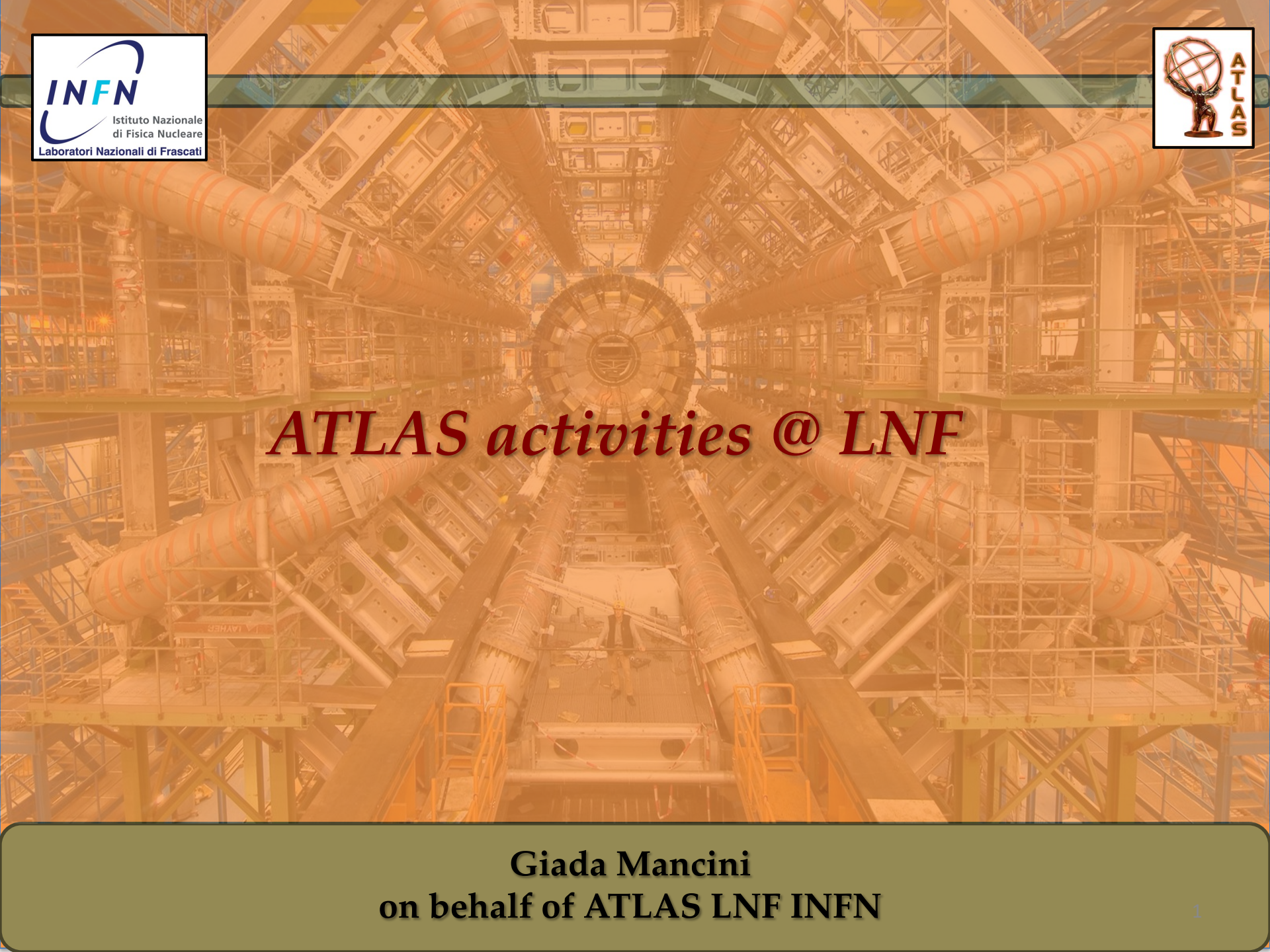


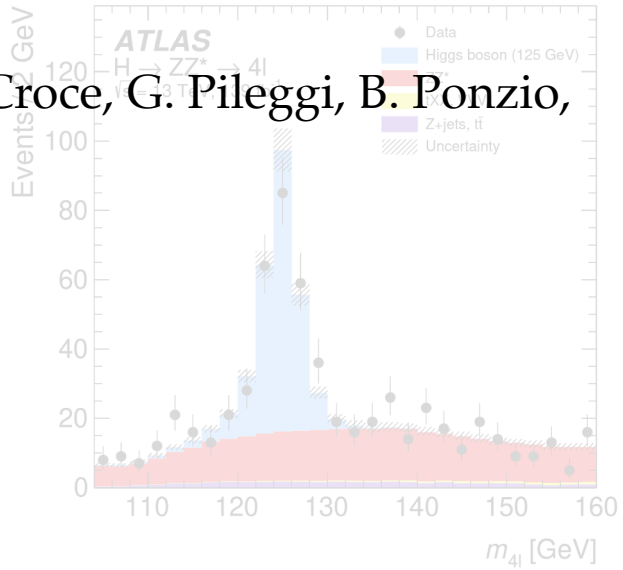
ATLAS activities @ LNF

Giada Mancini
on behalf of ATLAS LNF INFN

Anagrafica 2024 ATLAS (+FASE2+Sinergiche)

Cognome	Nome		Profilo	Percentuale	
Albicocco	Pietro	Dipendente	Tecnologo	30%	Fase2
Antonelli	Mario	Dipendente	Dirigente di Ric.	100%	
Arcangeletti	Chiara	Dipendente	Assegnista di Ric.	100%	
Beretta	Matteo Mario	Dipendente	Tecnologo	70%	Fase2
Cesarini	Gianmario	Dipendente	Assegnista di Ric.	100%	Fase2
Chiarella	Vitaliano	Dipendente	Associato Senior	0%	
Chubinidze	Zaza		Assegnista di Ric.	100%	Fase2
Dane'	Emiliano	Dipendente	Tecnologo	50%	Fase2
Gongadze	Levan		Assegnista di Ric.	100%	
Ligi	Carlo	Dipendente	Tecnologo	10%	Fase2
Li Voti	Roberto	Associato	Prof. Ordinario	70%	
Mancini	Giada	Dipendente	Tecnologo	100%	
Paraskevopoulos	Christos		Borsa Stranieri	100%	
Sansoni	Andrea	Dipendente	Primo Ric.	70%	
Testa	Marianna	Dipendente	Ricercatore	80%	Fase2
Tomassini	Sandro	Dipendente	Primo Tecnologo	40%	Fase2
Abritta Costa	Igor			50%	Sinergico
Curciarello	Francesca			100%	Sinergico
Vilucchi	Elisabetta	Dipendente	Tecnologo	90%	Sinergico
TOTALE				**13.6 FTE**	

Activities and Responsibilities



ATLAS Technical Team: M. Battisti, E. Capitolo, A. Croce, G. Pileggi, B. Ponzio, F. Rosatelli (+S. Lauciani on demand ;))

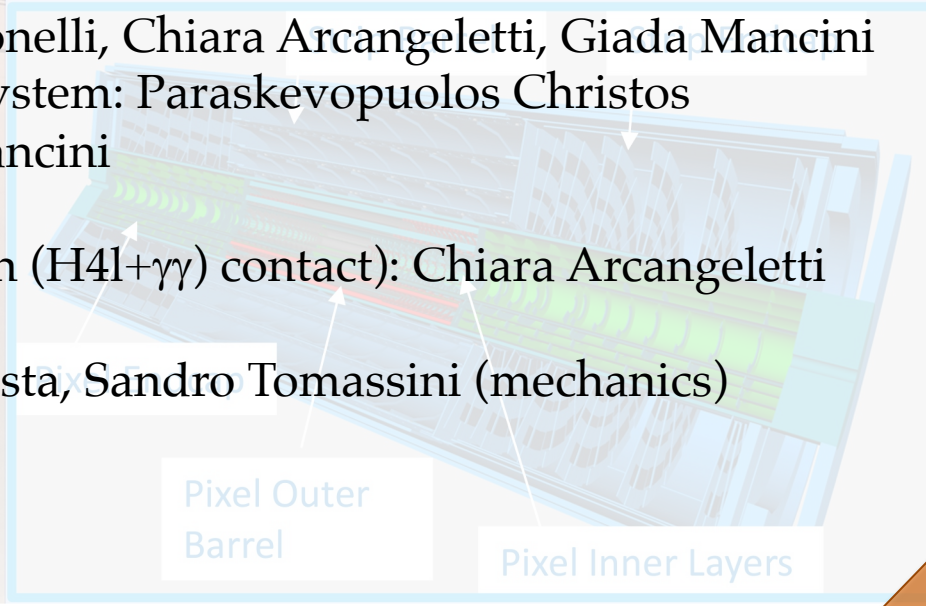
LNF ATLAS Group Leader: Mario Antonelli

LNF ATLAS Muons:

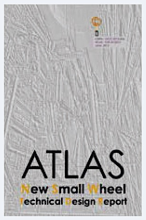
NSW Project Leader: Mario Antonelli
NSW Primary Experts: Mario Antonelli, Chiara Arcangeletti, Giada Mancini
DCS Coordinatore for the Muon System: Paraskevopuolos Christos
Muon Institute Member: Giada Mancini

LNF ATLAS Analysis (H4l and Combination (H4l+γγ) contact): Chiara Arcangeletti

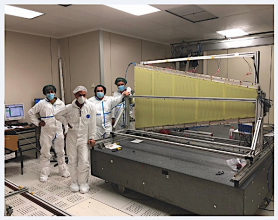
LNF ATLAS ITk Coordinators: Marianna Testa, Sandro Tomassini (mechanics)



