

ATLAS

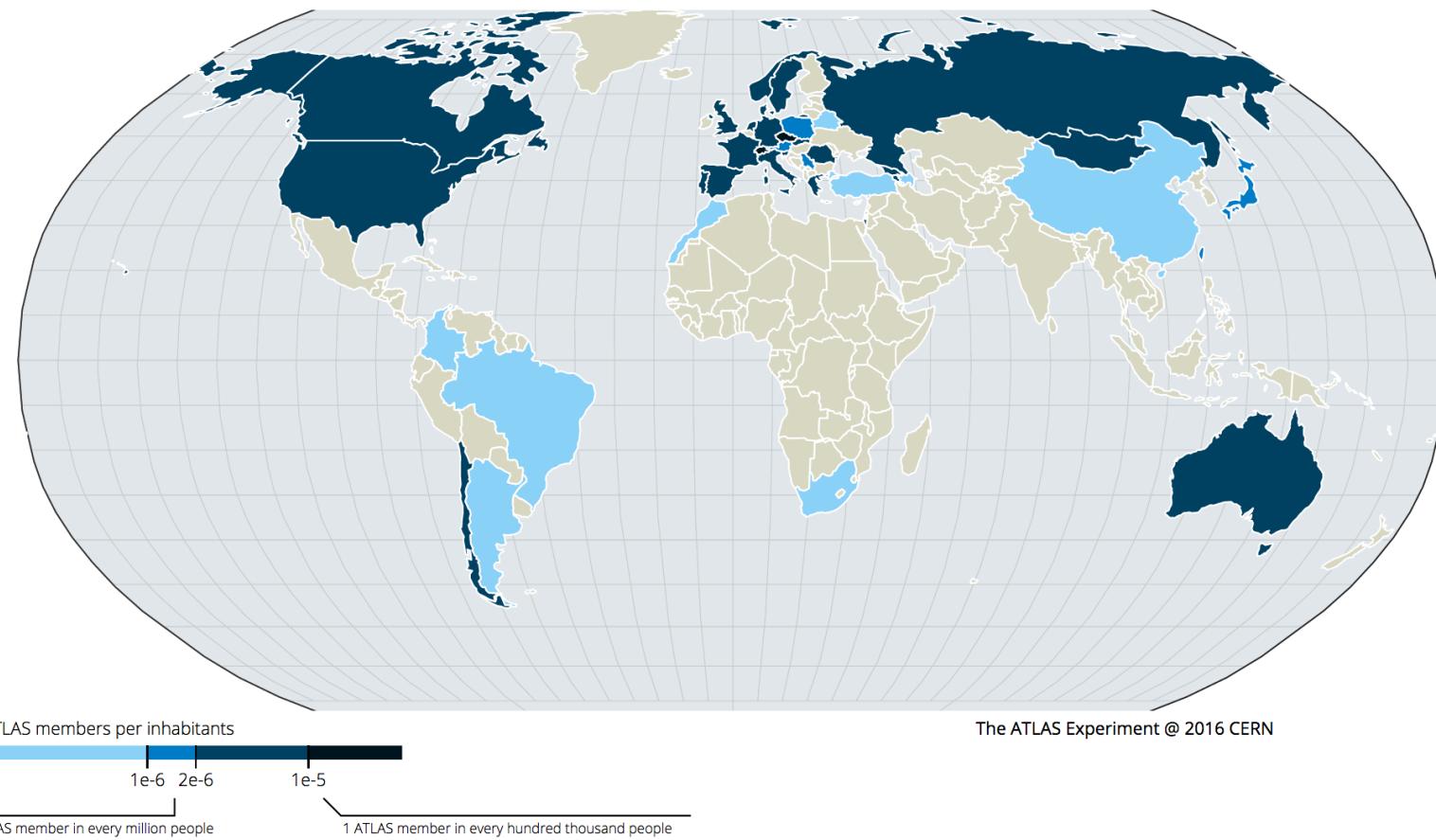
Biennale du LPNHE
Tirrenia (Pise)

