

# Monolithic suspension assembly procedure (DRAFT)

Status 27<sup>th</sup> May 2009

LIGO-T0900203-v2



# Monolithic assembly procedure

Monolithic suspension is done for the ETM and ITM



3 main stages

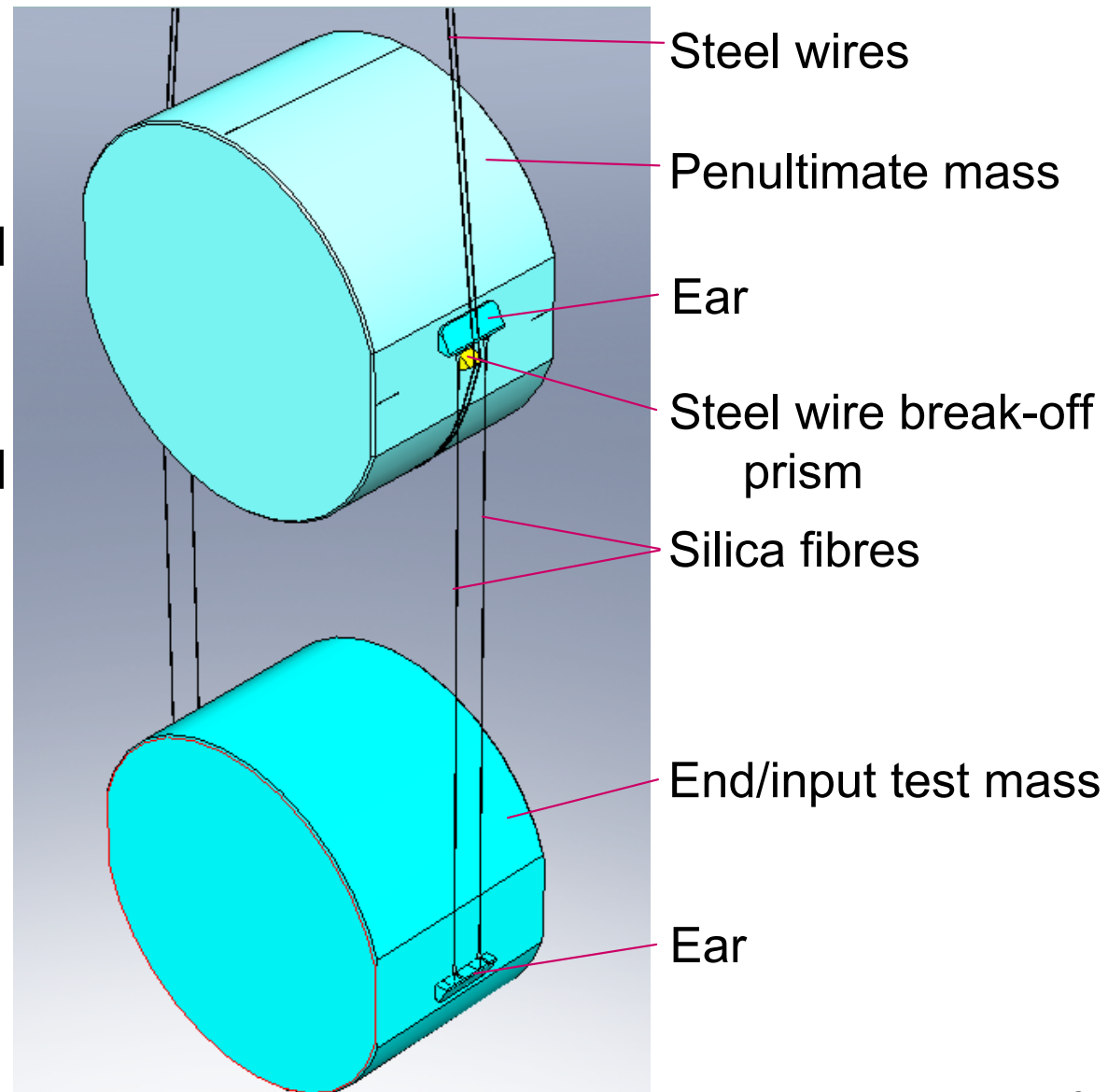
- Preparing masses
  - Test masses
  - Penultimate masses
- Manufacturing and proof testing fibres
- Installation of fibres



