MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

A new look at star formation history with the first-ever thousand-objects spectrometer that includes the near IR

- *Project overview and status*
- *Technical highlights*
- *Main scientific goals*
- *Team, plan & funding*
- *Perspectives & leadership*

MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Project overview and status

- Response to ESO call for new MOS instruments in 2010. Kick-off in 2014. First-ever (and so far only) massive MOS extending to the near IR .
- 1000 simultaneous apertures with D=1”, patrol f.o.v. of 500 sq.’ on 8.2m VLT, fast positioning time of fibers, possible deployment in pairs (obj-sky)
- Wavelength coverage 630-1800 nm. Two observing modes
  LR: Simultaneous full coverage at resolving power R~4000-6000, for faint objects
  HR: 3 simultaneous bands at selected λ‘s and higher R (up to 19000), for stars
- Very high throughput: >30% to optimize survey efficiency
- 300 GTO nights split in two main surveys coordinated among all partners
  - 200 nights for Extragalactic survey (LR mode)
  - 100 nights for Galactic survey (HR mode)

MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Project overview and status

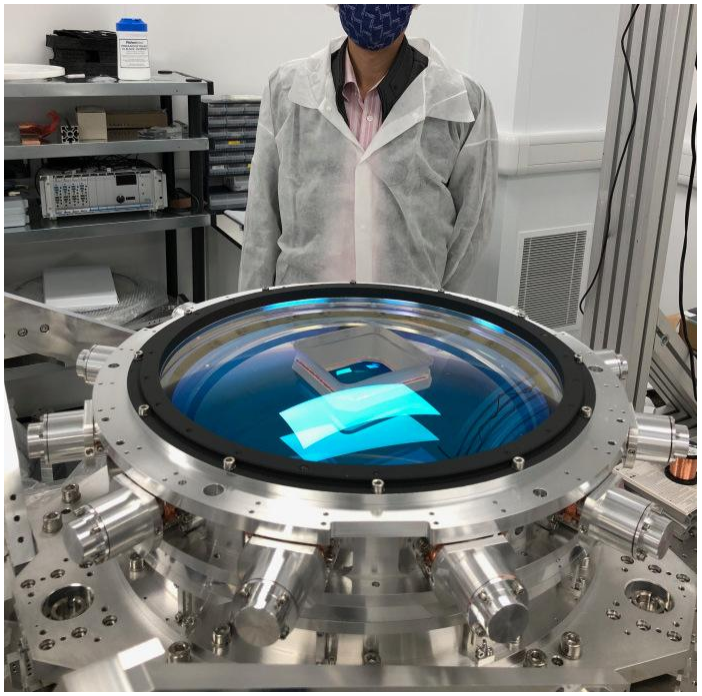
Milestone	Original Target	Status on May 2021	Risk based delay (weeks)
Kick-off	Oct 2014	Completed Oct 2014	-
Preliminary Design Review (PDR)	Oct 2015	Completed Oct 2015	-
Final Design Review – Optics only	Oct 2016	Completed Oct 2016	-
Final Design Review (FDR)	Feb 2017	Completed Mar2017	-
Integration Readiness Review (IRR)	Sep 2019	Completed May2020	-
Test Readiness Review (TRR) Front End	Feb 2021	Expected July 2022	32-38
Test Readiness Review (TRR) Spectrometer	Mar 2021	Expected Dec 2022	8-13
Preliminary Acceptance Europe (PAE) Front End	Mar 2021	Expected Sep 2022	32-38
PAE Spectrometer	Apr 2021	Expected Mar 2023	8-13
Preliminary Acceptance Chile (PAC)	Dec 2021	Expected Sep 2023	32-38+