G. Calderini for the ATLAS LPNHE group

4-7/10/2016



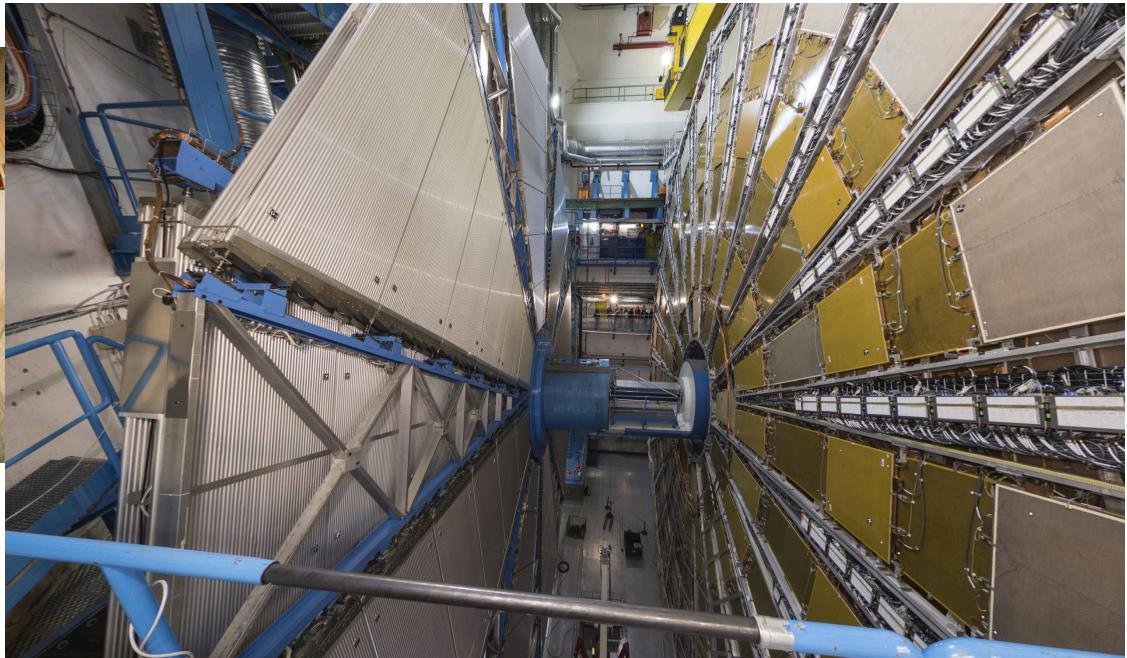
The ATLAS Collaboration



More than 5000 scientists from 38 countries

180 institutions

The LHC and ATLAS physics

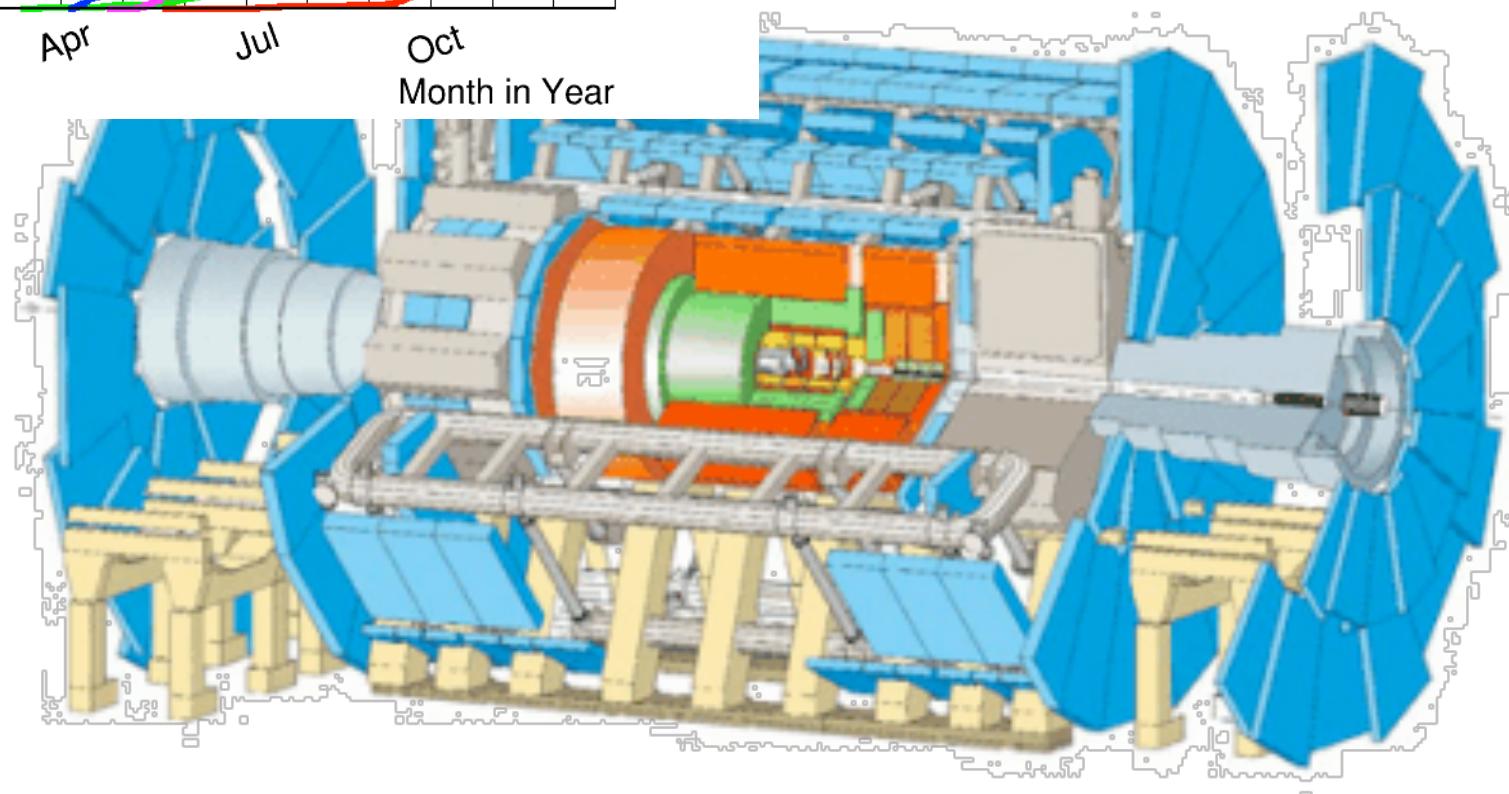
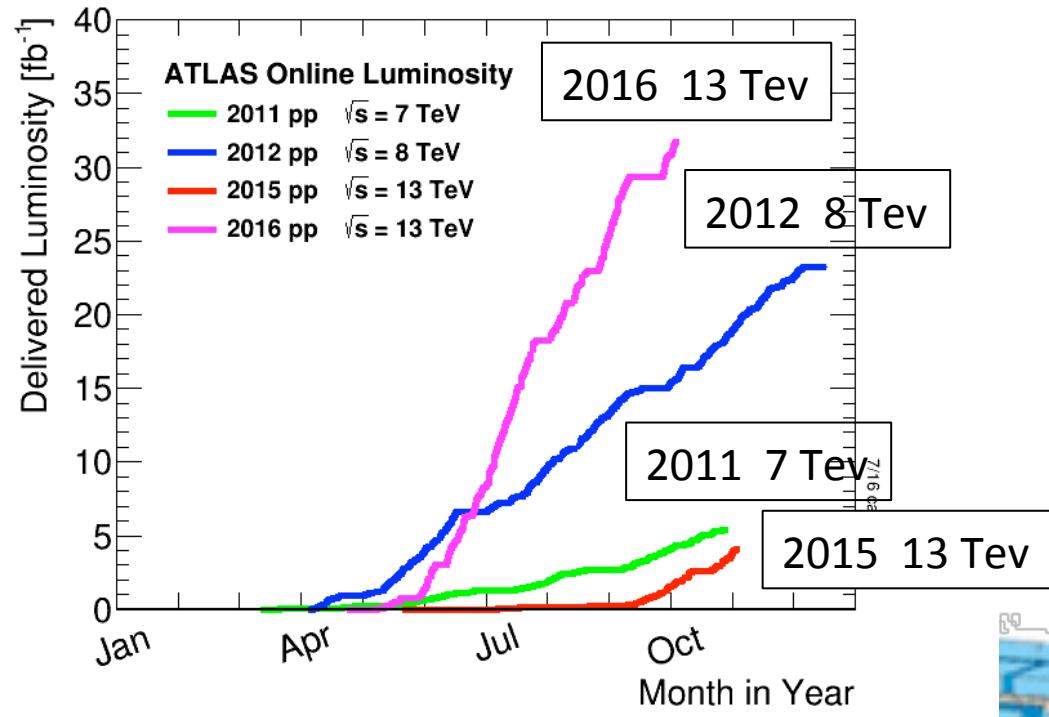


