H->bb Weekly Meeting

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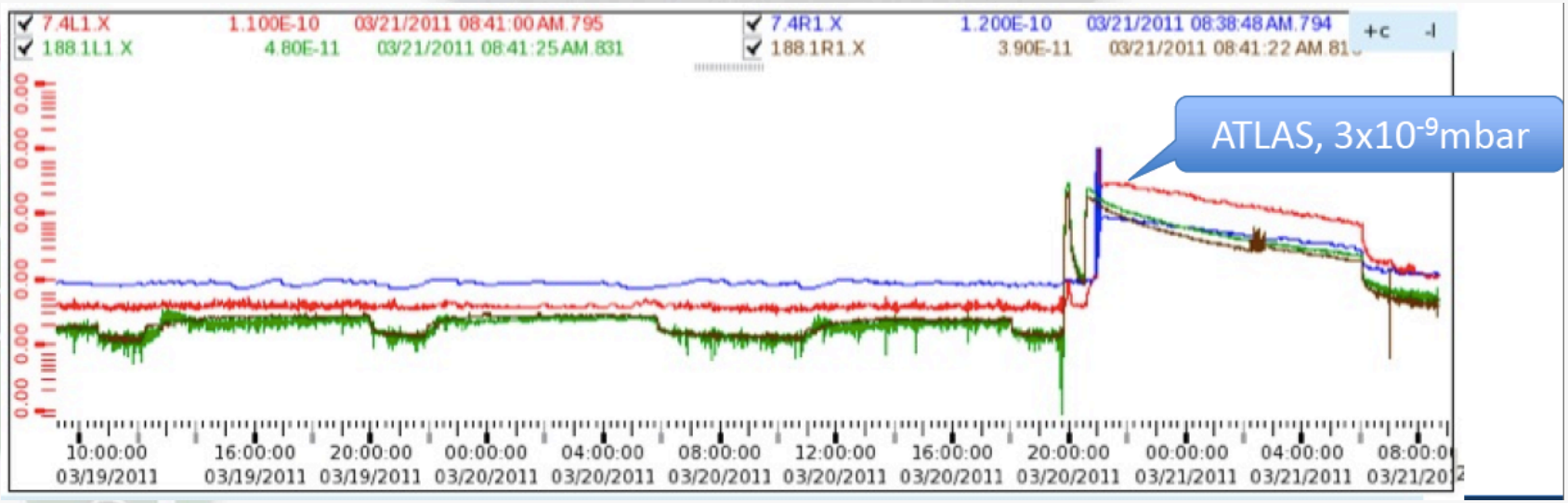
HSG5 H->bb Weekly Meeting, 22 March 2011

News! News! News!

- Currently 136 bunches in 7 trains (+ pilot) – 450 GeV and 3.5 TeV
- Collected data without magnetic field during weekend
  - Solenoid now up, but toroid still down for μ alignment run
- Good beam lifetimes (≈50h) but vacuum spike in ATLAS (up to 10^{-6}mbar) not yet understood
  - Clear e-cloud effect (up to 10^{-8}mbar in IP8) – e-cloud-protection solenoids are still OFF until technical stop



The story so far…

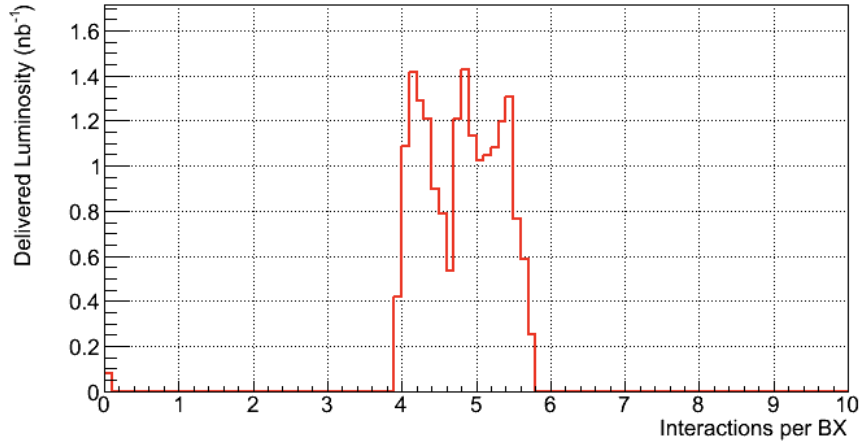
- See Beate's talk at the last weekly: http://indico.cern.ch/getFile.py/access?contribId=3&resId=0&materialId=slides&confId=119629

