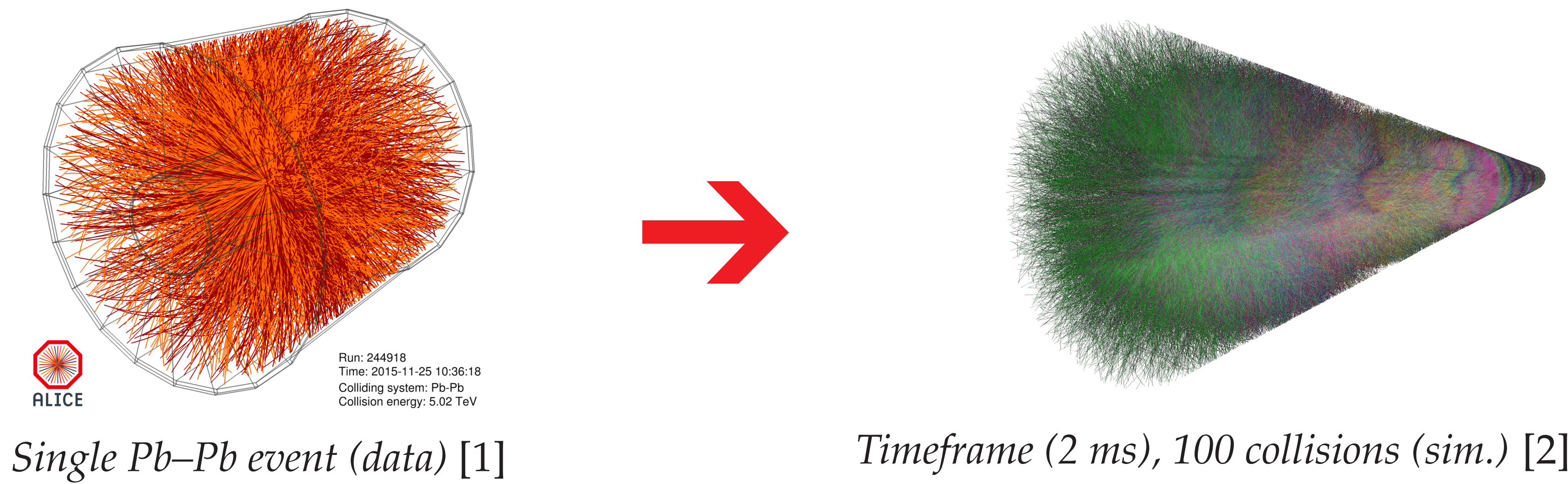


## Tracking challenge in future data taking periods



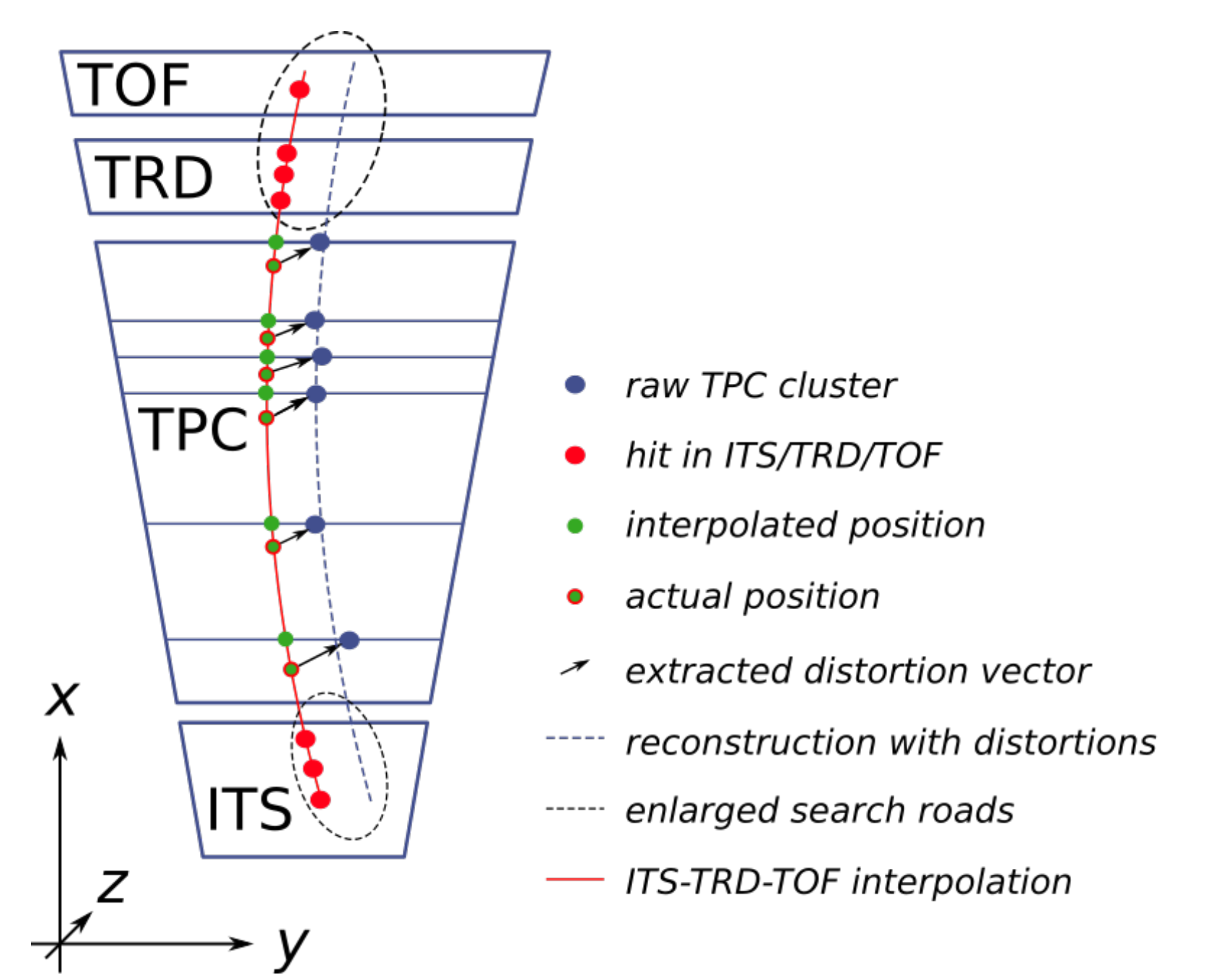
The maximum interaction rate in Pb-Pb increases from 7 to 50 kHz in LHC Run 3.

⇒ typically 4-5 overlapping collisions in the Time Projection Chamber (TPC) instead of a single collision per drift time



