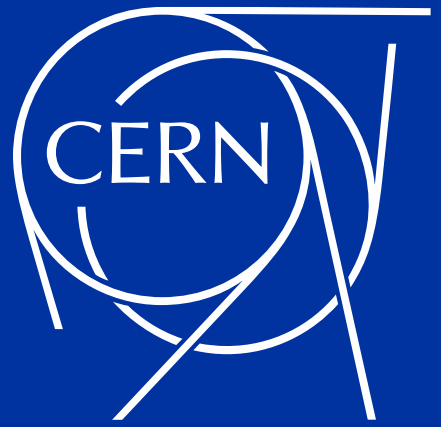


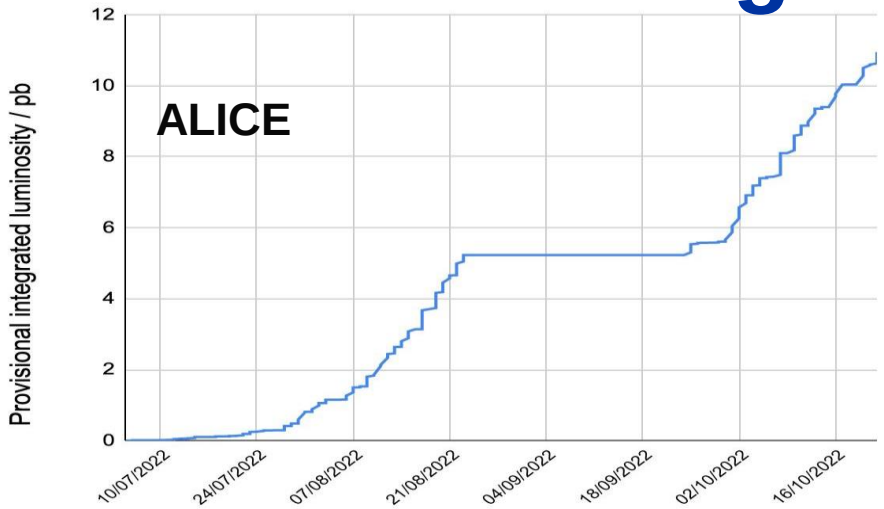
Status of the Experiments

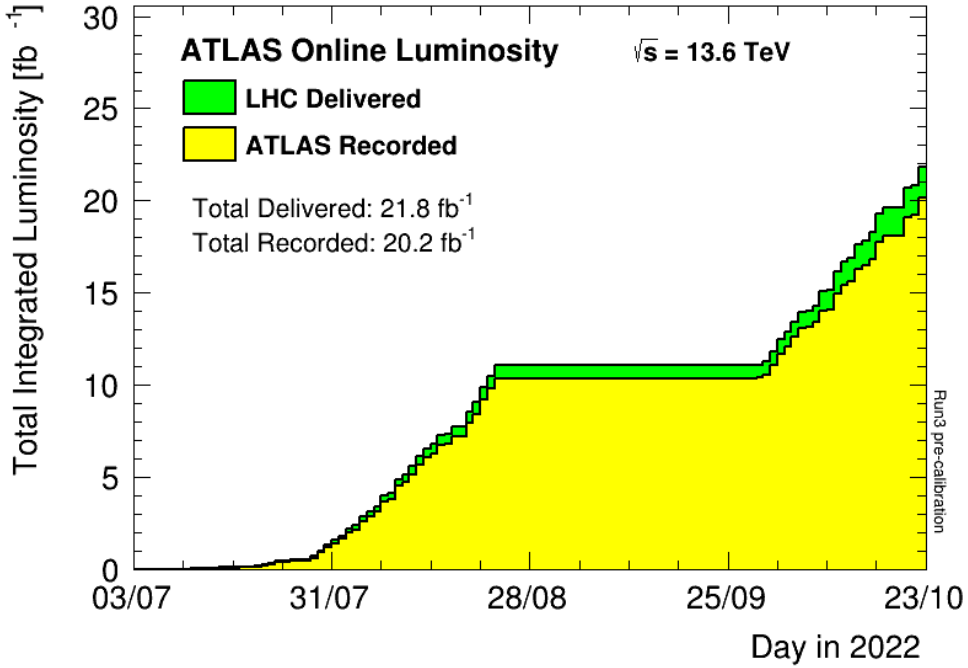
Plenary RRB 55th Meeting

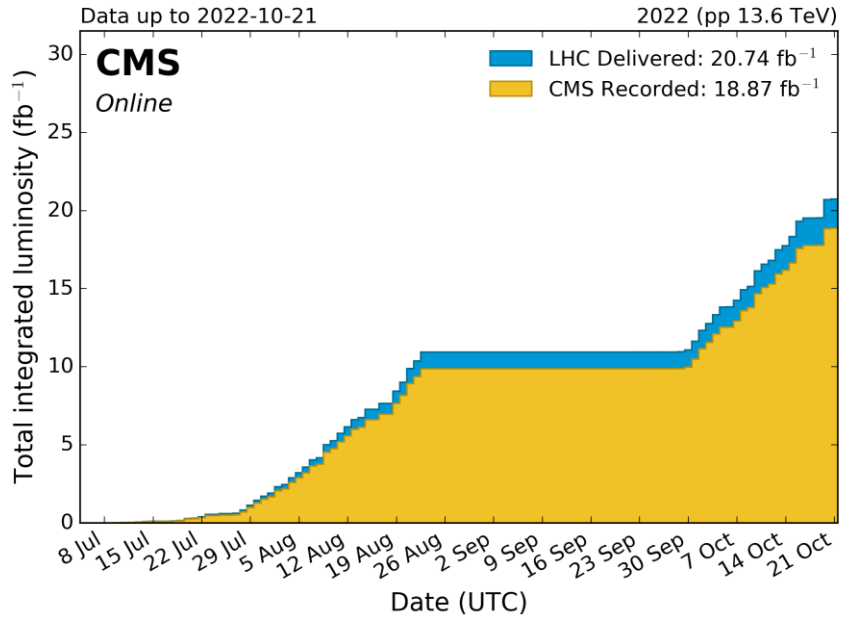
Joachim Mnich

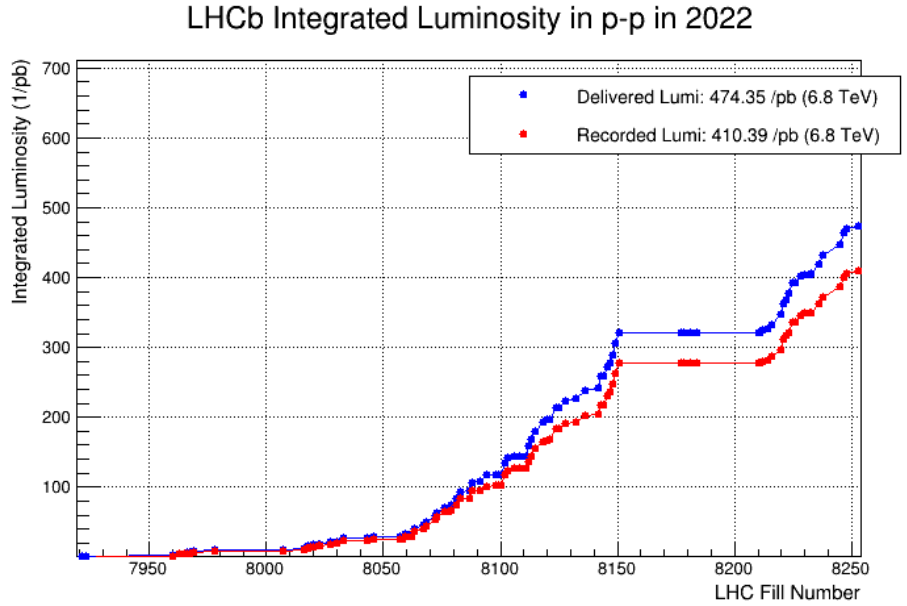
October 24th, 2022

Run 3 Data Taking









Operation of the Detectors in Run 3

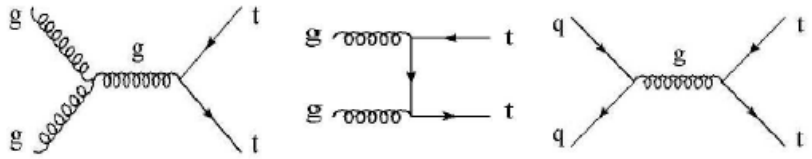
- The experiments do have problems to fill the shifts for the detector operation
  - Was not the case in previous runs
