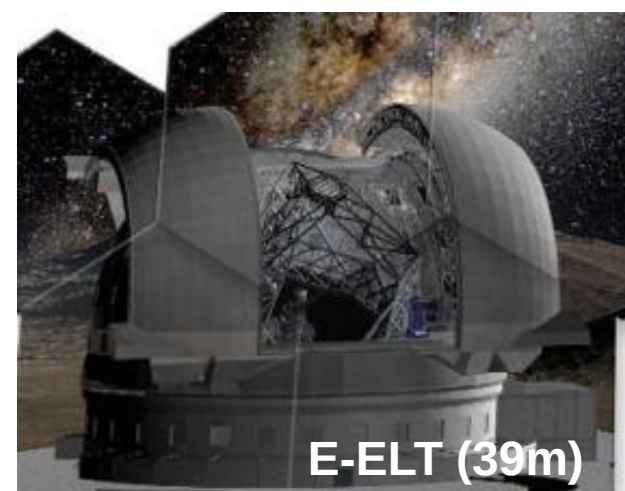
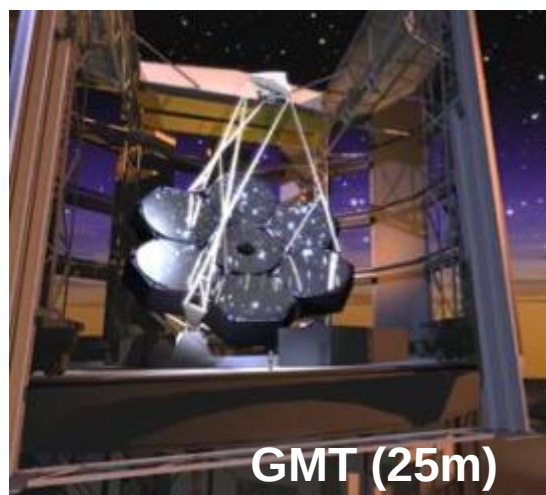
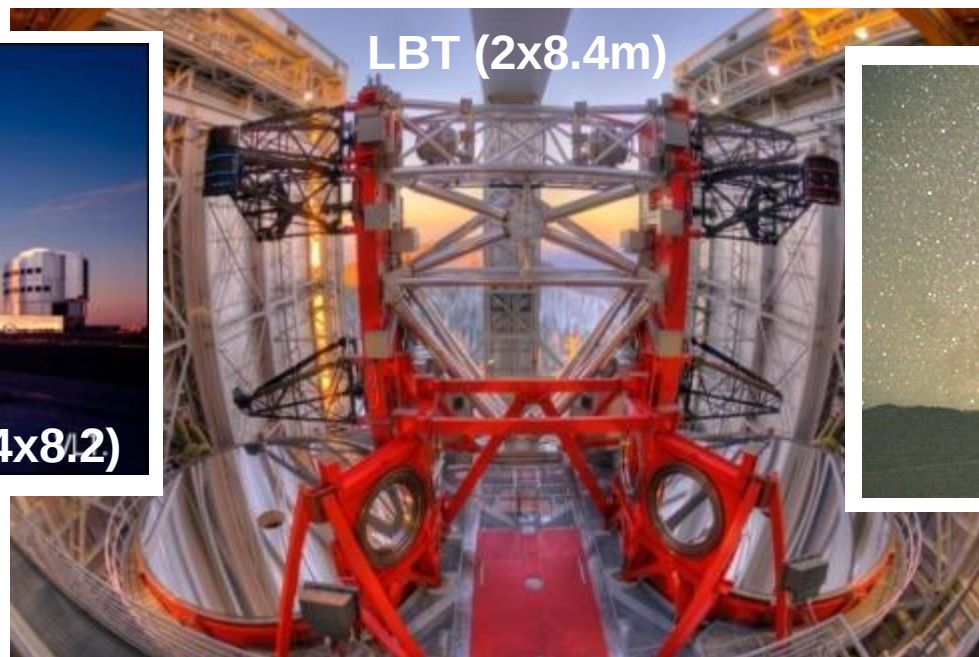




Attività del gruppo AO di Arcetri





Giornate di Arcetri– 3 Feb 2012

AO Group People and Collaborators



**Guido
Agapito**



**Carmelo
Arcidiacono
(OABO)**



**Valdemaro
Biliotti
(IR Group)**



**Marco
Bonaglia**



**Runa
Briguglio**



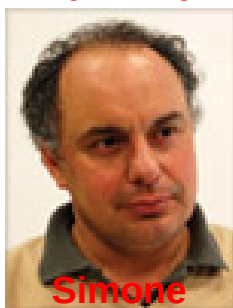
**Lorenzo
Busoni**



**Luca
Carbonaro
(Radio/AO)**



**Ciro
Del Vecchio**



**Simone
Esposito**



**Debora
Ferruzzi
(IR Group/AO)**



**Luca
Fini**



**Franco
Lisi**



**Luciano
Miglietta**



**Enrico
Pinna**



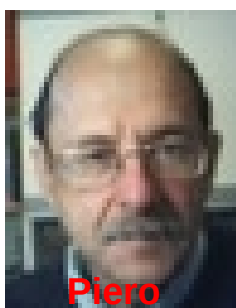
**Danny
Puccetti**



**Alfio
Puglisi**



**Fernando
Quiròs-Pacheco**



**Piero
Ranfagni
(collab.)**



**Armando
Riccardi**



**Piero
Salinari
(collab.)**



**Paolo
Stefanini
(collab.)**



**Marco
Xompero**

EARTH worshiper
How about you?

PAVEMENT
ENDS
500 FEET

SAVE
MT.
GRAHAM





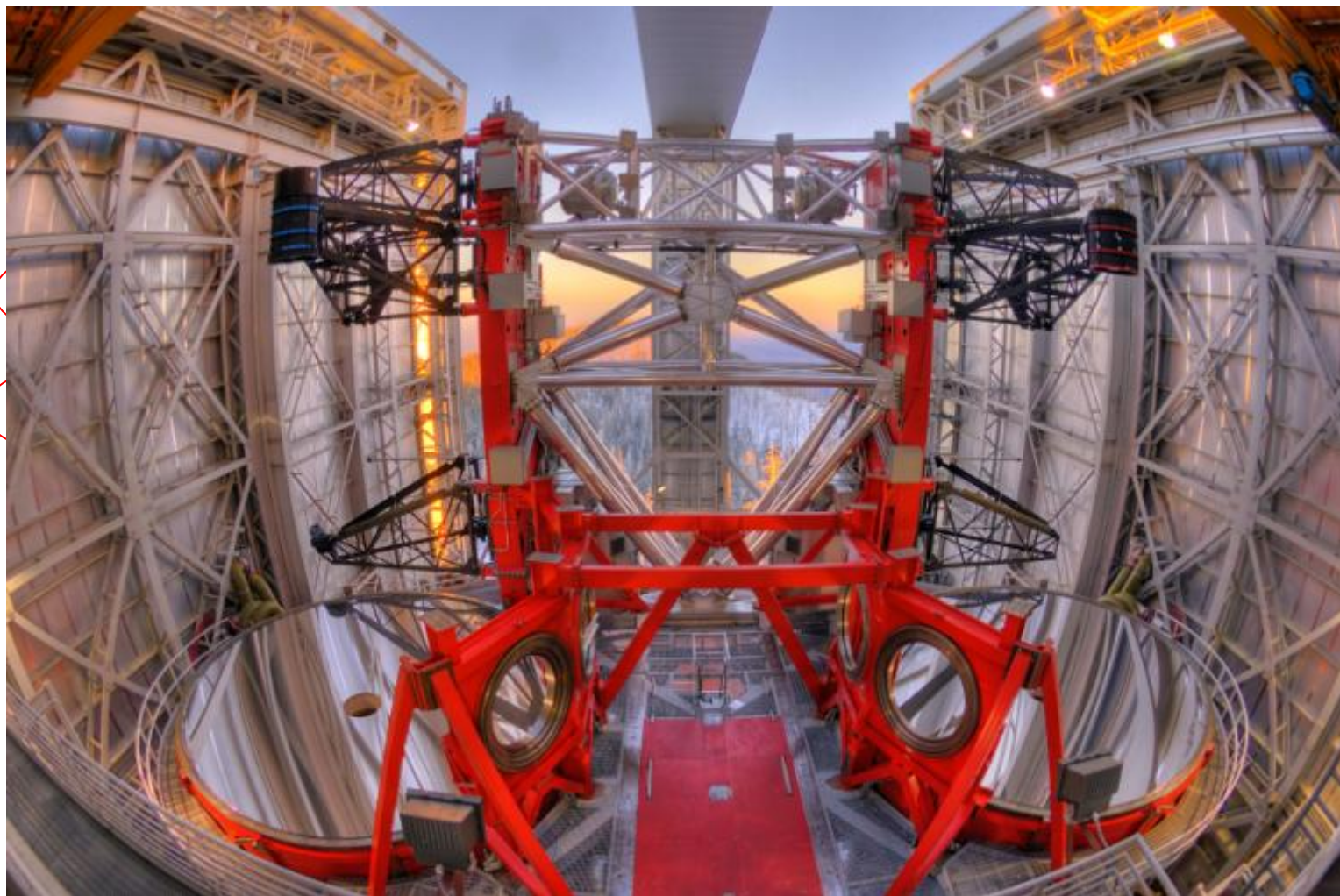
LBT: the first Adaptive Telescope

LUCIFER:

- Seeing limited
- GLAO assisted
- diffraction limited imager and spectrograph ($0.9\text{--}2.5\ \mu\text{m}$)

LBTI:

- Nulling
- Fizeau interf. ($3\text{--}20\ \mu\text{m}$)