NSW Roadmap

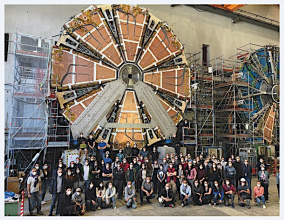


ATLAS TDR
2013

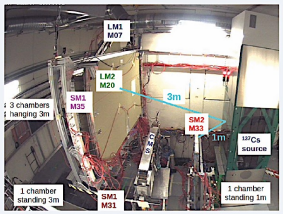


Module production
2018-2020

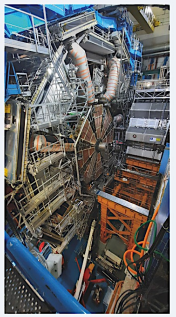
Integration at CERN 2019-2021



NSW A End Surface
Commissioning 18/06/21



MM validation of the ternary gas
mixture 2018-2022

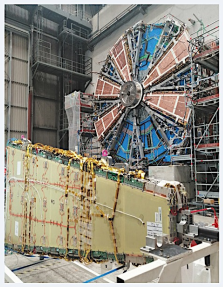


NSWs Underground
Commissioning
10/21-04/22

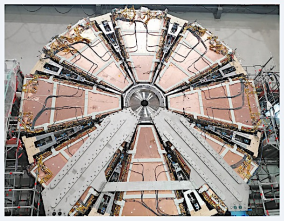
2013 — **2019** — **2020** — **2021** — **2022**

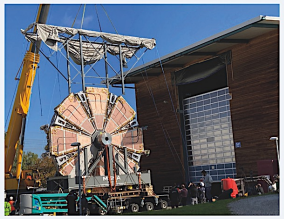
1° sector on the Wheel
12/2019

Surface Commissioning
2019-2021



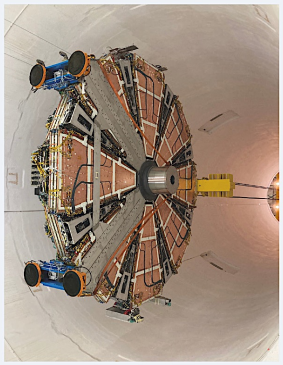
NSW C End Surface
Commissioning 08/10/21





NSW A to the cavern 12/07/21

NSW C to the cavern
15/11/2021



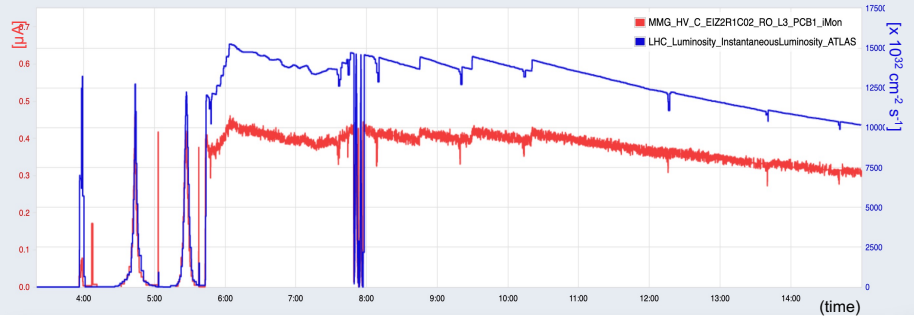
NSWs Running in ATLAS
since 05/2022

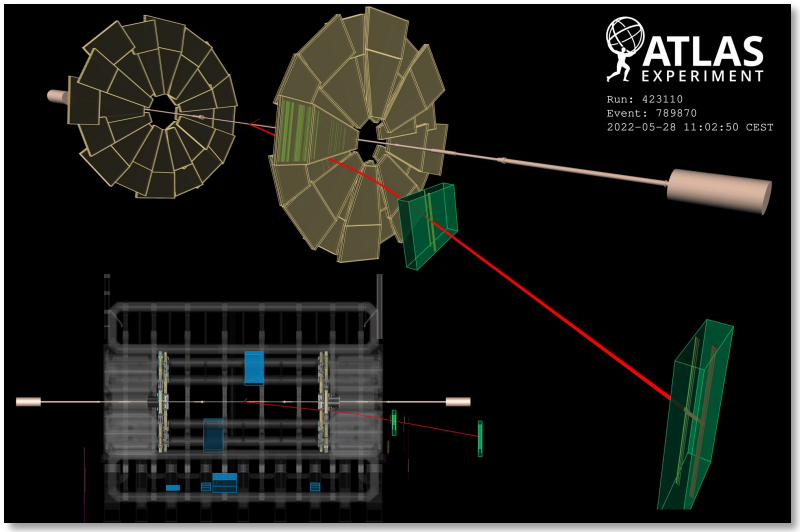
NSW Roadmap (from the LNF Highlights 2022)!

NSWs in ATLAS

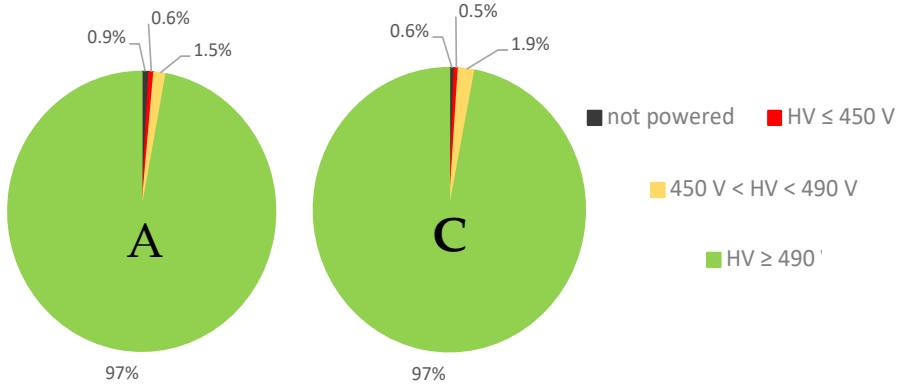
ATLAS Early Run 3 started on 5 July 2022!

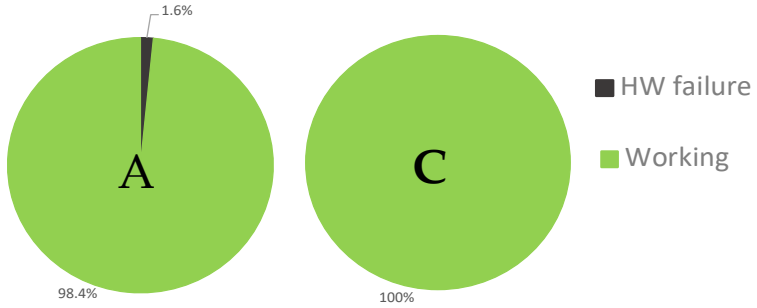
Currents of MM detectors are following the LHC Istantaneous Luminosity amazingly!





NSW HV and LV status:





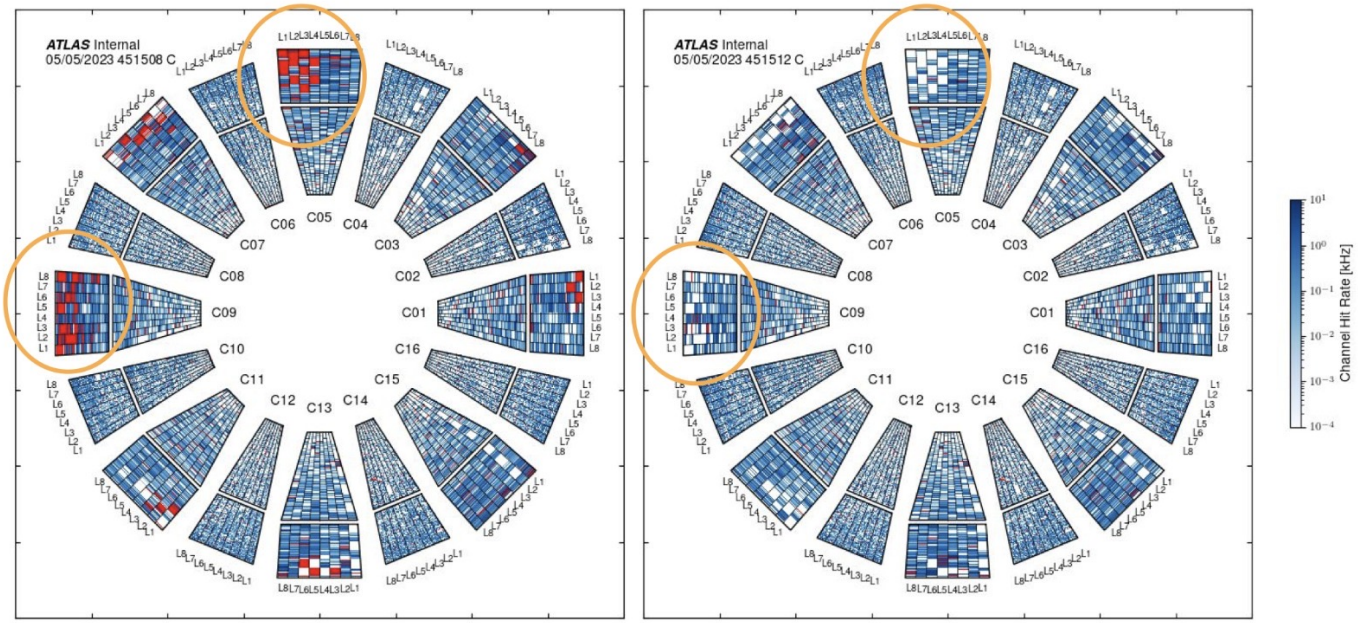
HW failure as from LV known issues that cannot be solved during standard interventions.

