SALT NEWSLETTER

ISSUE DECEMBER 2020

Southern African Large Telescope,
Sutherland, South Africa
Cover image: Michele du Plessis

TOPICS

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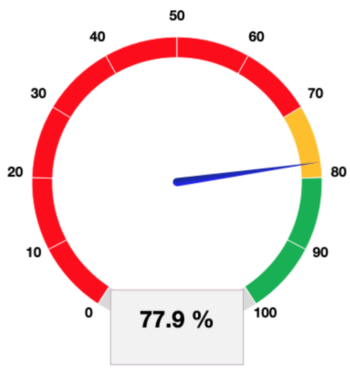
LETTER FROM THE HEAD OF ASTRO OPS

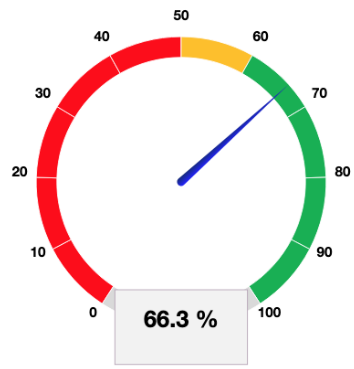
Dear SALT Community,

A lot has happened since our last newsletter back in April, when the lockdown/social distancing was just starting and we were all struggling to get used to the new normal. Fast forward only a few weeks and, at the beginning of May, we were back on sky, observing your proposals! It has been a very busy semester, with a lot of high priority targets to get through at the beginning of the night. Luckily, the weather cooperated and we managed to observe a grand total of over 1567 blocks, nearly 78% of all P1s, over 66% of all P2s and over 80% of all of our blocks for semester 2020-1.

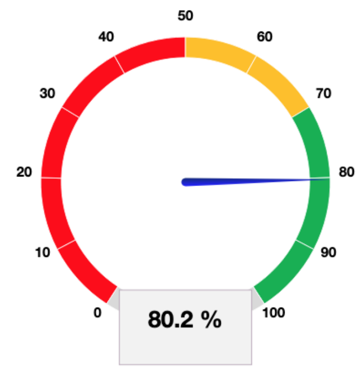
P1 SEMESTER TO DATE



P2 SEMESTER TO DATE



P0-P3 SEMESTER TO DATE



OK, I may have made it sound easy, but getting remote operations going was a huge effort from everyone: the SAs and SOs working out how to operate SALT from their own homes; the SAAO arranging office space, safety procedures, accommodation and permits for those who could not operate from home; the technical crew getting the telescope sounds streamed, finding solutions to all of the possible risks and taking up a lot of the hands-on tasks that were regularly done by the night staff... and all in the space of a few weeks. I cannot stress enough how amazing this was, the entire SALT and SAAO teams are awesome and I am hugely proud of this achievement. We totally rocked! :)

The good news doesn't stop there: we are also very pleased to have recently completed two of our top priority projects: we have upgraded our primary reductions pipeline and released the SALT data archive (https://ssda.saao.ac.za/). In addition, the SALT Fabry-Pérot project is progressing well, and we expect the arrival of Dr. Liz Naluminsa, our new SALT FP postdoc, as soon as her work permit has been processed. You can read more about these projects and even more exciting news in the articles below.

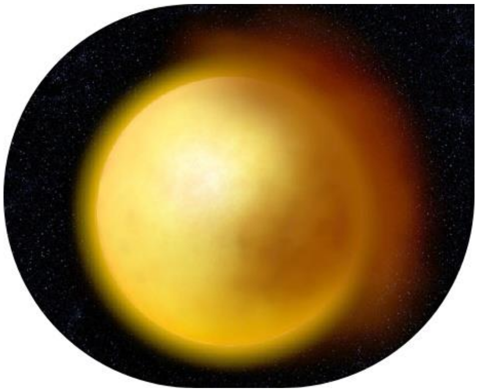
Finally, hot of the press: our preliminary results on the HRS-HS mode using simultaneous ThAr are extremely promising - so watch this space!

Unfortunately, not all the news is good. A few months ago we discovered that a configuration change in the HRS files made in January had accidentally changed the dimensions of the HRS images. This caused the HRS MIDAS pipeline to occasionally produce incorrect wavelength calibrations. The good news is that the fix did not take as long as we feared and affected PIs received an email from the team soon after announcing that the corrected files are ready to download. A special thank you to Deneys, Enrico, Alexei and Rudi for their prompt response! :)

During this time, we have also had to say goodbye to one of the SAs, Dr Marissa Kozte, and to one of our software developers, Sifiso Myeza, as they both resigned at the end of July/beginning of August. They have both left big shoes to fill and we miss them already - and we wish them all the best in their future endeavours!

Clear skies and stay safe!
Encarni

SCIENCE HIGHLIGHT

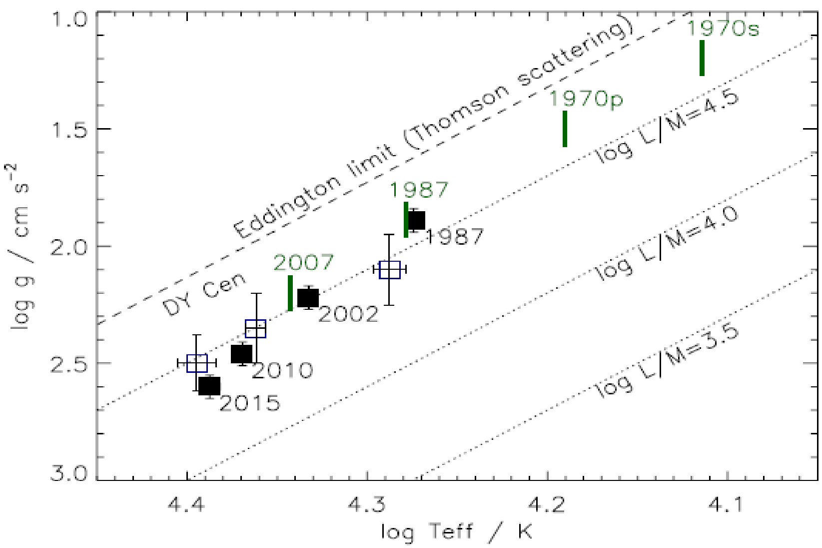


DY Centauri - stellar evolution while you watch.

In 1930, Dorrit Hoffleit reported that star number 4749 in the Harvard List of variables had faded four times between 1897 and 1929, and identified it as an R Coronae Borealis (RCB) variable. RCB stars are luminous low-mass stars (red giants) with surfaces around 5,000 - 7,000 K — not much hotter than the Sun. They are remarkable for having little or no hydrogen on their surfaces; this is replaced by helium and carbon. They dim by factors of 100 or more every so often by ejecting clouds of carbon, or ‘soot’. When thrown towards Earth, soot clouds block the starlight, until they expand enough to let the light through once more. Being in the constellation of Centaurus, H.V. 4749 was given the variable star name DY Centauri, or DY Cen for short.

