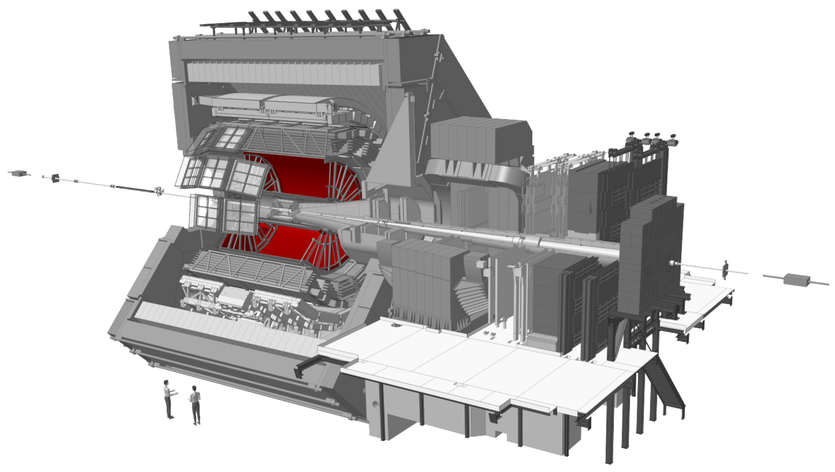
Upgrade of the Readout System in the ALICE TPC for Run 3

Lars Bratrud for the ALICE Collaboration

Introduction

When LHC Run 3 starts, the interaction rate in the ALICE experiment will be increased to a maximum 50 kHz in Pb-Pb collisions. The main tracking detector of ALICE, the TPC, has been upgraded from MWPC-based readout chambers to GEM-based readout chambers to allow for continuous readout.



The ALICE detector system with the TPC indicated in red

Time Projection Chamber

Completely new front-end electronics, capable of a continuous readout of the GEM TPC at a data rate of ∼3.5 TB/s was developed to be able to keep up with the higher interaction rates.

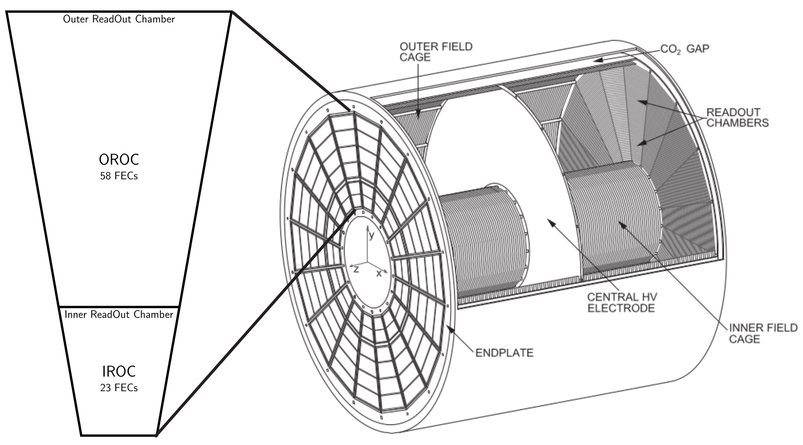
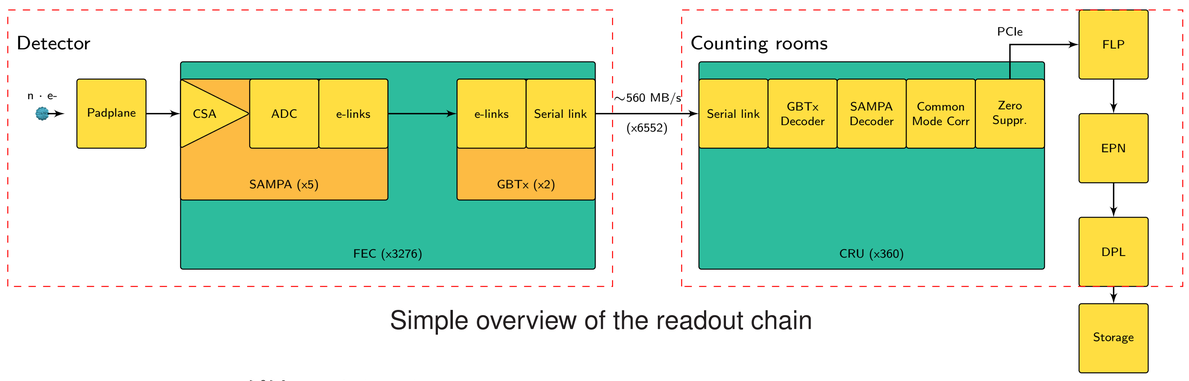
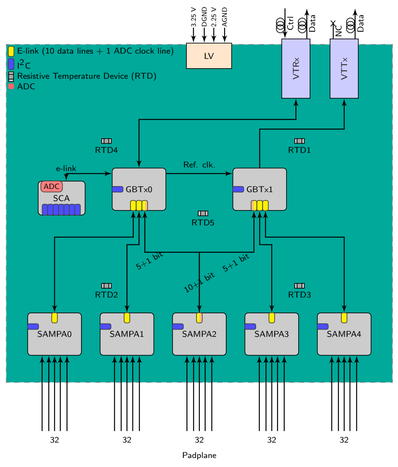