## Monolithic assembly procedure

### Preparing masses

- Test masses
  - Hydroxide catalysis bond ears
- Penultimate mass
  - Hydroxide catalysis bond ears
  - Glue break-off prisms
  - Glue earth-quake stops



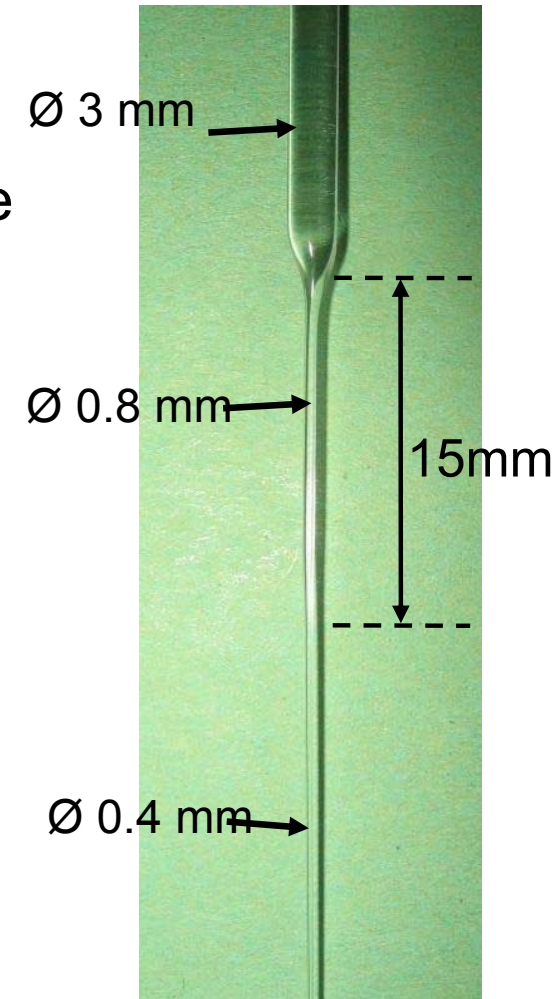
LIGO-T0900203-V2

## Monolithic assembly procedure



### Manufacture and proof test fibres

- Pull fibres with a laser pulling machine
  - Dumbbell shape for thermo-elastic noise optimisation and frequency
  - Diameter of fibres  $\pm 5 \mu\text{m}$
  - Length  $\pm 0.1 \text{ mm}$
- Proof test fibres
  - Load fibres with 12.5 kg
- Measure the fibre profile (accuracy  $\pm 5 \mu\text{m}$ )
- Bounce test fibres
  - To determine the bounce frequency and therefore the stiffness of the fibres (required frequency 10 Hz loaded)



