Recent results and future prospects of ATLAS experiment

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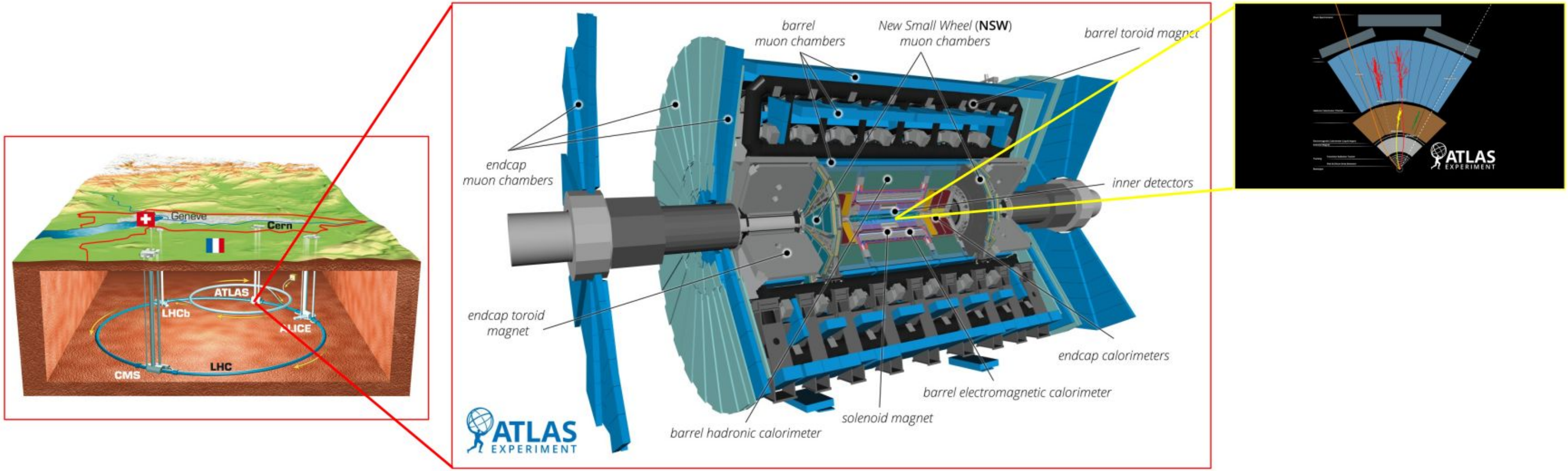
U N L P

Annual Meeting of DDAp/DDEIT and HIRSAP 2025

The ATLAS Experiment

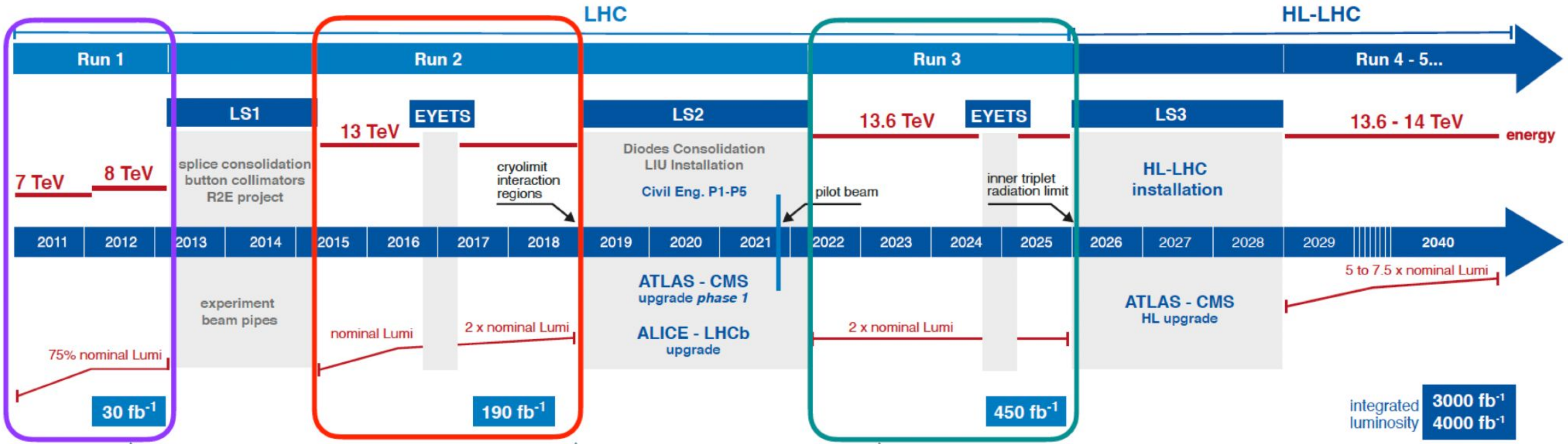


The ATLAS experiment is designed to shed light on elementary particle interactions: **test the SM and search for phenomena beyond it.**

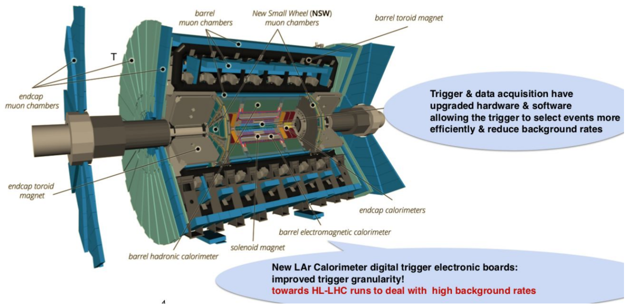
ATLAS is a general-purpose detector running at the LHC collider with excellent reconstruction, identification and energy-momentum measurement of electrons, photons, muons, taus, jets and flavor-tag covering a wide energy range (sub-GeV to TeV).

Collecting **proton-proton collisions at ECM = 13.6 TeV** (world record collider energy) at instantaneous luminosity ~$2\times10^{34}s^{-1}cm^{-2}$ with ~60 minimum bias interactions per bunch crossing (well above the design value of 20).

The road map

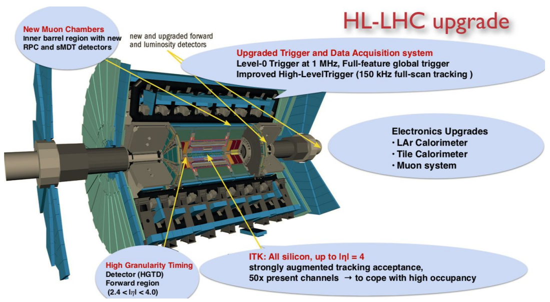


LHC
HL-LHC
Run 1
Run 2
Run 3
Run 4 - 5...
LS1
EYETS
LS2
EYETS
LS3
7 TeV
8 TeV
13 TeV
13.6 TeV
13.6 - 14 TeV
energy
splice consolidation
button collimators
R2E project
cryolimit
interaction
regions
Diodes Consolidation
LIU Installation
Civil Eng. P1-P5
pilot beam
inner triplet
radiation limit
HL-LHC
installation
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2040
experiment
beam pipes
ATLAS - CMS
upgrade phase 1
ALICE - LHCb
upgrade
ATLAS - CMS
HL upgrade
5 to 7.5 x nominal Lumi
75% nominal Lumi
nominal Lumi
2 x nominal Lumi
2 x nominal Lumi
30 fb-1
190 fb-1
450 fb-1
integrated
luminosity
3000 fb-1
4000 fb-1



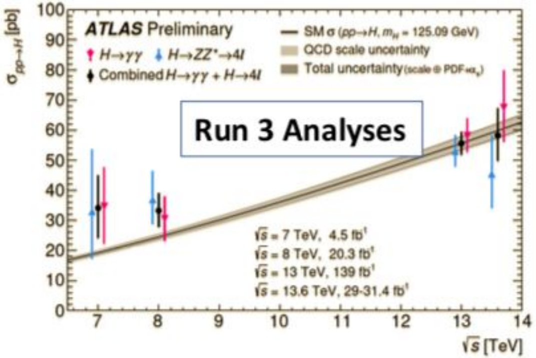
barrel
muon chambers
New Small Wheel (NSW)
muon chambers
barrel toroid magnet
T
endcap
muon chambers
endcap toroid
magnet
endcap calorimeters
barrel electromagnetic calorimeter
solenoid magnet
barrel hadronic calorimeter
Trigger & data acquisition have upgraded hardware & software allowing the trigger to select events more efficiently & reduce background rates
New LAr Calorimeter digital trigger electronic boards:
improved trigger granularity!
towards HL-LHC runs to deal with high background rates

ATLAS

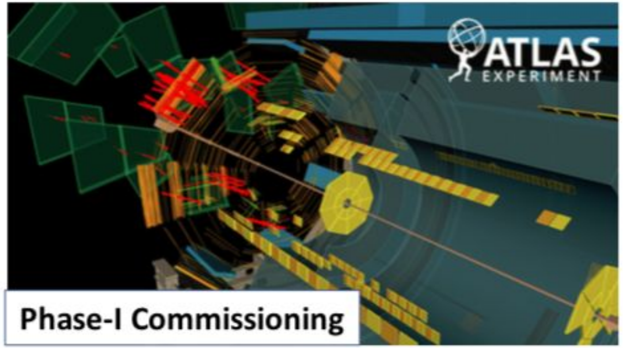


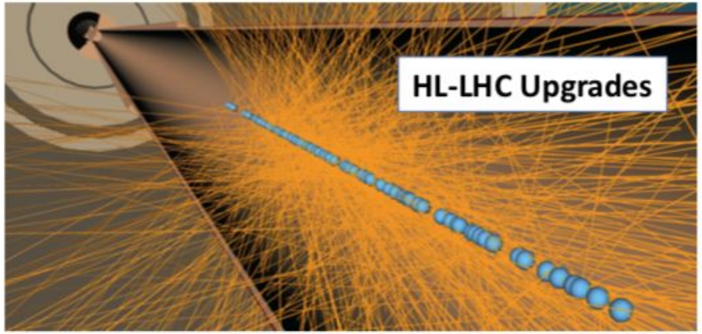
HL-LHC upgrade
New Muon Chambers
Inner barrel region with new RPC and sMDT detectors
new and upgraded forward and luminosity detectors
Upgraded Trigger and Data Acquisition system
Level-0 Trigger at 1 MHz, Full-feature global trigger
Improved High-LevelTrigger (150 kHz full-scan tracking)
Electronics Upgrades
· LAr Calorimeter
· Tile Calorimeter
· Muon system
High Granularity Timing Detector (HGTD)
Forward region
(2.4 < |η| < 4.0)
ITK: All silicon, up to |η| = 4
strongly augmented tracking acceptance,
50x present channels → to cope with high occupancy

ATLAS Collaboration Activities



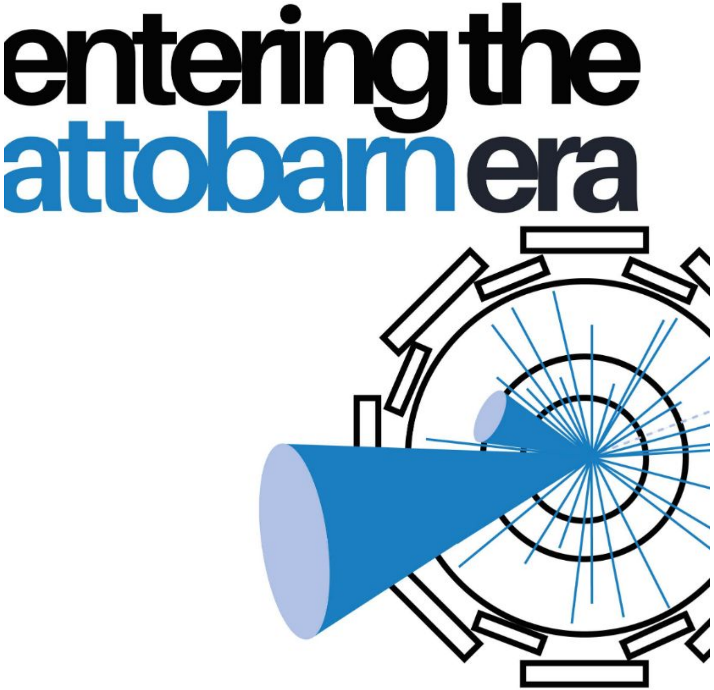
There are many ongoing activities at ATLAS...

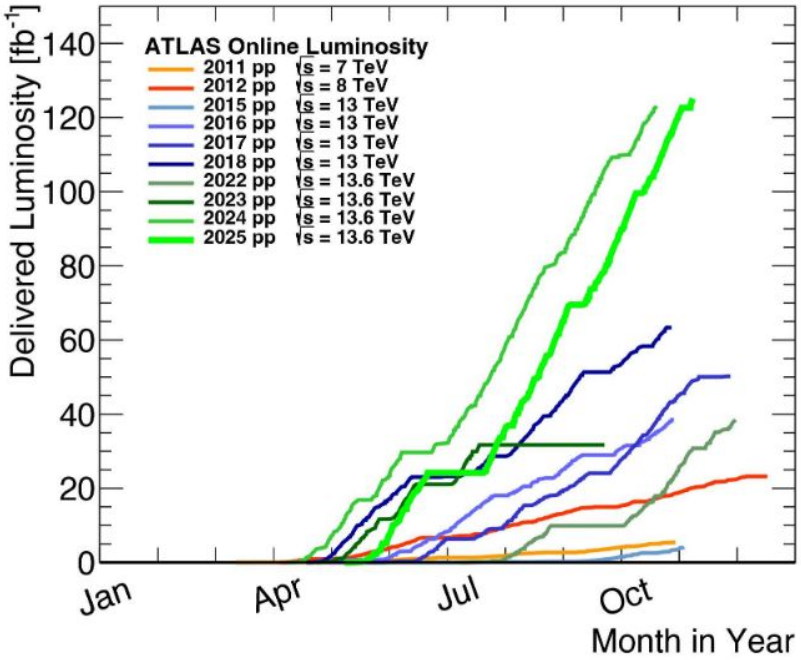




Data Taking and Performance

Energy-frontier physics relies on the LHC

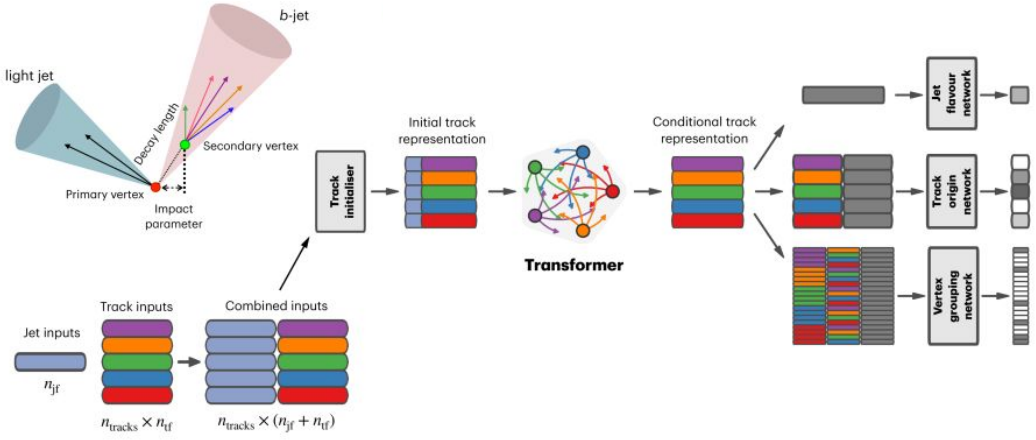


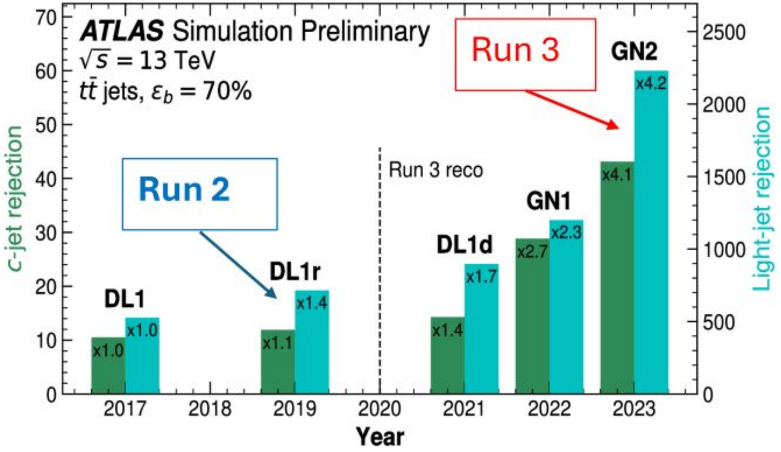


Since the LHC began operations in 2010, it has delivered over 0.5 attobarns (500 fb^{-1}) of proton–proton collisions to ATLAS. This extraordinary achievement was made possible thanks to the dedication of the ATLAS Collaboration and the CERN accelerator teams.

