

T-REX Operating Unit 3

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OU3 Overview

- Main objective: support INAF activities related to MAORY+MICADO system and to E-ELT adaptive optics instrumentation
- OU3 breakdown
 - WP3.1 MAORY
 - WP3.2 MICADO
 - WP3.3 Atmospheric parameters
 - WP3.4 Technology developments for adaptive optics



OU3 People

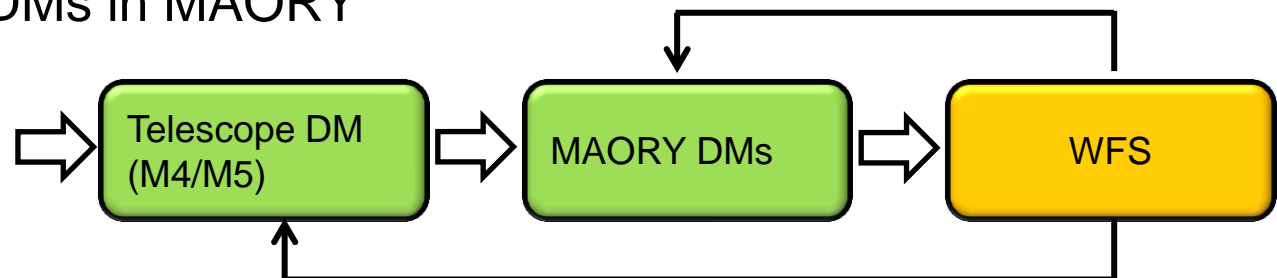
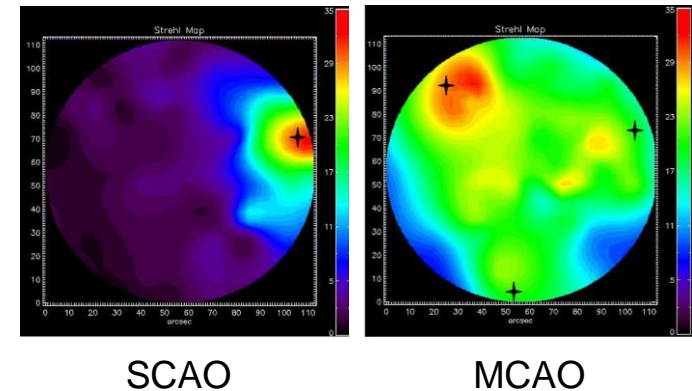
- MAORY
 - **OA-Bologna:** R. Abicca, C. Arcidiacono, M. Bellazzini, G. Bregoli, P. Ciliegi, F. Cortecchia, G. Cosentino, E. Diolaiti, I. Foppiani, M. Lombini, M. Patti, L. Schreiber
 - **IASF-Bologna:** C. Butler, A. De Rosa, G. Malaguti, G. Morgante, S. Ricciardi et al.
 - **OA-Arcetri:** G. Agapito, J. Antichi, G. Di Rico, S. Esposito, C. Giordano, F. Patru, A. Riccardi, P. Spanò et al.
 - **OA-Brera:** M. Riva et al.
 - **OA-Capodimonte:** E. Cascone, V. De Caprio
 - **OA-Cagliari:** I. Porceddu
 - **OA-Padova:** A. Baruffolo, D. Fantinel, E. Giro, R. Ragazzoni, B. Salasnich
- MICADO
 - **OA-Padova:** R. Falomo, L. Greggio, M. Gullieuszik, D. Fantinel, S. Paiano, L. Schreiber, S. Zaggia
 - **IASF-Milano:** M. Uslenghi
- Atmospheric parameters
 - **OA-Arcetri:** L. Fini, F. Lascaux, E. Masciadri, A. Turchi
 - **OA-Padova/OA-Bologna:** S. Cavazzani, S. Ortolani, V. Zitelli
- New development for adaptive optics
 - **OA-Padova:** C. Arcidiacono, M. Bergomi, M. Dima, J. Farinato, M. Gullieuszik, D. Magrin, L. Marafatto, E. Portaluri, R. Ragazzoni, V. Viotto



MAORY / Instrument overview

- First-light adaptive optics module to support MICADO
 - Multi-Conjugate Adaptive Optics
 - Single-Conjugate Adaptive Optics
- Laser Guide Stars
 - Sky coverage
 - Performance uniformity
 - Natural stars needed anyway
- Deformable mirrors
 - Telescope M4/M5
 - One or two DMs in MAORY

MAD Strehl Ratio maps © ESO



MAORY / Consortium



- **INAF (Italy)**

- OA-Bologna, IASF-Bologna, OA-Arcetri, OA-Brera, OA-Capodimonte, OA-Padova
- System design, integration and delivery to ESO
- Adaptive optics engineering
- Sub-systems
 - Platform
 - Adaptive optics sub-systems (optical relay with adaptive mirrors, NGS & SCAO wavefront sensor, real-time computer)
 - Auxiliary equipment
 - Science support tools

