SALT NEWSLETTER

ISSUE JUNE 2018

Southern African Large Telescope,
Sutherland, South Africa
Cover Image: Simon Fishley

TOPICS

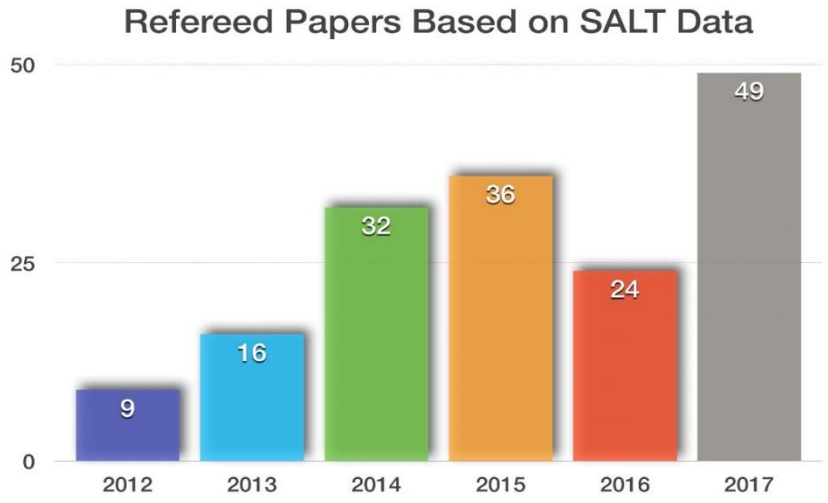
Contributors to this issue: Encarni Romero Colmenero, Brent Miszalski, Nhlavutelo Macebele, Rosalind Skelton, Christian Hettlage, Itumeleng Monageng, Keith Browne, Chris Coetzee, Thea Koen (editor).

LETTER FROM HEAD OF ASTRO OPS

Dear SALT community –

This time we have truly exciting news to share with you: earlier this year, an agreement was signed between the South African Radio Astronomical Observatory (SARAO) and the South African Astronomical Observatory (SAAO) to fund three projects arising from the SALT Strategic Plan: the Generation 1.5 instrument, which is a simple, maximum-efficiency spectrograph (MaxE) for transient science, the development of the high-stability mode of HRS for exoplanet science and a very exciting new project to robotizise the entire SAAO Sutherland plateau to respond to alerts in a coordinated manner. These projects are kicking off on 1st January 2019.

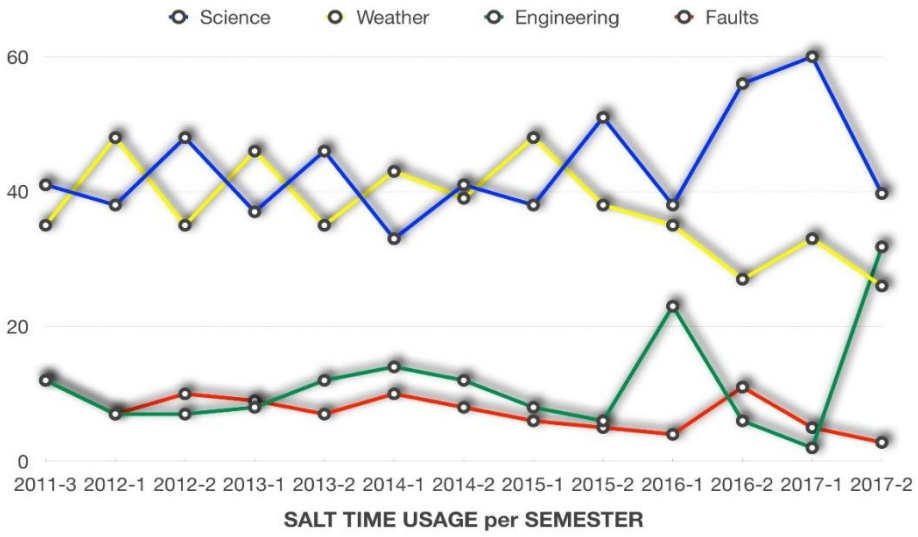
We're also happy to share with you that we have yet again broken the SALT publication record in 2017, with 49 refereed publications (see figure below), including several that featured the SALT data on GW170817. Thank you to all of you who publish your data and, for those who haven't, a gentle encouragement - go on, you know you want to! Should you require any support, please don't hesitate to contact us.



