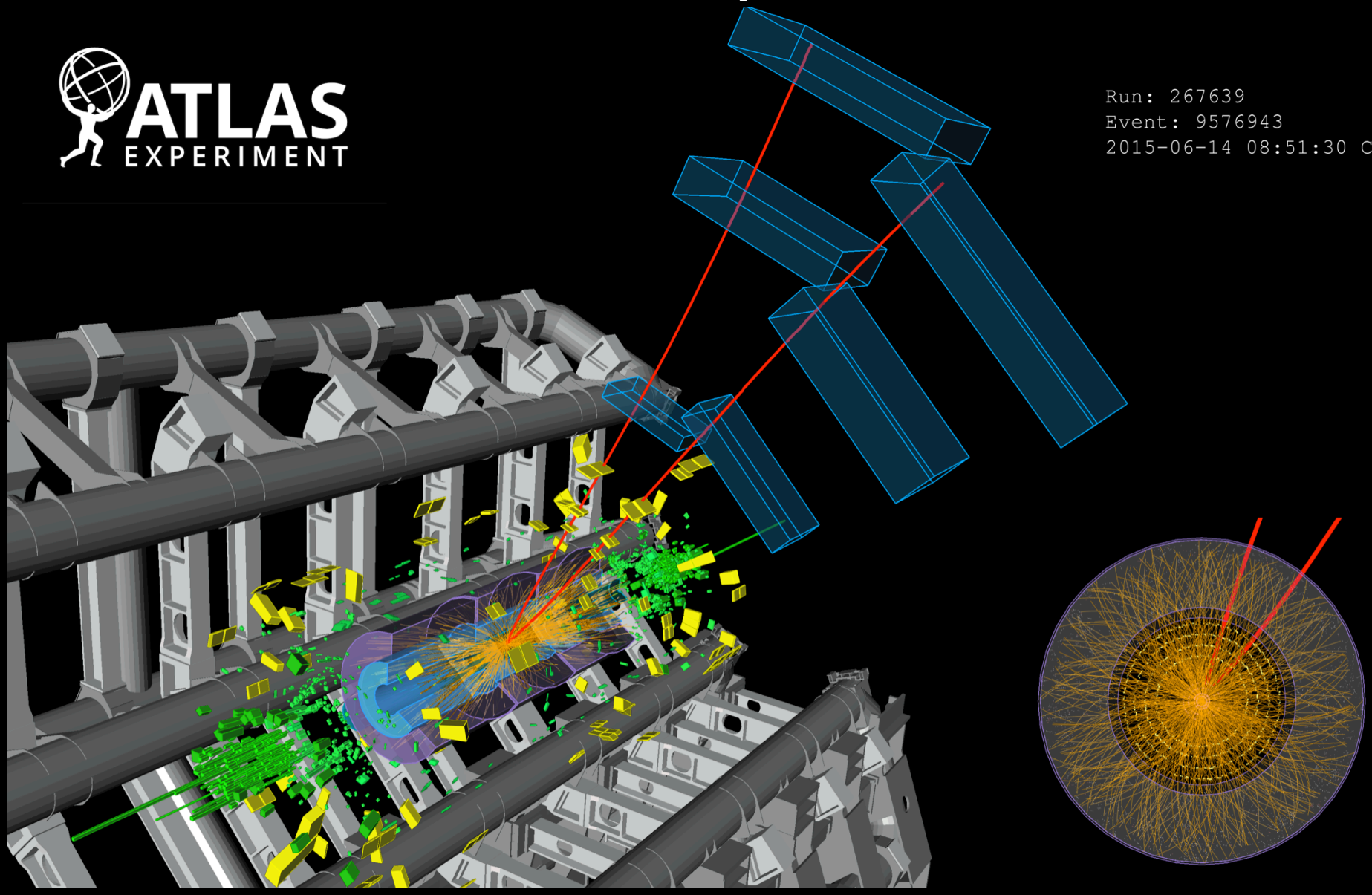
ATLAS Report 2015



Edoardo Gorini

On behalf of the ATLAS Lecce Group

M.Aliev, K.Bachas, G.Chiodini, E.M.V.Fasanelli, G.Fiore. A.Forte, E.Gorini, F.Gravili, A.Innocente, L.Longo, P.Mazzotta, A.Miccoli, A.Mirto, C.Pinto, M.Primavera, M.Reale, F.Ricciardi, G.Rispoli, S.Spagnolo, A.Ventura

Outline

- LHC Restart @13 TeV
- Physics Highlights
- Phase I Muon Detector Upgrade
- Lecce Group Contributions and Activities
  - Hardware
  - Detectors
  - Physics

LHC RESTART @13 TEV

LHC Run 2

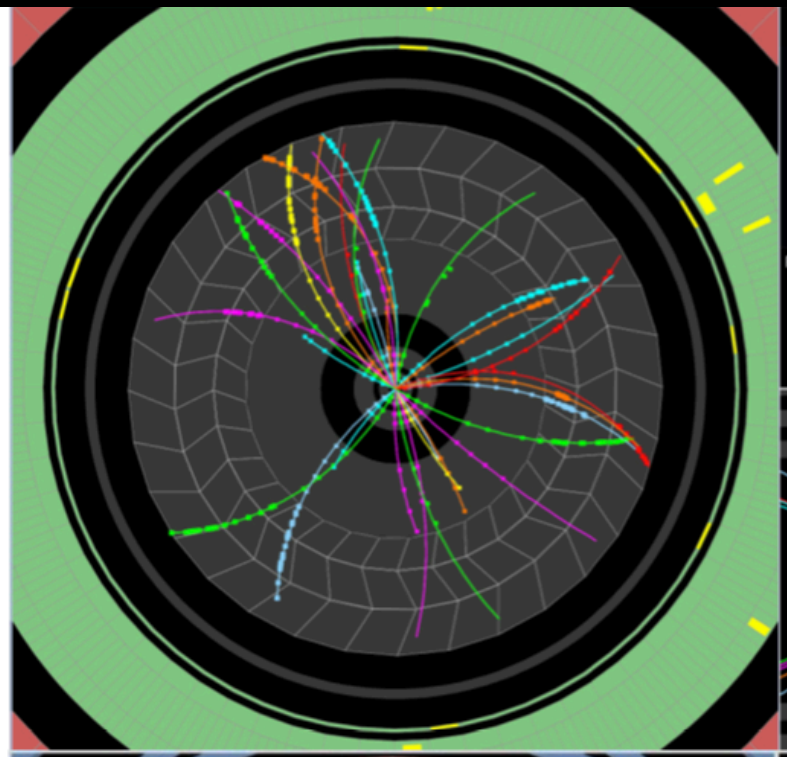
Run-2 is underway

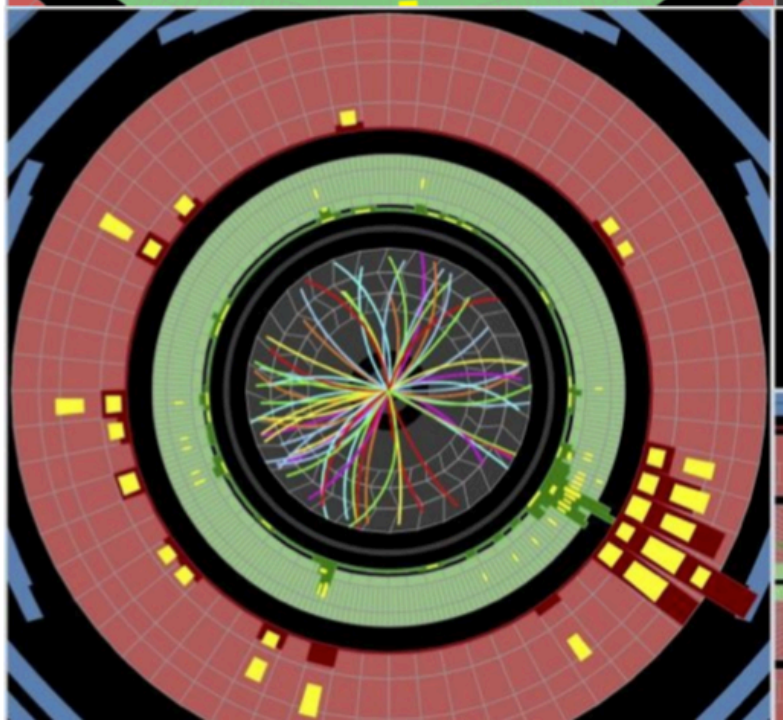
5/7 April: first beams, beam splash events

6 May: "Quiet beam" collisions at 900 GeV

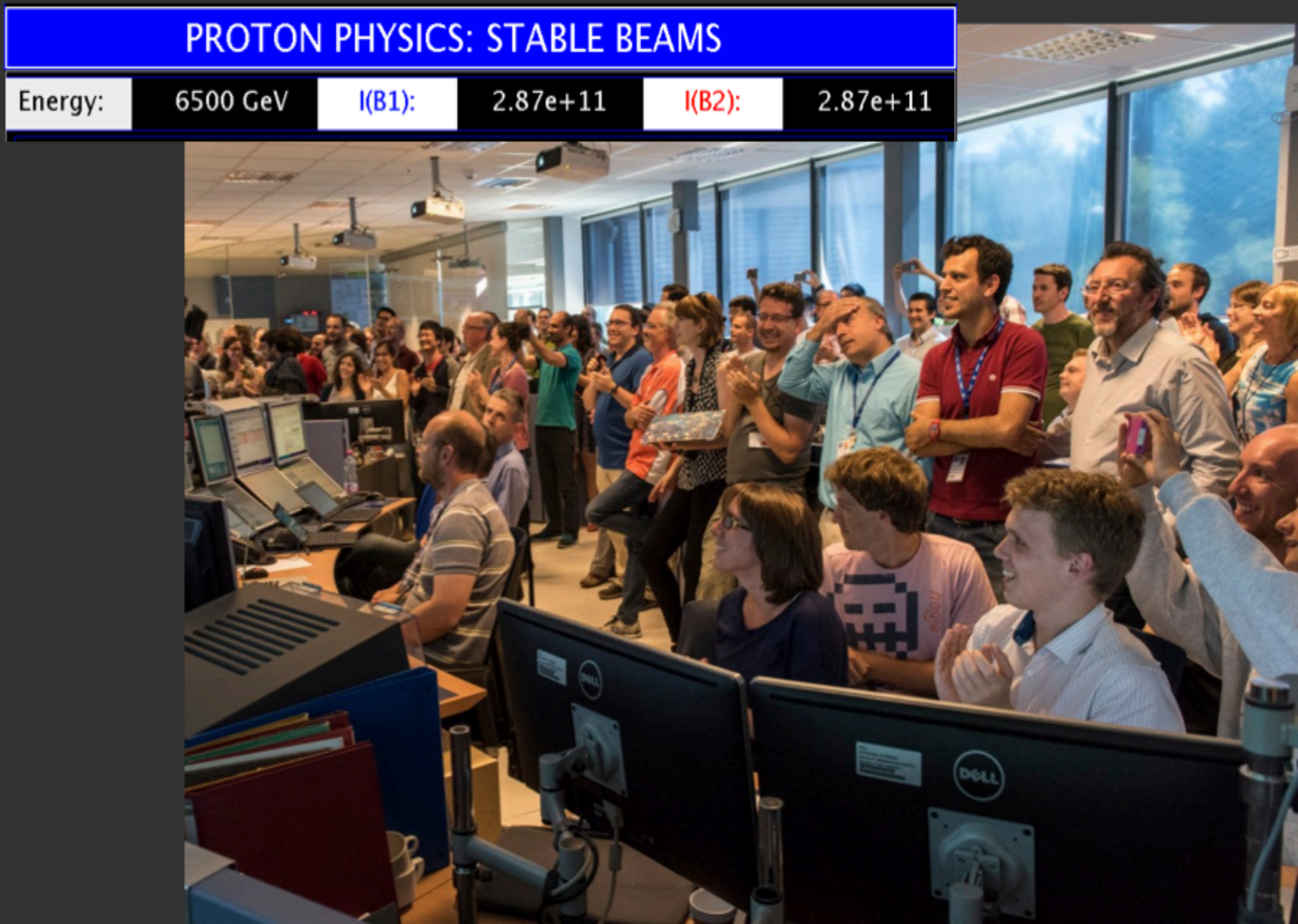
21 May: "Quiet beam" collisions at 13 TeV

Extremely valuable data for detector and trigger commissioning

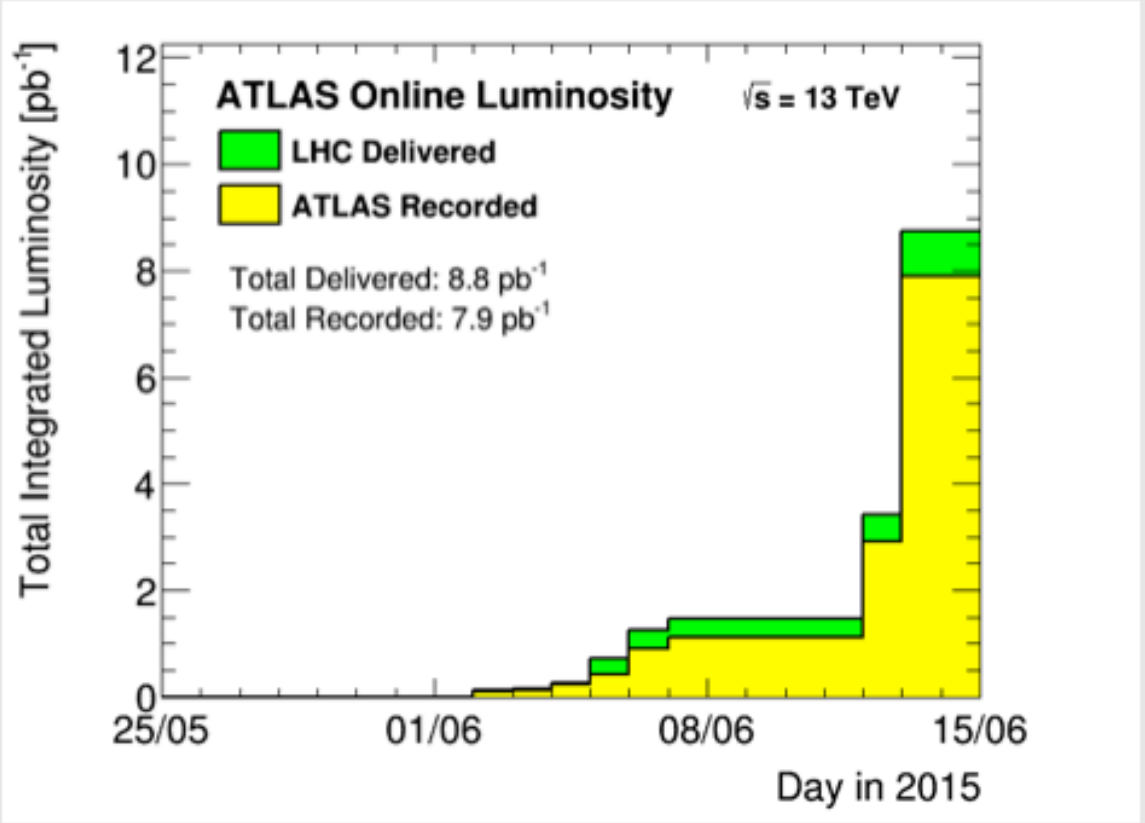


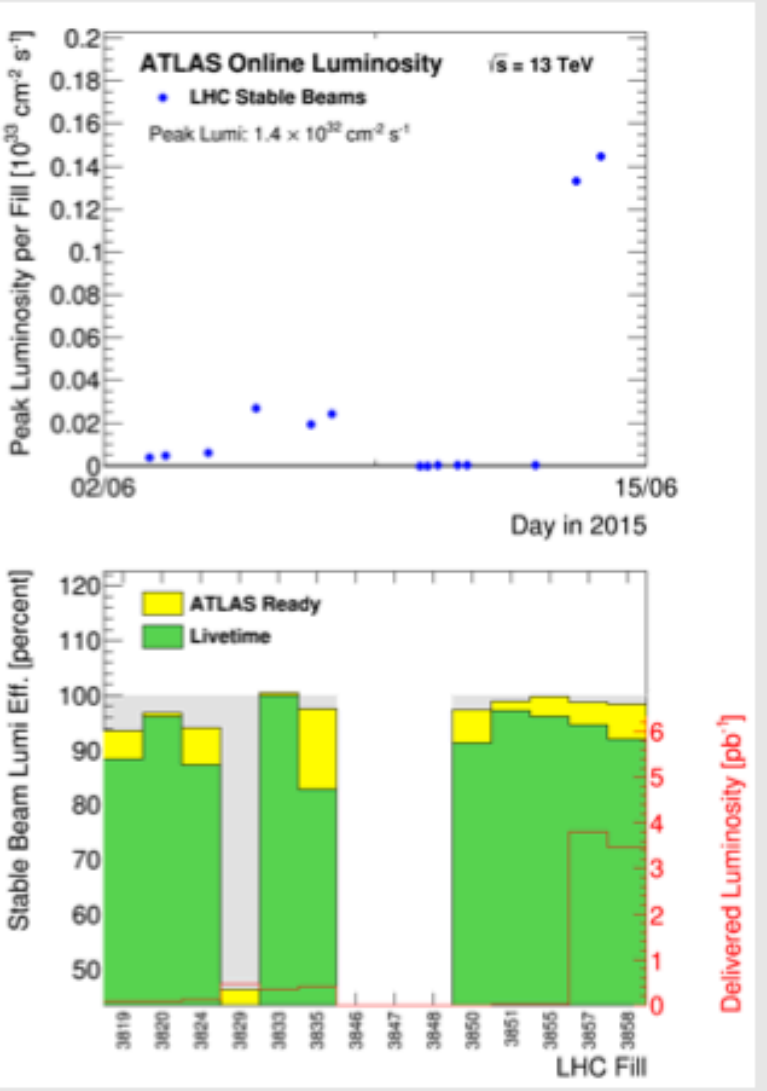


First Stable Beams June 3rd



Luminosity

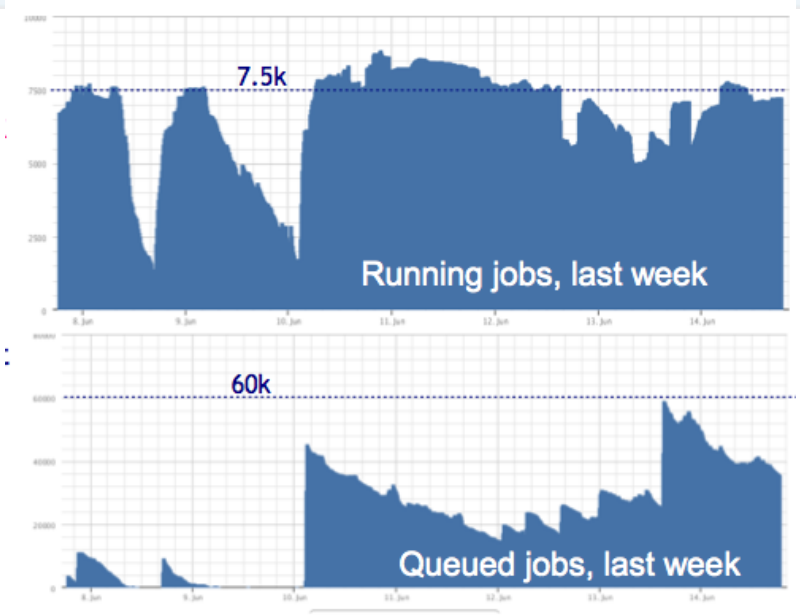

ATLAS Online Luminosity
√s = 13 TeV
LHC Delivered
ATLAS Recorded
Total Delivered: 8.8 pb-1
Total Recorded: 7.9 pb-1
Total Integrated Luminosity [pb-1]
Day in 2015
25/05
01/06
08/06
15/06

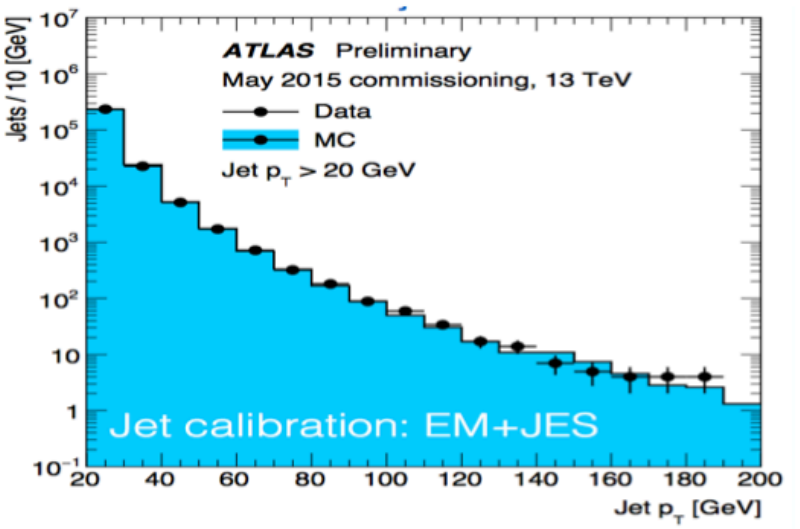

ATLAS Online Luminosity
√s = 13 TeV
LHC Stable Beams
Peak Lumi: 1.4 × 10^32 cm^-2 s^-1
Peak Luminosity per Fill [10^33 cm^-2 s^-1]
Day in 2015
02/06
15/06
ATLAS Ready
Livetime
Stable Beam Lumi Eff. [percent]
Delivered Luminosity [pb-1]
LHC Fill

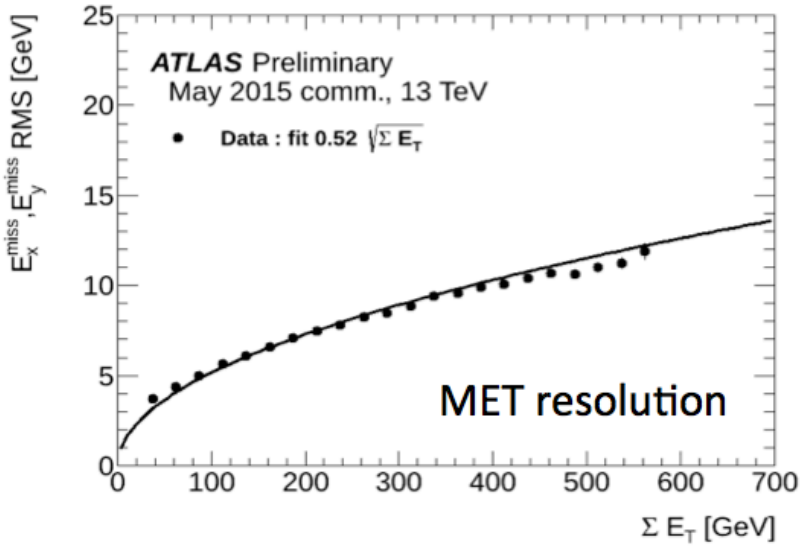
Detector, Jobs, Calibration

Detector Status

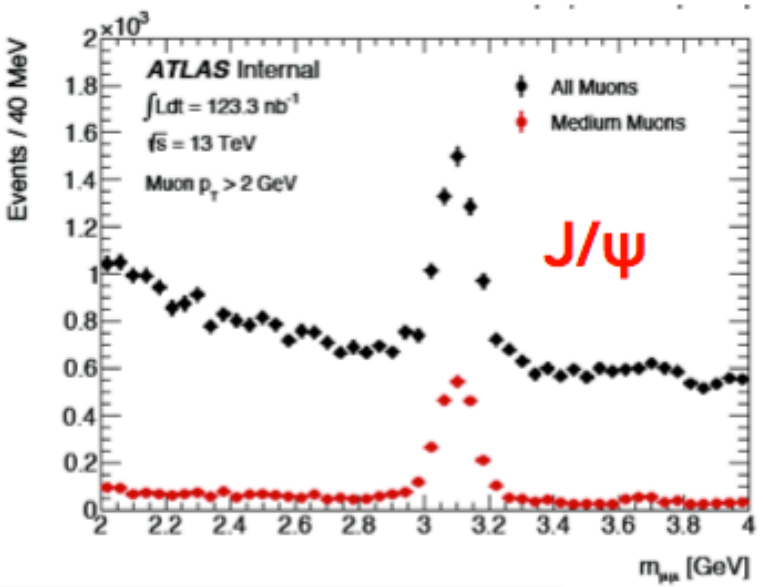
Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	92 M	99.0%
SCT Silicon Strips	6.3 M	98.9%
TRT Transition Radiation Tracker	350 k	97.3%
LAr EM Calorimeter	170 k	100%
Tile calorimeter	4900	99.2%
Hadronic endcap LAr calorimeter	5600	99.6%
Forward LAr calorimeter	3500	99.8%
LVL1 Calo trigger	7160	100%
LVL1 Muon RPC trigger	370 k	98.7%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	357 k	99.8%
CSC Cathode Strip Chambers	31 k	98.4%
RPC Barrel Muon Chambers	370 k	97.1%
TGC Endcap Muon Chambers	320 k	99.8%

