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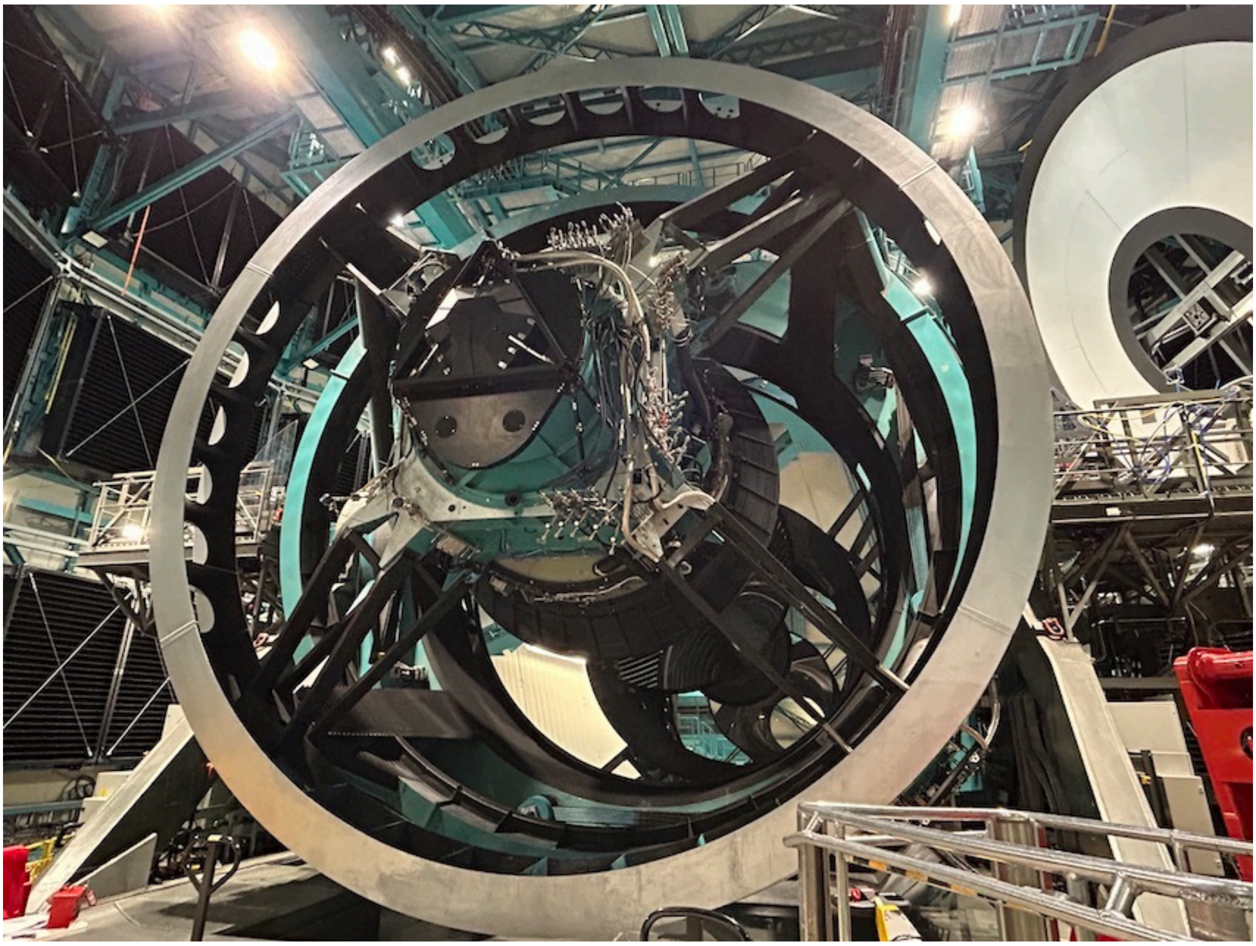
Volume 84 Nos 11-12 December 2025



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Front Cover: Looking down the barrel of the Rubin telescope (camera in the top left, one of the spiders coming down at 4 o'clock, then the secondary baffle with all its fins, then M1/M3 & the various reflections in each surface). This is all extremely confusing to look at, that's part of the fun! See the article on p. 147 by Lisa Crause, who took this picture during a recent visit to "the holy-land of ground-based astronomy".

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News Note: SALT Celebrates Two Decades of Discovery

On 10 November 2025, the Southern African Large Telescope (SALT) marked a significant milestone: twenty years since its inauguration as Africa's largest optical telescope and one of the most powerful of its kind in the world. Officially opened in 2005 by former President Thabo Mbeki, SALT has since become a flagship facility for South African and international astronomy, operating from Sutherland in the Northern Cape.

The anniversary celebrations, hosted jointly by SALT, the Department of Science, Technology and Innovation (DSTI) and the National Research Foundation–South African Astronomical Observatory (NRF-SAAO), brought together scientists, dignitaries and international partners to reflect on SALT's scientific achievements and broader legacy. Prof Brian Chaboyer, Chair of the SALT Board, highlighted the bold decision to design and build the first major optical telescope within South Africa itself, describing it as a courageous step that positioned the country at the forefront of Southern Hemisphere astronomy.

In her keynote address, Deputy Minister of Science, Technology and Innovation Dr Nomalungelo Gina described the government's 1998 decision to fund SALT as a defining moment for national science. Conceived not only as a research instrument but as a driver of education, technology and socio-economic development, SALT has demonstrated how "big science" can contribute to national progress. This vision was echoed by NRF Board Chair Prof Mosa Moshabela, who emphasised the role of strong governance and long-term stewardship in sustaining a world-class facility.

Over the past two decades, SALT has achieved numerous astronomical milestones, including:

- **Kilonova of GW170817 (2017):** Among the first telescopes to capture the optical afterglow of a neutron star merger, contributing critical data to confirm theories of heavy element formation.

- **Exoplanet Microlensing (2019):** Supported the characterisation of newly discovered exoplanets, showcasing SALT's capacity for rapid follow-up spectroscopy.

- **Eight Super-Hot Stars Unveiled (2020):** Identified eight new extremely hot subdwarf stars, advancing understanding of stellar evolution.

- **"Peekaboo" Galaxy Discovery (2022):** Characterised an ultra-low-metallicity galaxy offering a rare local glimpse into early-Universe conditions.

- **Four-Star Multi-Stellar System (2023):** Confirmed the gravitational binding of a unique quadruple star system, informing theories of multi-star formation.

Speaking at the celebrations, SAAO Director Dr Rosalind Skelton reminded attendees that SALT's success is inseparable from the community of Sutherland, whose dark skies make such exploration possible. From this small Karoo town, SALT continues to provide South Africa—and the world—with a window on the universe, as it looks ahead to the discoveries of its next decades.