- **IPAG (France)**

- LGS wavefront sensor

- **ESO**

- Wavefront sensor cameras
- Common specifications & toolkit for real-time computer development
- Software simulator of telescope control system



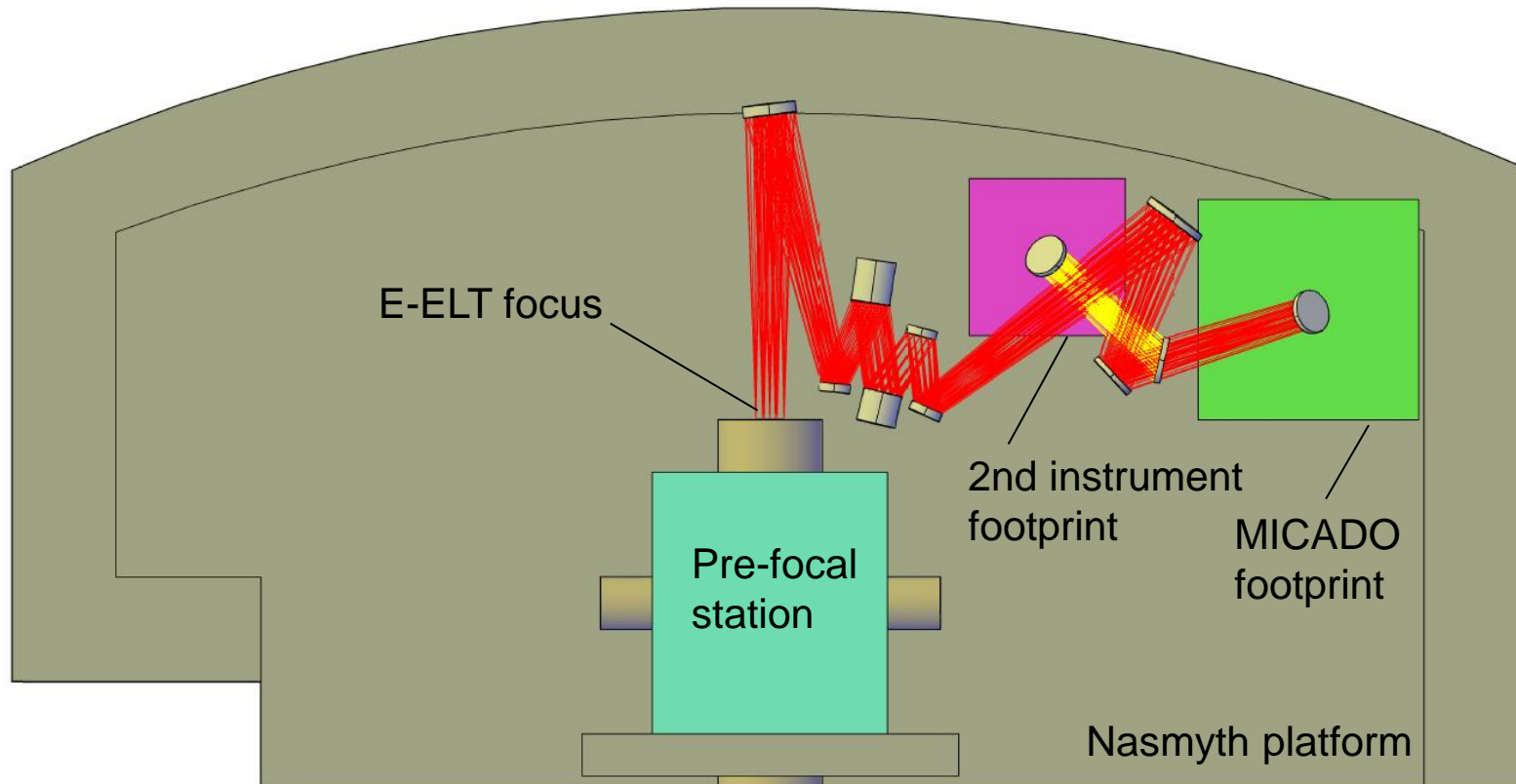
MAORY / Deformable Mirrors

- Voice-coil motor actuator
- Pros
 - Technology Readiness Level
 - Tolerant to actuator failure
 - Commonalities with M4
- Main features
 - 700 mm diameter
 - 24 actuators across diameter
 - Two equal mirrors (flat or curved)
- Feasibility study funded by T-REX to support MAORY Phase B



