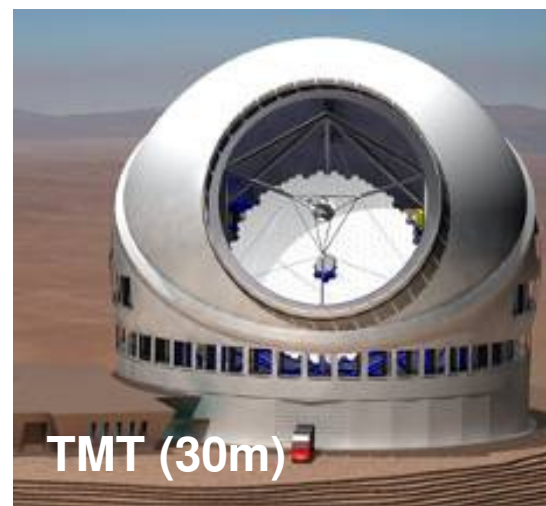
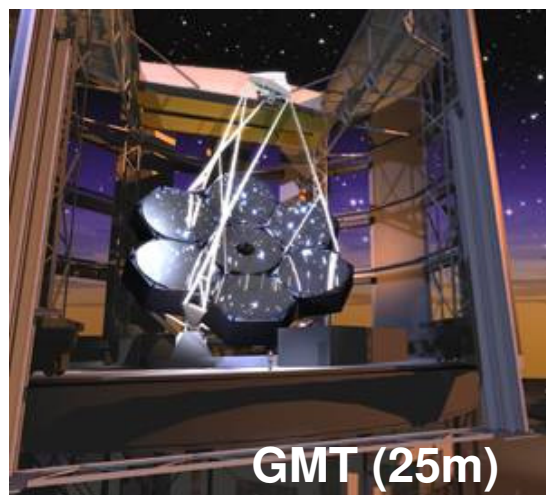
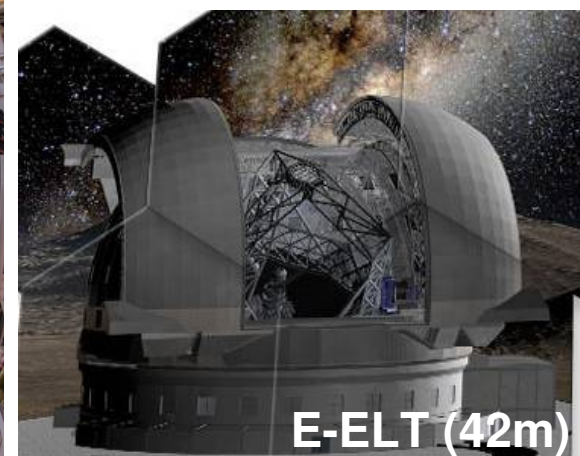
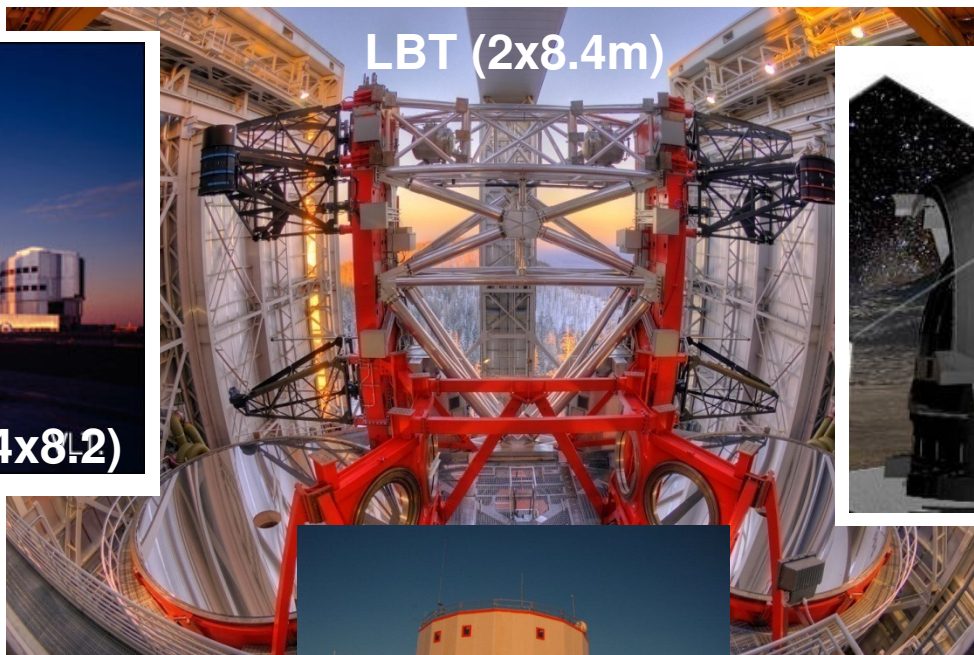




Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Attività del gruppo AO di Arcetri





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

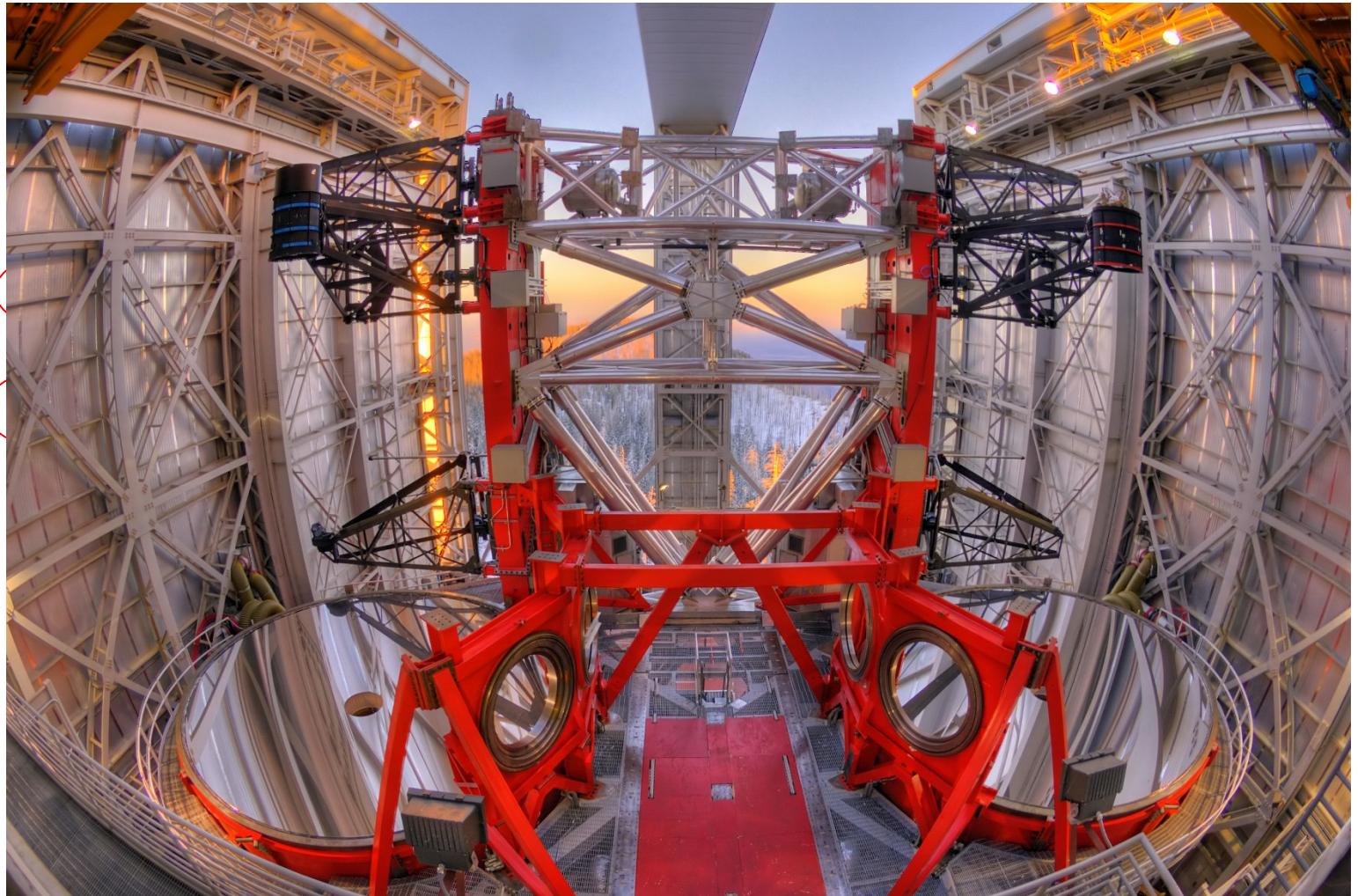
LBT: the first adaptive telescope

LUCIFER:

- Seeing limited
- GLAO assisted
- diffraction limited imager and spectrograph (0.9-2.5 μm)

LBTI:

- Nulling
- Fizeau interf. (3-20 μm)



