

TORCH Prototype and Combined (Volume) RICH2 Feasibility Study

Adam Lowe

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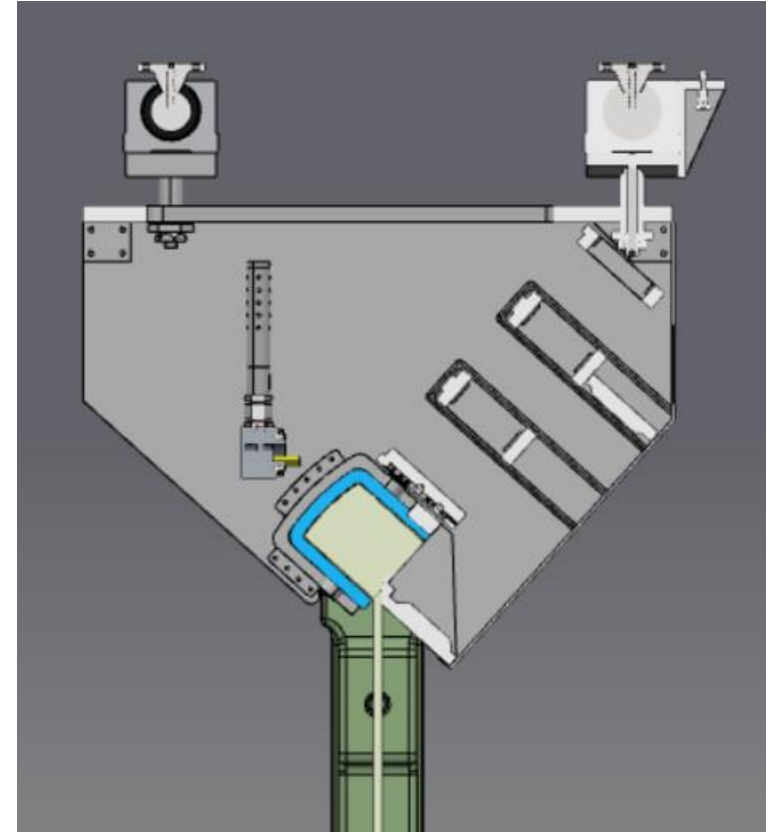
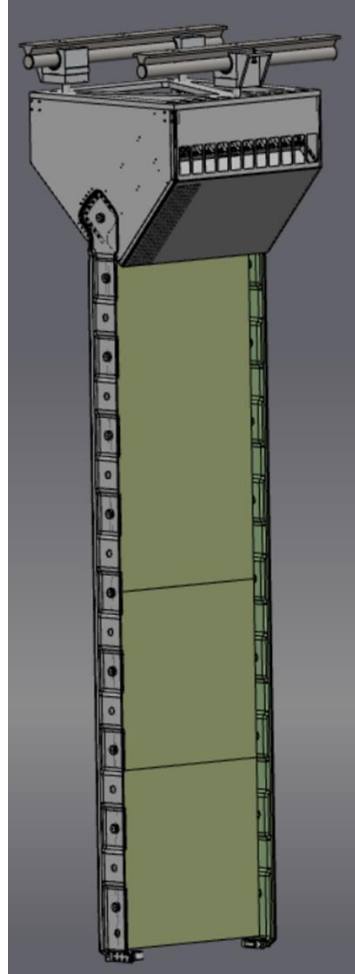
⚙️ Advancing the Concept

⚙️ Next Steps

⚙️ Open Discussion/Questions

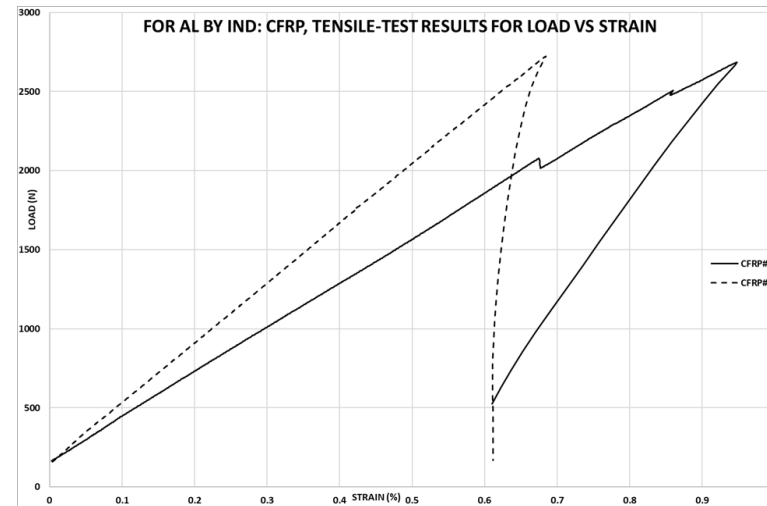
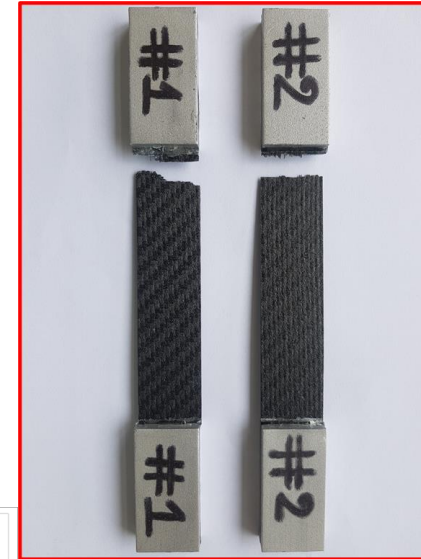
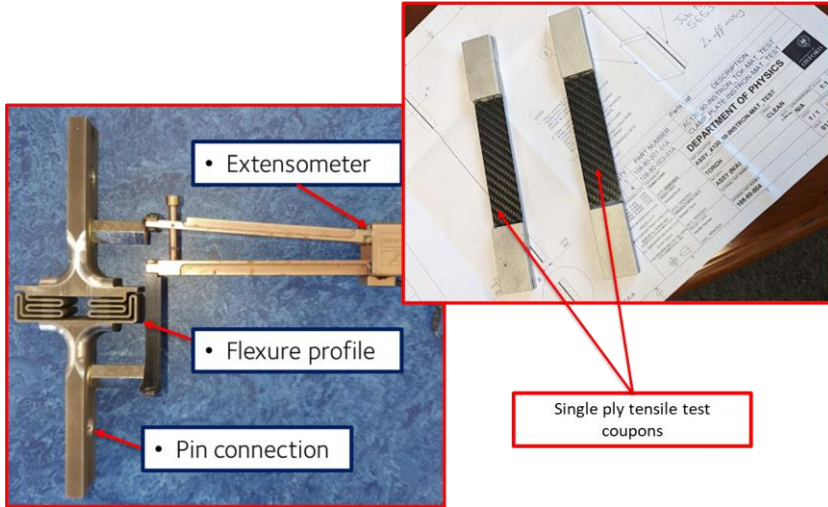
Frame Design Re-Cap

- Lightweight, minimum material CF frame



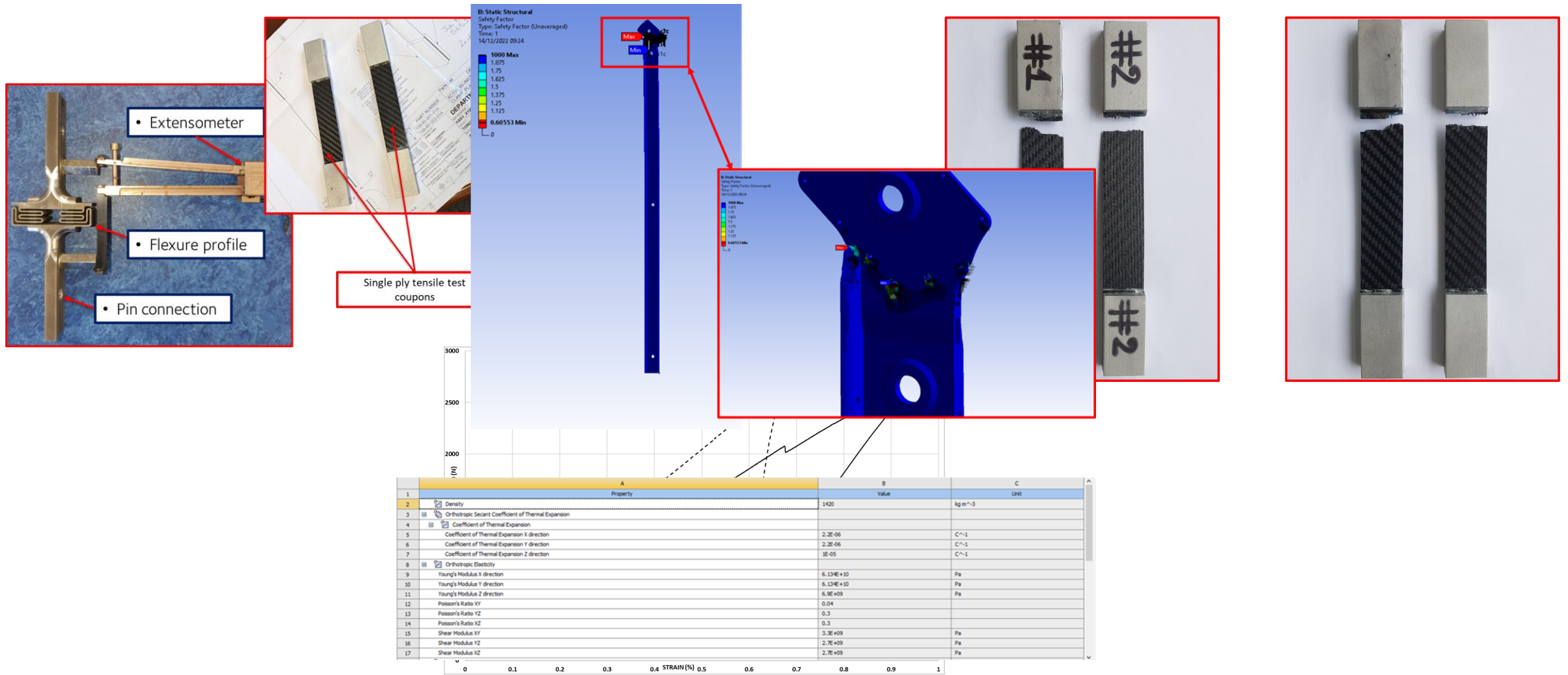
Frame Design Re-Cap

⚙ Full orthotropic FEA of the frame has been carried out with material sample testing to validate



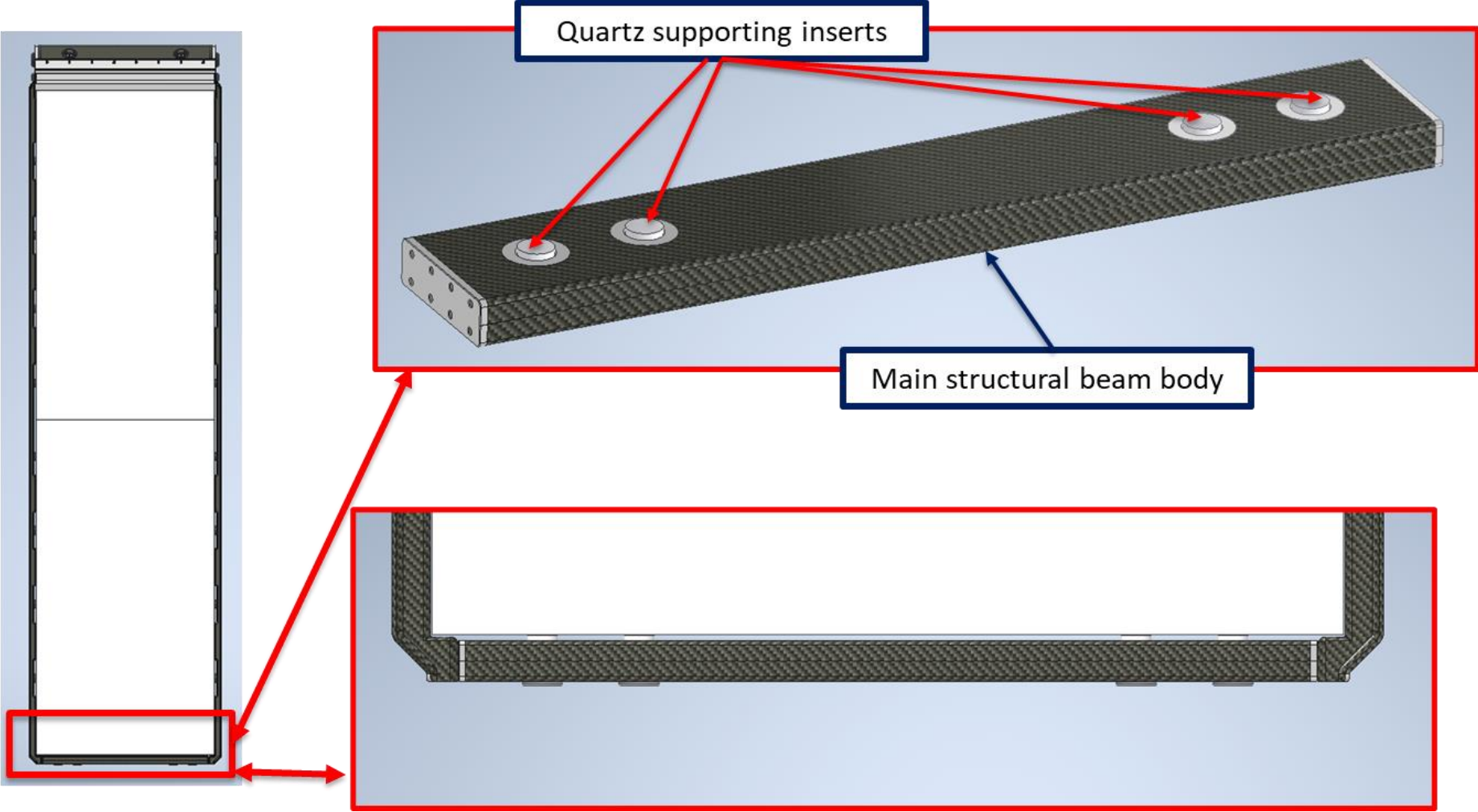
Frame Design Re-Cap

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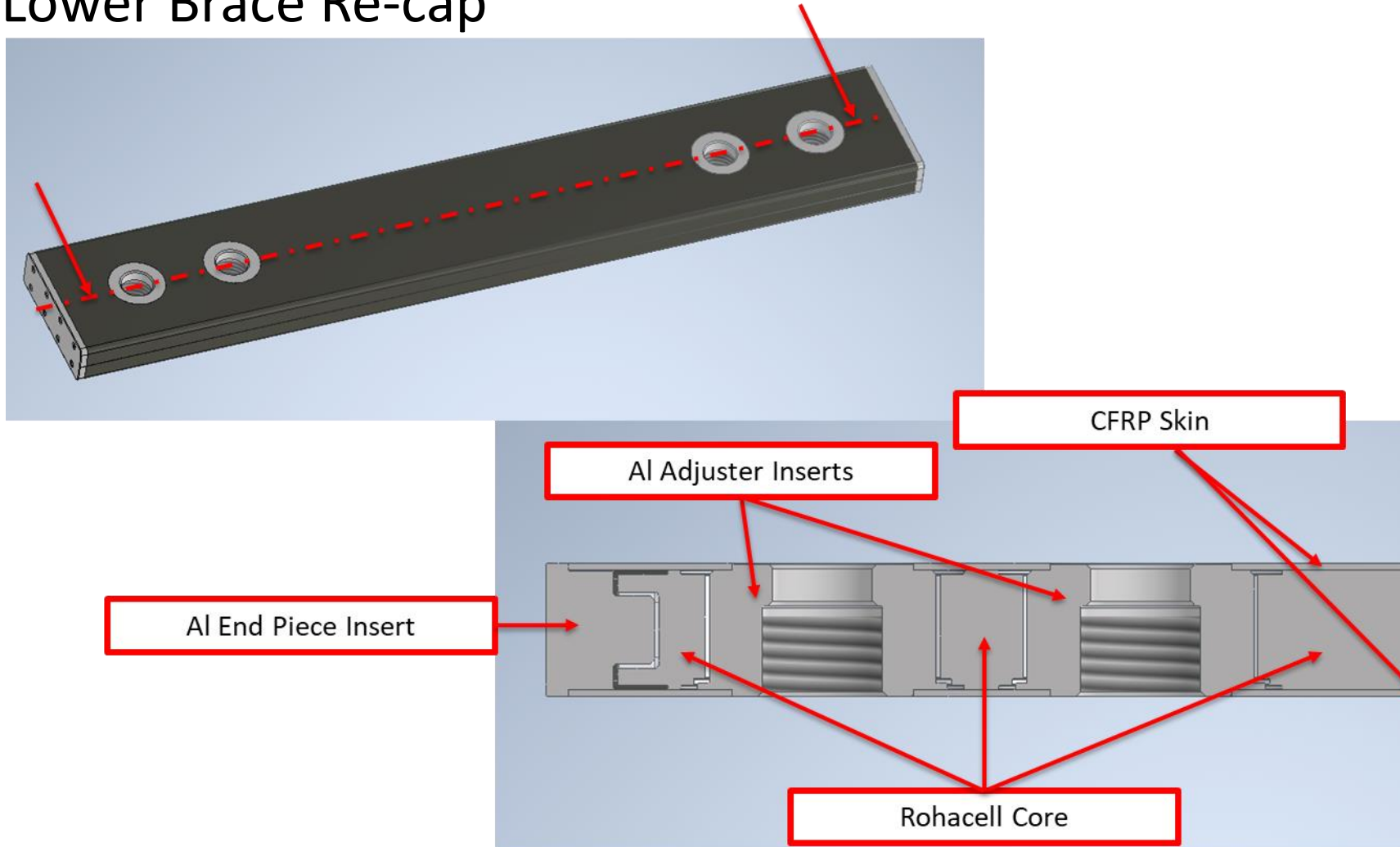
Lower Brace Design Recap

⚙️ TORCH Lower Brace Re-cap



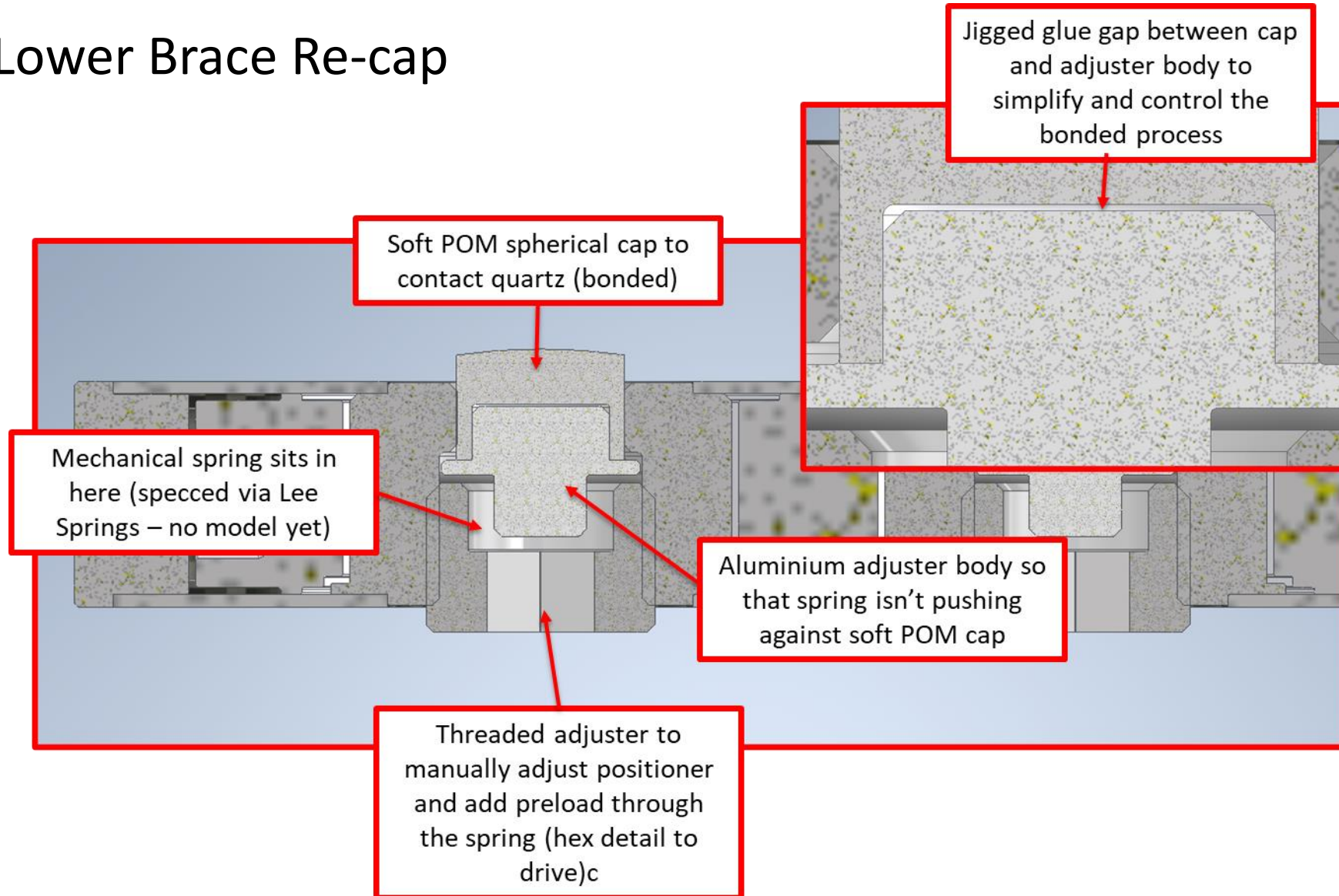
Lower Brace Design Recap

⚙️ TORCH Lower Brace Re-cap



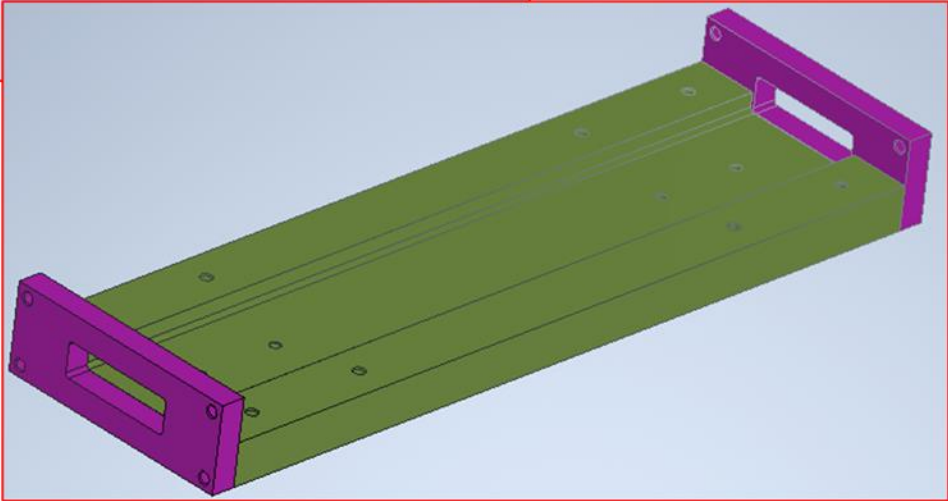
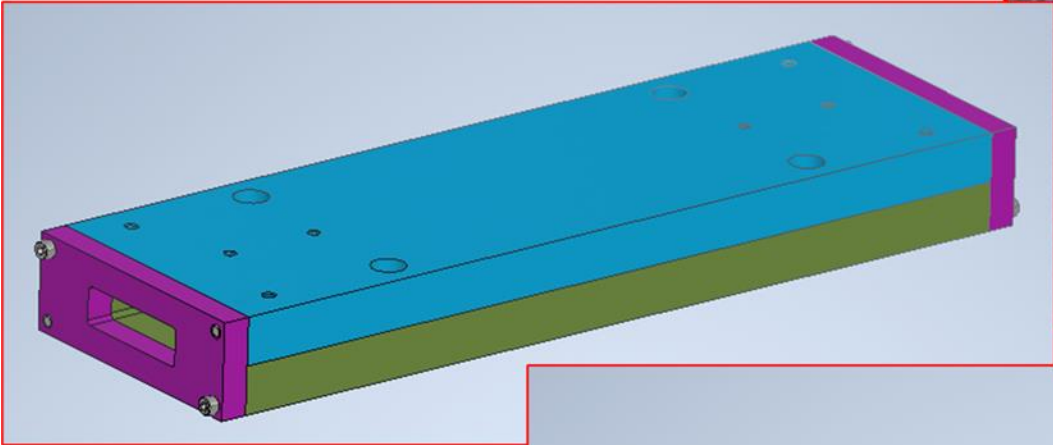
Lower Brace Design Recap

