A New Electronic Readout for the Multiwire Drift Chambers in the HADES Experiment at GSI

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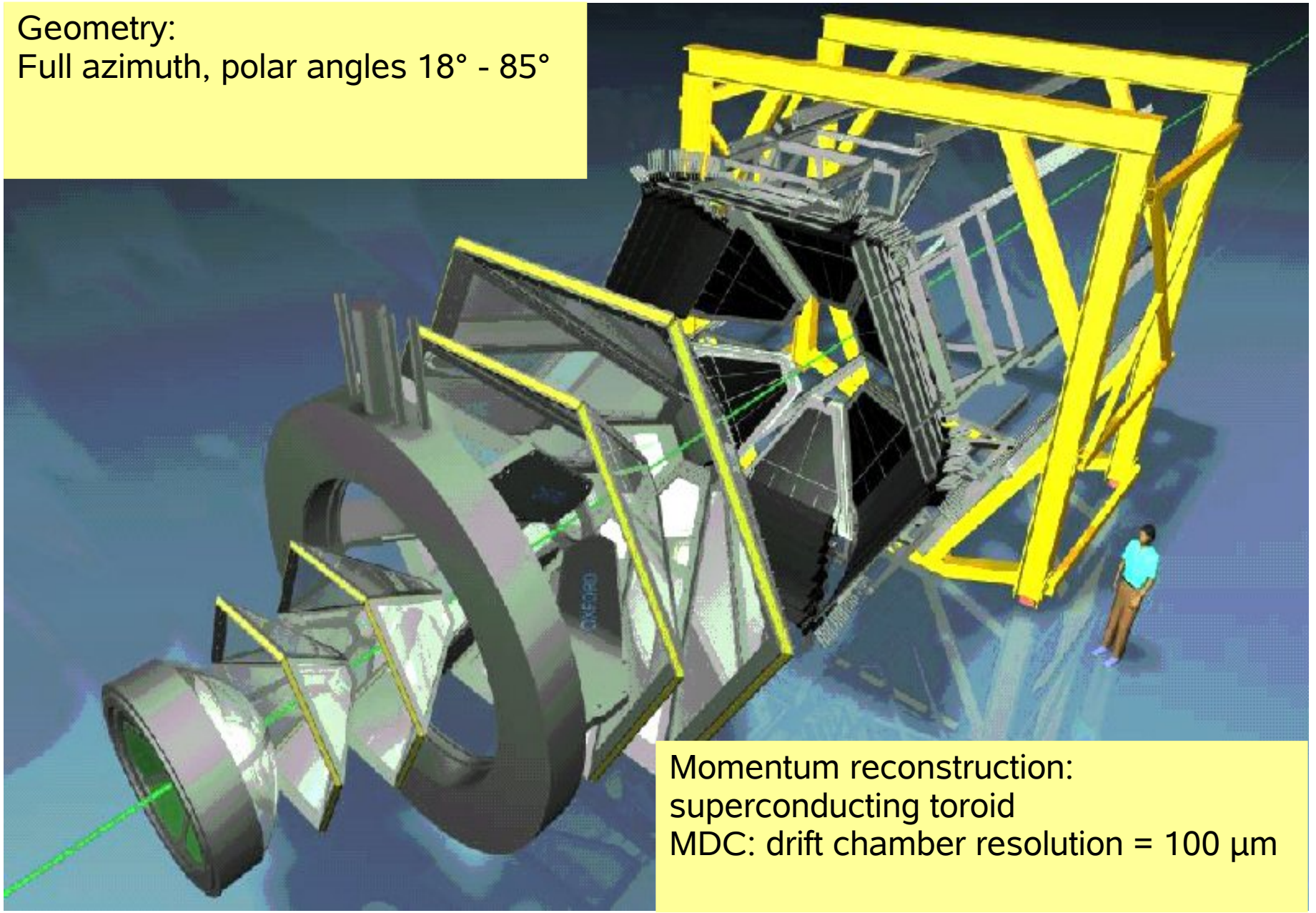
OUTLINE

- The HADES Experiment, Motivation for the Project Upgrade.
- The Multiwire Drift Chamber (MDC) Electronics Upgrade:
  - The Common Readout Platform: *T*DC *R*eadout *B*oard (TRB).
  - MDC Add On Board.
  - Further Improvement: Data Transmission over Plastic Optical Fiber (POF).
- Summary.