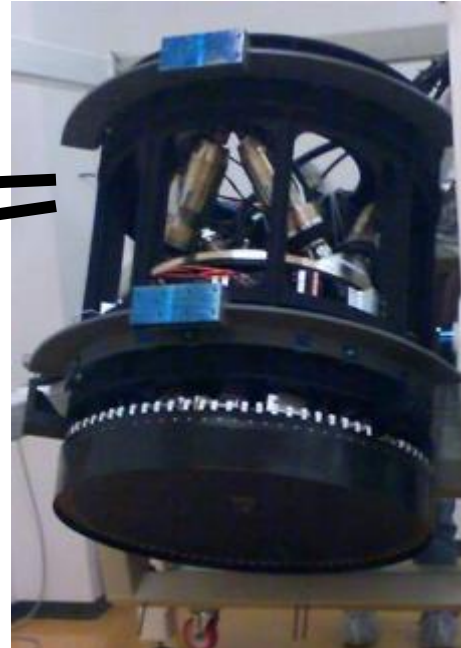
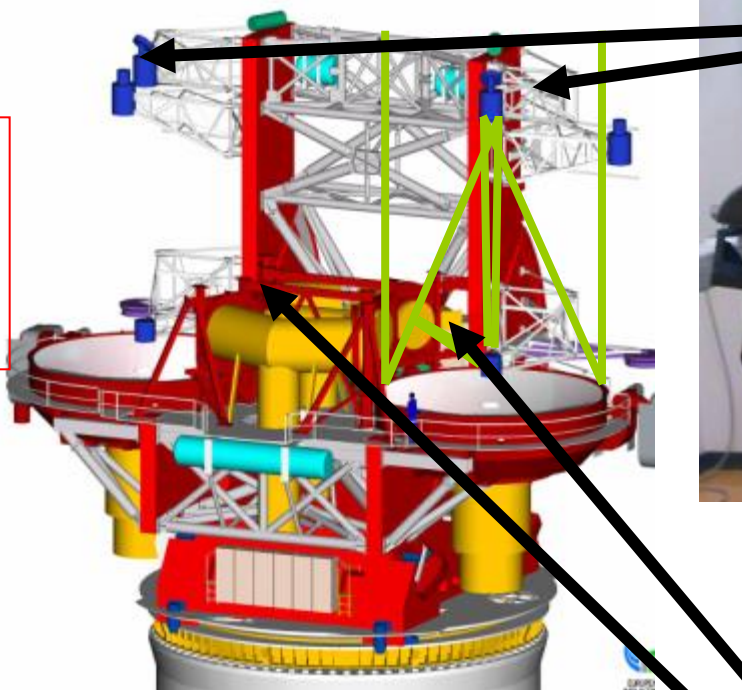




First Light AO (FLAO) for LBT

AdSec units 2002/2011
Contract # AO104
Funds 1M€
~ 30 FTE

W units 2002/2011
Contract # AO103
Funds 2M€
~ 50 FTE



Scala temporale

	FLAO #1	FLAO #2
Commissioning	Feb 2010 – Oct 2011	Dic2011 – Set/Ott2012 (2.4FTE)
Science Demostration Time w/PISCES	Set 2011 – Ott 2011	N.A.
FLAO+Lucifer	> Set 2012 (?? FTE)	?? (?? FTE)





Commissioning FLAO#1

Run # (day/night)	Start date	End date	Days total	Persons	Person-days total
system tel. inst. & first test	09-Feb-10	17-Mar-10	37	7	259
1st daytime run	10-May-10	26-May-10	17	5	85
1st night time run	27-May-10	03-Jun-10	8	9	72
2nd daytime run	06-Jun-10	12-Jun-10	7	4	28
2nd night time run	19-Jun-10	25-Jun-10	7	7	49
3rd daytime run	18-Sep-10	28-Sep-10	11	7	77
4th run (day/night)	13-Oct-10	28-Oct-10	16 (7)	4	64
5th run (day/night)	14-Nov-10	28-Nov-10	15 (7)	5	75
6th run (day only)	12-Jan-11	22-Jan-11	11	4	44
7th run (day/night)	01-Jun-11	21-Jun-11	21 (12)	4	84
8th run (day/night)	08-Oct-11	15-Oct-11	8 (5)	3	24

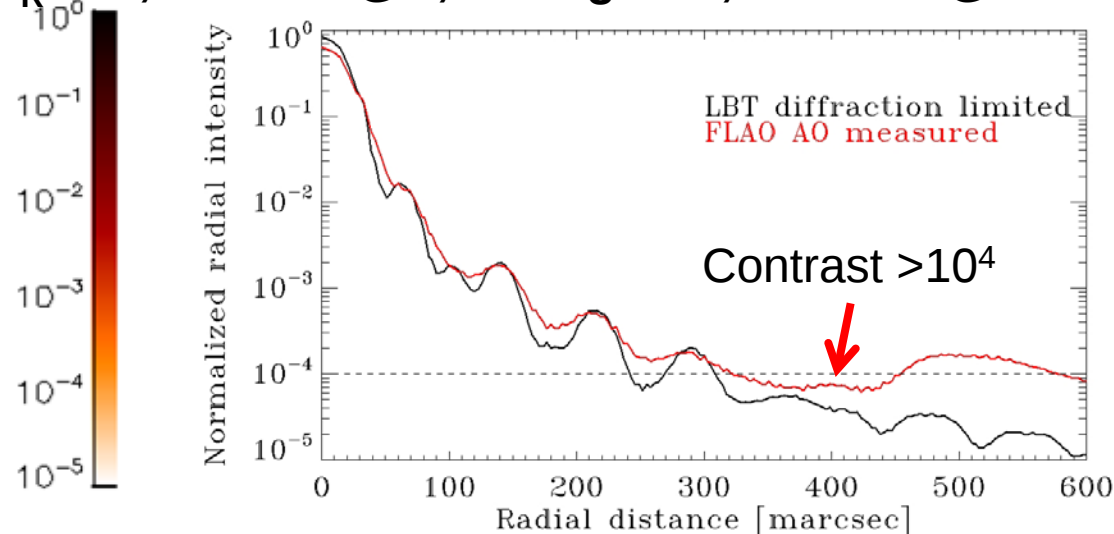
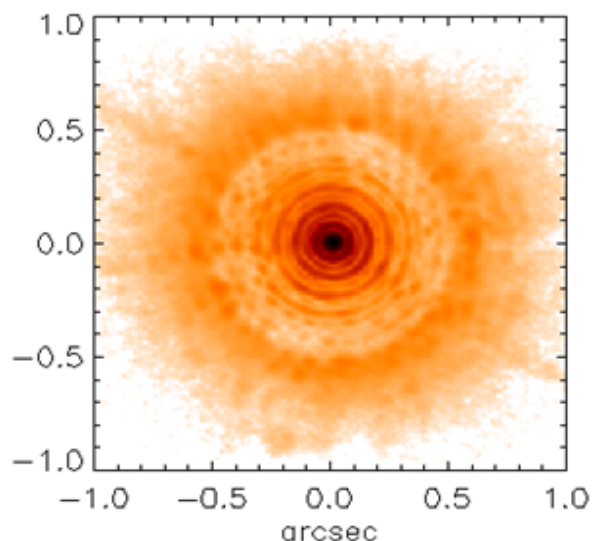
1 installation and test run and 8 commissioning runs
158 days of work in 20 months with ~4 year-man (861 day-man)



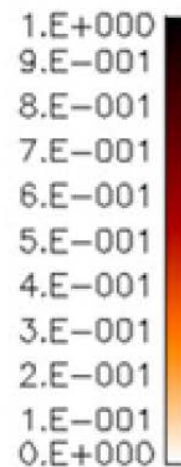
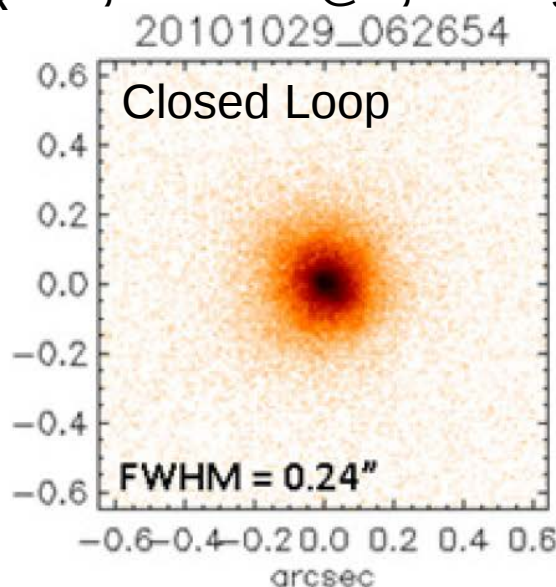
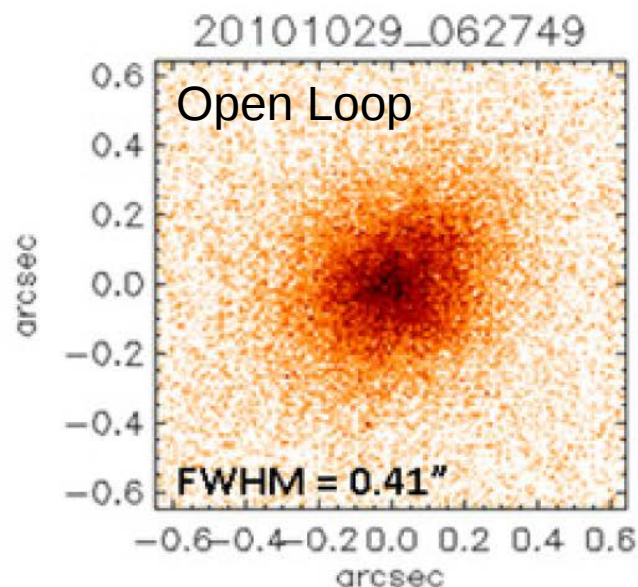
Commissioning FLAO#1

