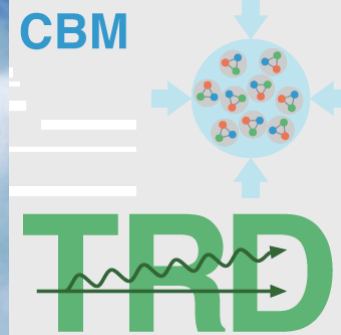




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Detector Performance Tests for the CBM TRD

Martin Kohn
martinkohn@uni-muenster.de
DPG-Frühjahrstagung (spring meeting)
Darmstadt, 16.03.2015



Bundesministerium
für Bildung
und Forschung



Study of Strongly Interacting Matter



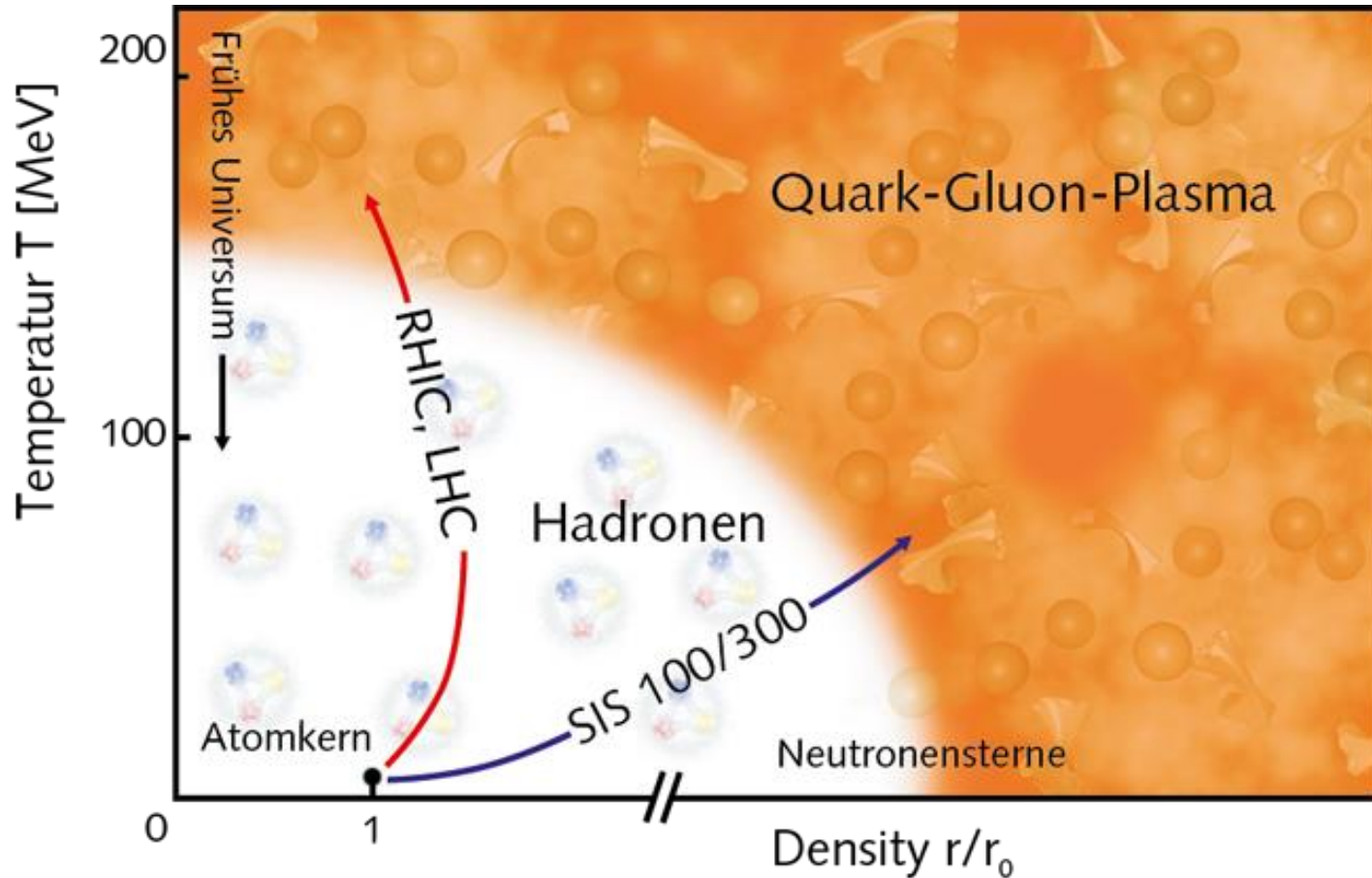


Introduction to CBM TRD

Lab measurements with ^{55}Fe

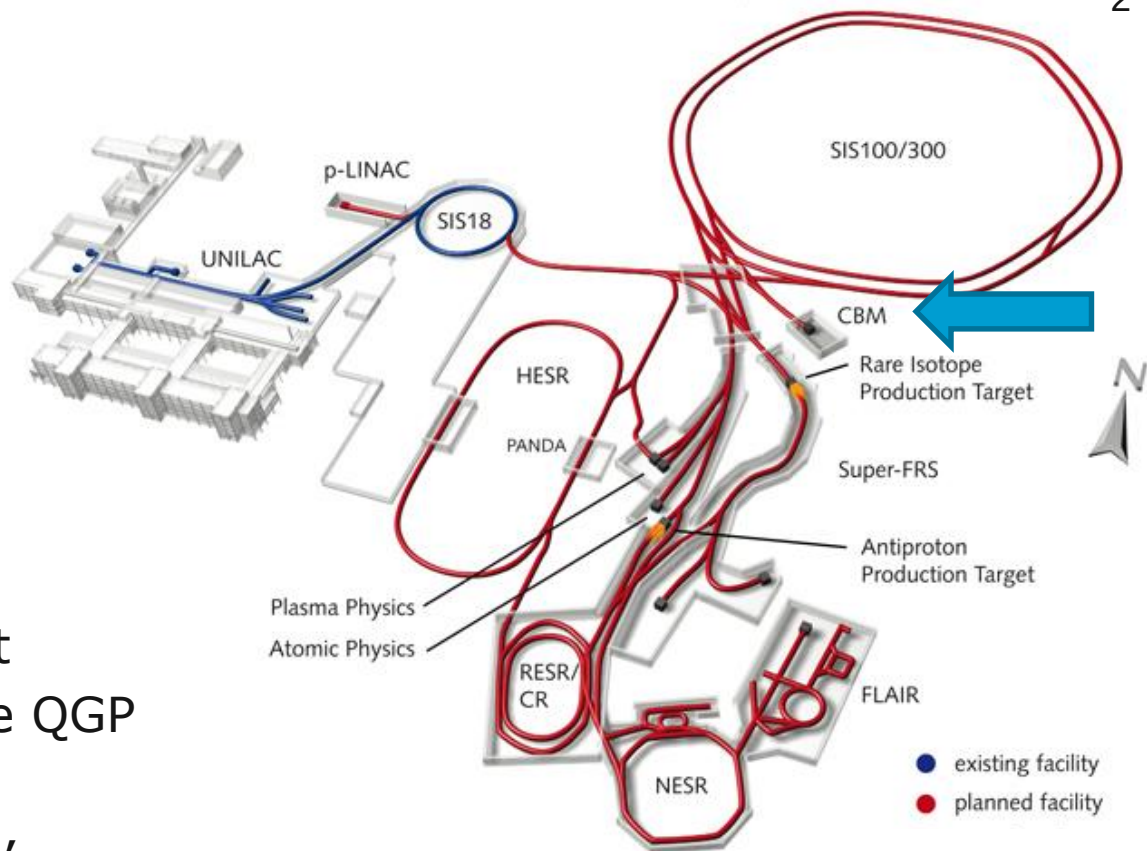
