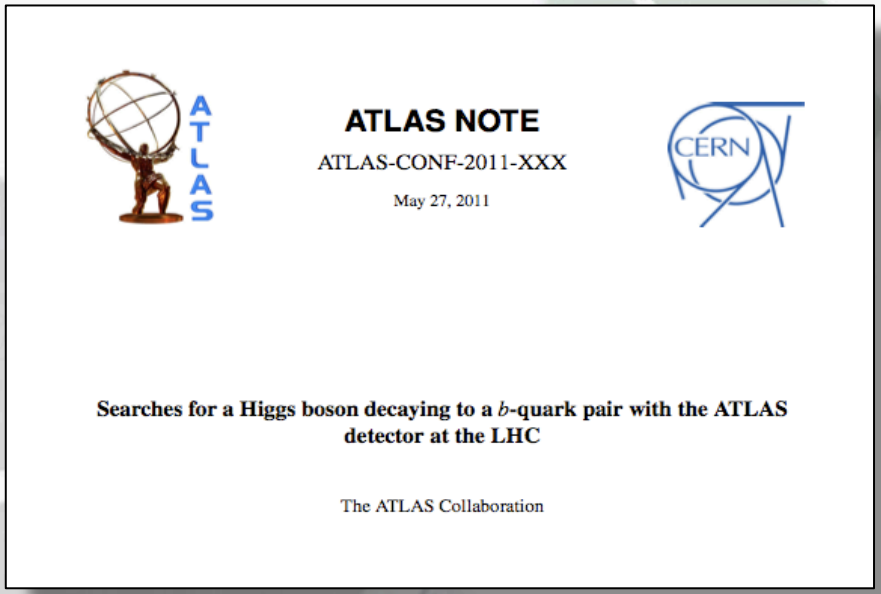
H->bb Note Plans for Summer

Ricardo Gonçalo (RHUL) on behalf of the HSG5 H->bb group

Higgs Working Group Meeting, 9 June 2011

H->bb CONF note plans

- ATL_COM_PHYS_2010_929
- CONF note for EPS
- First H->bb results from ATLAS with real data
- WH and ZH un-boosted channels only, for now
- Expect exclusion limits for WH and ZH in low Higgs mass range
- If all goes well…



ATLAS NOTE

ATLAS-CONF-2011-XXX

May 27, 2011

Searches for a Higgs boson decaying to a *b*-quark pair with the ATLAS detector at the LHC

