Results of the “Absolute Multiline” Measurements on the Very Large Telescope

S.Leveque, S.Guisard, European Southern Observatory

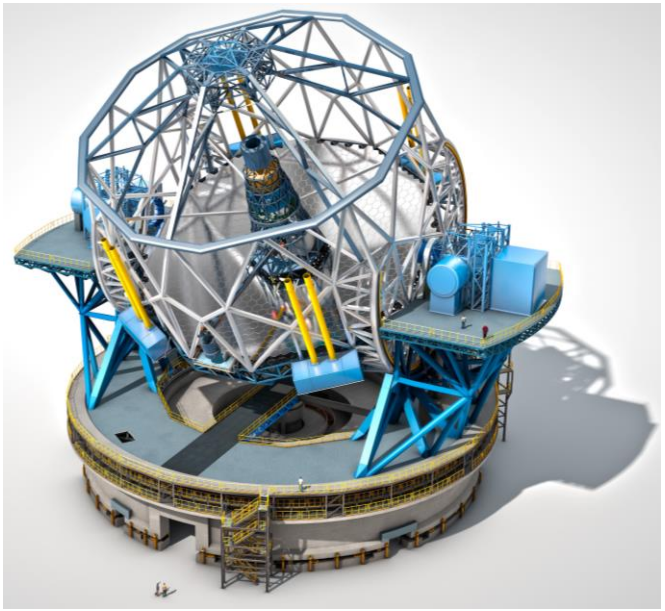
M.Wissmann, Etalon AG.

Contact: sleveque@eso.org

Outline

- Context and Rationale
- Test set-up
- Experimental Results
- Conclusion and perspectives

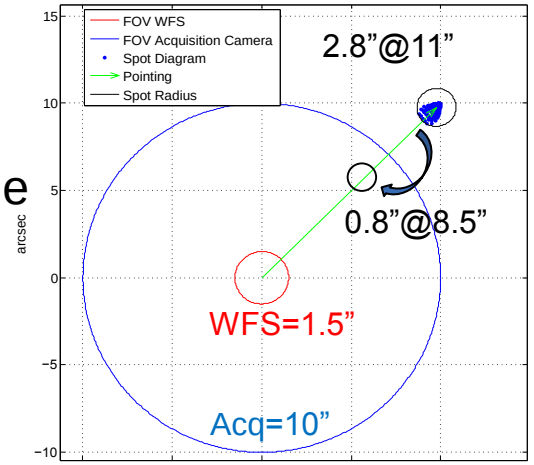
Context and Rationale



Monitoring the inter-mirror position and Rigid Body Motion:

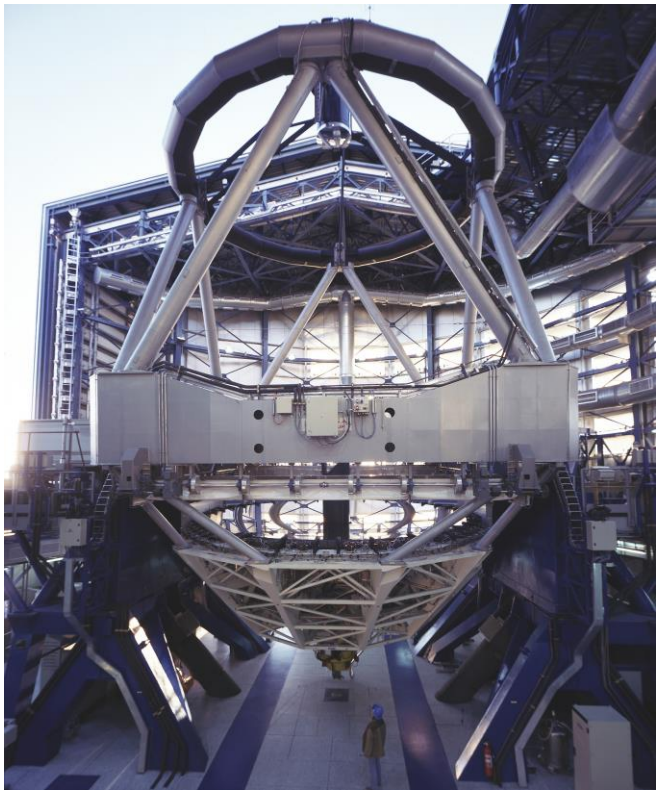
- integration phase
- insure proper collimation to enter in the capture range of the star acquisition camera and WFS for active optics

