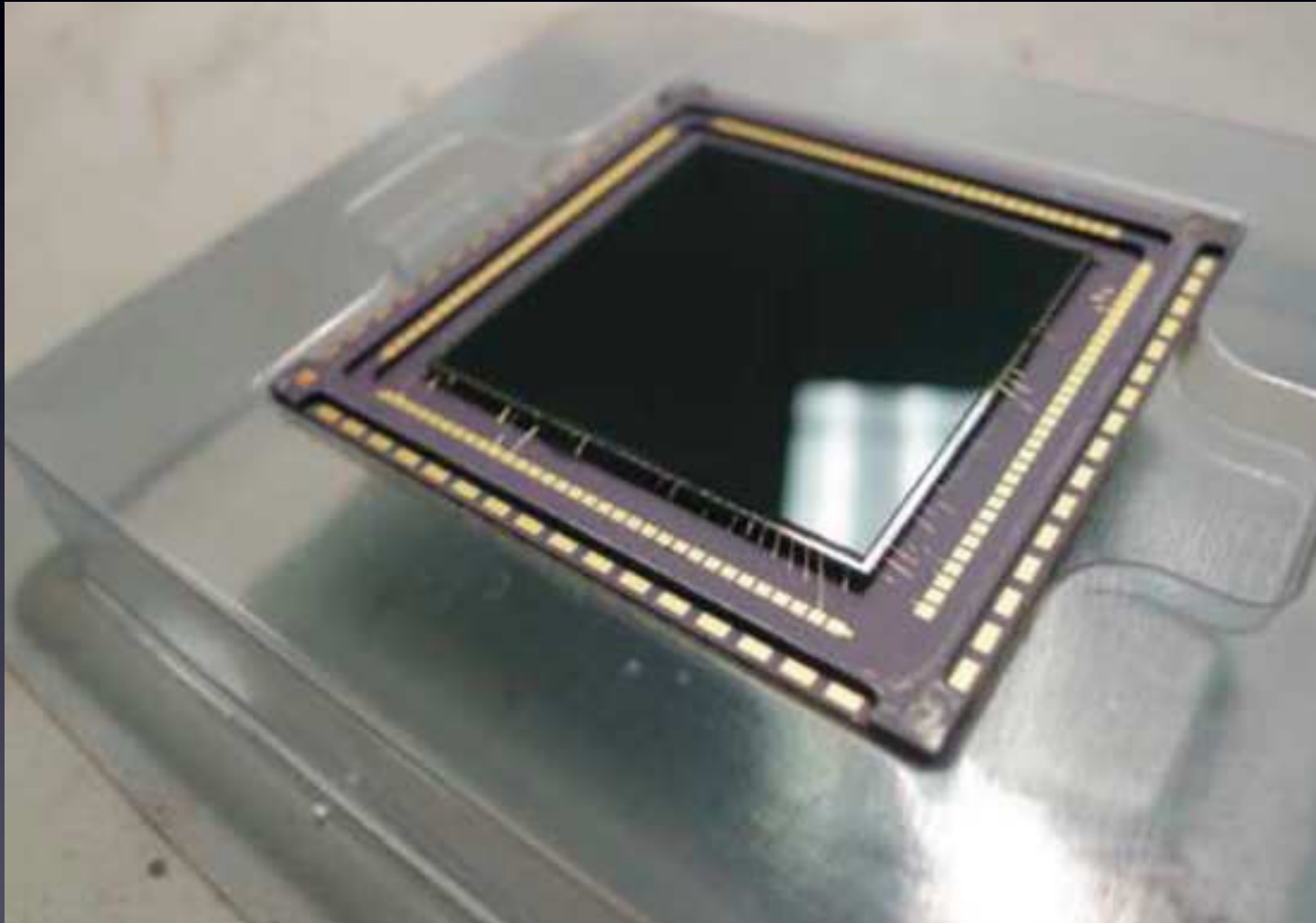
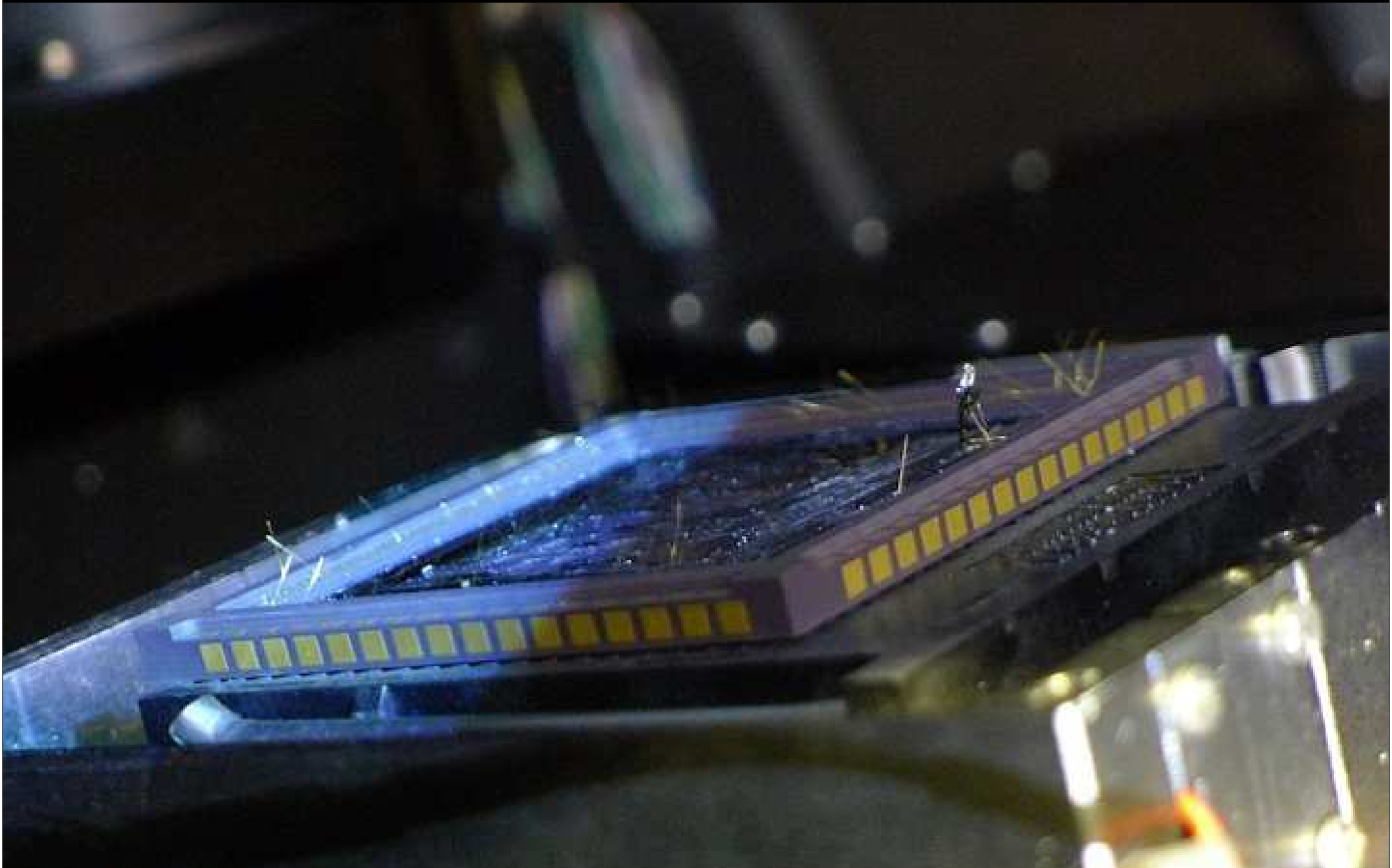


# LUCI I detector

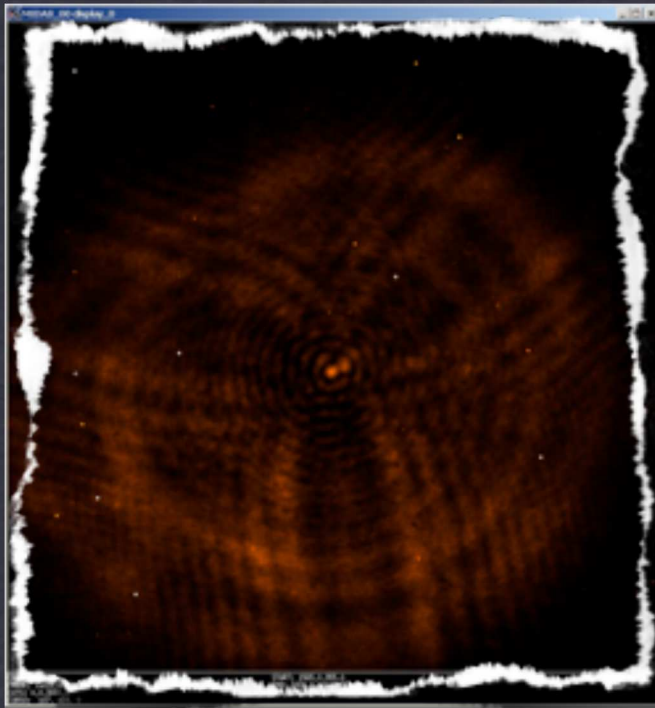


# LUCI I detector

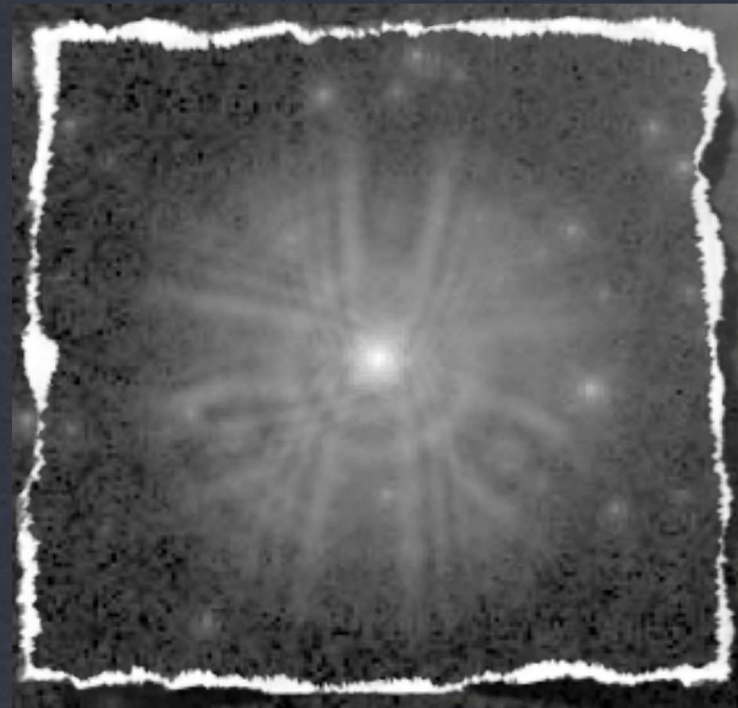


# Luci 2 A0 performance

Luci 2 cold run July 2012 - Strehl 0,15 (J)



