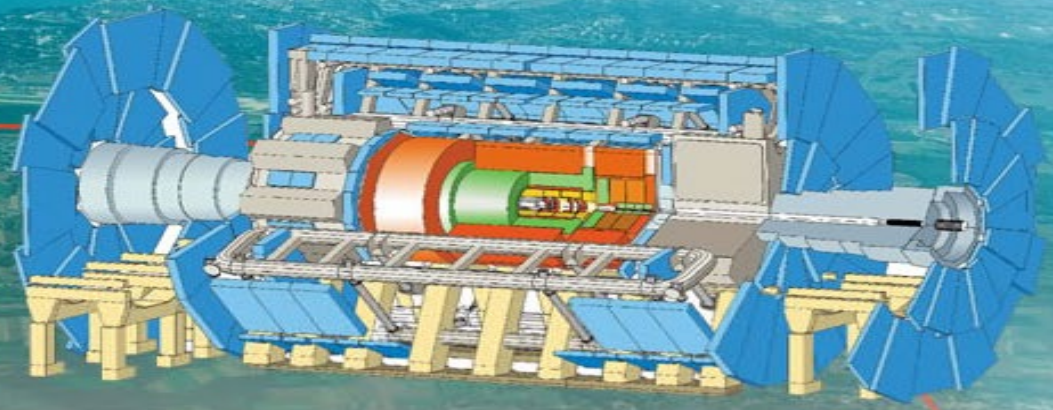
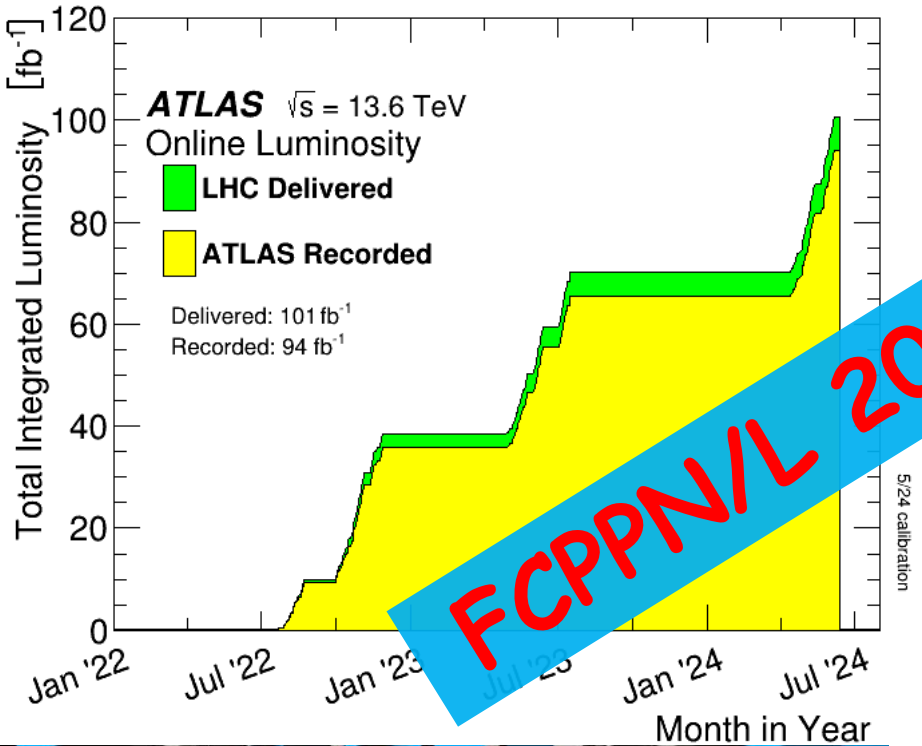
ATLAS FCPPN/L Projects Session Introduction

Emmanuel MONNIER (CPPM)

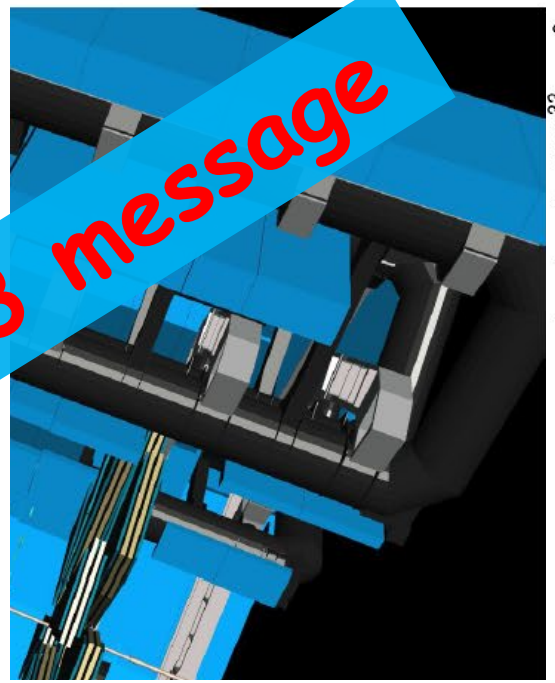


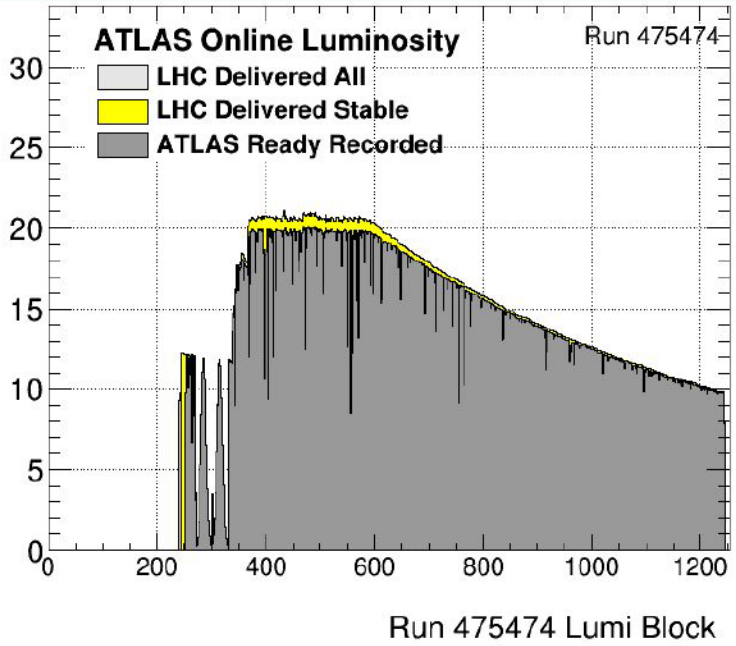
FCPPN/L 15th workshop
Qingdao 22nd July 2025

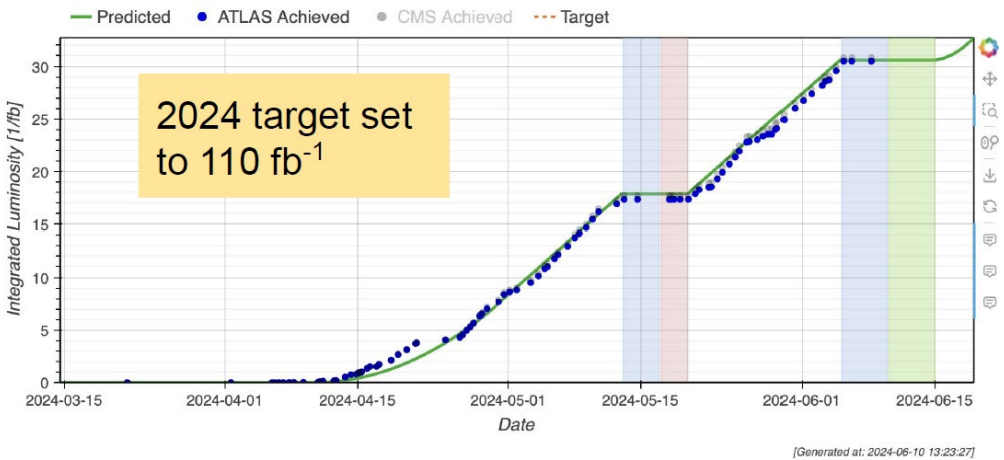
And now ATLAS has recorded 94 fb^{-1} of pp Run 3 data !

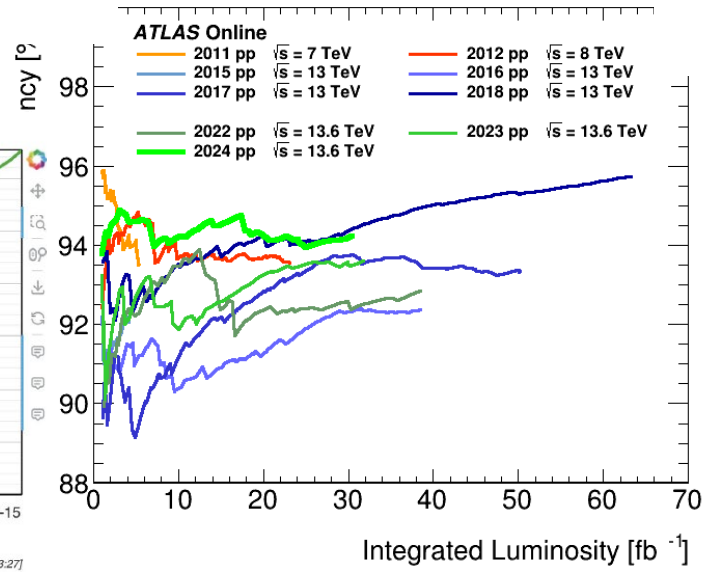


FCPPN/L 2023 message









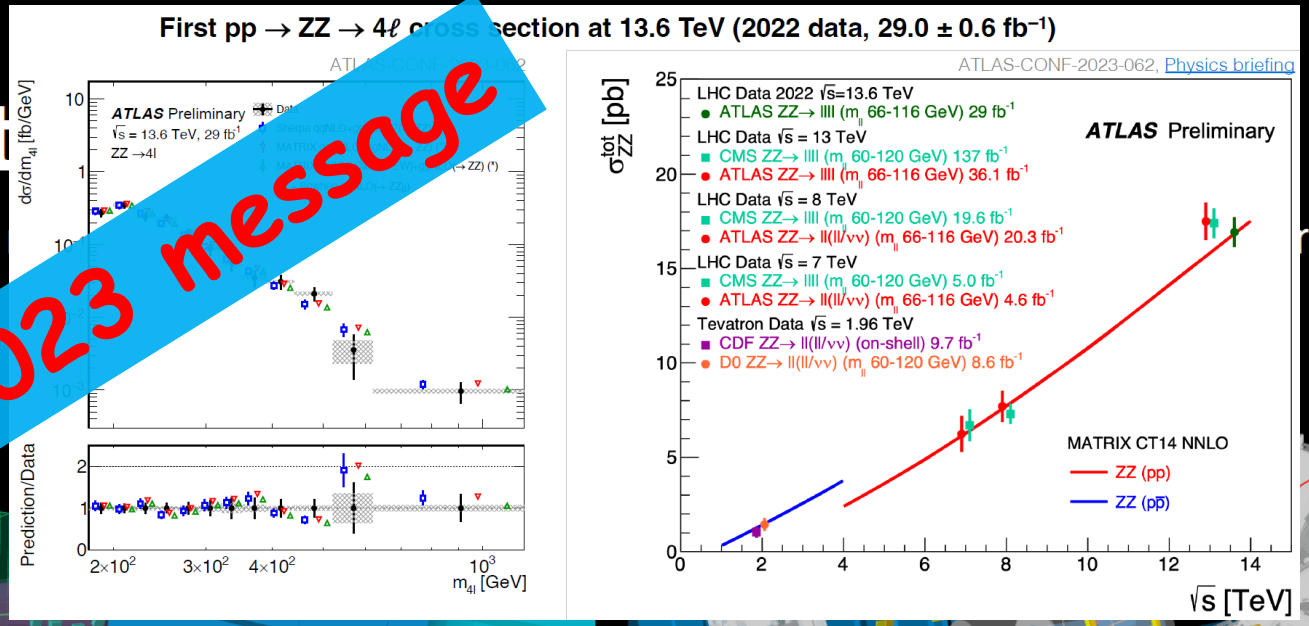
- Currently running at a L1A rate of ~95 kHz at $\mathcal{L}$ = 2.1e34 cm^{-2}s^{-1} at a peak $\langle\mu\rangle$ = 63

Run-3 dat

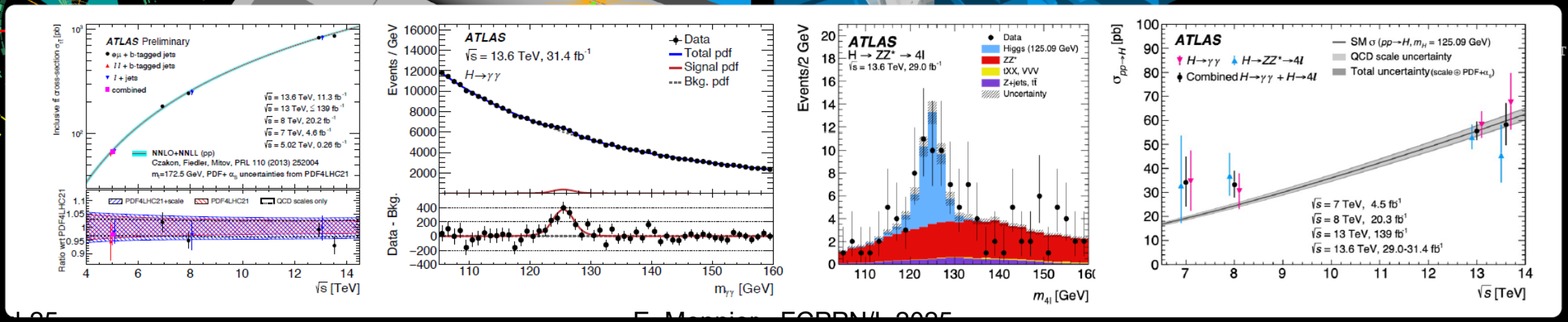
Excellent detector and

released on Run-3 data

FCPPN/L 2023 message



ATLAS well into Run3 in 2023 and now in 2024 !



