An AO testing facility at the Asiago Copernico telescope

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On behalf of

R. Ragazzoni, J. Farinato, S. Benetti, M. Bergomi, F. Biondi, E. Cappellaro, E. Carolo, V. Chiomento, M. Dima, A. Frigo, D. Greggio, M. Gullieuszik, D. Magrin, L. Marafatto, G. Martorana, E. Portaluri, M. Rebeschini, L. Tomasella, L. Traverso, M. Turatto, D. Vassallo, V. Viotto

INAF – Osservatorio Astronomico di Padova

ADONI Workshop, Firenze 12-14 aprile 2016

An ADONI Project @Osservatorio Astronomico di Padova (OAPd)

Set-up facilities accessible to the Italian and international AO community

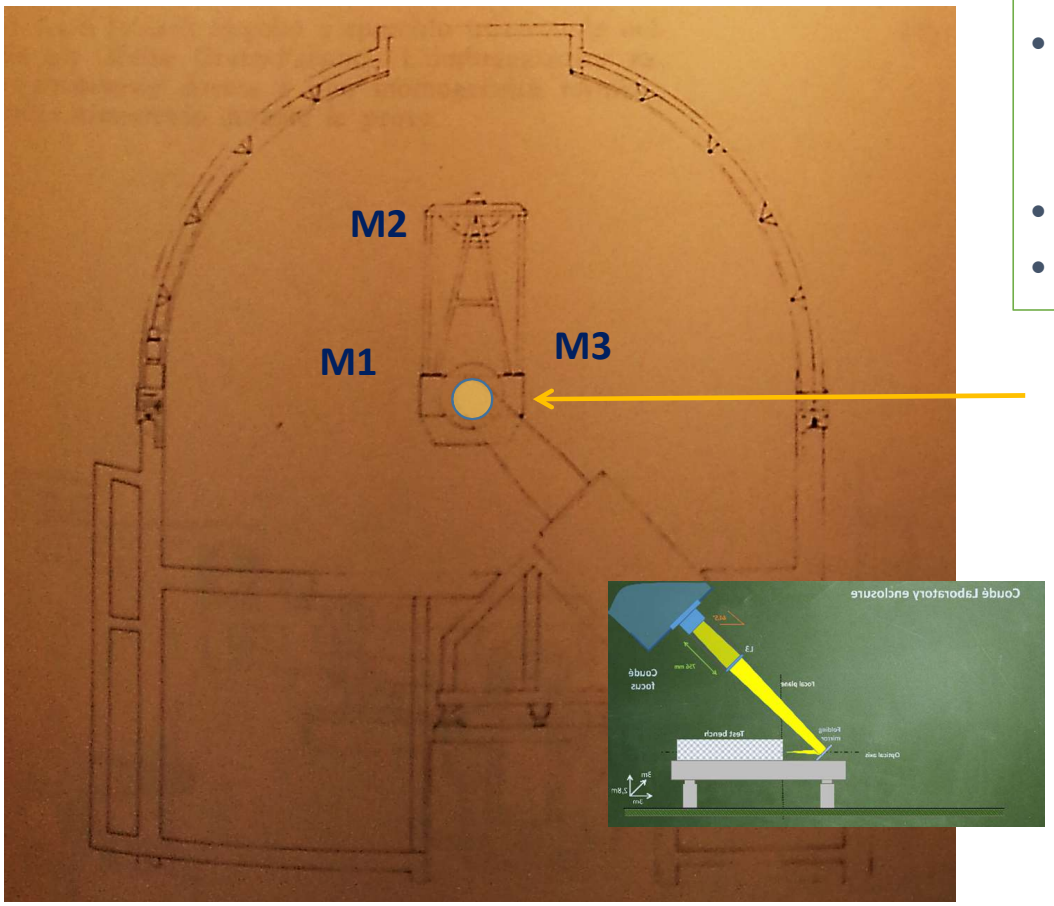
TESTING of critical sub-systems or components or prototypes of innovative concepts which may require **ON-SKY demonstrations**, mainly related to **AO**, but not only

→ **A permanent facility at the Coudé focus of the 182cm Copernico Telescope in Asiago-Ekar**