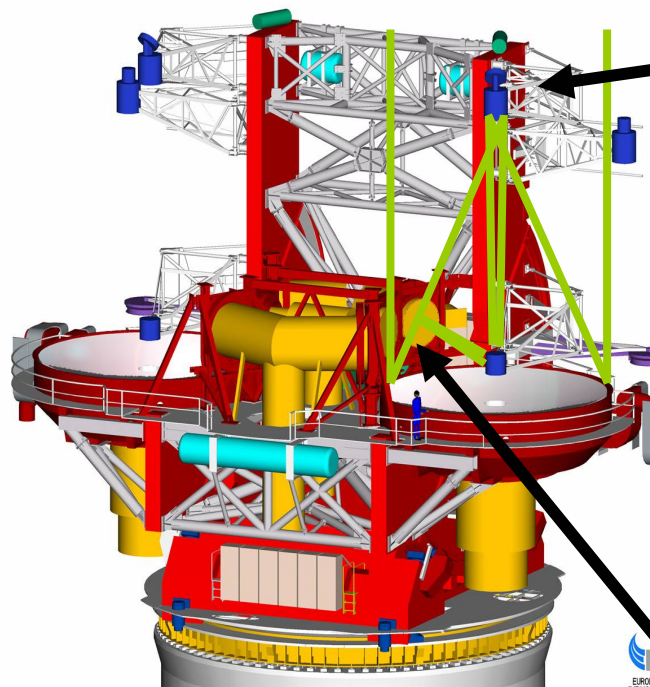


Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

First Light AO for LBT

AdSec units 2002/2008
Contract # AO 104
Funds 677KEuro
~ 15 FTE

W units 2002/2008
Contract # AO103
Funds 1433KEuro
~ 40 FTE



Scala temporale

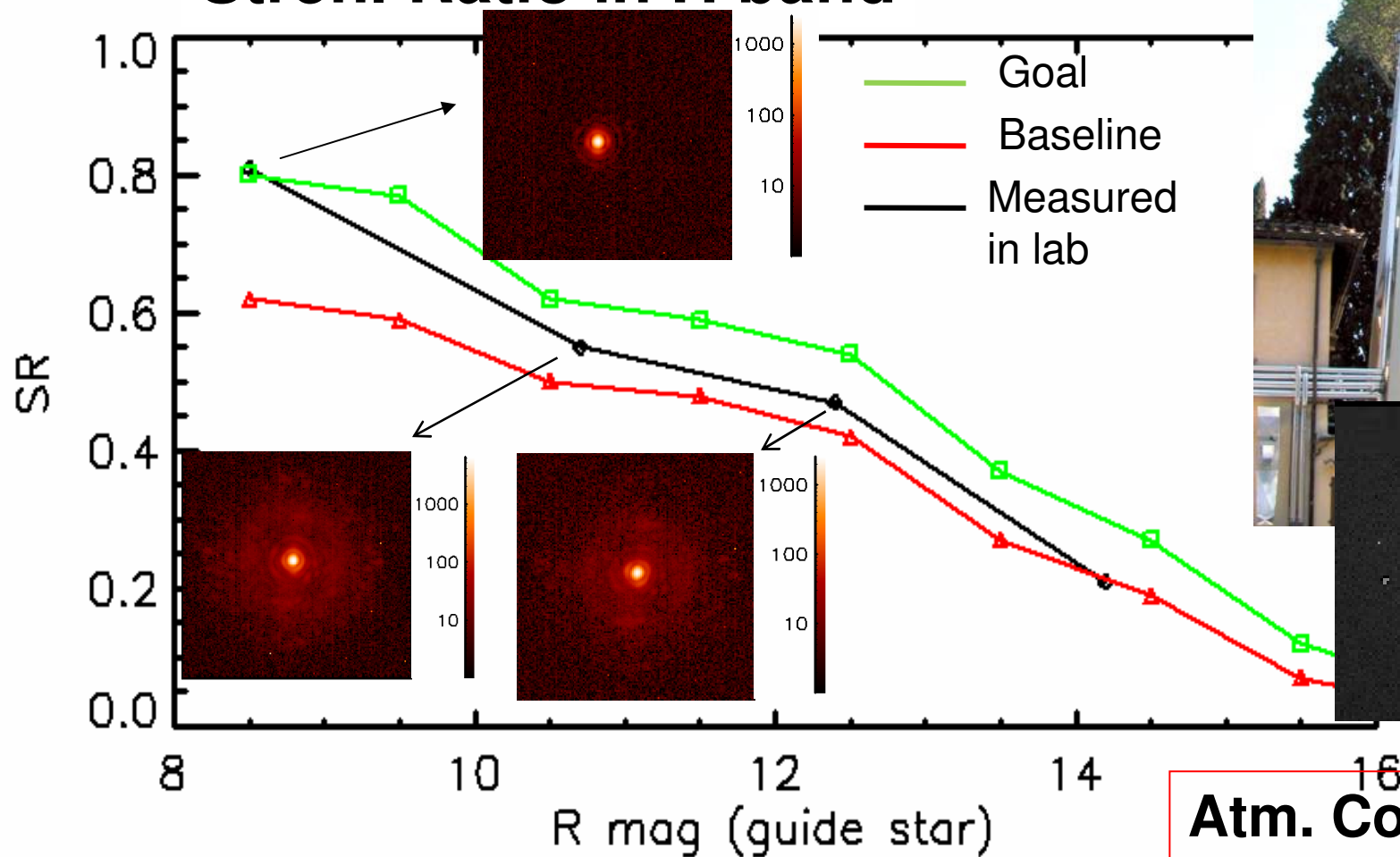
	FLAO #1	FLAO #2
AO acceptance ad Arcetri	1a sett. Dic. 2009	4a sett. Set. 2010
Commissioning a LBT (IRTC)	Mar. / Set. 2010	Dic. 2010 / Mag 2011



Che tipo di osservazioni nelle 62 notti di
commissioning (IRTC) ?

Dove siamo con FLAO ?

Strehl Ratio in H band



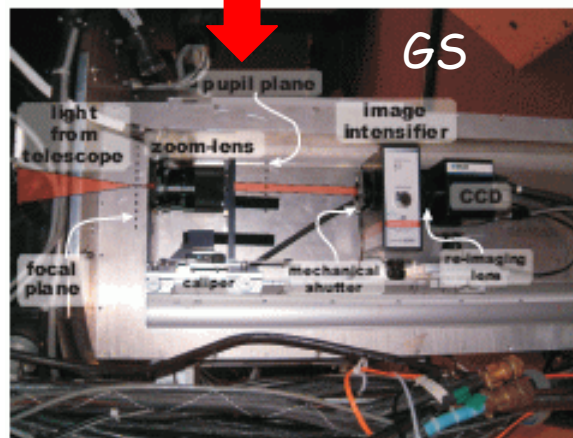
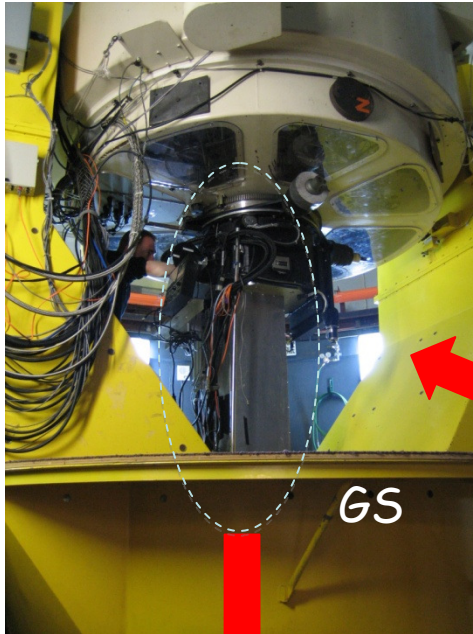
Atm. Conditions:
Seeing 0.8 arcsec
V_wind 15m/s





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Mt. Graham - Site Testing

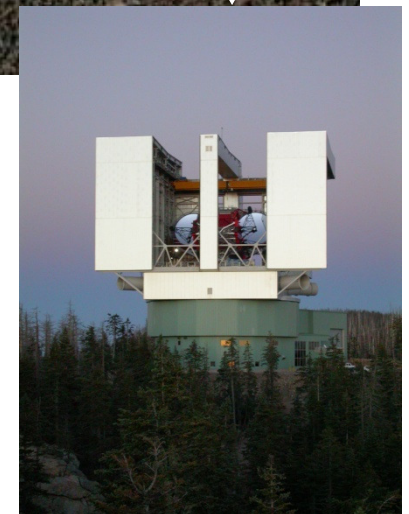


Satellite image

VATT

LBT

250 m



4 Generalized Scidar runs

43 nights





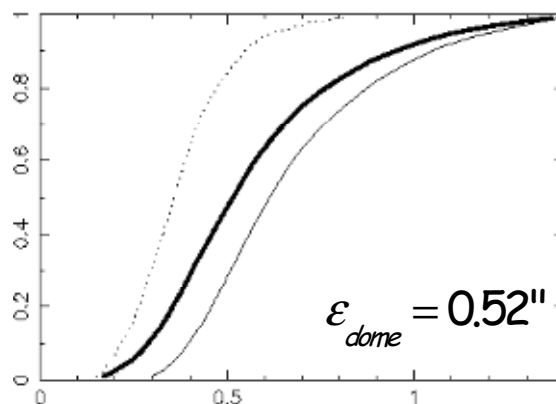
Mt. Graham - Site Testing

with dome contribution

	Total			Summer			Winter		
Parameter	25 th	50 th	75 th	25 th	50 th	75 th	25 th	50 th	75 th
ε (arcsec)	0.65	0.95	1.34	0.53	0.61	0.72	0.89	1.19	1.50
θ_0 (arcsec)	1.6	2.5	3.6	3.1	3.8	4.5	1.4	2.0	2.7
τ_0 (msec)	2.7	4.8	8.7	6.4	10.1	14.6	2.5	3.8	6.2
V_0 (ms ⁻¹)	5.1	7.2	9.3	3.7	5.1	7.8	5.9	7.7	9.6

Measurements
taken from VATT
telescope (1.8m)

VATT dome seeing



Median seeing without
dome contribution

$$\varepsilon_{TOT} = 0.72''$$

Median seeing and astroclimatic parameters
comparable to those of the
best astronomical sites
in the world !!!



