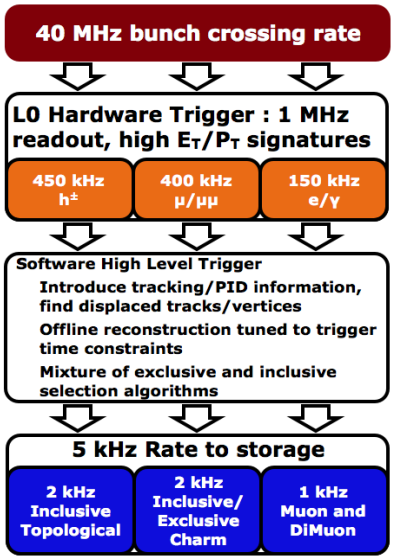
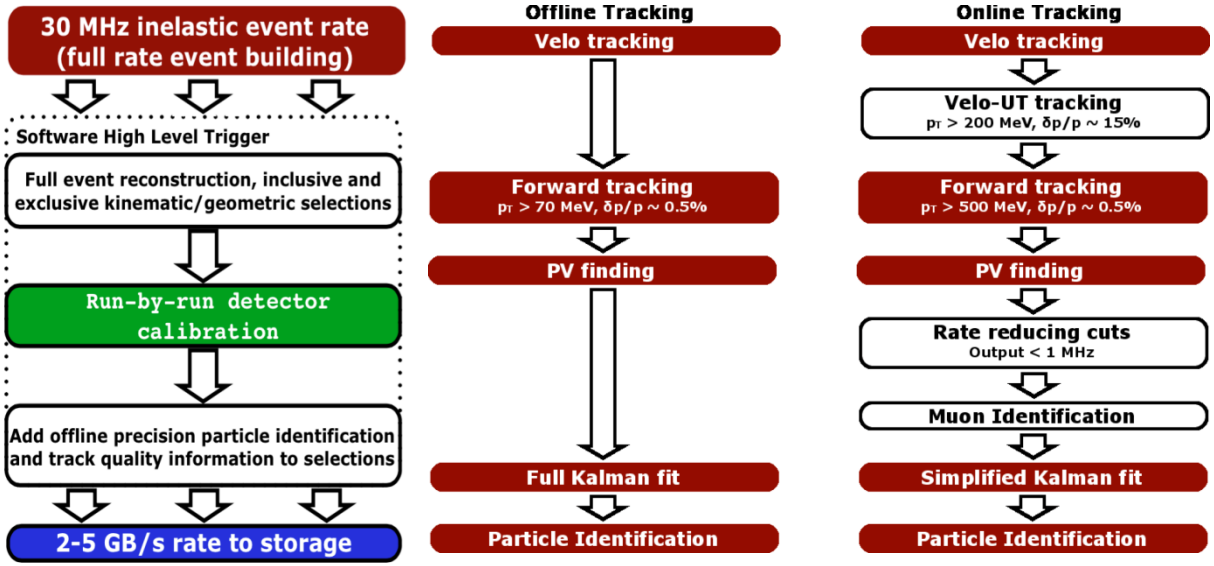
The LHCb trigger system and its upgrade

Agnieszka Dziurda, on behalf of the LHCb collaboration,
Institute of Nuclear Physics PAN, Krakow, Poland

In the hadron collider such as LHC it is not possible to record all events produced in proton-proton collisions.
The LHCb trigger system uses simple criteria to decide which signatures are interesting for further studies and it keeps them for the offline analysis.



In Run I (2010-2012) of data taking the trigger reduces the input rate of 40 MHz to 2-5 kHz.
Excellent performance allowed to produce many high quality results.



In the upcoming Upgrade run (>2020) the trigger system will be replaced by the software High Level Trigger which allows the full inelastic collision rate of 30 MHz to be processed. It will be possible for **the first time** in a hadron collider.
To maximize trigger efficiency and minimize systematic uncertainties the online selection **must be** as similar as possible to offline.

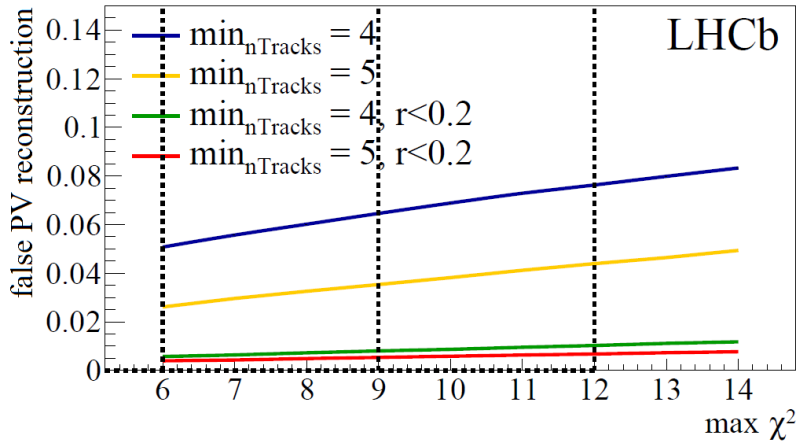
PV finding in the trigger system

Primary Vertex is the position of proton-proton interactions. Its precise reconstruction is crucial for physics analysis especially all time-dependent measurements.

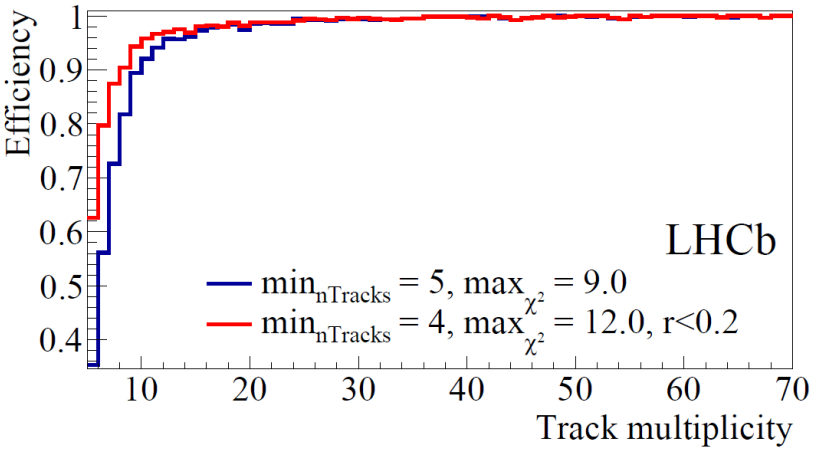
The new algorithm was optimized according to maximize the efficiency of the reconstruction and minimize the false PV reconstruction.

New working point:

minimum 4 tracks to form vertex ($min_{nTracks}$=4), maximum χ^2 to accept track equal to 12 (max χ^2 =12), radial PV distance less than 0.2 (r<0.2).



The use of the radial cut **reduces false PV reconstruction by 70%**



Efficiencies comparison for new (red) and old (blue) working points. Optimized algorithm reconstructs more PVs with low track multiplicty. **Effiency gain is about 3%.**

For Run II (2015-2018) the time budget in the trigger system allows a **more offline-like** reconstruction, which will be also used in Upgrade (>2020) run.