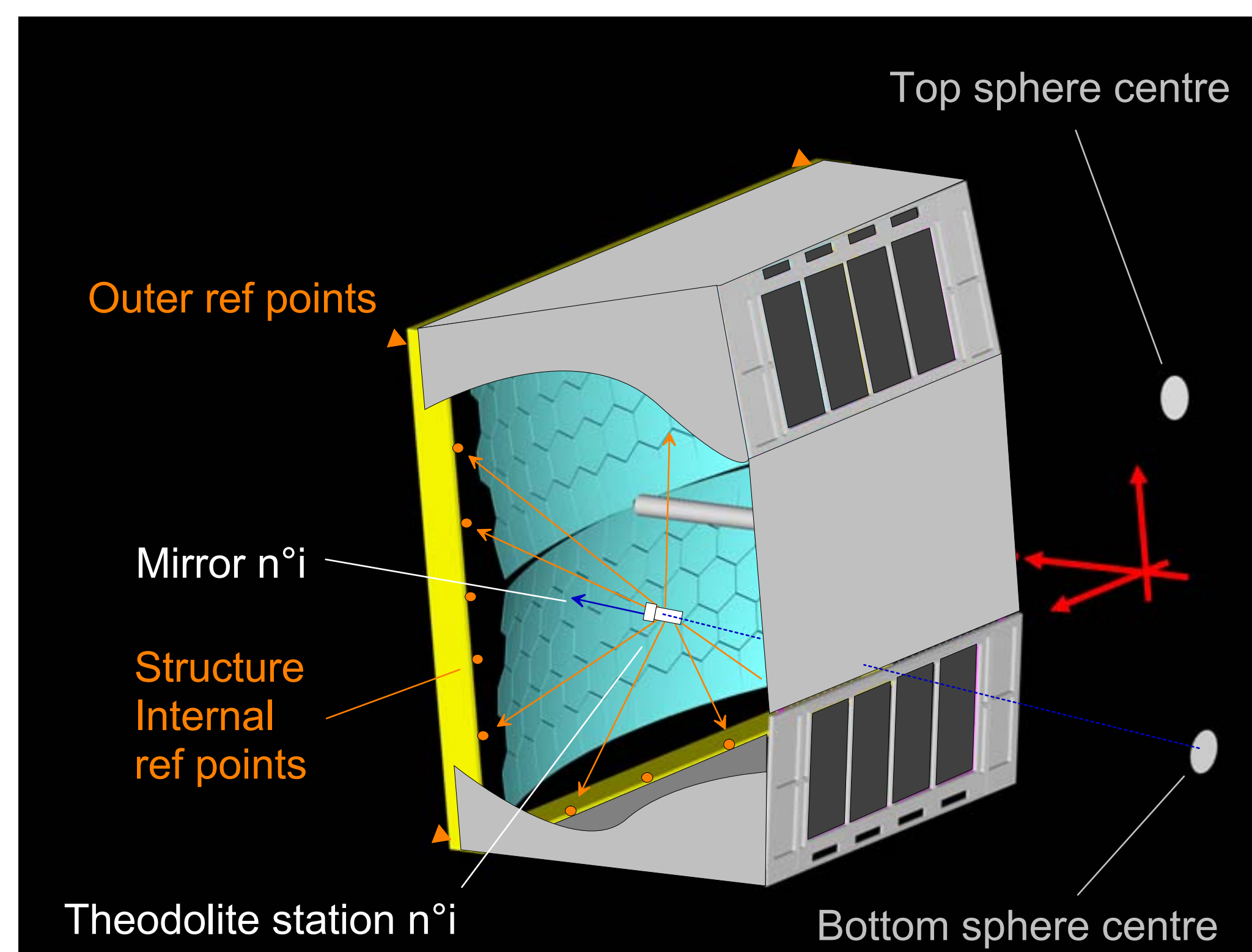
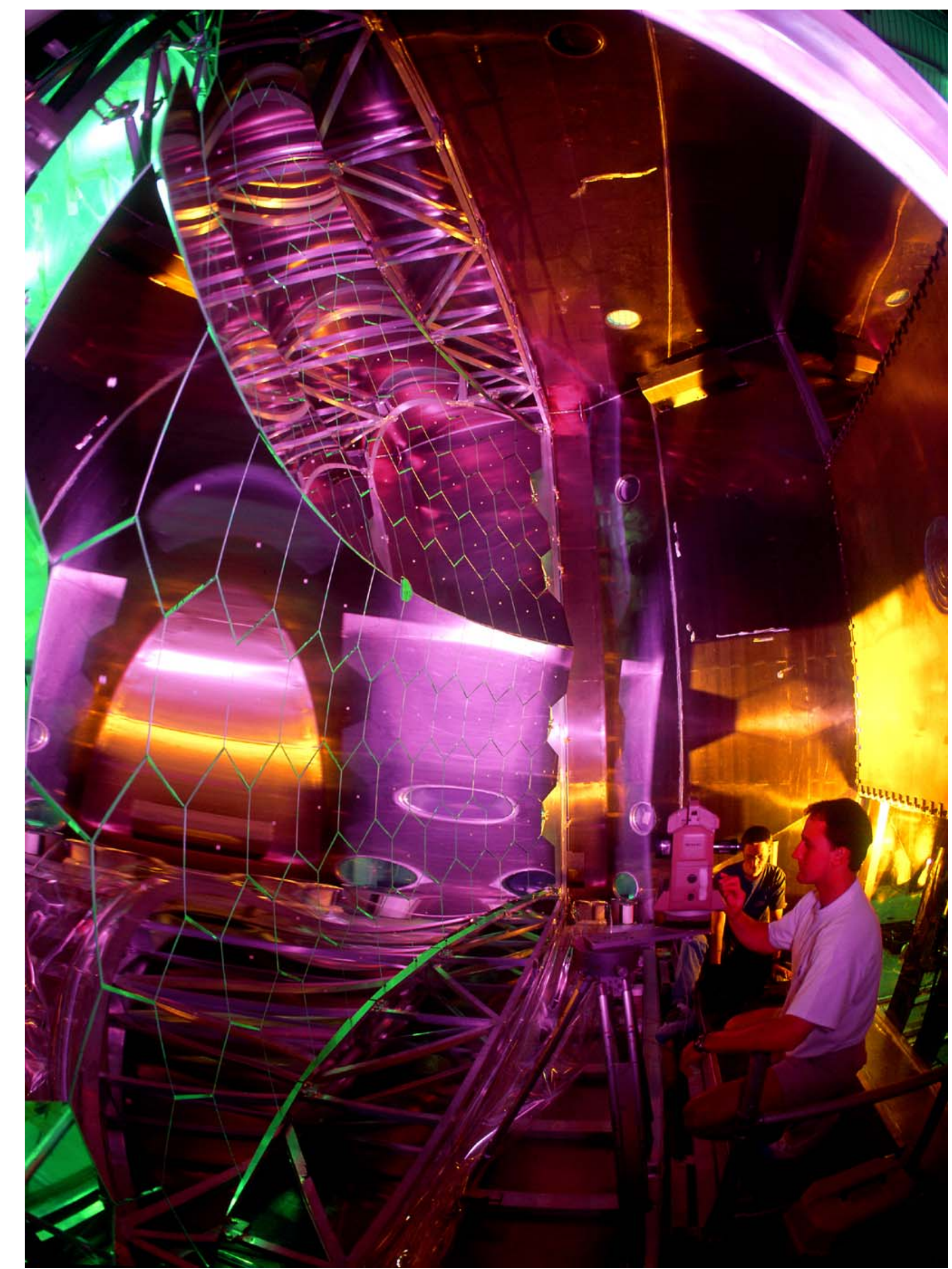