2 Drifts not working: 1 layer on wheel A and 1 on wheel C.

E. Capitolo, G. Pileggi, B. Ponzio

Interventions are forseen during EOY shut down period (YETS):

- Interventions on ICS
- Repair of LV distribution on detector
- Improved grounding scheme on detector (anomalous noise in specific location)-> high rate in some locations -> channels masked -> efficiency loss
- Finalization of LV patch panel in Sector 3 if possible

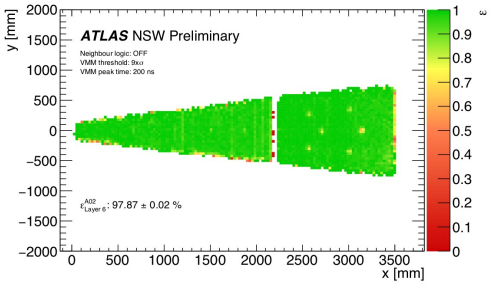


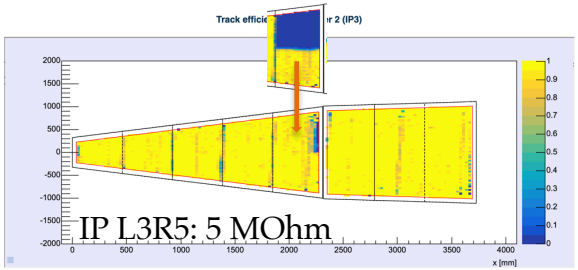
- New masks significantly remove hot channels
- Red channels: rate >10 kHz

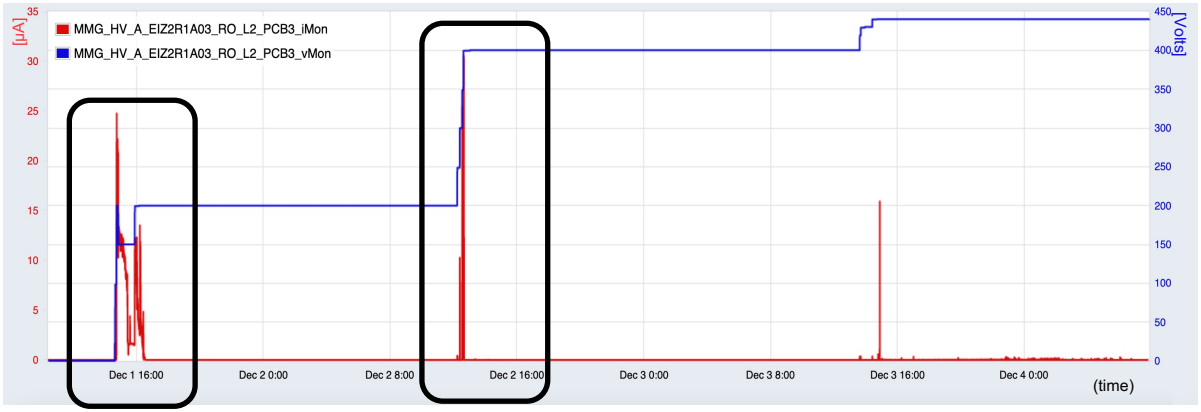
NSW LNF Activity

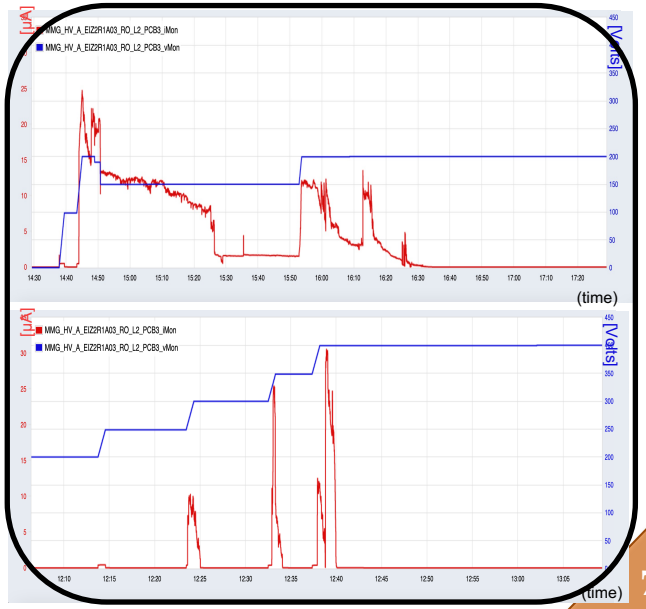
LNF Group: Leading role in construction (Production Manager), commissioning and operation of the NSW MM detectors.

- **Passivation solution to overcome HV issues (still 2-10% of weak HV channels in Ar-CO_2) for single layer fully working (elex and HV) ε~98% via self-tracking**
- **Resistive pcbs -> high stable currents coherent with an equivalent resistor in the amplification gap of 5-10 MOhm** -> weak known points of the pcbs
  - Instead of having OFF sections we only loose few cm
  - Resistive layout allows for Voltage drop only on small region
- **Curing: pure Argon to clean the region by means of sparks** *(Rui De Oliveira)*
  Intensive studies during construction period (part of the validation)
  NOW regular curing during operation -> **50% successful treatments -> channels reaching stability up to nominal HV**





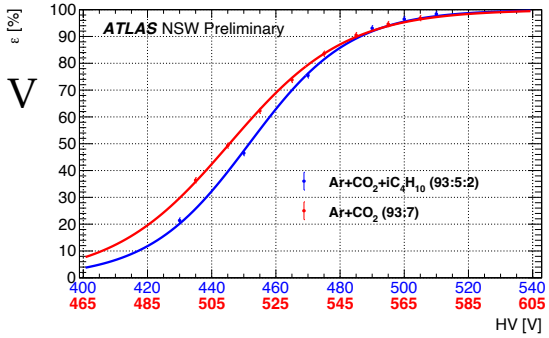


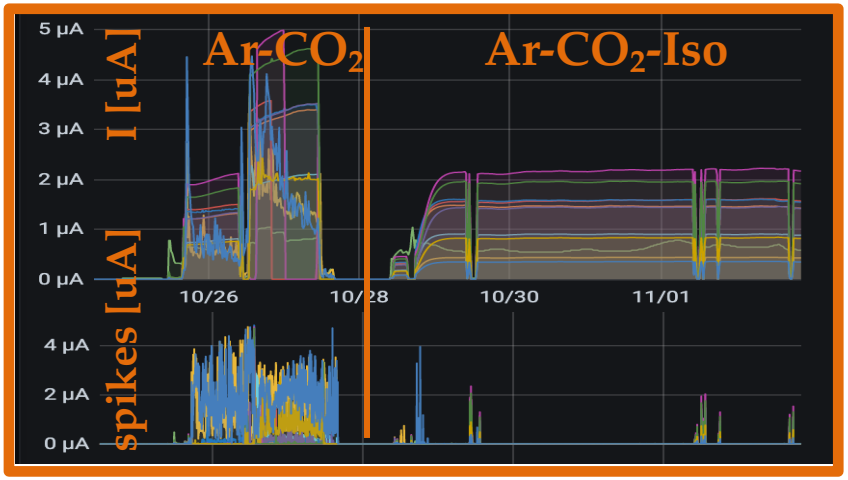


LNF Group: Leading role in construction (Production Manager), commissioning and operation of the NSW MM detectors.

- **New ternary gas mixture Ar:CO_2:Iso (93:5:2):**

iC_4H_{10} allows to lower the working HV, wrt 570 V in Ar-CO_2 having better stability, higher gain and better performances!

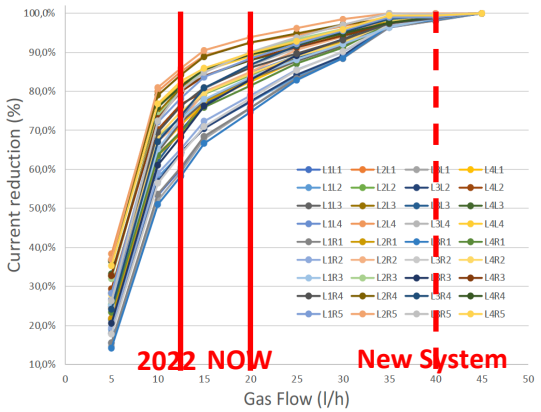




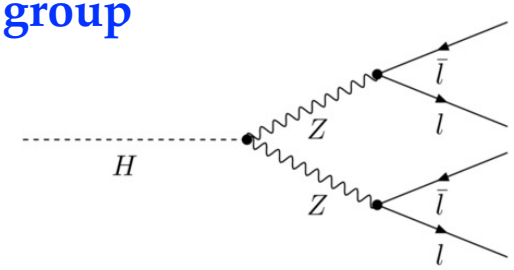
obtained at LNF Capannone Gran Sasso (Feb 2020)

- **Performance studies as a function of the gas flux and proposal of upgrading the fluximeters to achieve better detector performances:**
  increasing the gas flux by +80% (NOW) -> we expect +30% on average on the charge and less spread

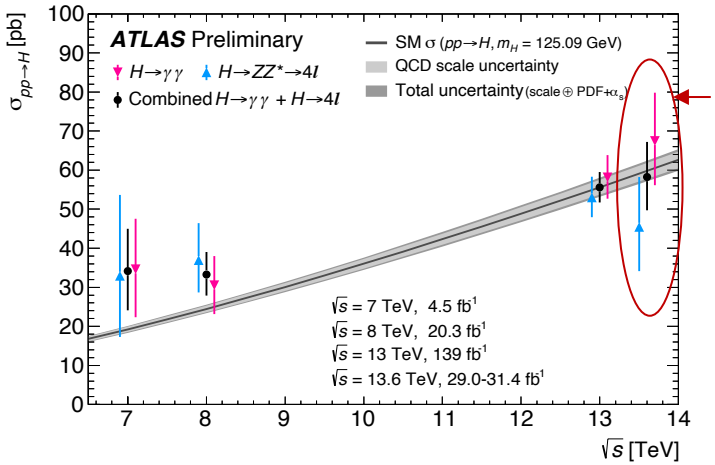
- **Online tools (current monitoring via Grafana) developed for monitoring, data-quality control and analysis (S. Lauciani)**
  Thanks to DB Experts, now exported to many systems in ATLAS



LNF is involved in H→ZZ* and Higgs Combination ATLAS group

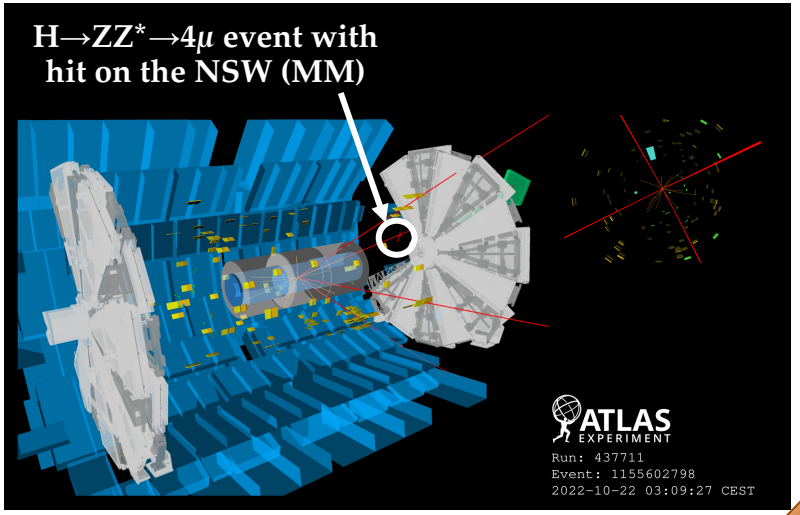


- Run2 stat.: Test of the CP–Invariance of the Higgs boson in VBF and H→ZZ*→4l decay channel (JHEP arXiv:2304.09612)
  -> all measurements are consistent with SM expectations (CP-even), no significant CP-odd component observed
- Run 2 stat.: Higgs Mass Combination: ongoing -> combined measurement of the Higgs boson mass (H4l and γγ)
- **Early Run 3 dataset @ 13.6 TeV**: Higgs boson production fiducial XS measurement -> (EPJC arXiv:2306.11379)



