Recent ATLAS+CMS results

(a fully biased selection of highlights)

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What can you expect?

- Few highlights from Spring-Summer conference results from ATLAS and CMS
  - Mainly sourced from LHCP, LP, some newer ones
- Not intending to be comprehensive, just focused on few things that I personally found interesting when perusing recent results.
- Very minimal detail !!

Standard model results

The good old classics … or not so much anymore
(Higgs not included)

"Pay heed to the tales of old wives.
It may well be that they alone keep
in memory what it was once
needful for the wise to know."

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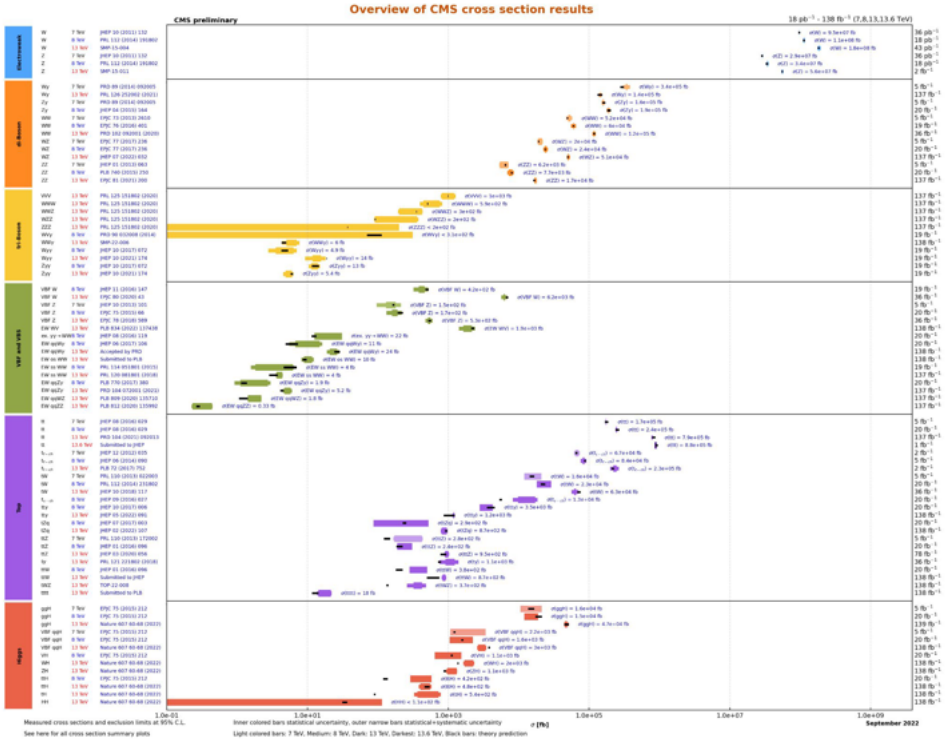
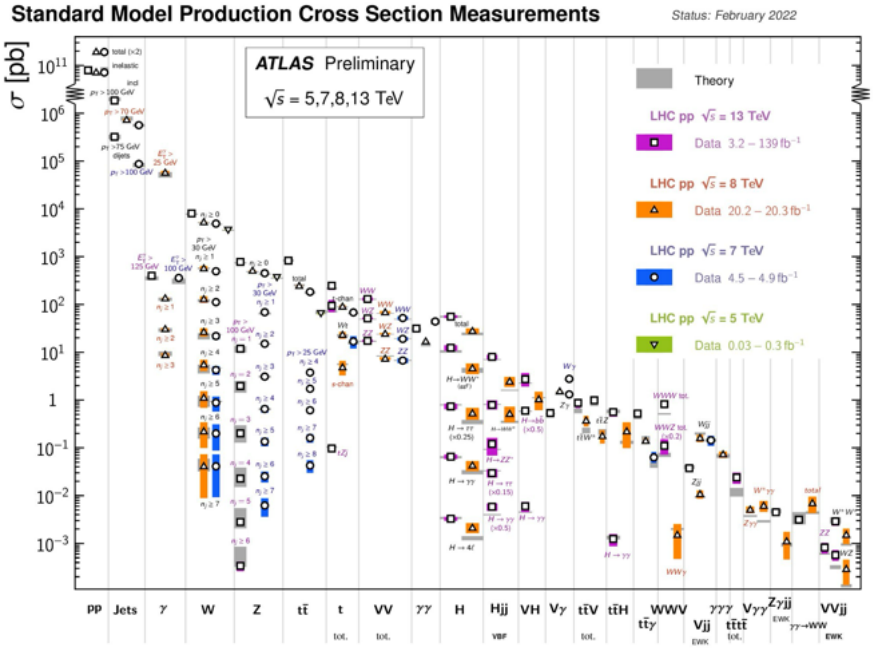
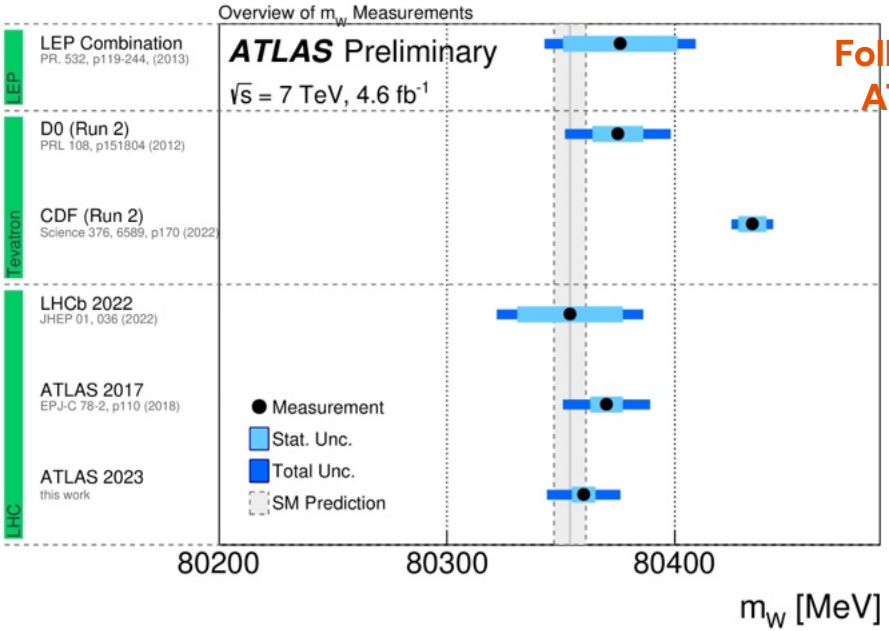
High precision & rare processes



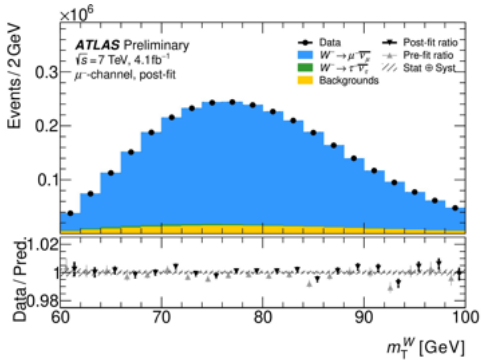


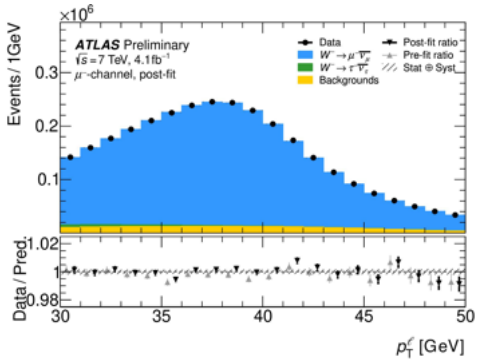
From the rare to the common, 15 orders of magnitude !

