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# mnassa

monthly notes of the astronomical society of southern africa

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**Cover caption**

*The LOGO of the SAAO200 Symposium*

Astronomical Society of Southern Africa
ASSA

# mnassa

**Vol 79 Nos 9-10** **October 2020**

## Bi-Centenary of the South African Astronomical Observatory (SAAO)

On the morning of 20th October 2020, the 200th anniversary to the day of the official establishment of the Royal Observatory/SAAO, a ceremony was held in front of the main entrance of the historic building. Only a small audience could be present on account of the Covid-19 epidemic.

The Department of Science and Innovation (DSI), the National Research Foundation (NRF) and the South African Heritage Resources Agency (SAHRA) were the co-hosts of the unveiling ceremony. Among the speakers were: Prof Petri Vaisanen (SAAO Overview), Mr Sivuyile Manxoyi (SAAO Outreach), Dr Molapo Qhobela (NRF CEO): Prof Shazrene Mohamed (SAAO), Adv Lungisa Malgas (SAHRA CEO Introduction), Prof Ewine van Dishoeck (Congratulations from IAU), Dr Ian Glass (SAAO, History) the Hon. Nkosinathi Mthethwa (Minister of Sports, Arts and Culture), Ms Buzani Khumalo (SAAO Education and Indigenous Astronomy), Mr Anthony Mietas (SAAO) and the Minister of Higher Education and Training, Science and Innovation, the Honourable Dr B.E. Nzimande MP and Mr Kevin Govender (OAD).

This event marked the convergence of Arts & Culture and Science & Technology as components of our National Heritage.

The "Virtual Unveiling" of a National Heritage Site Plaque was carried out by SAHRA Council Member: Dr Luyanda Mpalhwa and that of the 200 Year Commemoration Plaque by the Director-General DSI: Dr Phil Mjwara.

**Wording of the SAHRA Plaque**

BY VIRTUE OF THE POWERS VESTED IN THE SOUTH AFRICAN HERITAGE RESOURCES AGENCY (SAHRA), IN TERMS OF SECTION 27(5) OF THE NATIONAL HERITAGE RESOURCES ACT NO.25 OF 1999. SAHRA HAS HEREBY DECLARED ON 21 DECEMBER 2018 THE SOUTH AFRICAN ASTRONOMICAL OBSERVATORY (FORMERLY KNOWN AS THE ROYAL OBSERVATORY) AS A NATIONAL HERITAGE SITE.

THE SOUTH AFRICAN ASTRONOMICAL OBSERVATORY IS LOCATED ON OBSERVATORY ROAD (ERF 26423), OBSERVATORY, CAPE TOWN, EAST OF VALKENBERG PSYCHIATRIC HOSPITAL. WEST AND NORTH-WEST OF THE SITE IS THE CONFLUENCE OF THE BLACK AND LIESBEEK RIVERS.

THE CULTURAL LANDSCAPE THAT SURROUNDS THE SITE HAS GREAT HISTORICAL, SOCIAL, ARCHITECTURAL, ENVIRONMENTAL, AND SCIENTIFIC VALUE. THE LANDSCAPE HAS BEEN ASSOCIATED WITH PAST EVENTS, PERSONS, USES, COMMUNITY IDENTITY AND ORAL HISTORY LINKED TO THE FIRST NATIONS PEOPLE (KHOI AND SAN HERITAGE).

THE SOUTH AFRICAN ASTRONOMICAL OBSERVATORY IN CAPE TOWN HAS PLAYED A HIGHLY SIGNIFICANT SCIENTIFIC ROLE OVER TIME AS THE OLDEST PERMANENT OBSERVATORY IN THE SOUTHERN HEMISPHERE. THOUGH IT HAS BEEN CONNECTED TO THE HISTORY OF ASTRONOMY BOTH LOCALLY AND INTERNATIONALLY FOR MORE THAN TWO HUNDRED YEARS, IT REMAINS A LIVING INSTITUTION AND RETAINS ITS PROMINENCE IN THE INTERNATIONAL ASTRONOMICAL COMMUNITY.

THIS NATIONAL HERITAGE SITE WAS UNVEILED ON 20 OCTOBER 2020.

**Wording of the Bicentenary Plaque**

ON THIS DAY, THE BICENTENARY OF THE FOUNDING OF THIS OBSERVATORY ON 20 OCTOBER 1820, WE COMMEMORATE ITS SCIENTIFIC ACHIEVEMENTS OVER THE PAST TWO CENTURIES.

FOR MUCH OF ITS HISTORY THIS OBSERVATORY WAS THE MAJOR CONTRIBUTOR TO POSITIONAL ASTRONOMY IN THE SOUTHERN HEMISPHERE.