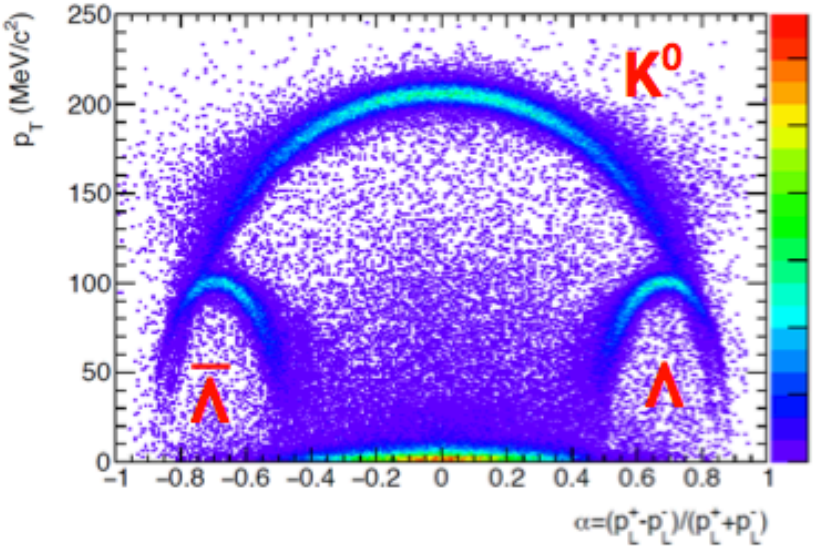


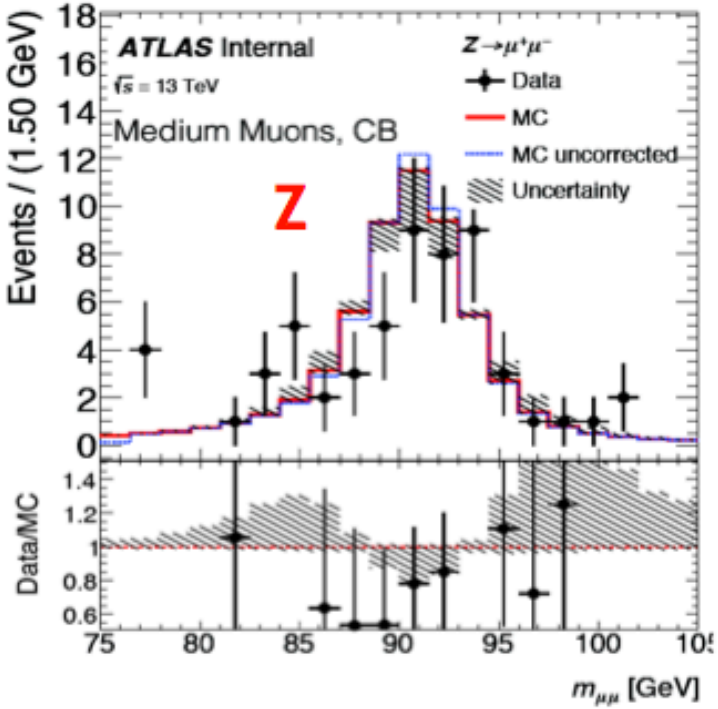


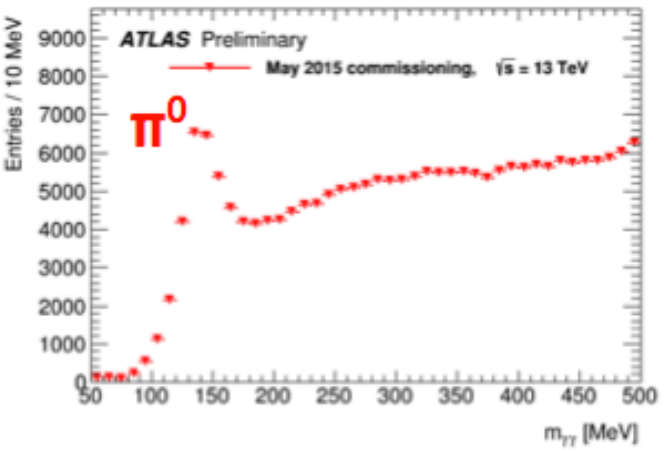


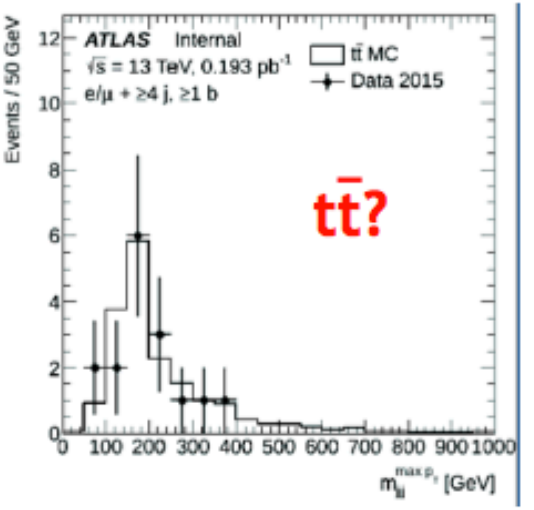
Bump Hunting @13 TeV





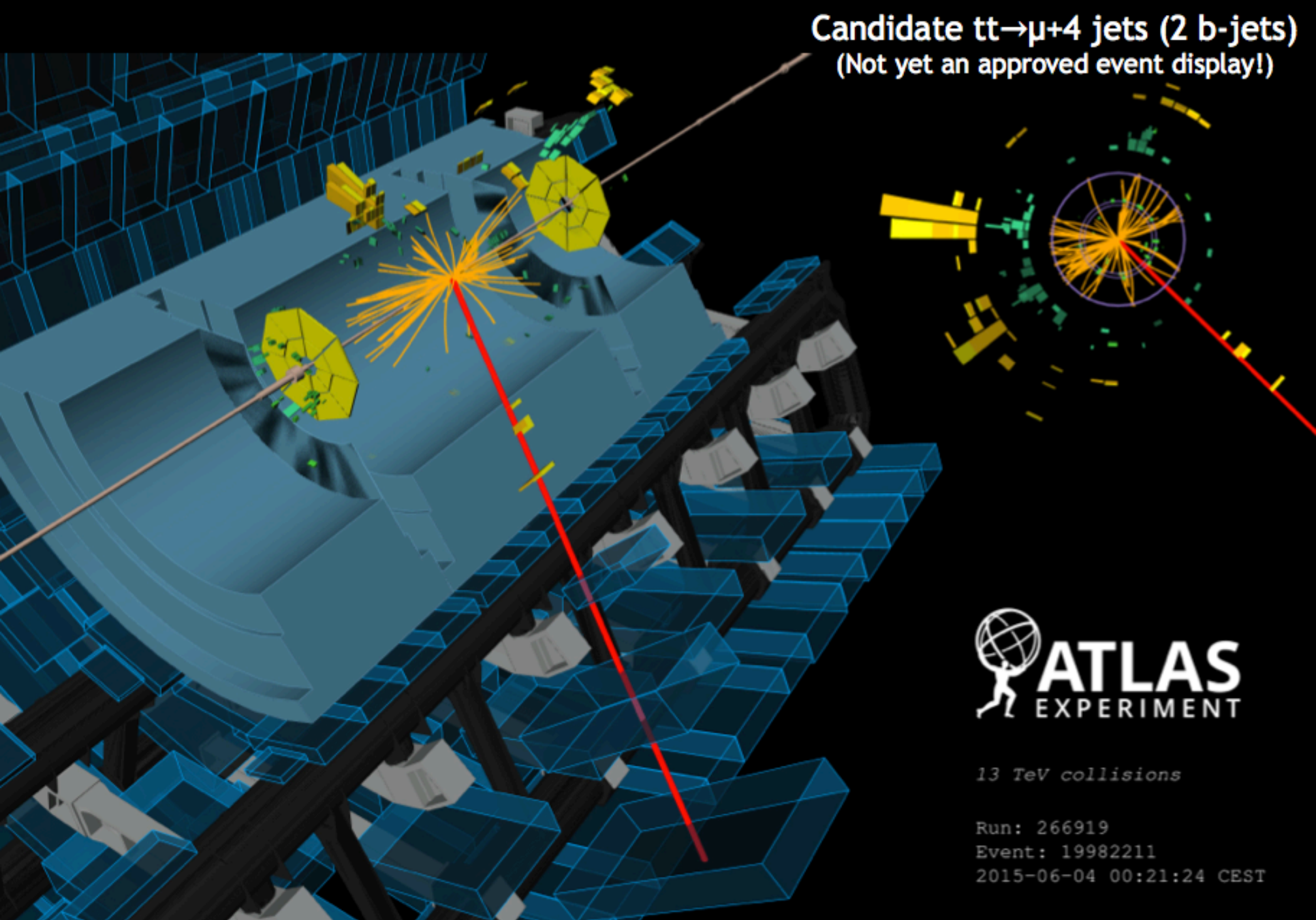






→ Much more, way beyond bump-hunting, in physics analysis group talks later this week!

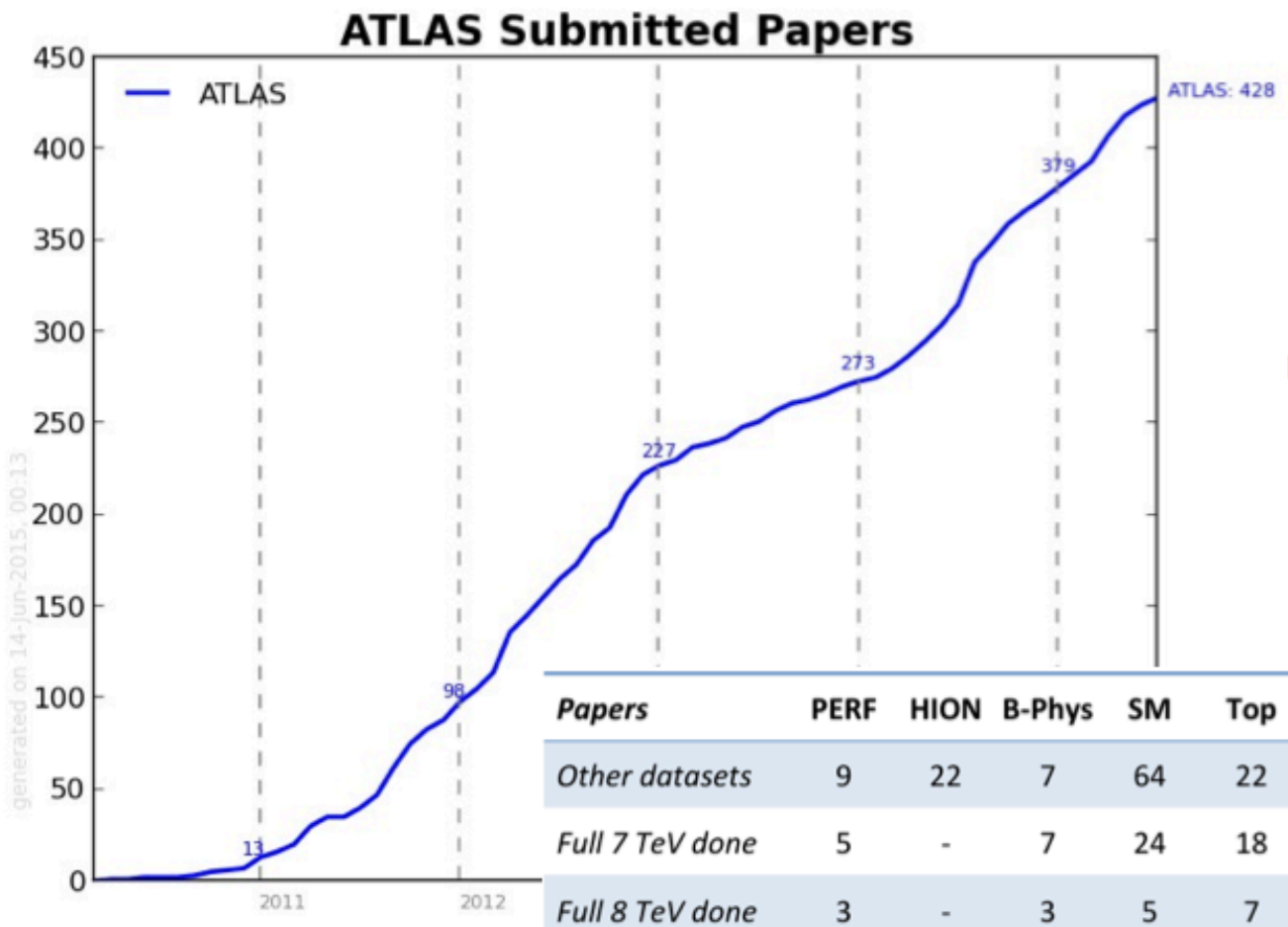
Event Displays



PHYSICS HIGHLIGHTS RUN I

ATLAS Submitted Papers

Wrapping up Run-1



We have seen many Run-1 analyses completed recently - many papers finished and in circulation

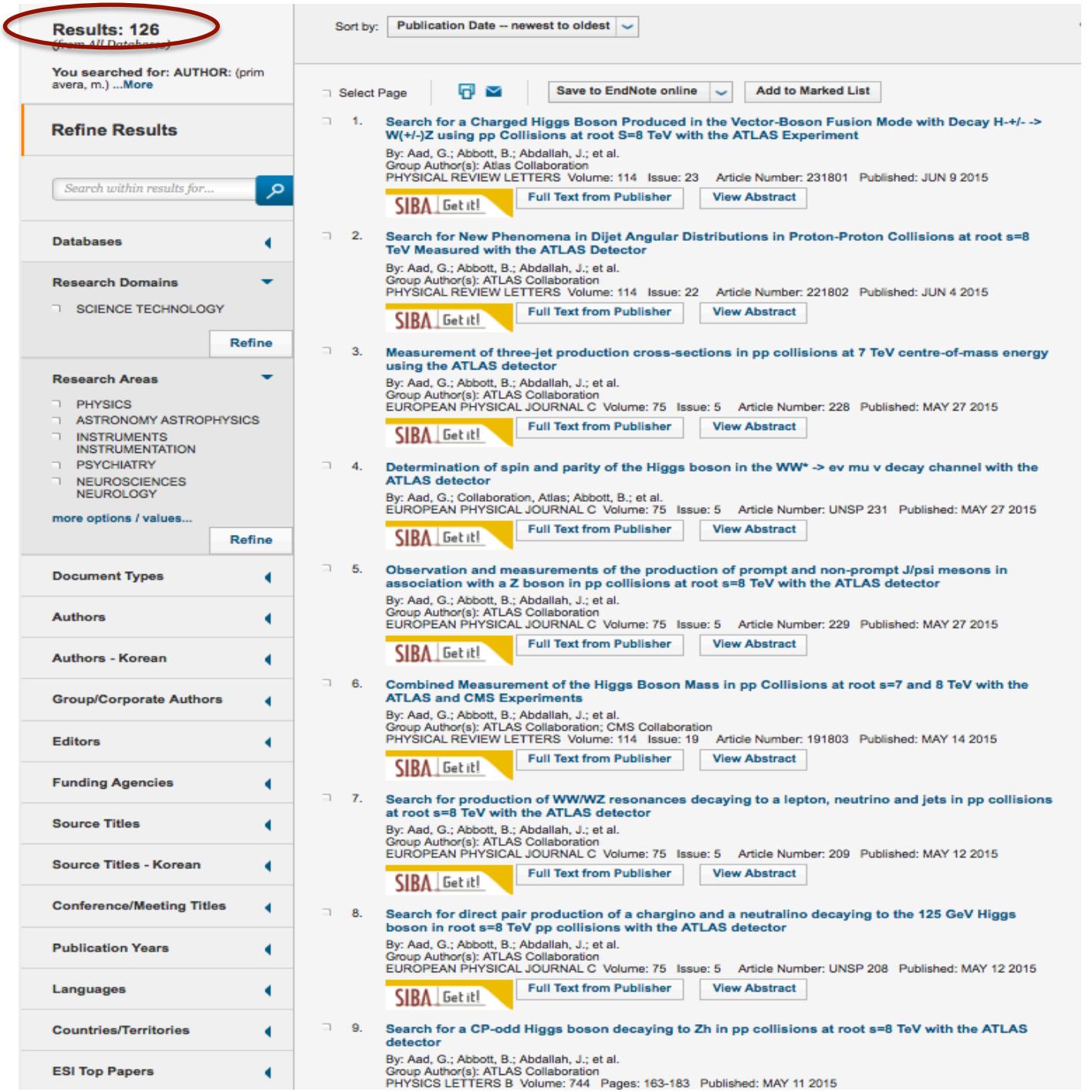
There are more to come, measurement papers may still add a lot of value

For all groups, the priority must now be on the new data!

Papers	PERF	HION	B-Phys	SM	Top	Higgs	SUSY	Exotics	
Other datasets	9	22	7	64	22	8	27	37	
Full 7 TeV done	5	-	7	24	18	17	23	17	
Full 8 TeV done	3	-	3	5	7	31	26	38	Σ = 420
Has EdBoard	13 (not in circ: 10)	20 (15)	12 (6)	24 (21)	23 (18)	20 (12)	7 (2)	13 (12)	Σ = 132 (36 in circ)
Before EdBoard	0	O(5)	O(15)	O(25)	O(10)	1	0	0	O(50)

Status June 11, 2015

Publications



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Languages

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ESI Top Papers

Sort by: Publication Date -- newest to oldest

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1. **Search for a Charged Higgs Boson Produced in the Vector-Boson Fusion Mode with Decay H-+/- -> W(+/-)Z using pp Collisions at root S=8 TeV with the ATLAS Experiment**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): Atlas Collaboration
   PHYSICAL REVIEW LETTERS Volume: 114 Issue: 23 Article Number: 231801 Published: JUN 9 2015
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2. **Search for New Phenomena in Dijet Angular Distributions in Proton-Proton Collisions at root s=8 TeV Measured with the ATLAS Detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   PHYSICAL REVIEW LETTERS Volume: 114 Issue: 22 Article Number: 221802 Published: JUN 4 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

3. **Measurement of three-jet production cross-sections in pp collisions at 7 TeV centre-of-mass energy using the ATLAS detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   EUROPEAN PHYSICAL JOURNAL C Volume: 75 Issue: 5 Article Number: 228 Published: MAY 27 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

4. **Determination of spin and parity of the Higgs boson in the WW* -> ev mu v decay channel with the ATLAS detector**
   By: Aad, G.; Collaboration, Atlas; Abbott, B.; et al.
   EUROPEAN PHYSICAL JOURNAL C Volume: 75 Issue: 5 Article Number: UNSP 231 Published: MAY 27 2015
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5. **Observation and measurements of the production of prompt and non-prompt J/psi mesons in association with a Z boson in pp collisions at root s=8 TeV with the ATLAS detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   EUROPEAN PHYSICAL JOURNAL C Volume: 75 Issue: 5 Article Number: 229 Published: MAY 27 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

6. **Combined Measurement of the Higgs Boson Mass in pp Collisions at root s=7 and 8 TeV with the ATLAS and CMS Experiments**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration; CMS Collaboration
   PHYSICAL REVIEW LETTERS Volume: 114 Issue: 19 Article Number: 191803 Published: MAY 14 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

7. **Search for production of WW/WZ resonances decaying to a lepton, neutrino and jets in pp collisions at root s=8 TeV with the ATLAS detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   EUROPEAN PHYSICAL JOURNAL C Volume: 75 Issue: 5 Article Number: 209 Published: MAY 12 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

8. **Search for direct pair production of a chargino and a neutralino decaying to the 125 GeV Higgs boson in root s=8 TeV pp collisions with the ATLAS detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   EUROPEAN PHYSICAL JOURNAL C Volume: 75 Issue: 5 Article Number: UNSP 208 Published: MAY 12 2015
   SIBA Get it! | Full Text from Publisher | View Abstract

9. **Search for a CP-odd Higgs boson decaying to Zh in pp collisions at root s=8 TeV with the ATLAS detector**
   By: Aad, G.; Abbott, B.; Abdallah, J.; et al.
   Group Author(s): ATLAS Collaboration
   PHYSICS LETTERS B Volume: 744 Pages: 163-183 Published: MAY 11 2015

Citations

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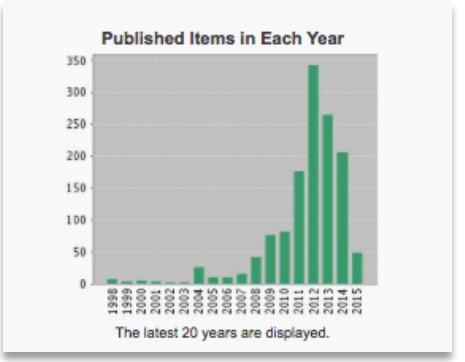
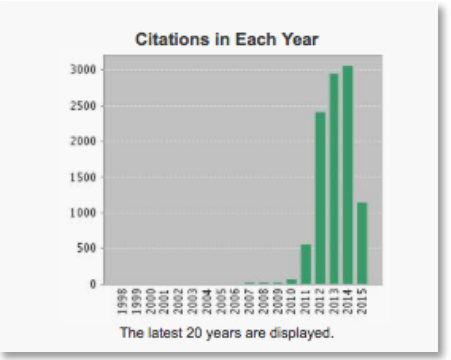
		2011 ◄	2012	2013	2014	2015 ►	Total	Average Citations per Year
		559	2417	2950	3059	1158	10348	574.89
1.	**Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC** By: Aad, G.; Abajyan, T.; Abbott, B.; et al. Group Author(s): ATLAS Collaboration PHYSICS LETTERS B Volume: 716 Issue: 1 Pages: 1-29 Published: SEP 17 2012	0	138	1043	1006	335	2522	630.50
2.	**The ATLAS Simulation Infrastructure** By: Aad, G.; Abbott, B.; Abdallah, J.; et al. Group Author(s): ATLAS Collaboration EUROPEAN PHYSICAL JOURNAL C Volume: 70 Issue: 3 Pages: 823-874 Published: DEC 2010	53	117	73	86	40	368	61.67
3.	**Combined search for the Standard Model Higgs boson using up to 4.9 fb(-1) of pp collision data at root s=7 TeV with the ATLAS detector at the LHC** By: Aad, G.; Abbott, B.; Abdallah, J.; et al. Group Author(s): ATLAS Collaboration PHYSICS LETTERS B Volume: 710 Issue: 1 Pages: 49-66 Published: MAR 29 2012	0	223	79	29	12	343	85.75
4.	**Observation of a Centrality-Dependent Dijet Asymmetry in Lead-Lead Collisions at root s(NN)=2.76 TeV with the ATLAS Detector at the LHC** By: Aad, G.; Abbott, B.; Abdallah, J.; et al. Group Author(s): ATLAS Collaboration PHYSICAL REVIEW LETTERS Volume: 105 Issue: 25 Article Number: 252303 Published: DEC 13 2010	44	80	86	61	22	293	48.83
5.	**Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC** By: Aad, G.; Abajyan, T.; Abbott, B.; et al. Group Author(s): ATLAS Collaboration PHYSICS LETTERS B Volume: 726 Issue: 1-3 Pages: 88-119 Published: OCT 2013	0	0	18	127	28	173	57.67
6.	**Search for the Standard Model Higgs Boson in the Diphoton Decay Channel with 4.9 fb(-1) of pp Collision Data at root s=7 TeV with ATLAS** By: Aad, G.; Abbott, B.; Abdallah, J.; et al. Group Author(s): ATLAS Collaboration PHYSICAL REVIEW LETTERS Volume: 108 Issue: 11 Article Number: 111803 Published: MAR 13 2012	0	82	48	24	0	154	38.50
7.	**Search for squarks and gluinos using final states with jets and missing transverse momentum with the ATLAS detector in root s=7 TeV proton-proton collisions** By: Aad, G.; Abbott, B.; Abdallah, J.; et al. Group Author(s): ATLAS Collaboration PHYSICS LETTERS B Volume: 710 Issue: 1 Pages: 67-85 Published: MAR 29 2012	0	92	40	6	2	140	35.00
8.	**Evidence for the spin-0 nature of the Higgs boson using ATLAS data** By: Aad, G.; Abajyan, T.; Abbott, B.; et al. Group Author(s): ATLAS Collaboration PHYSICS LETTERS B Volume: 726 Issue: 1-3 Pages: 120-144 Published: OCT 2013	0	0	7	95	27	129	43.00
9.	**Observation of Associated Near-Side and Away-Side Long-Range Correlations in root S-NN=5.02 TeV Proton-Lead Collisions with the ATLAS Detector** By: Aad, G.; Abajyan, T.; Abbott, B.; et al. Group Author(s): ATLAS Collaboration	0	0	19	75	22	116	38.67





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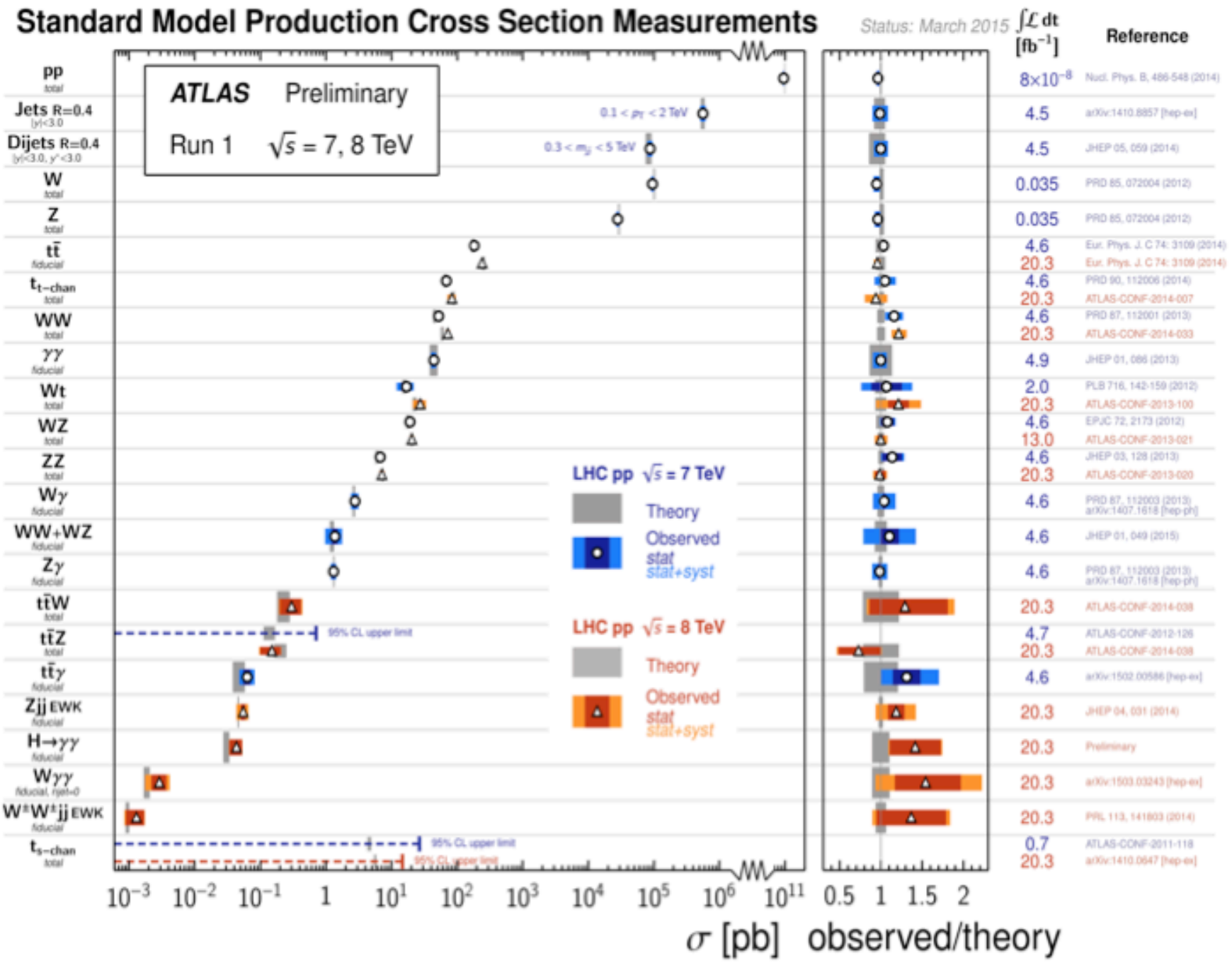
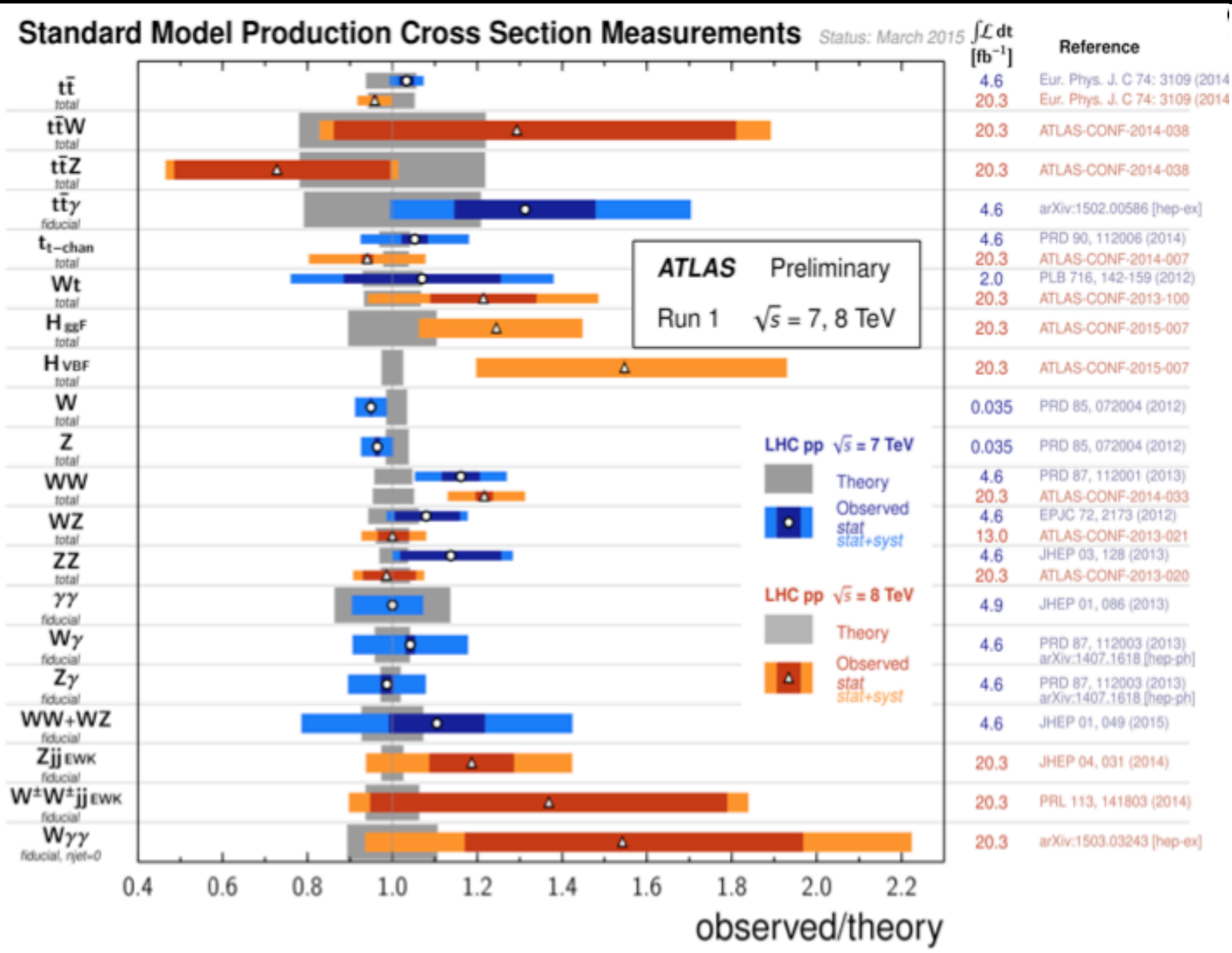
Standard Model Measurements

