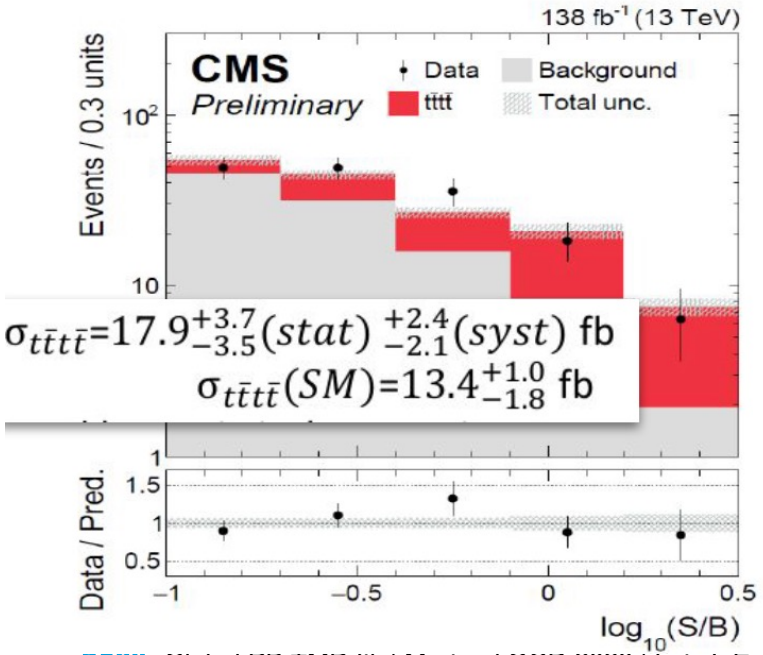
- Both CMS and ATLAS reported observation (>5 σ) of tttt production

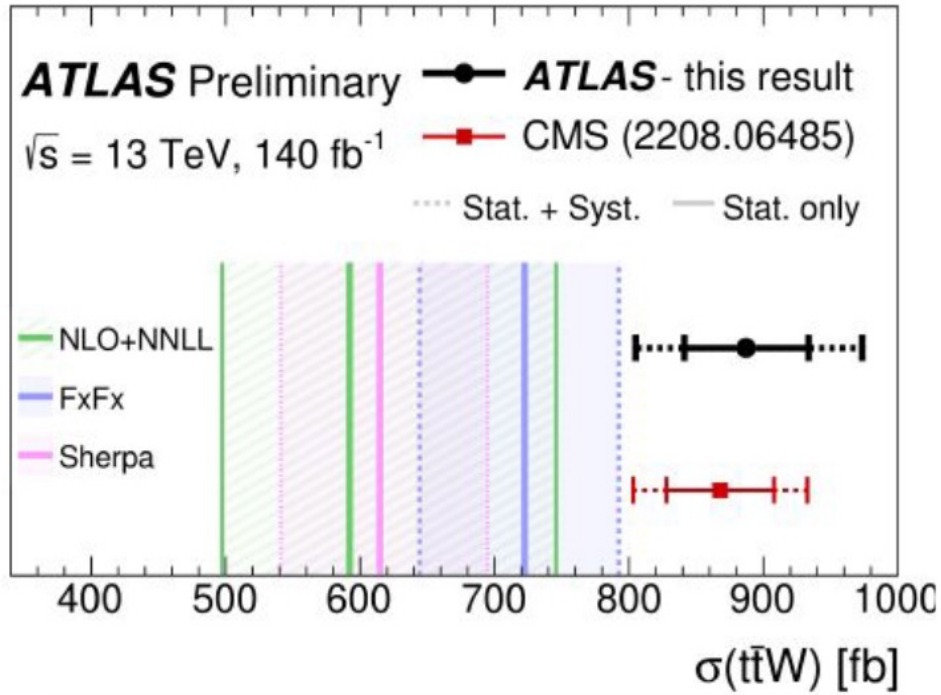
  DNN/BDT score fit to di

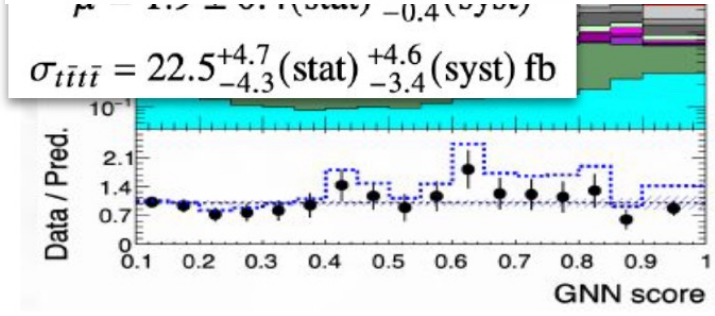
- ATLAS tested correla

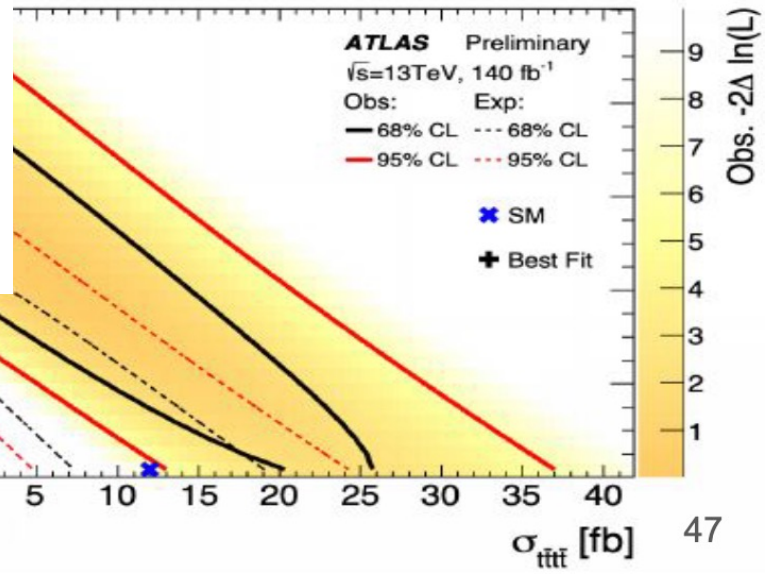
  Same shape, expected aller

  Highly correlated (the fr mild constraints on tt would anyhow be sufficient to clea