We are also proud to announce that we will be hosting a conference "Advances with SALT" on 14-16 November at the headquarters of the National Research Foundation of South Africa, which are located in Pretoria. The aim is not only to share our science results, but also to learn/improve our data reduction and analysis skills and to get the SALT community together to

talk SALT and plan more exciting SALT science projects. More information, and the link to the awesome conference website, in this newsletter.
The planned telescope engineering shutdown in March/April went really well and we were back on sky as planned. Unfortunately, our shiny new two-probe RSS guider had a few teething problems that interfered with the rest of the telescope operation and they have taken a while to track down. Please see more information about the shutdown in the newsletter.

Mainly as a result of the shutdown and new RSS guider commissioning decreasing our available science time, especially towards the end of the 2017-2 semester, our completion statistics were not as high as we'd hoped or grown used to, but they are not too shabby either: 85% of P0, 66% of P1 and 68% P2s.



And to end on a personal note, despite having been with SALT for many years, I've only been in my new role since the beginning of January so I feel a bit like a newbie. It's been a bit of a steep learning curve but also an exciting journey. With Petri as director of the SAAO and with the extra funding from the SAAO and SARAO, I am really looking forward to seeing SALT going from strength to strength!

Encarni Romero Colmenero
Head of SALT Astronomy Operations

PS As usual, please do not hesitate to contact salthelp@salt.ac.za with any questions or feedback you may have, or with lessons learnt from your SALT data analysis.

SCIENCE HIGHLIGHT

SALT's High Resolution Spectrograph sees double in Hubble's Eye on the Universe

Brent Miszalski, Rajeev Manick, Joanna Mikołajewska, Hans Van Winckel and Krystian Iłkiewicz

Around 15 months after South Africa held its first democratic elections, the *Hubble Space Telescope* (*HST*) captured what would turn out to be one of its most iconic images. In focus was a little studied planetary nebula called MyCn18, named after its discoverers Margaret Walton Mayall and Annie Jump Cannon. Mayall and Cannon identified MyCn18 from photographs taken during 1938-1939 with telescopes located in Bloemfontein, South Africa. Seen from the ground, MyCn18 appears as a small, nondescript double-lobed nebula of ionised gas, but from space the details revealed by the HST were astounding!

Peering out from the inky void of space appeared to be an eye at the centre of an hourglass-shaped nebula with peculiar ripples visible in its lobes. The sparkle of the eye, the ionising star of the nebula, was also offset from its expected position at the centre. Even more curious, an inner hourglass reminiscent of the outer nebula was present, as in a Matryoshka doll. The enigmatic beauty of MyCn18, also known as The Etched Hourglass Nebula, soon drew widespread attention amongst the wider public, gracing the covers of the April 1997 issue of National Geographic and Pearl Jam's 2000 album Binaural (Fig. 1: see below).

Fig.1

Apart from its artistic appeal, the complexity revealed in the *HST* images of MyCn18 proved particularly intriguing to astronomers interested in how planetary nebulae form. The offset central star and inner hourglass did not seem to fit the standard formation recipe of planetary nebulae. Initial studies of the *HST* images all strongly suspected a binary star to be responsible for producing these features. Comparisons have also been made between the nested hourglass configuration of MyCn18 and the so-called `triple-ring nebula', the remnant of Supernova 1987A, which is believed to have formed after the merger of a massive binary system (Fig. 2). More recently, several authors have suggested a classical nova explosion could have produced the features of MyCn18 and especially its impressive system of collimated outflows or jets which reach speeds of up to 630 km/s.