At the construction, the ATLAS / CMS physics program was composed of several parts

"A": Guaranteed: study the QCD and the SM with unprecedented probe capability

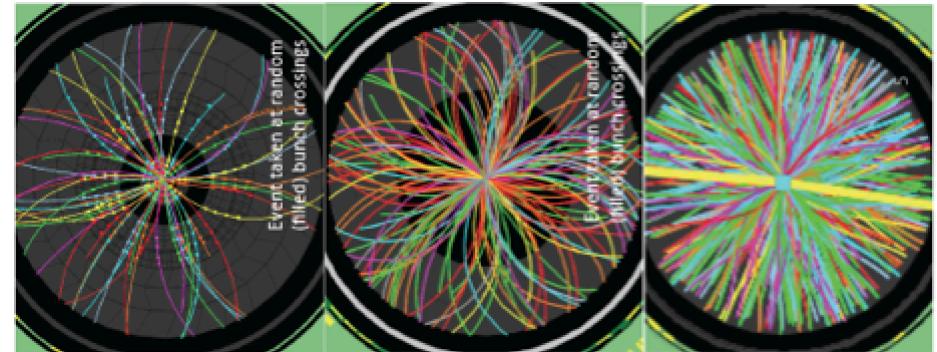
"B": Probable: Find the SM Higgs where everybody thought it was (but sensitivity to a wide range of masses) and study its properties

"C": Speculative-grade: Unprecedented capabilities to find new physics (if it exists)



The LHC and ATLAS physics

Record peak at 1.3×10^{34}
>29 fb-1 delivered,
>>27 recorded in Run 2 (2016)