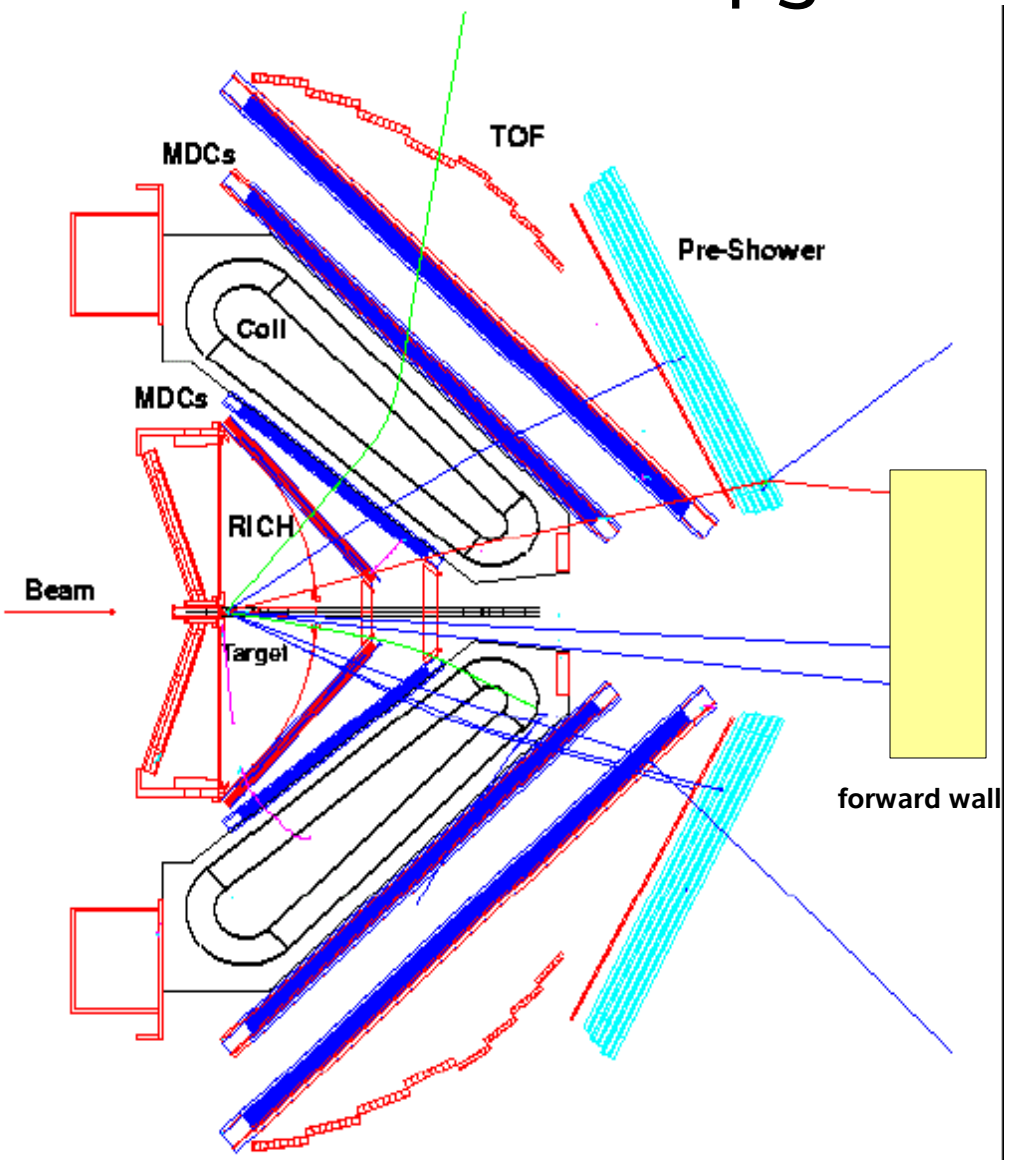
The HADES Experiment, Motivation for the Project Upgrade

Geometry:
Full azimuth, polar angles 18° - 85°



Momentum reconstruction:
superconducting toroid
MDC: drift chamber resolution = 100 µm

