

Final Doublet Stability and in-detector Interferometry MONALISA

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MONALISA

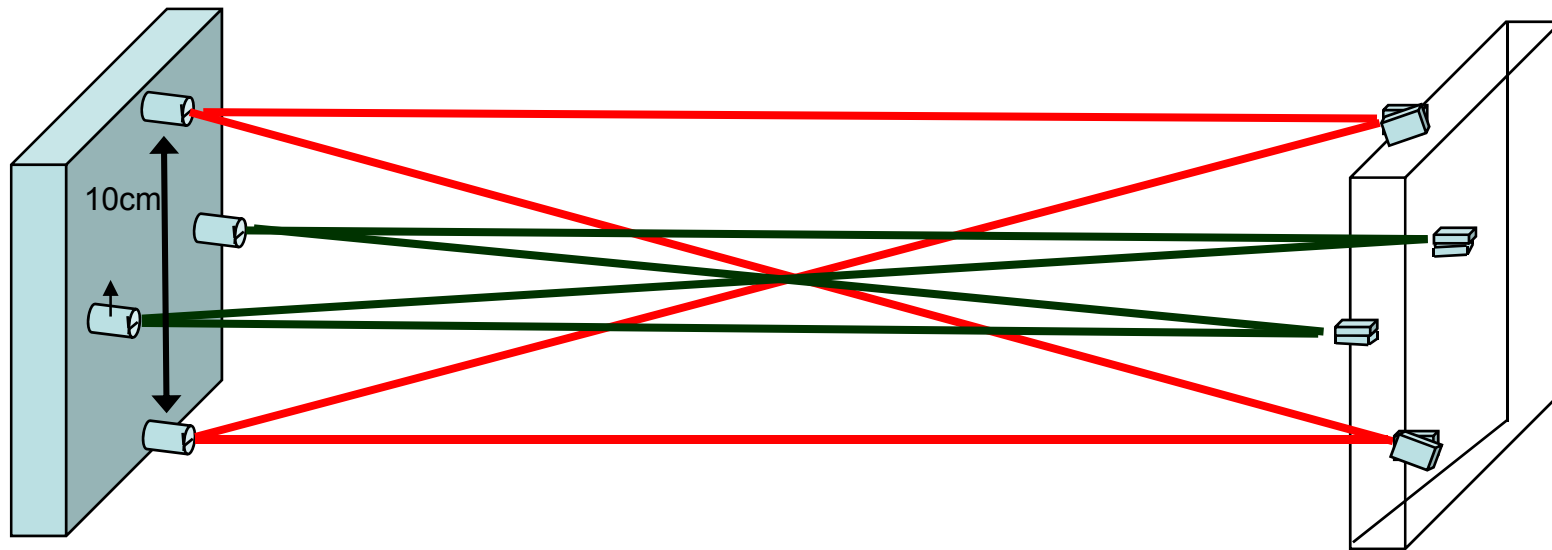
MONitoring ALIgnment and Stabilisation with high Accuracy

- Is an interferometric metrology system for continuous monitoring of position critical accelerator components
- Consists of a fixed network of evacuated interferometric distance meters with nanometre type resolutions over $O(10\text{m})$

MONALISA at ILC

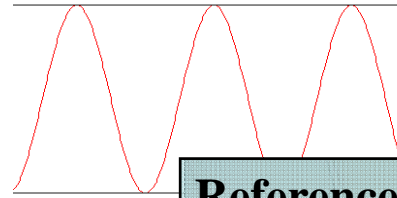
- Survey and initial alignment required.
- Working alignment needs to be maintained / restored.
 - between trains
 - 200 ms is long enough for several 100 nm movement
 - Take into account long term drifts
 - after push-pull events:
 - IR hall floor will move after rolling two heavy detectors
 - Restore luminosity quickly after shutdown periods
- A position monitoring system of critical elements is your friend.