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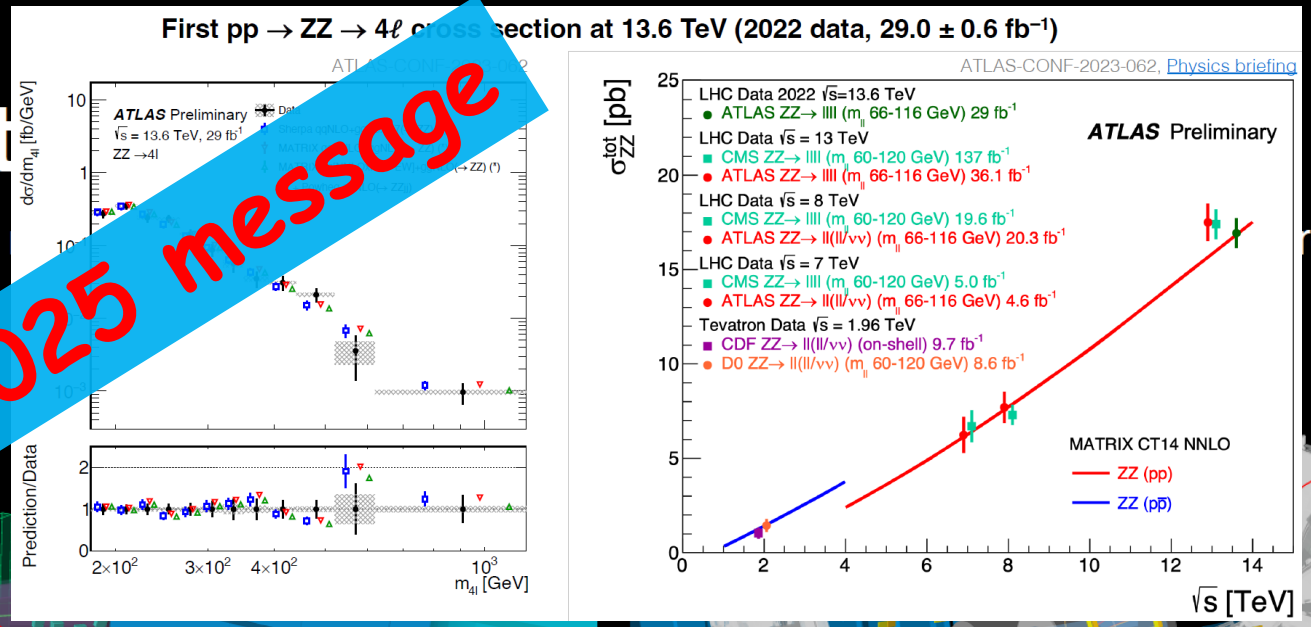

FCPPN/L 2025 message

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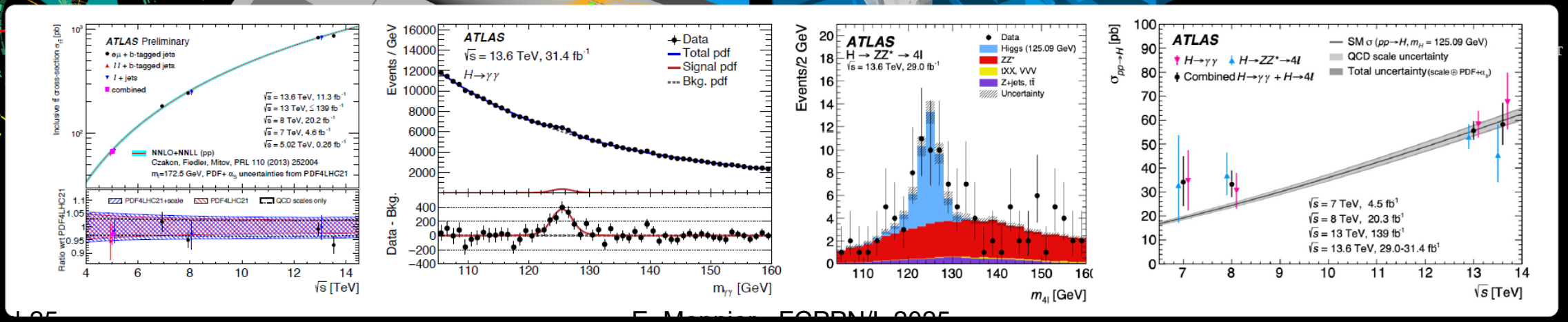
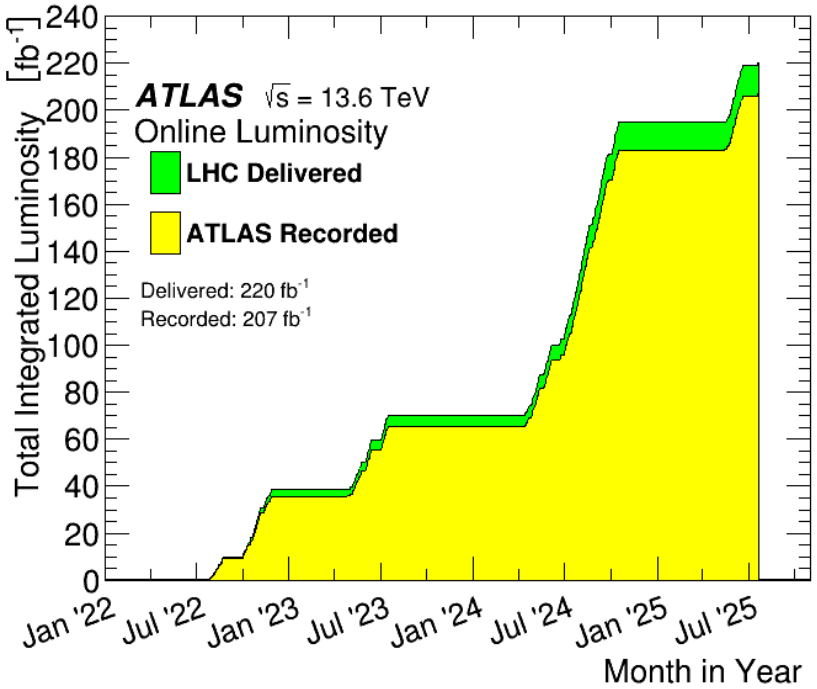
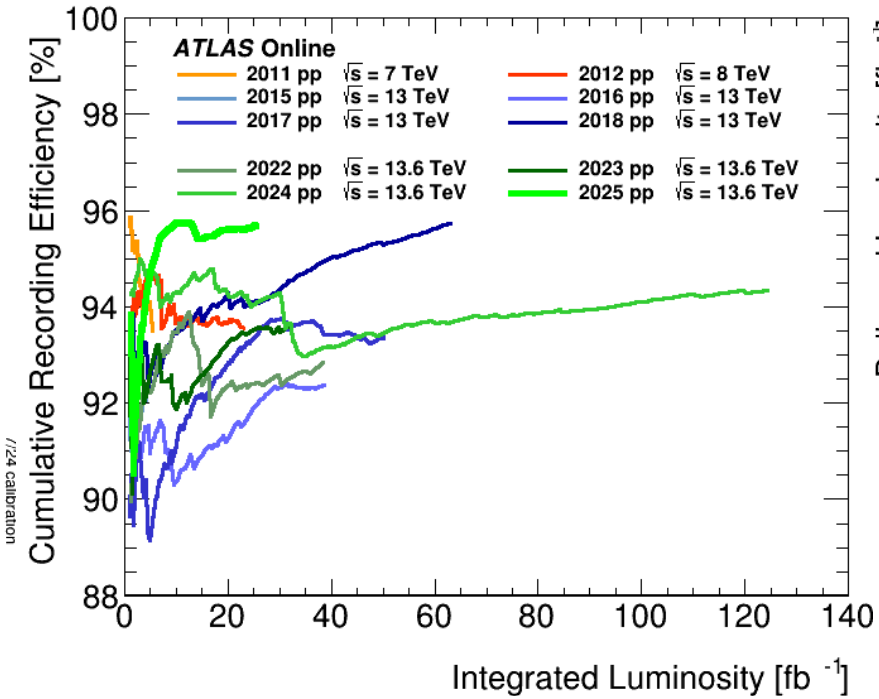
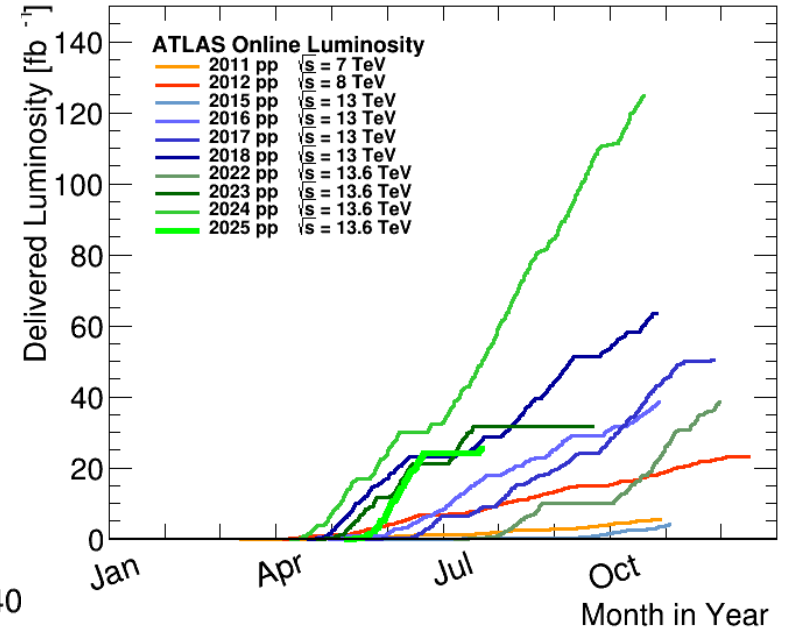
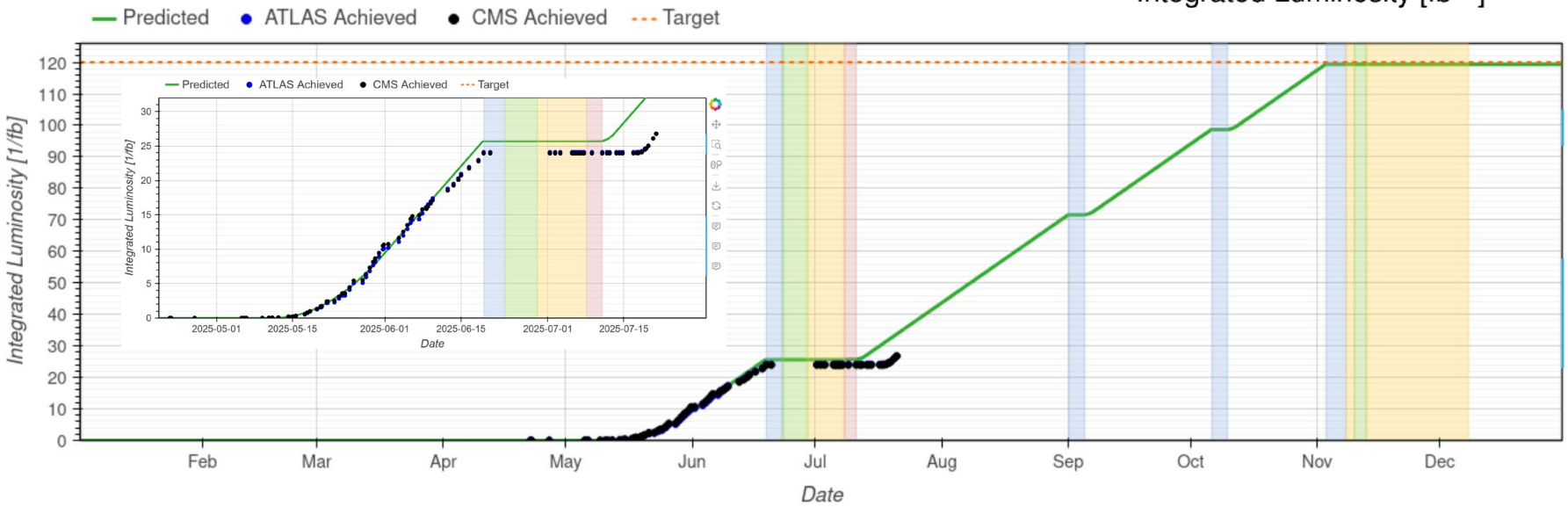


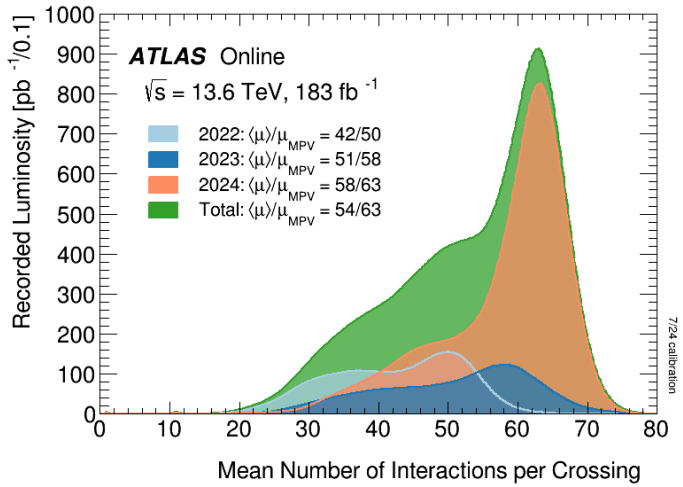
in 2022/2025 ATLAS has >200 fb^{-1} of pp Run 3 data !







