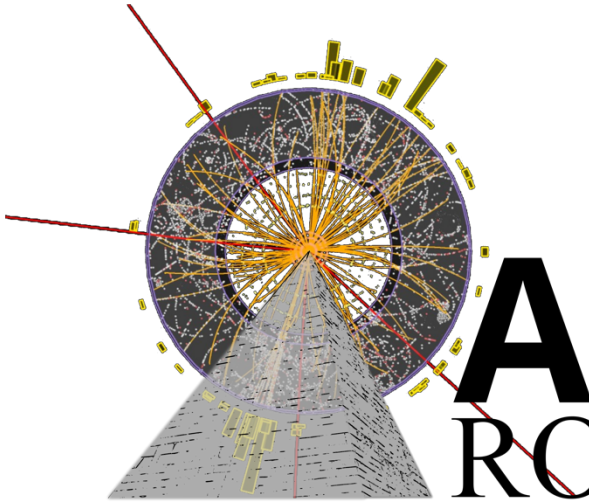


ATLAS
ROMA TRE

Nuovo logo by Valerio, Luca

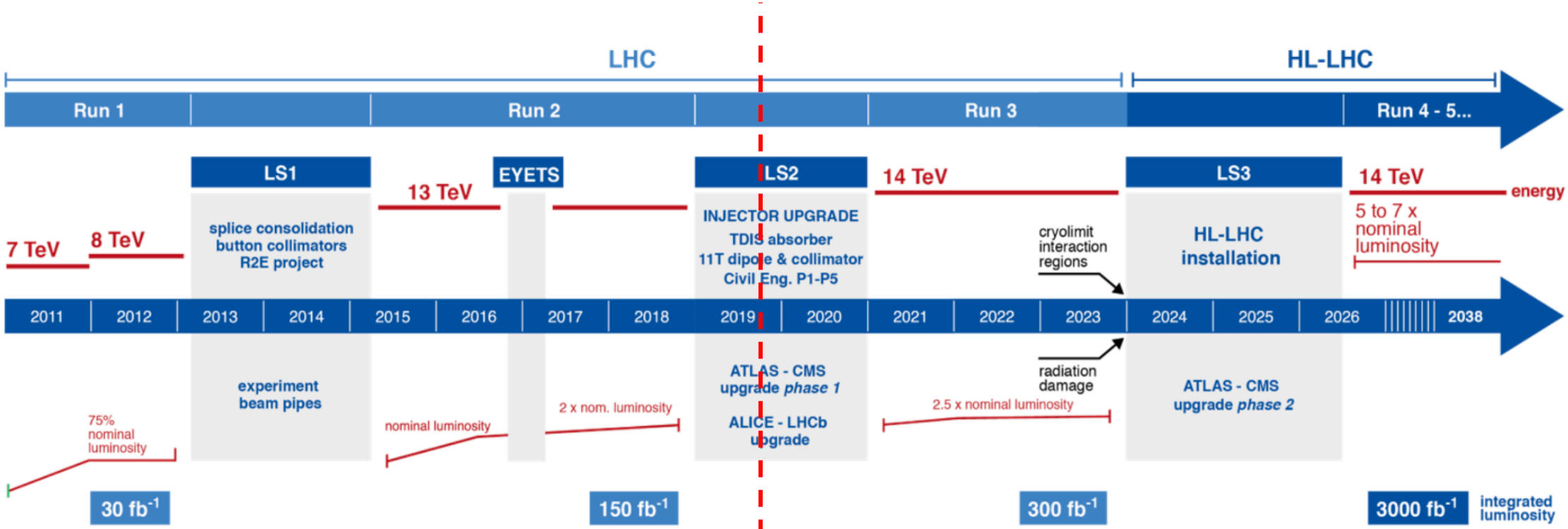
Stato e attività 2019 e piani 2020

Mauro Iodice

Congressino INFN – Roma Tre

12 Luglio 2019

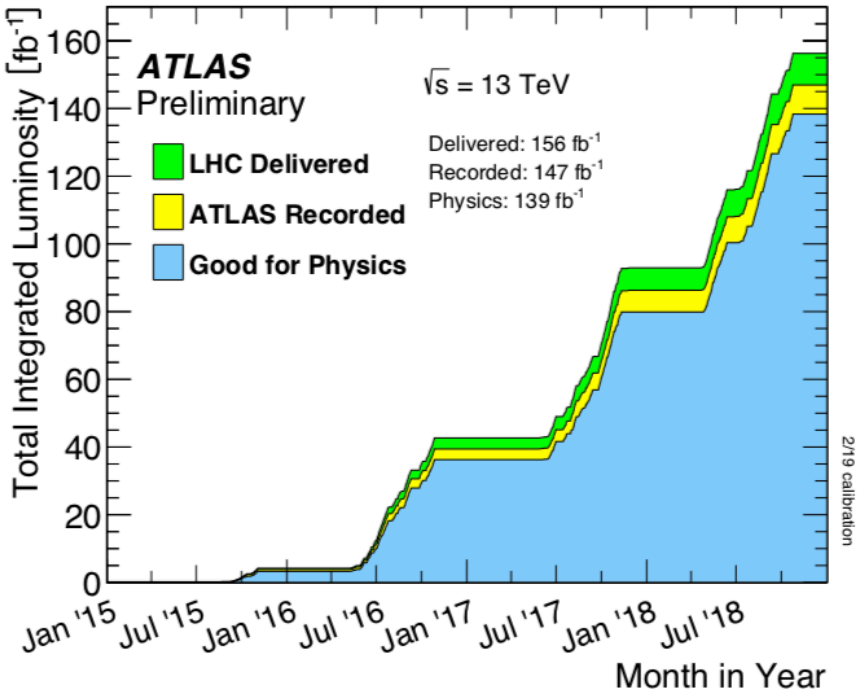
LHC - A che punto siamo

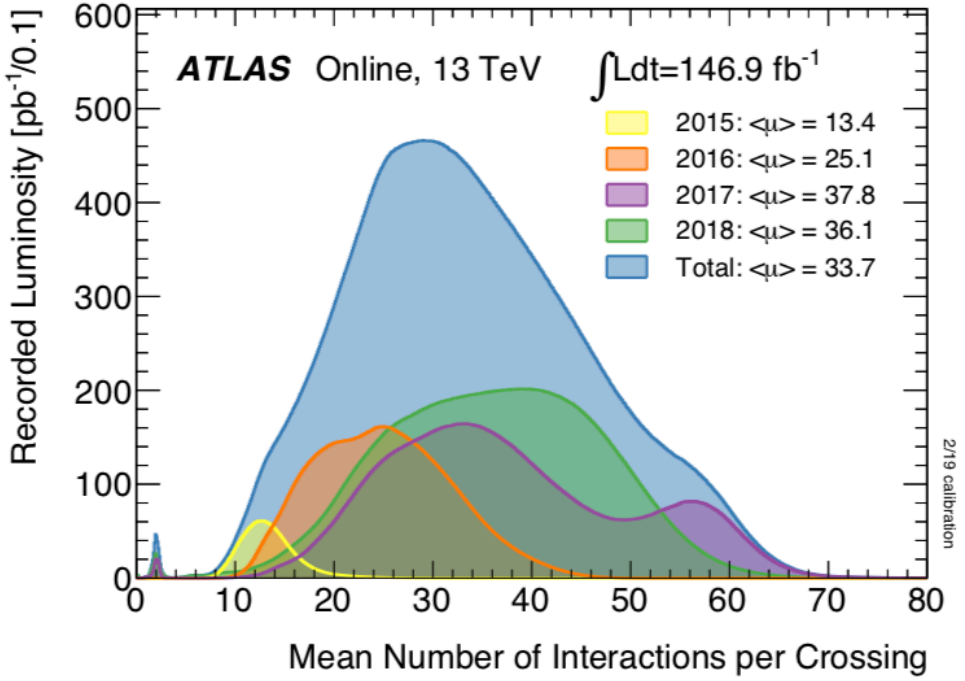


Siamo qui.
CONCLUSO il RUN 2 con successo!
Iniziato a inizio anno il Long Shutdown 2 **LS2**
In piena fase di upgrade di LHC e degli Esperimenti
L'inizio del RUN3 previsto a inizio 2021
(Decisione se andare a 14 TeV o rimanere a 13 probabilmente a Ottobre)

Concluso il Run2

- Performance della macchina ECCELLENTI → Raggiunto (e superato) l'obiettivo dei 150 fb^{-1} forniti da LHC
- Performance ECCELLENTI dei rivelatori di ATLAS → Altissima efficienza di dati analizzabili
  ...in condizione di altissimo pile-up (fino a 60 eventi simultanei per collisione)