Luci 2/N30



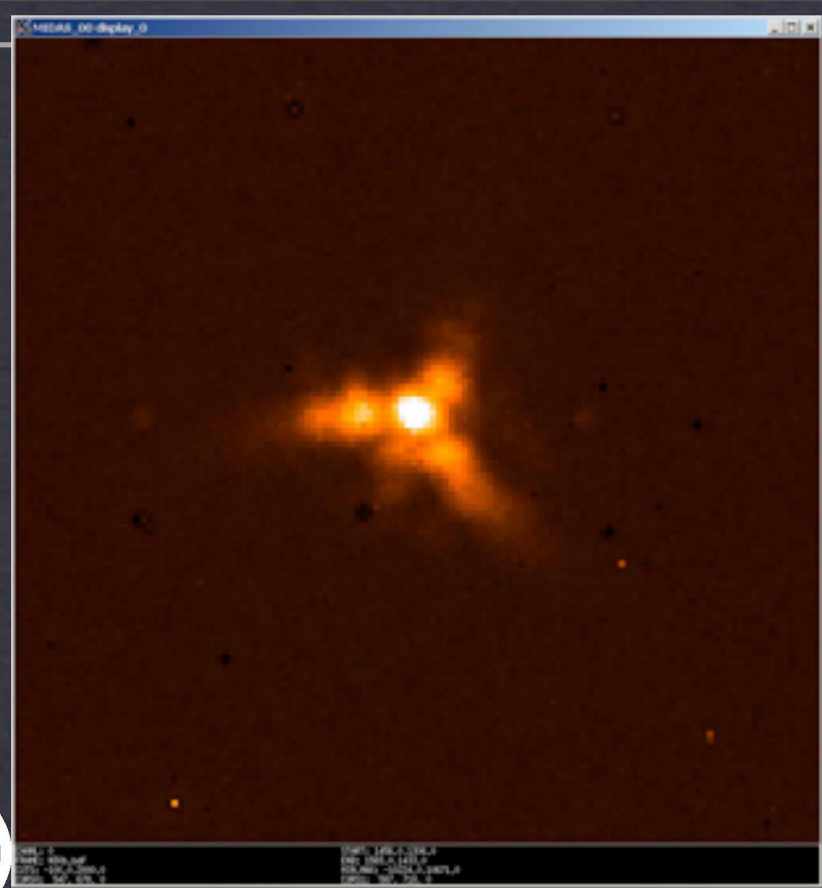
WF/PC



# Luci 2 - analysis summer 2012

**Total Strehl 0.15 (J)**

- **Zemax analysis (ARakich)**
  - astigmatism & spherical on pupil mirror
- **MPIA construction ( $R^3$ )**
  - mount pupil & folding mirror F4 & light-weighting ill-designed
  - introduces stress at cryogenic temperature

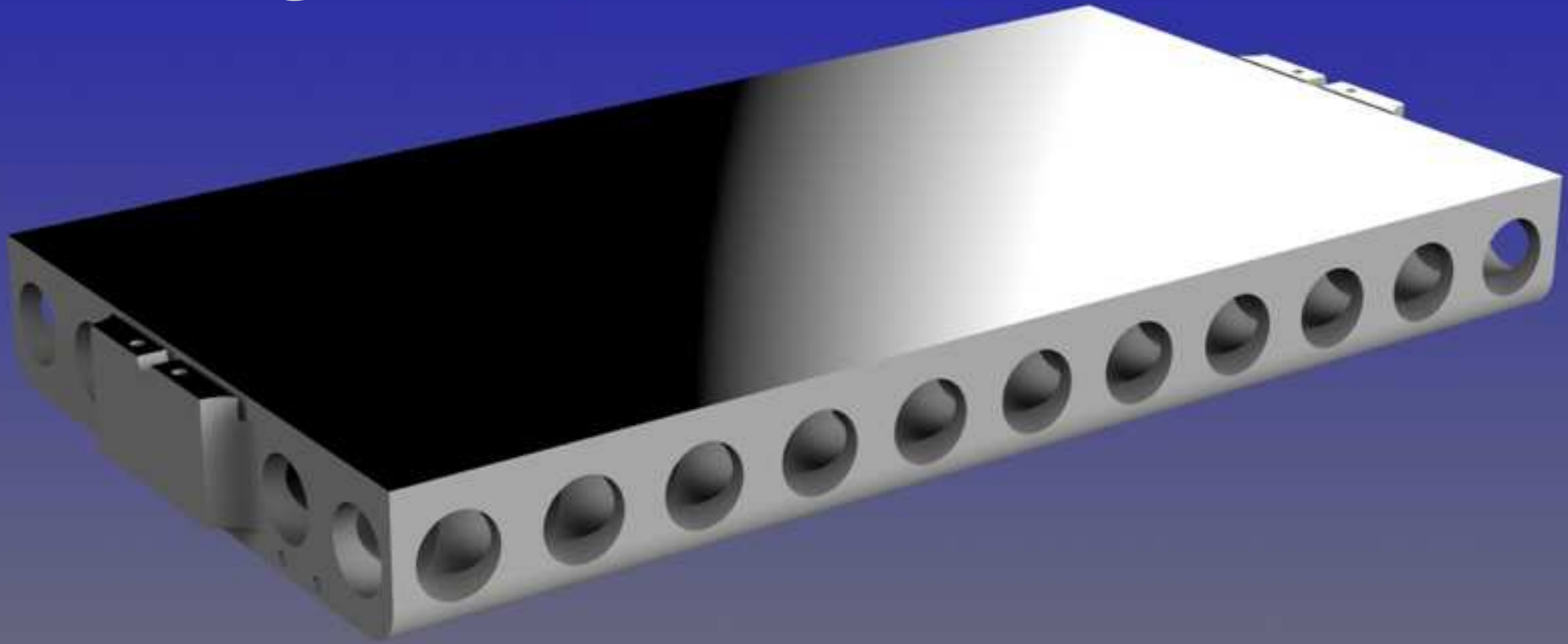


# Luci - general overview

PUPIL MIRROR



# Folding mirror F4



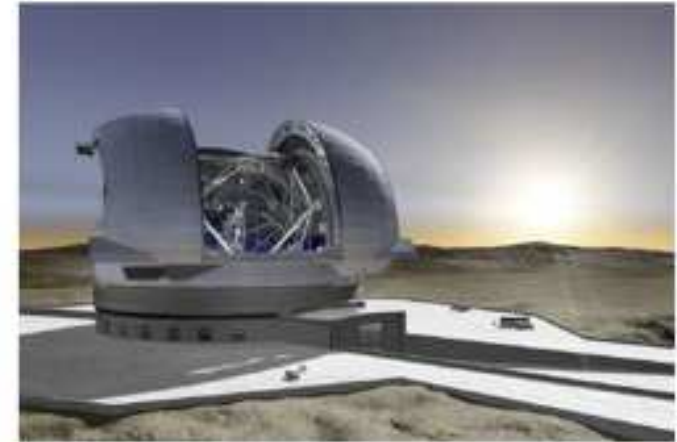




- **Spiegeloptiken für die Großteleskope der Zukunft**
- Erforschung ultrapräziser Metalloptiken für den Einsatz in extremen Umgebungsbedingungen, wie z.B. Kälte, Temperaturwechsel und Vakuum.
- Optiken für Großteleskope, für die Wetter- und Klimaerkundung sowie für die optische Nachrichtenübertragung.



Freiform-Metallspiegel



Teleskop der nächsten Generation: European Extremely Large Telescope (E-ELT)



MPI für Astronomie

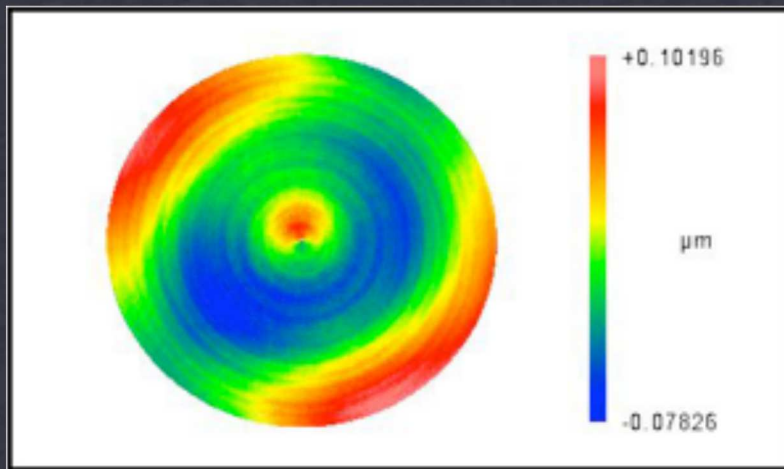


FhI für Optik und Feinmechanik

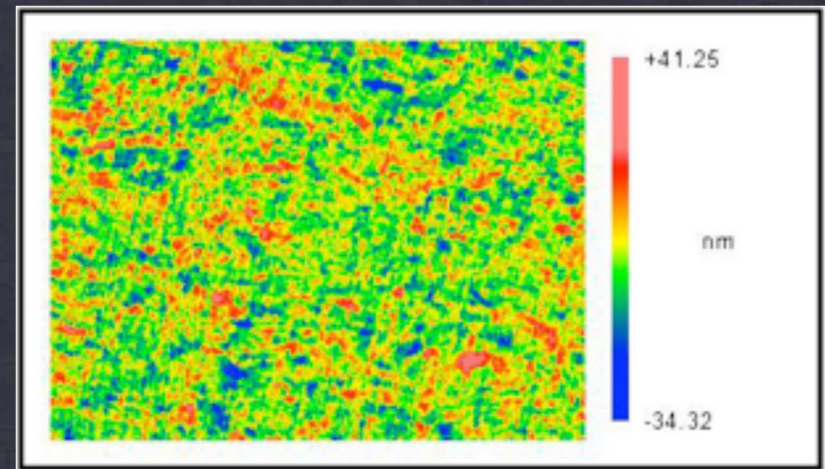
Projektvolumen (beide Partner zusammen): 1,2 Mio Euro (2010 - 2013)