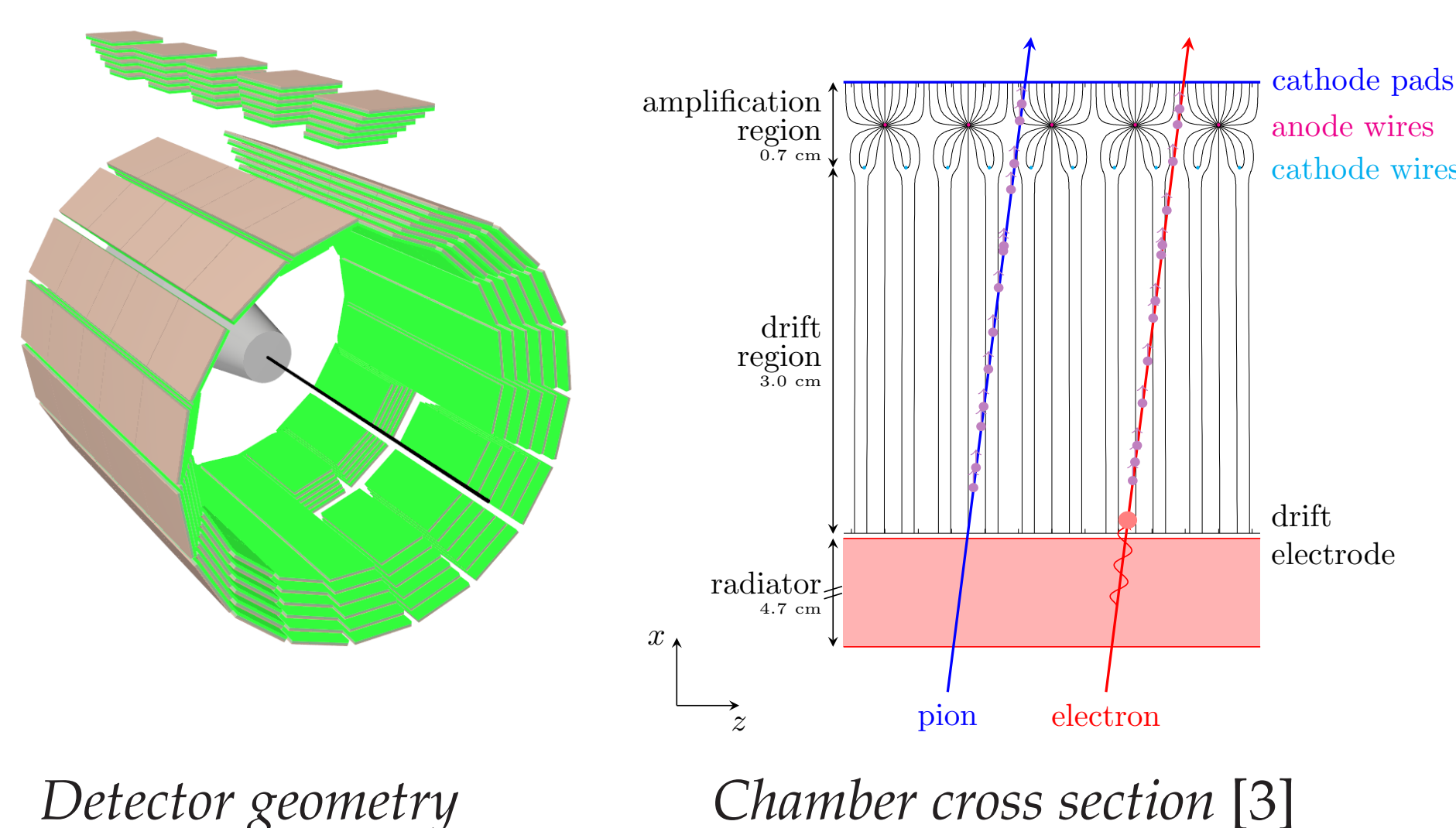
- continuous instead of triggered readout for most detectors
  - ⇒ even with carefully tuned new quadruple GEM-based readout chambers for the TPC space charge distortions of several cm fluctuating in time
- online tracklet readout only instead of raw data for the Transition Radiation Detector (TRD) due to bandwidth constraints ⇒ new reconstruction approach needed
- a completely new Online-Offline computing system
  - ⇒ The calibration procedure for the TPC needs to be adapted and ported to the new O<sup>2</sup> computing system.

