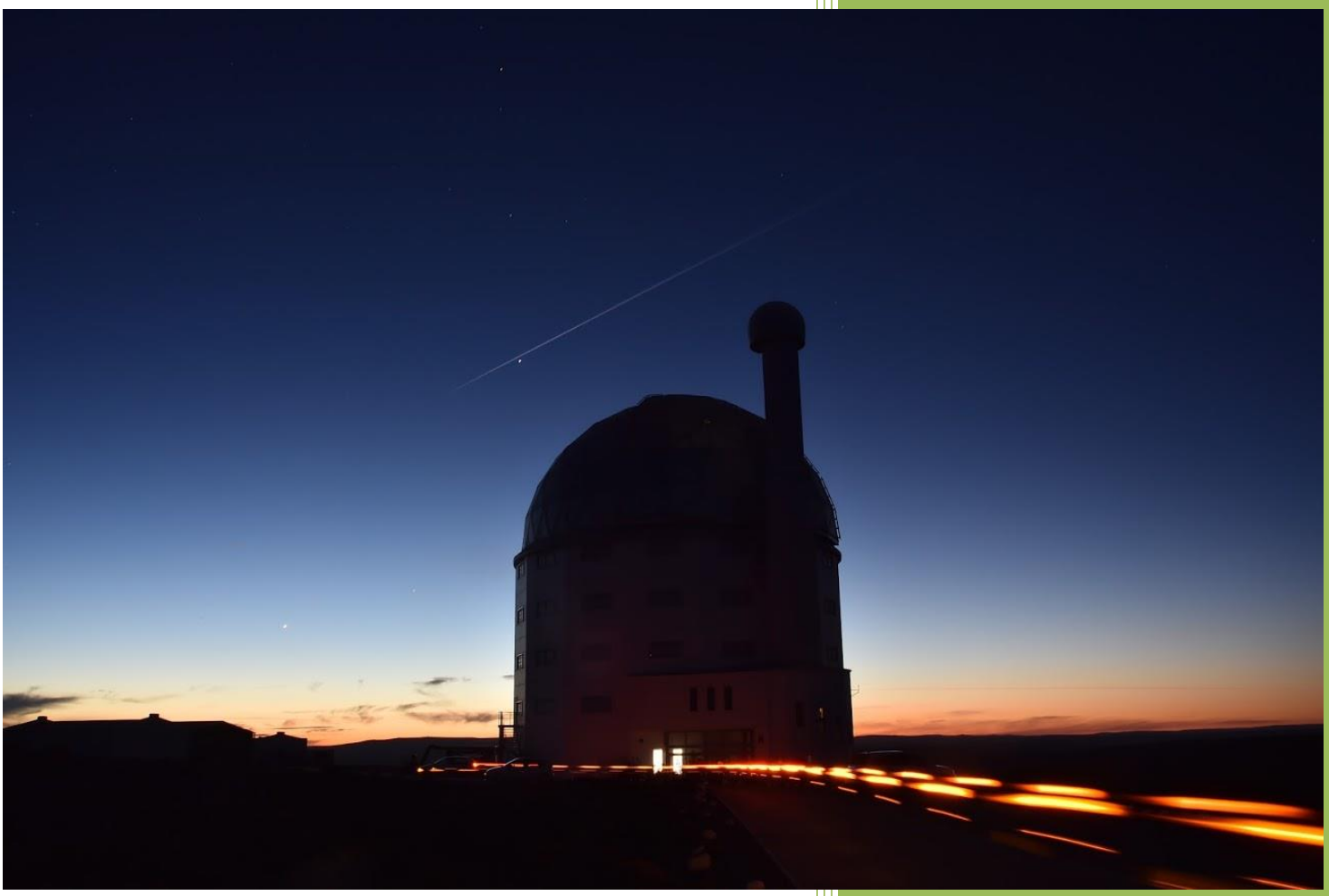
# SALT NEWSLETTER

# ISSUE APRIL 2019

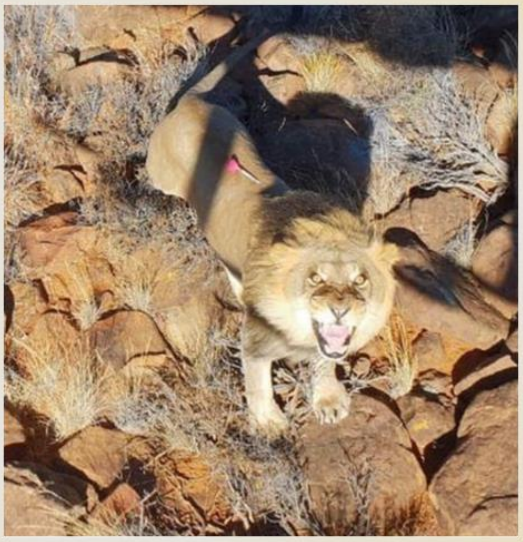


Southern African Large Telescope, Sutherland, South Africa

Cover Image: Vanessa Lorenzo Toquero

# TOPICS





Mufasa visits Sutherland!

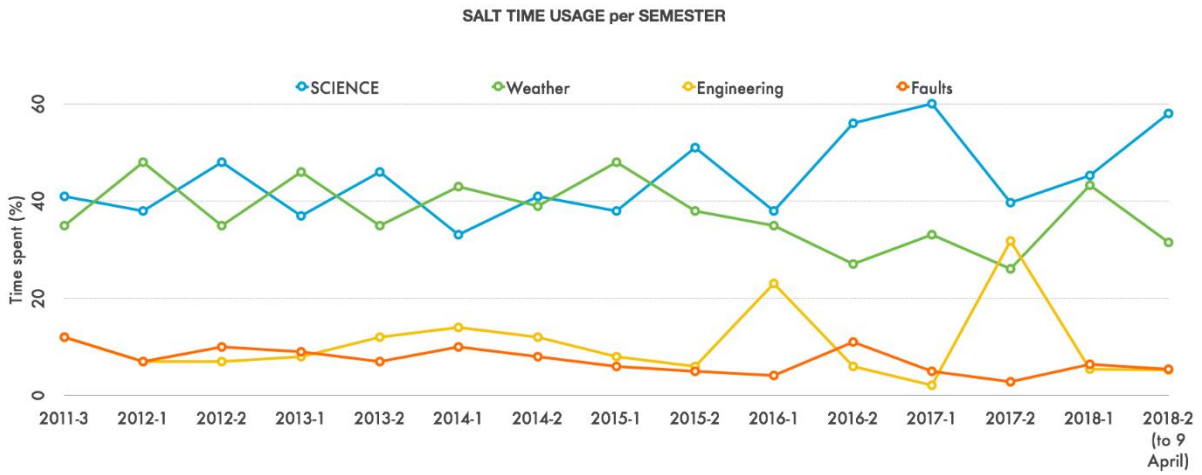

Contributors to this issue: Encarni Romero Colmenero, David Buckley, Christian Hettlage, Lisa Crause, Rudi Kuhn, Daniel Cunnama, Danièl Groenewald, Thea Koen (editor).

# LETTER FROM THE HEAD OF ASTRO OPS

Dear SALT community –

We're nearing the end of the 2018-2 semester and our stats are looking pretty good, with 58% time available for science and well spent on 1147 blocks to date! The paper output for 2019 is also promising, with 11 papers up to the end of March. We would really like to beat the 2017 record of 49 papers - we were so close last year... Please keep them coming!

We've spent ~ 5% of our time on engineering tasks, mainly to establish the HRS capabilities in its High Stability mode and defining the telescope capabilities in readiness for the NIR spectrograph, which is expected to arrive sometime next year. The status of the HS project is summarised by Lisa below. The technical downtime is slightly higher than spec (5% vs 3%), mostly due to some lingering stability issues with the new RSS guider. The new 2019-1 semester is around the corner - PIs have been notified of their new time allocations and we're looking forward to all the Phase 2s coming in by the 22nd April. As always, please let us know if there is anything we can help with.




The winner of the 1h P0 time draw from answering our Astro-Ops questionnaire is Jedidah Isler from Dartmouth College, USA - Congratulations! :) A huge thank you to all of you who filled it in, your inputs are very much appreciated! We've summarised your answers below: rest assured, we hear you and we're already working on it!

And another huge thank you for your prompt responses with your articles for the SALT Annual Report 2018. You provided the awesome content and our team have worked their magic again and it also looks awesome... and it's already at the printers! :)

There have also been some changes in the Astro-Ops team. At the end of January we said goodbye to Dr. Éric Depagne after nearly 5 years of being with us - we all wish him all the best in "the real world out there". On the 1st of April we welcomed Dr. Enrico Kotze as a new SALT Astronomer with a focus on the data reduction pipeline. We also have a new intern, Lonwabo Zaula, joining Christian and his team working on improving the proposal tools: the PIPT, Web Manager, etc. Welcome!

There are also more fun articles below about how the SALT structure got some slippery slippers and how a lion (yes, a lion!) came to spend the night in jail in Sutherland - it's been a busy semester! ;)

Clear skies!
Encarni

## SCIENCE HIGHLIGHT

A new binary star system has been discovered where a small white dwarf star is cannibalising its larger Sun-like companion. Such objects are actually quite common, but for this new object the white dwarf binged on its neighbour at a prodigious rate, heating part of it to nearly a million degrees. The object, named ASASSN-16oh, was found on 2 December 2016 by the *All-Sky Automated Survey for Supernovae* (*ASASSN*), a network of about 20 optical cameras distributed around the globe which automatically surveys the entire sky every night in search of transient events, objects which suddenly appear. ASASSN-16oh was found to be in the Milky Way's satellite galaxy, the Small Magellanic Cloud, at a distance of ~200,000 light years.

Optical follow-up observations were conducted by the Southern *African Large Telescope (SALT)*, the Polish *OGLE* telescope in Chile and the *Las Cumbres Observatory (LCO)* telescope network. It was also discovered to be a so-called "supersoft" X-ray source by the NASA *Neil Gehrels Swift Observatory* and the *Chandra X-ray Observatory*, produced by gas at temperatures of ~900,000 degrees. Such supersoft systems have previously always been associated with a thermonuclear

runaway explosion on the surface of a white dwarf, as occurs in a hydrogen bomb, brought on by the accumulation of hot and dense accreted gas which eventually reaches a critical explosive limit.

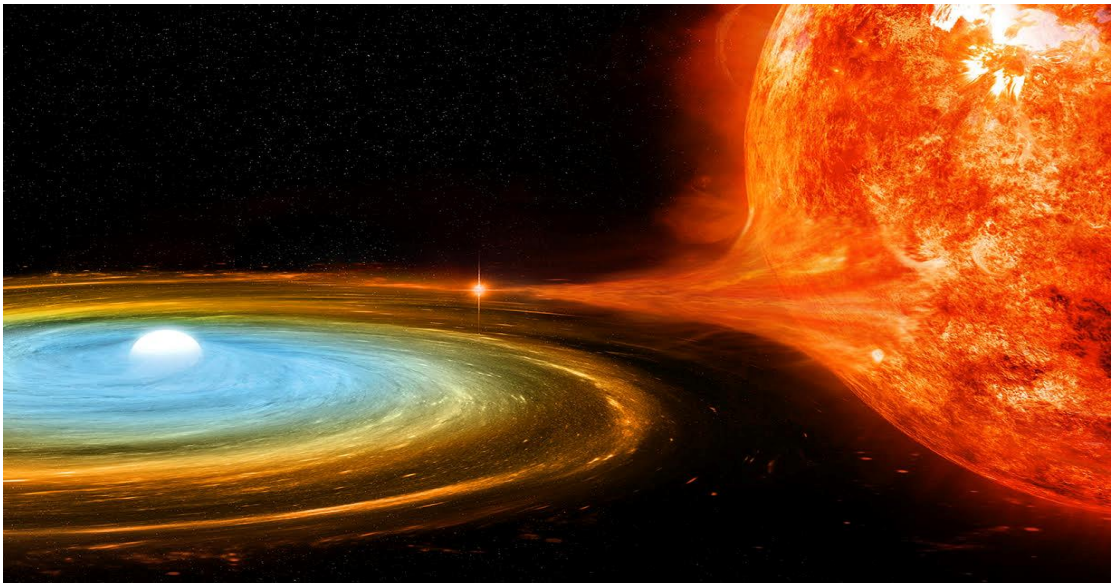


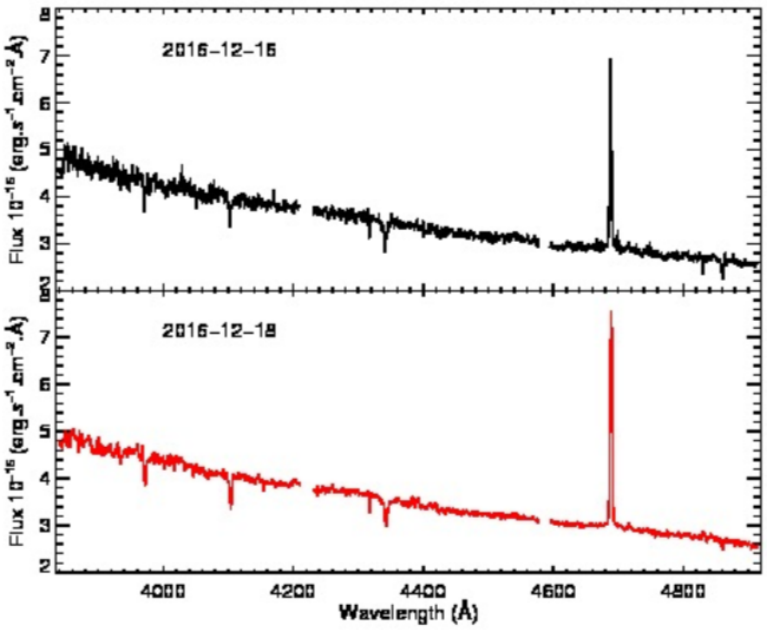
**Illustration:** An artist's impression of the supersoft X-ray binary system, ASASSN-16oh, with a small white dwarf star (left) accreting hot gas from its Sun-like companion (right), through an accretion disk. The stream of gas from the companion forms a flattened accretion disk and the gas gradually spirals down to the white dwarf, getting hotter as it does so. Eventually the accreted gas impacts the equator of the white dwarf, heating it up to nearly a million degrees, emitting in soft X-rays.
Picture credit: NASA/CXC/M.Weiss

"Supersoft sources are a really interesting class of transient events, and ASASSN-16oh is no exception", says David Buckley, the Principal Investigator of the SALT Large Science Programme on transients, who is based at the South African Astronomical Observatory. "We were fortunate to be able to react quickly to its discovery and undertake crucial observations during the outburst phase", he said. "Our SALT spectra showed all the hallmarks of a highly energetic system, with an intensely strong emission line from ionized helium which changed in velocity from night to night", says Buckley. In addition robotic observations were triggered with the LCO telescopes in South Africa, Chile and Australia, allowing for monitoring over a 34 hour period, beginning on Christmas Day 2016. "A nice Christmas present courtesy of the LCO Director who granted the time", quipped Buckley. The SALT and LCO data were then quickly analysed by another member of the SALT transients collaboration, Andry Rajoelimanana, at the University of the Free State, in Bloemfontein, South Africa.

It became clear after the optical and X-ray observations were analyzed that ASASSN-16oh was no normal thermonuclear powered supersoft source. "In the past, the supersoft sources have all been

associated with nuclear burning on the surface of white dwarfs," said lead author Tom Maccarone, a professor in the Texas Tech Department of Physics & Astronomy, lead author of the ASASSN-16oh discovery paper that appeared in the December 3rd issue of Nature Astronomy.

If nuclear fusion is the cause of the supersoft X-rays from ASASSN-16oh then it should begin with an explosion and the emission should come from the entire surface of the white dwarf. However, the optical light does not increase quickly enough to be caused by an explosion and the *Chandra* X-ray data show that the emission is coming from a region smaller than the surface area of the white dwarf. The source is also a hundred times fainter in optical light than white dwarfs known to be undergoing fusion on their surface. These observations, plus the lack of evidence for gas expelled away from the white dwarf, provide strong arguments against fusion having taken place on the white dwarf.




SALT optical spectra taken shortly after the optical peak brightness on 14 December.

Because no signs of nuclear fusion are present, the authors present a different scenario. As with the fusion explanation, the white dwarf pulls gas from its companion star, a red giant, in a process called disk accretion. The gas forms a large flattened rotating disk surrounding the white dwarf, becoming hotter as it spirals inwards, as shown in our illustration. The gas then falls onto the white dwarf, producing X-rays along an equatorial belt where the disk meets the star. The rate of inflow of matter through the disk varies by a large amount and when the rate of mass loss from the companion increases, the X-ray and optical brightness of the system becomes much higher.

“The transfer of mass is happening at a higher rate than in any system we’ve caught in the past,” added Maccarone.

If the white dwarf keeps gaining mass it may reach a mass limit and destroy itself in a Type Ia supernova explosion, a type of event which was used to discover that the expansion of the universe is accelerating. The team’s analysis suggests that the white dwarf is already unusually massive, so ASASSN-16oh may be relatively close – in astronomical terms – to exploding as a supernova.

“Our result contradicts a decades-long consensus about how supersoft X-ray emission from white dwarfs is produced,” said co-author Thomas Nelson from the University of Pittsburgh. “We now know that the X-ray emission can be made in two different ways: by nuclear fusion or by the accretion of matter from a companion.”

## SUMMARY OF THE SALT SURVEY


We would like to thank everyone that participated in the SALT Survey in December 2018. We appreciate all the feedback and will use the information you provided to give you as SALT users even better service than before. Here is a short summary of the results, and also a few of the comments (anonymously of course) we would like to share with all of the SALT community.

Of the 50 responses we received, only 60% are regular SALT users. The reasons for the rest of the survey participants to not use SALT include bad experiences in the past, and not being able to find a suitable SALT project. A number of responses also highlighted the fact that the application process takes longer and is more complicated than those at other observatories. We would like to encourage those (and all the SALT users) to email us if they find themselves stuck or unable to complete a certain task during the application process. We would also encourage the SALT users to start the application process slightly earlier, so that problems and misunderstandings can be rectified before the submission deadlines.

For those SALT users who have had bad experiences in the past, we would like to help you get the most out of SALT in the future and ask that you contact us so that we are aware of the problems and can rectify the situation.

## Instruments

The types of observations and instrument configurations most often used are as follows:

1. SALTICAM is mostly used for normal imaging.
2. RSS longslit mode is used 4 times as much as any of the other modes.
3. HRS is used in all three modes equally.

## Communication

Most of the SALT users have contacted the SALT team at least once a semester, with 93% of those respondents rating our support very highly. The areas that were highlighted for improvement are the current websites that are sometimes out of date and the documentation being overly complicated (especially for first time users). We will work harder to ensure that the websites have the most current information and is updated whenever things change.

## Software

More than 75% of the responses we received rated the various software tools we provide as “very high” or “excellent”. The need for a SALT data archive and SALT data reduction tools were rated as extremely important by most of the user community. We realise that SALT is a very different telescope to most others and the data reduction process is more complicated. We are continuously updating and improving these tools and encourage our users to help us with these improvements. We would also like to use this opportunity to communicate to our users that we have been working very hard on the SALT data archive and we will be releasing more information on this shortly.

The comments on the areas where we could improve have been well received and we are working on getting the various tools documented properly. We also received a large number of comments on the use of IRAF and older versions of Python required to reduce the data products. We are aware of these issues and have already started updating the various tools, and ask the user community for a little more patience.

## What we should start/continue/stop doing

To help our users publish more papers, the survey respondents would like us to provide clearer documentation on the reduced data products and improve the pipelines that produce these products. With the recent appointment of a new SALT Astronomer specifically to deal with the data reduction pipeline and all associated tools, we want the user community to be assured that we have taken your feedback on board and will be working on getting the results you are expecting.

The newsletter and other information we provide was well received and most of the SALT users were very happy with the current level of support and information we provide.
SALT conferences were also very well received and the feedback on the structure and frequency of the SALT workshops was very helpful. We are always looking forward to getting the SALT user community together and sharing ideas.

Once again, we would like to thank everyone for their responses and feedback on the SALT Survey. We are encouraged that the majority of the SALT user community thinks we are doing a good job and we would like to thank them for their encouraging words. It's always good to know when we are doing things right. We have also listened to your suggestions of where we can improve and we will be working hard to implement your ideas. We hope to make the SALT user experience even better in the near future.

## HRS IODINE CELL COMMISSIONING

The new HRS iodine cell was tested during an on-sky engineering campaign in May/June 2018. This process successfully verified the basic performance of the new system and allowed iodine cell specialist Paul Butler to adapt his precision radial velocity (PRV) raw-reduction and analysis software to accommodate HRS data.

An "engineering change request" was then executed by the Tech Ops team to render the system operationally robust, to support routine iodine cell observations on SALT. A custom-built insulating housing for the new cell, better temperature control and safety measures, as well as the necessary software changes for the HRS instrument control GUI were implemented in late February 2019.

A series of observations of a bright, highly-stable RV standard star were then made over the course of about three weeks to qualify the new setup and these data are currently being reduced. The re-introduction of the high-stability (HS) mode's sky fibre (which was bypassed during the 2018 tests) and some other changes made to improve the throughput of the system (specifically the re-alignment of the HS-mode fibres in November) necessitated considerable modifications to the PRV raw-reduction pipeline. Paul is making good progress on this, despite currently being on vacation in Scandinavia! We look forward to seeing how these results compare with the earlier engineering data. Our next step will be to observe a couple of systems known to host exoplanets, to see if we can recover them with

SALT HRS.  This will be done for stars of different brightnesses to establish how faint we can go with the iodine cell before tackling some new TESS targets!

Image 1 - Iodine cell in beam: This overhead view of the high-stability bench shows the iodine cell positioned in the fibre double-scrambler gap.  The fibres inject light into the cell from the bottom of this photo and it enters the top pair of fibres (labeled P and O) that go into the HRS vacuum tank.  The cell is mounted on the black translation stage that moves horizontally to place the cell, or the optical feeds for other precision calibration modes in the beam.  The HS bench's ThAr lamp is visible to the upper right.

Image 2 – New housing: The housing is made of a composite material called Tufnol, which has good dimensional stability and insulating properties at elevated temperatures (the cell is run at ~60C).

Image 3 – New cell wrap: The new HRS iodine cell with its heating tape, two thermocouples and thermal fuse being installed in the new insulating housing.

## PHASE 2 SUBMISSIONS

Congratulations to all of you who have been allocated time for the 2019-1 semester!

The phase 2 process is the same as in previous semesters. You may download a phase 2 version of your proposal in the PIPT by using the menu item Online > Download from Server. If you are asked

whether to replace an existing version, you have to confirm this. Otherwise your phase 2 proposal won't have the correct proposal code, and you won't be able to submit it.

