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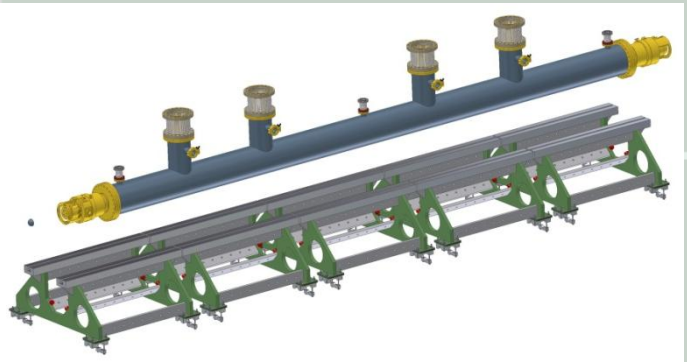
FETS Meeting @ RAL

MEBT Assembly

Support frames, vacuum manifold and assembly

By Peter Savage

3rd July 2013



Contents

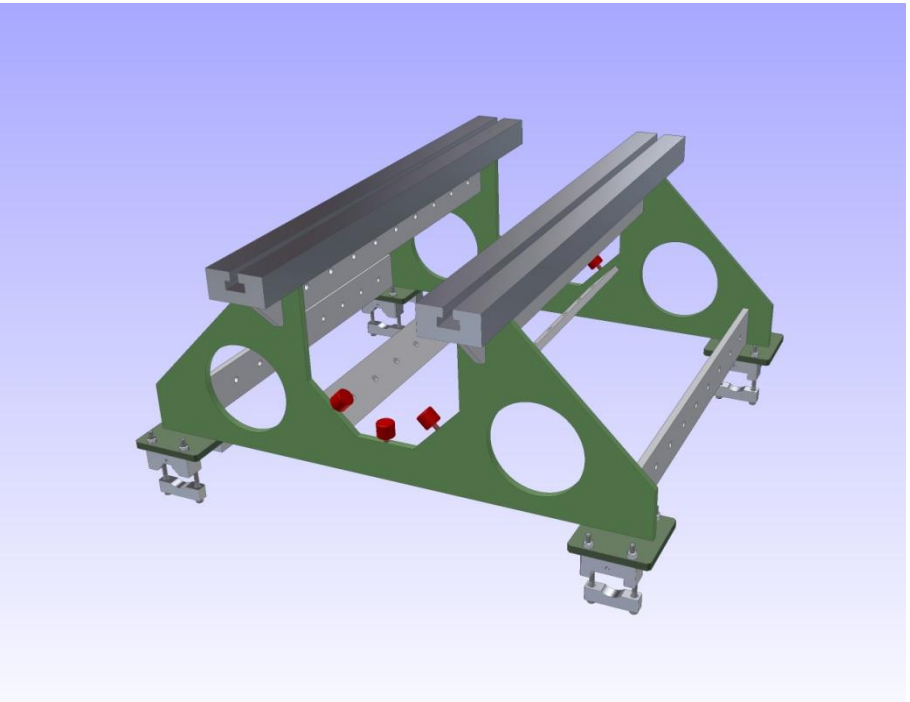
- MEBT support frames
- Vacuum manifold
- MEBT assembly
- MEBT including laser diagnostics

The following images are intended to show the **CONCEPT** only. Please ignore missing bolts, components floating in mid-air, component clashes etc.

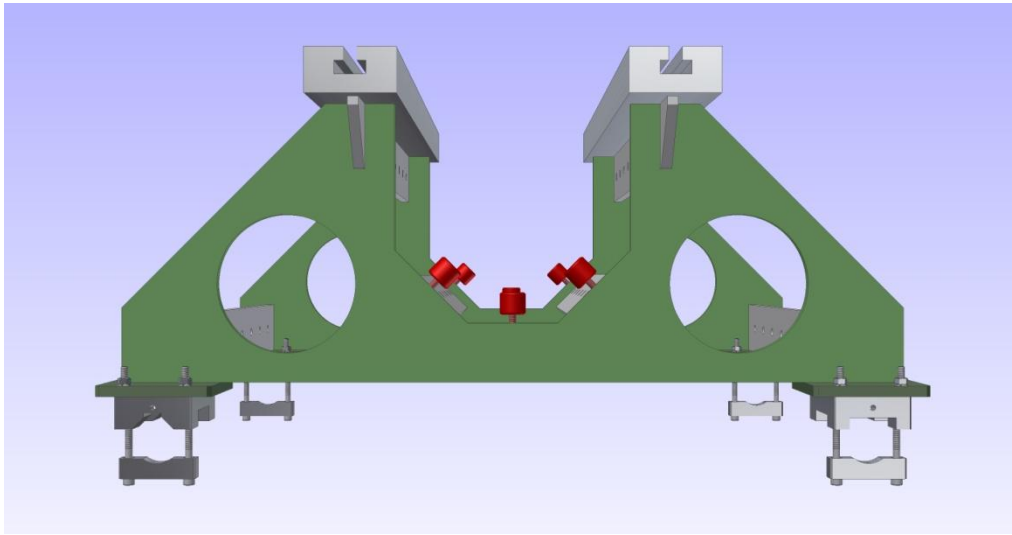
Contents

- **MEBT support frames**
- Vacuum manifold
- MEBT assembly
- MEBT including laser diagnostics

MEBT support frame



The MEBT support frame is a welded mild steel assembly that is approximately one metre long. It's transverse U-shaped profile accepts the vacuum manifold. The lack of high level cross bracing allows for **any** MEBT component spacing and hence will accommodate either the 3 or the 4 rebunching cavity lattice.



Key features:

Flatness: of the top faces

Slot parallelism: to the beam axis

Slot spacing: from the beam axis

Equal Height: to each other

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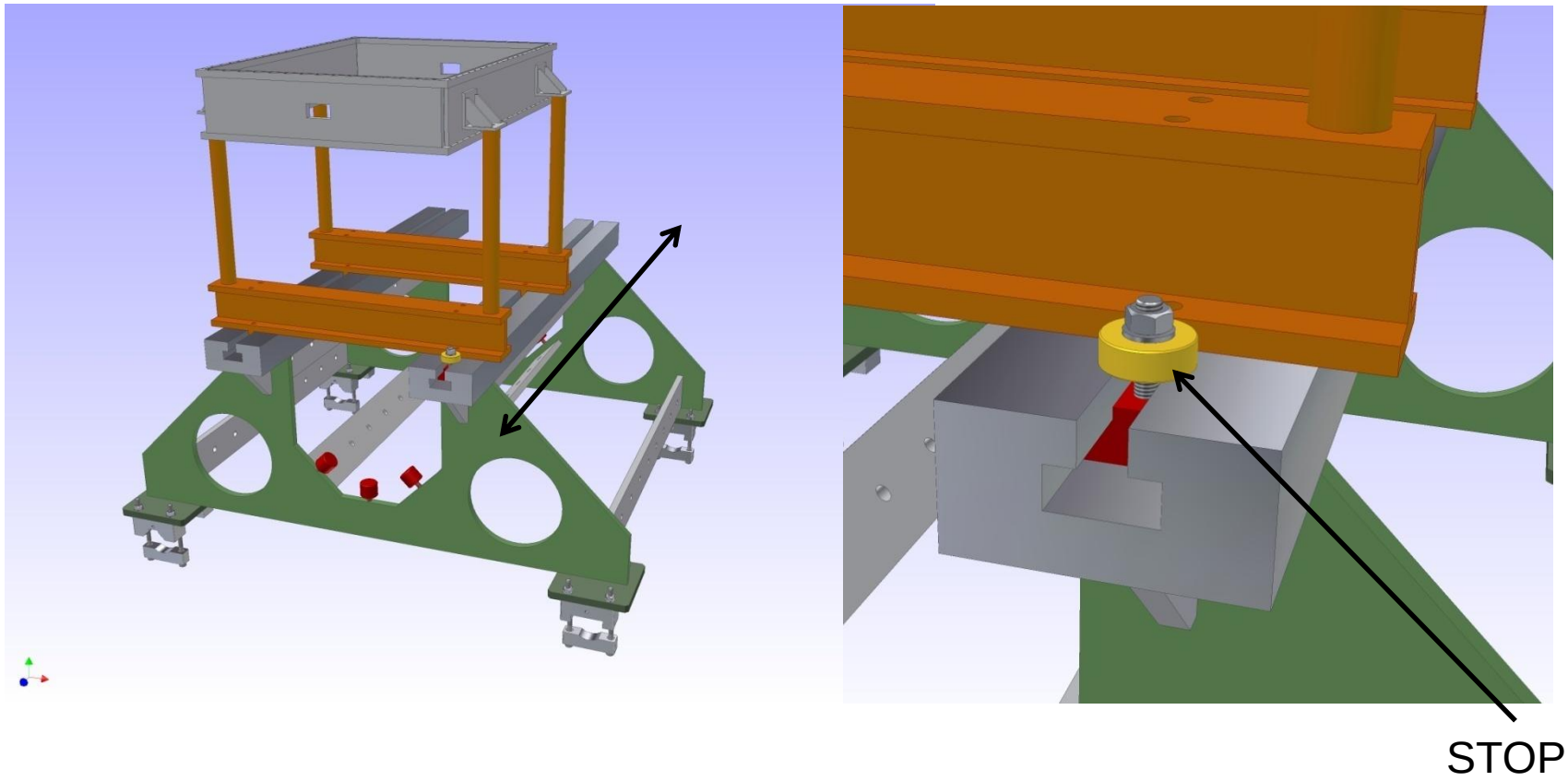
Showing T-slot concept