## Calibration procedure



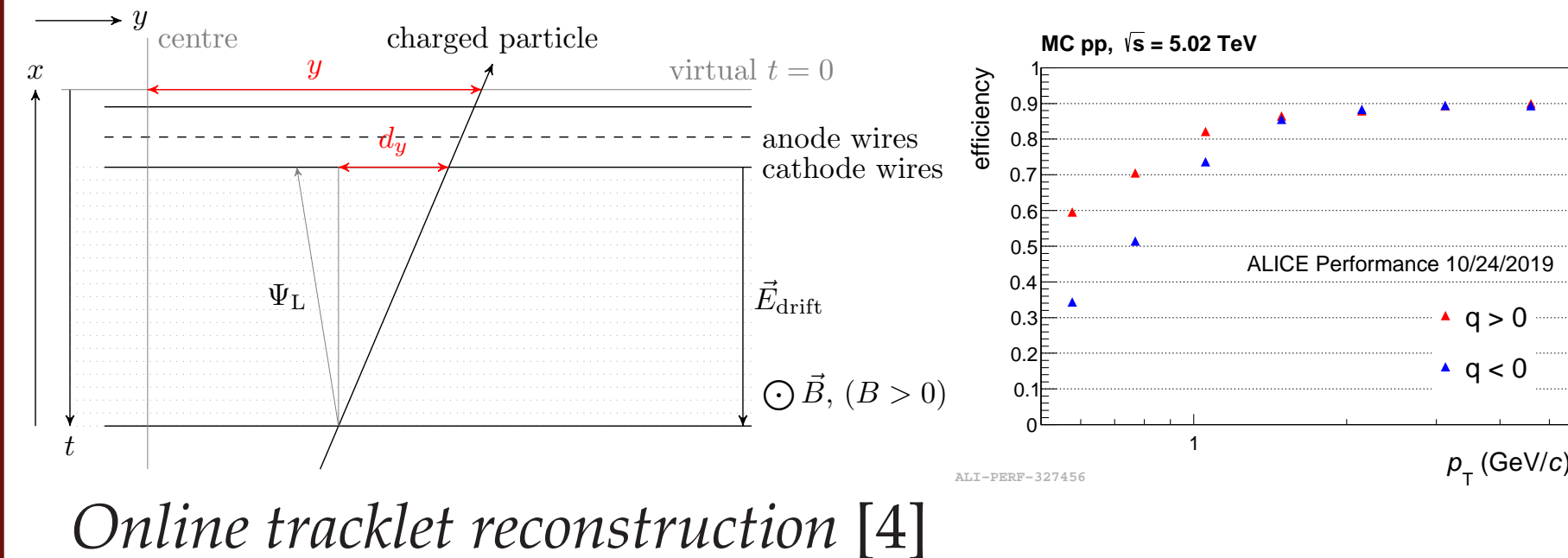
- 1) reconstruct tracks inside TPC with relaxed tolerances
- 2) matching to ITS and TRD/TOF with open search roads
- 3) refit ITS-TRD-TOF part and interpolate to TPC as reference
- 4) collect residuals in  $y$  and  $z$  in TPC sub-volumes
- 5) extract 3D vector of distortions in each sub-volume
- 6) create smooth parameterization for data taking intervals of  $\mathcal{O}(3 \text{ min})$

## Transition Radiation Detector



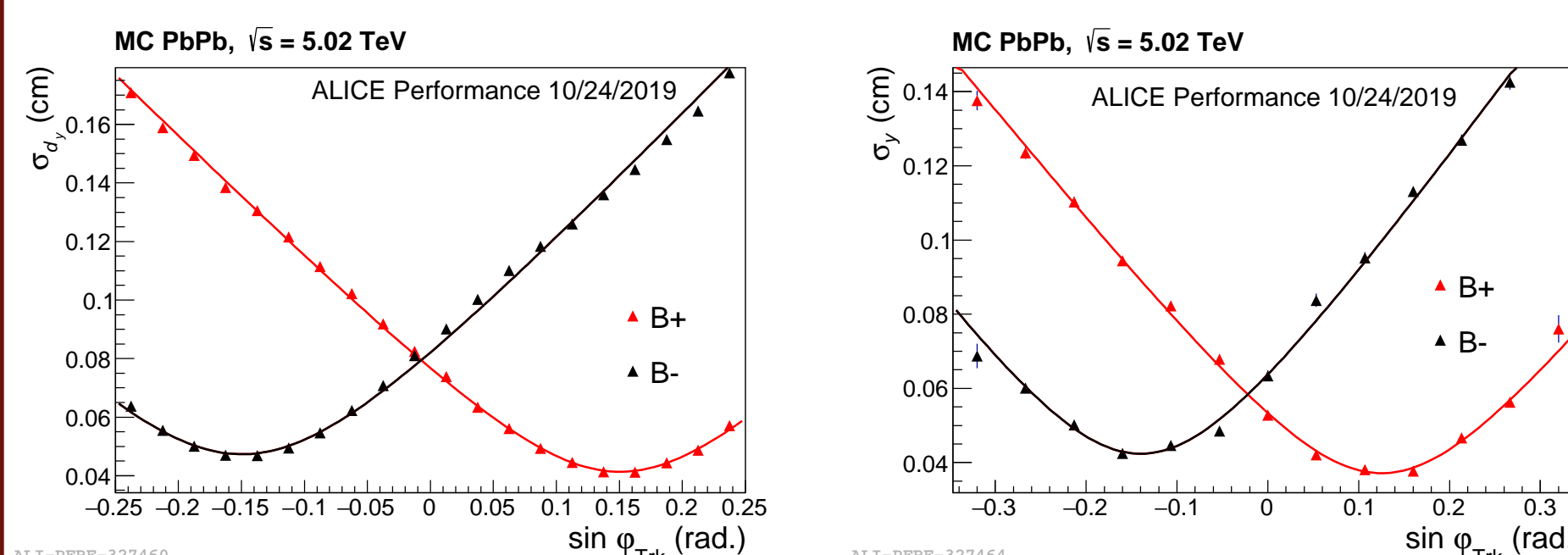
- composed of 540 chambers, each consisting of a radiator, a 3 cm drift region and a MWPC with pad readout
- will continue to be operated in triggered mode in Run 3
  - ⇒ association of tracklets to a certain bunch crossing is a priori known

