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The KMOS Spectroscopic Public Surveys

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We summarise the steps leading to the call, selection, approval and start of operations of the *K*-band Multi Object Spectrograph (KMOS) Spectroscopic Public Surveys. Following the ESO Scientific and Technical Committee's recommendation, the process, which began in 2024, resulted in two KMOS public surveys, EMPOWER (extragalactic) and VVVX–GalCen (galactic). They began data acquisition in January 2026 and will collect data over the next three years. The survey management plans detailing the observing strategies, data reductions and data releases will be published on the ESO web pages.

First phase with submission of letters of intent

Following a recommendation by the ESO Scientific and Technical Committee, ESO issued a call for Letters of Intent for public surveys (PSs) with the *K*-band Multi Object Spectrograph (KMOS) on the Very Large Telescope in July 2024. This call was part of a multi-staged approach that first stimulated the community to identify consortia with novel scientific cases for KMOS and interest in pursuing a PS project. It then enabled the identification of synergies, which prompted the consolidation of similar ideas into compelling scientific proposals with legacy value for the broader astronomical community.

A PS is understood to be an observing programme in which the investigators commit to produce and make publicly available, within a defined time, a fully reduced and scientifically usable data set that is likely to answer major scientific questions and be of general utility and broad interest to the astronomical community. The raw data are made public immediately. A KMOS PS was envisaged to be an observing programme requesting up to 200 observing nights to be allocated over six semesters, with observations in both visitor and service mode. The KMOS instrument was offered with a guaranteed minimum of 20 working arms. Owing to the difficulty of using mosaic mode if individual arms fail/are missing, it was decided not to offer the mosaic mode in this call.

The deadline for submission of Letters of Intent for PS with KMOS was on 15 October 2024. The Public Survey Panel (PSP), chaired by Miguel Mas-Hesse, reviewed the Letters of Intent and suggested integrations and possible merging of projects with similar aims and observing strategies.

Nine Letters of Intent were submitted for the KMOS PS, covering a broad range of scientific topics, from Galactic (young stellar objects, star clusters, nuclear stellar discs of the Milky Way), through near-field cosmology (nearby clusters) to the evolution of disc galaxies at higher redshifts. The total time requested amounted to an oversubscription of a factor five of the total time available with KMOS. The proposed targets were well spread in right ascension and observations generally requested good seeing conditions ranging from 0.7 to 1.0 arcseconds.

Submission and selection of the KMOS PS proposals

The PSP triaged and ranked the Letters of Intent and proposed suitable mergers; the PIs of the Letters of Intent were informed of the outcome in February 2025. The PSP selection led to the rejection of five projects. Two projects targeting the Galactic plane and two extragalactic projects were invited to submit proposals, with the recommendation that they be merged into one Galactic project and one extragalactic project. One Galactic PS proposal and two extragalactic PS proposals were submitted by 17 April 2025. ESO could commit to one