# Spring 2013 new pupil mirror

PT cold            1120 nm → 212 nm (spec 200 nm)  
Surface cold      224 nm → 33 nm RMS  
roughness                            8.2 - 8.9 nm RMS (spec 7nm)



PV	180.225	nm	Size X	125.2	mm
rms	39.321	nm	Size Y	120.2	mm

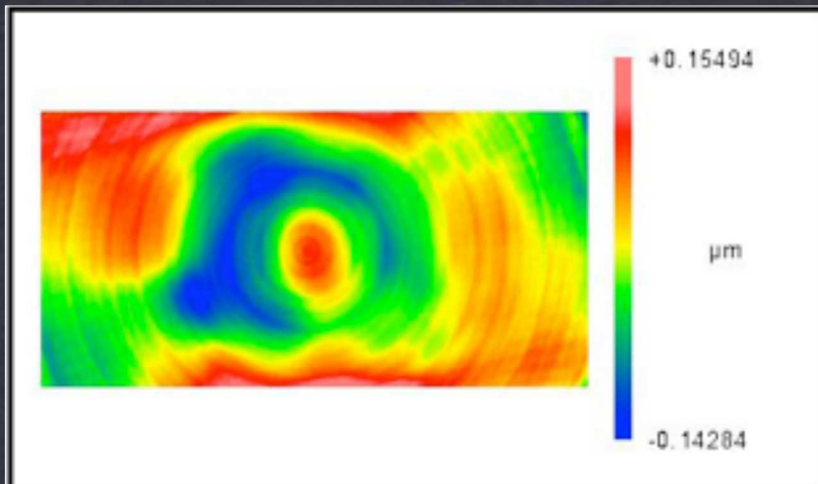


PV	75.573	nm	Size X	2.82	mm
rms	8.212	nm	Size Y	2.12	mm

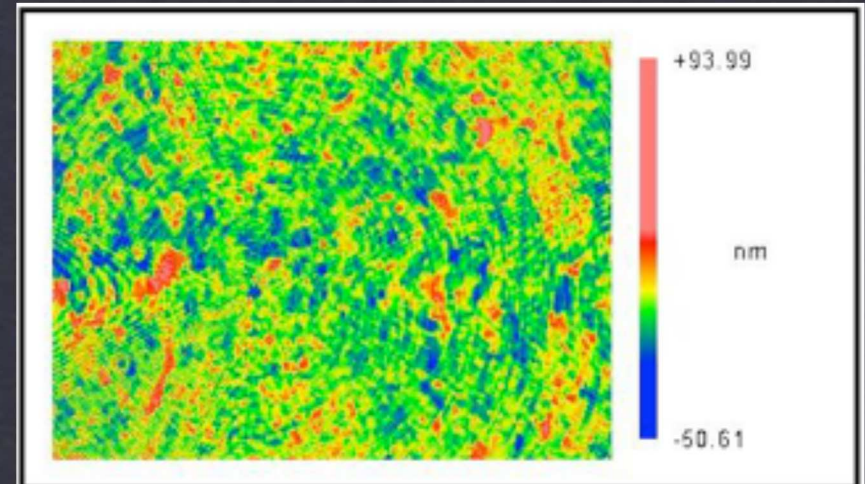


# Spring 2013 new folding mirror F4

PT            1200 nm → 300 nm  
RMS           240 nm → 57 nm  
roughness     9.1 - 9.8 nm



PV	297.774	nm	Size X	313.0	mm
rms	56.822	nm	Size Y	158.0	mm

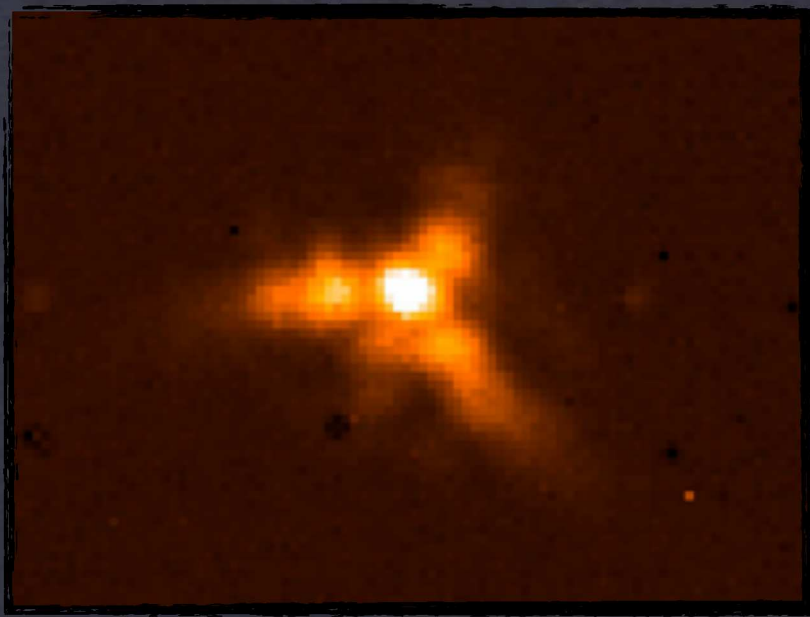


PV	144.596	nm	Size X	2.82	mm
rms	9.529	nm	Size Y	2.12	mm

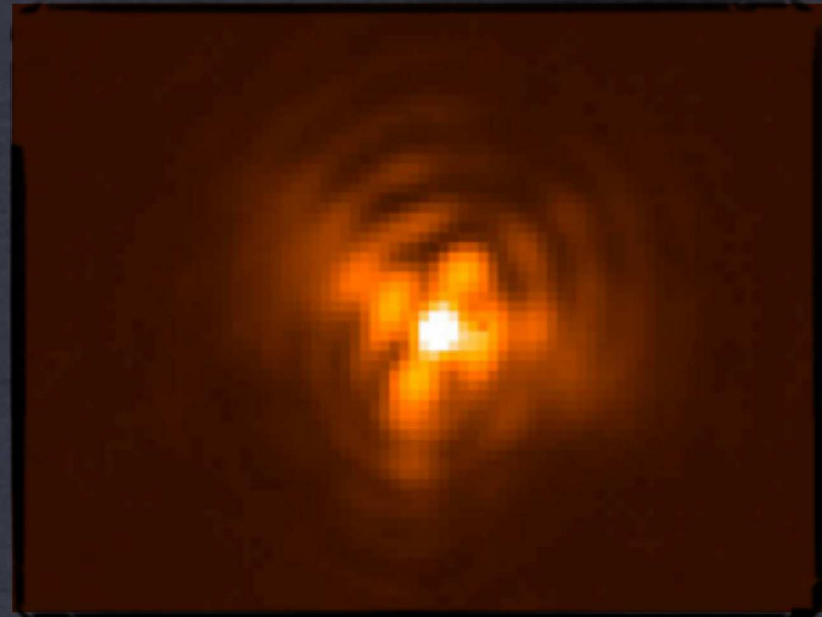
# Status of LUCI2 - March 2013

PUPIL & FOLDING MIRROR OK - EXPECTED SR 60% (H)