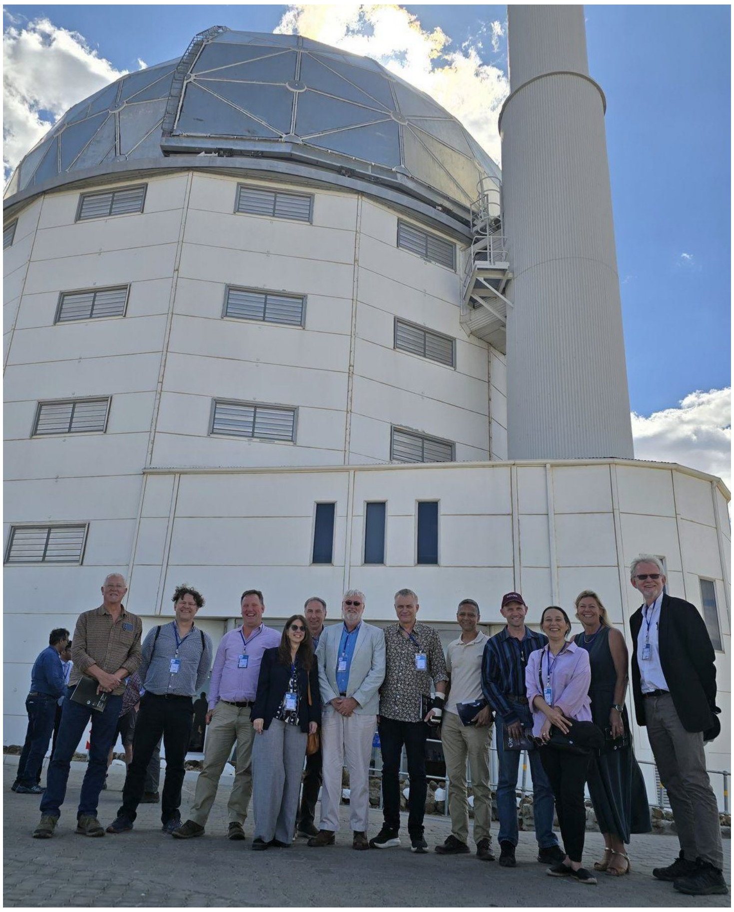

Fig 1: Nearly all the members of original the SALT Project Team attended the event. From left to right: Deon Bester, Hendrik Schalekamp, William Whitaker, Arek Swat (who specially flew in from Europe), Encarni Romero Colmenero, David Buckley, Jian Swiegers, Faried Ebrahim, Willem Esterhuysen, Nazli Mohamed, Mariaan Badenhorst and Kobus Meiring. An engaging interview with Kobus Meiring, SALT Project Manager, was aired on 16 November 2025 on Afrikaans radio – the podcast is here: https://omny.fm/shows/sterre-en-planete/sterre-en-planete-16-november-2025

Fig 2: This momentous event was attended by NRF|SAAO Directors past and present, as well as many dignitaries, many whom travelled in from all over the globe for the occasion. From left to right: Prof Ted Williams, Prof Patricia Whitelock, Prof Brian Chaboya, Cllr Mervin Cloete, Dr Ros Skelton, Dr. Nomalungelo Gina, Prof Mosa Moshabela, Prof Petri Väisänen and Prof Phil Charles.

Astronomical Pilgrimage

Lisa Crause, SAAO

Abstract

Back in September 2025, SALT Observatory Scientist, Lisa Crause and her partner John Booth, retired chief engineer for McDonald Observatory and SALT's older twin, the Hobby Eberly Telescope, made a pilgrimage to the holy-land of ground-based astronomy: The Atacama Desert in Chile. On the hit-list were the four Very Large Telescopes on Cerro Paranal (the VLTs), the staggeringly enormous Extremely Large Telescope (ELT) under construction on Cerro Armazones, and then the mind-boggling Rubin Observatory on Cerro Pachón. With John's son currently working on the ELT, and having worked at Paranal before that, and Rubin before that (back when it was still called the Large Synoptic Survey Telescope, LSST), we were treated to the most fascinating technical tours imaginable for a pair of telescope and instrumentation geeks!

The Very Large Telescope (VLT)

We visited two of the VLT unit telescopes (Antu and Yepun), during the day and then again shortly before sunset while they were being prepared for night-time operations. A huge highlight was being shown around the underground tunnels that house the delay lines for the VLT interferometer. The impressive combination of optical assemblies and precision mechanics used to herd the beams from the various telescopes around is fascinating to see. Another special treat was getting the backstage tour of the huge mirror coating facility, used to re-coat each of the VLT primaries. Of the instruments, we got to see MUSE, KMOS, HAWK-I, FORS2 and ERIS, as well as the enclosure where ESPRESSO lives and a few of the new laser guide star units associated with the GRAVITY+ upgrade. During the telescopes' early-evening limbering up exercises, we watched UT1 slew around elegantly before tilting over to show us its pristine 8.2 m primary, the largest single mirror we've ever eyeballed.

Our visit to Paranal also included a night at the exceedingly zippy European Southern Observatory (ESO) hotel known as La Residencia. This "observatory hostel" was made famous by the James Bond movie *Quantum of Solace*. Most of 20 years later, the place still feels uniquely futuristic. Amazing as it is, we were entertained by the fact that it leaks like a sieve! The Atacama is the driest non-polar desert on earth, typically receiving about 1 mm of rain per year, so a bout of heavy rain is rare and that's when the roof leaks appear... Although we didn't get to see the telescopes open that night, we earned the rare distinction of having been rained on up there!

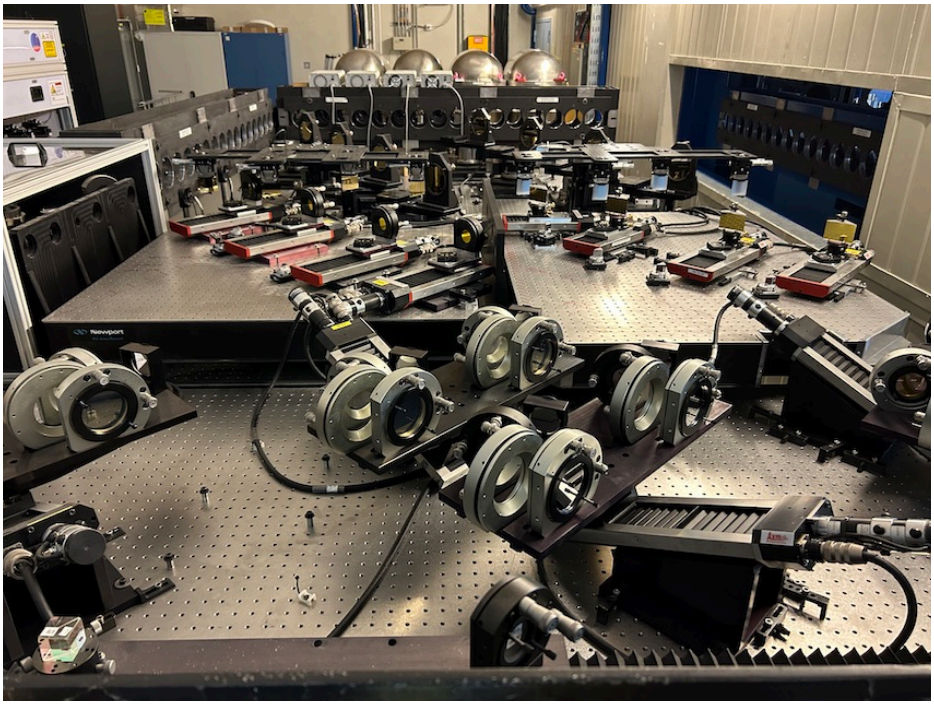

Fig 1: Optics associated with the VLT Interferometer (VLTI) system.

Fig 2: The delay lines for the VLTI.