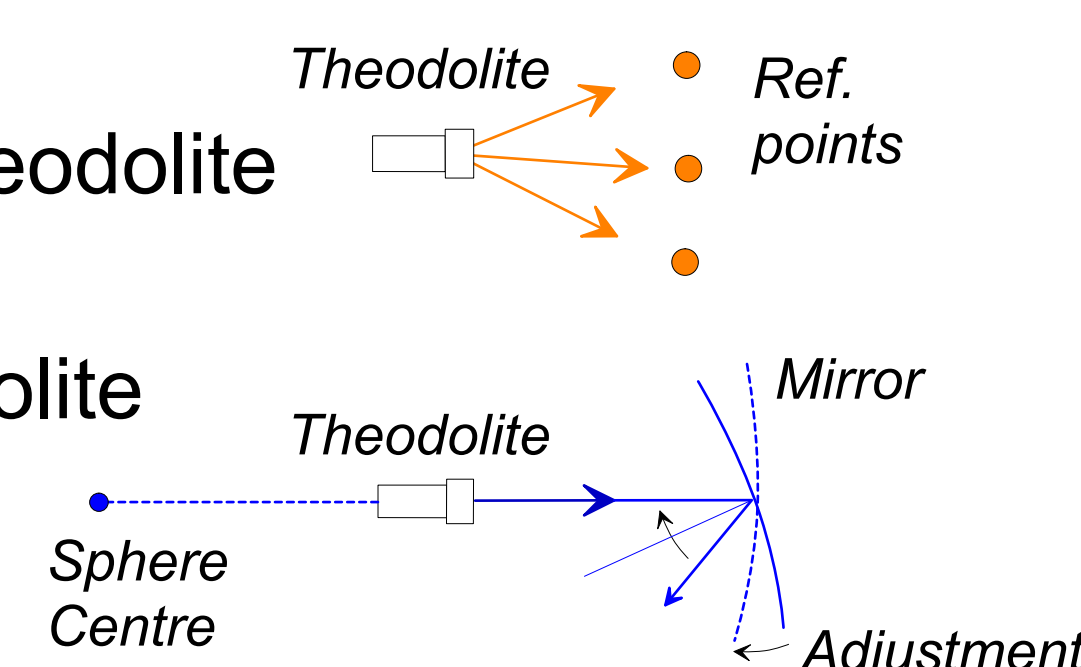


COMPASS RICH-1 MIRRORS TOWARDS AN ABSOLUTE ALIGNMENT WITH CLAM BY CAMERA CALIBRATION AND PHOTOGRAMMETRY

SURVEY METHOD ... APPLIED FOR EACH MIRROR



- Positioning of the theodolite approx. on the line Mirror-Centre
- Determination of the precise position and orientation of the theodolite by observing internal reference points
- Adjustment of the telescope along the direction Centre-Theodolite
- Adjustment of the mirror to get the theodolite image returned
- Control: Measurement of the real mirror orientation



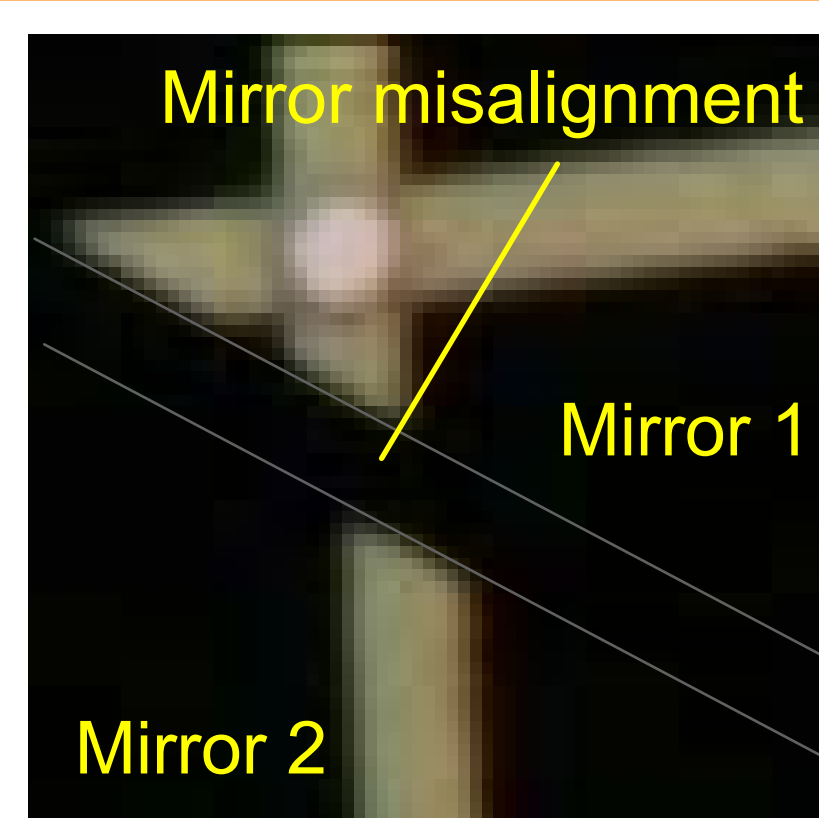
Precision : 0.1 mrad but ... no info as soon as the vessel is closed

