SALT

Newsletter

April 2022

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Editor: Anja C. Schröder

Cover image: Sun sets behind SALT. -- *Credit*: SAAO

Letter from the Head of Astro Ops

Dear SALT Community,

Thank you very much for your awesome response to our appeal for some extra personal information on the Web Manager, we really appreciate it! If you are one of the few SALT users who have not yet responded, it is never too late — you can easily update your Web Manager profile the next time you log in, and there will be a very clear explanation of what we are asking for and why. And for the rest of you, thanks again — you rock! ☺

Our bad news this semester is that the weather continues to be abysmal for observations – we've lost over 50% of the time! Just to put this into perspective, our traditional weather downtime for summer in Sutherland is ~ 35%. With only a few weeks to the end of the semester, completion rates are very low and our high-priority queue remains very busy. Please get in touch with your liaison SA via salthelp@salt.ac.za if you have concerns about your program.

Our technical downtime is also higher than usual this semester, mainly due to SALTICAM experiencing an unexpected failure in late December and having to be brought down to Cape Town for repairs. While it was offline, it was replaced by our backup acquisition camera BCAM, which has a much smaller field of view (FoV). The smaller FoV would have been a major problem for us in the past, but thanks to our guiders positioning themselves automatically when we point the telescope, we experienced very few issues and our users received their data and their BCAM acquisition images soon after. Big thank you to the SALT Ops and SAAO teams for the SALTICAM repairs during the holidays, excellent team effort! ☺

Then HRS underwent maintenance in February, which Lisa explains nicely below together with some rare and really beautiful images of "Her Royal Spectrographness" herself. The maintenance went well, but we then found it impossible to cool the HRS red detector to its previous operating temperature of –120^{o} C. At –88^{o} C, however, multiple tests were taken and the detector response is good, it seems more stable and the signal-to-noise ratio is better — so that's where it's at!

Our new NIR spectrograph is finally in transit, slowly making its way to South Africa on board a cargo ship, and it is expected to arrive in the next couple of weeks. Once it clears customs, it will be taken to Sutherland, where the SALT team and the UW team are eagerly waiting for the fun to commence. Moses, our local NIR SA, gives a brief update on the plans below. In addition, Christian highlights our new finding chart package for SALT, which has been created mainly to cater for the NIR needs but is flexible enough to use in multiple other ways.

And to make things much easier for us at the telescope, Enrico showcases below our new queue scheduling software — which is awesome! In the next phase of the project, we will be running semester simulations, hoping to improve our completion stats. Stay tuned!

Our SALT Annual Report should be available for download in the next few days, but we highly recommend you get a hardcopy if you can! In addition to mailing copies all over the world, we will have some at our SALT Exhibition stands at the EAS and the IAU-GA in Busan.

Just to finish off, Dr Liz Naluminsa, our Fabry–Pérot postdoc, whom you have “unofficially met” in previous newsletter articles, introduces herself below.

Please don’t forget the deadline for SALT phase 2 proposals: 15 April 2022. The new semester starts 1 May 2022 — and I’ll be observing, hopefully from SALT!

Clear skies and stay safe!

Encarni

SCIENCE HIGHLIGHT

HI gas playing hide-and-seek around a powerful FRI type quasar at z~2.1

by Neeraj Gupta (IUCAA)

The observations of absorption lines associated with active galactic nuclei (AGN) provide crucial insights into the different feedback processes operating in AGN host galaxies. By revealing the chemical composition, clumpiness, and physical conditions in denser and colder phases of the gas at parsec to kiloparsec scales from the nucleus, these absorption line studies can bridge the gap in our understanding of how the ubiquitous halo gas and circumnuclear disk fuel the AGN activity. Neeraj Gupta from the SALT partner institution Inter-University Centre for Astronomy & Astrophysics (IUCAA) and his team recently used the Robert Stobie Spectrograph on SALT and the Very Long Baseline Array to discover a curious case of high HI column density absorber that exhibits strong HI 21-cm absorption at radio wavelengths but is absent at optical wavelengths.

The milliarcsecond-scale radio continuum observations of this quasar M1540–1453 (z_{em} = 2.104 ± 0.002) show Fanaroff–Riley class I (FRI) morphology caused by the interaction with dense gas within 70 pc of the AGN. Interestingly, while there are indications for the presence of absorption from low-ionisation species like Fe II, Si II, and Si III in the optical spectrum, the expected strong damped Lyα absorption is not detected at the redshift of the H I absorber (SALT spectrum presented above). In comparison to typical high-*z* quasars, the Lyα emission line is much narrower. The "ghostly" nature of the H I Lyα absorber partially covering the broad-line region of extent 0.05 pc and the detection of widespread H I absorption covering the diffuse radio source (extent >425 pc) imply the presence of a large clumpy