ttW process is a hot topic

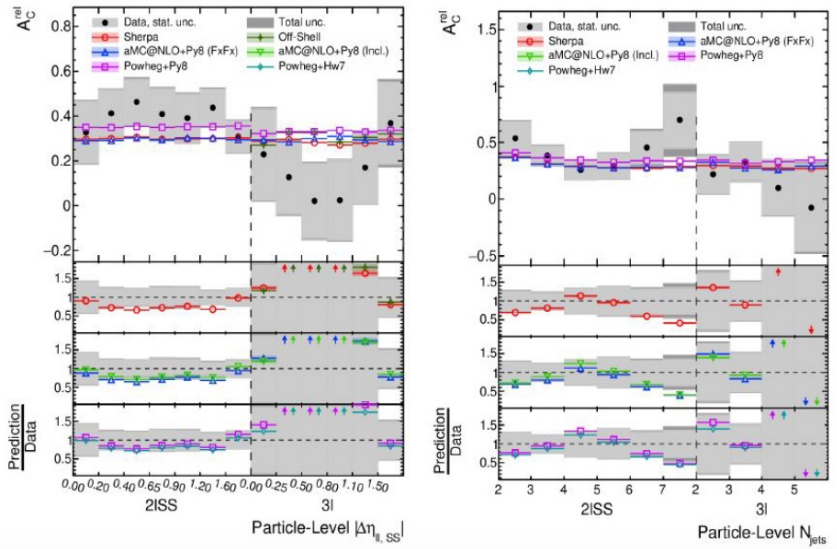
Fabri

Still not totally in agreement with SM

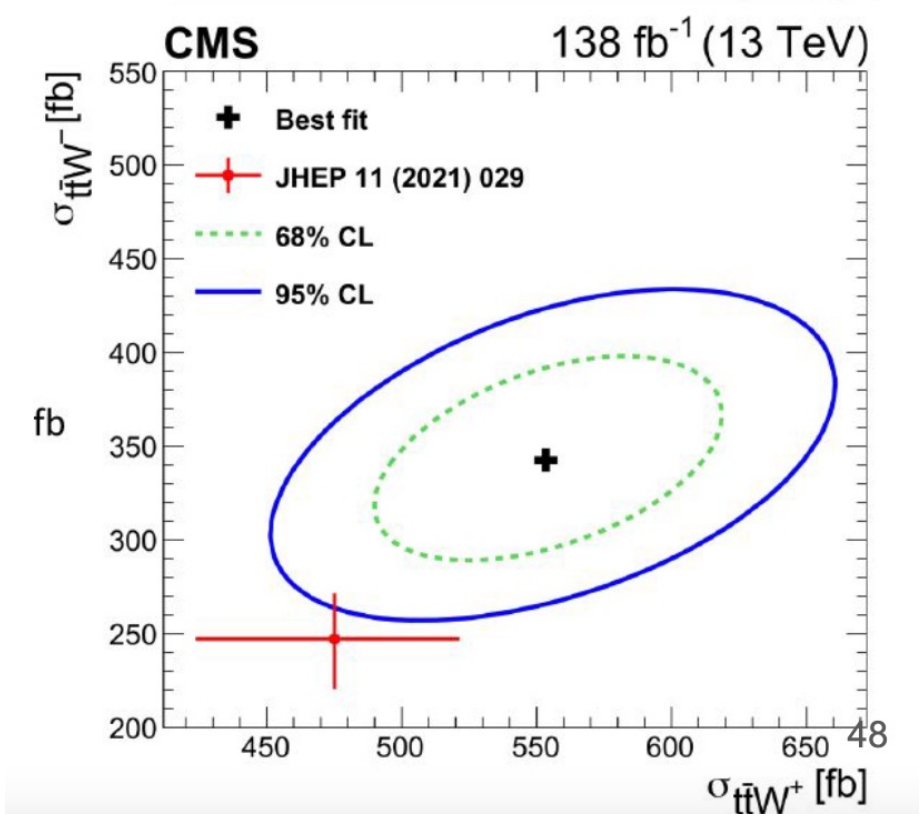
- a background in many channels (e.g. 4tops)
- both inclusive and differential measurements show some disagreement with theory predictions

$t\bar{t}W$ — $A_C^{rel} = \frac{\sigma(t\bar{t}W^+) - \sigma(t\bar{t}W^-)}{\sigma(t\bar{t}W^+) + \sigma(t\bar{t}W^-)}$

ATLAS-CONF-2023-019



Dedicated off-shell calculation compared with results in the 3l channel (Eur. Phys. J. C 81 (2021) 675)

