Progress report on the readout plane for FoCal-H

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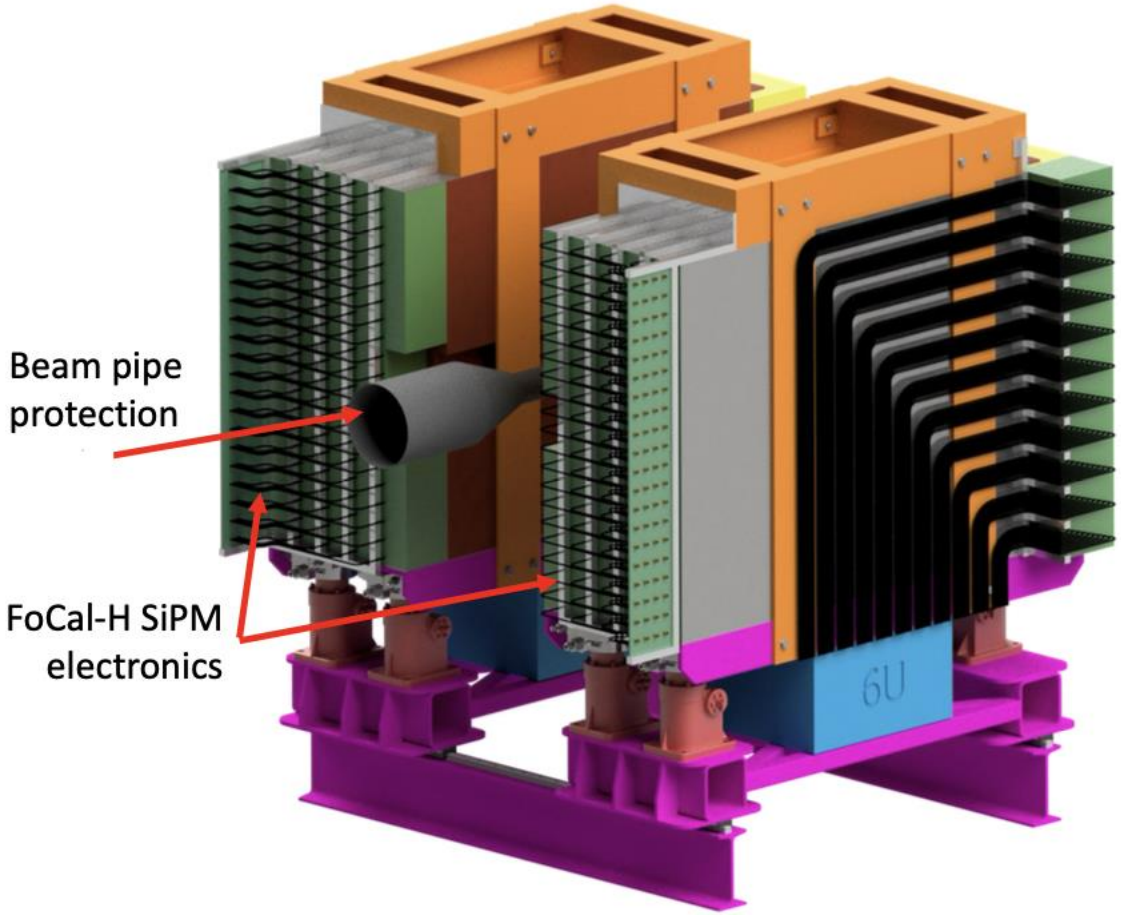
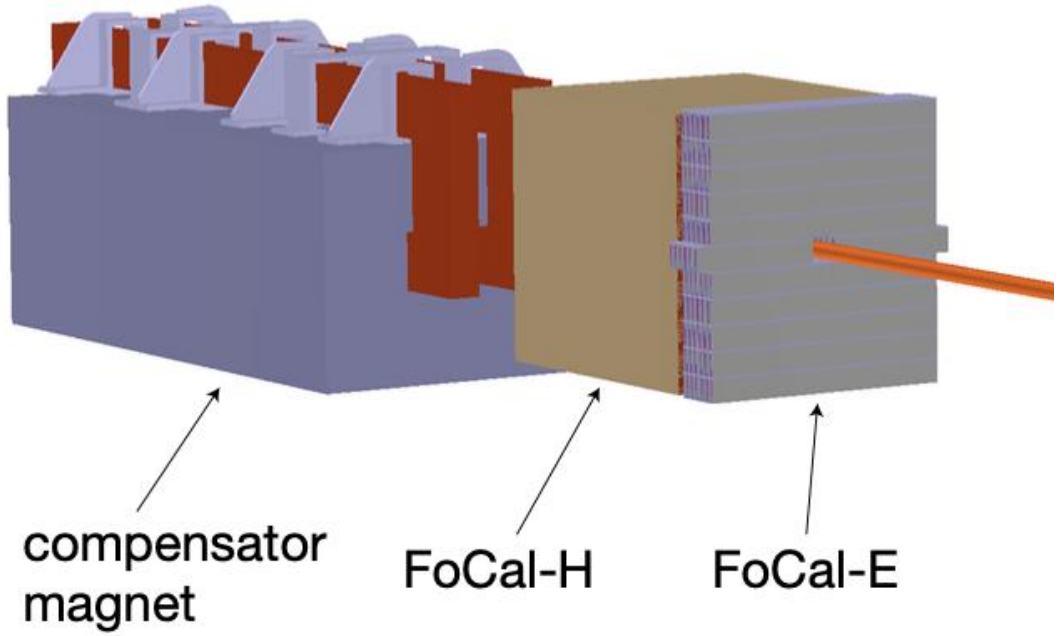
on behalf of ALICE-FoCal