MIRROR ALIGNMENT MONITORING WITH THE CLAM SYSTEM

RELATIVE MIRROR ORIENTATION

Observation of continuous lines in the mirrors

=> relative orientation of the mirrors

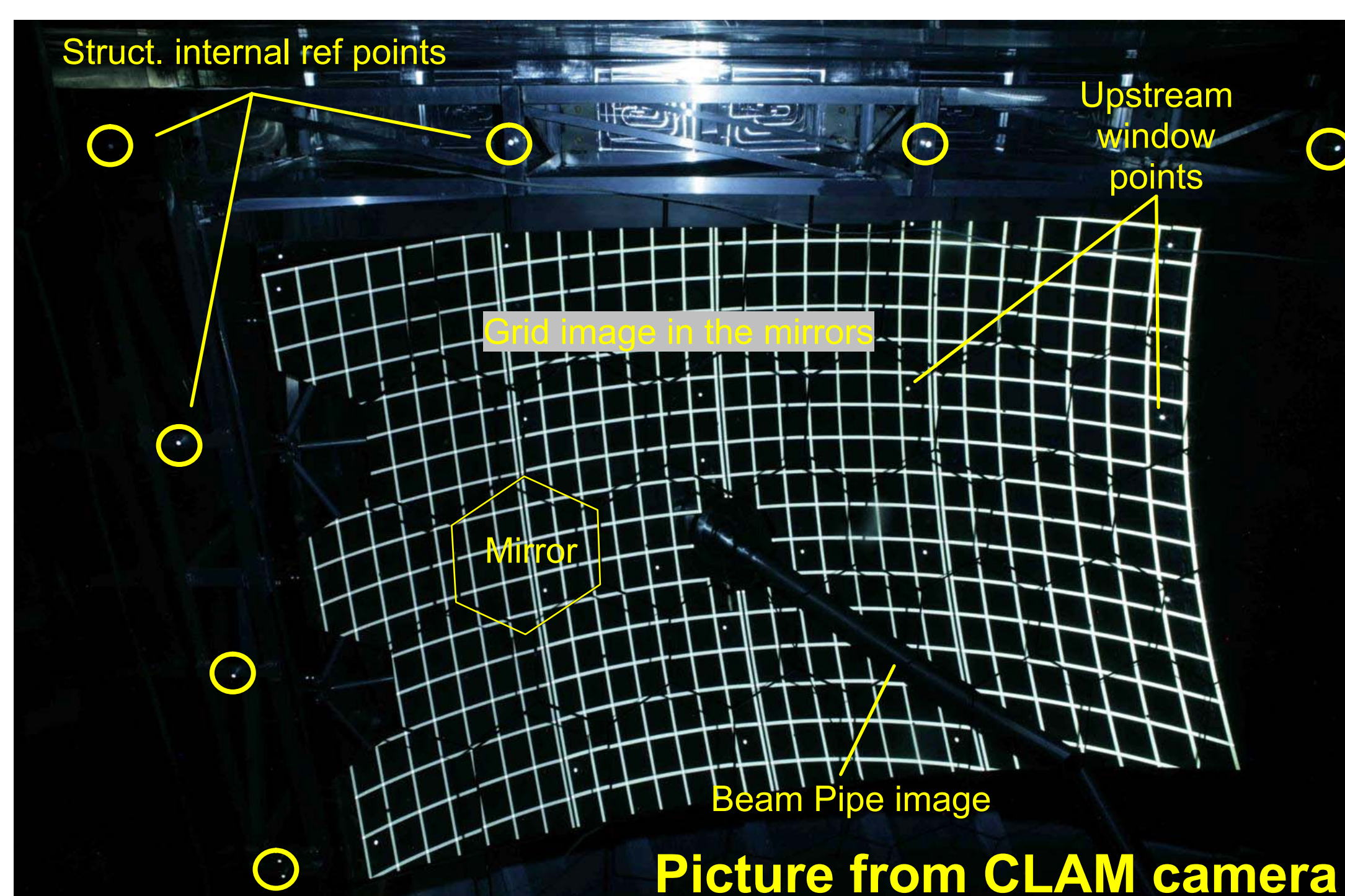
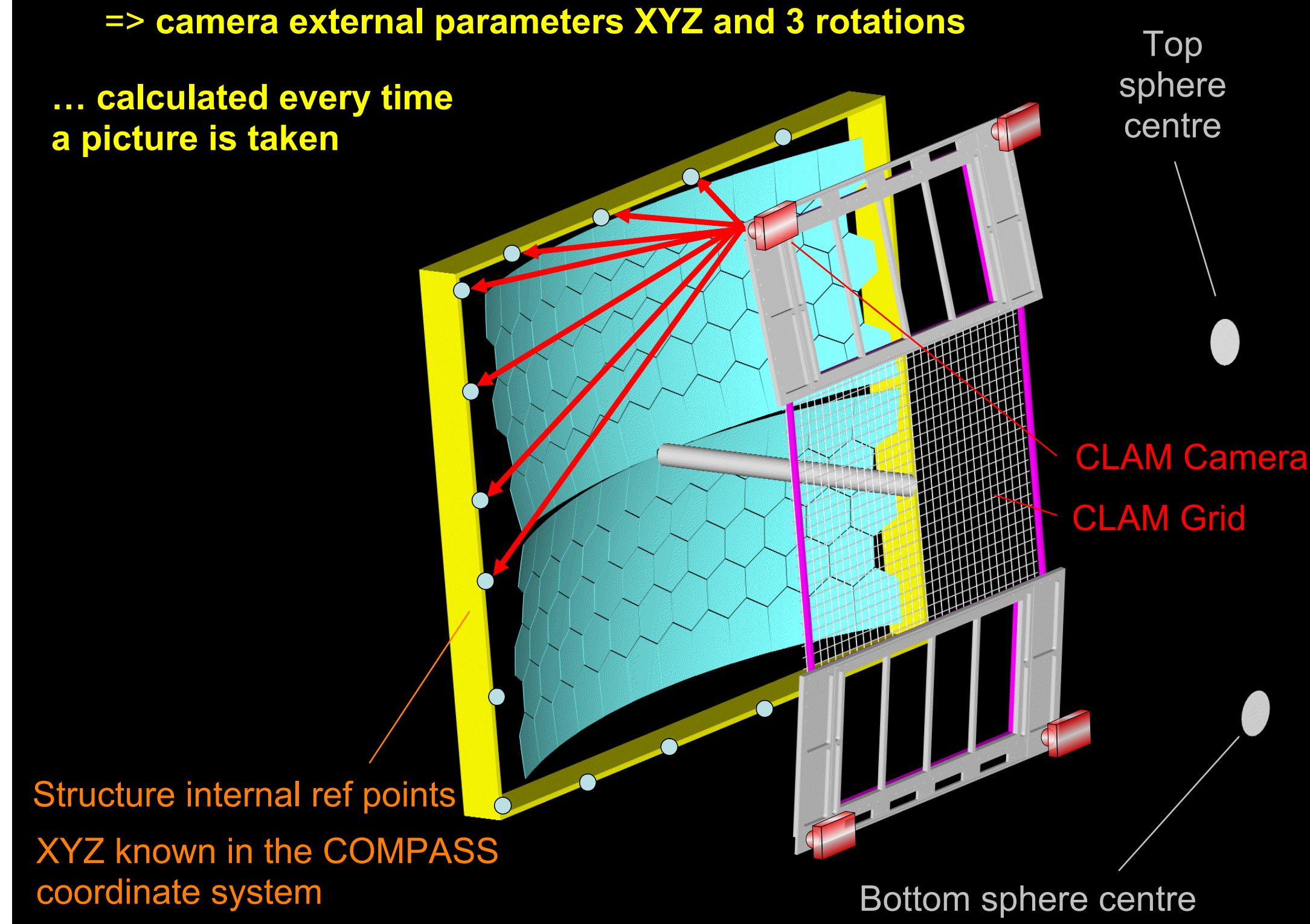