Main Component: CSM (Compact Straightness Monitor)

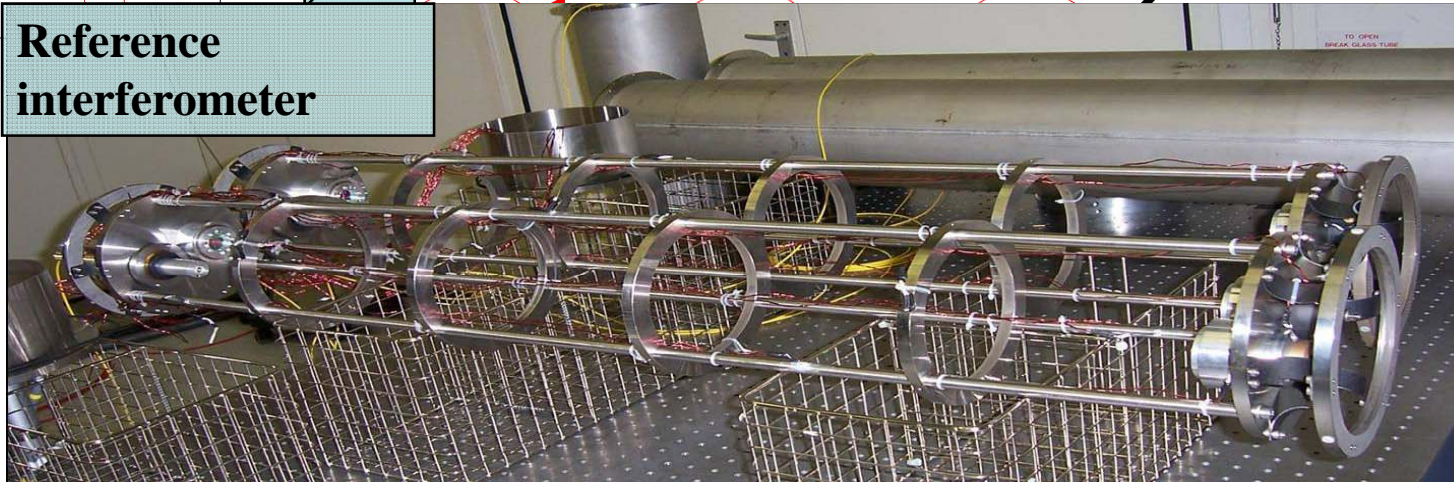
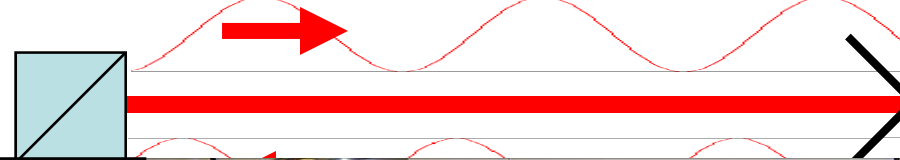


- 6D position transferred from left to right
 - Integral use of sturdy endplates required.
 - Relative measurements $O(1\text{nm})$
 - To understand geometry absolute measurement $O(1\mu\text{m})$

FSI



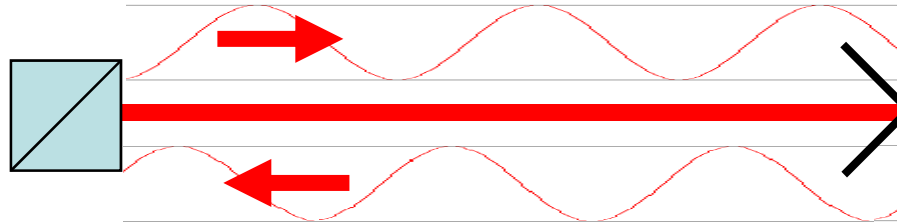
Reference
interferometer



$$D = (c/2\pi) (\Delta\Phi/\Delta\nu)$$
$$R = (c/2\pi) (\Delta\theta/\Delta\nu)$$
$$D = R (\Delta\Phi/\Delta\theta)$$