In Beam Measurement CERN SPS Nov. 2015

Densities of matter in detail



CBM Overview

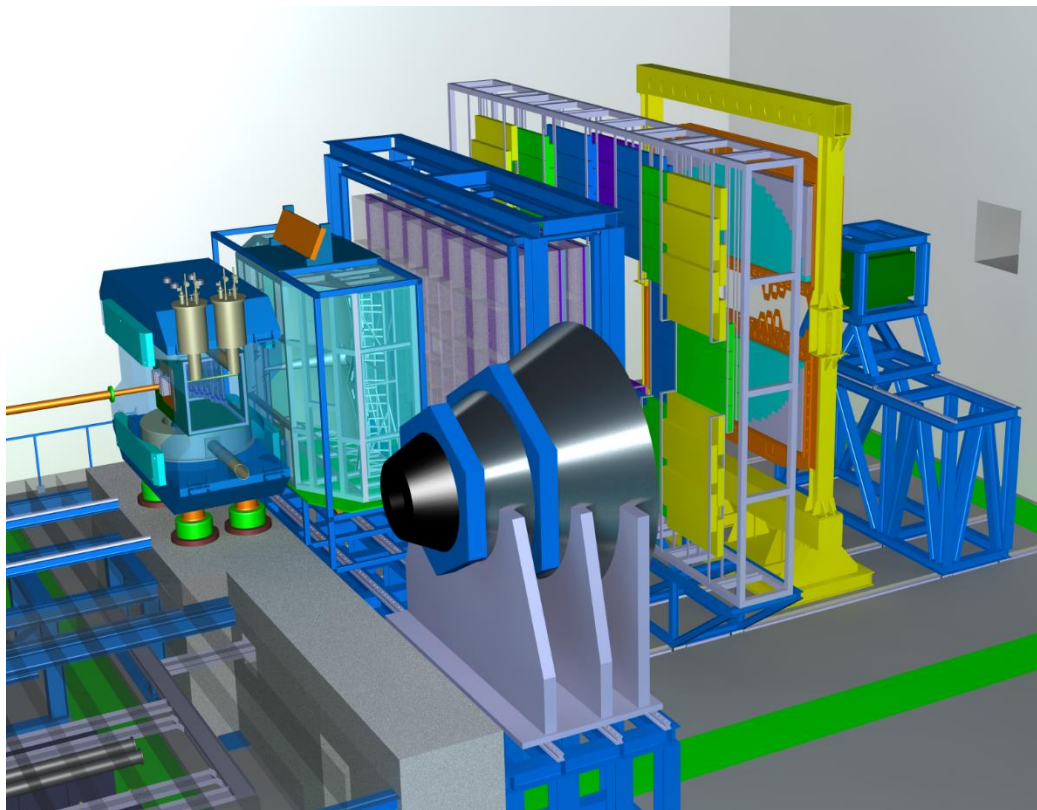
- Planned at FAIR@GSI in Darmstadt
- Built to investigate the QGP phase diagram at finite baryochemical potential, complementary to LHC
- Study of rare probes (multi-strange hyperons) and low-mass dileptons require very high reaction rates. This determines the readout rate and sensitivity of detector/electronics