W mass measurement



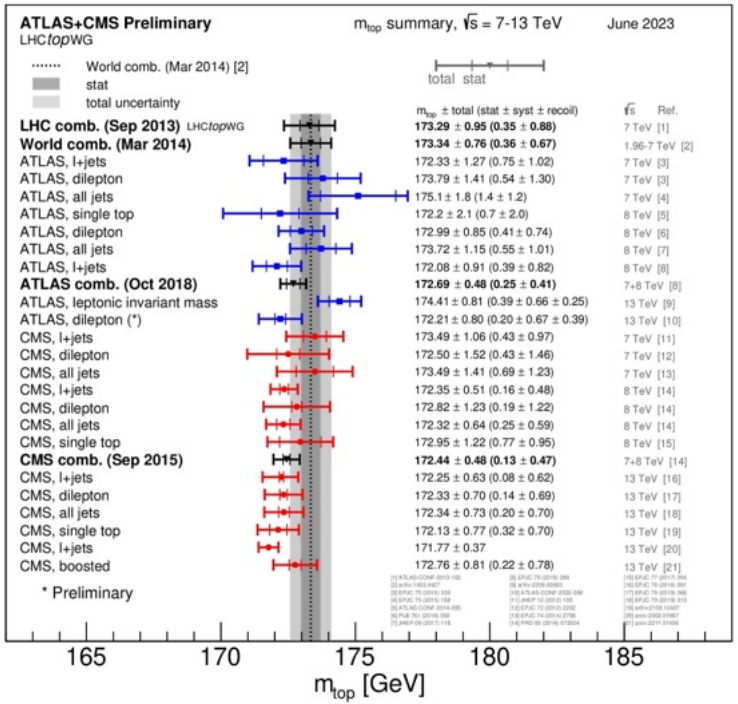
Following the excitement of the CDF results last year ATLAS has published a new result with 7 TeV data

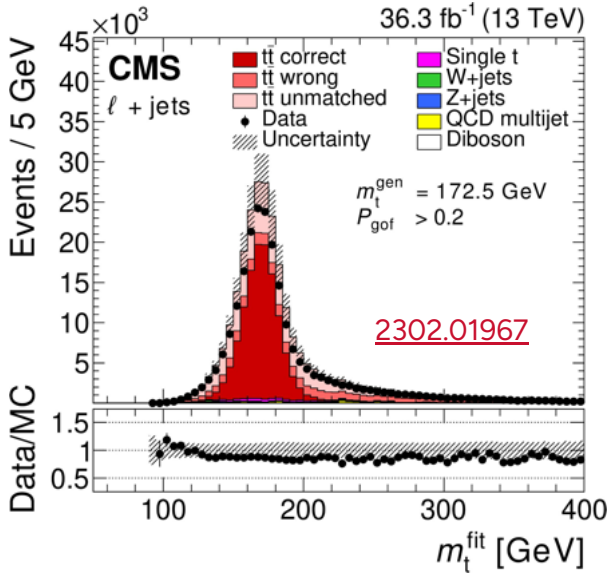




Profile likelihood fit with Mw as parameter using transverse mass of the W and the Pt of the lepton, more precise than previous analysis, compatible with SM

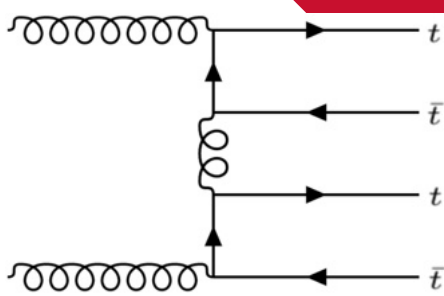
Top mass measurement





Most precise measurement of the top quark mass, slight tension with previous measurements

Observation of SM 4-top



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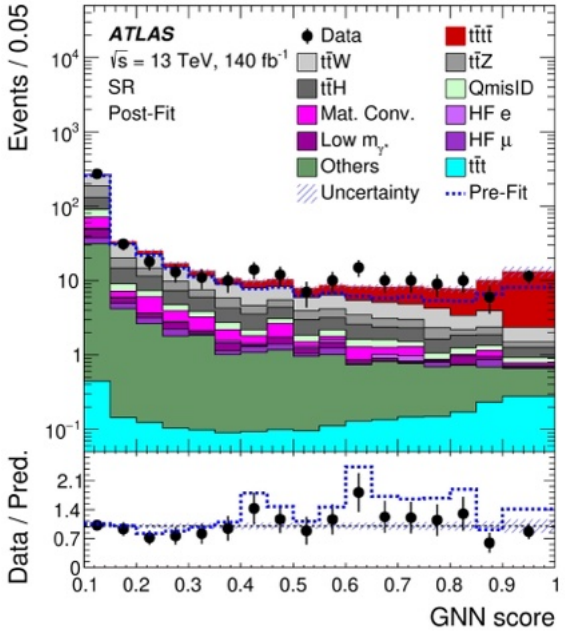
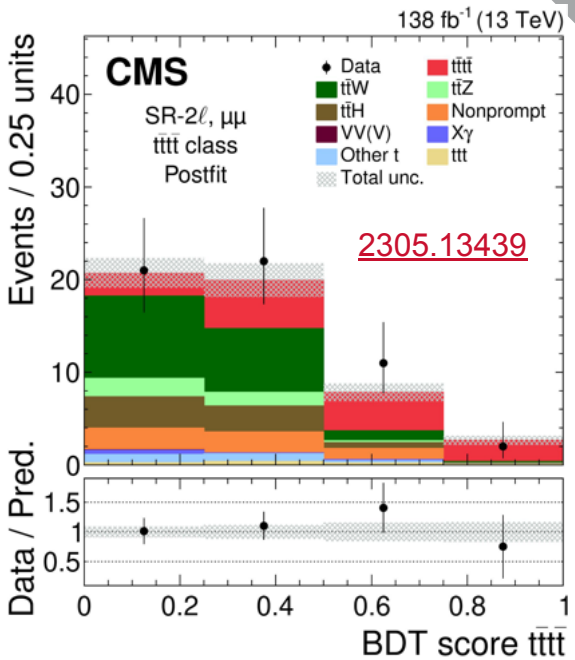


Near simultaneous publication of the observation (6-5 σ) of 4 top production by ATLAS and CMS

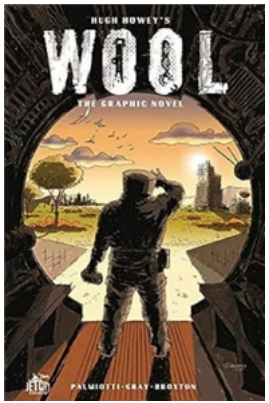
Excess with respect to standard model expectation (around 2 σ)



Higgs boson results

Discovery was only the beginning!