Frequency Scanning Interferometry

Interferometer operation



Phase = 2π (Optical Path Distance) / Wavelength

$$\Phi = 2\pi D / \lambda$$

$$= 2\pi D (\nu / c)$$

frequency scanning

$$\Delta D = (c/2\pi \nu) \Delta\Phi$$

Fixed Frequency Interferometry

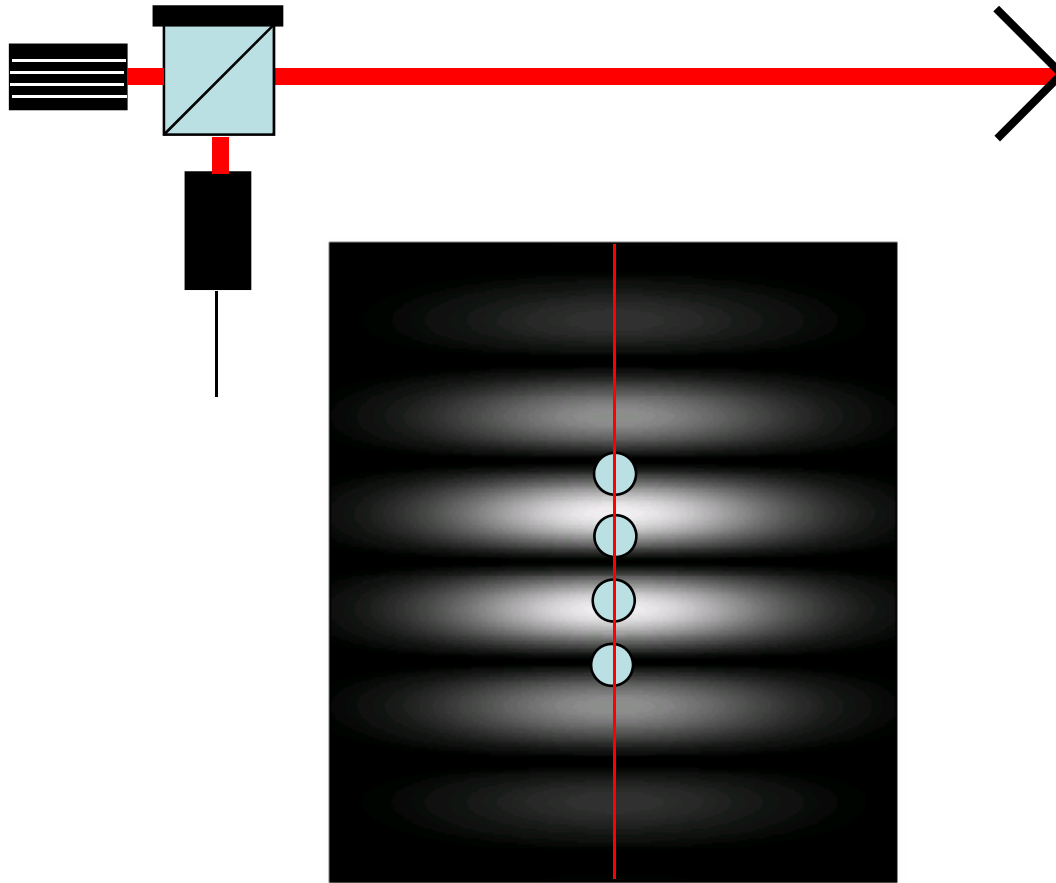
$$D = (c/ 2\pi) (\Delta\Phi/\Delta\nu)$$

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$$D = R (\Delta\Phi/\Delta\theta)$$

