Vacuum Chamber Design and Infrastructure Requirements and for the ATF Laser-wire Experiment

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(on behalf of the UK Laser-wire collaboration)

Vacuum Chamber Design - The Challanges

- The design of the optical, vacuum and mechanical hardware systems are **strongly** coupled

- For 'micron' spot sizes the lens needs to be very close to the beam-line, with a very large aperture

- This required a non-standard approach to chamber design (see later)

- The very high peak laser power (GW) requires specialized optical components to avoid damage and 'image' distortion

- A novel indium window seal has been designed and tested to avoid distortion of the vacuum window

- Precise alignment of the lens and incoming laser beam will be critical - special procedures will need to be developed to achieve 'micron' spots

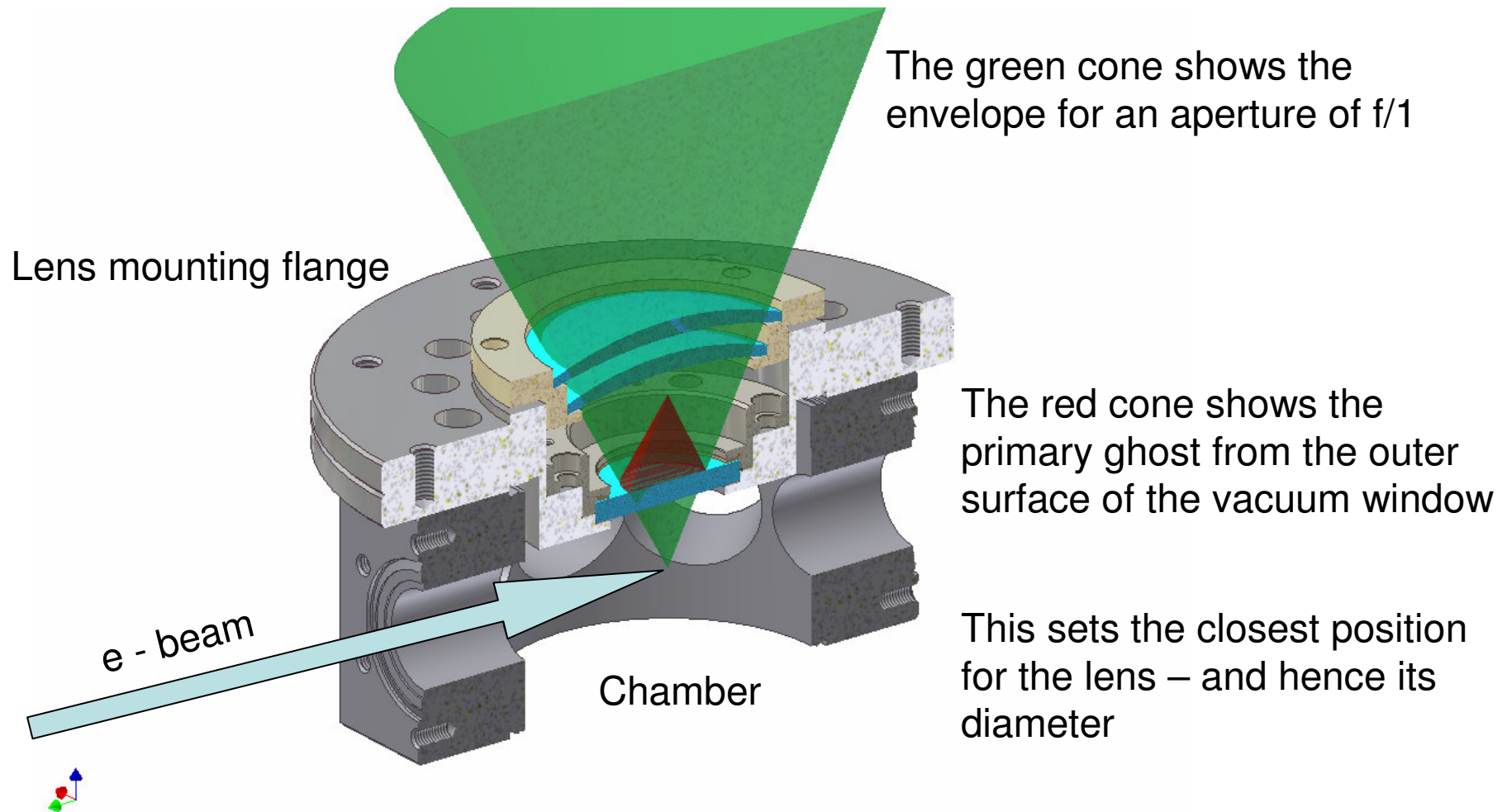D howell & F Gannaway

Design study for Vacuum Chamber

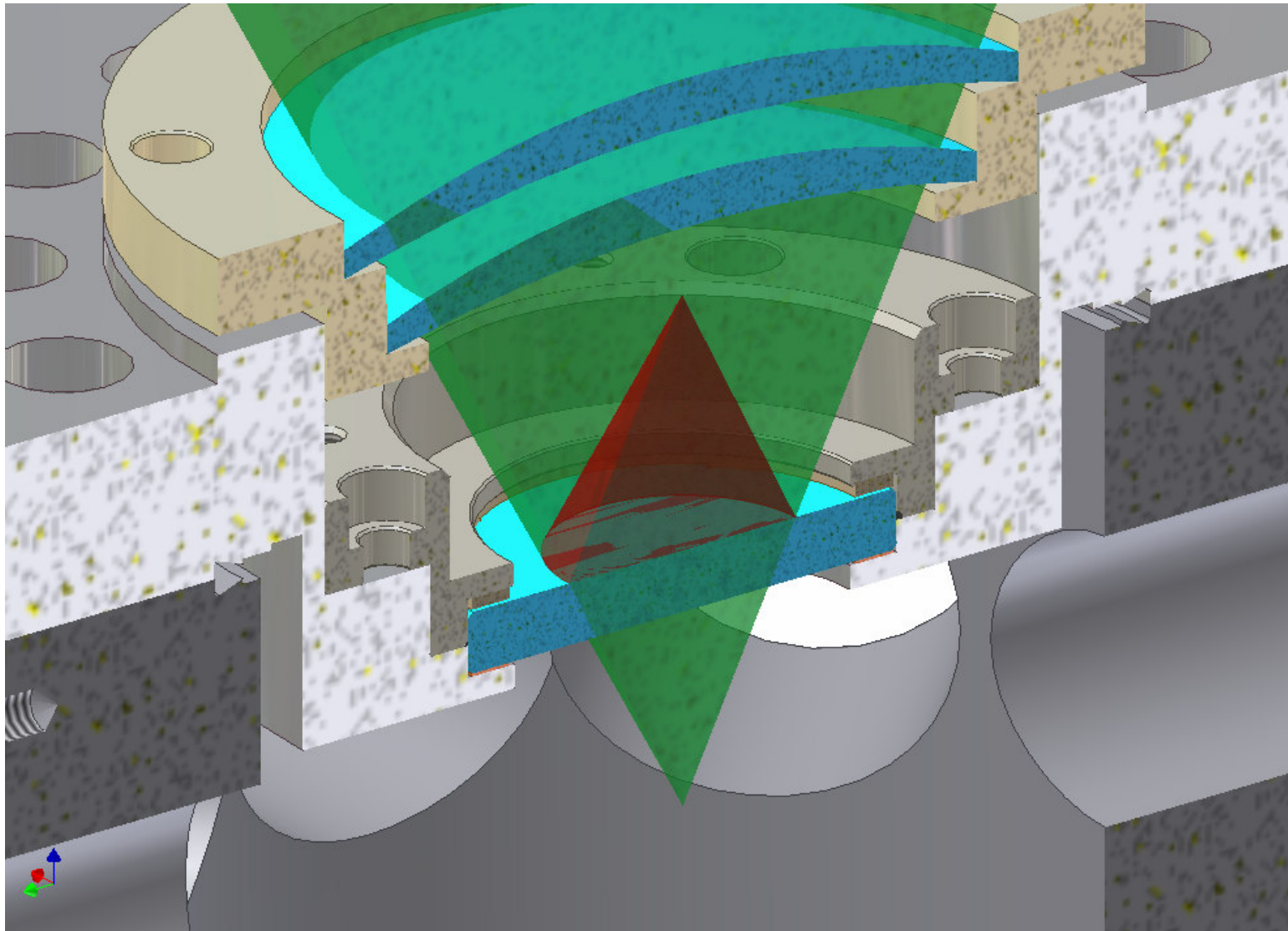## Solid model using AutoCad Inventor

Objectives:

• Limiting aperture of f/1

