# Electronics Ideas from Poland

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# Introduction – who are we?

- Small group at the Warsaw University of Technology, specializing in nuclear & medical electronics.

- Currently involved in:
  - R&D for Hyper-K and nuPRISM (electronics)
  - T2K (SMRD, were involved in MPPC QA)
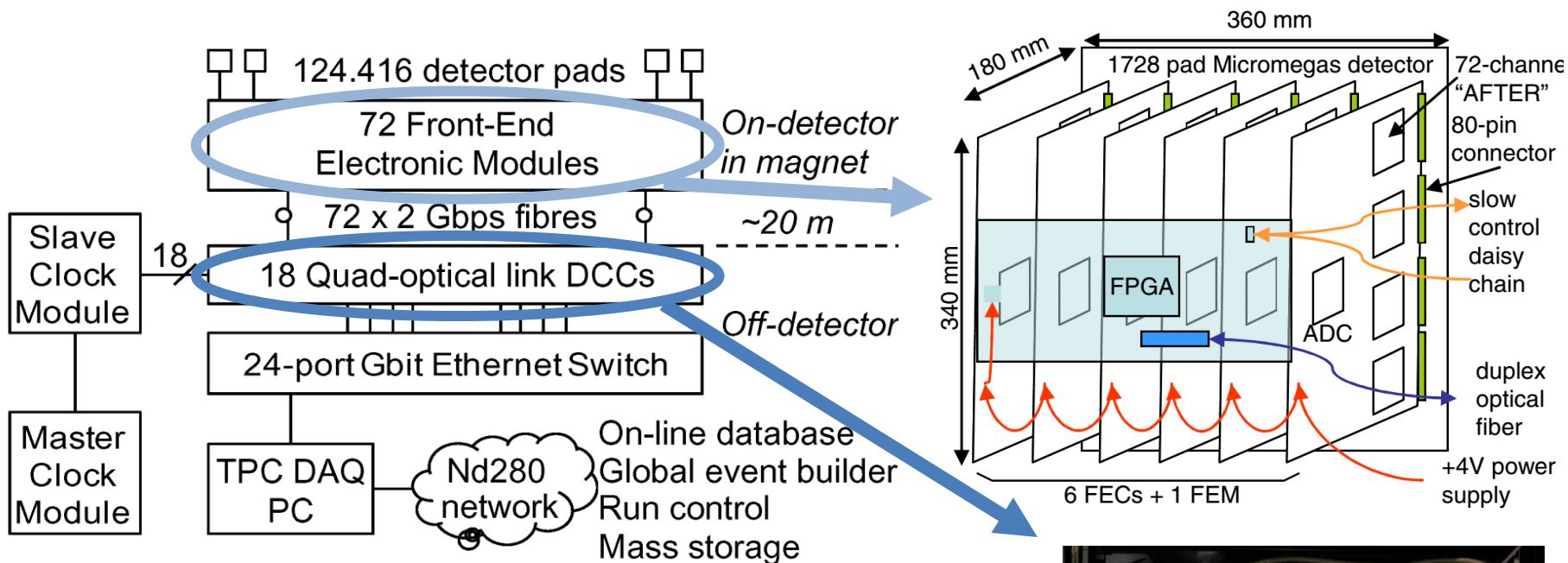  - COMPASS (various projects, most finished)



**MPPC QA for SMRD**

HV bases pre-amps CAMERA

**Front-ends for ECAL0**

*T2K*

*COMPASS*

# TPC readout architecture (now)



- 3 TPC chambers × 24 micromegas modules
- 72 modules × 1726 pads = 124 416 channels
- 50 MHz SCA (AFTER) + 20 MHz/12 bits ADC
- Total data bandwidth 144 Gbps (FEM→DCC)

*Architecture and Implementation of the Front-End Electronics of the Time Projection Chambers in the T2K Experiment*
P. Baron, et al.

Crate with DCC modules

# Back-end electronics – DCC

- 18 × Xilinx ML507 development boards with extensions
  - Virtex 5 FPGA with embedded processor not recommended for use in new designs
  - 256 Mbyte DDR2 SODIMM memory
  - Gigabit Ethernet
  - 6 RocketIO transceivers available + 2 in loopback mode
- Mezzanine card
  - 3 Fiber Connectors connected to RocketIO transceivers
  - Reference clock received via RJ45 cable, then it is fed to a clock conditioner (TI LMK03200) and finally conveyed to the ML507 via Coax.
  - Single DDC performs aggregation from four FEMs
- One DCC crate holds 6 ML507 DCCs
  - Each crate reads 24 detector modules
  - Total number of crates for TPC = 3

Not available anymore

**Xilinx ML507 with extensions**



MEZZANINE

ML507
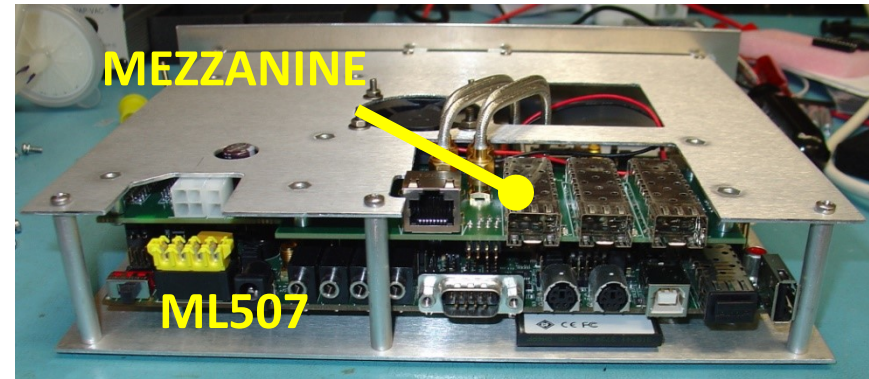
Custom-made crate populated with six DCCs
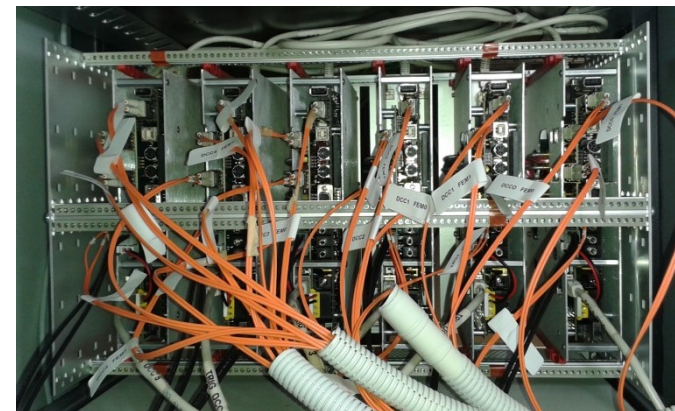
# New DCC design for HTPC

- 4 HTPC $\rightarrow$ ~70 MicroMegas $\rightarrow$ $1.3\times10^5$ channels

- 70 new Front-Ends and DCC optical channels needed

**WUT proposal:**

- Custom made VME DCC boards with Virtex UltraScale FPGA
  - 20 nm architecture
  - 45% lower power
  - **36-120** transceivers per FPGA
  - Max. Transceiver Speed 30.5 Gb/s
  - VCXO and fractional PLL integration reduces clocking component cost

- 8-16 optical ports per VME card

- One VME crate for 4 TPC modules needed

- Either single board or carrier + mezzanine topology for easier serviceability