Science & Technology Facilities Council

MICE

Spectrometer Secondary Absorber

Design, Manufacture and Procurement

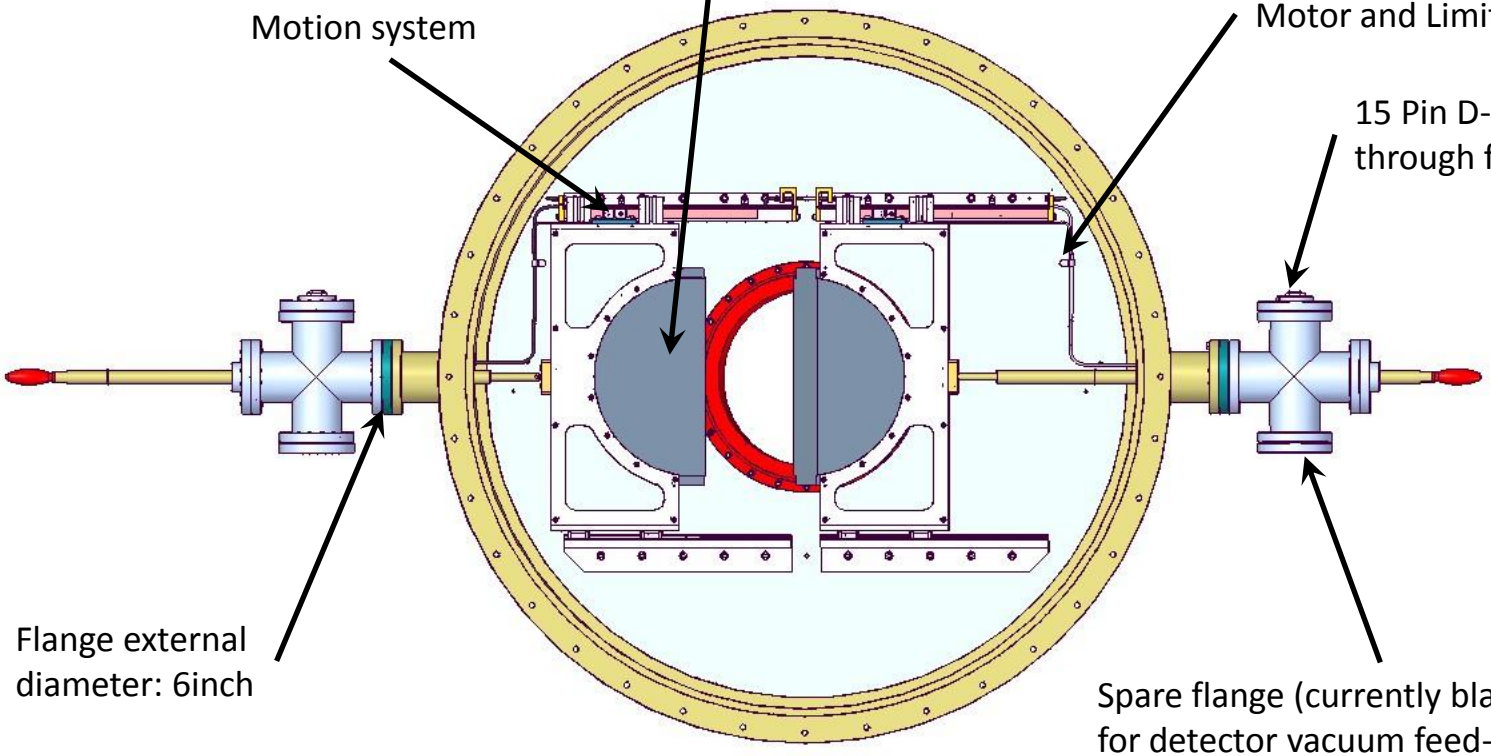
Agenda

1. Current Status
   a) Hardware
   b) Software
2. Requirement – Specification
3. Proposal
4. Conclusion

Current Status: Hardware

CAD information depicted below:

Approximately 50kg per side
230mm stroke traversed in approx. 1.5 seconds



Current Status: Hardware

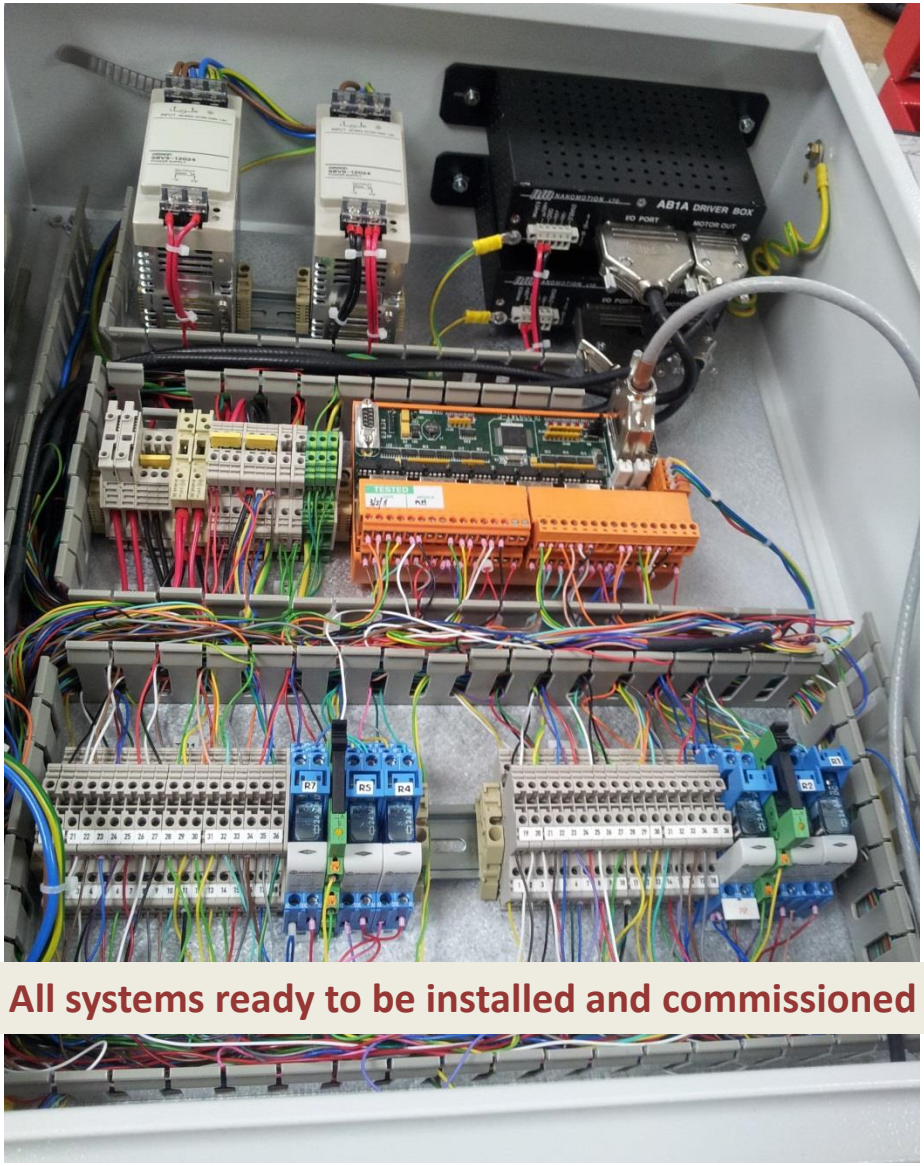
Shutter Control Box

Box AND Shutter tested successfully

Input and output connections

Current Status: Hardware

Power Supplies, Relays, Motor Controllers and CAN bus system in Box
Includes 4 Interlock inputs per side feeding into CAN bus



All systems ready to be installed and commissioned

Current Status: Software

Graphic User Interface written for test purposes.
Shows:

1. Status
   a) Open
   b) Moving
   c) Closed
   d) Fault

2. Command
   a) Open
   b) Close
   c) Enable/Disable

Requirement - Specification

Vacuum:

From He backfilled at 10^{-3} Torr to "No backfill" at 10^{-8} Torr

Specification for systems checked → conclusion:

Motor and Linear Motion system OK,

Manual Handling system needs to change as only guaranteed to 10^{-6} Torr

Shielding:

Lead to be removed and replaced by Lithium Hydride

LiH to act as secondary absorber

Should be located as close as possible to RF system

Thickness at 32mm

Electronics:

Motor, Controller and connections to remain as per original shielding plan

Interlock specification not required (absorber must be in beam)

All other requirements remain as is.

Requirement - Specification

Integration (Spectrometer):

- Must fit into envelope
- Spectrometer has “longer bellow” to connect to RF unit
- Secondary absorber must permit the Spectrometer to be taken in/out of position without additional dismantling of systems
- Manual Handling system deemed necessary and remain