⚙️ TORCH Lower Brace Re-cap



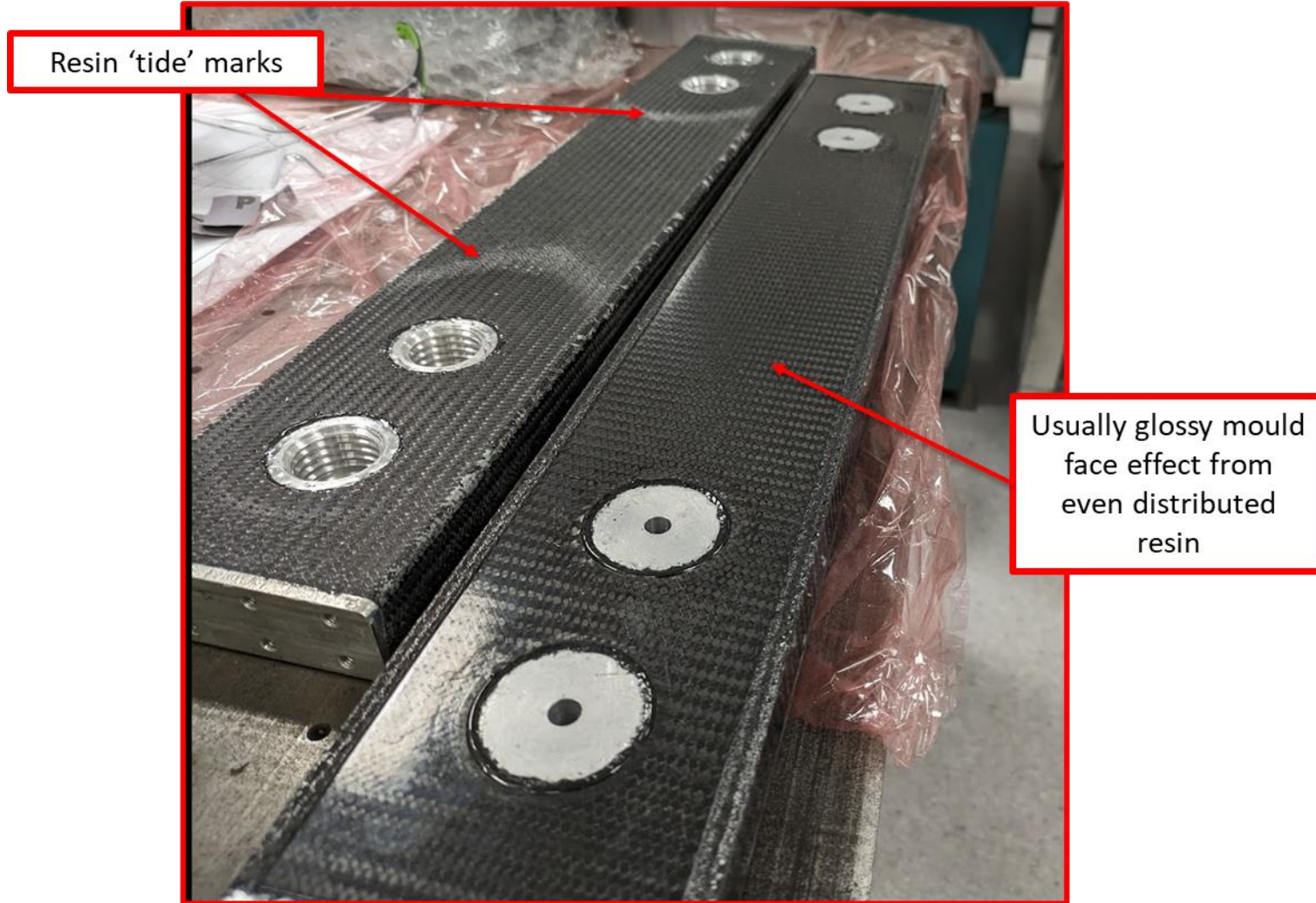
Lower Brace Design Recap

⚙️ TORCH Lower Brace Re-cap



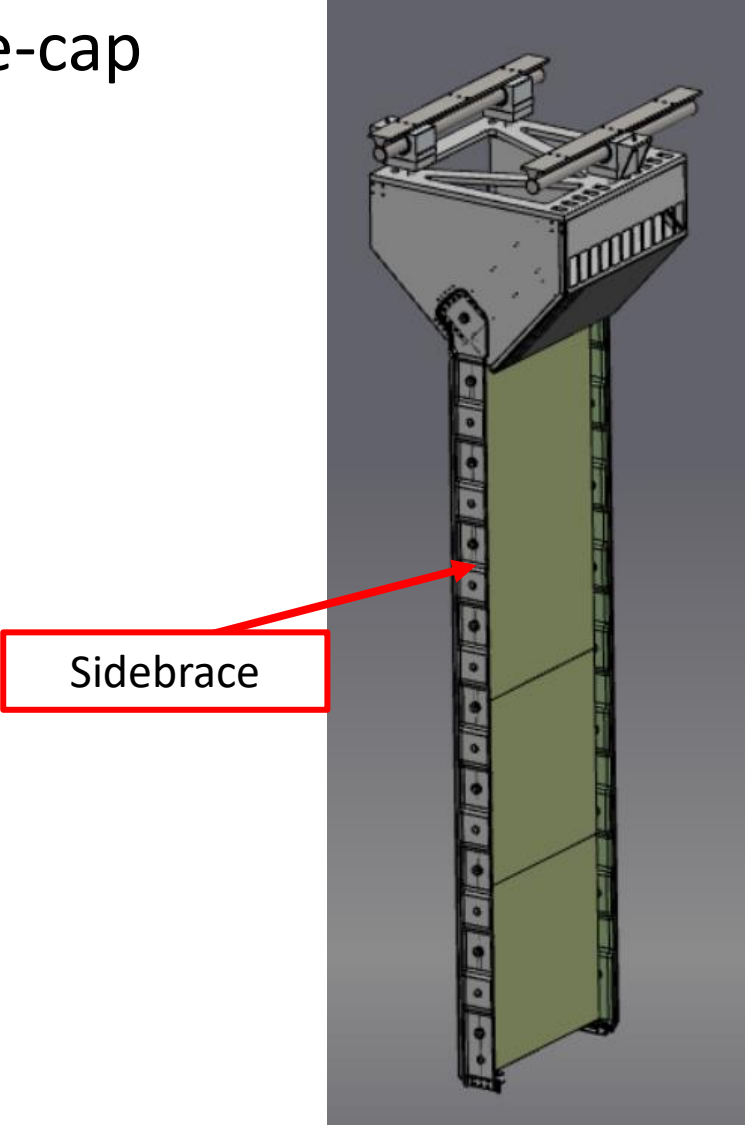
Lower Brace Design Recap

⚙️ TORCH Lower Brace Re-cap



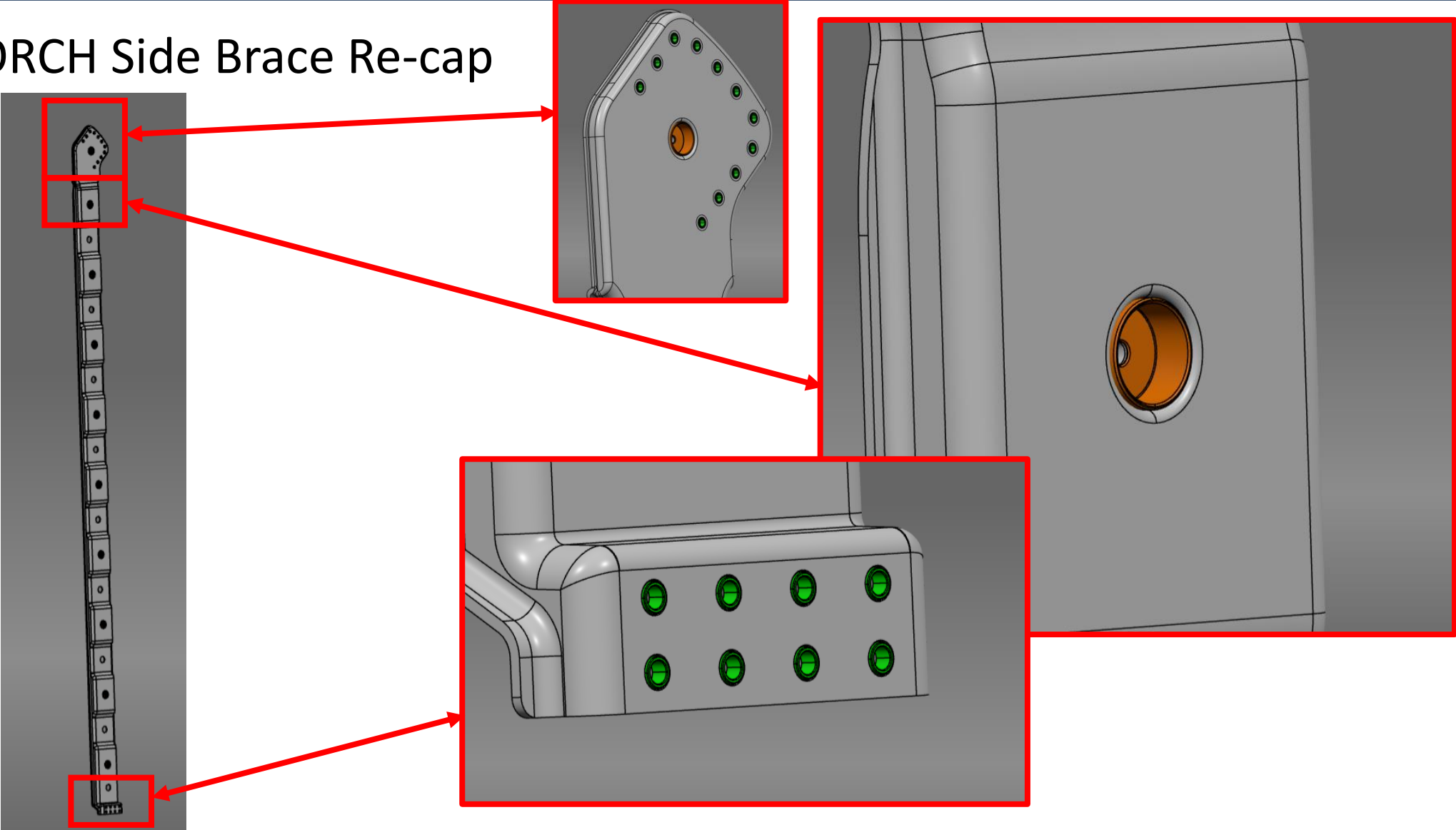
Side Brace Design Recap

⚙️ TORCH Side Brace Re-cap



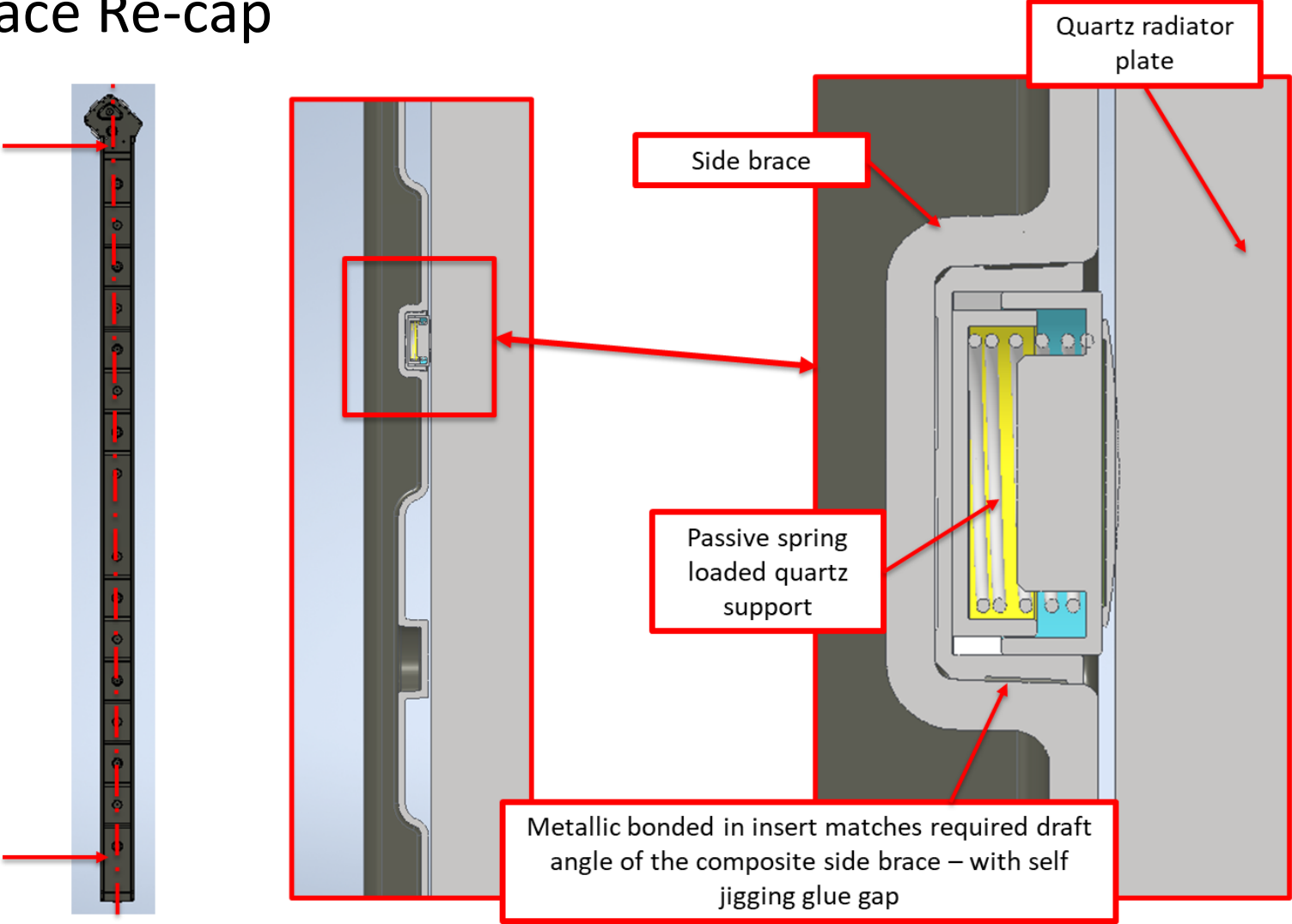
Side Brace Design Recap

⚙️ TORCH Side Brace Re-cap



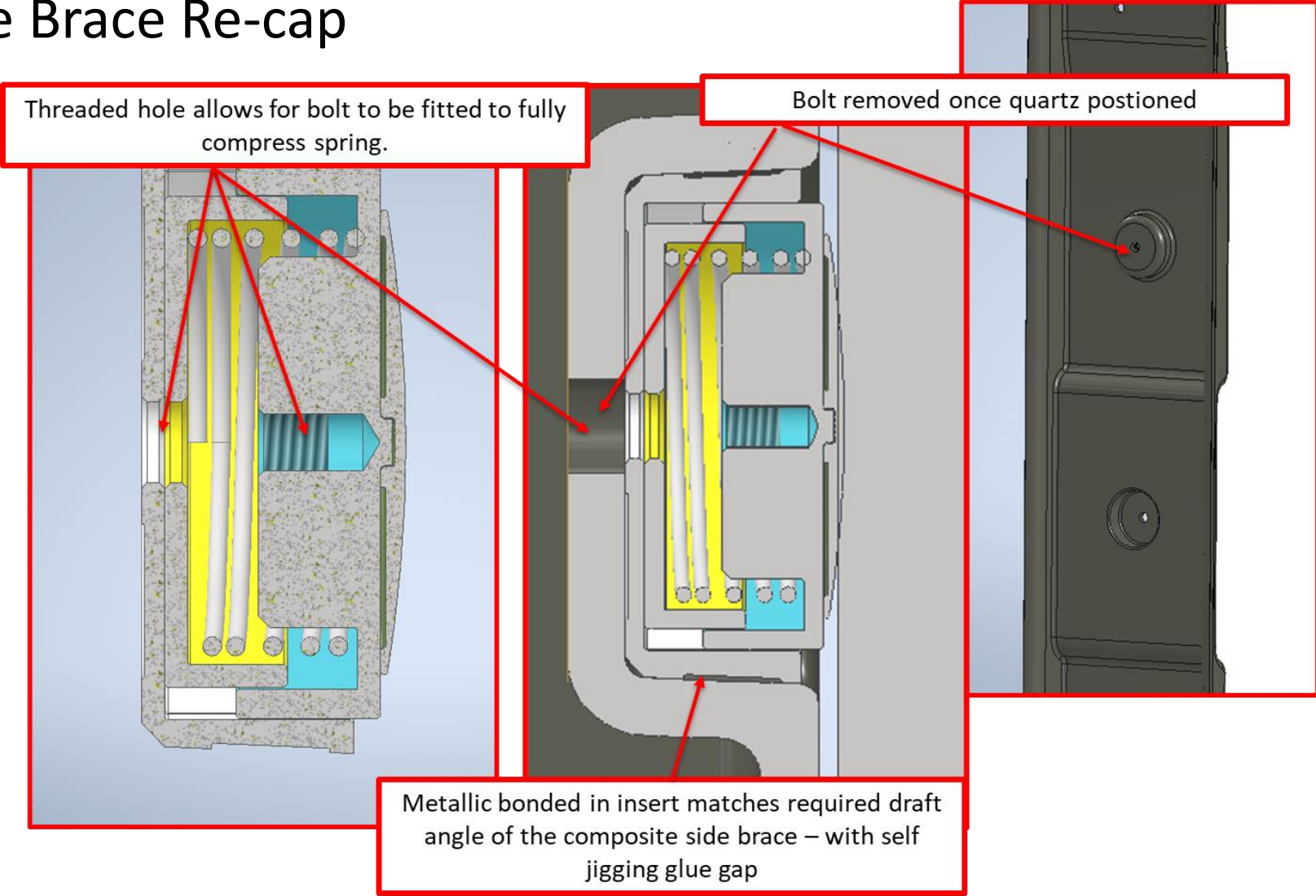
Side Brace Design Recap

⚙️ TORCH Side Brace Re-cap



Side Brace Design Recap

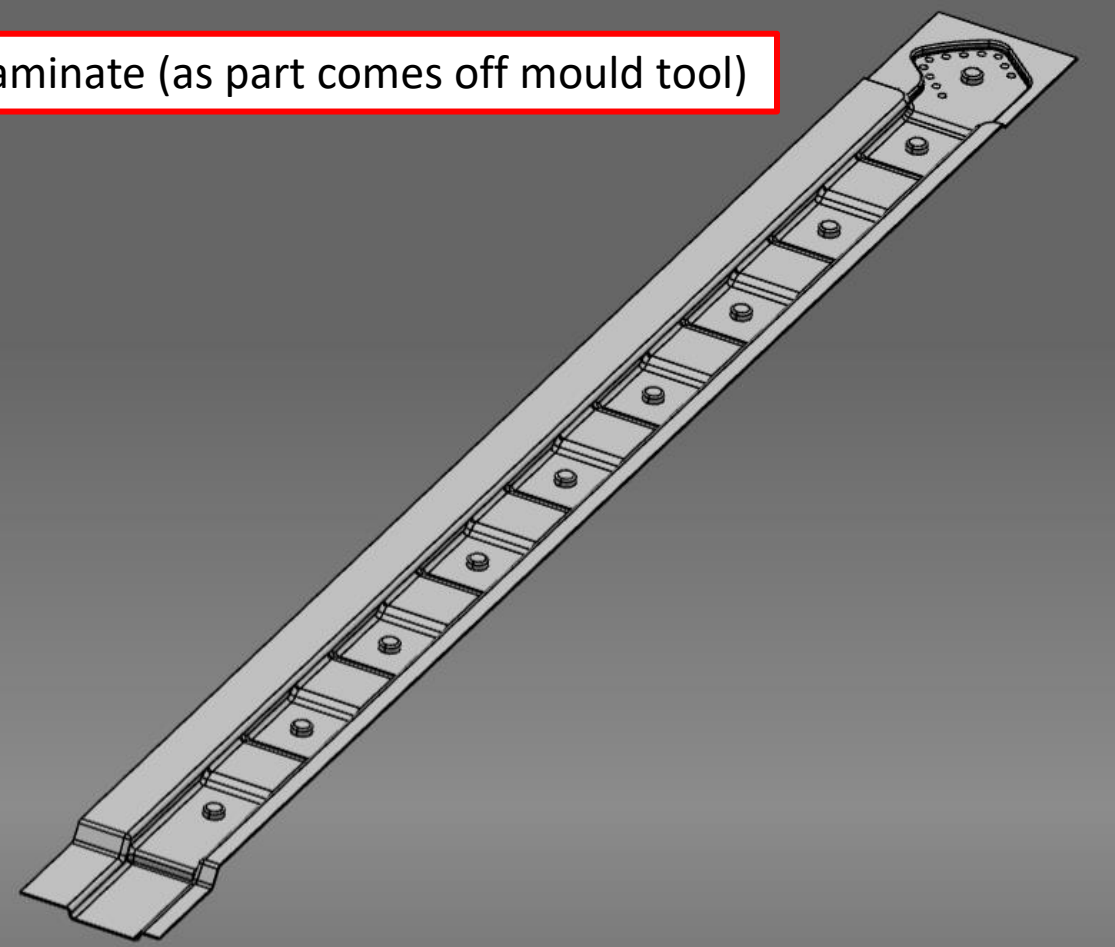
⚙️ TORCH Side Brace Re-cap



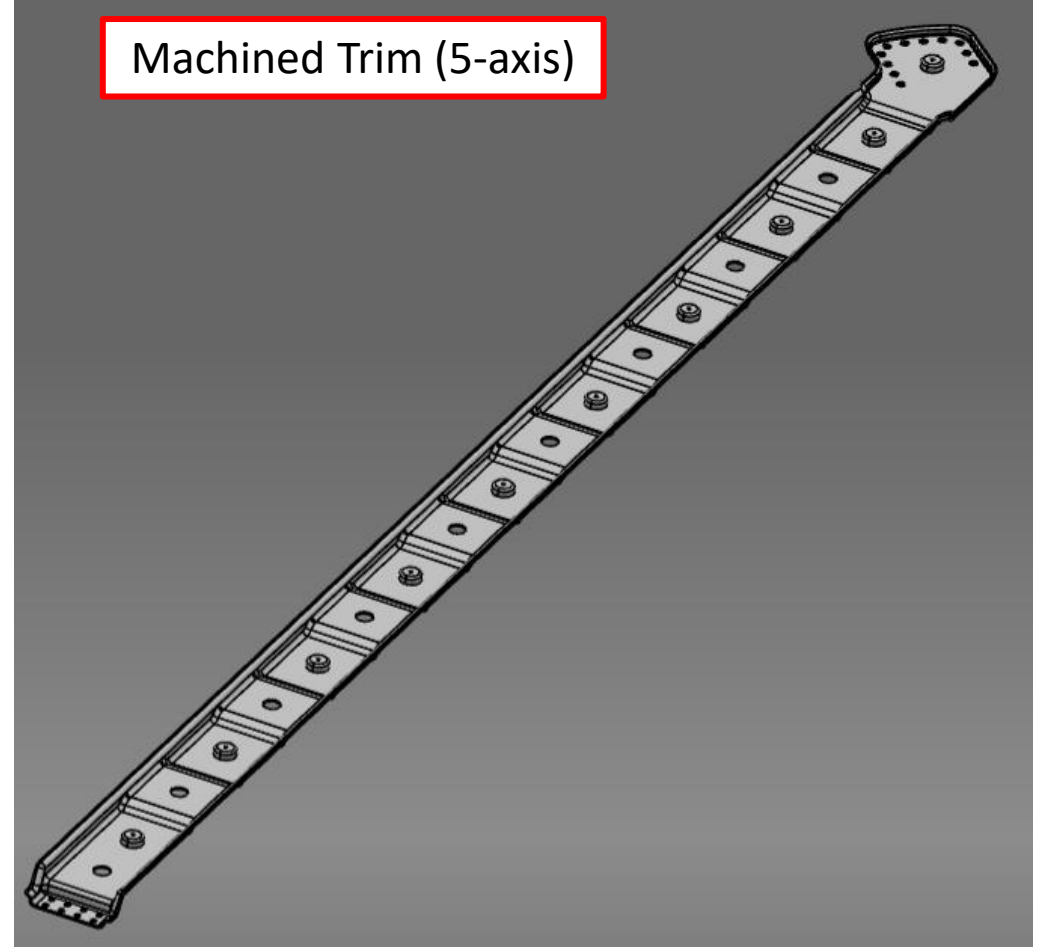
Side Brace Design Recap

⚙️ TORCH Side Brace Re-cap

Laminate (as part comes off mould tool)

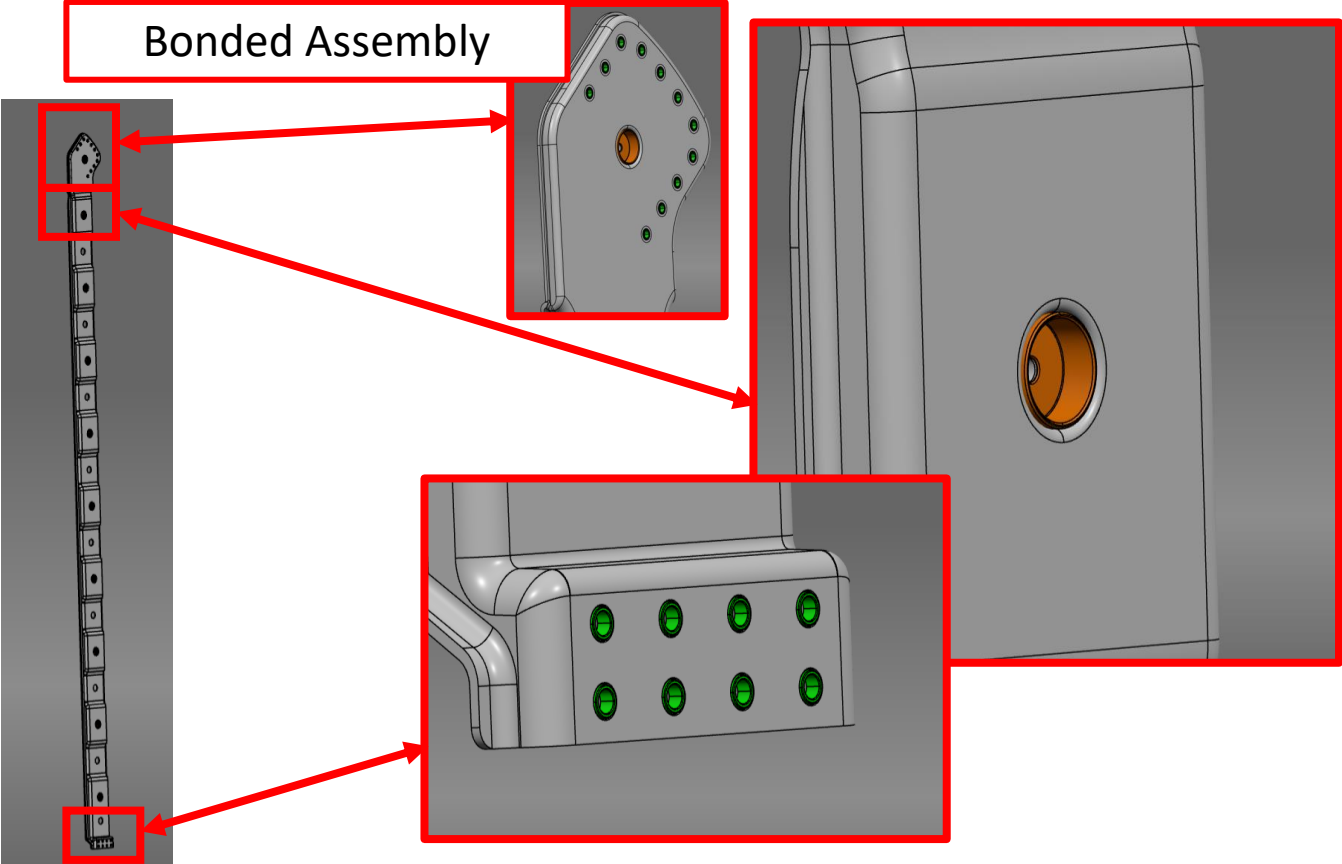
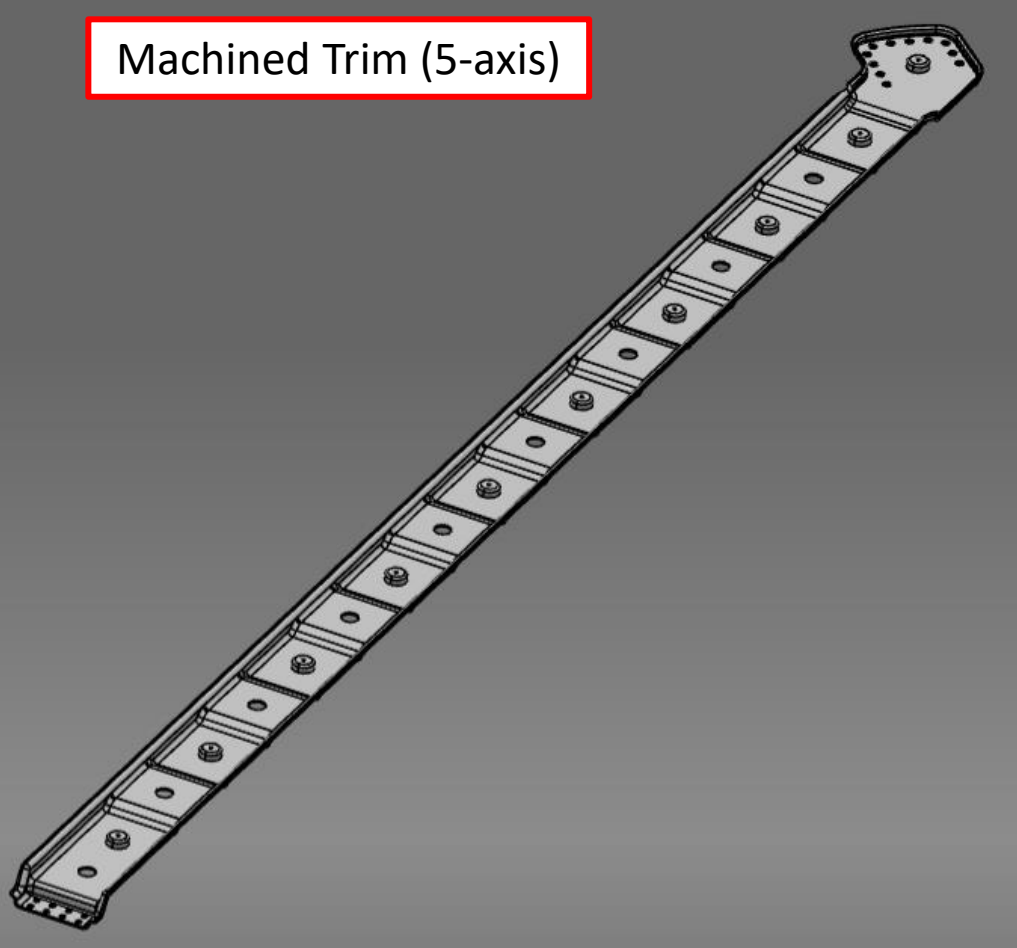


Machined Trim (5-axis)



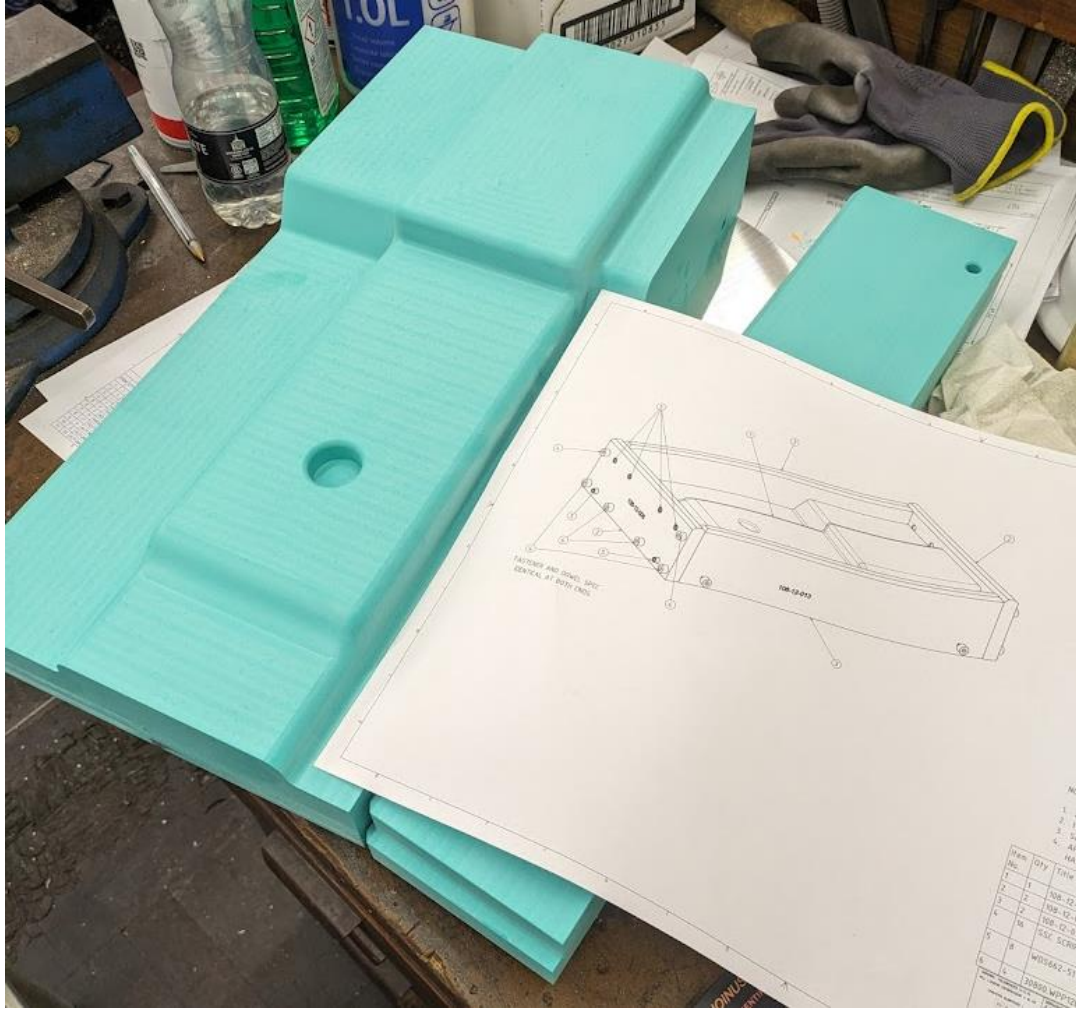
Side Brace Design Recap

⚙️ TORCH Side Brace Re-cap