- Reasons: difficulties in international travel, reduced travel support at institutes?

- Experiments have moved online tasks to remote as much as possible
  - Shift crews at the experiments are still essential
  - Need to train up new shift crews after a long shutdown
  - Experiments rely on numerous on-call specialist present in the area

- Need your help for travel support

CMS: First Result from Run 3

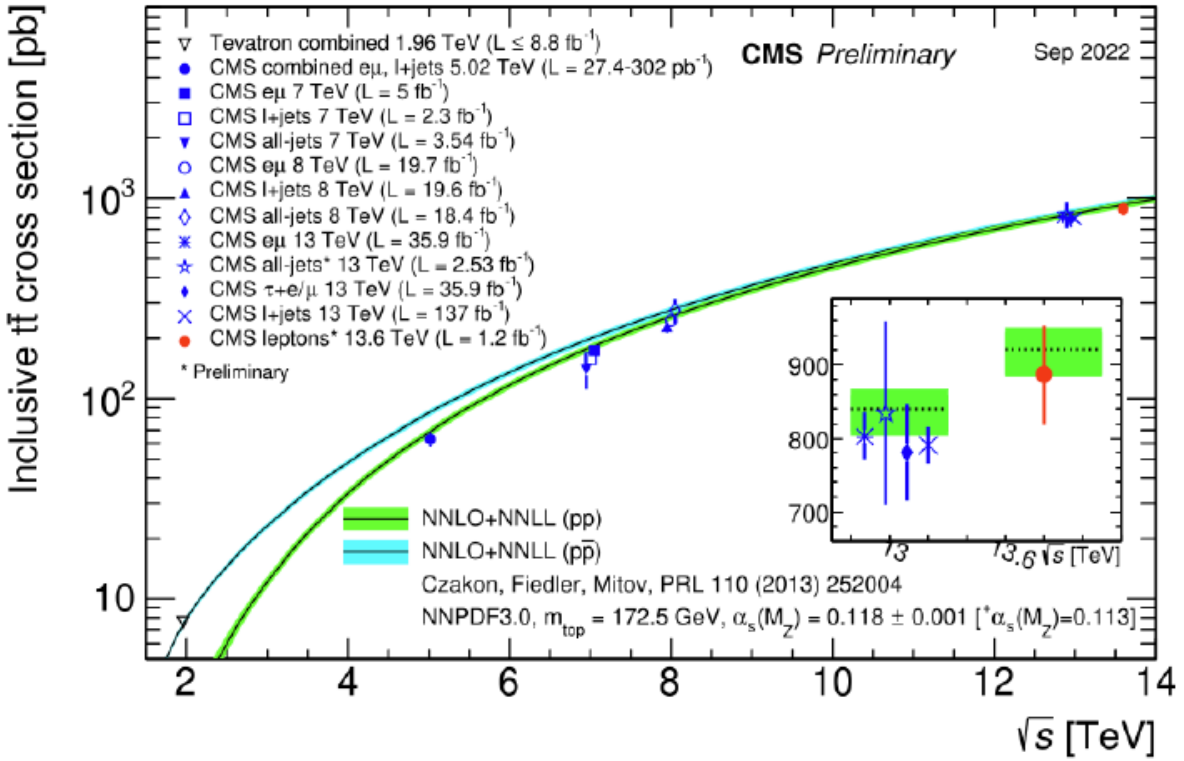
First measurement of the top-pair cross section at 13.6 TeV



