An Onverview of MAORY : the AO module for ELT

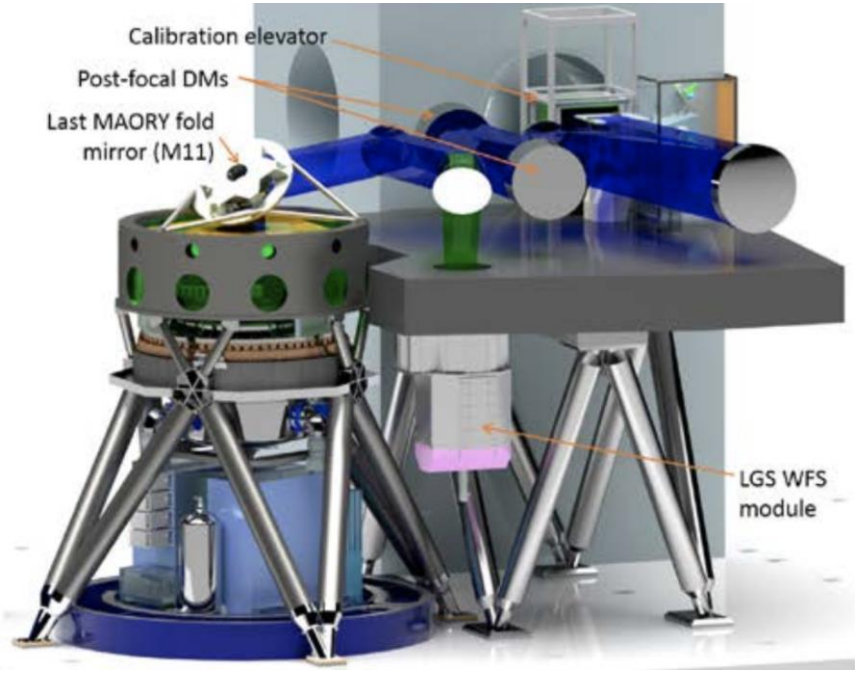
Paolo Ciliegi on behalf of the MAORY consortium

MAORY CONSORTIUM

COUNTRY	INSTITUTE	PRINCIPAL SUPPLIES
ITALY	INAF	PI : **PAOLO CILIEGI** Co-I : **ESPOSITO - RAGAZZONI** Project Office Sub-system level: ICS software, instrument control hardware, main structure, post-focal relay optics, opto-mechanics, LOR WFS module, RTC, DMs, calibration unit, science support tools Contribution to SAT, System Team and Science Team
FRANCE	CNRS/INSU representing IPAG (Grenoble)	Co-I : **FEAUTRIER** Sub-system level: LGS WFS Contribution to SAT System Team and Science Team
IRELAND	School of Physisc at the National University of Ireland Galway (NUIG)	Co-I : **DEVANEY** Subsystem level : Test and Wavefront Correction Verification Contribution to SAT and System Team and Science Team

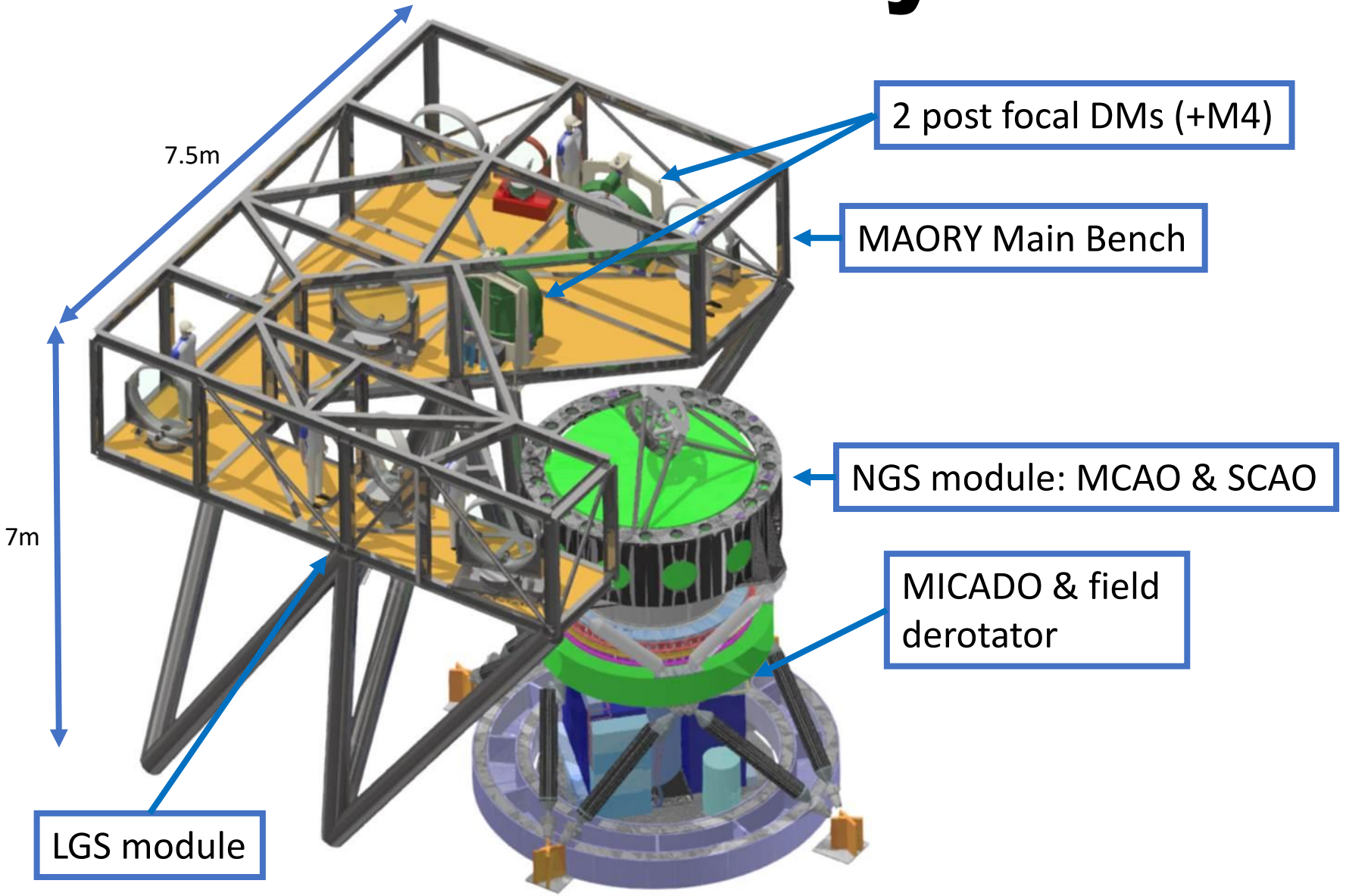
MAORY and MICADO

- MAORY is the MCAO module of the ELT, providing large field diffraction limited correction to MICADO
- MICADO imager 0.8-2.4um
- 53x53" @ 4 mas/px - 20x20" @ 1.5 mas/px
- longslit and coronograph
- SCAO system developed by LESIA



