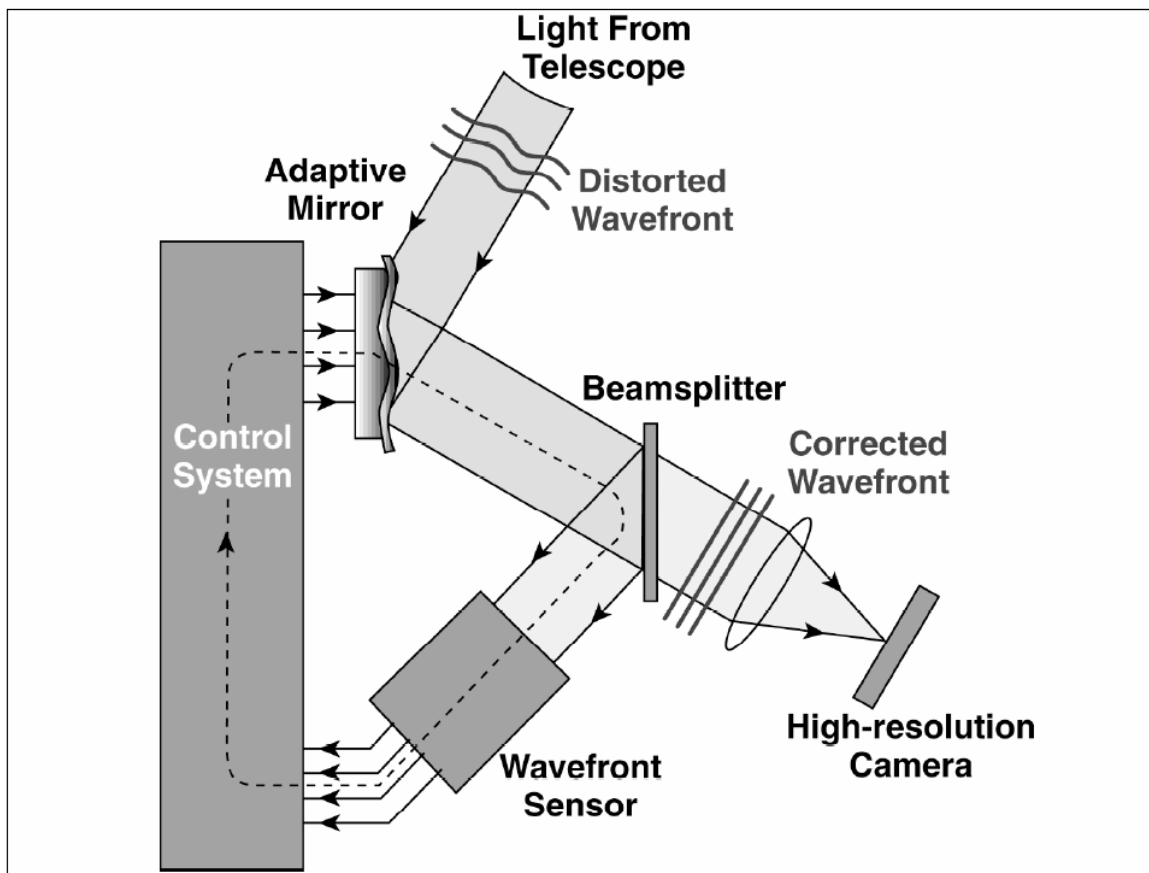


# From P45 to LBT672

## The Adaptive Secondary is arriving...

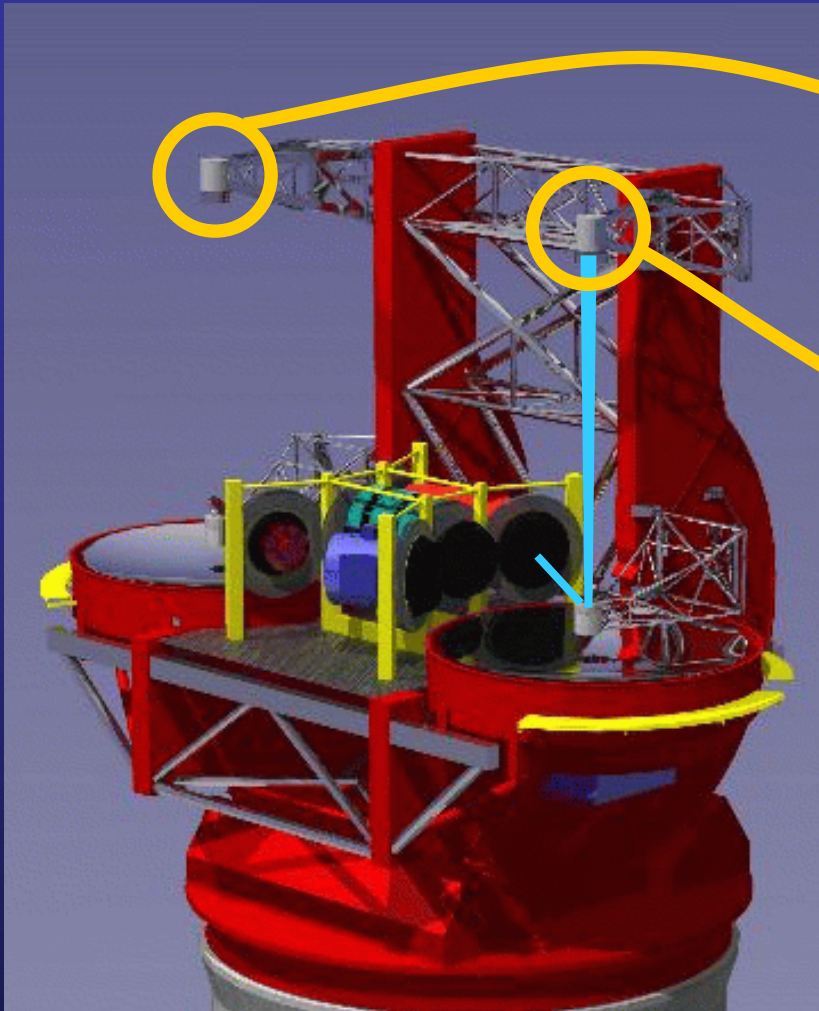
(Marco Xompero, Daniela Zanotti)

# What is AO?

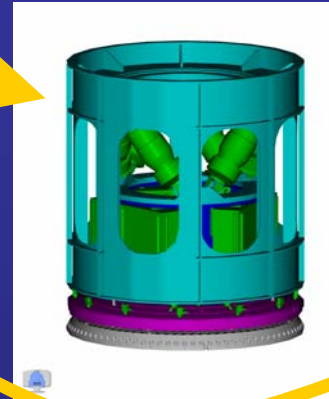


All AO systems work by determining the shape of the distorted wavefront, and using an "adaptive" optical element -- usually a deformable mirror -- to restore the uniform wavefront by applying an opposite cancelling distortion.

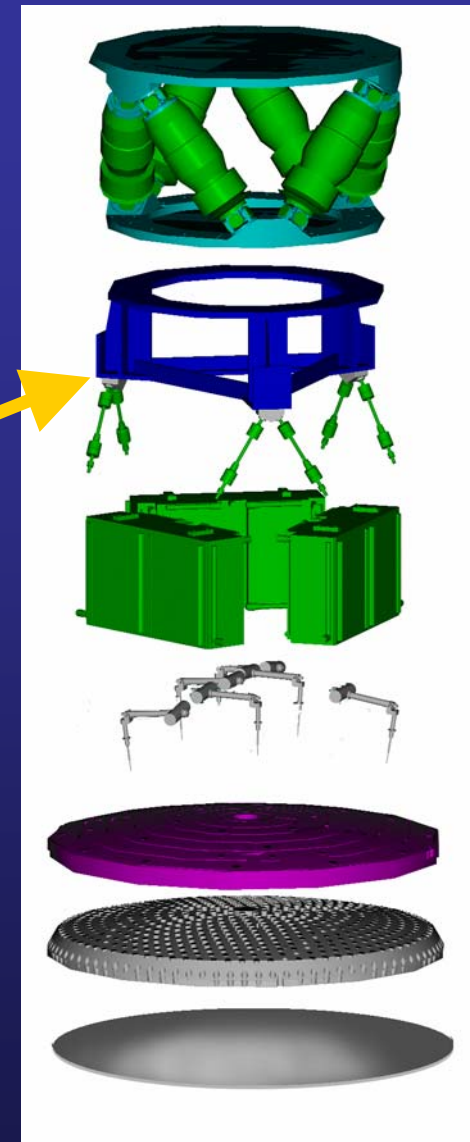
# The AdSec@LBT



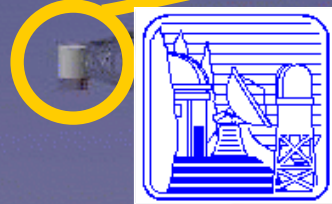
2x8.4m mirrors



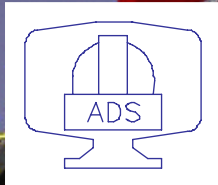
Each AdSec:  
672 actuators  
911mm diam.



# The AdSec@LBT



INAF-Osservatorio Astrofisico di Arcetri (Italy):  
Conceptual design. Optical and electromechanical tests,  
calibration and diagnostic software development.



ADS (Italy): mechanical engineering,  
mechanical drawings, production and assembly

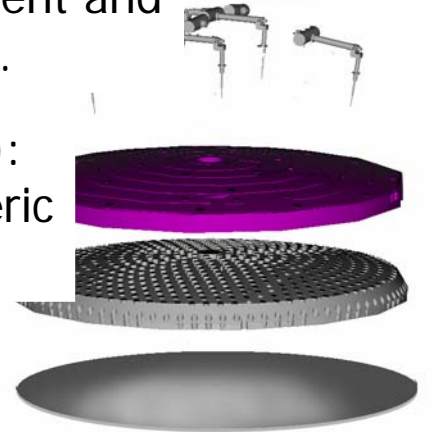
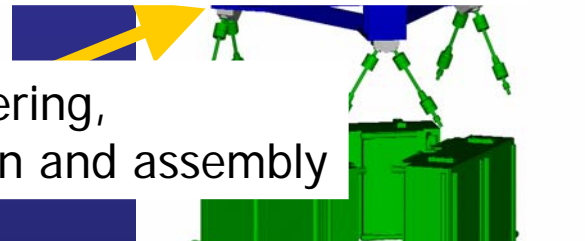
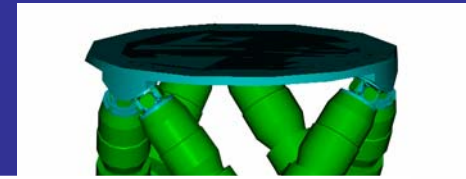


Microgate (Italy): electronics development and  
production. DSP software development.