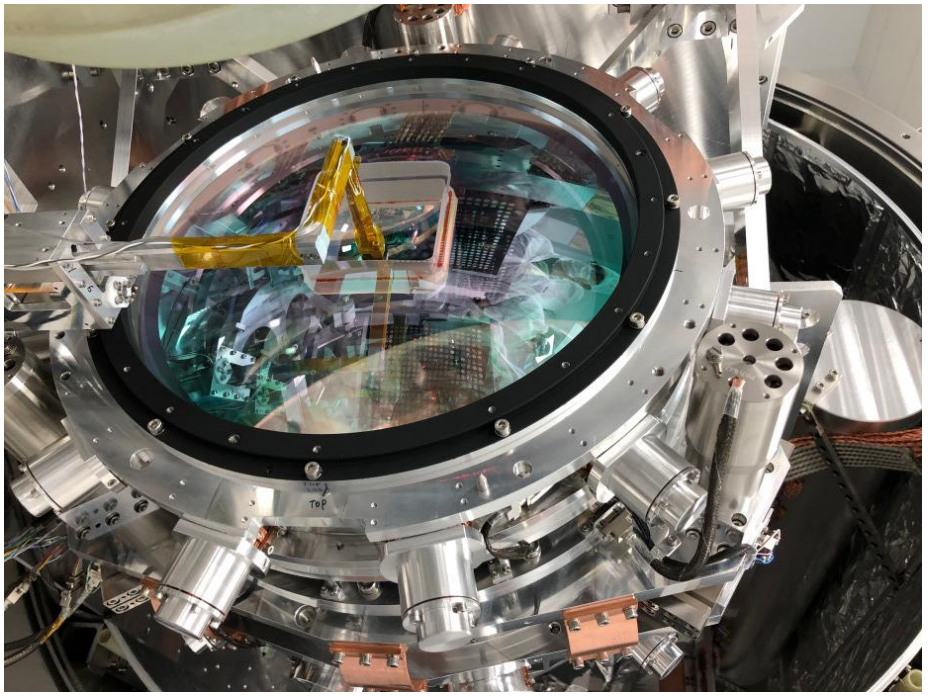
MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Technical highlights

The optical cameras of MOONS, with a focal aperture F/0.9, are the most extreme optics ever employed in an astronomical instrument. Designed in INAF-OA, they are the first-ever temperature-invariant cameras that can deliver the same optical quality at any temperatures ranging from 350 K to 1 K.





MOONS-VLT

Technical highlights

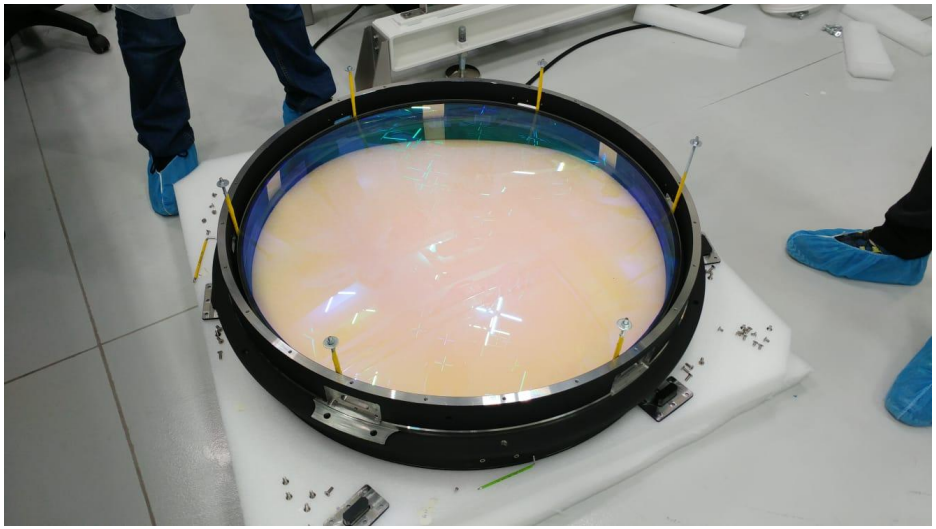
The cryogenic mechanisms for the selection of the MOONS dispersers, made by INAF-OA and ADS international (LC), are the largest high-accuracy cryogenic-mechanical systems ever developed for a ground-based astronomical instrument.

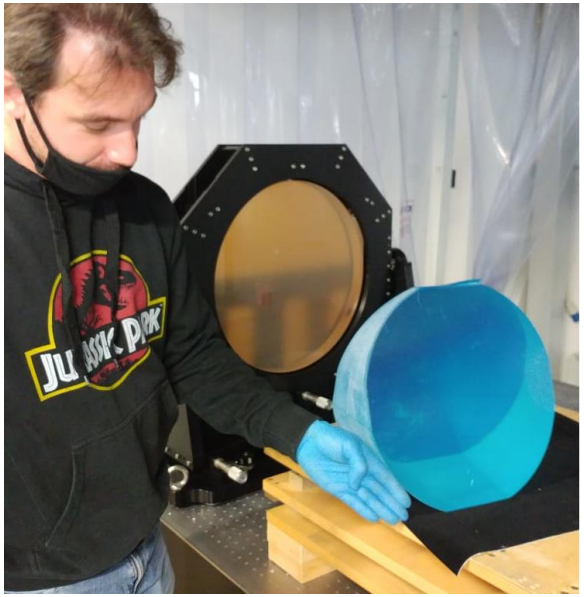
MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Technical highlights

The two lenses of the MOONS front-end corrector and the prisms for the MOONS HR-I dispersers are the largest and most massive optical dioptric elements ever produced by an Italian company (Officina Stellare, VI).





