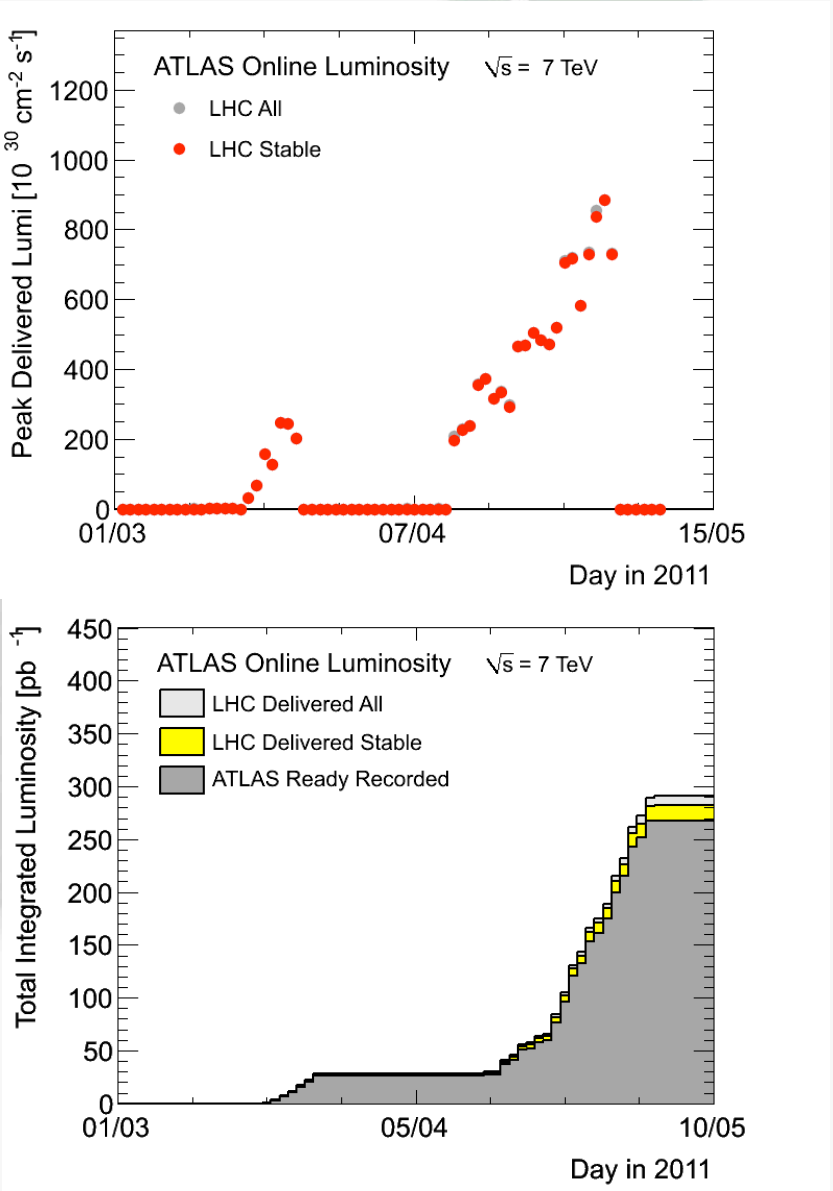
H->bb Weekly Meeting

Ricardo Gonçalo (RHUL)

HSG5 H->bb Weekly Meeting, 10 May 2011

News! News! News!

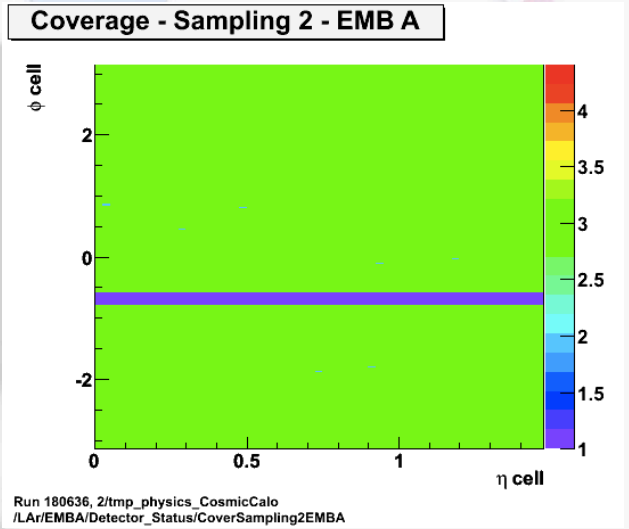
- Currently in technical stop – no changes since last week
- About 0.27 fb^{-1} collected with stable beams so far
  - 50ns bunch spacing
  - 768 colliding bunches
  - 700 bunches in ATLAS
- Inst Lumi up to ≈$9x10^{32}cm^{-2}s^{-1}$
  - From increased nr of bunches, so peak pileup stays ≈ 10 - 14 collisions per bunch crossing



News! News! News!