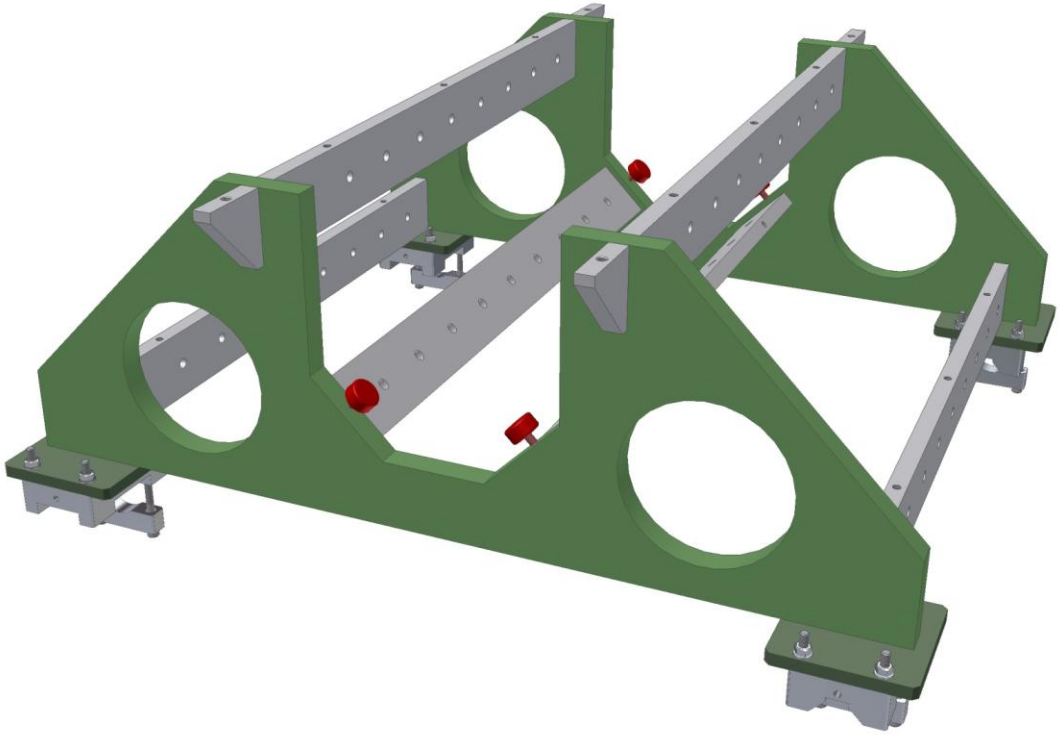


•MEBT components can occupy any longitudinal position

•Allows the same frame to be used for both 3xRBC and 4xRBC MEBT schemes

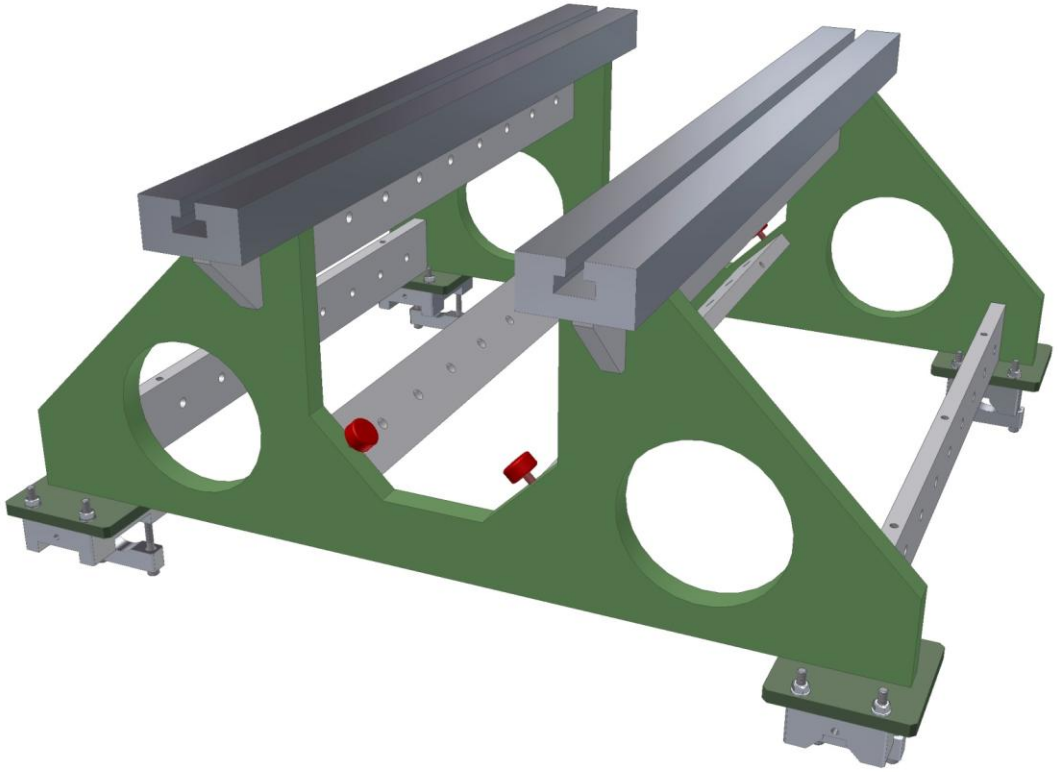
•Finalised positions are marked by simple ‘stops’, allowing component removal and replacement without realignment.

MEBT support frame



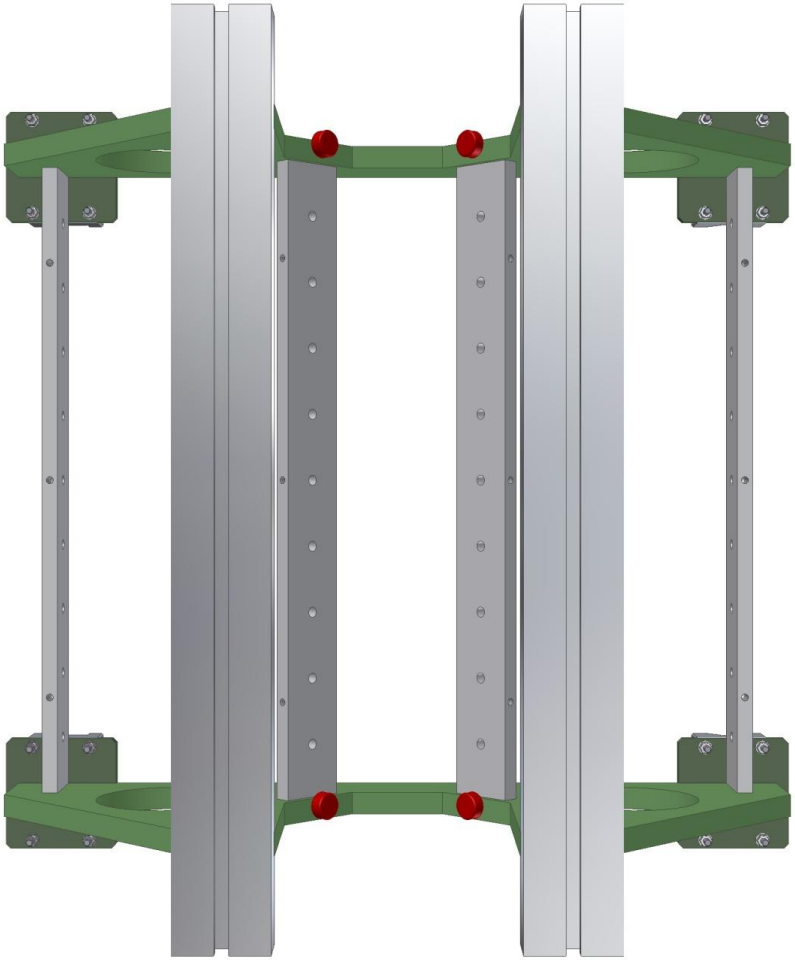
After the assembly has been welded the feet and top will be skimmed to gain the required flatness.
Then the top spars will be accurately drilled for the T-slot rail mounting.

MEBT support frame



The T-slot rails will be added and aligned parallel to each other and with the correct separation before being bolted tight. A simple jig will help with this operation. Finally the feet will be attached and aligned w.r.t. to the T-slot rails.

MEBT support frame



The plan view shows the off-the-shelf adjustable rubber feet that the vacuum manifold will sit on.

Contents

- MEBT support frames
- **Vacuum manifold**
- MEBT assembly
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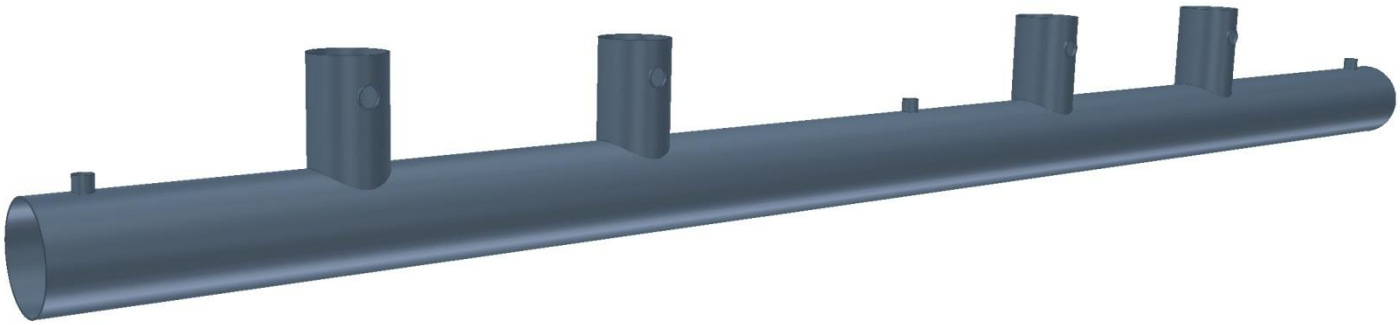
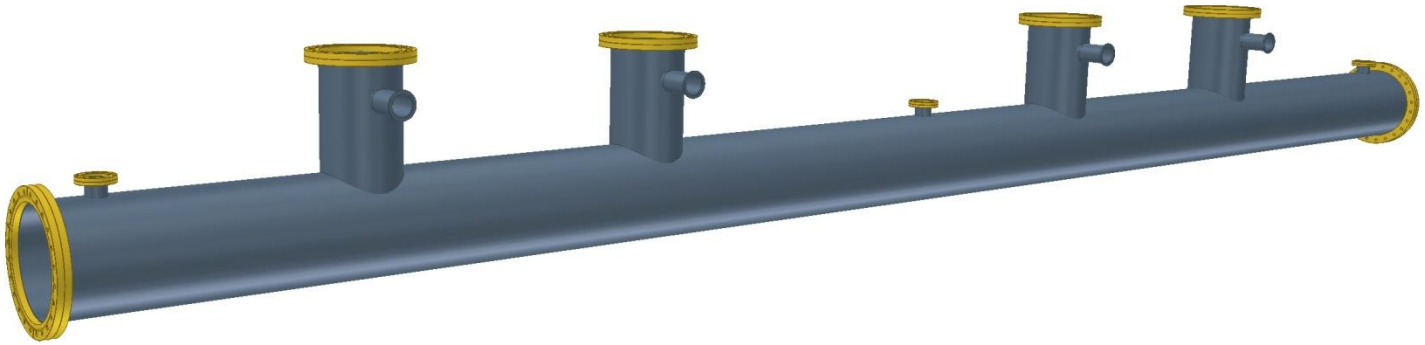
MEBT vacuum manifold