Where a story ends is nothing more than a snapshot in time, a brief flash of emotion, a pause. How and if it continues is up to us.



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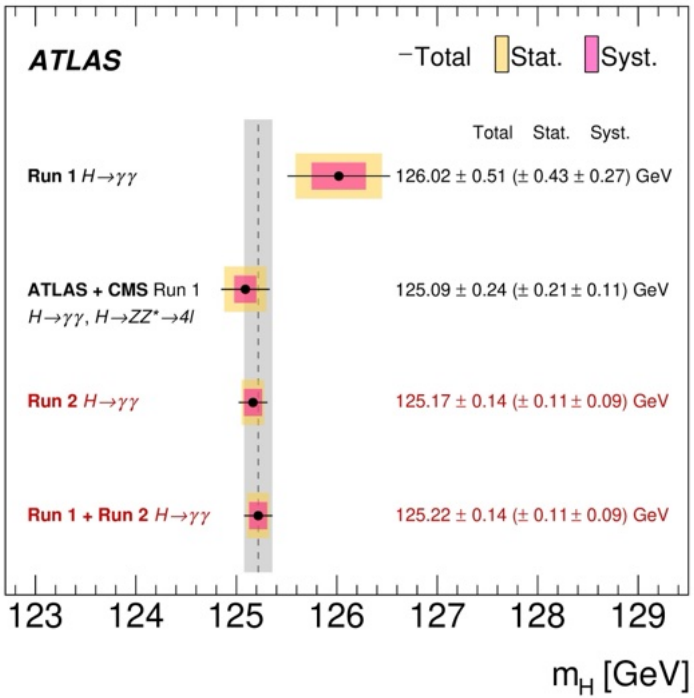
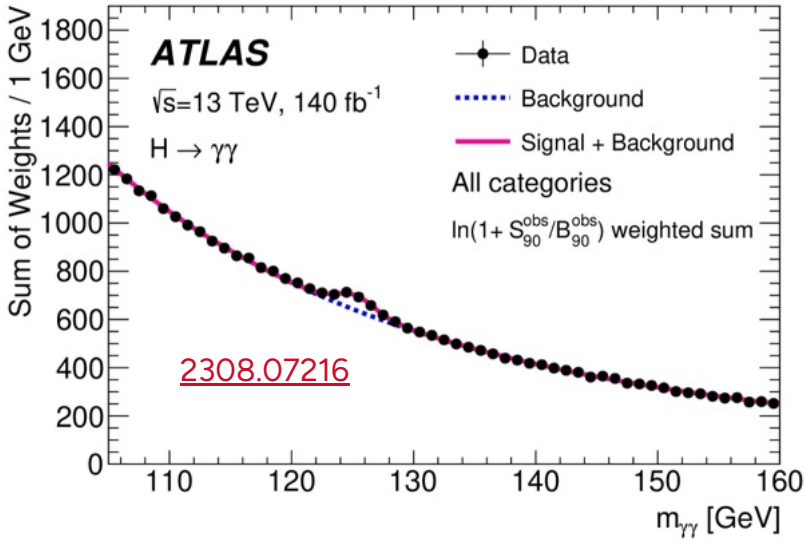
Higgs mass measurement update





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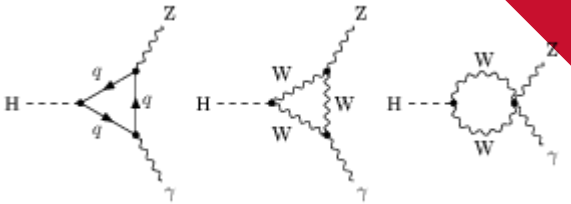
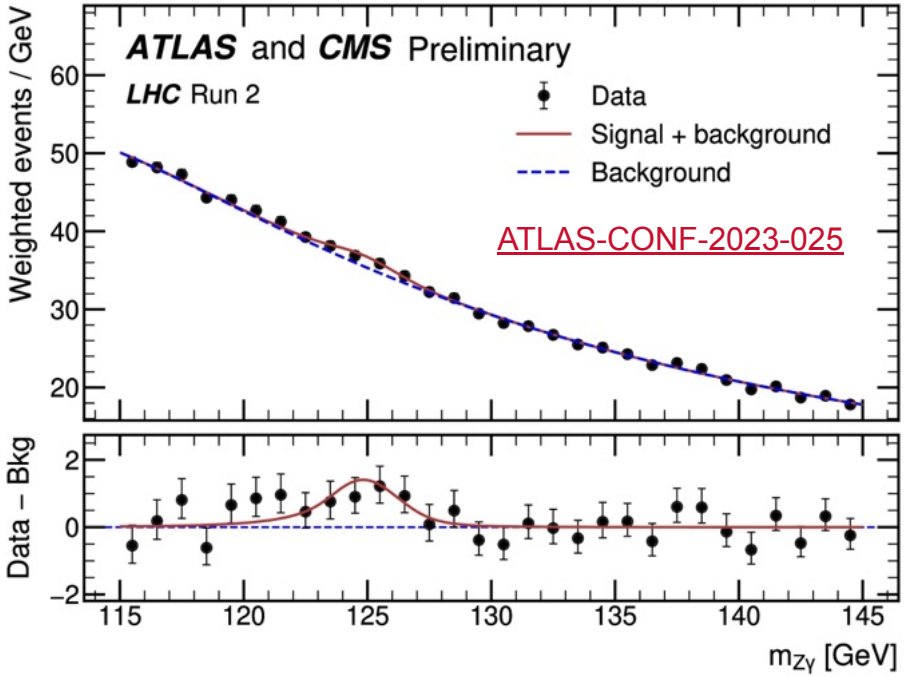
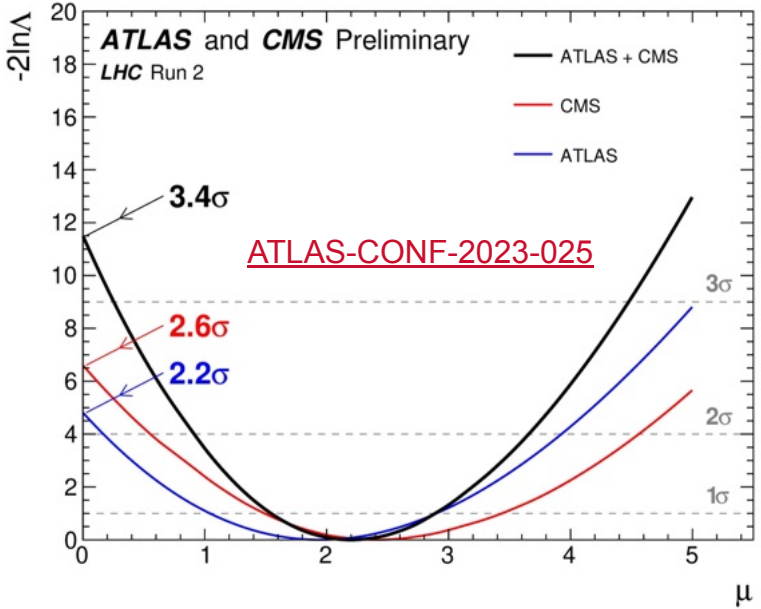
Increased statistics, much improved photon energy calibration

