Standard Model at 13TeV with the CMS detector

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On behalf of the CMS Collaboration

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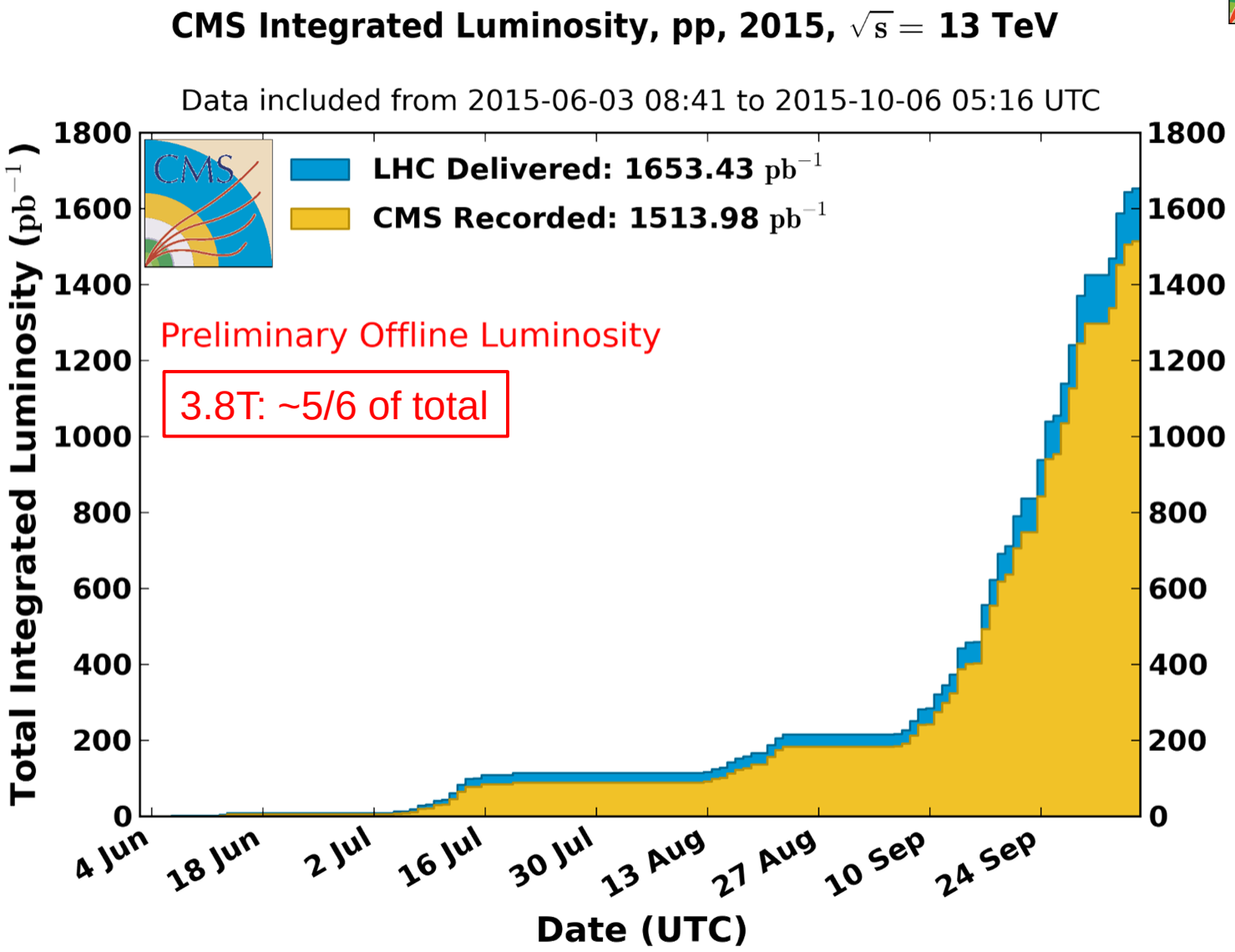
Executive Summary

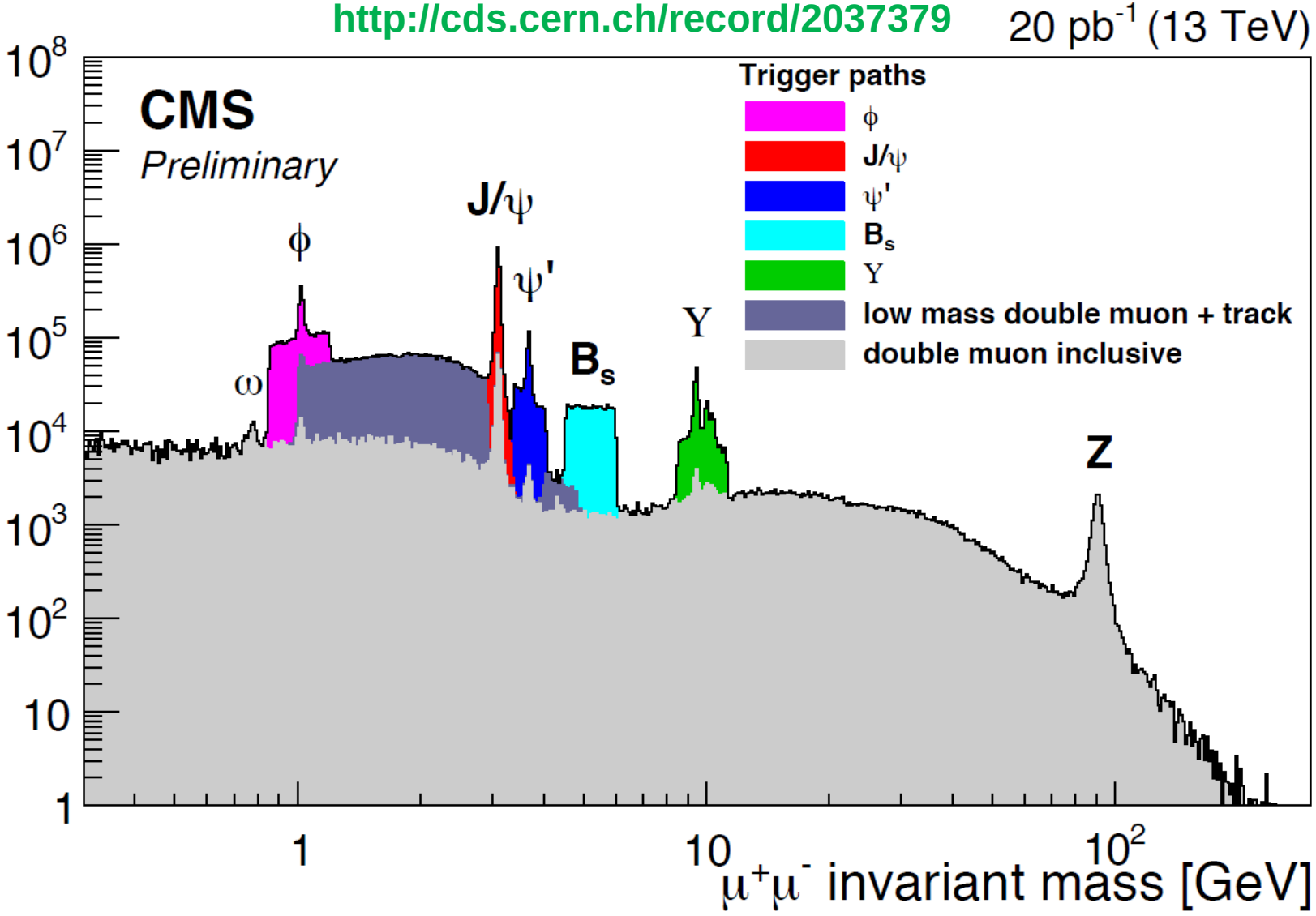
- Run-2 quite a bumpy ride with CMS magnet
  - Enough 3.8T data for early searches and cross-section measurements; notable exception: di-boson physics
- First 13TeV results already presented at major conferences
  - Tracking and calorimetry performance
  - Charged-hadron multiplicity; top cross section
- CMS focus on completing 8TeV legacy papers
  - Completing preparations to fully exploit 13TeV sample when LHC ramps up
- SM results and prospects

Data Samples



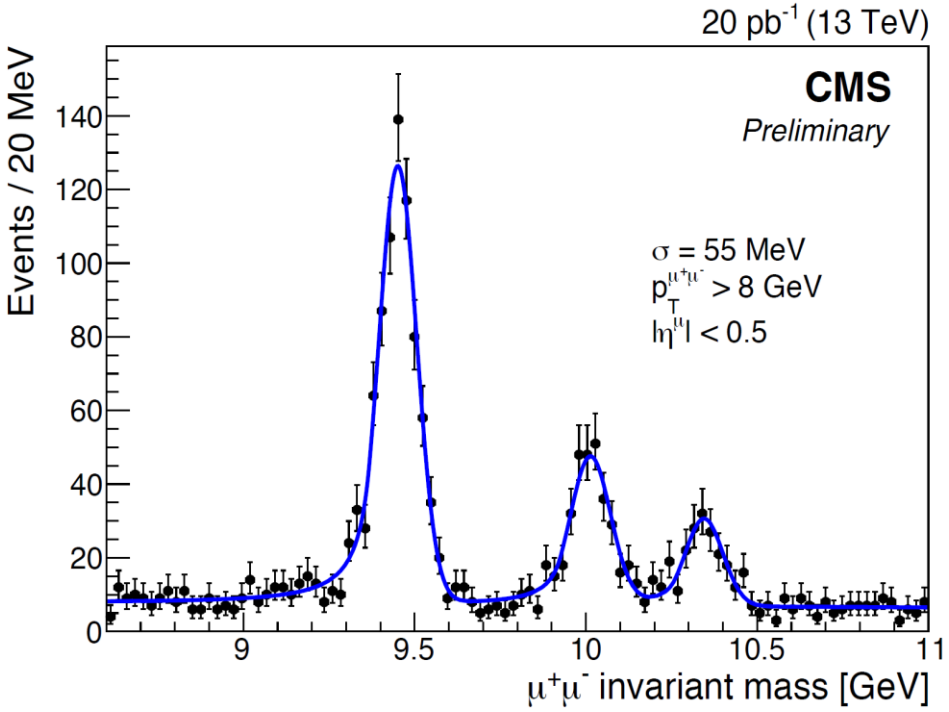
Rediscovering SM…

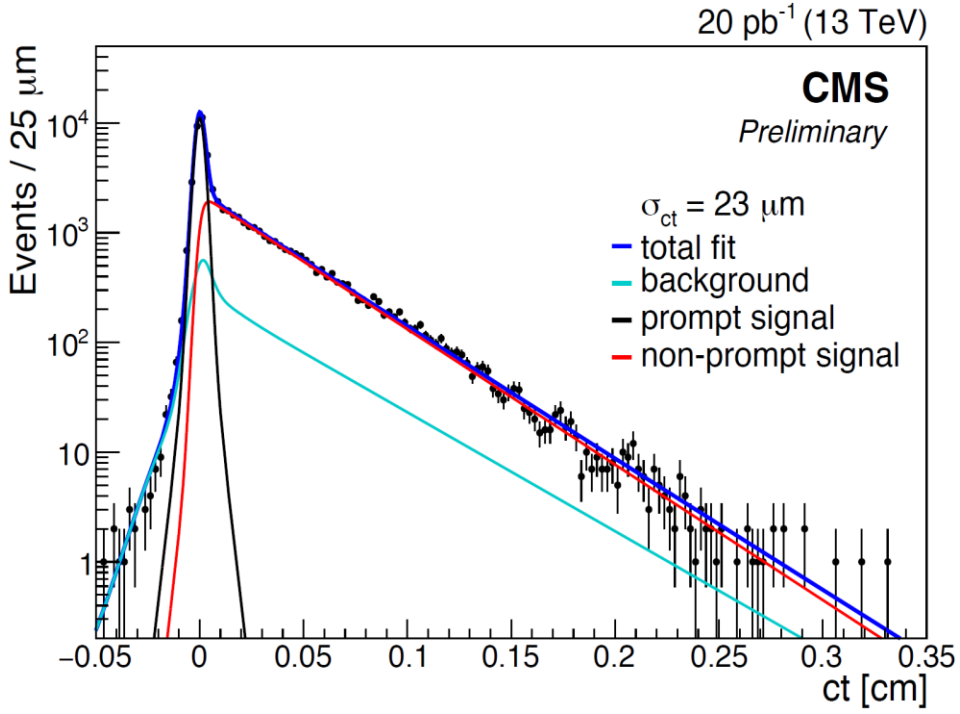
http://cds.cern.ch/record/2037379



… more SM…

http://cds.cern.ch/record/2037379



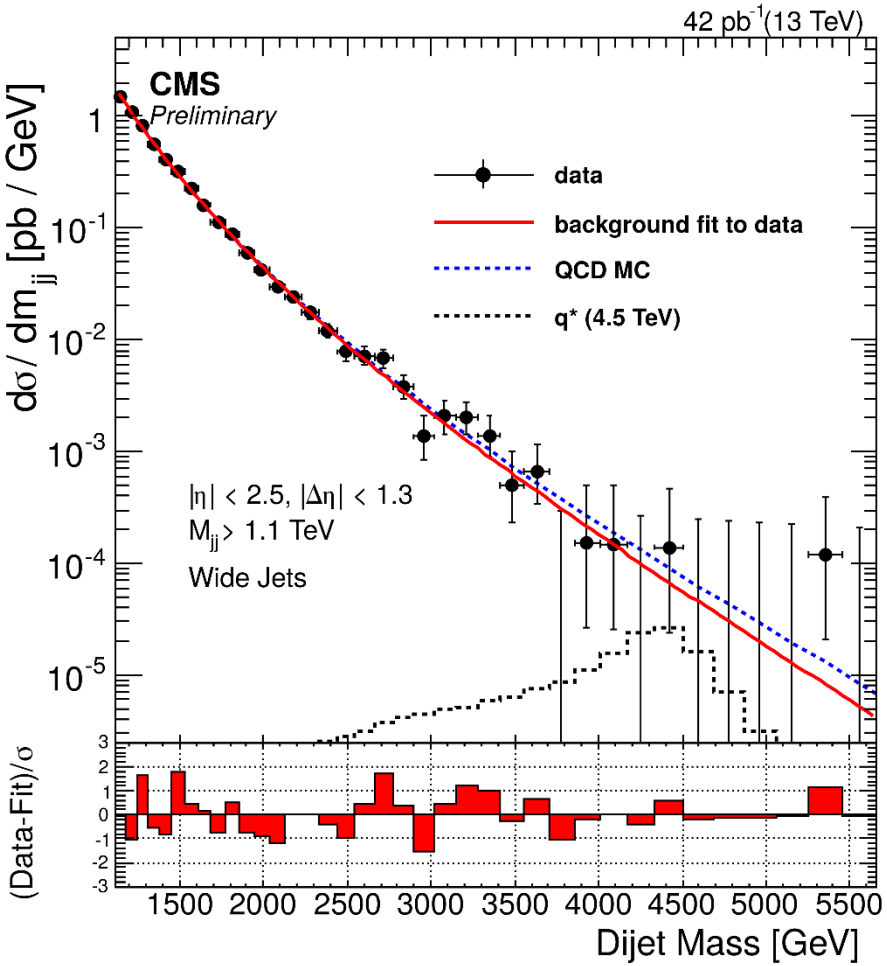


Zoom in ϒ(nS) region