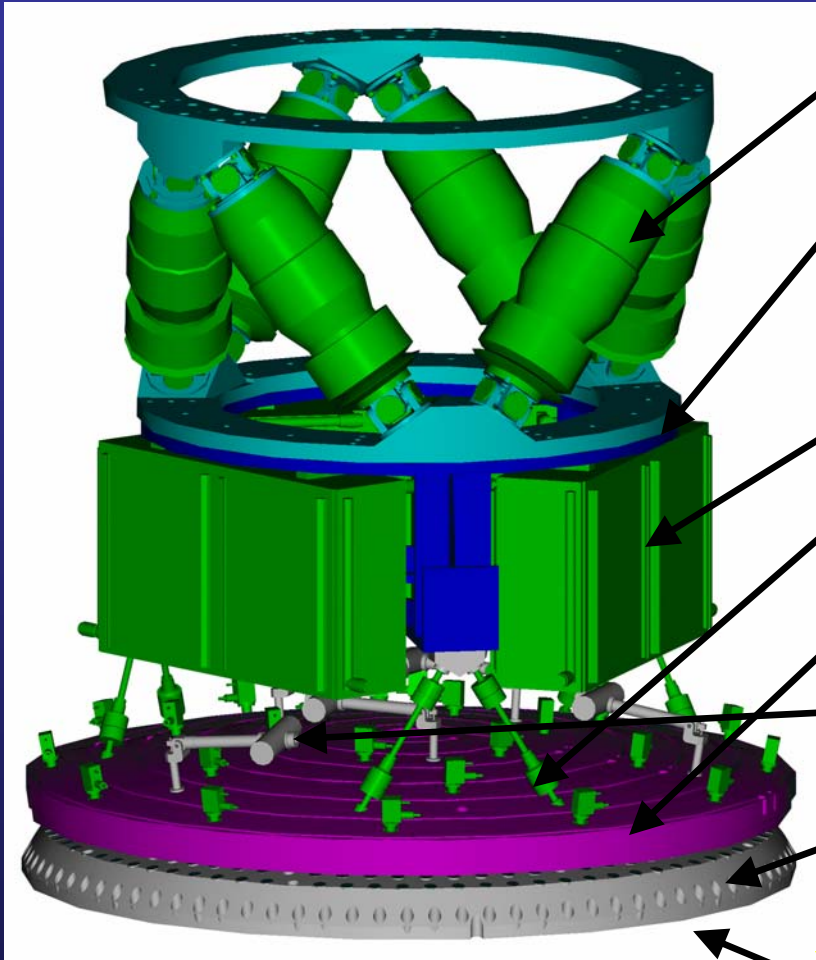


Mirror Lab-Steward Observatory (USA):  
Optical components production (aspheric  
shells and reference plates)

2x8.4m mirrors



# LBT672 in detail



Hexapod

Interface flange and structural support

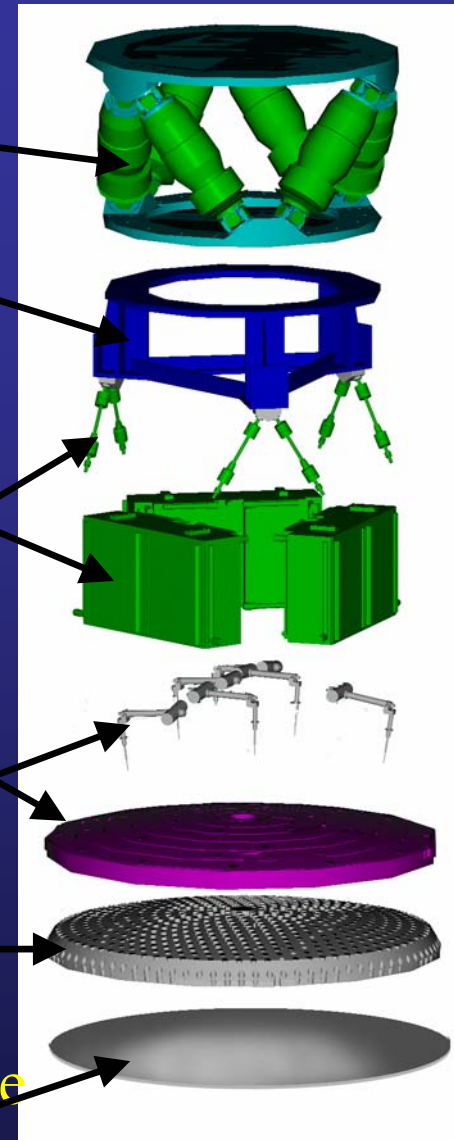
3 cooled electronics boxes

Fixed hexapod  
Cold-plate and actuator support

Astatic levers

50mm thick Zerodur reference-plate

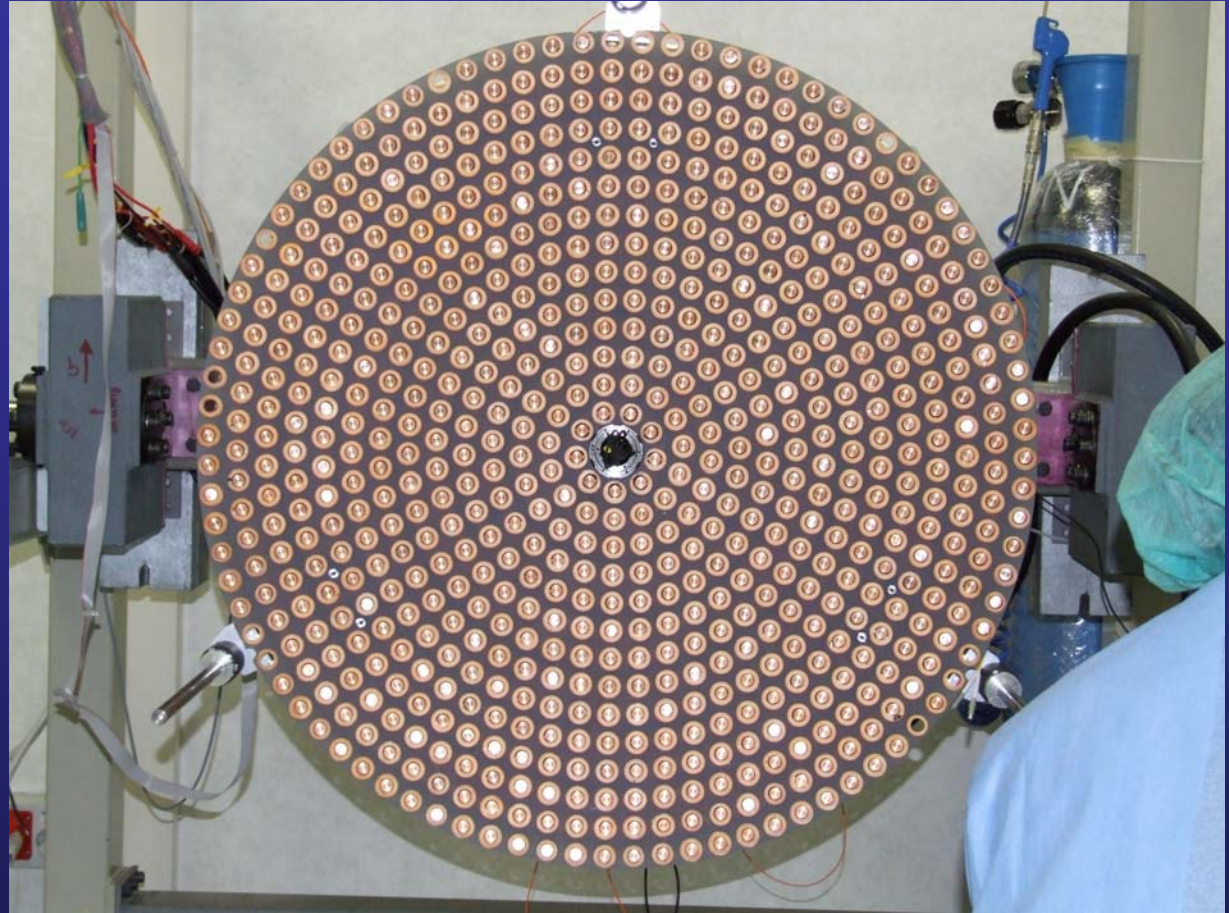
1.6mm thick deformable Zerodur shell



# Have a look to the hardware



240 mm



911 mm

11/10/2007

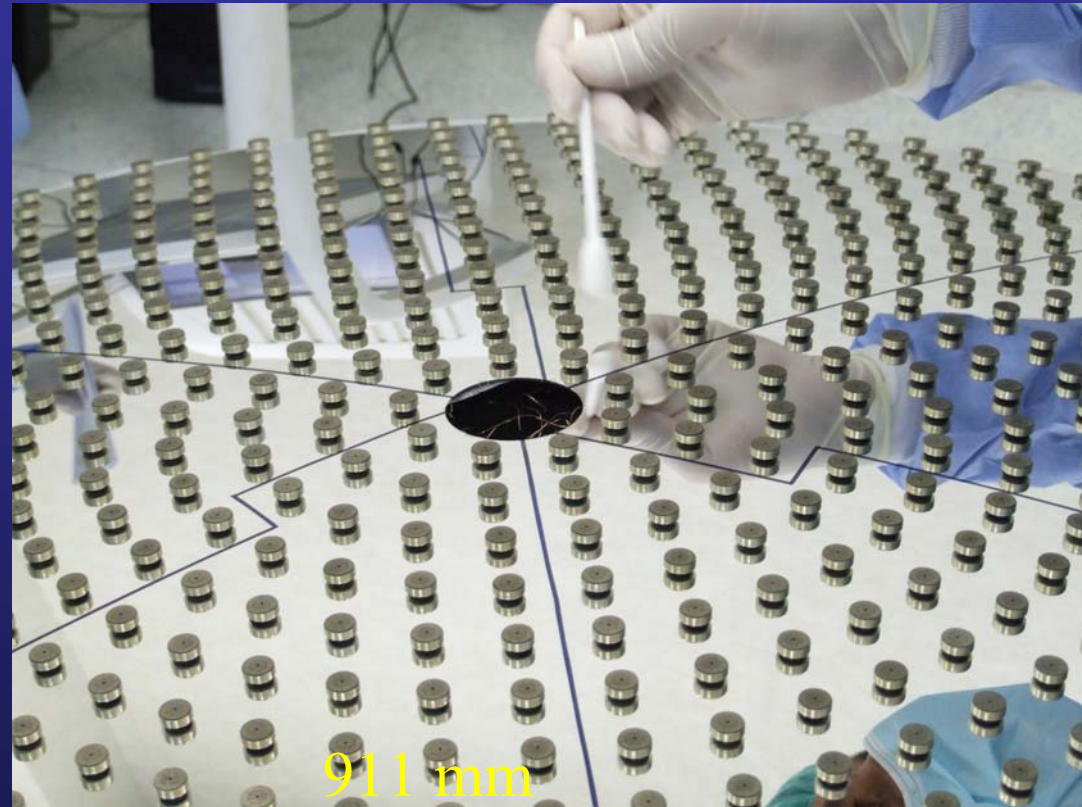
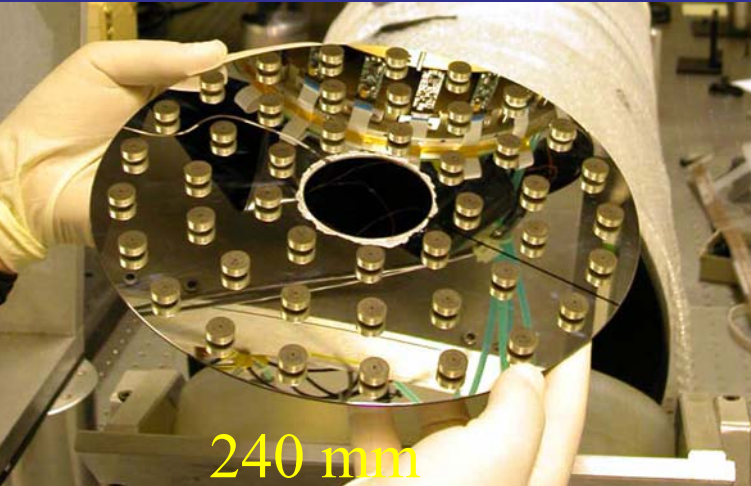
45 acts