Evidence of Zγ



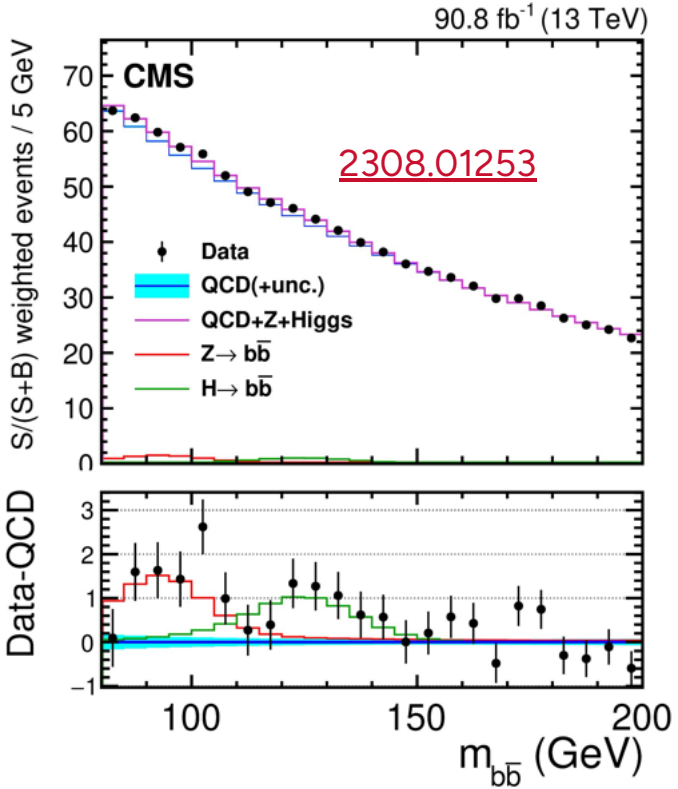
Combining both ATLAS and CMS run 2 measurements of the Zγ decay

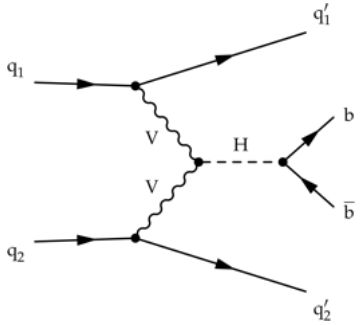




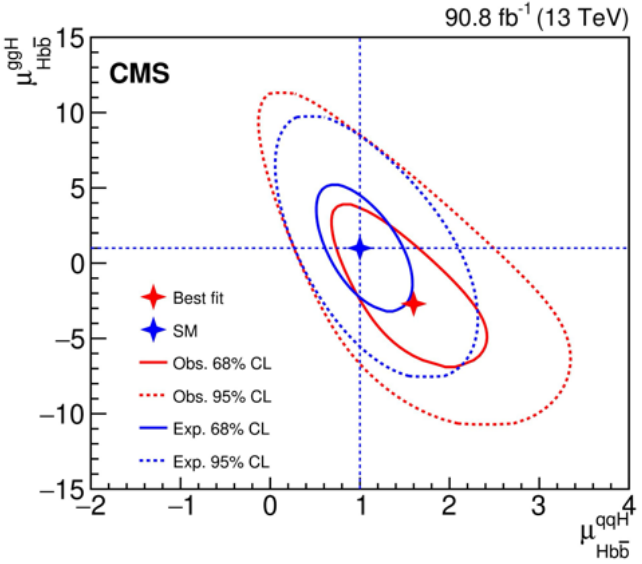
Evidence (3.4σ) . Slight excess (2σ) above the standard model prediction.

Measurement of VBF production



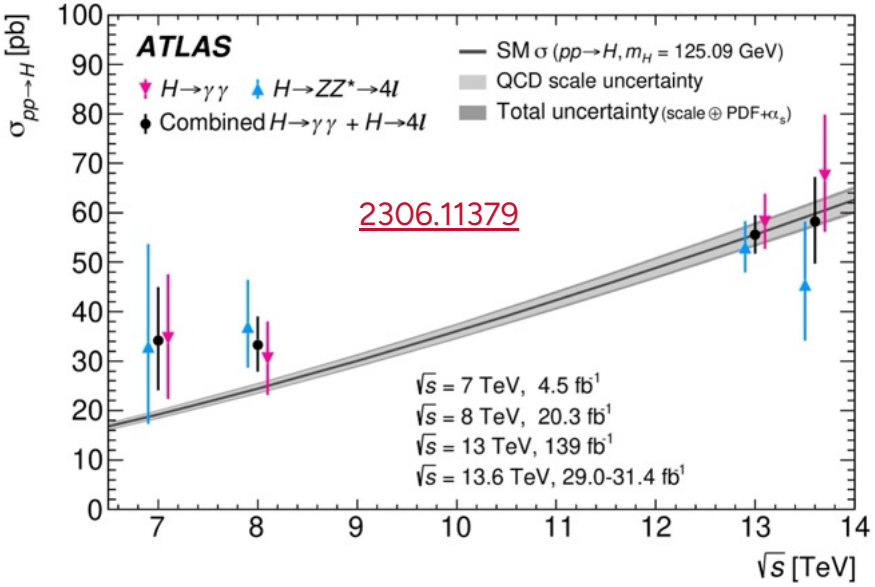


Difficult to measure decay in difficult to measure production mode



Around 2.2σ significance, consistent with standard model

First 13.6 TeV results !



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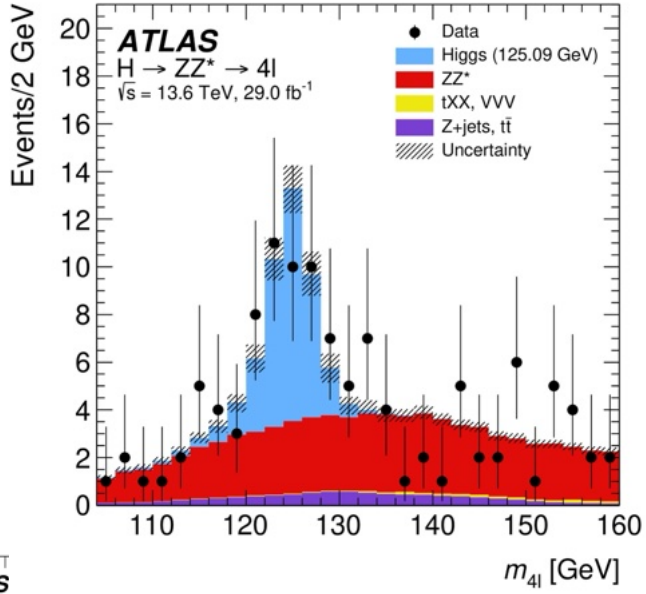
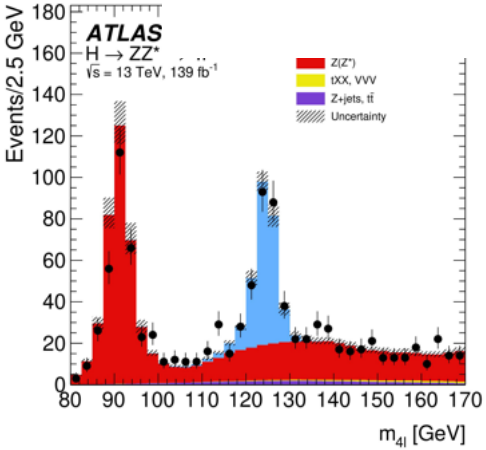