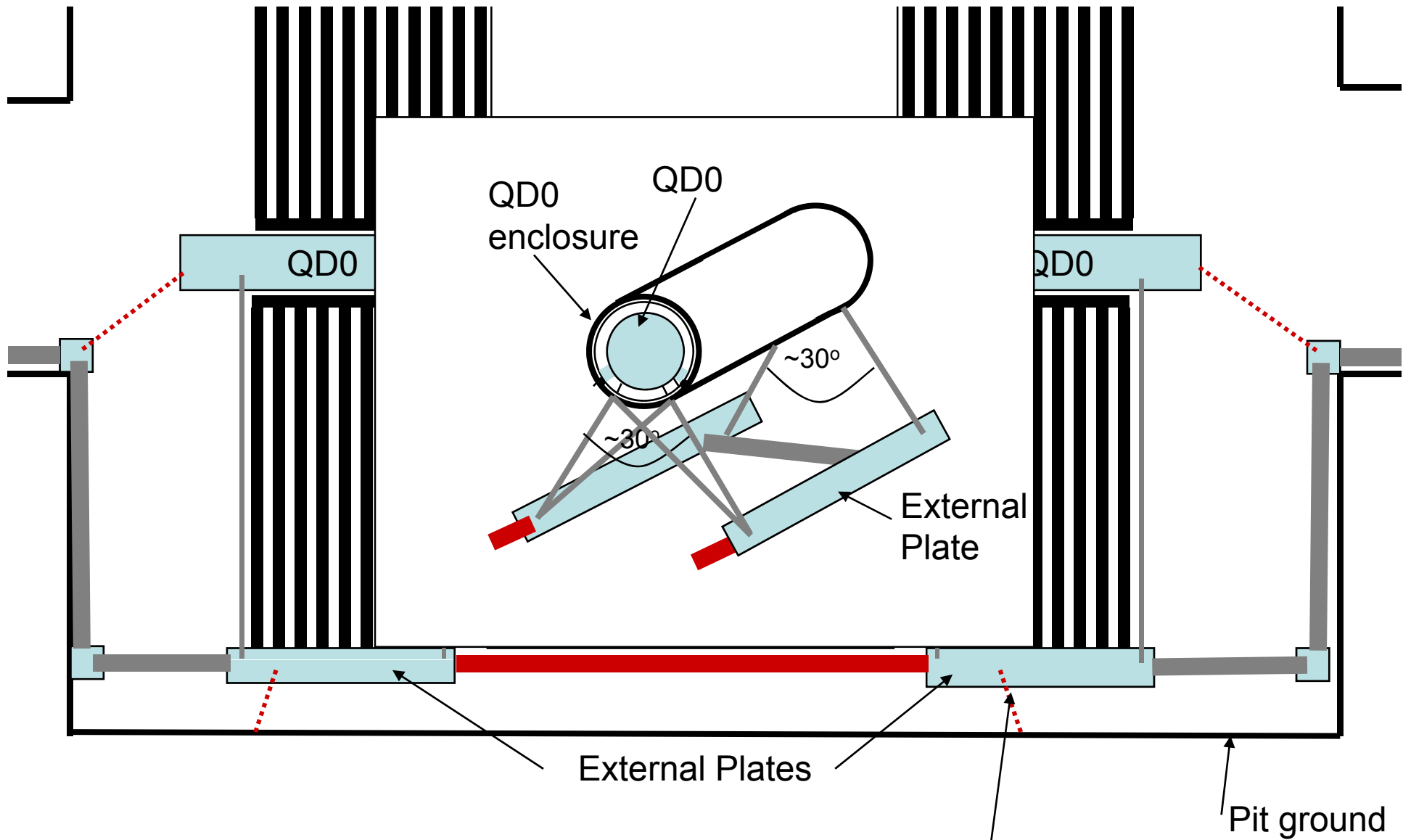
Frequency Scanning Interferometry

Interferometer operation



Distance meter

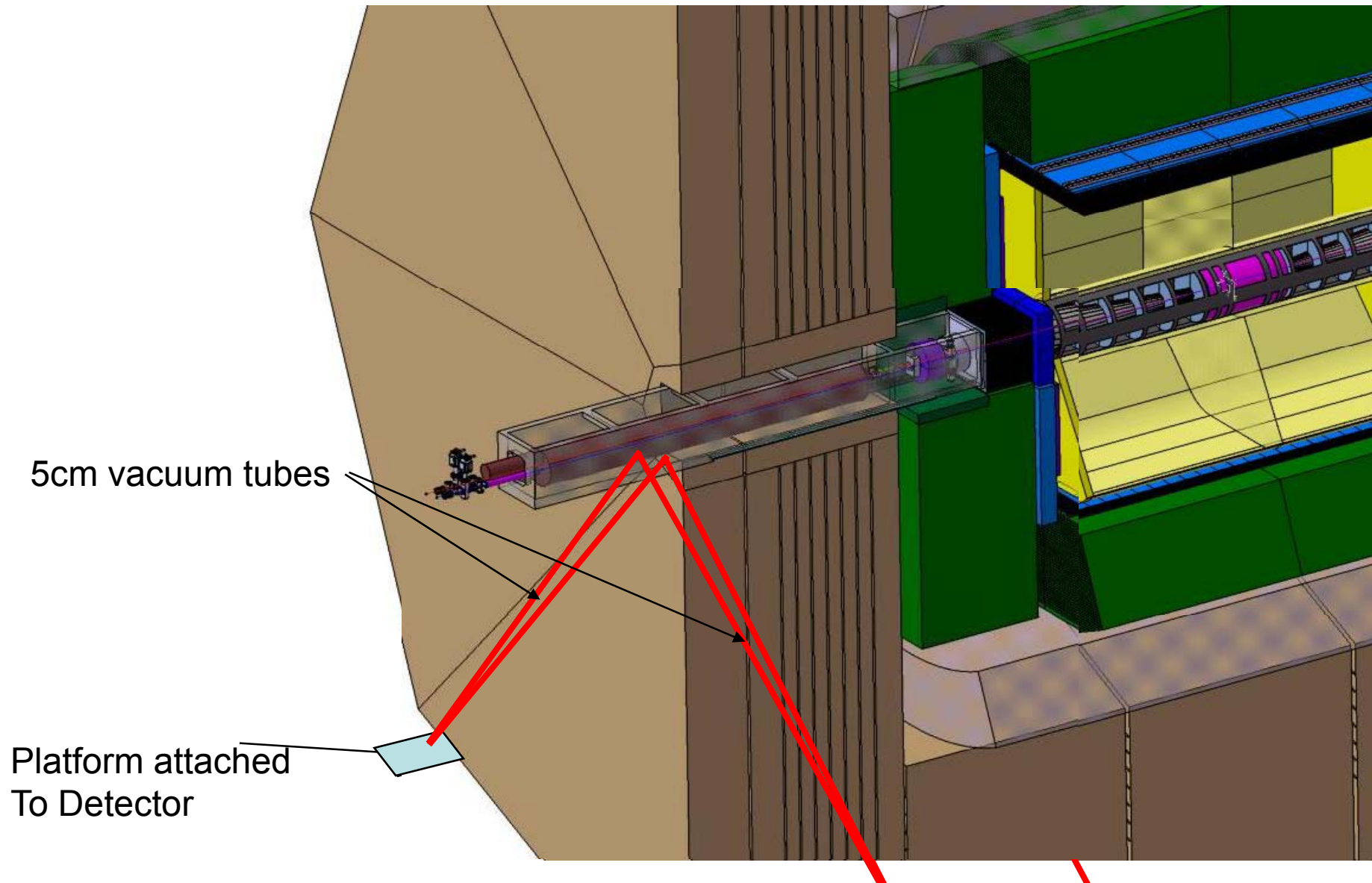
- Measurement Frequencies:
 - FFI: up to 10kHz
 - FSI: up to 1Hz
- Long term stability determines low frequency behaviour
 - For FSI given by quality of reference interferometer
 - For FFI we are building a system to lock the laser frequency to spectral feature of rubidium.
- Advantage of interferometric measurement system is fairly low cost per line.
 - Use of telecom frequency allows use of cheap commercial hardware.
 - Cheap amplification of light.