See also video at https://www.officinastellare.com/projects/the-eso-vlt-moons-lenses/

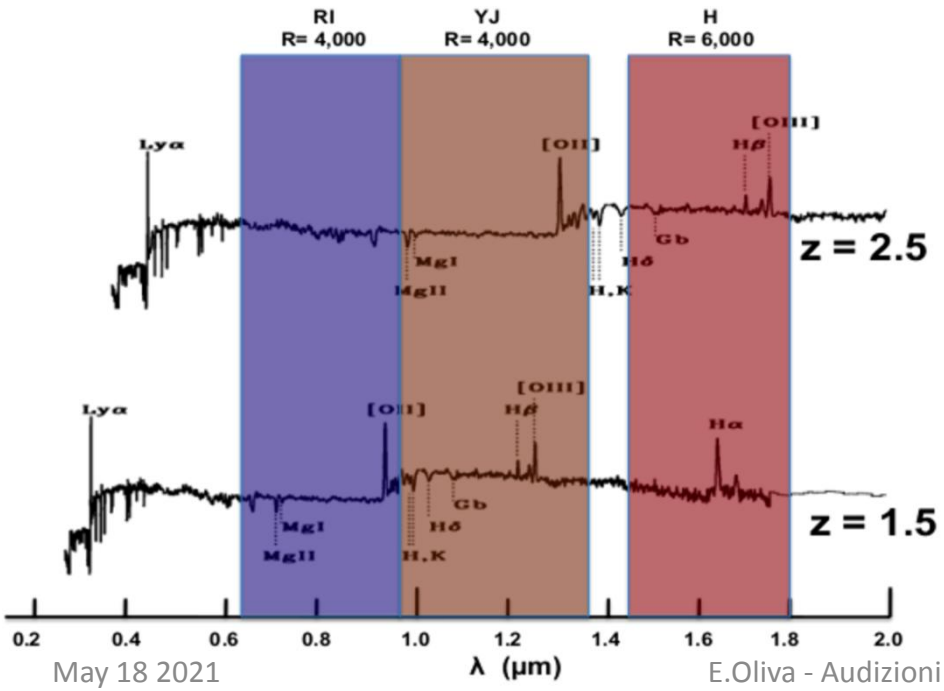
MOONS-VLT

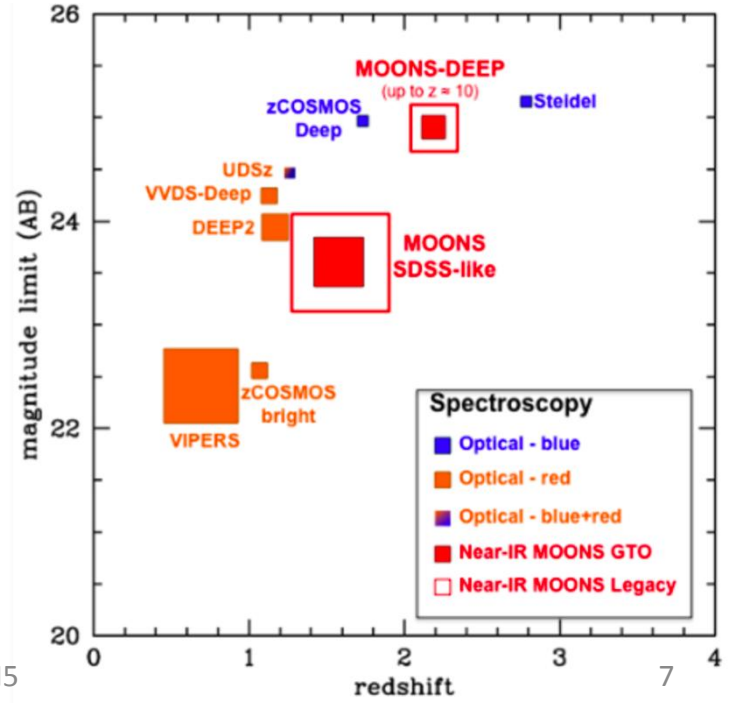
INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Main scientific goals