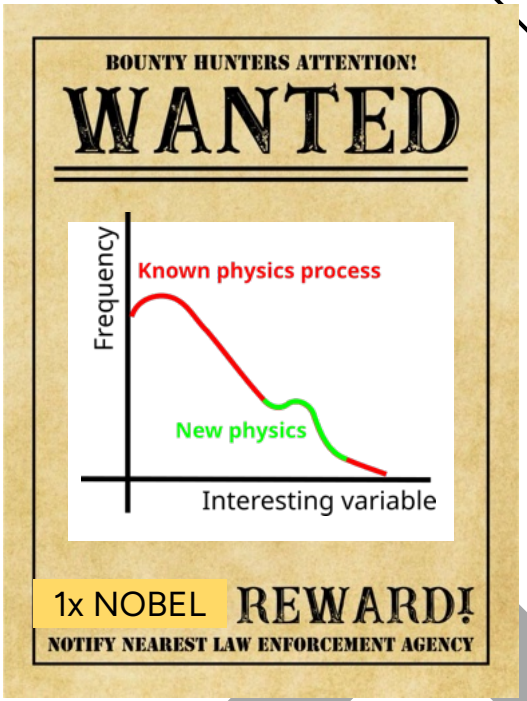


Combined diphoton and 4l measurement. One of the first papers coming out in run 3!!

New physics

We are looking everywhere, I swear

The most exciting phrase to hear in science, the one that heralds new discoveries, is not “Eureka!”, but “That's funny ...”



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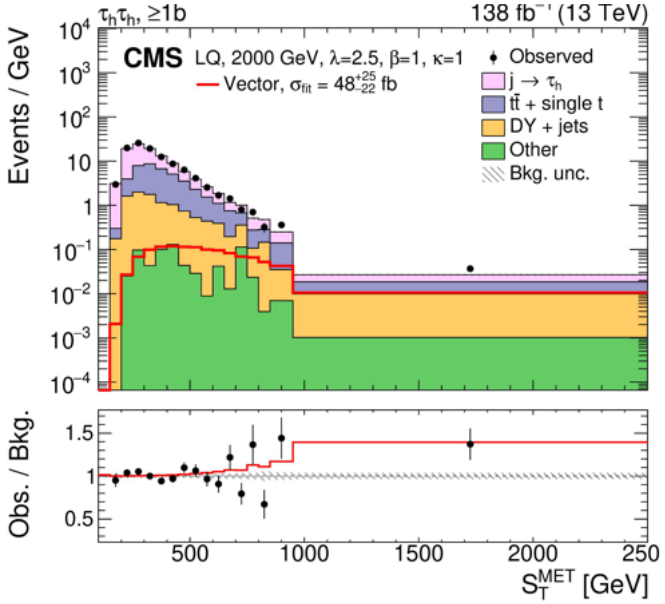
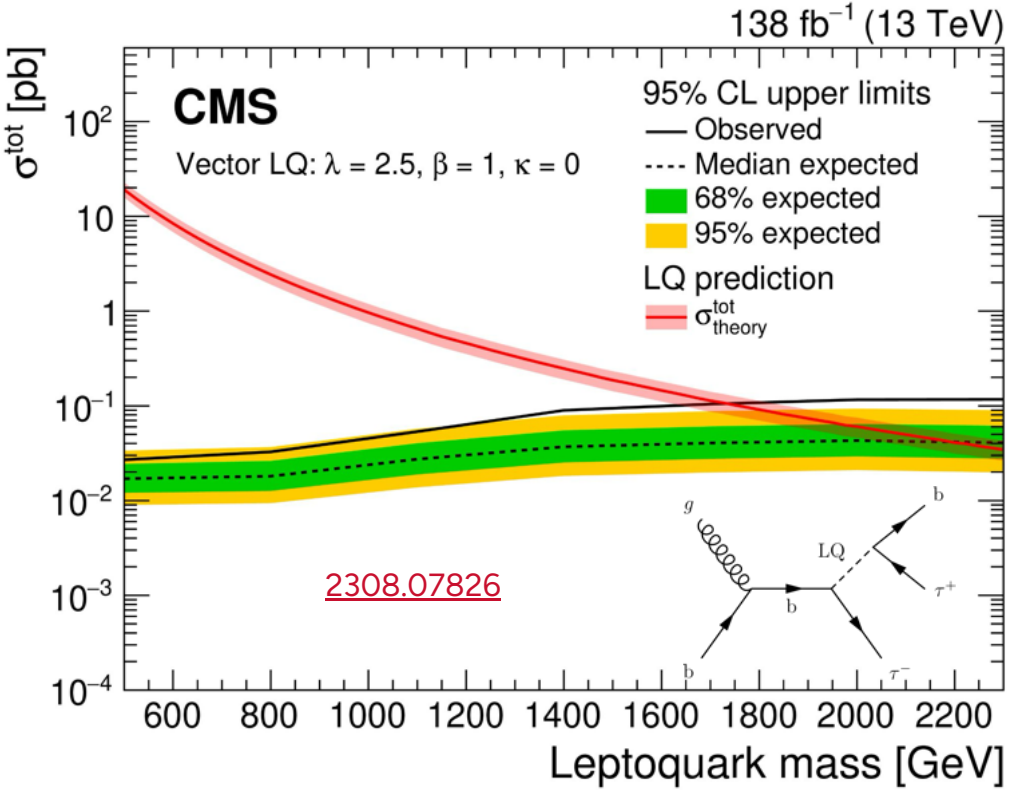
3rd generation leptoquarks