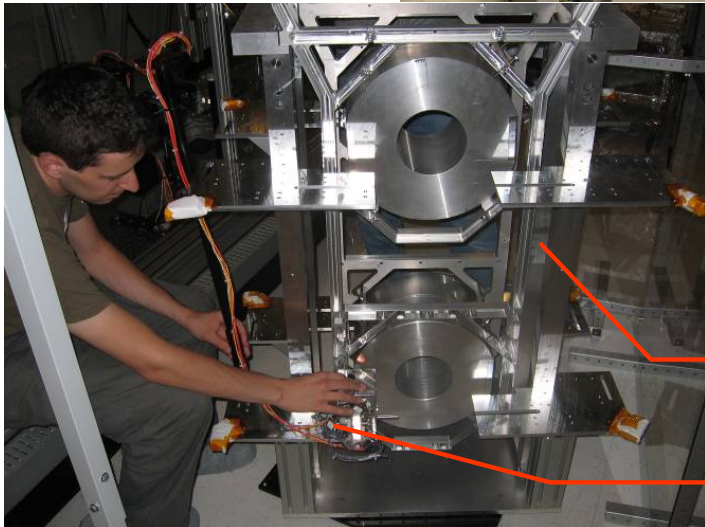


# Monolithic suspension tooling



Fibre pulling machine and articulated arm

Close-up of the conical mirrors for fibre pulling

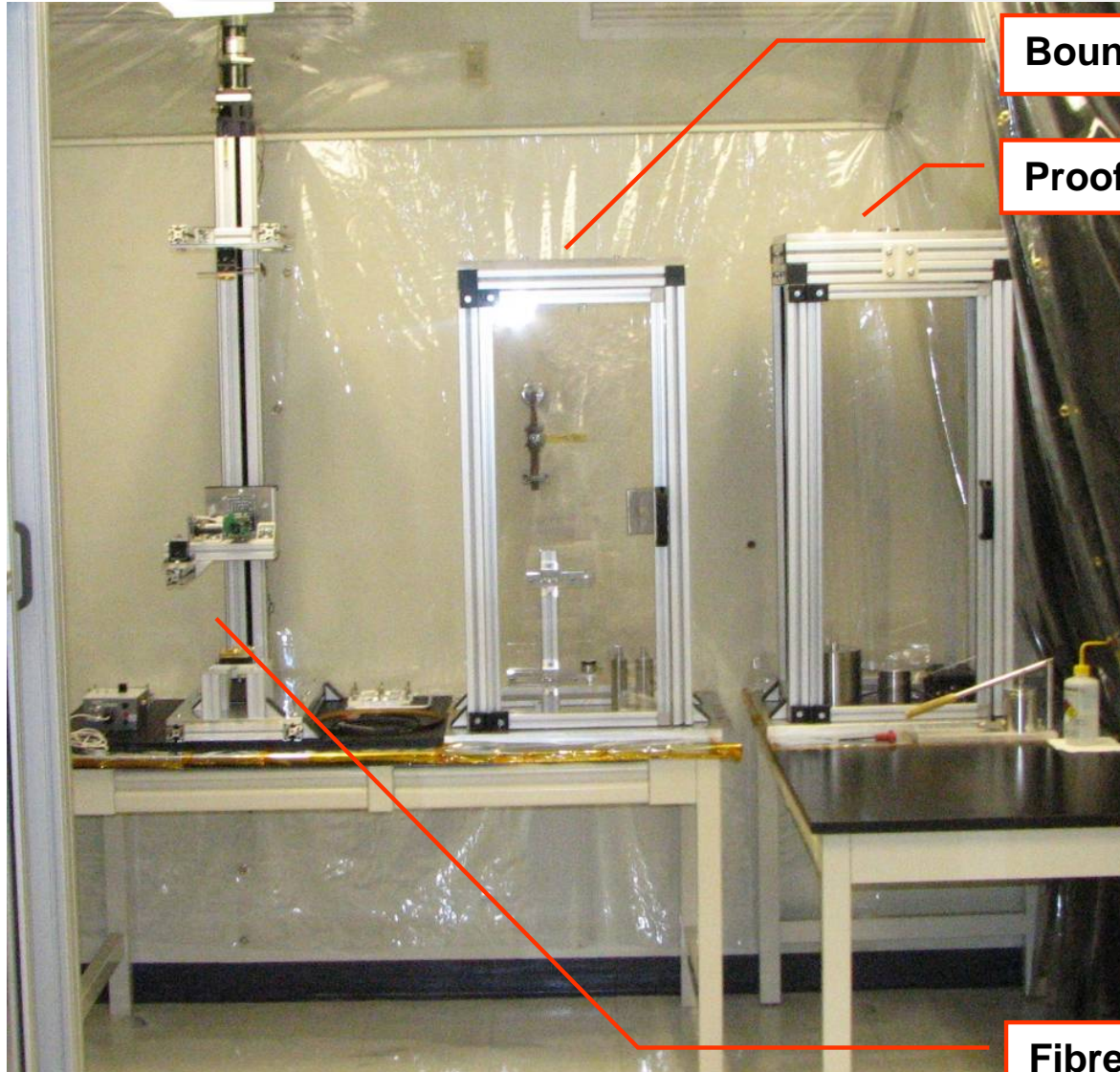


Lower structure assembly with metal masses

Fitting the articulated arm