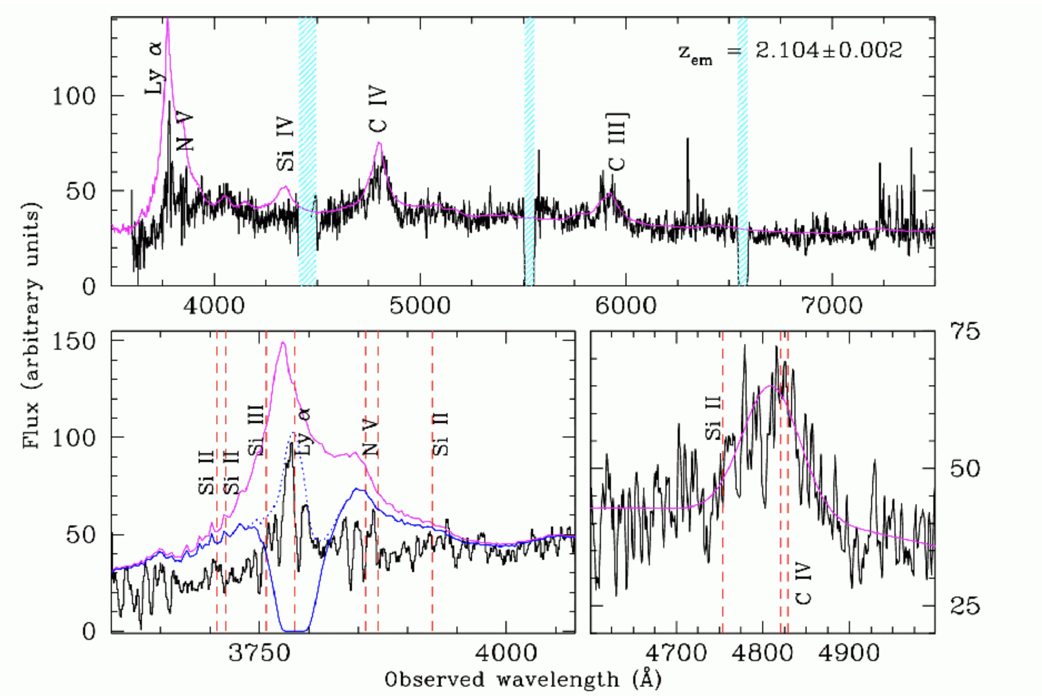


Figure 1: SALT RSS spectrum

H I halo, which may have been blown by the jet–interstellar medium (ISM) interaction. The cartoon depicts a quadrant of M1540–1453 embedded in a clumpy ISM. The quasar's optical sight-line (dashed line) may not intercept infalling high-N(H I) clouds. In comparison, extended radio emission (>425 pc) from the lobes will be intercepted by several such clouds, producing the broad redshifted H I absorption line. The extent of the H I halo and radio emission could be as large as 10 kpc.

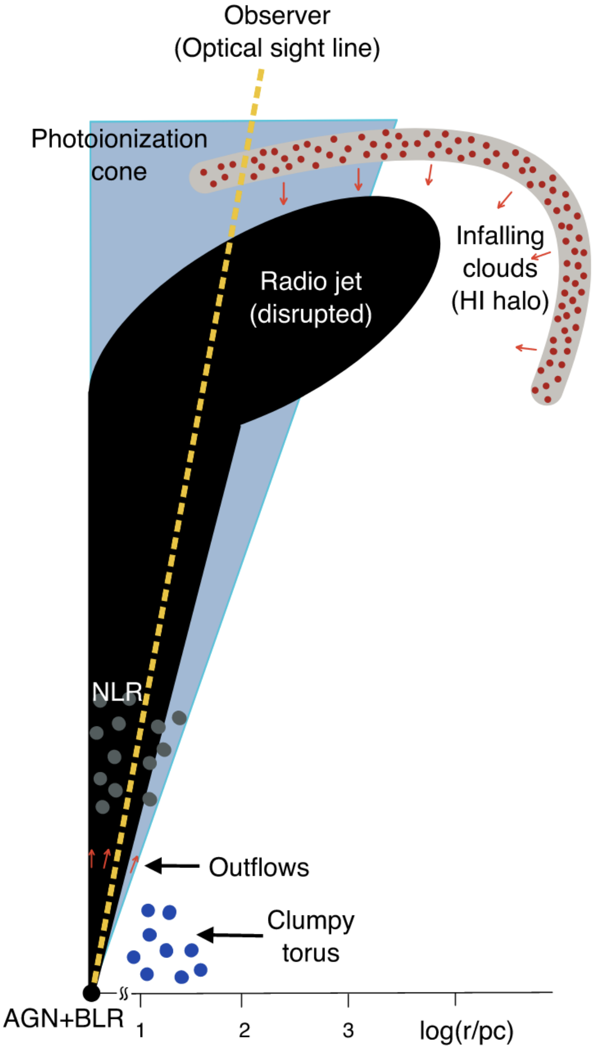


Figure 2:.Cartoon of the quasar

The quasar M1540-1453 was discovered through an ambitious spectroscopic survey using SALT (180 hrs) and the Nordic Optical Telescopes (6 nights) to build a purely infrared-selected sample of radio-loud quasars (RLQs) at z > 1.5 and define the footprint of the MeerKAT Absorption Line Survey (MALS). The MeerKAT Absorption Line Survey (MALS; PIs: N. Gupta and R. Srianand from IUCAA) is one of the ten large surveys being carried out with the MeerKAT radio telescope in South Africa. In the coming years, the SALT-NOT survey and MALS are expected to address various fundamental issues related to AGN and cold gas evolution.

Published as Gupta et al. (2022), ApJ Letters, 927, 24

A new finder chart package for SALT

SALT's online finder chart generation tool[1] which is also used for the automated finder chart creation in the PIPT, has been working well for years. With the finder charts needed for the new NIR instrument, however, the online tool is now faced with a challenge: In many cases, a zoomed-in version will be required, detailing the precise location of the science fibre bundle relative to the target. And while the sky surveys used by the finder chart tool are perfect for charts covering SALT's field of view of 10 arcminutes, their resolution is inadequate for zoomed-in versions. PIs will thus have to provide their own finder charts. On the one hand, these charts need to conform to SALT's finder chart standards. On the other hand, it would be a bad idea to turn finder chart generation into an onerous process for SALT users.

We therefore provide a new Python package, `imephu`, for generating finder charts, both for sidereal and for solar system targets. In case you are wondering what the name means: "`imephu`" is the isiXhosa word for "map", and isiXhosa, in turn, is one of the eleven official languages in South Africa.