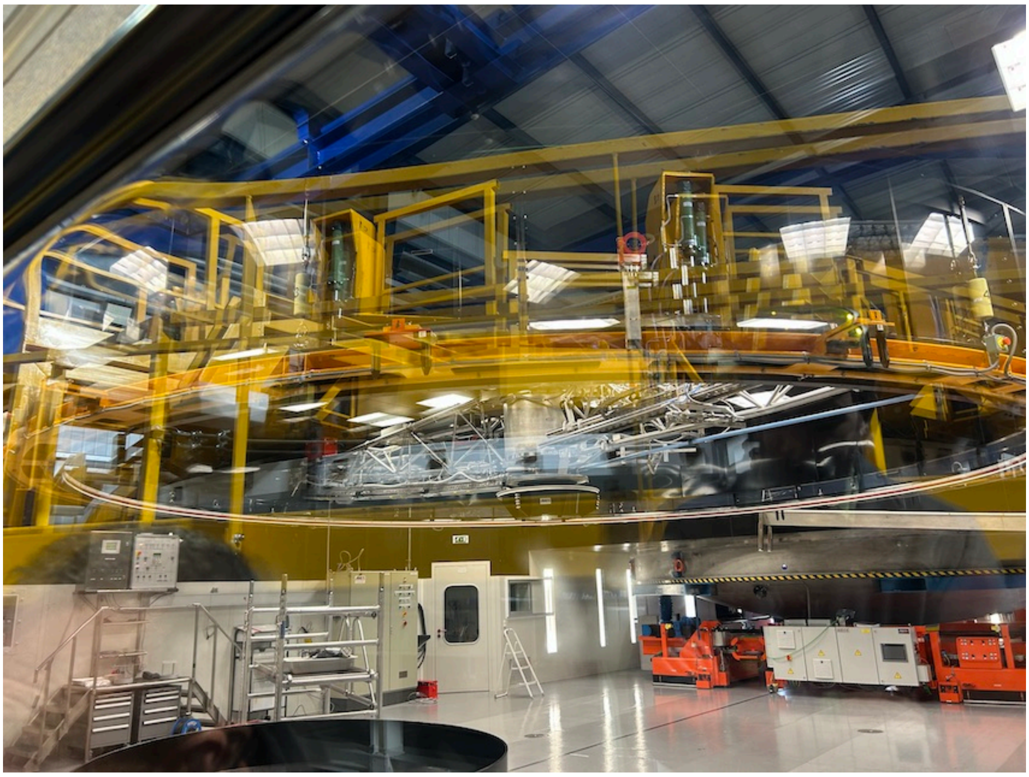

Fig 3: VLT primary mirror coating facility.

Fig 4: UT1 (Antu) showing us its primary mirror.

Fig 5: Inside La Residencia, the ESO hotel on Paranal.

The Extremely Large Telescope (ELT)

The next day we made our way up the nearby hill to the Armazones site, where the ginormous ELT's taking shape. To help put the relative scales in perspective, the two Nasmyth platforms on the ELT are each large enough to carry an individual VLT! The weather was pretty extreme over there too, with ferocious winds and later some sleet as well. Being 80 metres high, 93 metres in diameter and weighing 6100 tons, the rotating part of the telescope enclosure is more like a sports stadium than any kind of dome we've ever seen. Most impressive of all is the fact that all of this, including the eventual 4600 ton telescope structure, is specced to survive a ninth magnitude earthquake! The level of engineering involved in ensuring this is eye-watering. For example, there's a set of 72 leaf springs arranged beneath the telescope, where each "leaf" in a pair consists of an 180 mm thick slab of steel that's more than two metres long and over a metre wide!

The massive truss for the primary mirror is in place and the full set of mirrors is already in storage in a warehouse over on Paranal, alongside the coating facilities for the M1 segments, as well as the chamber for coating the other mirrors (M2-M5). The primary array will consist of 798 individual 1.4 m segments. But given that each ring of mirrors has a slightly different curvature (unlike the 91 1.0 m segments each for SALT and the HET, that are all spherical), the ELT needs over 130 spares! Then M2 is the largest convex mirror ever made, the adaptive M4 is the largest deformable mirror ever built and M5 will be the largest tip/tilt mirror ever deployed on a telescope.

Although ESO gets flack for being incredibly bureaucratic and slow to complete major developments, it's truly impressive to see what's possible when an audacious vision is backed up with a budget to match. At this stage, I'd bet that this will be the only one of the three proposed ELTs that will be built, and humanity probably won't build a larger optical telescope than this one on earth.

Fig 6: *ELT enclosure under construction, with the telescope structure visible inside & the dome shutters being completed.*

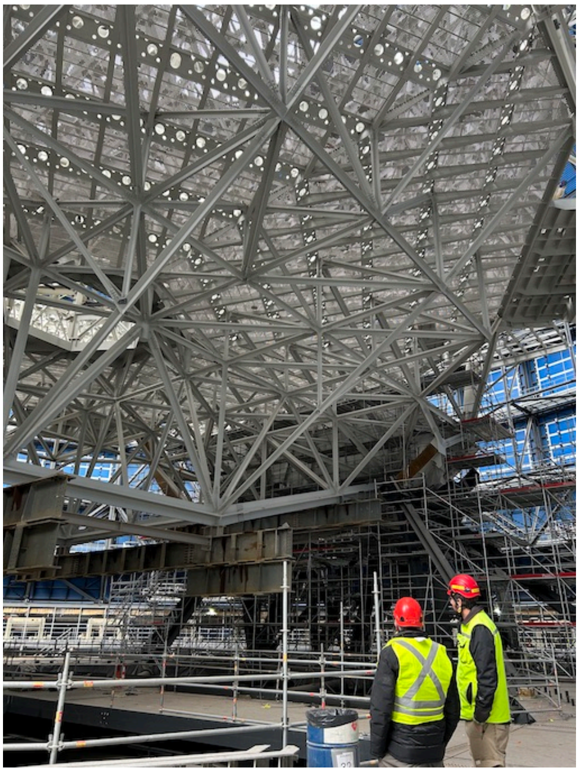

Fig 7: Beneath the ELT primary mirror truss.

Fig 8: Looking up through the ELT primary mirror truss from below, to where the optical tower will house M2, M3 & M4.