- Open Discussion of the first draft on the combination of Higgs searches https://indico.cern.ch/conferenceDisplay.py?confId=137883

- New calibration of the 2011 luminosity now available: https://atlas-datasummary.cern.ch/lumicalc/
  - For all 2011 data (periods A to E)



- Lost LAr Front End Boards (FEBs)
  - Φ = [-0.64,-0.74] & η = [0,1.4]
  - Lost after power glitch on 30 April
  - Possibly only recoverable during Christmas

- LAr cleaning and object quality: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/LArCleaningAndObjectQuality
  - To allow filtering out of:
    - LAr noise bursts and data integrity errors
    - Bad quality clusters through the Object Quality Flag
    - Dealing with LAr hardware problems in Monte Carlo.

Trigger menus in 2011: from Anna Sfyrla's talk at the last Weekly:
https://indico.cern.ch/getFile.py/access?contribId=2&resId=0&materialId=slides&confId=119636

- At $2x10^{33}cm^{-2}s^{-1}$ (not so far away) e20_medium and mu18 disabled
- On e.g. e/gamma trigger optimization see A.Tricoli's talk in today's weekly
- We need someone to follow the menu/trigger performance evolution for our group!

Trigger Menu Changes wrt to 2010

Egamma	Simultaneous optimization trigger-offline • New e20_medium deployed, but rate is high. • Work on e20/22_medium1 ongoing.
Muons	No big changes; however, L1 rates at 50ns are twice as high as expected.
Jets	New EF algorithm: Calorimeter Full-Scan, with anti-kt 0.4 that processes the cells into topo-clusters ('a4tc_EFFS'). New topological triggers (mainly for SUSY).
Taus	Simultaneous optimization trigger-offline, ongoing.
BJets	New developments, now in active selection. Potential for further improvements.
MET/XS	• MET performs better than expected in the 2011 pile-up. • XS still under commissioning, new parameterization to come. Performance in signal data-sets still under investigation.
MinBias	Mainly random triggers. MBTS not usable anymore.

News! News! News!

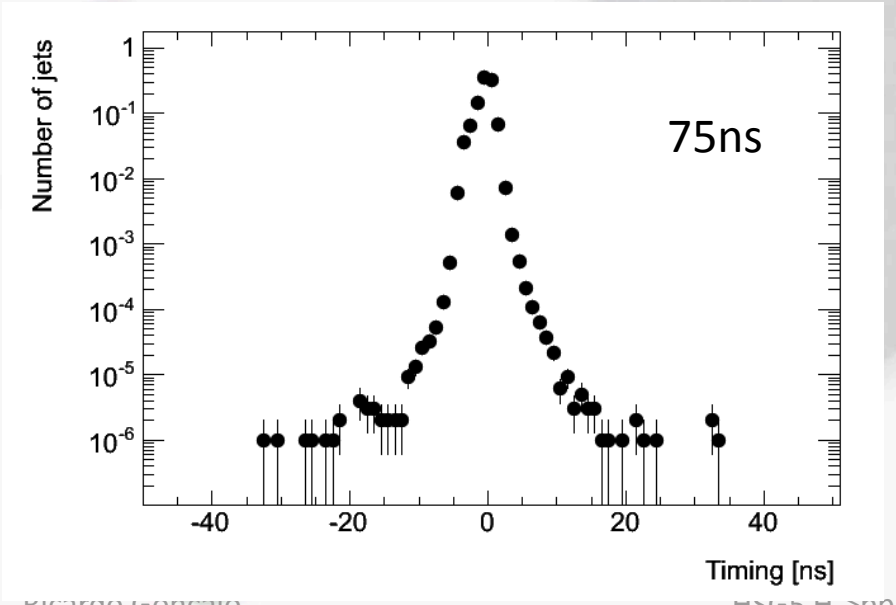
- Jet calibration task force meeting today dedicated to fat jets: https://indico.cern.ch/conferenceDisplay.py?confId=138439
  - Jet substructure note: http://cdsweb.cern.ch/record/1347794
  - And backup note: http://cdsweb.cern.ch/record/1344082/