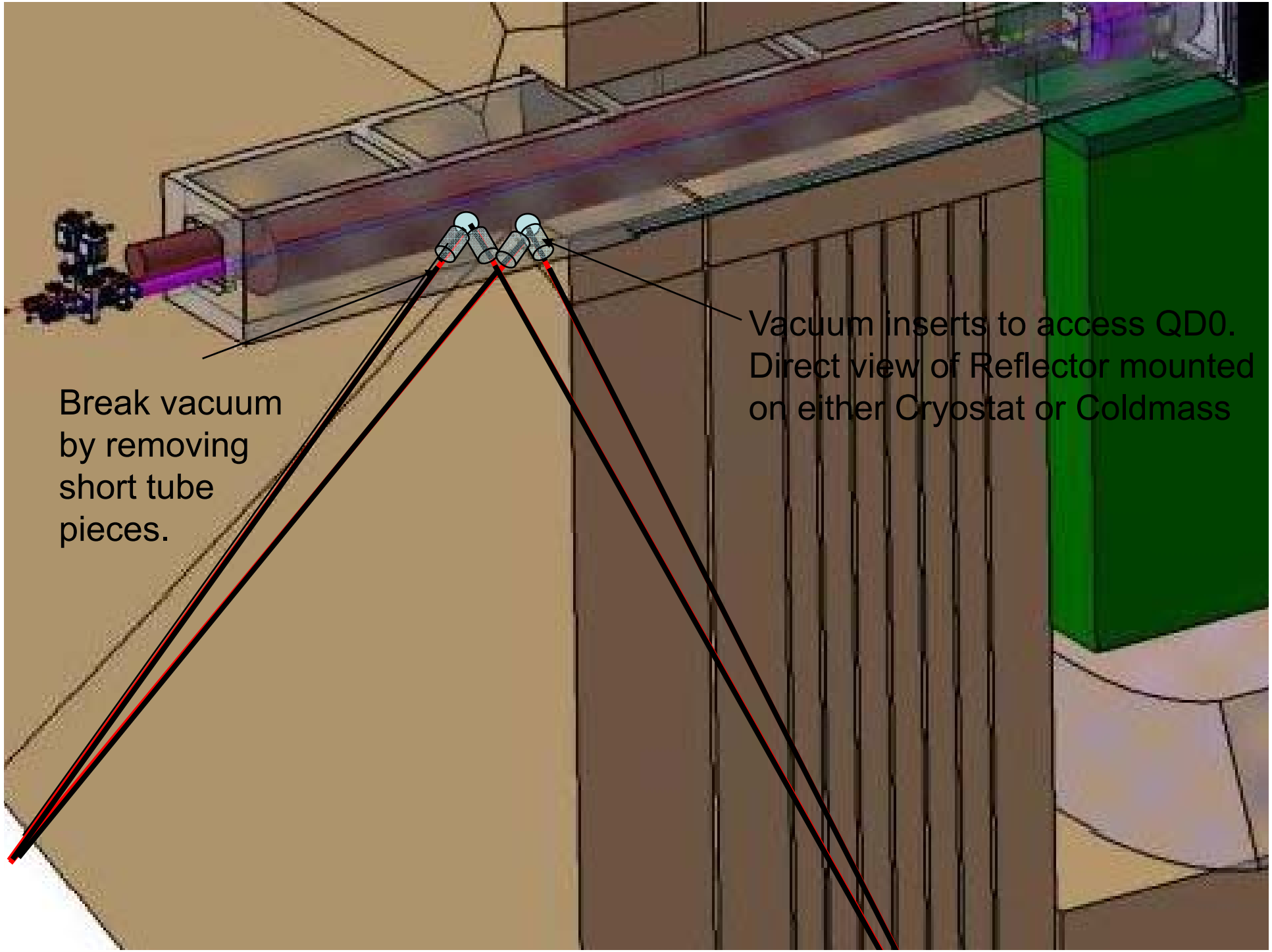


- Distance meter in air (protected)
- Distance meter in vacuum (5 cm)
- CSM (18 cm)

Several lines needed to wall and ground used to reposition detector

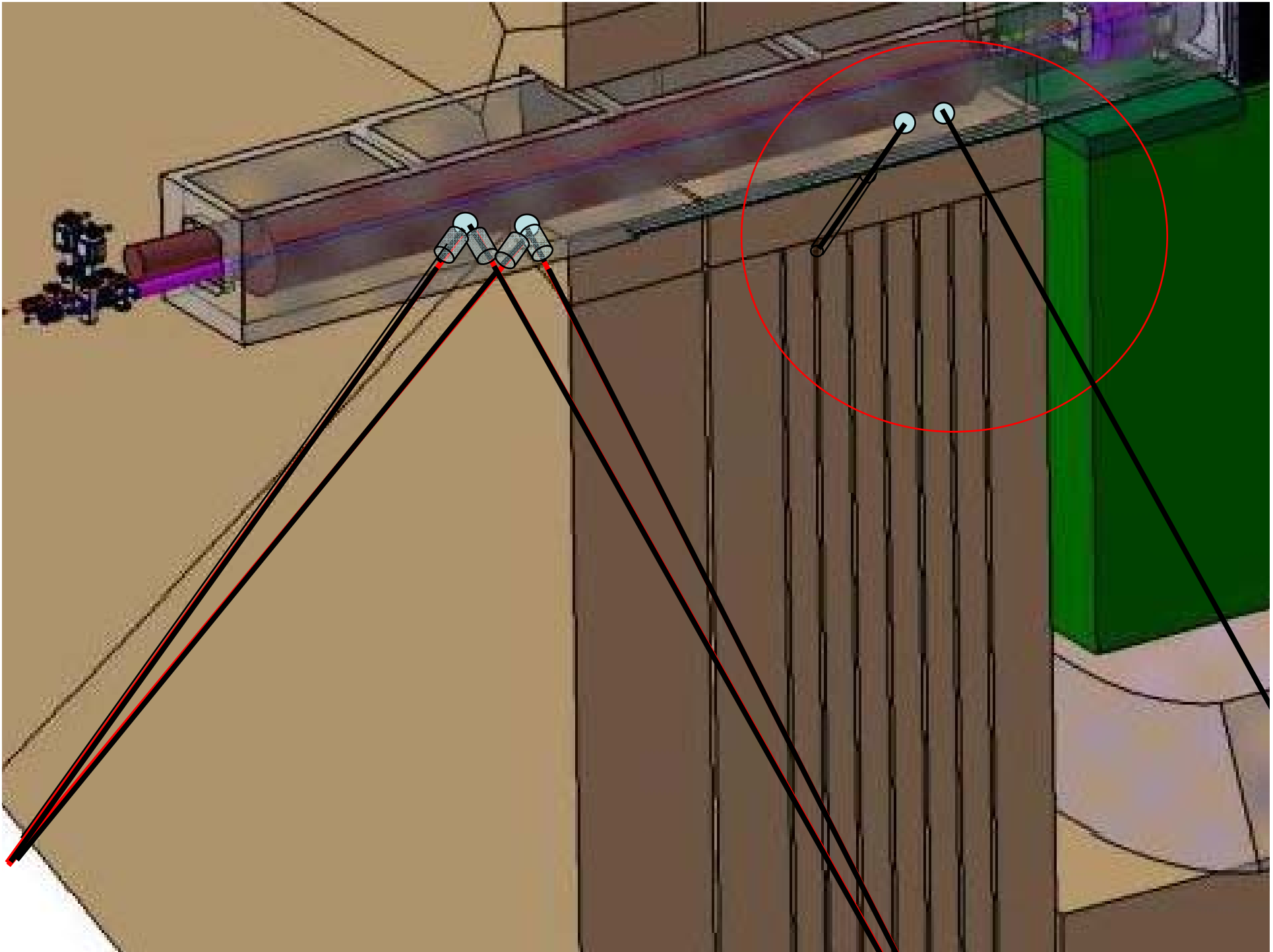
Access to QD0 (ILD)