Positioning of the FoCal-H



Isometric view showing entire FoCal

Source: ALICE-TDR-022



Isometric view showing placement of each section of FoCal detector

Source: ALICE-TDR-022

General assumptions of the project

Primary objective

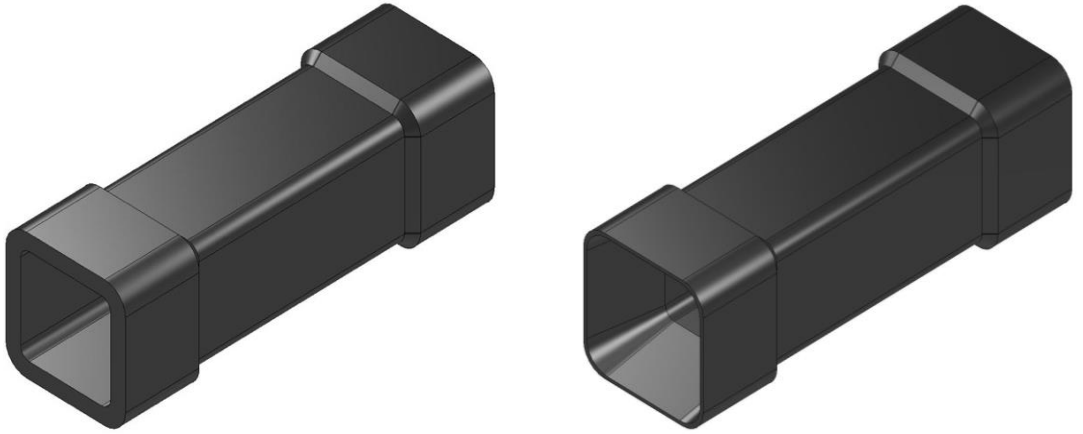
The main goal of the project is to design components that enable the efficient mounting of scintillating fiber bundles in their designated positions. This ensures that SiPMs are correctly attached to accurately read data from the fibers.

Key assumptions:

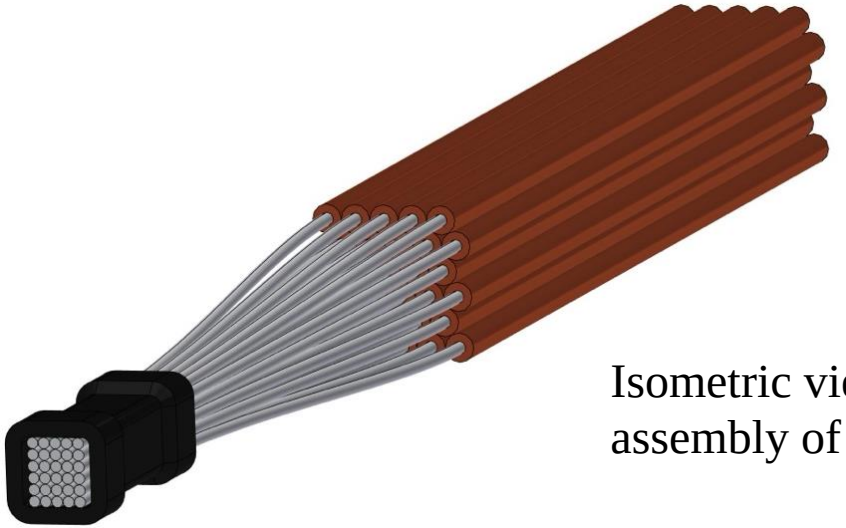
1. Precise positioning of SiPMs relative to fiber bundles.
2. Easy and quick assembly of all parts.
3. Easy access to key components for replacement.
4. Project must comply with spatial constraints of the FoCal-H detector.
5. Stable and secure structure throughout the entire installation process.
6. Every material used needs to meet radiation hardness criteria.

Progress Overview – Sleeve design

- Designed to accommodate a bundle of 30 optical fibers.
- Ensures fibers are arranged within the active readout area of the SiPMs, avoiding any overlap.
- Provides a stable hold for fibers within the collector plane.
- The sleeves are designed with 3D printing in mind, allowing for precise customization and flexibility in adjustments as needed, but other methods are also considered.



Isometric view from both sides showing the design of the sleeves for scintillating fibers



