Event reconstruction for the RICH prototype beamtest data 2014

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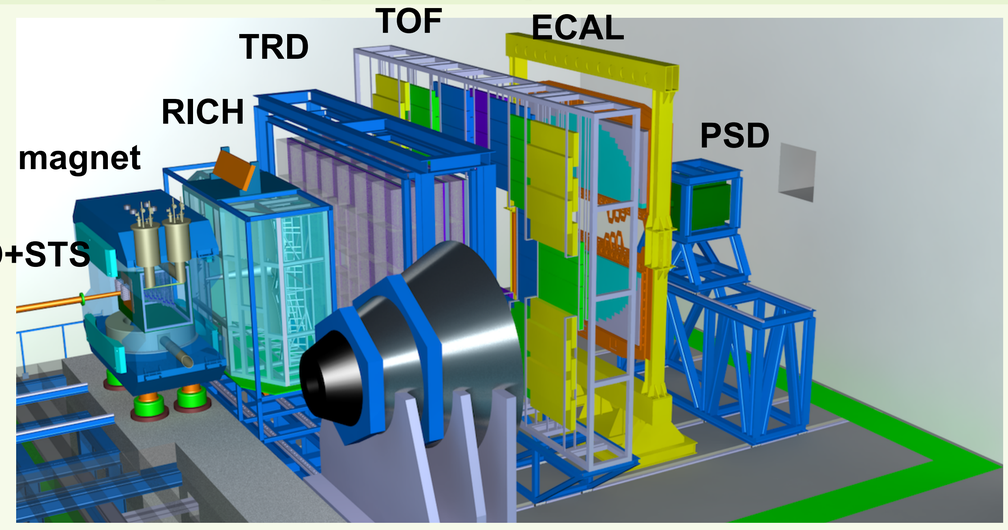
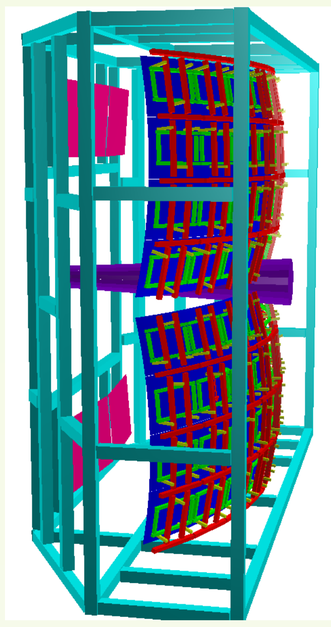
Compressed Baryonic Matter experiment

A key item of the CBM physics program is the precise measurement of low-mass vector mesons and J/Ψ in their leptonic decay channel for investigating the QCD phase diagram at highest netbaryon densities.





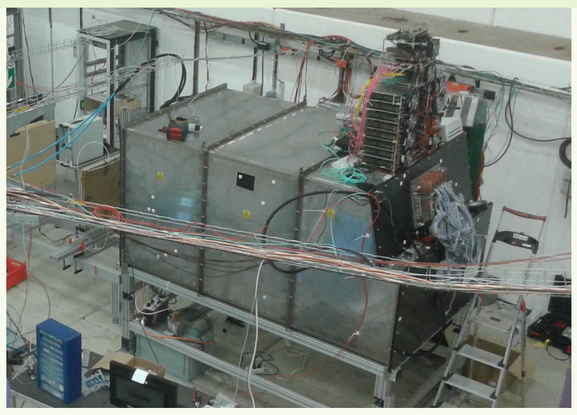
Electrons will be identified by the Ring Imaging Cherenkov detector (RICH) combined with several Transition Radiation detectors (TRD) positioned behind Silicon Tracking System (STS).

Concept of the RICH detector:

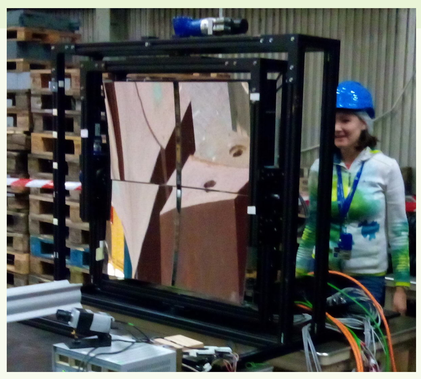
- ✓ CO_2 radiator gas,
- ✓ MAPMTs (Multi-Anode Photo Multiplier) as photodetector, Hamamatsu H12700 MAPMT
- ✓ spherical glass mirrors as imaging elements to project the Cherenkov cones as rings on the photodetector plane
- ✓ 22 hits per electron ring