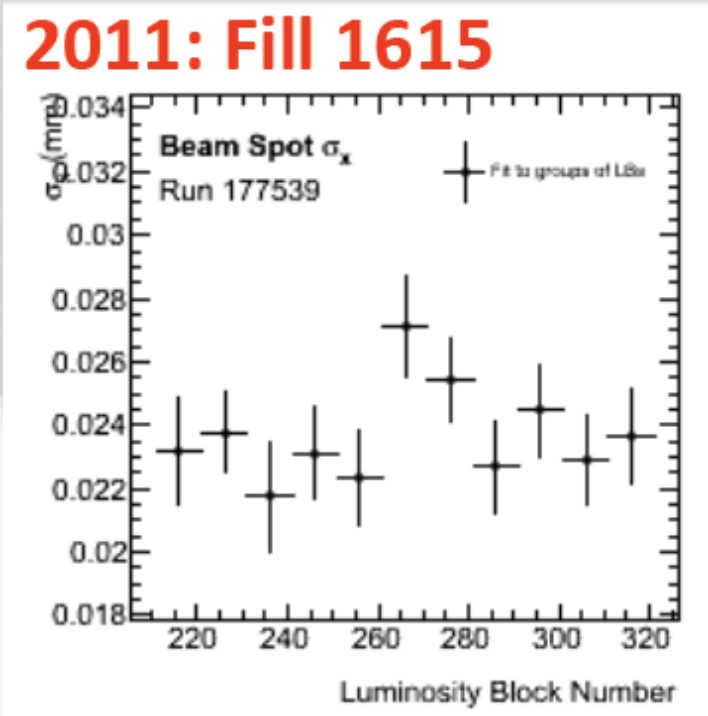
- Luminosity per bunch ≈1.3 times larger than in last 2010 runs (smaller β* now)

- Overall luminosity normalization not yet fully understood
  - Differences of 5-10% seen between different algorithms
  - The 3.4% uncertainty from last year not directly applicable for 2011

- Beamspot ≈2 times smaller than in 2010

- Pileup peak values up to μ = 5.8 found
  - No values below 2.8
  - This agrees to within 10% with expectation given machine parameters
  - Highest value in 2010 was 4.7





Data Distribution Model

…or life without the ESD

- 2011/2012 plan for the distribution of data coming into effect – described here: http://cdsweb.cern.ch/record/1335459
- ESDs for bulk physics streams will only be available for a fixed time period (initially 6 weeks)
- Analyses concerned need to change to either DESDs or AODs
- DESD content described here: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/PerformanceDPD

Physics-Statistics meeting

- Preliminary meeting on procedure for ATLAS-CMS exclusion limits last week: http://indico.cern.ch/conferenceDisplay.py?confId=131204
- New meeting (probably this Friday) to continue discussion

ATLAS – CMS exclusion limit comparison

- Point 2 -- **ATLAS and CMS will produce** a plot where results of each experiment on the exclusion limit(s) are obtained using the CLs method.
  The comparison of ATLAS and CMS findings is then made in this plot.
  This plot can be put in the paper, or, it could also be just an additional plot (it is just *sufficient to make it public*).
  - Ideally this plot should be produced together with the paper plots, and the auxiliary plots. If this is not possible, then it should be done immediately after the release of the paper in arXiv.
  - A similar approach could be followed for CONF Notes.
- Eilam and Glen will address this point in the next talk

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Summary

- ATLAS stat forum proposes to use the profile likelihood as a test statistic
- Toy MCs should be generated (unless the asymptotic is completely verified)
- Use toy MCs to derive the upper limit, the median and the error bands.
- Constrain the upper limit by a power of 16%; i.e. the limit cannot go below the -1 sigma band generated by bg-only experiments
- Do not hide results, show the full observed upper limit.
- Use the asymptotic to verify the sense of your results
- Calculate also CL_s (for the time being) to compare with other experiments (can be easily done with asymptotic)
- Validate with an independent code (for the time being)

26 LCG meeting, Eilam Gross Thursday, February 10, 2011

News! News! News!