## TRD online tracklets



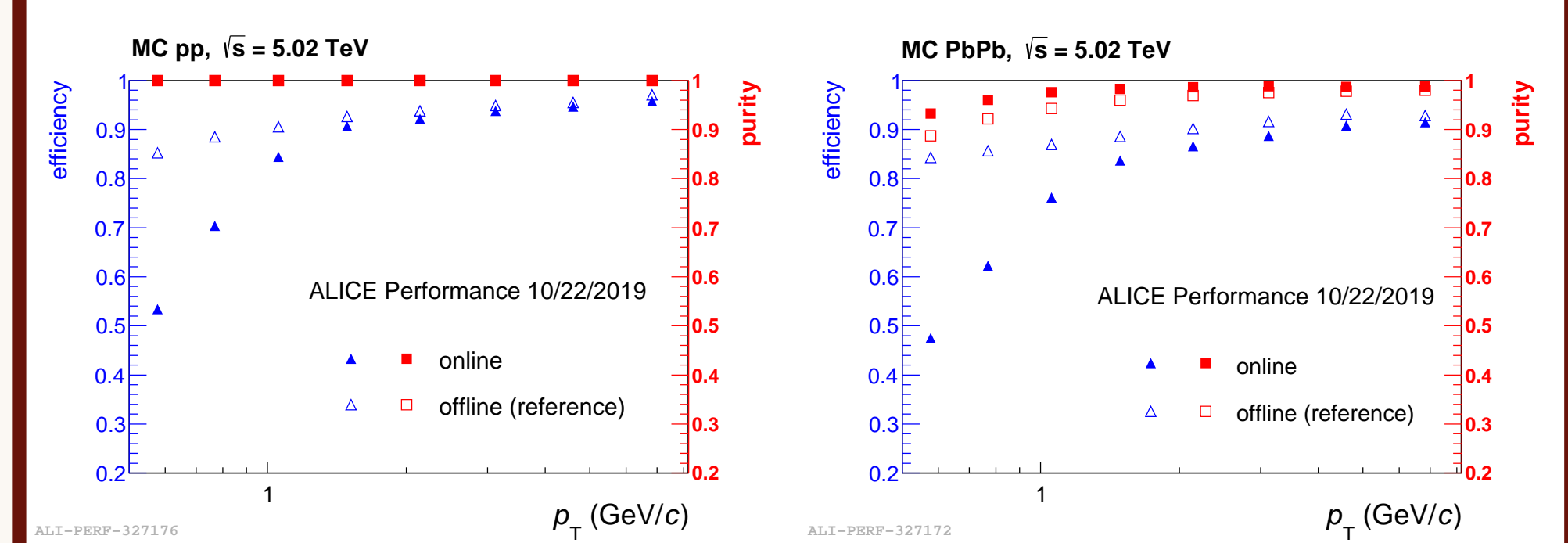
- straight line fit through clusters in TRD FEE  $\rightsquigarrow$  fit parameters ( $y$ ,  $d_y$ ) encoded in TRD online tracklets

- position dependent cut on deflection leads to drop of efficiency below  $p_T = 1 \text{ GeV}/c$