MAORY main requirement: 30% SR@K (goal 50%) on 50% sky coverage at SGP with ESO "median" profile

MAORY system architecture



Performance Evaluation

The technical teams provide inputs for the analysis performed by :

- **Science Operation WG** (WP manager and Instrument Scientist : Carmelo Arcidiacomo)
  - Builds instrument description and Test the evaluation tools
- AWG (**Astrometric Working Group**)
  - MAORY and MICADO share information and collaborate to detail the astrometry performance.
- **MAORY Science Team**
  - Provides feedback based on specific science case analysis
  - Estimates genuineness and validity of science goals

Performance Evaluation

The Instrument description for Science users

From the user point of view the instrument is characterized by:

- PSF and PSF stability (temporal and spatial);
  - SR/EE/FWHM vs wavelength (Filter)
- Optical Field distortion and stability;
- Robustness/repeatability vs seeing
- Camera definition (min max DIT, pix, …)

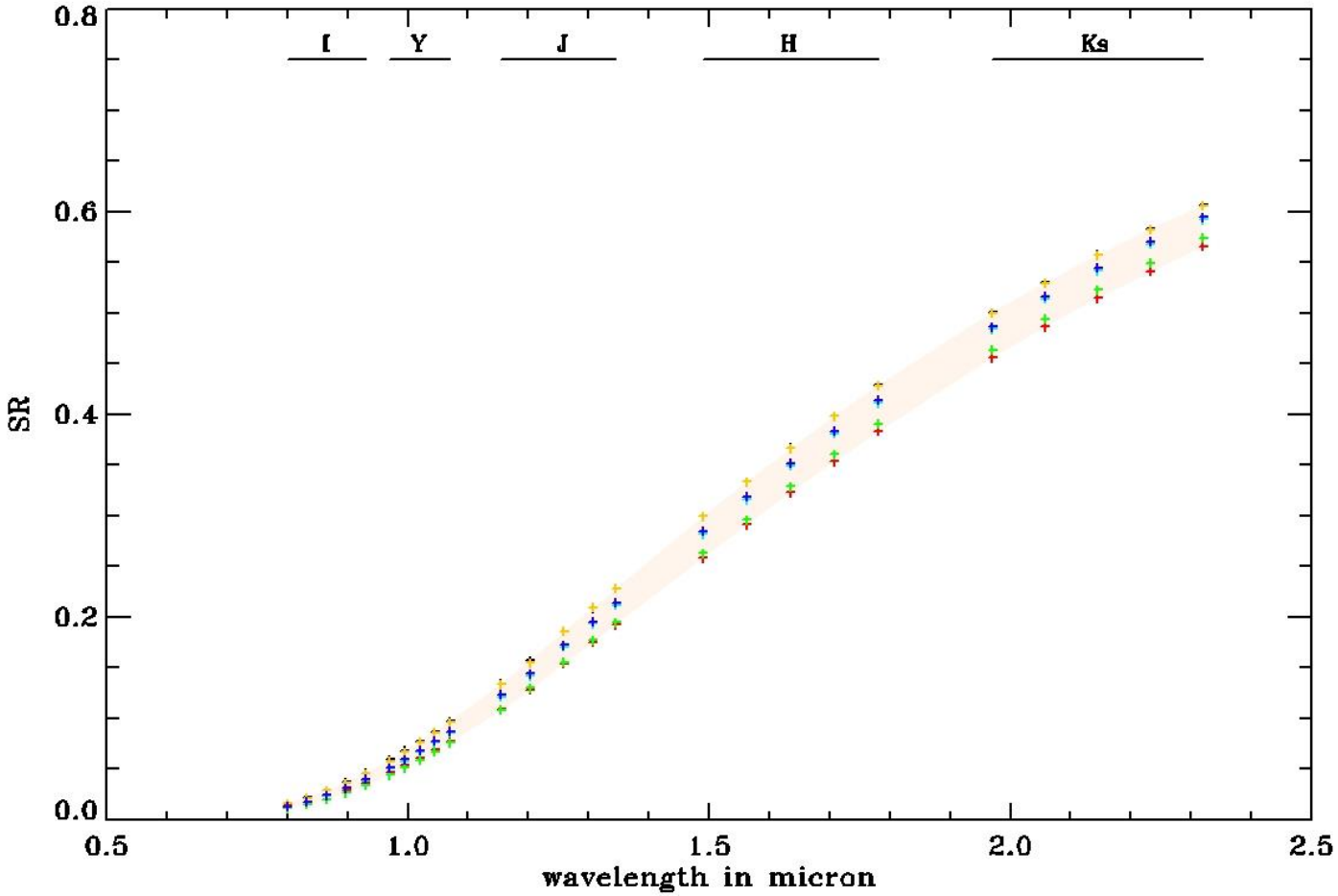
How to estimate performance and sky coverage

- For any given pointing, MAORY has to choose up to 3 NGS, of different magnitudes, arranged on different asterisms and with a choice of Cn2 profiles and dependence on correction on NGS WFS
- We developed a **semi-analytical, statistical estimate** of NGS-related WFE taking into account all these factors
  - E2E simulations
  - random pointings in simulated star fields at SGP (TRILEGAL)
  - Interpolation on NGS noise
  - Analytical computation of tomography and vibrations
  - Add fixed terms (telescope / optics / NCPA / LGS truncation / ...)