Transforming jet flavour tagging

[Submitted to Nature Communication]



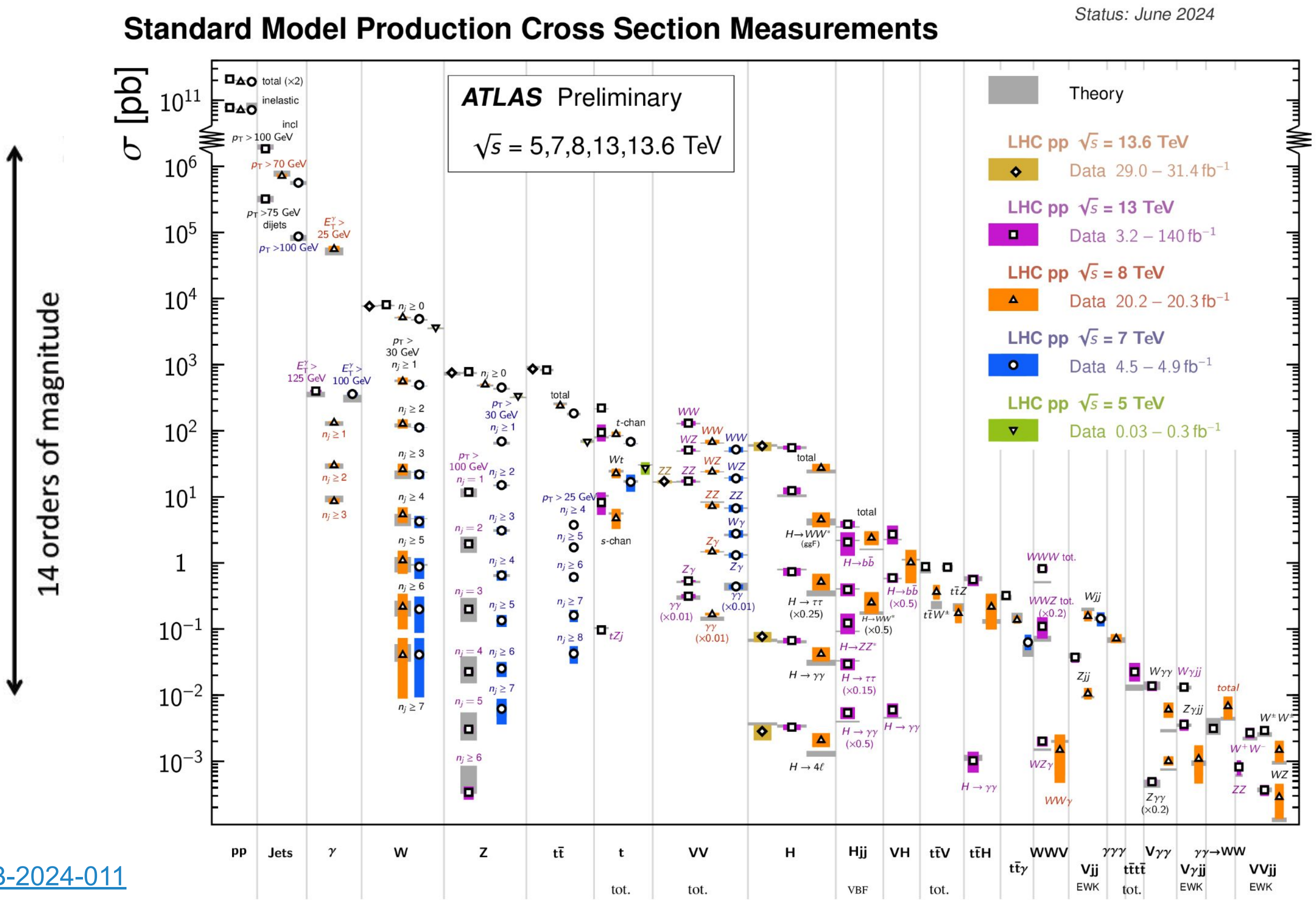


- Traditional approach (DL1r): low-level quantities based on tracks followed by high-level multivariate classifier
- New approach (GN2): directly process track and jet information. In addition to the primary training target (jet flavor prediction) auxiliary training objectives are introduced to reconstruct the internal structure of a jet by grouping tracks originating from a common vertex
- GN2 used in Run 3 analyses and reprocessed Run 2

https://atlas.cern/Updates/Briefing/GN2-Jet-Flavour-Tagging

SM and Top

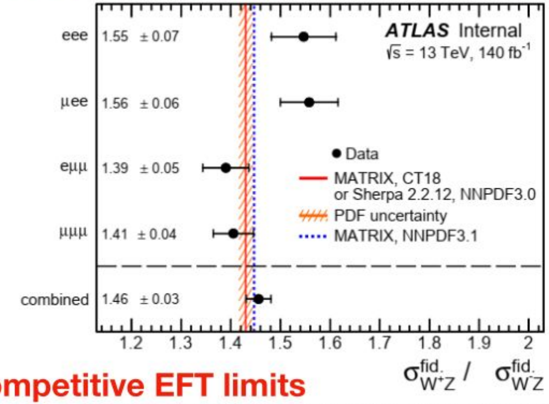
The Standard Model at LHC



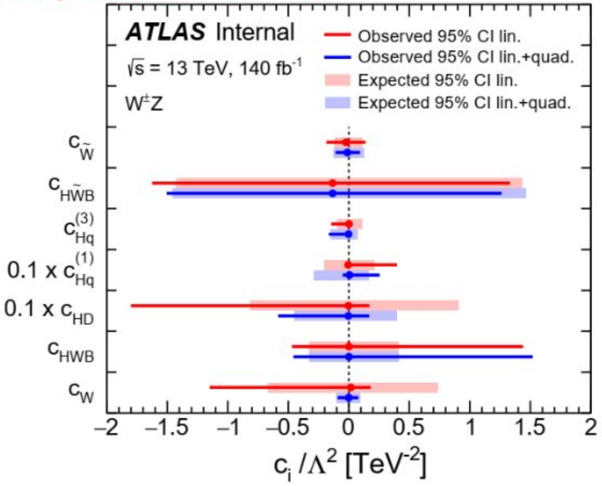
ATL-PHYS-PUB-2024-011

Di-Bosons: W/Z cross sections

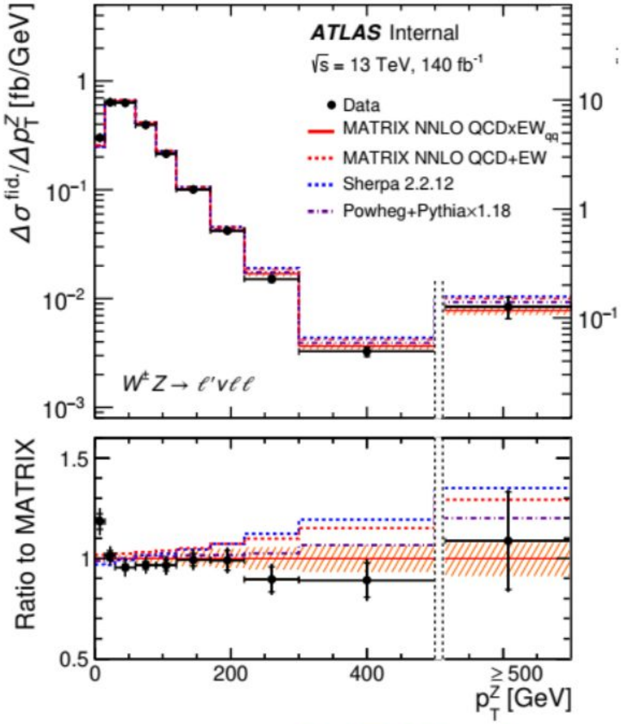
Most precise charge ratio in WZ diboson



Competitive EFT limits

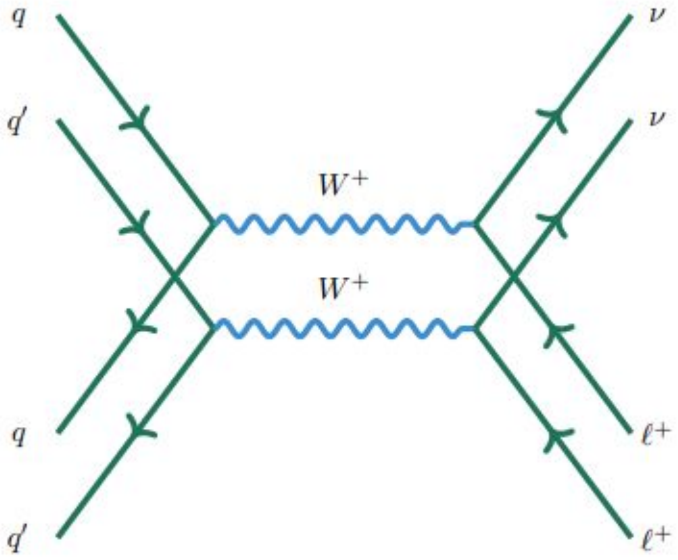


Great precision reveals: The need of precision modelling for high-order resummation, NNLO QCD + NLO EW corrections

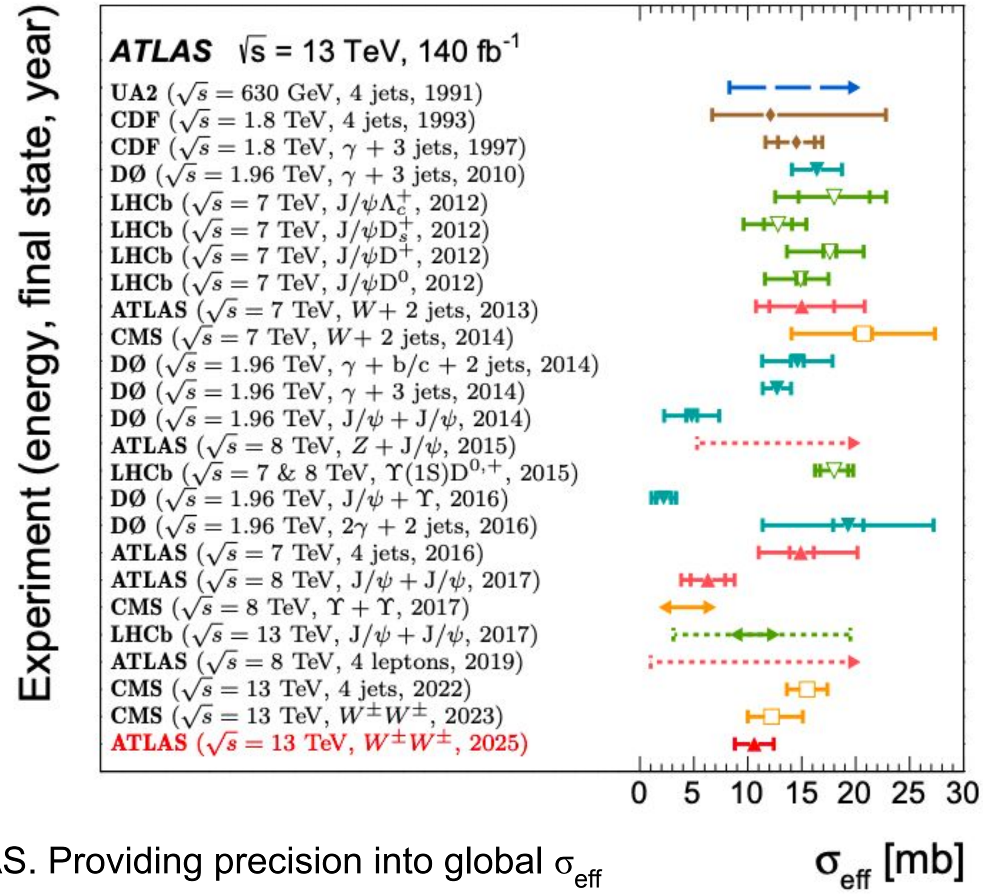


JHEP11(2025)006

Observation of double parton scattering



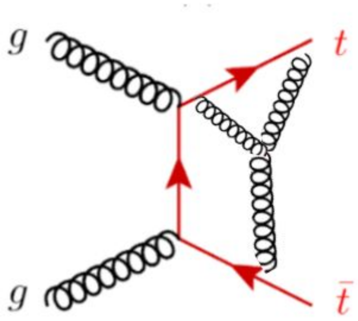
[Submitted to Phys. Lett. B. (arXiv:2505.08313)]

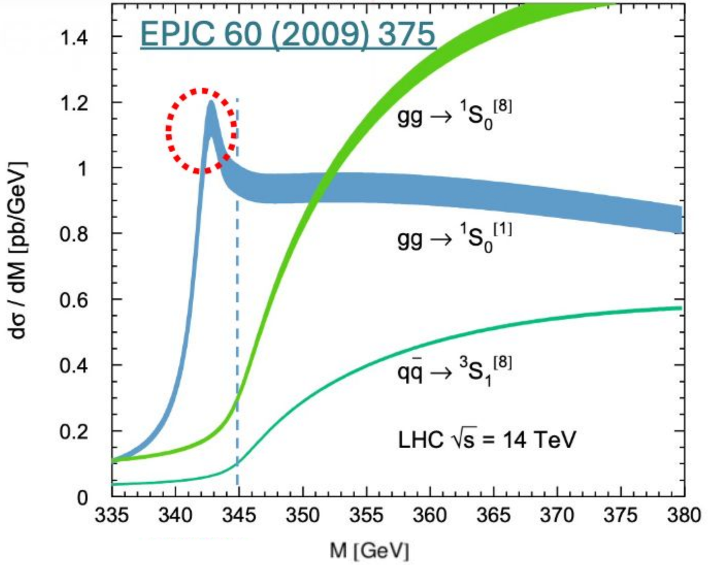


First same-sign WW DPI observation for ATLAS. Providing precision into global σ_{eff}

Observation of a cross-section enhancement near the $t\bar{t}$ production threshold

- SM predicts a quasi-bound toponium state just below the $t\bar{t}$ threshold
  - Unlike charmonium or bottomonium, it cannot self-annihilate — one of the top quarks decays before binding
  - The pseudoscalar nature of the state is reflected in the angular distributions of the top decay products
- CMS observes a cross-section enhancement consistent with a ${}^1S_0$ toponium state:
  σ = 8.8 ± 1.3 pb [CMS-TOP-24-007]
- Use dileptonic $t\bar{t}$ events at $M(t\bar{t}) \leq 500$ GeV to fit various models





Observation of a cross-section enhancement near the $t\bar{t}$ production threshold

