ESO E-ELT INSTRUMENT

INSTRUMENT ACRONYM and FULL NAME:

MAORY - the **M**ulti conjugate **A**daptive **O**ptics **R**ela**Y**

SCIENTIFIC OBJECTIVES:

MAORY is a post-focal adaptive optics module for the E-ELT that forms part of the first light instrument suite for the telescope.

MAORY provides two adaptive optics modes to support the MICADO near-infrared camera. The first is a multi-conjugate adaptive optics (MCAO) mode, the second is a single conjugate adaptive optics (SCAO) mode.

MAORY works on the wavelength range from 0.8 µm to 2.4 µm. In the MCAO mode, it provides a wide field of view (the science field of MICADO is about 1 arcminute) with good compensation of the atmospheric turbulence effects and with excellent uniformity of the instrumental response. In the SCAO mode, peak performance on a smaller field of view, rather than uniformity, is the relevant performance metric.

MAORY also offers provision for a second port for a future instrument, as yet undefined.

SPECS & TECHNICAL CHALLENGES (R&D needed, procurement opportunities):

A short description of the main hardware components of the instrument is presented here. The technical requirements are preliminary. Given the fact that MAORY is a first-light instrument, its baseline design is based on proven technologies as far as possible.

Optics

MAORY contains an optical relay with diffraction-limited performance to re-image the telescope focal plane and a specific channel to focus the laser guide star light. The main optical components are described below.

- Mirrors (both flat and with optical power, conic sections, off-axis, diameter range 350–1300 mm, substrate material: Zerodur or similar).
- Dichroic beam-splitter (reflected wavelength range 0.6 µm - 2.4 µm, transmitted wavelength <0.6 µm, diameter 450 mm, material optical glass).
- Lenses (diameter < 400 mm, possible aspheric surfaces, material optical glass).

Mechanics

- Large optical bench (approximate size 12 m × 5 m in plant).
- Hexapod to support the bench.
- Opto-mechanical mounts for the optics described above.
- High-accuracy large rotator bearings.
- Custom mechanics of several sub-systems (typical sub-system size is 1-2 m on a side).

Real Time Computer

The MAORY Real Time Computer has to process the signal from the wavefront sensor cameras (up to 12 cameras are required in MAORY) and produce the control commands for up to three deformable mirrors and one tip-tilt mirror (total number of actuators > 6000). The loop rate is 500-700 Hz. The baseline technology and architecture of the Real Time Computer has not been decided yet.

Wavefront sensor cameras

The following cameras are required for the wavefront sensors.

- Visible camera for laser guide star wavefront sensor: central wavelength 0.589 µm, at least 800x800 active pixels, 6 units required (plus spares).
- Visible camera for natural guide star wavefront sensor: wavelength 0.6-0.9 µm, at least 200x200 active pixels, 4 units required (plus spares).
- Infrared camera for natural guide star wavefront sensor: wavelength 1.5-1.8 µm (upper wavelength cut-off mandatory), at least 256x256 active pixels, 3 units required (plus spares).

All cameras have to be low-noise (typical required read-out noise is a few electrons/pixel/readout) and fast (frame rate 500-700 Hz, to be confirmed).

Deformable mirrors

MAORY includes one or two post-focal deformable mirrors which complement the E-ELT adaptive and tip-tilt mirrors M4 and M5. The baseline technology is voice-coil motor actuators, due to its high technology readiness level and technical advantages for MCAO (e.g. contactless actuators). The reference model is the VLT adaptive secondary mirror.

POINT OF CONTACT:

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CONSORTIUM:

- Istituto Nazionale di Astrofisica (INAF), Italy – Lead Institute
- Institut National des Sciences de l'Univers du Centre National de la Recherche Scientifique (INSU/CNRS) – Institut de Planétologie et d'Astrophysique de Grenoble (IPAG), France

WEBSITE:

http://www.bo.astro.it/maory/Maory/Welcome.html (In preparation)

TIMELINE:

Expected project Phase B kick-off: October 2015. Instrument delivery and commissioning: as required for E-ELT first light.