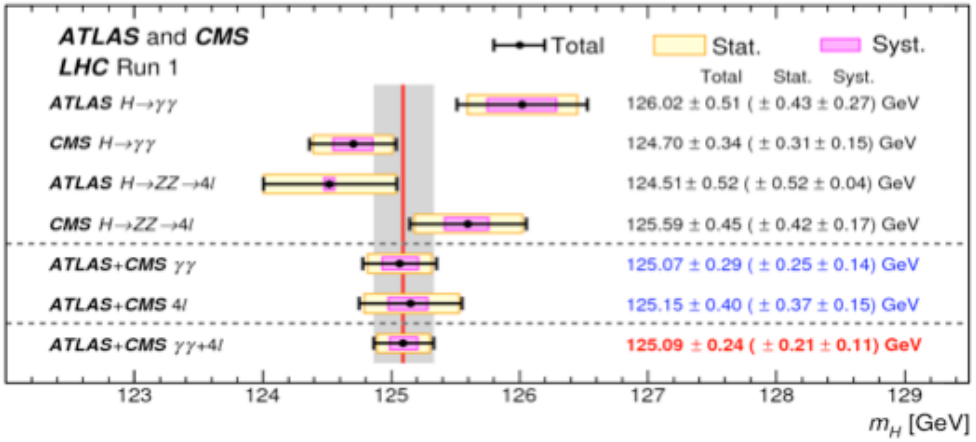


No Disagreement

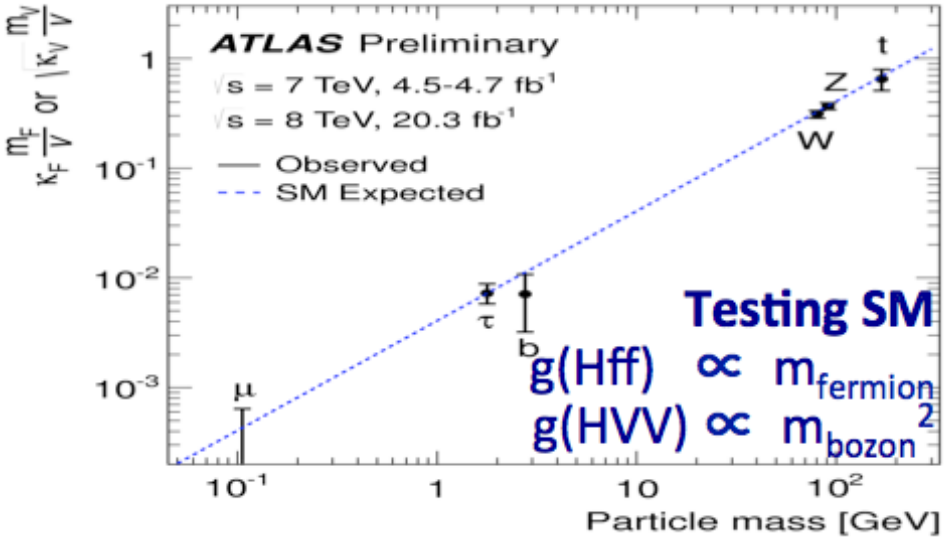


No significant discrepancy observed wrt theory predictions

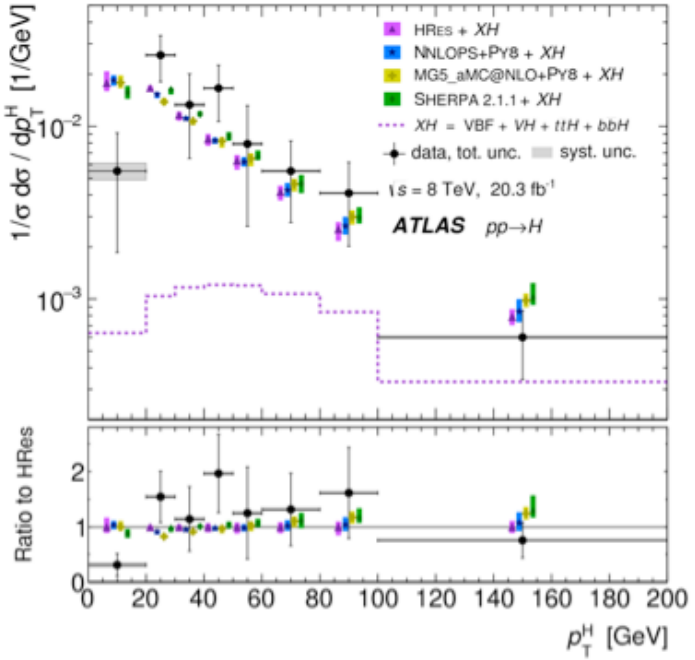
Higgs



Mass

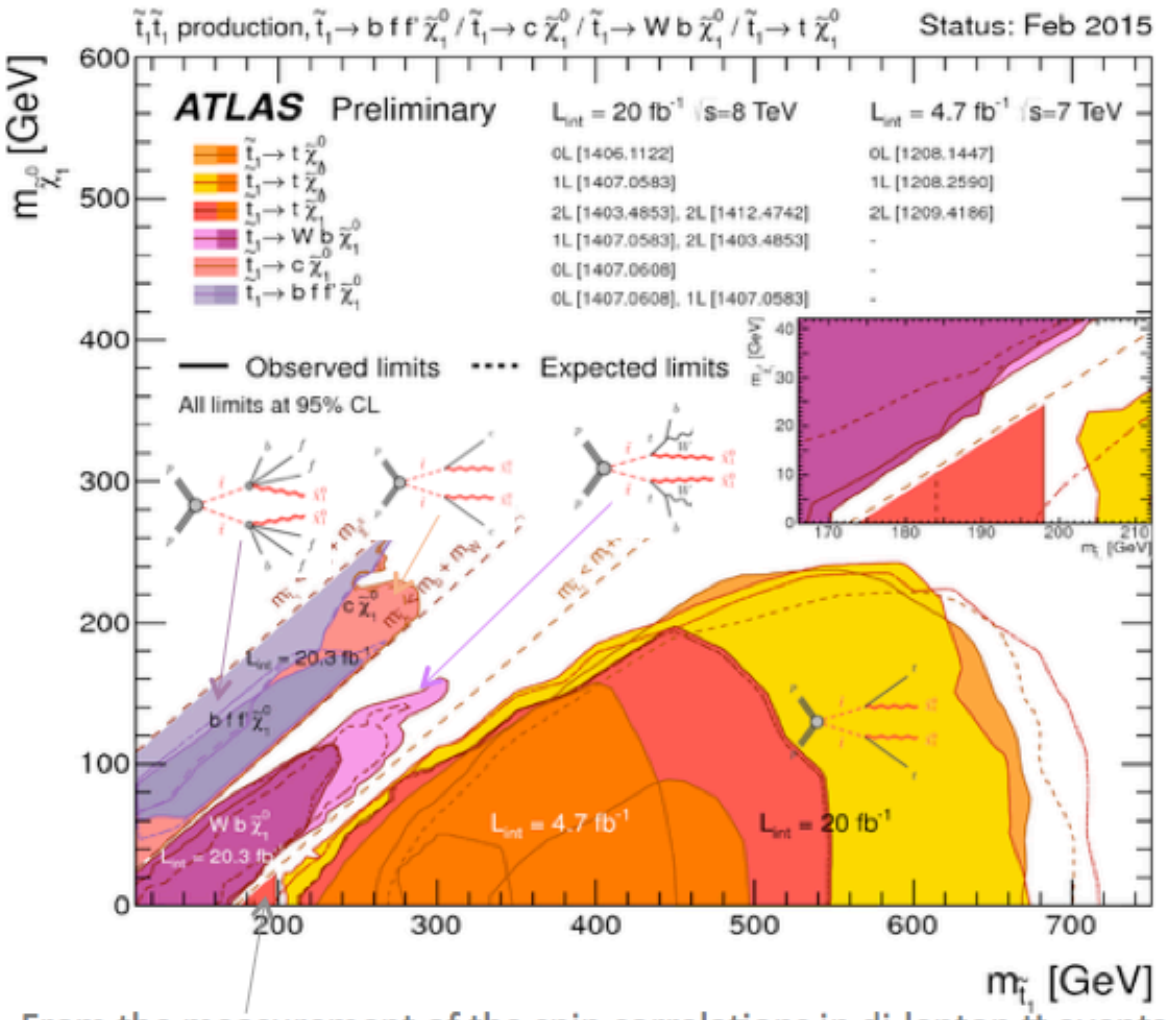


Couplings



Differential Cross Sections

Beyond SM



From the measurement of the spin correlations in di-lepton tt events ('clever trick' to fill the gap)

Gaps in the exclusion come from cases where the stop signal looks like background, either tt or WW → "stealth stop"

Light stop needed for SUSY to solve the Higgs mass fine-tuning in the SM

Assuming $m(\tilde{t})<m(\chi^+_1)$, four decay modes separately considered with BR=100%

1) $\tilde{t} \to t\chi^0_1$
2) $\tilde{t} \to Wb\chi^0_1$ for $m(\tilde{t})<m(t)+m(\chi^0_1)$ (off-shell top, 3-body decay)
3) $\tilde{t} \to c\chi^0_1$ (flavour changing 2-body decay)
4) $\tilde{t} \to ff'b\chi^0_1$ (off-shell W / 4-body decay)

Overlay contours belonging to different stop decay channels, different sparticle mass hierarchies, and simplified decay scenarios!

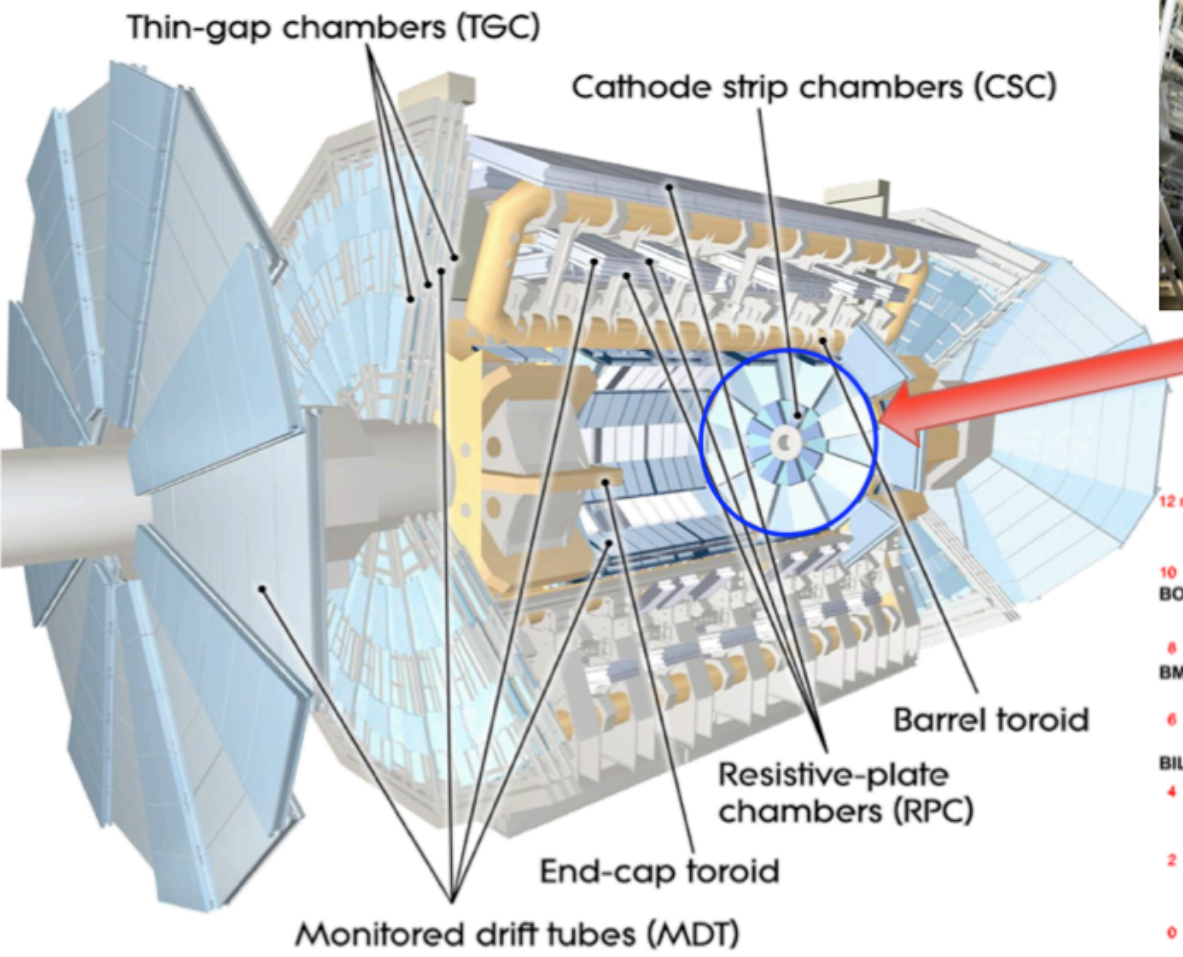
PHASE I MUON DETECTOR UPGRADE

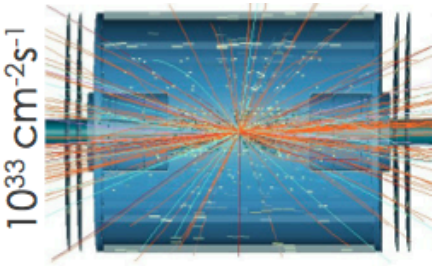
The New Small Wheel

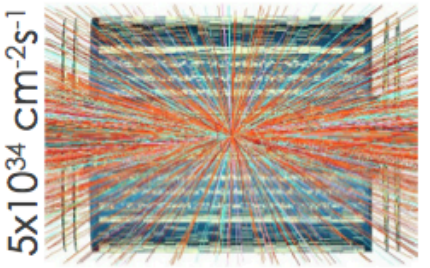
The **New Small Wheel** (NSW) upgrade is motivated primarily by the high background rate that is expected at L = 2..5×10^{34}cm^{-2}s^{-1} during LHC Run-3 and HL-LHC

→Replace SW *with fast, high rate, precision* detectors

BCID < 10ns up to 15 kHz <100 µm/plane

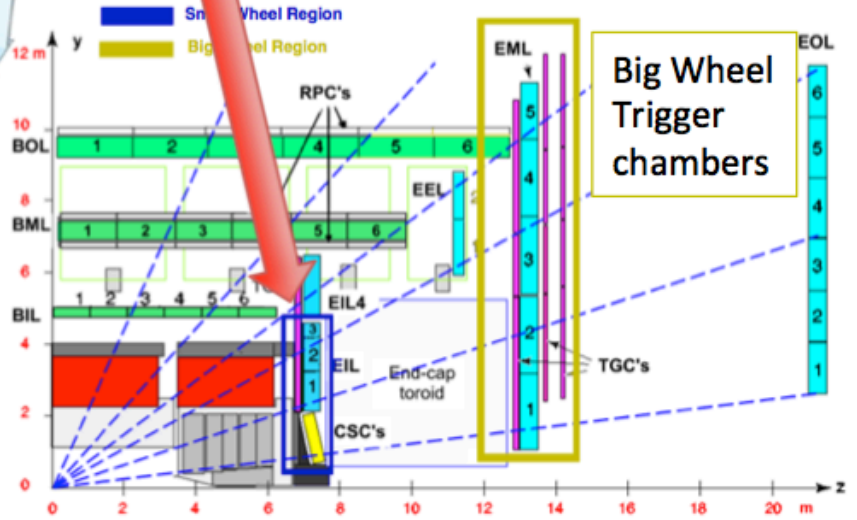






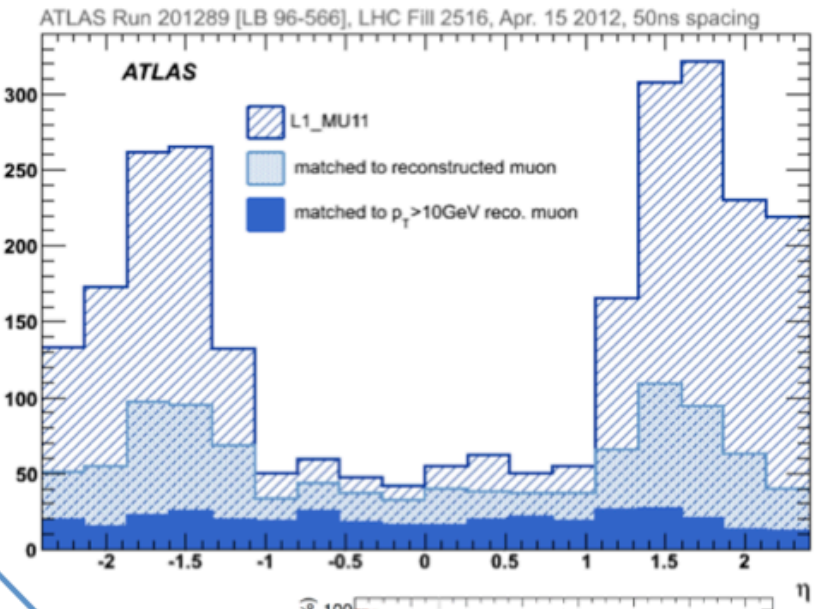
Small Wheel (SW)

Coverage:
1.2 < |η| < 2.5

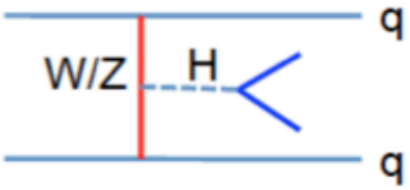


Motivation

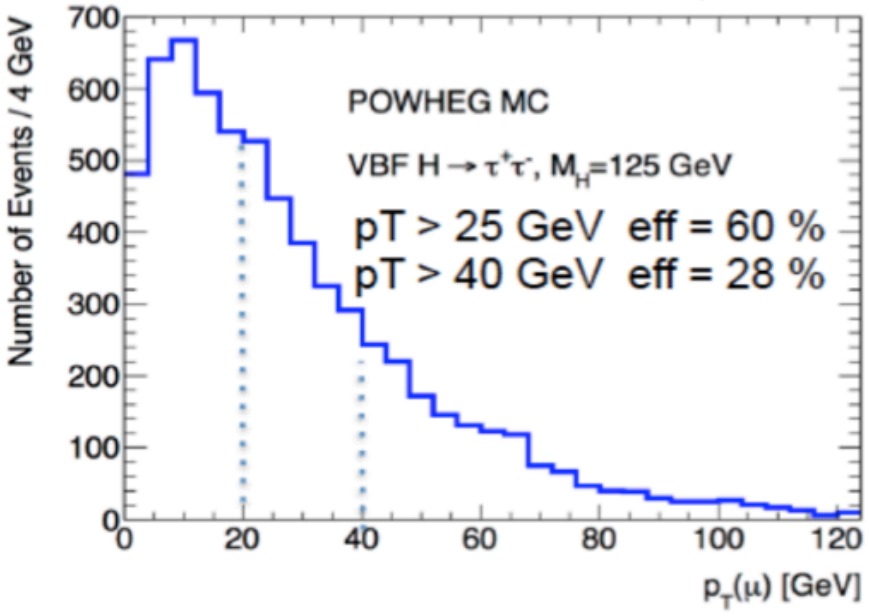
- Forward muon triggers have currently high fake rate
  - ➢ Simply raising muon trigger p_T thresholds to reduce the trigger rate results in *significant physics loss*
- SW chambers can't cope with expected rates ≈15 kHz
  - ➢ For high p_T muons, resolution is dominated by the muon spectrometer → Losing SW → losing muons

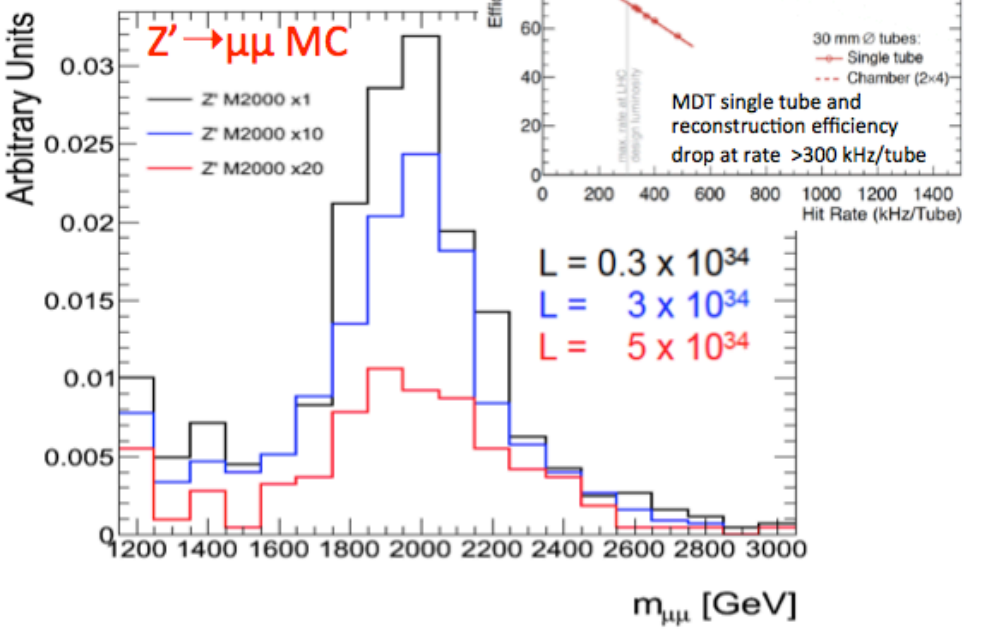


Example:
(single lepton trigger)

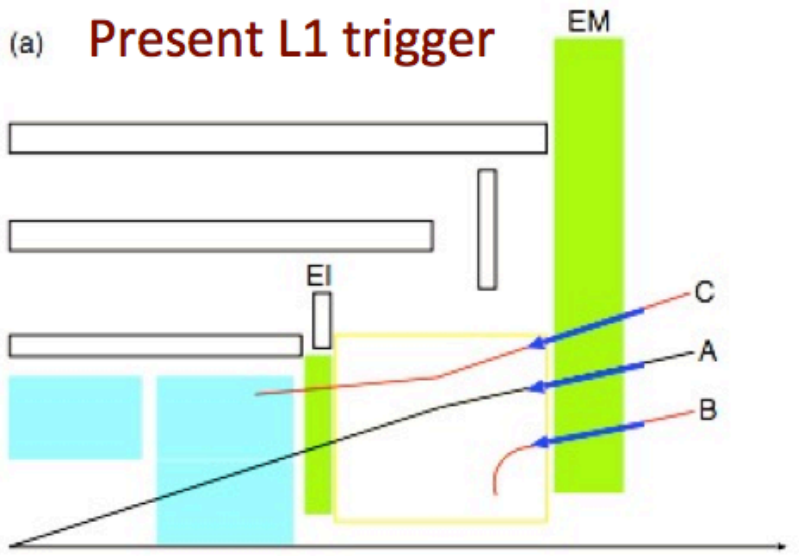


VBF $H \rightarrow \tau_{lep}\tau_{had}$





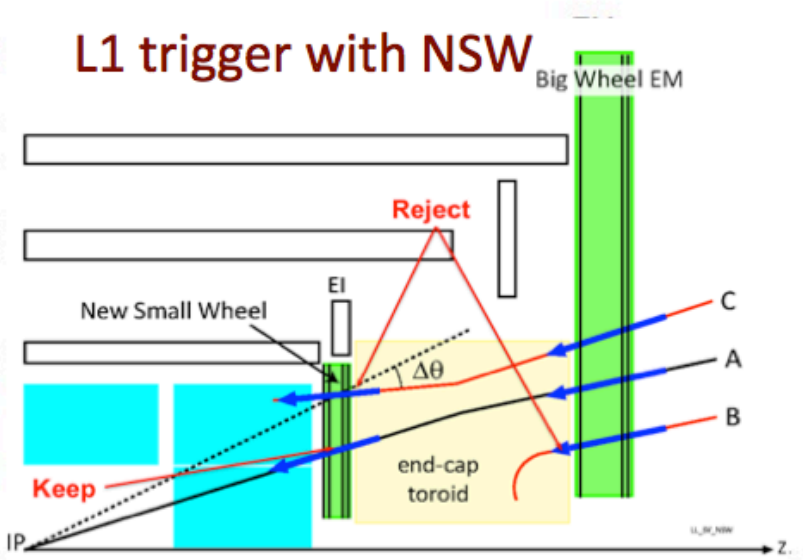
Muon Trigger with NSW

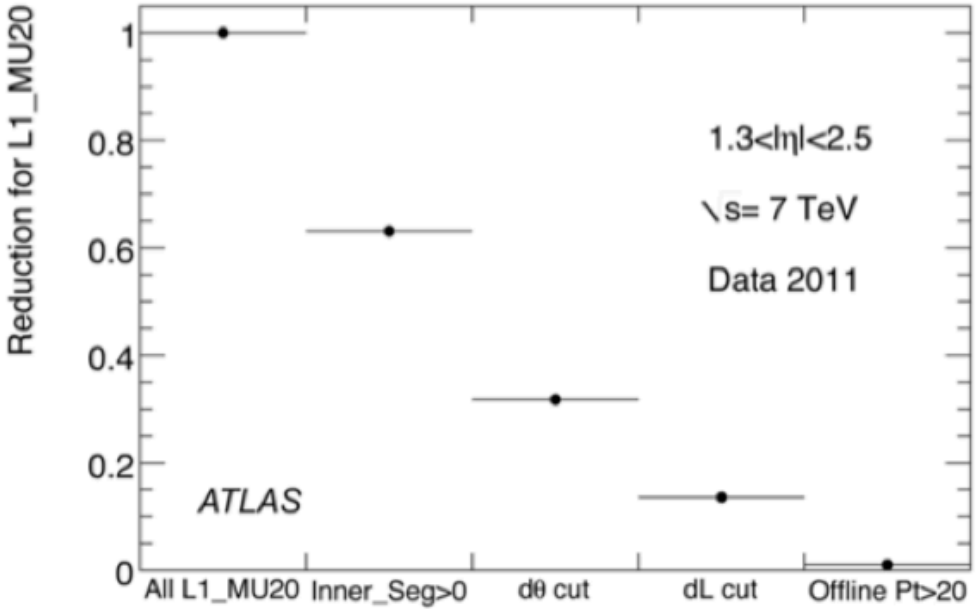


NSW will provide improved trigger for forward muons and improved tracking

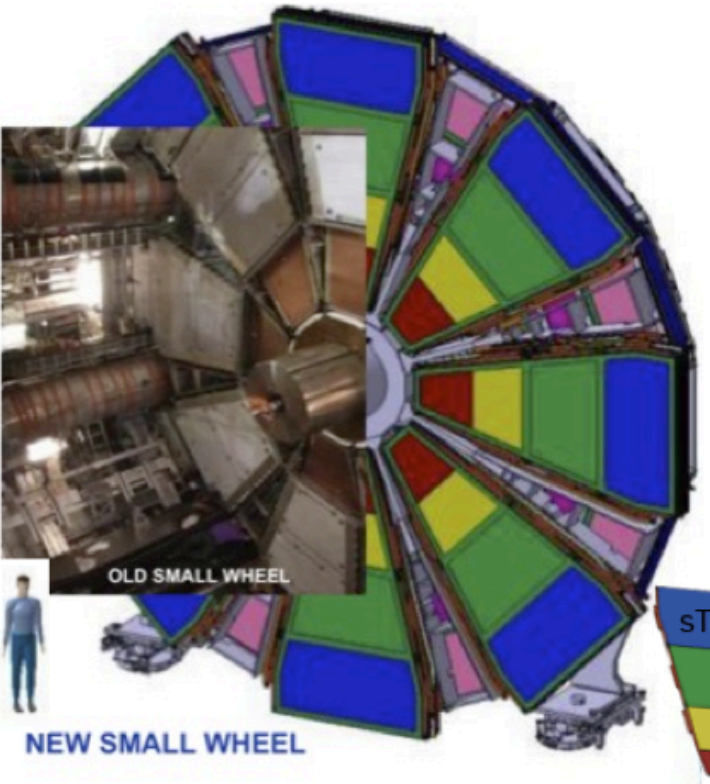
New (fast) precision tracker in NSW
that works up to the ultimate luminosity, with some safety margin

Kill the fake triggers
by requiring high quality (σ_θ~ 1mrad) pointing segments in NSW



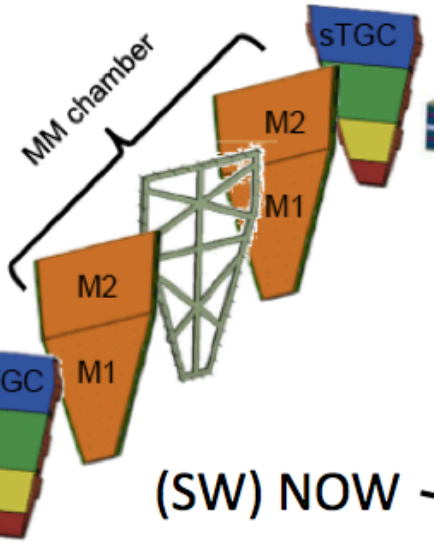


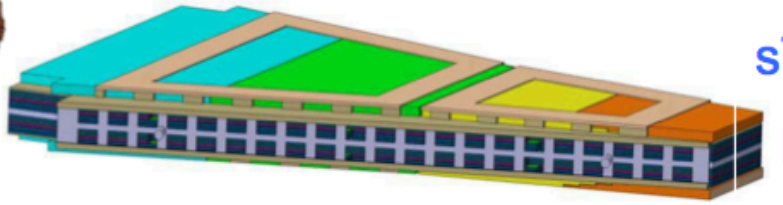
NSW Detector Layout



NSW will utilize two detector solutions:

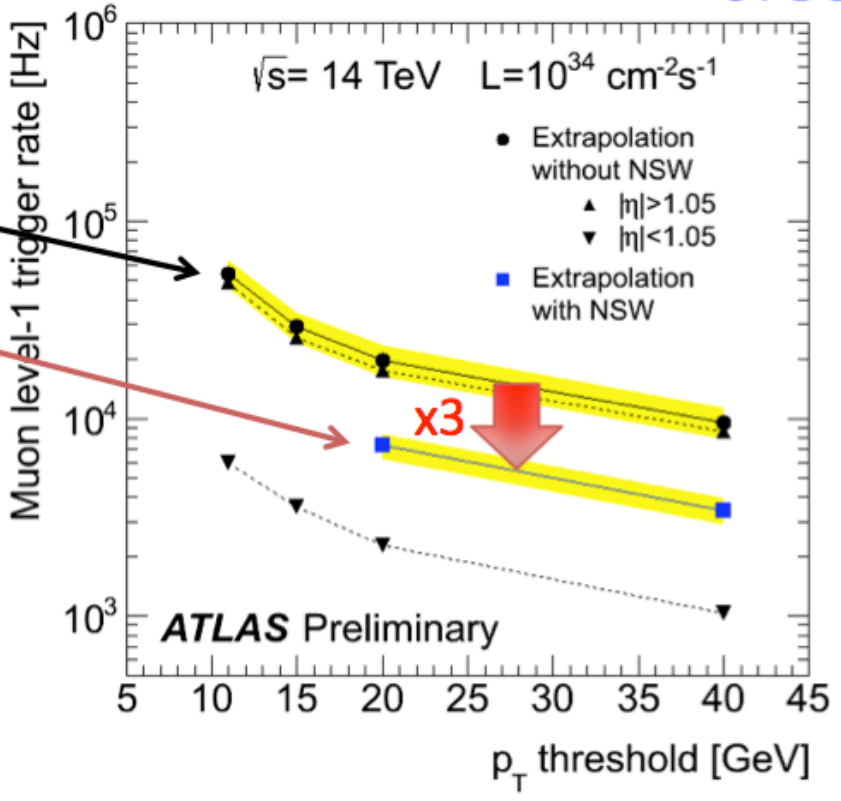
- Small strip Thin Gas Chambers (sTGC) as primary trigger
- Micromegas (MM) for primary precision tracker