OBSERVATIONS MADE BY THE CAPE ASTRONOMERS INCLUDE THE FIRST MEASUREMENT OF THE DISTANCE TO A STAR, THE FIRST PHOTOGRAPHIC SKY SURVEY, THE ACCURATE MEASUREMENT OF THE DISTANCE TO THE SUN, DEVELOPMENTS IN STELLAR SPECTROSCOPY, THE DETERMINATION OF THE SHAPE OF THE EARTH IN THE SOUTHERN HEMISPHERE AND THE FIRST ACCURATE GEODETIC SURVEYS OF SOUTHERN AFRICA.

# SAAO200 Anniversary Symposium Abstracts

The celebrations of the 200th anniversary of the foundation of the Royal Observatory/South African Astronomical Observatory a Symposium included a "virtual symposium", held 20-24 October 2020. The event had to take place on-line since a normal gathering was precluded by the Covid-19 pandemic. The full presentations are to be posted on the SAAO web site (www.saao.ac.za).

## SAAO200 Oral presentations abstracts

### The SAAO in the 21st Century

*Prof. Petri Vaisanen, Director, SAAO.*

**Abstract:** In his talk, Professor Vaisanen will discuss the role that SAAO plays in global astronomy made in Africa, highlight upcoming trends and flagship projects of the new decade and beyond, as well as touch on SAAO's aspirations in transformation and development of the field locally

### SKA: Building an Observatory to Study the Dawn of Time and the Origins of Life

*Dr Philip Diamond, SKA*

**Abstract**: In this presentation he will discuss a partnership of 15 nations that has designed and is poised to start construction of the world's largest astronomical observatory, the Square Kilometre Array. The two telescopes, which will be located in South Africa and Australia, are designed to enable an enormous range of fundamental science, from exploring the origins of our universe, the nature of gravity, magnetism across the cosmos, to the study of bio-molecules, the precursors to life itself. I will describe the challenges of constructing such a huge infrastructure in remote areas of the world and how we plan to transmit and process the enormous volumes of data generated by these physics machines.

### Socio-Economic Impact of SAAO and Salt

*Mr Anthony Mietas SAAO*

**Abstract:** My talk will be about what the NRF/SAAO has been doing in partnership with various stakeholders to make a meaningful impact to address the socio-economic challenges within Sutherland.

**IAU Astronomy for Development**
*Prof. Vanessa McBride, OAD, UCT, SAAO*

**Abstract:** The Office of Astronomy for Development (OAD) is a joint initiative of the International Astronomical Union and the National Research Foundation that aims to use the skills, methodologies, and inspirational power of astronomy to address socioeconomic development. In this talk I will discuss the approach of the OAD, explain some of the past and current projects, and take a look at what "science for development"

**A Golden Age for Astronomy**
*Dr Bernard Fanaroff SKA SA*

**Abstract**: Will speak about the genesis and history of the SKA project in South Africa and the opportunities and challenges for astronomy in South Africa.

**The Cape Observatory 1820 – 1971**
*Dr Ian Glass SAAO*

**Abstract**: This talk will cover the history of the Royal Observatory at the Cape of Good Hope with special emphasis on its foundation, purpose and achievements. The determination of the distance of α Centauri and the first photographic sky survey (CPD) will be included as well as other notable activities

**Royal Astronomical Society**
*Prof. Emma Bunce, University of Leicester*

**Abstract:** The South African Astronomical Observatory and the Royal Astronomical Society are sharing their Bicentenary in 2020. My talk will introduce a brief history of the Society, the evolution of both our science and our methods of support for our community of Fellows, and highlight key current activities of the RAS as we celebrate 200 years of supporting and promoting the study of astronomy and geophysics.

**Using The Iziko Planetarium and Digital Dome to bring South African Astronomy to the Public**
*Dr Sally Macfarlane UCT*

**Abstract:** She will address the current challenges in communicating South Africa's astronomical achievements to the public, the unique capabilities of modern digital dome planetaria and their use as effective multi-disciplinary educational tools, the innovative visualisation research conducted by the IDIA Visualisation Laboratory at the Iziko Planetarium and Digital Dome, the importance of producing local digital

dome content in South Africa, and will introduce South Africa's first full-length 360-degree digital dome film about South African astronomy.

**An Update on MeerKAT and Progress Towards the SKA**
*Dr Rob Adam SARAO*

**Abstract**: Dr Adam will present on the current status of the MeerKAT observing programme and data processing systems as well as progress towards the construction of SKA-1 will be given. MeerKAT was unveiled officially in July 2018 and has observing since that time and will continue as an independent telescope until it is integrated into SKA-1 MID in the mid 2020s. In addition, plans are at an advanced stage for the Max Planck Institute for Radio Astronomy and the South African Radio Astronomical Observatory to partner in adding a further 20 dishes to MeerKAT's current complement of 64.

