



Southern African Large Telescope

Africa's Giant Eye on the Sky:

Inspiring society by exploring the Universe

SALT Strategic Plan Document

(Draft - version 2)

Executive Summary

This strategy sets out the priorities for the Southern African Large Telescope (SALT) over the next 5-10 years, to ensure its continued scientific relevance, operational sustainability, and role as a flagship for African astronomy. It builds on the Board-approved framework of 2018, refined to reflect current challenges and emerging opportunities.

Four high-level goals underpin the strategy: to enable world-leading astrophysical research, to advance instrumentation and modernisation, to drive human capital development and partnerships, and to secure sustainable operational and financial support. These are aligned with South Africa's national science agenda and with international trends in large-scale astronomy.

Key recommendations focus on consolidation and renewal. The immediate priority is to address the degradation of the Spherical Aberration Corrector (SAC), without which SALT's competitiveness will be compromised. In parallel, the strategy emphasises completing high-impact projects already underway — notably the laser frequency comb on HRS, the NIRWALS detector replacement, and the upgrade of RSS — while investigating new instrumentation to sustain long-term capability.

The strategy also strengthens SALT's positioning within the global astronomy ecosystem. By leveraging its niche in time-domain astrophysics, galaxy evolution, and exoplanet science, and by deepening partnerships with other major facilities such as LSST, MeerKAT, SKA, and PLATO, SALT will remain a valued partner in the multi-messenger era.

Finally, the plan highlights the need for stable funding, modernised operations, and a deliberate focus on human capital and diversity to build resilience. These measures are intended to support SALT's continued role in producing world-class science, inspiring the next generation, and showcasing Africa's capacity to host and operate global research infrastructure.

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1. Introduction

The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere and amongst the largest in the world. It is hosted and operated by the South African Astronomical Observatory and it's located in a remote area in the Karoo desert, near a town called Sutherland, in South Africa. It has a hexagonal primary mirror array 11-m across, comprising 91 individual 1-m hexagonal mirrors. The light gathered by its huge 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 current shareholders of this company include universities and science funding agencies from South Africa, India, Europe and North America. The South African National Research Foundation (NRF) is the major shareholder with an approximately 33% stake. Other large shareholders are the University of Wisconsin-Madison, the Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences, Dartmouth College, and Rutgers University. Smaller shareholders (<10%) include the Indian Inter-University Centre for Astronomy and Astrophysics, the American Museum of Natural History, and the UK SALT Consortium, the latter currently representing only Armagh Observatory. The size of the shareholding of each partner determines the access to the telescope which they enjoy.

SALT was inaugurated in 2005 and has been in regular operations since 2011. It is fully queue-scheduled and it has a versatile suite of instrumentation, with varying resolution and wavelength coverage, including rare modes in other facilities of its size. It has excellent scientific and operations support, basic data reduction pipelines and a public data archive. SALT has been operating reliably and its current mode of operations is highly successful. However, it is also a 20 year old facility. It is clear that to retain relevance in the current scientific, financial and international context and well into the future, SALT needs to develop a suitable strategy.

In 2016, the Board adopted a basic fundamental principle:

SALT should continue operating as a general-purpose telescope for PI- driven science.

Following this strategic decision, future SALT science was actively discussed by the SALT community the following year, and the Board ratified the resulting recommendations in November 2017.

The 2017 strategy was implemented, albeit at a slower pace than anticipated. It was largely successful and most of the planned goals have already been achieved or are nearing completion.

This document represents an updated SALT strategic plan for the next 5-10 years of SALT operations.

2. SALT Vision

Africa's Giant Eye On The Sky:

Inspiring society by exploring the Universe

3. SALT Foundation Mission Statement

- Provide a world-class large telescope research facility cost-effectively to an international community of astronomers.
- Lead the advancement and development of optical astronomy on the African continent, and inspire and educate new generations of scientists and engineers worldwide.

4. Situational Analysis

This section presents a comprehensive situational analysis undertaken to inform SALT's strategic planning and future positioning. It begins with a **SWOT analysis** to identify key internal strengths and weaknesses, as well as the external opportunities and threats shaping the organisation's performance. This is followed by a **PESTEL analysis**, which examines the broader political, economic, social, technological, environmental, and legal factors that influence SALT's operating context. Finally, **Porter's Five Forces analysis** assesses the competitive landscape and the external pressures that shape SALT's position within the global astronomical community. Together, these frameworks provide an integrated understanding of SALT's strategic environment and inform the priorities set out in this strategy.

4.1. SWOT analysis summary

This summary highlights the key internal strengths and weaknesses, as well as external opportunities and threats, most relevant to SALT's strategic planning. The full analysis is provided in [Appendix D](#) for reference.

Strengths

SALT combines a powerful 10-metre-class aperture with exceptionally dark, stable skies, enabling high scientific productivity at comparatively low operational cost. Its skilled and diverse staff, queue-scheduled operations, and strong institutional support from the host, the South African Astronomical Observatory (SAAO), provide a robust operational foundation. Through the SAAO, SALT benefits from access to key technical infrastructure and expertise in precision engineering, fibre optics, detector systems, and cryogenics. These strengths allow SALT to deliver internationally competitive science while maintaining a strong socio-economic and educational presence in Sutherland and across Africa.

Weaknesses

Despite these advantages, SALT faces growing internal challenges. The facility and its instruments are aging, and throughput losses from the SAC, one of its main optical components, now threaten scientific output — the throughput is currently roughly equivalent to that of a 4m telescope and will continue to decrease until replaced. The instrument suite is no longer state-of-the-art, limiting competitiveness. Recruitment and retention remain difficult due to location, visa restrictions, and non-optimal employment

policies. Organisational systems, including HR and project management processes, require modernisation to strengthen agility and accountability.

Opportunities

SALT is well positioned to expand its impact through strategic partnerships, technological innovation, and collaborative networks. Its flagship status within South Africa's science strategy, combined with a growing emphasis on African collaboration and capacity development, provides a strong policy foundation. Emerging technologies, including AI, automation, and instrumentation co-development, present opportunities for operational efficiency, innovation, and cost-effective upgrades. In particular, co-development of fibre technology with SAAO or external partners would maintain access to specialist capabilities, support modular instrument design, and foster local expertise. SALT's low operational costs make it an attractive platform for international partnerships. Globally, SALT can strengthen its niche in time-domain and spectroscopic follow-up of major survey facilities such as LSST, SKA, and PLATO, while also serving as a low-cost, high-impact platform for prototype testing and training the next generation of astronomers and engineers.

Threats

SALT faces several external risks that could impact its long-term sustainability and competitiveness. If the SAC degradation is not addressed, it could lead to operational downtime, diminished scientific output, and reputational damage, affecting SALT's standing in the global astronomy community. Stagnant funding, coupled with the potential withdrawal of international partners or a reduction in their shareholding, could increase financial pressure on remaining partners, raising operational costs and constraining strategic initiatives. Increasing competition from larger, more technologically advanced telescopes, combined with limited international visibility, further threatens SALT's global profile and ability to secure high-impact scientific programs. Without timely reinvestment, proactive partnership management, and strengthened international engagement, SALT risks a gradual erosion of competitiveness, relevance, and influence internationally.

4.2. External environment analysis

4.2.0. Political Factors

Government Support: SALT is operated by SALT (Pty) Ltd, a South African-registered private company governed by a shareholders' agreement among international partners. Most of the partners rely on funding from their respective national governments. Therefore, SALT's continued operation is sensitive to each partner's ongoing political commitment and the stability of their government funding sources. Political and economic stability, both domestically and internationally, is essential to maintain these collaborations.

In South Africa, astronomy and science-related research, particularly through institutions like the SAAO, is crucially reliant on Government sources of funding. This support is subject to shifts in national priorities and legislation. Currently, SALT enjoys strong backing from the South African government and retains flagship status within the country's international science strategy.

However, the broader international political landscape remains volatile. In particular, recent shifts in U.S. foreign science policy could impact existing partnerships, posing a potential risk to SALT's collaborative and funding structures.

Strategic Partnership Opportunities: The broader political and research landscape offers several avenues for SALT to strengthen its international engagement. For example, collaborations arising from the UK-STFC–SAAO AI initiative present potential opportunities to contribute to advanced data and operational systems. Continental initiatives, such as the reformed African Astronomical Society (AfAS, 2019), could expand SALT’s role in pan-African science and capacity-building programs. Participation in BRICS-led research and technology networks also offers potential for funding, shared expertise, and strategic influence. These represent opportunities rather than current commitments, but they highlight environments in which SALT could leverage partnerships to enhance its scientific and operational impact.

Regulatory Environment: Changes in research funding, national space policy, or international collaboration rules could affect SALT’s operations.

It’s important to note that the South African Astronomy Geographic Advantage Act has strategically positioned South Africa as an attractive host for large scale scientific projects of global importance, SKA and SALT in particular.

Visa and Employment Constraints: The challenges regarding work visa applications, combined with the NRF policy that limits permanent contracts for non-South African citizens, reduce SALT’s appeal as an employer to established researchers from the wider international community, making recruitment and retention more difficult.

4.2.1. Economic Factors

Budget Constraints: The loss of international partners represents a significant risk to SALT operations. In addition, economic fluctuations in individual partner countries could potentially also affect the individual contributions towards SALT’s operating costs.

Alternative funding models: There may be opportunities to change the partnership model from a time-per-share arrangement. For example, technological development partners may prefer access to SALT as a testbed for new innovations rather than traditional observing time shares.

