BELGIAN CONTRIBUTIONS AT ESO

Belgian Excellence in the Space Sector : Advancing collaboration with ESO in Chile

June 2025

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Belgium is one of the five founding members of the European Southern Observatory (ESO), established in 1962 alongside Germany, France, the Netherlands, and Sweden. From the very beginning, Belgium recognized the value of a shared European approach to astronomical research — one that would surpass what any single country could achieve alone. This foundational commitment to ESO signalled Belgium's deep investment in scientific cooperation, large-scale infrastructure, and international collaboration. Since then, Belgian astronomers, engineers, and industry have actively contributed to and benefited from numerous ESO projects. Belgium currently finances approximately 3% of ESO's budget.

A Long Tradition of Scientific engagement

Over six decades, Belgian researchers have consistently contributed to ESO's scientific output. Institutions such as the Royal Observatory of Belgium, KU Leuven, Université de Liège, UGent, and ULB have engaged in a broad spectrum of ESO-related research, ranging from stellar astrophysics to cosmology and planetary science. Belgian scientists participate in instrument consortia, data processing teams, and science advisory committees, and have authored or co-authored many high-impact publications using data from the VLT, ALMA, and other ESO facilities.

This long-standing involvement means Belgium is not simply a user of ESO infrastructure, but an integral part of its scientific and strategic development. Belgian experts have also contributed to shaping ESO's priorities through their representation on governing bodies like the ESO Council[1].

Academic Impact and Talent Development

As a founding member, Belgium has used its position to foster the development of next-generation researchers through active participation in ESO's training programs and international networks. Belgian PhD students and postdocs benefit from access to ESO's world-class facilities and from collaboration with leading European research groups. Many Belgian students have taken part in ESO summer schools, workshops, and internships, helping them to build careers in astrophysics, instrumentation, and data science.

[1]Belgium counts two members of ESO's Council 2025 ; Dr Sophie Pireaux from the Belgian Science Policy Office (BELSPO) and Dr Emmanuel Jehin from the University of Liege. In the Finance Committee sits Mr Alain Heynen from the Belgian Science Policy Office. ESO's Scientific Technical Committee and subcommittee count on Dr. Olivier Absil from the STAR Institute in Liège. Finally, Prof. Denis Defrère from the Institute of Astronomy at KU Leuven is member of the Users Committee.

Belgium's early and continuous access to ESO's infrastructure has enabled its universities to design research-based curricula in astronomy, combining theoretical and observational expertise with real-time engagement in active missions and discoveries.

Industrial and Technological Contribution

Belgium's involvement in ESO is not only academic but also technological. Belgian firms, particularly in aerospace, optics, and precision engineering, have contributed to major ESO construction projects[2]. Companies such as AMOS (Advanced Mechanical and Optical Systems) have supplied high-precision components for ESO's large telescopes, including mirrors, supports, and mechanical systems.

The Extremely Large Telescope (ELT), now under construction, benefits from Belgian technological know-how — not only through components but also through collaborative engineering and system integration efforts. These contributions demonstrate the economic and technological return Belgium receives from its early and sustained engagement in ESO.

Thanks to the momentum created by the State Visit, the already close and long-standing collaboration between Belgian stakeholders and the European Southern Observatory will, without any doubt, be further consolidated and strengthened. This renewed engagement is expected to deepen scientific partnerships, expand industrial participation in cutting-edge instrumentation, and enhance opportunities for academic training and international mobility — reaffirming Belgium's commitment to advancing world-class astronomy through multilateral cooperation.

Christian de Lannoy

Ambassador of Belgium to Chile

[2] 124 contracts were awarded to Belgian companies in the period between 2015-2024.

The VLT in action

Credit: ESO/S:Brunier

PRESENCE OF BELGIAN COMPANIES AND UNIVERSITIES ON SITE

AMOS

Xavier Verians

xavier.verians@amos.be

www.amos.be

+32 4 361 40 40 ext 247

AMOS, as a supplier of world-class telescopes for astronomy and optical systems for space and science applications, has been a longstanding partner of the European Southern Observatory (ESO). The collaboration between AMOS and ESO started 30 years ago and resulted in numerous achievements, mostly related to the Very Large Telescope interferometer (VLTi) and the Extremely Large Telescope (ELT).

AMOS was involved at the early stages of the VLT project by delivering a seeing monitor used to estimate the level of atmospheric turbulence at Paranal and by performing studies of the VLT forks. During the VLTi construction, AMOS designed and manufactured the four Auxiliary Telescopes and their transporters that are roaming on the platform of the VLTi. It also built the twelve Adaptor-Rotators of the four VLT units, the carriage system to extract the VLT mirrors of the telescope and bring them down on a transporter for their recoating, and the washing unit of the 8m mirrors.

Regarding the ELT, AMOS contributed, as for VLT, to preliminary studies. AMOS is now under contract with the consortium building the ELT structure to provide engineering expertise on two critical aspects: the computation of how the telescope structure will impact the resulting image; and how to control with exquisite precision the slow movement of the gigantic ELT structure to accurately track stars. AMOS also polished the M4 support plate, which is the optical reference of the ELT, and produced some test mirrors for the M4 subsystem.

CENTRE SPATIAL DE LIÈGE (CSL)

Serge Habraken

shabraken@uliege.be

+ 32 (0) 4 3824 635

The Centre Spatial de Liège (CSL) is renowned for its calibration and qualification of optical instruments on board satellites. The CSL is involved in most of the European Space Agency's missions. The research activities are focused on technologies related to optics and thermos-mechanical systems.

CSL has a limited history of involvement in the field of ground-based telescopes, despite the similarity of the focal plane instruments. It should be noted that the requirements are diverging, with volume and mass being of particular importance for space systems. Thanks to the very close collaboration with the ULiège astrophysics department, CSL intends to extend his expertise in ground-based telescopes. This historical proximity has already given rise to a few renowned technologies:

The early 2000s saw the development of the vortex phase mask for coronagraphs, a key technology for direct imaging of exoplanets with ground- and space-based telescopes. This collaboration, which included the present manager of CSL, Serge Habraken, and is now driven by the group of Olivier ABSIL at ULiège, was instrumental in this development.

Between space and ground, technical and scientific synergies are obvious and concern CSL:

Laser-based satellite telecom systems require ground-based telescopes for operation.

Research in secure quantum communication systems is currently being undertaken at the Ph.D. level.

A visit to Paranal is vital for strengthening the connections between space-based and ground-based instrumentation.

GHENT UNIVERSITY

Pablo Marchant

pablo.marchant@ugent.be

www.ugent.be/we/physics-astronomy/en/research#Other

UGent researchers are deeply embedded in the scientific exploitation of the world-class observational capabilities of ESO. The data collected at ESO observatories are a critical pillar of their ongoing astrophysical research, enabling high-impact scientific discoveries across a wide spectrum of fields. Specific examples of this are:

- Prof. Arjen van der Wel is the PI of the Public Spectroscopic Survey LEGA-C, a 100+ night VLT program (largest 8m galaxy survey worldwide, together with its "sister survey" VANDELS). He was also user committee representative for ESO in Belgium and has spent over 300 at Paranal for visitor mode observations.
- Prof. Ilse De Looze is a co-I on the ALMA Large Program REBELS, and co-PI on the ALMA Large Program CRISTAL, both projects have just finished and focused on analysing [CII] and dust continuum in high-redshift galaxies. Not sure if that's useful for this specific visit, since the ALMA site won't be visited.
- Dr. Sharon Meidt van der Wel is a founding member of the PHANGS collaboration, and co-I on all its succesful large programs for the VLT and ALMA. PHANGS aims to understand the interplay of the small-scale physics of gas and star formation with galactic structure and galaxy evolution.
- Prof. Pablo Marchant is actively involved in two major international collaborations that make extensive use of VLT data. In particular the BLOeM large program for the VLT/FLAMES is studying ~1000 massive stars in the nearby Small Magellanic Cloud

KU LEUVEN

Prof. Denis Defrère

denis.defrere@kuleuven.be

www.denis-defrere.com

+32 494 21 71 99

The Institute of Astronomy is closely linked to the European Southern Observatory (ESO). In addition to extensively using ESO facilities for cutting-edge scientific research, the institute is actively involved in the development of the observatory.

KU Leuven's' contributions to new ESO telescopes and Infrastructure:

- Extremely Large Telescope (ELT): KU Leuven is part of the international consortium developing METIS, a mid-infrared imager and spectrograph.
- Very Large Telescope Interferometer (VLTI): KU Leuven hosts the Belgian VLTI Expertise Centre and plays a key role in the development of the Asgard/NOTT and GRAVITY+ instruments.
- BlackGEM Telescope: KU Leuven is part of the telescope consortium, located at ESO's La Silla Observatory in Chile.

ESO Science Exploitation at KU Leuven

Researchers at KU Leuven rely on ESO observations and lead multiple 'ESO large programs', designed to tackle high-impact scientific questions. Active areas of research include:

- Massive & binary stars (FEROS, FLAMES, UVES, SPHERE, …).
- Exozodiacal dust around nearby stars (VLTI).
- Circumstellar environment of evolved stars (ALMA, VLT, …).
- Stellar parameters of pulsating OB-stars (UVES, FEROS).
- Circumstellar disks around evolved binary stars (VLTI).

Key discoveries:

Recent highlights include:

- The debunking of the "closest black hole" to Earth, revealing a rare "vampire" star system (VLTI, Muse).
- Identifying dust as the cause of Betelgeuse's great dimming (SPHERE).

Profs. Van Winckel, Defrère, and Sana have served on several ESO committees and working groups. Prof. Sana is a former ESO instrument scientist for UVES.

SOLCOR

Simon Hendrick

simon@ematchile.com

www.socorchile.com

+56 9 3426 1279

SOLCOR has completed the installation of the Paranal-Armazones photovoltaic plant, which will generate 9 MW of solar power—sufficient to supply the ELT (Extremely Large Telescope) and VLT (Very Large Telescope) facilities during daylight hours, particularly for their energy-intensive cooling systems. Spanning 7.2 hectares and equipped with 18,565 solar panels, the plant stands as one of the largest solar complexes in Chile. It represents a flagship achievement in Belgian-Chilean technological cooperation.

SPACEBEL

Eric Lardinois

Eric.lardinoisspacebel.be

www.spacebel.com

+ 32 2 658 20 21

At the beginning of the year 1993, **SPACEBEL** won a major contract with ESO for the Very Large Telescope (VLT) project at Cerro Paranal in Chile consisting of four main telescopes and four movable auxiliary telescopes. The contract covers the development of a generic software system for real-time control of all telescopes making up the VLT.

Real-time control of the VLT and its associated instruments is carried out by interconnected microprocessor systems known as LCUs (Local Control Units). Each LCU runs application software specific to the required type of control.

SPACEBEL designed and developed the « Local Control Units Common Software », i.e. the basic software used by the software applications running on each Local Control Unit (LCU). Beyond ESO, SPACEBEL continues has brought its expertise in terms of Earth observation applications to Chile's mining industry.

UNIVERSITÉ DE LIÈGE

Emmanuël Jehin

ejehin@uliege.be

www.star.uliege.be

+32 4 366 97 26

The SPECULOOS Southern Observatory (SSO), funded by the ERC and supported by the European Southern Observatory (ESO), is led by the University of Liège at ESO's Paranal Observatory in Chile. Comprising four 1-meter telescopes, it is dedicated to detecting Earth-sized exoplanets orbiting ultra-cool dwarf stars. Under Professor Michaël Gillon's leadership, the project focuses on monitoring nearby, often-overlooked stars using the transit method. Equipped with sensitive infrared cameras, the telescopes detect minute dips in starlight caused by planets passing in front of their host stars.

In 2021, astronomers from the ULiege-STAR Institute made a groundbreaking discovery using ESO's Very Large Telescope (VLT): they detected iron and nickel in the atmospheres of comets throughout the Solar System, including those far from the Sun.

In collaboration with KU Leuven, the ULiège is also developing coronagraphic masks—key optical components for the Mid-infrared ELT Imager and Spectrograph (METIS). These will enable the ELT to directly detect and characterize exoplanets, addressing one of its most critical scientific goals.

Renowned scientists at the University of Liège

Professor Emmanuel Jehin completed his Ph.D. in astrophysics (ULiège) before spending seven years in Chile as an instrument scientist for the FORS instrument on the VLT. Returning to Belgium, he joined the STAR Institute, where he holds a permanent FNRS-funded research position and teaches space science. He received the FNRS Wernaers Prize, and the International Astronomical Union named an asteroid after him.

Professor Michaël Gillon leads the TRAPPIST project, which gained worldwide acclaim for discovering the TRAPPIST-1 system, featuring seven Earth-sized exoplanets, three within the habitable zone.

UNIVERSITÉ LIBRE DE BRUXELLES

Sophie Van Eck

Sophie.van.eck@ulb.be

www.astro.ulb.ac.be/~vaneck/

+32 2 650 28 63

ULB and its Institute of Astronomy and Astrophysics have a robust partnership with the European Southern Observatory (ESO), leveraging ESO's telescopes for groundbreaking research. Several faculty members, including Pr. Alain Jorissen, Pr. Sophie Van Eck and Dr. Thibault Merle, have strong ties with ESO, having served in various roles (as ESO fellows and OPC members) and obtaining competitive observing time on a regular basis. Several ULB alumni have now permanent positions at ESO.

ULB's expertise in spectroscopy and interferometry has led to significant advances, such as the discovery of lead-rich stars, the development of stellar thermometers and chronometers, and in interferometry of late-type stars leading to landmark observations of convective features on the surface of the red giant star π^1 Gruis, all published in the Nature Journal.

Current ESO programs involving ULB researchers include VLTI instrument GRAVITY observations to resolve the 3D orbits of a quadruple system that we recently discovered, studies on black holes, compact multiple systems, and nucleosynthesis diagnostics in stars formed early in the Galaxy history. These projects highlight the crucial role of ESO facilities in advancing stellar astrophysics at ULB, demonstrating the institute's commitment to pushing the boundaries of astronomical research.

Finally, BLU-ULB, the Brussels Laboratory of the Universe, brings together all the research groups active in the field of space research within ULB. Theoretical cosmology, astrophysics, the composition of planetary atmospheres, Earth observation, microgravity

UNIVERSITY OF ANTWERP

Prof. Nick Van Remortel

nick.vanremortel@uantwerpen.be

www.uantwerpen.be/en/staff/nick-vanremortel/research/

+32 32 65 35 68

Katrien Kolenberg is a member of the Belgian National Committee on Astronomy and the Belgian National ESO Committee. She is in close contact with colleagues from ESO Paranal Observatory.

Nick Van Remortel has no active collaboration with ESO, but he would like to strengthen ties with ESO. There is certainly interest from the gravitational wave community to use ESO data and perhaps even interest to develop instruments.

Marc David was involved in several observing projects using instruments from the ESO La Silla observatory between 1986 and 2003. His contribution was in the theoretical field, in data reduction and interpretation of the resulting high-resolution spectra for the measurement of the radial velocity of stars, to investigate the kinematics and dynamics of young star systems.

Later, he was active as a member of the 'single-transition analysis' team for processing spectroscopic data provided by the ESA Gaia mission, a team led by Dr Ronny Blomme of the Royal Observatory of Belgium.

OTHER BELGIANS COMPAGNIES CONTRIBUTING AT ESO

In addition to the previously listed universities and compagnies, two other Belgian companies have been contributing to ESO. Even if they are not part of the official State Visit Delegation, they are other examples of the Chilean-Belgian cooperation at ESO.

AGC Glass Europe

AGC Glass Europe has begun work on the supply of a magnetron sputtering coating plant as part of its contract with the European Southern Observatory (ESO). This high-precision facility will be used to coat the mirror segments of the Extremely Large Telescope (ELT), which will be the world's largest optical telescope. The €10.3 million contract was awarded to AGC in 2018.

SEAQX

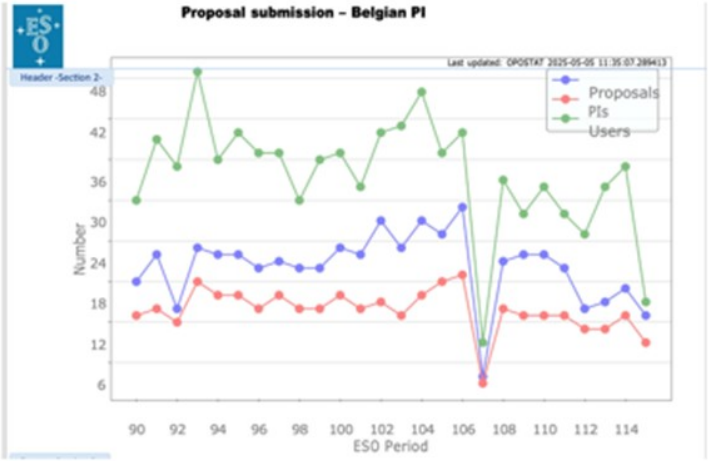
SEAQX Engineering & Production contributed on the ELT Internal Transporter for a value of 0.3 million Euros in 2023. SEAQX specializes in the design and production of modern transport solutions for the industry. They build innovative machines that facilitate the handling of loads ranging from a few 1000 kg to several hundreds of tons.

ADDITIONAL INFORMATION PROVIDED BY ESO

ESO time allocation at La Silla Paranal

Overview, all ESO telescopes (P90-P115, 2012-2025)

All LPO telescopes	Requested time (hours)	Allocated time (hours)
All countries	632,000	208,000
Belgium	11084	3838



ALMA time allocation

Overview – All investigators (PIs, co-PIs and co-Is)

Belgian investigators get overall a success rate above that of European and worldwide investigators when all proposals are taken into account, in all Arrays. They are well above average in their success rate in the 7-m and TP array.

