Table of Contents

Low-pT electrons

This TWiki briefly documents the support available for and the performance of low-pT electrons.

Authors and contacts

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Contact: ?

Quick start guide

Low-pT electrons are fully supported in ... blah ... (very short statement).

Documentation

"Recording and reconstructing 10 billion unbiased B meson decays in CMS to probe lepton flavour universality"
EPJ Web of Conferences 245, 01025 (2020), CMS-CR-2020-081

"Recording and reconstructing 10 billion unbiased b hadron decays in CMS"
CMS-DP-2019-043

Analysis note

Relevant talks:

- Status report to XPOG, 28th April 2021 here

Etc?...

Algorithm overview

List of modules and their functions

Support for CMSSW data sets and simulation

- All CMS data sets are supported except for Heavy Ion
- Fast Simulation is not yet supported

Support for CMSSW releases and data tiers

Recommended

- **The recommended release version is CMSSSW_10_6_20 for studies with UltraLegacy data sets.**
- The very latest developments can be found in the development release cycle, currently 11_3_X
- We attempt to back port useful developments to previous release cycles (currently only 10_6_X)

The table (and key/footnotes) below provides the details of status for the supported release cycles.

How to read the table? Choose the CMSSW release cycle you wish to work with and then choose a release version (i.e. the column). Look down the column to see what you get by default and by applying the available eras and modifiers (e.g. bParking, run_miniAOD_UL, run_miniAOD_devel, ...).

Release Cycle	10_6_X		11_3_X
CMSSW Version	10_6_20	>10_6_20 (PR under review here...)	11_3_0_pre6
Recommended?	Yes	Yes	Yes
RECO/AOD data tiers			
Default behaviour	**Modifiers**: None **Ele**: Yes (Sequence,Collections) **Thr**: pT > 1.0 GeV, Tight Seed **Rekey**: No **EReg**: No [1] **ID**: Autumn18 [2] Already used in earlier release for UL RECO of non-BParking data sets. Sub-optimal ID. No longer recommended. Listed for completeness.	**Modifiers**: None **Ele**: Yes (Sequence,Collections) **Thr**: pT > 1.0 GeV, Tight Seed **Rekey**: No **EReg**: No [1] **ID**: Autumn18 [2] Sub-optimal ID. Not recommended. Listed for completeness.	**Modifiers**: None **Ele**: Yes (Sequence,Collections) **Thr**: pT > 1.0 GeV, Tight Seed **Rekey**: Yes **EReg**: Yes GT(mc): xxx GT(data): xxx **ID**: 2020Nov28 [3] Recommended for future (non-BParking) data sets.
(Only the "delta" for the bParking modifier w.r.t. default is shown below)			
bParking era	**Modifiers**: bParking **Thr**: pT > 0.5 GeV, VLoose Seed Not recommended. Listed for completeness.	**Modifiers**: bParking **Thr**: [[][pT > 0.5 GeV, VLoose Seed]] **Rekey**: [[][Yes]] **EReg**: [[][Yes]] GT(mc): xxx GT(data): xxx **ID**: [[][2020Nov28]] [3] Recommended for UL re-RECO of BParking data sets.	**Modifiers**: bParking **Thr**: pT > 0.5 GeV, VLoose Seed Recommended for future BParking data sets.
MINIAOD data tier			
Default behaviour	**Modifiers**: None **Pat**: No	**Modifiers**: None **Pat**: No	**Modifiers**: None **Pat**: Yes [5] **Select**: pT > 1.0 GeV, ID > -0.25 [6] Recommended for future (non-BParking) data sets.