FWHM=40mas

$m_R=6.5$, SR~85%@H, seeing 0.7", CL 400m@1kHz

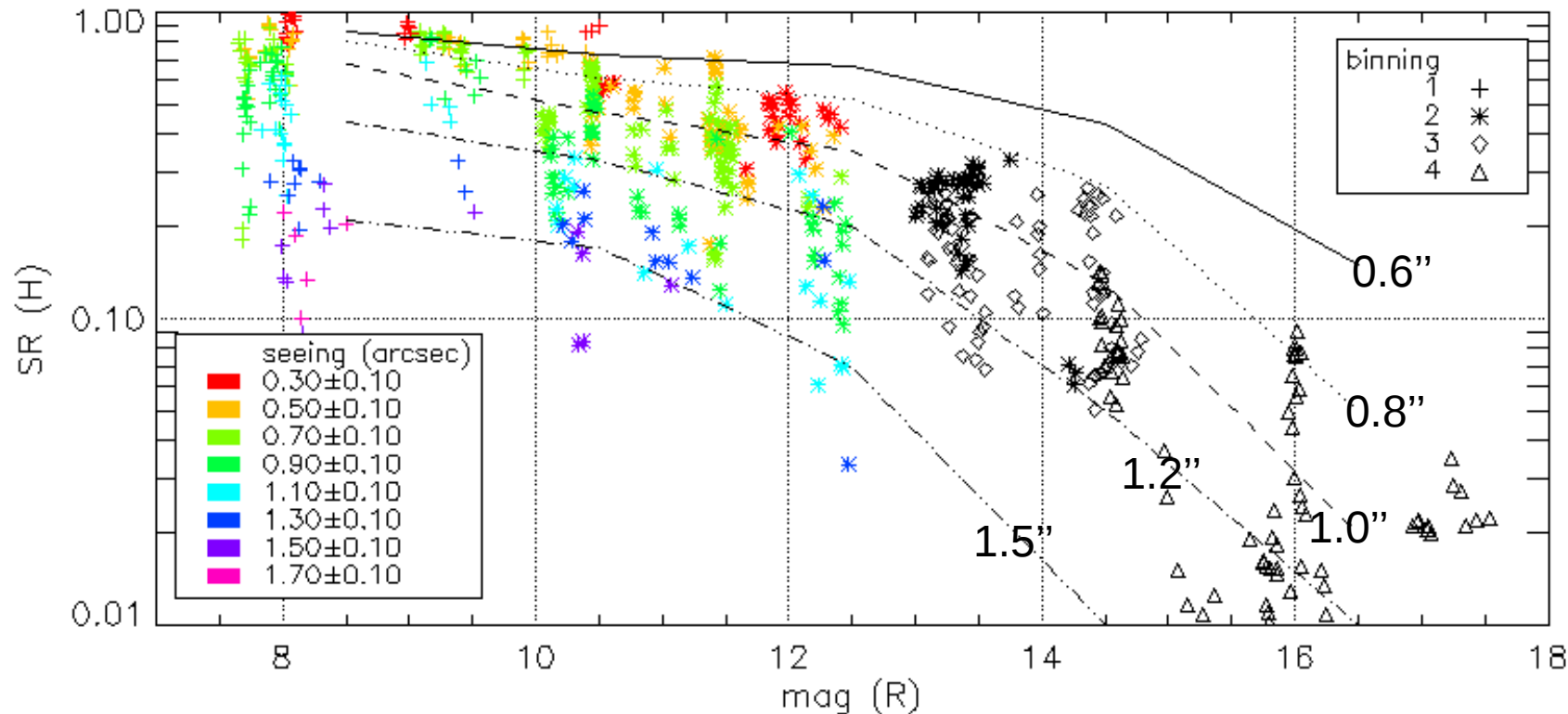


$m_R 17.2$, SR~85%@H, seeing 0.7", CL 10m@100Hz





Commissioning FLAO#1





LUCIFER

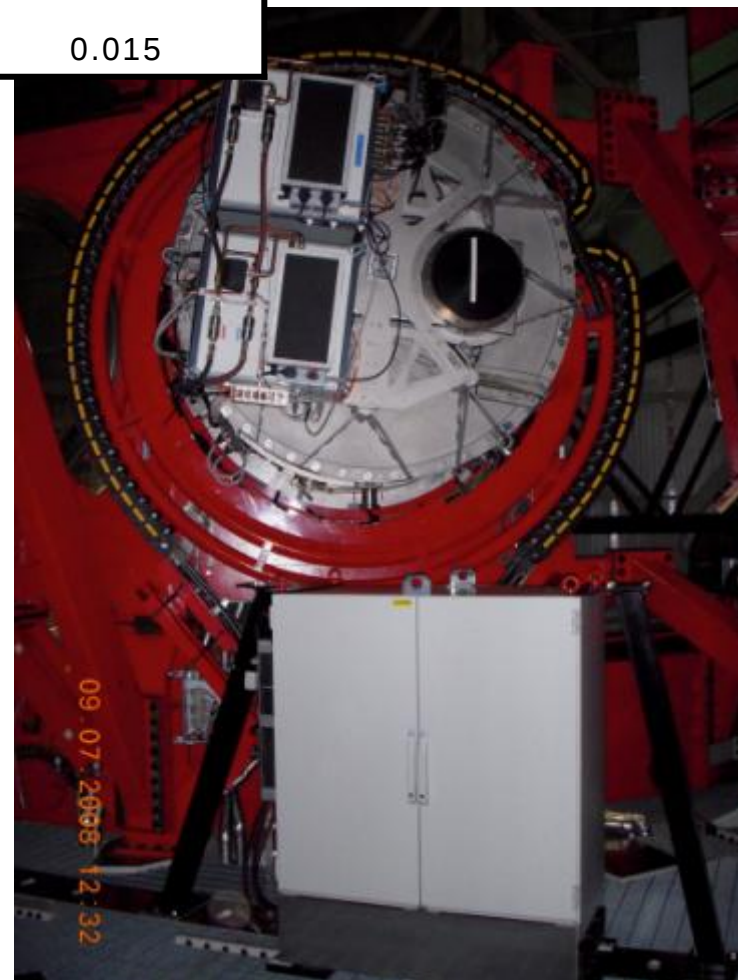


LBT NIR spectroscopic Utility with Camera and Integral-Field Unit for Extragalactic Research



Modes	Spectral Coverage (μm)	Spectral Resolution	Field of View	Pixel Scale (arcsec/pixel)
Imager, Longslit, MOS	Z, J, H, K	5,000 - 10,000	4' $\times$ 4'	0.12 - 0.25
AO	J, H, K	$\sim$ 30,000	30" $\times$ 30"	0.015

LUCIFER installed at LBT SX FBG



LUCIFER1	Seeing limited	Diffraction limited
Telescope Commissioning dates	Sep. 2008	Not before Sep. 2012



PISCES e SDT

Detector	Hawaii-1 (HgCdTe) array 1024x1024.
QE	60% in J band.*
Wavelength	1-2.5um.
Input f/ratio	f/15, reimaging f/22.
Pixel size.	18.5um/pixel.
FOV.	21x21 arcsec.
Plate scale.	19 mas/pixel.
Gain	4.55 e ⁻ /ADU.
Read noise.	5.13 ADU **
Dark current.	~0.03 ADU/sec.

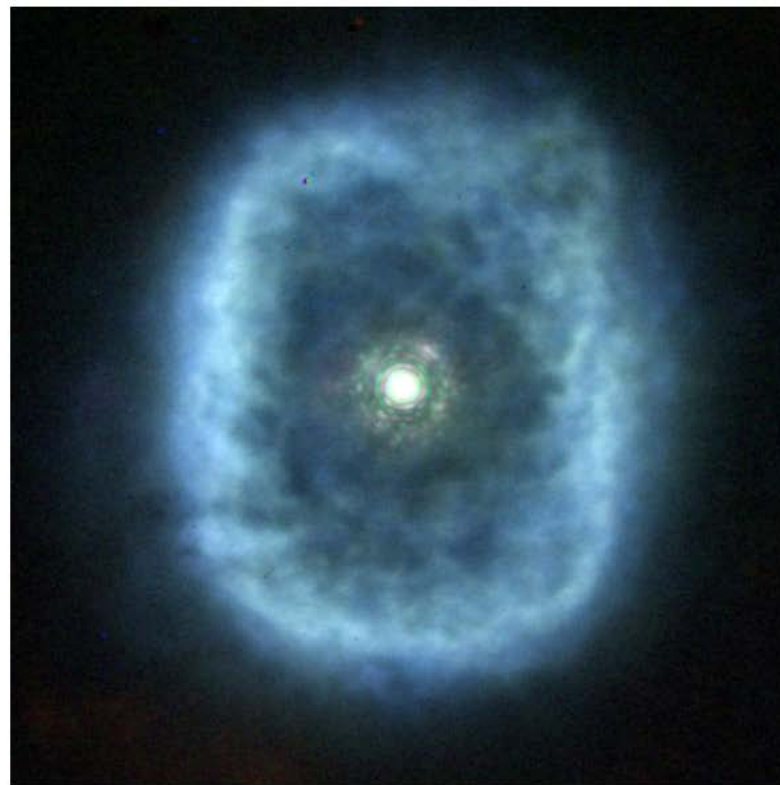
Number #	Filter	Central wavelength (um)
0	2.14	2.14
1	H2	2.12
2	Open	
3	Blind/Dark	
4	J	1.27
5	Ks	2.12
6	H	1.63
7	Br_gamma	2.169
8	FeII	1.64
9	2.086	2.086

Nov 2011: 6 notti (solo 50% tempo buono)

Tagets diversificati: asteroidi, popolazioni stellari in GC e in galassie vicine, nebulose planetarie, dischi di formazione, Quasars, ...

11 Scientific papers in preparation from SDT run

Science Demonstration Time



Comparison of two images of BD+303639 from Hubble Space Telescope (left) and LBT+AO system (right). The false color LBTO image of **BD+303639** is composed of a stack of 10 exposures with 60 seconds exposure time in H2 and J band.



