Status of the B-TOF at Panda

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On behalf of the Panda SciTil group

Stefan-Meyer-Intitut, 09.09.2017

Outline

- Current status
- New Railboard v3
- Current Supermodule
- New Supermodule Design
- Material Budget
- Advantages / Disadvantages
- Open Projects

Current Status

- Scintillator performance tested
  - Electron source → 50 ps time resolution
- The TDR was approved (2018)
- 2 versions of the backbone PCB (the Railboard) have been tested
  - Potential publication
- A new board will be ordered shortly
  - This includes a redesign of the B-TOF holding structure
- 2018 parasitic beamtime is currently being analyzed

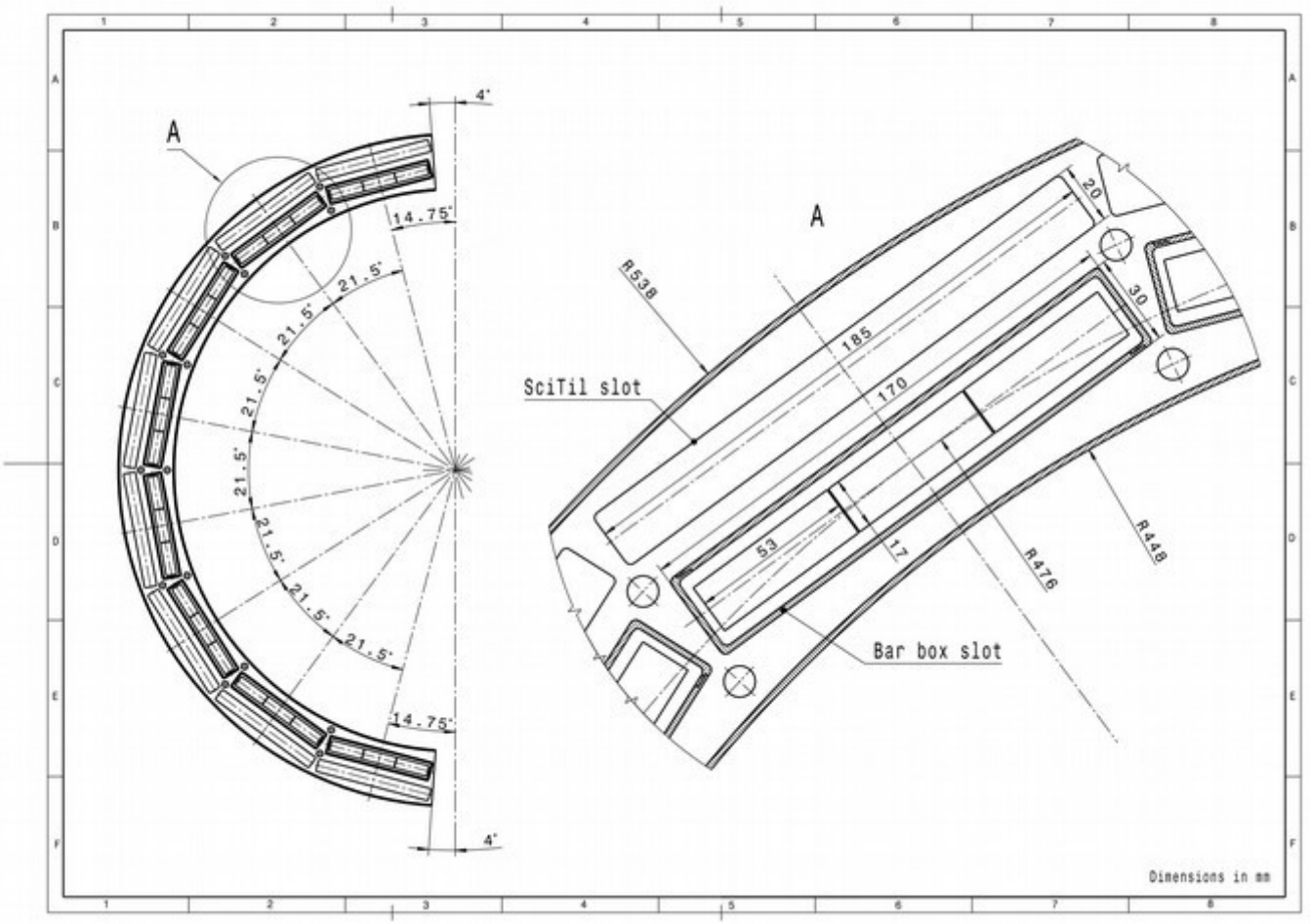
The New Railboard

- We found companies which theoretically could produce > 1800 mm boards
  - Thales PCB
  - CERN Micro-Pattern Technologies
- With certain material limitations however
- Low loss PCB material (eg. Rogers 4000 series) has a limited size

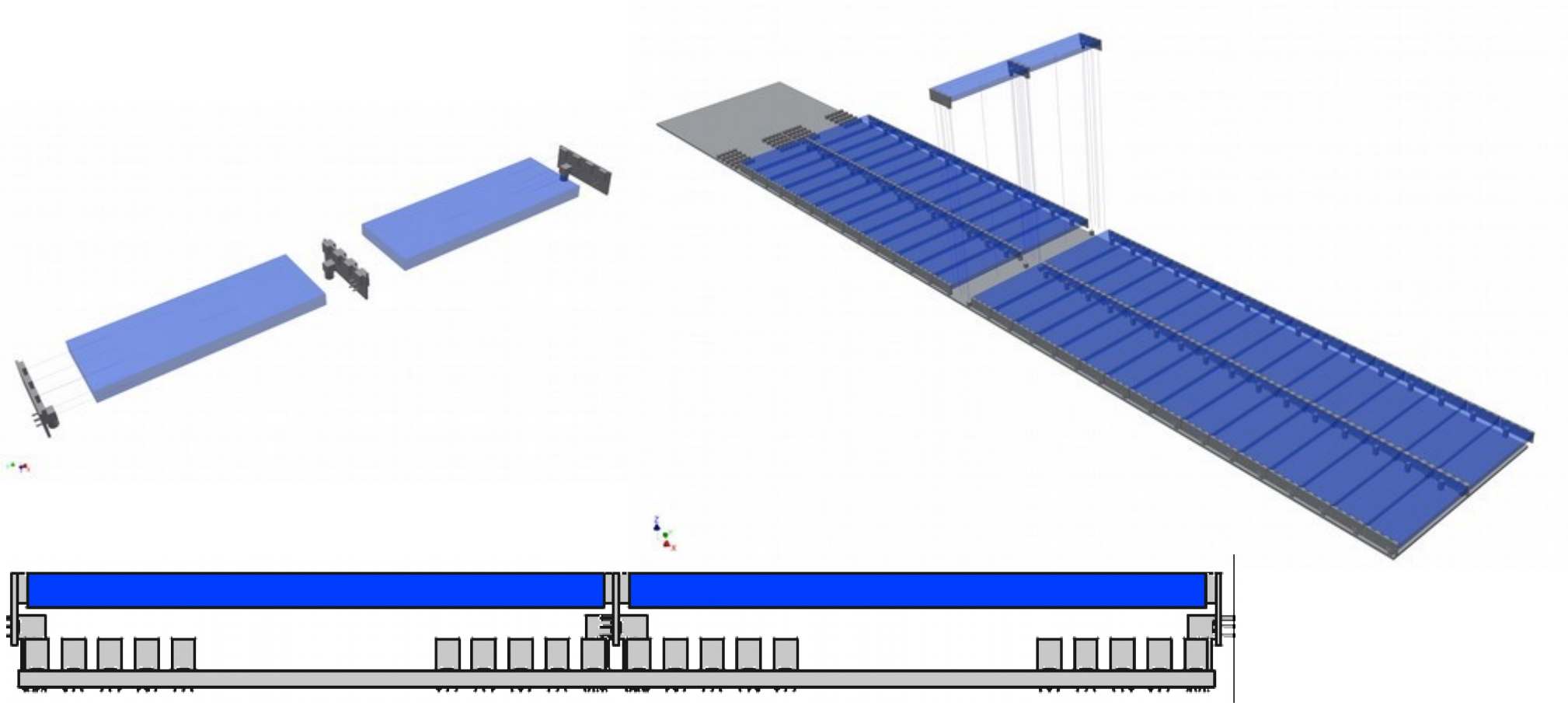
  → Boards have to be split into 2 or 3 parts due to material availability