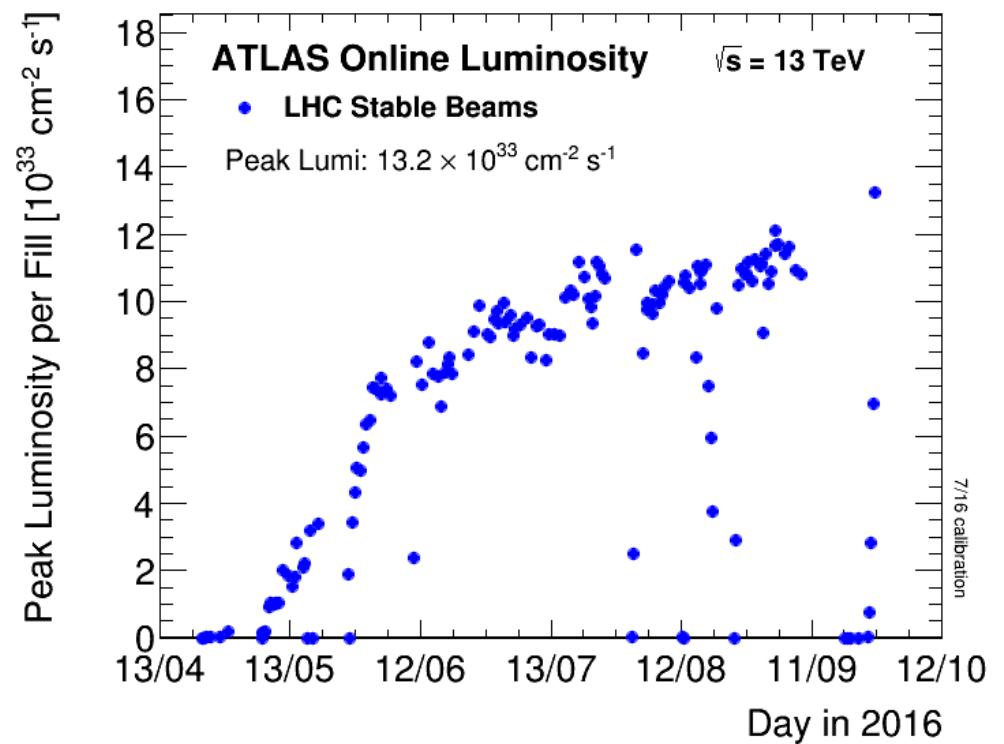
In addition

Run1:

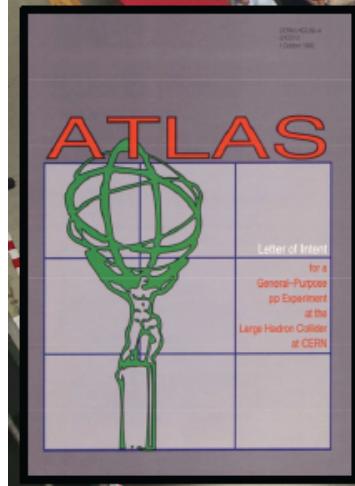
5.6 (4.6) fb-1 @ 7 TeV
23 (20.3) fb-1 @ 8 TeV

Run2 (2015):

3.2 fb-1 good data



1989 R&D begins
1992 Atlas Letter of Intent
1996 Approval
1997 Construction starts
2003 Underground installation starts
2008 Installation completed, cosmic ray data taking to commission the detectors
2009 First collisions at 0.9 and 2.36 TeV
2010 First collisions at 7 TeV
2012 First collisions at 8 TeV
2012 July 4th → Observation of a new particle in search for SM Higgs boson!



The adventure started very long ago and the LPNHE group took part to every step of the experiment's life from construction and commissioning, reconstruction and performance to final analysis

The ATLAS group at LPNHE

- E-chercheurs: (9) T. Beau (MdC), M. Bomben (MdC), S. De Cecco (MdC),
B. Laforge (Prof), I. Nikolic-Audit (MdC),
J. Ocariz (Prof), M. Ridel (MdC), S. Trincaz-Duvold (MdC)
J. Chauveau (Prof, Emeritus, now mostly at SHiP)
- Chercheurs (9): G. Bernardi (DR), G. Calderini (DR), F. Derue (CR),
M.W. Krasny (DR), D. Lacour (DR), S. Laplace (CR),
B. Malaescu (CR), G. Marchiori (CR), L. Roos (DR)
(in black: HDR)
- Post-doc: (4) D. Varouchas* (CNRS, -2016), P. Francavilla (ILP, -2016) +
A. Mirzaei (ANR, -2016), R. Wang (ILP, -2019) +ANR (2016-19)
+ANR (2017-20)
- Doctorants: (12) C. Pandini, Y. Yap,
A. Lopez Solis, P. Luzi,
A. Ducourthial, D. Portillo Quintero,
L. D'Eramo, R. Hankache, I. Luise, A. Tarek
S. Manzoni (co-tutelle UniMI), C. Li (co-tutelle USTC)
- ITA: F. Crescioli, D. Laporte, O. Le Dortz, V. Mendoza

From detector to performance

Traditional involvement of the group in the LAr
Calorimeter:
(construction, commissioning, run)

- reco/performance
- improved isolation
- conversions with shower shape
- cross-talk
- Calo Trigger Software & Performance (Convener Laforge -2013)

Jets:

Jet calibration and resolution
(Convener + LHC WG: Varouchas)
Jet production analysis

e-gamma (Convener: Laplace)

Photon ID (Convener Marchiori)

Isolation forum (Convener: Laplace)

DQ e-gamma (resp: Laforge)
MC e-gamma (resp: Ocariz)

From detector to performance (II)

IBL:

- Construction
- Commissioning
- Run

b-tagging
Missing Transverse Energy
(Convener Francavilla in 2014)

ATLAS pixels:

- software, reconstruction
- btagging

Phase-II: inner tracker

- sensors
- electronics (RD53, OmegaPix2)
- cooling solutions (AIDA-2020 WP9 Task 9.2 Convener Calderini)
(micro-channels)
- test-beams (ATLAS coordination: Bomben)

G. Calderini: Tracker Upgrade coordinator at IN2P3

Not to be forgotten computing/GRID:

CAF (Mendoza) / High Perf. Computing (Derue, Beau)