- Combination of five channels eμ, ee, μμ, e+jets, μ+jets
- Good agreement with theory

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

Theory prediction: 921^{+29}_{-37} pb



ALICE: Hypermatter

ALICE studied the hyper-triton $^{3}_{\Lambda}H$

- ❑ think of a tritium nucleus (pnn) in which one neutron is replaced by a lambda hyperon (Λ)

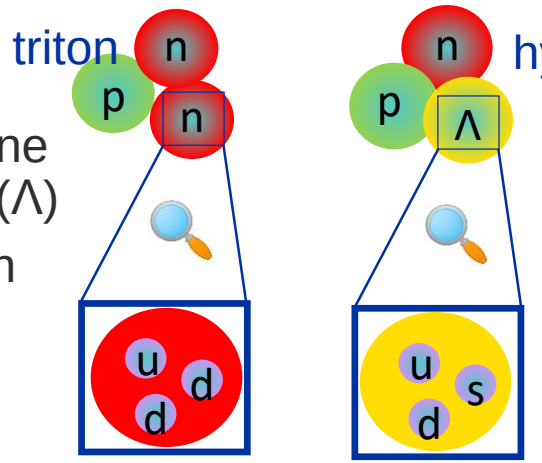
Hyper-nuclei may exist in the cores of neutron stars

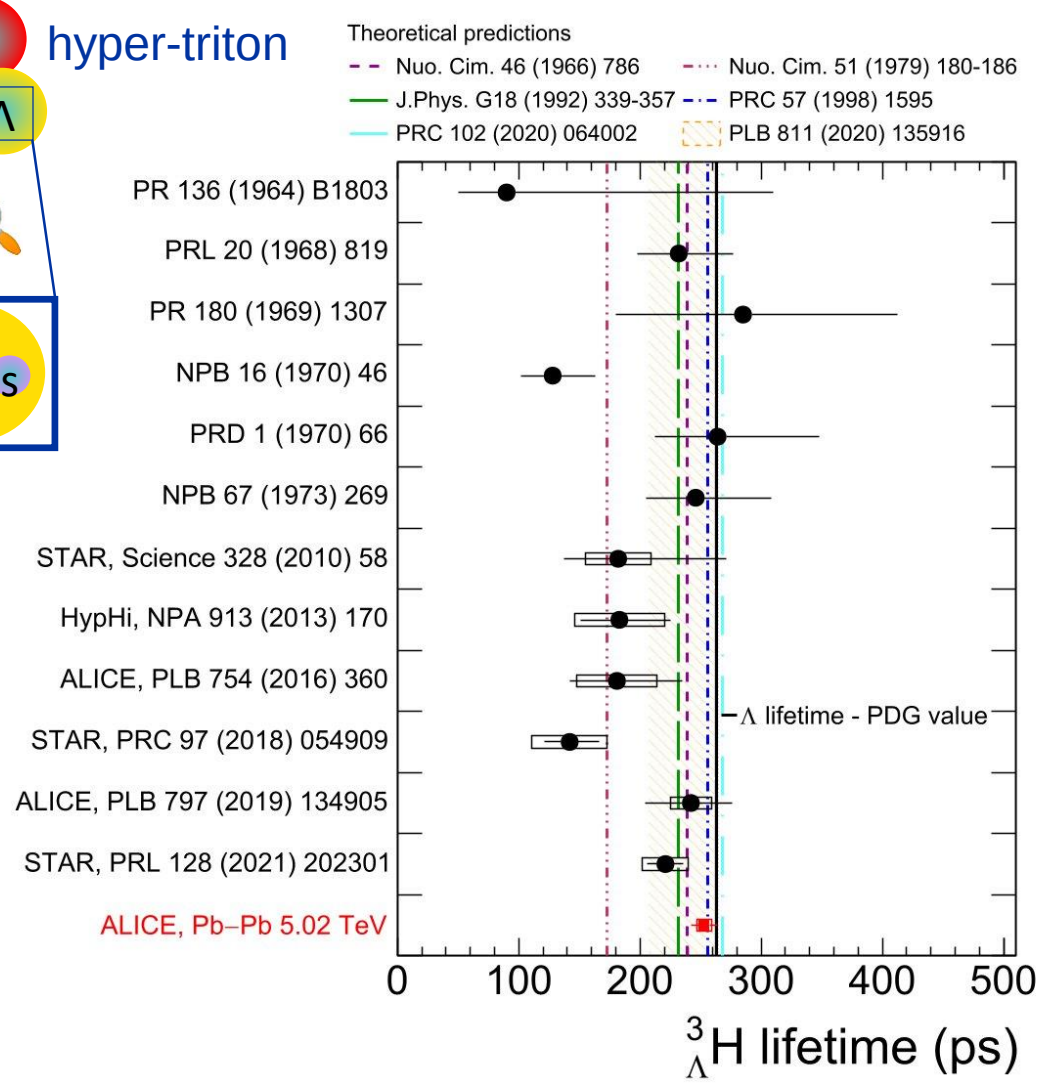
Through the decay $^{3}_{\Lambda}H \rightarrow {}^{3}He + \pi^{-}$

