20 YEARS

SOUTHERN AFRICAN LARGE TELESCOPE

ANNUAL REPORT 2025

SALT CELEBRATES 20 YEARS OF SCIENCE, COMMUNITY AND COLLABORATION

This year marked SALT's celebration of two decades of cutting-edge astronomy and world-wide collaboration. Inaugurated in November 2005 as "Africa's Giant Eye on the Sky", SALT has since grown into a renowned observatory. The global partnership, international collaborators and local communities have made SALT a success. SALT has become a cornerstone of South African science and a symbol of Africa's growing presence in global astronomy.

SALT's 20-year journey speaks to a long-term vision, steady perseverance, and a deep commitment to excellence. The observatory stands as an example of how large-scale science initiatives can contribute to national development – inspiring young people, creating opportunities, and strengthening South Africa's links to the global research community. Perhaps most importantly, SALT's legacy is measured not only in discoveries made, but in the people it has impacted and the possibilities it continues to create.

As we celebrate this milestone, SALT continues to look forward – strengthening scientific infrastructure, expanding engagement with the public and schools, advancing discovery, inspiring new generations, and shaping our understanding of the Universe beneath the beautiful African skies. Twenty years on, SALT remains not only a world-class scientific facility, but a shared achievement belonging to everyone who has contributed to its journey.

PROGRAMME

The anniversary events, hosted in Sutherland, brought together members of the SALT and SAAO teams, representatives from partner institutions, members of the SALT and NRF Boards, visiting speakers, dignitaries, students, and the local community. They took place over the weekend of 8 – 9 November, with community activities starting on Saturday and official engagements continuing through the weekend. The formal celebration was held on Monday, the 10th. Many of SALT's achievements were reflected in the talks and discussions held during the celebration, with speakers from across the SALT partnership highlighting both scientific outcomes and the collaborative spirit that has underpinned them.

Saturday, 8 November

The public celebration highlighted SALT's strong and lasting connection with the Sutherland community. Activities included school engagements, prize-giving events, the donation of books to the community library, and the official opening of a special new children's room at the local police station to help comfort young people who have suffered abuse and/or trauma. The Sutherland community choir added local spirit, and evening stargazing on the plateau gave visitors a memorable opportunity to experience the night sky from one of the world's premier observing sites.

Sunday, 9 November

On Sunday, the Deputy Minister of the Department of Science, Technology and Innovation, Honourable Dr Nomalungelo Gina, was welcomed to Sutherland alongside members of the SALT and NRF Boards. A special dinner was hosted in honour of the visiting delegates, followed by a guided tour of the telescope. SALT Operator Nomzamo Mokoena and SALT Astronomer Moses Mogotsi, who were on duty that week, walked the guests through the workings of the telescope and the science being carried out, offering an insider's view of life at the sharp end of discovery – and confirming that SALT is even more impressive up close.

Monday, 10 November

The official celebration took place on 10 November, with SAAO and SALT staff members arriving in the morning from Cape Town. Everyone was warmly welcomed by the organising committee, with much-needed refreshments and the happy buzz of reunions as past and present colleagues caught up. The proceedings opened with remarks from the SALT Board Chair, Prof. Brian Chaboyer. The Executive Mayor of the Namakwa District Municipality, Councillor Mervin Cloete, then offered reflections and perspectives from the local community. This was followed by remarks from the NRF Board Chair, Prof. Mosa Moshabela, and from the SALT Director, Dr Encarni Romero Colmenero, who highlighted the NRF's and SALT's continued commitment to advancing science.

Further talks were given by Prof. Saurabh Jha (Rutgers University) on some of the scientific highlights drawn from SALT data, Dr Itumeleng Monangeng (SAAO) on how SALT affected his career in astronomy, and Drs David Buckley (SAAO) and Takalani Nemaungani (DSTI Chief Director: Astronomy) who recognised the vital role played by SALT's international partners. Mr Sivuyile Manxoyi (SCBP manager) highlighted the educational outreach efforts led by SAAO and SALT. The keynote address was delivered by the DSTI Deputy Minister Dr Nomalungelo Gina, who emphasised SALT's impact not only as a scientific flagship, but also as a meaningful presence within the local community. Closing remarks were delivered by the NRF's Deputy Chief Executive Officer, Dr Angus Paterson.

A tour of the facility, an indigenous dance performance, more refreshments, and – of course – birthday cake rounded off the day, because no birthday celebration is complete without one! As guests departed, there was a shared sense of how far SALT has come, from a bold idea to a world-class observatory, and of how many hands and hearts helped bring that vision to life.

SOUND BITES

Many attendees commented on the sense of connection and pride in seeing the project's journey brought together in one space, from its early beginnings to future ambitions. Here are some selected voices.

At the inauguration ceremony on 10 November 2005, President Thabo Mbeki unveils a plaque.

Phil Charles, former SAAO Director and SALT Board member:
With splendid weather, exactly reminiscent of the Inauguration on the same day in 2005, and many of the original SALT construction team able to join us (most of whom I hadn't seen in years), it proved to be an excellent celebration of quite how far SALT has come in the last 20 years. SALT really has had a global impact, and I saw its importance for true multi-wavelength work alongside MeerKAT/SKA being highlighted. And given how much of my time it took when I was SAAO Director, I was delighted at several speakers' highlighting the growth in South African PhDs through the last 20 years of the SAAO/UCT NASSP programme, always envisaged as an important by-product of the original SALT funding.

Lisa Crause, SALT Observatory Scientist:
This was an extremely special occasion and I was grateful for the opportunity to personally thank members of the original SALT project team (who I looked up to as heroes while I was a student, watching them build the telescope) for this wonderful facility. Though sobering to consider how much time has passed since then, it was a privilege to be able to show several of them around and trade stories about this much-loved beast!

David Buckley, former SALT Project Scientist:
After overcoming initial technical issues, SALT has become a very productive telescope in terms of performance and the research output by its wide community of users. But we cannot rest on our laurels. Only by continuing to invest in future instruments and enhancing the performance of the telescope can we remain competitive and relevant. New opportunities continually arise, both from new scientific discoveries, but also engineering innovations, which SALT must exploit going forward. We have met our initial 20 year goals and the challenge will be to continue to do so for the next decades to come.

Sarah Blyth, Head of Astro Department, UCT:
It was very exciting to be able to celebrate 20 years of SALT and all its astronomical accomplishments so far! Being there in person to see the telescope is always a privilege and it was lovely to see some of the familiar faces again from over the years!

Christian Hettlage, SALT Software Engineer:
It is a privilege to have seen so many dedicated people keeping SALT running and improving it for the last 20 years.

Nomzamo Mokoena, SALT Operator:
On Sunday, the Deputy Minister visited the telescope and I explained to her how SALT is operated. It made me aware of the depth of expertise that has gone into this technology. It was a reminder that SALT's success rests as much on skilled technical work as on the science it enables.

BEHIND THE SCENES

The success of the anniversary events was made possible by months of planning and coordination by SALT and SAAO staff across multiple departments. From logistics and technical support to communications, outreach, hosting and safety, a great deal of dedication and teamwork ensured that the celebration ran smoothly and reflected the importance of the occasion. The anniversary was as much a testament to this ongoing work as it was to the telescope itself.

Brian Chaboyer and Encarni Romero Colmenero cut the birthday cake.

A selection of visitors.

Southern African Large Telescope

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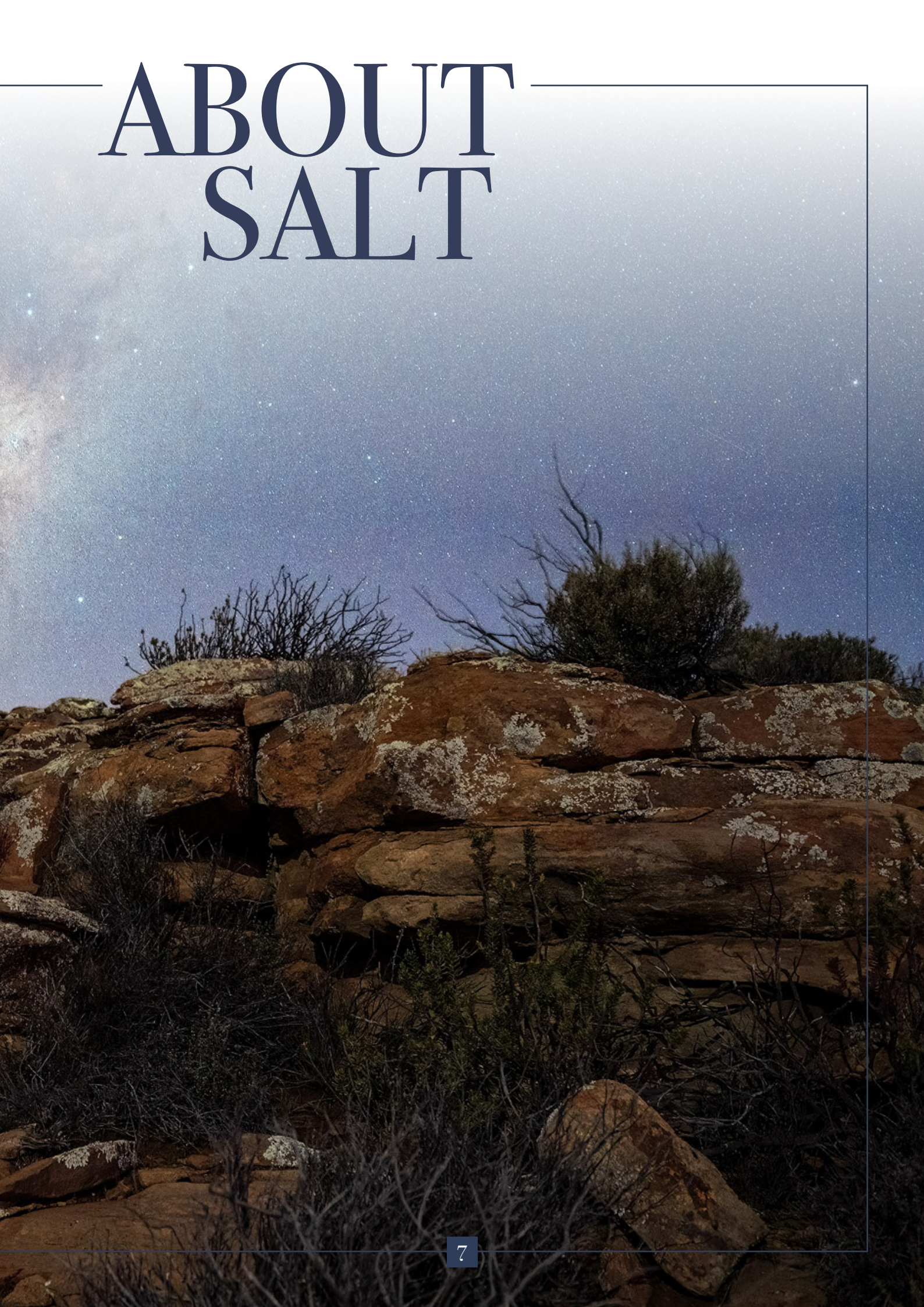
ABOUT SALT



About SALT

SALT is located at the observing site of the South African Astronomical Observatory (SAAO), near the small Karoo town of Sutherland, about 370 km northeast of Cape Town. This site has been host to a number of other smaller telescopes since the early 1970s, and benefits from its location in a semi-desert region with clear, dark skies. The quality of this site for optical astronomy is preserved by South African legislation.

The Board of the Southern African Large Telescope (SALT) is proud to present its Annual Performance Report for the period 1 January 2025 to 31 December 2025. This report offers an overview of the activities and performance of SALT, highlights a selection of SALT research projects, and introduces the SALT partner institutions/consortia.

SALT is the largest single optical telescope in the southern hemisphere and amongst the largest in the world. It has a hexagonal primary mirror array 11 metres in diameter, consisting of 91 individual 1-m hexagonal mirrors. It is the non-identical twin of the Hobby–Eberly Telescope (HET) located at McDonald Observatory in West Texas (USA). The light gathered by SALT's huge primary mirror is fed into a suite of instruments (an imager and three spectrographs) from which astronomers infer the properties of planets, stars and galaxies, as well as the structure of the Universe itself.

SALT is owned by the SALT Foundation, a private company registered in South Africa. The shareholders of this company include universities, institutions and science funding agencies from Africa, India, Europe and North America. The South African National Research Foundation (RSA) is the major shareholder, owning approximately one third of the shares. Half of the operating costs are currently covered by the NRF, ensuring that significant observing time is available to the South African community. Other large shareholders are Rutgers University (RU), the Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences (POL), Dartmouth College (DC), the University of Wisconsin–Madison (UW), and the Inter–University Centre for Astronomy and Astrophysics in India (IUCAA). Smaller shareholders include the American Museum of Natural History (AMNH) and the UK SALT Consortium (UKSC), with the latter representing Armagh Observatory & Planetarium. The size of the shareholding of each partner determines the access to the telescope that they enjoy. The HET Consortium, although not a shareholder, received ten percent of the telescope time for the first ten years of operation, in return for providing all of the designs and plans from the HET, as well as assistance during the construction of SALT. Some of the original shareholders, Göttingen University (GU), the University of Canterbury (UCN) and the University of North Carolina (UNC), as well as the Universities of Nottingham, Southampton, Central Lancashire, Keele and the Open University of the UKSC, left the SALT Foundation. The SALT Foundation is currently looking for new shareholders.

Vision

Africa's Giant Eye on the Sky: Inspiring society by exploring the Universe.

Mission

Lead the advancement and development of optical astronomy on the African continent and inspire and educate new generations of scientists and engineers worldwide.

Provide a world-class large telescope research facility cost-effectively to astronomers in an international community.

Strategic objectives of SALT

1 Enable world-leading astrophysical research

To provide high-quality data that result in highly-cited papers published in front-rank journals. This is achieved by maximising SALT's scientific productivity, i.e., minimising technical downtime and optimising operational efficiency. Which is contingent on having the financial resources to support operational needs and to nurture and retain a cohort of skilled and creative staff, and enabling them to identify and pursue key scientific and technical initiatives.

2 Pursue instrumentation development

To establish the local skills and capacity required to design and build internationally competitive astronomical instrumentation. This calls for leveraging expertise available within the SALT partnership and other international instrumentation groups, to build active collaborations that drive technological innovation and skills transfer, and ultimately enhance SALT's capabilities. This, too, relies on securing the necessary financial support, for both equipment and people (staff, students, interns and apprentices spanning a broad range of levels).

3 Drive human capital development and science engagement

To employ this iconic facility and the ubiquitous appeal of astronomy to encourage widespread interest in science and technology, through outreach to undergraduates, schools and the general public; to train graduate students; to have a special focus on developing and leading professional astronomy and high-tech astronomical instrumentation on the African continent; to promote SALT as a global flagship optical telescope, increasing its visibility and growing its reputation in the international scientific community, as well as national and international media.

Chairman's Overview

The year 2025 has been particularly rich in achievements for SALT: we not only celebrated our 20th anniversary, but SALT received a prestigious Science Diplomacy Award. In addition, we had an extensive shutdown period with a very successful global reset of SALT's massive primary mirror.

Twenty years ago, on 10 November 2005, President Mbeki officially inaugurated SALT. This was a historic day, as SALT became the largest single optical telescope in the southern hemisphere. In the 20 years since, SALT has become a successful and extremely productive telescope making highly significant discoveries. There have been over 600 publications based upon SALT data; one of the many science highlights was SALT obtaining one of the first optical spectra associated with a gravitational wave detected on 17 August 2017. SALT has been very fortunate to have a large number of talented and engaged individuals who are focused on ensuring that SALT is so productive. SALT is also a flagship of South African science, catalysing the growth of its astronomical community and elevating its global standing in big science. I've been coming to South Africa for over 20 years now, and I keep being impressed with this dynamic, diverse country. I'm very grateful to be a part of this wonderful endeavor.

Hot on the heels of this special day, SALT received a prestigious Science Diplomacy Award at the Science Forum South Africa (SFSA). These awards celebrate individuals, organisations and institutions demonstrating outstanding commitment to advancing science diplomacy. As one of the largest telescopes in the world, SALT was recognised in the category of International STI Partnership Achieving Excellence in Global Science, acknowledging SALT's success story as one of national pride and aspiration. I'd like to extend my congratulations to the SALT team for this well-deserved award.

On a more technical side, another major event in 2025 has been the extensive shutdown of the telescope in the southern autumn. While annual shutdowns are a standard part of operations, the 2025 period was unique because of the comprehensive global adjustment of the primary mirror. The mirror team spent several weeks climbing around in the truss each day, making careful manual adjustments to the positions of the individual mirrors. In addition, the atmospheric dispersion compensator, moving baffle and pupil mask could be serviced.

At an age of 20 years, SALT has some aging infrastructure, most notably its spherical aberration corrector, which is the optical heart of the telescope. The delicate optical coatings on the mirror surfaces are deteriorating, requiring a full replacement, called the ReSAC project. We have started reaching out to possible international vendors to establish interest and to gather preliminary cost and schedule estimates as we move this project forward.

Our other upgrade projects are moving forward as planned. We now have a second slitmask IFU, this one with 300 micron fibres, which will become available to users later in 2026. The final piece of the RSS 'Big 5', the new monolithic detector, is likewise nearing completion, and Lisa Crause and her colleagues from Heriot-Watt University have been extremely busy with the laser frequency comb, readying it for on-sky commissioning in 2026.

On the software side, users now have access to the spectropolarimetric calibration pipeline, a reduction pipeline for HRS in high resolution mode, and a new RSS-MOS pipeline which enables a relative flux calibration of around 20% using SDSS stars.

The SALT board continues to be grateful for the excellent work being done by SALT staff. SALT operates on a relatively lean budget, and is able to do so due to the focus and dedication of the SALT astronomy and technical operations teams. In particular, the work done during the shutdown had been a major feat which deserves an extra round of applause.

Prof. Brian Chaboyer
Chairperson, SALT Board

SALT PARTNERS

Introduction

SALT is an international consortium consisting of a number of partners that share the costs of the telescope, in return for corresponding fractions of the available observing time. Some of the partners have also made in-kind contributions, in the form of instruments and/or other intellectual property, to secure their membership. Each partner country or institution has their own time allocation committee, and scientists outside the consortium that wish to use SALT are welcome to collaborate with those affiliated with partner institutions. SALT also offers a limited amount of free Director's Discretionary Time* (DDT) for the opportunistic pursuit of high-impact science, as the flexibility of SALT's queue-scheduled operation supports the rapid response to new top-priority targets.

The SALT Foundation now also invites researchers from around the world to purchase their own guaranteed SALT time. This can be in the form of normal time divided into the default priority categories ("P0" to "P3"), to be inserted in the service observing queue (at a rate of ~$3300/h). It may also be in the form of the highest priority time only, which is guaranteed to be observed fully, at a rate of ~$4300/h. Note that any partner institution may also purchase time beyond their normal share, and reduced rates apply in that case. Finally, the consortium is seeking an additional 10%-level partner (~$11M) to support significant second-generation instrumentation development. Interested parties should contact the chair of the SALT Board of Directors, Brian Chaboyer.

* https://astronomers.salt.ac.za/proposals/directors-discretionary-time/

Republic of South Africa

South Africa's National Research Foundation (NRF) is the majority shareholder in SALT, with approximately a one-third share, and currently covering about one-half of the operating costs. The South African Astronomical Observatory (SAAO), contracted to host and operate SALT, is also one of the NRF's several national facilities. As the intermediary agency between the policies and strategies of the government of South Africa and the country's research institutions, the NRF's mandate is to promote and support research through funding, human resource development and the provision of the necessary facilities, in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology (including indigenous knowledge), and to thereby contribute to improving the quality of life of all South Africans. The country's considerable investment in astronomy, both in optical and radio, is due in no small part to this field's extraordinary potential to capture the imagination and hence to encourage the brightest young minds to pursue scientific and technical qualifications.

SALT is located at the Sutherland site of the SAAO in the Karoo desert (about 370 km from Cape Town), making it one of the darkest observing sites in the world. SAAO hosts all the SALT Astronomers, responsible for liaising with PIs and making the observations, as well as all the technical and support staff associated with SALT. The Observatory's mechanical and electronics departments at the SAAO headquarters in Cape Town include large workshops and a dedicated CCD lab. SALTICAM and the RSS detector packages, as well as the fibre-instrument feed and various auto-guiders for the SALT instruments, were designed and built here. The maintenance and servicing of all instruments and telescope sub-systems are done in Sutherland by the Technical Operations team.

One of SALT's strategic objectives is Human Capital Development which is particularly important for South Africa and, even more so, for the African continent. Thus the SALT Collateral Benefits Programme (SCBP) was established during the construction of SALT and the objectives of this programme were clearly directed at the benefits derived by society from building this large telescope. The SCBP is mainly directed at schools but also includes outreach to the general public.

South Africa's astronomical community has grown significantly since SALT was built, with SALT and later the MeerKAT initiatives spurring much of this growth. The entire South African community has access to SALT. There are now over two hundred PhD astronomers, and students are encouraged to participate in SALT projects and to propose for time. The recent decision to have two additional board members from South Africa will provide further opportunities to develop leadership expertise and to continue to drive optical astronomy research.

South African researchers are active across a wide range of the multi-wavelength astronomy domain. The strategic vision for SALT, developed by the South African community in 2017, identified two main focus areas for future development, which tie in closely with both MeerKAT, the country's precursor to the SKA, and local high-energy astrophysics research. These are transient science and galaxy evolution (particularly understanding the fuelling of star formation and recycling of gas in the baryon cycle). Exoplanet research and building instrumentation capacity have also been highlighted as growth points for the future, resulting in the current improvements of the high-stability mode of the HRS.

SALT Board members:
Sharmila Goedhart, SARAO
Itumeleng Monageng, SAAO/UCT
Angus Paterson, NRF
Rosalind Skelton, SAAO/NRF

Rutgers University (USA)

Rutgers, the State University of New Jersey, is a large public research university in the United States. Originally chartered as Queen's College in 1766 during the colonial era, in 1825 it was renamed Rutgers College after a wealthy benefactor. Rutgers became the New Jersey land-grant institution in 1864 and in the mid-20th century, it was designated the State University of New Jersey by the state legislature. Rutgers University has expanded far beyond its modest colonial roots and now includes campuses in Newark and Camden as well as the flagship campus in New Brunswick. Across the state, more than 8000 Rutgers faculty instruct over 49,000 undergraduate as well as 19,000 graduate students. There are more than 150 undergraduate majors and 200 graduate programs.

Astronomy was part of the curriculum at Rutgers since its earliest days. The current Department of Physics and Astronomy at Rutgers–New Brunswick traces its origins to the late 19th century. Significant expansion in the astronomy programme began in the 1990s with the addition of a number of research-active astronomers and an increase in the number of graduate students. In 2001, Rutgers joined the SALT consortium. The astronomy group in 2025 comprised nine faculty (which includes one faculty member on leave at NASA), four emeritus faculty, five postdoctoral associates (including two joint Rutgers-Flatiron Postdoctoral Fellows), and 17 active doctoral students. Three Rutgers astrophysics graduate students defended their PhD theses in 2025, one of whom included SALT observations.

Rutgers' astronomers, led by T. Williams, participated in the design, development and fabrication of the RSS and led the effort to build the Fabry–Pérot Imaging Spectrophotometer subsystem. Williams and his colleagues used this instrument to carry out the RSS Imaging spectroscopy Nearby Galaxies Survey (RINGS) of nearby, normal galaxies to characterise their structure using measurements of Hα velocity fields.

S. W. Jha uses SALT to study supernova explosions. Type Ia supernovae (SN Ia) are used as cosmological distance indicators and Jha uses RSS observations to better understand the progenitors and explosion mechanisms for SN Ia and other varieties of white dwarf supernovae. The queue schedule and rapid response capabilities of SALT allow Jha to classify and study new supernovae soon after explosion. Jha uses SALT data to study supernovae in coordination with observations from the HST, the JWST, and a variety of ground-based telescopes around the world to give a fuller picture of the explosive deaths of stars.

The main focus of J.P. Hughes' current research is the astrophysics of supernova remnants and clusters of galaxies. In collaboration with colleagues in South Africa, Hughes is studying the brightest cluster galaxies in massive clusters detected by the AdvACT. The goal is to trace the evolution of AGN feedback (both radio and quasar mode), stellar populations, and the growth of central galaxies in clusters over a 3.4 Gyr time period ($0.3 < z < 0.8$). Hughes also has an on-going SALT project for confirmation and redshift measurement of Planck cluster candidates. Hughes continues to work with Xola Ndaliso, a PhD student at the University of the Witwatersrand, on writing up the results of the work begun during his visit to Rutgers in July 2024. A draft article is nearing completion on the X-ray properties of the galaxy cluster Abell 3408 and the effects of the intracluster gas on HI gas depletion in MeerKAT-detected galaxies.

A. Baker is one of the three PIs of the "Looking At the Distant Universe with the MeerKAT Array" (LADUMA) deep HI survey, which is probing the 21-cm emission line of neutral atomic hydrogen over the last 9 billion years of cosmic time. SALT is playing an important role in support of LADUMA analyses, ranging from joint optical/radio dynamical studies of nearby spiral galaxies, to redshift confirmations for distant MeerKAT detections, to expansion of samples that can be stacked to achieve statistical HI detections. In 2025, Baker hosted visits to Rutgers by Ph.D. students Mika Naidoo (University of the Witwatersrand) and Craig Smith (UWC), which advanced their multiwavelength analyses of galaxies in the LADUMA field.

E. Gawiser worked with post-bac George Kharchilava to analyse RSS MOS observations of low redshift ($z < 0.4$) [O II]-emitting galaxies from HETDEX. Two methodological publications have resulted from this programme detailing the `CARRSSPipeline` that adds flux calibration and reprojection capability to `RSSMOSPipeline`. A third paper in preparation reports key properties of these star-forming galaxies.

SALT Board member:
Jack Hughes

The Physics & Astronomy department building at Rutgers–New Brunswick.

Poland

Poland is a country with a long astronomical tradition. For example, Nicolaus Copernicus (1473–1543) was the creator of the heliocentric system, and Johannes Hevelius (1611–1687) was the founder of lunar topography. After World War II, Polish astronomy started to slowly build up its resources but it was only after the communist regime fell in 1989 that Poland could join ESO, ESA and other international astronomical organisations. About 250 astronomers are employed at six separate universities and two institutes of the Polish Academy of Sciences (PAS). Some of these form the Polish SALT Foundation, which has a 10% share in the construction and running costs of SALT. There are five main SALT partner institutions.

The **Nicolaus Copernicus Astronomical Center** (CAMK, or NCAC in English) of the PAS is the leading astronomical institute in Poland. It is located in Warsaw and was established in 1978. It is the coordinator of the SALT project, with K. Hełminiak being Poland's Board director and the Chair of the STC. J. Mikołajewska is also a member of the STC, being highly involved in several SALT committees. At present, 80 scientists are working at CAMK along with ~30 PhD students. They are involved in a number of major international observational projects (e.g., CTA, *Athena*, SALT, LIGO-VIRGO, BRITE, PLATO, *Ariel*), and collaborate with scientists all over the world. Scientific research conducted at CAMK with SALT include: the search for symbiotic stars and the study of individual systems; classical and recurrent novae; post AGB binaries; multiple stellar systems; characterisation of exoplanet host stars; dark matter studies using spectroscopic long term monitoring of selected quasars.

The **Astronomical Observatory of the Jagiellonian University** is a part of the Faculty of Physics, Astronomy and Applied Computer Science of the Jagiellonian University. The Observatory was founded in 1792 and comprises a number of small radio and optical telescopes that are located at Fort Skała on the outskirts of Kraków. The Observatory is involved in exploiting large facilities such as H.E.S.S., CTA and SALT and runs one of the LOFAR telescope stations. SALT data is used in studies of giant-size radio galaxies, accretion discs in AGNs using Doppler tomography and timing analysis of their multi-wavelength light curves.

The **Institute of Astronomy of the Nicolaus Copernicus University** in Toruń, located in Piwnice village, 15 km north of Toruń, is home to a VLBI station and a few optical instruments. The telescopes are used mainly for student training and modest research projects. SALT researchers are interested in symbiotic stars, novae, PNe, and follow-up of the *Gaia* mission alerts.

Founded in 1919, the **Institute Astronomical Observatory (IAO) of Adam Mickiewicz University** runs a Global Astrophysical Telescope System (GATS) consisting of two robotic instruments (Poland and Arizona) used for photometry and spectroscopy. The third node — a cluster of 0.7-m and 0.3-m telescopes for space debris tracking — is under construction. IAO uses SALT for photometric and spectroscopic observations of asteroids. T. Kwiatkowski is a member of the SUGAR committee.

The **Astronomical Institute of the Wrocław University** is located in the eastern part of Wrocław. Research concentrates on the investigation of solar activity (with a coronagraph located near Wrocław) and on pulsating stars (with SALT among others). Satellite observations also play an important role in these investigations.

SALT Board member:
Krzysztof Hełminiak, CAMK

Dartmouth College (USA)

Founded in 1769, Dartmouth College is one of the leading liberal arts universities in the United States. Dartmouth has forged a singular identity for combining its deep commitment to outstanding undergraduate liberal arts and graduate education with distinguished research and scholarship in the Arts & Sciences, and its three leading professional schools: the Geisel School of Medicine, the Thayer School of Engineering, and the Tuck School of Business. Dartmouth College educates the most promising students (approximately 4300 undergraduates and 2000 graduate students) and prepares them for a lifetime of learning and of responsible leadership, through a faculty dedicated to teaching and the creation of knowledge.

Astronomy has a long history at Dartmouth, with the Shattuck Observatory (built in 1853) being the oldest scientific building on campus. The first photograph of a solar prominence was obtained by the Shattuck Observatory (in 1870).

Today, the astronomy group at Dartmouth is housed within the Department of Physics and Astronomy and has a 25% share in the MDM observatory (consisting of a 2.4-m and 1.3-m telescope in Kitt Peak, Arizona, USA) in addition to its ~10% investment in SALT. Astronomers at Dartmouth have a broad range of research interests and have used SALT to study supernovae, active galactic nuclei and metal-poor stars, among other projects. Currently, the astronomy group consists of six faculty members, two post-doctoral fellows and about ten graduate students.

SALT Board member (chair)
Brian Chaboyer

The Shattuck Observatory on campus.

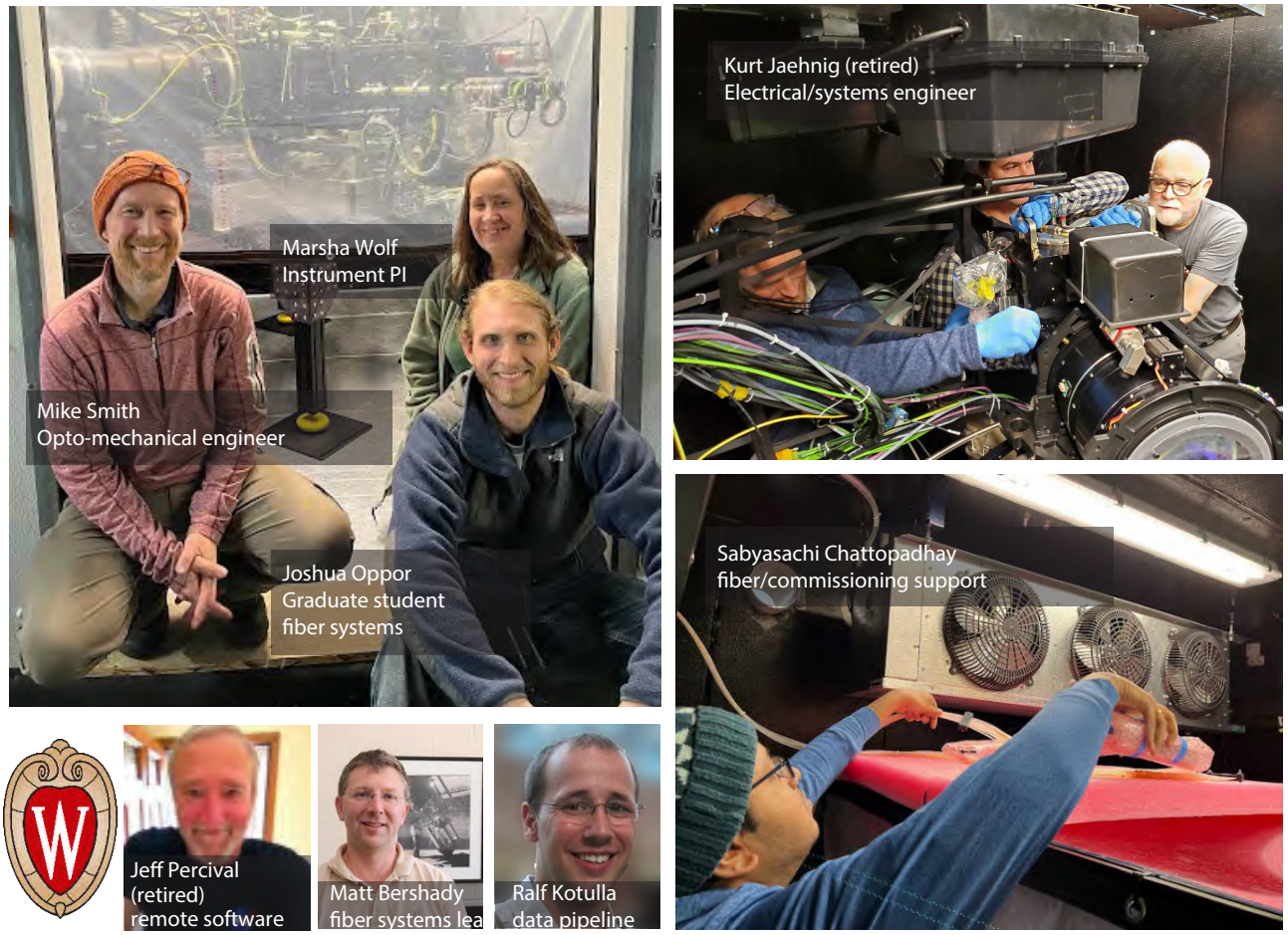
University of Wisconsin–Madison (USA)

The University of Wisconsin–Madison (UW-Madison) is a public, land-grant institution that offers a complete spectrum of studies through 13 schools and colleges. With more than 52,000 students from every U.S. state and 130 countries, UW–Madison is the flagship campus of Wisconsin's state university system. UW–Madison is a formidable research engine, ranking sixth among U.S. universities as measured by dollars spent on research. Faculty, staff, and students are motivated by a tradition known as the Wisconsin Idea that the boundaries of the university are the boundaries of the state and beyond. One of two doctorate-granting universities in the University of Wisconsin System, UW–Madison has the specific mission of providing "a learning environment in which faculty, staff and students can discover, examine critically, preserve and transmit the knowledge, wisdom and values that will help ensure the survival of this and future generations and improve the quality of life for all."

UW–Madison is a member of the SALT partnership and contributed to the construction in addition to the designing and building of the Prime Focus Imaging Spectrograph, which has since been renamed the Robert Stobie Spectrograph (RSS). In addition, UW-Madison completed and delivered a cutting-edge near-infrared, integral-field spectrograph for SALT called NIRWALS, which is currently being commissioned.

UW-Madison astronomers have traditionally used SALT to measure the distribution of mass in galaxy clusters from redshift surveys; to understand the kinematics and distribution of ionised gas in and around galaxies; and to study the stellar content and dynamics of nearby galaxy discs. Currently, they are undertaking an ambitious new multi-semester near-infrared quasar reverberation mapping programme and a systematic survey of post-starburst galaxies with NIRWALS. In addition, recent programmes have used high-resolution spectroscopy to measure the atmosphere of a transiting Brown Dwarf and to constrain the ages of planet-hosting stars via their Lithium abundances. With the launch in 2024 of an inter-disciplinary centre at UW-Madison across seven departments for the study of the origins of life, called the Wisconsin Center for Origins Research, there may be future demand for high-stability spectroscopy on SALT for the identification and characterisation of exoplanet systems.

SALT Board member:
Eric Wilcots



The NIRWALS commissioning team.

Inter-University Centre for Astronomy & Astrophysics (India)

The Inter-University Centre for Astronomy & Astrophysics (IUCAA) was established in 1988 by the University Grants Commission of India in Pune. The main objectives of IUCAA are to provide a centre of excellence within the university sector for teaching, research and development in astronomy and astrophysics, as well as to promote nucleation and growth of active groups in these areas in colleges and universities. Besides conducting a vigorous research programme of its own, workers from Indian universities, teachers and students are enabled to visit IUCAA for any length of time to participate in research and to execute developmental projects. IUCAA also actively collaborates with universities in initiating and strengthening teaching and research in Astronomy & Astrophysics in the university system.

Research interests of IUCAA members and associates include (i) gravitation, cosmology, large scale structures in the Universe, gravitational wave physics and data analysis; (ii) cosmic microwave background theory and data analysis, cosmic magnetic fields; (iii) galaxies, quasars, quasar absorption lines, intergalactic and interstellar matter; (iv) X-ray binaries, accretion disc theory, radio and X-ray pulsars, gamma-ray bursts; (v) solar physics, stellar physics, stellar spectral libraries, machine learning; (vi) observations in optical, radio and X-ray bands, astronomical instrumentation and (viii) data-driven astronomy, virtual observatory. IUCAA runs a 2-m telescope at Girawali to support various observational projects. Members of IUCAA are actively involved in various national large science projects such as the Indian participation in TMT and SKA etc., and one of the 4 leading institutes in the country entrusted with building LIGO-India.

IUCAA has a 7% share in SALT. It is used to identify and study extragalactic sources (large scale outflow, quasars, radio galaxies and field galaxies producing absorption lines in quasar spectra), high-resolution spectroscopy of stars and coordinated observations of time-varying sources. Astronomers from IUCAA are also involved in various Indian space observatories like *Astrosat* and *Adithya-L1*. IUCAA's technical contribution to SALT is the SIDECAR Drive Electronics Controller (ISDEC) which is used as the control and data acquisition system for the H2RG detector in the new NIRWALS spectrograph. Members of IUCAA's instrumentation laboratory are also involved in the RSS detector upgrade project.

SALT Board member:
Raghunathan Srianand

View of IUCAA's campus.

UK SALT Consortium

An early and enthusiastic supporter of the SALT project, the UK's consortium (UKSC) originally consisted of six astronomy groups, comprising the Universities of Nottingham, Southampton, Central Lancashire, Keele as well as the Open University and the Armagh Observatory & Planetarium (AOP). By the end of 2025, only the AOP is in the consortium, after the exit of Keele and Open University in April. All of UKSC have had a long-standing involvement with astronomers in South Africa (SA), including providing support for visiting graduate students and postdocs to SA. UKSC has successfully hosted a half-dozen SALT–Stobie scholarships, greatly enhancing the production of SA astronomy PhDs. From 2018 – 2020, the "Global Challenges" research funding was used to support SA post-docs to visit the UK for extended periods, and follow-up visits have continued. UKSC have a wide range of SALT science interests and are involved as collaborators in a number of major SALT science projects, in particular playing a leading role in the X-ray binaries component of the SALT Transients Large Programme. The UKSC main contributions this year came from Keele University and the AOP.

At **Keele University,** Nigerian student J. Anih passed her PhD viva in December 2025. Her PhD research has heavily relied on SALT/RSS spectroscopy of samples of intermediate-redshift (up to z = 2) AGNs of which she studied the infrared variability. A publication including the SALT spectra is in preparation.