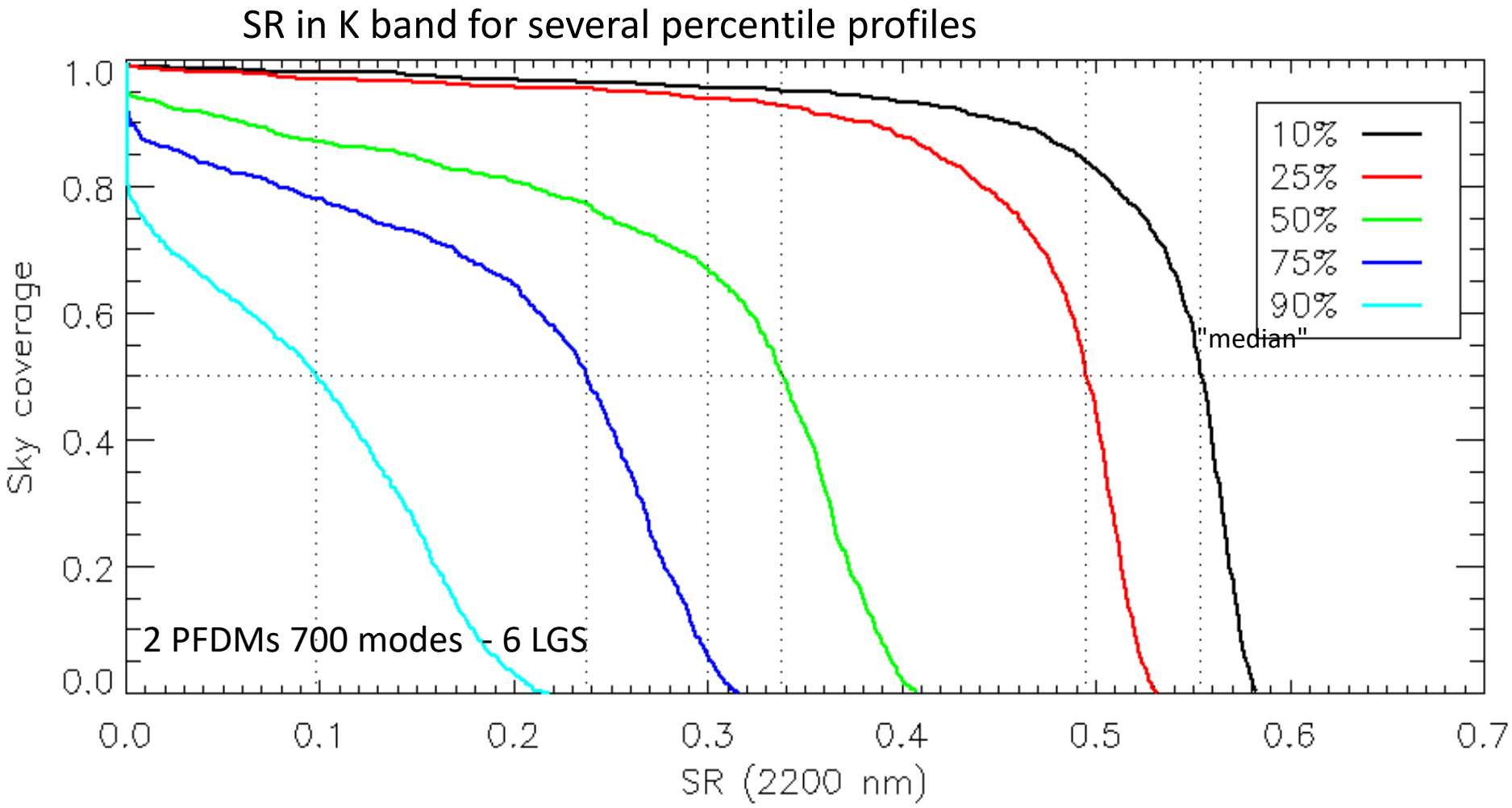
Expected performance

The PSF is the sum of 6 realization of

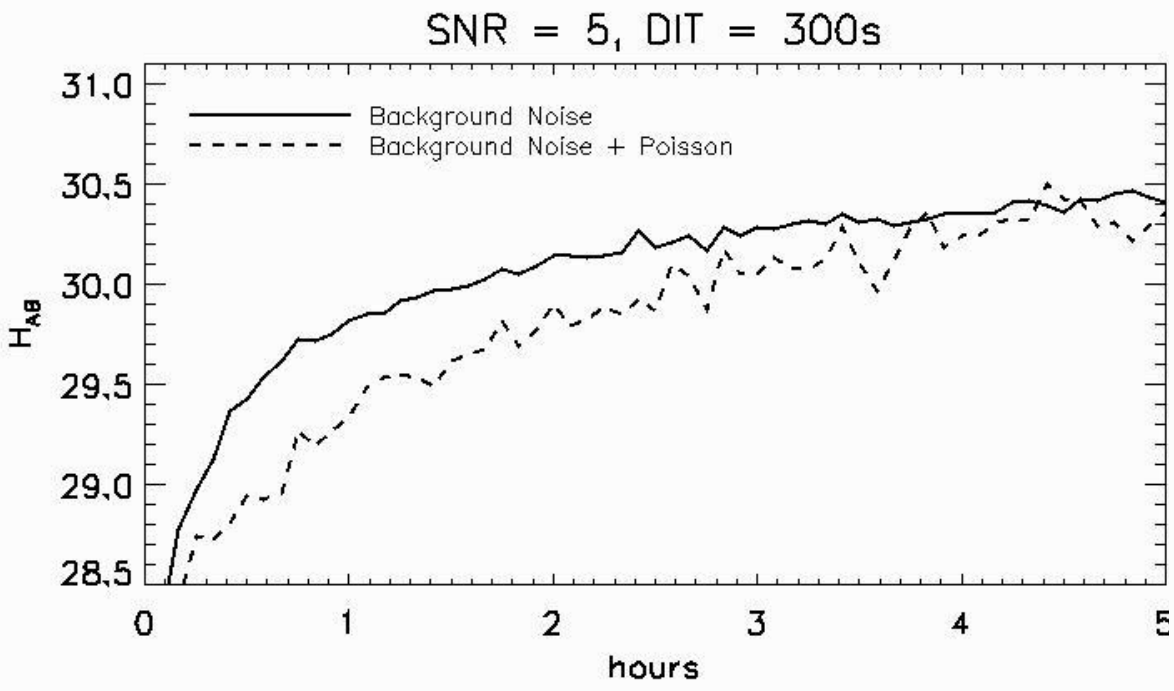
- Atmospheric MCAO WF residuals +
- Telescope MCAO WF residuals +
- Non Common Path Aberrations +
- WF Error Budget terms

