SALT NEWSLETTER

ISSUE JANUARY 2020

Southern African Large Telescope,
Sutherland, South Africa
Cover image: Chantal Fourie

TOPICS

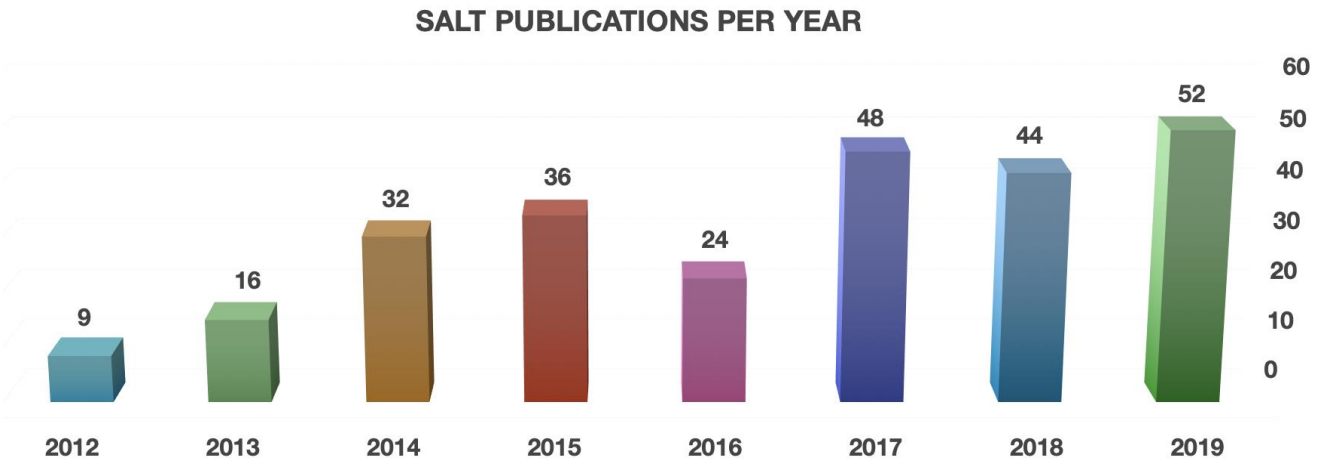
Contributors to this issue: Encarni Romero Colmenero, Rosalind Skelton, Danièl Groenewald, Christian Hettlage, Keith Browne, Stephen Hulme, Daniel Cunnama and Thea Koen (editor).

LETTER FROM THE HEAD OF ASTRO OPS

Dear SALT Community,

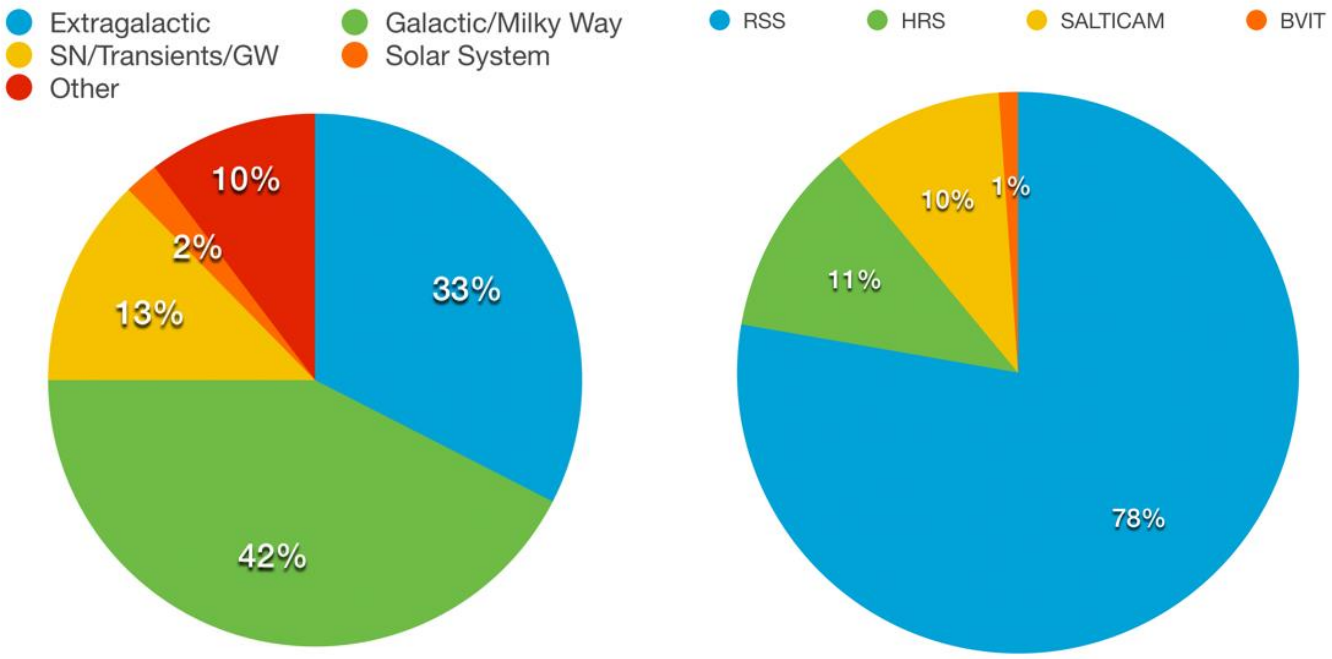
We bring you some excellent news: last year we broke our previous record for SALT refereed publications, with 52 papers! As you know, the number of publications is the ultimate measure of the success of a telescope, so thank you very much for continuing to publish and making SALT a success!