• 30mm internal diameter for electron beam-line

• Window mount >17mm from IP

• Primary and secondary ghosts from window not formed in lens

• Very stable mounting of lens relative to window and incoming
    laser beam

• Very fine adjustment of lens angle relative to window

• Small overall size

•Two options for lens studied

Preliminary design study – Lens option 1
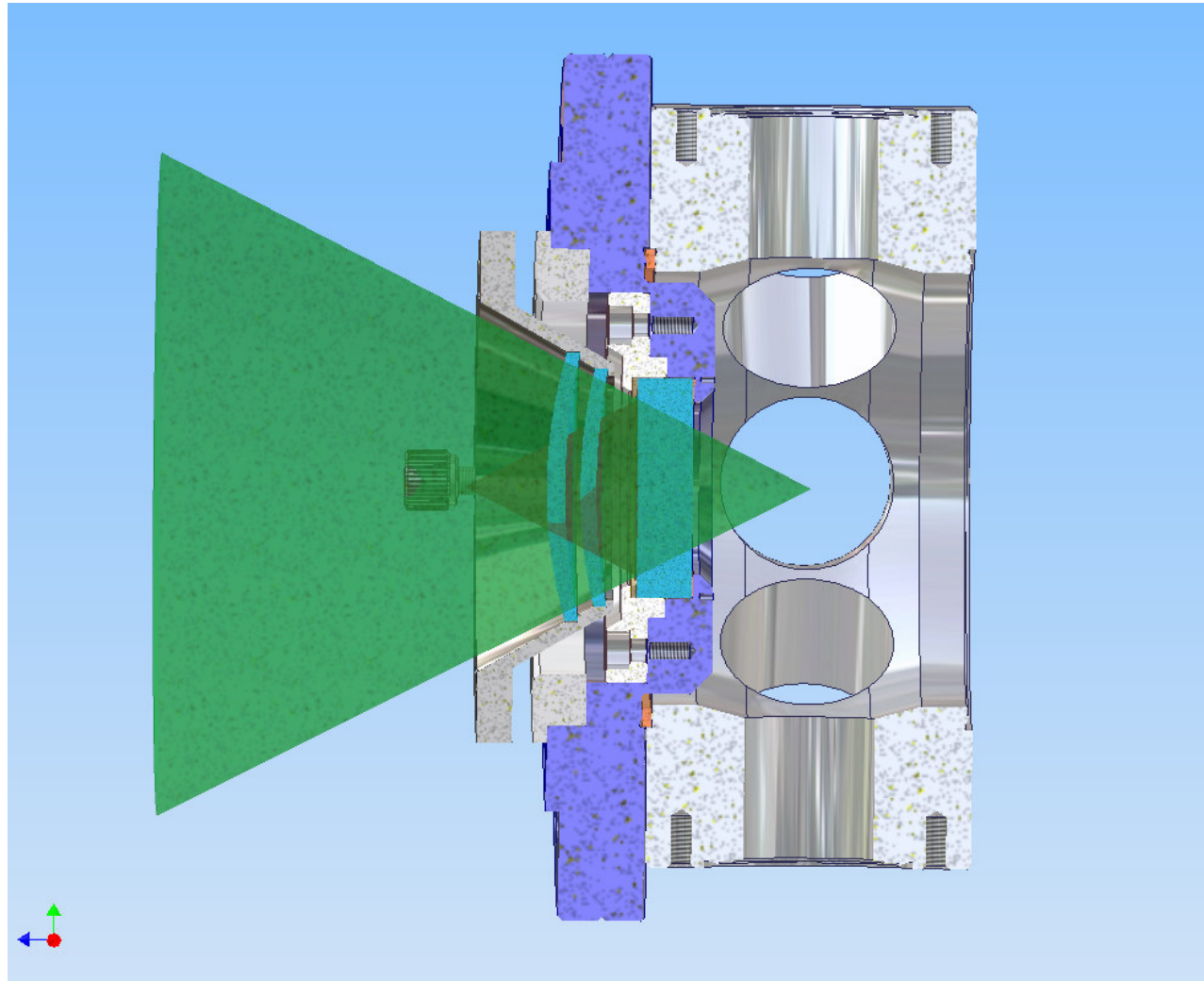## Cross-section in the plane containing the electron beam line and the laser beam axis

The green cone shows the envelope for an aperture of f/1

Lens mounting flange

The red cone shows the primary ghost from the outer surface of the vacuum window

e - beam

This sets the closest position for the lens – and hence its diameter

Chamber

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Close-up of window and lens mounting arrangement

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Lens option 2
Minimum lens/window spacing

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Lens option 1 showing fine lens angle adjusters
The final design will use differential micrometer screws