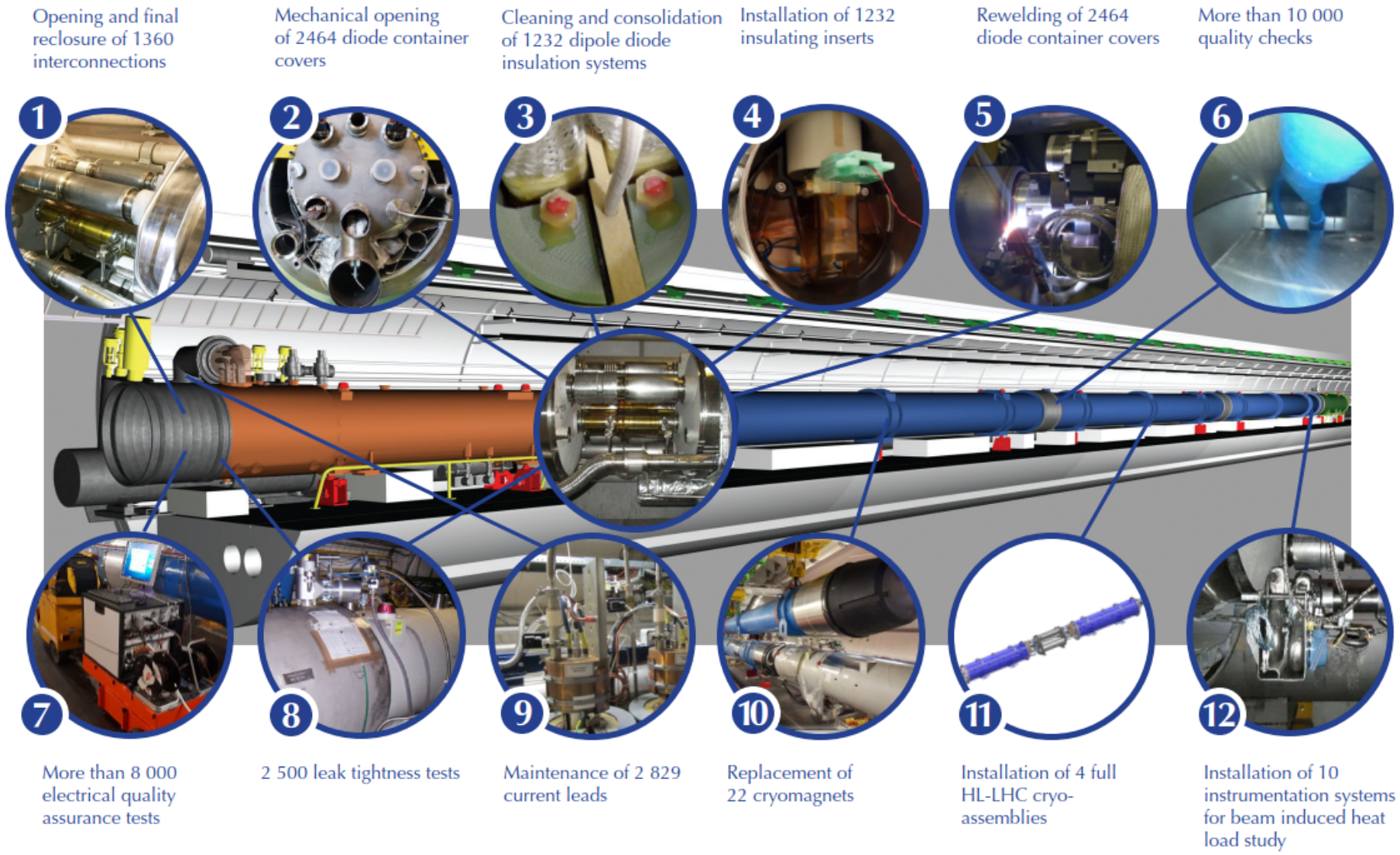


Total Run-2 Integrated Luminosity:
13 TeV pp high-μ with Standard GRL

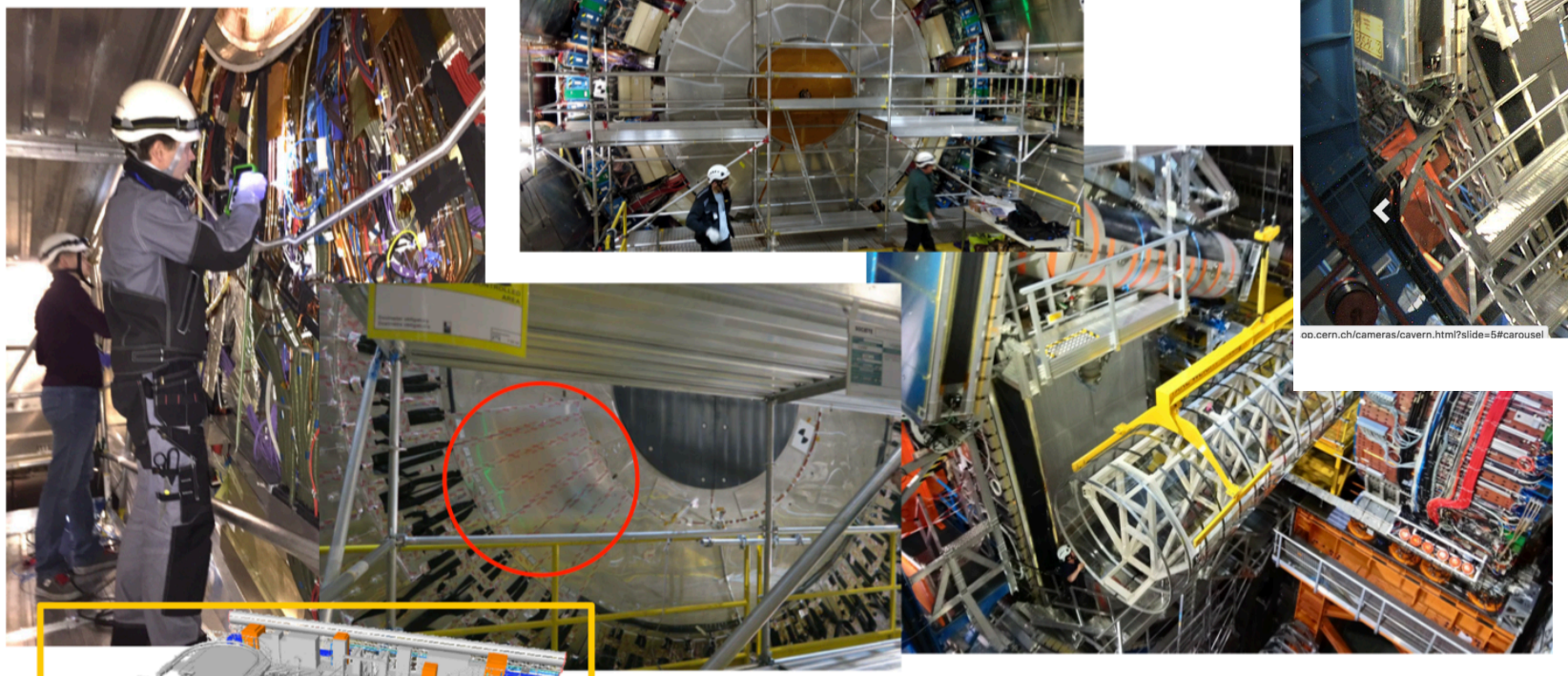
$(139.0 \pm 2.4)\,\mathrm{fb}^{-1}$
★ 1.7 % uncertainty ★

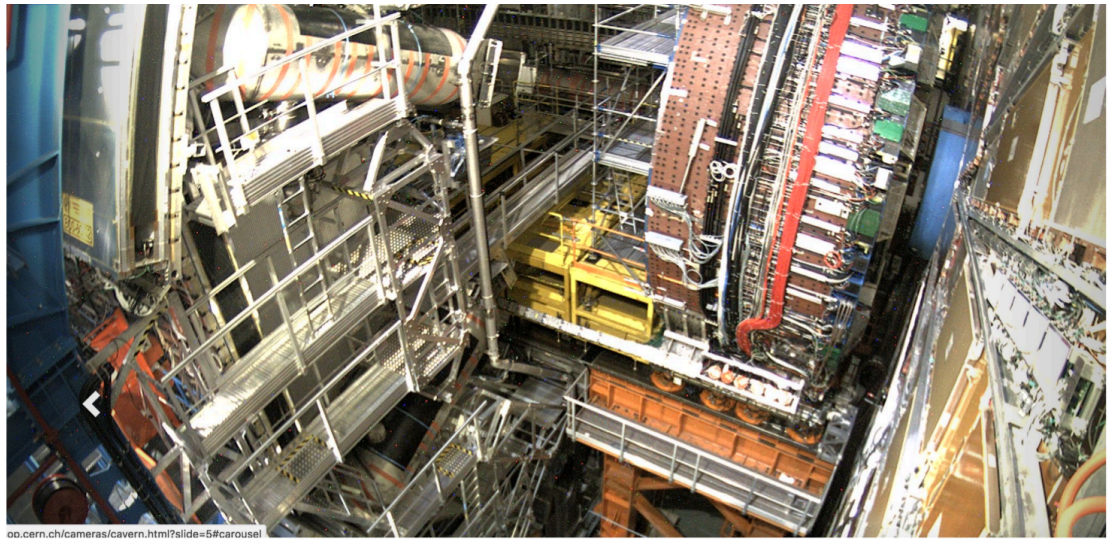
Attività in corso in LS2 (Long Shutdown 2)

- Manutenzione e UPGRADE di molte componenti dell'acceleratore



Attività in corso in LS2 (Long Shutdown 2)





Side C (June 2019)

- Detector / electronics refurbishment
- Cooling refurbishment
- Ventilation upgrade
- Infrastructure maintenance
- Cabling activities
- Phase-I installation
- Phase-II preparations
- ...

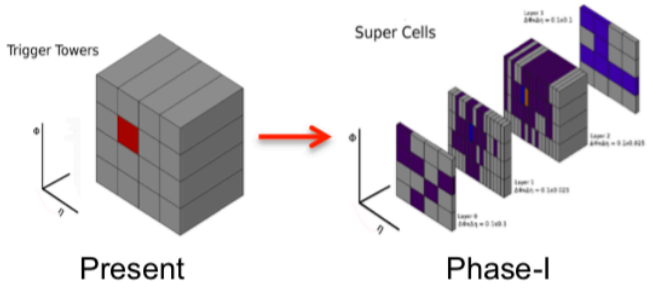
- Tantissima attivita' di manutenzione dei rivelatori e dei servizi

Attività in corso in LS2 (Long Shutdown 2)

- UPGRADE di FASE1 dei rivelatori

(i) Liquid Argon Calorimet… …tronics
Aim to improve th… calorimeter decision
for Run 3 an… …d
(enhan… …ejection and pile-up subtraction)

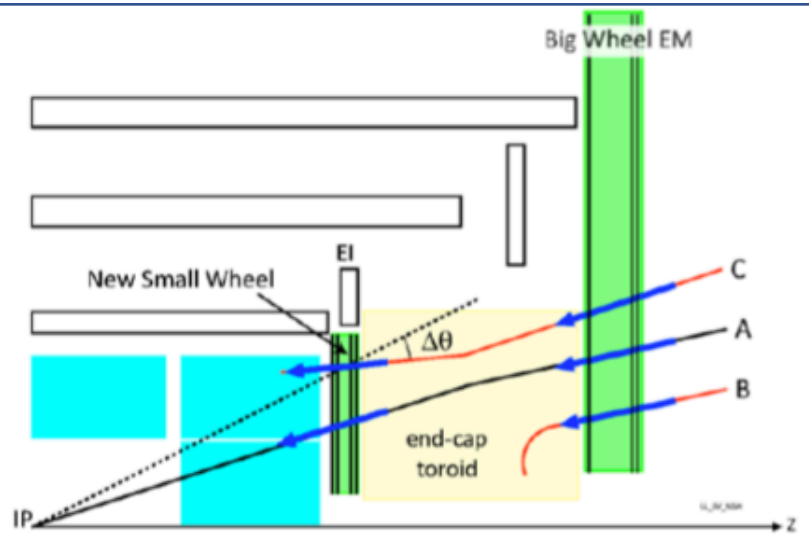
On track, risks reducing



(ii) Trigger / DAQ upgrade
Take full advantage … …er segmentation
available with … …tronics upgrade, and
improved … …igger information (NSW)

On track, risks reducing

(iii) Muon System: New Small Wheel
Replacement of the inner muon station in the endcap regions of the detector;
→ reduced muon fake trigger rate, preserve position resolution and efficiency at HL-LHC



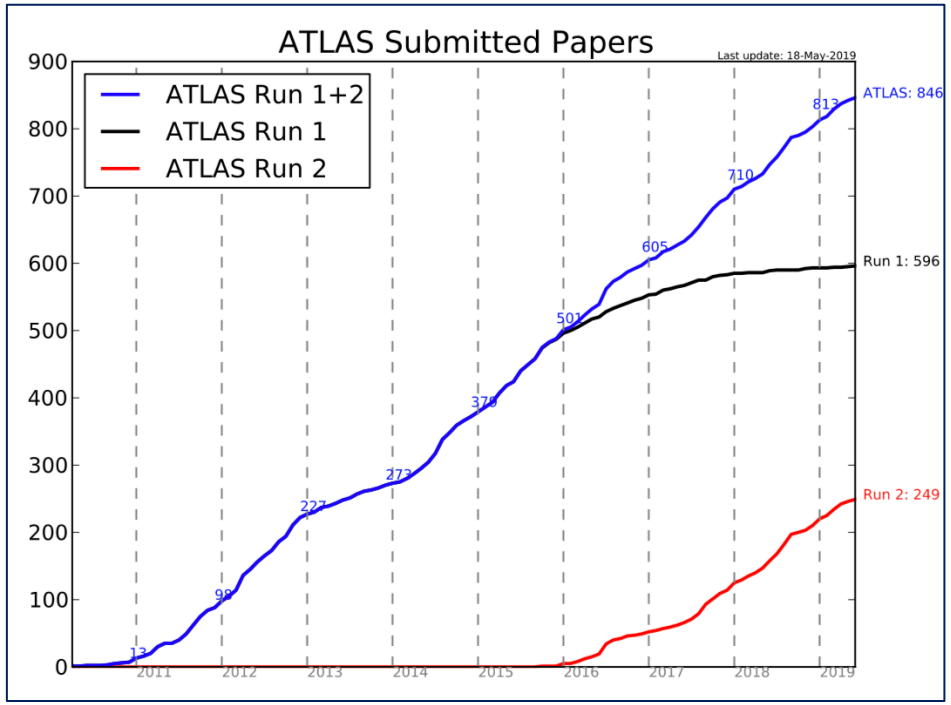
La NSW è il principale UPGRADE di Fase1 nel quale Roma Tre è pesantemente coinvolta

Nel seguito

- Panoramica della Produzione scientifica di ATLAS
- ATTIVITA' DI ANALISI DATI di Roma Tre
- La New Small Wheel e l'attività di Costruzione Micromegas di Roma Tre