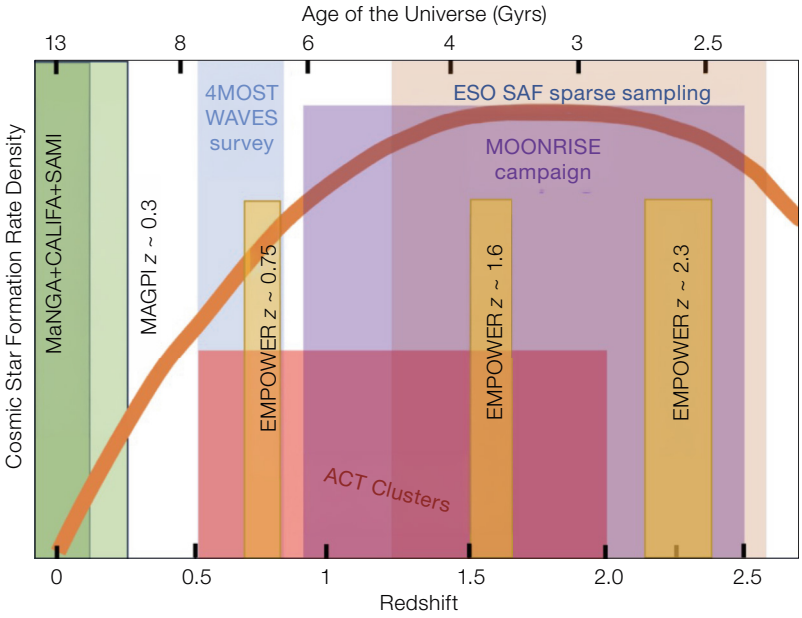

Figure 1. Redshift distribution of IFU (in black) and existing and upcoming spectroscopic surveys (in color). The EMPOWER redshift slices are indicated by the orange regions. The solid orange line indicates the evolution of the cosmic SFR density.

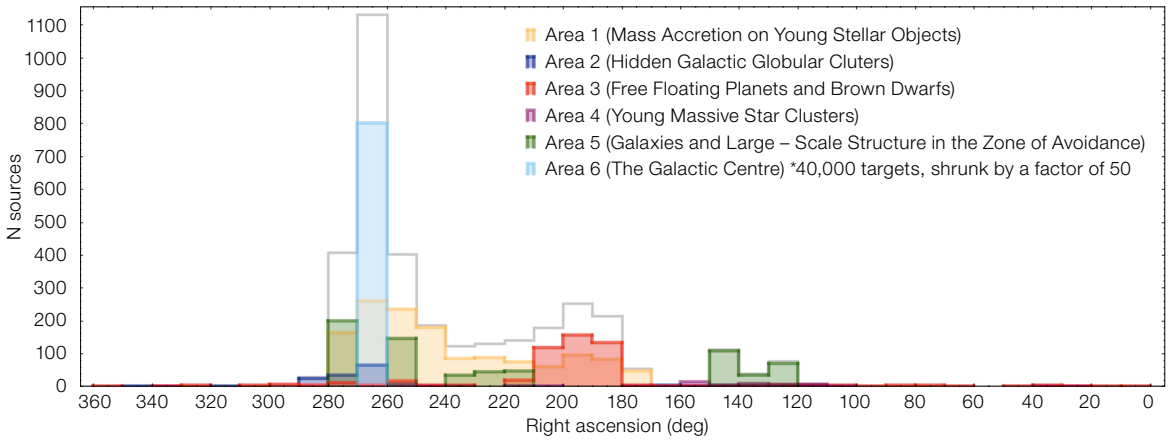

Figure 2. VVVX–GalCen Spectroscopic Survey targets for high-priority observations from different science areas (labelled 1 to 6), distributed along right ascension (RA). Area 6 has a total of 40 000 targets. Its histogram has been shrunk by a factor of 50 for visualisation purposes.

extragalactic project only. The period 116 Observing Programmes Committee (OPC), held in May 2025, recommended the implementation of the Galactic project and one of the two extragalactic projects. Any conflicts of interest were considered by including only non-conflicted members in the discussions and voting, as is routinely done in the OPC.

The two KMOS PS are[1]: the extragalactic survey — Emission line Mapping of the galaxy POpulation in the cosmic WEb enviRonments (EMPOWER), PI Paola Popesso (ESO) and the Galactic survey, the KMOS VVVX–GalCen Spectroscopic Survey, PIs Matias Gomez Camus (Andres Bello University, Chile) and Francisco Nogueras-Lara (Institute of Astrophysics of Andalucía [IAA-CSIC], Spain). The selected teams were invited to prepare a survey management plan (SMP), approval of which by ESO is mandatory before final acceptance of a PS.

The following conditions apply to the KMOS PS:

– No proprietary time is granted; raw data will become public immediately after observation and available to the world via the ESO Science Archive Facility (Romaniello et al., 2023).
– The ESO Science Archive Facility is going to be the repository of the survey products, both raw and science data products, and will provide the primary access to these products for the ESO community. Survey data products are to be prepared according to the ESO science data product standard and submitted in agreement with the policies for ESO Phase 3 (Arnaboldi et al., 2011). The teams are responsible for processing and validating the data products. Regular survey data product releases are expected every year.
– Progress of the approved KMOS PS is to be reviewed regularly by ESO on the basis of the yearly reports submitted by the teams. Corrective steps will need to be identified in cases where the survey execution is delayed or the data product delivery schedule cannot be maintained.