Proper decay length J/ψ candidates

…and going beyond

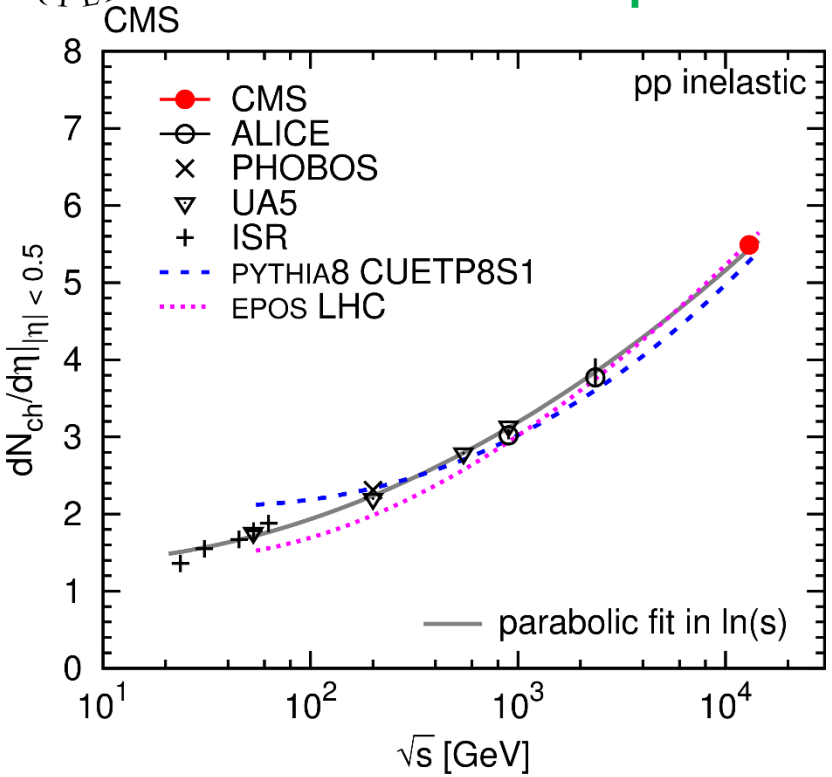
- Di-jet mass distribution fitted with 4-parameter function
- Superimposed q*(qg) signal with resonance mass 4.5TeV
- 42/pb enough to exceed 8TeV sample sensitivity for narrow resonances above 5TeV