Side Brace Tooling

- ⚙️ Side brace patterns and carbon fiber mould tools fully produced;



- ⚙️ Patterns produced from ‘Epoxy block tooling board’;
 - ⚙️ Easy to machine;
 - ⚙️ Cheap;
 - ⚙️ Does not inhibit pre-preg cure;
- ⚙️ Mould tools produced from a tooling grade pre-preg carbon fiber;
 - ⚙️ Matched CTE with the final component;
 - ⚙️ Tough and re-usable tool;
 - ⚙️ Lower cure temperature than component pre-preg (hence less thermal expansion difference between pattern and mould tool) – OR SO WE HOPED!;

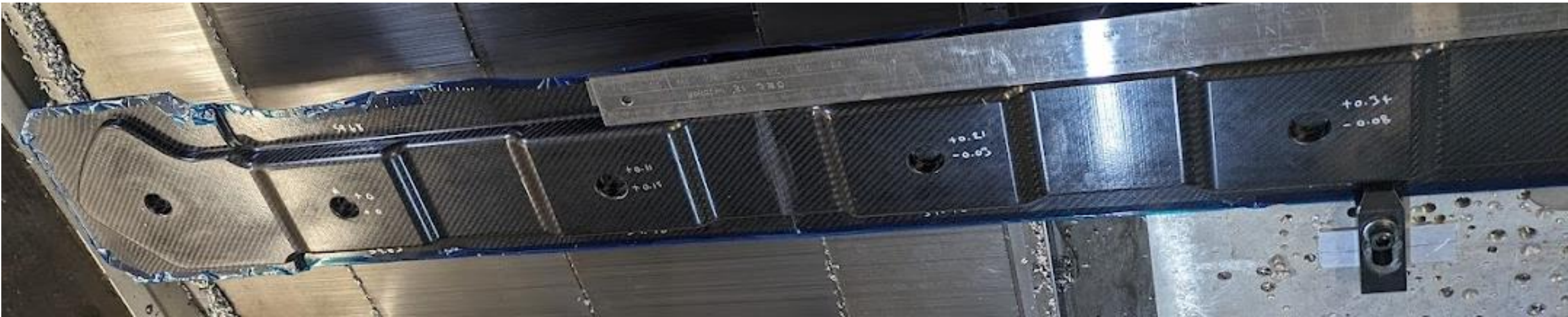
Side Brace Laminate

✿ First side brace laminate was produced in the 3m autoclave at Brick Kiln Composites (Banbury);



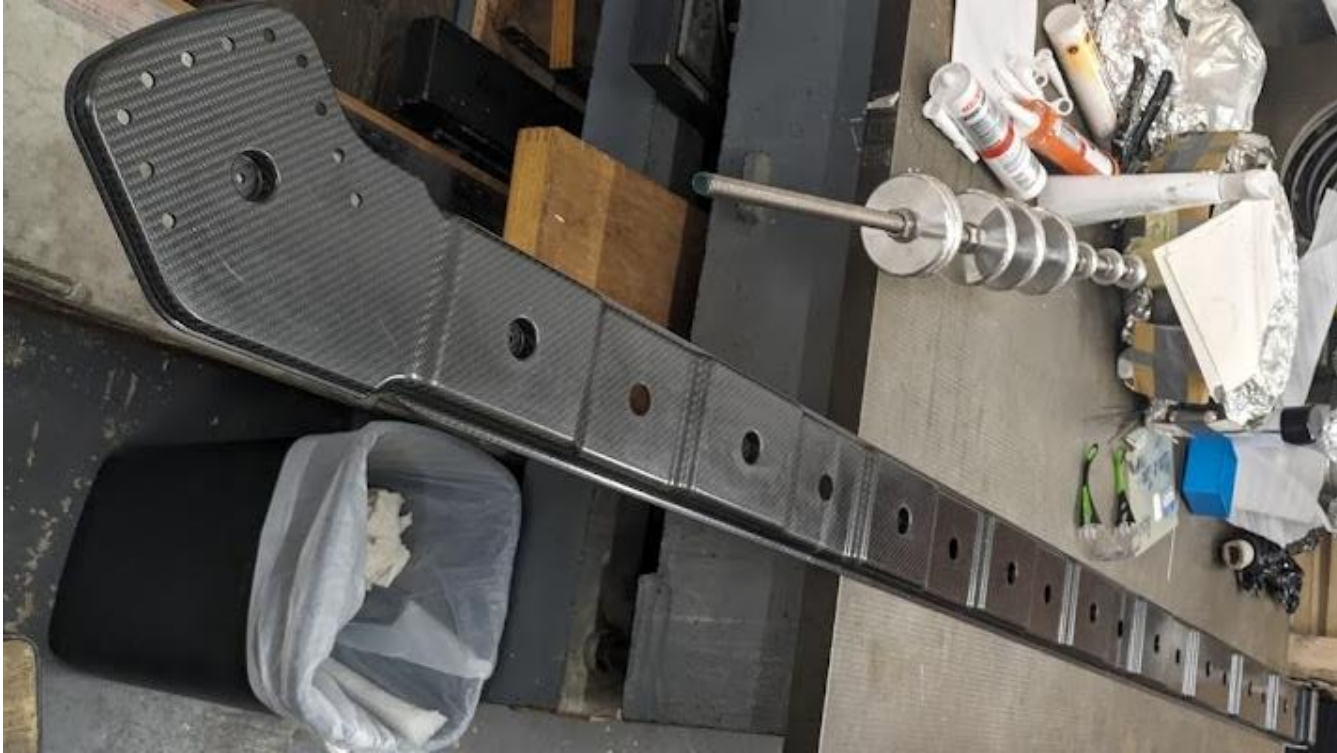
Side Brace Laminate - Measurement

⚙ The laminate was put on the large 1600mm 5 axis mill at Oxford to be quasi-CMM inspected;



Side Brace Machining

- ⚙️ Machining op successful without inducing any twisting or bending;



