Improvements and current status of the ACTS-based ITk main pass reconstruction

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Pixel clustering

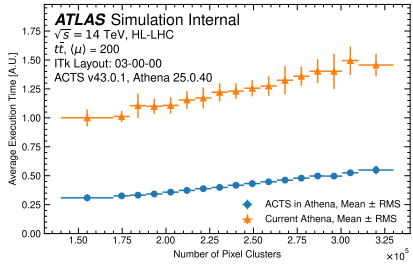

Figure: Average execution time (in arbitrary units) of the pixel clustering algorithms as a function of the number of reconstructed pixel clusters, obtained with the Athena framework running the current implementation of the clustering algorithm (comparable to the one used during Run 3 operations) and a modified version including the ACTS toolkit. The measurement was taken on the same machine and the same set of $t\bar{t}$ events at $\langle\mu\rangle = 200$ with a center of mass energy of $\sqrt{s} = 14$ TeV, using the ITk Layout 03-00-00. An average timing improvement per event of $\sim 3\times$ with the ACTS based clustering algorithm is observed while achieving exactly identical physics results.

Strip clustering

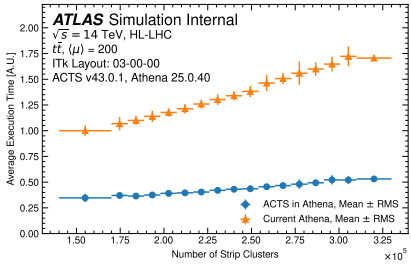

Figure: Average execution time (in arbitrary units) of the strip clustering algorithms as a function of the number of reconstructed strip clusters, obtained with the Athena framework running the current implementation of the clustering algorithm (comparable to the one used during Run 3 operations) and a modified version including the ACTS toolkit. The measurement was taken on the same machine and the same set of $t\bar{t}$ events at $\langle\mu\rangle = 200$ with a center of mass energy of $\sqrt{s} = 14$ TeV, using the ITk Layout 03-00-00. An average timing improvement per event of $\sim 3\times$ with the ACTS based clustering algorithm is observed while achieving exactly identical physics results.

Tracking efficiency

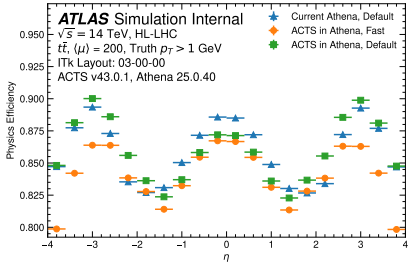

Figure: Tracking efficiency as a function of the pseudo-rapidity η of the associated truth particle using the ITk Layout 03-00-00 for $t\bar{t}$ events at $\langle\mu\rangle = 200$. Efficiency is defined as the ratio between the number of reconstructed tracks matched to truth particle and all selected truth particles. The truth particles considered must satisfy $p_{\mathrm{T}} > 1$ GeV and $|\eta| < 4.0$, and be produced by the primary interactions and are matched to a reconstructed track if the matching probability is larger than 50%. Track candidates are reconstructed using the ACTS Combinatorial Kalman Filter from ACTS v43.0.1 in Athena 25.0.40. Final tracks are fulfilling the following list of requirements: number of measurements (pixel + strip) ≥ 7, $p_{\mathrm{T}}^{\mathrm{reco}} > 900$ MeV (400 MeV) in $|\eta| < 2.0$ ($2.0 < |\eta| < 4.0$), $|z_0^{\mathrm{reco}}| \leq 20$ cm and $|d_0^{\mathrm{reco}}| \leq 2$ mm (10 mm)

Tracking resolution $\sigma(d_0)$

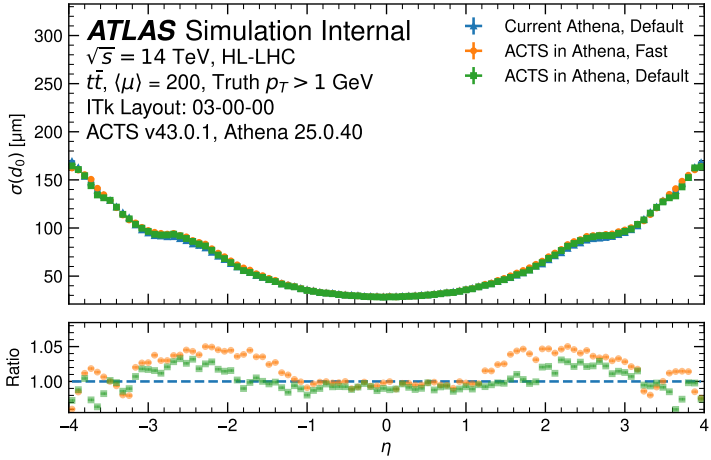

Figure:

Tracking resolution $\sigma(z_0)$

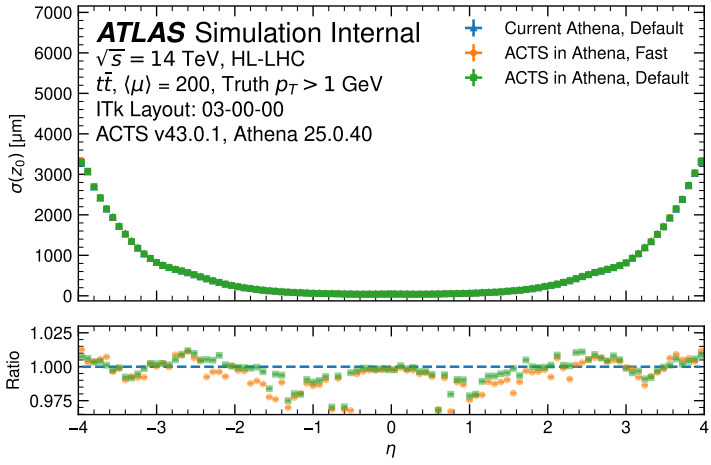

Figure:

Tracking resolution p_t $\sigma(q/p_t)$

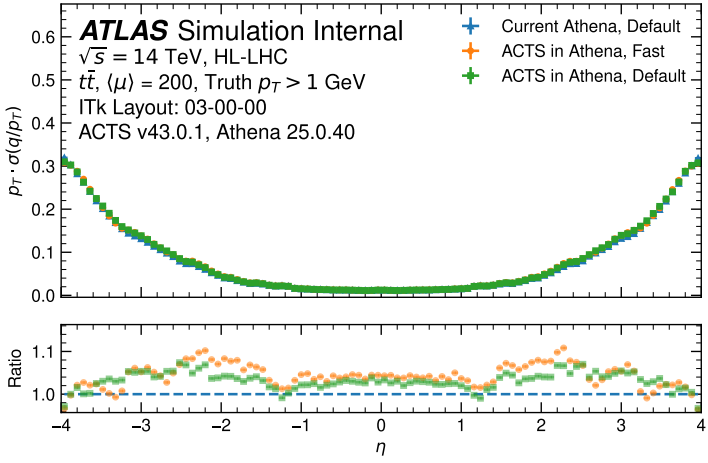

Figure:

CPU time evolution

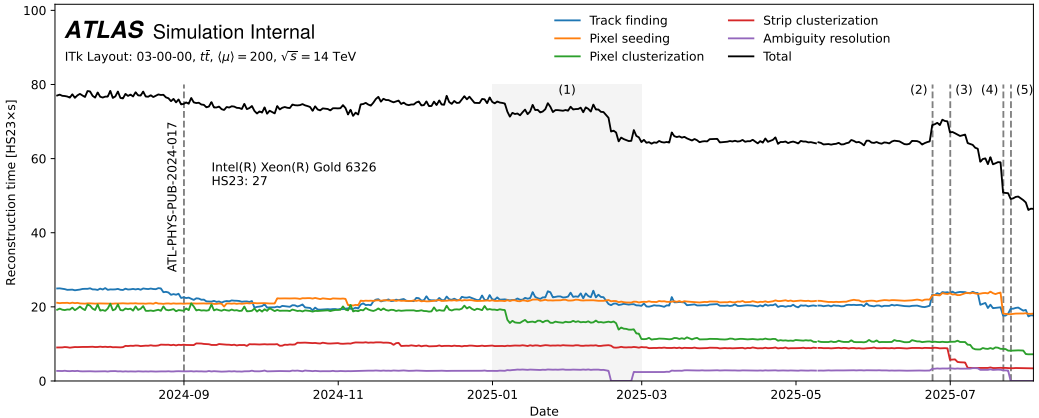

Figure: