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

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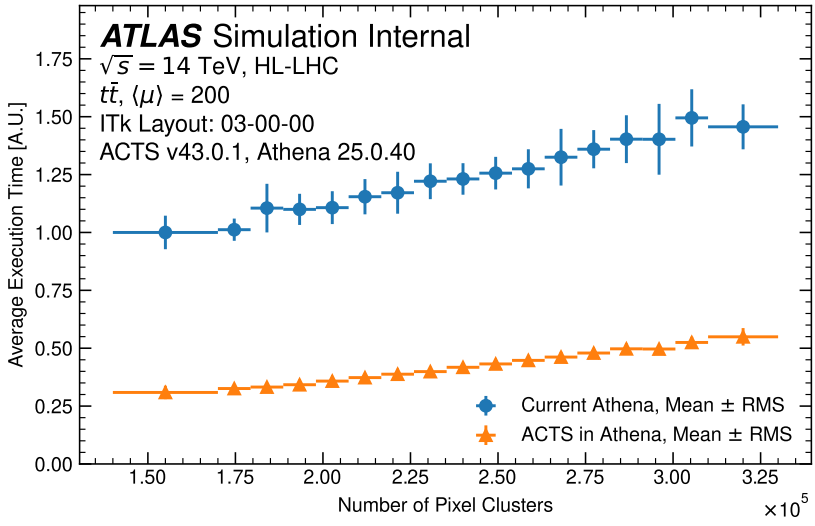
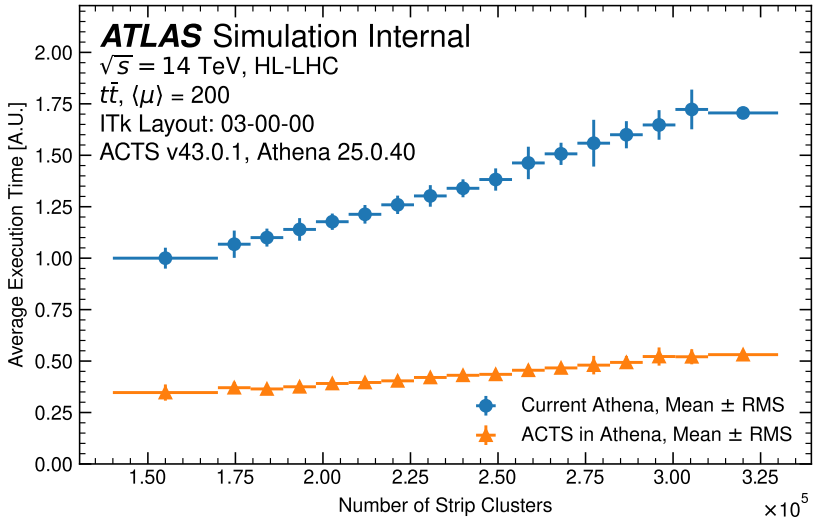
Pixel clustering



Pixel clustering

Average execution time (in arbitrary units) of the pixel clustering algorithms as a function of the number of reconstructed pixel clusters, obtained with the current Athena implementation (comparable to the one used for Run 3) and an ACTS-based version. 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 identical physics results.

