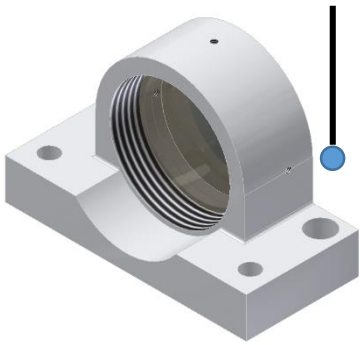
Mechanical metrology for alignment @OABr

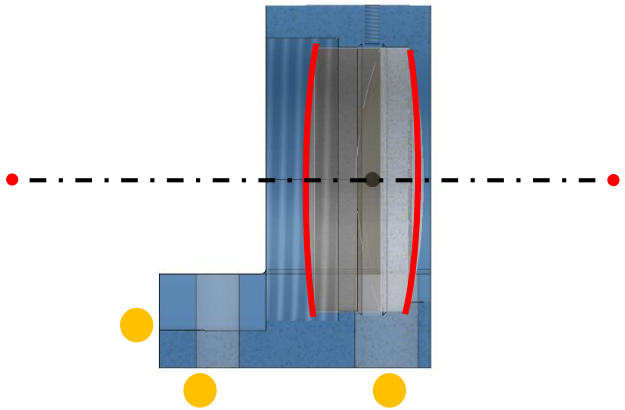
1. Concept
2. Available facilities and expertise at OABr
3. Examples of use

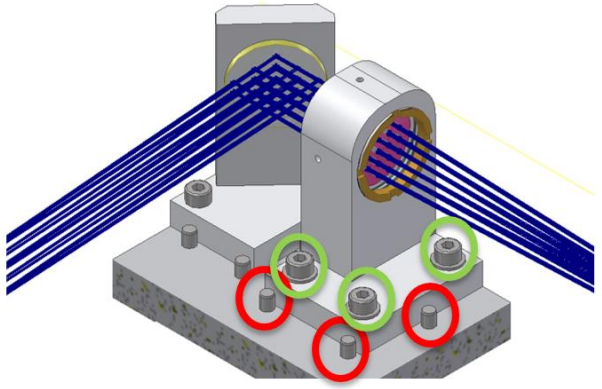
Concept

New approach based onto **dimensional characterization** of optical/optomechanical elements and semi-kinematic **interface adjustment**

- Characterize the optical elements by means of non optical metrologies
- Characterize the optomechanical mounts
- Reference the optical surfaces vs. mechanical data
- Position the optomechanics in space
- Evaluate the stability in time







measure → reference → align

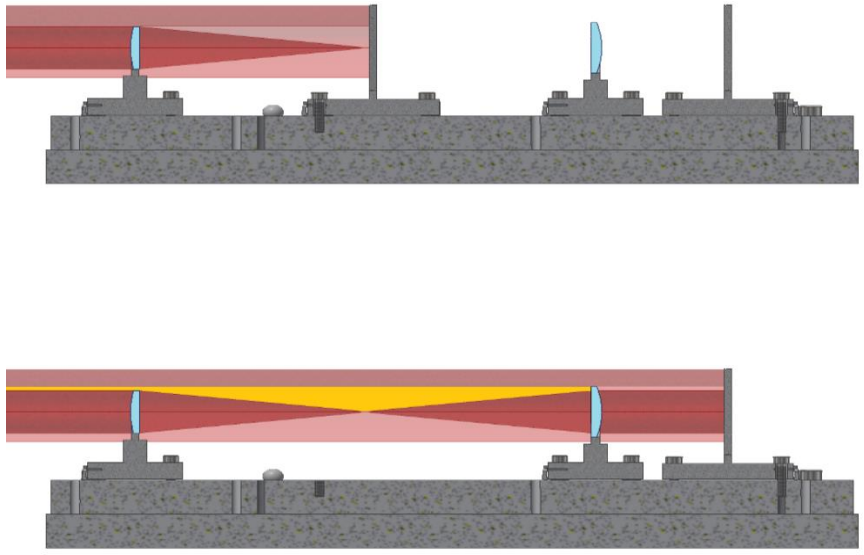
Facilities

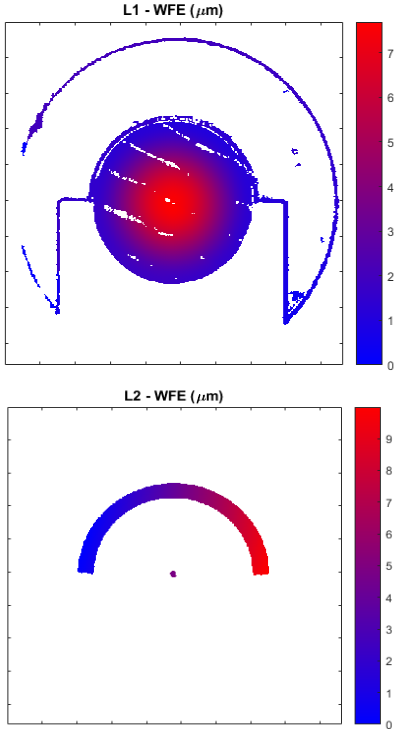
- Articulated arm
  - 7 DoFs system
  - Contact measurement, manual
  - Volumetric accuracy = +/-0.041 mm

- Coordinate measuring machine (CMM)
  - Cartesian reference system
  - Contact measurement
  - MPE = 1.8 um + 3 um/m

- Laser tracker (LT)
  - Spherical reference system (alt-azimuth)
  - Time of flight radial distance measurement
  - MPE = 16 um + 0.8 um/m (linear)
    20 um + 5 um/m (radial)