Calcul HTC (High Throughput Computing),

GRIF : projet de grille de calcul, existant depuis 2005

<http://lpnhe.in2p3.fr/grif/>



V. Mendoza : resp. technique (80%) + représentant du LPNHE au Calcul Atlas France, F. Derue (15%)

~3200 coeurs de calcul et ~2000 TB de stockage

~60% de ces ressources utilisées par ATLAS

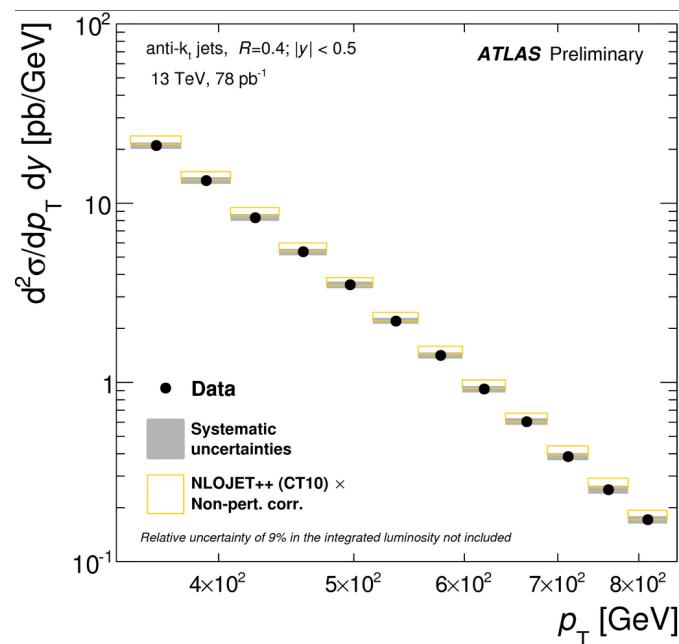
Calcul HPC (High Performance Computing)

- LPNHE : cartes GPU/XeonPhi : T. Beau, F. Derue, V. Mendoza
- ressources disponibles à l'UPMC et UPD : >10000 coeurs, ~200 Tflop/s
- BigData/Machine Learning

<http://lpnhe.in2p3.fr/spip.php?rubrique295>

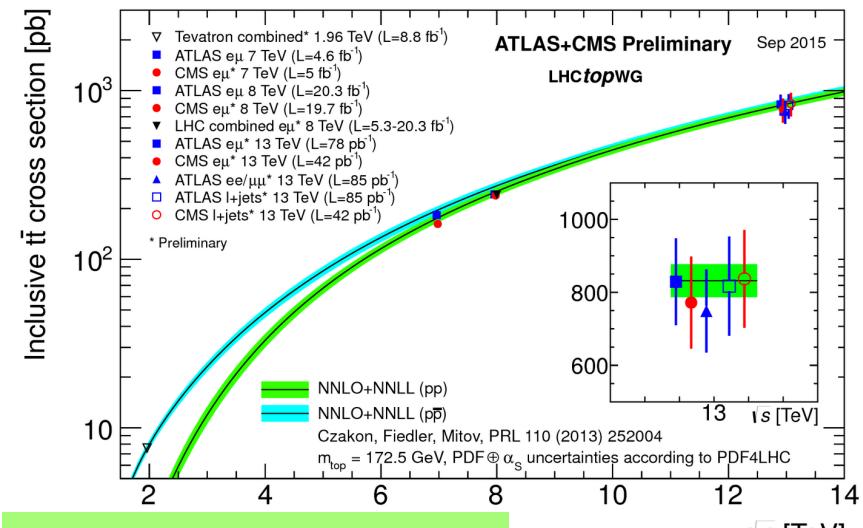
"A": Study of QCD and Standard Model

- Jets cross section
 - ★ understand all aspects of detector
 - ★ importance of energy calibration



- Top Cross section measurement
 - ★ to be done at all energies
 - ★ look for consistency with SM

Section efficace de production ttbar



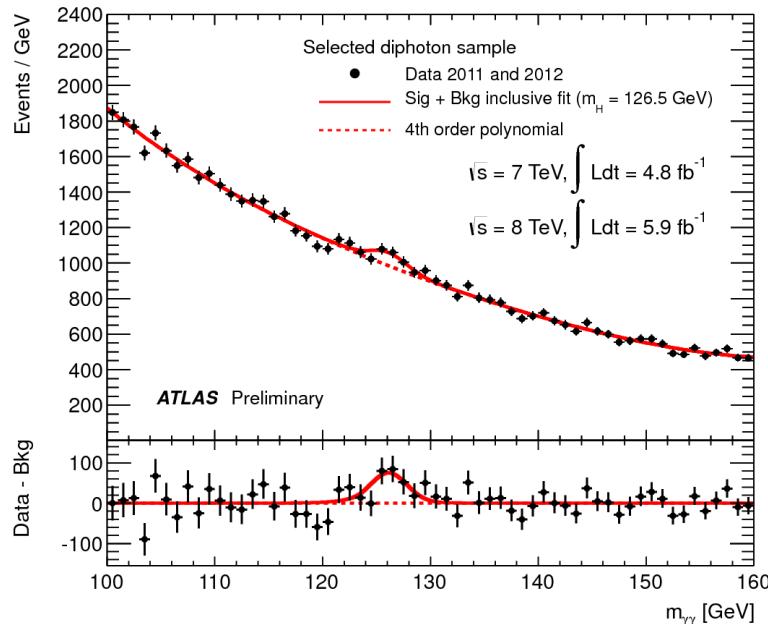
- Top mass measurement
 - ★ fundamental parameter of SM
 - ★ put constraints on New Physics