Currency Fluctuations: Since SALT’s operational levies are specified in South African Rand, fluctuations in exchange rates pose a financial risk primarily to international partners, potentially affecting their ability to meet their funding commitments and thus impacting SALT’s overall budget stability.

Inflation and Cost Increases: Rising operational and maintenance costs driven by infrastructure age, obsolescence, inflation, supply chain disruptions, and increased compliance requirements may outpace available funding, placing additional pressure on SALT’s financial sustainability.

Diversification of Funding: Exploring philanthropic support, private sector partnerships, or public fundraising campaigns could supplement core funding and enhance financial resilience.

Economic Benefits to Local Economy: SALT’s operation contributes to the local economy of Sutherland through employment, tourism, and associated services, which strengthens the case for continued investment and support at regional, national and international levels.

4.2.2. Social Factors

Public Interest in Science: Growing public interest in science and space exploration benefit SALT. The SAAO are extremely successful within public outreach programs and educational initiatives are critical to gaining societal support and encouraging future generations to engage in astronomy, and SALT, as a South African flagship facility, is central to most of these programs. The outstanding success of the recent International Astronomical Union General Assembly, for the first time on the African Continent, bears testament to the increasing national and global reach within society.

Diversity and Inclusion: SALT is committed to fostering a diverse and inclusive environment, recognizing that a broad range of perspectives strengthens scientific innovation and outreach impact. Efforts are ongoing to attract and support underrepresented groups within the astronomy and engineering communities and to promote equitable opportunities across all operational levels.

Digital Engagement: SALT, mainly through the SAAO's Science Engagement and Outreach departments, leverages social media and digital platforms to enhance public engagement, expand educational outreach, and raise awareness of its scientific contributions. These channels provide valuable tools for connecting with global audiences, promoting STEM education, and building a supportive community around SALT's mission.

Educational Impact: SAAO, which is contracted to operate SALT, plays a role in STEM (Science, Technology, Engineering, and Mathematics) education in South Africa, partnering with universities and research institutions and training teachers. It helps inspire interest in scientific careers. SALT supports a Maths and Science teacher in Sutherland.

Community Engagement: Local communities around SAAO's sites, particularly in the Sutherland area have benefited immensely from the increase in tourism to the area drawn by interest in the observatory.

4.2.3. Technological Factors

Innovation and Technology: The field of astronomy is highly reliant on cutting-edge technology. SALT is an aging facility that has been in regular operations since 2011. New instrumentation is key to refresh our offering and remain relevant in the era of 30m class telescopes and large state-of-the-art instrumentation. The recent instrumentation upgrades have been slow - they are functional but not state-of-the-art. SALT should review its instrumentation suite and its niche in this new arena as part of the new strategy.

Intelligent Observatory, AI, 4IR: Astronomy in general requires vast data processing capabilities. The continued development of computing infrastructure and access to advanced software systems are critical for processing large astronomical datasets. The Intelligent Observatory project has begun creating a global cooperative network of otherwise independent facilities, which will greatly enhance accessibility across the African continent and further afield. AI has the potential to bring many potential benefits in terms of ease of proposal preparation, predictive maintenance, and many other benefits.

Cybersecurity: As SALT increasingly relies on digital infrastructure and international data exchange, robust cybersecurity measures are essential to protect sensitive operational data and intellectual property from evolving cyber threats. Ongoing investment in security protocols will safeguard SALT's reputation and ensure uninterrupted scientific operations.

Software Development and Open Source Collaboration: Software tools play a critical role in data processing, telescope control, and observation scheduling. SALT would benefit from engaging in collaborative open-source astronomy software projects, fostering innovation, and maintaining interoperability with global observatories and research networks.

Maintenance and Upgrades: Given SALT's ageing infrastructure, maintaining high operational availability while upgrading hardware and instrumentation presents logistical and technical challenges. Securing access to specialized components and skilled engineering support is vital to minimize downtime and ensure the telescope remains competitive.

Technology Co-development Partnerships: SALT can leverage partnerships with universities, industry, and international consortia to co-develop new instrumentation, detectors, and operational technologies. These collaborations can help SALT stay at the forefront of technological innovation despite budgetary constraints.

4.2.4. Environmental Factors

Dark Sky Reserve: With its large collecting area, SALT is highly sensitive to light pollution and dust pollution, which can affect its ability to conduct observations. Ensuring minimal and sensitive development of wind farms and mining interests in and around Sutherland is a major concern. The AGA act has been instrumental in ensuring the preservation of the Dark Sky reserve. We are carefully monitoring the effects of mega space projects such as the Starlink satellites from SpaceX and expect little impact on SALT, however telescopes that carry out wide field surveys may be affected. We continue to engage with the international community in this respect, in particular with a new global office for the protection of dark skies jointly formed by the IAU and SKAO.

Sustainability: As a scientific institution, SALT is very aware of the tremendous environmental impact posed by the infrastructure and the people conducting and supporting research. The effects of climate change will become more marked over the next few years.

Renewable Energy Use: SALT has already taken meaningful steps toward sustainability through the use of solar panels, which provide a significant share of the facility's daytime energy needs. This reduces dependence on fossil fuels and aligns SALT with global efforts to mitigate carbon emissions in research infrastructure. Continued investment in renewable energy could further enhance environmental performance and long-term cost efficiency.

Ecological Stewardship: The telescope's location in a remote, dark and ecologically sensitive area necessitates active environmental monitoring.

4.2.5. Legal Factors

Intellectual Property (IP): Collaborations with international research partners may involve IP concerns, especially related to technological innovations or discoveries made at the observatory.

Regulations: SALT must comply with national and international regulations on data sharing, research ethics, and environmental laws. Any changes in regulations, especially related to international data policies, could affect the way the observatory operates.

Corporate Governance and Shareholders' Agreement: SALT is operated as a private company, SALT (Pty) Ltd, with international shareholders governed by a shareholders' agreement. This legal structure introduces complexities around decision-making, liability, and governance, particularly when navigating partner withdrawals or changes in financial contributions.

Contractual Obligations and Funding Agreements: Legal risks may arise from long-term contractual obligations with partner institutions, including those related to operational levies, instrument development and valuation and scientific access. These agreements must be carefully managed to avoid disputes and ensure compliance across jurisdictions.

Labour and Immigration Law: South African labour law and immigration regulations (especially around work visas and permanent residency for international staff) have a significant legal impact on hiring and retention, particularly given NRF's policies. These laws affect not only staffing but also SALT's ability to comply with equity and diversity mandates.

Liability and Insurance: Given the scale and cost of the infrastructure, SALT must manage legal liability related to equipment damage, visitor safety, and force majeure events. Ensuring appropriate insurance coverage and legal readiness for accidents or natural disasters is critical.

4.3 Porter's Five Forces Analysis for the Southern African Large Telescope (SALT)

3.3.1. Competitive Rivalry – HIGH

Key Competitors:

- **Gemini North & South (8.1m):** Adaptive optics, IR capabilities, full-sky access.
- **Keck I & II (10m):** Advanced AO, exoplanet studies, premier spectroscopy facility.
- **VLT – ESO (8.2m × 4):** Extensive instrumentation suite, interferometry, powerhouse in global astronomy.
- **GTC (10.4m):** Largest single-aperture optical telescope; strong in spectroscopy, deep imaging, and time-domain astrophysics. Similar queue-based model. Recent upgrades include **MEGARA (IFU spectrograph)** and **EMIR (near-IR)**.
- **HET (9.2m):** Shares SALT's design; direct spectroscopic competitor post-VIRUS upgrade.
- **Subaru (8.2m):** Wide-field surveys, AO, and IR strength.
- **Magellan (6.5m × 2), SOAR (4.1m), and others:** Southern competitors in niche science areas.

SALT Positioning:

SALT's 10m-class aperture is a strength, but the fixed-altitude design limits the amount of time available per observation, which, in turn, also adds flexibility to the observing queue scheduling. Its core strength lies in optical spectroscopy, supported by a versatile instrument suite. Notably:

- **Robert Stobie Spectrograph (RSS)**: Multipurpose optical spectrograph with polarimetric and multi-object modes. RSS is complemented by the new small integral field unit, SMI-200.
- **NIRWALS**: Newly developed IFU-fed near-infrared spectrograph intended to extend SALT's spectral coverage. However, its detector arrived degraded due to long-term storage at room temperatures. Ongoing testing is assessing whether its performance—particularly in terms of sensitivity and noise—can support scientific research.
- **High Resolution Spectrograph (HRS)**: Dual-beam, fibre-fed, cross-dispersed echelle spectrograph that supports high-stability, high-resolution spectroscopy. Recent additions include a laser frequency comb (LFC), expected to deliver radial velocity precision of 1–3 m/s, enhancing SALT's capability for exoplanet science.
- **High-speed capability**: SALT is well positioned for time-domain studies of transient and compact objects, aided by rapid queue-scheduled observing.

Compared to its peers, SALT lacks high-performance adaptive optics, multi-object integral field units, and high-resolution infrared spectrographs — areas where competitors lead. Comparisons with GTC, a spectroscopically focused facility with similar cost-effectiveness, highlight SALT's advantages in sky darkness and operating costs, though GTC enjoys better seeing conditions and more modern instrumentation.