(Only the "delta" for various combinations of the bParking, run2_miniAOD_UL, and run2_miniAOD_devel modifiers w.r.t. default is shown below)			
UL re-miniAOD No bParking era	**Modifiers**: (~bParking & run2_miniAOD_UL) **Rekey**: Yes **ID**: 2020Sept15 [4] (Rerun on AOD) **Pat**: Yes [5] **Select**: pT > 1.0 GeV, ID > 1.5 [7] Already used for UL re-miniAOD of non-BParking data sets (Winter 2020 campaign). (Subject to no-change rule.) No longer recommended.	**Modifiers**: (~bParking & run2_miniAOD_devel) **Rekey**: [[][Yes]] **EReg**: [[][Yes]] ([[][Rerun]] on AOD) GT(mc): xxx GT(data): xxx **ID**: [[][2020Nov28]] [3] ([[][Rerun]] on AOD) **Pat**: [[][Yes]] [5] **Select**: [[][pT > 1.0 GeV, ID > -0.25]] [6] Recommended for future UL re-miniAOD of non-BParking data sets.	**Modifiers**: (~bParking & run2_miniAOD_UL) **Rekey**: Yes **EReg**: Yes (Rerun on AOD) GT(mc): xxx GT(data): xxx **ID**: 2020Nov28 [3] (Rerun on AOD) **Pat**: Yes [5] **Select**: pT > 1.0 GeV, ID > -0.25 [6] Can be used for future UL re-miniAOD of non-BParking data sets.
bParking era No UL re-miniAOD	**Modifiers**: (bParking & ~run2_miniAOD_UL) **Rekey**: Yes **ID**: Autumn18 (Rerun on AOD) **Pat**: Yes [5] **Select**: None (i.e. open) Sub-optimal ID. Not recommended on top of re-RECO of bParking data sets. Listed for completeness.	**Modifiers**: (bParking & ~run2_miniAOD_UL) **Pat**: [[][Yes]] **Select**: None (i.e. [[][open]]) Can be used on top of re-RECO of bParking data sets. Not recommended due to absence of run2_miniAOD_UL. (Instead, see below.)	**Modifiers**: (bParking & ~run2_miniAOD_UL) **Pat**: Yes **Select**: None (i.e. open) Recommended for future BParking data sets.
UL re-miniAOD bParking era	**Modifiers**: (bParking & run2_miniAOD_UL) **Rekey**: Yes **ID**: 2020Sept15 [4] (Rerun on AOD) **Pat**: Yes [5] **Select**: None (i.e. open) Not recommended on top of re-RECO of bParking data sets. Listed for completeness.	**Modifiers**: (bParking & run2_miniAOD_UL) **Pat**: [[][Yes]] **Select**: None (i.e. [[][open]]) Recommended for UL re-miniAOD of bParking data sets.	**Modifiers**: (bParking & run2_miniAOD_UL) **Pat**: Yes **Select**: None (i.e. open) Recommended for future BParking data sets.
NANOAOD data tier			
Default behaviour	No	No	No
(Below: only "delta" w.r.t. default is shown)			
To come...			

iniAOD
Standard data sets
Winter 2020
Modifiers: (run2_miniAOD_UL & ~bParking) **ID**: 2020Sept15 [4] (Rerun on AOD)
Pat: Yes [5]
Select: pT > 1.0 GeV, ID > 1.5 [7] Not applicable *Note: identical to default behaviour.*
EReg: Yes (Rerun on AOD)
GT(mc): xxx
GT(data): xxx
ID: 2020Nov28 [3] (Rerun on AOD)
Pat: Yes [5]
Select: pT > 1.0 GeV, ID > -0.25 [6] UL re-miniAOD
BParking data set
Summer 2021?
Modifiers (bParking & run2_miniAOD_UL) **ID**: Autumn18 (Rerun on AOD) Bug!
Pat: Yes [5]
Select: None (i.e. open) **Pat**: [[][Yes]]
Select: None (i.e. [[][open]]) **Pat**: Yes
Select: None (i.e. open) Future UL re-miniAOD
Standard data sets
Winter 2021?
Modifiers: (run2_miniAOD_devel & ~bParking) Not applicable *Note: identical to bParking except for "Select".*
EReg: [[][Yes]] ([[][Rerun]] on AOD)
GT(mc): xxx
GT(data): xxx
ID: [[][2020Nov28]] [3] ([[][Rerun]] on AOD)
Pat: [[][Yes]] [5]
Select: [[][pT > 1.0 GeV, ID > -0.25]] [6] Not applicable Default behaviour No No No
(Below: only "delta" w.r.t. default is shown) To come... ################################ REORGANISED TABLE ################################ -->

ikiTableCol3 twikiLastCol" valign="top"> **Thr**: pT > 0.5 GeV, VLoose Seed MINIAOD **ID**: Autumn18 (Rerun on AOD) Bug!
Pat: Yes [5]
Select: None (i.e. open) **Pat**: [[][Yes]]
Select: None (i.e. [[][open]]) **Pat**: Yes
Select: None (i.e. open) Only the "delta" from the run2_miniAOD_UL modifier w.r.t. the default behaviour is shown below. MINIAOD **ID**: 2020Sept15 [4] (Rerun on AOD)
Pat: Yes [5]
Select: pT > 1.0 GeV, ID > 1.5 [7] Not applicable *Note: identical to default behaviour.*
EReg: Yes (Rerun on AOD)
GT(mc): xxx
GT(data): xxx
ID: 2020Nov28 [3] (Rerun on AOD)
Pat: Yes [5]
Select: pT > 1.0 GeV, ID > -0.25 [6] Only the "delta" from the run2_miniAOD_devel modifier w.r.t. the default behaviour is shown below. MINIAOD Not applicable *Note: identical to bParking except for "Select".*
EReg: [[][Yes]] ([[][Rerun]] on AOD)
GT(mc): xxx
GT(data): xxx
ID: [[][2020Nov28]] [3] ([[][Rerun]] on AOD)

Pat: [[][Yes]] [5]
Select: [[][pT > 1.0 GeV, ID > -0.25]] [6] Not applicable ############################## ORIGINAL TABLE END ############################## -->

Key:

- **Modifiers**: indicates the logic required to obtain the desired behaviour (in certain cases, the logic for past campaigns is implicitly rather than explicitly coded).
- **Ele**: indicates if reconstructed low-pT electrons are available by default in the RECO/AOD data tiers.
- **Thr**: indicates thresholds applied during reconstruction:
    - ♦ ElectronSeed working point, e.g. Tight or V(ery)Loose (see Performance section below for details)
    - ♦ Minimum seed track pT, e.g. 0.5 or 1.0 GeV
- **EReg**: indicates if energy regression is applied by default.
- **Rekey**: indicates if the ValueMaps holding the Seed BDT scores are rekeyed by reco::GsfElectronRef
- **ID**: indicates if ID is available in the form of a discriminator score from the specified BDT model. Further details can be found in the Performance section.
- **Pat**: indicates if "low-pT" PAT electrons are available by default in the MINIAOD data tier
- **Select**: indicates thresholds applied during the PAT select step, e.g. on the ID score and/or pT

Footnotes:

- Current recommendations given in coloured text: recommended, possible / previously used, not recommended.
- Embedded URLs typically point to the relevant CMSSW python configuration.
- [1] The absence of an energy regression does not significantly affect the ID performance. A possible "patch" is to build the electron 4-momentum from GsfTrack mode momentum and electron mass.
- [2] Recipes are available to run the latest ID algorithm as a post-processing step. in case a model is not available by default in the release or to supersede an existing model. While this is discouraged, please contact the authors for details if required.
- [3] The "2020Nov28" ID model was trained with CMSSW_10_6_20 using 10_6_X MC B->Kee (UltraLegacy) samples.
- [4] The "2020Sept15" ID model was trained with CMSSW_10_2_15 using 10_2_X MC B->Kee samples.
- [5] The MINIAOD contains two collections: the "slimmedLowPtElectrons" and the "gsfTracksOpenConversions". The former embeds all useful information (BDT-based seed and ID discriminator scores, GsfTrack and cluster info, etc). The latter is used to identify low-pT electrons from photon conversions.
- [6] The pT and ID score thresholds are tuned to give a 90% signal efficiency and add 2% to the default MINIAOD footprint

Minimal support

- The release cycle 10_2_X is not recommended. (This release cycle is used by some of the ongoing BParking-based analyses, e.g. R(K) using 2018 data. However, the code base relies heavily on cms-merge-topic recipes supported by experts.)
- The release cycle 11_2_X is not recommended.

The table (and key/footnotes) below provides the details of status for **unsupported** release cycles.

Release Cycle	10_2_X	11_2_X
CMSSW Version	10_2_15	11_2_0

Recommended?	No	No
Default Processing		
RECO/AOD	**Ele**: Yes **Thr**: pT > 1.0 GeV, Tight **EReg**: No **ID**: Autumn18 Sub-optimal!	**Ele**: Yes **Thr**: pT > 1.0 GeV, Tight **EReg**: No **ID**: **ID**: Autumn18 Sub-optimal!
MINIAOD	**Pat**: No	**Pat**: No
NANOAOD	No	No
(Re)processing with the bParking era		
RECO/AOD	**Ele**: Yes **Thr**: pT > 0.5 GeV, VLoose	**Ele**: Yes **Thr**: pT > 1.0 GeV, VLoose
MINIAOD	**Pat**: Yes	**Pat**: Yes

GT: MC: 106X_upgrade2018_realistic_v16_L1v1 Data: 106X_dataRun2_v33

Key:

- **Ele**: indicates if reconstructed low-pT electrons are available by default in the RECO/AOD data tiers.
- **Thr**: indicates thresholds applied during reconstruction ...
  - ♦ ElectronSeed working point, e.g. Tight or V(ery)Loose (see Performance section below for details)
  - ♦ Minimum seed track pT, e.g. 0.5 or 1.0 GeV
  - ♦ ... OR indicates thresholds applied during the PAT select step, e.g. on the ID score
- **ID**: indicates if ID is available in the form of a discriminator score from the specified BDT model. Further details can be found in the Performance section.
- **EReg**: indicates if energy regression is applied by default.
- **Pat**: indicates if "low-pT" PAT electrons are available by default in the MINIAOD data tier

Recent developments

Recent PRs to CMSSW are detailed below

- #31220
  - ♦ Merged to master on 2 Dec 2020, entered CMSSW_11_3_0_pre6
  - ♦ "Add low-pT electrons to MINIAOD, update ID, improve end user experience"
  - ♦

Code examples

This section provides some concrete code examples on how to use the low-pT electrons.

Performance

Shown below are some representative performance plots.

Analyses using low-pT electrons

Several analyses have expressed an interest in using low-pT electrons. Below is a (non-exhaustive) list of those we are aware of. Please volunteer to add your information here if you plan to use low-pT electrons.

- A. N. Other, some analysis ...

This topic: Main > RobBainbridgeSandBox
Topic revision: r136 - 2021-05-12 - RobBainbridge