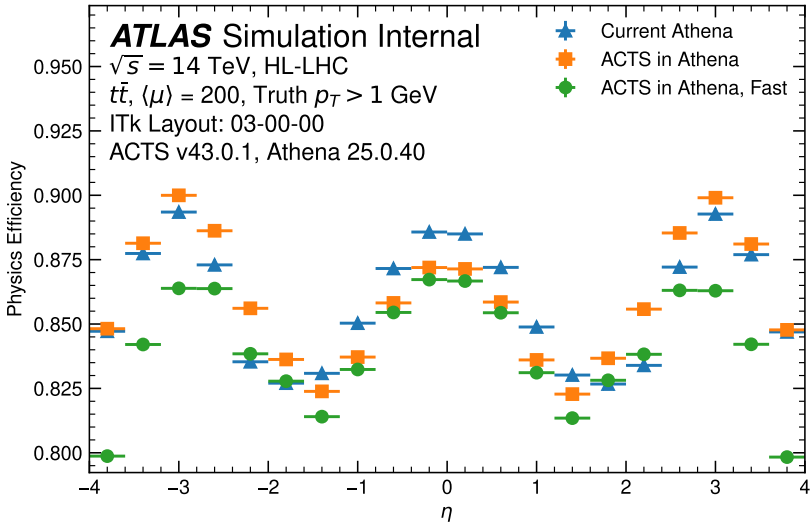
Strip clustering



Strip clustering

Average execution time (in arbitrary units) of the strip clustering algorithms as a function of the number of reconstructed strip clusters, obtained with the current Athena implementation (comparable to the one used for Run 3) and an ACTS-based version. 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 identical physics results.

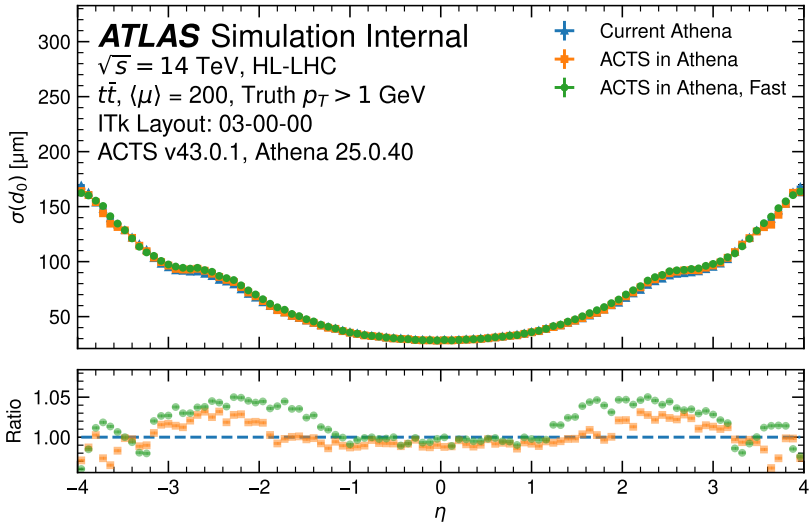
Tracking efficiency



Tracking efficiency

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 $\langle\mu\rangle = 200$. ACTS-based chains are compared to the current Athena implementation. Lower efficiency is observed in the barrel region $|\eta| < 1.5$. The ACTS-based fast configuration drops further in the endcap region $|\eta| > 2.0$ which is due to CPU optimization trade-offs and under investigation.

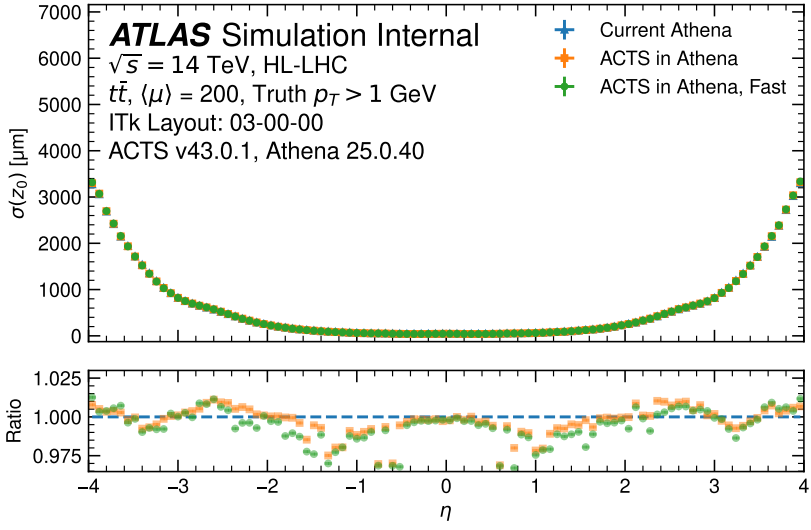
Tracking resolution $\sigma(d_0)$



Tracking resolution $\sigma(d_0)$

Transversal impact parameter d_0 resolution 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 $\langle\mu\rangle = 200$.