Diagram showing TPC readout segmentation

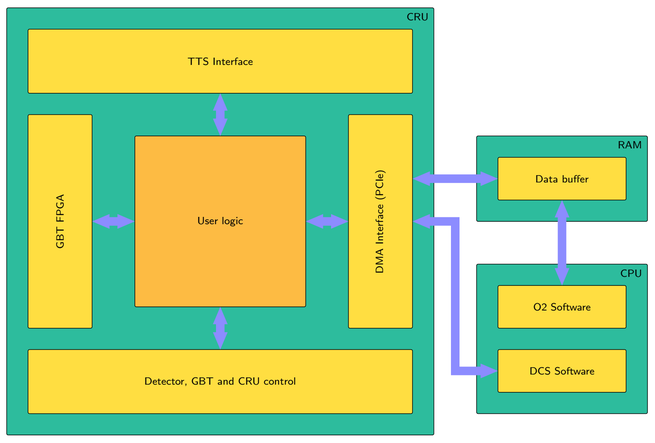
Readout Chain



Simple overview of the readout chain



Front-End Card

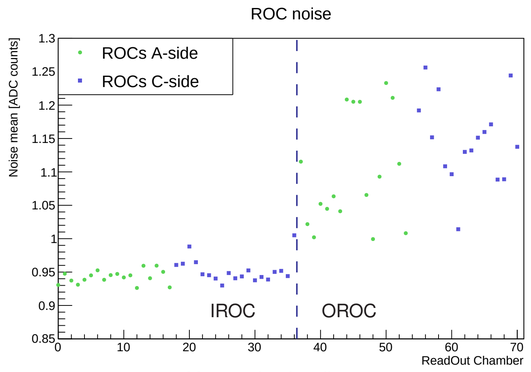


Common Readout Unit

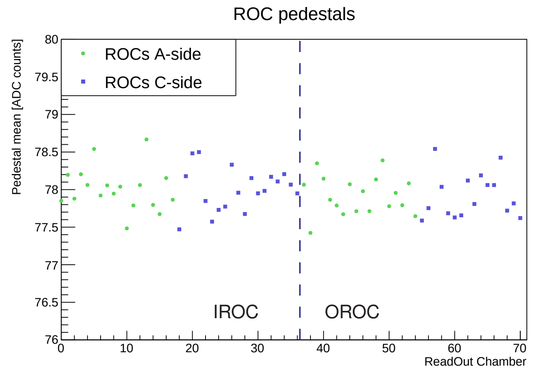
- 9828 links, 6552 uplinks (data), 3276 downlinks (control)
- 360 Common Readout Units segmented over 144 Front-Level Processors
- Monitoring of board temperatures, currents, voltages and link status

Noise Performance on Detector

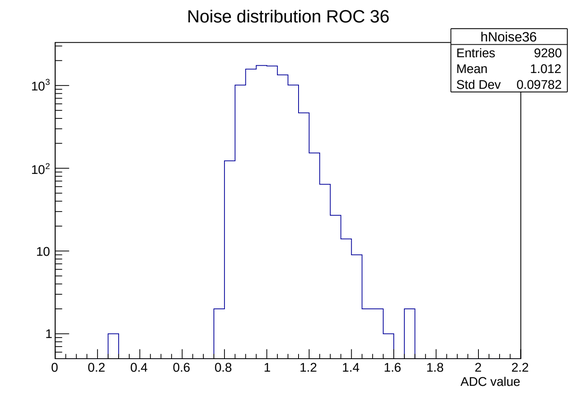
- System noise design value: 670 e^- (1 ADC Least Significant Bit)
  - ∼550 e^- contributed to FEC, the rest is attributed to other detector effects
- OROCs lie typically above this value – pick-up from surface machinery at P2