Planned TRD Setup of the CBM Experiment at SIS 100

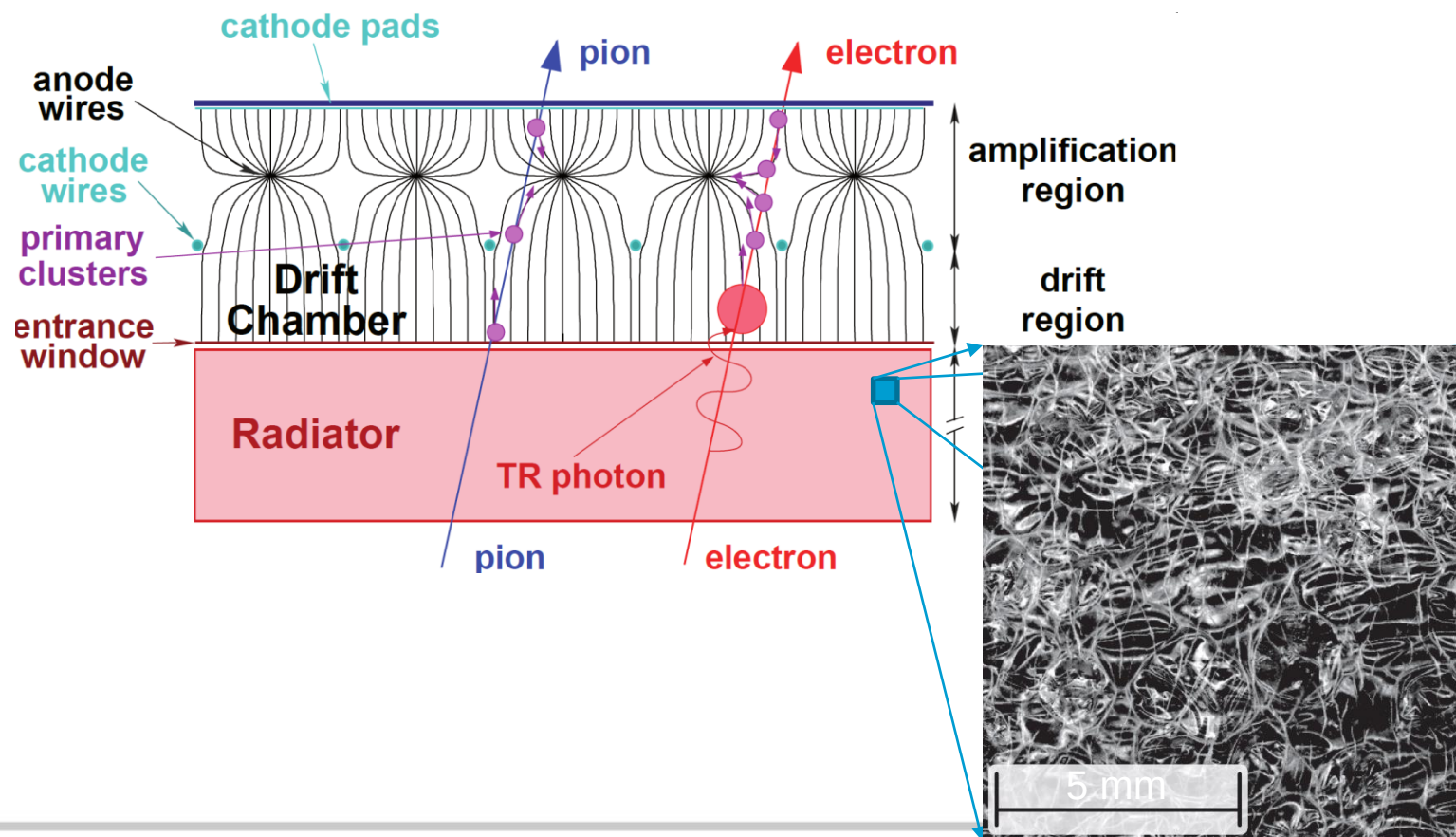
3

TRD properties:

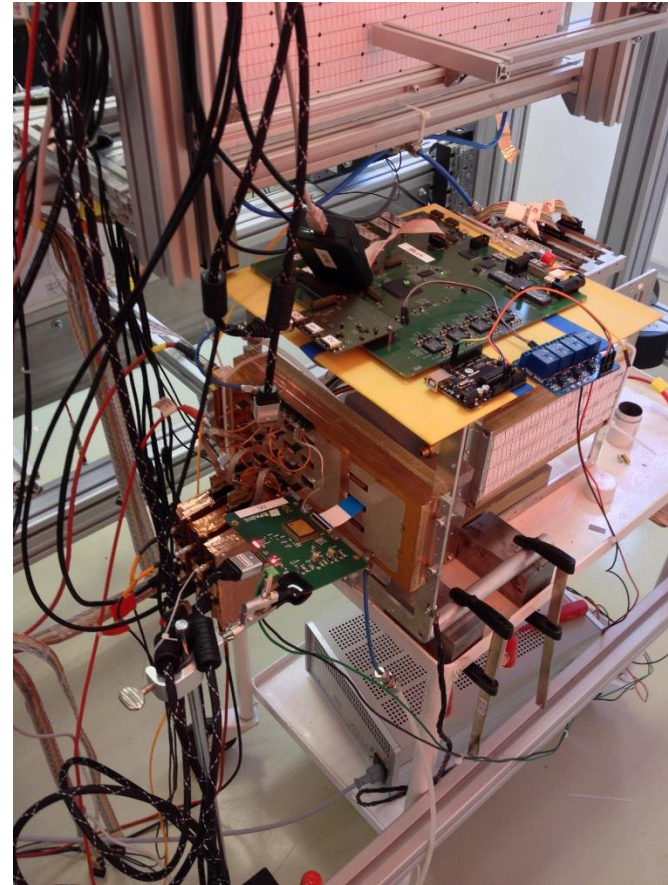
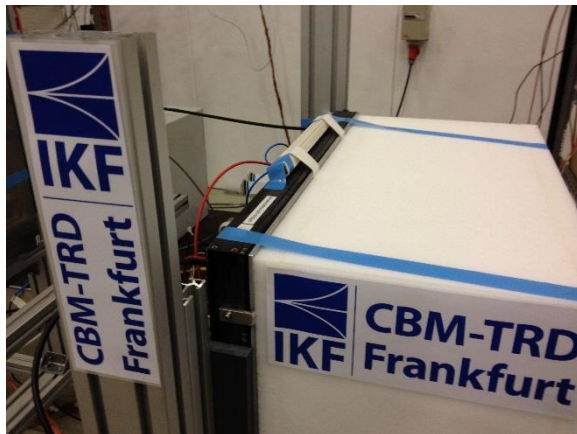
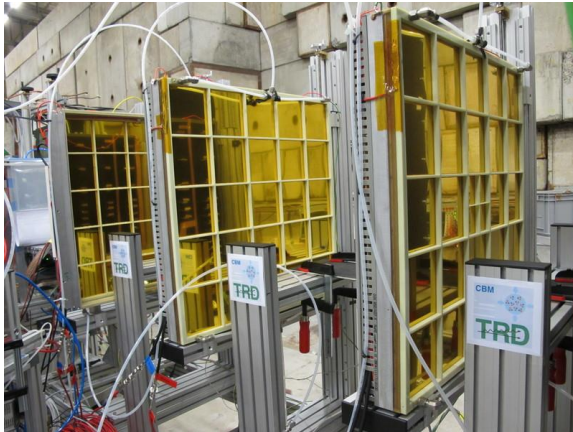


- **Geometry**
 - 4 layers in 1 station
- **Electron Identification**
 - Pion suppression: ~ 10
 - @ 90% electron-efficiency
- **Tracking all charged particles**
 - Position resolution: $\sim 200\text{-}300\ \mu\text{m}$
 - @ high rates ($>100\ \text{kHz}/\text{cm}^2$)
 - and high multiplicities

Transition Radiation Detector



Prototypes from Bucharest, Frankfurt and Münster



Münster 2014

Motivation

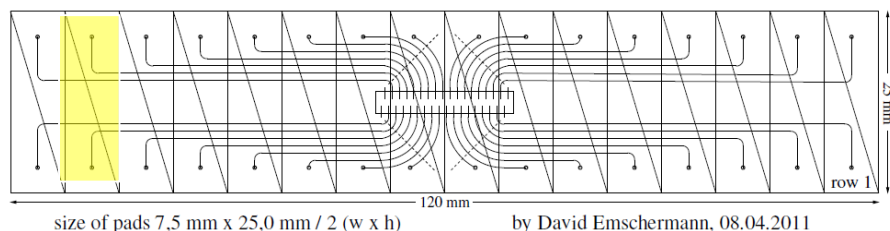
Up to now:

- Measurements with SPADIC1.0 Data Acquisition Chain Münster and Frankfurt prototypes in laboratory and in beam(CERN PS) 2014 and 2015
- Measurements with SPADIC1.0 Data Acquisition Chain at TRD prototypes developed from IFIN-HH Bucharest (Horia Hulubei - National Institute for Physics and Nuclear Engineering (NIPNE))

TRD Prototype Bucharest

- Differences to Prototypes from Münster and Frankfurt
- 2*4mm amplification region for faster readout
- 4mm drift region
- 25 μ m aluminized Kapton foil for Drift electrode on 8mm Rohacell
- Readout electrode of 300 μ m thickness PCB
- Anode wires are Au coated W wires of 20 μ m diameter 3mm pitch
- Cathode wires are 75 μ m Cu/Be alloy with 1,5mm pitch
- Rectangular pads split on diagonal for a triangular shape, 2D position reconstruction