- Current plan:
  - Use low loss material Rogers 4003C
  - Split the sensitive part of the detector into two parts and four boards
  - Combine them using connecting cables
  - Splitting the FEE side of the PCB is no issue, since the ASICs need to interface somehow anyway
  - Low loss material has less rigidity than FR4
    - Additional holding structures necessary

Limitations / Requirements

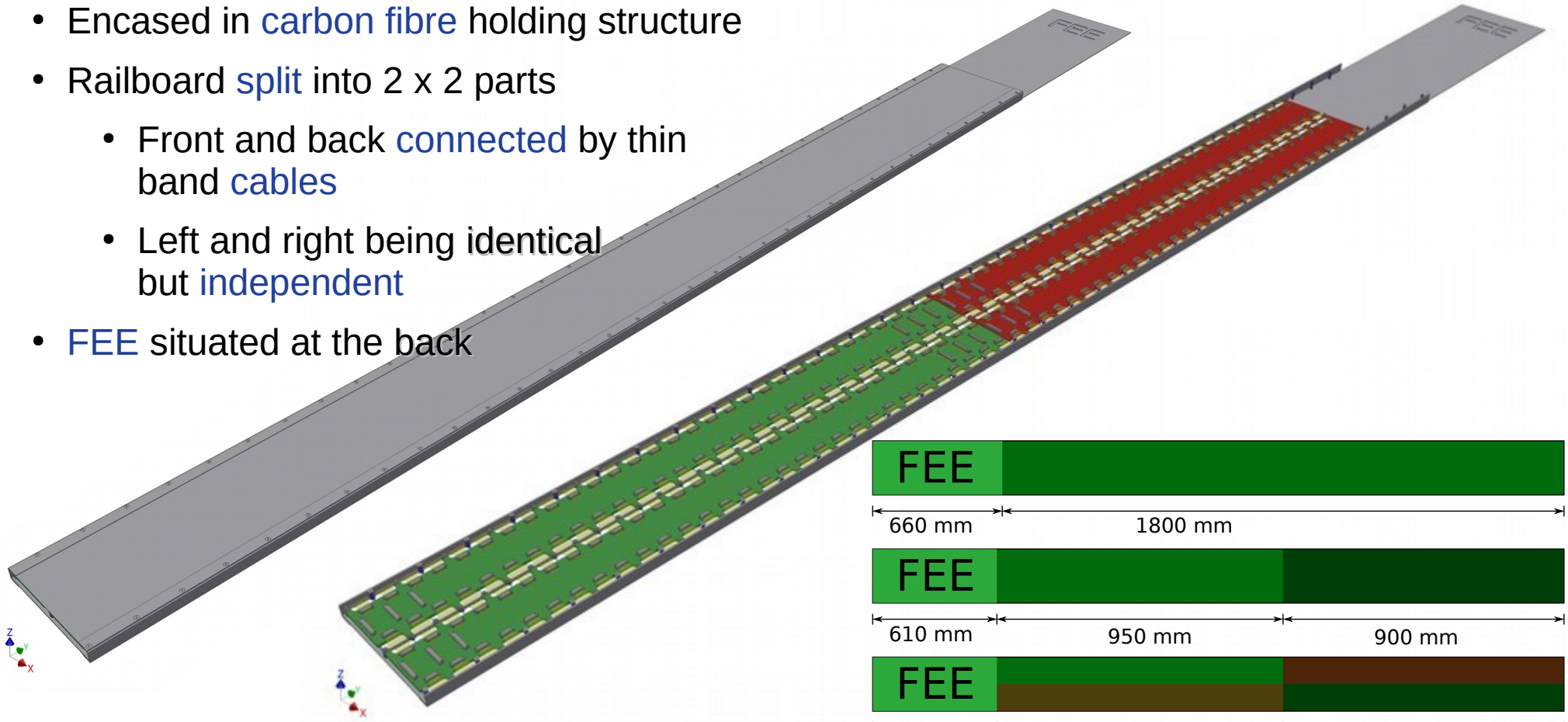


Old Supermodule

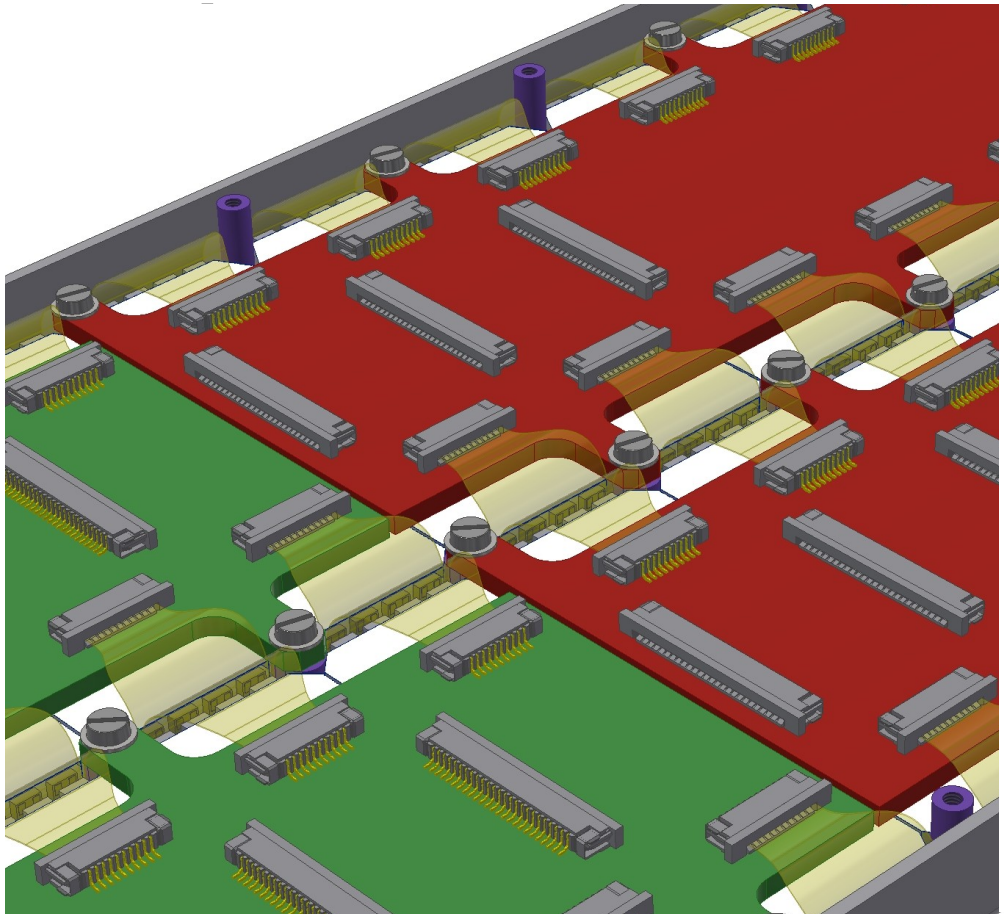


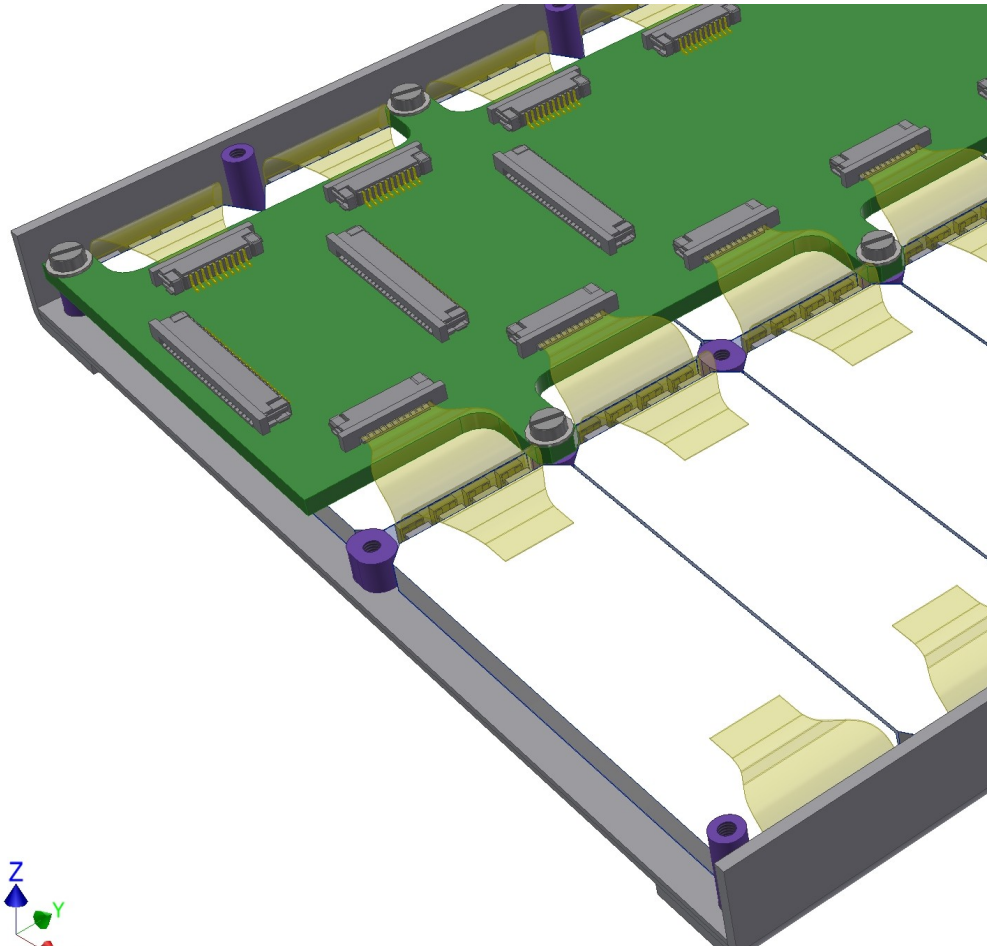
New Supermodule Design

- Encased in carbon fibre holding structure
- Railboard split into 2 x 2 parts
  - Front and back connected by thin band cables
  - Left and right being identical but independent
- FEE situated at the back

