QuARC v5 – Mechanical Overview.

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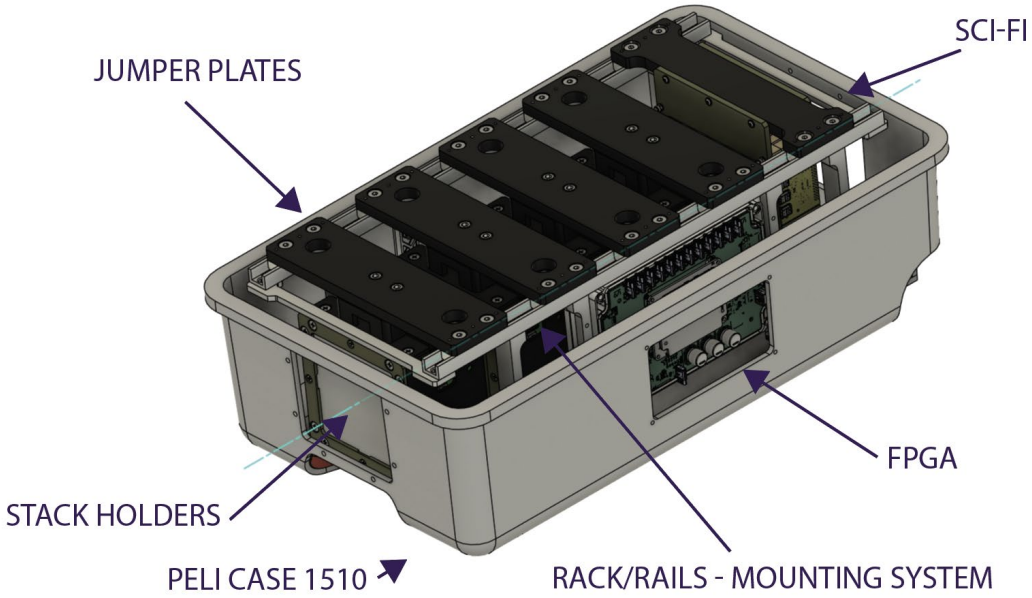
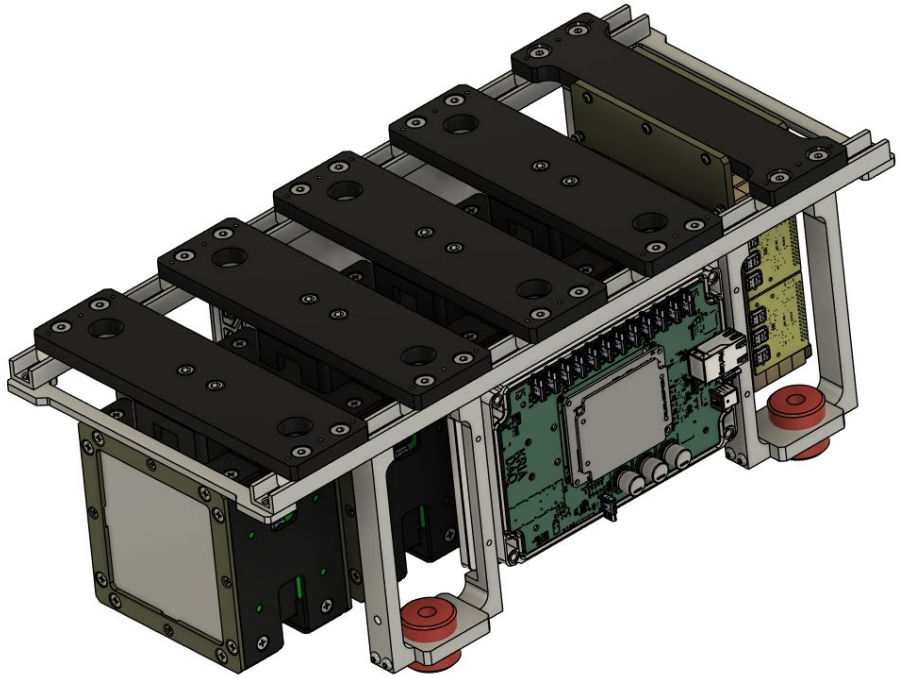
Overview