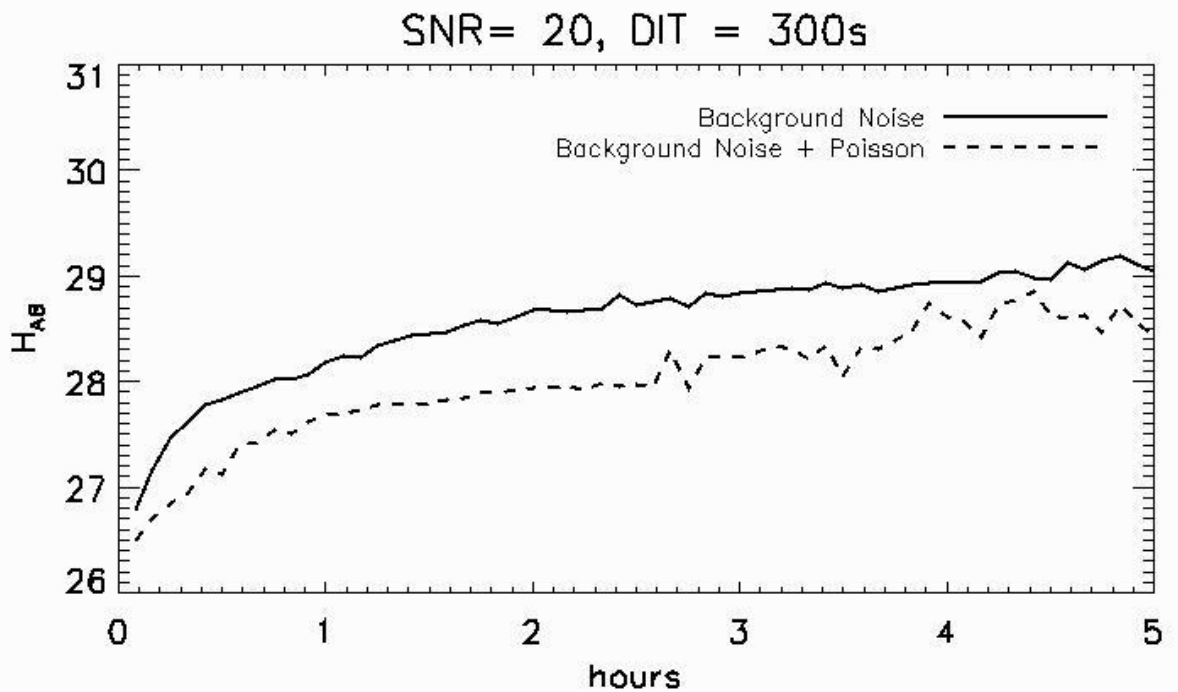


Expected performance

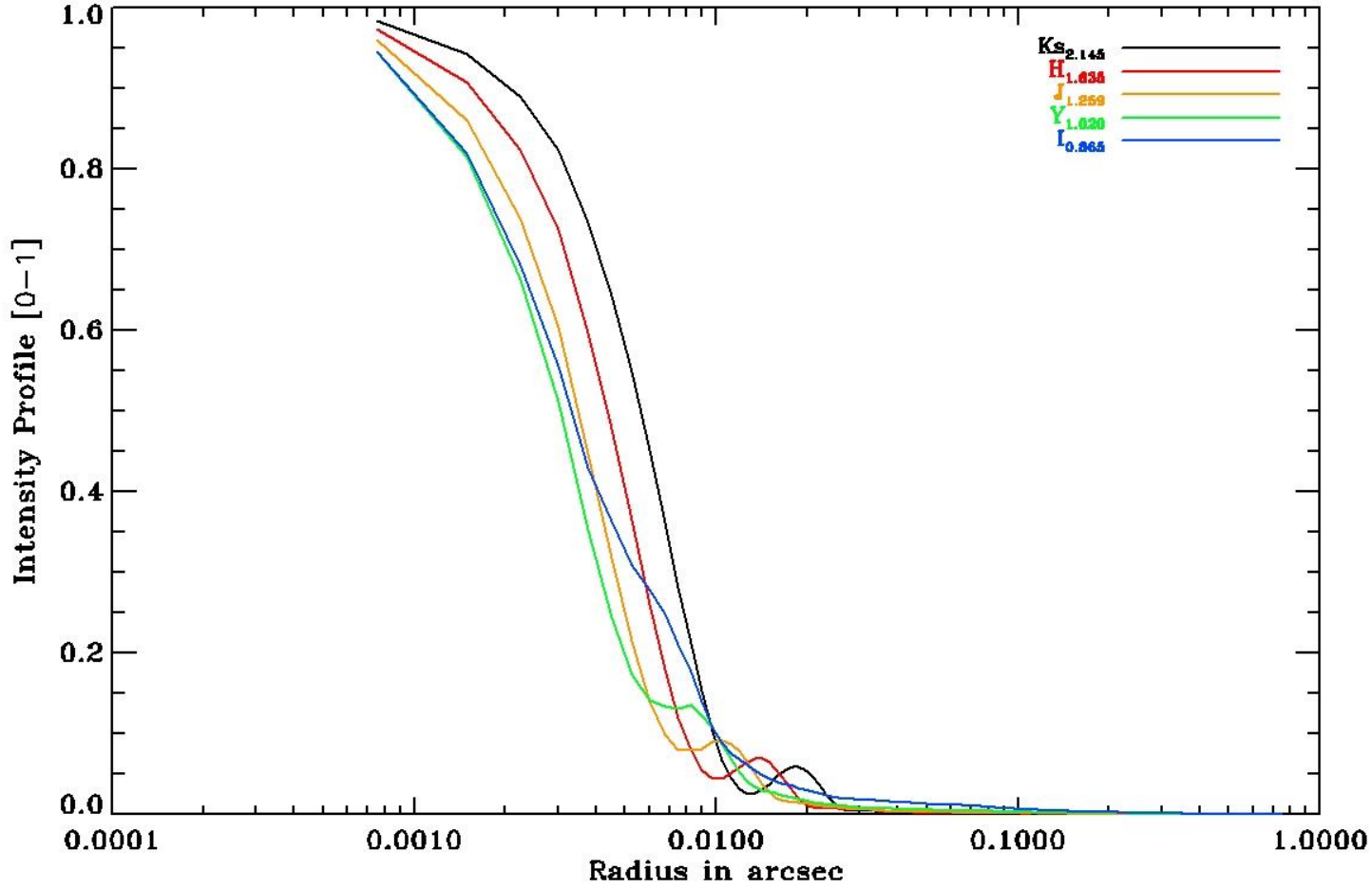


Expected Performance





On axis PSF intensity profile



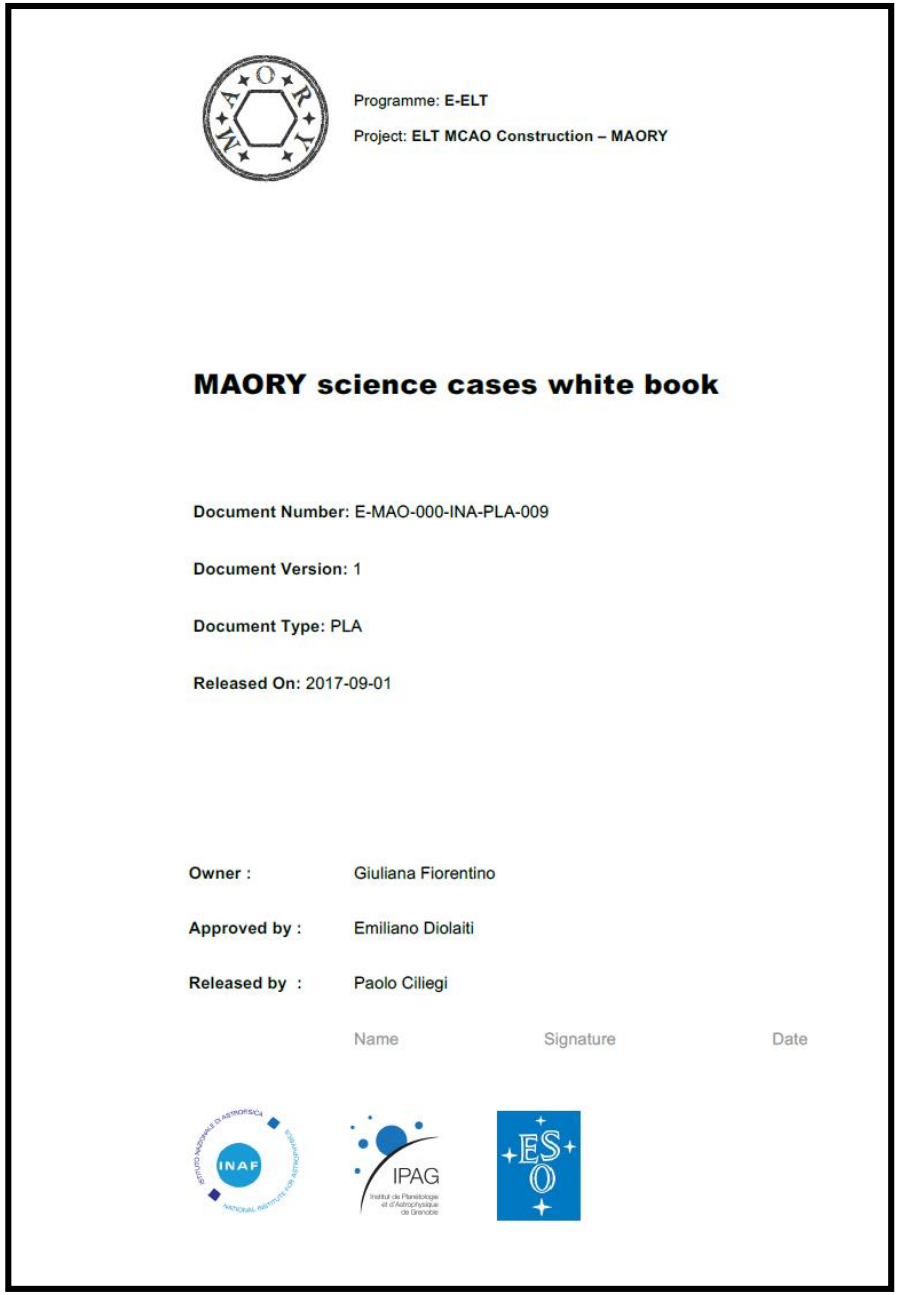
Scientific Simulation

Science Team works using

- SimCADO Leschinski et al. (2016) (https://simcado.readthedocs.io/en/latest/)

- AETC (Falomo et al. INAF/OAPD) is also considered

Science Operation WG keeps updated the instrument description by means of PSF, optical distortion, thermal background



Programme: **E-ELT**