This brings us to nearly 300 papers since the beginning of SALT. As can be seen from the pie charts, Galactic papers (especially stellar) dominate our publications, closely followed by our extragalactic community and with a strong component from our ToOs and transients.



Most of our papers to date come from RSS, which has traditionally been our main workhorse instrument, in particular its longslit mode. However, the picture has been changing over the last few years. While RSS remains our most popular instrument during our dark nights and best conditions, HRS is now our main workhorse instrument for worse weather/bright time, and its number of papers has also been on the increase. So watch this space!

It is also worth mentioning that, while SALTICAM and BVIT are not as popular for science due to them not having autoguiders, they are both incredibly efficient in terms of publication outputs.



SALT publications by science (left) and by instrument (right).

On another topic, last November, several of us attended a SALT Science Meeting at IUCAA, Pune (India), followed by the SALT Board meeting also near Pune. It was the first time many of us had been to India, which made the meetings not only scientifically interesting, but also a culturally fascinating trip. Please see Ros Skelton's article about it below. Petri Väisänen (SAAO Director), Paul Rabe (Head of Technical Operations) and myself also visited IIA in Bangalore afterwards, which led to many fruitful discussions and opportunities for further collaboration.

And to end off, here are a few brief reminders:

- Call for Proposals for semester 2020-1 (observing 1 May - 31st October), with deadline 29th January at 16:00UT.
- The shutdown begins on the 10th February and is planned to last for 4 weeks.
- The SAAO turns 200 years old in 2020! Looking forward to the birthday party (or is it parties!?) in October! :)

We also sadly said goodbye at the end of 2019 to one of our senior SALT Astronomers, Brent Miszalski. We will miss him, and we wish him all the best in his future endeavours.

Thank you again for a record-breaking 2019 and wishing all of you an even more awesome 2020!

Clear skies!
Encarni

SCIENCE HIGHLIGHT

MeerKAT and SALT combine to solve mystery stellar event

The MeerKAT radio telescope was built as a pathfinder to the SKA. The 64-antenna array is located at the SKA site at Losberg, about 90 kilometres from Carnarvon. Credit: South African Radio Astronomy Observatory.

Scientists using the MeerKAT radio telescope and SALT have combined forces for the first time to discover and identify a unique and previously-unseen flare of radio emission from a binary star in our Galaxy.

The MeerKAT radio telescope in the Northern Cape of South Africa discovered the object which rapidly brightened by more than a factor of three over a period of three weeks.

This is the first new transient source discovered with MeerKAT and scientists hope it is just the tip of an iceberg of transient events to be discovered with the telescope in future.