Array	Requested time (hours) [Total 12-m/7-m/TP]	Allocated time (hours) [Total 12-m/7-m/TP]
Total	31608/12994/8928	4107 (13.0%) /2204 (17.0%) / 2203 (24.7%)
Europe	13438/5644/3417	1688 (12.6%) /869 (15.4%) / 617 (18.1%)
Belgium	123/58/69	20 (16.3%) /17 (29.3%) / 23 (33.3%)

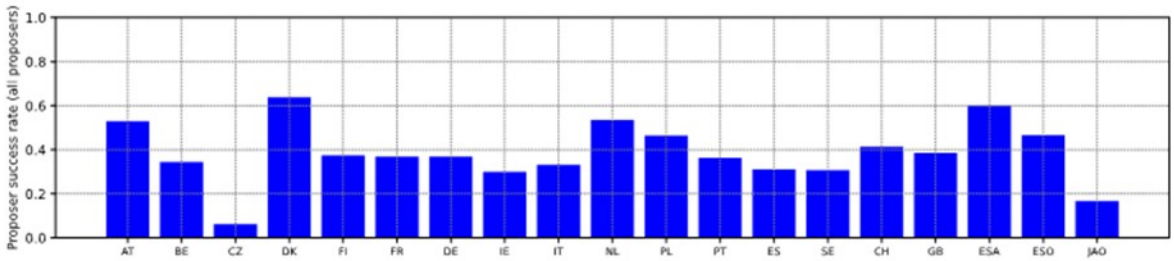
ADDITIONAL INFORMATION

ALMA time allocation

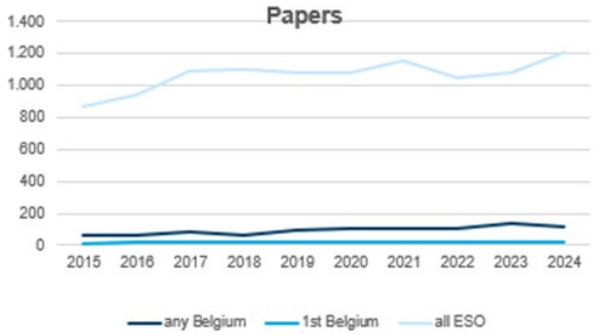
12-m Array - All investigators (PIs, co-PIs and co-Is)

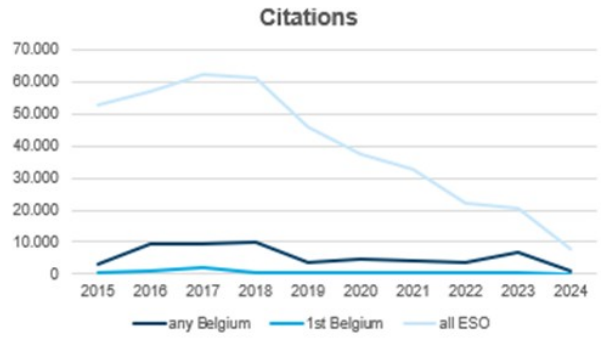
Belgium has a proposer success rate* in the 12-m Array similar to most ESO countries (34% in Belgium versus an average of 38%)

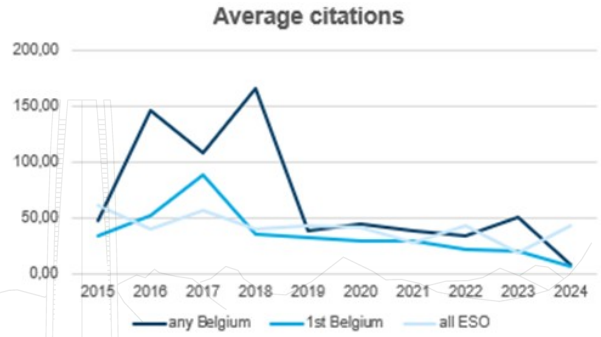
*Number of proposers that got time allocated divided by the total number of proposers



Belgian Publications







Total solar eclipse, La Silla Observatory, 2019

Our warmest thanks to the ESO staff for making this visit possible.

Credit: ESO/P.Horálek

NOTES

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STUDY IN BELGIUM

Wallonia.be EXPORT INVESTMENT

Flanders State of the Art

hub.brussels our business is to help yours