Create a **LABORATORY @ Coudé focus**

Refurbishment of Copernico in order to **implement the Coudè optical train**

The COPERNICO Telescope



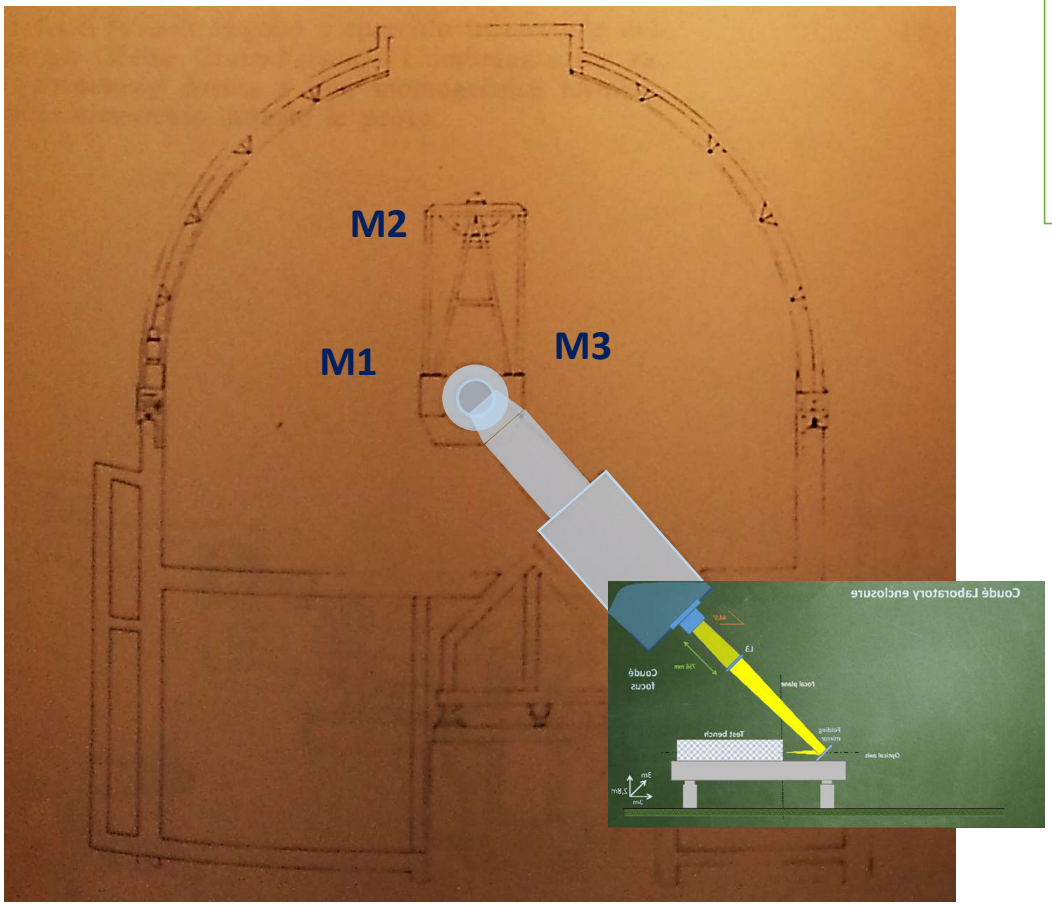
- 182 cm diameter: currently the biggest telescope in Italy
- equatorial mount
- Classical Cassegrain
  - Primary parabolic
  - Secondary hyperbolic
- Focal length 16.38 m
- f/9