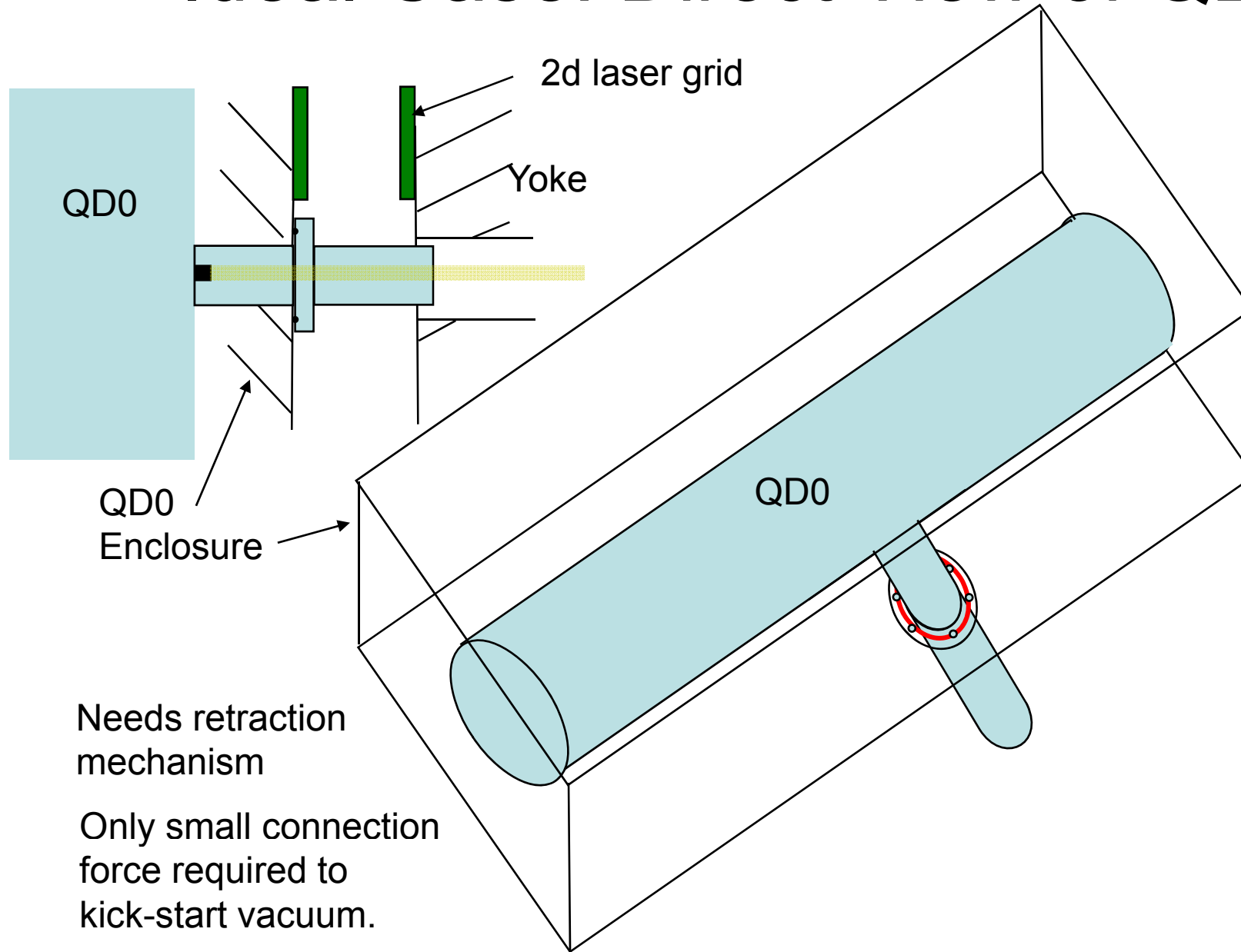


Break vacuum by removing short tube pieces.