Isometric view showing the assembly of 30 scintillating

Progress Overview - Assembly concept

Bundling a specified number of fibers together

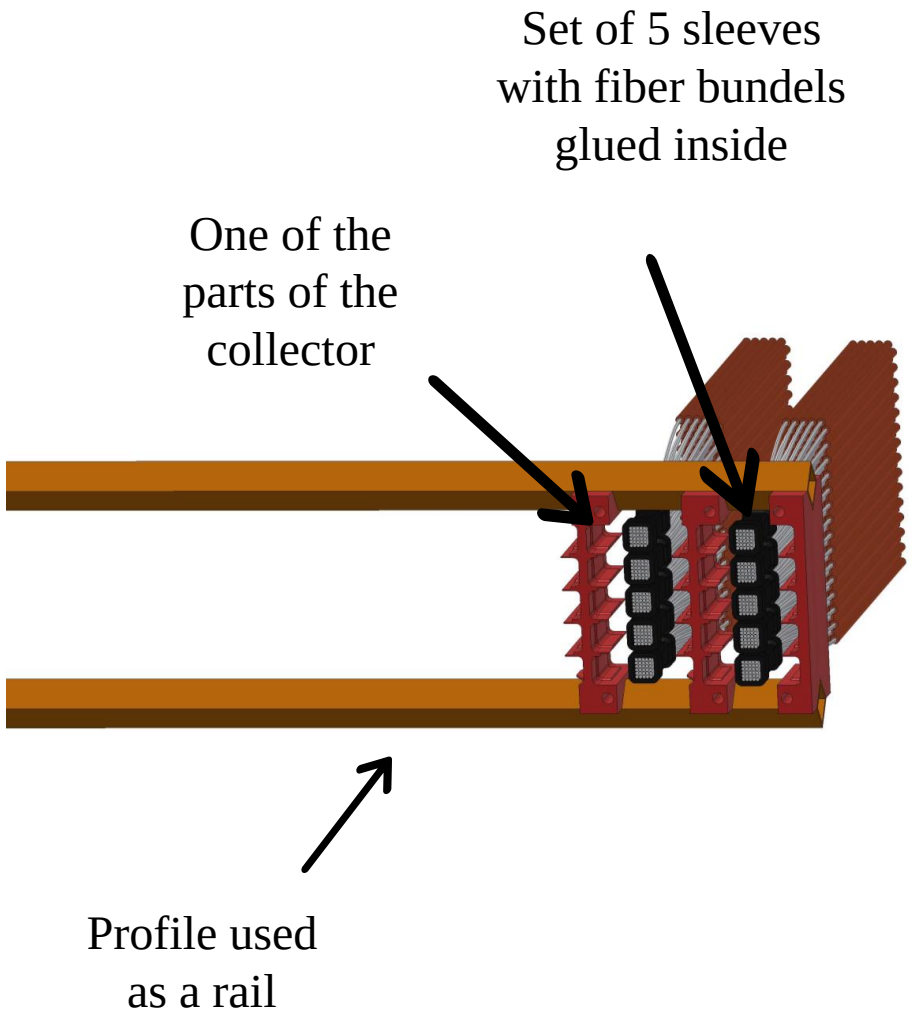
Gluing all fibers inside one sleeve

Sliding collector parts on rail-like system

Inserting a set of sleeve between collector parts

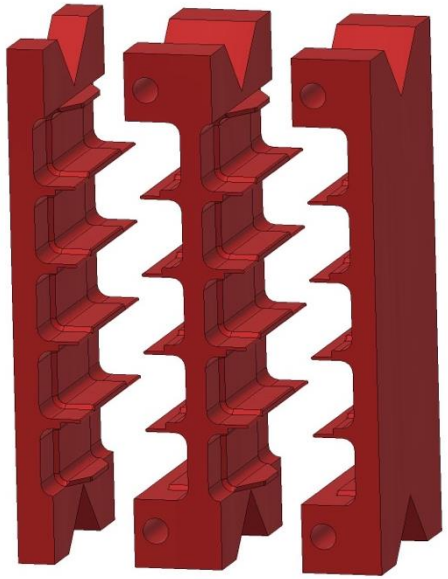
Pressing the collector parts together

Mounting the PCB with SiPMs onto the colletor parts

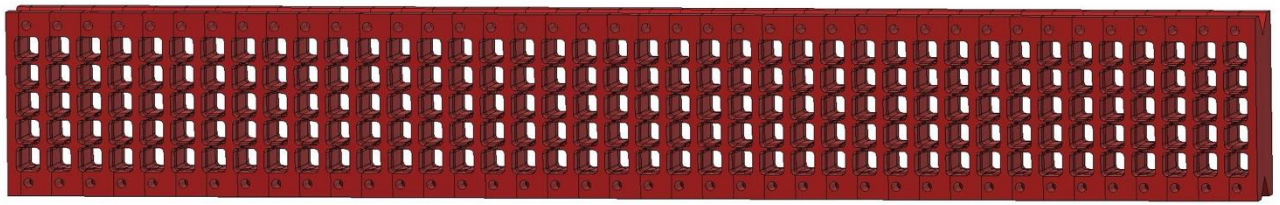


Progress Overview – Collector design

- Each set comprises 5 sleeves, aligned with a PCB board containing 5 SiPM detectors.
- The collector is divided into three main sections—bottom, middle, and top—that assemble into modular units.
- Designed with cut-outs for square profiles, serving as rails for smooth and precise movement and fixing the collectors in place.
- Easily adjustable to accommodate any changes made in the number of sleeves per set.



Isometric view showing, from left to right, the top part, middle part, and bottom part of the collector