**The Gleam 4-Jy Sample: The Brightest Radio-Sources in the Southern Sky**
*Dr Sarah White, Rhodes University*

**Abstract:** Dr White will present an overview of a new catalogue of the brightest radio-sources in the southern sky, the vast majority of which are active galaxies with powerful radio-jets. However, there are also two star-forming galaxies, with one of these having been discovered at the Cape of Good Hope in 1752. Subsets of this radio-source sample are being followed up with both the Southern African Large Telescope and MeerKAT, and Dr White will present a few exciting images from the latter telescope.

**The History of SALT: From Vision to Reality**
*Dr David Buckley SAAO*

**Abstract:** This talk will cover the history of the SALT project, from the initial modest 4-m class concept in the mid-1990s to its eventual realization as a 10-m telescope, the largest in the southern hemisphere, for which construction was completed in 2005. The initial efforts to motivate for the telescope and the attempts to raise support and find partners, eventually leading to the "green light" in 1999, will be described. The remainder of the talk will discuss the construction, commissioning and eventual steady-state transition of SALT into a competitive state-of-the-art astronomical facility, producing forefront research, some highlights of which will be presented.

**SALT and TESS Monitoring of Central Stars of Planetary Nebulae**
Ms Kelebogile Bonokwane, UCT, SAAO

**Abstract:** Planetary nebulae (PNe) are the product of Asymptotic Giant Branch (AGB) evolution. Complex, aspherical morphologies are observed in PNe and binary central stars (CS) have been the favoured explanation for deviations from spherical symmetry. The objects of this study are Hen3-1333, Hen2-113 and Hen2-47, with Wolf-Rayet (WR) CS that commonly exhibit fast, dense stellar winds. All exhibit multipolarity in their young nebulae and additionally dual-dust chemistry, a disk in Hen3-1333 and offset central stars in the other two. Here we develop a quantitative time-series analysis to determine whether these objects have binary CS and develop constraints to permissible orbital parameters. HRS of the Southern African Large Telescope (SALT) was used to collect Echelle spectroscopic data and The Exoplanet Survey Satellite (TESS) was used to obtain photometric data for the objects. Using cross-correlation and Gaussian line fitting, radial velocity (RV) time-series were compared to lightcurves determined from the TESS data. Lomb-Scargle periodograms were used to search for periodic variability in the time-series data. The results were discussed based on short (0 - 10 days), intermediate (10 - 100 days) and long (100 - 1000s days) orbital period ranges. The quantitative variability analysis excludes short orbital period binaries, suggesting that if their multiple features are due to binary interactions, the most likely case is the long orbital period range. If the variability observed is due to a companion, rather than pulsations from the CS, the companion masses of 0.05 -- 0.12Msun correspond to a spectral class of M- or L-type dwarfs.

**AfAS: The New Continental Astronomy Player and a Tale of Two Observatories**
*Prof Jamal Mimouni AfAS*

**Abstract:** He will present the Bouzareah Observatory in Algeria, the second oldest astronomical observatory in Africa whose construction was achieved in 1890. Like the Royal Observatory at Cape Town, it participated to the "Carte du Ciel" project, the first worldwide astronomical project in history. He will also present a series of documents including unique pictures spanning the period of time between its construction and the modern era.

**Outreach and Publicity - History snd Current**
*Mr Sivuyile Manxoyi SAAO*

**Abstract:** Mr Manxoyi's presentation, will highlight the role, impact, and achievements of the SAAO science engagement programme and will raise questions about the future of the programme. This will include the reflections on the SAAO science engagement approach and strategy and will acknowledge all the roles played by previous and current members of the division.

**Shared Sky to Karoo Cosmos Indigenous Knowledge and Ethno-Astronomy**
*Prof John Parkington, Archaeology, UCT*

**Abstract:** I'm going to talk about the Cosmology of the Karoo San who were /Xam speakers and whose life histories, stories and landscape knowledge was gathered by Wilhelm Bleek and Lucy Lloyd in the late middle 19th century. The local rock art, engravings on boulders and ridges in the local geology, does not include many direct references to stars, but the stories certainly do. David Morris has coined the phrase 'intimate cosmology' for the /Xam understanding of the sky at night because it differs quite dramatically from the 'infinite cosmology' of astronomers. In 2015 we put together a display of /Xam sky knowledge in an exhibit at the National Gallery called Karoo Cosmos

**Natural Philosophy and Education for the Common Good: Parallel Elements in the Work, Lives, and Thoughts of Victorian Scientists**
Prof Chris Sterken, University of Brussels

**Abstract:** Victorian scientists shared cultural, economic, and social backgrounds: their families were well off, allowing them to cultivate their interests as "gentlemen scientists". Offspring of aristocracy, they nevertheless fostered overlapping moral concerns and educational ideas. John Herschel, for example, rejected the implementation of a European Classical education in South Africa, and played an active role in raising the standard of education in the colony. This presentation examines parallel thoughts on education by nineteenth-century emigrant scientists.

