ATLAS Note

EXOT-2018-XX

October 23, 2018

Draft version 0.1

EXOT group text snippets for INT notes

ATLAS EXOT Group

This note contains text snippets and tables that should be included in supporting notes from the EXOT group.

The templates are in American English. Some adaption to British English is therefore required.

This document was generated using version 05-08-00 of the ATLAS LaTeX package.

2018-10-23: This file is a work in progress (WIP) and will probably be updated. Backwards incompatible changes may be made as the examples develop.

Contents

1 Executive Summary

This section, ideally 2-pages (max), should be placed at the beginning of the internal note. It should give a high-level overview of the analysis including (but not limited to):

- physics target and the general characteristics of the signal;
- analysis strategy;
- general characteristics of the control, validation, and signal regions;
- background estimation strategy overview;
- highlight major or most important points of the analysis;
- team overview task list;
- list of all critical tasks, who is responsible for each, and what else they are working on outside of this analysis.

split as in the subsections below.

1.1 Target

O(1 paragraph) Is this a new analysis? If not, what are the main improvements expected with respect to the previous version? What is the target publication date / conference?

1.2 Context

Motivate this analysis in 1 paragraph: why is this signature interesting? Which kind of models are you probing?

How is the analysis done is 1 paragraph: what are the main BG processes and how do you estimate them (are they MC- or data-driven, what is the general idea of the control regions, . . .), general characteristics of the PL fit (which distribution, binned?, . . .)

1.3 Milestones

Table giving a factual list of who is working on what and what else they do; the idea is to show how the team can / does progress.

The following table summarizes the tasks to be worked on by analysis team. This is not a complete analysis outline but only an overview of the further steps to be taken as of the time of writing. Details are not provided here but in the dedicated sections throughout this note. Tasks which are based on established techniques and straightforward to achieve are marked green in the table. Tasks which require new work are marked red. Concerning the involved people, the responsible student supervisors and analysis coordinators are already mentioned in the list of contributions above, which shall not be repeated here. A fair overview of all single tasks including past work and of all relevant team members is only given in the list of contributions above! It is also worth noting that some of the tasks listed below are being worked on in parallel.

Table 1: Milestones in the analysis.

Task	Analyzer	Role	Other responsibilities
Describe a first milestone.			
A straightforward task	Name	PhD student, PostDoc/Prof/. . .	thesis writing / teaching / name some CP work . . .
A more involved task			
Describe a second milestone			
First task . . .			

2 Object selection

The supporting notes should now include the following standardized tables of properties: each analysis should simply fill them in by writing / replacing the value with the appropriate number or by choosing the appropriate option. The idea of these tables is to harmonize some sections of the supporting notes as to make review and analysis comparisons simpler.

If you use non-standard selections which do not fit in these tables, this should of course be noted and discussed in more detail in the text.

2.1 Electron selection

Table 2: Electron selection criteria.

Feature	Criterion
Pseudorapidity range	$\|\eta\| < \mathrm{X}$
Energy calibration	`es2017_R21_PRE` (ESModel)
Energy	$E > \mathrm{XX\,GeV}$
Transverse energy	$E_{\mathrm{T}} > \mathrm{XX\,GeV}$
Transverse momentum	$p_{\mathrm{T}} > \mathrm{XX\,GeV}$
Object quality	Not from a bad calorimeter cluster (`BADCLUSELECTRON`) Remove clusters from regions with EMEC bad HV (2016 data only)
Track to vertex association	$\|d_0^{\mathrm{BL}}(\sigma)\| < X$ $\|\Delta z_0^{\mathrm{BL}} \sin\theta\| < \mathrm{X\,mm}$
Identification	(`Loose/Medium/Tight`)
Isolation	`LooseTrackOnly / Loose / Tight / Gradient / ...`

Notes:

- Pseudorapidity: when the calorimeter crack is not excluded, the range can be indicated simply as "$|\eta| < 2.47$", when the crack is excluded: "$(|\eta| < 1.37) \quad || \quad (1.52 < |\eta| < 2.47)$".
- Usually only one among "Energy", "Transverse energy" and "Transverse momentum" criteria is applied — the 30 GeV value is just an example. In special cases energy (i.e. calorimeter-based measurement) and momentum (i.e. tracking-based measurement) criteria can be required in order to constraint different aspects of the reconstruction.
- Electron ID: 3 working points (Loose/Medium/Tight) are evaluated using the Likelihood-based (LH) method, by the ElectronPhotonSelectorTools.
- Energy calibration of electrons is implemented in the ElectronPhotonFourMomentumCorrection tool.
- Scale Factors for efficiencies for electrons are implemented in the ElectronEfficiencyCorrection tool.
- Updated configurations for the EGamma CP tools can be found on this TWiki page.

2.2 Photon selection

Table 3: Photon selection criteria.

