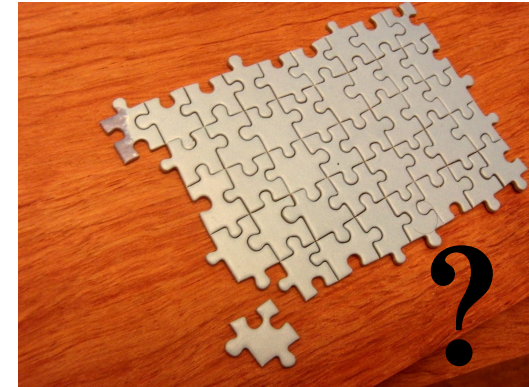
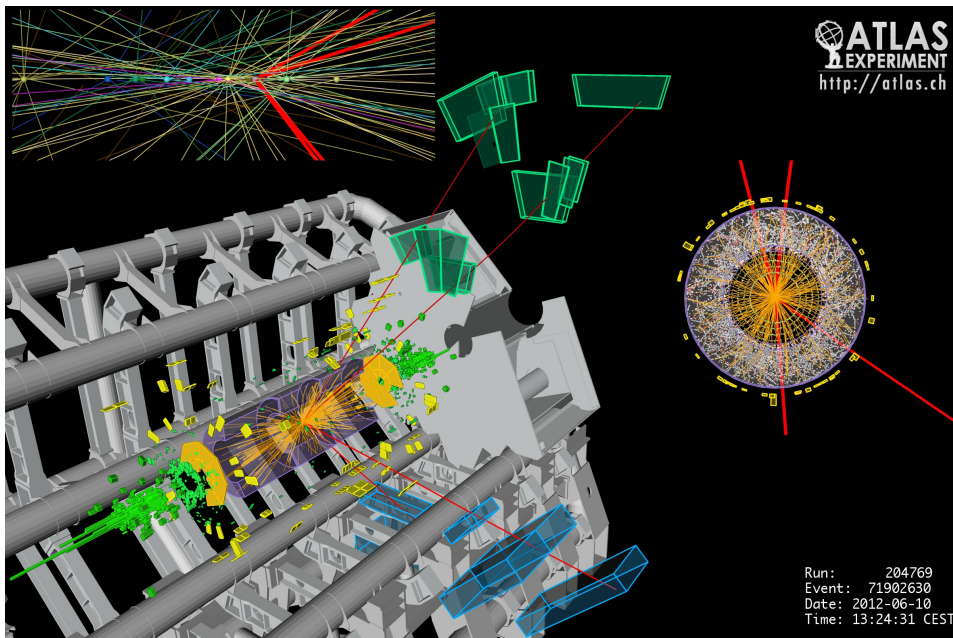