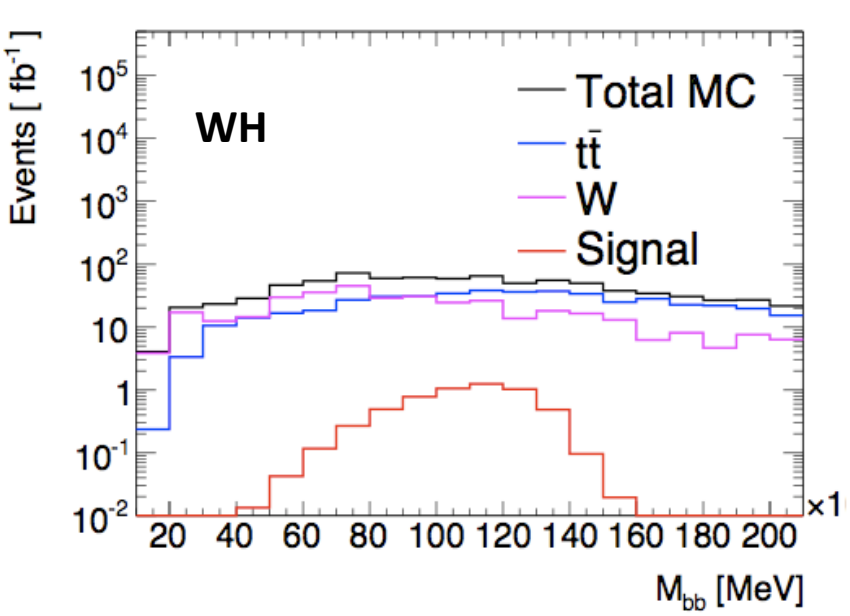
The ATLAS Collaboration

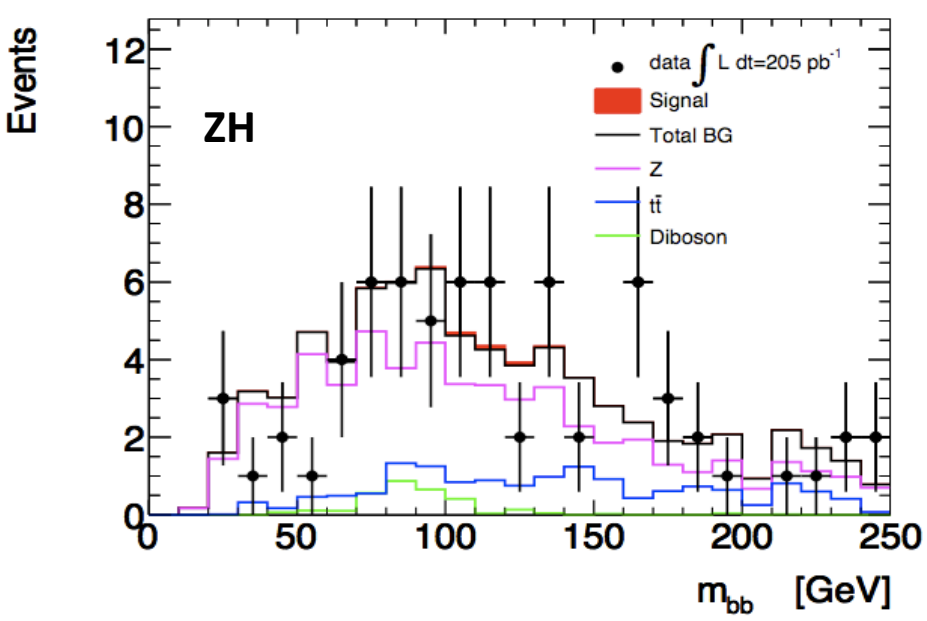
Editors:
Patricia Conde Muino
Andrew Mehta
Paul Thompson

1. Introduction
2. Data and MC samples
3. Object selection
4. Event selection
5. WH analysis
6. ZH analysis
7. Systematic uncertainties
8. Results
9. Summary

Results so far

- **Before systematic** uncertainties…
- WH: reject around 7x the SM at 95% CL with 1 fb^{-1}
- ZH: reject 12x the SM with 1 fb^{-1} / 3.5x for 10fb^{-1}
  - Note: these are just preliminary numbers, shown in the Dubna workshop, and likely to change significantly after systematics