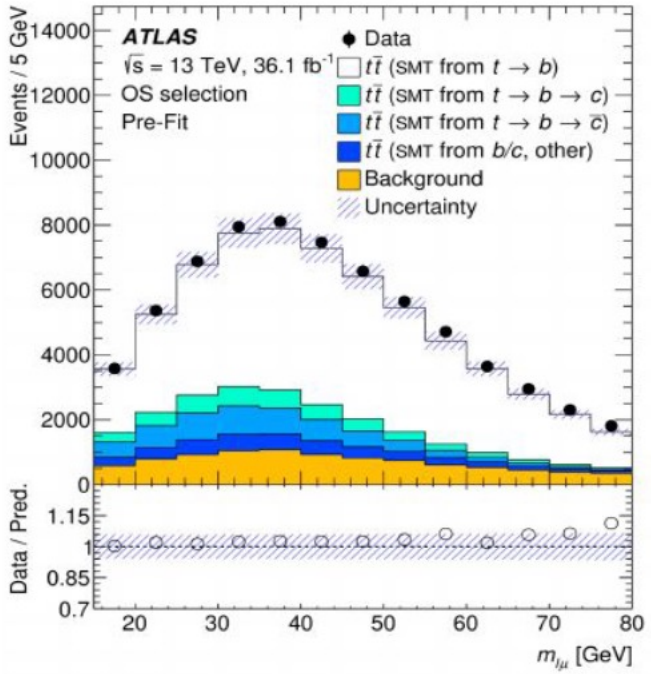


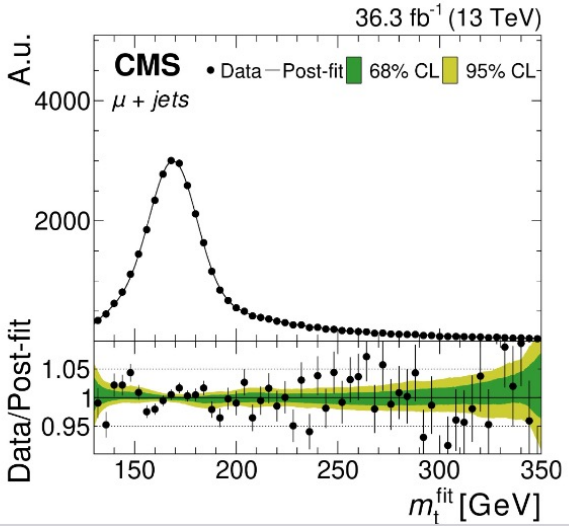
Top mass measurements

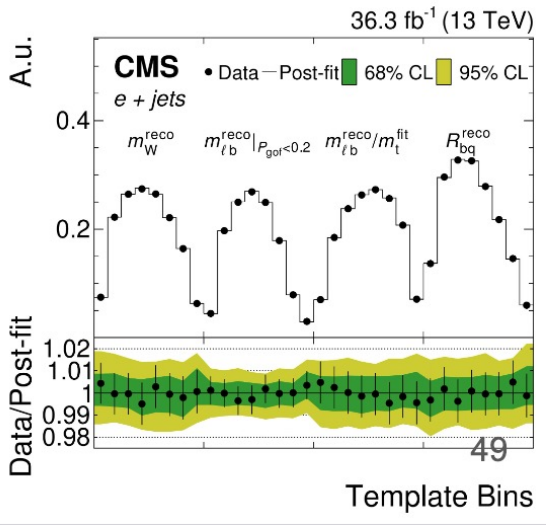
ATLAS and CMS measurements

Pinamonti

- Top mass measurement attacked from multiple point of views
  - Direct measurements of “MC” mass
  - Indirect measurements from cross sections
- Multidimensional fit from CMS to better constrain profiled uncertainties
- No-jets measurement fitting di-muon mass (soft mu from b decay + prompt mu from W)

