Design status of the HGND active module and HGND mechanics

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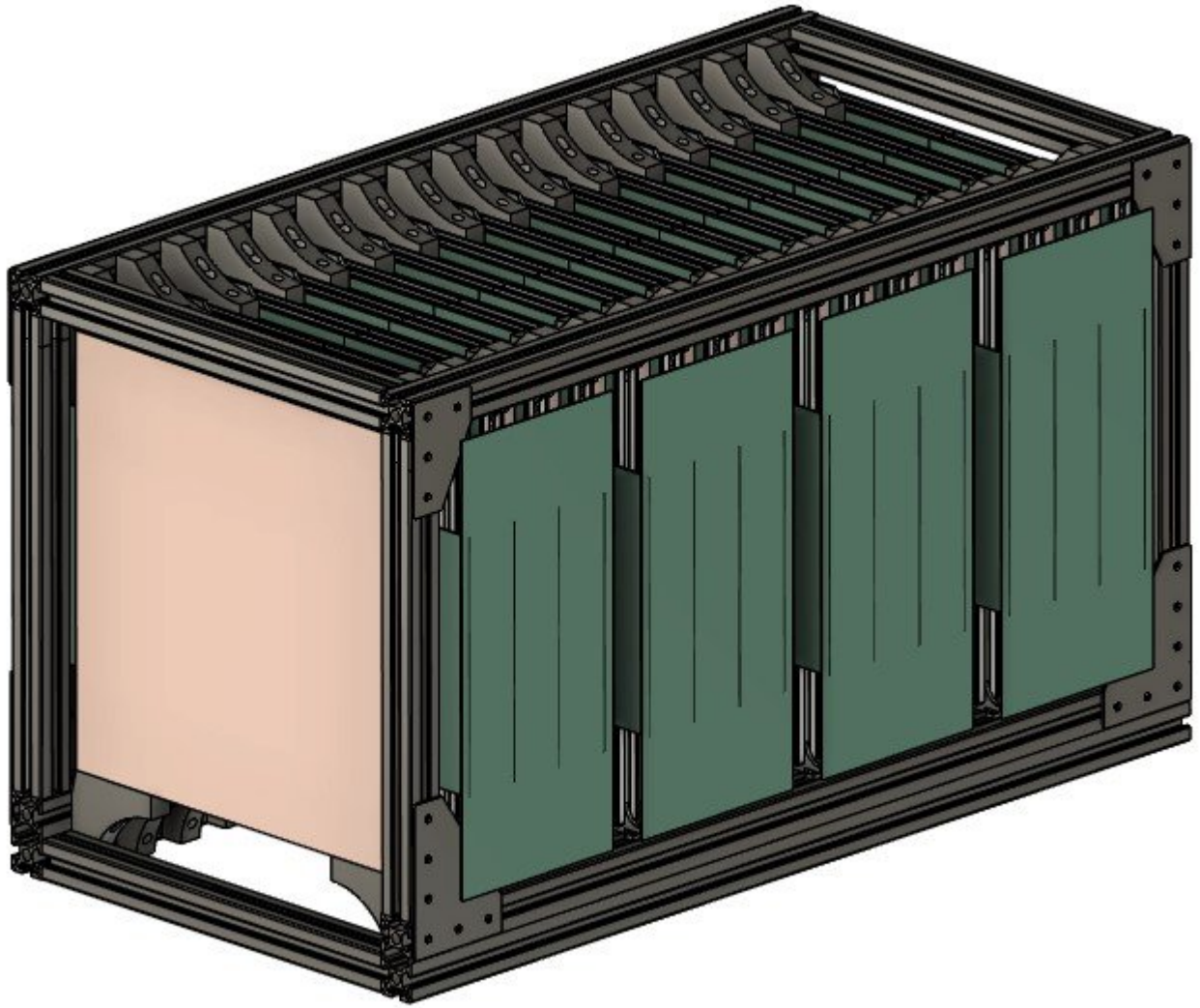
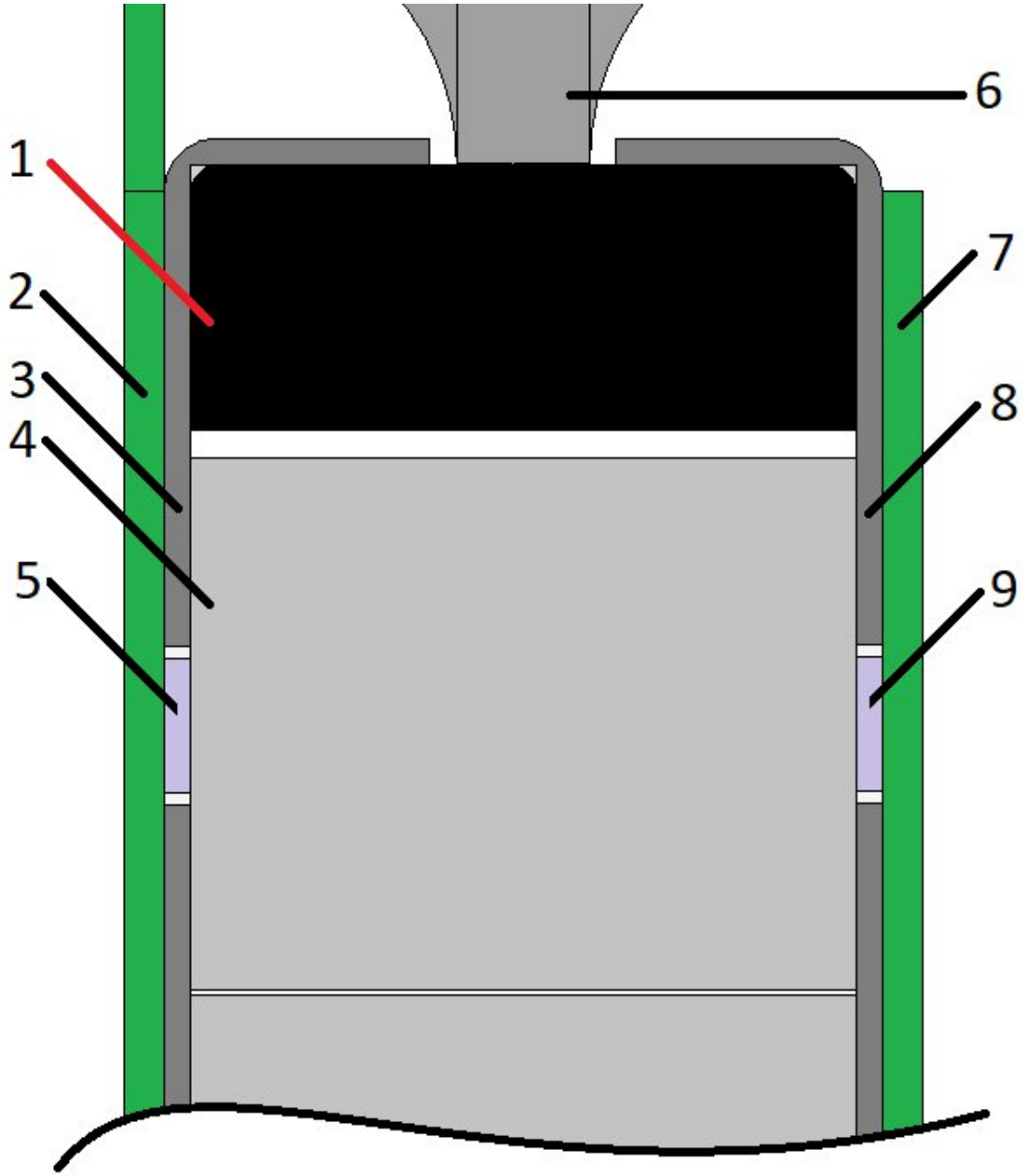
HGND assembly