The HADES Experiment, Motivation for the Project Upgrade



- Lepton ID
  RICH+TOF+SHOWER
- Tracking
  MDC+MAGNET
  - *Dielectron spectrometer*
    (C + C up to Au + Au)
  - *Detector and electronic upgrade is needed to cope with high multiplicities in heavy collisions system*

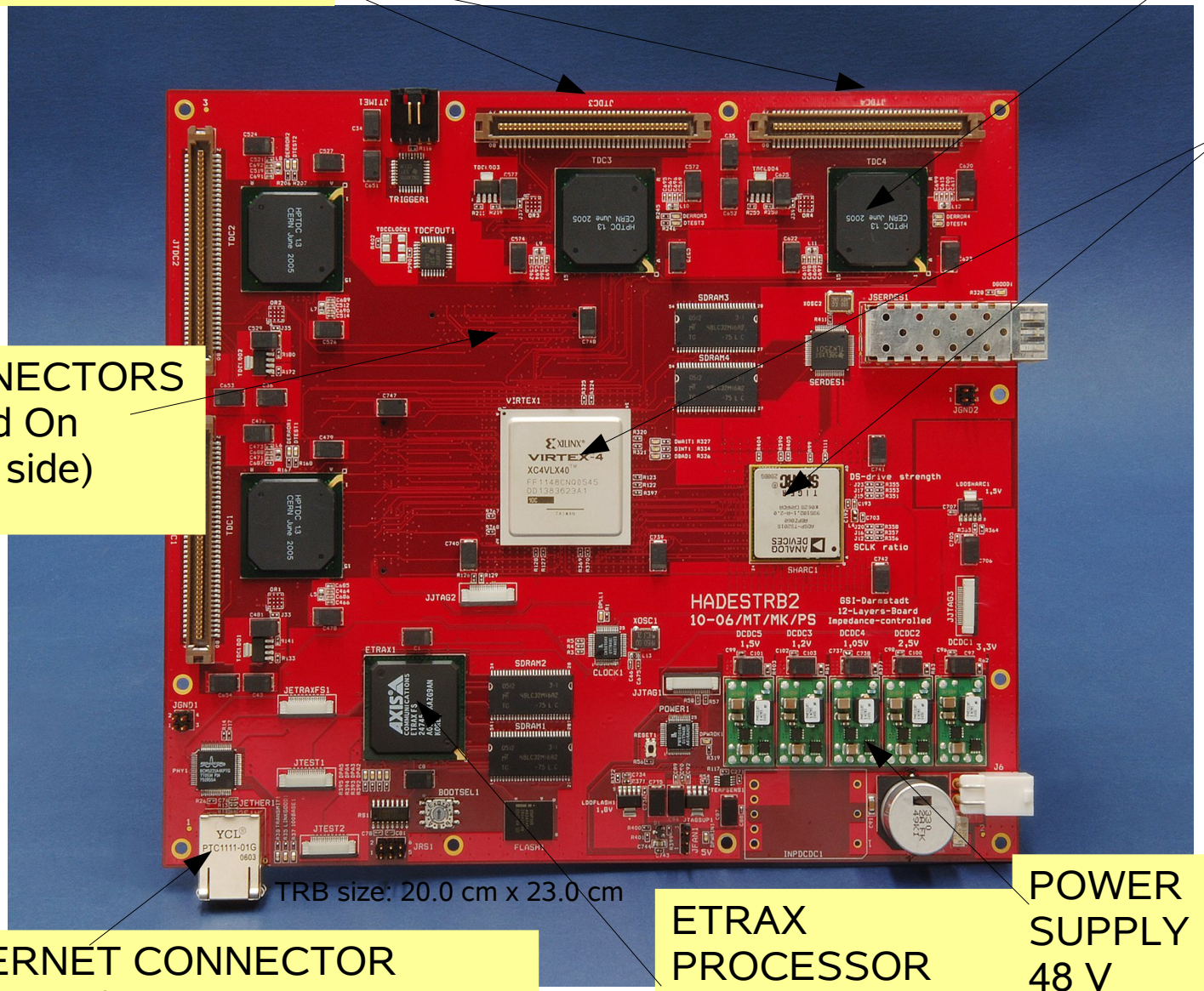
The Common Readout Board: *T*DC *R*eadout *B*oard (TRB)