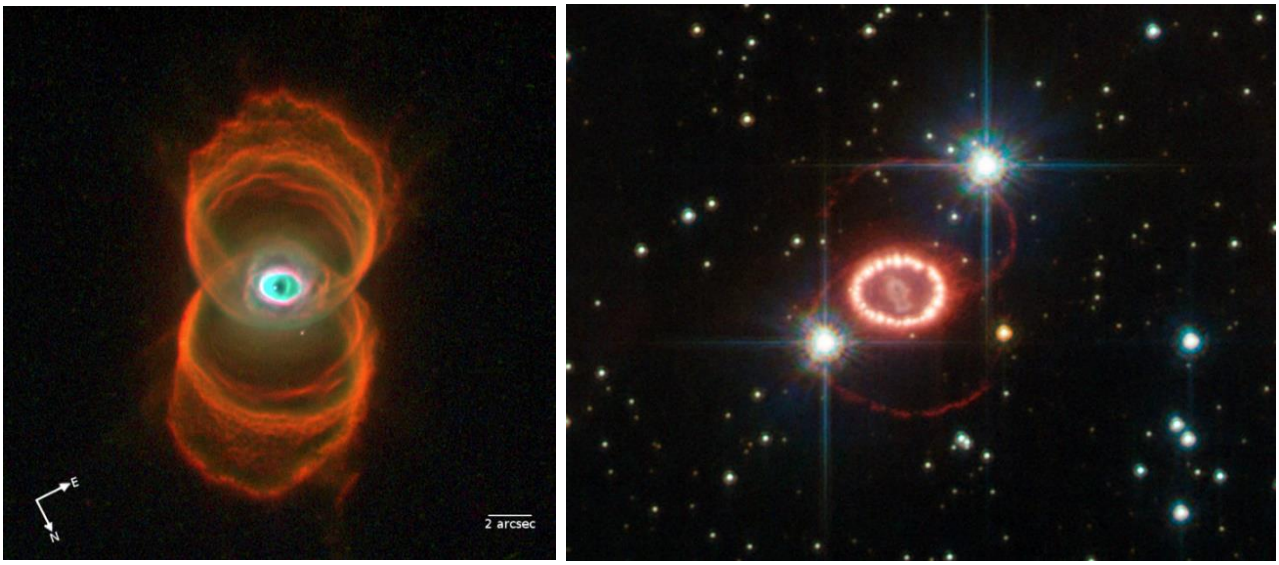


Fig. 2: MyCn18 (Left; image credit: Raghvendra Sahai and John Trauger (JPL), the WFPC2 science team, and NASA) and the remnant of SN 1987A (Right; image credit: ESO/Hubble & NASA) share similar morphologies.

One critical piece of MyCn18's story was missing, however: No one knew whether the central star was actually a binary star! We set out to resolve this issue with the High Resolution Spectrograph (HRS) on SALT as part of a systematic survey searching for binaries in planetary nebulae. A total of 26 SALT HRS spectra were obtained and a study of the results has recently been accepted for publication in the Publications of the Astronomical Society of Australia (PASA) journal https://arxiv.org/abs/1805.07602. Figure 3 shows the SALT HRS radial velocity measurements that demonstrate a significant periodicity of 18.15 days, finally proving the binary

nature of the central star. SALT HRS was ideally matched to detecting the low radial velocity semi-amplitude of 11 km/s in the relatively faint central star (V=14.9 mag). Assuming the orbital plane inclination matches the orientation of the nebula, the companion would have a mass about ⅕ that of the Sun, corresponding to an M5 dwarf.