Astronomers call an astronomical event “transient” when it lasts only for a short time, it may appear or disappear, or become fainter or brighter over seconds, days, or even years. These events are important as they provide a glimpse of how stars live, evolve, and die. Using an assortment of telescopes around the globe, the researchers determined that the source of the flare is a binary system; where two objects orbit each other approximately every 22 days. While the cause of the flaring and the exact nature of the stars that make up the system is still uncertain, it is thought to be associated with an active corona – the hot outermost part of the brighter star.

The source of the observed activity is located in the Southern constellation of Ara and was found to be in the same place as a giant star about twice as massive as the Sun. The star’s orbital motion was discovered and measured using optical observations with SALT. Fortuitously, the star is sufficiently bright to have also been monitored by optical telescopes for the last 18 years and it is seen to vary in brightness every three weeks, matching the orbital period.

“This source was discovered just a couple of weeks after I joined the team, it was amazing that the first MeerKAT images I worked on had such an interesting source in them.”

Image credit: South African Astronomical Observatory (SAAO).

“Once we found out that the radio flares coincided with a star, we discovered that the star emits across almost the entire electromagnetic spectrum from X-ray to UV to radio wavelengths,” said Laura Driessen, a PhD student at The University of Manchester who led this work.

Patrick Woudt, Professor and Head of the Astronomy Department at The University of Cape Town said: “Since the inauguration in July 2018 of the South African MeerKAT radio telescope, the ThunderKAT project on MeerKAT has been monitoring parts of the southern skies to study the variable radio emission from known compact binary stars, such as accreting black holes.

“The excellent sensitivity and the wide field of view of the MeerKAT telescope, combined with the repeat ThunderKAT observations of various parts of the southern skies, allows us to search the skies for new celestial phenomena that exhibit variable or short-lived radio emission.”

Dr David Buckley from the SAAO, who leads the SALT transient follow-up programme, that followed up on the discovery, commented: “This is a perfect example of where co-ordinated observations across different wavelengths were combined to give a holistic view of a newly discovered object”.

“This study was one of the first to involve co-ordination between two of South Africa’s major astronomy facilities and shows the way for future such work.” Said Buckley.

Professor Ben Stappers from The University of Manchester said: “The properties of this system don’t easily fit into our current knowledge of binary or flaring stars and so may represent an entirely new source class.”

The MeerKAT telescope is sweeping the sky for sources that vary on timescales from milliseconds to years, and will significantly improve human understanding of the variable radio

sky. The discovery of this new transient with MeerKAT demonstrates how powerful this telescope will be in the search for further new transient events.

Rob Adam, Managing Director of the South African Radio Astronomy Observatory (SARAO) said: “Once again we see the potential of the MeerKAT telescope in finding interesting and possibly new astrophysical phenomena, as well as the power of the multi-wavelength approach to the analysis of observations.”

SHUTDOWN UPDATE

The shutdown start date has been moved to the 10th of February to accommodate the Concept Design Review (CoDR) for the RSS Dual upgrade (aka the MaxE project), taking place on the 30th of January.

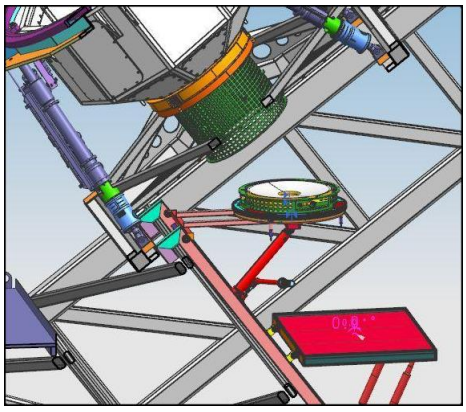
The long-awaited cleaning of one of the mirrors (M3) in SALT’s spherical aberration corrector will be the first task. Pre- and post-cleaning tests will be done on-sky before the telescope is taken out of service for the rest of the shutdown.

The new RSS Doublet will not be ready in time to be installed on the RSS due to the resources being consumed by the RSS Dual CoDR preparations.

The SPS project is in the integration phase at the moment, testing began in mid-January in order to be ready for installation during the shutdown.