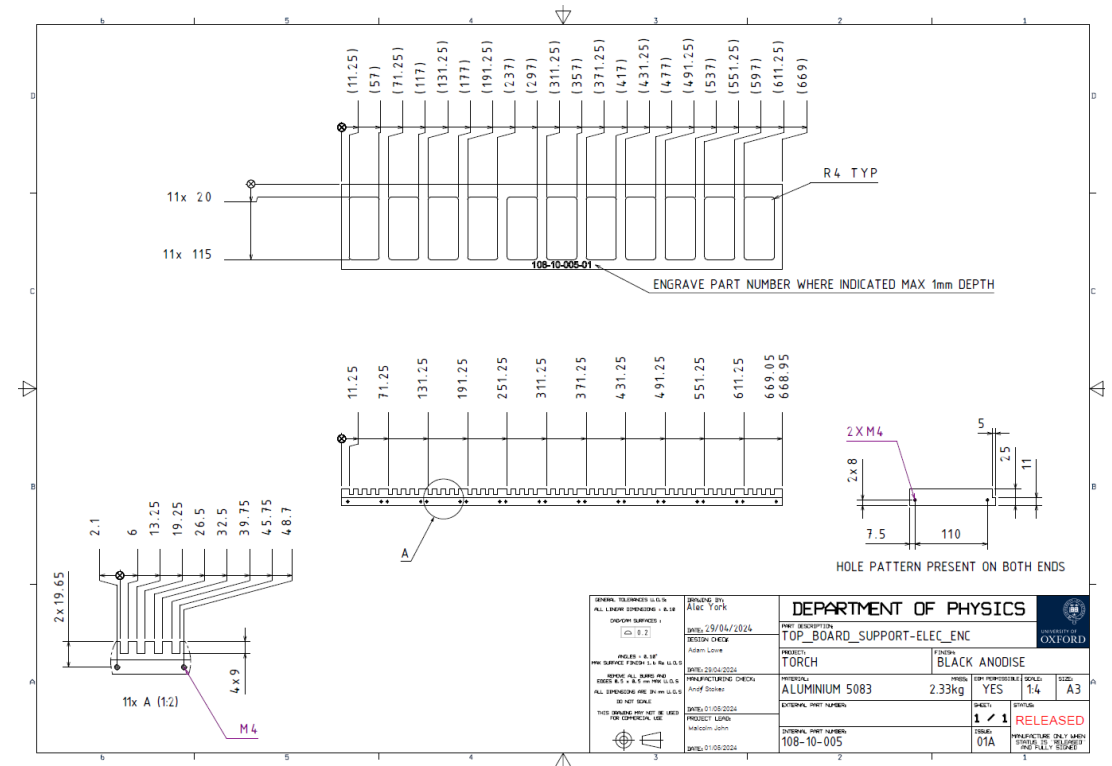
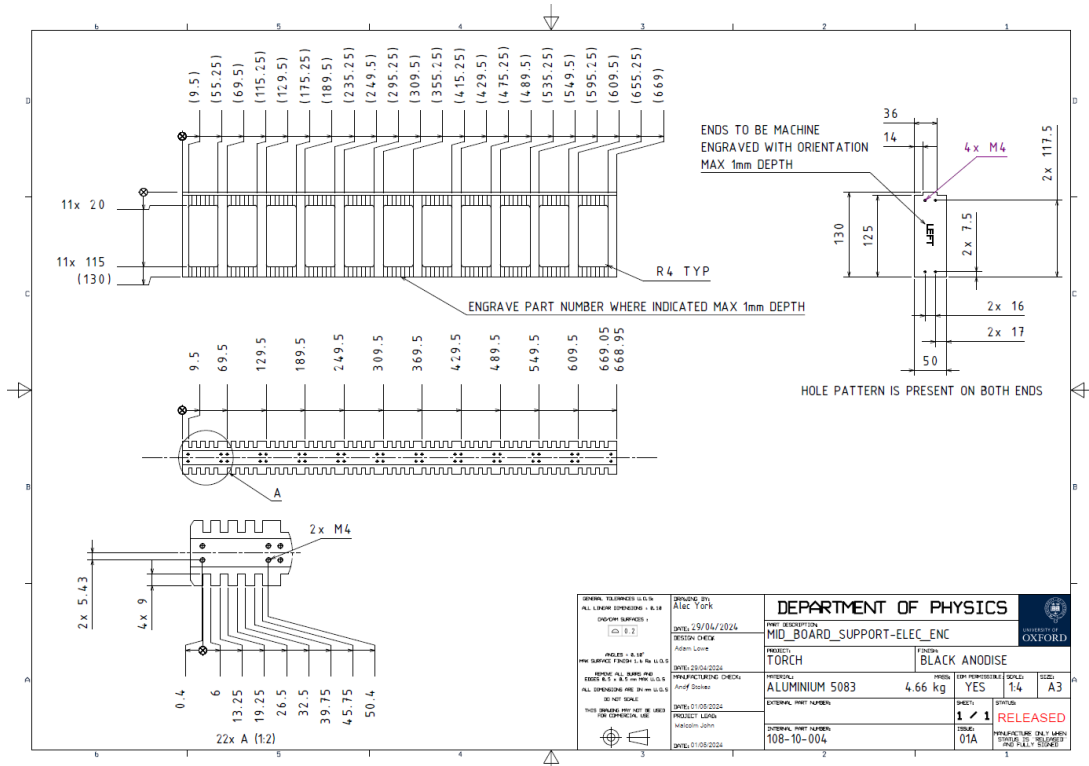
Side Brace Bonding

⚙️ Full bonding op of metallic inserts into sidebrace completed;



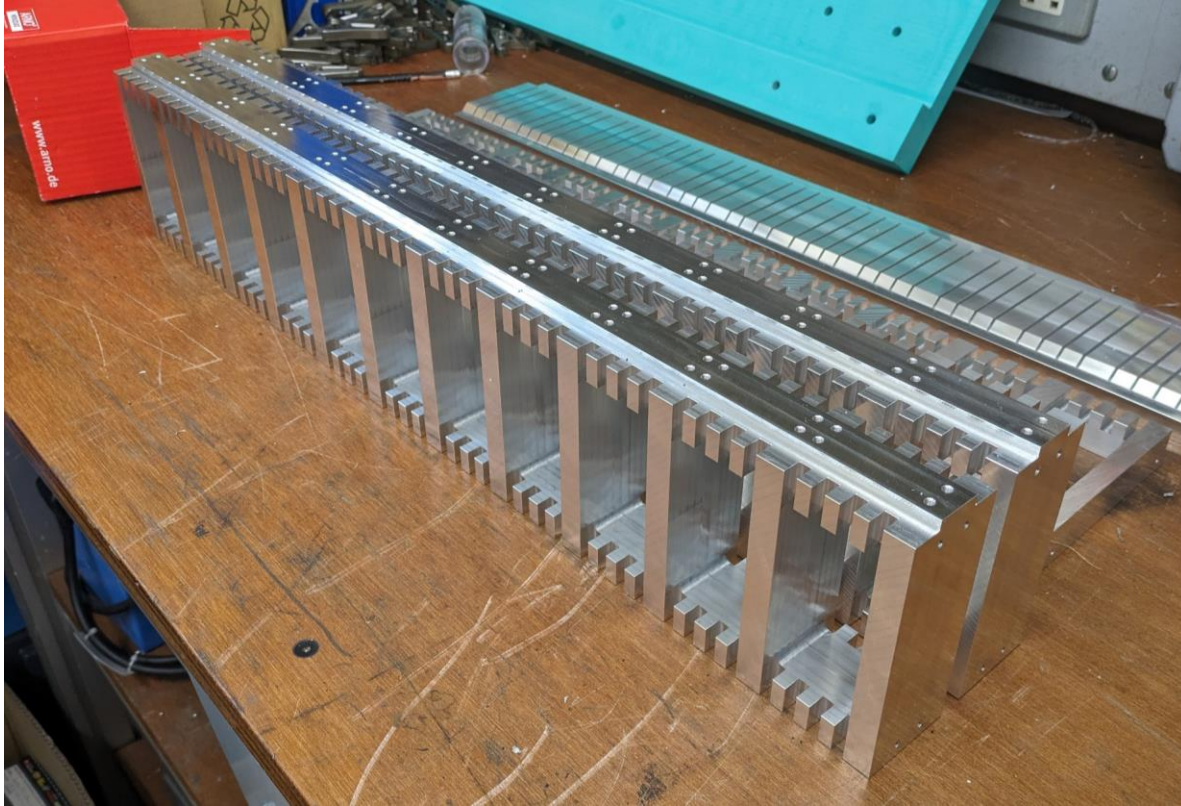
Electronic Boards Detailed

⚙️ Mid and upper board supports fully detailed and manufactured;



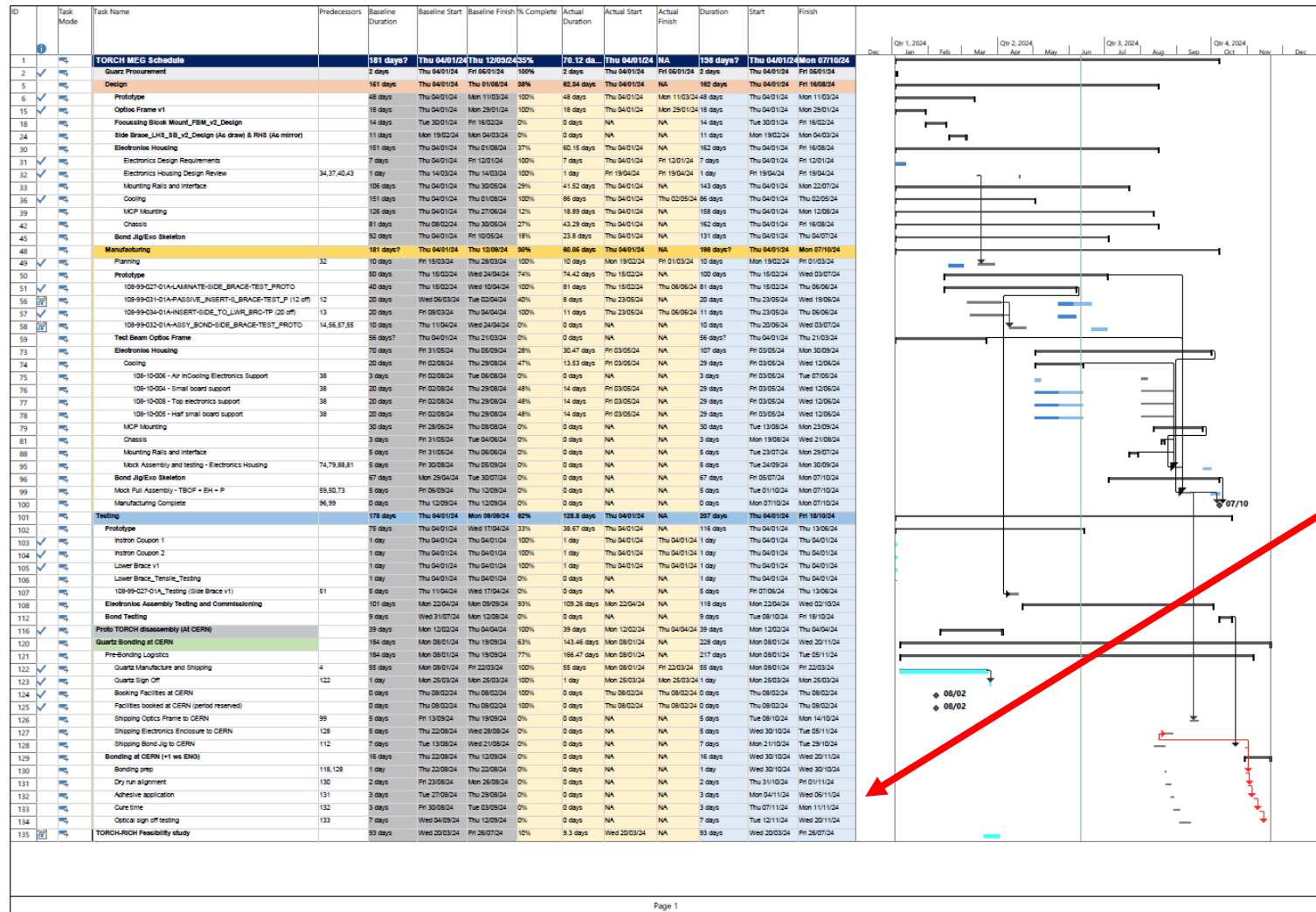
Electronic Board Supports Manufactured

⚙ Board supports fully manufactured and co-ordinate measured on machined – full CMM inspection pending.



TORCH Prototype Build Plan

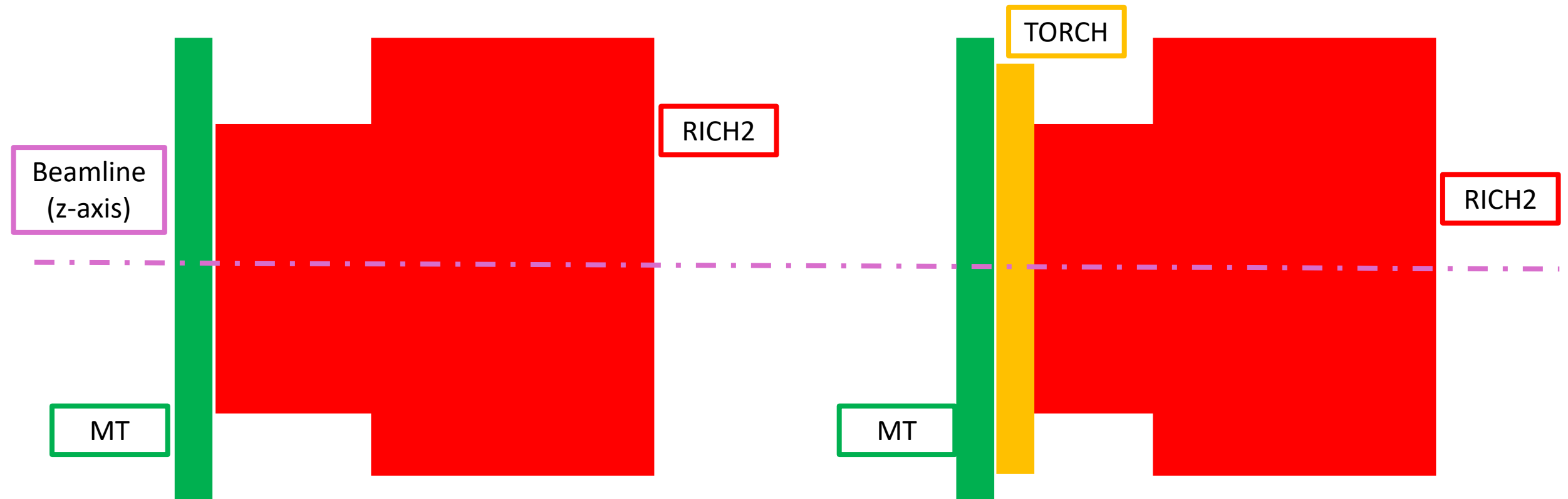
Board supports fully manufactured and co-ordinate measured on machined – full CMM inspection pending.



16 days	Wed 30/10/24	Wed 20/11/24
1 day	Wed 30/10/24	Wed 30/10/24
2 days	Thu 31/10/24	Fri 01/11/24
3 days	Mon 04/11/24	Wed 06/11/24
3 days	Thu 07/11/24	Mon 11/11/24
7 days	Tue 12/11/24	Wed 20/11/24

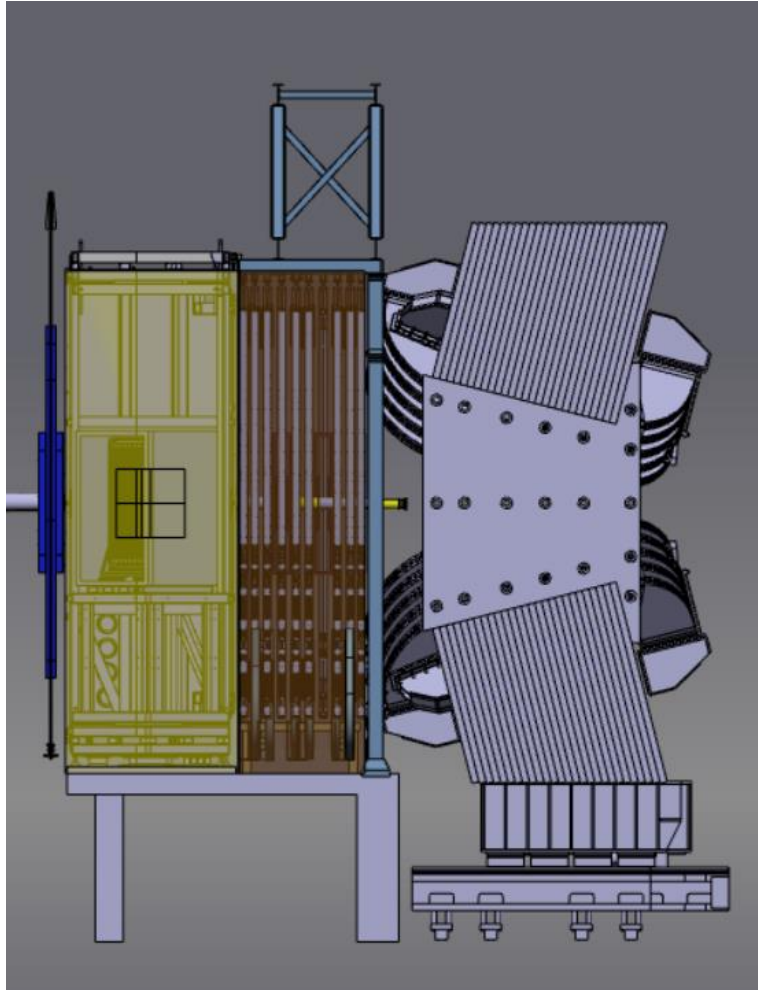
RICH2/TORCH Integration - Introduction

- ⚙ Motivation is to occupy the same volume of space (overall envelope) as RICH2.

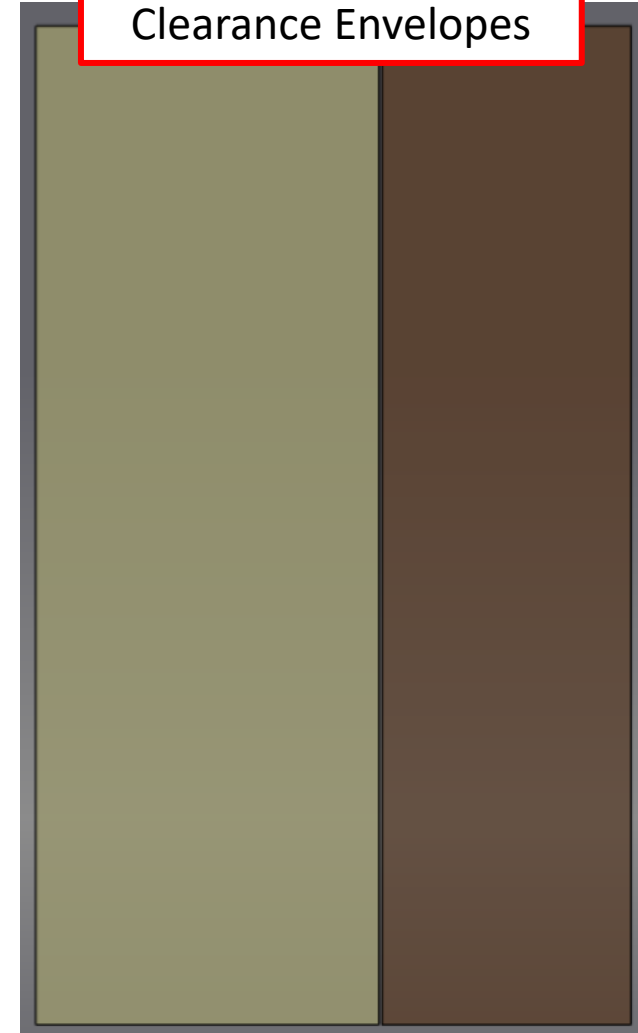


RICH2/TORCH Integration - Introduction

⚙️ Current concept states;



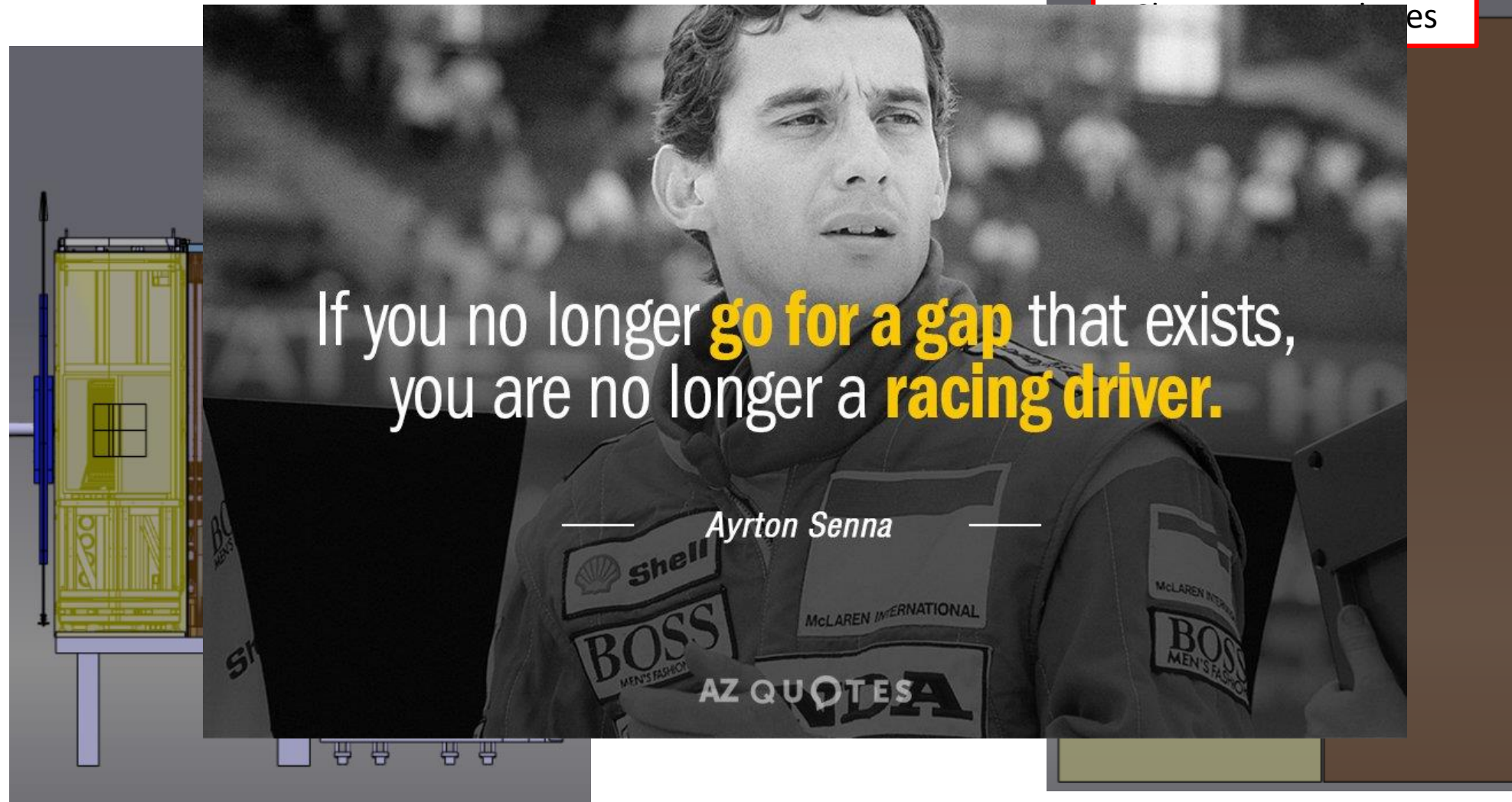
22mm **Gap!!** Between Clearance Envelopes