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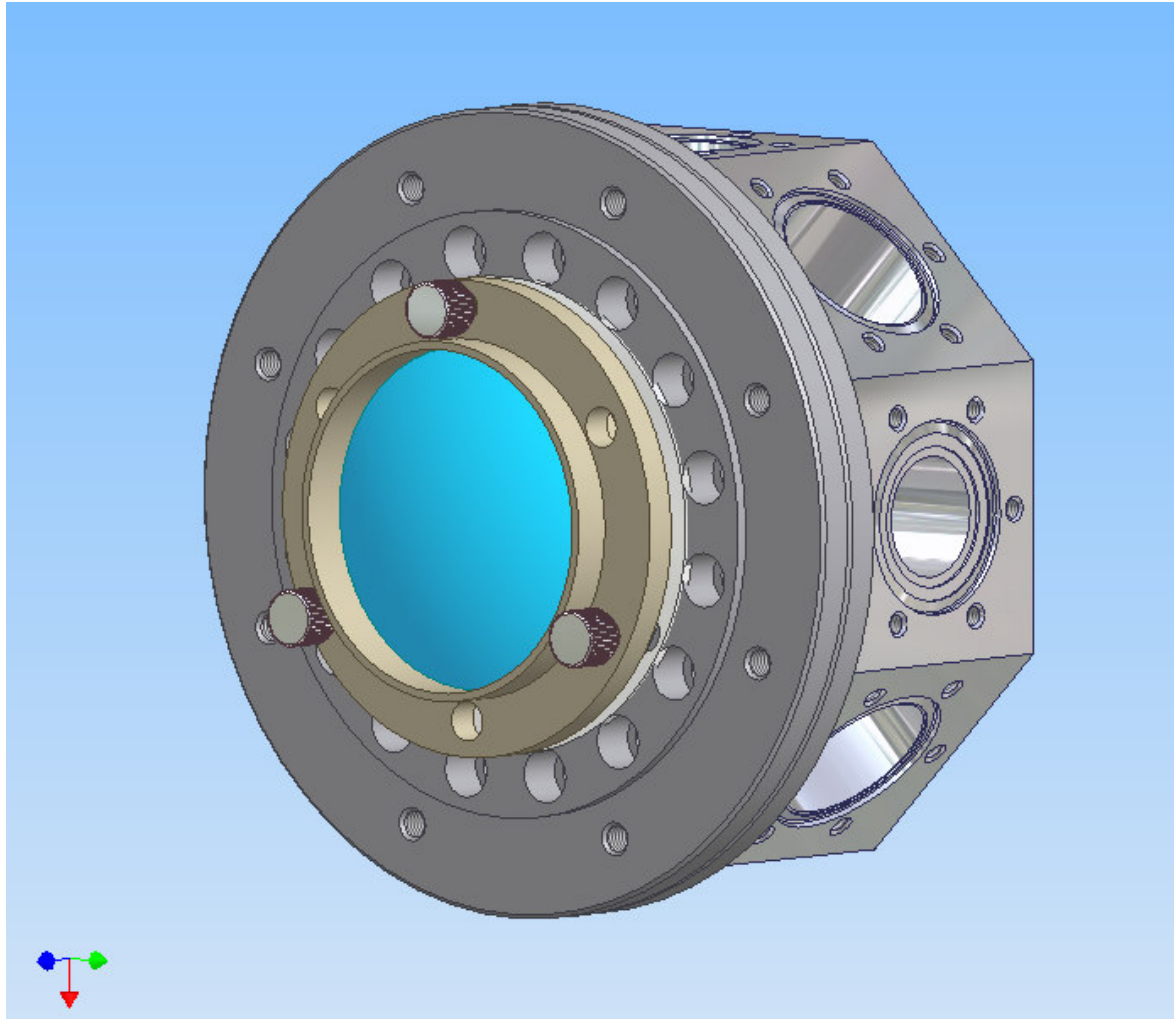
Novel Indium window seal

- This is **crucial** to the success of our approach

- Prototype designed, manufactured and tested in Oxford

- Further vacuum tests at KEK

- 4 seals cycled many times between vacuum and atmospheric pressure

- No Indicated Leaks

- Seal design works

Close-up indicating initial Indium seal position (in black)
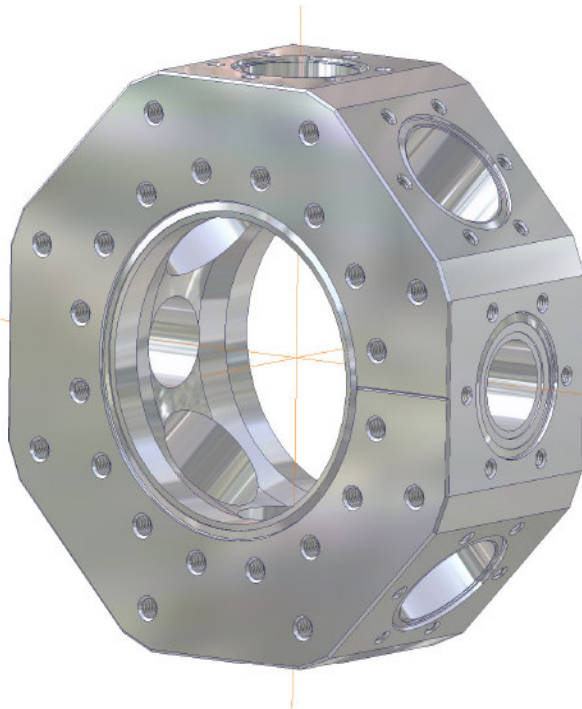## Also showing thin annealed copper washer under window