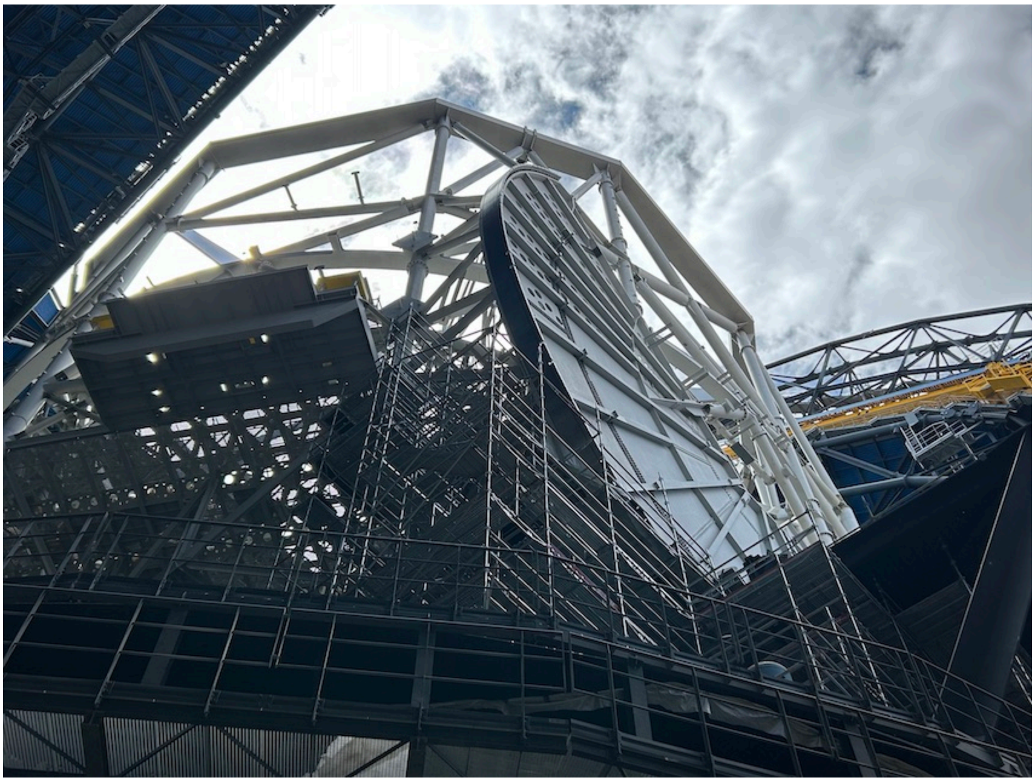

Fig 9: ELT telescope structure with one of the elevation bearings visible near the centre of the image.

The Vera Rubin Observatory

Our final telescope visit for the trip was to Cerro Pachón, a two-hour drive from La Serena, to see the Rubin Observatory. The drive up is spectacular enough in its own right, as the road climbs from sea level to 2700 m in less than 100 km. Then from the parking lot you find yourself staring up at the telescope that's most likely to fundamentally change our understanding of the universe - by repeatedly surveying the southern sky, every three nights, for the next decade.

We started at the very bottom and worked our way up the seven levels to the actual observing floor. We didn't get to see it slew (at the unthinkable 7 degrees/second that it does) as the team had been working on the insanely huge 3.2 gigapixel camera, so the telescope was in its horizon-pointing service position. But that meant we got to look down the barrel and be mesmerised by the incredible M1/M3 mirror, with its two different radii of curvature on a single substrate (see cover picture). The M1/M3 coating facility and all of equipment associated with cooling the camera system were intriguing to see and hear about, likewise for every aspect of the mirror cell, telescope enclosure, shutters, ventilation and calibration systems. Rubin's chief engineer sheepishly apologised for rambling on, our five-hour tour was by far the longest he's ever given. We could not have been more honoured, or blown away by this wicked beast of a telescope!

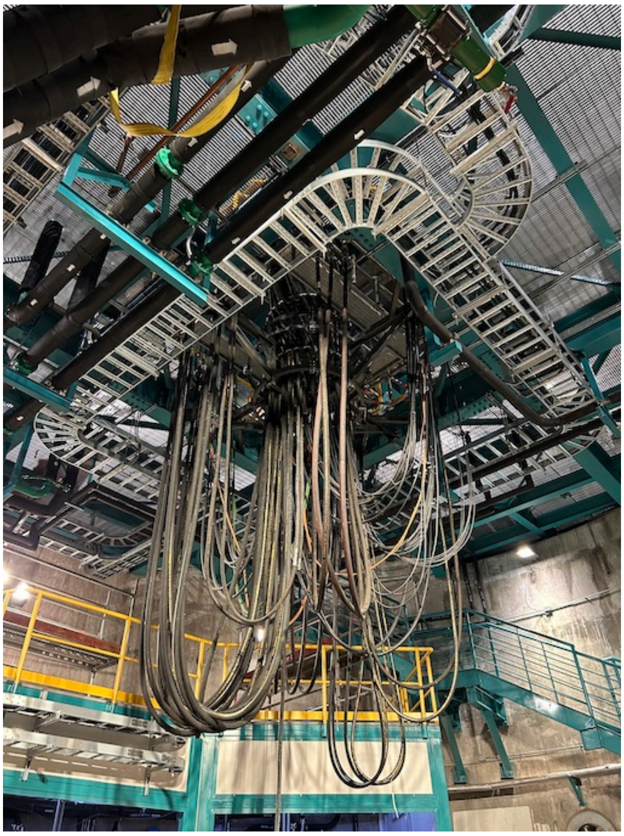

Fig 10: Proctologist’s view of Rubin telescope, showing all the cooling pipes & other utilities etc coming down through the telescope's central may-pole structure.

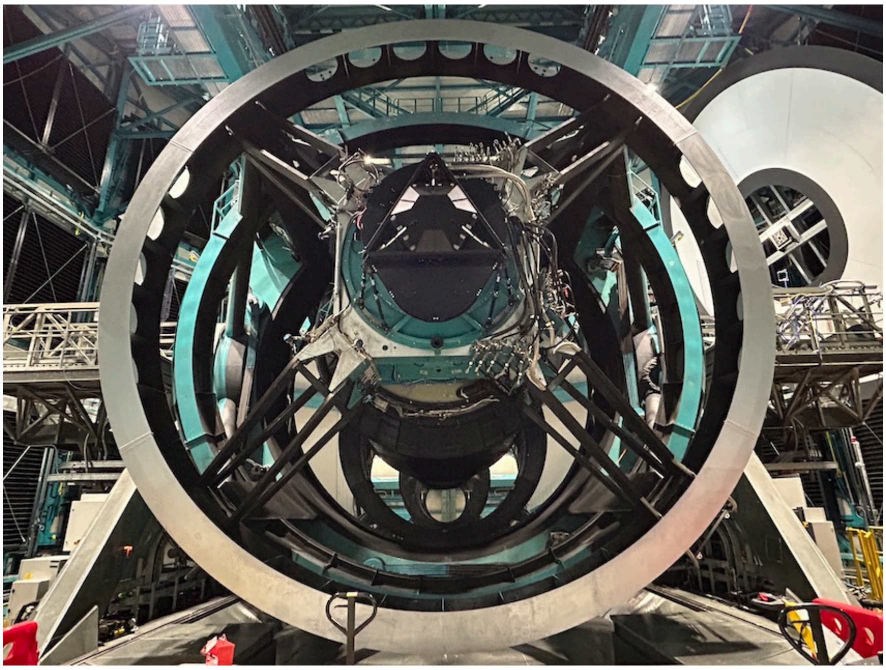

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Fig 11: Straight “down the barrel” view of Rubin, while in its horizon-pointing service position

Fig 12: Exterior view of Rubin, with a crane being tested.

Chilean Landscapes

Beyond all the telescopes, we soaked up as much as we possibly could of the countless other-worldly landscapes in northern Chile. The scenery out there is truly unbelievable: volcanoes everywhere, salt flats, a geyser field, bright blue high-altitude lakes, colourful rock formations, maze-like canyons and more. We fell completely in love with the country - with its spectacular landscapes, dark skies, delightful people, and the Pisco Sours (be sure to order them "catedral" to get a meaningful size glass). And if you spend any time in San Pedro de Atacama, be sure to visit the absolutely brilliant Museo del Meteorito at the edge of town. Don't be put off by the place's humble appearance, a wealth of information is Superbly well presented and the staff are completely wonderful. If you're not careful, you could even end up bringing a fragment of the asteroid Vesta back home with you!