# Monolithic suspension tooling



Bounce tester

Proof tester

Fibre profiling machine



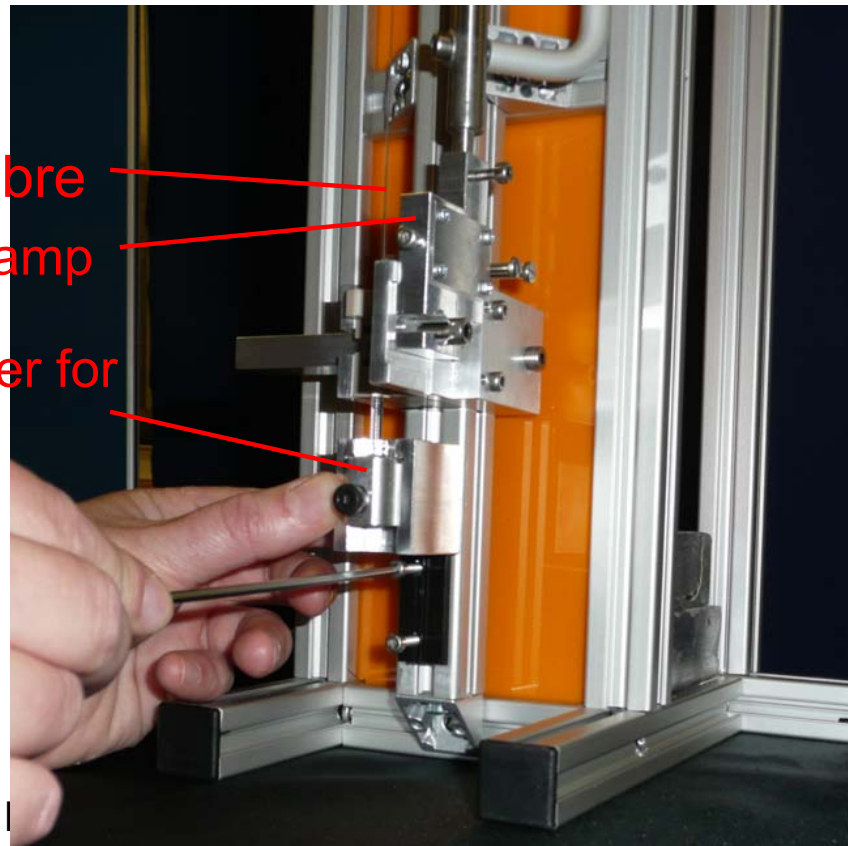
## Monolithic assembly procedure

Manufacture and proof test fibres

- Store fibres (in dry noncirculating air)
- Cut fibres to length on cutter (2 or 3 mm too long) and mount into a cartridge