(SW) NOW

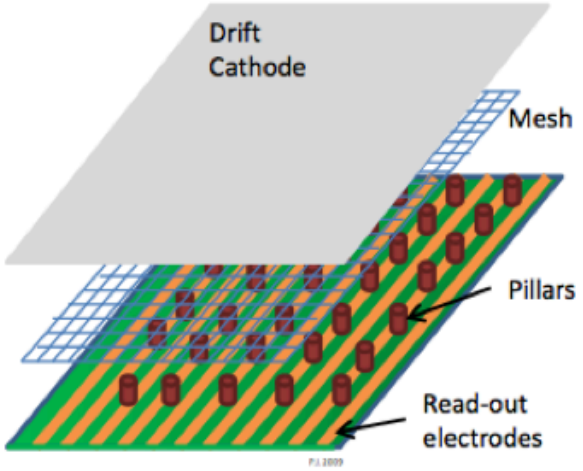
with NSW

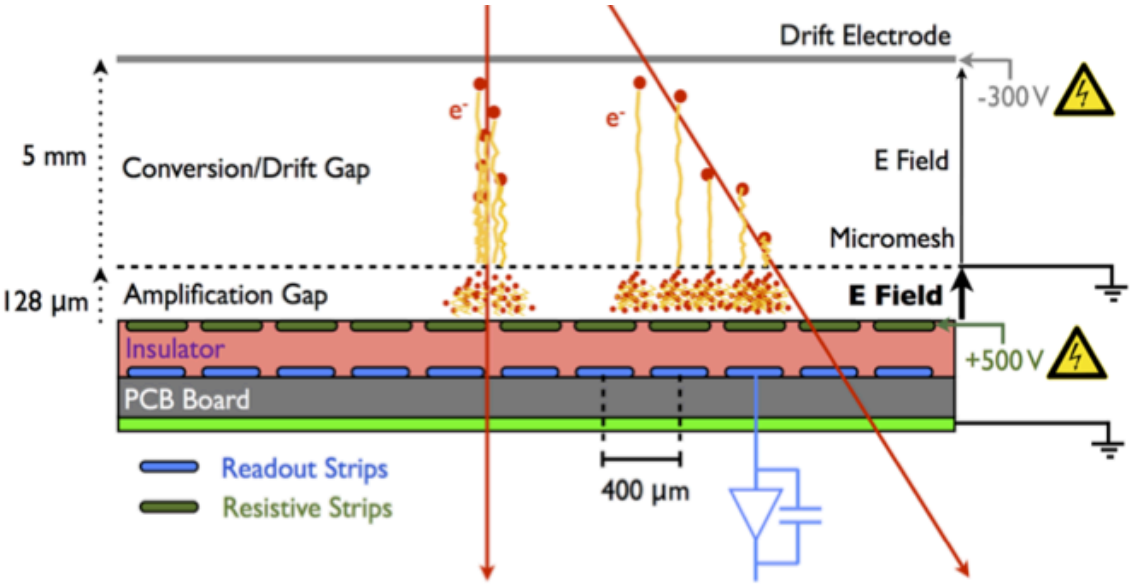


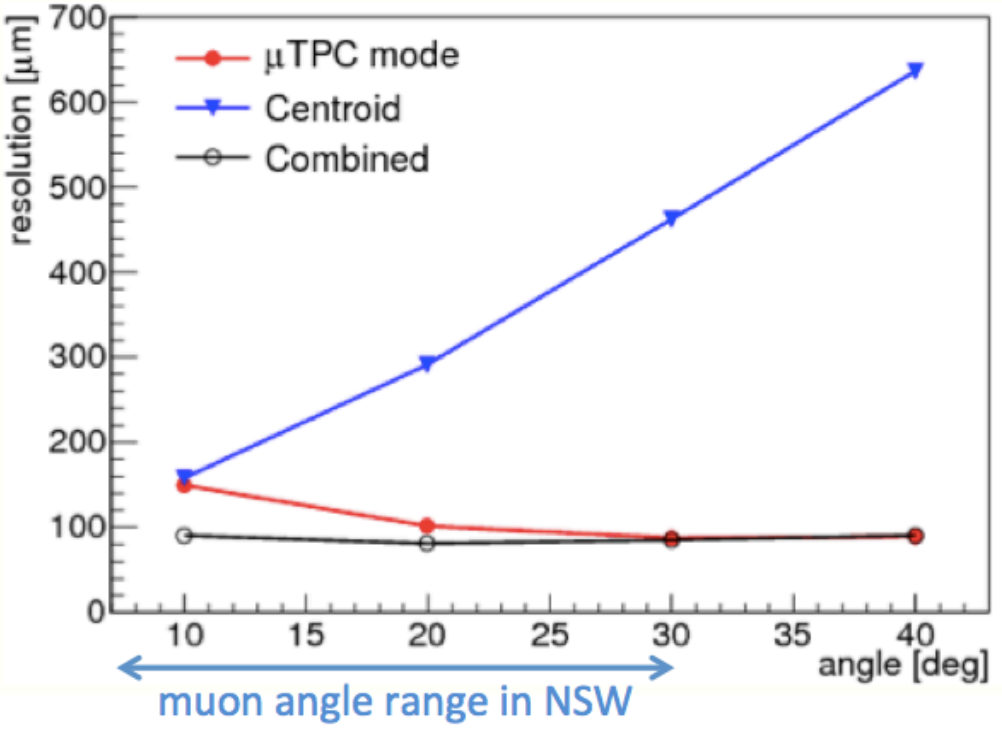
- 16 Sectors per wheel (8 large, 8 small)
- 4 Layers per Wedge (quadruplets) for each technology (sTGC and Micromegas)
- 2 quadruplets per sector
- Position determination of the precision coordinate readout elements better than 30-40 µm

Micromegas Technology

- Parallel plate chambers where the amplification takes place in a ***thin amplification gap*** (128µm) separated from the drift gap by a fine micromesh
- Read-out strips (0.5 mm) covered by resistive strip layer
- Novel technology with excellent high rate capability due to thin amplificatior gap and small space charge effects.
- Primary Precision Tracker with spatial resolution better than 100 µm *independent* of track incident angle.

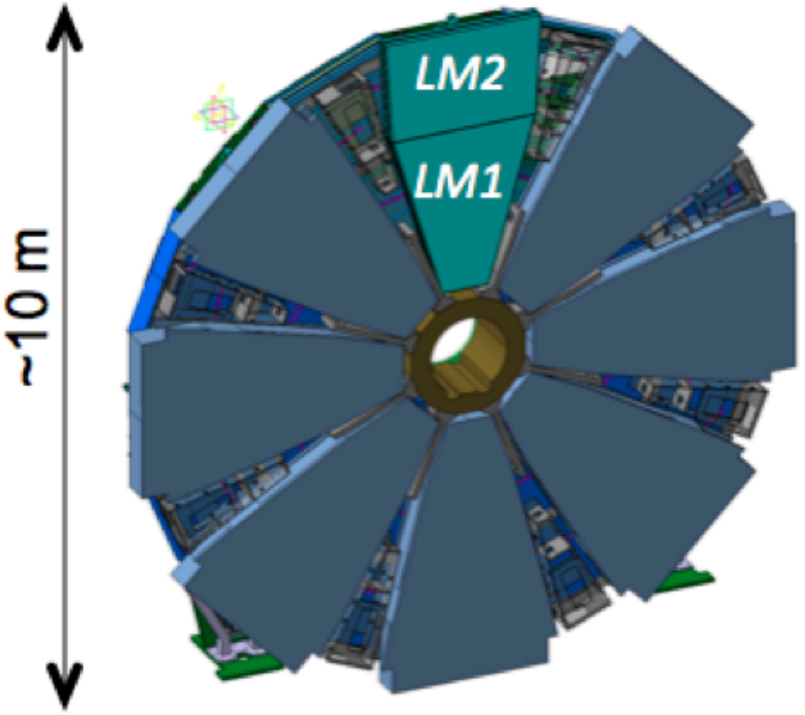


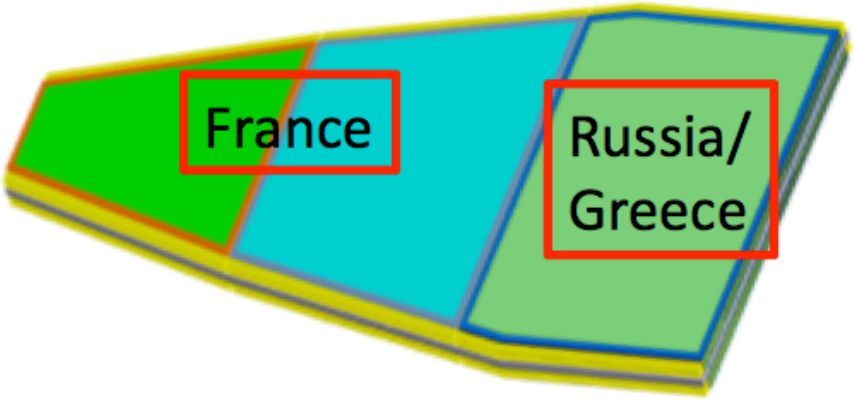




Micromegas Production

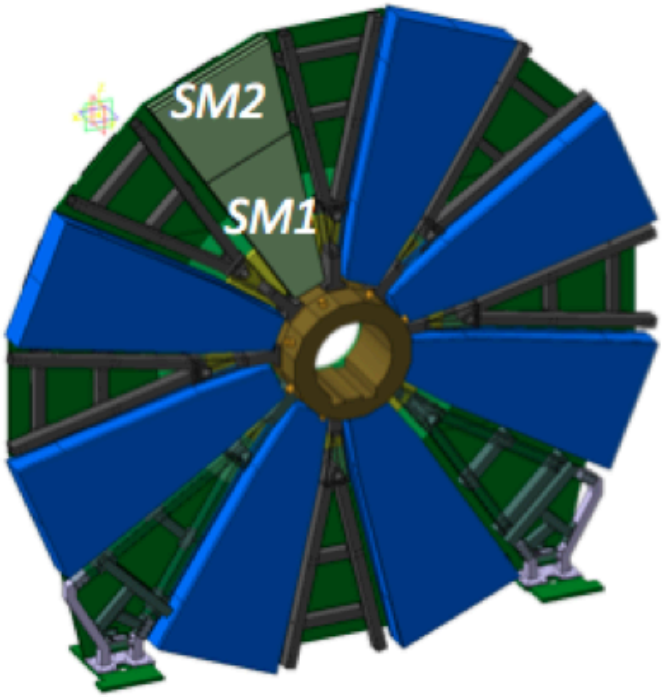
MM Large Sector



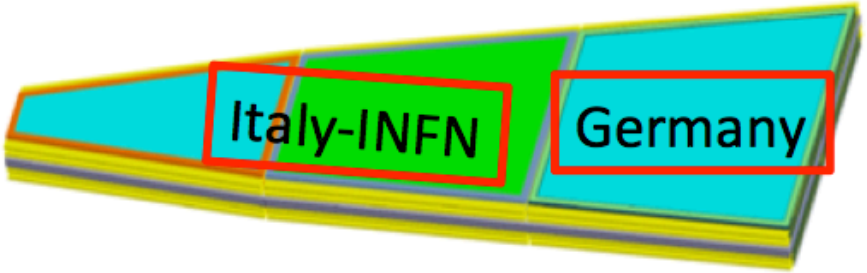


MM Small Sector

Four types of Micromegas quadruplets

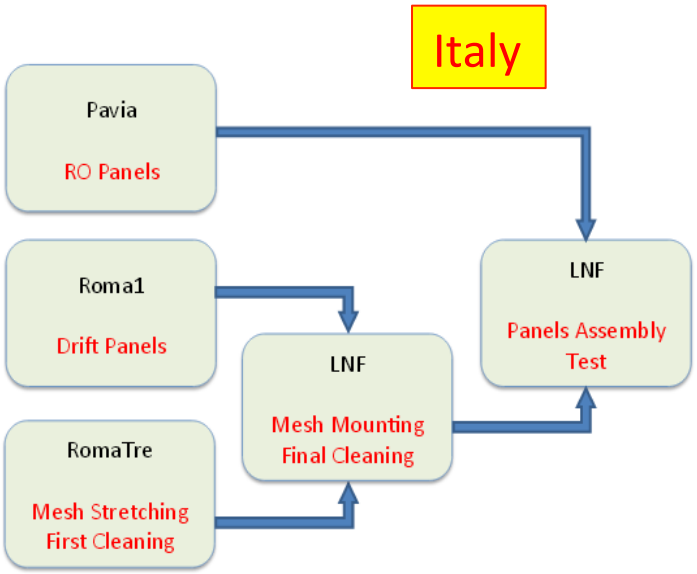


All with trapezoidal shapes, dimensions between 2-3 m^2



Full site wide production starting in 2015.

MM Production sites

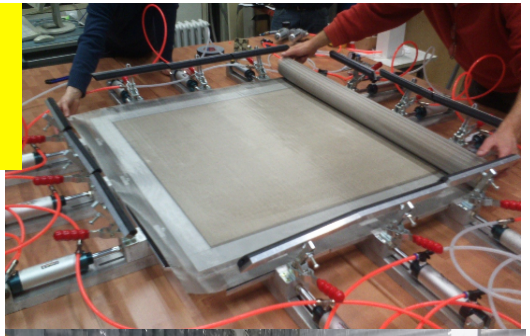


- **Rome 3**: Mesh stretching and preparation
- **Pavia**: Readout panels construction
- **Rome 1**: drift panels construction
- **Frascati**: assembling , tooling
- **Cosenza/Lecce/Napoli**: tooling, mechanics

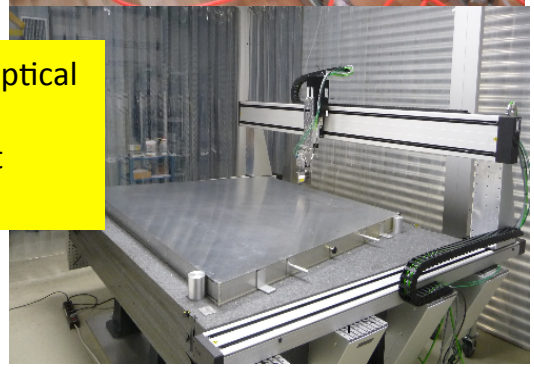
Germany

Mainz : drift sandwiches (glueing)
Würzburg: mesh cleaning
mesh stretching
mesh transfer to drift-panels
München: readout sandwiches (glueing)
cleaning of drift- and ro-sandwiches
recheck of mesh-tension
assembly of quadruplets
test of quadruplets Cosmic Ray Facility
Freiburg: precision tools, precision measurements

12 Clamp stretch mesh setup



MUC: stiffback, optical CMM machine, laminar flow tent (ISO5)



MM Production sites

CERN / Dubna / Thessaloniki

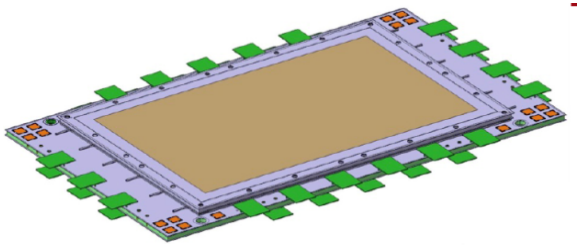
Tooling @ CERN:
- Gluing machine
- Vacuum tables (in production)
- Mesh stretching (ready)

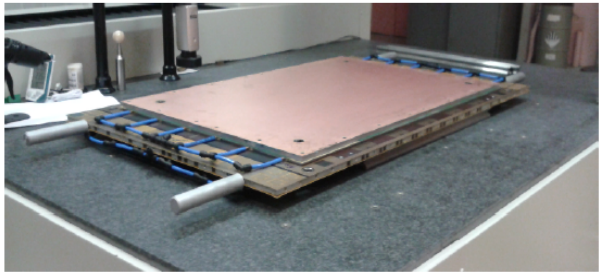
QA/QC tooling @ CERN
- Laser device to measure the panels flatness
- Cosmic test stand
- Xray gun

To be integrated and finalized
- Alignment pins and module fixations
- Cooling layout
- Zebra connections and electronics integrations

Dubna (R/O Panels and Assembly)
Thessaloniki (Drift Panels)
Dubna and Thessaloniki will use the stiff back system realized at CERN

Saclay





Two quadruplet (medium size) already built as module -1 at CERN and extensively tested with cosmic and test beam at CERN

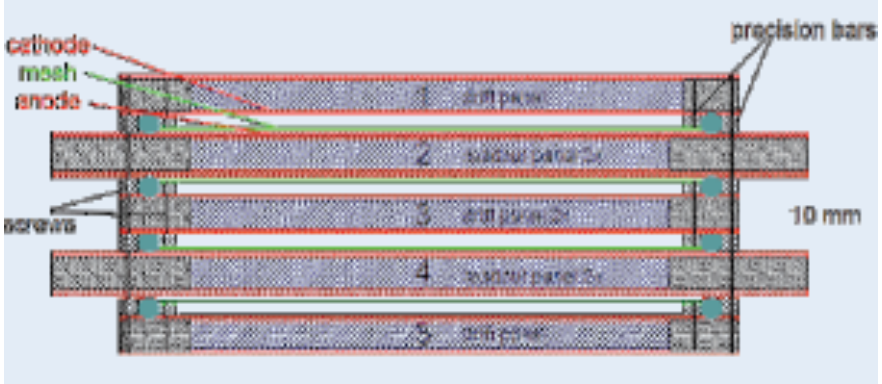
Functional prototype (doublets) has been built and now under test.
Procedure and tools to be finalized for Module0 production.
Production facility in preparation

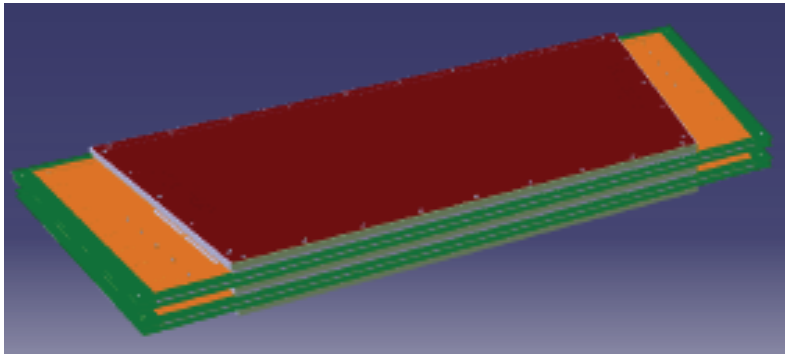
Mod. 0 production start in autumn

The Micromegas Small Wheel prototype (MMSW)

The 0,5m2 prototype adopts the general design foreseen for the Micromegas detectors in the NSW:

- A quadruplet structure with two double sided readout boards, one double sided and two single sided support (drift) panels equipped with the drift electrode and a frame holding the micromesh.
- Readout comprises 1024 strips per plane with a pitch of 415μm. The strips are rotated by 1,5º on two planes to measure the second coordinate.
  A spatial resolution of <100 μm / <1mm in the precision/ second coordinate is expected.
- The readout strips are covered by Kapton® foil with sputtered resistive strips to improve spark tolerance and a pattern of 128μm high support pillars to define the position of the floating mesh.

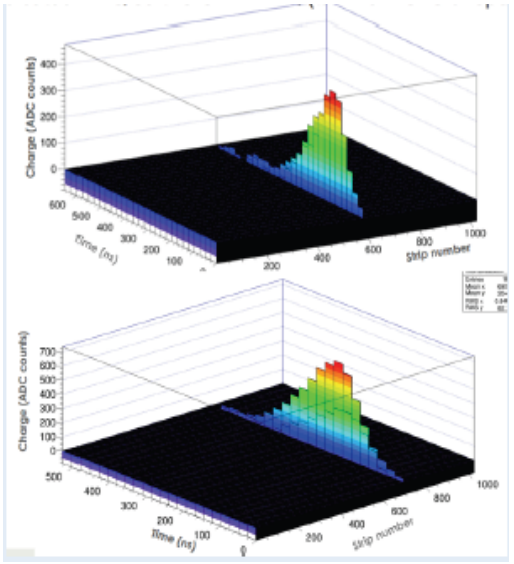


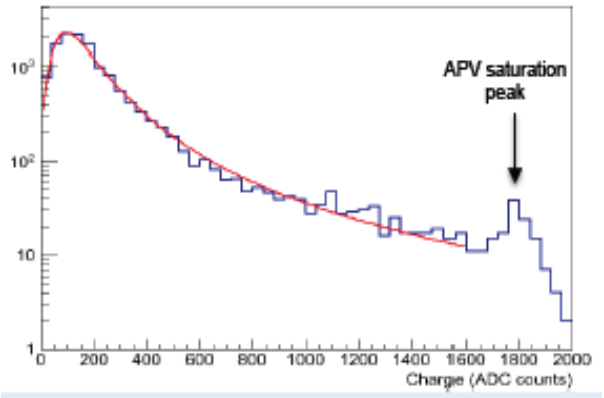


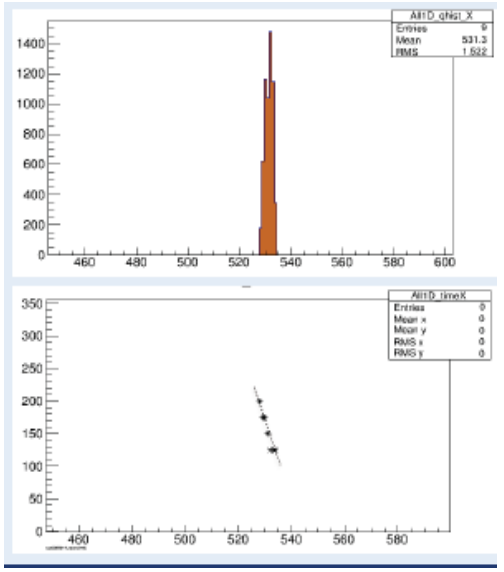
MMSW chamber cosmic tests

One Micromegas doublet (1 double sided readout panel + 2 external (single sided) drift panels has been pre-assembled to perform first tests in the ATLAS cosmic ray stand in the RD51 laboratory at CERN.

Using APV25 front-end ASIC, an SRS based readout system and the dedicated DAQ software MMDAQ cosmic rays could be detected in both detector layers







LECCE ACTIVITY & CONTRIBUTIONS

Activities

- Hardware
  - RPC: riparazioni gas inlets
  - Micromegas:
    - Progettazione e Lavorazioni Meccaniche Modulo 0 e Produzione MM
    - Costruzione del Modulo 0 a LNF
    - Partecipazione a Test Beams
    - Sviluppo DCS e Test Prototipi al CERN
- Detector Performance
  - Muon High Level Trigger Performance
  - Muon Trigger Validation
  - Muon Performance at low P_t with Data
  - Micromegas Test Beams Analyses
  - RPC maintenance, simulazioni e R&D
- Physics
  - Z/W+ b production
  - Analisi di produzione diretta di stop con decadimenti con 2 leptoni
    - Stop➔t+Neutralino
    - Stop➔b+Chargino
    - Stop➔stau+b+Neutrino

RPC

RPC Gas Leak Repairs

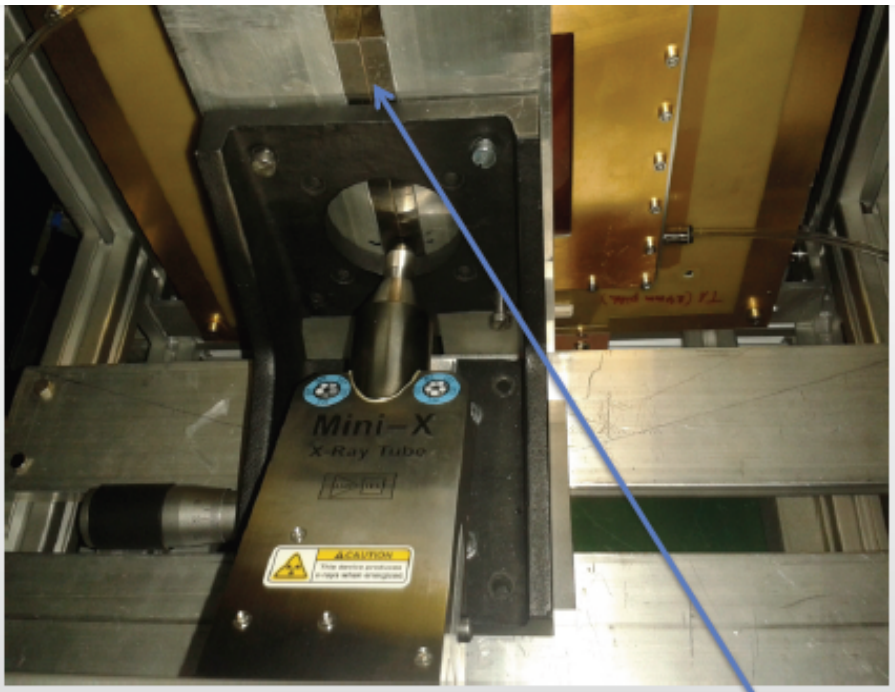
- ✓ Massive repair campaign all along LS1 (always 1 Russian team + ~always 1 Italian team)
- ✓ Dedicated R&D resulted in a repair technique using glue based on silane modified polymer
- ✓ More “traditional” inlet replacement also used when applicable (i.e. access to broken inlet)
- ✓ Total number of leaks detected in the system: ~400
  Unrepaired leaks: ~50
- ✓ Currently, fresh gas injected in the system to compensate for leaks: ~400 l/h including ~100 l/h due to leaks not on chambers (to be compared with 800-900 l/h at the end of 2012)

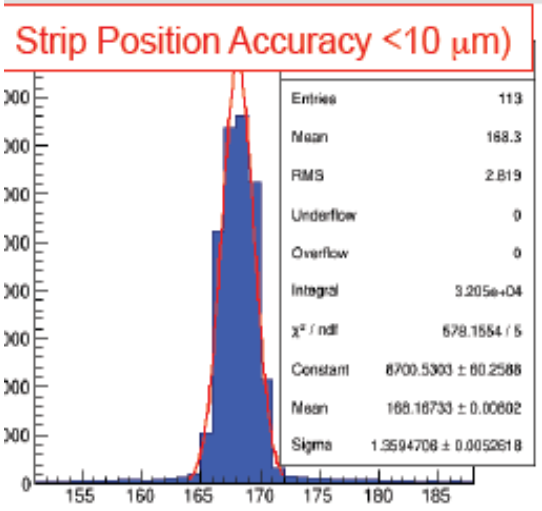
MICROMEGAS, MECHANICS

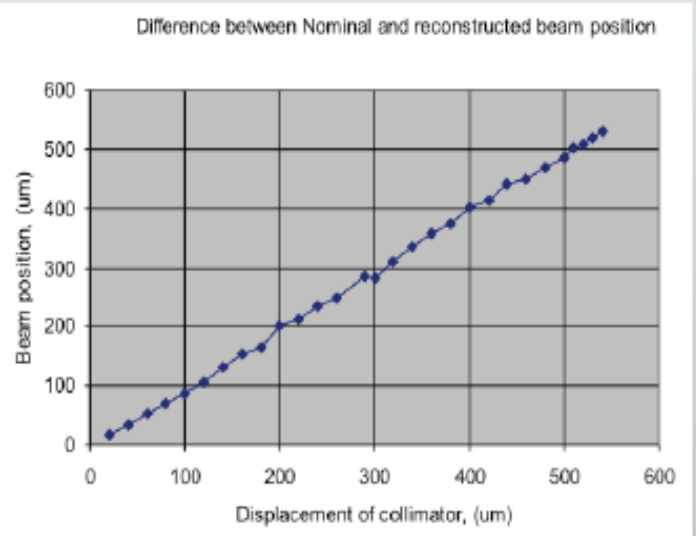
QA/QC with X-Ray scanner

Possible Tasks:

- Gas gain uniformity
- Hot spots detection
- HV instability regions
- Leakage current
- Position accuracy and quadruplet alignment verification
- Other…