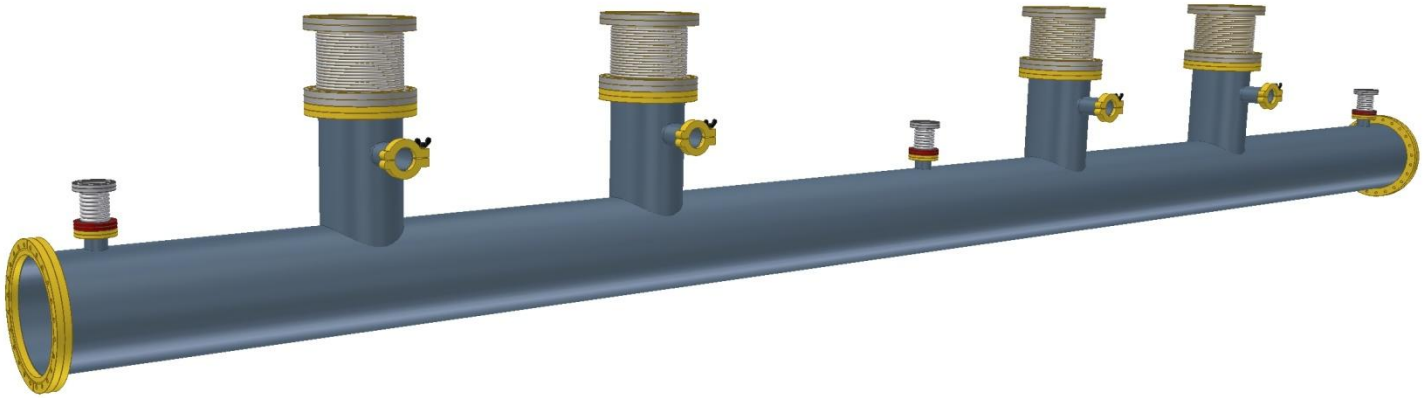
At its core the MEBT vacuum manifold is a long (~4.5m) DN200CF stainless steel tube. To one side of this tube are welded 4 x DN160CF tubes which align with the choppers and chopper beam dumps and 3 x DN40CF tubes which align with the rebunching cavities.

MEBT vacuum manifold



Next the DN200CF, DN160CF, DN40CF flanges are welded into position. I have also shown 4 x KF40 ports below the DN160CF flanges that could be used for vacuum measurement.

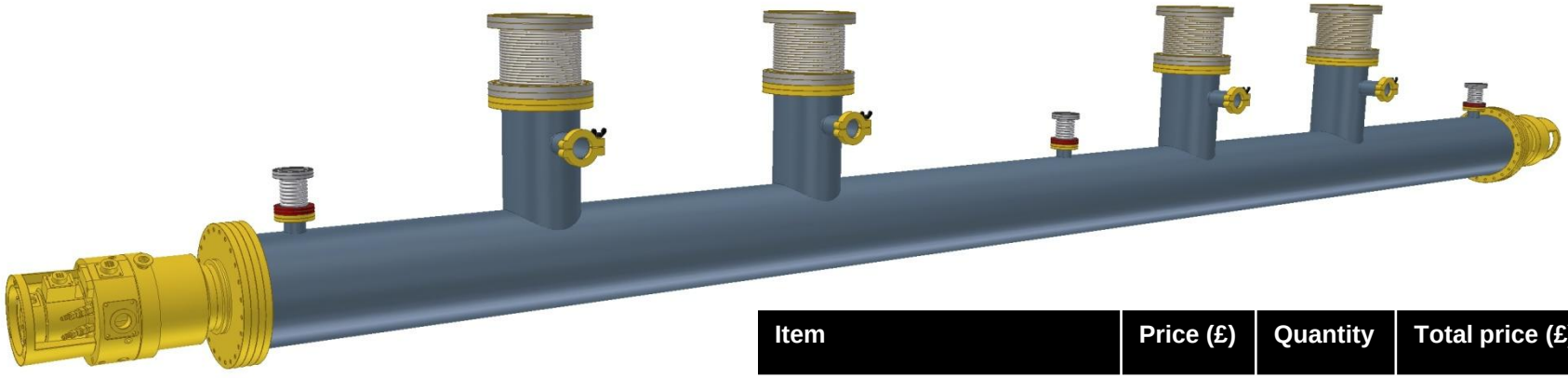
MEBT vacuum manifold



Next the bellows and KF40 flange blanks are fitted into position. Either the bellows are the manifold flanges will need to be rotatable. The bellows to be used are the hydro-formed type. They are cheaper and than the edge-welded type but will offer sufficient movement to compensate for manifold to MEBT component misalignment.

MEBT vacuum manifold

I have attempted to estimate the price of the manifold. The flange and bellows prices in the table are catalogue prices. An amount needs to be added for the fabrication of the tubes.



A reasonable estimate would be £5k. The pumps have already been purchased.

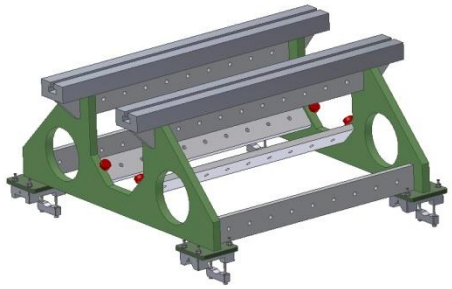
Item	Price (£)	Quantity	Total price (£)
DN160CF flanges	172	4	688
DN160CF bellows	420	4	1680
DN40CF flanges	22	3	66
DN40CF bellows	60	3	180
DN40KF clamps etc	20	4	80
DN200CF flanges	220	2	440
DN200CF converter flanges	300	2	600
	Total		3714

Contents

- MEBT support frames
- Vacuum manifold
- **MEBT assembly**
- MEBT including laser diagnostics

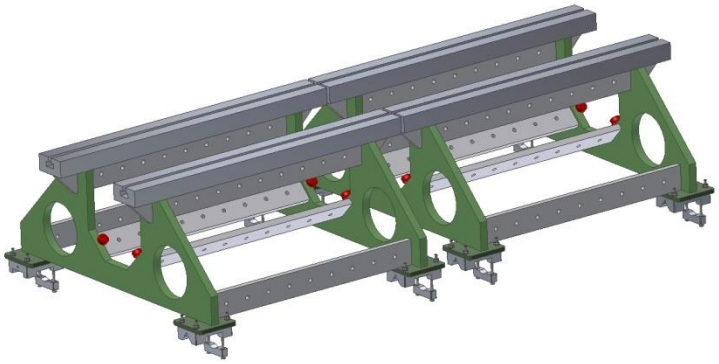
Assembling the MEBT.....

Each support frame should have the correct T-slot rail alignment and separation. Therefore each frame just needs to be added to the main FETS rails.

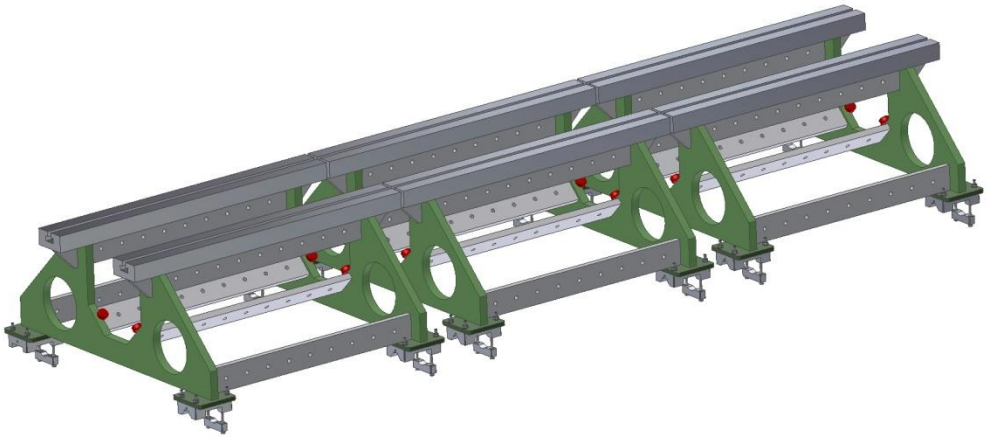


Assembling the MEBT.....

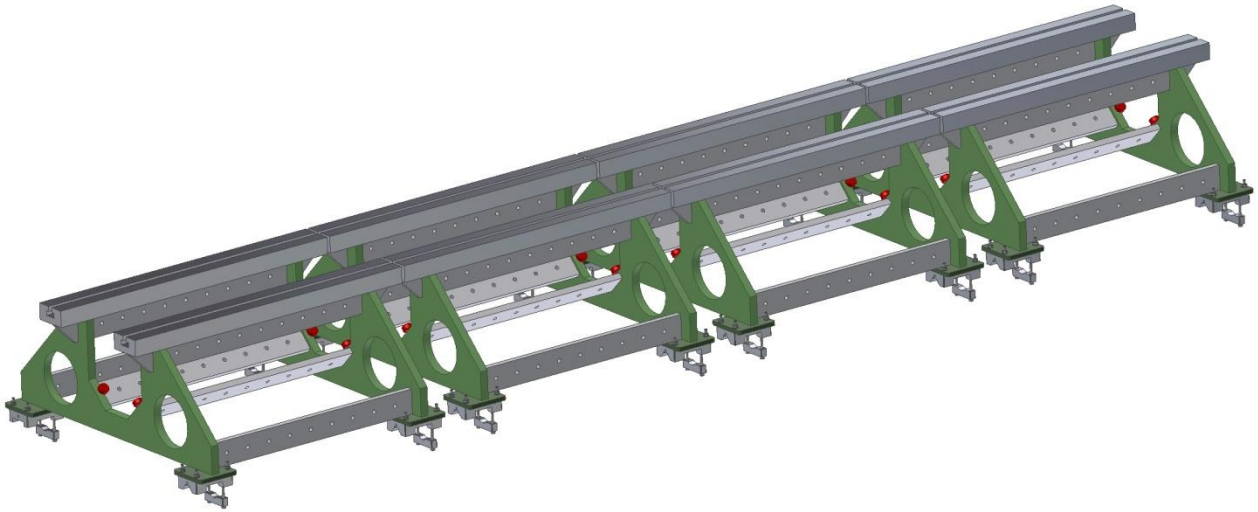
Support frame separation needs to be fixed. The actual separation is not critical but the chain of frames should be movable as a unit.



Assembling the MEBT.....



Assembling the MEBT.....