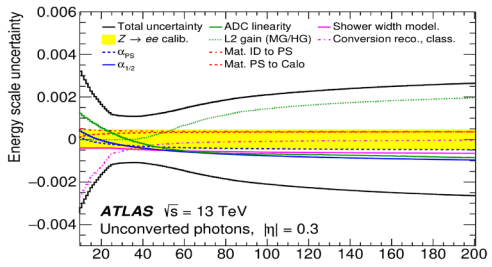


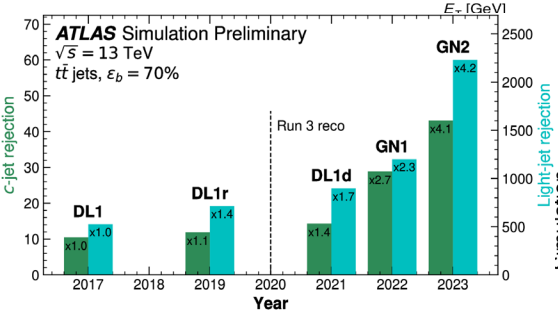


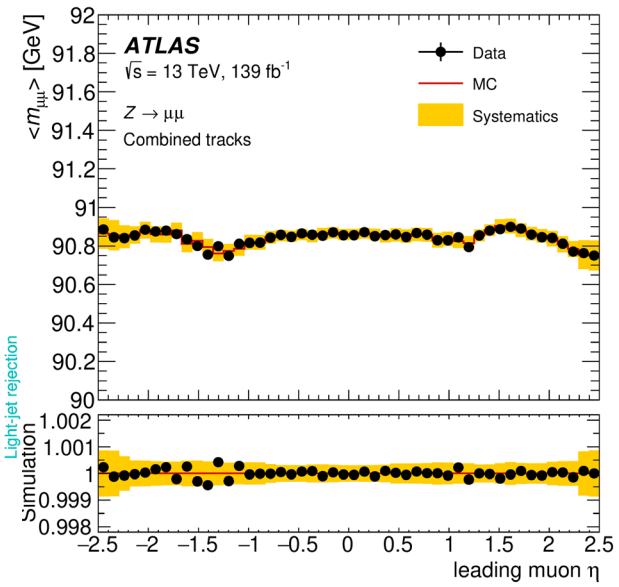
See J. Guo Highlight

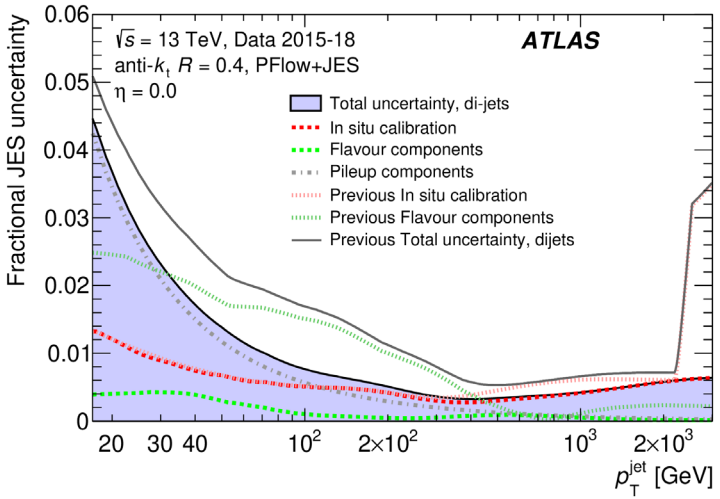
Among the recent ATLAS results

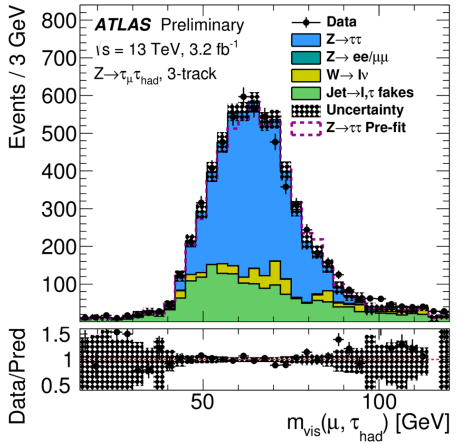
In 2024/2025 ATLAS continued Run 2/3 analysis !



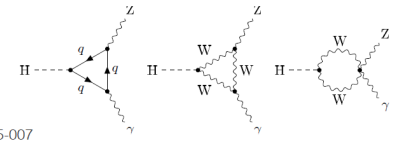




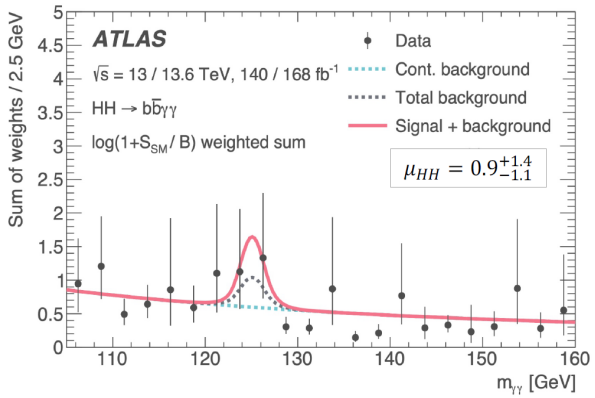


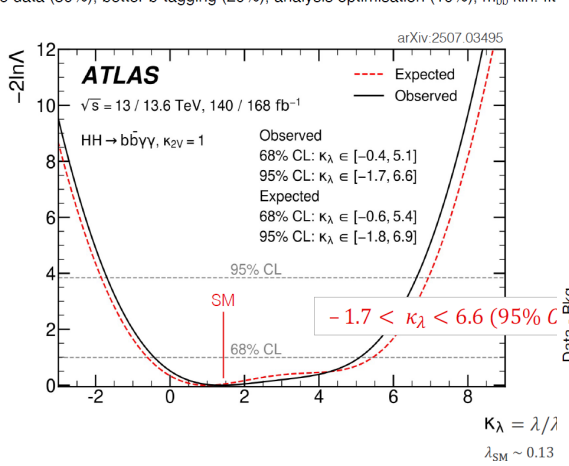


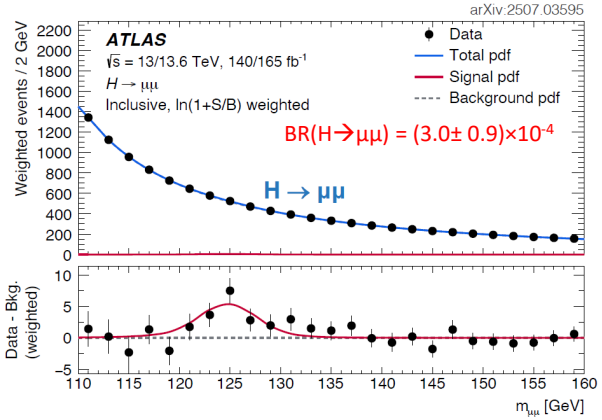
Using 305 fb⁻¹ of Run-2 + 3 data, ATLAS reports evidence for rare 2nd generation H → μμ, and released new result on loop decay H → Zγ

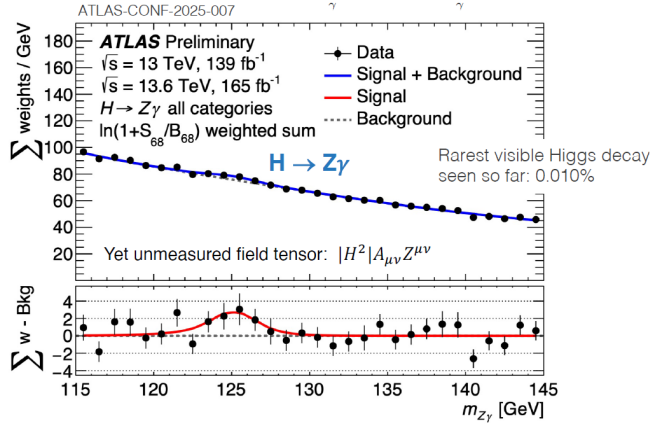


New ATLAS result on HH → bbγγ with 308 fb⁻¹ Improvements: more data (50%), better b-tagging (20%), analysis optimisation (10%), m_{bb} kin. fit









Significance: 3.4σ (2.5σ exp), μ = 1.4 ± 0.4

Reminder: CMS (Run 2): μ = 1.19 ± 0.43 (3.0σ) [arXiv:2009.04363]

Significance: 2.5σ (1.9σ exp), $\mu = 1.3^{+0.6}_{-0.5}$

Reminder: ATLAS & CMS (Run 2): μ = 2.2 ± 0.7 (3.4σ) [arXiv:2309.03501]

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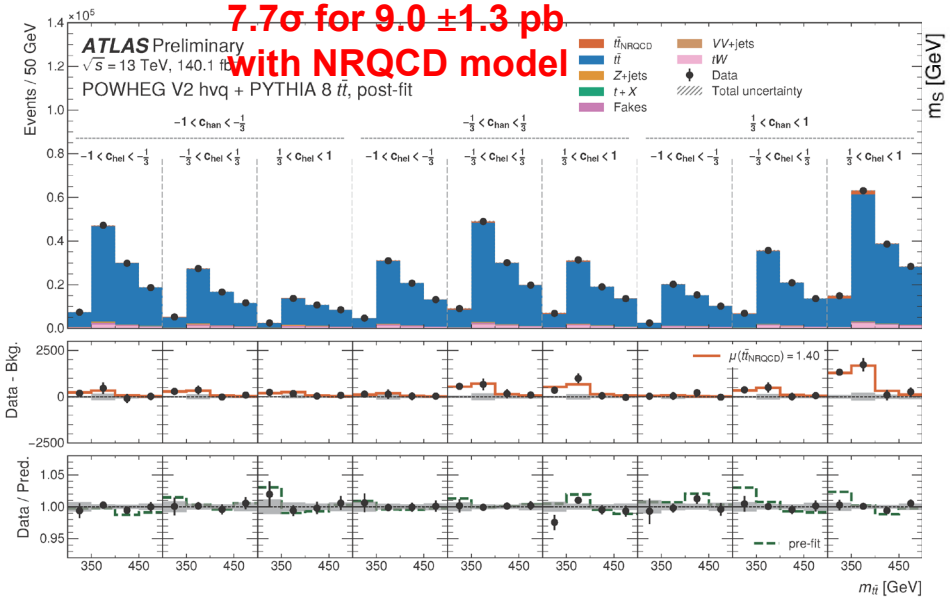

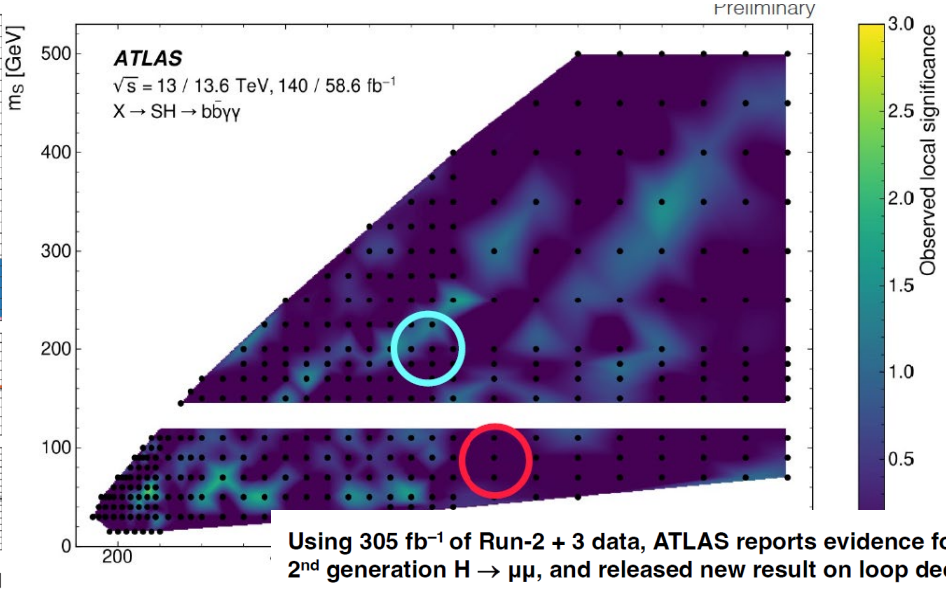

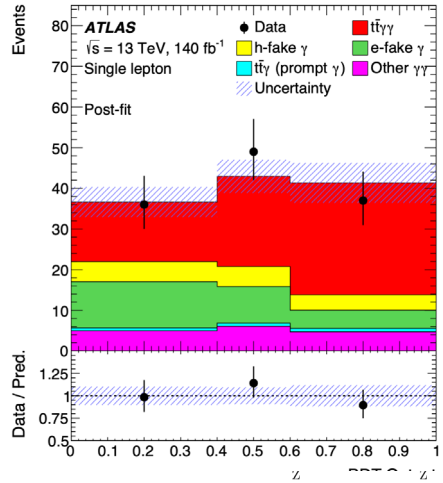

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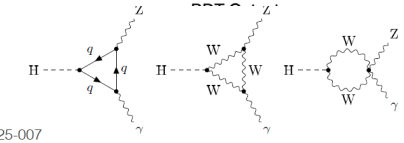

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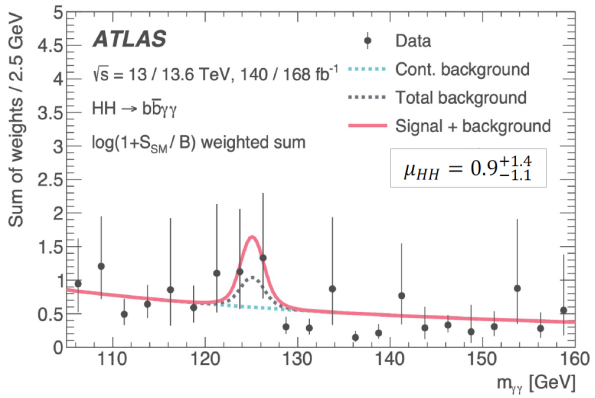