fibre  
fibre clamp  
fork holster for  
pulling



## Monolithic assembly procedure



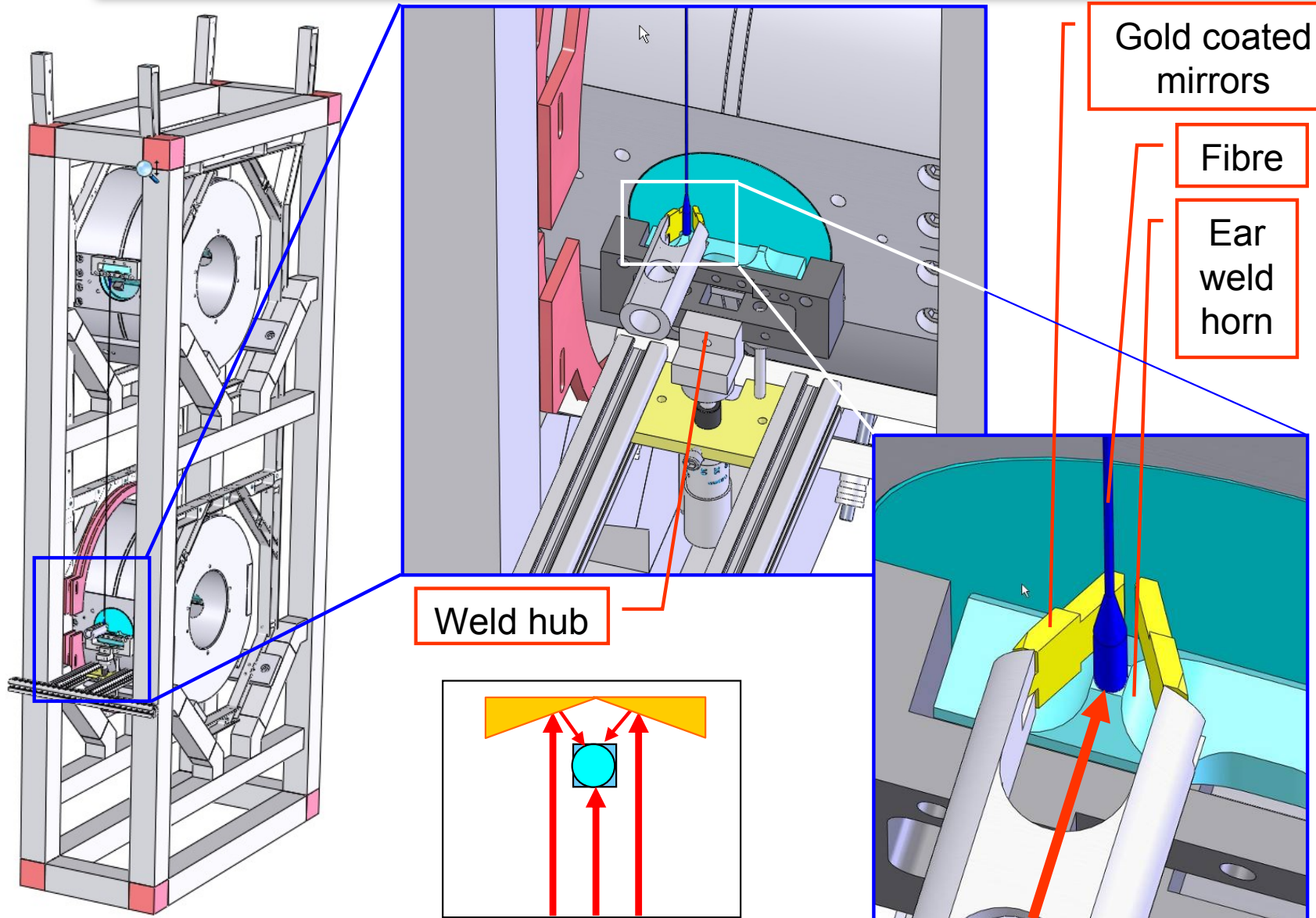
### Installation of fibres

- Install ring heater
- Move all masses into the structure
- Install spacers for welding
- Top Lever arm clamps for overload
- Install weld hubs
- Install weld shelves
- Install welding mirrors
- Install cartridge with fibre
- Move in articulated arm with birdcage (and baffles and welding screens)
- Weld fibre on one end
- Weld fibre at the other end