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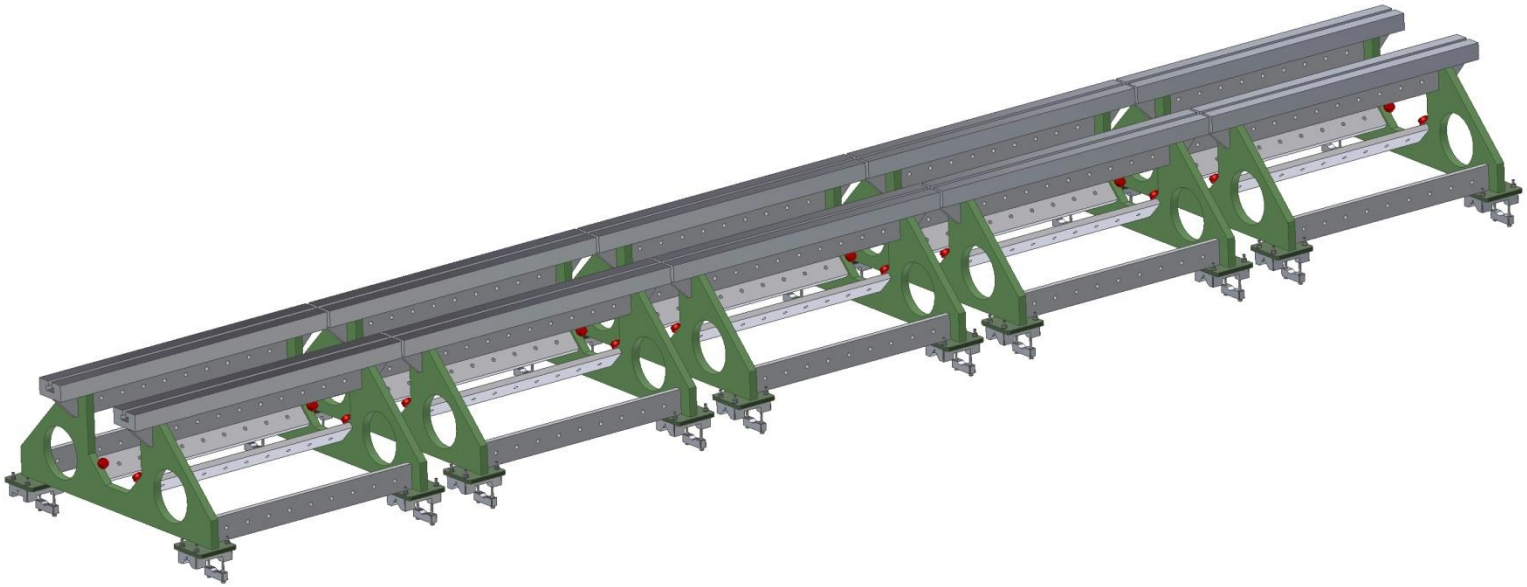
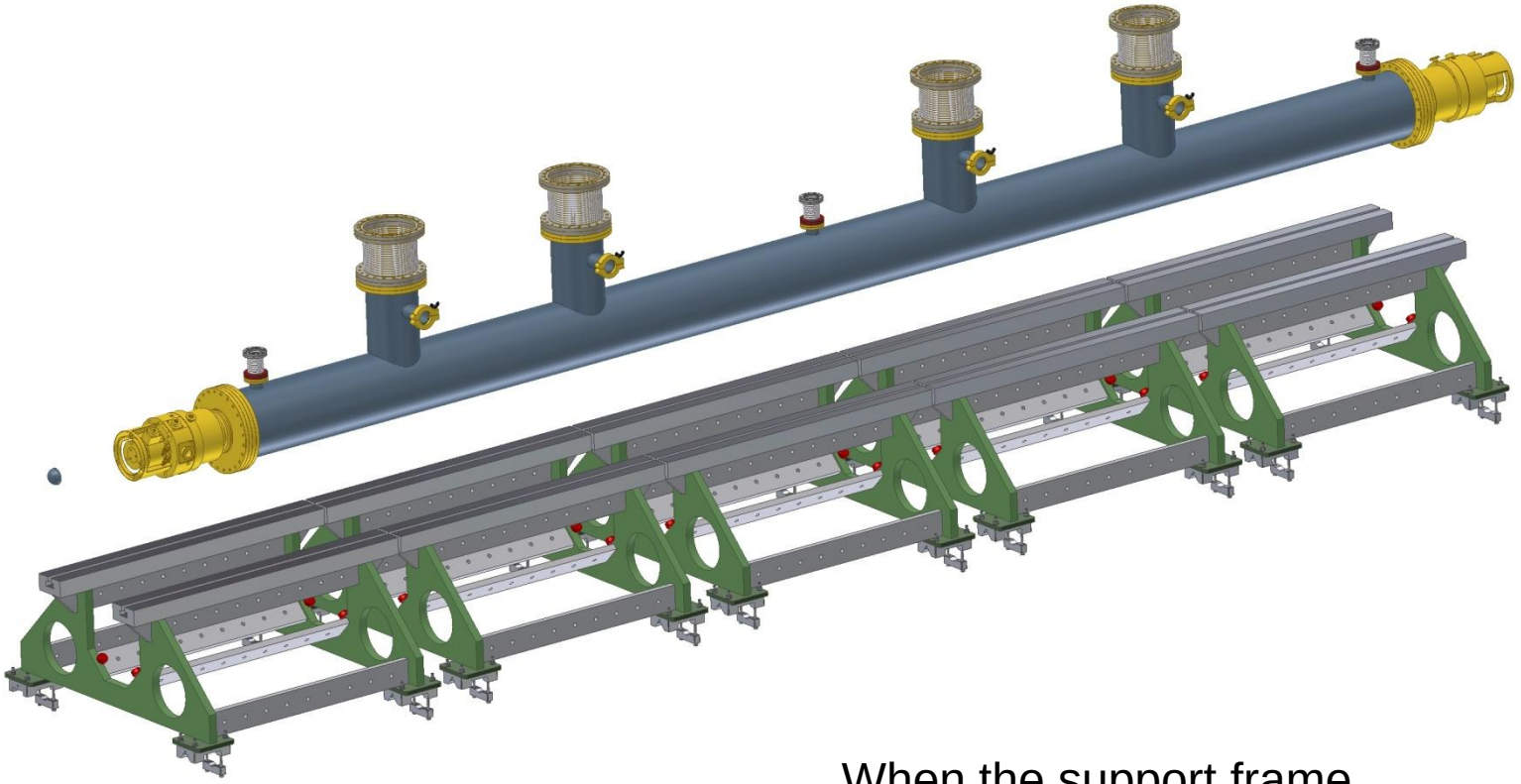
Assembling the MEBT.....

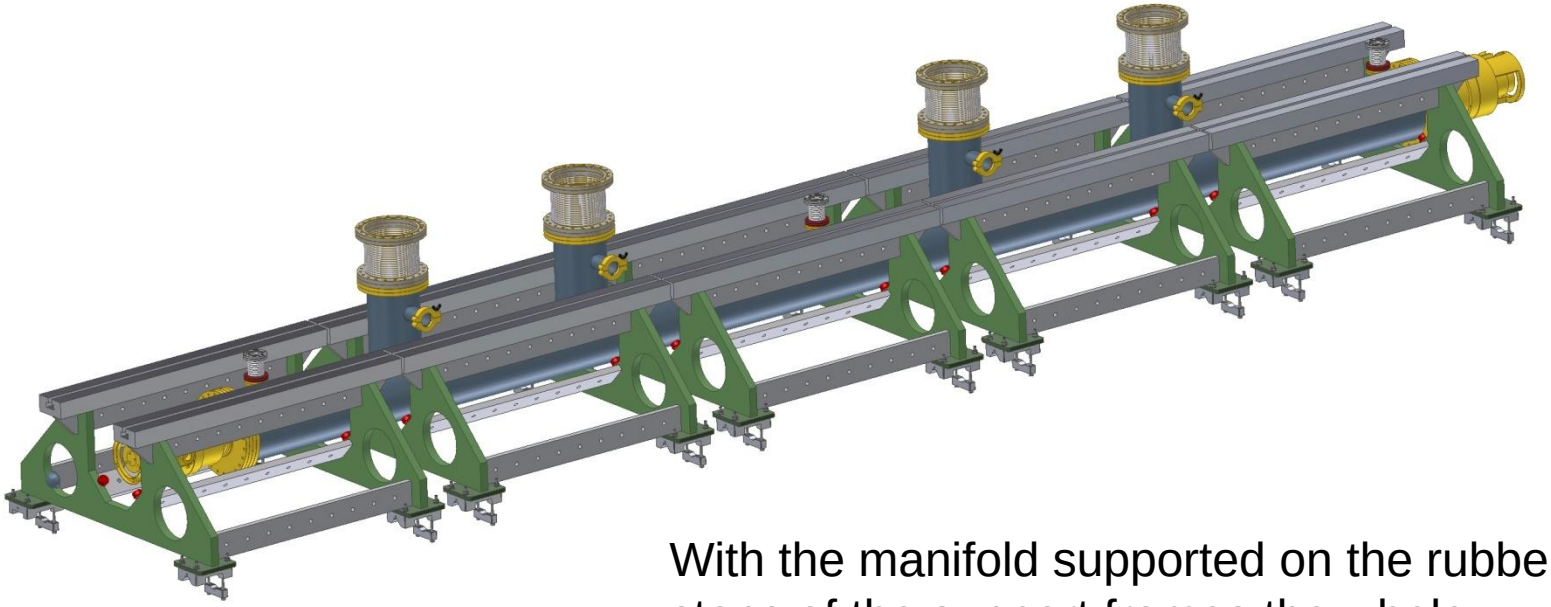


Assembling the MEBT.....