C. Pennock and her collaborators presented a comprehensive Probabilistic Random Forest supervised machine learning classification of sources in the direction of the LMC and SMC, focussed on uncovering populations of AGN in the background. This has benefitted from a long-term P4 programme to obtain low-resolution optical spectra of AGN for training purposes. The programme has continued over several SALT semesters and the full results are going to be published in a follow-up paper based on t-distributed Stochastic Neighbour Embedding unsupervised machine learning.

J. van Loon's recent interests has been low-resolution optical spectroscopic monitoring of the extreme red supergiant WOH G64 in the LMC, which started in late 2024 and continues through to 2026, mostly as P4. Surprising results discovered late in 2025 generated much media attention following a SALT press release (after acceptance of the publication in early January 2026), which was subsequently presented to a wider audience in "The Conversation, Astronomy & Geophysics" and the Dutch magazine "Zenit".

People involved at **Armagh Observatory & Planetarium** are S. Jeffery, M. Burton, G. Ramsay, J. Vink, G. Doyle as well as M. Sarzi, who has taken on the role of representing UKSC. S. Jeffery's survey of helium-rich hot subdwarfs with SALT is nearing completion. The final sample of 697 stars with spectral classifications was submitted for publication in late 2025, and the spectra will be made available at Data Central, based at the Australian Optical Data Centre. Jeffrey's PhD student A.P. Monai has completed and published an unsupervised classification and kinematic analysis of the sample. A full spectral analysis is nearing completion and will demonstrate that helium-rich hot subdwarfs are primarily helium main-sequence stars formed from the merging of two helium white dwarfs. Follow-up observations of suspected variables are continuing, along with time-resolved spectroscopy of Blue Large Amplitude Pulsators. G. Ramsay leads a programme to obtain spectroscopic observations of 'orphan' transients discovered through the GOTO and BlackGEM all-sky surveys. These orphans can be very faint Galactic sources which have gone into outburst, supernovae from either very faint galaxies, or ones in which the host galaxy is effectively invisible, making them ideal for follow-up observations with SALT.

At the **Open University**, science interests range from the "Dispersed Matter Planet Project" (C. Haswell), which has identified a key population of rocky exoplanets orbiting bright nearby stars and catastrophically disintegrating planets, to studies of variable star populations and unique individual variables from SuperWASP (A. Norton, M. Lohr). S. Serjeant, S. Urquhart (who had been the UKSC Board director for SALT in 2024) and L. Marchetti (UCT) coordinate the "SALT Gravitational Lensing Legacy Program", which combines Herschel wide-area sub-mm observations with multi-wavelength ancillary data to generate the largest (> 500) sample to date of homogeneously selected lens candidates, obtaining SALT spectroscopy for most of them.

SALT Board member:
Marc Sarzi, Armagh Observatory & Planetarium

A panoramic view of the Armagh Observatory campus.

The American Museum of Natural History (USA)

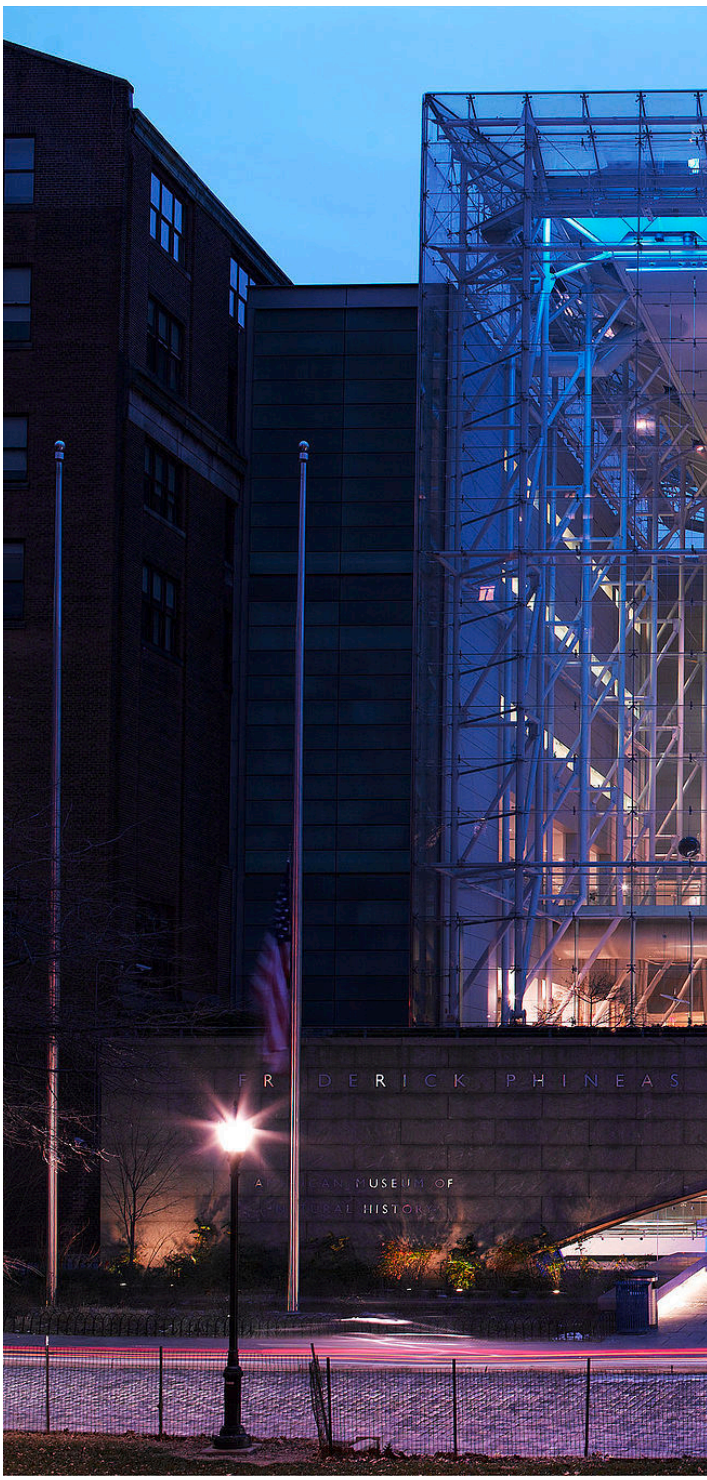
The American Museum of Natural History (AMNH) is one of the world's preeminent scientific and cultural institutions. Since its founding in 1869, the Museum has advanced its global mission to discover, interpret, and disseminate information about human cultures, the natural world, and the Universe through a wide-ranging programme of scientific research, education, and exhibition. With 200 active researchers, including curator/professors, postdoctoral fellows, PhD and Masters degree students as well as research associates and assistants, AMNH is the only institution in North America that is both a research university and a museum, hosting over five million visitors each year.

Astronomy has been part of AMNH since the opening of the Hayden Planetarium, partly funded by philanthropist Charles Hayden, in 1934. The completely rebuilt Planetarium, opened in 1999, is a 30-m diameter sphere inside an eight story-high glass cube, which houses the Star Theater. The theatre uses high-resolution full-dome video to project space shows based on scientific visualisation of current astrophysical data. A customised Zeiss Star Projector system replicates an accurate night sky as seen from Earth. The AMNH Astrophysics research department is responsible for the content of space shows, for conducting research in astrophysics, and for training graduate students and postdoctoral fellows.

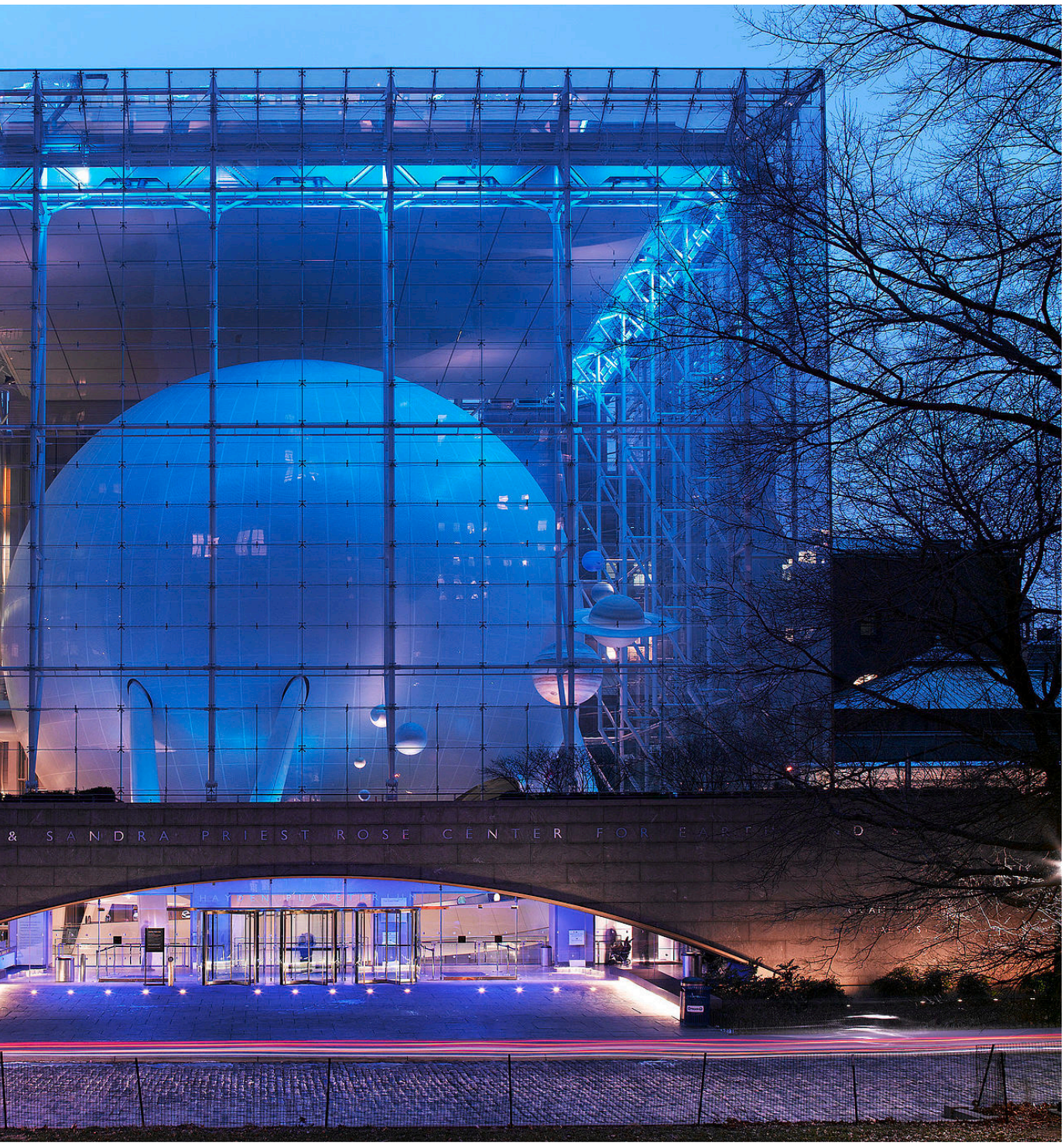
AMNH became a member of SALT in 2008 on the basis of a gift from the late Paul Newman. AMNH astrophysicist Michael Shara became Chairman of the SALT Board in 2012 and served in that position until 2021. Shara uses SALT to study cataclysmic binary stars — novae, the stars that give rise to them, and the ways that they hide from astronomers during the millennia between eruptions. He is also interested in mass transfer in such binaries that spins up the black hole progenitors — O stars in O+Wolf-Rayet star binaries — to high speeds.

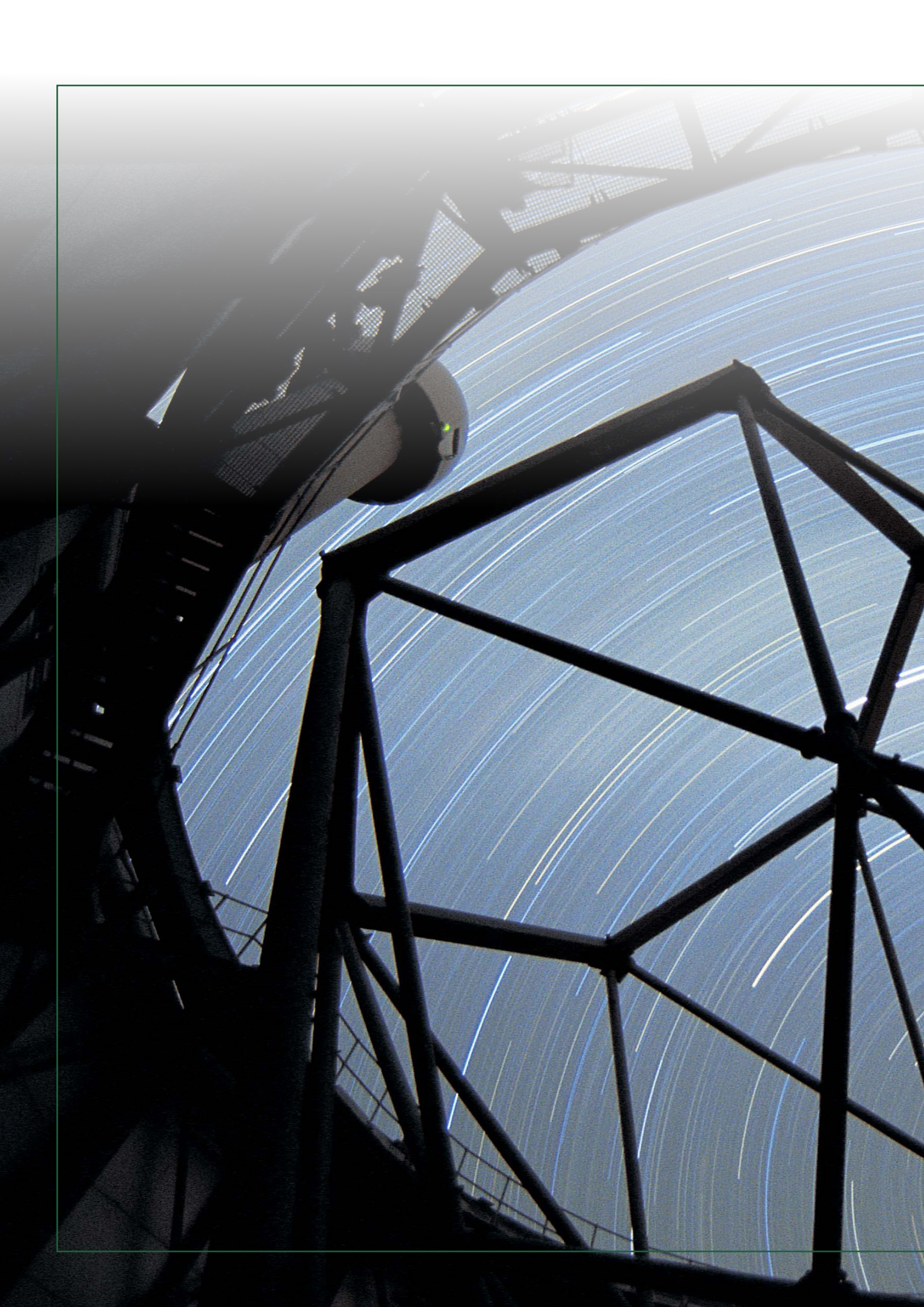
In collaboration with Shara, post-doctoral Fellow Laura Rogers (University of Cambridge and University of Arizona) continues to use SALT/HRS to characterise white dwarfs heavily polluted with metals, probably via accretion of asteroids and dust. City University of New York astronomers Saavik Ford and Barry McKernan are using SALT to characterise afterglows of black hole mergers in AGN discs.

SALT Board member:
Michael Shara



The American Museum of Natural History's Rose Center for Earth and Space in New York City.

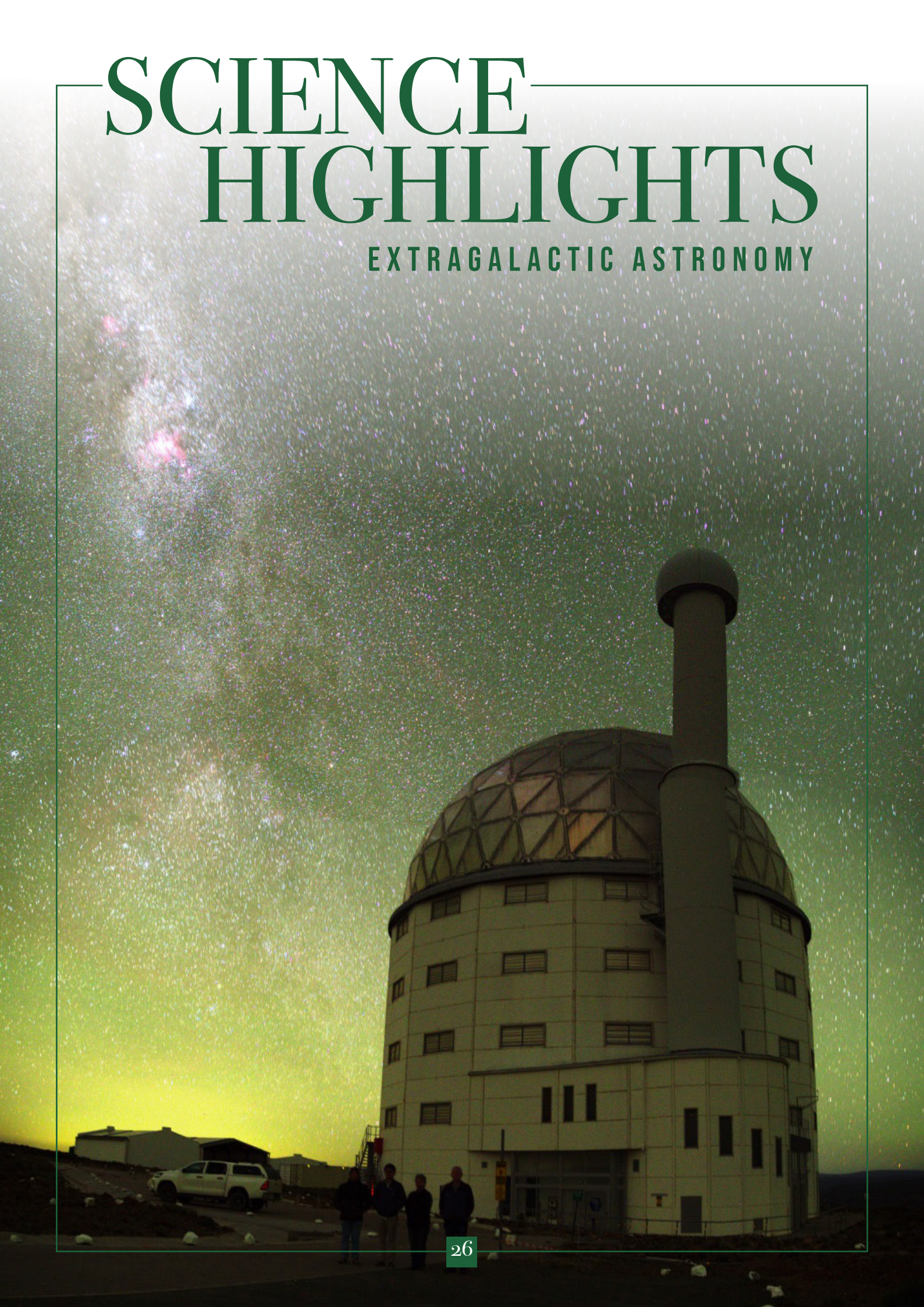




SCIENCE HIGHLIGHTS

SCIENCE HIGHLIGHTS

EXTRAGALACTIC ASTRONOMY

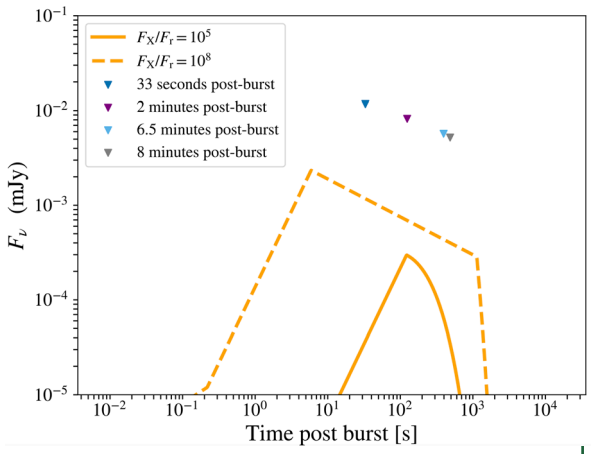


Contemporaneous optical-radio observations of an FRB

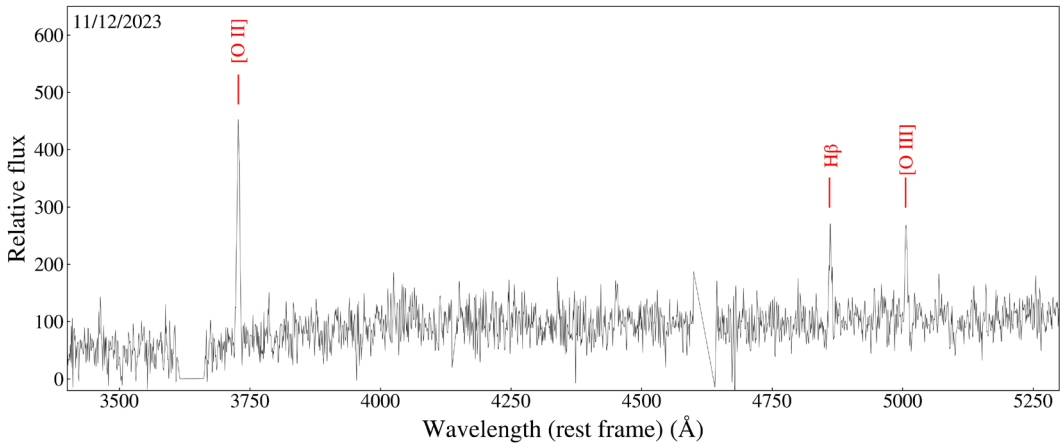
Fast radio bursts (FRBs) are bright, millisecond-duration pulses of radio emission that were first discovered by Lorimer in 2007 in archival pulsar data. Despite the fact that almost 1000 FRBs have been published to date, the cause of these intense bursts remains uncertain. Numerous models have been proposed, but it is difficult to narrow down the list of possible scenarios, partly due to the fact that FRBs have only ever been observed at radio wavelengths. Detecting an FRB at another wavelength would rule out any model that does not predict such a counterpart. However, observing FRBs at multiple wavelengths is challenging, primarily due to the fact that the majority of FRBs appear to be once-off events, lasting for only a few milliseconds. Only a small percentage of FRBs (around 3%) repeat, and multi-wavelength observations can be carried out while they are supposed to be active, but most FRBs remain elusive. This is problematic not only because repeating FRBs represent only a small minority of known FRBs, but also because it is possible that repeating and once-off FRBs have different progenitors/underlying emission mechanisms, in which case we would still be unable to confidently rule out possible scenarios for the once-off FRBs.

However, there is a unique opportunity to observe all types of FRBs — once-off or repeating — by having access to the radio interferometer MeerKAT and the optical telescope MeerLICHT, both located in South Africa. MeerLICHT was specifically commissioned to co-observe with MeerKAT, providing us with the ability to observe all types of FRBs at both radio and optical wavelengths simultaneously. In the early hours of 8 August 2023, MeerKAT discovered the once-off FRB 20230808F, while MeerLICHT and MeerKAT were co-observing. MeerLICHT obtained an exposure of the region containing the FRB coordinates 3.4 seconds after the FRB arrival time, which is the shortest delay time between radio and optical observations for a non-repeating FRB (the previous shortest delay was around 2 hours). This allowed Kira Hanmer and her colleagues to set upper limits on any optical emission associated with an FRB on a relatively short timescale. First, the authors narrowed down the position of the FRB to two spatially close, and possibly interacting, galaxies and obtained SALT/RSS spectroscopy of them. The resulting spectra allowed them to identify several emission lines, leading to a redshift of $z = 0.347$ and a distance estimate of approximately 1900 Mpc. From this they estimated the luminosity and isotropic energy of the FRB, which is necessary for calculating the predicted afterglow for the FRB.

The authors were able to compare the upper limits to the synchrotron maser model, which predicts that the FRB pulse results from maser emission in magnetised shocks and that an optical afterglow follows the radio burst. The limits, unfortunately, were unable to constrain the model because they were higher than the predicted model values. Had the limits been lower, or if the redshift had been approximately 2.5 times smaller, the authors would have been able to constrain the model. The method could be validated, though, and the authors are confident to achieve their goal in the future.



A comparison of the upper flux limits to the synchrotron maser model.



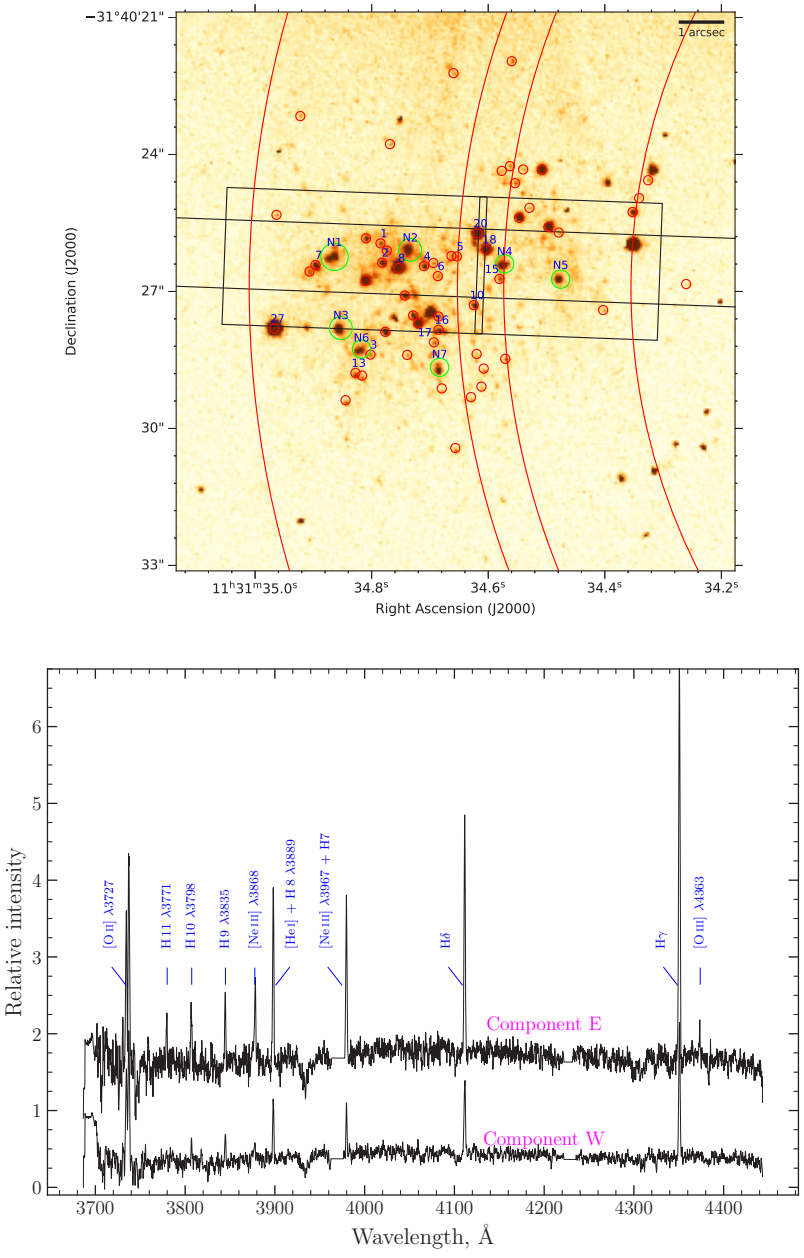
A SALT spectrum showing several emission lines which enabled the redshift calculation.

Hanmer, K. Y., et al. 2025/04, MNRAS 538, 1800: Contemporaneous optical-radio observations of a fast radio burst in a close galaxy pair

The Peekaboo galaxy: New SALT spectroscopy

The dwarf galaxy Peekaboo was discovered with the HI line survey HIPASS as HIPASS J1131–31. In a SALT publication in 2023, Karachentsev determined its distance at 6.8 Mpc and estimated the metallicity of the gas in the galaxy using the so-called 'direct' (and most reliable) method at a level of $Z \sim Z_{\odot}$ /50. However, the accuracy of this estimate was low with an uncertainty range of a factor of two. To verify this very low Z value, SALT Astronomer Alexei Kniazev and his colleague conducted a series of new observations at SALT, significantly improving the quality of the total spectrum and the accuracy of the metallicity measurement. Using the direct method, the authors obtained the same metallicity as above but with a much improved accuracy of 15%. Thus, Peekaboo's status as the closest galaxy with record-low metallicity has been confidently established. Peekaboo is a new and unique testing ground for detailed observational studies of star formation and the evolution of massive stars at metallicities characteristic of the early universe.

In addition, using archival HST data, the authors have identified massive hot O stars ionising the gas in the galaxy, as well as probable super-hot WO-class stars and several supergiants. They have also identified several compact nebulae that have unusually blue colours, as predicted in models for very young star-forming regions with $Z \sim Z_{\odot}$ /50.



Top: HST image of the Peekaboo galaxy, resolved into stars, with the position of SALT's slit superimposed. The bluest massive stars and compact blue nebulae are marked with numbers. *Bottom*: Spectra of two [H II] regions with emission lines indicated. In component E, the auroral line of the oxygen ion [O III] λ4363, used in the direct method of determining the metallicity of gas, is clearly visible.

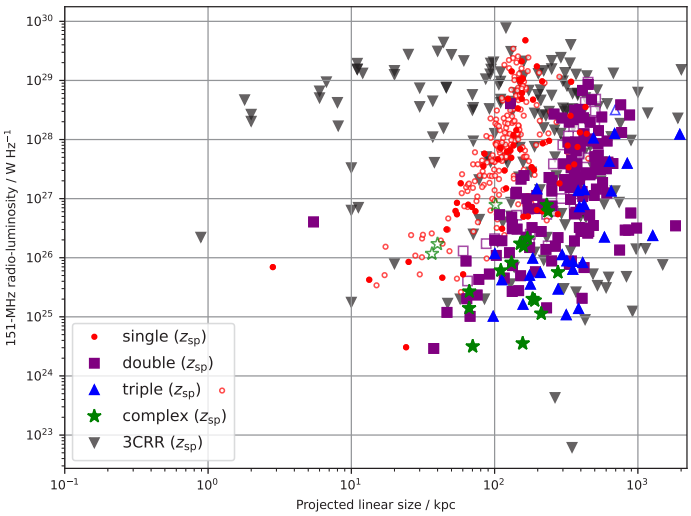
Kniazev, A. Y. and Pustilnik, S. A., 2025/06, A&A 698, L20: The Peekaboo galaxy: New SALT spectroscopy and implications of archive HST data

So near, and yet so far… SALT redshifts for the G4Jy sample

Low-frequency radio emission allows powerful AGNs to be selected in a way that is unaffected by dust obscuration and orientation of the radio-jet axis. Currently, there are too few 'radio-loud' AGNs for robust studies in terms of redshift-evolution and/or environment. Hence, Sarah White and her team used low-frequency radio observations over the southern sky to construct a sample that is 10 times larger than the heavily relied-upon 3CRR sample of the northern hemisphere. The GLEAM 4-Jy (G4Jy) sample is a legacy compilation of 1,863 bright radio sources, created in preparation for AGN science with the Square Kilometre Array (SKA).

Despite their brightness in the radio, these sources are poorly studied, with the vast majority lacking a redshift measurement in the literature. Therefore, White and her colleagues decided to follow up the G4Jy sample with a multi-semester SALT campaign. The long-slit spectroscopy led to crucial redshift determinations for some of the most interesting G4Jy sources, including the famous 'Dancing Ghosts', which are also known as G4Jy 1704 and G4Jy 1705. In addition, the dataset has formed the basis of Katlego Sejake's PhD project, resulting in the discovery of a particularly rare, high-redshift radio galaxy at $z = 3$.

The accumulation of redshifts from SALT and other telescopes has enabled the widely awaited multi-wavelength analysis of the G4Jy sample, with sources spanning a large redshift range of $0.0 < z < 3.6$. The team's cutting-edge research includes calculating intrinsic properties that reveal the true power of these radio galaxies, as well as showing how AGN life-cycles can be constrained via spectral curvature in the radio part of the spectrum. The latter suggests that there is an interesting predominance of candidate remnant radio galaxies with sizes ≤ 200 kpc — a result that would not have been possible without SALT spectroscopy for such a large, complete sample.



The radio-power–size (P–D) diagram for the G4Jy sample, as a function of radio morphology. Upper limits in the linear size are represented by unfilled symbols. Spectroscopic redshifts (z_{sp}) are from SALT and other telescopes.

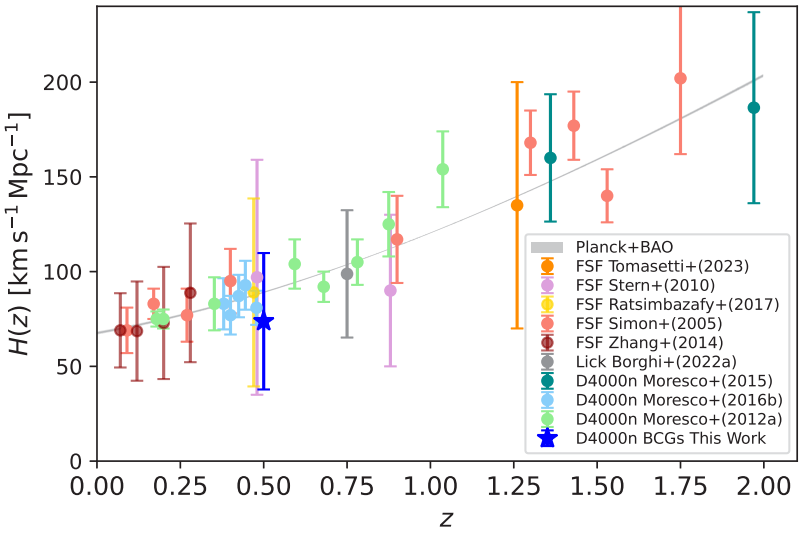
White, S. V., et al. 2025/06, PASA 42, e085: SALT spectroscopic follow-up of the G4Jy sample

BEAMS GALAXIES AND AN INDEPENDENT ESTIMATE OF H AT $z = 0.5$

Ilani Loubser and her colleagues measured the expansion rate of the Universe at redshift $z = 0.5$ using an independent technique and without making any assumption of the underlying cosmology. Specifically, they applied the so-called 'cosmic chronometer' method to a carefully selected, homogeneous sample of 53 of the most massive and oldest galaxies in the Universe: the brightest cluster galaxies (BCGs) in massive galaxy clusters. These BCGs were observed with SALT as part of the LSP BEAMS project ("BCG evolution with ACT, MeerKAT, and SALT", PI M. Hilton), employing long-slit RSS spectroscopy to obtain high-quality spectra and to measure the age-sensitive $D4000_n$ index (a spectral break around 4000 Å directly linked to the age of the stellar population).

Choosing BCGs as cosmic chronometers is advantageous because they minimise systematic biases: being old, massive, and (in this sample) passively evolving, they reduce the uncertainties related to varying star formation histories, metallicity and stellar mass. Focusing on a homogeneous population and using uniform observations delivers a robust, model-independent point for the Hubble parameter $H(z)$.

The key result of the project is the measurement of the Hubble parameter at $z = 0.5$ of 72.1 ± 33.9 (stat) ± 7.3 (syst) km s^{-1} Mpc^{-1}. While the statistical uncertainty remains large (dominating the error budget), this result demonstrates that SALT can contribute meaningful, independent cosmological measurements. When extrapolating under a standard flat ΛCDM cosmology (using priors from other datasets), the authors infer a Hubble constant of $H_0 = 54.6 \pm 25.7$ (stat) ± 5.5 (syst) km s^{-1} Mpc^{-1}. The project highlights how SALT's capabilities, access to southern-hemisphere clusters, and stable instrumentation allow us to independently trace cosmic expansion at intermediate redshifts. The new estimate of $H(z)$ at $z = 0.5$ adds a valuable data point to the worldwide effort to map the Universe's expansion history without reliance on more conventional distance ladders.



$H(z)$ derived from the cosmic chronometers method at different redshifts. The team's estimate using only BCGs is shown with a blue star at $z = 0.5$. Labels refer to measurements made using full-spectrum fitting (FSF), Lick indices, or $D4000_n$. For reference, the standard ΛCDM Planck evolution is shown in a grey band with its width determined by ±1σ variation of cosmological parameters.

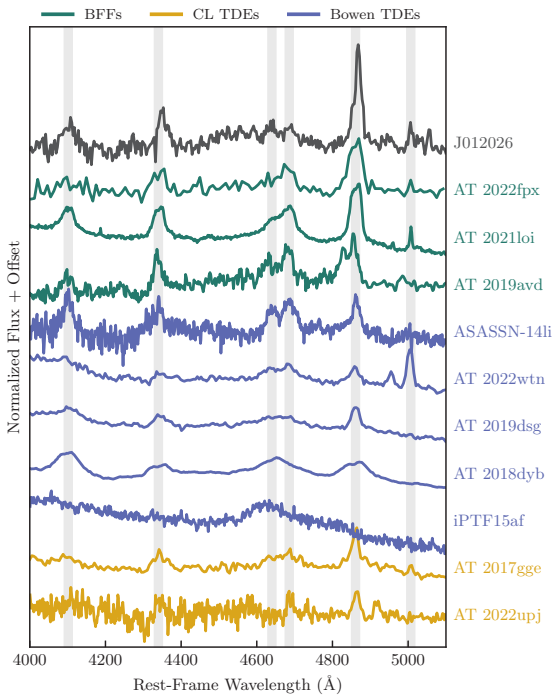
Loubser, S. I., et al. 2025/07, MNRAS 540, 3135: An independent estimate of H(z) at z = 0.5 from the stellar ages of brightest cluster galaxies

SALT classifies a supermassive black hole X-ray transient

When a star comes too close to a supermassive black hole (SMBH), it can be torn apart in a tidal disruption event (TDE). As the stellar debris is accreted, it produces a luminous flare spanning optical to X-ray wavelengths, typically rising over a few weeks and fading over months to years. These events reveal otherwise dormant SMBHs and provide unique laboratories for studying the formation, evolution, and dissipation of accretion flows.

Using the X-ray all-sky time-domain survey carried out by eROSITA aboard the *SRG* spacecraft, Pietro Baldini and his colleagues discovered the peculiar transient eRASSt J012026.5−292727 (hereafter J012026). Unlike typical TDEs, J012026 displayed X-ray rebrightenings approximately one year after the initial peak. To securely classify this source, the scientists obtained multi-epoch optical spectroscopy with SALT and other facilities.

The spectra revealed characteristic TDE signatures: prominent high-ionisation iron 'coronal lines' and emission produced via the Bowen fluorescence mechanism. However, these features persisted for several years, which is longer than in standard TDEs, where such lines typically fade within months. Additionally, the emission-line widths were about an order of magnitude narrower than those observed in classical TDEs. Combined with a multi-wavelength analysis, these properties revealed that J012026 is a member of the extremely rare class of Bowen Fluorescence Flares (BFFs), potentially powered by TDEs occurring in gas-rich environments. With fewer than ten such events known to date, J012026 represents the first BFF discovered through X-ray selection. This result highlights the crucial role of X-ray time-domain observatories and underscores the necessity of rapid, multi-epoch optical spectroscopic follow-up for discovering exotic SMBH-related transients.