Implications: SALT's continued **competitiveness** depends on **deepening its niche in time-domain and follow-up spectroscopy**, particularly in coordination with survey facilities like LSST and PLATO. Strategic instrumentation upgrades are critical. The installation of a laser frequency comb (LFC) will enable the High Resolution Spectrograph (HRS) to perform high-precision radial velocity measurements (1–3 m/s), opening new opportunities in exoplanet science. The **development of modular spectrographs** — which are designed for adaptability, allowing components or modes to be added, replaced, or upgraded more easily — could provide SALT with greater scientific flexibility and responsiveness to evolving research needs, while managing costs over time.

Implications:

- To remain competitive, SALT must **focus on niche leadership** (e.g., time-domain follow-up, transient astronomy, survey follow-up) and **develop/invest in instrumentation** aligned with upcoming survey missions (e.g., LSST/Vera Rubin, PLATO).

4.3.2. Threat of New Entrants – LOW

Barriers to Entry:

- Extremely high **capital expenditure** (>USD 100 million), complex international governance, and environmental permitting.
- Long lead times (~10–15 years from concept to first light).
- High **operational costs** and need for world-class human capital in astronomy, engineering, and data science.

Emerging Entrants:

- **Extremely Large Telescopes (ELTs)** under construction (e.g., **ESO ELT, TMT, GMT**) will eventually eclipse current facilities in capability, but are not direct competitors in the next 5 years due to their niche targeting and expected oversubscription.

Strategic Implication:

- SALT should **maximize value before ELTs come online**, finding roles in **survey follow-up, Southern Hemisphere time-domain studies**, and as a **platform for capacity-building** in African astronomy.
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4.3.3. Bargaining Power of Suppliers – MODERATE

Technical Suppliers:

- Specialized components (e.g., CCDs, optics, cryogenic systems) are often sourced from a **small global vendor pool** (e.g., Teledyne, Andor, Zeiss).
- Currency fluctuations and international shipping add procurement complexity.

Human Capital:

- Skilled astronomers and engineers are globally mobile, and African institutions face challenges retaining talent.
- Brain drain to facilities in Europe, North America, or SKA-adjacent projects is a growing concern.

Strategic Response:

- SALT can **mitigate risk through long-term vendor partnerships, local procurement where possible, and investment in local training pipelines** (e.g., via NRF scholarships, NASSP).
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4.3.4. Bargaining Power of Buyers – HIGH

Who Are the Buyers?

- **Primary users:** Astronomers from consortium institutions (e.g., SAAO, Rutgers, Wisconsin, etc.) who compete for telescope time.
- **Funders:** National Research Foundation (NRF), Department of Science, Technology and Innovation (DSTI), and international partners.

Buyer Leverage:

- Astronomers can shift to more versatile telescopes if SALT instruments are not competitive or user support is lacking.
- Funders increasingly demand metrics beyond scientific output: **socio-economic impact, training**, and

African science diplomacy.

Strategic Response:

- Prioritize responsive proposal review cycles and technical help, high-quality data pipelines, and compelling narratives around **transformation, inclusion, and innovation**.
 - Promote **multi-wavelength partnerships** with facilities like **MeerKAT**, **SKA**, and consider space-based missions (e.g., **JWST**, **PLATO**).
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4.3.5. Threat of Substitutes – MODERATE

Substitute Modalities:

- **Space telescopes** (e.g., JWST, HST) deliver diffraction-limited imaging and stable photometry across wavelengths SALT cannot reach.
- **Radio astronomy** (MeerKAT, SKA) is attracting significant national investment, which has been diverting policy and funding focus.
- **Simulations & AI models** increasingly supplement observational data in cosmology and galactic dynamics.

Scientific Substitution:

- Missions like **Rubin Observatory (LSST)** and **Euclid** will generate massive datasets requiring rapid spectroscopic follow-up — an opportunity or a threat depending on SALT's readiness, particularly given the recently identified SAC problem.

Strategic Response:

- **Position SALT as a critical follow-up platform** for large surveys (e.g., Rubin's alert stream, PLATO).
 - Collaborate with space/radio missions to **create integrated science observations**.
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Strategic Takeaways

- **Niche Differentiation:** We must prioritize science areas where SALT excels: time-domain astronomy, Southern Hemisphere follow-up, and spectroscopy of faint or variable sources.
- **Instrumentation Modernization:** Restore the telescope throughput by repairing the SAC, further improve our spectrographs, pursue new modular spectrographs, and consider feasibility of cost-effective AO or deployable, multi-object IFUs.
- **Stakeholder Engagement:** Highlight SALT's role in African astronomy development, education, and science diplomacy.
- **Partnerships:** Strengthen ties with facilities (MeerKAT, LSST, SKA, PLATO) and data science programs to build relevance in a multi-messenger era.

5. SALT Strategic Goals

Based on the current competitive landscape, internal capabilities, and external opportunities, SALT's strategic goals for the coming 5–10 years are designed to ensure continued scientific relevance, operational sustainability, and growth in African astronomy leadership. These goals reflect SALT's commitment to aligning its development with both partner priorities and international research trends, as identified through the situational analysis.

The overall high-level goals of SALT, approved by the Board in 2018, continue to guide its strategic direction. These goals are now refined to reflect recent advances, competitive realities, and emerging opportunities:

SG1 Enable world-leading astrophysical research

Deliver internationally competitive science by maximising operational efficiency, enhancing data quality, and strengthening SALT's niche capabilities within global astronomy. Achieving this requires continuous investment in both technology and people—nurturing a skilled, creative scientific and technical team capable of driving innovation and responding to evolving research priorities. Through targeted instrumentation upgrades, collaborative technology development, and selective prototype testing aligned with scientific needs, SALT will remain a responsive, high-impact facility supporting frontier research and discovery.

SG2 Drive human capital development, outreach, and partnerships

Harness SALT's unique status as Africa's premier optical observatory to inspire interest in STEM across the continent, foster graduate and technical training, and build professional expertise in astronomical instrumentation. Strengthen international collaborations and strategic partnerships to amplify SALT's scientific impact and socio-economic contributions, while promoting inclusivity and transformation within the team and the user community.

SG3 Strengthen SALT's operational, financial, and environmental sustainability

Enhance long-term sustainability by securing diverse and reliable funding streams to support operations, scientific initiatives, and infrastructure renewal. Strengthen organisational efficiency and transparency through modernised processes and active stakeholder engagement, reinforcing SALT's value and relevance within the evolving global astronomy landscape. Integrate environmentally responsible practices into all aspects of operations and planning to reduce impact and ensure long-term stewardship of resources.

These strategic goals provide a focused framework to guide SALT's ongoing evolution, balancing tradition with innovation, and local capacity building with international collaboration, to maintain its role as a flagship observatory in the Southern Hemisphere.

5.1. SALT Science Focus Areas

As mentioned in the introduction, a key decision of the SALT strategic plan is that adopted by the SALT Board in 2016:

SALT should continue operating as a general-purpose telescope for PI- driven science.

However, SALT still needs to play to its strengths and focus its development and instrumentation suite on niche areas where it is most likely to make an impact. The three original focus areas from the 2017

strategy have been reviewed and still apply:

- i. ***Understanding fundamental physics and the nature of the Universe: Transient and time-domain astrophysics.*** The SALT community has a firmly established interest in this area. An essential step is to support Rubin Observatory's LSST-cadence time-domain studies, ensuring its inclusion into sophisticated decision-making software and networking with other instruments. Examples of the community's interest in this area are the very successful large Transient Universe program, and Rutgers' successful supernovae follow-up program. MeerKAT, along with the MeerLICHT connection, already offer South Africa a globally-unique new window into this exciting field as well. In other words, this strategy positions SALT as a pivotal player in the multi-wavelength / multi-messenger astronomy era occasioned by the establishment of SKA, the Rubin Observatory, and other advanced and complementary global instruments.
- ii. ***Finding life in the Universe: Exoplanets and their characteristics.*** SALT already has an excellent instrument for detecting and characterising classes of exoplanets, in the form of the HRS, in particular once the LFC project, which also includes an automatic data reduction pipeline, is complete. In addition, SALT is already included in PLATO's list as a key follow-up facility.
- iii. ***Tracking the flow of matter from stars and galaxies to us: Baryon cycle and the low-surface-brightness Universe.*** *Galaxy evolution* remains one of the largest and most active fields in astronomy. The Karoo night sky is extremely dark, while the stability of the atmosphere (seeing) is modest. Thus, studying the nearby Universe to extremely faint levels and in great detail is a global niche, a niche that SALT is well placed to exploit given its massive light-gathering power and the characteristics of the Sutherland site. Galaxy evolution is also a Key Science driver for SKA and hence it offers potential for powerful multi-wavelength synergies.

5.2. SALT Strategic Objectives

To realise SALT's broad strategic goals and respond effectively to the challenges and opportunities identified in the situational analysis, the following specific objectives and priorities are proposed. These actionable steps will guide resource allocation, partnerships, and operational focus over the short- to medium-term (1–5 years).

SG1. Enable World-Leading Astrophysical Research

- a. **Maximise scientific productivity** by *repairing the SAC*, reducing technical downtime, improving efficiency, and enhancing user support services.
- b. **Advance SALT's scientific leadership** across its three core focus areas — time-domain astronomy, exoplanet science, and the baryon cycle — by leveraging the telescope's unique capabilities and partnerships.
 - i. In **time-domain** astronomy, develop rapid-response observing modes and protocols for transient phenomena.
 - ii. In **exoplanet** science, fully commission the laser frequency comb (LFC) on the High Resolution Spectrograph (HRS) to enable high-precision radial velocity measurements.
 - iii. In **baryon-cycle** studies, enhance multi-object spectroscopy (MOS) and IFU capabilities, add data pipelines to support investigations of galaxy formation and evolution.