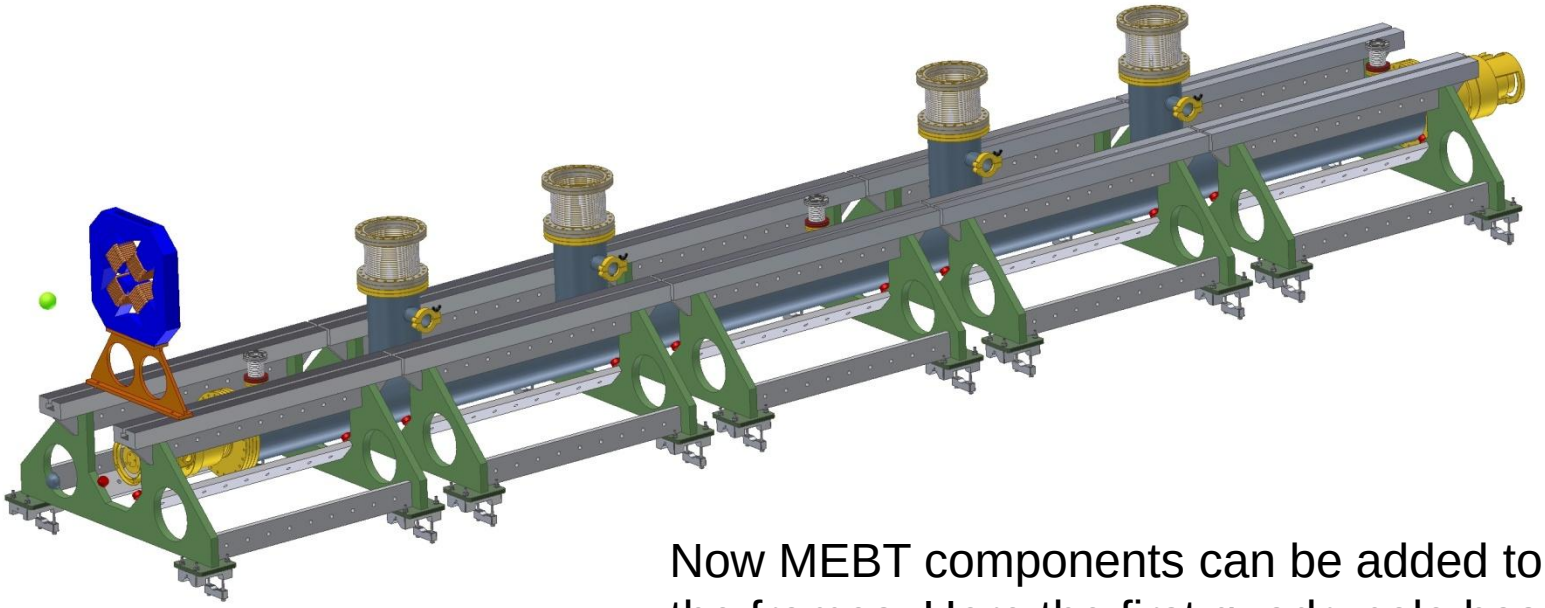
When the support frame chain is complete the vacuum manifold can be lowered into position.

Assembling the MEBT.....



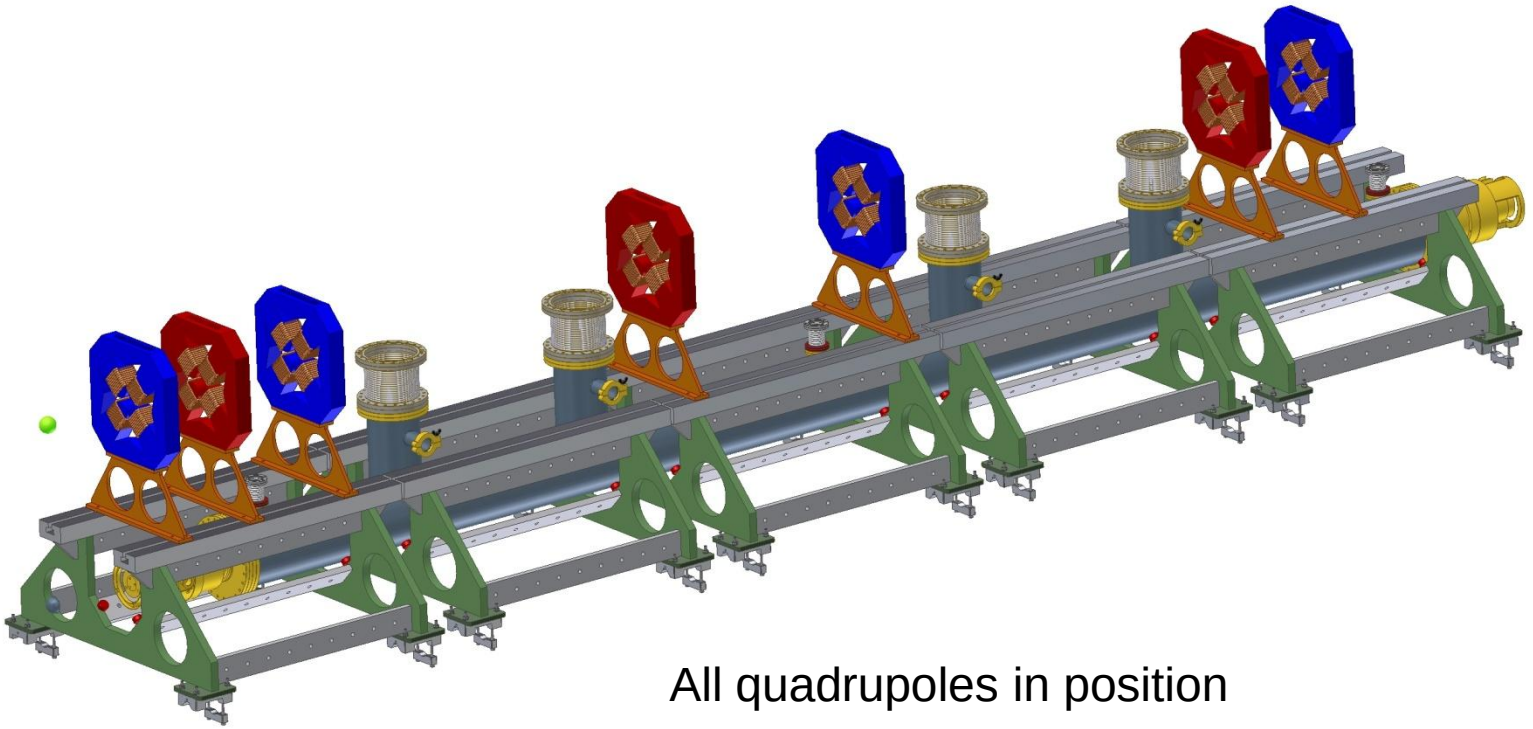
With the manifold supported on the rubber stops of the support frames the whole assembly can now be positioned longitudinally, i.e. So that the first port aligns with the first rebunching cavity.

Assembling the MEBT.....



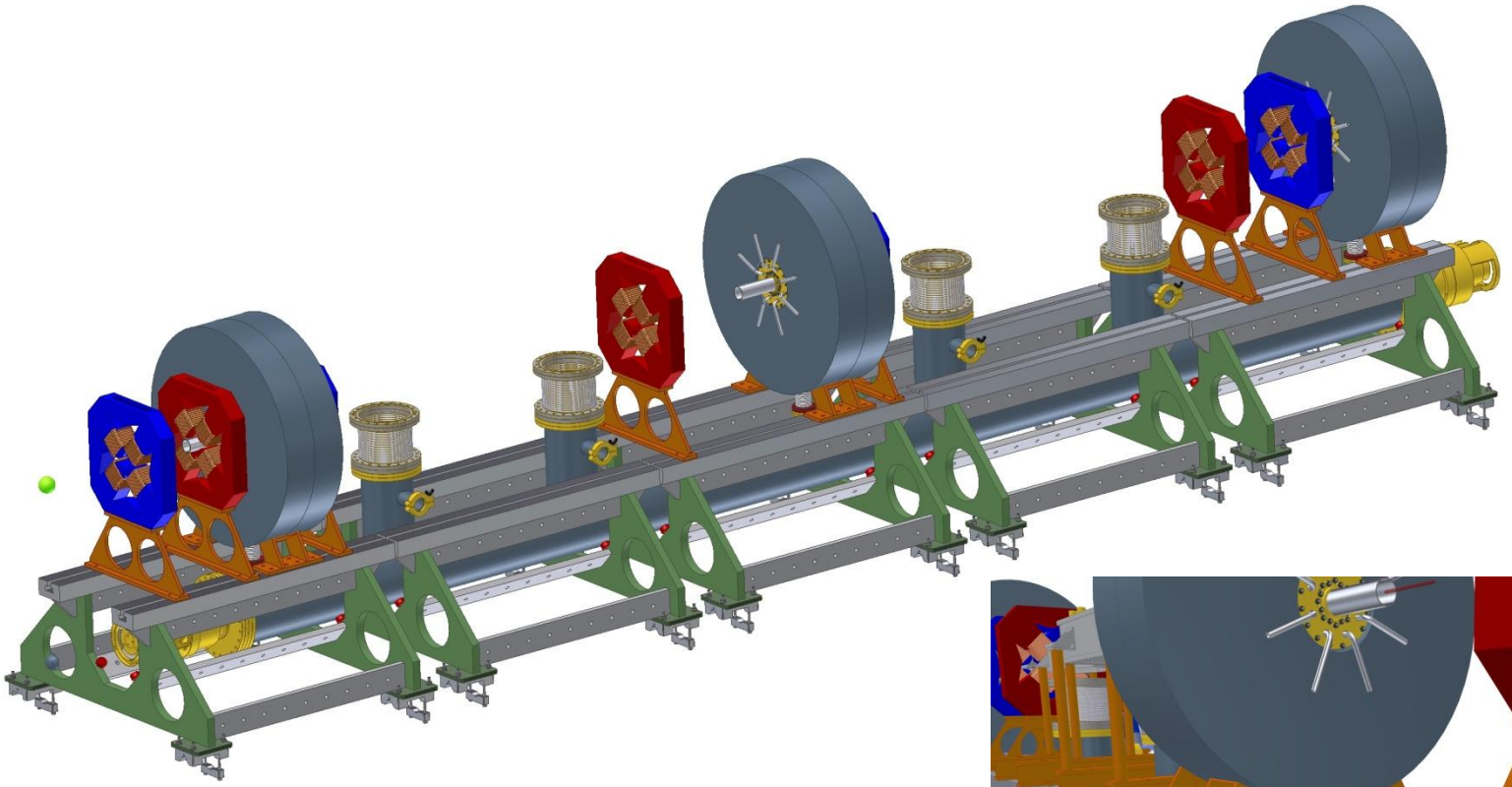
Now MEBT components can be added to the frames. Here the first quadrupole has been positioned on the T-slot rails. It's position can be coarsly made by tape measure before final positioning by Adrian Hooper and team.