`Imephu` can be used in two ways. First, there is a command line interface (CLI) which allows you to generate a finder chart from a given configuration file. Example configuration files will be available in the documentation. As there is a JSON schema file, if your IDE or text editor supports it, you can enjoy error checking and autocompletion while creating a configuration file. The example finder charts in this article were created with the CLI (note that the final bundle layout might still change).

Second, the package exposes a public API for creating finder charts, so that, for example, you could easily use part of a script which creates and submits blocks for SALT proposals. As both high-level functions (for all the bells and whistles of a SALT finder chart) and low-level functions (for geometrical forms) are provided, another use case might be to automatically add some markup specific to your proposal.

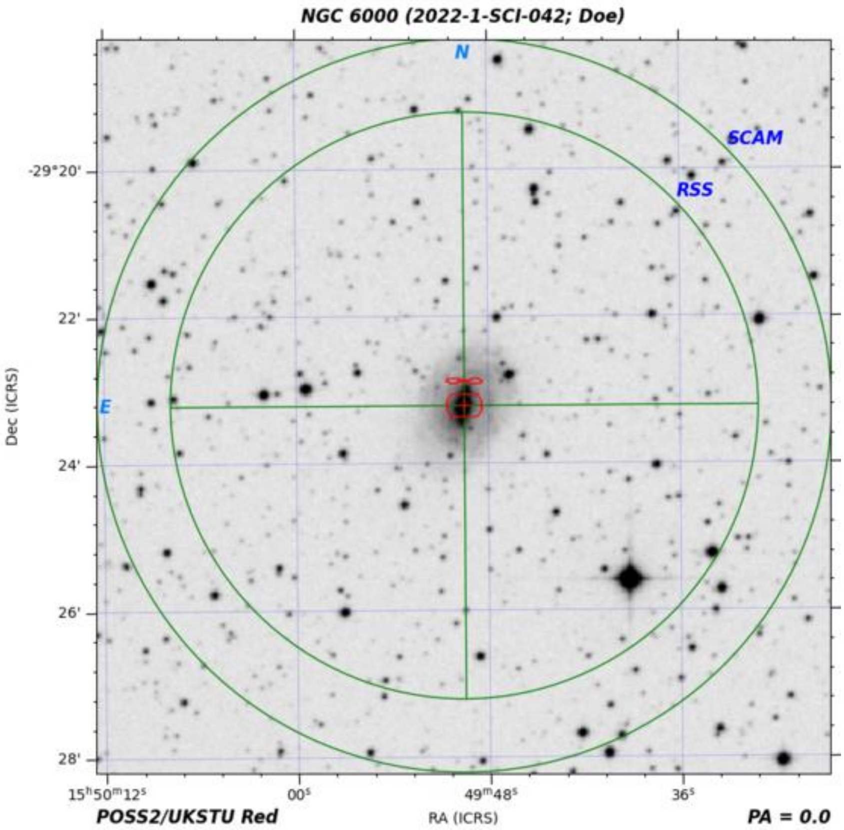
While `imephu` has been created with SALT in mind and is certainly no replacement for APLpy[2], its architecture allows an easy adaptation to other telescopes.

If you want to try out `imephu`, you can install it in the same way you'd install other Python packages, such as with `pip install imephu`. You can find out how to use the package in its quickstart guide[3]. Any bug report, feature request etc. will be highly appreciated.

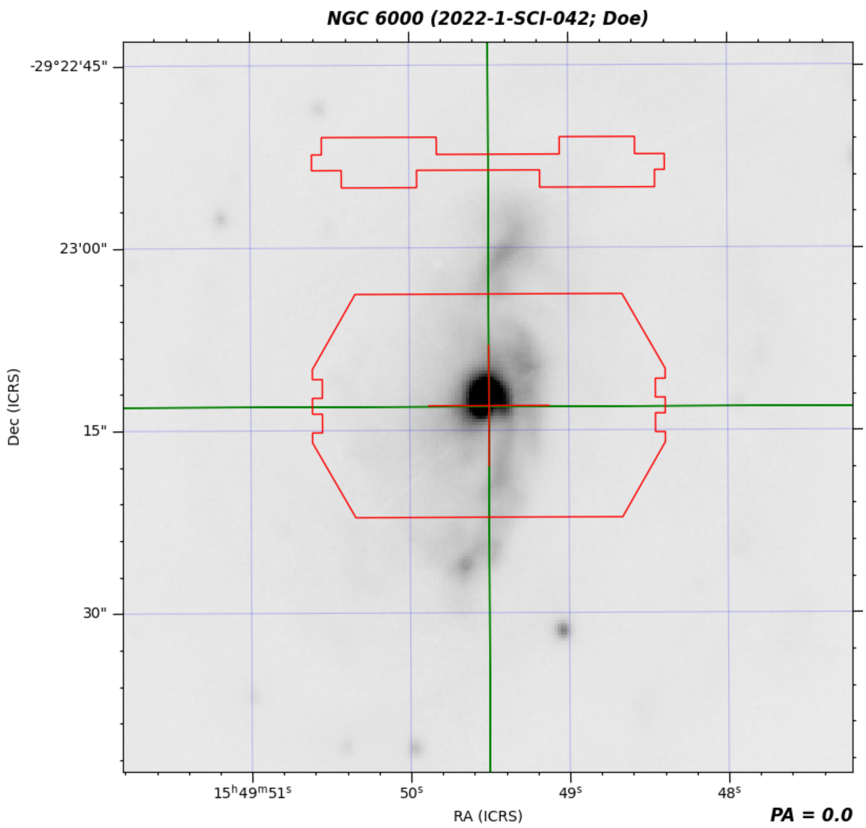
[1] http://pysalt.salt.ac.za/finder_chart/

[2] http://aplpy.github.io/

[3] https://saltastroops.github.io/imephu/quickstart.html



NIR finding chart



Zoom-in finding chart

Christian Hettlage.--

Managing the observing queue
aka
What to observe and when?