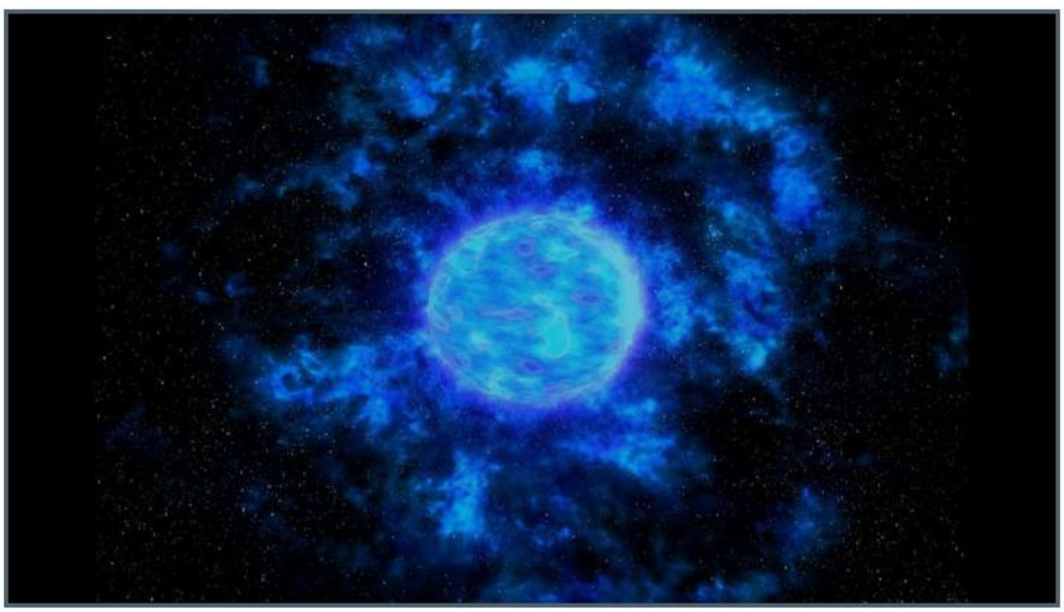
After 1935 or thereabouts, DY Cen stopped showing soot-cloud fading, but its apparent brightness started to fade. In 1980, Kilkenny & Whittet reported DY Cen to be bluer than other RCB stars, with a surface at 10,000 K - so they called it a hot RCB star. Armagh astronomer Simon Jeffery obtained the first high-resolution spectrum in 1987, when the surface was nearly 20,000 K. The overall fading is another sign that the surface is getting hotter and bluer, because light is emitted at ultraviolet instead of visible wavelengths. Additional spectra were obtained in 2002 and 2010 — DY Cen was still getting get hotter.

Left:
Evolution of DY Cen
in surface temperature
and surface gravity.
Jeffery et al. 2020.
MNRAS, 493:3565.



The 2010 data also suggested that DY Cen might be a binary star, with a period of about 40 days. Since this could help to explain how DY Cen was formed, why it has such unusual surface chemistry, and why it is heating up so quickly, Simon returned to DY Cen in 2015. Using the High Resolution Spectrograph (HRS) on the Southern Africa Large Telescope (SALT), Simon and his collaborators Kameswara Rao and David Lambert, made a series of measurements over a complete orbit. They did not find what they were looking for … DY Cen is a single star after all!

Digging deeper, DY Cen continues to heat up … already 25,000 K. It is heating because it is shrinking, from about 200 x the Sun in 1890 to a mere 5 x the Sun today. As it shrinks, it is spinning faster. Simon and colleagues have observed the spin-speed going from 20 km/s in 1987 to 40 km/s in 2015. They have predicted that DY Cen may start to spin so fast that its surface may start to break off within a few decades. The spectrum is starting to show stronger and stronger emission lines, possibly a sign that radiation is winning the surface battle with gravity. The team also made another surprising discovery. Looking back at the 1987 and 2002 observations they found evidence for a huge excess of strontium on the star's surface. Strontium is formed inside stars when iron is bombarded by neutrons, usually in a very late stage of evolution.



Above: Artists impression of mass-losing star: NASA.

It seems that DY Cen is the remnant of a star that nearly finished its life as a white dwarf. Sometime not long before 1890, in a last burst of helium burning, the white dwarf puffed up to become a red supergiant, the ashes of neutron bombardment were dredged to the surface, and DY Cen became an RCB star. However, the reborn star was already doomed. With no nuclear fuel left to support them, the surface layers are collapsing once again and spinning up — as we watch. SALT will be ready to catch the next episode in this fascinating story.

Dorrit Hoffleit 1907 – 2007

Dorrit Hoffleit is often remembered for her discoveries of variable stars. Inspired by the 1919 Perseid meteor shower, she studied mathematics hoping to be a geometry teacher. Taking a research position at the Harvard College Observatory in 1928, she was enthralled and became an expert spectroscopist, eventually earning her PhD in 1938 with the guidance of Harlow Shapley (a former Armagh Observatory director).

Her first paper in 1930 was a forerunner to a career which identified more than 1000 variable stars from the Harvard Sky Patrol using measurements of 500,000 photographic plates obtained between 1889 and 1989. In 1956 she moved to Yale, where her interest in variable stars led her to co-discover the first quasar, 3C 273. But Dorrit's most lasting legacy will be as compiler of the Yale Bright Star Catalogue, a list of fundamental places, proper motions, magnitudes and spectral types of over 9,000 of the brightest stars in the sky.

THE SALT PRIMARY PIPELINE

We all experience moments that cause us to pause and reflect on what has made that moment possible. Maybe the moment you receive the email informing you that your article has been accepted for publication is one. Maybe, as you read the template wording of the email, you pause and allow yourself to feel satisfied. Maybe you drift through your memories to how you got your SALT proposal submitted before the deadline without suffering a caffeine overdose.

Maybe you contemplate the cosmic journey of the photons that evidenced the science that you were privileged to unravel and share, and maybe you remember another email: The one sent by the SALT primary pipeline informing you that your SALT data were available for pickup through ftp. Maybe you start thinking about what happened in between SALT's interception of the corroborating photons, locking their proof away in zeros and ones, and you receiving the "SALT data available for download"-email. Maybe you already know...

Every morning at 10:30 SAST the SALT primary pipeline kicks off to process and distribute the data taken for the preceding observation date. In short, the primary data processing involves the reduction** of the raw data from the different instruments into products that are ready for science reductions, while the data distribution involves making said raw and product data available to the owning researchers and informing them accordingly. Up to the run on 12 June 2020 on the former primary pipeline (call it V1.0) the science data processing occurred after completion of the primary pipeline. As of the run on 13 June 2020 a new primary pipeline (call it V2.0) has been active and taking care of data processing and distribution with some minor and some major changes to the way V1.0 did things. So what are these changes?

For starters, V2.0 is coded in Python 3 with no legacy package dependencies whereas V1.0 is coded in Python 2 with complete dependency on the IRAF legacy package. V2.0 employs a workflow approach which allows for flexible configuration, as well as multi-processing (processed-based parallelism), of tasks. Setting up separate workflows for primary data processing, science data processing and data distribution makes it possible to execute any science data processing before the data distribution. This flexibility contrasts strongly with the plain sequential approach of V1.0 which has minimal flexibility in configuring the execution flow. In V1.0 the science pipeline for data from the High Resolution Spectrograph (HRS) was invoked only after completion of the primary pipeline. This meant that the HRS science reduction products were not included in the primary pipeline data distribution and the owning researchers had to request the distribution of the science data via the SALT Web Manager, but in V2.0 the science data processing precedes the data distribution which means the HRS science reduction products are now included in the primary pipeline data distribution.

The documentation included in the V2.0 data distribution has weather, seeing and guider information for each observation which has been missing in the V1.0 data distribution. The multi-processing functionality in V2.0 allows for processing the primary data reductions for the different instruments in parallel with a noticeable reduction in the overall execution time. A further reduction is achieved by doing the data distribution (copying the raw and product data to the ftp areas of the researchers) for different proposals in parallel. V2.0 also endeavours to be more communicative via email providing clear success or error summaries to the SALT Astronomer (SA) on weekly Cape Town duty (i.e., the SA responsible, amongst many other things, to check that the pipeline has done its work).

V2.0 DISCLAIMER: No snakes (pythons or otherwise) were harmed in the making of this software.

**The primary reductions applied are gain correction, amplifier cross-talk correction (if applicable), overscan subtraction and amplifier-CCD mosaicking (if applicable).