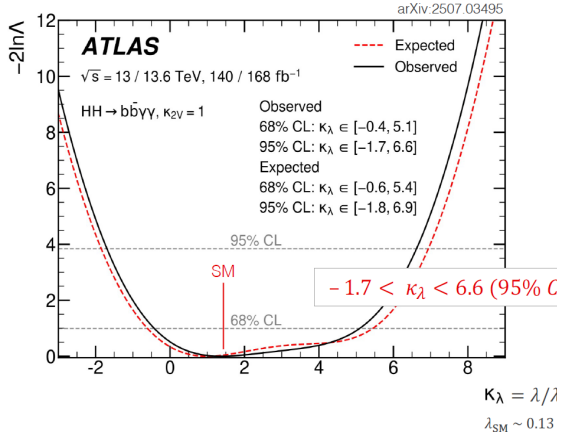

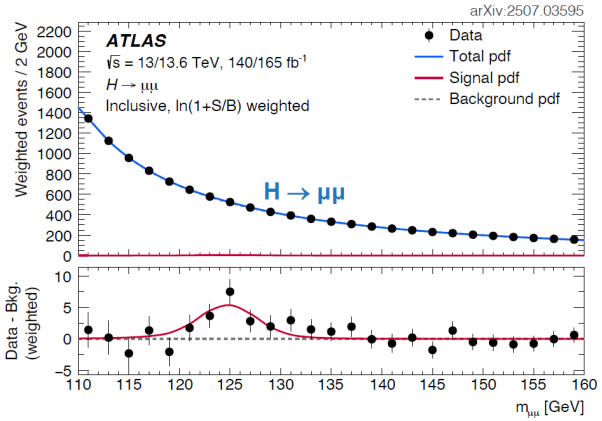

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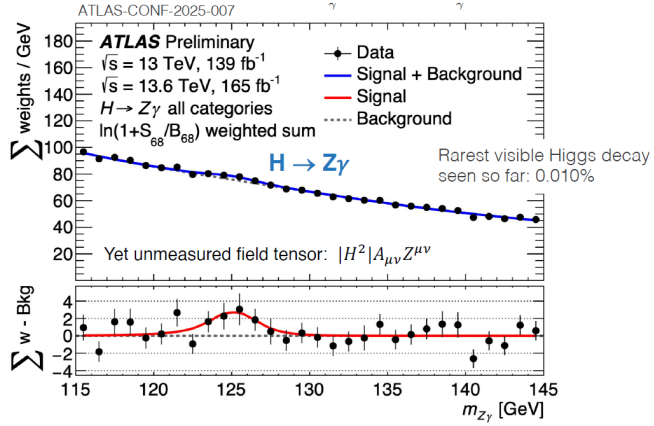

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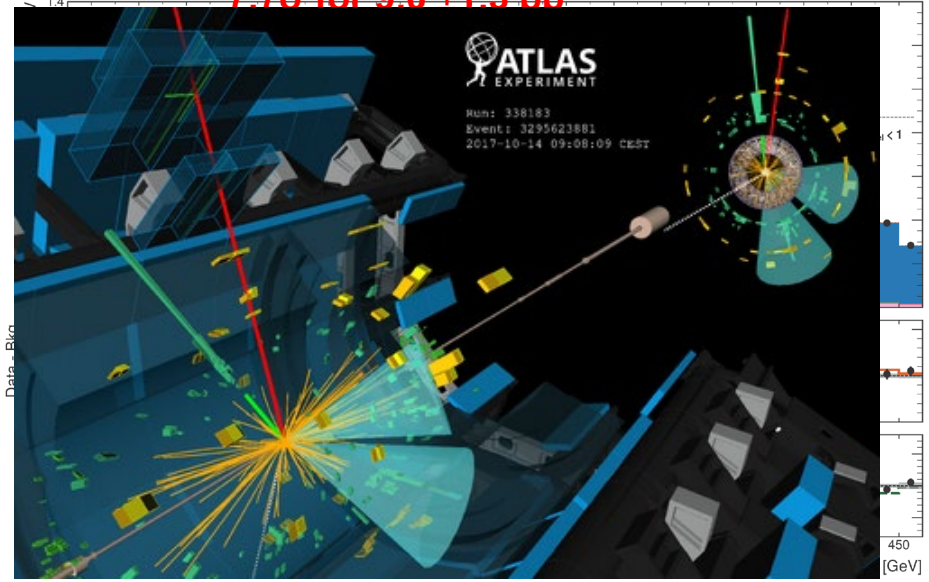
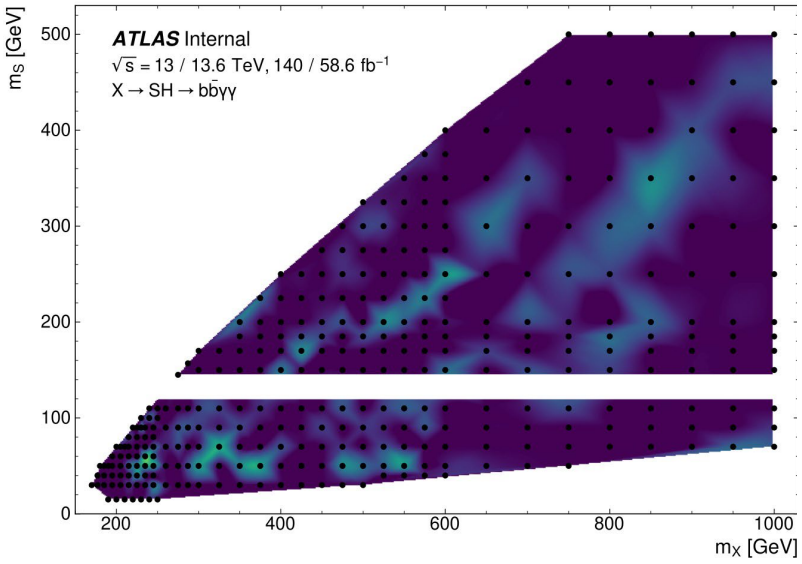
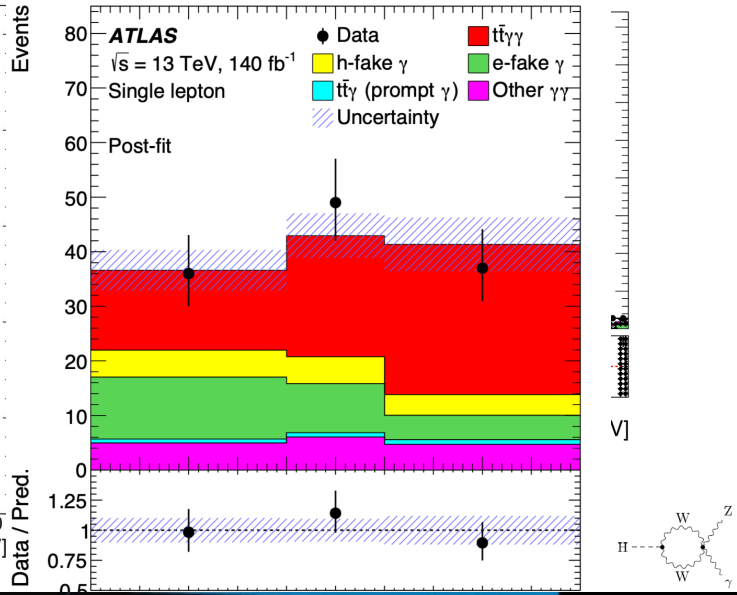
7.7σ for 9.0 +1.3 pb







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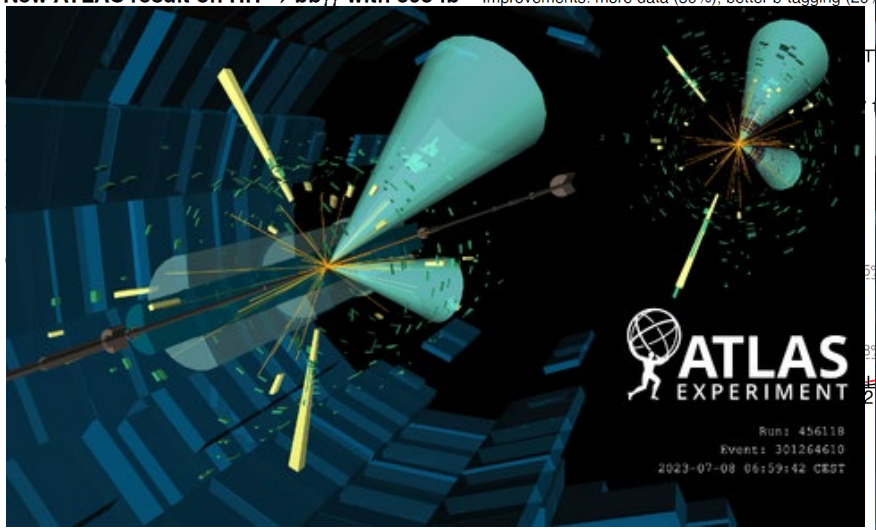
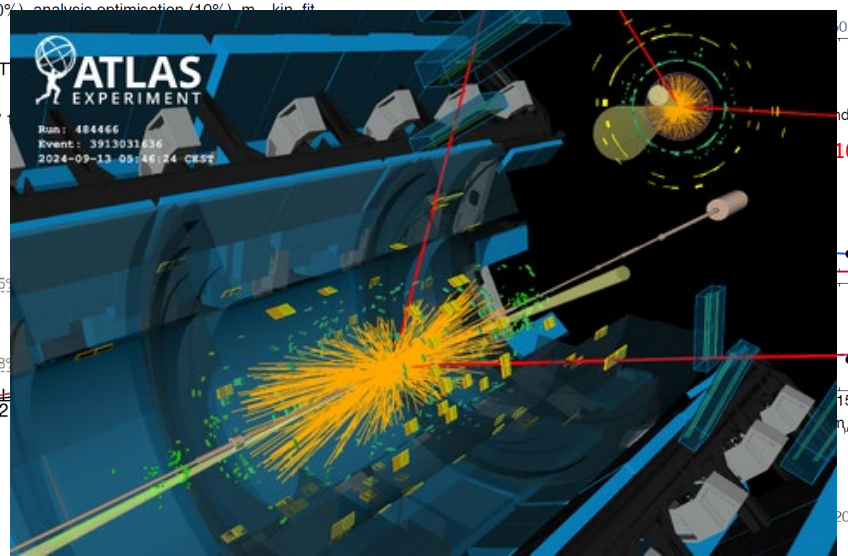
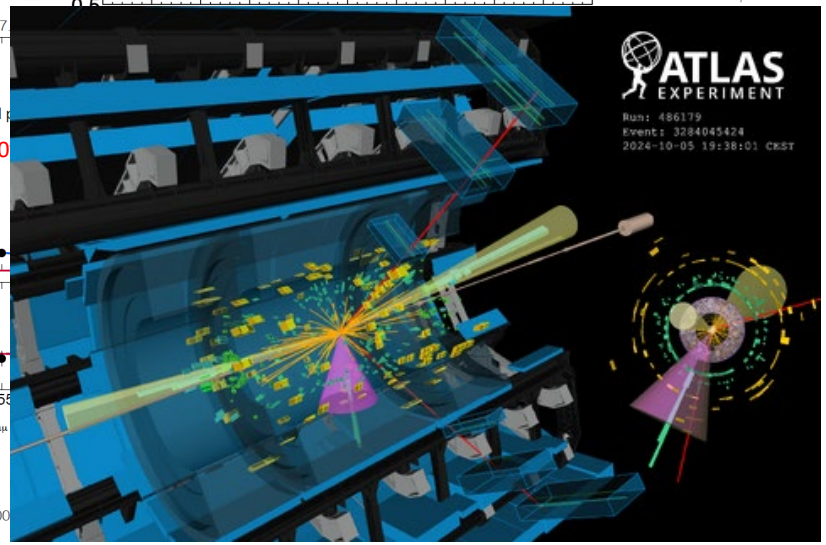
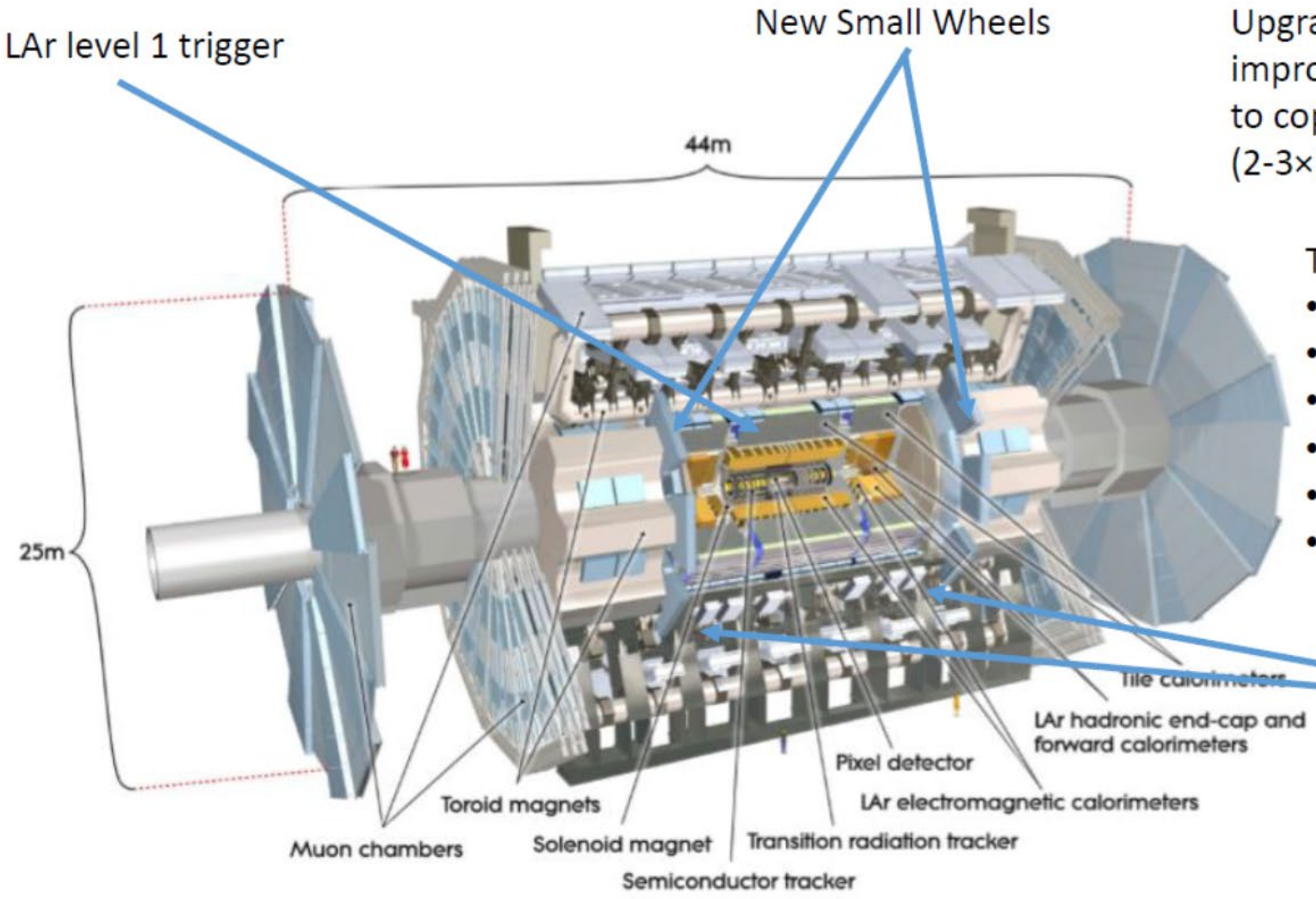