In what follows, we provide a brief overview of the main science goals and observing strategies of the extragalactic and Galactic KMOS PSs.

EMPOWER is a transformative PS that will expand the ESO KMOS Science Archive Facility with deeper and new observations. This ambitious integral field unit (IFU) campaign will target around 900 galaxies with $M_* > 10^{10}\ M_\odot$ across three key epochs, at $z \sim 0.75$, $z \sim 1.6$, and $z \sim 2.3$, which span the decline, peak and early rise of the cosmic star formation rate (SFR) density. EMPOWER is designed to answer fundamental questions in galaxy evolution: when and where do galaxies quench their star formation? What roles do mass, active galactic nucleus feedback and environment play in regulating star formation? How does the cosmic web shape these processes across cosmic time? EMPOWER will answer these overarching questions by sampling the full galaxy evolution parameter space — including stellar mass, SFR, nuclear activity and position within the Cosmic Web. It will deliver deep spatially resolved maps of dust-corrected SFR, metallicity, and ionised gas kinematics out to galaxy outskirts. By fully charting a galaxy's journey across both cosmic time and environment, EMPOWER will enable the broadest possible range of science for the community, standing as a true legacy resource for extragalactic astronomy. In Figure 1 we show the redshift distribution of IFU (in black) and existing and upcoming spectroscopic surveys (in colour).

The KMOS VVVX–GalCen Spectroscopic Survey builds on two very successful observational efforts: the wide-area, multi-epoch VVV/VVVX near-infrared survey and the high-resolution GALACTICNUCLEUS imaging of the innermost regions of the Galaxy. This is a diverse multipurpose survey aiming to serve the wider astronomical community. Its scientific objectives are to characterise eruptive young stellar objects and their environments across the southern disc, identify and measure the physical parameters for Galactic globular clusters hidden by extinction, confirm and measure nearby free-floating planets and brown dwarfs, characterise numerous young massive star clusters across the Galactic disc, classify nearby and distant galaxies and galaxy clusters in the zone of avoidance, revealing the large scale structure in the background, and conduct the first high-completeness spectroscopic study of the Galactic centre, revealing its star formation history, dynamics and structure. In Figure 2 we show the number of Galactic sources distributed in right ascension.

Observations for the KMOS PSs will be executed either in designated Visitor mode (remotely), in Visitor mode on

Paranal or in Service mode; the total allocation is 140 nights for the Galactic VVVX–GalCen Spectroscopic Survey and 145 nights for the extragalactic EMPOWER PS.

Next steps for the KMOS PS proposals

Following the selection of the KMOS PS proposals, the teams were invited to submit their SMPs. Given the extensive participation of ESO staff astronomers in the KMOS PS teams, the discussion of the SMP took into account potential conflicts of interest by including only non-conflicted members in the discussion and voting. Similar policies will apply should it come to actions during the surveys' operations, such as, for example, monitoring the progress of a survey.

Once the SMPs are approved they will be published on the dedicated ESO web page[1]. They detail the target selection, observing strategy, data releases and team composition. The start of data acquisition for the KMOS PSs was 1 January 2026. The runs scheduled in P116 are all carried out in visitor mode. They provide the opportunity for the survey teams to work hands-on with their observations, gaining experience in light of the very large allocation they will have in the future.

The two KMOS PSs join the successful endeavour of the previous 17 ESO PSs (Arnaboldi et al., 2019), which are now completed and whose scientific impact and legacy value led to tens of data releases[2] and the publication of nearly 2000 refereed highly cited (~100 000 citations) scientific papers. They will run in parallel to the 4-metre Multi-Object Spectroscopic Telescope (4MOST) PS whose science goals and strategy are illustrated in the 4MOST Survey Management Plan[3].

