CMS overview with first Run 3 experience

24 November 2022

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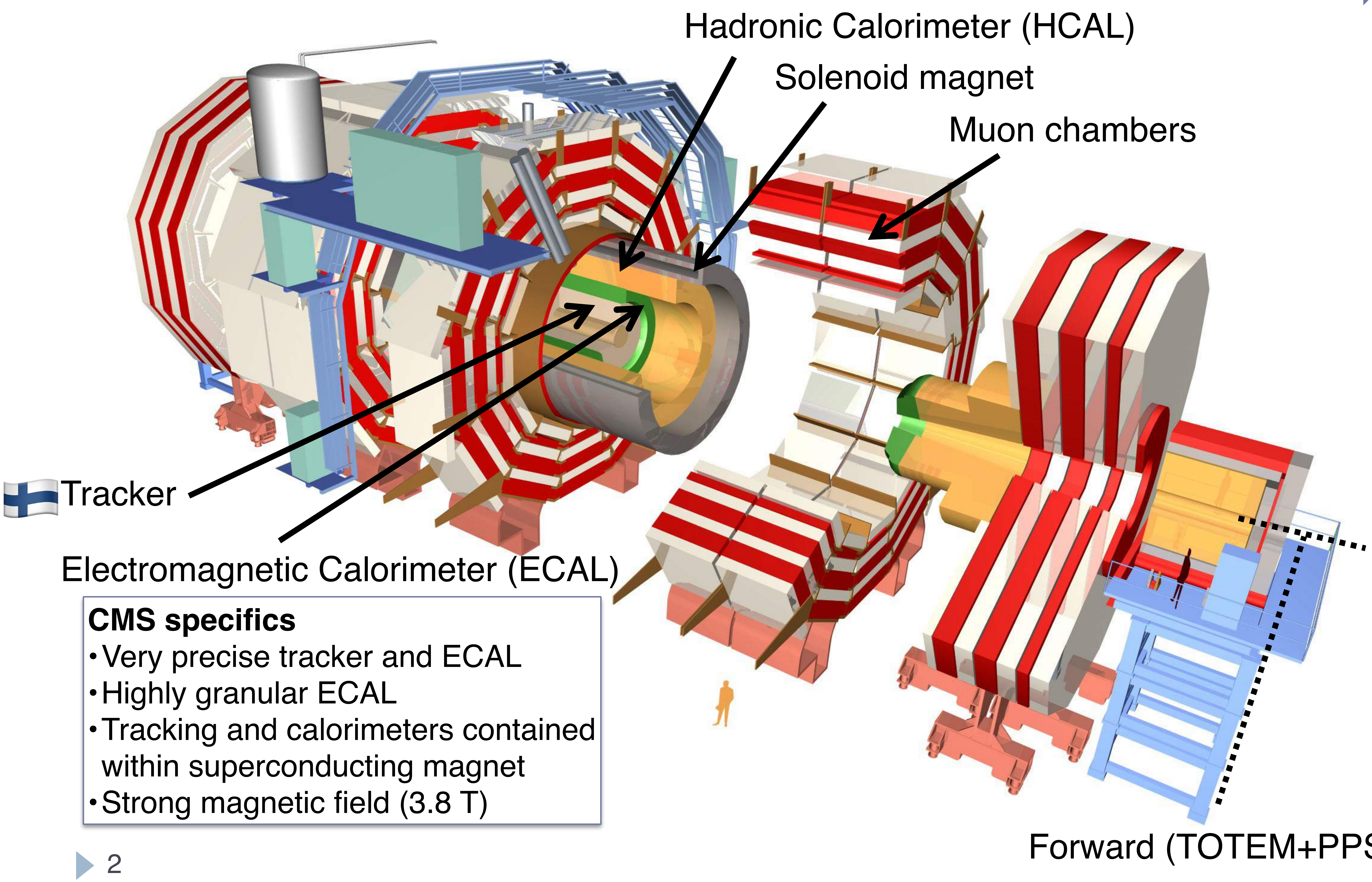
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

HELSINKI INSTITUTE OF PHYSICS

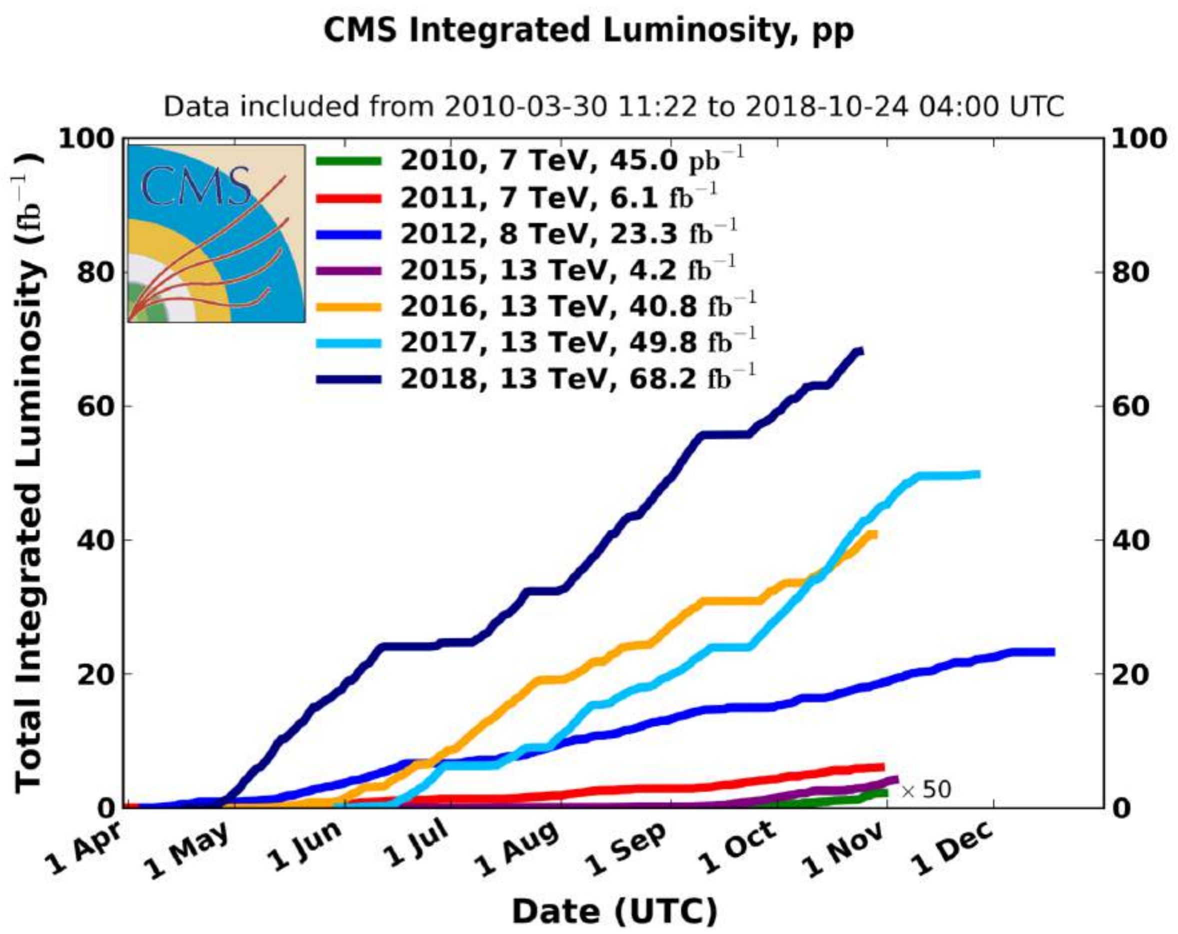
CMS (in Finland)



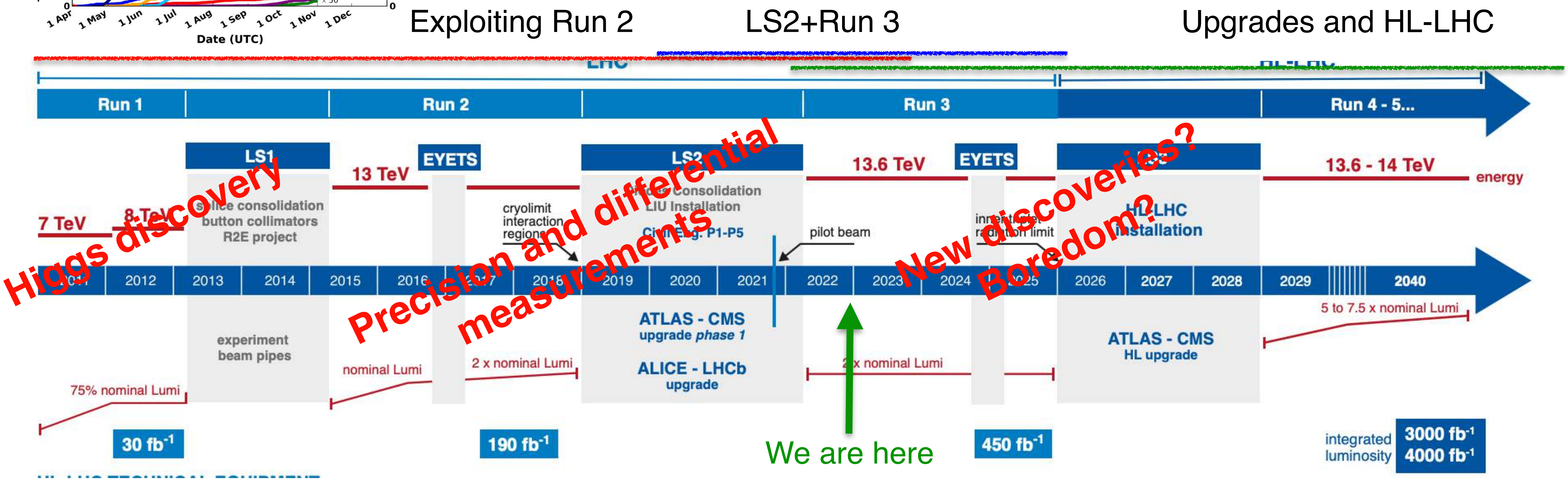
CMS specifics
- Very precise tracker and ECAL
- Highly granular ECAL
- Tracking and calorimeters contained within superconducting magnet
- Strong magnetic field (3.8 T)

- Key contributions to
  - hardware (pixel tracker, PPS diamond)
  - Detector operations (alignment, jet calibration)
  - Analyses (searches: H^+, SUSY, BSM with PPS; measurements: top mass, jet cross sections, VBS)

CMS (in time)



- Physics objects and performance
- Physics results
- LS2 reminder and ongoing Run 3
- Upgrades and HL-LHC

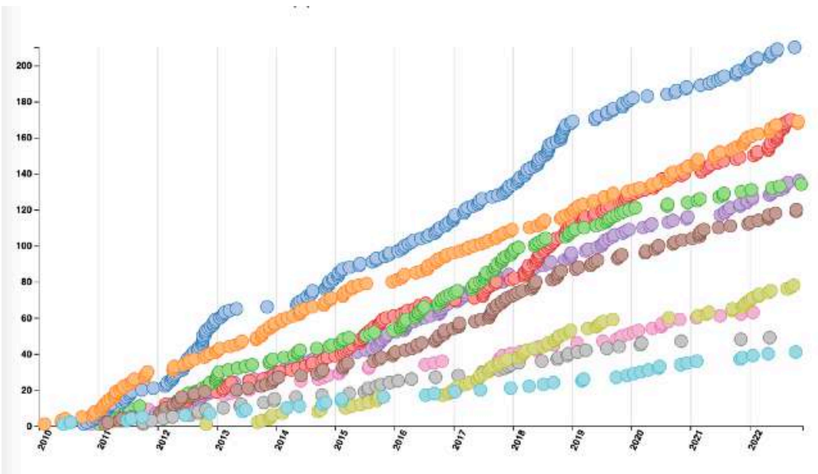


Exploiting Run 2

- Run 2 analyses in full swing
- Many new results also during this year

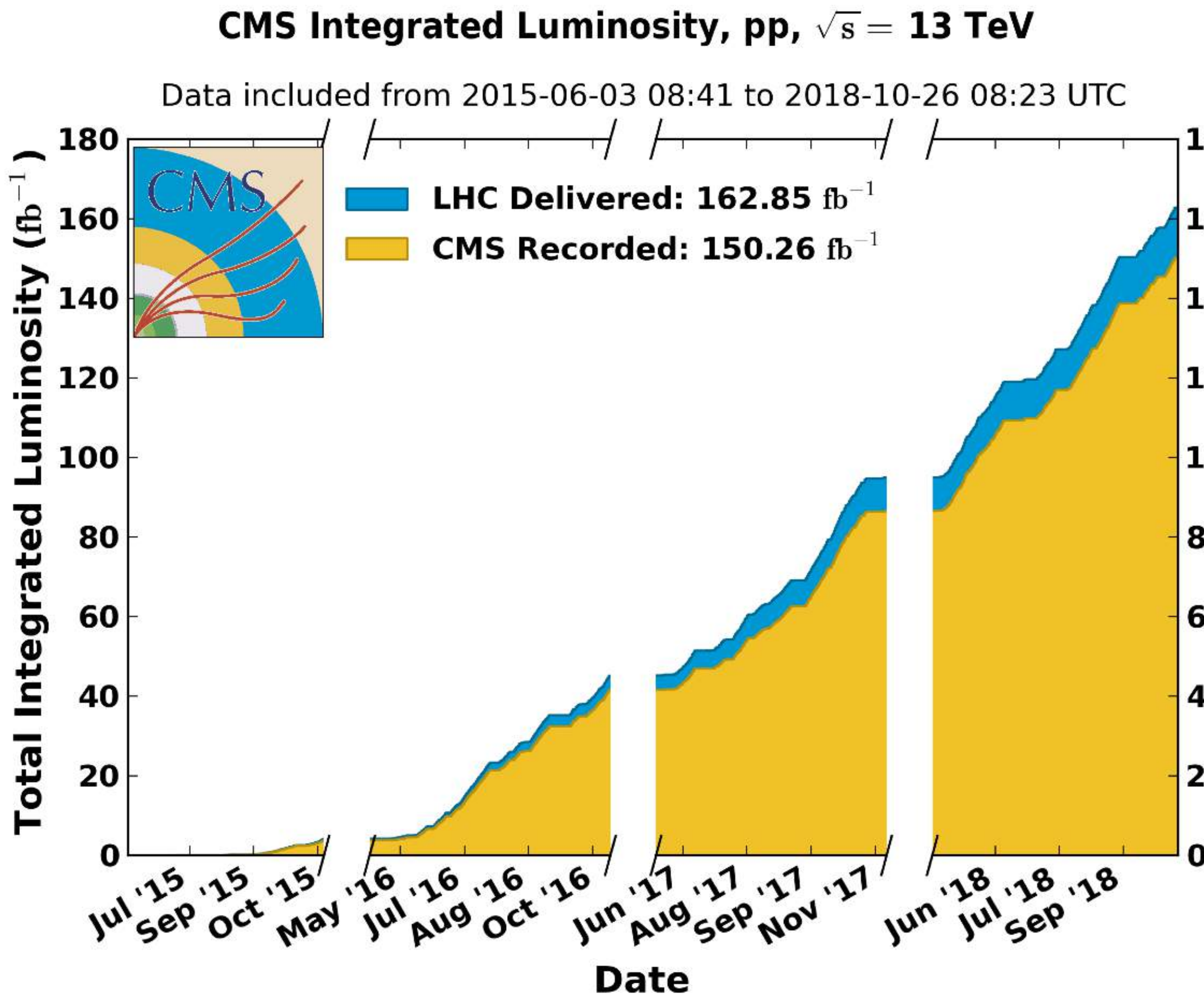
56th Rencontres de Moriond 2022

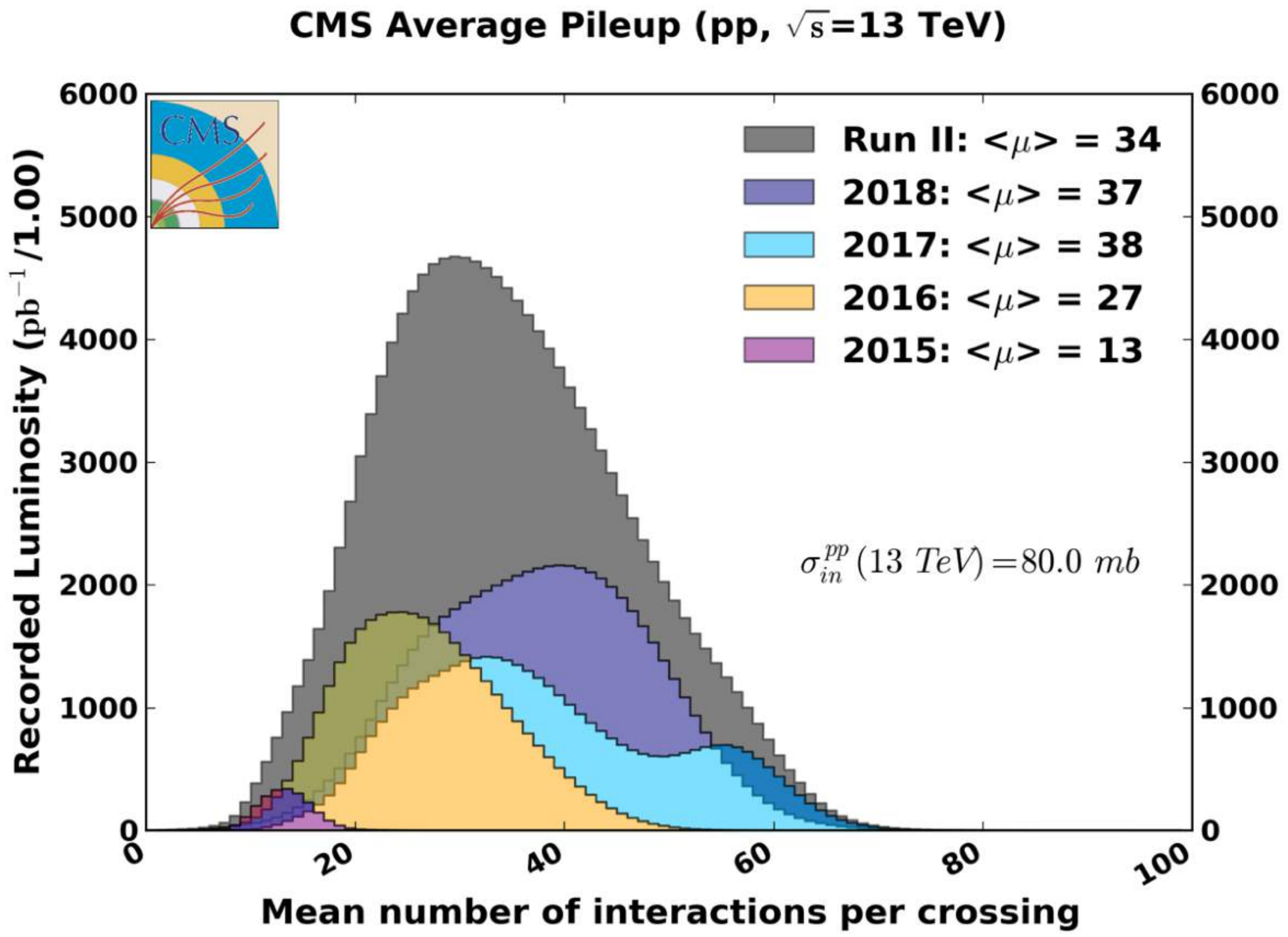
19th June 2020: 1000



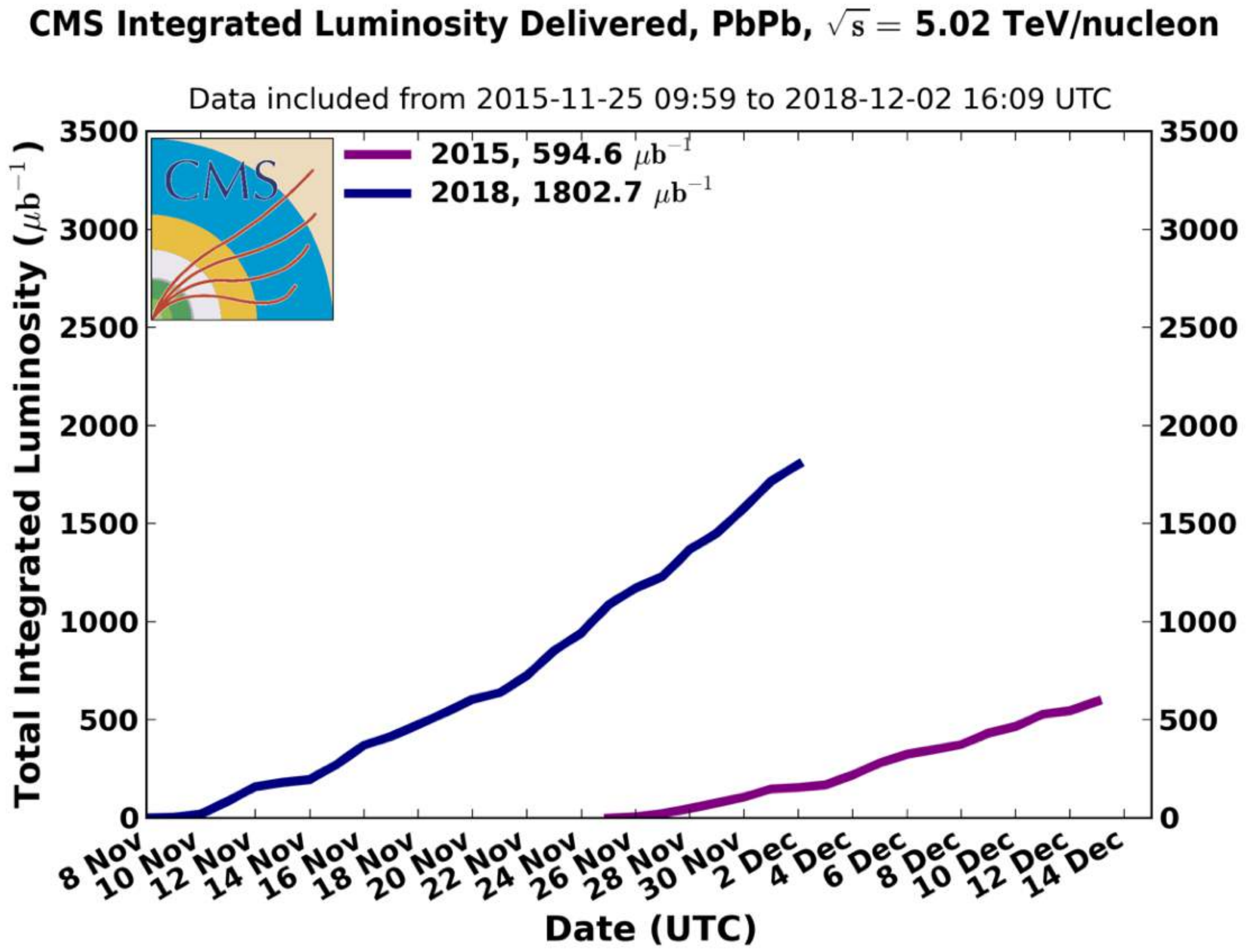
16th Nov. 2022: 1170

Run 2 ended in 2018 and CMS collected an integrated luminosity good for all physics of almost 140 fb^{-1} at 13 TeV





Heavy Ion data, mainly PbPb and pPb



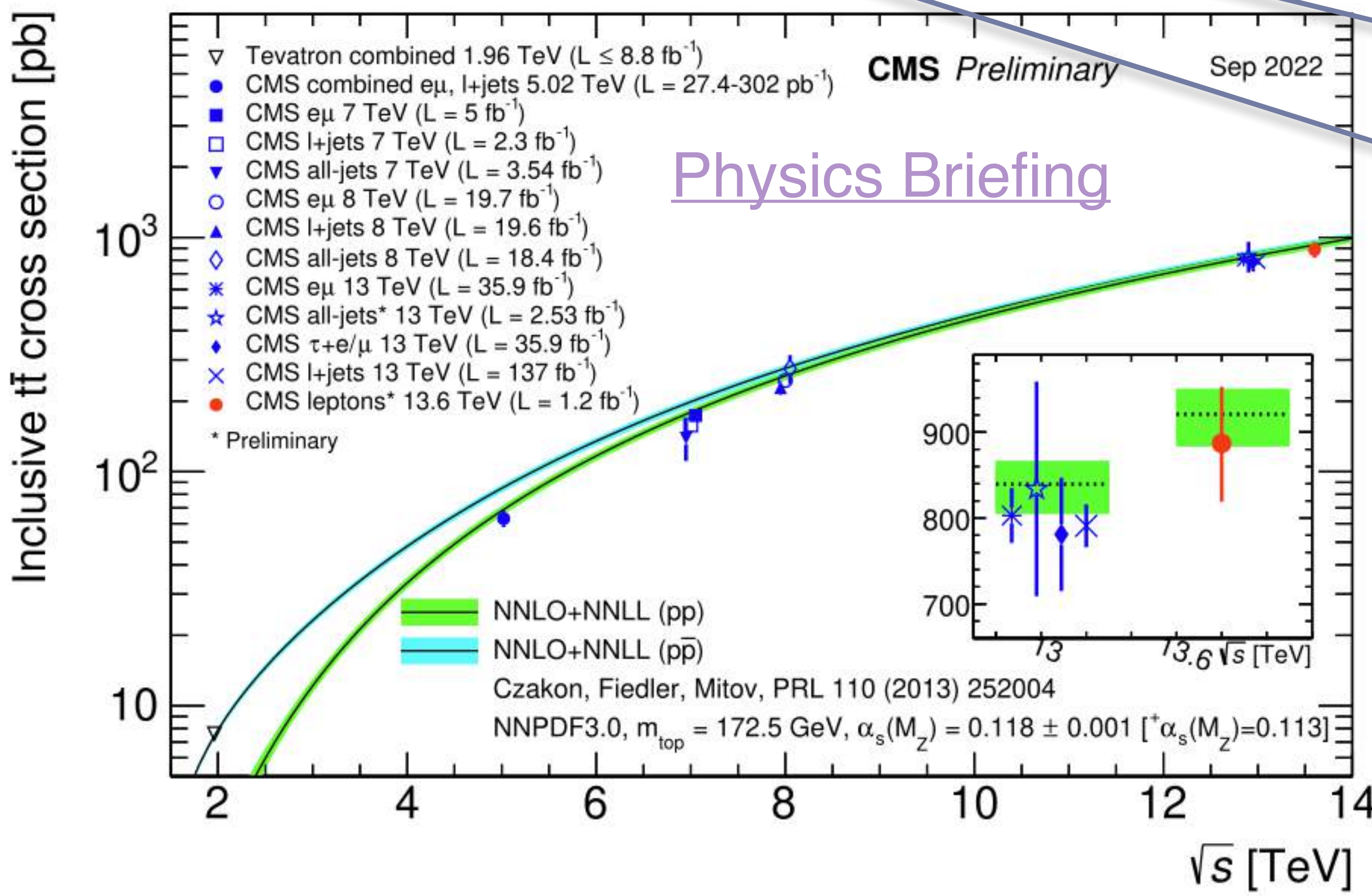
Exploring Run 3

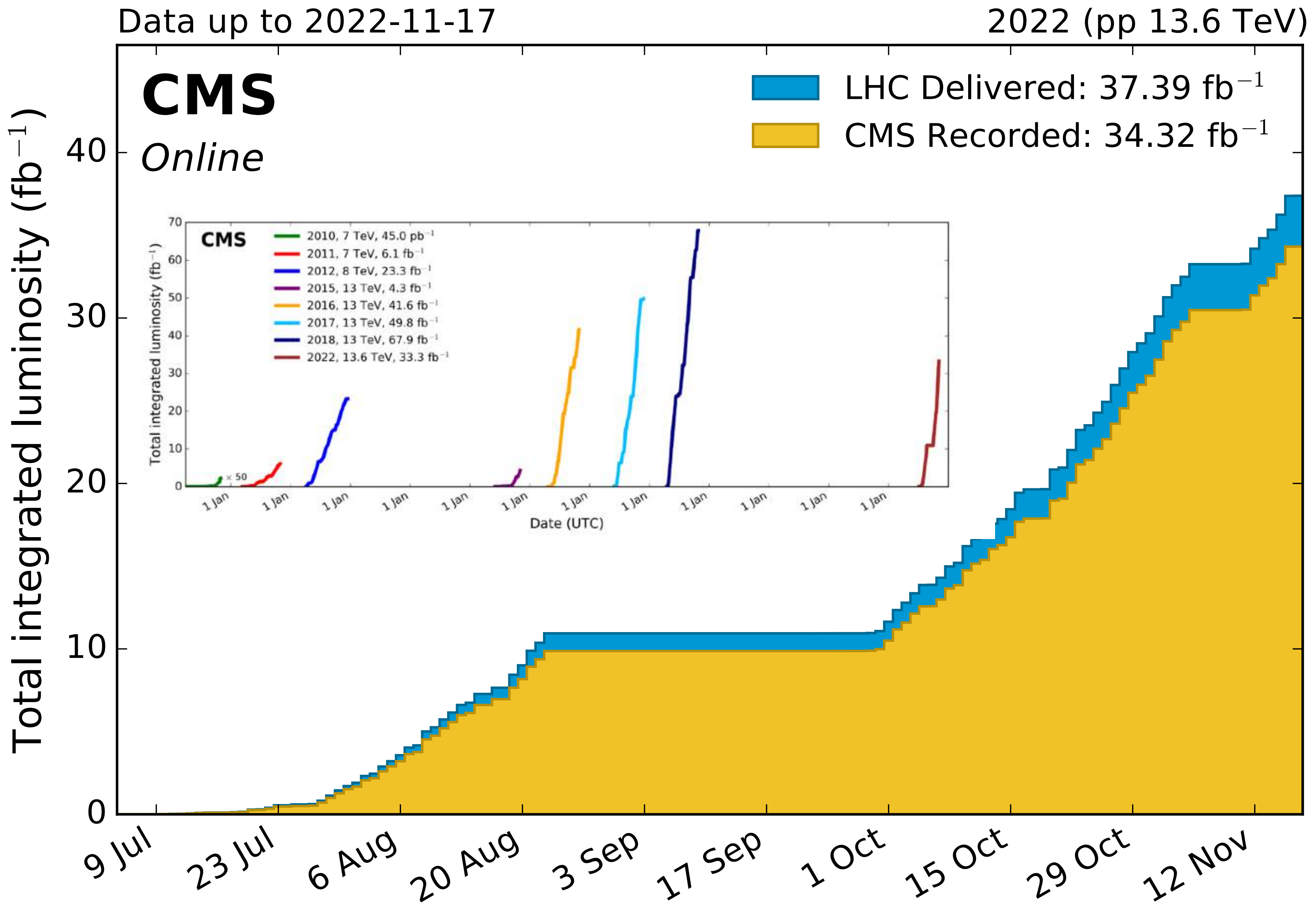
- Surpassing Run 2 data-taking when running: max. 1.2/fb/day in 2022 vs. 0.9/fb/day in 2018
- Already first physics result available (!)
  - Dataset: July 28th to August 3rd
  - Presented: 8 September
  - Preparation: exercise strategy on 1/fb of 2018 data