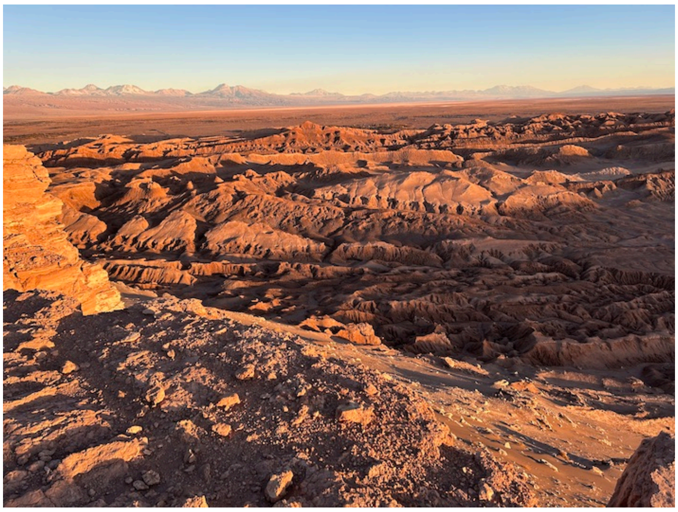


Fig 13: Overlooking part of Valle de la Luna (the Valley of the Moon) near San Pedro de Atacama around sunset.

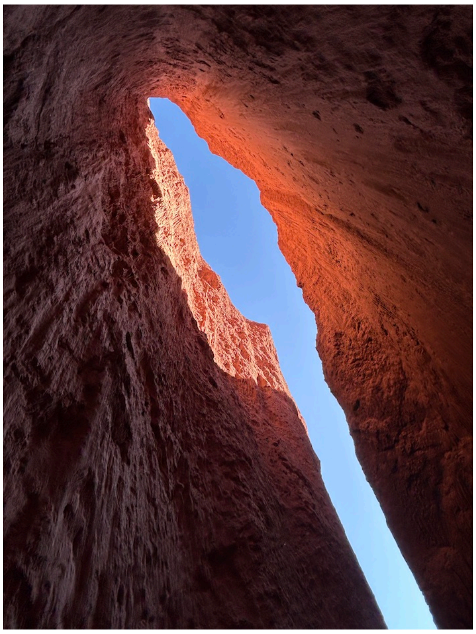


Fig 14: Looking up at sunlight blasting into a box canyon in Valle de Arcoris (Valley of the Rainbow).

Fig 15: One of the spectacularly beautiful Lagunas Altiplánicas, high altitude (4200m) lakes, this one is Laguna Miñiques.

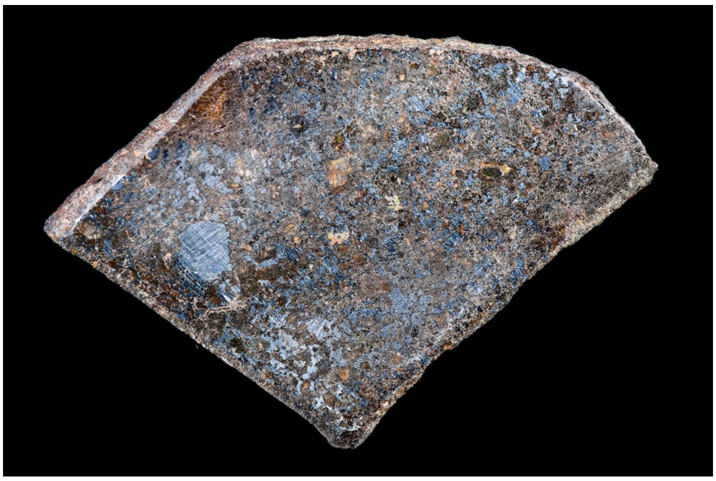


Fig 16: A small fragment of meteorite (found in the Atacama) purchased from the museum to turn into a pendant, known to be a part of the asteroid Vesta.

Fig 17: Meteorite museum in San Pedro de Atacama

Early Upgrades to the 74-inch telescope

I.S. Glass (SAAO)

Introduction

When the Radcliffe telescope came to Sutherland in the 1970s it was sorely in need of updating. This article outlines my recollections of the work we did during its first years at SAAO. The instrument had been completed mechanically in 1938 by Grubb Parsons in Newcastle upon Tyne but the optics had only arrived from 1948 onwards. It was originally located at the Radcliffe Observatory in Pretoria but was sold in 1974, complete with its unusual turret “dome”, to the CSIR, for use at the SAAO. Dismantling at the old site began in October 1974 and re-erection was completed in Sutherland in January 1976.

Recollections

I had used the telescope in Pretoria on several occasions from 1972 until 1974 and looked forward to its arrival in Sutherland. Sir Richard Woolley was then director of SAAO and insisted that the telescope should be moved “as is”. His term as director was due to expire at the end of 1977 and he was anxious that the instrument should be working again well before that.

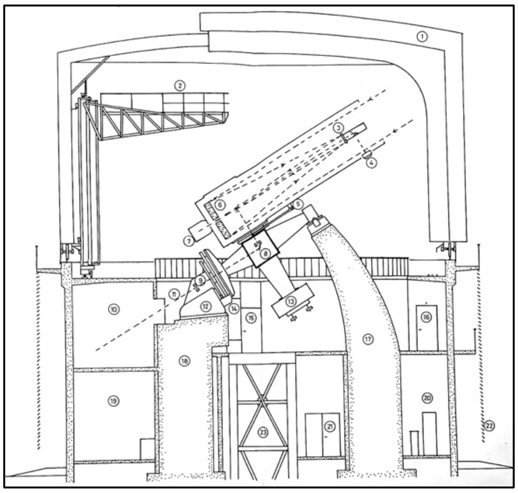


Fig 1: Section of the 74-inch telescope and dome as installed at Sutherland. The polar axis had to be tilted more than in Pretoria on account of the latitude change. The encoders were located at points 8 and 9, inside the “cube” and near the coudé focus.

By 1976 the telescope was 38 years old and quite old-fashioned. It had already been subject to various improvements and occasional ad-hoc repairs. The main change had been that the original clock drive and slow-motion controls had been altered from a tuning-fork controlled system to a newer version with quartz crystal control and a complex system of motors, valve-generation electronics and differential gears, driving a final servomotor.

The telescope was difficult to set precisely, the slewing controls being very crude. It was hard to get a setting accuracy better than about two arcmin (the positions had to be precessed in advance for the current date). There were separate drives for slewing and fine motions, engaged by clamps or clutches as appropriate.

The original RA slewing mechanism was so coarse that it had already been removed in Pretoria and replaced by a steering wheel! Usually, one had to use one of the two side-mounted finder telescopes and a finding chart, viewed with a red torch, perched on the top of a ladder, after setting the telescope as accurately as the circles would allow. Because of the sheer size of the telescope and its asymmetrical English mount, if working at the usual Cassegrain focus, one was from 2 to 6 metres above the floor. This meant climbing one of several structures such as movable steps, an old observing chair inherited from some ancient refractor or a sort of climbable tower that could be wheeled around and wound up to the desired height (not forgetting to check each time that it was properly latched!). After using the finders, the steps had to be moved to the eyepiece of the instrument at Cassegrain for the actual observation. Then the final centering had to be done with chart and red torch. No television finders in those days! Not surprisingly, there were several accidents over the years. The setting procedure was quite time-wasting unless one was observing a bright object. Finding charts for faint things were a problem since we then had no Digitized Sky Survey and the Schmidt Charts for the southern hemisphere did not yet exist. On a typical night, doing photometry, with perhaps 30 settings of the telescope, one climbed several hundred metres.

While making an observation, one always had to watch whether the turret needed to be rotated to keep up with the telescope’s motion.