First Higgs boson production XS measurement @ 13.6 TeV

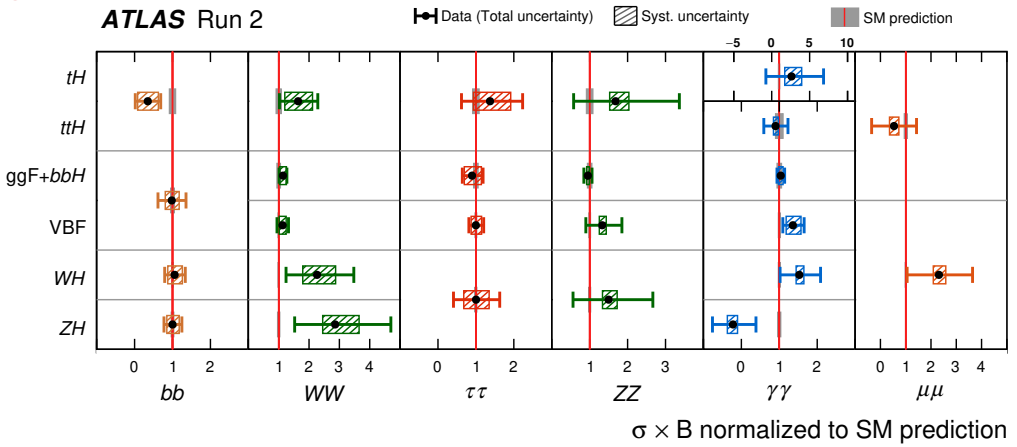
Run 3 Era just began!



Plans:

- **First measurement of the H boson couplings at 13.6 TeV** in the H4l decay channel

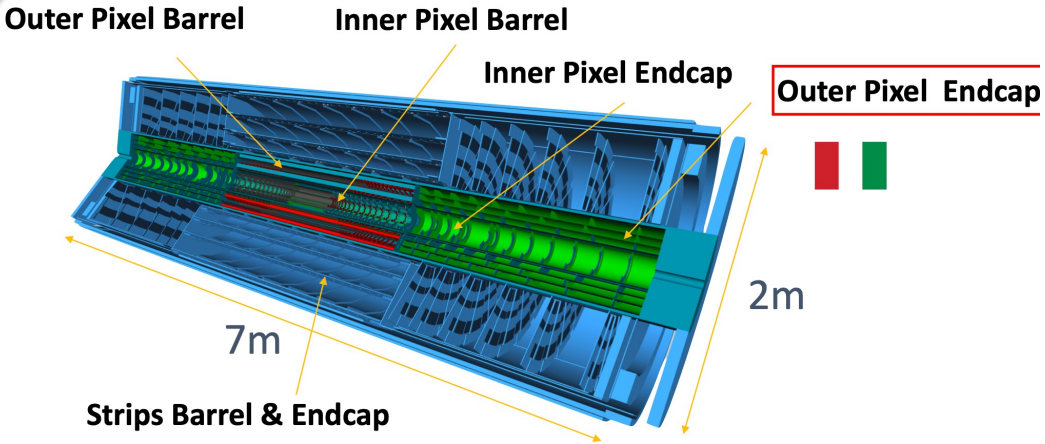
- **Combination of the coupling measurements between decay modes and between experiments to reach higher sensitivity** (for the evidence of the H→Zγ decay channel as an example)



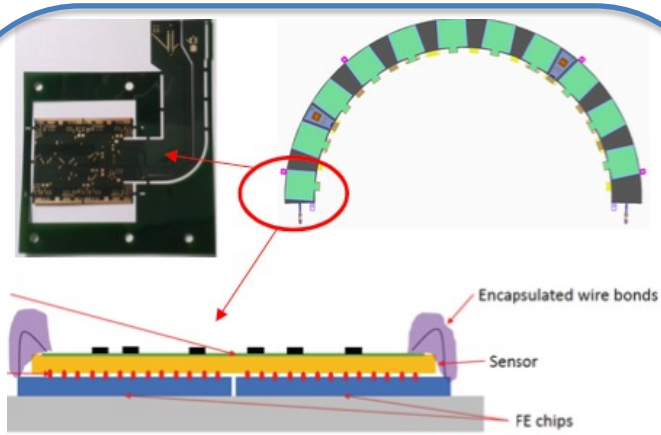
- **Investigation of Beyond Standard Model Physics in the Higgs sector**
  - Studies within the Effective Field Theory framework (H→ZZ*→4l channel as well as on the combined measurement) with more statistics → expected sensitivity improvement, especially in statistically limited channels as the four-lepton one
  - Investigate new possible H→ZZ* final states to gain statistics and probe New Physics in the Higgs sector at higher energy scale

ITk Activity

During LS3, ATLAS will install a new inner tracker, all silicon based (with strips and pixel sub detectors) to cope with the higher luminosity forseen for the HL-LHC Runs



Italy will build one outer pixel endcap (OPE), LNF is responsible for the integration and testing of one OPE

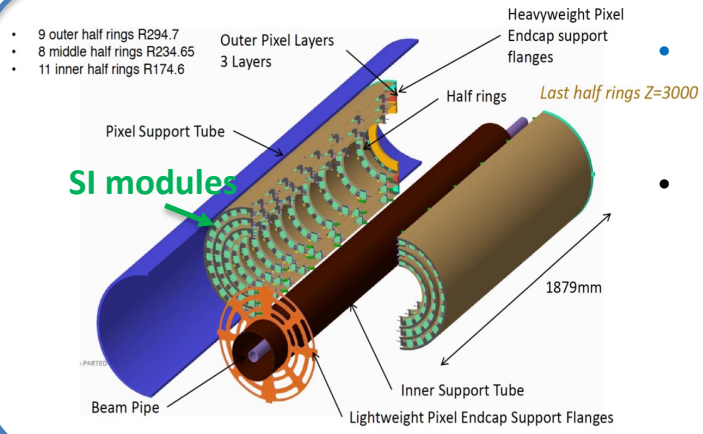


Hybrid modules

- Sensor bump bonded to FE chip
- 1172/endcap

FE:

- 65 nm technology
- 50 x 50 mu pixel size
- 8912 data link / endcap from modules to off-detector electronics

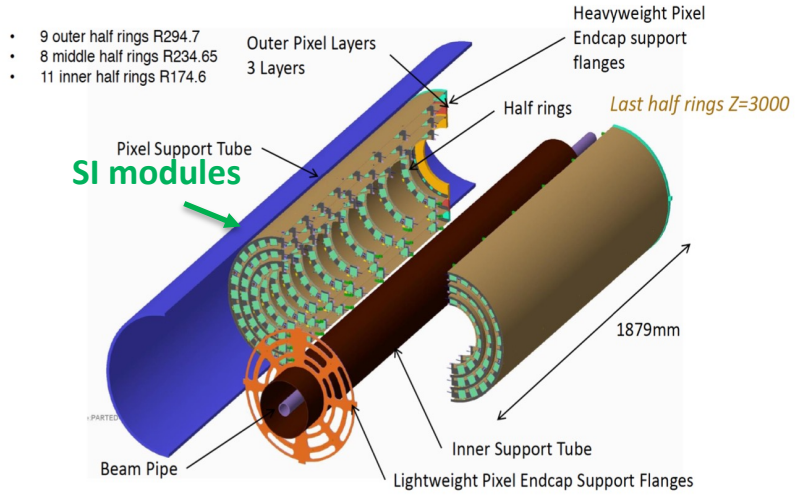


- **carbon fiber** half cylinder shell supports
- novel **ring** system to optimise coverage (up to η=4): min 9 (13) hits in the barrel (forward)

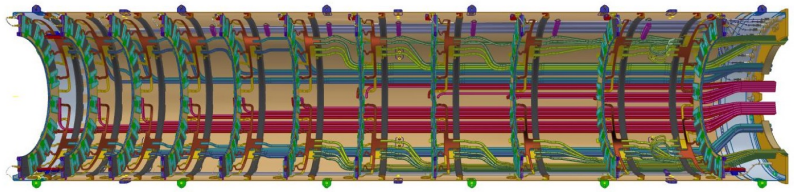
Assembly and commissiong of one outer pixel endcap

Workflow:

0. Half-ring reception test
1. insertion of services – cooling lines, data/pwr cable-and half-ring with silicon modules
2. Testing functionality (cooling with CO_2)
3. Thermo-clycles test with detector OFF
4. Making couple of half-shells to form a layer
5. Shipment to CERN



1



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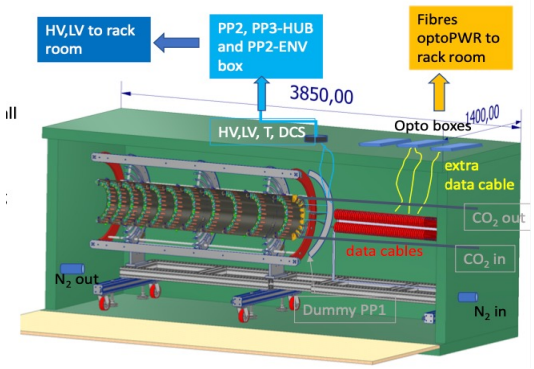

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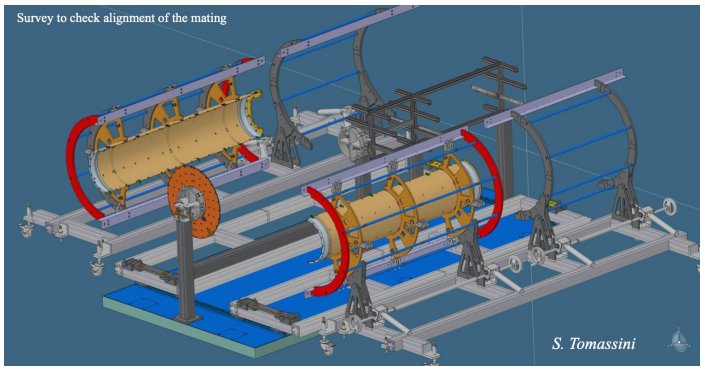