RICH detector prototype and CERN beamtest in 2014

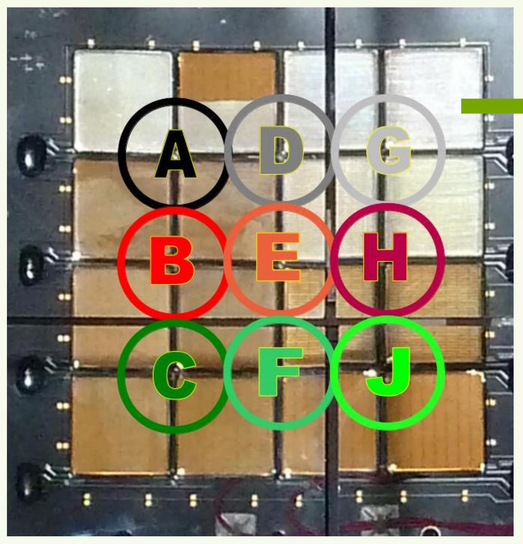
The real-size prototype of the RICH detector was tested for the third time together with other CBM groups at the CERN PS/T9 beam line in November 2014. For the first time the analysis of the RICH data was fully performed within the CBMROOT framework.



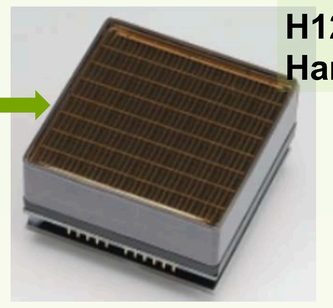
RICH radiator box filled with CO_2



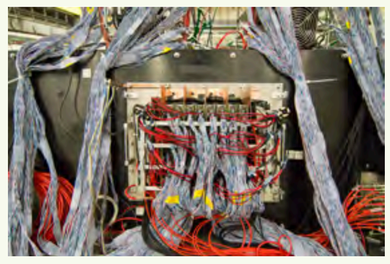
2x2 mirror array with remote-movable mirror frames for PMT plane scan



PMT plane with different MAPMT sensors with and without WLS coating



H12700 MAPMT, Hamamatsu



Camere readout electronics

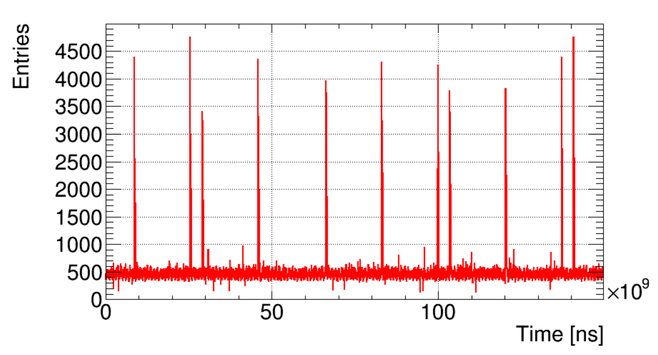
Data analysis

Data unpacking:

- ✓ HLD data format (http://trb.gsi.de)
- ✓ Retrieving raw messages from the data stream. One MAPMT pixel was read out by one PADIWA channel which is split to two TDC channels – one for the leading edge and one for the trailing edge of a signal.
- ✓ Matching leading and trailing edges.
- ✓ Fine time calibration. The fine time counter in the TDC uses the *Tapped Delay Line*. The standard calibration procedure based on *Look Up Tables* is implemented.
- ✓ Synchronization of TDCs. The time offset for each TDC is calculated based on synchronization signal on channel 0.
- ✓ Creation of raw hits. The raw hits contain the information about leading and trailing time, TDC identifier and TDC channel number.

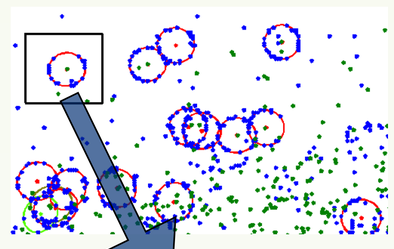
Event building:

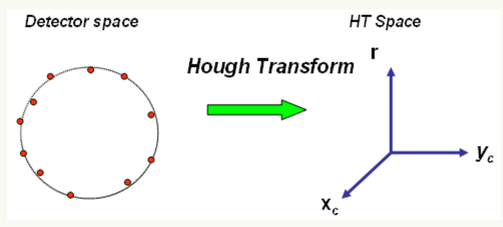
- ✓ The raw hits are not grouped into events and stored as free streaming data
- ✓ The event building procedure uses the reference time signal from the hodoscope.
- ✓ All raw RICH hits which belong to a time window (300 ns) around the reference time are collected into one event.