Imagine you are the SALT Astronomer (SA) on duty. You have just arrived at the telescope and you want to plan the observing schedule for the night. It is more or less the middle of the observing semester and there are ~150 observable blocks with priorities ranging from 0 to 4 in the queue. Each block has its own instrument configuration and required observing conditions. Some blocks can have two observing windows (one rising and one setting) while others may have just one observing window for the night. Some blocks share the same observing window and may even have the same priority. Add the block scoring scheme, which scores each block based on a long list of parameters (block priority, block and program completeness, PI ranking, partner share, block visibility windows, number of days the block is still observable and, if applicable, required wait period between observations). As the SA on duty you are responsible for observing the highest priority and highest scoring blocks that match the observing conditions during the night. So … what to observe, and when?

To aid the SA on duty at the telescope, a new tool has been added to the existing toolbox available for managing the observing queue. The **`SALT: On sky`** application provides the SA with a complete view of all the observable blocks during a specific night (Figure 1). It includes an hour angle (HA) and declination visualisation of the block targets (Figure 2). In the HA plot, South is at the top and East is on the left (i.e., upcoming objects are on the left). The green lines represent the visibility annulus or so-called SALT "toilet seat". Each observable block is represented as a horizontal bar with a clickable dot. The observation time for the block determines the length of the bar with the required science and calibration times, respectively, on the right and left of the dot. Clicking the dot will display some basic block information and provide a link to the block in the Web Manager.