Other news & etc:

- Foreseen trigger menu and expected rates can be found here: https://aagaard.web.cern.ch/aagaard/Rates/Mar01.html
  - Please remember to check also list of triggers in HSG5 validation (backup slides)

- Discussion on jet-electron overlap removal for W/Z measurements in SM group (conclusions?): http://indico.cern.ch/conferenceDisplay.py?confId=131538

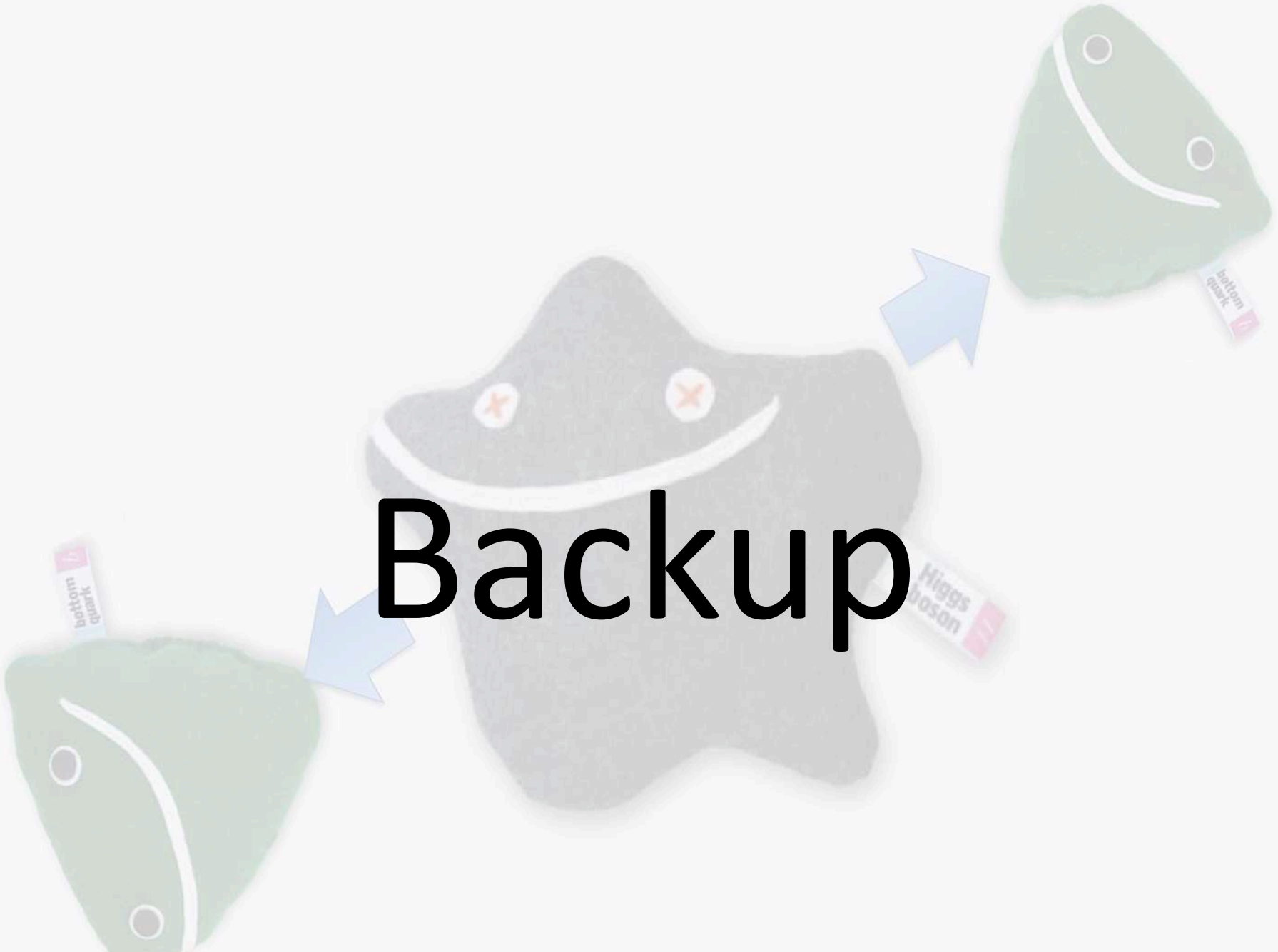
- Meeting on W + heavy flavour jet analysis tomorrow: https://indico.cern.ch/conferenceDisplay.py?confId=131971