Project: **ELT MCAO Construction – MAORY**

MAORY science cases white book

Document Number: E-MAO-000-INA-PLA-009

Document Version: 1

Document Type: PLA

Released On: 2017-09-01

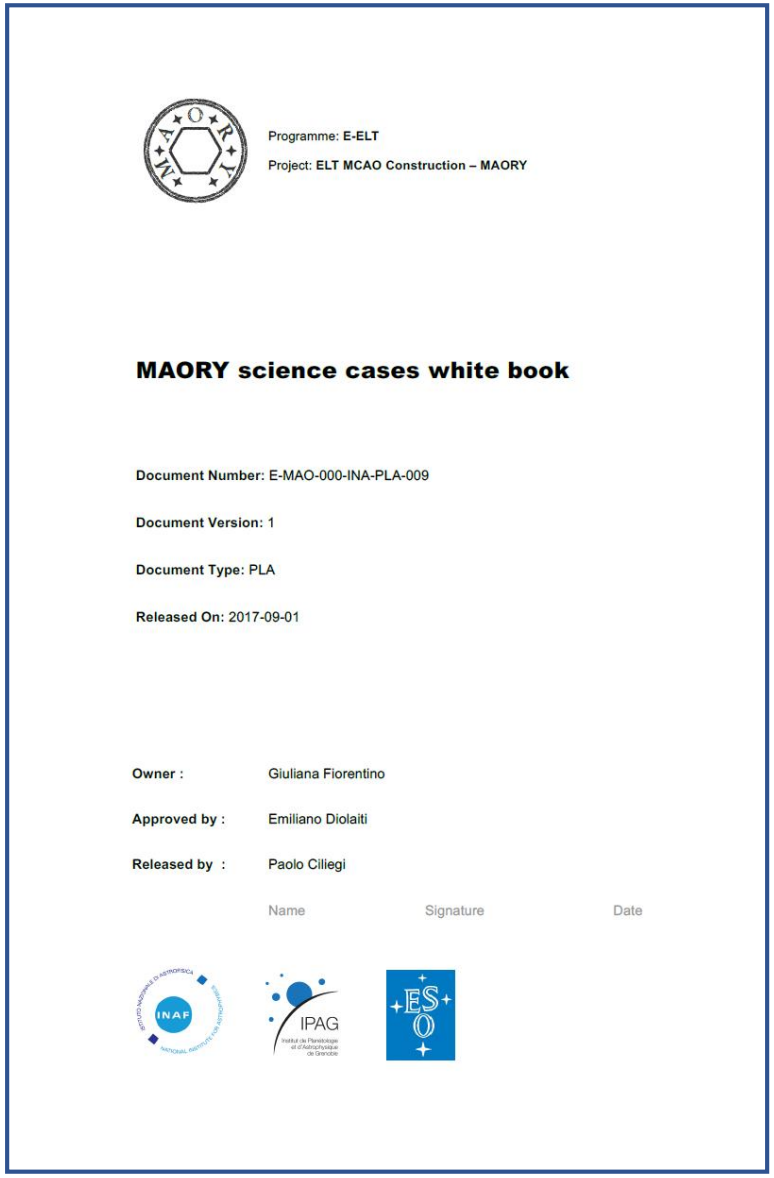
Owner :	Giuliana Fiorentino		
Approved by :	Emiliano Diolaiti		
Released by :	Paolo Ciliegi		
	Name	Signature	Date

45 MAORY – MICADO scientific cases

Broad Scientific community mainly from INAF and IPAG

To trigger the interest of the community at large on the MAORY project and on its scientifc capability