ATLAS Phase-I upgrades + Commissioning completed in 2024



Upgrades mainly aim at improving trigger selectivity, to cope with increasing luminosity ($2\text{-}3\times10^{34}cm^{-2}s^{-1}$)

TDAQ off-detector electronics

- L1 Calorimeter
- L1 Topological
- L1 NSW
- L1 Endcap
- L1 MUCTPI
- Fast Track Trigger (FTK)

New muon RPC detectors

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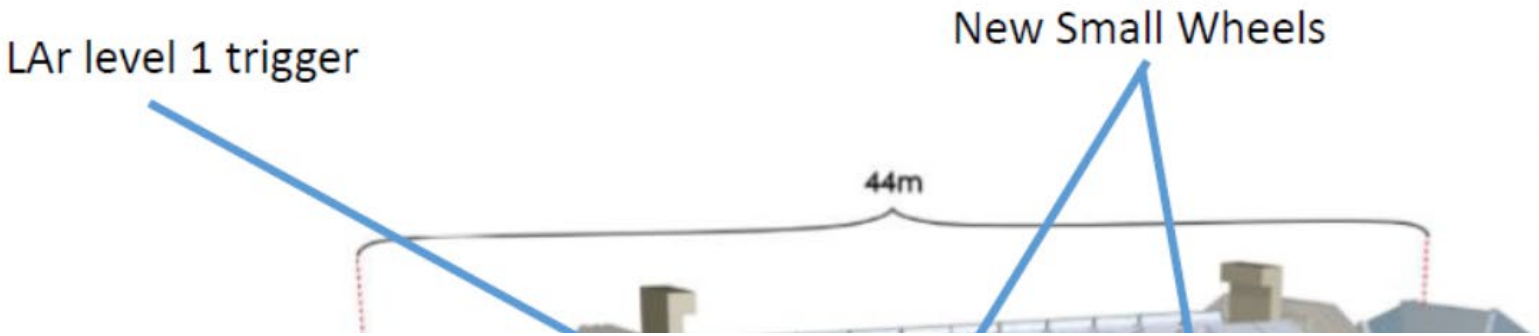

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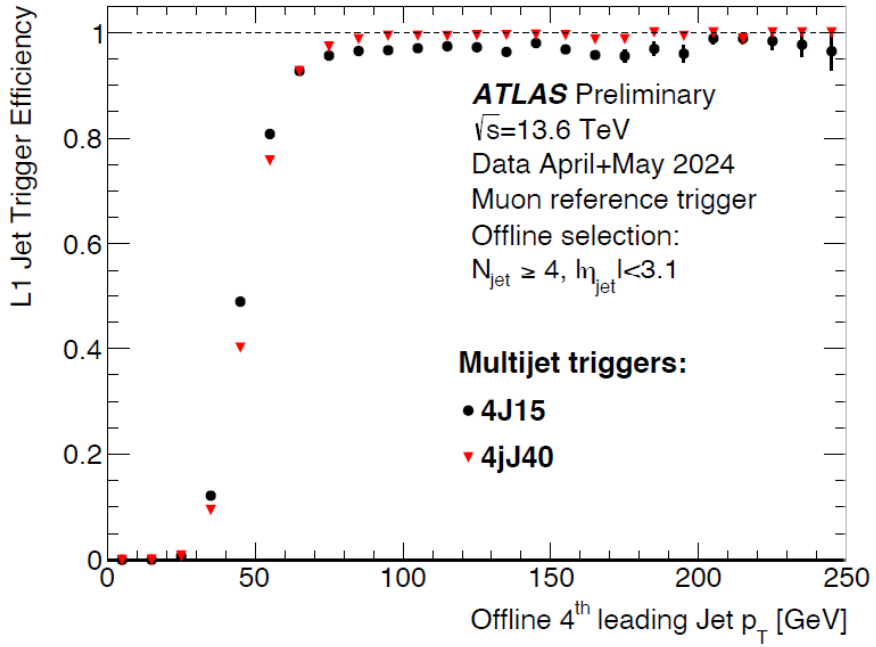
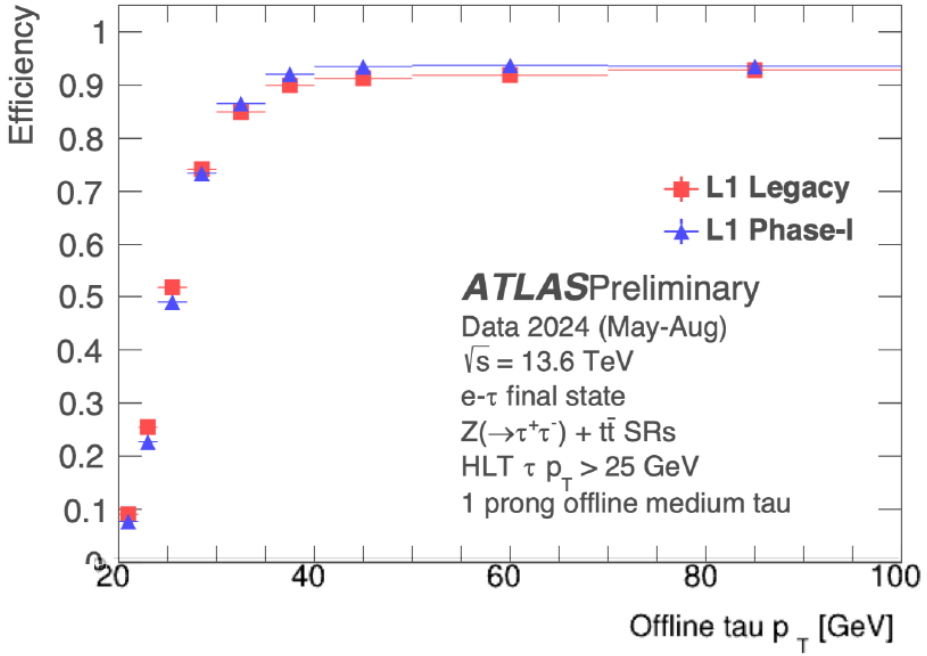
TDAQ off-detector electronics
lorimeter
pological
SW
dcap
UCTPI
Track Trigger (FTK)

Phase-I multijet jFEX (left) and cTAU (right), large-R jet & MET gFEX triggers also performing





New muon RPC detectors

Semiconductor tracker

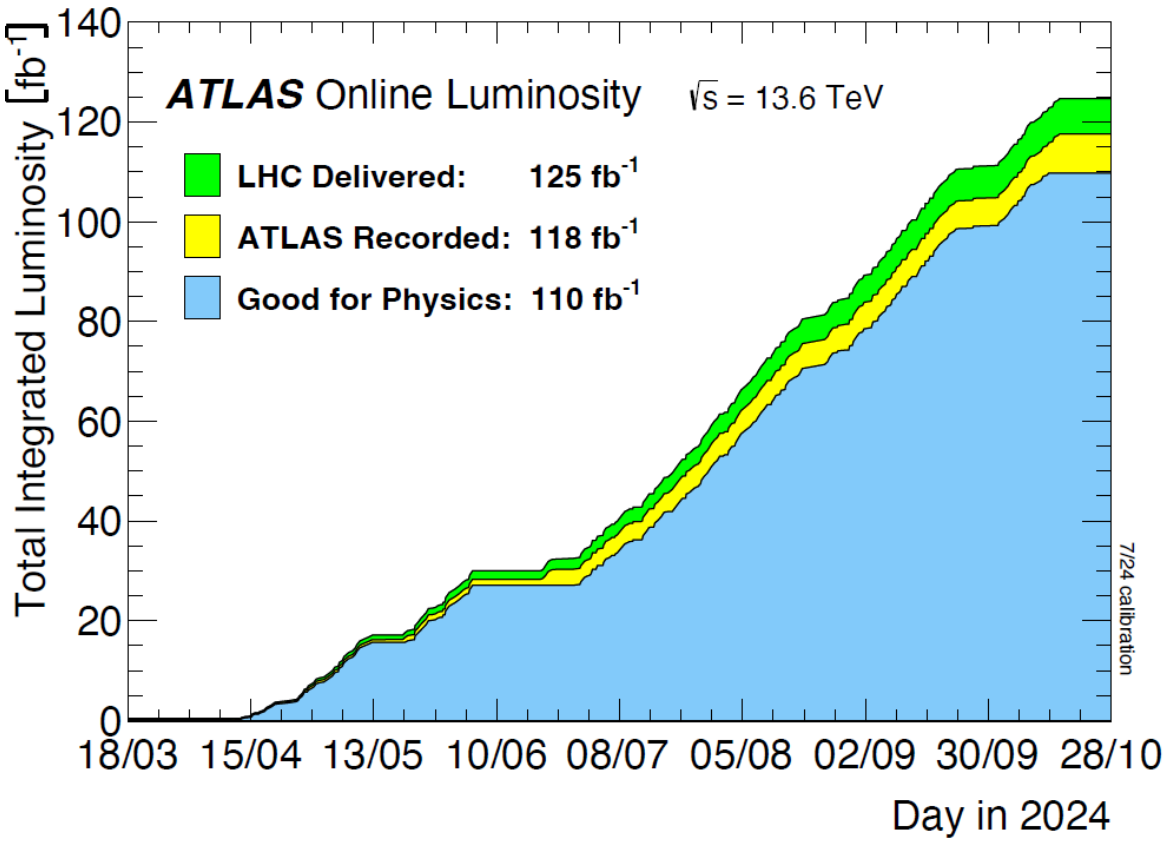
in 2024 ATLAS took 118 fb^{-1} of pp Run 3 data !

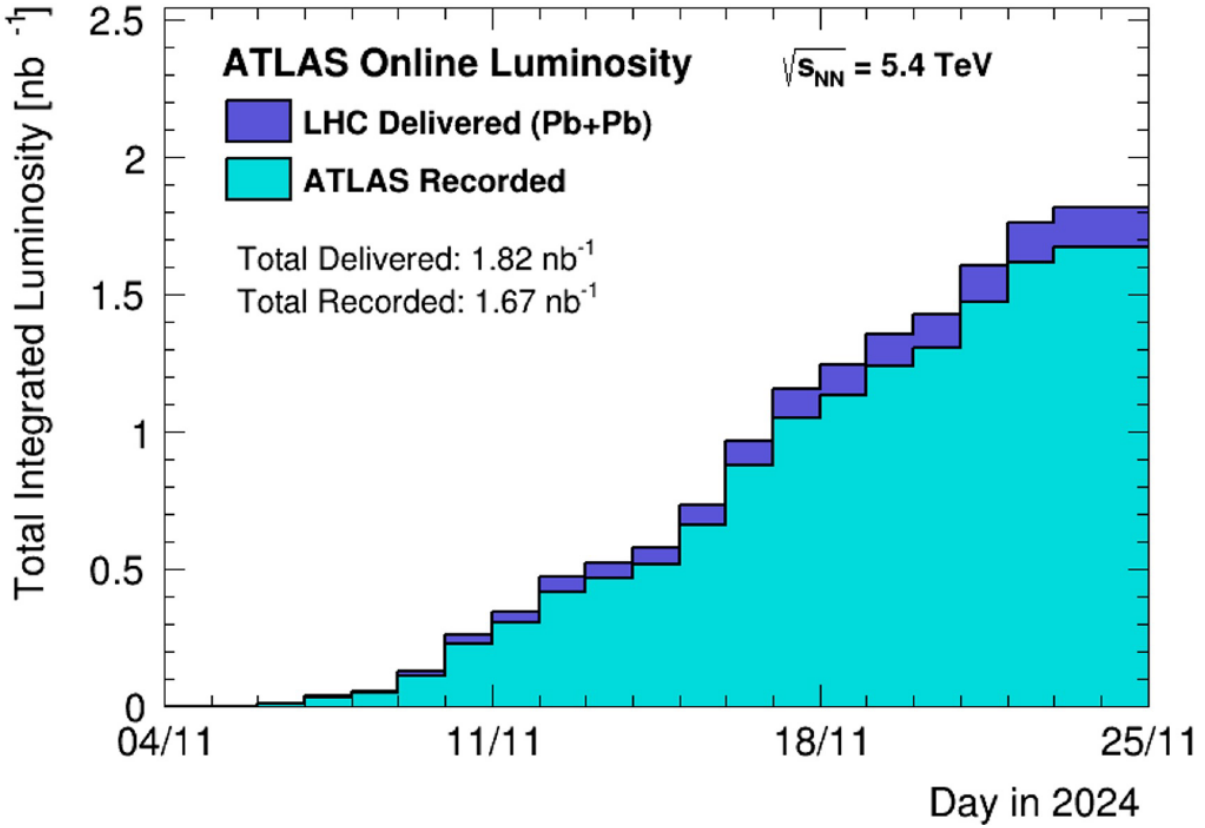
LHC and ATLAS luminosity above target — and smashed records in 2024