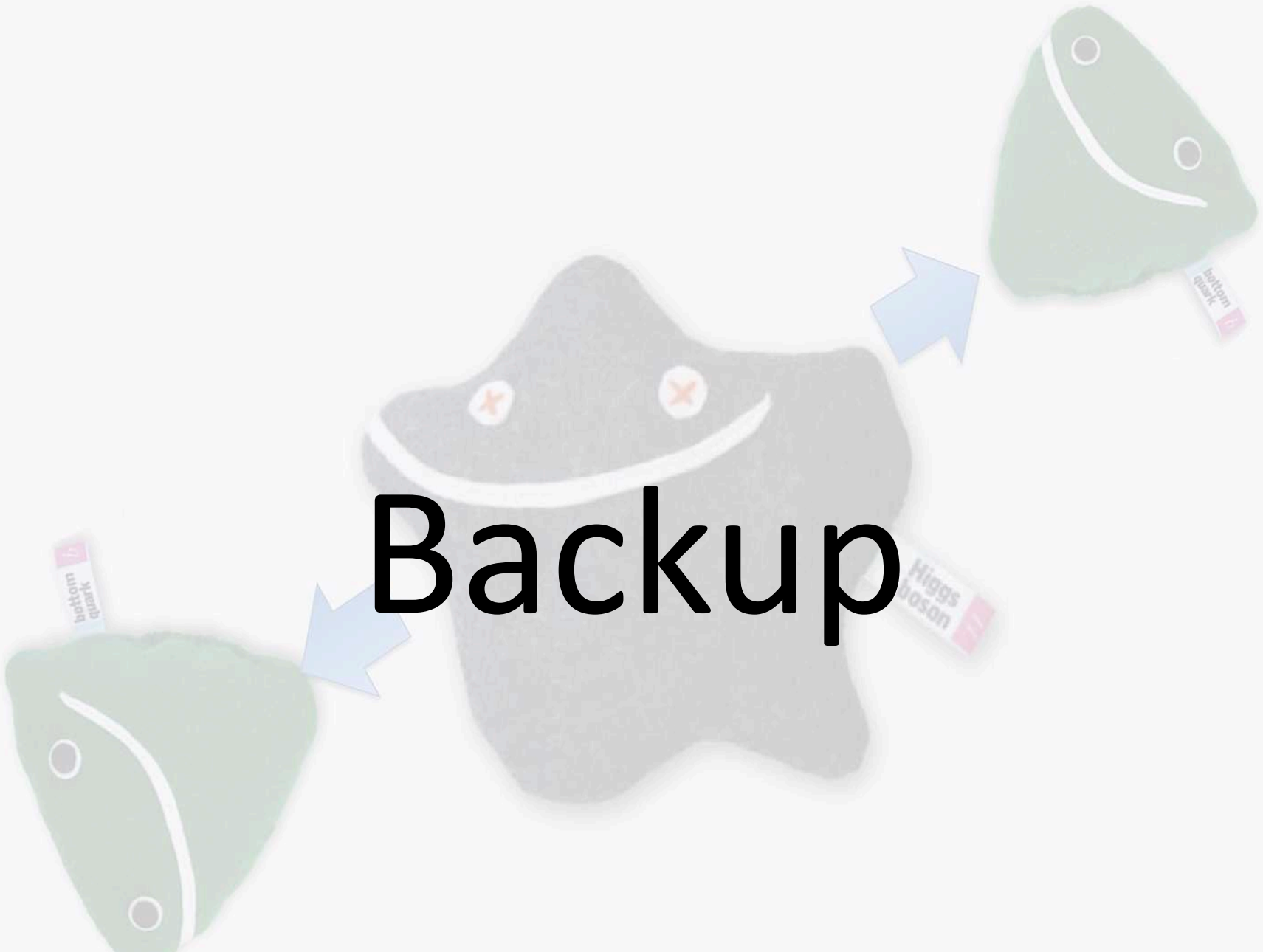
Missing Ingredients

- Editorial board:
  - Composition almost final
- b tagging:
  - Need advanced tagger for increased background rejection
  - Efficiency scale factors almost done
  - Calibration & fake rate: preliminary on week of 20th June - will re-do analysis with final numbers
  - IP3D+SV1, 60% efficiency working point
- Jet Vertex Fraction:
  - Bug affecting all data reconstructed with rel.16
  - Fix exists but applicable only to AOD-based analyses – i.e. only one analysis in our group
  - Would like to re-run D3PD production
- MC10b:
  - Can move to this essentially now
- QCD background (incl. bb, cc):
  - Tuning method to estimate from data
  - Almost there, but not quite – examining remaining features (at 10% level)
- Systematics:
  - First estimates done – dominated by b-tagging uncertainty (around 30%)
  - Jet energy scale uncertainty still missing – expected of same order
- For note & beyond… exclusion analysis & SM Higgs combination:
  - Done “by hand” for WH channel
  - Need to produce inputs for SM Higgs combination

Outlook

- Skeleton draft of INT note should be available tomorrow
- Then a couple of weeks to finish details of QCD BG determination and interact with Editorial Board
  - Expect some changes to cuts etc during this
- Dataset frozen on 22 June (I think)
- Preliminary b-tagging calibrations around same time
- Aim for Higgs approval at end of June
- Last iteration with final b-tagging calibrations on…
- Circulate note to ATLAS for CONF approval in early July for approval in time for EPS