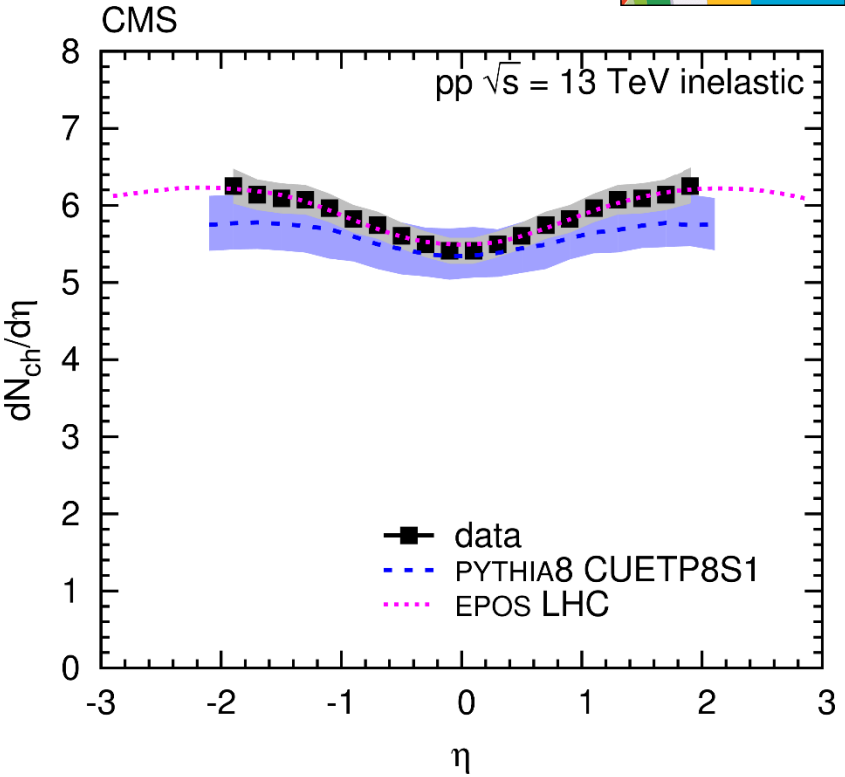


https://cds.cern.ch/record/2048099

Standard Model at 13TeV

http://arxiv.org/abs/1507.05915

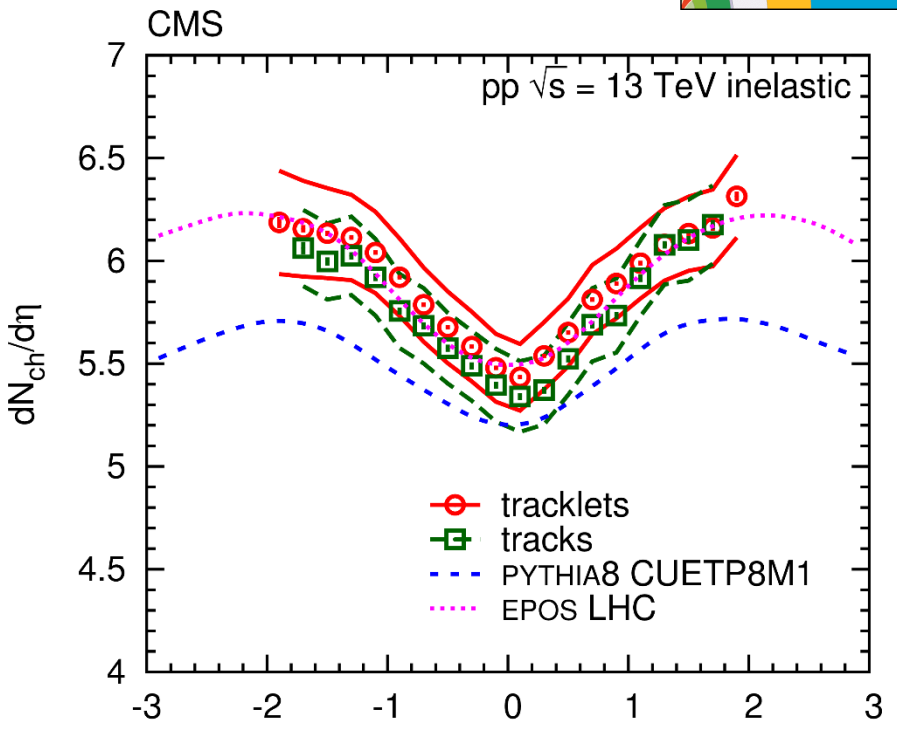


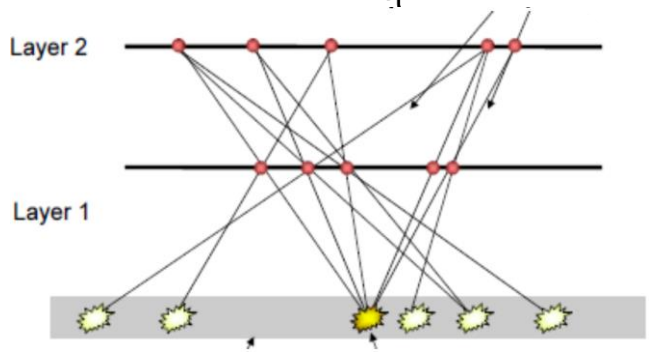


- Charged-hadron multiplicity and η-density
  - First 13TeV publication
  - Straight-track multiplicity: 0Tesla measurement
  - Crucial ingredient for tuning MC generators and pileup backgrounds

Cross-check with Tracklets

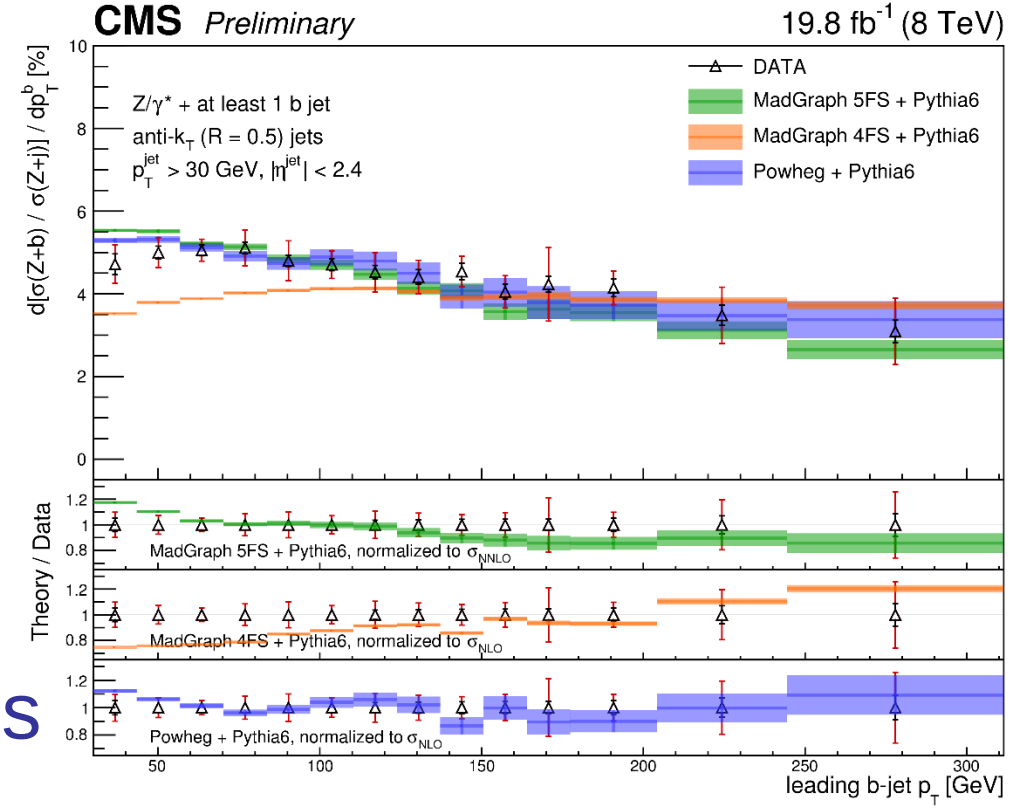
- Look for combination of pixel pairs in different layers
  - Sharp correlation in $\delta\eta$ and $\delta\phi$ for straight tracklets
  - Robust measurement, insensitive to alignment
- Consistent η-distribution with track-based result