–>$\Delta P=100\mu m$ $\Delta\Theta=25\mu rad$, range=30m+



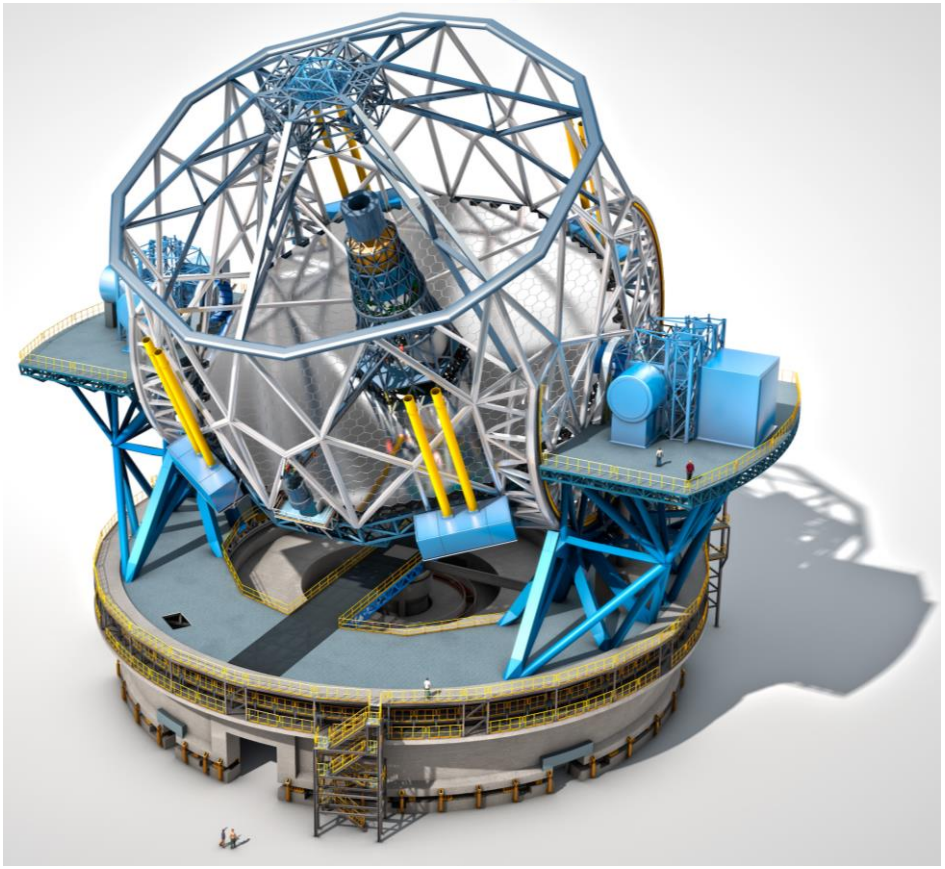
Context and Rationale

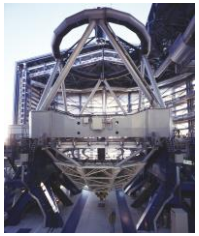
- Test of the adequacy, performance and robustness of the *Absolute Multiline* on the VLT
  - Effective access time for measurements: 2.5 days



Context and Rationale

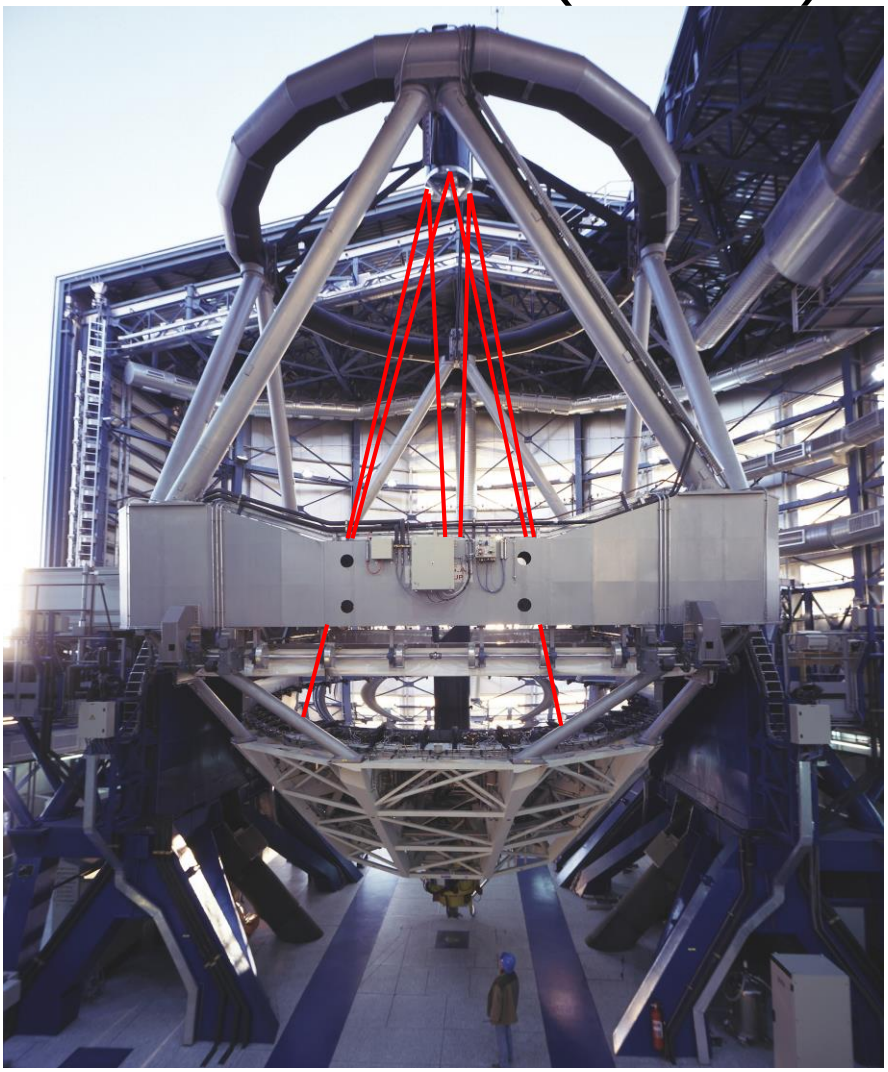
- Not quite the same scale… but similar operational and environmental conditions