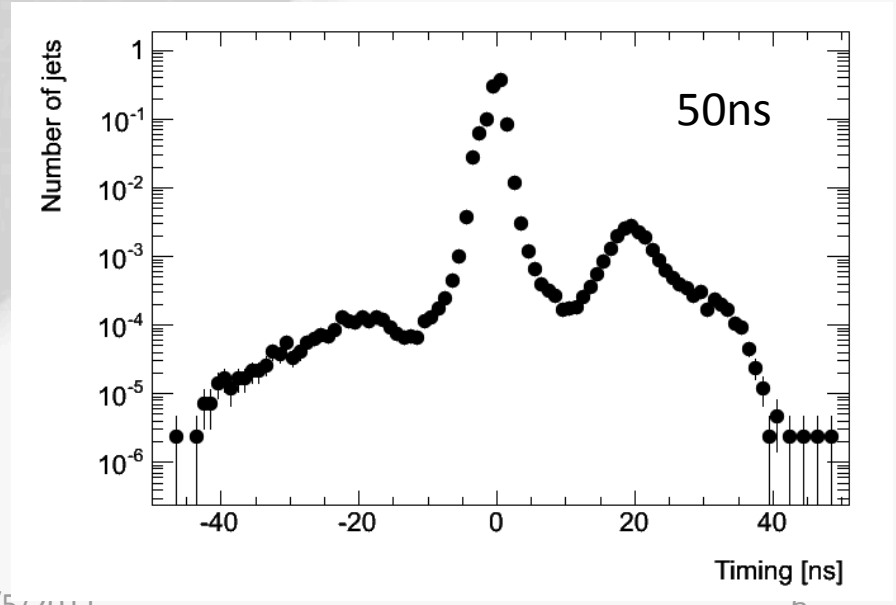
- From Sandra's intro talk to Higgs WG meeting last week: https://indico.cern.ch/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=136406
  - Ongoing work on jet performance:
    - JES uncertainties, especially due to pile-up.
    - Expect recommendations for central jets, $|\eta|<2.1$ on PLHC time scale
    - **Call for manpower** to join studies – work needed especially on JVF and effect of pileup on MET (MET recommendation based on 2010 studies)
  - b-tagging – operating points to be calibrated for PLHC:
    - **SV0** 50% (w>5.85)
    - **JetProb** 50%, 70%, 80%, 90% (-log10(w) > 3.25, 2.05, 1.40, 0.60)
    - Plan to update **uncertainties** related to pile-up and run conditions.
    - Run calib with two **JVF** settings (to check stability): no JVF cut, JVF>0.8

Jet timing problem

- Found last week:
  - Peak at Δt ≈ 20ns in jet timing distribution https://indico.cern.ch/getFile.py/access?contribId=10&sessionId=0&resId=2&materialId=slides&confId=135825
  - Appeared in 50ns running, not apparent in 75ns running

- Problem understood:
  - Effect from HLT jets seeded by random triggers (not L1 jets) active in empty bunches between colliding bunches
  - EF_j20_a4tc_EFFS, EF_j10_a4tc_EFFS, EF_j15_a4tc_EFFS affected (full-scan EF jets)
  - Problem became evident after changes in jet trigger coincidental with 50ns running





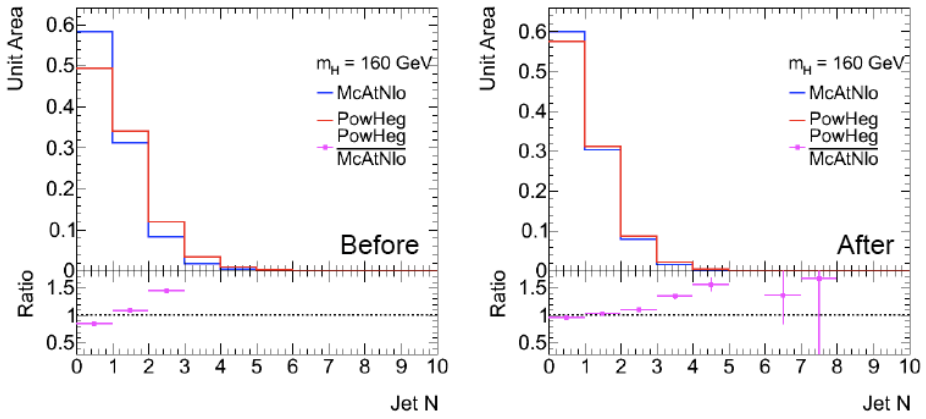
Monte Carlo

- From Jianming's talk on Higgs reweighting to NLO at Higgs WH meeting:
- Large differences between NLO generators in jet distributions
- Watch this space…