CONNECTORS to Front End Electronics

x 4 TDCs

PROCESSORs (preprocessing data)

CONNECTORS to Add On (back side)



Successfully used in two beam times in 2007!
Readout of
- hodoscope/RPC
- forward wall
-scintillation detector
-diamond detector

ETHERNET CONNECTOR (data transfer/remote control)

ETRAX PROCESSOR (Linux kernel)

POWER SUPPLY 48 V

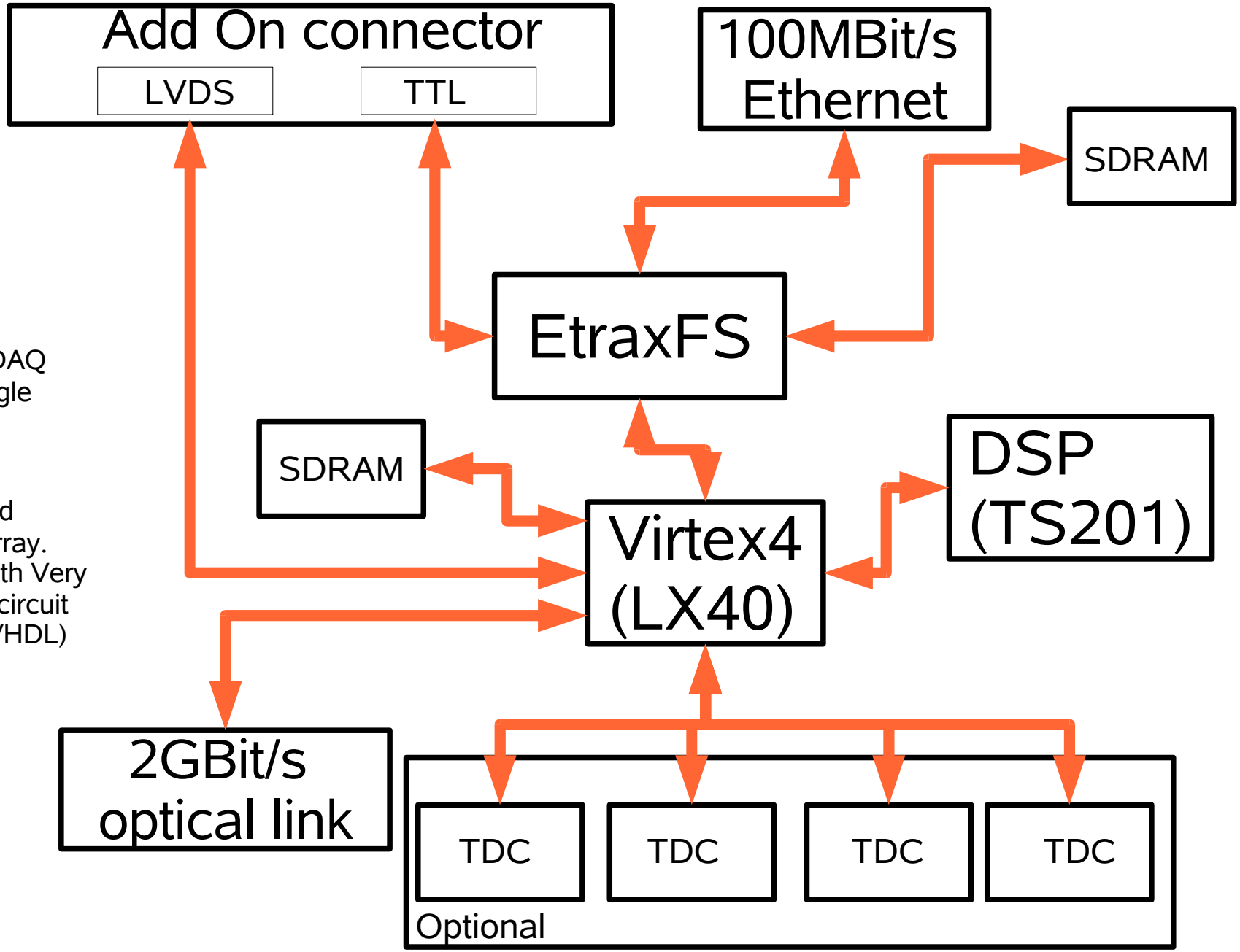
The Common Readout Board: *T*DC *R*eadout *B*oard (TRB)