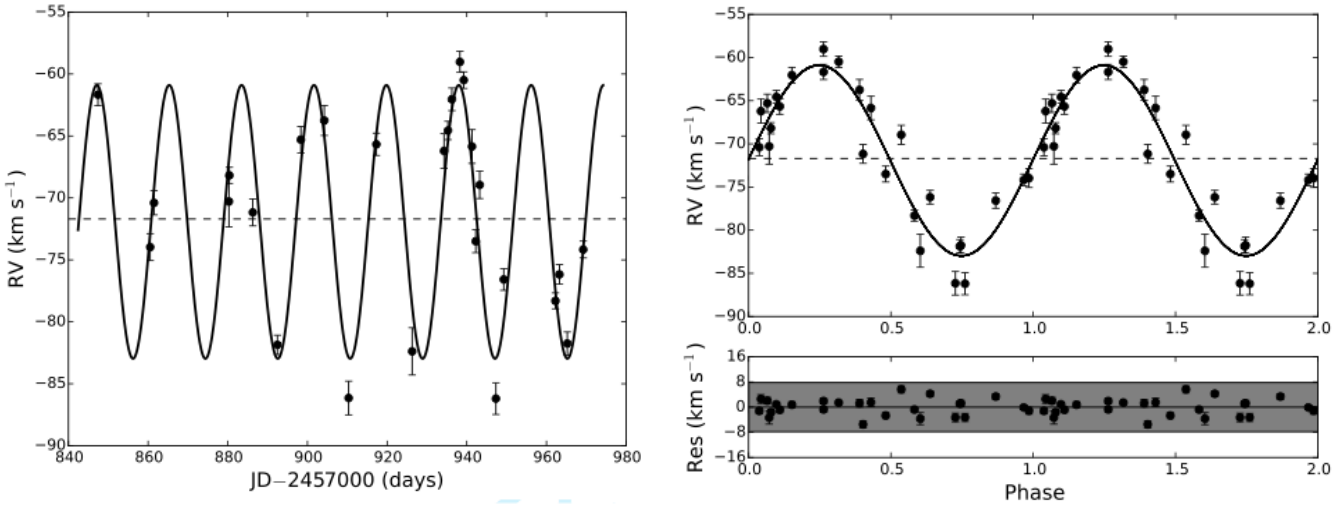


Fig. 3: SALT HRS radial velocity measurements of the central star of MyCn18 displayed in time (left) and phased with the 18.15 day orbital period (right). The solid lines represent the Keplerian orbit fit to the data.

What makes this discovery most peculiar is that all previous explanations for how MyCn18 formed don't seem to fit the observed binary. The orbital period is neither short enough to fit a classical nova explanation, nor is it long enough to fit often cited formation scenarios for the offset central star or double lobed morphology of MyCn18. We suggest the unusual characteristics of MyCn18 may be attributed to the binary system accreting some of the residual nebula envelope, creating a circumbinary disk around both stars. The jets may then have formed from such a disk, helping to remove the remaining accreted material to form the inner hourglass. Full details of this process are yet to be determined, but the scenario provides a promising avenue for further investigation into precisely how MyCn18 formed.

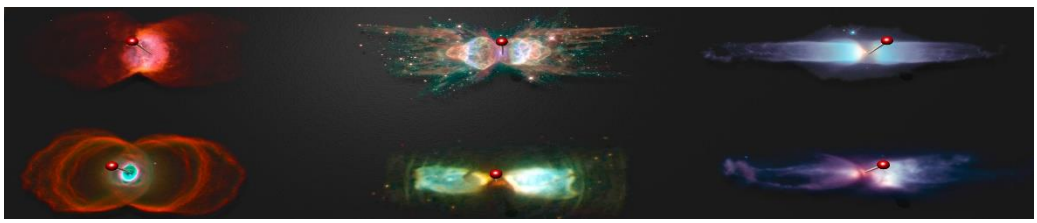


Fig. 4: Butterflies from space. *Image Credit: ESA/Hubble.*

SHUTDOWN

SALT was taken off-line for a planned shutdown for upgrades and maintenance on 5 March 2018. The required tasks were completed within the estimated 6-week timeframe thanks to the tireless work of the Technical Operations team – well done! Milestones achieved during the shutdown include the following:

- ☑ Installed tracker upgrade: Rho wrap
- ☑ Installed the guider upgrade on the RSS
- ☑ M3 Mirror in the SAC inspected to determine the technicalities involved in removing it for cleaning during the next shutdown
- ☑ Checked the alignment of the optics in the Rotating Structure (RS)
- ☑ Upgraded the fibre optic cable between the SALT server room and the SAAO server room
- ☑ Fixed coupling fluid leaks on the RSS optics
- ☑ Reworked the SALTICAM SDSU for improved cooling
- ☑ Improved Waveplate reliability

Astronomy operations will benefit tremendously from the installation of a new guidance system for the RSS. The new instrument has two cameras, each covering half of the FOV, and can guide on significantly fainter stars than was previously possible. The new guider will also allow for auto-focus and by guiding on two stars simultaneously will prevent rho drift, which will greatly improve our ability to keep multiple objects on their slits during MOS observations.

The Salticam SDSU is now running cooler which bodes well for the longevity of the electronics. The waveplates are finding the stations correctly and we have a high level of confidence in the mechanism after running a stringent ATP. The upgrade of the rho wrap will have a significant impact on the longevity of the cables inside it, the opportunity was also taken to replace ageing fibre optic cable.

We have been back on-sky since mid-April, with ongoing commissioning of the new guider now nearing completion.

CALL FOR PROPOSALS

It's that time of the year again...

On 15 June we will release the call for proposals for semester 2018-2. The semester will run from 1 November to 30 April. We recommend that you use the latest versions of the software, as listed in the call document.

The call document will be available at:
http://astronomers.salt.ac.za/proposals/
You may find all the software required for planning & submitting your proposal at:
http://astronomers.salt.ac.za/software/

There will be a new version of the PIPT with full multi-semester support and the capability to submit individual blocks instead of whole proposals.