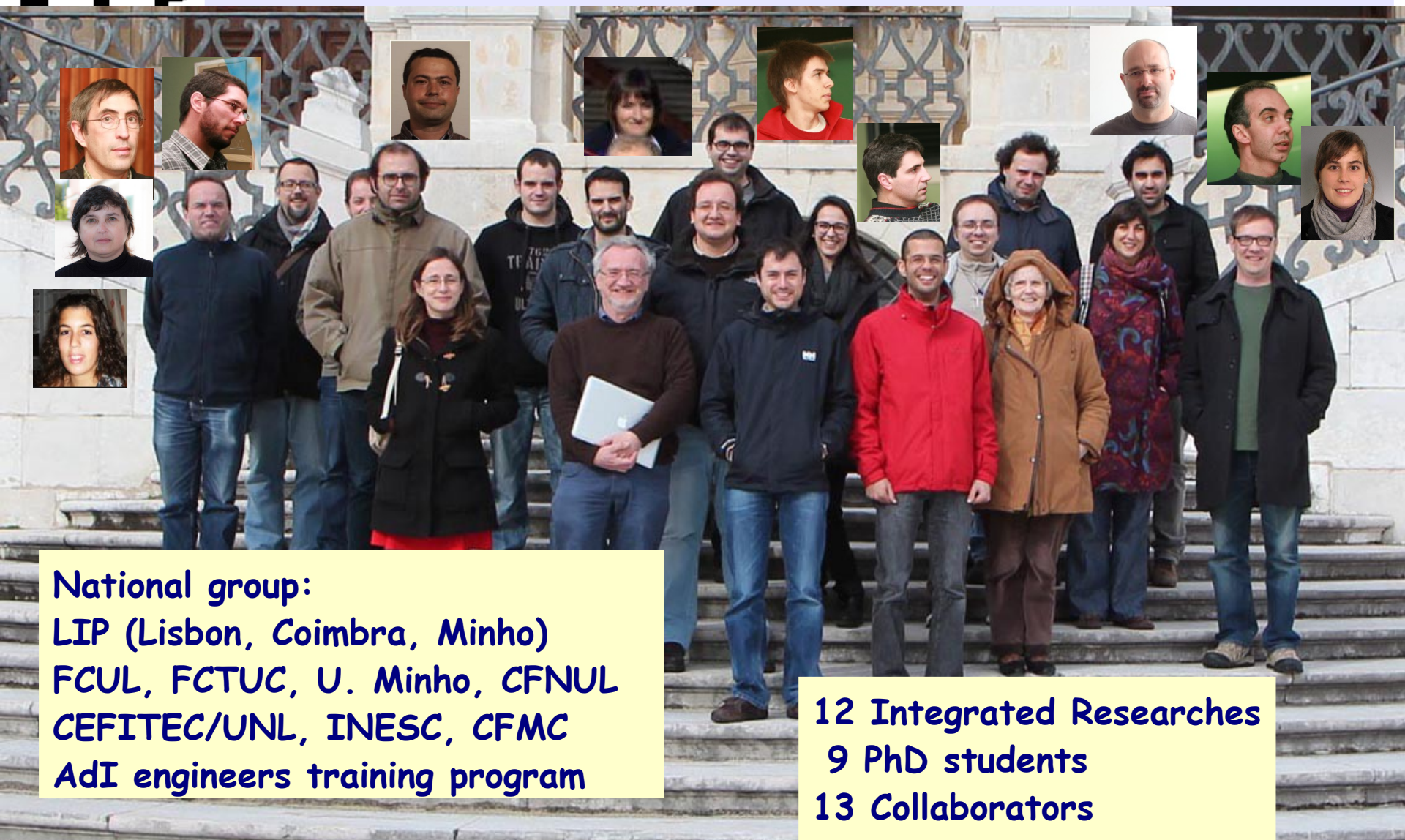
ATLAS Overview



Patricia Conde Muíño
(on behalf of the ATLAS-Portuguese team)



The Portuguese ATLAS Team



National group:

LIP (Lisbon, Coimbra, Minho)
 FCUL, FCTUC, U. Minho, CFNUL
 CEFITEC/UNL, INESC, CFMC
 AdI engineers training program

12 Integrated Researches
 9 PhD students
 13 Collaborators

Physics Activities

Organized in subgroups lead by a senior member

Higgs Boson Physics

P. Conde,
R. Gonalo

Top Quark Physics

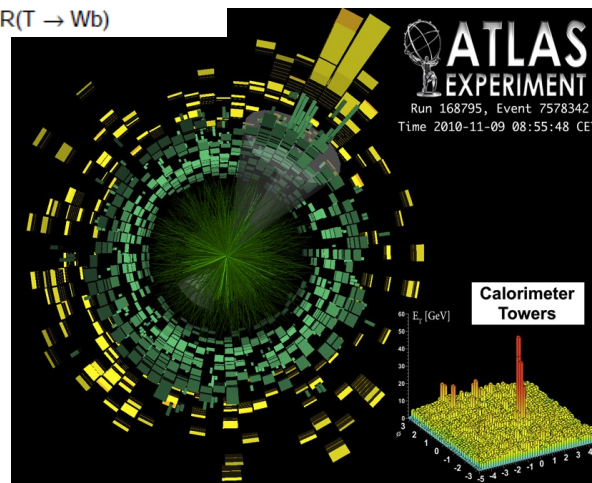
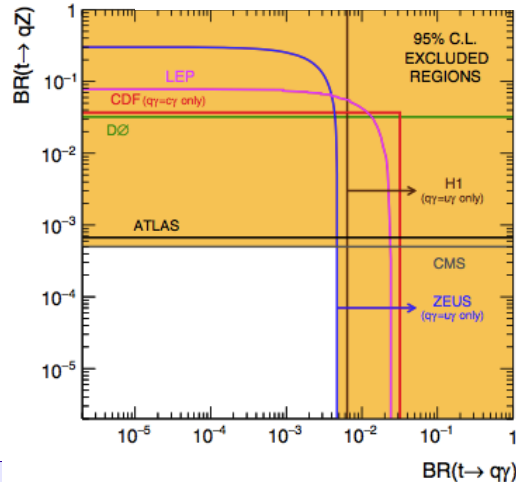
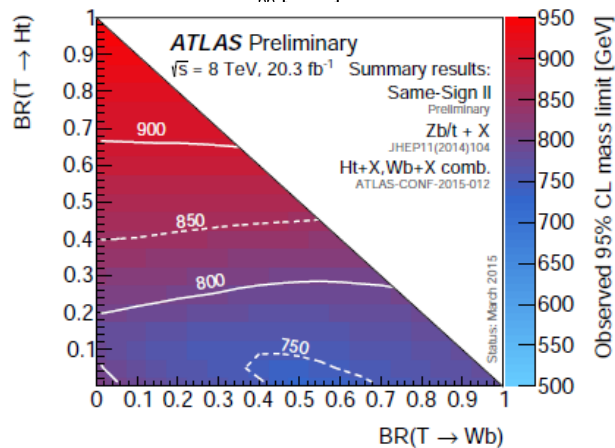
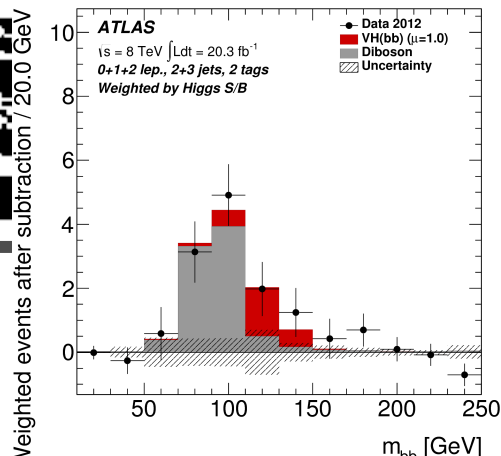
A. Onofre
F. Veloso

Exotics Physics Searches

N. Castro

Heavy Ions Physics

H. Santos



Coordination positions @ ATLAS in 2015:

- Heavy Quarks, Top and Composite Higgs Exotics subgroup convener (N. Castro)
- VLQ Run 2 and theory contact person (N. Castro)

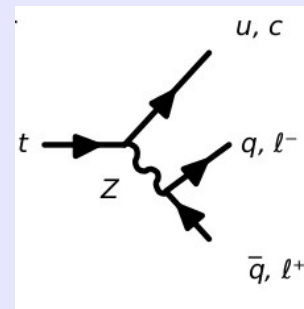
Higgs Boson Physics

P. Conde, R. Gonalo

- Couplings of the Higgs to quarks
 - $H \rightarrow b\bar{b}$ and $t\bar{t}H$
 - Spin, CP properties in $Hb\bar{b}$, $t\bar{t}H$, WWH vertices
- $t\bar{t}H$
 - Angular observables to discriminate from $t\bar{t}b\bar{b}$ background
- ZH/WH ($H \rightarrow b\bar{b}$)
 - Combine MVA & boosted tagging
 - Angular variables to study Spin/CP