Science Demonstration Time

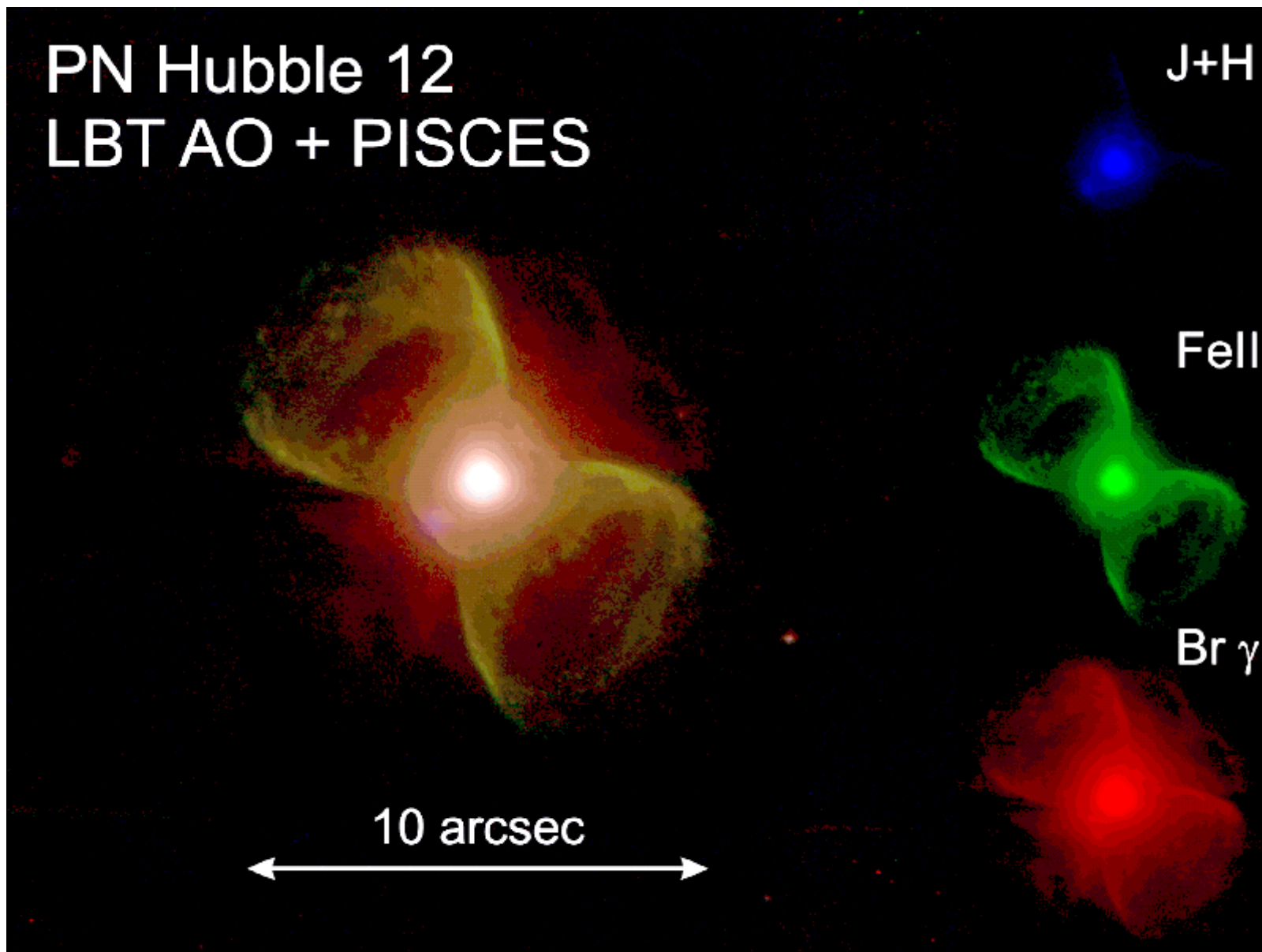
PN Hubble 12
LBT AO + PISCES

J+H

FeII

Br γ

10 arcsec



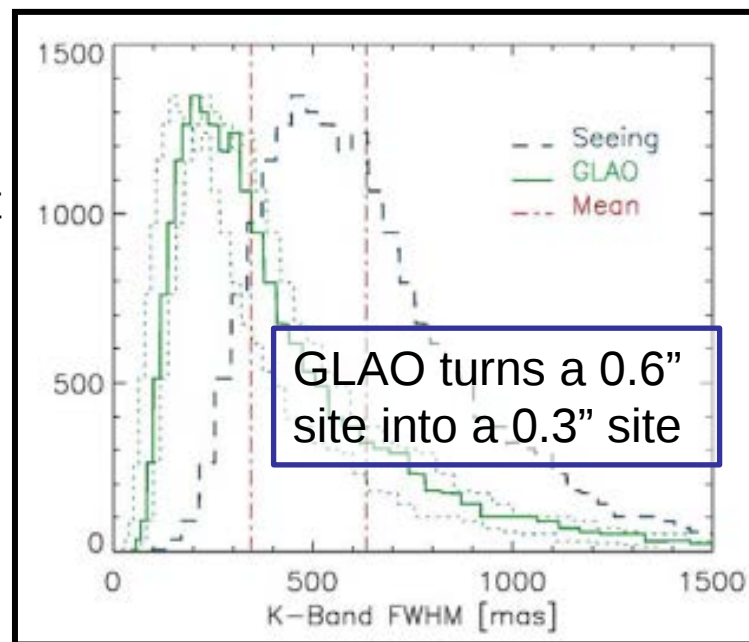
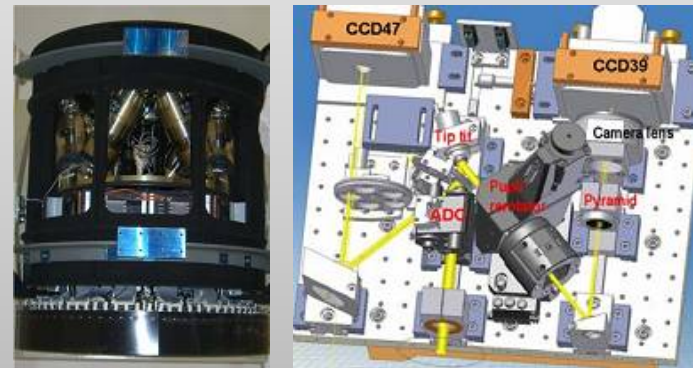
ARGOS

Advanced Rayleigh Ground Layer Adaptive Optics System

- Correction of Ground Layer turbulence
- Resolution improved of a factor 2-3
- Gain a factor 4-9 in integration time
- Correction over a large field (4x4')
- Nearly 100% sky coverage
- Operates under most seeing conditions
- PDR 2009, FDR 2010, LBT installation 2012+
- Possible upgrade w/ sodium LGS for Diffr.Limit

**Use of LUCI as MOS 4x4' FoV
@ 0.3" seeing**

ARGOS exploits the existing Adaptive Secondary Mirror and the FLAO Pyramid WFS as tip-tilt tracker.

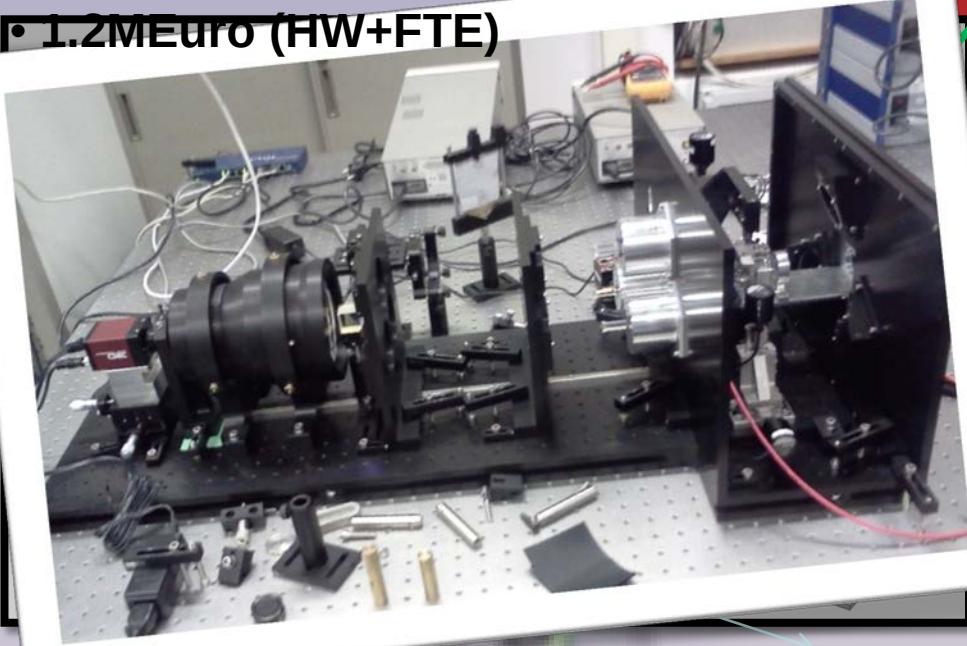


CAAO
Center for Astronomical
Adaptive Optics

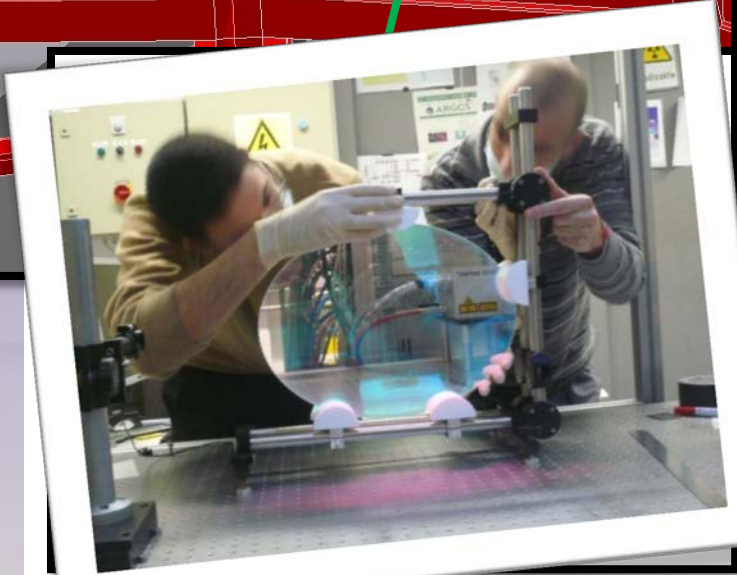
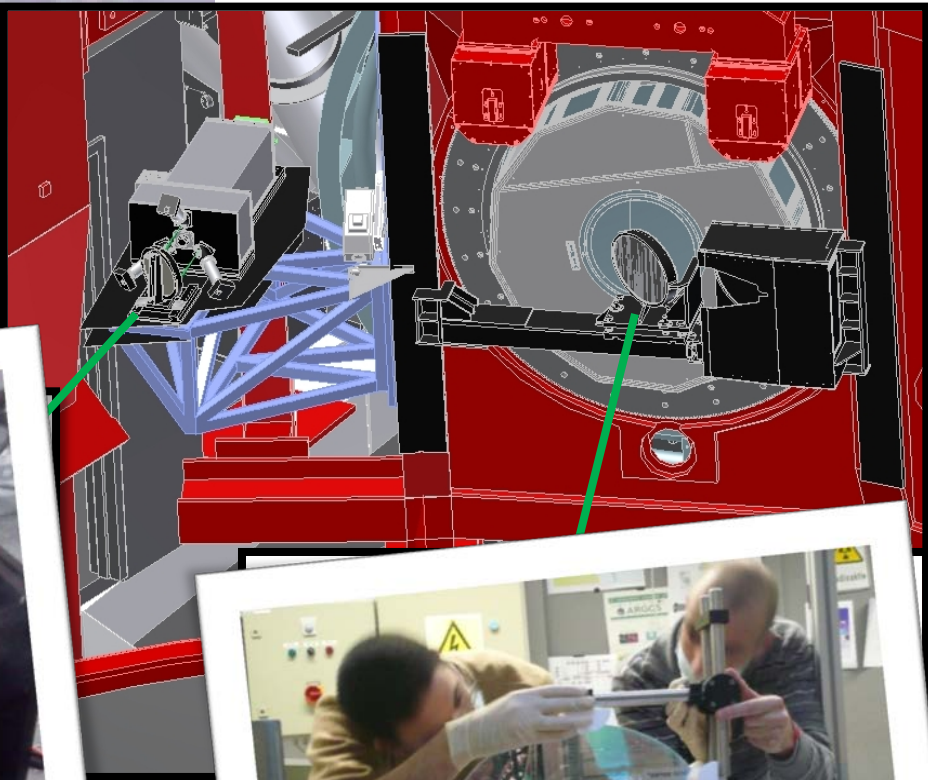


Arcetri's tasks in ARGOS

- Dichroic and LGS WFS design, integration and test
- 10 FTE in 3 years
- 1.2MEuro (HW+FTE)