LUCI FAR FROM SPEC; N30 CAMERA STILL PROBLEMATIC



OCT 2012

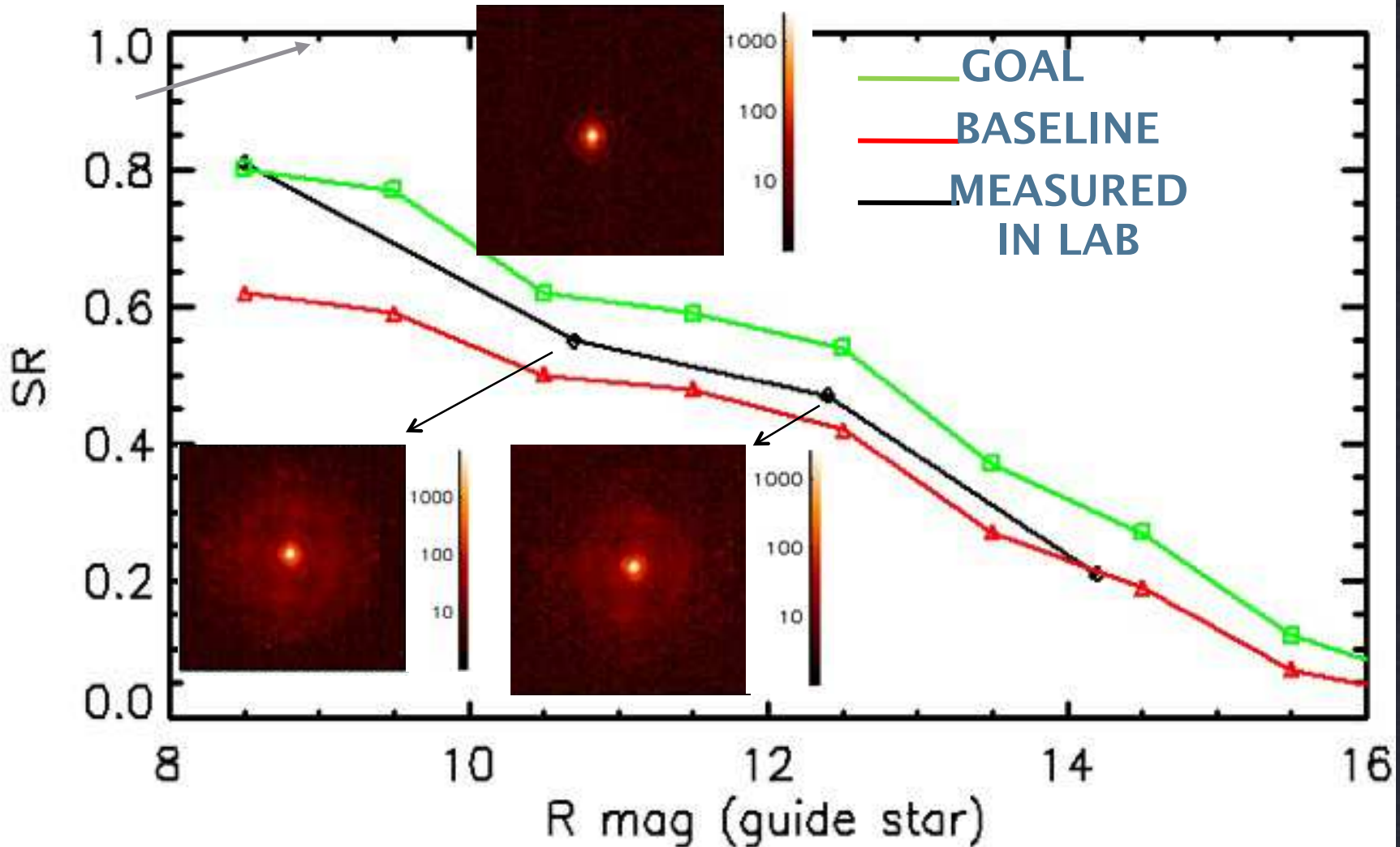


FEB 2013

# Strehl ratio

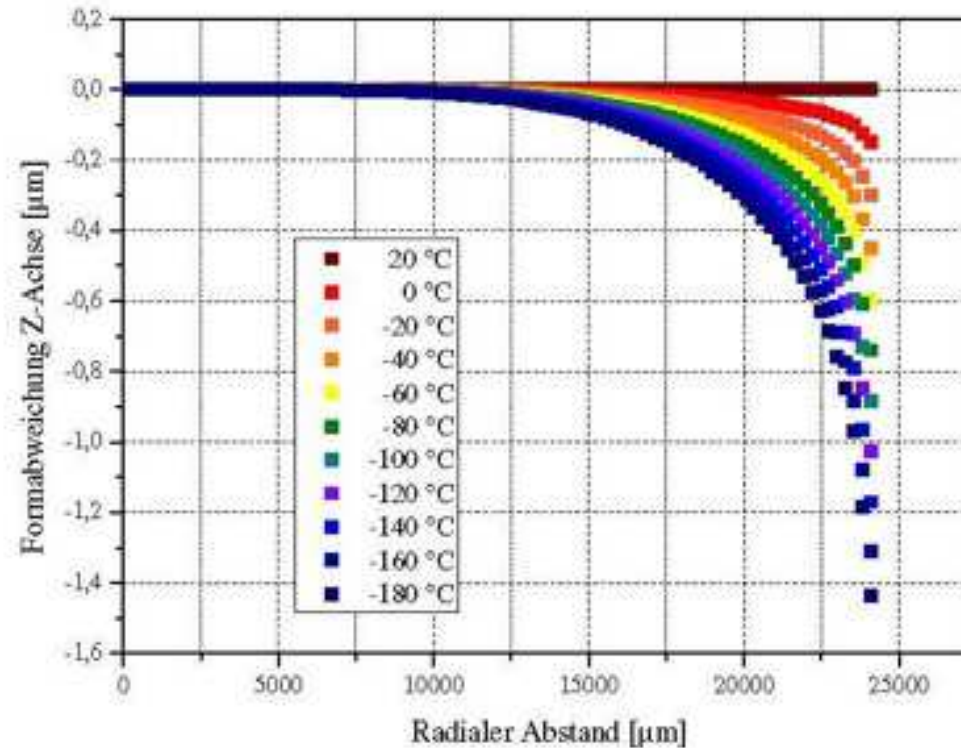
ATM. CONDITIONS:  
SEEING 0.8 ARCSEC  
V\_WIND 15M/S

## STREHL RATIO IN H BAND





# Simulation NiP-Schicht



Durchmesser = 48 mm,  
Dicke = 15 mm  
Dicke NiP = 80 µm  
(Stirn-  
und Seitenflächen)

Abbildung 35: Formabweichungen bei Temperaturänderungen von Al 6061 mit thermisch nicht angepassten Chemisch Nickel - Simulation 1

AXSYS arbeitet z.B. mit NiP-Schichten < 20 µm, um den Bimetalleffekt klein zu halten.