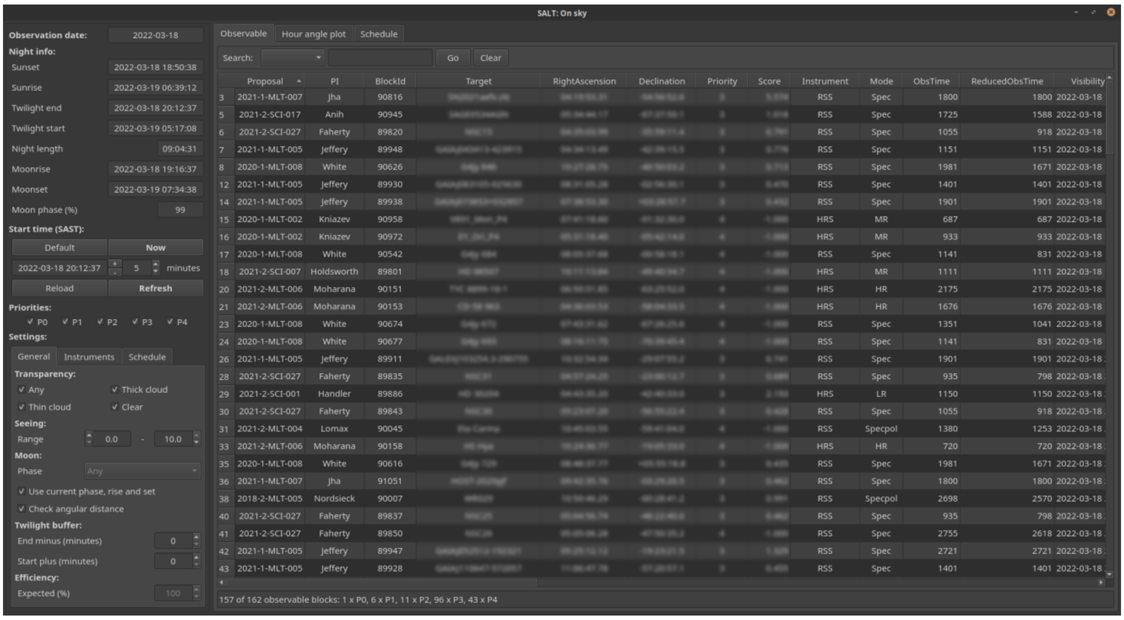


Figure 1: List of observable blocks

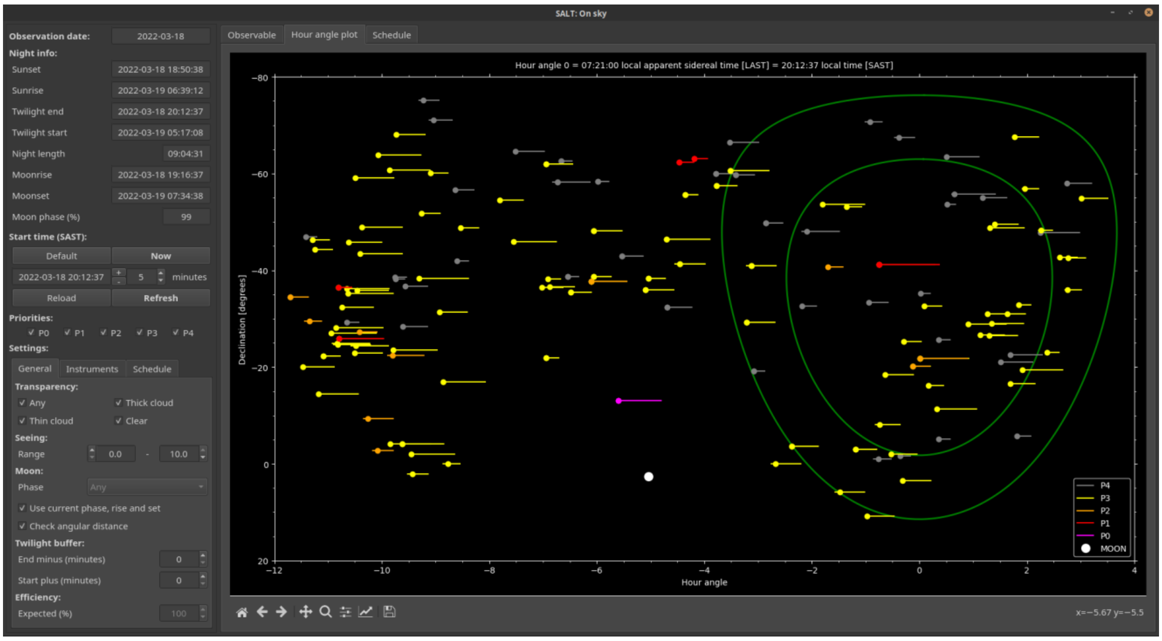


Figure 2: Hour angle and declination visualisation (HA plot)

The application employs a scheduling algorithm to determine an optimised observing schedule (Figure 3) at any point during the night. The SA can filter the observable blocks, which include any newly submitted blocks during the night (e.g., ToOs), for the applicable observing conditions and instrument availability. The observing schedule is then calculated from the filtered blocks. It takes less than a second to calculate the schedule, and the scheduling algorithm ensures that the highest priority and highest scoring blocks that match the observing conditions are included in the suggested schedule. Apart from being used in the **`SALT: On sky`** application, the scheduling algorithm will be used also in semester simulations. Using different block scoring parameters for each simulation will allow us to optimise the block scoring scheme.

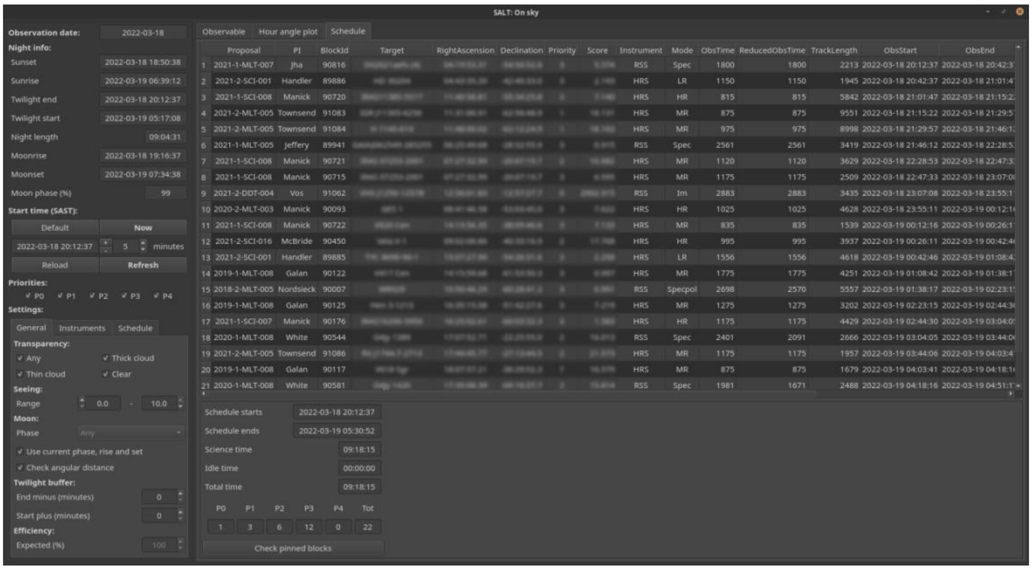


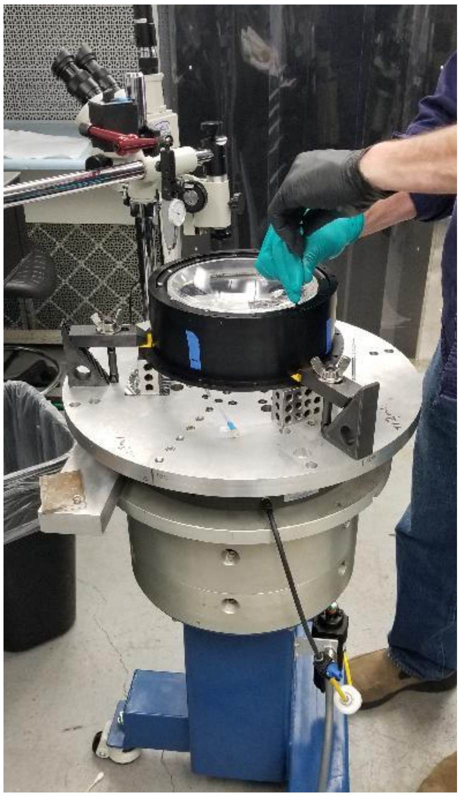
Figure 3: Observing schedule

Enrico Kotze.--

Arrival of the new RSS Collimator Triplet

The SALT team recently received the new RSS Collimator Triplet. The new triplet will be installed during the next SALT shutdown later this year. Installation involves removing the collimator main group from RSS, removing the old triplet from the main group assembly, and then installing and aligning the new triplet to the two fused silica singlet lenses in the main group assembly. The rest of the RSS collimator optics are then aligned to the main group optics.

The triplet currently inside the RSS collimator has gone through many hardships over the years and is currently in poor condition. Some years ago the coupling fluid was changed from Cargille Laser Liquid 5610 to Cargille Laser Liquid 3241. The fluids are not miscible and some of the remaining old fluid is forming droplets and streaks, reducing the throughput and causing scattering.