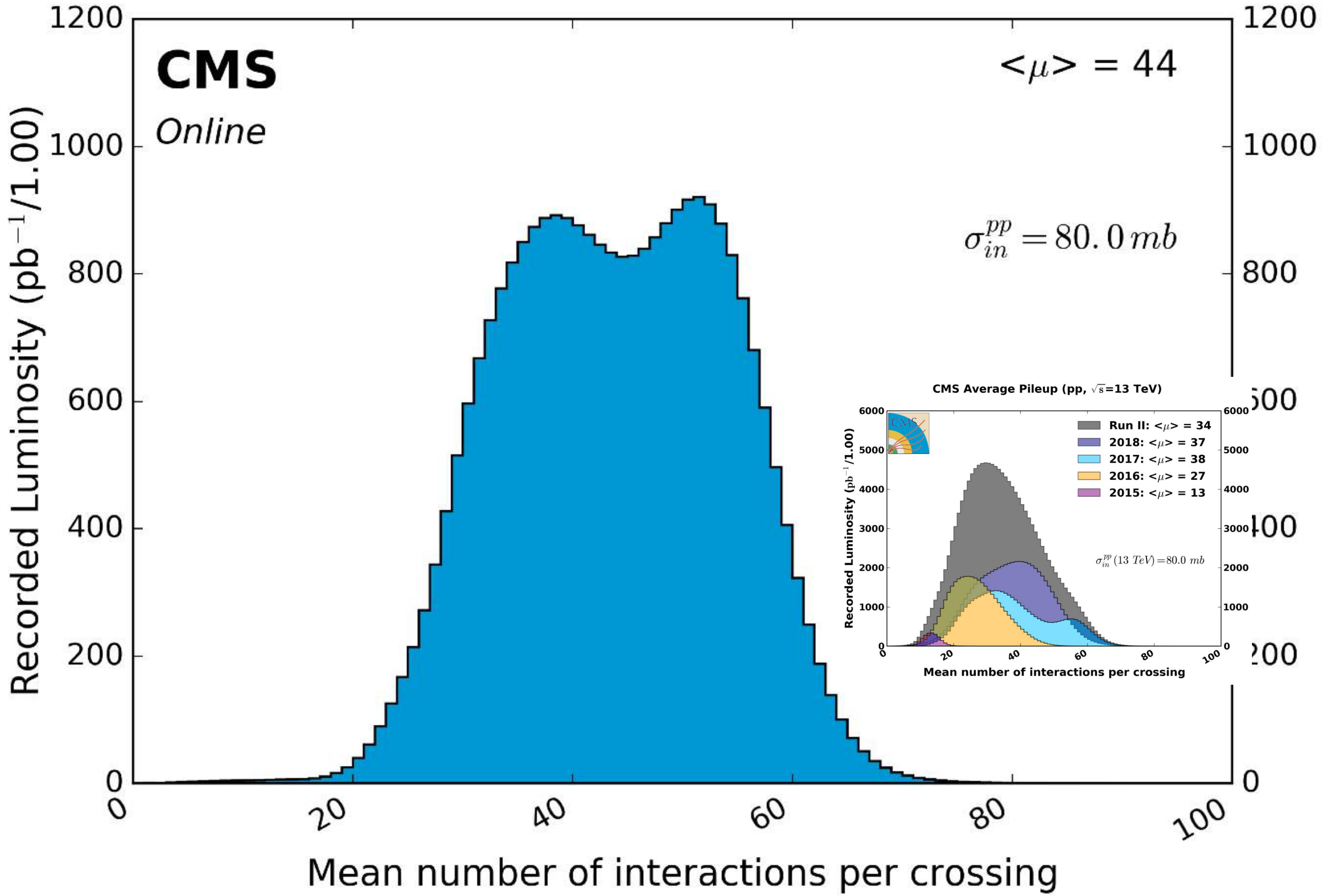
$$\sigma_{tt} = 887^{+43}_{-41}\ (\text{stat} + \text{syst}) \pm 53\ (\text{lumi})\ \text{pb}$$

+/- 6%

+/- 5%





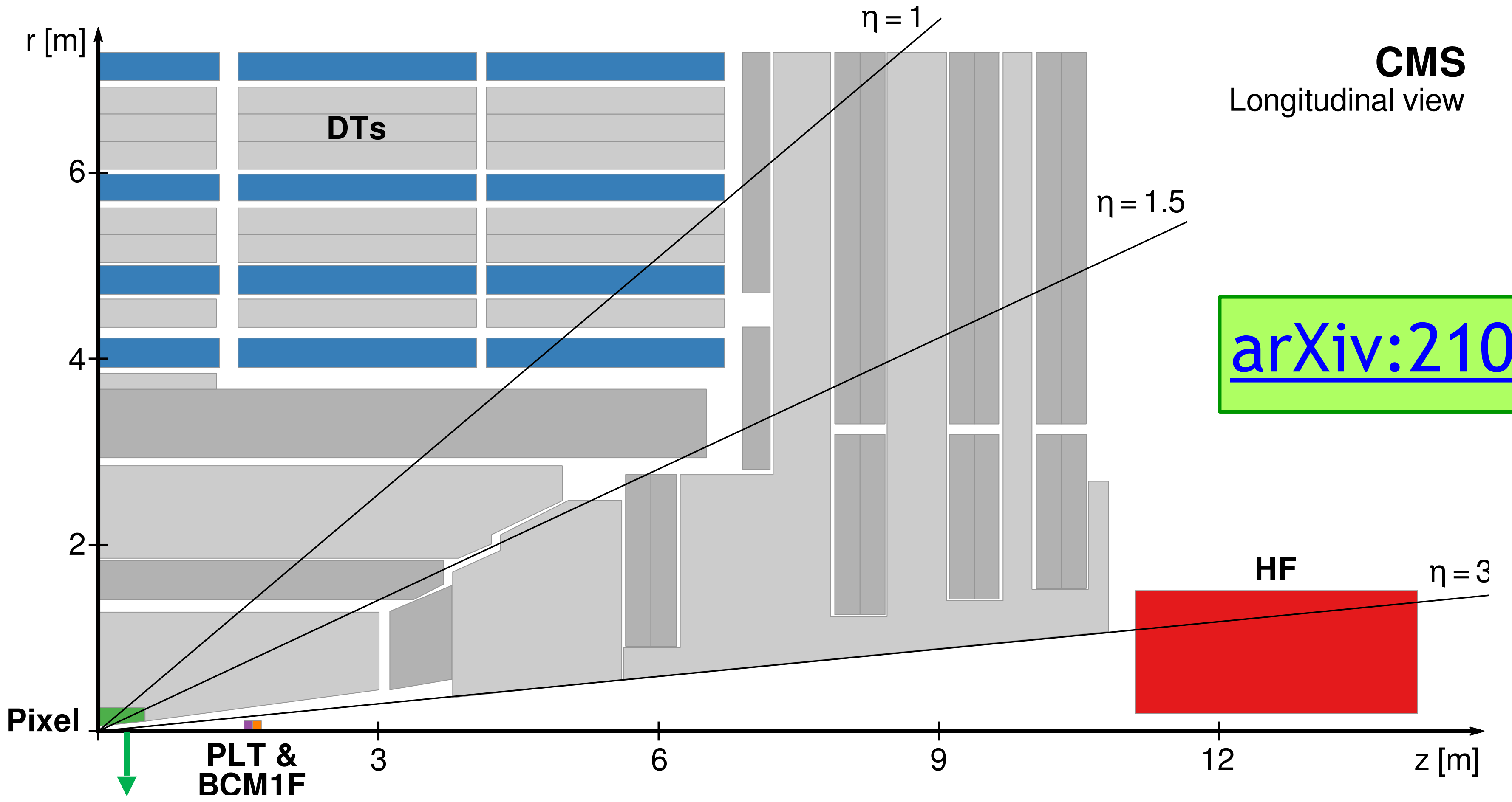


Physics objects and performance

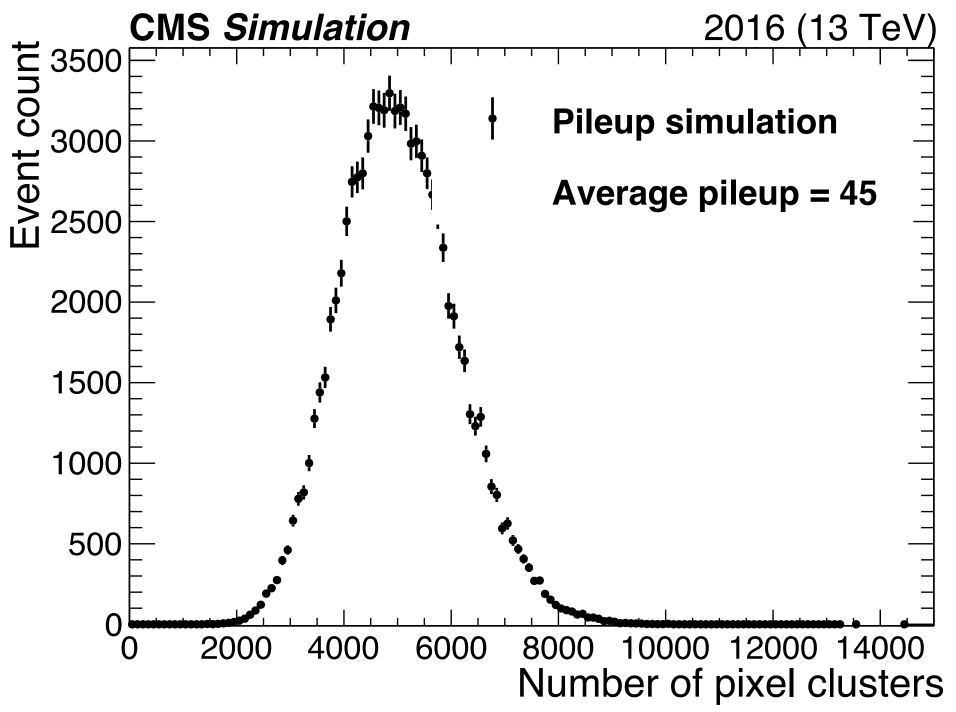
- No sense to “just” wait for more data
- Improve performance on existing and upcoming data

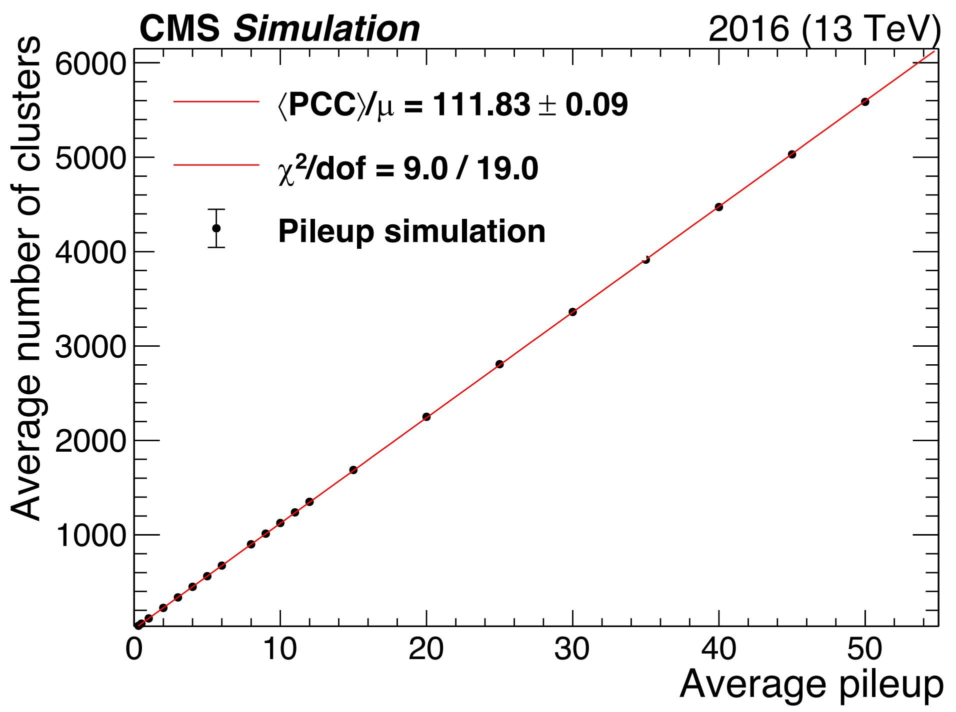
Precision luminosity measurement at CMS

- Ultimate precision for 2015-2016 luminosity
  - Luminosity uncertainty of 2016 data from 2.5% to 1.2%
  - Current uncertainty for full Run 2 is 1.6%
  - Updated luminosity for 2017 and 2018 will come soon and further reduce the overall uncertainty



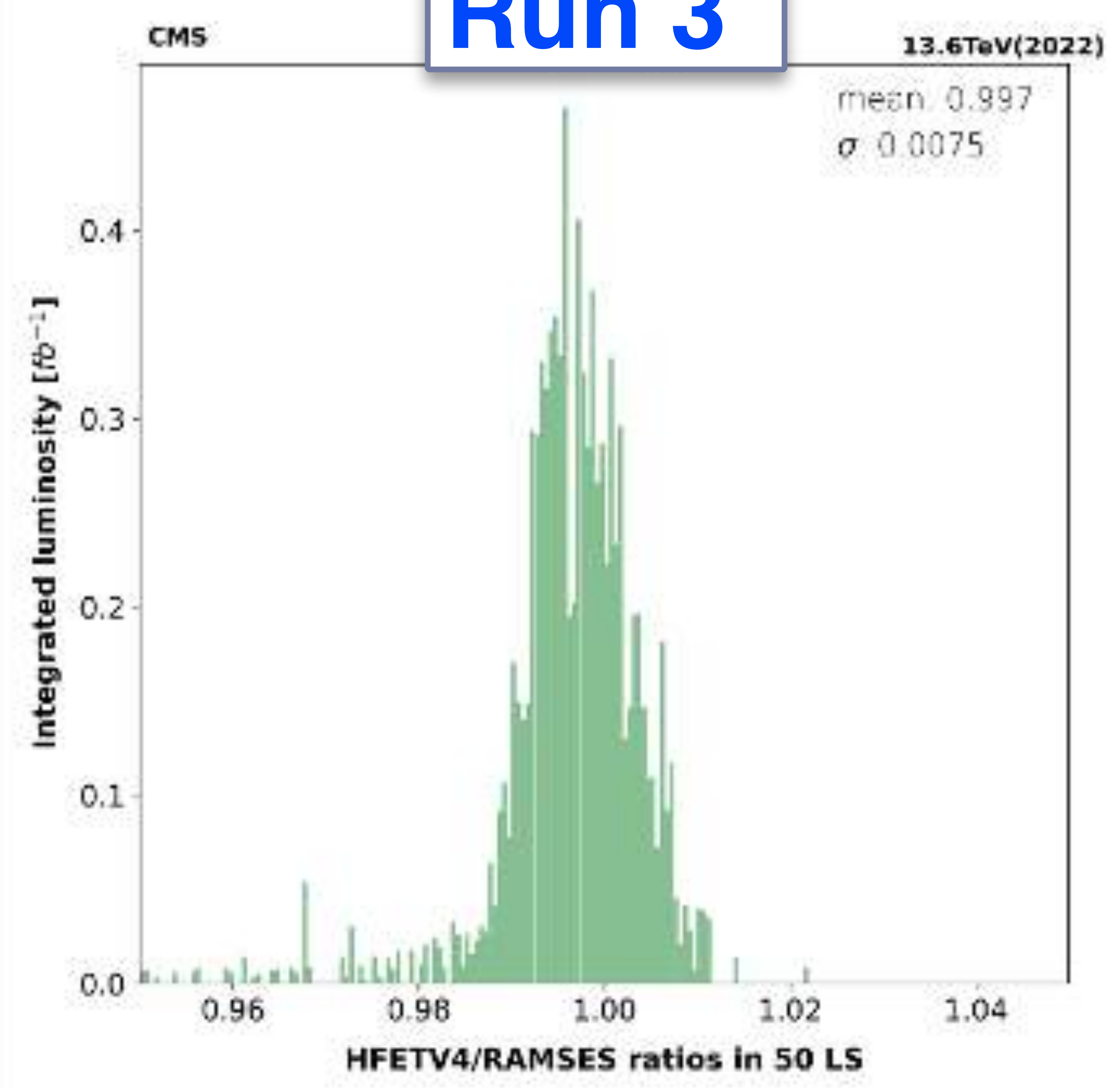
arXiv:2104.01927

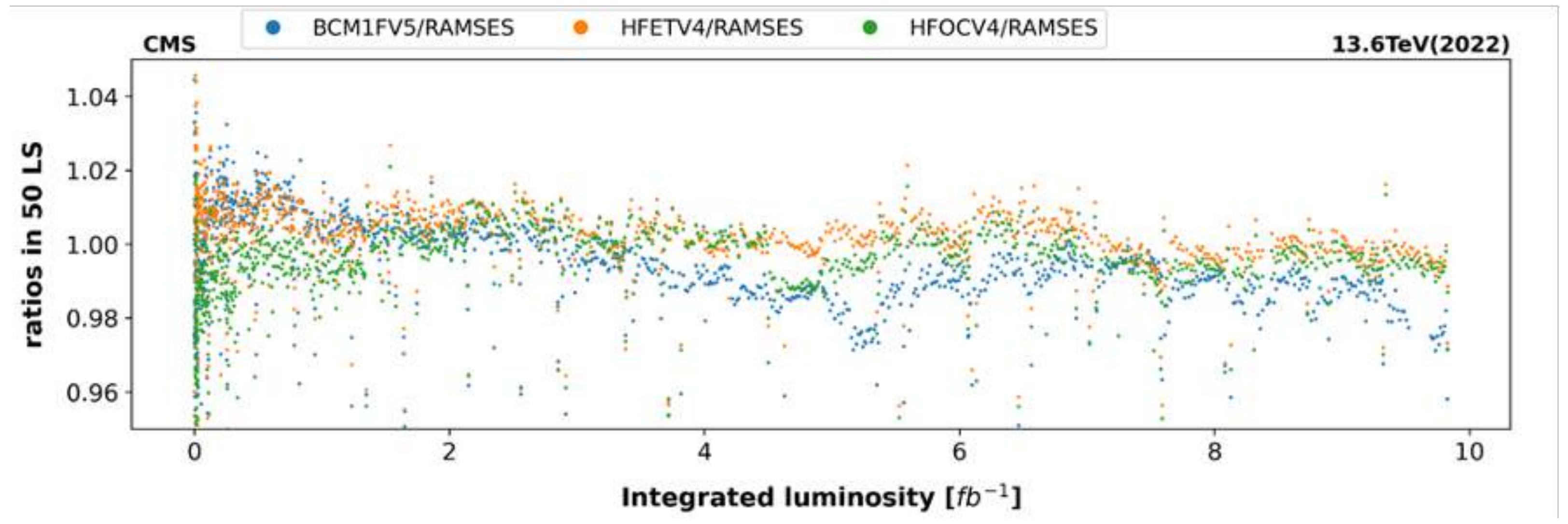




Pixel Cluster Counting (PCC) is the nominal Luminosity measurement method

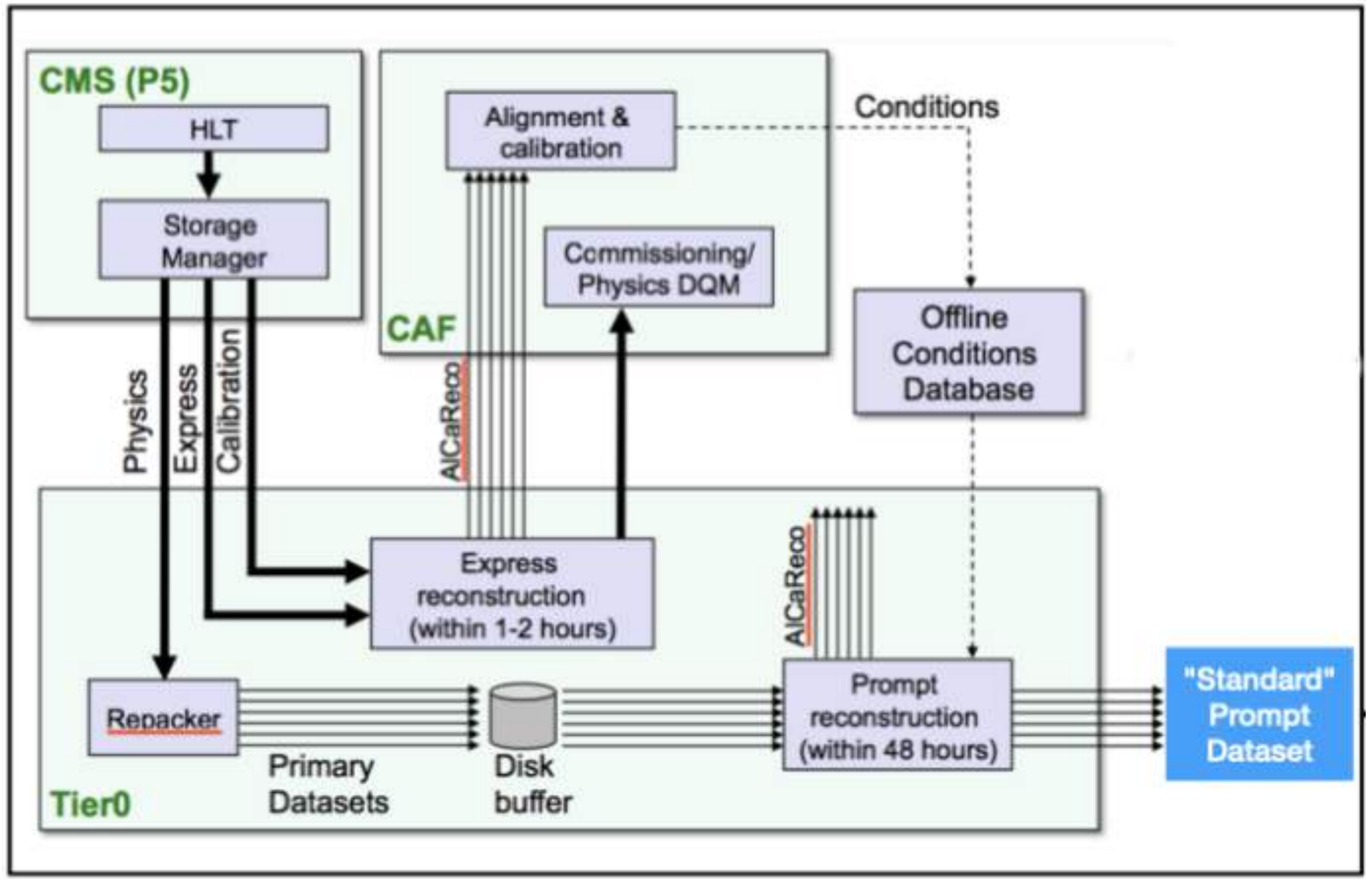
Run 3





- RMS better than 1% in Run 3 data for nominal method
- All luminometers consistent within 2%

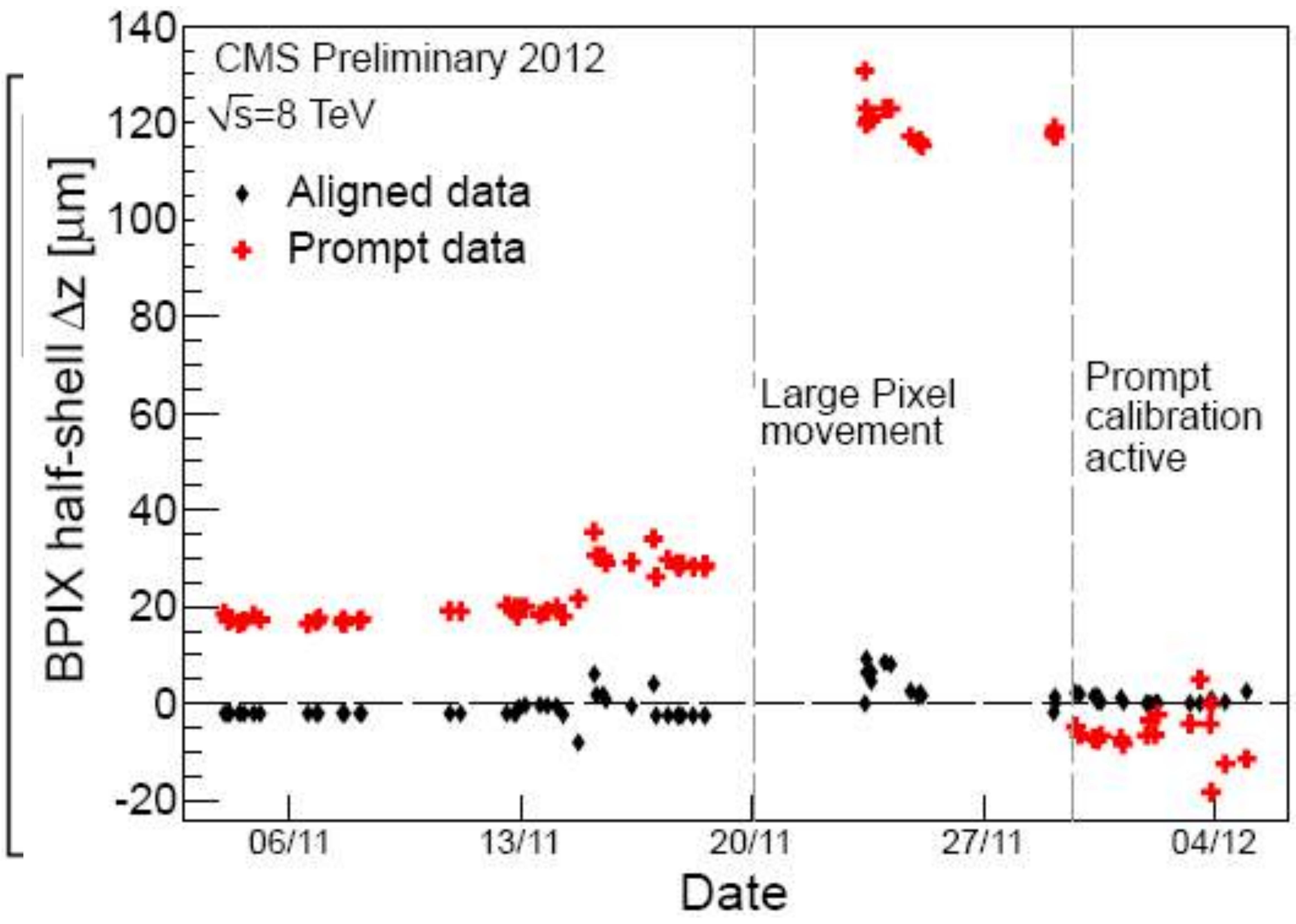
Prompt calibration loop 🇫🇮



- **Automatization**, can significantly improve data quality right after data taking
- Framework for quick calibration **Prompt Calibration Loop** (PCL) exists since Run 1, new calibrations are being implemented
- Medium-term plan to also include jet-energy calibration

BeamSpot (4 wfs)	SiStrips Quality	SiStrips Gains	ECAL pedestals
SiPixel Alignment	SiPixel Quality	Lumi PCC	SiStripGainsAAG

Prompt calibration loop 🇫🇮



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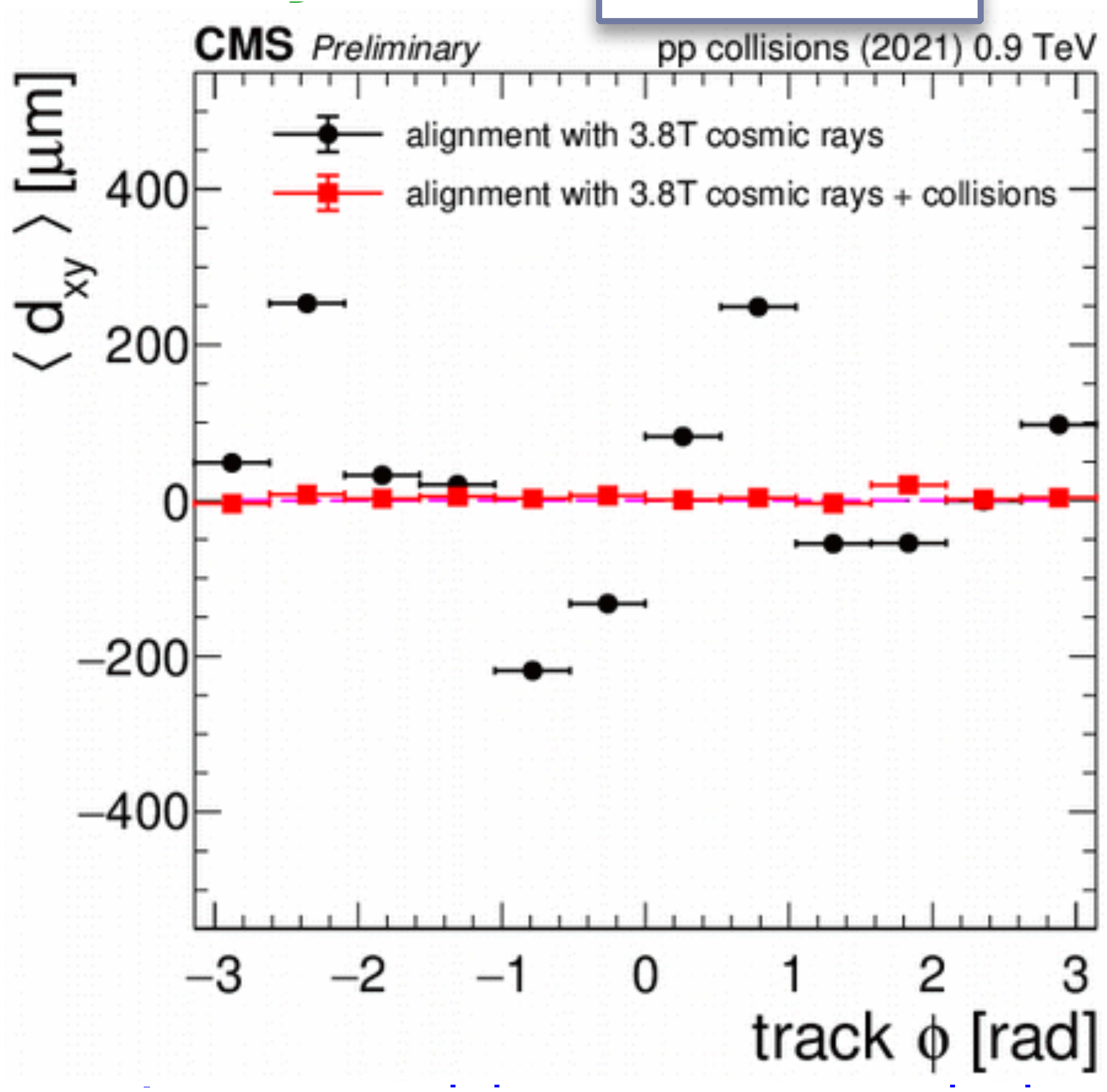
Run 3



During LS2 most of these workflows were consolidated/improved and new ones were added for Run 3

BeamSpot (4 wfs)	SiStrips Quality	SiStrips Gains	ECAL pedestals
SiPixel Alignment	SiPixel Quality	Lumi PCC	SiStripGainsAAG
SiStrip HitEff	SiPixel LA	SiPixel Ali HG	PPS Timing
PPS Sampic	PPS Alignment		

HIP effort on jet-energy corrections in the news

CMS

Jet-energy corrections blaze a trail 🇫🇮

Understanding hadronic final states is key to a successful physics programme at the LHC. The quarks and gluons flying out from proton–proton collisions instantly hadronise into sprays of particles called jets. Each jet has a unique composition that makes their flavour identification and energy calibration challenging. While the performance of jet-classification schemes has been increased by the fast-paced evolution of machine-learning algorithms, another, more subtle, revolution is ongoing in terms of precision jet-energy corrections.