- c. **Facilitate the development, testing and integration of innovative instruments and enabling technologies** that enhance SALT's scientific capabilities and maintain its agility as a platform for cutting-edge research.
- d. **Strengthen data management and analysis pipelines** to support timely publication and enhance usability, and expand the **SALT data archive** for **IVOA compatibility** to increase global discoverability and broaden community access.
- e. **Deepen strategic partnerships** with global survey projects (LSST, MeerKAT, SKA, PLATO) to increase SALT's role in multi-wavelength and multi-messenger astronomy.

SG2. Drive Human Capital Development, outreach, and partnerships

- a. **Expand training and capacity-building programmes** targeting African students and early-career technicians, engineers and researchers through internships, fellowships, and collaborations.
- b. **Enhance recruitment policies and incentives** to attract and retain scientific and technical talent.
- c. **Broaden public outreach and science engagement initiatives**, leveraging SALT's inspirational appeal to stimulate STEM interest and raise SALT's profile nationally and internationally.
- d. **Promote diversity and inclusion** within all SALT programmes to build a sustainable, innovative workforce.

SG3. Strengthen SALT's operational, financial, and environmental sustainability

- a. **Review governance structures and frameworks** to ensure effective decision-making, adaptability and long-term sustainability.
- b. **Implement rigorous project management procedures** to strengthen transparency, accountability, and due diligence across all major initiatives.
- c. **Secure sustainable funding** by demonstrating socio-economic impact and alignment with national and international science priorities.
- d. **Implement proactive maintenance and infrastructure renewal plans** to address ageing telescope optics and facilities.
- e. **Integrate environmentally sustainable practices** into operations and infrastructure planning, including energy efficiency, waste reduction, and responsible resource use.

5.3 Summary of strategic goals and objectives

SALT is currently advancing or nearing completion of several key objectives outlined in the 2017 strategy, including the completion of the LFC, the installation of the new monolithic RSS detector, the replacement of SALTICAM in its acquisition mode, the finalization of IFUs for use with RSS, and the development of various data reduction pipelines.

In April 2025, however, it was discovered that the Spherical Aberration Corrector (SAC) optics have significantly degraded. These optics are critical to SALT's operations, and their deterioration could substantially reduce the telescope's high collecting power and impact its reputation. Additionally, the highly anticipated NIRWALS instrument was delivered with a damaged detector, which has hindered its characterization, evaluation, and broader use within the SALT community.

Partnership dynamics have also shifted. UK policy changes have affected the UKSC consortium, leaving

Armagh as the sole remaining partner, while UW's continued involvement is largely contingent on the valuation of NIRWALS.

Given these developments, the key objectives for the next five years focus on consolidation: prioritizing SAC repairs, completing existing high-impact projects, and ensuring financial stability. This is summarised in the graphics below.

SALT strategy timeline

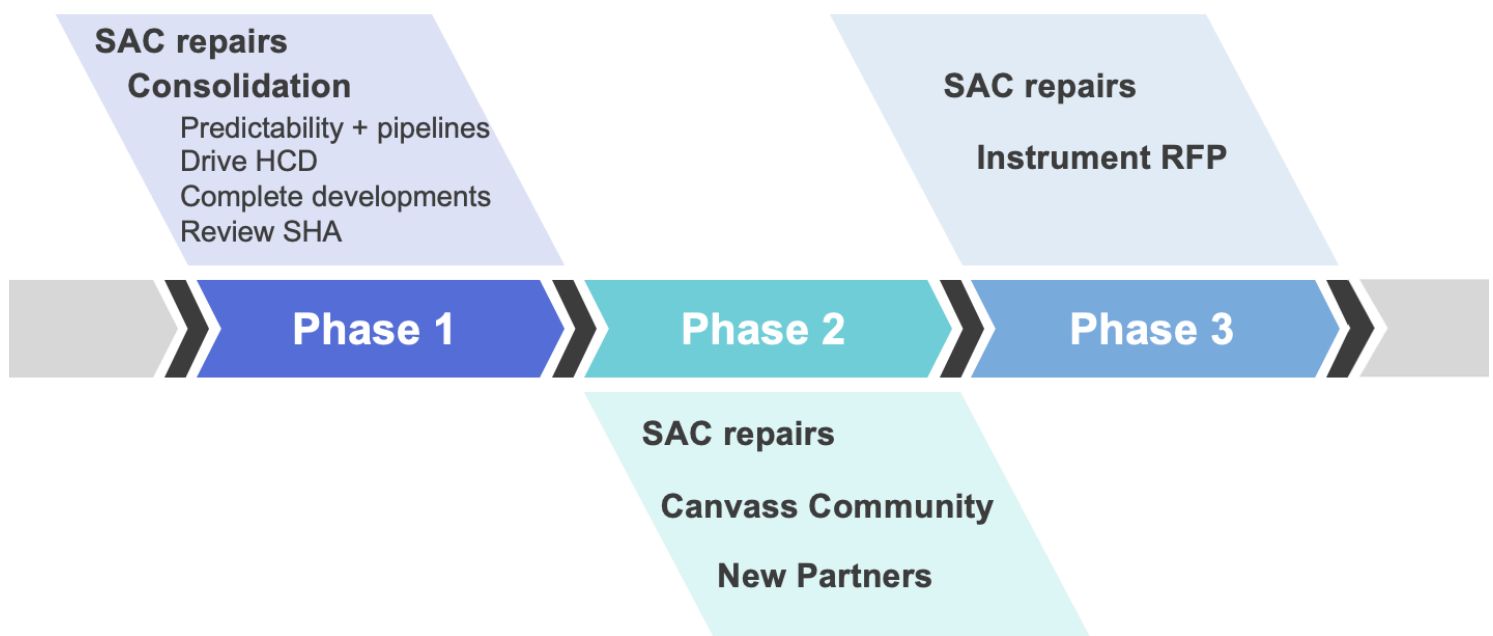


Fig 1. SALT Strategy timeline.

6 Risks and Enablers

Strategic Risks

Critical

- **Funding Constraints:** Dependence on partner and government contributions exposes SALT to budget fluctuations, directly threatening upgrades, operations, and long-term sustainability.
- **Talent Pipeline and Retention:** Difficulty in attracting and retaining highly skilled staff risks

operational continuity and innovation capacity.

- **Technological Obsolescence:** Without timely investment, SALT risks falling behind newer facilities, reducing its ability to deliver competitive science.
- **Spherical Aberration Corrector (SAC) Degradation:** The degradation of SALT's critical SAC optic threatens image quality and performance. With long repair lead times and major upcoming scientific opportunities (e.g. PLATO, LSST), under-performance risks loss of scientific impact and partner confidence.

High

- **Global Competition:** The rise of next-generation facilities (e.g. ELT, Rubin Observatory, new instrumentation for existing large telescopes) could overshadow SALT unless its unique niche is fully leveraged.
- **Operational Vulnerabilities:** Technical downtime or degraded key optics (eg SAC) could damage SALT's reputation and user confidence.
- **Stakeholder Alignment:** Misaligned priorities among partners could impact on decision-making.

Medium

- **Environmental and Infrastructure Risks:** Remote site logistics remains an ongoing operational risk.

Strategic Enablers

Critical

- **Unique Scientific Niche:** SALT's location and capabilities provide unmatched opportunities in the southern hemisphere, particularly in time-domain and transient follow-up astronomy.
- **Alignment with National Priorities:** Clear linkage to South Africa's research and innovation agenda strengthens its case for continued investment.
- **Strong International Partnership Model:** Governance structure ensures shared risk, resources, and expertise.
- **Finding New Partners:** Broadening the partner base reduces financial risk, strengthens resources, and increases international engagement.

High

- **Skilled and Committed Staff:** Dedicated technical and scientific teams provide stability and innovation capacity.
- **Growing African Astronomy Ecosystem:** Synergies with MeerKAT, SKA and continental initiatives create opportunities for collaboration and skills development.

Medium

- **Track Record of Scientific Impact:** Demonstrated achievements reinforce credibility but must be maintained.
- **Public Engagement and Visibility:** High potential to attract support, though dependent on effective communication and outreach.

7. Expected Outcomes & Impact

By the end of the strategy period, SALT will be recognised as a flagship scientific facility for South Africa and the global astronomy community, with visible contributions across science, partnerships, community, and national impact.

Scientific Outcomes

- SALT operates at peak throughput through the refurbishment or replacement of the **Spherical Aberration Corrector (SAC)**, enabling its expanded instrumentation suite to deliver science at full capability and reinforcing the telescope's competitiveness for the decade ahead.
- SALT is firmly established as a leading southern hemisphere facility for time-domain and transient astronomy, uniquely positioned to capitalize on opportunities offered from global facilities, such as LSST, SKA and PLATO.
- A vibrant and competitive instrumentation suite ensures SALT continues to deliver forefront science capabilities and adapts to emerging research priorities.
- SALT data pipelines ensure rapid, high-quality analysis of new observations, enabling timely and influential scientific results.
- The SALT data archive — both new and historical — broadens accessibility and supports sustained scientific impact through a growing body of publications.

Operational Outcomes

- SALT is recognised for highly responsive, reliable, safe, and efficient operations, with high levels of user confidence in performance and data quality.
- Modernised systems and processes enable responsive scheduling, rapid follow-up of transient events, and streamlined data access.