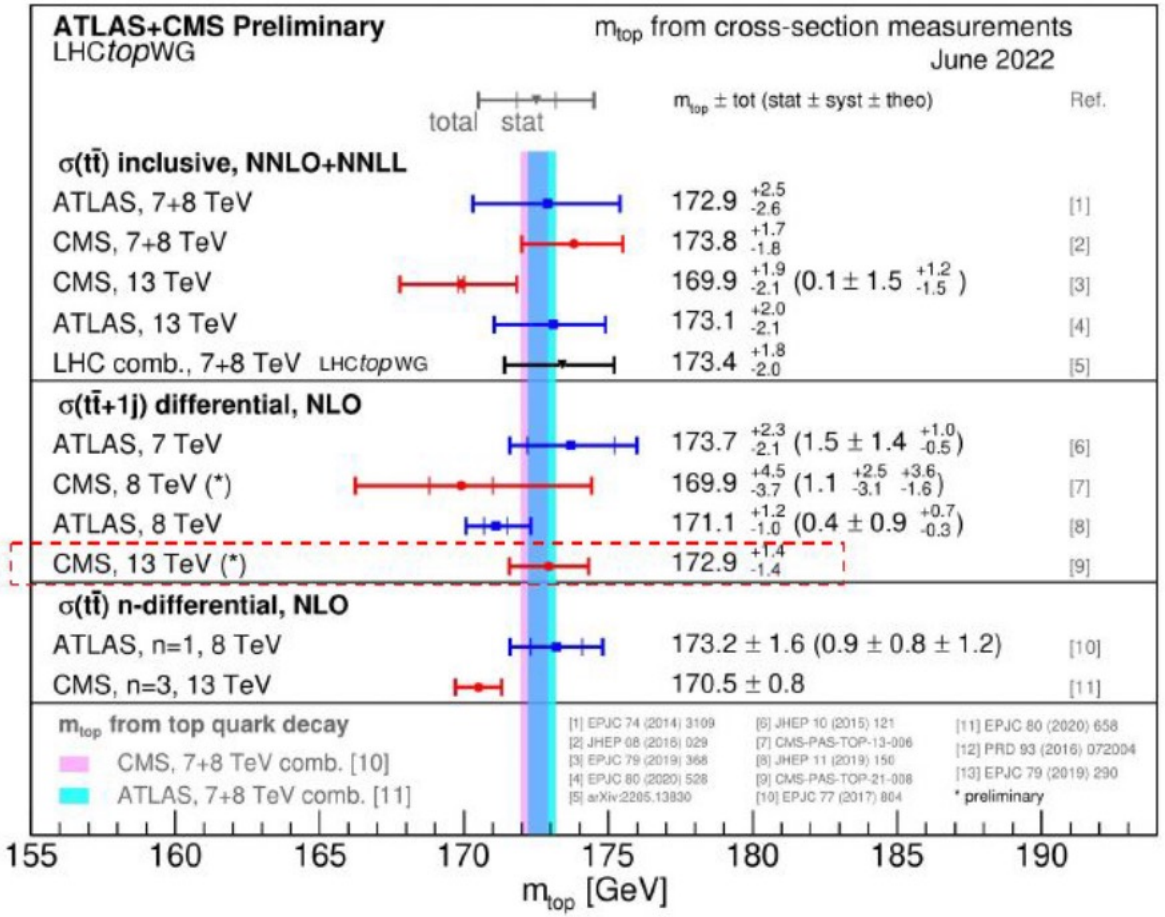


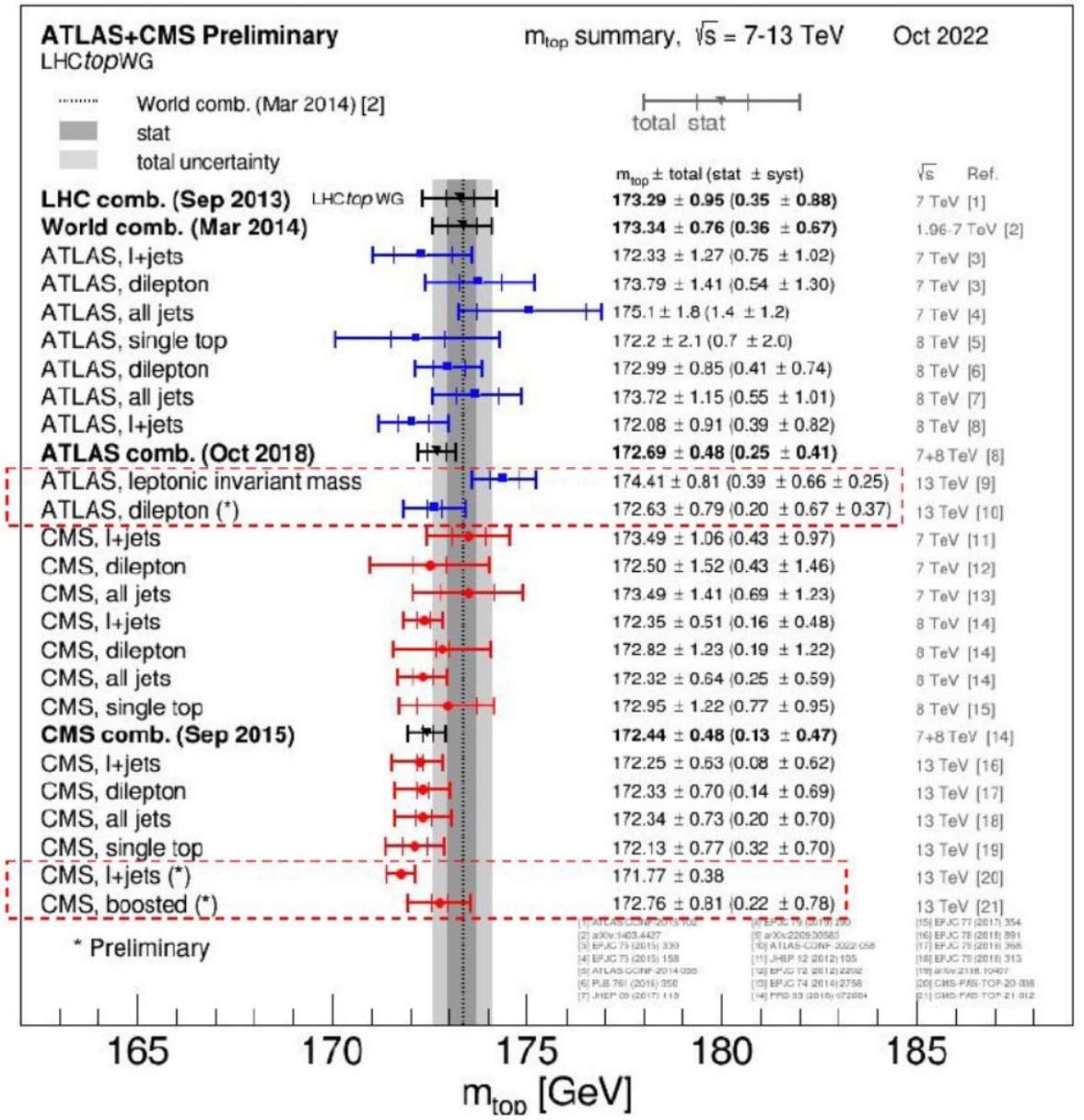




Top mass measurements

ATLAS and CMS measurements summary





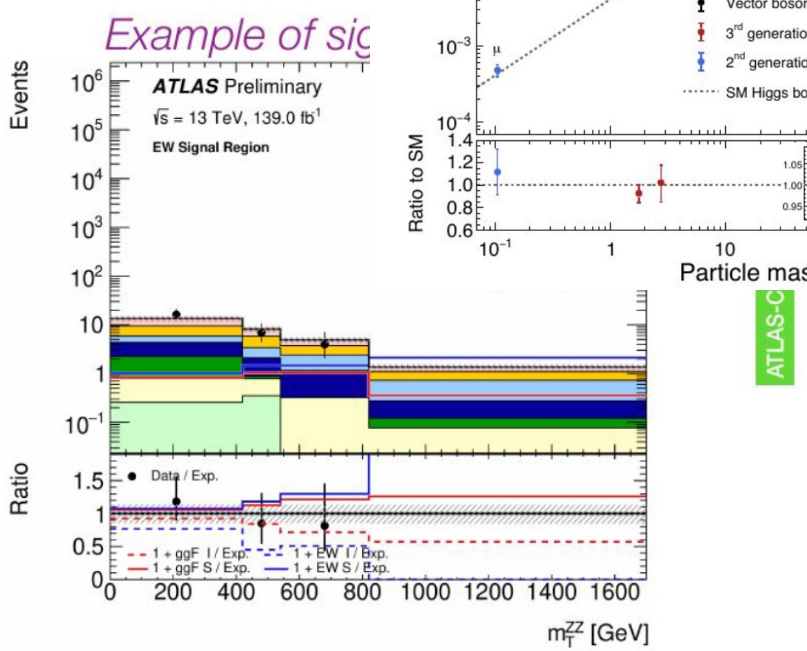
Higgs physics

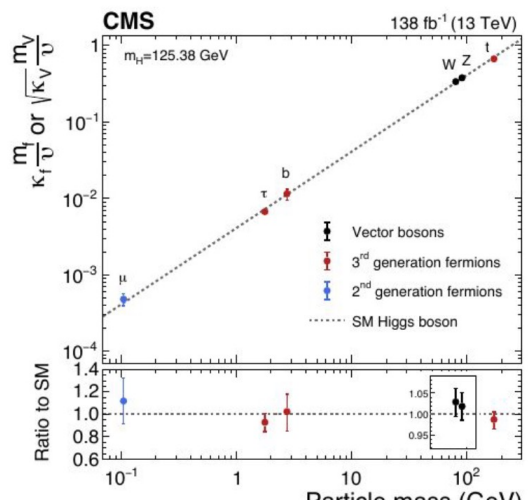
Higgs width measurement

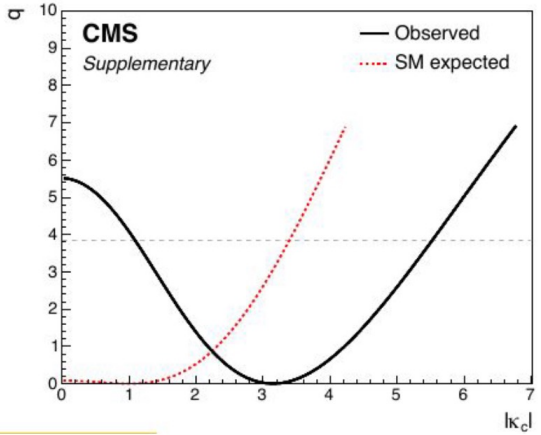
Marchiori

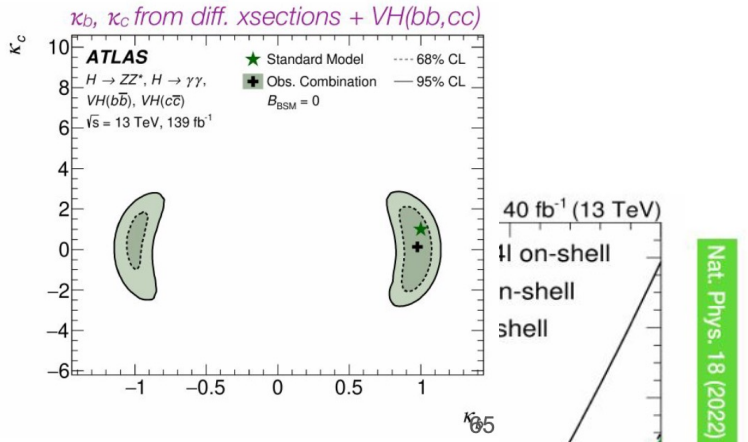
ATLAS and CMS measurements summary

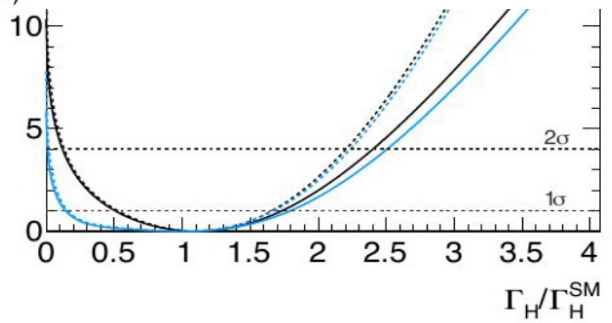
- Evidence of off-shell production from CMS and ATLAS experiments
  - Showin ss!
- Combined