Top Quark Physics

A. Onofre, F. Veloso

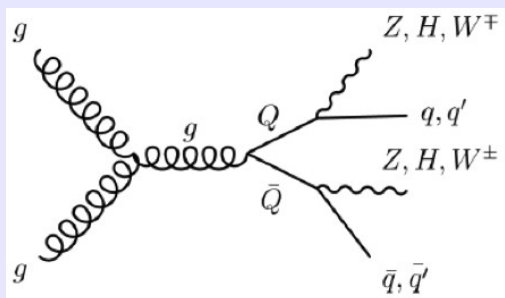


Rare top quark decays

- Precision measurements of the top quark properties and new physics searches
- Measurement $BR(t \rightarrow Ws)$
 - Develop s-tagging algorithm
- FCNC in top quark decays ($t \rightarrow Zq$)

Exotics Physics Searches

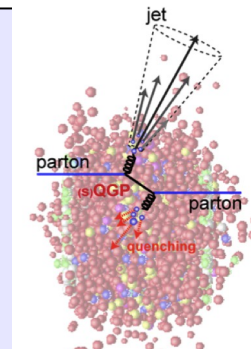
N. Castro



- Vector-like quarks
 - Predicted in many SM extensions
- Leading the $Zt/b+X$ topology analysis
- Search for single T fully hadronic decays
- Search for tZ production via FCNC

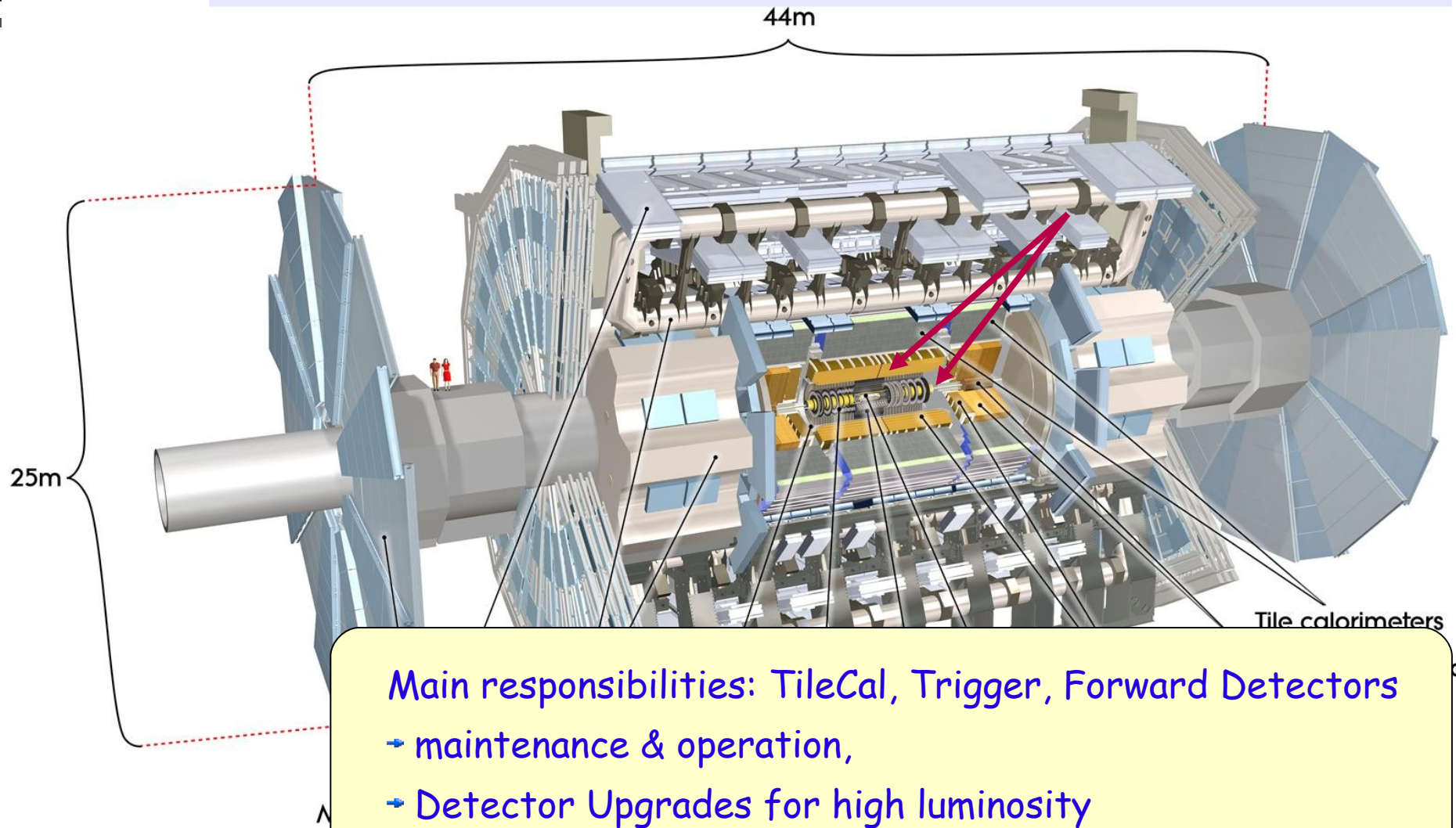
Heavy Ions Physics

H. Santos



- Study the quark-gluon plasma with jets as probes
- Disentangle the energy loss mechanism: radiative?, collisional?
 - Di-jet asymmetries for heavy quarks (b-jets)
- B-tagging performance in HI collisions
- Monitoring and data quality