Picture© R.Cerisola

MAORY / Optical design



Talk by Matteo Lombini
Optical design of the post focal relay of MAORY



MAORY / NGS & SCAO

- Natural Guide Star wavefront sensor
 - Essential complement to LGS wavefront sensor in MCAO mode
 - 3 (faint) stars on 2.5 arcmin field of view
- SCAO wavefront sensor / mode
 - Permanent SCAO mode in MAORY
 - MICADO stand-alone mode for risk mitigation
 - Joint development between MICADO and MAORY

Talk by Simone Esposito

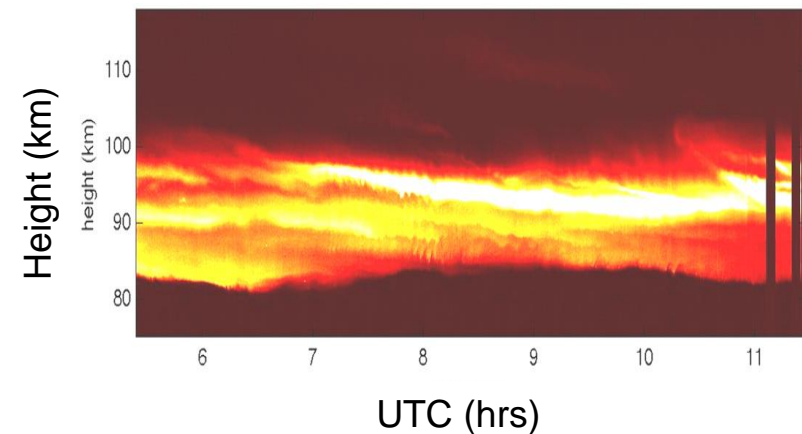
NGS WFS and operations of MAORY/MICADO

MAORY / System modelling



- End-to-end simulation code
 - System modelling and design
 - Modular structure
 - Accelerated by use of GPUs
 - Accurate mode / fast mode

Sodium layer data kindly provided by
Paul Hickson



Talk by Laura Schreiber

*Modeling the multi-conjugate adaptive optics system
of the E-ELT*

MAORY / Lab demonstration



- Laboratory prototype
 - Emulation of realistic LGS images under different working conditions
 - High-order wavefront sensor (40x40 subapertures)
 - Experimental support to simulations

Talk by Mauro Patti

Laboratory prototype for the demonstration of sodium laser guide star wavefront sensing on the E-ELT

MAORY / Real Time Computer



- Under INAF responsibility
 - Originally to be supplied by Durham University
 - Project Management Plan under revision
- Role of ESO
 - Requirements capture in collaboration with MAORY consortium
 - Supply of common specifications and toolkit



MAORY / Facilities for AIV

- Laboratory for MAORY instrument integration
 - Refurbishment of existing laboratory at IASF-Bologna
 - Tools and equipments
 - Interferometer
 - Laser tracker
 - Optical lab tools
 - Electronics instrumentation
- Laboratory for NGS & SCAO WFS integration
 - Refurbishment of existing laboratory at Arcetri



MICADO



- WP coordinator: Renato Falomo
- E-ELT high angular resolution infrared camera
- Study of MICADO science cases by simulation and analysis of synthetic images
- Consolidation of INAF involvement in MICADO Consortium
- 2 research grants (M. Gullieuszik, S. Paiano)

Talk by Marco Gullieuszik

Exploring the stellar populations of nearby and high redshift galaxies with ELTs



Atmospheric parameters

- WP coordinator: Elena Masciadri
- MOSE project for ESO
 - Feasibility study to setup an automatic system at Cerro Paranal and Cerro Armazones for the forecast of optical turbulence and atmospheric parameters
 - MOSE Phase B June 2014 - July 2015
- 1 research grant co-funded (F. Lascaux)

Talk by Elena Masciadri

MOSE: operational optical turbulence forecast for the EELT flexible scheduling



Atmospheric parameters

- WP coordinators: S. Ortolani, V. Zitelli
- Evaluation and forecast of weather conditions from ground-based and satellite data
 - Cloud cover
 - Photometric quality of atmosphere
- 1 research grant funded (S. Cavazzani)

Talk by Stefano Cavazzani

Analysis and forecasting of weather conditions from satellite data and correlation with astronomical parameters for the E-ELT site

Technology development for AO



- WP coordinator: Roberto Ragazzoni
- Global Multi-Conjugate Adaptive Optics (GMCAO)
 - Wavefront sensing by natural stars only on a wide field of view at the telescope focal plane
 - Metrology to "see" post-focal deformable mirrors
- 2 research grants (M. Gullieuszik, E. Portaluri)

Talk by Roberto Ragazzoni
Global Adaptive Optics and beyond



Conclusions

- Support from T-REX to E-ELT activities at INAF has been essential
- Grants for young researchers
 - 13 young researchers + 1 PhD supported by T-REX / OU3
- Travels
- For MAORY project
 - Facilities and equipment for instrument integration
 - Support to instrument design