Issues with FM structure design concept

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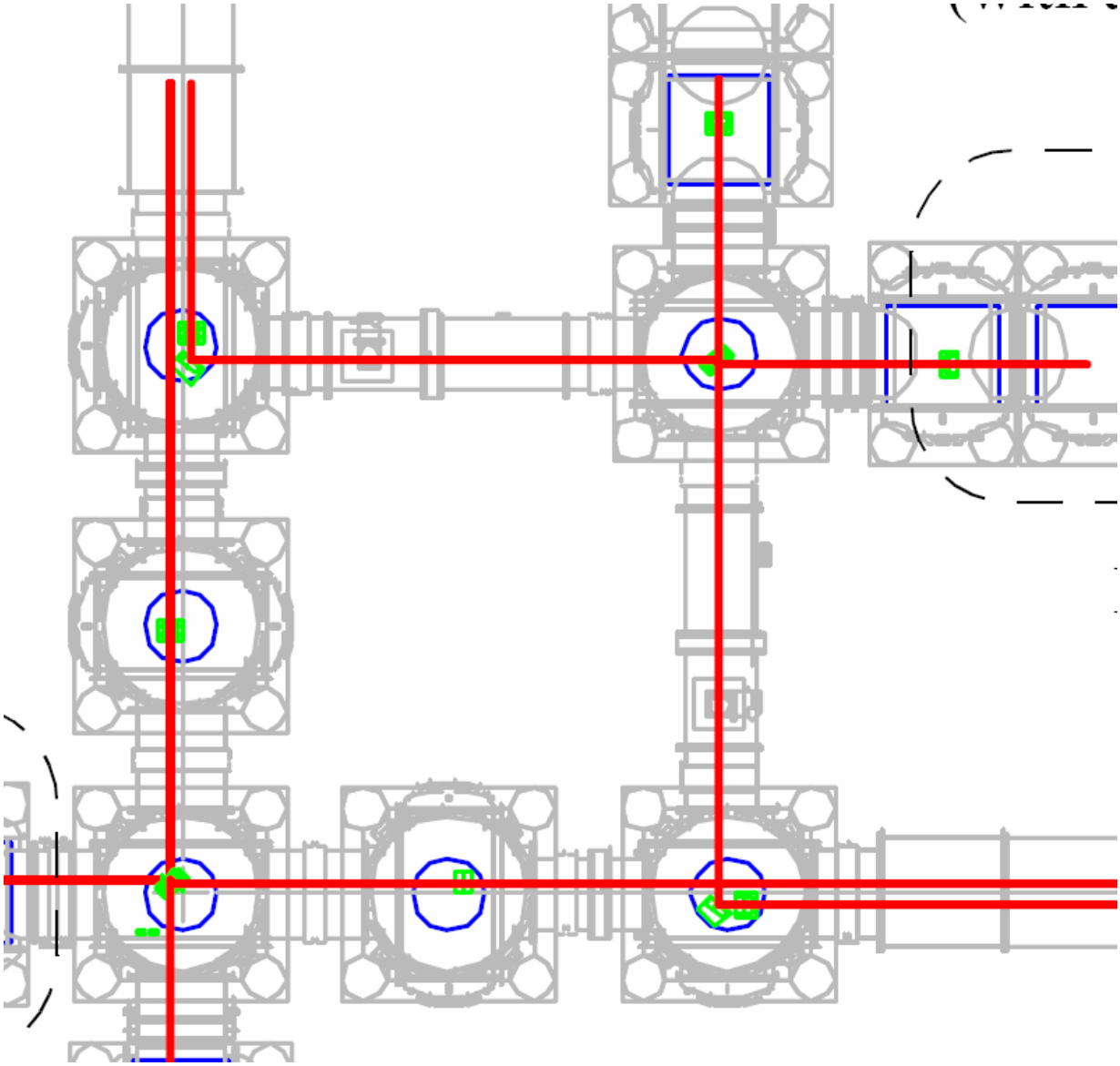
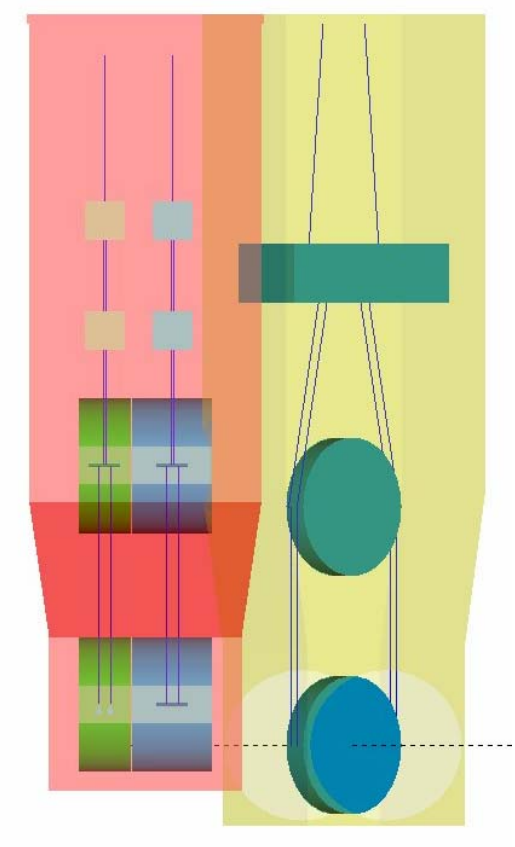
1. OPTICS LAYOUT