**Cosmology with the SKA**
Prof Roy Maartens, SKA

**Abstract:** I will describe the exciting prospects for advances in cosmology with the advent of the SKA, which will open a new window on the cosmos and cover larger volumes than ever before. The combination of optical surveys like Euclid and LSST with the SKA promises to provide excellent precision in measuring Dark Energy and Dark Matter, as well as delivering new tests of our model of the Universe.

**Multiwavelength Views of Feedback and the Baryon Cycle**
*Dr Moses Mogotsi, SAAO*

**Abstract**: In my talk I will discuss some of the major questions regarding the baryon cycle and star formation feedback and how they affect galaxy evolution. I will then illustrate how multi-wavelength observations from facilities and instruments such as SALT, ALMA, WiFeS, MUSE, and MeerKAT are being used in these studies; and show

how future projects on MeerKAT, 4MOST, and SALT-NIR will provide new insights into these studies.

**Before the Big Bang of the Square Kilometre Array (SKA): 250 Years Of Astronomy in South Africa**
*Prof Saul Dubow Cambridge University, UK*

**Abstract:** He will address long-range themes in the history of South African astronomy, from the foundation of the Royal Observatory at the Cape to the present.

**An e-Learning Platform for African Radio Astronomy**
*Ms Ruby van Rooyen SARAO*

**Abstract**: South Africa hosts world-class large telescopes such as SALT and MeerKAT, yet the fact remains that South Africa, and Africa as a whole, has a severe lack of technically skilled personnel such as mechanical, electrical, and software engineers, as well as the astronomers and applied scientists that these large telescopes require. This begs the question: how do we harness the instruments at our doorstep to educate and promote young African scientists and engineers? Radio astronomy is a multidisciplinary science and MeerKAT a multidisciplinary instrument. This complex, highly flexible, next-generation telescope is at the forefront of an era of software interferometers, multi-wavelength astronomy, big data processing, and intelligent observatory strategies. We are faced with the task of upskilling and training young scientists and engineers to interface with – and develop for – automated, intelligent systems. At the same time we require astronomers to develop new algorithms to interact with – and process – large datasets. Highlighting the fact that during the initial stages, technology and technical skills will play a big role in student learning as part of their radio astronomy and data processing education. We must therefore empower students to easily and freely access material related to astronomy and related engineering topics. In addition to continuing to support a growing community of young researchers, we also enable them to undertake research at universities in South Africa and Africa. The reach and extended ability provided by online resources such as the e-learning platform for radio astronomy will help us to build a strong African science contribution to astronomy.

**The National Astrophysics and Space Science Programme (NASSP)**
*Prof Patricia Whitelock SAAO, UCT*

**Abstract**: In 2000, when the construction of SALT had been given the go-ahead and before anyone thought of South Africa as a possible host of the SKA, there were about 30 PhD astronomers in South Africa, most of them born and trained outside of the country. The lack of qualified local scientists, and the extreme lack of black scientists,

represented a challenge that the astronomy community met with the creation of the National Astrophysics and Space Science Program (NASSP).

**Line-of-Sight-Effects in Strong Gravitational Lensing**
*Dr Julien Larena UCT*

**Abstract**: Weak lensing is a significant source of systematic uncertainties in strong gravitational lensing observations, via line-of-sight effects. This work would like to show that what has so far usually been considered a nuisance can actually be turned into a signal. After presenting a general framework to account for the impact of weak lensing on strong gravitational lensing systems, we then use this formalism to propose: (i) a new set of observables to measure cosmic shear, flexion, and higher-order distortion modes using string lensing events; (ii) a way to measure some intrinsic properties of the strong lens. This last point may be useful in the current H0 debate.

**Historical Challenges of Astronomy Transformation in South Africa**
*Prof Lerothodi Leeuw UNISA*

**Abstract:** He will give insights into the historical challenges of astronomy transformation in South Africa, by shining light on some of the seeds of these challenges and their systemic nature.

**Cosmology with Fast Radio Bursts**
*Prof Amanda Weltman UCT*

**Abstract:** Fast Radio Bursts (FRBs) are brief, bright bursts observed in the radio spectrum mostly at extragalactic distances. In this talk we will explore what is currently known about FRBs, touch on some open problems and discuss some of the exciting potential to learn about the large scale features of our universe with FRB observations.