- 16 detector layers with absorbers
- 1 VETO layer
- Detectors boards are split in half due to manufacturing concerns
- Each detector layer connects to a readout board:
  - Heat-generating components
  - FPGAs
  - PSUs
  - Outside connectors
- 4 “half-layers” per readout board

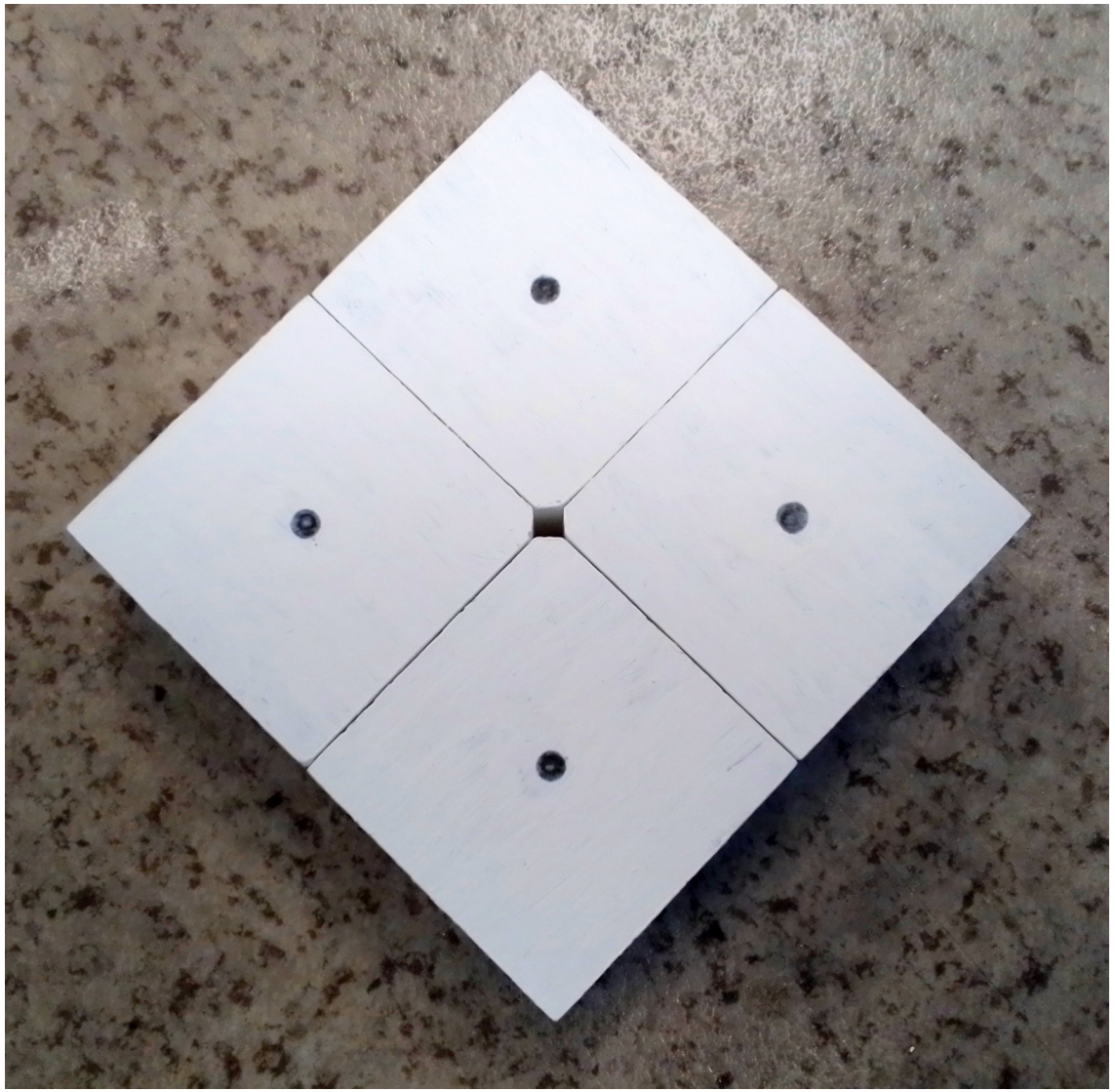