Update version during next years



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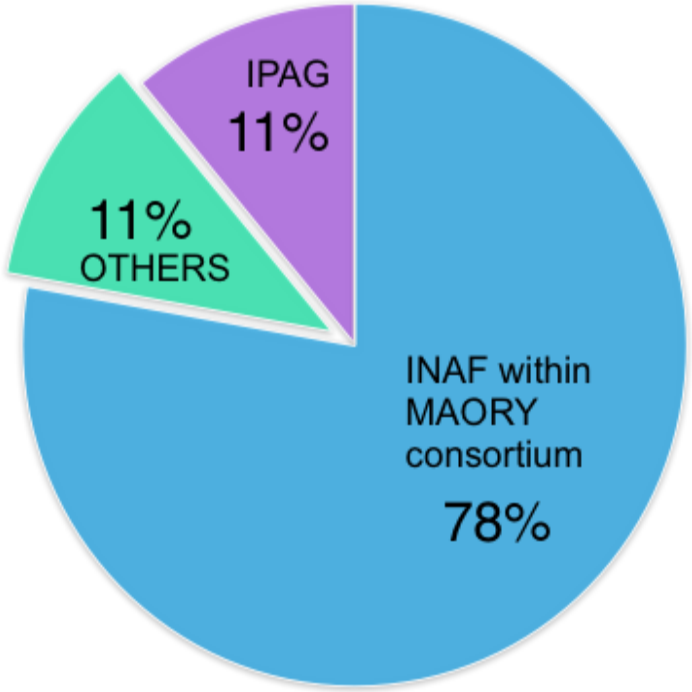
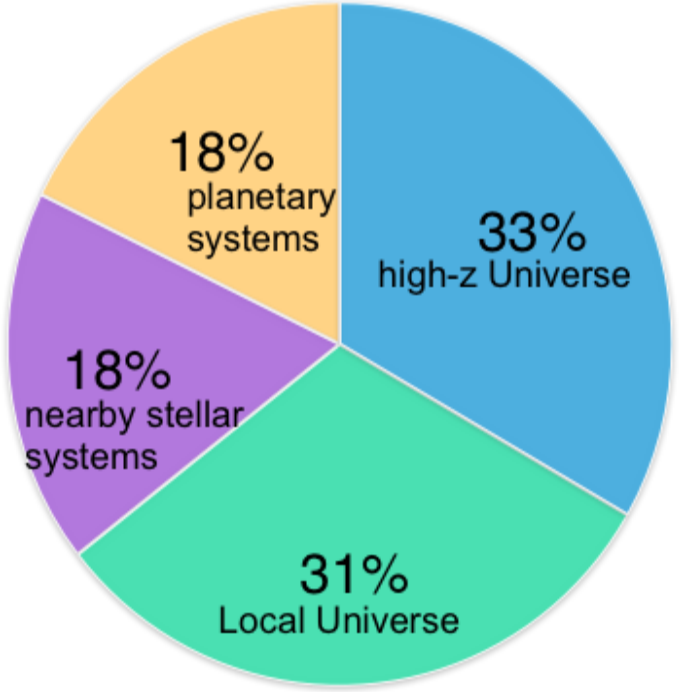
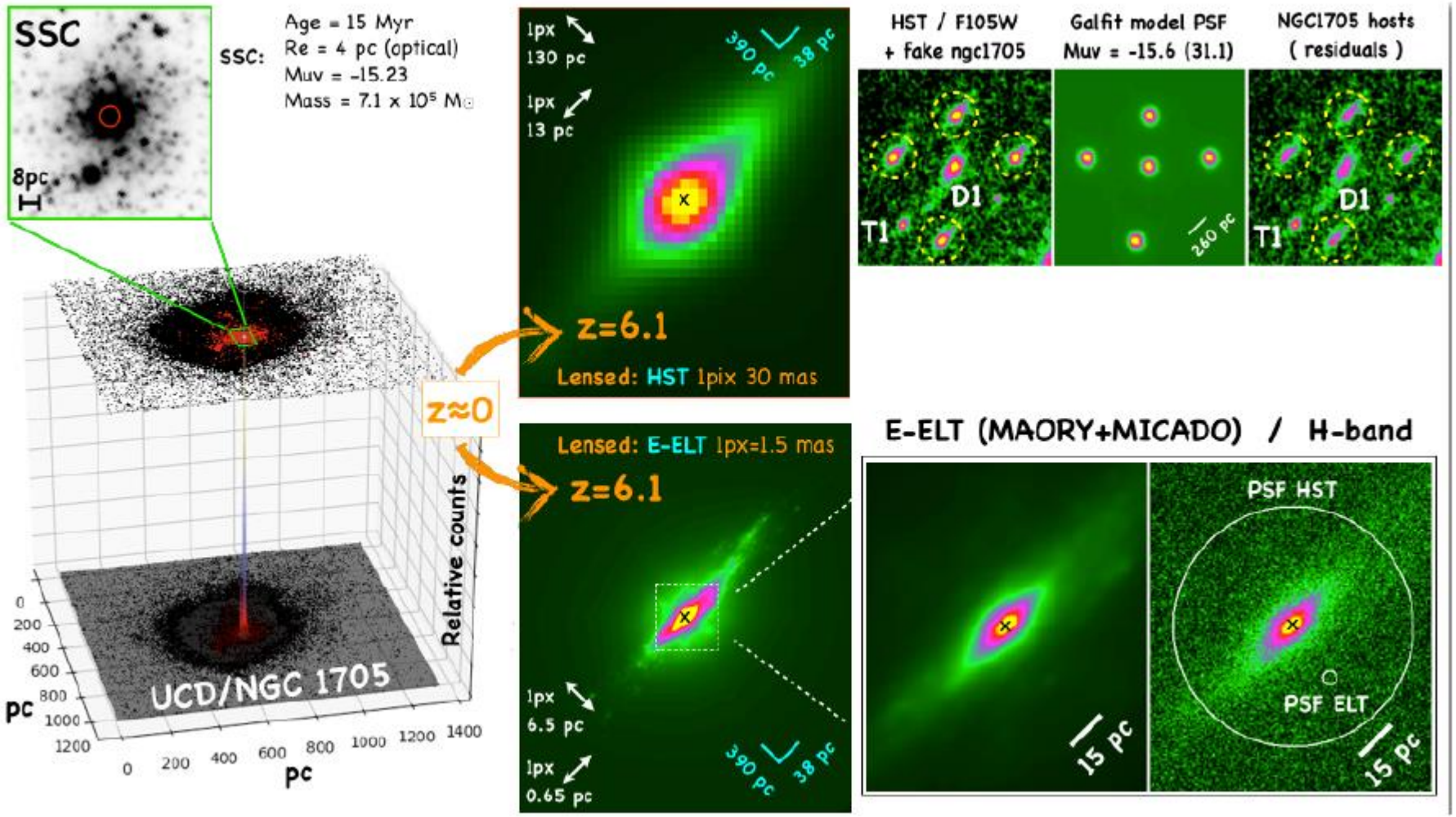




Affiliation of the PIs (left) and distribution of the different topics proposed, as divided by main streams (right).