Today…

- Charged agenda! Good! 
- Status reports on ttH analyses from Glasgow and Barcelona
- Status reports on WH analyses
  - Including cut-based and multivariate analyses
  - Discussion on WH selection – important! Should try to conclude on this in ≈1 week (see “roadmap wish list” in backup slides)

Tuesday 22 March 2011

11:00 - 11:10	Introduction *10'* Speaker: Ricardo Jose Morais Silva Goncalo (Royal Holloway)	
11:15 - 11:30	Status report on Glasgow ttH analysis *15'* Speaker: Alistair Gemmell (University of Glasgow)	
11:35 - 11:50	Status and plans for the Barcelona analysis *15'* Speaker: Francesco Rubbo (IFAE, Barcelona)	
11:55 - 12:00	Status of Argonne WH analysis *05'* Speaker: Jinlong Zhang (Argonne National Laboratory (ANL))	
12:05 - 12:20	Neural Net based WH analysis *15'* Speaker: Dr. Paul Thompson (University of Birmingham)	
12:25 - 12:40	Second Round of Acceptance Challenge *15'* Speaker: Dr. Lianliang Ma (University of Wisconsin (Madison))	
12:45 - 13:15	Discussion on un-boosted WH selection cuts *The idea is to look at the current selection and combined performance group recommendations for reconstruction objects, quality cuts etc. We should arrive at a first idea of the object selection and cuts to be used for the summer analysis. This will be refined in the near future.* *Our current plan is outlined here (page 10): https://indico.cern.ch/getFile.py/access?contribId=0&resId=1&materialId=slides&confId=127580*	



Backup

HSG5 Validation

- Arnaud asks how to update the Trigger menu in the HSG5 validation package

- Triggers currently being monitored:
  - L1 Triggers: L1_MU10, L1_MU15, L1_MU20_XE30, L1_EM10, L1_EM14, L1_EM18_XE30, L1_TAU9I_3J5_2J20, L1_TAU9_XE15, L1_XE40
  - L2 Triggers: L2_mu10, L2_mu15, L2_mu20_xe30, L2_e10_medium, L2_e15_medium, L2_e20_loose, L2_e20_loose_xe30, L2_tau16i_loose_3j30, L2_tau16_loose_xe20, L2_xe40
  - Event Filter Triggers: EF_mu10, EF_mu15, EF_mu20_xe30, EF_e10_medium, EF_e15_medium, EF_e20_loose, EF_e20_loose_xe30, EF_tau16i_loose_3j30, EF_tau16_loose_xe20, EF_xe40

- Several of these are already obsolete…

- Please check what your triggers will be for 2011 (until Summer) and let us know

Proposed Roadmap for WH Analysis

- After the effort on cut flows, we're ready to start producing results!
  - Concentrating on un-boosted results here only because it's still unclear what would be feasible in boosted analysis until Dubna – commissioning work ongoing
  - BUT: work on boosted VH is starting in parallel – see e.g. Wahid's talk today
- Intended results:
  - Cut-based analysis focusing on WH -> e/μ ν b b
    - I think there should be at least 2 analyses, for cross checking results
    - Ideally using 2 different data formats (AOD vs D3PD)
  - Multivariate analysis in parallel, to improve on cut-based analysis
- Timeline:
  - Analyses should be semi-frozen by Dubna (17 – 19 May)
  - This leaves around 7 weeks
- Results in the form of:
  - Histogram with # events vs m_H
  - Table of # events expected for each value of m_H and background type – including statistical and systematic uncertainties
  - Exclusion plot vs m_H (95% C.L. limit on σ/σ_{SM})
  - …plus control plots etc

Questions to be answered

- Cut-based analysis focusing on WH -> e/μ ν b b
  - Establish analysis selection: why is each cut applied and why at each particular value? Are we convinced this is the right thing to do?
  - Establish set of systematic uncertainties: start from combined performance group recommendations. What are the most important? Are there any hidden pitfalls for us?
  - What b-taggers and why? What calibrations do we expect to be ready in time? What is the corresponding systematic uncertainty?
  - What sort of exclusion limits can we expect for 0.5, 1, 2 fb^{-1} ?