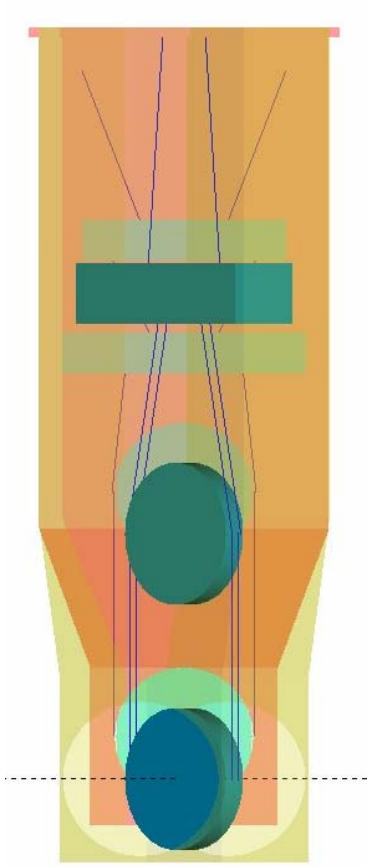
Figure taken from T010076-01 on systems web page:

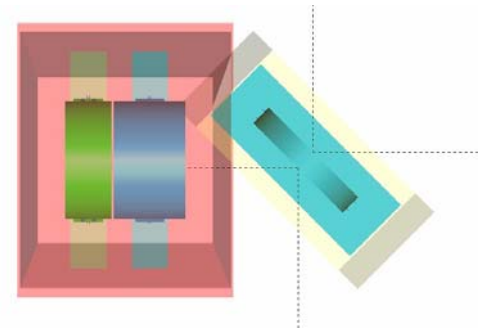


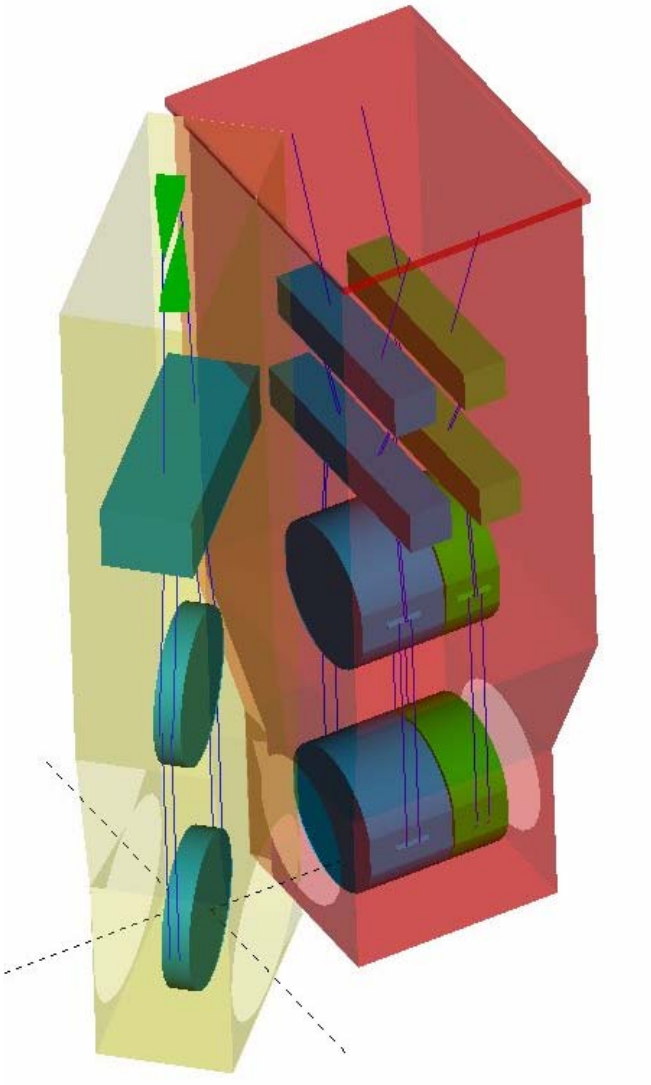
2. INITIAL VIEW OF THE PROBLEM.