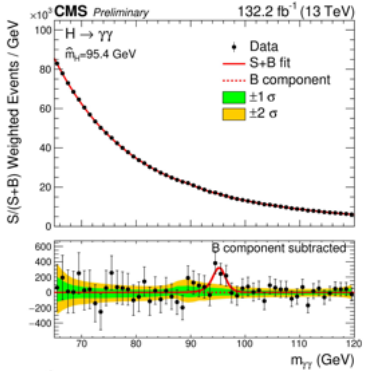


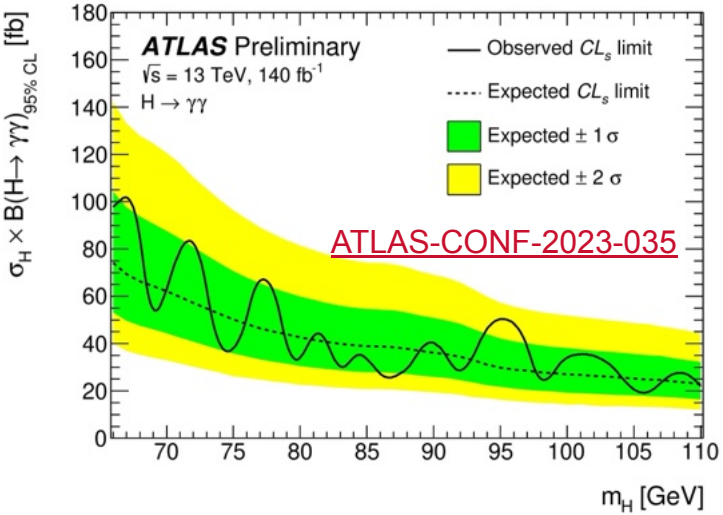


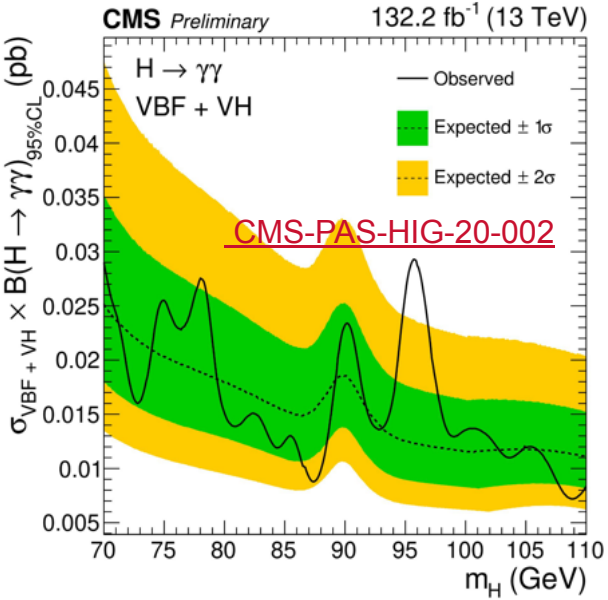
Large programme of LQ searches in both ATLAS and CMS, very interesting in FLUV scenarios

Low mass diphoton search

Mild low mass diphoton excess seen in previous CMS search.
Updated studies from ATLAS and CMS. Still present ~ 95 GeV.
Significance hasn't increased with luminosity

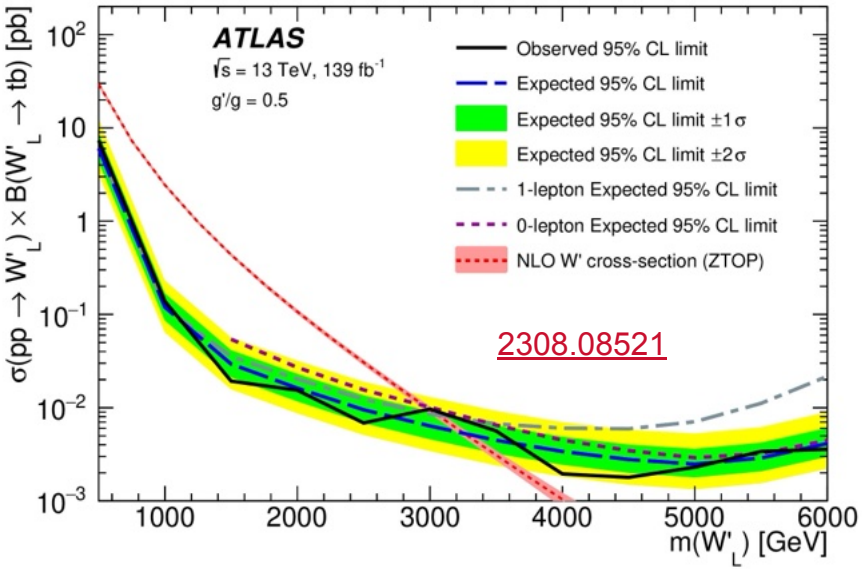


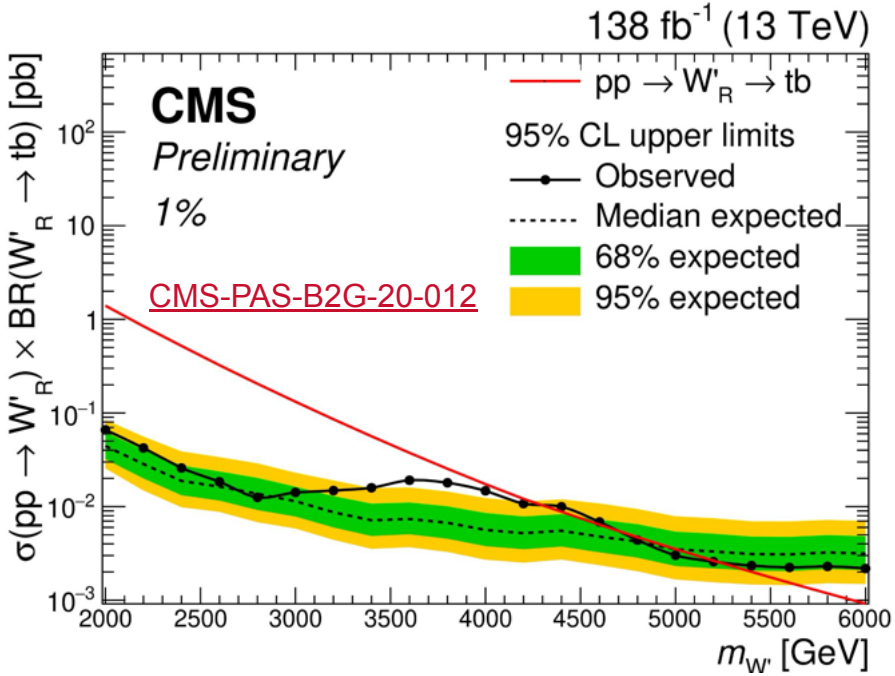




W'->tb searches

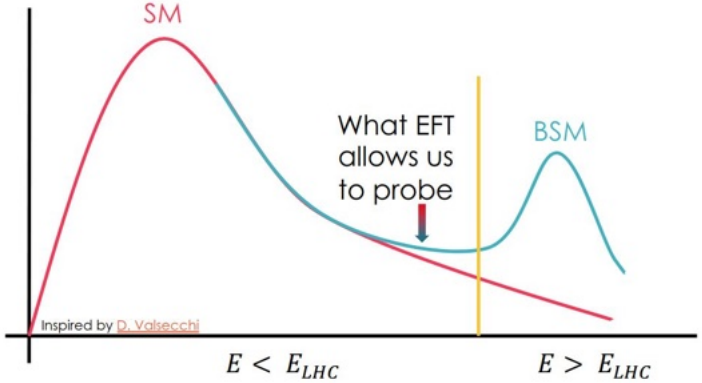
Updated results from both ATLAS and CMS on W'->tb searches. Very different strengths and approaches to analysis and interpretation.