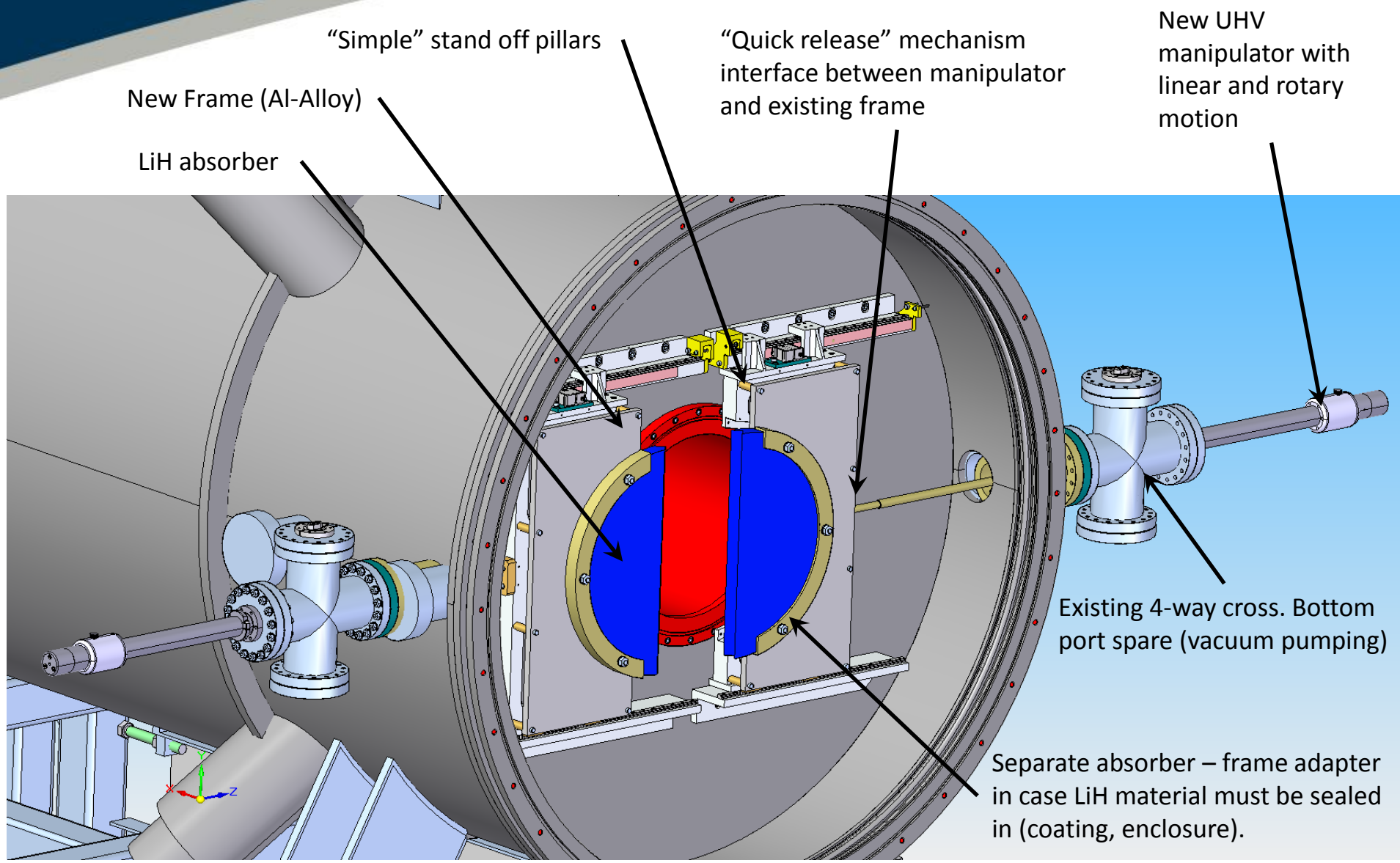
Partial Return Yoke:

- Proposed Manual Handling System requires the same aperture as previous solution
- Operation of Manual Handling mustn’t be obstructed by PRY
- PRY designed and ideally to be left as is