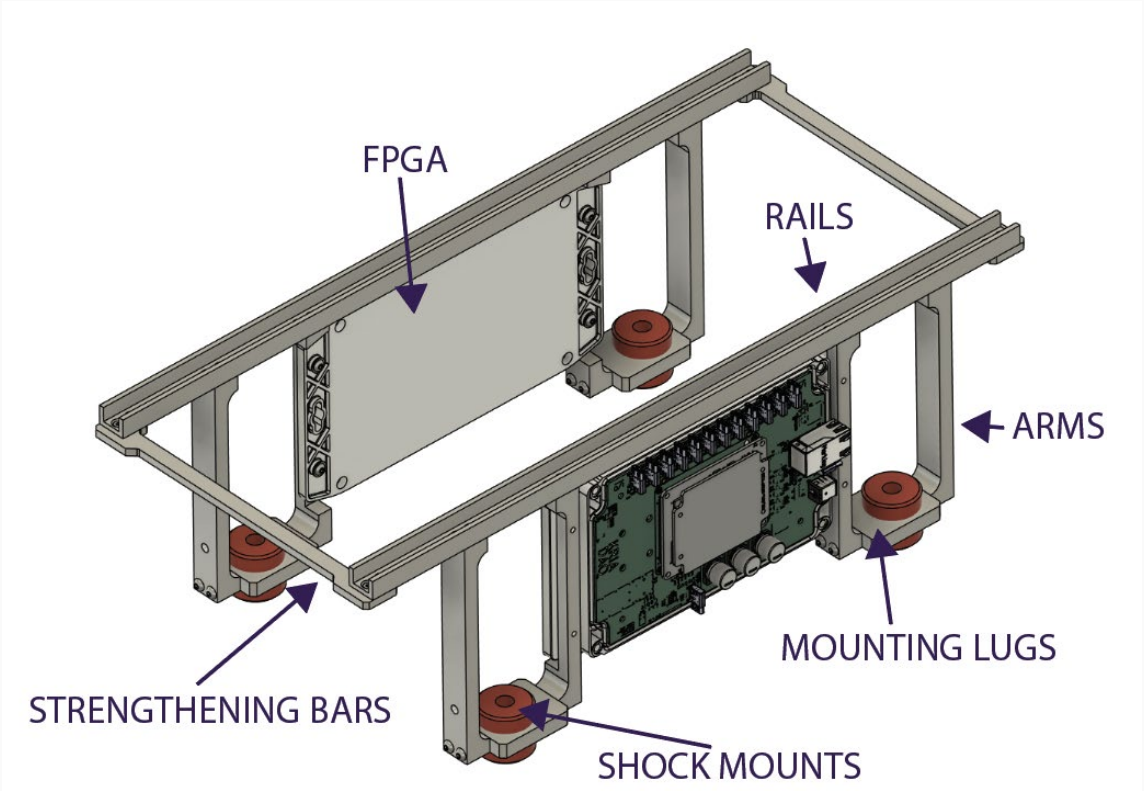




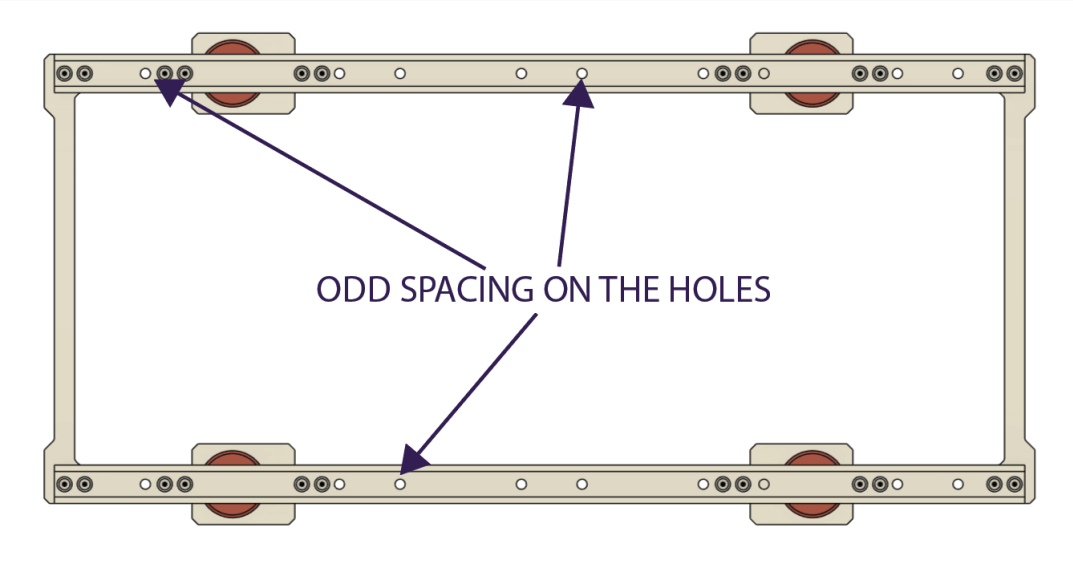
- Entire rail system moved upwards into the box.
- Designed for improved ease of access, ease of use, and overall accessibility.
- New layout allows all electronics to be mounted directly onto the racks.
- Electronics are shock-dampened and isolated from the outer box.
- Increased protection against knocks, impacts, and rough handling.
- Overall goal: a more accessible, robust, and durable system.