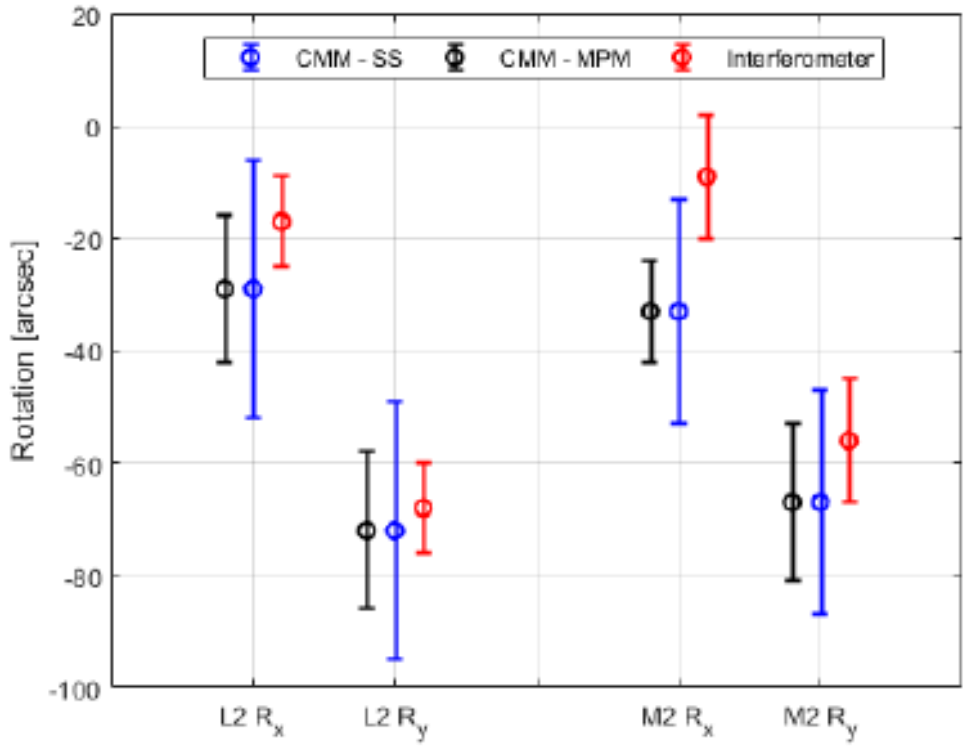
Verification: CMM vs. interferometer



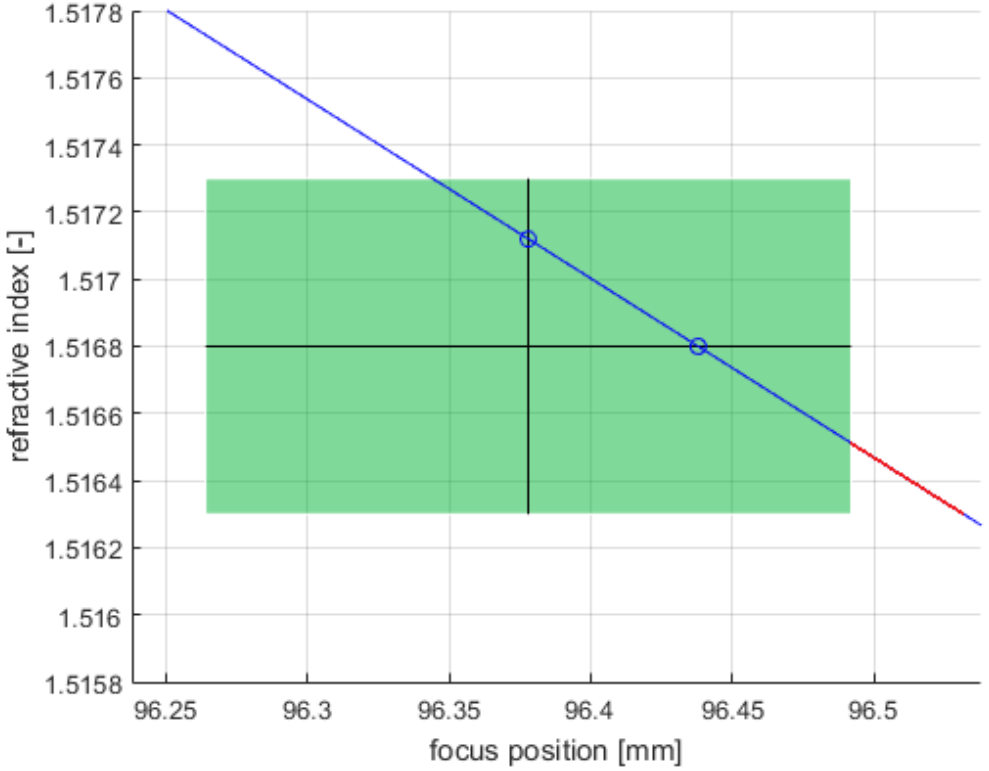


Verification: CMM vs. interferometer

Tip-tilt

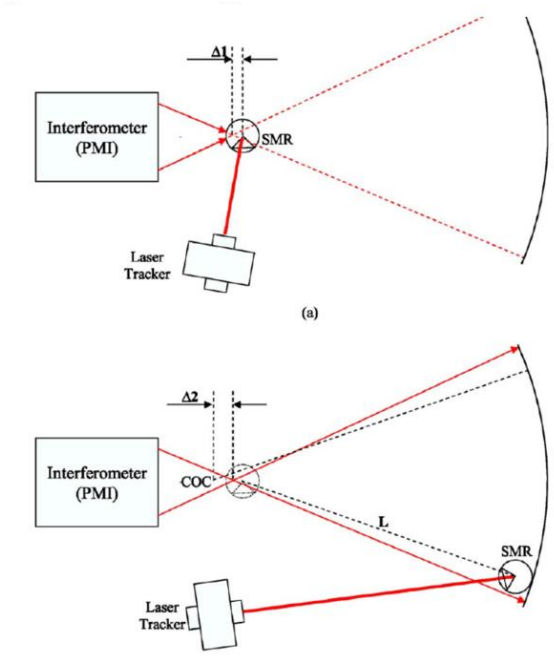


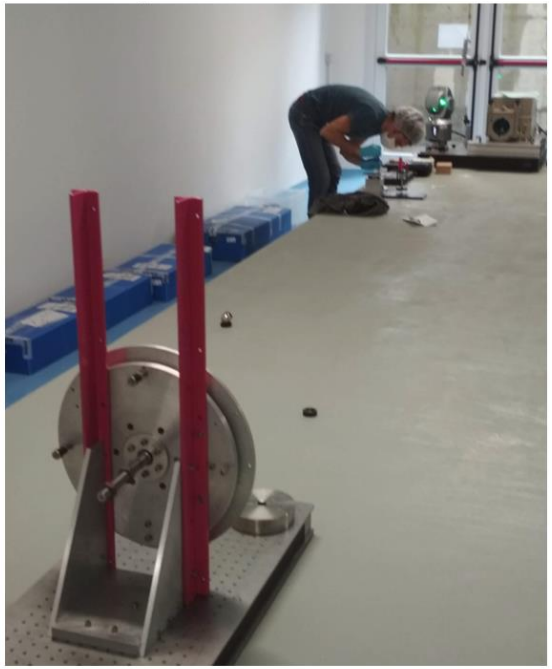
Focus

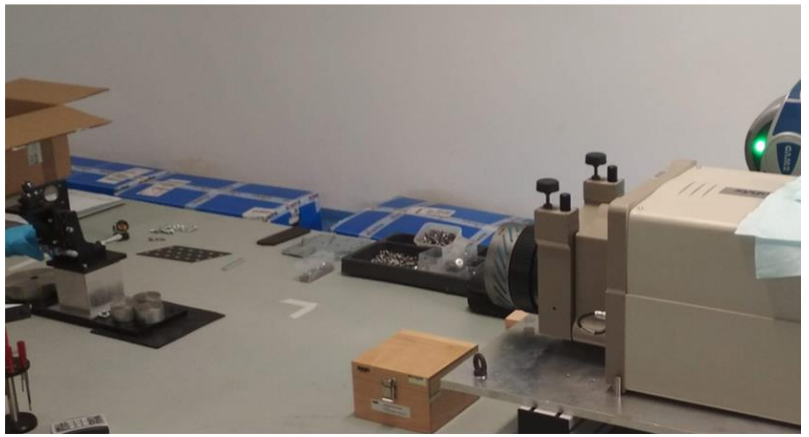