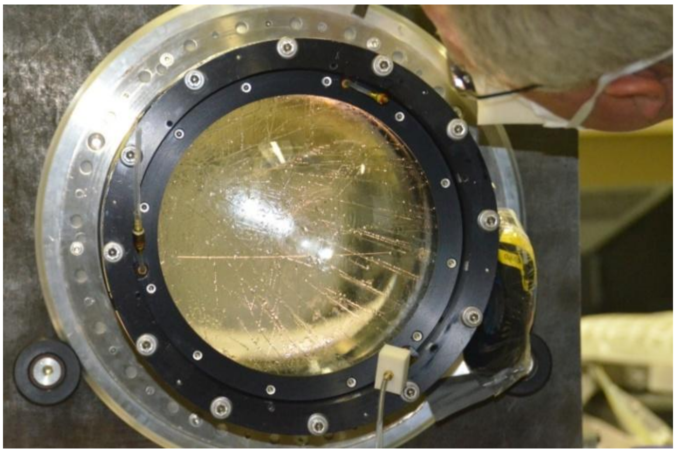


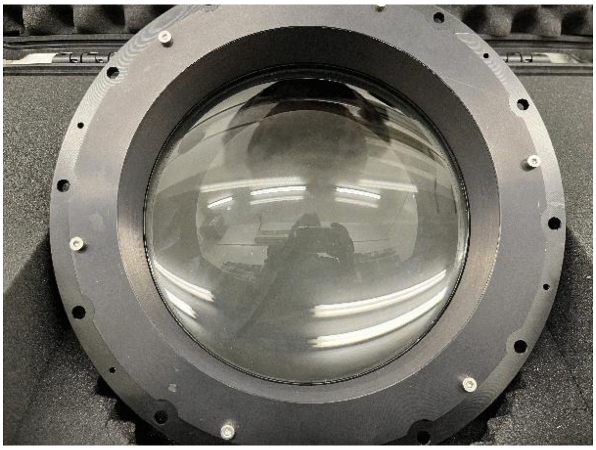
Assembly of the RSS triplet
– Credit: Alan Schier

The new RSS Collimator Triplet consists of two Calcium Fluoride lenses on either side of a NaCl (salt) lens. The lenses are fluid coupled for increased transmission. The triplet forms part of the collimator main group.

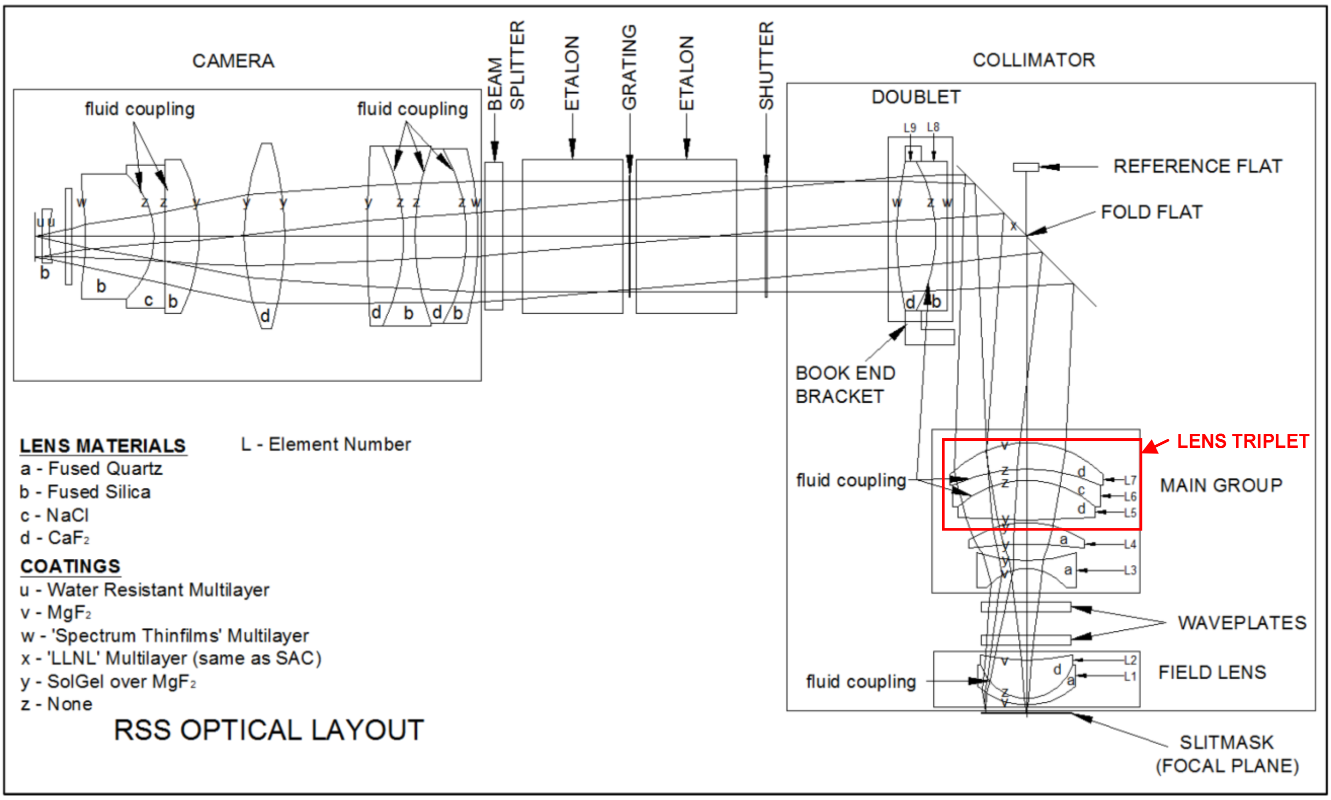
The replacement lenses for the triplet (and also for the new doublet) were manufactured several years ago. On 1 March 2021, the three lenses of the new RSS Collimator Triplet were packed and sent to Alan Schier at The Pilot Group (TPG) in California. Alan Schier and TPG had designed and manufactured the opto-mechanics for the original RSS. TPG assembled and aligned the individual triplet lenses into newly manufactured opto-mechanics and then sent the assembly back to Cape Town.