**The Conundrum of Hubble Constant: a Physical Solution**
*Prof Yin-zhe Ma, University of Kaw-Zulu-Natal*

**Abstract:** In this talk he will cover the following four topics: (1) What is the Hubble constant puzzle? What are the two sets of observations give contradictory predictions? (2) The holographic principle of quantum gravity, and how this leads to a testable prediction of quantum vacuum energy fluctuations (holographic dark energy). (3) We further put this holographic dark energy into current cosmological constraints and show that it can beautifully resolve the Hubble tension. (4) We further

show that this is a verifiable or falsifiable model which produces generic different feature than ΛCDM, and be tested with future data.

**Imaging Black Hole Shadows from African Soil**
*Prof. Roger Deane, University of Pretoria*

**Abstract:** On 10 April 2019, the Event Horizon Telescope Collaboration revealed the first image of a black hole. This required a large international effort by over 200 scientists spread across five continents, including Africa. The team synthesises a virtual telescope with the effective diameter of the Earth, by using millimetre-wave antennas separated by inter-continental distances. This approach enables unprecedented views of relativistic jet launch in active galactic nuclei, as well as sub-horizon scale imaging for suitably nearby and massive black holes. In this talk, I will give a brief overview of the instrument and early scientific results. I will then look to the future of this exciting new field with the next generation EHT (ngEHT), which could include stations on African soil.

**A Multiwavelength Study of Be Xray Binaries in the Small Magellanic Cloud**
*Dr Itumeleng Monageng UCT, SAAO*

**Abstract:** Dr Itumeleng Monageng will present recent results for work done on Be X-ray binaries - stellar objects which comprise a neutron star in an eccentric orbit around a Be star companion with a geometrically thin Keplerian disc. The interaction of the neutron star with the Be disc results in accretion of matter leading to X-ray outbursts. He will show results from data obtained with the Southern African Large Telescope and X-ray facilities (Swift and RXTE) to characterise the variability that is observed in these objects. Background information on X-ray binaries (more specifically, high mass X-ray binaries). Observational techniques used to study these objects. Theoretical considerations.

**Astrostays: Community-Centric Astro-Tourism for Livelihood Creation**
*Dr Amidou Sorgho SAAO, SAD*

**Abstract**: He will introduce the concept of Astrostays to the audience, a programme that builds on Astrotourism and that was pioneered by our partners in India. He will specifically discuss how the concept can be implemented in remote towns in South Africa such as Sutherland, and what benefits may be expected

**The Effects of Environment on Galaxy Evolution**

*Dr Rosalind Skelton SAAO*

**Abstract**: In this talk I will present the recent work that we're doing at SAAO to explore how galaxies are affected by the environments they are found in. We are looking at the influence of neighbouring galaxies, groups, clusters and filamentary large scale structure on the morphologies, stellar and gas content of galaxies in the local universe and out to intermediate redshifts. In future, the excellent sensitivity of MeerKAT will shed further light on how gas is distributed in these environments and within their galaxies, to better understand star formation and quenching.

**Nicolas-Louis De Lacaille: Pioneer of Scientific Cartography in Southern Africa**

*Dr Roger Stewart, Antiquarian*

**Abstract:** Nicolas-Louis de Lacaille is famous for the pioneering, rigorous studies he conducted in astronomy and geodesy at the Cape of Good Hope. He is not well known as a cartographer. Yet, he produced pioneering and influential terrestrial maps of the cape of Good Hope and Mauritius and a celestial chart. I argue that Lacaille's mapping of land and skies was the beginning of scientific cartography in Southern Africa.

**A Brief History of the Radcliffe Observatory in South Africa**

*Dr Robin Catchpole, Institute of Astronomy, Cambridge, UK*

**Abstract:** In a bold move the Radcliffe Observatory, founded in Oxford in 1773, was re-established in Pretoria, becoming fully operational in 1948. For a few years it was the largest telescope in the Southern Hemisphere and fifth largest in the world. Dr Catchpole will summarise the Observatory's operation, impact on astronomy and its relationship to other South African Observatories.