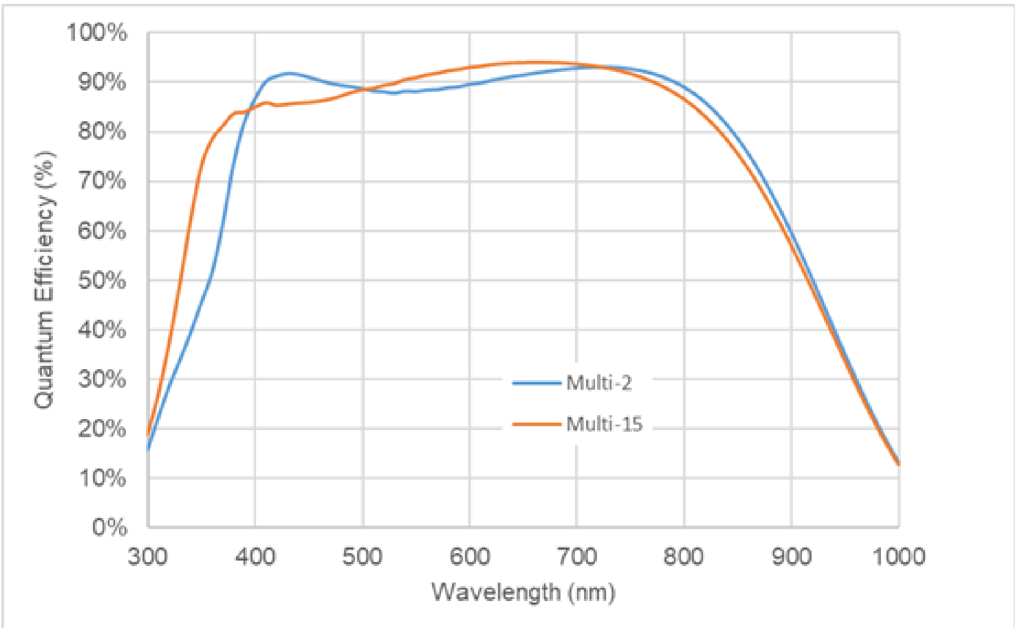
Image above: SALT sunset captured by Jackie Boshoff.

RSS DETECTOR UPGRADE

The plans to upgrade the Robert Stobie Spectrograph detector to a single monolithic chip have progressed well and we have reached the stage where we are ready to order the new CCD, kicking this off as a fully-fledged project. The cryostat and controller package will be developed by the SAAO instrumentation group with input from the SALT operations team, with Ros Skelton as the overall project lead.

The proposed CCD replacement is a 6k x 6k 231-C6 chip from Teledyne e2v. The 231-C6 CCD has the same size pixels as the current chip and low readout noise. The new CCD will be coated with the "multi-15" coating shown in the plot below, which has high blue throughput and excellent efficiency across most of the wavelength range. Even with this coating, we are unlikely to match the high quantum efficiency of the current blue CCD in RSS (~77% at 355nm), however we look forward to better red performance due to the high throughput and reduced fringing at longer wavelengths.

Please let us know if you have any comments or questions about this project!



Above: Typical quantum efficiency as a function of wavelength modelled by Teledyne e2v for two types of CCD coating (Lawrie, 2020, private communication).

FP STATUS

As many of our Fabry-Pérot fans have noticed, the RSS Fabry-Pérot (FP) system is still currently offline. Unfortunately, the project was delayed due to the COVID-19 pandemic, but we do have some good news to share with you.

Firstly, we'd like to remind you that the full refurbishment plan approved last year by the SALT Board is very comprehensive, including:

- New coatings. These have been designed to increase the spectral resolution of the etalons to their original specs and to reduce significantly the number of regions required to calibrate them, simplifying the calibration process and the number of scans required to cover a given wavelength range.
- New sealed cells to hold the etalons, expected to prevent zero-point wandering, tripping and future environmental degradation.
- Ability to operate the controllers remotely, allowing us to adjust their balance automatically and prevent tripping.
- A new, remotely operable, sturdier mount with tip/tilt adjustments for the dual etalon mode. It is hoped that the new housing will remove the need to operate the etalons at rho=0, thus allowing PIs the flexibility to choose a suitable position angle.
- A dedicated 3 year Fabry-Pérot postdoc.

The new Fabry-Pérot postdoc has been appointed: her name is Dr Liz Naluminsa and she is currently waiting for her work permit to clear before she can come to Cape Town and get started. We will introduce her properly in our next SALTeNewsletter - all I'm saying now is that we are really looking forward to working with her on this exciting project! :)

The company who will be repairing our etalons is back in business after the lockdown and the order to do so has gone out. Prof Ted Williams has been liaising with the company and he will hopefully be able to visit us in Cape Town to lead the re-commissioning of the system once the etalons arrive back in Cape Town.

SAAO TURNS 200 YEARS OLD!

The South African Astronomical Observatory recently celebrated its 200th anniversary, having been founded in October 1820. The SAAO headquarters in Cape Town was unveiled as a National Heritage site on 20 October, kicking off an exciting week of events to mark this special occasion. A three day virtual symposium brought the wider community across the country and world together, with excellent talks and posters covering the full spectrum of past, present and planned astronomical research being done in Africa, cultural astronomy and history. This gave us an opportunity to reflect on the rich history of astronomy in South Africa and look forward to the exciting developments to come. A virtual astronomy festival with talks and workshops for the public, educators and learners was also held, and continues with a longer term ”200 Days Festival of Astronomy” programme organized by the SALT collateral benefits department at SAAO.

Congratulations to everyone involved in organizing and contributing to the events!

For more information and a virtual tour of the observatory, have a look at the website https://saao200.saao.ac.za/.

DATA ARCHIVE

At the beginning of July SALT's new data archive was launched, allowing users to query data from the end of 2010 onwards. The archive is open to the general public at https://ssda.saao.ac.za/ and you don't need an account for performing searches.

As you can see from the screenshot below, queries can be refined by a set of different criteria. You may opt to search by title, PI, target coordinates, date or more SALT-specific details. So if you ever wanted to find out whether [enter your favourite astronomer's name here] had observations taken with the pg1300 grating of RSS between the 1st of April 2019 and the 1st of January this year, now is your chance to find out.

While a reasonable set of default criteria are included for search results, you can add to these if you need more specific details. The defaults include the target coordinates, but you might be surprised that these aren't displayed for all observations. The explanation is simple: Target positions are included only for non-proprietary data (unless you happen to own the data).

Similar to online shops, you can add (public or your own) observations to a cart in order to request their FITS files later. In order to make the actual request you have to be logged in, though.