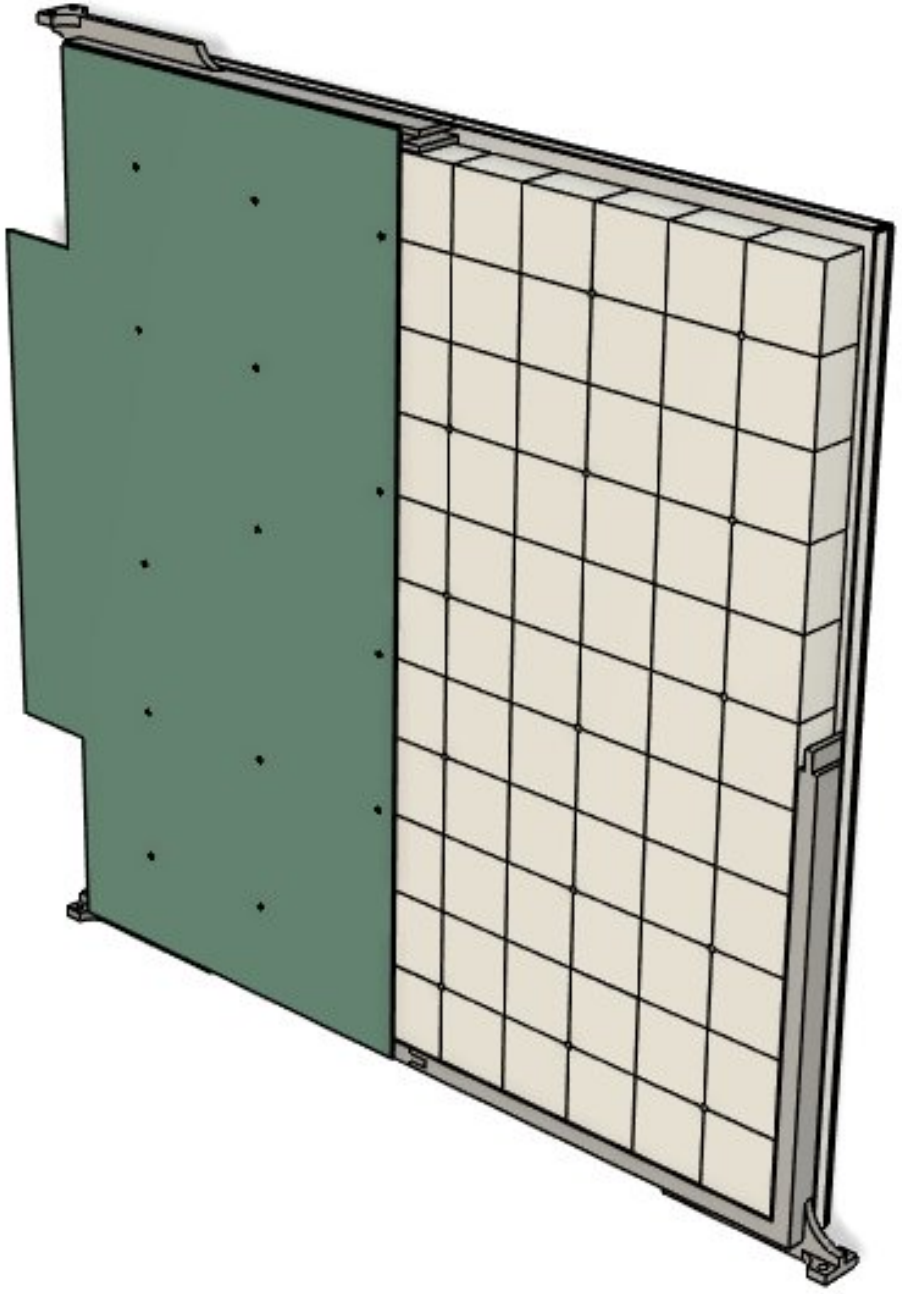
HGND active layer cross-section

- Each detector layer contains:
  - A light-tight casing
  - 121 scintillator cells
  - A readout board split into two “half-layer” boards due to size concerns
    - 121 MPPC, amplifiers and comparators
  - An LED board, split into two, allowing for direct readout chain verification