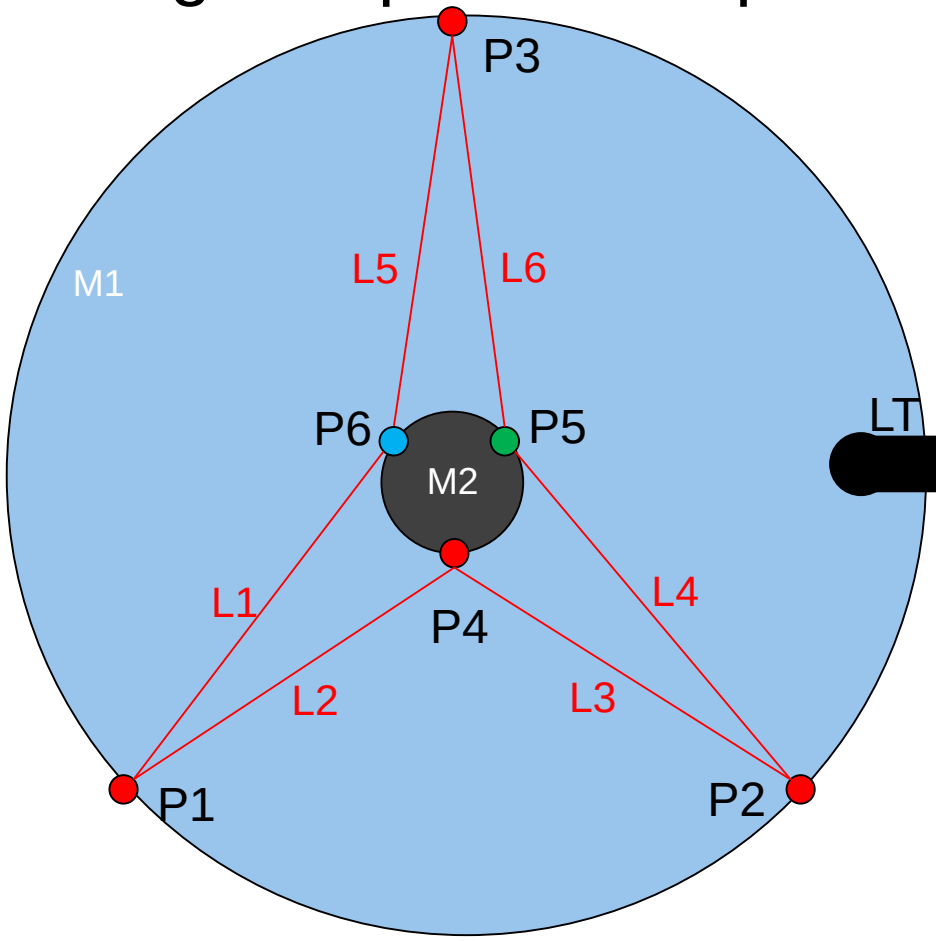




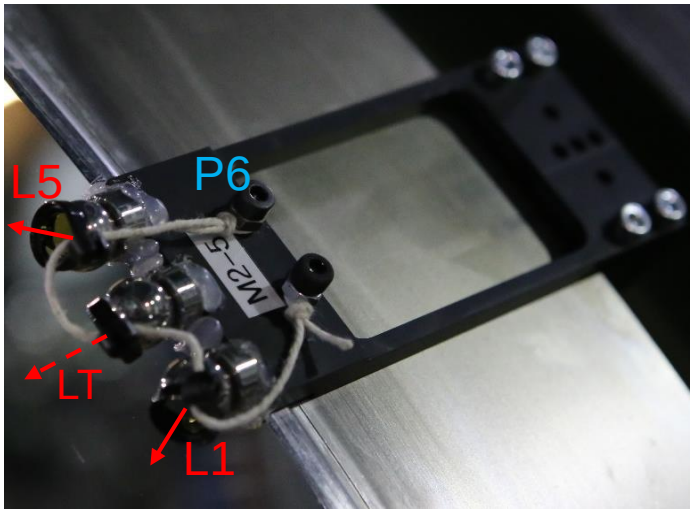
Test set-up: An optical hexapod

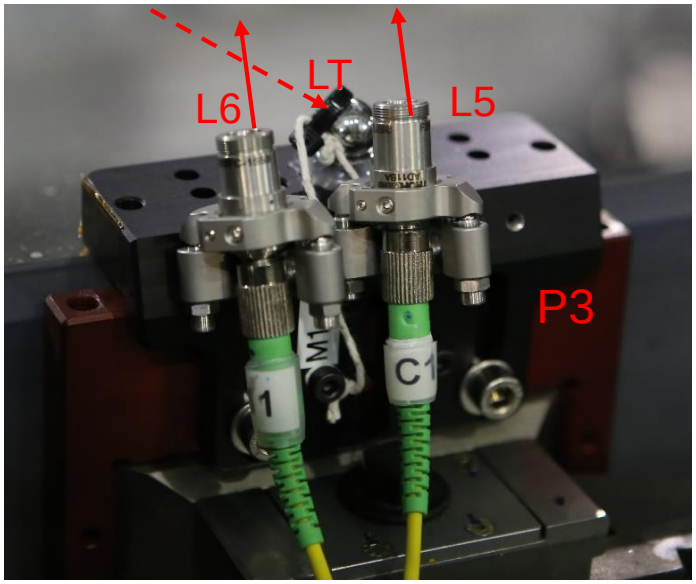
- Monitor RBM (M1,M2) by forming an optical hexapod.



