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Development of theCBM RICH readout and DAQ

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The prototype of the triggerless readout and DAQ chain for the CBM RICH detector is characterized.
The chain starts with a MAPMT Hamamatsu H12700 counting the Cherenkov photons. The MAPMT is followed by the FPGA-based front-end board PADIWA consisiting of the preamplifier and the discriminator. The leading and trailing edges of the logical LVDS signal from PADIWA are digitized by the FPGA-based time-to-digit converters (TDC) on the multifunctional board TRB3. The FLIB was used as an interface between the readout electronics and PC running simulation, DAQ and analysis software application CbmRoot which is based on FairRoot framework. Necessary unpacking, calibration and analysis software modules have been developed.
The readout and DAQ chain has been run both at the beam tests with the CBM RICH prototype and in the lab. In some tests the MAPMTs were partially covered by the wavelength shifter (WLS).
A versatile peformance analysis of the readout and DAQ chain of this type has been conducted for the first time. In particular, the accuracy of the leading edge timestamp detection by separate components and the whole chain was studied; the method of software timestamp correction aimed at better timing performance is developed; influence of such effects as the MAPMT transition time jitter, eventual high frequency spikes or pick-ups in the analog input stage, baseline instability and time walk are investigated and discussed; the method for measuring luminescence time profile is developed and applied to the WLS decay time determination.
The achieved timing performance is shown to satisfy the requirements, nevertheless, the possibilities for further improvement are discussed.

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