Nasmyth foci

Coude focus

ON-SKY testing

The COPERNICO Telescope: Workbench @ Coudé focus



An optical bench installed for VISITING INSTRUMENTS

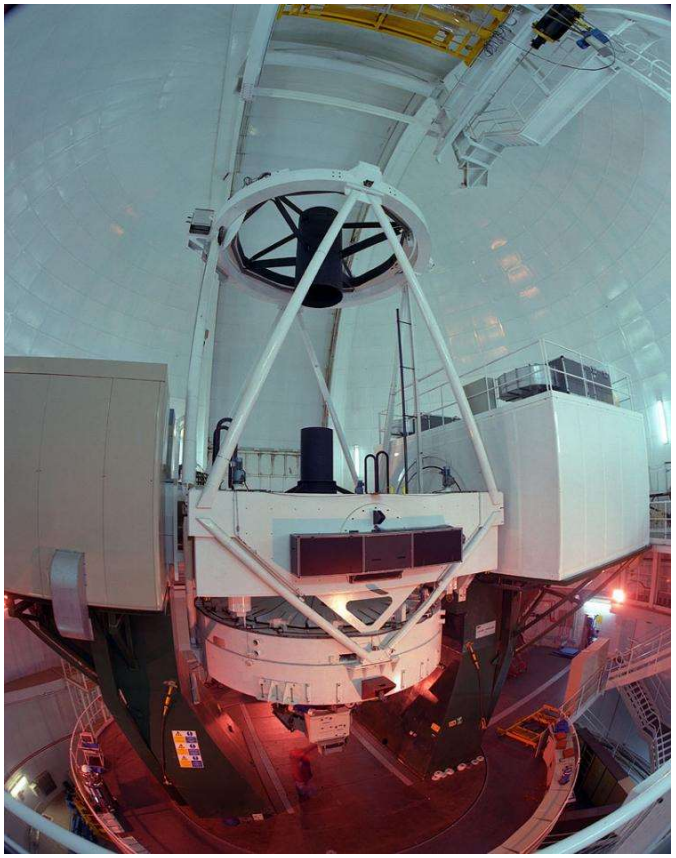
A facility of particular benefit to experiments in high resolution imaging.

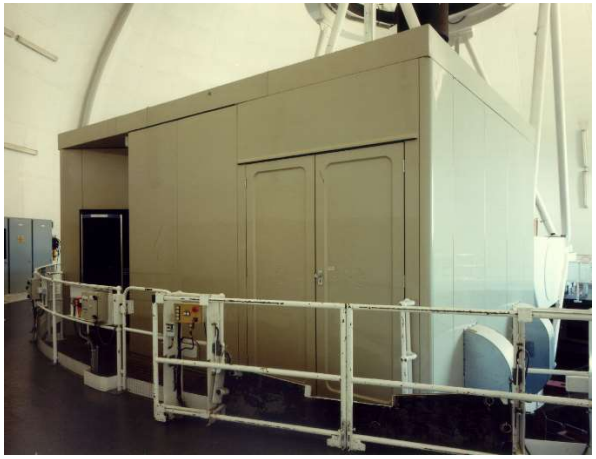
Refurbishment:

- The optical train to the Coudé focus: opto-mechanical design
- The Laboratory in correspondence of the Coudé focal station: room and optical Setup

ON-SKY testing

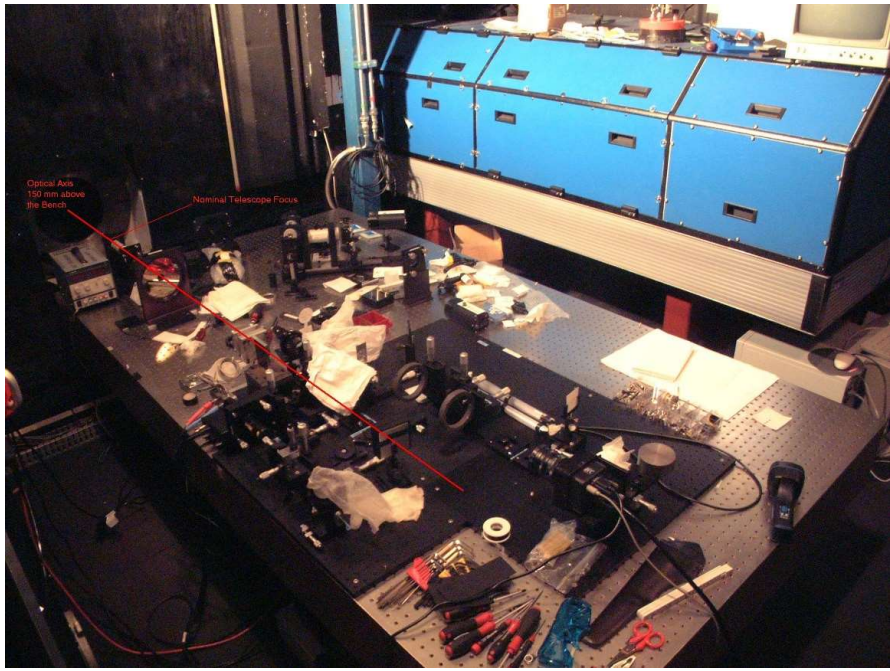
Existing laboratories: WILLIAM HERSCHEL TELESCOPE (WHT)