**SKA African VLBI Network**

*Ms Carla Sharpe SARAO Africa*

**Abstract:** In 2018, the South African Radio Astronomy Observatory (SARAO) completed the construction of the MeerKAT telescope in the Karoo, South Africa. This is a precursor telescope to the SKA Phase 1 telescope, due to begin construction at the same site within the next few years. The SKA Phase 1 will be made up of 133 dishes that will be integrated with the 64 MeerKAT dishes to form a total array of 197 dishes. With the support of the Department of International Relations (DIRCO) through their African Renaissance Fund (ARF), in 2012 South Africa initiated the AVN programme with eight African Partner countries; Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia. The AVN programme aims to establish Very Long Baseline Interferometry (VLBI) capable radio telescopes in the SKA African partner countries through the conversion of redundant

telecommunications antennas, new-build antennas or through the establishment of training facilities with training telescopes. Developing a network of VLBI capable radio telescopes on the African continent will allow for the transfer of knowledge and technology as well as the development of the necessary and transferable skills within participating countries. The Africa colocation plan was developed in response to the need for sustainability of the African Partner Country (APC) sites for the AVN network. The colocation plan allows for a collaboration between industry, government and academia to generate innovation, revenue and space sciences from one collocated site.

**Breaking the Shackles of Time: Library & Information Services in Astronomy (Lisa) at the SAAO**

*Ms Theresa De Young SAAO*

**Abstract**: Information Services in Astronomy (LISA) at the SAAO" illustrating how library and information services to observatories have evolved in parallel to the development of modern astronomy and how the two are inter-twined and their histories interrelated. She will cover the history of library and information services at the SAAO, from how it began with the arrival of the first Royal Astronomer in the 1820s who brought books with him to the new Observatory, to the present, also giving a peek into what the future holds for LISA.

**Sunny Outlook for Computational Stellar Astrophysics**

*Prof Shazrene Mohamed SAAO*

**Abstract:** Evolved stars lose copious amounts of mass and momentum via powerful, dense stellar winds. In double star systems, known as binary stars, the winds impinge upon a close companion and a wide range of phenomena can result, from the ejection of jets and spirals to violent nova and supernova explosions. In this talk, Prof Shazrene Mohamed will discuss our 3D supercomputer simulations of these complex stellar outflows and explosions, and what they tell us about the impact dying stars have on their circumstellar environments.

**After Gill: The Shape of Astronomy in South Africa, 1907 – 1937**

*Prof Keith Snedegar, Utah Valley University, USA*

**Abstract:** In this talk he will touch upon the entry of South Africa into the international astronomical community; evolving roles of the Cape Observatory and Union Observatory as imperial/national scientific institutions; leadership of foreign scientists in the development of astronomy in South Africa; and astronomical interests of the majority population in an age of racial segregation.

**Developing an Array of Small Parabolic Antennas at Mauritius Radio Telescope (MRT) Site for Radio Astronomy Experiments**
*Mr Albert Forson, University of Mauritius*

**Abstract:** The Square Kilometre Array (SKA) project has been a global endeavour. In April 2016, Mauritius joined Botswana, Ghana, Kenya, Madagascar, Mozambique, Namibia, and Zambia as one of the SKA partner states. Trained and skilled personnel are required to develop, maintain, and run the radio telescopes and the instrumentation of Africa Very Long Base Line Network (AVN) in each of the SKA partner countries. Three 2.4m unused telecommunications off-set parabolic dishes available at the MRT site are being developed with a design of study mount suitable for the Mauritian cyclonic weather, feed, tracking, and receiver system for enhancing the potential for various types of radio astronomy observations. The aim of the interferometry array with small parabolic antennas is to perform a variety of radio astronomy observations experiments including synthetic imaging, intensity mapping and 1420MHz radio-sky observations. Increase accessibility to training and experimental astronomical tools among students in Africa to support astronomy education. And help build capacity in skills development in readiness for the SKA out station yet to be built in Mauritius.

**How AGN Studies are benefiting Astronomy Development in Ethiopia and Africa**
*Dr Mirjana Povic*

**Abstract:** This talk will summarise different research projects carried out in Ethiopia and East Africa, in collaboration also with SAAO, that are focused on the study of nuclear activity in galaxies and physics behind AGN. It will also highlight how through our research activities we can increase in future possibilities of attaining the United Nations Sustainable Development Goals for the benefit of all.

**The Astronomical Society ff Southern Africa**
*Mr Chris Stewart, President ASSA*

He will discuss a brief history of its formation, give a description of its structure and activities, and discuss highlights of Pro-Am collaboration.

**The History Of Gamma-Ray Astronomy in South Africa – Scientific Synergies Between The SKA And High-Energy Astrophysics**
*Prof Garret Cotter, Department of Physics, Oxford, UK*

**Abstract**: This presentation is on the relativistic jets in many Active Galactic Nuclei (AGN) produce powerful emission across the electromagnetic spectrum, from low-frequency radio to the highest energy gamma rays. Southern Africa is unique in the

world in having a range of state-of-the-art local facilities spanning this entire wavelength spectrum from MeerKAT to SALT to H.E.S.S. He shall review the current experimental results on the broad-band spectra and variability and AGN jets, theoretical progress in modelling the underlying machinery that creates them, and the synergies made possible by the facilities in the region.