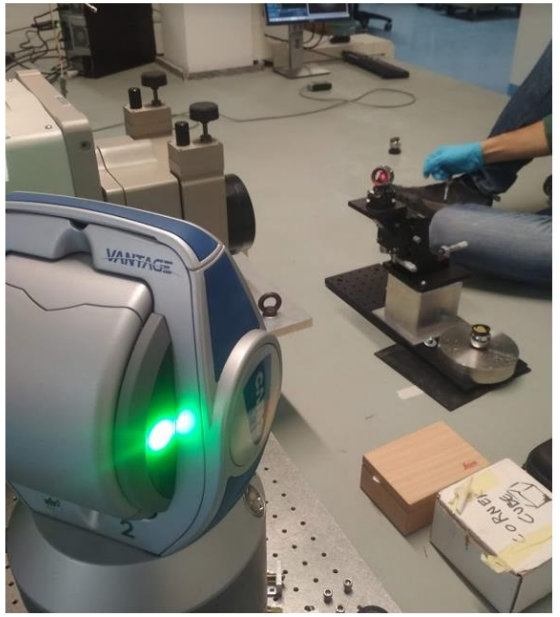
Example: LT + Interferometer

Measure of the RoC of a low F/# sphere









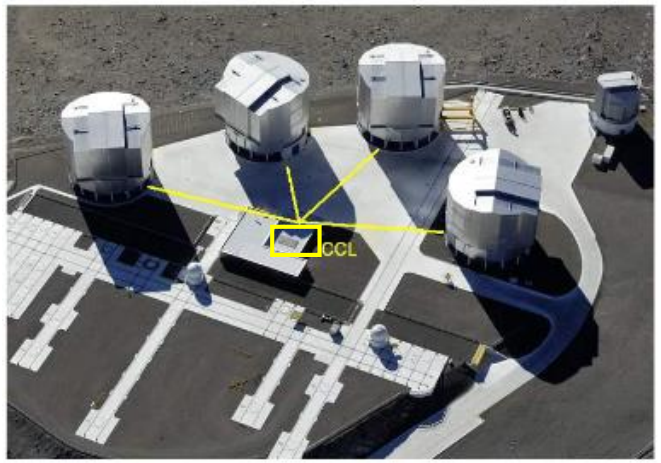
Radius with spherometer: 4921.0 ± 0.5 mm

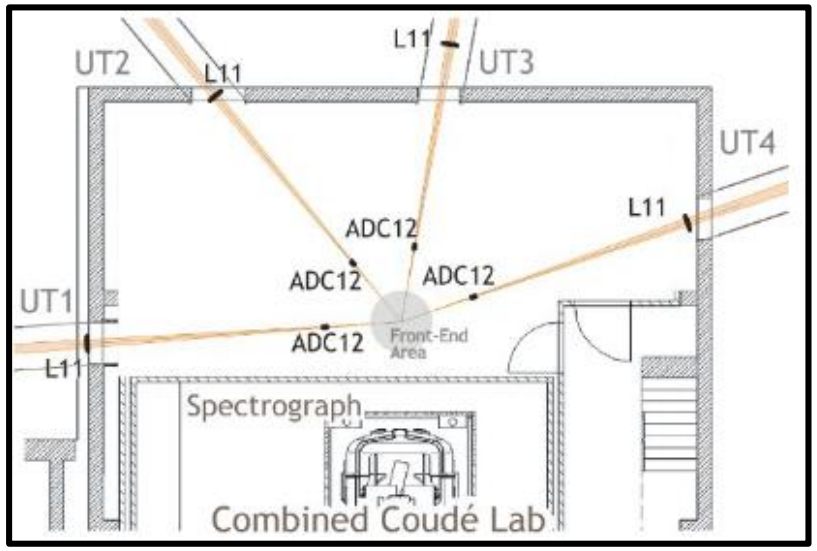
Radius with LT+Interferometer: 4921.094 ± 0.014 mm