Mild excess in CMS analysis not seen in ATLAS analysis

EFT searches

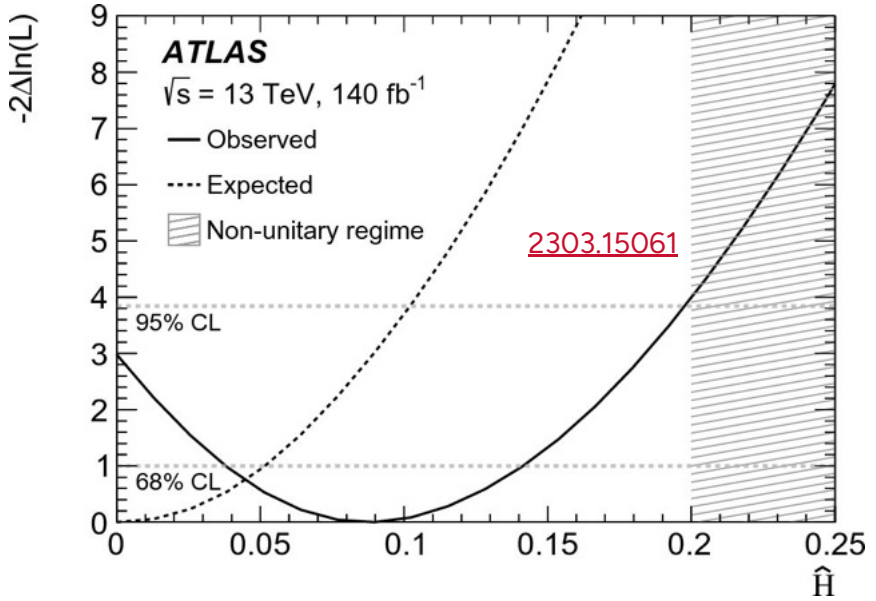


$$\mathcal{L}_{SMEFT} = \mathcal{L}_{SM} + \mathcal{L}^6 + \mathcal{L}^8 + \cdots \Rightarrow$$

$$\sigma_{SMEFT} = \sigma_{SM} + \underbrace{\sigma_{int,6}}_{\text{linear } (1/\Lambda^2)} + \underbrace{\sigma_{BSM,6} + \sigma_{int,8}}_{\text{quadratic } (1/\Lambda^4)} + \ldots$$

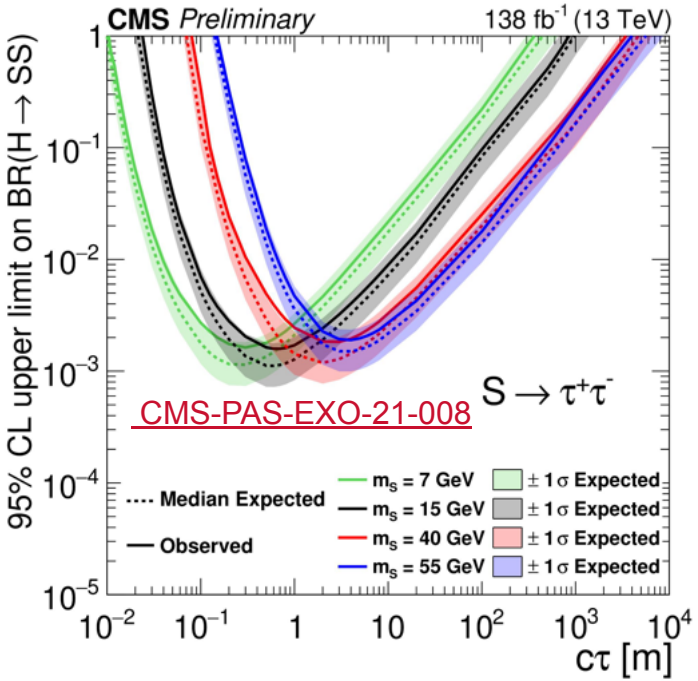
V.M.M.CAIRO

Evolving program in both ATLAS and CMS using tails of distributions. Possible to add EFT interpretations in many existing analysis



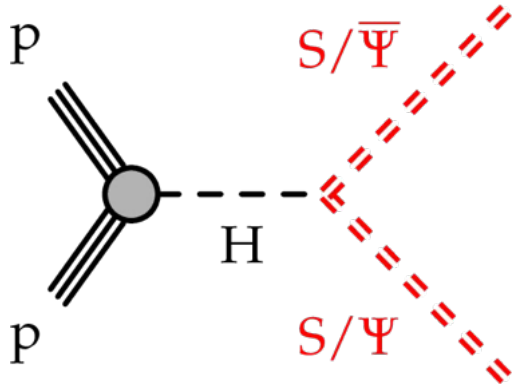
4tops analysis includes EFT interpretation

Muon LLP CMS



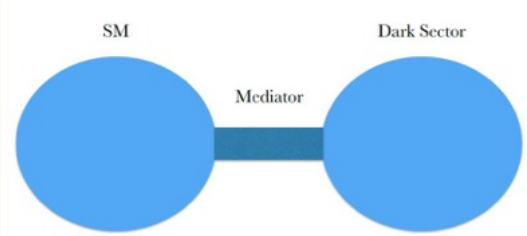
Many searches from both ATLAS and CMS of Long lived particles (LLP). Very non-standard and different searches with complex backgrounds, depending on where the decay happens.

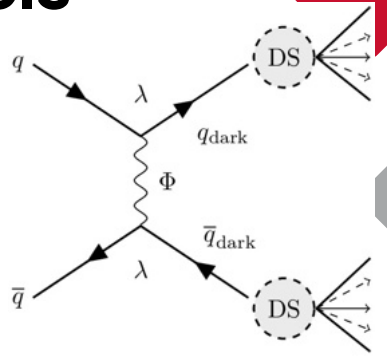
New CMS analysis looking for a heavy scalar decaying in the muon detector, using it to detect EM and Had showers !

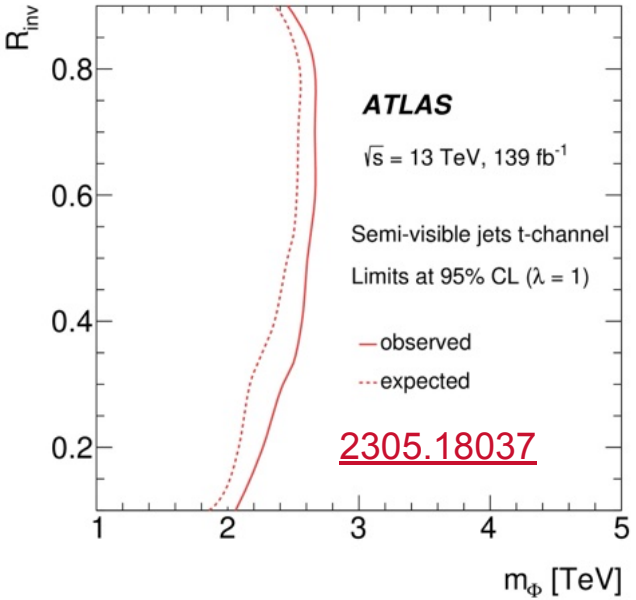


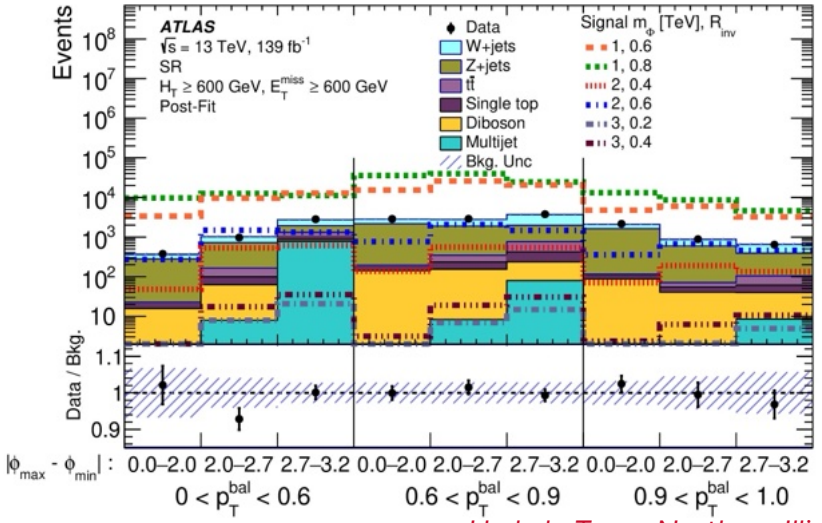
Semi-visible jets from Dark Sector models