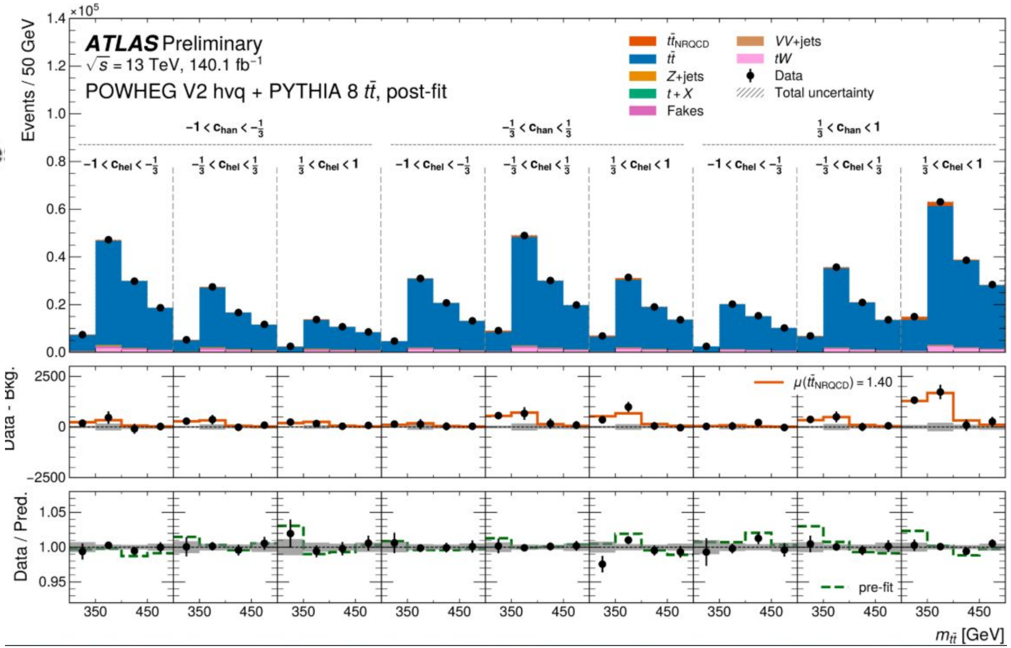
- Use $tt \rightarrow \ell\nu b\ \ell\nu b$ leptonic decay:
  - Reconstruction of m_{tt} → mass resolution **~20%** at threshold
  - Enhance sensitivity using lepton angular variables sensitive to tt spin correlation (c_{hel} and c_{han}) signal behaves as "*pseudo-scalar*"
- Fit to the data in 9 SR with m_{tt} bins (300-500 GeV)
  - Background Model: baseline pQCD
  - Signal Model: NRQCD (from Fuks et al.)
- Bkg.-only hypothesis rejected at **7.7σ**

$\sigma(tt_{NRQCD})$ = 9.0 ±1.3 pb (expected 6.4pb, 5.7σ)

ATLAS **observed** this *elusive* NRQCD phenomena

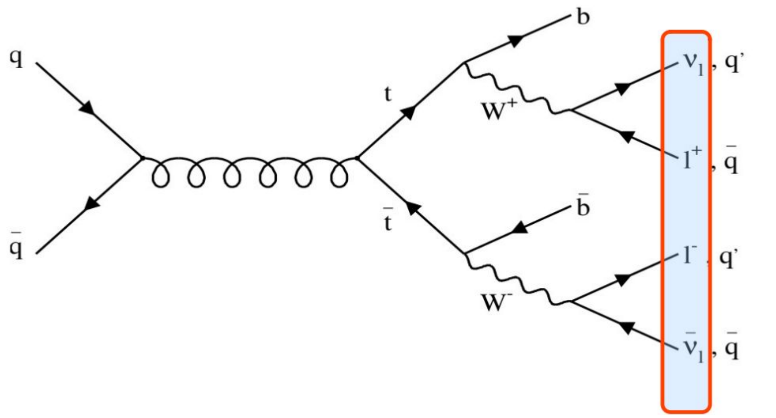
more work is needed on theory side (off-shell effects, matching pQCD and NRQCD, other NRQCD effects, ...) to better establish the properties of the observed signal

EPS 2025 - ATLAS-CONF-2025-008



Highest-energy detection of quantum entanglement

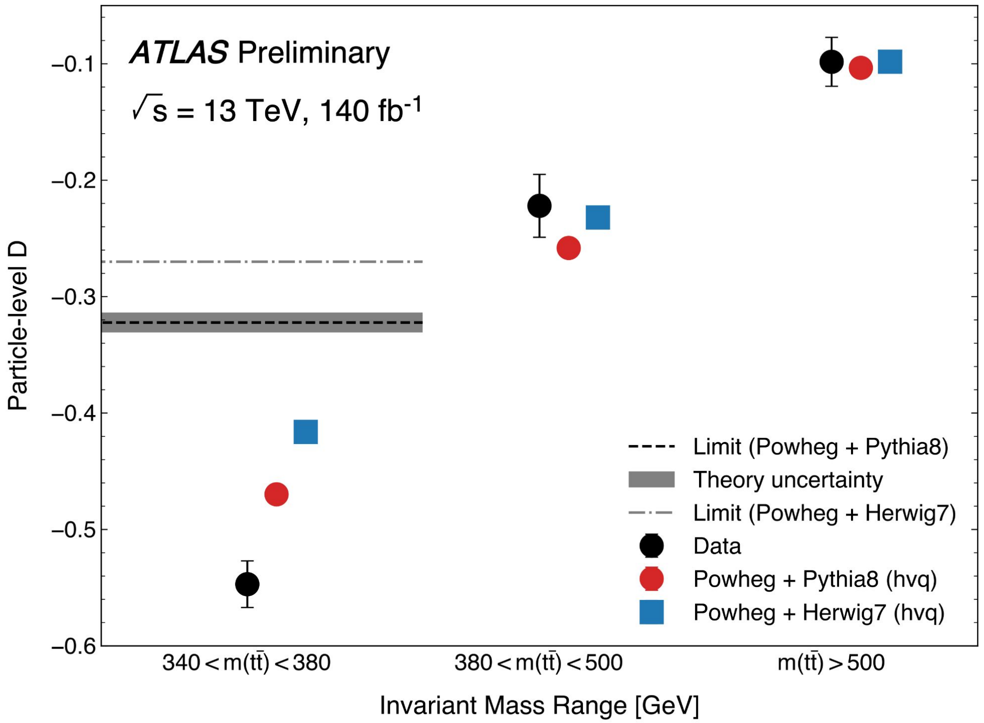
Nature 633 (2024) 542



$$\frac{1}{\sigma}\frac{d\sigma}{d\Omega_+ d\Omega_-} = \frac{1 + \mathbf{B}^+ \cdot \hat{\mathbf{q}}_+ - \mathbf{B}^- \cdot \hat{\mathbf{q}}_- - \hat{\mathbf{q}}_+ \cdot \mathbf{C} \cdot \hat{\mathbf{q}}_-}{(4\pi)^2}$$

$$D = \mathrm{tr}[\mathbf{C}]/3 \qquad D = -3 \cdot \langle \cos\varphi \rangle$$

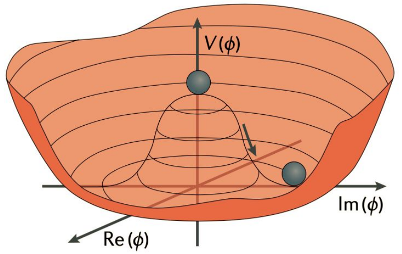
The vectors $B^{\pm}$ determine the top-quark and antitop-quark polarizations, whereas the **matrix C contains their spin correlations**. The **degree of entanglement (D)** is related to the angular distribution ($\cos \varphi$) of the particles the top quarks decay into.



Higgs

Higgs properties and beyond

Coupling to the different particles → proportional to the masses



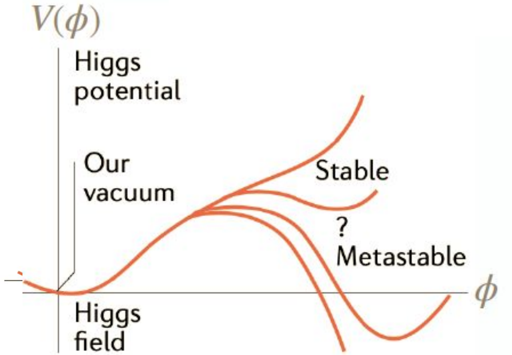
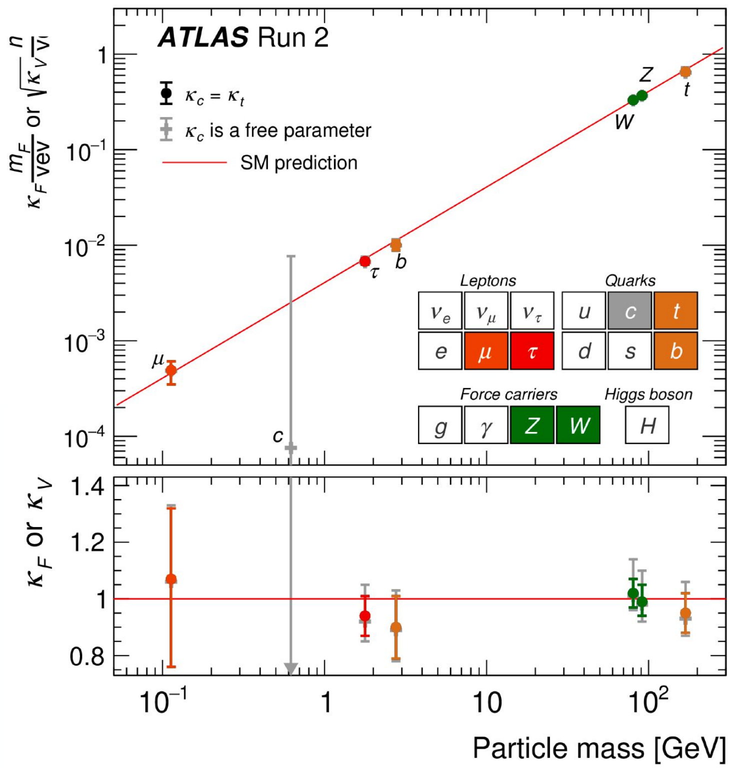
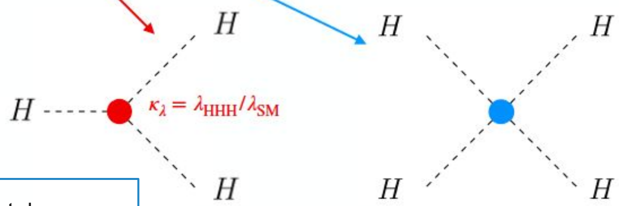


Image credit: Nature Reviews Physics 3.9 (2021)



$$V(\phi) = \frac{1}{2}\mu^2\phi^2 + \frac{1}{4}\lambda\phi^4 \supset \lambda v^2 h^2 + \lambda v h^3 + \frac{\lambda}{4}h^4$$

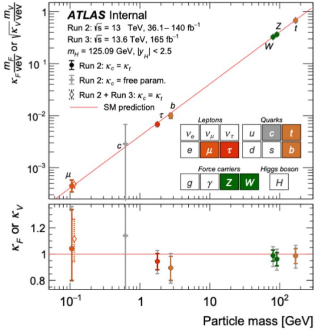


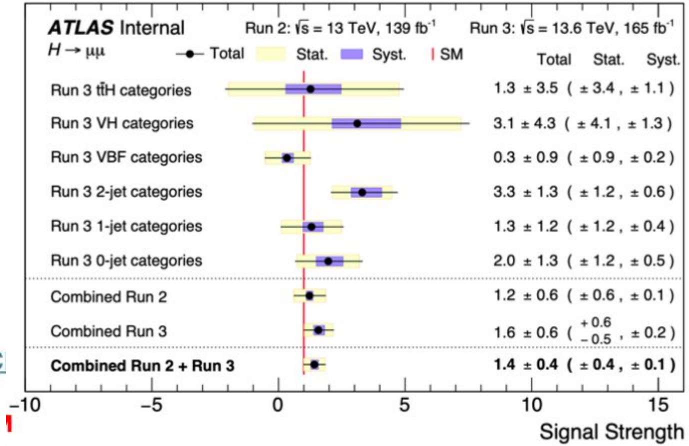
Mass term

self-coupling

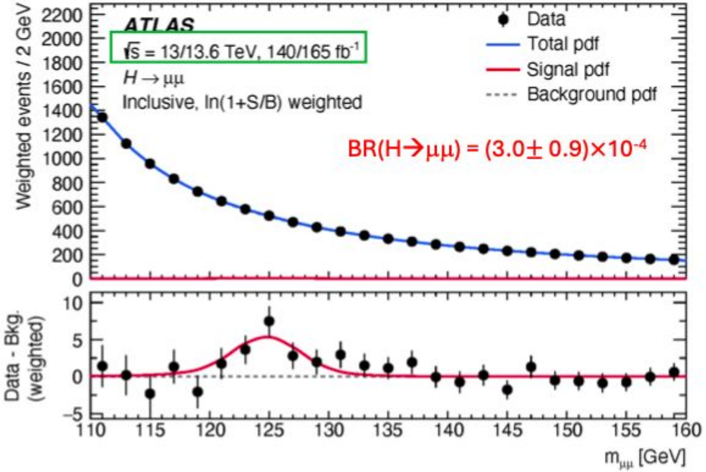
The Higgs self-coupling is a fundamental parameter. It can be measured at the LHC using Di-Higgs production, but it is 1000 times smaller than the production of a single Higgs boson.

Rare Higgs Decays: H → μμ





- Test **SM Yukawa sector** on **2nd Fermion generation**
- Rare decay **BR~2x10^{-4}** with huge DY background: S/B inclusive ~0.2%
- 23 Categories based on Higgs production mode and kinematic (BDT/NN) to enhance S/B
- Use Run 3 up to 2024!
- **Run 3**: $\mu(\sigma/\sigma_{SM})$**=1.6 ± 0.6** → **2.8 σ** (Exp. 1.8 σ)
- **Combined Run 2+Run 3: $\mu(\sigma/\sigma_{SM})$=1.4 ± 0.4 → 3.4 σ** (2.5 σ)



STRONG **evidence for H→ μμ** decay in agreement with SM

Sensitivity improved by ~50% relative to Run 2 analysis

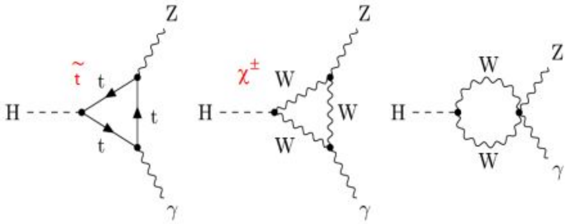
https://atlas.cern/Updates/Briefing/Rare-Higgs-Run3

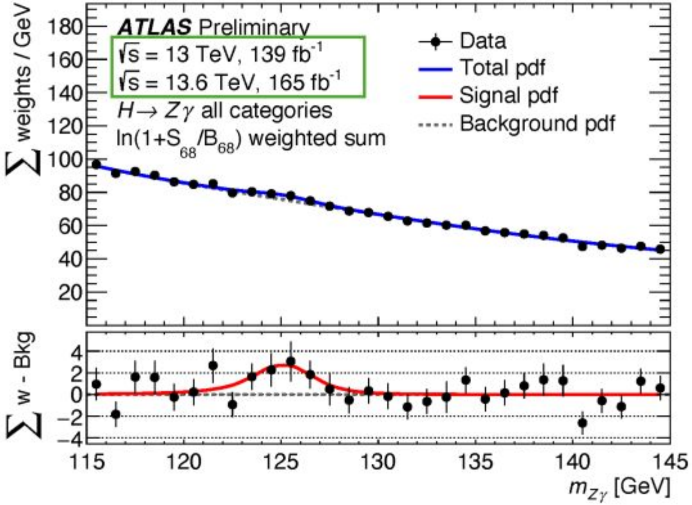
Submitted to Phys. Rev. Lett.