Fellow Days 2008

672 acts

6/22

# Have a look to the hardware



11/10/2007

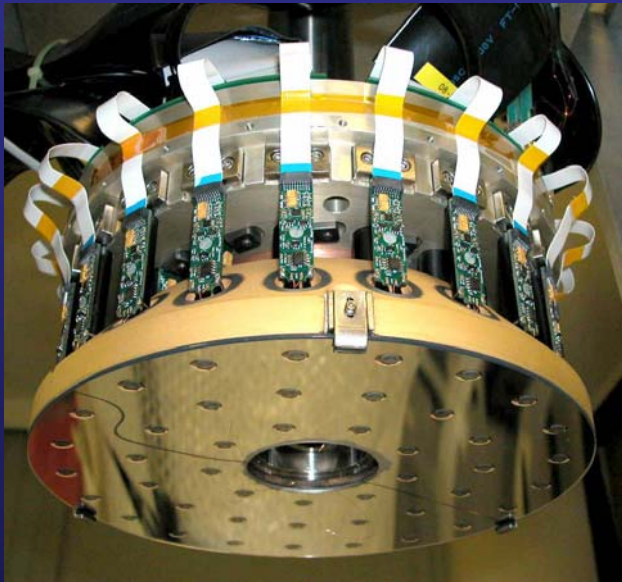
45 acts

Fellow Days 2008

672 acts

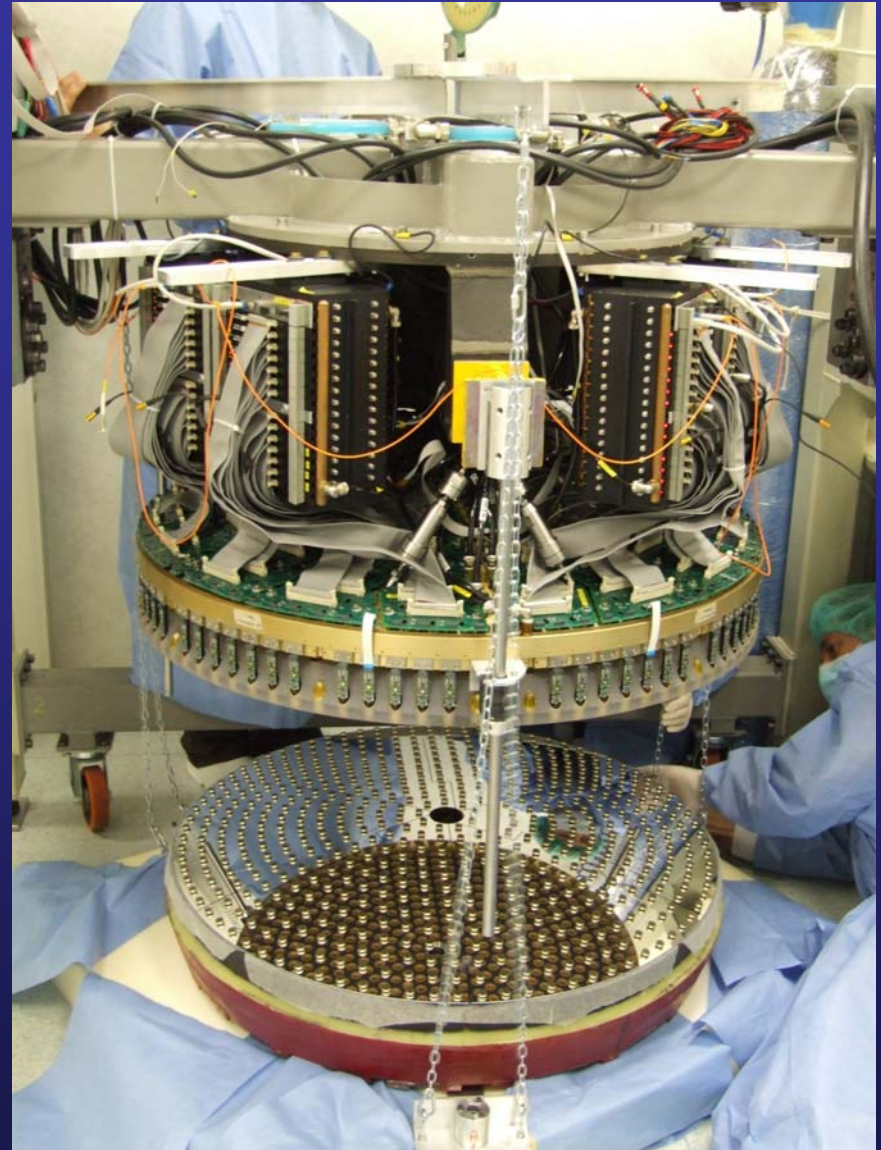
7/22

# Have a look to the hardware



11/10/2007

45 acts



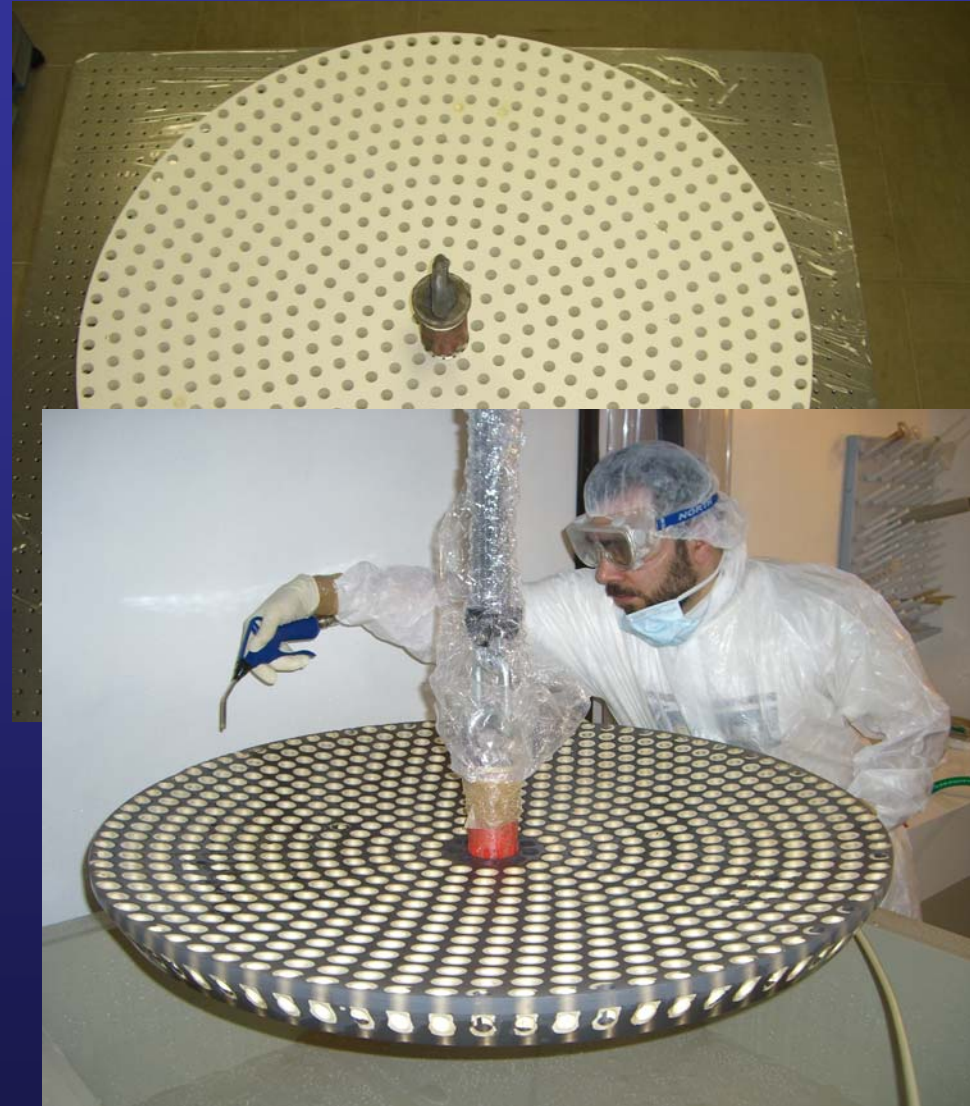
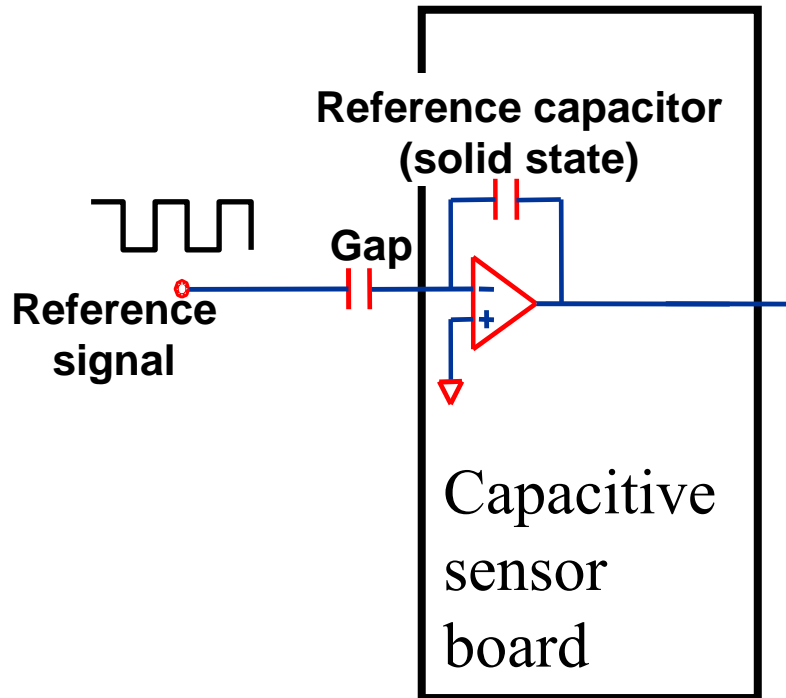
Fellow Days 2008