The phase 1 deadline will be on 31 July at 18:00 SAST (16:00 UT).
The phase 2 deadline is 19 October (16:00 UT).

In case you need to continue your program in the next semester, you may either submit a new proposal or submit a proposal progress report on your proposal's page in the Web Manager (https://www.salt.ac.za/wm).

If you have any questions regarding the submission process, you should contact salthelp@salt.ac.za

We are always glad to help!

SALT ANNUAL REPORT

We would like to proudly announce the publication of the SALT Annual Report 2017, which was completed in lightning-record time. It is full of great science achievements, information about our SALT partners, plans for the future, our record-breaking observing statistics, outreach activities, etc. And it also looks amazing! www.salt.ac.za/news/salt-annual-report-2017

SARAO / SAAO AGREEMENT

Earlier this year an exciting agreement was signed between the South African Radio Astronomy Observatory (SARAO) and the South African Astronomical Observatory (SAAO). SARAO is a sister organization to the SAAO, also falling under the National Research Foundation. It is responsible for the MeerKAT, KAT-7 and Hartebeeshoek radio telescopes and is leading South Africa's involvement in the Square Kilometre Array, which will be built in the Karoo a few hours north of SALT over the next few years. The arrangement will fund three projects arising from the SALT Strategic Plan: the Generation 1.5 instrument, which is a simple, maximum-efficiency spectrograph (MaxE) for transient science, improvements to the high-stability mode of HRS that will enable it to be exploited for exoplanet science and a very exciting new project to enable the entire SAAO Sutherland plateau to respond to transient alerts in a coordinated manner through automation and AI. These projects are kicking off on 1st January 2019, with involvement from both SAAO (www.saao.ac.za) and SARAO (www.ska.ac.za) engineers and astronomers.

NRF National Research Foundation | SAAO South African Astronomical Observatory

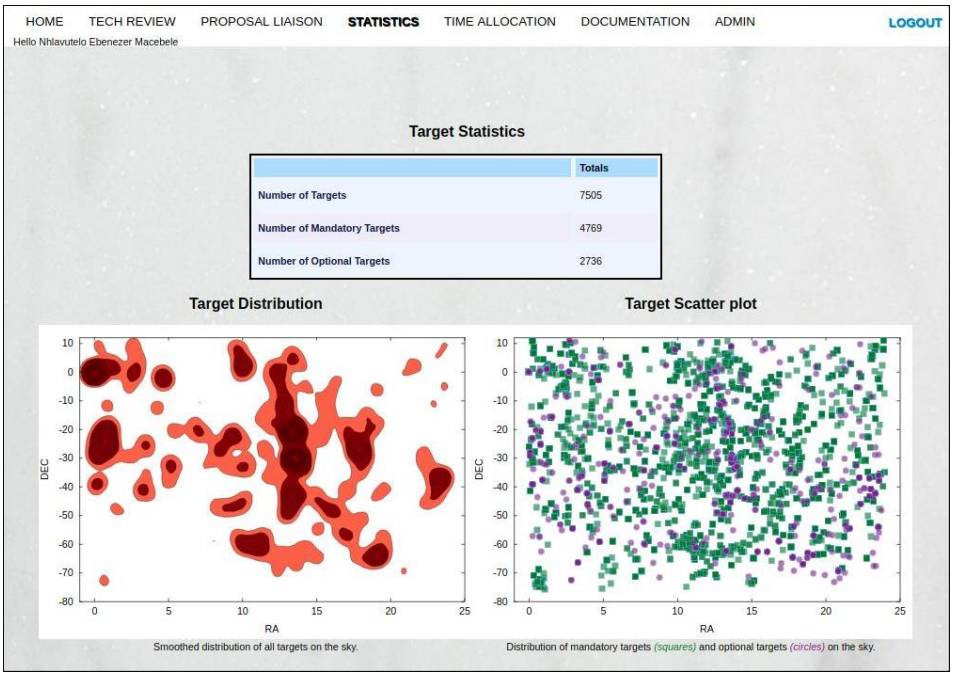
NRF National Research Foundation | SARAO South African Radio Astronomy Observatory

NEW TAC PAGES

As part of the software upgrades related to the new version of the SALT Science Database, the TAC functionality was moved from the Web Manager to a new website of its own. This move brought about various improvements:

- The proposal statistics can now be accessed online and includes information on the number of proposals submitted, the requested time per instrument, and the target distribution on the sky.
- As before, TAC chairs can still enter their time allocations in an online form, but they can now also upload (and download) them from a csv file, allowing them to use a spreadsheet editor like Excel when compiling them.
- The TAC site lists all the proposal details and provides links to the proposal pages in the Web Manager, which is complemented by the functionality to download all the proposal pdf summaries either individually, or as a zip file containing all the summaries.
- The new site also endeavours to facilitate the administrative tasks of SALT Astronomers, and allows them to view and select proposals for technical review.