ALICE measured properties of the hyper-triton

- ❑ Lifetime
- ❑ Separation energy
- ❑ Lifetime difference between the hyper-triton and its anti-particle

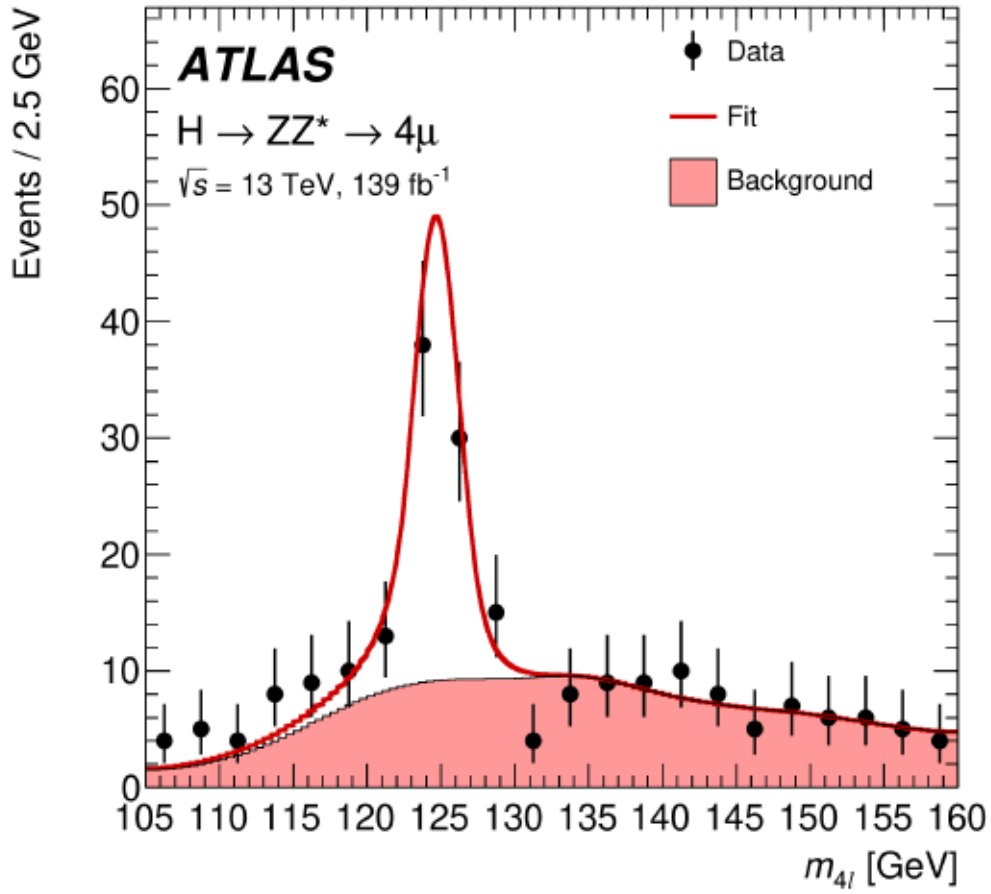
All are consistent with theoretical expectations and provide valuable insight into the nature of the strong force