Jet Multiplicity

$gg \to H \to WW \to \ell\ell\nu\nu$

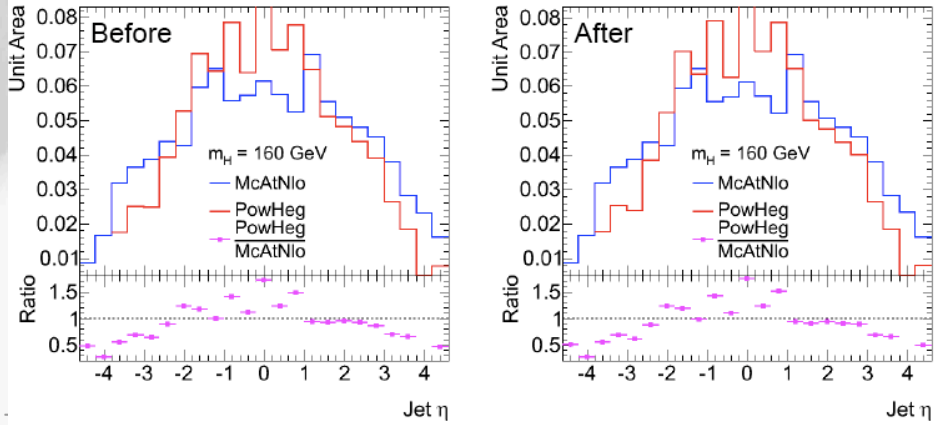
- Large difference between MCatNLO and Pythia
- Higgs pT reweighting significantly reduces the difference



Jet Eta Distributions

$gg \to H \to WW \to \ell\ell\nu\nu$

- Significant difference between MCatNLO and POWHEG
- Higgs pT reweighting does not reduce the difference
- Potential large systematics if too restrictive on η



- Conferences:
  - for EPS-HEP, focus on papers instead of notes
  - Higgs approvals for EPS-HEP: 20th – 25th July

Summer 2011 Conferences

- PLHC, June 6th ⟹ Higgs approvals next week at latest
- LHCC, June 15th
- EPS, July 21st ⟹ Higgs approvals June 20th - 25th
- Lepton-Photon, August 21st
- SUSY11, August 28th

Remarks:

- Run the analysis during approval process to update the results with new data.
- PLHC results: based on conference notes.
  (write them as short as possible, since these are based on Moriond 2010 notes.)
- EPS and beyond: should be aiming for journal papers.
  - In some cases, circulation to ATLAS could be shortened,
    as some analyses will be already documented for PLHC.
  - Approval of paper plots during Open Discussion meetings:
    only if the paper can be sumbited to arXiv within the next 10 (to 14) days.

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https://indico.cern.ch/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=136406

- From Chris C-T's talk in Higgs meeting: https://indico.cern.ch/getFile.py/access?contribId=8&resId=0&materialId=slides&confId=136406

EPS: Timeline from a "top-group" perspective

- Thu July 21- Conference starts
- Mon July 18 – Final reader approval
- Tue July 12 – ATLAS approval meeting
- Mon July 4 – CONF note circulation
- Tue June 28 – top-wg approval on full data
- Mon June 27 – INT/CONF on full data posted
- Wed June 22 – full dataset available for analysis
- Wed June 15– End of LHC run
- Tue June 14 – top-wg analysis pre-approval
- Fri June 10 - INT note posted
- Fri June 3 – Cut dataset for preapproval
- Thu May 19– Signoff on TopPhys production cache
- Sat May 14– Start of LHC run
- Thu May 12 – Finalization of object definitions

5.5 weeks approval time starting from pre-approval

2 weeks available for analysis of full data to pre-approval

5 weeks available for analysis (from ~100 pb-1 to pre-approval)

