ALICE charged-particle-jet trigger

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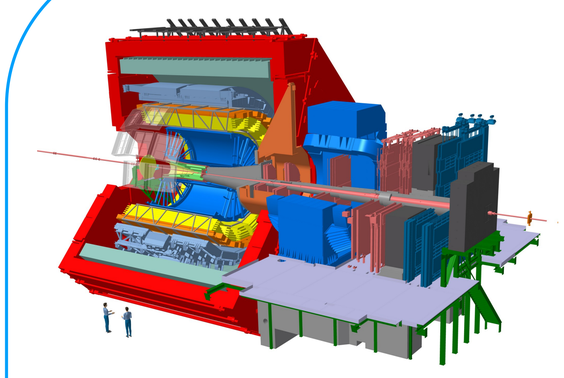
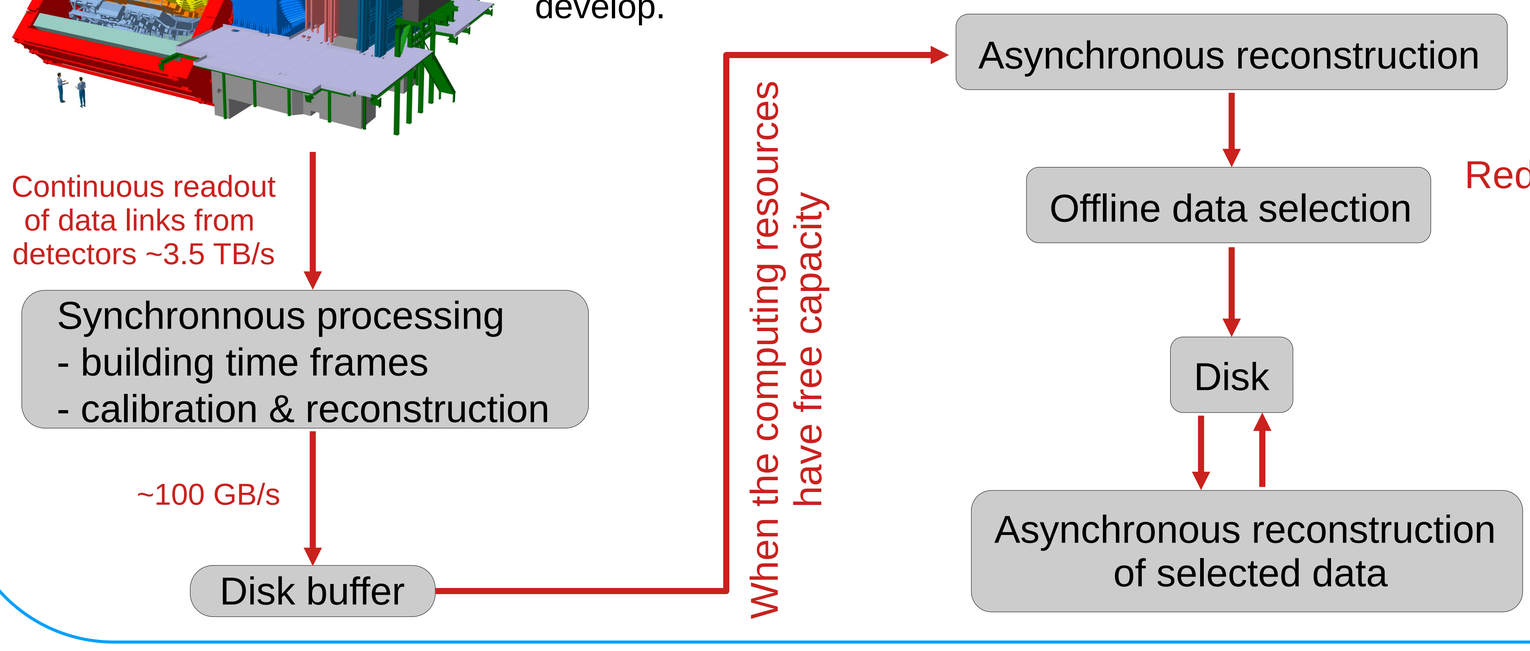
ALICE data processing scheme in Run 3



The ALICE data-taking concept for the LHC Run 3 and Run 4 allows the collection of minimum bias collisions in a continuous readout mode, their subsequent asynchronous reconstruction, and the final offline selection of events for permanent storage. This design enables the implementation of dedicated event selection schemes, tailored for a given observable, and avoids the need for dedicated hardware triggers, which in many cases would be difficult to develop.