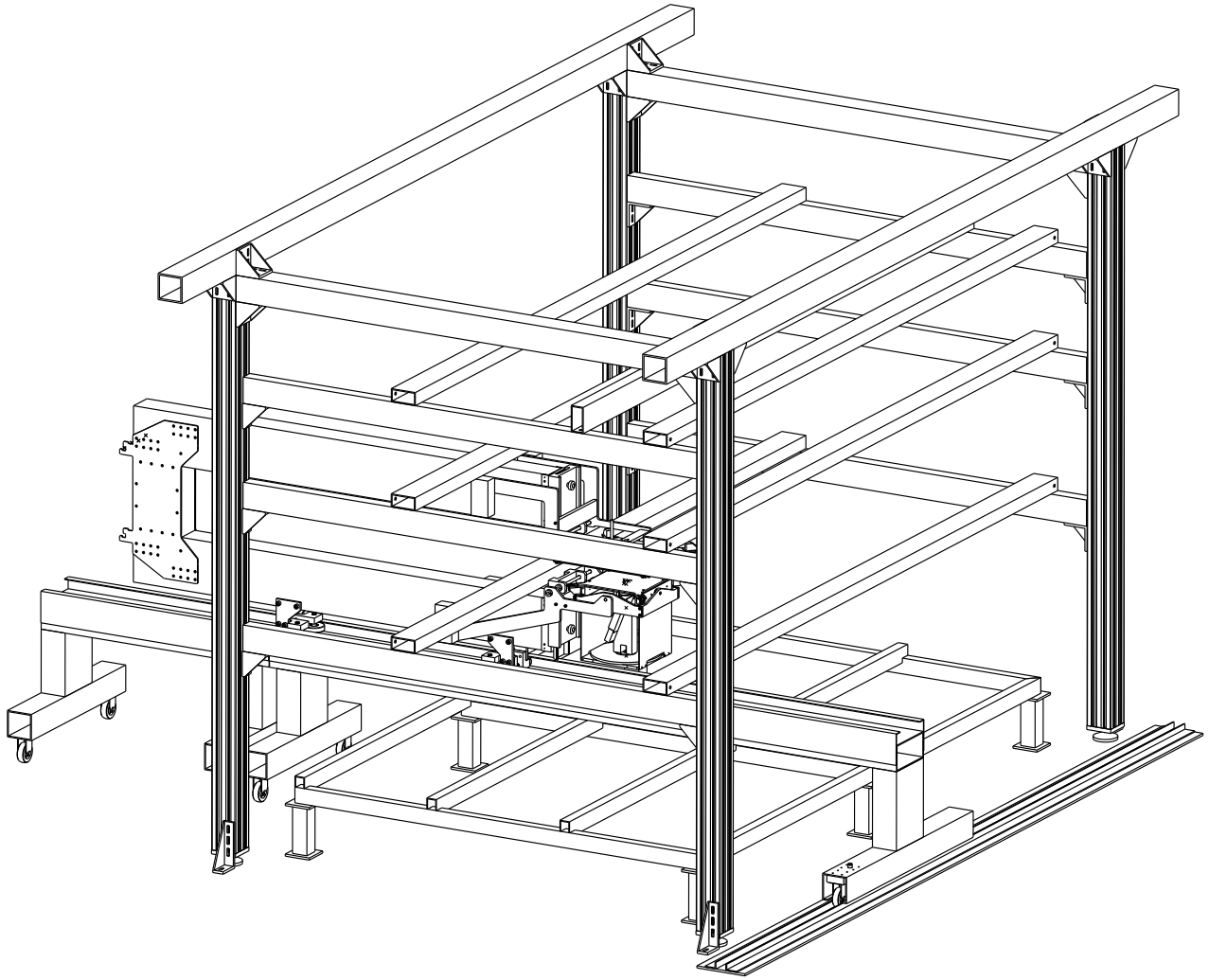




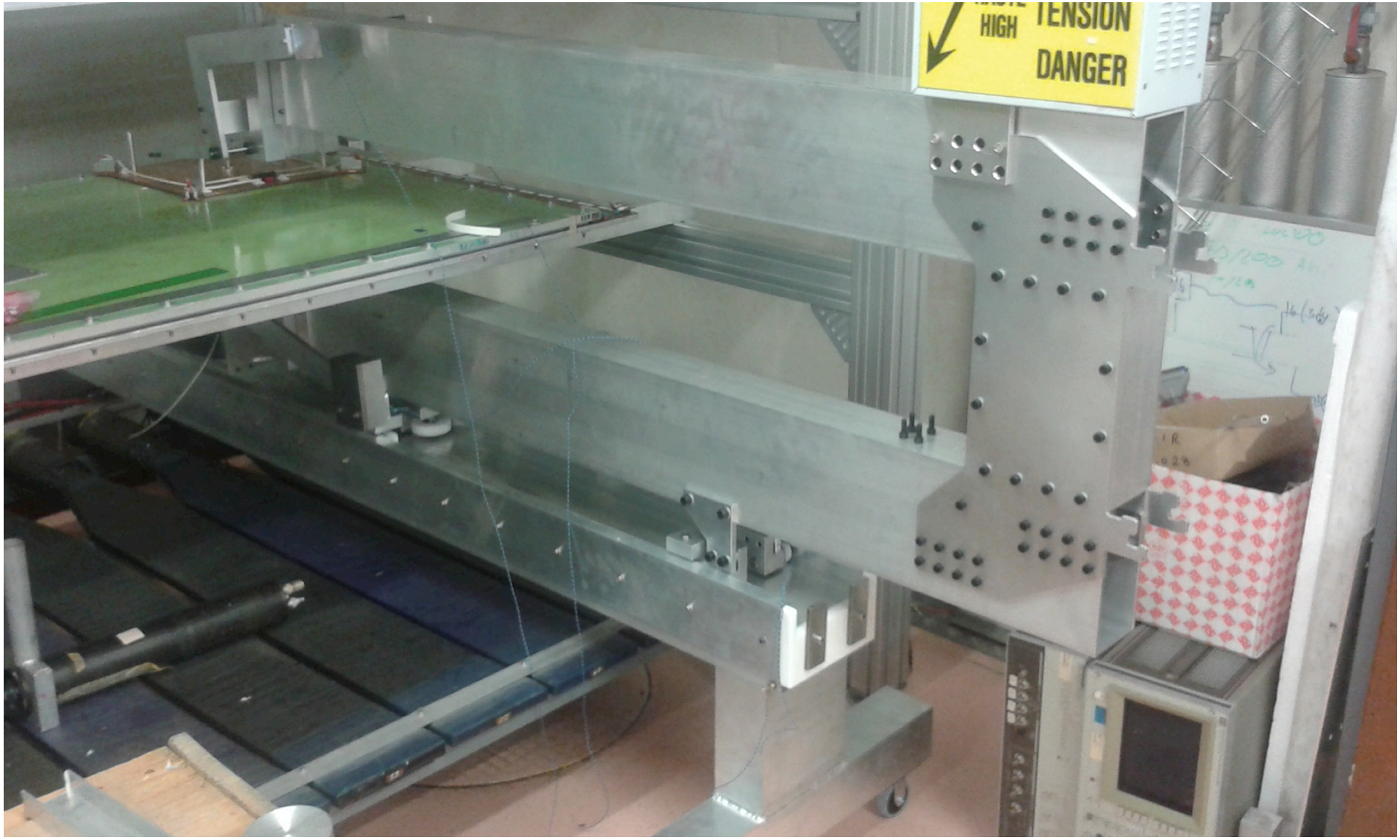


- 1mm Xray Collimator + 0.2 mm collimator in front of the chamber
- AVP25 DAQ used
- HV=520->470 to reduce saturation
- Xray at U=10 kV I=100 uA

Micromegas X-Ray CERN Test Stand



X-Ray Cern Test Stand Cart, Lecce



MICROMEGAS, DCS AND R&D

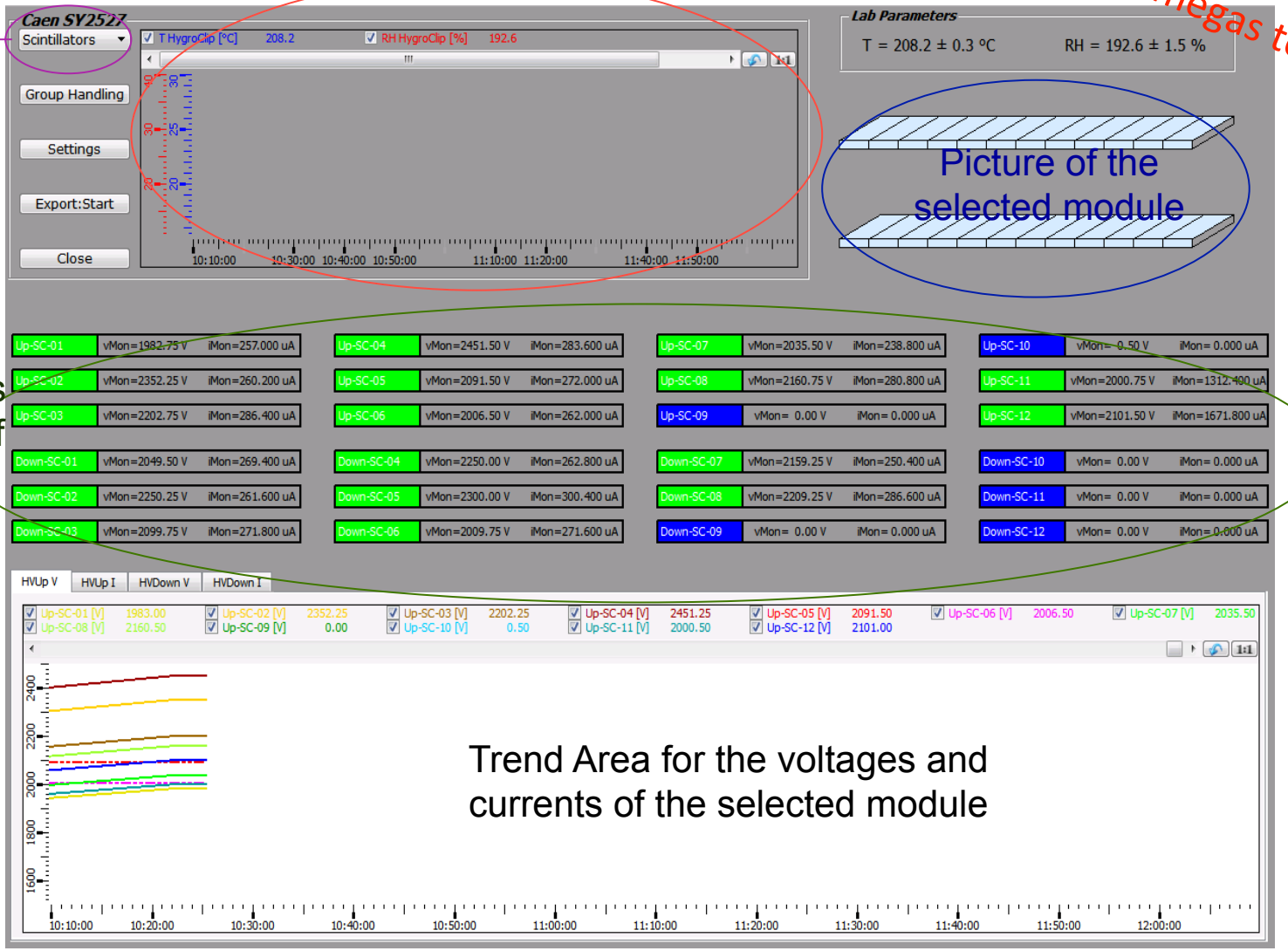
DCS project (WinCC OA 3.11)

Designed to work with CAEN SY2527

- Scintillators
- SM2
- SM1
- LM2
- LM1
- MMSW

!!! DCS is now used at the GIF++ for Micromegas test

Trend Area for Lab RH and T, Gas RH and T

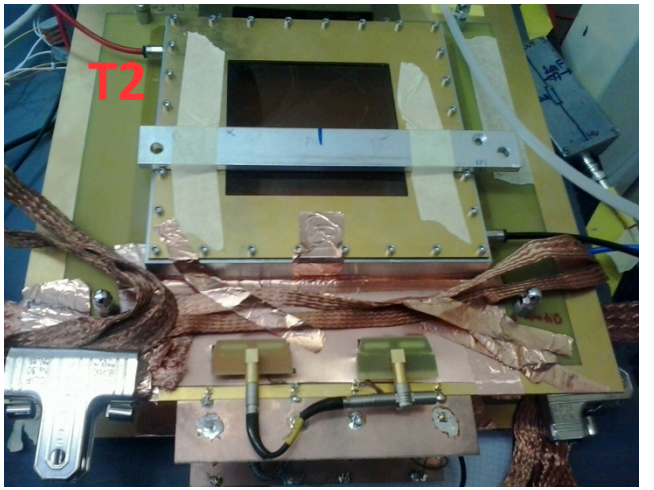


Actual voltages and currents of the selected module

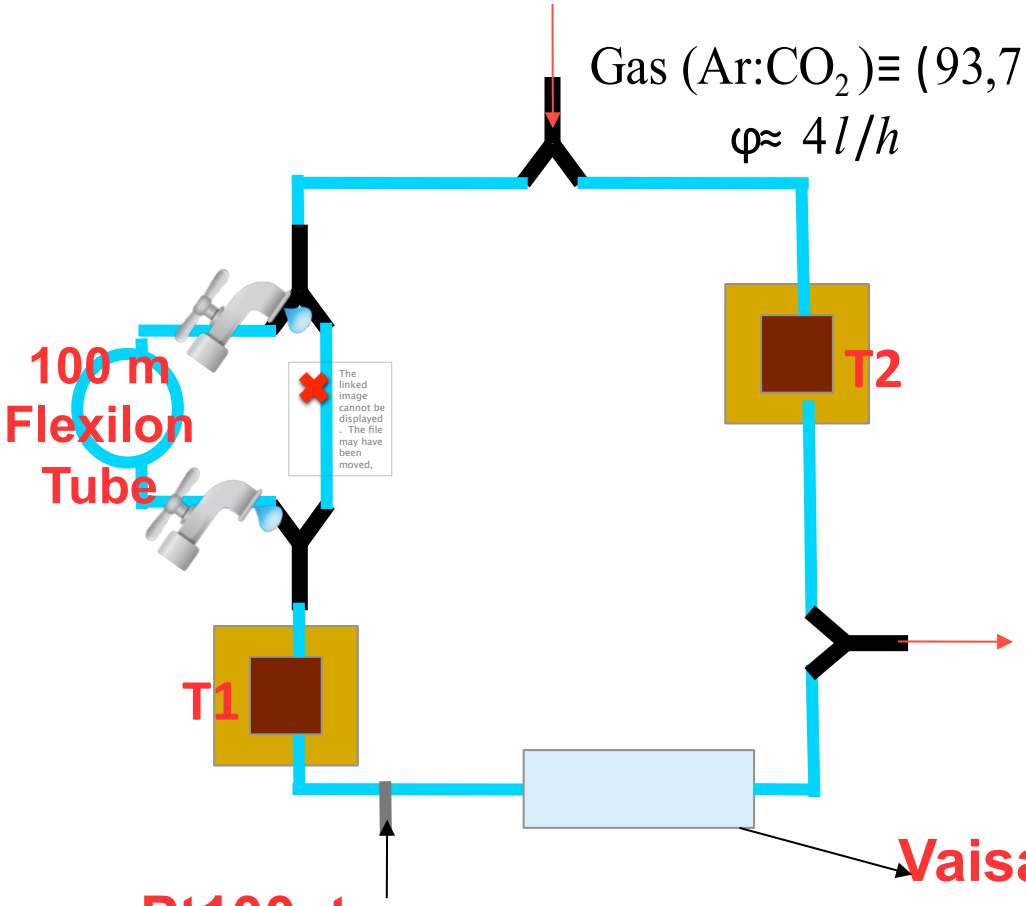
Possibility to store the information of each data point element in a root file

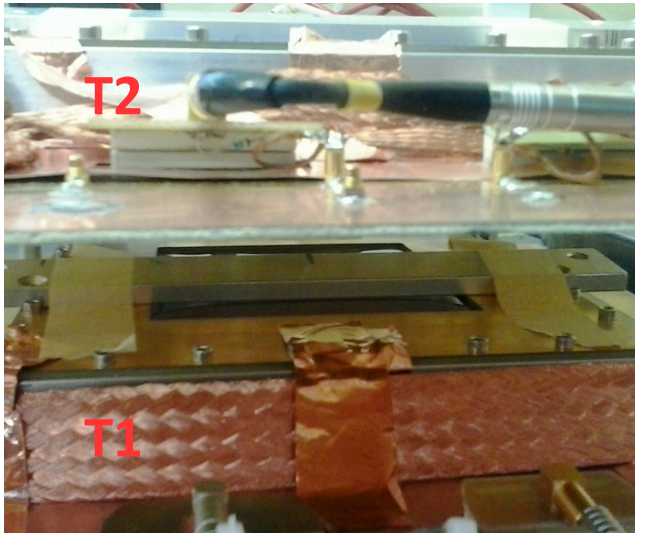
Studies of impact of humidity on MM at RD51: Experimental Setup

- **Chambers** considered: **T1 & T2**
- **IDEA:** vary the humidity in T1 and consider T2 as reference

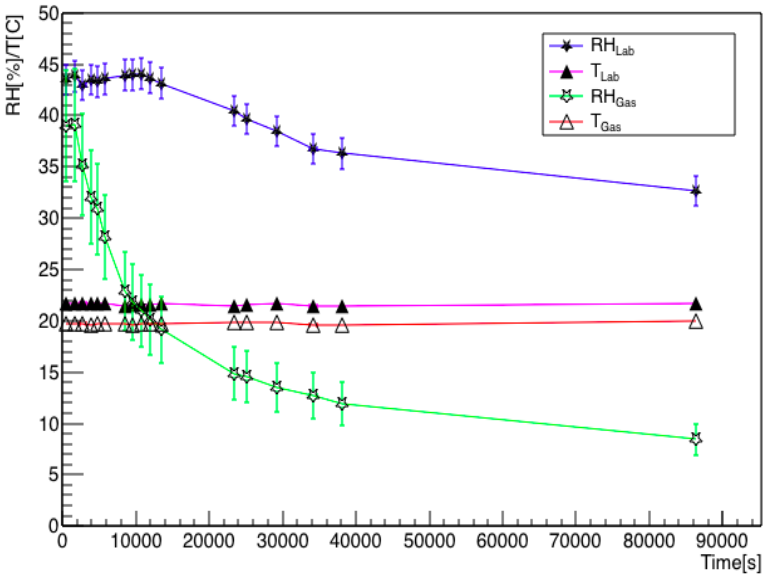


Gas Distribution Setup



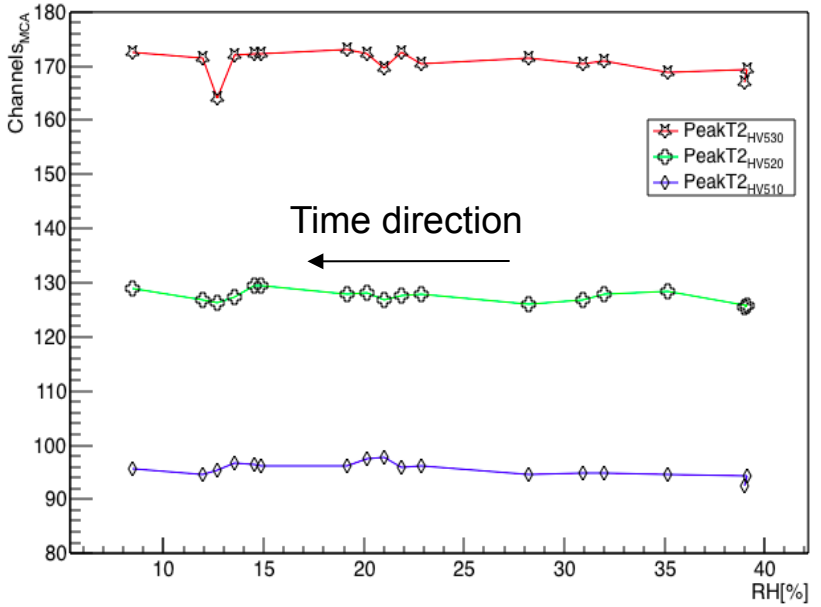


Studies of impact of humidity on MM at RD51: De-Humidification

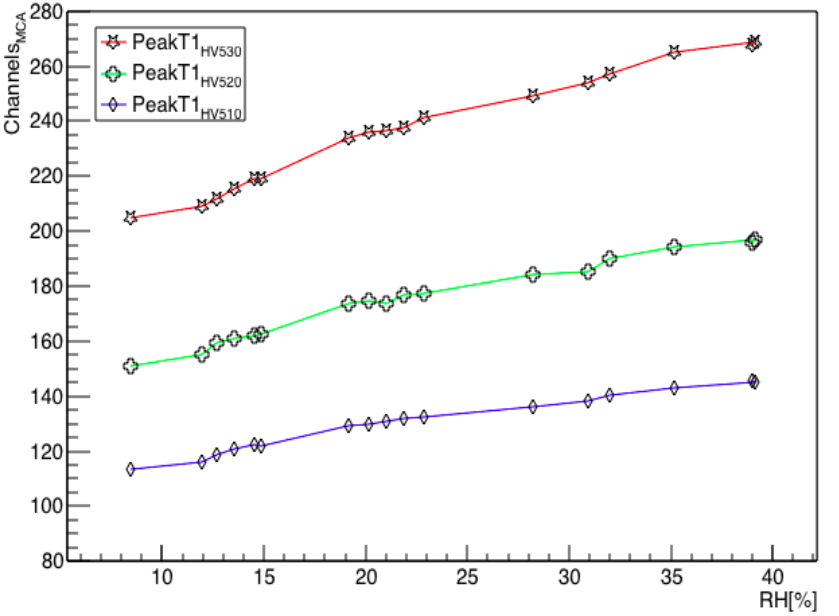


- Gas and Lab temperature were stable for all the data taking;
- Gas RH showed an exponential decay behaviour;
- Lab RH started to decrease after ~ 4 hours;

T2 chamber:
The Peak position of 55Fe was stable with respect to the humidity held by the T1 chamber

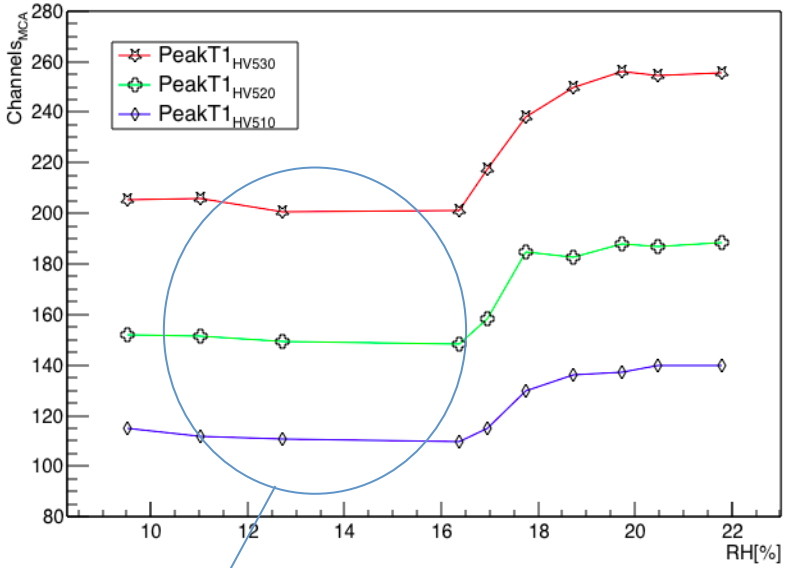


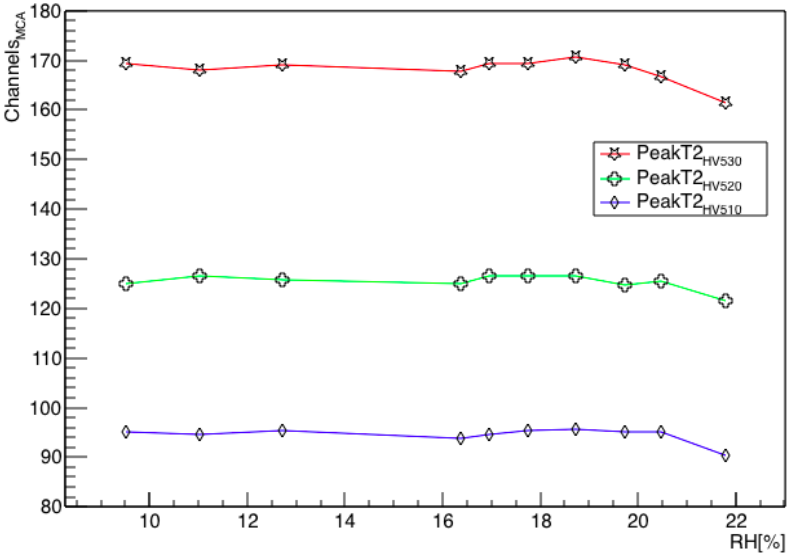
T1 chamber:
The 55Fe peak position decreased in agreement with RH



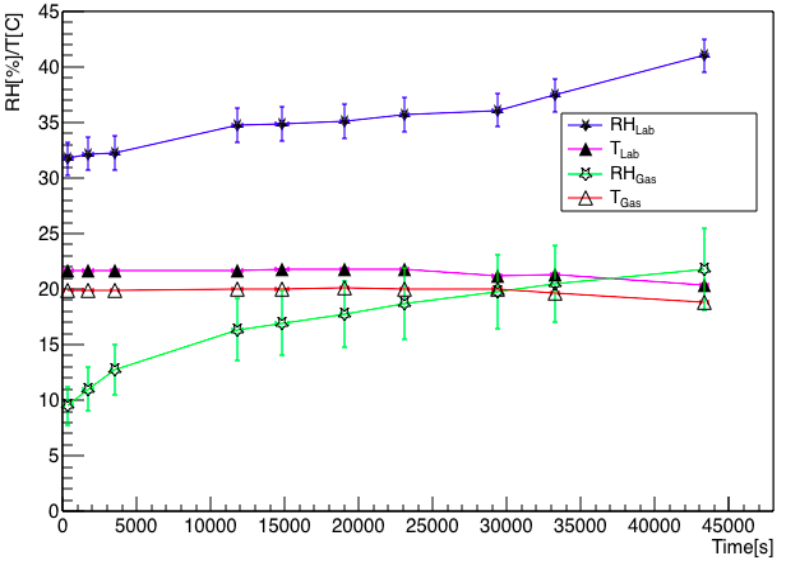
Studies of impact of humidity on MM at RD51: Humidification

Same behaviour observed in the de-humidification phase





An inertia effect seems to be present



!!! New tests are going to be done to understand the reason of this behaviour

MUON HIGH LEVEL TRIGGER

Muon Trigger Validation

A. Ventura responsible of

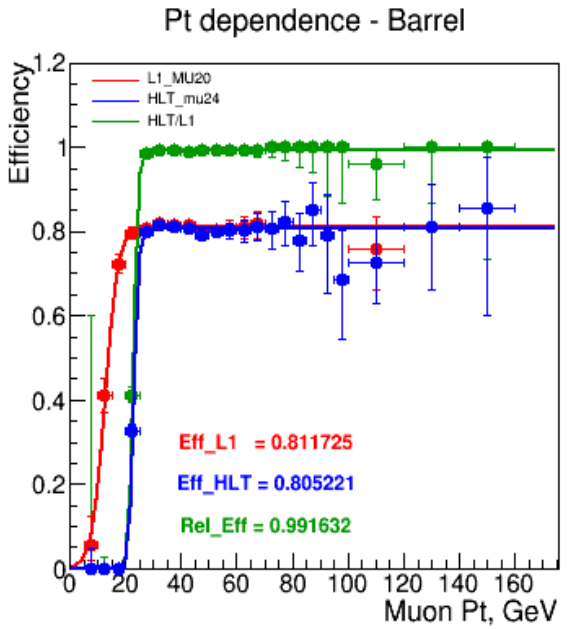
- central ATLAS trigger validation (rotating coordination),
- muon trigger validation.