125 fb^{-1} pp delivered, 118 fb^{-1} recorded, 110 fb^{-1} good for physics (94.3% data taking efficiency, 93.8% DQ efficiency)

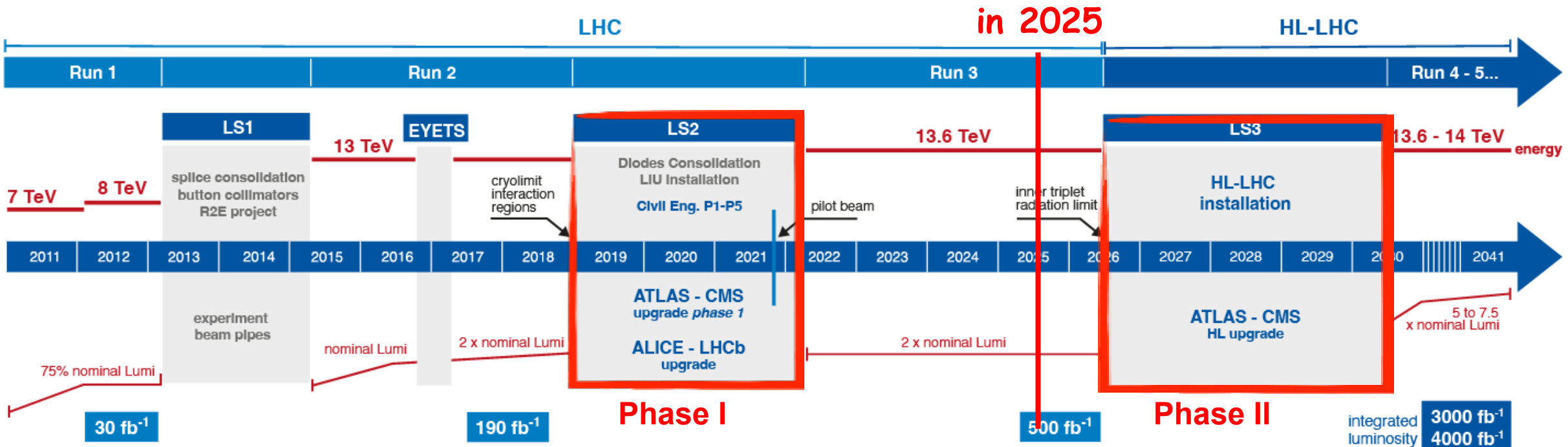
Record pp luminosity, double previous peak year: 63.3 fb^{-1} (2018)
Total del. (rec.) lumi in Run 3: 195 (184) fb^{-1}, Run 2: 156 (147) fb^{-1}

Excellent PbPb year: 1.82 nb^{-1} (2024), 1.87 (2023), 1.80 (2018)
Record per-day luminosity: 235 μb^{-1} (2024), 134 (2023), 152 (201





LHC / HL-LHC Plan



HL-LHC TECHNICAL EQUIPMENT:

DESIGN STUDY | PROTO

PHYSICS

HL-LHC CIVIL ENGINEERING:

DEFINITION

LS2: Phase-I Upgrade goals

- $\mathcal{L} \cong 3 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$
- $\langle \mu \rangle \cong 80$
- Keep trigger (max) 100 kHz; latency $\leq 3\ \mu s$

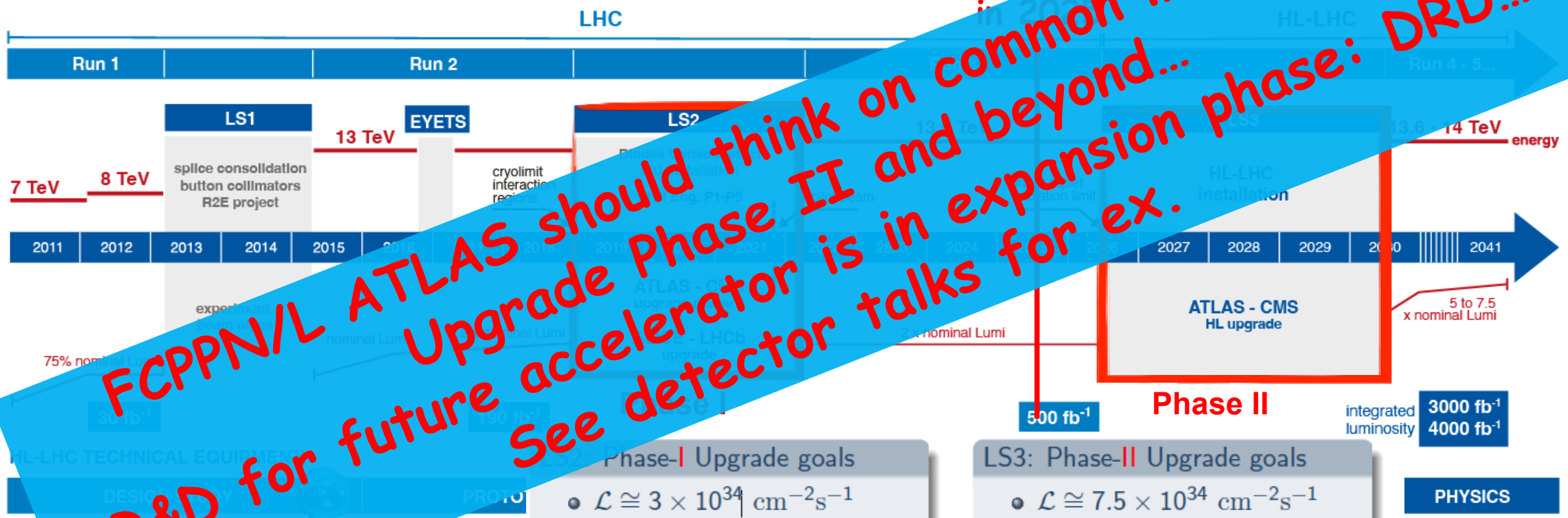
Upgrade of LAr trigger readout

LS3: Phase-II Upgrade goals

- $\mathcal{L} \cong 7.5 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$
- $\langle \mu \rangle \cong 200$
- Upgrade trigger to 1 MHz; latency $\leq 10\ \mu s$

Upgrade of LAr main readout*

LHC / HL-LHC Plan



FCPPN/L ATLAS should think on common interest for Upgrade Phase II and beyond...
R&D for future accelerator is in expansion phase: DRD...
See detector talks for ex.

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Upgrade of LAr main readout*

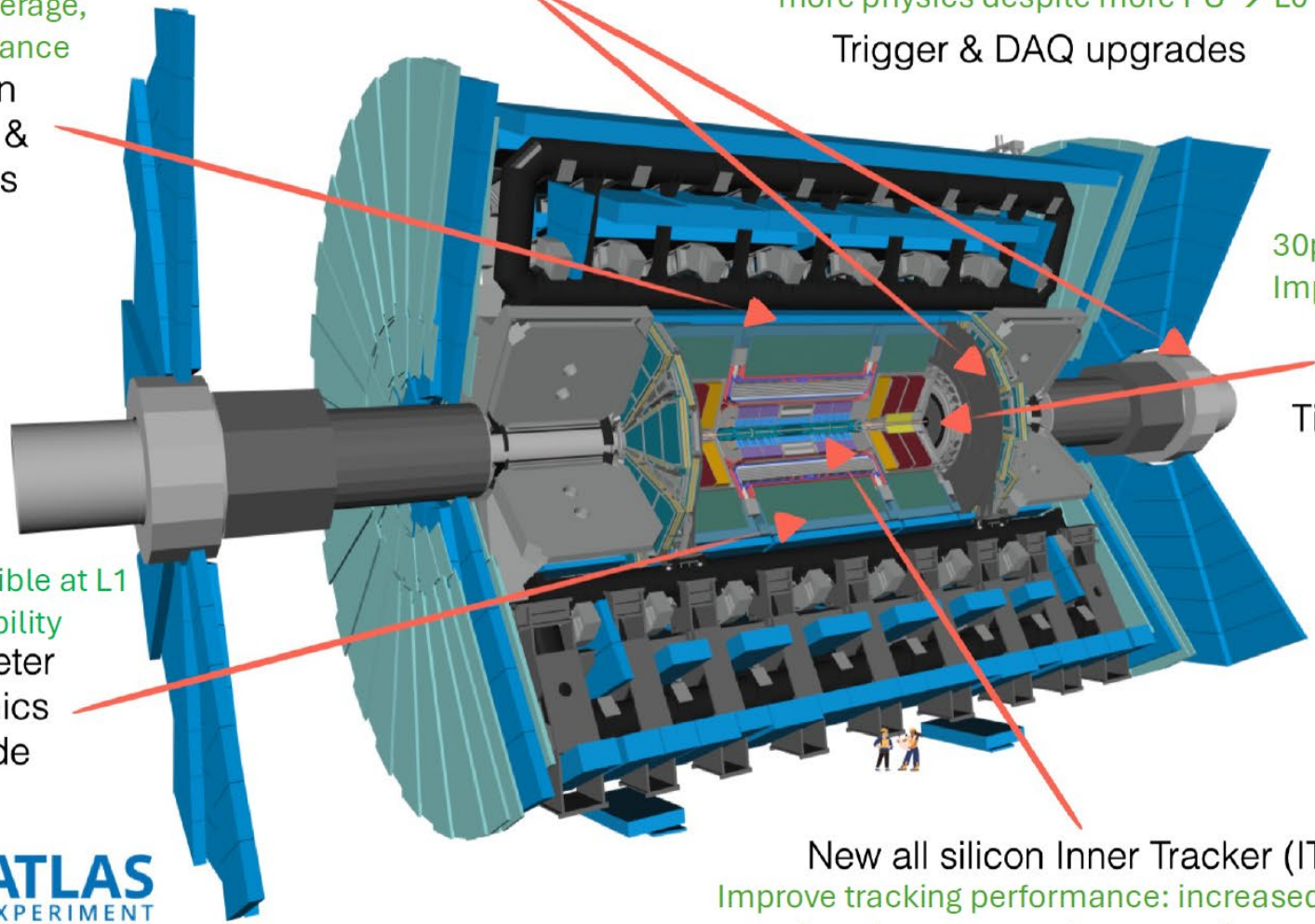
The Phase II upgrade program

ATL-UPGRADE-PUB-2025-001/

1% luminosity accuracy
New and upgraded forward and luminosity detectors

Improve trigger performance/rate:
more physics despite more PU → L0 trigger at 1 MHz, EF 10kHz
Trigger & DAQ upgrades

Improve muon trigger coverage, electronics and performance
New muon chambers & electronics

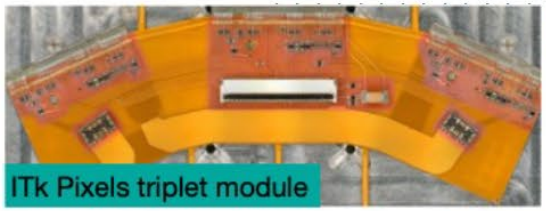


30ps time resolution per track
Improve PU rejection in forward region
New High Granularity Timing Detector (HGTD)

Full granularity data accessible at L1 trigger, increased rate capability
Calorimeter electronics upgrade

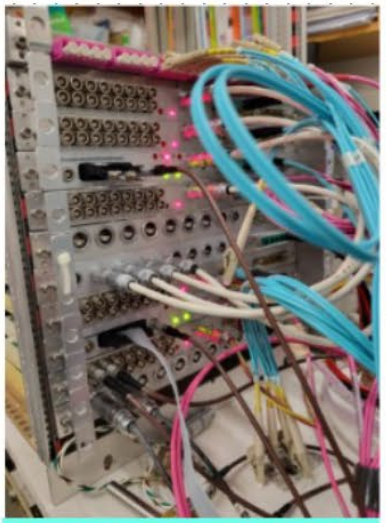
New all silicon Inner Tracker (ITk)
Improve tracking performance: increased coverage, reduced occupancy, better track p_T resolution