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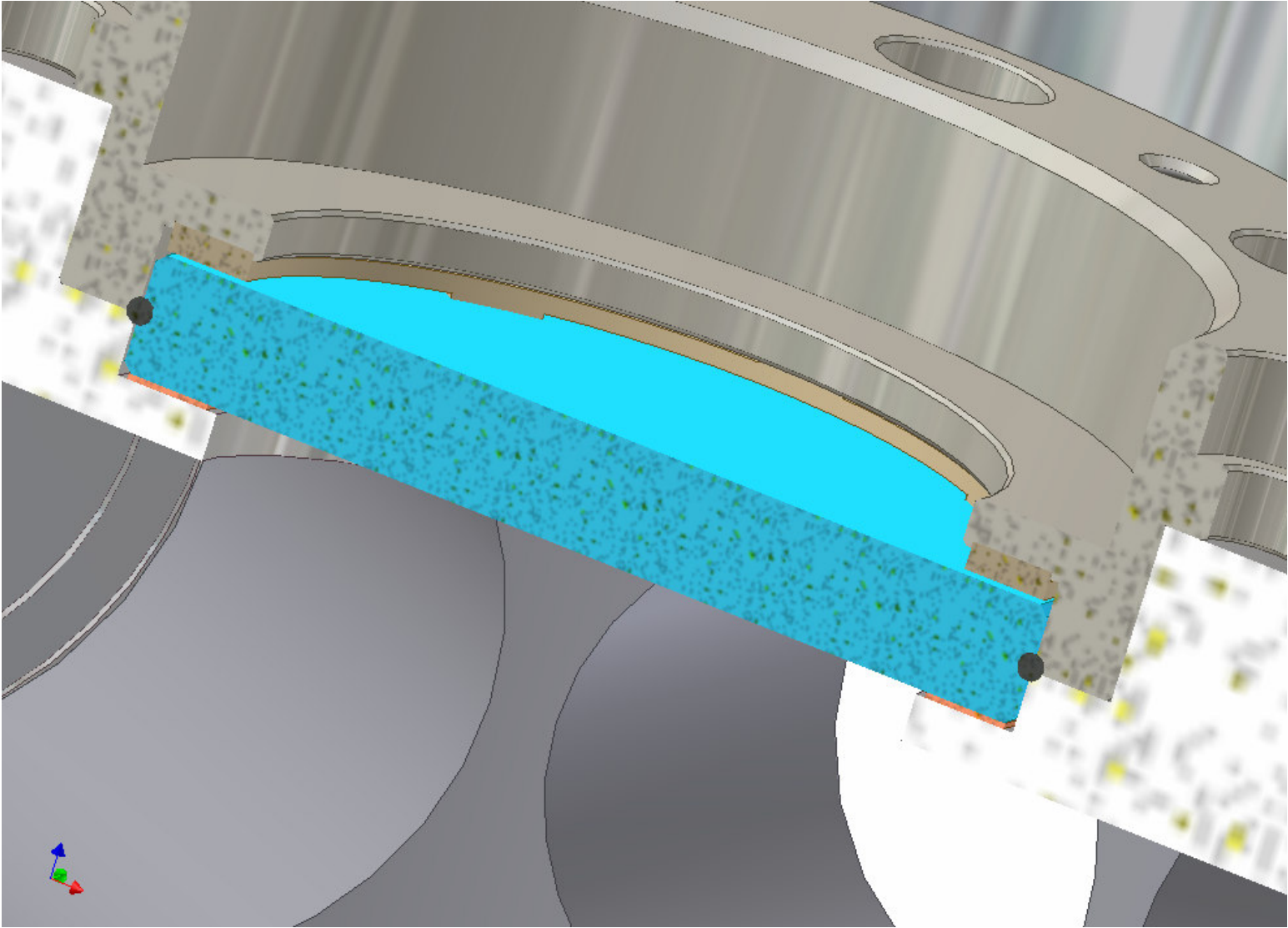
Actual window after vacuum testing at KEK
Showing Indium still firmly attached to edge of window
### The Indium had to be 'torn' to release the window from the mount – which required significant force

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Vacuum chamber block – Final version
80 mm thick, 190 mm flats

Ready to start CNC machining in Oxford tonight!
Need to confirm overall dimensions and bore for e-beam (30 mm)
– TODAY –
in order to meet September deadline to install complete system