672 acts

8/22

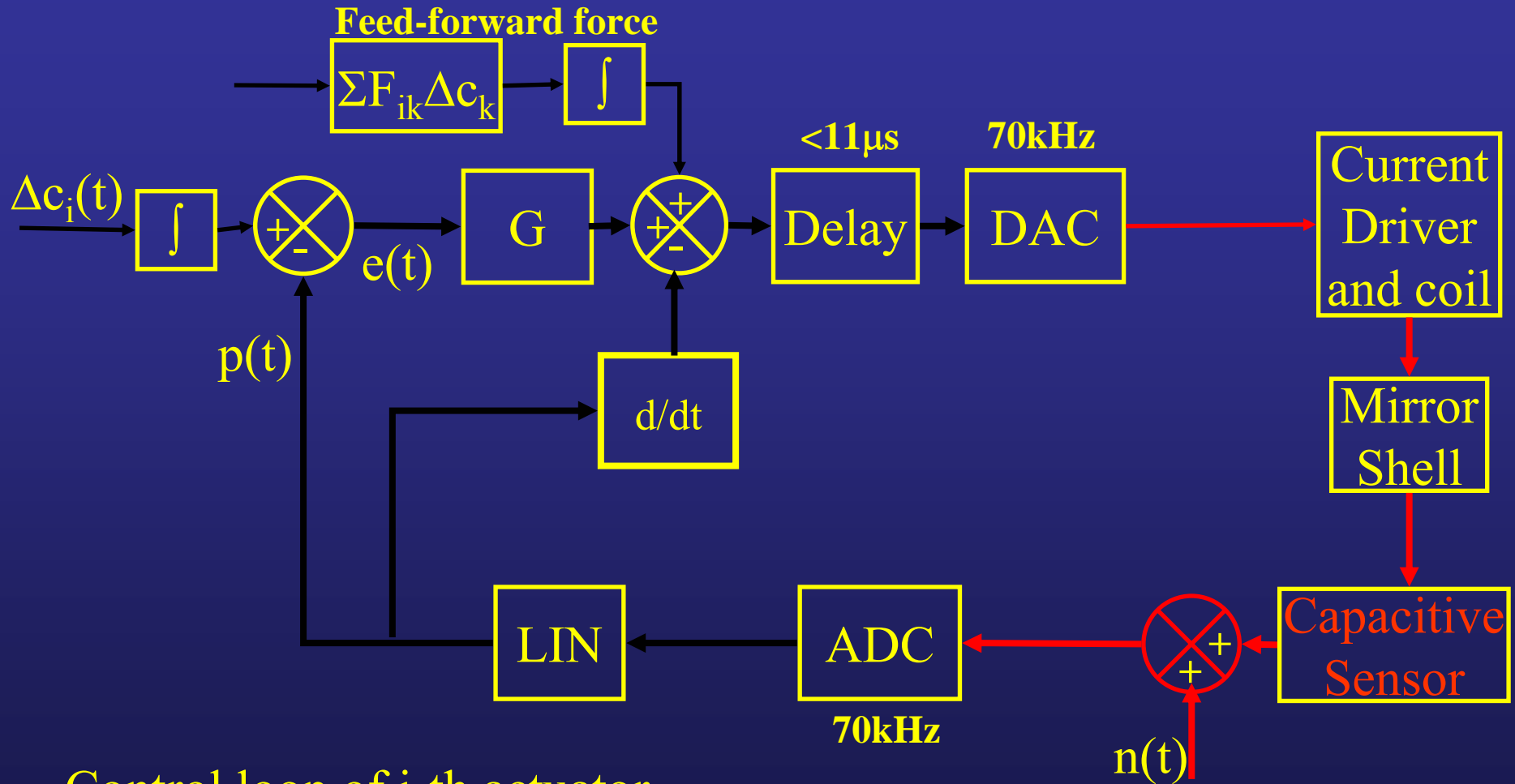


# Actuators and Sensor



Noise # 4,5 nm rms

# Control Theory

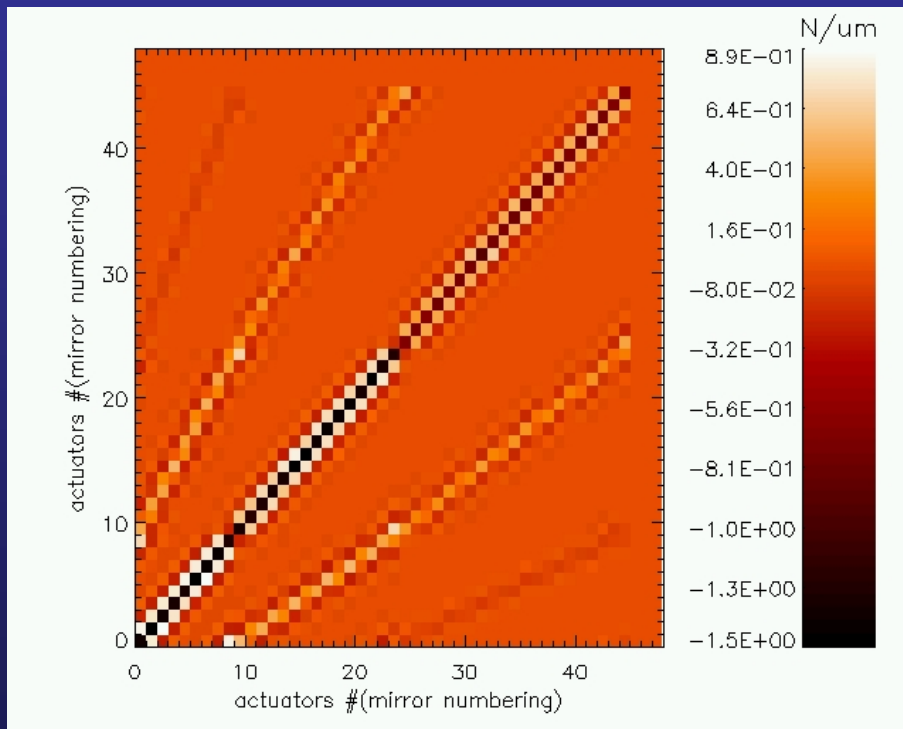


# Feed-forward matrix

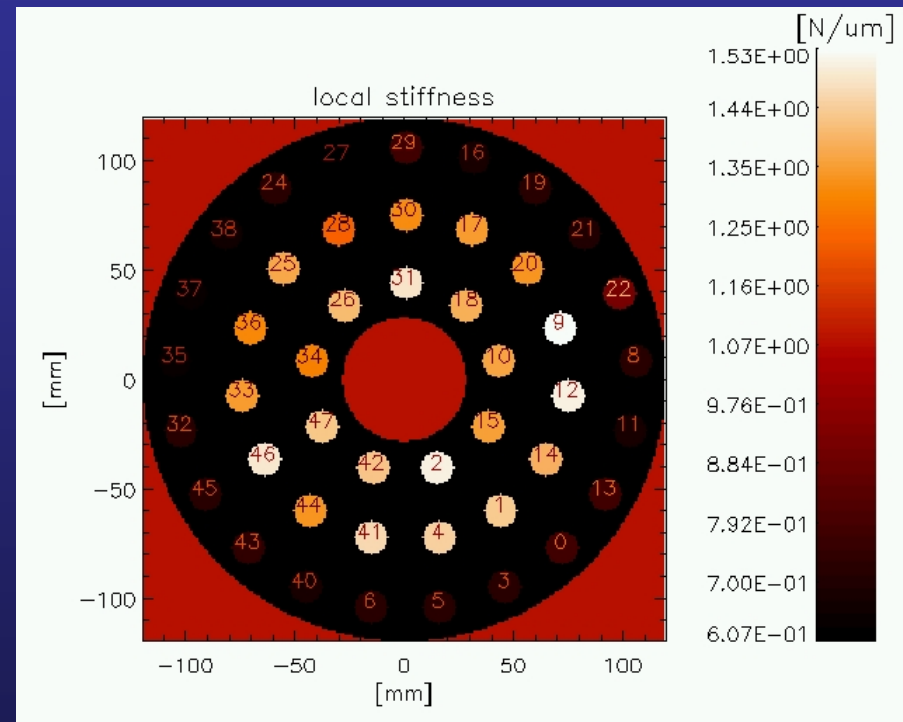
$$\{\Delta f\}_i = [K] \{\Delta p\}_i$$



P45



measured feed-forward matrix

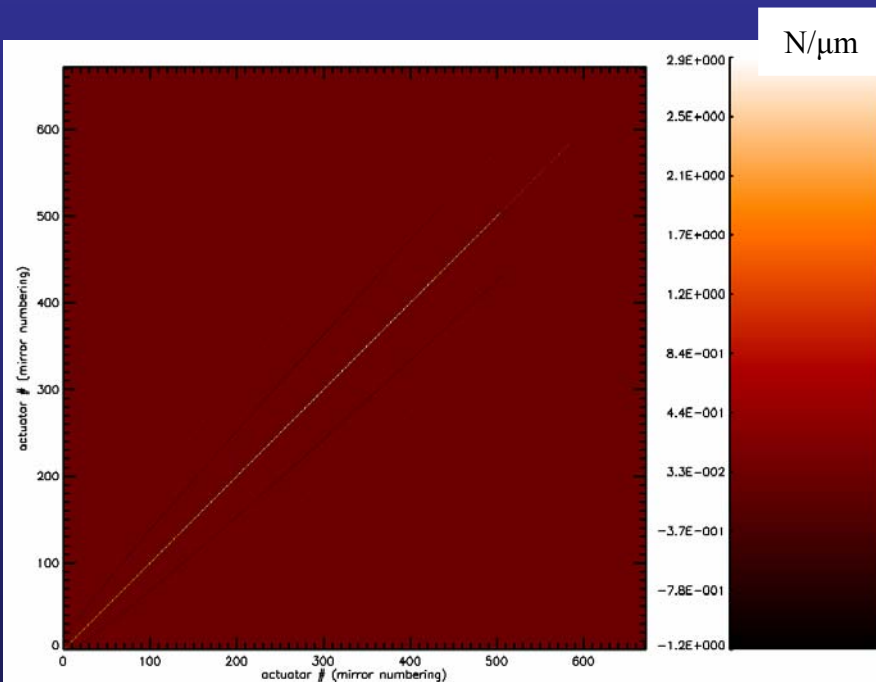


local stiffness: diagonal of the feed-forward matrix

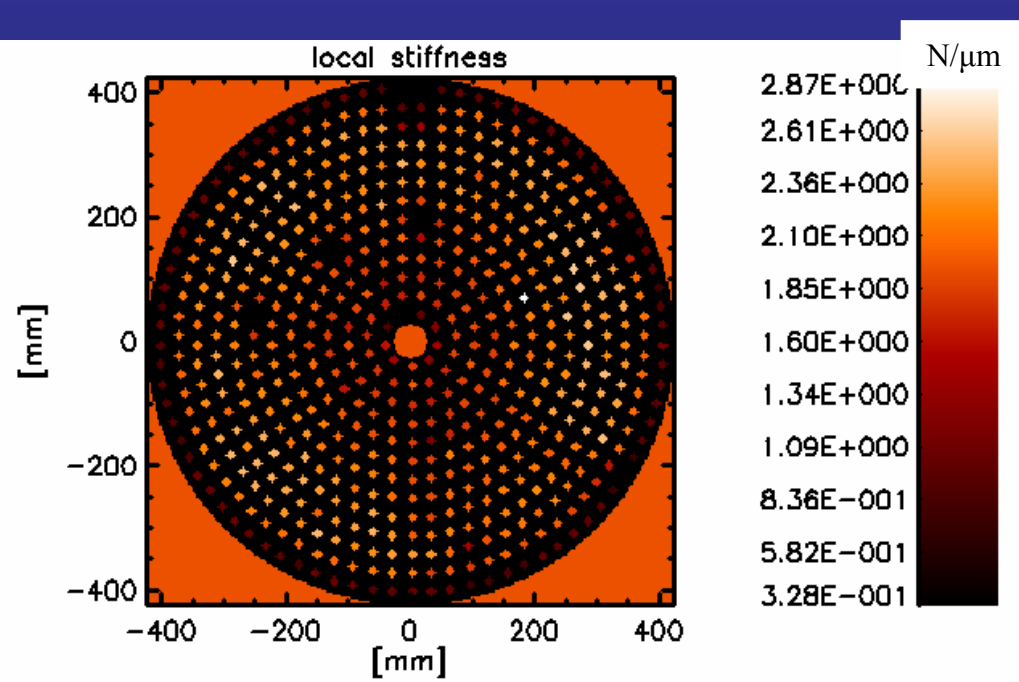