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

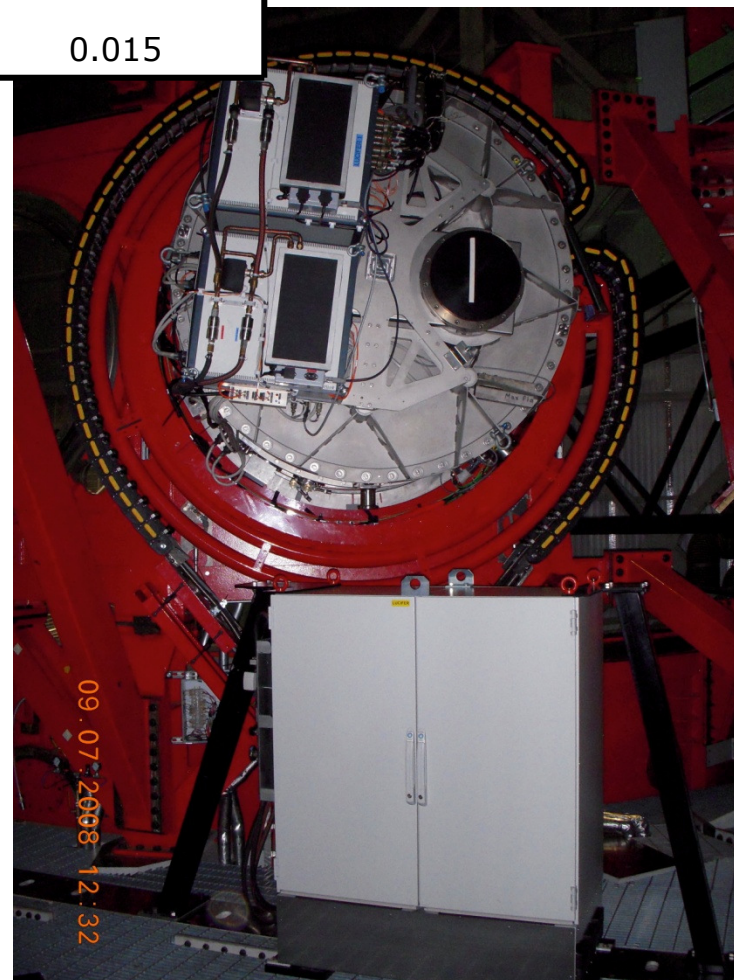
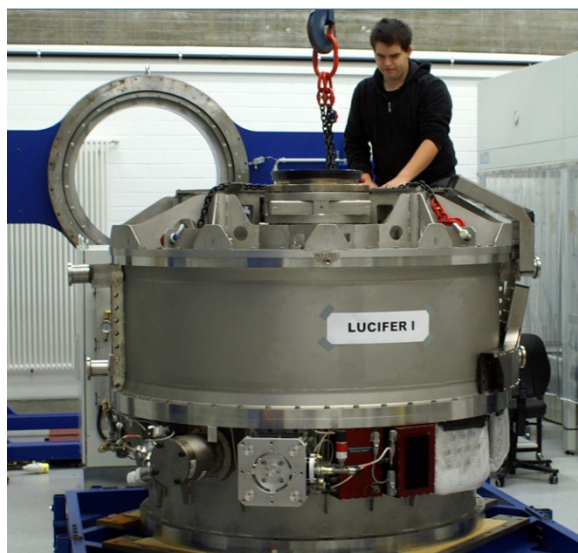
LUCIFER



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 BG DX



LUCIFER	Seeing limited	Diffraction limited
Telescope Commissioning dates	Sep. 2008 Nov. 2009	Jun. 2011 Oct. 2011



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Images from commissioning

Ritorno scientifico per gli astronomi:

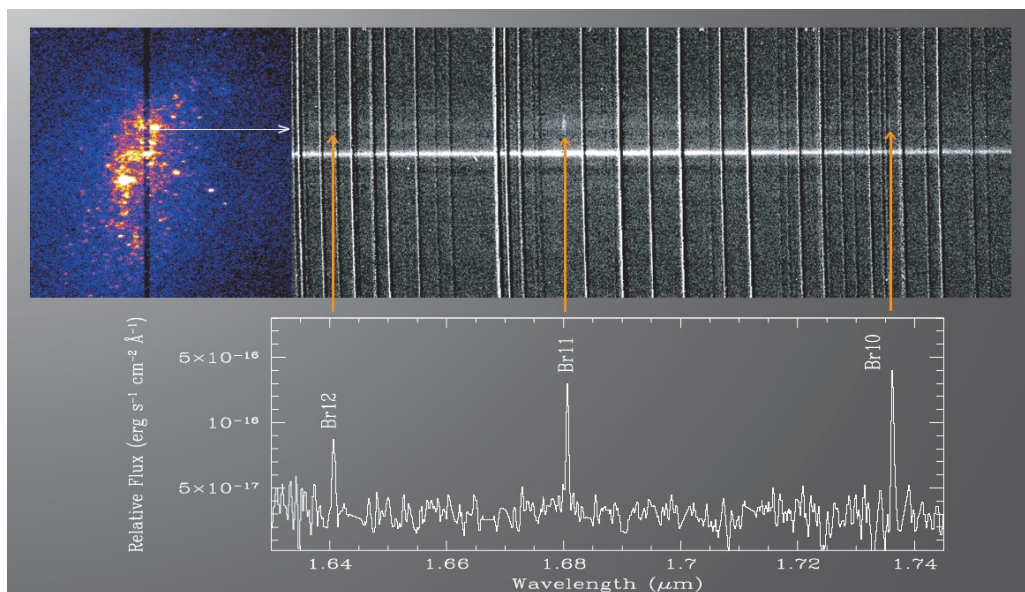
- Imaging/spettroscopia DL (25% tempo LBT)
- Supporto alle osservazioni vs. tempo oss.

NGC 1569

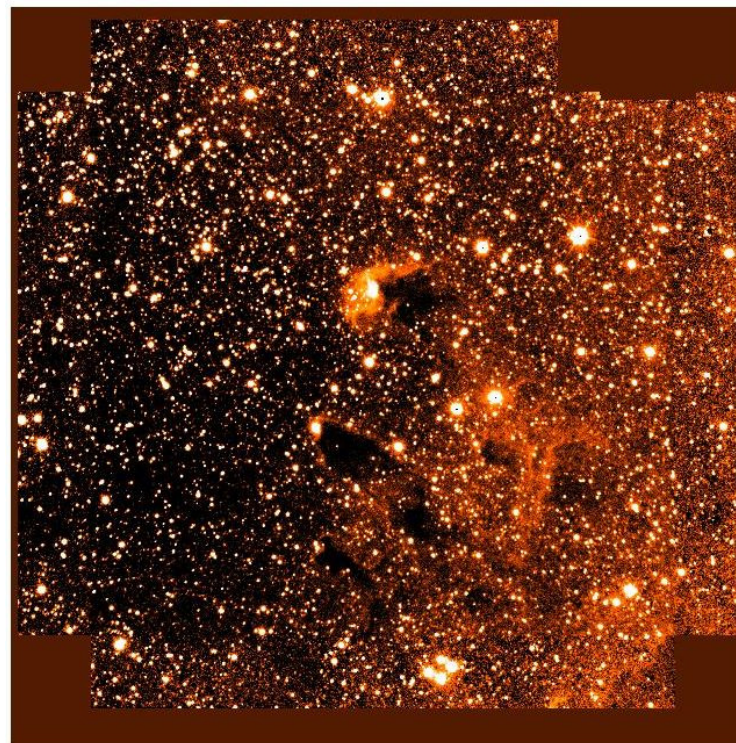
H2 region

300s total exp. time

Slit width 1 arcsec



M16: K band 150s total exp. time





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

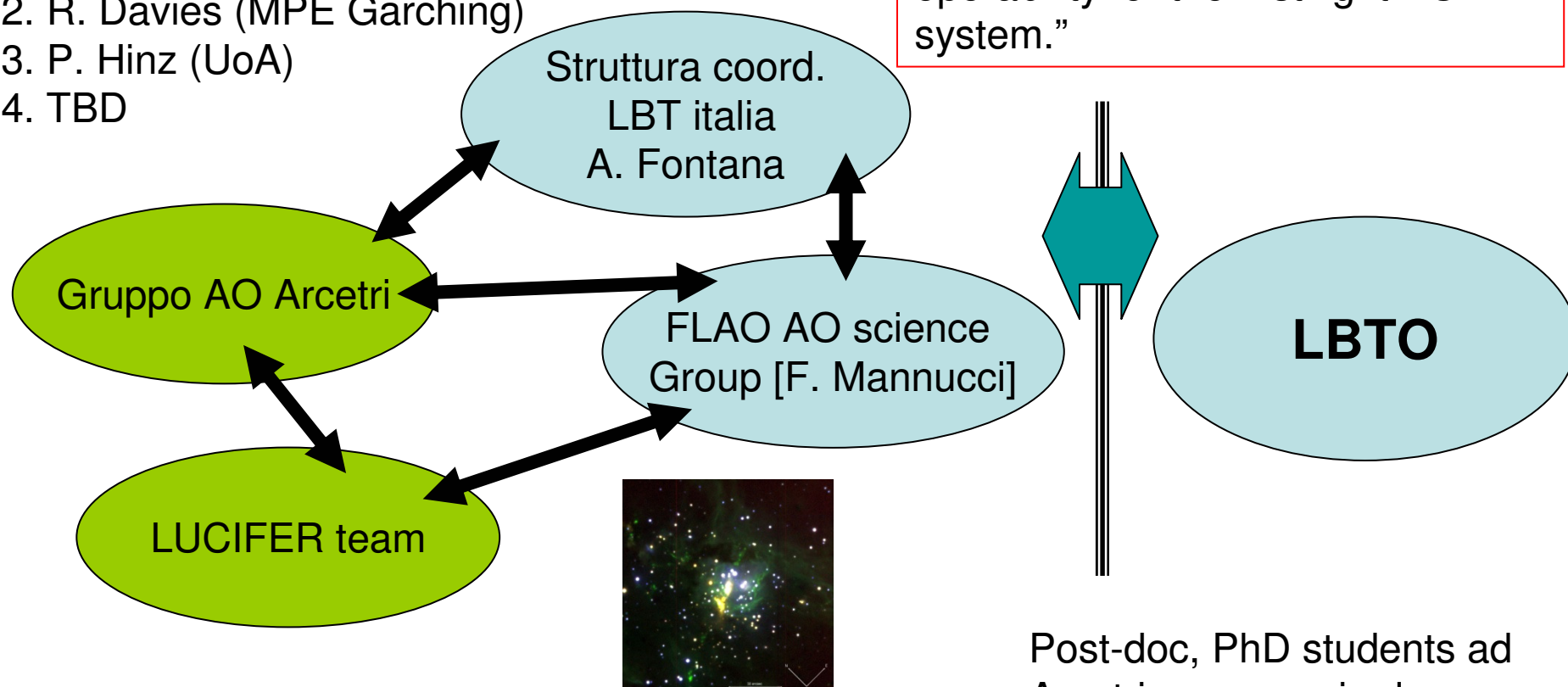
LUCIFER & FLAO

LBT AO Science Working Group [F. Mannucci]