Feature	Criterion
Pseudorapidity range	$\|\eta\| < \mathrm{X}$
Energy calibration	`es2017_R21_PRE` (ESModel)
Energy	$E >$ XX GeV
Transverse energy	$E_{\mathrm{T}} >$ XX GeV
Object quality	Not from a bad calorimeter cluster (`BADCLUSELECTRON`) Remove clusters from regions with EMEC bad HV (2016 data only)
Photon cleaning	`passOQquality`
Fudging	Applied for Full sim / not for AtlFastII
Identification	(`Loose/Tight`)
Isolation	`FixedCutTightCaloOnly / FixedCutTight / FixedCutLoose`

Notes:

- Pseudorapidity: please note that the maximum value for $|\eta|$ for photon candidates (2.37) is smaller than for electron candidates (2.47). If crack excluded: "($|\eta| < 1.37$) || ($1.52 < |\eta| < 2.37$)".
- Usually only one between "Energy" and "Transverse energy" criteria is applied — the 30 GeV value is just an example.
- Photon cleaning: a new Photon helper is available to apply the photon cleaning cut (from the `ElectronPhotonSelectorTools`, tag ≥ 00-02-92-21, release ≥ 2.4.30).
- Photon ID: 2 working points (Loose/Tight) are evaluated using a cut-based method, by the ElectronPhotonSelectorTools.
- Energy calibration of photons is implemented in the ElectronPhotonFourMomentumCorrection tool.
- Scale Factors for efficiencies for photons are implemented in the ElectronEfficiencyCorrection tool.
- Updated configurations for the EGamma CP tools can be found on this TWiki page.

2.3 Muon selection

Table 4: Muon selection criteria.

Feature	Criterion
Selection working point	`Loose/Medium/Tight /High-pT`
Isolation working point	`LooseTrackOnly/Loose/Tight/Gradient/...`
Momentum calibration	Sagitta correction [used/not used]
p_{T} Cut	X GeV
$\lvert\eta\rvert$ cut	$< X$
d_0 significance cut	X
z_0 cut	X mm

The selection criteria are implemented in the `MuonSelectorTools-XX-XX-XX` with `MuonMomentumCorrections-XX-XX-XX`, isolation in `IsolationSelection-XX-XX-XX` and d_0 and z_0 cuts in `xAODTracking-XX-XX-XX`. The muon recommendations can be found in MCPAnalysis-GuidelinesMC16.

2.4 Tau selection

Table 5: Tau selection criteria.

Feature	Criterion
Pseudorapidity range	$\|\eta\| < X$
Track selection	1 or 3 tracks
Charge	$\|Q\| = 1$
Tau energy scale	`MVA TES`
Transverse momentum	$p_{\mathrm{T}} >$ XX GeV
Jet rejection	BDT-based (`Loose/Medium/Tight`)
Electron rejection	BDT-based
Muon rejection	Via overlap removal in $\Delta R < 0.2$ and $p_{\mathrm{T}} > 2$ GeV. Muons must not be Calo-tagged

If the crack is excluded: $(|\eta| < 1.37)||(1.52 < |\eta| < 2.5)$

The selection criteria are all implemented in the `TauSelectionTool` as part of the `TauAnalysisTools`. Documentation can be found in the README-TauSelectionTool.rst.

2.5 Small-R jet selection

If you want to use variables such as `\fcut` you need to add the option `jetetmiss` to `atlaspackage`.

Table 6: Jet reconstruction criteria.

Feature	Criterion
Algorithm	Anti-k_t
R-parameter	0.4
Input constituent	EMTopo
Analysis release number	21.2.10
`CalibArea` tag	00-04-81
Calibration configuration	`JES_data2017_2016_2015_Recommendation_Feb2018_rel21.config`
Calibration sequence (Data)	`JetArea_Residual_EtaJES_GSC_Insitu`
Calibration sequence (MC)	`JetArea_Residual_EtaJES_GSC`
Selection requirements	
Observable	Requirement
Jet cleaning	`LooseBad`
BatMan cleaning	No
p_{T}	$>$ XX GeV
$\lvert\eta\rvert$	$< X$
JVT	(*Update if needed*) > 0.59 for $p_{\mathrm{T}} < 60$ GeV, $\lvert\eta\rvert < 0.4$

2.6 Large-R jet selection

Table 7: Large-R jet reconstruction criteria.