# **Luci 2/A0 - strategy (Spring 2013)**

**removal of non common path aberrations via  
A0 secondary**

**loss of sensitivity**

**pyramid wfs, linearity**

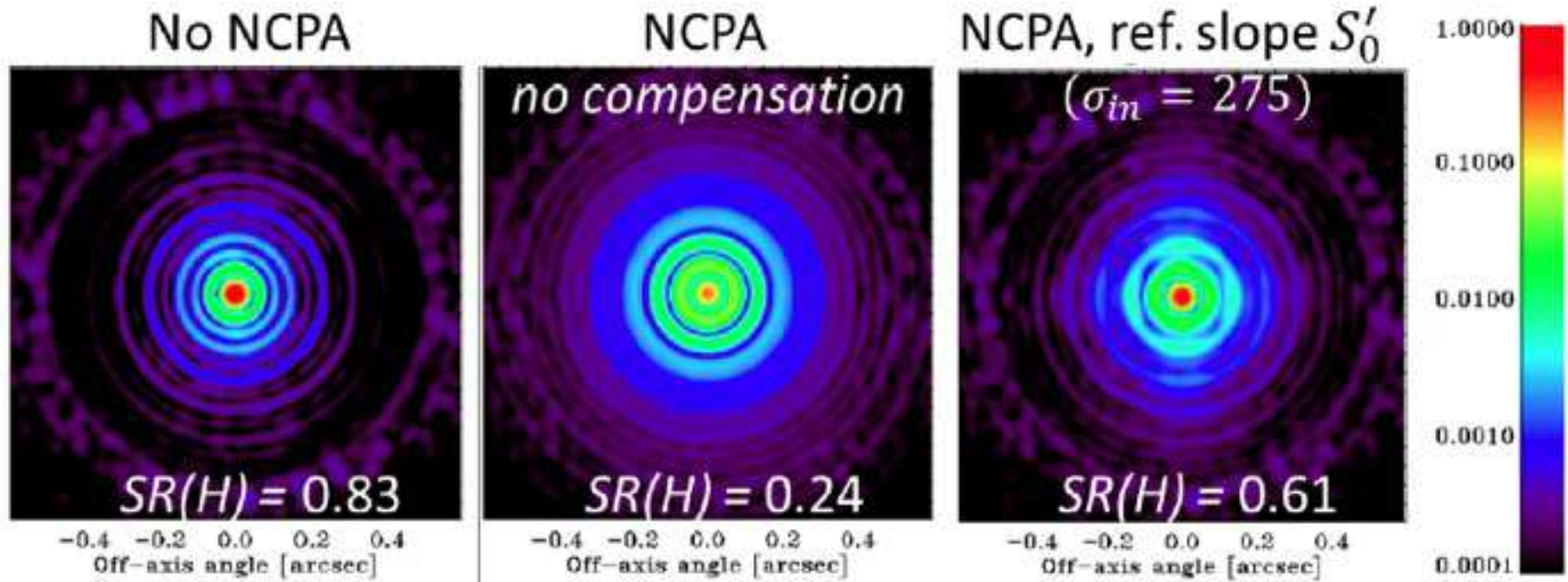
**bright sources: compensation on**

**high Strehl ratio**

**faint sources: compensation off**

**high sensitivity**

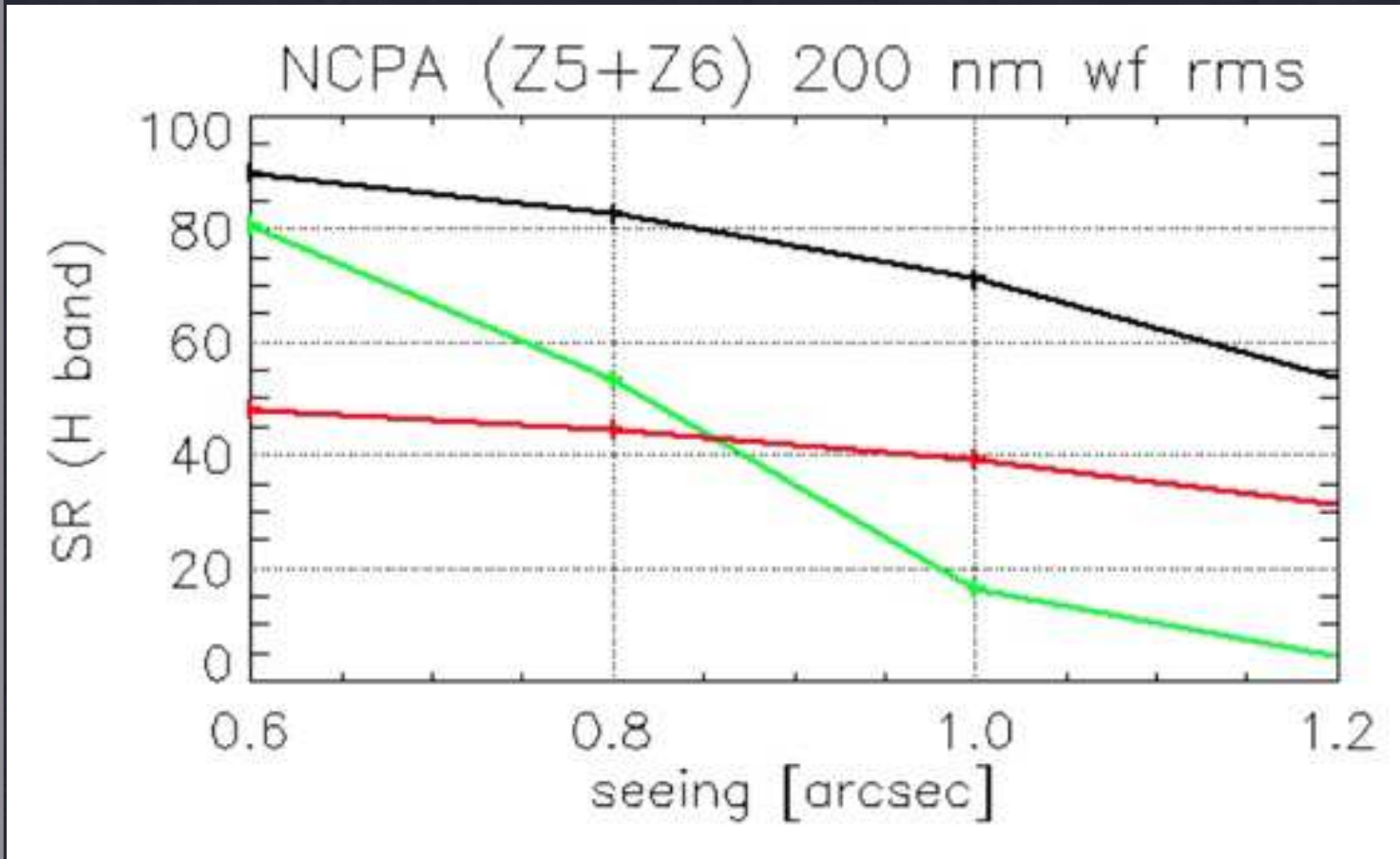
# LUCI 2 A0 performance



QUIRÓS-PACHECO MARCH 2013



# LUCI 2 A0 performance



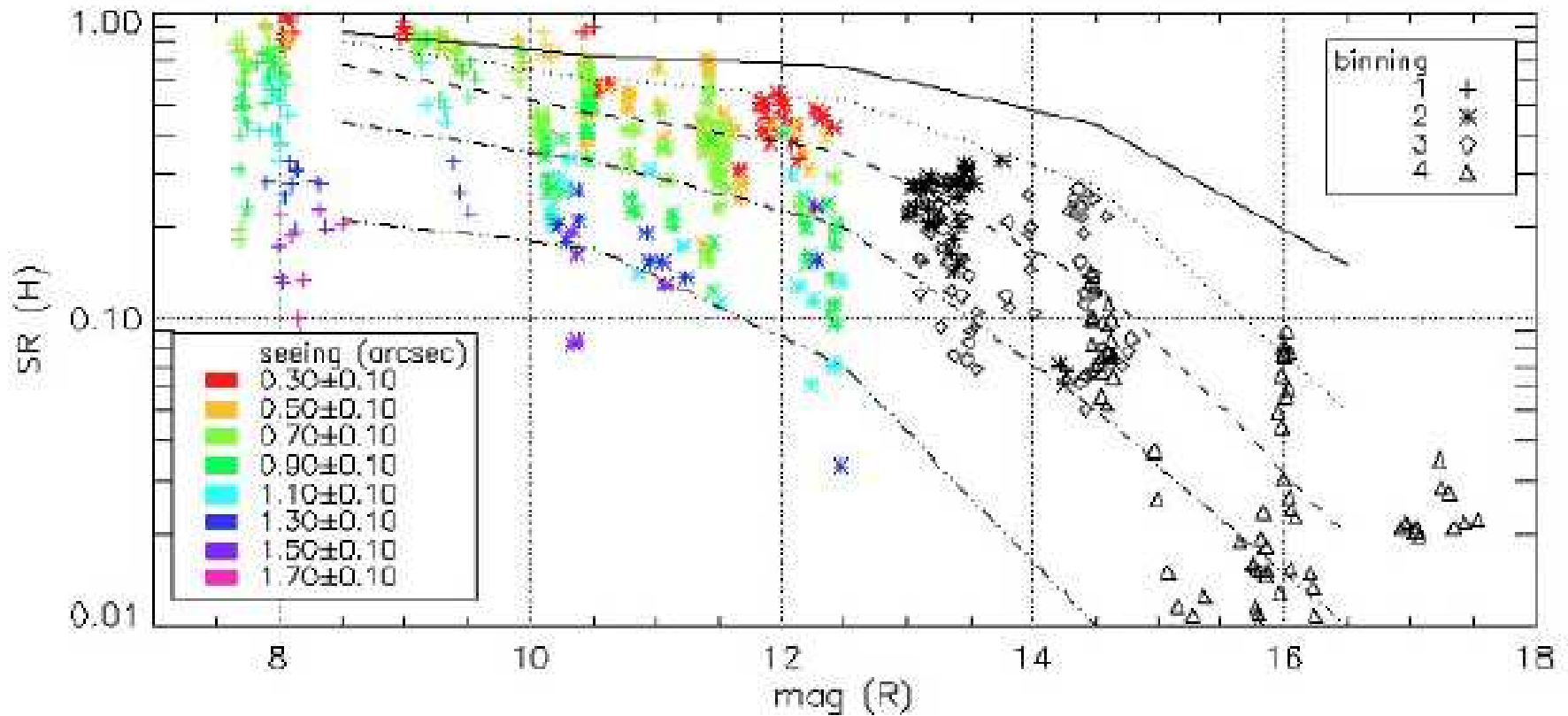
**SECONDARY**

**COMPENSATION OFF**

**COMPENSATION ON**

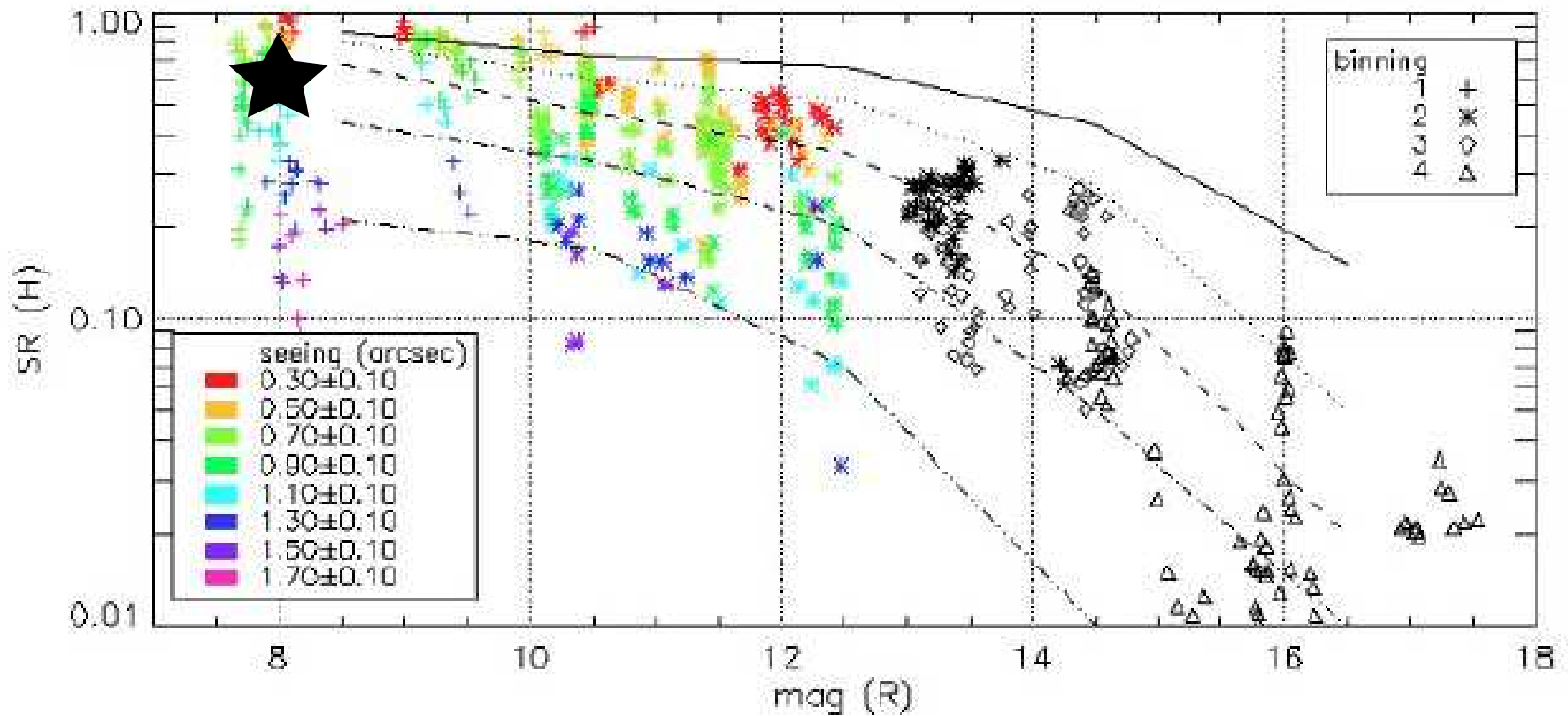
**QUIRÓS-PACHECO MARCH 2013**

# FLAO reported SR



ESPOSITO 2011, ELT AO-CONFERENCE

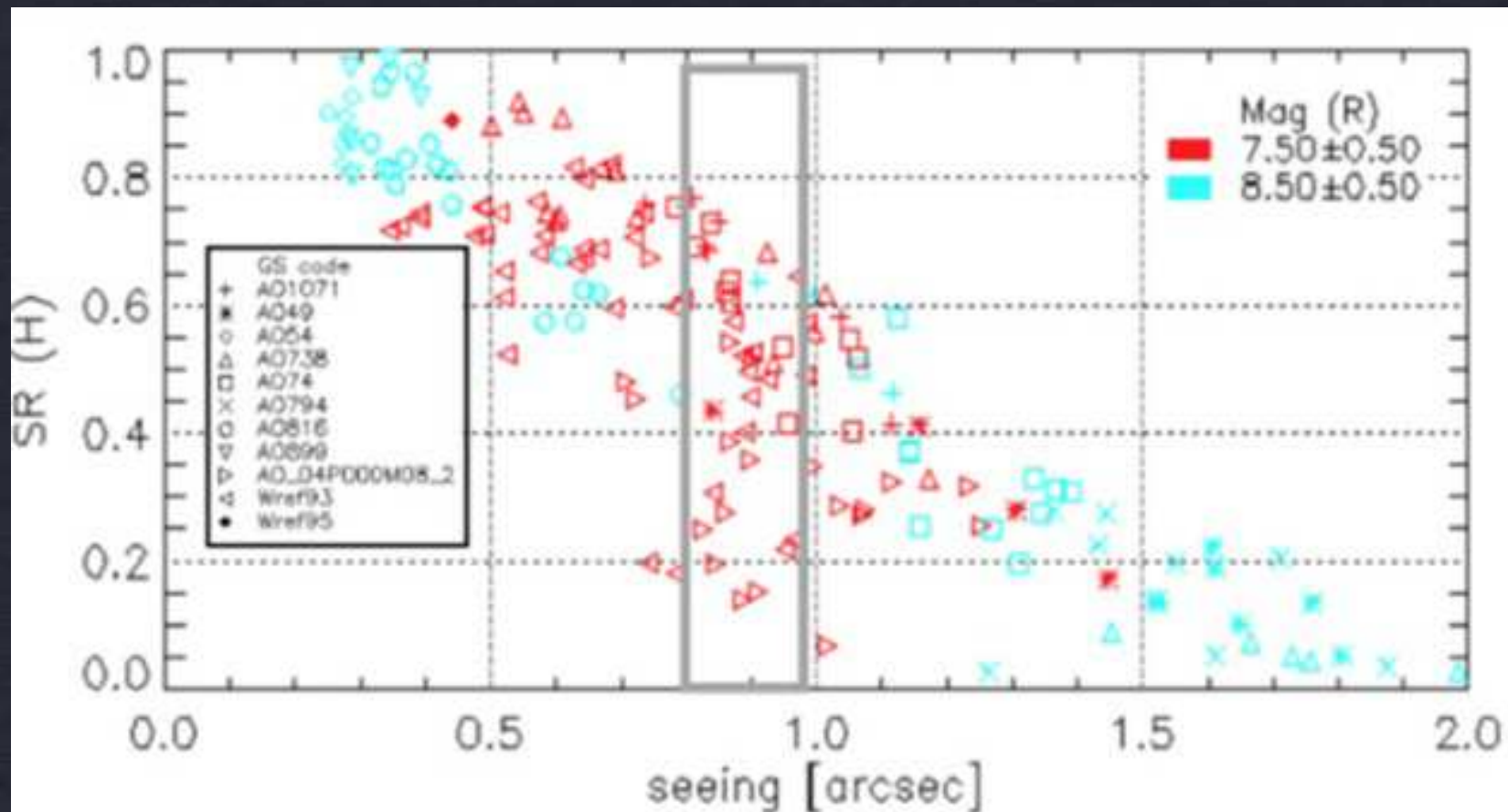
# FLAO reported SR



ESPOSITO 2011, ELT AO-CONFERENCE

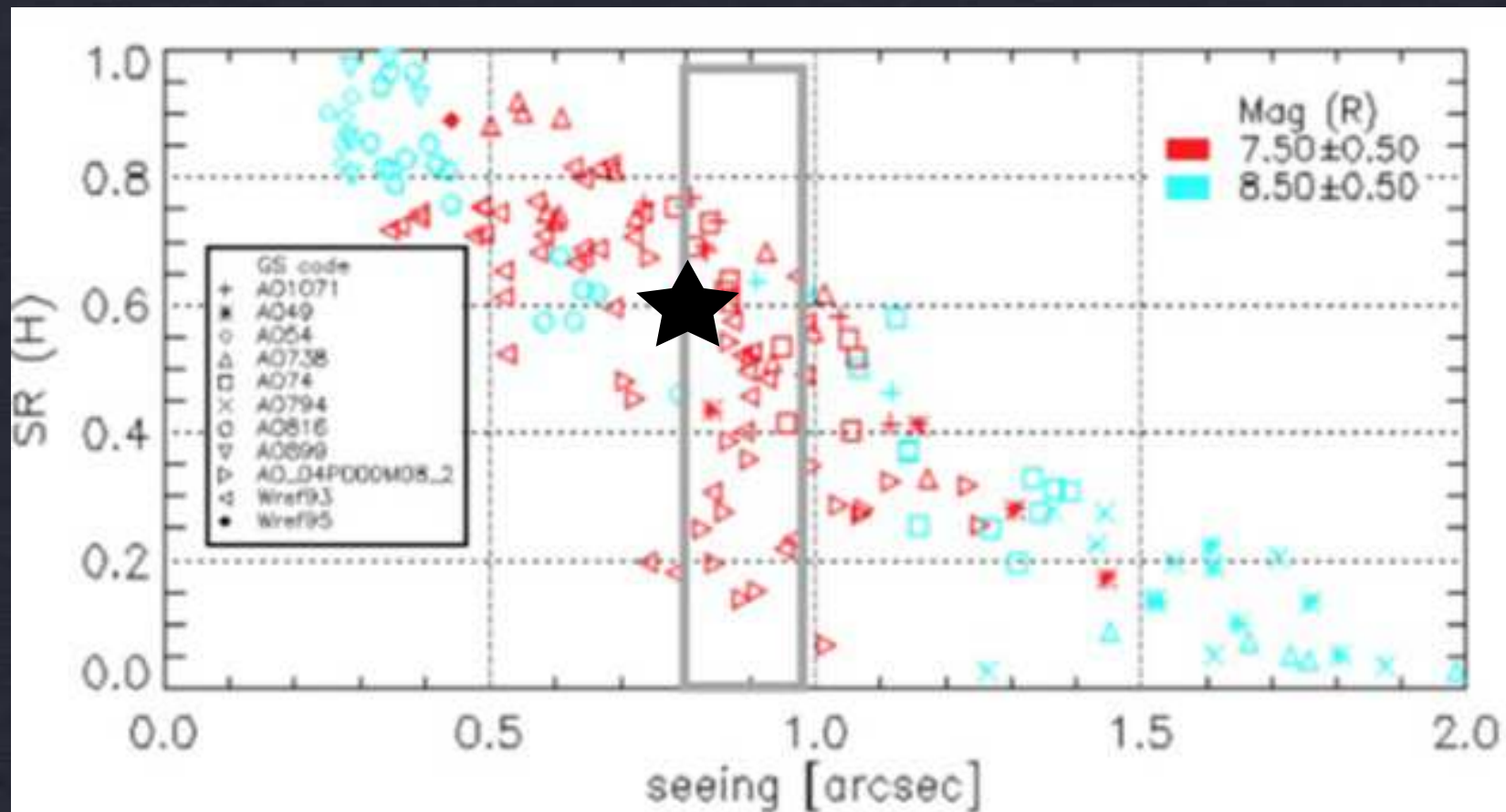


# FLAO reported SR



ESPOSITO 2011, ELT AO-CONFERENCE

# FLAO reported SR



ESPOSITO 2011, ELT AO-CONFERENCE