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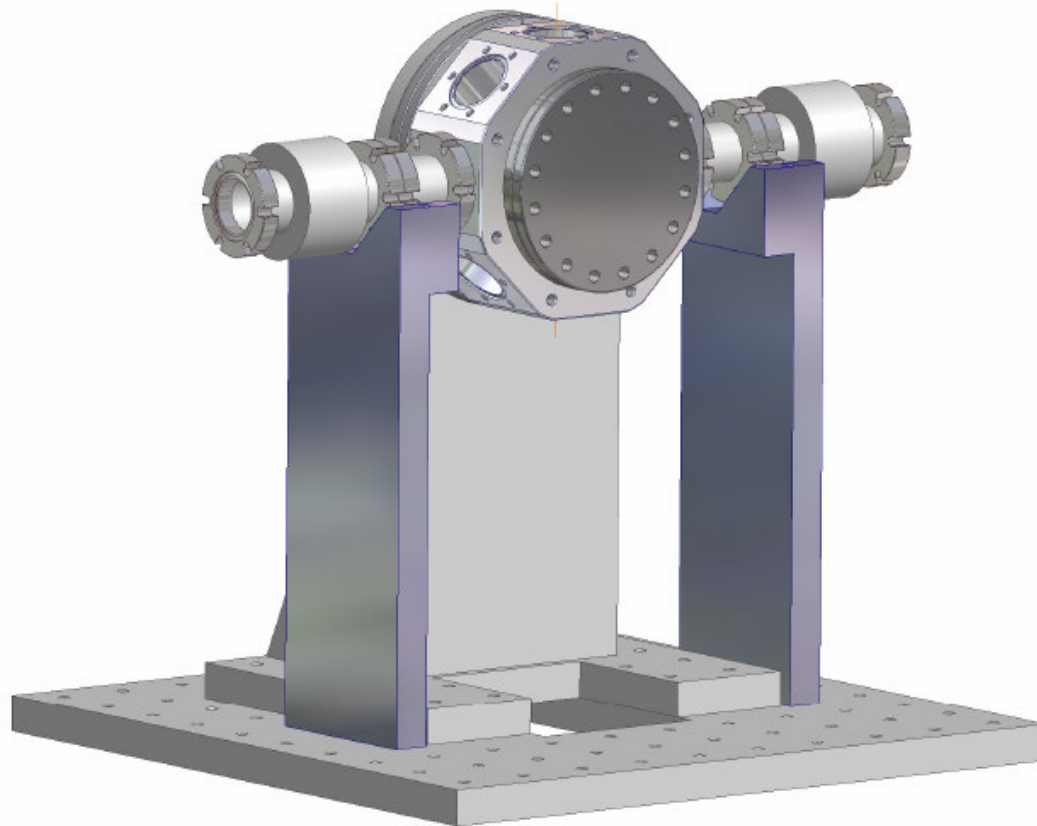# Laser-wire chamber with special CF70 nipples and existing BPMs attached
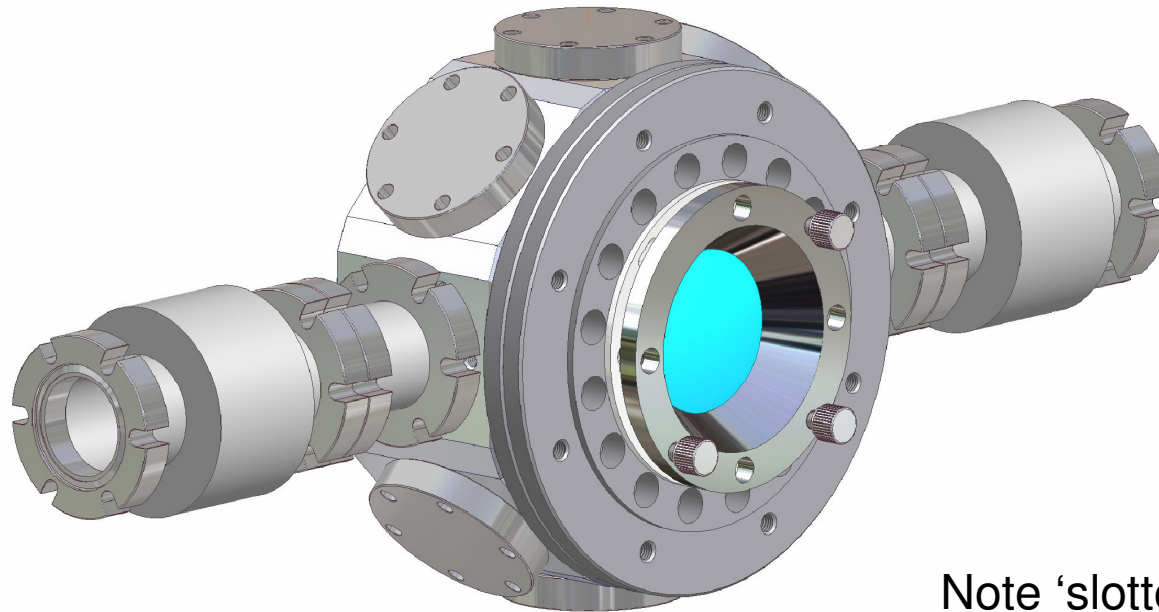
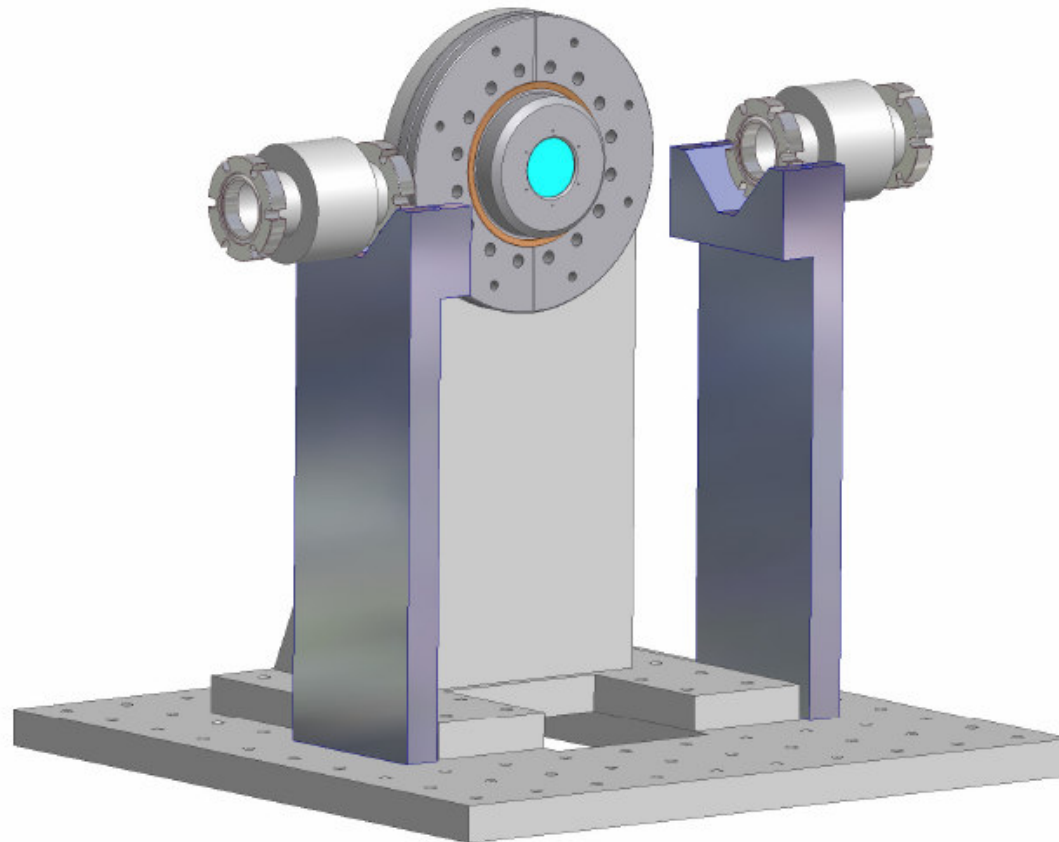Note 'slotted flanges' are required to fit bolts

Possible mounting arrangement
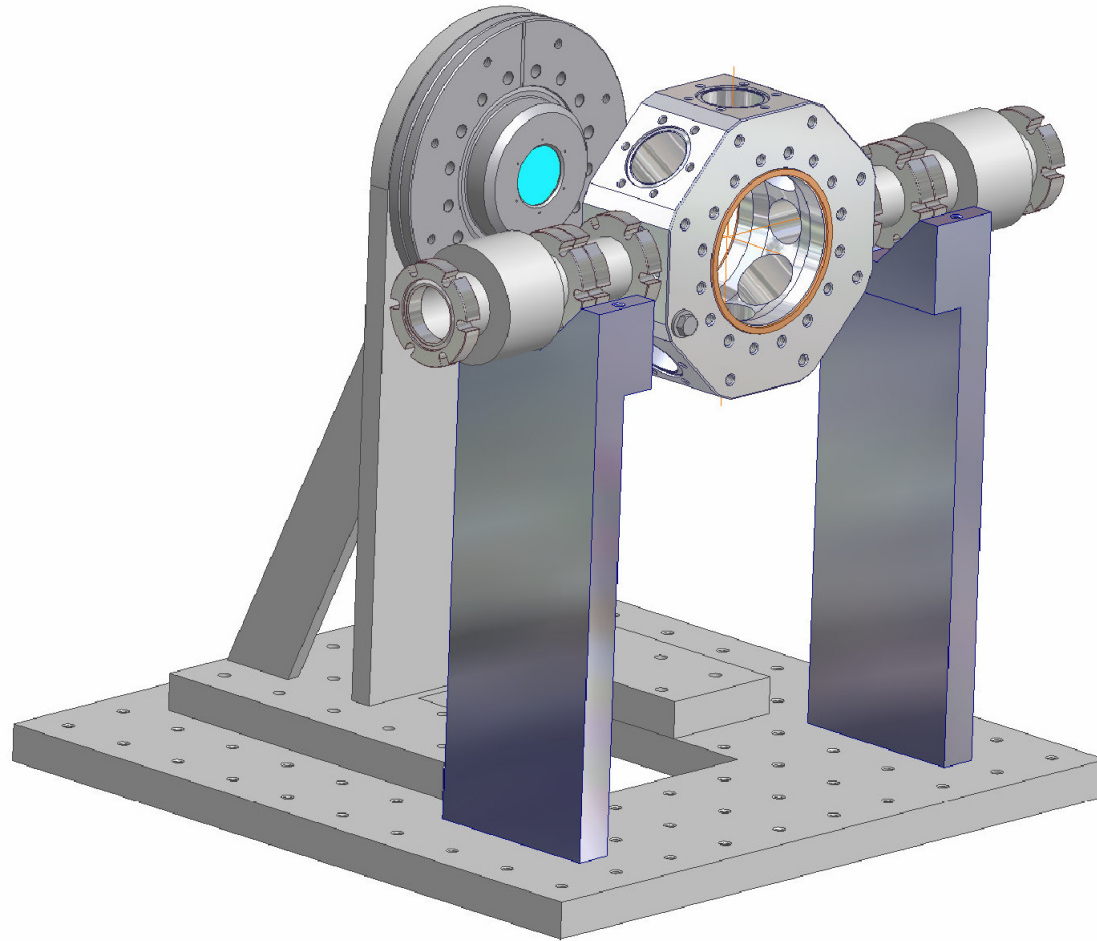## Rough idea only - further work is already underway