The instruments being used during most of the earlier years at Sutherland were the “Unit Spectrograph” that had been made around 1970 and boasted the latest image detectors then available for spectra. This was the generation of the Carnegie 2-stage image tube whose output was recorded photographically and the McGee electronographic Spectracon that recorded the spectra on a nuclear emulsion (a photographic-type process). There was also a UBVRI “Peoples Photometer” and my infrared photometer. All these had been built at the Royal Greenwich Observatory. In very occasional use was the original “2-prism” Casella spectrograph, which was purely photographic, by David Thackeray, the last director of Radcliffe. The coudé spectrograph and Newtonian plate camera were also put to work from time to time, requiring the careful interchange of auxiliary mirrors. To the latter a photoelectric “Radial Velocity Machine” had been added.

Fig 2: The first warm room in the 74-inch. On the left is the Nova computer with a 2.5MB(!) disc drive, a paper tape reader and a Teletype terminal. On the right is the infrared recording equipment with paper tape output and a chart recorder.

The first thing we did to upgrade the telescope was to put encoders on the axes so that we would have much better pointing accuracy (Glass, 1978). It was necessary to find encoders that could be installed on-axis yet did not obstruct the coudé beam. Fortunately, I was able to find a pair with 19-bit (approx. 2 arcsec) resolution that had large enough hollow centres yet small enough outer diameters to fit into the small spaces available. These had to be mounted dead concentric with the axes and dead perpendicular to them and had to be protected against any slop in the axial bearings. To read the encoders and apply a pointing model to get the best results from them, allowing for flexure of the telescope, non-perpendicularity and misalignment of the axes, we interfaced the encoders to a Nova minicomputer and built special displays. To accommodate the computer we built a small warm room. The epoch of the positional display could be set. Alaistair Walker wrote the initial programme. Extensive pointing tests led to the adoption of an empirical pointing model.

While we were at it, we decided to encode and automate the dome rotation. The dome is driven by two big old 3-phase motors on opposite sides though a rack-and-pinion system. Robin Catchpole and I counted the teeth on the rack and found they came to 1912. The pinions had 16 teeth each. We checked several times. 1912 is 8 x 239, the latter a prime. So, if we could reduce the pinion by 2:1 and somehow acquire a worm wheel with 239 teeth, we could drive an absolute encoder that turned once for each turn of the dome. Unfortunately, nobody wanted to make a 239-tooth gear and we had to resort to hollowing out one with 240 teeth, removing 1 tooth, and fixing it onto a new centre. This worked just fine. Luis Balona helped by devising an algorithm that yielded the necessary azimuth for an English mount in a cylindrical dome. Since the dome motors worked at a single speed, we had to devise a "bang-bang" control system that allowed for coasting after the power was removed.

Looking by eye for faint objects such as obscured infrared sources, quasars or Magellanic Cloud stars is often very difficult because they can be near the limit of human vision. Fortunately, a type of television camera tube called the Intensified SEC Vidicon was then becoming available. Whereas most TV camera tubes are designed to be read 50 or 60 times per second, the ISEC Vidicon could be made to accumulate photoelectrons for up to tens of seconds. They could therefore detect stars much fainter than by eye. We therefore decided to purchase one of these cameras. They came with an early form of digital image store to drive a TV monitor. Getting hold of one of these systems was very difficult as they were made in the USA and for some reason were regarded as military equipment (although they were far too delicate for any military purpose). Nevertheless, we succeeded in acquiring one and I designed a simple focal reducer (Glass, 1979) to couple the it to whatever instrument was being used on the telescope at the time.

One of the major deficiencies of the telescope had for years been the slow-motion drive in declination, used when setting and guiding. This system made use of a screw driven through a gear-train, operating on a nut. There was inevitably some looseness in the screw-nut connection and in the bearings of the screw. Added to this, the rotation of the telescope on the declination axis was very stiff. As a consequence, the telescope responded erratically and with a lot of delay when the guiding or slow-motion buttons were pressed. My solution to this was to install a ball-screw, driven by a stepping motor through a low-backlash gearbox. This solution greatly improved the response, though it never achieved an exact 1:1 relationship between the number of steps commanded and the actual angle moved in declination! Later, when automatic nodding (frequent precisely-controlled movement of typically 30 arcsec in declination) was required, I added an incremental encoder running against a steel band around the original declination circle to measure offsets to better than one arcsec.

Not long after this we junked the second-generation Grubb-Parsons slow-motion drive in Right Ascension. Fortunately, the original worm and wheel system was very precise and we could concentrate on driving the worm through a stepping motor, which allowed for a relatively simple approach to well-controlled sidereal driving, guiding and setting. The SAAO Electronics Group produced a new modular drive that became the standard for this and the other Grubb-Parsons telescopes.

Many years before, the small electric motor that drove the Right Ascension clamping mechanism connecting the axis to the wormwheel had expired and been replaced by an electric drill with the handle cut off! This had worked so well that it was one of the few motors that we never changed. A similar temporary (from Pretoria days) focus motor, based on an old water pump, was however replaced.

The RA slewing drive – that with the steering wheel – was the next to receive attention. The original one-speed motor had obviously never been a good idea and had long since disappeared. Likewise, the solenoid-operated clutch. The new RA slewing motor was a permanent-magnet DC type with a tachometer feedback allowing its speed to be set to any value. It was connected through a 30:1 reduction gearbox and a dog clutch to the existing, unused, slew gears. This clutch was a small, self-contained, unit with internal electromagnetic actuation.

The original Declination slewing drive was located within the counterweight. It utilized a DC motor running at 1500 RPM and a cone clutch (probably not original) operated via a lever from an electromagnet. The outer counterweights had to be re-designed to allow access to the inside. The DC motor was substituted by an AC washing machine motor with two configurations, giving speeds of 3000 and 375 RPM. Both speeds were made reversible and it drove the previous shaft though a 2:1 belt drive. Since the original cone clutch was orientated in a direction affected by the position of the telescope (and as a consequence was very touchy to adjust), a new electromechanical dog clutch was fitted.

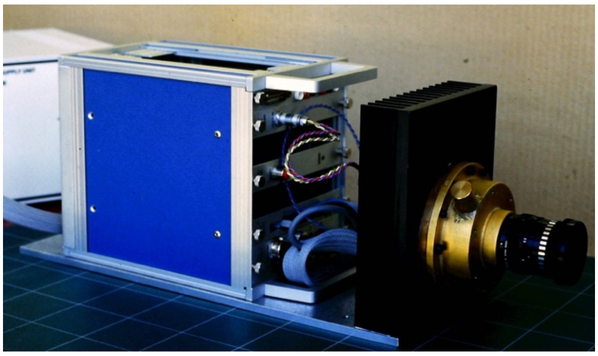
The clamp that engages the declination slow motion drive operates a plunger in a groove adjacent to the declination circle and was originally controlled only in position. Because of the unevenness of the groove, it was almost impossible to adjust into a reliable state. This had been replaced already in Pretoria with a force-limited plunger that had ensured a firm grip and was consequently left in place.

Finally, the hodge-podge of setting control switches and push-buttons was replaced with a single box on each side of the north pier, so that the telescope could be operated from either position. Though usually it was used “telescope east”, the whole telescope could be pointed to the south pole and turned over to work “telescope west” when objects low in the east were to be observed.

During a visit in 1975 to the Mount Stromlo 74-inch, a younger brother telescope of ours, I found they had an electrically operated scissors lift that could be driven around the observing floor and set to a convenient height. They had just acquired a bigger one to carry a large amount of auxiliary electronics and were willing to sell the original to us. This eased many of the telescope operations.