# LUCI 2 A0

**March 2013 LBT board: build N30 with  $SR > 0.8$  JHK**

**→ N30 review July 2013**

**Rodger Thompson/UofA**

**Harland Epps/UCOLick**

**Gabby Kroes/ASTRON**

**David Montgomery/UKATC**

**David Henry/UKATC**

**Peter Bizenberger/MPIA**



# LUCI 2 N30 Review

## Review conclusions

**Maintain goal to have N30 camera by Spring 2014**

**Zerodur provides higher risk than metal**

**Order 1<sup>st</sup> set of metal mirrors**

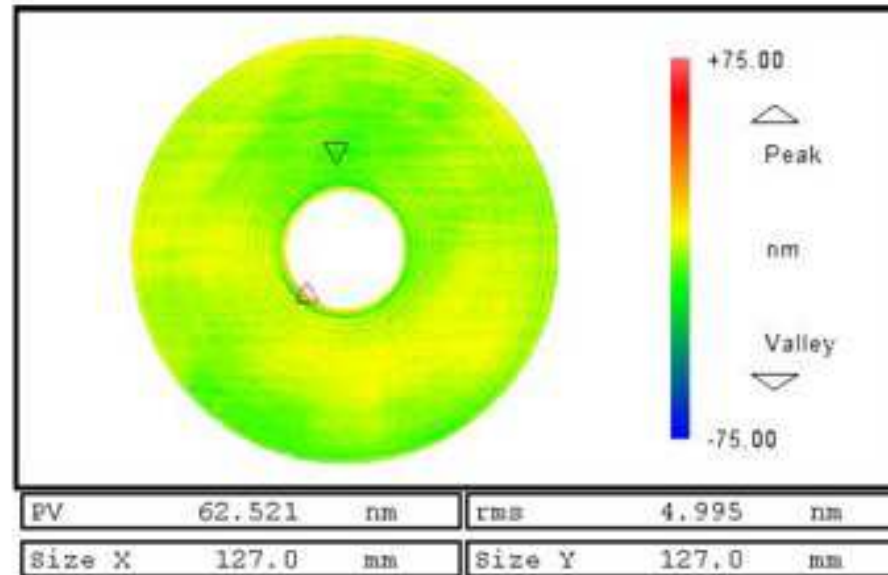
**maintain fallback option:**

**agressively pursue design of Zerodur-based camera**

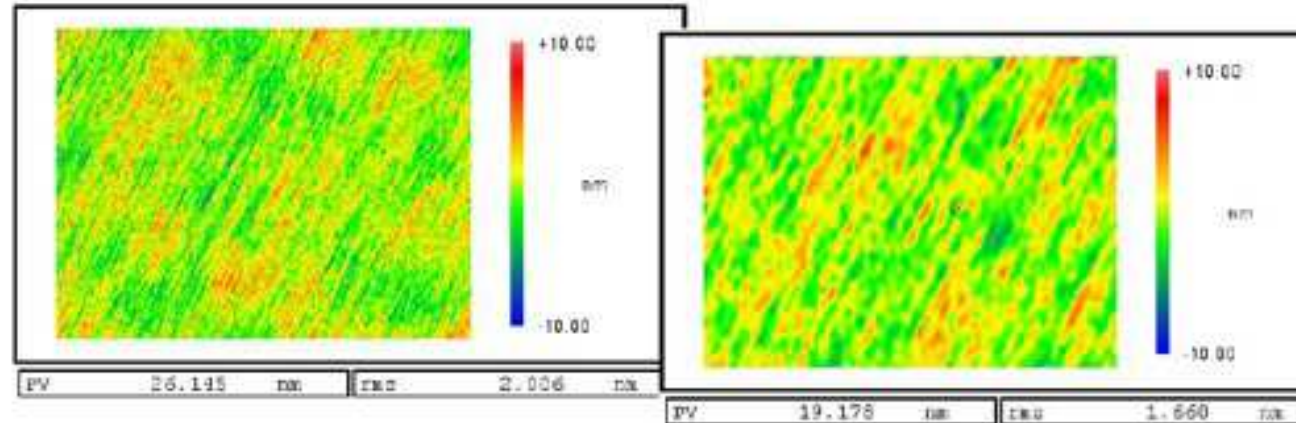
# Prozesskette für AlSi40/NiP Spiegel für Tieftemperatur realisiert

## Prozesskette

- Halbzeugfertigung
- Thermische Behandlung
- CNC Bearbeitung
- Ultrapräzisionsbearbeitung
- Beschichtung mit chemisch Nickel
- Thermische Behandlung
- Zyklieren, Tieftemperatur
- Ultrapräzisionsbearbeitung
- Zyklieren, Tieftemperatur
- Lokale Formkorrektur und Glätten
- Reinigung
- Optische Beschichtung
- Finale Charakterisierung