- Talk a Conferenze
- Responsabilità
- Richieste Finanziarie

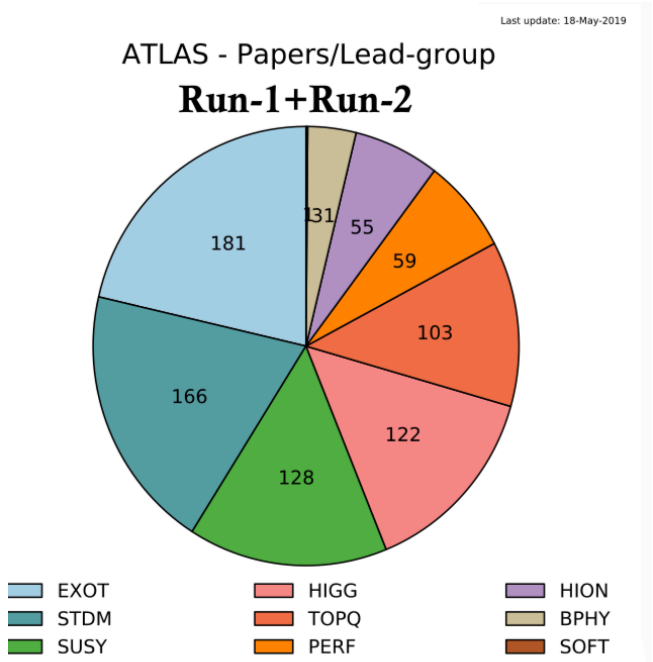
ATLAS - Produzione Scientifica



~850 articoli

~240 articoli già pubblicati con dati RUN2

60% Ricerche BMS (Susy+Exo)
22% SM (+ Top+B-Physics)
18% SM Higgs

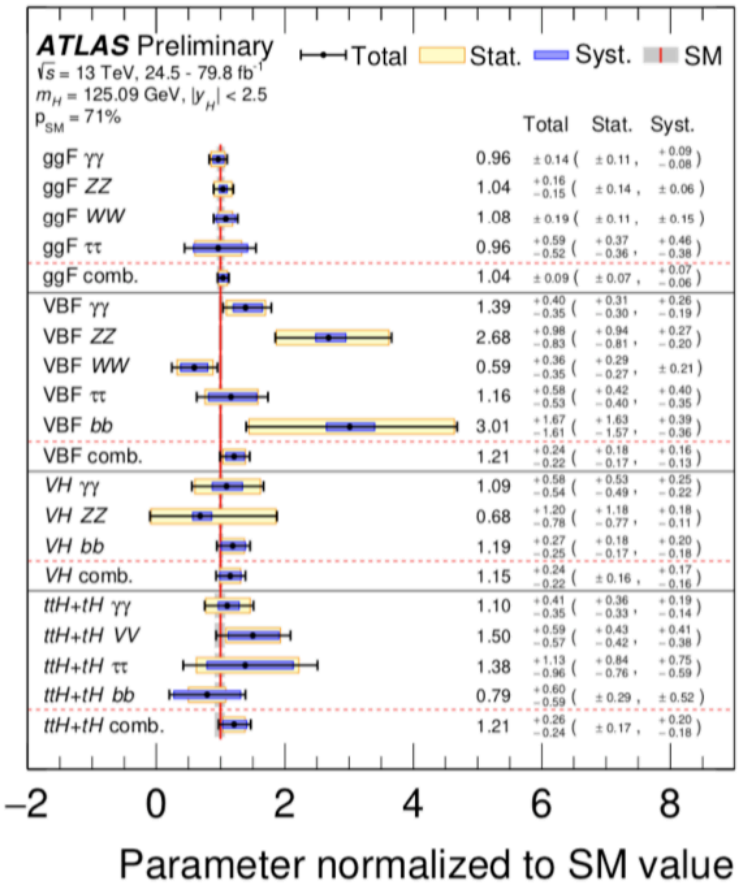


Run1+Run2:
36% Ricerche BSM
35% SM+Top+B Physis
14% Higgs

Alcuni Highlights – Higgs Physics

Full Combination

ATLAS-CONF-2019-005

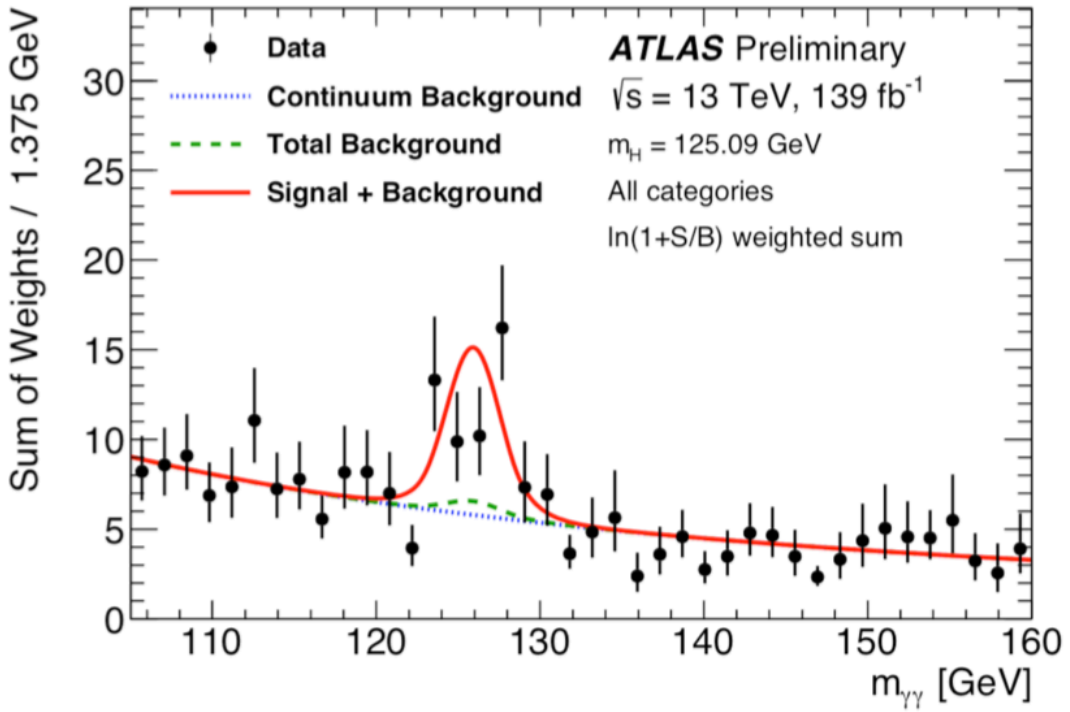


First full combination based on template cross sections (reduced theory uncertainty)

139 fb-1

ATLAS-CONF-2019-004

$\sigma_{ttH} \rightarrow \gamma\gamma$

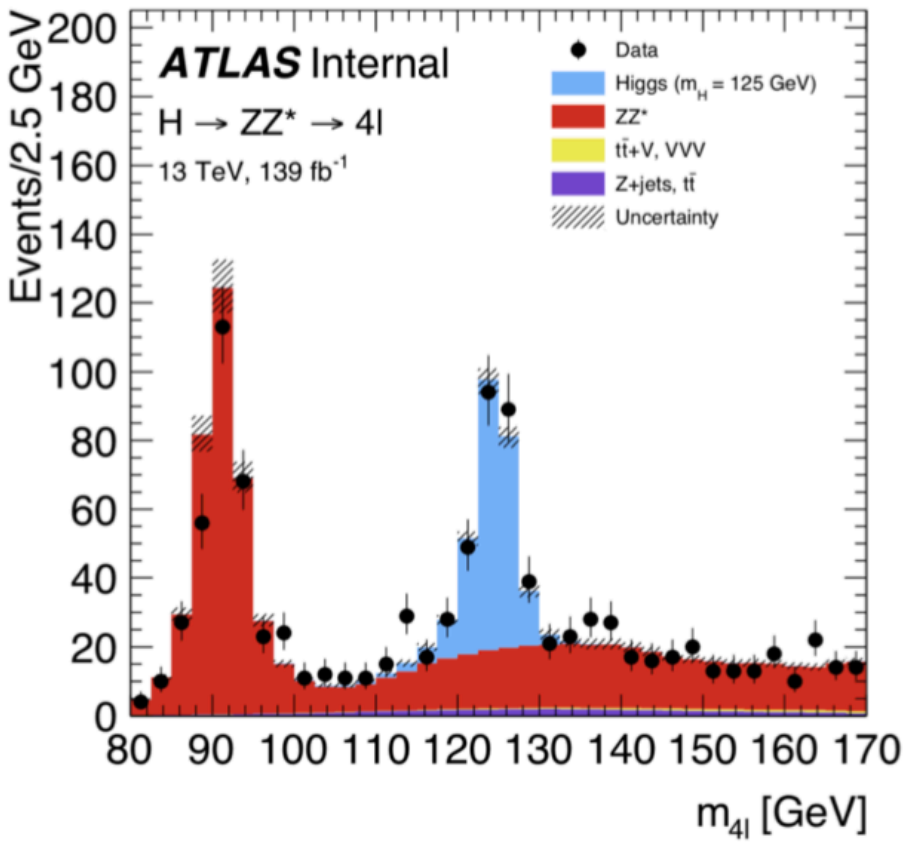


Full Run-2 dataset provides a significance of 4.9σ in H → γγ decay mode alone (exp. 4.2σ)

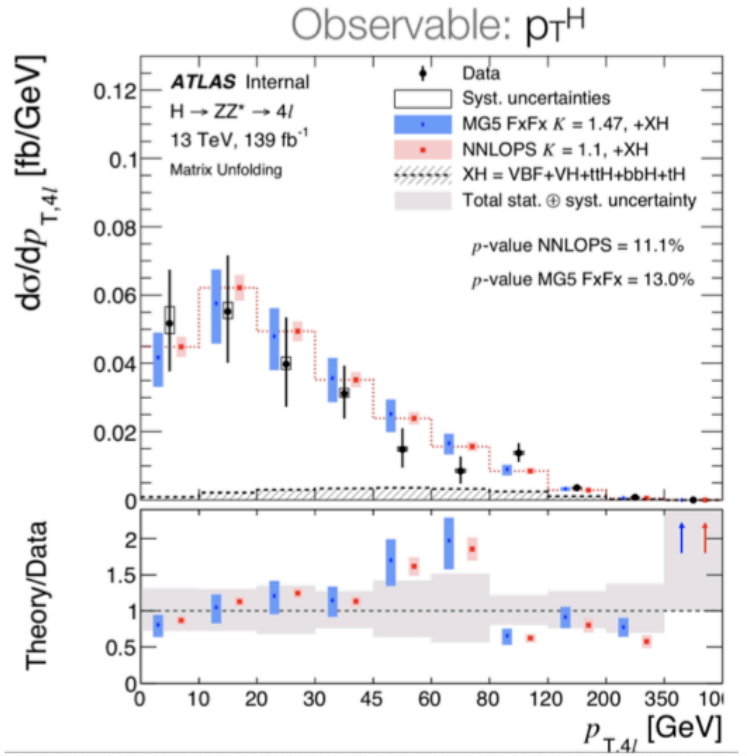
$$\sigma_{t\bar{t}H} \times B_{\gamma\gamma} = 1.59^{+0.43}_{-0.39}\ \text{fb}$$

SM value: $1.15\ ^{+0.09}_{-0.12}$ fb

Alcuni Highlights – Higgs Physics



H→ ZZ* → 4l full statistics 139 fb^{-1}



Differential cross sections

L'attività di ATLAS Roma Tre di Analisi Dati

ANALISI DATI

- Produzione associata WH con misura decadimento WH→ lvlvlv [Ada Farilla, Michela Biglietti, Toni Baroncelli]
- Misura di produzione doppio-Higgs HH in WWbb [Biagio Di Micco, Valerio D'amico (PhD)]
- Higgs Self-coupling da misura diretta HH e da single Higgs [Biagio Di Micco, Eleonora Rossi (PhD)]
- Misura elemento di matrice CKM Vtb da Rb da eventi ttbar [Giuseppe Salamanna, Valentina Vecchio (PhD)]
- Sezione d'urto ttbar (inclusiva e differenziale) [Giuseppe Salamanna, Luca Martinelli (PhD)]

Higgs Self-coupling da misura diretta HH e da single Higgs

Higgs-self coupling

Eleonora Rossi & Biagio Di Micco

$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\Psi}\not{D}\Psi + h.c. + \bar{\Psi}_i y_{ij} \Psi_j \phi + h.c. + |D_\mu \phi|^2 - V(\phi)$

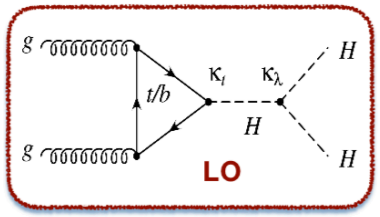
- The Higgs-potential low energy expansion around its minimum includes **triple** and quartic (and higher) terms:

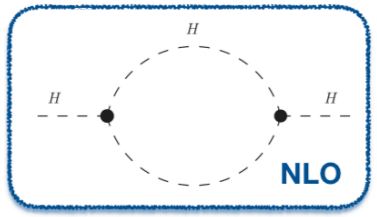
$$V(H) = \frac{m_H^2}{2} H^2 + \lambda_3 v H^3 + \lambda_4 H^4$$

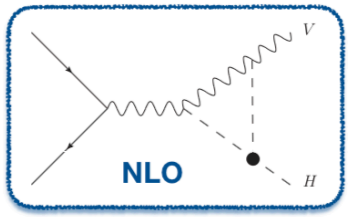
- New physics effects are parametrised via a single parameter κ_λ, i.e., the rescaling of the **SM trilinear coupling, λ_3^{SM}**

$$\kappa_\lambda = \frac{\lambda_3}{\lambda_3^{SM}}$$

- κ_λ can be measured directly using the Higgs boson pair production cross section or indirectly using NLO EW corrections to single Higgs processes







Roma Tre contributions to papers, ConfNote+PubNote

- **G. Degrassi**, P.P. Giardino, F. Maltoni, D. Pagani: *Probing the Higgs self coupling via single Higgs production at the LHC*, arXiv:1607.04251;
- ATLAS Collaboration, *Combination of searches for Higgs boson pairs in pp collisions at 13 TeV with the ATLAS experiment*, ATLAS-CONF-2018-043, 2018, (B. Di Micco editor);
- ATLAS Collaboration: *Combination of searches for Higgs boson pairs in pp collisions at* $\sqrt{s}$ *=13 TeV with the ATLAS detector*, arXiv:1906.02025, (B. Di Micco editor, E. Rossi analysis team);
- ATLAS Collaboration: *Constraint of the Higgs boson self-coupling from Higgs boson differential production and decay measurements*, ATL-PHYS-PUB-2019-009 (B. Di Micco editor, E. Rossi analysis team)

Direct measurement: double-Higgs analyses

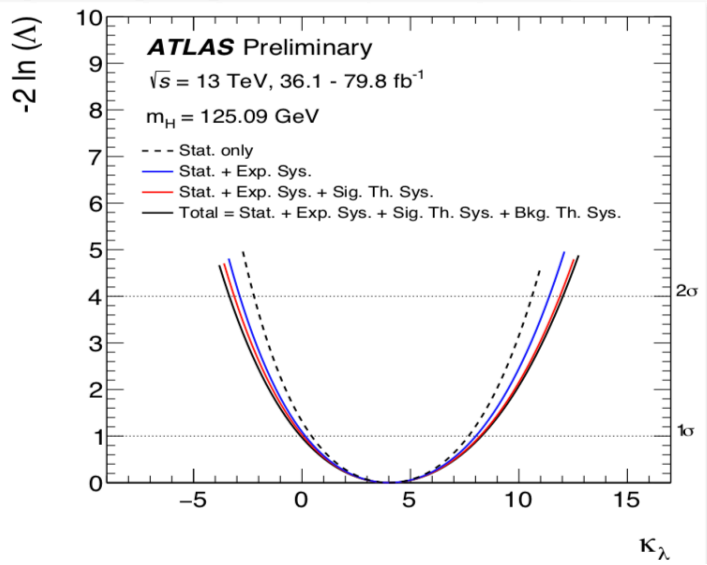
Analysis	Integrated luminosity (fb^{-1})
$HH \to b\bar{b}\tau^+\tau^-$	36.1
$HH \to b\bar{b}b\bar{b}$	27.5 - 36.1
$HH \to b\bar{b}\gamma\gamma$	36.1