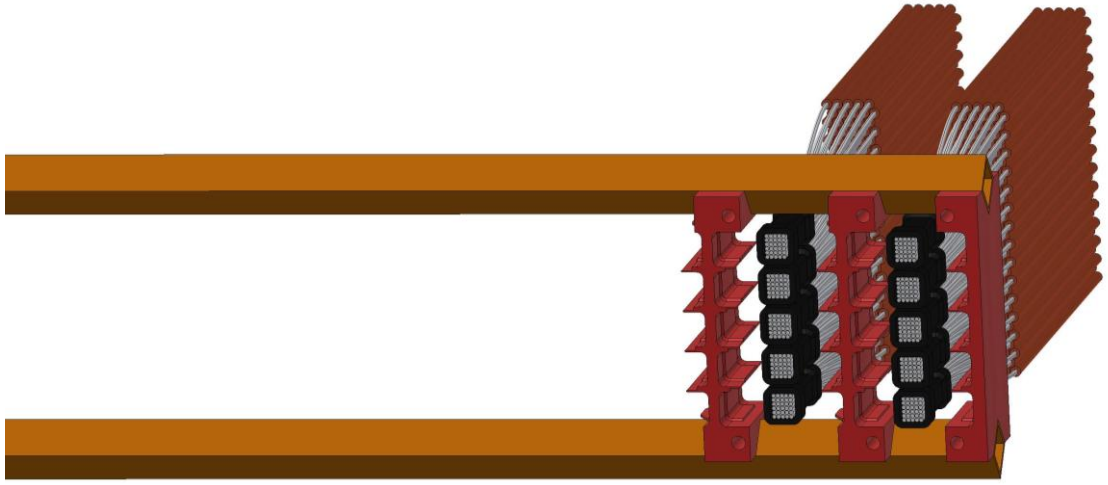


Isometric view showing one modular unit of assembled collector parts

Progress Overview – Profile selection

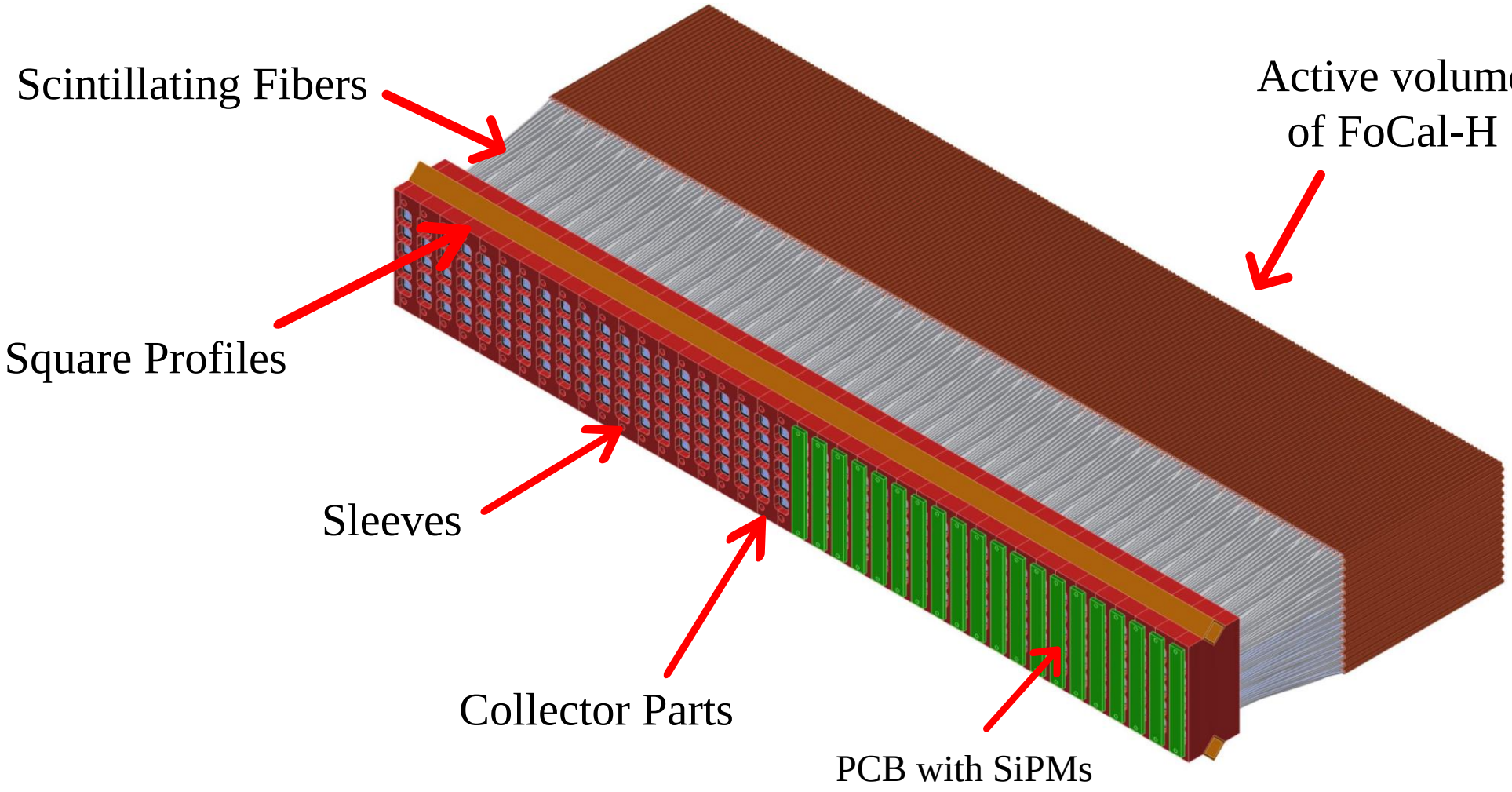
- Square profiles were chosen as rails for the collectors after the evaluation of alternative options.
- Selection was made with consideration of the limited available space.
- Profiles will be rotated 45 degrees for easier printing and smoother sliding during assembly.
- This design choice optimizes space utilization while maintaining system stability.