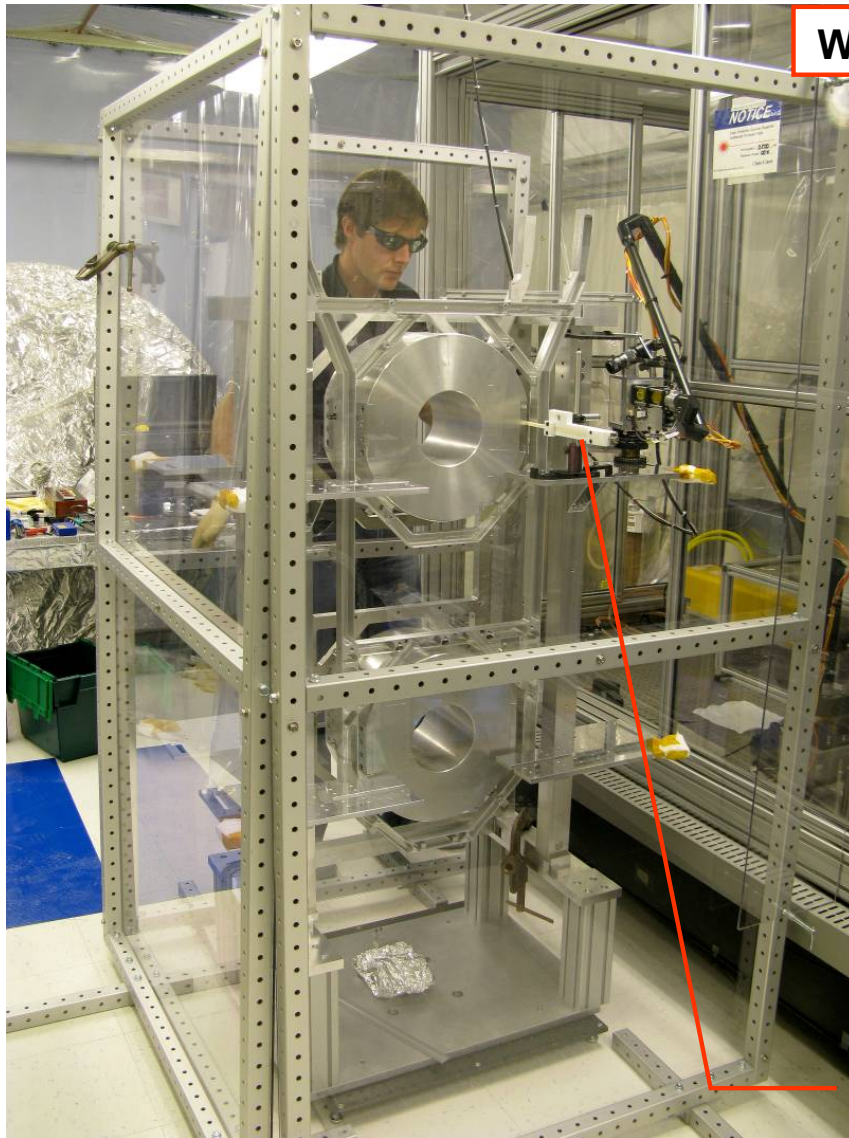




## Preparation for full test hangs in Glasgow

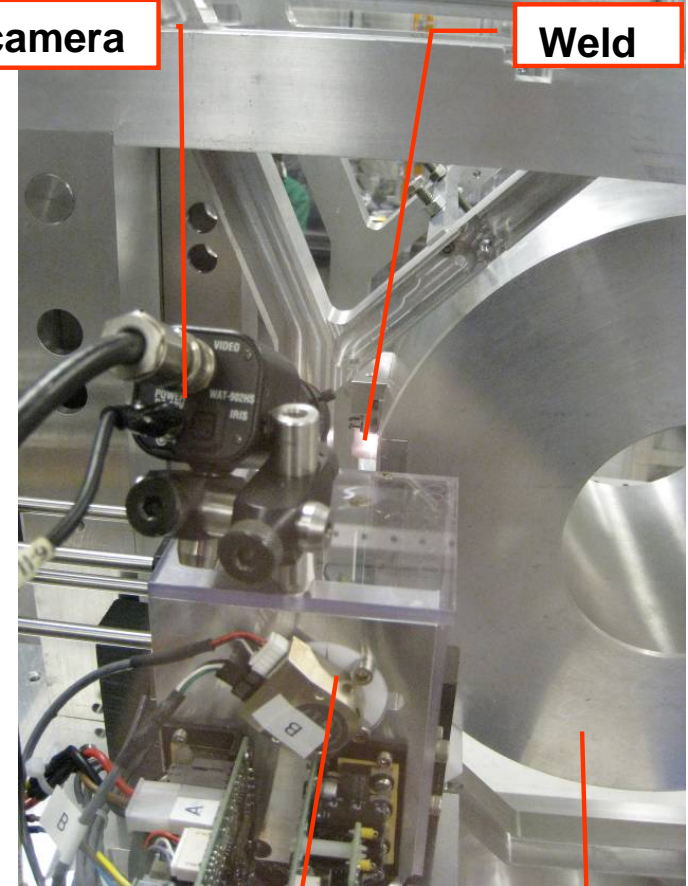


# Monolithic suspension tooling



Welding camera

Weld



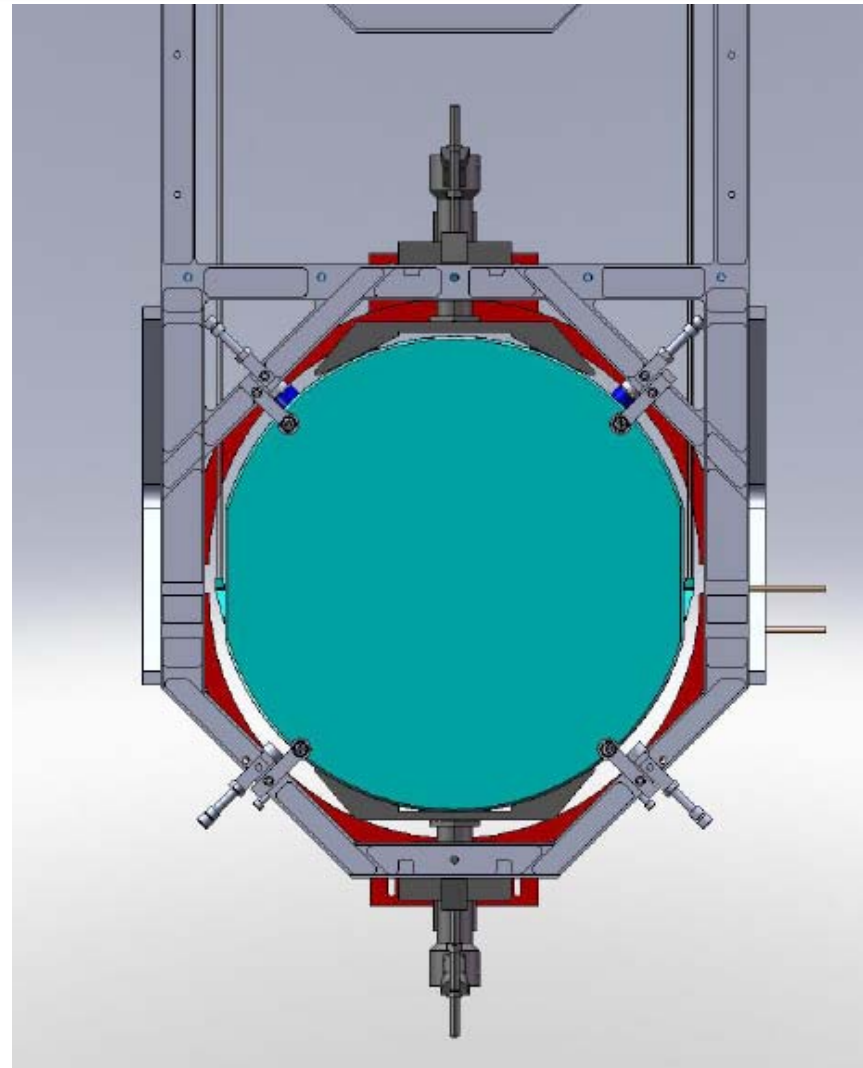
'Birdcage' with galvanometers

Mass

Fully assembled lower structure assembly for laser welding

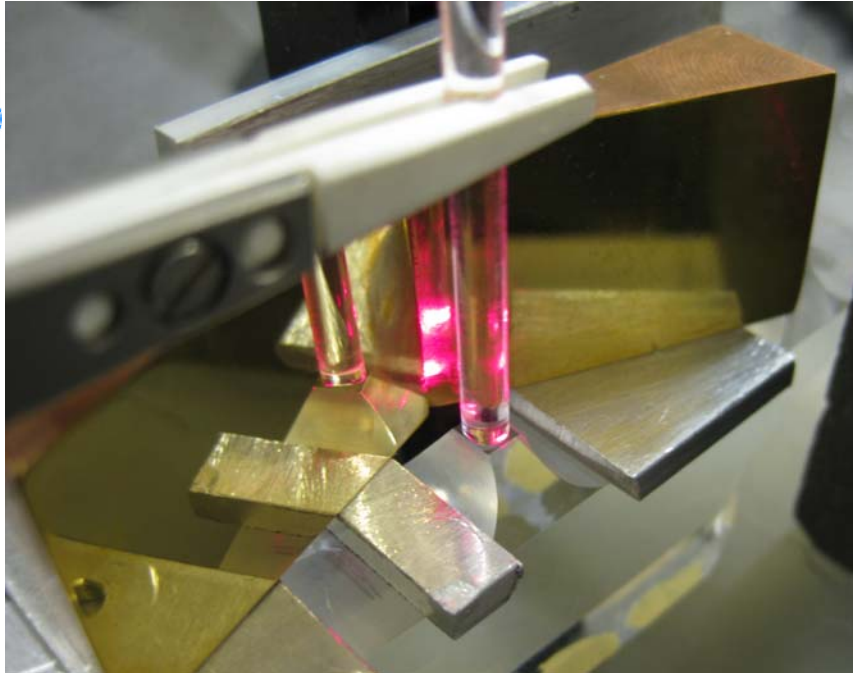


## Test mass with lever arm clamps





# Weld on ear



Welding mirrors behind ear horn



Welded ear



## Monolithic assembly procedure

### Installation of fibres

- Repeat welding for all four fibres
- Slightly lift the test mass with lower lever arm clamp
- Remove spacers for welding
- Install spacers for stress relief
- Lower lever arm clamp
- Stress relief all four fibres by heating up one weld per fibre.
- Raise lever arm clamp slightly, and remove stress relief spacers
- Remove tooling: birdcages, weld hubs, welding shelves
- Lower lever arm clamp for full load



## Monolithic assembly procedure

### Installation of fibres

- Press down onto the mass with the upper lever arm clamp to overload (10%)
- Remove load upper lever arm clamp
- Install full load spacers
- Remove lower lever arm clamp