Needless to say, any such site always benefits from user suggestions and we look forward to your feedback!



SALT CONFERENCE

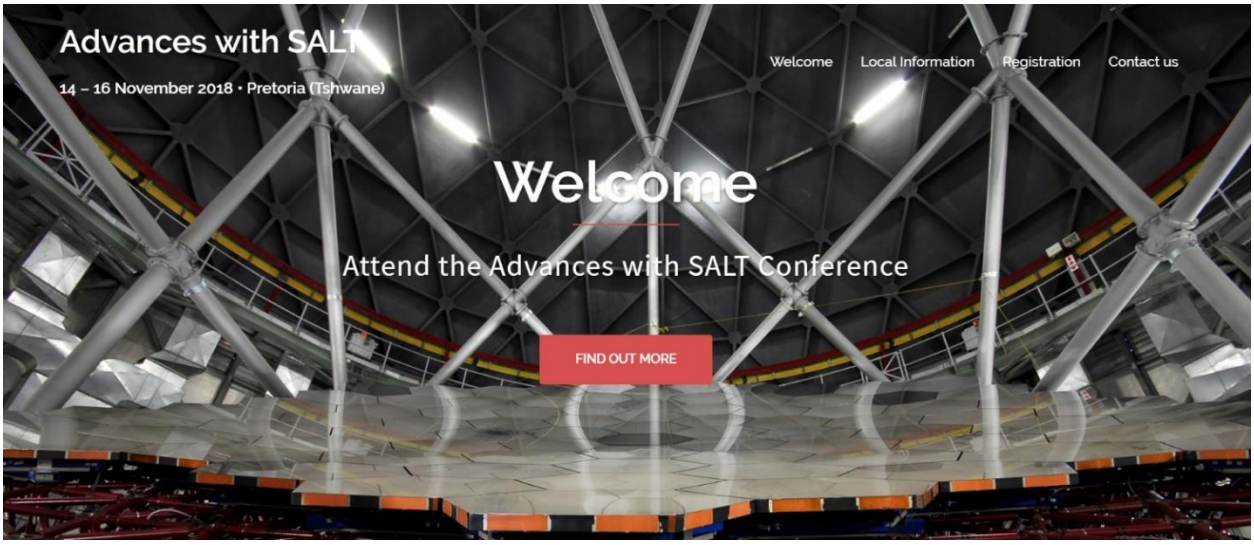
Save the date! SALT conference 14- 16 November 2018

We would like to invite the SALT community to join us for a conference “Advances with SALT", to be held in Pretoria (Tshwane), South Africa, from 14 - 16 November 2018. The conference will reflect on the recent scientific achievements enabled by SALT and looks forward to new developments, providing an opportunity for SALT users and staff to gather together to discuss new results, upcoming projects, the strategic vision and plans for SALT’s future.

In addition to keynote and contributed presentations, there will be practical sessions on making the most of SALT and dealing with data, less formal “unconference” sessions and discussions. We invite contributions on a broad range of science topics, instrumentation, SALT in education and outreach and other SALT-related themes. Funding is available for students to attend - please apply through the registration webpage.

Keep an eye out for more news on this, and visit **http://salt-conference-2018.salt.ac.za/** for more information.

Registration and abstract submission deadline: 15 August.



MEET THE TEAM: DR ITUMELENG MONAGENG

Tell us about yourself

I was born in Johannesburg in a township called Dobsonville, SOWETO, where I attended all of my schooling. My dad used to buy the daily newspaper and on one particular day in December 2002 when there was a solar eclipse, there was a small segment of the newspaper dedicated to explaining the ins and outs of solar eclipses (at a level that a 13-year-old could understand and explain to every single person they saw on that day!). That is what triggered my love for astronomy! My brother noticed my newfound fascination and bought me an astronomy book that pretty much solidified my decision of wanting to become an astronomer.