The 74-inch received a gold-coated f/50 “chopping” secondary around 1981 for use with the infrared photometer. This made it an exceptionally low-background instrument for infrared work and increased the sensitivity obtainable at longer wavelengths. At around the same time, the photometer was made remotely operable from the 2nd generation warm room (built when a Boksenberg digital detector was installed on the spectrograph). However, it was still necessary to set the telescope from within the dome because of the vigilance required. It was all too easy to crash it into the south support pier, for example.

Fig 3: Thermoelectrically cooled CCD camera attached to a SAAO Transputer-based CCD controller. This was designed to fit into the mount used by the previous ISEC vidicon camera.



Finally, and much later, I designed an acquisition camera based on a frame-transfer CCD with thermoelectric cooling to replace the ISEC Vidicon, enabling the addition of seeing monitoring and autoguiding. My original software was later improved by Peter Henning, Patricia Whitelock and others (Glass et al, 1995).

When first installed in Pretoria, the mirrors had to be removed and silvered every few months. Silver coatings had the further disadvantage that they did not reflect ultraviolet light. In 1959 an aluminizing plant was built and this was, of course, moved with the telescope to Sutherland. However, it was found that the coatings that were being obtained were of poor quality. I renovated a simple reflectometer which revealed, after extensive experiments by Drummond Laing and Eric Banner, using pieces of plate glass, that the coatings being applied were too thick and the appropriate correction measures were taken.

Fig 4: The 74-inch in its orange coat! Attached at Cassegrain is an infrared photometer with the ISEC camera in blue. The F/50 infrared chopping secondary, only 18cms in diameter, is in place (Photo: Cibachrome by RM Catchpole).

The original colour of the telescope had been a kind of dull green in Pretoria, followed by a battleship grey in Sutherland. When the need arose for a new coat, I suggested an orange colour, similar to what we had used on our refrigerator at home. I tried it out first on our model of the telescope in Cape Town and decided it was just right! Orange is a good colour to use to make the telescope visible with a red torch!

Afterword

The Unit Spectrograph was the recipient of many modifications over the years. Following the relatively short visit of the "Boksenberg device", it received an intensified dual-array Reticon detector. As a "temporary" measure, in 1996 a long-format CCD was installed. This was cooled from a liquid nitrogen reservoir cooled through a "cold finger" because of its orientation at 45° to the horizontal (following my suggestion). It was only de-commissioned in 2014, when it was replaced by SpUpNIC in 2015 – a much improved instrument with an efficient Schmidt camera and a large-format CCD detector (See, for example, Crause 2015).

The telescope is now (2025) more than twice as old as it was when moved to Sutherland and it is therefore not surprising that it has undergone many changes during the two decades since I was involved with it. A PLC (Programmable Logic Controller) system now controls the telescope and dome functions, allowing for automatic and even remote operation. These improvements were designed, built and installed by Piet Fourie and the on-site Mechanical Technician John Stoffels (see also van Gend, 2016).

As the coudé focus was no longer used, it was possible to fit better, more compact and more easily adjustable axial encoders, now with 20-bit resolution.

The declination slewing drive had to be replaced with an entirely new one, mounted externally, following an accident that damaged the original gearing in November 2007. At the suggestion of James O'Connor, a motor with a variable speed drive now engages an external gear originally intended for use with the small vernier declination indicators. A new RA motor with adjustable speed and a worm reduction gear are connected via the clutch in a way that overcomes a previous problem that freed the telescope to move uncontrollably if the power failed. There was also an interval between disconnecting the quick motion and engaging the slow, which has now been eliminated. This last problem was a nuisance when operating the telescope automatically.

Piet Fourie wrote further in a WhatsApp:

"One thing I did not mention is the dome rotation. The original motor control cabinet dating from the 1930s was replaced by a newer unit. The original control cabinet I had mounted in the entrance foyer of the building since it is such a beautiful example of the engineering when the telescope was built. The new controller is the size of a shoebox. All the drive systems of the dome shutters and windblind were replaced with new motors and frequency controlled drivers."

Acknowledgements

While I suggested nearly all the earlier modifications mentioned here and even made detailed designs for some of them, the changes would not have been possible without the expertise of the technical staff. The work involved mechanical design and construction, electronic engineering, computer programming at many levels, optical, cryogenic and vacuum expertise.

I would like to thank Piet Fourie for bringing me up-to-date on the changes that have been made over the last few years.

References

Glass, I.S., 1978. *MNASSA*, **37**, 4-8.
Glass, I.S., 1979. *MNASSA*, **38**, 38.
Glass, I.S., Carter, D.B., Woodhouse, G.F.W., Waltham, N.A., Newton, G.M., 1995. In Proc IAU Symposium, 167, New Developments in Array Technology and Applications, ed. AG Davis Philip, Kluwer, Dordrecht, 321-322.
Crause, L., 2016. *Quest*. **12,** #4, 15.
Van Gend, C., 2016. *Quest***, 12,** #4, 19.

Recent Southern African Fireball Observations Events # 535-544

Tim Cooper, Director, Comet, Asteroid and Meteor Section

This article continues the sequential numbering of reported fireball sightings from southern Africa. By definition, a fireball is any meteor event with brightness equal to or greater than visual magnitude (mv) -4. The following events were reported to the author and details are reproduced as given by the observer [any comments by the author are given in brackets]. Where the report originated from the American Meteor Society Fireball page, the corresponding AMS event number is given. All times were converted to UT unless stated, and all coordinates are for epoch J2000.0. Solar longitudes were calculated from the SollongCalc app by Kristina Veljkovic, Department of Probability and Statistics, Faculty of Mathematics, University of Belgrade, Serbia, accessed through the IMO webpage at https://www.imo.net/resources/solar-longitude-tables/. Descent angles, if given, are in degrees, with directly upwards = 0°, horizontally left to right = 90°, directly downwards = 180° and horizontally right to left = 270°. Azimuth angles are reckoned from north = 0°, through east = 90°.

Event 535 – 2025 October 29 – Touwsrivier, Laingsburg, Western Cape

Captured by GMN camera ZA0006 operated by Touwsrivier Primary School at 23:58:09, solar longitude 216.47°, screengrab shown in Figure 1. Path from RA/Decl. 10h24, -56.7° to 10h30, -51.5°.

Fig 1: Event 535 captured by GMN camera ZA0006 on 29 October 2025. Just above right of the fireball is the eta Carina region, and Vela is in the centre of the image.

Fig 2: Event 535 captured by GMN camera ZA0008 on 29 October 2025. The constellation Musca is immediately beneath the fireball, and below centre is Apus.

Captured by GMN camera ZA0008 operated by Laingsburg High School, screengrab shown as Figure 2. Path from RA/Decl. 11h31, -73.9° to 11h54, -70.5° and the fireball was possibly Northern Taurid.

Event 536 – 2025 November 5 – Bonnievale, Touwsrivier, Western Cape

Captured by GMN camera ZA0002 operated by ASTRONOC, Bonnievale at 00:46:59, solar longitude 222.50°, screengrab shown as Figure 3. The sky was covered in thin clouds at the time, and the fireball ended in a very bright terminal burst which made astrometry difficult, nevertheless path determined from RA/Decl. 01h42, -34.4° to 00h10, -52.1°.

Fig 3: Event 536, bright Taurid fireball captured by GMN camera ZA0002 on 5 November 2025.