Once you have the phase 2 version you can add all the required blocks etc. If you have a small number of blocks, it's perfectly fine to do this by hand. However, if you need to create dozens of similar blocks, you are probably better off generating your blocks with a script. You can find instructions on how to do this in the sections „Adding many targets" and „Adding many blocks" of http://pysalt.salt.ac.za/pipt-manual/html/pipt-manual.html#creating-a-proposal.

Also, if you have a need for fully automating the submission process, for example because you are observing targets of opportunity, you should contact salthelp@salt.ac.za to discuss how we might support you.

You can submit your completed phase 2 proposal in the PIPT. Resubmissions are possible. Please send an email to salthelp@salt.ac.za afterwards, so that we can reactivate your proposal.

If your proposal has lots of blocks, you might be interested to know that (after the initial phase 2 submission) you can submit individual blocks by going to the Blocks tab, selecting them in the table of blocks and using the bulk option „Submit". If you only need to submit a single block, you can submit it by clicking the button „Submit this block" at the bottom of its form.

Once observed or in the queue, only minor changes (such as updating the number of visits) may be made to a block. If you need to make other changes, you'll have to copy the block (and rename the copy). Remember to update the number of visits of the original block, if need be.

We recommend that you use the latest version of the PIPT (5.3 or higher), although you might get by with the previous one (5.2). However, if you want to submit a proposal for a gravitational wave event, as explained elsewhere in this newsletter, you'll have to use version 5.3 or higher.

The deadline for new phase 2 submissions is 22 April 2019, 16:00 UT. This is a strict deadline and no Phase 2 proposals will be accepted after this date, unless discussed with your liaison astronomer before the deadline.

As always, rather than wasting precious hours of your time you should not hesitate to send an email to salthelp@salt.ac.za with any questions or problems you might have. This is particularly true in case of

inexplicable validation errors, which might be caused by rogue elements not visible in the PIPT. We'll be happy to help!

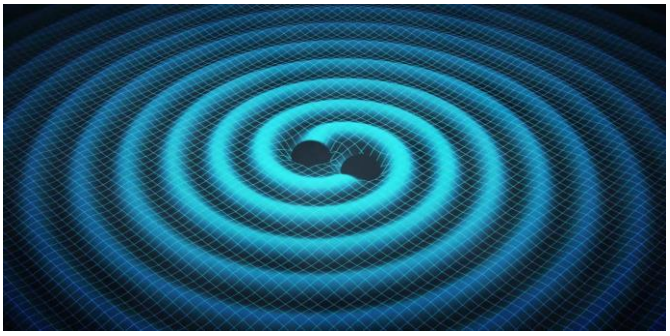
## GRAVITATIONAL WAVE EVENT PROPOSALS

With LIGO having come online again on 1 April, it should only be a matter of time before another neutron star merger or other explosive event is caught in the act by detecting the gravitational waves emitted by it. And needless to say, if there is an optical counterpart, SALT should observe it if possible.

SALT has therefore set aside time for proposals covering such gravitational wave events. The procedure of submitting such a gravitational wave event (GWE) proposal is straightforward: Make sure you have the latest version of the PIPT (5.3 or higher) installed and running, create a new proposal and when prompted choose „Gravitational Wave Event" as the proposal type. Add all the necessary details and submit the proposal, as you would do for any other proposal. If you are on the GWE proposal mailing list (see below), you can import existing GWE proposals into the PIPT by using the menu item Online > Import from Server.

No prior approval is required for a GWE proposal. However, you can only submit or resubmit a GWE proposal if you belong to one of the SALT partners. If you don't, you should contact salthelp@salt.ac.za and we'll put you in touch with members of the SALT partnership who might collaborate with you and submit the proposal.

Every time a GWE proposal is submitted, a notification is sent to a dedicated mailing list. You are automatically subscribed to that list when submitting a GWE proposal. However, you can also sign up yourself by going to https://www.salt.ac.za/wm/GW/. You need to belong to a SALT partner, though.



# SALT REMOTE OBSERVING STATION DEMONSTRATION


Image: The SAAO/SALT Team at the remote observing station in the South African Parliament

