# H->bb Weekly Meeting


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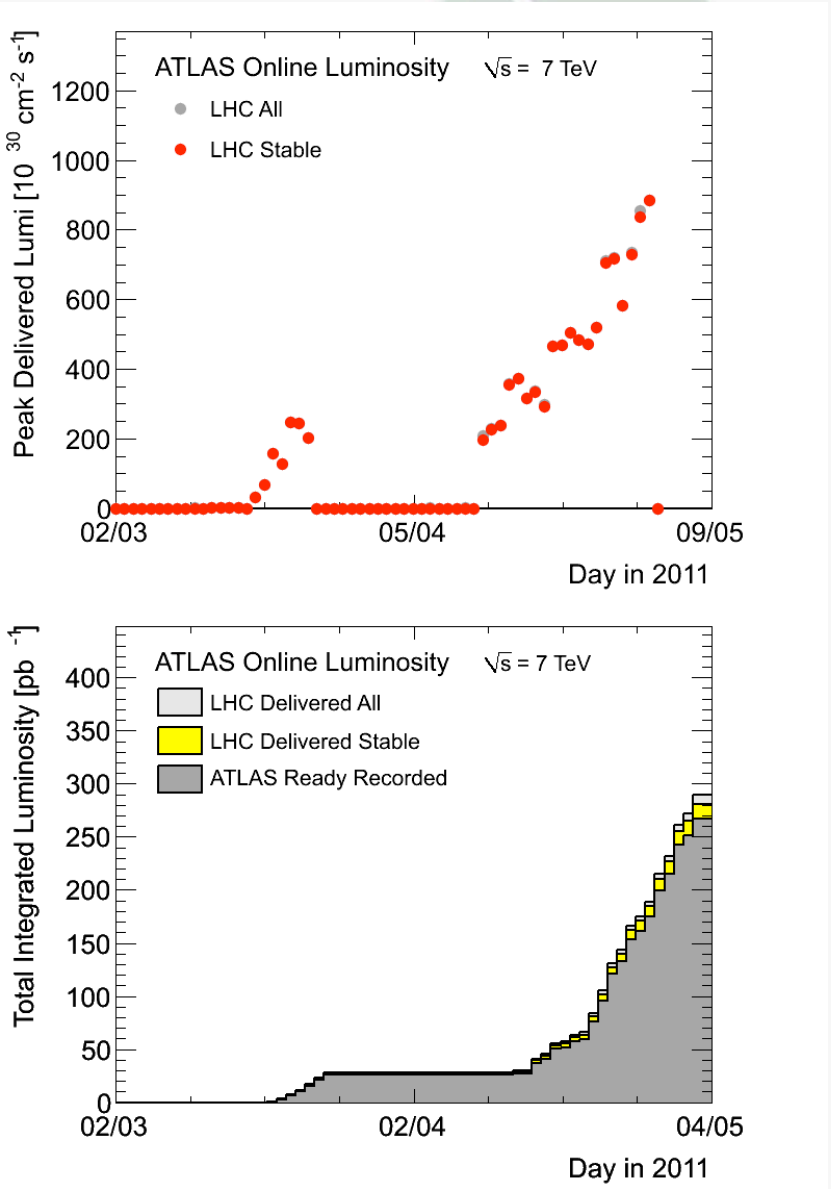
HSG5 H->bb Weekly Meeting, 3 May 2011

# News! News! News!

- 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!

- Data preparation for PLHC:
  - Last run will be taken on Wednesday, May 4th
  - Data processing should finish by May 8th
  - GRL available by May 10th for all 2011 data
  - Luminosity currently overestimated by 4-8%
  - Lumi uncertainty of a few % larger than 2010 (available by May 10th)

- Muon CP recommendations for PLHC:
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/MCPAnalysisGuidelinesPLHC2011
  - Same selection as for 2010 data. Muon efficiency scale factors and the muon momentum smearing code based on ≈30 $pb^{-1}$ (2011 data)
  - To be updated with ≈200 $pb^{-1}$ of data within two weeks

- First draft of Higgs combination paper:
  - http://cdsweb.cern.ch/record/1348030
  - H->γγ, H->ZZ->llll/llνν/llqq, H->WW->lνlν/lνqq, 2010 data

- LHC Higgs Cross Section Group workshop in BNL tomorrow: http://www.bnl.gov/hcs/

- Status report at Higgs WG meeting on Thursday – I will prepare some slides for Chris C-T to show