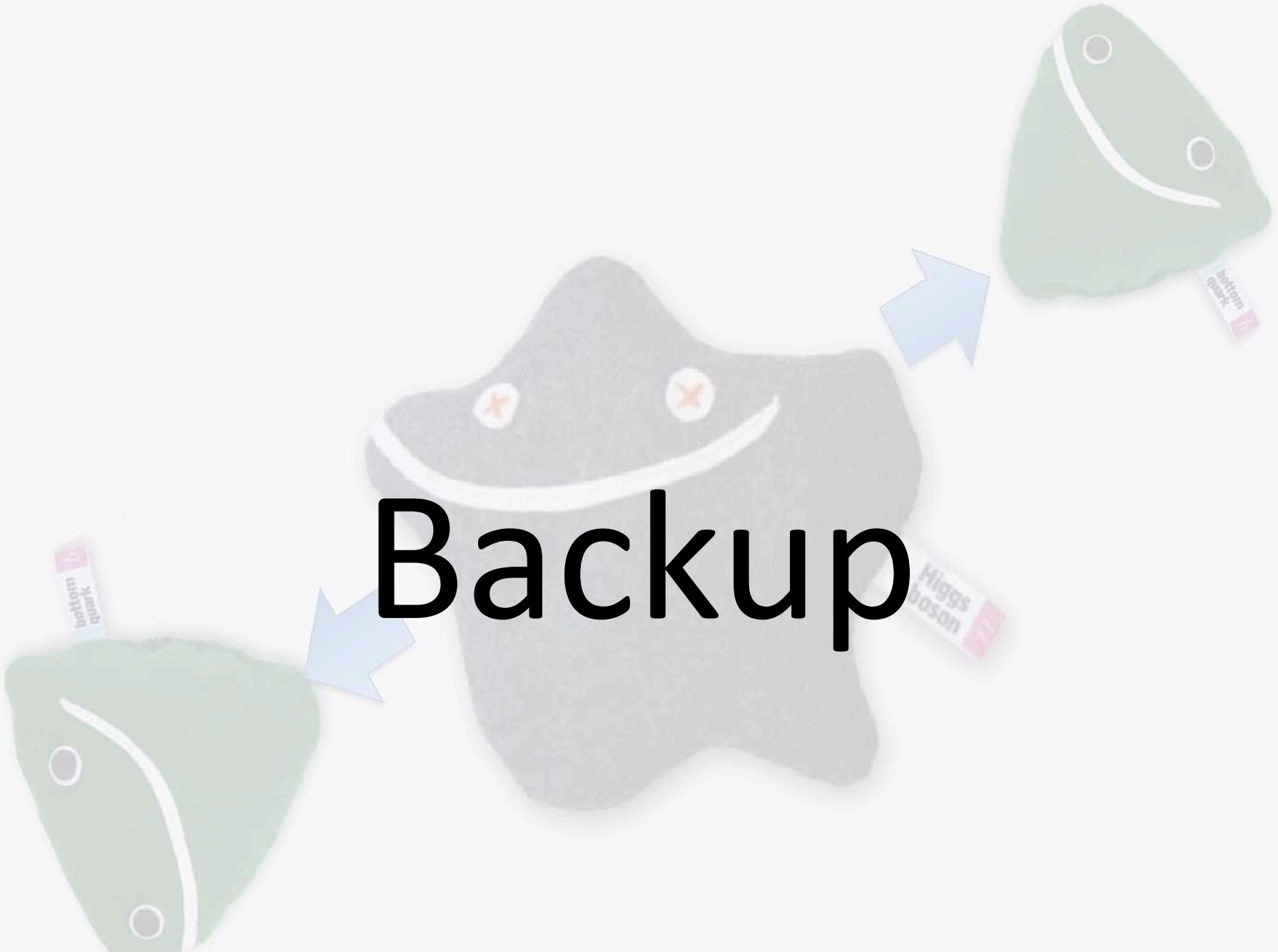
+2 weeks to final approval for both

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.

- In case it's accepted we'll need a candidate to present it at EPS
- Please let me know by email before Friday if you would like to do this
- Will randomly choose a presenter from candidates



Backup

The 1e33 Menu

The main primary triggers

	Trigger	Rate (Hz)
Egamma Triggers	e20_medium	50
	2e12_medium	1.1
	e10_medium_mu6	4
	g40_tight	16
	g80_loose	2.7
	2g20_loose	1.7
	3e10_medium	0.1
	g40_loose_EFxe40	1.8
	g150_etcut	1.5

	Trigger	Rate (Hz)
Muons / BPhys Triggers	mu18	40
	2mu10	1.0
	2mu4_DiMu	18
	mu40_MSOnlyBarrel	4
	mu40_slow	0.2

	Trigger	Rate (Hz)
MET / TE	xe60_noMu	4
	te1000	0.1

	Trigger	Rate (Hz)
Jets / Hadronic Triggers	j180_a4tc_EFFS	6
	multijets	10
	fj100_a4tc_EFFS	0.3
	ht350_a4tc_EFFS	7
	j75_j30_anymct150	4
	b10_4L1J10*	15
	b10_L1JE140*	14