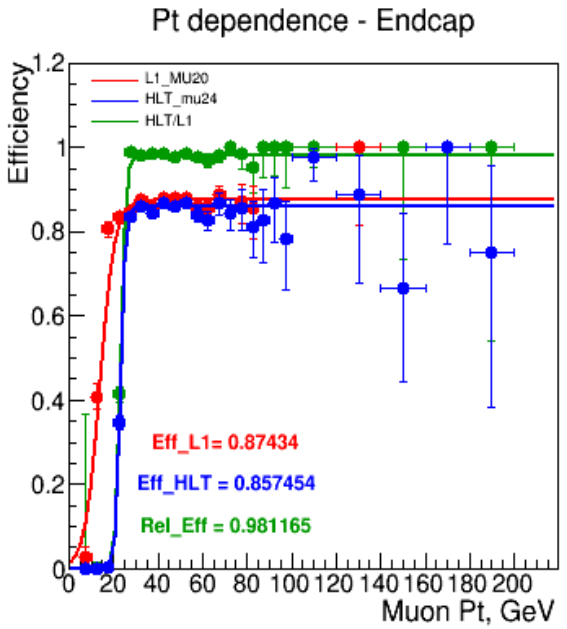
Central trigger validation shifts

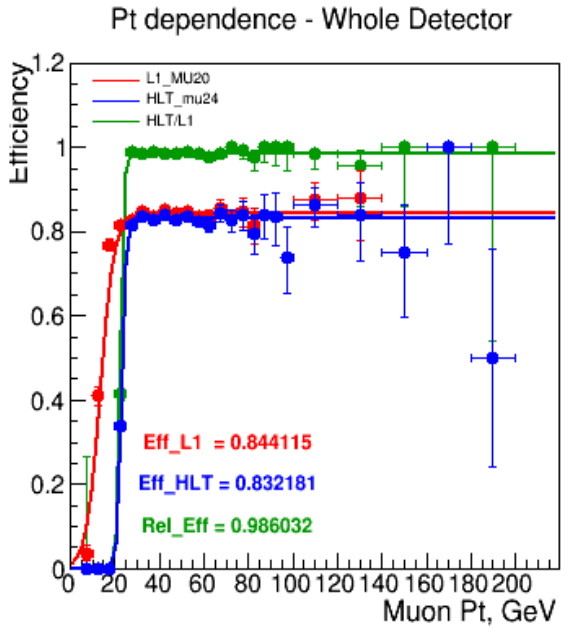
Constant feedback on **performance** studies and on Data/MC **scale factor** computation provided in Muon Trigger Signature Group meetings

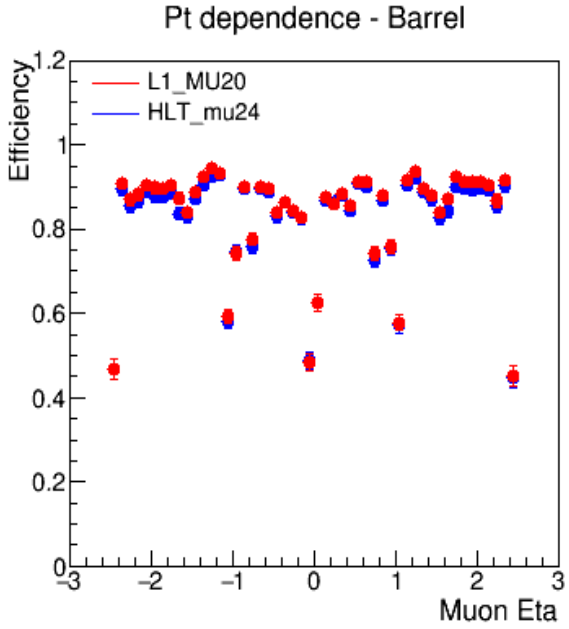
Monte Carlo studies vs. pt, eta and phi: HLT_mu24

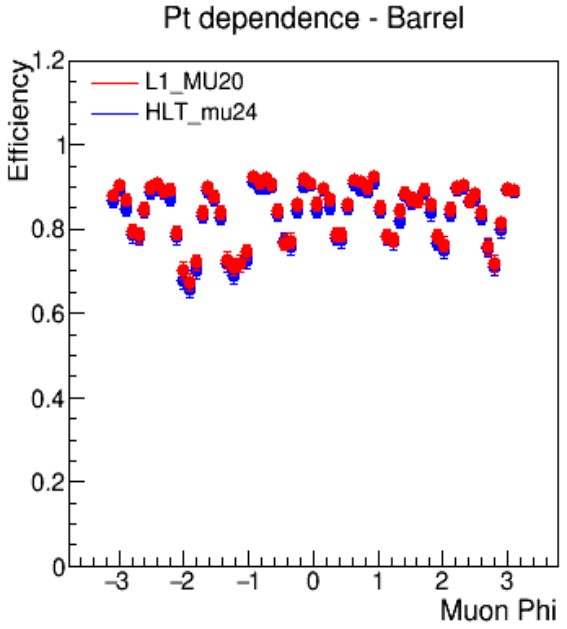
25ns pileup - 20.1.4.12: valid1.147407.PowhegPythia8_AZNLO_Zmumu.recon.AOD.e3099_s2578_r6727

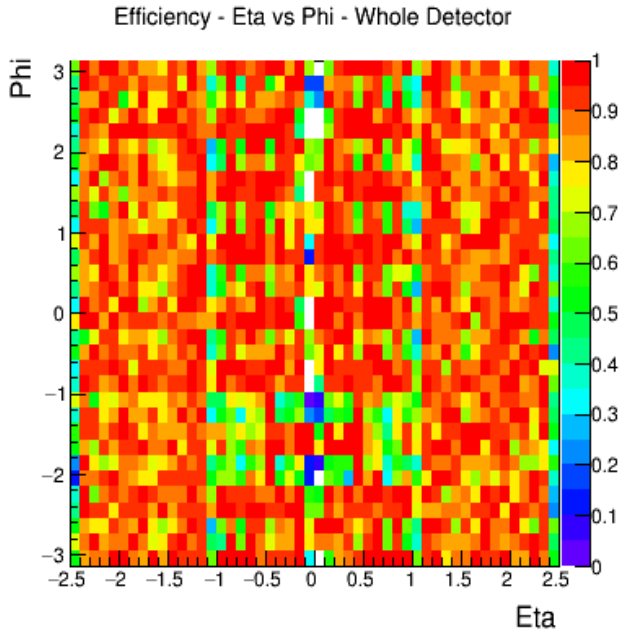






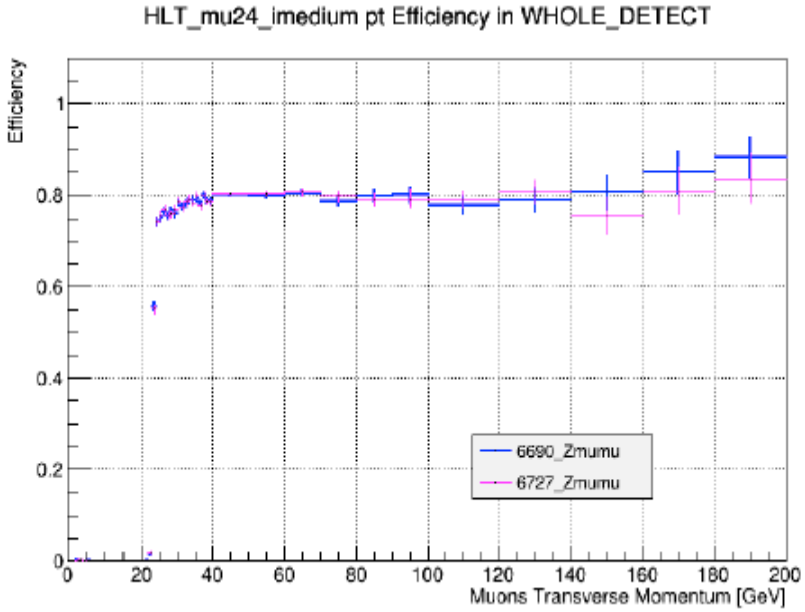


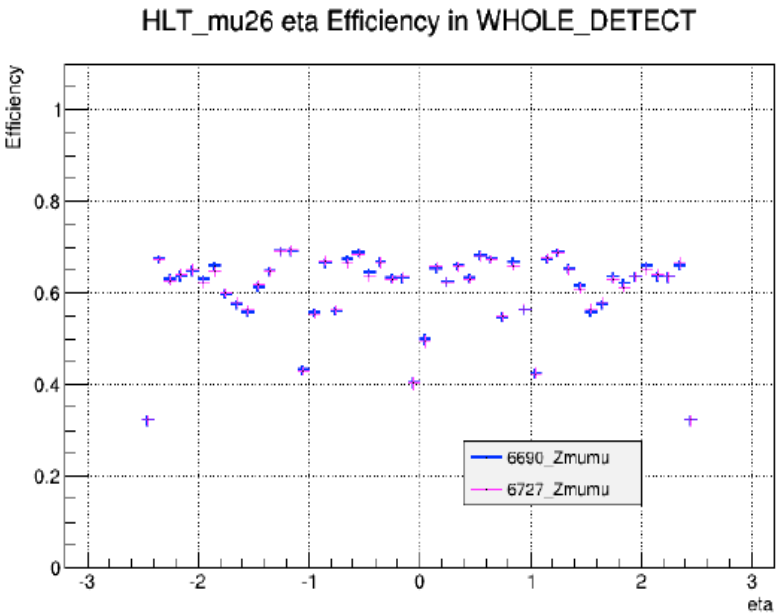


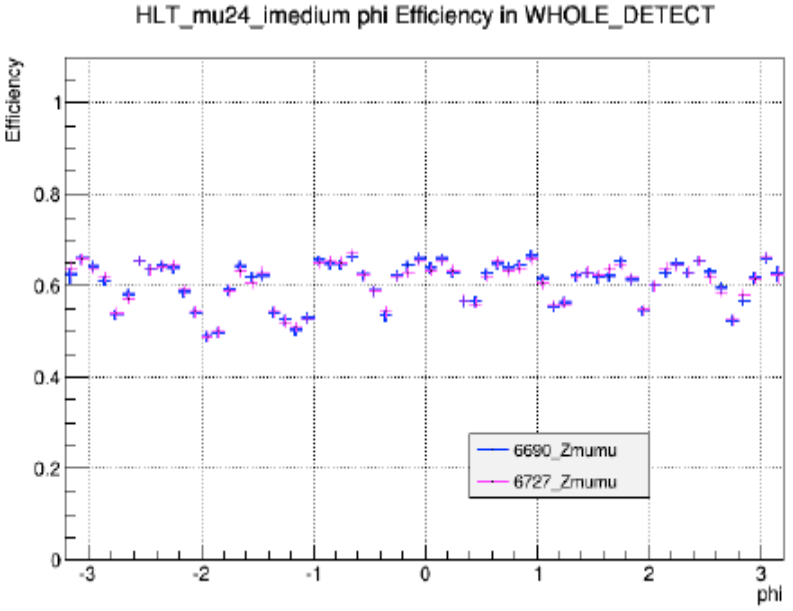


Comparisons vs. pt, eta and phi: HLT_mu24_imedium

Tags r6690 and r6727: improvement in detector simulation conditions toward Run II data taking

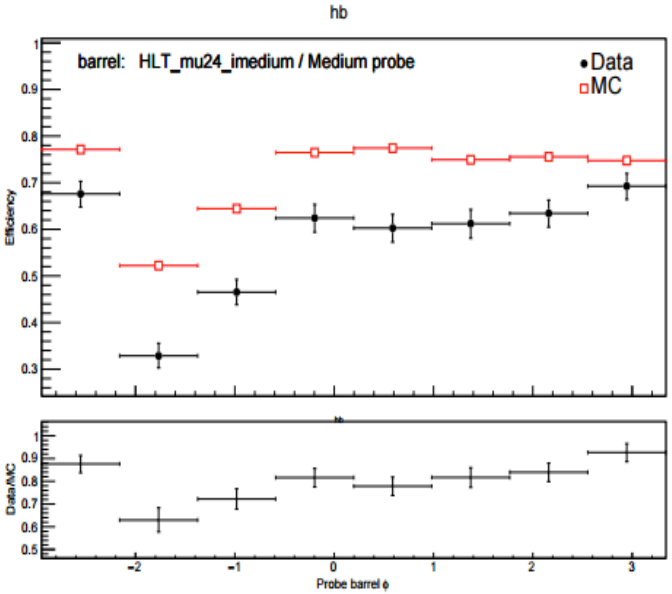


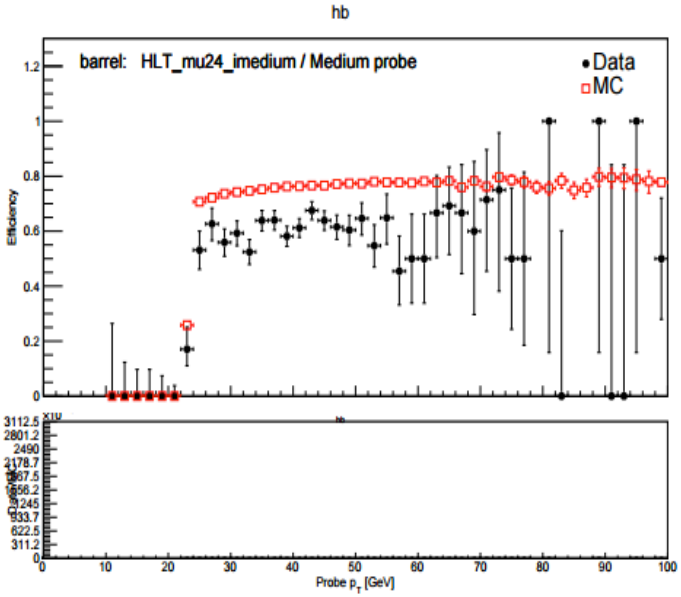


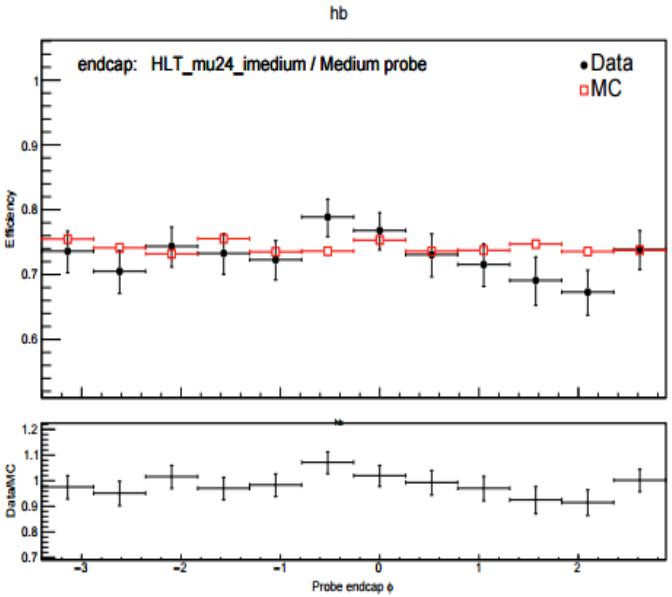


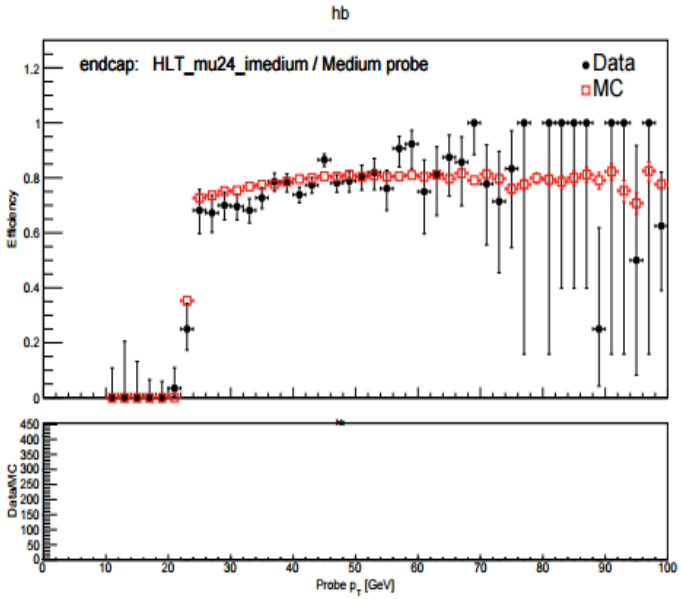
Data/MC scale factors for HLT_mu24_imedium (1/3)

Efficiencies are computed for many different L1 triggers and HLT signatures, as functions of eta, phi and p_T.
Data: week1 (start of Run II: ~7 pb^{-1}), MC: $Z \rightarrow \mu\mu$ events selected by means of the *Tag & Probe method*



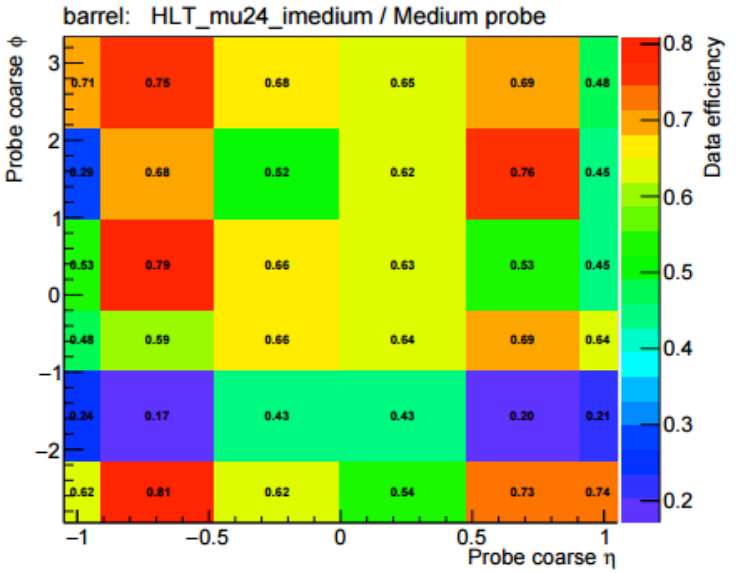


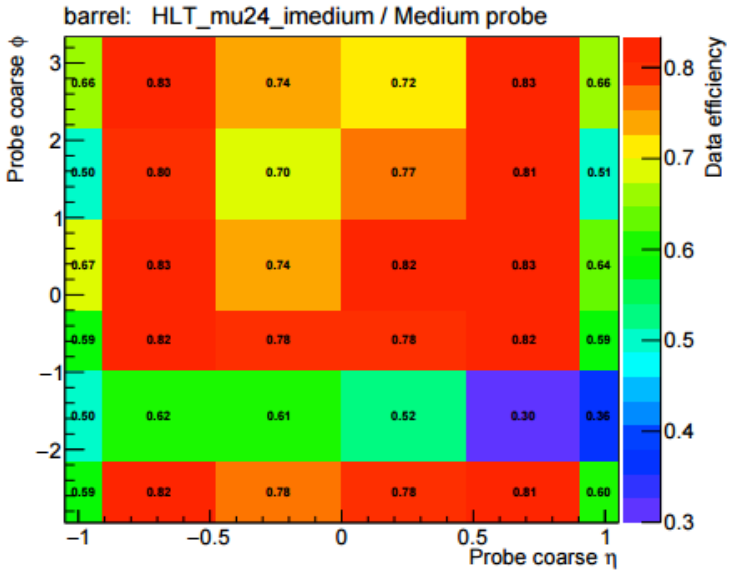


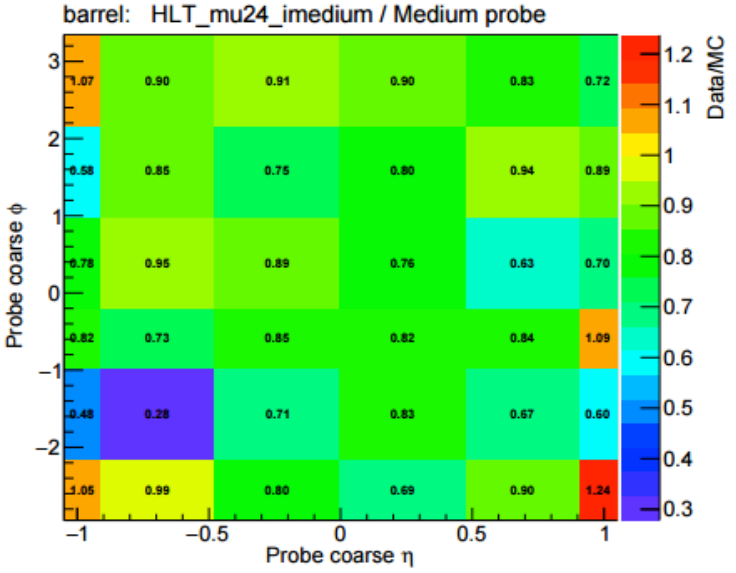


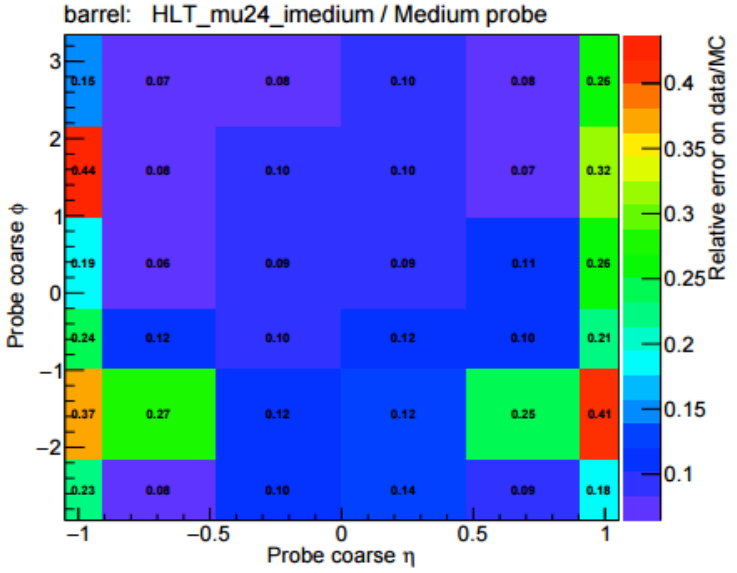
Data/MC scale factors for HLT_mu24_imedium (2/3)

Efficiencies and SFs (as Data/MC ratio) are computed as functions of eta and phi in barrel and endcaps.
Data: week1 (start of June: ~7 pb^{-1}), MC: $Z \rightarrow \mu\mu$ events selected by means of the *Tag & Probe method*



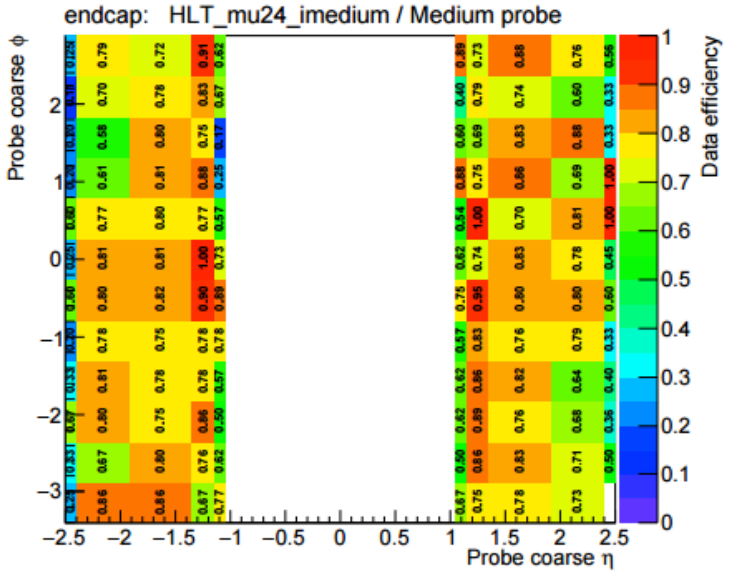


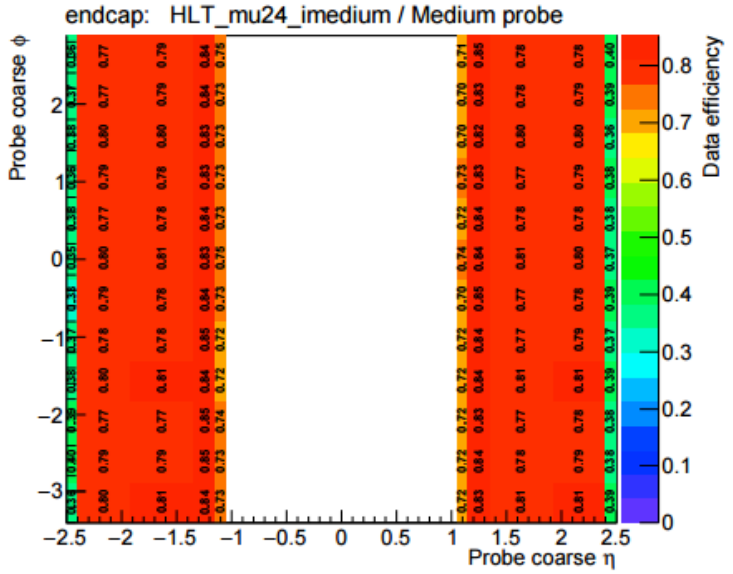


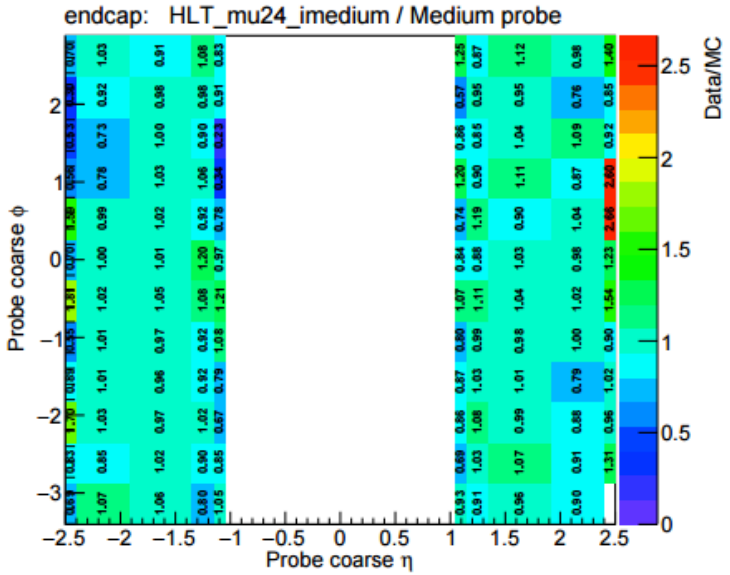


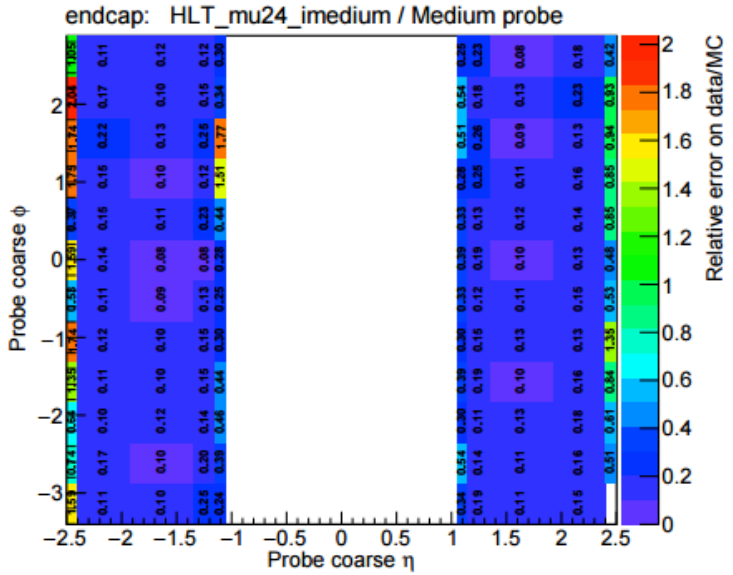
Data/MC scale factors for HLT_mu24_imedium (3/3)

Efficiencies and SFs (as Data/MC ratio) are computed as functions of eta and phi in barrel and endcaps.
Data: week1 (start of June: ~7 pb^{-1}), MC: $Z \rightarrow \mu\mu$ events selected by means of the *Tag & Probe method*









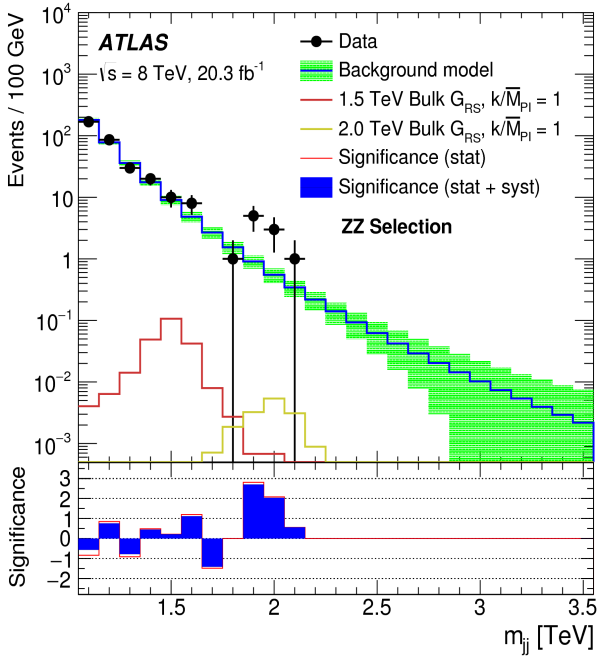
ELECTROWEAK PHYSICS

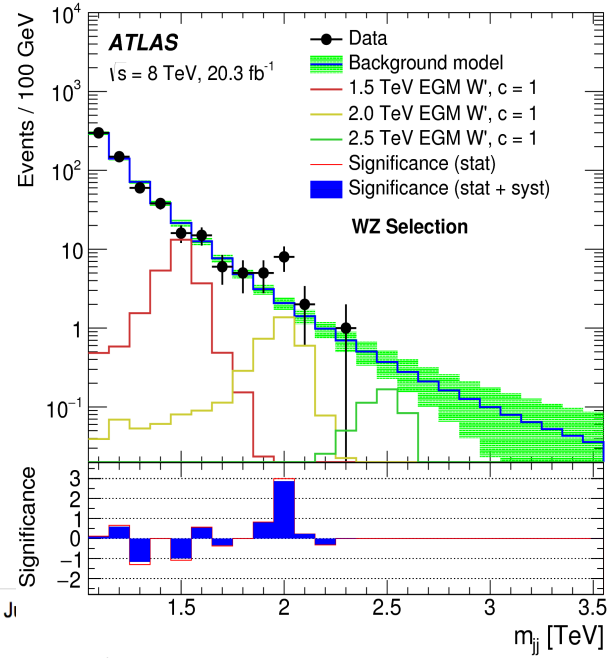
Z+b(b) production at LHC with ATLAS

- **misura d'urto differenziale di b-jets in associazione con Z** con i dati di ATLAS a $\sqrt{s}$=7 TeV (run 2011, 4.7fb^{-1})
- lungo processo di review terminato a inizio Giugno 2014, lavoro sottomesso a arXiv il 14 Luglio 2014, arXiv:1407.3643v2; tema della tesi di PhD di Nicola Orlando difesa il 15 Luglio 2014; pubblicato su JHEP a Ottobre 2014 doi: 10.1007/JHEP10(2014)141
  - Atlas Talk correlato nell'ultimo anno:
    - S. Spagnolo "Measurements of vector boson with associated jet production with the ATLAS detector" ATL-PHYS-SLIDE-2015-026 Lake Louise Winter Institute 2015, Alberta
- Motivazioni: background a H(bb)Z(ll) (e a Z(bb)Z(ll)); predizioni per produzione di HQ ancora affette da errori teorici importanti; alcuni schemi di calcolo sfavoriti dai dati, la nostra misura consente in confronto degli schemi di calcolo 4FNS e 5FNS (4,5-flavor number scheme) su stati finali Zb +X e Zbb+X sensibili in modo diverso alle alle approssimazioni su cui si basano le predizioni