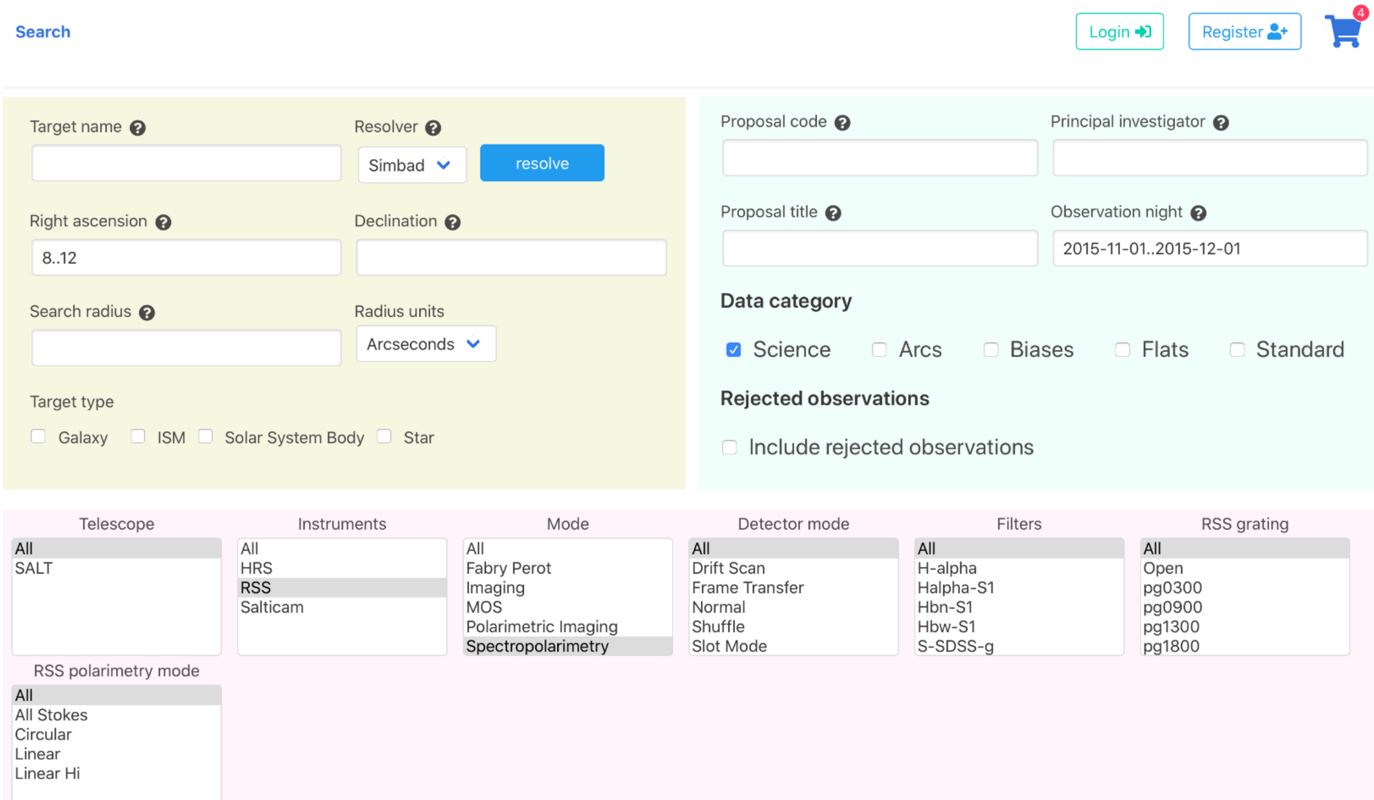
There are two ways of logging in. The first is to register on the data archive. The second is to use your existing Web Manager credentials. The latter is the preferable option, as it allows you to search your own proprietary observations by target position and to download their data.

When making a data request, you may opt to include standards, arcs, biases and flats. Both raw and reduced data can be requested. The data archive records all your data requests, making it easy for you to download the FITS files again at a later stage.

You might wonder when your SALT data becomes available for download in the data archive.

These are the proprietary periods for different kinds of proposals.

* Science proposals: 36 months, or 24 months if South Africa has allocated time
* Director's Discretionary Time proposals: 6 months
* Gravitational wave proposals: 0 months, data only available to SALT partners
* Commissioning proposals: 36 months
* Performance verification proposals: 12 months

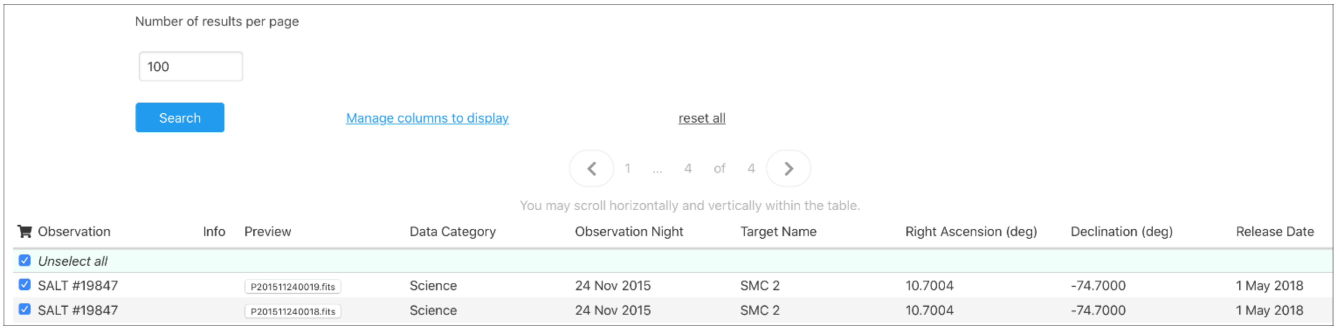


Above: screenshot of search functionality.

Should there be good reasons by which you would like to prevent your data from becoming public, there are two avenues open to you:

- For science proposals with no South African time allocation, you may extend the proprietary period.
- For all other proposals, you may request an extension of the proprietary period.

Both can be done from the proposal's page in the Web Manager (https://www.salt.ac.za/wm).



Number of results per page

100

Search

Manage columns to display

reset all

1 ... 4 of 4

You may scroll horizontally and vertically within the table.

Observation	Info	Preview	Data Category	Observation Night	Target Name	Right Ascension (deg)	Declination (deg)	Release Date
Unselect all								
SALT #19847		P201511240019.fits	Science	24 Nov 2015	SMC 2	10.7004	-74.7000	1 May 2018
SALT #19847		P201511240018.fits	Science	24 Nov 2015	SMC 2	10.7004	-74.7000	1 May 2018

While having a web-based data archive is important, there should also be a programmatic way of querying SALT observations. For this reason we are investigating the possibility of making the data archive available via Virtual Observatory tools and libraries. SALT observation queries might be coming to a Python library near you soon!

STAFF MOVEMENTS

April 2019 – December 2020:

Appointments:

Mechanical Engineer (Sutherland) Dec 2019: Mr Nico van der Merwe

Software Engineer (Cape Town) Jan 2020: Mr Sunnyboy Kabini

Software Engineer (Sutherland) Sep 2020: Mr Bryne Chipembe

SALT Fabry-Pérot postdoc (Cape Town) 2020: Dr Liz Naluminsa (awaiting permit)

Resignations:

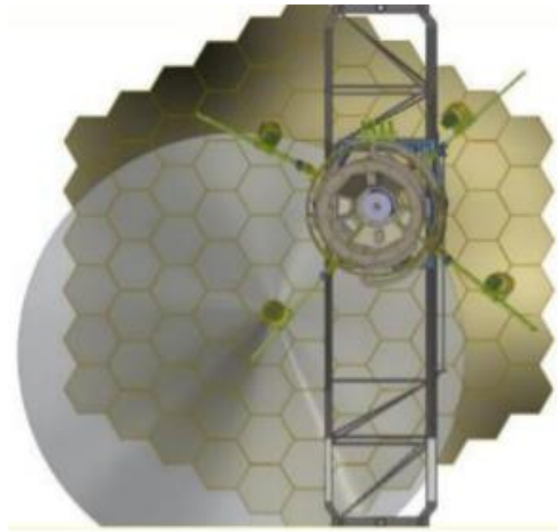
SALT Astronomer (Cape Town) July 2020: Dr Marissa Kotze

SALT Software developer (Cape Town) July 2020: Mr Sifiso Myeza

SALT Software developer (Sutherland) Dec 2019: Mr Mark Wichman

SALT MINI TRACKERS

At their November meeting in India, the SALT Board commissioned a study to explore the feasibility of pursuing the development of the SALT mini-tracker concept. Retired McDonald Observatory/HET chief engineer and 20-year SALT advisor/consultant John Booth led this 6-month initiative, assembling a small team to explore the practicalities of the optical and mechanical aspects in particular.



The Board is very grateful for the time and effort that went into the report that is extremely well thought out and shows a very viable option for enhancing SALT greatly in the era of transients. The BEC is in favour of giving John Booth the support to begin putting together a plan for what we do next.