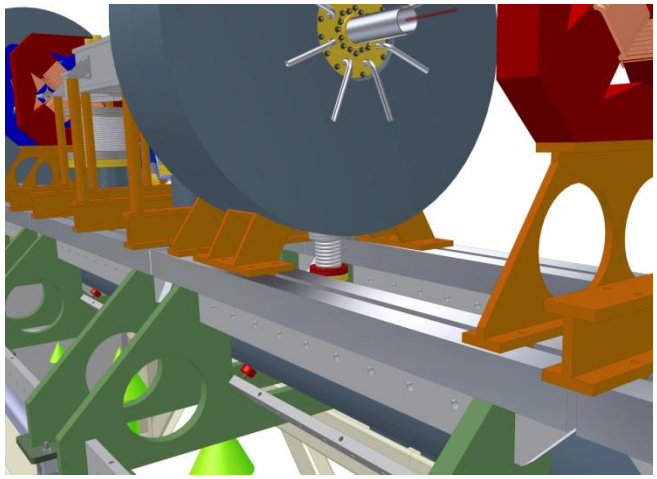
Assembling the MEBT.....



All quadrupoles in position

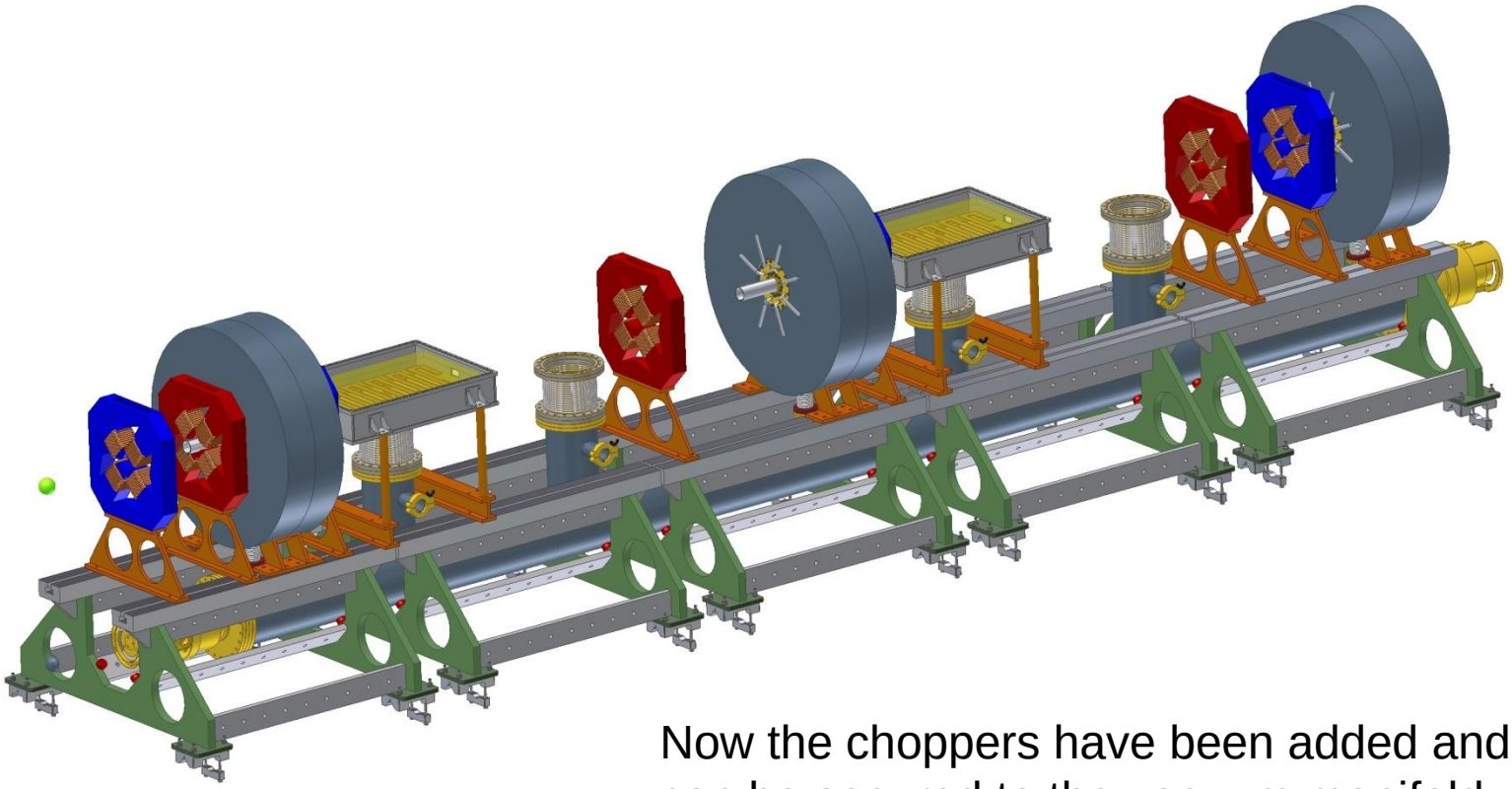
Assembling the MEBT.....





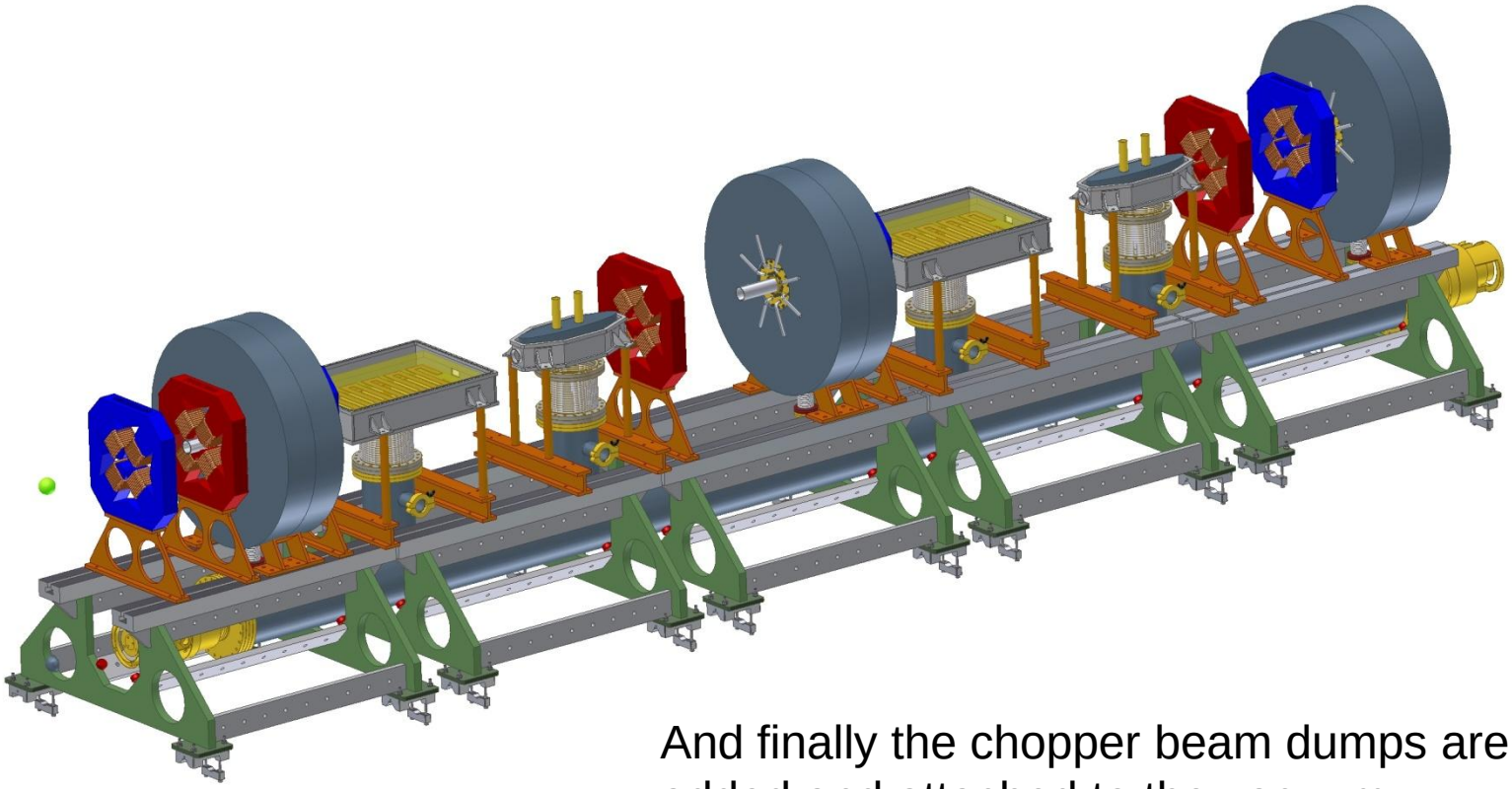
Now the rebunching cavities have been added. These items will be the trickiest to connect to the vacuum manifold.

Assembling the MEBT.....



Now the choppers have been added and can be secured to the vacuum manifold. Note that the downstream slow chopper has been shown as a meander type just for ease of CAD modelling.