Formabweichung des Luci-Primärspiegels nach allen Prozessschritten @ bei Raumtemperatur (22 °C)

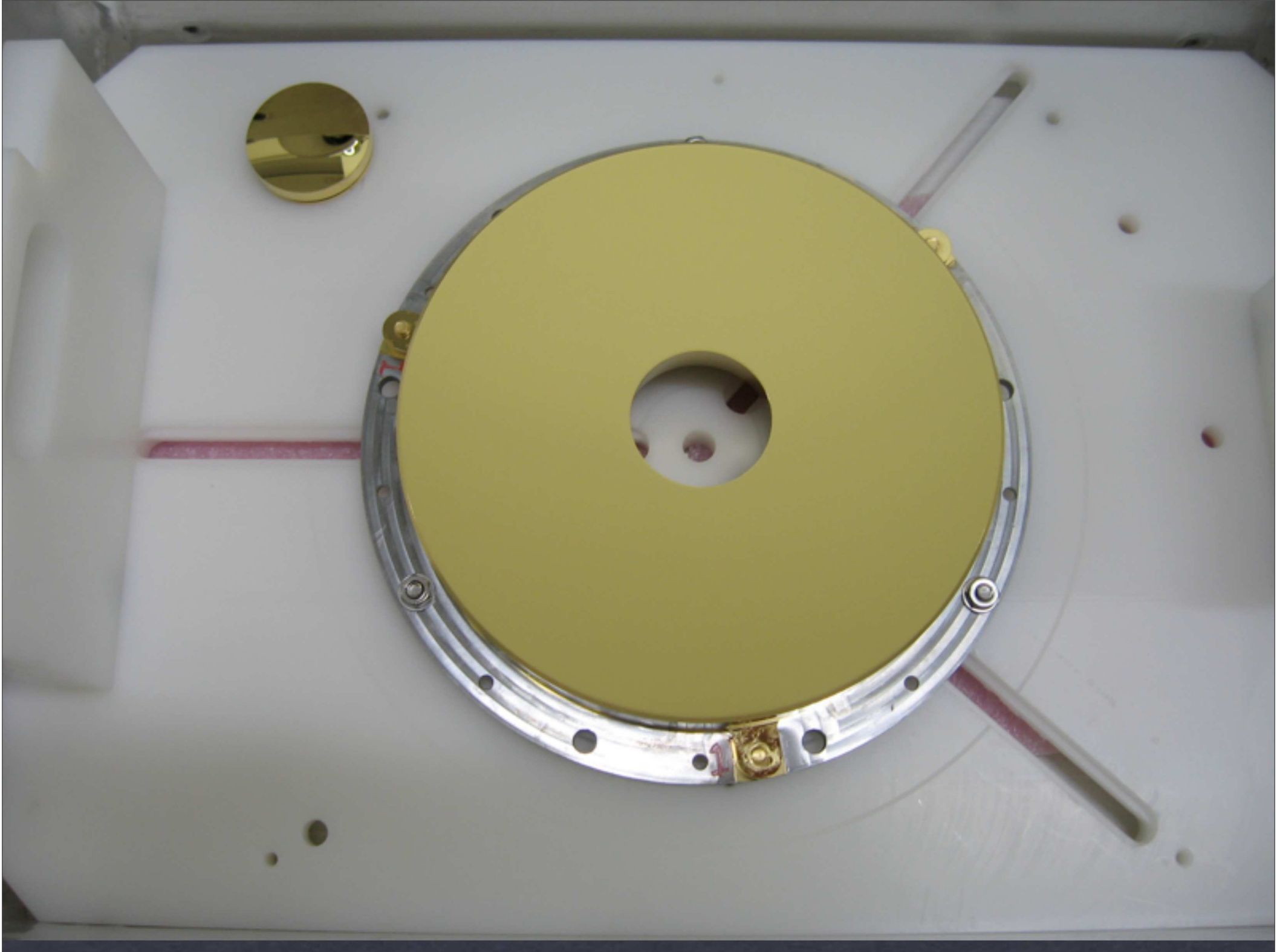


Mikrorauheit des Primärspiegels: 10x links, 50x rechts

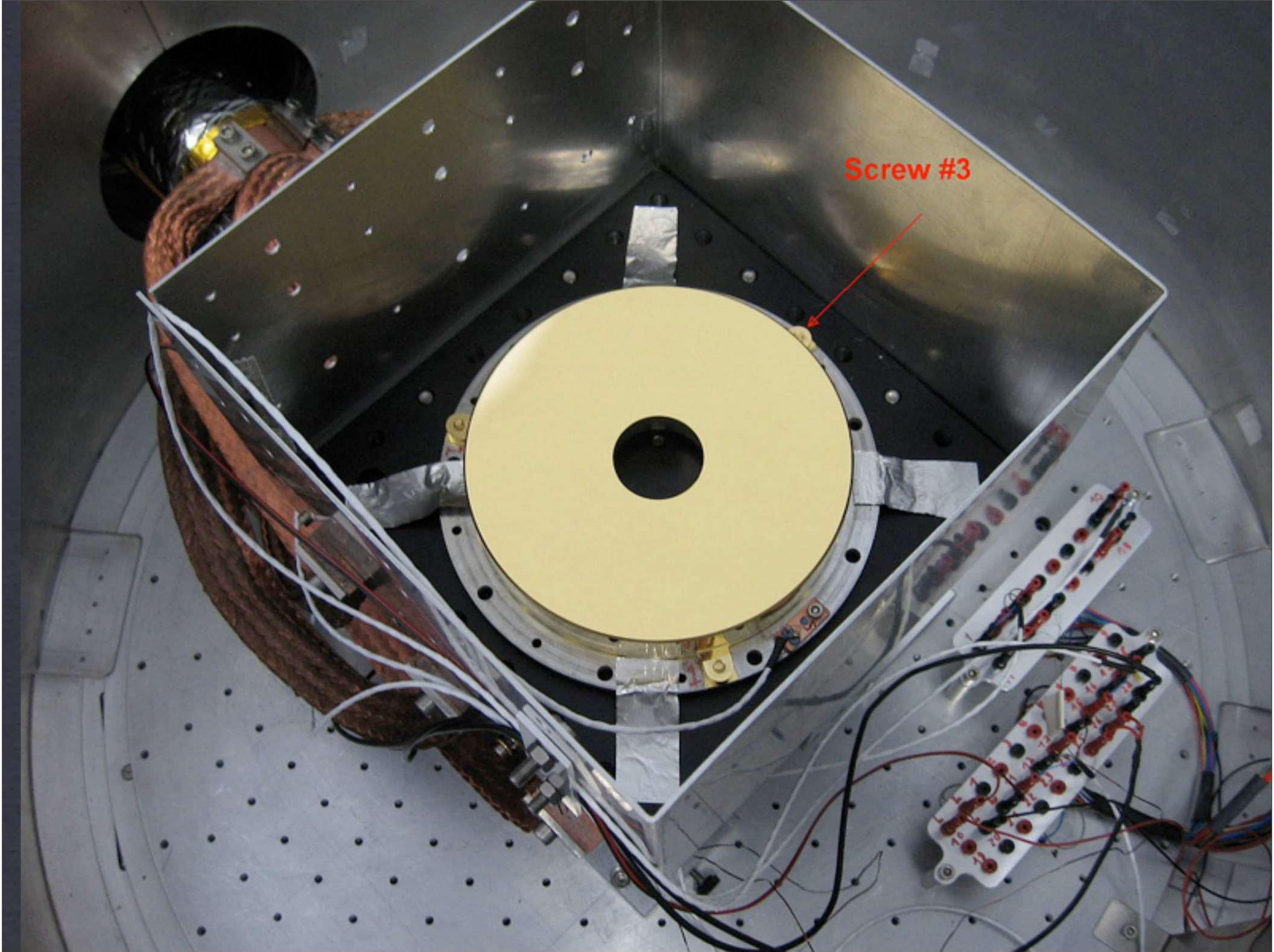
# LUCI 2 N30 camera

completely re-designed @MPIA









Screw #3

# Luci/A0

## AlSi40 based N30 camera

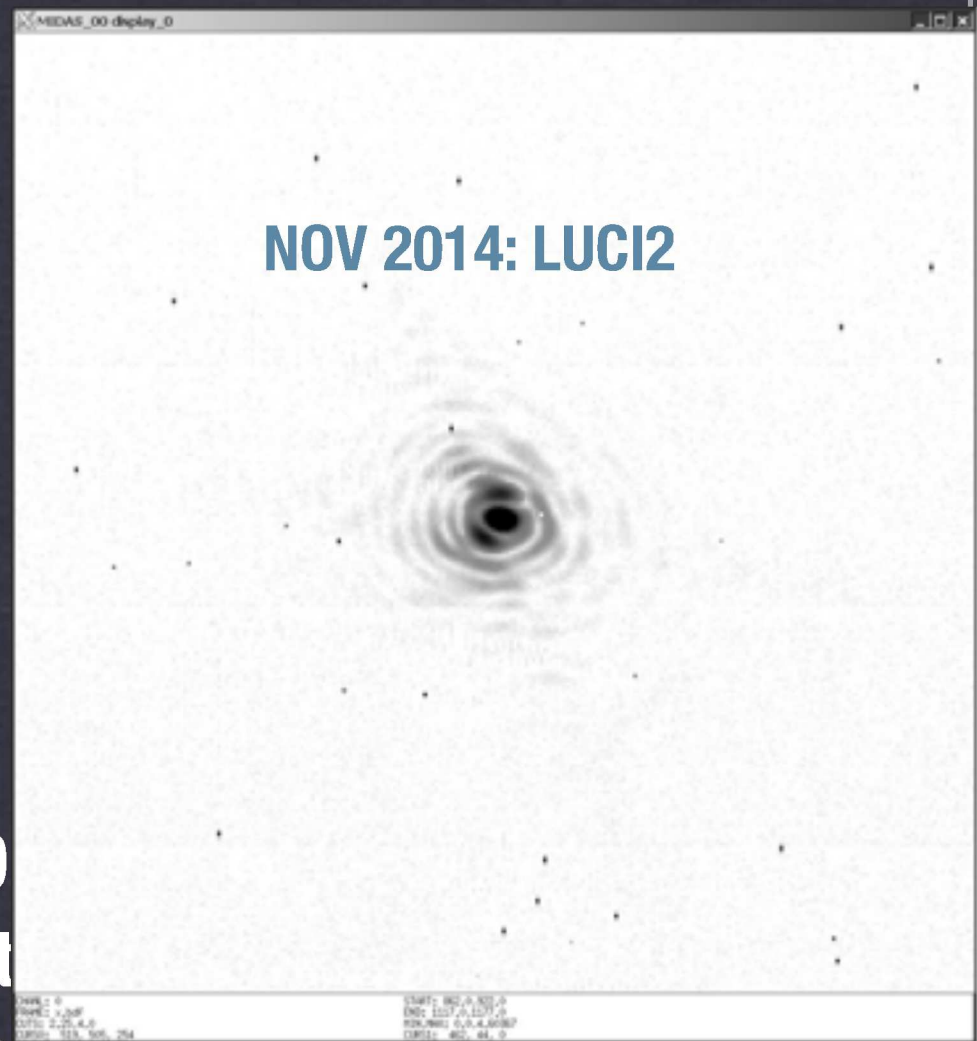
- 1<sup>st</sup> mirror set received Feb 2014
- AlSi40 vs. AlSi42: CTE mismatch
- board ... yet another metal optics design desaster ...
  