TOWARDS AN "ABSOLUTE" MIRROR ORIENTATION NEEDS

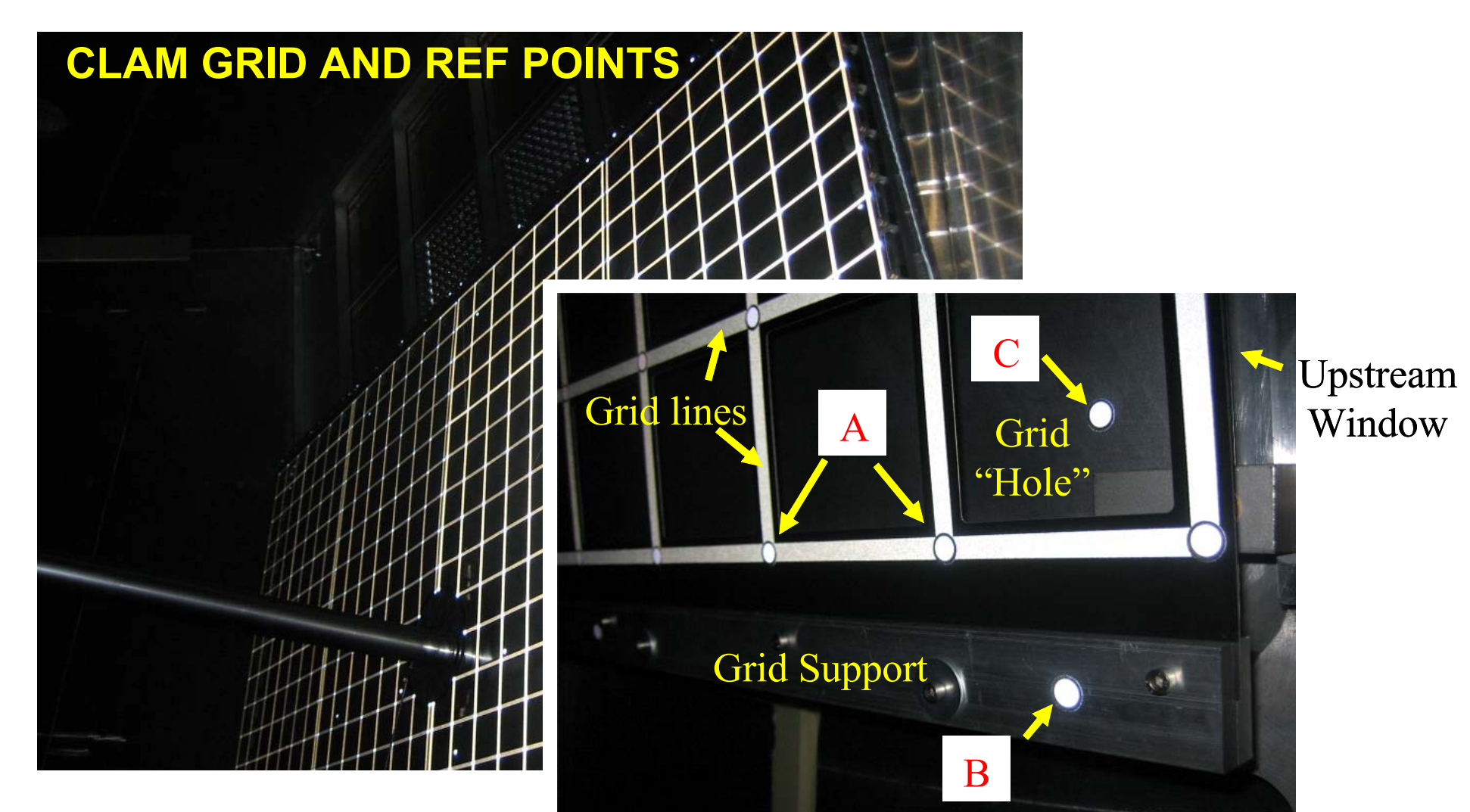
- => Observation of the grid intersection points in the mirrors with cameras
- => Knowledge of the grid geometry and position in the global coord system
- => Calibration of the cameras
- => Knowledge of the cameras position and orientation