The Phase II upgrade program


ITk Pixels triplet module


ITk Pixels Layer-0 stave @SLAC

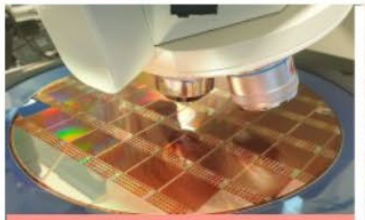

ITk Pixels Layer-3 longeron @CERN


Tile calib. system testbench

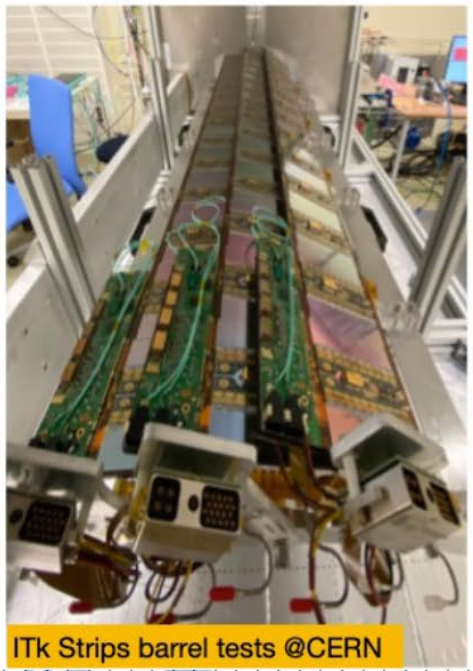

HGTD demonstrator


Trigger L0Calo prototype


Tile FENICS card

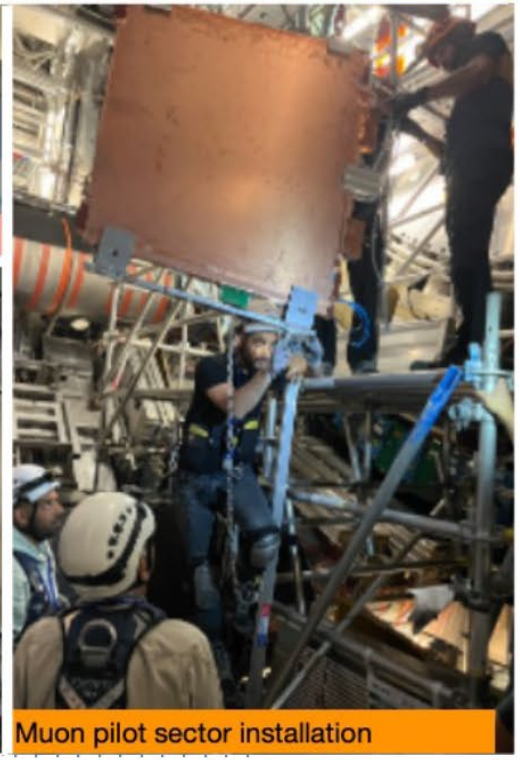

HGTD ALTIROC2 wafer


ITk Strips end-cap tests @DESY


ITk Strips barrel tests @CERN


ITk Strips module assembly @USBC

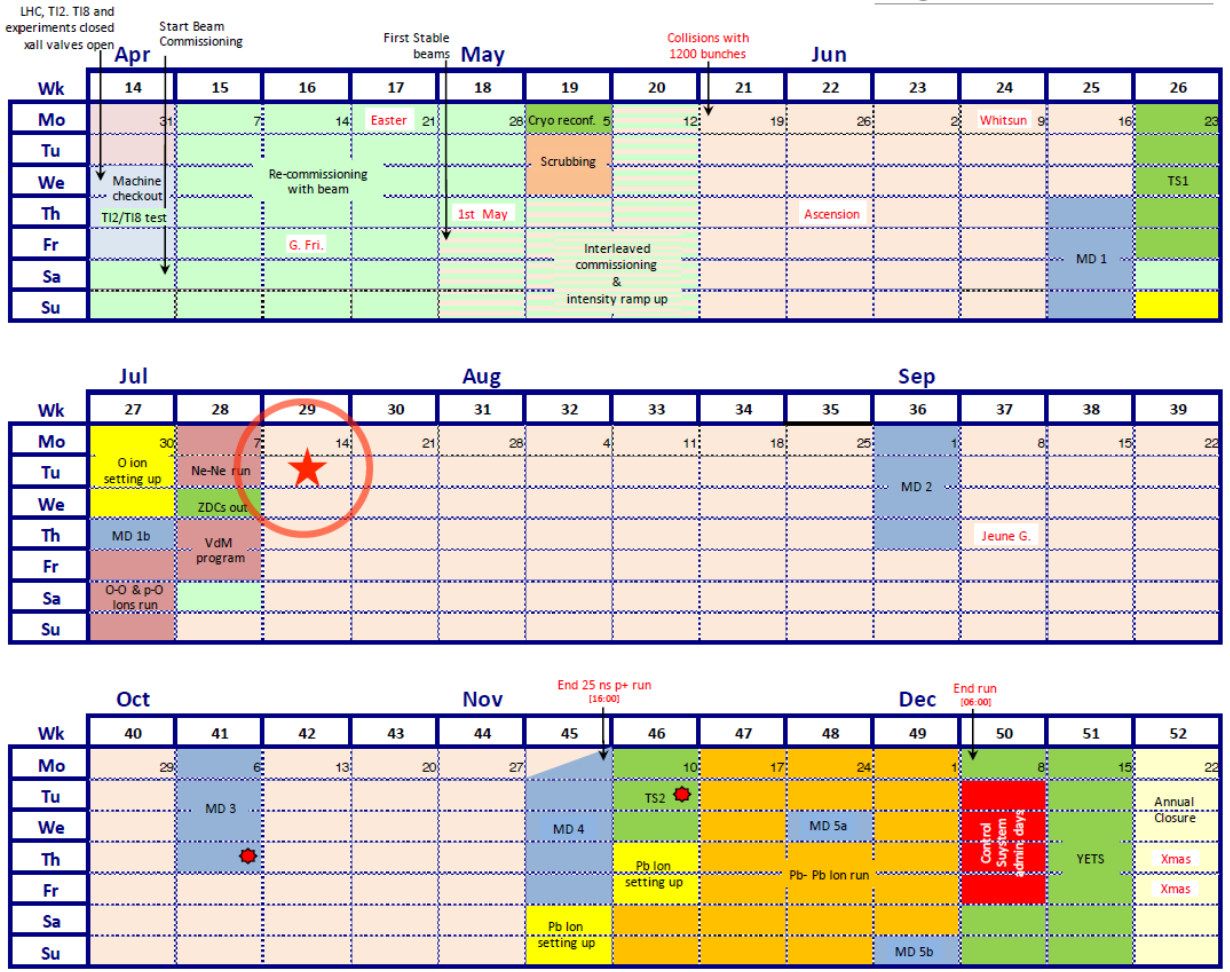

LAr FEC system


Muon pilot sector installation

LHC & ATLAS into Run 3 @ full swing !

- **Plan ahead** ATLAS planning LHC planning
  - Stable beams at 13.6 TeV with 2460 bunches
  - Luminosity limited to ~2.2 x 10^{34} cm^{-2} s^{-1} due to cryo limit on inner triplet
  - Machine development (MD1): June 19 - 22
  - Technical stop (TS1): June 23 - 27
  - Light-ions pO, OO, NeNe: June 29 - July 8
  - Luminosity program: July 10 - 14
  - pp runs: July 18 - Aug 31
- Several small issues with injectors and LHC delayed luminosity program somewhat
- Official schedule underestimates time needed for luminosity program and revalidation/ramp-up

LHC 2025 schedule v1.1



- **Goal: pp 120 fb^{-1} delivered in 2025**

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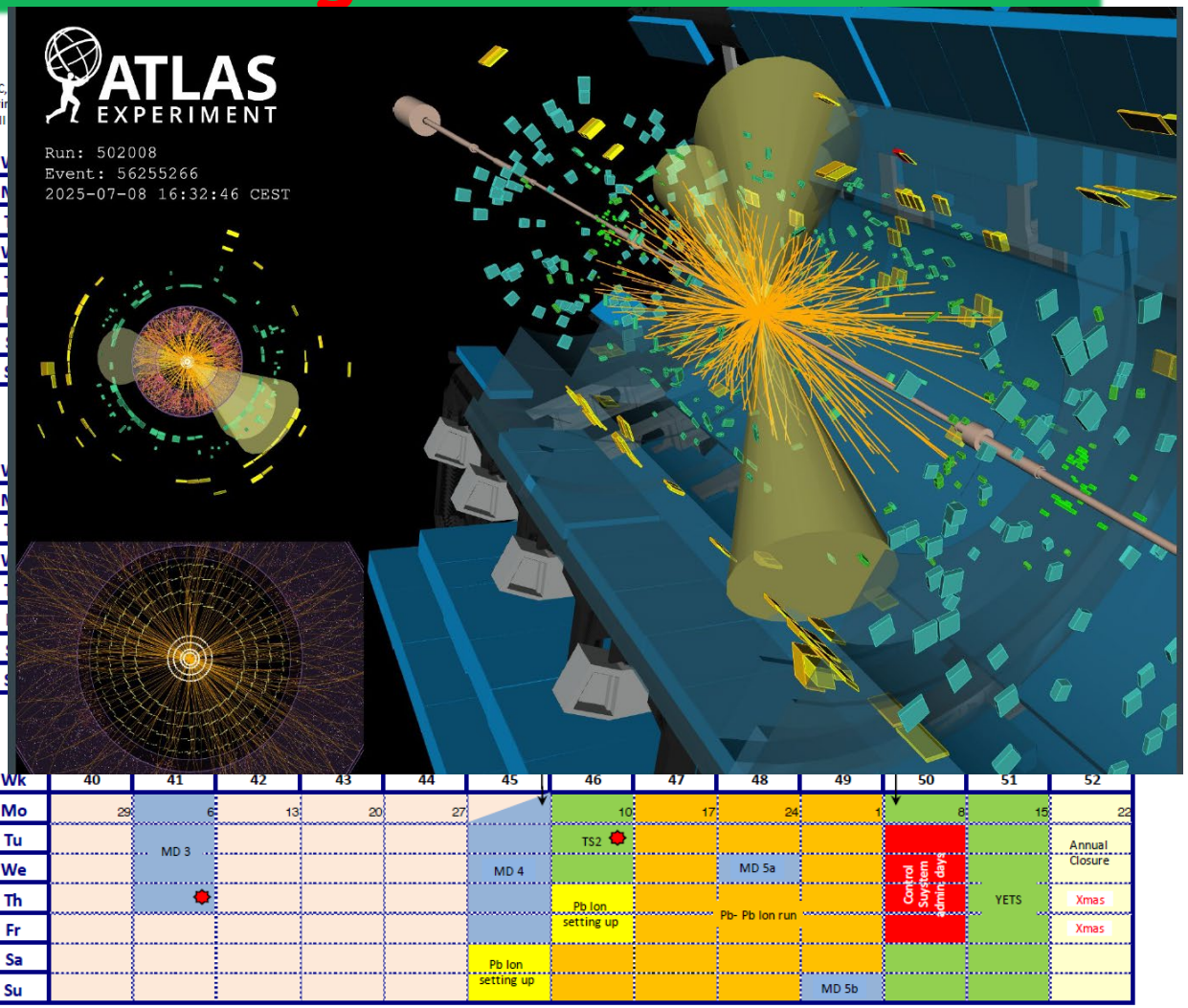

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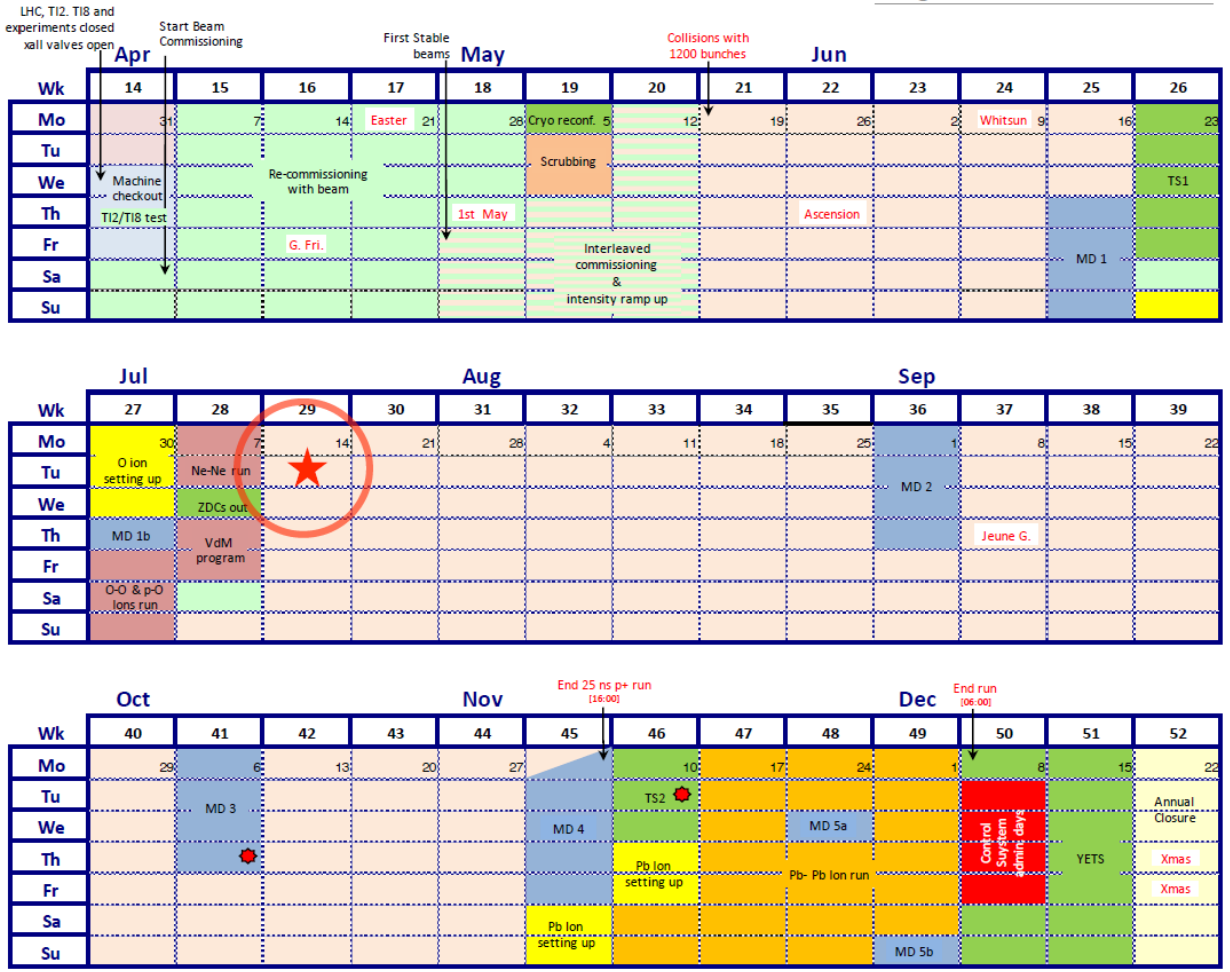