CMS physicists have taken advantage of the data collected during LHC Run 2 to observe jets in many different final states and systematically understand their differences in detail. The main differences originate from the varying fractions of gluons making up the jets and the different amounts of final-state radiation (FSR) in the events, causing an imbalance between the leading jet and its companions. The gluon uncertainty was constrained by splitting the Z+jet sample by flavour, using a combination of quark–gluon likelihood and b/c-quark tagging, while FSR was constrained by combining the missing-E_T projection fraction (MPF) and direct balance (DB) methods. The MPF and DB methods have been well established at the LHC since Run 1: while in the DB method the jet response is evaluated by comparing the reconstructed jet momentum directly to the momentum of the reference object, the MPF method considers the response of the whole hadronic activity in the event, recoiling versus the reference object. Figure 1 shows the agreement achieved with the Run 2 data after carefully accounting for these biases for samples with different jet-flavour compositions.

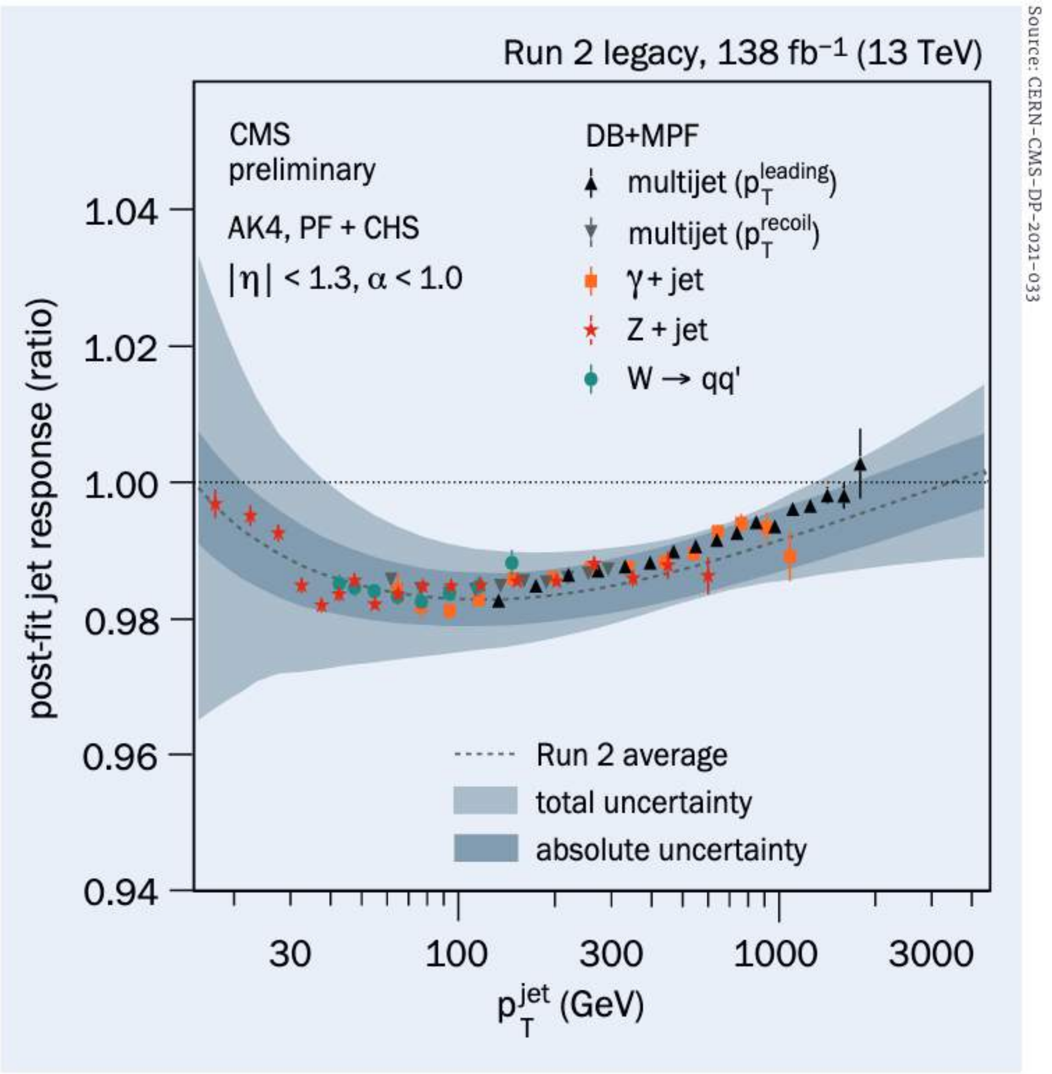


Fig. 1. *The measurement of particle-flow jet to particle-jet momentum ratio (or response) with multiple different final states, combining two complementary techniques (DB+MPF) to explicitly account for biases from initial- and final-state radiation. The ratio between data and simulation is shown after accounting for systematic biases in a global fit.*

Precise jet-energy corrections are critical for some of the recent high-profile measurements by CMS, such as an intriguing double dijet excess at high mass (*CERN Courier* May/June 2022 p15), a recent exceptionally accurate top-quark mass measurement (*CERN Courier* July/August 2022 p8), and the most precise extraction of the strong coupling constant at hadron colliders using inclusive jets.

The expected increase of pileup in Run 3 and at the High-Luminosity LHC will pose additional challenges in the derivation of precise jet-energy corrections, but CMS physicists are well prepared: CMS will adopt the next-generation particle-flow algorithm (PUPPI, for PileUp Per Particle Id) as the default reconstruction algorithm to tackle pileup effects within jets at the single-particle level.

Jets can be used to address some of the most intriguing puzzles of the Standard Model (SM), in particular: is the SM vacuum metastable, or do some new particles and fields stabilise it? The top-quark mass and strong-coupling-constant measurements address the former question via their interplay with the Higgs-boson mass, while dijet-resonance searches tackle the latter.

Underlying these studies are the jet-energy corrections and the awareness that each jet flavour is unique.

Further reading

CMS Collab. 2021 CERN-CMS-DP-2021-033.
CMS Collab. 2021 CERN-CMS-DP-2021-001.
CMS Collab. 2022 CMS-PAS-TOP-20-008.

- Several highlights during past year:
  - Public note on Run 2 legacy results ➜ paper in preparation and featured in CERN Courier

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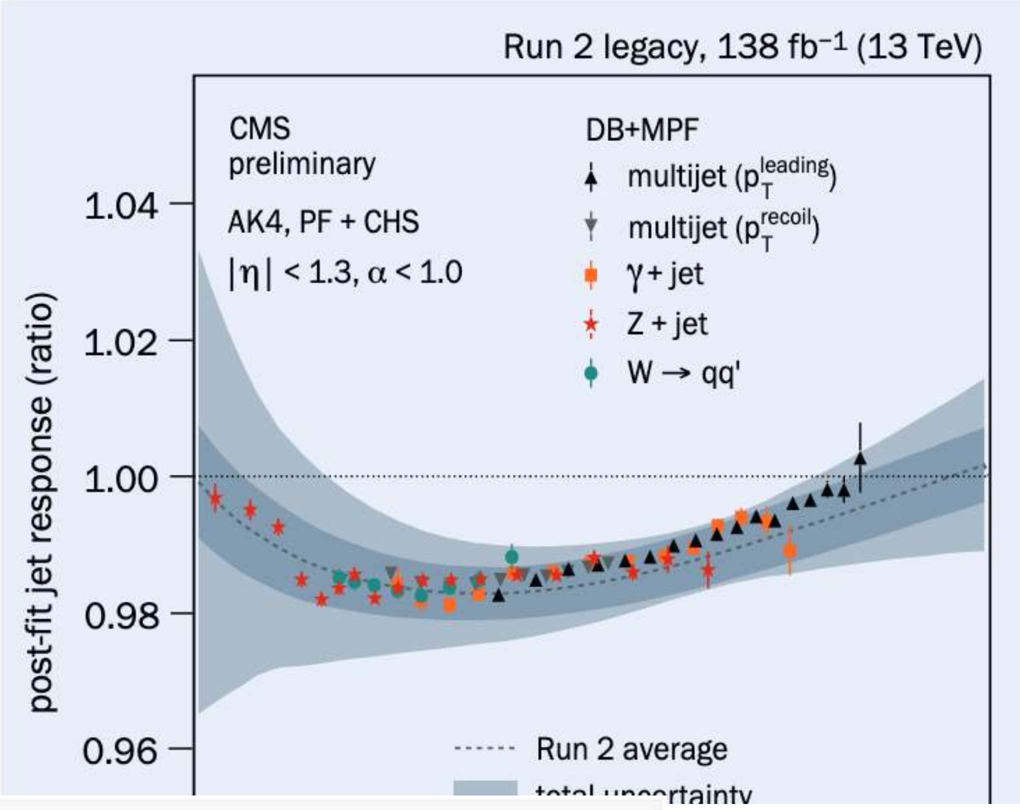
CMS physicists have taken advantage of the data collected during LHC Run 2



Source: CERN-CMS-DP-2021-033

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Mikko Voutilainen @skvarkki · Mar 17

Good news from ERC! My Consolidator Grant for Jet Energy Corrections at High-Luminosity LHC was approved as one of the 313:

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Can we transition to renewable energy sources faster by creating social tipping points? What can ...

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Bucking the current trends in HEP, I did not promise to (a) use machine learning, or (b) find dark matter. I did kind of promise to probe physics up to the Planck scale and save the universe from the brink of metastability, though.

1 · 5

Faculty of Science, University of Helsi... @KumpulaScien... · Mar 29

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- Several highlights during past year:
  - Public note on Run 2 legacy results ➜ paper in preparation and featured in CERN Courier
  - ERC-CoG by Mikko to further expand and consolidate the effort ➜ ultimate goal 0.1% precision

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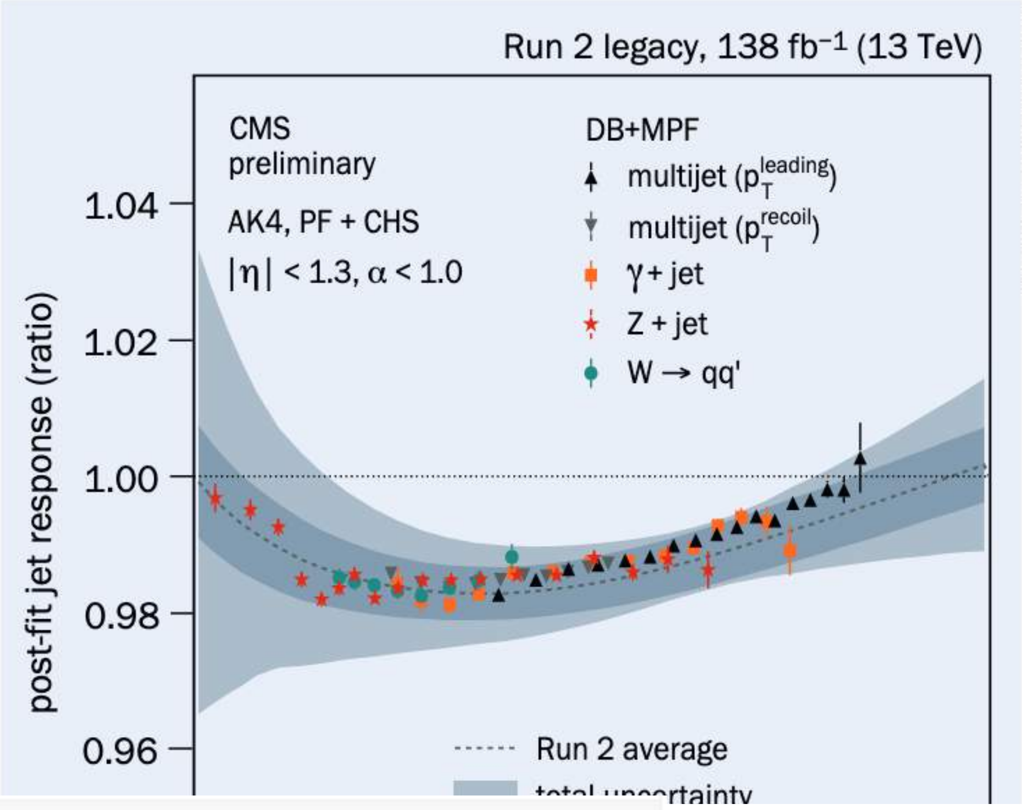

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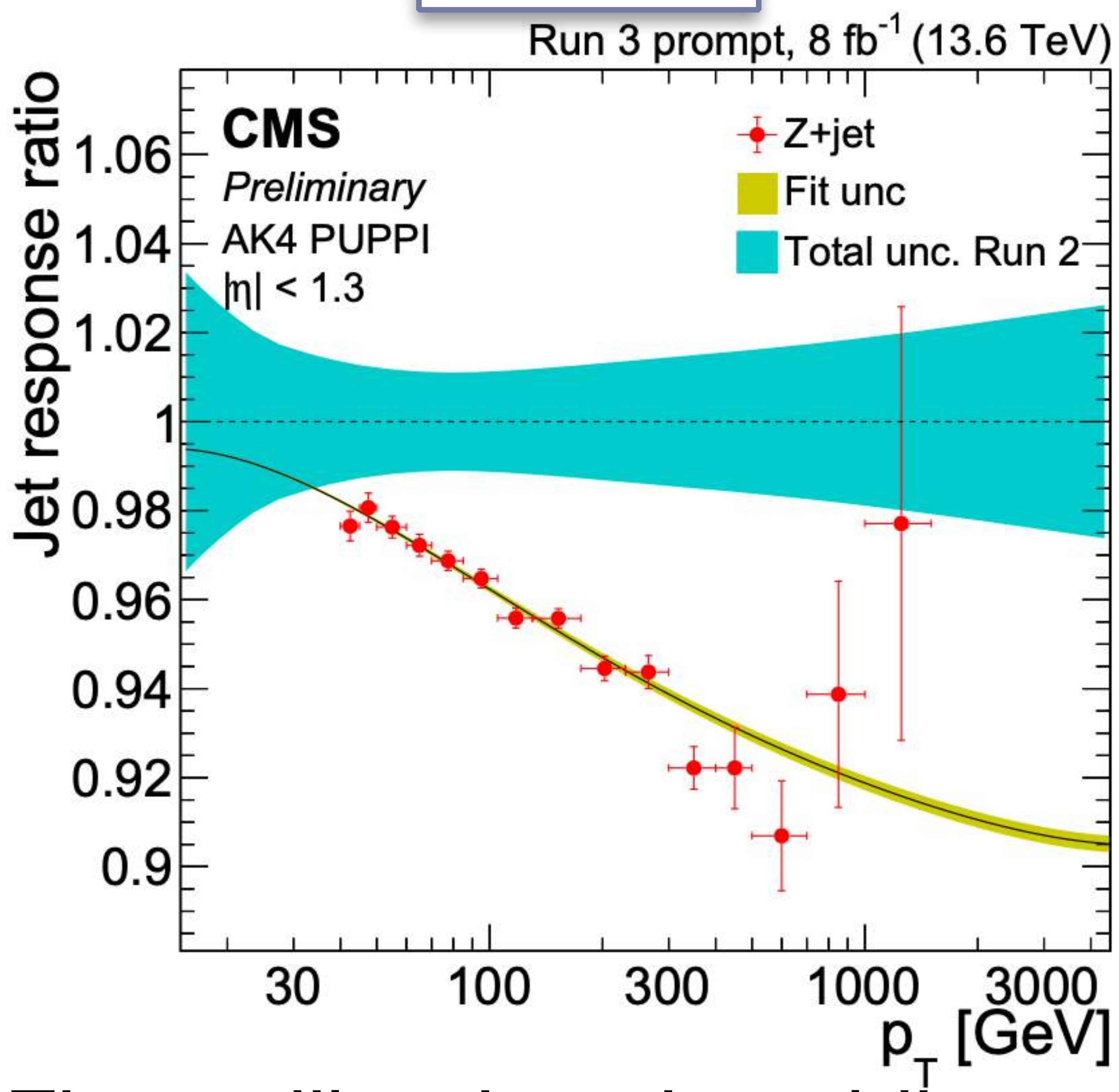
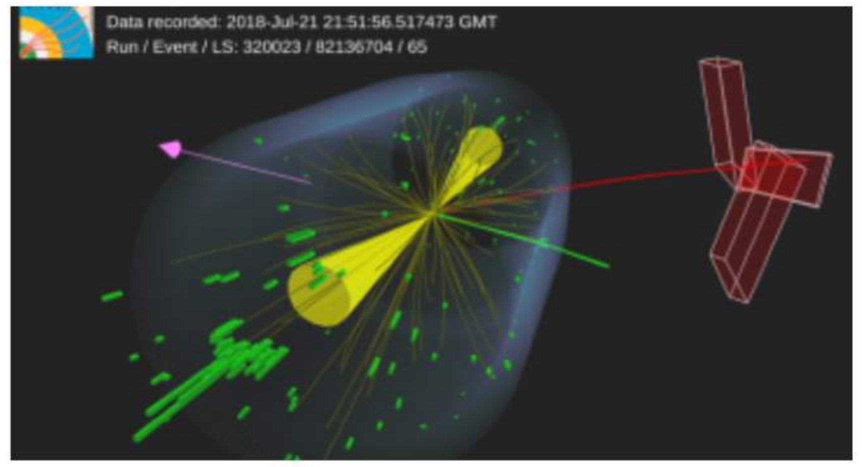
Run 3



- First calibrations in public note
  - Exercising streamlined workflows and proving readiness
  - Some lower-level miscalibration in PromptReco (but understood)

[Just a few] physics results

- All preliminary results
- All physics briefings



MEASURING THE HIGGS BOSON DECAY TO WW IS 90% PHYSICS, THE OTHER HALF IS TEAMWORK!

04 NOV 2022

It was a bit more than 10 years ago that together with our colleagues from the ATLAS experiment, we at CMS announced the discovery of this new (and quite amazing) particle. Now, detecting a new fundamental particle is no easy feat; in these 10 years...

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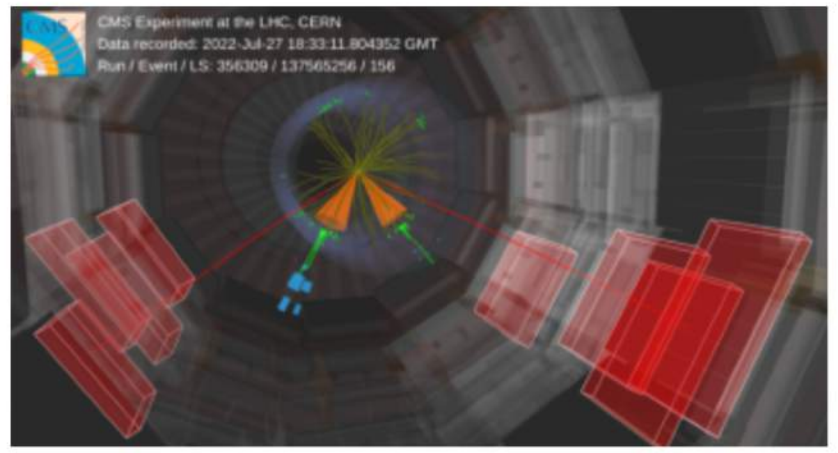

TOP QUARKS FAST TO ARRIVE AT NEW ENERGY FRONTIER

24 OCT 2022

On 5 July 2022, the LHC surpassed the previous energy limits of experimental particle physics, breaking its own record by achieving stable proton-proton collisions at a center-of-mass energy of $\sqrt{s}$ = 13.6 TeV. This marked the start of Run 3, the...

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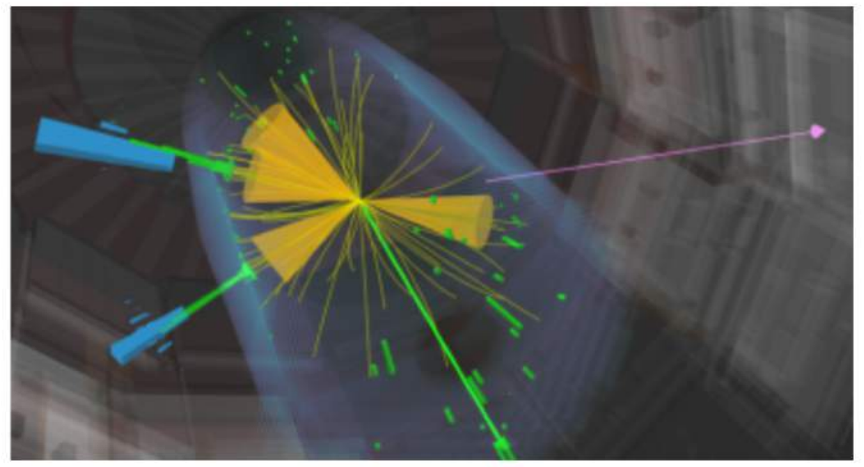

SEARCHING FOR TOP SQUARKS WITH CMS DATA

14 OCT 2022

What is the Universe made of? Searching for the answer to this question has been the main quest of particle physicists. Part of the answer is provided by the highly-successful Standard Model (SM) of particle physics, whose last achievement is the...

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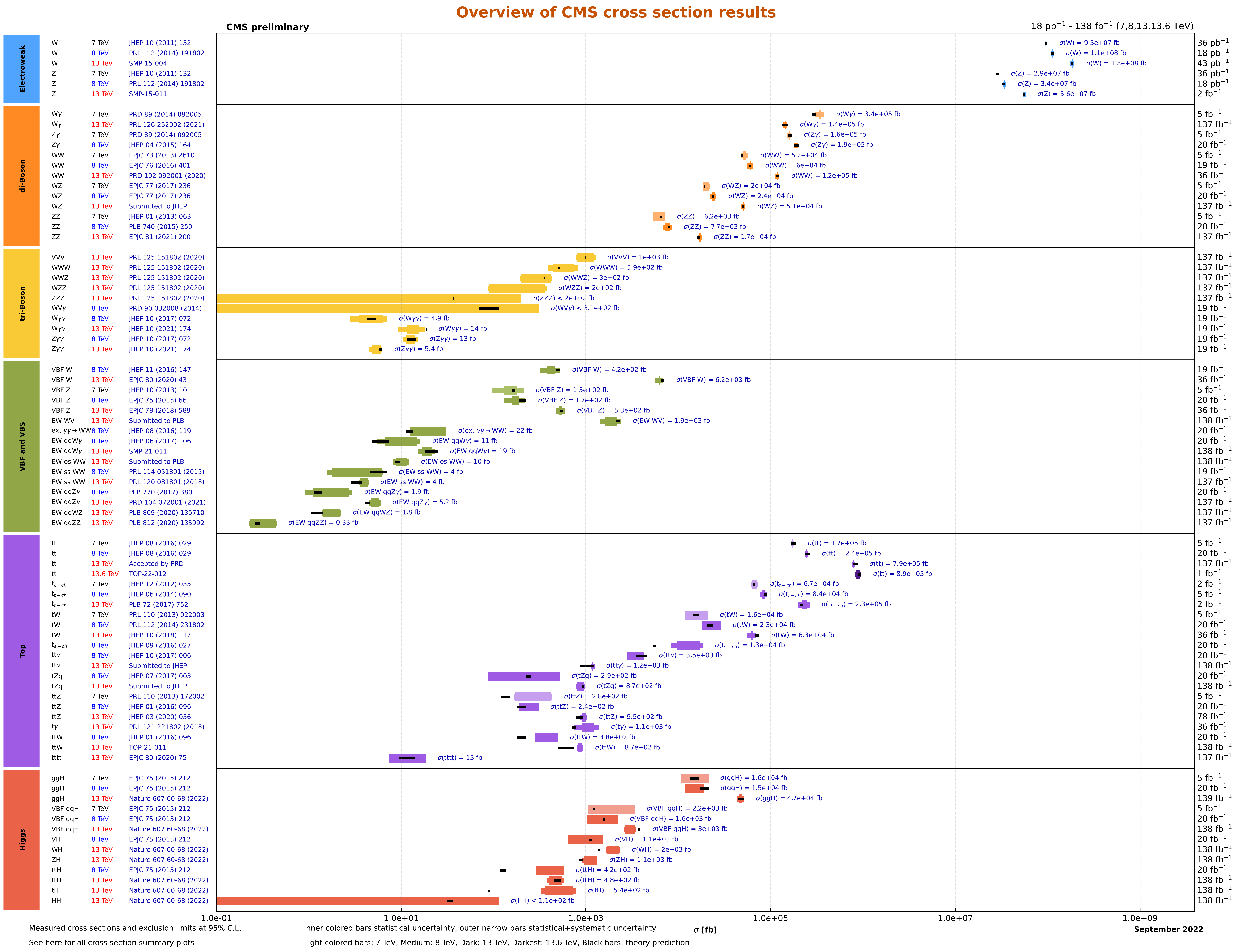
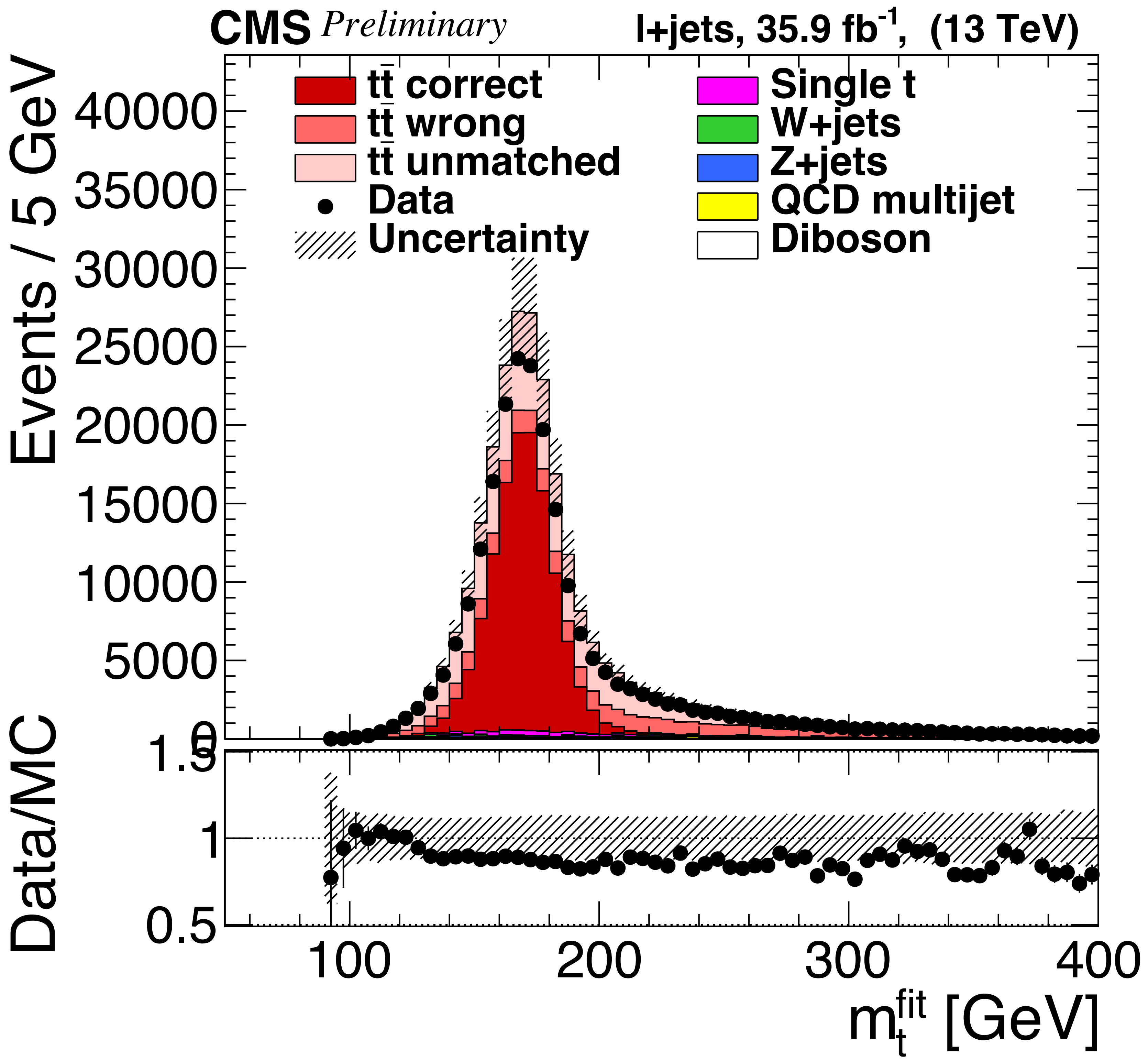
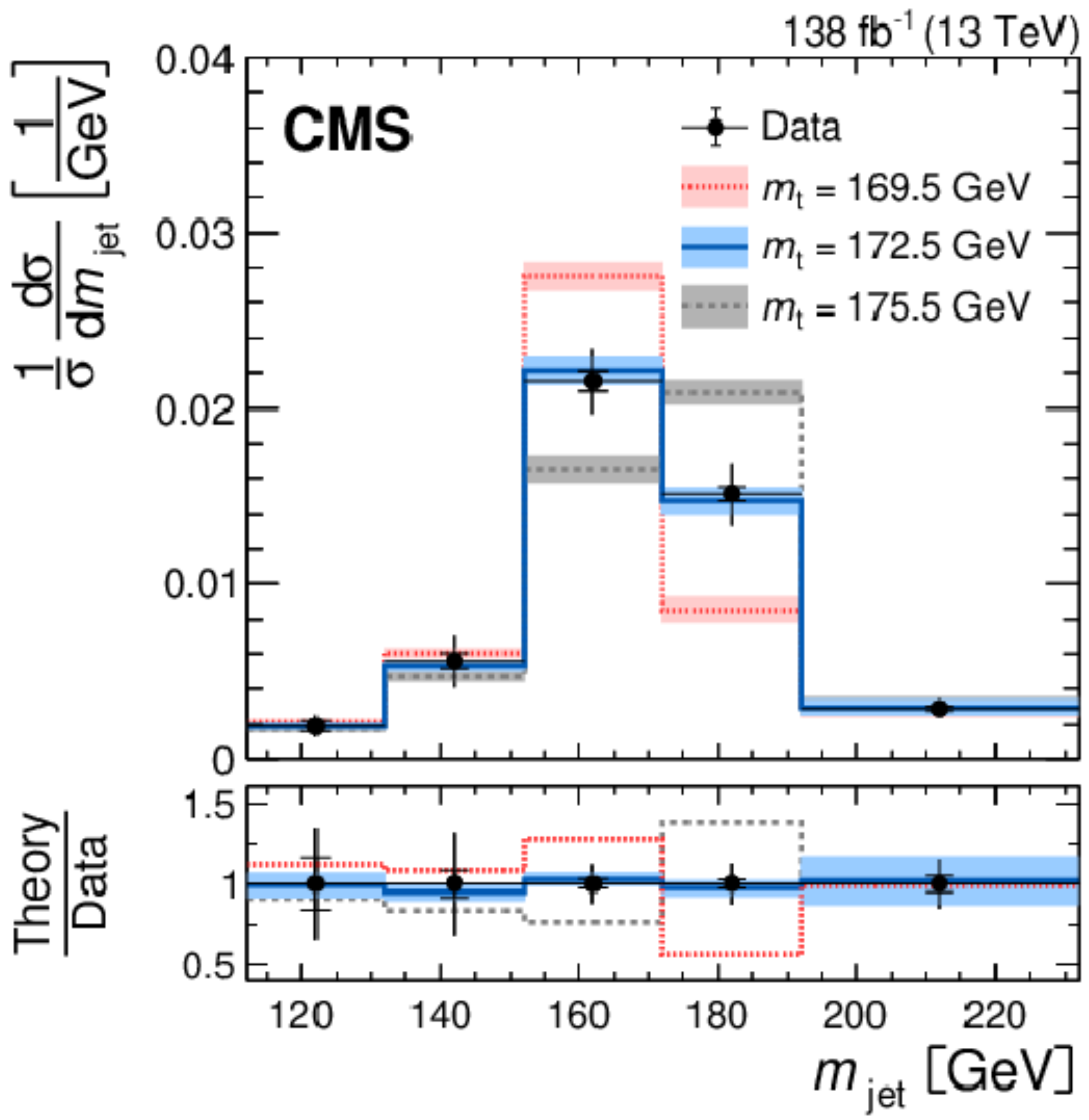
SM overview