Comparison of optical spectra of J012026 with other members of the BFF class (green), TDEs with Bowen Lines (blue), and TDEs with coronal lines (CL TDEs, yellow). The grey shaded areas show, respectively from left to right, the wavelength corresponding to Hδ, Hγ , [N III], [He III], Hβ and [O III] λ5007. The spectrum of J012026 resembles more closely the spectra of BFFs.

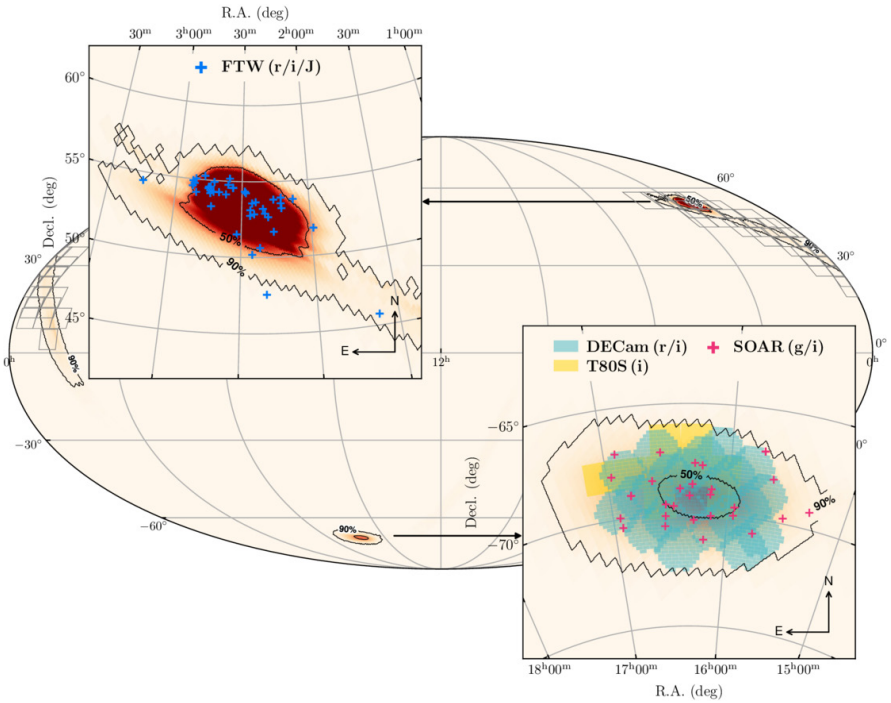
Baldini, P., et al. 2025/09, A&A 701, A224: A new Bowen fluorescence flare and extreme coronal line emitter discovered by SRG/eROSITA

Kilonova models and a candidate GW binary merger involving a neutron star

The GW-MMADS (GW MultiMessenger Astronomy DECam Survey) programme conducted a coordinated multi-messenger follow-up of the gravitational wave event S250206dm, one of the most promising neutron star–black hole / binary neutron star merger candidates identified during the LIGO/Virgo/KAGRA (LVK) O4 run. To search for an optical or NIR kilonova counterpart, a team around Lei Hu combined wide-field DECam imaging with targeted observations from SOAR, T80-South, and the Fraunhofer Telescope at Wendelstein Observatory, complemented by SALT spectroscopy. This combined strategy enabled robust searches across the high-probability regions of the event localisation.

SALT provided crucial spectroscopic data for four DECam-selected candidates: AT 2025bnp, AT 2025bnj, AT 2025bnt, and AT 2025bnh. SALT detected clear host galaxy features for three of the sources, yielding secure redshifts in the range $z \approx 0.10 - 0.14$. These spectroscopic constraints, when combined with the photometric evolution observed in the DECam imaging, demonstrated that none of the candidates were consistent with a red and rapidly evolving kilonova at distances compatible with the LVK localisation of S250206dm.

By integrating SALT spectroscopy with the imaging observations, the authors are able to place competitive constraints on kilonova models — effectively ruling out all kilonovae as bright as or brighter than AT2017gfo within the northern fields covered by SOAR, and nearly half of such models within the southern regions covered by DECam.

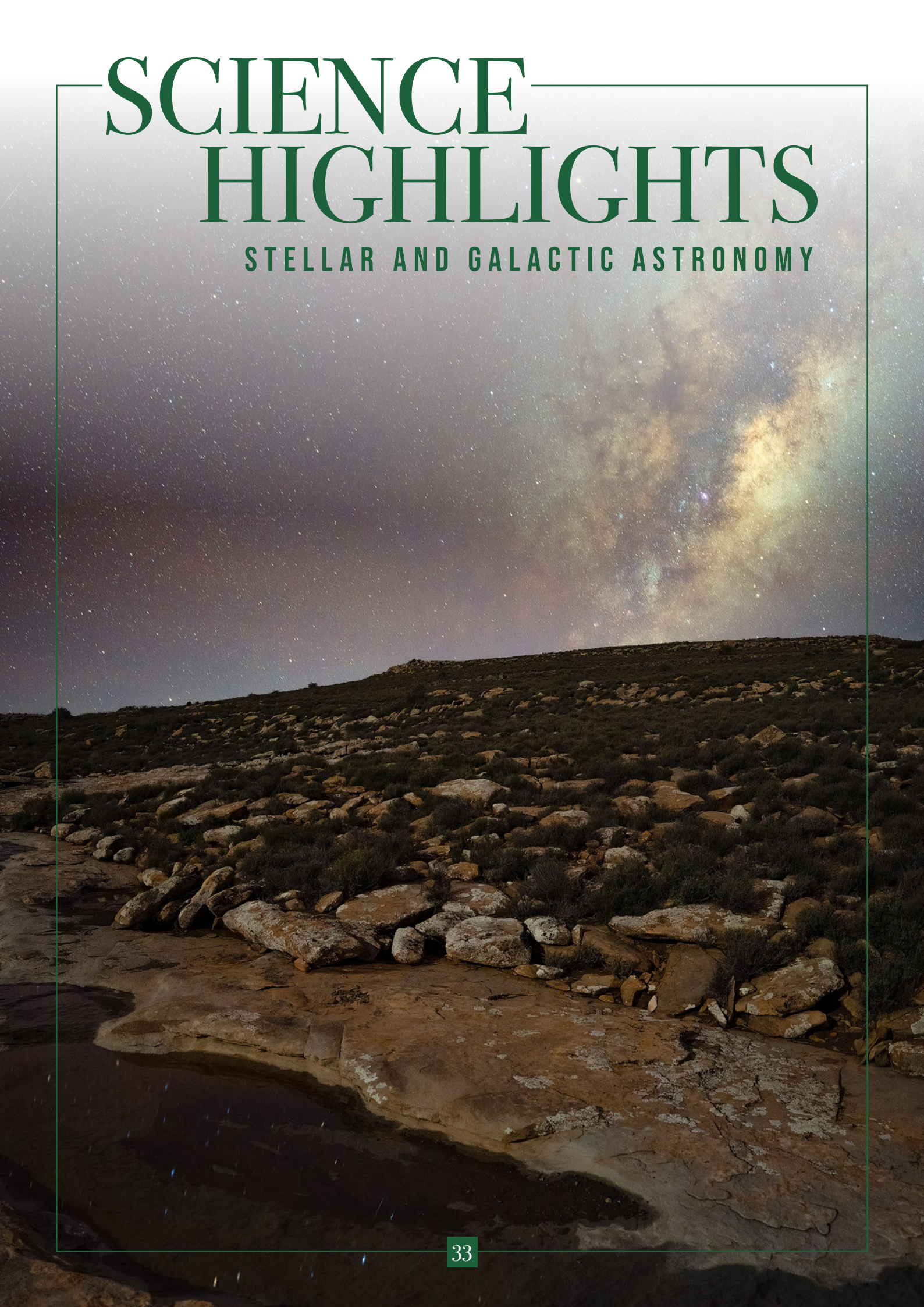


Localisation region of S250206dm overlapped with the footprints of GW-MMADS follow-up observations. The upper and lower inset panels show zoomed-in views of two lobes of the LVK sky map with high probability, located in the northern and southern hemispheres, respectively. For reference, the grey outline indicates the sky tiles in the northern lobe used for ZTF observations of S250206dm.

Hu, L., et al. 2025/09, ApJL 990, L46: Kilonova Constraints for the LIGO/Virgo/KAGRA Neutron Star Merger Candidate S250206dm: GW-MMADS Observations

SCIENCE HIGHLIGHTS

STELLAR AND GALACTIC ASTRONOMY

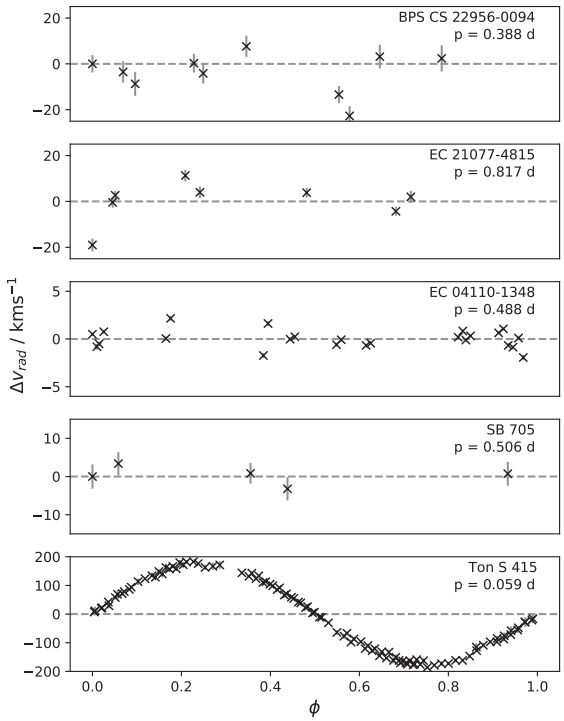


SALT survey of hydrogen-deficient stars: close binary systems

Hot subdwarfs are a diverse group of subluminous, early-type stars that lie between the main sequence and the white dwarf cooling sequence in the extended horizontal branch (EHB) region of the Hertzsprung-Russell diagram. They can be broadly categorised according to their atmospheric helium abundances, with most examples having He abundances <1% by number. However, a significant minority (~10%) instead have hydrogen-deficient atmospheres dominated by He abundances of up to 99.9%. The formation and evolution of hot subdwarfs is challenging to fully explain, due to the varied and interconnected nature of EHB populations. The most widely-accepted channels for He-deficient hot subdwarfs involve Roche lobe overflow within close binary systems, which are supported by the large observed binary fraction of these stars. Conversely, formation models for H-deficient hot subdwarfs typically rely on merger processes, implying that such stars should not exist in close binaries. Despite this, examples of H-deficient binaries have been found, but the rarity and diversity of such objects makes establishing a basis for new evolutionary models difficult.

Since 2016, Simon Jefferey from Armagh Observatory led multiple SALT observing programmes focused on H-deficient stars, making use of RSS and HRS spectroscopy to classify as many objects as possible and to determine their parameters and abundances. One of the many goals of the SALT survey is to identify new H-deficient binaries to help strengthen our understanding of how such systems can form and evolve. In his study, PhD student Edward Snowdon made use of the SALT spectra and combined them with photometric data from the *Transiting Exoplanet Survey Satellite (TESS)* to identify candidate binaries within the catalogue of H-deficient objects in the SALT survey.

Snowdon examined 395 stars from the SALT survey, of which 153 also had available *TESS* data. Six objects from this sample showed periodic variability in their *TESS* light curves. Analyses of RSS and HRS spectra and SEDs of these objects confirmed Ton S 415 to be a close binary of an intermediate-He hot subdwarf with an unseen white dwarf companion. The causes of the variability in the remaining candidates could not be conclusively determined, though cross-correlation of the SALT spectra allowed close binary motion to be ruled out, due to a lack of periodic radial velocity variations. The observed binary fraction of the SALT H-deficient star catalogue was therefore found to be <1%.



Radial velocity measurements from cross-correlation for the SALT candidate binaries. Each star's measurements have been phase-folded to their periods. Apart from Ton S 415, no candidates show significant radial velocity variations corresponding to their photometric periods. The formal error in each RV measurement is shown in grey.

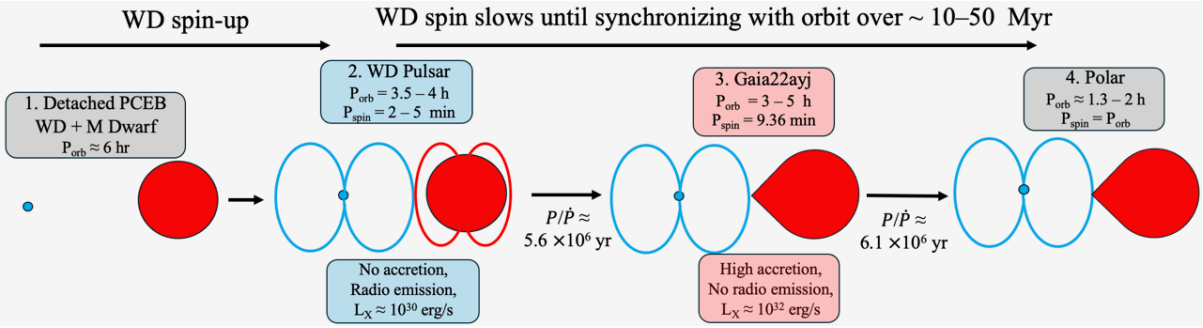
Snowdon, E. J., et al. 2025/02, MNRAS 537, 2079: A search for close binary systems in the SALT survey of hydrogen-deficient stars using TESS

Gaia22ayj: an evolutionary link between white dwarf pulsars and polars

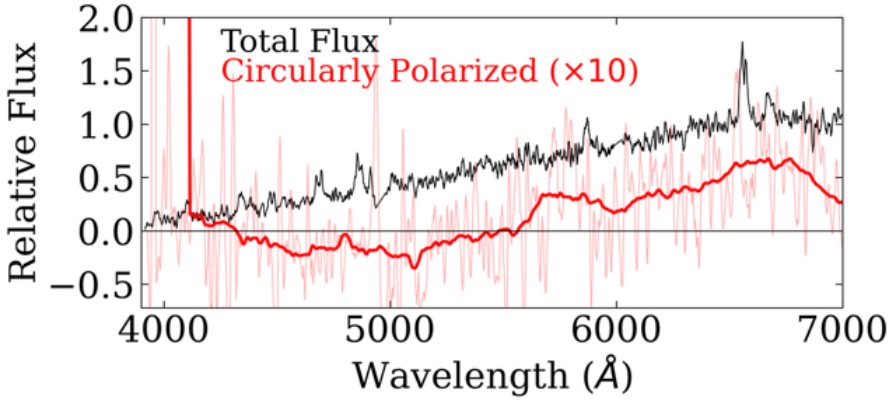
Gaia22ayj exhibits dramatic optical variability that marks it as one of the most compelling magnetic white-dwarf binaries identified in recent years. First flagged in outburst by the Gaia Photometric Science Alerts system in March 2022, the source was found to show a striking 9.36-minute modulation nearly two magnitudes in amplitude, which was interpreted as an orbital period.

Shortly after the initial discovery, Antonio Rodriguez and his collaborators obtained high-quality spectropolarimetry that was only possible with the instrumentation available on SALT. They detected circular polarisation, reaching 5%, a signature traditionally associated with cyclotron emission from magnetically funnelled accretion flows in polars. This discovery initiated a nearly two-year-long campaign to acquire further X-ray, radio, infrared, and optical data on this object, resulting in a first comprehensive characterisation of this object. The data reveals that the 9.36-minute period instead is due to pulsation, that Gaia22ayj is spinning down at a rate of ~6 × 10^6 yr, and that it exhibits high levels of linear polarisation (40%), behaviours resembling that of white dwarf binary pulsars such as AR Sco. On the other hand, the presence of circular polarisation points toward ongoing accretion onto magnetic poles.

Only by capturing both the magnetic geometry and spin-down evolution of this object could the team assemble a coherent physical model of the system. They conclude that Gaia22ayj blends features normally associated with two distinct classes: the rapidly rotating, non-accreting white-dwarf pulsars and the accreting, magnetically channelled systems known as polars. This unusual combination immediately sets Gaia22ayj apart as a possible transitional object or 'missing link' between these evolutionary stages: a source where strong magnetism, rapid rotation, and active accretion coexist all while the system is rapidly spinning down. Its discovery hints at a richer and more diverse population of magnetic white-dwarf binaries awaiting discovery by the upcoming Vera C. Rubin Observatory's Legacy Survey of Space and Time.



Significance of Gaia22ayj as a 'missing link' between two classes of binary stars. From left to right: An initially non-magnetic WD is spun-up by mass transfer from a companion star to periods of 2 – 5 minutes. At this point, the system is no longer transferring mass due to the extreme magnetism, but emits radio pulses. Eventually such systems are thought to resume mass transfer, though with a slowly spinning white dwarf, at periods of 1.3 – 2 hours.

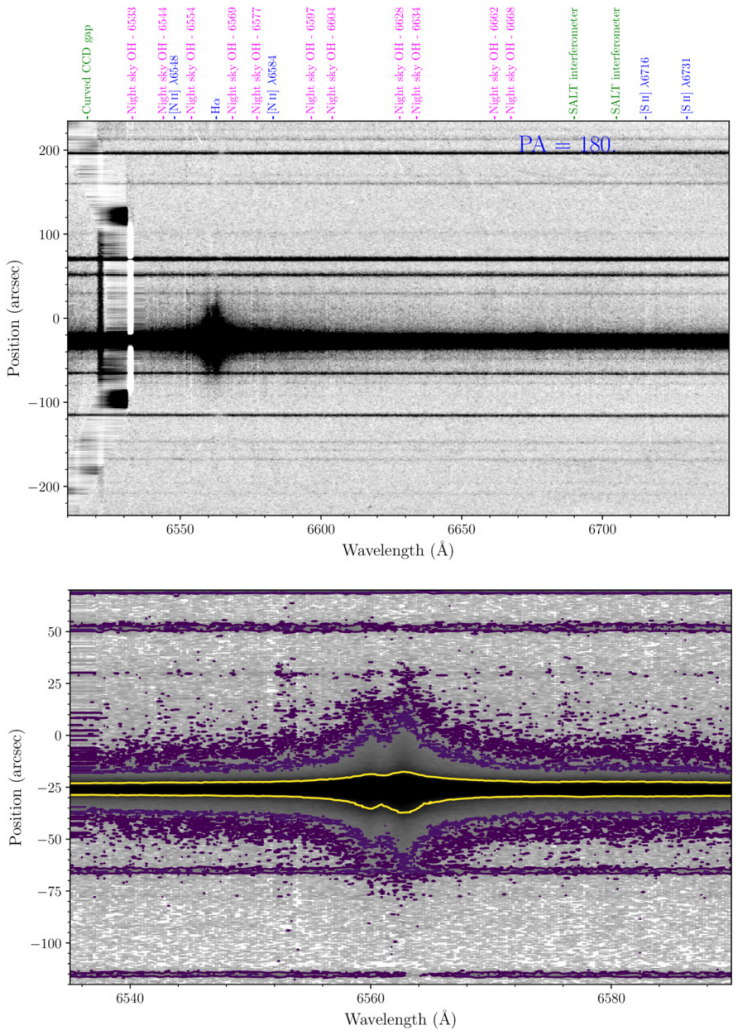


The SALT spectrum of Gaia22ayj (black) shows clear emission lines, indicative of high mass transfer. The circularly polarised spectrum (red) peaks around 6800 Å. The height of the feature corresponds to a five percent level of circular polarisation (>1σ), consistent with magnetic CVs.

Rodriguez, A. C., et al. 2025/02, PASP 137, 024202: A Link Between White Dwarf Pulsars and Polars: Multiwavelength Observations of the 9.36-minute Period Variable Gaia22ayj

Nova super-remnant surrounding the recurrent nova RS Ophiuchi

Deep narrowband Condor Array Telescope imagery of the environs of the recurrent nova RS Oph has revealed a ~1.5° (~70 pc) sized, possibly bi-lobed nebulosity surrounding RS Oph; a nova super-remnant. Such nebulae are predicted to be intrinsic and unavoidable features surrounding all RNe, and their detection strongly supports the theoretical model of the pile-up of thousands of ejected shells. The RS Oph super-remnant must be at least tens of thousands of years old to be consistent with RS Oph's (Gaia-determined) proper motion and the ~3600 km/s initial speed of ejection of its nova events. SALT's demonstration of the lack of significant [O III] emission rules out a supernova or planetary nebula origin for the observed nebulosity. The logarithmic ratios of the [N II] λ6584/Hα and [S II]/Hα lines, both about –0.45, are indicative of shock ionisation as expected for a nova super-remnant. The SALT-observed line ratio [S II] λλ6716/6731 is consistent with a matter density of ~50 atoms/cm^3. A simple model of a (mostly hollow) shell yields a shell mass of ~20 – 200 $M_\odot$, expanding at a few tens of km/s, with an age of order 50 – 100 kyr.



Top: Sky-subtracted SALT spectrum of the inner RS Oph shell. All unidentified (vertical) lines are due to the night sky. Unidentified horizontal lines are field stars that were aligned with the slit during the observations. *Bottom*: A close-up of the sky-subtracted region around Hα. The black, grey, and purple pixels are, respectively, at least 200, 20, and 2 counts above background.

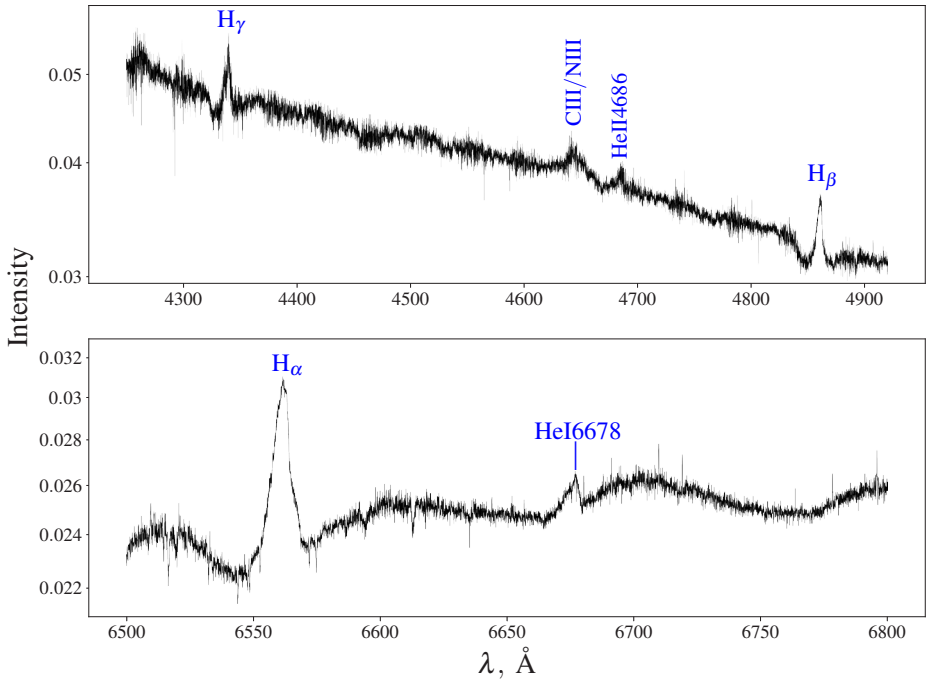
Shara, M. M., et al. 2025/07, AJ 170, 56: A 70 pc Diameter Nova Superremnant Surrounding the Recurrent Nova RS Ophiuchi

SALT's classification of an eROSITA-detected novalike CV

The eROSITA all-sky survey has revealed a vast population of previously unknown X-ray sources, including hundreds of candidates for compact accreting binaries whose physical nature cannot be determined from eROSITA X-ray data alone. To this end, the project initiated an intensive multi-wavelength campaign combining sensitive *XMM-Newton* X-ray observations with dedicated ground-based optical follow-up. Artur Avakyan and his colleagues used this data to secure classification of two particular candidates, namely, 1eRASS J061330.8+160440 and 1eRASS J161201.9–464622. Central to this undertaking was the use of SALT to obtain high signal-to-noise spectroscopy of the second source, eRASS J161201.9–464622, required to diagnose its complex optical features.

The optical spectrum obtained by SALT robustly points toward a classification of eRASS J161201.9–464622 as a cataclysmic variable (CV). The spectrum is characterised by a very blue continuum that rises toward the short-wavelength cut-off, hinting at a strong, hot ultraviolet component originating from the emitting region. Crucially, the spectrum is rich in emission features, prominently displaying the H-Balmer series, neutral and ionised He-emission lines, and the fluorescent [C III]/[N III] Bowen blend — all hallmarks of an accreting binary system with a hot, optically thin plasma layer. Furthermore, the absence of any spectral features from a companion (donor) star, combined with the presence of broad absorption wings accompanying each Balmer emission line, strongly supports the model of an optically thick accretion disc around a white dwarf, viewed at a low inclination angle. With all emission lines exhibiting small equivalent widths (|EW| < 10 Å) and a low [He II]/Hβ ratio, the source is ruled out as a magnetic CV, like an intermediate polar.

Ultimately, the robust SALT spectroscopy allowed the authors to classify this source as a weakly magnetised, novalike CV. This result establishes 1eRASS J161201.9–464622 as only the second novalike CV discovered by eROSITA (SRGt 062340.2–265751 being the first, also confirmed by SALT), underlining SALT's key role in turning wide-field survey detections into robust astrophysical classifications.



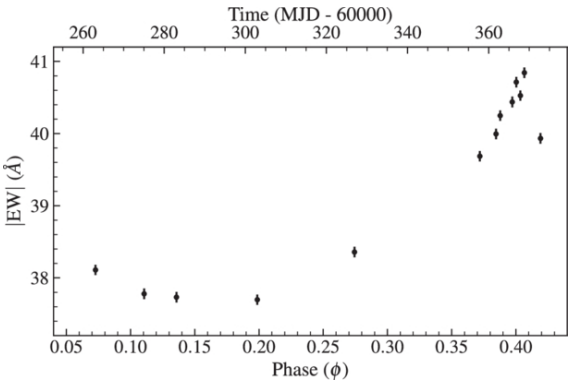
Blue (*top*) and red (*bottom*) arms of J161201's SALT/HRS spectrum. The HRS provides data in arbitrary, uncalibrated intensity units. Identified emission lines are labeled.

Avakyan, A., et al. 2025/07, ExA 60, 6: XMM-Newton follow-up of two eROSITA X-ray binary candidates

New insights into pulsar–disc interaction: HESS J0632+057

While there are hundreds of known X-ray binary star systems, there are only a few known sources that are bright at gamma-rays, emitting up to TeV energies. One such system is the gamma-ray binary HESS J0632+057, which consists of an unknown compact object orbiting a Be type star with a period of around 320 days. The compact object is believed to be a young pulsar, and the non-thermal emission is thought to be produced in a shock that forms between the stellar and pulsar winds. HESS J0632+057 has shown complicated behaviour, with multiple peaks in the X-ray and gamma-ray light curves, and orbit-to-orbit variability.

Jaegeun Park and collaborators undertook a large multi-wavelength study using new observations with SALT, the Swift spacecraft, the *Nuclear Spectroscopic Telescope Array (NuSTAR)*, and the Very Energetic Radiation Imaging Telescope Array System (VERITAS).



Orbital modulation of the Hα equivalent width as measured with SALT.

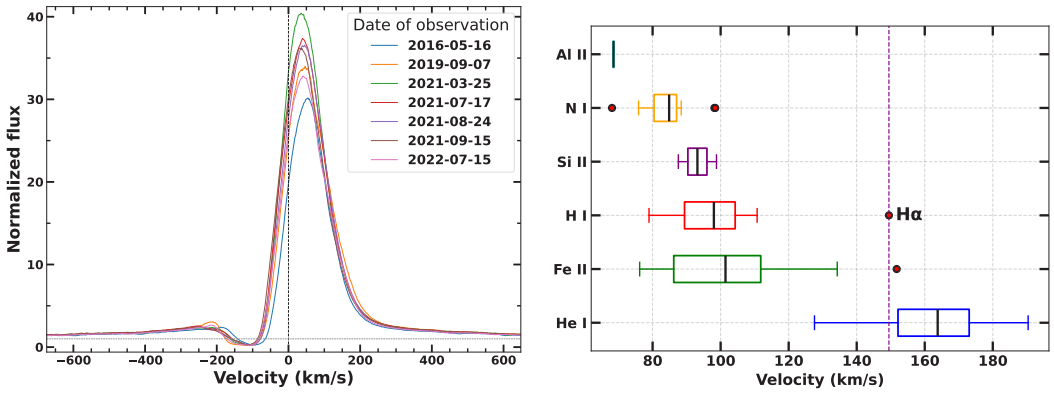
The new analysis showed an increase in X-ray flux and N_H around orbital phase 0.35, which suggests the pulsar is passing through the Be star's circumstellar disc during this orbital phase. This is supported by the observed increase in the equivalent width of the Hα emission line, arising from the disc, around the same phase. A comparison between the new and archival X-ray observations showed both short-term (day timescales) variability, which could be due to clumpiness in the disc, as well as long-term (year timescales) variability, likely due to long-term changes in the size of the circumstellar disc. The latter is supported by the long-term change found in the Hα equivalent width. A gamma-ray flare was also detected around the same orbital phase with VERITAS, showing a complicated link to this interaction phase.

Park, J., et al. 2025/09, ApJ 991, 28: Multiwavelength Study of HESS J0632+057: New Insights into Pulsar–Disk Interaction

Fullerenes in the shell of a luminous blue variable candidate

Luminous blue variables (LBVs) represent a transient yet pivotal stage in the evolution of massive stars, exhibiting dramatic photometric and spectroscopic variability. Arun Roy and his colleagues report the first-ever detection of fullerene (a carbonaceous molecule composed of 60 carbon atoms arranged in a spherical shape) in the circumstellar environment of the candidate LBV WRAY 16-232, alongside polycyclic aromatic hydrocarbons (PAHs), using *Spitzer* low-resolution spectra.

The authors also obtained seven archival SALT/HRS spectra of WRAY 16-232, obtained in the low-resolution mode (R ~ 16000). They used the spectrum obtained on 16 May 2016 to perform a complete optical spectroscopic analysis, while the remaining spectra were used to study the variability of the Hα line and to confirm the variable nature of WRAY 16-232. In their analysis, the authors identified a total of 109 emission lines, with P Cygni profiles being the most prevalent. Velocities were calculated from unblended P Cygni profiles using the Doppler shift formula. The team then constructed a velocity box plot, which revealed a multi-layered structure in the envelope of WRAY 16-232. This provided insight into the possible formation mechanism of C_{60} in the envelope of WRAY 16-232, in which shocks with velocities ranging between 75 – 150 km/s can structurally transform PAHs into C_{60}.



Left: Variability of the Hα line from seven epochs of SALT data. *Right*: The box plot of velocities of various species identified in SALT spectra.

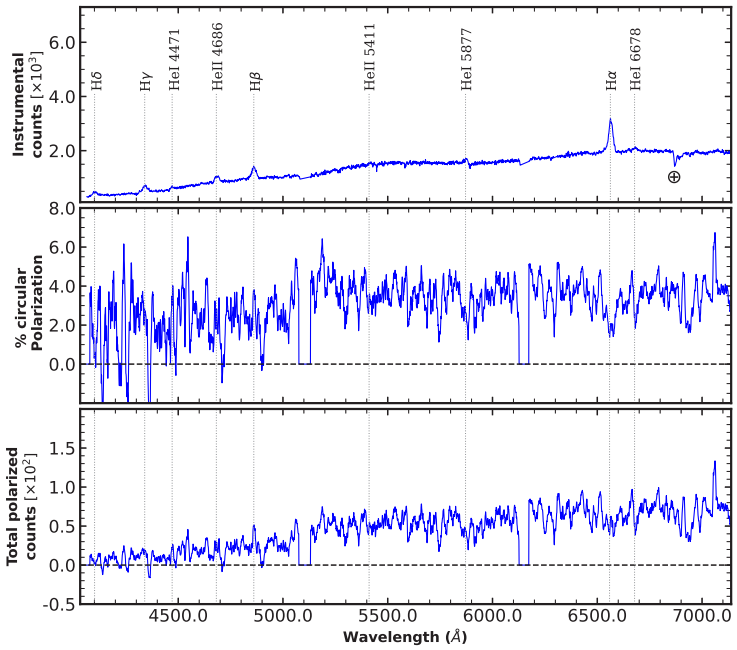
Arun, R., et al. 2025/11, MNRAS 543, 3214: Discovery of fullerenes in the shell of candidate luminous blue variable WRAY 16-232

Multi-technique observations of the intermediate polar 1RXS J080114.6–462324

Cataclysmic variable stars (CVs) are semi-detached interacting binary systems characterised by ongoing mass transfer from a low-mass companion star to a white dwarf (WD) via Roche-lobe overflow. Intermediate polars (IPs) are a subclass of magnetic CVs, distinguished by moderate WD magnetic field strengths, typically in the range of 1 – 10 MG, which are sufficient to disrupt the inner regions of the accretion disc while leaving the outer disc largely intact. These systems commonly exhibit two distinct periodicities, one associated with the binary orbital motion and another corresponding to the spin of the accreting WD. Victor Moloi and his colleagues obtained multi-technique observations of the recently identified IP 1RXS J080114.6–462324 with a known WD spin period of approximately 1307.50 s. Their aim was to investigate orbital variations in the emission lines of 1RXS J080114.6–462324, to explore the underlying emission mechanisms, and to examine the wavelength-dependence and polarisation properties of the system. In addition, they also identified and refined key periodicities, including the WD spin period and the binary orbital period.

The team obtained polarimetric observations with SALT's RSS in circular spectropolarimetry mode. The large aperture of SALT, combined with the capabilities of RSS, provides excellent sensitivity for polarimetric observations, making it well suited for this type of science. The observations provided the first detection of circular polarisation from 1RXS J080114.6–462324 in both photopolarimetry and circular spectropolarimetry observations, confirming the magnetic nature of this system.

Circularly polarised emission has been detected in only a small fraction of the IP population, with confirmed detections in approximately 7 – 13% of known systems. The detection of strong, coherently spin-modulated circular polarisation from 1RXS J080114.6–462324, reaching ~ +5 per cent, therefore makes this source particularly noteworthy. The comparatively high polarisation amplitude observed in this system places it among the most strongly polarised IPs currently known (e.g., 1RXS J173021.5–055933), making it an excellent candidate for high signal-to-noise, multi-filter polarimetric follow-up observations aimed at investigating potential wavelength and epoch-dependent variations in the cyclotron emission. As a long-period IP, this system also provides a valuable benchmark for understanding the evolutionary pathway of IPs from longer to shorter orbital periods.

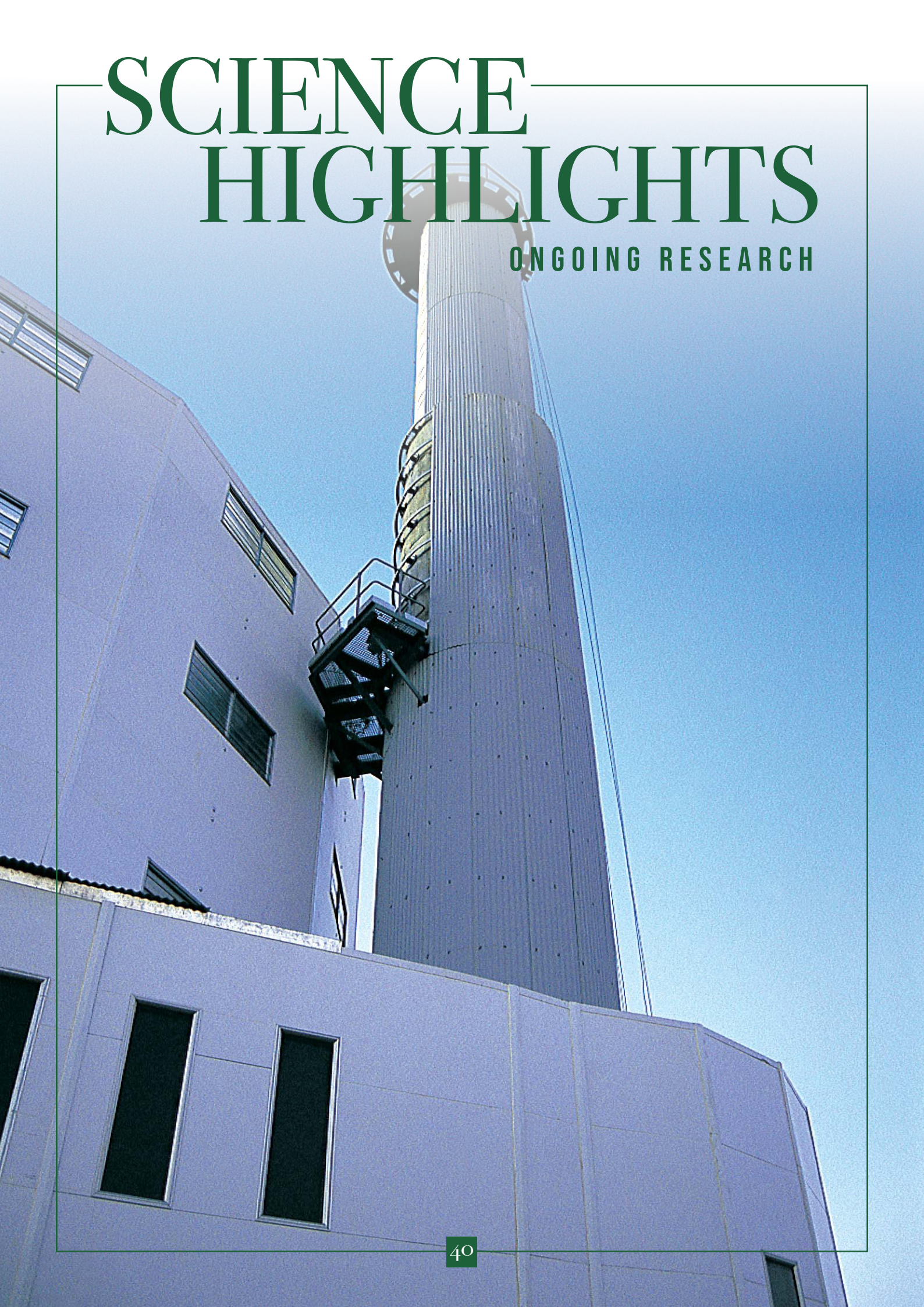


The spectra of 1RXS J080114.6–462324 obtained on 21 January 2025, centred at the spin phase ϕ = 0.816. Prominent emission lines are indicated, while the ⊕ symbol marks regions affected by atmospheric telluric features. From top to bottom, the panels present the average spectrum, the circular polarisation percentage spectrum, and the total polarised flux.