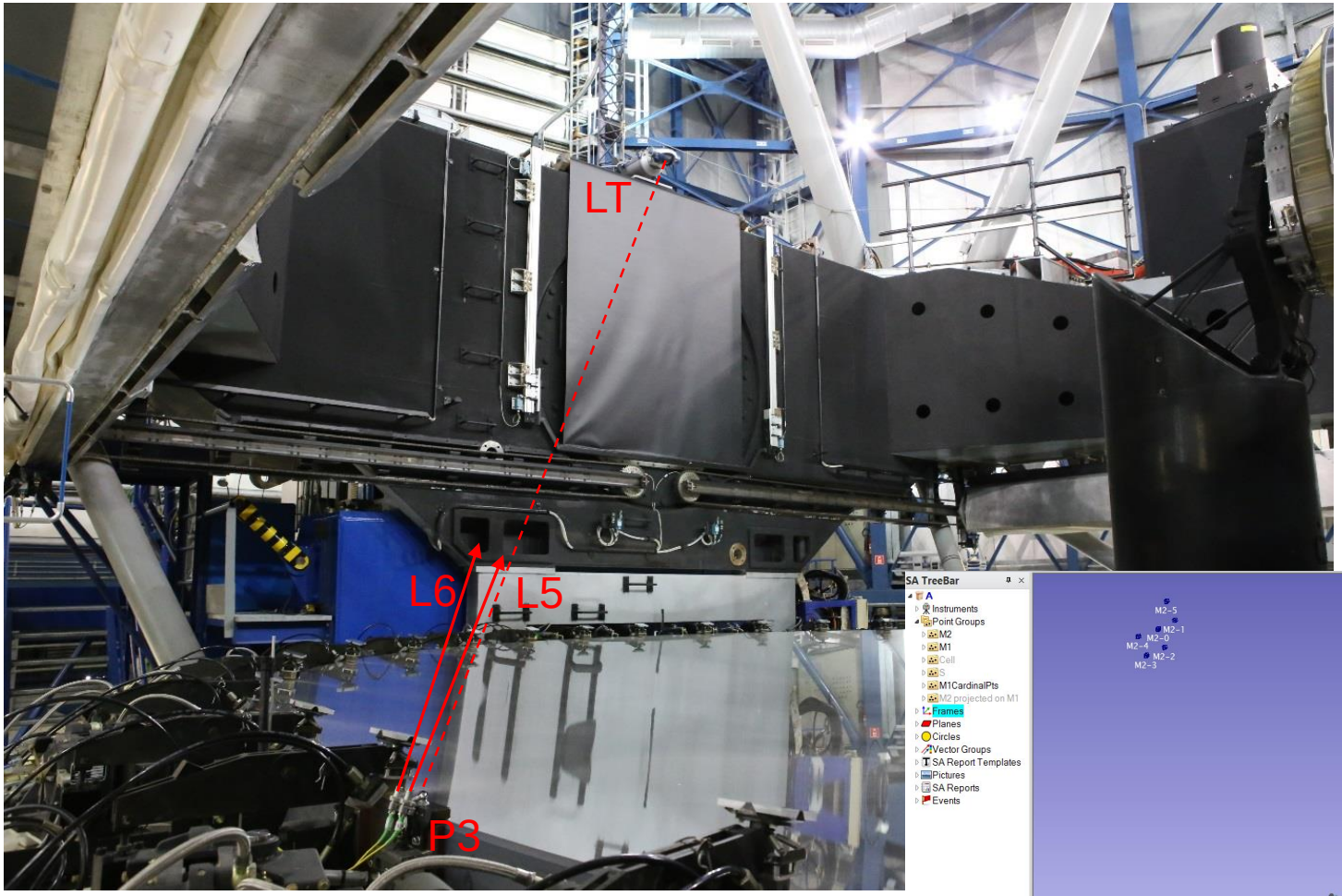


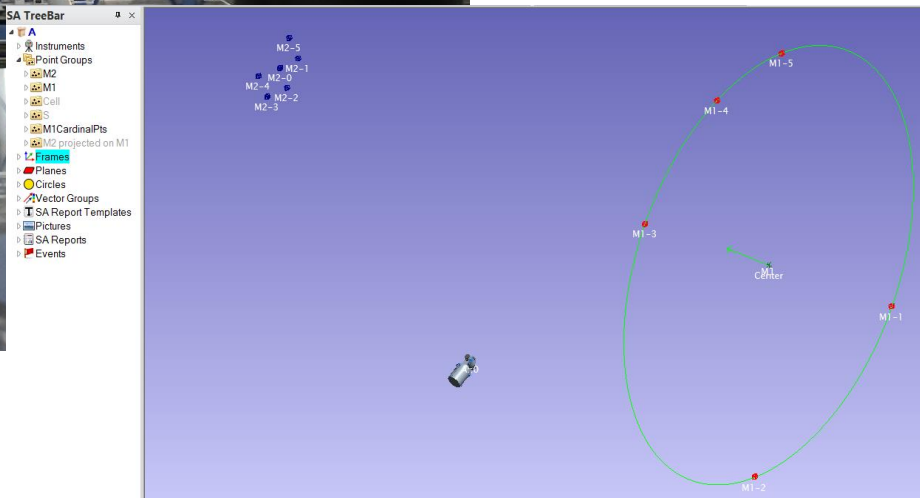
Test Set-up





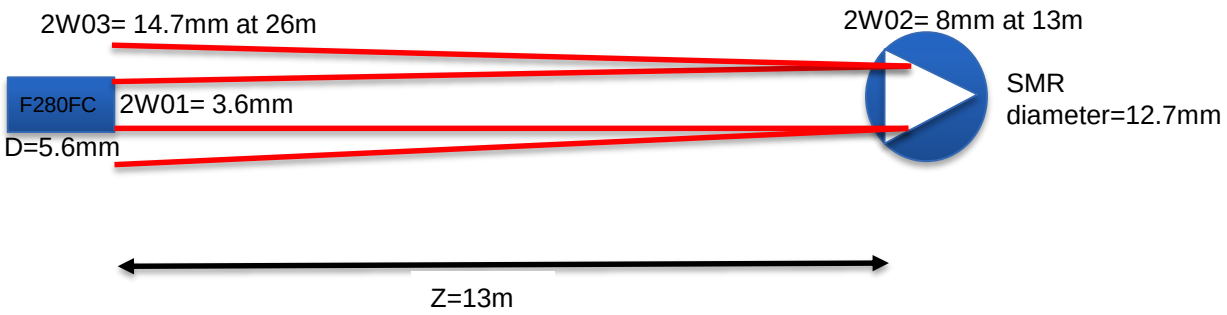
Test Set-up


LT
L6
L5
P3

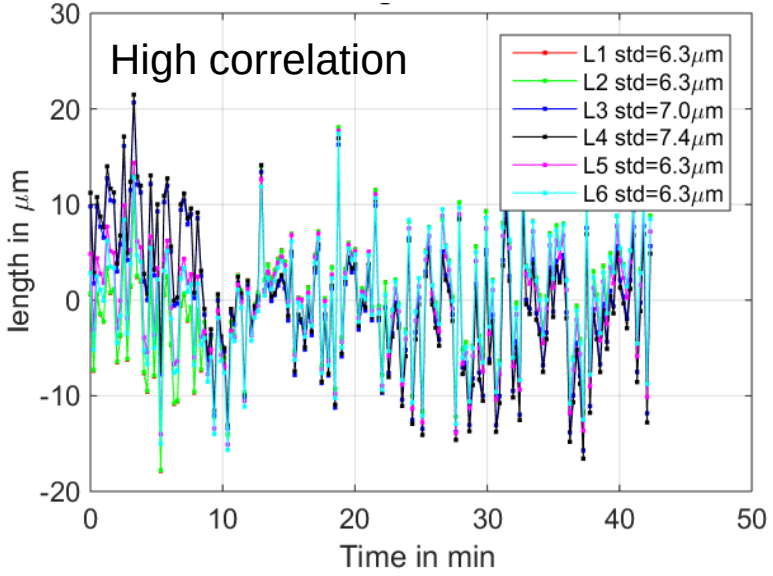

SA TreeBar
A
Instruments
Point Groups
M2
M1
Cell
S
M1CardinalPts
M2 projected on M1
Frames
Planes
Circles
Vector Groups
SA Report Templates
Pictures
SA Reports
Events
M2-5
M2-1
M2-0
M2-4
M2-2
M2-3
M1-5
M1-4
M1-3
Center
M1-1
M1-2