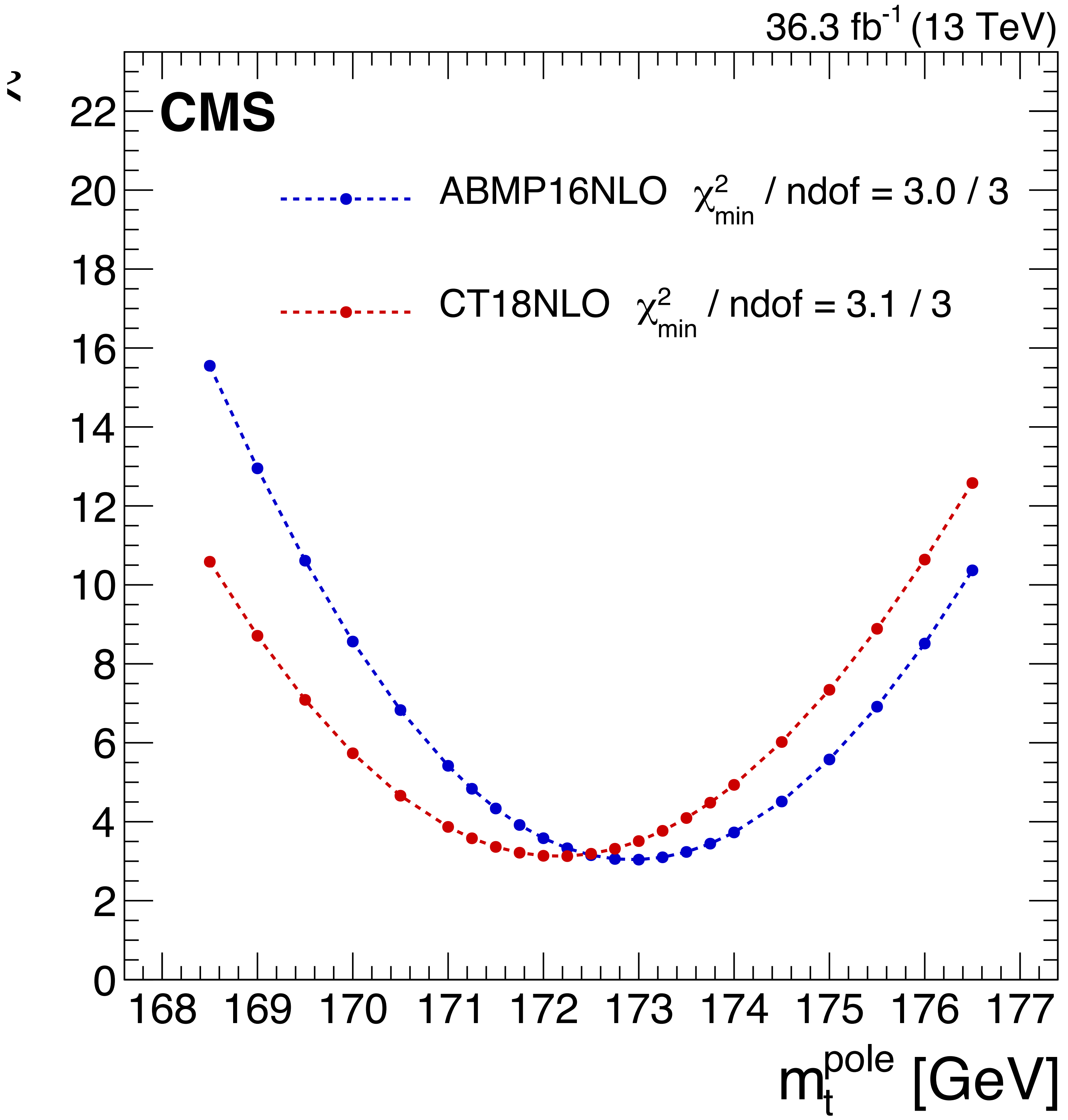
- Exploring process rates over 9 orders of magnitude from inclusive W, Z, and top pairs, to the smallest measured multiboson processes
- Evolving theory calculations. Deviations may indicate new physics effects



Top masses done differently x3 this year





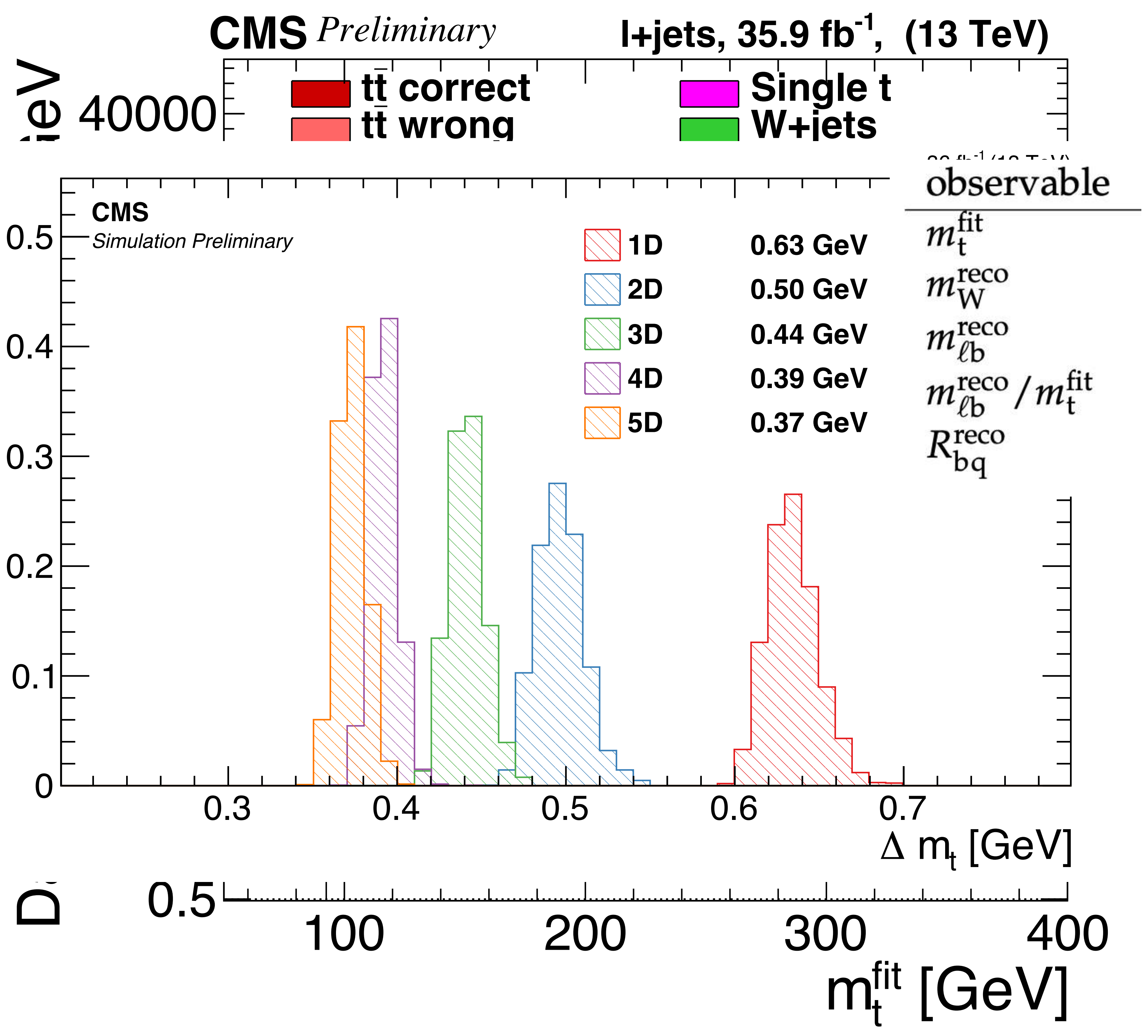


- Direct measurement with 5D fit (TOP-20-008)
- m_t = 171.77±0.38 GeV
- 2016 data, Physics Briefing, most precise
- Cf. Hannu's thesis (defended two days ago) for 2017/2018 preview (towards 0.2 GeV uncertainty)

- Measurement of mass distribution and m_t in hadronic decay to boosted jets (TOP-21-012)
- Physics Briefing
- m_t = 172.76±0.81 GeV
- XCone to reconstruct a large jet with three subjets inside and then use jet mass

- Measurement from tt+jet cross section (TOP-21-008)
- m_t^{pole} = 172.94±1.37 GeV
- Complementary to direct measurement, avoids MC mass definition ambiguity

Top masses done differently x3 this year



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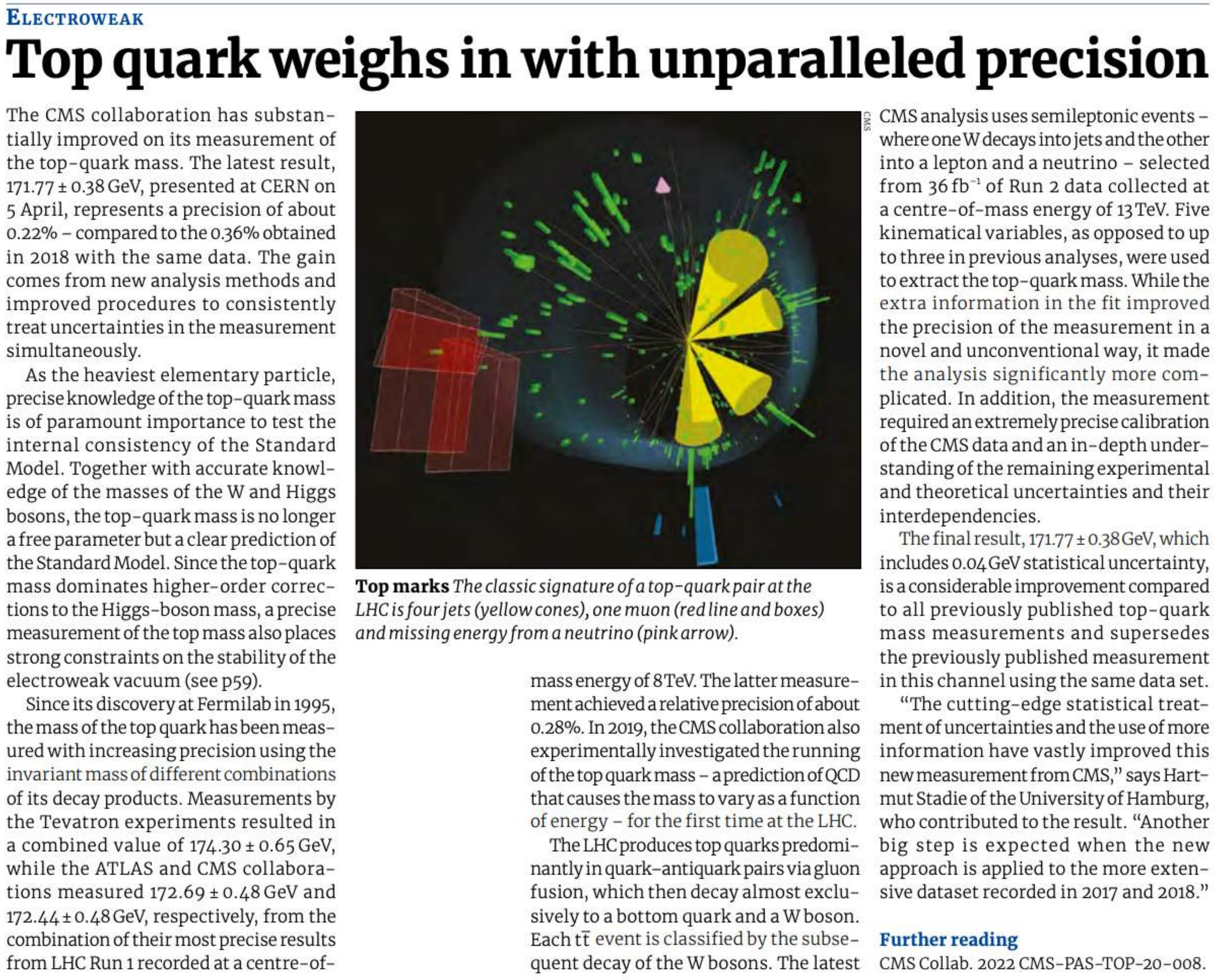


ELECTROWEAK

Top quark weighs in with unparalleled precision

The CMS collaboration has substantially improved on its measurement of the top-quark mass. The latest result, 171.77 ± 0.38 GeV, presented at CERN on 5 April, represents a precision of about 0.22% – compared to the 0.36% obtained in 2018 with the same data. The gain comes from new analysis methods and improved procedures to consistently treat uncertainties in the measurement simultaneously.

As the heaviest elementary particle, precise knowledge of the top-quark mass is of paramount importance to test the internal consistency of the Standard Model. Together with accurate knowledge of the masses of the W and Higgs bosons, the top-quark mass is no longer a free parameter but a clear prediction of the Standard Model. Since the top-quark mass dominates higher-order corrections to the Higgs-boson mass, a precise measurement of the top mass also places strong constraints on the stability of the electroweak vacuum (see p59).

Since its discovery at Fermilab in 1995, the mass of the top quark has been measured with increasing precision using the invariant mass of different combinations of its decay products. Measurements by the Tevatron experiments resulted in a combined value of 174.30 ± 0.65 GeV, while the ATLAS and CMS collaborations measured 172.69 ± 0.48 GeV and 172.44 ± 0.48 GeV, respectively, from the combination of their most precise results from LHC Run 1 recorded at a centre-of-mass energy of 8 TeV. The latter measurement achieved a relative precision of about 0.28%. In 2019, the CMS collaboration also experimentally investigated the running of the top quark mass – a prediction of QCD that causes the mass to vary as a function of energy – for the first time at the LHC.

The LHC produces top quarks predominantly in quark–antiquark pairs via gluon fusion, which then decay almost exclusively to a bottom quark and a W boson. Each $t\bar{t}$ event is classified by the subsequent decay of the W bosons. The latest CMS analysis uses semileptonic events – where one W decays into jets and the other into a lepton and a neutrino – selected from 36 fb⁻¹ of Run 2 data collected at a centre-of-mass energy of 13 TeV. Five kinematical variables, as opposed to up to three in previous analyses, were used to extract the top-quark mass. While the extra information in the fit improved the precision of the measurement in a novel and unconventional way, it made the analysis significantly more complicated. In addition, the measurement required an extremely precise calibration of the CMS data and an in-depth understanding of the remaining experimental and theoretical uncertainties and their interdependencies.

The final result, 171.77 ± 0.38 GeV, which includes 0.04 GeV statistical uncertainty, is a considerable improvement compared to all previously published top-quark mass measurements and supersedes the previously published measurement in this channel using the same data set.

"The cutting-edge statistical treatment of uncertainties and the use of more information have vastly improved this new measurement from CMS," says Hartmut Stadie of the University of Hamburg, who contributed to the result. "Another big step is expected when the new approach is applied to the more extensive dataset recorded in 2017 and 2018."

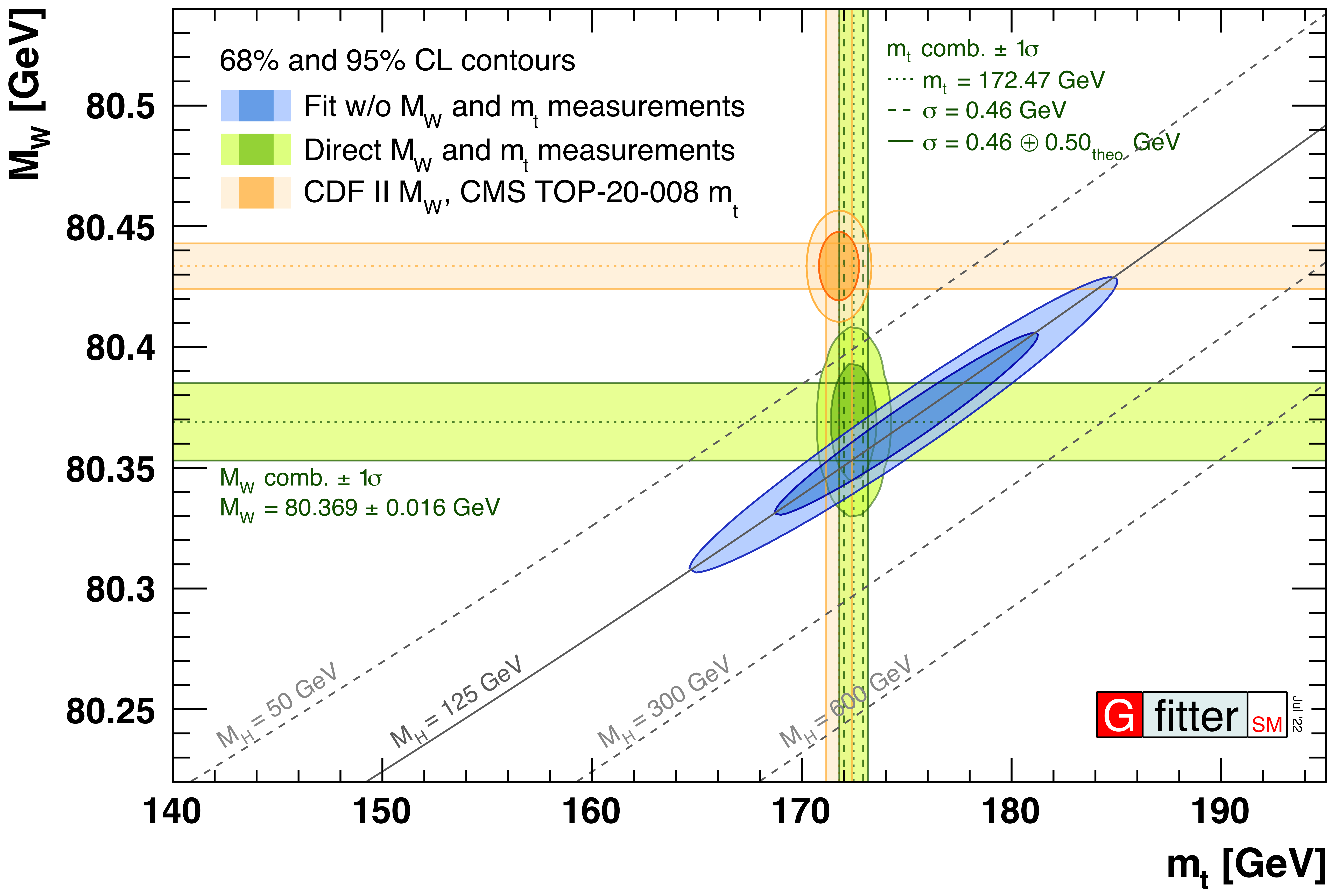
CMS

Top marks *The classic signature of a top-quark pair at the LHC is four jets (yellow cones), one muon (red line and boxes) and missing energy from a neutrino (pink arrow).*

Further reading

CMS Collab. 2022 CMS-PAS-TOP-20-008.

EWK Results Summary in 2022



- Many new measurements available this year M_H , M_t (CMS result just shown) , M_W (CDF in April)
- Before CDF M_W 2022 result – consistent agreement between the world average masses in the presence of the measured M_H
- Now – tensions in global EWK fits only to be resolved with new precision results and possible effects of new heavier particles
- W mass measurements from LHC eagerly awaited

Higgs 10 years: 4 July 2022


nature

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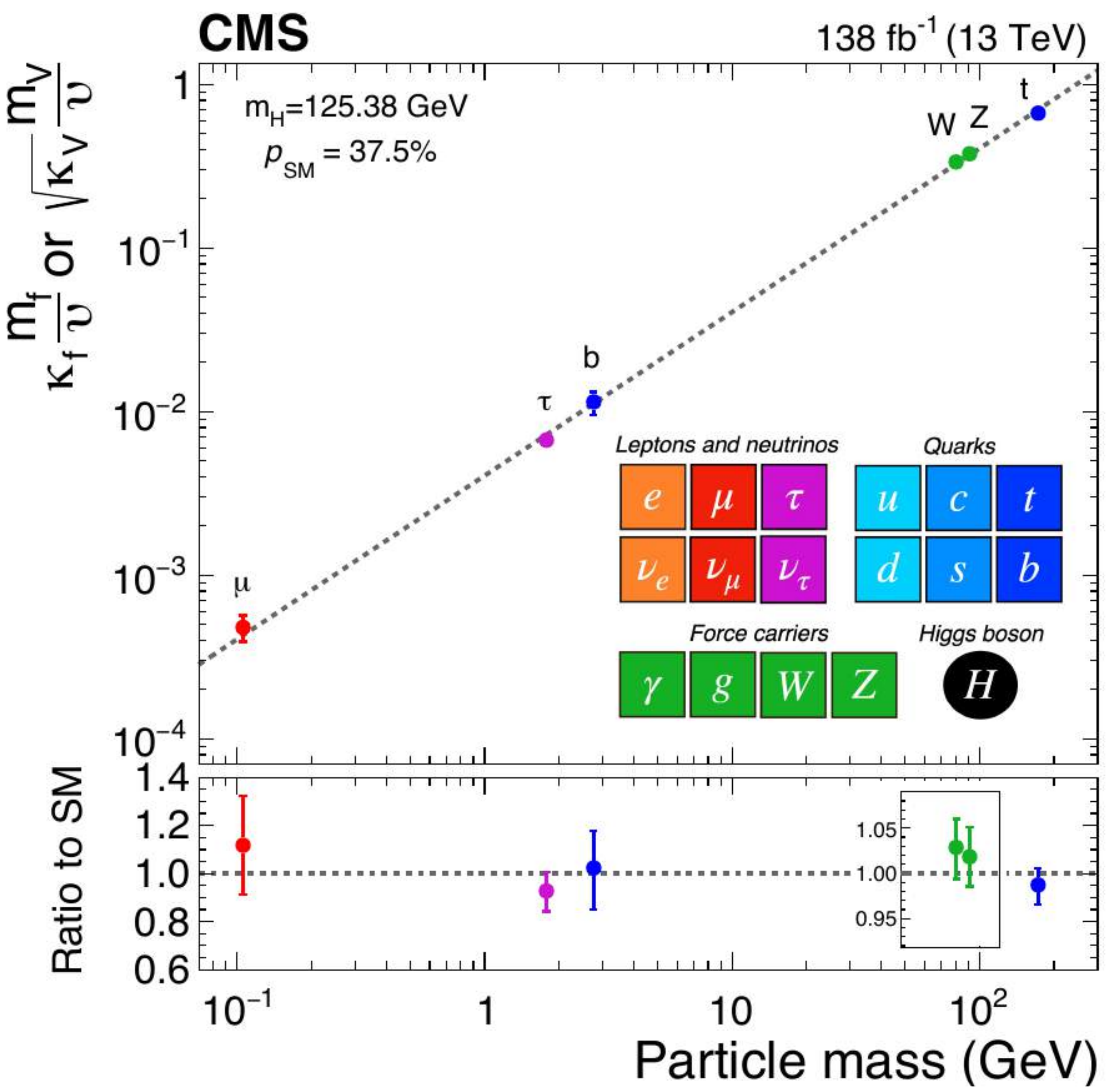
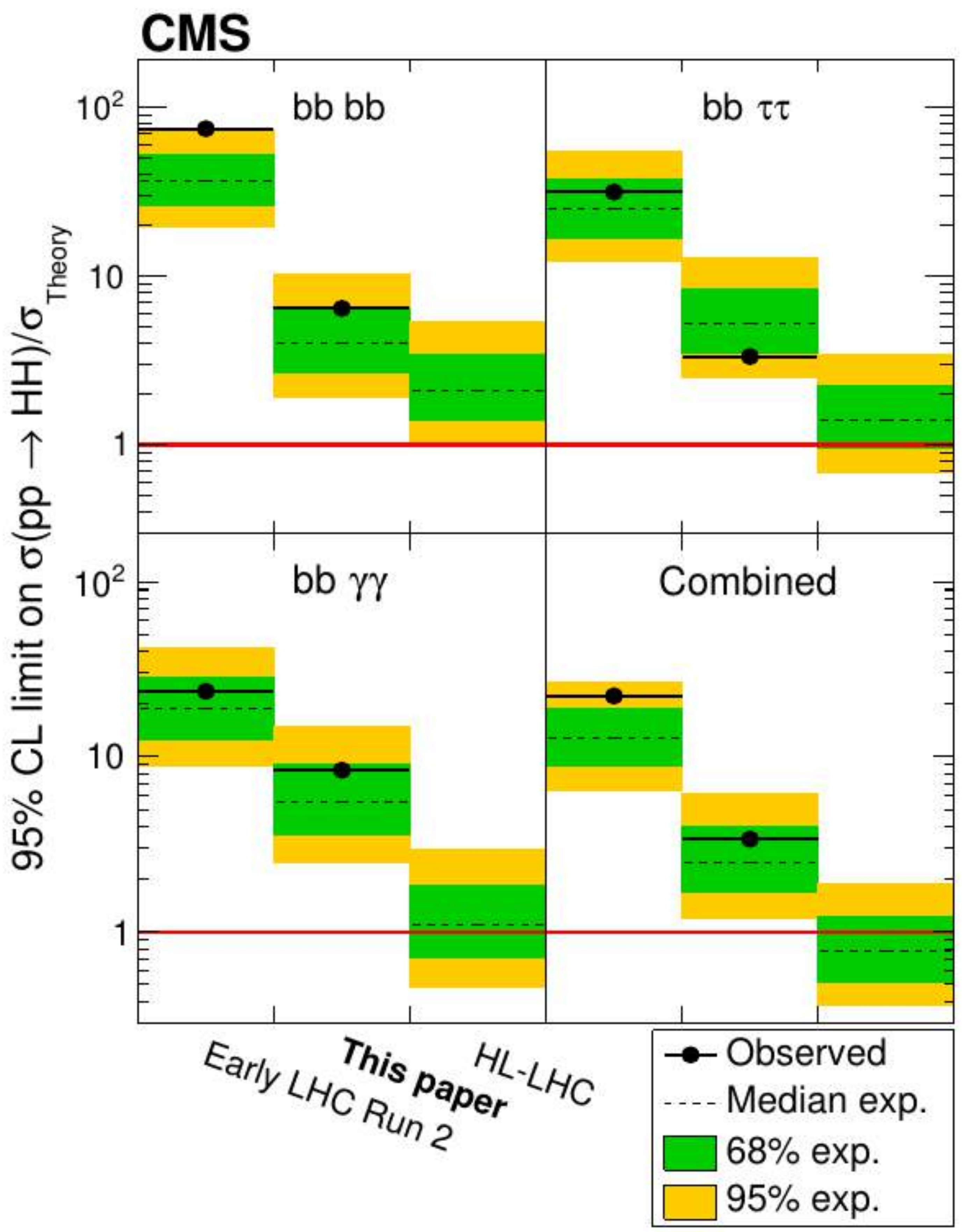
Article | Open Access | Published: 04 July 2022

A portrait of the Higgs boson by the CMS experiment ten years after the discovery