Moloi, V., et al. 2025/11, MNRAS 544, 1146: Detection of spin-modulated circular polarization and radial velocity variations in the long-period Intermediate Polar 1RXS J080114.6—462324

SCIENCE HIGHLIGHTS

ONGOING RESEARCH



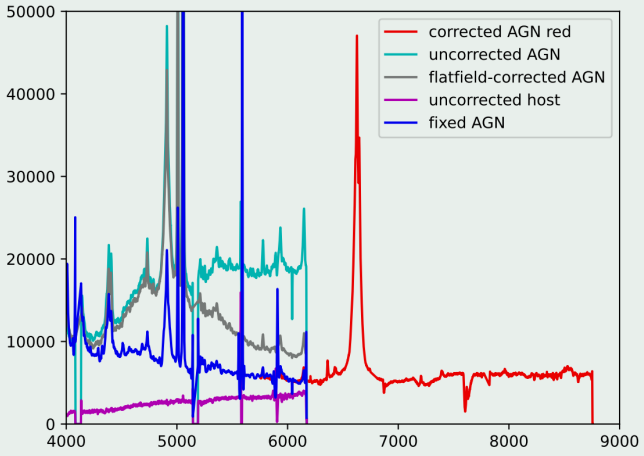
A number of exciting SALT science projects are either close to being published or are longer-term projects that may lead to publications on selected objects of interest, awaiting completion of the final science goals. We give here an overview of a small selection of these.

PROPOSAL STATISTICS

Over the two semesters in 2025 (2024-2 and 2025-1) a total of 110 proposals were accepted by the various TACs (plus another 26 that had been carried over from previous semesters). Nine of these were DDT proposals, receiving a total of 78 kiloseconds of observing time. The results of one of these (on the interstellar comet 3I/ATLAS observation) has been published a mere two months after observations. There were six commissioning proposals (COM), dealing with polarimetry, the slitmask IFU, the High Stability mode for the HRS and the magic pixel project (97 kiloseconds). Four gravitational wave event proposals (GWE) resulted in 16 kiloseconds taken, of which one has already led to a publication (see the contribution by Hu in the extragalactic science section). There were four Large Science Proposals (LSP) submitted in the two semesters. The longest lasting is the Transient Universe project led by David Buckley. A new proposal, led by Mirjana Pović, makes use of the new slitmask IFU and is described below. Finally, there were 76 normal science proposals (SCI), 30 multi-semester proposals (MLT) and seven OPTICON-Radionet proposals (ORP).

Polluted white dwarfs offer a rare window into the bulk composition of exoplanetary material, but recent theoretical work suggests that abundance measurements may be complicated by time-variable or asynchronous accretion. Using SALT/HRS, **Laura Rogers and Mike Shara** monitored six metal-polluted white dwarfs to test whether their atmospheric compositions change over time. Five stars show remarkably stable abundances, consistent with steady-state accretion, while one object, WD 0106-328, exhibits a ~35% increase in the strength of the [Mg II] doublet compared to MIKE/Magellan data from 2007 – 2009. This intriguing result motivated a Hubble Cycle 32 programme to confirm the variability and explore additional elements. Rogers and Shara have recently obtained the Hubble observations and are in the process of analysing the data and preparing a publication.

In a SALT DDT proposal, **Paulina Karczmarek and Bożena Czerny** from CAMK, Poland, asked to obtain an RSS spectrum of the AGN NGC 3783, optimised to capture both the Balmer and Paschen continua across two spectroscopic configurations to complement high-cadence, multi-band photometric monitoring at Cerro Murphy Observatory, Chile. The light curves exhibit well-correlated variability, enabling inter-band lag measurements with ≤ 10% uncertainty. Combining these lags with spectral energy distribution fitting permits an independent determination of the Hubble-Lemaître constant. The SALT spectra are essential to validate the photometric detection of Balmer and Paschen jump contamination and to correct for broad-line region contributions that systematically bias the inter-band lag measurements. The result is very interesting. It shows that the Balmer edge at 3634 Å rest frame is practically invisible in the spectrum while it is strongly present in the time delay profile. The analysis is still ongoing, but in a qualitative sense this discrepancy in the Balmer edge strength rather implies a very large ratio between the intrinsic time delay from the broad line region and from the disc.



Achieving calibration of the SALT spectrum of NGC 3783 in the blue setup. The uncorrected blue spectrum is plotted in cyan, unreliable flat-field corrected spectrum in grey, the uncorrected host galaxy in magenta, while the solution for the blue setup is shown in blue and the red setup in red. The final spectrum is thus represented by the blue (short wavelengths) and red (long wavelengths) line.

Observing the transient Universe

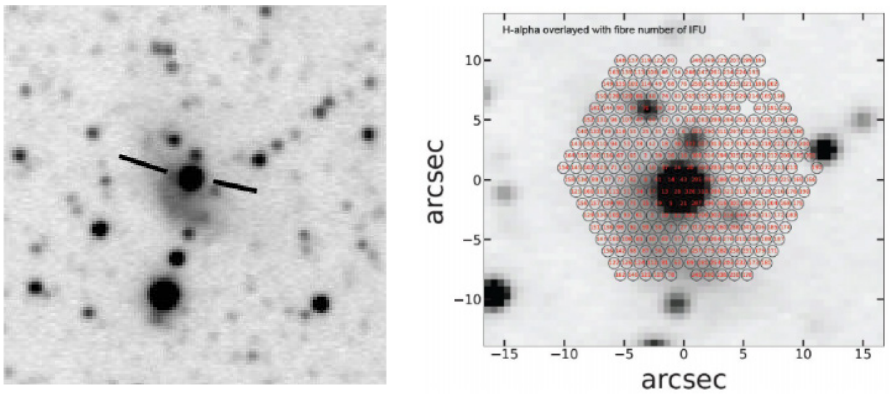
The SALT Large Science Programme on transients, begun in 2016 and led by David Buckley, has continued during 2025. It was renewed for another three years from semester 2024-2. The programme has been very productive, with another 13 refereed publications in 2025. This year's main thrust of the programme has been follow-up of candidate cataclysmic variables discovered as X-ray transient or variable sources by eROSITA, ART-XC (instruments on-board the *SRG* satellite) and the *Einstein Probe (EP)*, a Chinese X-ray satellite launched in February 2024. A number of new CV discoveries were made during the year, and follow-up observations were conducted of several of them. An increased amount of time was given to the identification of transients discovered by the BlackGEM telescopes in Chile, most being dwarf novae or supernovae. A total of 160 observing blocks were observed for 100 targets, of which several had repeat visits, for a total of 425,897 sec. The success rate for completion of the observations was 83.5%, with rejected blocks mostly due to technical issues and weather (23).

Candidate cataclysmic variables (CVs)	31.9%	50 targets
Radio stars/transients	17.5%	15 targets
Be X-ray binaries (HMXBs)	15.0%	3 targets
Supernovae (SNe)	11.9%	8 targets
AGNs & blazars	7.5%	8 targets
BH binary candidates	5.6%	2 targets
Novae/luminous red novae	3.8%	5 targets
X-ray transients	2.5%	2 targets
Misc. objects (GRBs, microlens, WD pulsar, binaries)	2.5%	6 targets
Calibrators	1.9%	1 target

Apart from some publications resulting from this programme described in the science highlight section, a couple of highlights from the year are mentioned below.

Minjung Liu reported on a remarkable **orphan X-ray flare from a blazar candidate EP240709a**, detected by the *Einstein Probe* in July 2024. Orphan flares from blazars have only been detected a few times, providing an opportunity to understand the structure of the jet in the accreting system. With the help of SALT, Liu and his team were able to unravel the nature of this object. The multiband spectral properties and variability support EP240709a as a high-energy peaked BL Lacertae-type object. EP240709a exhibits the harder-when-brighter tendency in the X-ray band during the orphan flare, while its infrared-optical spectra are featureless.

SXP 31.0 is an X-ray source in the SMC that was first identified as a Be X-ray binary system when it went into X-ray outbursts in 1998. It is now known to consist of an OBe main sequence star and a neutron star with a spin period of 31 s. In 2025 a new X-ray outburst phase began with the source exhibiting luminosities approaching the Eddington limit of 10^{38} erg/s. Unusually, Hα images show it has a surrounding halo whose nature has not been clear. Observations obtained with both HRS and RSS (including the new multifibre IFU) identified the halo emission as probably a coincidental [H II] region rather than a Supernova Remnant. The X-ray, UV and optical data cover a period of ~200 d and reveal that the source underwent two bright, back-to-back, Type II outbursts in 2025 — a rare occurrence for any BeXRB system.



Left: Hα image from SALTICAM of SXP 31.0 showing the halo.
Right: The same overlayed with the fibre IFU positions.

Supernova **SN 2024abfo** was the subject of intensive followup with the SALT and SAAO transient programmes. Type IIb SNe are a transitional subclass of stripped-envelope SNe showing hydrogen lines in their spectra that gradually weaken and give way to helium lines reminiscent of SNe Ib. The presence of hydrogen indicates that these SNe retain a non-negligible hydrogen-rich envelope that has been stripped through stellar winds or binary interaction. The direct detection of SN progenitors is a valuable way to connect the various SN sub-types with their progenitor stars. SN 2024abfo is the seventh SN IIb with a direct progenitor detection. Simon de Wet used HST imaging to determine whether the SN position is consistent with the progenitor candidate position. Photometry on archival DECam imaging was used to derive the spectral energy distribution of the progenitor candidate and to investigate its temporal variability. Similar to SN 2008ax, SN 2024abfo does not show a prominent double-peaked light curve. The semi-analytic light curve modelling shows that this may be due to a very low mass of hydrogen ($\lesssim 0.006\ M_{\odot}$) in the outer envelope. Spectrally, SN 2024abfo is most similar to SN 2008ax at early times, while at later times (~80 days) it appears to show persistent Hα absorption compared to the comparison sample.

The Pan-African AGN survey using SALT/IFS data

Led by Mirjana Pović and Antoine Mahoro, the Pan-African AGN survey using SALT/IFS data (PanAfroAGN-SI) is the first LSP using the new SMI-200 IFS instrument. It is aimed to better understand the role of AGN in galaxy evolution through a detailed study of the properties of a large sample of active galaxies. Specifically, it aims to obtain a census of the properties of ~ 1100 AGN host galaxies up to $z < 0.2$ using the IFS 3D data cubes and their combination with multi-wavelength data (radio, X-rays), focusing on fundamental drivers of galaxy evolution such as stellar populations, metallicity, star formation and AGN interplay, AGN feedback, scaling relations, and environment.

In addition, MeerKAT data will be used when available to better understand the connection between the radio and optical/NIR properties of AGN, and between the HI distribution and AGN activity. In a broader scope, beside its science legacy, this project aims to bring together all AGN communities from Africa around African infrastructures, such as SALT and its new IFS instruments in the optical and NIR. The collaboration comprises more than 80 researchers from 14 African and 6 European countries. PanAfroAGN-SI will be a truly unique AGN IFS survey in terms of the sample size, wavelength coverage, and the overlap with MeerKAT, perfect to study the role of AGN in galaxy evolution, as well as to strengthen international collaborations in AGN research and to contribute to astronomy development in Africa.

Observations have started in the 2024-2 semester, and the team is busy developing the data reduction and calibration pipeline. So far, ten sources have been obtained and some of them have already been reduced and calibrated, resulting in very interesting results. The PanAfroAGN-SI survey has been presented as an invited talk, given by Pović, at the 4th African Conference on Fundamental and Applied Physics (ACP2025) at the University of Lome, Togo, in September 2025.

The SALT survey of helium-rich hot subdwarfs

Starting in 2016 with the commissioning of the HRS and as a UK-South African collaboration, Simon Jeffery from Armagh Observatory obtained his first RSS and HRS spectra in a project to study H-deficient subdwarfs. The project grew with regular proposal submissions and a to-date small but international team to become a medium-resolution spectroscopic survey of helium-rich hot subdwarfs, totalling about 840 kiloseconds observing time. Objectives include the discovery of exotic hot subdwarfs, resolving distinct subclasses, identifying evolutionary sequences, and establishing the past and future histories of many of these unusual stars. A very recent publication extends the previously published sample of 100 stars to 697 stars. It describes the selection criteria and presents spectral classifications based on the MK-like Drilling system. The new sample includes 283 extremely helium-rich hot subdwarfs, 17 extreme helium stars, 110 intermediate helium-rich hot subdwarfs, as well as 21 helium-rich stars of other types. It now represents the largest homogeneous sample of both 'normal' He-sdOs and 'luminous' or 'hot' He-sdOs. Interesting stars discovered include magnetic hot subdwarfs, extremely hot pre-white dwarfs and hot subdwarfs, including hot subdwarfs showing [N V] emission, one short-period binary, new extreme helium stars and several double-subdwarf candidates.

So far this long-term project has produced 13 refereed papers, with more papers in preparation on kinematics and an analysis that addresses the key science questions. In the planning stage are follow-up papers on extreme helium stars and hopefully papers on variables to come from current observations. Moreover, the sample is expected to produce more exciting discoveries, such as the record-breaking hot dwarfs (with effective temperatures between 110,000 K and 180,000 K). Concerning the future, Jeffery plans to focus more on the analysis of existing data and more theory. In addition, enhanced sensitivity and the monolithic RSS detector would allow the team to go deeper with better systematics.

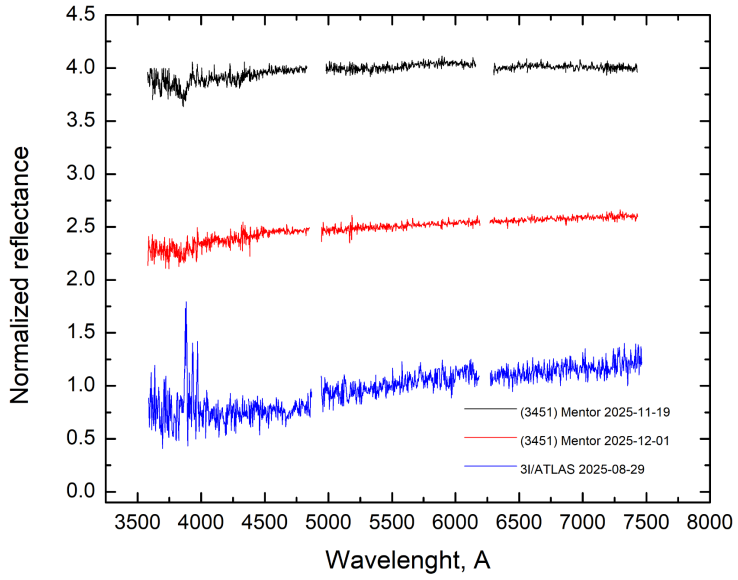
Jeffery, C. S., et al. 2025/12, arXiv:2512.10529: The SALT survey of helium-rich hot subdwarfs: final sample and classification

Investigation of activity among main-belt objects with SALT

Active asteroids constitute a relatively new dynamical class within the solar system, exhibiting both asteroid-like orbits and comet-like physical activity. These bodies can develop comae, dust tails, and episodic mass-loss features, yet their activity stems from a diverse array of mechanisms not limited to classical ice sublimation. Potential drivers include sublimation of residual volatiles, impacts, rotational instability, electrostatic dust lofting, thermal fracturing, and radiation-pressure-induced dust removal. Since their formal recognition in 2006, active asteroids have significantly broadened scientific perspectives on small-body evolution and volatile transport. They may represent a third reservoir of volatiles, complementing the Oort Cloud and Kuiper Belt, and provide key insights into the delivery of water and other volatiles to the terrestrial planets.

A team around PhD student Sofiia Mykhailova, from the AMU (Poland), and her supervisor Tomasz Kwiatkowski decided on a spectral and photometric monitoring campaign of Main Belt asteroids — specifically C, B, F, G, and X types — which may harbour internal water ice. As these bodies approach the Sun, transient activity may emerge in the form of low-density dust comae. A key strength of the project is its combined observational and modeling strategy. It will leverage the capabilities of SALT, an underutilised asset for small-body research, along with coordinated photometric observations from medium-sized telescopes. This dual-platform approach will allow detailed examination of dust properties, surface structures, and activity evolution. The project aims not only to improve activity detection but also to characterise the physical properties of these asteroids, develop shape models, and evaluate the processes responsible for their mass loss. With forthcoming large-scale surveys, such as the Vera C. Rubin Observatory's LSST, which are expected to expand the known population, targeted studies are urgently needed to interpret new discoveries and constrain activity mechanisms.

In November 2025, SALT observations started on targets across the solar system. The selected RSS setup was initially tested during DDT observations of the third interstellar object, 3I/ATLAS, which resulted in a publication. Using the recently installed PG0700 grating, the team confirmed changes in the reflectance gradient of 3I/ATLAS in July 2025 and later detected the presence of the CN emission line in the near-UV range (see figure). Using the same configuration, two visits were conducted for the first target, (3451) Mentor, though, at the time of writing, no evidence of activity has been found.



Black and red curves: reflectance spectra (spectra of the asteroid divided by a spectrum of the solar analogue star) of asteroid (3451) Mentor from observations on 2025-11-19 and 2025-12-01. No activity was detected during either visit. Blue curve: reflectance spectrum of the active object 3I/ATLAS, obtained on 2025-08-29, showing strong CN emission at 3880 Å, consistent with a cometary classification. All spectra were obtained using RSS with grating PG0700 at R ~ 1800.

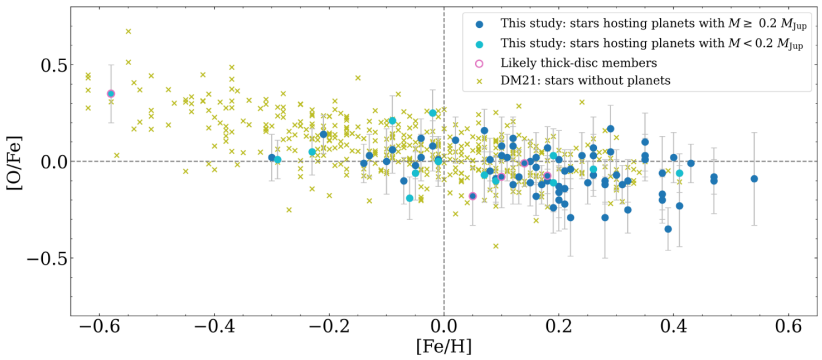
Santana-Ros, T., et al. 2025/10, A&A 702, L3: Temporal evolution of the third interstellar comet 3I/ATLAS: Spin, color, spectra, and dust activity

SALT HELPS THE *ARIEL* MISSION TO CHARACTERISE EXTRASOLAR PLANETS

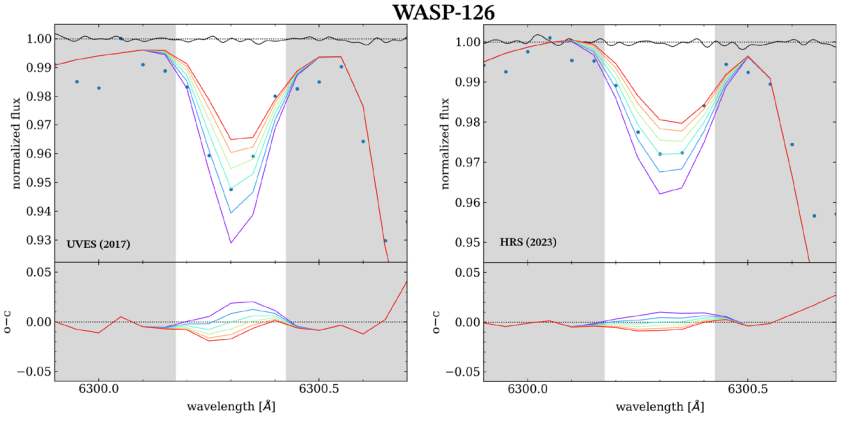
With a few thousand exoplanets discovered, it is time to shed light on their planetary nature, formation and evolution. Planetary properties are critically dependent on their stellar host properties, hence it is imperative to globally characterise the host star (its radius and mass) to retrieve an absolute value of the planetary radius and/or mass. The planetary density permits a first distinction between gas-rich and rocky/icy planets, but on its own it is an inaccurate and potentially misleading indicator of the exoplanet bulk composition. To clearly resolve the uncertainties in the mass–radius relationship, we need to determine the composition of planetary atmospheres. This is the goal of ESA's mission *Atmospheric Remote-sensing Infrared Exoplanet Large-survey* (or *Ariel* for short), which is scheduled to be launched in 2029.

Ariel will observe the atmospheres of about 1000 diverse transiting planets for statistical understanding. Its observational methodology, based on differential spectroscopy in and out of transit, measures planetary signals of 10 – 50 part-per-million relative to the star. Consequently, the exact knowledge of the host star's spectrum is required at the same level of the planetary signal, or better, to map any stellar intrinsic variation due to activity and avoid confusion with planetary features, requiring both high-quality data and a uniform approach to the data analysis. To obtain a meaningful characterisation to be used for the compilation of the final *Ariel* planetary system sample well before the launch, the *Ariel* Mission Science Consortium's mission is to gather high resolution and high signal-to-noise ratio spectra of hundreds of *Ariel* stars, with SALT being involved in this massive undertaking since 2023, alongside other major instruments around the world.

Krzysztof Hełminiak from CAMK and his collaborators are conducting the long-term HRS programme aimed at the characterisation of such stars. Their objective is to obtain spectra with a signal-to-noise ratio >180 (around the oxygen line at 778 nm). They found that SALT's HRS is particularly useful for 'difficult cases' where other observatories failed, for example, if the star is very faint or if the abundances of O and/or C could not be obtained because meaningful spectral lines were either contaminated with atmospheric emission or were out of the reach of a given spectrograph. So far, SALT data has been used in two publications of the "*Ariel* stellar characterisation" series, with more in preparation.



[O/Fe] abundance ratios as a function of the stellar metallicity. Light and dark blue points refer to planet-hosting stars. Yellow crosses are for single stars without planets

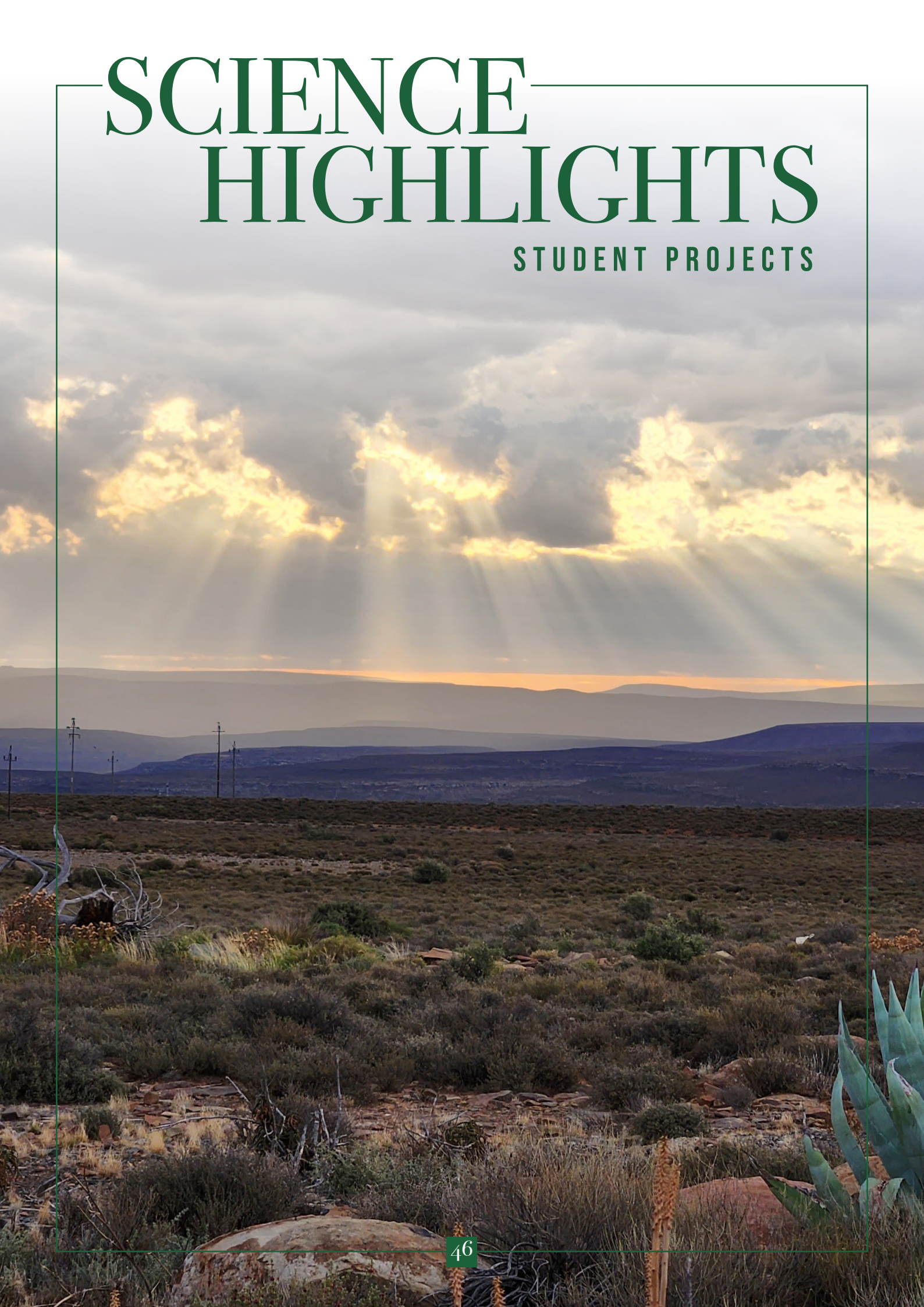


The [O I] line at 6300 Å in spectra from VLT/UVES (left) and SALT/HRS (right). The observed spectra are marked with blue dots in the upper panels; coloured lines are the synthetic spectra for different O abundances, separated by 0.1 dex; the black solid line represents the telluric spectrum. The rms of the residuals (lower panel) is 0.0014 and 0.0005 for UVES and HRS, respectively.

Tsantaki, M., et al. 2025/05, A&A 697, A102: Ariel stellar characterisation: III. Fast rotators and new FGK stars in the Ariel mission candidate sample

SCIENCE HIGHLIGHTS

STUDENT PROJECTS



In compliance with SALT's strategic objective of Human Capital Development, a large number of projects involve students or are initiated by students. Some examples of student projects are presented here. Projects with refereed publications in 2025 can also be found in the research section.

PhD student **Delphine Nishimwe** from Rwanda started her project under the scope of the PanAfroAGN-SI survey (PI Mirjana Povic), focusing on AGN outflows and their impact on star formation in active galaxies.

In 2024, **Alberto Floris** worked as a summer student with Bożena Czerny (CAMK, Warsaw). He reduced 13 RSS long slit spectra, which were obtained within the frame of Bożena's long-term project of monitoring three intermediate redshift quasars, covering the period from 2012 – 2024. The main goal of the project — measurement of the time delay in [Mg II] band — was achieved and the corresponding papers were published, but a few datasets were not reduced or are required to be repeated. Alberto finished the reduction, and though he moved on to the University of Crete to start his PhD, he was able to continue his project with Bożena on the side. He is now analysing the excellent data that covers 13 years with good spacing (46 data points for CTS C30.10, 32 for HE 0435-4312, and 34 for HE 0413-4031) and looking for any time drift of the [Mg II] line. As a preliminary result, he noticed that HE 0435-4312 shows a puzzling drift, particularly when the data is supplemented with old NIR observations of the [O III] and Hβ line. The drift seems to be almost uniform over the years, eventually reaching a velocity above 1000 km/s.

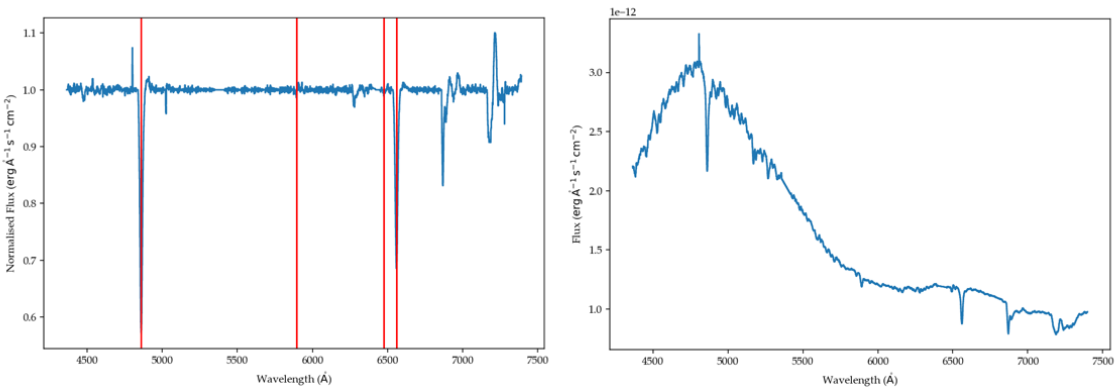
Cordelia Dashwood Brown from University of Southampton conducted a study using SALT spectra during her doctoral research. She used RSS for a radial velocity study aimed at identifying and characterising non-interacting black holes, and though the project proved to be unsuccessful, it provided a great deal of insight into the *Gaia* astrometric fits for putative binaries.

UW-Madison has three students currently working with SALT data. Graduate student **Jodie Kiyokawa** is working on a NIRWALS AGN reverberation mapping pilot project with Kate Grier as part of her thesis. Graduate student **Marissa Perry's** first year project is on modeling the stellar populations of post-starbursts observed with NIRWALS and *SPHEREx*, working with Marsha Wolf and Christy Tremonti. Physics graduate student **Julia Sheffler** is working with Melinda Soares-Furtadoto using Lithium abundances measured with HRS to constrain the ages of moving groups and their planet-hosting stars. In November, she presented her work at the GLEAM conference in Madison, USA.

Citizen science classification of long-baseline stellar variability in the SuperWASP all-sky survey

Online citizen science is a well established method of analysing data, wherein untrained volunteers are presented with images and other data and answer simple questions about what they are looking at. This has been used particularly effectively in astronomy and related fields, to study everything from Martian surface features, to galaxy morphology, to gravitational waves. For his PhD, Adam McMaster from the Open University, under the supervision of Andrew Norton, Hugh Dickinson, and Ulrich Kolb, has been working on the application of citizen science to archived data from the SuperWASP all-sky survey, with the aim of enabling new discoveries beyond the original exoplanet search. Two searches formed the bulk of his work: a search for new long-period pulsating variable stars, and a search for self-lensing binaries, that is, edge-on binaries containing a star and a compact object, where the compact object is positioned so as to cause gravitational microlensing of the stellar companion once per orbit.

The nature of the SuperWASP data and the physics behind the phenomenon meant that only self-lensing binaries with very long orbital periods (decades or centuries) could potentially be found during this search. This meant that no repeating self-lensing magnifications could be seen to confirm the nature of any candidates, and therefore long-term radial velocity monitoring was the best option to confirm the presence of a compact binary companion. To this end, Adam obtained spectroscopy of eight candidates using SALT's RSS during two observing seasons. Confirming these candidates will require longer-term monitoring than was possible during a PhD project, but his thesis includes a preliminary analysis of the spectra to derive radial velocities and elemental abundances with promising results.

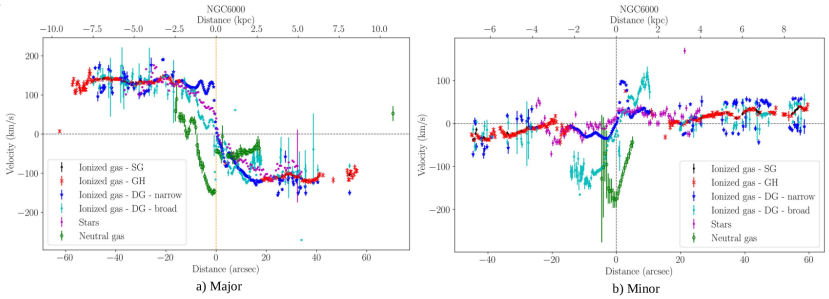


Example spectrum before and after being flattened (*left* and *right*, respectively).

Adam McMaster, Open University (UK), PhD 2025

Studying gas flows in the SUNBIRD starburst galaxies and LIRGs

Gas flows are an important aspect of feedback and the regulation of star formation in galaxies. Nearby starburst galaxies and luminous infrared galaxies (LIRGs) provide extreme environments, where feedback and the changes due to it can be studied in great detail. Understanding the gas flows in these galaxies will help us to understand galaxy evolution better. For her PhD project, Petro van Rensburg from UCT under the supervision of Moses Mogotsi and Petri Väisänen from SAAO, studied the resolved gas flows in a sample of a dozen nearby ($0.0073 \leq z \leq 0.0374$) starburst galaxies and LIRGs in the SUperNovae and starBurst in the InfraReD (SUNBIRD) survey with long-slit spectra from SALT. She found evidence of ionised and neutral non-circular gas flows (which includes outflows, inflows and extraplanar gas) in all twelve galaxies at varying velocities. The first ever measurements of gas flows were made for five galaxies (ESO 428-G023, ESO 550-IG025, IRAS 18293-3413, NGC 1819 and NGC 3508). The non-circular gas flow velocities of the twelve galaxies range between 35 – 182 km/s for the ionised gas and 61 – 403 km/s for the neutral gas and originate from the nucleus for most of the galaxies. Petro's results also show that none of the gas flows are strong enough to leave the galaxies and could possibly cool down to form more stars. This suggests that for these starburst galaxies and LIRGs, even though their star-formation rate is enhanced and gas is flowing outwards, star formation is not necessarily quenched by this, and could continue in future via the galactic fountain model.

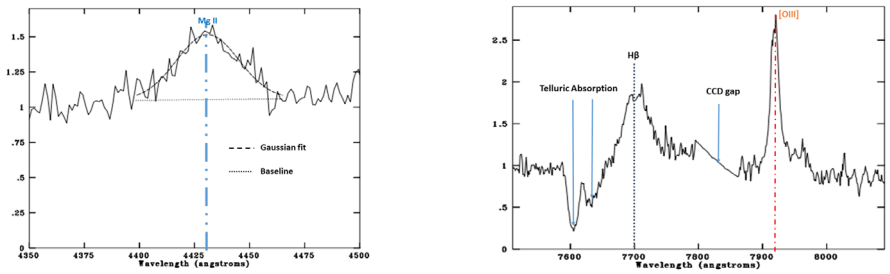


Rotation curves of NGC 6000 with RSS long-slit spectra along the major (a) and minor (b) axes. The black dashed lines indicate the optical photometric centre of the galaxy and the velocity associated with it. The dashed orange line indicates the kinematic centre. The velocities of the ionised gas is shown in blue (narrow) and cyan (broad) points for the double Gaussian (DG) model, red plus signs for the Gaussian-Hermite (GH) model and black crosses for the single Gaussian (SG) model. The velocities of the neutral gas are shown as green diamonds, and the velocities of the stars are shown as magenta points. The rotation curves suggest an ionised and neutral gas outflow from the centre of the galaxy as well as the disc.

Petro Janse van Rensburg, University of Cape Town (South Africa), PhD 2025

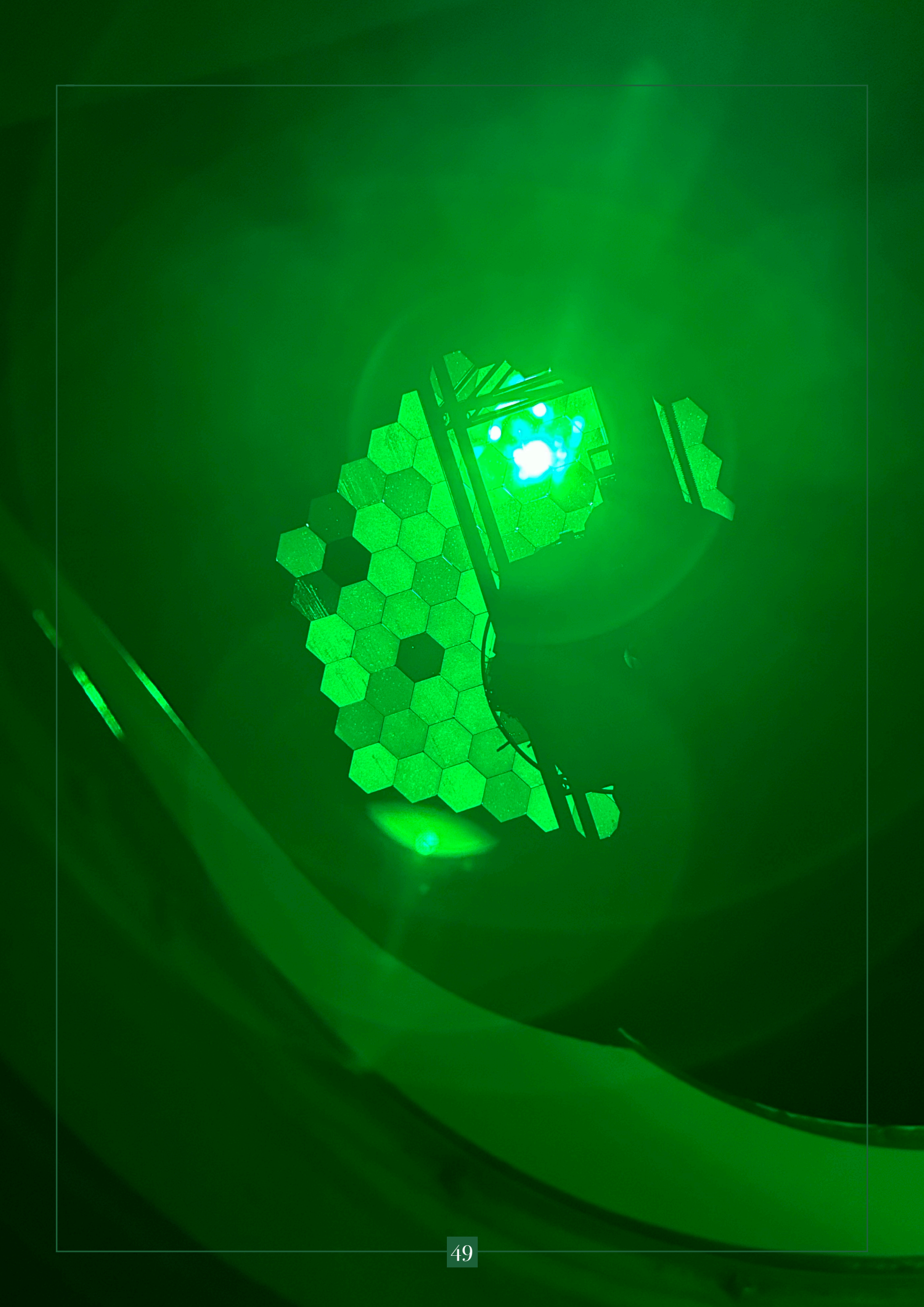
SALT spectroscopy of AGNs behind the Magellanic Clouds

Joy Anih from Keele University, supervised by Jacco van Loon, obtained her PhD studying infrared variability of active galactic nuclei behind the Magellanic Clouds. The Magellanic Cloud system spans well over a hundred square degrees on the sky, and much of it is extensively covered with multi-wavelength survey data, making it a worthwhile dataset. The large number of active galaxies that can be found in the background can be used to identify extreme phases in the evolution of AGNs. Joy selected her sample from unprecedented radio continuum imaging using ASKAP and obtained SALT long-slit spectroscopy to find out the state of the nuclear activity and how it is related to the radio emission. Besides confirming the AGN nature, these spectra provided redshift (and thus distances) and black hole masses (and thus Eddington rates) for a sample of AGNs dominated by circumnuclear dust. In addition, she studied the infrared variability using VISTA and *WISE*. She found that the variability is sensitive to the relative contribution of disc and torus, but that it generally is related to the time-variable hot dust contribution.



Annotated spectral emission lines of the AGN LMCtSNE5. The spectrum shows that [MgII] λ2798 is detected in the blue setting (*left*) and [OIII] λ5007 is detected in the red setting (*right*). The redshift of the source is 0.582 ± 0.001. Hβ is also detected but cut on the blue side by telluric absorption at 7600 Å; likewise, Hγ is detected but cut (on the red side) by telluric absorption. The CCD gap fell just between Hβ and [OIII]. A Gaussian was fit to the [MgII] line.