Rare Higgs Decay: H → Zγ

- Rare decay loop-suppressed in the SM with BR=1.5×10^{-3} → Sensitive to BSM effects
- Intriguing ATLAS+CMS in Run 2: $\mu(\sigma/\sigma_{SM})=2.2\pm0.7$ (Obs./Exp. Significance 3.4/1.6σ - about 2σ above SM prediction) Phys. Rev. Lett. 132 (2024) 021803
- Use Run 3 up to 2024!
- Fit to $m_{Z\gamma}$ 2 leptons $Z\rightarrow\ell\ell$ (e,μ) + isolated photon in 13 Categories
- **Run 3**: $\mu(\sigma/\sigma_{SM})=\mathbf{0.9^{+0.7}_{-0.6}}$ significance **1.4σ** (exp. SM **1.5σ**)
- **Combined Run2+Run3**: $\mu=\mathbf{1.3^{+0.6}_{-0.5}}$ significance **2.5σ** (exp. SM **1.9σ**)

Sensitivity improved by **60%** relative to Run 2 and by **20%** relative to ATLAS+CMS combination





Rarest visible Higgs decay seen so far: 0.010%

Briefing

Search for HH → bbγγ

- New measurement using reprocessed Run 2 + Run 3 (2022-2024!) → Total **308 fb^{-1}**
- **Timely calibration of physics objects** for Run 3 (up to 2024!)
- Improvements on HH sensitivity relative to Run 2 legacy analysis:
  - Additional data: **50%**
  - New flavor tag algorithm **GN2**: **20%**
  - Analysis preoptimization: **10%**
  - m_{bb} kinematic fit : **5%**
- Signal extracted by a fit to $m_{\gamma\gamma}$ in 7 BDT categories
  - Observed $\mu(\sigma/\sigma_{SM})_{HH} = 0.9^{+1.4}_{-1.1}$
  - 0.8 σ significance (1.0 expected)
  - Similar sensitivity of Legacy Run 2 combination (5 chan.)
- Higgs boson self-coupling modifier (coupling normalized to its SM prediction) $\kappa_\lambda \in [-1.7, 6.6]$ @95% CL

[Briefing](#)

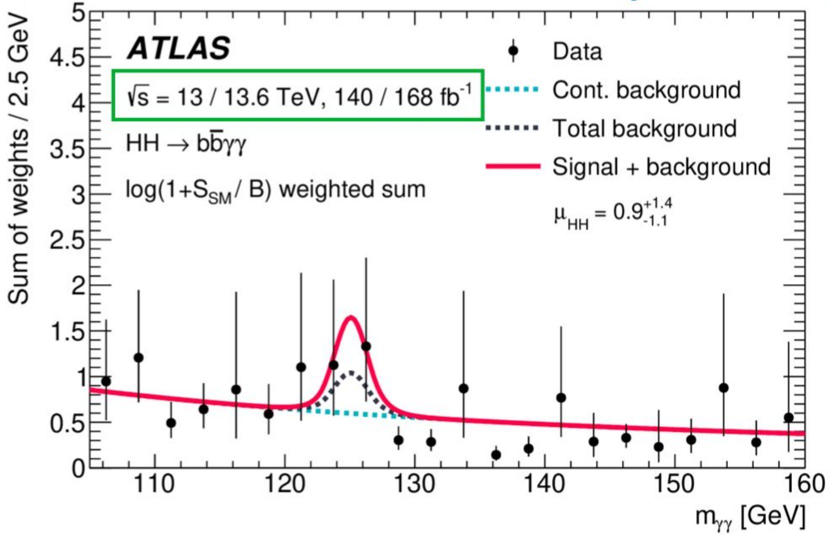
HH decay channels

Large decay fraction

	bb	WW	ττ	ZZ	γγ
bb	34%				
WW	25%	4.6%			
ττ	7.3%	2.7%	0.39%		
ZZ	3.1%	1.1%	0.33%	0.069%	
γγ	0.26%	0.10%	0.028%	0.012%	0.0005%

Clean final state

- No single "golden channel"
- bbbb (34%):
  - The most abundant final state
  - Challenging multi-jet backgrounds
- bbγγ (0.26%):
  - Low decay fraction
  - Excellent $m_{\gamma\gamma}$ resolution
- bbττ (7.3%):
  - Happy medium



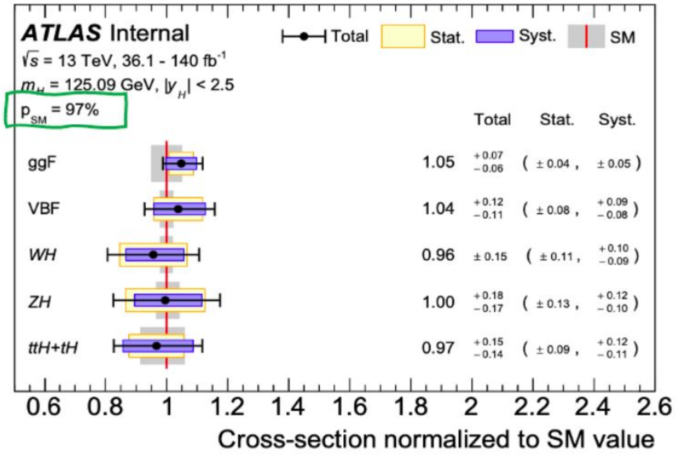
Run 2 Higgs coupling combination

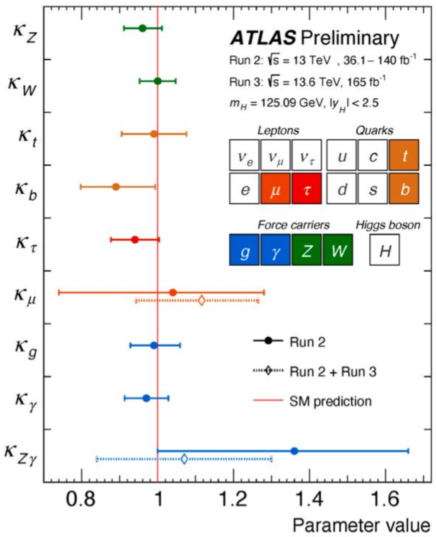
ATLAS-CONF-2025-006

- Added new Run 2 measurements relative to Nature 607 (2022) 52
  ttH→bb, VH→bb,cc, H→ττ, H→WW*
- $\mu(\sigma_{obs}/\sigma_{SM}) = 1.023\ ^{+0.056}_{-0.053}$ (0.028(stat)±0.026(exp)±0.039(th))
- Main improvements on σ (BR fixed to SM)
  - WH/ZH reduced by **30/20%** new V(H→bb)
  - ttH+tH reduced by **25%** new tt(H→bb)
- Test SM with coupling modifiers κ (coupling normalized to its SM prediction)

$$\sigma_i \times B(H \to f) = \frac{\sigma_i \times \Gamma_f}{\Gamma_H} = \frac{\kappa_i^2 \kappa_f^2}{\kappa_H^2} \sigma_i^{SM} \times B^{SM}(H \to f)$$

Achieved precision* ranging from **5-10%** (p_{SM} 89%)





*No BSM contributions to Higgs boson width

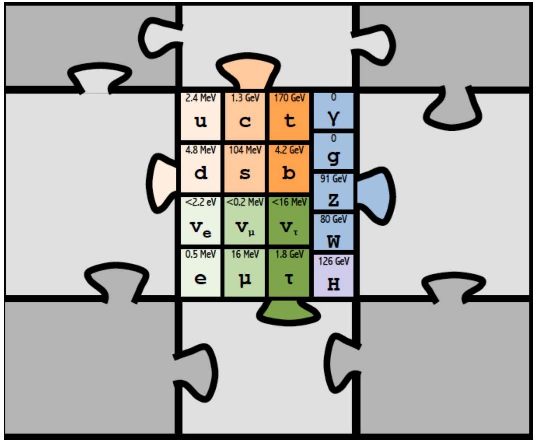
ATLAS-CONF-2024-006

Beyond Standard Model (BSM)

Guide for New Physics

Extraordinary predictions of the Standard Model, but…

- It does not include gravity
- It does not include dark matter
- It does not consider baryonic asymmetry
- Non-massive neutrinos



Simplicity

- Effective Theories
- Simplified Models
- Complete Theories

Complexity

Long Lived Particles
Higgs BSM
Dibosons
QBH
WIMPs
Extra dimensions
Dark Matter
Supersymmetry
Heavy particles
Compositeness
Resonances
Dark Sector
Invisible decays
New gauge bosons
Axion-like particles
Highly Ionizing Particles

Guide for New Physics

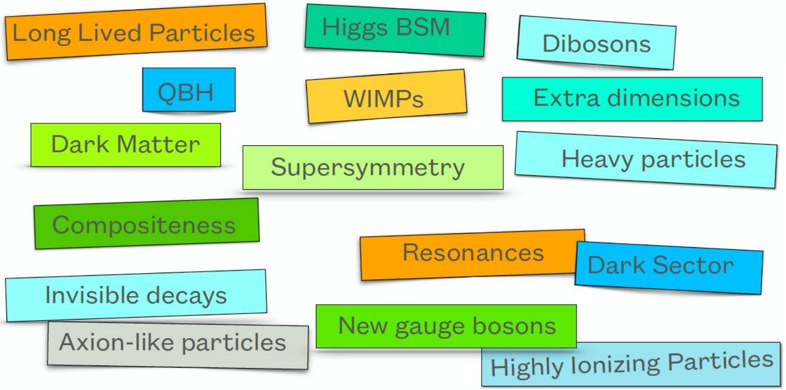
- For the last ~50 years, we've known what to look for at each step: Z boson, W boson, top quark, Higgs boson.
- Many expected SUSY particles to follow shortly after the Higgs, but now increasingly pushed to extreme regions of parameter space.

- Today, we **no longer have a single guiding theory to motivate discoveries**, but we do have largest HEP dataset ever collected
  - BSM not around the corner → **Make sure we leave no stone unturned** !

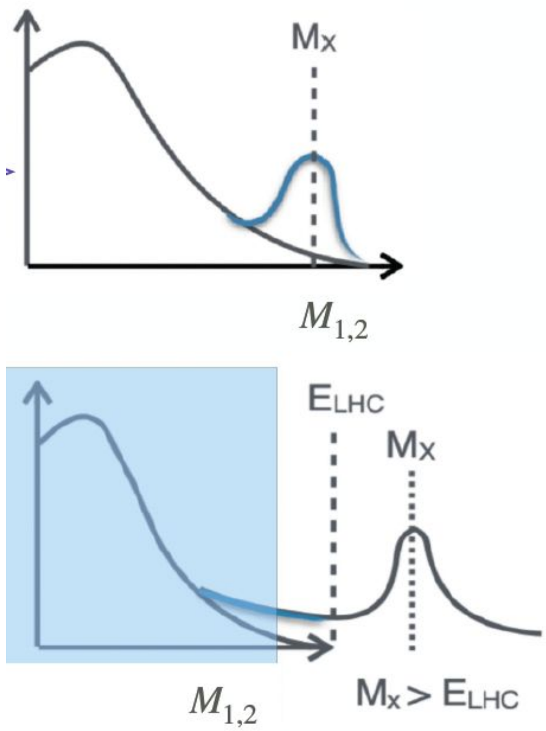
Simplicity

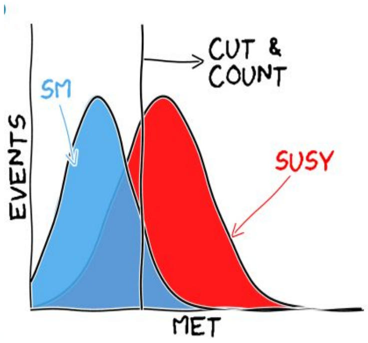
- Effective Theories
- Simplified Models
- Complete Theories

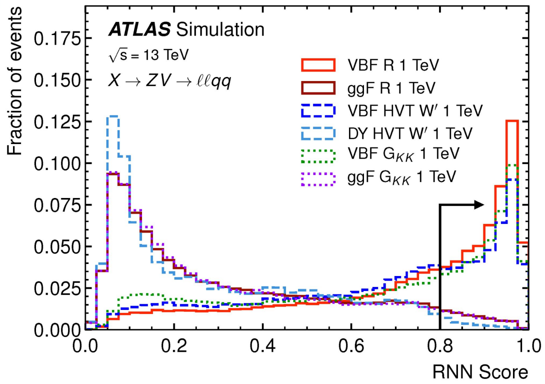
Complexity

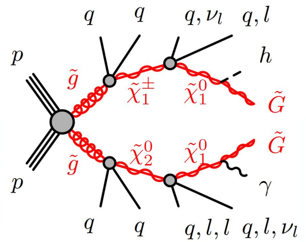


Search for New Physics

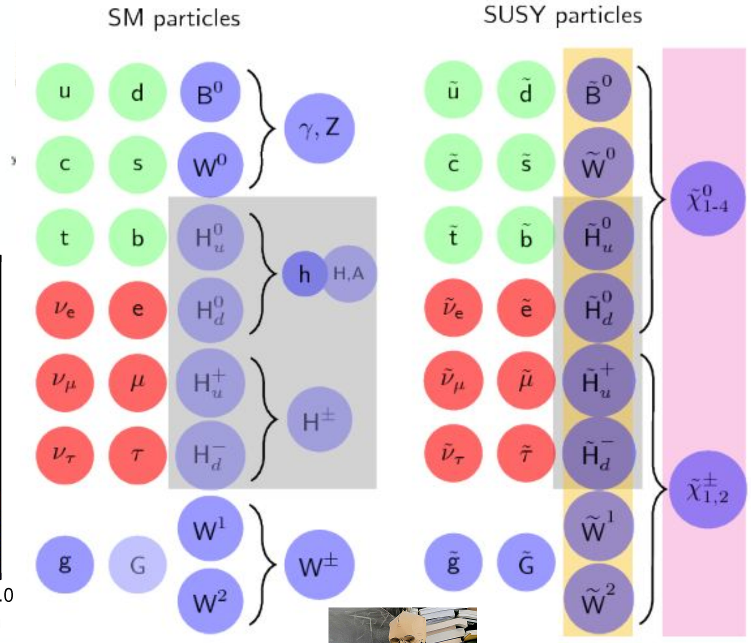


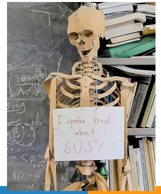






Supersymmetry: an extension of the SM which postulates the existence of an additional (super)symmetry between bosons and fermions.

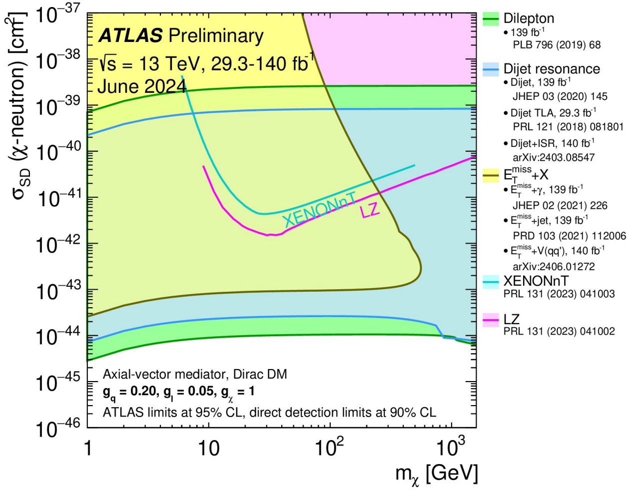


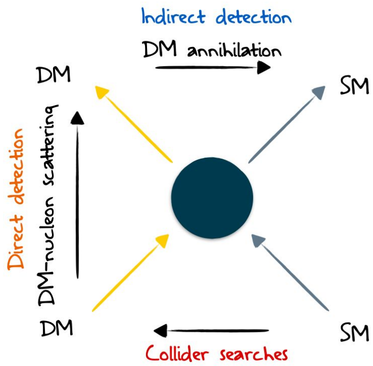


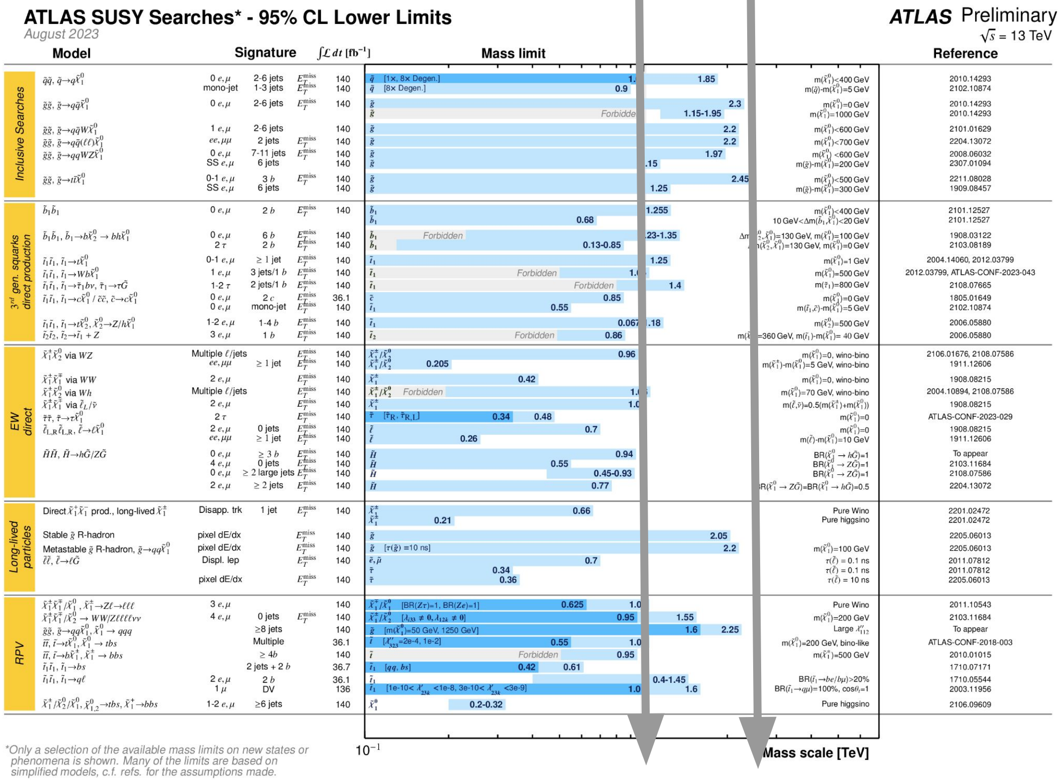
Who spoke bad about SUSY?