GHRIL
Ground-based High Resolution Imaging Laboratory
@ Nasmyth
Gravity invariant

WHT: 4.2 m - La Palma



For instruments requiring mechanical stability

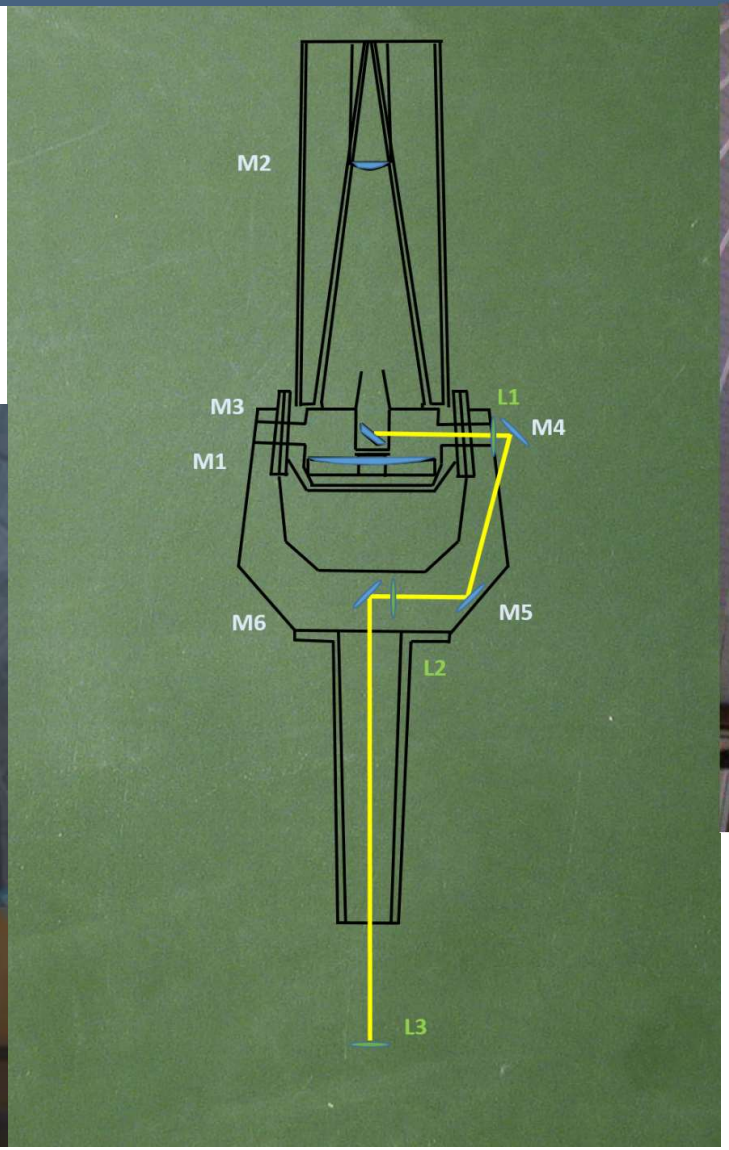
Existing laboratories: VISITOR FOCUS @ VLT

Visitor focus @ ESO VLT
Available for Visitor Instruments to permit innovative observations by instrument teams using their own stand-alone instruments.