RICH2/TORCH Integration - Introduction

⚙️ Current concept states;

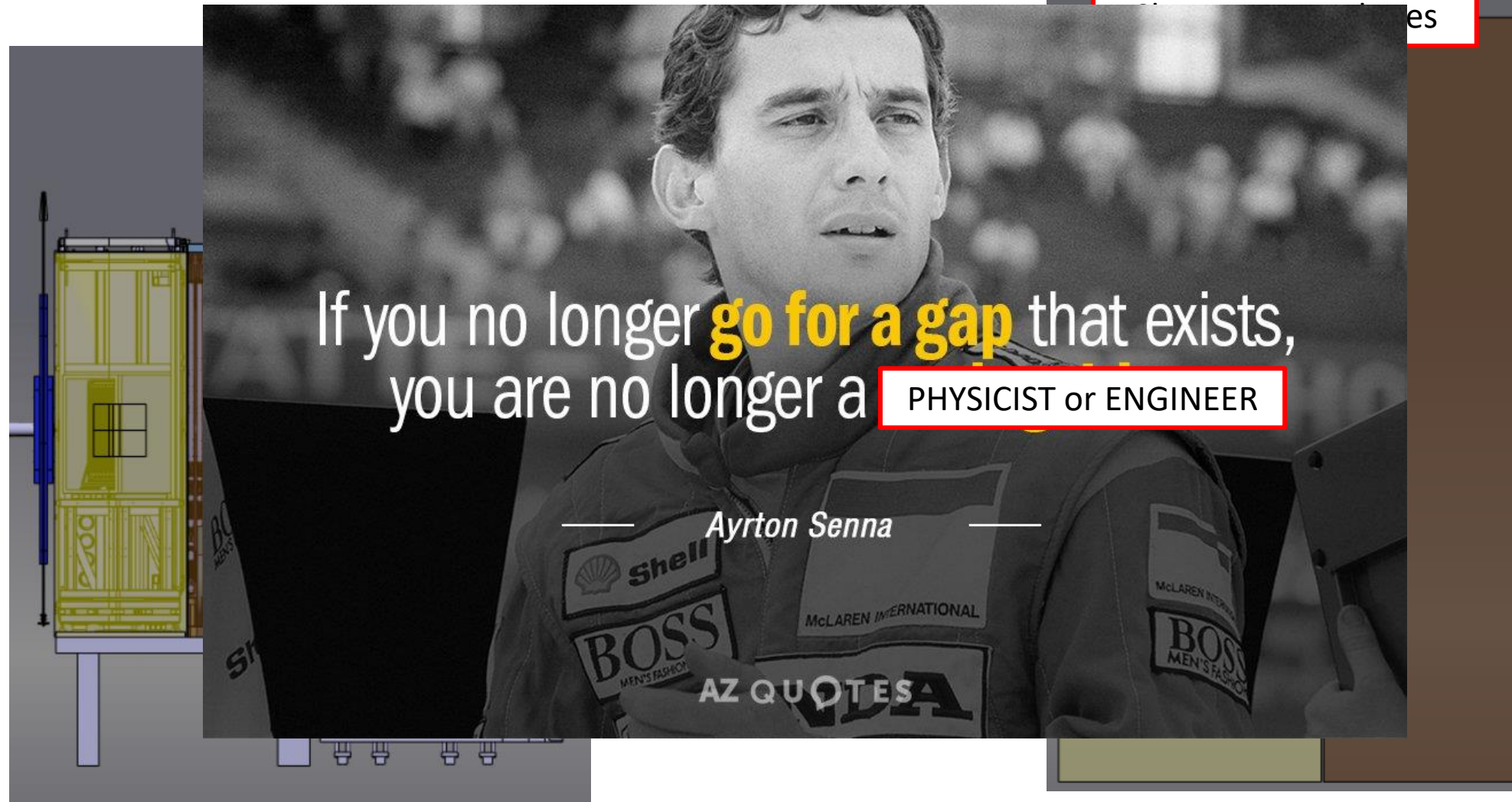
22mm Gap Between
es



RICH2/TORCH Integration - Introduction

⚙️ Current concept states;

22mm Gap Between
es

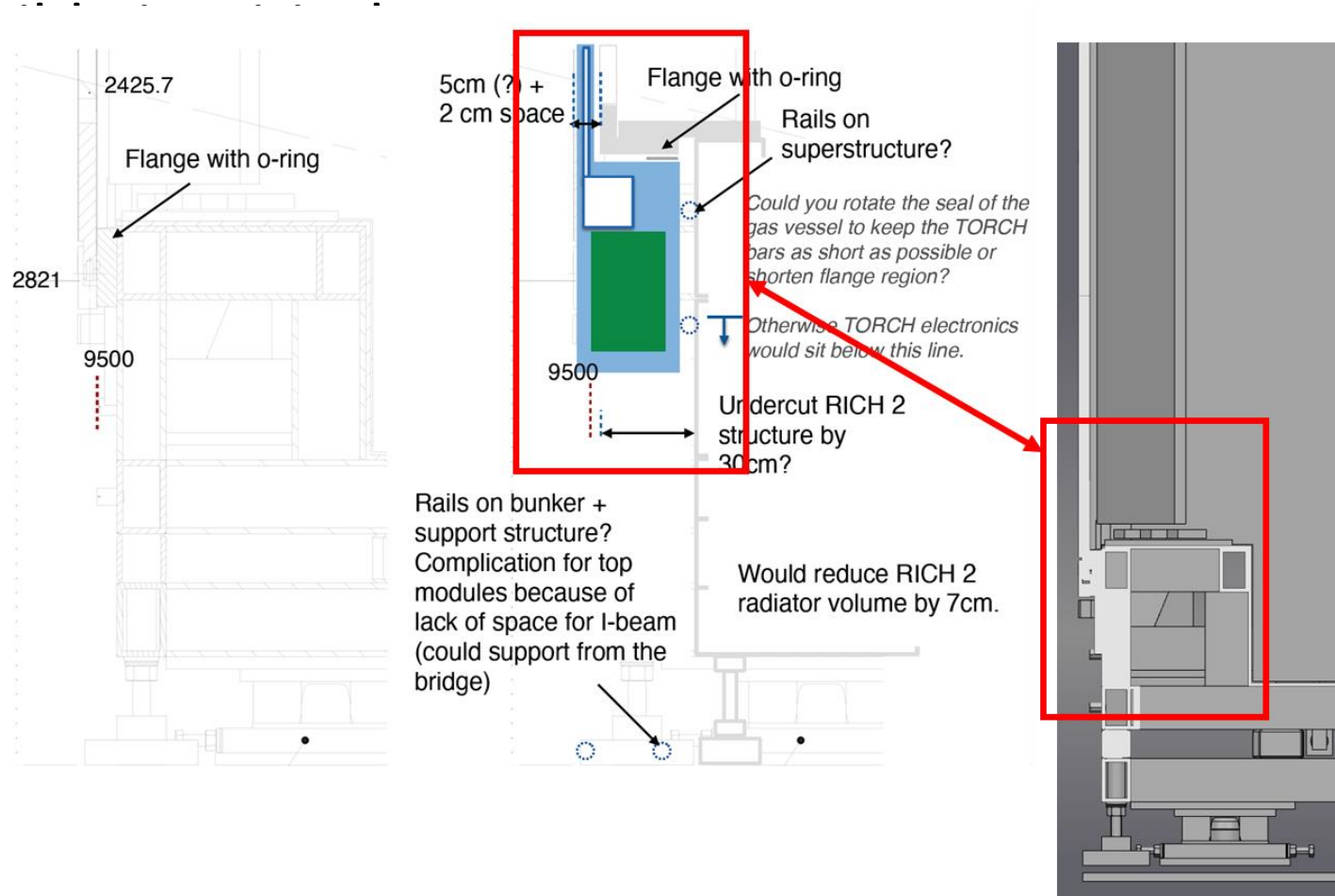


If you no longer **go for a gap** that exists,
you are no longer a **PHYSICIST or ENGINEER**

Ayrton Senna

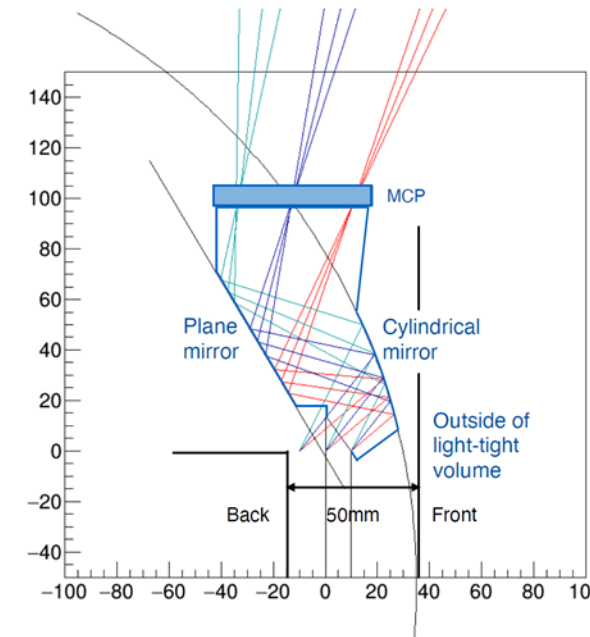
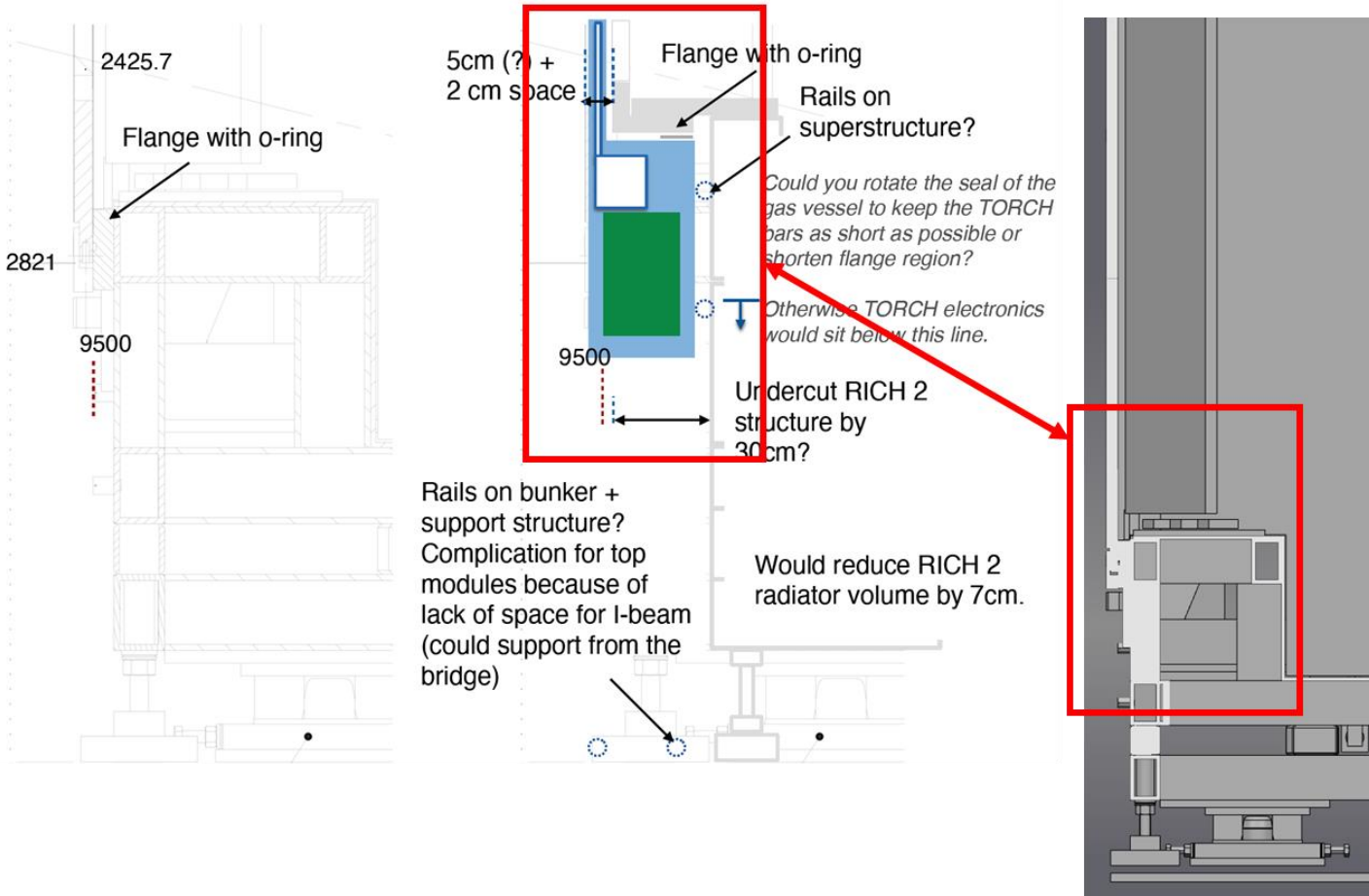
RICH2/TORCH Integration – Skinny is Key

- ⚙ In order to successfully integrate into any space in this region of the experiment it becomes obvious that slimming down the sub-detector as much as possible



RICH2/TORCH Integration – Focussing Block Change for V-Elec

⚙ In order to accommodate this design, a focussing block re-design is required



It should be possible to design a focusing block with minimal protrusion in z beyond one face of the radiator.

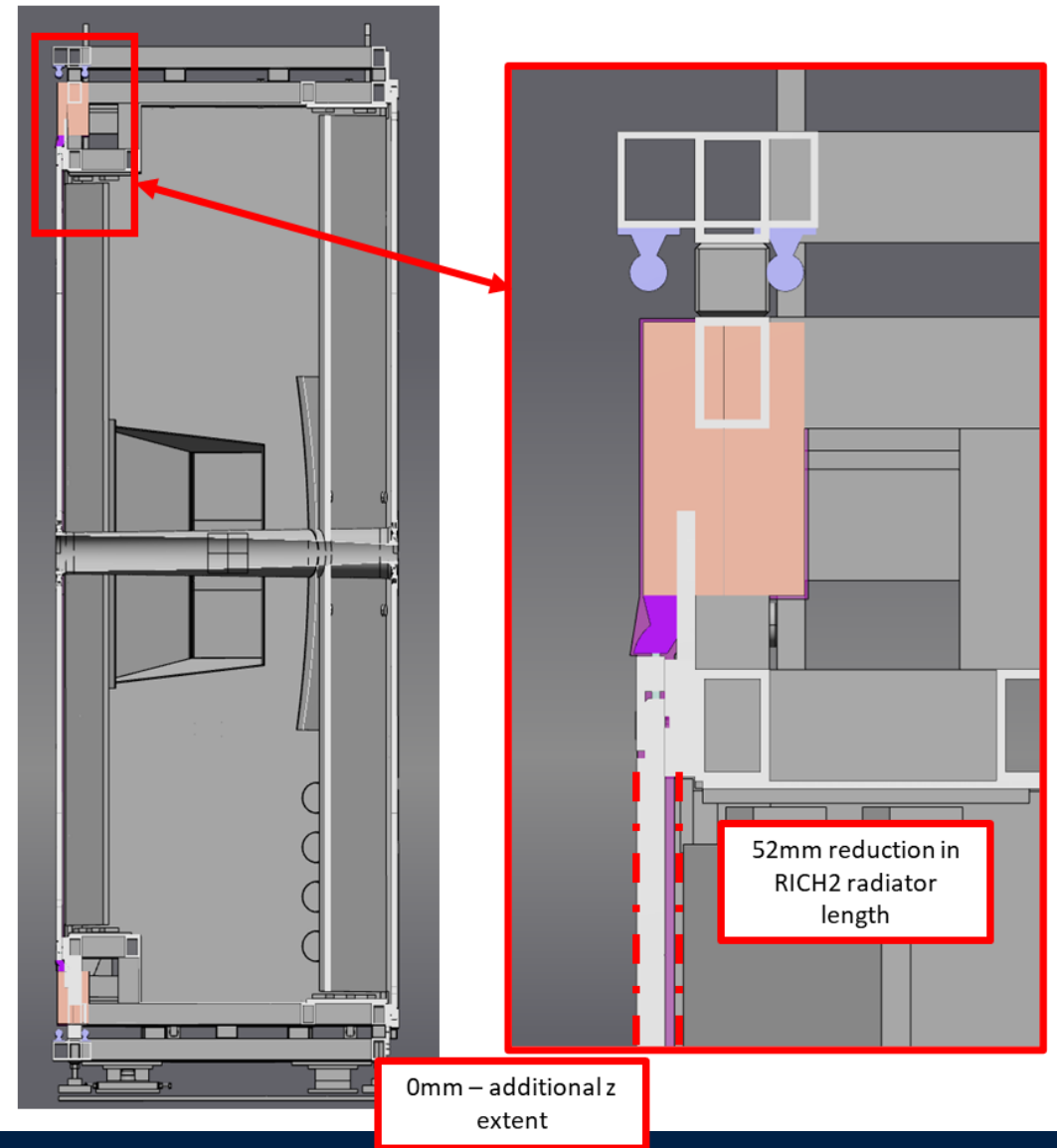
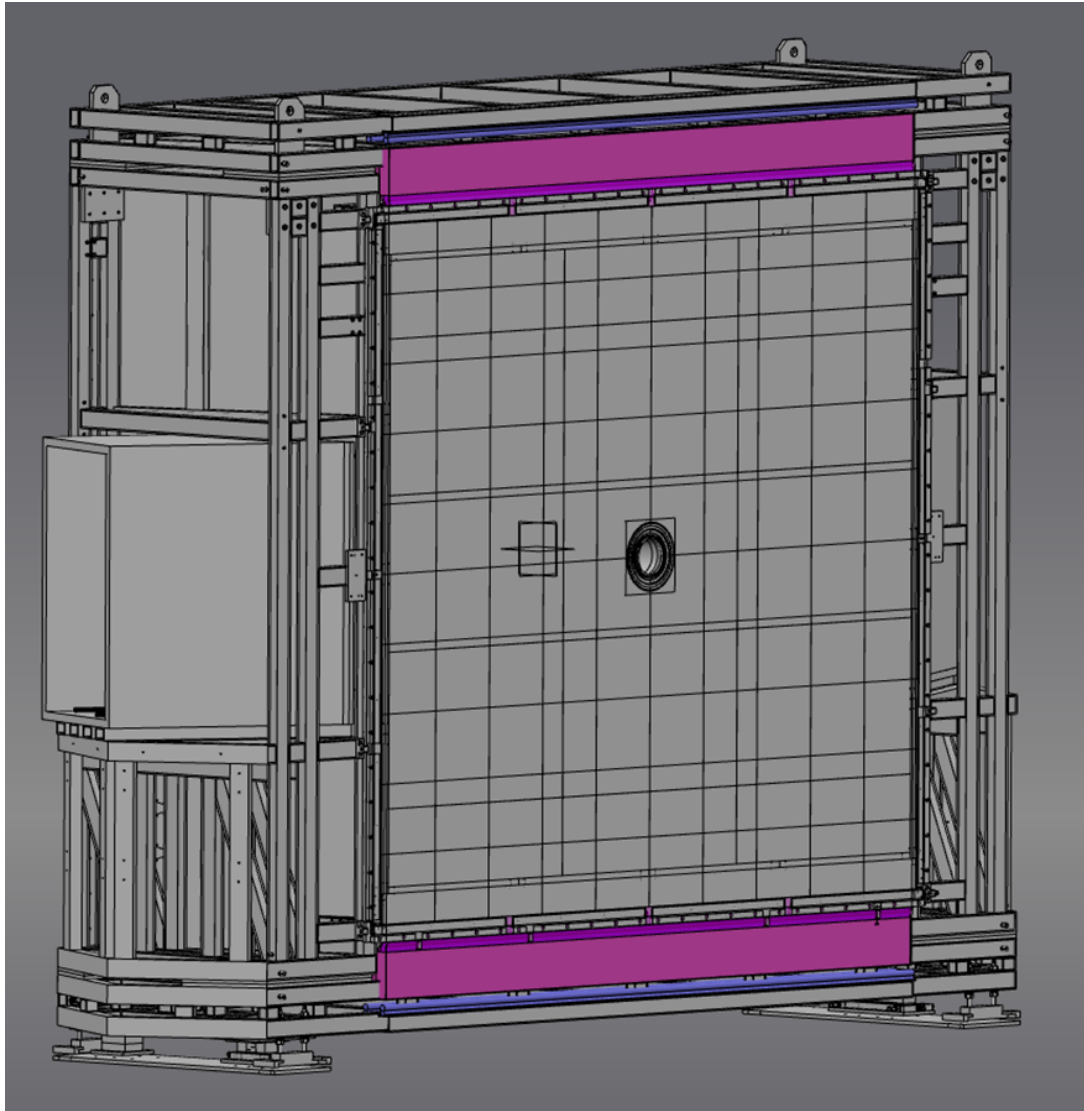
Could we package in 50mm inside the detector acceptance?

NB: This is an aggressive redesign of the focus to make the packing as small as possible.