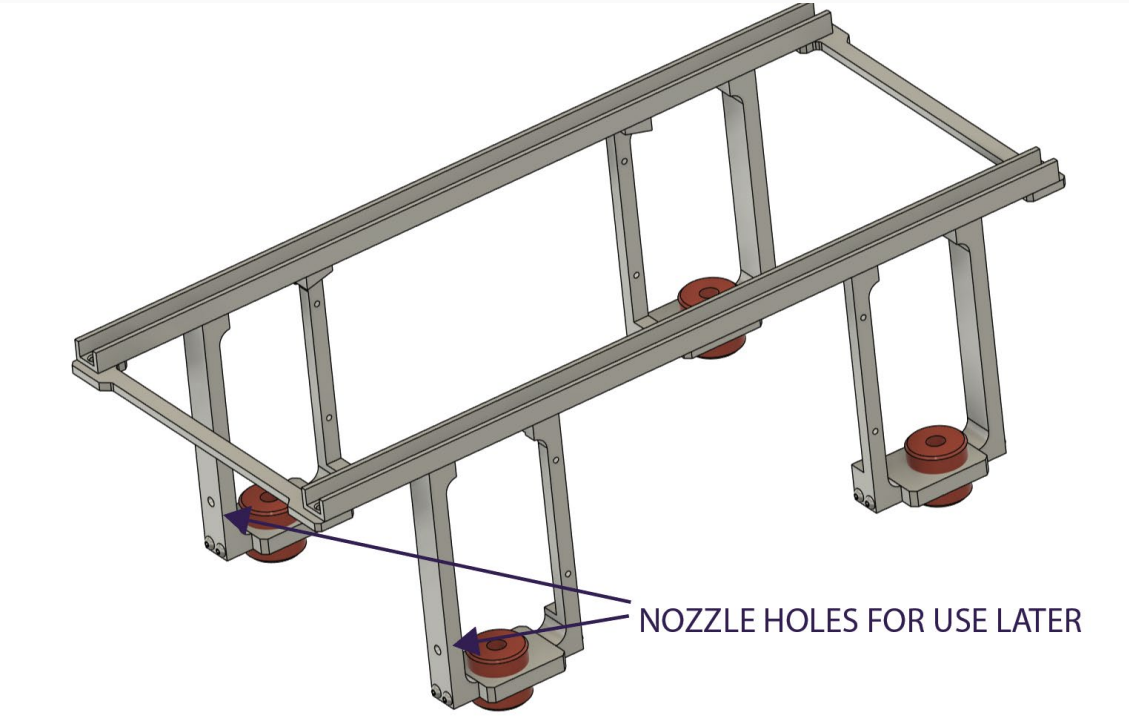
New Mounting System

- FPGAs are mounted directly to the frame
- A rail system has been retained, but aluminum extrusion has been replaced with a simpler U-shaped rail.
- Aluminum extrusion is no longer required, reducing unnecessary complexity.
- Strengthening bars connect the two rails, adding rigidity and helping keep them parallel.
- Maintaining parallel alignment between the rails is important for the design.
- All mounting lugs are the same.
- All arms start from the same base design, with different machining processes applied depending on there location in the box
- We are making a larger lever from the mount points this is a key change and will need to be considered carefully.
- Simulations can be carried out to determine the force required to bend the arms, although this will require additional time.
- This approach is similar to the previous design, and hopefully taking what worked well.