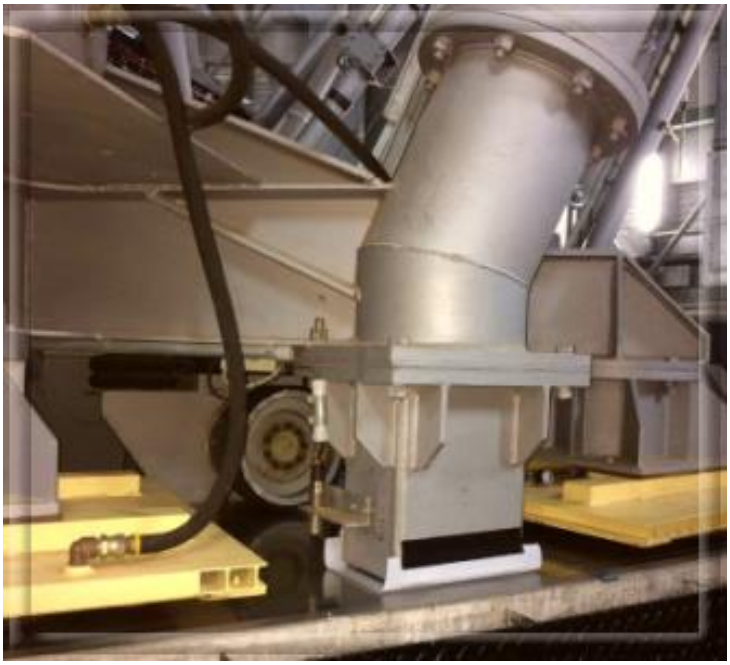
SAAO and SALT were invited to exhibit in Parliament from 12-15 February 2019 as part of the Department of Science and Technology's 4th Industrial Revolution Expo, demonstrating South Africa's readiness for the digital revolution.

A fully operational remote observing station was set up to control SALT from the parliament precinct. The exhibit featured on Morning Live on Tuesday, 12th February 2019, and had numerous visitors from parliament, the public and school groups, including the Minister of Science and Technology, and the Speaker and Deputy Speaker of the House.

The SAAO/SALT exhibition also formed the backdrop for all Morning Live and DST interviews and resulted in many other impressed individuals requesting further information and interviews regarding the remote station. Scientists, learners, members of parliament and the public left feeling extremely excited by what we displayed. This show of our excellence culminated in apparent media publicity with a viewership of 2.5 million.

This exhibition and its set-up were coordinated by a fantastic team consisting of support from IT, SALT, and our enthusiastic Astronomers. It showcased what team-work and collaboration can achieve and illustrated our ground-breaking science and research.

## SALT GETS SLIPPERS



The surface of the huge concrete pier that SALT lives on has taken a beating over the many years of operation and so the Tech Ops team fitted large, smooth stainless steel plates to protect it. This looks great and does shield the concrete, but it had some unintended consequences.

The telescope started making loud banging noises at random times - sometimes soon after a structure move, other times many hours later, even during the daytime. The problem was eventually traced to the structure feet, which need to be able to slide radially outwards slightly when the structure is set down after an azimuth move.

The vivid analogy provided by former HET chief-engineer John Booth, who was visiting SALT in February, was: "picture the legs of a cow after you pick it up by the body and then set it back down again". The higher friction due to the polished stainless steel plates resulted in the telescope feet sticking and then later popping outwards with a bang. The movement is only of order a millimetre or so, but the structure weighs about 90 tons, so there's a significant amount of energy involved!

The telescope thus received a set of teflon "slippers" to allow the feet to slide around as much as necessary for the structure to settle comfortably. With that, the banging stopped and all was well! Proving once again that everyone needs a good pair of slippers, especially up in Sutherland...

## LINDAU NOBEL LAUREATE MEETING

Massive congrats go out to Itumeleng Monageng, an SAAO postdoc who also assists with observations at SALT. Itumeleng was selected by the Academy of Science of South Africa (ASSAf) as one of the 20 top young scientists, from South Africa, to attend the prestigious Lindau Nobel Laureate Meeting, which will be held in Germany later this year! They will be joining 580 young scientist from 88 countries, along with 42 Nobel laureates.

## MUFASA VISITS SUTHERLAND

After nearly a month on the loose, the Karoo National Park lion Mufasa was finally captured on a farm just outside of Sutherland Observatory…and jailed! Yes, you heard right. On Wednesday, 13th March 2019, after being spotted and subsequently tranquilized, Mufasa was airlifted to the town of Sutherland where he was then carried on a stretcher by several brave souls from the helicopter and placed into a jail cell. His overnight stay was necessary as there was not sufficient tranquiliser to transport him all the way back to Beaufort West. Mufasa, who is estimated to be between two and four years, old took down several buck and 5 sheep during his time on the prowl.

Mufasa's escape sparked some interesting discussion about the perils of wild animals to local astronomers in South Africa...

"According to one early resident, in Fearon Fallows' days an astronomer might find a leopard disputing his right to adjust the shutters on the roof, and hippo could sometimes be found in nearby marshes." AND: "A number of SA observatories were built on sites known locally as "slang kop" – snake's head. At Radcliffe, if the night watchman killed a dangerous snake, he left it outside the front door of the dome so that the astronomers could see he was doing his job. I expect that caused some interesting moments ....."