TTL: Transistor-Transistor logic

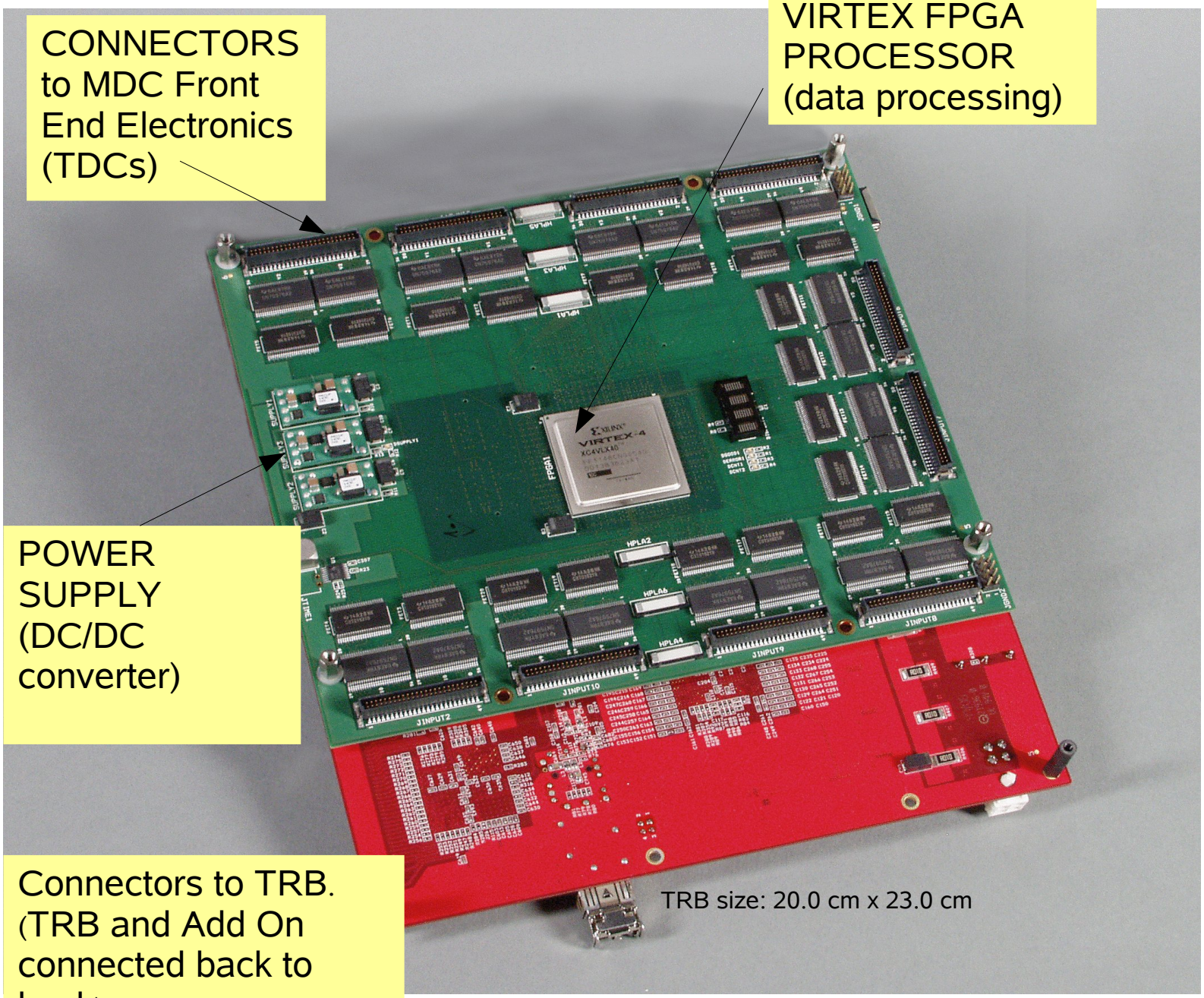
LVDS: Low Voltage Differential Signaling