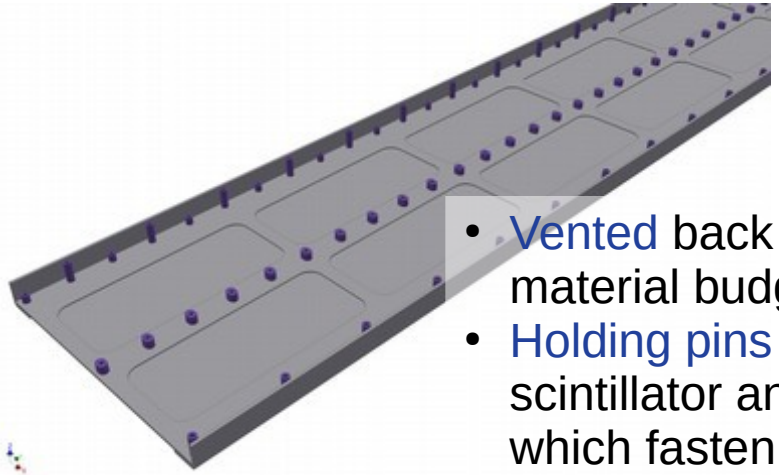


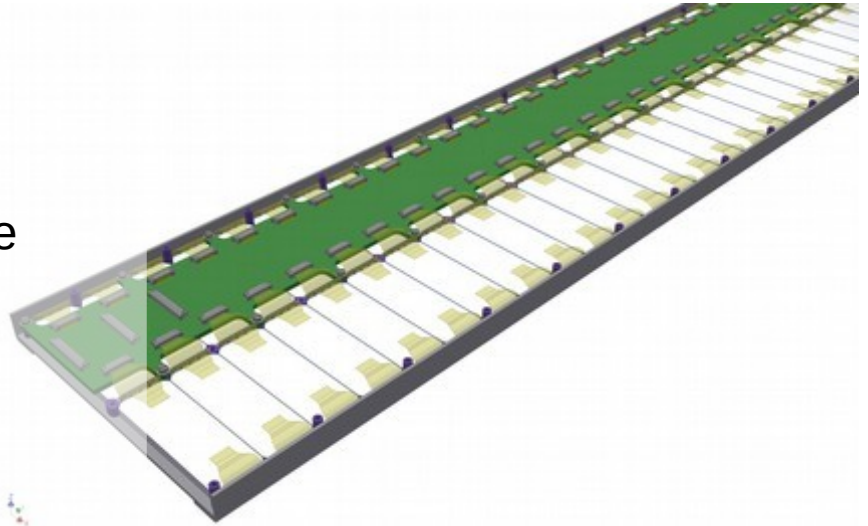
Scintillator holding & Railboard connection



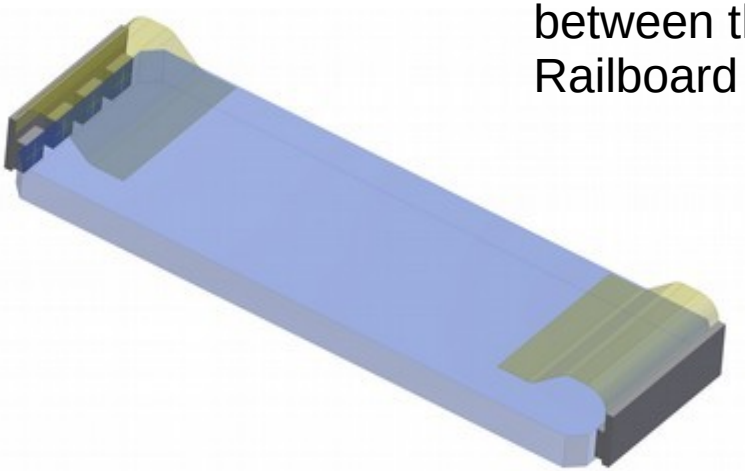


Back plane & Scintillators