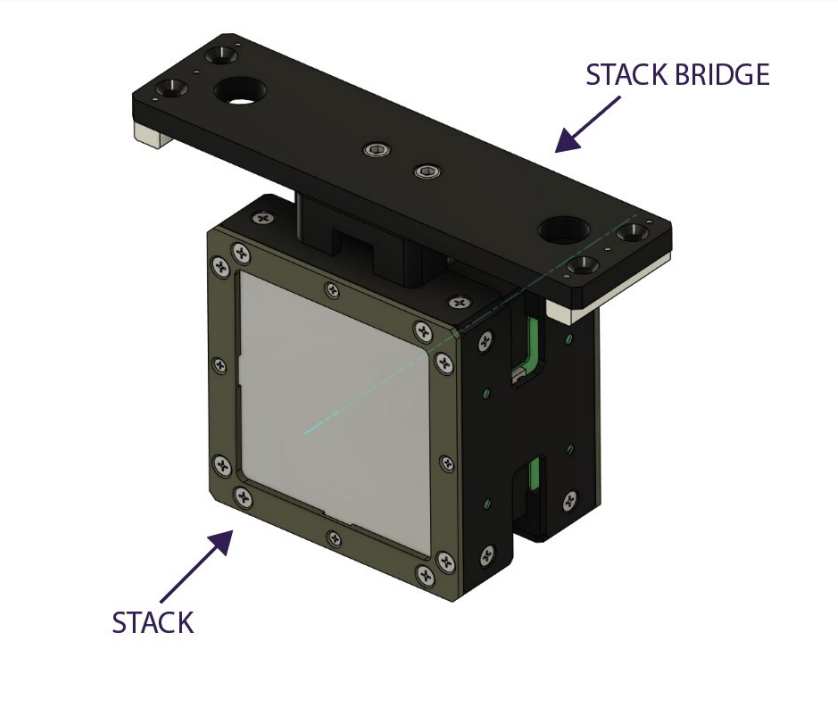
New Mounting System

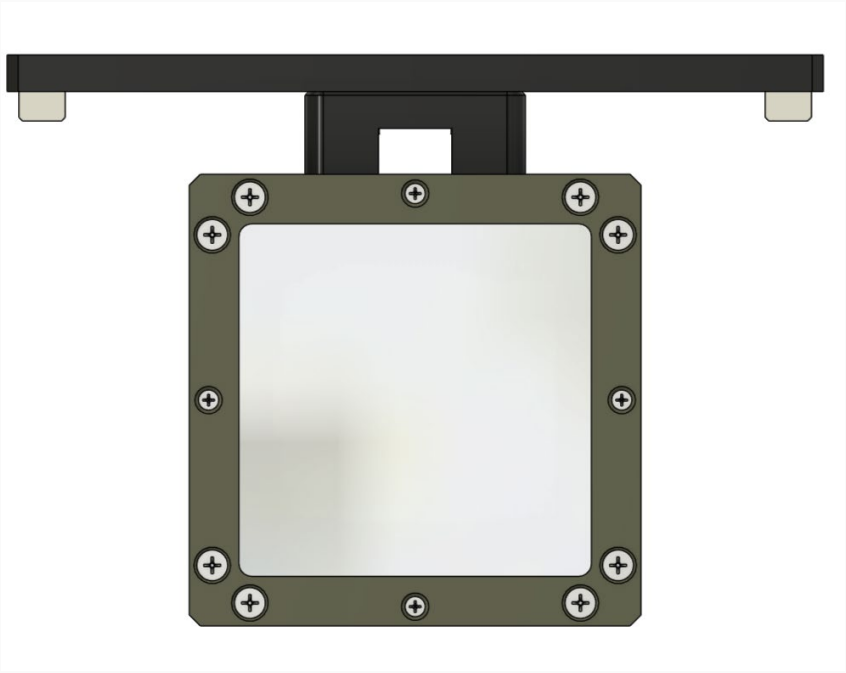




- The hole spacing along the rails is intentionally uneven.
- This is because the bolt locations for travel differ from the “experiment” locations.
- Experiment locations are flexible as the stack are held by gravity and friction. The travel location is fixed
- Additional mounting holes have been included on the arms to allow a future nozzle-mounting component to be attached.
- Mounting directly to the nozzle should make alignment easier and more consistent compared with the QUARC being positioned on the patient bed.