Anticipated dates for shutdown milestones:

10 Feb: Shutdown starts with M3 cleaning
15 Feb: RSS and Payload removed from Tracker
05 Mar: RSS and Payload installed on Tracker
06 Mar: Engineering tests & recommissioning begins
13 Mar: Back to regular operations



SALT SCIENCE MEETING AT IUCAA

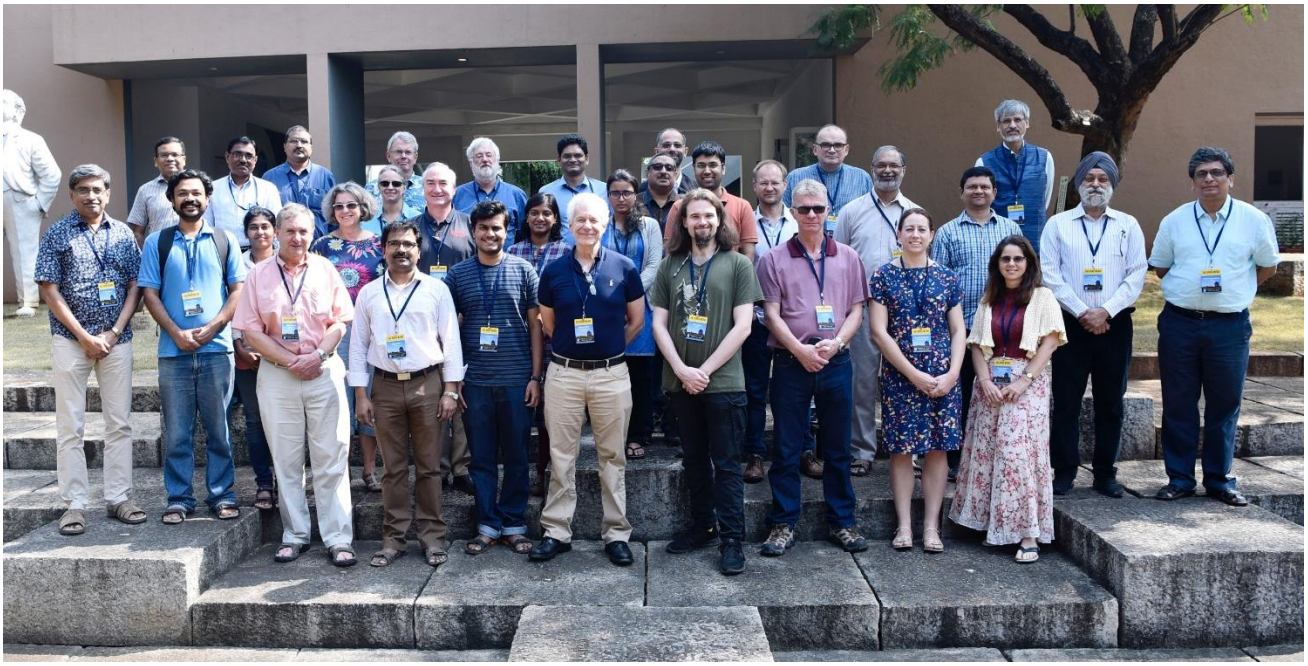


Image: Participants at the IUCAA SALT meeting. Photo courtesy of Shashank Tarphe.

A SALT Science Meeting was held at the Inter-University Centre for Astronomy and Astrophysics (IUCAA) in Pune, India, on the 13th and 14th November 2019 ahead of the November board meeting. The gathering was a great opportunity to share recent results and discuss new and ongoing SALT-related projects. The talks covered a wide range of topics, from exciting news about long-term projects like the MeerKAT Absorption Line Survey (MALS) SALT programme and the SALT Transients programme, to new instrumentation possibilities for SALT (including mini-trackers!).

Those of us visiting India thoroughly enjoyed the delicious food and beautiful, peaceful IUCAA campus, where we were so warmly welcomed. Thank you very much to all the participants, our hosts, and everyone involved in the organisation of the meeting, particularly Raghunathan Srianand and his team.

Image right: Dome of stars on the IUCAA campus, photo by Ros Skelton.