GTO #1 : Growth of Galaxies. 200 nights to perform:

- SDSS-like survey: 250k mag-selected galaxies over 10 deg^2 photometric z=0.8-1.8
  - → star-formation rates, metallicities, dynamical masses and trace the assembly history of galaxies over cosmic time.
- Deep Survey : 30k fainter galaxies over 2 deg^2 → redshift and basic diagnostics for galaxies in the redshift desert and follow-up of the earliest galaxies at z>7.

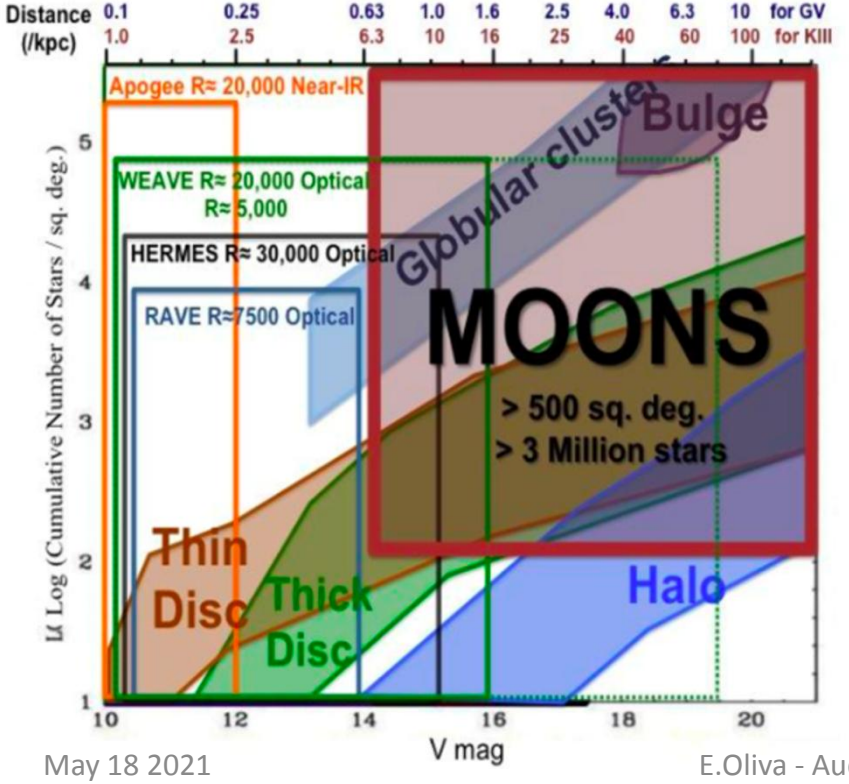


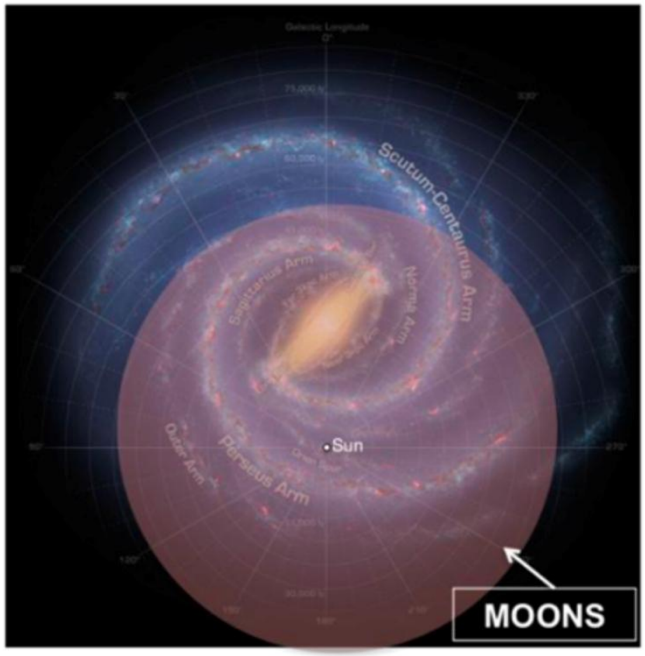


MOONS-VLT

Main scientific goals

GTO #2 : MOONS-GAL: 100 nights to obtain a complete kinematic and chemical screening of 500k red or reddened stars in regions that are prohibitive for other surveys at optical wavelengths and at 4m class telescopes, i.e. the inner disc+bulge of the Milky Way and its closest satellites (Sagittarius, Magellanic Clouds).