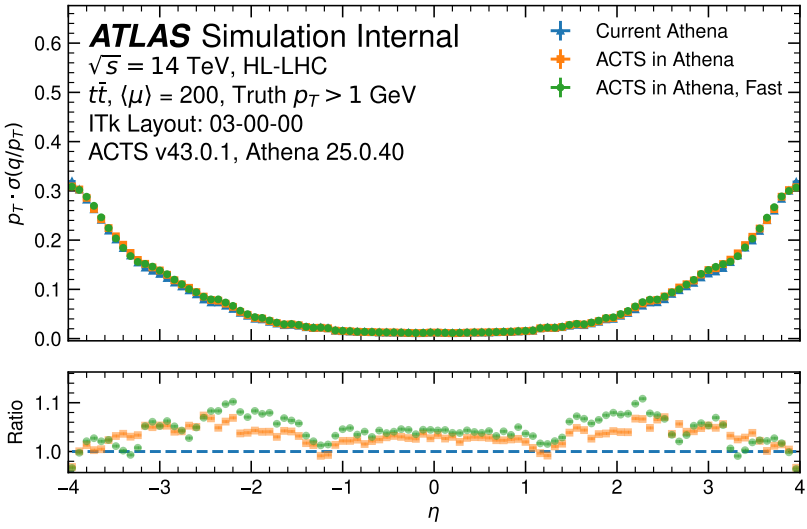
Tracking resolution $\sigma(z_0)$



Tracking resolution $\sigma(z_0)$

Longitudinal impact parameter z_0 resolution 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 $\langle\mu\rangle = 200$.

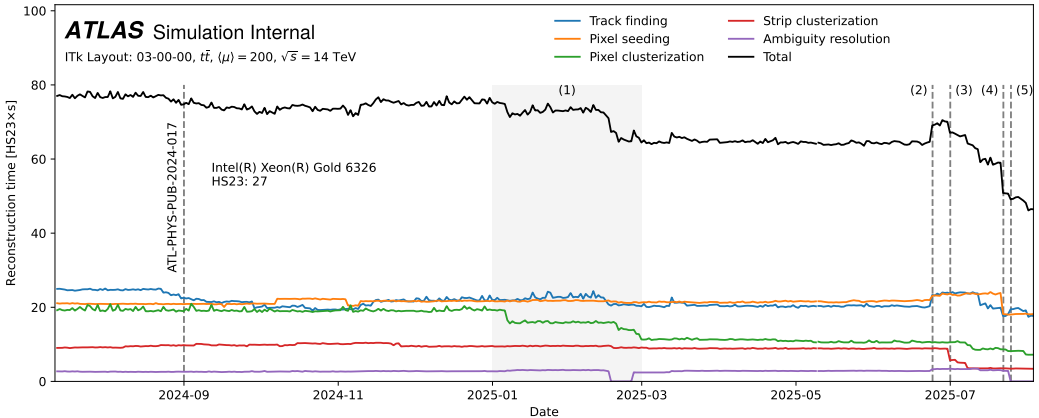
Tracking resolution p_t $\sigma(q/p_t)$



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

Relative transversal momentum p_t resolution 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 $\langle\mu\rangle = 200$.

CPU time evolution



CPU time evolution

CPU time evolution of the ACTS-based ITk main pass fast reconstruction, measured on a single core of a Intel Xeon Gold 6148. All measurements were 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. The measured reconstruction time is scaled to HS23×s. On a high level the major changes are: (1) optimizations of the pixel clustering, (2) lowering the p_T reconstruction cut from 1 GeV to 900 MeV, (3) optimizations of the strip clustering, (4) tuning the redundancy of the pixel seeding, (5) merging the ambiguity resolution into the track finding.