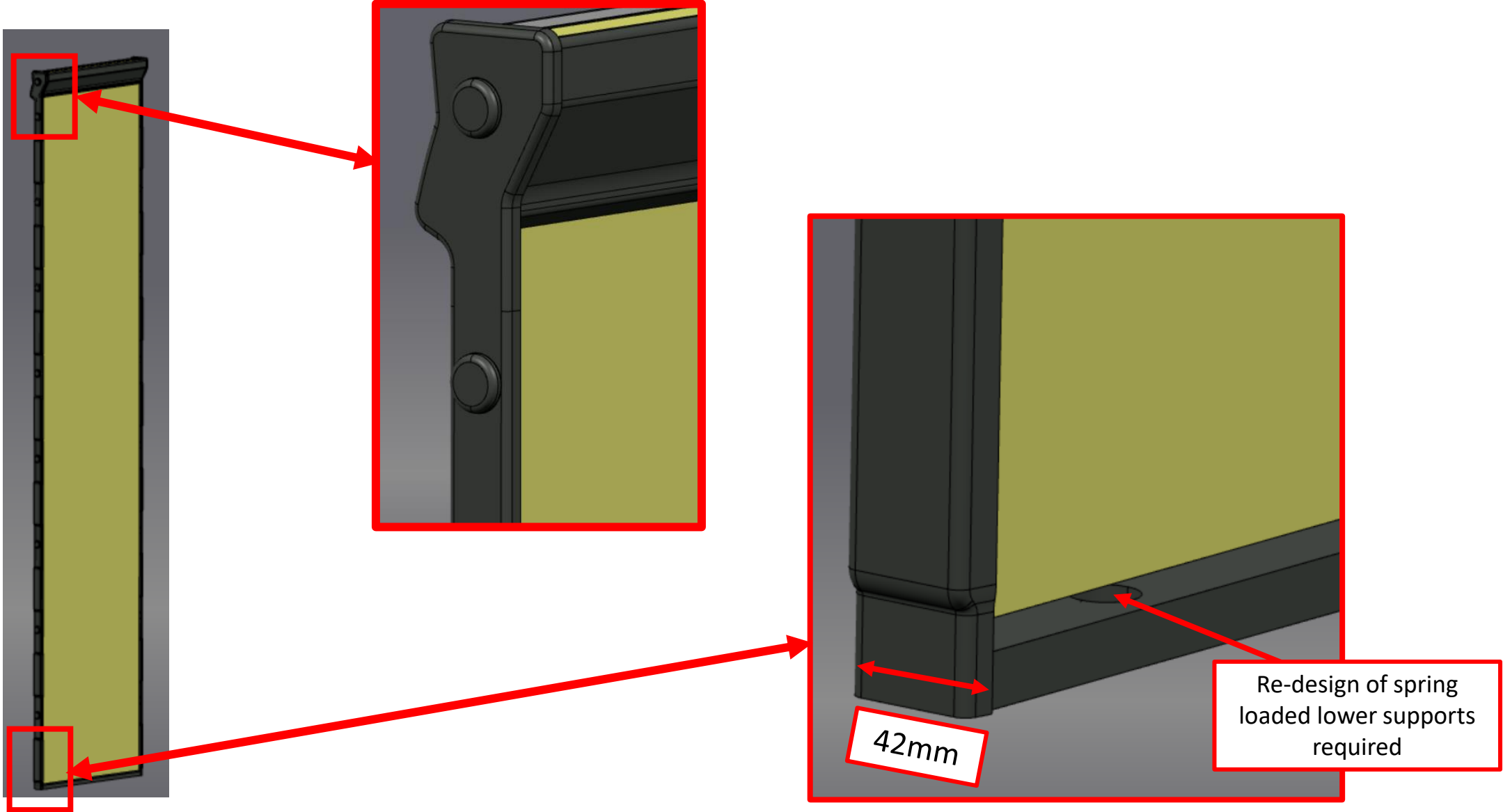
RICH2/TORCH Integration – Integration Strategies

- ⚙️ Several different TORCH design strategies have been investigated;
 - ⚙️ Minimal/Zero RICH2 Impact (at the expense of additional Z-volume); **RULED OUT**
 - ⚙️ Zero additional Z-volume (at the expense of RICH2 structure); **Preferred**
 - ⚙️ Halfway house requiring minimised compromise from both RICH2 and Sci-Fi; **RULED OUT**
 - ⚙️ Differing electronic layouts for all of the above options; **Under - Consideration**

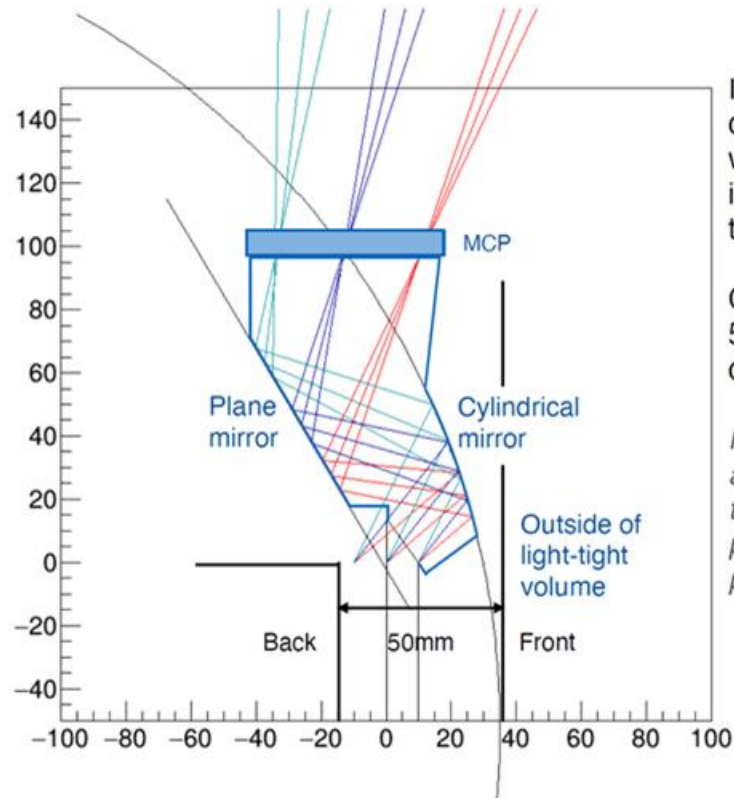
RICH2/TORCH Integration – **PREFERRED SOLUTION – 1b)**



RICH2/TORCH Integration – Advancing the TORCH Frame



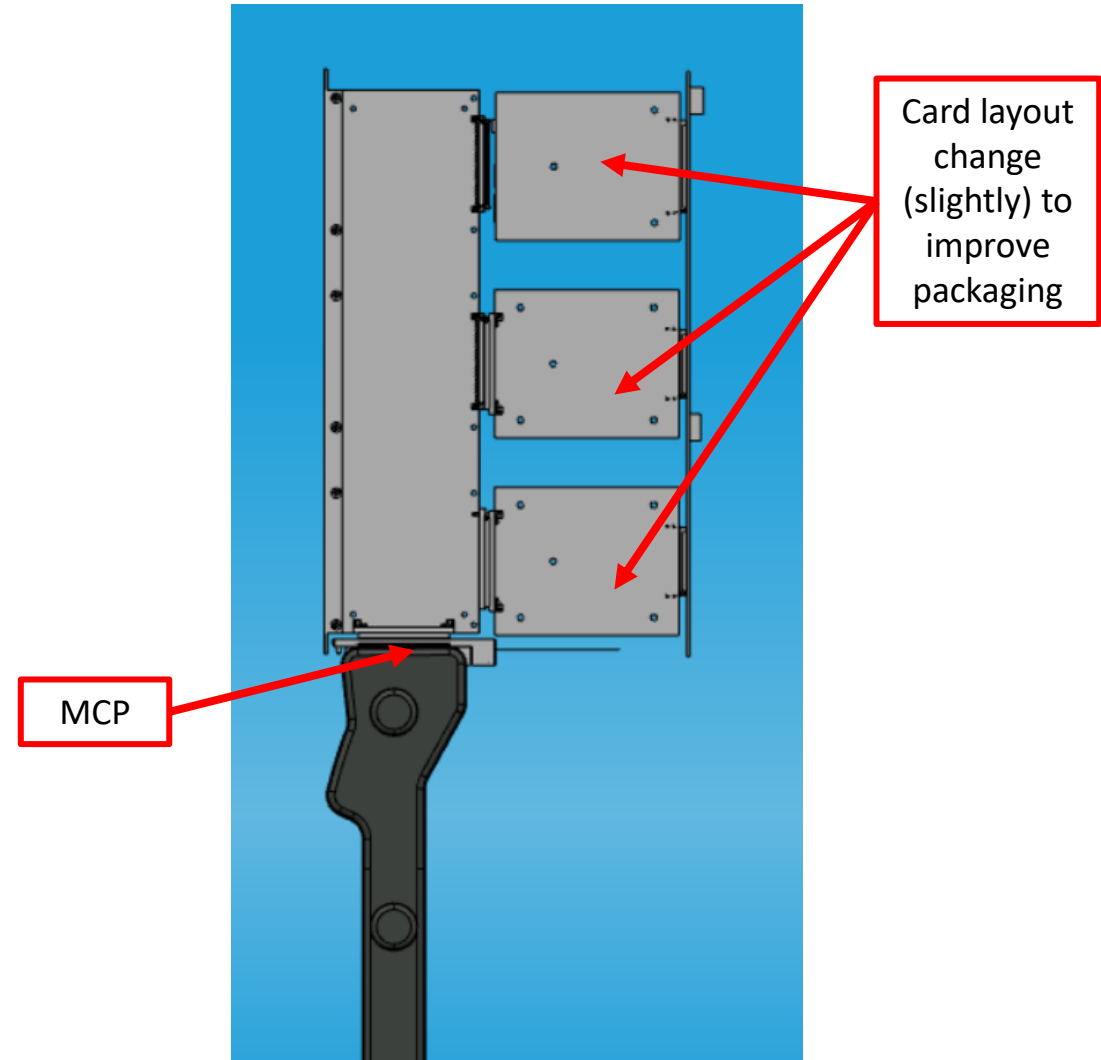
RICH2/TORCH Integration – Adapting the Electronics



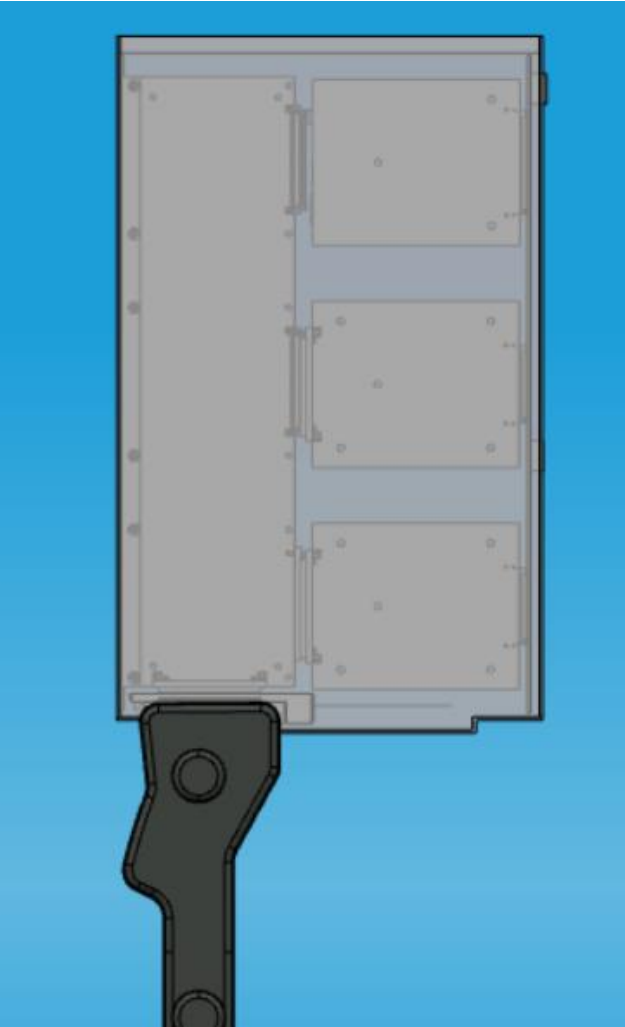
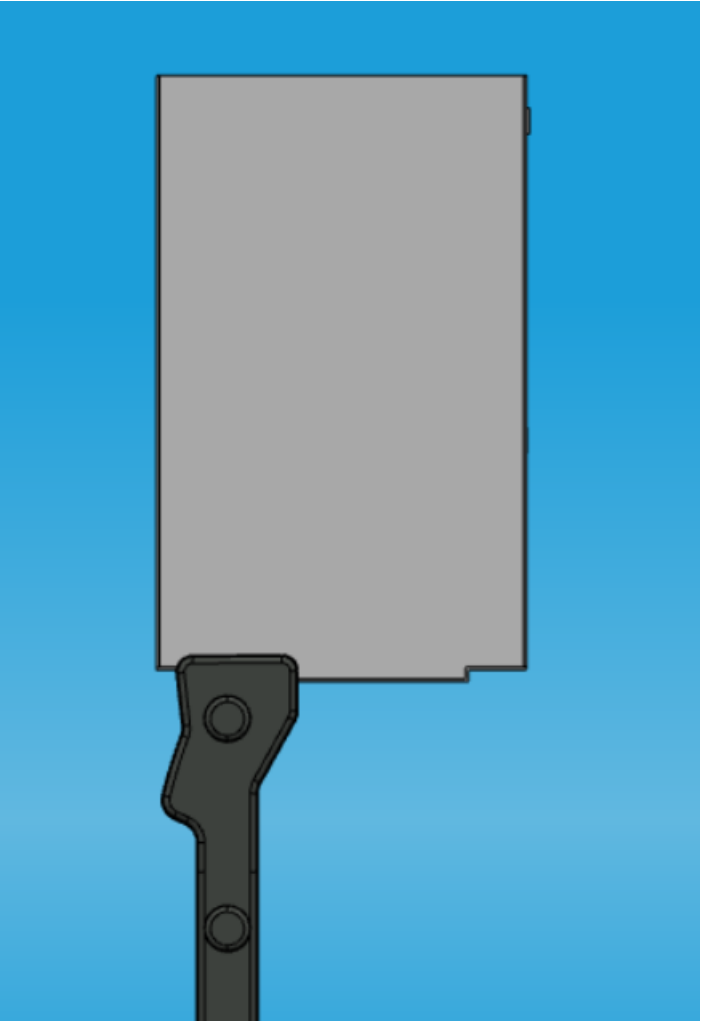
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Could we package in 50mm inside the detector acceptance?

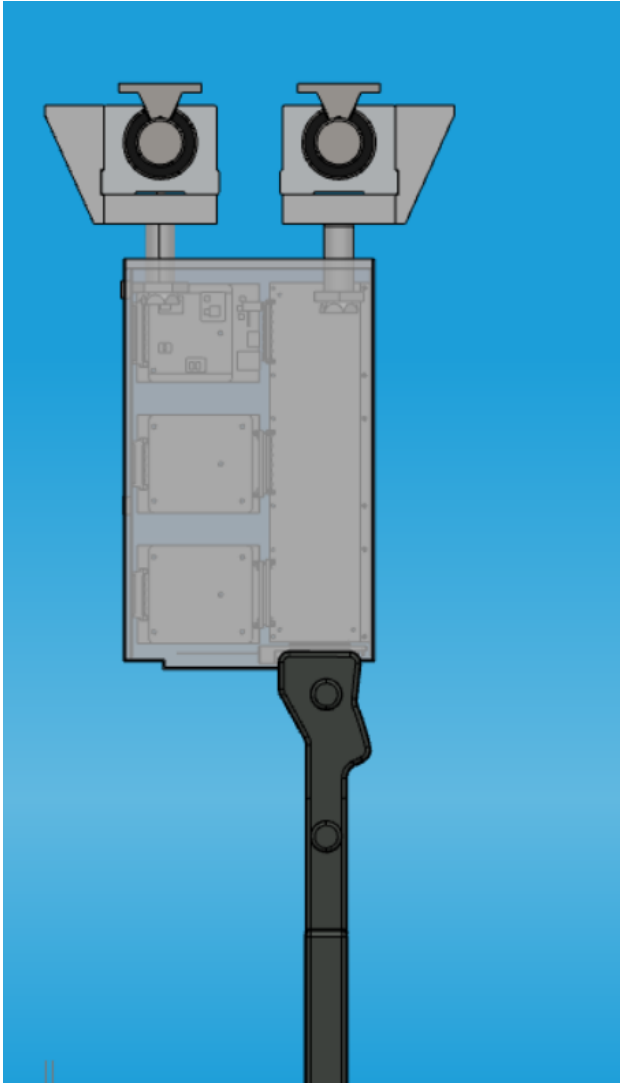
NB: This is an aggressive redesign of the focus to make the packing as small as possible.



RICH2/TORCH Integration – Assuming an Electronics Housing

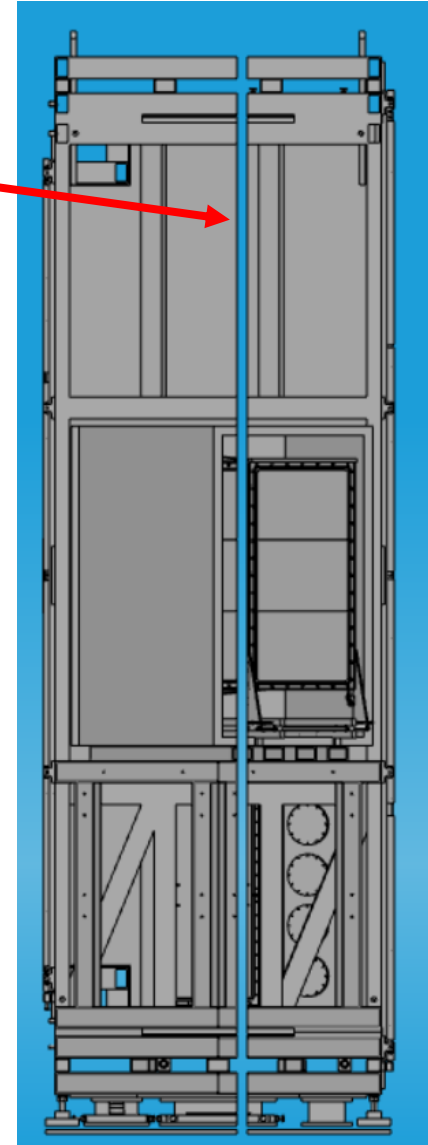
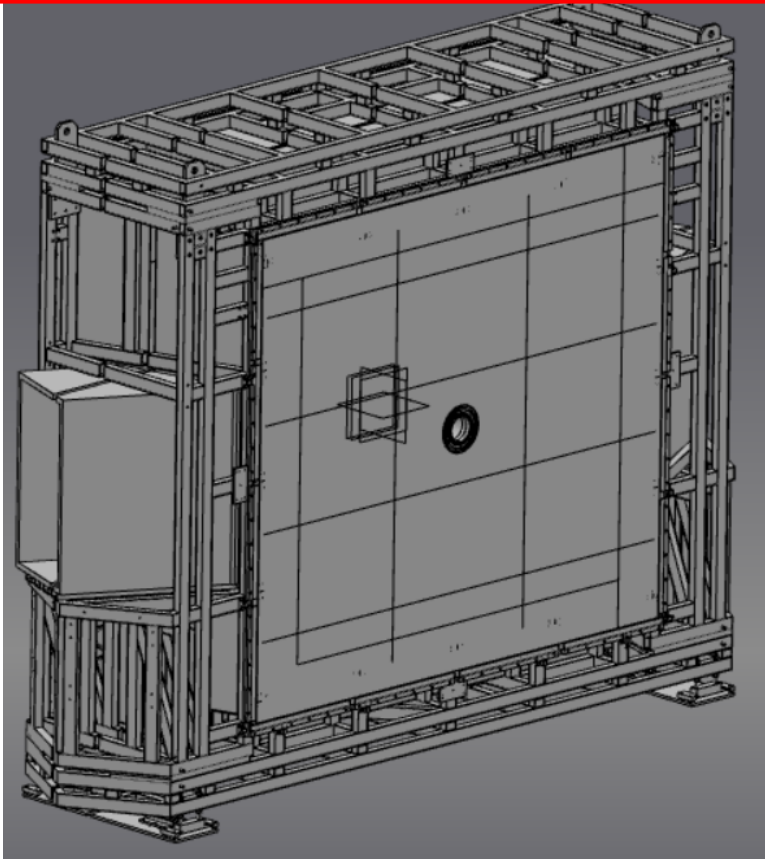