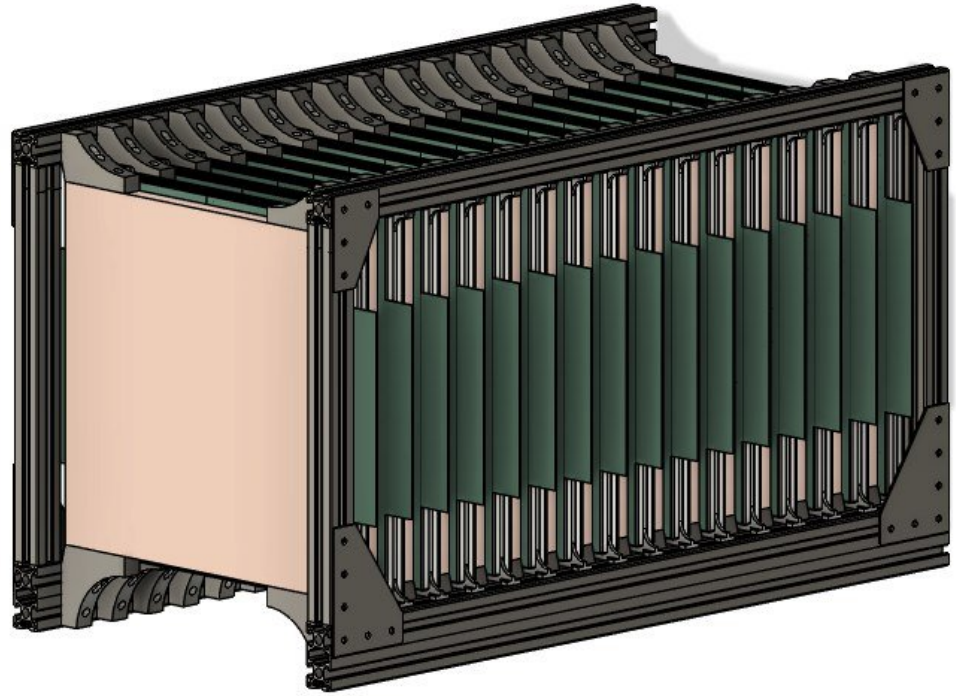
HGND active layer view

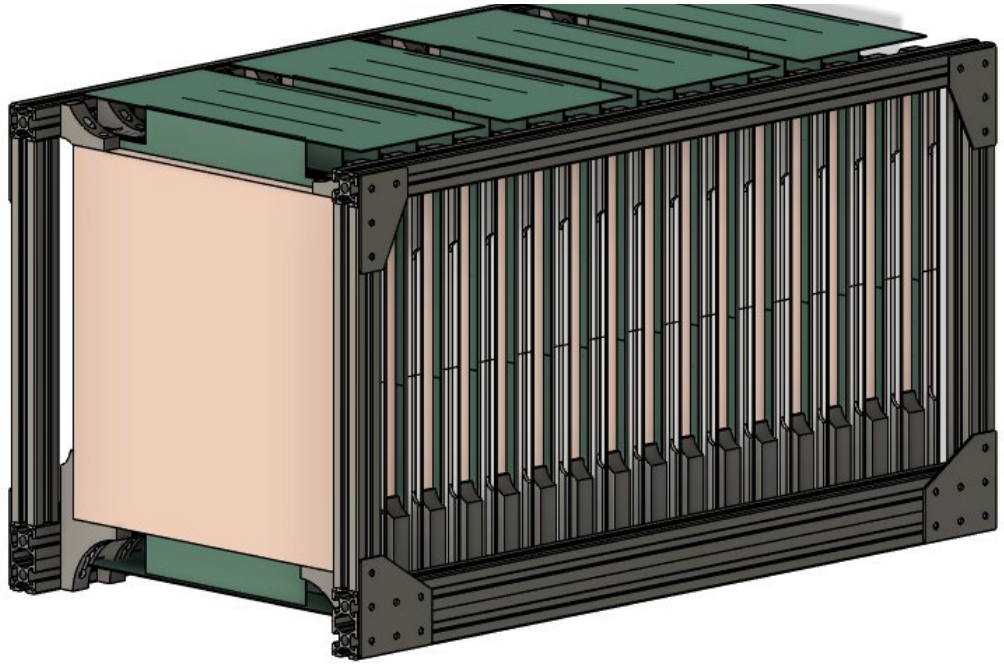




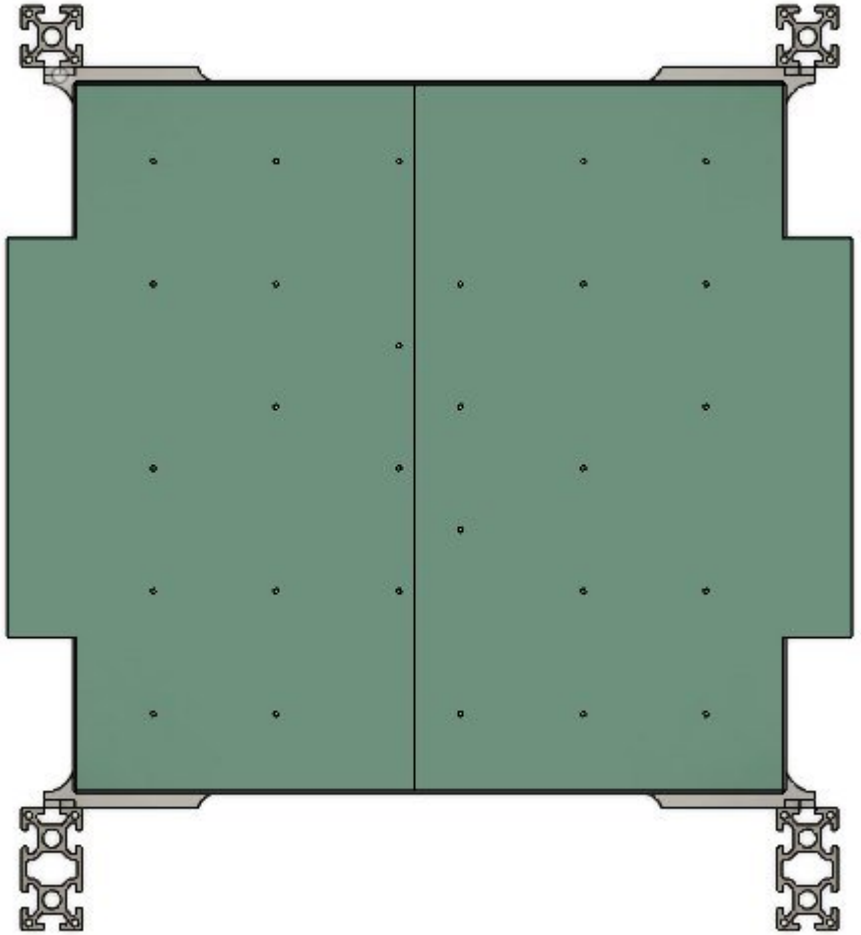
HGND mechanical design

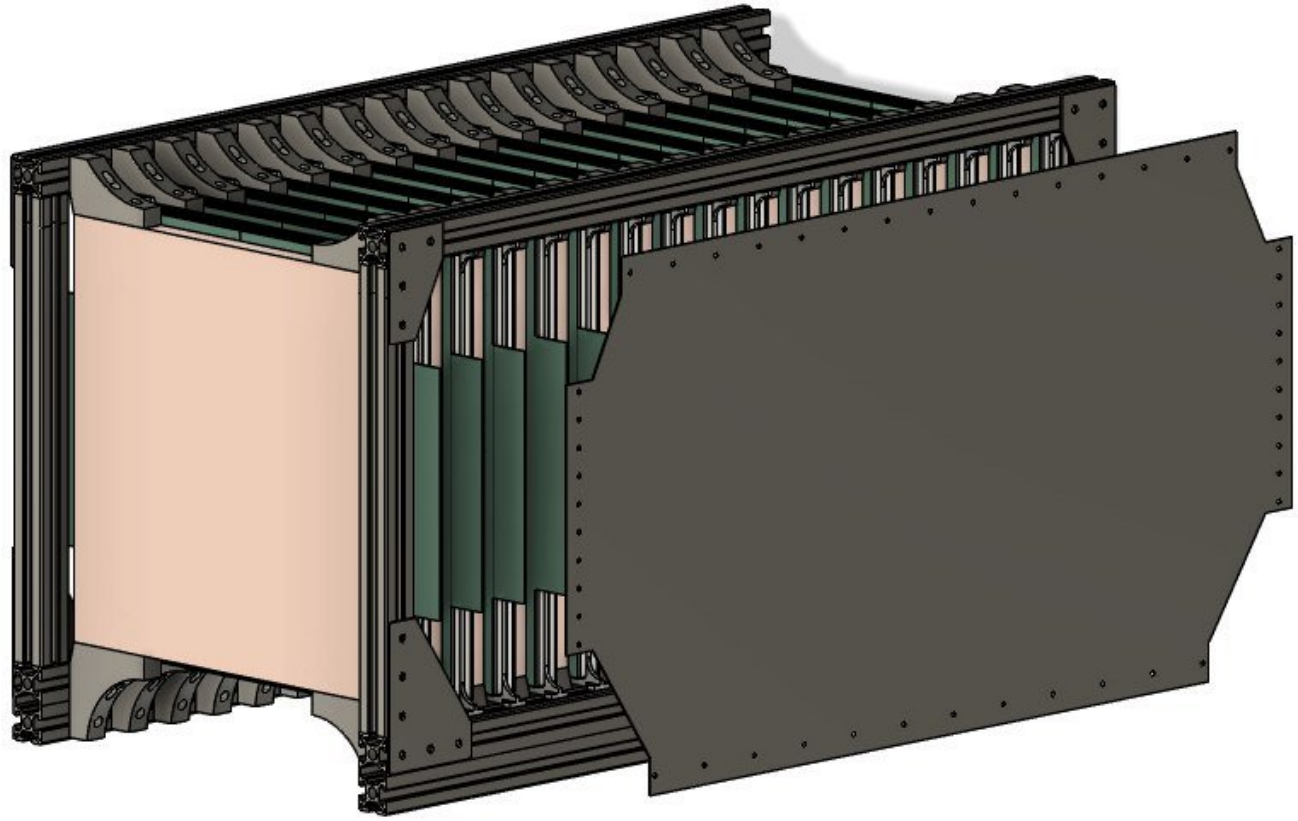
- Bosch-Rexroth Aluminium frame
- 3D-printed support brackets for Cu absorbers
- 3D-printed detector light-tight casings
- 1st option considered:
  - Crane-operated top-loading design for absorbers
  - Side-loading design for detector layer and readout boards
- 2nd option considered:
  - Top loading for both absorbers and detectors