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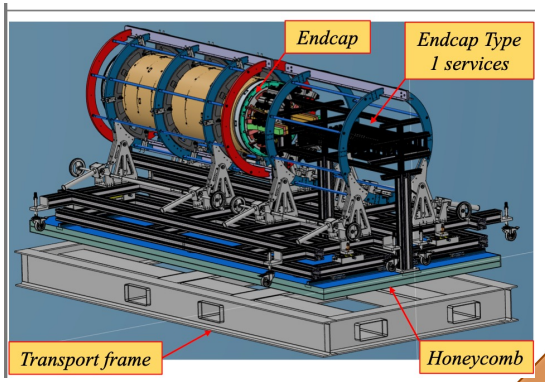
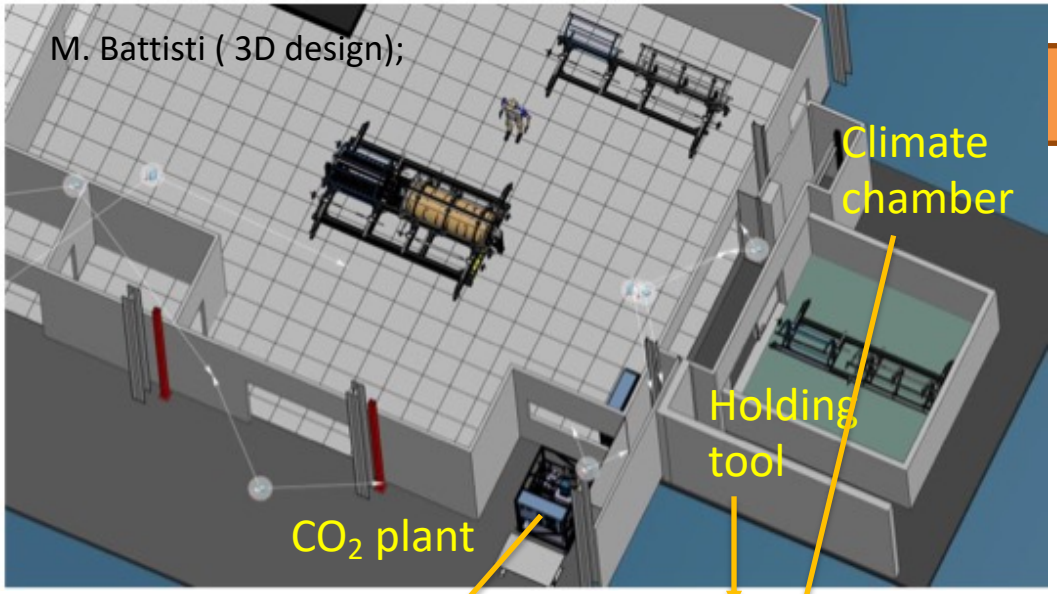
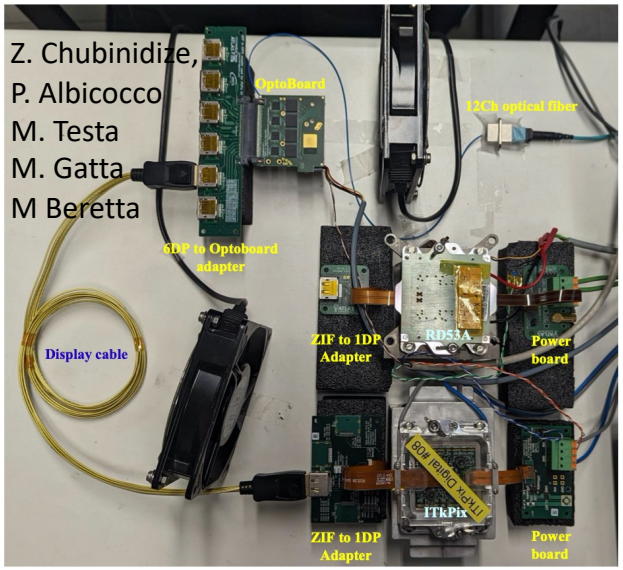


ITk Activity Status

- Prototype holding tool almost ready
- Climate Chamber commissioned
- CO_2 plant commissioned at DESY;
  - test in progress at LNF
- System Test:
  - Modules reading, Interlock, DCS
  - Interface board design and testing
- Clean room: work restarted recently (end of september - october)



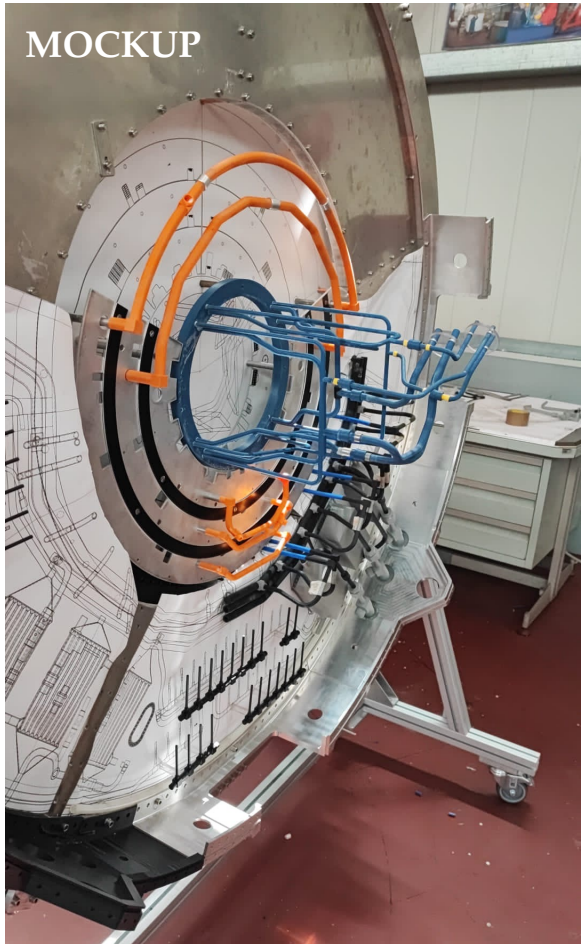


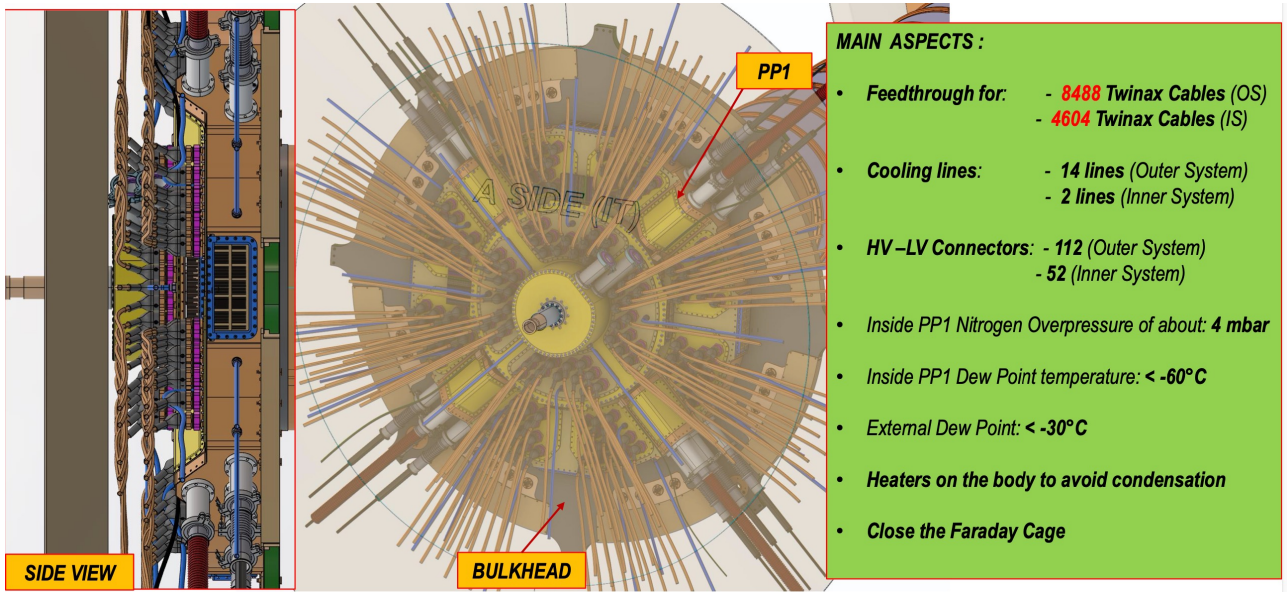
Patch Panel 1

PP1 is the patch panel designed to collect all the services exiting from the ITk detector (strips+pixels)

- Mechanics design
- Cabling and piping design
- Services (feedthroughs, heaters, shielding)
- Production

Mockup realization in collaboration with Naples





S. Tomassini, E. Dane', F. Rosatelli, G. Cesarini, B. Ponzio, M .Beretta, G. Pileggi, E. Capitolo

ATLAS Richieste

MISSIONI	**[mu]**	**[kEuro]**
Missioni per lo YETS (interventi in caverna):	6 mu	22 kEuro
Missioni Turni Primary Expert	3 mu	11 kEuro
Missioni		14 kEuro + 50 kEuro
Missioni Responsabilità		39 kEuro
Missioni OTP		79 kEuro
Missioni ITk		6 kEuro + 13 kEuro
TOTALE		**234 kEuro**