Threaded full square profile used for rail-like system



Full square profile

Progress Overview – Assembly of single module



Progress Overview – Profile mounting method

- Methode chosen :
  - Thread the square profile to M6 size.
  - Drill corresponding holes in the frame plate.
  - Secure profiles at the correct angle using an M6 screw and washer.

- This approach ensures minimal space usage while maintaining structural stability.

Assembly of one profile to a steel plate

Arrangement of all modules on half of the readout plane

Progress Overview – Printing method testing

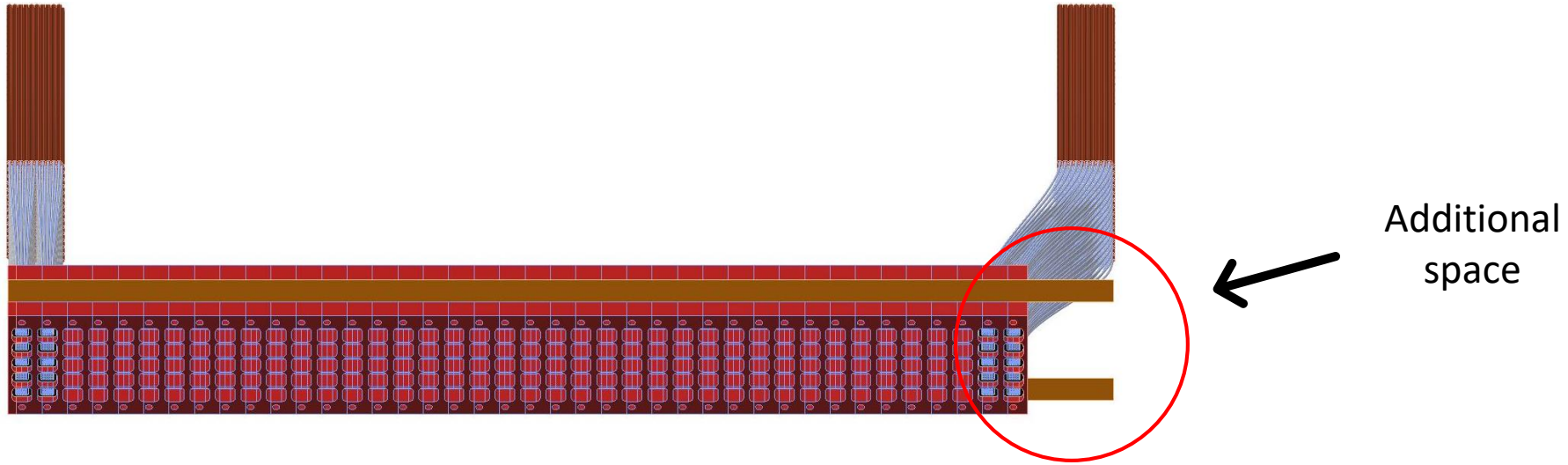
Tested Methods:
- Fused Deposition Modeling (FDM)
- Stereolithography (SLA)

Collector Parts:
- Print-tested only on FDM printer.
- Tested on diffrent brands of printers

Sleeves:
- Printed using both FDM and SLA methods.
- SLA Printing showed promising dimensional accuracy.
- A study was conducted to further optimize the final dimensions by changing the exposure time in SLA printer.

Progress Overview – Collector optimization

- Repositioned sleeve sets closer together to maximize available space.
- Achieved up to 64.5 mm of additional space.
- Provides essential room for relocating SiPMs further from high-radiation areas.