See talk of F. Derue

F. Derue	conv. Fake Top (-2016)
B. Malaescu	conv. Statistical forum, SM Jet & Photons
D. Varouchas	conv. Top cross-section

"B": Look for the Higgs where people thought it was

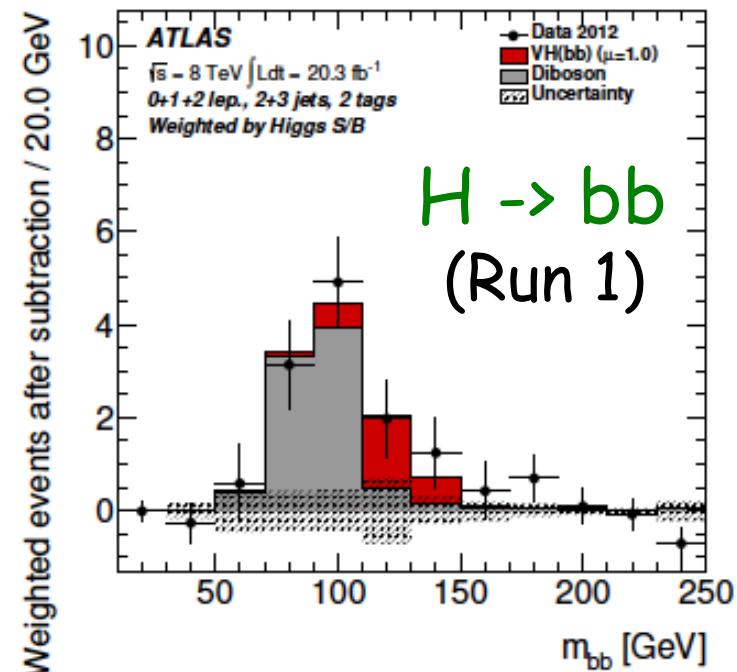
H $\rightarrow \gamma\gamma$ and properties



Plot of 2012 discovery
Was done in our group !!!

And the Higgs was
actually there !

See talk of G. Marchiori and P. Francavilla



We also look for
H(SM) $\rightarrow Z\gamma$

G. Marchiori
S. Laplace
P. Francavilla

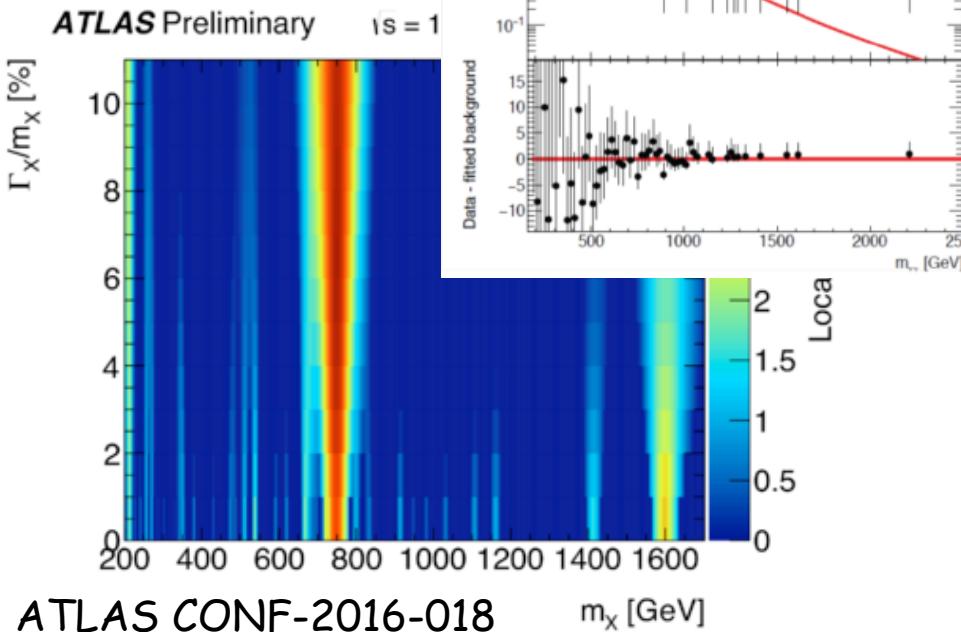
conv. HGAM (2016-)
former conv. HGAM
conv. Hbb (-2016)