Direct $-5.0 < \kappa_\lambda < 12.0$ *(obs) at 95 % CL*

Indirect measurement: single-Higgs analyses

Analysis	Integrated luminosity (fb^{-1})
$H \to \gamma\gamma$ (including $t\bar{t}H, H \to \gamma\gamma$)	79.8
$H \to ZZ^* \to 4\ell$ (including $t\bar{t}H, H \to ZZ^* \to 4\ell$)	79.8
$H \to WW^* \to e\nu\mu\nu$	36.1
$H \to \tau\tau$	36.1
$VH, H \to b\bar{b}$	79.8
$t\bar{t}H, H \to b\bar{b}$ and $t\bar{t}H$ multilepton	36.1

Indirect $-3.2 < \kappa_\lambda < 11.9$ *(obs) at 95 % CL*



Misura V_{tb} da R_b da eventi ttbar

LOOKING FOR NEW PHYSICS IN TOP QUARK PRECISION MEASUREMENT

Valentina Vecchio & Giuseppe Salamanna

Top quark is considered a good probe for the search of New Physics

- heaviest particle known so far, thus Yukawa coupling is ~1
- does not hadronize and it decays only in bottom+W boson **Vtb~1**

$$R \equiv \frac{|V_{tb}|^2}{|V_{td}|^2 + |V_{ts}|^2 + |V_{tb}|^2}$$

Measurement of Vtb from Rb

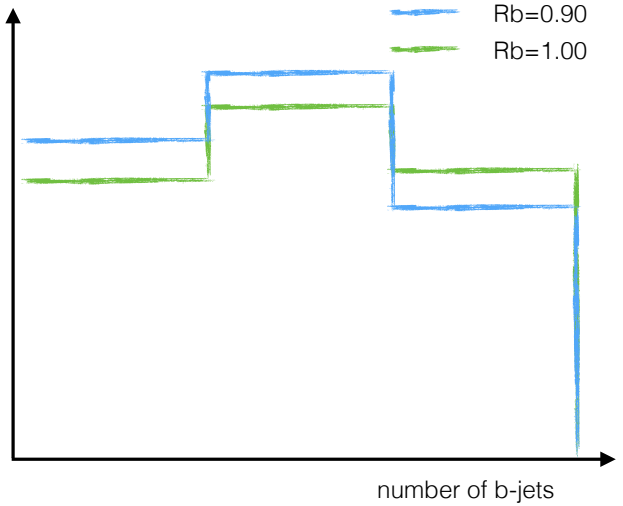
- if top couples to NP particle Rb<1
- current estimation has 3% uncert.

Selecting ttbar event

- exploiting large QCD production
- clear experimental signature

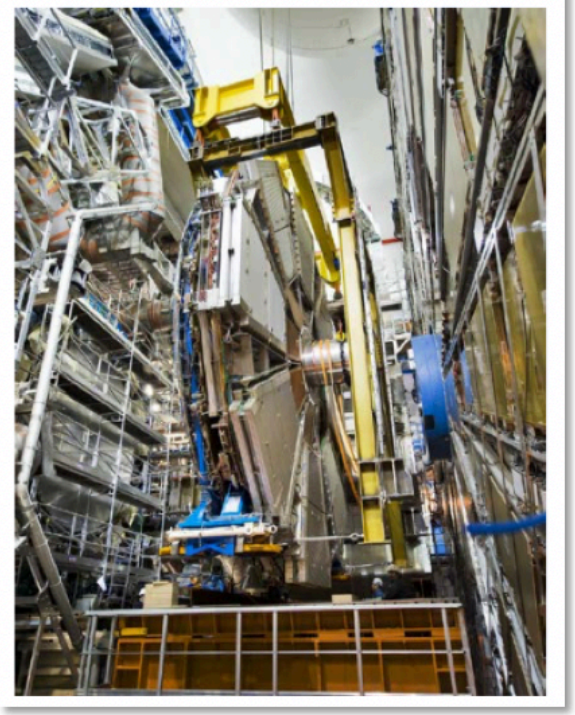
Methodology

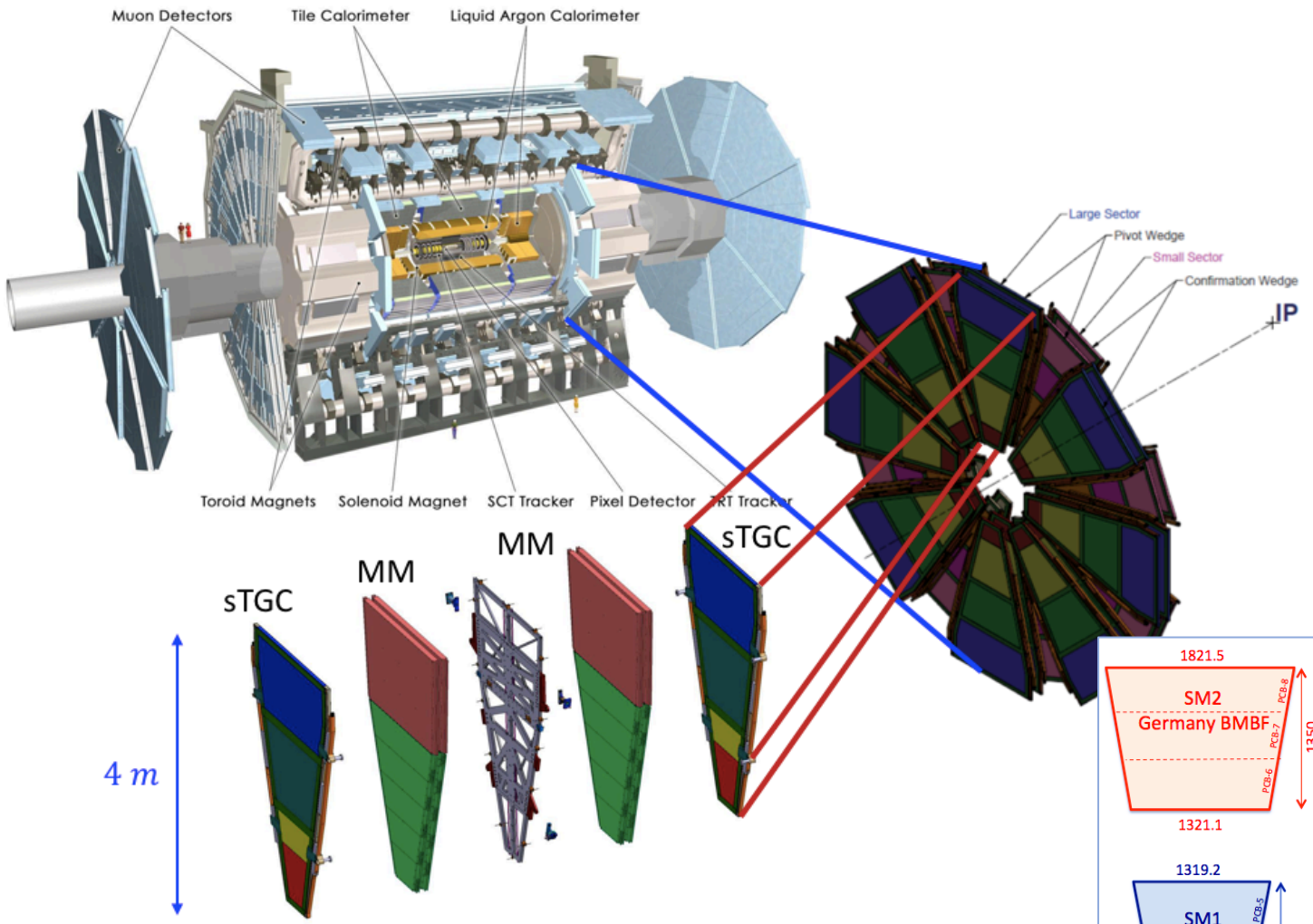
- Kinematical reconstruction of top quarks
- Data estimation of jets coming from the top decay
- Extraction of Rb from b-jets multiplicity distribution via a binned likelihood fit

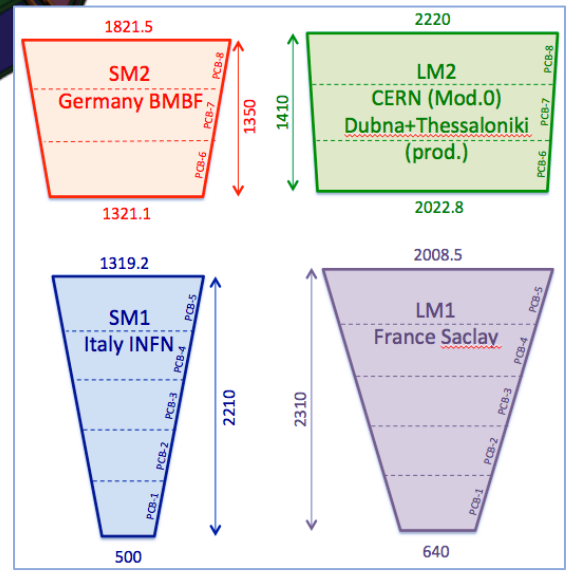


THANKS TO NEW APPROACH AND AD-HOC CALIBRATION OF BTAGGING EFFICIENCY WE EXPECT A 2% UNCERTAINTY!

La New Small Wheel

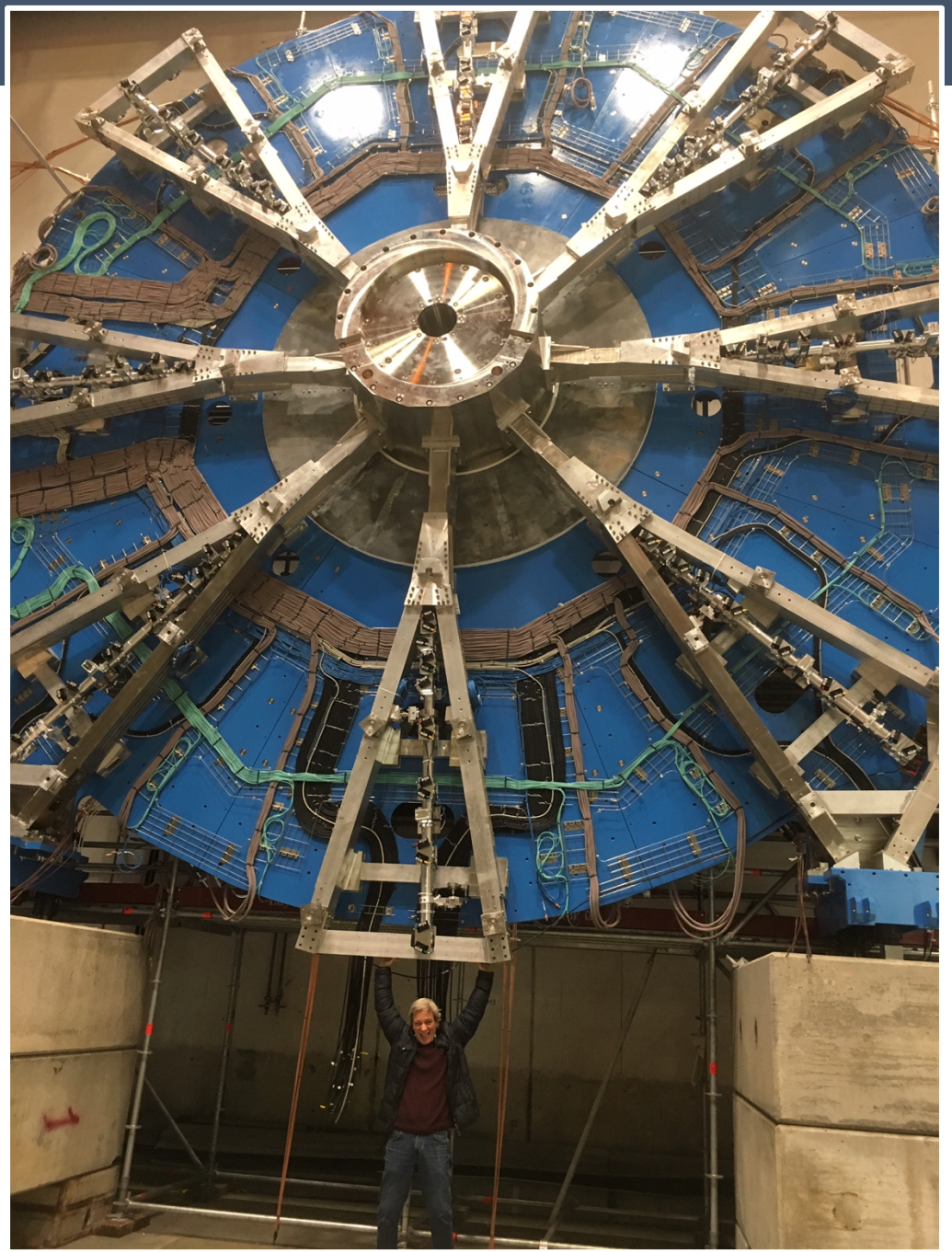






Micromegas (MM) and small strip TGC (sTGC) will replace the present Small Wheel CSC, MDT and TGC chambers, and both provide tracking and triggering capability

The wheels are taking shape!