EtraxFS: chip with DAQ functionality (Linux single chip computer)

Virtex4 FPGA: Field Programmable Gate Array. Device programmed with Very High speed integrated circuit Hardware Language (VHDL)

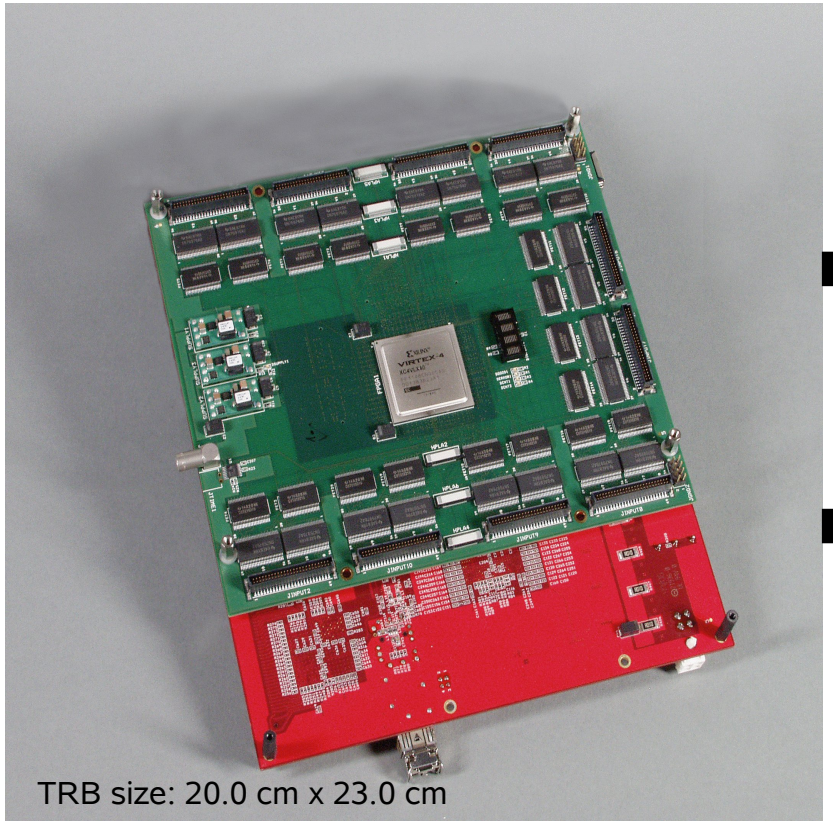


The MDC AddOn Board

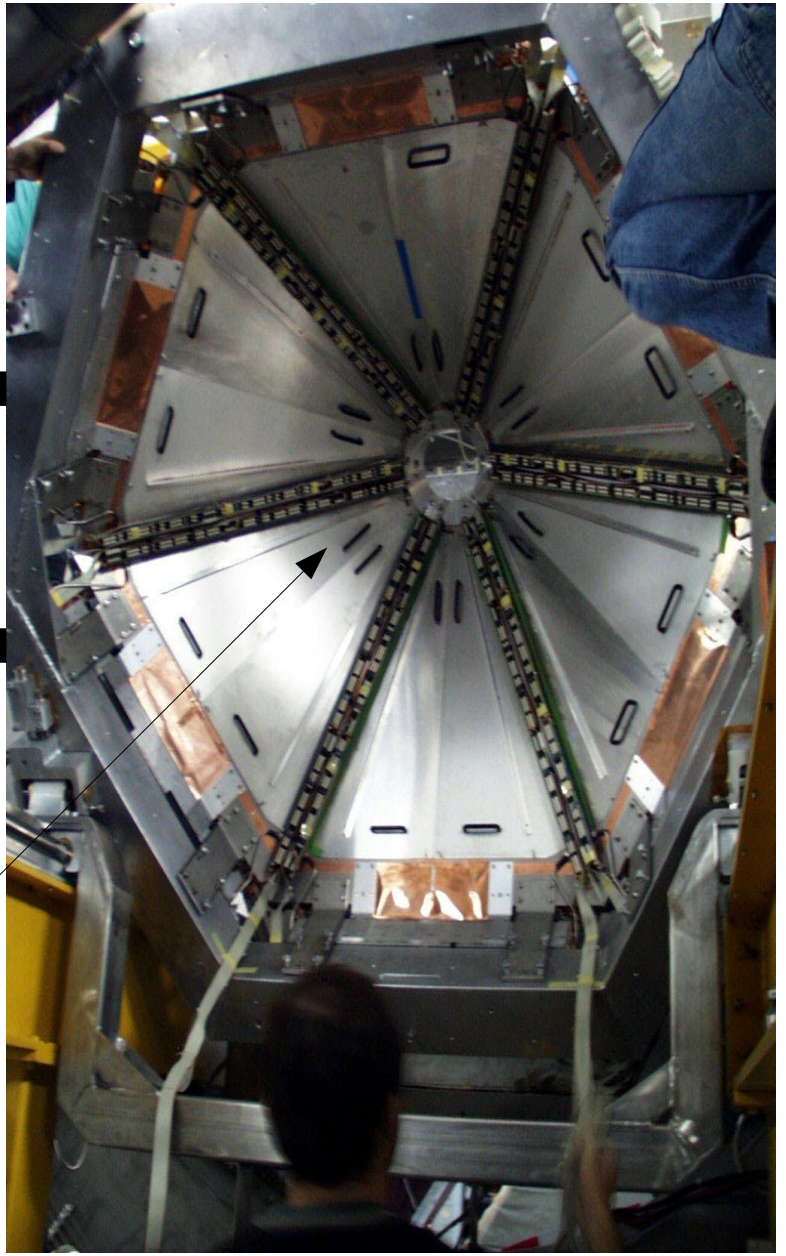


- 24 Boards will read out all HADES Chambers