Acknowledgements

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References

Arnaboldi, M. et al. 2011, The Messenger, 144, 17
Arnaboldi, M. et al. 2019, The Messenger, 178, 10
Romaniello, M. et al. 2023, The Messenger, 191, 29

Links

[1] KMOS public surveys: https://www.eso.org/sci/observing/PublicSurveys/KMOS-surveys-projects
[2] ESO Phase 3 data releases: https://eso.org/rm/publicAccess#/dataReleases
[3] 4MOST Survey Management Plan: https://www.eso.org/sci/observing/PublicSurveys/4MOSTsmp

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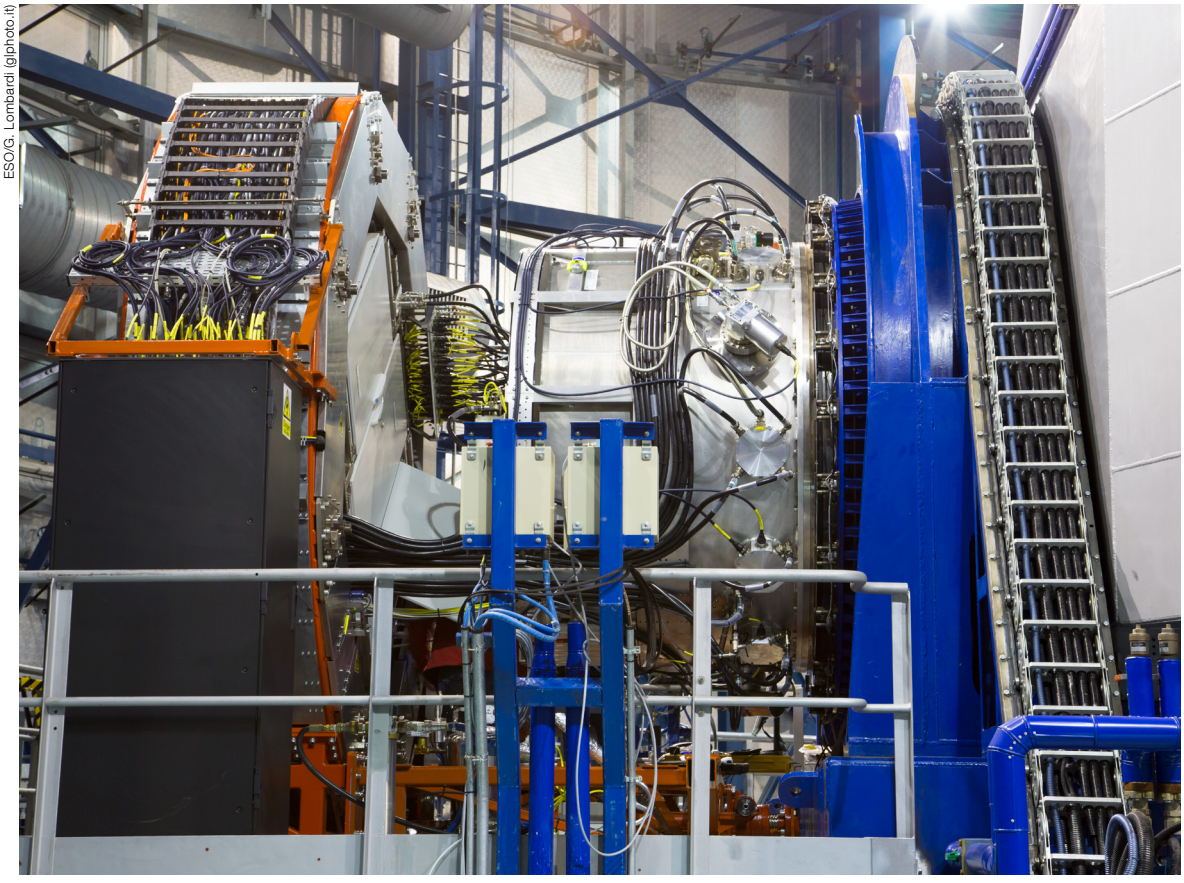

The KMOS instrument mounted on ESO's Very Large Telescope at the Paranal Observatory in Chile. KMOS is unique as it will be able to observe not just one, but 24 objects at the same time in infrared light and to map out how their properties vary from place to place. It will provide crucial data to help understand how galaxies grew and evolved in the early Universe — and provide it much faster than has been possible up to now. KMOS was built by a consortium of universities and institutes in the United Kingdom and Germany in collaboration with ESO.