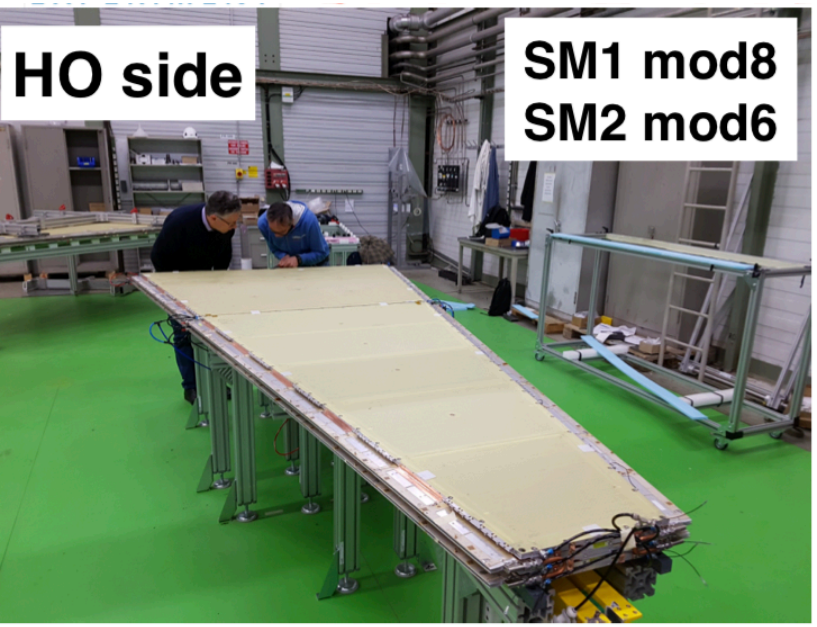
…and the Micromegas Modules are being delivered to CERN

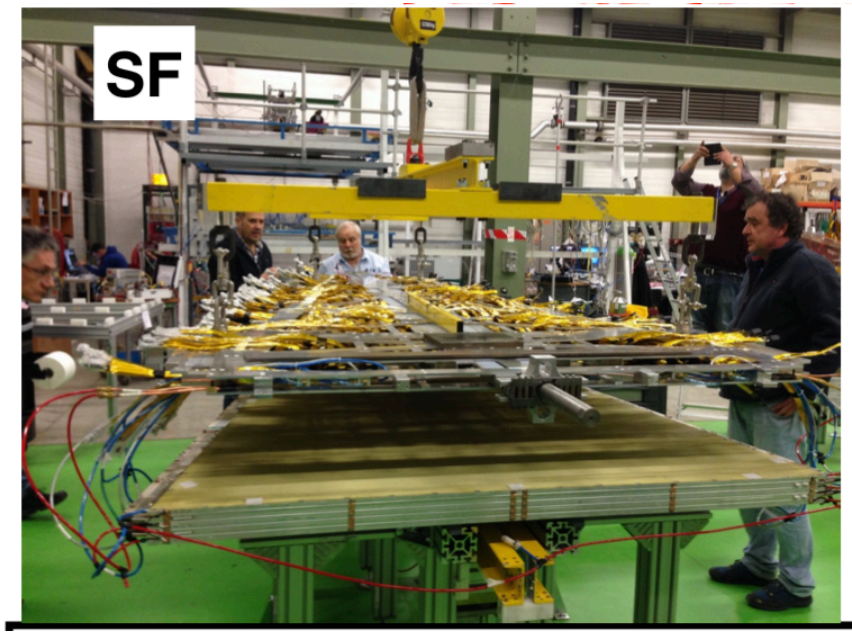
- The first 4 SM1 (INFN) Modules delivered to CERN
- Under validation tests at BB5
- Including high gamma irradiation tests at GIF++

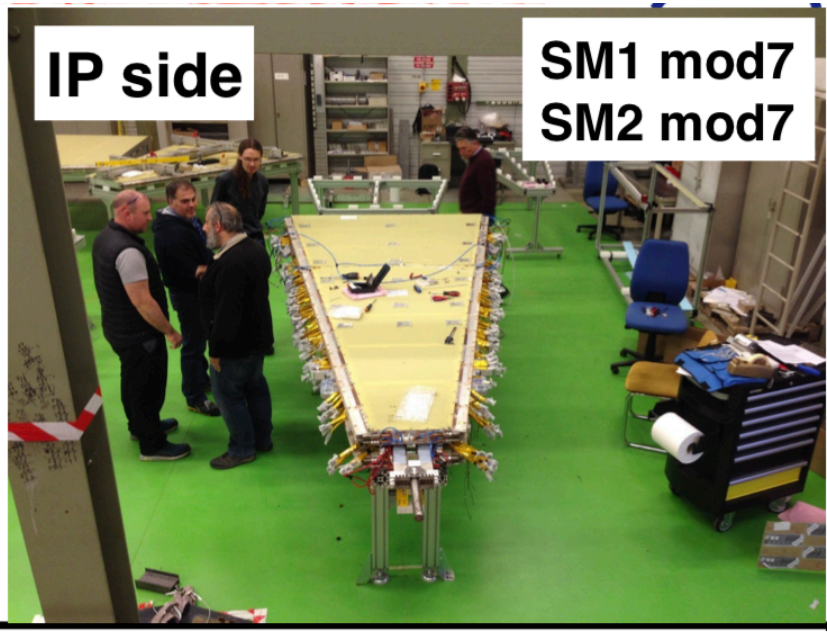
- Two modules are now assembled in a double-wedge together with 2 SM2 from LMU (Germany)

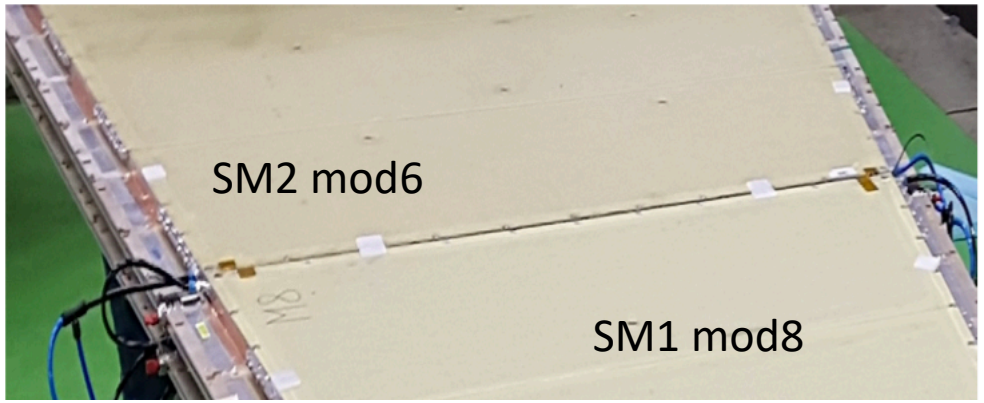
next slide

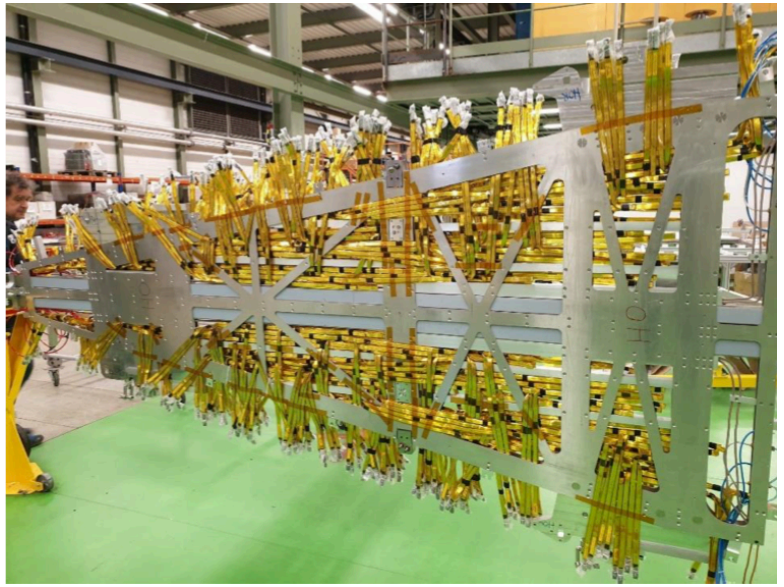
The first assembled Double Wedge at CERN





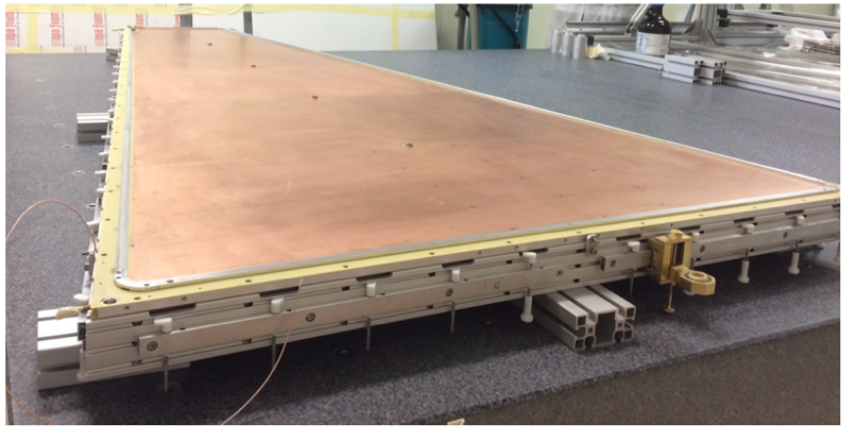




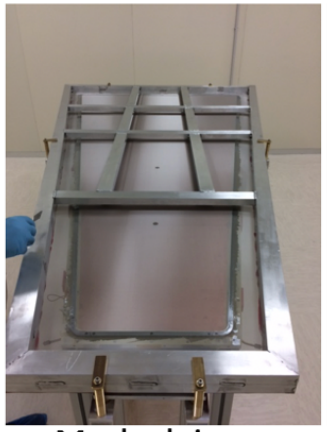


Spacer frame - the cabling nightmare... (each sector has 65k channelss to readout !)

Le Camere Micromegas di ATLAS

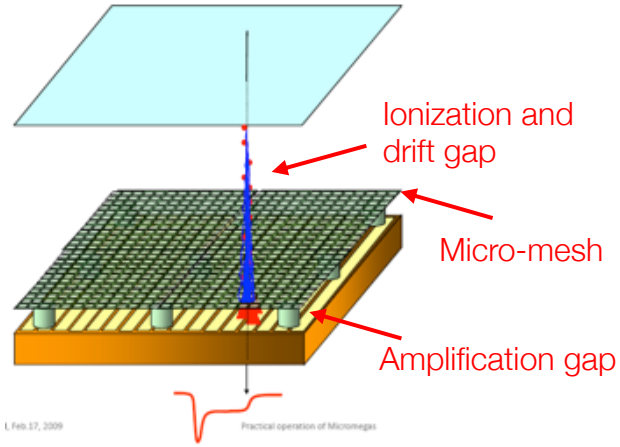


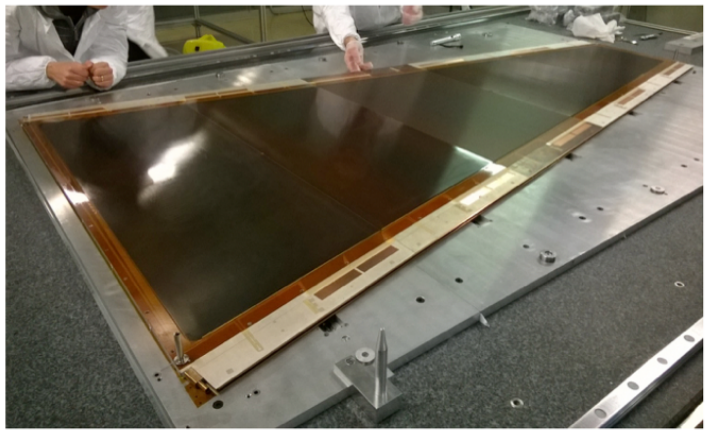
A bare Drift panel (with mesh-frame)