- ~30.000 TDC channels
- Parallel readout of ten buses within one Processor
- Possible platform to implement “on line” tracking or RICH ring/MDC segment correlation
- The Processor code is highly reusable!

The MDC AddOn Board



10 flat copper cables

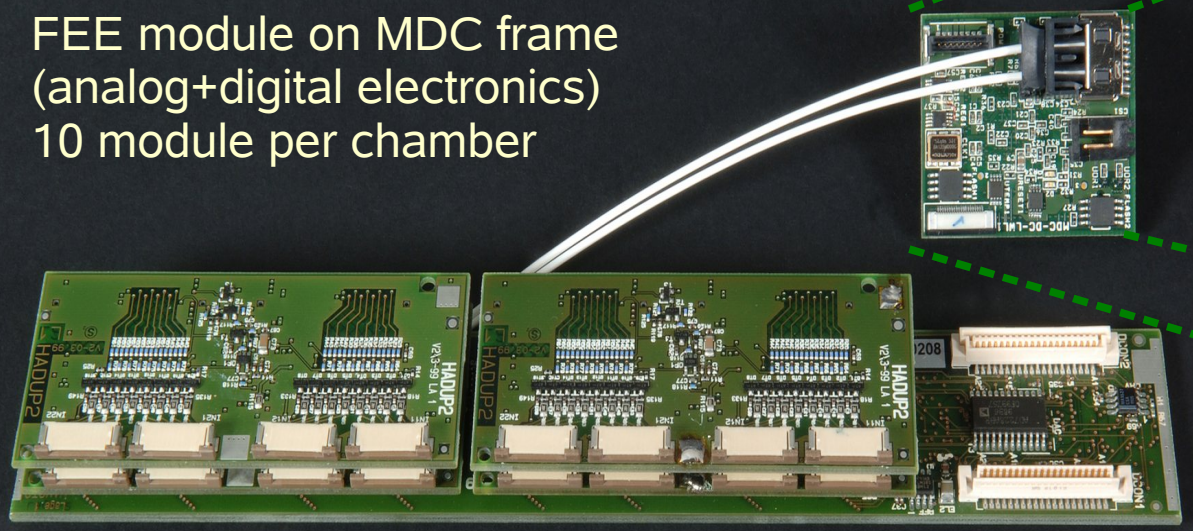


MDC AddOn reads out 1 Chamber
(10 FEE modules)