Chamber removed to allow laser spot to be precisely measured 'in-situ'

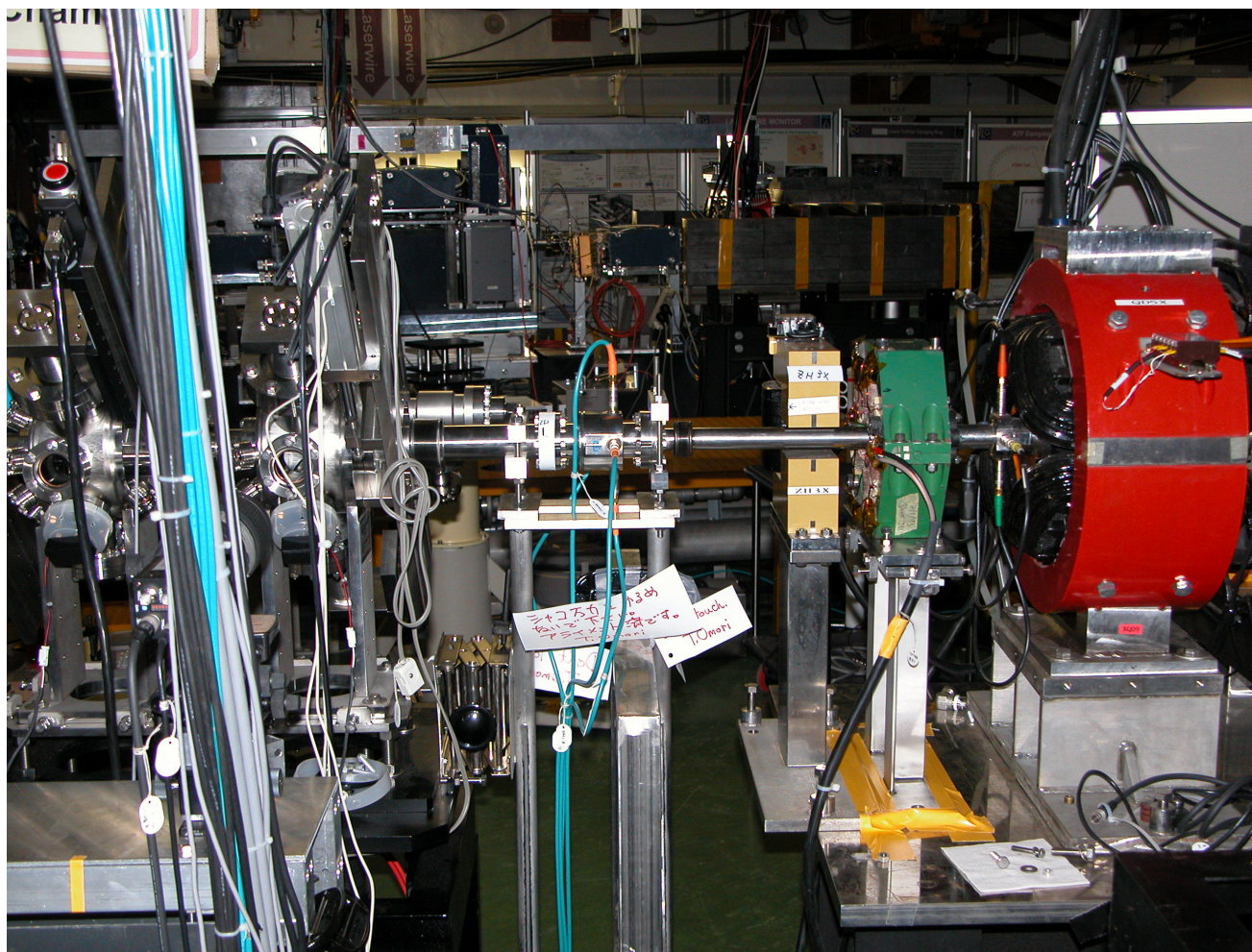## Laser-wire spot referenced to flange – need to add survey points to flange