The study report, along with the science case produced by Retha Pretorius and the initial 2018 SPIE paper are all included in the document linked below. Since no show-stoppers were uncovered, the Board is eager to take this revolutionary concept forward so funding will now be sought to support the development of a single prototype mini-tracker. The report is available for download from the SALT website at: http://www.salt.ac.za/news/salt-mini-trackers.

PROGRESS ON THE MAXE PROJECT (RSS DUAL)

The MaxE project was conceived to extend the capability of RSS on SALT to cover the widest possible waveband at a scientifically useful resolution. The proposal is to implement a 'red' arm on RSS to cover the wavelength range from 630 nm to 900 nm at a resolving power of about 2000, while the existing spectrograph using the PG900 grating or a planned 700 line/mm one will simultaneously cover the range from 630 nm down to the bluest accessible wavelength.

SALT has ongoing programmes of transient identification and follow-up science and while the current RSS can do good science in this area, its restricted wavelength coverage at a useful resolution limits what can be achieved.

Currently, transient alerts come from a number of surveys that cover a relatively bright magnitude range. The 10-year survey by the Vera C Rubin Observatory (LSST) of the visible sky promises to revolutionise the study of transient events in both the Galaxy and the extragalactic Universe. The projected rate of alerts is 107 per night, but this will be reduced to a handful of potentially interesting events by event brokers. There will be a need for spectroscopic follow-up to permit identification of the objects responsible for these events. Although Rubin Observatory full science operations are planned to start at the beginning of 2023, there have been delays as a consequence of the COVID-19 pandemic, as well as of civil unrest in Chile, so the beginning of 2024 may be more realistic. Of course, we have the MeerKAT/MeerLICHT combination right on our doorstep, and there are likely to be interesting transient discoveries that SALT will be well-positioned to observe – the first of these transients has already been discovered and followed up by SALT.

The MaxE project is managed by Roufurd Julie of SARAO under a contract between SAAO and SARAO. It is a multi-team effort involving optical design (Janus Brink, SALT), opto-mechanical design (Ockert Strydom, SALT) and detector package design (Instrumentation team, SAAO), and there will ultimately be a software effort to modify the control system and interface as well as the data pipeline.

Progress is being made on both the management and technical sides of the project. In the former case, the team is currently engaged in determining the overall timeline for completion of the project, in the first instance of the Preliminary Design Review. This involves an assessment of the time required for completion of all aspects of the project, which depends to a large extent on the availability of the required human resources, and requires coordination with other major SALT projects either underway or planned. The current aim is to have the instrument on-sky in 2024 to take maximum advantage of the overlap with the Rubin Observatory.

Meanwhile, on the technical side, the optical design is fairly mature and a firm timeline is being established for the procurement of the collimator doublet, red fold flat and camera optics. Work continues on the mechanism for interchanging the existing fold mirror and the dichroic beamsplitter that transmits red light into the RED arm.

Members of the SAAO instrumentation team (Kathryn Rosie, Pieter Swanevelder, James O'Connor, Hitesh Gajjar, Tapuwa Makombore) are working on various aspects of the detector package:

Discussions are underway with Teledyne in the UK for the procurement of two identical CCDs, one for the RSS VIS upgrade (PI Ros Skelton) and the other for the RED arm. CCD coating manufacture is still something of a black art, so ordering two CCDs at once offers the possibility of using the one with the better blue/UV response for RSS VIS.

A test cryostat is being constructed in the SAAO workshop that will allow rigorous evaluation of new large-format CCDs. The design of the on-telescope cryostat, and the location and housing of the associated electronics on SALT is well under way. The requirements for the detectors on the RSS RED arm and the existing VIS arm are very similar and both projects will benefit from the development work.

Image above: SALT sunset taken by Jaco Brink.

HRS DATA FIX

One of the long-term efforts to improve the HRS was porting the two detector PC's from Windows to Linux. It was hoped that this would resolve the infernal readout crashes that seemed to randomly strike, wiping out otherwise successful exposures during the CCD readout process. Having the Red and Blue PC's running under Linux is an important step in the right direction, but we were disappointed to find that it did not eliminate the readout crashes. So software engineer Deneys Maartens went back to the drawing board and in May came up with a far more elegant way to trigger the readout process than the original software had provided. This did indeed resolve the readout crashes, a major breakthrough! As with the porting to Linux, extensive testing was done to ensure that all was well and that nothing else had been disrupted by the changes.

However, in July it was noticed that the MIDAS pipeline for HRS data had produced incorrect wavelength solutions for some observations made in June and July. A known issue that occasionally causes this sort of problem (when an echelle order is not detected properly in the extraction process) was not to blame in these cases, which meant we had a new problem.

After a few days of detective work, the problem was traced to a subtle quirk that had crept in during the migration to Linux. The number of virtual pixels in the prescan region of each chip had changed, due to that value actually being set by a different config file (not the ones stored on the detector PC's and meticulously transferred to the Linux machines). Inadvertently using long-outdated but minimally different config files had silently altered the prescan region on each chip (not something we're sensitive to, since we work with bias frames instead), effectively changing the width of the CCD and therefore wrecking the wavelength solutions calculated by the MIDAS pipeline.

Once the problem had been found and all its consequences identified, the various people responsible for the different software elements related to HRS could formulate and execute a step-by-step recovery plan: Deneys dealing with the instrument software and SA's Enrico Kotze, Alexei Kniazev and Rudi Kuhn attending to the primary reductions pipeline, the MIDAS HRS pipeline and the data quality monitoring scripts, respectively.

First (Deneys) setting the correct number of prescan pixels for the two chips, so that new data would be in the correct form. Then (Enrico) using a standalone script to fix up processed raw and product data taken between late January and the implementation of the fix. Also (Enrico) fixing the raw data from the problem interval, in case anyone ever wants to rerun the primary pipeline on data from that time at some future date. Then (Rudi) running the data quality checks on the fixed up files. Followed by (Alexei) running all of the affected data (in fact, going back to the start of the 2019-2 semester for completeness) through the updated MIDAS pipeline. Lastly, (Enrico) using another standalone script to replace all the data in the relevant ftp areas and sending a "SALT data available for download" email, along with a note to the principal contacts explaining what had happened.

This whole episode stems from an extremely tricky, well-hidden problem that had serious implications in terms of the data we were sending out to HRS users. We regret and sincerely apologise for the inconvenience this may have caused our community. The associated lessons are highly valuable to us though and the superb team effort that defined the recovery process is a real positive for us to draw and build upon. It's also worth remembering the significant improvements made to the HRS software along the way: the debilitating readout crashes have been resolved, the detector PC's now run under Linux and the MIDAS pipeline has been modified to fix an intermittent problem that occasionally led to incorrect wavelength solutions and extra work for the SA on Cape Town duty, as they had to rectify them.

Image above: SAAO headquarters in Cape Town.

SALT OPS WORKSHOP

In mid-August 2019, we held a SALT Ops "relaunch", a team workshop to mark the start of a new era in SALT Operations, and to introduce the "*No Photon Left Behind!!*" campaign. This would see us directing our collective (Astro Ops + Tech Ops) efforts towards increasing SALT's efficiency on all fronts. Specifically: improving the throughput of the telescope and its instruments wherever possible, streamlining the processes leading up to (and including) taking data, and then ensuring the best possible use can be made of the photons collected.

A year on from the relaunch – in a strange new world of entirely remote observations and with a large number of us still working from home, we decided it was time to get the whole team together again. It was an opportunity to reflect on our progress over the past year, and to collectively brainstorm about improving operations, especially while negotiating the unprecedented challenges of COVID-19 and national lockdown restrictions.