- Multivariate analysis in parallel, to improve on cut-based analysis
  - What event preselection should be used and why?
  - Use for signal-background separation only or target particular backgrounds?
  - What are the possible bias? Where can it go wrong?
  - What improvement can be expected wrt cut-based analysis for 0.5, 1, 2 fb^{-1} ?

- Exclusion plot vs m_H (95% C.L. limit on σ/σ_{SM})
  - Need someone to implement RooStats workspace

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

Muon Channel Selection

Muon Object and MET Definition

- STACO Combined Muon
- Author=1 or 6
- MCP Quality Cuts for rel16
- MET Definition: MET_LocHadTopo
  - ex = MET_LocHadTopo_etx + MET_MuonBoy_etx - MET_RefMuonTrack_etx;
  - ey = MET_LocHadTopo_ety + MET_MuonBoy_ety - MET_RefMuonTrack_ety;
  - MET = sqrt(ex2+ey2);

Preselection

1. Vertex Cuts
   - $N_{vtx} \geq 1$ with $N_{tracks} \geq 3$
2. Jet Cleaning Cuts
   - Reject Events with ≥ 1 loose bad jet
   - Reject Events with ≥ 1 ugly jet
3. Muon PreSelection
   - ≥ 1 offline Muon with p_T>15 GeV
   - $|z_0^{wrtPV}| < 10$ mm for the 0^{th} vertex
4. Trigger
   - E4-G1 : EF_mu10_MG (seeded by L1_MU0)
   - G2-I1 (up to run 167576) : EF_mu13_MG (seeded by L1_MU0)
   - I1 (from run 167607) - I2 : EF_mu13_MG_tight (seeded by L1_MU10)

W → μν Selection

1. Preselection
2. One muon with
   - p_T >20GeV
   - $|\eta|$<2.4
   - Isolation $\Sigma p_{ID}^{Cone0.2}/p_T$ <0.1 (Tracks must come from selected vertex)
   - Veto Events with 2nd cb muon with p_T>20GeV
3. Missing Energy based on MET_LocHadTopo
   - E_T^{Miss} >25GeV
4. Transverse Mass
   - M_T >40GeV

Z → μμ Selection

1. Preselection
2. Two muons with the largest p_T which fulfill
   - p_T >20GeV
   - $|\eta|$<2.4
   - Isolation $\Sigma p_{ID}^{Cone0.2}/p_T$ <0.1 (Tracks must come from selected vertex)
3. Opposite Charge
4. Invariant Mass Cut
   - $66<m_{\mu\mu}<116$GeV

Electron Channel Selection

Electron Object and MET Definition

- use v16 OTX check and only using final map for run 167521
- use simple combination of E of the cluster and η and ϕ from the track (unless the track has <4 SCT +Pixel hits)
- η-cuts should be performed with cluster coordinates for OTX, $|\eta|<2.47$, crack removal
  - More Details under: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/ElectronsEnergyDirection
- MET Definition: MET_LocHadTopo
  - To be corrected for energy scaling/smearing

Preselection

1. Vertex Cuts
- $N_{vtx} \geq 1$ with $N_{tracks} \geq 3$

2. Jet Cleaning Cuts
- Reject Events with ≥ 1 loose bad jet
- Reject Events with ≥ 1 ugly jet

3. Electron PreSelection
- ≥ 1 offline electron with p_T>15 GeV with egammaPID::Medium_WithTrackMatch

4. Trigger
- Period ABCDE1-E3 (up to and including run 160879) : L1_EM14
- Period E4-I2: Trigger EF_e15_medium

W → eν Selection

1. Preselection
2. One electron with
- egammaPID::Tight_WithTrackMatch
- Author 1 or 3
- p_T >20GeV
- $|\eta|<2.47$ excl. $1.37 < |\eta| < 1.52$
- Veto Events with 2nd medium electron with p_T>20GeV and electron isolation: 4 GeV on corrected E_T^{cone20}

3. Missing Energy based on MET_LocHadTopo
- E_T^{Miss} >25GeV

4. Transverse Mass
- M_T >40GeV

Z → ee Selection

1. Preselection
2. Two electrons with the largest p_T which fulfill
- Author 1 or 3
- egammaPID::Medium_WithTrackMatch
- p_T >20GeV
- $|\eta|<2.47$ excl. $1.37 < |\eta| < 1.52$