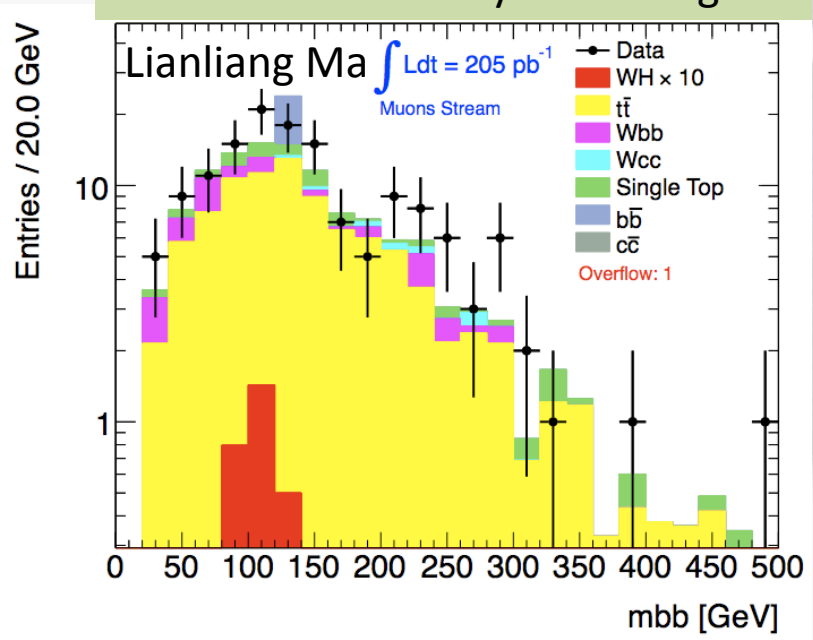
Backup



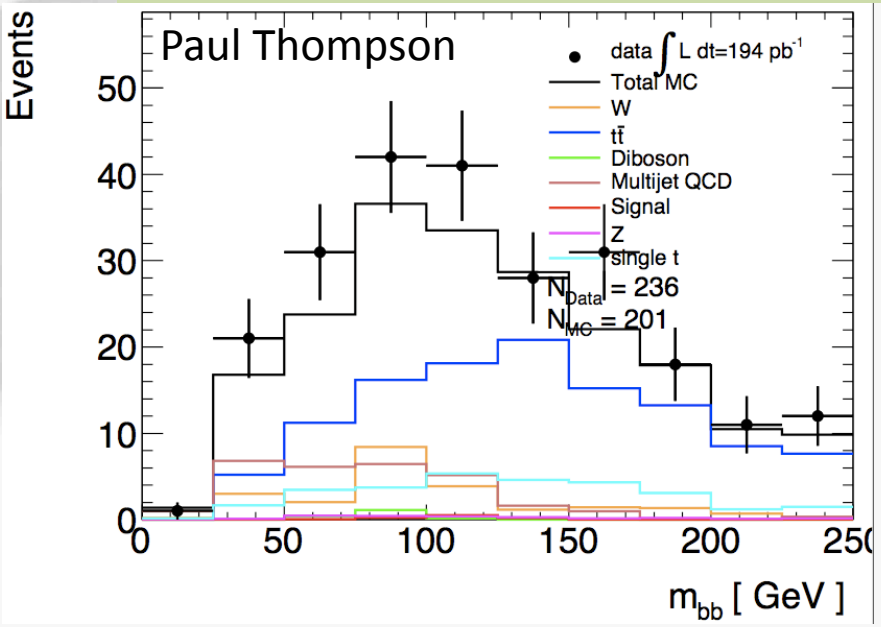
Do we need a JVF cut?

- In principle yes!…
- Need to use cut $N_{jets} = 2$ to suppress tt background; use $N_{jets} = 3$ as tt control region
- So must suppress spurious jets from pileup…

Njets < 4
All backgrounds from Monte Carlo
bb and cc MC clearly not enough



Njets = 2
QCD background from data
Before last scale factor (1-b sideband)

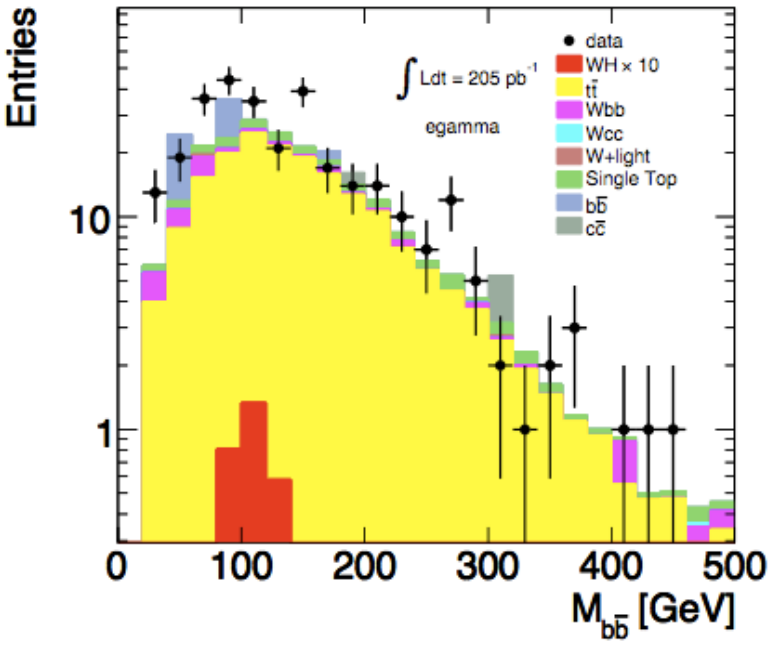


Do we need a JVF cut?