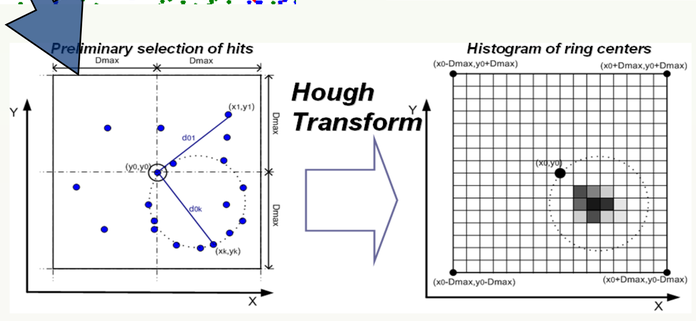


Event reconstruction:

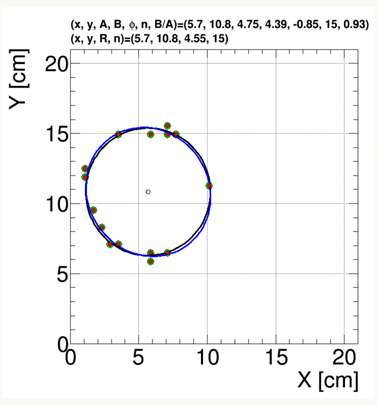
- ✓ Rings are reconstructed using an algorithm based on the Hough Transform method
- ✓ Ring parameters are derived with high accuracy by circle and ellipse fitting procedures
- ✓ The algorithms are the same as they are used in the event reconstruction for simulated data.

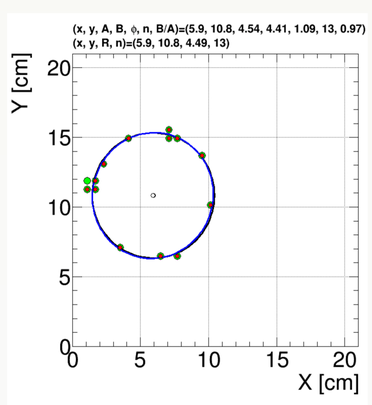


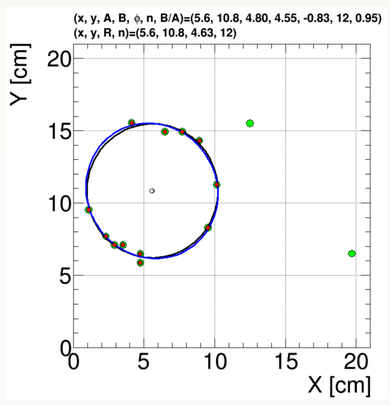




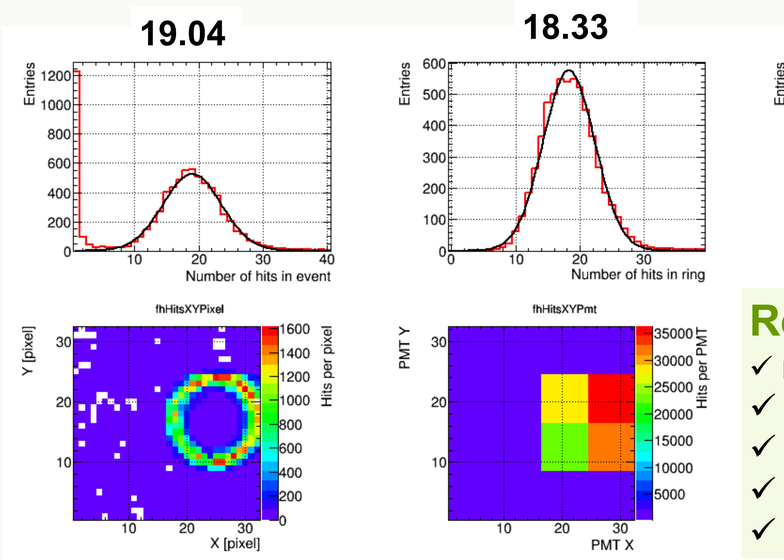
Example of analysis results







Event displays of a single events



Results from dashboard:

- ✓ number of hits in event
- ✓ number of hits in found ring
- ✓ ring radius
- ✓ number of hits per pixel
- ✓ number of hits per PMT.