"C": brave high-gain search for the unknown

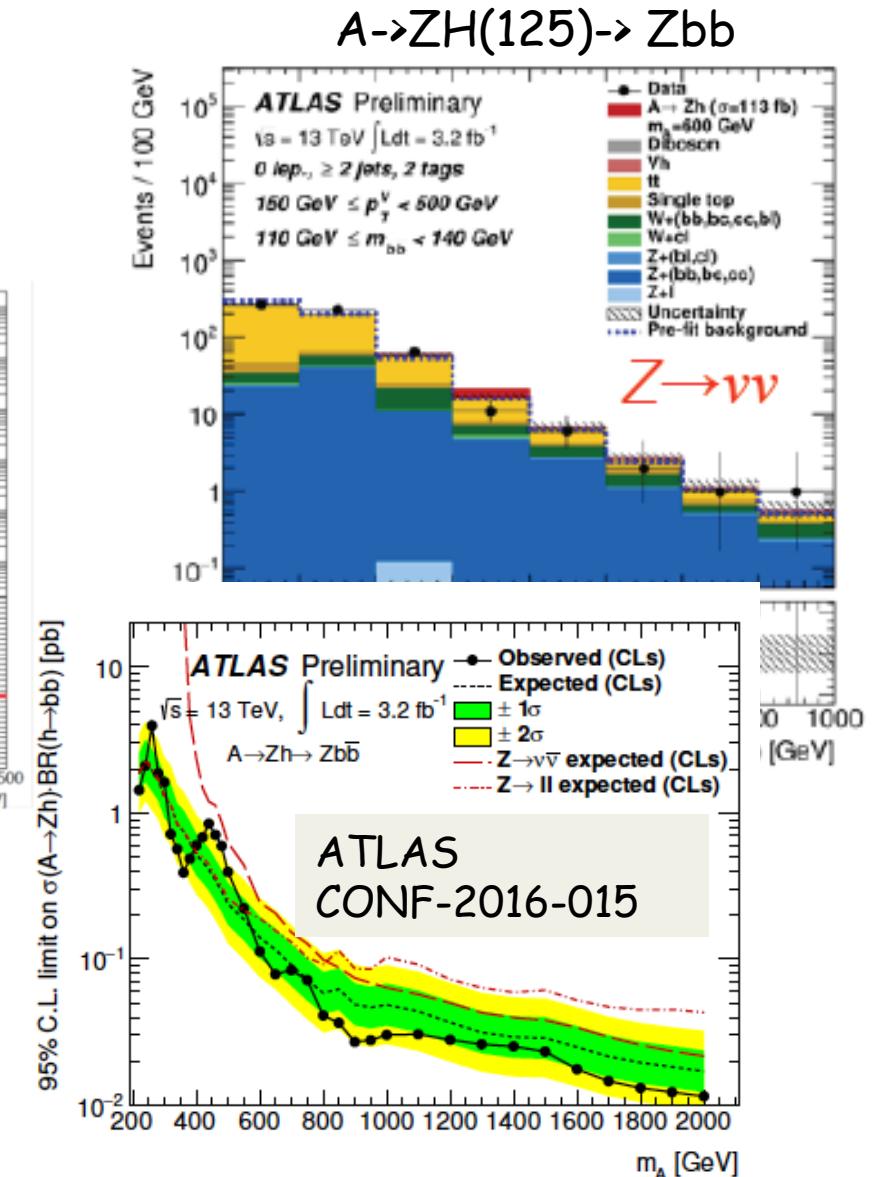
Di-photon resonances

Missing Et topologies
 (Hbb+MET, $\gamma\gamma$ +MET, H $\gamma\gamma$ +MET,
 V+MET)