Coming Up…

- Vector bosons
  - W/Z inclusive cross section
  - Inclusive di-photon spectrum
- Vector bosons + jets
  - NNLO calculations available for Z+jets
    - 1507.02850
- Multi-boson final states
  - Coming a bit later, affected by small data sample

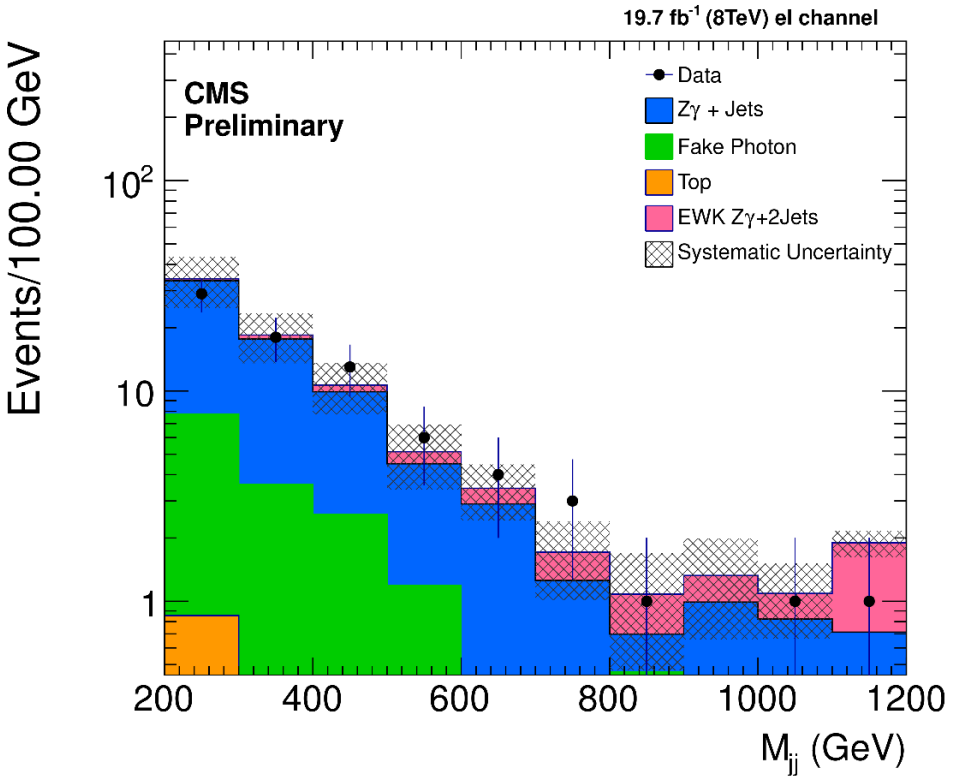


Z+b-jets (8TeV)

https://cds.cern.ch/record/2044919

Setting Final Words on 8TeV

- Large effort dedicated to completion of 8TeV legacy papers
  - About 20 papers in last two years from SM group
- Latest result: Zγ+jets
  - Evidence of electroweak production and limits on quartic gauge couplings



Zγ+2-jets (8TeV)