3 laser beams combined on a single detector
15x15 subaps @ 1kHz, pupil and jitter actively compensated, acquisition cameras 1' FoV, Pockels cells to gate @ 12km



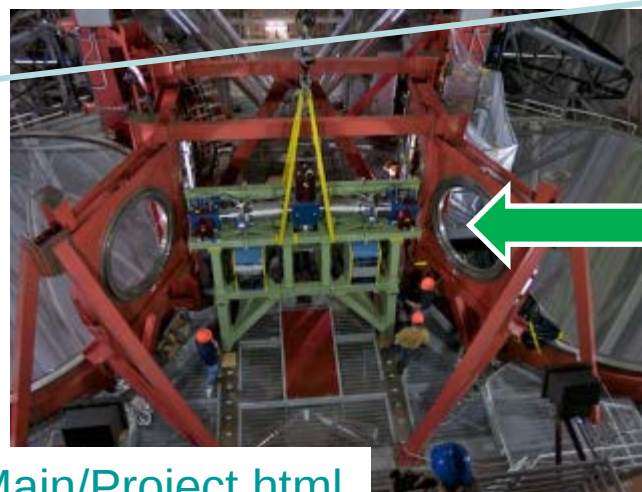
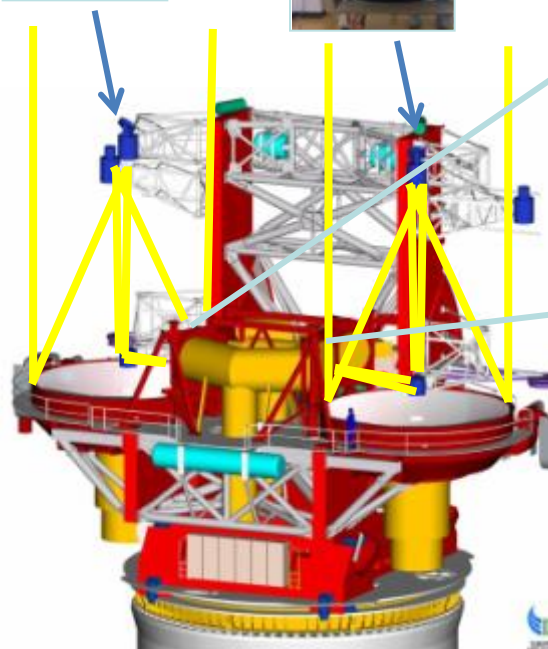
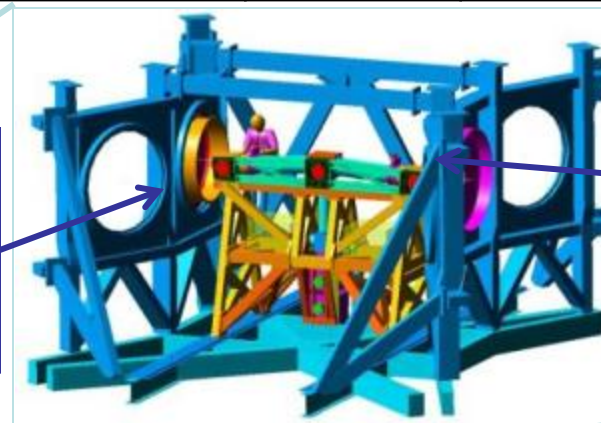
Dichroic unit deployed to split laser beams from red & NIR



AO system for LBTI



Focal Station	Modes	Spectral Coverage (μm)	Spectral Resolution	Field of View	Pixel Scale (arcsec/pixel)
Center-Bent	Nulling Interf Short Fizeau Long Fizeau	8 – 13 3-5 8-25	2 - 30	25"	0.1



Nulling and Imaging Camera:

- Nulling Optimized Mid-Infrared Camera (8-25 μm)
- LMIRCam (3-5 μm)
[Hinz - SPIE 2008]



AO system for LBTI



Sub-Contract

INAF/OAA – Arizona University

Voce	k€
3.5 FTE	143.5
Hardware	165.5
Travel	10.0
TOTAL	319

Scala temporale

Inizio AIT	Luglio	2009
Acceptance test	Gennaio	2011
Commissioning unit#1	Settemb	2011
Commissioning unit#2	TBD	2012

Link al sito NASA/LBTI

<http://lbt.as.arizona.edu/LBTI-Main/Project.html>

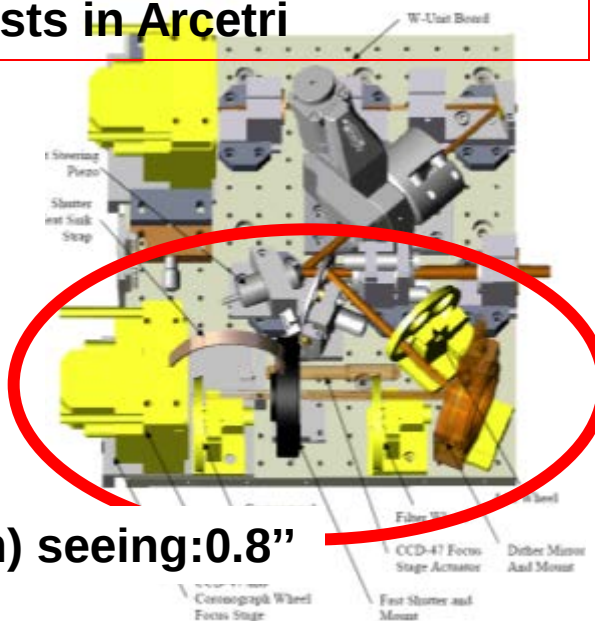
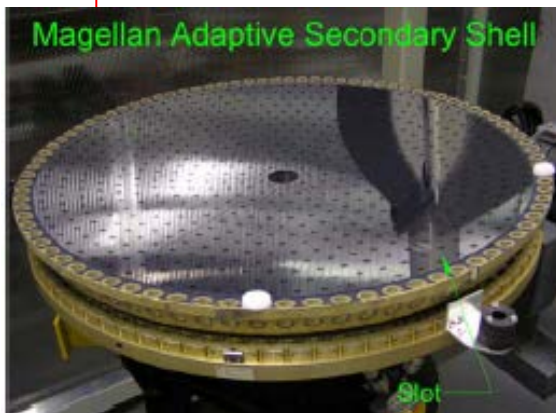


Magellan

Contract with UofA “AO W unit” #2.05.23.01

Funds to Arcetri: 500 k€ (9 persons)

- Pyramid WFS
- AdSec optical calibration
- AO control SW
- AO closed loop tests in Arcetri



VisAO: SR=55%@i'(765nm) seeing:0.8"

Scala temporale



Magellan tasks

dates

AO acceptance ad Arcetri

Feb – Mar 2012

Commissioning a Magellan

Giu 2012 – Gen 2013

Accordi per osservazioni future ?



AO nel Visibile: TecnoINAF 2009

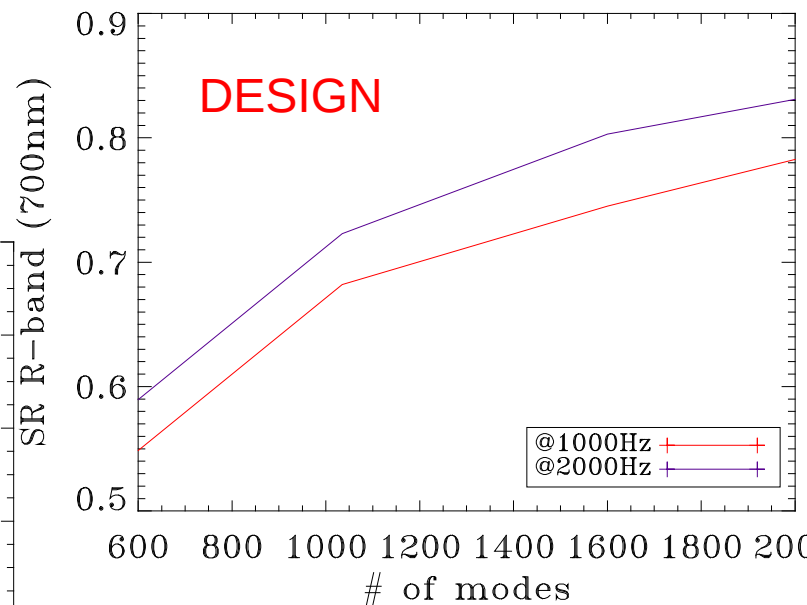
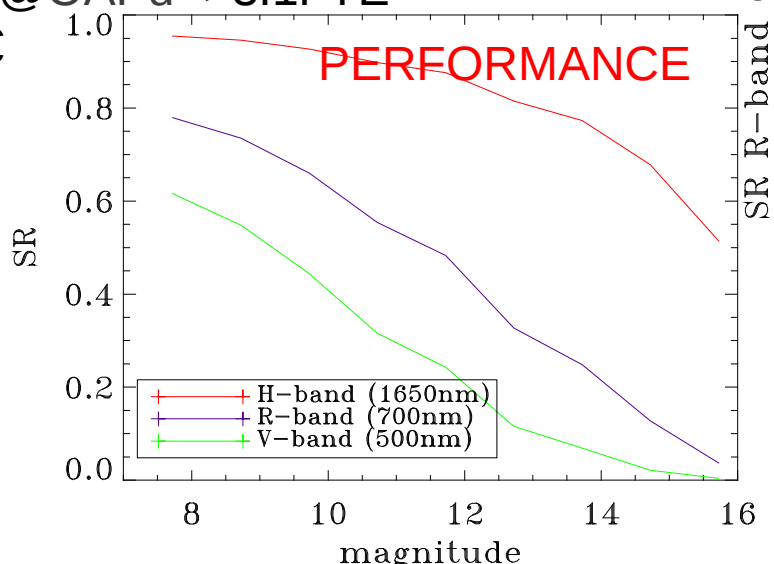
- Goal: Demonstration of the possibility to perform high SR(>50%) adaptive correction on 8meter class telescope on $0.4\mu\text{m}$ - $1.0\mu\text{m}$ bandwidth
- Rationale: High spatial resolution ($\sim 10\text{mas}$) and contrast imaging and spectroscopy on 8-10meter class telescopes will provide synergies to (6-11mas) E-ELT resolutions on the Near IR. A new possible role for VLT and LBT in the ELT era.
- Synopsis: Numerical Simulations provide the baseline design of a AO@SW system

Start-End Aug 2010-Jul2012

People 8@OAA- > 13.1 FTE,

1@OABo+ 3@OAPd ->3.1FTE

Funds 55 k€





VLT DSM (AOF)