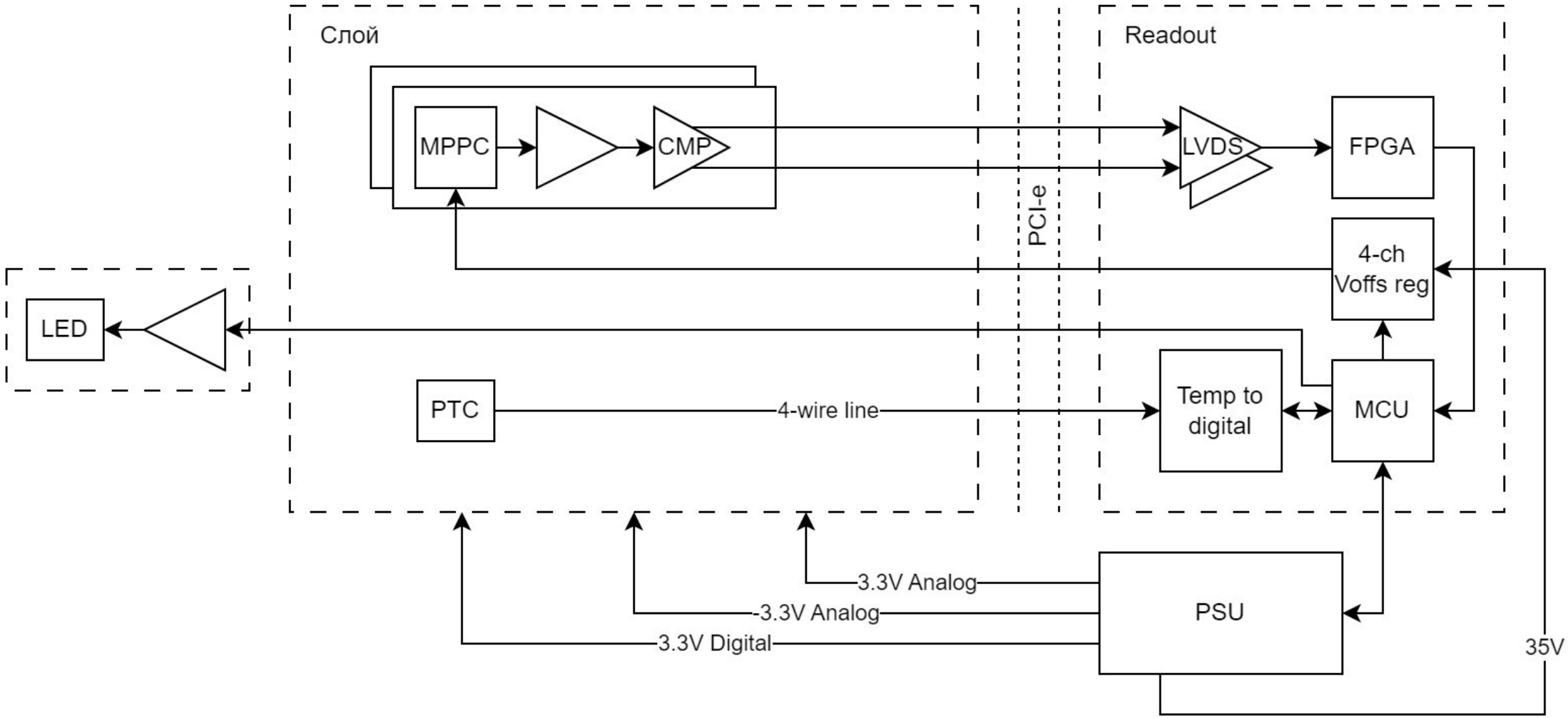


HGND mechanical design

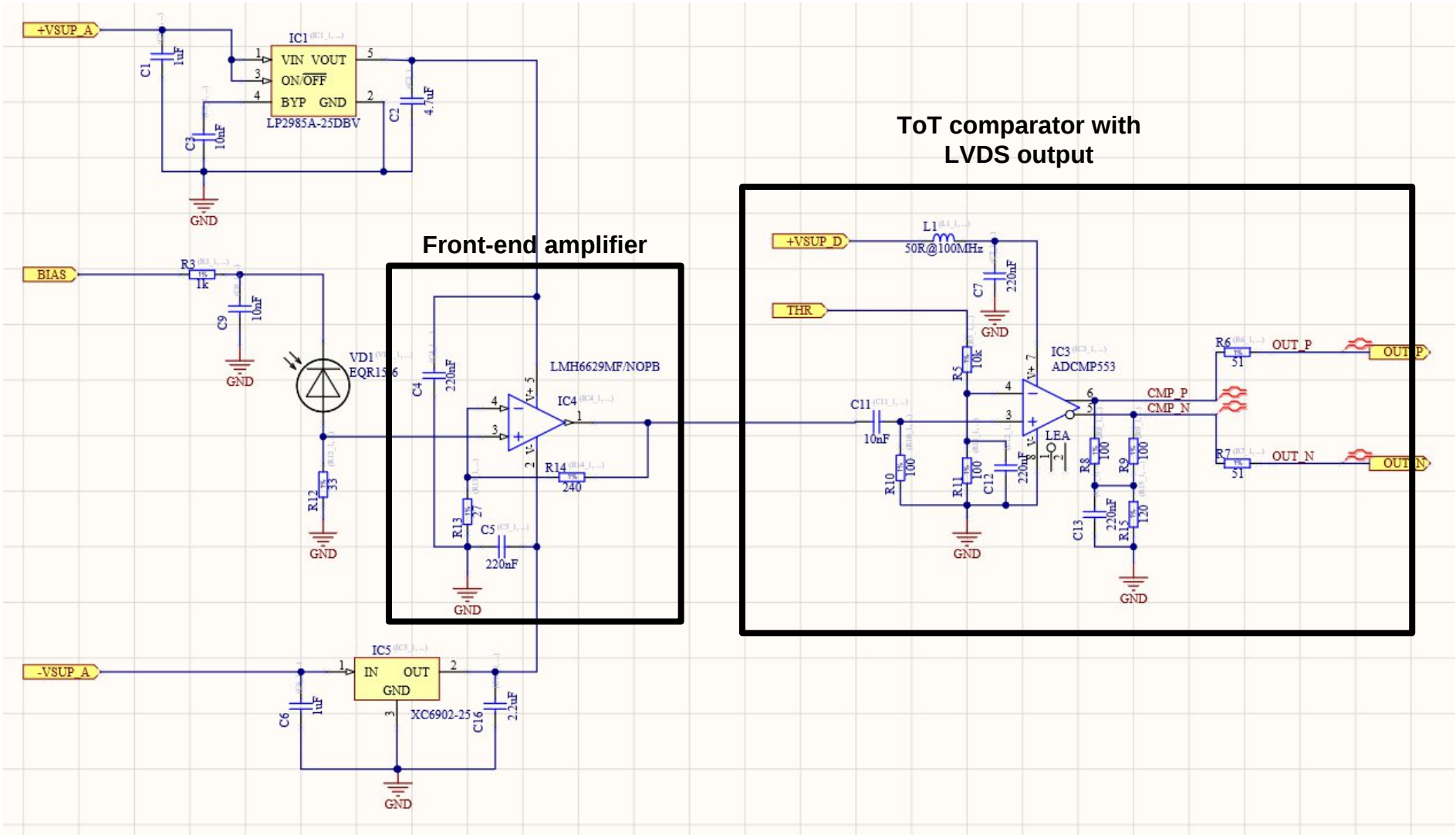




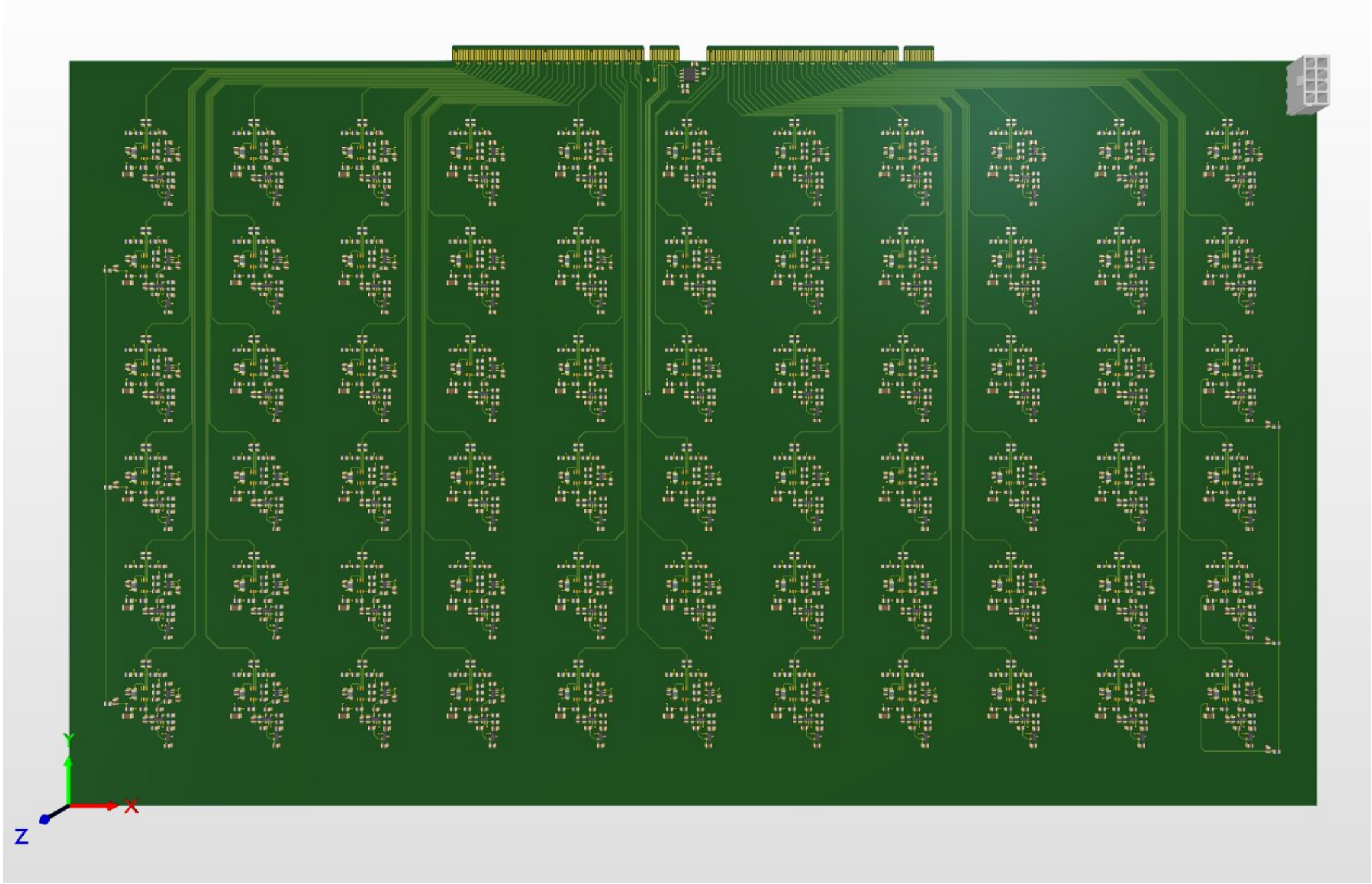
HGND electronics architecture



HGND front-end amplifier and board design

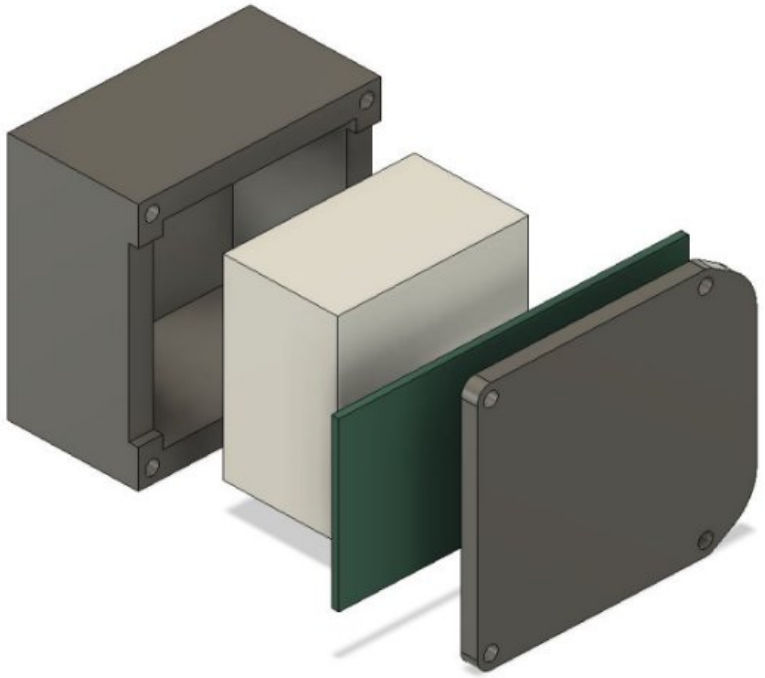


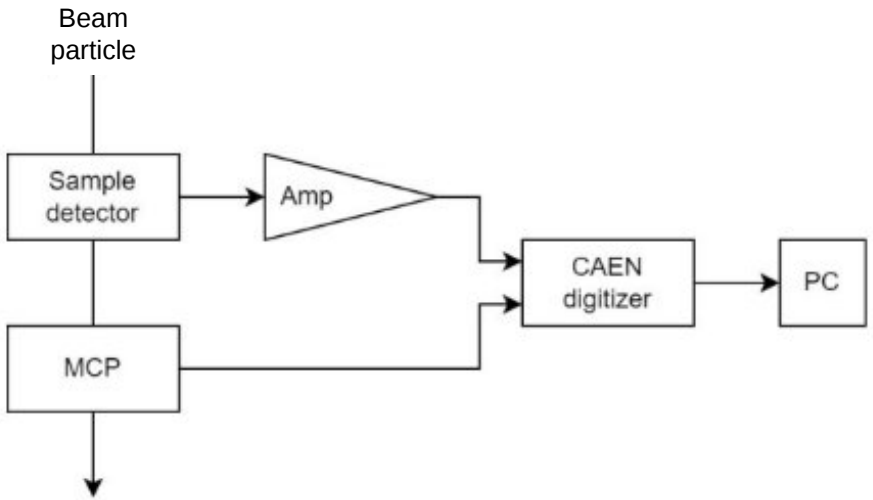
- 20dB amplification
- 2.2 nV/$\sqrt{Hz}$ noise level
- Per-channel supplies
- Variable threshold (common for the half-layer)
- LVDS output


Y
X
Z

Single-channel prototype