Detector Responsibilities



TileCal and Forward Detectors

TileCal Maintenance, operations

A. Gomes, A. Maio

- DCS: development, maintenance and continuous upgrade
 - TileCal DCS Coordinator (F. Martins)
- Laser II PMT calibration & stability
- Noise studies

Forward Detectors

A. Maio, P. Conde

- ALFA DCS: cooling & vacuum controls
- Test beam participation
- Software triggers

TileCal Upgrade

A. Gomes, A. Maio

- Phase I
 - Gap/crack scintillator, WLS fibres and optical couplings
- Phase II: HV distribution boards
 - Two different options: on-detector/remote systems
 - Design and construction of a remote prototype for test beam

Trigger and distributed computing

Jets High Level Trigger

R. Gonalo, P. Conde

- Run 2:
 - ATLAS Jet Trigger coordinator (2014-15): R. Gonalo
 - Operations reorganization, menu
 - Partial scan implementation
- Upgrade Phase I
 - Test GPUs for trigger speed up
 - Development of a calorimeter demonstrator prototype:
 - Topological Automaton Clustering
 - Important also for Phase II (L1 or HLT)

Tile-Muon trigger

J. Gentil

- Links TileCal and Trigger activities
- Software and performance
- Study extension to the barrel for Phase II Upgrade

Distributed computing

H. Wolters

- Iberian cloud coordination
- Portuguese Tier 2 infrastructure
- Monitoring tools and shift coordination

Backup

For Run II (2015 and beyond)

➤ Explore sensitivity to spin and CP properties

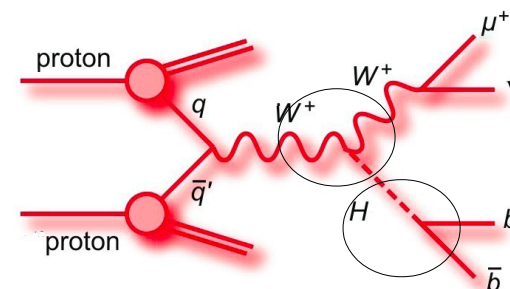
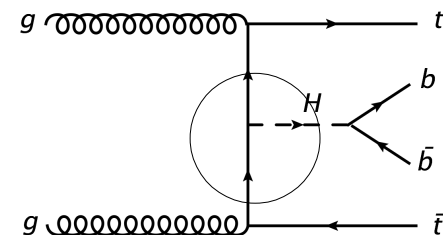
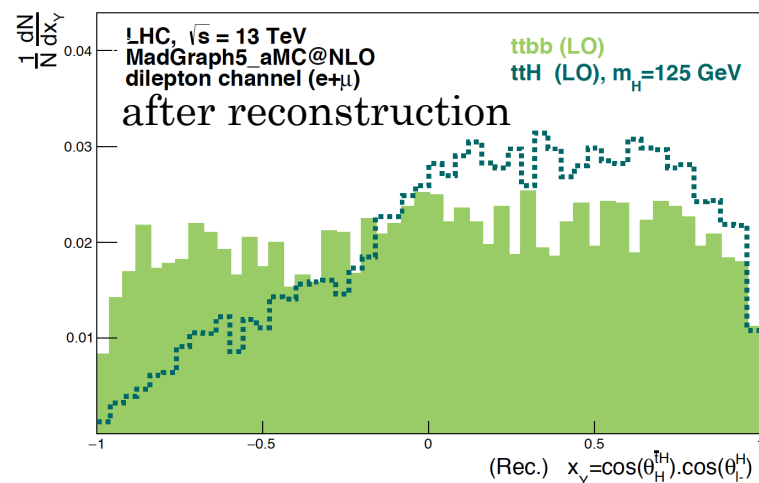
Couplings ttH , bbH , WWH

Use angular variables to
discriminate Spin/CP components

ttH

Angular observables to discriminate
from $ttbb$ background

ArXiv:1503.07787, submitted to JHEP



HV ($H \rightarrow b\bar{b}$)