Large systems

Infrastructures

- VLT - Coudé tunnels
- VLT - Coudé room



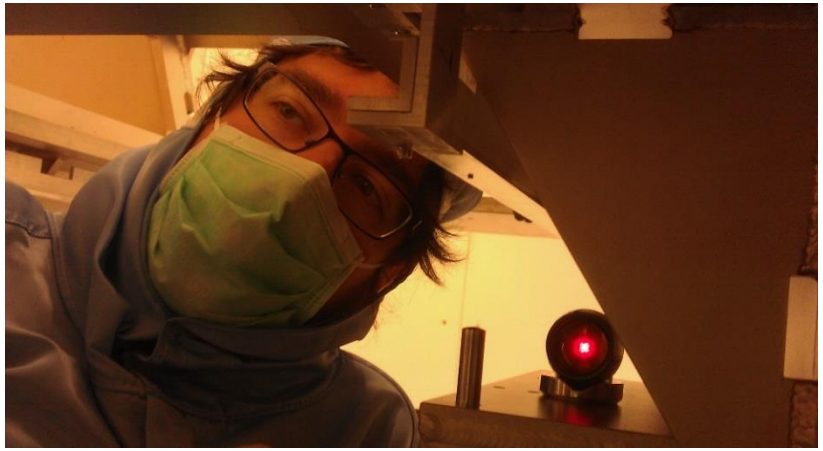


Large systems

Meter size instruments

- VLT - ESPRESSO Spectrograph: active alignment with optical metrology

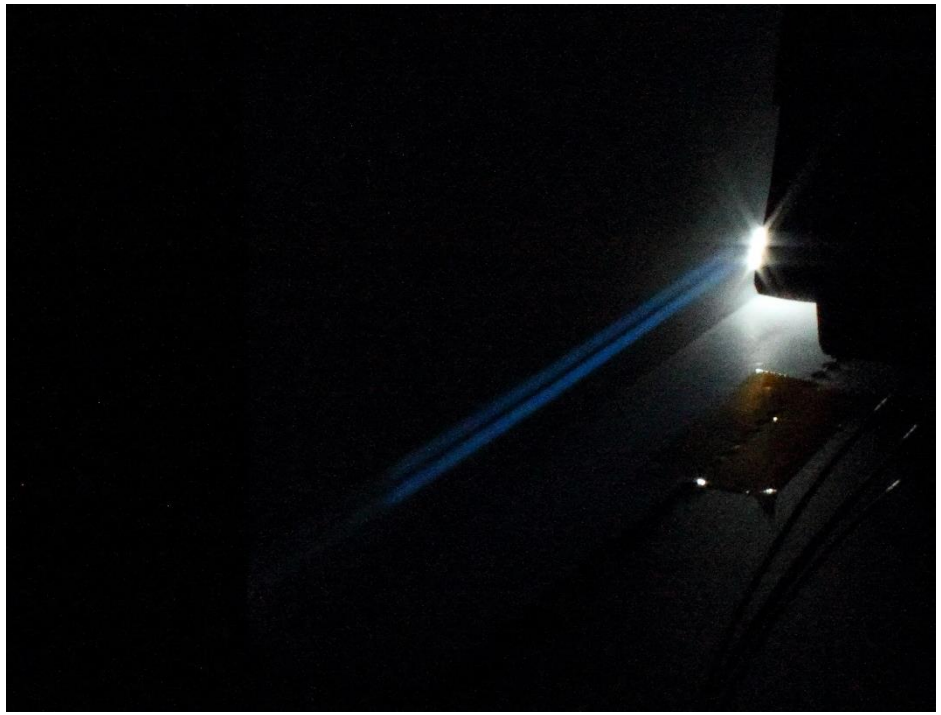
Genève



Large systems

Meter size instruments

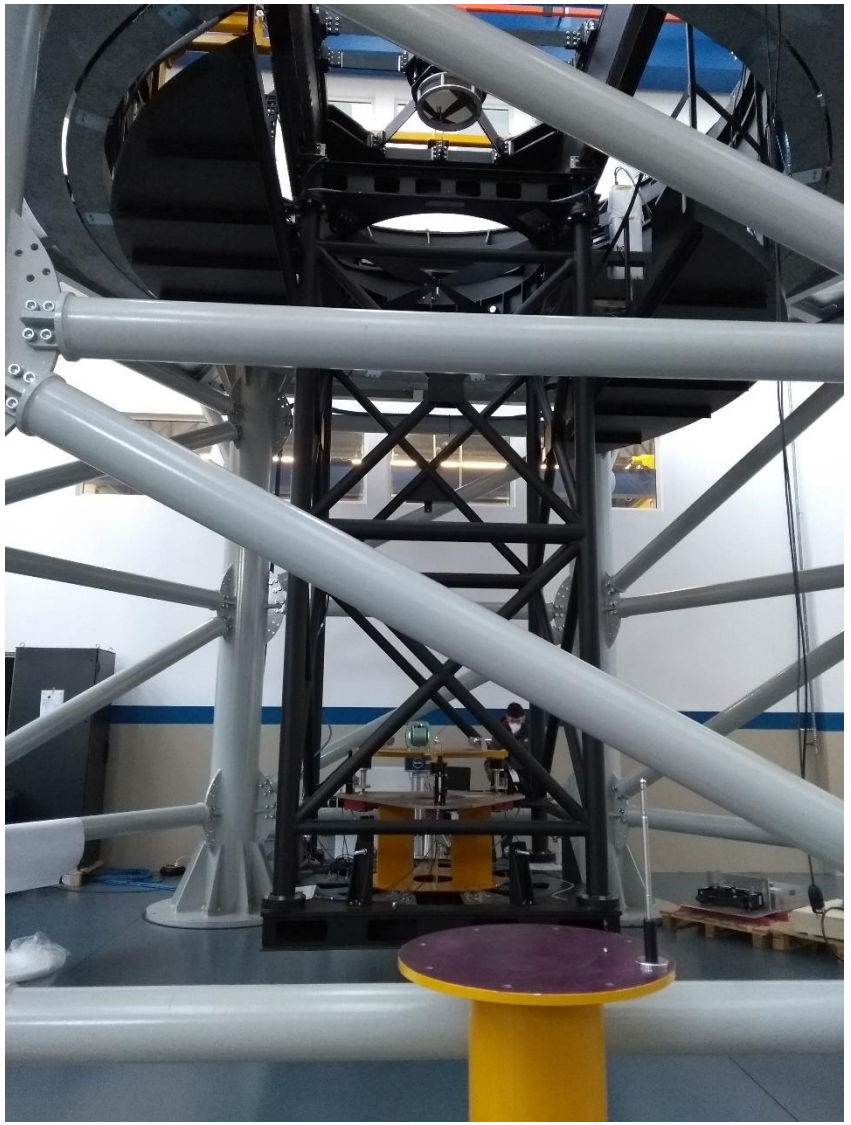
- VLT - ESPRESSO Spectrograph: autocollimation test