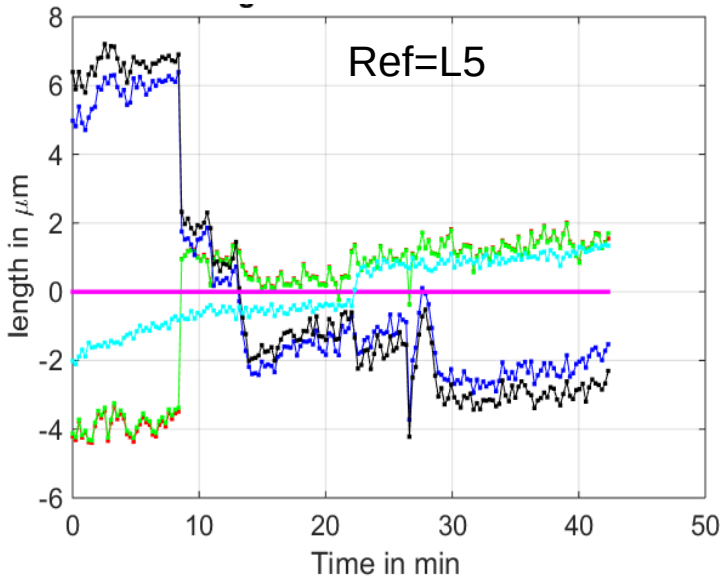
Experimental results

- d(M1,M2)=12m, acceptable lateral displacement ~+/- 2mm



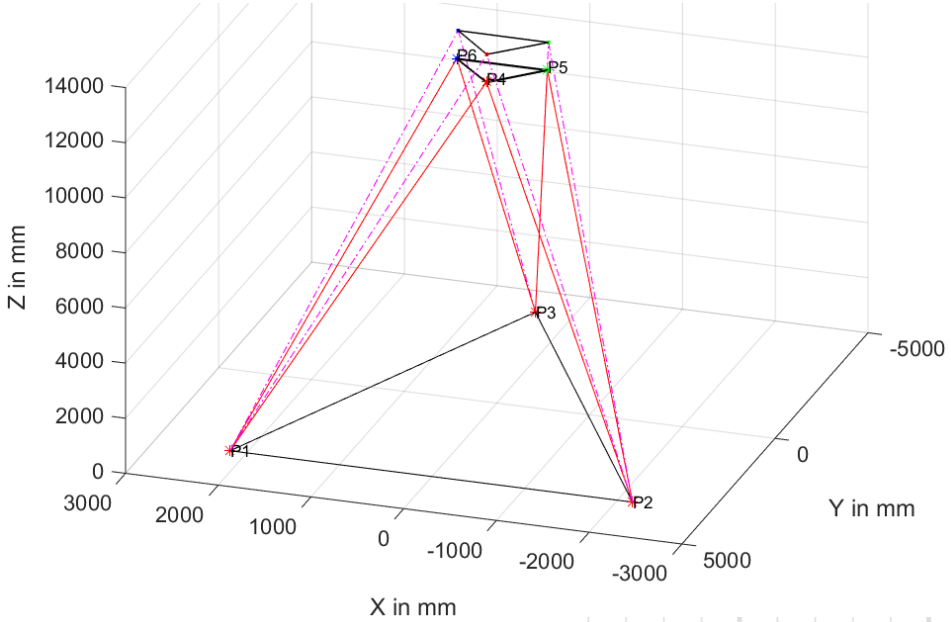
- Stability (dome closed, air conditioned)