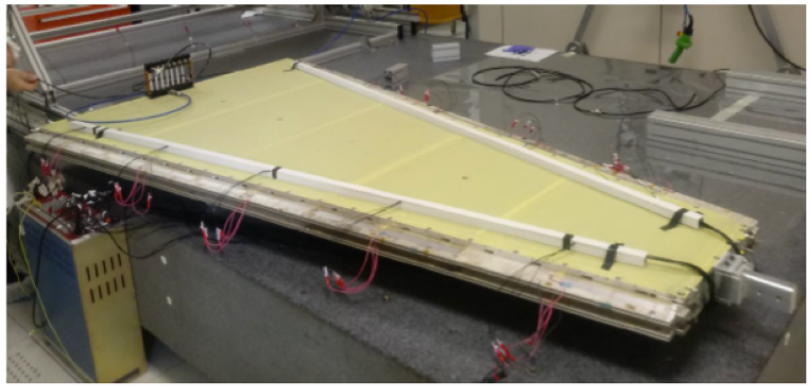
Mesh gluing

A Completed Drift Panel





A Readout Panel



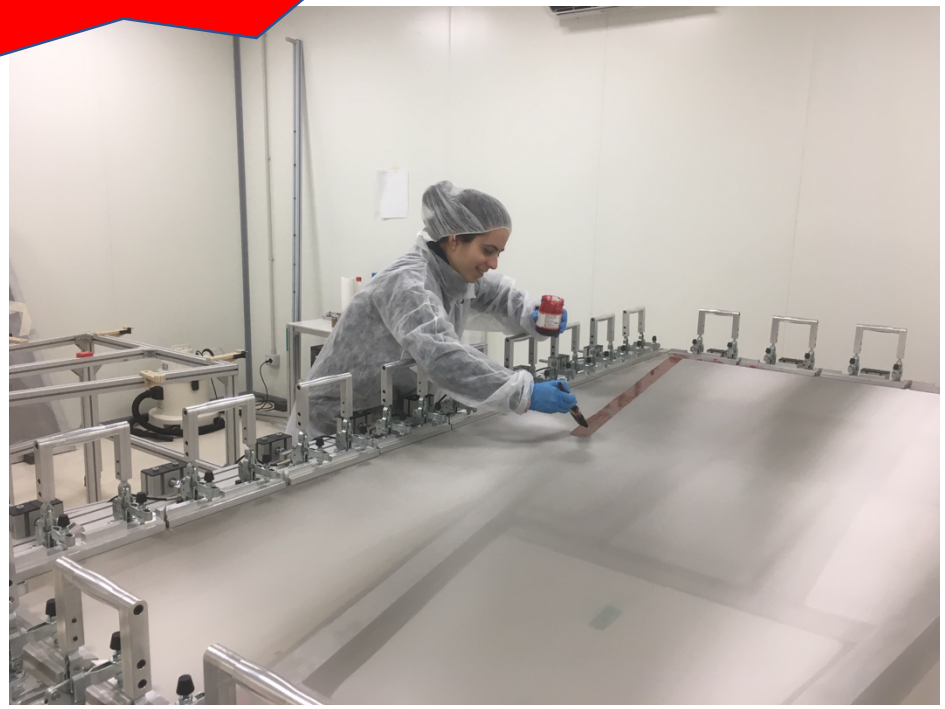
Assembled SM1 Module_1

- Gas detector, Ar:CO_2 93:7
- Main Components: Drift cathode, stainless steel mesh, Readout-boards with anode strips with kapton foil with screen-printed resistive strips on top

Mesh Stretching at Roma3

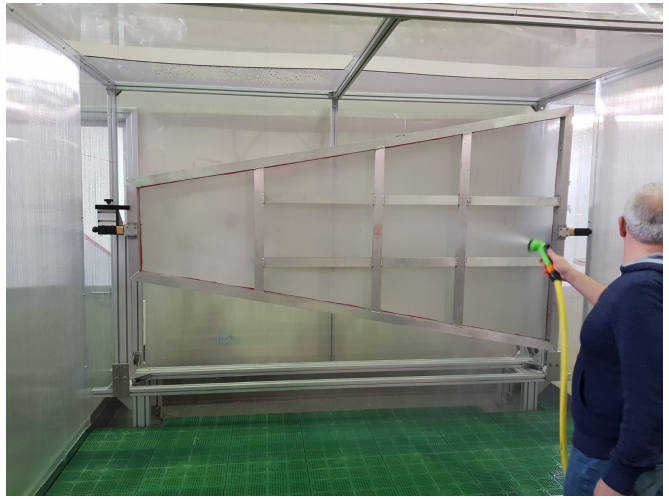
Ampiamente superata la meta' della produzione
→ NSW A DONE!

expected end of stretching by mid 2020

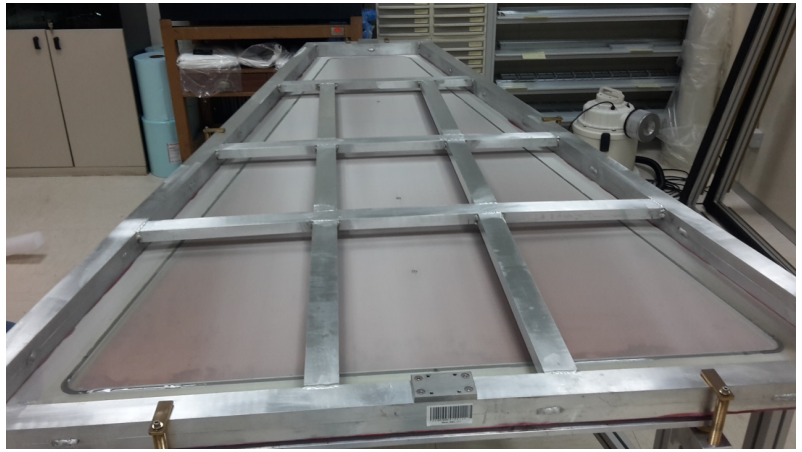


Turni Regolari in Laboratorio.
Team: Maria Teresa, Ina, Luca, Valerio, Toni, Domizia, Fabrizio Mauro, Roberto (NEW ENTRY!)
Supporto tecnico: Gianfranco

Il nostro Contributo all'assemblaggio delle camere a LNF



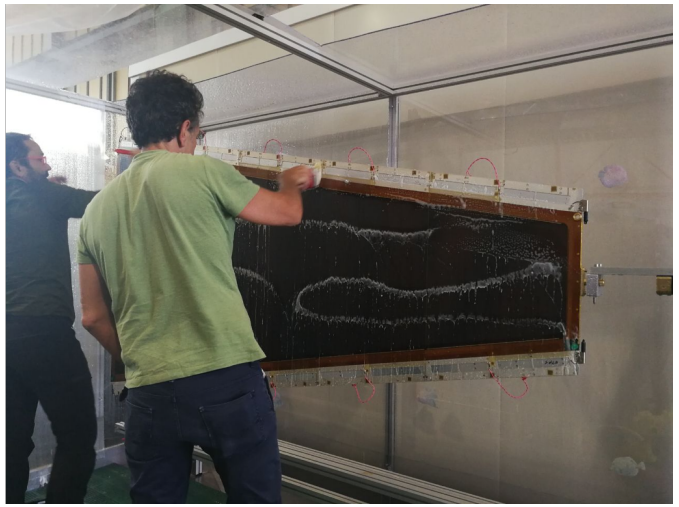
LAVA...



INCOLLA...

ASCIUGA...

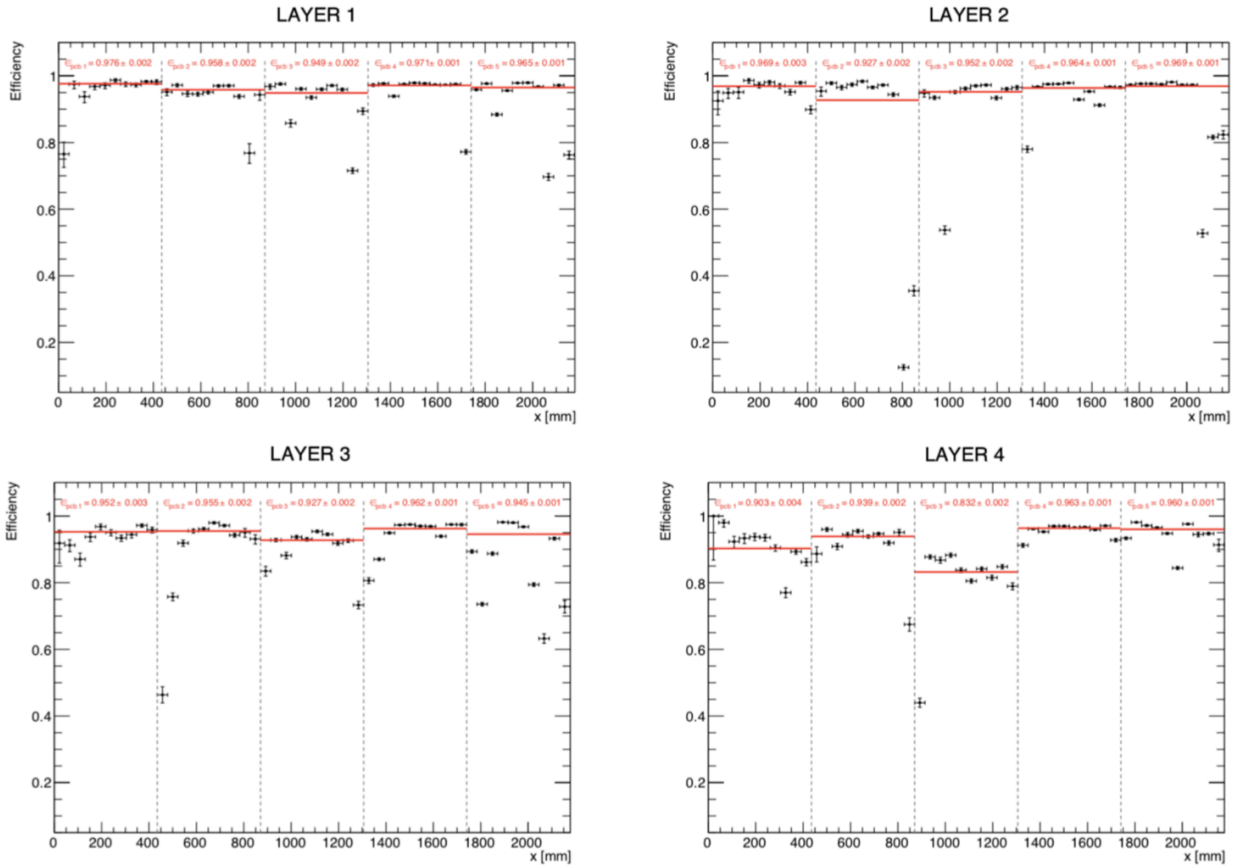
Polishing...



RILAVA...

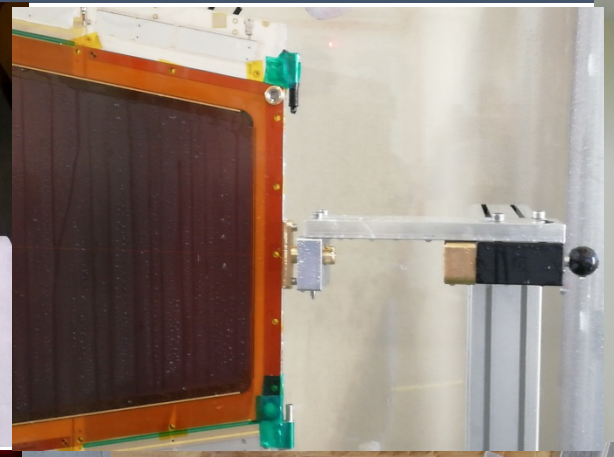
Il nostro Contributo all'assemblaggio delle camere a LNF

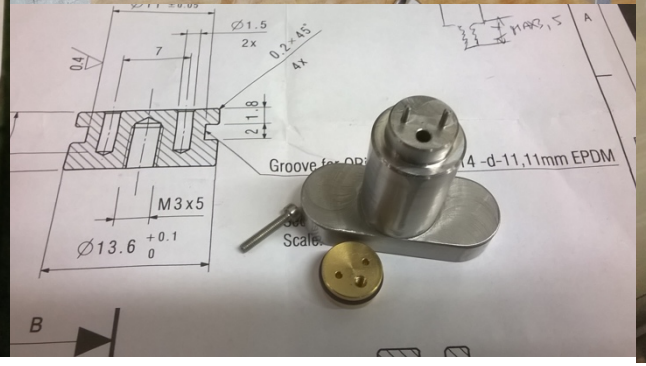
Assemblaggio in Clean-Room (LNF)



Efficienze con Raggi Cosmici (LNF)