Large systems

Meter size mirrors

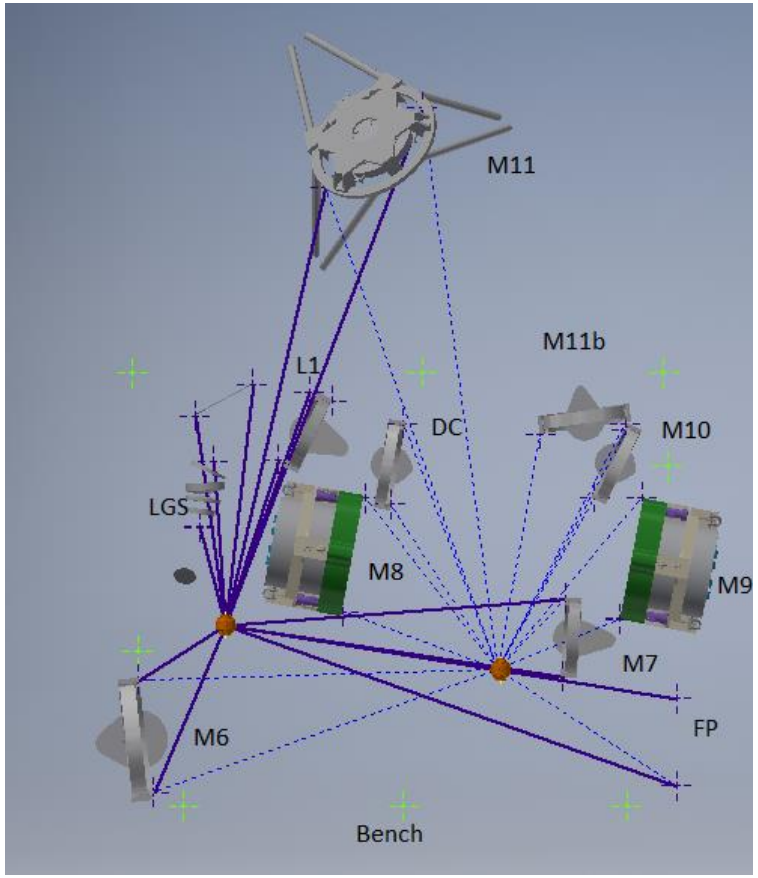
- ELT - M4-OTT alignment

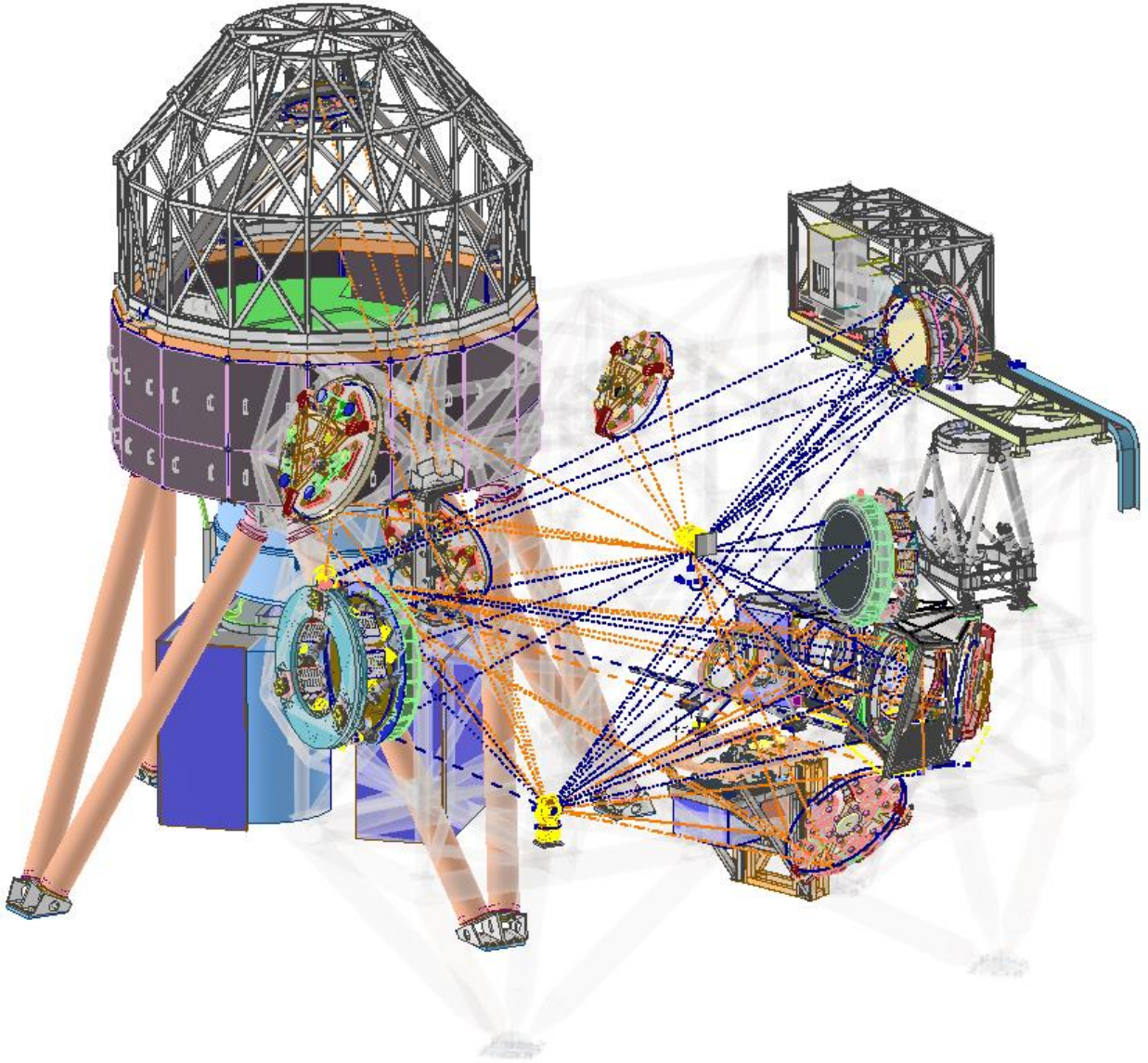


Large systems

Meter size instruments

- ELT - MAORY



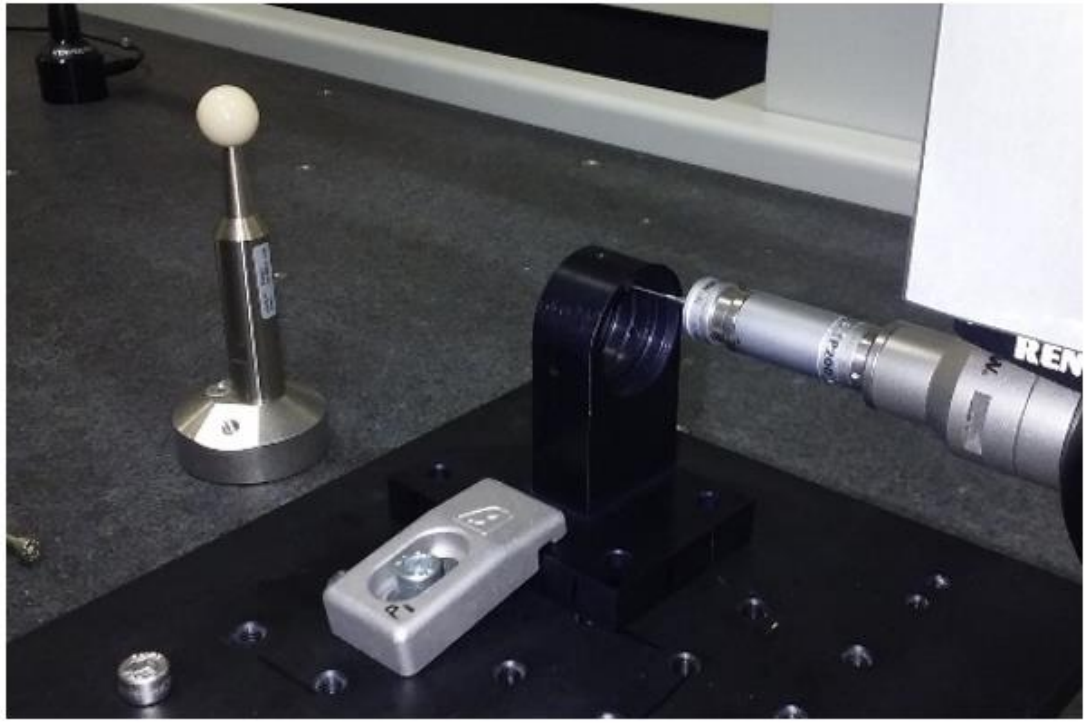