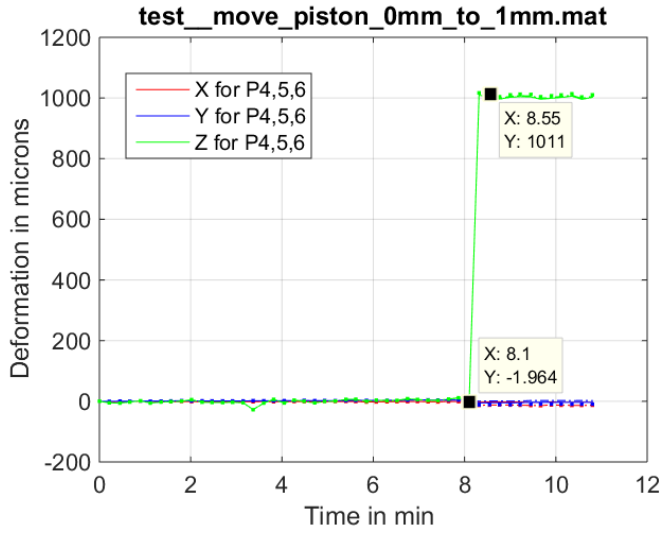


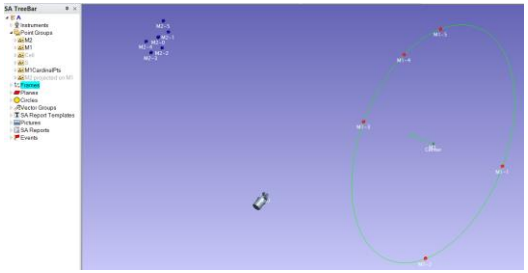


Experimental results

- Comparison with LT measurements for M2 Δz=+1mm



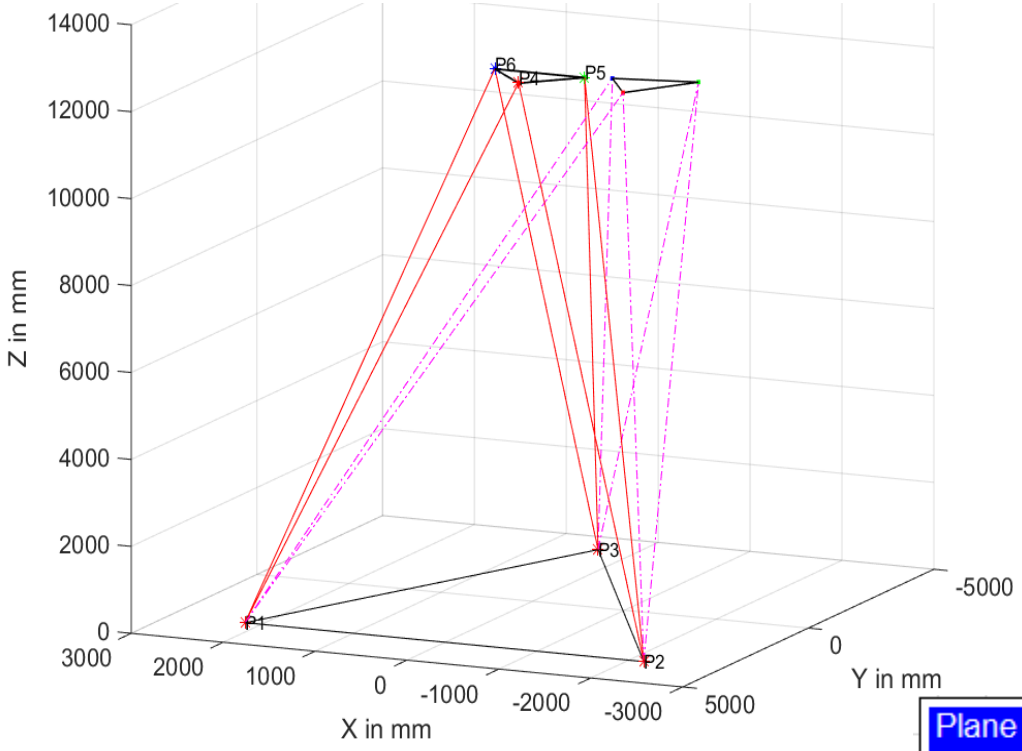


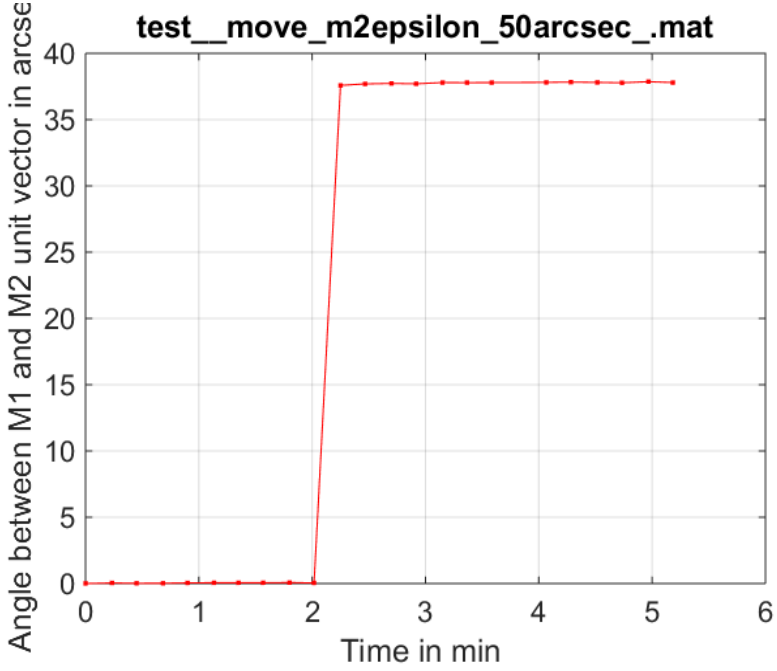


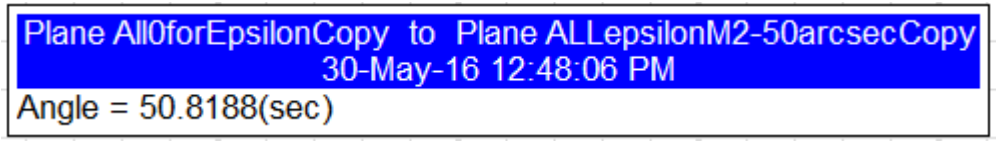
Vector Group A::All0forM2copy-ALL1mmpistoncopy										
Name	Begin			End			Delta			
	X1 (mm)	Y1 (mm)	Z1 (mm)	X2 (mm)	Y2 (mm)	Z2 (mm)	dX (mm)	dY (mm)	dZ (mm)	Mag (mm)
P1	2182.9693	3471.6205	6.4064	2182.9832	3471.5428	6.3478	0.0139	-0.0777	-0.0586	0.0983
P2	-2158.6498	3486.8254	6.2923	-2158.6376	3486.8250	6.2872	0.0123	-0.0004	-0.0051	0.0133
P3	398.3124	-4081.5659	6.3349	398.3157	-4081.5679	6.3306	0.0033	-0.0020	-0.0043	0.0058
P4	-0.0326	560.3650	12117.3724	-0.0231	560.3689	12118.3728	0.0096	0.0038	1.0004	1.0005
P5	-488.1593	-283.5553	12117.8356	-488.1750	-283.5550	12118.8495	-0.0156	0.0003	1.0139	1.0140
P6	487.3829	-284.5931	12117.5288	487.3690	-284.5925	12118.5444	-0.0139	0.0006	1.0156	1.0157

Experimental results

- Comparison with LT measurements for M2 $\Delta\varepsilon$=50as at R_{M2}=4.553m (Δx=1138μm Δz=142 μm)