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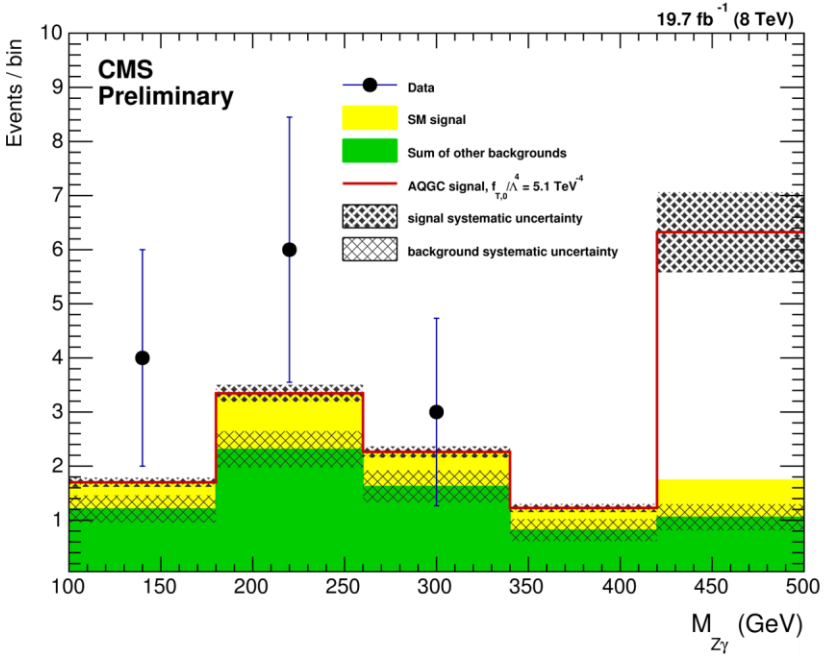
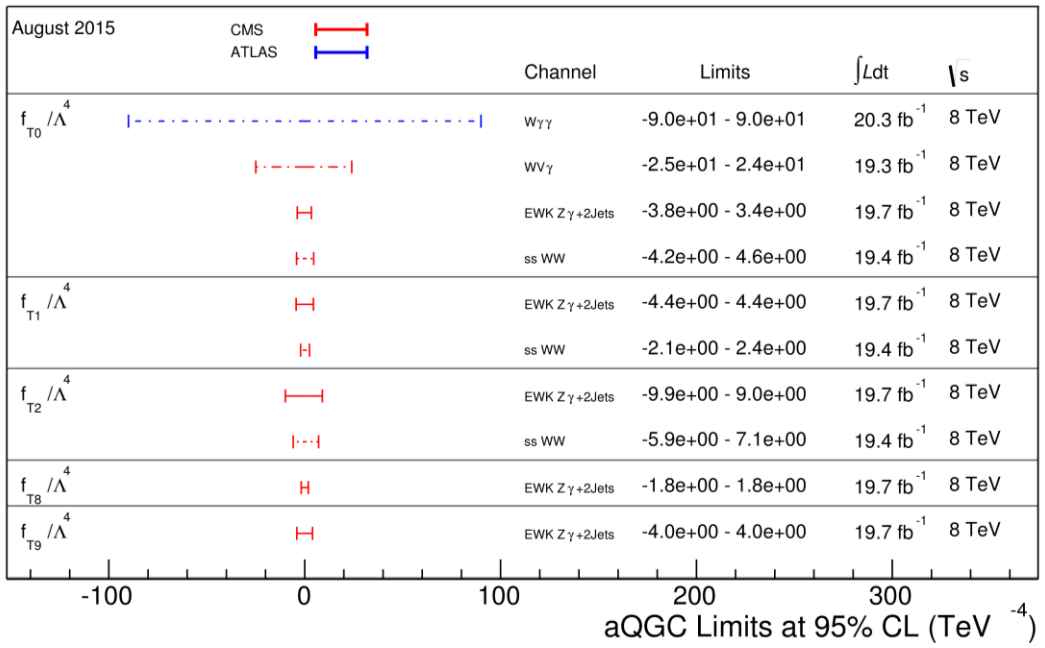
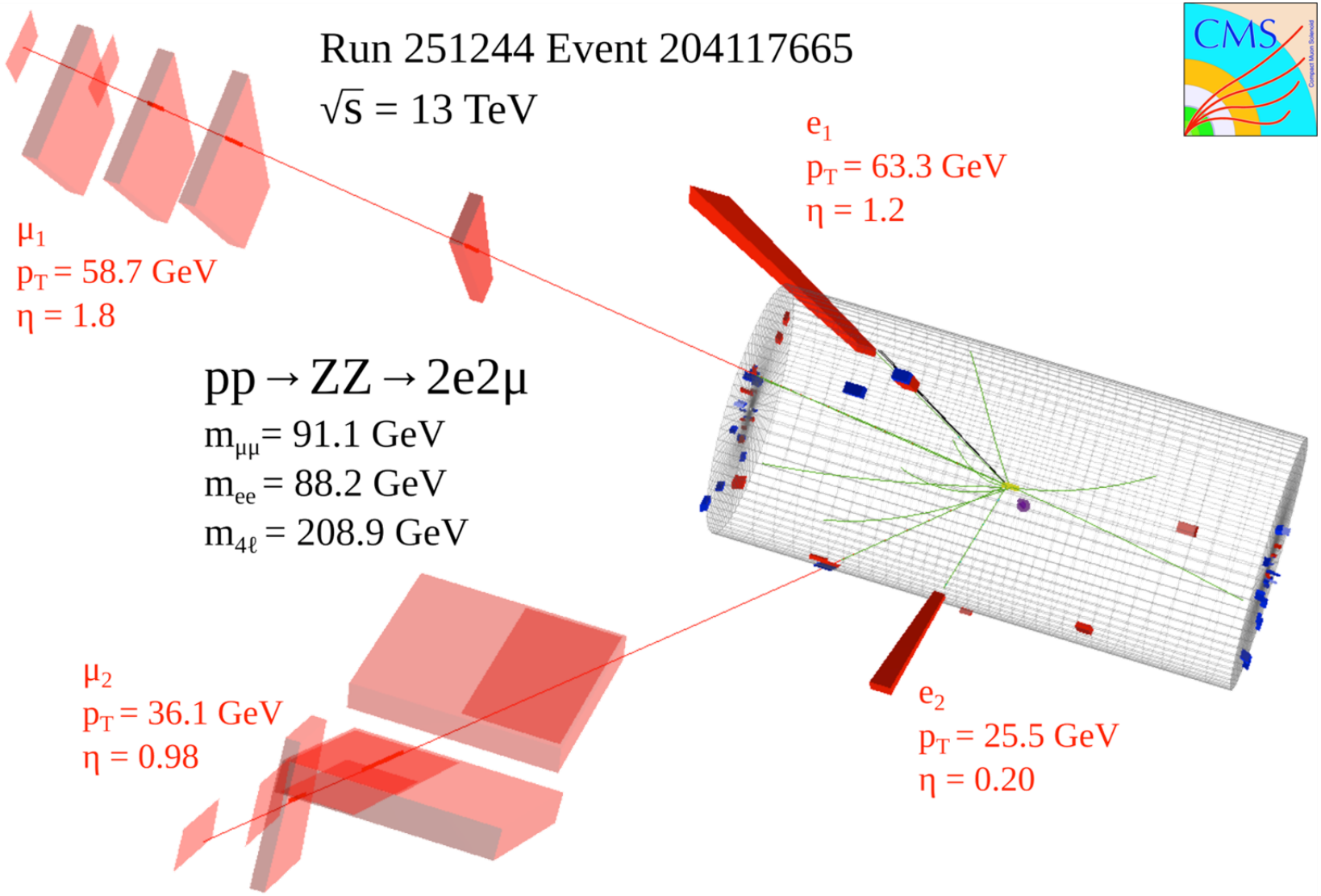
Electroweak Zγ Production