Lensed dwarf galaxy NGC 1705



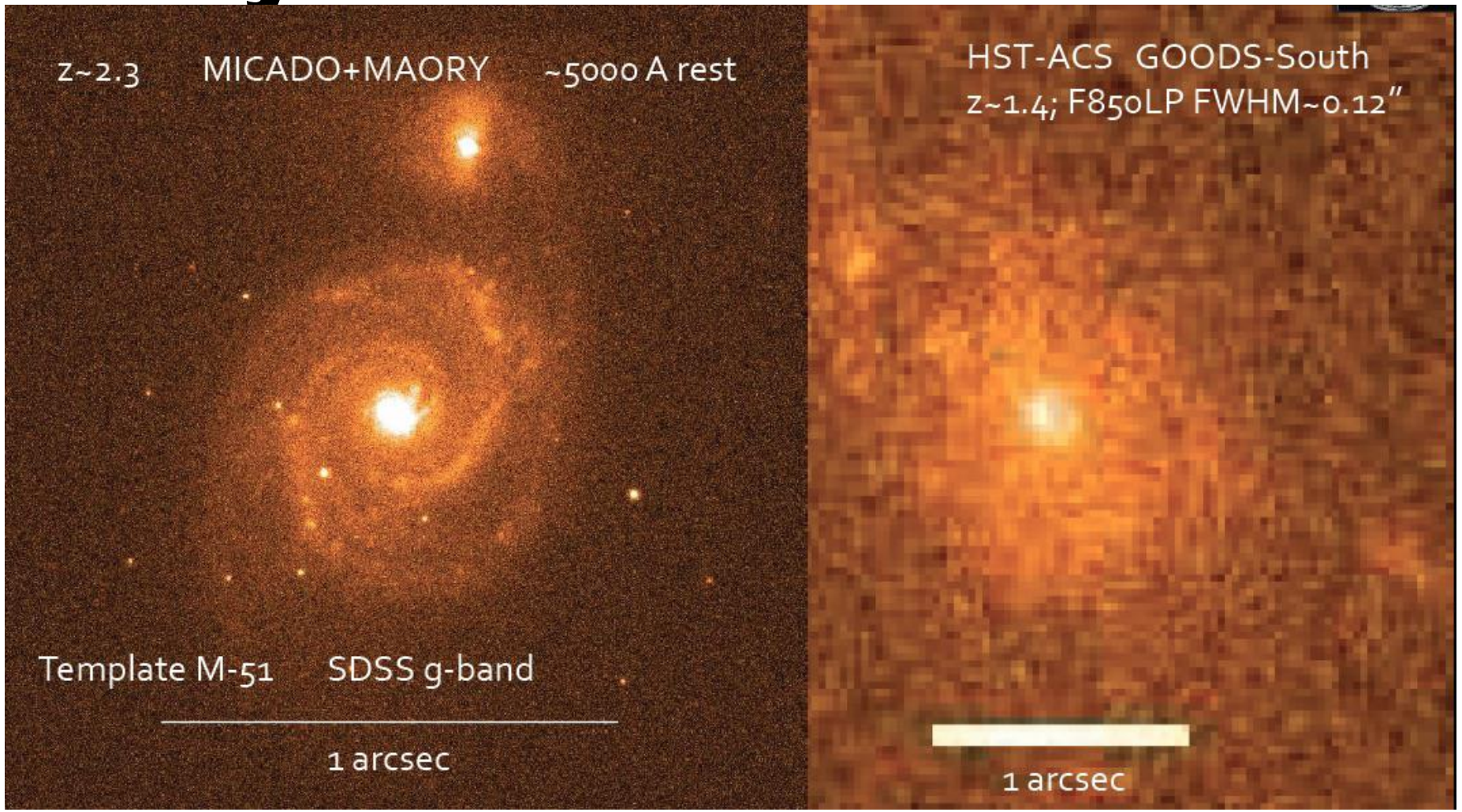
Vanzella et al. 2019
MNRAS, 483, 3618

We will able to detect Star Cluster at high z up to Re about 4 pc

More details

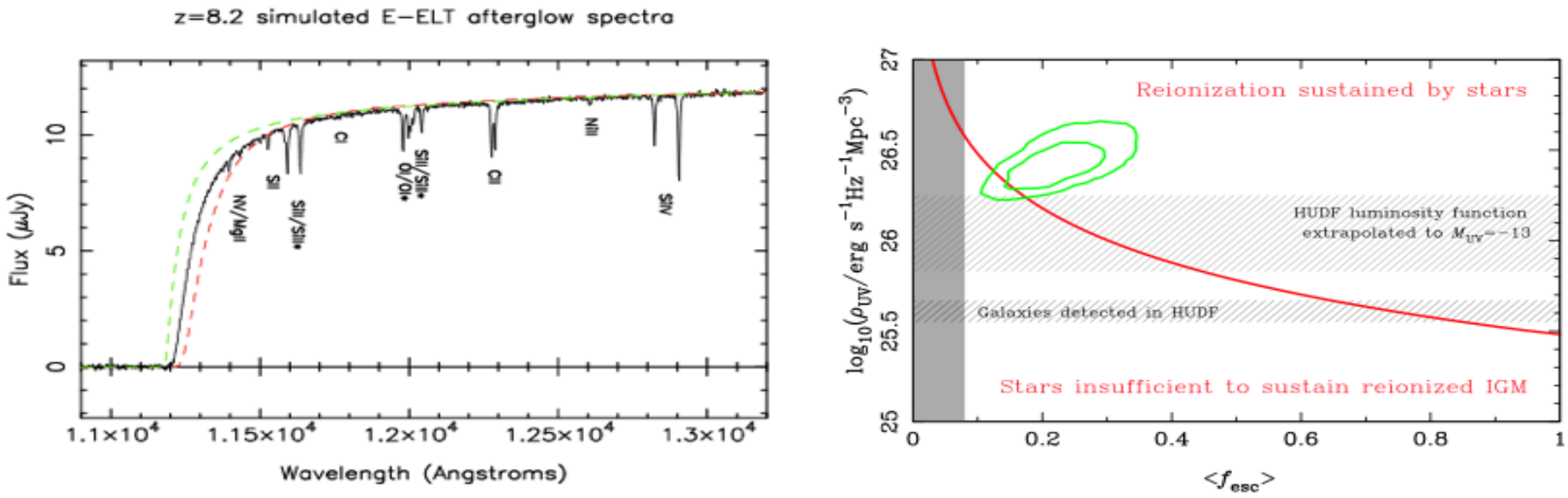
Talk Eros Vanzella
Wednesday 9:00 am

Simulated z=2.3 giant spiral galaxy as seen by MAORY+MICADO



Saracco et al. 2017
MAORY White Book

Exploring the Early Universe with Gamma-Ray Burst

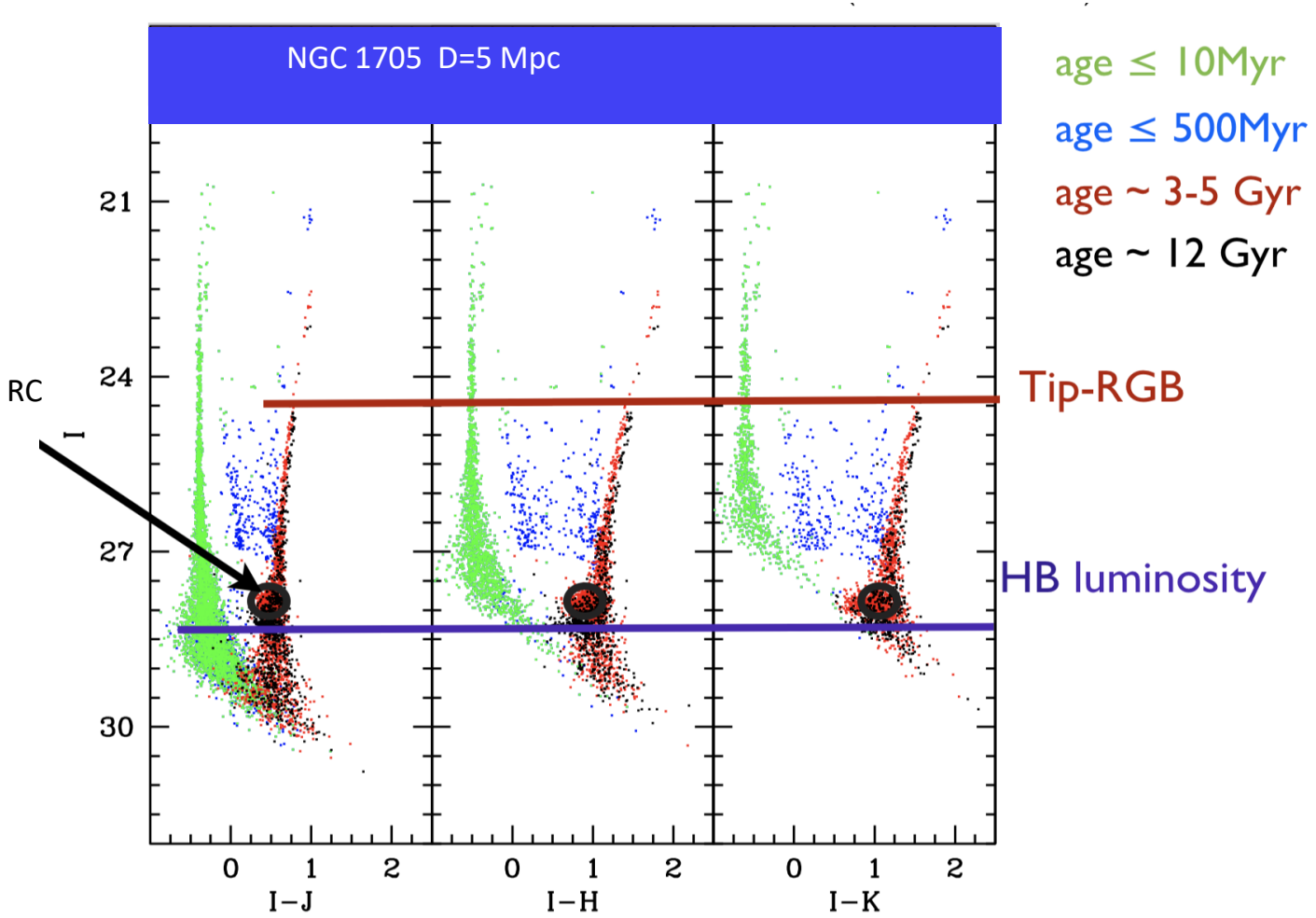


Simulated ELT 30 min spectrum of a faint GRB afterglow observed after ~1 day.

The S/N provides abundance determinations from metal absorption lines, while fitting the Lyman-α damping wing simultaneously fixes the IGM neutral fraction and the host HI column density, as illustrated by the two extreme models, a pure 100% neutral IGM (green) and best-fit host absorption with a fully ionized IGM (red).

Maiorano et al. 2017
MAORY White Book

Resolved stellar population studies of galaxies outside the Local Group



Simulated CM Diagram for blue compact dwarf NGC1705 at 5 Mpc (from G. Fiorentino).

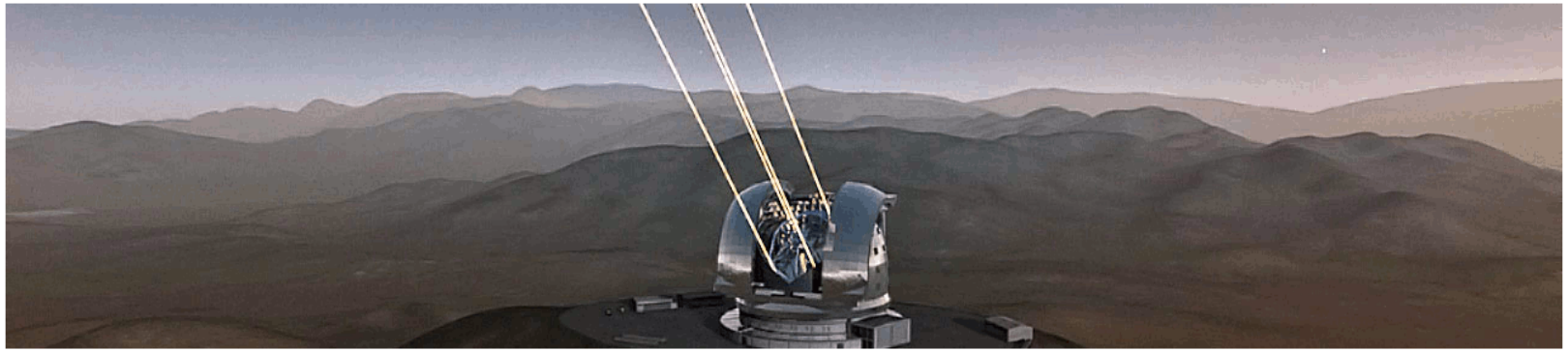