Captured by GMN camera ZA0007 operated by Touwsrivier Primary School at 00:46:59, screengrab shown as Figure 4. Path from RA/Decl. 00h20, -61.0° to 21h44, -68.0° and there is excellent agreement from both paths as a Northern Taurid.

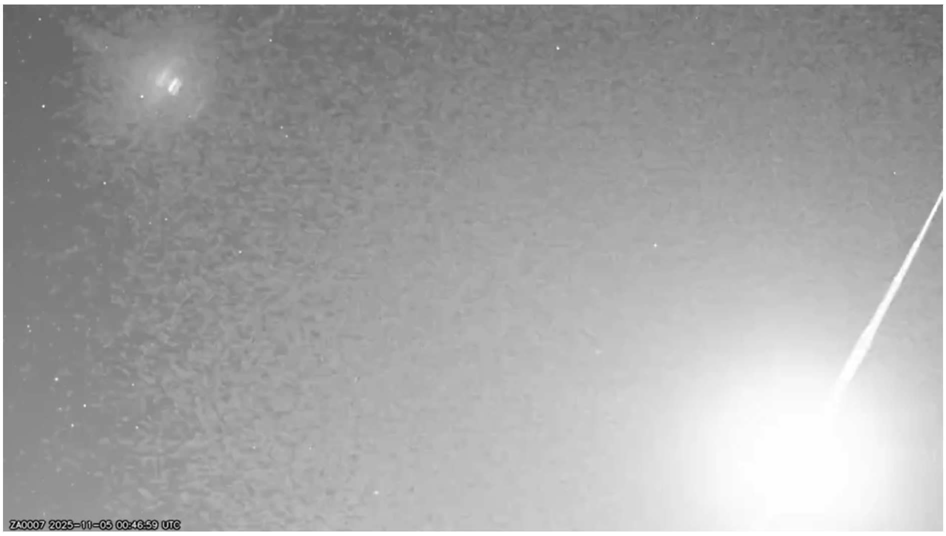


Fig 4: Event 536 captured by GMN camera ZA0007 on 5 November 2025.

Event 537 – 2025 November 6 – West Nicholson area, Zimbabwe

Observed by Dianne Drummond at 17h30, solar longitude 224.2°, it was a cloudy evening and the sky was also bright from the near-full moon which had just risen. The fireball was seen through an area where the clouds were thinner, duration 3 seconds, starting yellow and became green as it descended, path from close to the position of Saturn and descending towards the west where it faded out, no terminal flash or fragmentation observed. From the general description of the path the object was probably sporadic.

Event 538 – 2025 November 9 – Hermanus, Western Cape

Two reports were received of a fireball seen between 19h30 and 19h45, solar longitude 227.3°. Observed by Wanya van der Walt who gave the duration as 7-8 seconds, mv about -9 [about as bright as a 6-day old crescent moon, not visible at the time], bright yellow and orange colours, no fragmentation or terminal flash reported. Path from az/alt 260°, 62° to 300°, 16°, which is RA/Decl. 21h45, -35° to 20h00, +14°.

Observed by Zoë Mathee, duration about 15 seconds, said ‘I thought it was a satellite at first but it had an orange/blue streak behind it as it went down past the mountain’. The fireball was sporadic. AMS Event 8266-2025

Event 539 – 2025 November 11 – George, Western Cape
Captured by GMN camera ZA000D operated by Johann Swanepoel at 01:32:51, solar longitude 228.55°, screengrab shown as Figure 5. Bright meteor with terminal flash, path from 09h50, +1.5° to 11h10, -5.8°, and the event was probably Anthelion (Northern Taurid).

Fig 5: Event 539 captured by GMN camera ZA000D on 11 November 2025. The 63% waning gibbous moon is just outside frame upper left. The bright star above the fireball is Alphard (alpha Hydrae) and closest star to the left of the fireball is Regulus (alpha Leonis).

Event 540 – 2025 November 12 – Pinehurst, Western Cape
Observed by Justin de Reuck at 18h35, solar longitude 230.3°. Duration 2 seconds, definitely brighter than Venus [not visible at the time], white colour and left a persistent train visible for 1 second. No fragmentation or terminal burst. Path from RA/Decl 17h27, -56.4° to 20h33, -11.3°, and the fireball was sporadic.

Event 541 – 2025 November 15 – Touwsrivier, Western Cape
Captured by GMN camera ZA0006 operated by Touwsrivier Primary School at 21:06:34, solar longitude 233.40°, screengrab shown as Figure 6. The weather was partly cloudy at the time, but from manual astrometry path from RA/Decl. 06h30, -36.8° to 07h53, -47.8.

Fig 6: Event 541 captured by GMN camera ZA0006 on 15 November 2025. The star just below the artefact is gamma Velorum, and the star below left of that is zeta Puppis. The False Cross is at right but obscured by cloud. Canis Major is at bottom left but is similarly obscured.

Fig 7: Event 541 captured by GMN camera ZA0008 on 15 November 2025. The constellation of Apus is below centre and top left are stars in Volans.

Captured by GMN camera ZA0008 operated by Laingsburg High School at 21:06:38, screengrab shown as Figure 7. The weather was clear, and the start of the fireball was outside the field of view, path from RA/Decl. 06h04, -71.0° at the point it enters the frame to 08h43, -79.7°. There are several bright flaring events along the path before burning out. The fireball was probably Northern Taurid.

Event 542 – 2025 November 20 – Worcester, Western Cape
Observed by Dillon Bennett at 20h20, solar longitude 238.4°. Duration 3 seconds, said extremely bright orange head and tail, head much brighter than the full moon [not visible at the time]. Path descending downwards to the left of Orion from az/alt 59°, 45° to 52°, 20°, that is RA/Decl. 04h00, -5° to 05h00, +17° and the fireball was sporadic. AMS Event 8878-2025.

Event 543 – 2025 November 30 – George and Strand, Western Cape
Captured by GMN camera ZA000D operated by Johann Swanepoel at 18:33:52, solar longitude 248.45°, screengrab shown as Figure 8. Path from RA/Decl. 03h30, -19.2° to 04h43, +17.8°.

Fig 8: Event 543 captured by GMN camera ZA000D on 30 November 2025. Orion is at the bottom of the frame, the bright star just above the termination of the path is Aldebaran (alpha Tauri), and at right is Canopus (alpha Carinae).

Observed by Katya Zoio, duration 7-8 seconds, yellow colour and as bright as the moon which was then 76% illuminated, magnitude -12, altitude 49° in azimuth 8°. Path from az/alt 150°, 53° to 94°, 22°, that is RA/Decl. 02h48, -62° to 05h06, -15°. The fireball disintegrated before burning out, leaving no persistent train, but Katya said she 'heard a crackling sound concurrent with the meteor; it appeared to break up as though it hit something, one bit [appearing] to fly backwards' [possibly a trailing fragment]. The fireball was probably sporadic. AMS Event 9349-2025.

Event 544 – 2025 December 11 – Mossel Bay, Western Cape
Observed by Pamela Gauto at 19h50, solar longitude 259.7°. Duration less than 1 second, orange colour, mv = -7, no terminal flash, fragmentation or persistent train. Path from az/alt 6°, 30° to 38°, 46°, that is RA/Decl. 03h00, +25° to 04h20, +3° and the fireball was sporadic. AMS Event 9875-2025.

Acknowledgments
Thanks to Bob Lunsford for forwarding fireballs reported to the AMS website (https://www.amsmeteors.org/fireballs/fireball-report/).

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