Community Outcomes

- A diverse and active user community regards SALT as a facility of choice, with strong participation from partner institutions and increasing engagement from across Africa.
- SALT is a recognised training ground for the next generation of astronomers, engineers, and data scientists, contributing meaningfully to human capital development.
- SALT plays a visible role in advancing diversity, equity, and inclusion within astronomy.
- SALT generates broader societal and developmental benefits through initiatives aligned with its Collateral Benefits Plan, supporting education, skills development, and community engagement.

Partnership Outcomes

- The partnership base has grown in strength and resilience, with new partners contributing scientific breadth, resources, and global connections.
- SALT is embedded in international collaborations that leverage its unique capabilities, ensuring its

relevance in the era of multi-wavelength, multi-facility astronomy.

Strategic Host Outcomes

- SALT is a clear example of South Africa's leadership in large-scale science infrastructure, showcasing the country's ability to host, manage, and deliver world-class facilities.
- Contributions to education, training, and innovation demonstrate the value of SALT to South Africa's knowledge economy and to society more broadly.
- SALT's visibility and outreach inspire public pride and political support for astronomy and big science.
- The sustained scientific use of **archival data** reinforces South Africa's role as a steward of enduring, high-value research assets.

Appendices

A – SALT History and Operation Mode

The Southern African Large Telescope (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-m across, comprising 91 individual 1-m hexagonal mirrors. The light gathered by its huge mirror is fed into a suite of instruments (an imager and two spectrographs) from which astronomers infer the properties of planets, stars and galaxies, as well as the structure of the Universe itself. SALT is the nearly-identical twin of the Hobby-Eberly Telescope (HET) located at McDonald Observatory in west Texas.

SALT is owned by the SALT Foundation, a private company registered in South Africa. The current shareholders of this company include universities and science funding agencies from South Africa, India, Europe and North America. The South African National Research Foundation (NRF) is the major shareholder with an approximately 33% share. Other large shareholders are the University of Wisconsin-Madison, the Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences, Dartmouth College, and Rutgers University. Smaller shareholders (<10%) include the Indian Inter-University Centre for Astronomy and Astrophysics, the American Museum of Natural History, and the UK SALT Consortium, the latter representing only Armagh Observatory. The size of the shareholding of each partner determines the access to the telescope which they enjoy.

Table A: The SALT Partnership (as of August 2025)

PARTNER INSTITUTION	COUNTRY	SHARE (%)
National Research Foundation (NRF) ¹	South Africa	33.56 (51.88)
Rutgers University (RU)	USA	9.98
Centrum Astronomiczne im. M. Kopernika (CAMK)	Poland	9.67
Dartmouth College (DC)	USA	9.49
University of Wisconsin – Madison (UW)	USA	8.08
Inter-University Centre for Astronomy and Astrophysics (IUCAA)	India	6.90
UK SALT Consortium (UKSC) ²	UK	2.26
American Museum of Natural History (AMNH)	USA	1.74

¹ The formal share-holding of South Africa (NRF) is 33.56%. However, NRF currently has shares **on-loan**, after agreeing to cover the Operations Levies of several small partners that have left the Consortium over the years (Goettingen University, University of Canterbury, and University of North Carolina), as well as currently having partial shares of existing partner, UW and UKSC. This is why the share of SALT time for NRF is currently 51.88%.

² Currently consisting of Armagh Observatory.

SALT is located at the observing site of the South African Astronomical Observatory (SAAO), near the small town of Sutherland, about 400 km north-east of Cape Town in the Karoo. This site has been host to a number of other smaller telescopes since the early 1970s, and benefits from location in a semi-desert region with clear and very dark skies. The quality of this site for optical astronomy is preserved by South African legislation.

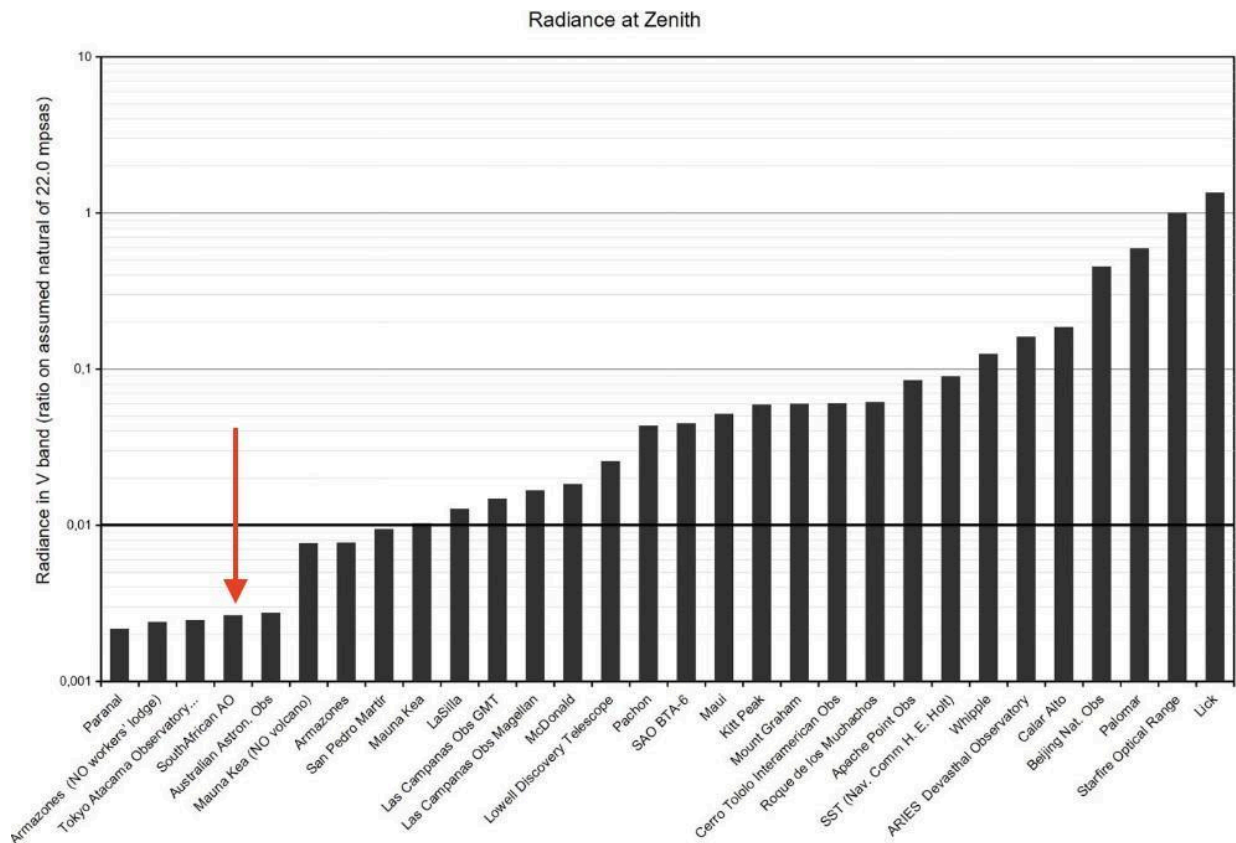


Figure 1. Night sky brightness of all professional observatories in the world. The SALT-site at the SAAO/Sutherland is seen to be among the very darkest together with the VLT and EELT sites in Atacama, and the AAO in Australia. From Falchi et al. (2023), see details therein.

SALT is operated in “service mode”, it is a fully “queue scheduled” observatory without visiting astronomers. The SAAO is tasked with operating SALT with a team of astronomers and engineers funded by the SALT Foundation. Observing time is allocated to astronomers through a competitive peer-reviewed proposal process, per partner, on a 6-month schedule. Accepted programs are submitted to the SALT Operations team who manages the scheduling and execution of the observations, as well as the data reduction and data delivery to all users. In this sense, SALT is a normal general-purpose telescope for the user community. However, there are more and less efficient ways of using SALT, which derive from its characteristics.

B – Telescope and Site Characteristics

Sky Access:	• DEC range: +11 to -76 degrees • Fixed altitude, typically 1 hour tracks, up to 4h, with a moving prime focus
Field of View:	• 8 arcmin science FoV for RSS and SALTICAM

Wavelength coverage:	• The instruments operate in wavelengths between ~320nm and ~950nm, expanding to 1650nm with NIRWALS
Image quality:	• Seeing-limited with median effective FWHM of about 1.5 arcsec on the detectors
Tracking accuracy:	• Closed-loop telescope position is stable and offsets can be done with rms 0.3 arcsec accuracy • Rotation is currently open-loop with drifts up to 0.05 deg per hour <i>[update status for new 2023 situation]</i>
Instrument availability:	• Rapid instrument selection makes for flexible operations and increase in science efficiency
Relative (spectro) photometry:	• Telescope pupil changes during an observation • Relative photometry can be done down to a few percent accuracy over the whole field, limited by flat-fielding currently • Higher accuracy can be achieved for individual sources using close-by reference stars, e.g. in high-time resolution observations

	• Absolute fluxes can be obtained using supplementary calibration information of the target fields • Spectral shapes are calibrated using regular spectrophotometric standard stars observations
Cost-effective:	• Building and operating costs at level of international 4-m class telescopes • Science output as measured by refereed papers is on a par with international 10-m class telescopes