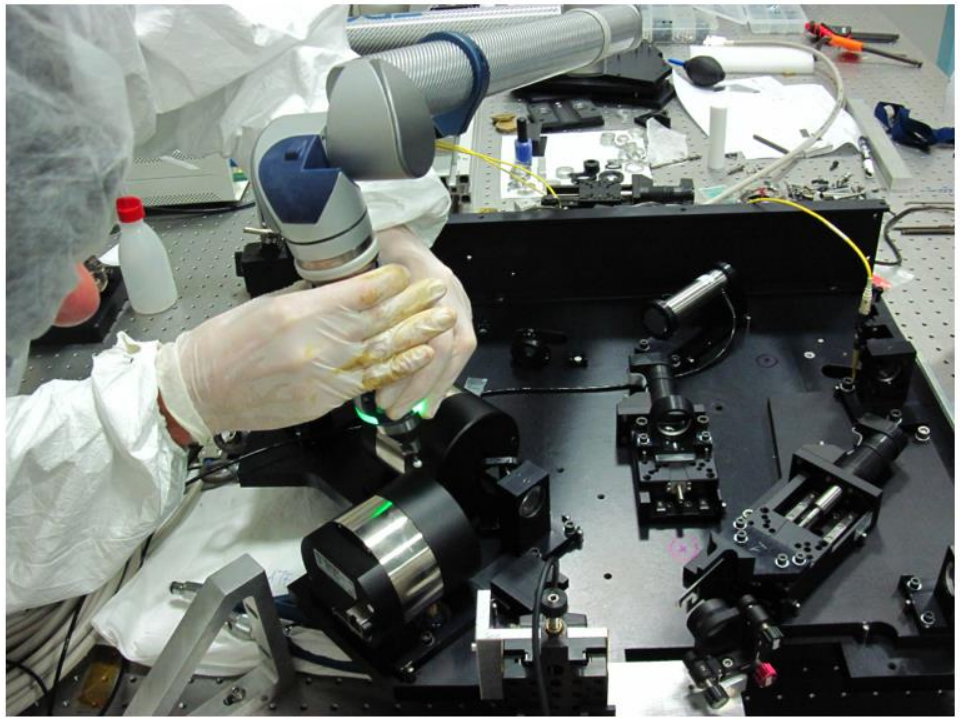
Small systems

Every element mechanically characterized and 6 reference points are acquired (CMM).

Optical elements glued into the mounts

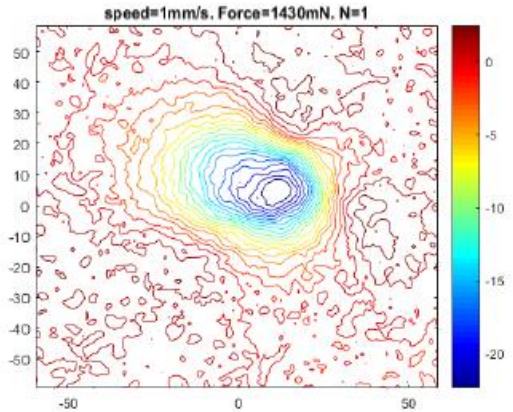
Elements aligned using the 6 reference points (AACMM)