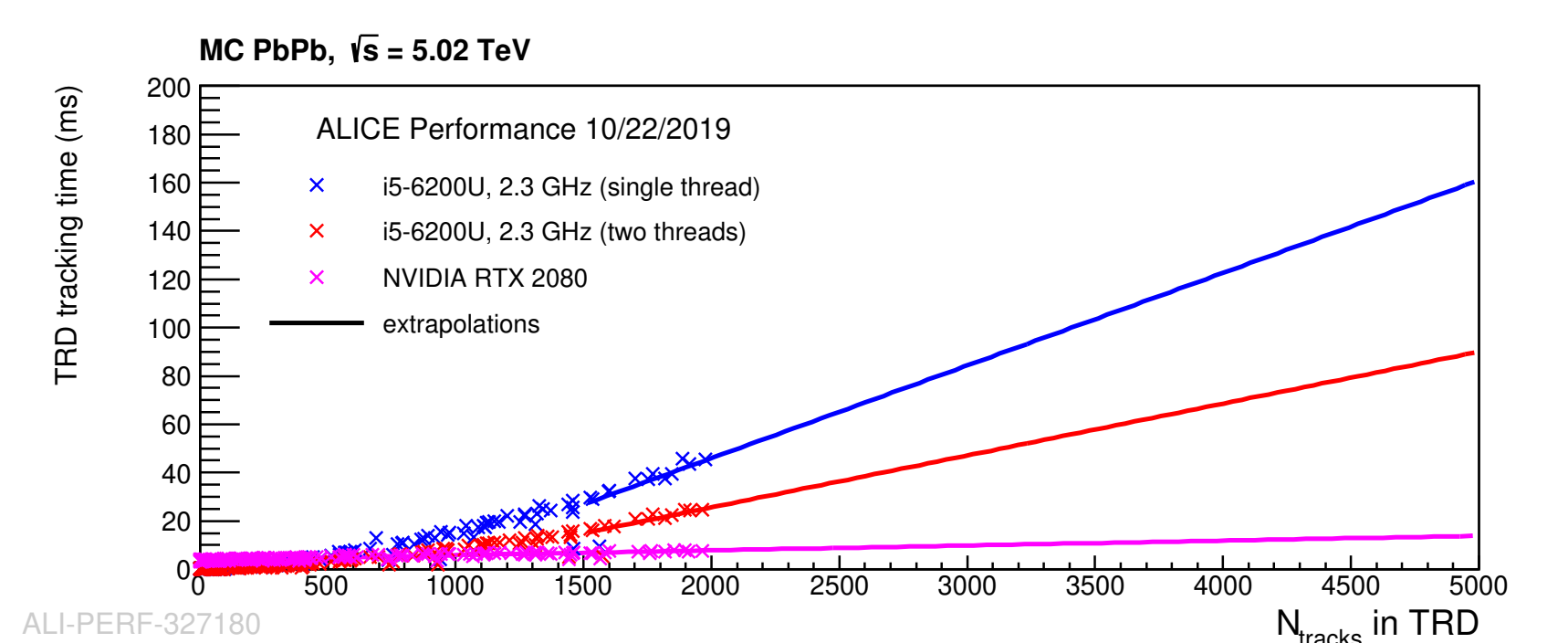
- the resolution depends on the associated track's azimuthal angle  $\varphi_{\text{Trk}}$ 
  - ⇒ tracklet errors need to be re-evaluated for each track seed