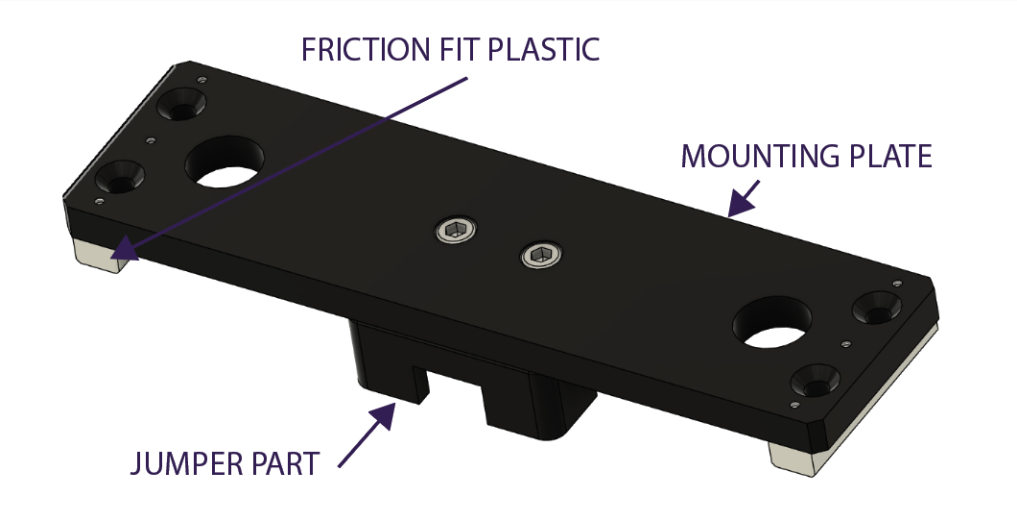
Stack Holders & Stack Bridge





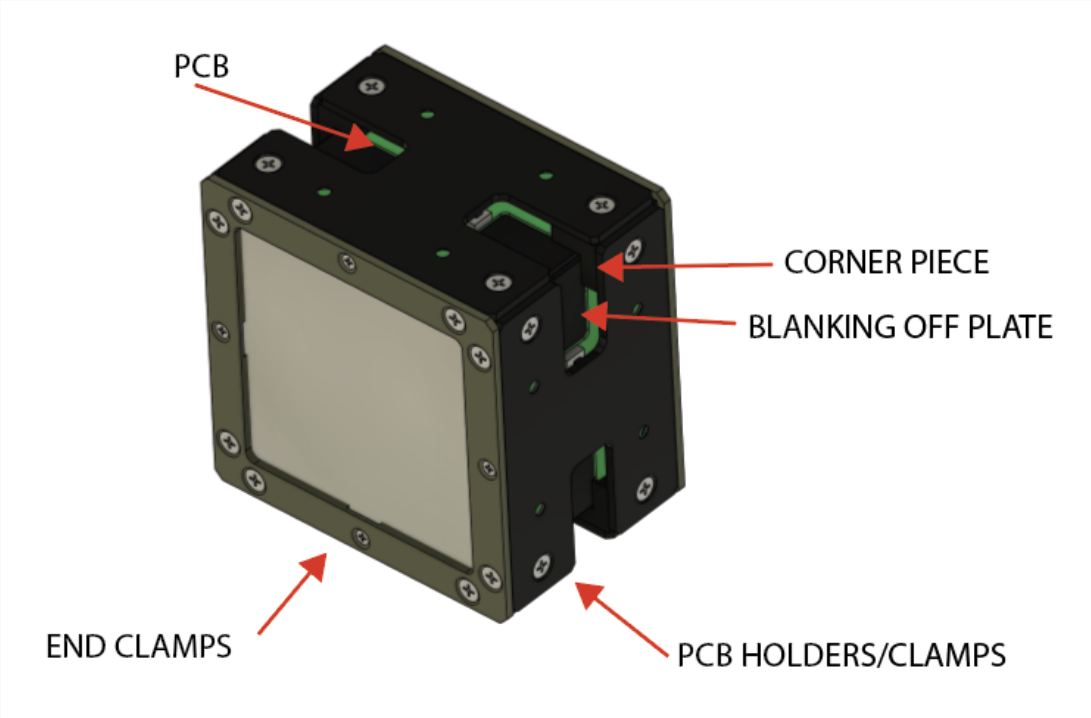
- The stack holders and mounting bridges connect the stacks to the main mounting system.
- The stack bridge holds each stack on-axis and at the correct position for the beam to pass through the centre.
- Through-holes connect the PCB clamp to jumper – hence we have a strong clamp between them.
- These components are intended to remain permanently assembled; separating them would be a lengthy process.
- One limitation of the current design is that rotating (if wanted) an individual stack would be difficult.
- The two top mounting bolts provide a possible solution: separating the jumpers from the mounting plate
- This would provide the ability for stack rotation but would increase the number of components required.