VLT-DSM: 1170act, D=1120mm



VLT-DSM: Contratto Microgate-ESO

- ☐ Arcetri ha partecipato alla fase di disegno con OPTICON (2004-2008)
- ☐ Nell'attuale fase di produzione e test Arcetri partecipa con due sottocontratti verso Microgate:
 - **Software per Maintenance and Calibration DSM (90k€ contratto in essere, 0.5 FTE)**
 - **Test Ottica del DSM a ESO (Assist) (contratto in definizione, 1 FTE)**

Scala temporale

DSM Production, Integration and EM test (Maintenance and Calibration SW)	Lug 2008 - Lug 2012 (Mar 2009 – Giu 2012)
Test ottici DSM a ESO	Nov 2012 – Feb 2013
Test con Strumenti dell AOF a ESO	Mar 2013– Feb 2014
DSM in Cile con AOF	Mid 2014



VLT ERIS (AOF)



ERIS

Enhanced Resolution
Imager and Spectrograph

JHK-LM

LGS-AO (SH + Pyr)

NGS-AO (Pyr)

VLT-ERIS: Contratto Arcetri-ESO

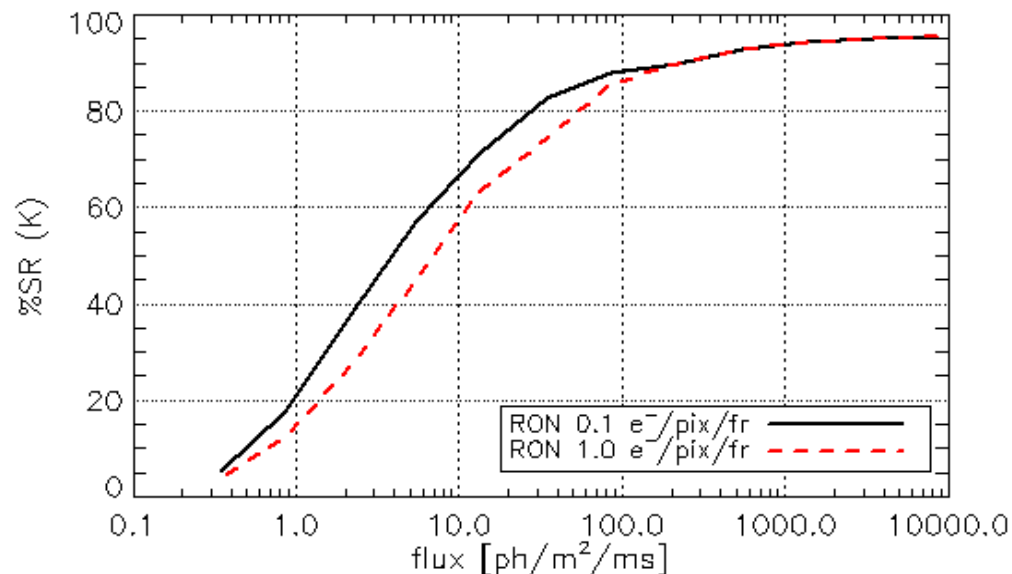
- ❑ Conceptual Design of a NGS Pyramid WFS for ERIS
- ❑ Ott-2011 Apr-2012.
- ❑ 1.4 FTE (8 persons in Arcetri)
- ❑ Total to Arcetri: 60k€

2012: NACO will be
decommissioned

Needed general purpose
high-res imager in AOF:

-> ERIS

❑ **Backdoor per rientrare nei progetti di sistema per
AO di EELT**





EELT

M4AU: Specchio adattivo (M4) per E-ELT



E-ELT (39m)

Estensione della tecnologia dei secondari adattivi a E-ELT
Prototyping and Preliminary Design: 2007 - 2010

End 2011: ESO Council approva EELT Construction Plan (nostro M4 OK)
Nuovo contratto a Lug 2012 dopo ESO Finance Committee di Mag 2012



MICROGATE
ENGINEERING

ADS International



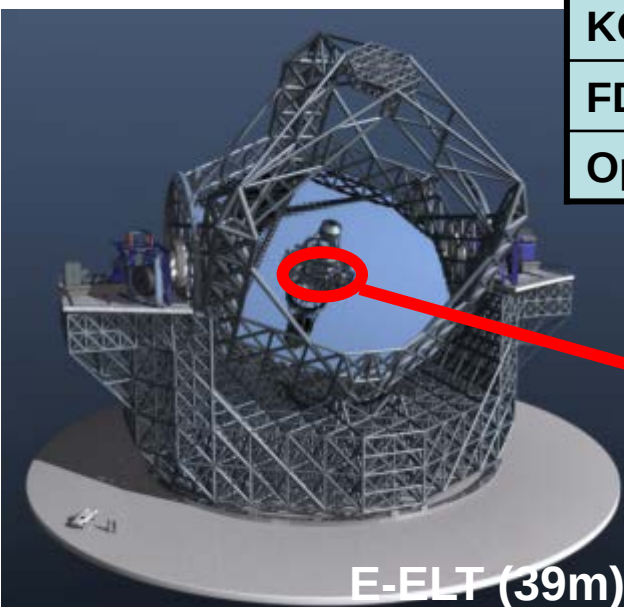
Sagem Défense Sécurité
SAFRAN Group



Osservatorio
Astronomico di
Brera

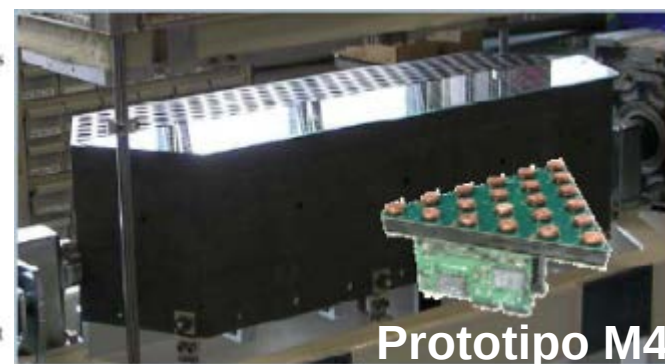
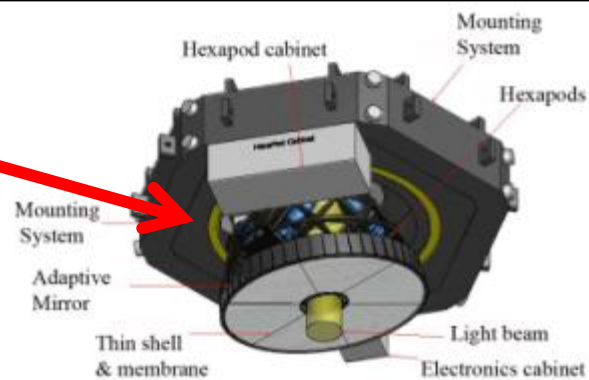
Contratto Microgate-ESO (INAF subcontract) 2012-2020 per:

- ❑ Final Design e costruzione M4 adattivo da 2.6m (~6300 attuatori)
- ❑ Brera+Arcetri: calibrazione ottica di M4
- ❑ Arcetri: AO-scientist
- ❑ Totale ad Arcetri: 1M€, 13 FTE (4 persone)



E-ELT (39m)

KO	Lug 2012
FDR	Gen 2015
Optical test	2019-2020



Prototipo M4



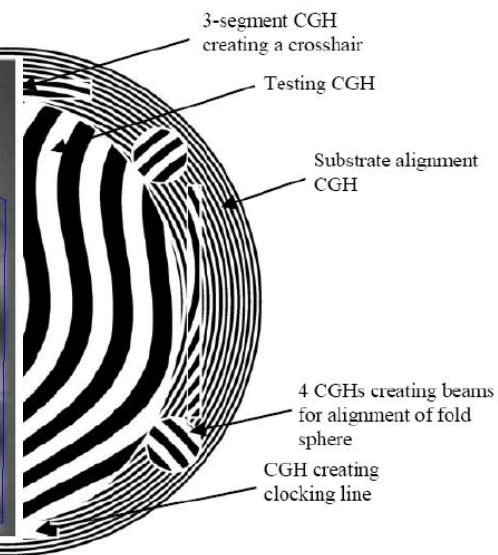
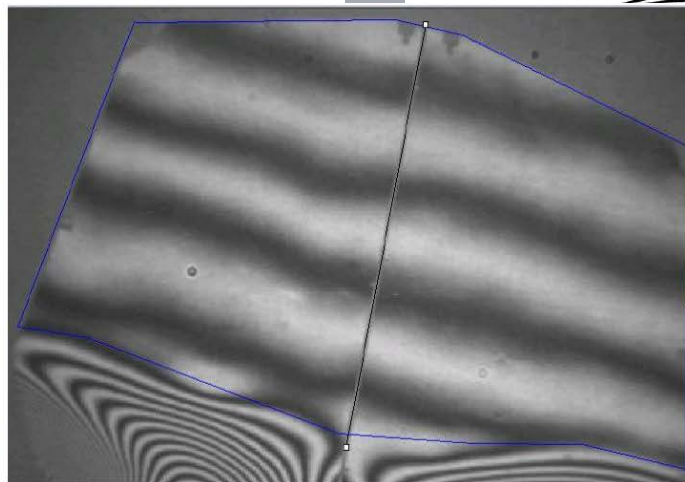
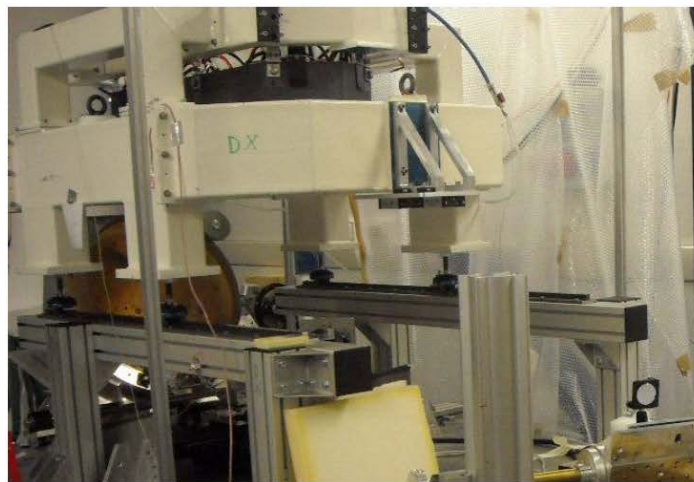
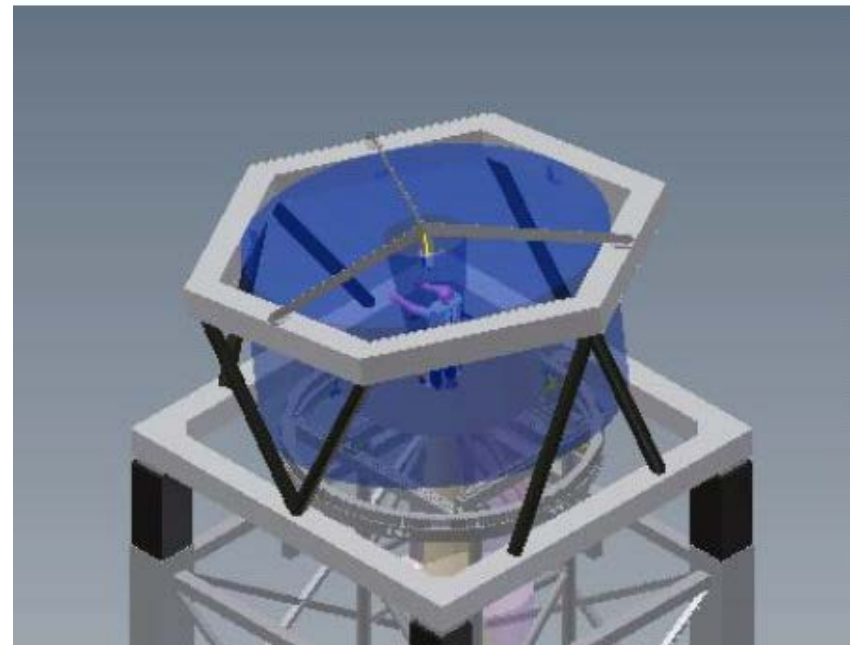
M4-EELT: TecnoINAF 2010