One astronomer per partner:

1. F. Mannucci (OAA)
2. R. Davies (MPE Garching)
3. P. Hinz (UoA)
4. TBD

The LBT AO Science Working Group is charged with advising the Arcetri AO team on both scientific priorities and expectations of operability for the first light AO system.”



Ritorno scientifico vs. supporto al telescopio.
Meeting LUCIFER team FLAO team (Nov09)

Post-doc, PhD students ad
Arcetri per eseguire le
osservazioni con LUCIFER



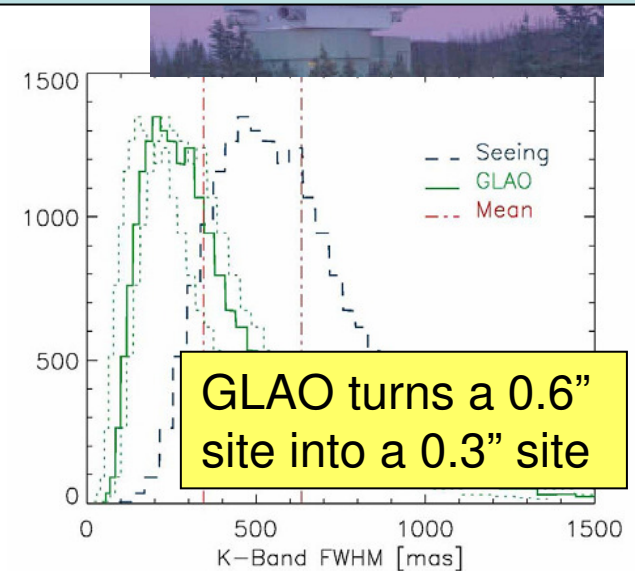
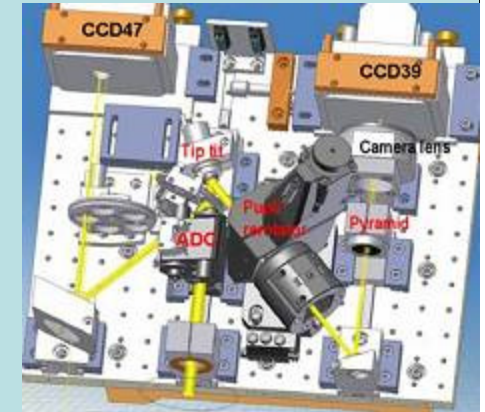
Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Advanced Rayleigh Ground Layer Adaptive Optics System

- Correction of Ground Layer turbulence
- Resolution improvement 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
- Upgrade plan to Diffraction Limited operation
- **FDR Apr. 2010, AIT 2011, LBT comm. 2012**

**Strong increase of the LBT
science capabilities:
Use of LUCIFER as MOS 4x4
arcmin FoV @ 0.3 arcsec**

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

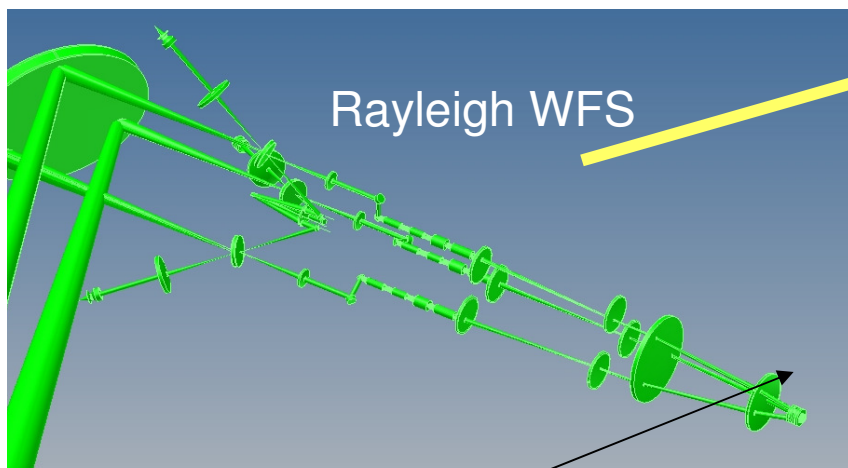




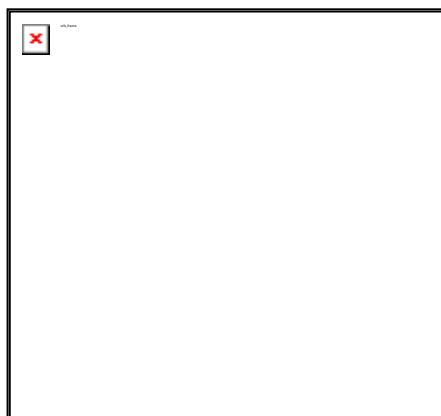
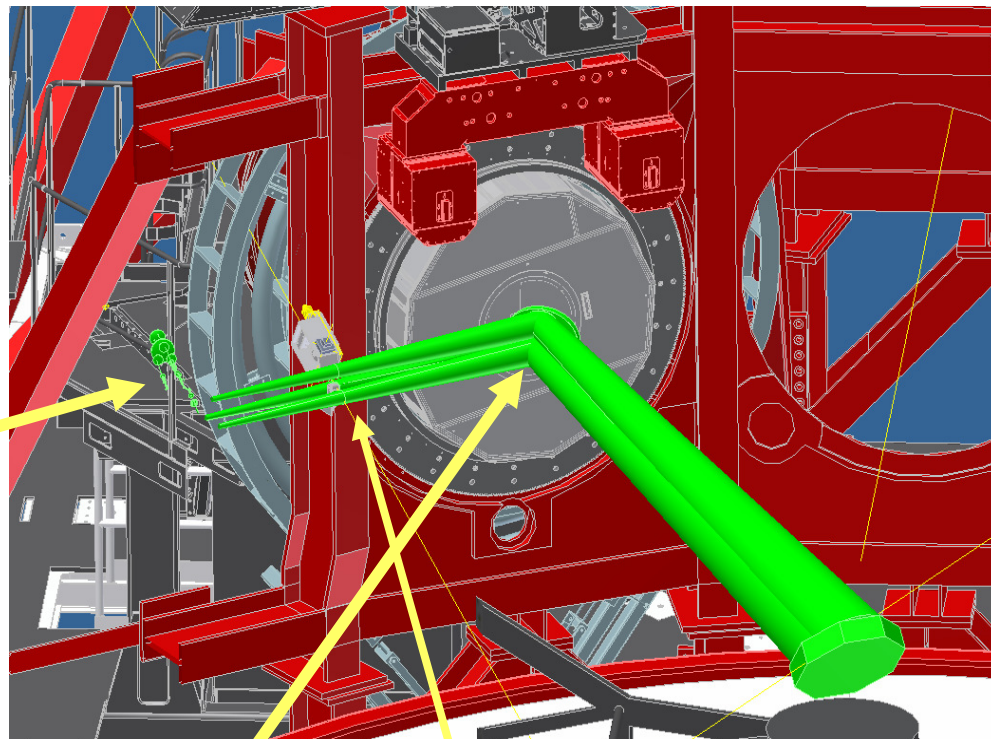
Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

INAF/Arcetri contribution to ARGOS

- Performance simulations
- Dichroic and Rayleigh WFS design, integration and test
- DL/LTAO system (phase B)
- 10 FTE in 3 years
- 1.2MEuro (HW+FTE)



Rayleigh WFS

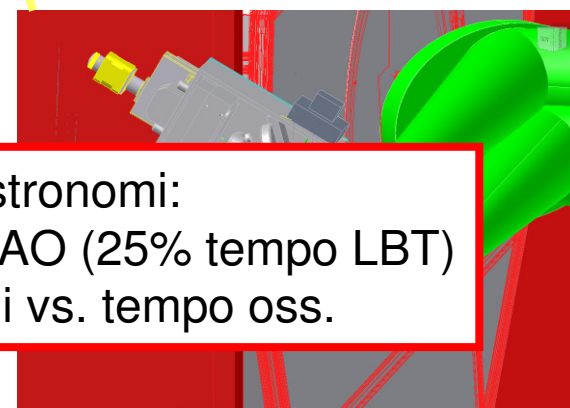


Spot pattern on CCD

Dichroic

Ritorno scientifico per gli astronomi:

- Imaging/spettroscopia GLAO (25% tempo LBT)
- Supporto alle osservazioni vs. tempo oss.