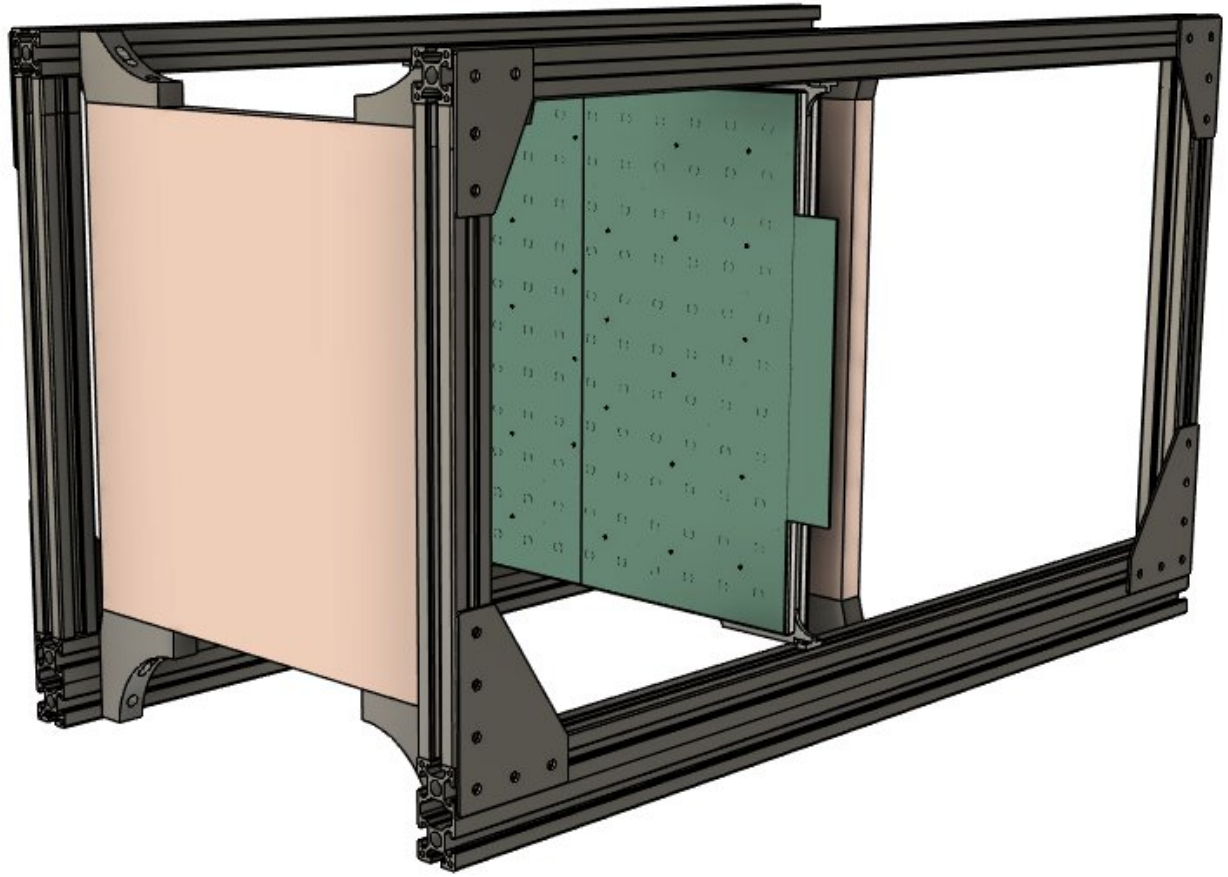
- Front-end schematics were tested with a single channel prototype
- MPPC used: EQR15-6060
  - 15um pitch
  - 6x6mm active area
  - 4444 cells/mm^2
  - 45% PDE
  - $40x10^5$ gain
- Timing resolution achieved:
  - 117 ps with JINR-produced high-speed scintillatior
  - 74 ps with EJ-230





Mechanics prototype

- Mechanics prototype with iron absorbers is under construction
- Prototype consists of:
  - Same frame as in the final design
  - 3 absorbers
  - 1 detector
- Rationale: test the rigidity and assembly operations



Conclusions

- Mechanical design for the final version of the detector is **completed**
- Front-end electronics design for the final version of the detector is **completed**
- Single-channel prototype and timing resolution measurements are **completed**

- Detector layer prototype is under construction
- Full-scale mechanics prototype is under construction
- Both prototypes to be completed by the **end of 2023**