# Feed-forward matrix

## TS1

(LBT672 Technical shell, 585 acts)



measured feed-forward matrix

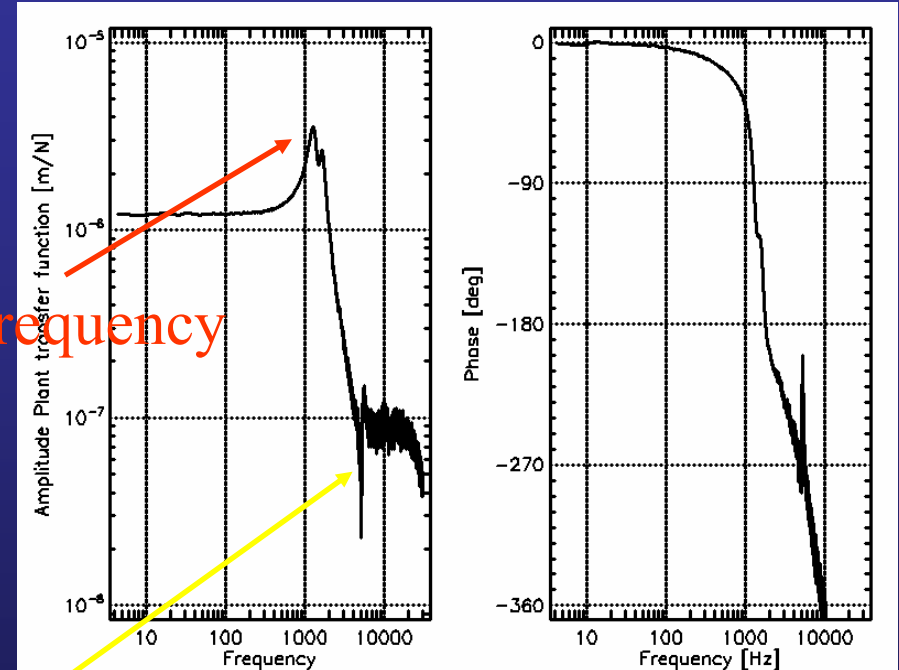
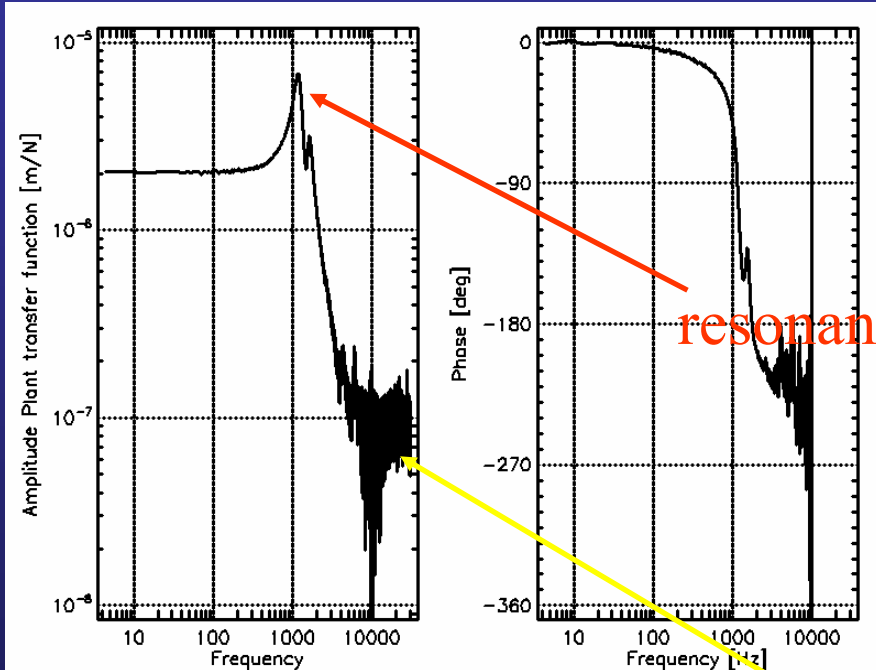


local stiffness: diagonal of the feed-forward matrix

# Mode Transfer Function

P45

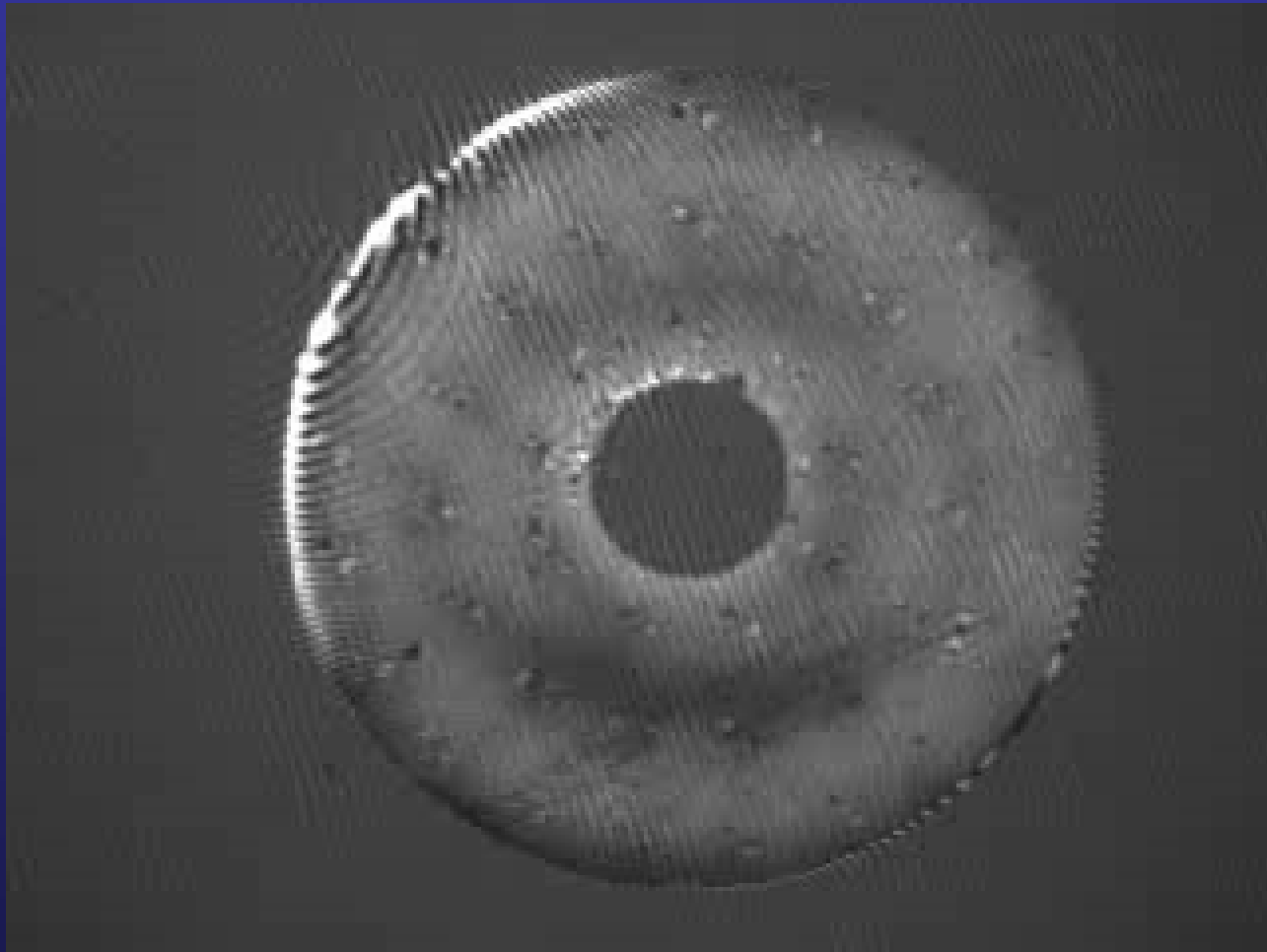
TS1 (LBT Technical Shell)



resonant frequency

Better behavior of cross-talk in the LBT672a unit: The LBT672a amplitude tends to decrease, while the P45 amplitude increases