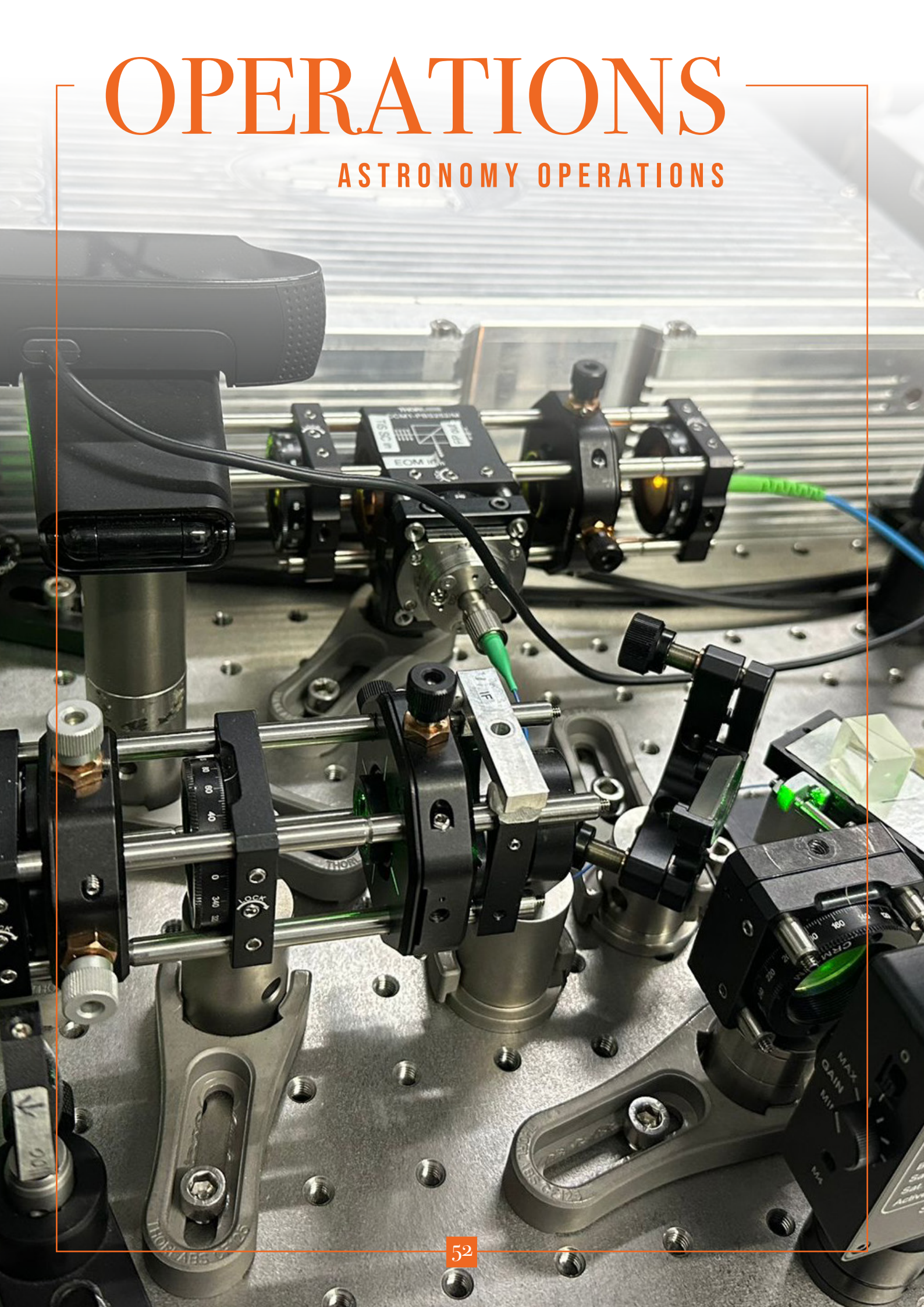
Joy Anih, Keele University (UK), PhD 2025



OPERATIONS

OPERATIONS

ASTRONOMY OPERATIONS



One of the year's key highlights was the release of the long-awaited linear spectropolarimetry calibrations. The Gamma version of the polSALT software substantially reduces the position angle ripple seen with earlier calibrations and stabilises the wavelength dependence of the position angle. Combined with an optimised wide-slit strategy and validation against VLT/FORS2 standard star measurements, it delivers enhanced systematic stability, repeatability, and improved absolute polarimetric accuracy.

Another major milestone this year was the successful completion of the SMI-300 IFU hardware. Recent laboratory characterisation confirmed excellent performance, achieving a total system throughput of 75% — surpassing requirements — and meeting specifications for dark fibres and throughput uniformity across both object and sky fibres. The SMI-300 is now ready for deployment to SALT, with on-sky commissioning planned for the coming months.

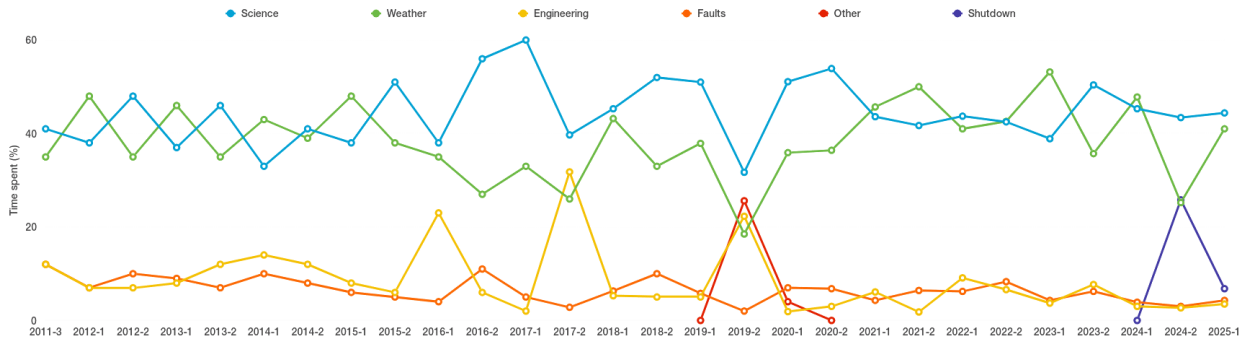
In addition, work is ongoing to further refine and better understand the NIRWALS science reductions.

Semester statistics

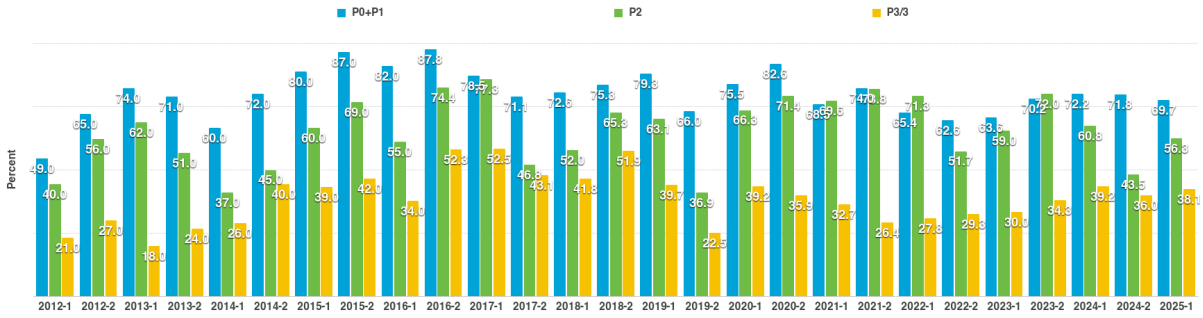
During the 2024-2 semester, weather-related downtime was 25%, the lowest recorded since 2018 (excluding the COVID-19-affected period). In contrast, the 2025-1 semester experienced weather losses around the typical winter average of 40%, reaching approximately 41%. Engineering activities (referring to calibration tests, observations required to study instruments and telescope stability, as well as any commissioning activities) accounted for 3% in 2024-2 and 4% in 2025-1. The latter was still below average, despite testing of the RSS slitmask IFU and commissioning observations for the HRS high-stability mode. Technical downtime (or faults, referring to periods when technical issues at the telescope cause the telescope and/or instruments to be offline or unavailable for observations) remained low in both semesters, at 3% and 4%, respectively. Science observations were close to average in both semesters (comprising 43% and 44%, respectively) despite the seven-week shutdown between 24 March and 13 May 2025, which contributed 26% in 2024-2 and 7% in 2025-1. These numbers show that the time of the shutdown was well chosen, that is, when weather losses are at their greatest.

The effect of the shutdown is more obvious in the priority completion statistics. In 2024-2, fewer low-priority blocks were executed because the shutdown occurred shortly before the end of the semester and coincided with two bright Moon cycles, during which such blocks are typically observed. In 2025-1, completion rates in these priorities were comparable to previous winter semesters. Importantly, both semesters achieved good completion rates for higher-priority blocks.

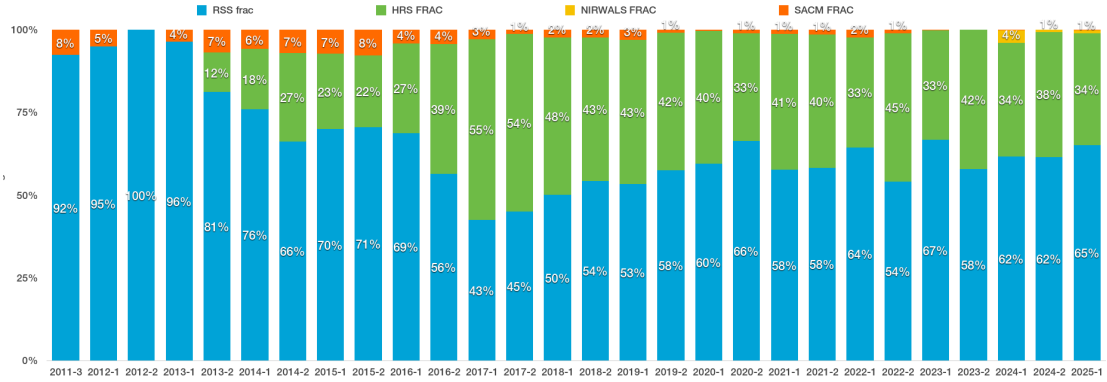
In terms of instrument usage, RSS continues to serve as the primary workhorse, particularly under optimal observing conditions — dark, clear nights with good seeing. HRS remains the dominant instrument during bright time and poorer seeing conditions. SALTICAM, due to its lack of guiding and limited focus control, is now used primarily for target acquisition. NIRWALS accounted for approximately 1% of total instrument usage.



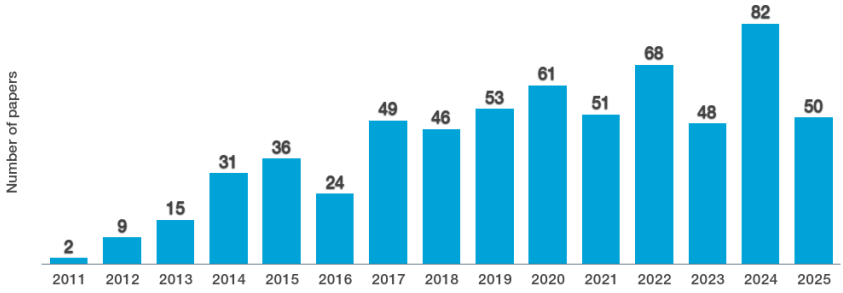
SALT time usage per semester, including the lockdown period (as 'other'). The 2024-2 and 2025-1 semesters also include a Shutdown category to account for time lost during the telescope-wide shutdown.



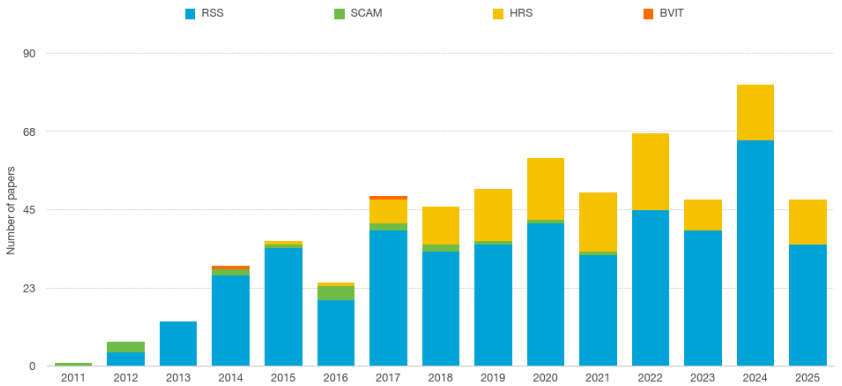
Completeness per priority in percent. The oversubscription factor for P3s has not been taken into account.



SALT instrument usage per semester.

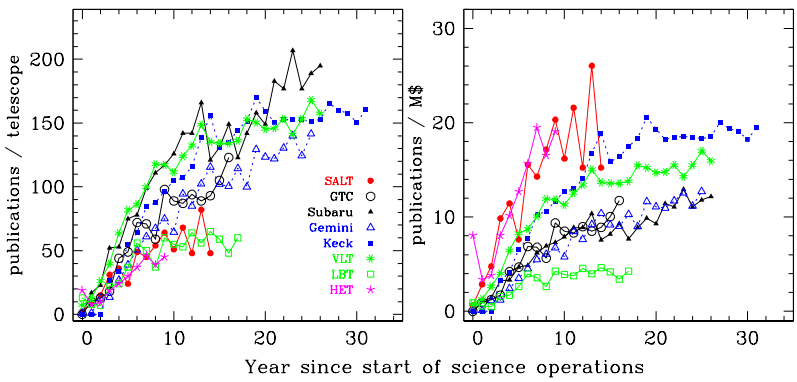


Refereed publications based on SALT science data and including instrument-related publications, from the start of science operations in 2011.



Instrument usage in SALT publications.

Refereed publications since science operation started for major telescopes. *Left*: publications per year and per telescope; *right*: publications per year and per operation cost in million US Dollars.



Publication statistics

In 2025, a total of 48 papers were published, including two instrument papers that focused on pipeline developments. After a record high in 2024 the publication count is rather low, continuing the trend to a large scatter over the last few years. In terms of cost per paper, SALT continues to deliver excellent value, with much lower costs than similarly-sized single telescopes around the world. The number of data publications was nearly balanced between Galactic science (18 papers) and extragalactic science (17 papers), with an additional ten papers focused on supernovae and one on kilonovae.

RSS continues to be the leading contributor to SALT publications, with HRS gradually increasing its share to account for about one-third of recent publications. Due to its limited observing time, SALTICAM has not been used for publication in recent years. The BVIT instrument is no longer in operation.

User support

Danièl Groenewald and the original RSS PI Ken Nordsieck (University of Wisconsin), have collaborated over the past few years on polarimetry user support and calibrations for linear spectropolarimetry. In March 2025, they released the long-awaited polarimetry calibrations along with updates to the polSALT reduction software.

The year has seen several software releases to support proposal submission and data access. We now have a new PIPT that is simpler and more robust. The old Web Manager was officially decommissioned, with improvements on the new Web Manager continuing. Work also continued on expanding SALT data access via Virtual Observatory tools such as TOPCAT. A lightweight wrapper around SALT's API (PyAstroSALT) has been released to support the upcoming integration of SALT into Las Cumbres Observatory's AEONlib Python library,

Conferences and workshops

The annual AfAS conference in March 2025 that took place at the University of South Africa (UNISA) saw several presentations involving SALT data. In addition, SALT Astronomer Sabyasachi Chattopadhyay talked about the new slit-mask IFU instrument, and Danièl Groenewald, as Acting Head of Astro Ops, delivered an oral presentation on the current operational status of SALT.

Danièl also led a dedicated workshop on the SALT proposal tools during the conference. Prior to the workshop, participants received a set of SALT proposal tools — including the PIPT and the relevant instrument simulators — along with four predefined observing scenarios. They were tasked with using these resources to construct a Phase 1 proposal, identify suitable targets, and calculate the exposure times needed to reach a given signal-to-noise ratio attainable under specific observing conditions. The session was positively received and served as a practical introduction to SALT's proposal preparation framework, especially for emerging African PIs. By walking through the tools and overall workflow, the workshop helped to clarify the process and strengthen user confidence in preparing competitive proposals.

Personnel

We had one new addition to the team in 2025: Phelokazi Dube joined the AstroOps software team as a Software Developer in July. She has already made a significant contribution by ensuring that all features of the legacy Web Manager were successfully migrated to the new version, enabling the decommissioning of the old system.

The SALT Leadership Team officially welcomes Danièl Groenewald as the new Head of SALT Astronomy Operations in August 2025. She had been serving in an acting capacity since July 2024.

Enrico Kotze, former SALT Astronomer for the pipeline development, continued to assist with pipeline related upgrades/support on a temporary contract. This is to bridge the gap until Nikki Zabel, who has been appointed as the new Pipeline SALT Astronomer, will commence her employment in early 2026.

Also on a temporary contract is Daniel Holdsworth, who is working on the HRS pipeline upgrade.

OPERATIONS

TECHNICAL OPERATIONS

A year of revitalisation and stability

The 2025 operational year represents a milestone in the history of SALT. For the Tech Ops division, this year was defined by a strategic shift away from reactive repairs — simply fixing what had broken — towards a culture of proactive care and long-term reliability. By focusing on the fundamental health of the facility, the team successfully navigated one of the most complex years in the observatory's history while maintaining exceptional availability for astronomers. Throughout the two semesters, technical downtime was kept remarkably low at 3% to 4.1%. This level of reliability is a testament to the dedication of the technical staff and the success of the major maintenance projects undertaken this year.

The 2025 shutdown: A "Global Reset"

The operational centrepiece of the year was the extensive seven-week maintenance shutdown, which took place from 24 March to 13 May, accounting for around 490 hours of observing time. While annual shutdowns are a standard part of running SALT, the 2025 period was unique in its ambition. The primary goal was nothing less than a global reset of SALT's massive primary mirror. The comprehensive global adjustment of the primary mirror was necessitated by a significant physical misalignment that had developed across the array over time. Inspections revealed that a large number of segments in the upper-right quadrant had drifted too close to the supporting truss, while those in the lower-left were positioned too far away. In a feat of precision engineering, the technical team spent weeks performing the global adjustment. This involved manually turning nearly 300 heavy-duty bolts to physically realign the entire mirror array. It was a painstaking process involving 40 rounds of measurement and adjustment, but the mirror array has been returned to its nominal orientation, allowing us to continue to recoat and replace segments to maintain telescope performance.

Safeguarding the observatory: The cooling upgrade

Beyond the telescope itself, 2025 saw a critical upgrade to the facility's life support systems. While cooling is often associated with preventing equipment from overheating, at SALT, its primary and most critical function is dome conditioning and to ensure that each system's cooling needs are met. This is achieved by cooling a 35 000 litre tank of a water and glycol mix down to –6° Celsius using an industrial cooling unit. The glycol mix is then pumped throughout the telescope to each system. To achieve the best possible image quality, the air inside the dome must remain stable and match the outside ambient temperature. The chilled glycol mix is used to provide the cooling to achieve optimal dome conditioning. In October, the team successfully commissioned a new, high-capacity cooling unit. For the past few years, the facility had been operating without a backup, meaning a failure in the cooling system could have halted telescope operations and damaged equipment. The installation of this new unit provides a vital insurance policy, restoring full redundancy to the cooling system. We can now seamlessly switch between our primary and backup cooling systems, ensuring that SALT's instruments are safe and operational regardless of hiccups or heatwaves.

Preserving our history: The digital library

While much of the work in 2025 was physical, a major achievement of the year was digital. SALT is a bespoke machine, built with custom parts that do not exist anywhere else in the world. The blueprints, manuals, and design decisions from twenty years ago are just as valuable as the hardware itself. This year, the Tech Ops team launched a major Product Lifecycle Management initiative. It involves hunting down, organising, and digitising two decades' worth of technical drawings and documents into a central, secure digital library. By treating our data with the same care as our mirrors, we are ensuring that the knowledge required to maintain and upgrade SALT is preserved. This institutional memory ensures that future generations of engineers will understand exactly how the telescope was built and how to keep it running for decades to come.

Improving the environment

Finally, the team completed a major project to seal the telescope's giant dome and shutter. Using specialised rope-access teams, the gaps and seals of the telescope building were refurbished to make it weather-tight.

Conclusion

The 2025 year was not without its challenges. We are, for instance, carefully monitoring a gradual natural aging of some internal optical coatings, which reduces the amount of light reaching our sensors. However, the team has implemented new monitoring systems to track this accurately and plan for future solutions. Overall, 2025 concludes with SALT in its strongest technical position in years. The massive effort to realign the mirror, the investment in new cooling infrastructure, and the preservation of our technical history have reset the baseline for the observatory. We move into 2026 not just maintaining the telescope, but actively optimising it for the future of African astronomy.

Personnel

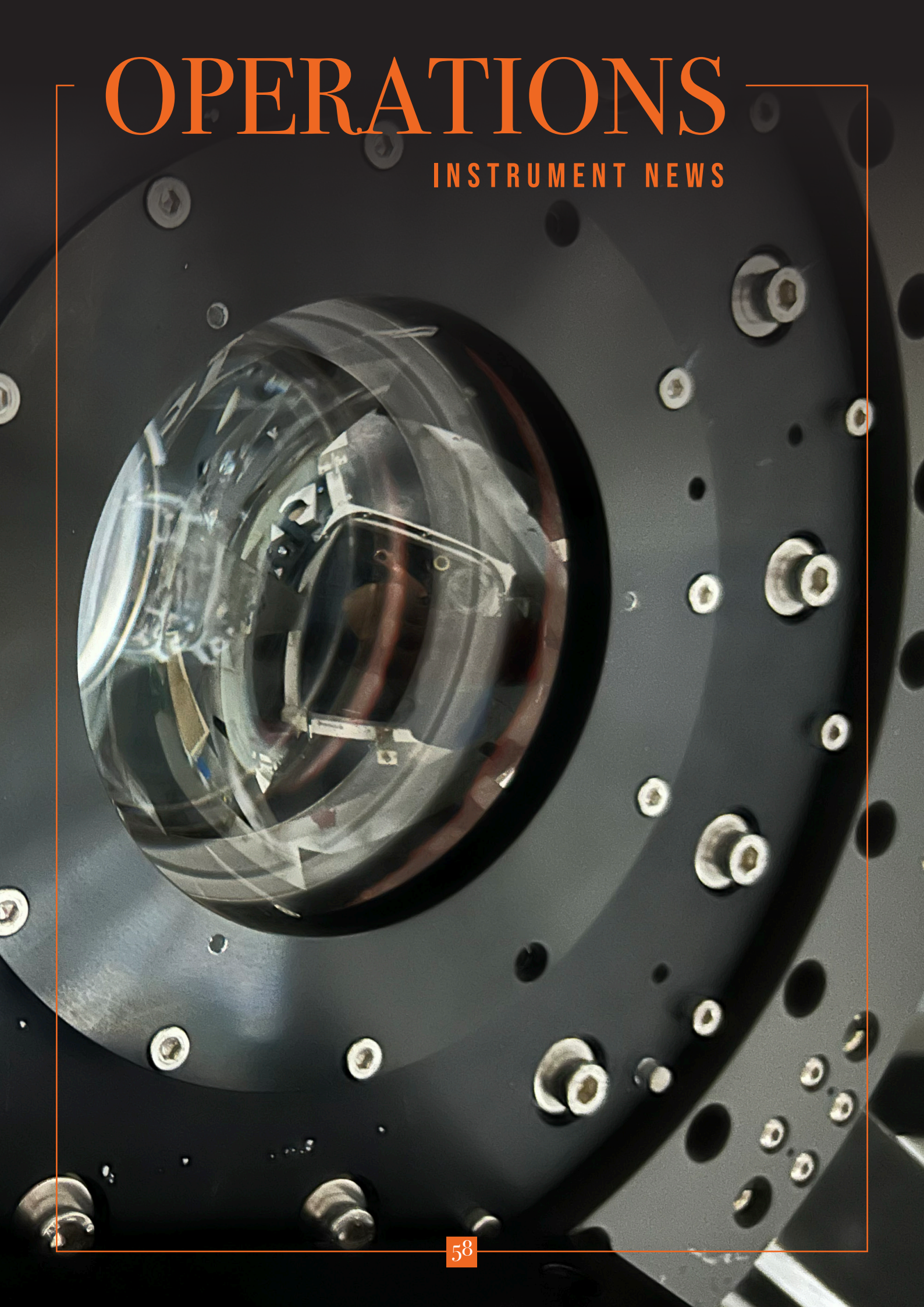
Anita Jonker, a Junior Software Developer, left the Tech Ops team at the beginning of 2025 after spending two years with us. There have been no new appointments in 2025.

Health and Safety

We are happy to report that no injuries to staff occurred during the reporting period.

OPERATIONS

INSTRUMENT NEWS



SALT
Shutdown

The 2025 SALT shutdown took place from 24 March to 13 May 2025. Besides the opportunity to service each of the instruments and the tracker payload's rotating structure, a key focus of this shutdown was to tackle a serious problem with the primary mirror array. We also took the opportunity to inspect the coatings on some of the spherical aberration corrector (SAC) mirrors at prime focus. We knew that two of the four mirrors are in bad condition, but their coatings have deteriorated significantly since last seen in 2020, increasing the urgency of replacing the SAC.

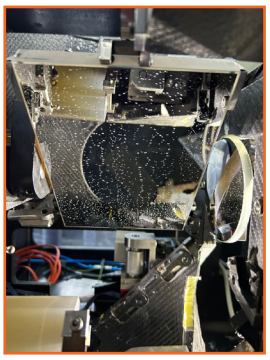
The atmospheric dispersion compensator, moving baffle and pupil mask could also be inspected and serviced. Likewise, the various mirrors within the rotating structure (the two fold flats and the three mirrors that form the RSS slit-view system) could be accessed and cleaned while the payload was on the ground. Obsolete electronics could be removed, and components that needed replacing were easily reached and tested before the payload was re-installed on the tracker at the end of the shutdown.

The HRS cryostats were each given a pump-and-bake treatment to improve their vacuum integrity. NIRWALS was warmed up to allow a careful inspection of all the hardware inside the thermal enclosure. A basic mechanical service was done on the relevant components, contractors came out to service the refrigerant systems for the thermal enclosure, and the infrared detector underwent routine maintenance. Both the SALTICAM and RSS shutters needed replacing, and much work went into getting those tricky mechanisms to operate correctly prior to re-installation. The SALTICAM optics were cleaned and issues with the filter magazine received attention. The RSS collimator doublet and triplet optical assemblies that were installed in 2023 are still in excellent condition, but the temperamental RSS waveplates had to be serviced and extensively tested as they can only be accessed when the spectrograph is on the ground. Work was done on the RSS slit-mask elevator and various motors, plugs and encoders, electronics racks, the glycol leak detection system and the two probes that make up the RSS auto-guider, to improve the instrument's overall reliability. When getting back online at the end of the shutdown, we discovered that the RSS detector's cooling system had lost its refrigerant gas, likely when everything was disconnected in late March. This added a couple of stressful days as it was necessary to replace various components, then comprehensively leak-test the entire system before recharging it with the required refrigerant gas. After all that, the cooling proceeded smoothly and RSS was back online from 17 May.

Midst these many tasks, the major focus of the 2025 shutdown was the global adjustment (in tip, tilt and piston) of the entire SALT primary mirror array. This was necessary to correct the problem of having many segments (in the upper-right corner of the array, as viewed by incoming photons) being too close to the truss, and others (in the lower left) being too far away from it. This was an entirely new operation that no one at SALT or at our sister telescope (the HET in West Texas) had ever attempted, making it an extremely daunting undertaking. We had yet to establish why and how the array got like this, but our priority for the shutdown was to resolve the issue, the underlying cause could be understood later.

Establishing a workable plan for this process involved drawing in external expertise that included François Strümpfer (who was part of the SALT image quality team during the SAC repair in 2009 — 2010), Herman Kriel (the HET Operations Manager, who left SALT back in 2009), Jerry Martin (the retired HET primary mirror specialist), John Booth (the retired HET chief engineer) and a few other members of the HET operations staff. The various Zoom conversations and brain-storming sessions we had eventually yielded a plan that we could begin executing at the start of April.

The SALT mechanical team drove the mirror tilting process, with daily calculations to work out the required adjustments for the various segments. The mirror guys then spent several weeks climbing around in the truss each day, making carefully-controlled 3-point adjustments to the 273 M30 bolts that provide coarse positioning of the mirror mounts. To avoid 'losing control' of any segments, we opted for an iterative approach to stay within the ±4 mm travel range of the linear actuators on each segment (that provide the fine adjustment needed for the mirror's closed-loop segment alignment control system). This approach was highly labour-intensive, but worth it to avoid losing track of any of the segments. Since the actuators are mounted with a 1 in 13 ratio, each 1300 micron piston adjustment only yields a 100 micron mirror movement at the edge of the array, so the 40 iterations (typically involving about 50 segments per day) done over the five-week period ultimately yielded a 4 mm change at each extreme of the array, along with a change in the tip/tilt of the central segment. The envisioned tip and tilt adjustments were checked periodically with spherometer measurements made from the cherry-picker and, when weather permitted, with mirror alignments at night. Alignments done after a week of multiple iterations per day took six or seven hours (normal mirror alignments typically take about half an hour), as the return spots from many of the segments had to be hunted down in tip and tilt. We encountered several control and software problems during this period, but ultimately managed to get the mirror alignment instrument in the centre of curvature (CCAS) tower re-positioned to 'find' the adjusted primary mirror. The final step



in early May was to adjust the static offsets to align the tracker to the primary using equipment set up in the CCAS tower.

The IT and software teams also played a critical role in the shutdown, taking advantage of the opportunity to perform important tasks like migrating virtual machines and cloning physical ones. Much effort also went into assorted software improvements and migrations on multiple systems throughout the telescope to improve stability, reliability and operational efficiency. Hardware configurations from numerous controllers were also archived in the version control repository for documentation purposes, and the latest versions of engineering software were checked into version control to ensure consistent deployment and versioning across all active software engineering modules.

Although this was an incredibly busy and slightly chaotic time at SALT, it provided an ideal opportunity for people to get to see hardware and optics that would ordinarily not be visible. As a result, countless visitors — ranging from SAAO staff and students, to visiting observers, groups from high-tech companies in Cape Town, journalists, overseas visitors, friends, family, and even the residents and staff from the old age home in Sutherland — got to take a look behind the scenes at SALT.

Lastly, the 2025 shutdown served as a massive team-building exercise, for the Tech Ops team in particular. Nothing like a demanding but critically important shared-endeavour, packed with interesting puzzles and challenges, to rally behind in order to improve our telescope!

Throughput measurement system

After years of frustration with SALT's on-sky throughput measurement procedure, we have at last implemented a new measurement system that will allow us to reliably and consistently monitor the throughput of each of the instruments, the telescope's secondary optics and the integrated performance of the primary mirror. The system employs fibre-coupled stabilised light sources in both the payload and the CCAS tower, allowing us to individually illuminate each instrument, or the corrector + ADC (all using the telescope's calibration system), or the primary mirror (with the lamp situated at the centre of curvature). We have a set of bandpass filters for measurements at ten specific wavelengths in the optical, and another set of ten in the near infrared (that we have yet to employ, but which will be used for NIRWALS). Filters associated with both SALTICAM and RSS can be used as well, in combination with various neutral density filters that can be installed within the stabilised lamp housings. The individual instruments can also be tested in different ways to help identify if any particular filters or other optics have degraded for some reason. Baseline measurements were made in late 2025 and data analysis procedures have subsequently been developed. Going forward, we will take routine throughput measurements quarterly.

The ReSAC project

The spherical aberration corrector (SAC) is the optical heart of the telescope. This set of four very specifically figured mirrors is located at prime focus, so that the severely aberrated image produced by the spherical primary mirror array (M1) gets cleaned up before the light is fed into SALT's various instruments. The SAC was designed and built in France more than 20 years ago, and the delicate optical coatings on the mirror surfaces are now far beyond their sell-by date. Over the years we have successfully cleaned M3, M4 and M5. The coating on the last one, the upward-facing M5, has always been problematic and it can no longer be cleaned without the risk of making the surface worse. To our surprise (horror, actually), in early 2020 we discovered that the coating on the downward-facing M2, which happens to be the best protected of the SAC mirrors, had begun to fail for no apparent reason. During the 2025 shutdown we managed to do a limited visual inspection of the SAC from below and found that M2 has deteriorated considerably, to the point that it will now be dramatically limiting telescope performance. Various technical challenges and the amount of telescope downtime that it would involve make refurbishment of the current SAC impractical. Given the state of M2 and M5, and knowing that the coatings on M3 and M4 could also fail at any time (as M2's did), the SALT Board gave the go-ahead during their May meeting for us to explore options for fully replacing the SAC. This effort was dubbed the ReSAC project and the first step was to reach out to a variety of The NOVA group in the Netherlands initially expressed interest and a representative visited SALT in July to get a better sense of the operational environment and associated constraints. Although they were keen to take this on, the evolving schedules for the two ELT spectrographs that they are currently building prevented them from committing to the ReSAC project. By the end of the year we had contacted six other groups and received enthusiastic responses from the four that replied. We will meet with each in the new year to continue the discussions.

The M2 mirror showing the degradation in the coating.

The RSS Instrument

THE RSS 'BIG 5' – FINALISING THE DETECTOR UPGRADE

After a busy few years for the RSS 'Big 5', 2025 has been somewhat muted in terms of operational news. The major accomplishment has been the completion of the long-slit mask project: The final few masks were cut and tested early in 2025 and were accepted into operations soon thereafter. The project has been officially signed off by SALT operations and the SALT Board. This marks the 4th of the original 'Big 5' projects to be completed.

The final project on this list is, of course, the eagerly anticipated detector replacement. SALT users and team members alike are waiting with bated breath, as the detector upgrade will significantly improve data quality and operational resourcing, especially since there will be no chip gaps!

The current detector has really started showing its age this past year, with issues, or 'quirks', becoming more frequent and more worrying. Electronic noise previously (and rarely) seen in just one particular amplifier is now appearing in several other amplifiers with increasing frequency. On a few occasions we have had the readout of an amplifier fail altogether. These issues have thankfully not cost too much on-sky time so far and are being managed by the team. Since the problems appear sporadically (and disappear as fast as they show!), we have opted to avoid invasive cable or card swaps that will likely just move the problems around or make things worse. This tactic seems to be working. The issues are somewhat stable at the time of writing and are not regularly costing us on-sky time, but there may still be some small impact on data quality.

The detector replacement team is a multi-disciplinary team from SAAO, SALT, IUCAA, and SARAO — comprising scientists, engineers and technicians, machinists, software developers and procurement personnel. The team has worked flat out this past year to ensure delivery of the new detector in the latter part of the 2026-1 semester. Major progress has been made on several fronts:

- Finalisation of requirements documents;
- Finalisation of timelines and project workflows;
- IDSAC and associated software development: the IDSAC firmware has been updated to properly fulfill the SALT requirements. There is a functional 'middleware' layer, which acts to parse information from the IDSAC to the SALT software ecosystem. A lot of work has gone into this layer from the SAAO instrumentation team.
- Test cryostat: The test cryostat has been used with an earlier version of the IDSAC to take some test images and test functionality;
- Procurement of assorted hardware;
- Enclosures and mechanical structures are being assembled by the SAAO workshop.

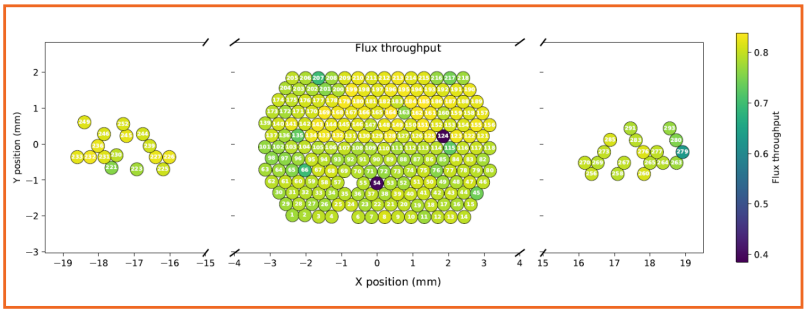
The detector and SALT operations teams are now very much looking forward to First Light of the new detector.

PG0700 SETUPS

We are planning to take some additional engineering data using the PG0700 grating in early 2026, with the aim of commissioning extra grating angle / camera angle setups. This will allow users a little more freedom to choose setups appropriate for their science beyond the three currently recommended setups.

PROGRESS ON THE RSS SLITMASK IFUS

Thanks to a significant institutional investment from the SAAO instrumentation team, together with strong support from the SALT Tech and Astro Ops teams, we are pleased to announce that the SMI-300 hardware has successfully been completed. One of the key objectives was to internalise the critical intellectual property before our slitmask expert Sabyasachi Chattopadhyay's departure in mid-November 2025 to the University of Hawaii. The core design knowledge, assembly procedures, and performance optimisation expertise are now embedded within the SAAO and SALT teams. This places us in a much stronger and more sustainable position going forward, particularly as we move toward the design and development of the SMI-200 V2 in the near future.



Flux throughput for the SMI-300 fibres.

Following a focused campaign by engineering staff from both SAAO and SALT, the hardware was successfully completed, culminating in the production of an SMI-300 cassette. The IFU assembly was completed and fully integrated at the end of December 2025. The development phase resulted in several important improvements when compared to the existing SMI-200, particularly in the optimisation of the optical and fibre assemblies. These refinements not only improved throughput performance but also simplified the assembly process — something that will benefit us in future builds.

Laboratory characterisation, concluded in early 2026, confirmed a strong performance. The total system throughput reaches 75%, exceeding the median integrated throughput requirement. The unit also meets or exceeds specifications for dark fibres (<6) and throughput uniformity (>50%) across both object and sky fibres. In short, the SMI-300 is ready for deployment to SALT for on-sky commissioning, which is expected to commence in the coming months.