The CMS Collaboration

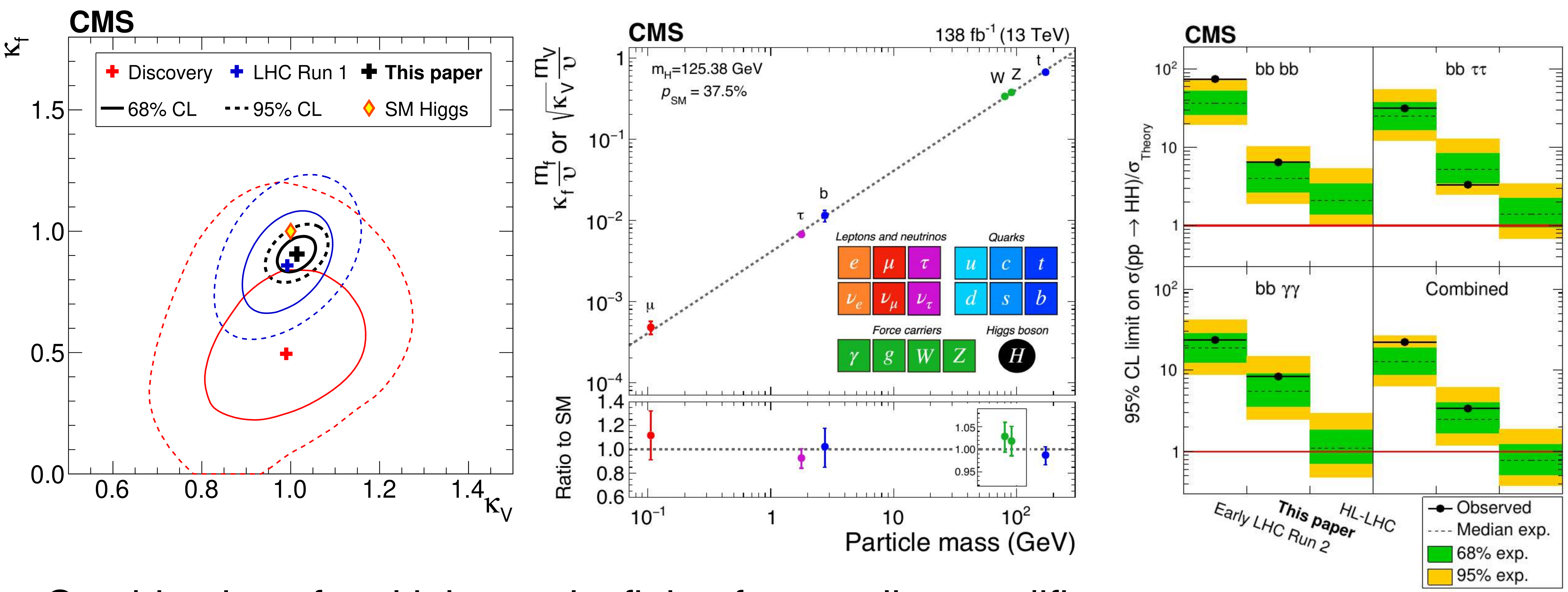




- Combination of multiple results fitting for coupling modifiers
- Combination of HH results for the three most sensitive channels (4b, 2b2τ, 2b2γ)
- Reaching ~3x SM sensitivity, expect SM sensitivity with HL-LHC

All details in our Nature paper

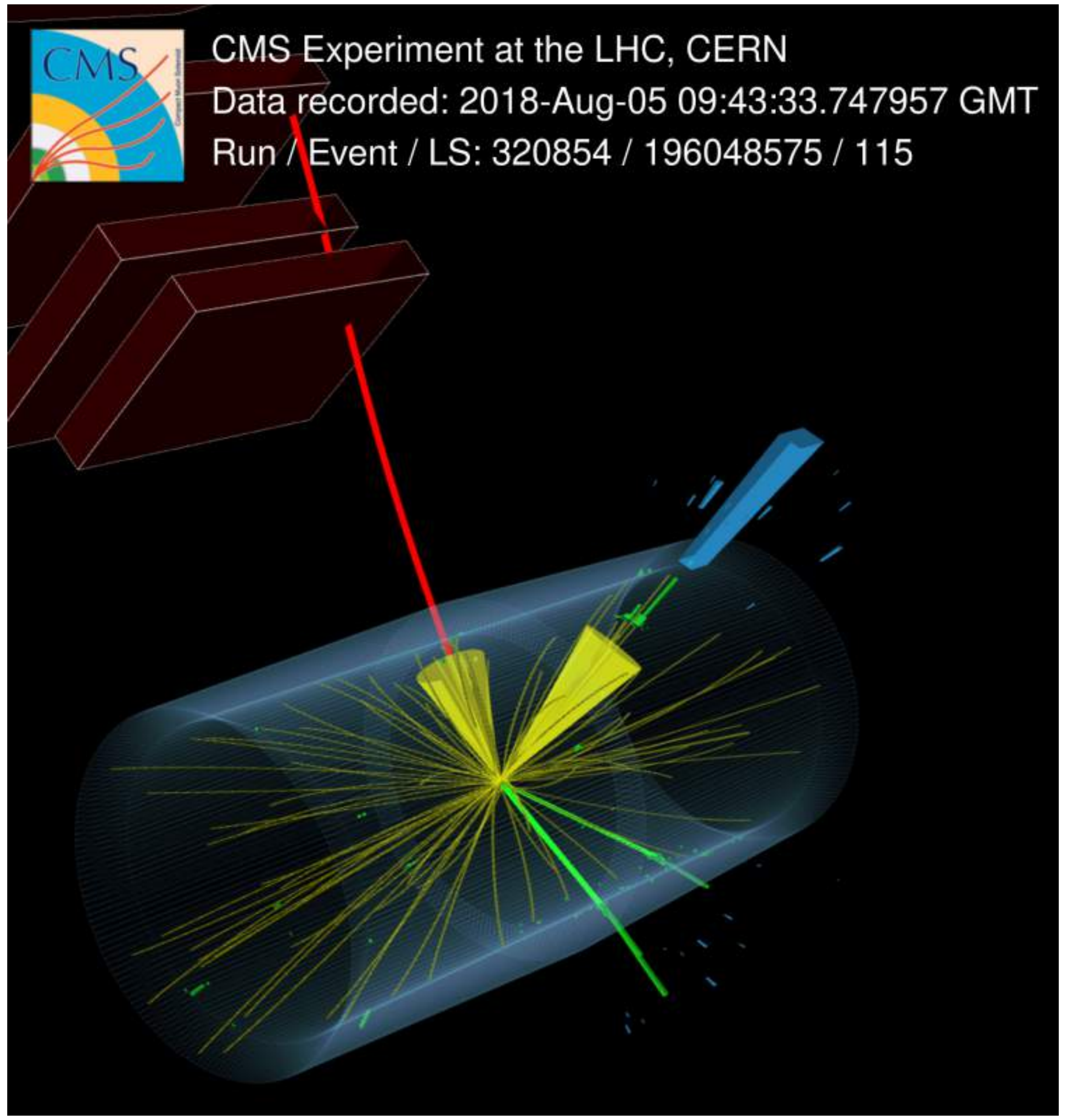
Higgs 10 years: 4 July 2022

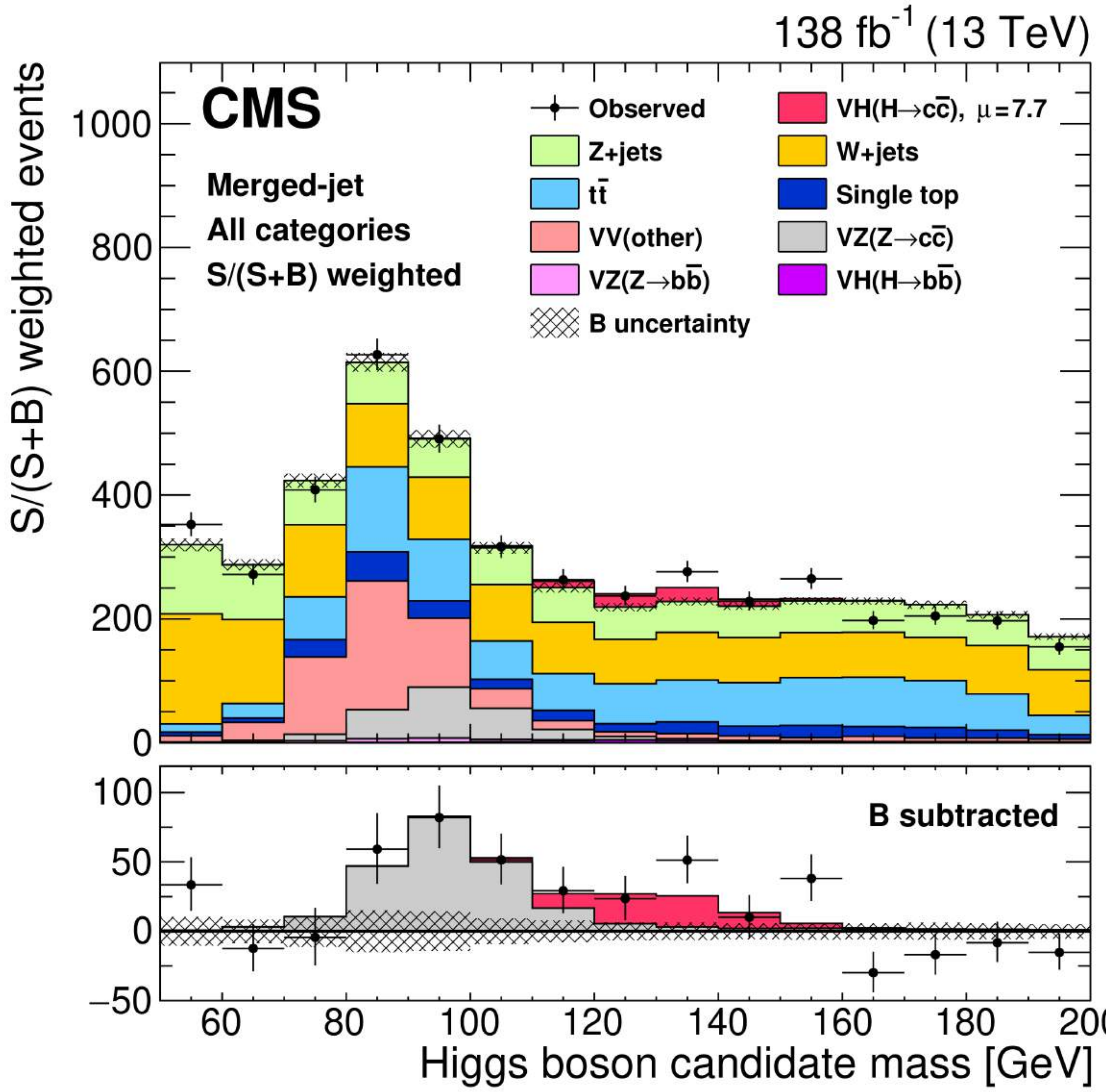


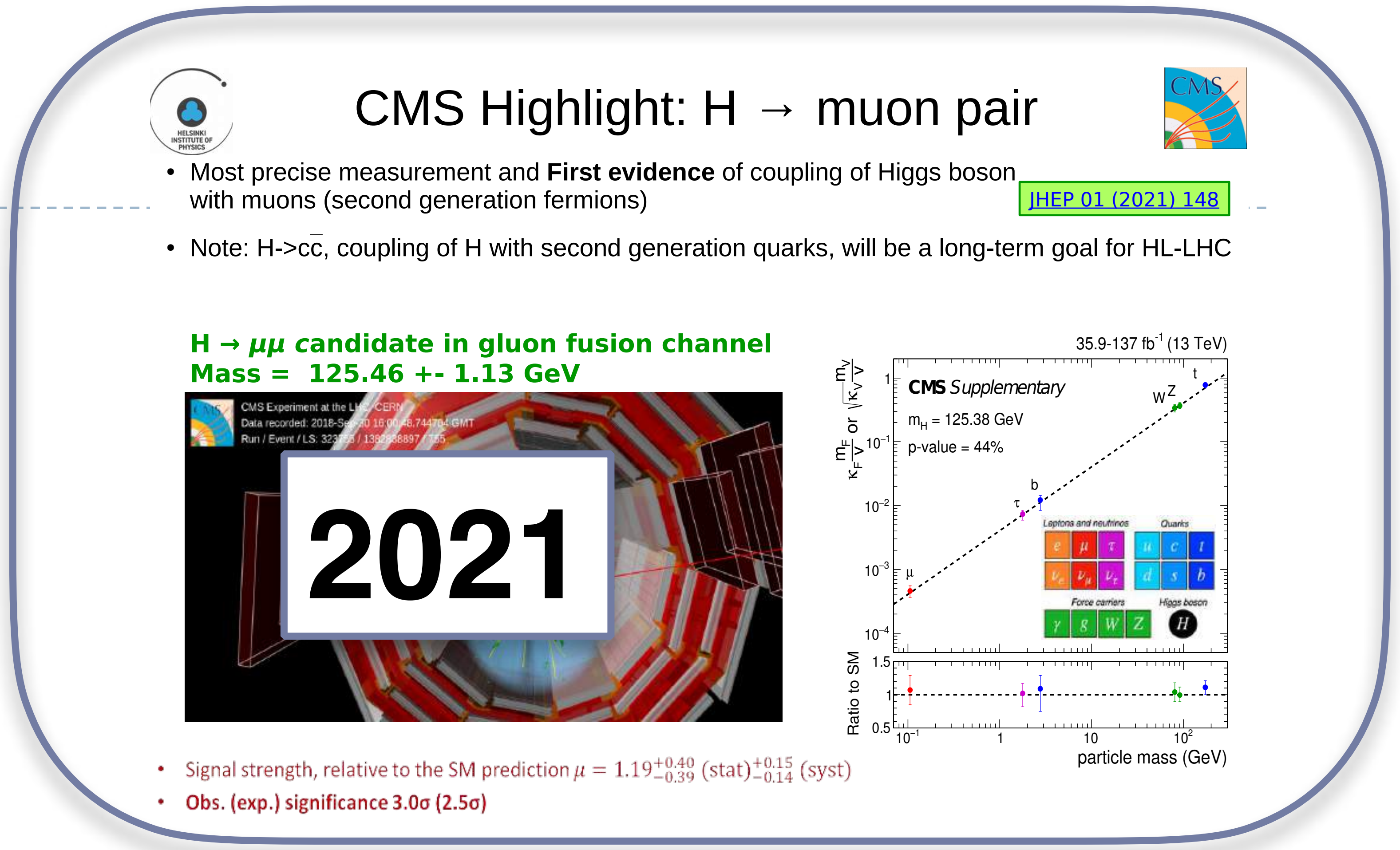
- Combination of multiple results fitting for coupling modifiers
- Combination of HH results for the three most sensitive channels (4b, 2b2τ, 2b2γ)
- Reaching ~3x SM sensitivity, expect SM sensitivity with HL-LHC

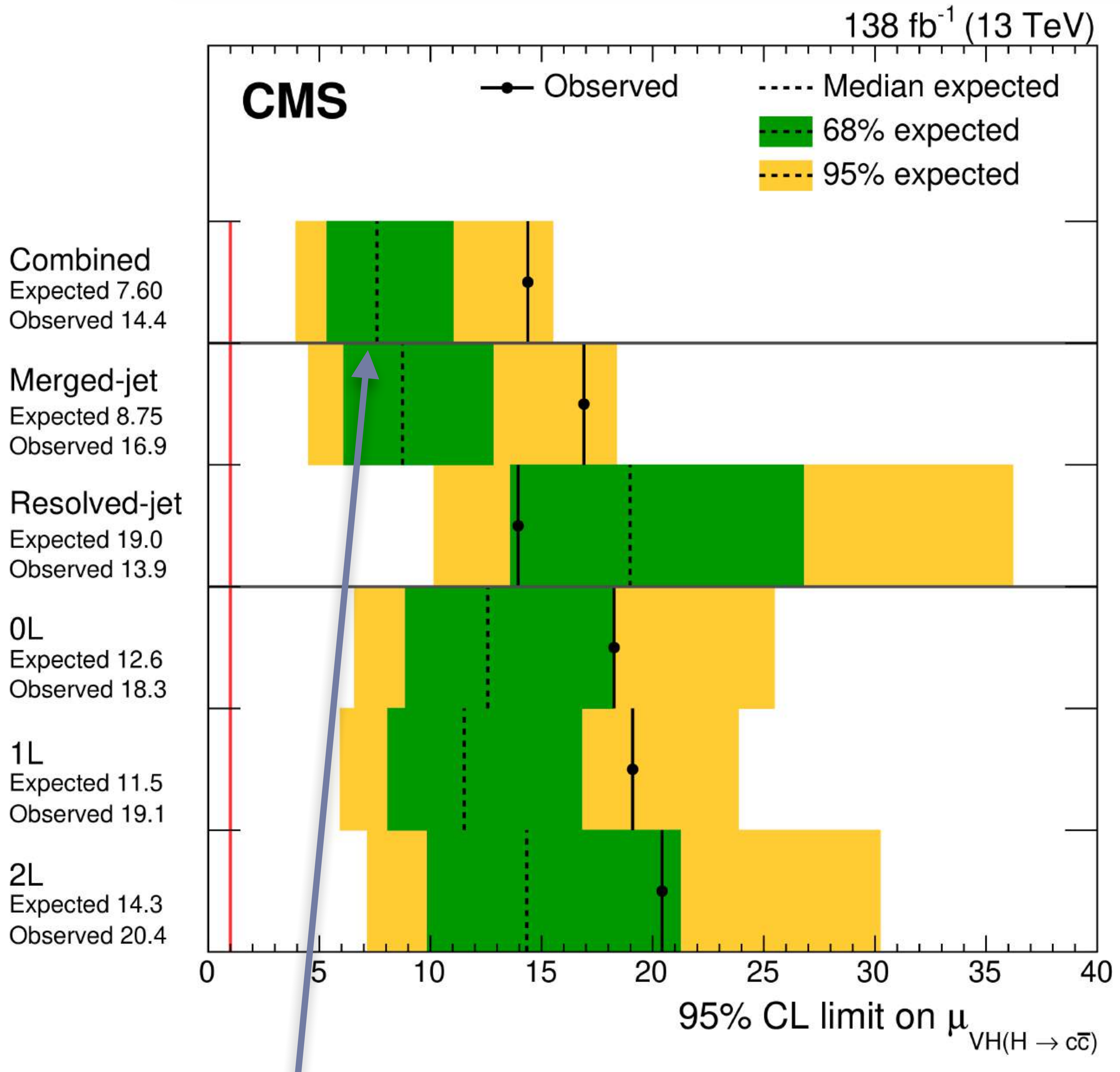
All details in our Nature paper

Observations on the way to H→ cc





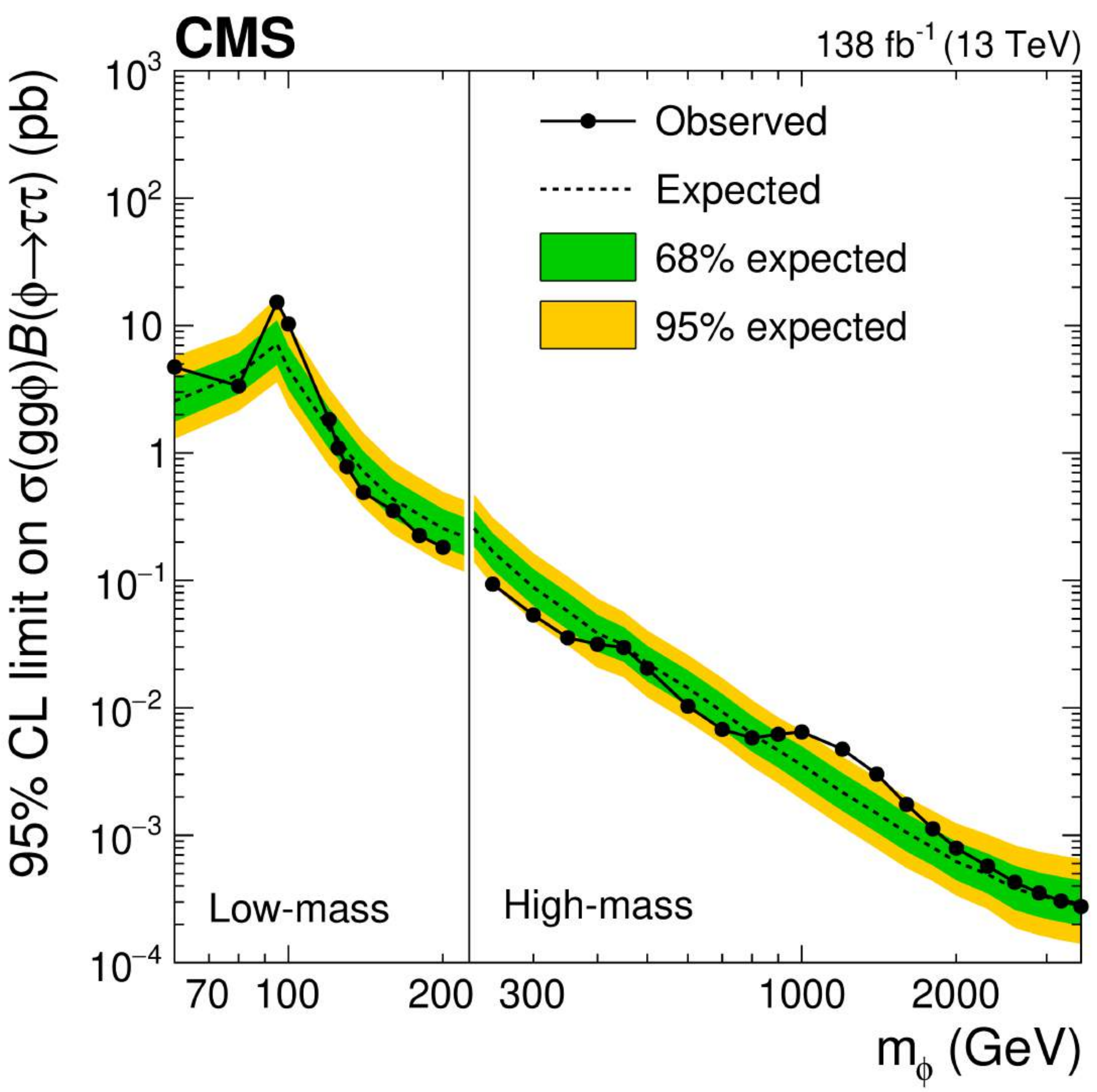




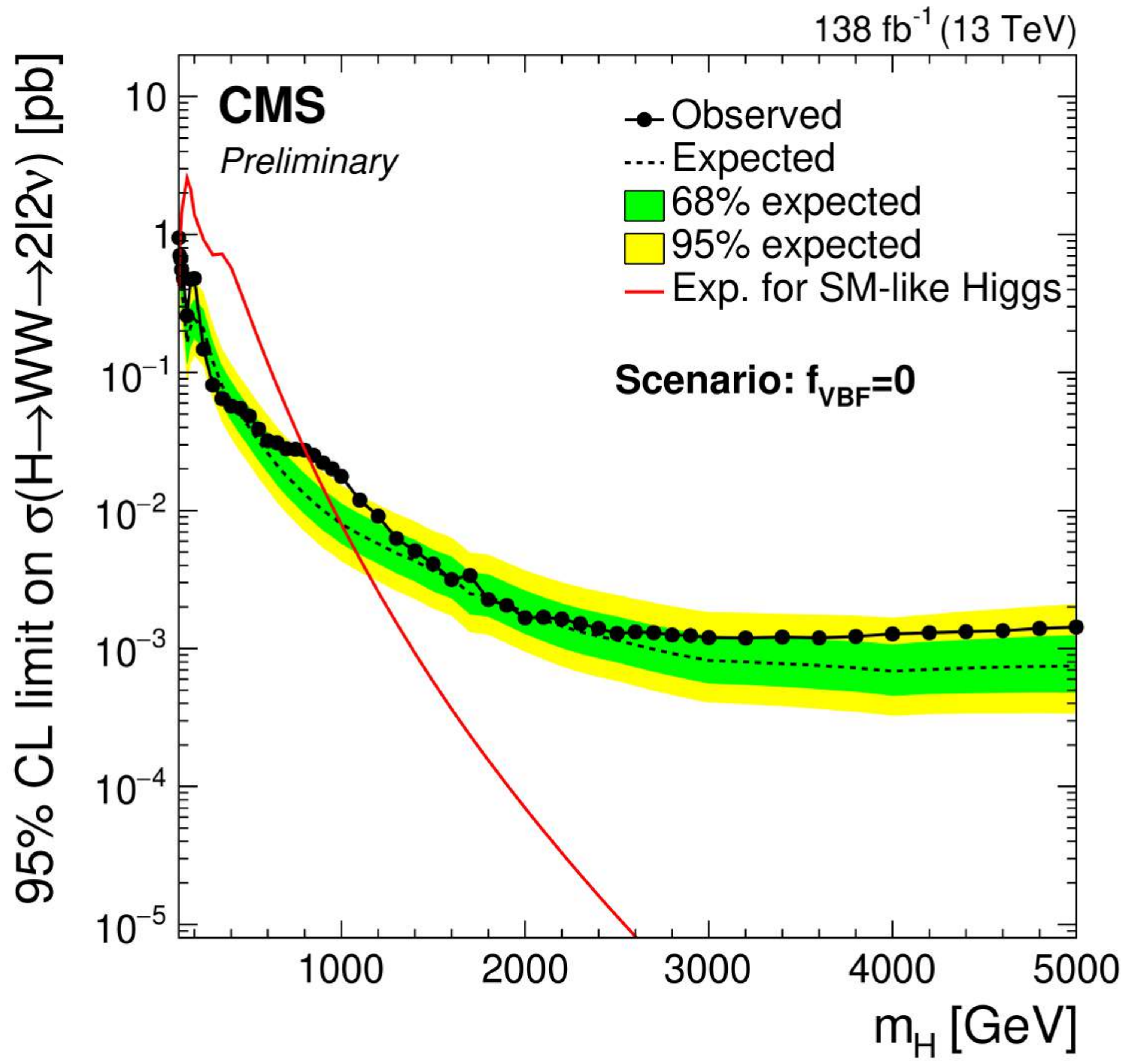
- Coupling to charm is **extremely challenging** to measure at SM value
- CMS developed **new charm tagging techniques** based on Graph Neural Networks (ParticleNet)
- Sizeable sensitivity improvement (~10x SM sensitivity)
- Calibration candle is the Z→cc decay (bonus 5σ observation of Z→cc)
  - μ = 1.002 ± 0.036 (th) ±0.033 (exp) ±0.029 (stat)