I registered for a BSc degree in Physics and Astrophysics at UCT and then enrolled for an honours and MSc degree through the National Astrophysics and Space Science Programme (NASSP). I am currently awaiting my PhD results.

Tell us about your science

I work on multiwavelength properties of X-ray binary stars, in particular, high mass X-ray binary stars. This involves using observations and analytical modeling to understand circumstellar disc behavior, the origins of high energy emission and the nature of the compact object.

What do you do outside of astronomy?

I do various things with my spare time! I watch a lot of sports (soccer, cricket, tennis). I also play five-a-side soccer, go for jogs regularly and participate in races, collect vinyl records, do some reading and hang out with friends over a few (or not so few) drinks.

DOME SEALING SUCCESS

During January we experienced severe thunderstorms with 50 mm of rain and ping pong sized hailstones. It was exacerbated by driving winds from the West, which tested the new sealing schemes and repairs to the utmost. The design of the sealing schemes and correct implementation of those kept water and hail ingress at bay. Well done to whole of the Project Team, well led by Raoul van den Berg (in the past) and Eben Wiid (recently).

Image credit: Thea Koen.
To see the “River of hail” which ensued, visit https://www.youtube.com/watch?v=SRQVpNPhywk. The weather was so extreme that the video was picked up by local media and went viral, getting almost 60 000 views!

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.

- Amvrosiadis, A., Eales, S.A., Negrello, M., et al. 2018/04. ALMA observations of lensed Herschel sources: testing the dark matter halo paradigm. *MNRAS,* 475, 4939. http://adsabs.harvard.edu/abs/2018MNRAS.475.4939A
- Aydi, E., Page, K. L., Kuin, N. P. M., et al. 2018/02. Multiwavelength observations of nova SMCN 2016-10a – one of the brightest novae ever observed. *MNRAS*, 474, 2679. http://adsabs.harvard.edu/abs/2018MNRAS.474.2679A
- Buckley, D., Andreoni, I., Barway, S., et al*.* 2018/02. A comparison between SALT/SAAO observations and kilonova models for AT 2017gfo: the first electromagnetic counterpart of a gravitational wave transient – GW170817. *MNRAS (Letters)*, 474, 71. http://adsabs.harvard.edu/abs/2018MNRAS.474L..71B
- Gvaramadze, V. V., Alexashov, D. B., Katushkina, O. A. and Kniazev, A. Y. 2018/03. Modelling interstellar structures around Vela X-1. *MNRAS,* 474, 4421. http://adsabs.harvard.edu/abs/2018MNRAS.474.4421G
- Gvaramadze, V. V., Kniazev, A. Y., Maryeva, O. V. and Berdnikov, L. N. 2018/02. Optical spectroscopy of the blue supergiant Sk-69° 279 and its circumstellar shell with SALT. *MNRAS*, 474, 1412. http://adsabs.harvard.edu/abs/2018MNRAS.474.1412G
- Holdsworth, D. L., Kurtz, D. W., Saio, H., et al. 2018/01. Whole Earth Telescope discovery of a strongly distorted quadrupole pulsation in the largest amplitude rapidly oscillating Ap star. *MNRAS*, 473, 91. http://adsabs.harvard.edu/abs/2018MNRAS.473...91H
- Hviding, R. E., Hickox, R. C., Hainline, K. N., et al. 2018/02. Characterizing the WISE-selected heavily obscured quasar population with optical spectroscopy from the Southern African Large Telescope. *MNRAS*, 474, 1955. http://adsabs.harvard.edu/abs/2018MNRAS.474.1955H
- Miszalski, B., Manick, R., Mikolajewska, J., et al. 2018/01. SALT HRS discovery of a long-period double-degenerate binary in the planetary nebula NGC 1360. *MNRAS*, 473, 2275. http://adsabs.harvard.edu/abs/2018MNRAS.473.2275M
- Mitchell, C.J., Sellwood, J.A., Williams, T.B., et al. 2018/03. The RINGS Survey. III. Medium-resolution Ha Fabry–Pérot Kinematic Data Set. *AJ*, 155, 123. http://adsabs.harvard.edu/abs/2018AJ....155..123M
- van Jaarsveld, N., Buckley, D.A.H., McBride, V.A., et al. 2018/04. Identification of high-mass X-ray binaries selected from XMM-Newton observations of the LMC. *MNRAS*, 475, 3253. http://adsabs.harvard.edu/abs/2018MNRAS.475.3253V