Event based unpacker and digitizer for the CBM TOF in CBMROOT *

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In CBM the Time-of-Flight (TOF) method will be used to provide charged hadron identification. The measurement will be done with a wall built from Resistive Plate Chambers (RPC). The electronics and the reconstruction software for the TOF wall will follow the CBM data acquisition concept called free-streaming.

Figure 1 presents a summary of the previous status of the CBM TOF software. The software chains for real test data (top) and the one for simulated data (bottom) are fully separated. Until 2013 the unpacking, monitoring and analysis software for the TOF test setups was based on the *GO4* framework [1]. A CBM dedicated library containing standard *GO4* analysis sub-steps and sub-events for the CBM test hardware was developed to re-use existing software parts in the analysis of the data from various beamtimes [2]. In parallel, the tools used for the simulation of the TOF wall and the evaluation of its physics performance in the CBM setup were developed within the *CBMROOT* framework. These tools were mainly a direct hit producer, which converts directly the Monte-Carlo points at the TOF wall position into TOF hits with a position and time. This method, however, ignores the effect of charge sharing between channels, that in real data causes the formation of clusters (correlated hits).

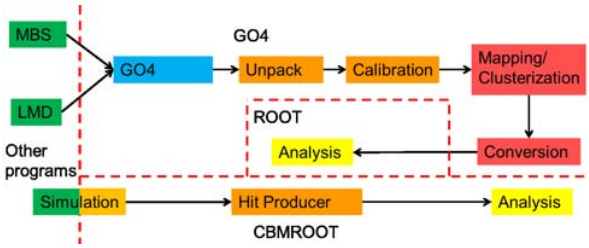

Figure 1: Status of the ToF wall analysis softwares before the integration of the unpackers in CBMROOT.

In order to speed up the development of the TOF reconstruction tasks, it is necessary to have compatible unpacking and simulation chains implemented in the same framework and feeding the same reconstruction algorithm. Reconstruction tasks are e.g. the channels alignment, the clusters building or the mapping between an electronics oriented address scheme and a detector/physics oriented geometric position. The free-streaming data acquisition concept also pushes toward this software unification as the difference between the offline physics analysis software and the online event selection software needs to be minimal in order to ensure a good quality of the archived data. The final software also needs to be compatible with a time-based data organization.

The first steps toward a final time-based common software are the conversion of the existing *GO4* unpacker to *CBMROOT*, the development of an event-based realistic digitization chain for the simulation and the development of common output objects for the unpacker and the digitization chain.

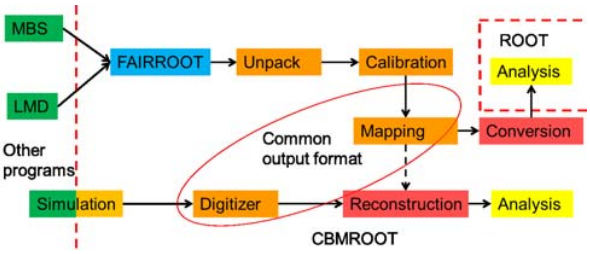

Figure 2: Currently available ToF wall analysis softwares organization using only CBMROOT and ROOT macros.

These three tasks were realized. Figure 2 presents the current status of the TOF software in *CBMROOT*. The unpacker supports the two main TDC system used in last TOF test setups, the GET4 v1.0 [1] and the VFTX [3]. A calibration tool for the TDC data is included in the data processing chain. A conversion tool was developed in addition to keep the compatibility with the existing analysis in *ROOT* macros. A new TOF digitizer gives the possibility to use as input for the simulation detector parameters measured during test beamtimes, e.g. cluster size, efficiency or time resolution. It also provides a choice between various methods to obtain the signal charge and the cluster size. Both branches of the TOF software are filling objects of the CbmTofDigi class, which is the input format of a newly developed TOF clusterizer. The clusterizer delivers the same TofHit format as the direct hit producer. For testing the unpacker, its output was compared to the one of the original *GO4* unpacker. No significant differences were found. The digitizer+clusterizer branch was tested in comparison to the direct hit producer. While the new implementation reproduces the results of the direct hit producer when the cluster size is minimized, it now allows for the study of a more realistic detector response

References

[1] P.-A. Loizeau et al., CBM Progress Report 2012, Darmstadt 2013, p. 66

[2] J. Adamczewski-Musch and S. Linev, CBM Progress Report 2011, Darmstadt 2012, p. 68

[3] J. Frühauf et al., CBM Progress Report 2012, Darmstadt 2013, p. 71

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