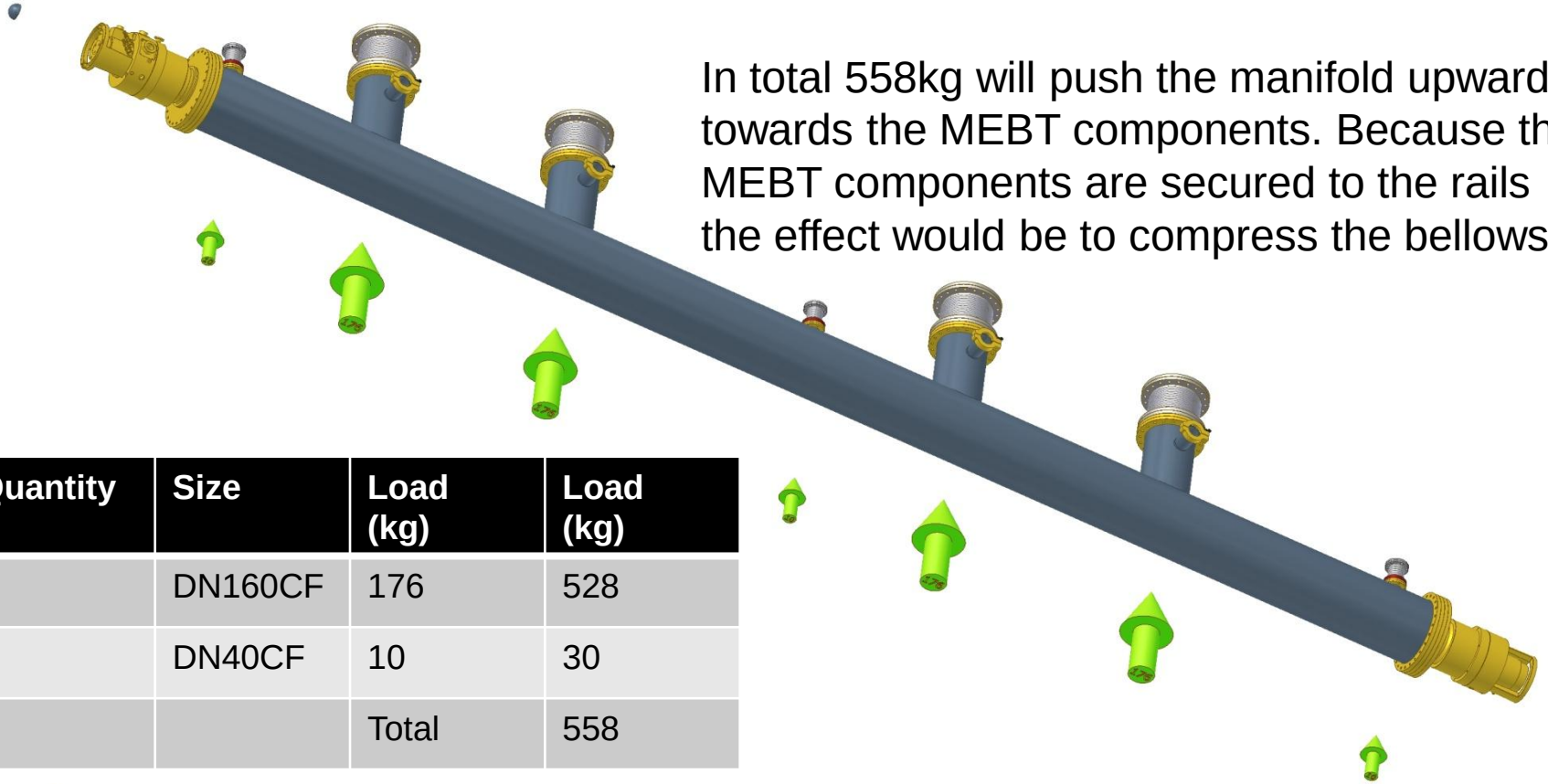
Assembling the MEBT.....



And finally the chopper beam dumps are added and attached to the vacuum manifold.

MEBT vacuum manifold – vacuum forces

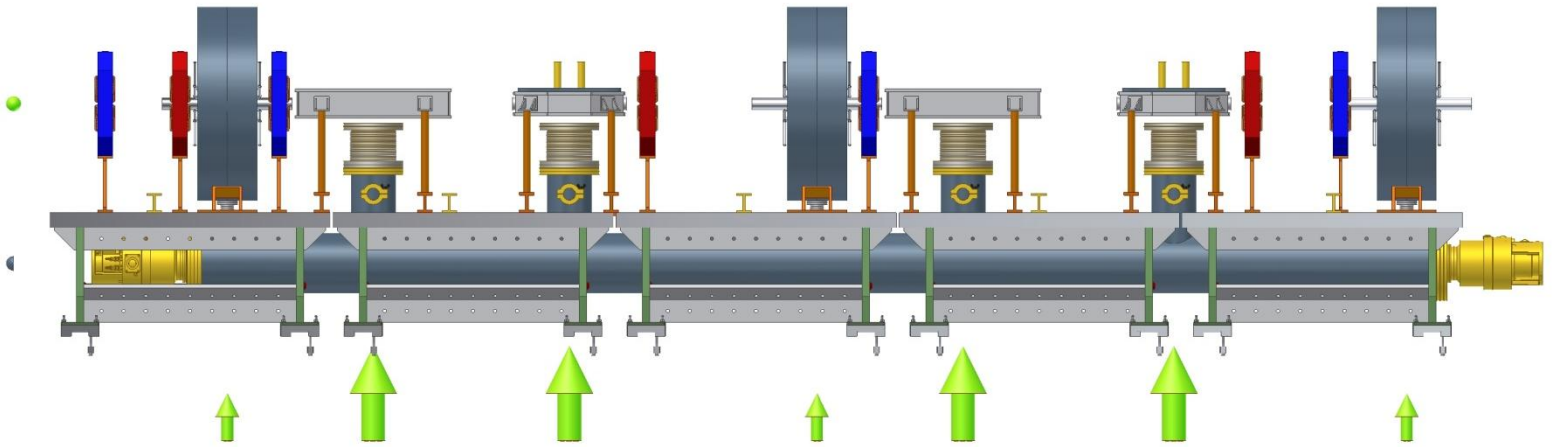
There are 4 off-axis openings of ~160mm diameter which each result in a vacuum load of 176kg. Similarly there are 3 off-axis opening of ~40mm diameter which each result in a vacuum load of 10kg.



In total 558kg will push the manifold upwards towards the MEBT components. Because the MEBT components are secured to the rails the effect would be to compress the bellows.

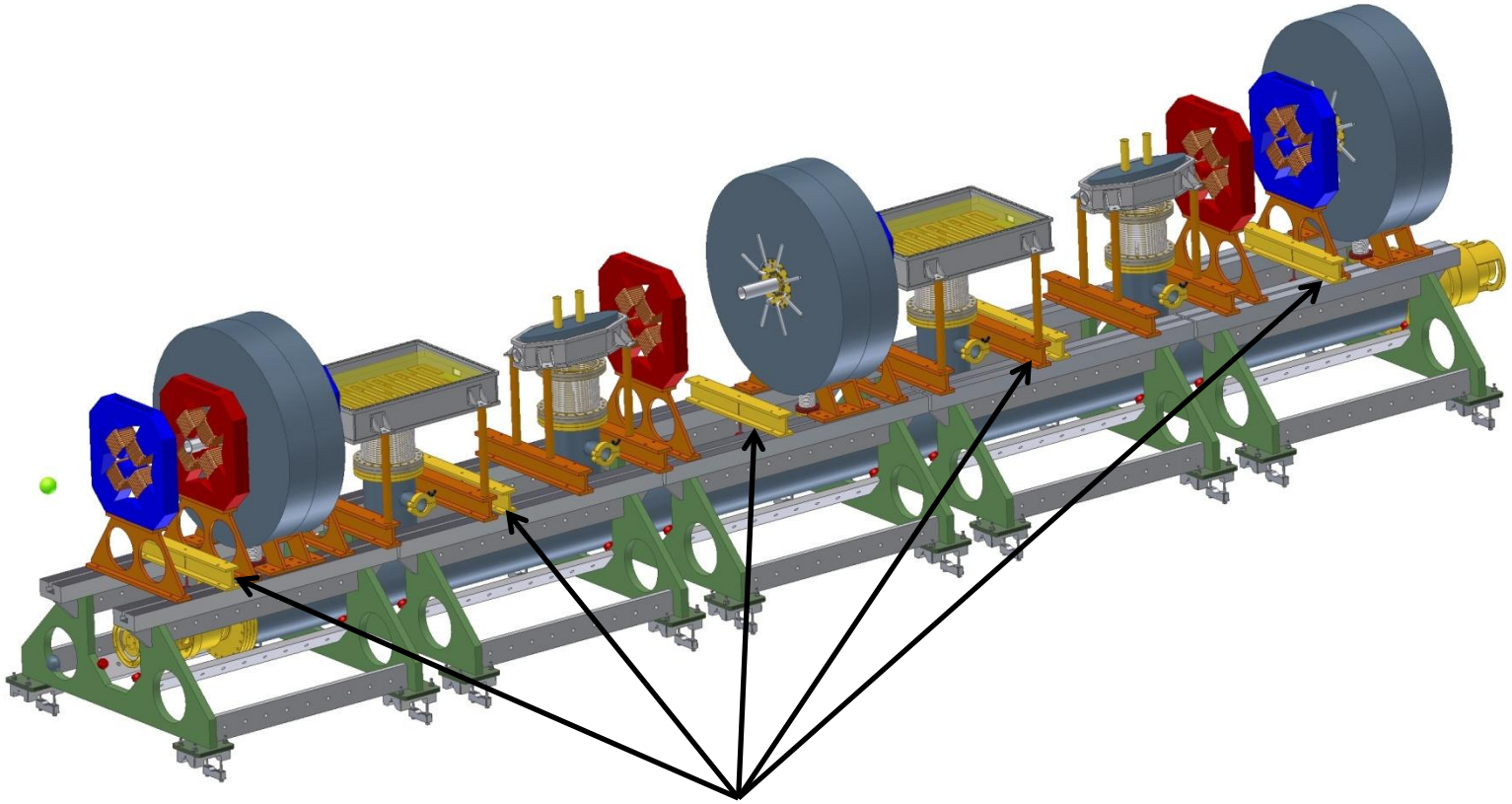
Quantity	Size	Load (kg)	Load (kg)
4	DN160CF	176	528
3	DN40CF	10	30
		Total	558

MEBT vacuum manifold – vacuum forces



To prevent the bellows from being compressed transverse beams will be placed above the vacuum manifold to hold it in position. The beams will be secured via the T-slots and will be positioned wherever there is a suitable gap. Stress analysis will be performed to determine the number of beams required to restrict the manifold movement without locally deforming the MEBT support structures to such a degree as to push the adjacent MEBT components out of alignment. It is imagined that about 5 beams will be required, each holding off about 100kg load.

MEBT vacuum manifold – vacuum forces



Five transverse beams are shown here in yellow. On their underside they will have a simple, off-the-shelf threaded rubber foot that can be wound down until it contacts the manifold.