# 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)

# 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.

# 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

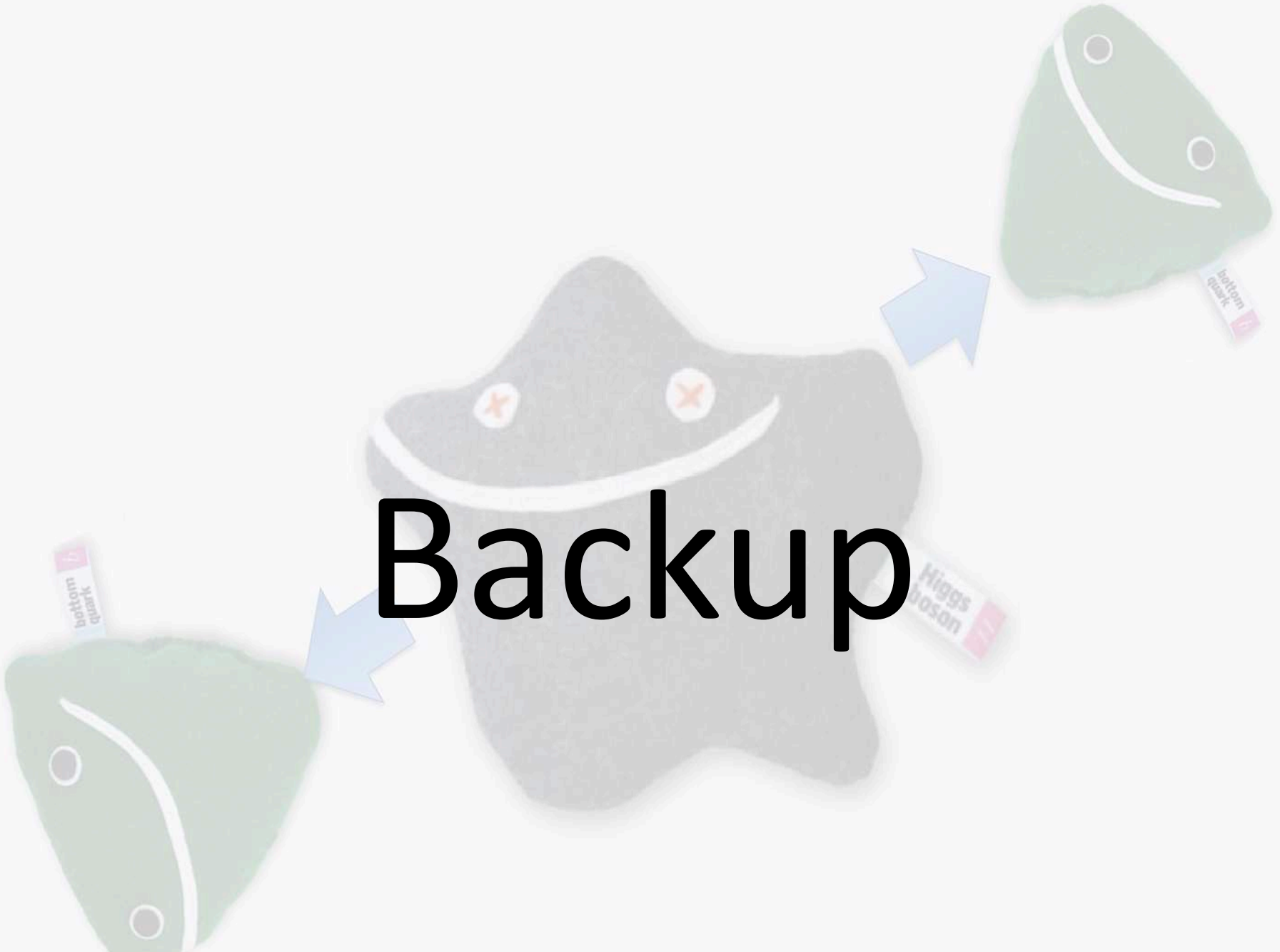
- 09:00 **Hbb: Overview and Aims** *20'*
  Speaker: Ricardo Jose Morais Silva Goncalo (Royal Holloway)
- 09:20 **WH Update from LIP** *20'*
  Speaker: Dr. Patricia Conde Muíño (LIP-Lisbon)
- 09:40 **WH analysis update** *20'*
  Speaker: Dr. Paul Thompson (University of Birmingham)
- 10:00 **WH MVA analysis** *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 |




# Backup

**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 | remove muon for dR<0.4 | NA | Not needed (2nd lepton veto) |
| **Event selection** | | | (for 2011 data recluster jets) | | | |
| 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<br>After this: add data to un-boosted analysis and prepare for result approval<br>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.<br>Any surprises? How does the MC describe the new data?<br>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<br>First report on MVA preliminary results – establish plan for getting results by Dubna |
| 5 April | Identify the worst systematics and discuss any possible improvements:<br>•Any changes needed in analysis cuts?<br>•Any study necessary for corrections to some systematic effect?<br>Multivariate analysis: iterate on preselection cuts, methods, questions<br>Assign tasks – divide the work to achieve better results! |
| 29 March | Establish analysis cuts:<br>•If possible as result of optimization<br>•Use 2010 data to develop cuts and show that data is well described by background MC<br>Start evaluating systematics |
| 22 March | Iterate on analysis cuts – why is each cut applied at each particular value?<br>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