- If rework is required, then this ought to be done prior to installation

Cabling:

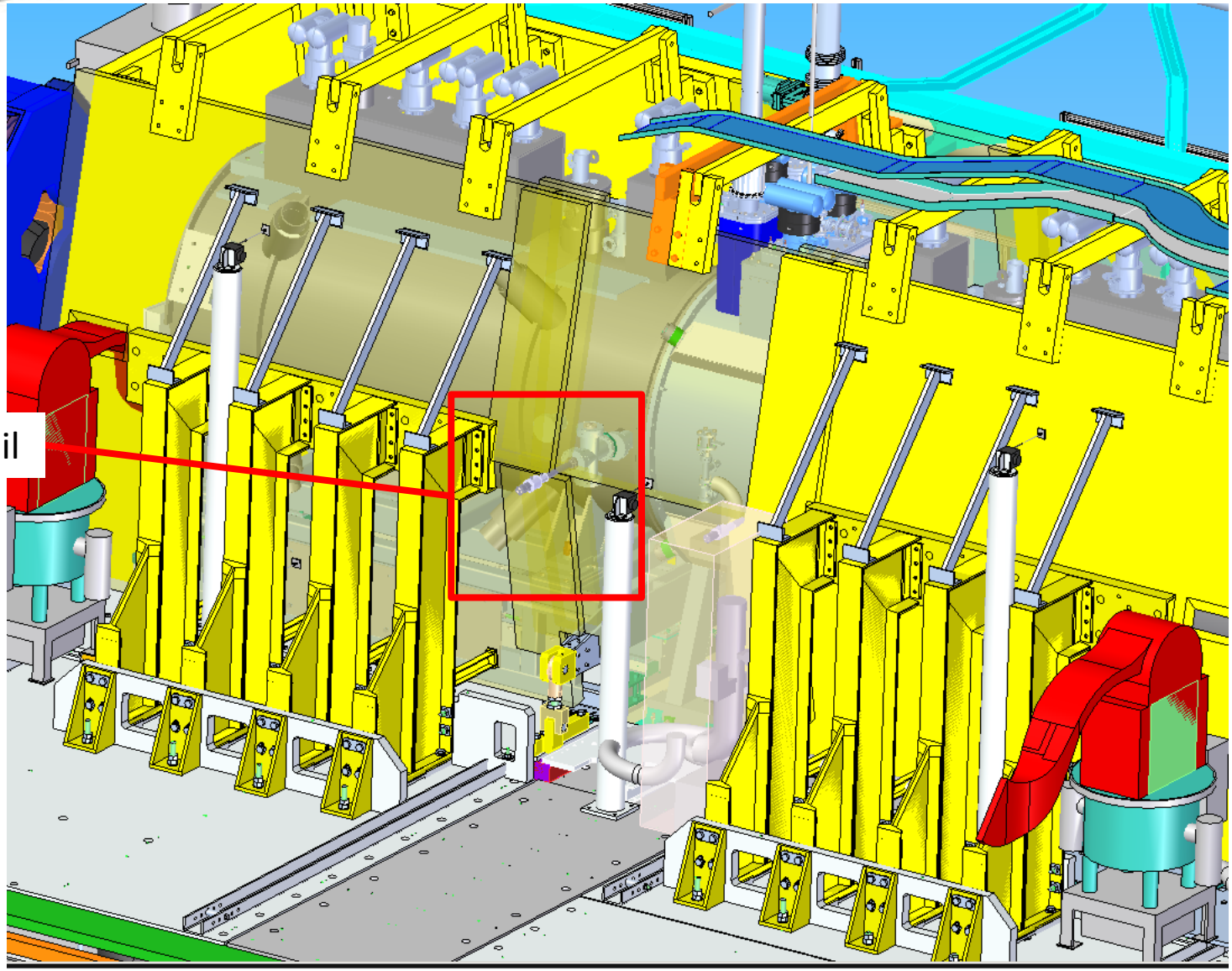
- Cable routes not changed
- Cable length restriction still requires control box to be located within 18m of motor
- All other requirements remain as is.