Arcetri + Brera

Development and test of new CGH-based techniques with automate calibration for future large-format Adaptive-Optics mirrors

Jul 2011 – Jul 2013

Tot. ad Arcetri: 42.5k€, 2.6FTE (3 persone)

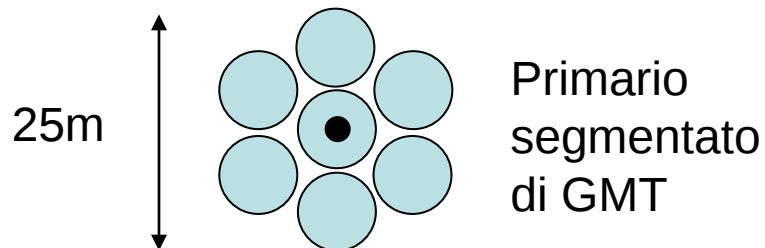




Giant Magellan Telescope (GMT)

Stesso gruppo di Magellan.

Tecnologia molto simile a LBT: GMT è fatto da 6+1 primari tipo LBT.



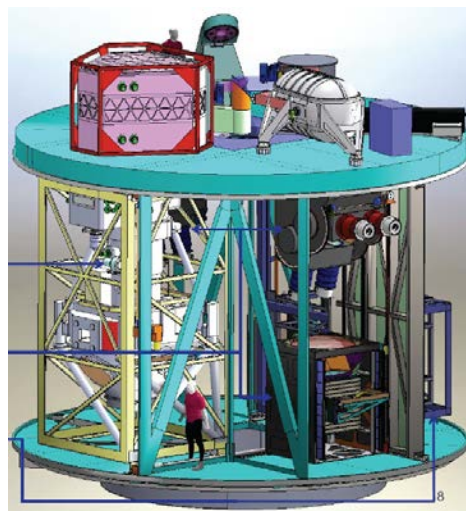
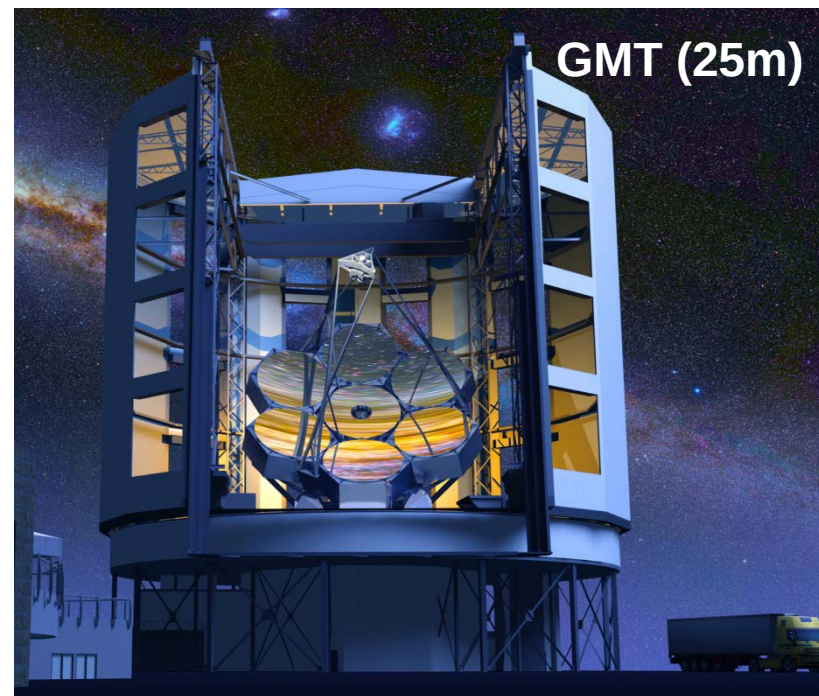
Contratto ad Arcetri per Preliminary Design del **NGS Pyramid WFS** Subsystem (NGWFSS) (AO+co-phasing)

Feb.-Ott. 2012

4FTE (13 persone)

Tot ad Arcetri: 309 k€

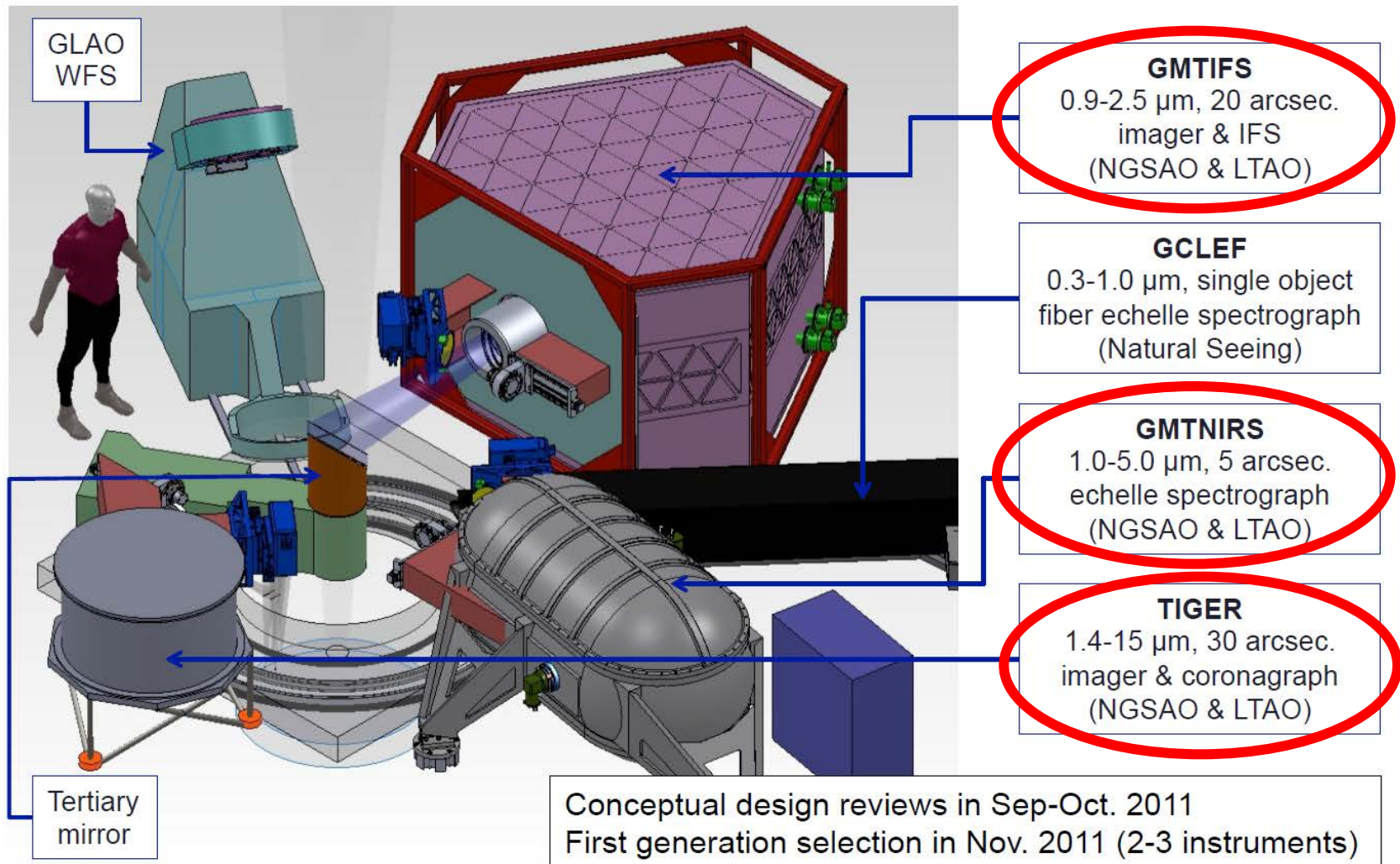
✓ KO meeting 18-19 Feb 2012



GMT - NGWFSS

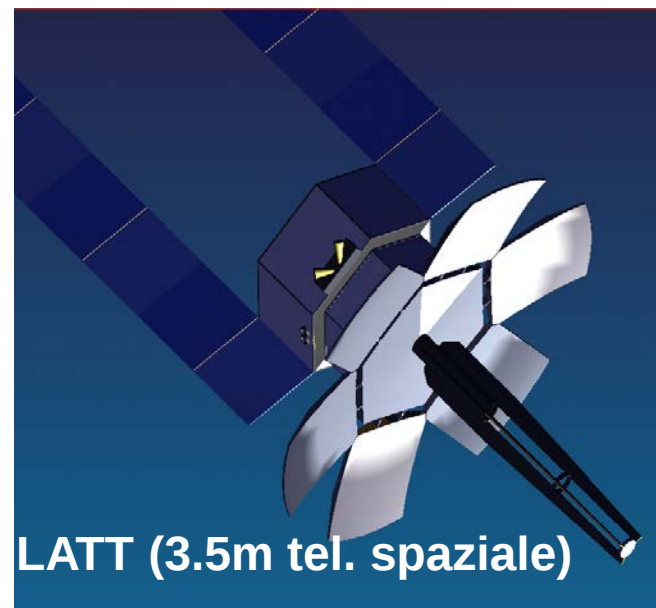


Narrow-Field Instruments



Specchi superleggeri per telescopi spaziali

- Contratto ESA per lo sviluppo della tecnologia (LATT)
- Partner di INAF: INOA, ADS, Microgate, CGS
- Fase 1: aprile 2011 → dicembre 2011
- Fase 2: marzo 2012 → ottobre 2012
- 0.5FTE (3 persone ad Arcetri)
- Totale ad Arcetri: 37 k€