Sutherland site	• Night sky is very dark, ~22 mag/sq.arcsec in V-band with no artificial sky spectral features • Seeing is modest with intrinsic ~1.4 arcsec zenithal V-band median • Approximately 60% of annual night-time is available for on-sky observations
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C – Current (and near-future) Instrument Characteristics

RSS:	• Low to medium resolution spectroscopy • Observing modes: a. Long-slit spectroscopy b. Multi-object spectroscopy c. High time resolution spectroscopy d. Narrow-band imaging e. Optical IFU – SMI200 available, SMI300 and new SMI200 commissioning planned for 2025/26 • Grating spectroscopy modes (a), (b), and (c) provide spectral resolving power ($R=\lambda/\delta\lambda$) from 250 to 5500 for 1.25 arc-second slits, over the spectral range 320- 900 nm (R to 9000 for 0.6 arc-second slits). • Continuous time-resolved spectroscopy with temporal resolution of a few seconds is available via frame transfer for all grating modes, and long-slit slot mode spectroscopy gives time resolution of 0.05 sec
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	• Narrow band imaging ($R\sim 50$) is available over the spectral range 430-890 nm • Linear, circular and all-Stokes polarimetric capabilities associated with each mode • Optical IFU mode provides 320-900nm coverage for spectral resolutions of 200-9000 using two fibre-bundles with FoV's of 18x23 and 21x44 arcsec, and fibre sizes 0.9 and 1.8 arcsec, respectively
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NIRWALS:	• Near-infrared Integral Field Unit (IFU) imaging spectroscopy – currently being characterized. • NIR fibre-fed IFU provides 800-1650nm wavelength coverage with spectral resolution of 2000-5000, and 1.3 arcsec fibre size, over an 18x29 arcsec FoV
HRS:	• Dual-beam (370-555 nm and 555-890 nm) fibre-fed, white-pupil, échelle spectrograph, employing VPH gratings as cross dispersers • HRS is a single-object spectrograph with simultaneous sky measurement, using pairs of optical fibres • Three resolving power modes - o R ~16,000 (unsliced 500 µm fibres) - o R ~37,000 (sliced 500 µm fibres) - o R ~67,000 (sliced 350 µm fibres) - o High stability mode at R~67,000 employing fibre double-scrambler and optional iodine cell or simultaneous ThAr calibration injection; a laser frequency comb and associated precision radial velocity data pipeline is under development, due to be commissioned in 2025/26
Imaging:	• SALTICAM is the main imaging instrument, also used as the acquisition camera. Being replaced soon with monolithic E2V Sophia camera. Imaging capability requirements to be discussed. • Provides seeing and image quality-limited imaging over the spectral range 320-900 nm for the full 8-arcminute science field of view of the telescope • Filters include standard Johnson-Cousins, Sloan, and Strömgren sets and also Hα, 380 nm, and neutral density [not available with Sophia] • Operating modes: - o Full-field normal imaging - o High speed frame transfer - o High-speed slot-mode offers high-time-resolution imaging at up to 10 Hz

C – SALT Publications Analysis

C1. Introduction

This appendix reviews publication and citation statistics of SALT and highlights the types of science that have been most successful during the first decade of full operations. The aim is to benchmark SALT's productivity and impact relative to international peers and to draw lessons that can inform future strategic planning.

Bibliometrics, while inherently delayed due to the ~2 year lag between data acquisition and publication, provide an increasingly robust measure of performance now that SALT has more than a decade of operational history. In addition to output volume, citation impact, science fields, program efficiency, and instrument usage are considered.

C2. Publication Output and Benchmarking

Early measures of SALT productivity appeared low, largely due to the natural delay between observations and publication. With over ten years of steady operations, however, publication output now provides a meaningful basis for comparison.

The annual number of refereed papers based on SALT data has increased steadily, reaching 82 papers in 2024 and a cumulative total of 564 refereed data papers by August 2025. Including instrumentation and survey-description papers, the total rises to 590 refereed publications. In addition, there are more than 130 SALT-related papers in the SPIE Astronomical Telescopes and Instrumentation conference series, underscoring SALT's strong record in technical and instrumentation development.

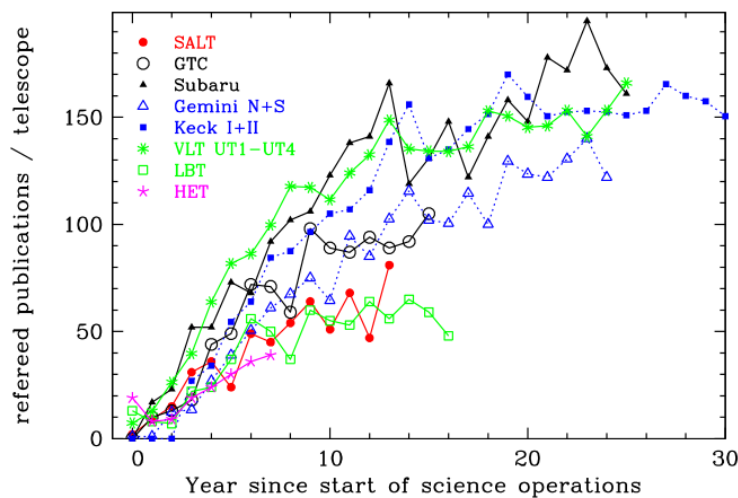


Figure C1. Refereed publications per telescope for 8-10m class optical observatories. SALT, in red, is seen to follow the broad general trend after the start of full science operations. (Note that the HET graph starts at its return to science operations after the telescope's full top-end redesign).

Benchmarking SALT against other 8–10m class facilities shows that its publication trajectory is consistent with global trends when normalized by the number of telescopes (Figure C1). Comparisons with the Large Binocular Telescope (LBT), the Gran Telescopio de Canarias (GTC), and the Hobby–Eberly Telescope (HET) are particularly relevant, given their similar start times and, in the case of HET, comparable design.

When normalised by construction and annual operating costs, SALT emerges as the most cost-effective telescope of its class worldwide (Figure C2). Based on trends at comparable facilities, SALT's publication rate can be expected to plateau in the range of 90–110 papers per year.

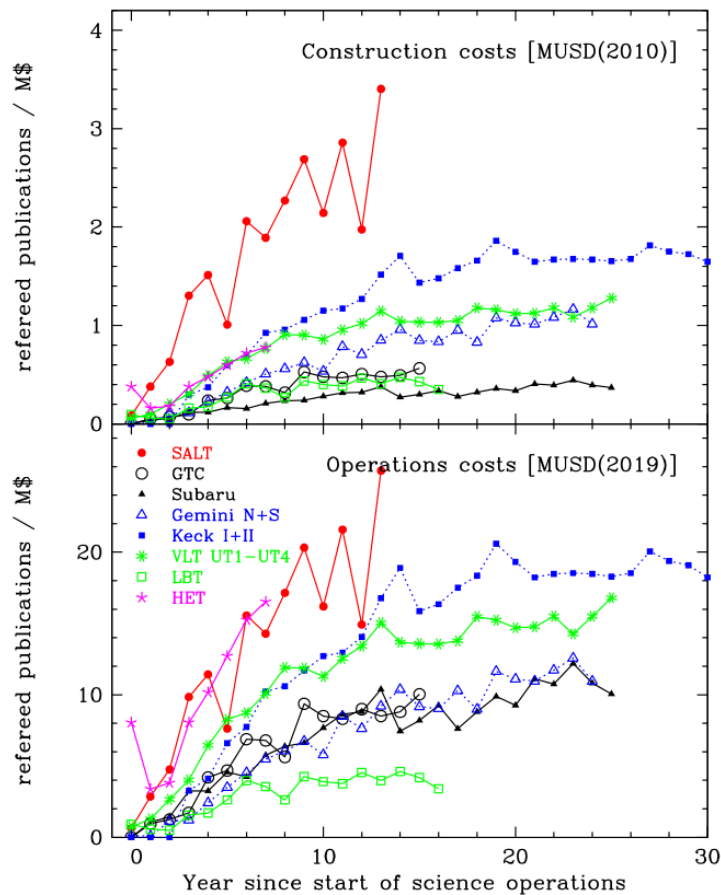


Figure C2. Paper counts as in Figure C1, but now normalised by the observatory construction and operations costs, respectively, highlighting the cost-effectiveness of SALT.

C3. Program Efficiency and Productivity

Program-level analyses provide further insight into SALT’s effectiveness and different approach towards benchmarking SALT’s publication rate. An extensive study performed by ESO (Sterzik et al. 2016) on over 8000 VLT programs over a 16-year period revealed that, approximately, only 35% of all (normal) programs publish. On the other hand, those that do publish produce an average of 1.7 papers. Applying these benchmarks to SALT’s ~140 programs per year implies an eventual expectation of 80–90 papers annually.

SALT-specific analyses indicate that:

- **Normal programs:** ~26% publication rate (likely to rise due to publication lag).
- **Director’s Discretionary Time (DDT) programs:** ~53% publication rate, more than twice that of normal programs, though absolute numbers remain small (~10 programs per year).
- **Large Science Programs (LSPs):** The “Observing the Transient Universe” LSP alone has produced over 90 papers, accounting for ~17% of all SALT publications while using only 8% of observing time.
- **Target of Opportunity (ToO) programs:** Responsible for more than one-third of all SALT data papers, despite using just 9% of observing time over the past decade (Table C1).

These findings show that LSPs and ToOs, in particular, are highly productive, and highlight the value of prioritising strategic focus areas.