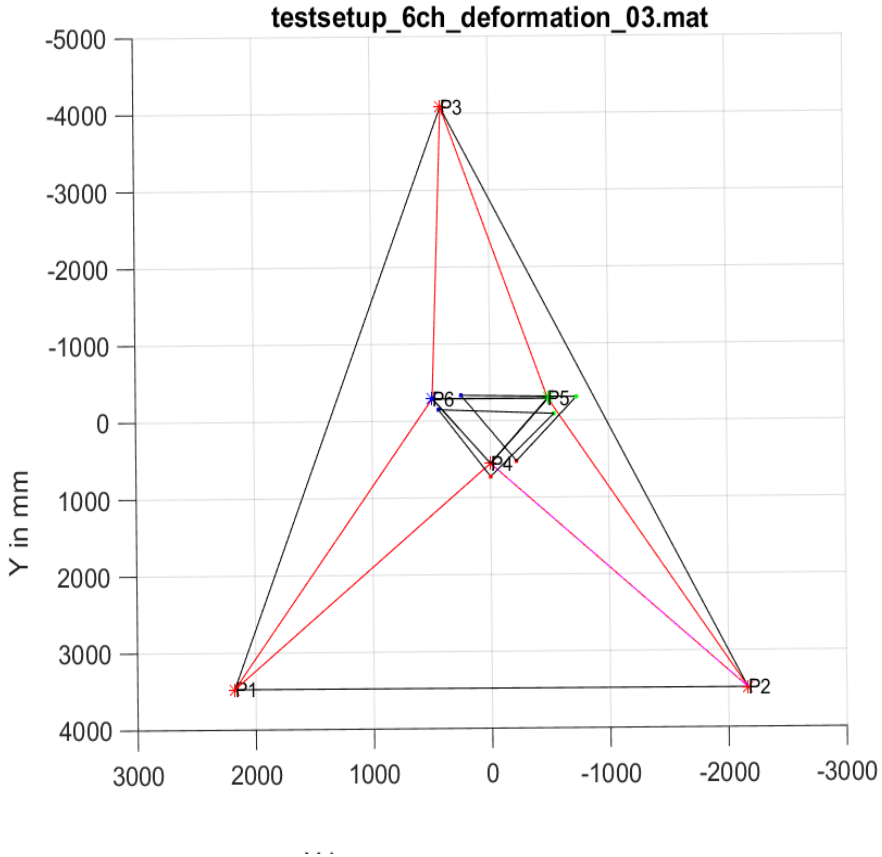


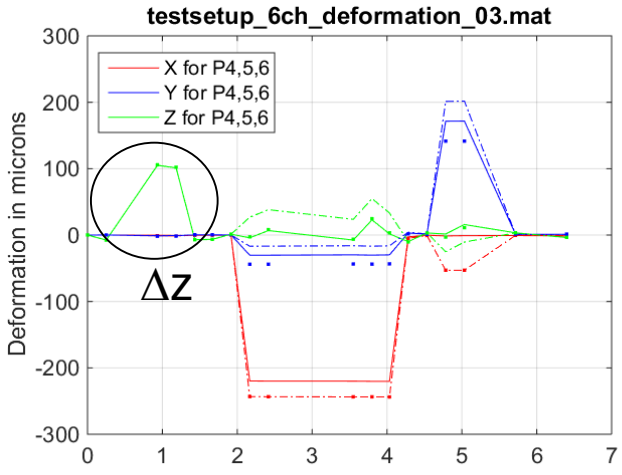


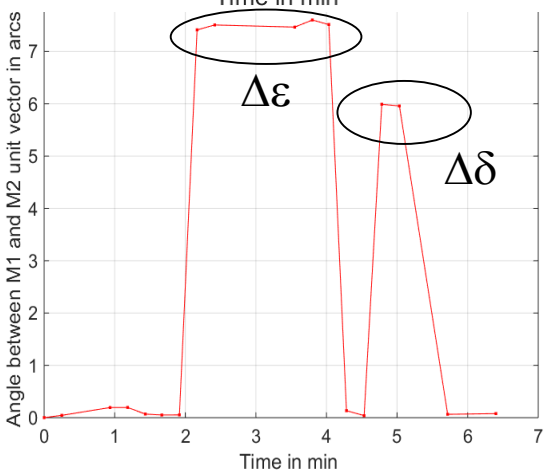


Experimental results

- Response to a small known motion of M2: Δz=+0.1mm
  $\Delta\delta$, $\Delta\varepsilon$=10as at R_{M2}=4.553m (Δy, Δx=220μm)

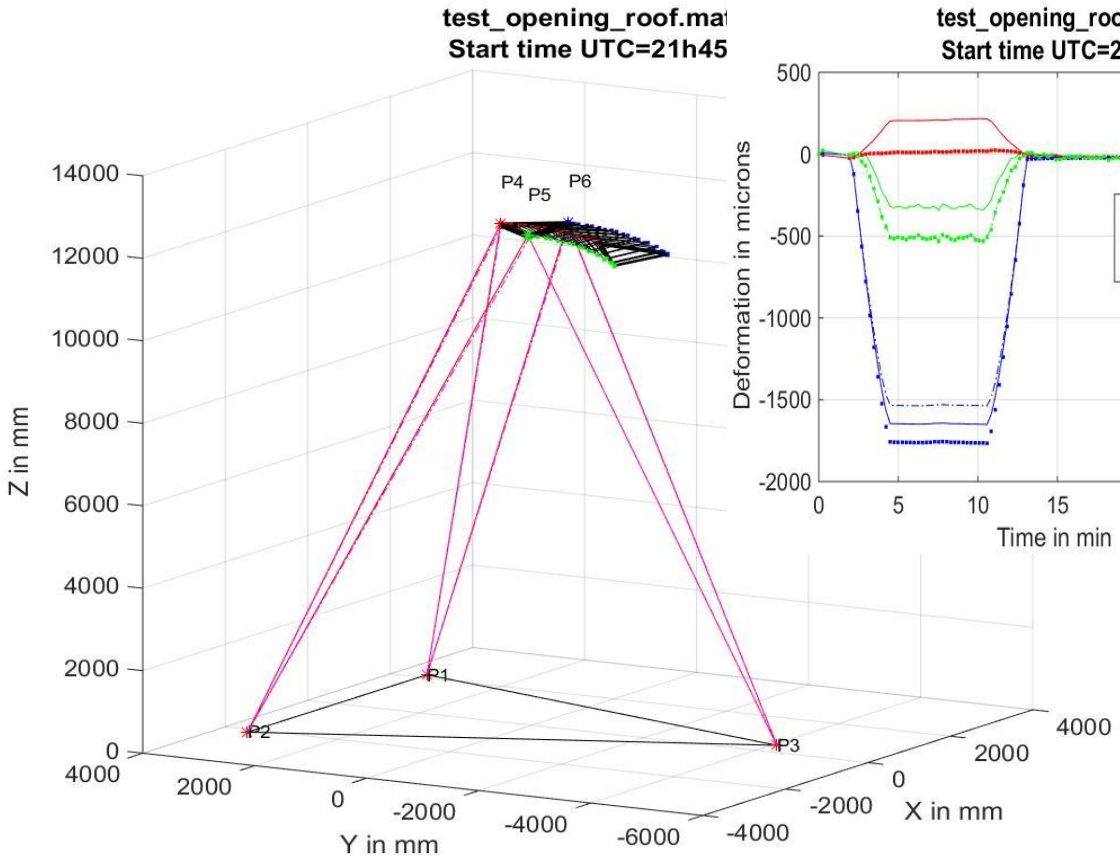


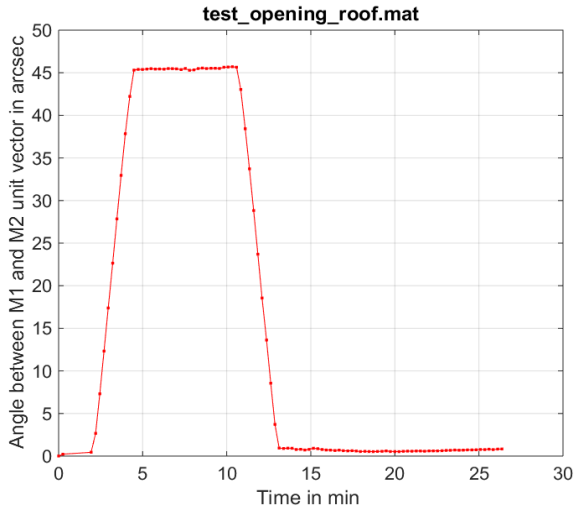




Experimental results

- Robustness in representative operational conditions: telescope start-up, El=89->20->89 deg