ATLAS Richieste

Inventario, Consumo

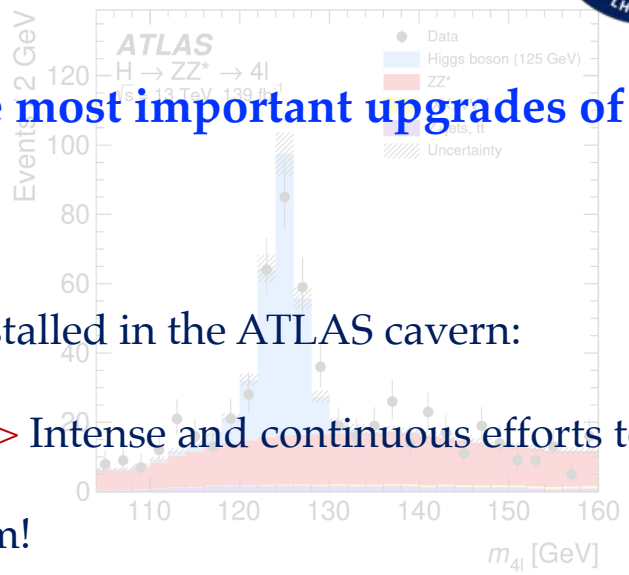
Descrizione	Categoria	non-CORE	CORE	Totale
Manutenzione camera pulita	INFRA	2		
Saldatrice orbitale Polysoude (come a MI)	INFRA	73,5		
Tubazione metallica da essiccatore	INFRA	3,5		
PP1 prototipi DTF	PREPROTO	5		
Supporti per cavi in stampa 3D	PREPROTO	1,5		
Protitipo 1m^3 EC Transport box	PREPROTO	10		
Accessori e consumabili LUCAS	PREPROTO	1		
Cavi tipo 1	CORE - A		20	
Outer endcap structures	CORE - B		100	
Integrazione EC	CORE - B		50	
Prototipi heaters PP1	PREPROTO	2,5		
Prototipi PP1 cooling pipes OB	PREPROTO	13		
Adattatori optoboard-DP per loading	CORE - A		10	
Totale		112	180	292

Consumo metabolico	20.5 kEuro
Richieste calcolo	vedi slide coordinatrice

ATLAS Richieste Servizi 2024

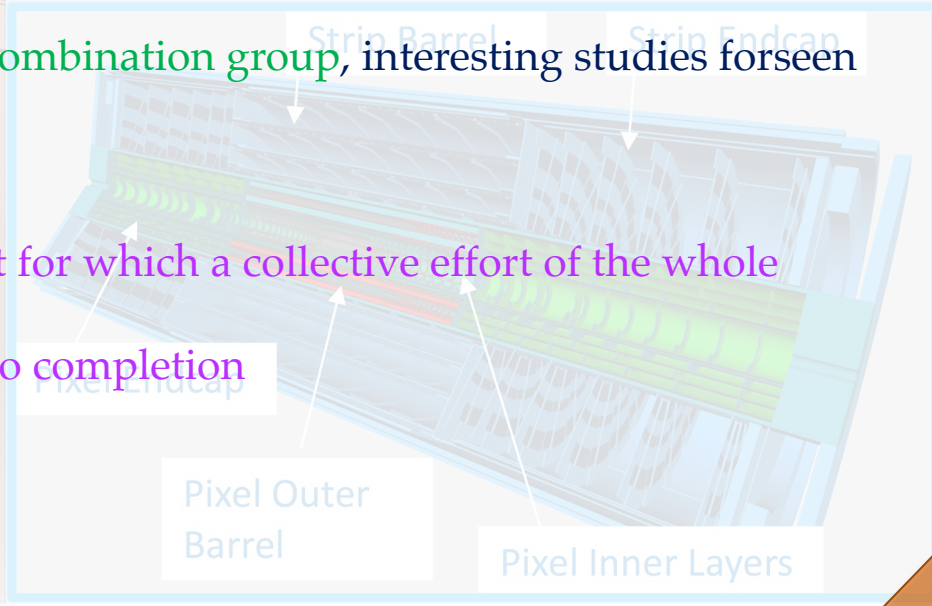
Stima necessità 2024	**[mu]**
SPCM (Servizio Progettazione e Costruzione Meccanica)	6 mu
Reparto Supporto Esperimenti	10 mu
SEA (Servizio Elettronica)	2 FTE Staff +1 FTE
SEM	2.2 FTE

Conclusions

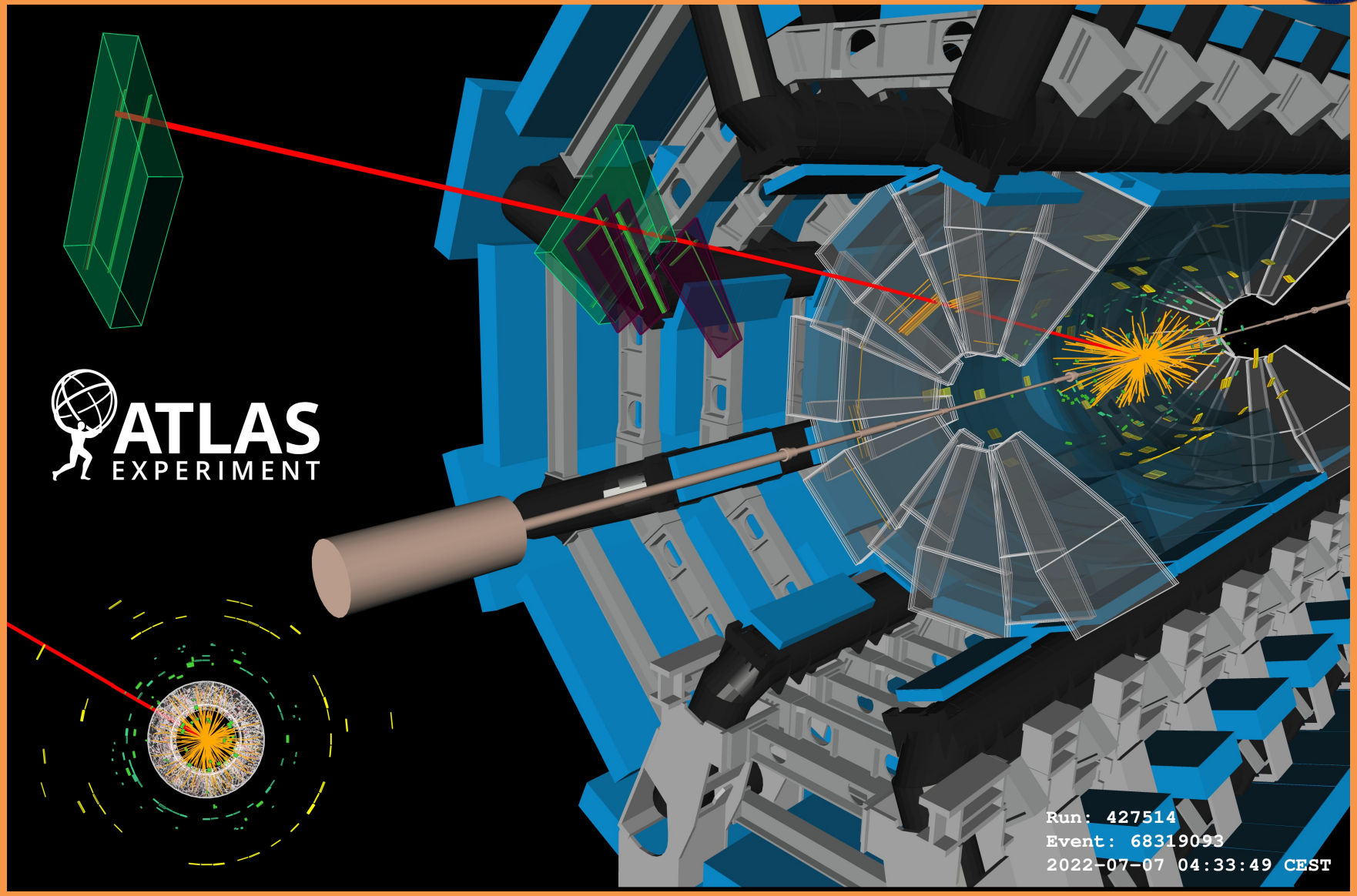


The ATLAS LNF group is strongly involved in the most important upgrades of ATLAS detector for the Phase-1 and Phase-2

- **NSW:** Detectors have been fully commissioned and installed in the ATLAS cavern: Milestone for ATLAS during LHC Long Shutdown 2! -> Intense and continuous efforts to understand and improve the performance of the system!
- **Higgs Anlysis:** key roles within the H4l and combination group, interesting studies forseen with higher luminosity and statistics
- **ITk:** we are involved in this important project for which a collective effort of the whole group will be required to succesfully bring it to completion



Thanks for your attention!



ITk Activity: Richieste

- INFRASTRUTTURE ~ 80 kE
  - Saldatrice orbitale
  - Tubazioni da essiccatori
  - Mantuazione camera pulita

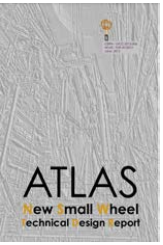
- PROTOTIPI ~ 33 kE
  - Passanti, sistema cooling e scaldatori di PP1
  - Prototipo testing box
  - Consumabili impianto CO_2
  - Stampe 3D

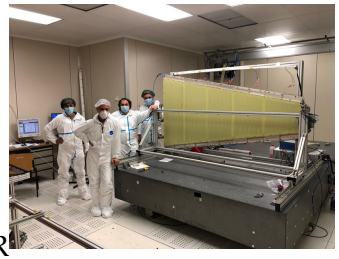
- CORE A ~ 30 kE
  - Servizi elettrici
  - Schede di adattamento

- CORE B ~ 150 kE
  - Tools per assemblaggio
  - Strutture di supporto in fibra di carbonio

Roadmap

ATLAS TDR

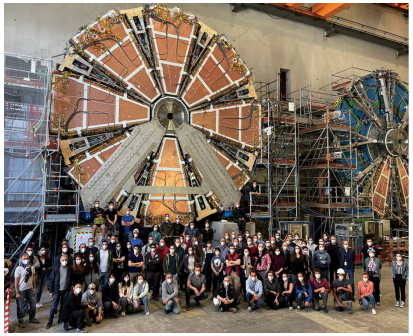




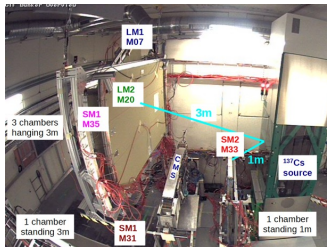
Module production
2018-2020

Integration at CERN
2019-2021

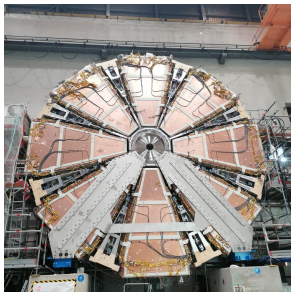
NSW A End Surface Commissioning
18/06/21