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- Vacuum manifold
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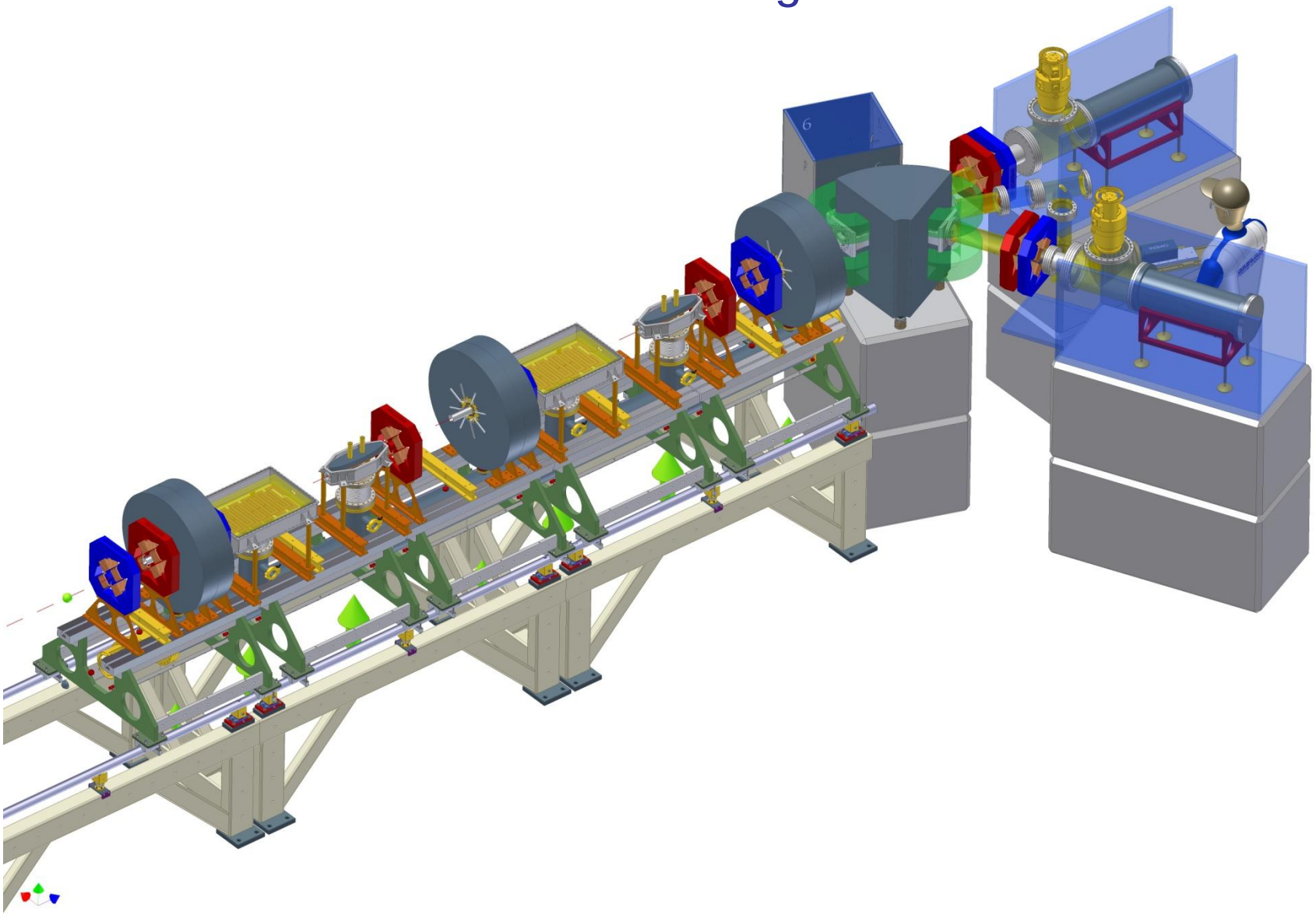
- **MEBT including laser diagnostics**

MEBT + laser diagnostics



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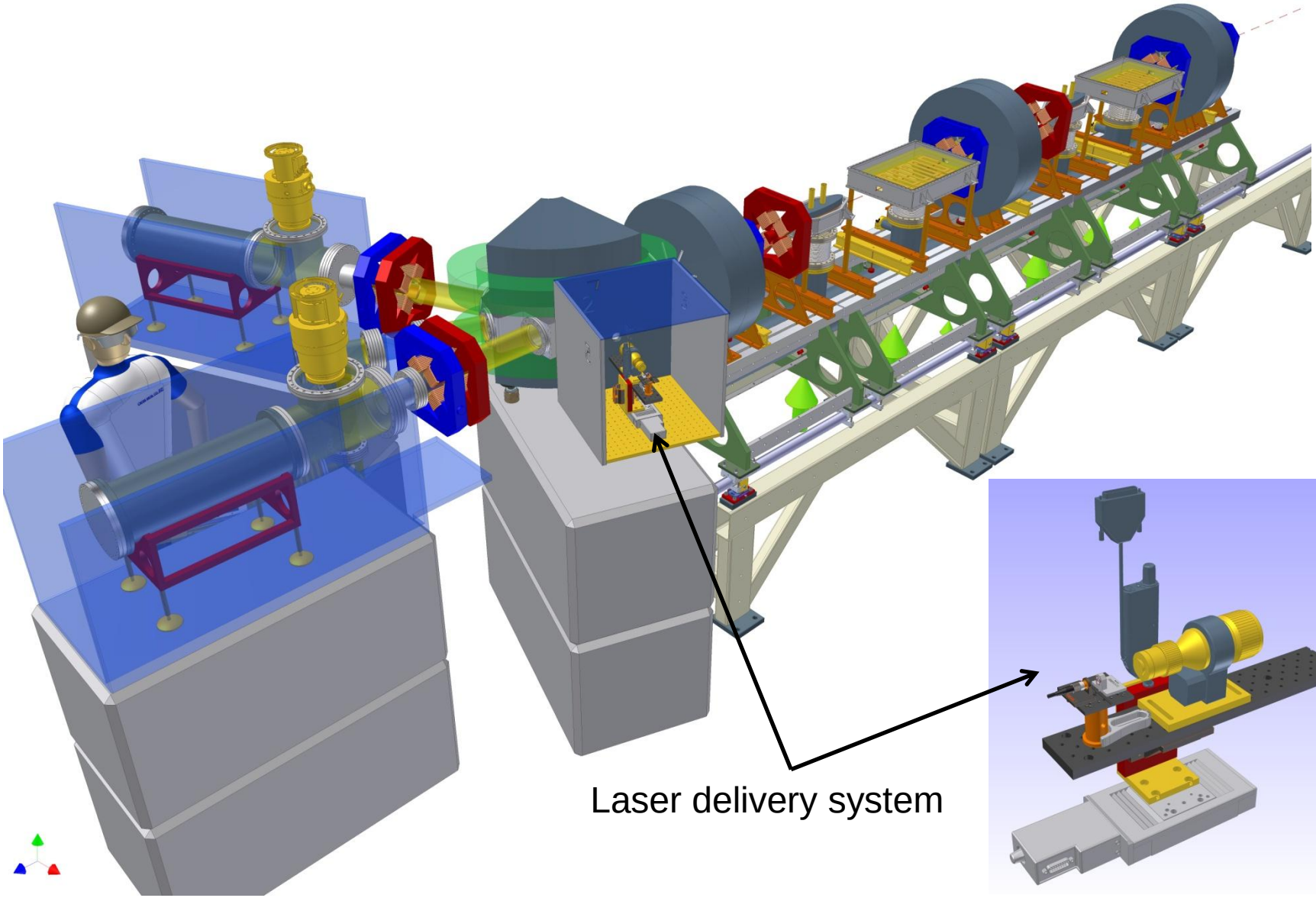
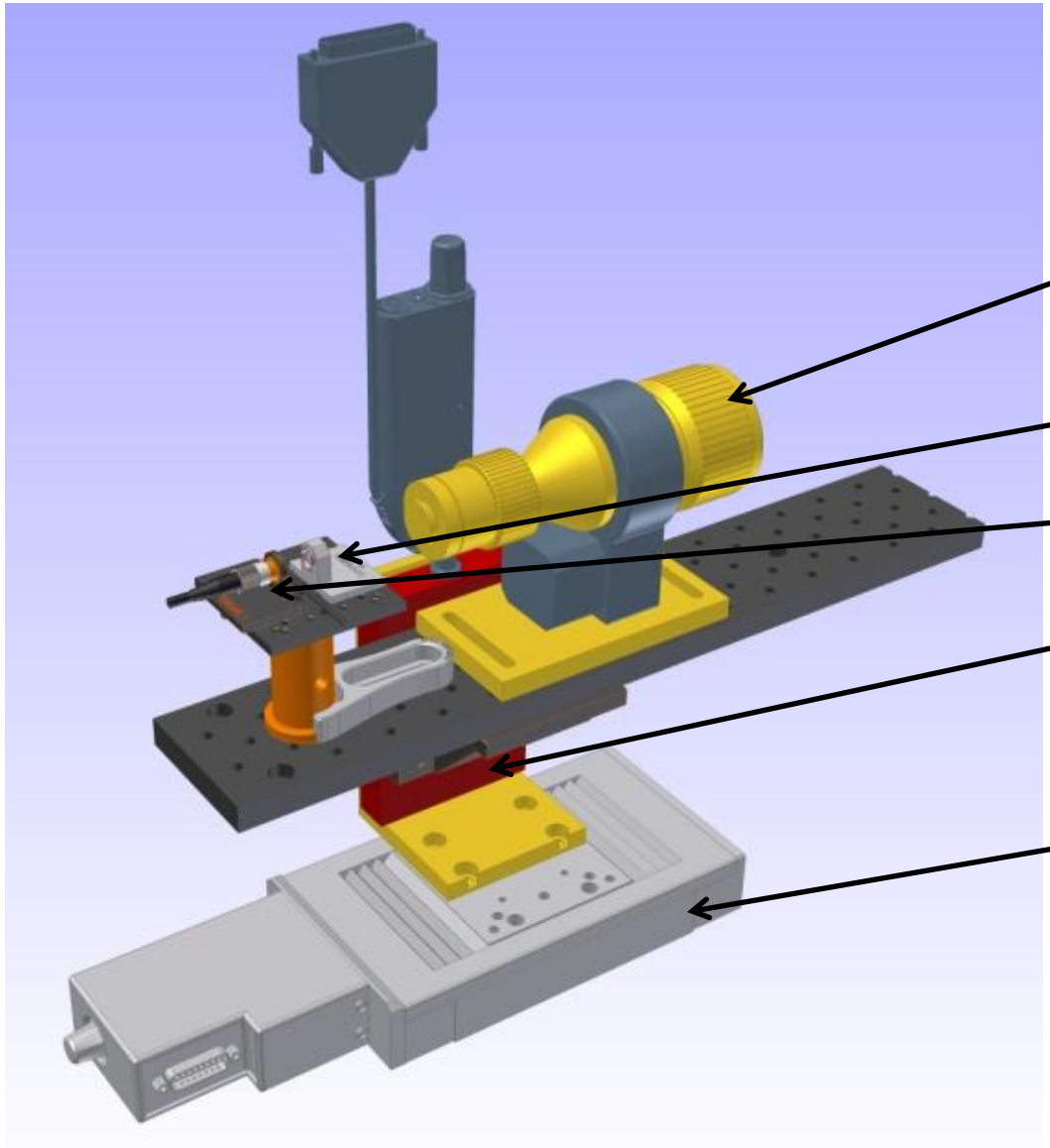
MEBT + laser diagnostics



Laser delivery system – main components



- Motorised beam expander
- Lens
- Fibre connector
- Motorized vertical stage
- Motorized horizontal stage

- End