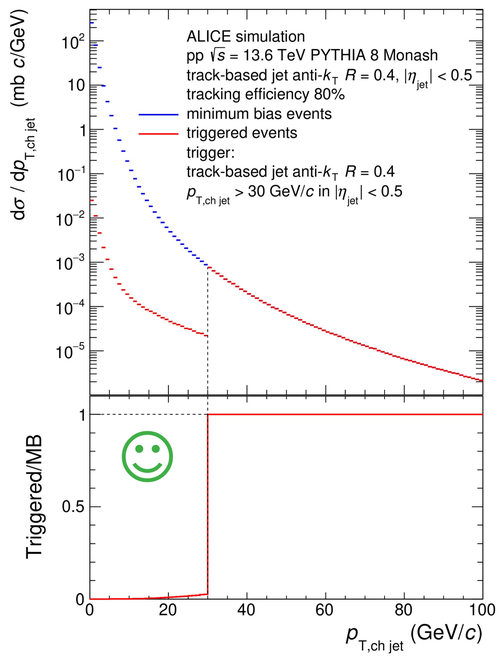
Reduce total volume of pp data ~50 times ⇒

Selectivity for events containing a high-p_T track-based jet ~10^{-5}

Investigation of different trigger designs

- Requirement: Trigger should provide unbiased access to inclusive anti-k_T track-based jets above a certain p_T threshold for a wide range of jet resolution parameters in the fiducial volume $|\eta_{jet}| < 0.9 - R$ of the ALICE central barrel.
- Check performance of different trigger designs with PYTHIA.
- Example: Impact of triggering on a $R = 0.4$ anti-k_T track-based jet having $|\eta_{jet}| < 0.5$ and $p_{T,ch\ jet} > 30$ GeV/c on:

a) Anti-k_T track-based jets with $R = 0.4$ within $|\eta_{jet}| < 0.5$



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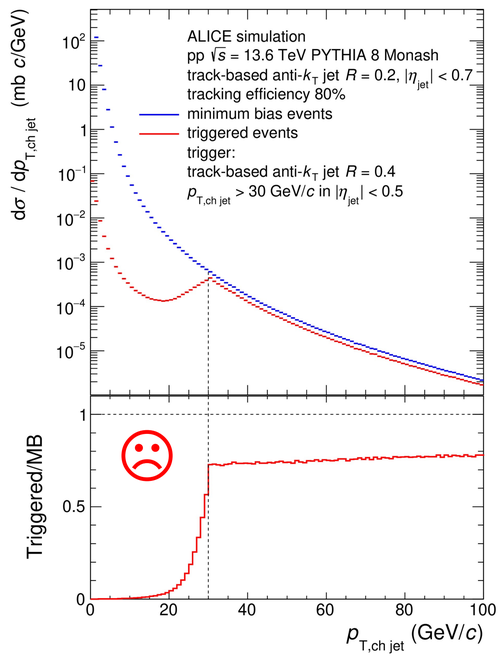
b) Anti-k_T track-based jets with $R = 0.2$ within $|\eta_{jet}| < 0.7$



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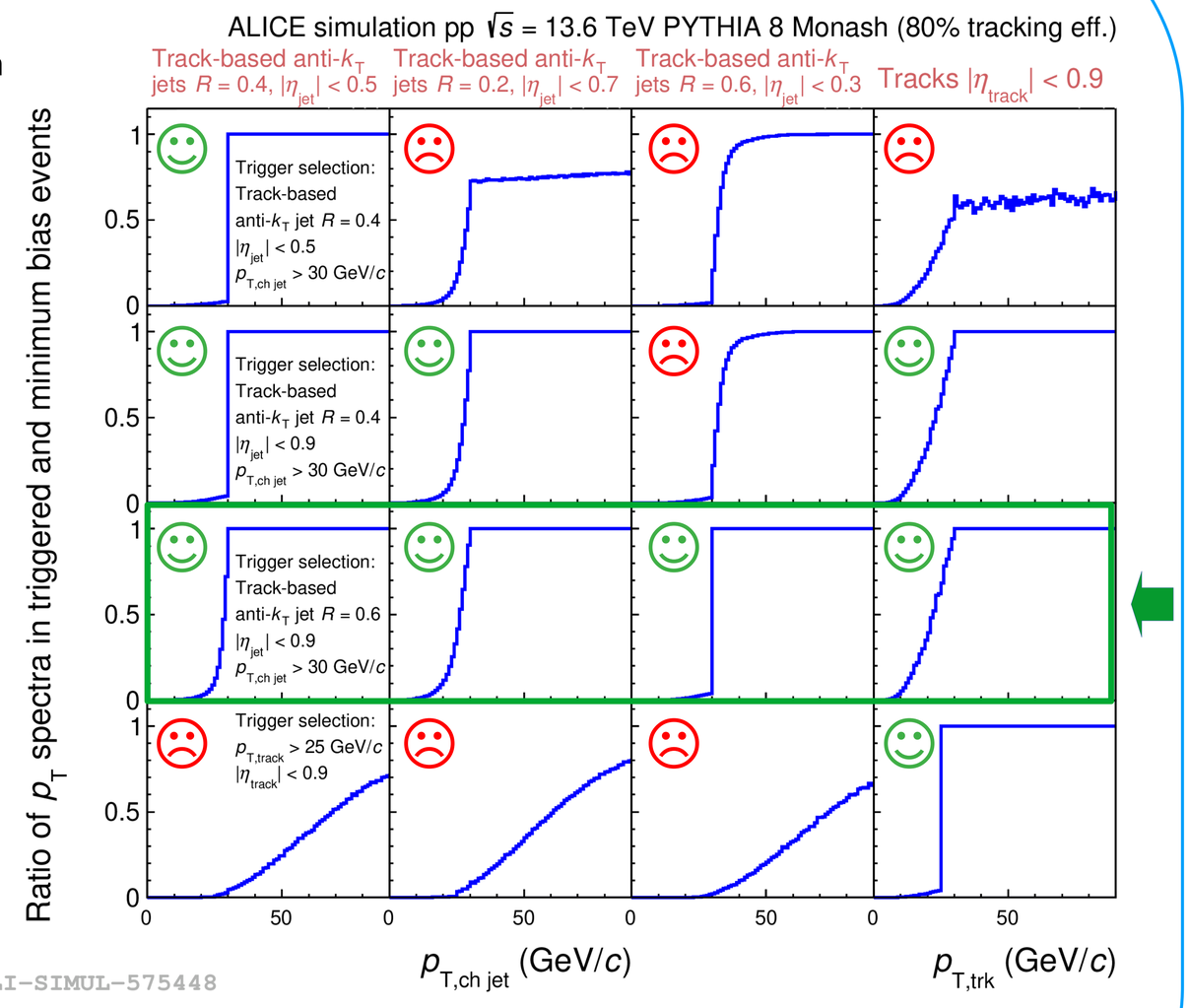