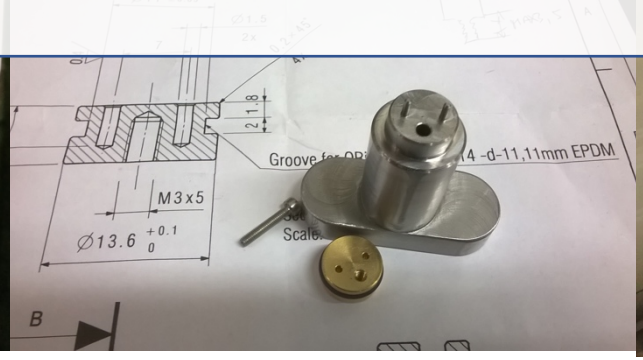
Il Contributo dell'OFFICINA MECCANICA





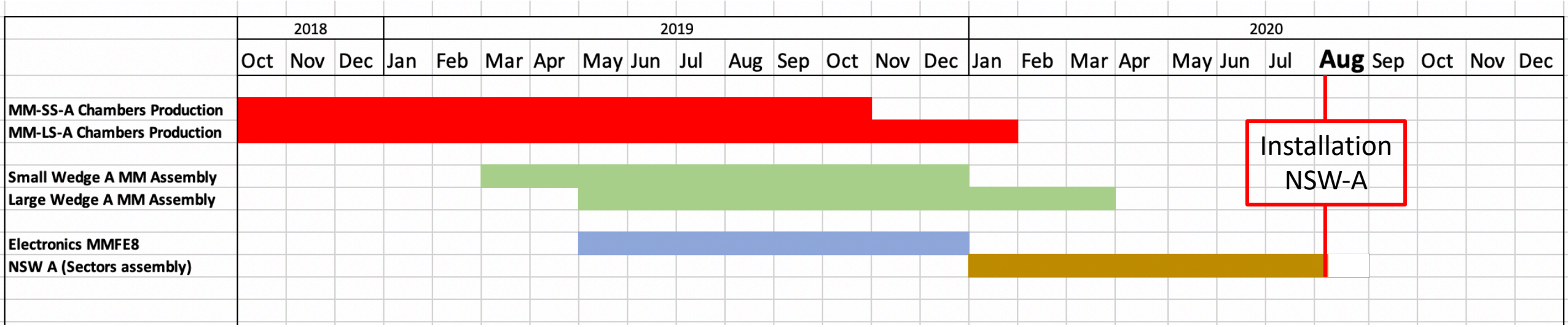
Il Contributo dell'OFFICINA MECCANICA

Un'enorme quantità di lavoro di progettazione e di realizzazione dei pezzi
...in una condizione non semplice...
Molto apprezzato dalla Collaborazione



Piani per il 2020

L'Installazione della NSW-A nel 2020 e della NSW-C durante il Technical Stop di fine anno 2021 SONO LE PRIORITA' DI INFN Italia e della Collaborazione ATLAS



- Installation of NSW-A scheduled for August 2020 (trying to implement actions to gain some time)
- End date of NSW project, including completion of NSW-C is expected in July 2021

  → SIGNIFICANTLY beyond the present end-date of LS2
- Will start ATLAS Run3 with an "asymmetric" Muon Detector (NSW side A + old SW side C)
- ATLAS will request installation of NSW-C during the first EYETS after LS2 (end 2021)

Talk a Conferenze

- A. Baroncelli, *"ATLAS results on H(125) boson decays"*, Higgs Hunting, July 23-25, 2018, Orsay-Paris, France
- M. Verducci, *"Challenging searches at the LHC (results and perspectives)"* Johns Hopkins Workshop Series - Beyond Standard Model - JHWS-BSM2018, Oct. 01-05, 2018, Firenze, Italy
- M. Biglietti, *"Measurements of the Higgs boson properties at the ATLAS experiment"*, DISCRETE18 , 26-30 November 2018, Vienna, Austria
- B. Di Micco, *"Introduction to the HH Production Workshop at Colliders"*, Double Higgs Production at Collider, 4-9 September 2018, Fermilab, USA
- B. Di Micco, *"Summary of discussion paper and white paper"*, Double Higgs Production at Collider, 4-9 September 2018, Fermilab, USA
- V. D'Amico, *"Studi di performance e sviluppo di algoritmi di analisi dei rivelatori Micromegas dell'esperimento ATLAS"*, 104° Congresso SIF, 17-21/9/2018, Cosenza, Italia
- L. Martinelli, *"Studio dell'influenza della mesh per i rivelatori micromegas di ATLAS"*, 104° Congresso SIF, 17-21/9/2018, Cosenza, Italia
- IFAE Camerlingo, Martinelli
- EPS Poster Eleonora

- Giuseppe Salamanna, Lomosonov19, talk "Top quark measurements with the ATLAS detector" - 22-29 Agosto, Mosca, Russia
- Fabrizio Petrucci, HEPMAD19 talk "Measurements of the Higgs boson properties at the ATLAS experiment" 14-20 Ottobre 2019, Antananarivo, Madagascar

Responsabilità

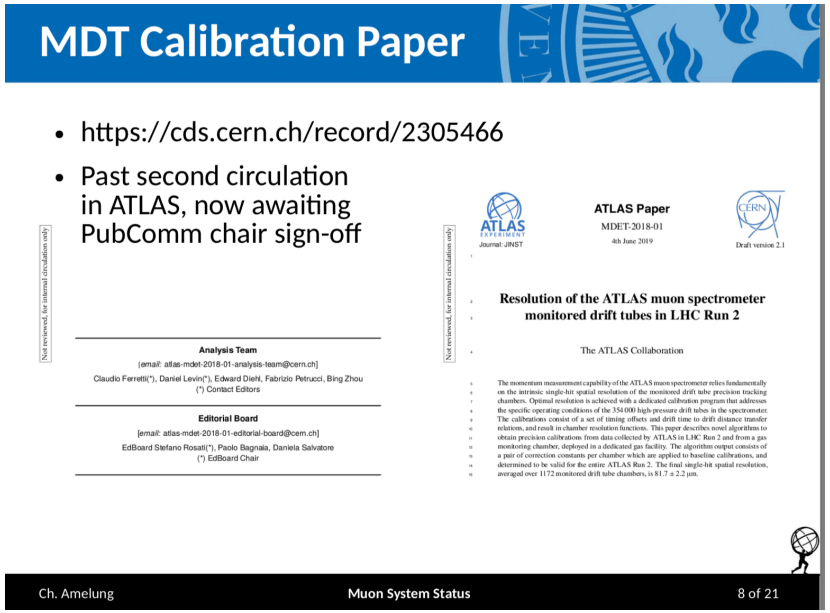
Responsabilità (Livello2)

- Iodice NSW MM Coordinator
- Baroncelli Muon IB Chair

Responsabilità (Livello3)

- Petrucci MDT Calibration Expert
- Farilla Coord sottogruppo analisi VH di HWW
- Di Nardo Convener dell' LHC Higgs Combination Group (LHC-HCG)

→ ..continua l'attivita' di calibrazione MDT



Richieste Finanziarie

- Supporto tecnico: come per il 2018
  - **12 mu** servizio meccanico (siamo in attesa della nuova borsa per la meccanica) DA CONFERMARE;
  - **2 mu** servizio elettronico;
  - **2 mu** calcolo e reti

- Consumo come da tabelle dei referee: **24 keuro** (18 metab. + 6 spese al CERN)

- Camera Pulita : **2 kE**

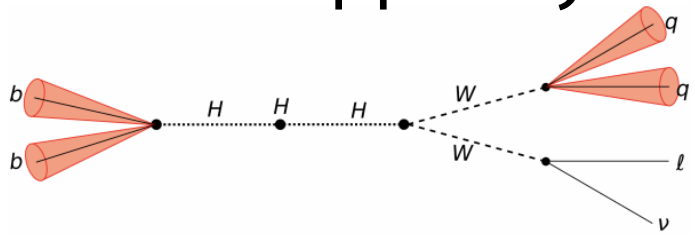
- Missioni TOT: **94 kE**
  - Metabolismo (da tabelle dei referee algoritmi basati su responsabilita', FTE): **85 kE**
  - NSW Attivita' di Integrazione Micromegas al CERN : **7 kE**
  - Missioni a LNF per NSW: **2 kE**

BACKUP

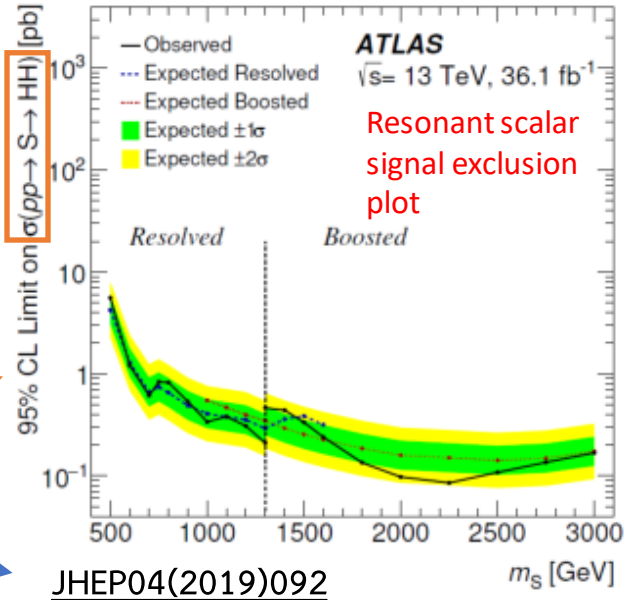
Valerio

Non-resonant HH->bbWW->bblνqq analysis

- SM process: double Higgs production with 1 lepton and 4 jets in the final state



- **Published analysis** with 36.1 fb-1 : cut-based analysis, studied also resonant channel
  σ(pp->HH) < 2.5 pb @95%CL corresponding to 305 x SM

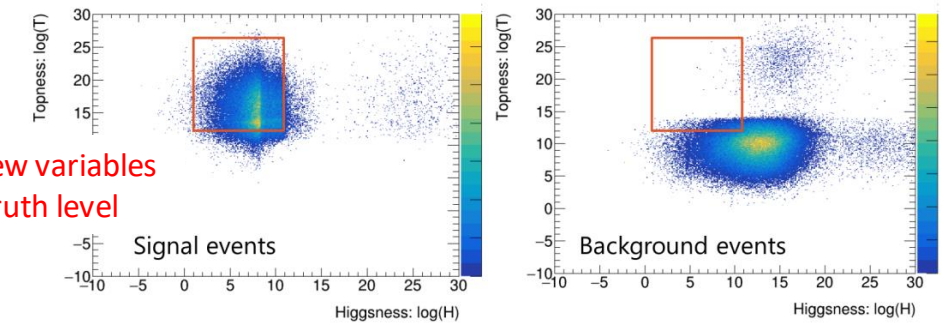


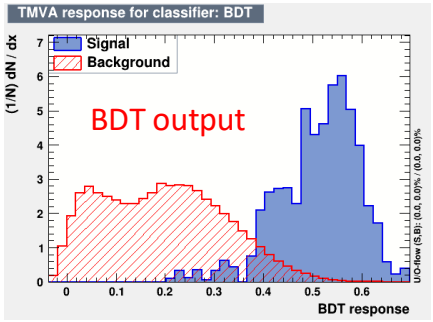
JHEP04(2019)092

B. Di Micco (editor)

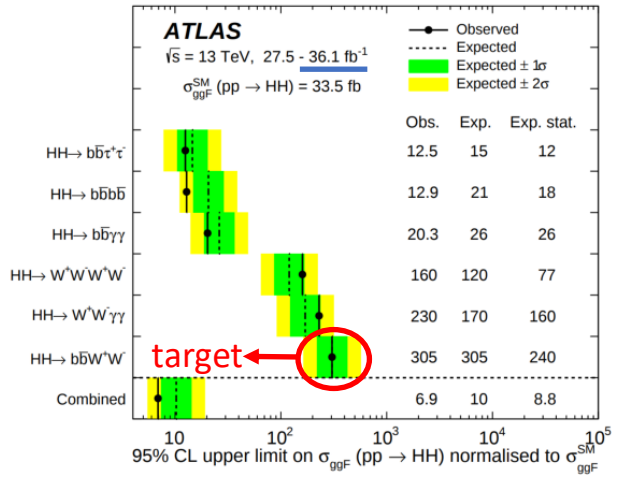
- **New analysis** started with full Run2 data (139 fb-1): **(V. D'Amico, PhD thesis)**
  - Studies with truth MC particle information to investigate new useful kinematics variables
  - Sensitivity estimation at truth-level using signal with ttbar background, and a BDT for the selection:

2 new variables at truth level





M. Sohail (analysis team, PhD thesis)



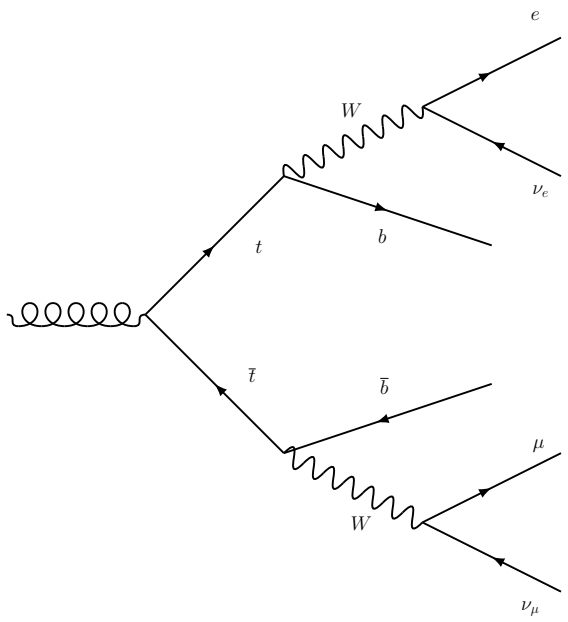
arXiv:1906.02025

- New triggers investigated at reco-level to recover events (was a problem with the previous analysis)
- Studies on jet topology : different radius, track-jets, large-R jets
- Plan to use Machine Learning techniques for event selection (BDT, NN, DNN)

Luca

Top-antitop cross section measurements (inclusive and differential) @13 TeV

L. Martinelli
G. Salamanna

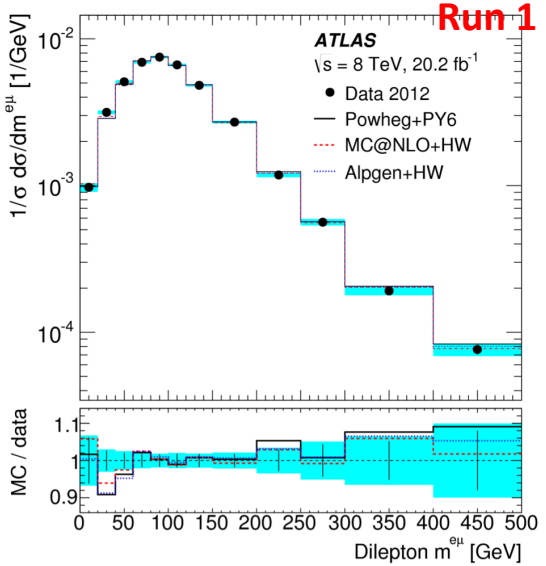


- The goal of the analysis is to **measure** the **differential** (and **inclusive**) $t\bar{t}$ **cross-section** as a function of kinematic variables in a fully leptonic final state (one electron + one muon);
- This channel as a very clean signature with low hadronic activity and Z boson decays (purity region at level of 90%);
- We developed a technique to extract $\sigma_{t\bar{t}}$ in events where one and two b-jet have been identified;
- Kinematic variables → sensitive to the value of top quark mass.