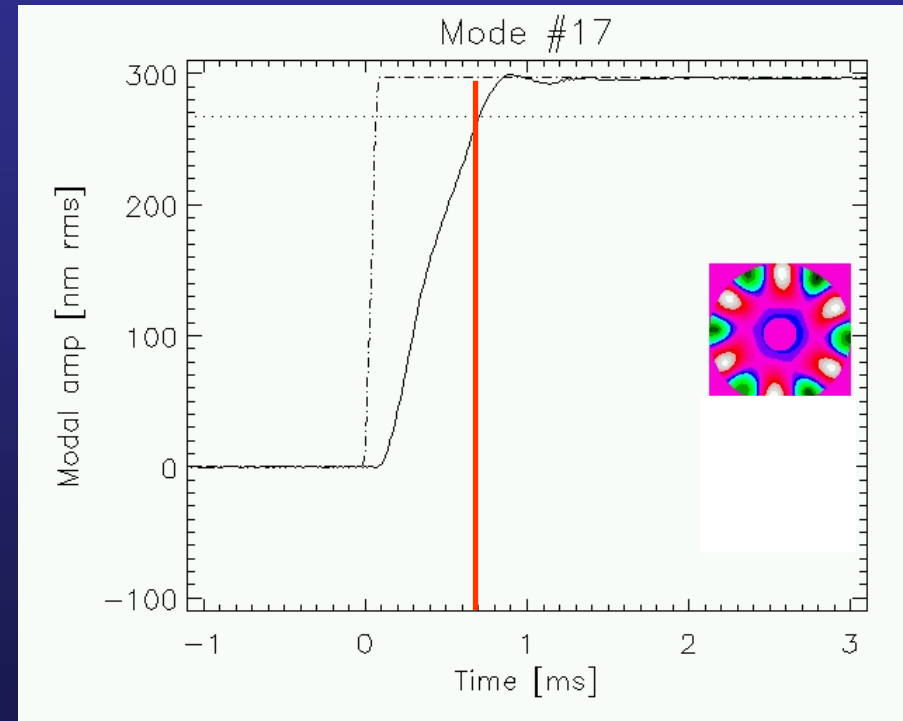
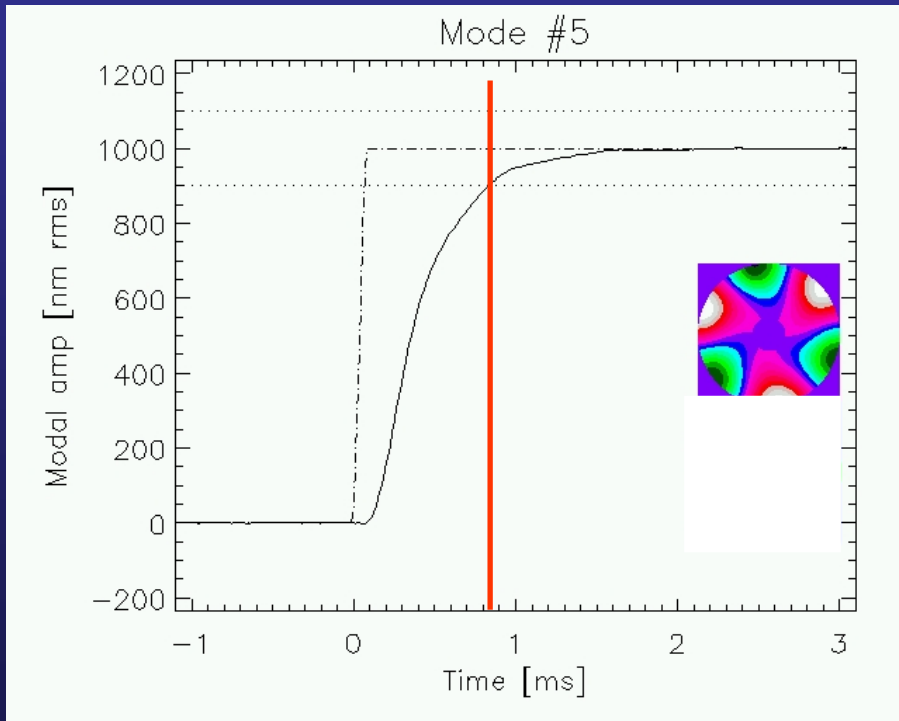
# Step Response



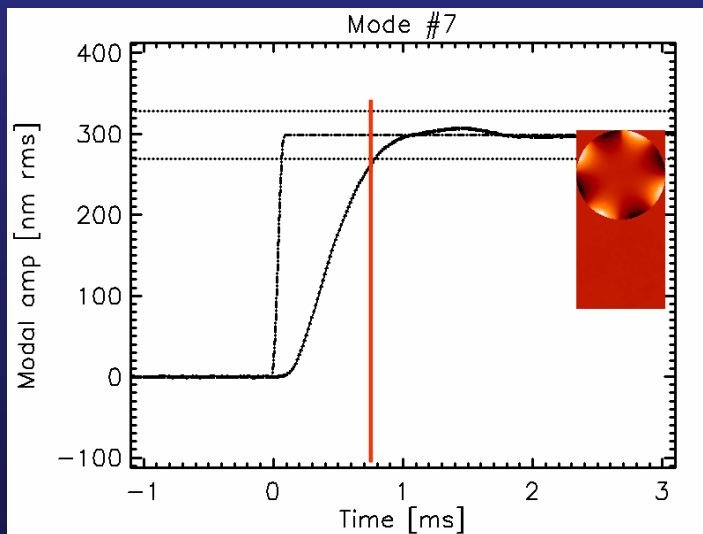
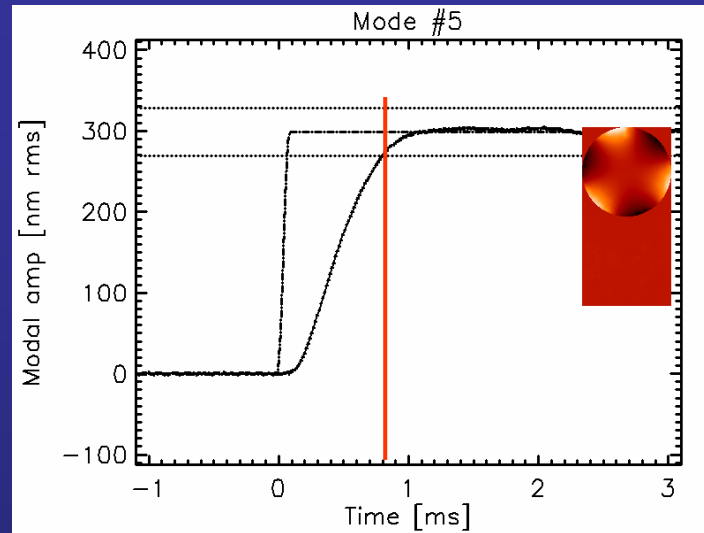
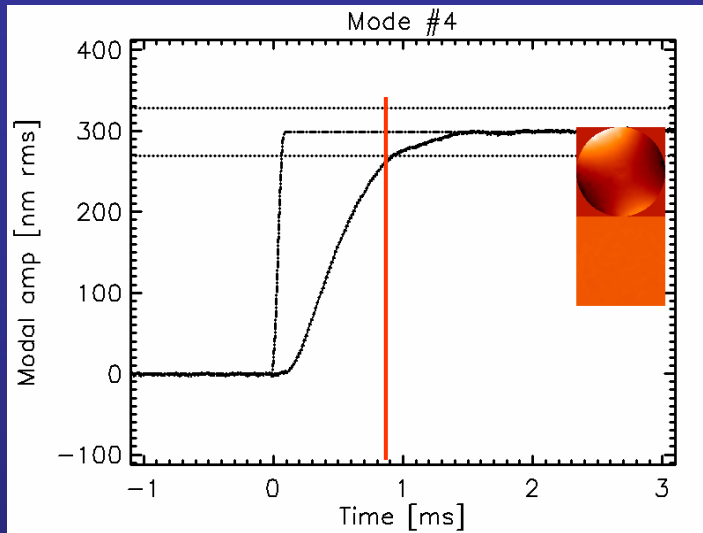
# Step Response

Goal of Optical Loop is 1KHz  $\longrightarrow$  LBT672 Settling Time  $< 1$  msec