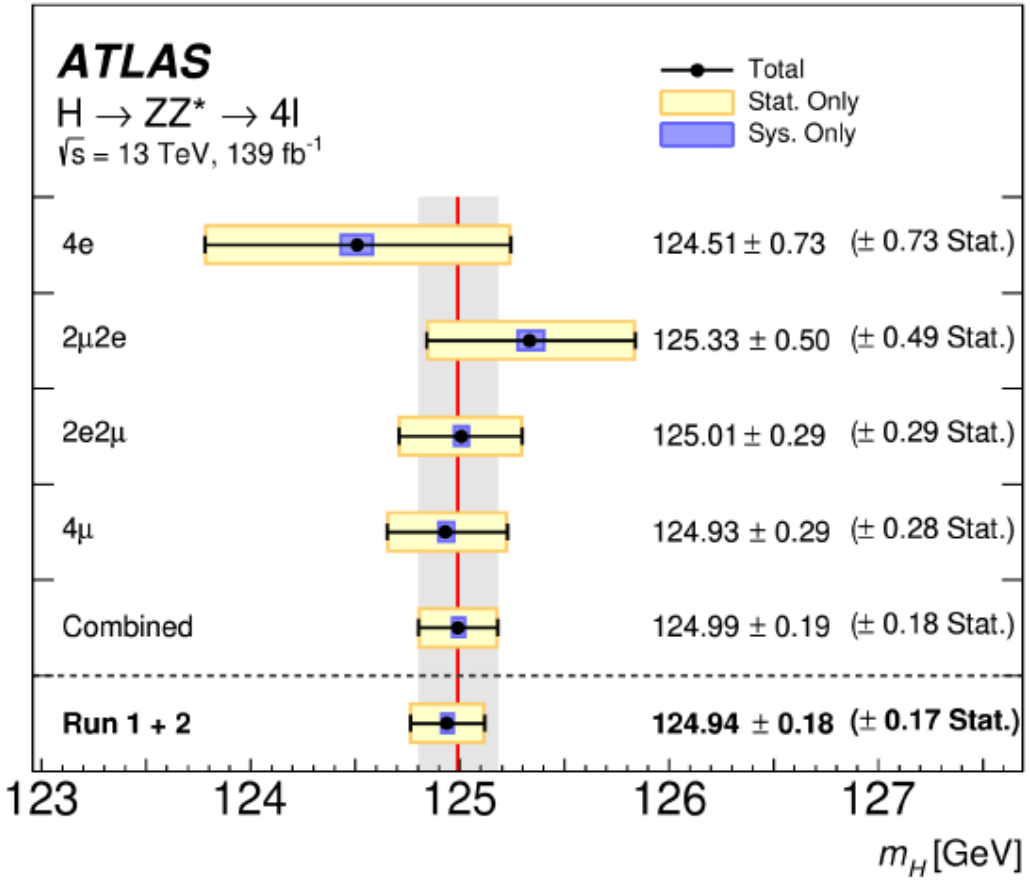




ATLAS Measurement of the Higgs Boson Mass

Run 2 data



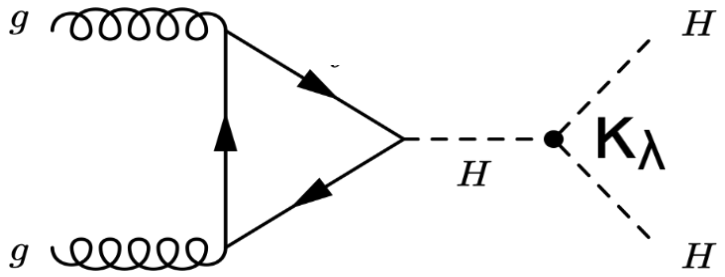


0.15% precision!

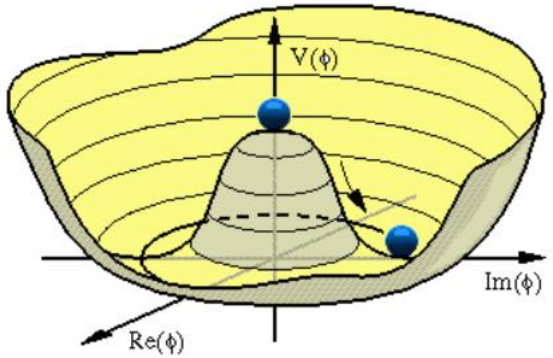
ATLAS Di-Higgs Boson Production

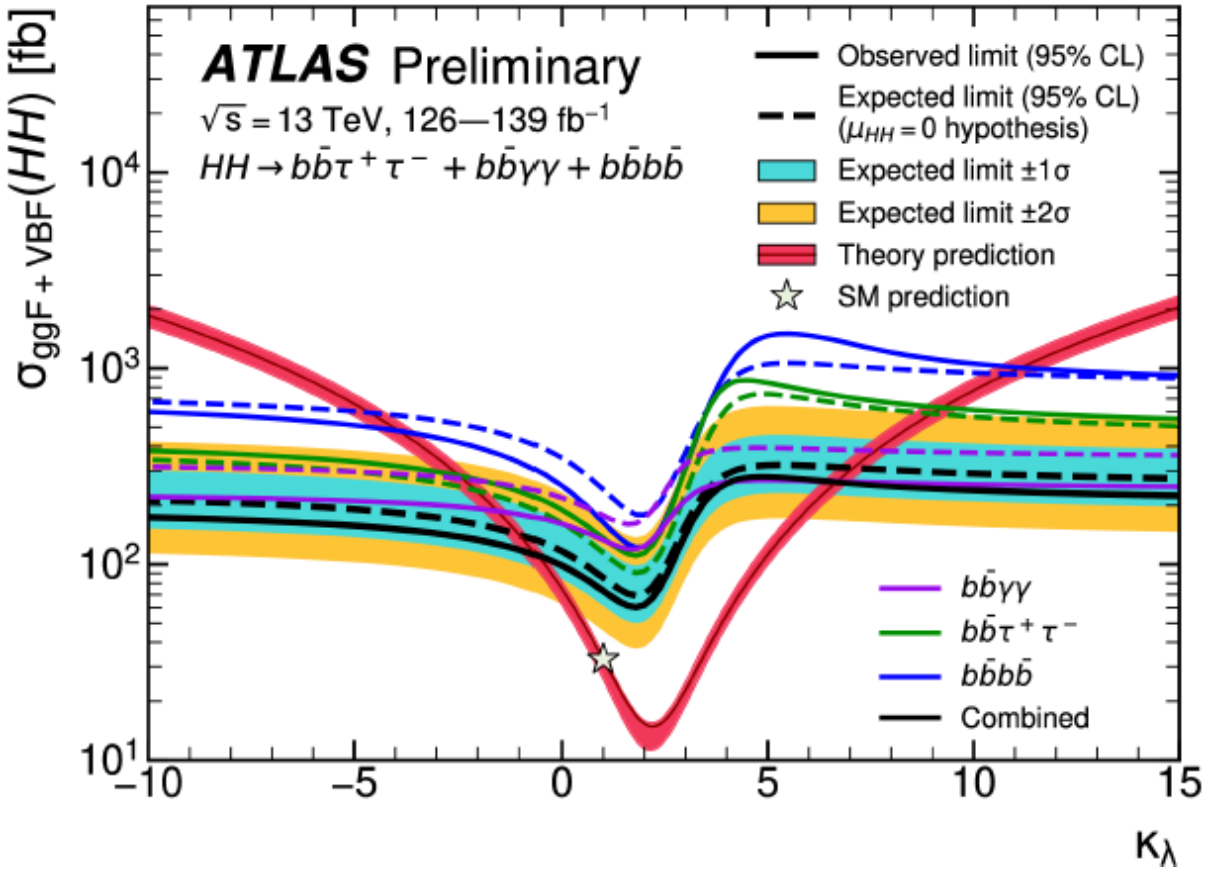
Higgs self-coupling:

Key to understand the Higgs potential



$$\mathcal{L} \supset \frac{1}{2}m_h^2 h^2 + \frac{m_h^2}{2v}h^3 + \frac{m_h^2}{2v^2}h^4$$





Upper limit cross section:

$$\sigma_{HH} < 2.4\ \sigma_{HH}^{SM}$$

One of the main objectives for HL-LHC

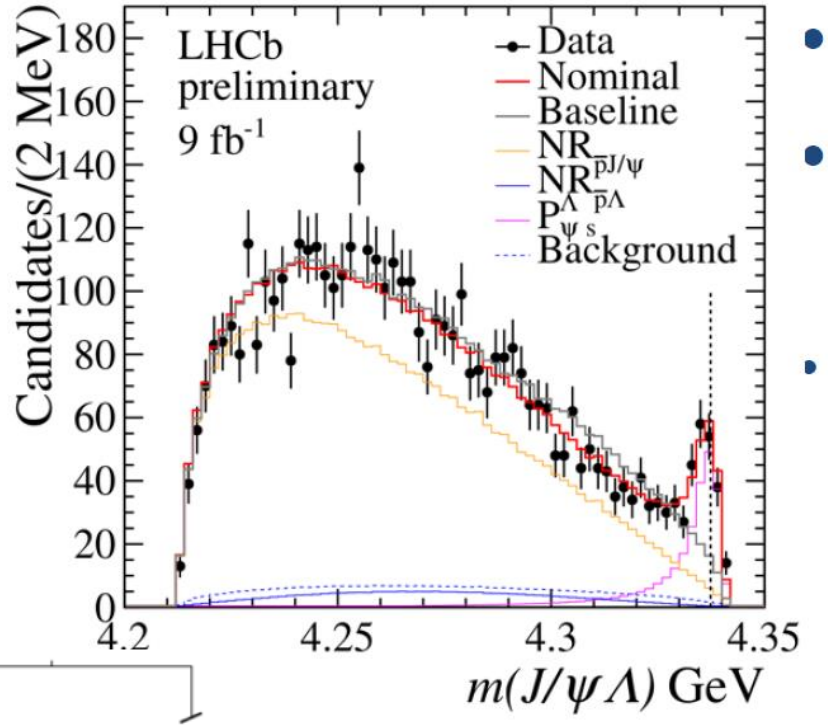
LHCb: New Exotic States

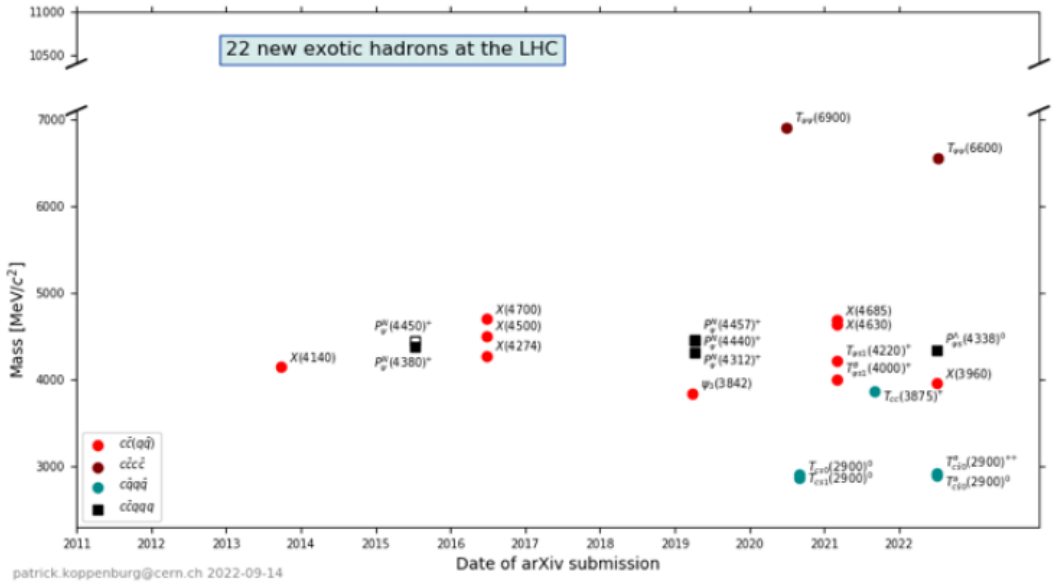
- First strange pentaquark
- Tetraquark isospin partners
  - Starting to build up multiplets
  - First doubly charged tetraquark
- 22 new exotic states discovered at the LHC (in total > 60 new states)
- LHCb proposed a new naming scheme