For these images, the envelopes of the existing ITM and BS designs have been superposed. This is simply to allow some visualisation of the issues, and is no way a statement of final design. For example, the FM is clearly at the wrong height.









3. FEATURES OF THE DESIGN OPTIONS

We split the design options up into three broad categories, depending upon the extent to which the FM structure and the ITM structure are integrated. By the upper structure we mean the part that provides stiffness and that supports the tablecloth for the top mass. By the lower structure we mean the part that encloses the test mass(es), the penultimate mass(es) and, for the quad, the UI masses.

The crucial issues we have identified are yaw adjustment, installation, and weight.

- When adjusting yaw, we need to be able to move the ITM test mass so as to point it at the ETM. We do not want to upset the alignment of the suspension, and this adjustment will be done by moving the whole suspension structure. This keeps the chains aligned to each other and to the OSEMs and stops. So much for the ITM. However, we will also need to adjust the FM so as to steer the beam to the (folded) BS mirror – without disturbing the ITM. If the structures of the ITM and BS are integrated then the FM will have to be yawed within its structure – upsetting the adjustment of the OSEMs and stops.
- When repairing a ribbon or fibre, in the case of the fully integrated (upper and lower) structure, you woul d need to remove the ITM

In the table below, relatively good points are green, relatively bad points are red, and in-between points are amber. Bold face indicates particularly important issues.

	separate upper structures separate lower structures	Single upper structure separate lower structures	single upper structure single lower structure
FM yaw adjustment	**Easy – adjust the whole FM suspension independently of the ITM**	**Tough – the upper structure can be yawed to bring the ITM into line along the arm but then the FM will need to be adjusted relative to the structure which will upset all of the osem and stop clearances.**	
design	Easiest – re-use ETM/ITM design and some aspects of BS design	Requires a new design for the upper structure. The lower structures should be at least partially recycled from the ETM/ITM and the BS.	Upper and lower structure both need redesigning.
Repair – getting at a test mass	Easiest	Moderately easy	**Hard – you would be doing a "5 and 2" de-install and re-install.**
Weight	**heaviest**	Lightest	
Needs stays	Yes for FM structure	Probably not	
frequency	**Probably worse**	Probably better	
Usage of space	**worst**	better	

Based on the information in the table, it looks as though the first option is the least bad. However, the weight/space issue may well be a show-stopper, which leaves us with the middle option.

4. QUESTIONS:

What are the restrictions on the separation between the ITM and the FM in the direction along the main beam? What are the other restrict6ions on where the structure/structures could fit?

How serious is the weight problem?

What are the light path clearances required for the non-folded IF beam to pass the FM suspensions (there are two cases – the X and Y FM suspensions are opposite handed). And what are the real requirements for the beams entering and leaving the FM?

Is there a strict requirement (as there was with the ETM/ITM design) to allow a split in the structure so that if need be the lower part of the structure could be supported from somewhere other than the SEI?

The FM is s little higher than the BS. Is it safe to assume we can simply reduce the lengths of all three stages a little from the BS conceptual design to achieve the required shortening for the FM design?