*Not in final configuration

	Trigger	Rate (Hz)
Taus / Combined	tau100_medium	8
	tau29_tau20_medium1	5
	tau29_xe35	6
	tau16_e15_medium	7
	tau16_mu15	6
	j75_xe45_loose	10
	HV triggers	4

	Trigger	Rate (Hz)
MinBias	rd0_filled	5

Prescaling Triggers

Priority Lists

Trigger (already disabled)	Baseline trigger
Priority 1	
e20_medium	e20_medium1
mu18	mu20
2mu4_DiMu	2mu4_Bmumu/Jpsimumu
2j30_j75_anmct150	2j30_j75_anymct175
3mu6_MSOnly	2mu6_MSOnly_g10_loose
tau20_medium1_tau29_medium1	2tau29_medium
e15_medium_xe30	e20_medium1
j75_a4tc_EFFS_xe45_loose	j75_a4tc_EFFS_xe55_loose
mu40_MSOnly_Tighter	mu40_MSOnly_Barrel
Priority 2	
2mu4_DY	2mu10
ht350	ht400
g40_tight	g80_loose
mu40_MSOnly_tight	mu40_MSOnly_Barrel
tau29_medium_xe35	tau29_medium_xs80
g100_etcut_g50_etcut	g150_etcut
2g15_loose	2g20_loose
High L1-Rate	
e15_tight	e20_medium
2e10_medium	2e12_medium

Prescaling depends not only on the EF rates, but also on the L1 and L2 hardware limits (detector readout, network, …)

No additional triggers expected to be prescaled till 1.5e33

Discussion on Summer conferences

- **Dubna** (in 2 weeks) should be time to **freeze** our plans

- Reminder of Summer conferences:
  - Data estimates from February seem to be on track!
  - PLHC 2011: 6 June (http://www.pg.infn.it/plhc2011/) L ≈ 0.6 fb^{-1}
  - **EPS-HEP 2011: 21 July** (http://eps-hep2011.eu/) L ≈ 1 fb^{-1}
  - Dataset frozen ≈ 1 month before; expect GRL, Lumi etc to be refined then

- We aim to have **CONF note for EPS – HEP 2011**
  - PLHC too soon for us – would need a draft ready today…
  - Note on WH:
    - Lots of work has been building up to this, mostly on **un-boosted** channel
    - Let work evolve (task list) up to Dubna and start to write up – see Jike's talk today
    - Expect at bb mass plot plus control plots and data-driven background determination
    - Anything to include on **boosted** channel? Define in Dubna…
  - What else? **ttH**? **ZH**?... Again, define in Dubna and then stick to the plan
  - Would like to send abstract for poster on H->bb (see next slide)

Dubna Workshop

- Focus of H->bb agenda is WH
- Should define final strategy for Summer conferences
- https://indico.cern.ch/conferenceDisplay.py?confId=124954

Thursday 19 May 2011

09:00 - 11:00 H->bb

- 09:00 **Hbb: Overview and Aims** *20'*
  Speaker: Ricardo Jose Morais Silva Goncalo (Royal Holloway)
- 09:20 **WH Update from LIP** *20'*
  Speaker: Dr. Patricia Conde Muíño (LIP-Lisbon)
- 09:40 **WH analysis update** *20'*
  Speaker: Dr. Paul Thompson (University of Birmingham)
- 10:00 **WH MVA analysis** *20'*
  Speakers: Dr. Lianliang Ma (University of Wisconsin (Madison)), Dr. Lianliang Ma Ma (Atlas), Lashkar Kashif (University of Wisconsin-Madison)
- 10:20 **Boosted analysis/Jet Substructure** *20'*
  Speaker: Adam Davison (University College London)

11:30 - 12:00 Discussion: Goals for H->bb Summer Conferences

WH Task List

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/WHNoteSummer2011#Analysis_Tasks