Results on the search for new particles

ATL-PHYS-PUB-2024-010



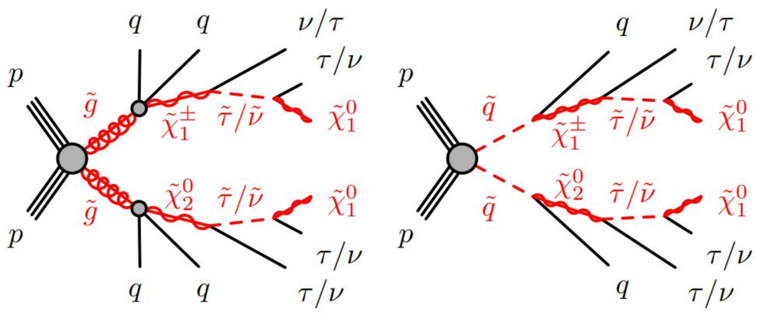




Exclusion of new particles up to a few TeV in different possible scenarios

ATL-PHYS-PUB-2024-014

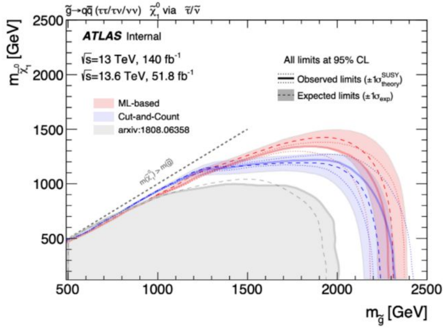
Search for squarks and gluinos with τ leptons

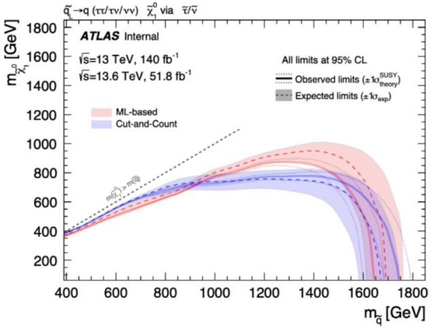


- SUSY partner of the gluon and quarks have large σ at the LHC, and are usually searched in jets + MET but for some region of SUSY parameter space decay chains involving final states with **τ's are dominant**

- Select events with 1 or 2τ, at least 2 jets and large MET (>200 GeV)
- 2 new analyses dividing events into (1τ,0l), (1τ,1l) (2τ):
  - ML-learning based (more sensitive)
  - cut-based (less model depended and optimized for mass-compressed scenario)
- No excess found in Run 2 + Run 3 (2022-2023) data, 95% CL limits in gluino-LSP and squark-LSP planes largely improving on previous results

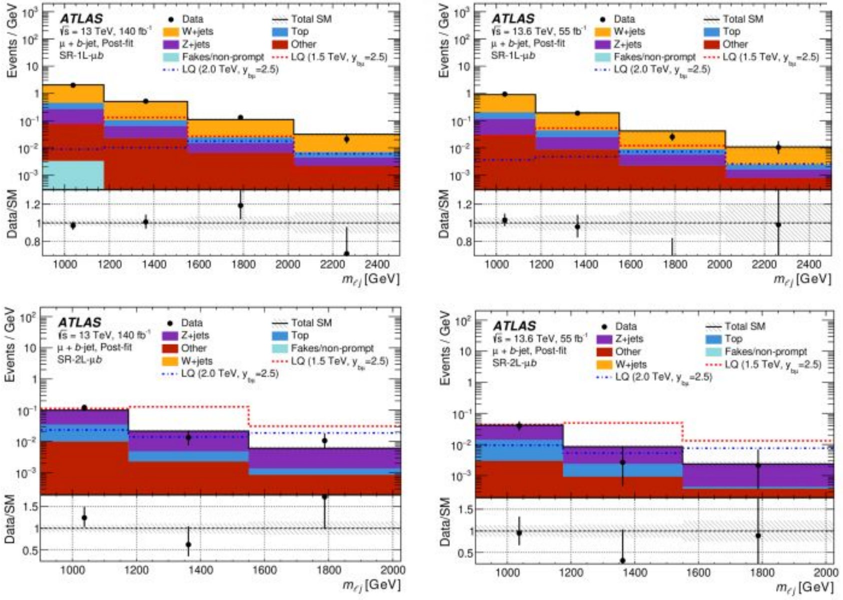
	Compressed SR		**High Mass SR**		**TwoTau SR**
Channel	1TAU0LEP	1TAU1LEP	1TAU0LEP	1TAU1LEP	2TAU
$N_e + N_\mu$	$= 0$	≥ 1	$= 0$	≥ 1	–
N_τ	$= 1$				2
$E_{\mathrm{T}}^{\mathrm{miss}}$ [GeV]	> 400				> 200
H_{T} [GeV]	–		> 1000		> 800
N_{jets}	≥ 2		≥ 3		≥ 3
$p_{\mathrm{T}}^{\tau_1}$ [GeV]	< 45		> 45		–
$m_{\mathrm{T}}^{\tau_1}$ [GeV]	> 80	–	> 250	> 120	–
$m_{\mathrm{T}}^{\tau_1} + m_{\mathrm{T}}^{\ell_1}$ [GeV]	–	> 350	–	> 350	–
$m_{\mathrm{T}}^{\tau_1} + m_{\mathrm{T}}^{\tau_2}$ [GeV]	–	–	–	–	> 150

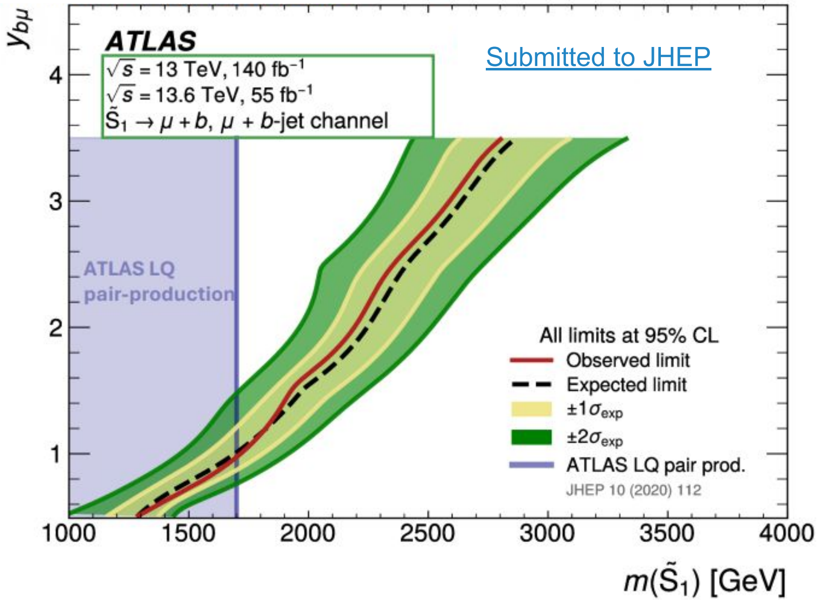




Submitted to EPJC

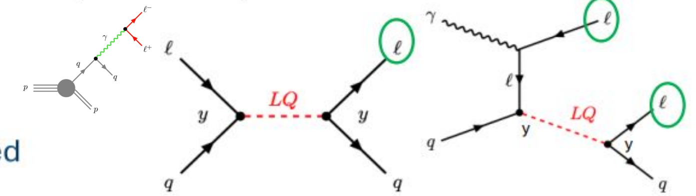
Search for resonant leptoquark production via lepton-jet signatures





[Submitted to JHEP]

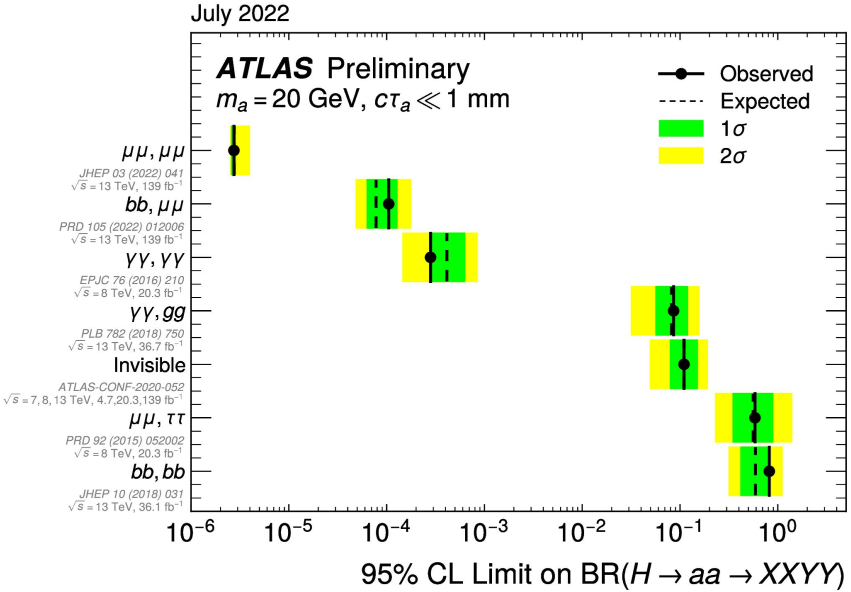
- LQ s-channel production via *lepton PDF of the proton* using Run 2+Run 3(2022+2023):
  - lepton+jet resonances in $m_{\ell j}$, untagged-jet and b-tagged categories
  - 1- and 2-lepton channels
  - No significant excesses: limits on LQ mass vs y coupling derived



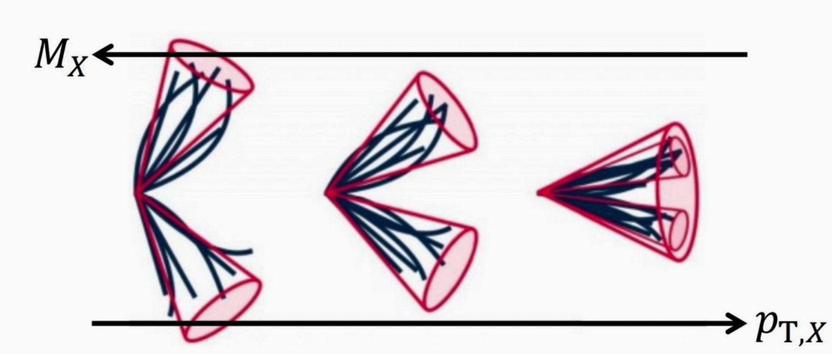
[Briefing]

Searches for low-mass BSM physics

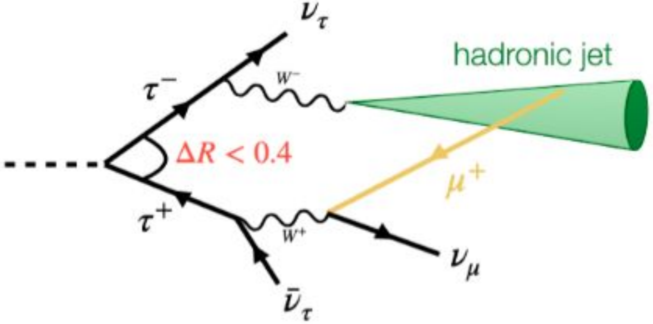
So far:
- No discovery of EW/TeV scale BSM physics
- **Many models well-constrained at high mass**
- **Weaker constraints on low-mass BSM scenarios**
- Many models allow for low-mass new physics:
  - Additional Higgs-like particles, a-la 2HDM(+s)
  - Axion-like particles (ALPs) in SM extensions with broken shift symmetry
  - Heavy neutral leptons (HNLs), e.g. in seesaw mechanism models



Low-mass BSM searches often quite challenging:
- Collimated decay products → dedicated tagging methods
- Long-lived, weakly coupled → displaced tracking/vertexing
- Background-rich → innovative analysis strategies (+clever ML)



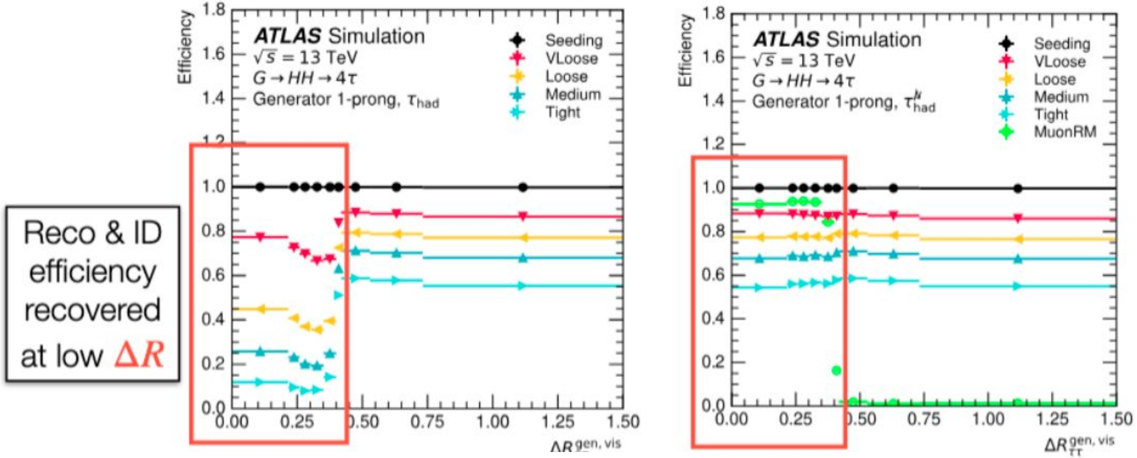
Improved reconstruction of highly boosted τ-lepton pairs

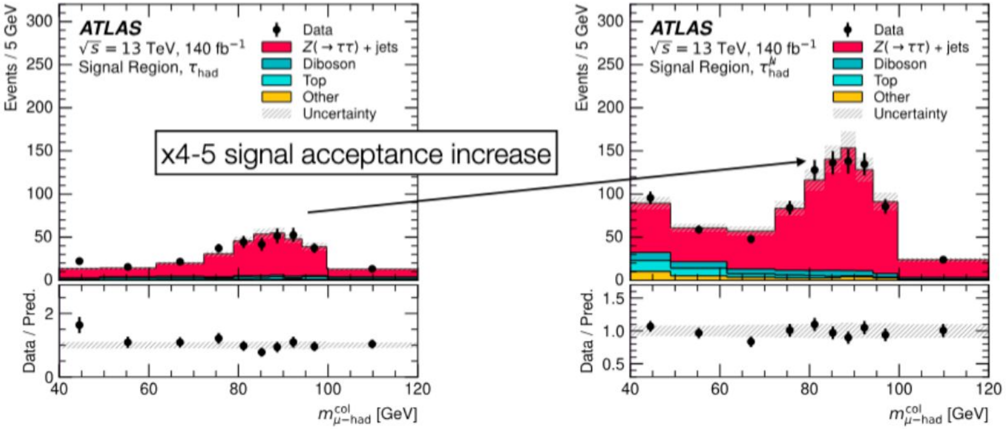


- In boosted topologies, overlapping objects degrade tau reconstruction and ID efficiency

- Subtracting muon/electron tracks and clusters in overlap cases recovers tau performance

- Validated in Z→ττ, yielding a 4–5× acceptance gain over standard reconstruction





Eur. Phys. J. C 85 (2025) 706

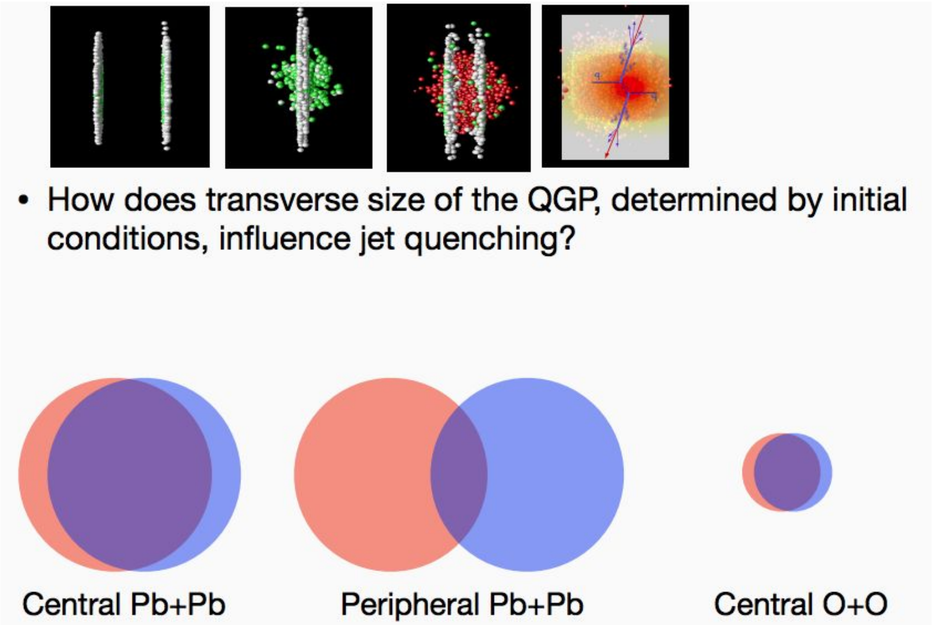
Heavy Ions

New window onto the study of quark-gluon plasma (QGP): Dijet transverse momentum balance in O+O

This extreme state of matter mimics the conditions of the early Universe during the first microseconds after the Big Bang.