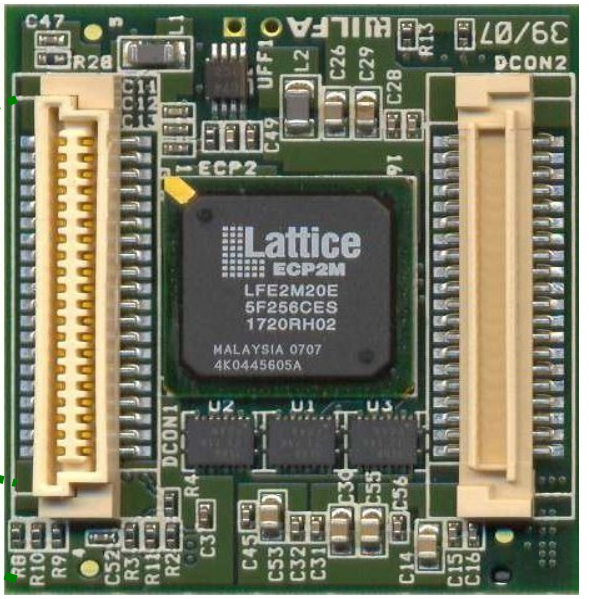
The Front End Electronic (FEE) is squeezed between MDCs!
=> induces noise!

Further Improvement: the New Driver Card

FEE module on MDC frame
(analog+digital electronics)
10 module per chamber



One FEE module: 24.0 cm x 4.0 cm

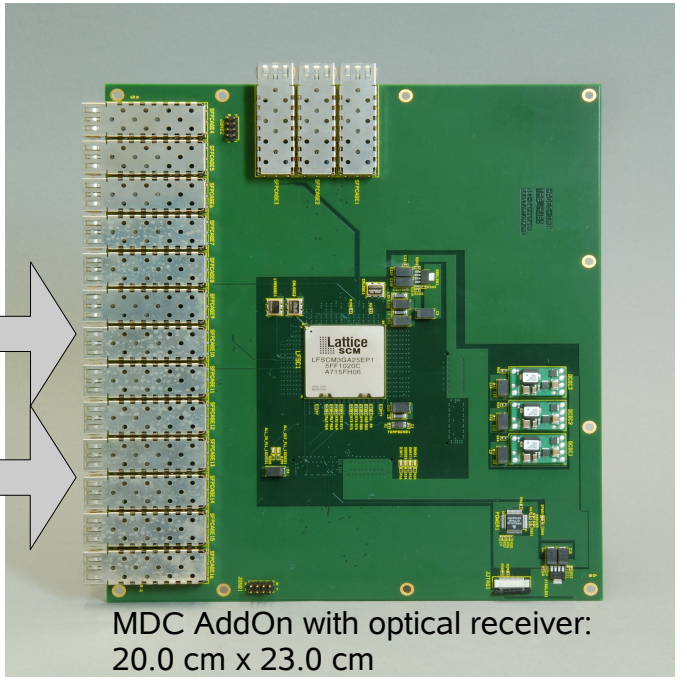


Driver Card size: 4.0 cm x 4.5 cm

Advantages:

- Plastic Optical Fiber (POF) are easy to maintain and do not induce noise conducted or irradiated!
- Fast data transmission: 250 Mbits/sec
- Cheap optical fiber and transmitter

I/O:16 optical fibers



MDC AddOn with optical receiver:
20.0 cm x 23.0 cm

Summary

- Success of the TRB concept: flexible system, usable by many detectors and different experiment!

- MDC AddOn, as “an example of a *TRB-detector interface*” is working as designed.

- “*A big project in a small board*”: Data AcQuisition functionalities as close as possible to the FEE:
  - Optical transmission: small, cheap and fast devices are now on the market (not available few years ago!)
  - All this integrated to the TRB

Literature

- A General Purpose Trigger and Readout Board (TRB), for HADES and FAIR-Experiments, GSI Scientific report GSI 2006.
M. Traxler, I. Froehlich, M. Kajetanowicz, K. Korcyl, W. Krzemien, M. Palka, P. Salabura,C. Schrader, H. Stroebele, J. Stroth, P. Skott, A. Tarantola, R. Trebacz

- 128 channel high resolution TDC with integrated DAQ-system, GSI Scientific report GSI 2005.
M. Traxler, D.Gil, M. Kajetanowicz, K. Korcyl, M. Palka, P. Salabura, P. Skott, R. Trebacz

- ETRAX, Axis www.axis.com