AA-ANO2 ELT / MOSAIC

Brief description of the service

MOSAIC is the multi-object spectrograph (MOS) for the ESO Extremely Large Telescope (ELT-MOS). It will harness the full resolution of a 39-meter telescope, combined with Ground-Layer Adaptive Optics (GLAO) correction over a very wide field of view, to achieve unprecedented sensitivity. A vast array of scientific projects will be developed for MOSAIC/ELT—ranging from the study of the universe's first galaxies to the faintest stars in the local universe—engaging a broad community. MOSAIC features extensive wavelength coverage, spanning from the visible (0.39 microns) to the near-infrared (1.8 microns), and offers two observing modes: a high-multiplex mode (~200 objects) and a moderate spatial resolution mode (using IFUs in the NIR) with a multiplex of 8 objects. Thanks to this latter mode, MOSAIC will be the only instrument capable of conducting a comprehensive inventory of both baryonic matter (probing gas phases in the halo via UV lines redshifted into the visible at z ~ 3.5) and dark matter (mapping extended galaxy rotation curves at z = 2–4 in the NIR with GLAO assistance). In moderate-resolution spectroscopy (R = 5000), MOSAIC could surpass the JWST in detecting ultra-faint near-infrared sources, potentially offering up to two additional magnitudes of depth at this resolution, depending on the quality of sky subtraction. Simultaneous observations combining different modes and wavelength ranges will be possible. MOSAIC has been optimized to efficiently conduct surveys of faint objects.

The MOSAIC consortium comprises 24 partners across 13 countries (France, Austria, Brazil, Finland, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States), working in collaboration with ESO. Under the leadership of CNRS-INSU, French laboratories are heavily involved, notably holding the project lead and other system/sub-system responsibilities:

- PI, Project Manager for the Front End, mechanical and optical leads (LAM)
- Project Manager, co-PI, French Lead & PA/QA lead (UNIDIA)
- Instrument System Engineering (UNIDIA)
- Instrument AITV (LAM)
- NIR Spectrograph Optics (LAM)
- SSO (LAM & UNIDIA/LUX)
- Instrument System Engineering & Project Scientist (UNIDIA/LUX)
- Fiber Link (UNIDIA/LUX)
- Electronics and Instrument Control System: + EFOSOFT (IRAP)
- Optical Relays (OCA/Lagrange)
- Coordinators of Science Working Groups 1 and 2 (LAM)
- NIR Channel Scientist (LAM)

MOSAIC is the only instrumental project for the ELT with French Principal Investigator (PI) status—a P0 priority in the last three INSU strategic planning cycles (2014, 2019, and 2024)—and it will most likely be the first Multi-Object Spectrograph (MOS) on an ELT. Given how MOS instruments are used on existing telescopes, MOSAIC is expected to be in operation for more than half the observing time on the world's largest telescope; consequently, its design, definition, construction, and on-sky characterization

represent a major undertaking for the entire French and European astrophysics community, as well as for ESO.

Service Tasks (2026) :

- T**ask 1 (until instrument delivery): "Software Scientist".** The need for this specific task arose at the end of Phase B1. This task comprises several components, as follows:

  - Coordinate software development activities across the "Data Reduction Software," Observations Preparation ("ObsPrep") and "Survey Scheduling" work packages, noting that responsibility for the entire observation software suite lies with the French team.
  - Facilitate communication between developers in the aforementioned work packages and those working on the "CALEMOS" (Calibration Unit) work package—specifically the Calibration Scientist based at the Universidad Complutense de Madrid (Spain).
  - Ensure coordination between the aforementioned observation software development efforts and the Control System (EICS) work package, which is led by IRAP (Toulouse).
  - Actively participate in meetings of the PICCS group (MOSAIC Project/Instrument/Calibration/Channel Scientists)—comprising the Project Scientist, Instrument Scientist, VIS & NIR Channel Scientists, Calibration Scientist, and PI—and proactively contribute proposals to the group (aligned with the activities mentioned above).
  - Propose science-oriented validation tests for observation, calibration, and—at a later stage—scientific data analysis software.
  - Actively participate in meetings of the SSO (Science Software) work package, the volume and frequency of which will increase as the project progresses. Act as a liaison to ensure consistency between the work performed in this work package (under contract with ESO), the requirements of the Science Working Groups, and the priorities of the Channel Scientists.
  - During and after commissioning, propose and verify the implementation of necessary changes to the observation software, acting as a bridge between scientists and developers.

- **Task 2 (short term):** Implementation and operation of a focal plane simulator incorporating the optical responses of the entire instrument chain and the atmosphere, in order to validate the feasibility and execution times for key observations of representative objects that define the architecture's priorities (Phase B2).

- **Task 3 (short term):** Finalization of all technical specifications for the instrument (Phase B2). Observational testing of key specifications and instrument operability using data available from current and upcoming instruments (KMOS, MUSE, MOONS, etc.), as well as specific simulations.

- **Task 4 (short- to medium-term):** Optimization of sky subtraction for fiber-fed and multi-IFU instruments. Characterization of the optimal observational strategy for observing extremely faint objects. Analysis and characterization (light distribution) of the faintest sources of high scientific interest (ranging from the first sources in the distant Universe to stars or star clusters in the local Universe).

- **Task 5 (short- to medium-term):** Optimization of the instrument's simultaneous observing modes (VIS and NIR, medium and high resolution), which are highly complex and will be key for the community when preparing for major surveys with MOSAIC.

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- **Task 6 (up to instrument delivery):** Implementation and testing of algorithms and tools for observation preparation, data reduction, and analysis, as well as test data simulation for the DRS. This work is to be carried out within the SSO Work Package. The tools will be made available to the community, extending the scope of the tools required by ESO and delivered with the instrument.

These tasks often cut across different work packages and will need to evolve throughout the instrument's development cycle: progressing from subsystem specification and performance analysis to detailed modeling, and finally to characterization and validation during the integration and testing phases and subsequent on-sky commissioning.