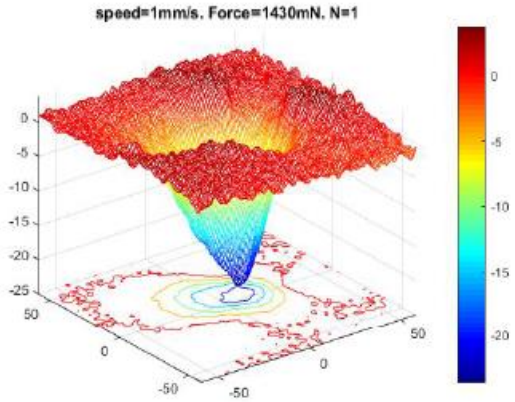




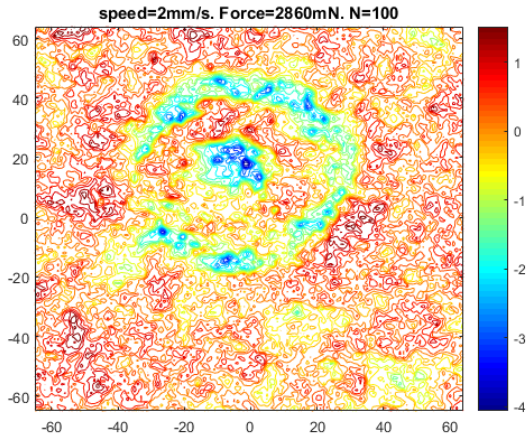
CMM contact damage

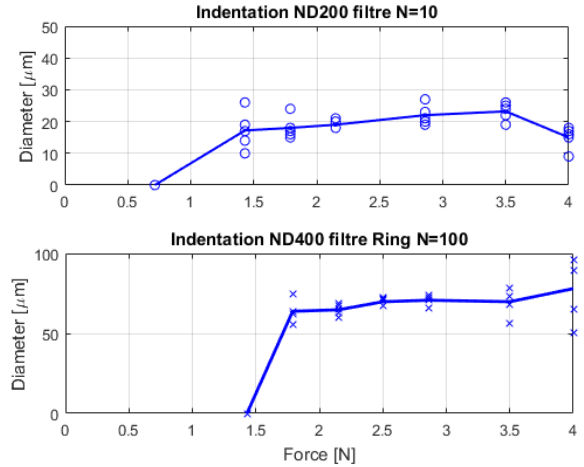
CaF_2 – uncoated



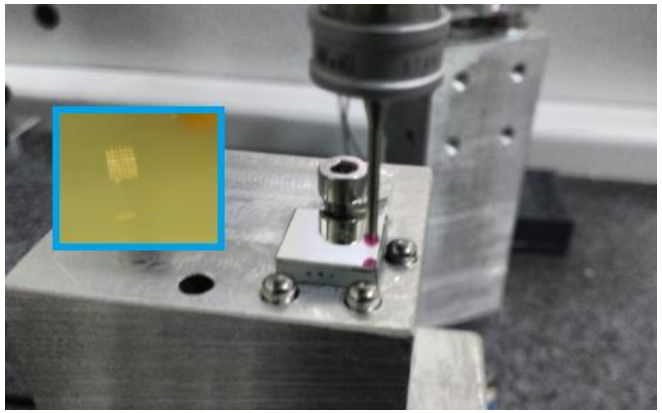


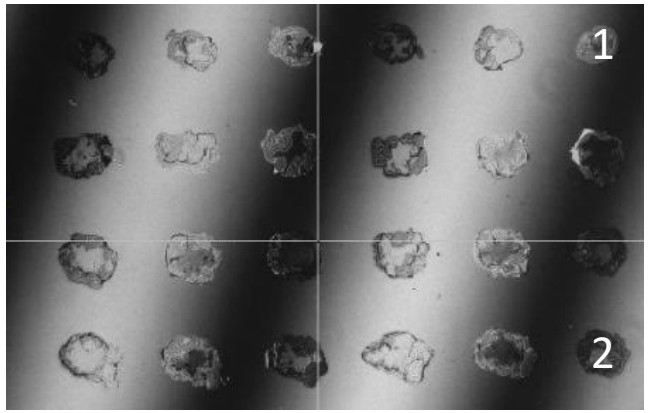
Inconel coating on borosilicate

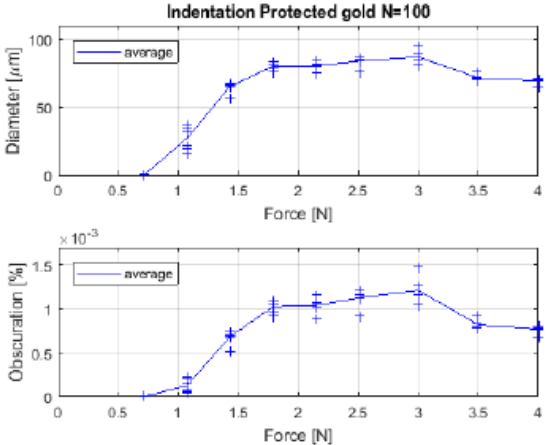




Protected Gold coating on SiO2

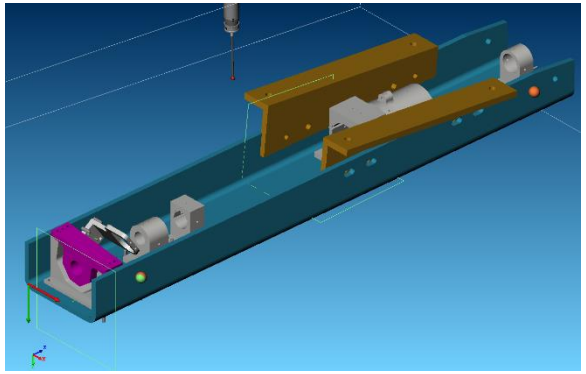