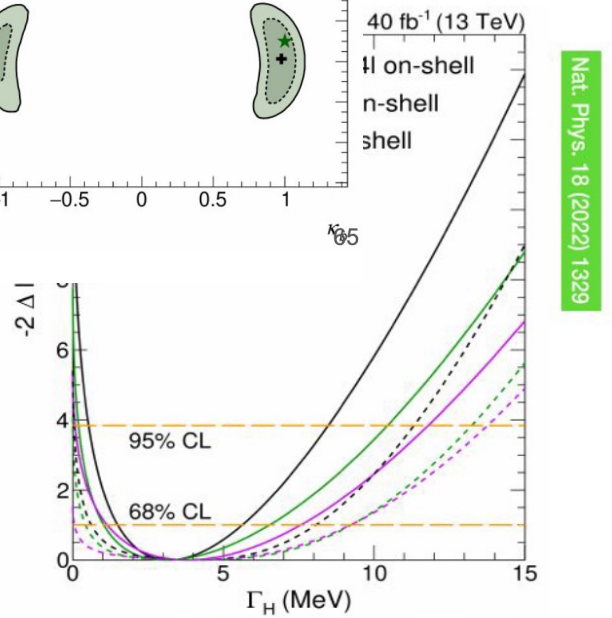








$\Gamma_H = 4.6^{+2.6}_{-2.5}$ MeV @68 % C.L.



$\Gamma_H = 3.2^{+2.4}_{-1.7}$ MeV @68 % C.L.