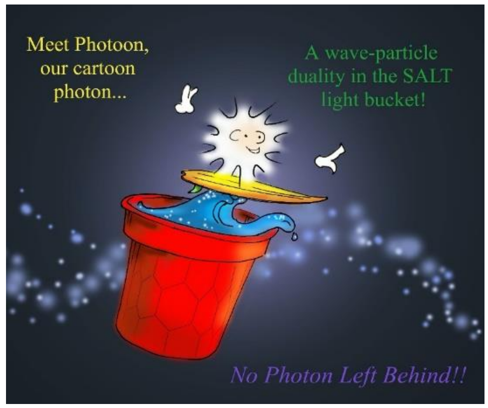


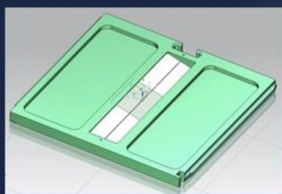
Image above: We relied on the creative talents of software engineer Anthony Koeslag to generate a campaign mascot!

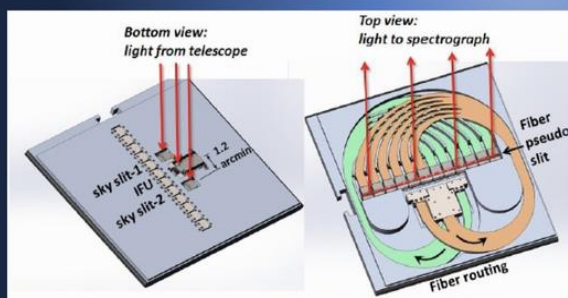
A fiercely contested 20-question online quiz involving SALT-related trivia got everyone's minds into gear. This was followed by a presentation recapping the tasks and projects completed over the past year, updates on other initiatives in progress and yet others coming up, along with feedback about the practicalities of virtual meetings, remote observing and operations, resource issues, priorities, planning and the like.

Participants were then asked to go off and fetch their thinking hats, before applying their minds to the question of "How can we improve the way we operate now?". Many good ideas were surfaced and some broad themes emerged, including a general appetite for more frequent gatherings like this one.

The slides below highlight tasks that have been completed, those still in progress and others coming up, as well as the creative thinking caps donned by the team!

Projects Moving Along

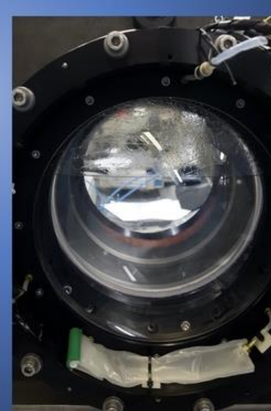


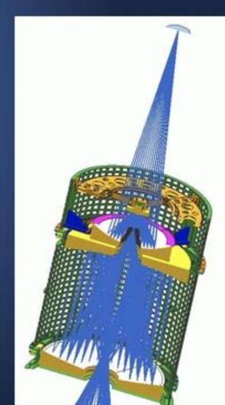


- Guider pre-positioning
- Improving pointing model
- New RSS long-slits
- Procuring a new ADC
- Progress on NIR with UW
- Circular polarimetry tools
- New RSS doublet
- Slit-mask IFU development
- Etalon refurbishment
- HRS precision RV potential
- SDC controller upgrade
- Mirror coating plant controller replacement

Cool Stuff Coming Up

- Order new 6K x 6K CCD for RSS
- Contract out RSS triplet replacement
- Contract out new 700 l/mm grating
- Revamp PIPT & WebManager
- Plans to recoat SAC M2 & M5
- Develop plan for SAC maintenance
- Prepare for NIR (Calsys, FIF, software…)
- RSS Dual (MaxE) development
- Consider SALTICAM's future?
- Pursue prototype mini-tracker?



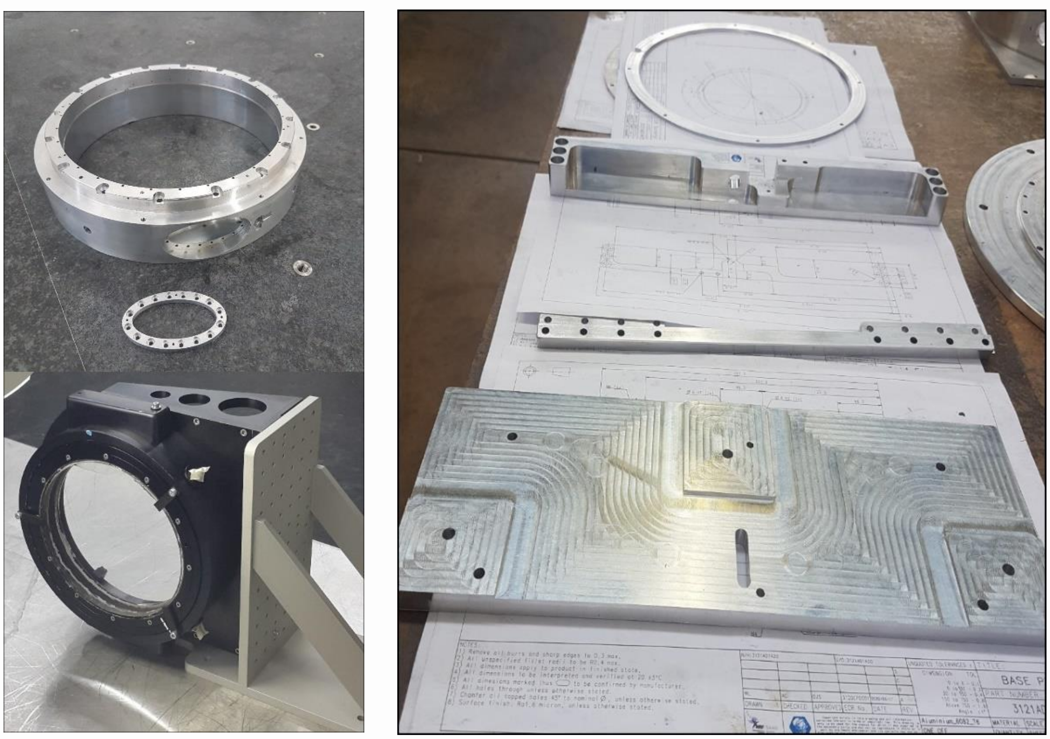


THE RSS DOUBLET REPLACEMENT

The RSS Doublet replacement has been in the works for quite some time. The repair involves replacing the RSS Doublet with a new optical assembly. The bonds which retain the lenses and the seal in the optical coupling fluid has been deteriorated by the coupling fluid (Cargille LL5610) to the point where we fear a leak might occur. The loss of the coupling fluid would render RSS inoperable and hence this replacement is of quite a high priority.

A new opto-mechanical design was developed with an improved alignment and bonding process using a different coupling fluid called LL3421. The parts are in the final stages of manufacturing and we are quite close to integration of the lenses. The final throughput testing will then be done and then we'll be ready for the installation.

We also hope to see an improvement in the UV throughput of the Doublet as the new lenses use an improved coating.