The SMI-300 programme has also provided valuable lessons that directly inform the next phase of development. In particular, we identified a telecentricity issue in the current SMI-200 V1 that limits throughput performance. The redesigned 200 µm V2 will address this, incorporating targeted improvements that will enhance performance and further streamline the manufacturing and assembly process

Towards a replacement for SALTICAM

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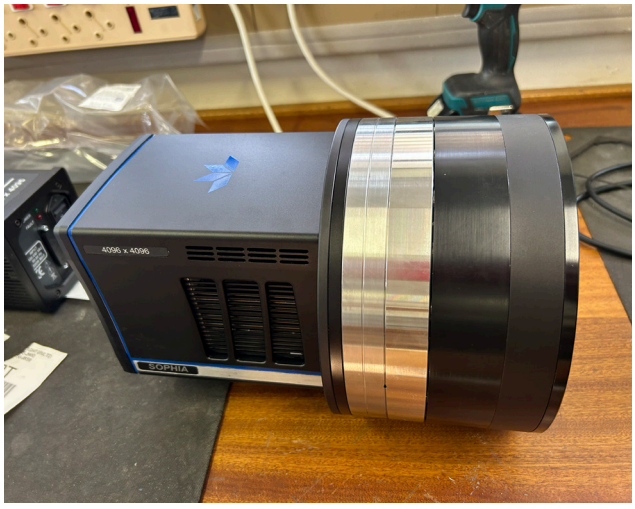
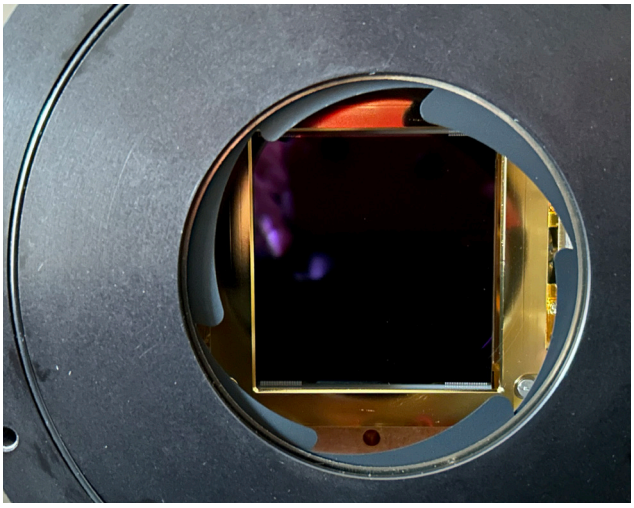
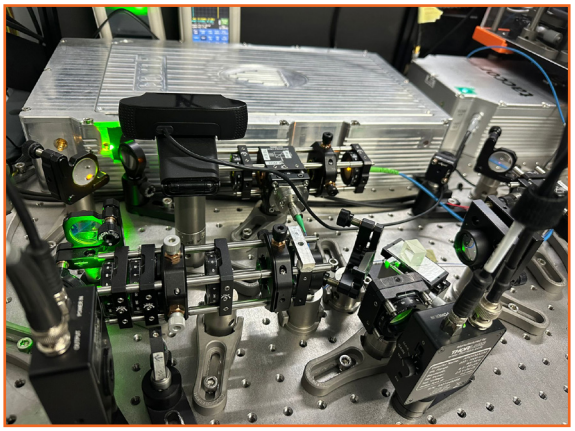
One of the exciting SALT purchases made in 2025 was a new 4K × 4K CCD camera that is intended to replace SALTICAM during the coming year. This off-the-shelf system from Teledyne, known as the Sophia 4096B, offers a number of significant operational advantages over our ageing acquisition and imaging system. This new device will retire the risk of still being reliant on long-obsolete CCD controller cards, and the Sophia camera also does not require a cryocooler system. Instead, it uses thermoelectric cooling to get the camera temperature to –60° C, while liquid cooling (using the SALT glycol system) will bring it down to –90° C. The camera will be used in conjunction with the BCAM (backup acquisition camera) lens barrel to deliver the same field of view as SALTICAM, but with the added advantage of there being no chip gap. The Sophia has a variety of readout options, including impressive high-speed capabilities. The number of filters we will have access to initially will be limited, but provision will be made for at least one optical filter as well as an unfiltered option. The time-frame for the installation and commissioning of this new system is uncertain as it will depend on various other projects ahead of it in the queue, but at least we can get to grips with the camera itself and the software in the meantime.





Laser frequency comb development

In the run-up to the SALT 20th birthday celebration, we had an intensive campaign intended to complete the installation of the laser frequency comb (LFC) for the HRS. Four members of the team of laser physicists from Heriot-Watt University (HWU) in Edinburgh came out to SALT over a three-week period, lugging assorted crates of fragile equipment. Richard McCracken and Shan Cheng arrived on 19 October and set about replacing a problematic module with a home-built system, and getting the various locking loops working reliably. Richard left a week later, then postdoc Jake Charley and PhD student William Newman (who already has years of work experience in the laser industry) arrived the next day, hugely excited about their first ever trip to SALT. Shan left on 2 November, but not before they had tidied up the LFC optical bench, organised all of the equipment in the comb lab (as the HRS electronics room is now known), and given us a walk-through of the GUI for running the comb.



Jake and William had brought along the spectral flattener, the last piece of the LFC puzzle, as well as a couple of other amazing tools that they had been building and experimenting with in their lab. One of these suffered potentially devastating damage during the trip across from Scotland, but thankfully they were able to recover the mangled hardware and get through some of the testing they had planned to do. During their last week at the telescope, they were joined by the high-stability (HS) mode's pipeline developer Daniel Holdsworth, who at the time had been working on a new data reduction pipeline for the high-resolution (HR) mode of the HRS. The team put in ridiculously long days/nights during this run and at times had to be physically persuaded out of the comb lab, or they would literally have worked around the clock.

The comb has evolved dramatically since Richard and Shan's last visit that ended in early December 2024. The main laser even acquired a second storey, as there was not enough space on the optical bench to accommodate the new flattener module. Bad weather during the last night of the run afforded us access to the spectrograph, so we could get the LFC into a workable form from which to refine its performance. The timing of all this could not have been better, since the HWU guys finished up the morning of Saturday 8 November, the same day that the SALT festivities kicked off. On the Sunday and Monday we got to share the spectacularly beautiful LFC with members of the original SALT project team that built the telescope, past and present members of the SALT Board, the Deputy Minister of the DSTI, the chair of the NRF Board, as well as various colleagues from UCT, SARAO, SAAO and SALT.

We had yet another LFC-related run in early December, with two other members of the HWU team (Derryck Reid for one week and Ewan Allan for both) working on a compact version of an LFC and testing it on the HRS. The project — called TICTAC: Turnkey, Inexpensive and Compact Ti:sapphire AstroComb — yielded extremely exciting results, including success in using a new waveguide (instead of the usual photonic crystal fibre, which also worked well) for supercontinuum generation. The TICTAC approach offers significant opportunities for ongoing development that could help to both simplify and reduce the cost of LFCs for precision radial velocity work.

The bad news was that during the TICTAC campaign we discovered a faulty off-the-shelf component within the SALT comb's spectral flattener that will need to be replaced. Members of the team now plan to return in March 2026 to install that. But the great news is that the HWU team has funding and strong motivation to keep working on the SALT comb over the coming year, particularly in terms of further automating the system to render it more user-friendly and operationally robust. We should be able to characterise the performance of the comb and get it ready for commissioning and on-sky testing during the first half of 2026. Furthermore, we are able to offer an MSc project in 2026 – 2027 related to these aspects of the LFC development.

OPERATIONS

SOFTWARE UPDATES

Tech Ops

support

Alongside supporting day-to-day operations, the Tech Ops software team continued its commitment to improving engineering processes and system reliability at SALT. A key achievement this year was the completion of a comprehensive **audit of the telescope software** stack. This audit provided a clear understanding of which areas require modernisation and will serve as the foundation for a structured upgrade plan. The aim is to improve reliability, reduce maintenance overhead, and ensure long-term sustainability and compatibility with future technologies. The team is currently charting a way forward and developing a roadmap to guide these upgrades. It will be presented for review in the coming year.

The **RSS-VIS detector upgrade** project is well underway. Requirements have been critically analysed and documented, and development has commenced with the architecture specification drafted and under review. The team is conducting continuous software integration with their instrumentation partners to ensure that the final integration into the telescope minimises risk and identifies potential failure points early. Integration on the telescope is expected in the coming year.

During the SALT shutdown, the team executed **module-level updates** across RSS, SOMMI, NIR, and TCS, integrated version control for key software modules, and supported telescope recommissioning efforts. Contributions included configuration updates, alignment support, and improvements to pointing and focus performance. Internal processes were strengthened with improved ticketing workflows, and migration of team communication and document revisions to Microsoft Teams. Over the second half of the year, dozens of software-related issues were tracked and resolved through the ticketing system, reflecting improved responsiveness and maintenance efficiency.

Other **operational highlights** included:

- Segment Positioning System: Stability improved through auto-query refinements and hardware tune-ups, reducing crashes and enhancing fault tolerance.
- HRS: FITS header discrepancies and false alarms were investigated, with additional indicators introduced to assist observers and technical staff.
- NIRWALS: Software modifications mitigated intermittent communication faults; detector concerns remain under review.
- SOMMI interface: Minor updates completed.
- Chiller upgrade: Requirements gathering and supplier engagement commenced in October 2025 to support software integration and system enhancements. In December, a configuration session with the supplier enabled the team to display operational values on a locally hosted website. These changes allow leveraging the enhanced capabilities of the new chiller product and to deliver improved monitoring, control, and integration with SALT's operational systems.

Training and development remained a priority. Members of **the team** completed the Systems Engineering course and initiated biweekly sessions on an applied data science course. Discussions on funding for certifications (LabVIEW, Engineering Council of South Africa), ensuring long-term skills development, sustainability and remaining compliant with South African engineering regulations. Management feedback highlighted successful adoption of remote work practices, improved clarity on standby and TOIL procedures. Team morale remained positive, supported by feedback sessions and quarterly team-building events. Two positions remain vacant. Recruitment is expected to resume in the 2026/2027 financial year following finalisation of the project portfolio.

User support

A major new version of the PIPT was released. It focussed on addressing performance bottlenecks and improving the overall responsiveness of the graphical user interface. The XML format for storing proposals underwent a substantial revision, with a view to having simpler and more robust XML, which in the long run will facilitate proposal submissions without the PIPT.

The RSS Simulator was updated to handle the new RSS detector to be installed in 2026.

Las Cumbres Observatory proposed to have SALT added to its AEONlib Python library for facilitating proposal submissions across various facilities. Work on a respective module has started, and (with the exception of some edge cases) SALT proposals can now be represented with Python-based models. During development work, some contributions to the core AEONlib code were made. SALT is expected to become available in AEONlib during the first half of 2026.

Version 0.1 of PyAstroSALT was released. This Python library is a light wrapper around SALT's API, and it will be used for submissions made with the help of AEONlib.

Browser access to the old, PHP-based Web Manager was officially decommissioned. Bug fixes and feature requests were implemented for the new Web Manager. For example, it now offers support for dark and light mode and lets the user choose from different themes for appearance.

As a first step towards a full dashboard for SALT's key performance indicators (KPIs), a Marimo notebook was created for tracking a large portion of the technical and operational KPIs.

Work continued on making SALT data available via Virtual Observatory Tools such as TOPCAT.

Improved calibrations for RSS spectropolarimetry

Over the last several years, we have undertaken a comprehensive effort to improve the calibrations for RSS spectropolarimetric observations. In collaboration with Kenneth Nordsieck from UW, this work has culminated in the Gamma release of the polSALT data reduction software in March 2025. This release introduced an updated calibration scheme for RSS spectropolarimetry with the PG0900 grating and, for the first time, enabled reductions of spectropolarimetric data obtained with the PG0700 grating. Together, these advances represent a substantial step forward in the reliability and scientific quality of SALT polarimetric data products.

The RSS is capable of high-throughput, medium-resolution spectropolarimetry over a wavelength range of 350 – 900 nm, using VPH gratings, and with a field of view of 4 × 8 arcminutes. RSS uses a mosaic calcite beamsplitter in the collimated beam and Pancharatnam waveplates after the focal plane. It has been operational since 2016, using an on-axis calibration based on calibration system lamps viewed through a polaroid.

Our initial goal was to achieve high-precision spectropolarimetry, given the 10-m primary mirror. Extensive observations of this nature have revealed a variable pseudo-sinusoidal wavelength position angle calibration error, with an amplitude of up to 0.5 degrees. This error varies predictably with the position in the SALT 'track'. During an observation, SALT fixes the primary mirror and tracks the primary focus instrument, causing variation in the pupil illumination. This effect likely arises from varying illumination of the pupil on the waveplate, which is not in the collimated beam.

Detailed analysis of high signal-to-noise observations over multiple semesters revealed two systematic effects in the previous calibrations: (I) **Position Angle (PA) ripple**: A wavelength-dependent oscillatory pattern in the measured position angle was traced to changes in waveplate illumination during a SALT track, reflecting variations in pupil illumination. (II) **Polarisation degree dependence**: Comparisons with well-characterised VLT/FORS2 standard stars exposed a subtle PA-dependent trend in the wavelength behaviour of the degree of polarisation. These findings motivated a full reassessment of the calibration strategy.

Key improvements in the Gamma release are

- **Track-dependent calibration model**. A new correction accounts for variations in RSS pupil illumination along the SALT track. This significantly suppresses the previously observed PA ripple and stabilises the wavelength dependence of the position angle (Fig. 1).
- **Optimised wide-slit strategy**. Observations obtained with a 3″ longslit, combined with a telescope PA offset by 90° from the intrinsic polarisation PA, deliver the most accurate and stable results. This configuration minimises systematic effects and improves repeatability (Fig. 2).
- **Improved external consistency**. Direct comparisons with VLT/FORS2 standard star measurements demonstrate a markedly reduced PA ripple and excellent agreement in polarisation degree, confirming the improved absolute accuracy of the calibration (Fig. 3).

Performance comparisons and reduction guidelines are provided in the updated polSALT documentation on the GitHub wiki: https://github.com/saltastro/polsalt/wiki/Linear-Polarization-Reduction:-Gamma-version

Development is already underway on the forthcoming Delta release, which will further refine the treatment of slit- and position-angle–dependent effects. These ongoing improvements are part of our broader commitment to strengthening RSS polarimetric capabilities and ensuring that SALT remains a competitive facility for high-precision spectropolarimetry.

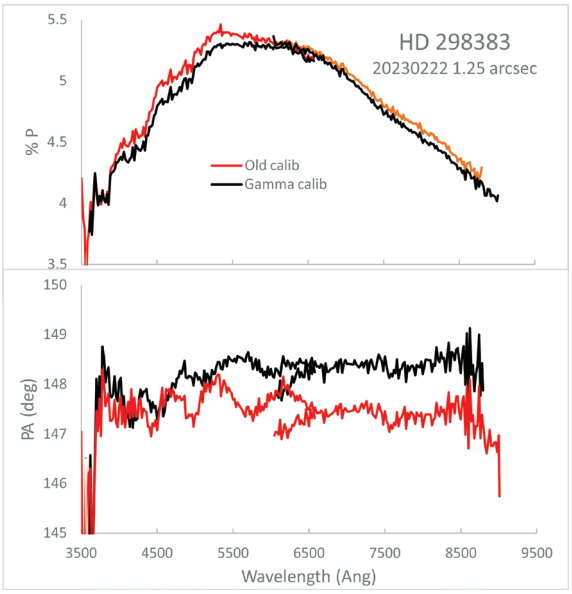


Figure 1: Comparison of old and new calibration for HD 298383, using a narrow slit.

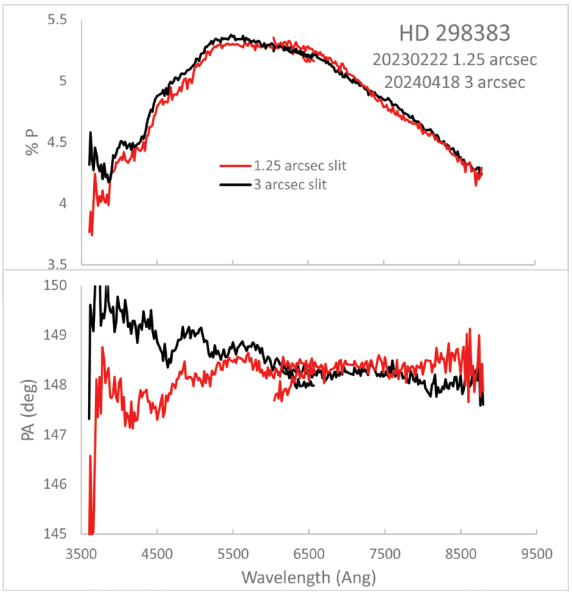


Figure 2: Comparison of the new calibration for a narrow and wide slit observation of HD 298383.HD 298383, using a narrow slit.

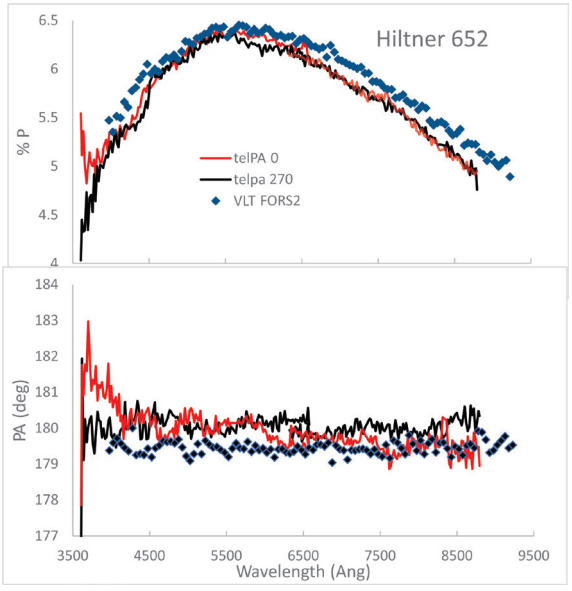


Figure 3: Comparison of the new calibration for standard Hiltner 652 with the telescope PA set to be 0 and optimal, 90 deg from the polarization PA. The VLT/FORS2 mean result for Hiltner 652 is also shown.

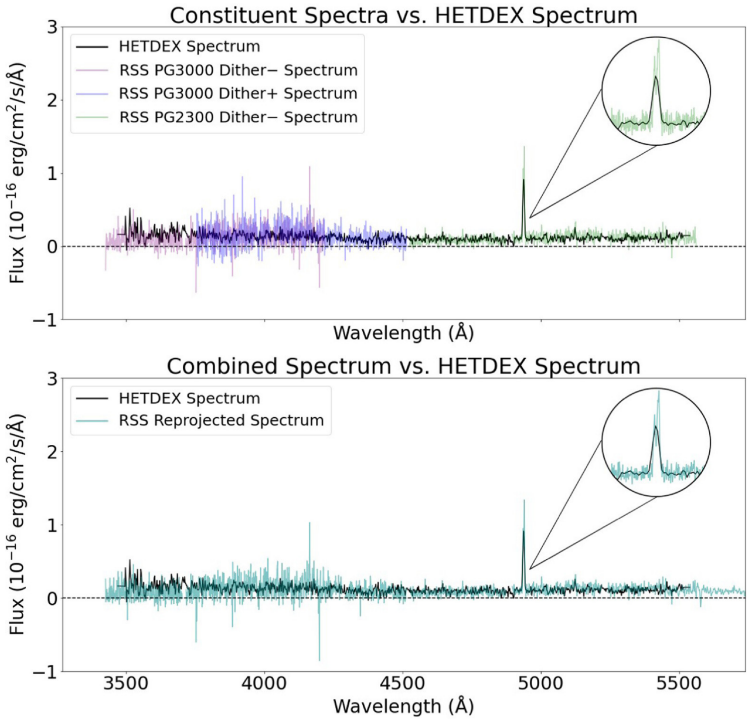
[1]https://github.com/saltastro/polsalt

A PIPELINE FOR MOS FLUX CALIBRATION AND NON-LINEAR REPROJECTION

Many SALT users are aware of the flux calibration limitations resulting from how the tracker moves as the sky rotates, limiting the science that can be done with RSS. George Kharchilava and his colleagues decided to develop the Calibration And Reprojection for RSS Pipeline (`CARRSSPipeline`), which performs flux calibration in a novel way made possible by including SDSS stars in the masks as secondary flux standards. The authors show that a relative flux calibration of roughly 20% is possible.

Wavelength calibration and other standard data reduction procedures like flat fielding and 2D spectral extraction are performed by Matt Hilton's `RSSMOSPipeline`[1]. Following these procedures, `CARRSSPipeline` takes the observed RSS spectrum of each SDSS star and divides it by the star's flux density known from the SDSS catalogue. The resulting sensitivity function is then applied to each observed science spectrum. The team's science programme observes [O II] emitting galaxies discovered by HETDEX across three gratings, using two dithers per grating to cover the total optical wavelength range of 3500 – 9500 Å. The pipeline runs on each observation separately, then offers the option to stitch multiple observations together into a single, aggregated 2D spectrum. This is done by reprojecting the data onto an exponential wavelength array that accounts for the change in resolution across the three gratings. Though sky subtraction is available from `RSSMOSPipeline` for the employed science slits, the team found that it often oversubtracts the sky in the spectra of very bright stars like the SDSS calibration stars. `CARRSSPipeline` corrects for this and then uses `RSSMOSPipeline` to extract 1D spectra for the stars.

This paper follows the target HETDEX J100041.45+021331.8 as it moves through the reduction process. The figure shows the calibrated spectrum of this target over the unresolved spectrum from HETDEX to show flux calibration accuracy and successful resolution of the [O II] doublet. The authors note that a primary cause of uncertainty in the absolute flux calibration comes from slit losses, which they measure by comparing line fluxes post calibration to known line fluxes in the HETDEX catalogue. The measured correction factor (close to the expected slit loss of extended targets) is applied during the reduction process and can be changed depending on the programme. The authors propose ways to increase accuracy, such as observing the SDSS stars in science slits instead of star boxes to better match slit losses. The final results show the flux values for each target that was reduced, including the differences between corresponding observed fluxes and wavelengths compared to HETDEX. Overall, the `CARRSSPipeline` offers a way to further reduce spectra taken by SALT/RSS, which can help expand the science capabilities of future observations. This software is open source and made available to interested observers.



Target spectrum flux density (black line) from the HETDEX catalogue plotted against wavelength. *Top*: the spectrum of each observation (grating) overlaid on HETDEX; *bottom*: the aggregated extracted spectrum post wavelength reprojection. The zoom-in insets on the [O II] region show the successful resolution of the doublet and accurate wavelength calibration. The continua and emission line flux for this target matched HETDEX to well within 20% error.

Kharchilava, G. V., et al. 2025/03, PASP 137, 034503: CARRSSPipeline: Flux Calibration and Nonlinear Reprojection for SALT-RSS Multi-Object Spectroscopy over 3500–9500 Å

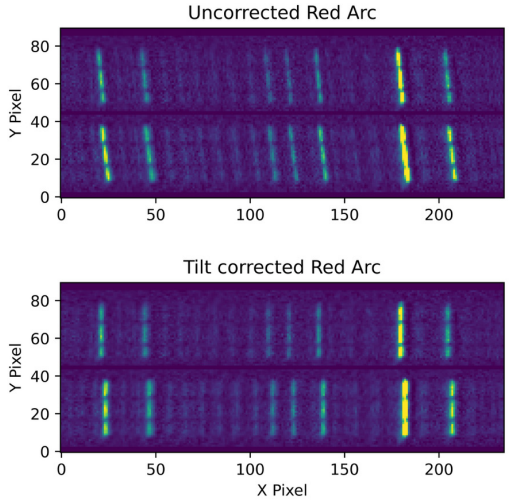
[2]https://github.com/mattyowl/RSSMOSPipeline
[3]https://github.com/GeorgeTheGeorgian/CARRSSPipeline.git

HRS-HR

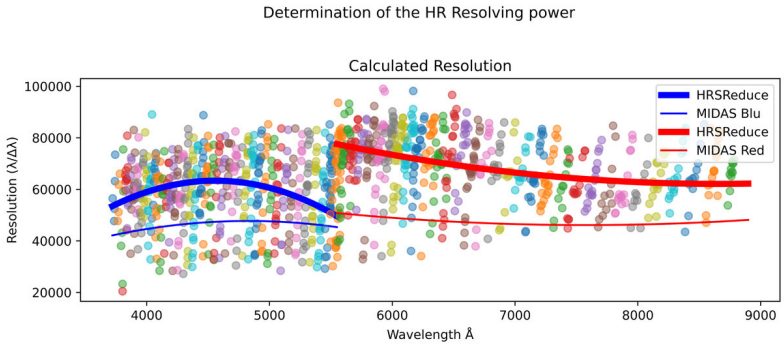
PIPELINE

The initial version of HRSReduce, the new python reduction pipeline for HRS, has been completed. This version deals with data collected in the HR mode. We are currently integrating the pipeline into the SALT data reduction ecosystem, which will be followed by further extensive testing before data products are made available to users. We are pleased to report that the major upgrade to the data products will be the spectral resolution obtained in the data. This is achieved by straightening the tilt of the slit within the order trace, as demonstrated in Figure 1. Figure 2 shows the resultant resolution after applying this correction in HRSReduce compared to the current MIDAS pipeline. HRSReduce produces data that are close to, or beyond, the stated instrument resolution (as given in the Call for Proposals). This allows higher precision science to be conducted with the data products received by the user. HRSReduce also extends the extraction of the Blue arm data to bluer wavelengths, down to ~3700Å, providing better coverage in the near UV range.

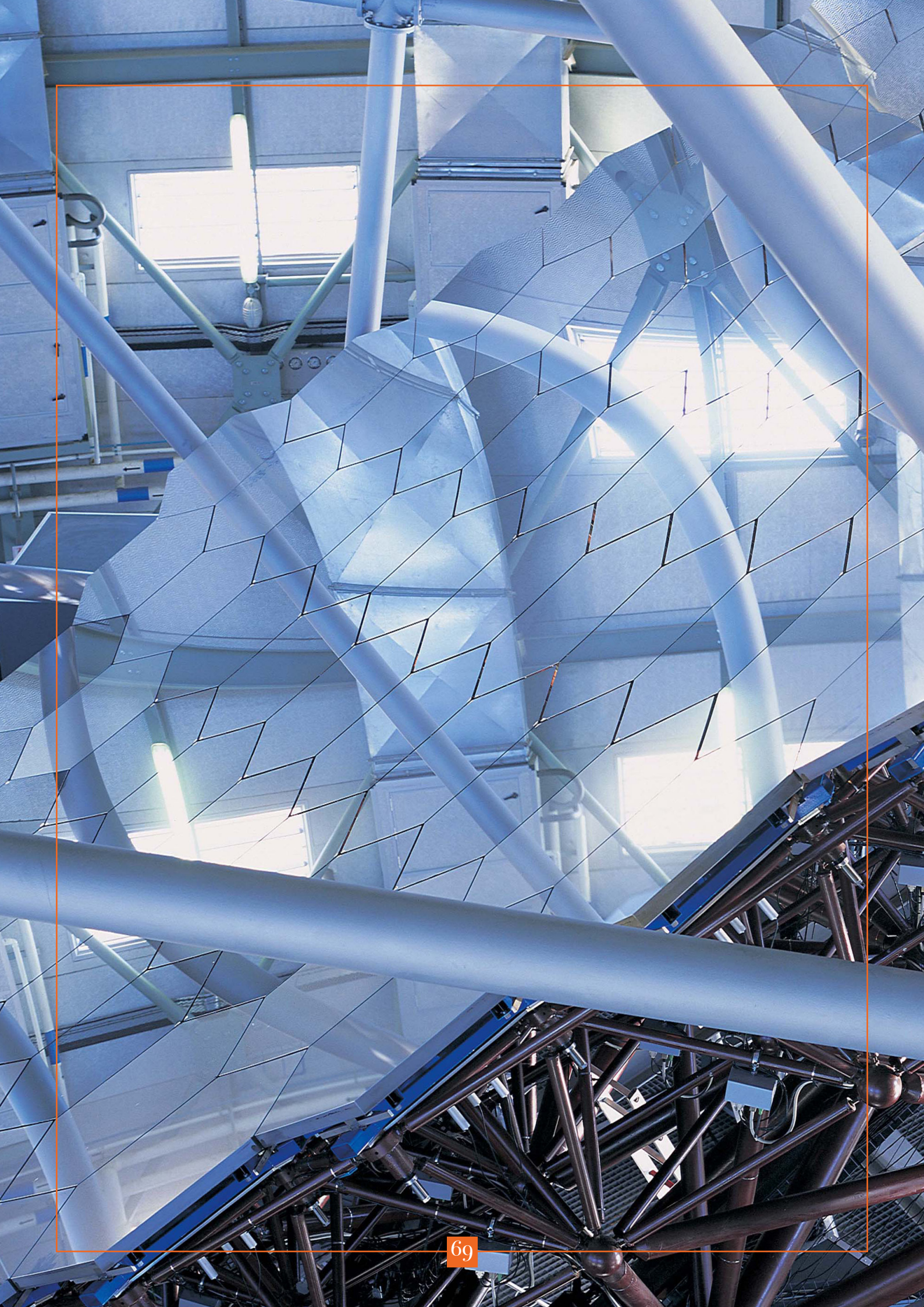
We are now in the process of extending the functionality of HRSReduce to include the MR and LR modes. While the degradation of the resolution is not as significant in these modes, users will receive data at the resolution expected of the instrument. Looking further to the future, historic data may be re-reduced with HRSReduce if users wish to revisit old observations and require the highest possible resolution for the instrument mode, since the information is still present in the raw frames.



An example of the correction of the slit tilt in a Red arm HRS HR order. The top panel shows a section of an uncorrected arc frame, while the bottom shows the same region after the tilt is corrected. A vertical summation of the pixels in the top frame would result in a lower resolution, while the bottom frame resolution is significantly higher since the spectral features are spread over fewer x pixels.



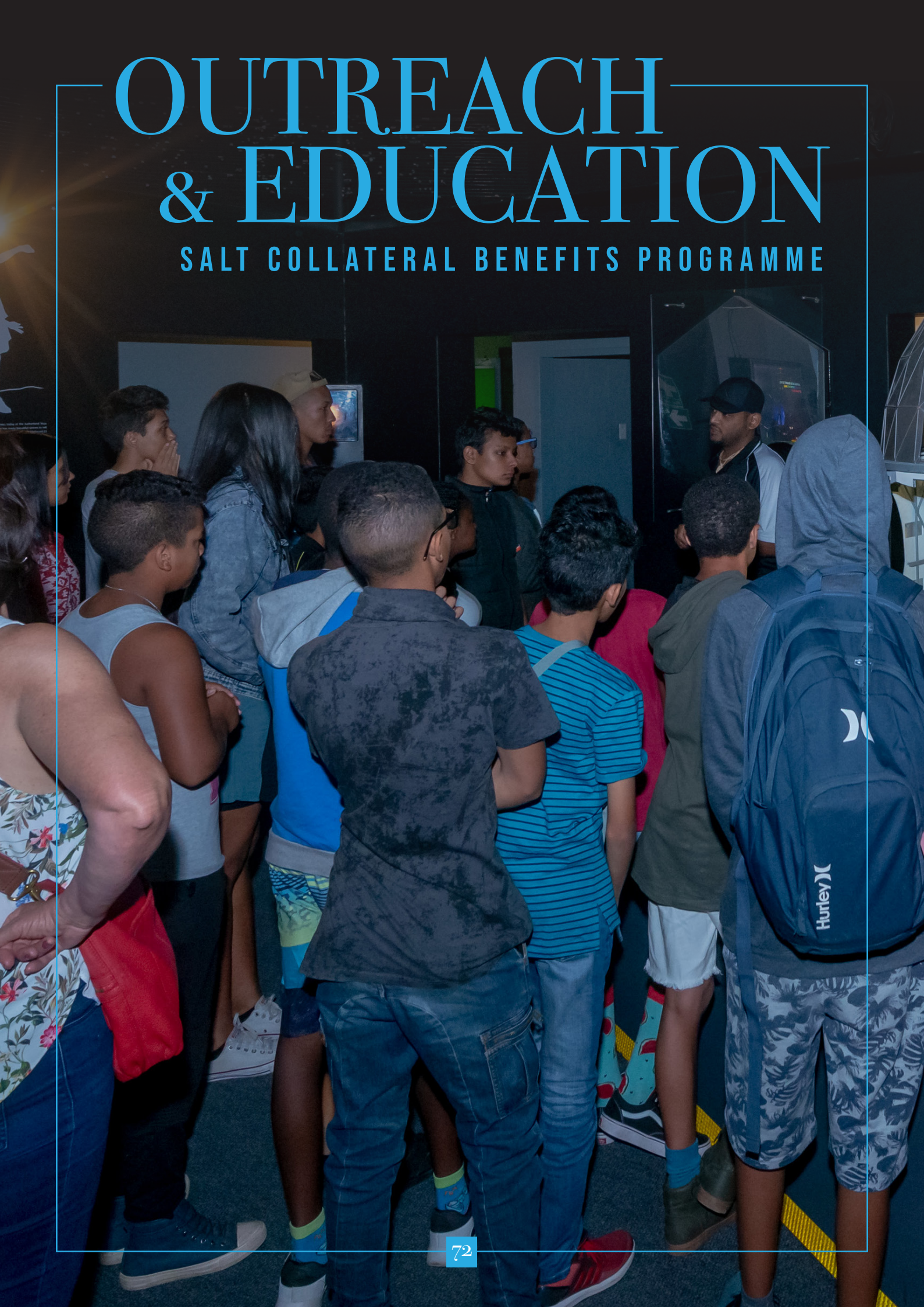
A comparison of the resolving powers achieved by the current MIDAS pipeline (thin lines) and the new HRSReduce pipeline (thick lines). The faint circles show the measurements of individual ThAr emission lines, with each colour referencing a different order (plotted for HRSReduce only). The same lines and methods have been used to measure both MIDAS and HRSReduce results.



OUTREACH & EDUCATION

OUTREACH & EDUCATION

SALT COLLATERAL BENEFITS PROGRAMME



The SALT Collateral Benefits Programme (SCBP) was established during the construction of SALT, with the objectives of this programme being clearly directed at the benefits derived by society from building this large telescope. Its focus points are education in mathematics, science, engineering and technology; science communication and awareness; socio-economic development, and public engagement. Today, the SCBP activities are run by the SAAO science engagement personnel.

2025 has been an extraordinary and highly successful year for the SCBP. With the dedicated support of SAAO staff, the team has continued to ignite curiosity and inspire minds through dynamic science education, impactful science communication, and engaging science awareness initiatives. Beyond the world of astronomy, the programme has also strengthened its commitment to uplifting the Sutherland community through meaningful development and support initiatives — making 2025 not just a year of achievement, but a year of lasting impact. Finally, 2025 marked 20 years since the construction of SALT, a telescope that has been an epitome of research excellence and technological innovation but has been also a tool of development, empowerment and socio-economic development through SCBP. Through our efforts in 2025, a total of 36,595 people participated in various programmes including teacher development workshops, learner empowerment programmes, public engagement, open nights, exhibitions, tours and community development programmes. This included 8958 learners, 1356 teachers and 26,281 members of the general public.

Teacher training, support and development

The SCBP is committed to teacher support, development and training. This is achieved through workshops, teacher based competitions, support for teacher participation in conferences, teaching and learning materials development and team teaching. The SCBP continues to collaborate with various science centres, national and provincial departments of education, science centres and education based non-governmental and non-profit organisations. Teacher training, development and support is imperative for the transformation of science classrooms and for inspiration of learners. With inspired, well trained and well-resourced teachers, the battle for science, technology and innovation and advancement is already half won. The SCBP education team is led by education officer Ms Buzani Khumalo and Head of SCBP, Mr Sivuyile Manxoyi. As follows, various interventions have been implemented in 2025 and involved a total of 1356 teachers from the following provinces: Western Cape, Eastern Cape, Northern Cape, KwaZulu Natal, Mpumalanga and Limpopo.

In collaboration with the Limpopo Provincial Education Department and SAASTA, the SAAO science education team facilitated two two-day teacher development and support workshops on 14 – 15 April in Lephalale and on 16 – 17 April in Warmbaths, with 115 teachers participating. The workshop, based on the "Earth and Beyond" theme, included providing the relevant astronomy content, introducing creative pedagogical approaches and sharing interactive and engaging hands-on resources.They were well received, and the audience felt that the NRF in the form of SAAO and SAASTA should extend their efforts to more districts in Limpopo, especially the underdeveloped and rural districts.

A total of 16 teachers from Roggeveld Primary in Sutherland attended and participated in an Earth-and-Beyond workshop held on 9 May, conducted by Mr Jeremy Stuurman, the SAAO public outreach officer based in Sutherland. The workshop focused on "Earth and Beyond" and included teaching and learning about the Earth, Sun-Earth-Moon relations, and the solar system. The workshop covered basic curriculum content and pedagogical approaches and included familiarising the teachers with the resources available at SAAO. Teachers were taken through the SAAO visitor centre exhibits and taken to the plateau for a tour of the research telescopes, including SALT.

In July and September, two kinds of teacher based interventions were implemented in the Eastern Cape, KwaZulu Natal and Mpumalanga, with the aim of supporting teachers in rural towns. Both interventions were based on the "Earth and Beyond" theme, with one being aimed at Natural Science teachers, while the other was designed in the form of a train–the–trainer approach and involved curriculum advisers and Master/Lead teachers. The workshops were held in the following locations: the rural town of Ebenezer near Mbizana (Eastern Cape), Port Edward and Port Shepstone in KwaZulu Natal, while the final two, implemented in conjunction with the Osizweni Science Centre and Mpumalanga Education Department, took place in Amsterdam and in Secunda in Mpumalanga. A total of 573 teachers participated in the workshops. All interventions were well received and the Osizweni Science Centre has expressed the desire to establish a firm partnership with SAAO to ensure that teaching training and development is implemented at all their sites.

The last set of teacher workshops were held in October. In collaboration with the KwaZulu Natal Provincial Education Department, Osizweni Science Centre and SAASTA, the SAAO science education team facilitated a teacher development and support workshop on 14 – 17 October. The "Earth and Beyond" themed workshop included providing the relevant astronomy content, introducing creative pedagogical approaches and sharing interactive and engaging hands-on resources. A total of 122 teachers participated in the workshops. Working with the Western Cape Education Department, Cape Town Science Centre and supported by SAASTA, the SAAO education unit delivered workshops for 530 Western Cape teachers on 20 – 22 October, providing the attendees with support on content and teaching approaches, and it also dealt with misconceptions. Teachers from Limpopo joined the workshops virtually.

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Learner activities

The SCBP learner based programmes include curriculum aligned activities such as lab based workshops, co-curricular activities such as the astronomy quiz and astronomy debates, and extra curricular programmes such as career info based activities, robotics, holiday and girls-focused programmes. In 2025, 8958 learners were reached this way. Some of these activities are presented below.

As part of the biennial **Dartmouth College** outreach programme, Prof. Brian Chaboyer and his students, together with the SCBP Cape Town group, visited Aloe High School in Beacon Valley, Mitchellsplein on 6 February. A total of 233 learners participated in the programme, which included presentations and a number of hands-on activities and demonstrations.

A **celebration of the equinox** was held on 20 March at the Roggeveld Primary school, with 31 learners participating. This opportunity was used to explain equinoxes and solstices. With the ubiquity of confusion about the cause of seasons, the programme also dealt with the misconceptions using hands-on activities and demonstrations.

The SCBP education team, NYS volunteer Mr Asive Bomvu, and the SALT funded Sutherland based science teacher Mr Thabo Banda recently developed and introduced a **coding and robotics programme** for Grade 8 and 9 learners in Sutherland. The aim of this programme is to first and foremost inspire and inform the learners about the 4th industrial revolution skills and techniques, and how these are transforming the world into a better place. The programme seeks to reduce the number of drop-outs and to retain learners, particularly in the mathematics and science fields. Working with SARAO colleagues, Mr Odwa Magabuko and Filliciano Skippers, the first training session was held on 15 – 16 April with 16 learners participating. For many of the learners, this was a first time experience of the world of coding and robotics. Working with the UNISA science engagement team led by Dr Patricia Gouws, the second intervention was held on 27 – 29 May. The number of participants had increased, with 39 learners participating. The learners and educators were introduced to guiding learners step-by-step as they built and programmed their own robots to perform a range of tasks — such as moving in specific directions, responding to sensors, and navigating simple challenges. The workshop focused on developing critical thinking, problem-solving, and teamwork skills, but went beyond and became a catalyst for change by planting a seed of technology and innovation knowledge into the young minds of the rural town of Sutherland. The robotics programme continues to run and will be further developed, strengthened, regularised and institutionalised as one the major programmes at the Sutherland schools.