Some way to go for H→cc, still

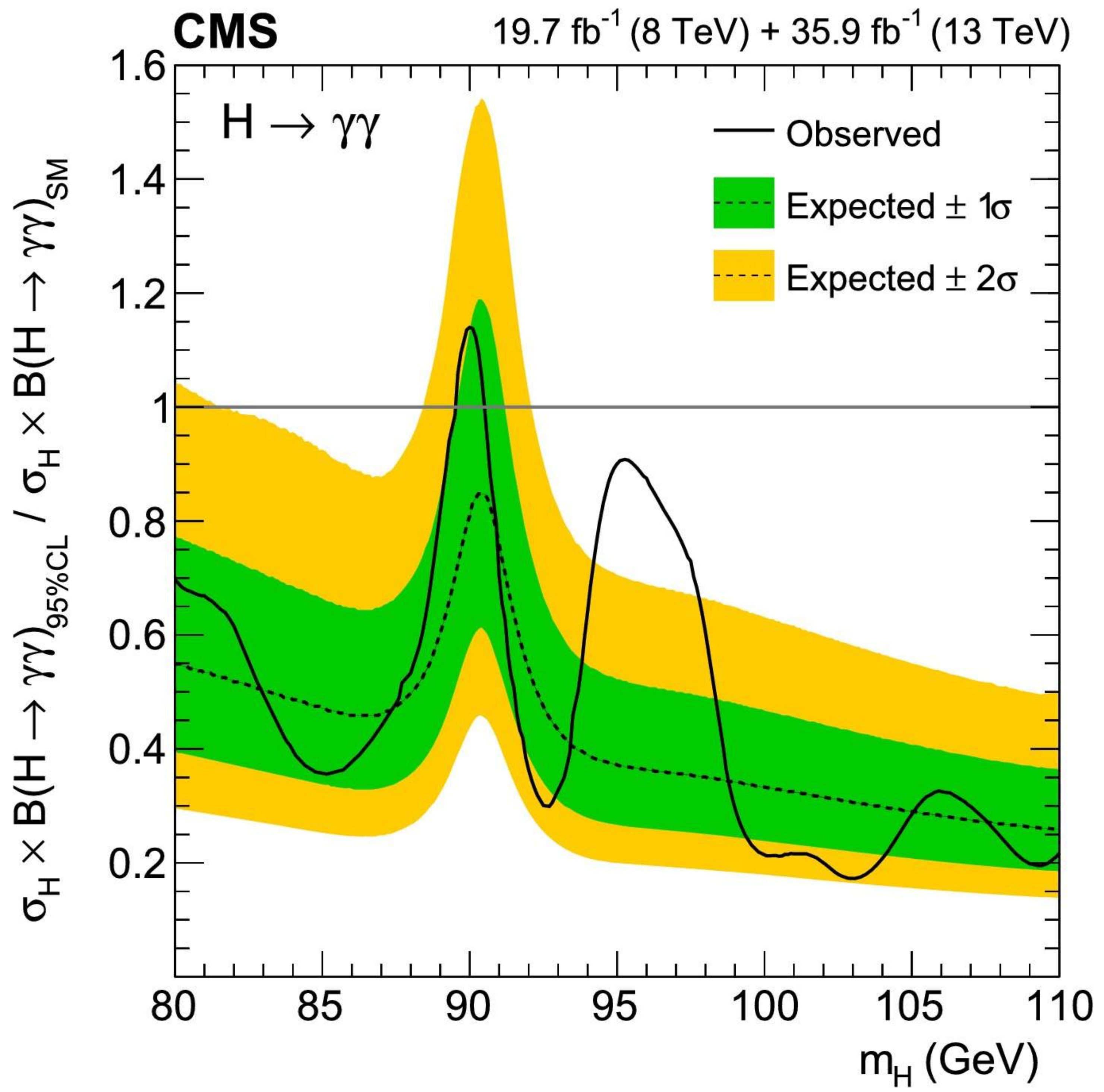
Hints for new physics with Higgs



CMS-HIG-21-001



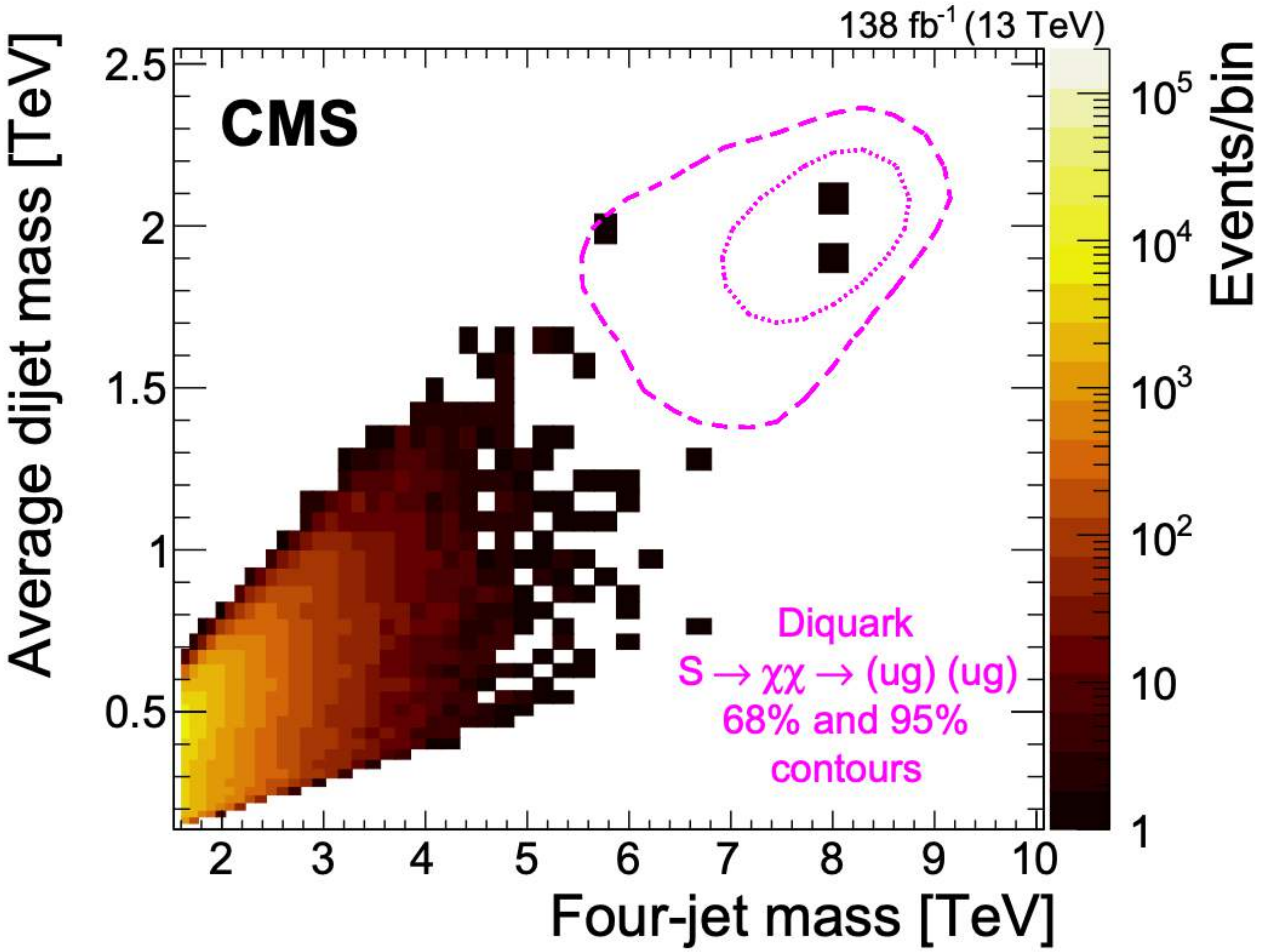
CMS-PAS-HIG-20-016

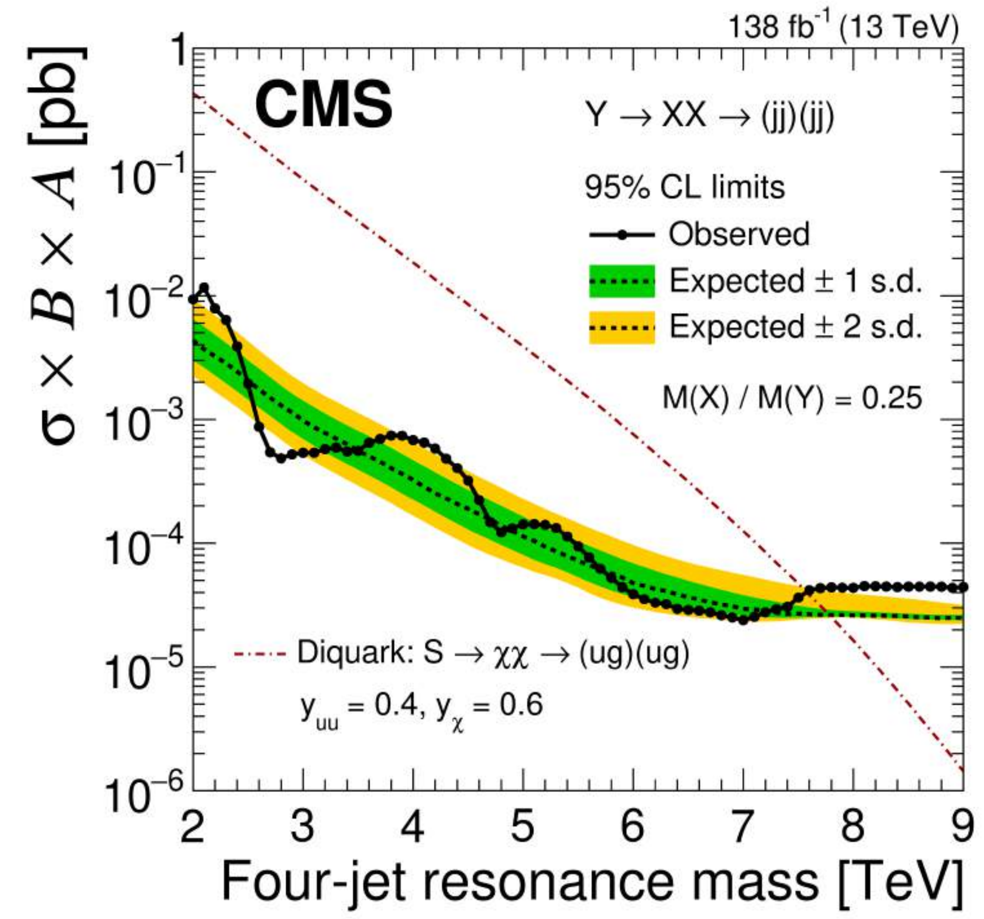


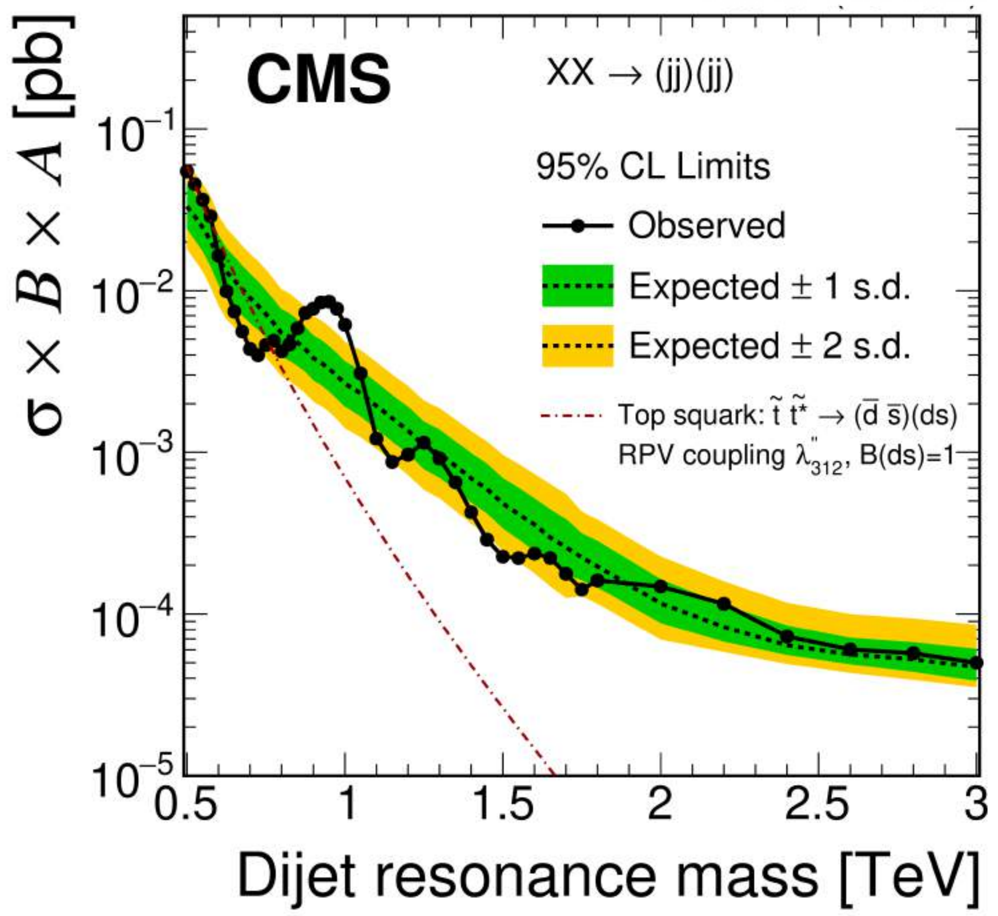
Phys. Let. B 793

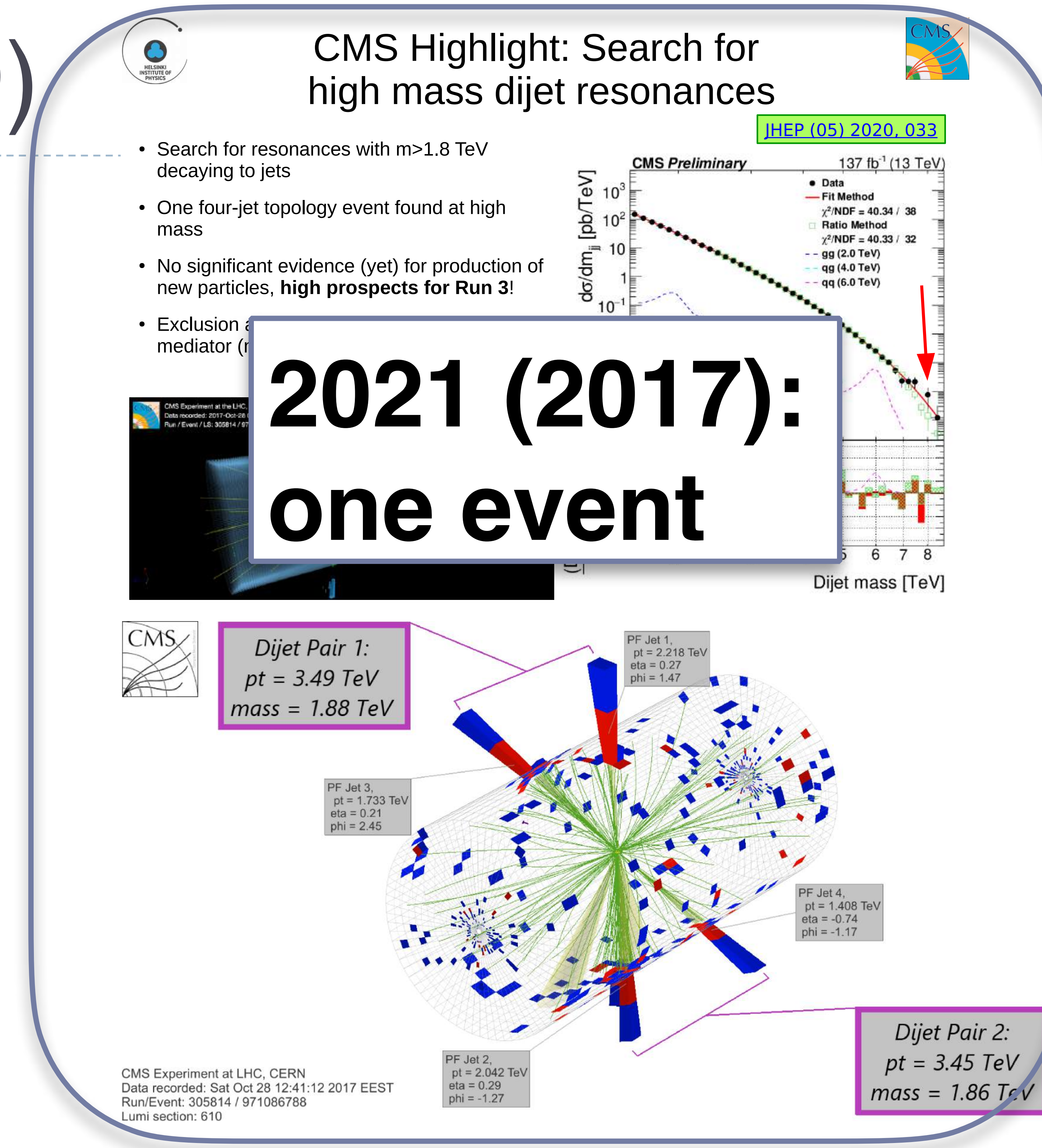
- Interesting excesses with Higgs/scalars observed by CMS:
  - H→ττ ; excess 3.1σ (local), 2.7σ (global) at M_{ϕ} = 90 – 100 GeV
  - H→WW ; excess 3.8σ (local), 2.6σ (global) at M_H = 650 GeV
  - H→γγ; excess 2.8σ (local), 1.3σ (global) at M_H = 95 GeV.

Dijet excess intrigues at CMS (cf. last year's PPD)









2021 (2017): one event

2022: dedicated paired dijet search - second very similar event

- Four-jet resonance m = 8.6 TeV, 3.9σ(1.6σ) local (global).
- Non resonant dijet m = 0.95 TeV, 3.6σ(2.5σ) local (global).

Dijet excess intrigues at CMS

The Standard Model (SM) has been extremely successful in describing the behaviour of elementary particles. Nevertheless, conundrums such as the nature of dark matter and the cosmological matter–antimatter asymmetry strongly suggest that the theory is incomplete. Hence, the SM is widely viewed as an effective low-energy limit of a more fundamental underlying theory that must be modified to describe particles and their interactions at higher energies.

A powerful way to discover new particles expected from physics beyond the SM is to search for high-mass dijet or multi-jet resonances, as these are expected to have large production cross-sections at hadron colliders. These searches look for a pair of jets originating from a pair of quarks or gluons, coming from the decay of a new particle "X" and appearing as a narrow bump in the invariant dijet-mass distribution. Since the energy scale of new physics is most likely high, it is natural to expect these new particles to be massive.

CMS and ATLAS have performed a suite of single-dijet-resonance searches. The next step is to look for new identical-mass particles "X" that are produced in pairs, with (resonant mode) or without (non-resonant mode) a new intermediate, heavier particle "Y" being produced and decaying to pairs of X. Such processes would yield two dijet resonances and four jets in the final state: the dijet mass would correspond to particle X and the four-jet mass to particle Y.

The CMS experiment was also motivated to search for Y→XX→four

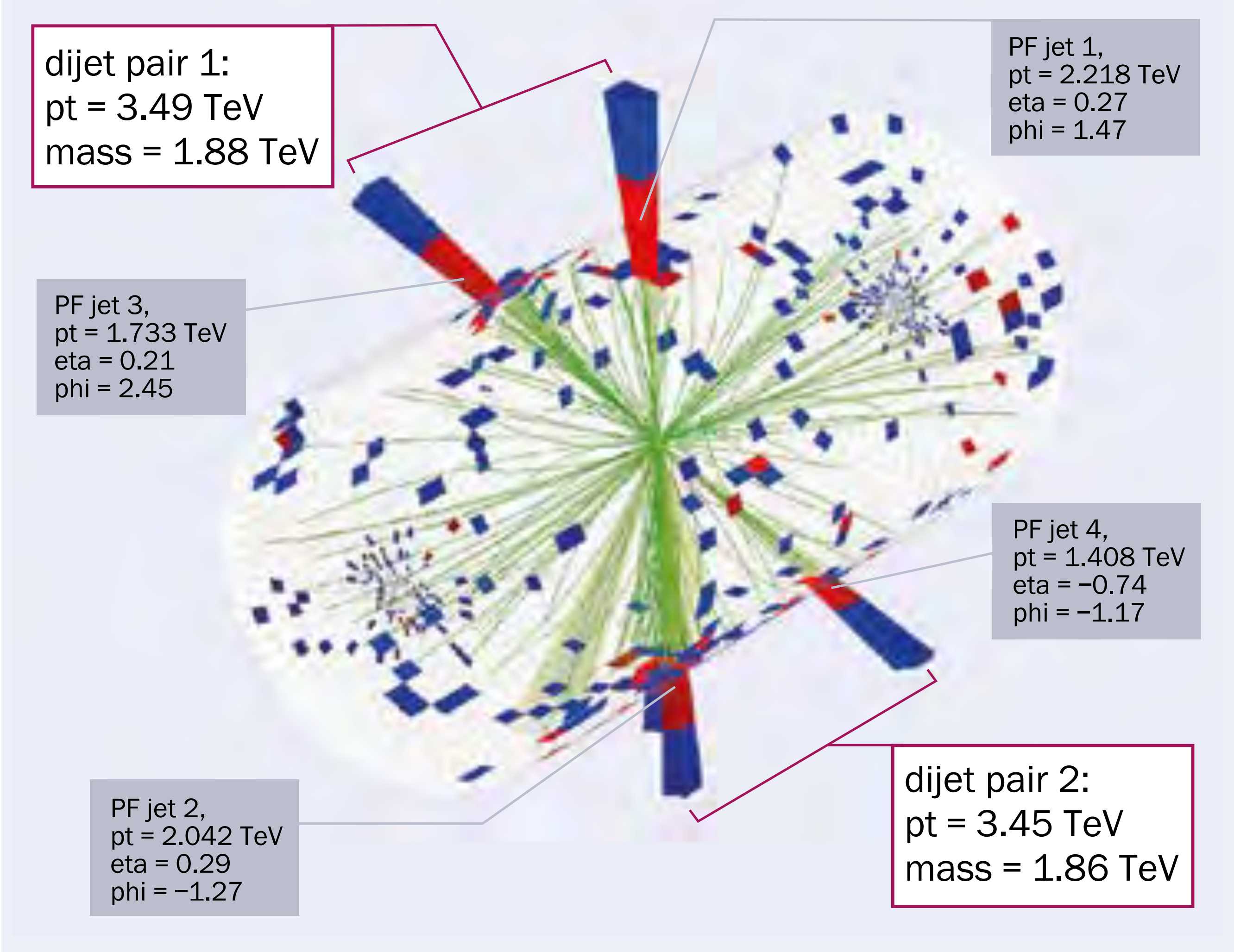


Fig. 1. *Display of the highest mass event with a four-jet mass of 8 TeV, in which each pair of jets has a dijet mass of 1.9 TeV.*

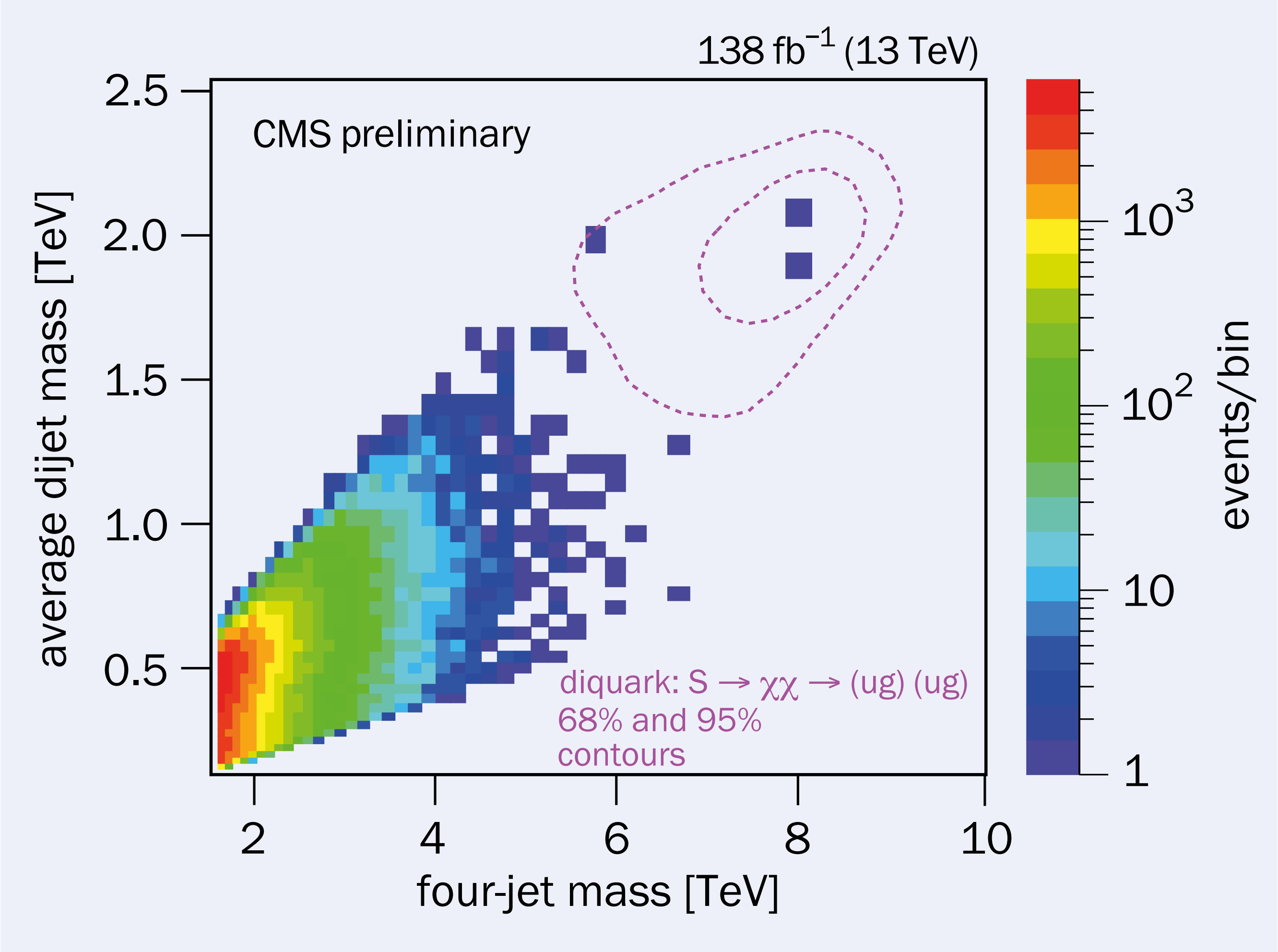


Fig. 2. *Number of events observed (colour scale) within bins of the four-jet mass and the average mass of the two dijets. Purple ellipses show the 1 and 2σ resolution contours from a signal simulation of a four-jet resonance, with a mass of 8.4 TeV, decaying to a pair of dijet resonances, each with a mass of 2.1 TeV.*

jets by a candidate event recorded in 2017, which was presented by a previous CMS search for dijet resonances (figure 1). This spectacular event has four high-transverse-momentum jets forming two dijet pairs, each with an invariant mass of 1.9 TeV and a four-jet invariant mass of 8 TeV.

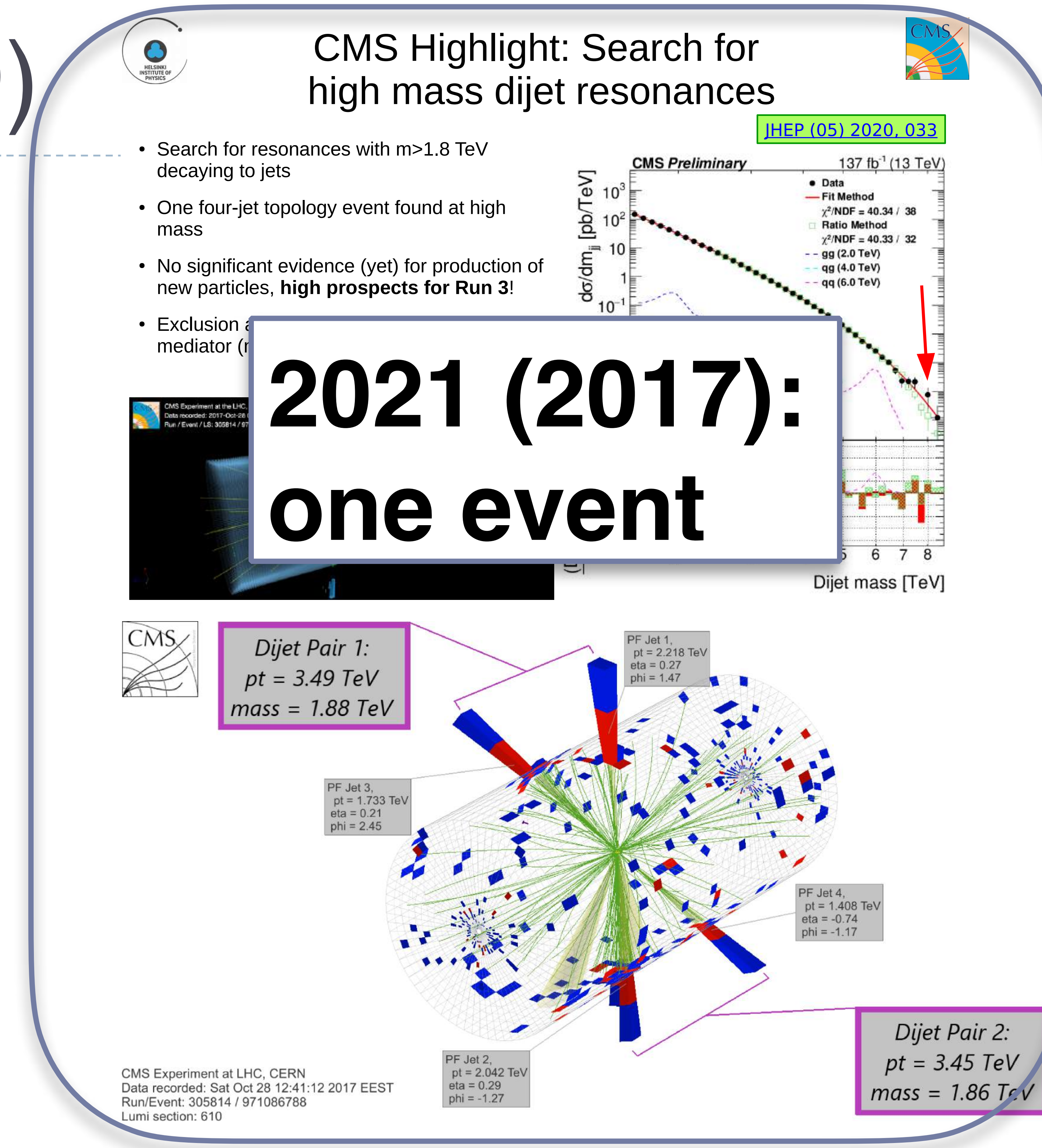
The CMS collaboration recently found another very similar event in a new search optimised for this specific Y→XX→four-jet topology. These events could originate from quantum-chromodynamic processes, but those are expected to be extremely rare (figure 2). The two candidate events are clearly visible at high masses and distinct from all the rest. Also shown in the figure (in purple) is a simulation of a possible new-physics signal – a diquark decaying to vector-like quarks – with a four-jet mass of 8.4 TeV and a dijet mass of 2.1 TeV, which very nicely describes these two candidates.

The hypothesis that these events originate from the SM at the observed X and Y masses is disfavoured with a local significance of 3.9σ. Taking into account the full range of possible X and Y mass values, the compatibility of the observation with the SM expectation leads to a global significance of 1.6σ.

The upcoming LHC Run 3 and future High-Luminosity LHC runs will be crucial in telling us whether these events are statistical fluctuations of the SM expectation, or the first signs of yet another groundbreaking discovery at the LHC.

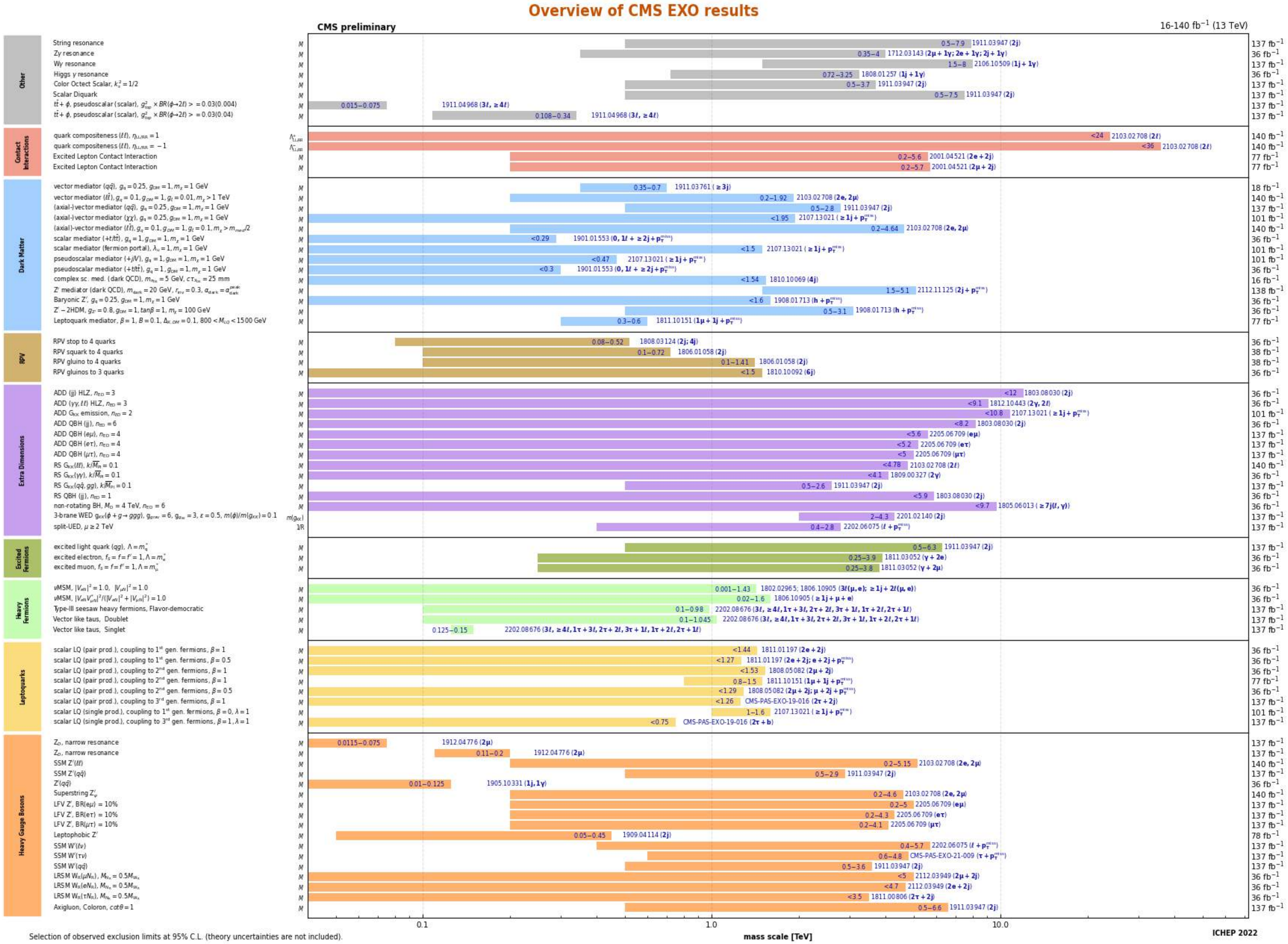
Further reading

CMS Collab. 2022 CMS-PAS-EXO-21-010.