Jets with Mixture of SM and DS hadrons
Events with jets and missing Et









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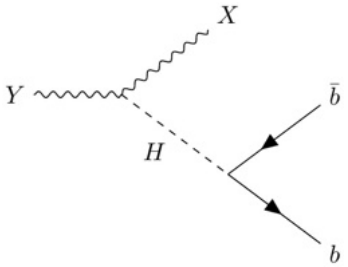
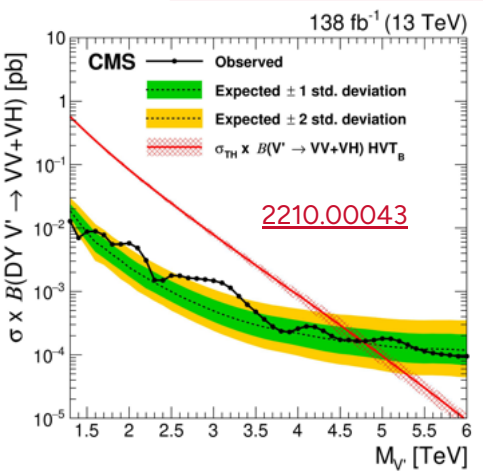
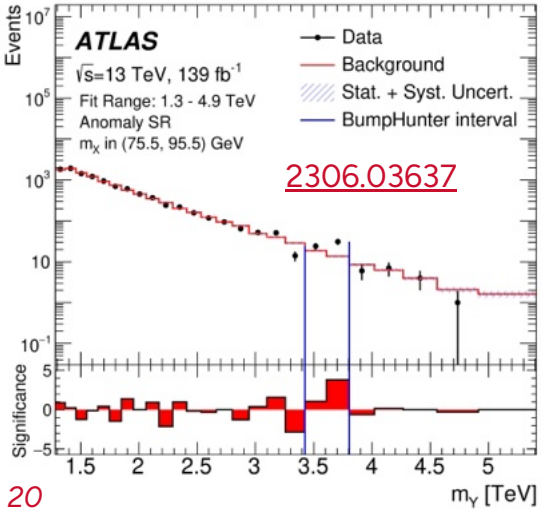
XH final states -> In a new way



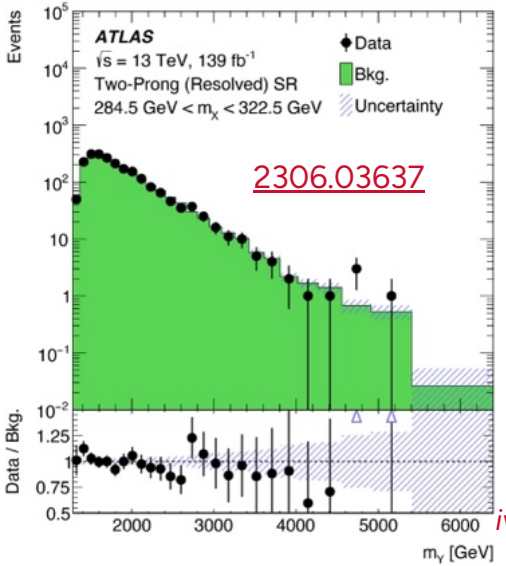
VV, VH is a final state with a history of 'small' excesses in several channels

New ATLAS search with a new approach
Unsupervised ML architecture
X-tagging to define main SR. Supplemented by 'traditional' hadronic search





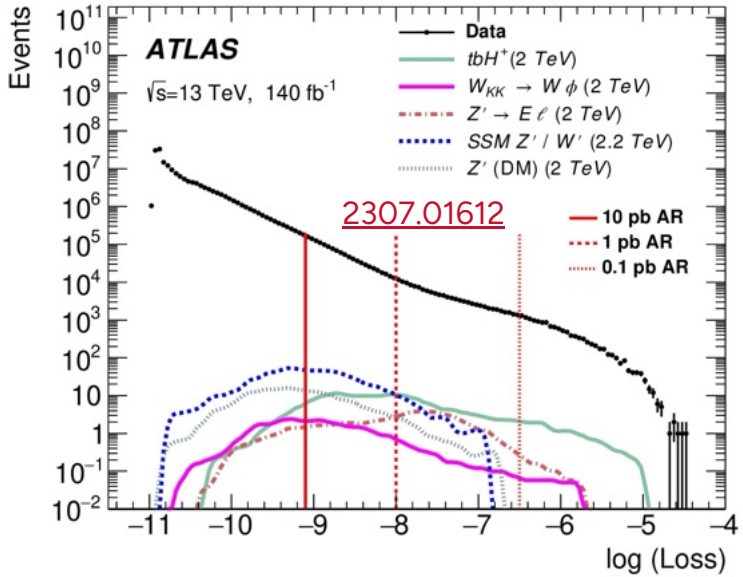
Small excesses in supplemental SR. Shape not very signal like



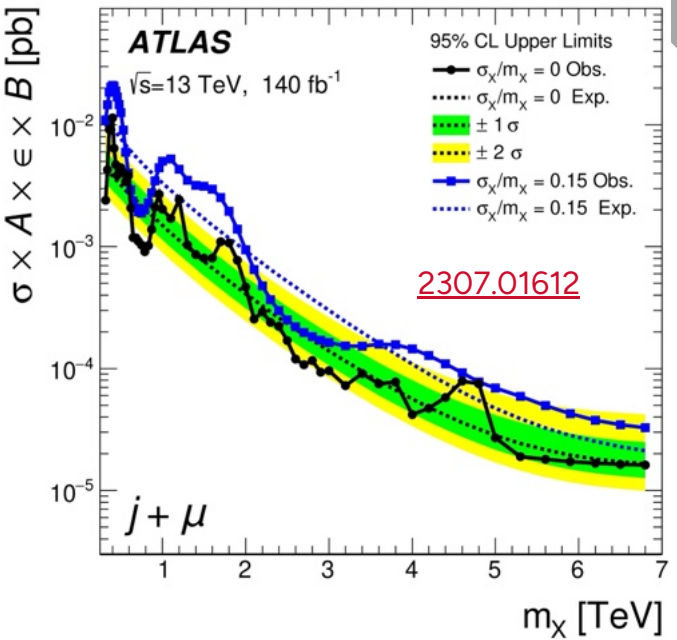
Anomaly detection in j+x events

Wide range of X (lepton, jets, photons)

Event level anomaly detection for the first time in an ATLAS analysis



Largest excess in the j+muon search at 4.8 TeV, 2.9 σ



Summary

Many exciting new results this summer

- Increased precision and/or sensitivity on ‘classic’ analysis and searches
- New rare SM processes and increasingly complex final states for BSM searches
- New techniques to try to improve existing topologies or access new ones
- Going beyond the energy reach with EFT approaches
- First analyses with run 3 data at 13.6 TeV center of mass energy

Many more to come in the next few years with Run 3 and in the near future with the HL-LHC