3. Opposite Charge
4. Invariant Mass Cut
- $66<m_{ee}<116$GeV

Tight Selection and Jet Definition

1. Additional Tight Selection for W/Z+jets

- Electrons: Require additional relative Isolation (on corrected isolation energy):

  $E_T^{cone20,Corrected}/P_T^{ele} < 0.2$

  - Note: cut value need to be adjusted
  - this is not yet in the WZ-D3PDs but can be calculated via el_Etcone20
    - https://svnweb.cern.ch/trac/atlasusr/browser/mfiascar/WjetsD3PDskimming/trunk/IsoCorrection.cxx
    - https://svnweb.cern.ch/trac/atlasusr/browser/mfiascar/WjetsD3PDskimming/trunk/IsoCorrection.h
    - float El_Etcone20_pt_corrected = isoTool.correctElectronIsolation (m_el_eta->at(i), m_el_pt->at(i), m_el_Etcone20->at(i));
- $|d_0^{wrtPV}| < 0.1$mm
- W-Channel: Reject events with second lepton
  - Isolated, medium electron with p_T>20GeV
  - Combined muon with p_T>20GeV
- Currently no JVF Cut

2. Overlap Removal

- Lepton/Jet Overlap removal
  - Remove closest jet to a well reconstructed W/Z decay lepton if this jet is closer than ΔR<0.2
  - Remove event if jet with $p_T \geq 20$ GeV is closer than 0.6 to signal lepton
- Jet-Isolation
  - Apply no Jet Isolation, but apply uncertainties from jet/etmiss group for close-by jets

4. Jet Selection

- Collection: AntiKt jets build from topoclusters
  - Size: results from various jet sizes: 0.4 and 0.6 (add more as calibration get available)
  - Priority: 0.4 Cone Size
- Scale Definition: Use EM+JES jets with offset, and beam spot corrections until GCW and LCW get available
- Remove Jets (which are no signal leptons) with $p_T \geq 20$ GeV and
  - Medium Bad Jets Definition (= tight+ in rel15)
  - Negative Energy
- Jet threshold: Jets are considered if $p_T \geq 30$ (Baseline) and 20 GeV (Optional after careful studies)
  - both cuts should be applied through out the full analysis. Keep in mind that the 20GeV might only be doable for the 2010 data
- Rapidity Rage: $|y| < 4.5$

5. B-Jet Selection

- Collection: AntiKt jets build from topoclusters with cone-size 0.4
- Scale Definition: Use EM+JES jets with offset, and beam spot corrections
- $P_T \geq 30$ GeV (Baseline) and $P_T \geq 20$ GeV
- $|\eta| < 2.1$
- SV0 tagger: Cut at 5.85 in r16
- use BTagging Calibration Tool to reweight MC using SF provided by b-tagging group

Future changes in W/Z baseline selection

To be studied and discussed

To be studied

Electron Selection
- Study various electron isolation criteria
- Study possibility to replace tight with medium +isolation for inclusive measurements

Muon Selection
- Effect of z0 and d0 cuts on the track selection
- Effect of new isolation cut on the inclusive measurements
- Staco / Muid ?

MET Definition
- Performance of MET_RefFinal_em and MET calculation of M.Boonekamp et.al. in VB+jets

Jet/Lepton Overlap removal
- Possibility to resolve jet reconstruction with nearby leptons
- Effect of lepton/jet overlap removal for large jet multiplicities
- Jet Unfolding: Compare unfolding w.r.t. pure truth container or to truth container when applying same lepton/jet/jet removal cuts

Jets:
- Calibration for jets in W/Z+jets events (flavor effects, this is multiplicity dependent)
- Close-by jets in W/Z+jets topology with more than 1 jet.
- Similar effects in B-jets

JVF Cut
- Study impact of new JVF Cut in rel.16
- Study Impact of Mc and data discrepancies
- Is it possible to correct for pile-up during unfolding?

B-Jet Definition
- Study sensible definition of truth b-jet
- Study Calibration constants for b-tagging between 2.1 and 2.5 (get in contact with C. Weiser)

Study S/B ratio of Di-Boson analyses
- Loosen p_T cut on second lepton
- Use medium electron with/without isolation