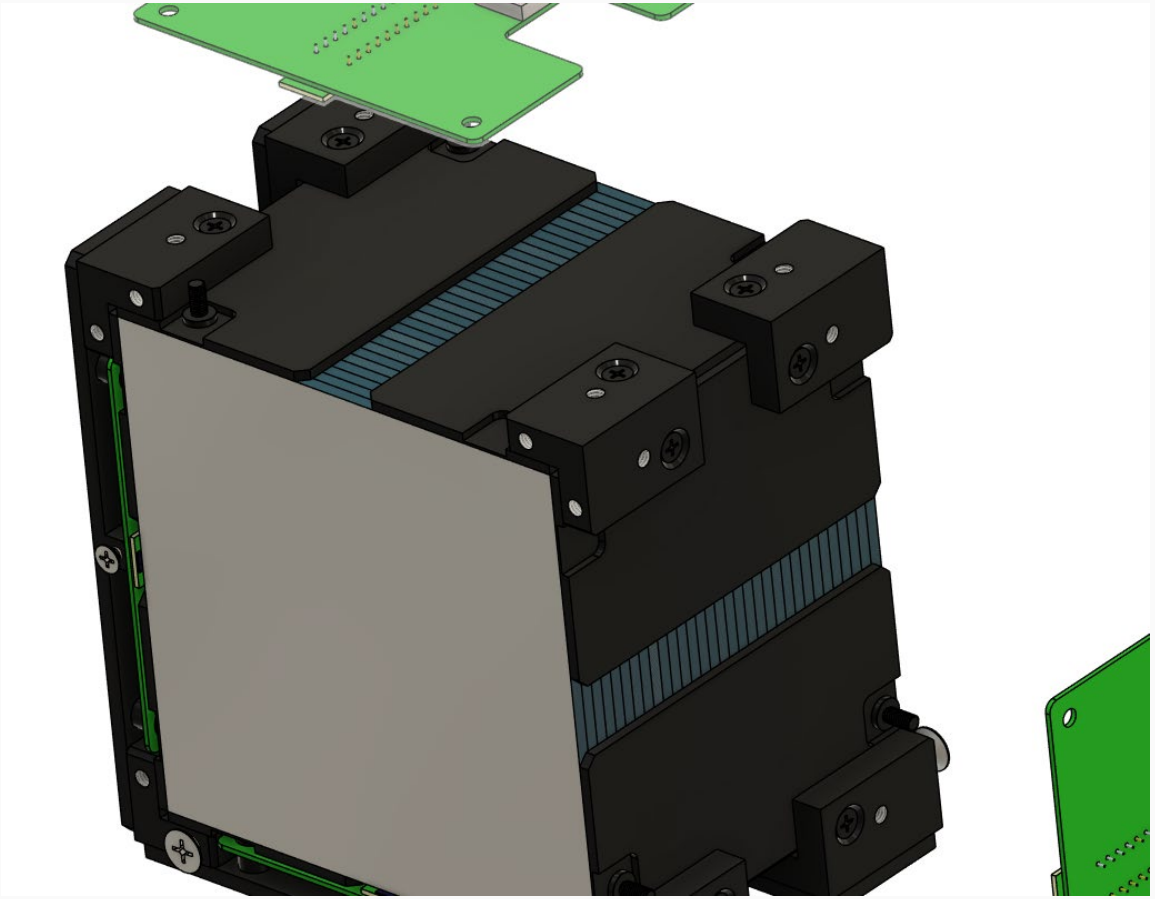
Stack Bridge



- The stack bridge consists of three main elements: the mounting plate, the jumper, and the friction-fit pieces.
- The jumper is the section that clamps directly to the stack.
- The two end pieces friction-fit into the rails to locate and secure the assembly.
- Originally, we considered adding a pressure or clamping mechanism to hold the bridge in place.
- The current approach relies on gravity combined with a close friction fit between the components and rails.
- This should provide sufficient stability while keeping the design simple.
- If the friction-fit approach proves insufficient during testing, an additional retention or clamping method can be revisited.