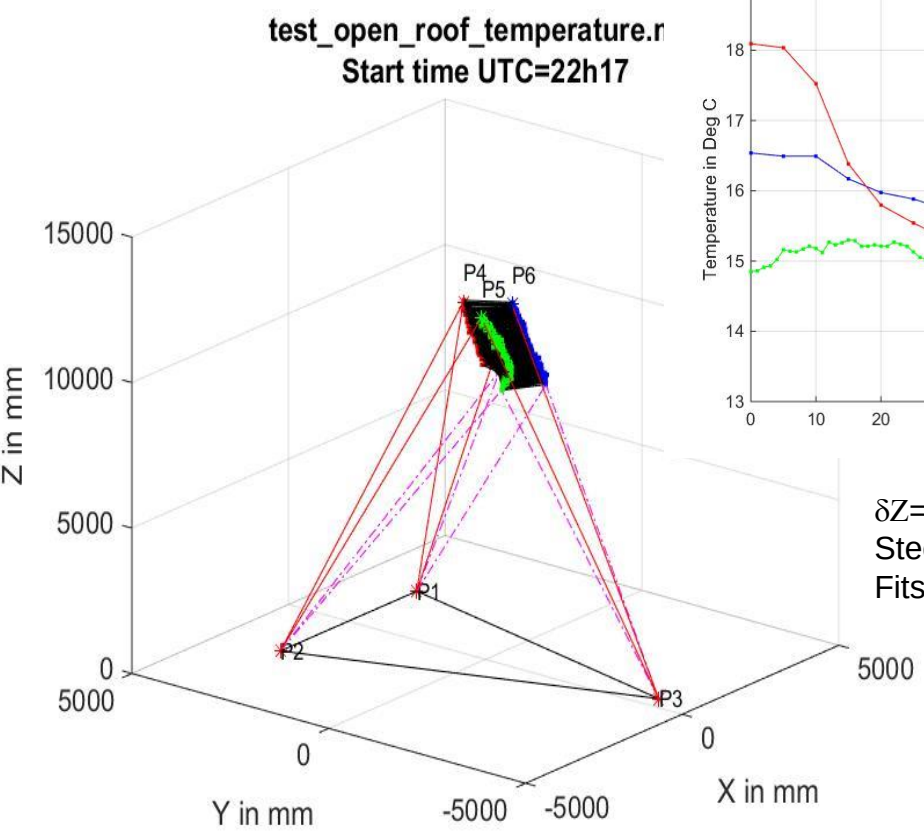


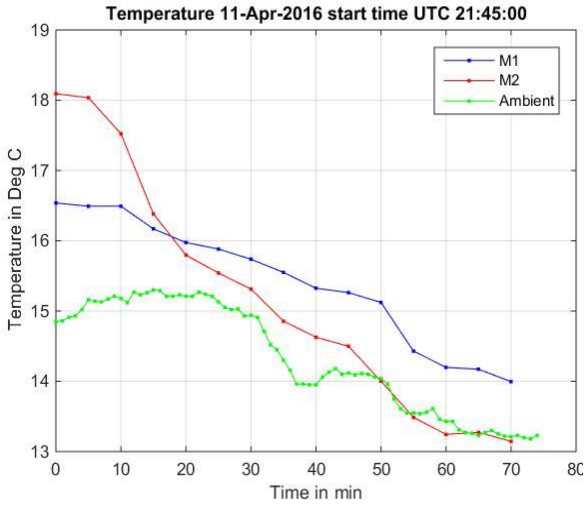


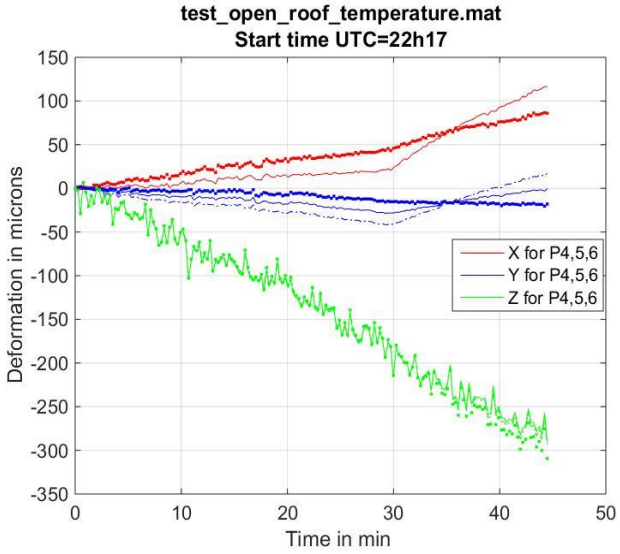
Load Case	FEM: M1 M2 relative motion Ymm)	Z(mm)	Θx(as)
El 89->0	0.98	-0.13	83
El 89->60	0.95	0.18	29

Experimental results

- Robustness in representative operational conditions: Dome opened, thermalization, wind speed 8 m/s)



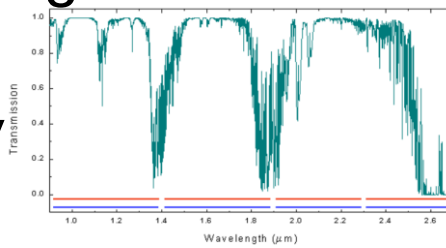




δZ=300 microns.
Steel structure CTE=12ppm/m/deg at d_{M1M2}=12m, , Expected ΔT=2 degC.
Fits well temperature recording

Conclusion

- Great potential for monitoring RBM of mirrors in future large telescope and maintain collimation
- Robust in “standard” operational conditions of the VLT
- Improvements:
  - Extend range to >30m
  - Reduce sampling period to <1s for tens of channels (100?)
  - Wavelength change for measurements during scientific observations (589, 1178,1400nm)
  - Simplify retro-reflectors with increased FoV
  - Beam tracking



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