Chemistry and dynamics for all components of the Milky Way (Bulge, Disc and Halo)

MOONS-VLT

Team, plan & funding

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

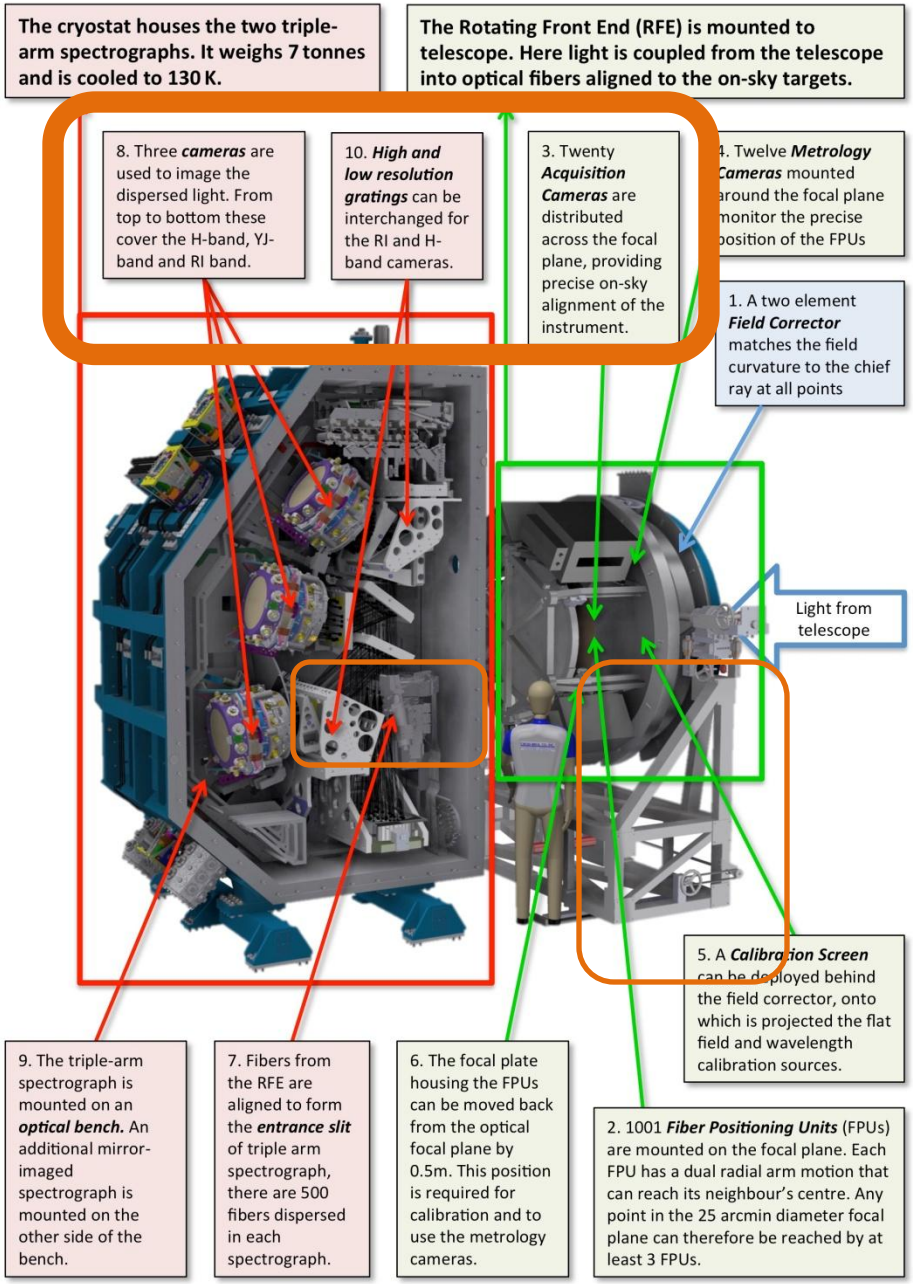
WBS construction phase

- Design Phases B, C & D1
  - 1.0 INSTRUMENT ROTATING FRONT END
    - 1.1 Rotating Front End Infrastructure
    - Calibration Source
      1.2 Calibration Source Module
    - 1.3 Acquisition Cameras
    - 1.4 Fibre Positioning Module
    - 1.5 Metrology Cameras
    - 1.6 Fibre Front End Assemblies
    - 1.7 Path Analysis and Anti-Collision Software
    - Rotating Front End Mounting Structure
    - Rotating Front End Cover
    - Retractor Module
    - Field Corrector
    - Installation & Maintenance Trolley
    - Local Control Electronics
    - Cable Wrap
  - 2.0 TRIPLE ARM SPECTROGRAPH
    - 2.1 Cryostat and Spectrograph Infrastructure
    - 2.2 Spectrograph Optics Design
      - Collimator
      - Dichroics Mounts
      - Disperser Exchange Modules
      - Fibre Slit-End Assembly
      - Shutter
      - Slit Module
    - 2.3 Spectrograph Front End
    - 2.4 Cameras I,YJ, H
    - 2.6 IR & CCD Detector Modules
    - 2.7 Detector Adjustment Modules
    - 2.8 Spectrograph Local Control Electronics and Software
  - 3.0 INSTRUMENT CONTROL SUB-SYSTEM
    - 3.1 Instrument Control Electronics
    - 3.2 Instrument Control Software (INS)
    - 3.3 Science Data Reduction Software
    - 3.4 Observation Preparation Software
    - 3.5 Instrument End-to-End Science Simulator

UK Astronomy Technology Centre · INAF · AIUC Centro de Astro-Ingeniería UC · University of Cambridge · ETH zürich · ESO · Université de Genève Faculté des Sciences · cnrs · ia instituto de astrofísica e ciências do espaço · l'Observatoire de Paris GEPI

Post Location

AIUC Chile	GEPI, PARIS France
CAAUL Portugal	INAF Italy
UKATC	ESO
University of Genèva	ETH



INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

WBS construction phase

UK Astronomy Technology Centre
INAF
AIUC
CENTRO DE ASTRO-INGENIERIA UC
UNIVERSITY OF CAMBRIDGE
ETH zürich
ESO
UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
cnrs
ia
instituto de astrofísica e ciências do espaço
l'Observatoire de Paris
GEPI
Galaxies Étoiles Physique et Instrumentation

Post Location

AIUC Chile	GEPI, PARIS France