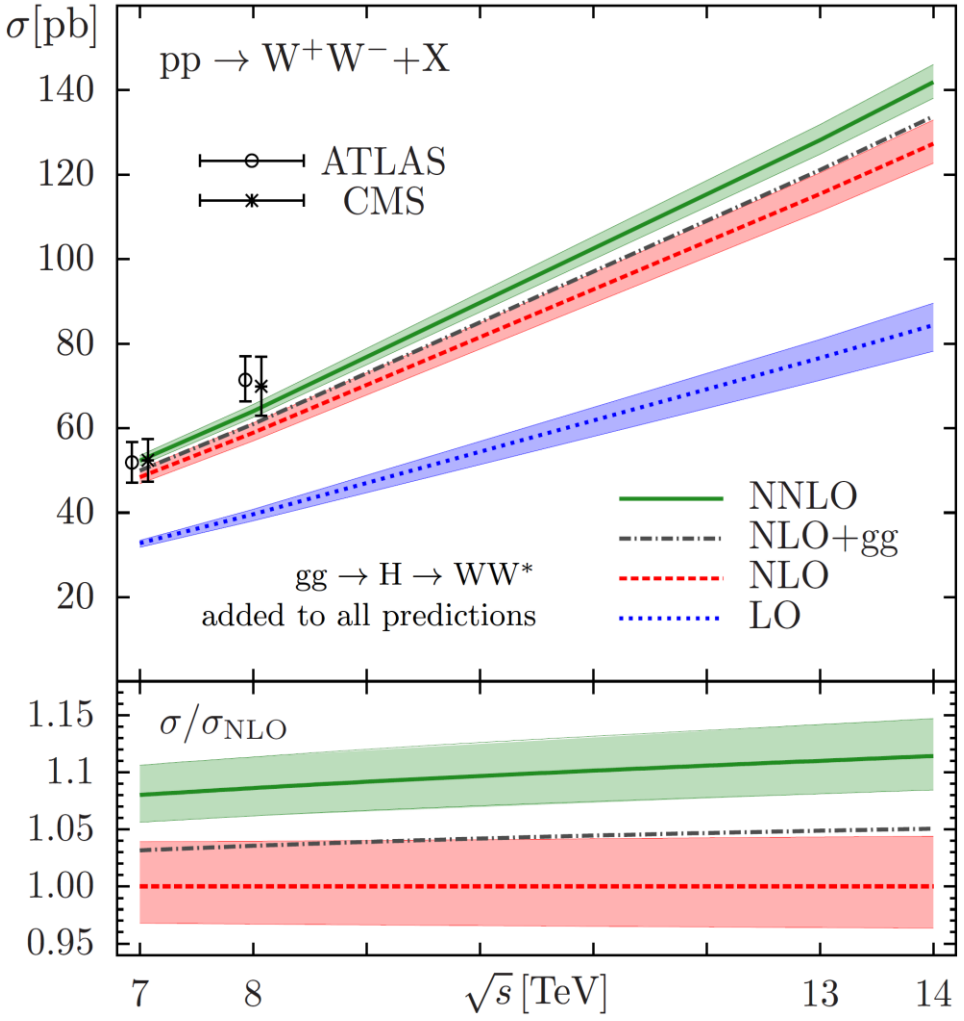
- First measurement of electroweak Zγ production
  - Cross section consistent with LO predictions
- Limits on aQGC competitive with other multi-boson channels
  - Dim-8 effective operators framework

ZZ Candidate at 13TeV



A few more on multi-boson

- NNLO precision now available for large number of processes
  - WW: 1408.5243
  - ZZ: 1507.06257
    - QCD N3LO: 1509.06734
  - Wγ, Zγ: 1504.01330
- 5-10% increase w.r.t. NLO
  - Important for comparison to measurements
- Significance of higher-order corrections increase with center-of-mass energy

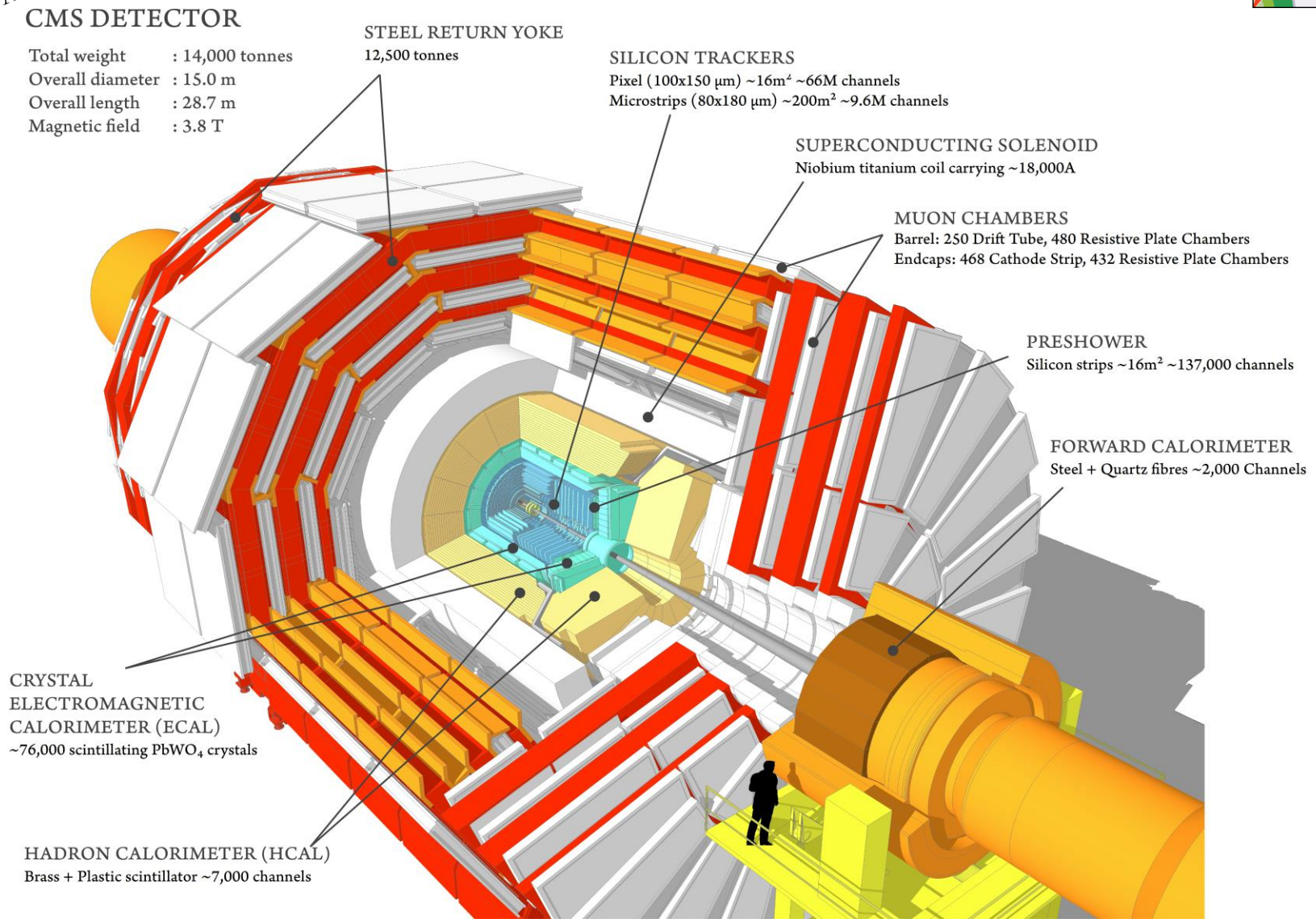


Conclusion

- The 13TeV SM program in CMS is shaping up
  - First measurements available, more soon to arrive
- Strong focus on legacy papers
  - Expect many high-precision papers on 8TeV data
- Appropriate resources devoted to preparation of 13TeV analyses requiring larger dataset
  - Multi-boson analyses ready for quick-start