Nat. Phys. 18 (2022) 1329

Higgs couplings to charm

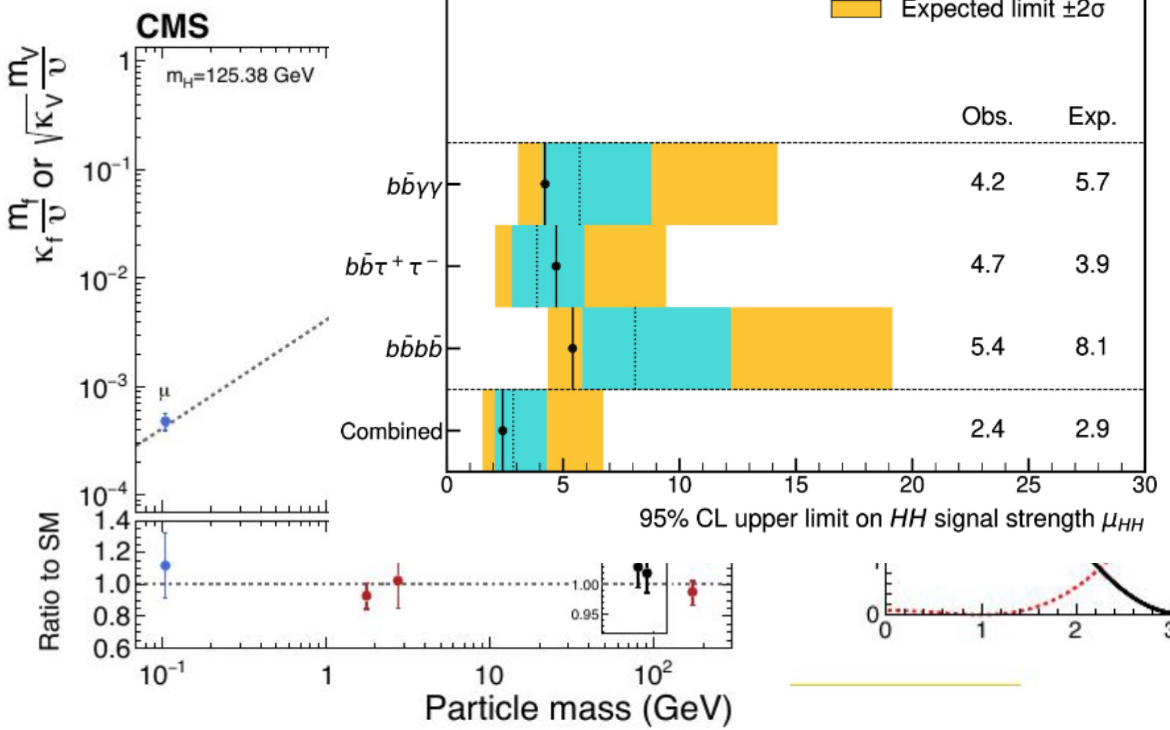
Marchiori

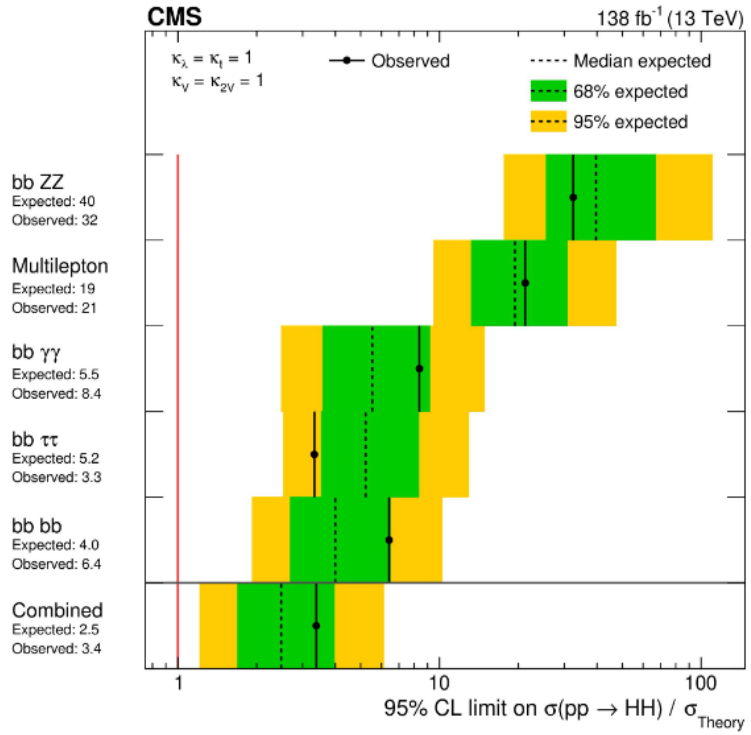
ATLAS and CMS measurements

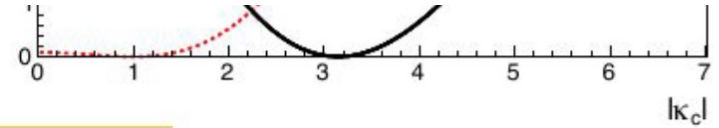
- Update on
  - ATLAS
  - CMS pr

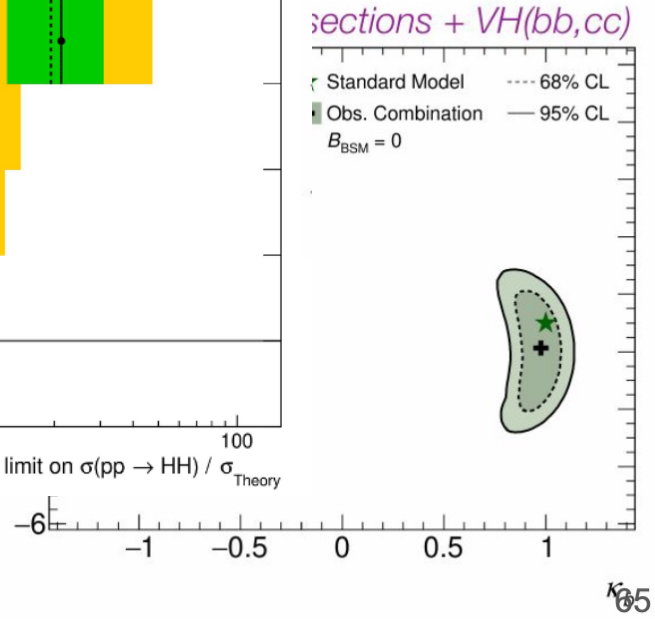
2.4 Obs (2.9 Exp)