RICH2/TORCH Integration – Repurposing current TORCH mount

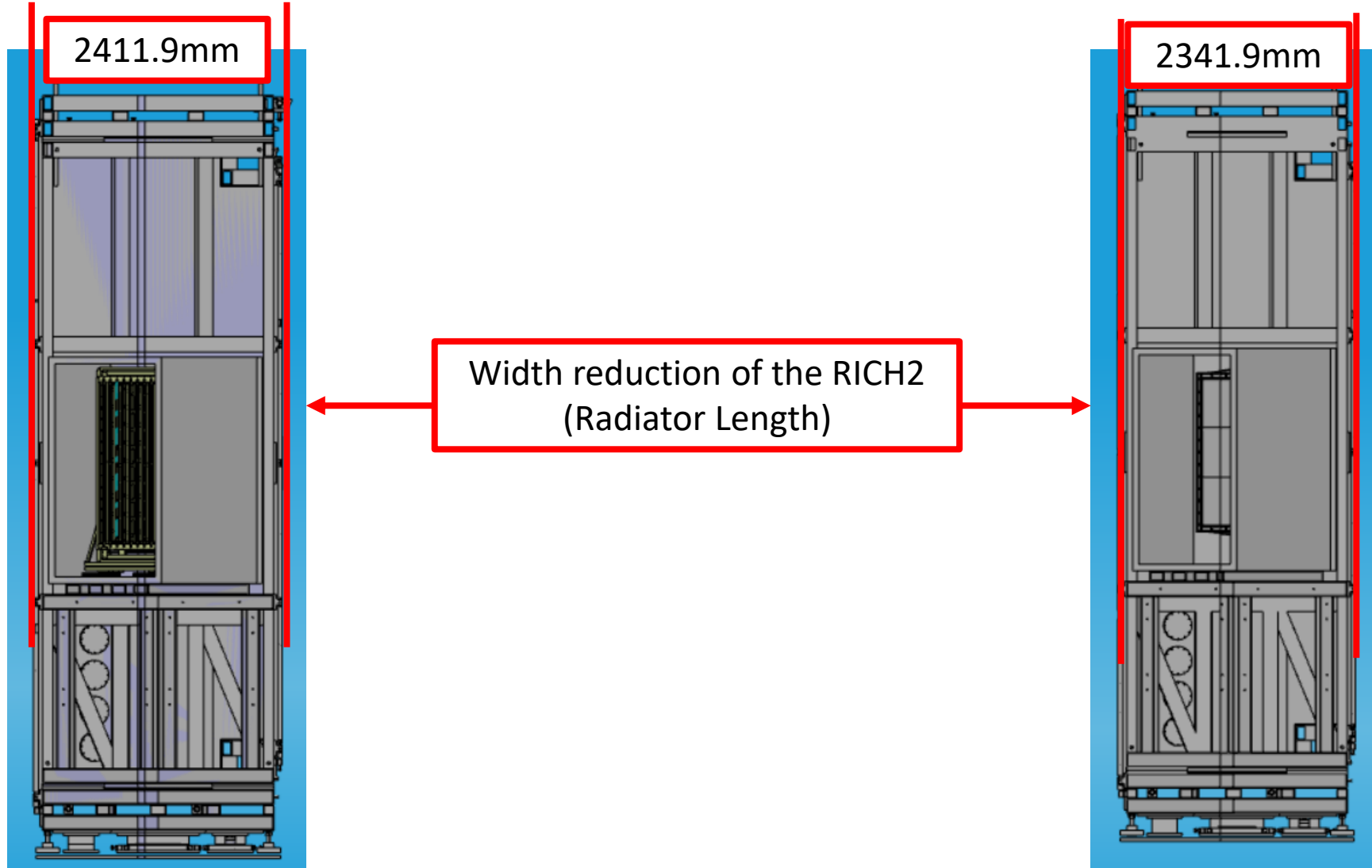


RICH2/TORCH Integration – RICH2 Radiator Length Reduction

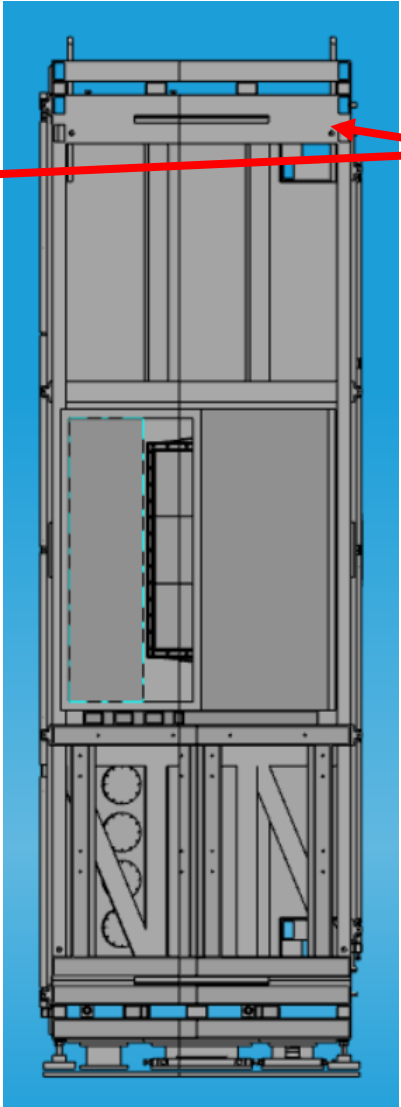
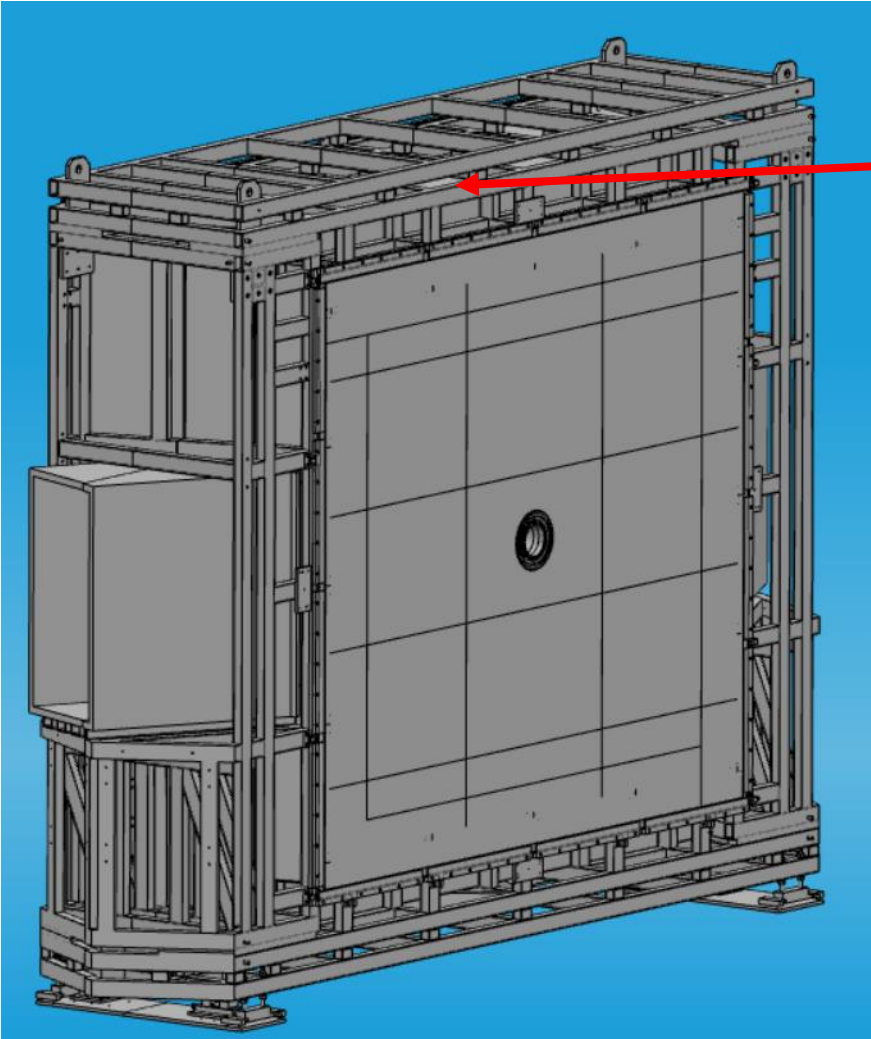
Suggestion would be to remove ~70mm from the centre of the RICH chamber/structure and 'stitch back together' from a design point of view – **NOT LITERALLY!**



RICH2/TORCH Integration – RICH2 Radiator Length Reduction



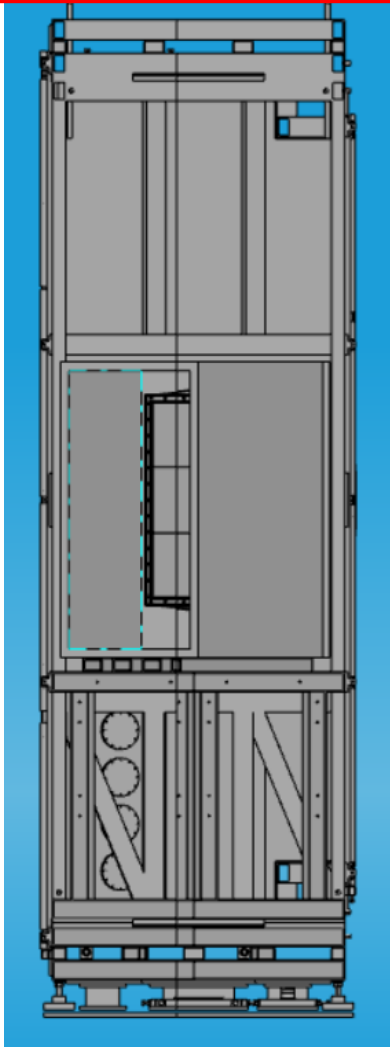
RICH2/TORCH Integration – RICH2 Frame Modification



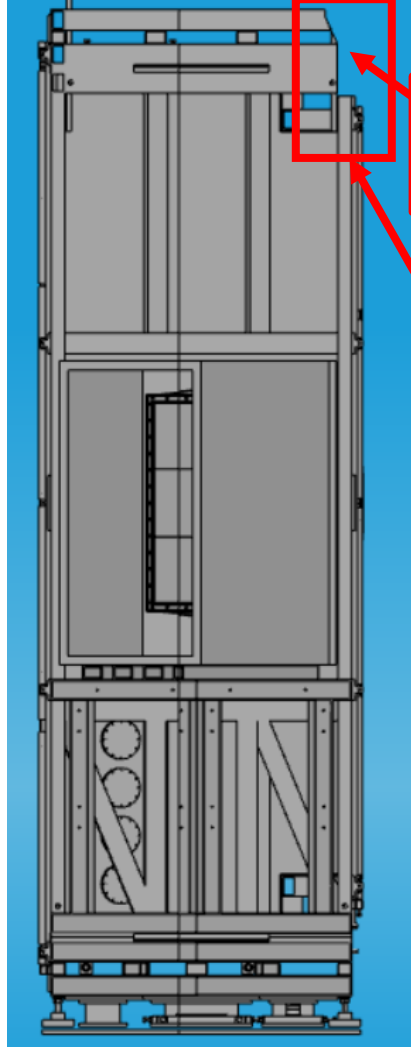
Electronics need space here

RICH2/TORCH Integration – RICH2 Frame Modification

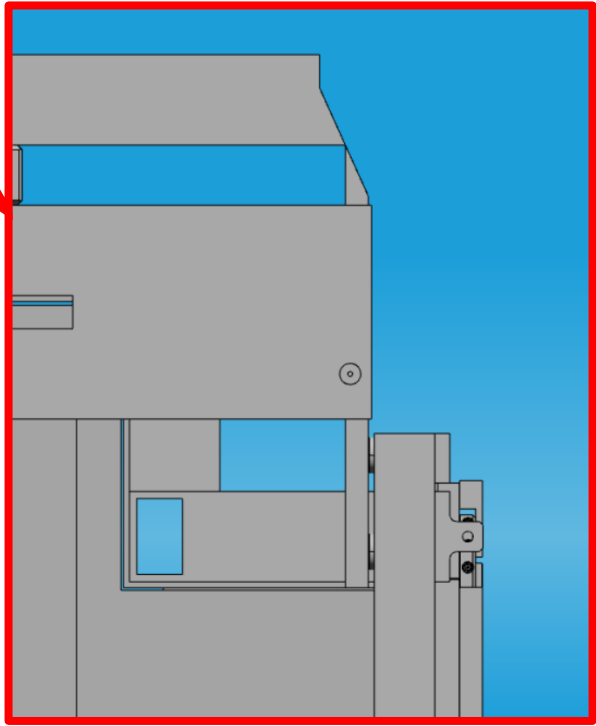
Without mat removal



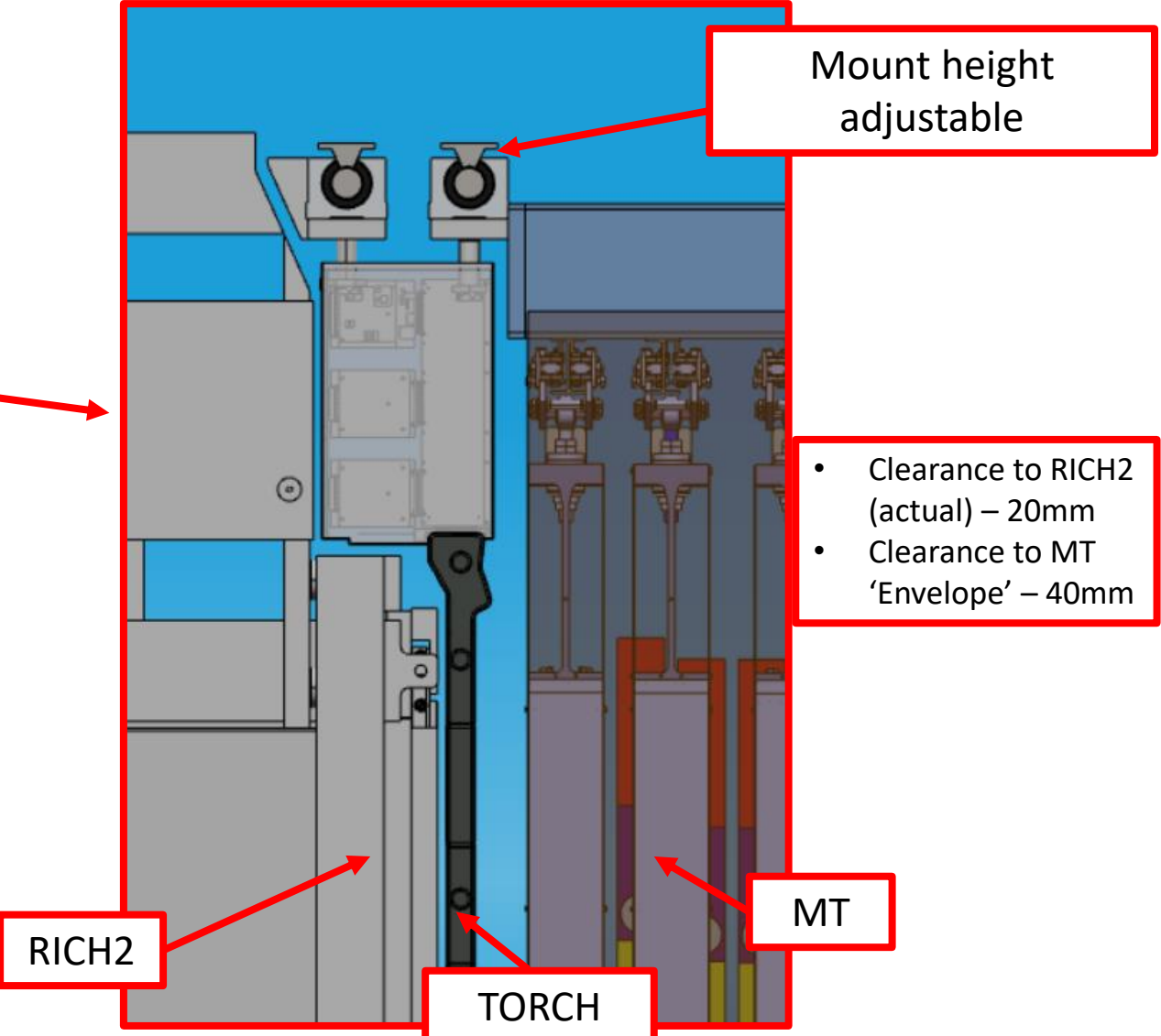
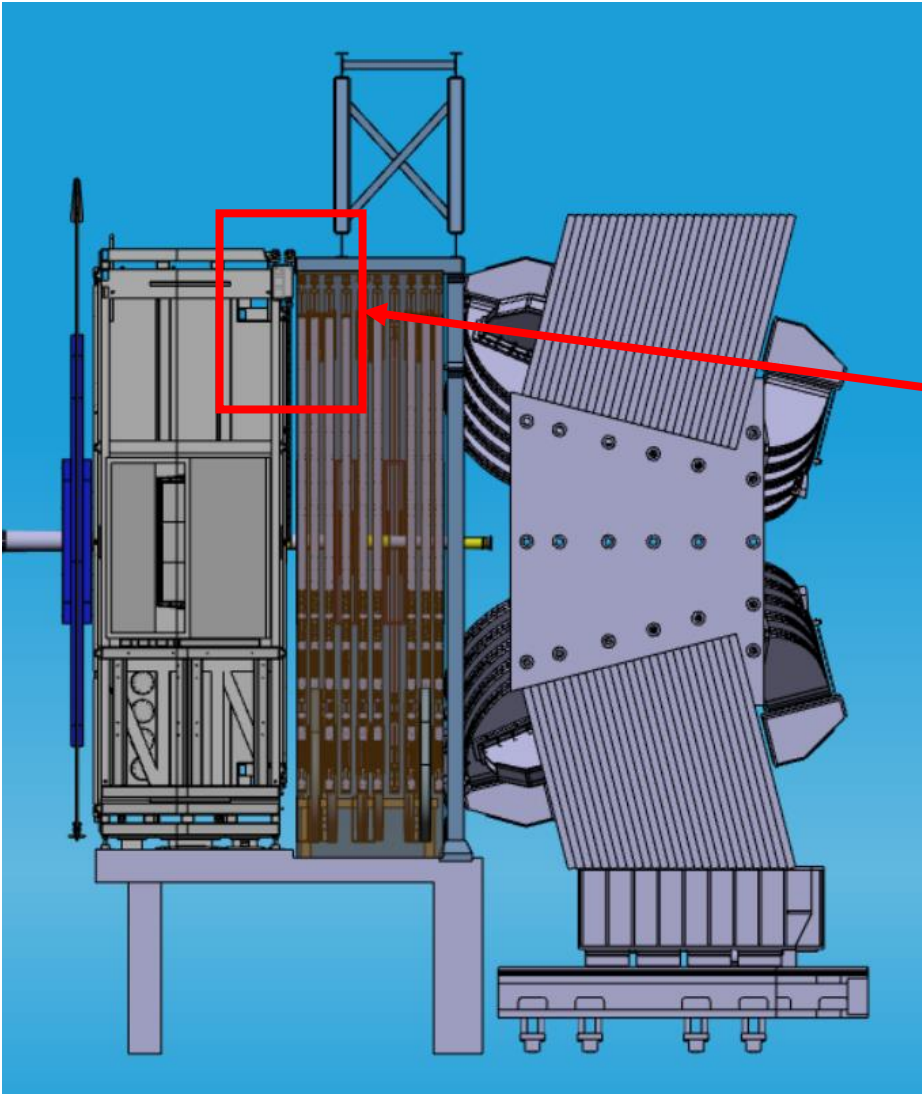
With mat removal



~180mm
recess



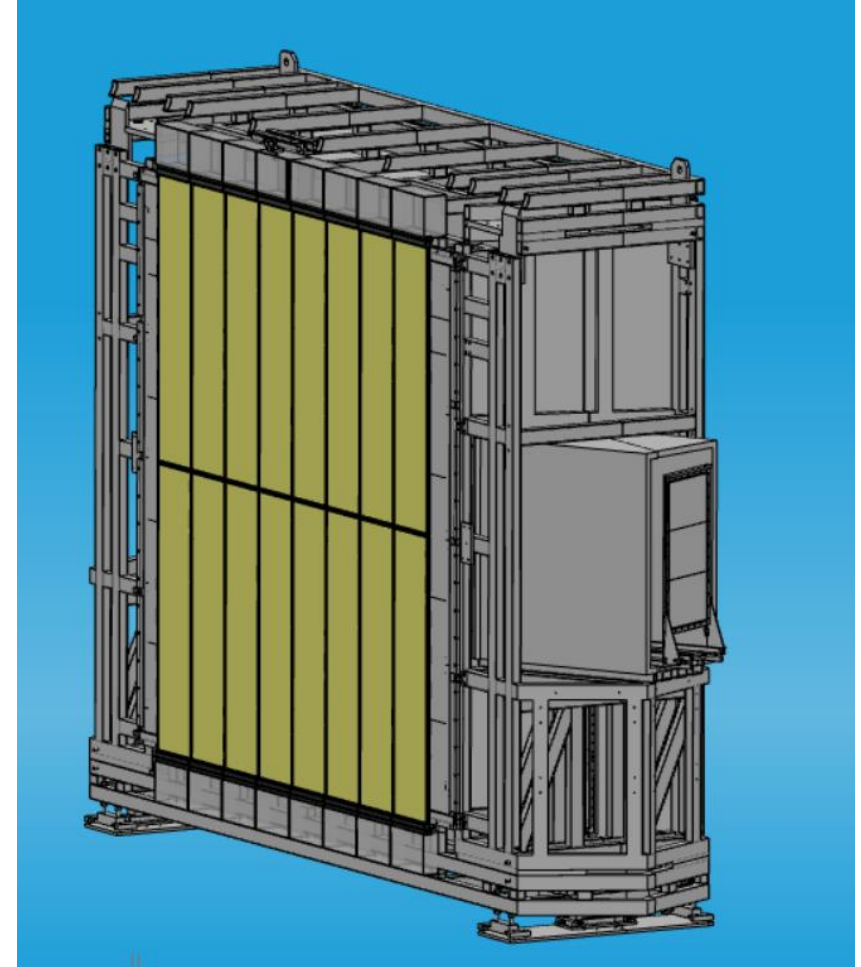
RICH2/TORCH Integration – All of this creates (just showing 1 upper TORCH module)....



RICH2/TORCH Integration – It looks ‘not impossible’ from a packaging point of view....