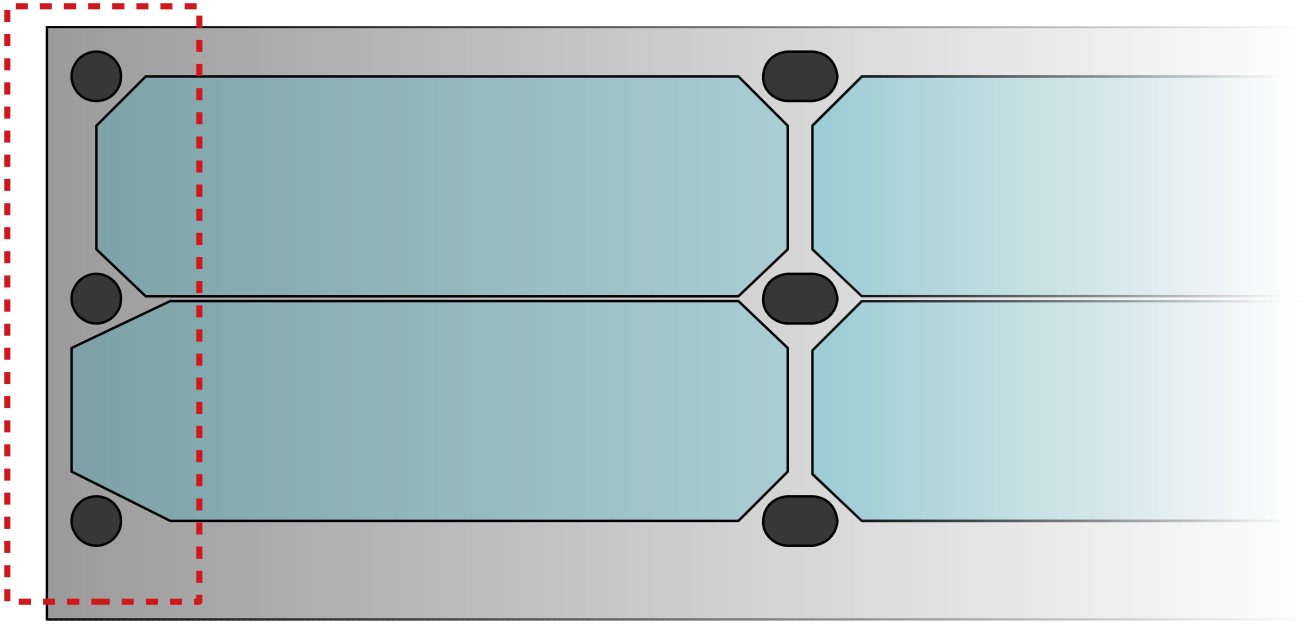
- Vented back plate to reduce material budget
- Holding pins to constrict scintillator and hold screws which fasten the Railboard
- Scintillator sandwiched in between the carbon fibre and the Railboard