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Impact of different trigger selection conditions (rows) on spectra of anti-k_T track-based jets and inclusive tracks (columns)

- Offline selection should be based on anti-k_T jets with large R.
- Small jets can be closer to the acceptance boarder than large R jets ⇒ application of the fiducial cut on jets should be avoided.

⇒ Trigger on anti-k_T track-based jets with $R = 0.6$ in $|\eta_{jet}| < 0.9$

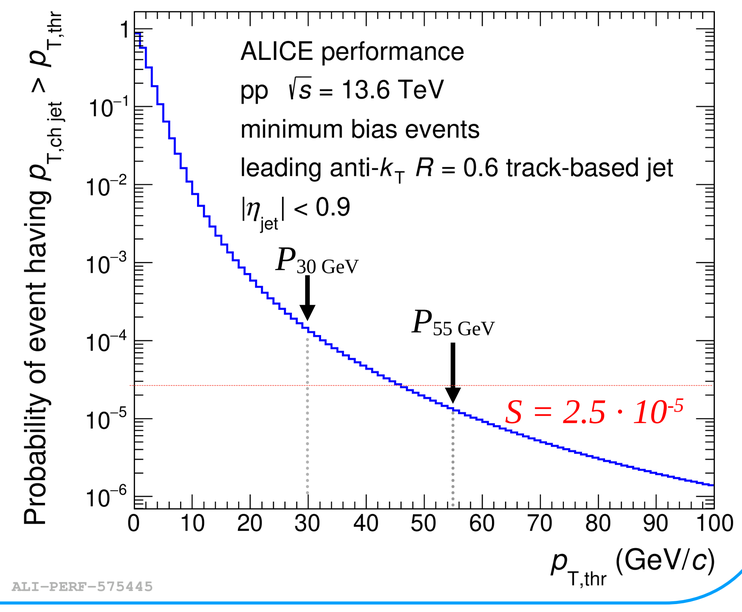
Trigger threshold and downscaling

- Requested selectivity for high-p_T track-based jet events $S = 2.5 \cdot 10^{-5}$
- Fill the available bandwidth with events containing a leading anti-k_T $R = 0.6$ track-based jet having $|\eta_{jet}| < 0.9$ and $p_{T,ch\ jet}$ that exceeds either
  a) 55 GeV/c threshold (events will not be downscaled) or
  b) 30 GeV/c threshold (events will be downscaled by a factor 10)

$$S = \frac{P_{30\,GeV}}{downsc.} + P_{55\,GeV}$$

Expected number of selected raw $R = 0.4$ anti-k_T track-based jets with $|\eta_{jet}| < 0.5$ in 2024 ($L_{int} = 30$ pb^{-1})

$p_{T,jet}$ bin (GeV/c)	20 – 25	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60	60 – 65	65 – 70
Min. bias (downsc. 333x)	420 k	170 k	80 k	41 k	22 k	14 k	8.3 k	5.3 k	3.6 k	2.5 k
Thr. 30 GeV/c (downsc. 10x)			2.6 M	1.3 M	760 k	450 k	280 k	180 k	120 k	82 k
Thr. 55 GeV/c (not downsc.)								1.8 M	1.2 M	820 k



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