On 11 May, Hermanus-based **SANSA** brought 46 learners, who had been visiting them, to SAAO in Cape Town. This event was a form of consolidation and an exposure to areas not covered by SANSA. The learners were given presentations on astronomy and SAAO linked telescopes, a tour of the visitor centre, an inflatable planetarium show, and hands-on activities linked to astronomy. Over the years, the SCBP group has developed a solid collaborative relationship with SANSA.

The SAAO Cape Town site hosted 52 Grade-7 learners of the **Astro Club** from Saldanha on 17 May. The after-school club is supported by the Acelormital Science Centre. The programme was geared towards supporting and preparing the learners for Round 3 of the National Astronomy Quiz. A quiz consisting of 20 questions (10 to be answered as a group, and another 10 as individuals) was designed and administered. The group questions were more demanding and needed critical thinking and application of known facts to produce solutions, while the individual questions were more of the recall type. The learners were also given a site tour and learnt about the history of astronomy in South Africa and modern astronomical infrastructure such as SALT.

In an **SAAO–iThemba Labs school partnership programme**, iThemba Labs brought 36 learners, who participated in their school programme, to SAAO on 30 September as part of their exposure to science and technology and, in particular, to astronomy and space science. This is part of a concerted effort at engaging learners in a more collaborative and holistic way. We hope and intend to host the group in Sutherland as well so that they can experience modern astronomy facilities such as SALT and various other telescopes on the plateau.

The Grade-12 physical science tutoring project named "**The Rising Star**", initiated in 2023 in collaboration with the nearby Thandokhulu High, continued in 2025. We were overjoyed when results showed that all the natural science (physics and chemistry) learners had passed their exams. "The Rising Star" is an after school tutoring project aimed at improving the natural science performance at the school by providing extra classes as well as creating opportunities for learners to complete some exercises based on the curriculum content and to raise questions for clarity on their studies. The tutoring sessions are held on a weekly basis on alternate Wednesdays and Thursdays. The tutors are drawn from SAAO staff, post-graduate students and volunteers from UCT faculty of science students. Thanks to Ms Fezile Khoza (an NYS volunteer) who assisted with the administration and coordination of the project. Thanks also to the SAAO and UCT based post graduates who volunteered to lead the tutorials and afternoon classes.

Career-based activities

The career based programmes serve to disseminate information on various science and technology based careers, introduce the learners to role models, and generally inform and inspire learners about the relevance and significance of science-based studies on development and society.

THE JOB SHADOW PROGRAMME

The year 2025 was an extremely successful year to the SAAO job shadow programme as an unprecedented number of inquiries and applications were received. The popularity of the programme has grown over the years, with learners from various provinces attending, including Gauteng, Eastern Cape and North West Province, as well as in-province (but outside of Cape Town) participants from nearby towns and cities. This programme is exceptional since it draws various professionals from all the departments at SAAO, including astronomers, engineers, technicians, software developers and IT specialists. Due to its excellence and impact, SAAO's job shadowing programme is sought after, and learners apply to be part of the programme from as far as Gauteng and KwaZulu Natal.

The first SAAO job shadow session was held on 2 – 3 July, where 14 high school learners participated, and the second was implemented on 7 – 8 October with 15 learners. The latter session was rich in diversity as it was part of the new Career Diversity & Cross-Facility Collaboration and included presenters from the sister facilities OAD, SARAO and SAEON. One of the highlights of the programme was the demonstration by Robin Van Wyk and Grant Adams from SARAO on the MeerKAT array and how the telescopes can be controlled individually or collectively. Astronomy PhD candidates Mikhail de Villiers and Anke van Dyk also shared their inspirational journey into astronomy postgraduate studies and offered frank insights on how to be successful in academic studies.

SCBP is immensely grateful to the job shadow team (drawn from various SAAO departments) and to the programme manager, Mrs Natalie Jones, for their commitment and dedication in continuously delivering programmes exceeding the expectation and needs of the participating learners. The programme continues to be a beacon of enlightenment and hope for diverse groups of learners from different schools, areas and backgrounds, all searching for their possible future career paths.

GIRL-FOCUSED PROGRAMMES

Young female astronomers from Dartmouth College working with the SAAO outreach team designed and implemented a programme to celebrate the **International Day of Girls and Women in Science** on 11 February. They visited two high schools in the West Coast district in Vredenburg to inspire high school girls to take STEM subjects, in particular in astronomy and space science. They spoke about their experiences regarding their career choices while still at high school, how they ended up in astronomy, and their first year at university. They started in Louwville High School, reaching 49 girls from Grades 10 – 11, and proceeded to New Vredenburg High School where 81 girls from Grades 10 – 12 participated.

In honour of women and girls and to encourage girls' interest and participation in science and technology, SCBP annually organises a special programme on **National Women's Day** on 9 August. Due to commitments and programmes related to the National Science Week, it was not possible to host the event on that very day, instead, a women's programme was organised and implemented on 16 August. A total of 66 girl learners, drawn from different high schools, participated in the programme. The girls were addressed by various female scientists including astronomers, food scientists, engineers, software developers, IT specialists and aviation professionals. They had opportunities to interact with the exhibitions and also had space and time to interact with female professionals in small groups and as individuals.

CAREER BASED EXHIBITIONS

The SCBP, jointly with other NRF facilities, exhibited at the **World of Work Exhibition**, which was held at the Feather Market Hall in Gqeberha (previously known as Port Elizabeth) from 18 – 20 February. The exhibition sought to inform Grade 10 – 12 learners, teachers and members of the general public about various careers and work opportunities available in various industries across South Africa. A total of 9893 people passed and interacted with the exhibition. It was a great success and presented a holistic view and multi-wavelength concept of the astronomy facilities including SALT, MeerLicht, MeerKAT.

The Sutherland SCBP team, led by Ms Anthea Oliphant, worked collaboratively with NERSA, SAICA, the department of education, the provincial government departments, and industry in the Northern Cape to deliver the **Northern Cape Careers Project** from 17 – 20 February. This was implemented as a roadshow, with exhibition and presentations at the towns Fraserburg (106 learners), Williston (51), Hantam (28), Calvinia (44) and Loerisfontein (20 and 23 in two schools). The most challenging and painful lesson is that many of the schools do not offer pure mathematics (instead they have mathematics literacy), and others do not offer physical sciences at all. This therefore limits the career opportunities and studies learners can undertake. There is a need to promote and support the teaching and learning of mathematics, particularly at high schools in the Northern Cape.

The **Harry Gwala Career Exhibition** was held from 5 – 9 May in Kokstad and Ixopo in the Harry Gwala district in KwaZulu Natal. Organised by the Harry Gwala Department of Education, the aim of the event was to inspire and empower high school learners to pursue STEM careers. The exhibition targeted learners from Grades 8 – 12, particularly those from rural and under-resourced schools, with 2545 learners attending. A number of prestigious institutions and organisations participated in the exhibition: SAAO, SARAO, SANSA, UNISA, the Council for Scientific and Industrial Research, the African Space Research Institute, and the Department of Agriculture, Land Reform and Rural Development. These organisations showcased career pathways, study opportunities, and cutting-edge scientific work to help learners picture a future in STEM.

Public engagement and awareness

The SCBP Sutherland team, consisting of Mrs Claudine Stuurman and Mr Patrick van Wyk, responded to the request from the Karoo Hoogland Municipality (KHM) to set up and facilitate stargazing sessions in the towns of Williston and Fraserburg, which are neighbouring towns of Sutherland. The Williston **stargazing session** held on 26 February attracted 38 people, while the one in Fraserburg was held on 27 February with 190 people participating. The request from KHM was motivated by the visibility of all naked eye planets at the same time in the sky and the excitement generated by social media on the planetary alignment.

The public programme **An Evening with NASA**, involving a presentation by Mr Jim Adams, a retired NASA Deputy Chief Technologist, was held on 17 March at SAAO. A total of 95 members of the public attended the event and had opportunities to ask questions and later to interact with Mr Adams individually. A tour of the site and stargazing through telescopes was offered to all the participants.

VOX Cape Town is an innovative ensemble that was created to invigorate local choral music through imaginative programming and staging to create intimate, multisensory experiences. The choir recently celebrated its 10-year anniversary with a series of breath-taking performances at SAAO. The performances were held on 16 – 25 June, and the series was dubbed |gamirodi! khaes or "The Place of the Stars". A total of 254 members of the public participated in this event, which demonstrated a beautiful synergy between science and art and demonstrated how art can be used to inspire interest in science and technology.

A **Vera C. Rubin Observatory Look event** was implemented at the Iziko planetarium. This was the first opportunity to share First Light images from the Vera C. Rubin Observatory and information on new discoveries and the capabilities of the telescope. The programme was held on 23 June and was attended by 118 people, including university students, astronomers, science engagement professionals and the general public.

Both the **SAAO visitor centre and the remote operations centre** were officially opened by the Minister of Science, Technology and Innovation on 9 July. The Deputy Minister of Sciences, Technology and Innovation, the Minister of Tourism and the members of the Parliamentary Portfolio Committee on Science and Technology were all in attendance, as well as 350 people including high school learners, students, teachers, astronomers, indigenous knowledge practitioners (including Dr Gcina Mhlophe). The programme included site tours, workshops, indigenous astronomy storytelling and addresses by Prof. Ros Skelton, Mr Sivuyile Manxoyi and Dr Blade Nzimande. The CEO and the Chairman of the NRF board also addressed the audience.

The **NRF Next Generation of Emerging Researchers symposium** took place in Durban on 2 – 5 September. An exhibition based on SAAO and SALT was part of the broader NRF facilities exhibitions for this event. A total of 230 people, including post graduate candidates, young researchers and members of the general public, participated in this programme.

A special moon gazing **"Red Moon"** event was held on 7 September at the SAAO Cape Town site to observe the lunar eclipse. A total of 160 members of the public joined and participated in the programme. Included were a presentation on eclipses, moon gazing and stargazing. Various media units, including national television, joined and captured the events of the day. A community observation was also held in Sutherland next to the Sutherland Community Centre.

The SCBP team, BRICS and IAU OAD participated in the **Physics Open Day** held at the Stellenbosch University on 10 September, reaching 150 members of the public, including students and learners. The event included the launch of the New Astronomical Society for the students at the university.

An exhibition on SALT and SAAO was set up to support the implementation of the **Presidential PhD programme** held at iThemba Labs on 22 September. The exhibition sought to highlight research excellence and technological innovation of Sutherland-based telescopes, including SALT. A hundred people participated in the exhibition. The Presidential PhD programme was initiated by the South African President and is intended to increase the number of South African PhD holders in various fields, including science.

National Heritage Day was celebrated on 24 September in Cape Town with 341 people participating. The programme included fun and astronomy activities for the children, tours of the site, astronomy presentations and visitor centre experiences, which included interaction with the exhibits.

The SCBP unit joined SAEON, iThemba Labs, the Inkcubeko science centre and Eh! Woza in **the SANSA Open Day** science exhibition on 11 October in Hermanus. The SAAO team exhibited on astronomy as science, provided information on astronomy as a career, and facilitated inflatable planetarium shows. A total of 1048 members of the public visited the SAAO exhibition and planetarium shows.

The SCBP team also participated in the iThemba Labs organised **Science and Career Exhibition** that was held on 18 October at the Blackheath Primary School with 190 people participating. Exhibitors included SAEON, SANSA, iThemba Labs and AfAS. The SAAO team led an exhibition and provided planetarium shows.

SCIENCE COMMUNICATION

A Media and Society workshop on science communication was facilitated by SAAO communications officer Ms Thembela Mantungwa on 3 May as a pre-conference workshop for the Planetary Defence Conference held on 5 – 9 May in Stellenbosch. The workshop was addressed by Dr Nic Erasmus, one of SAAO astronomers and instrument scientists, with a presentation focusing on asteroids and the work conducted at SAAO in studying Near Earth Objects. The second part of the workshop dealt with how science is communicated in print and broadcasting media and what the communities expect from science communication. On 9 May, Ms Thembela Mantungwa took part in the panel discussion on risk communication and how to handle fake news and pseudo-science. A total of 30 people attended the media workshop, and 365 people attended the panel discussion on risk communication.

The SCBP Sutherland team continues to offer support to the SARAO trained astro guides on both the night sky and observations using the Dobsonian telescopes.

FESTIVALS, EXPOS AND CONFERENCES

The **African Astronomical Society** (AfAS) held a conference on 24 – 28 March, hosted by UNISA at the Emperor's Palace in Gauteng. SAAO communications officer Ms Thembela Mantungwa presented a talk on "Co-creating community engagement in Sutherland" on 25 March in the science communication, education, and outreach session. Based on a small sample research project, she found out that even though SALT has been in Sutherland for 20 years, some community members in Sutherland still have a keen interest in knowing more about what happens behind the scenes when astronomers observe. During her talk, she presented how she conducted the first contact and with whom, the feedback from the group, and what they expect for next year. The approach might be useful to the community and to give pointers on how to measure impact. On the last day of the conference, she gave a report back on the 3-year work of the AfAS communications committee since she has been the committee chair. The attendance was mostly AfAS members since the last day of the meeting was mostly on AfAS business. A total of 98 delegates were in attendance.

Hannes Breytenbach, a PhD candidate in astrophysics based at SCBP and UCT, represented SAAO at the **Rocklands Highline Festival** on 18 April. He conducted stargazing as a side event. A total of 53 members of the public participated in the stargazing session, where they were exposed to different celestial objects including star clusters, nebulae, galaxies and planets. They were also apprised about the South African astronomical research infrastructure that includes SALT and MeerKAT.

The SCBP team participated in the **National Science Week** (NSW; held on 4 – 9 August) in four provinces, namely Mpumalanga, Western Cape, KwaZulu Natal and the Northern Cape. In Mpumalanga, the activities included presentations, large interactive screens from OAD distributions and hands-on workshops, with 811 learners participating. In the Northern Cape, activities included participation in the science and career exhibition (the NWU Chancellor exhibition) at Kuruman, which was held on 6 August and was attended by 1200 high school learners. It also included presentations and hands-on workshops at Revilo High, Sutherland High and Roggeveld Primary. In Cape Town, the three high schools Khulani High, Isilimela High and Sinethemba High participated. The activities at the schools focused on using space science and X–space experiments. A Women's Day programme with 66 girl learners participating was initially intended for 9 August but due to unforeseen circumstances it had to be moved to 16 August. The KwaZulu Natal leg of the National Science Week celebration consisted of an astronomy quiz involving 600 learners, a spectroscopy workshop involving 250 learners, and a Women's Day celebration, which involved 600 learners. These activities took place at the Anton Lembede MST academy.

The annual national science festivals, SciFest and Sasol Techno X, as well as provincial science festivals, such as Eiding, did not take place in 2025.

UNIVERSITY STUDENTS ENGAGEMENT PROGRAMMES

The Observatory has built a healthy relationship with UCT and other universities. Students from journalism, science and science education have in the past visited the Sutherland and Cape Town observatories for various purposes linked to their studies, research and career related reasons.

A total of 60 university students who are members of the **UCT Space and Astronomy Society** visited SAAO on 5 April. They were offered guided tours through the SAAO site, which included the history of the observatory in particular and optical astronomy in general, and a visit to the historical telescopes as well as the engineering workshops. They were given talks on modern astronomy and Sutherland based telescopes including SALT. A group of 16 **UCT** post graduate students in astrophysics led by Prof. Patrick Woudt from UCT also completed a tour of the site on 23 May. Their programme included a history tour, a visit to the instrumentation workshops and talks by researchers.

On 30 June, 10 **BCIEE** electrical engineering students visited SAAO with interest in exploring the interaction between the world of engineering and astronomy. They visited the electronics and mechanical workshops and were given presentations by astronomers and engineering staff. Four **NASSP** post graduate students were afforded an opportunity to visit the SAAO site in Cape Town on 15 July.

A professor of science education at the UCT school of education and his 18 **Post Graduate Certificate of Education** students visited the Observatory on 8 October for a tour, presentations and hands-on activities based on how to use astronomy to inspire interest in science and technology. Ten students from the **Sol Plaatjie University** also visited the observatory on 10 October and enjoyed the tour of the site but also spent time at the mechanical, electronic, optical workshops and also with SAAO IT and software development professionals. On 15 October 56 member students of **UCT Astronomy 1000** visited the SAAO site and completed the tour of the site.

OPEN NIGHTS

The Cape Town observatory continues to host open nights on every second and fourth Saturday of each month. These include a public lecture by an astronomer, PhD student or technician. The lectures are followed by a site tour and stargazing through small telescopes. The open nights serve to bridge the gap between science and the general public, to demystify the scientists and as a platform for direct engagement, dialogue and discussion between scientists and the general public.

A total of 3306 people attended the Open Nights in 2025. Presentations included a talk titled "The Future of the NRF-SAAO" by the Managing Director of SAAO, Rosalind Skelton, and "From the Cosmic Dawn to a Better World" by Charles Takalana, Deputy Director of the IAU-OAD. Apart from astrophysical research, the talks included widely diverse topics such as the future of gravitational waves and LISA, using astronomy to help development, technical issues like sharpening astronomical images, astronomy and art, SAAO's telescopes and the star of Bethlehem as a christmas talk.

TOURS IN SUTHERLAND AND CAPE TOWN

The SAAO through its Cape Town and Sutherland sites continues to drive the astro-tourism in the Western Cape and Northern Cape, respectively. This intervention also serves to promote astronomy awareness through day and night tours. A total of 11,239 people participated in these tours, of which 3579 visited the Cape Town site and 7660 visited the Sutherland site.

Tours on the Cape Town site for the general public have become very popular since their introduction in 2024. While day tours are only held for special events, night tours are given more regularly once or twice per week, depending on demand and availability. An additional night tour is offered on every third Saturday of a month as an alternative to the Open Night events. These night tours offer a visit to the visitor centre instead of a presentation, which is more convenient for parents with young children, who often struggle to sit through an hour long presentation. In 2025, 67 night tours and 6 day tours were given. As part of SALT's 20th anniversary celebrations, there were two special free tours offered to the public in Cape Town on 25 October, which attracted a total of 120 members of the public. These tours have attracted and included a wide of range of the spectrum of the public audience this year, including DSTI officials (who were on site for the Geodesy Workshop and DUT-DSTI Space Science Workshop), members of the Chinese Consulate, Royal Bafokeng Nation representatives, Stellenbosch University lecturers and researchers, and the Valkenberg Hospital management.

The Sutherland tours continued strongly throughout the year with 6436 people attending the day tours and 1224 attending the night tours. These tours create opportunities for the public to view and appreciate research infrastructure, learn about our institution's research, inspire and generate pride about South African achievements and contributions to modern astrophysics research. SALT continues to be a pioneer of astro-tourism in South Africa. The National Astro-Tourism Strategy was inspired by the impact of SALT initiated tours and how this has contributed to socio-economic transformation and development in Sutherland.

SUTHERLAND ACTIVITIES

The **Parliamentary Portfolio Committee** (PPC) on Science, Technology and Innovation, in collaboration with DSTI, conducted a visit to the Sutherland site on 24 – 25 February. During the two-day visit, committee members were briefed about the observatory's recent discoveries, technological advancements, and capacity-building efforts. Discussions centred around how it contributes to human capital development by training astronomers, engineers, and technicians to foster the country's scientific leadership on the global stage. They visited the Sutherland Community Centre to interact with SAAO/SALT beneficiaries and stakeholders including school learners, community members and the Sutherland Astro-tourism Association. Addresses were given by Prof Ros Skelton, Mr Sivuyile Manxoyi and Ms Duduzile Khubeka. The committee was highly impressed with both the science and the social and economic development inspired by SALT.

The **Sutherland Careers Day** was held at the Roggeveld Intermediate School on 29 August. The intention of the programme was to inspire and inform the learners about career options and possibilities. A total of 224 learners were given career info by the SAAO staff and other government departments and institutions based in the town. Usually career programmes target high school learners, while the aim of this intervention was to motivate and inspire the learners before they reach high school so as to prevent them from dropping out of high school.

On 24 September, **National Heritage day**, 19 Roggeveld Primary school learners together with their parents visited the 1.9-m telescope and SALT to see what astronomers do when they are observing. This programme was coordinated and led by Ms Thembela Mantungwa and our retired colleague Mr Cedric Jacobs. At both telescopes, they received a wonderful welcome that encouraged them to ask a lot of

questions about astronomy, space travel, the possibility of asteroids hitting Earth, extra-terrestrial life, etc. SALT astronomers were able to show a supernova observation, which made the children even more curious. At the 1.9-m telescope, the group watched in fascination how the telescope was set up, and proceeded to the control room for further discussions.

The **20th anniversary celebrations of SALT** were held on 8 – 10 November. The public event was preceded by a stargazing session at the Roggeveld and Sutherland High school and members of the public in Sutherland were offered free special tours of SALT. A total of 640 members of the public of all ages participated in the day activities, while 210 members of the public joined the stargazing in the evening. Through SALT sponsorship, a trauma room was opened at the Sutherland Police station, and efforts are ongoing through collaboration with various stakeholders to ensure that the region also has its own safe house to cater for victims of gender based violence and for children abused in Sutherland and neighbouring towns. SALT also sponsored the purchase of books and equipment for the Sutherland local library. Before the official celebrations on 10 November, the Deputy Minister of Science, Technology and Innovation, Dr Nomangulelo Gina, was taken to the primary school to see the art works that were submitted by the learners on 8 November. She also visited the Community Development Centre and the trauma unit.

THE SUTHERLAND COMMUNITY DEVELOPMENT CENTRE AND SOCIAL INTERVENTIONS

Thanks to sponsorship by the DSTI and the technical support by the SAAO IT team, new computers for the community centre were purchased and the old ones were replaced and the internet signal and access was improved.

A Community Drive project was held on 29 – 30 May. A large number of generous donations had been collected since February to support vulnerable members of the Sutherland community, which included the Johenco Old Age Home, Roggeveld Primary and Sutherland High schools, the Safe Room, and a distressed community member who tragically lost her home in a fire. Donations included mainly clothing and toys. Thanks to Anthea Oliphant's coordination and commitment, the reach of this drive was far and wide, touching many lives across the community.

SCBP partnered with the local soup kitchen in Sutherland to feed the broader community who came to collect donations. The SAAO sponsored the ingredients while the team from the soup kitchen assisted with the distribution of the delicious soup which they made. We were fortunate to be able to offer seconds and in some instances a third helping of the soup to the hungry.

RETIREMENT OF CEDRIC JACOBS – A TRUE CHAMPION OF OUTREACH

For over four decades, Mr Cedric Jacobs has been more than just an education assistant officer — he has been an inspiration to thousands of learners, educators, and members of the public. The usually quiet, behind-the-scenes Cedric transforms the moment he stands before a group of eager students or curious visitors at the SAAO. His enthusiasm is infectious, his knowledge immense, and his ability to make complex astronomical concepts exciting and accessible is truly remarkable. Whether presenting on planets, the solar system, or demonstrative telescope and binocular workshops, Cedric does not just teach or present, he ignites curiosity. Cedric is at his best when guiding young and seasoned visitors alike through the Observatory, turning every tour into an unforgettable experience. With his signature humour and storytelling, he has the rare ability to bring science to life, making every encounter with him both educational and entertaining. He has also played an important role in mentoring emerging science communicators by helping to train SCBP interns, particularly in the use of the inflatable planetarium, an outreach tool that brings the night sky to life for audiences.

In February, Cedric retired — officially, but he keeps coming back and has remained actively involved in several initiatives, including the Roggeveld Primary School community engagement, the SALT 20 public event in Sutherland, and the World of Work Exhibition at Gqeberha. The SAAO and SALT community is deeply grateful for his dedication and for the generosity with which he continues to give back to astronomy. His story is a reminder that while retirement may mark the end of a formal career, a commitment to sharing the wonder of the universe can last a lifetime.

WORD OF GRATITUDE AND ACKNOWLEDGEMENT

Mr Sivuyile Manxoyi (Head of SCBP) wishes to thank all SCBP staff for their willingness to go the extra mile to deliver public engagement and socio-economic programmes. We would like to also acknowledge all the material and financial support that we receive from the SAAO Managing Director, Ros Skelton, her management team and SAAO/SALT staff. Thanks to Prof. Brian Chaboyer and the SALT Board for all the support. Astronomy is not only about looking up but also lifting others up. It is not only about the stars but also people. Thank you.

SCBP HIGHLIGHT: SALT 20 CELEBRATIONS

The outreach activities for the SALT 20th anniversary were centred on October and November 2025, focusing on both the Cape Town and Sutherland communities.

Cape Town activities

The celebrations in Cape Town on 25 October served as the kickoff for the public engagement programme. The guided Celebrational Day Tours, hosted by SAAO, were free and explored the history and science of SALT, offering the public a behind-the-scenes look at the observatory's operations. The SALT 20 Open Night was a special edition of the regular Open Night and featured a presentation by Dr Gourab Giri from the University of Pretoria on "Cosmic Fountains". The session concluded with stargazing through the historic McClean telescope and other, smaller instruments.

Sutherland town events

A large-scale public event was held on 8 November at Roggeveld Intermediate School from 9am to 2pm to bring the celebrations to the local community. Learners and community members gathered with representatives of DSTI, SAAO and SALT to mark two decades of scientific achievement and community partnership.

The official activities started at 10am with welcome speeches by the dignitaries. Anthony Mietas, Executive Mayor of the Karoo Hoogland municipality, talked about how Sutherland's economy and society have been reshaped since SALT's inauguration in 2005. Though there had been telescopes in the area before, one of the strategic objectives of SALT said that there should be tangible benefits to society, leading to a significant growth in tourism. As a result, there are now 74 guesthouses in Sutherland, employing nearly 500 people. In addition, with the help of the SCBP, which focuses on education and skills development, the town has produced engineers, operators, entrepreneurs and teachers, and — hopefully — one day there will be a local astronomer working at SALT.

Takalani Nemaungani, Chief Director for Astronomy at the DSTI, called this a proud moment for South African science, referring to a collaboration that involves both the international partners, who form part of the SALT community, and the people of Sutherland, who host this facility. The SALT Board Chair Brian Chaboyer talked next, explaining that SALT's future is one of renewal and collaboration. SALT's diversity of expertise, based on having eight stakeholders across five countries and four continents, means that everyone brings different perspectives, but all share one vision: to keep SALT a world-class observatory. The final orator, SAAO's Managing Director Rosalind Skelton, also remarked on the collaboration with the community.

In the spirit of DSTI's mantra of placing science at the centre of government, education, industry and society, the day's programme was designed to bring science closer to the people. Learners participated in art and model-building competitions inspired by the telescope. There were interactive science exhibits and two large inflatable planetaria for which learners had to queue. Children participated in sporting games, face painting and jumping castles. During the day, there were local performances including a choir, and near the end prize-giving ceremonies were led by school principals. Key milestones included the formal handover of a book donation to the local library and the announcement of the refurbished trauma room at the Sutherland police station.

Sutherland plateau Open Night

In the evening, the festivities moved to the observatory site for a public access event. Held between 20:30 and 23:30, this event offered 105 guests the opportunity to tour the SALT facility at night and stargaze using the site's telescopes. This was a rare opportunity for the public to experience the Sutherland night sky from the plateau itself, which is typically a restricted research area at night.

OUTREACH & EDUCATION

SALT PARTNER OUTREACH PROGRAMMES

Dartmouth
student visit

Dartmouth College partnered with SAAO and the UCT astronomy department to continue their off-campus astronomy programme. A group of 16 undergraduates, two PhD students and three faculty members spent 10 weeks in South Africa, from early January to mid-March. During their time in South Africa, students learned about observational astronomy and were introduced to research methods and current astronomical research in South Africa. Classes were held in the mornings at both SAAO and UCT during the first five weeks of the programme. The students really enjoyed their tours of the SAAO Cape Town facilities, along with attending morning tea. Several UCT and SAAO astronomers gave invited talks to the students, describing their research. During their visit, the students also participated in outreach programmes to local schools, working with the SAAO public outreach group. A highlight of the programme was a two-week observing run using the SAAO telescopes in Sutherland (1.9m, 1.0m and Lesedi). Each student was able to spend a week in Sutherland, taking observations of CVs, RR Lyrae stars and exoplanet transits. The students had a chance to tour SALT during the day and observed SALT night-time observations. The last few weeks were spent in Cape Town, where the students analysed the data they obtained at Sutherland, as well as SALT/RSS spectra of low-mass galaxies.

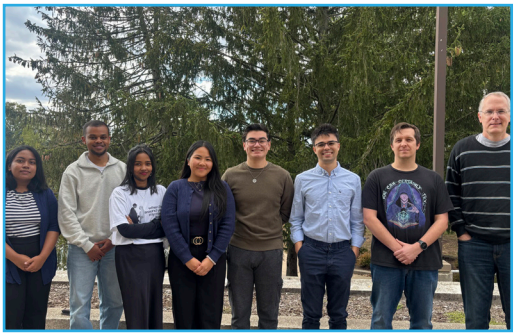
SALT scholarships and visits programme

The SALT scholarship programme supports research visits for students, postdoctoral fellows and early career researchers from South Africa to spend time at SALT partner institutes. The Call for Applications usually ends in March, and visits take place later in the year, usually between October and December. In 2025, one postdoc and two PhD students participated in the programme.

Nikita Rawat, a Postdoc at SAAO, visited IUCAA. She enjoyed the calm and welcoming atmosphere that makes collaboration especially enjoyable and productive. She primarily worked with Anupam Bhardwaj and his team on the reduction and analysis of SALT/HRS data of Cepheids and RR Lyrae stars with the aim to trace the chemical evolution of the Milky Way and to study stellar populations. In addition, she worked on a cataclysmic variable system, where they have likely identified the first eclipsing dwarf nova with a very long orbital period, showing signatures consistent with disc wind accretion. Nikita also attended an international conference on stellar variability, which provided valuable insights into ongoing global efforts addressing the Hubble Tension.

PhD student Craig Smith from UWC undertook a month-long research visit to Rutgers to work with one of his co-supervisors, Andrew Baker. He enjoyed collaborating and exchanging ideas with researchers at different career stages, who provided invaluable insights into academic and professional development. His doctoral project makes use of the LADUMA MeerKAT survey and probes low surface brightness HI in individual galaxies. Detecting this diffuse HI gas is strongly dependent on accurately characterising galaxy kinematics, requiring robust measurements of their rotation curves. In addition to the HI data, Craig used SALT spectroscopic observations to obtain optical rotation curves for several LADUMA galaxies. During his visit, Craig also initiated an investigation into newly generated machine-learning-based photometric redshifts from the Dark Energy Camera Legacy Survey (DECaLS), evaluating their potential incorporation into the group-finding algorithm being developed for LADUMA.

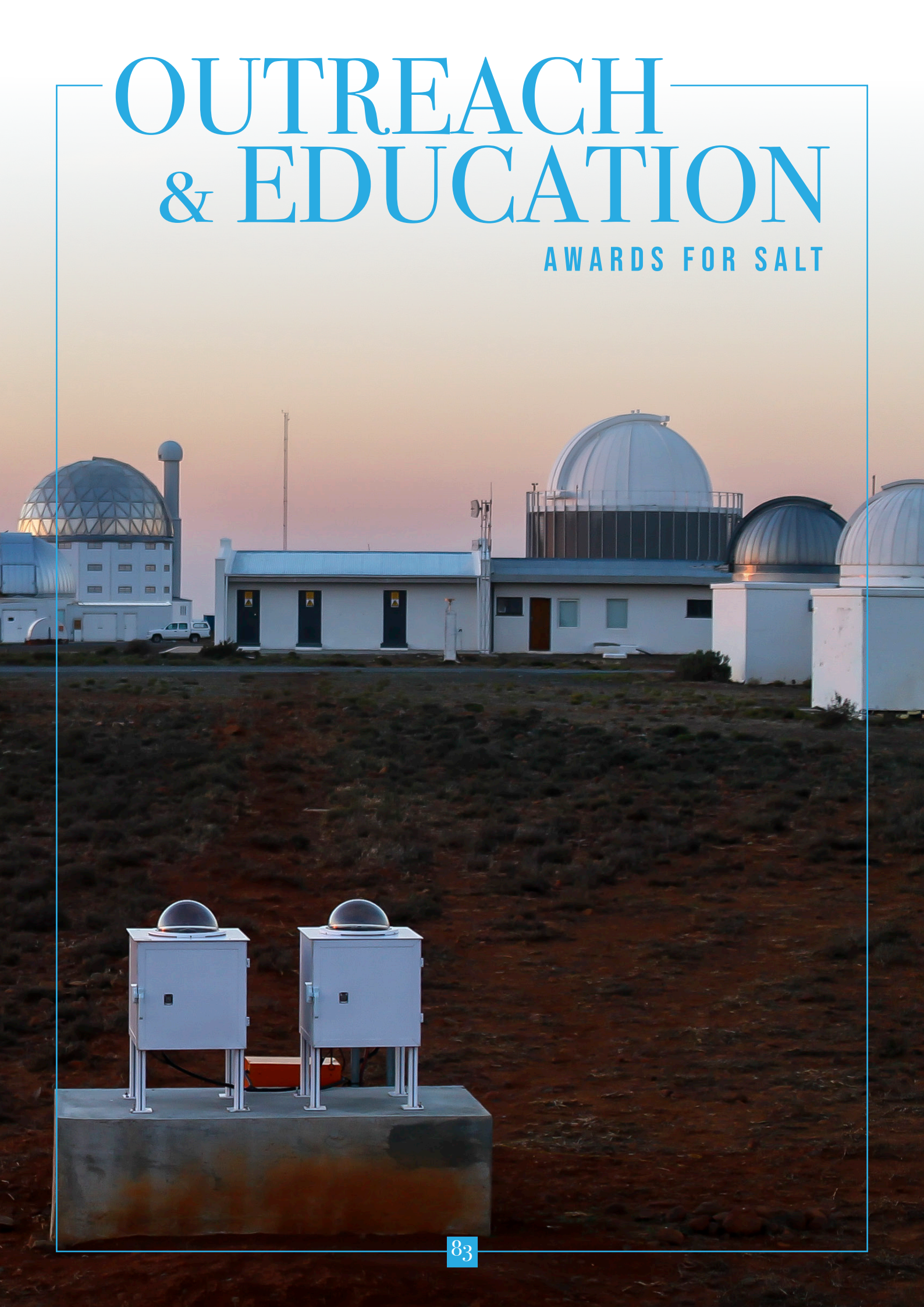
Mika Naidoo, a PhD student at Wits University, also visited Rutgers, an experience that helped both in advancing her PhD research and in building meaningful professional connections for the future. She finally met in person with her supervisor Andrew Baker after being limited to online interaction. Working together face-to-face allowed them to address several issues that had been overlooked and to make significant progress toward the completion of their paper. Mika also gave an overview of her project at the Rutgers journal club, and, since the audience was mostly not radio specialists, obtained feedback from a different perspective which strengthened both her communication skills and put her research into a different perspective. Attending the regular journal clubs and seminars presented by Rutgers graduate students and visiting researchers, helped her to understand the importance of multiwavelength approaches in astrophysics. Mika found that learning about different research cultures and traditions and to engage with students from diverse backgrounds, had been a memorable and enriching aspect of her visit.



Craig (second from left) and Mika (third from left) with Andrew Baker (far right) and the Rutgers team.

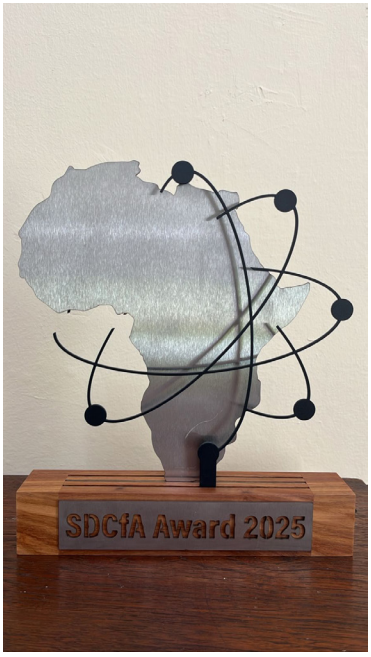
OUTREACH & EDUCATION

AWARDS FOR SALT



Science Diplomacy Award

SALT has added another wonderful milestone to its long list of achievements, receiving a prestigious Science Diplomacy Award at the closing ceremony of the 2025 Science Forum South Africa (SFSA), held from 24 – 28 November at the CSIR International Convention Centre in Pretoria. The SFSA Science Diplomacy Awards celebrate individuals, organisations and institutions demonstrating outstanding commitment to advancing science diplomacy — those whose work contributes meaningfully to the intersection of scientific research, international cooperation and partnerships, policy development, evidence-based decision-making, and diplomacy with a footprint in the regional and global science community.



As the largest single optical telescope in the southern hemisphere — and one of the largest in the world — SALT was recognised in the category of International STI Partnership Achieving Excellence in Global Science. SALT is supported by eight shareholder partners, including universities, science organisations, and funding agencies across four continents and a powerful symbol of what international collaboration can achieve. Beyond its scientific achievements, SALT has also made a lasting impact through education, skills development, and outreach. Through the SALT Collateral Benefits Programme, teacher training initiatives, student workshops, and exchange programmes, the telescope has helped inspire a new generation of scientists, engineers, and data specialists across the continent.

Receiving the award, Rosalind Skelton, SALT Board Member and Managing Director of SAAO, described SALT as a catalyst for South Africa's leadership in astronomy and a shining example of the power of international scientific partnership. The project's success also played a role in securing South Africa's position as host of the SKA-Mid telescope, further strengthening the country's standing in global big-science initiatives. This recognition is not only a celebration of an extraordinary telescope, but of the many people, institutions, and nations who have worked together to turn a bold idea in the Karoo into a world-class scientific landmark.