Mean noise for all sectors

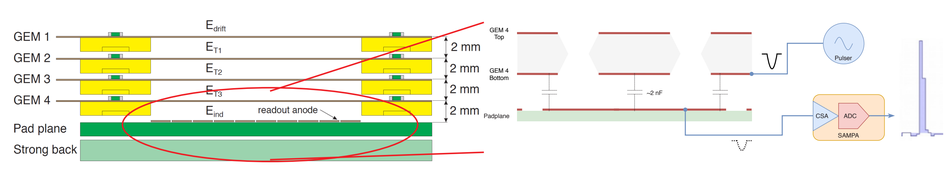


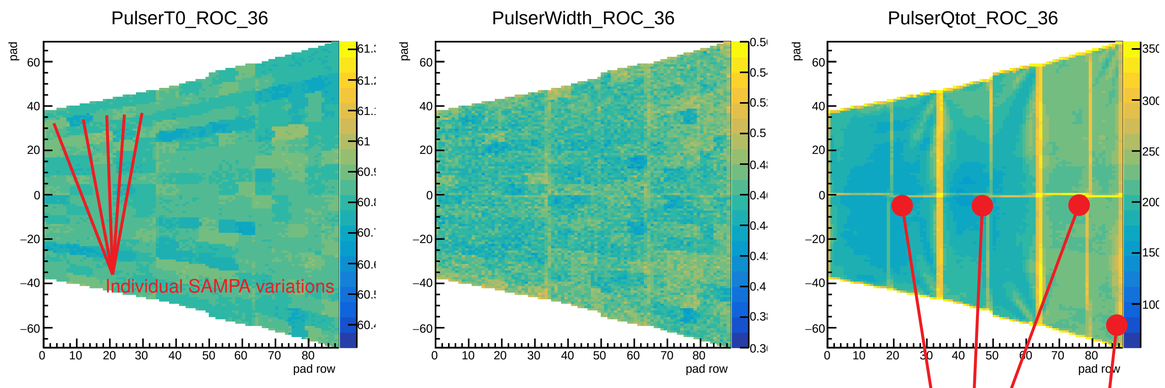
Mean pedestals for all sectors

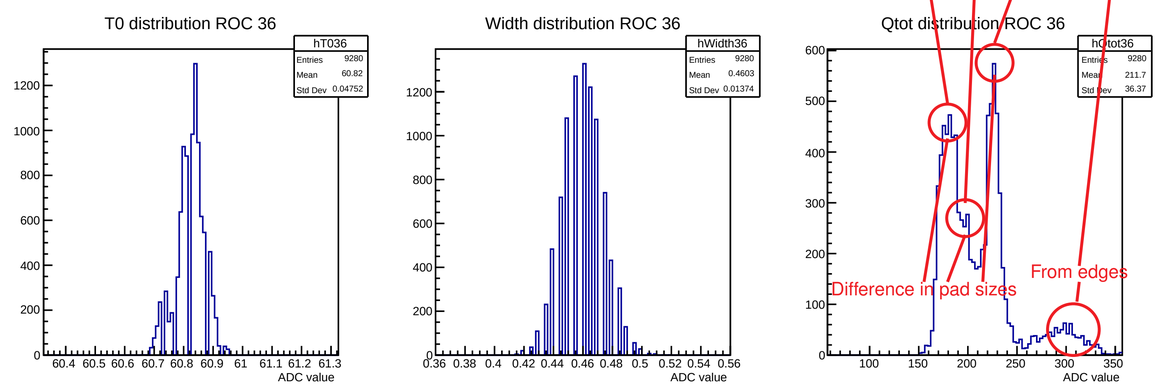


"Perfect" OROC with minimal pick-up noise

Readout Chambers and Detector Performance

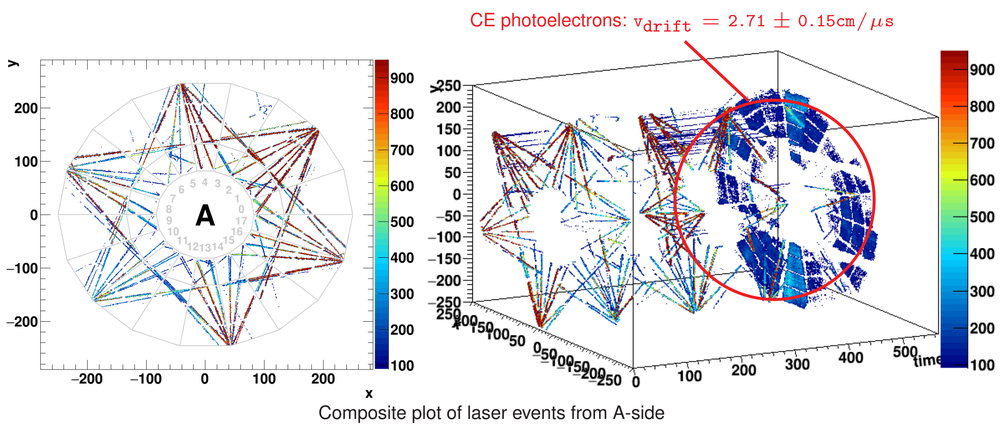






Pulser calibration for OROC of sector A00

CE photoelectrons: $v_{drift} = 2.71 \pm 0.15 cm/\mu s$



Composite plot of laser events from A-side

Summary and Outlook

- The commissioning of the GEM-based TPC is ongoing, with readout of two out of 36 sectors in parallel
- Acquiring cosmic, laser, pulser and pedestal/noise data for calibration purposes
- Readout was demonstrated with random triggers and directly storing black events
  - Preparation and exercising the full data processing chain is ongoing

lars.bratrud@cern.ch, IKF, Goethe-Universität Frankfurt