## Results for TRD tracking



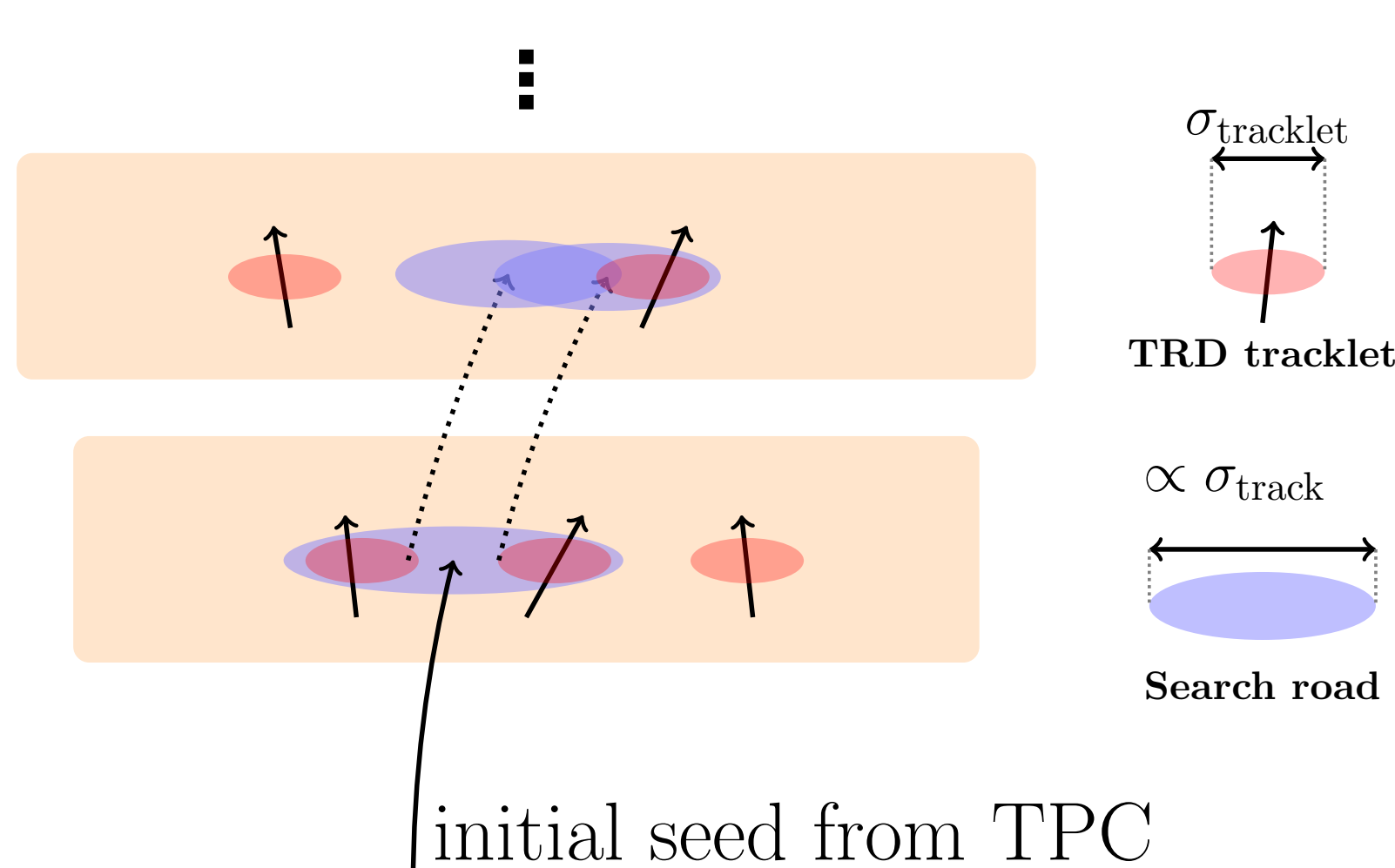
**efficiency:** fraction of tracks with at least two matching TRD online tracklets

**purity:** fraction of those tracks without fakes



- performance requirements met, speedup of factor  $\sim 12$  achieved on GPU compared to single CPU core for extrapolation to timeframe with 5k tracks inside the TRD
- the TRD tracking ran in production in the High Level Trigger during data taking for both pp and Pb-Pb in 2018

## TPC-TRD matching algorithm



- Kalman filter is used to match TRD online tracklets to seeding tracks provided by TPC
- multiple hypothesis can be kept per detector layer

## Summary and Outlook

With the new matching between TPC and TRD being ready and fulfilling the computing speed requirements for Run 3, the remaining points 3) - 6) of the space point calibration procedure are currently being ported from the Run 1+2 software AliRoot to the new O<sup>2</sup> framework.

## References / Contact information

- [1] <https://cds.cern.ch/record/2202730>
- [2] arXiv:1811.11481
- [3] <https://doi.org/10.1016/j.nima.2017.09.028>
- [4] <http://cds.cern.ch/record/1973326>



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