⚙️ Next Steps;

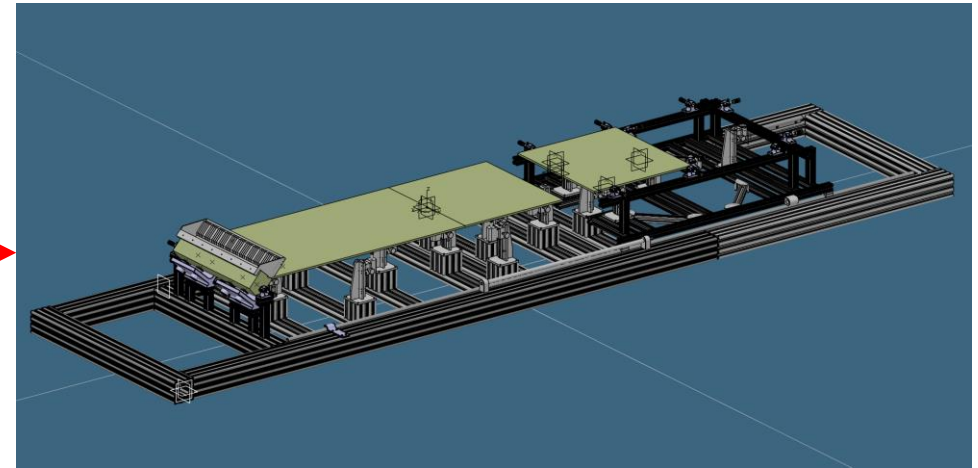
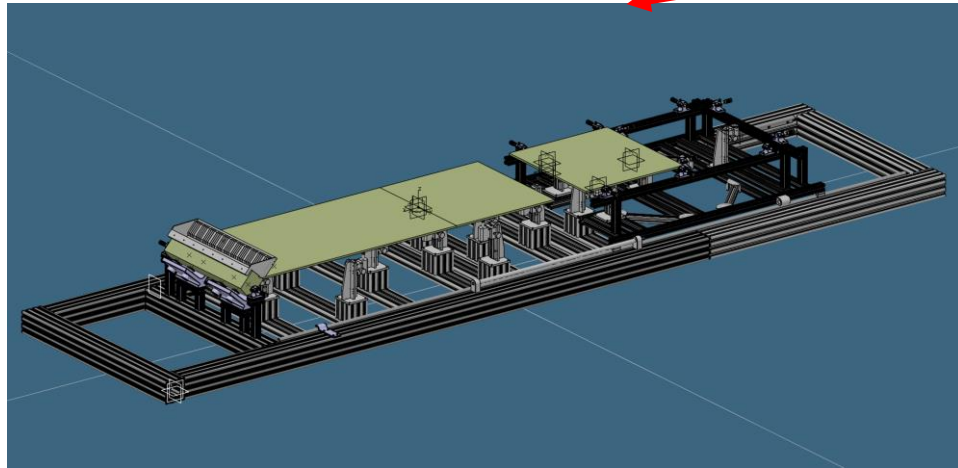
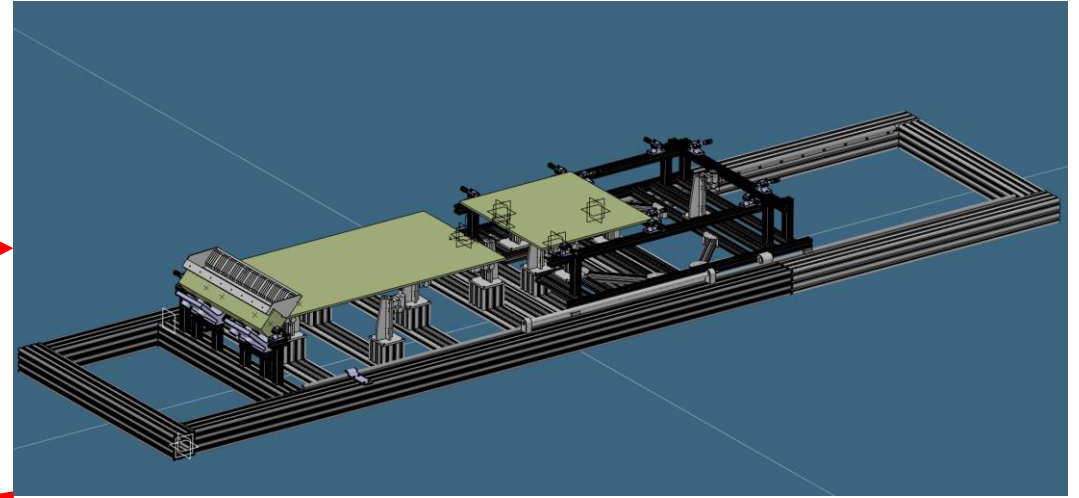
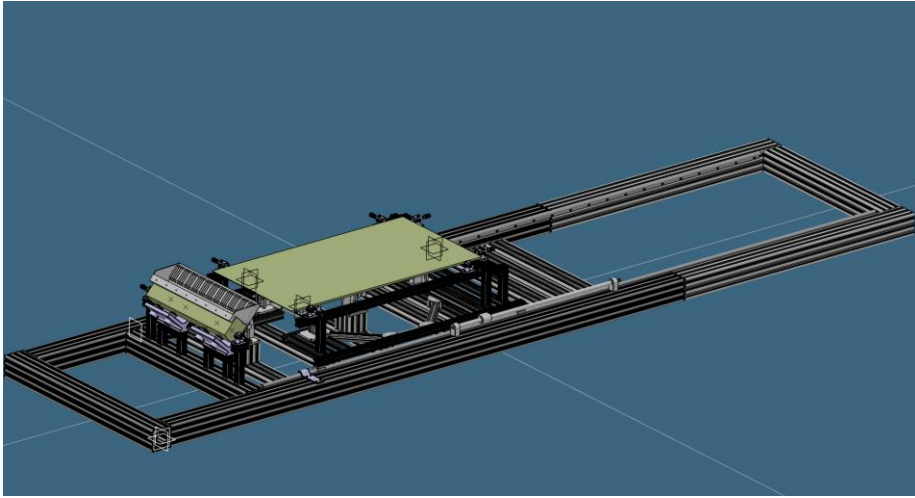
- ⚙️ Full detector design;
- ⚙️ Beampipe clearance consideration;
- ⚙️ Module Integration;
- ⚙️ Further evolve design with RICH2 and MT team to identify where there may be space issues.



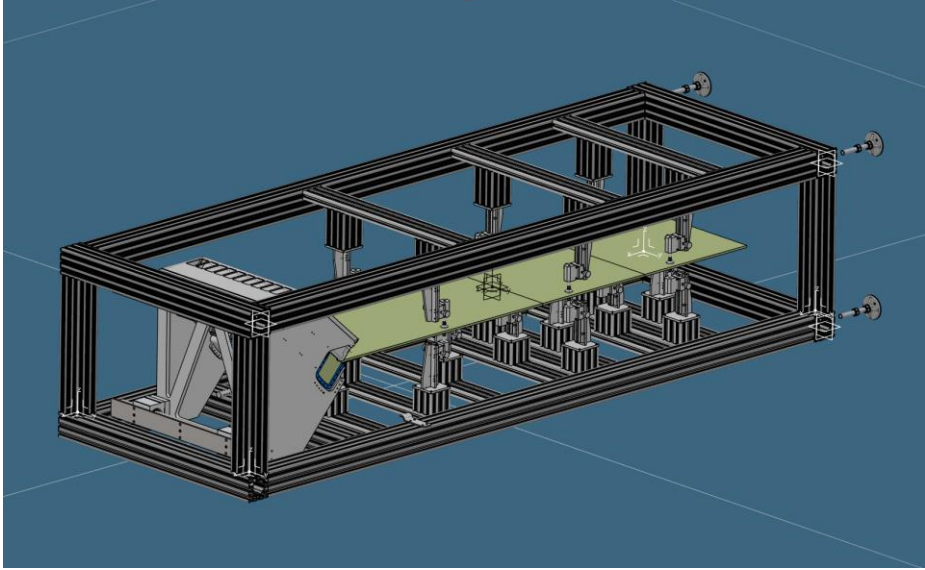
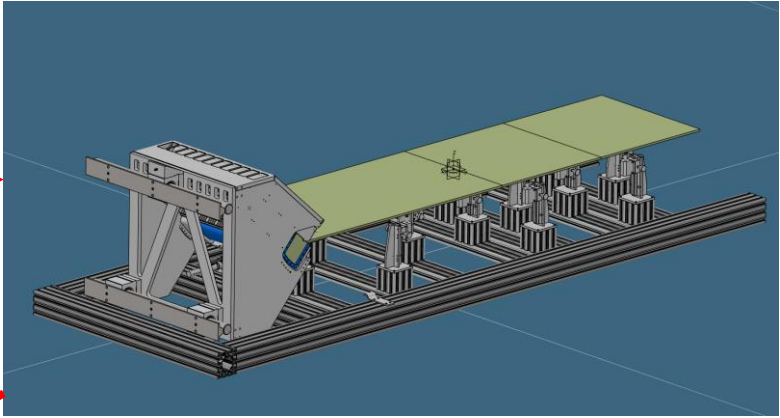
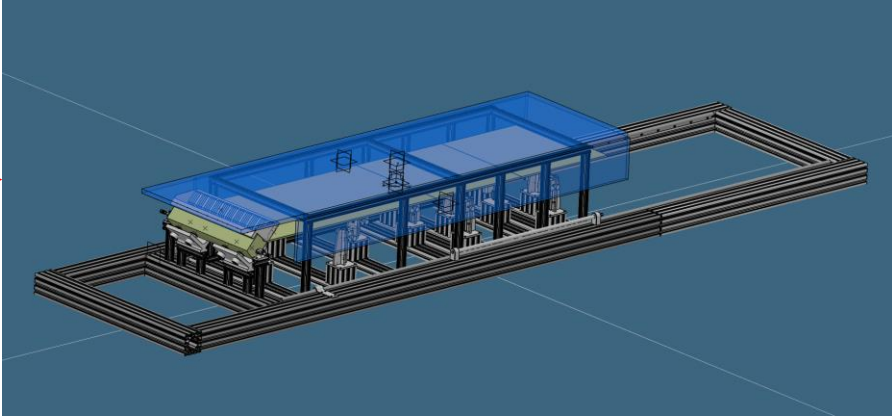
BACK UP



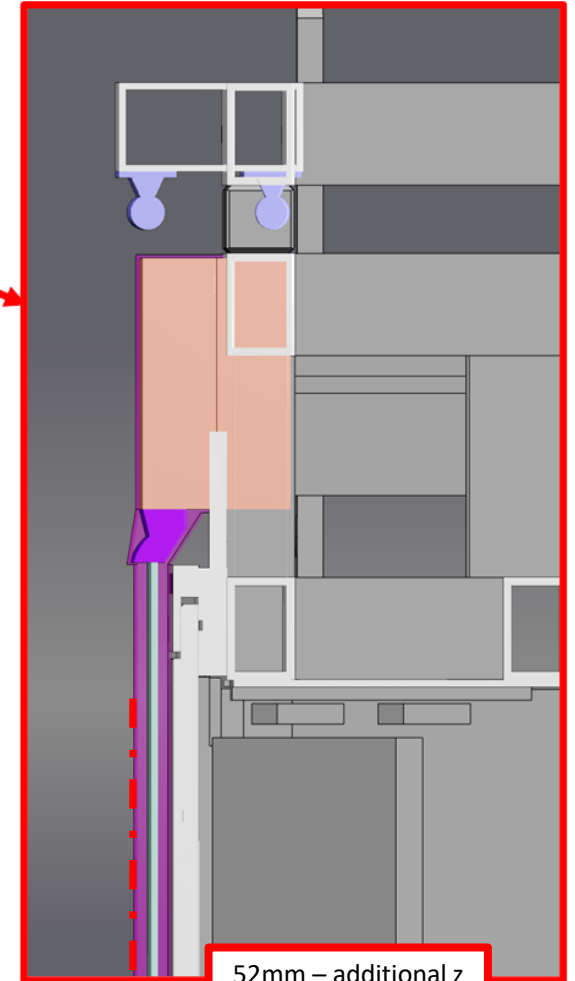
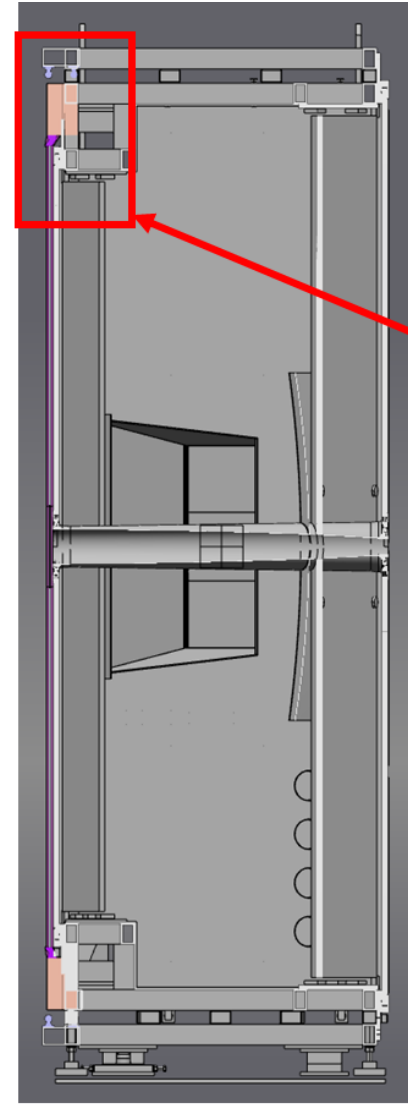
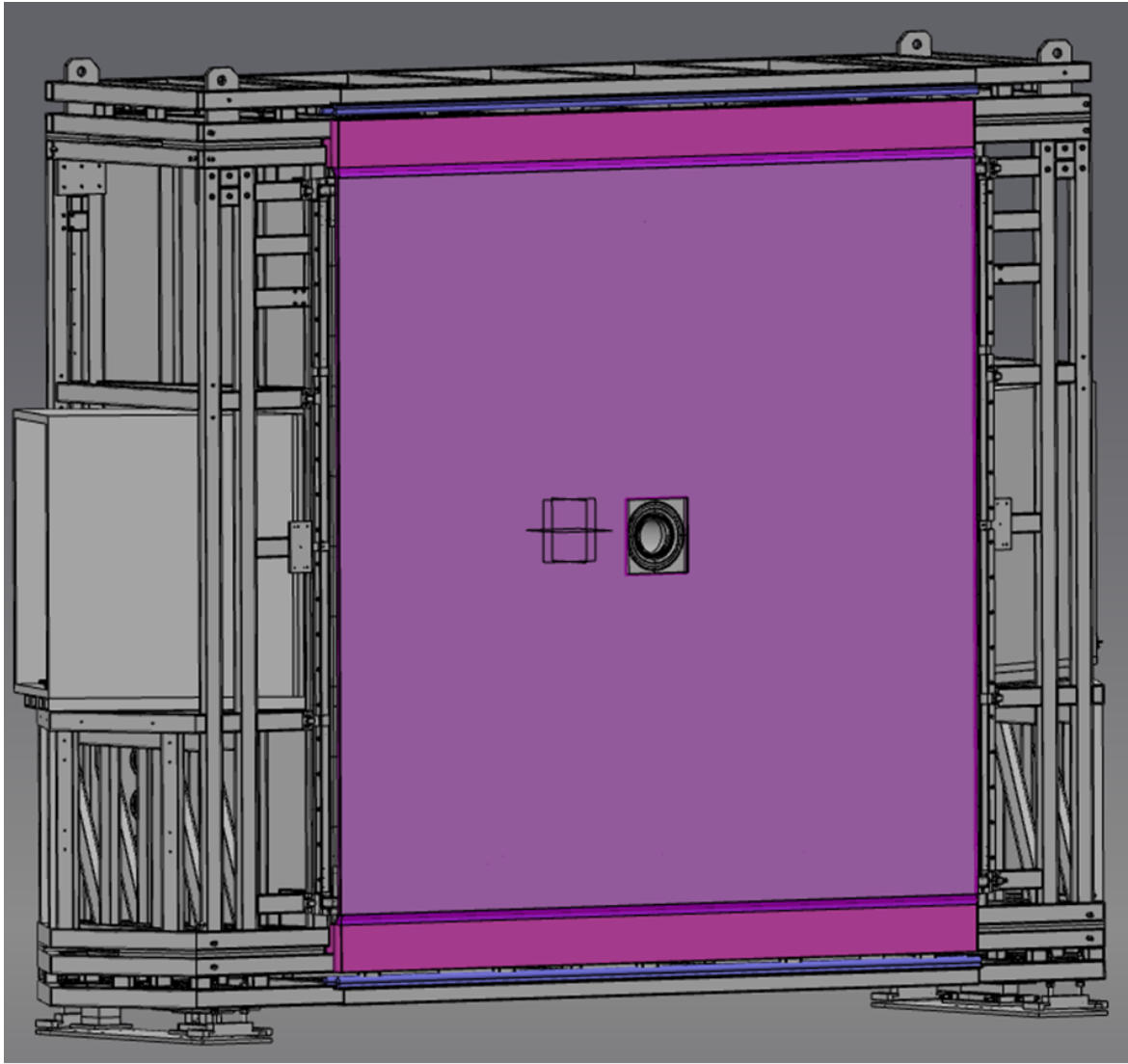
Bond Jig and Exo-Skeleton



Bond Jig and Exo-Skeleton

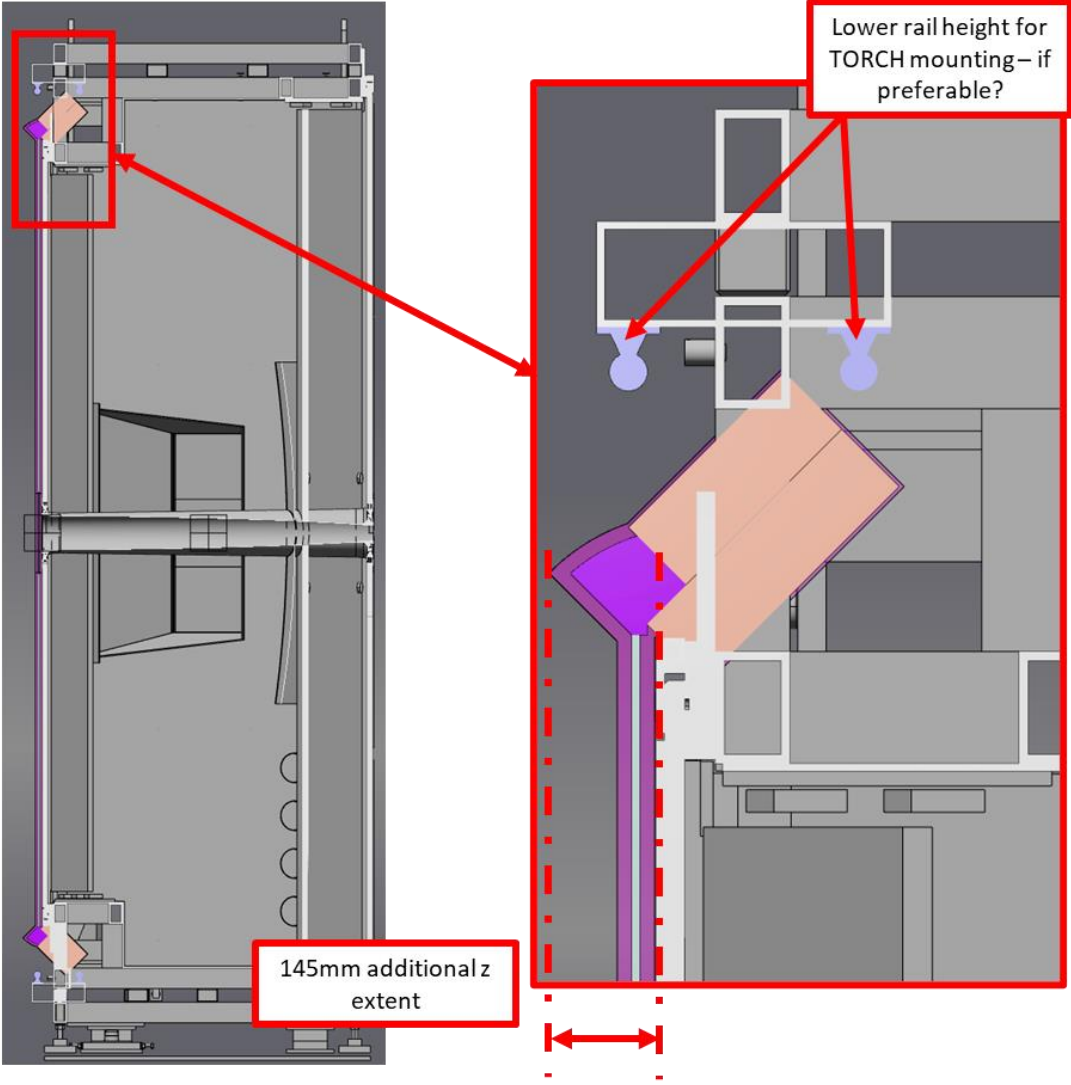
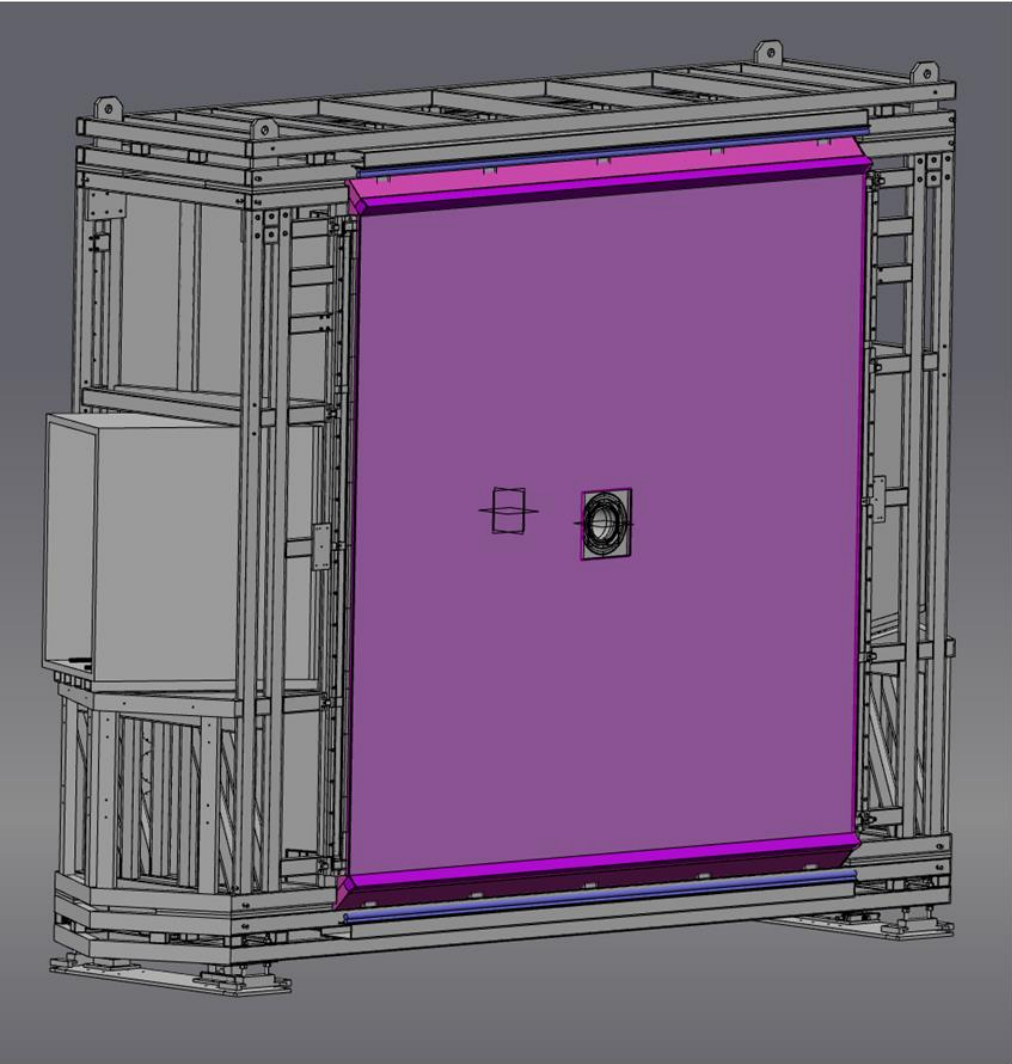


RICH2/TORCH Integration – Option 1a) Minimal RICH2 Impact



52mm – additional z extent

RICH2/TORCH Integration – Option 2a) Minimal RICH2 Impact (Angled Electronics)



RICH2/TORCH Integration – Option 2b) Minimal RICH2 Rad Length Reduction (Angled Electronics)