- tapered edges to fit holding slots
- Glued SiPMs on scintillator
- Flex cable to Railboard

Scintillator Taper

- Two ways to taper the scintillators
  - Symmetric on both sides
  - Increase angle on one side to achieve a larger scintillator coverage



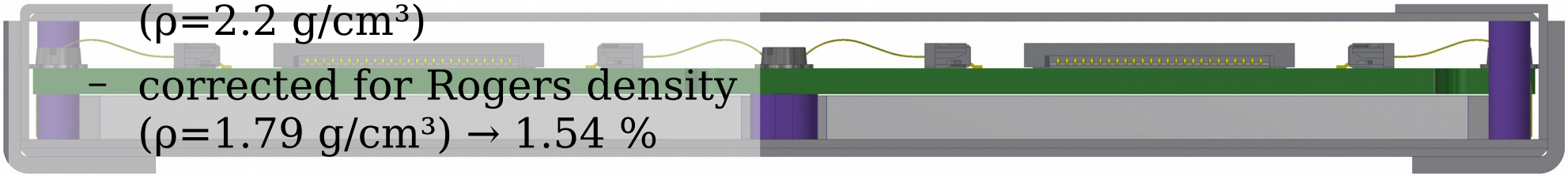
Material Budget

- 3 x 1 mm carbon fibre layers
- 5 mm Scintillator
  - Considered as homogeneous plate, replacing plastic screws and bumper
- 3 mm PCB (hydro-carbon ceramic/Rogersmaterial RO4003C)
  - Estimation done with PTFE (ρ=2.2 g/cm³)
  - corrected for Rogers density (ρ=1.79 g/cm³) → 1.54 %

- Material Budget:

Material	Carbon fibre	Rogers	Copper	Scintillator	SiPMs
X/X_0	1.21 %	1.54 %	1.07 %	1.2 %	0.1 %

- Total = 5.09 %



Advantages / Disadvantages

- Sensitivity to single part tolerances is reduced
- Scintillators are held firmly in place from all angles without putting pressure on the wrapping
- SiPM-Scintillator joint does not carry any weight
  - Leads to a longer lifetime of that connection
- All parts modular and easily swappable

- Material budget is higher than anticipated ($X/X_0 \sim 5\ \%$)
- More parts for assembly
- Specialized carbon fibre production is expensive

Supermodule Design Comparison

- Old design:
  - Scintillators held by glue to the SiPMs
  - SiPMs soldered to sensor board
  - Sensor board connects to railboard and held by MMCX connectors
  - Railboard acts as backbone
- New Design:
  - Scintillator still glued to SiPMs but held by support structure
  - SiPMs soldered to sensor board
  - Sensor board connects via flex PCB to Railboard, held by srews
  - Railboards are reduced and additional support structure (carbon) added, sandwiching the scintillators

Open Projects

- Integration of temperature sensors
- LED calibration System
- Readout electronics:
  - Get commercial version up and running
  - redesign / restructure commercial boards
    - Disc DIRC Group in Gießen is working with the same boards and have similar requirements
- Evaluation of updated Railboard
- Full assembly of (partial) system

Thank you for your attention