P45 @68 $\mu$ m



# Step Response



## TS1

Settling time @60 $\mu\text{m}$  < 1msec

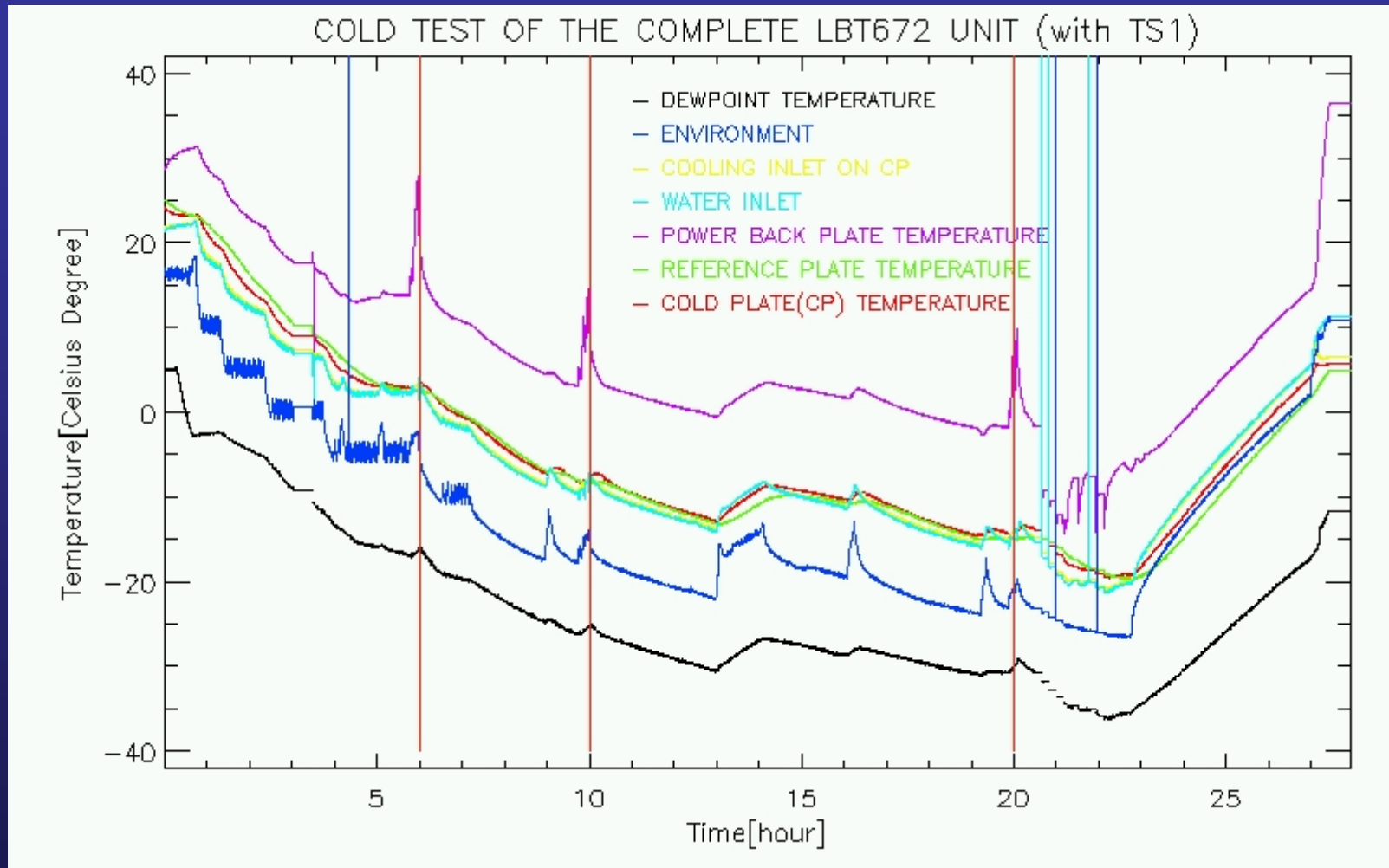
Maximum Overshoot 2.8%

Proportional gain 0,14N/ $\mu\text{m}$

Derivative gain 40Ns/m

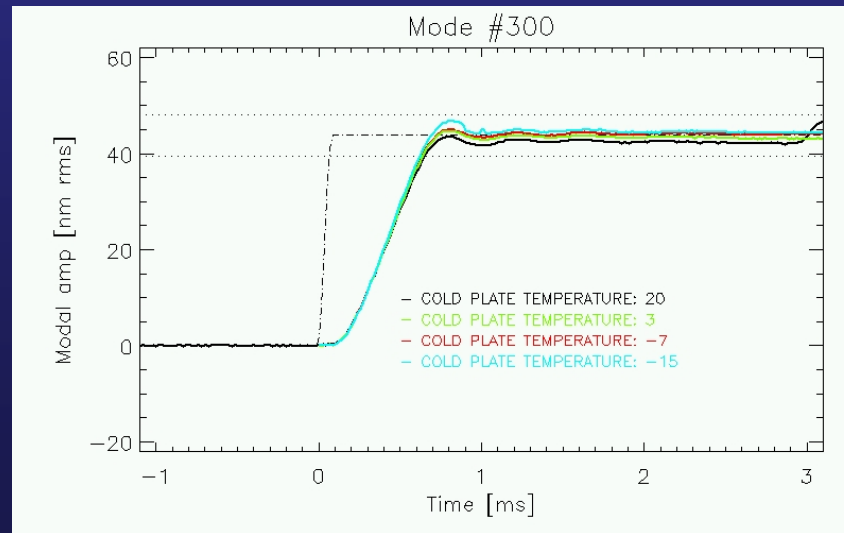
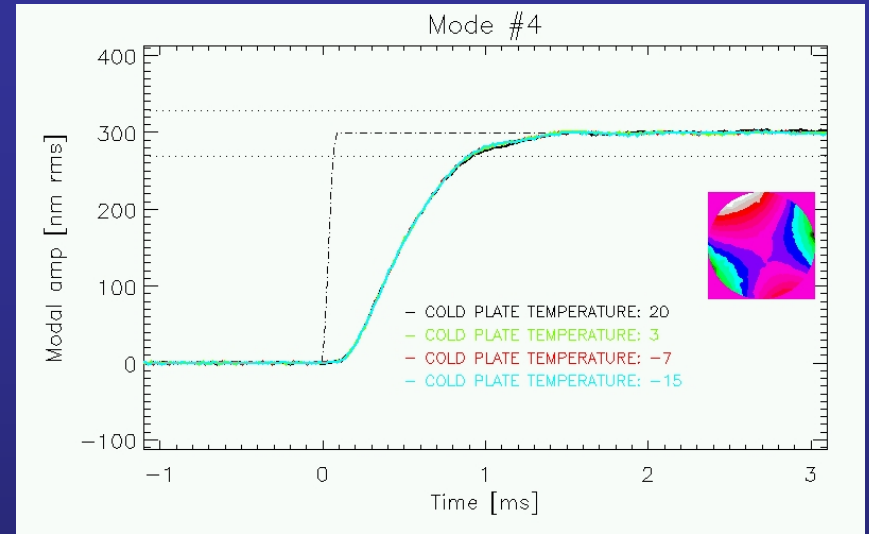
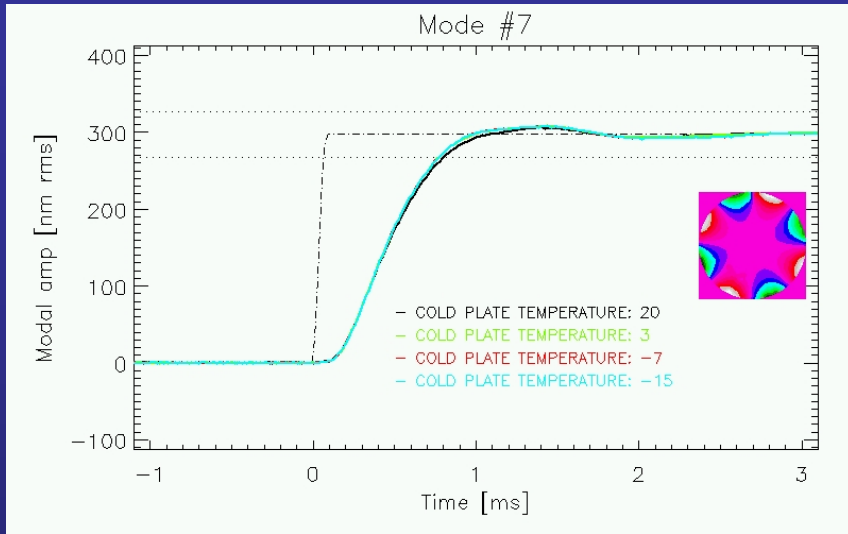