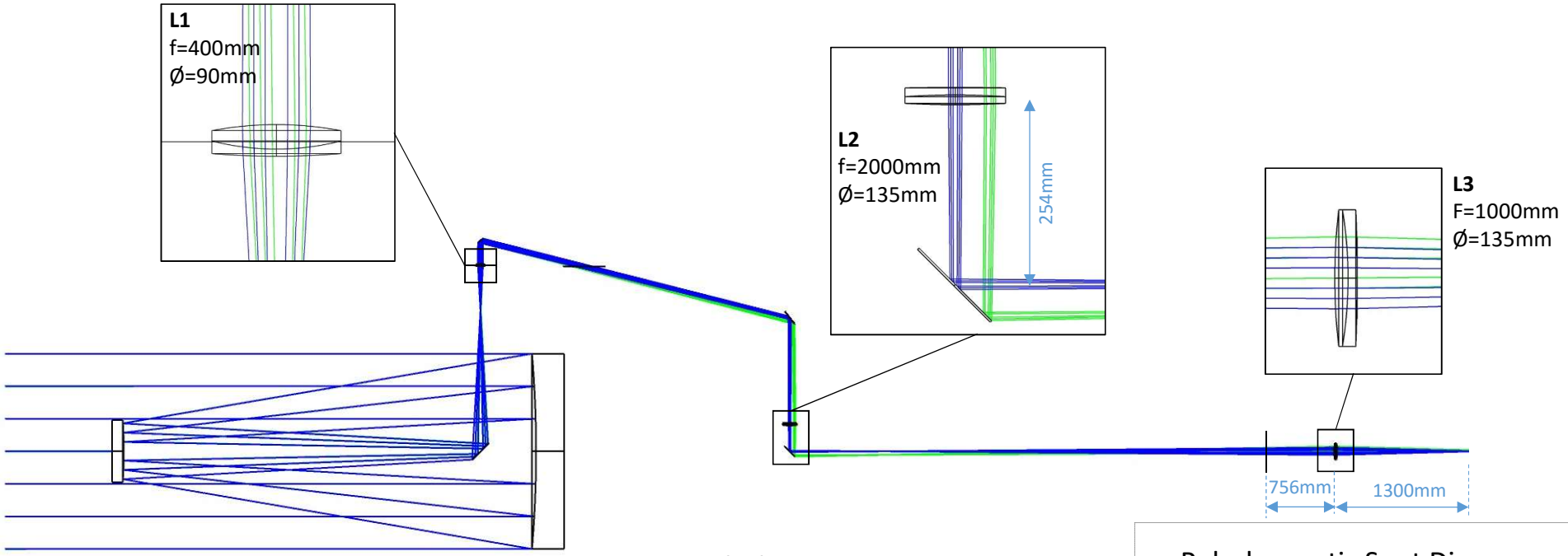
On-sky testing

Refurbishment of the optical train @ Coudé focus

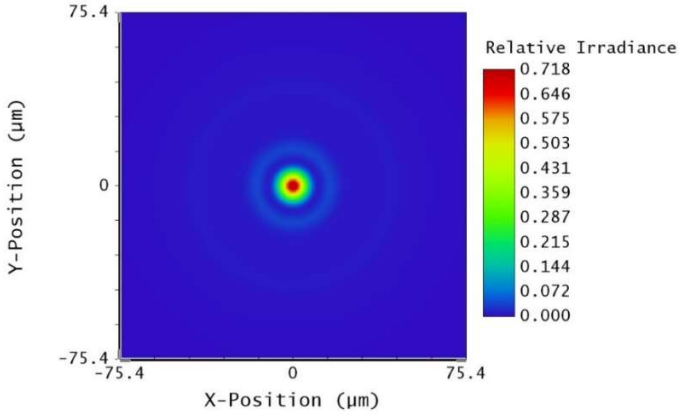
Opto-mechanical design from M3 to Coudè focus



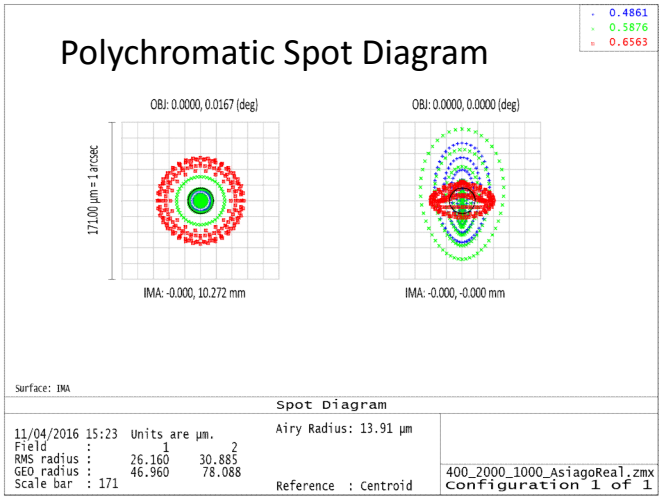
OPTICAL DESIGN – F/19.5 – Max radial FoV = 1.2 arcmin