$A \rightarrow Z h(b\bar{b})$

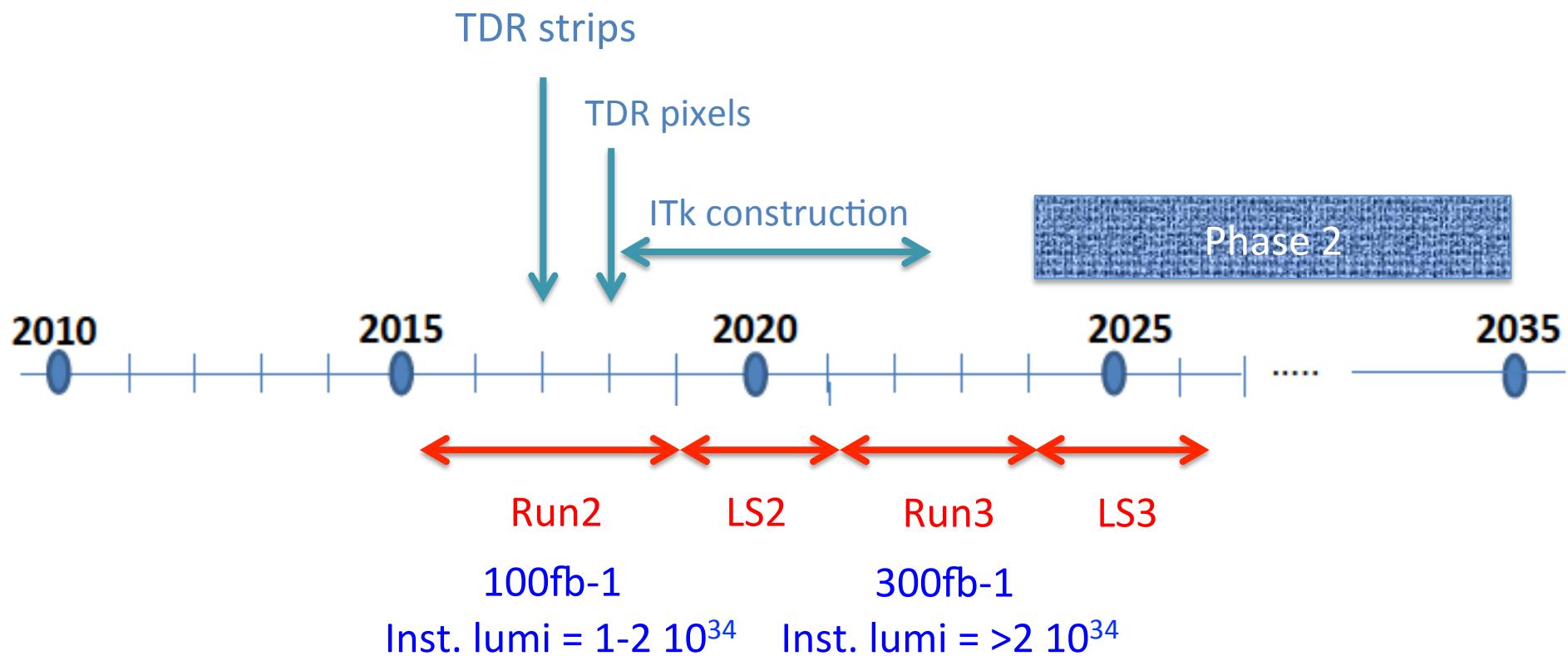


Again, see talk of G. Marchiori and P. Francavilla



No discoveries without detectors

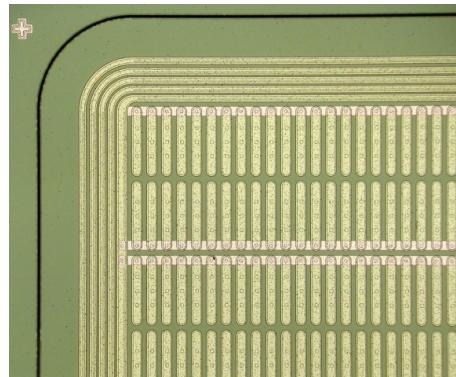
The ATLAS roadmap in the LHC upgrade



R&D activities

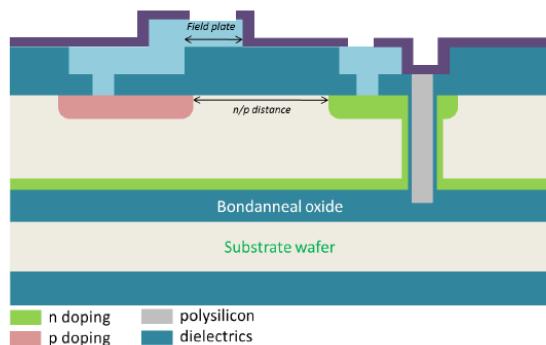
Sensors

- Device Simulations
- Sensor Production
- Characterization
- SIMS activity
- Irradiations
- Testbeams

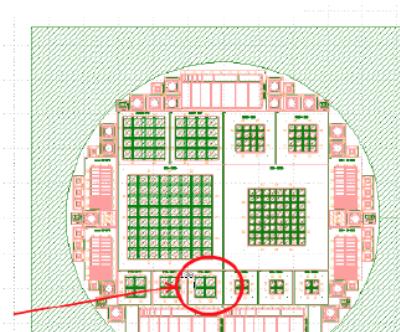
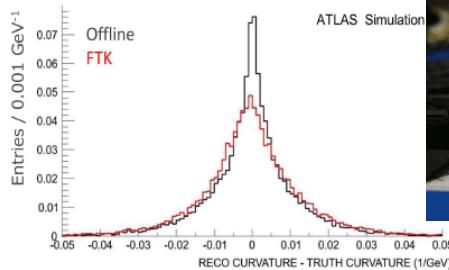


Edgeless sensors

- Active edge at FBK



Fast track-trigger



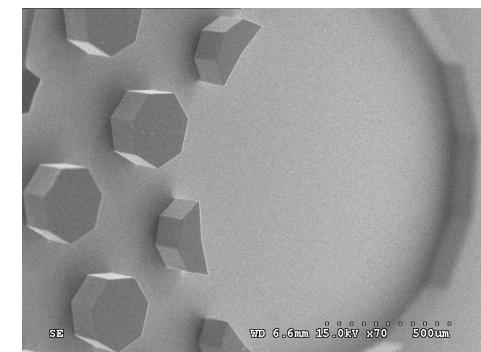
See presentations tomorrow

FE electronics

- Development of 65nm (RD53)
- On-beam characterization

Mechanics

- Thermal simulations
- Thermal characterization
- Mechanical design
- Micro-channel cooling



HGTD

Tentative offer of future theses

(see the dedicated session)

2017

- Roos: cotutelle w/ USTC, low/high-mass diphoton resonances
- Laforge: possible cotutelle with WITS, dark matter in $\gamma\gamma + \text{MET}$ final state
- Ocariz: Higgs properties with $H \rightarrow \gamma\gamma$
- Marchiori: $H \rightarrow b\bar{b}$
- Beau+Derue, Mesure de précision de la masse du quark top

2018

- Bomben: ITK R&D + high-luminosity physics prospects
- Lacour+Trincaz-Duvold, Développement/tests HGTD + physique avec les jets

2019:

- Laplace: Run3 performance and analysis preparation & analysis of first ~1.5 years of Run3
- Bernardi ou Calderini: $H \rightarrow b\bar{b}$
- Malaescu+Ridel : recherche BSM avec les jets

Conclusions

The ATLAS group is operating since many years at LPNHE

- A solid scientific program covering all phases of the lifetime of experiment
- Strong bases in the reconstruction and physics performance (coming also from the participation to the construction/commissioning of the detector)
- Very visible participation in the analysis life of the Collaboration
- Strong contribution to the formation of the new generation of physicists through several PhD theses and many tens of stage students

I leave the pointer to Fred, Giovanni, Paolo