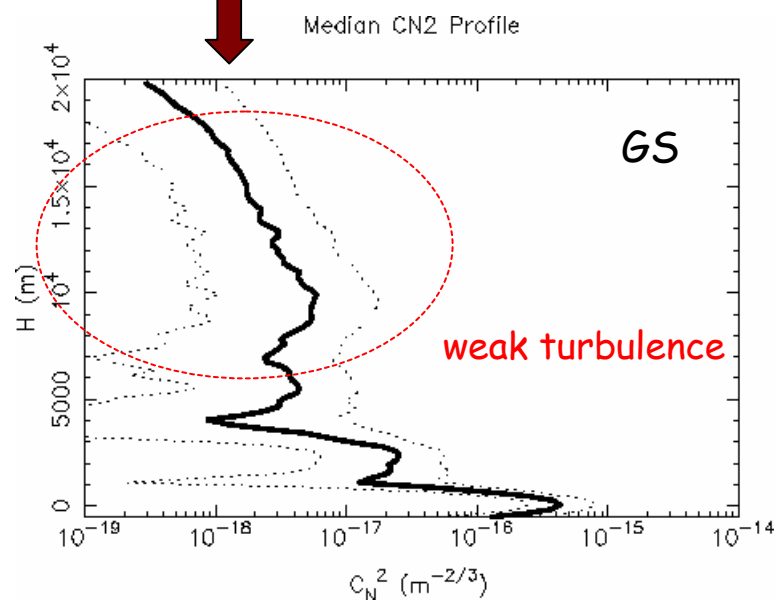
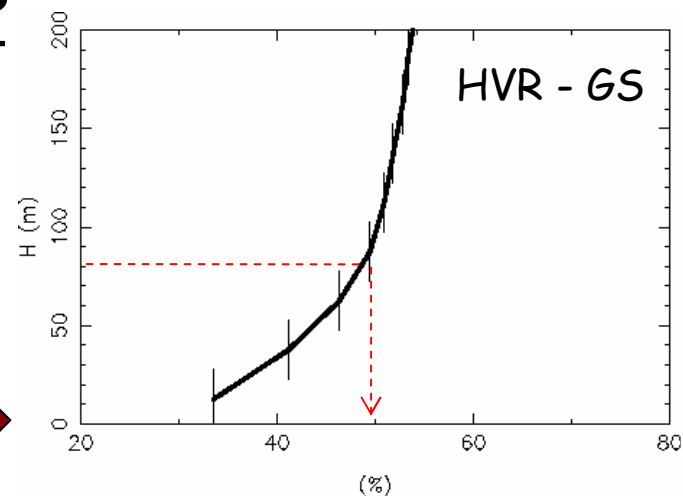
Sodium WFS
(study for phase B)

Which turbulence for ARGOS ?

50% of the turbulence below 80 m

median $\theta_0 = 2.5''$

Extremely favourable conditions
for GLAO applications



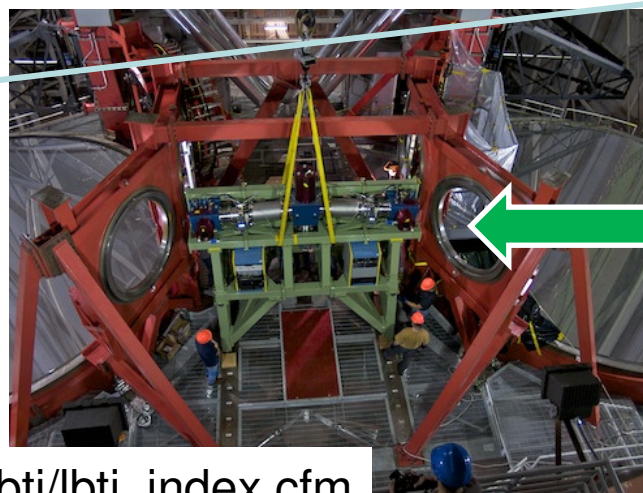
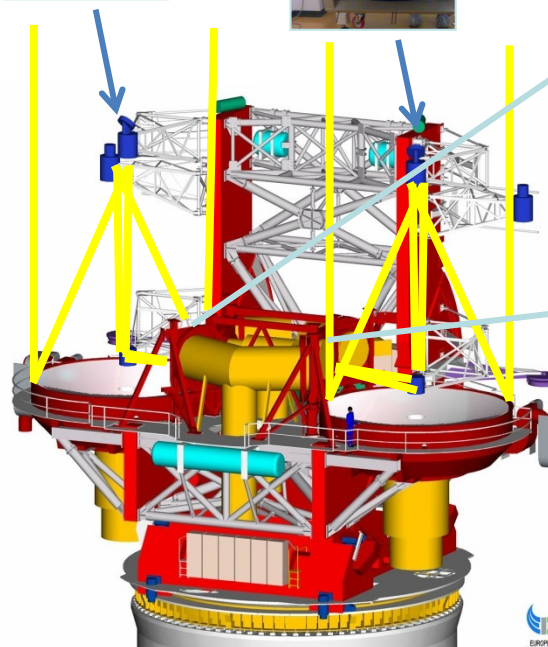
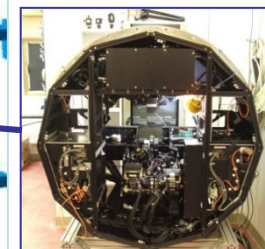


Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

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]

http://planetquest.jpl.nasa.gov/lbti/lbti_index.cfm



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

AO system for LBT



Sub-Contract INAF/OAA – Arizona University

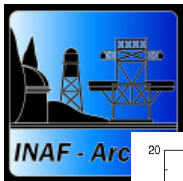
Voce	k€
3.5 FTE	143.5
Hardware	165.5
Travel	10.0
TOTAL	319

Scala temporale

Inizio AIT	Luglio	2009
Acceptance test	Gennaio	2011
Spedizione a LBTO	Febbraio	2011
Commissioning unit#1	Luglio	2011
Commissioning unit#2	TBD	2011

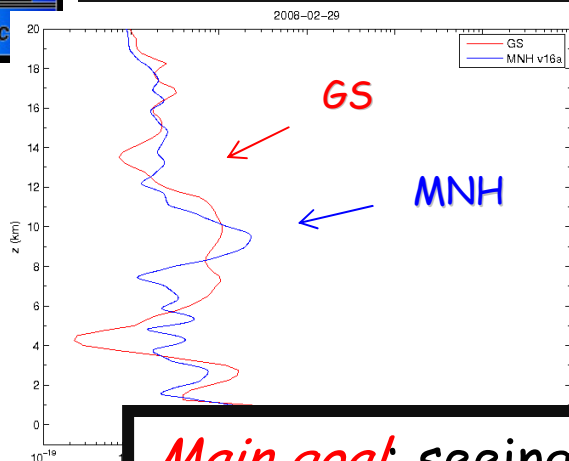
Link al sito NASA/LBTI

http://planetquest.jpl.nasa.gov/lbti/lbti_index.cfm

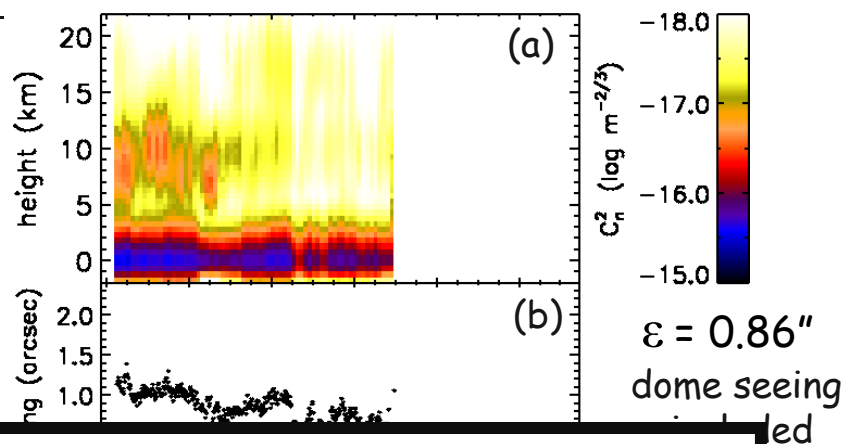


Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Mt. Graham - OT Modeling



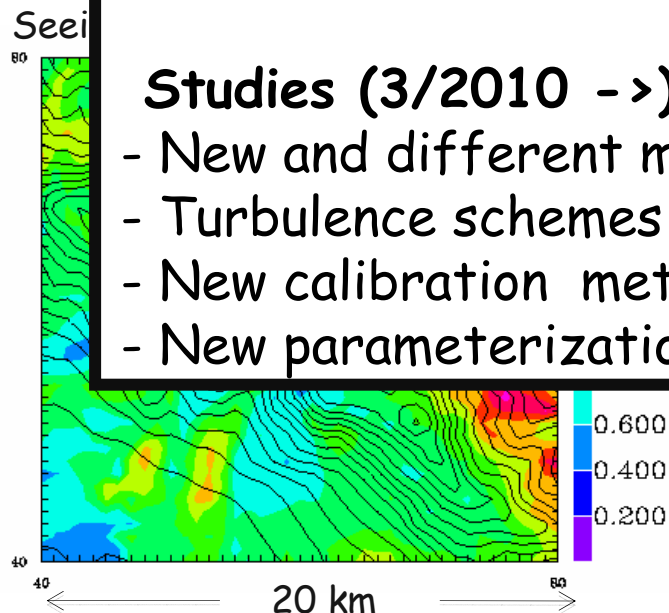
Generalized Scidar MEASUREMENTS



Main goal: seeing forecasting for flexible scheduling

Studies (3/2010 ->):

- New and different measurements to constrain the model
- Turbulence schemes in stable regimes
- New calibration methods
- New parameterization schemes



average

$\epsilon_{\text{GS}} = 0.53''$

dome-seeing
excluded

SIMULATIONS with the non-hydrostatic atmospherical meso-scale model (Meso-Nh)