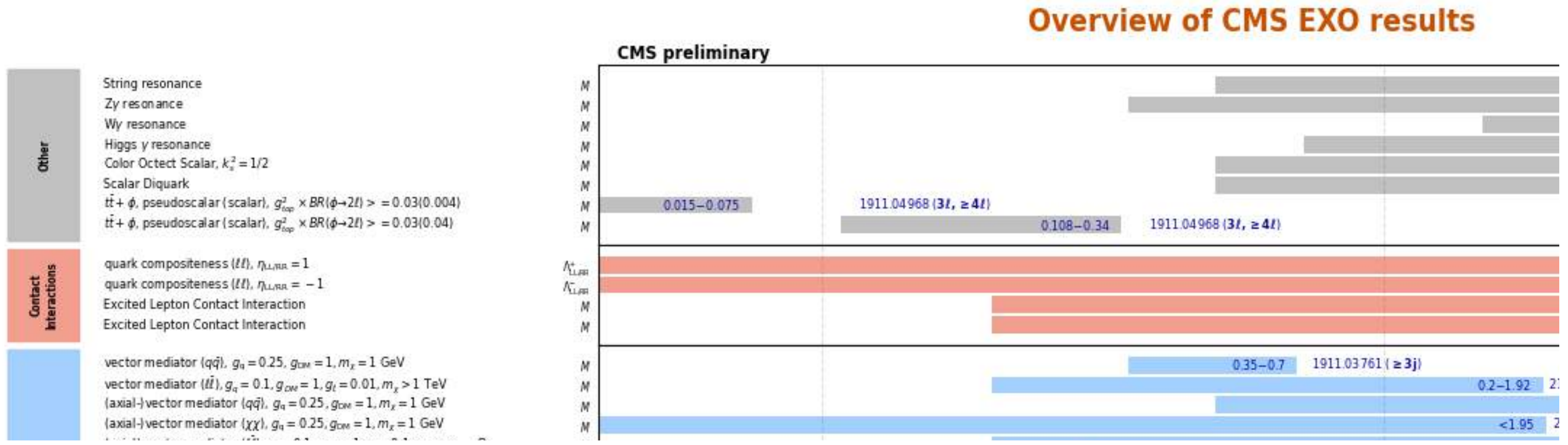
ce m = 8.6 TeV,
global).
et m = 0.95 TeV,
global).

Other searches



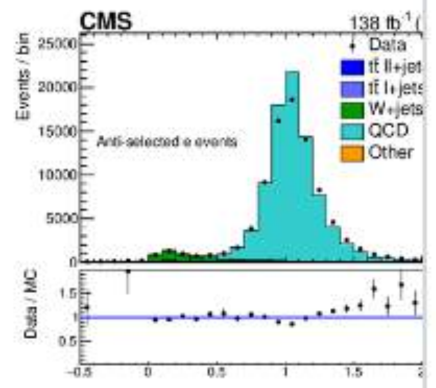
- Most standard searches have been carried out with Run 2 data
- Two things to do:
  - Follow up excesses (there are quite a few around, did not cover all)
  - Also target even more exotic signatures and models which have not yet been covered
- Also expanding searches for Long Lived Particles (LLP)

Other searches



CMS Publications @CMSpapers · Nov 15

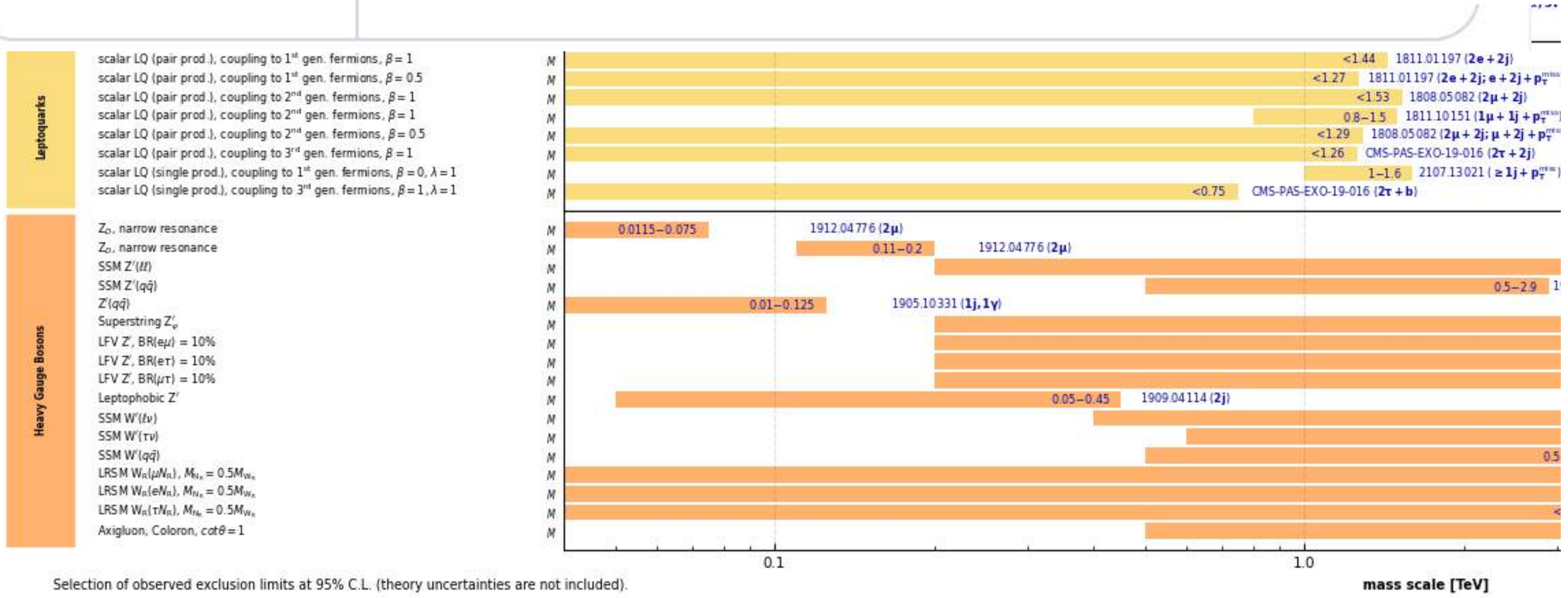
#CMSpaper soon on arXiv: Search for supersymmetry in final states with a single electron or muon using angular correlations and heavy-object identification in proton-proton collisions at √s = 13 TeV (CERN-EP-2022-169) cds.cern.ch/record/2841130 #SuperSymmetry

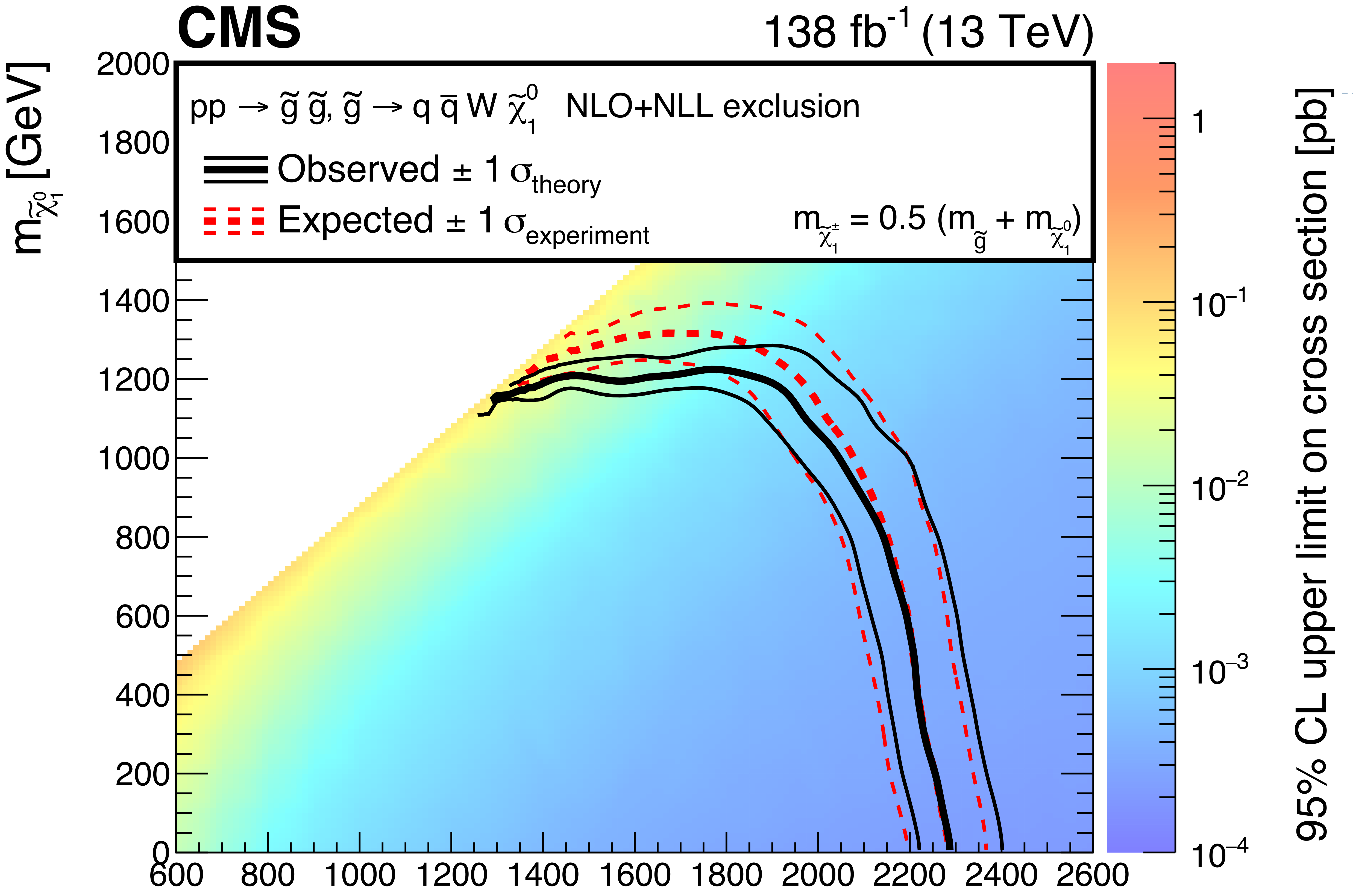


cds.cern.ch

Search for supersymmetry in final states with a sin...

A search for supersymmetry is presented in events with a single charged lepton, electron or muon, an...





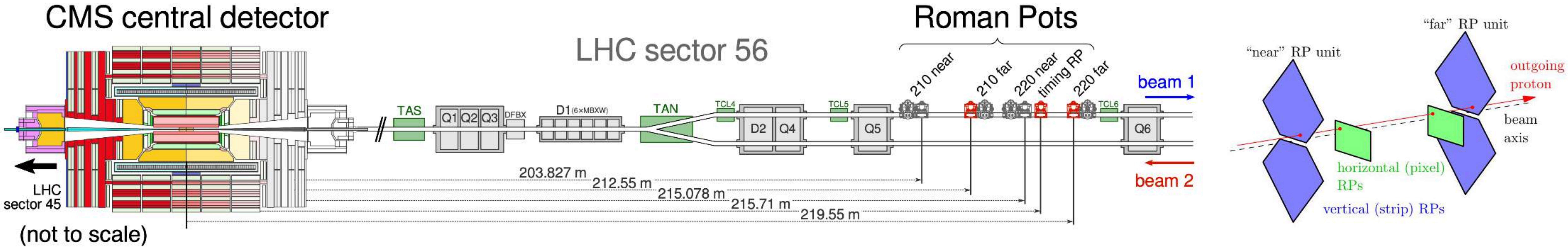
- Full Run 2 CMS result expanding [full Run 2] ATLAS limits by up to 150 GeV
- Relying on DNN-based heavy object (t/W) tagging
- 🇫🇮 heavily involved in the results, submitted last week

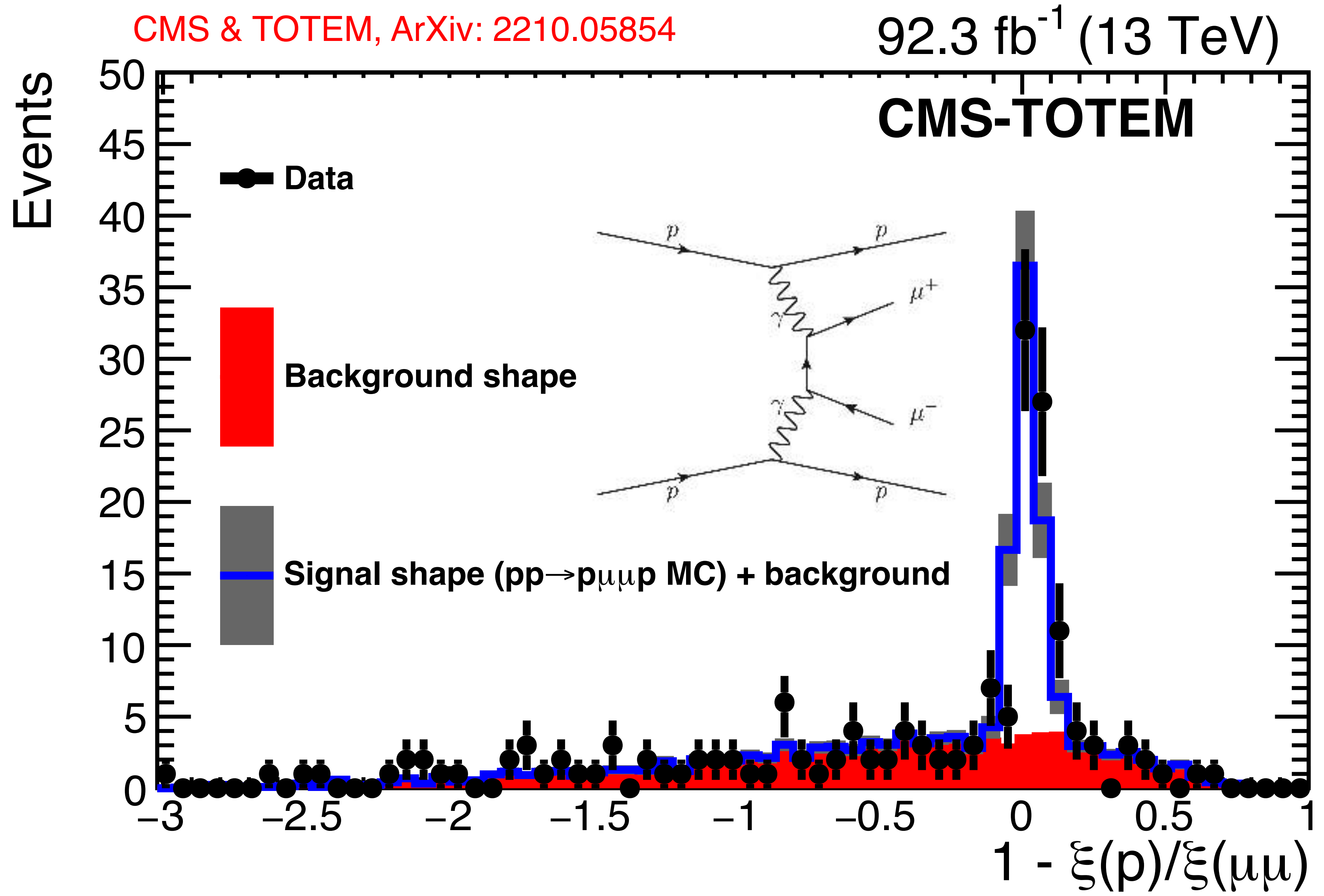
Exploiting the Precision Proton Spectrometer (PPS) @Helsinki

Continuous high luminosity data taking with CMS in Run 2: ~ 100 fb^{-1} in 2016-18

Roman Pots (RPs) with proton tracking detectors: 3D Si pixels detectors

RPs with proton Time-of-flight (TOF) detectors: double-layered diamond sensors





- One or both protons can survive intact after an LHC interaction
- Deviation from LHC orbit allows to measure momentum loss
- Knowing proton momentum allows to access full event kinematics
- Paper on calibration of the PPS (timing and alignment) recently published by CMS and TOTEM collaborations
- Physics calibration comparing di-lepton events independent reconstruction via PPS and in the central CMS detector

- Physics Briefing

Exploiting the Precision Proton Spectrometer (PPS) @Helsinki

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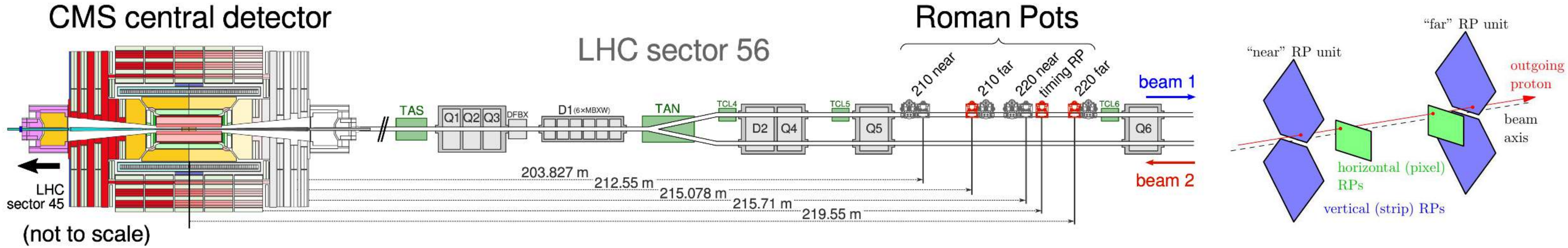
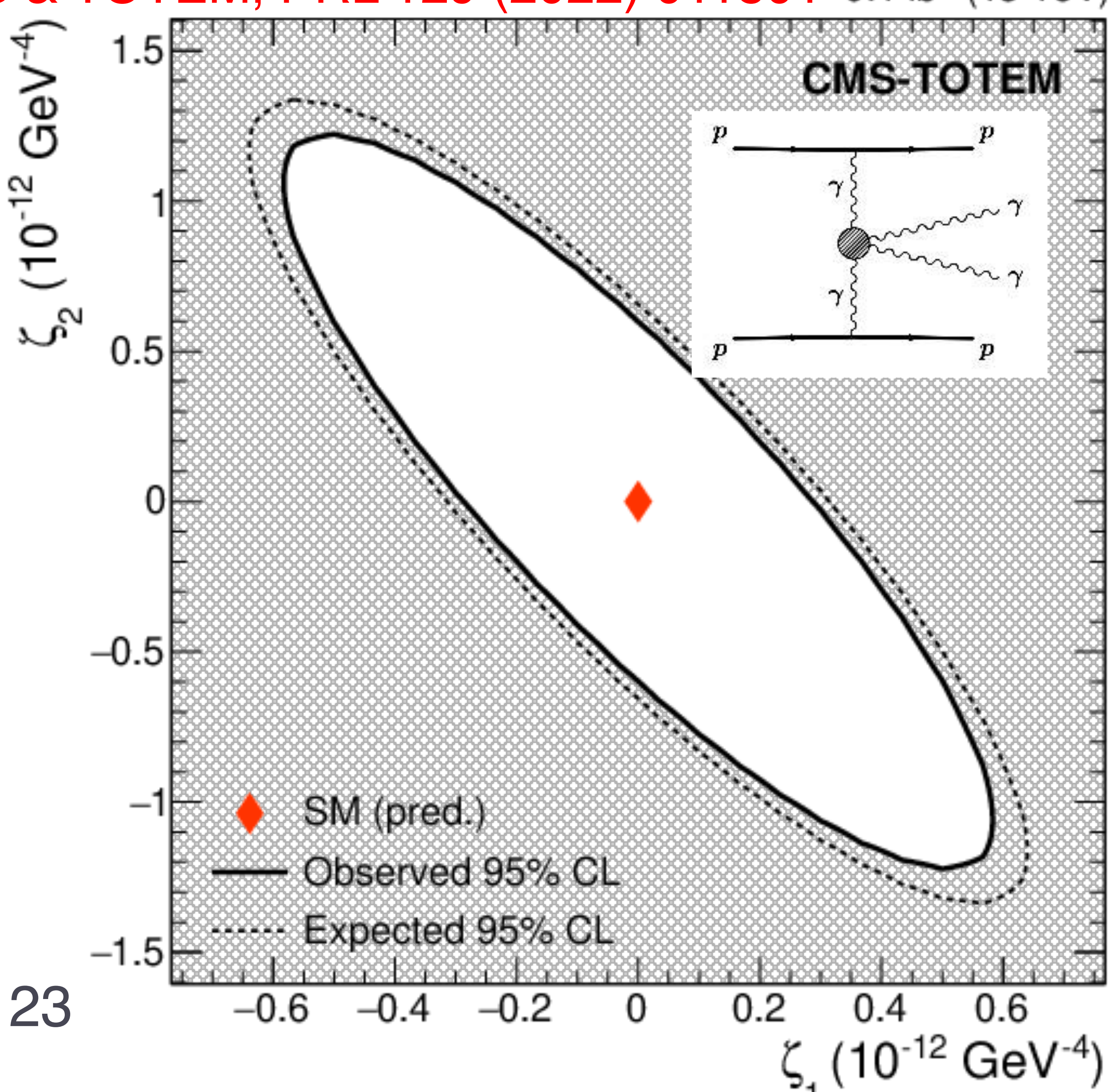


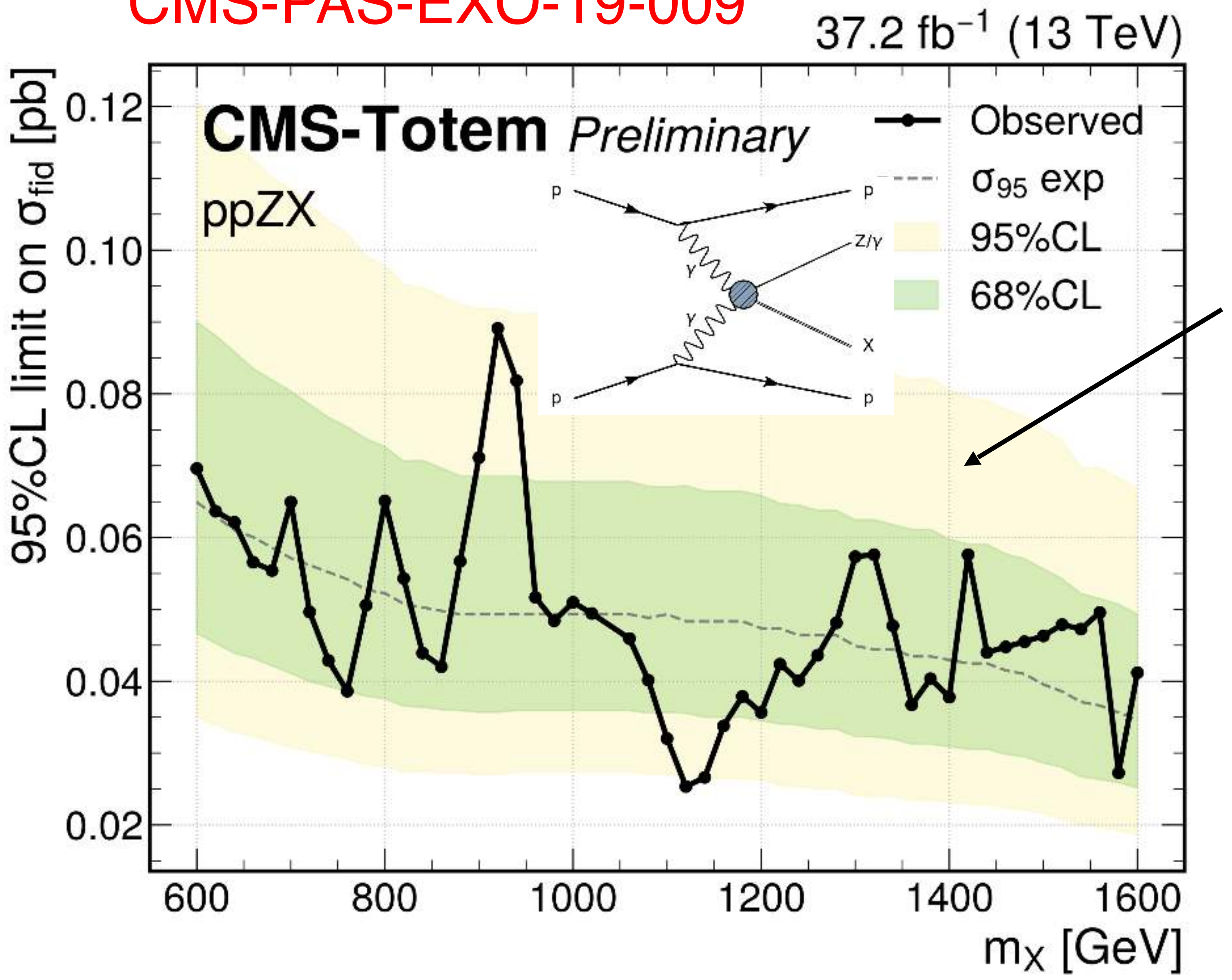
CMS & TOTEM, PRL 129 (2022) 011801



- Limits on anomalous quartic γγγγ gauge couplings from searches for high mass exclusive γγ events with PPS
- One of the first of a whole series of "Large Photon Collider" analyses, really nice additional possibilities thanks to PPS
- Now published