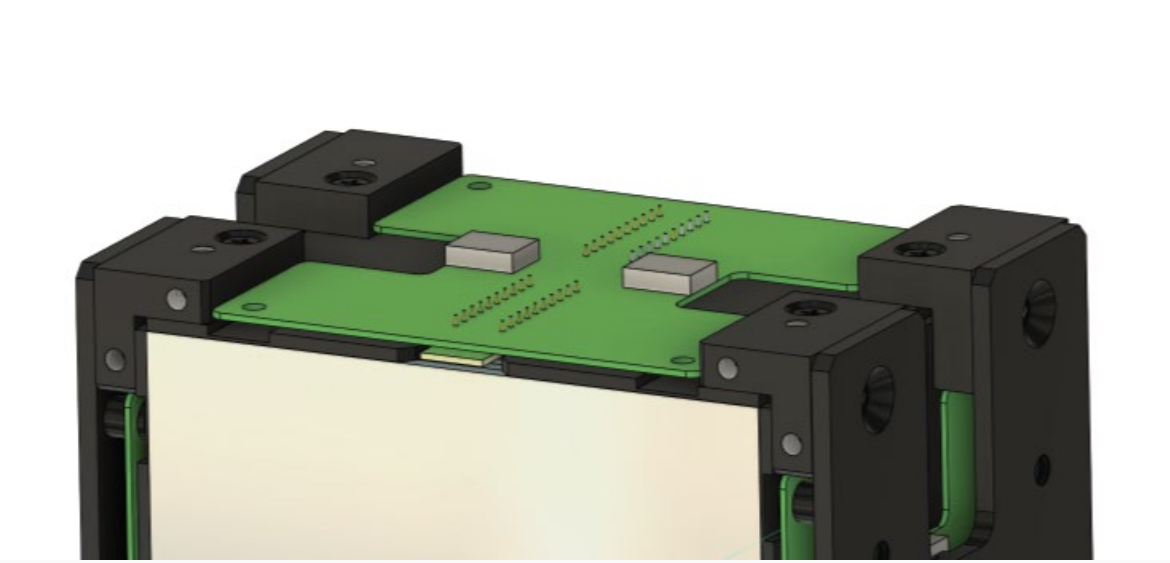
Stacks





- The overall stack design has been established for some time, but this slide provides an overview of the main components.
- The end clamps will be manufactured from Tufnol, providing the strength required while remaining a plastic component.
- Most of the remaining stack components will be manufactured from Delrin.
- The custom PCBs containing the photodiodes are held in position by the PCB clamps.
- The exploded view shows how the corner pieces are split to provide clearance for the USB-C cable.
- Blanking plates are attached to the corner pieces around the scintillator sheets.
- These plates are designed to minimise light leakage and retain as much light as possible within the scintillator sheets.

Stacks



- This slide provides a general overview of how the stack components are assembled.
- On the left, the corner piece is split to provide clearance and routing for the cables.
- On the right, the PCB clamp includes features to limit movement around the USB-C ports
- The PCB clamp also provides a pressure point behind the photodiode.
- A small piece of compressible foam will sit between the photodiode PCB and the main PCB.
- This should provide gentle, consistent pressure to hold the photodiode PCB neatly against the scintillator sheets.

SciFi

- The SciFi assembly itself remains largely unchanged; the main change is how it interfaces with the new mounting system.
- The SciFi holder has its own individual mounting plate.
- The rectangular holder frames will be manufactured from Tufnol, the same material used for the stack end clamps.
- Tufnol provides the additional rigidity required, particularly as the assembly is supported at relatively few points.
- Although the SciFi assembly is relatively lightweight, the holder should be as robust as possible.
- The mounting plate follows a very similar design and mounting principle to the stack bridges.