Traditionally, researchers have focused on studying QGP formed in the collisions of heavy ions (like lead or xenon), which maximize the size of the plasma droplet created. **But in recent years, interest has grown in exploring the QGP using smaller ions (such as oxygen) to better understand the QGP across different system sizes.**

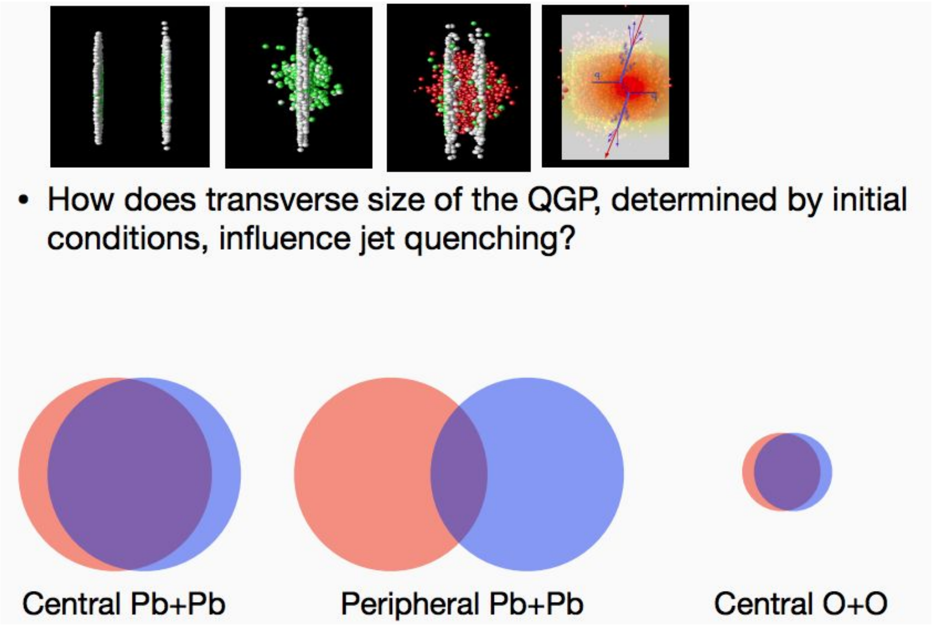
Studying jet quenching in collisions of oxygen ions (O+O) provides a unique opportunity to investigate the path-length dependence of energy loss using a system with a smaller transverse extent than Pb+Pb



Briefing

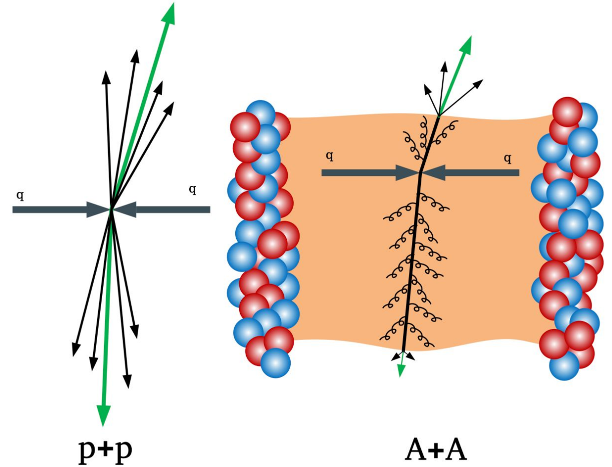
Dijet transverse momentum balance in O+O

Thanks to the LHC preparation and performance, the oxygen special run in July 2025 was exceptionally successful
- Due to the short run, ATLAS was able to increase DAQ (SFO) output rate by 40-50%
• Sampled luminosity after applying ATLAS DQ requirements:
- p-O: 7.76 nb^{-1} (Pierre Auger request!)
- O+O: 8.08 nb^{-1}
- Ne+Ne: 1.03 nb^{-1}

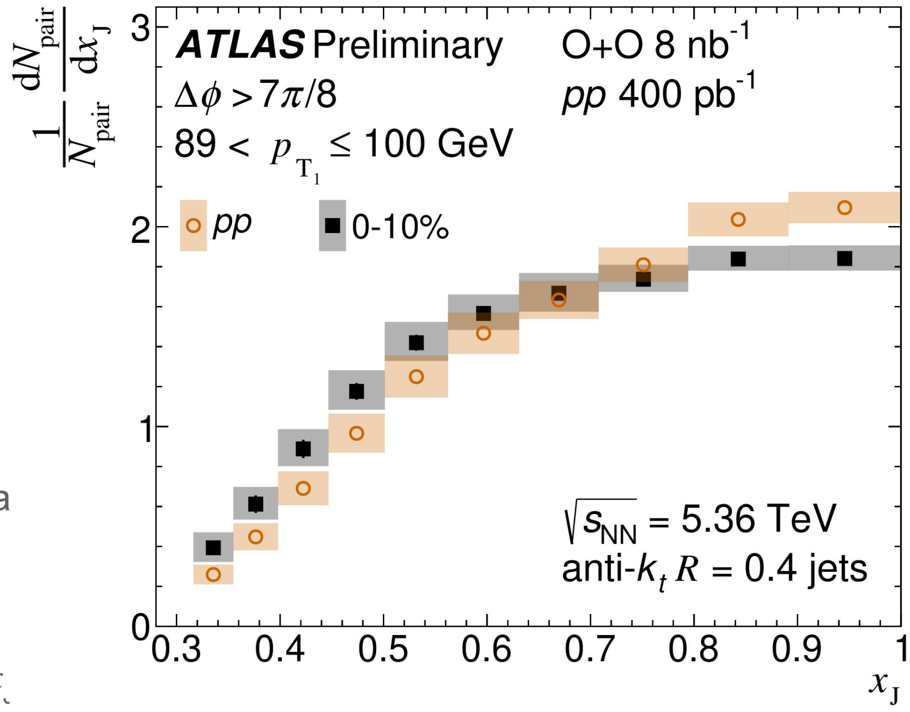


Briefing

Dijet transverse momentum balance in O+O



- The smallest percentiles indicate the most centra events
- Effect ~1/2 of that observed in PbPb for central collisions
- An increase in the relative contribution of lower x_J dijets in 0–10% central O+O collisions

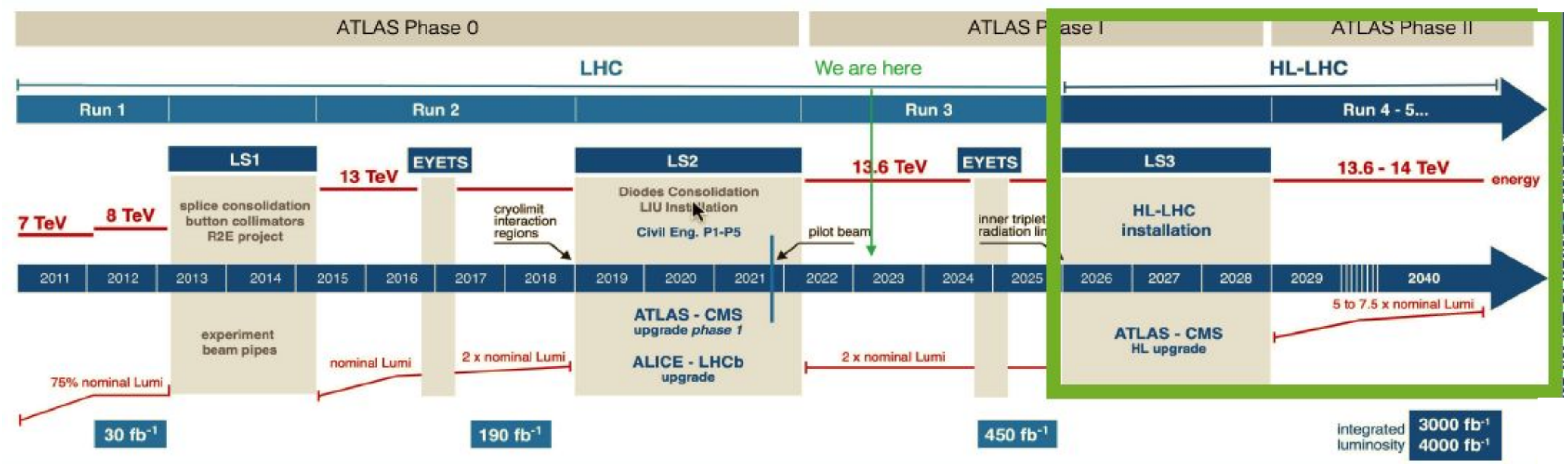


$$x_J \equiv p_{T_2}/p_{T_1}$$

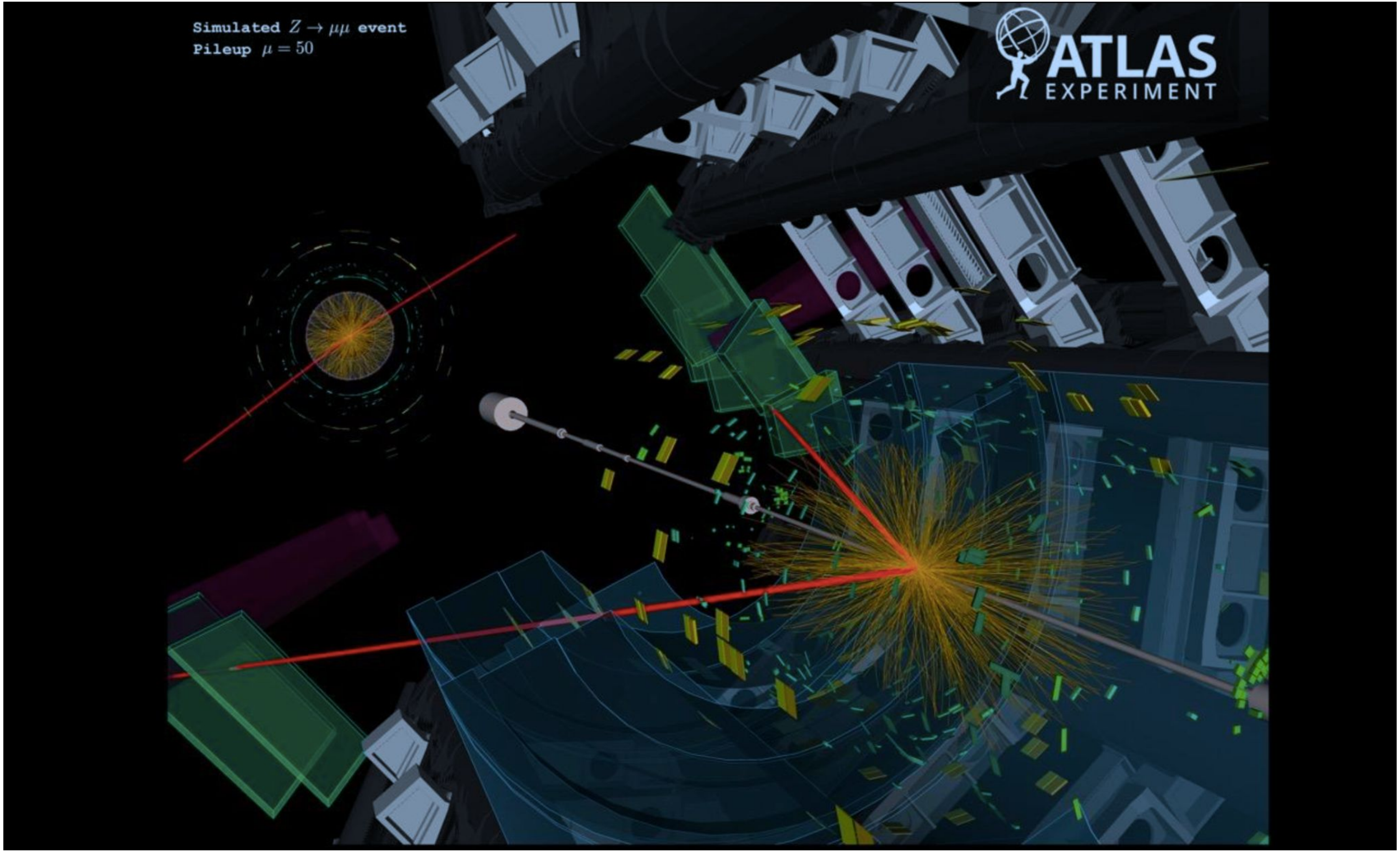
HL-LCH

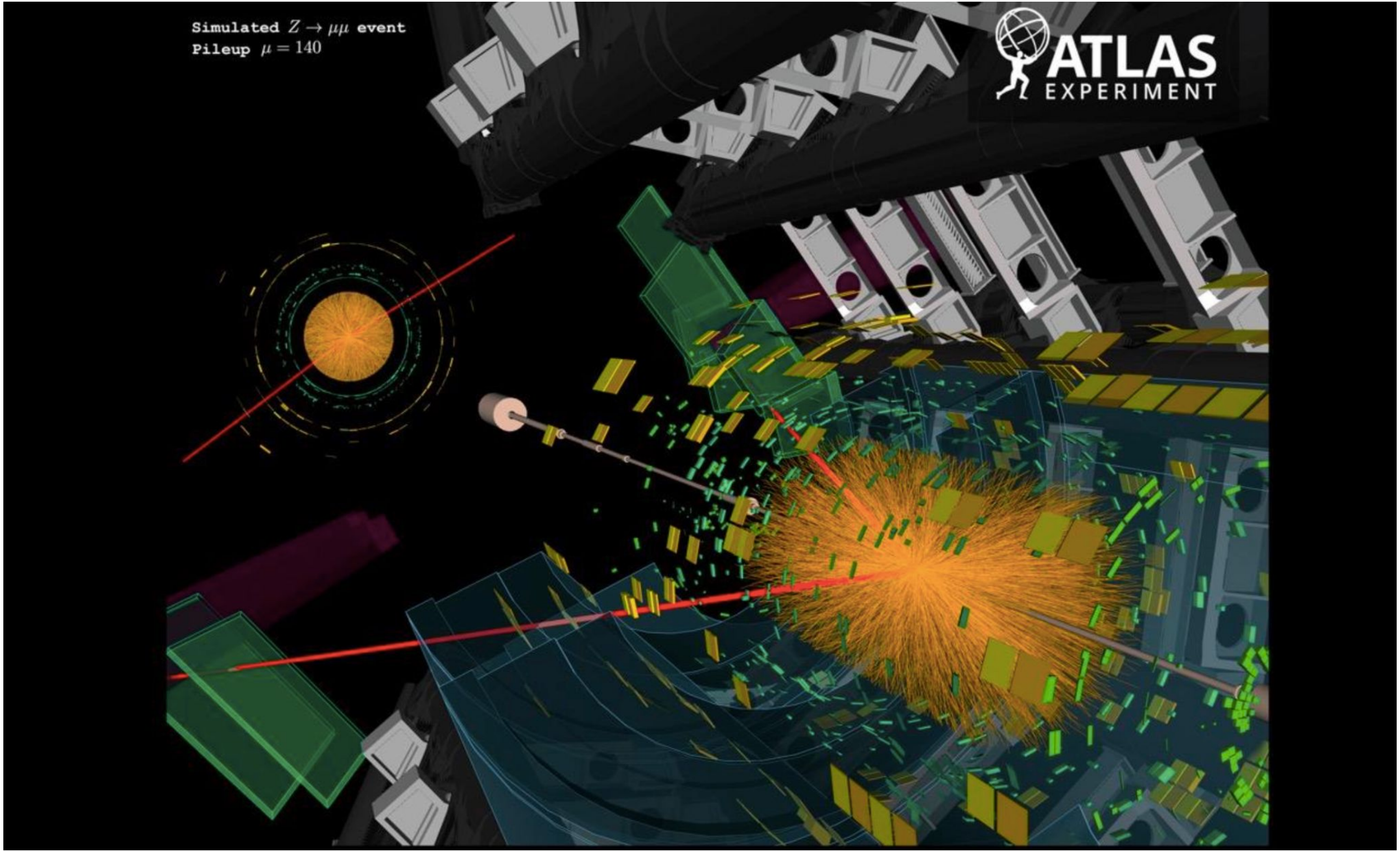
High Luminosity LHC (HL-LHC)