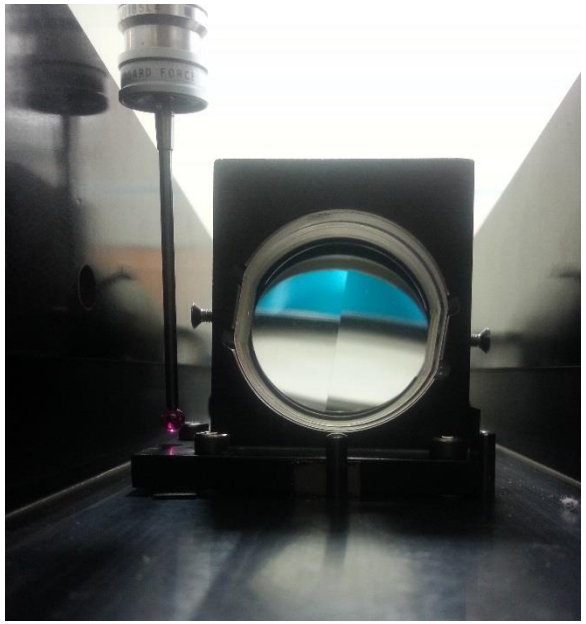


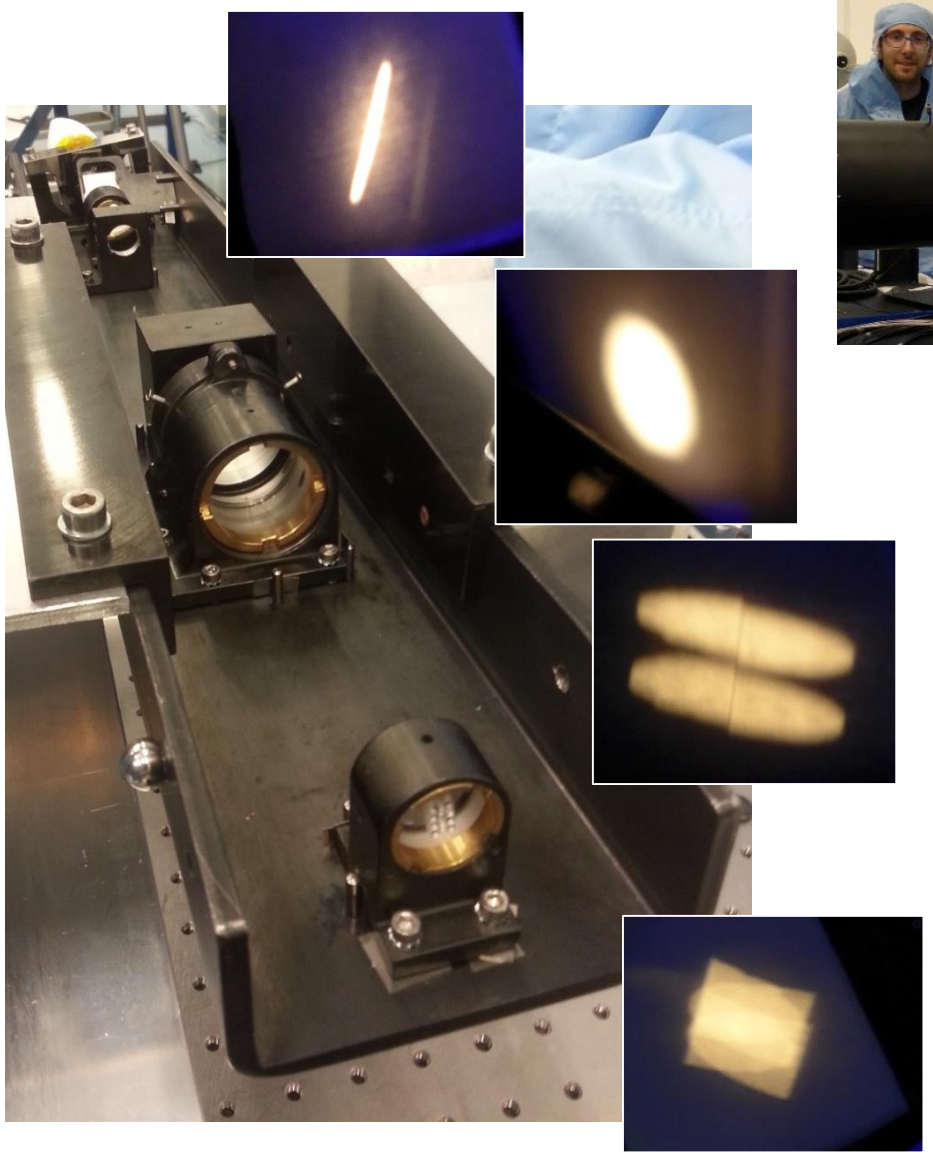


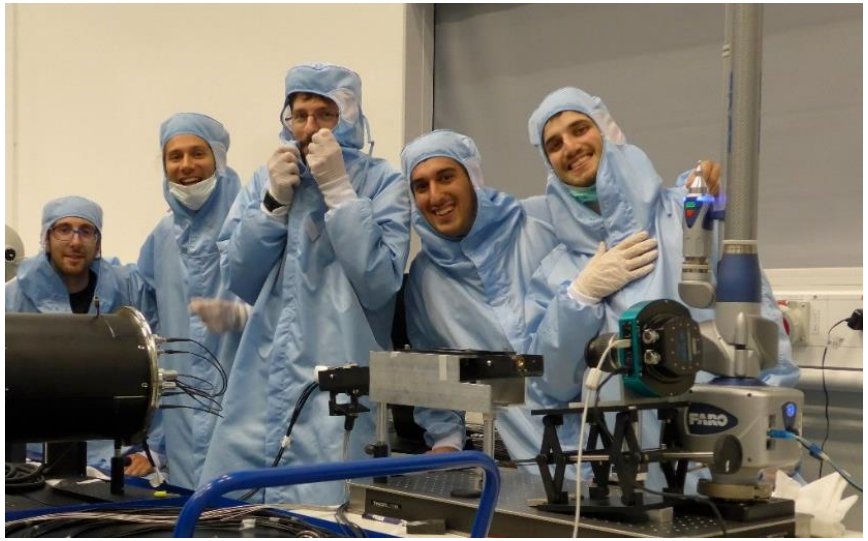
Anamorphic pupil slicer

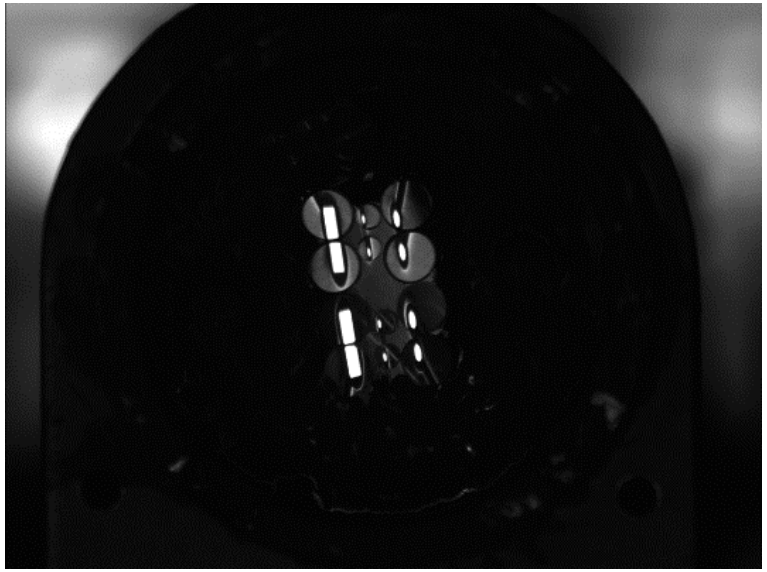
Integration with CMM







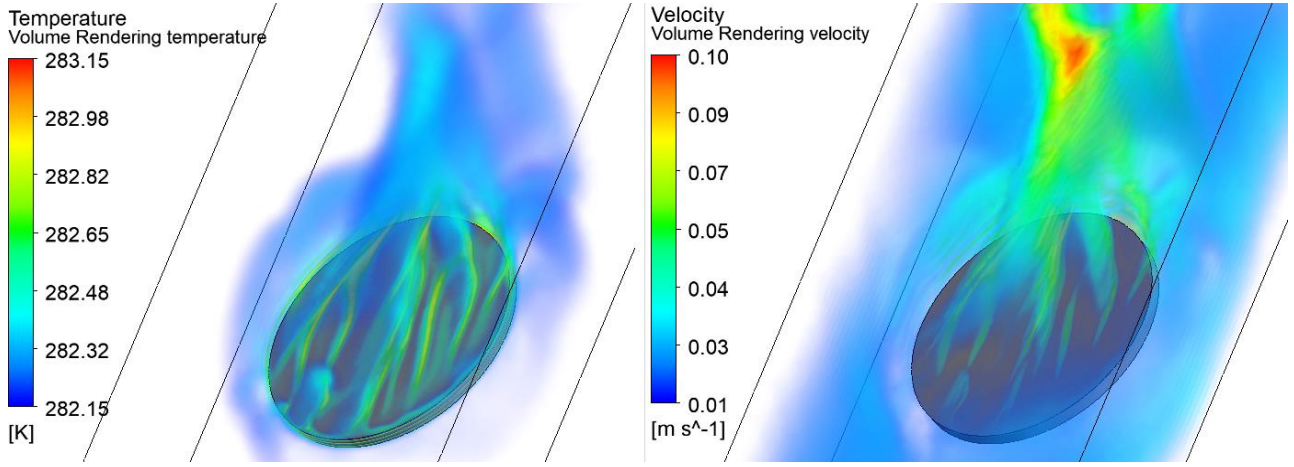


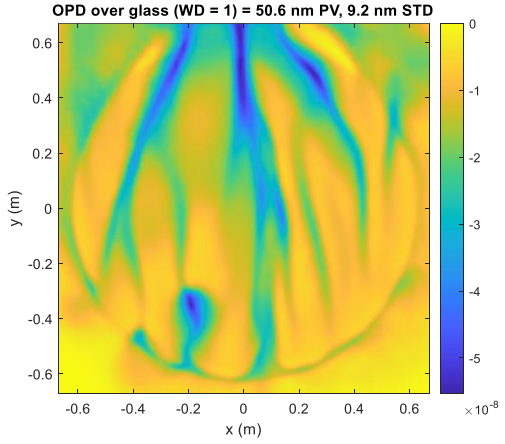


Thermal analyses

ELT – MAORY as an example.

CFD → Optical





FEM → Mechanical → Optical