Fisica nel Run2

- interesse e coinvolgimento
  - produzione di di-bosoni, in particolare (ZZ) nella configurazione di vector boson scattering, *da portare avanti nel lungo termine per esempio per vincolare accoppiamenti quartici anomali*
  - produzione di stati finali esotici con di-bosoni, *già con i primi dati è possibile esplorare una situazione interessante*:
    - a Giugno è stato pubblicato un risultato con i dati a 8 TeV del 2012 che merita attenzione nel nuovo run a causa di un *interessante eccesso localizzato*
      - ricerca di risonanze nello stato finale VV; entrambi bosoni vettori sono ricostruiti nei loro decadimenti adronici (alta statistica) e mediante la tecnica dei Fat Jet, combinando i due jet dal decadimento del bosone W/Z;
        - Fat Jet, tecnica ormai di ampio utilizzo nelle analisi a LHC, garantiscono maggiore efficienza a M_{VV} alte, dove i bosoni (e i jet dai loro decadimenti) sono boostati
    - le search condotte nei dati a 8 TeV nei canali leptonici e semileptonici non erano sensibili attorno a M~2TeV
    - con i dati del run2 ci si aspetta che 5fb-1 siano sufficienti a confermare/correggere l'eccesso
    - Già impegnati nel working group che studia ll+J (J= fat jet)





Search for high-mass diboson resonances with boson-tagged jets in proton–proton collisions at √s = 8 TeV with the ATLAS detector NEW!	Submitted to JHEP	Plots and more Info; arxiv:1506.00962	20.3/fb	Ji

Fisica nel Run

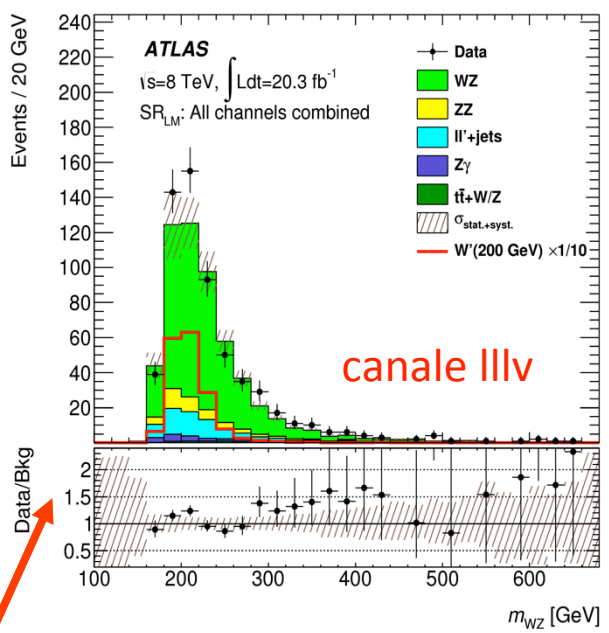
WW/WZ resonance search in 2jet (standard) e 1 leptone + missing Et, ha prodotto limiti inferiori a 1.5 TeV

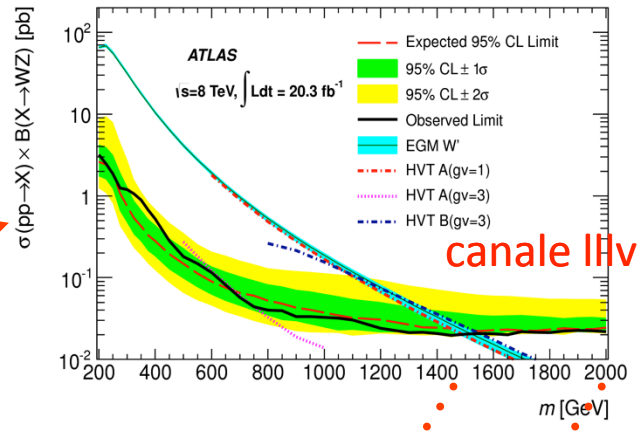
observed (expected) lower mass limit of 1.52 (1.49) TeV is derived for the W' at the 95% confidence level

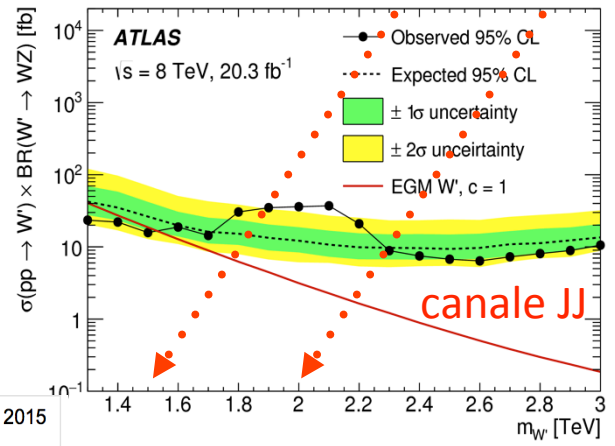
G. Chiodini, N. Orlando, S. Spagnolo
studio dello stato finale llbb (bb non risonante)

S. Spagnolo impegnata in passato negli Editorial Boards che hanno fatto la review interna delle ricerche di risonanze WZ in canali leptonici

D. Bachas editor della misura di sezione d'urto di produzione SM per WZ nel canale leptonico ed estrazione di limiti su accoppiamenti anomali trilineari, co-autore delle misure di sezione d'urto di produzione di ZZ



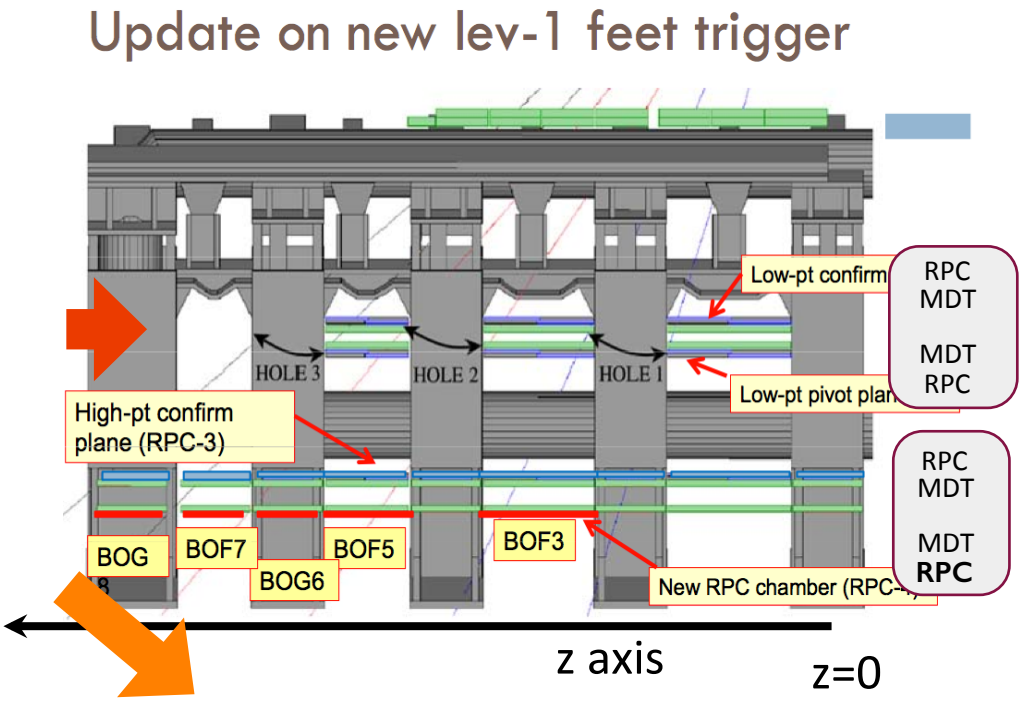


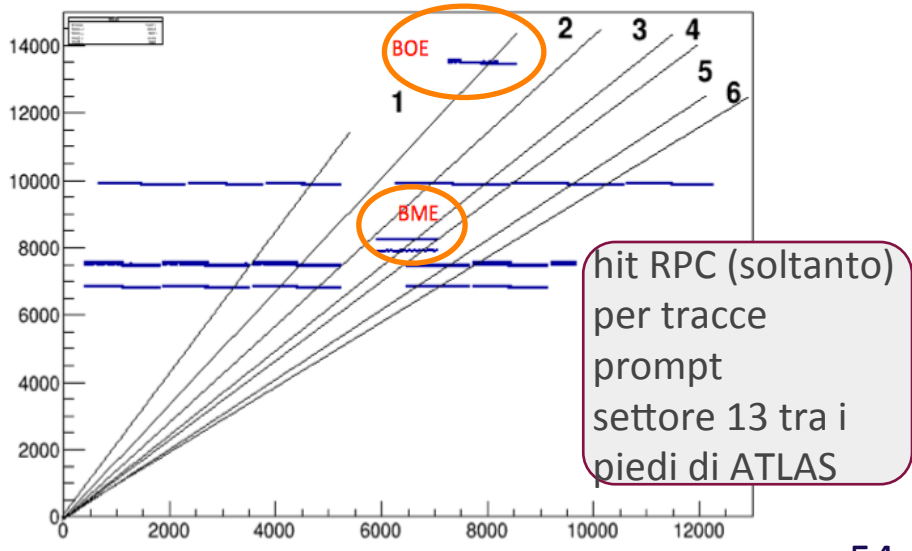


Search for high-mass diboson resonances with boson-tagged jets in proton–proton collisions at √s = 8 TeV with the ATLAS detector NEW!	Submitted to JHEP	Plots and more Info; arxiv:1506.00962	20.3/fb	June 2015

RPC detector maintenance, studi, simulazioni

- durante il long shut-down sono state installate
  - le schede di lettura (e trigger) delle **camere extra nei settori (12 e 14) dei piedi**
  - **alcune camere MDT+RPC in buchi di accettanza** (per ascensori nel settore tra i piedi) settore 13
- nostro ruolo: integrazione di queste nuove camere nella simulazione e nel data model di ATLAS, per consentire la lettura, decodifica, configurazione delle strade di trigger e utilizzo dei dati
  - update del software di cabling, decodifica, integrazione nel monitoring offline, simulazione e ricostruzione
  - commissioning con i dati in corso
  - DQ offline, utilizzato dagli shifters+esperti per definire la qualità dei dati, aggiornato - *responsabilità G.Chiodini*





Altre attività e responsabilità

- S. Spagnolo
  - partecipazioni a Editorial Boards; Chair di un editorial board per la ricerca di risonanze di stati a 3 leptoni (per vincolare masse/sezioni d'urto di produzione di leptoni pesanti in modelli see-saw di tipo III) articolo sottomesso a JHEP il 3 Giugno 2015 arXiv:1506.01291
  - da Luglio 2014 a Ottobre 2015 componente dell'ATLAS Speaker Committee
  - rappresentante del Muon Spectrometer nel ATLAS Data Preparation Coordination group

- G. Chiodini
  - responsabile della stesura della sezione del TDR di AFP (Atlas Forward Physics) che descrive l'utilizzo di rivelatori a diamante per timing e trigger standalone [contributo al TR per la review di AFP nel 2013]
    - TDR pubblicato a Maggio 2015 CERN-LHCC-2015-009 ; ATLAS-TDR-024
    - comprende appendice su proposta di upgrade del timing detector con diamante sintetico

ATLAS
Forward Proton Phase-I Upgrade

Technical Design Report
May 20, 2015

Appendix C R & D for AFP Upgrades

In order to prepare for participation by AFP in standard running at high average pile-up during Run 3, the AFP R&D program focusses primarily on background rejection from further improvements in the proton Time-of-Flight, both by increased pixellation, and by improved timing resolution. This R&D program is not part of this Technical Design Report for the AFP detector in Run 2, but because it is of high interest to the future of forward physics at the LHC, it is described in the next two sections of this Appendix.

C.1 R & D on Fast Diamond Detectors

Diamond detectors, an alternative solution to the quartz-based Cherenkov timing detector in run III, are investigated by three INFN groups from Bologna, Lecce, and Roma Tor-Vergata. Several advantages are foreseen by a diamond sensor solution in terms of radiation hardness, granularity, trigger capability, and compactness.

Diamond detectors produced by Chemical Vapor Deposition (CVD) have a potential for high temporal resolution due to their intrinsic fast response to ionizing radiation (less than 100 ps rise

- contributo al gruppo di lavoro che studia opzioni di upgrade di ATLAS per la fase-2 che estendano l'accettanza a grandi valori di pseudorapidità (<4) su "Possible detector technologies under investigation" per un preshower del calorimetro ad alto eta con capacità di timing

ATLAS NOTE

ATL-UPGRADE-INT-2015-001

31st May 2015

Large Eta Task Force Report

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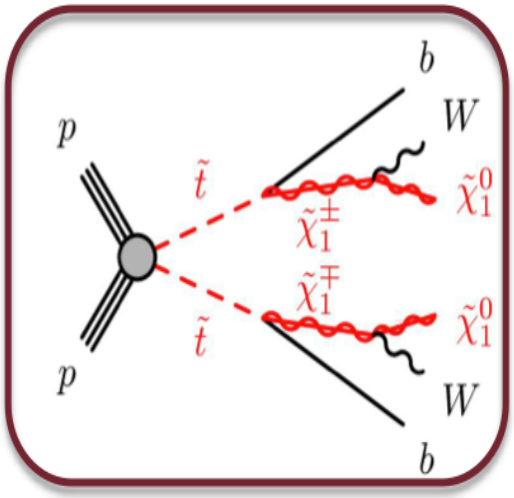
JE-INT-2015-001

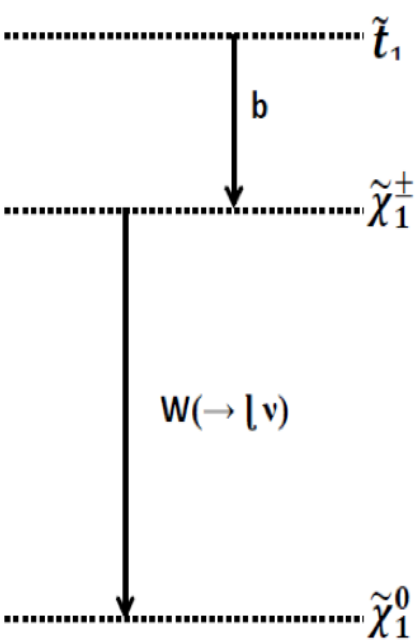
SUPERSYMMETRY

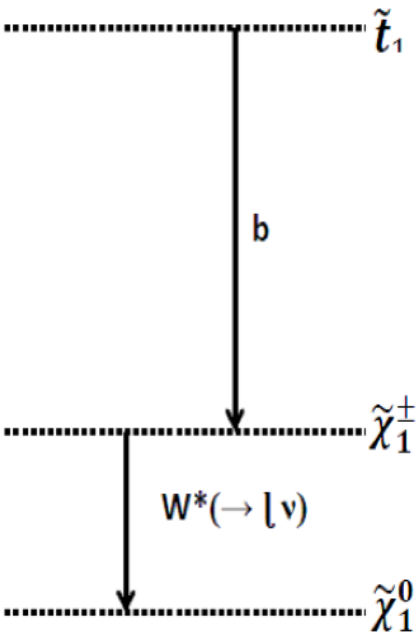
8 TeV Stop->b+chargino Analysis



$$\tilde{t}\tilde{t} \rightarrow \tilde{\chi}_1^+ b \tilde{\chi}_1^- b \rightarrow W^{(*)+}\tilde{\chi}_1^0 b W^{(*)-}\tilde{\chi}_1^0 b \rightarrow l^+ \nu \tilde{\chi}_1^0 b l^- \nu \tilde{\chi}_1^0 b$$

- Chargino decay with on-shell W otherwise off-shell W
- **Final State:** E_T^{miss} + 2 opposite sign leptons + 2Jets
- The kinematics of the $\tilde{t} \rightarrow \tilde{\chi}_1^+ b$ decay mode depend upon the mass hierarchy of the $\tilde{t}$, $\tilde{\chi}_1^{\pm}$ and $\tilde{\chi}_1^0$ particles

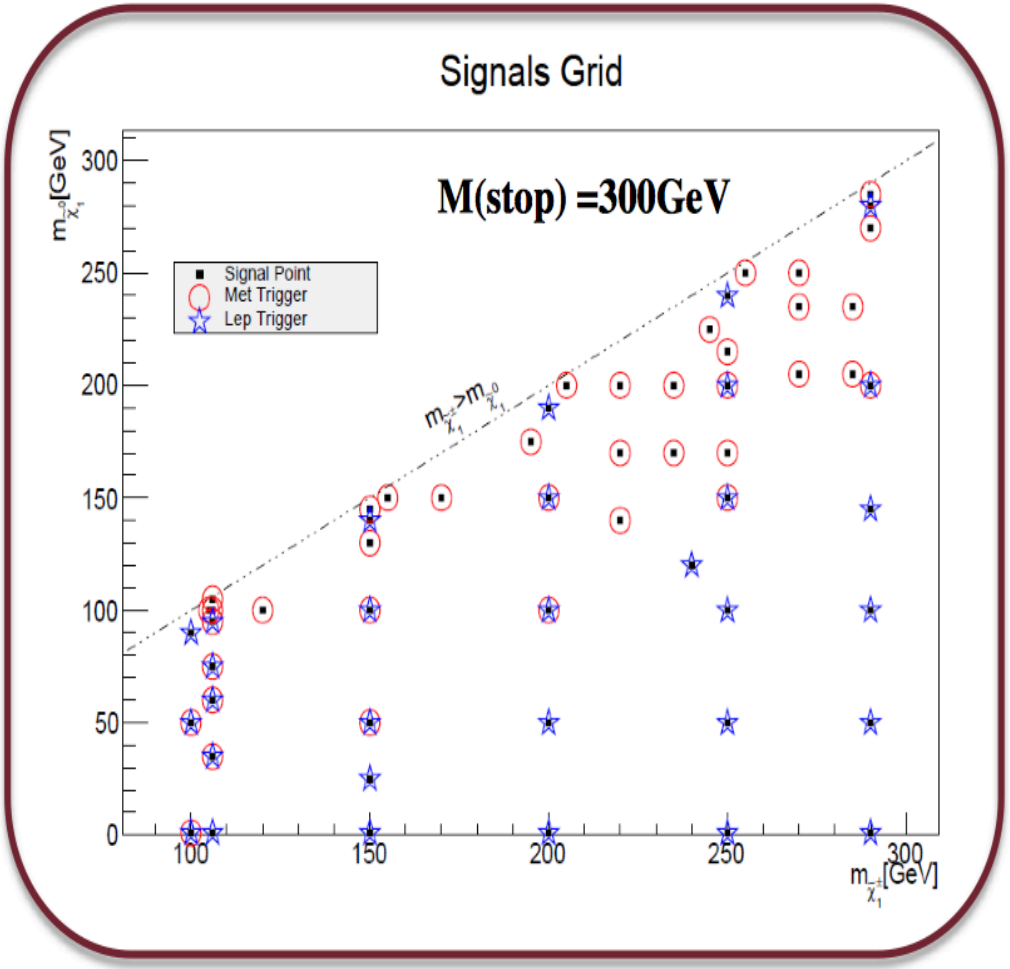




Scalar top quark decay modes in through real (left) or virtual (right) W boson production

Signal Grid

- Grid: for m(stop)=300GeV, scan the $\tilde{\chi}_1^{\pm}$ and $\tilde{\chi}_1^0$
- Both $\tilde{\chi}_1^{\pm}$ and $\tilde{\chi}_1^0$ masses vary in steps of at-least 50GeV. (at lower $\tilde{\chi}_1^0$ masses, steps of 25 GeV used)



- **In order to be sensitive to all the possible mass splittings, two complementary analysis strategies are designed:**
  - ✓ one to target $\tilde{\chi}_1^{\pm}$ - $\tilde{\chi}_1^0$ mass splittings (larger than the W bosons mass)
  - ✓ the other small $\tilde{\chi}_1^{\pm}$ - $\tilde{\chi}_1^0$ mass splittings (smaller than the W bosons mass).

- **Two strategies target two different scenarios:**
  i. compressed mass spectrum with soft leptons
  ii. mass spectrum with hard leptons.

Event Selection

The list of applied cuts, both for MET trigger and Lepton Trigger

1. **GRL:** GoodRunLists selection
2. **LArError!=2, TileError!=2 and Core Flags**: Events with no error form LAr and Tile quality assessment (for adat
3. **Trigger:** Satisfying the appropriate trigger requirement (MET or Lepton Trigger)
4. **Jet Cleaning**: Reject events with one or more jets failing the jet quality criteria
5. **Primary vertex:** Select events where the primary vertex is associated with at-least five tracks
6. **Cosmic veto:** Rejects events that contain at-least one muon failing the cosmic rejection cuts
7. **Exactly two Leptons:** Select events with exactly 2 leptons **(Different Flavor (DF) and Same Flavor (SF) separately studied)**

Soft Leptons (MC1)

- Two "baseline" leptons, p_T >7GeV for electron and p_T >6GeV muon
- Exactly two "Opposite Sign" leptons
- Medium Isolation cut
- E_T^{miss} >120 GeV
- At least two jets (p_T >20GeV)
- Lepton invariant mass M_{ll} > 8GeV
- At-least one b-jet (only for signal region)

Hard Leptons (LC1/LC2)

- Two "tight" leptons, p_T >25GeV for leading lepton
- Exactly two "Opposite Sign" isolated leptons
- M_{ll} > 20GeV (removes low mass DY and overlapping e-μ)
- At least two jets (p_T >20GeV)

Additional cuts:

- E_T^{miss} >50GeV
- two cuts on meff (scalar sum of E_T^{miss} and transverse momenta to two leptons and the two most energetic jets)

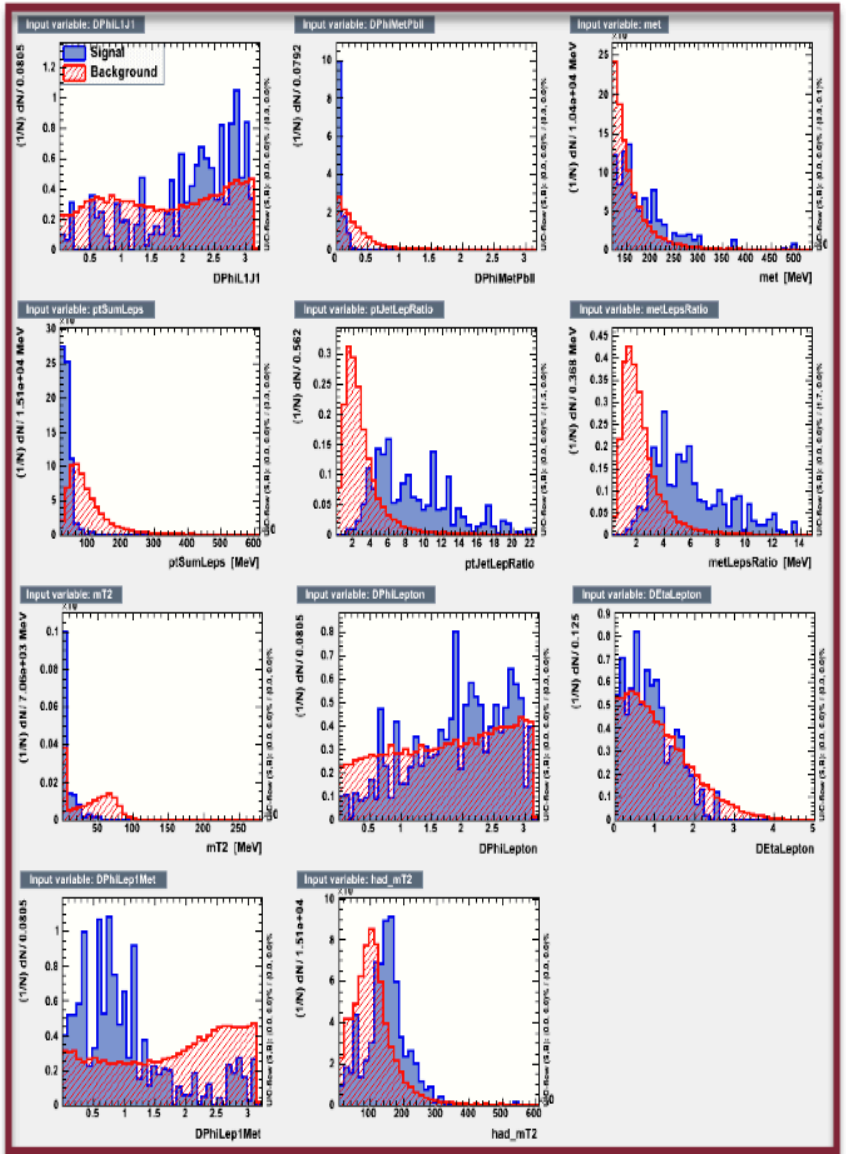
✓ **LC1: meff > 200 GeV**

✓ **LC2: meff>300 GeV**

MVA Distribution and Variable Ranking (DF)

example of distributions for signal (ref point RPA) and SM background)

MET Trigger $m(\tilde{\chi}_1^{\pm}, \tilde{\chi}_1^0)$=120,100



Rank	Variable	Variable Importance
1	met/$\sum_i p_T^{li}$	3.621e-01
2	$\sum_i p_T^{Ji}/\sum_i p_T^{li}$	3.369e-01
3	DPhiLep1Met	7.139e-02
4	had_mT2	5.307e-02
5	$\sum_i p_T^{li}$	3.951e-02
6	mT2	3.771e-02
7	met	3.221e-02
8	DPhiLepton	2.482e-02
9	DPhiL1J1	2.257e-02
10	DEtaLepton	1.964e-02
11	DPhiMetPbll	0.000e+00

Signal Regions

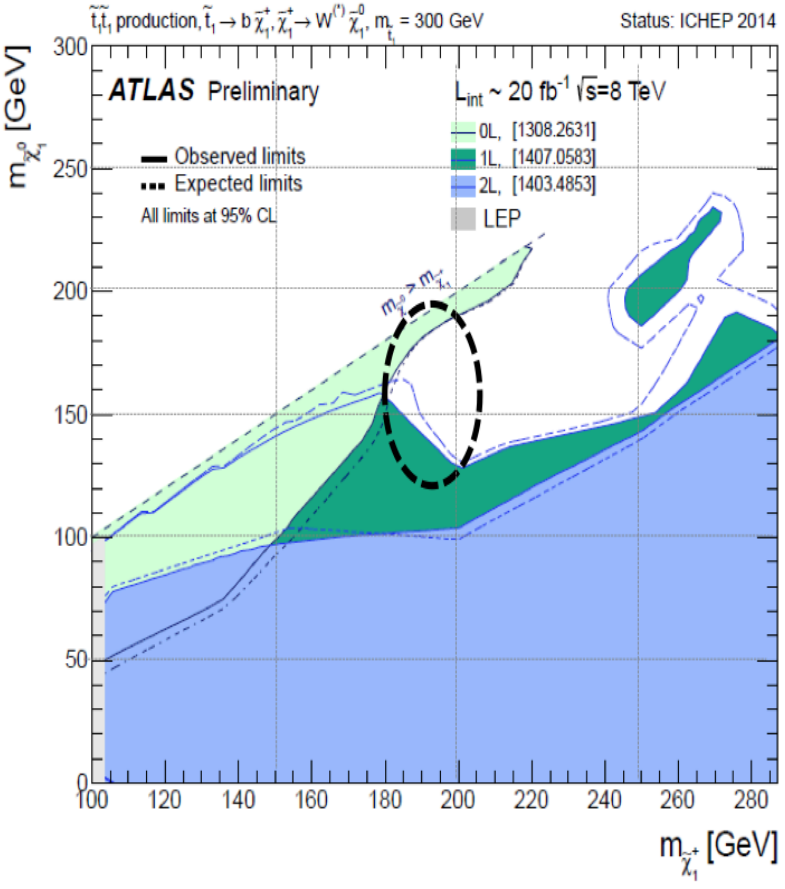
	reference point	preselection cuts	t_{cut}	b-jets
SR_1^{DF}	RPA	MC1	-0.49	≥ 1
SR_2^{DF}	RPB	MC1	-0.39	≥ 1
SR_3^{DF}	RPC	MC1	-0.57	≥ 1
SR_4^{DF}	RPD	LC1	-0.38	-
SR_5^{DF}	RPE	LC1	0.36	-
SR_6^{DF}	RPG	LC2	0.20	-
SR_1^{SF}	RPA	MC1	-0.53	≥ 1
SR_2^{SF}	RPB	MC1	-0.53	≥ 1
SR_3^{SF}	RPC	MC1	-0.45	≥ 1
SR_4^{SF}	RPE	LC1	-0.25	-
SR_5^{SF}	RPF	LC2	-0.09	-

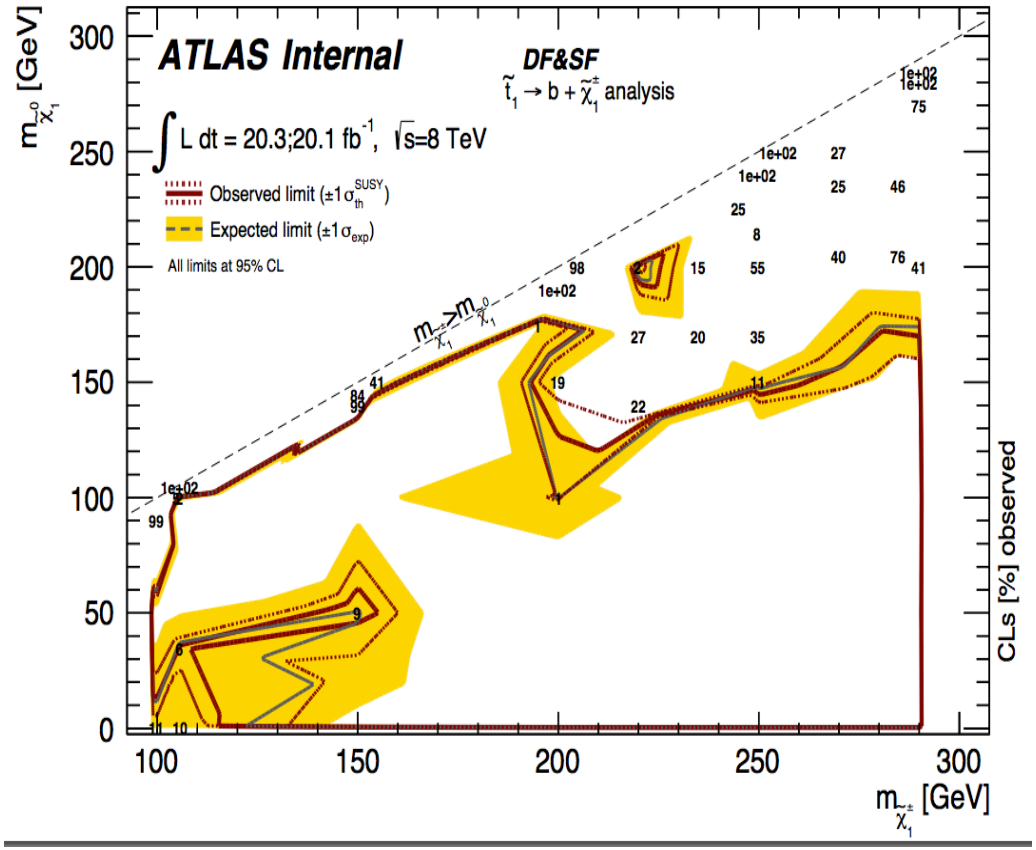
Table 14: Observed events and total expected background events from the background-only fit, for the different signal regions. The quoted errors take into account both statistical and systematic uncertainties.