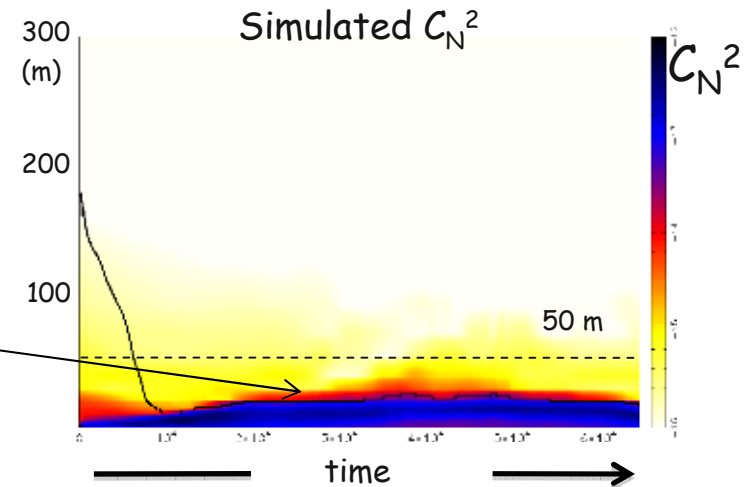




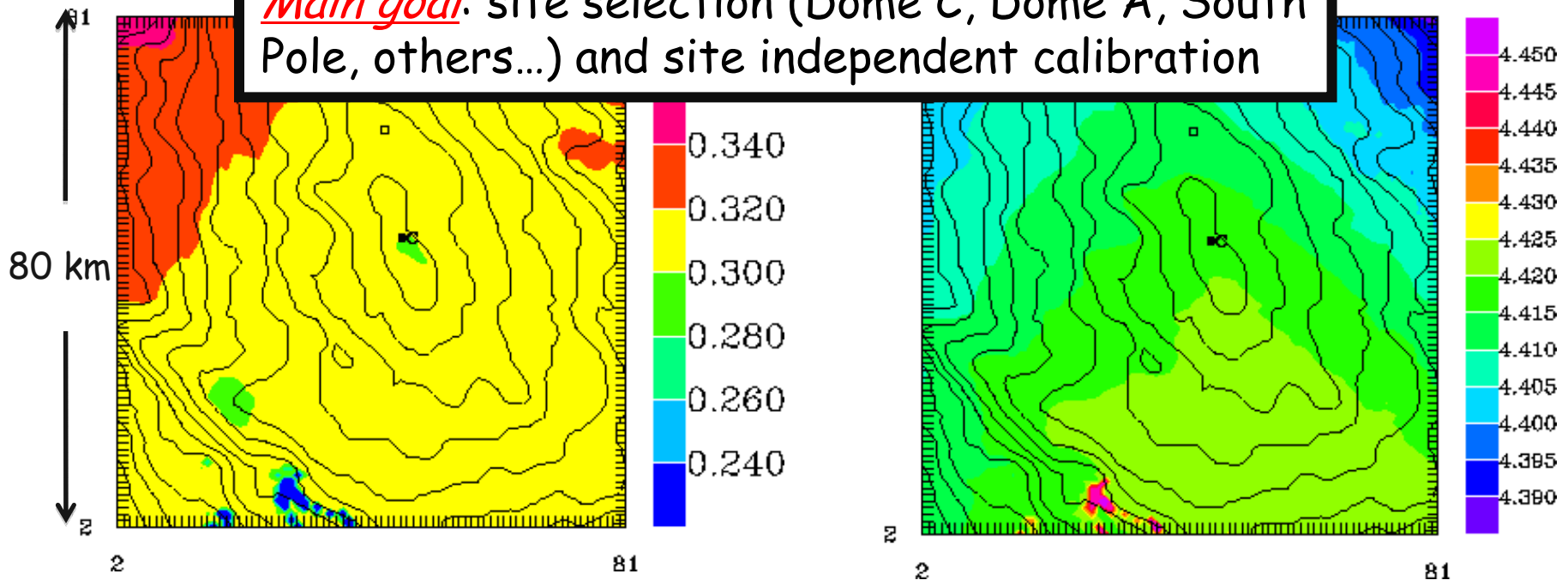
Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Antarctica: DOME C

$h_{SL} = 20$ m (average in the night)
 h_{SL} : height of the surface layer (black line)



Main goal: site selection (Dome C, Dome A, South Pole, others...) and site independent calibration



$\Delta T = 10$ hours: (02:00 - 18:00) UT; sampling = 10 min

At present 2 papers: Lascaux et al., 2009, MNRAS and Hagelin et al., 2008, MNRAS





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

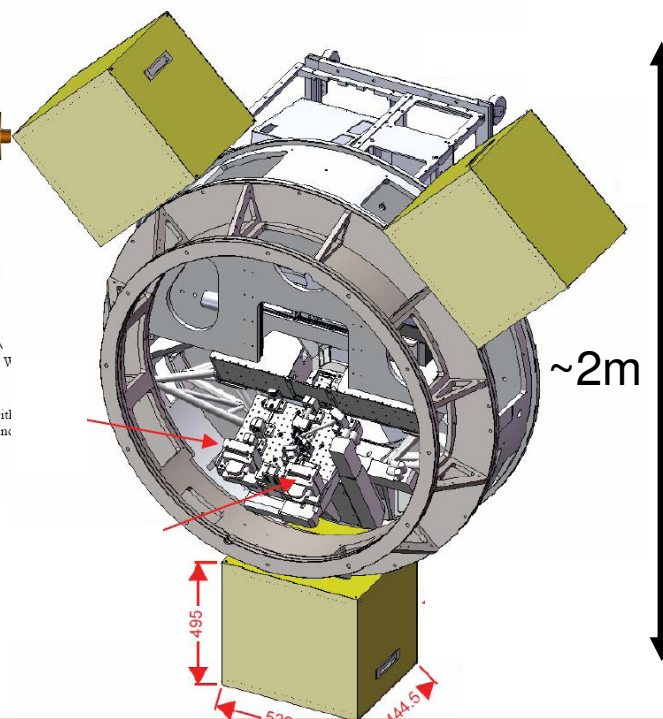
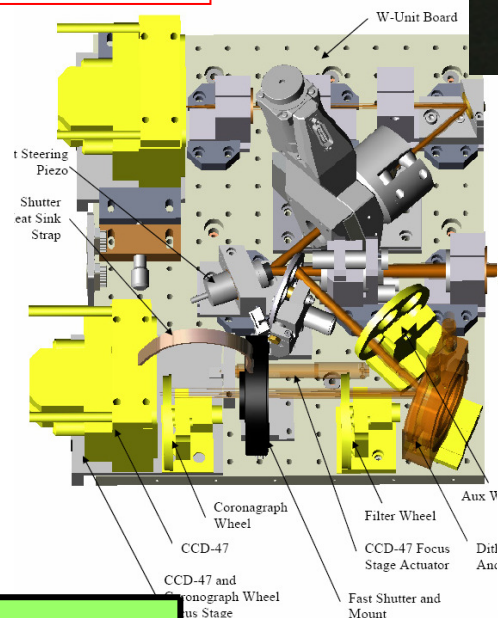
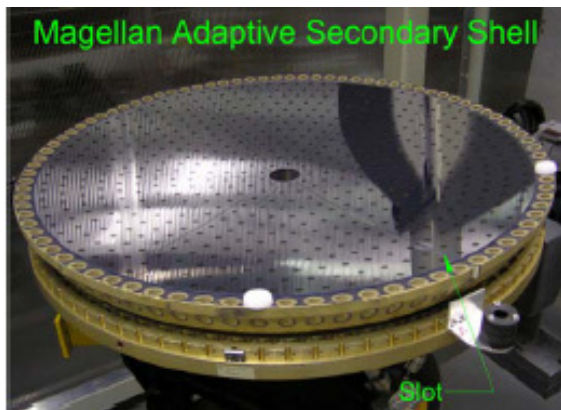
Magellan

Contract # AO W unit 2.05.23.01

Fondi 500.0 KEuro

➤WFS

➤AO control SW



Scala temporale

Magellan tasks	dates
AO acceptance ad Arcetri	Gen. – Ago. 2011
Commissioning a Magellan	Ott. 2011 – Feb 2012

Accordi per osservazioni future ?