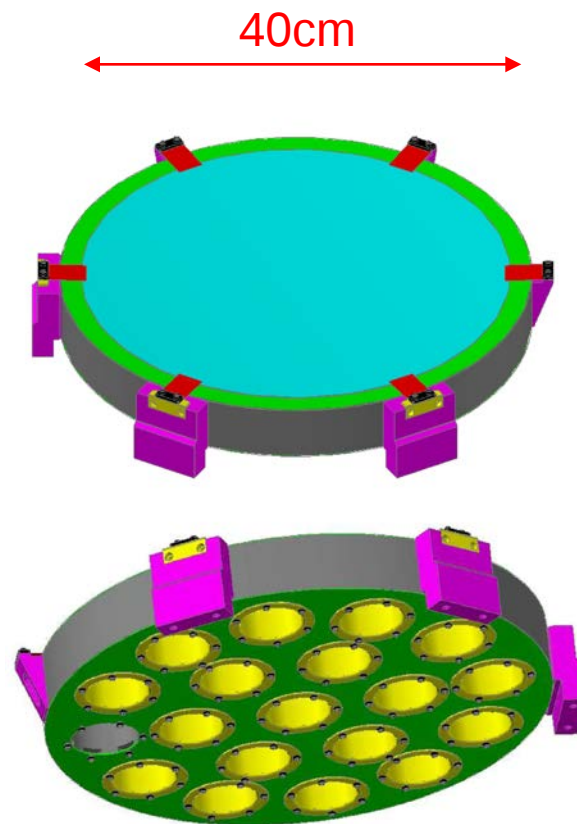
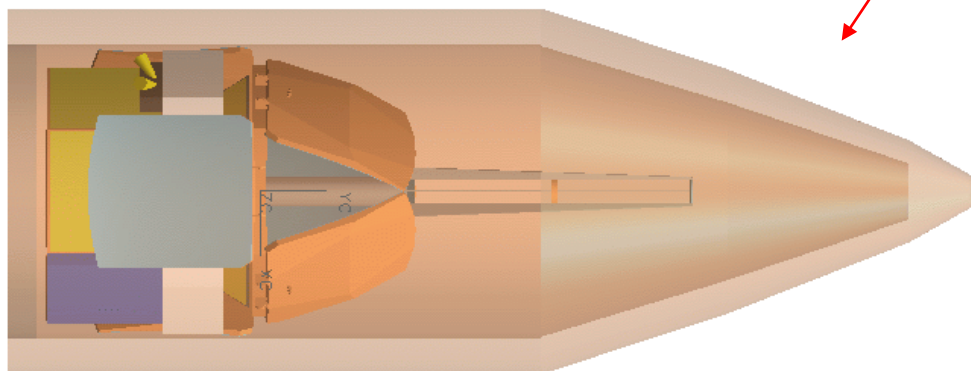
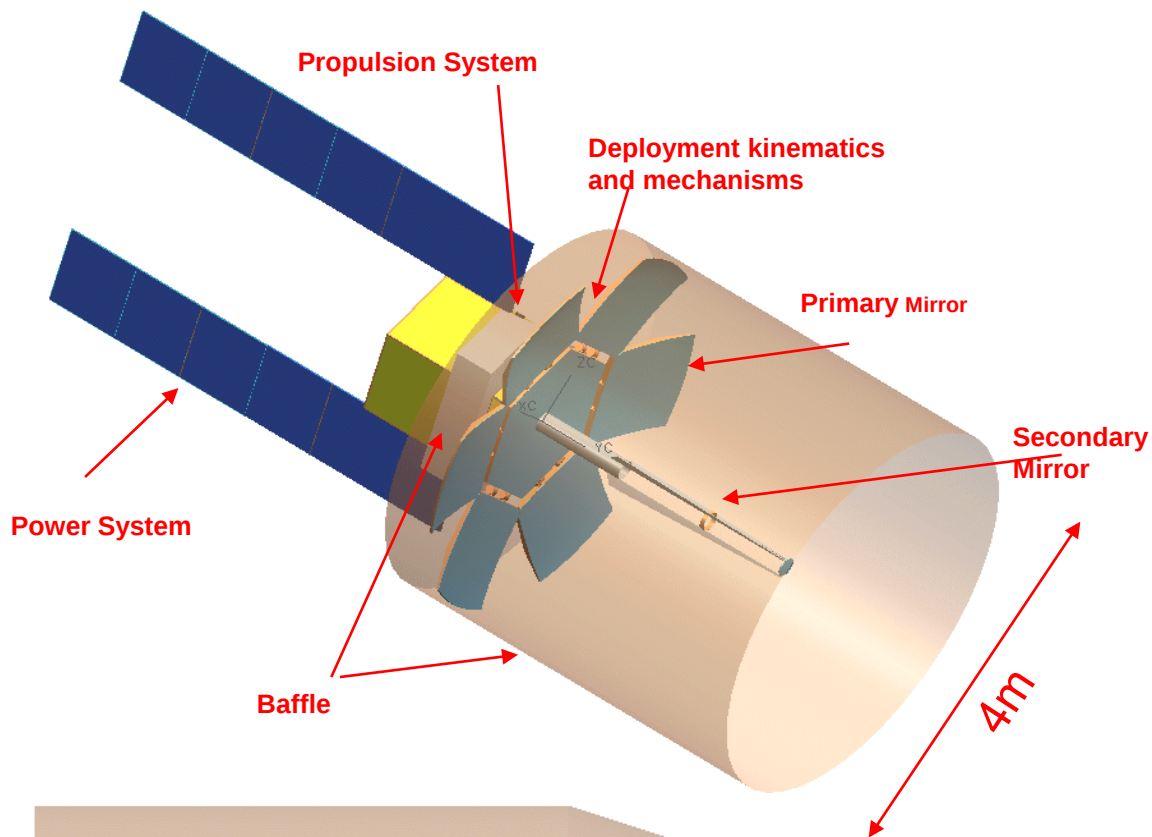


- ❖ Progetto di specchi segmentati superleggeri (3.5 metri di diametro equivalente) che rispondano alle specifiche di una missione spaziale basata su lanciatori di piccole dimensioni.

Fase 1. Arcetri: applicazione delle tecnologie AO sviluppate per i secondari adattivi e sensori di fronte d'onda per LBT.

Fase 2. Arcetri: Test ottico di un prototipo di specchio adattivo per lo spazio (electromech ADS/MG, shell ottica: INO)

Il satellite e il prototipo di specchio



Optical Breadboard
(prototipo 19acts)



2009

Il manpower disponibile

Totale personale	22
Personale strutturato	10
TD varie forme	12

Guido	Agapito	Temporary contract	Control Eng.
Marco	Bonaglia	PhD student	
Runa	Briguglio	Temporary contract	Researcher
Lorenzo	Busoni	Temporary Contract	Researcher
Ciro	Del Vecchio	Staff Member	Mech. Engineer
Simone	Esposito	Staff Member	Researcher
Luca	Fini	Staff Member	SW Engineer
Pierre Marie	Cori	Temporary contract	PostDoc
Juan Carlos	Cuerra	Temporary contract	PostDoc
Franco	Lisi	Staff Member	Researcher
Luciano	Miglietta	Staff Member	Mech. Engineer
Francesca	Pieralli	PhD student	
Enrico	Pinna	Temporary Contract	Researcher
Danny	Puccetti	Staff Member	Secretary
Alfio	Puglisi	Staff Member	Technician
Fernando	Quirros-Pacheco	Temporary Contract	Researcher
Piero	Ranfagni	Staff Member	Technician
Armando	Riccardi	Staff Member	Researcher
Piero	Salinari	Staff Member	Researcher
Paolo	Stefanini	Consultant	Technician
Francesco	Troiano	Temporary Contract	Technician
Marco	Xompero	Temporary Contract	Researcher
Luca	Carbonaro	Temporary Contract	Technician (1/2)



Il manpower disponibile

Totale personale	15.5
Personale strutturato	9
TD varie forme	6.5

Guido	Agapito	Temporary contract	Control Eng.
Marco	Bonaglia	PhD student	
Runa	Briguglio	Temporary contract	Researcher
Lorenzo	Busoni	Staff Member	Researcher
Ciro	Del Vecchio	Staff Member	Mech. Engineer
Simone	Esposito	Staff Member	Researcher
Luca	Fini	Staff Member	SW Engineer
Franco	Lisi	Staff Member	Researcher
Luciano	Miglietta	Staff Member	Mech. Engineer
Enrico	Pinna	Temporary Contract	Researcher
Danny	Puccetti	Staff Member	Secretary
Alfio	Puglisi	Staff Member	Technician
Fernando	Quirros-Pacheco	Temporary Contract	Researcher
Armando	Riccardi	Staff Member	Researcher
Paolo	Stefanini	Consultant	
Marco	Xompero	Temporary Contract	Researcher
Luca	Carbonaro	Temporary Contract	Technician (1/2)

Progetti e scadenze

[illegible]



Remarks.....

L'anno 2012 sarà di grande impegno per il gruppo:
20 FTE/anno sicure + eventuali estensioni dei presenti contratti
contro un gruppo di 15 persone di cui 7 precari

Nel 2013 i contratti “apri-pista” correnti potrebbero farci entrare nei progetti AO di VLT e soprattutto per gli ELTs garantendo lavoro a lunga scadenza, ma mantenendo il carico criticamente alto (19 FTE/anno)

La partecipazione agli ELT projects e' criticamente dipendente dal lavoro svolto in passato e attualmente.

- 1) Necessita di stabilizzare i TD per mantenere lo expertise locale.
- 2) arruolamento nuovi giovani per fronteggiare l'aumento del lavoro
- 3) Ottimizzare i servizi tecnici dell'Osservatorio



Posti & Spazi futuri

Posti:

3 posti di tecnologo (1 già bandito)

2 posti tecnico (1 Elettronico, 1 meccanico)

1 disegnatore meccanico (in condivisione)

1 Amministrativo TD per amministrazione 7 possibili progetti dal 2013

Supporto tecnico trasversale!

Spazi:

Laboratori per AIT dedicati ai progetti:

➤ **ARGOS WFS**

➤ **ERIS-PWM AIT**

➤ **GMT AIT**

➤ **Pyr EELT**

Attuali 2 stanze con 4 banchi ottici

➤ **Banco ottico test generici** Ex Lab Miglietta

➤ **Laboratorio ottico produzione e test piramidi** Da individuare

➤ **Magazzini strumenti/parti ottiche** Da individuare