2030 a 2041

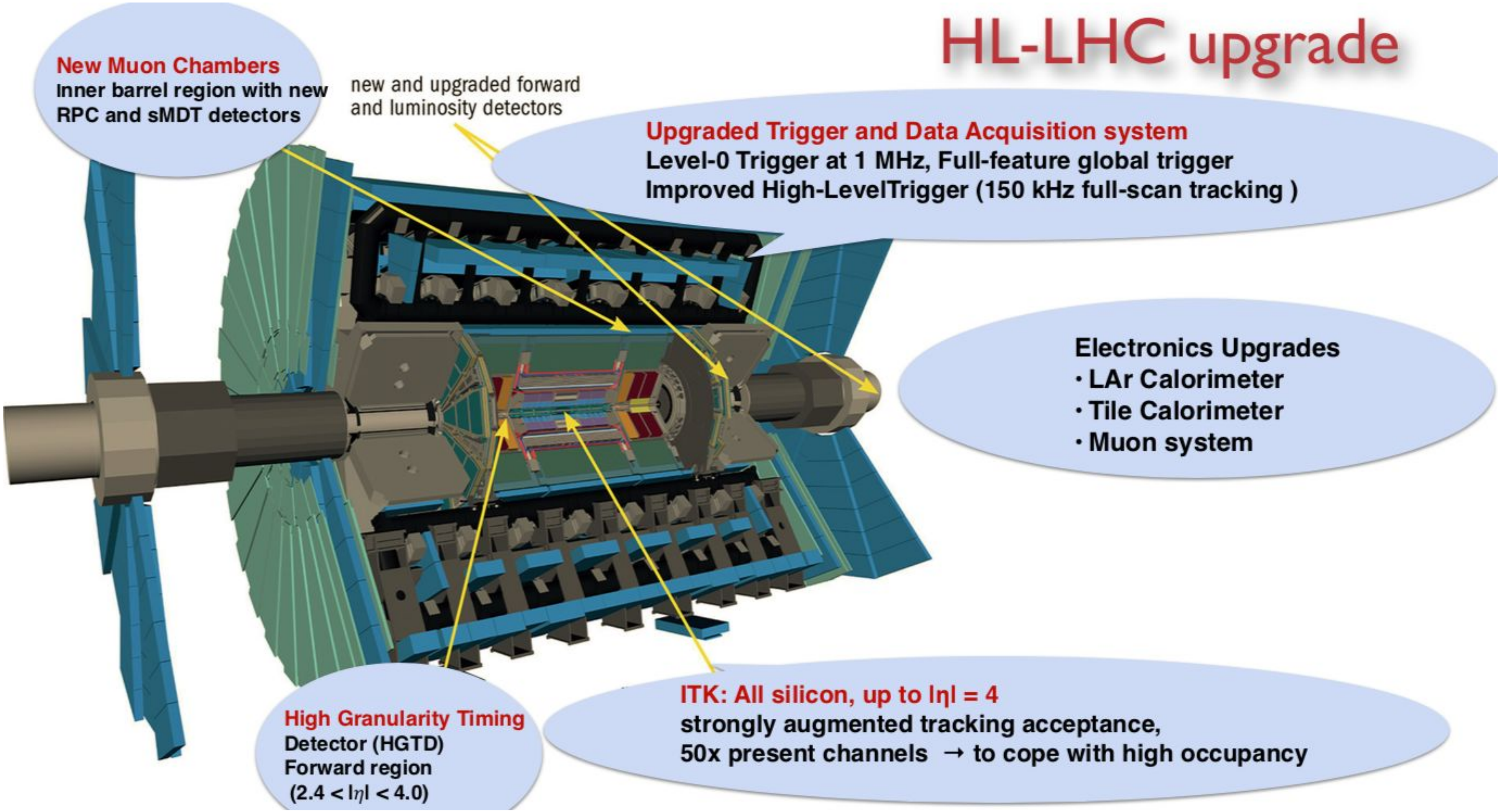


Collect more than 3000 fb^{-1} of data (or 180 million Higgs bosons in ATLAS)


Simulated $Z \to \mu\mu$ event
Pileup $\mu = 50$
ATLAS
EXPERIMENT


Simulated $Z \to \mu\mu$ event
Pileup $\mu = 140$
ATLAS
EXPERIMENT

HL-LHC upgrade



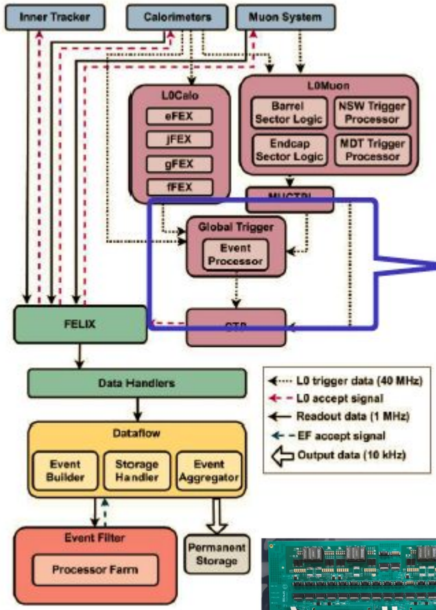
ATLAS Prepares for HL-LHC

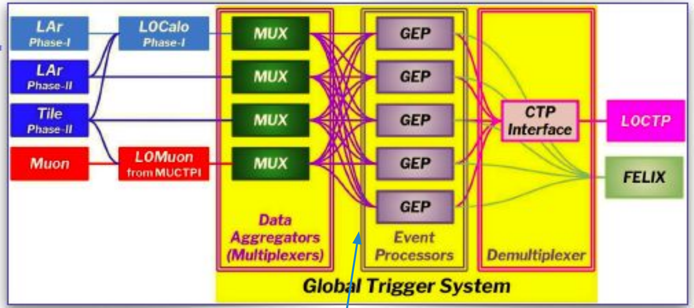
Next Generation of Trigger System

Real time complex analysis at Hardware level

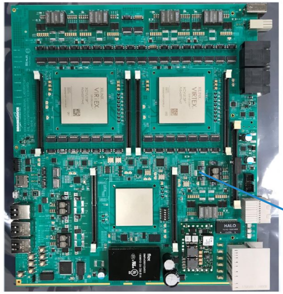
- Development of firmware and testing the FPGAs common modules
- Custom Made fiber optics modules for signal distribution

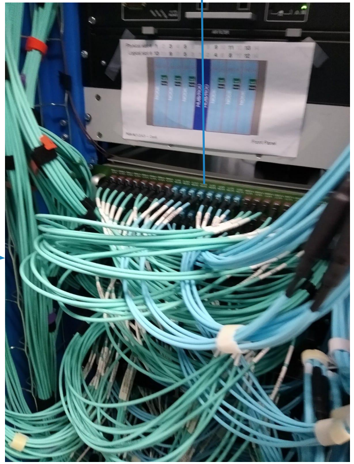
The main challenge in this project is the large number of individual fibers needed to connect the MUXs to the GEPs; the number is on the order of 4700 fibers. First small scale prototype has been recently tested at CERN.





Argentina





Board with two large Xilinx programmable processing gate arrays (FPGAs), with multigigabit transceivers accessing Gb/s modules each, using chips with clock speeds of ~25,000 Gb/s.

Projections for HL-LHC at ATLAS and CMS

The HL-LHC dataset will be unprecedentedly versatile and rich.

Recent developments for the **2026 European Strategy Particle Physics Update:**
"**Highlights of the HL-LHC physics projections** by ATLAS and CMS",
The ATLAS and CMS Collaborations, arXiv:2504.00672

- All projections based on published results
- Scenario S2: Run 2 method with $\sqrt{L}$ for experimental systematic uncertainties, halved theory uncertainties, and negligible uncertainties due to MC statistics
- Scenario S3: object reconstruction improvements on top of S2 for analyses that have already documented advancements from publications

https://arxiv.org/abs/2504.00672

Higgs properties and beyond

Coupling to the different particles → proportional to the masses

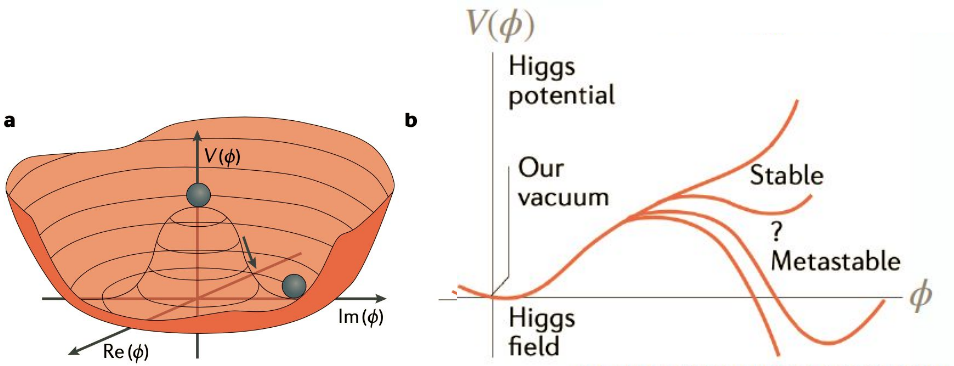
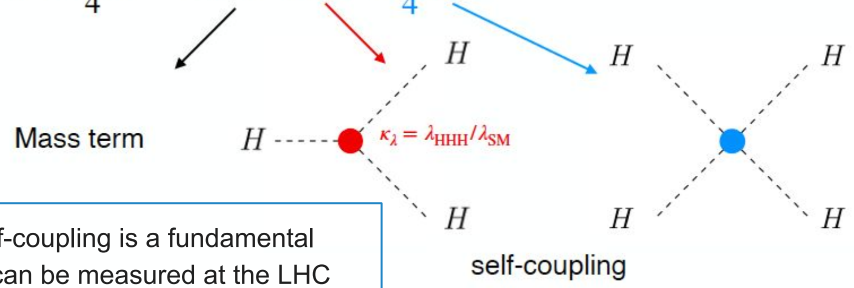
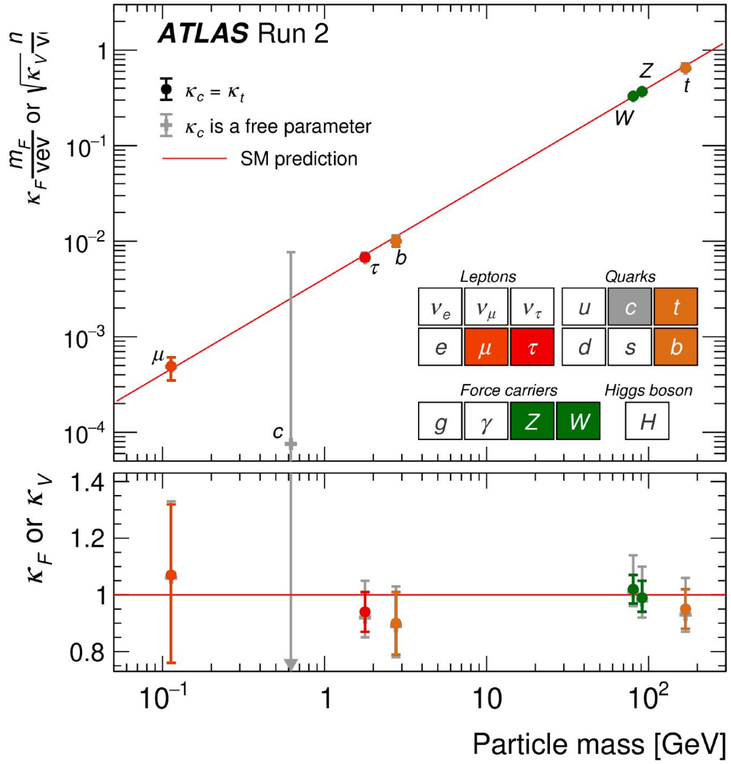


Image credit: Nature Reviews Physics 3.9 (2021)

$$V(\phi) = \frac{1}{2}\mu^2\phi^2 + \frac{1}{4}\lambda\phi^4 \supset \lambda v^2 h^2 + \lambda v h^3 + \frac{\lambda}{4}h^4$$

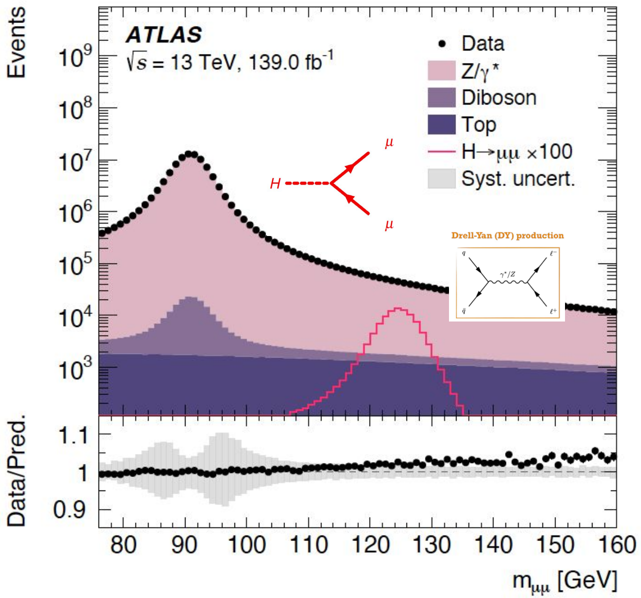


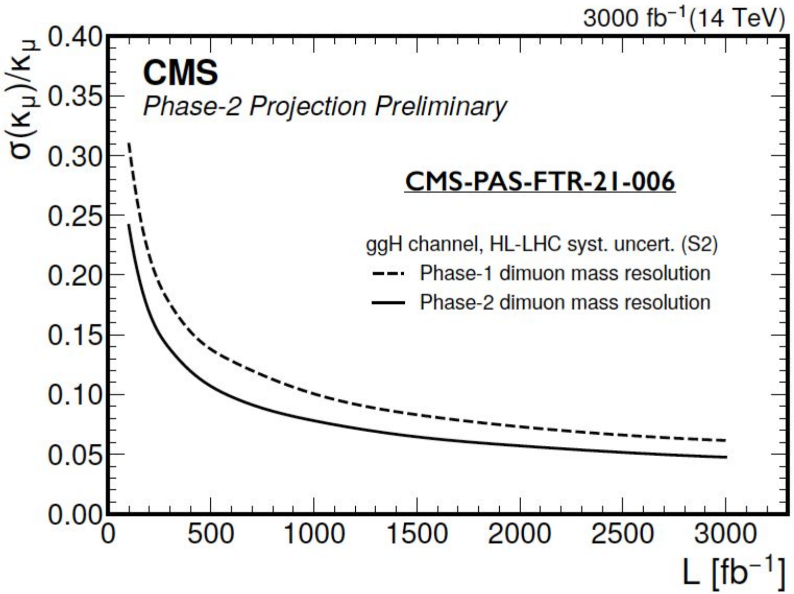
The Higgs self-coupling is a fundamental parameter. It can be measured at the LHC using Di-Higgs production, but it is 1000 times smaller than the production of a single Higgs boson.