CBM TRD triangular pad plane interface to 32ch SPADIC

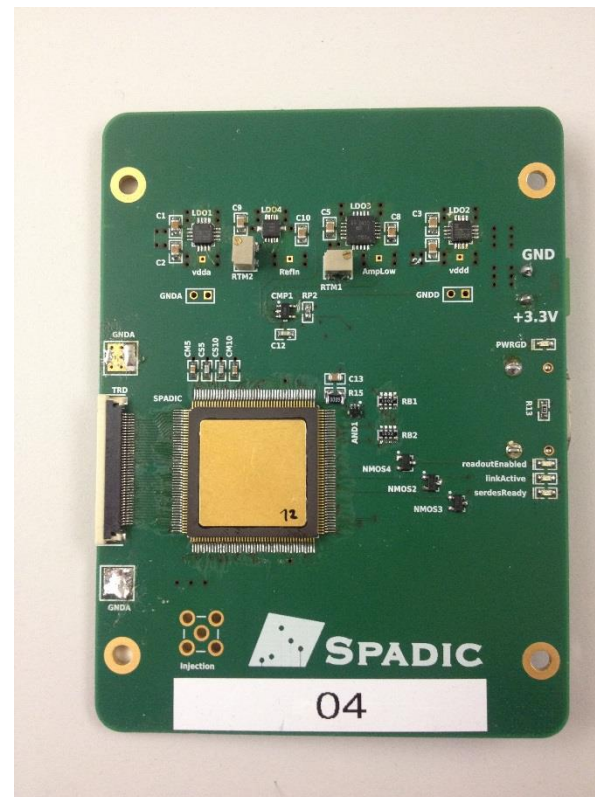


by David Emschermann, 08.04.2011

SPADIC1.0

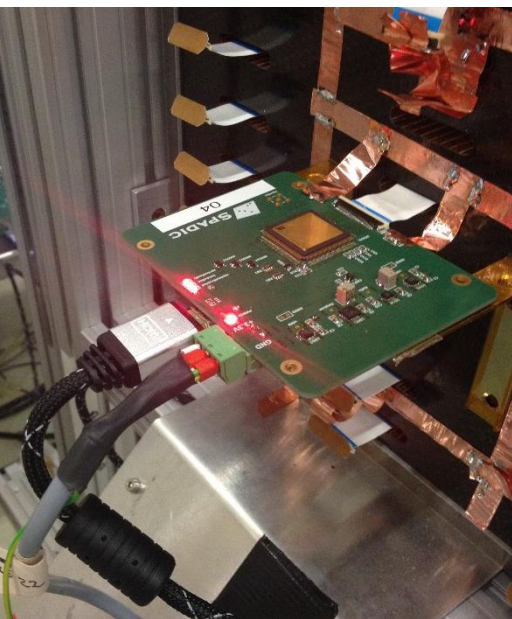
- Self-triggered *Pulse Amplification and Digitization asIC*
- *32 channel organized in two groups of 16ch each*
- Max 32 samples (time bins) of about 60ns each per pulse
- ADC Range from -256 to 256
- Neighboring channels can trigger each other
- Free streaming data, see also:

**Philipp Kähler HK 8.4:
Vortrag
Montag, 14. März 2016,
15:00–15:15, S1/01 A3**



DAQ Chain for beam tests and laboratory

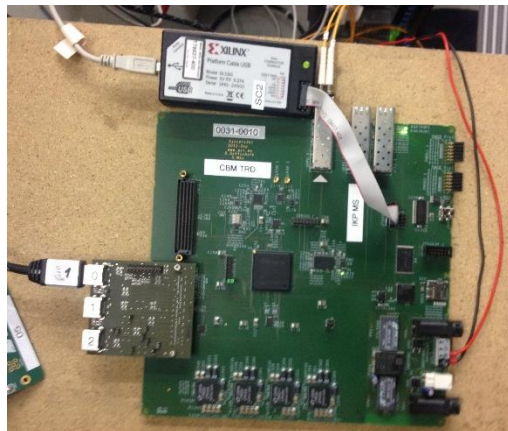
SPADIC :
Self-triggered *P*ulse
Amplification and
*D*igitization as/*C*



LVDS



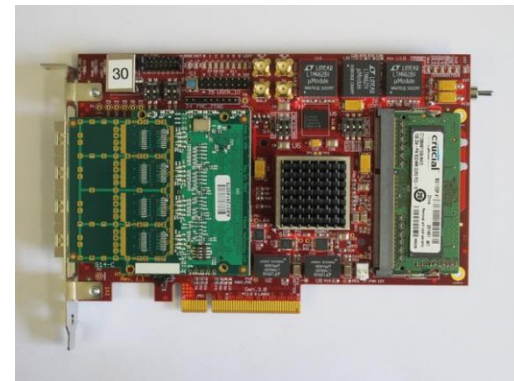
Syscore:
Data
Concentrator
Board



Optical



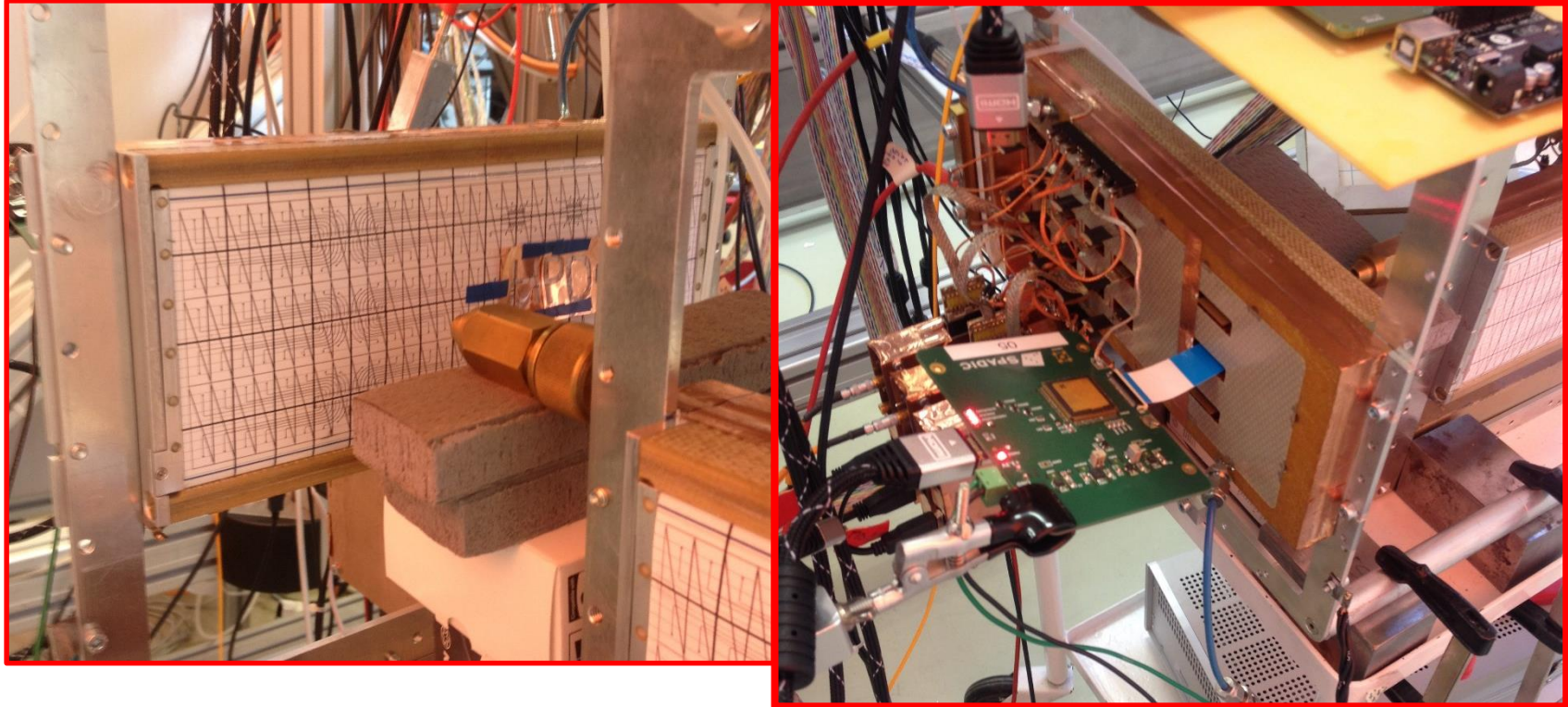
FLIB: **F**irst **L**evel
Event **S**elector
(FLES) Interface
Board