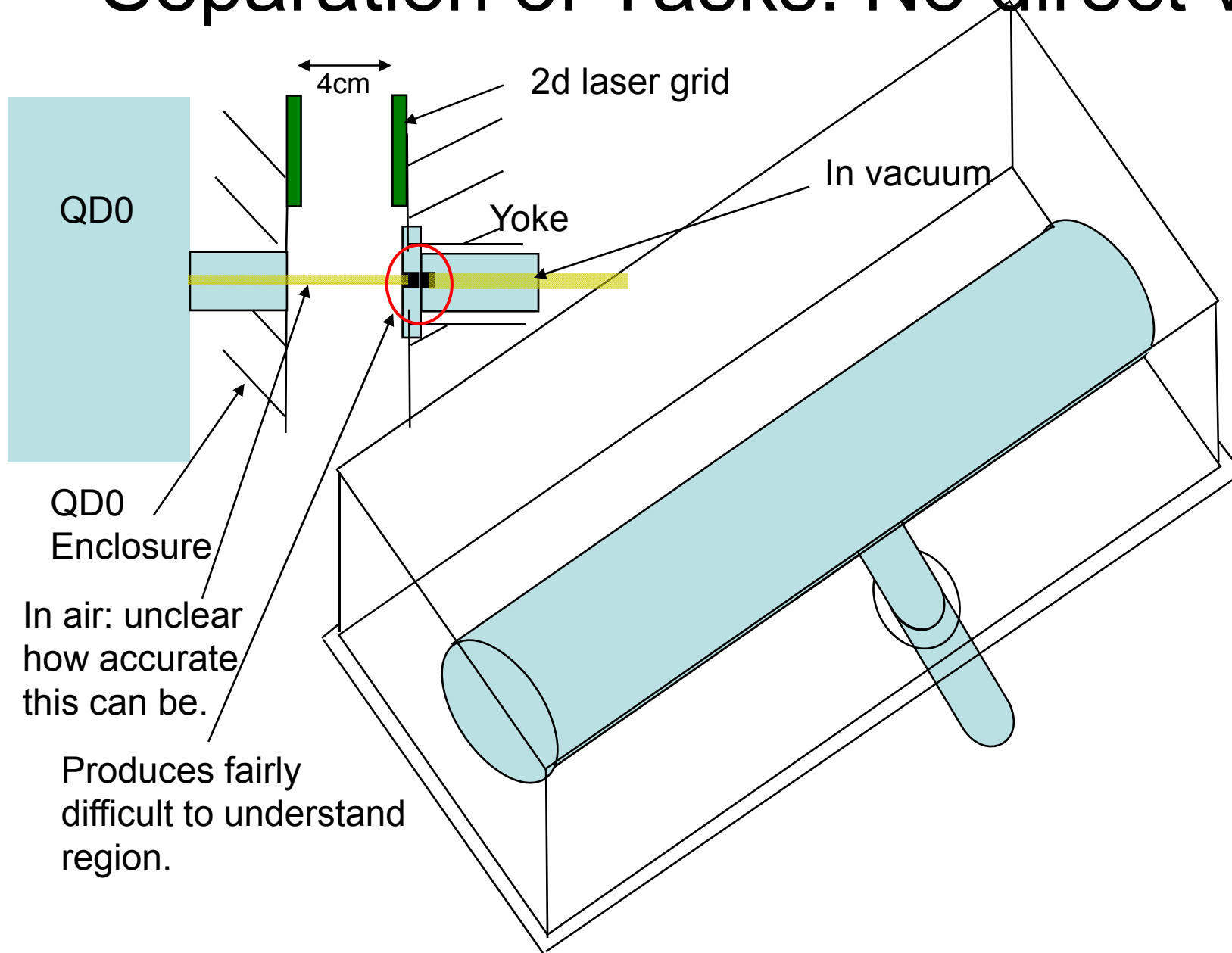
Vacuum inserts to access QD0. Direct view of Reflector mounted on either Cryostat or Coldmass



Ideal Case: Direct View of QD0



Separation of Tasks: No direct view



How to go from here

- Need real engineering
 - Who is doing what?
 - Conceptual design would be good basis to decide on direct/indirect view
- SID will be different – should we try to keep commonalities?
- Not heard from 4th concept yet.