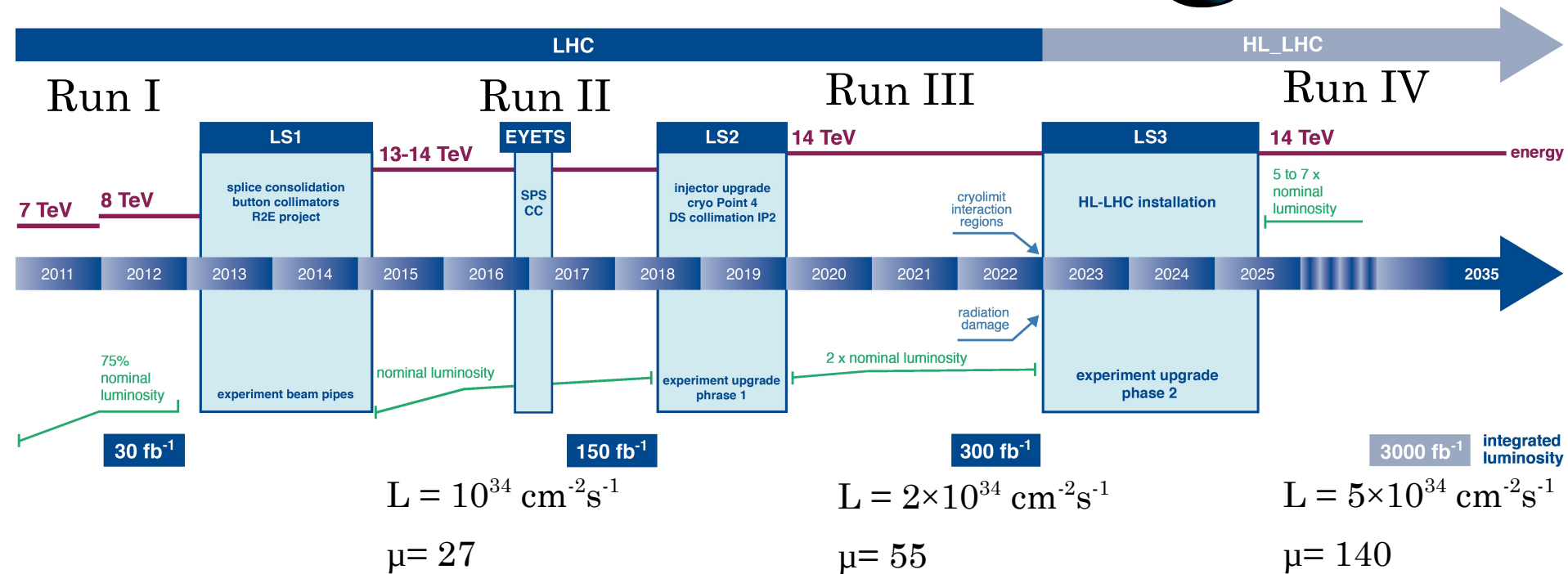
Boosted topologies more sensitive

Combine MVA and boosted Hbb
tagging

Continue m_{bb} studies

LHC Upgrade Schedule

LHC / HL-LHC Plan



ATLAS Detector Upgrades

LS1 → PHASE 0

$\mathcal{L} = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ $\langle \mu \rangle = 24$
100 fb⁻¹ (2014-2017)

- 4th Pixel Detector Layer (IBL)
- Pixel Detector improvements
- Topological L1 triggers
- Silicon tracker cooling system replacement
- Muon Endcap Extension chambers completion



- Tile laser system
- Tile-muon L1 trigger
- Tile DCS

LS2 → PHASE 1

$\mathcal{L} = 2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ $\langle \mu \rangle = 50$
350 fb⁻¹ (2019-2021)

- New Muon Small Wheel detector
- Upgrade of the central L1 trigger processor
- L1 Calo granularity increase



- AFP detector
- HLT jet trigger
- Tile gap/crack scintillators
- Tile DCS

LS3 → PHASE 2

$\mathcal{L} = 5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ $\langle \mu \rangle = 140$
3000 fb⁻¹ (2023-2030)

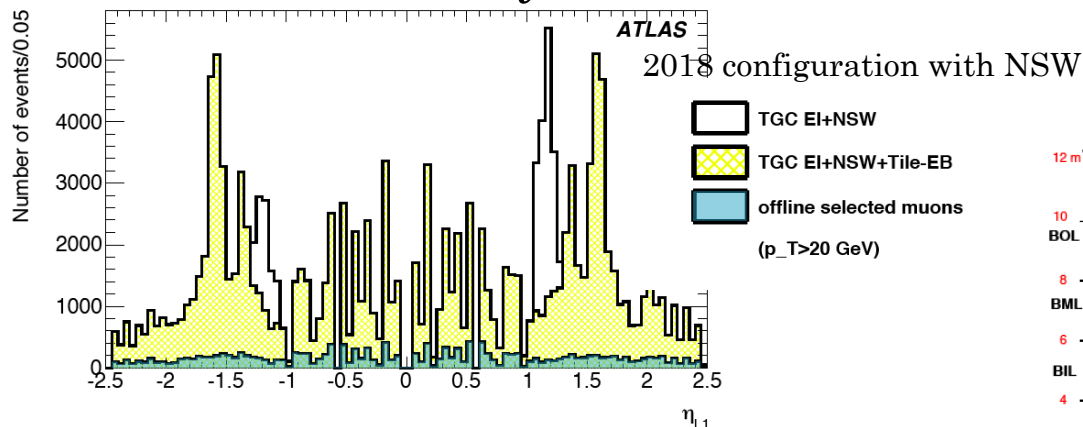
- New “All Silicon” tracker
- L0-L1 trigger separation
- Track info at L1
- Upgrade of the calorimeter readout
- Upgrade of the muon spectrometer



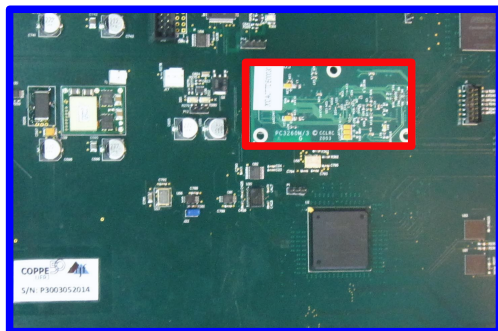
- Tile HV distributor system
- Tile DCS

L1 Tile-Mu Trigger

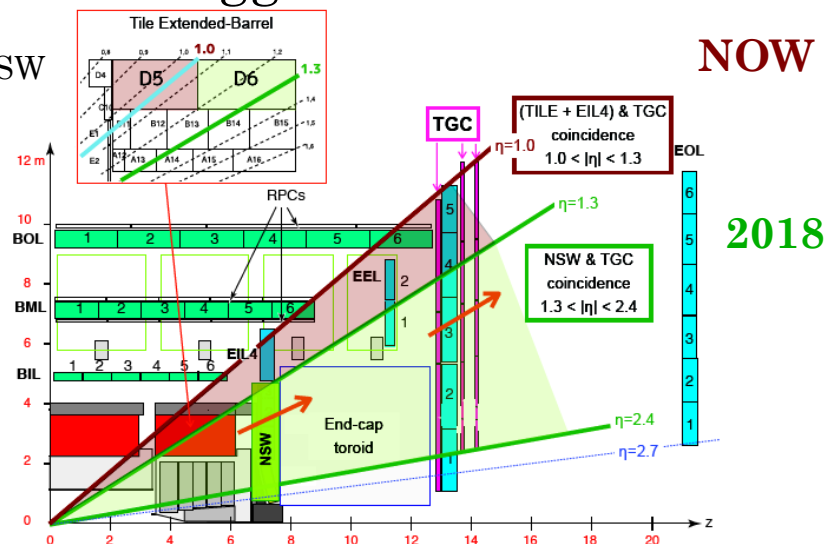
Use TileCal 3rd layer to reduce fake muon triggers