$P^{\Lambda}_{\psi s}(4338)^0$ $c\bar{c}sud$

$T^{a}_{c\bar{s}0}(2900)^{++}$ $c\bar{s}u\bar{d}$

$T^{a}_{c\bar{s}0}(2900)^{0}$ $c\bar{s}\bar{u}d$





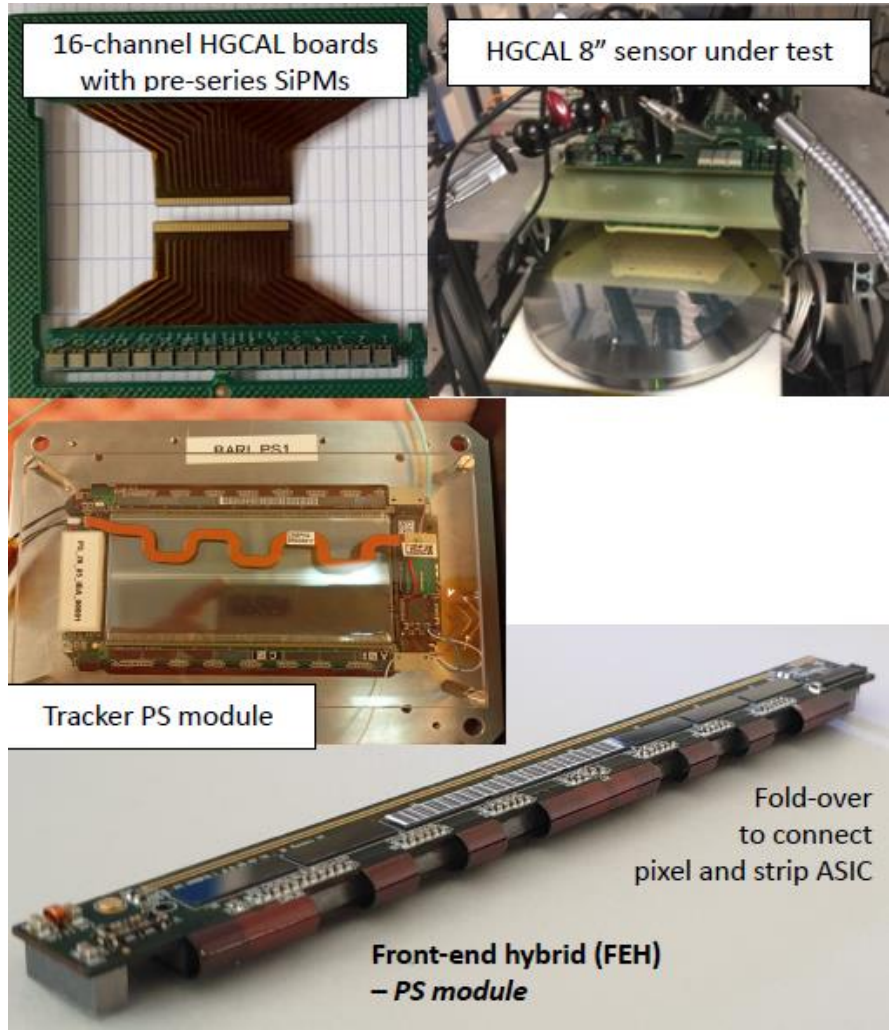
Phase II

Good progress for ATLAS and CMS

Area of concern: ASIC design, validation and procurement

CMS (examples):

- ❑ HGCAL
  - ❑ Si-sensor production Readiness Review successfully passed
  - ❑ 5 module assembly centres qualified for pre-series
  - ❑ Concentrator ASICs progressing – but on critical path
- ❑ Inner Tracker
  - ❑ Planar sensor tender contract in preparation
  - ❑ Irradiation & test beam of 3D and planar modules completed
  - ❑ Delay in readout ASICs
- ❑ Outer Tracker
  - ❑ Sensor production continues
  - ❑ Hybrid contract signed
  - ❑ Final module prototypes built

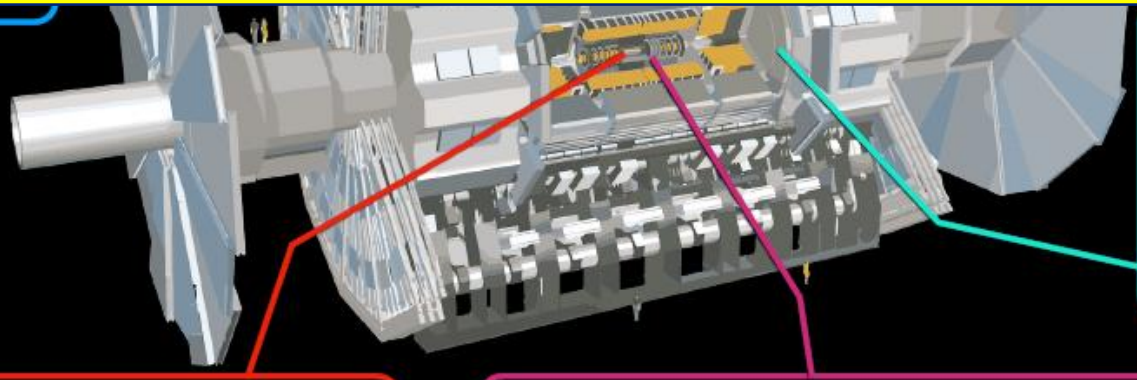


ATLAS
Upgrade project status

TDAQ:
- Resource conflicts with Phase-I commissioning
  - L0Calo, EF tracking
- EF technology choice 2025

Muons:
- sMDT good progress
- RPC FE ASIC discussed CERN CHIPS — progres but schedule slippage

Challenges for the ATLAS & CMS Phase II Upgrades:
- ❑ Price increases and procurement issues
- ❑ Contributions from institutes in Russia