POLARIMETRY UPDATE

In September of this year, the SALT Operations team was notified by Ken Nordsieck (affiliated with the University of Wisconsin) that the instrumental polarisation calibration of SALT had been compromised. Ken is in the unique position of having repeated SALT observations, spread out over numerous semesters, of various polarised sources. The observations taken in the 2019-2 semester for his program showed a consistent position angle (PA) shift of 4 degrees from previously published PA values. The same PA shift affected other sources in his program as well. Following this, the polarimetry mode was declared non-functional (and all PIs of spectropolarimetric observations were notified) while the SALT team investigated the problem.

The investigation took us to December 2018, when there was a problem with a sensor for the half waveplate (HWP) detente. Careful visual inspection and repeatability testing indicated that the detente was indeed going in, but the sensor was not responding. The waveplates are inside RSS and cannot be accessed nor removed without removing RSS, so a combination of a software and a procedure change was then devised, whereby the detente sensor was bypassed and homing the waveplates was required before each observation, to ensure that the positioning of the waveplates was correct.

However, some time after the software fix was applied, the 0 degree position moved by 13 steps (or 1.95 degrees) from its default position, which was enough for the detente to not insert. This 2 degrees shift on the waveplate roughly corresponds to 4 degrees on sky, which accounted for the PA shift noted by Ken.

We do not yet understand how this shift occurred and we will be investigating this further during the upcoming shutdown in February. Once the shift was corrected and the detent was again inserting reliably, the software bypass was removed.

The stability of the polarimetry mode was extensively tested in October and November through weekly observations of polarised standard stars. The first set of test observations (taken on 2019/10/14) indicated that the PA was within a degree of zero.

The PA determined from the three HWP cycles used in these observations agreed within 0.005 degrees. The PA of the star, obtained from a second set of test observations (taken on 2019/10/18), agreed with that derived using observations from June 2016 (the same star and observational setup used).

The polarimetry mode was finally declared back online on 4 November, and we continue to monitor the stability of the mode through monthly observations of polarised standard stars.

Unfortunately, this problem meant that we had to reject a total of 171 polarimetry blocks (mostly high priority) observed between 2018/12/03 and 2019/10/01, amounting to just over 105 hours of telescope time. Ouch! :(

GUIDER POSITIONING

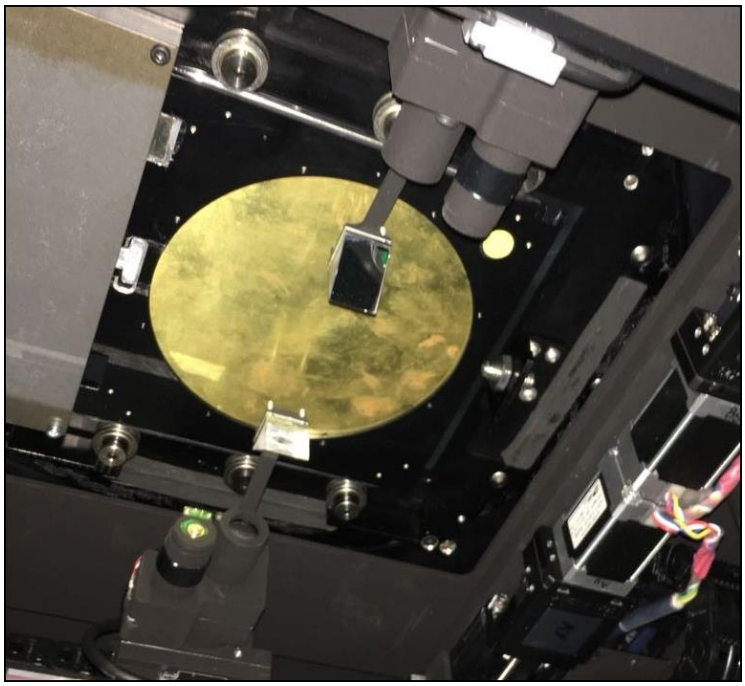


Image: The new Prime Focus Guidance System, the two-probe guider for the RSS, shortly after installation on the instrument in 2018. Photo courtesy of Lisa Crause.

At the request of the board, SALT Ops has been pushing ahead with implementing automatic probe positioning of the telescope's guiders. A script to identify guide stars from a locally-hosted subset of the GAIA-DR2 catalogue has been written and is in the process of being

integrated with the Telescope Control System (TCS). Changes will need to be made to the TCS for the commands to move the probes to be sent from the payload.