Packing up the collimator triplet fort shipping





The current RSS collimator triplet (left) with its coupling fluid drained out, showing the problematic residues from the original fluid. When the triplet is filled with fluid, these structures are greatly reduced, but the scattering produced by this random array of "micro-lenses" certainly reduces the signal-to-noise in RSS data. The image on the right shows the new collimator triplet, filled with pristine lens fluid.



Optical layout

Melanie Saayman & Lisa Crause .—

Laser Frequency Comb update

With a memorandum of understanding in place between SALT and Heriot-Watt University (HWU; Edinburgh) by July 2021, the design work for the LFC began, and certain long lead items were already ordered. The full contract for the comb development was signed in January 2022, and the official kick-off meeting for this exciting project took place on 1 March 2022. Since then, numerous local and international orders have been placed to acquire the multitude of components that will ultimately make up this new precision wavelength calibration device for SALT's high-resolution spectrograph (HRS).

The Class IV Titanium-Sapphire femtosecond laser that will form the heart of the comb had a 16-week lead-time and therefore was ordered first. It arrived at SAAO at the end of 2021 and is awaiting testing in the lab in Cape Town. Unfortunately, the chiller unit for the laser cooling system has a leak, and so we have not yet been able to fire up the 2000 mW, 800 nm laser, but we will do so once the spare parts for the chiller arrive from overseas. Some of the other major electronics modules have been delivered already and their performance was verified in February.

We are eager to recruit a local PhD student for the project, since this will be an excellent opportunity to participate in the development of a state-of-the-art instrument. The danger with instrumentation projects is often the relatively unpredictable time frames involved. However, the schedule for the HRS LFC is very well defined at this stage (with assembly set to take place in early 2023) and so we feel confident that it will be a sound option for a suitable student. The candidate will get to spend time in the laser labs at HWU to learn about the comb technology, before participating in the integration, testing and commissioning of the LFC at SALT. After that, the focus will shift towards applying the LFC in support of exoplanet research, a field that SALT is keen to contribute to going forward.

The 800 nm Ti:Sapphire femotosecond pulsed laser that will drive the LFC.

Assorted LFC components that were delivered to SAAO in late December 2021.

Lisa Crause .—

NIR is in transit!

Good news — the NIR instrument structure and cooling system are finally on their way to South Africa! The ship, with its precious cargo, is expected to arrive in Port Elizabeth on 16 April and in Cape Town on 27 April. The team are currently looking into whether it is possible to collect it directly from PE to save some time. The other components of the instrument will be shipped later. We are very excited and are hard at work preparing for its arrival and integration into SALT. Various pre-commissioning tests are planned at SALT using a test IFU, getting the telescope ready for the instrument. The actual commissioning effort will be split into 3 campaigns, each separated by 3 – 4 week breaks for the commissioning team. The first commissioning campaign will consist of the assembly of the cold room and mechanical structure, scheduled to start on 5 May. The full optical integration will be done in the second campaign, which is planned to begin on 21 June. The science and instrument commissioning will be the final campaign and will most likely run from 25 August to 2 October. Given this updated schedule, we are considering issuing a separate call specific for NIR proposals once we are ready. We will let you know — so watch this space!

Moses Mogotsi.—

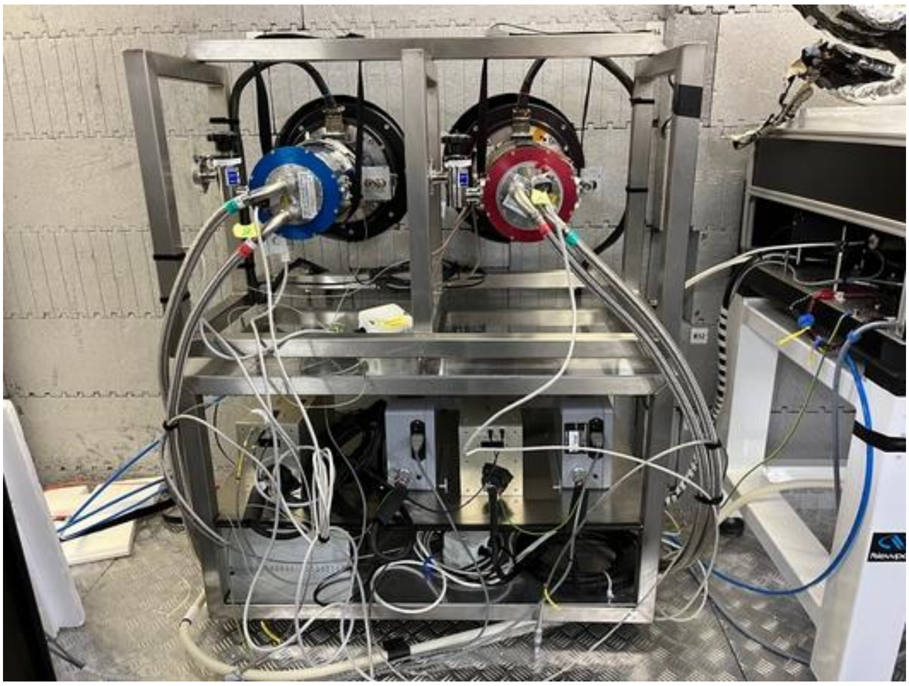
HRS cryostat mainenance

Some rather invasive maintenance work was done on the HRS cryostats at the beginning of February. The two cameras had to be warmed up and the cryostats detached from the instrument's large stainless-steel vacuum tank. Thus, the HRS was offline during the dark moon period, when RSS typically sees the most use.