CAAUL Portugal	INAF Italy
UKATC	ESO
University of Genèva	ETH

MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Team, plan & funding

FTEs and funds needed for technical works

Hardware is almost completed. Most of INAF FTEs and cash (950k€) were already invested. Sub-systems in charge to INAF were completed and delivered. Planning support to integration and commissioning, until 2014. No criticalities

Software is reaching a peak that will probably extend until 2015. No criticalities

Requirements for 2021-2023

- 6.3 staff FTEs
- 3.2 non-staff FTEs
- 300k€ , mostly travels

MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Team, plan & funding

FTEs and funds needed for science

The work of the Science Team is currently concentrated on the preparation of the surveys to maximize the scientific return. The science activities are expected to ramp up after the instrumental acceptance in Chile. The GTO nights will be distributed over 5 years, i.e. mid 2014 to mid 2020. A much increased FTEs contribution is expected in this period. Two dozens of young researchers and students have already expressed great interest in contributing to the project.

Requirements for 2021-2023

- 7.5 staff FTEs
- 1.2 non-staff FTEs

NB: MOONS will need about 3 non-staff FTEs/year from 2014 to 2020.

MOONS-VLT

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

Perspectives & leadership

- The GTO surveys are fully coordinated among all the partners, i.e. no “private” use of GTO. Formally, the partners will contribute to the science publications according to their shares. In practice, however, the strongest and most active partners will have ample opportunities to exploit the best scientific results.
- INAF is the second strongest partner with a nominal share of 18%. It is already over-represented in the science team (~22%). Many young researchers are in the waiting list, willing and ready to work on MOONS data.
- Given the scientific interest in the community, INAF has good chances to take advantage of the GTO data much above the nominal share.
- MOONS was also an opportunity to develop new technologies and to boost the collaboration with Italian companies. All with a quite low investment (~1 M€ so far, 10% of the hardware cost of the instrument).

- A good reference for ***HIRES-ELT***