Polychromatic PSF



Polychromatic Spot Diagram



Workbench: procurement of laboratory setup

Laboratory setup: room for optical bench and components

Requirement for Coudé Room: THERMICALLY INSULATED

Control Room

Coudé Room

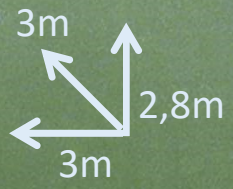
Coudé Laboratory enclosure

f/19.5 TELECENTRIC beam

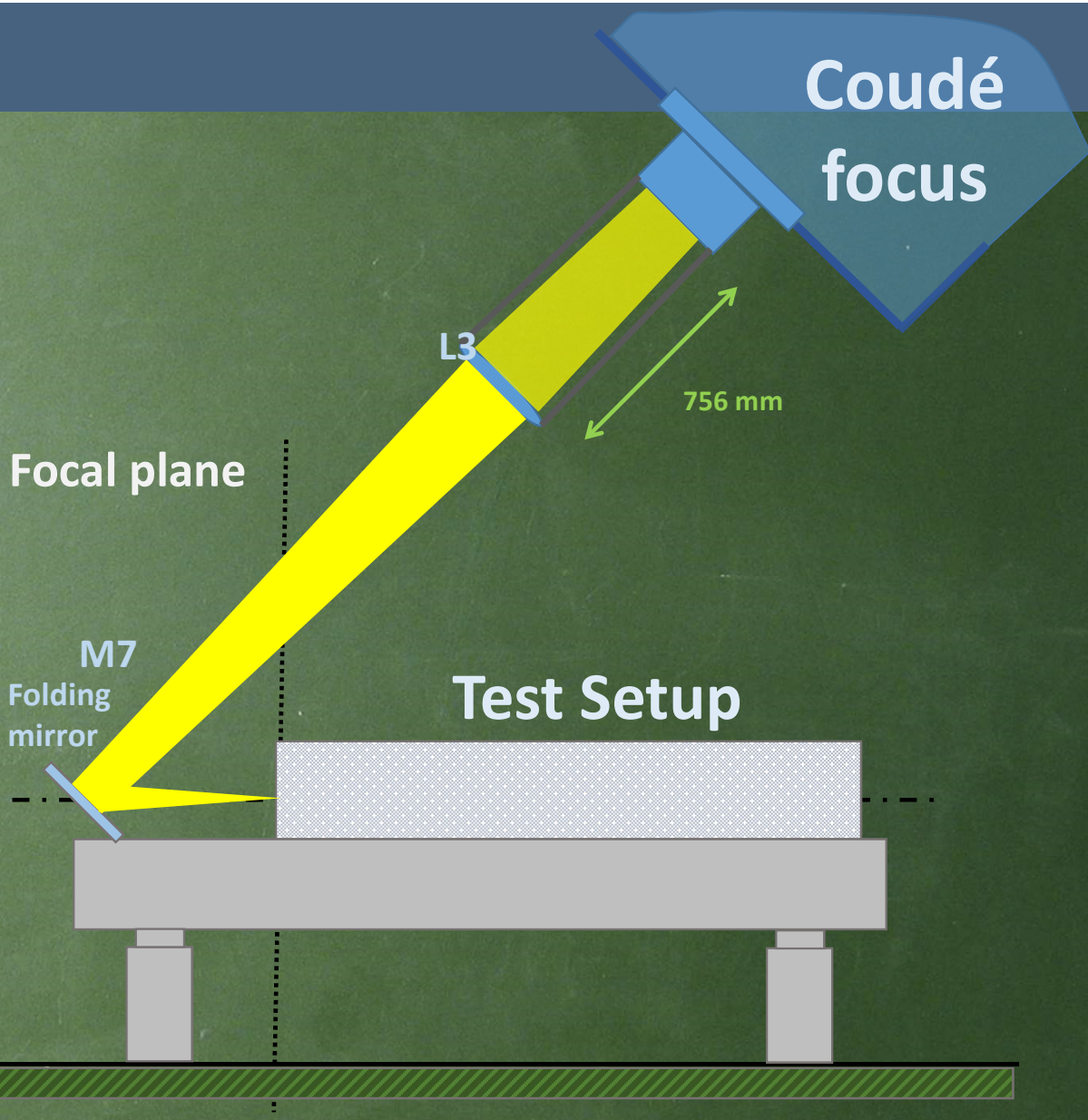
FoV ~ 2.4 arcmin

Scale ~ 6 arcsec/mm

Room dim



Optical table
1800 x 1200 mm



Examples On-Sky testing

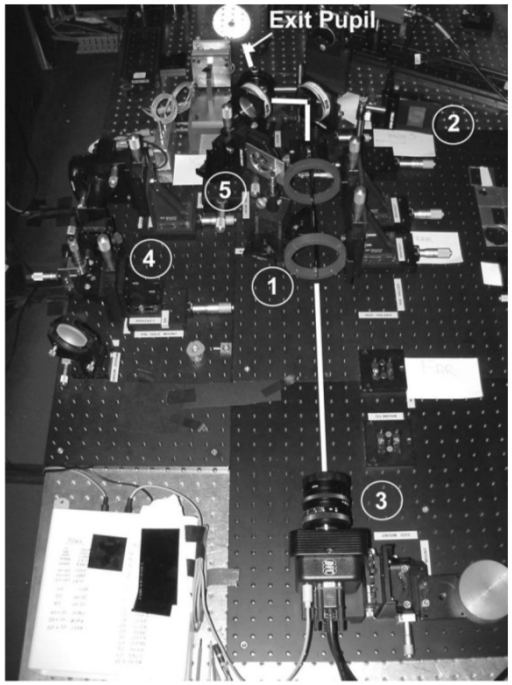
- the very fast implementation of novel concept of wavefront sensing

PIGS – First results on sky