C4. Citation Impact

Citations provide a measure of scientific relevance. Citations to papers published in a given year of course only become relevant 2-4 years after the publication year, since they grow as a paper ages (see e.g. ESO Publication Statistics for an example). For SALT papers published between 2013 and 2019, the average citation rate is 30–40 per paper, comparable with other large facilities. Exceptional peaks (80–90 citations per paper) occurred in 2014 and 2017, driven by highly cited works on supernovae and the first detection of a gravitational-wave optical counterpart (GW170817).

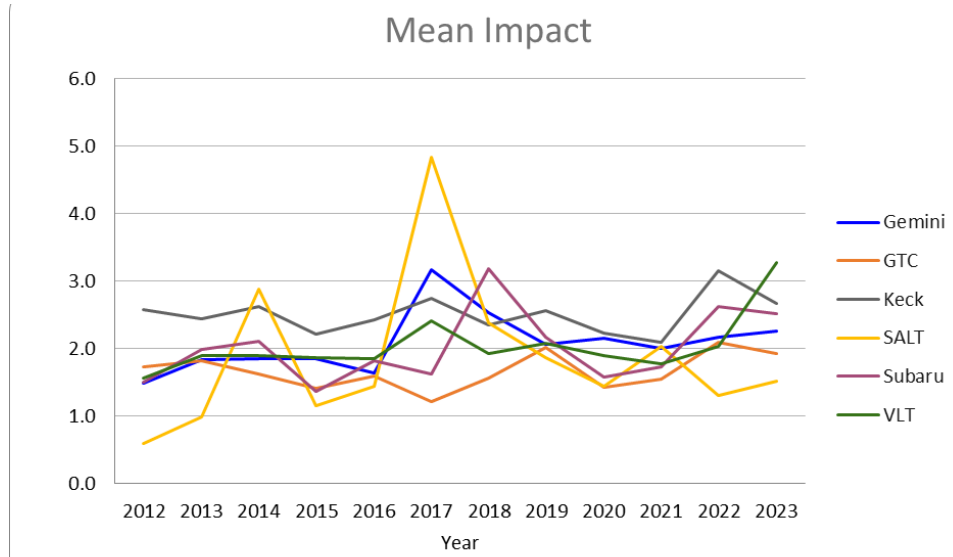


Figure C3. ‘Mean impact’ of large optical observatories based on citation counts of papers based on the facility. SALT is following the broad trend. The peak in 2017 is due to a single extremely highly cited paper on the electromagnetic follow-up of the gravitational wave event that year. Mean impact in this case means the average citation count in a given year normalised by the citation impact value of ApJ in that year. (The graph above hence means that large telescope data papers are on average 2-3 times more cited than overall ApJ papers; there may also be smaller implicit effects shaping the curves, depending on which journal, with varied citation impacts, the bulk of given facilities data is published in.) (Image courtesy of the Gemini librarian, Xiaoyu Zhang.)

A comparative analysis by Gemini Observatory (Figure C3) shows SALT’s “mean impact” in line with other major observatories, with data papers typically cited two to three times more than the average *Astrophysical Journal* article (Figure C3). This indicates that SALT publications are of broadly comparable influence to those from larger facilities, despite differences in community size and resources.

C5. Science Fields and Strategic Strengths

The distribution of SALT publications by science area reflects both the telescope’s strengths and the interests of its community (Figure C4 and Table C1):

- **Galactic astronomy** has been the largest field (47%), led by studies of variable stars, cataclysmic variables, symbiotic stars, white dwarfs, novae, and exoplanets.
- **Extragalactic astronomy** (37%) is balanced between nearby galaxies (dwarfs, early-type, and star-forming systems) and high-redshift targets (AGN, QSOs, galaxy clusters).
- **Transient science** has been especially productive, including supernovae (14%), gravitational-wave follow-up (2% since 2017), gamma-ray bursts, and tidal disruption events. Many of SALT’s most cited papers fall in this category.
- **Synergies with MeerKAT** have been strong, particularly through LADUMA, MIGHTEE, and MALS surveys, often involving multi-partner proposals.

● Extragalactic ● Galactic/Milky Way ● SNe/GW ● Solar System

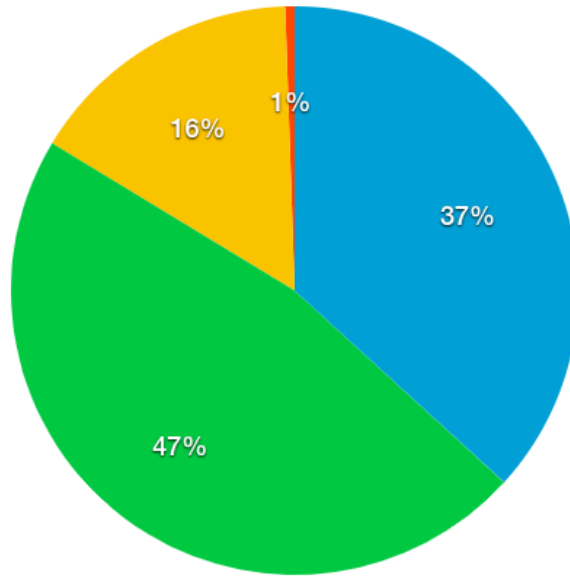


Figure C4. Breakdown of papers based on SALT data by science field. Note that we have classified Supernovae and gravitational wave follow-up separately from the broader “extragalactic” category.

N = 564 refereed SALT data papers (08/2025)	
Galactic	47%
Extragalactic (excl SNe etc.)	37%
SNe / GW	16%
Solar System	1%
total	100%
Target-of-opportunity (ToO) [% of total N]	36%
More than 10 targets/observations [% of total N]	7%
RSS	75%
HRS	21%
SALTICAM	3%

Table C1. Breakdown of papers based on SALT data by science field, and the instrument used. In addition, the fraction of the papers that are from ToO proposals, and from proposals with more than ten targets, are also shown.

C6. Instrumentation Trends

Publication statistics also reflect instrument usage (Figures C5–C6; Tables C1, C2):

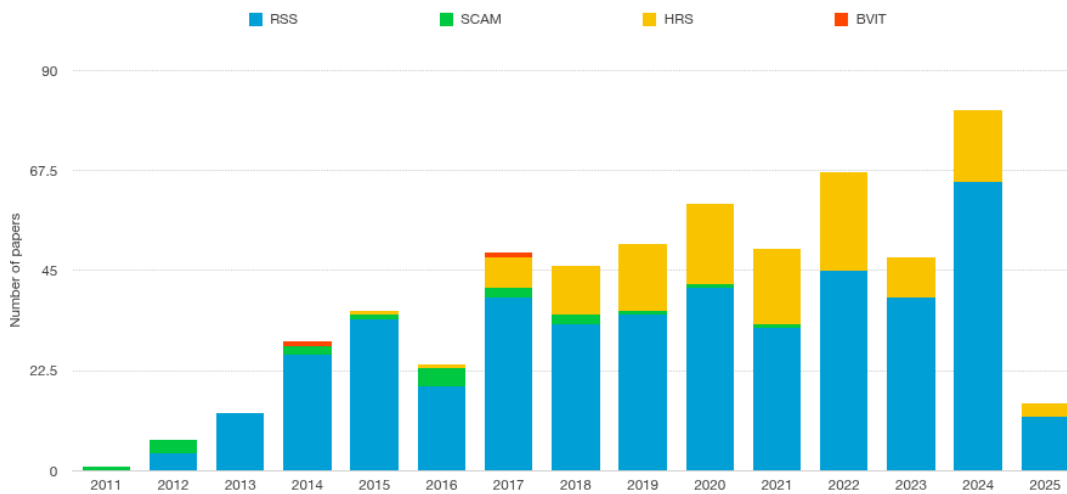


Figure C5. Historical split of SALT papers per year broken down by instrument used.

- **RSS (Robert Stobie Spectrograph)** remains the workhorse instrument, used in ~75% of all publications, particularly in long-slit mode.
- **HRS (High Resolution Spectrograph)** has grown strongly since 2018, now contributing 30–40% of annual publications. This growth coincided with the release of the HRS data pipeline in 2017, which significantly improved data usability.
- **SALTICAM** contributions have declined from 10% of publications in 2018 to 3% in 2025, despite stable usage of 1–2% of observing time. Technical challenges with its high time-resolution mode have shifted most time-domain work to RSS.
- Over the past 8 years, HRS papers have contributed to 30–40% of annual data papers, which in fact is similar to the split in time-usage on the telescope between RSS and HRS instruments (Figures C7 and C8). Thus **there is no significant difference between the productivity of the two instruments and/or the communities using them.**

An unsurprising key takeaway from this analysis is that both instrument pipelines and data quality strongly influence publication efficiency. Investments in tools that streamline data analysis and monitor data quality can yield measurable gains in scientific productivity.