Task	Obs	People
Trigger: study optimal trigger for the 2011 data. Bear in mind that single-lepton triggers will likely increase to pT thresholds of ≈20 GeV – i.e. analysis cuts will need to increase to ≈22 GeV; check also any sculpting, angular acceptance, etc	Does this need AODs? Enough info on WZ/top D3PDs? Sample A or sample T should have the foreseen menus Liaise with Gemma Wooden	
Muon reconstruction: investigate different options		Jinlong Zhang
Electron reconstruction: investigate alternatives	Inclusion/exclusion of cracks Inner detector cuts (B layer?)	
Pileup: what do we need to do with 2011 pileup	Reweighting method. Jet vertex fraction. Choice of vertex reconstruction	Jike Wang
Jet energy scale: investigate size of systematic uncertainty	Worry about b jets. Any way to improve di-jet mass resolution? Liaise with JetETmiss	Patricia Conde, Jose Maneira, Nuno Anjos
B tagging algorithms	Effect of each different choice on significance	Jinlong Zhang
Fast monitoring: implement WH baseline selection in online monitoring infrastructure	Example exists. Involves programming in Athena. Liaise with Fabien Tarrade.	Lianliang Ma
QCD background estimation from data		Michiel Sanders, Jonas Will

Baseline analysis for WH, H->bb

Recommendations for WH baseline
Differences wrt WH cut flow
Expected CP recommendations for 2011

Sources:

lvqq: (winter note)	https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HiggsWWsemilepConfNote2011Winter
llqq: (winter note)	https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HiggsZZllqq
W/Z common:(2010 data)	https://espace.cern.ch/atlas-sm-wz-physics/Lists/Common%20Selection/AllItems.aspx
WH selection for cut flow:	https://twiki.cern.ch/twiki/bin/view/AtlasProtected/WHNoteSummer2011

Muon Selection	**lvqq**	**llqq**	**W/Z common**	**WH->lvbb (cut flow)**	**Proposal for WH**	**Obs**
finder	Staco combined or MuTag	Staco combined or MuTag	Staco	Muid	Muid + segment tags	Investigate MuTag and Staco later
pT	> 20 GeV	> 20GeV	> 20 GeV	> 20 GeV	> 20 GeV	may need to go to 22GeV - study trigger
|eta|	< 2.4	< 2.5	< 2.4	< 2.5	< 2.4	muon trigger coverage
MCP quality cuts	yes	yes	yes	yes	yes	
|Z0 wrt PV|	< 10mm	< 10mm	< 10mm	< 10mm	< 10mm	
|d0 wrt PV|	< 1mm	< 1mm	< 0.1mm	< 1mm	< 1mm	study later?
isolation	pT(calo)20<1.8GeV	pT(trk)20<1.8GeV	pTtrk20/pT<0.1	pT(trk)20<1.8GeV	pTtrk20/pT<0.1	But study effect of different approaches
Electron selection						
author	1 or 3	1 or 3	1 or 3	1 or 3	1 or 3	
PID	RobusterTight	RobustMedium	Med/Tight_withTrackMatch	Tight_withTrackMatch	Tight_withTrackMatch	Investigate alternatives later
pTcluster	> 20 GeV	> 20 GeV	> 20 GeV	> 20 GeV	> 20 GeV	may need to go to 22GeV - study trigger
|eta|	< 2.47 excl. crack	< 2.5 incl. cracks	< 2.47 excl. crack	< 2.5 excl. crack	< 2.47 incl. crack	But check effect of crack in study the crack after studies
isolation	etcone30<6GeV	NA	caloIso98 (what's this???)	NA	NA	This should be studied
b-layer hit	NA	NA	yes	NA	NA	Do we need b-layer hit cut?
|z0 wrt PV|	< 10mm	NA	NA	NA	NA	
|d0 wrt PV|	d0signif < 10	NA	< 0.1mm	NA	NA	But study effect of different approaches
vertex						
primary vertex	Nvtx>=1 & Ntrks>=3	Nvtx>=1 & Ntrks>=3	Nvtx>=1 & Ntrks>=3	Nvtx>=1 & Ntrks>=3	Nvtx>=1 & Ntrks>=3	Apply to first vertex
MET						
algorithm	MET_LocHadTopo(|eta|<4.5) + MET_MuonBoy-MET_RefMuonTrack	MET_LocHadTopo - Sum(pTmu - ETlossInCalo)	METRefFinal	MET_LocHadTopo - Sum(pTmu - ETlossInCalo)	METRefFinal	Investigate alternatives later
Jet selection						
finder	AntiKt4H1Topo	AntiKt4H1Topo	AntiKtTopo (0.4 priority)	AntiKt4Topo	AntiKt4Topo	Should check other options
pT	> 30GeV	> 25GeV	> 30GeV	> 25GeV	> 25GeV	Investigate alternatives later
scale	EM+JES	EM+JES	EM+JES	EM+JES	EM+JES	
calibration	H1	H1	?	?	?	Should check other options
|eta|	< 4.5	< 3.2	< 4.5	< 2.5	< 4.5	
jet vertex fraction	NA	< 0.75 wrt PV	NA	< 0.75 wrt PV	< 0.75 wrt PV	Investigate pileup - to be changed in 2 weeks
jet cleaning	Loose	Loose	Medium	Loose	Loose (for pTjet>20GeV and not MC)	Investigate alternatives later - use OffsetEtaJES tool to data only
Overlap removal						
jet-e	remove jet for dR<0.3	remove jet for dR<0.4	remove jet: dR<0.2(0.5 if pT>20)	remove jet for dR<0.4	remove jet for dR<0.4	Investigate alternatives later
mu-jet	NA	remove muon for dR<0.4	remove jet: dR<0.2(0.5 if pT>20)	remove muon for dR<0.4	NA	Investigate alternatives later
mu-e	remove electron for dR<0.1	NA	NA (for 2011 data recluster jets)	remove muon for dR<0.4	NA	Not needed (2nd lepton veto)
Event selection						
trigger						Need to investigate trigger
event cleaning	jet/ETmiss recommendation	jet/ETmiss recommendation	jet/ETmiss recommendation	jet/ETmiss recommendation	jet/ETmiss recommendatio	same as Jet cleaning
lepton	exactly 1 lepton	exactly 2 leptons same flavour	exactly 1 lepton	exactly 1 lepton	exactly 1 lepton as defined	
extra lepton veto e channe	veto robustMed. Electrons	opposite charge, veto otherwise	veto additional med.electrons	veto additional tight electrons	veto add. signal electrons	Investigate alternatives later
extra lepton veto mu chan	NA		veto add. combined muons	veto add. combined muons	veto add. signal muons	Investigate alternatives later
lepton pT additional cut	> 30GeV	NA	NA	NA	NA	
MET	> 30GeV	< 50GeV	> 25GeV	> 25GeV	> 25GeV	Investigate alternatives later
Njets	exactly 2 or 3	>=2	NA	>= 2	>=2	
b tag	b-tag veto (SV0>5.72)	NA	SV0>5.85, |eta|<2.1, pT>30	IP3D+SV1 > 1.55	Investigate 1 and 2-tags	Start with IP3D+SV1>1.55, but check all possibilities
Additional cuts	m(jj) near mW & |eta(j)|<2.8	70<m(jj)<105, 76<m(ll)<106, etc	NA	MT > 40 GeV	MT > 40 GeV	Investigate alternatives later