**Southern African Large Telescope Spectroscopy of Blazars for the Cherenkov Telescope Array Project**

*Dr Eli Kasai, University of Namibia*

**Abstract**: In the last decade, very-high-energy gamma-ray astronomy has reached maturity: over 200 sources have been detected, both Galactic and extragalactic by ground-based experiments. At present, Active Galactic Nuclei (AGN) make up about 40% of the 200+ sources detected at very high energies with ground-based telescopes, the majority of which are blazars, i.e. their jets are closely aligned with the line of sight to Earth and three quarters of which are classified as high-frequency peaked BL Lac objects. One challenge to studies of the cosmological evolution of BL Lacs is the difficulty of obtaining redshifts from their nearly featureless, continuum-dominated spectra. It is expected that a significant fraction of the AGN to be detected with the future world-wide Cherenkov Telescope Array (CTA) observatory will have no spectroscopic redshifts, compromising the reliability of BL Lac population studies, particularly cosmic evolution. We started an effort in 2019 to measure the redshifts of a large fraction of the AGN that are likely to be detected with CTA, using the Southern African Large Telescope (SALT). This collaborative multi-facility effort among African, European, North and South American institutions is ongoing and we will present some of the preliminary results. Importance of SALT redshift measurements of blazars for the CTA science goals, Present results of the programme, Sample selection and spectral fitting, Relative flux measurements/calibration and Photometric follow-up support.

**Public Engagement at SAAO: Astronomy In The Community**

*Dr Tana Joseph, AstroComms*

**Abstract**: I will be talking about the work I did with the wider community as Outreach Astronomer at SAAO. I will briefly describe the types of interventions we engaged in during my time at SAAO, and I will conclude with some suggestions on further work that can be done going forward.

**Dark Energy with Hirax 21cm Intensity Mapping**
*Prof Kavilan Moodley, University of Kwa-Zulu-Natal*

**Abstract**: In this talk I will present the Hydrogen Intensity Mapping and Real time Analysis eXperiment (HIRAX) project, which is a proposed 21cm intensity mapping experiment operating at 400-800 MHz that will measure the evolution of dark energy over the redshift range z=0.8-2.5 by using the characteristic baryonic acoustic oscillation scale as a standard ruler. The HIRAX radio telescope array will be sited in the radio-quiet Karoo astronomy reserve in South Africa and will ultimately comprise 1024 dishes, each six metres in diameter, placed in a compact configuration. I will discuss the design and project status of HIRAX and its scientific prospects.

**The Structure of a Quasi Keplerian Disc around a Millisecond X-Ray Pulsar**
*Dr Edward Jurua, Mbarara University of Science and Technology*

**Abstract**: We investigated the time-independent dynamics (disc structure, forces and torques) of a quasi-Keplerian disc around a millisecond pulsar (MSP) with an internal dynamo. We considered the disc around a MSP to be divided into the inner, middle and outer regions. By assuming that the disc matter flows in a quasi-Keplerian motion, we derived analytical equations for a complete structure (temperature, pressure, surface density, optical depth and magnetic field) of a quasi-Keplerian thin accretion disc, and the pressure gradient force (PGF). In our model, the MSP-disc interaction results into magnetic and material torques, such that for a given dynamo and quasi-Keplerian parameter, we obtained enhanced spin-up and spin-down torques for a chosen star spin period. Results obtained reveal that PGF results into episodic torque reversals that contribute to spinning-up or spinning-down of a neutron star, mainly from the inner region.

**Impact of Astronomy in Transforming Africa**
*Prof Solomon Tessema, ESSTI, Ethiopia*

**Abstract**: The audience can expect to hear about astronomy for innovation, the impact of astronomy for economic development, and astronomy for scientific-based transformation.

**What can the Simba Galaxy Formation Simulations do for you?**
*Prof Romeel Davé, University of Edinburgh, Scotland*

**Abstract**: It will highlight the emerging importance of galaxy formation simulations in understanding the evolution of the visible universe. Modern simulations include a wide range of complex processes interplaying within the cosmic ecosystem that shape the properties galaxies, black holes, and intergalactic gas. Understanding this so-

called baryon cycle occurring within the cosmic ecosystem is one of the grand challenges in modern astrophysics, and he will highlight their state-of-the-art efforts towards this using the Simba simulations.

**Star Clusters and Radio AGNs as vital Tools to study Star Formation and Galaxy Evolution**

*Dr Zara Randriamanakoto, SAAO, AfAS*

**Abstract**: This talk will highlight various results and the motivation behind my ongoing research: the investigation of young massive clusters in strongly star-forming galaxies and the search for remnant and restarted radio galaxies in deep radio continuum surveys such as MeerKAT/MIGHTEE Early Data Science. She will also briefly report how South African-based institutions (including SAAO) play a vital role toward the advancement of Astronomy in all its aspect in her home country, Madagascar.