Once completed, the script will identify the guide stars and move the probes of the required guider to where the guide stars are expected to be found. From there, the operator will confirm that the correct stars have been chosen, take an acquisition image, and proceed with the observation. While good progress is being made, development of RSS Dual (née MaxE) and the telescope shutdown in February, could potentially delay the release of this exciting development to the final months of this observing semester.

CALL FOR PROPOSALS

The call for proposals for semester 2020-1 is open and the semester will run from 1 May to 31 October 2020.

The call document is available from:
http://astronomers.salt.ac.za/proposals/

You may find all the software required for planning and submitting your proposal at:
http://astronomers.salt.ac.za/software/

We recommend that you use the latest version of the software, as listed in the call document. We expect to release another PIPT update before the Phase 2 submissions start.

Please remember to use the correct 2020-1 template for the scientific justification. These are available as Word, OpenOffice and LaTeX files at:
https://astronomers.salt.ac.za/proposals/proposal-templates/

The phase 1 deadline will be on 29 January 2020 at 18:00 SAST (16:00 UT).
The phase 2 deadline will be on 15 April 2020, again at 18:00 SAST (16:00 UT).

If you have any questions regarding the submission process, you should contact salthelp@salt.ac.za - we are always glad to help!

SAAO 2020 PLANS

Image: Star trails above the South African Astronomical Observatory in Cape Town. Photo by Chantal Fourie.

Africa has a long and rich relationship with astronomy, dating back millennia. The unique geographical importance of Africa in global astronomy was recognised almost two centuries ago with the establishment of the Royal Observatory, Cape of Good Hope in 1820.

On 21 December 2018, the South African Heritage Resources Agency (SAHRA) officially declared the SAAO a National Heritage Site. This was an exciting development for the SAAO: providing recognition for the organisation's significance and incredible achievements over the past two centuries. This new designation will ensure the preservation of that heritage and in October 2020 the National Heritage site will be officially unveiled by the Minister of Arts and Culture.

In light of its bicentenary, the Observatory is planning various events in 2020, including a

Symposium organised and hosted by the SAAO, taking place at Kirstenbosch, in Cape Town, South Africa, from 20 to 22 October 2020.

The Symposium, themed “Beyond 200 Years of Astronomy”, will host an expected 300 attendees with strong representation by students and postdocs from South Africa and the rest of the continent. With participation from across Africa, through the African Astronomical Society, and by highlighting the incredible astronomical achievements of the past two centuries, we aim to expand African astronomical research beyond South Africa and into the continent as a whole.

Additionally, SAAO and SALT will host South Africa’s first international Astronomy Festival from Tuesday, 20 October 2020 to Saturday, 24 October 2020.

Main Events at the Festival:

- Workshops for Learners, Educators and the General Public
- Astronomy Science Shows / Exhibitions
- General Science Exhibitions
- Stargazing and Entertainment Events
- Astronomy Site Open days
- Public Lectures and Talks

SALT SCIENCE PAPERS (SEP-DEC 2019)

- Boettcher, E.; Gallagher, J.S. III.; and Zweibel, E.G. 2019/11. A Dynamical Study of Extraplanar Diffuse Ionized Gas in NGC 5775. *AJ*, 885:160. https://ui.adsabs.harvard.edu/abs/2019ApJ...885..160B/abstract

- Charles, P.; Matthews, J.H.; Buckley, D.A.H.; et al. 2019/10. Hot, dense He II outflows during the 2017 outburst of the X-ray transient Swift J1357.2−0933. *MNRAS Letters*, 489**:**47. https://ui.adsabs.harvard.edu/abs/2019MNRAS.489L..47C/abstract

- Coughlin, M.W.; Ahumada, T.; Anand, S.; et al. 2019/11. GROWTH on S190425z: Searching Thousands of Square Degrees to Identify an Optical or Infrared Counterpart to a Binary Neutron Star Merger with the Zwicky Transient Facility and Palomar Gattini-IR. *AJ Letters,* 885:19. https://ui.adsabs.harvard.edu/abs/2019ApJ...885L..19C/abstract