	SR_1^{DF}	SR_2^{DF}	SR_3^{DF}	SR_4^{DF}	SR_5^{DF}	SR_6^{DF}
Observed events	5	1	1	3	8	4
Fitted bkg events	4.07 ± 1.45	2.06 ± 1.53	1.22 ± 0.88	4.09 ± 1.07	8.26 ± 4.44	3.34 ± 1.79

	SR_1^{SF}	SR_2^{SF}	SR_3^{SF}	SR_4^{SF}	SR_5^{SF}
Observed events	5	10	4	9	2
Fitted bkg events	7.25 ± 2.49	6.16 ± 1.48	2.95 ± 0.99	6.33 ± 1.57	5.50 ± 1.78

Exclusion Plots/Limit Setting

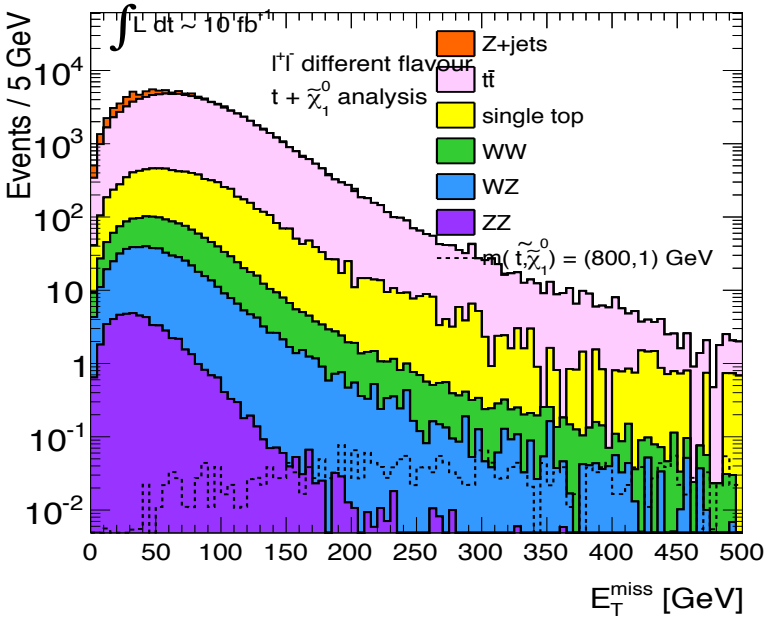


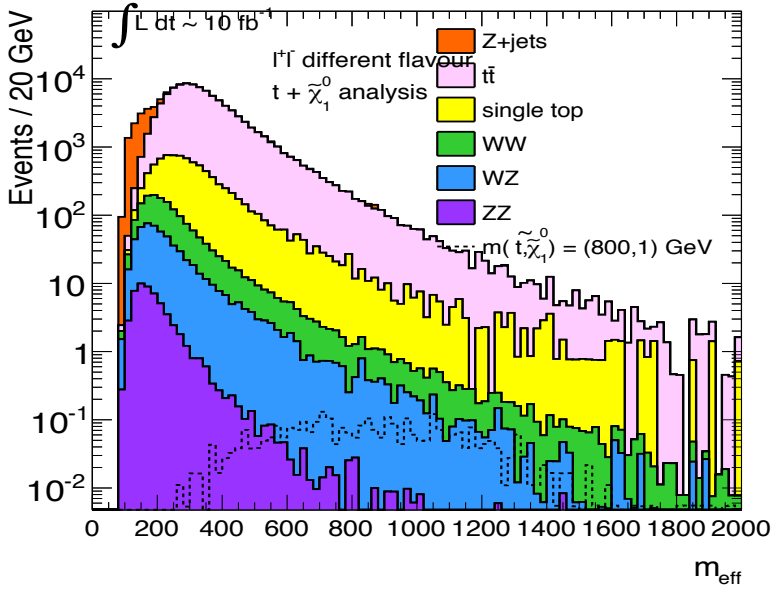


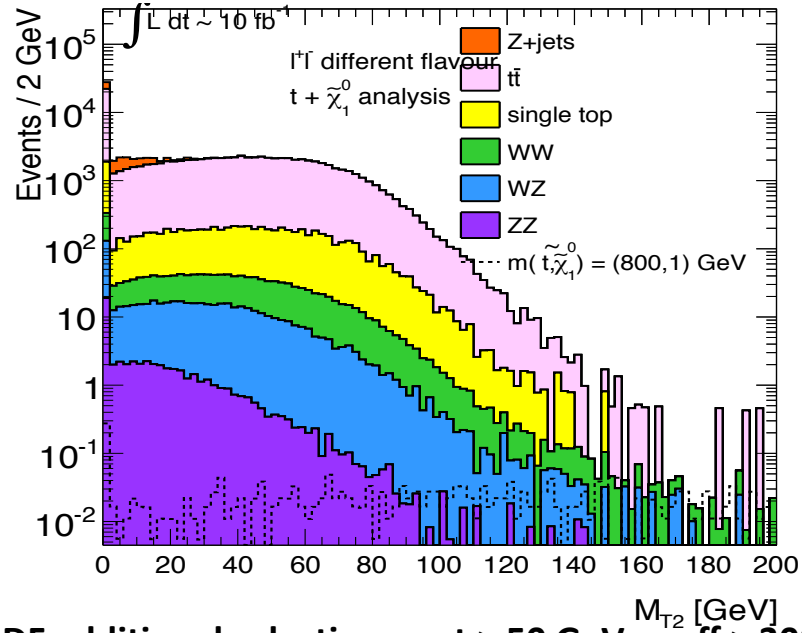
13 TeV: $\tilde{t} \rightarrow t + \chi_1^0$ Analysis

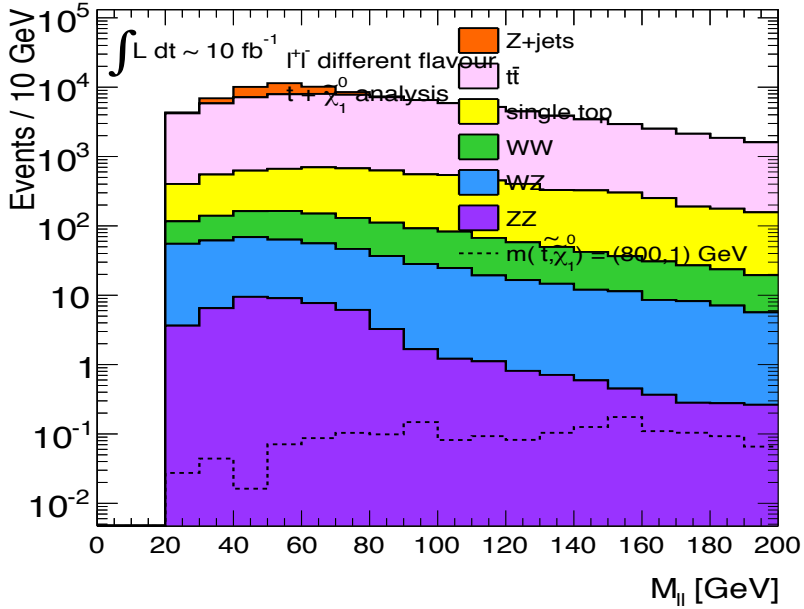
- First look to a set of variables to understand: background normalization, signal/background comparison, possible SR definition
- Selection:
  - 2 OS IsSignal leptons (mediumLLH + GradientLoose Iso.),
  - P_T leading lepton > 25 GeV,
  - at least 2 jets > 20 GeV,
  - m_{ll} > 20 GeV
- Background: ttbar,Wt, Dibosons, Z+jets
- Signal: M_{stop}= (600,700,800,900,1000) GeV $M_{neutralino}$= 1 GeV

Plots









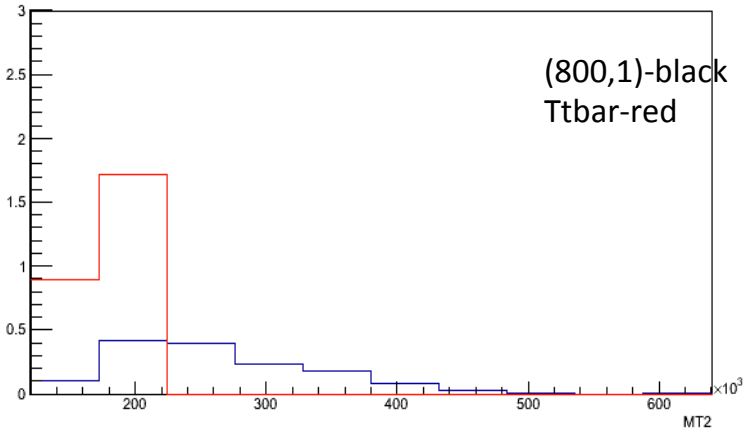
DF additional selection: met > 50 GeV, meff > 300 GeV-> 3.25 total sig. ev. (800,1)!

SF additional selection: met > 50 GeV, meff > 300 GeV, Z veto in [71,111] -> 2.95 total sig. ev.(800,1)!

SR Cut&Count (mT2)

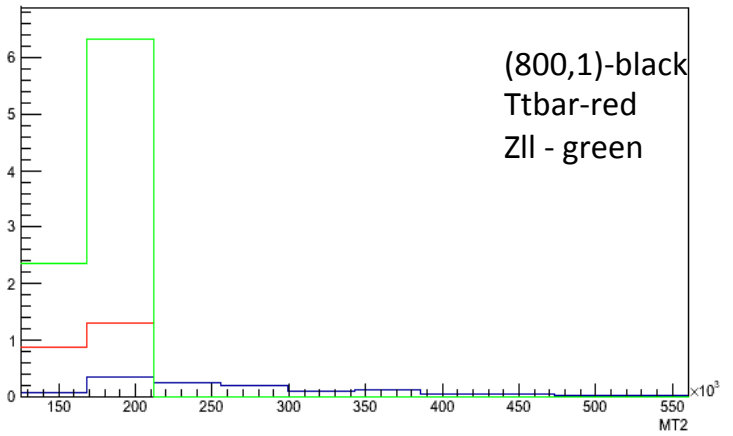
- DF SR-> mT2 > 160 GeV (no optimization):
  - (stop,neutralino)=(800,1) -> 1.45 ev
  - ttbar-> 2.65 ev
  - Wt -> 0.7 ev
  - WW -> 0.4 ev
  - WZ -> 0.2 ev
  - ZZ -> 0.
  - Zll -> 0.
  - Total expected background -> 3.95 ev

DF MT2 > 160 GeV



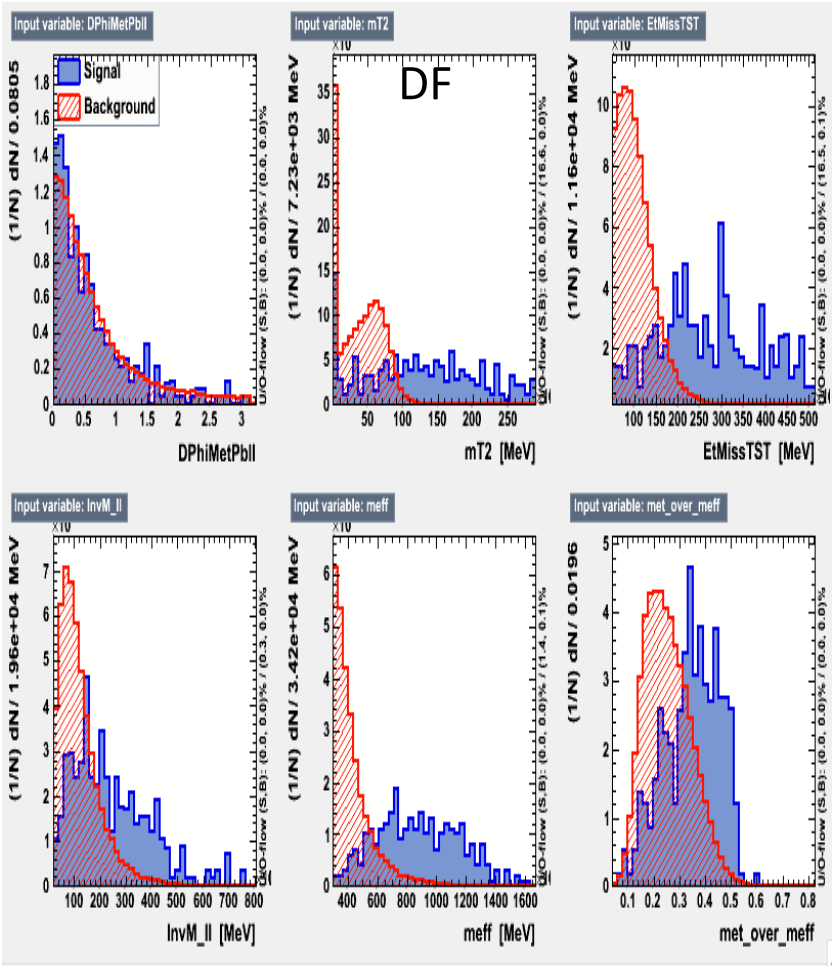
- SF SR-> mT2 > 160 GeV (no optimization):
  - (stop,neutralino)=(800,1) -> 1.16 ev
  - ttbar-> 2.17 ev
  - Wt -> 0.7 ev
  - WW -> 0.22 ev
  - WZ -> 2.28 ev
  - ZZ -> 1.28
  - Zll -> 8.7
  - Total expected background -> 15.35 ev

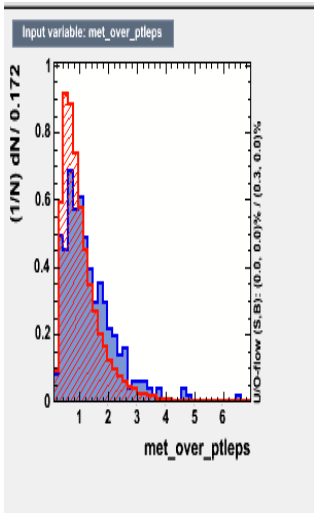
SF MT2 > 160 GeV

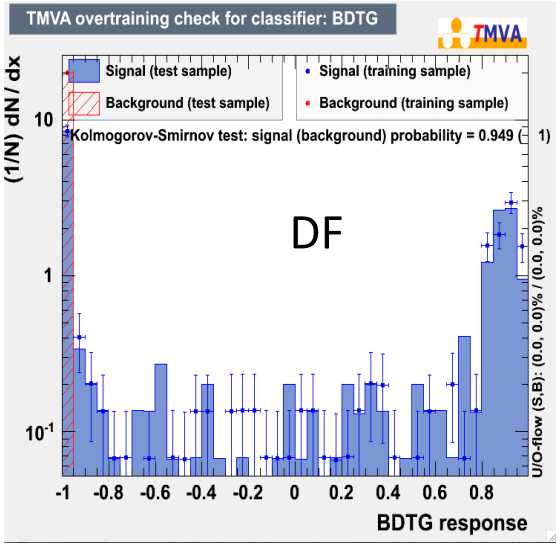


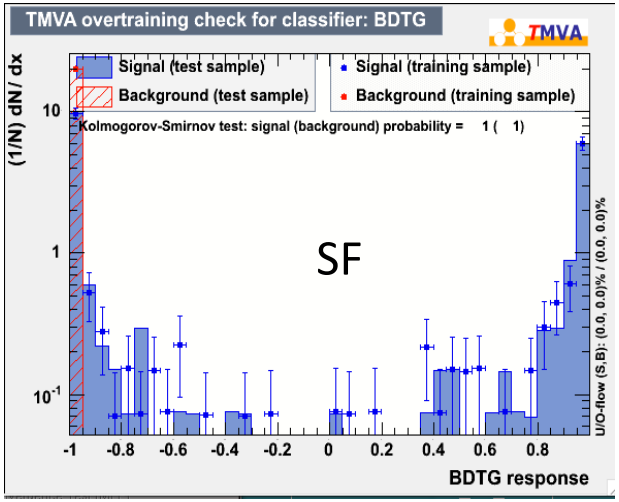
TMVA (BDTG)

- Training DF,SF (stop,neutralino)=(800,1) against only ttbar, 7 variables: mT2,mll,met,meff,met/meff,met/(ptlep1+ptlep2), $\Delta\Phi$(met-pbll) and no special optimization, no overtraining









SR TMVA (BDTG)

- DF SR-> BDTG > 0.5:
  - (stop,neutralino)=(600,1) -> 5.37 ev
  - (stop,neutralino)=(700,1) -> 3.09 ev
  - (stop,neutralino)=(800,1) -> 1.39 ev
  - (stop,neutralino)=(900,1) -> 0.70 ev
  - (stop,neutralino)=(1000,1) -> 0.27 ev

  - ttbar-> 0 ev
  - Wt -> 0.7 ev
  - WW -> 0.2 ev
  - WZ -> 0.1 ev
  - ZZ -> 0 ev
  - Zll -> 0 ev
  - Total expected background -> 1.00 ev

- SF SR-> BDTG > 0.5:
  - (stop,neutralino)=(600,1) -> 5.79 ev
  - (stop,neutralino)=(700,1) -> 2.55 ev
  - (stop,neutralino)=(800,1) -> 1.15 ev
  - (stop,neutralino)=(900,1) -> 0.72 ev
  - (stop,neutralino)=(1000,1) -> 0.37 ev

  - ttbar-> 0.4 ev
  - Wt -> 0. ev
  - WW -> 0.1 ev
  - WZ -> 0.77 ev
  - ZZ -> 0.43 ev
  - Zll -> 0 ev
  - Total expected background -> 1.73 ev

SUSY Notes, Papers, Talks etc.

NOTES and PAPERS:

- ATL-COM-PHYS-2014-754:
  Search for a scalar top in final states with two leptons and intermediate values of m_T2
  M. I. Besana et al.

- ATL-COM-DAQ-2013-147 (TRIG-2012-03) - published on Eur. Phys. J. C 75 (2015) 120:
  Performance of the ATLAS muon trigger in pp collisions at sqrt(s) = 8 TeV
  J. Almond et al. Among editors: M. Primavera, A. Ventura

- ATL-COM-PHYS-2015-325:
  Search for top squark pair production in final states with two leptons
  M.Aliev, P.Dondero, E.Gorini, T.Lari, L.Longo, F.Meloni, C.Merlassino, G.Polesello, M.Primavera, M. Reale, M.Rimoldi, M.E.Stramaglia, A.Ventura, M.Weber

- ATL-COM-PHYS-2015-643:
  Search for a heavy top partner decaying in $b+\tilde{\chi}^{\pm}$ in final states with two leptons using a multivariate analysis technique
  Malik Aliev, Maria Ilaria Besana, Michele Bianco, Smita Darmora, Paolo Dondero, Andrea Favareto, Gabriella Gaudio, Mario Paolo Giordani, Edoardo Gorini, Tommaso Lari, Luigi Longo, Federico Meloni, Giacomo Polesello, Margherita Primavera, Marilea Reale, Giulio Usai, Andrea Ventura

- ATL-COM-PHYS-2015-102 (SUSY-2014-07) - to be submitted to Eur. Phys. J. C:
  Summary of the ATLAS Run-I searches for direct pair production of third generation squarks at the Large Hadron Collider
  J. Abdallah et al.

TALKS@International Conferences:

Third generation squarks searches (Quy-Nhon2014) - A. Ventura (ATL-COM-PHYS-2014-896)
Natural SUSY searches in ATLAS and CMS (Naturalness2014, Weizmann institute, Israel) – M. Primavera

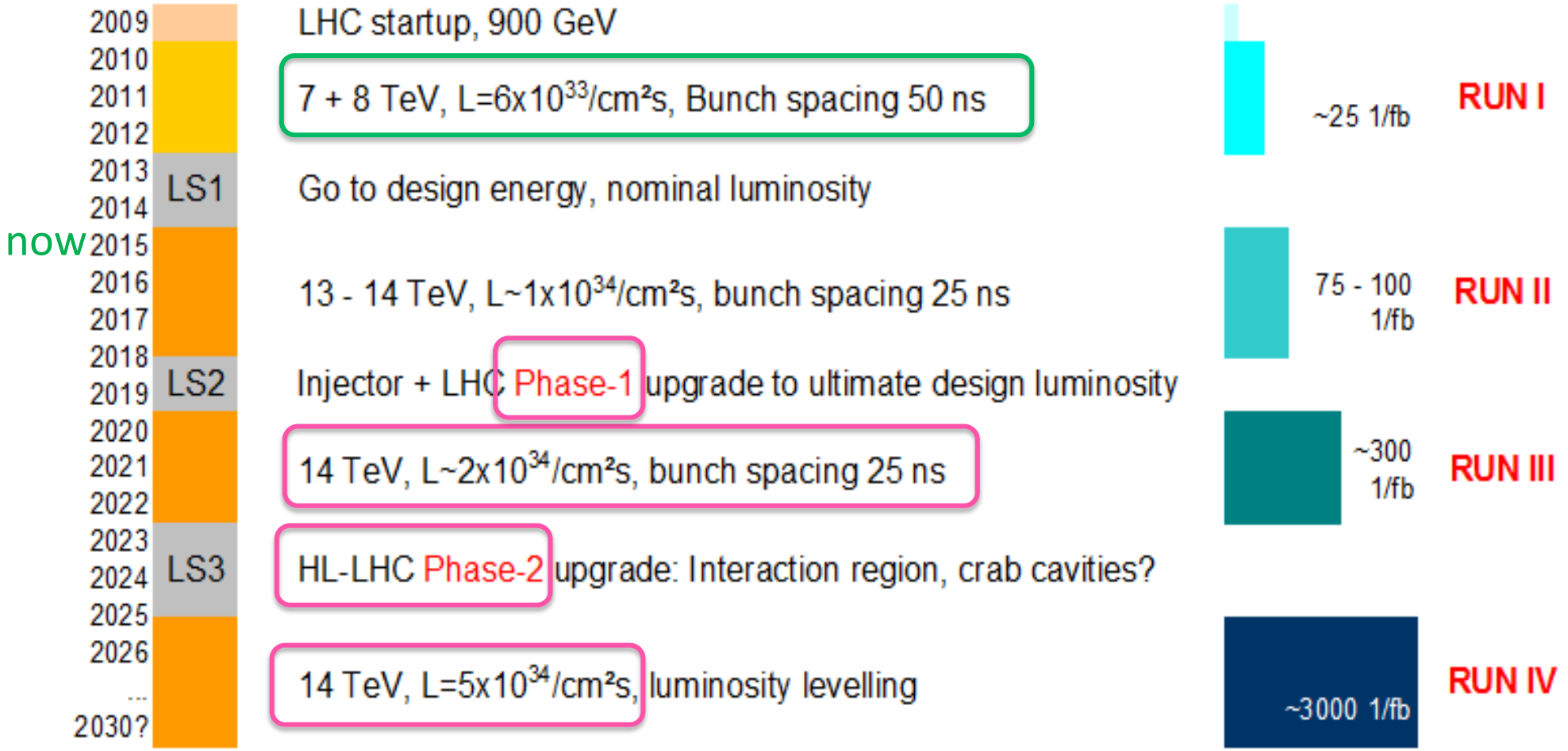
Committees

M. Primavera: membro della commissione giudicatrice per il conseguimento del Ph.D. della Dott.ssa S. Darmora,"Search for a supersymmetric partner to the top quark using a multivariate analysis technique", Università di Arlington, Texas, dissertazione del 05/05/2015

Studenti

- Tesi Triennale
  - Isabella Oceano: Simulazione di un rivelatore di particelle di tipo MicroMeGaS, 14/4/15 (Primavera/Gorini)
  - Pierpaolo Savina: Ottimizzazione dell'analisi dati per la ricerca del decadimento del mesone B_s in due muoni di segno opposto all'esperimento ATLAS al CERN, 14/4/15 (Gorini)
- Tesi Magistrale
  - Annalisa De Lorenzis: *Ricerca della produzione diretta di squark top con tecniche di analisi multivariata*, 29/4/14 (Gorini/ Primavera)
  - Luigi Longo: *Limiti sulle masse dello squark top e della particella supersimmetrica più leggera in processi con due leptoni nello stato finale all'esperimento ATLAS a LHC*, 29/4/14 (Primavera/Gorini)
  - Marilea Reale: *Studio di decadimenti di partner supersimmetrici del quark top con stati finali a due leptoni attraverso tecniche di analisi multivariata con l'esperimento ATLAS* , 23/7/14) (Ventura/Gorini)
- Dottorato
  - Nicola Orlando: *The associated production of a Z gauge boson and b-jets at LHC with the ATLAS experiment: first differential cross section measurements* (Spagnolo/Chiodini)
- CERN Summer Student (2014), Reference Letter
  - Stefano Marinaci: Ingegneria, con Gerardo Ganis (PROOF il Parallel Computing di ROOT)
- Progetto MIUR Messaggeri della Conoscenza (luglio-agosto 2014 al CERN, Micromegas, Analisi dati decadimenti rari)
  - Francesco Gravili: Simulazione Micromegas su Geant4 (Tutor A.Dell'Acqua)
  - Rosaria Nesca: Micromegas Mesh Stretching (Tutor P.Iengo)
  - Isabella Oceano: Micromegas Simulation (Tutor M.Iodice)
  - Pierpaolo Savina: Analisi dati B_s in mu mu con Roofit e Roostat (Tutor S.Palestini)
- Technical Student, Reference Letter
  - Gianluigi D'Alessandro: marzo-dicembre 2014, Gruppo Magneti Superconduttori
- Laureandi Triennale:
  - Maria Pia Malagnino: Micromegas
- Laureandi Magistrale:
  - Alessandro Mirto (SUSY), Laurea prevista Ottobre 2015
  - Francesco Gravili (SUSY/Trigger/MM?), Laurea prevista Aprile 2016

LHC and ATLAS Upgrade Roadmap



ATLAS:

- Phase-0 Upgrade: *Consolidation + Insertable B-Layer (IBL) in LS1*
- Phase-1 Upgrade: ***New Small Wheels***, *LAR Calo + TDAQ upgrade, Fast Track Trig.*
- Phase-2 Upgrade: *New Inner Tracker*