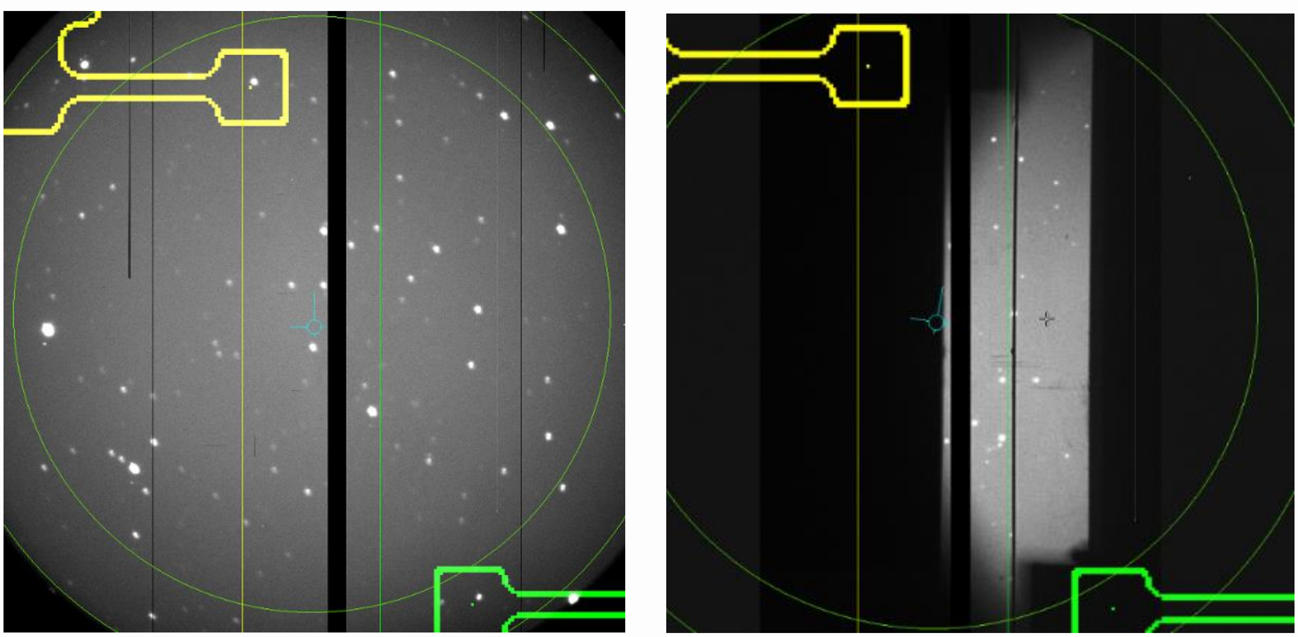
Above: New lens cell (top left). Old doublet 2014 (bottom left). New doublet mounting hardware (right).

GUIDE PROBE PRE-POSITIONING UPDATE

Automatic probe positioning of the telescope's guiders has been pushing ahead despite pressures from the development of RSS Dual (née MaxE), SALT operations, and of course the COVID-19 conundrum. Once completed, this will position the guide probes over the expected location of the guide stars as part of the telescope's point-to-target procedure. This will decrease the acquisition time, not only by pre-positioning the guide probes, but also by reducing the need to nudge the science target into the slit.

The required changes to position the probes have been made to the Telescope Control System (TCS) and fine-pointing accuracy is currently being verified with on-sky engineering tests in the early evenings.

The current deployment plan is to have guide probe pre-positioning operational for RSS as soon as is practical, followed by the HRS guide probe soon afterwards. Finally, the guide star selection script will connect to an on-site guide star database allowing the pre-positioning system to continue to function even if internet access is not available.



Left: Pre-positioned probes on SALTICAM.

Right: Science target aligned precisely on slit with pre-positioned probes.

RSS TRIPLET REPLACEMENT

The history of the complicated RSS optics (see below) is a tortured one. This is largely due to issues with the refractive index-matching fluid used to optically couple lenses within the various multiplets (to minimise surface reflection losses). Initial problems caused by the coupling fluid interacting with other materials within the lens assemblies led to assorted woes, particularly since the exotic optical materials are extremely fragile and difficult to work with. Calcium fluoride (CaF2) readily shatters under thermal stress, while sodium chloride (NaCl, good old table salt) fogs and needs re-polishing if it gets exposed to moisture in the air.

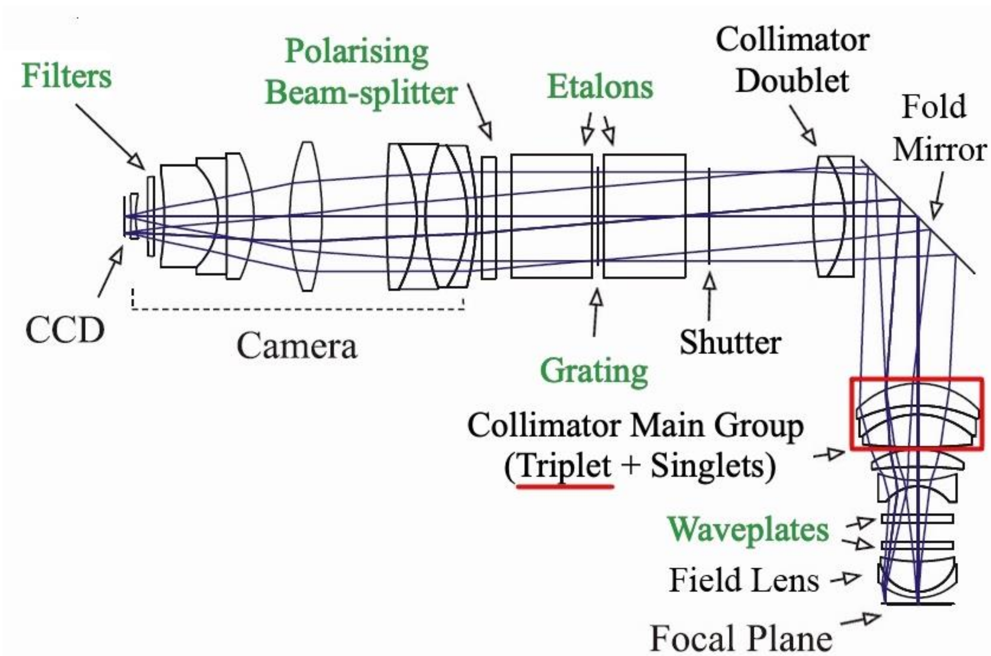
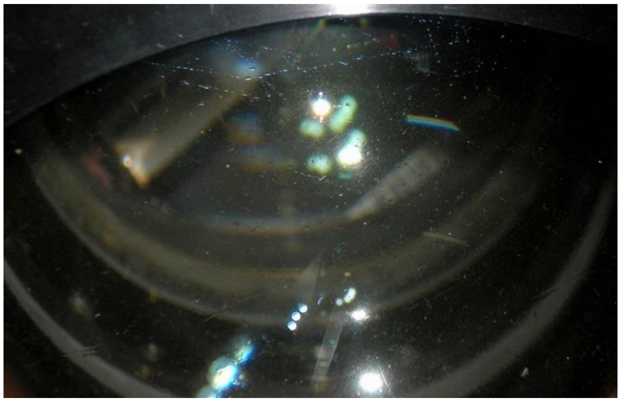


Image above: RSS optical layout, with selectable elements for various modes labeled in green. The location of the collimator triplet is highlighted in red.

The camera optics were successfully repaired in California in about 2008, but the collimator suffered additional complications due to changing the fluid to better suit the planned RSS near-infrared arm (that at the time was intended to share that part of the beam). These silicone oils are very difficult to remove completely, so some residual old oil ended up remaining within the intricate triplet assembly. To our horror, we discovered in 2012 that the old and new fluids are immiscible, resulting in a nasty array of small droplets (effectively a random array of micro-lenses!) forming in the top fluid gap of the triplet (see below).

Image right: Droplets of the old coupling fluid can be seen festooning the inner surface of the top element of the collimator triplet.



During the first RSS optical service at SALT in 2014, the triplet was given an oil change, in the hope that this would remove the offending droplets. Unfortunately, though, the old droplets stubbornly stayed behind on the inner surface of the top fluid gap (above). Although much less obvious after refilling the gap with fresh fluid, the droplets do remain and they undoubtedly produce a considerable amount of scattered light within the instrument.