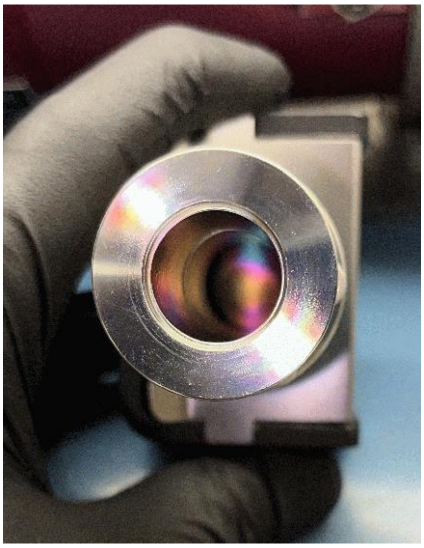
The two huge Pelican cases of precious cargo were transported from SALT to the CCD lab at the SAAO in Cape Town. There, each cryostat's set of charcoal-filled getters was carefully extracted from the two dewars and vacuum-baked to regenerate the charcoal. The two ion pumps were also inspected and found to be in good condition. This was a huge relief as it meant that all of our interventions since previously learning (the hard way) what all can go wrong with these systems has paid off. We were grateful to not have to replace the ion pumps this time.

The Red cryostat needed some additional attention, as we decided to replace the awkward set of copper leaves at the CCD-end of the Red cold-finger with a flexible copper braid, to avoid the risk of having the cold finger disrupt the CCD alignment during these maintenance tasks. The Blue system received a similar upgrade back in late 2013. This operation was not without its challenges and the system now does not cool all the way to its nominal –120^{o} C operating temperature, but instead it levels out at –88^{o} C.

Although the cryostats were re-installed on 4 February, we spent another week or so experimenting with the Red system before HRS was returned to full operation. This was after the Astro Ops team inspected the data and found that the –88^{o} C bias frames actually have less structure than those obtained at –120^{o} C. This is likely as a result of the CCD temperature not being actively controlled at this higher temperature, but rather being stable at the new limit of the system's cooling capacity. We could add an extra copper braid to enable the system to reach a lower temperature, but it is not clear that this is necessary, given the slight improvement in the data obtained at this new operating temperature.



HRS cryostats, prior to disconnection from the vacuum tank on 31 January.



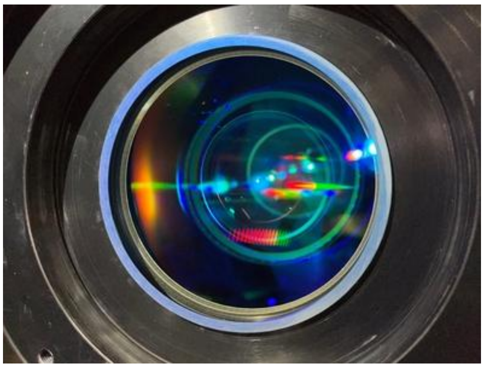
HRS ion pump still in good condition

HRS Red charcoal getters ready for vaccum- baking

Copper leaves at the CCD-end of the Red cryostat's cold-finger.

New flexible copper braid at the CCD-end of the Red cryostat's cold finger.

Illuminating the HRS Red camera optics.



Full-colour echellogram visible when illuminating the HRS Red camera optics.

Lisa Crause .—

MEET THE TEAM: Elizabeth Naluminsa

Hello everyone,

I was born in Rubaga, in central Uganda. Growing up, I had an appetite for books and a curiosity for science, which were faithfully fed by my parents. I developed interest in astronomy as a child when I read about the geology of the moon and Earth. The story of the moon-landing cemented my desire to study astronomy. At the time, there were no known academic courses or career paths in astronomy in Uganda; however, when I joined university for my BSc at Mbarara University of Science and Technology, I was blessed to find that there was a possibility of pursuing my desired path with the National Astrophysics and Space Science Programme. I joined the NASSP in 2011 at the University of Cape Town and completed my Honours and MSc before being admitted to the South African Research Chair Initiative bursary for my PhD research.

My research field is in extragalactic star formation dynamics, specifically gravitational instability and large-scale star formation. The interest I have in data pipelines grew from the computationally-leaning projects I had for my MSc and PhD studies. Thankfully, this skill has come in handy at my new job in the astronomy operations team, where I'm assisting with the recommissioning of the Fabry–Pérot observing mode. Working at SALT has been great, as I have enjoyed the strong team spirit and deep commitment of the team to see the success of SALT. I'm also engaged in astronomy outreach both in Uganda and South Africa. My passion for education and people has me engaged in student mentorship (both officially and unofficially).

In my free time, I like reading a book (while unofficially editing it!), reading about random stuff happening around the world, listening to music and taking long walks. When I'm home in Uganda, I enjoy gardening in my back yard.

Cheers, Liz

SALT SCIENCE PAPERS

December 2021 – March 2022

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.

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- Saunders, N., Grunblatt, S. K., Huber, D., et al. 02/2022: TESS Giants Transiting Giants. I.: A Noninflated Hot Jupiter Orbiting a Massive Subgiant, AJ 163, 53 -- https://ui.adsabs.harvard.edu/abs/2022AJ....163...53S
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- Han, C., Udalski, A., Lee, C.-U., et al. 02/2022: OGLE-2019-BLG-0468Lb,c: Two microlensing giant planets around a G-type star, A&A 658, A93 -- https://ui.adsabs.harvard.edu/abs/2022A&A...658A..93H

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Double rainbow over SALT .- - Credit: Nicolas Erasmus