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

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 optomeccanico del DSM a ESO (Assist) (contratto in definizione, 1 FTE)**

Scala temporale

DSM Production, Integration and EM test (Maintenance and Calibration SW)	Lug 2008 - Gen 2012 (Mar 2009 – Mag 2010)
Test ottici DSM a ESO	Feb 2012 – Ago 2012
Test con Strumenti dell AOF a ESO	Set 2012 – Set 2013
DSM in Cile con AOF	Nov 2013



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

EELT

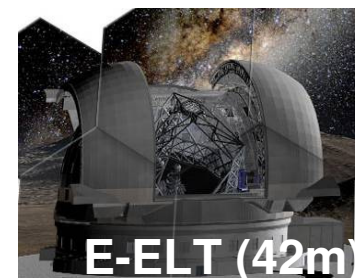
M4AU: Specchio adattivo (M4) per E-ELT

Estensione della tecnologia dei secondari adattivi a E-ELT

Contratto Microgate-ESO per:

- ☐ disegno specchio M4 adattivo da 2.6m (~6300 attuatori)
- ☐ produzione e test di un prototipo dello specchio (330acts)

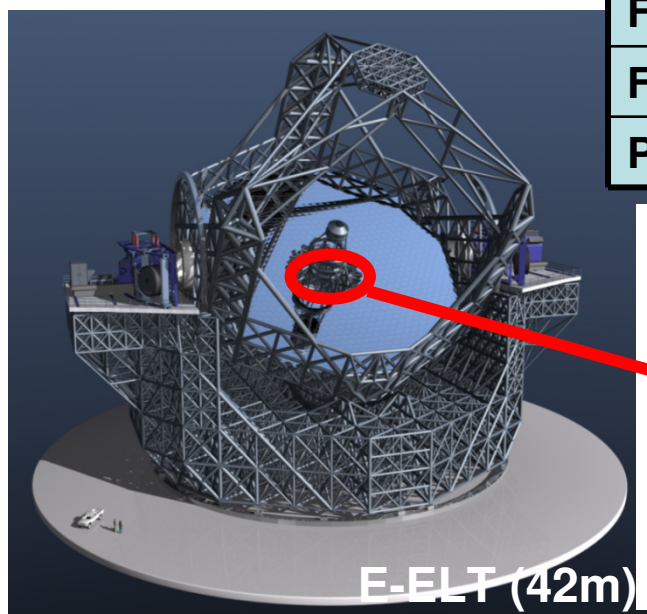
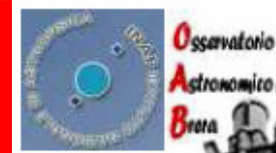
Arcetri partecipa con la posizione di AO-Scientist nel progetto
(piena sovrapposizione con LBT-AO: forzati a declinare offerta di maggiore coinvolgimento per il disegno e test)



ADS International



Sagem Défense Sécurité
SAFRAN Group



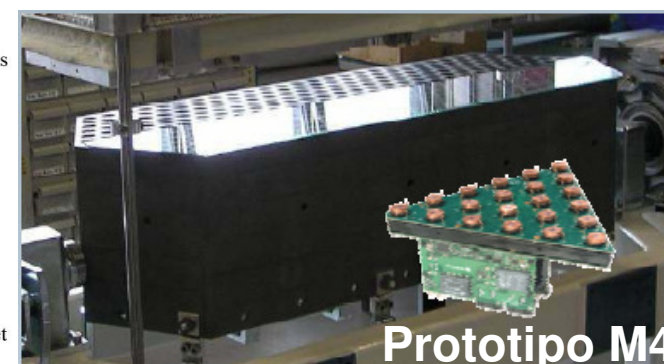
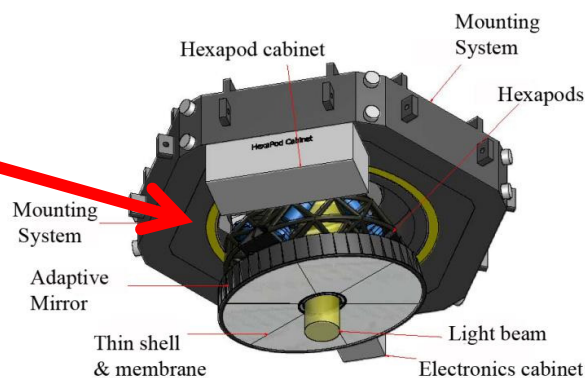
Fine Phase 3 (design+test proto)

Mag 2008 – Feb 2010

Fine Phase 4 (final design)

Feb-2010 - Apr 2010

Possibile follow-up costruzione unità tel.



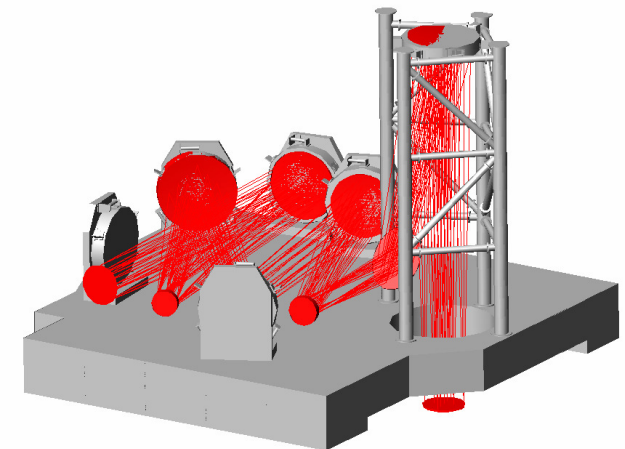
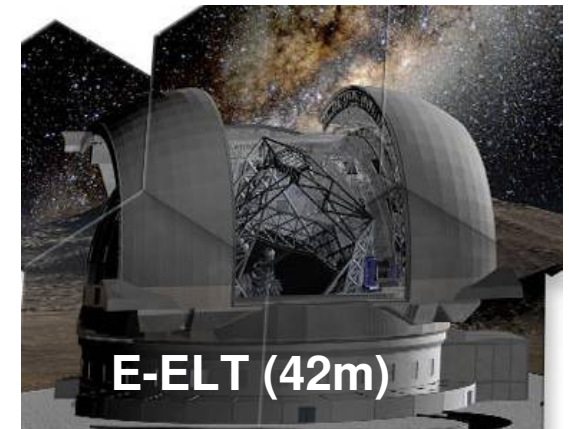
Prototipo M4



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

E-ELT

MAORY: modulo MCAO per E-ELT



- ❑ Due contratti in essere per il disegno di “Phase A”:
 - **ESO + FP7 (#211257)**

- ❑ ***Fine dei contratti di Phase A: Dic 2009***
Possibile follow-up per la Phase B

Arcetri contribuisce con il disegno dei NGS WFSs

- Il limite in manpower dovuto all’impegno LBT-AO ha complicato la partecipazione.

SR e EE(in50mas) vs field

	K band		H band		J band	
	SR	EE	SR	EE	SR	EE
1'	0.53	0.49	0.33	0.33	0.13	0.16
20"	0.56	0.52	0.37	0.36	0.16	0.18
10"	0.57	0.52	0.38	0.37	0.17	0.19

(seeing 0.8")

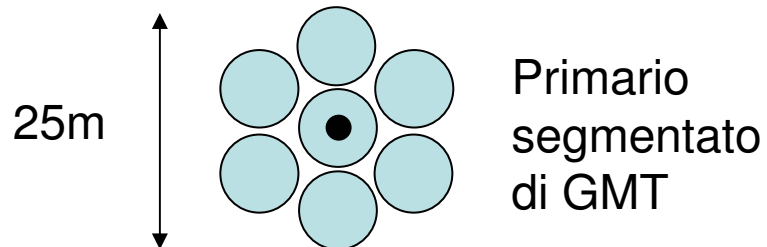


Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Magellan & Great Magellan Tel. (GMT)

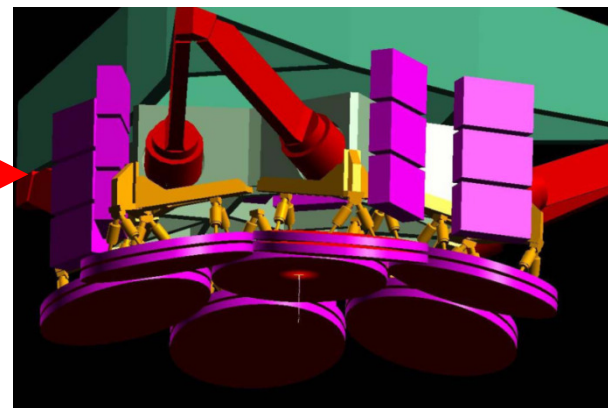
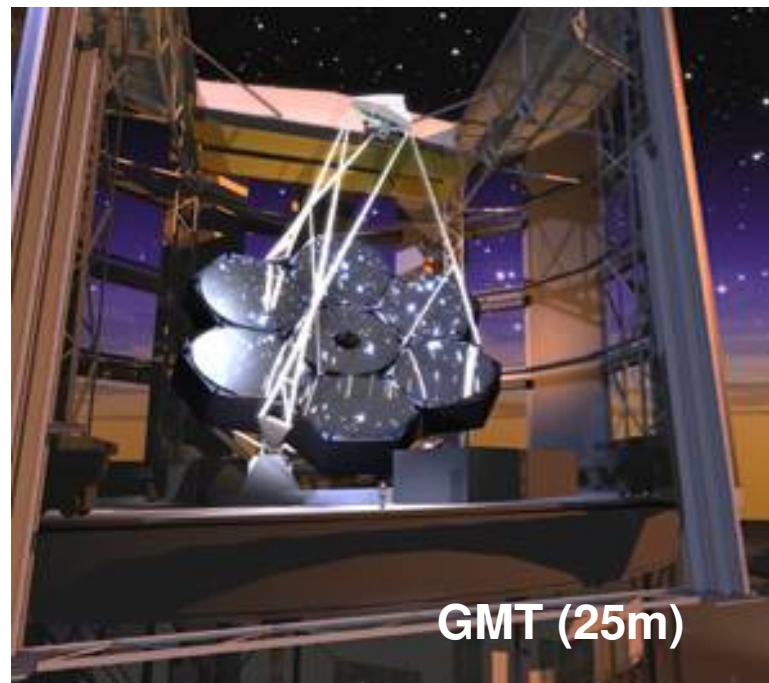
Stesso gruppo di Magellan.