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Possible to retract lens flange to allow initial setting up without disrupting ATF operations
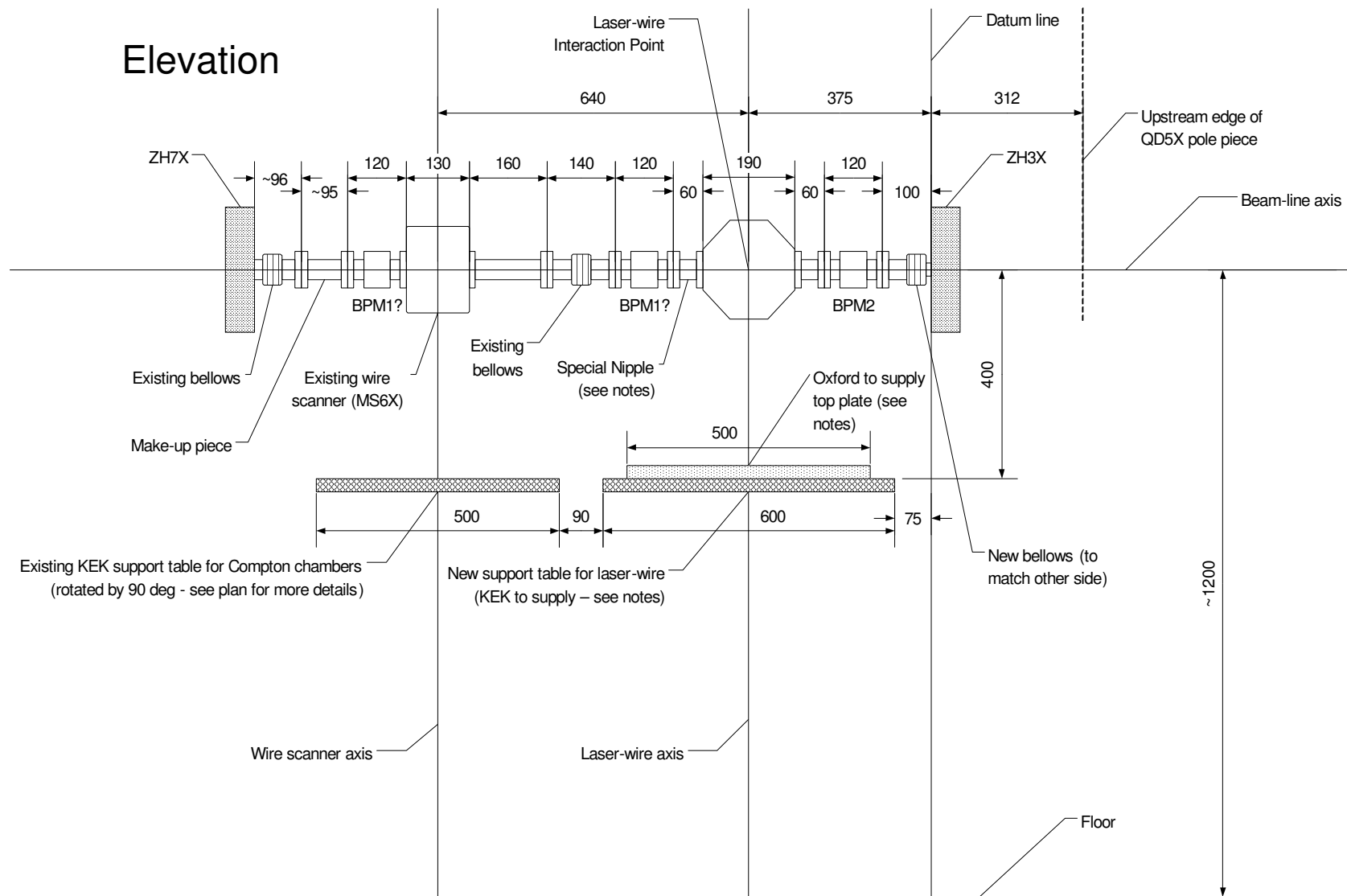
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Proposed location for Laser-wire Interaction Point

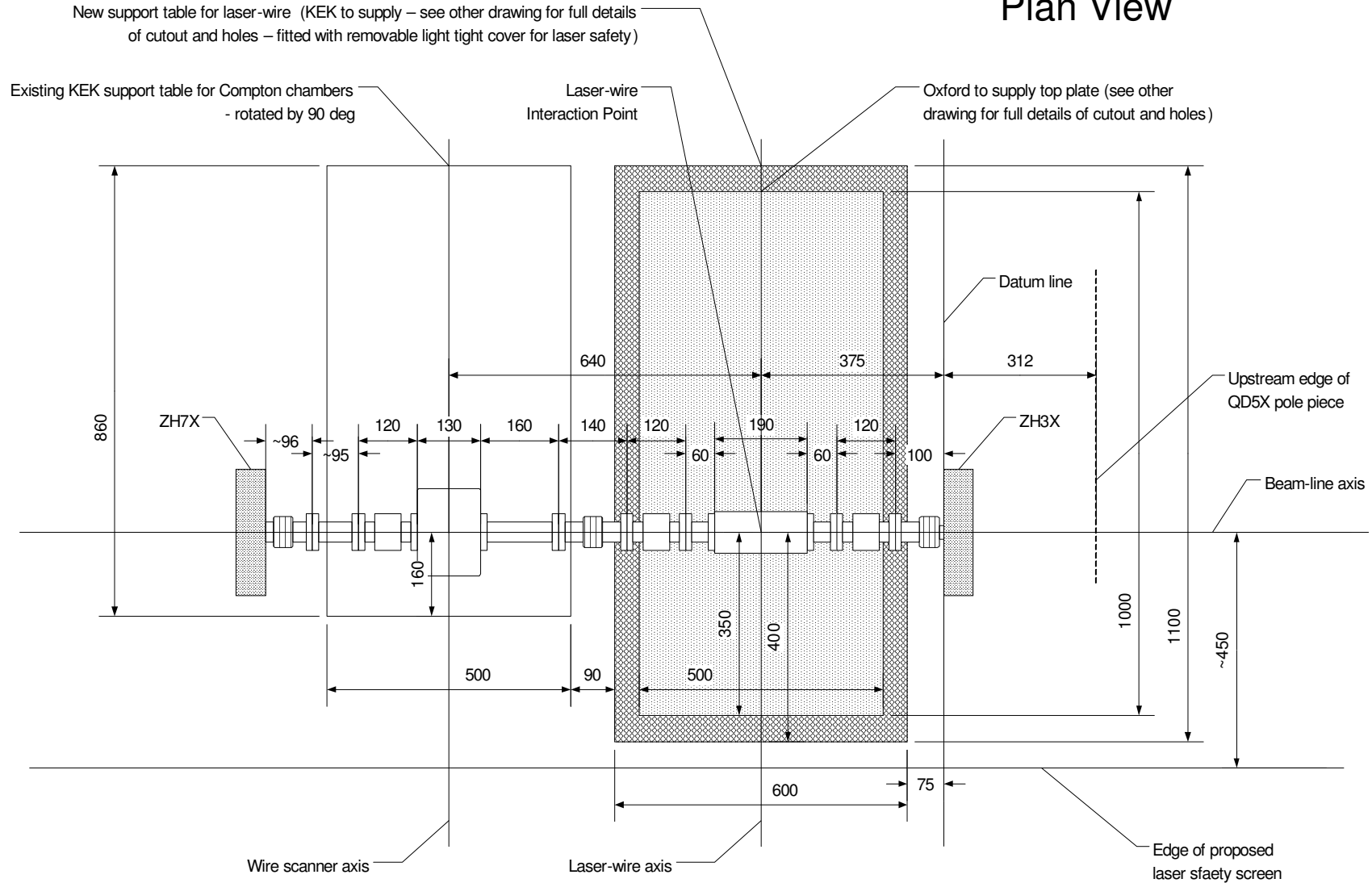Approximately 85 mm upstream of the white tape mark
– on the LHS flange of the BPM