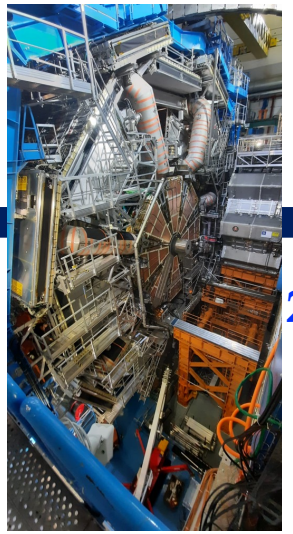
NSW C End Surface Commissioning
08/10/21



MM validation of the ternary gas mixture
2018-2022

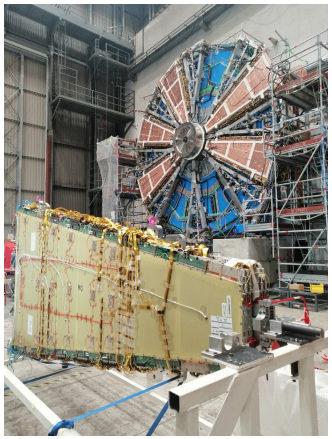


NSWs Underground Commissioning
10/21-04/22



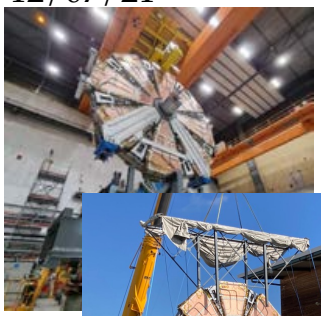
2013 2019 2020 2021 **2022**

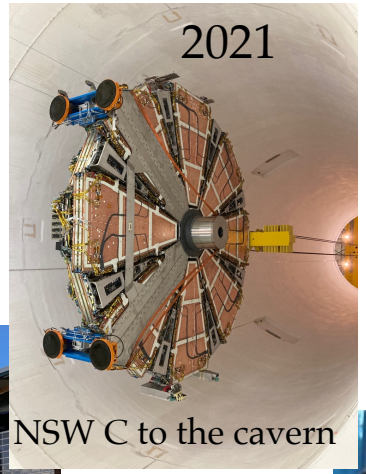
1° sector on the Wheel
12/2019



Surface Commissioning
2019-2021

NSW A to the cavern
12/07/21



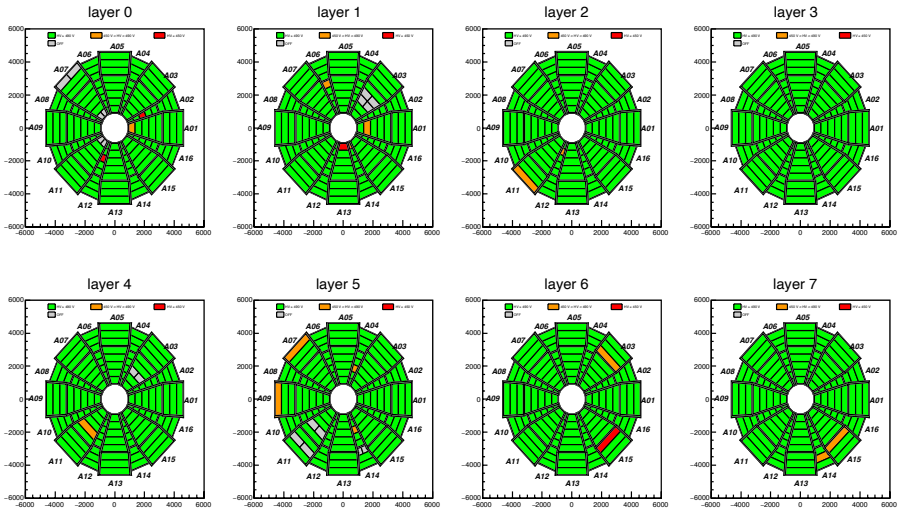


NSW C to the cavern

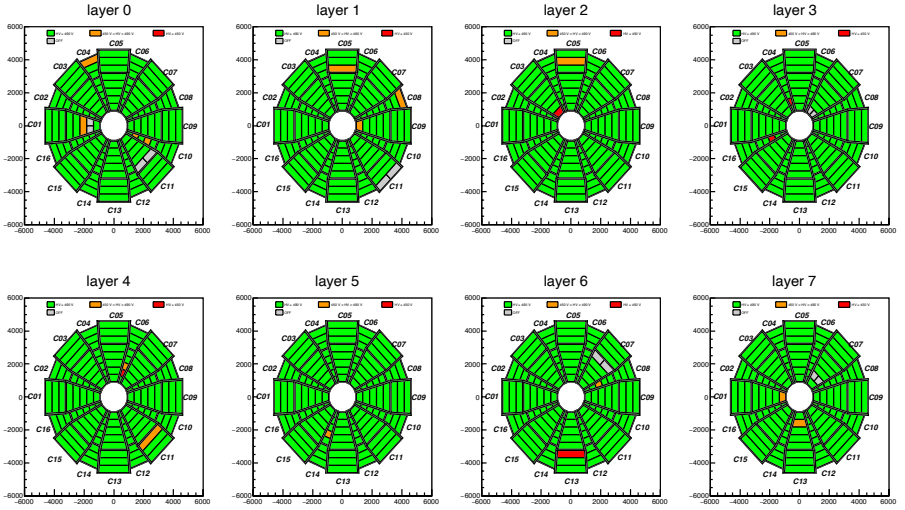
NSWs Running in ATLAS since 05/22

NSWs in ATLAS

A: HV pcb by pcb



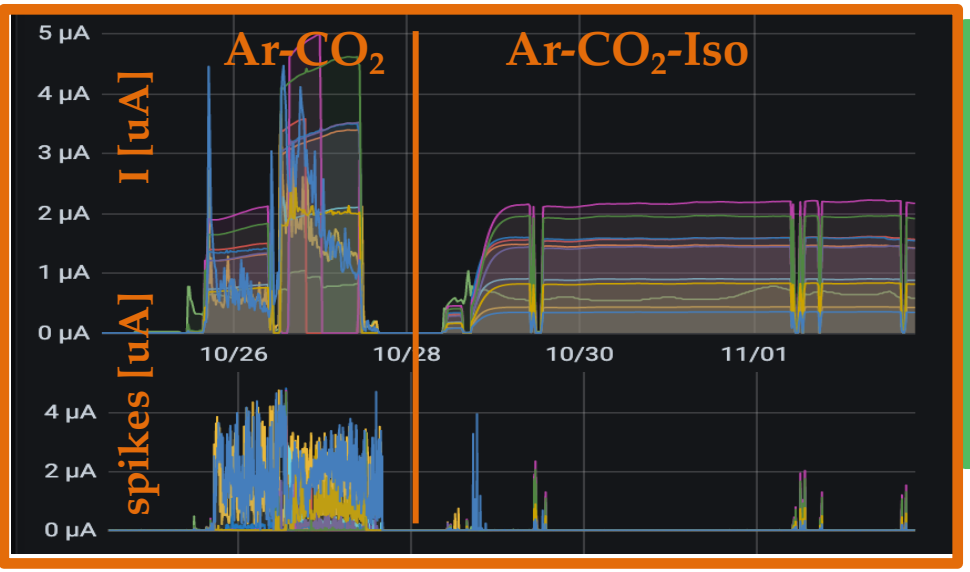
C: HV pcb by pcb

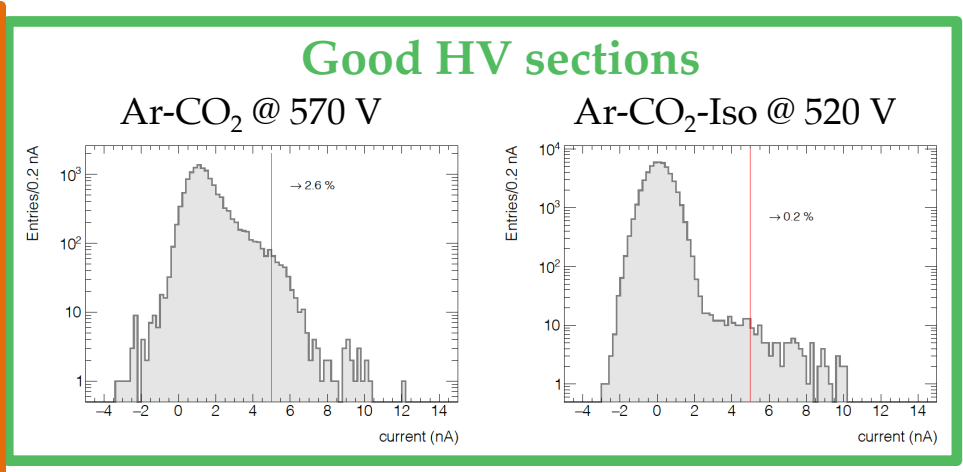


Isobuthane enriched gas mixture

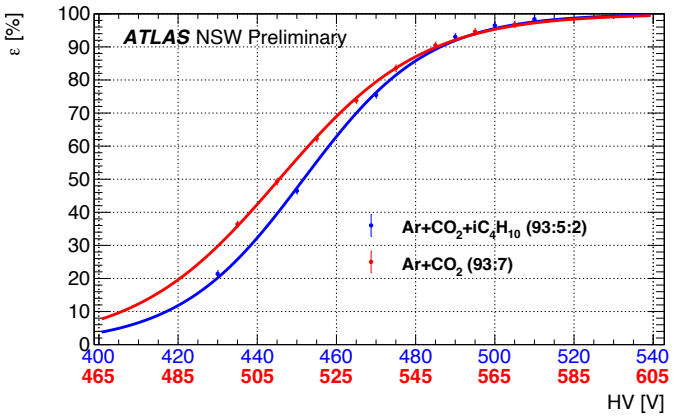
Ternary gas mixture (Ar-CO_2-Iso 93-5-2):

- **Iso allows to run at significantly lower amplification voltages**
- **Bad** HV-sectors behave better with the Isobutane enriched mixture
- Isobuthane addition improves the sparking picture for NSW MMs