3.4 Obs (2.5 Exp)









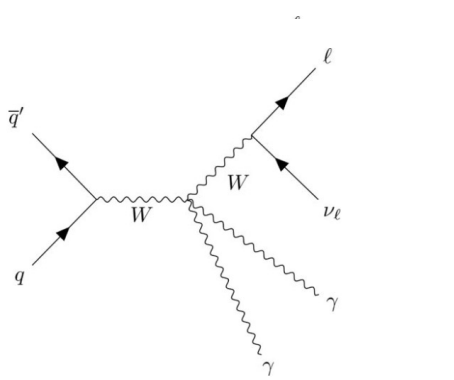
Higgs self coupling

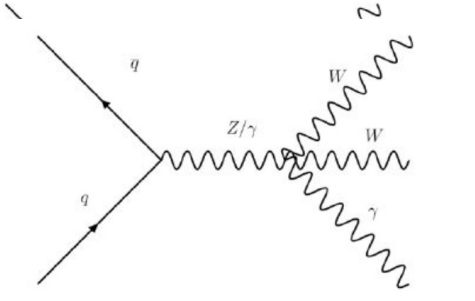
ATLAS and CMS measurements

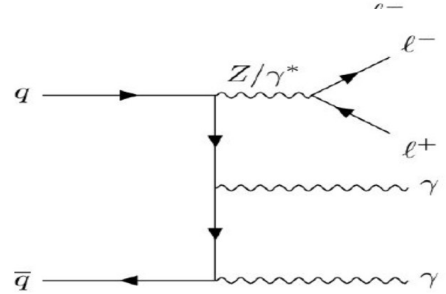
Marchiori

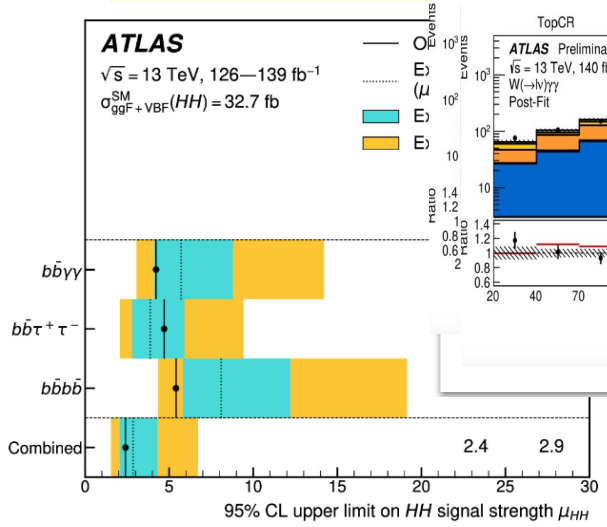
- Incredible p
  - Combir
    experime

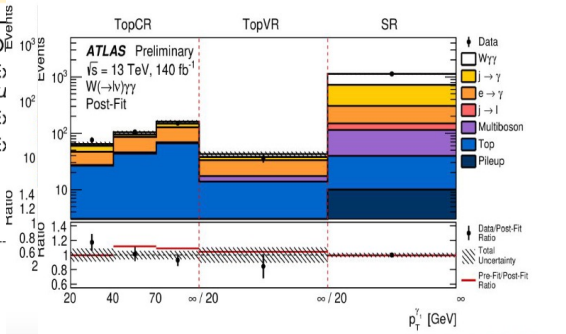
2.4 Obs (2.9 Ex



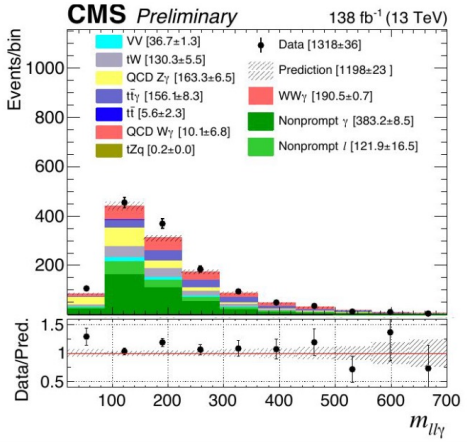




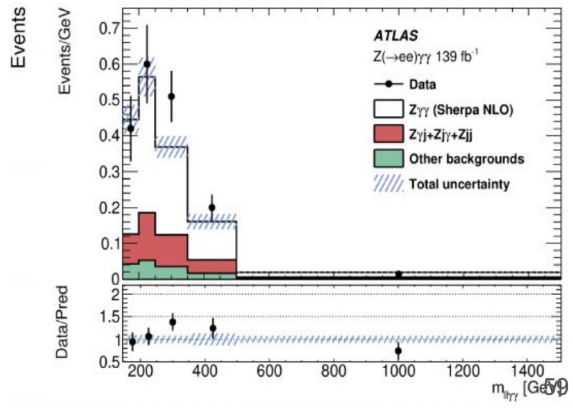


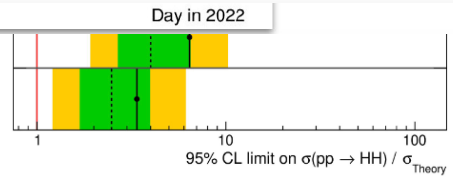


ATLAS-CONF-2023-005



CMS-PAS-SMP-22-006





WW	ZZ
llvv	
coming soon	4l
MultiLepton	×
inclusive WW decay	×
MultiLepton	×

New triple vector boson measurements

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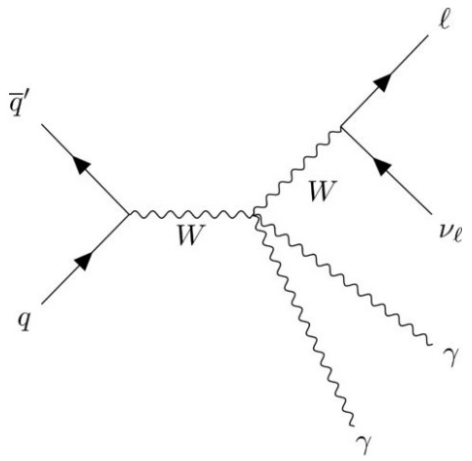
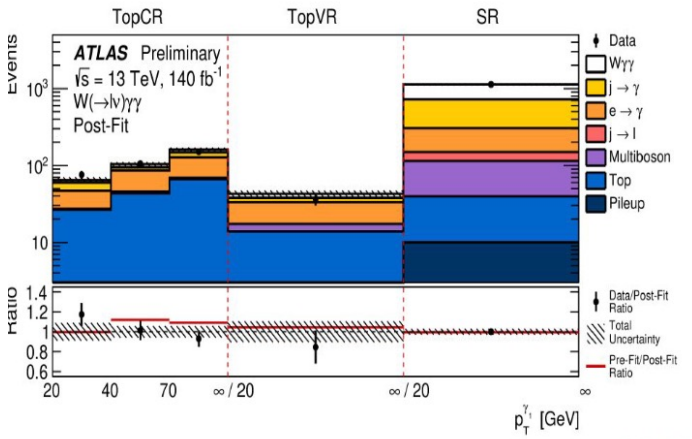
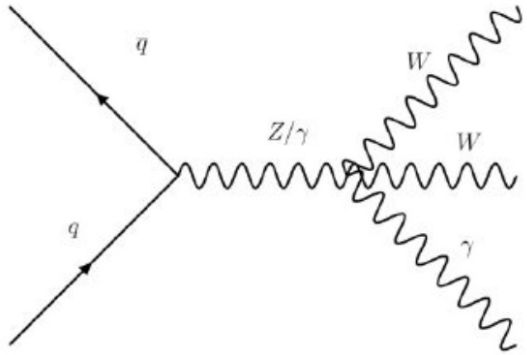
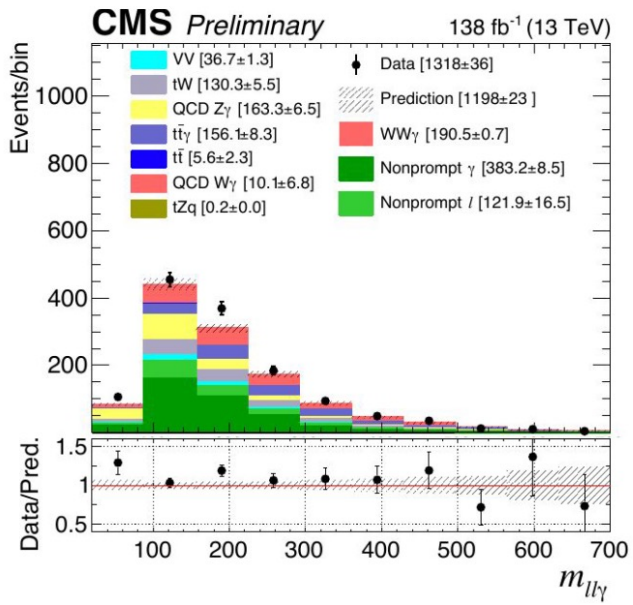
ATLAS and CMS measurements