- Galbany, L.; Ashall, C.; Höflich, P.; et al. 2019/10. Evidence for a Chandrasekhar-mass explosion in the Ca-strong 1991bg-like type Ia supernova 2016hnk. *AA*, 630:76. https://ui.adsabs.harvard.edu/abs/2019A%26A...630A..76G/abstract
- Gvaramadze,V.V.; Pakhomov, Y.V.; Kniazev, A.; et al. 2019/11. TYC 8606-2025-1: a mild barium star surrounded by the ejecta of a very late thermal pulse. *MNRAS*, 489:5136. https://ui.adsabs.harvard.edu/abs/2019MNRAS.489.5136G/abstract
- Holdsworth, D.L.; Saio, H.; and Kurtz, D.W. 2019/11. HD 42659: the only known roAp star in a spectroscopic binary observed with B photometry, TESS, and SALT. *MNRAS*, 489:4063. https://ui.adsabs.harvard.edu/abs/2019MNRAS.489.4063H/abstract
- Jeffery, C.S. and Miszalski, B. 2019/10. EC 22536−5304: SALT identifies a new lead-rich intermediate helium subdwarf. *MNRAS*, 489:1481. https://ui.adsabs.harvard.edu/abs/2019MNRAS.489.1481J/abstract
- Kovtyukh, V.; Lemasle, B.; Kniazev, A.; et al. 2019/09. The MAGIC project – II. Discovery of two new Galactic lithium-rich Cepheids. *MNRAS,* 488**:**3211. https://ui.adsabs.harvard.edu/abs/2019MNRAS.488.3211K/abstract
- McBrien, O.R.; Smartt, S.J.; Chen, T.; et al. 2019/11. SN2018kzr: A Rapidly Declining Transient from the Destruction of a White Dwarf. *AJ Letters*, 885:23. https://ui.adsabs.harvard.edu/abs/2019ApJ...885L..23M/abstract
- Miszalski, B.; Manick, R.; Rauch, T.; et al. 2019/11. Two's company, three's a crowd: SALT reveals the likely triple nature of the nucleus of the extreme abundance discrepancy factor planetary nebula Sp 3. *Publ. Astr. Soc. Australia*, 36:42. https://ui.adsabs.harvard.edu/abs/2019PASA...36...42M/abstract
- Monageng, M.; Coe, M.J.; Kennea, J.A.; et al. 2019/10. An X-ray and optical study of the outbursting behaviour of the SMC Be X-ray binary SXP 91.1. *MNRAS,* 489:993. https://ui.adsabs.harvard.edu/abs/2019MNRAS.489..993M/abstract
- Ogle, P.M.; Jarrett, T.; Lanz, L.; et al. 2019/10. A Break in Spiral Galaxy Scaling Relations at the Upper Limit of Galaxy Mass. *AJ Letters.,* 884:11. https://ui.adsabs.harvard.edu/abs/2019ApJ...884L..11O/abstract
- Paice, J. A.; Gandhi, P.; Charles, P.A.; et al. 2019/09. Puzzling blue dips in the black hole candidate Swift J1357.2 – 0933, from ULTRACAM, SALT, ATCA, Swift, and NuSTAR. *MNRAS,* 488**:**512. https://ui.adsabs.harvard.edu/abs/2019MNRAS.488..512P/abstract
- Sil'chenko, O.K.; Moiseev, A.V. and Egoro O.V. 2019/09. The Gas Kinematics, Excitation, and Chemistry, in Connection with Star Formation, in Lenticular Galaxies. *AJ*, 244:6. https://ui.adsabs.harvard.edu/abs/2019ApJS..244....6S/abstract
- Tofflemire, B.M.; Mathieu, R.D.; Johns-Krull, C.M. 2019/12. Accretion Kinematics in the T Tauri Binary TWA 3A: Evidence for Preferential Accretion onto the TWA 3A Primary. *AJ*, 158:245. https://ui.adsabs.harvard.edu/abs/2019AJ....158..245T/abstract
- Zhou, G.; Huang, C.X.; Bakos, G.Á.; et al. 2019/10. Two New HATNet Hot Jupiters around A Stars and the First Glimpse at the Occurrence Rate of Hot Jupiters from TESS. *AJ*, 158:141. https://ui.adsabs.harvard.edu/abs/2019AJ....158..141Z/abstract