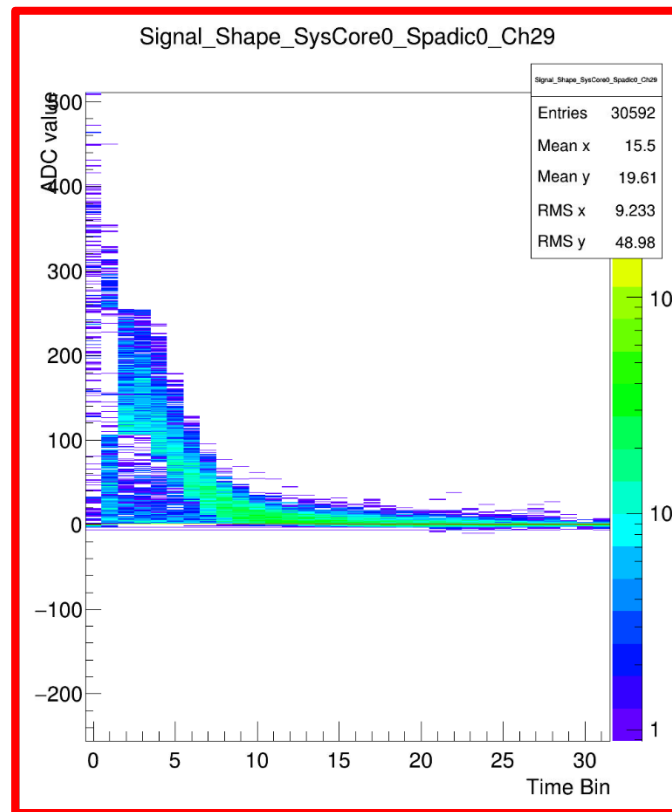
Laboratory measurements with ^{55}Fe

First Readout of Bucharest Prototype with SPADIC1.0 using a signal from ^{55}Fe Source ($\approx 3\text{MBq}$)



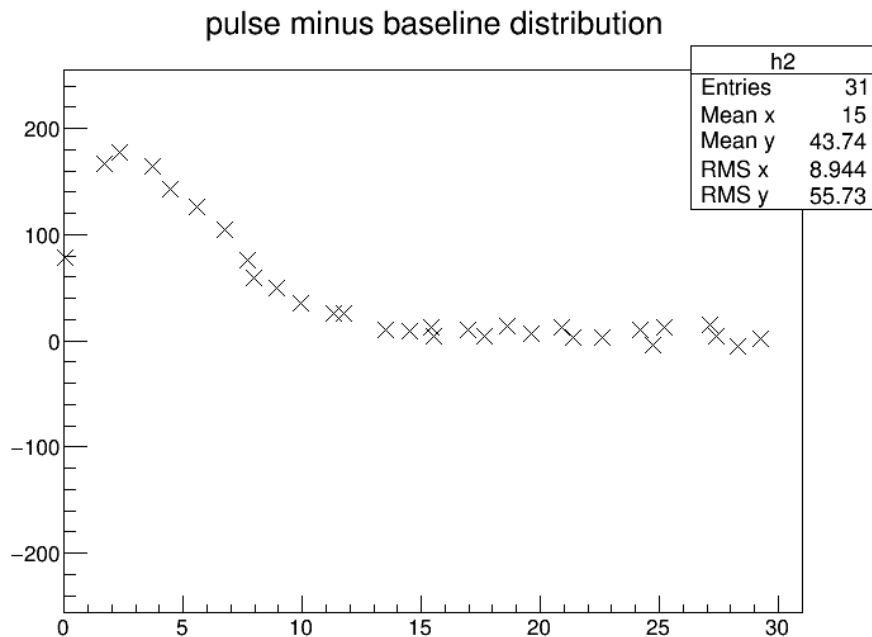
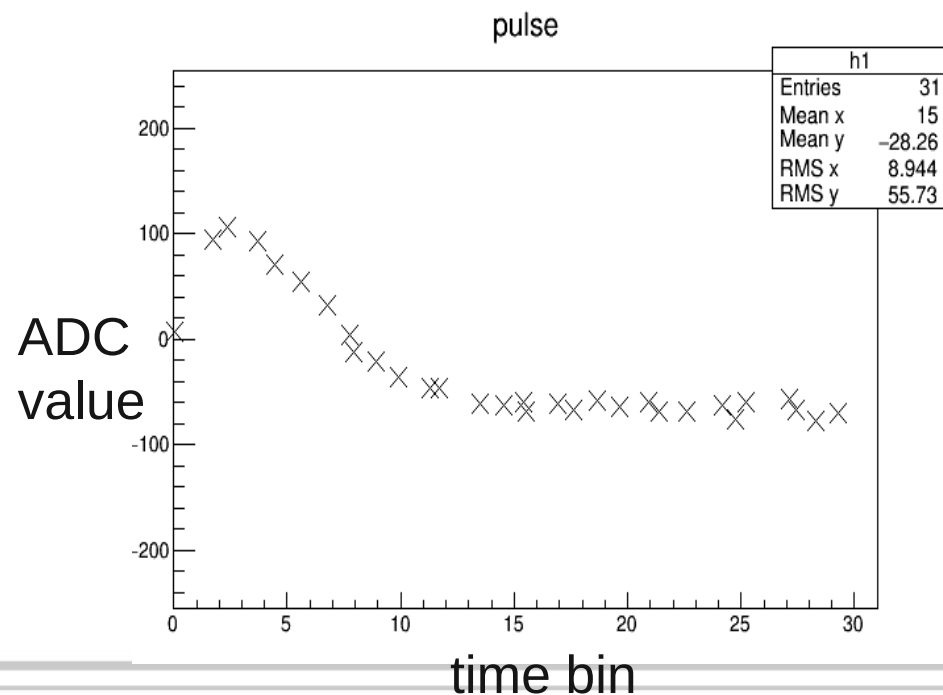
Statistic of recorded Data in preparation phase of two weeks