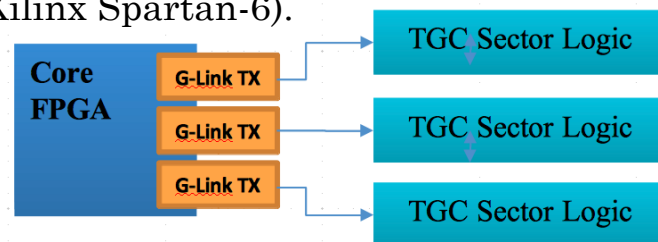
NEW hardware being installed at the ATLAS back-end: **TMDB board**, **TTC decoder mezzanine boards**



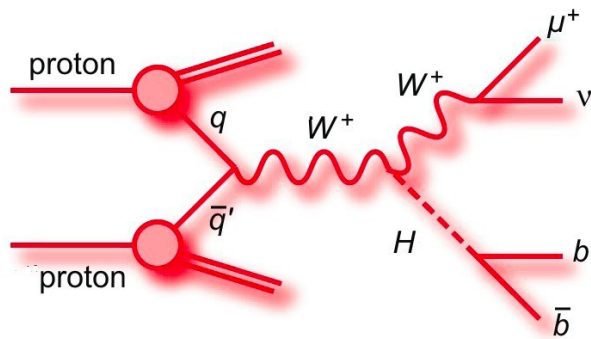
- ✓ Production of 38 TTCdec boards at HFA in Portugal (28 Tile-Mu Trigger+10 L1Calo).



- ✓ Implementation and test of G-Link TX (TMDB-SL), emulated on TMDB Core FPGA (Xilinx Spartan-6).



- ✓ Emulator of the TMDB board response.
- ✓ Bytestream converters.



VH (H→bb) analysis

➤ Constrain Γ_H and probe coupling to b-quark

➤ Contributed to WH, ZH search

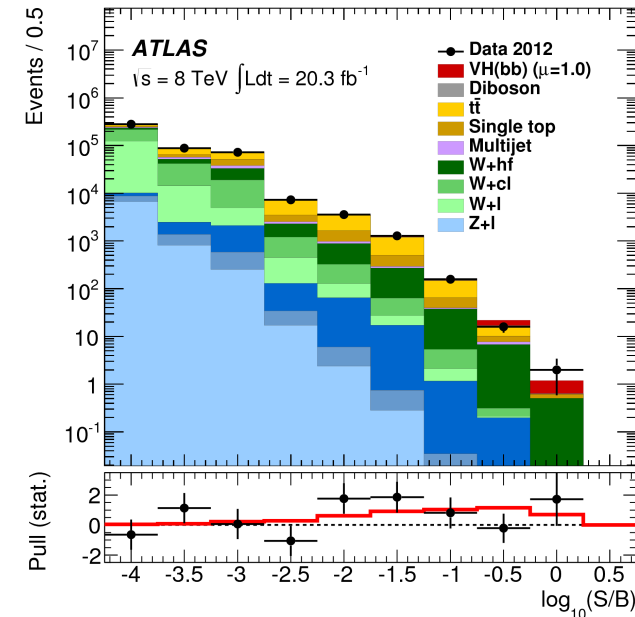
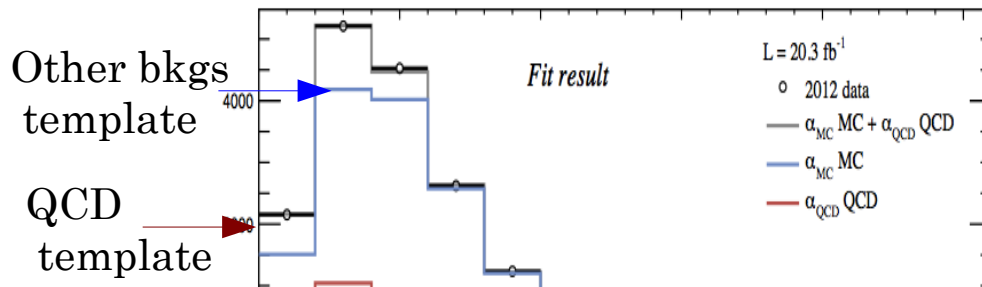
m_{bb} resolution improvement

QCD background estimation

systematic studies, MVA analysis,

global fits

Example: QCD extraction



Strong contribution to Run-I publication:

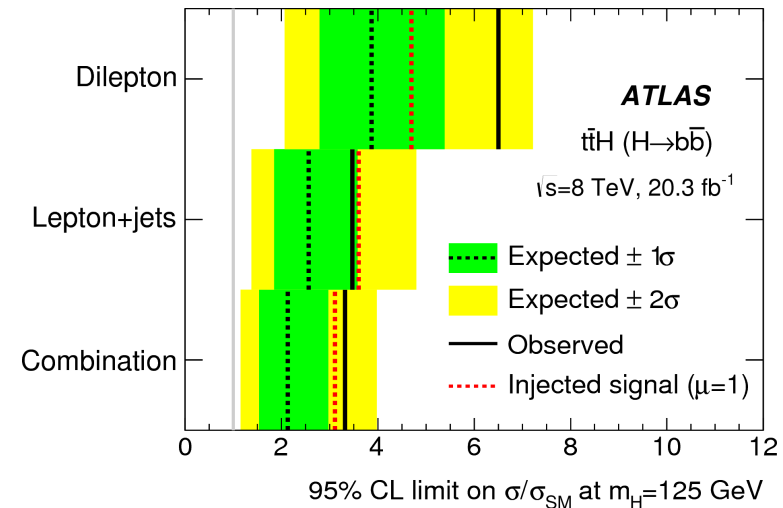
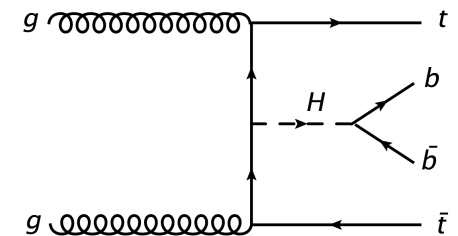
JHEP01(2015)069

Combined fit signal strength:

$$\mu = 0.52 \pm 0.32 \text{ (stat.)} \pm 0.24 \text{ (syst.)}$$

Higgs boson studies in $t\bar{t}H$ channel

- Direct access to top Yukawa coupling
- Latest ATLAS results:
 - $2 \times \sigma_{SM}$ sensitivity, consistent with SM signal
- Main contributions:
 - Dilepton channel: $H \rightarrow b\bar{b}$, $t/\bar{t} \rightarrow (e/\mu)\nu$
 - Data-driven studies of Z+jets background
- FCT-funded exploratory project
 - Explore improvements for Run 2
 - Local expertise in Higgs and top physics



ATLAS Distributed Computing

- Coordination of Iberian Cloud operations in ATLAS:

 - One of the 11 Regions in ATLAS Distributed Computing

 - Tier1 at PIC in Barcelona

 - Tier2: Spain, Portugal, Chile (since 2013), Argentina (setup in 2015)

 - ~5% of all ATLAS production and analysis

- Infrastructure of the Portuguese Tier2

 - Now installed at NCG centre (Lisbon) to optimize resources/ manpower

- Collaboration and development for global ADC operations:

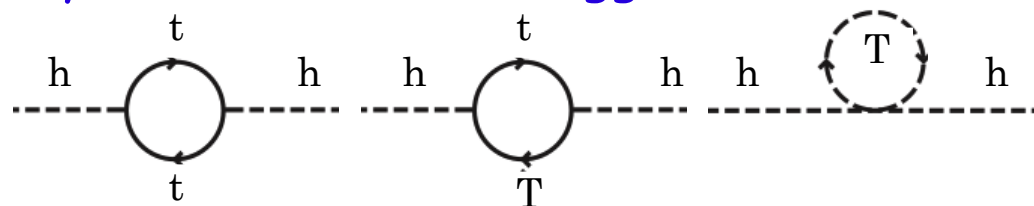
 - Monitoring Tools (ATLAS Site Status Board)

 - Computing shift organization for Run2

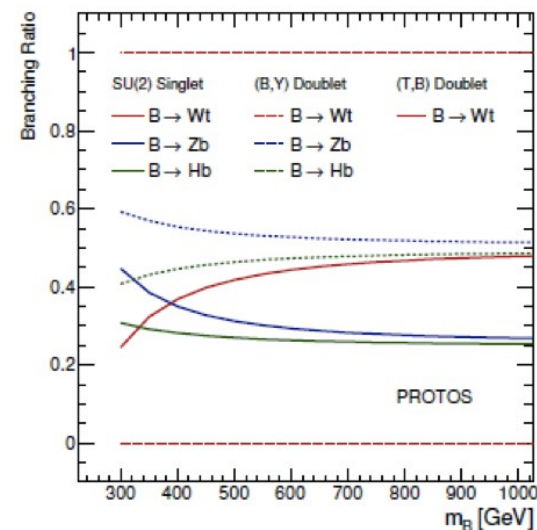
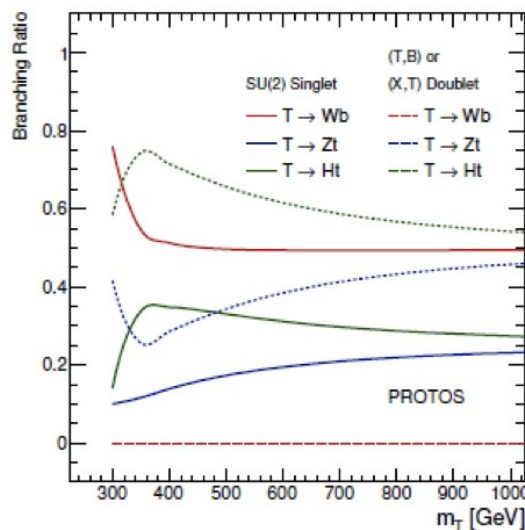
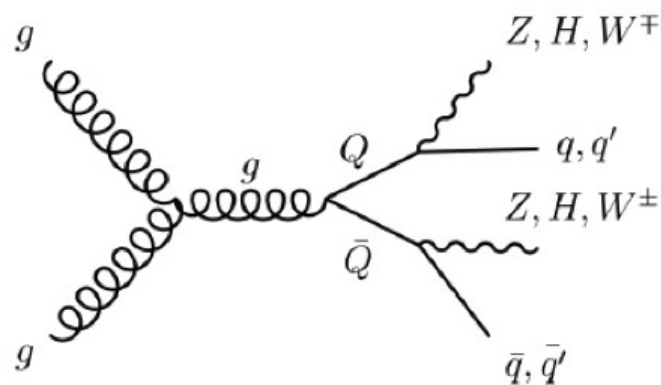
Vector-like quarks