Expected **sensitivity** at level of **2-3%** for the inclusive cross section measurement and of few (depending on the bin) for the differential cross-section measurements.

- Now finalizing the cross-section measurements.
- Devote last year PhD to the quark top mass measurements.

Run 1 example



VH (H → WW) analysis Ada, Michela, Toni

- The RomaTre group is involved since Run1 in this analysis, the main activities are: MVA analysis of the WH → lvlvlv final state, background estimation, group coordination, paper editing

- The last effort has been for the paper on 36 fb^{-1} of Run2 data:
  arXiv:1903.10052 Submitted to Phys. Lett. B

A. Farilla (subgroup convener, editor), M. Biglietti (MVA analysis, bkg estimation, editor), T. Baroncelli (bkg estimation)

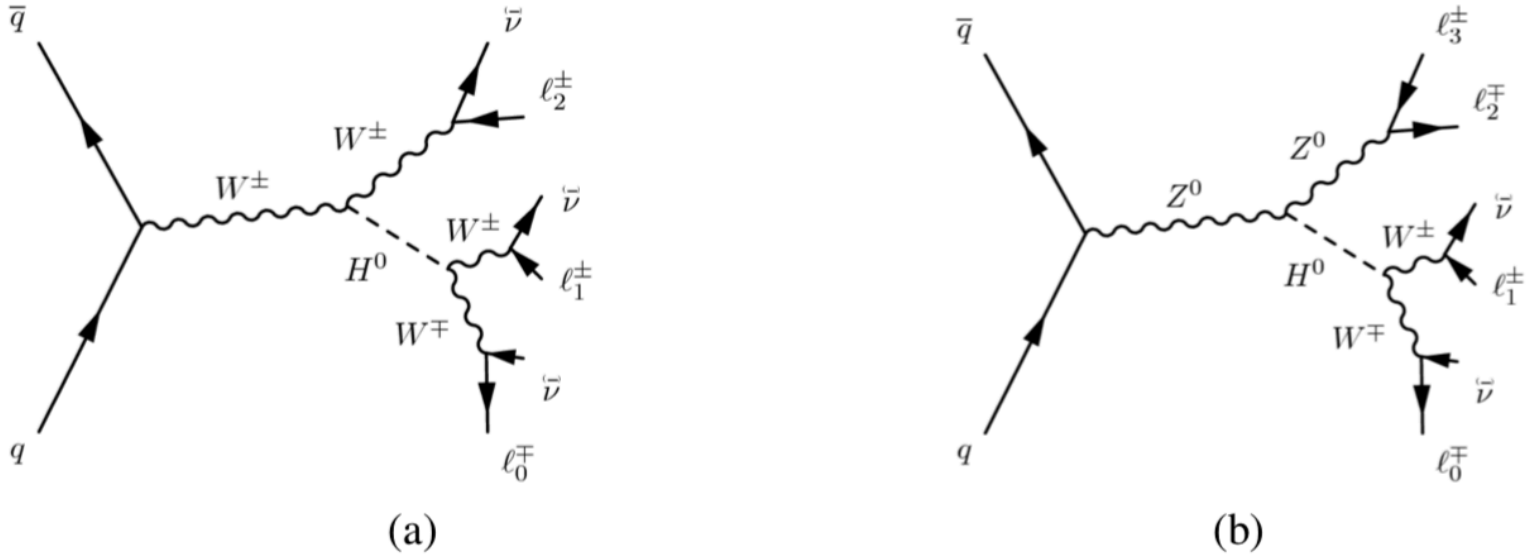


Figure 1: Tree-level Feynman diagrams for the $VH(H \rightarrow WW^*)$ topologies considered in this paper: (a) 3ℓ channel and (b) 4ℓ channel.

VH (H → WW) analysis Ada, Michela, Toni

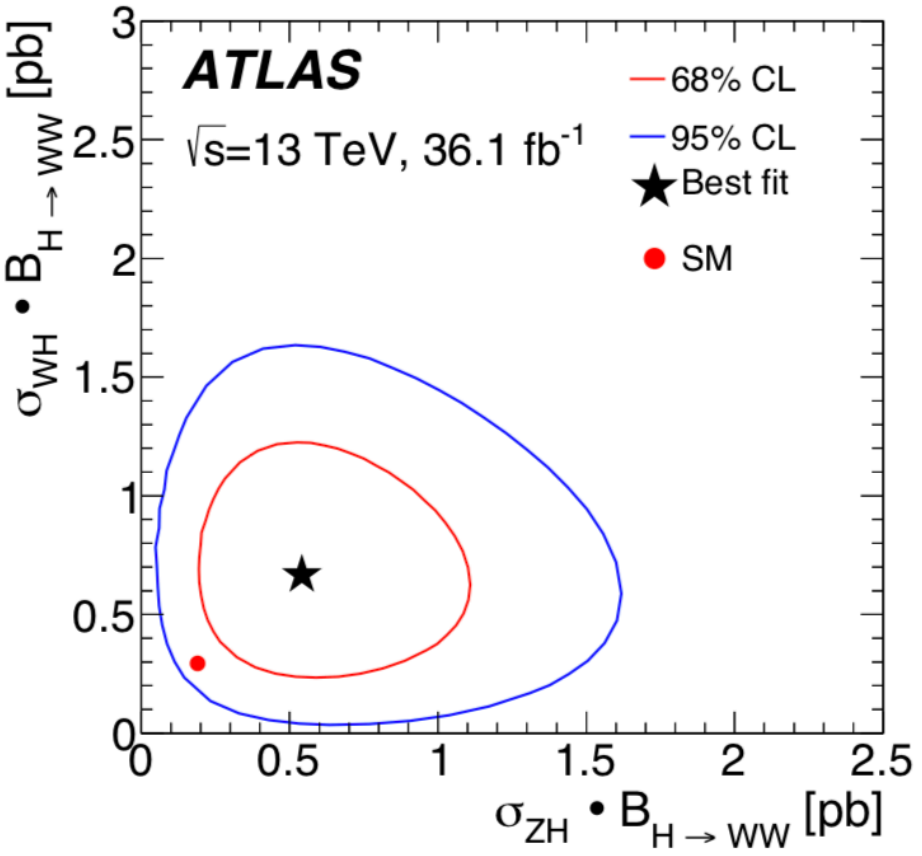
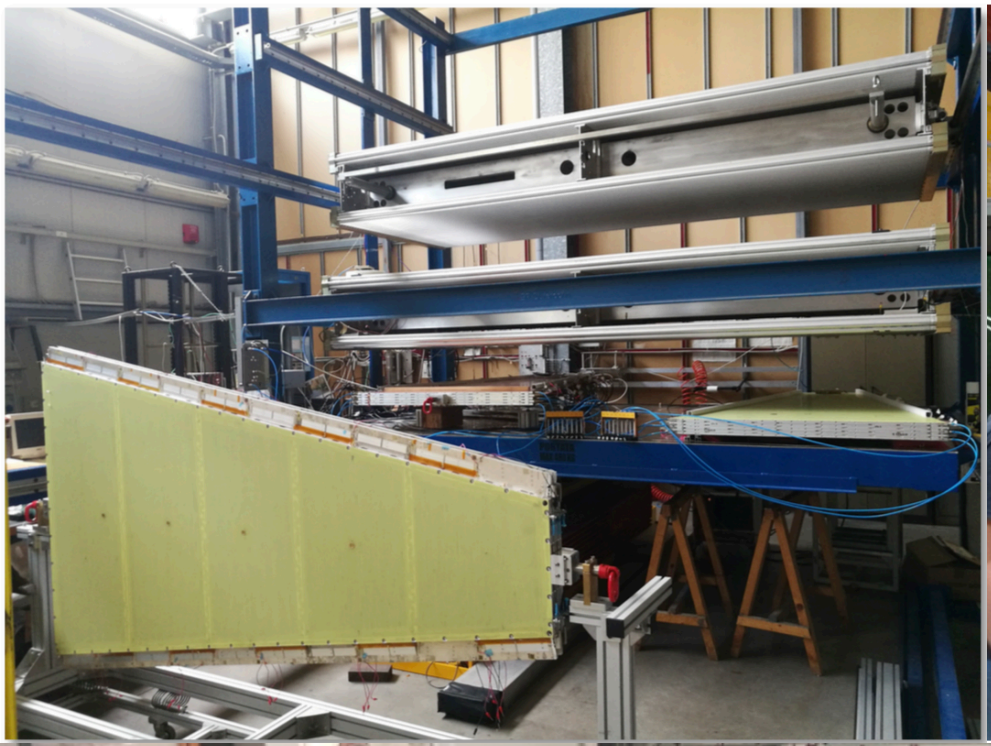


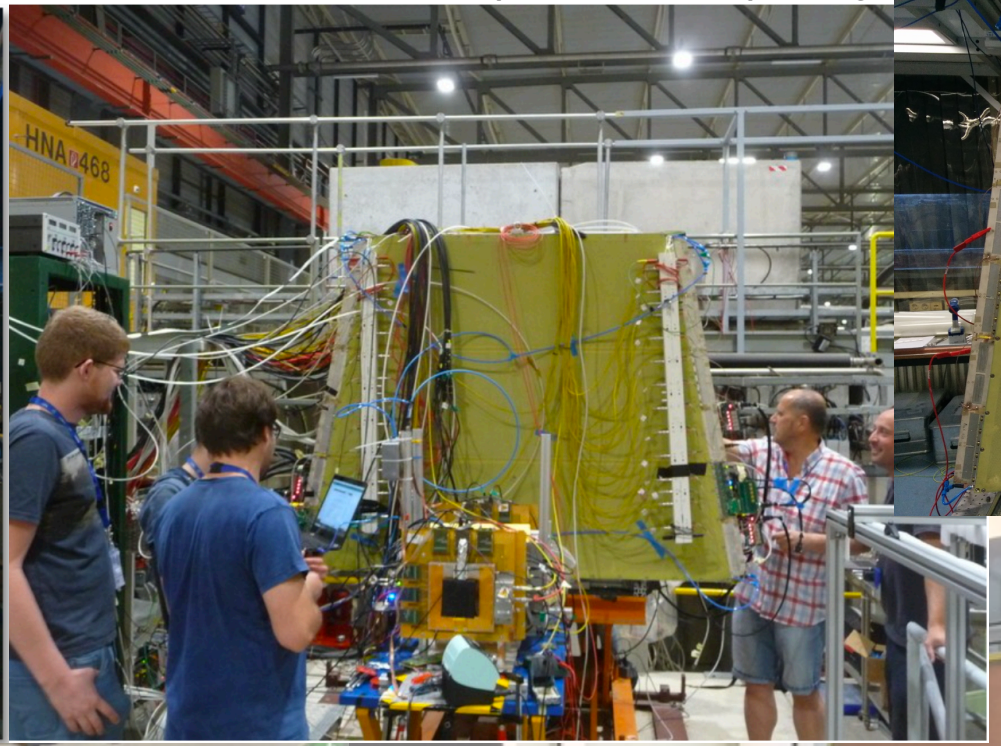
Figure 8: Two-dimensional likelihood contours of $\sigma_{WH} \cdot \mathcal{B}_{H\to WW^*}$ vs. $\sigma_{ZH} \cdot \mathcal{B}_{H\to WW^*}$ for 68% and 95% confidence level (CL) compared with the prediction from the Standard Model.

VH (H → WW) analysis Ada, Michela, Toni

	x-section (pb)	
WH	$0.67^{+0.31}_{-0.27}(\text{stat.})^{+0.11}_{-0.09}(\text{theo syst.})^{+0.14}_{-0.11}(\text{exp syst.})$	0.293 ± 0.007 pb
ZH	$0.54^{+0.31}_{-0.24}(\text{stat.})^{+0.11}_{-0.05}(\text{theo syst.})^{+0.10}_{-0.05}(\text{exp syst.})$	0.189 ± 0.007 pb

consistent with the SM predictions
within 1.3σ for *WH* and 1.5σ for *ZH*

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