- 41 runs (including short test runs)
- some problems with stability of half SPADICs
- 6 runs with stable SPADIC
- ≈ 10 GB "good" data
- ≈ 500000 signals

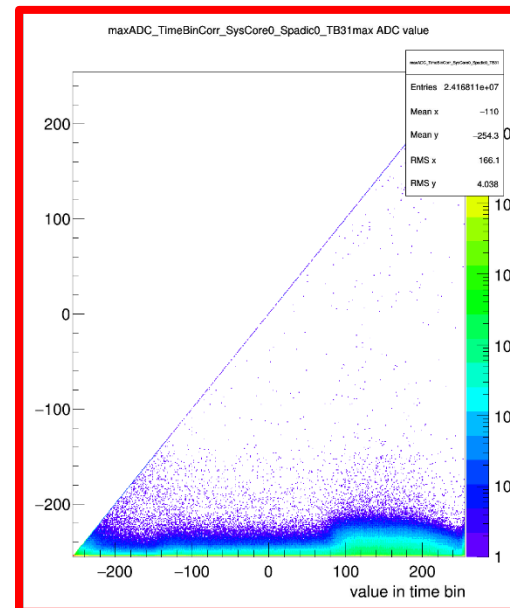
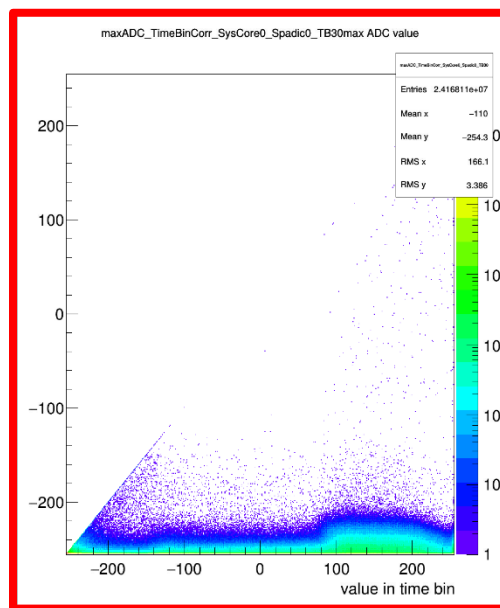
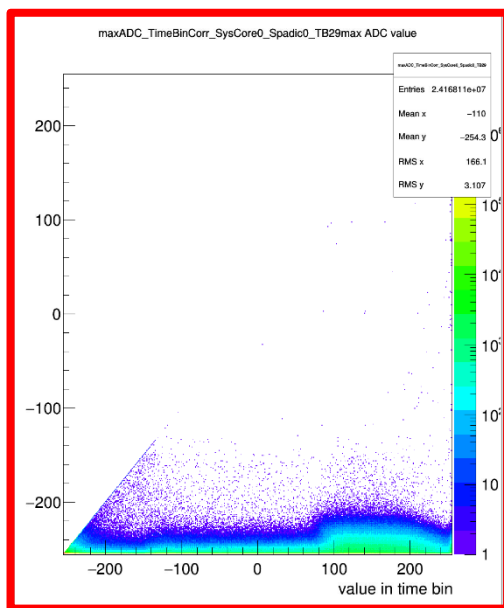


Baseline correction

- Take the last 3 bins and subtract the average value
- The average Value is used to normalize the signal

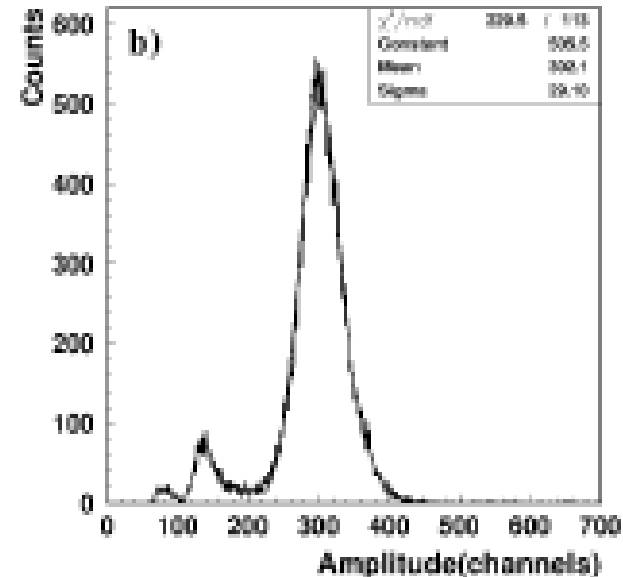


Correlation of last bins with max. (Baseline)



Max ADC Value of Pulse versus value in time bin
29,30,31

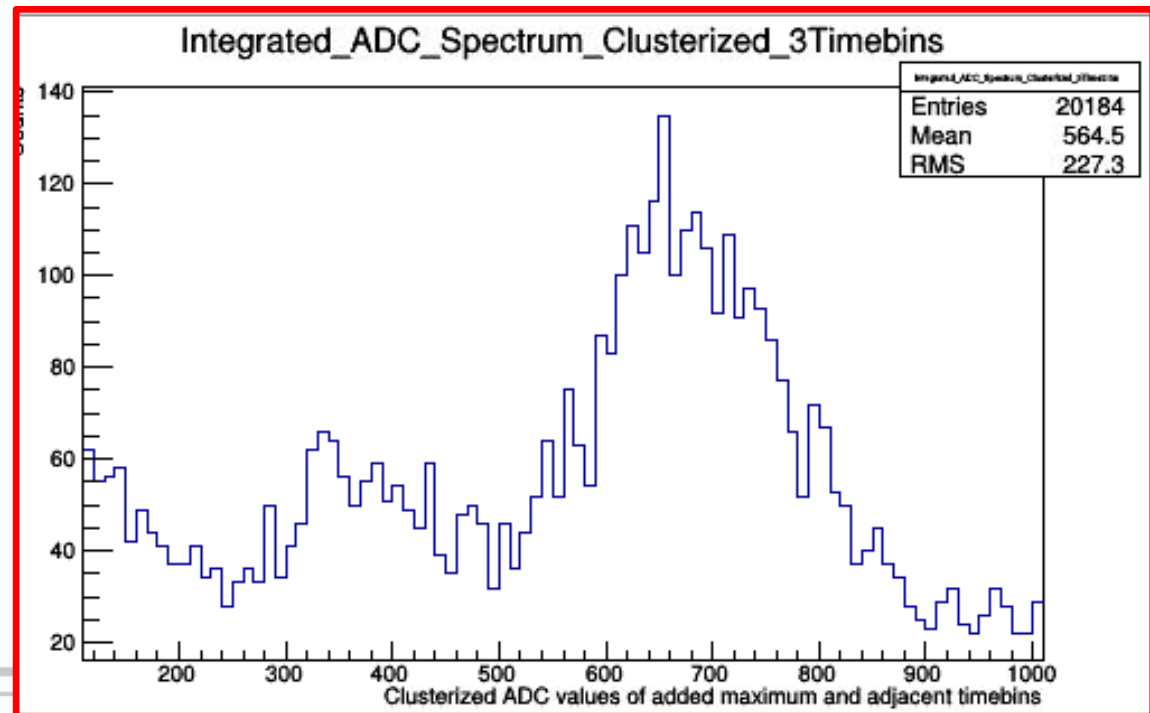
Reference
from CBM
TDR (FASP-
Electronics)