Tripadvisor Travellers' Choice Award'

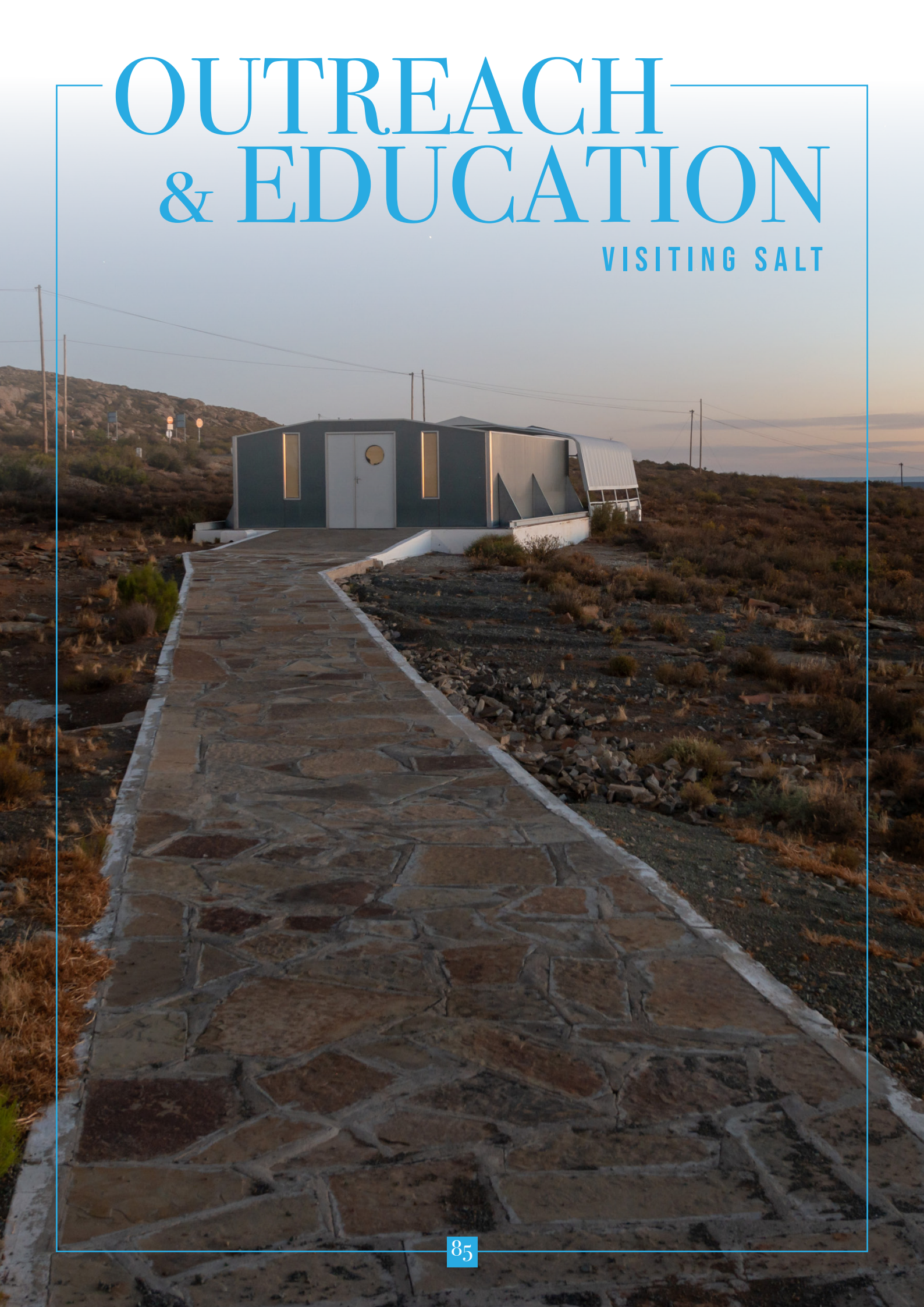
As a result of SALT's continued outreach and visitor engagement activities through the SCBP, SALT has been awarded the Tripadvisor Travellers' Choice Award for 2025, placing it among the top 10% of tourist attractions worldwide listed on the platform.

The Travellers' Choice Awards (formerly the Certificate of Excellence) recognise destinations that consistently deliver excellent visitor experiences, based on reviews and ratings from travellers. The award reflects the growing success of astro-tourism in Sutherland, where visitors can experience one of the world's leading optical telescopes while learning about the science and people behind modern astronomy.

This recognition also reinforces the importance of the SCBP's ongoing outreach and tourism initiatives. High-profile visits, such as the recent Parliamentary Portfolio Committee visit to the Sutherland site, highlight how facilities like SALT contribute not only to world-class research but also to tourism, science engagement, and regional economic development in the Northern Cape. Through these efforts, SALT continues to demonstrate the broader societal value of South Africa's investment in astronomy.

OUTREACH & EDUCATION

VISITING SALT



DELEGATIONS AND OFFICIAL VISITS

In 2025, the following parties visited SALT.

22 January: HRH The Princess Royal

Her Royal Highness Princess Anne, Princess Royal and President of the Commonwealth War Graves Commission (CWGC)
Dr Rosalind Skelton, Managing Director, SAAO
Prof. Stephen Potter, Head of Astronomy, SAAO
Members of NRF and DSTI

Princess Anne visited South Africa to unveil the new Cape Town Labour Corps Memorial during a ceremony honouring over 1700 South African WWI labourers. As part of her South African tour, she included a visit to SAAO, which served as a high-profile recognition of South Africa's leadership in global astronomy, with a specific focus on the operational and historical link between Cape Town and SALT. She was warmly received by SAAO's Managing Director and the Head of Astronomy and introduced to key stakeholders, including representatives from the NRF and DSTI. While the visit took place at the Cape Town headquarters, SALT was the 'scientific centrepiece' of the discussions. The Princess spent significant time in the remote operations room, where she was given a practical demonstration of how SALT — located 370 km away in Sutherland — is operated in real-time from Cape Town. The tour included a visit to the library, the McClean telescope and the Indigenous Astronomy and Heliostat exhibits at the visitor centre.

Princess Anne moves SALT remotely with one mouse click.

This visit reinforced the 'Science Diplomacy' aspect of SALT. By hosting the Princess Royal, the SAAO highlighted the enduring scientific partnership between South Africa and the United Kingdom (one of the original SALT partners through various UK universities). It underscored that SALT is a globally connected facility managed by a world-class team in Cape Town.

30 – 31 January: NRF Board, Corporate Executive, and DSTI

NRF Board members, led by Prof Mosa Moshabela (Chair)
NRF Corporate Executive members, led by Dr Fulufhelo Nelwamondo (CEO)
DSTI members, led by Mr Takalani Nemaungani (DSTI)
International partners from NASA, Osaka University, and the Astrobiology Centre of Japan
SAAO members, led by Ros Skelton (SAAO Managing Director)
SALT members, led by Brian Chaboyer (SALT Chair)

NRF Board and CorpEx members visited Sutherland to celebrate the official opening of the PRIME telescope on 31 January. As the anchor facility of the Sutherland plateau, SALT's role was highlighted as the benchmark for the success of South Africa's hosted telescope model. The inauguration programme included a tour of the plateau and of the community centre, with some wonderful star gazing ahead of the event. Everyone visited SALT at some point — some of them twice, during the day for a technical tour and night-time for observing.

SALT was presented not just as a standalone instrument, but as the core of a 'multi-messenger ecosystem'. The NRF board was briefed on how SALT (optical) and the new PRIME telescope (near-infrared) will work in tandem on transient and exoplanet discoveries, where SALT provides detailed follow-up observations on PRIME's discoveries. Prof. Moshabela focused on SALT as the NRF's most successful international partnership, serving as the blueprint for how South Africa hosts and manages international facilities. A key part of the visit was meeting the SALT Tech Ops team. The visit highlighted how the expertise developed through SALT's maintenance and instrument upgrades is being used to support the broader array of telescopes on the plateau. The Board also engaged with SALT-funded PhD and MSc students, emphasising that "behind every discovery is a person whose growth tells a parallel story of progress". The NRF Board reaffirmed its commitment to the South African National Multiwavelength Strategy, with SALT as the optical cornerstone, noting the scientific productivity of SALT as a justification for continued long-term investment in its upcoming instrumentation suite.

23 – 25 February: Parliamentary Portfolio Committee

Parliamentary Portfolio Committee (PPC), led by Ms Tsakani Goodness Shiviti (Chairperson)
Members of the DSTI, NRF Corp Ex, and SAAO

The PPC on Science, Technology, and Innovation conducted a high-level oversight visit to the Northern Cape from 24 – 28 February 2025. This visit focused on evaluating the country's world-class radio and optical astronomy infrastructure (that is, SARAO at Carnarvon and SAAO at Sutherland) and its socio-economic impact on local communities. The purpose of their tour was to evaluate the operational status and scientific output of SALT and MeerKAT, to understand the challenges and successes in diversifying the astronomy sector, to

monitor the early stages of the National Astro-Tourism Strategy following its Cabinet approval, and to ensure that high-level scientific investment translates into tangible benefits for rural towns like Sutherland and Carnarvon.

The Sutherland visit focused on the legacy and future of SALT. The committee followed a presentation on the Multiwavelength Astronomy Strategy, toured SALT and other telescopes, then visited the Sutherland community centre to interact with SAAO/SALT beneficiaries and stakeholders. After dinner there was a night-tour of SALT and a star gazing session. One of the recommendations resulting from this visit is the urgent need for continued government support to protect dark skies and radio silence against encroaching industrial activities and to ensure that high-speed fibre links used for astronomy also provide spillover benefits for local community schools and clinics.

9 July: Ministers and DSTI

Prof. Blade Nzimande, Minister of Science, Technology and Innovation
Ms. Patricia de Lille, Minister of Tourism
Dr. Nomalungelo Gina, Deputy Minister of DSTI
Dr. Fulufhelo Nelwamondo, NRF CEO
Key stakeholders from the Parliamentary Portfolio Committee (PPC)

The Budget Vote event on 9 July was a landmark day for SAAO and SALT, marking the official launch of two major infrastructure projects in Cape Town that bridge the gap between high-tech research and public engagement: The Remote Operations Centre (ROC) and the Visitor Centre (VC). The ROC allows astronomers and technicians to monitor and control telescopes and instruments located in Sutherland directly from the Cape Town campus. By reducing the need for constant travel to the Karoo, the ROC improves operational efficiency, lowers logistical costs, and provides a collaborative space for researchers to analyse real-time data in a central hub. Minister Nzimande highlighted that this facility enhances South Africa's global competitiveness in optical astronomy by modernising how we interact with large-scale infrastructure. The VC was unveiled as a flagship project of the National Astro-Tourism Strategy which, together with the historic McClean telescope and SAAO's status as a National Heritage Site, forms a modern tourist attraction.

The event began with a live demonstration of the ROC, hosted by Stephen Potter and Encarni Romero Colmenero, linking Cape Town to Sutherland in real time — a compelling reminder of how far accessibility in astronomy has come. The visitors were also invited to control SALT remotely. SAAO Managing Director Dr Rosalind Skelton noted in her address that these facilities are the culmination of a long-term vision. For the SALT community, the ROC specifically marks a transition into a more digitally integrated era of observing, while the VC ensures that the science produced by SALT is translated into cultural and educational capital for the public.

9 – 10 November: SALT 20th anniversary guests

Dr Nomalungelo Gina, DSTI Deputy Minister
DSTI Corporate and representatives
NRF Board, Corporate and representatives
Department of Tourism representatives
Councillor Mervin Cloete, Executive Mayor of Sutherland
Prof. Mosa Moshabela,
SAAO members,
SALT Board members (including former members)
SALT partner institution members

Twenty years ago, SALT was inaugurated on 10 November by the then President of South Africa, Thabo Mbeki. Since then, SALT has stood as the largest optical telescope in the southern hemisphere and a flagship of African astronomy. Over the years, it has enabled wide-ranging scientific research, supported the training of hundreds of students and early-career researchers, and strengthened South Africa's position in the global astronomical community. Many of these achievements were reflected in the talks and discussions held during the celebration, with speakers from across the SALT partnership highlighting both scientific outcomes and the collaborative spirit that has underpinned them. The year's anniversary celebrations culminated in the official celebrations at the Sutherland site with an outreach event on 8 November, a dinner on 9 November and presentations and tours of the facility on 10 November.

SALT EXHIBITIONS AT SCIENCE MEETINGS

23 – 28 March: AfAS 2025 at UNISA, South Africa

The 5th African Astronomical Society (AfAS) Annual Conference was hosted by UNISA and took place at the Emperor's Palace, which is home to three luxurious hotels located next to O.R Tambo international airport in Johannesburg. The SALT exhibition and presence at the conference served as a vital touchpoint for the African astronomical community, reinforcing the telescope's role as a cornerstone of the continent's research infrastructure. Apart from science talks, SALT's involvement featured an exhibition booth, high-level technical training and community-focused presentations.

The workshop "SALT Proposal Tools in Action: A Practical Session" on 27 March was a highlight of the technical programme and led by Danièl Groenewald. The hands-on workshop guided researchers through the latest Phase 1 and Phase 2 proposal tools, ensuring the community is equipped to access SALT's capabilities. A community engagement presentation by SAAO Communications Officer Thembela Mantungwa was titled "Co-creating community engagement in Sutherland". The presentation highlighted the successful collaborative models used by SALT and SAAO to integrate scientific research with local community development.

The SALT Exhibition Booth was located in the heart of the Emperor's Palace exhibition hall. It acted as a central hub for the SALT 20 promotion and strategic networking. The booth served as a precursor to the 20th-anniversary celebrations in November, featuring heritage displays and updates on the telescope's recent upgrades. It also facilitated discussions between international partners, African Regional Offices of Astronomy for Development (OAD), and the next generation of African astronomers.

In conclusion, by combining technical training with social responsibility frameworks and a promotion booth, the SALT presence at AfAS 2025 demonstrated a holistic approach to large-scale facility management — emphasising that scientific excellence and community impact are mutually reinforcing.

2 – 3 April: National Astro-Tourism Stakeholder workshop at Carnarvon, South Africa

The National Astro-Tourism Stakeholder workshop, held on 2 – 3 April 2025 at Carnarvon Primary School in the Northern Province, was a pivotal step in realising the Cabinet-approved National Astro-Tourism Strategy. Its purpose was to refine the implementation plan for the National Astro-Tourism Strategy and establish a formal governance body. It is a joint effort between the DSTI and the Department of Tourism, with active participation from SAAO, SARAO and the IAU OAD.

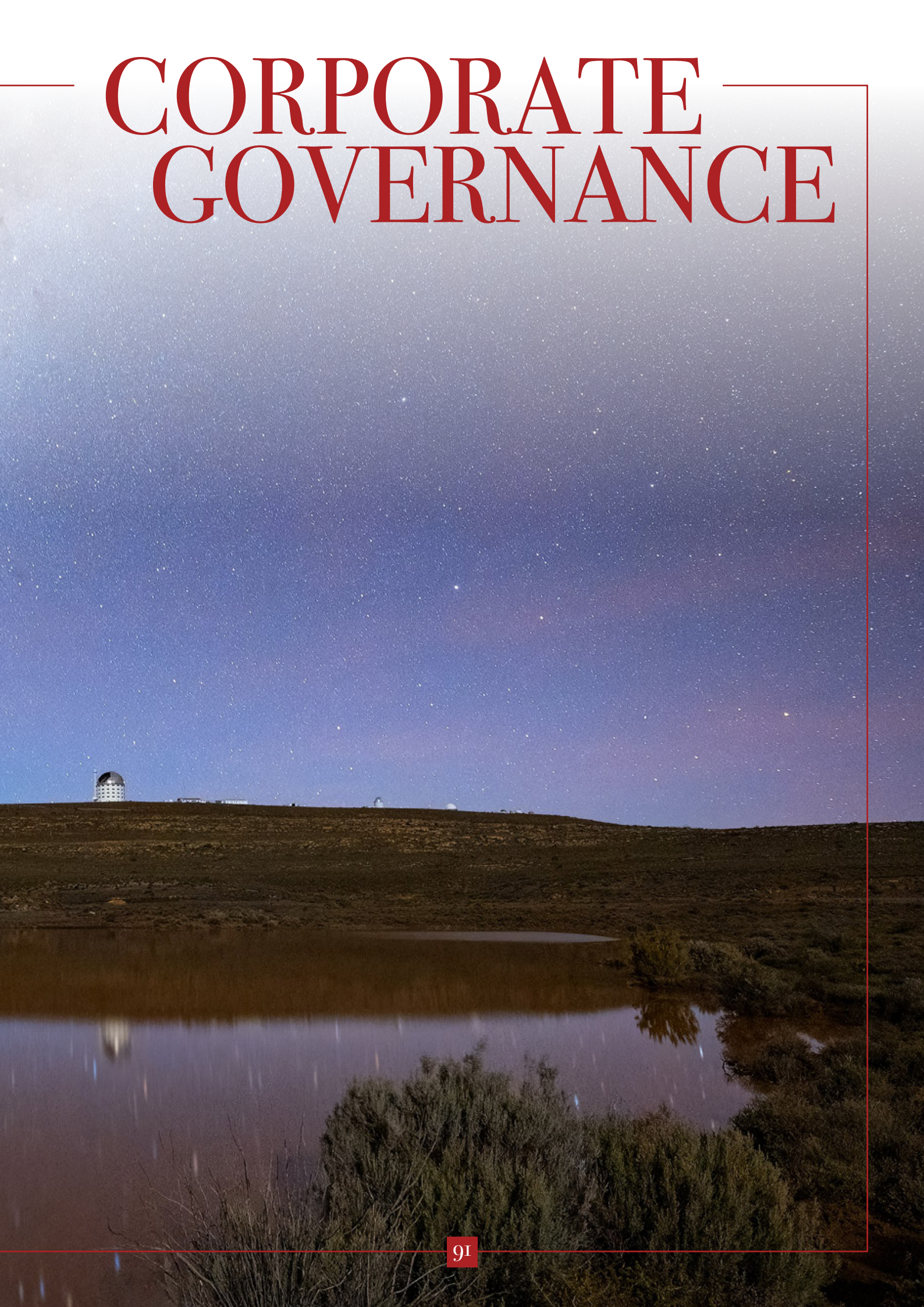
While the event was hosted near the MeerKAT and SKA site, SALT and SAAO played a crucial role as the operational 'blueprint' for the workshop's objectives. In particular, SALT's role as the Sutherland 'benchmark' was recognised, and the success of the astro-tourism model in Sutherland was used as the primary case study for what Carnarvon aims to achieve. This included:

- Knowledge transfer: SAAO representatives shared data on how SALT's presence has historically driven a tourism boom in Sutherland.
- The Carnarvon-Sutherland corridor: A major outcome of the workshop was the formalisation of the "Astro-Tourism Route". This corridor links the optical science of SALT with the radio science of MeerKAT, creating a unified narrative for domestic and international travellers.
- Infrastructure strategy: Discussions focused on replicating Sutherland's visitor infrastructure (like the recently opened visitor centre) in Carnarvon. This includes the planned R62 million SKA Science Tourism visitor centre.

The workshop emphasised that astro-tourism must be community-led rather than just facility-led. Here, the SALT/SAAO team contributed to discussions on training local guides. The workshop highlighted the success of the Carnarvon Astro Guides, who combine modern scientific facts from SALT and MeerKAT with indigenous Khoi-San celestial narratives. In addition, a dedicated commission (including SAAO technical staff) addressed the Astronomy Geographic Advantage (AGA) Act. They discussed how to fast-track 'Dark Sky Certifications' for the corridor to prevent light pollution from encroaching on SALT's scientific sensitivity.

The second day was broken into three strategic focus areas on infrastructure development (that is, stargazing platforms at lodges and road signage for the Astro-Route), human capital development with specialised training for Astro-Guides and hospitality staff, and indigenous Astronomy with the incorporation of storytelling and local heritage into the professional tourism offering.

CORPORATE GOVERNANCE



The affairs of the SALT Foundation are regulated by the Shareholders' Agreement, signed at the formation of the Company. In terms of this agreement, the Company is controlled by a Board of Directors comprising two members from the National Research Foundation, one member from each of the remaining partner institutions and two additional members. The Directors are elected at the Annual General Meeting of the Company and serve for a period of three years, following which they may be re-elected. All Board members are independent, Non-Executive Directors.

In this reporting period, the Board comprised of the following members:

Prof. Brian Chaboyer (Chair)
Dartmouth College, USA

Dr. Sharmila Goedhart (Resigned March 2025)
South African Radio Astronomy Observatory, South Africa

Prof. Krzysztof Hełminiak
Nicolaus Copernicus Astronomical Centre, Poland

Prof. John P. Hughes
Rutgers University, USA

Dr. Itumeleng Monageng
University of Cape Town, South Africa

Dr. Angus Paterson
National Research Foundation, South Africa

Prof. Marc Sarzi (Appointed January 2025)
United Kingdom SALT Consortium, UK

Prof. Michael Shara
American Museum of Natural History, USA

Dr. Rosalind Skelton
South African Astronomy Observatory, South Africa
National Research Foundation, South Africa

Prof. Raghunathan Srianand
Inter–University Centre for Astronomy & Astrophysics, India

Dr. Sheona Urquhart (Resigned December 2024)
United Kingdom SALT Consortium, UK

Prof. Eric Wilcots
University of Wisconsin–Madison, USA

Other officers of the Company include Mrs Lizette Labuschagne (Chief Financial Officer, Company Secretary and Business Manager).

The Board meets twice a year, usually in May and November. The SAAO Director and senior staff involved in the operation of the telescope also attend the Board meetings.

SALT Director 2025

Encarni Romero Colmenero

SALT Observatory Scientist 2025

Lisa Crause

Technical Operations Team 2025

Willem van der Westhuizen (Acting Head)

Shamiel Adams
Willa de Water
Denville Gibbons
Johan Hendricks
Nicolaas Jacobs
Anita Jonker*
Sunnyboy Kabini
Anthony Koeslag
Thabelo Makananise
Devakshan Naicker
Tasheen Naicker
Sam Ndumo
Jonathan Pieterse
Michael Sam
Etienne Simon
Chrey Sookha
Nicolaas van der Merwe
Eben Wiid

Astronomy Operations Team 2025

Danièl Groenewald
(Acting Head until July 2025, Head since August 2025)

Phelokazi Dube*
Christian Hettlage
Daniel Holdsworth*
Alexei Kniazev
Enrico Kotze*
Rudi Kuhn
Austun Louw
Nhlavutelo Macebele
Antoine Mahoro
Moses Mogotsi
Nomzamo Mokoena
Anja Schröder*
Lee Townsend
Veronica van Wyk

Corporate Governance Team 2025

Lizette Labuschagne
Adel Wimmers*

Operations contract

SALT is operated on behalf of the SALT Foundation by SAAO and managed by the SALT Director, Dr Encarni Romero Colmenero. The majority of the staff who carry out the day-to-day operational activities are SAAO employees. Engineering operations are managed by Acting SALT Technical Operations Manager, Mr Willem van der Westhuizen, while Dr Danièl Groenewald is the Head of the Astronomy Operations team. The operations plan and budget are presented by the SALT Director at the November Board meeting for the following financial year.

The Board Executive Committee (BEC)

The Board has delegated authority to the Board Executive Committee (BEC) to manage the Company during the period between Board meetings. The BEC meets once or twice between Board meetings and receives reports on the operations and development of the telescope from the SALT Director and other senior staff with the relevant responsibilities. The BEC comprises four Board members. In this reporting period, they were: Prof. Brian Chaboyer (Chair), Prof. Jack Hughes, Prof. Raghunathan Srianand and Dr Angus Paterson.

The Finance and Audit Committee (FAC)

Although the full Board takes responsibility for the Annual Financial Statements of the Company, the Board has appointed a Finance and Audit Committee (FAC) to interrogate the management of the financial affairs of the Company at a detailed level. This committee meets at least twice a year, shortly before Board meetings, and presents a report at the Board meeting. In this reporting period, the members of the FAC were: Prof. Jack Hughes (Chair), Dr Rosalind Skelton, Prof. Eric Wilcots, Mrs Kate Soule and Prof. Brian Chaboyer (ex officio).

Scientific and Technical Committee (STC)

The Scientific and Technical Committee (STC) was established in November 2018, as per recommendations arising from the SALT External Review. The fundamental purpose of this committee is to improve all levels of technical and scientific communication within the SALT collaboration, with the explicit goal of increasing the scientific productivity of the telescope. The SALT Observatory Scientist is a member of the committee. The STC reports to the SALT Board via the chair of the committee. In this reporting period, the members were: Prof. Krzysztof Hełminiak (Chair), Dr Lisa Crause, Prof. Paul Groot, Mr John Booth, Prof. Joanna Mikołajewska, Dr David Buckley and Dr Encarni Romero Colmenero.

*part-time and/or part of the year

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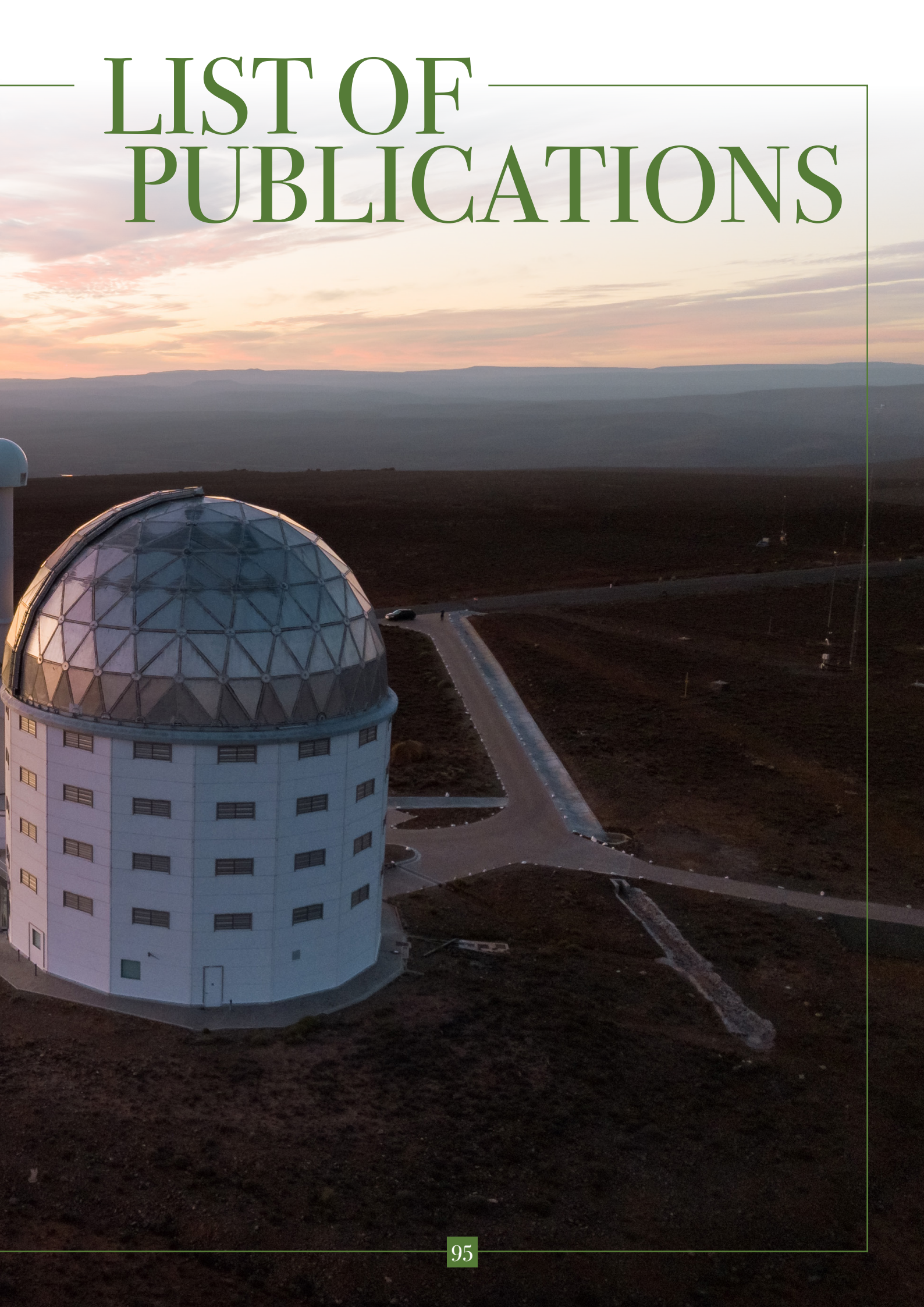

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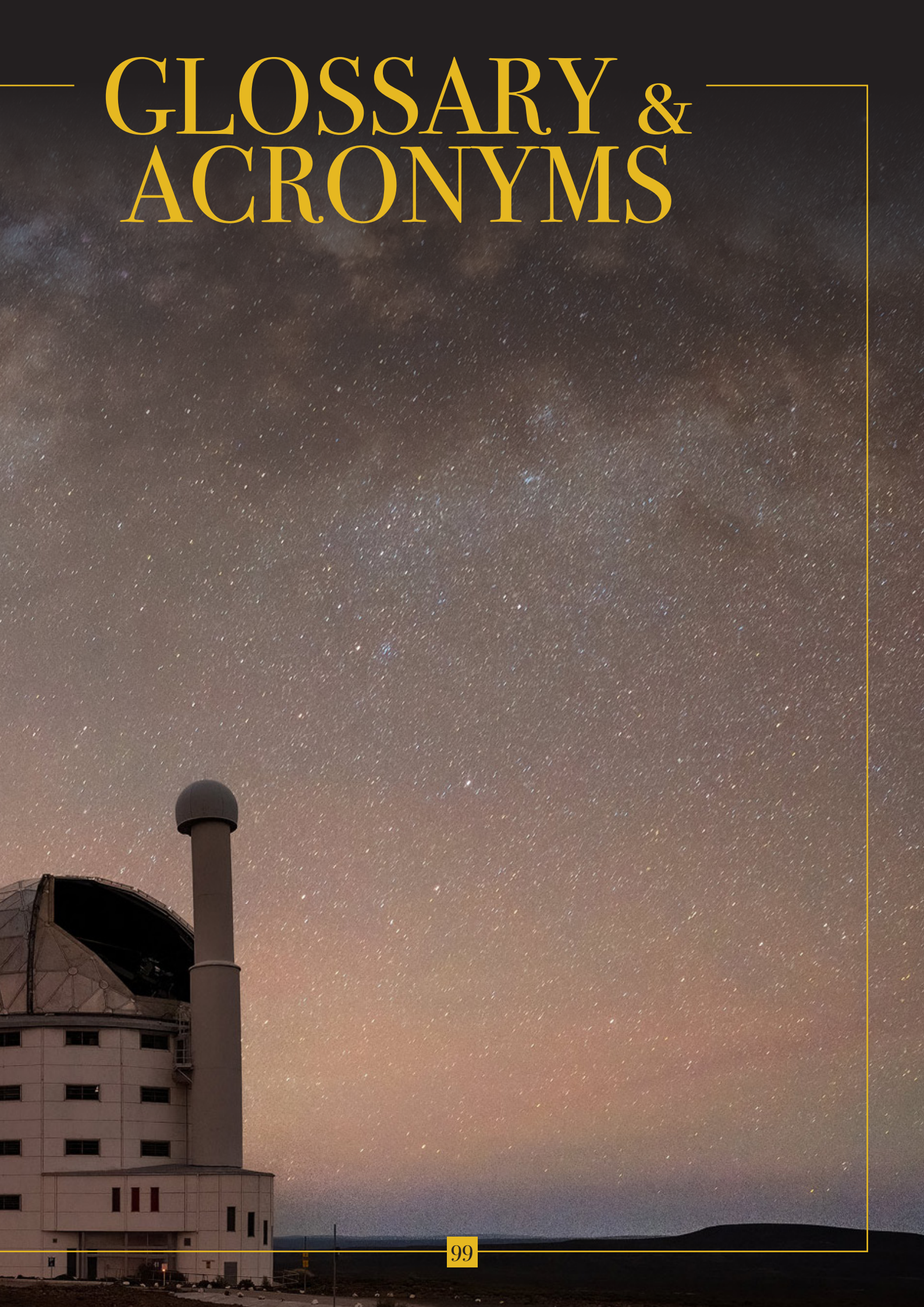

1D, 2D, 3D	one, two, three dimensional
3CRR	Third Cambridge catalogue of radio sources
ADC	atmospheric dispersion compensator
AdvACT	Advanced Atacama Cosmology Telescope
AEONlib	a suite of modules to enable time-domain and multi-messenger observations
AfAS	African Astronomical Society
AGA	the Astronomy Geographic Advantage Act
AGB	asymptotic giant branch
AGN	active galactic nucleus
AMNH	American Museum of Natural History
AMU	Adam Mickiewicz University
AOP	Armagh Observatory & Planetarium
API	application programming interface
Ariel	Atmospheric Remote-sensing Infrared Exoplanet Large survey
ART-XC	Mikhail Pavlinsky Astronomical Roentgen Telescope X-ray Concentrator
ASKAP	Australian Square Kilometre Array Pathfinder
AT	astronomical transient (object name prefix)
ATLAS	Asteroid Terrestrial-impact Last Alert System
BCAM	backup acquisition camera
BCG	brightest cluster galaxies
BEAMS	Brightest cluster galaxy Evolution with ACT, MeerKAT, and SALT
BEC	board executive committee
BFF	Bowen fluorescence flares
BH	black hole
BRICS	Brazil, Russia, India, China, and South Africa
BRITE	BRIght-star Target Explorer
CAMK	Nicolaus Copernicus Astronomical Center
CCAS	centre of curvature alignment system
CCD	charge-coupled device
CDM	cold dark matter
CEO	chief executive officer
COM	SALT commissioning proposal
COVID-19	coronavirus disease 2019
CTA	Cherenkov Telescope Array
CTS	Calan Tololo Survey
CV	cataclysmic variable star
CWGC	Commonwealth War Graves Commission
DC	Dartmouth College
DDT	director's discretionary time
DECam	Dark Energy Camera
DECaLS	DECam legacy survey
DSTI	Department of Science, Technology and Innovation
DUT	Durban University of Technology
EHB	extended horizontal branch
ELT	Extremely Large Telescope
EP	Einstein Probe (X-ray satellite)
eROSITA	extended ROentgen Survey with an Imaging Telescope Array
ESA	European Space Agency
ESO	European Southern Observatories
EW	equivalent width
FAC	finance and audit committee
FITS	flexible image transport system
FORS2	Focal Reducing / Low Resolution Spectrograph 2
FRB	fast radio burst
FSF	full-spectrum fitting
G4Jy	GLEAM 4-Jy survey
GATS	Global Astrophysical Telescope System
GLEAM	GaLactic and Extragalactic All-sky Murchison Widefield Array survey
GOTO	Gravitational-wave Optical Transient Observer
GRB	gamma-ray burst
GTC	Gran Telescopio Canarias
GU	Göttingen University
GUI	graphical user interface
GW	gravitational wave (object name prefix)
GWE	SALT gravitational wave proposal
H2RG	HAWAII–2RG detector
HD	Henry Draper catalogue
HE	Hamburg–ESO survey
H.E.S.S.	High Energy Stereoscopic System
HET	Hobby–Eberly Telescope
HETDEX	HET Dark Energy eXperiment
HIPASS	HI Parkes All-Sky Survey
HMXB	high-mass X-ray binary
HR	high resolution
HRH	Her Royal Highness
HRS	high-resolution spectrograph
HS	high-stability
HST	Hubble Space Telescope
HWU	Heriot-Watt University
IAO	Institute Astronomical Observatory
IAU	International Astronomical Union
IFS	integral field spectrograph
IFU	integral field unit
IRAS	Infrared Astronomical Satellite
ISDEC	IUCAA SIDECAR Drive Electronics Controller
ISI	international scientific indexing
IT	information technology
IUCAA	Inter–University Centre for Astronomy & Astrophysics
JWST	James Webb Space Telescope
KAGRA	Kamioka Gravitational Wave Detector
KAT	Karoo Array Telescope
KHM	Karoo Hoogland Municipality
KPI	key performance indicator
LADUMA	Looking At the Distant Universe with the MeerKAT Array
LBT	Large Binocular Telescope
LBV	luminous blue variable
LFC	Laser Frequency Comb
LIGO	Laser Interferometer Gravitational wave Observatory
LIRG	luminous infrared galaxy
LMC	Large Magellanic Cloud
LOFAR	LOw Frequency ARray
LR	low resolution
LSP	SALT large science programme
LSST	Legacy Survey of Space and Time
LVK	LIGO/Virgo/KAGRA observing runs
MDM	Michigan–Dartmouth–MIT Observatory
MIDAS	Munich Image Data Analysis System
MIKE	Magellan Inamori Kyocera Echelle spectrograph
MLT	SALT multi-semester proposal

MMADS	MultiMessenger Astronomy DECam Survey
MOS	multi-object spectrograph
MR	medium resolution
MSc	master of science
NASA	National Aeronautics and Space Administration
NASSP	National Astrophysics and Space Science Programme
NCAC	Nicolaus Copernicus Astronomical Center
NERSA	National Energy Regulator of South Africa
NGC	New General Catalog
NIR	near-infrared
NIRWALS	Near InfraRed Washburn Astronomical Labs Spectrograph
NOVA	Nederlandse Onderzoekschool Voor Astronomie (Netherlands Research School for Astronomy)
NRF	National Research Foundation
NuSTAR	Nuclear Spectroscopic Telescope ARray
NWU	North–West University
NYS	National Youth Service
OAD	Office of Astronomy for Development
OPTICON	Optical Infrared Coordination Network for Astronomy
ORP	OPTICON/Radio-Net Pilot project proposal
P0 ... P4	priority 0 – 4
PA	position angle
PAH	polycyclic aromatic hydrocarbon molecule
PanAfroAGN-SI	Pan-African AGN survey using SALT/IFS
PAS	Polish Academy of Sciences
PhD	doctor philosophiae
PHP	general-purpose scripting language
PI	principal investigator
PIPT	Principal Investigator Proposal Tool
PLATO	PLAnetary Transits and Oscillations of stars (ESA mission)
PN	planetary nebula
POL	SALT partner Poland
PPC	Parliamentary Portfolio Committee
PRIME	Prime-focus Infrared Microlensing Experiment telescope
RINGS	RSS Imaging spectroscopy Nearby Galaxies Survey
RN	reflection nebula
ROC	remote operations centre
RSA	Republic of South Africa
RSS	Robert Stobie Spectrograph
RU	Rutgers University
RXS	ROSAT survey (object name prefix)
SA	South Africa
SAAO	South African Astronomical Observatory
SAASTA	South African Agency for Science and Technology Advancement
SAC	spherical aberration corrector
SAEON	South African Earth Observation Network
SAICA	South African Institute of Chartered Accountants
SALT	Southern African Large Telescope
SALTICAM	SALT Imaging CAMera
SANSA	South African National Space Agency
SARAO	South African Radio Astronomy Observatory
SCBP	SALT Collateral Benefits Programme
SCI	SALT science proposal
sd	subdwarf
SDSS	Sloan digital sky survey
SED	spectral energy distribution
SIDECAR	system image, digitising, enhancing, controlling, and retrieving
SKA	Square Kilometre Array
SMBH	supermassive black hole
SMC	Small Magellanic Cloud
SMI	slit mask IFU
SN	supernova
SOAR	Southern Astrophysical Research telescope
SOMMI	SALT Operator Man Machine Interface
SPHEREx	Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer
SRG	Spektrum-Röntgen-Gamma satellite
STC	scientific and technical committee
STEM	science/technology/engineering/mathematics
STI	Science, Technology and Innovation
SUGAR	SALT User Group for Astronomical Resources
SUNBIRD	SUperNovae and starBursts in the InfraReD
SuperWASP	Super Wide Angle Search for Planets
SXP	SMC X-ray pulsar (object name prefix)
TAC	time allocation committee
TCS	telescope control system
TDE	tidal disruption events
TESS	Transiting Exoplanet Survey Satellite
TICTAC	Turnkey, Inexpensive and Compact Ti:sapphire AstroComb
TMT	Thirty Meter Telescope
TOIL	time off in lieu
TOPCAT	Tool for OPerations on Catalogues And Tables
U	university
UCN	University of Canterbury
UCT	University of Cape Town
UKSC	United Kingdom SALT Consortium
UNC	University of North Carolina – Chapel Hill
UNISA	University of South Africa
UV	ultraviolet
UVES	Ultraviolet and Visual Echelle Spectrograph
UW	University of Wisconsin–Madison
UWC	University of the Western Cape
VC	visitors centre
VERITAS	Very Energetic Radiation Imaging Telescope Array System
VIS	visible
VISTA	Visible and Infrared Survey Telescope for Astronomy
VLBI	very long baseline interferometry
VLT	Very Large Telescope
VPH	volume phase holographic
WD	white dwarf
WISE	Wide-field Infrared Survey Explorer
Wits	University of the Witwatersrand
WWI	World War 1
XML	extensible markup language
XMM	XMM–Newton observatory
XRB	X-ray binary
ZTF	Zwicky Transient Facility

The SALT consortium is seeking an additional 10%-level partner (~ $11M) to support significant second-generation instrumentation development. Interested parties should contact the chair of the SALT Board of Directors, Brian Chaboyer*.

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