# MEET THE TEAM: DANIÈL GROENEWALD

**How did you become an astronomer?**

I was born into a family of talented artists. Although I have to confess that I was not blessed with that particular talent... I can't draw a stick figure to save my life. All jokes aside though, I have my grandfather to thank for setting me on this career path. I have vivid memories from my early childhood of my grandfather pointing out constellations to me and teaching me their names. Later years we would talk about some of the scientific discoveries he read about, and it is through these discussions that my love for science was born. He had a passion for the night skies and our place in the Universe. I later learned, after his passing, that he had a doctorate in Chemistry and this was one of the driving forces for me to get my PhD. I think of him so often when I am up in Sutherland observing, he would have loved the view of the night skies.

**What is your research on?**

My research is on galaxy formation and evolution, specifically brightest cluster galaxies. I am particularly interested on the effects of close pairs/mergers on the evolution of these massive galaxies, a topic which is still highly debated in the literature.

**What is your role on the SALT team?**

During my first postdoc (with Stephen Potter) I got involved in the polarimetry of transient objects. I am currently assisting in the development of SALT's polarimetry tools and will also provide support to other polarimetry users.

**What do you enjoy doing outside of astronomy?**

I have a pretty active and inquisitive 18-month old toddler to keep entertained nowadays, but in my spare moments I love to read. One of my favourite pasttimes is browsing through book stores and my local library. With a toddler though I have developed some new hobbies which include getting covered in mud and finger painting with my little girl. Rediscovering the world through her eyes is a precious gift I try to savour everyday.

## SALT SCIENCE PAPERS

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.


- Arentsen, A.; Starkenburg, E.; Shetrone, M.D.; et al. 2019/01. Binarity among CEMP-no stars: an indication of multiple formation pathways? *AA*, 621. http://adsabs.harvard.edu/abs//2019A%26A...621A.108A
- Black, C.S.; Fesen, R.A. and Parrent, J.T. 2019/02. Narrow transient absorptions in late-time optical spectra of type Ia supernovae: evidence for large clumps of iron-rich ejecta? *MNRAS*, 483, 1114. http://adsabs.harvard.edu/abs/2019MNRAS.483.1114B
- Gromadzki, M.; Hamanowicz, A.; Wyrzykowski, L.; et al. 2019/02. Discovery and follow-up of the unusual nuclear transient OGLE17aaj. *AA*, 622. http://adsabs.harvard.edu/abs/2019A&A...622L...2G
- Gvaramadze, V.V.; Kniazev, A.; Castro, N.; et al. 2019/02. Two Circumstellar Nebulae Discovered with the Wide-field Infrared Survey Explore and Their Massive Central Stars. *AJ,* 157, 53. http://adsabs.harvard.edu/abs/2019AJ....157...53G

- Gvaramadze, V. V.; Maryeva, O. V.; Kniazev, A. Y.; et al. 2019/02. CPD–64°2731: a massive spun-up and rejuvenated high-velocity runaway star. *MNRAS*, 482**.** http://adsabs.harvard.edu/abs/2019MNRAS.482.4408G
- Katkov, I.Y.; Kniazev, A.Y.; Kasparova, A.V.; et al. 2019/02. The imprint of the thick stellar disc in the mid-plane of three early-type edge-on galaxies in the Fornax cluster. *MNRAS*, 483, 2413. http://adsabs.harvard.edu/abs/2019MNRAS.483.2413K
- Maccarone, T. J.; Nelson, T. J.; Brown, P. J.; et al. 2019/02. Unconventional origin of supersoft X-ray emission from a white dwarf binary. *Nature,* 3, 173. http://adsabs.harvard.edu/abs/2018NatAs...3..173M
- Monageng, I. M.; Coe, M. J.; Townsend, L. J.; et al. 2019/03. The SMC X-ray binary SXP4.78 : a new Type II outburst and the identification and study of the optical counterpart. *MNRAS,* 485, 4617. http://adsabs.harvard.edu/abs/2019MNRAS.tmp..699M
- Ohyama, Y.; Sakamoto, K.; Aalto, S.; et al*,* 2019/02*.* Dusty Superwind from a Galaxy with a Compact Obscured Nucleus: Optical Spectroscopic Study of NGC 4418. *AJ,* 871, 191. http://adsabs.harvard.edu/abs/2019ApJ...871..191O
- Spiniello, C.; Sergeyev, A. V.; Marchetti, L.; et al. 2019/03. Spectroscopic confirmation and modelling of two lensed quadruple quasars in the Dark Energy Survey public footprint. *MNRAS,* 485, 5086. http://adsabs.harvard.edu/abs/2019MNRAS.tmp..750S
- Yan, W.; Hickox, R.C.; Hainline, K. N.; et al*,* 2019/01. NuSTAR and Keck Observations of Heavily Obscured Quasars Selected by WISE. *AJ,* 870. http://adsabs.harvard.edu/abs/2019ApJ...870...33Y