Proposal - Overview



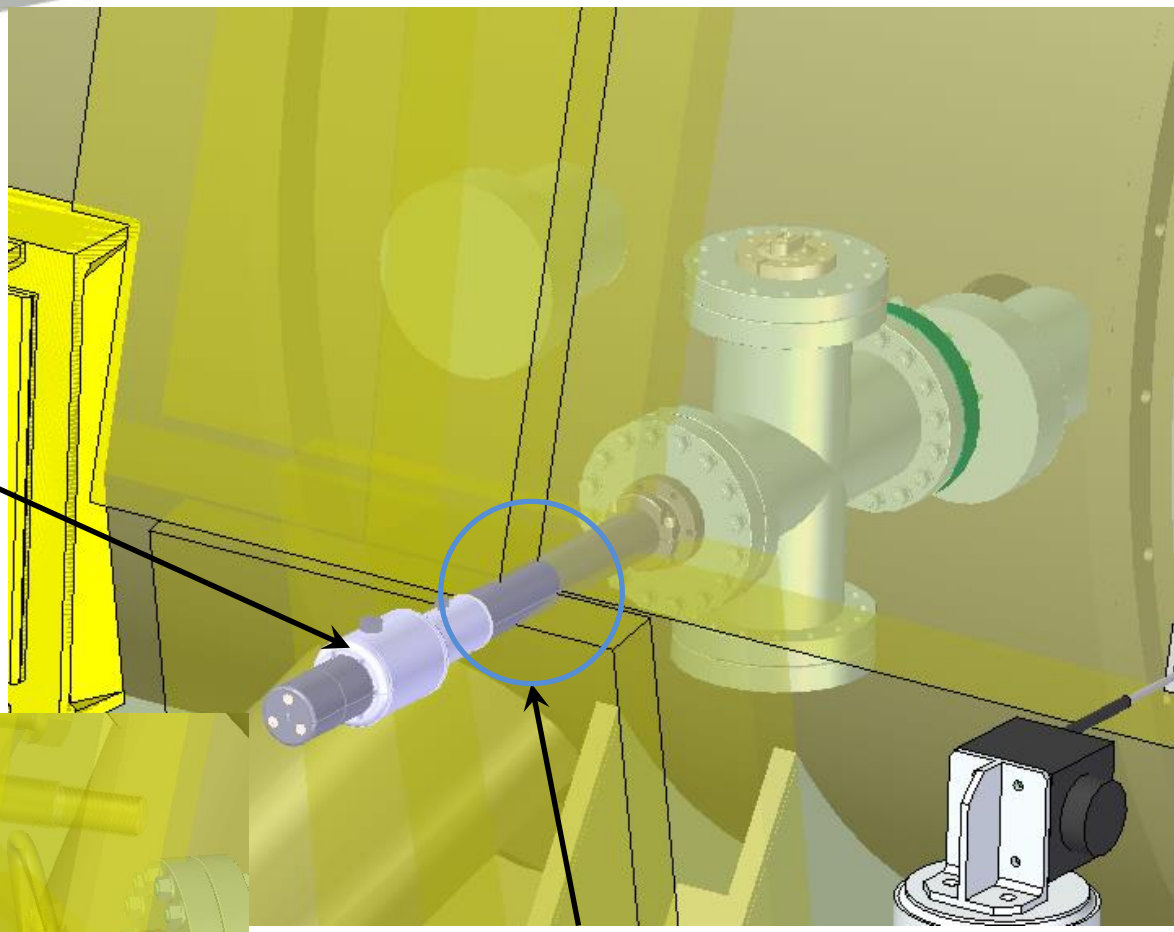
Proposal – Manual Handling

See next Slide for detail



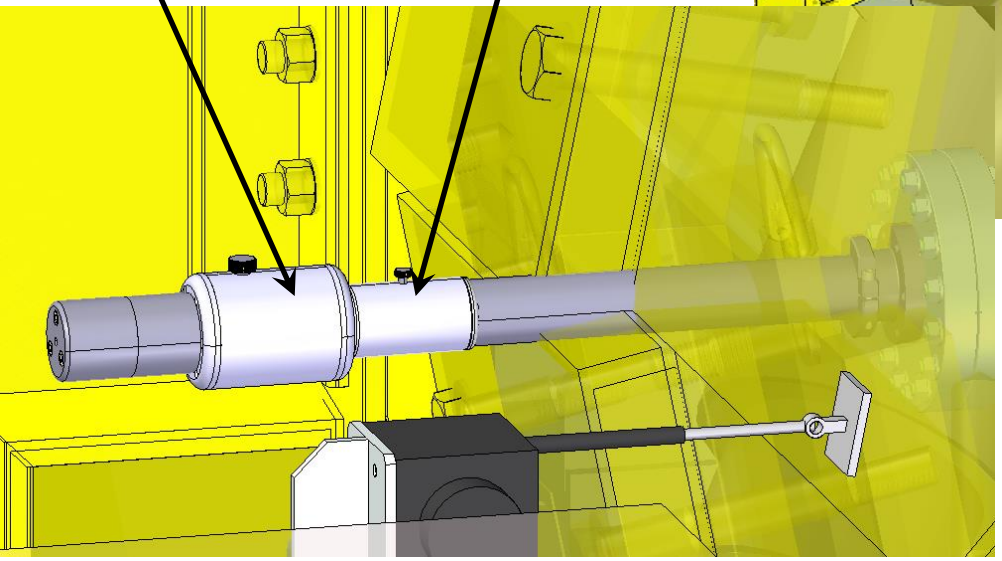
Proposal – Manual Handling

New UHV manipulator with linear and rotary motion; option large off-the-shelf or small dedicated – cost!



Large off-the-shelf unit

Small dedicated unit



Aperture required. Round Ø120mm.
CAD indicates manipulator exiting in line with PRY joint and reinforcing plates.

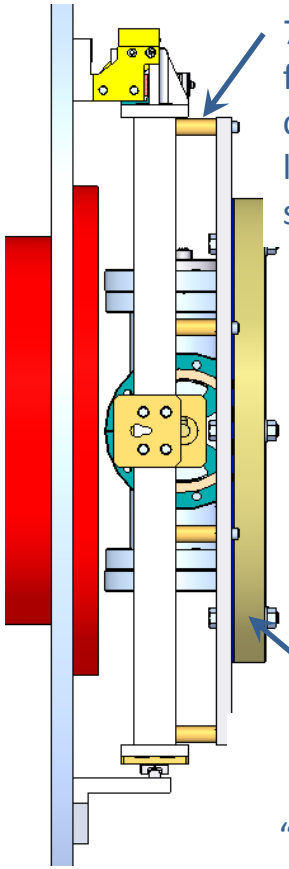
Thumb screw to “lock” manipulator in position.

Proposal – Absorber

Attempt to manipulate a complete disc in/out of beam proofed unsuccessful – insufficient space even at disc diameter 365mm!

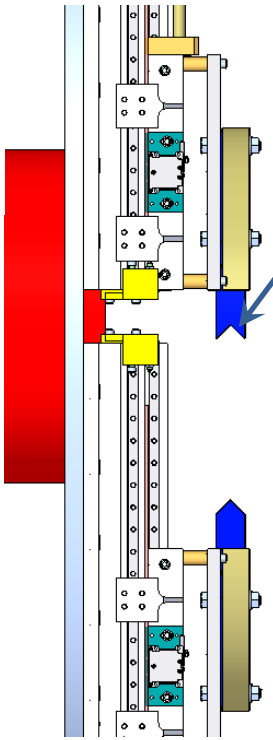
Side View:

Stand-off pillars (43mm) – overall 70mm from current lead shield

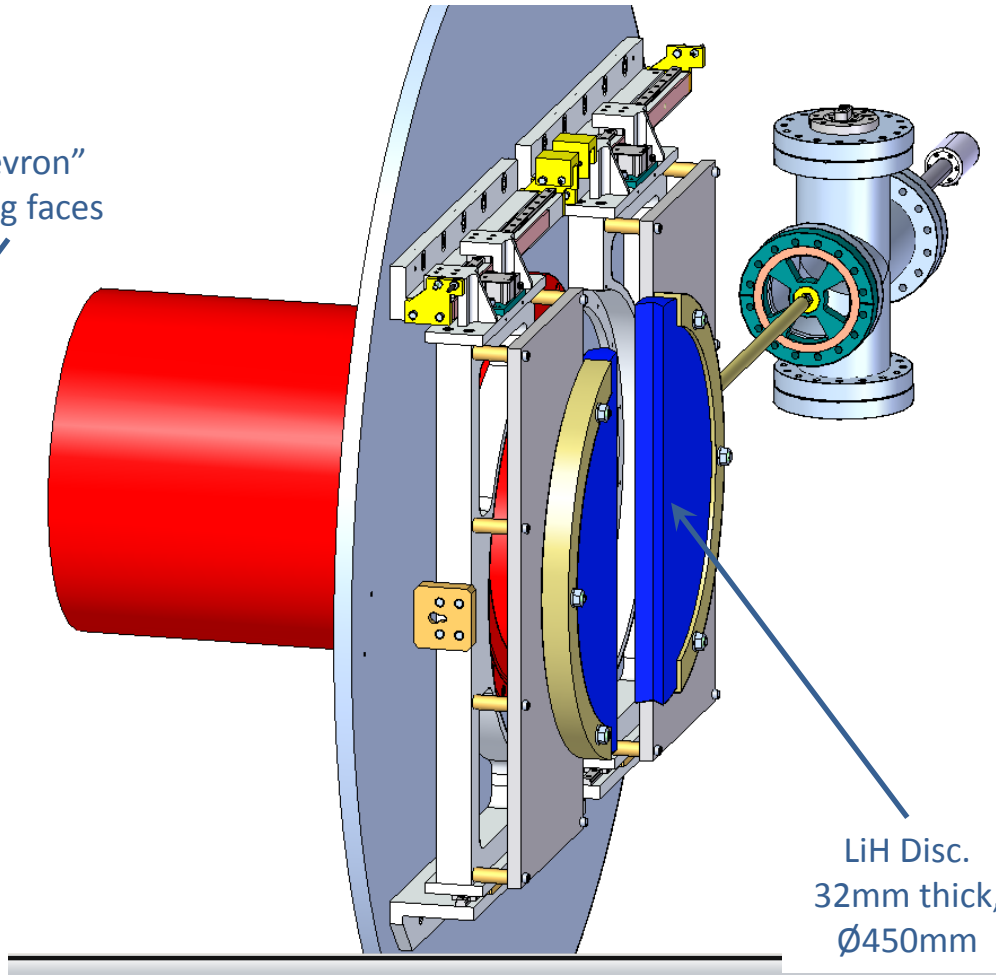


Absorber adapter "clamping" component

Plan View:



"Chevron" mating faces



LiH Disc. 32mm thick, Ø450mm

Proposal – Absorber

Absorber summary:

To keep cost at minimum:

a. Retain existing drive mechanism
b. Reutilise existing frame
c. Pick up on existing features
d. Keep any support items simple

Absorber proves to be difficult to procure despite the “easy” availability of the base material. Manufacture of disc extremely specialised from supplied powder or granulate form.

Very little information on material properties available in terms of:

a. Mechanical properties
b. Thermal properties
c. Vacuum related properties
d. Chemical properties
e. Corrosion and compatibility
f. Radiation information

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Proposal – Absorber

Absorber findings:

Only one manufacturer remains to be contacted.
A. Bross in discussion with Y12 in U.S. Preliminary drawings and details have been e-mailed.

May need to encase material in hermetically sealed envelope (material to be defined) due to:

a. Outgassing issues
b. Lithium Hydride reactivity with environment
c. Mechanical stability (depends on manufacturing method)
d. Radiation damage due to swelling

Need much more information about specification from scientists including material info such as density (determines manufacturing method), purity; environment such as radiation loading, potential heating, shock loads, etc.

Conclusion

To keep cost reasonable, the existing Radiation Shield design has been kept as much as is.

Drive system and Linear Motion system retained.

Manual Handling requires replacing due to vacuum specification change.

Need aperture in Partial Return Yoke to operate manual handling.

Secondary Absorber proves to be problematic to manufacture.

Need more information to determine a final design for Secondary Absorber.

Questions?