Feature	Criterion
Algorithm	anti-k_t
R-parameter	1.0
Input constituent	`LCTopo`
Grooming algorithm	Trimming
f_{cut}	0.05
R_{trim}	0.2
Analysis release number	21.2.10
`CalibArea` tag	00-04-81
Calibration configuration	`JES_MC16recommendation_FatJet_JMS_comb_19Jan2018.config`
Calibration sequence (Data)	`EtaJES_JMS_Insitu`
Calibration sequence (MC)	`EtaJES_JMS`
Selection requirements	
Observable	Requirement
p_{T}	$>$ XX GeV
$\lvert\eta\rvert$	$< X$
Mass	$>$ XX GeV
Boosted object tagger	
Object	Working point
W / Z / top	50% / 80%
$X \to bb$	single/double b-tagging with/without loose/tight mass

2.7 $E_{\text{T}}^{\text{miss}}$ selection

Table 8: $E_{\mathrm{T}}^{\mathrm{miss}}$ reconstruction criteria.

Parameter	Value
Algorithm	Calo-based
Soft term	Track-based (TST)
MET operating point	`Tight`
Analysis release	21.2.16
Calibration tag	`METUtilities-00-02-46`
Selection requirements	
Observable	Requirement
$E_{\mathrm{T}}^{\mathrm{miss}}$	$>$ XX GeV
$\sum E_{\mathrm{T}}/E_{\mathrm{T}}^{\mathrm{miss}}$	$< X$
Object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance	$> X$

2.8 Jet flavor tagging selection

Table 9: *b*-tagging selection criteria.

Feature	Criterion
	EM Topo Jets / Track jets / VR jets
Jet collection	`AntiKt4EMTopo/AntiKt2PV0/AntiKtVR30Rmax4Rmin02`
Jet selection	$p_{\mathrm{T}} >$ XX GeV $\lvert\eta\rvert < X$ JVT cut if applicable
Algorithm	`MV2c10/MV2c10mu/MV2c10rnn/DL1/DL1mu/DL1rnn`
Operating point	Hybrid / Fixed Eff = 60 / 70 / 77 / 85
CDI	`2017-21-13TeV-MC16-CDI-2017-12-22_v1`

2.9 Track selection

If you use tracks as particular objects on which you cut in your analysis.

Table 10: `TrackParticle` object selection criteria.

Tracking algorithm	Primary / Large Radius Tracking / Custom
Track quality selection (official)	`Loose/Tight`
p_{T}	$>$ XX GeV
$\lvert\eta\rvert$	$< X$
Track-vertex association criteria	`Loose/Tight`
Track-to-tet association method	Ghost Matched / ΔR

2.10 Overlap removal

The reconstruction of the same energy deposits as multiple objects is resolved using the standard overlap removal tools, `AssociationUtils`, documented here

The (Standard/Heavy-flavor/Boosted/Boosted+Heavy-flavor/lepton-favored) working point is used corresponding to:

Reject	Against	Criteria
Electron	Electron	shared track, $p_{\mathrm{T},1} < p_{\mathrm{T},2}$
Tau	Electron	$\Delta R < 0.2$
Tau	Muon	$\Delta R < 0.2$
Muon	Electron	is Calo-Muon and shared ID track
Electron	Muon	shared ID track
Photon	Electron	$\Delta R < 0.4$
Photon	Muon	$\Delta R < 0.4$
Jet	Electron	[$\Delta R < 0.2$ / Not a b-jet and $\Delta R < 0.2$]
Electron	Jet	[$\Delta R < 0.4$ / $\Delta R < \min(0.4, 0.04 + 10\,\mathrm{GeV}/p_{\mathrm{T}}(e))$/None]
Jet	Muon	[`NumTrack` < 3 and (ghost-associated or $\Delta R < 0.2$) / not a b-jet and `NumTrack` < 3 and (ghost-associated or $\Delta R < 0.2$)]
Muon	Jet	[$\Delta R < 0.4$ / $\Delta R < \min(0.4, 0.04 + 10\,\mathrm{GeV}/p_{\mathrm{T}}(\mu))$/None]
Jet	Tau	$\Delta R < 0.2$
Photon	Jet	$\Delta R < 0.4$
Fat-jet	Electron	$\Delta R < 1.0$
Jet	Fat-jet	$\Delta R < 1.0$

ΔR is calculated using rapidity by default.

3 Event selection

The following items should also be filled in for the event selection.

3.1 Event cleaning

Following the recommendations of the DataPrep group, the following event-level requirements are made.

We use the official GRL:

```
FILL IN HERE
```

The following event-level vetos are made to reject bad / corrupt events:

- LAr noise burst and data corruption (`xAOD::EventInfo::LAr`),
- Tile corrupted events (`xAOD::EventInfo::Tile`),
- events affected by the SCT recovery procedure for single event upsets (`xAOD::EventInfo::SCT`),
- incomplete events (`xAOD::EventInfo::Core`).

Debug stream events [have/have not] been included.

Checks [have/have not] been done to remove duplicate events.

Events are required to have a primary vertex with at least two associated tracks. The primary vertex is selected as the one with the largest Σp_{T}^2, where the sum is over all tracks with transverse momentum $p_{\mathrm{T}} > 0.4\,\mathrm{GeV}$ that are associated with the vertex.