17

Fe 55

- Preliminary spectrum from Bucharest laboratory measurements with Fe-55





In Beam Measurement CERN SPS Nov. 2015

In Beam Measurement CERN SPS Nov. 2015

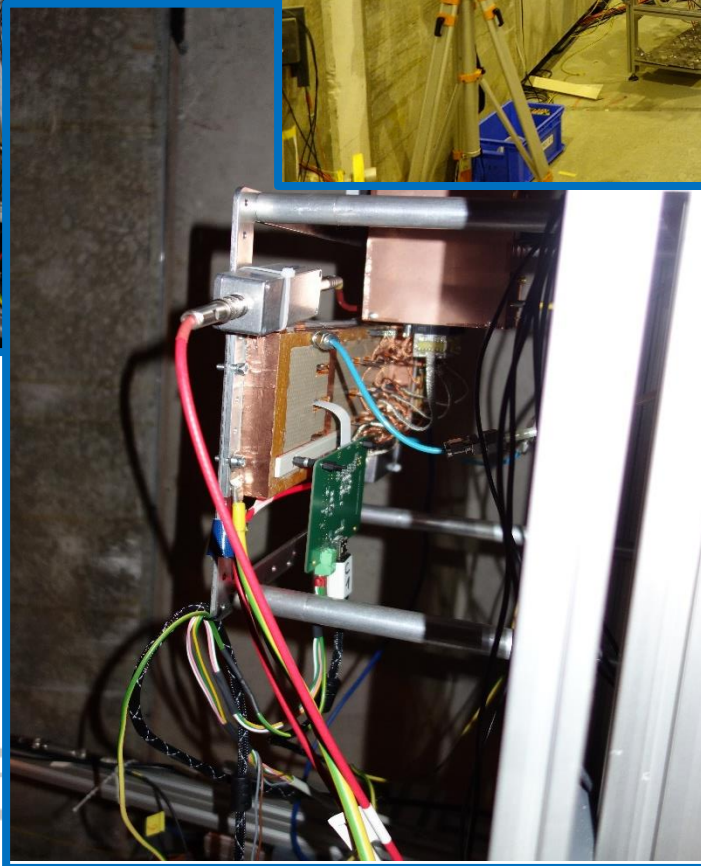
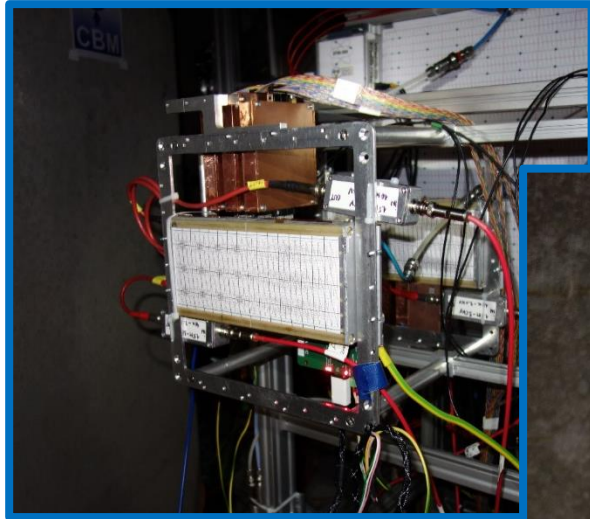
- Pb 30GeV per nucleon
- SPADIC1.0 on first Bucharest Chamber
- Two independent DAQ Systems for the SPADICs, one for Bucharest and one for Münster/Frankfurt Prototype





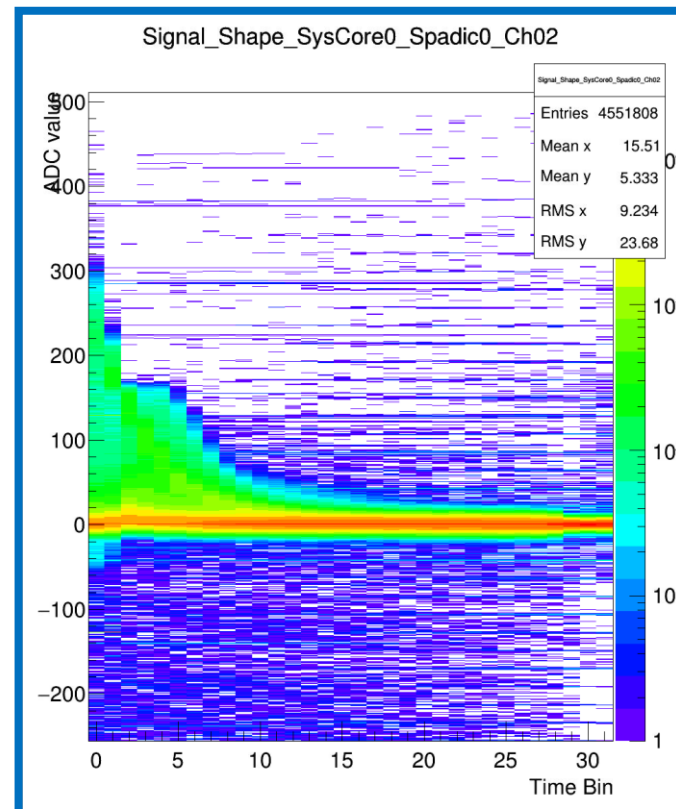
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Setup at CERN SPS