CAMERA POSITION AND ORIENTATION: EXTERNAL PARAMETERS

Observation of structure ref. points
=> camera external parameters XYZ and 3 rotations
... calculated every time a picture is taken



THE GRID GEOMETRY



- A: Points at the intersections of the GRID
- B: Points on the Grid Support bars (top/bottom)
- C: Points on the upstream RICH Window

GRID Geometry measurement ... Photogrammetry

- 250 photogrammetric pictures
- ~700 points at grid intersections measured in 3D
- x y z in a grid local system
- accuracy 0.2mm

Geometrical link to the global coord. System:

- Survey of some grid points w.r.to the structure internal ref points
- XYZ in the global coordinate system
- accuracy 0.5mm

CAMERA CALIBRATION: INTERNAL PARAMETERS

To be determined for each CLAM camera

- Focal length
- Principal point position
- Distortions
- Planarity of sensor

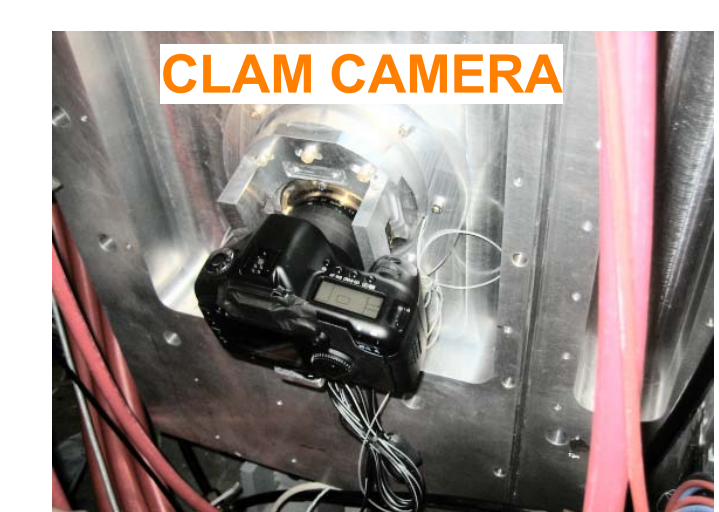
... done using a Calibration Plate

Calibration Plate Geometry ... Photogrammetry

- 70 photogrammetric pictures
- ~145 photogrammetric targets measured in 3D
- x y z in a local system linked to the plate
- accuracy 0.05mm

Calibration plate with very well known references observed in different positions by each CLAM camera
=> Internal parameters of CLAM cameras

Calibration done when the vessel is opened



PHOTOGRAMMETRY CAMERA

70 PICTURES FROM DIFFERENT POSITIONS



CLAM CALIBRATION PLATE