- 2<sup>nd</sup> mirror set Apr 2014; extensive testing until summer 2014; good



# Luci/A0

## AlSi40 based N30 camera

- 1<sup>st</sup> mirror set received Feb 2014
- AlSi40 vs. AlSi42: CTE mismatch
- board ... yet another metal optics design disaster ...
- 2<sup>nd</sup> mirror set Apr 2014; extensive testing until summer 2014; good



# Luci Genese

## Luci 2

A0 commissioning I/2015; available II/2015

## Luci 1

Zerodur-based N30-camera

H2RG & optics refurbishment Summer 2015

A0 comm II/2015

Luci 1 & 2 binocular

2016



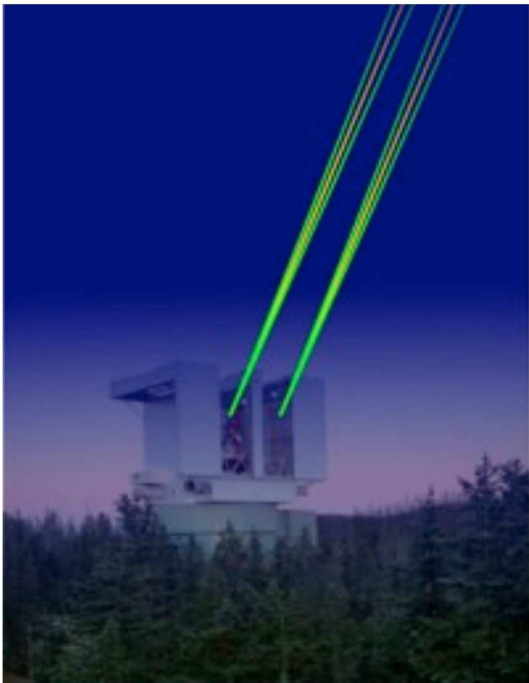
# GLAO system & FLAO Future plans



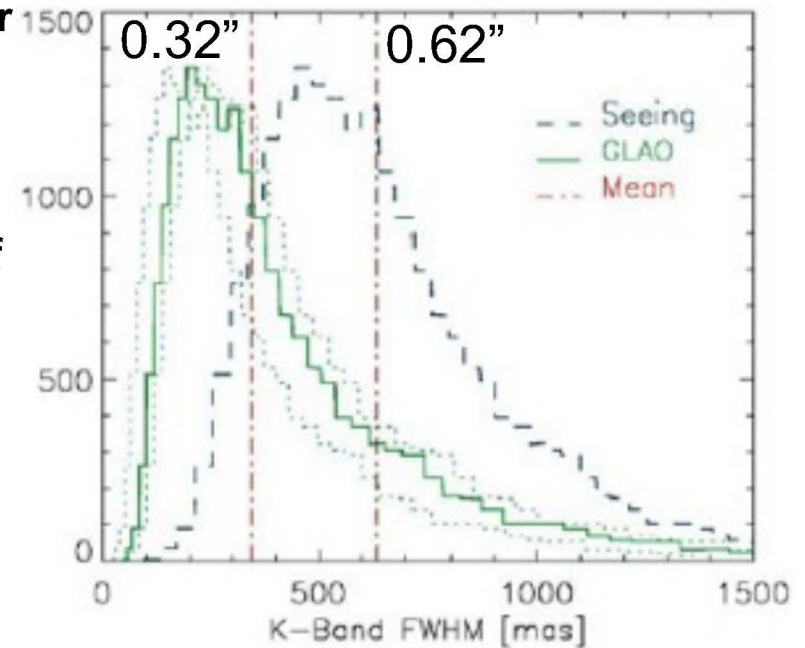
“The wide field capabilities of LUCIFER MOS and imaging, lead to unique observations when combined with GLAO.” [GLAO blue book]



PI S. Rabien

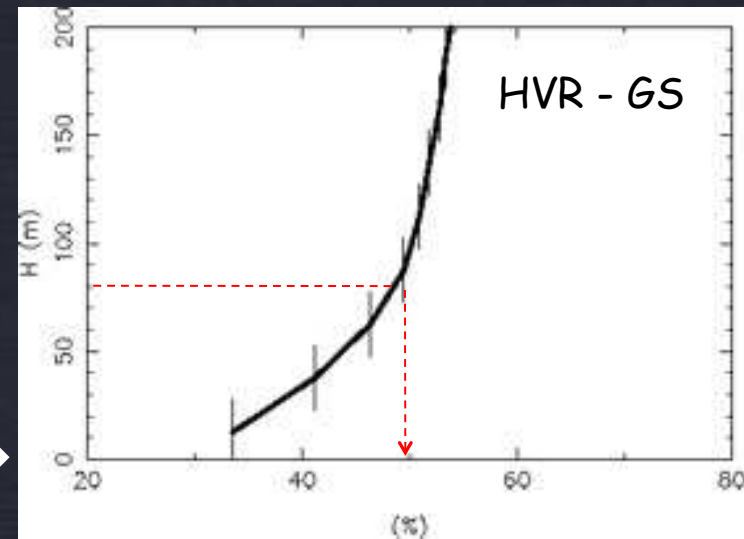


The ARGOS GLAO system under study corrects for low altitude turbulence using 12 km altitude Rayleigh sources. The GLAO correction is equivalent to an improvement of the statistic of  $r_0$  (see plot). At the mean of the distribution the FWHM is reduced with GLAO from 0.63 to 0.34 in K-band.

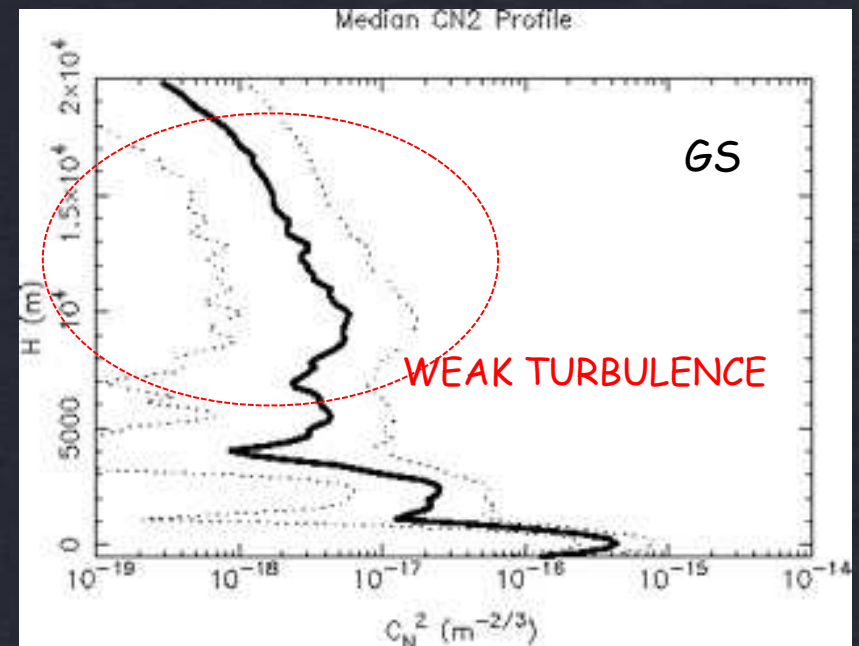


# WHICH TURBULENCE FOR ARGOS ?

50% OF THE TURBULENCE BELOW 80 M

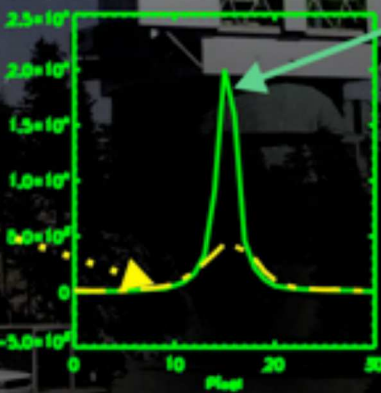


EXTREMELY FAVOURABLE  
CONDITIONS  
FOR GLAO APPLICATIONS



★ ARGOS ★  
First LGS GLAO

NGC2419



H band 100s @LUCI2  
Seeing 0.8" to 0.9"  
corrected 0.3" to 0.4"

LGS GLAO corrected 0.3-0.4"

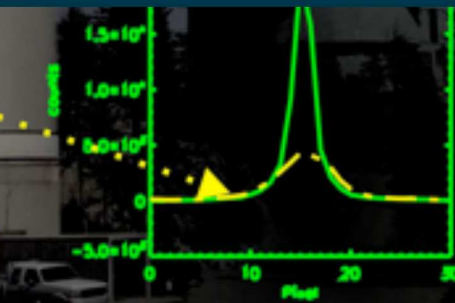
seeing limited 0.8-0.9"



ARGOS  
First LGS GLAO

# WOLFGANG GAESSLER JAN 16, 2015

seeing limited 0.8-0.9"



H band 100s @LUCI2  
Seeing 0.8" to 0.9" in H  
corrected 0.3" to 0.4"

LGS GLAO corrected 0.3-0.4"



# Luci/A0 outlook

# Luci/A0 outlook

the outlook is sharper



BEFORE AND AFTER STS-61 MISSION

# **Herzlichen Dank für Ihre Aufmerksamkeit**

**significant progress, only possible through  
MPIA technical departments**

**MPIA construction**

**MPIA workshop**

**MPIA optics & detectors**

**MPIA electronics & cryo**