Deep photometry of individual stars down to the Horizontal Branch probing the earliest star formation history occurred in this system.

For more details talk Francesca Annibali , Tuesday 12:20

MAORY
Multi-conjugate Adaptive Optics RelaY for E-ELT

http://wwwmaory.oabo.inaf.it

http://wwwmaory.oabo.inaf.it/index.php/science-pub/



SCIENCE PUBLIC PAGES

WELCOME THE THE PUBLIC MAORY SCIENCE PAGES

In this page there are links to general public documents related to the MAORY scientific activities

- MAORY SCIENCE CASES WHITE BOOK NEW !!!!
- MAORY FOR DUMMIES : brief and handily summary of the characteristic of MAORY (and of the instruments fed by MAORY) based on the official documentation available at the epoch of the document release
- MAORY SCIENCE CASE TEMPLATE . A doc file with the template for the MAORY Science Case.
- MAORY SCIENCE CASE PRESENTATION PDF file with the presentation " T*aking Part in the ELT adventure : Science Cases for MAORY*"

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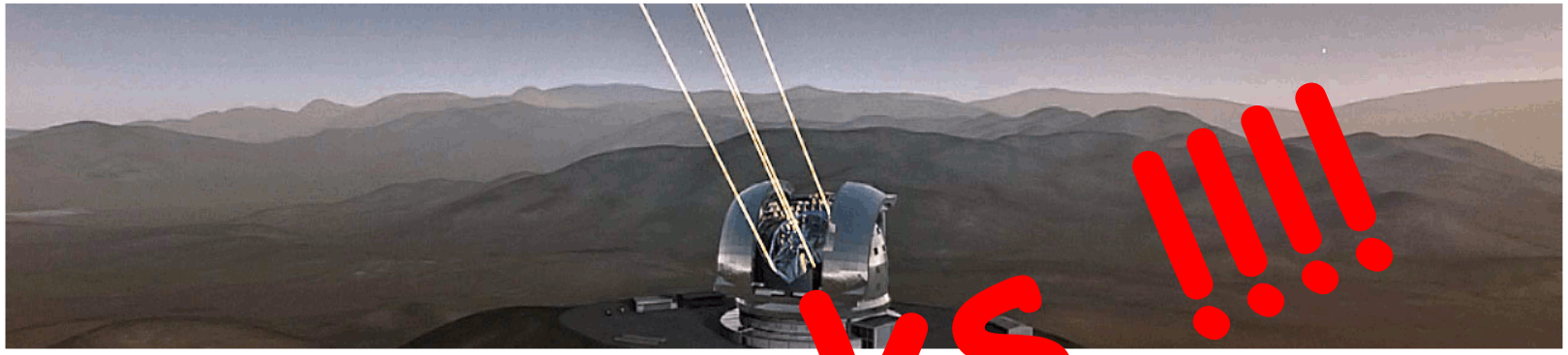

Thanks !!!!

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