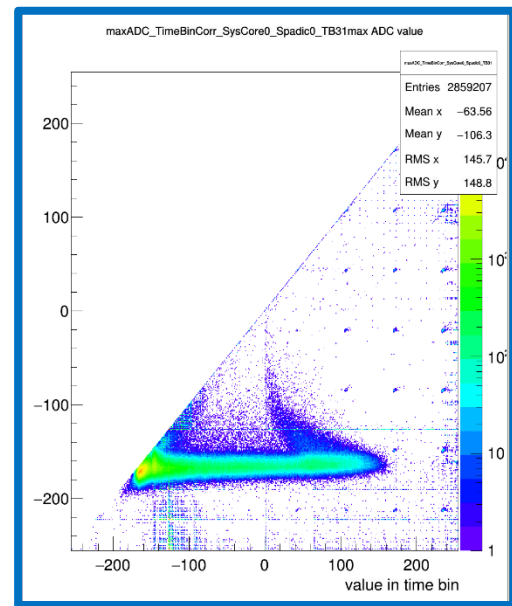
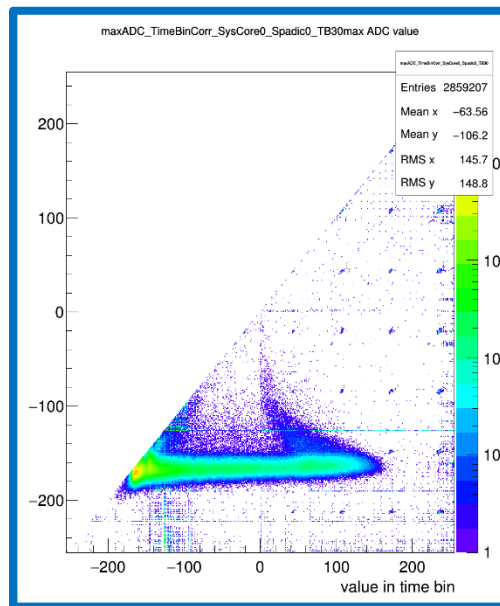
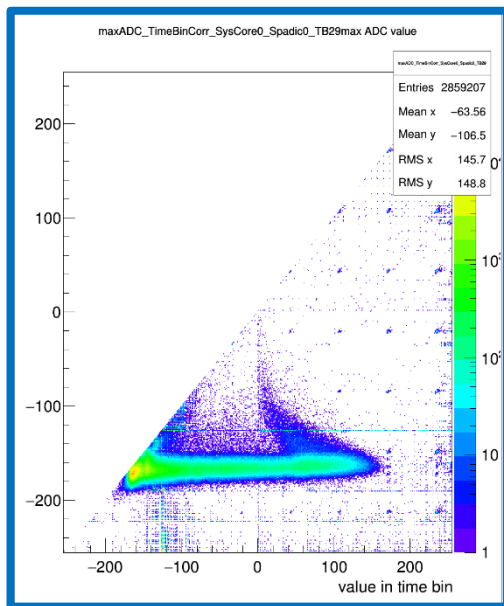


Statistic of recorded Data at CERN SPS

- 57 runs (including short test runs)
- Total 41GB
- Also some problems with stability of half SPADICs
- Quality Checks ongoing



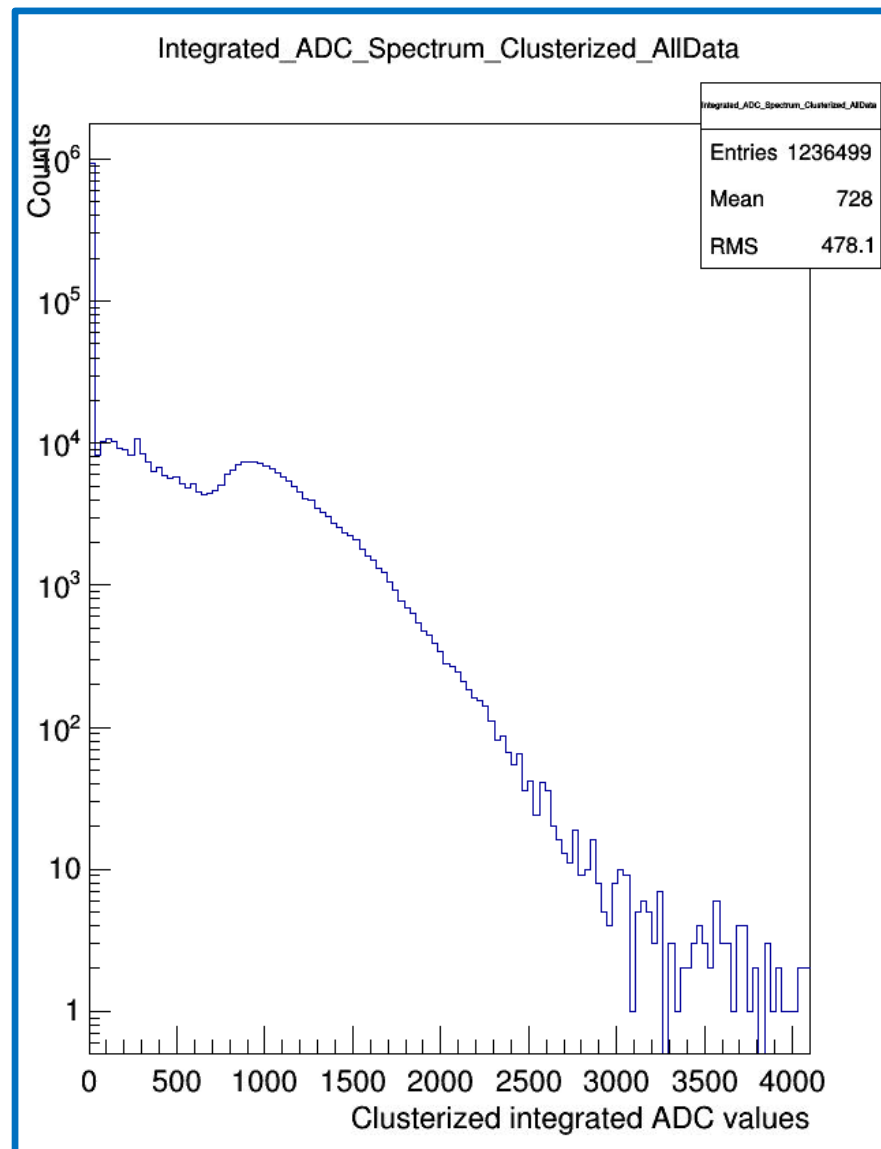
Correlation of last bins with max. (Baseline)



Max ADC Value of Pulse versus value in time bin
29,30,31

Spectrum

- Preliminary spectrum from SPS Nov 2015
- No reference detectors available in Setup



Outlook

- Still a lot of things to do and understand to archive comparable measurements but:
- Painful offline event building under way finally, facilitating further analyses.

Further R&D this year

- 1m² Chambers
- SPADIC1.1
- In Beam test at DESY in September
- In Beam test at CERN PS/SPS?



Thank you!