Date	Milestones wish list
17 May	Dubna workshop – analysis frozen After this: add data to un-boosted analysis and prepare for result approval Concentrate more effort on boosted VH with a view to obtaining results quickly
10 May	Review results with 2011 data from cut-based and multivariate analyses
3 May	Margin for dealing with unforeseen problems
26 April	Start looking at 2011 data if enough is available. Any surprises? How does the MC describe the new data? By now we should have a reasonable idea of results from the multivariate analysis
19 April	End of 2 weeks of beam scrubbing. (I'm away for Easter)
12 April	By now we should have a reasonable idea of the exclusion of the cut-based analysis First report on MVA preliminary results – establish plan for getting results by Dubna
5 April	Identify the worst systematics and discuss any possible improvements: •Any changes needed in analysis cuts? •Any study necessary for corrections to some systematic effect? Multivariate analysis: iterate on preselection cuts, methods, questions Assign tasks – divide the work to achieve better results!
29 March	Establish analysis cuts: •If possible as result of optimization •Use 2010 data to develop cuts and show that data is well described by background MC Start evaluating systematics
22 March	Iterate on analysis cuts – why is each cut applied at each particular value? Start iteration on multivariate methods to improve analysis

Reconstruction issues

- **Muon** CP group recommendations for release 16:
  - Reconstruction efficiency and isolation efficiency scale factors, momentum smearing functions
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/MCPAnalysisGuidelinesRel16
- Jet/Etmiss recommendations for **jet cleaning** in release 16:
  - Medium jet cleaning should give similar rejection to rel 15 cleaning but with better efficiency
  - Tight jet cleaning should not be used – still under discussion
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HowToCleanJets#Bad_jets_rel16_data
- New!: Final **b-tagging calibrations** for release 16 based on full 2010 data:
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/Analysis16
- e/gamma recommendations for **energy scale and resolution** in release 16:
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EnergyScaleResolutionRecommendations
  - And rescaler tool: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EnergyRescaler
- Standard Model **W/Z** group **baseline selection** for release 16 (next 4 slides):
  - See discussion in W/Z group Sharepoint
  - Also, finer points (and perhaps the not so fine) still being discussed