ATLAS-CONF-2023-005





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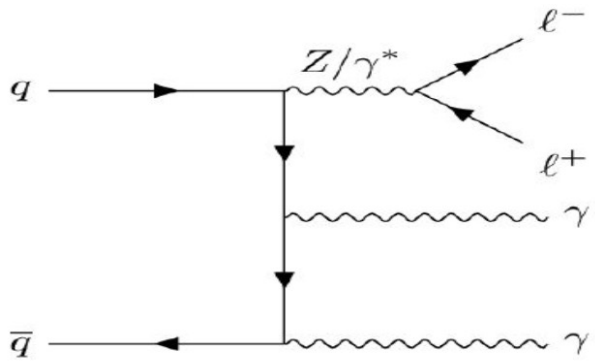
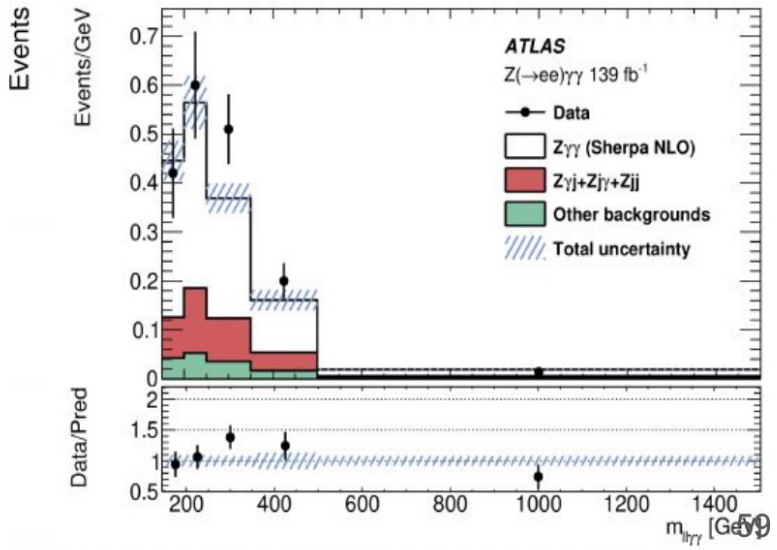
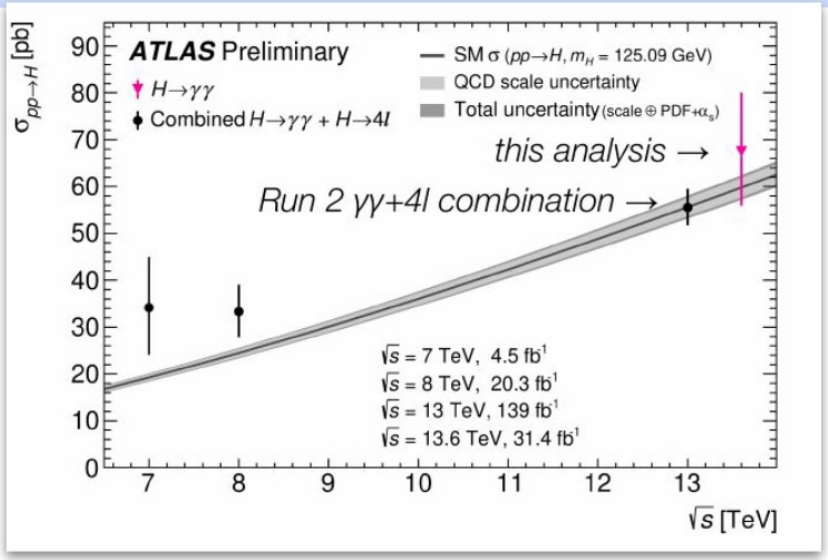
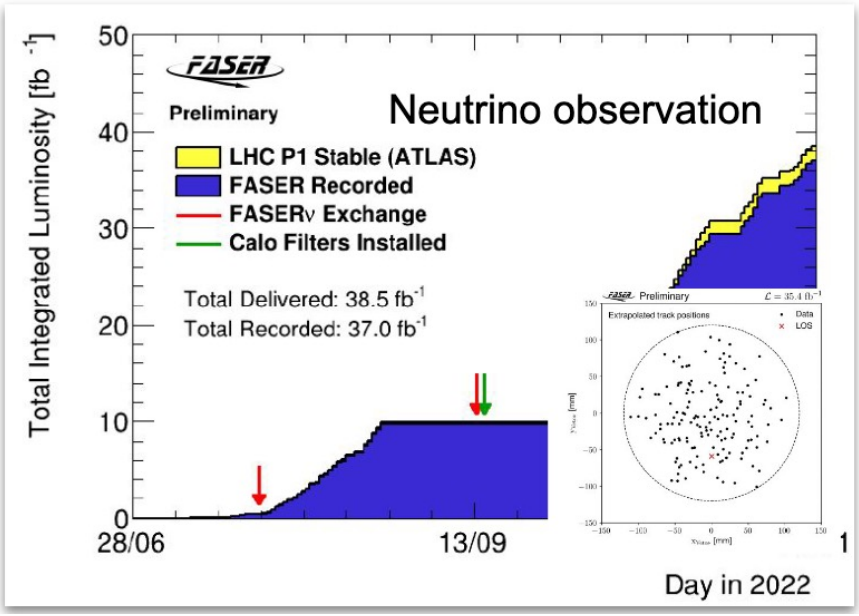


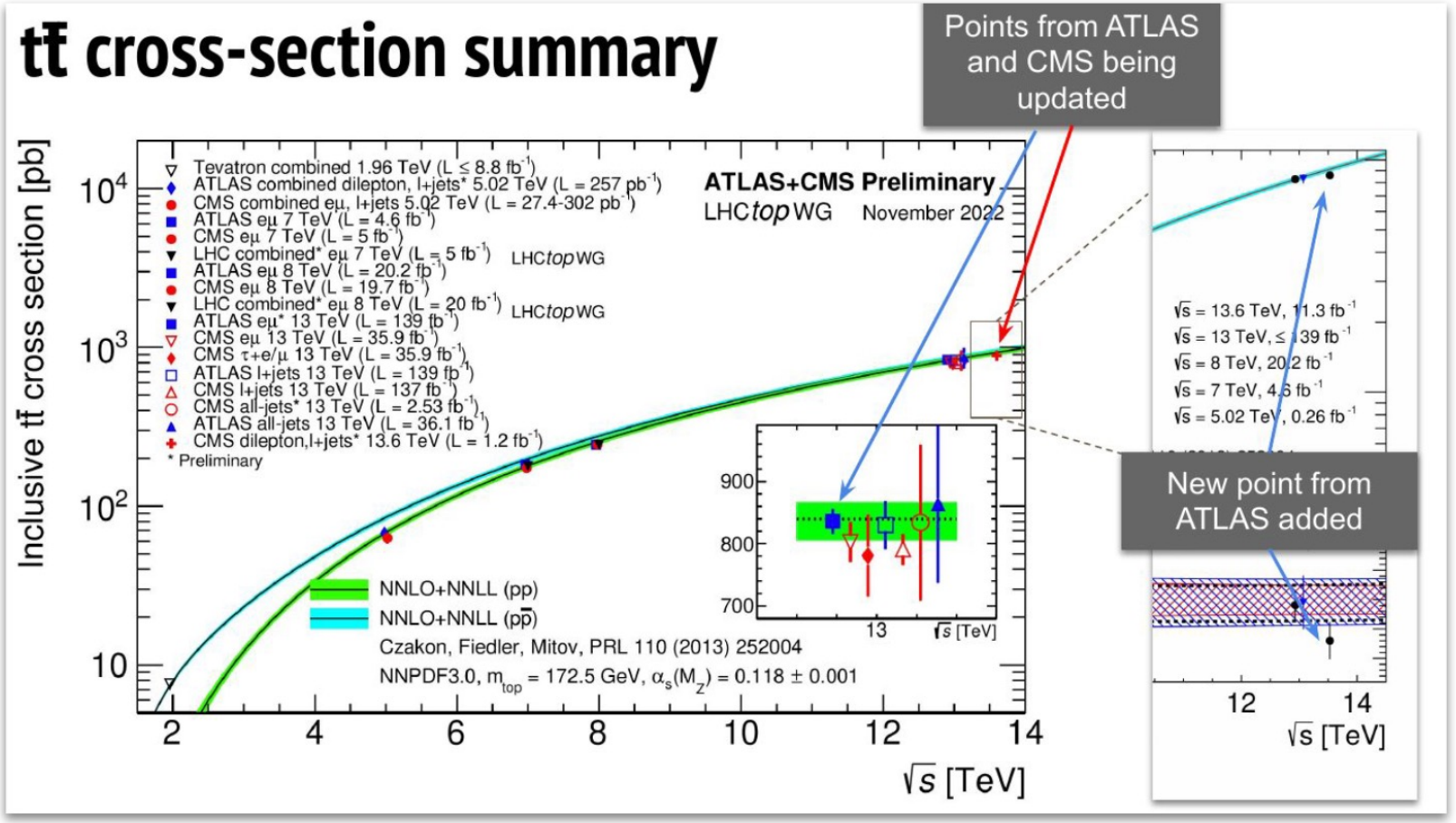


59

Run3 results are already among us







Summary and Conclusions

Moriond QCD 2023

Thank you !!!