S.Kellner[a], R. Ragazzoni[a,b], W. Gässler[a], E. Diolaiti[c], T. Morris[d],
Christopher Saunter[d], R. Meyers[d], J.Farinato[a,b], C. Arcidiacono[b], A. Ghedina[e]

Proc. of SPIE Vol. 5490

Pseudo Infinite Guide Star @ WHT
Tested under realistic conditions



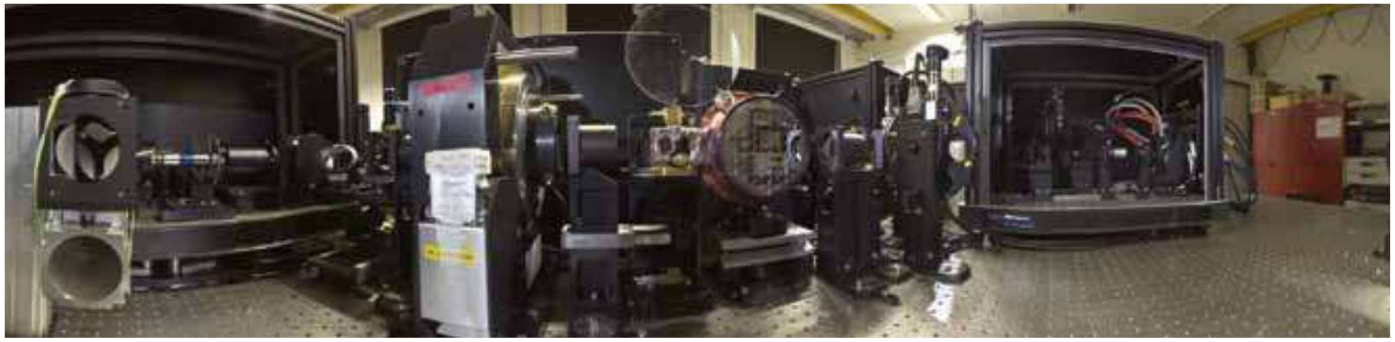
Examples On-Sky testing

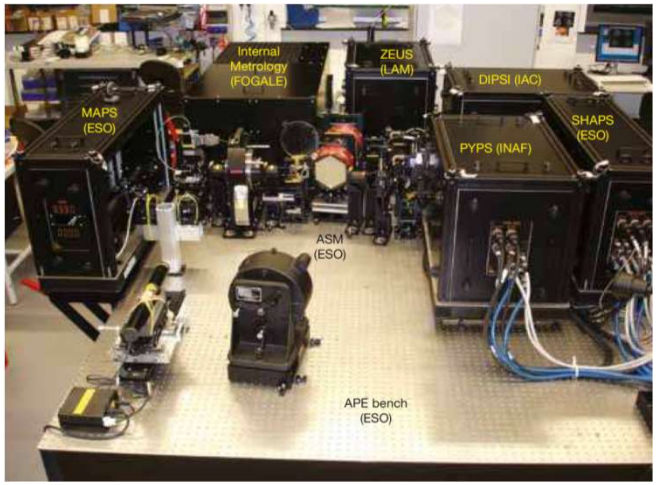
- the very fast implementation of novel concept of wavefront sensing
- the implementation of techniques in high angular resolution imaging (like lucky imaging, speckle interferometry, phase retrieval technique, ecc)