Backup Material

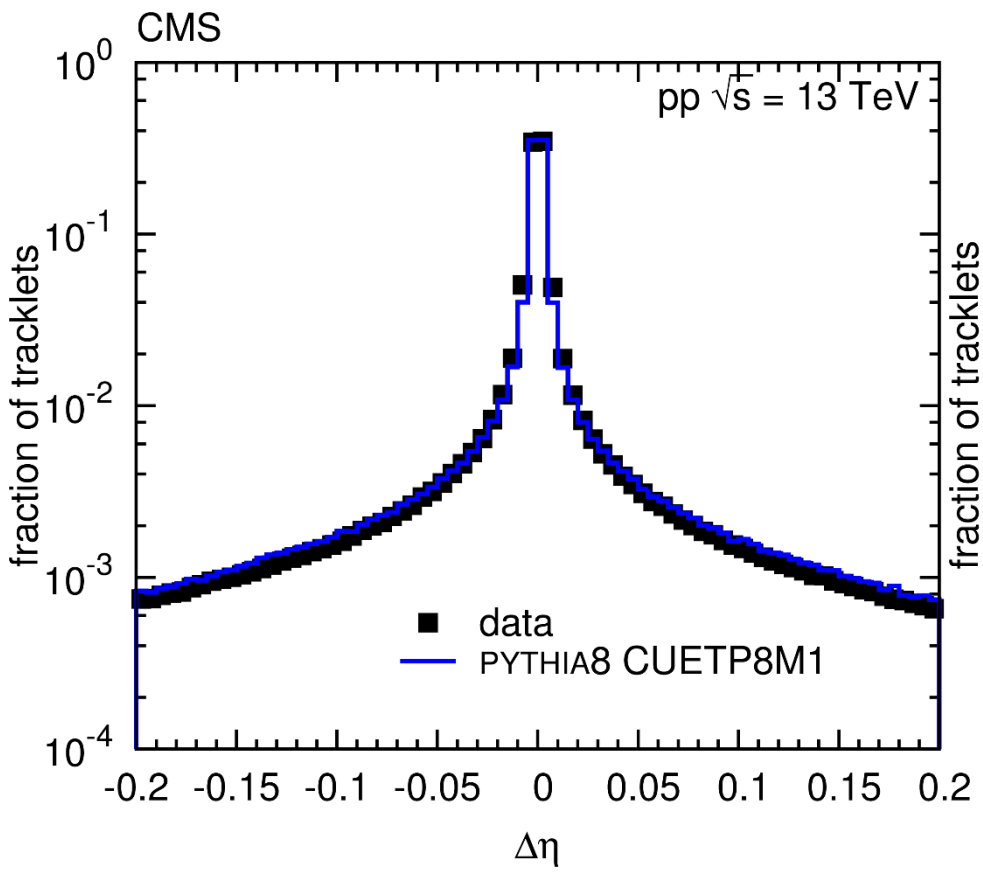
The CMS Detector

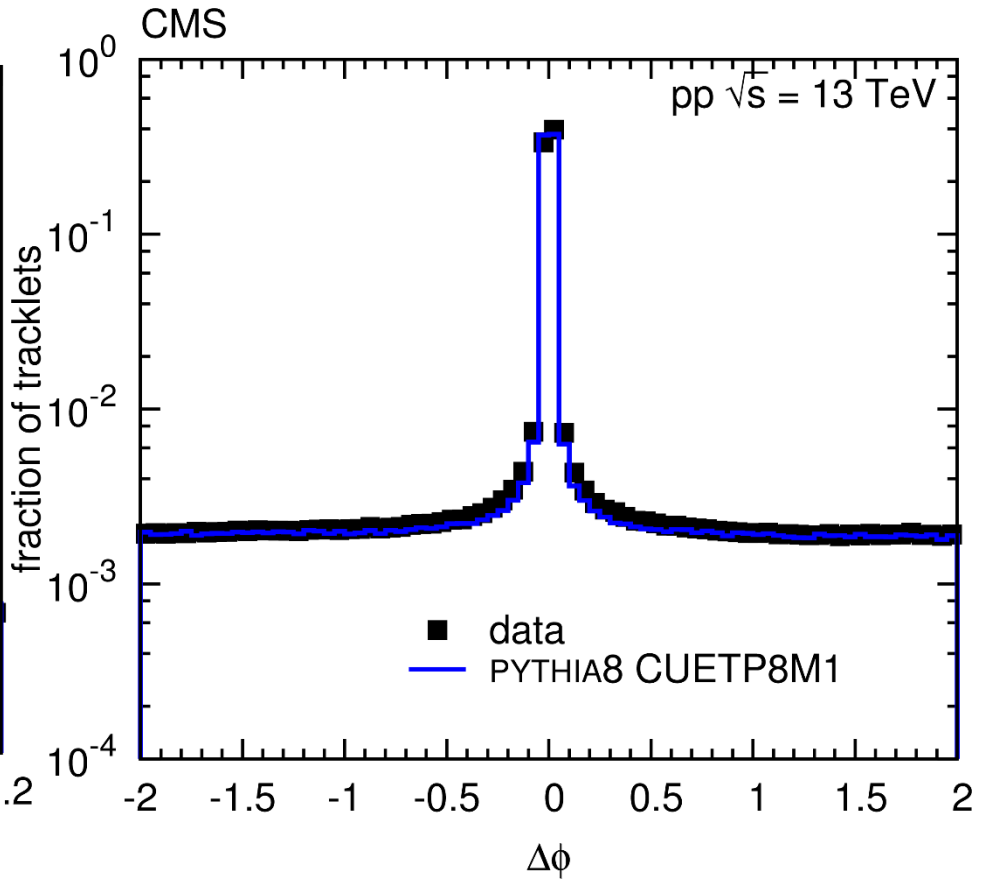


The Magnet Story

- The restart of the CMS magnet after LS1 was more complicated than anticipated due to problems with the cryogenic system in providing liquid Helium
- Inefficiencies of the oil separation system of the compressors for the warm Helium required several interventions and delayed the start of routine operation of the cryogenic system
- Currently the magnet can be operated, but the continuous up-time is still limited by the performance of the cryogenic system requiring more frequent maintenance than usual
- A comprehensive program to re-establish its nominal performance is underway. These recovery activities for the cryogenic system will be synchronized with the accelerator schedule in order to run for adequately long periods
- A consolidation and repair program is being organized for the next short technical stops and the long TS at the end of the year

Pixel Layer Correlations





δη and δϕ distributions of hit pairs on tracklets