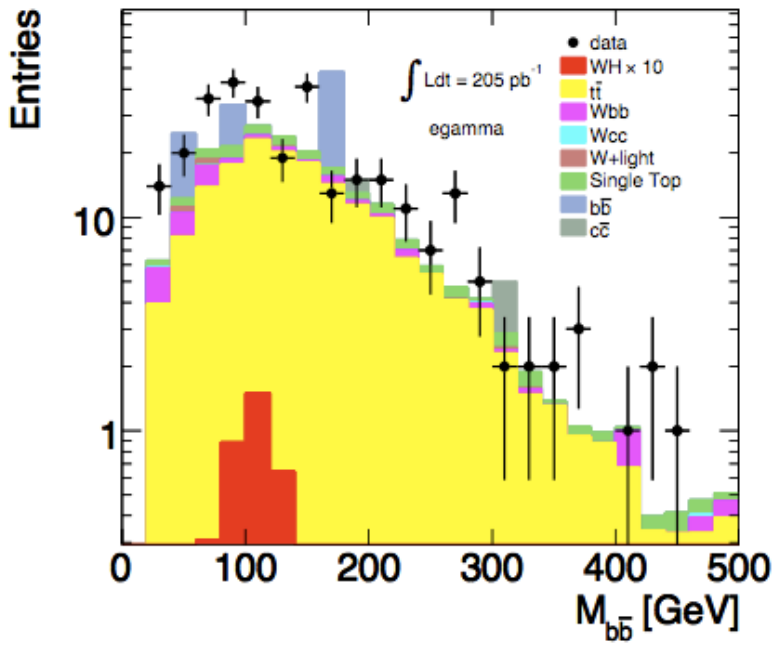
- In fact, not using the Jet Vertex Fraction seems to have a significant effect on Njets
- But a small effect after all cuts…

	data	tt MC
No JVF cut	303	200
JVF > 0.75	300	185

Haifeng Li With JVF



Haifeng Li No JVF



WH Cuts Summary

Leptons:

- Electrons *ElectronTight* with track isolation $p_T^{\text{cone}}/p_T < 0.1$
- $p_T > 25$ GeV, $|\eta| < 2.47$
- Muons (*Muid*). $p_T > 25$ GeV, $|\eta| < 2.4$. Tight muons only. Track isolation $p_T^{\text{cone}}/p_T < 0.1$, $d_0^{\mu} < 0.1$ mm, $z_0^{\mu} < 10$ mm.
- Additional lepton veto, overlap removal a la baseline Twiki

$E_{\text{T}}^{\text{miss}}$ (based on *MET_LocHadTopo+μ*):

- $E_{\text{T}}^{\text{miss}} > 25$ GeV, $M_T > 40$ GeV

Jets and B-tagging:

- Anti-$K_T(0.4)$, $E_T > 25$ GeV, $|\eta| < 2.5$, EM+JES with offset, origin corrections
- $|JVF| < 0.75$ (corrected from AOD)
- Btagging $IP3D + SV1 > 4.5$ ($\simeq 60\%$ efficient)
- Require $N_b^{\text{jet}} = 2$ restricted to $|\eta| < 2.5$

ZH Cuts Summary

- Common selection
  - Using WZ+jets GRL (includes *b*-tagging)
  - Triggers: (EF_e20_medium || EF_2e12_medium) or EF_mu18_MG
    - Using di-lepton trigger for electron to recover turn-on → check
  - Primary vertex containing at least 3 tracks
  - Reject events with LAr noise bursts (2 events after Z selection)
  - Reject events in data with jets failing loose cleaning cuts (no MC correction)
  - Exactly 2 leptons with $76 < m_{ll} < 106$ GeV
  - Opposite charge required for muons
- $ZH \rightarrow llbb$ selection
  - $E_T^{miss} < 50$ GeV
  - At least 2 b tagged jets
  - *b* tagger IP3D+SV1, cut 1.55

Poster abstract for EPS-HEP

H->bb searches with the ATLAS detector at the LHC

The H -> bb channel is extremely important for the observation of a Higgs boson signal at the LHC. In the Standard Model, this channel would provide a significant contribution to the Higgs boson search in the low mass region, where this decay mode constitutes the dominant Higgs decay channel. Due to the enormous jet production cross-section at the LHC, the search must target channels where the Higgs boson is produced in association with a weak boson, a pair of top quarks, or jets separated by a rapidity gap. It also requires complex techniques to reconstruct the signal and separate it from an overwhelmingly large background. We present the status of Higgs searches in the H->bb channel currently being performed within ATLAS.

- Accepted by the conference
- Will be presented by Patricia Conde Muino – after random selection