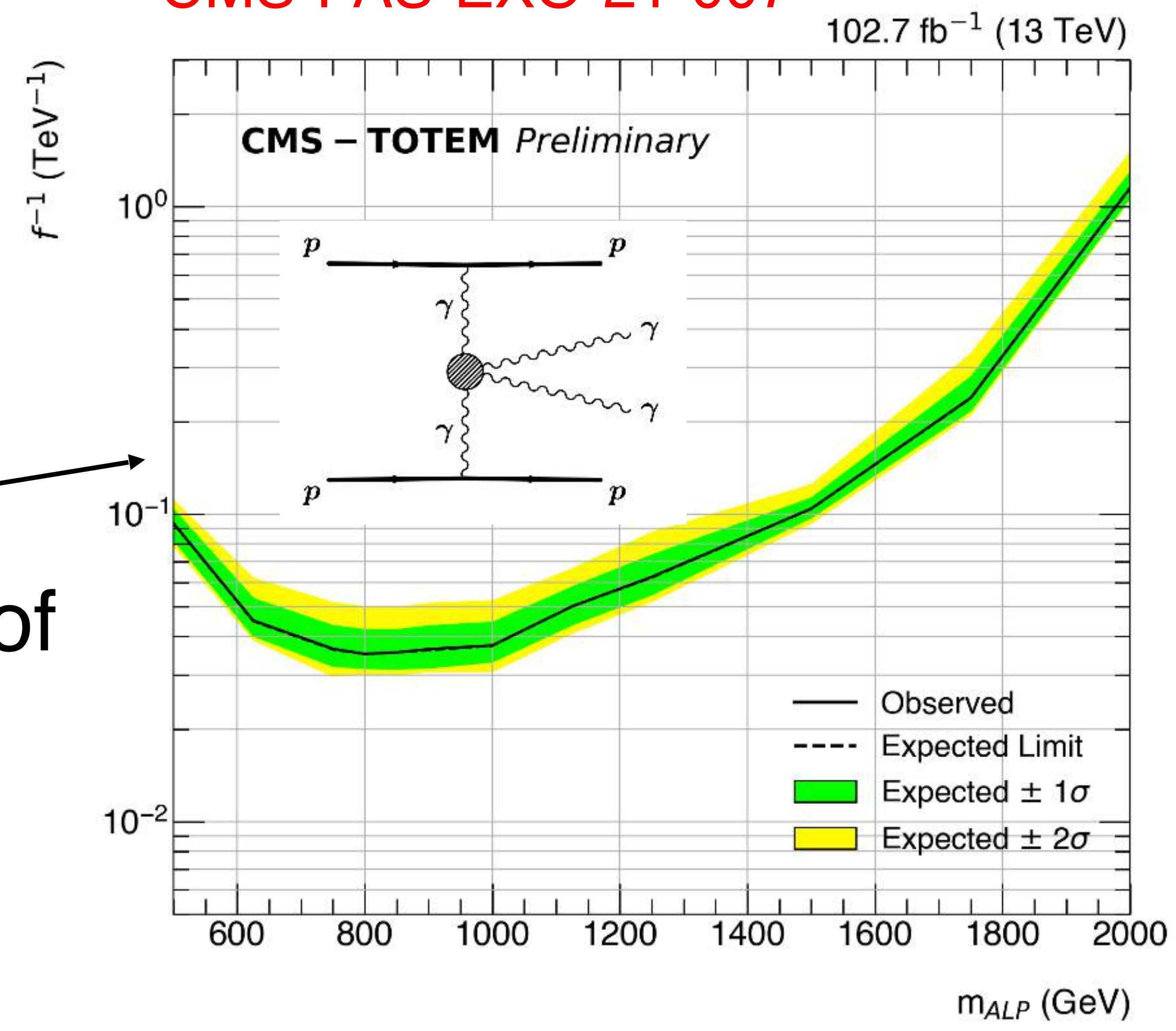
More recent PPS physics highlights

CMS-PAS-EXO-19-009



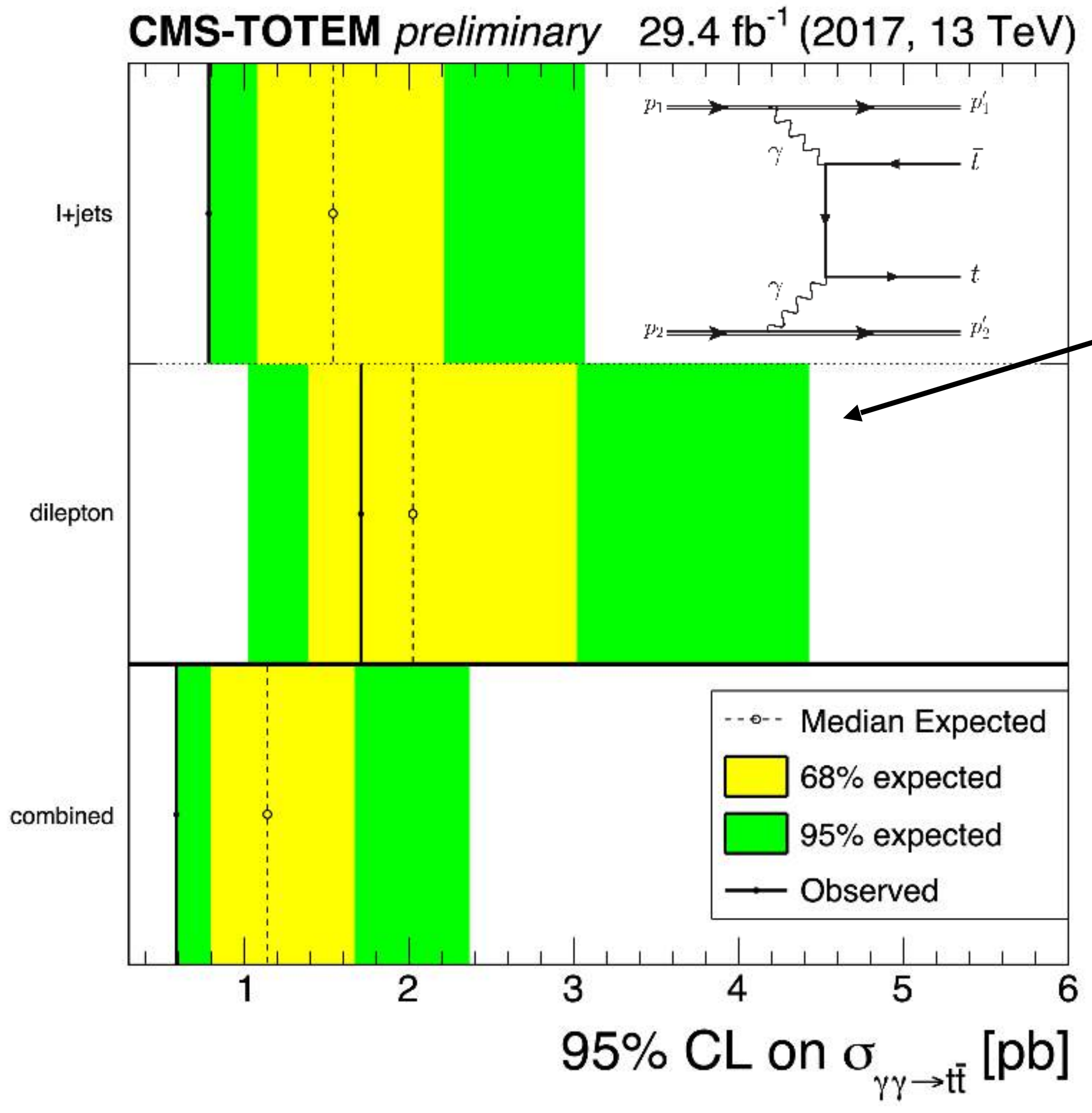
Search for Z/γ + X with PPS

CMS-PAS-EXO-21-007



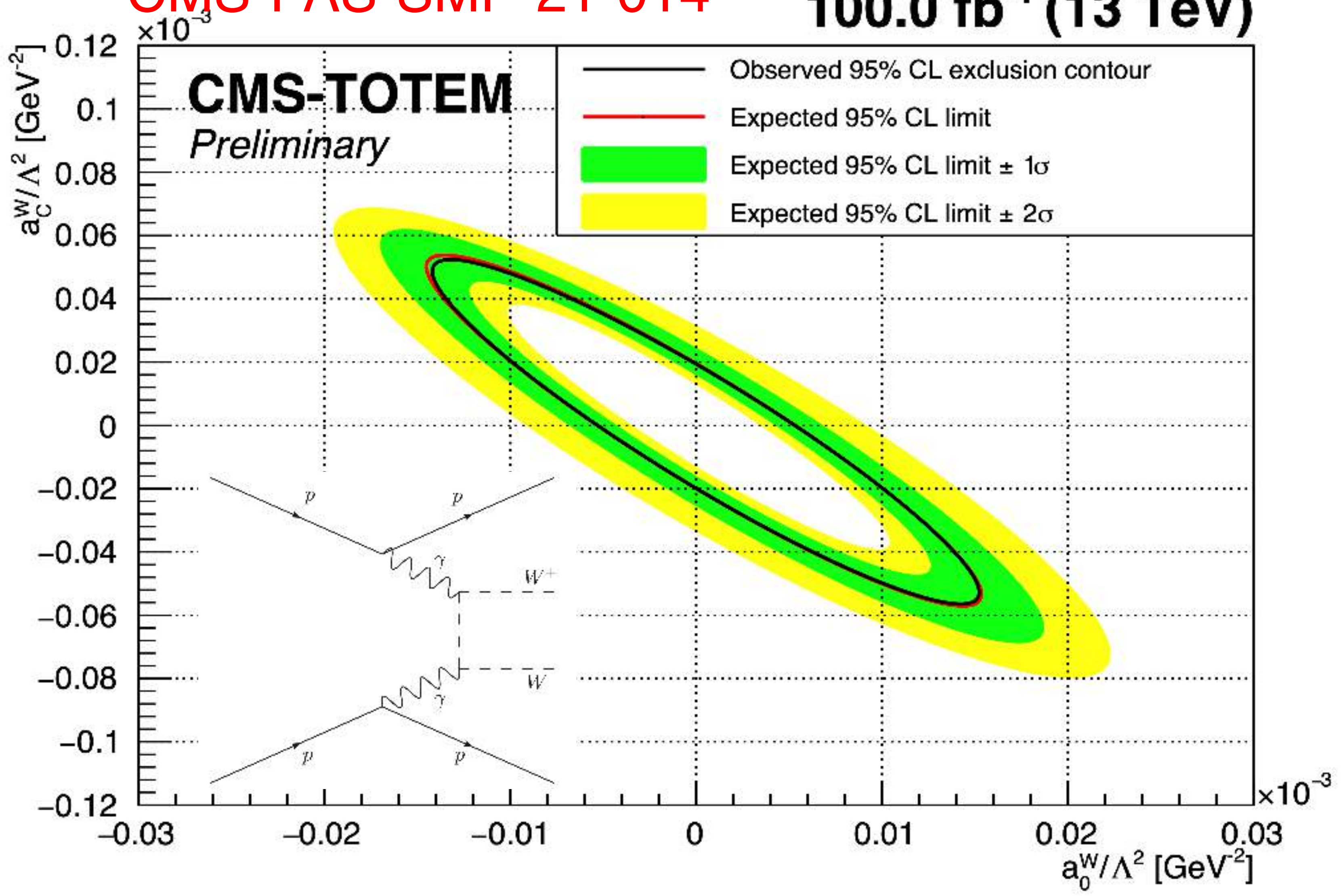
Search for high mass exclusive $\gamma\gamma$ with PPS
—> Full Run 2 follow-up of 10/fb analysis

CMS-PAS-TOP-21-007



Search for exclusive $t\bar{t}$ production with PPS

CMS-PAS-SMP-21-014



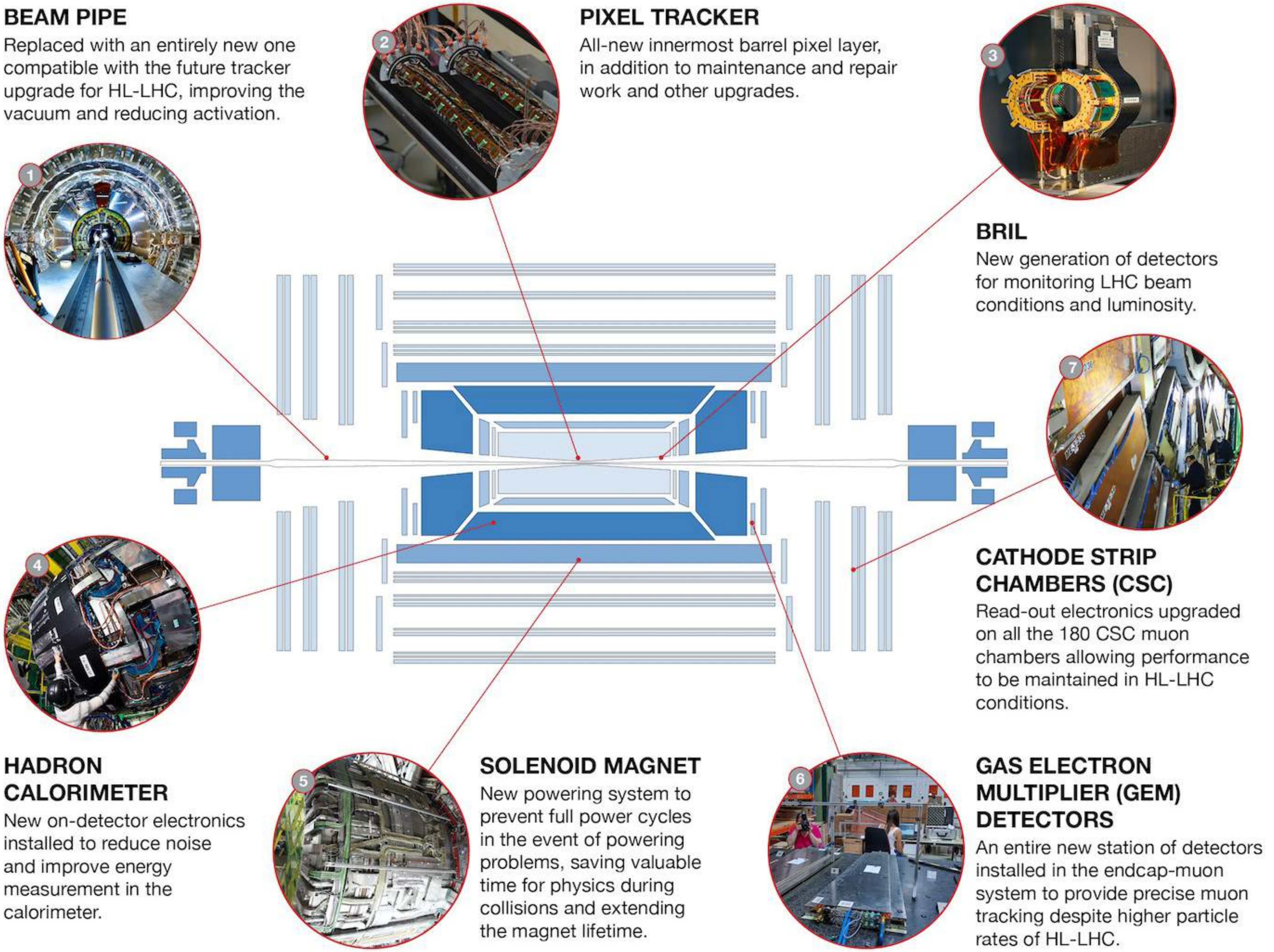
Search for high mass exclusive WW & ZZ with PPS

Long Shutdown 2 recap and Run 3 as test ground (and more)

- Run 3 ongoing
- Testground for techniques crucial for HL-LHC and new ideas

LS2 recap

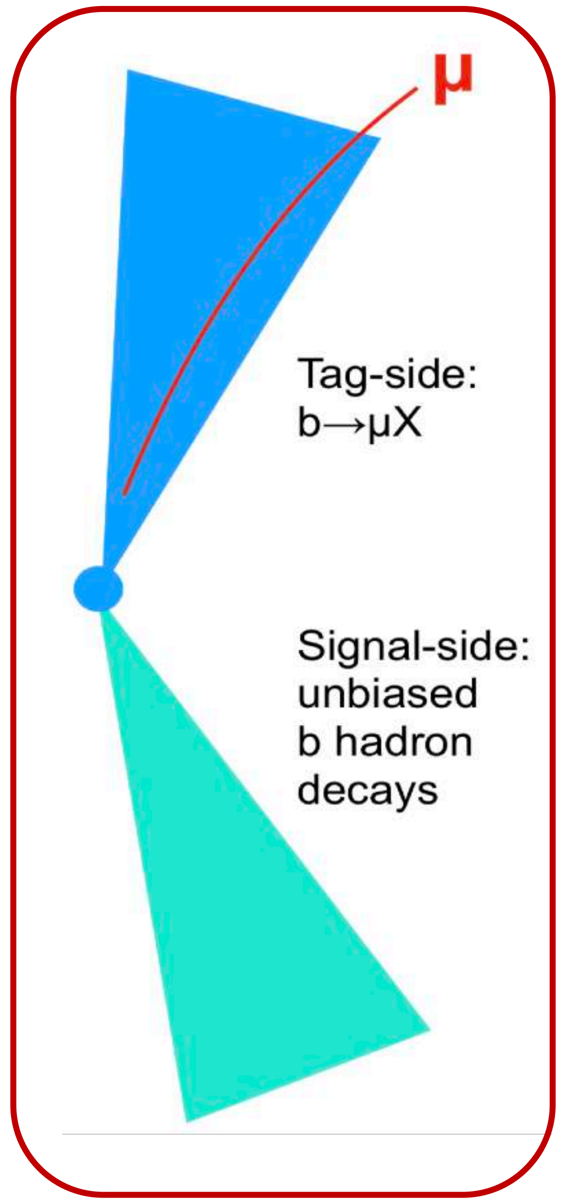
- Hardware upgrades, but also a lot of efforts under the software and FPGA hood
- For example:
  - Heterogeneous computing (GPU in use at HLT for Run-3: more tracking, more PF at HLT, 30% offloaded)
  - HLS4ML (machine learning inference in FPGAs) already in use with current L1-trigger. Full gain for upcoming Phase-2 system.



Run 3: Unconventional data-taking methods to increase opportunities

- B-parking
  - in 2018 we used low p_T displaced triggers to save a sample of unbiased B hadron decays recoiling wrt the triggered muon
    - Parked trigger rate ~2kHz was reconstructed after the end of the run
  - **Enables several analyses on LFU violation** currently in progress
    - Expect first approved results soon

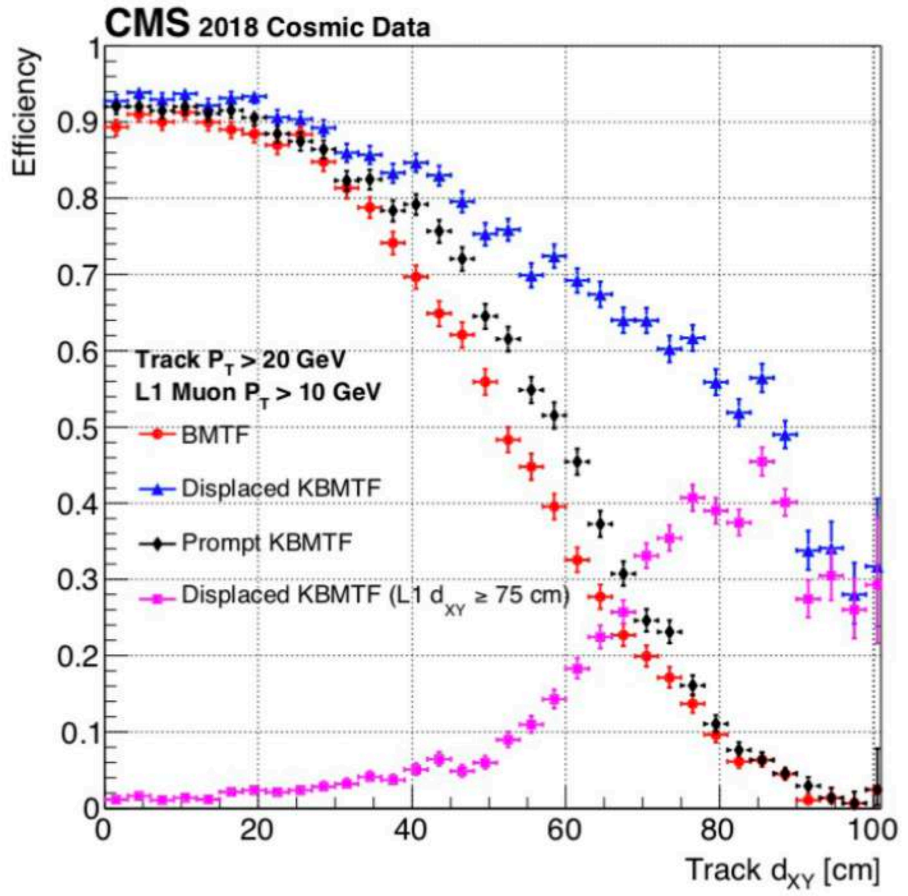
- Scouting
  - Analysis based on a reduced data format and on the online reconstruction in the HLT farm (do not save the full event data)
  - In Run 2 all analyses based about 5 kHz (~1 kHz of Particle Flow scouting)
  - **For Run 3 running PF on higher rate, adding additional L1 triggers (use GPUs and pixel tracks)**
- LLP improvements
  - **Developments in the L1 trigger** area with the aim to increase efficiency for displaced signatures
    - Increase efficiency for displaced muons
    - Extend muon triggers to hadronic showers
    - Out of time ECAL and HCAL at L1
    - Using HCAL depth information



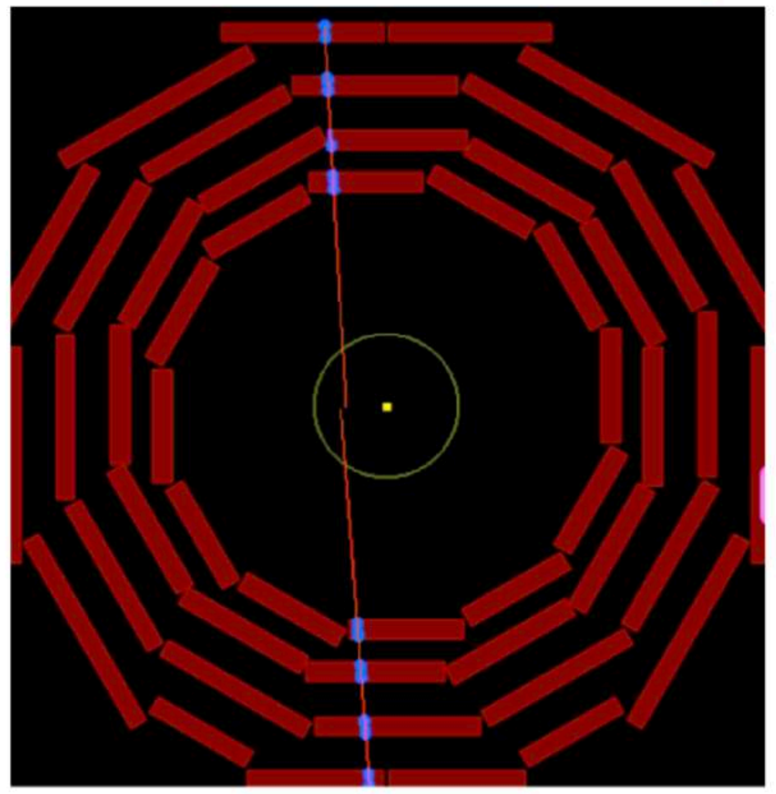
Collected billions of unbiased B decays
12 billion events total

Mode	N_{2018}	f_B	$\mathcal{B}$
Generic b hadrons			
B^0_d	4.0×10^9	0.4	1.0
$B^\pm$	4.0×10^9	0.4	1.0
B_s	1.2×10^9	0.1	1.0
b baryons	1.2×10^9	0.1	1.0
B_c	1.0×10^7	0.001	1.0
Total	1.0×10^{10}	1.0	1.0
Events for R_K and R_{K^*} analyses			
$B^0 \to K^*\ell^+\ell^-$	2600	0.4	6.6×10^{-7}
$B^\pm \to K^\pm\ell^+\ell^-$	1800	0.4	4.5×10^{-7}

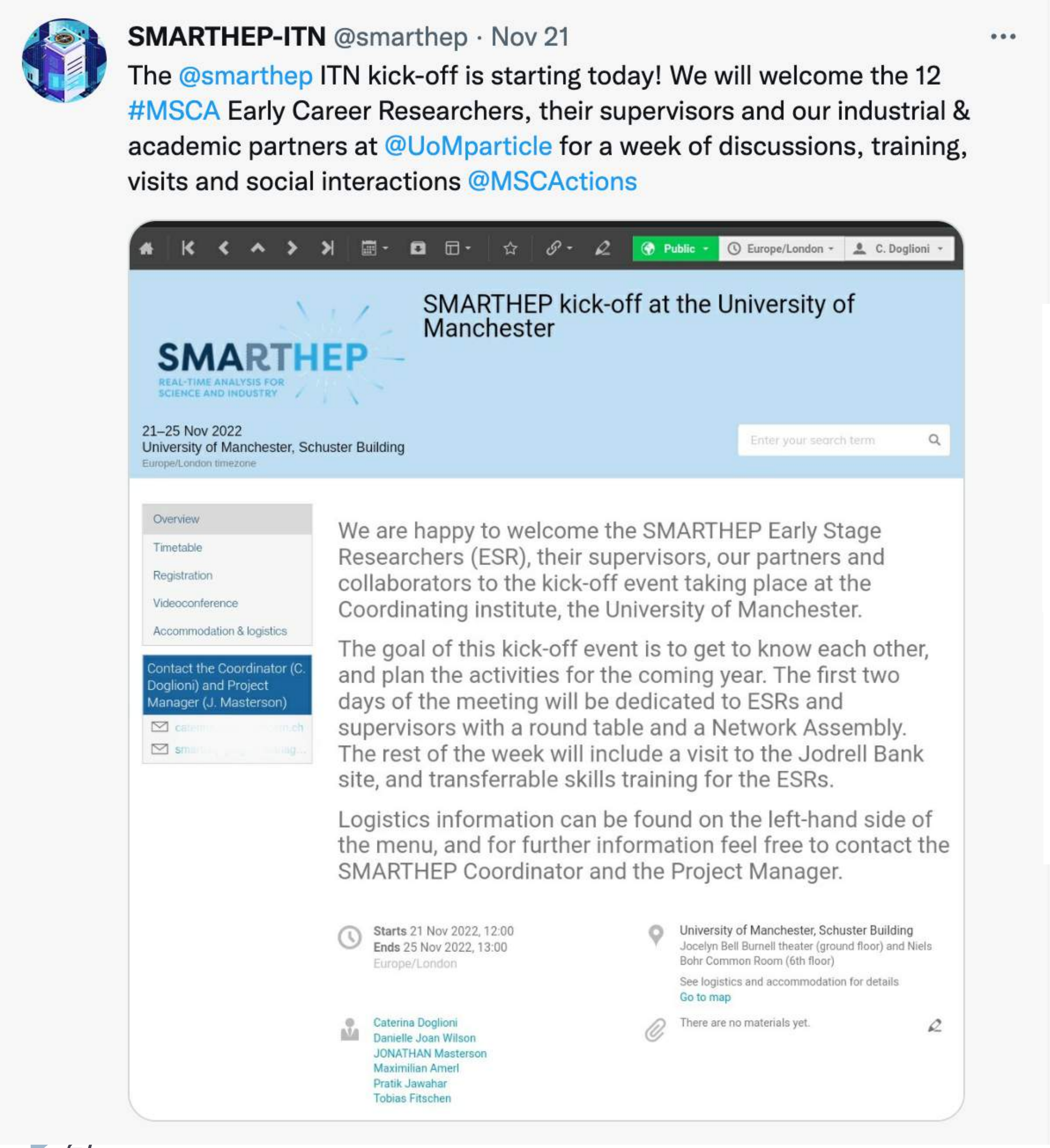
Kalman filter at L1



tested in parallel in 2018 and commissioned with cosmic rays



ethods to increase opportunities


SMARTHEP-ITN @smarthep · Nov 21

The @smarthep ITN kick-off is starting today! We will welcome the 12 #MSCA Early Career Researchers, their supervisors and our industrial & academic partners at @UoMparticle for a week of discussions, training, visits and social interactions @MSCActions

SMARTHEP kick-off at the University of Manchester

21–25 Nov 2022
University of Manchester, Schuster Building
Europe/London timezone

Enter your search term

- Overview
- Timetable
- Registration
- Videoconference
- Accommodation & logistics

Contact the Coordinator (C. Doglioni) and Project Manager (J. Masterson)

We are happy to welcome the SMARTHEP Early Stage Researchers (ESR), their supervisors, our partners and collaborators to the kick-off event taking place at the Coordinating institute, the University of Manchester.

The goal of this kick-off event is to get to know each other, and plan the activities for the coming year. The first two days of the meeting will be dedicated to ESRs and supervisors with a round table and a Network Assembly. The rest of the week will include a visit to the Jodrell Bank site, and transferrable skills training for the ESRs.

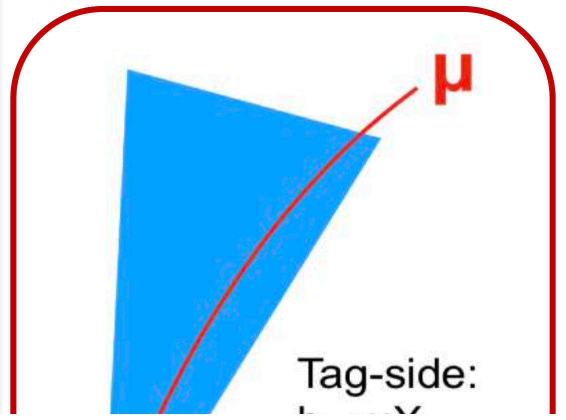
Logistics information can be found on the left-hand side of the menu, and for further information feel free to contact the SMARTHEP Coordinator and the Project Manager.

Starts 21 Nov 2022, 12:00
Ends 25 Nov 2022, 13:00
Europe/London

University of Manchester, Schuster Building
Jocelyn Bell Burnell theater (ground floor) and Niels Bohr Common Room (6th floor)
See logistics and accommodation for details
Go to map

Caterina Doglioni
Danielle Joan Wilson
JONATHAN Masterson
Maximilian Amerl
Pratik Jawahar
Tobias Fitschen

There are no materials yet.



Collected billions of unbiased B decays
12 billion events total

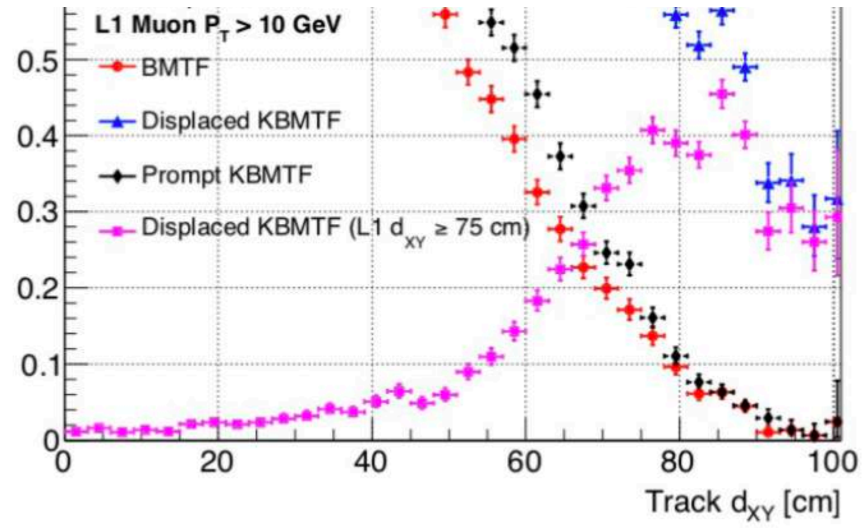
Mode	N_{2018}	f_B	$\mathcal{B}$
Generic b hadrons			
			1.0
			1.0
			1.0
			1.0
		1	1.0
			1.0
lyses			
			6.6×10^{-7}
			4.5×10^{-7}

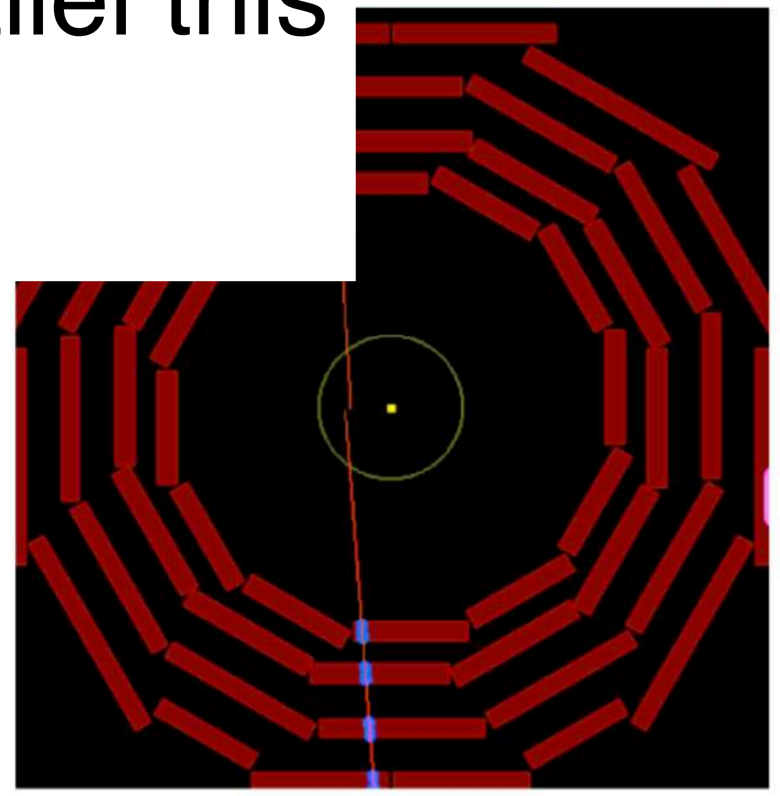
SMARTHEP
REAL-TIME ANALYSIS FOR SCIENCE AND INDUSTRY

··· Follow

Kick-off of "scouting/ ML+industry network" with all LHC experiments in parallel this week.

allel in 2018 and with cosmic rays





Summary

Exploiting Run 2

LS2+Run 3

- Wealth of new results analysing Run 2 data
  - Keep up to date with all preliminary results and physics briefings
- Full Run 2 analyses with highest precision "Legacy" reconstruction starting to appear
  - New baseline for Run 3 and sizeable improvements
- Run 3 is there and Phase-II upgrades/HL-LHC just 150/fb away
  - Use Run 3 as training ground **and** to make a discovery

Upgrades and HL-LHC

- Upgrades "everywhere", personal highlights for "central CMS": Extended tracking coverage and HGCAL, more in following talk
- New HL-LHC projections in context of Snowmass process

- And keep in mind CMS Open Data
  - Growing community to make it even more useful
  - Kati in central role