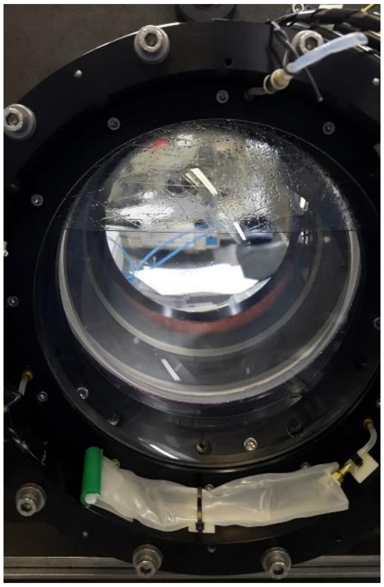


Image left: The RSS collimator triplet undergoing an oil change. Droplets of old lens fluid can be seen coating the inner surface of the top fluid gap after the fluid had been drained.

Given how superbly dark the Sutherland sky is, it's particularly frustrating to have our ability to work on faint, diffuse objects severely limited by scattered light in the spectrograph. Hence, we have long aspired to replacing the triplet. The optics were procured years ago and the plan was to cut our teeth on the RSS doublet (a much simpler system) before tackling the daunting triplet. The team remains hopelessly overloaded with various projects though, so the triplet has yet to reach the top of our to-do list. Therefore, we are now contracting the vendor that built the RSS optics in the first place to wrap metal around these lenses for us.

With their hard-won experience with these particularly challenging optics, The Pilot Group has the best chance of doing this without running into the various awful traps they uncovered previously. They estimate 8 weeks to get this done, so depending when exactly they can start, and assuming our other projects remain on schedule, we would aim to bring the RSS down in mid-2021 to replace various components. We would plan to install the new collimator doublet, the new triplet, the new 700 l/mm grating and the new focal plane letterbox mechanism that's being developed to accommodate the new and vastly improved RSS long-slits. All of which will yield significant performance gains for our prime focus spectrograph.

MEET THE TEAM: ALEXEY KNIAZEV

I was born in Volgograd city (former name Stalingrad) in the South-West of USSR. Astronomy has interested me since I was ten years old, and my career in it began at the Special Astronomical Observatory of Russian Academy of Science (SAO RAS). I was accepted there for a permanent position in 1989, one year before I graduated from the Physical Department of Rostov-on-Don State University. From SAO RAS I went to the Max-Plank Institute for Astronomy at Heidelberg (Germany) and the European Southern Observatory (ESO). My astronomical life then moved me to SALT where I started to work from the end 2005, one week before SALT inauguration.

From the early stages of my career I was involved in imaging and spectral surveys aimed at creating new samples of galaxies and stars of different types. I became very experienced in the different techniques for data reduction and analysis, such as stellar and surface photometry, astrometry, objective prism spectroscopy, long-slit and echelle spectral data.

My main research interests are located in various areas of extragalactic and stellar astrophysics, focused mainly on understanding how galaxies and stars form and evolve. I had to dedicate a lot of my efforts during the early stages of my career to various aspects of support of observational methods and astronomical data reduction. Different types of acquisition and reduction systems for astronomical imaging and spectral data, taken with different instruments and telescopes, were created by myself and under my supervision.

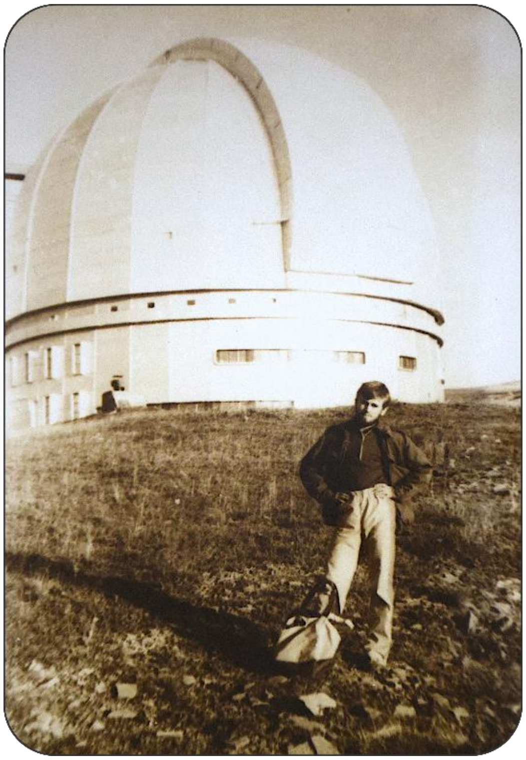


Image right: Special Astronomical Observatory of Russian Academy of Science 1986.

I have been working at SAAO/SALT for the last fifteen years, supporting SALT observations and SALT users, helping with different topics/subjects related to the data reduction and analysis and enjoying my science. This May I published my 150th paper in peer-review journals with SAAO/SALT affiliation and about half of these papers use SALT data.

SALT SCIENCE PAPERS (JAN-NOV 2020)

Below is the list of SALT publications since our last newsletter (for our full list of publications, please visit http://astronomers.salt.ac.za/data/publications/). We encourage SALT users to inform us of any papers making use of SALT data, and to double check the link above after publication.

- Battley, M.P.; Pollacco, D. and Armstrong, D.J. 2020/08. A search for young exoplanets in sectors 1-5 of the TESS Full-Frame-Images. *MNRAS,* 496:1197. https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.1197B/abstract
- Bedding, T.R.; Murphy, S.J.; Hey, D.R.; et al. 2020/05. Very regular high-frequency pulsation modes in young intermediate-mass stars. *Nature,* 581:147. https://ui.adsabs.harvard.edu/abs/2020Natur.581..147B/abstract
- Boettcher, E.; Gallagher, J.S., III; Ohyama, Y.; et al. 2020/05. VV 655 and NGC 4418: Implications of an interaction for the evolution of a LIRG. *AA,* 637:17. https://ui.adsabs.harvard.edu/abs/2020A%26A...637A..17B/abstract

➢ Bono, G.; Braga, V. F.; Crestani, J.; et al. 2020/06. On the Metamorphosis of the Bailey Diagram for RR Lyrae Stars. *AJ Letters,* 896:15.
https://ui.adsabs.harvard.edu/abs/2020ApJ...896L..15B/abstract

➢ Kollatschny, W.; Grupe, D.; Parker, M.L.; et al. 2020/06. Optical and X-ray discovery of the changing-look AGN IRAS 23226-3843 showing extremely broad and double-peaked Balmer profiles. *AA,* 638:91.
https://ui.adsabs.harvard.edu/abs/2020A%26A...638A..91K/abstract

➢ Neustadt, J.M.M.; Holoien, T.W.-S.; Kochanek, C.S.; et al. 2020/05. To TDE or not to TDE: the luminous transient ASASSN-18jd with TDE-like and AGN-like qualities. *MNRAS,* 494:2538.
https://ui.adsabs.harvard.edu/abs/2020MNRAS.494.2538N/abstract

➢ Pavana, M.; Raj, A.; Bohlsen, T.; et al. 2020/05. Spectroscopic and geometrical evolution of the ejecta of the classical nova ASASSN-18fv. *MNRAS,* 495:2075.
https://ui.adsabs.harvard.edu/abs/2020MNRAS.495.2075P/abstract

➢ Pursiainen, M.; Gutiérrez, C.P.; Wiseman, P.; et al. 2020/06. The mystery of photometric twins DES17X1boj and DES16E2bjy. *MNRAS,* 494:5576.
https://ui.adsabs.harvard.edu/abs/2020MNRAS.494.5576P/abstract

➢ Stoyanov, K.A.; Ilkiewicz, K.; Luna, G.J.M.; et al. 2020/06. Optical spectroscopy and X-ray observations of the D-type symbiotic star EF Aql. *MNRAS,* 495:1461.
https://ui.adsabs.harvard.edu/abs/2020MNRAS.495.1461S/abstract

Projection of the South African flag onto the main building of the SAAO at its unveiling as a National Heritage Site on the official bicentenary of it's founding on 20 October 1820.