- **Goal: pp 120 fb^{-1} delivered in 2025**

LHC Page1 | Fill: 10857 | E: 6799 GeV | t(SB): 09:55:29 | 20-07-25 03:56:09

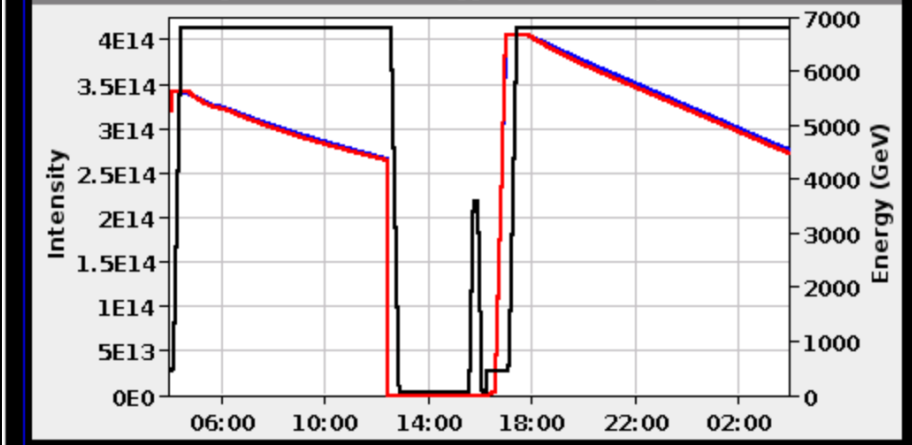
PROTON PHYSICS: STABLE BEAMS

Energy:	6799 GeV	I B1:	2.78e+14	I B2:	2.75e+14

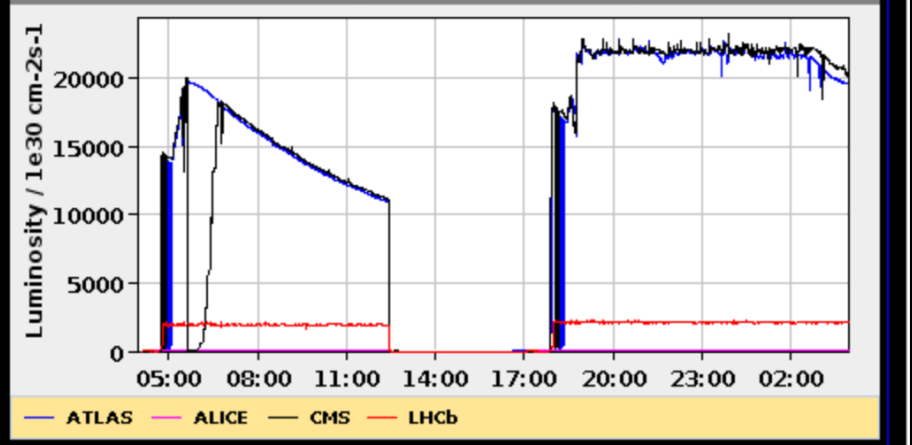
Beta* IP1:	0.60 / 0.18 m	Beta* IP2:	10.00 m	Beta* IP5:	0.18 / 0.60 m	Beta* IP8:	2.00 m

Inst. Lumi [(ub.s)^-1] IP1: 19527.85 IP2: 8.49 IP5: 20150.65 IP8: 2101.39

FBCT Intensity and Beam Energy Updated: 03:55:58



Instantaneous Luminosity Updated: 03:56:01



Comments (20-Jul-2025 02:58:01)

STABLE BEAMS

IPs 2 & 8 on target

Roman pots IN

BIS status and SMP flags	B1	B2
Link Status of Beam Permits	true	true
Global Beam Permit	true	true
Setup Beam	false	false
Beam Presence	true	true
Moveable Devices Allowed In	true	true
Stable Beams	true	true

AFS: 25ns_2460b_2448_2089_2227_144bpi_20inj PM Status B1 ENABLED PM Status B2 ENABLED

LHC & ATLAS into Run 3 @ full swing !

- **Plan ahead** ATLAS planning LHC planning
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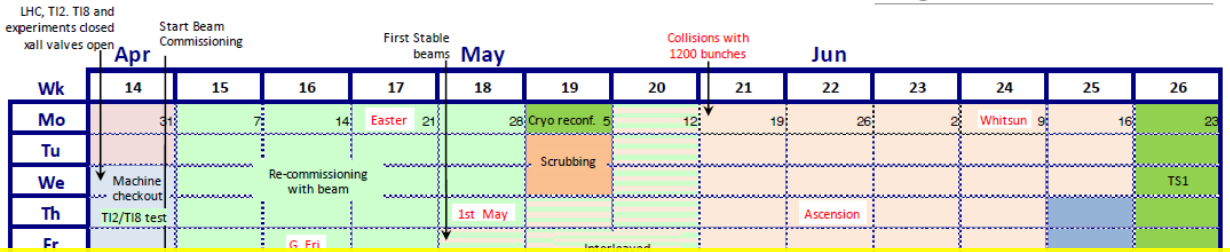
LHC 2025 schedule v1.1



ATLAS is in Run 3 at full swing !

FCPPN/L cooperation strongly contributes to many "Run 2" legacy papers as well as now to the first "Run 3" and combined R2&3 data analysis.

See today's talks as well as winter and summer conference slides and related conf. notes for ATLAS new results.

ATLAS Upgrade Phase II is also in full swing and FCPPN/L is strongly involved!

AND:

ATLAS FCPPN/L has opportunities to further cooperate: ITK, LAr Calo, HGTD,…

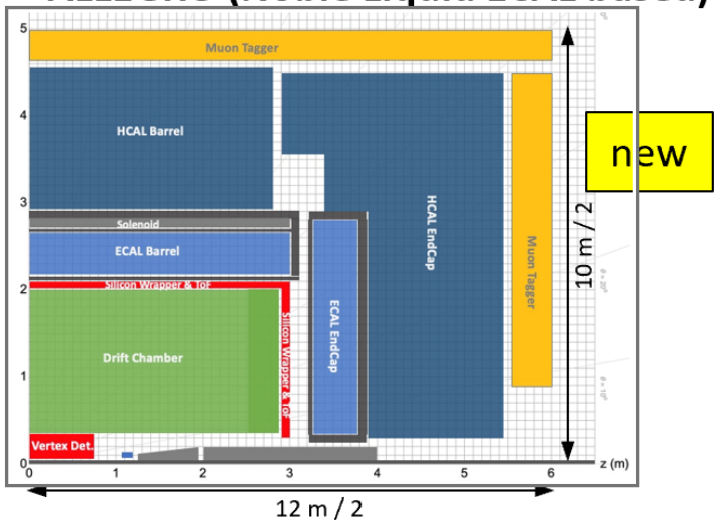
BUT: also in the emerging future detector R&D DRD program for ex…

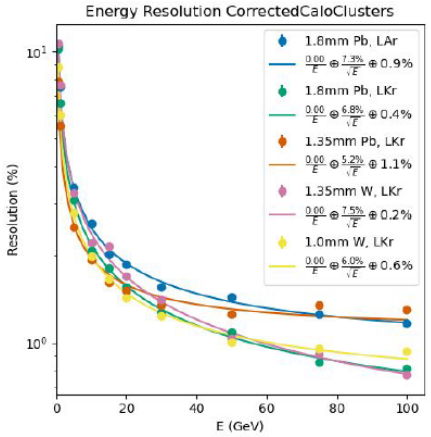
AND FCPPN/L cooperations have a role to play in it !

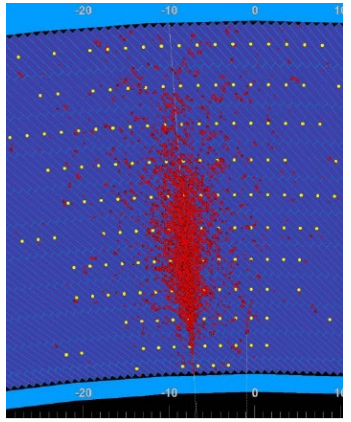
Future R&D program, DRDs, Allegro, Allegro calo…

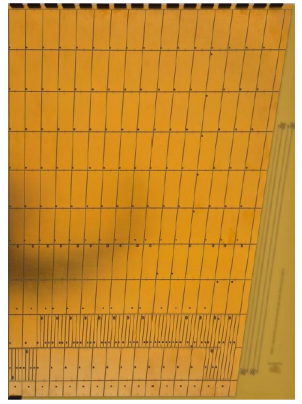
- **Right time to take part to these huge R&D effort ramping up for next e^+e^- colliders**
- **Many activities in many field, (see talks in the detector section)**

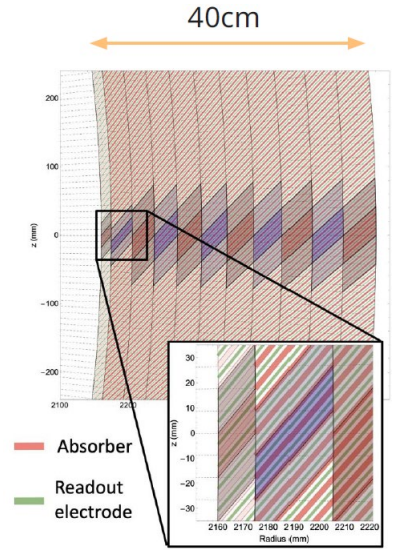
ALLEGRO (Noble Liquid ECAL based)





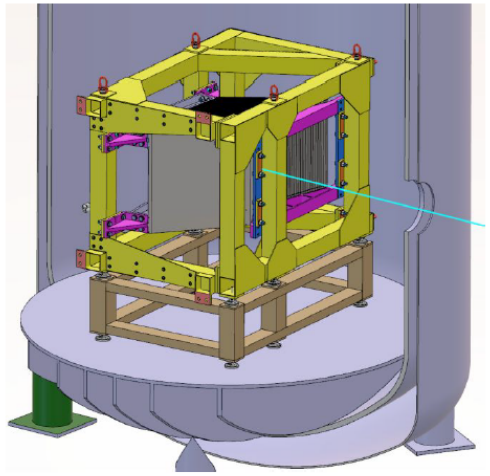






- A design in its infancy
- Si vtx det., ultra light drift chamber (or straw tracker or Si)
- High granularity Noble Liquid ECAL as core
  - Pb/W+LAr (or denser W+LKr)
- CALICE-like or TileCal-like HCAL;
- Coil inside same cryostat as LAr, outside ECAL
- Muon system.
- Very active Noble Liquid R&D team
  - Readout electrodes, feed-throughs, electronics, light cryostat, …
  - Software & performance studies

- Noble Liquid EM calorimetry is a very appealing solution for FCC-ee
  - Fulfils **all requirements** of the physics programme
  - Cost-effective
  - Significant progress in simulations to prove all important metrics
- Very active ALLEGRO Ecal R&D
  - As part of DRD6 collaboration
  - Working on all challenges to reach our performance goals
  - Design to be demonstrated by a prototype within 5 years
  - There is still plenty to do !
  - We are **always open to new collaborators !**



ACC(IHEP/NJU/SDU/SJTU/USTC)-IN2P3(APC/CPPM/IJCLAB/LPNHE/CC)-CEA

- Strong cooperation program between the Atlas Chinese Clusters and IN2P3 labs since many years:
  - Higgs, Susy studies, SM (through γ γ, WW final states and also lepton/jet/bjet/top final states such as in 4t, ttH, VH, H^{++}, HH, SH…)
    (G. Bernardi, N.K.Vu talks)
  - Performance studies (E/gamma, b tag, trigger, calorimeter)
  - Commissioning & operation for Run3 (Several FCPPN/L PhD students)
  - Silicon detector R&D and Phase II and future R&D (M. Li, D. Xu,…)
  - Numerous presentation in Atlas meetings, conferences as well as in internal, public/conf notes and publications. (See FCPPN/L reports)
  - Senior physicists visits (France and China) slowly restarted and cooperation work between physicists continue.
  - Several co-PhD thesis defended in 2023&24, Q. Shen, X. Wang, Y. Zhang, and more to come… (Co-PhDs important strengthening force for the FCPPN/L)
- On computing, IHEP/IN2P3/CEA (C. Gang,…)
- Phase II (HGTD, ITK, LAr…) & new accel. coop. started (M. Ruan, Y. Tan, T. Pasquier,…) + Ramp up on theory cooperation for future accelerator.

ATLAS ACC-IN2P3 continued full Run2 data analyses & performance studies to complete "legacy" full Run2 publications + full swing on Run3 analysis

- PhD:
  - X. Yang (LPSC/SDU) CSC funded (defended 06/20)
  - Y. Wang (LPNHE/USTC) USTC funded (defended 12/20)
  - H. Atmani (IJCLAB) IJCLAB funded (defended 12/20)
  - H. Xu (CPPM/USTC) CPPM/USTC funded (defended 09/21)
  - Z. Li (CPPM/SDU) CPPM/SDU/CSC funded (defended 09/21)
  - K. Han (IJCLAB/USTC) USTC funded (defended 03/22)
  - C. Wang (CPPM/SJTU) CPPM/SJTU/CSC funded (defended 02/23)
  - J. Tafoya (IJCLAB) IJCLAB funded (defended 10/23)
  - Y. Zhang (APC/SJTU) APC/SJTU/CSC funded (defended 12/23)
  - Q. Shen (APC/SJTU) APC/SJTU/CSC funded (defended 11/24)
  - X. Su (IJCLAB) IJCLAB/USTC funded (started in 10/20)
  - X. Wang (CPPM/SJTU) CPPM/SJTU/CSC funded (defended 11/24)
  - C. Mo (APC/SJTU) APC/SJTU/CSC funded (started 10/23)
  - D. Yu (APC/SJTU) APC/SJTU/CSC funded (started 25)
- Many former Co-PhDs now postdocs or permanent positions: Core for future Accelerator Prog
- HL-LHC (Calo, ITK, HGTD…) & future accelerator (Silicon detector, Calo…) cooperation program ongoing, but need new PhD students & short stay scientists to strengthen it !
- Need to strengthen person power/funds for strong ATLAS Run 2/Run 3 analysis, ATLAS upgrade and future detectors R&D to foster the future accelerator program.

09:00	**ATLAS FCPPN Project**	*Emmanuel MONNIER*
	Rose Hall (on the first floor), Haitian Grand Theatre Hotel, Qingdao	09:00 - 09:25
	Highlight on ATLAS recent results	*Jun GUO*
	Rose Hall (on the first floor), Haitian Grand Theatre Hotel, Qingdao	09:25 - 09:55
10:00	**Status of ATLAS SJTU/APC project**	*Gregorio BERNARDI*
	Rose Hall (on the first floor), Haitian Grand Theatre Hotel, Qingdao	09:55 - 10:15
	Dark Matter/Photon/Higgs search results from ATLAS	*Ngoc Khanh Vu*
	Rose Hall (on the first floor), Haitian Grand Theatre Hotel, Qingdao	10:15 - 10:35