Progress Overview – Offsetting the entire readout plane

Repositioning Options:

- Option 1 - moving the readout plane towards the outer edges of the FoCal system, utilizing space which is available there
- Option 2 - positioning the readout plane diagonally, extending from the outer edge towards the center.

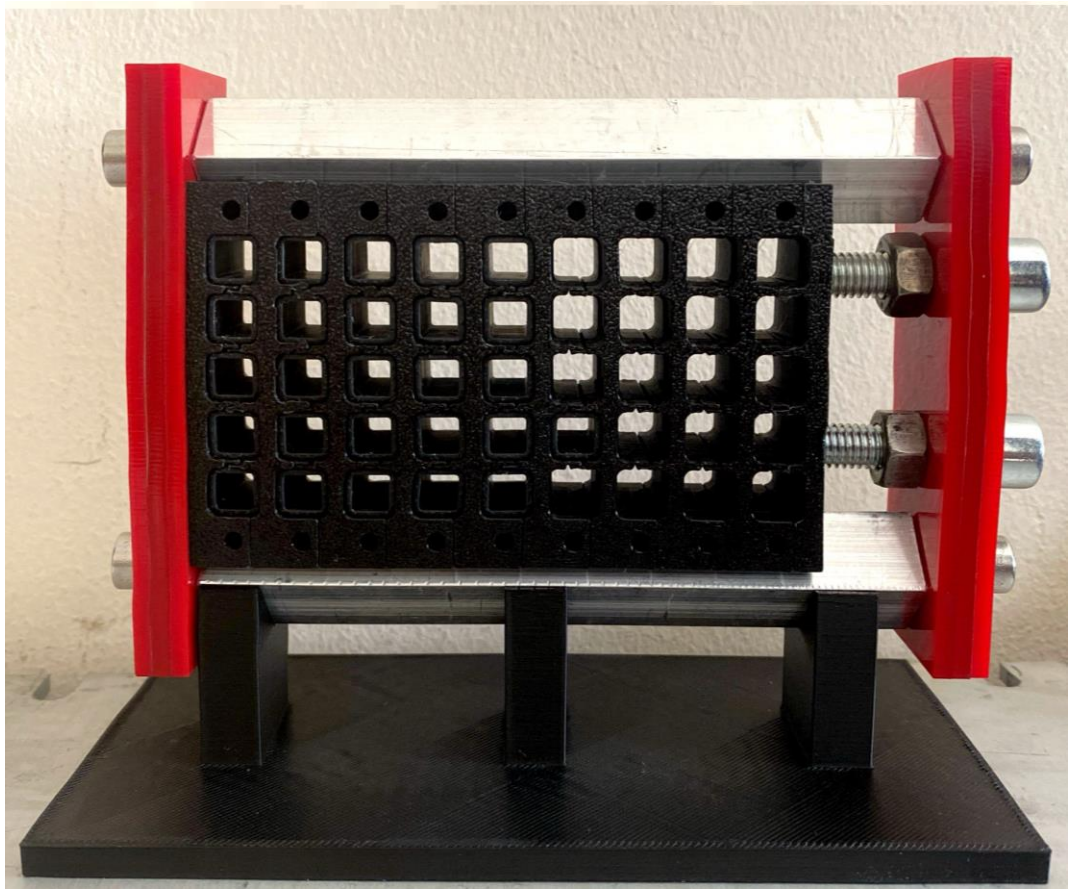
Consideration:

- Both options will necessitate longer outer fibers to fit the new positioning.

From left to right, representation of the arrangement of Option One and Option Two on a simplified FoCal model.

Summary of progress

- Components design
- Selection of a rail-like system
- Assembly mounting solution
- Test printing methods
- Optimalization of collectors



Mock-up of a single module assembly model

Next Steps

1. Fiber bundle fit testing

- Evaluating if 30 scintillating fibers fit within a single sleeve.

2. Clamping mechanism design

- Developing a clamping mechanism for collector components.

3. SiPM light shielding design

- Creating a component to shield each SiPM from unwanted light interference.

4. Selection of materials in terms of radiation hardness criteria

- Choosing components which can withstand high-radiation environment.

5. Readout plane frame design

- Design a structural framework for the entire readout plane.

6. Connection design to lifting structure

- Designing the interface and connection between the lifting structure and the readout plane frame.

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