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Proposed IP position and ATF layout in Laser-wire region

Elevation

Proposed new mounting table – KEK to provide

Plan View

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21/06/2005

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Proposed layout of the experimental area

Laser-wire optical table and interaction point   D F Howell 6/6/05

All dimensions in millimetres

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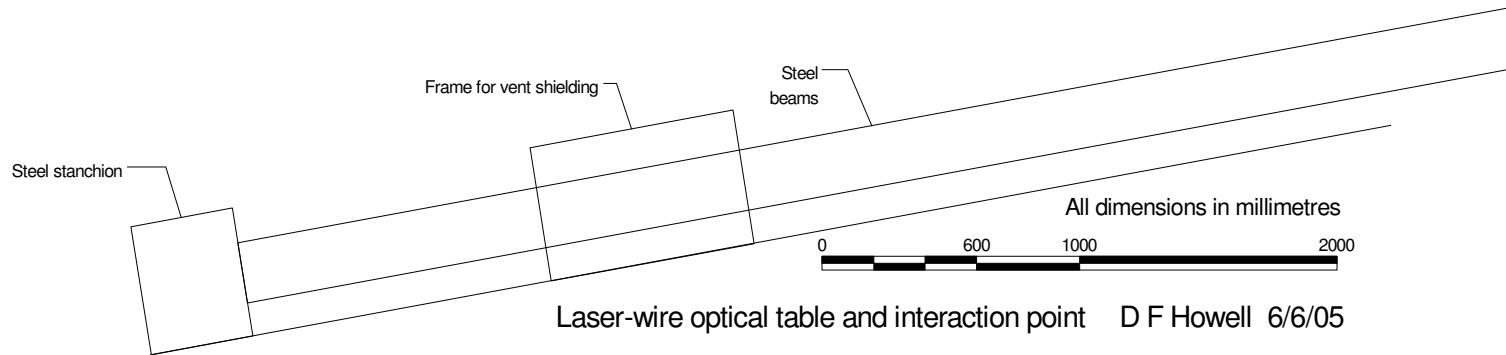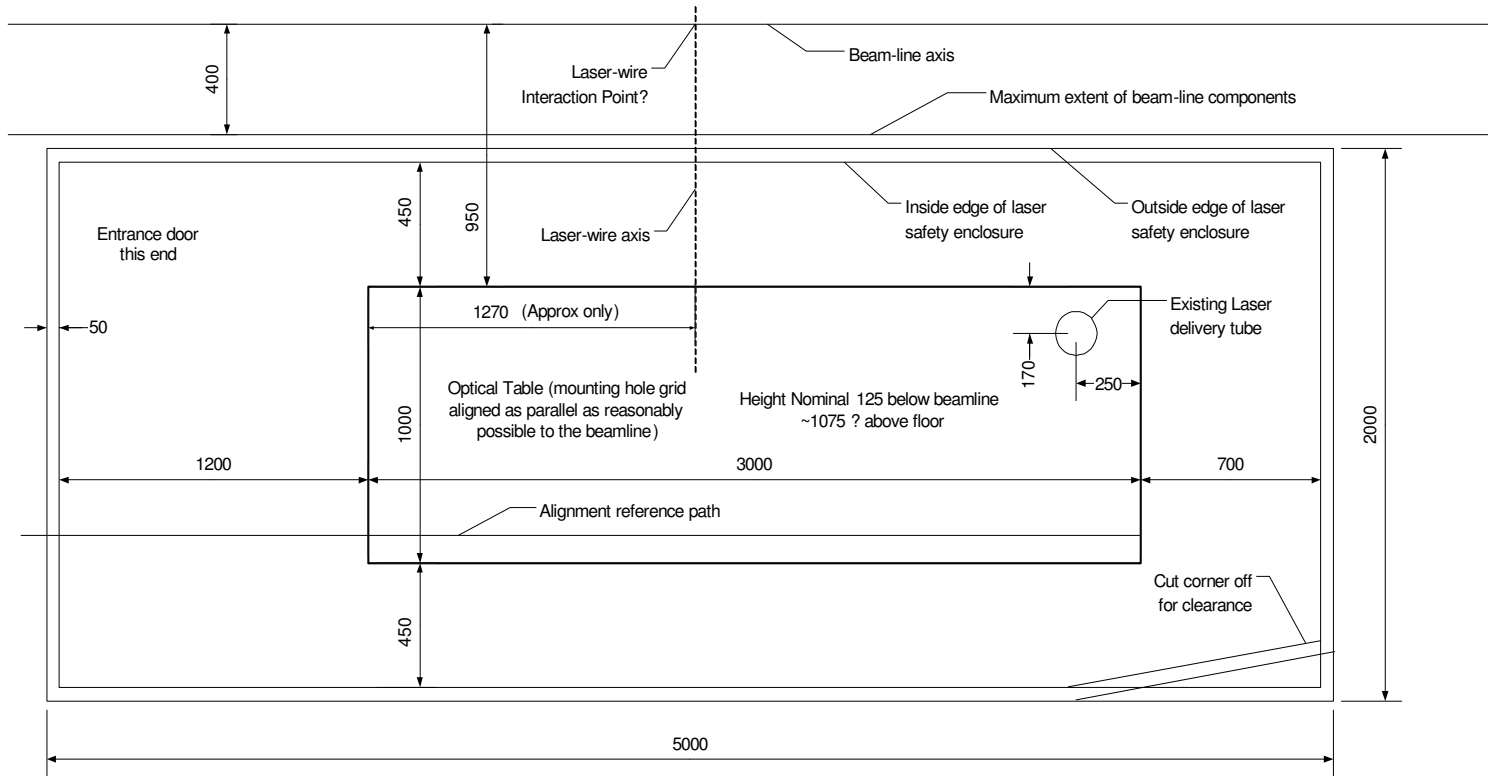
Infrastructure Summary
Request to KEK

- Confirm position of Laser-wire IP

- Confirm overall size of vacuum chamber and bore - **TODAY**

- Supply new optical table, 3000 x 1000 x ~300 mm (Top surface 125 mm below beam line - D Howell will confirm details this week)

- Provide support table for Laser-wire chamber – similar design as existing Compton chamber support table – dimensions as per drawing

- Provide laser-safety screening around both of the above

- Supply additional vacuum components – as per drawings

- Drill new cable hole through shield blocks - between existing laser hut and new optical table (approx 100 mm diameter)

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