Rare Higgs Decays: H→μμ

- Probe of the Higgs coupling to muon: a second-generation fermion
- SM predicts BR(H→μμ) = 2 x 10^{-4}
- Evidence reported at Run 2.
- Irreducible background from Z→μμ.
- Statistics of the data sample and the dimuon mass resolution crucial



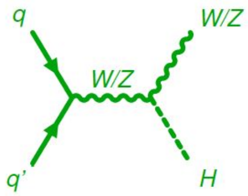


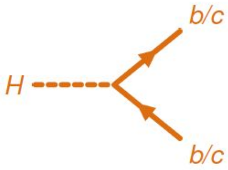
- An improved dimuon mass resolution by the upgraded tracker

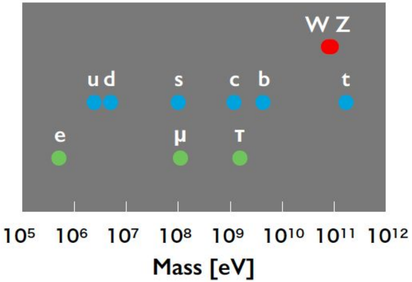
- Relative uncertainty on the coupling improved by larger statistics
- Observation of H → μμ (and H → Zγ) and determination of their couplings with a precision of 3 (and 7%), respectively.

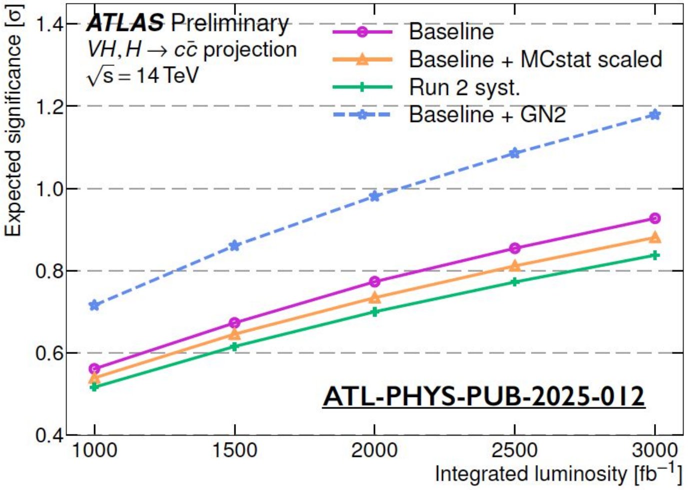
Rare Higgs Decays: H→cc

- Probe of the Higgs coupling to charm quark
- The most sensitive channel: WH/ZH, H→cc
- The b- and c-jet tagging crucial, recent improvements in ATLAS and CMS









- A significance level of 1.6σ is expected for ATLAS+CMS at 3000 fb^{-1}.
- The quark coupling modifier, κ_c, can be restricted to $|\kappa_c| < 1.5$ at 95% confidence.
- tH, H→cc is also important; further improvements to κ_c are possible.

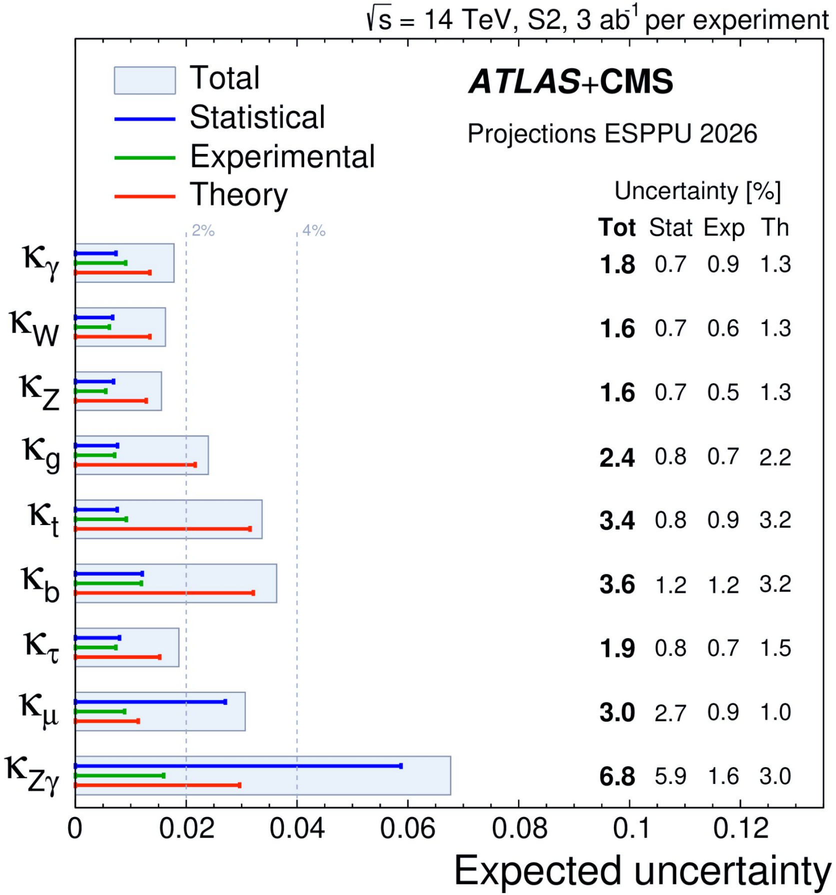
ATL-PHYS-PUB-2025-012 GN2-Jet-Flavour-Tagging

Higgs Coupling Summary

A few % for various couplings!

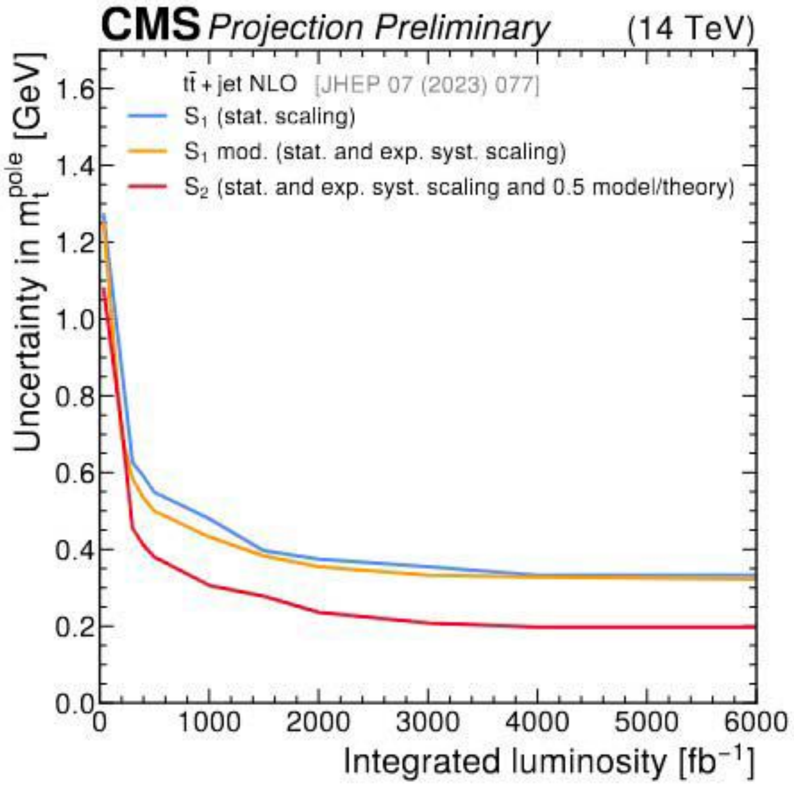
- Deviation from the SM
  - indication of BSM
- Consistency with the SM
  - stringent constraint on BSM

- Observation of H → μμ and H → Zγ and determination of their couplings with a precision of 3 and 7%, respectively.



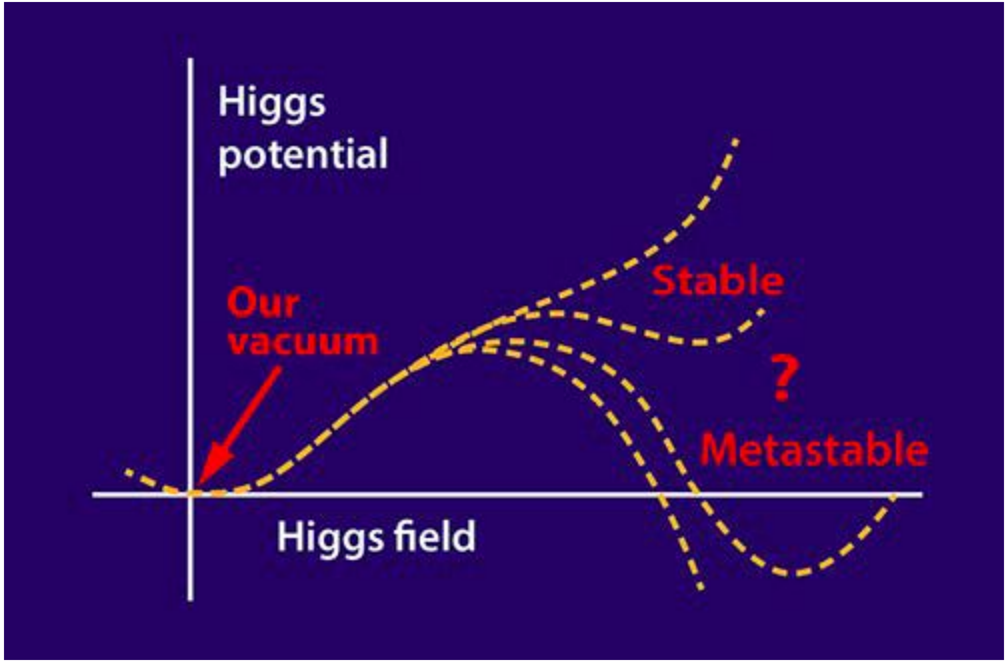
Quark Top Mass

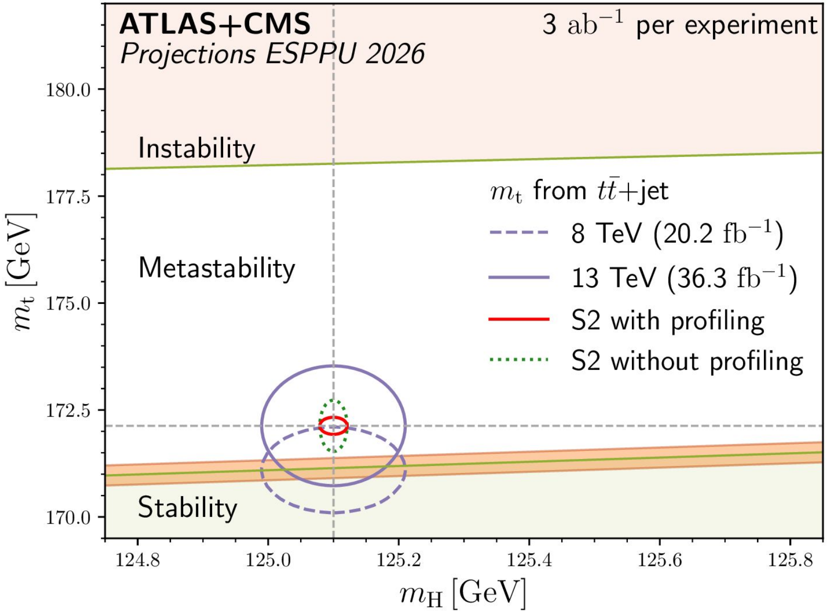
- The HL-LHC will improve the precision of the top quark mass measurement.
- Numerous measurements employing different techniques at ATLAS and CMS, varying sensitivities to theoretical uncertainties
- Recent projection study using the differential cross section of the tt+jet production, from the dependence of the gluon radiation on the pole mass



Electroweak Vacuum Stability

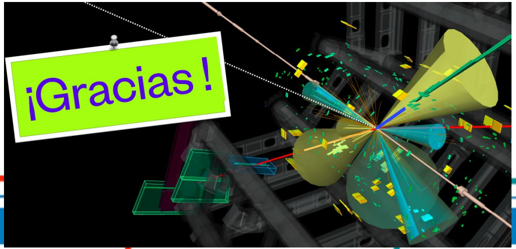
In the hypothesis that the SM is valid up to the Planck scale, the values of m_H and m_t provide information on the stability or metastability of our universe.

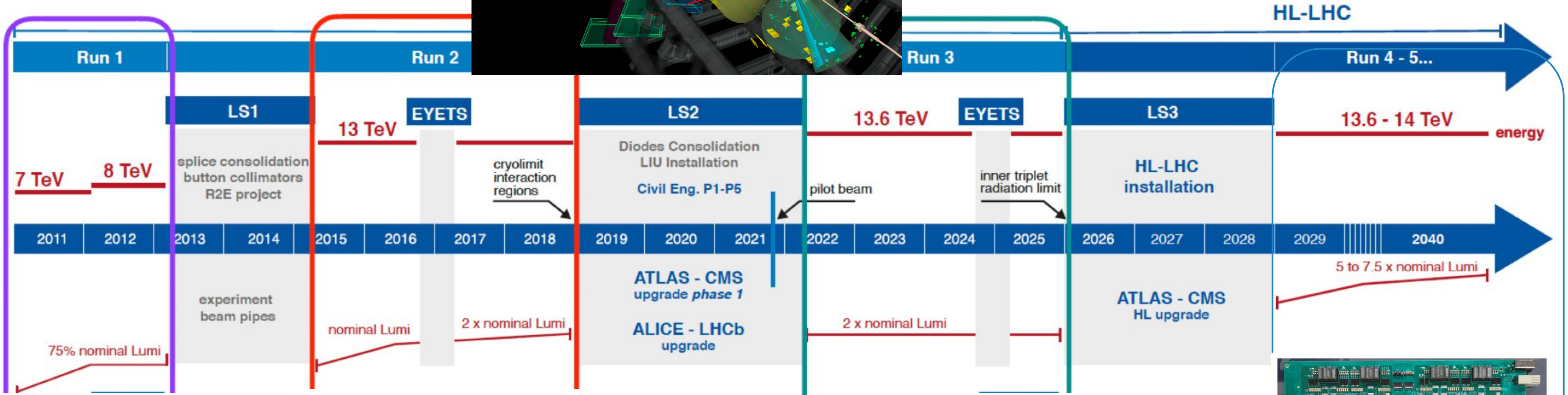


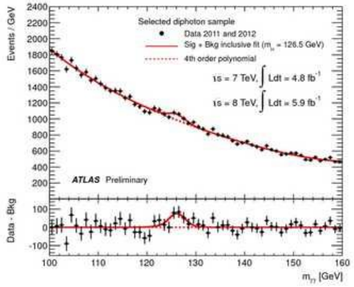


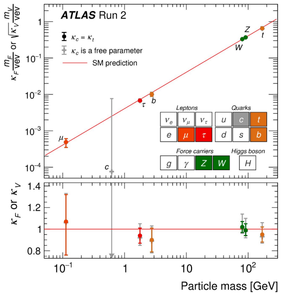
Depending on the central value of m_t, we may make a conclusive statement on the stability.

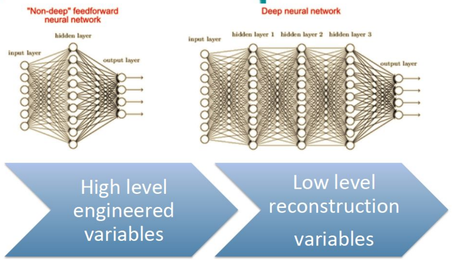
Searches, Discoveries, Precision and New Technologies!

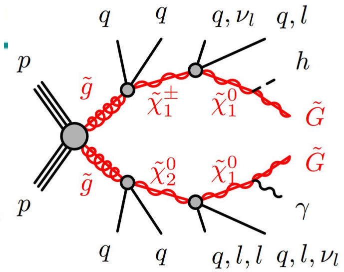












Backup slides

References

- EPS-HEP 2025: ATLAS Highlights (Fabio Cerutti)
- EPS-HEP 2025: Conference Highlights (Andreas Hoecker)
- HPNP 2025: HL-LHC Prospect (Yasuyuki Horii)