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



Vi sono discussioni in corso sulla partecipazione al disegno del telescopio e del sistema di ottica adattiva:

- Adaptive secondary (segmented)
- Pyramid WFS
- Segments co-phasing (M1 & M2)





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

ForOT: Projects Future (ELTs)

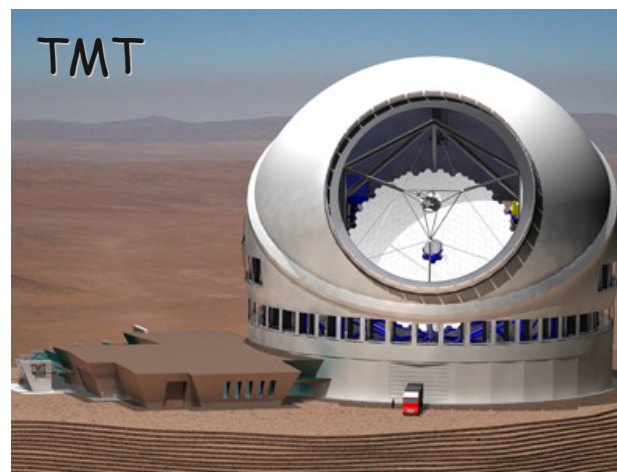
(C): National Science Foundation
- Mauna Kea Weather Center
- ForOT

(A): Feasibility Study - Phase A (ESO)



AND

(B): E-ELT site *



(*) to be selected within beginning of 2010

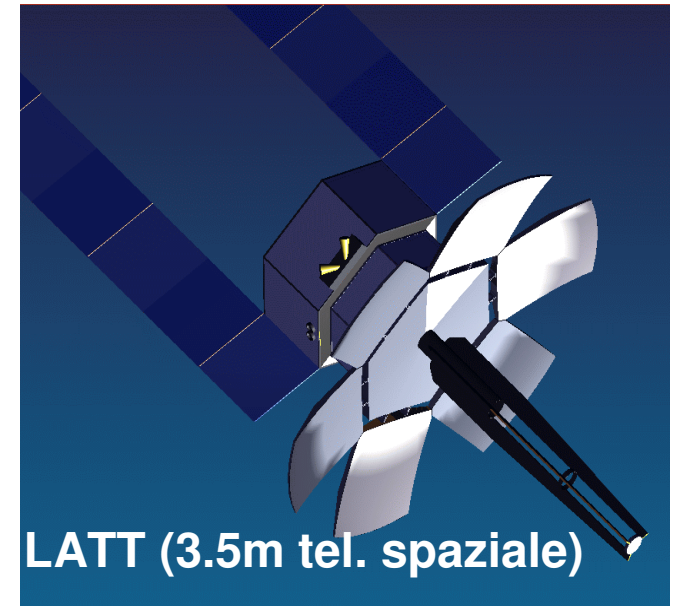




Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Specchi superleggeri per telescopi spaziali

- Contratto ESA per lo sviluppo della tecnologia
 - Partner di INAF: INOA, ADS, Microgate, CGS
 - Fase 1 agosto 2009 → aprile 2010
 - Fase 2 maggio 2010 → luglio 2011
- 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.

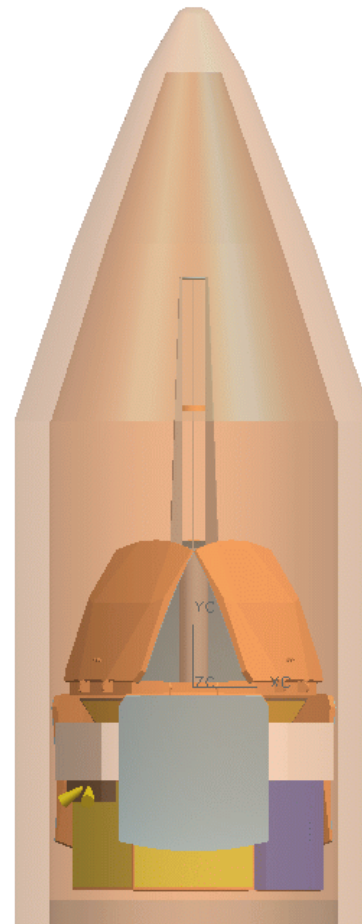
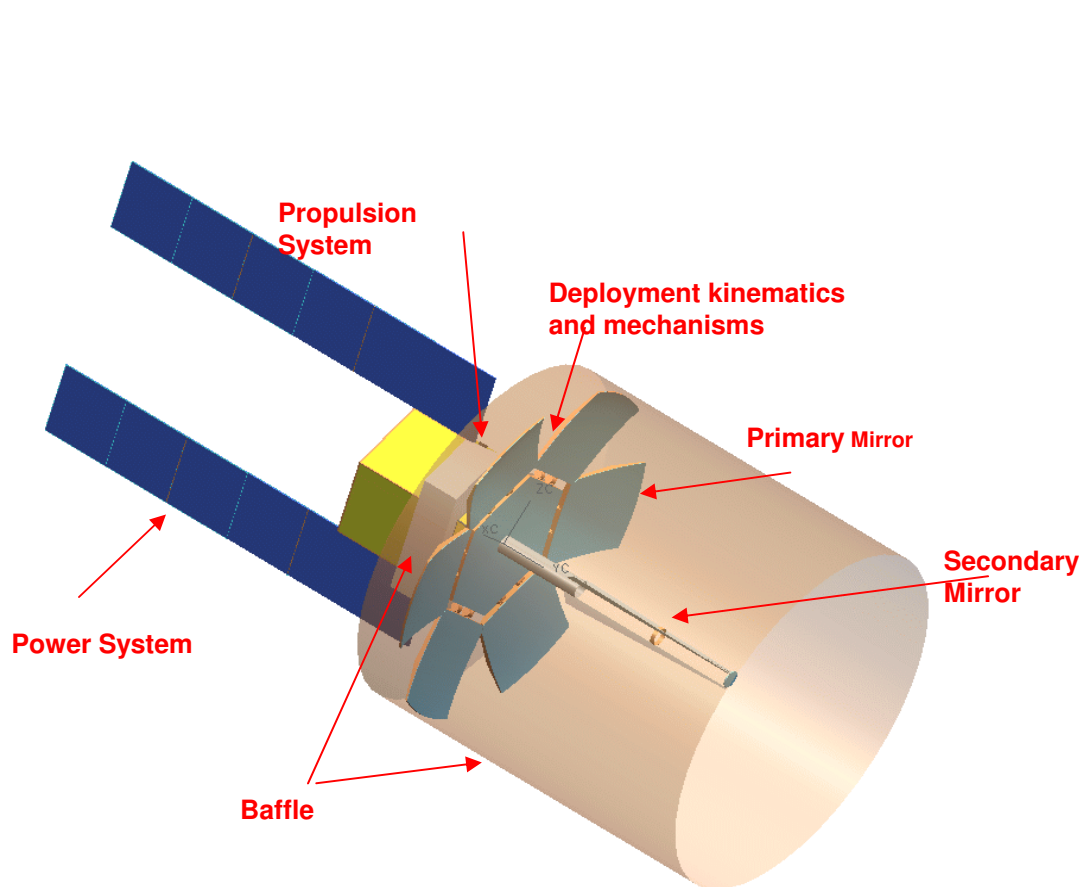


La nostra proposta: applicazione delle tecnologie AO sviluppate per i secondari adattivi e sensori di fronte d'onda per LBT



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Il satellite in orbita e ripiegato





Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Il manpower disponibile

Totale personale	25
Personale strutturato	11
TD varie forme	14

Ultimo ricercatore strutturato assunto nel gruppo nel Giugno 2000 !!!!

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	Gori	Temporary contract	PostDoc
Juan Carlos	Guerra	Temporary contract	PostDoc
Susanna	Hagelin	Temporary contract	Researcher
Frank	Lascaux	Temporary Contract	Researcher
Franco	Lisi	Staff Member	Researcher
Elena	Masciadri	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



Incontro attività tecnologiche ad Arcetri – 2 Nov 2009

Progetti e scadenze

Telescope	Project	#	2010	2011	2012	2013	FTE es/def	FTE poss
LBT	FLAO (incluso AdSec)		10	5	5		20,0	
LBT	ARGOS		3	3	3		9,0	
LBT	LBTI		2	2			4,0	
LBT	LINC-NIRVANA		1				1,0	
LBT	Seeing Model	1	1,25	1	TBD		3,0	
Magellan	AO system		2,5	2,5	1		6,0	
VLT	DSM Calibration SW		0,5				0,5	
VLT	DSM tests at ESO				1		1,0	
EELT	Maory			5	5			10,0
EELT	M4		0,3	3	3		0,3	6,0
Paranal/EELT	Seeing Model		2	3	3		8,0	
GMT	AO sys. and cophasing			5	5			10,0
TMT	Seeing Model			3	3			6,0
Antarctica	Seeing Model	1					0,8	
ESA	LATT	1	2	2	3		1,0	7,0
	FTE contratti es/def		25,05	21,5	8	TBD	54,6	
	FTE contratti possibili		2	18	19	TBD		39,0
	FTE totali		27,05	39,5	27	TBD		

	Contratti esistenti (es)
	Contratti in definizione (def)
	Contratti possibili (poss)



Remarks.....

Gli anni 2010 e 2011 sono di grande impegno per il gruppo:
23 FTE/anno sicure + eventuali EELT, GMT ecc ecc...
contro un gruppo di 25 persone di cui 14 precari.

Nel 2011 inizio studi fase 2 EELT con eventuale aumento delle FTE richieste. La partecipazione a ELT projects e' criticamente dipendente dal lavoro svolto in passato.

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



Posti & Spazi futuri

Posti futuri:

4 posti di ricercatore

2 posti tecnico (1 Elettronico, 1 meccanico)

1 disegnatore meccanico (condiviso con altri ?)

1 Amministrativo TD per ordini/amministrazione 7 progetti.

Supporto tecnico
trasversale invece
che per gruppi ?

1 posto ricercatore in arrivo per LBT AO (2010 ?)

Spazi

Laboratori per AIT:

- **LBTI AIT**
- **MAGELLAN AIT**
- **ARGOS WFS**
- **Laboratorio ottico**

Uffici:

- **Magazzino strumenti/parti ottiche**
- **Stanza per 2/3 persone (se si recupera 1 laboratorio)**

Attuali 2 stanze con 4 banchi ottici
1 stanza con 4 persone