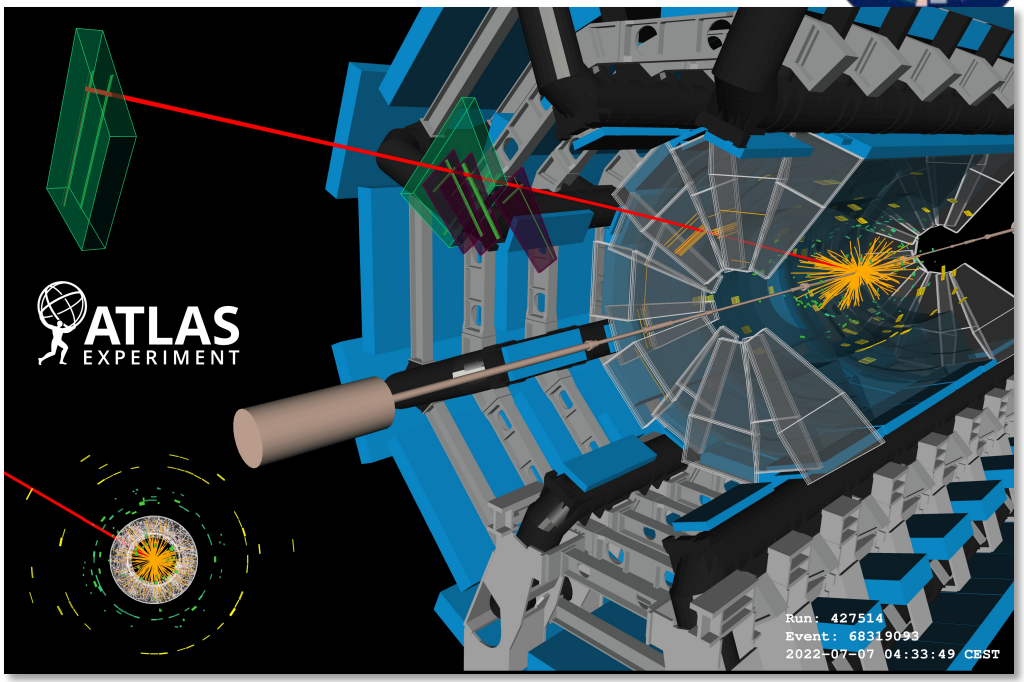
iC_4H_{10} allows to lower the working HV, wrt 570 V in Ar-CO_2 having better stability, higher gain and better performances!



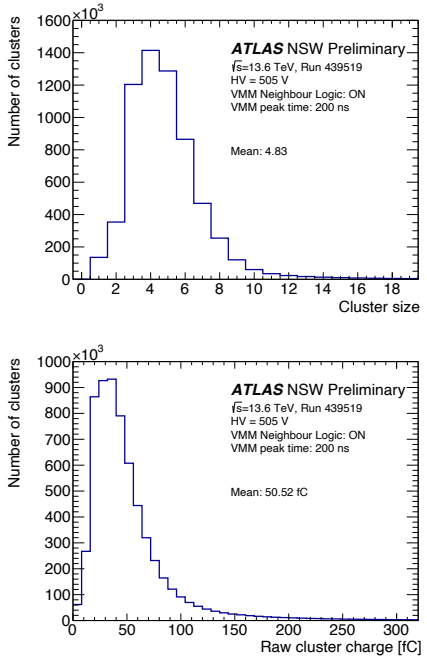
NSWs in ATLAS

- Muons reconstructed by the Inner Detector + Muon Spectrometer traversing the psudorapity region competing to the NSW are reconstructed in the NSW layers.

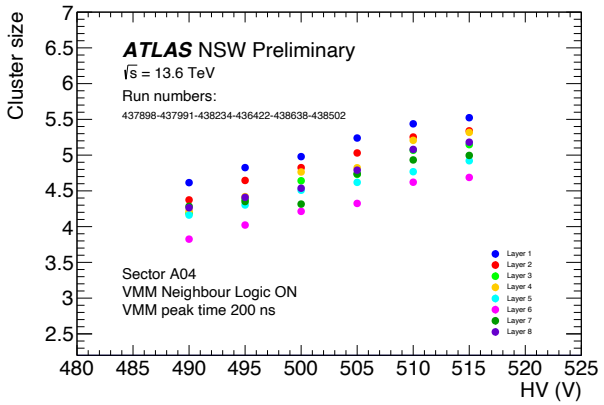
Performances of the MM layers are studied in terms of number of clusters, cluster dimensions and efficiencies as a function of the HV applied to the anode in a spatial window of 5mm wrt the reconstructed track.

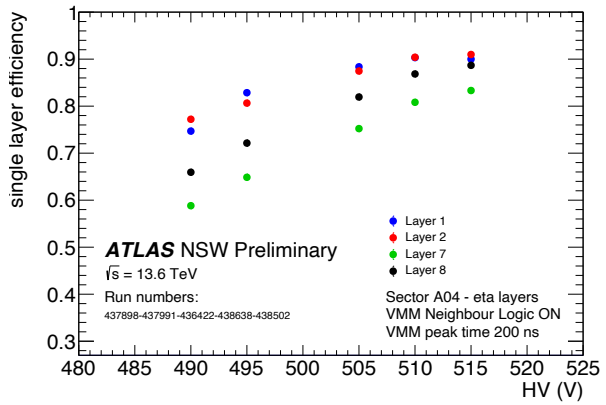


Very Preliminary Plots*!
*full system still undergoing operational tunings and improvements

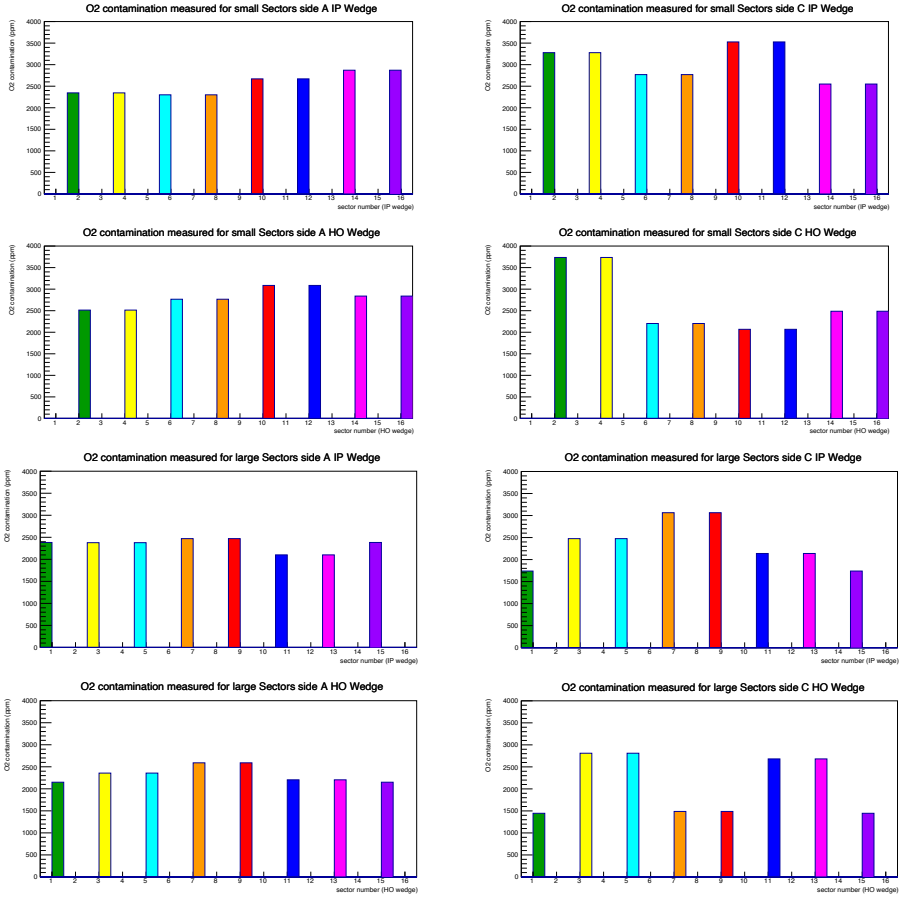


HV scan of cluster size and single layer efficiency



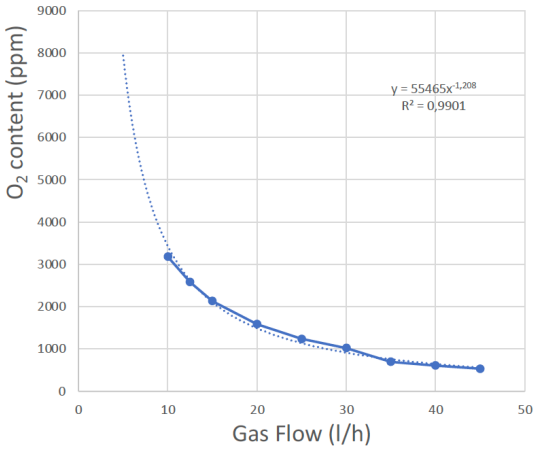


NSW Activity

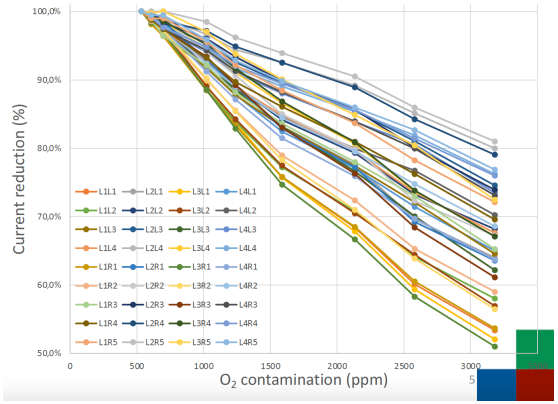


Measurements of O2 contamination are consistent with the flux we have at P1

- increasing the gas flux by +80% (now) -> we expect +30% on average on the charge and less spread



The effect on the current at our level of contamination has such a large spread that is difficult to find significant correlation without a flux scan



NSW Activity

- results from charge, efficiencies and currents from the detector are consistent
- DAQ issues are clearly visible
- correlation with the O2 contamination difficult to appreciate but consistent with the values observed with the same gas flux at GIF++
- expect +30% on average charge while increasing the gas flux to 20 L/h per chamber (for small sectors)
- New System seems to allow to complete
- online tools (currents, charge) can be use

  the sharing of the gas flow among differ
  - important with the current system
    overall efficiency
  - important in order not to stress the
    large overpressure to the input line