# Final Tests: Cold Test

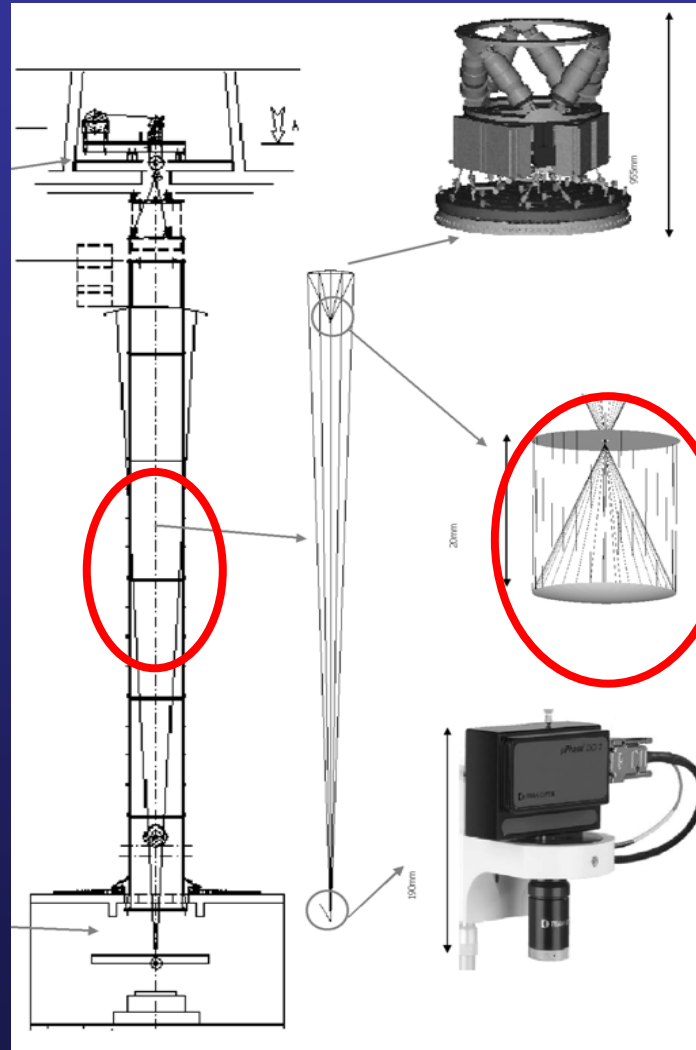


# Cold Test: Results

## Step response



# Optical test tower (1)

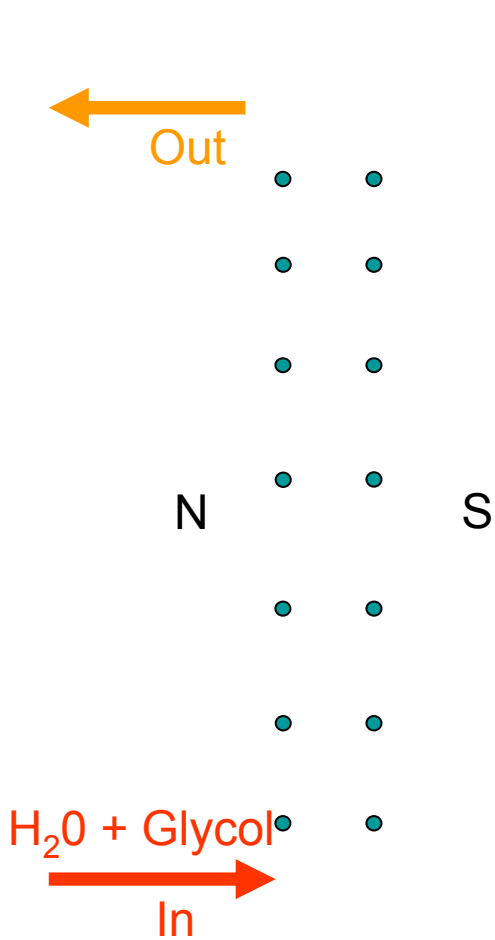


## GOALS:

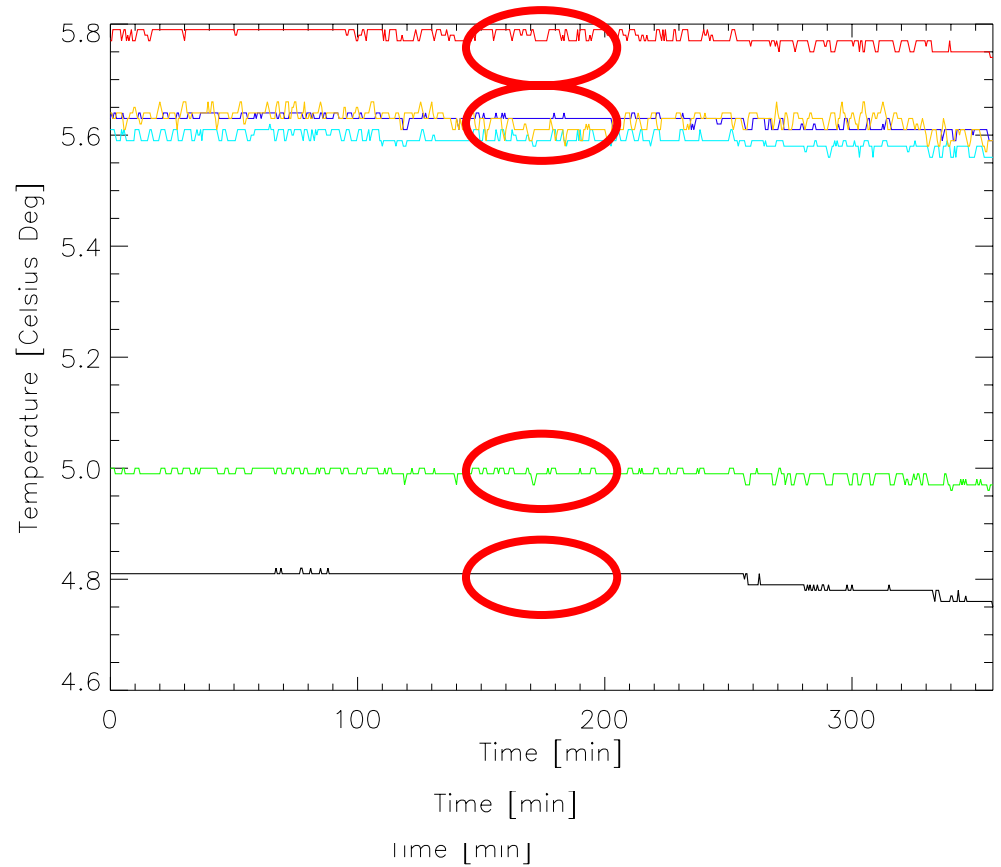
- Avoid air convection
- Minimum hexapod movement to correct defocus term in the optical path

## SOLUTION:

Local thermal stability in all tower length within 0.1 °C



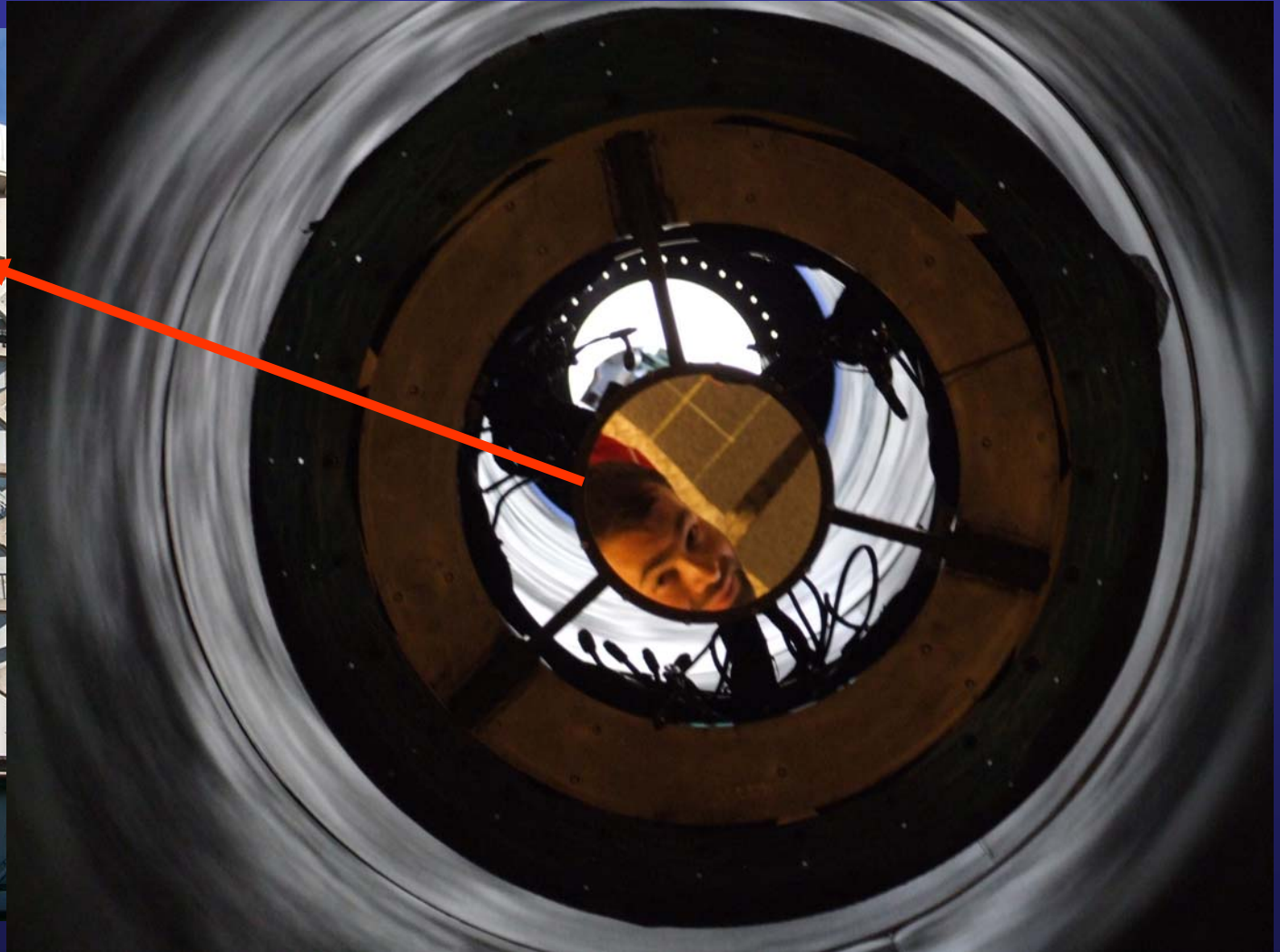
● Temperature  
 Sensors  
 (PT1000)



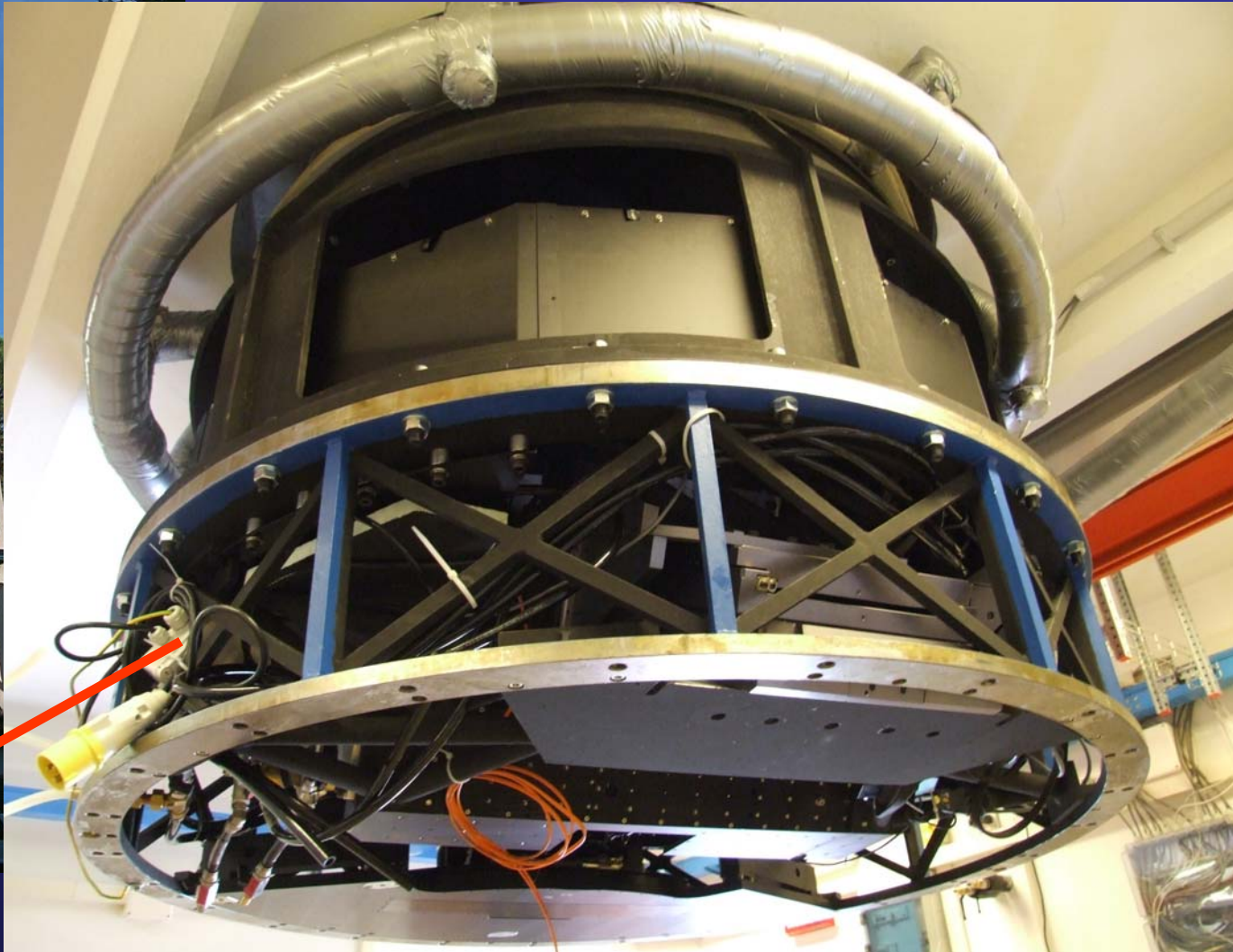
# Optical test tower (3) (WFS Group)



# Optical test tower (3) (WFS Group)



# Optical test tower (3) (WFS Group)



11/10/2007

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23/22

# Optical test tower(4)

Ready to silver the TS3 for the final optical test with the LBT672 unit

- Tested the Silvering process (Oxide-Reduction Process with spraygun)
- Silvering support ready.
- Test with a piece of glass with the same dimensions of the secondary mirror and the slumped shell.



# Optical test tower(4)

Ready to silver

- Tested the (spraygun)
- Silvering s
- Test with a secondary



# Optical test tower(4)

Ready to silver

- Tested the spraygun
- Silvering s
- Test with secondary



# Conclusions

The Future steps:

- Final characterization of the Scientific Thin Shell(TS3);
- From Nov. 07 to Jan. 08 LBT672a Optical Test;
- From Jan.08 to July 08 AO System test in solar tower with LBT672 and WFS unit.
- August 08 Shipment of all the system to Arizona

# Feed-forward Matrix - Zonal