HGTD:
- Sensor FDR passed
- Delayed submission of ALTIROC_V3 — critical path

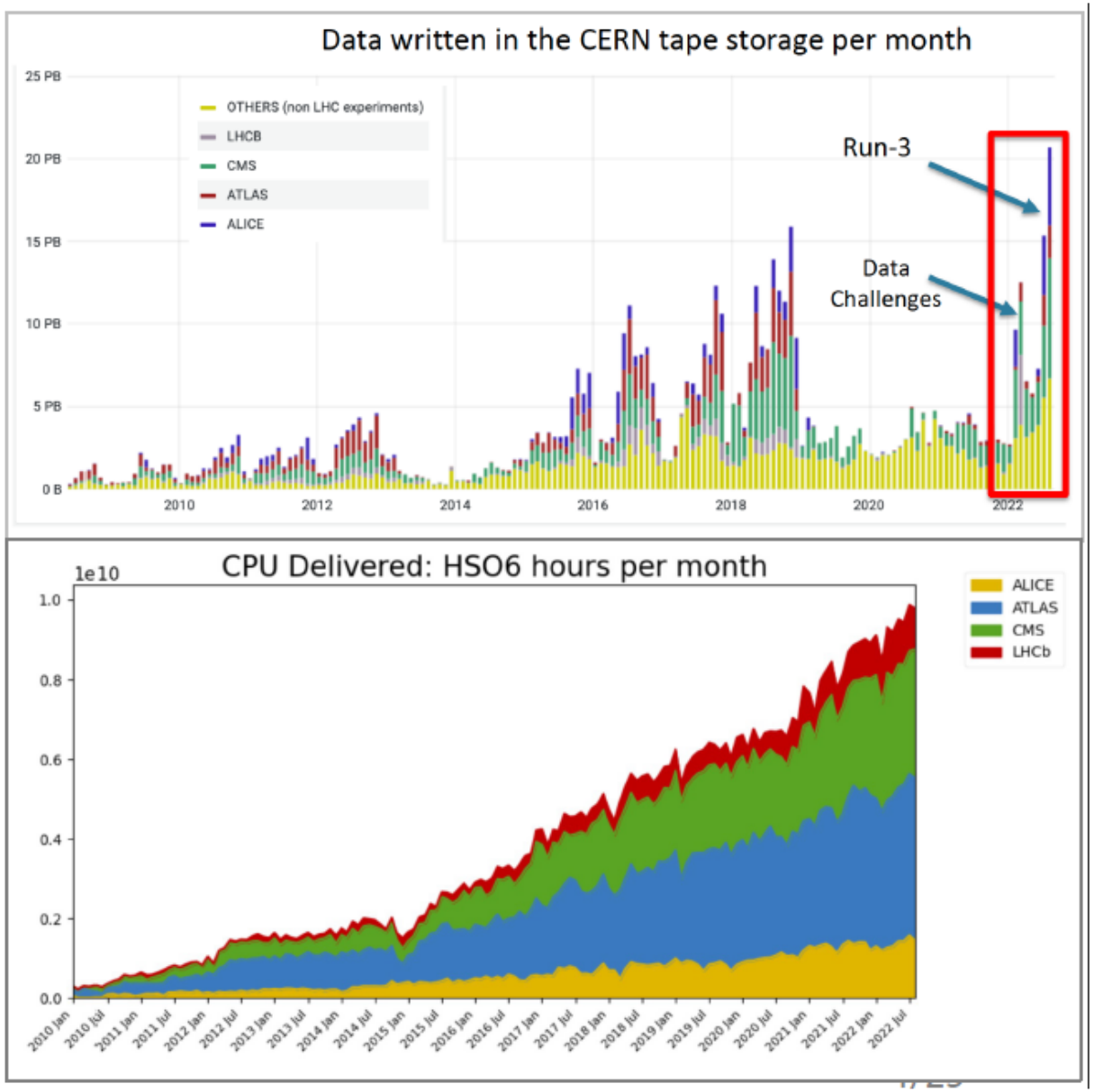
ITk Pixel: critical path, 6 months contingency
- Module FDR passed, Loaded Local Support FDR anticipated Nov ’22
- Readout chip ITkPixV2 submission Nov ’22
- Attention: data cables, routing, carbon foam

ITk Strips:
- Sensor delivery accelerating but still watched
- FE AMACStar Production Readiness Review passed
- Noise issues under investigation (split endcap modules, DCDC converters)

Status WLCG

WLCG is operating efficiently in Run 3

- CERN tape storage write
  - >15 PB written by LHC experiments in August 2022
- Experiments → Tier-0 network use
  - On average well below peaks expected during Run 3
  - Bursts during commissioning activities testing link capacity
- WLCG global transfer
  - Moderate increase of rate
- Capacity
  - Pledges continue to be delivered by WLCG
  - About 30% opportunistic capacity



Status Data Centre in Prévessin

2022

- End 2022: Civil engineering and structural work to be completed
- December: Tender for first installation of servers to be adjudicated at the FC

2023

- Summer: Delivery and installation in PCC planned (very dependent on actual delivery delays at the time)
- 3rd quarter: Data Centre ready for commissioning
- End 2023: Inauguration Ceremony foreseen

Open Science Policy

- **Open Science was recognized as a key organizational issue for the field in the European Strategy for Particle Physics (2020)**

  "The particle physics community should work with the relevant authorities to help shape the emerging consensus on open Science and should implement an Open Science Policy for the field"

  (ESPP update, 2020)

- **Open Science is increasingly recognized as a key element of international, national and research funder policies**
  - UNESCO Recommendation on Open Science released in Nov 2021
  - 22 of the 23 CERN MS have Open Science related policies in place or under development
  - Open Science practices are increasingly mandated by research funders

CERN Open Science Policy

- **Developed collaboratively by Working Group consisting of representatives from across departments and experiments (LHC/non-LHC)**
- **Captures current practice and states progressive vision across multiple Open Science domains:**
  - Open Access to Publications
  - Open Research Data
  - Open Software
  - Open Hardware
  - Research Integrity, Reuse & Reproducibility
  - Infrastructure for Open Science
  - Research Assessment & Evaluation
  - Education, Training & Outreach
  - Citizen Science
- **Policy to be regularly updated to reflect changes in landscape, practices, funder requirements & community demands**
- **More information:** https://openscience.cern

Summary

- Very good start of Run 3
- Experiments continue to produce excellent scientific results
  - incl. a first example from Run 3 data
- Good progress in Phase II upgrades
  - but challenges due to worldwide economic and political situation

Big thank you to

- All people who contributed to the successful start of Run 3
- All Funding Agencies for their continuous support