- Vector-like quarks appear in many models to cancel Higgs mass divergencies

Little Higgs, extra-dimensions

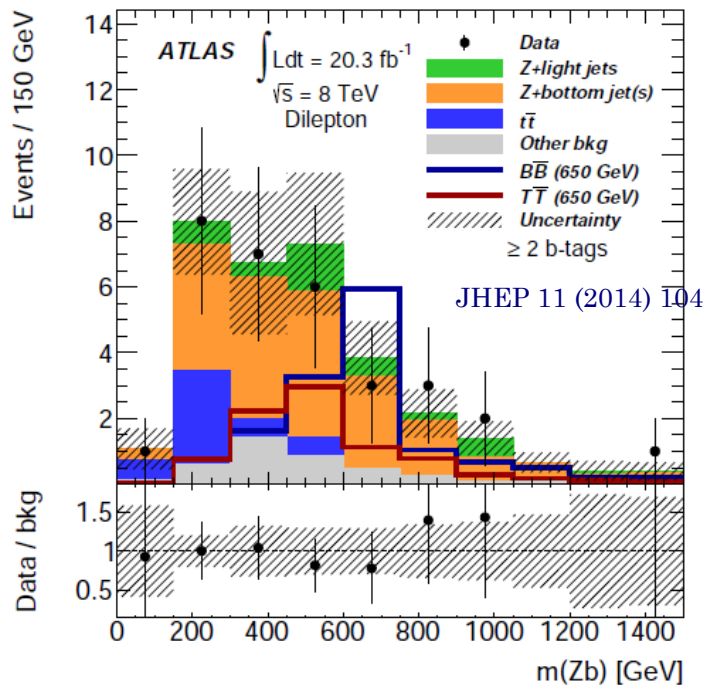


Left- & right-handed chiralities transform in the same way under $SU(2) \times U(1)$

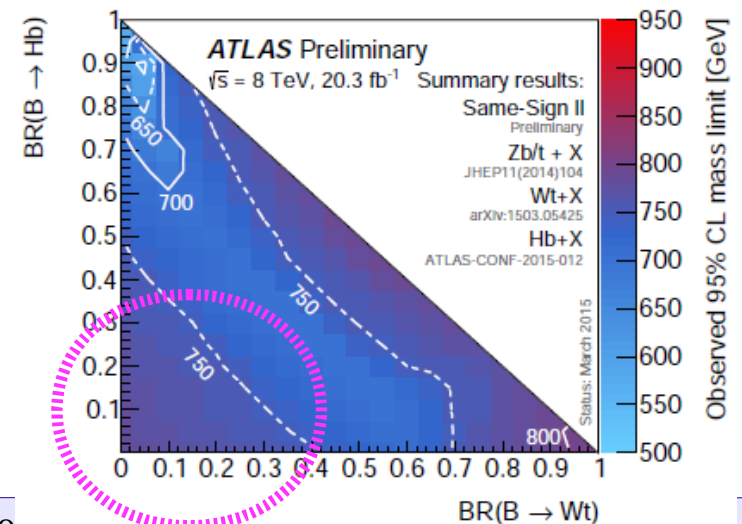
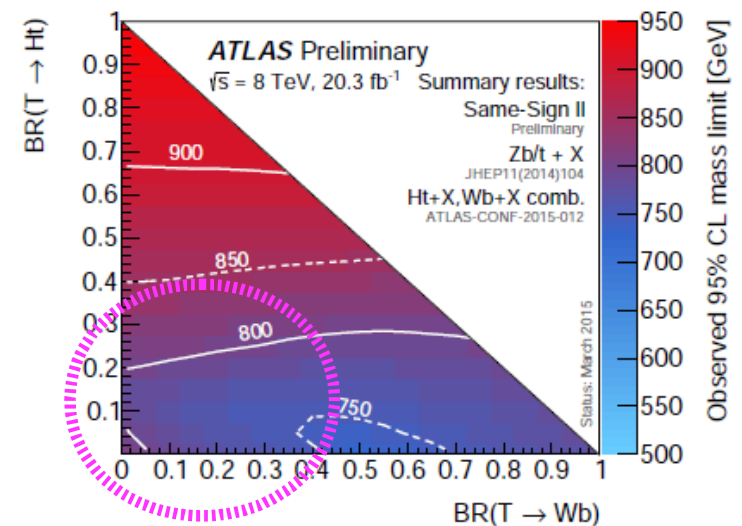


Search for vector-like quarks

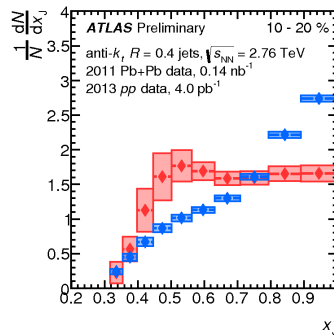
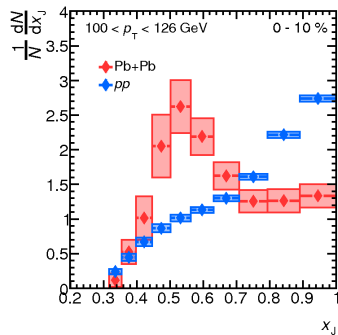
- $Zb/t + X$: at least one of the vector-like quarks decaying to a Z boson



- LIP has a leading role in the Z -tag dilepton analysis targeting one of the corners of the BR plane
- World most stringent limits obtained



Heavy Ions: probing the QGP with jets



$$x_J = p_T^{\text{SLJ}} / p_T^{\text{LJ}}$$

➤ Run I: di-jet asymmetry

➤ For Run II:

b-jets asymmetry study to probe the nature of the energy loss in the QGP performance tools and monitoring