On-sky Testing of the Active Phasing Experiment

Gonté F. et al.,

The Messenger 136 – June 2009





Controlling segmented primary mirrors for E-ELT
@ Visitor focus VLT
Demonstrate functionality on-sky

Examples On-Sky testing

- the very fast implementation of novel concept of wavefront sensing
- the implementation of techniques in high angular resolution imaging (like lucky imaging, speckle interferometry, phase retrieval technique, ecc)
- the direct comparison of different kinds or concepts of wavefront sensors in the same observational conditions

On-sky Testing of the Multi-Conjugate Adaptive Optics Demonstrator

Marchetti E. et al.,

The Messenger 129 – September 2007

Layer Oriented wavefront sensor for MAD on sky operations

C. Arcidiacono[a], M. Lombini[b], R. Ragazzoni[a], J. Farinato[a], E. Diolaiti[b], A. Baruffolo[a], P. Bagnara[a], G. Gentile[a], L. Schreiber[b], E. Marchetti[c], J. Kolb[c], S. Tordo[c], R. Donaldson[c], C. Soenke[c], S. Oberti[c], E. Fedrigo[c],E. Vernet[c], N. Hubin[c]

Proc. of SPIE Vol. 7015 70155P-2

MAD is a Multi-conjugate Adaptive optics Demonstrator @ Visitor focus VLT

Examples On-Sky testing

- the very fast implementation of novel concept of wavefront sensing
- the implementation of techniques in high angular resolution imaging (like lucky imaging, speckle interferometry, phase retrieval technique, ecc)
- the direct omparison of different kinds or concepts of wavefront sensors in the same observational conditions
- Testing of specialized pupil planes aperture (LBT, GMT, etc)

Interferometric imaging tests for the Large Binocular Telescope*

S. Correia and A. Richichi

Astron. Astrophys. Suppl. Ser. **141**, 301–311 (2000)

Simulating LBT pupil
@ TIRGO
Record realistic LBT-like data

Examples On-Sky testing

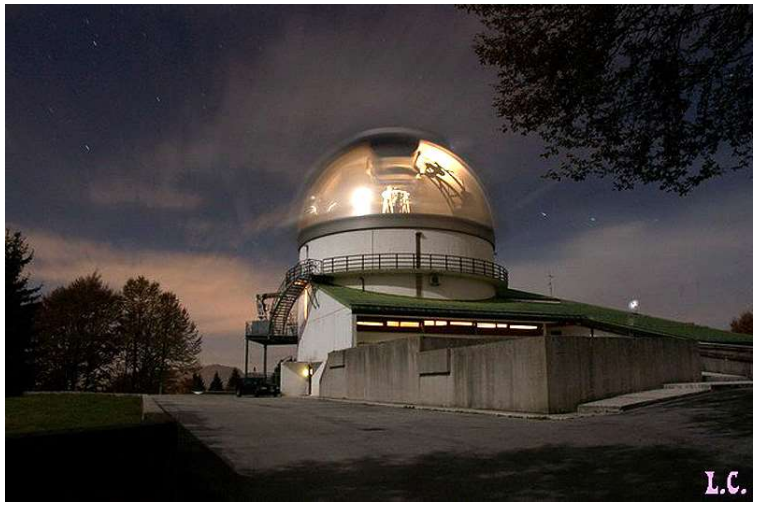
- the very fast implementation of novel concept of wavefront sensing
- the implementation of techniques in high angular resolution imaging (like lucky imaging, speckle interferometry, phase retrieval technique, ecc)
- the direct omparison of different kinds or concepts of wavefront sensors in the same observational conditions
- Testing of specialized pupil planes aperture (LBT, GMT, etc)
- Any instrumentation to be tested ON-SKY

Adaptive Optics Laboratory @ OAPd: a PUBLIC FACILITY

LABORATORIO NAZIONALE ADONI OTTICA ADATTIVA

A common user bench for AO multi-purpose instrumentation for ON-SKY testing

- Currently the biggest telescope in Italia → 182 cm diameter
- Easy to reach – 1.5h from VCE
- Coudé focus always accessible (switch in 10 min.)
- Facility with laboratory open to all
- Direct ON-SKY testing
- Versatile workbench
- Practicable: early 2017



Users from national & international community can get access to the Laboratory by applying for dedicated time.