Backup slides

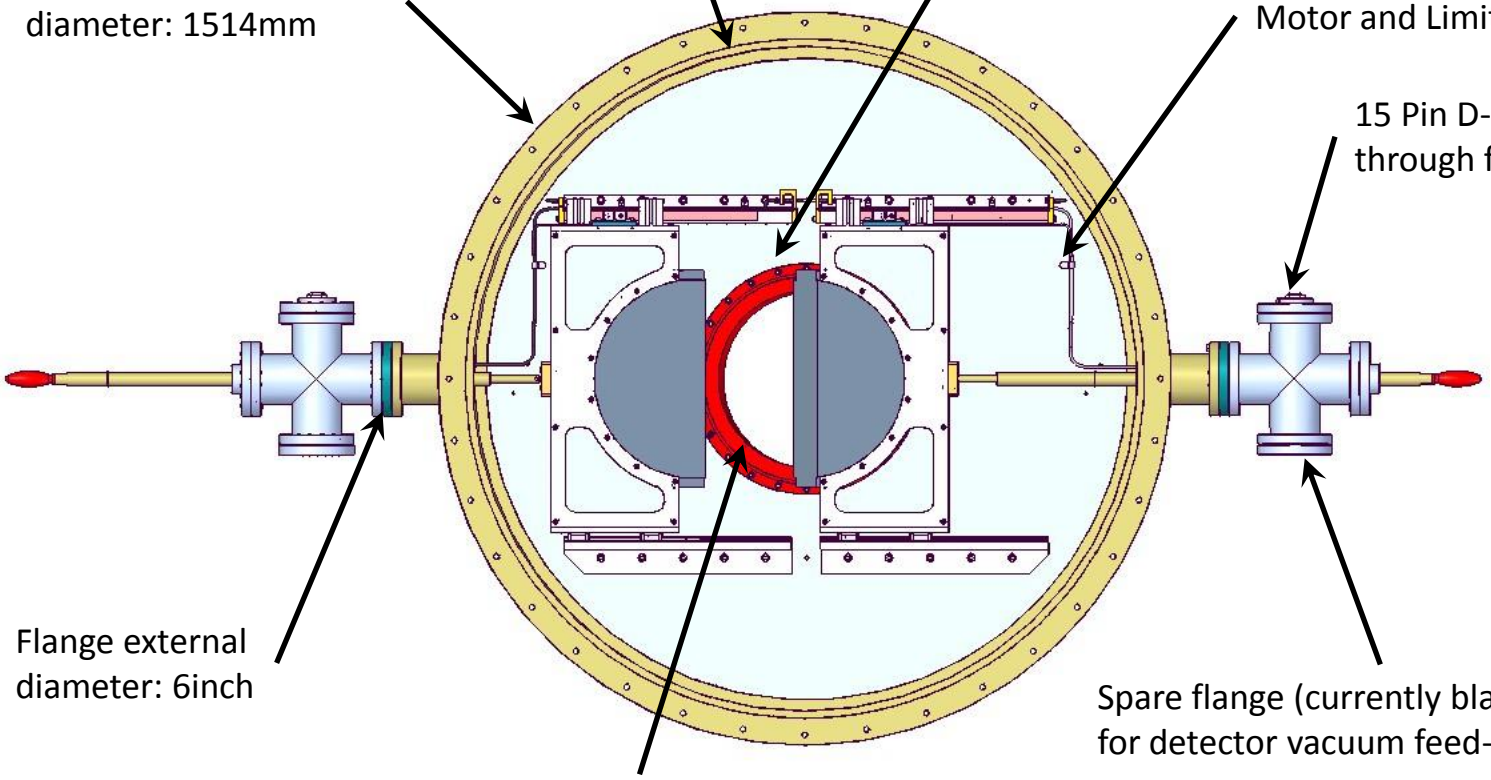
MICE Radiation Shield – Spectrometer

Spectrometer 1 (upstream) has arrived. We can compare CAD information with the real thing.

Images courtesy of Tim Hayler

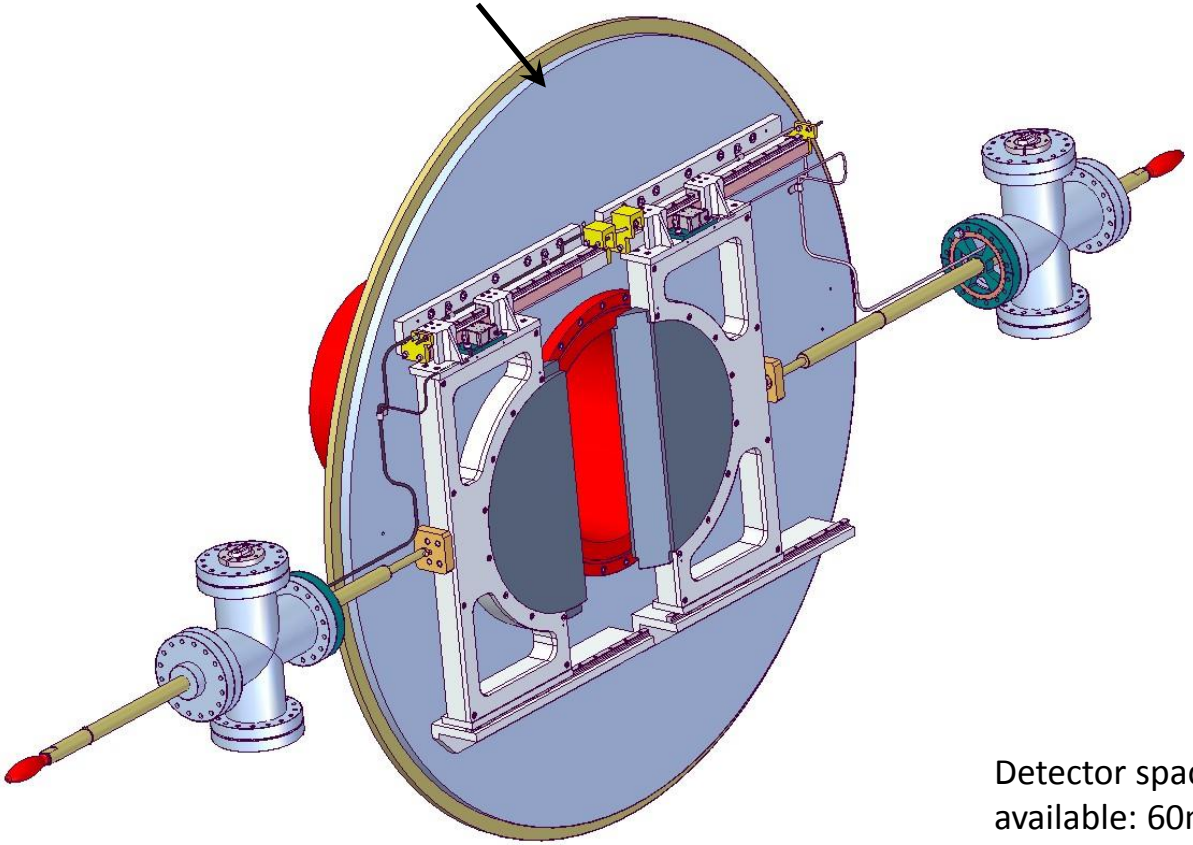
MICE Radiation Shield – Spectrometer

CAD information depicted below:



MICE Radiation Shield – Spectrometer

Spectrometer outer vessel removed for clarity



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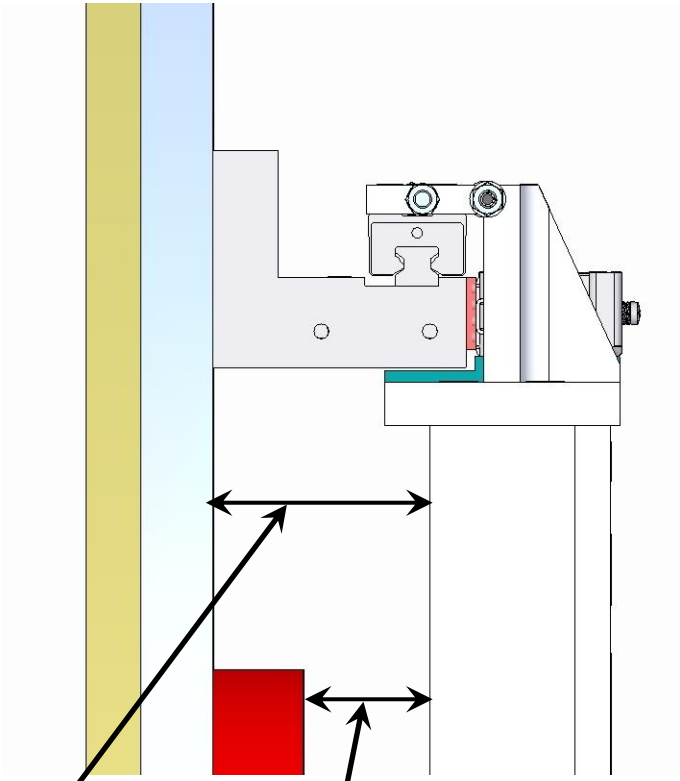
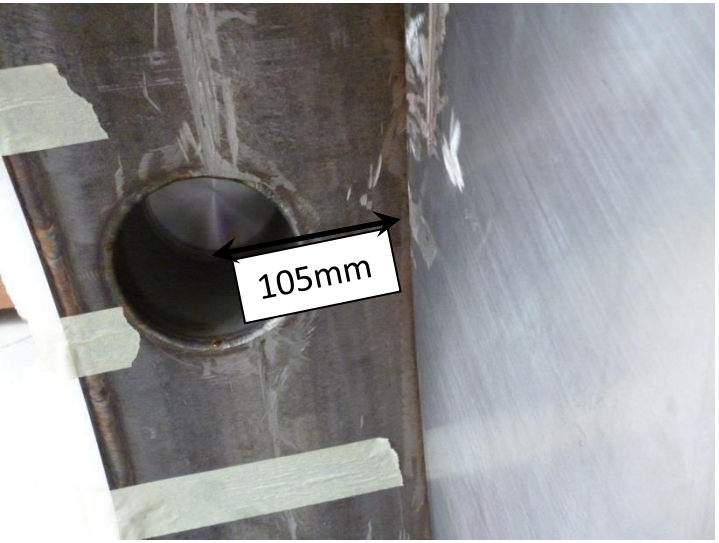
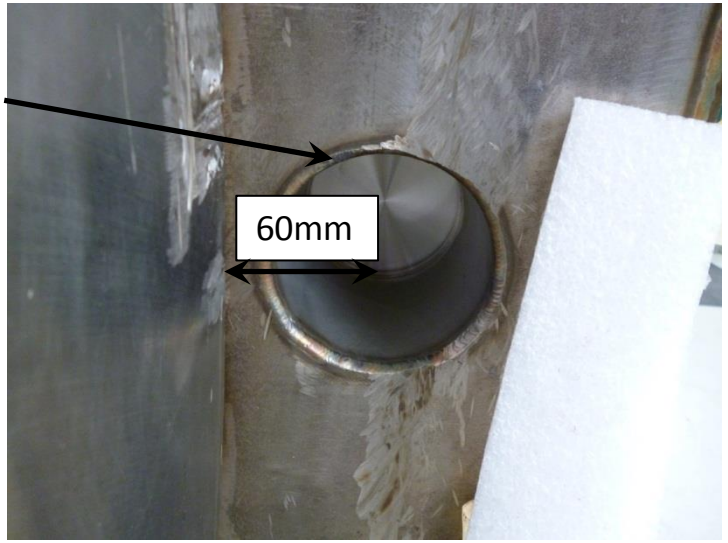


MICE Radiation Shield – Spectrometer



Bore internal diameter: 98mm
CAD 70mm



Right and left port longitudinal offset.

CAD dimensions: 108mm and 63mm respectively.
Flange to flange distance across Spectrometer face; measured: 1637mm, CAD: 1710 !!!!!
This is where the cables will be fed through.
See following slide for the manual handling test arrangement to illustrate the current set up.

Images courtesy of Tim Hayler