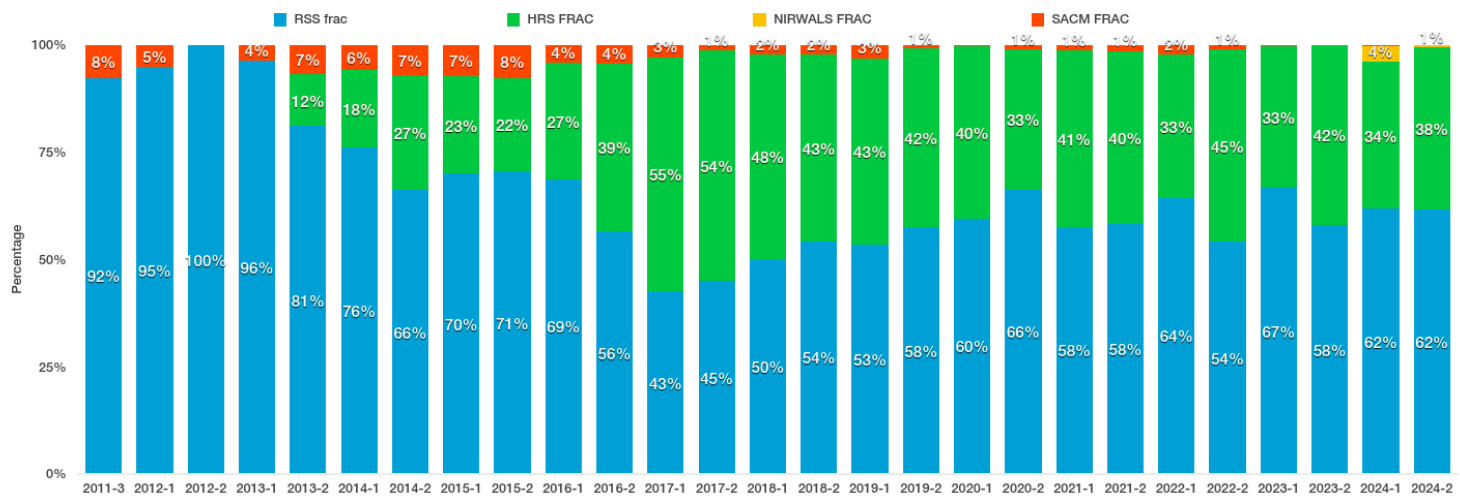


Figure C6. Historical split of time-usage on the telescope per semester broken down by instrument used.

N = 1361 <i>programs</i> contributing to the SALT data publications above (08/2025)		
RSS	71%	
Long-slit		92%
Multi-object		3%
Fabry-Perot		1%
Imaging		1%
Polarimetry		1%
High time resolution		1%
SALTICAM	11%	
High time resolution		22%
HRS	17%	
LR		24%
MR		52%
HR		22%
HS		2%
BVIT	<1%	

Table C2. Breakdown of SALT programs that have been included in publications, by instrument and instrument mode.

C7. Summary

SALT’s scientific output has reached maturity, with nearly 600 refereed publications and a citation impact comparable to global peers. Its cost-effectiveness stands out internationally, and its community has

achieved notable high-impact results, particularly in transient and multi-messenger astronomy.

Program-level analyses show that LSPs and ToOs deliver high returns on investment, while DDT programs also tend to outperform normal proposals in terms of publication rates. RSS continues as the main workhorse instrument, while HRS' scientific output has grown significantly, largely thanks to data pipeline support.

Looking ahead, the strategic opportunities for SALT include:

- Sustaining leadership in transient and rapid-response science.
- Leveraging synergies with multi-wavelength and/or large international facilities such as MeerKAT/SKA, LSST and PLATO.
- Supporting exoplanet science with HRS and the forthcoming Laser Frequency Comb.
- Enhancing productivity through continued development of data pipelines, data quality monitoring tools and active user support.

Overall, SALT has established itself as a scientifically productive, cost-effective, and strategically relevant facility within the global community of large optical telescopes.

D - Detailed SALT SWOT Analysis

The SWOT analysis below summarises the key internal and external factors that influence SALT's strategic position.

Strengths (Internal, Helpful)

- Astrophysics is inherently inspirational and serves as a gateway to STEM fields.
- SALT staff are diverse, dedicated, highly skilled, and passionate.
- SALT produces world-class scientific output, on par with comparable international facilities at similar lifecycle stages.
- Sutherland offers one of the darkest skies in the world (ranked 4th), with minimal seasonal weather variability.
- SALT is hosted by SAAO, which has infrastructure and expertise in key areas such as precision machining, fibre optics, detector, and cryostat laboratories.
- SAAO also hosts several strategic national and international offices, including the African Astronomical Society (AfAS) and the Office of Astronomy for Development (OAD).
- SALT contributes significantly to the socio-economic footprint in Sutherland through tourism, public tours, and educational outreach.
- SALT is highly cost-effective compared to similar-sized telescopes worldwide.
- Its fully queue-scheduled model ensures optimal usage, flexibility, and rapid response to Targets of Opportunity (ToOs).
- All instruments are available at all times, with changes conducted during telescope pointing.

Weaknesses (Internal, Harmful)

- Several founding partners have withdrawn and not been replaced.
- The remote location offers limited amenities, schools, and lifestyle options, making it difficult to attract and retain skilled professionals.
- Infrastructure is ageing — the telescope is now over 20 years old.
- Significant throughput loss due to degraded coatings on the SAC optics, with deterioration accelerating.
- Instruments are no longer state-of-the-art.
- Internal processes, particularly in HR, are inefficient and outdated.
- NRF policy limits permanent positions for non-South African citizens, reducing international appeal.
- Organisational challenges include weak project management, poor performance accountability, and limited institutional agility.
- South Africa faces increasing difficulty in attracting high-profile researchers and scarce skills due to a limited local pool and political and economic uncertainties.
- Administrative compliance burdens are rising without proportional funding support.

- SALT's large collecting area, combined with dark skies, makes it ideal for observing low surface brightness objects (though currently limited by SAC damage).

- The instrument suite is versatile and supports a broad range of science.

High scientific productivity relative to operational cost – competitive cost-per-publication among global 10m-class telescopes

Opportunities (External, Helpful)

- Astronomy's inspirational nature can attract public interest and funding

SALT's low operational costs can be attractive to international partnerships

- SALT holds flagship status within South Africa's international science strategy.

- Technology partnerships and industrial collaboration could lead to innovation and co-development (e.g., as a testbed).

- SALT can extend its global scientific footprint through partnerships in transient observation networks (e.g., NOIRLab, BRICS, African collaborations).

- Integration of AI and automation offers transformative operational potential.

- South Africa's government continues to support astronomy through favourable policy frameworks.

- Career progression and HR policy implementation remain slow.

- Weak international visibility due to SALT's limited presence in major international consortia, unlike competitors like GTC, VLT, or Gemini. This affects proposal competitiveness and visibility

Threats (External, Harmful)

- Lack of interest in the telescope due to the deterioration of throughput could force a telescope shutdown or even closure.

- Loss of international partners endangers long-term funding sustainability.

- Competition from larger, more technologically advanced telescopes may marginalise SALT without a focused niche.

- Political or legislative shifts could deprioritise science in national funding.

- Global political instability can hamper recruitment and retention of international talent.

- Competition from industry makes it difficult to retain skilled engineering staff.

- Reputational risk: instrumentation or throughput fall too far behind, loss of partnerships, or being perceived as non-competitive

- SALT can capitalise on its status as Africa's leading optical facility for capacity development across the continent.

- Funding remains stagnant while operational costs continue to rise.

- The construction of next-generation telescopes prompts SALT to reassess its niche and competitive value.

If instrumentation is not updated, SALT risks being left out of major upcoming survey pipelines

- Strong potential for synergy and/or repositioning as follow-up of major survey projects (e.g., MeerKAT, SKA, LSST, PLATO).

As SALT engages more in international data sharing and uses new technologies there are risks associated with data integrity, cyber security and digital sovereignty.

SALT can serve as a low-cost, high-impact test-bed for novel instrumentation or software.

SALT's soft-power value through training African postgrads and supporting science diplomacy is a unique opportunity

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F – List of Acronyms

ADC	Atmospheric Dispersioncompensator
AGN	Active Galactic Nucleus
ASASSN	All Sky Automated Survey for SuperNovae
BVIT	Berkeley Visible Image Tube camera
DES	Dark Energy Survey
FP	Fabry-Pérot

FWHM	Full Width Half Maximum
GTC	Gran Telescopio de Canarias
HET	Hobby-Eberly Telescope
HR	High Resolution
HRS	High Resolution Spectrograph
HS	High Stability
IFU	Integral Field Unit
JWST	James Webb Space Telescope
KAT	Karoo Array Telescope
LBT	Large Binocular Telescope
LFC	Laser Frequency Comb
LIGO	Laser Interferometer Gravitational-wave Observatory
LR	Low Resolution
LSST	Large Synoptic Survey Telescope
MASTER	Mobile Astronomical System of the Telescope-Robots Network
MaxE	Maximum Efficiency (spectrograph) (AKA RSS Dual, RSS Red)
MeerKAT	Meer-Karoo Array Telescope
MeerLICHT	More Light (in Dutch), optical telescope, shadows MeerKAT
MOS	Multi Object Spectroscopy
MR	Medium Resolution
NIR	Near-infrared
NRF	National Research Foundation of South Africa
PI	Principal Investigator
PLATO	ESA Space Mission: PLanetary Transits and Oscillations of stars
RSS	Robert Stobie Spectrograph
SAAO	South African Astronomical Observatory
SAC	Spherical Aberration Corrector
SALT	Southern African Large Telescope
SAMS	SALT array management system (i.e., edge sensors system)
SARChI	South African Research Chair Initiative

SDSS	Sloan Digital Sky Survey
SKA	Square Kilometre Array
SN	Supernova
STC	Scientific and Technical Committee
SUGAR	SALT Users Group for Astronomical Resources
TESS	Transiting Exoplanet Survey Satellite
ToO	Target of Opportunity
UK	United Kingdom
UKSC	United Kingdom Science Consortium