Electron trigger performance in 2012 ATLAS data

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Abstract

2012 electron trigger performance plots prepared for the upcoming summer conferences.
1 Resolution of electron shower shapes online with respect to offline reconstruction

Figure 1: Resolution of the electron transverse energy ($E_T$) and shower-shape variables ($E_{\text{ratio}}$, $R_\eta$, $E_{T,\text{had}}$) used for electron identification in the high-level trigger at the level-2 (L2) and event filter (EF) reconstruction with respect to the offline reconstruction. The variables are described in ATLAS-CONF-2012-048. The offline reconstructed electron is required to have a transverse energy of $E_T > 25$ GeV, a pseudorapidity of $|\eta| < 1.37$ or $1.52 < |\eta| < 2.37$ and pass medium identification. The resolutions were measured with a tag-and-probe method using $Z \rightarrow ee$ decays. They are compared to expectation from Monte Carlo simulation.
2 Single electron trigger efficiency

![Efficiency Graph](image)

**Figure 2:** Efficiencies of the e24vhi\text{medium1} OR e60\text{medium1} trigger requirement after the hardware-based Level-1 (L1), the software-based level-2 (L2) and event filter (EF) selections as a function of the offline electron candidate’s pseudorapidity $\eta$ for offline $E_T > 25$ GeV (left) and as a function of the offline transverse energy $E_T$ (right) for offline pseudorapidity of $|\eta| < 1.37$ or $1.52 < |\eta| < 2.37$.

The offline reconstructed electron is required to pass medium identification. The trigger efficiency for the e24vhi\text{medium1} is also shown after the event filter level. The e24vhi\text{medium1} trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_{\text{iso}}/E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1\_EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster. The e60\text{medium1} trigger requires an electron candidate with $E_T > 60$ GeV satisfying the medium identification with no isolation requirement. The efficiencies were measured with a tag-and-probe method using $Z \to ee$ decays. The error bars show the statistical and systematic uncertainties added in quadrature.
Figure 3: Efficiencies of the e24vhi#medium1 OR e60#medium1 trigger requirement for various offline selection criteria used in the analyses as a function of the offline electron candidate’s pseudorapidity $\eta$ for offline $E_T > 25$ GeV (left) and as a function of the offline transverse energy $E_T$ (right) for offline pseudorapidity of $|\eta| < 1.37$ or $1.52 < |\eta| < 2.37$. The e24vhi#medium1 trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_{T}^{\text{iso}}/E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1 EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster. The e60#medium1 trigger requires an electron candidate with $E_T > 60$ GeV satisfying the medium identification with no isolation requirement. The efficiencies were measured with a tag-and-probe method using $Z \rightarrow ee$ decays. The error bars show the statistical and systematic uncertainties added in quadrature.

Figure 4: Efficiencies of the e24vhi#medium1 OR e60#medium1 trigger requirement as a function of the offline electron candidate’s pseudorapidity $\eta$ for offline $E_T > 25$ GeV (left) and as a function of the offline transverse energy $E_T$ (right) for offline pseudorapidity of $|\eta| < 1.37$ or $1.52 < |\eta| < 2.37$ for different run periods in which the trigger selections did not change. The offline reconstructed electron is required to pass medium identification. The figure illustrates how the initial trigger looses were reduced with improved selection during the year. The shower-shape variables ($f_3$ and $w_{\eta}$) were first relaxed in period B4, then reoptimised in period B9. In period C1 a new tune of the level-2 tracking algorithm was deployed, which was then reverted in period C6. Further optimisation of the variable $f_3$ was applied in period D4. The e24vhi#medium1 trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_{T}^{\text{iso}}/E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1 EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster. The e60#medium1 trigger requires an electron candidate with $E_T > 60$ GeV satisfying the medium identification with no isolation requirement. The efficiencies were measured with a tag-and-probe method using $Z \rightarrow ee$ decays. The error bars show the statistical and systematic uncertainties added in quadrature.
Figure 5: Efficiencies of the e24vhi_medium1 OR e60_medium1 trigger requirement after the hardware-based Level-1 (L1), the software-based level-2 (L2) and event filter (EF) selections as a function of the number of mean interactions per bunch crossing $\langle \mu \rangle$. The offline reconstructed electron is required to pass medium identification. The e24vhi_medium1 trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_T^{\rm iso} / E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1_EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster. The e60_medium1 trigger requires an electron candidate with $E_T > 60$ GeV satisfying the medium identification with no isolation requirement. The efficiencies were measured with a tag-and-probe method using $Z \rightarrow ee$ decays. The error bars show the statistical and systematic uncertainties added in quadrature.
Figure 6: Efficiencies (left) and their uncertainties (right) of the e24vhi\_medium1 OR e60\_medium1 trigger requirement as a function of the offline electron candidate’s pseudorapidity $\eta$ and transverse energy $E_T$. The uncertainties are on the per mil level in the central region ($|\eta| < 1.37$) for $E_T < 100$ GeV. They increase to 0.5% in the endcap regions and up to 1% for some $\eta - E_T$ bins for $E_T > 100$ GeV or for $|\eta| > 2.4$ due to a lack of statistics. The offline reconstructed electron is required to pass medium identification. The e24vhi\_medium1 trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_T^{\text{iso}}/E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1\_EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster. The e60\_medium1 trigger requires an electron candidate with $E_T > 60$ GeV satisfying the medium identification with no isolation requirement. The efficiencies were measured with a tag-and-probe method using $Z \to ee$ decays. The error bars show the statistical and systematic uncertainties added in quadrature.

Figure 7: Sources of inefficiencies for the e24vhi\_medium1 trigger at the level-2 (left) and event filter (right) with respect to the offline reconstruction in run period L. The offline reconstructed electron is required to have a transverse energy of $E_T > 25$ GeV and pass medium identification. The inefficiencies were measured with a tag-and-probe method using $Z \to ee$ decays. The e24vhi\_medium1 trigger requires an electron candidate with $E_T > 24$ GeV satisfying the medium identification and a requirement $p_T^{\text{iso}}/E_T < 0.1$ on the relative track isolation calculated within a cone of $R = 0.2$. It is seeded by a level-1 trigger L1\_EM18VH that allows at most 1 GeV energy deposited in the hadronic calorimeter behind the electron candidate’s electromagnetic cluster.