**The UK – SALT Consortium – 50 years of UK Astronomers' Collaboration with South Africa**

*Prof Phil Charles, University of Southampton, UK*

**Abstract**: He will discuss UK participation in and contribution to SALT; science and outreach projects; plans for the future.

**Slit masks IFUS (SMI) for the Robert Stobie Spectrograph on SALT**

*Dr Sabyasachi Chattopadhyay, SAAO*

**Abstract**: 1. Understanding of star formation in galaxies through the perspective of gas accretion and feedback.
2. Use of Integral Field Unit (IFU) spectroscopy to map the chemo-dynamics of out of plane gas at the disk halo interface in the edge on systems.
3. Capabilities of Slit Mask IFU towards understanding the scientific query.
4. Functional description of Slit Mask IFU and its novelties as well as limitations.
5. Advantages of Slit Mask IFU over the existing long slit and its synergy with other SALT instruments.

**A High Resolution study of a Supernova Evolution**

*Dr Naftali Kimani, Kenyatta University*

**Abstract**: 1. The derived late-time shock-wave velocity between days 73 and 1400 was 12000km/s while the shockwave deceleration index, m=0.86 ± 0.02. 2. The Supernova SN2008iz spectral index did not show signs of evolution and remains steep (i.e. $\alpha \approx -1$) throughout the period at frequencies 1.4-43 GHz.
3. Evidence of unexpected supernova flaring 4 years (1500 days) after the explosion.

4. Evidence of inhomogeneities in the CSM (discussed from the confirmed flaring and from the high resolution shell Asymmetry seen during shell-expansion).
5. Evidence of confirmed flux suppression at lower frequencies (attributed to Free-Free Absorption (FFA) from foreground screen or Razin-Tsytovich effects.

**50 Years of Astronomy at UCT**
*Prof Patrick Woudt, UCT*

**Abstract**: The Astronomy Department at the University of Cape Town was formally established as a basic department in 1970, at a time when the Sutherland station of the South African Astronomical Observatory was under development. Highlighting the special relation that exists between the University of Cape Town and the South African Astronomy Observatory for over 50 years, I will present a brief overview of UCT's Astronomy Department's contributions to observational astronomy, to astronomical instrumentation in Sutherland, and to the development of the next generation of astronomers in South Africa, looking beyond 50 years of Astronomy at UCT.

**Machine Learning Applications in South Africa**
*Dr Michelle Lochner, SARAO*

**Abstract**: Machine learning and new statistical tools are becoming critical to astronomy as the amount of data increases rapidly. In this talk, I will highlight recent applications of artificial intelligence techniques in astronomy. I will particularly focus on the growing field of anomaly detection in astronomy, asking the question of how new scientific discoveries can still be made amongst the petabytes of data that may never be studied by human eyes.

**The Age of AI: The Next 200 Years**
*Prof Bruce Bassett, AIMS, UCT, SAAO, SARAO*

**Abstract**: Artificial Intelligence is radically changing society. Here we explore what it means for the future of science in general, and cosmology and astronomy in particular, from the highly philosophical to the very practical.

**Multiwavelength Astronomy in Namibia**
*Dr Michael Backes, University of Namibia*

**Abstract**: Will review the current situation of astronomical research in Namibia, from tests of electronics to theoretical modelling, from millimetre-wave radio astronomy up to highest energetic gamma-rays

**The IAU and Astronomy's role in Education and Development**
Prof Ewine van Dishoeck, Leiden University

**Abstract**: The International Astronomical Union (IAU) is the organization of all professional astronomers worldwide. Its mission is to promote and safeguard astronomy in all its aspects through international cooperation. Over the past decade, the IAU has evolved from an organization that was primarily focused on bringing together people for scientific meetings, to an organization that also has development, outreach and education as anchor points. To enable its mission, the IAU has four Offices: Astronomy for Development (OAD, at SAAO in Cape Town South Africa), Astronomy Communication and Outreach (OAO, in Tokyo Japan), Astronomy Education (OAE, in Heidelberg Germany) and Young Astronomers (OYA, in Oslo Norway). This brief talk will highlight some of the IAU activities that contribute to education and development, as outlined in the IAU Strategic Plan 2020-2030 posted at www.iau.org, and in which the OAD features strongly. The IAU100 centennial celebrations provided an opportunity to showcase astronomy's role in society.

## SAAO200 Poster Paper Abstracts

**Historical Co-Operation between the Royal Astronomical Observatory at the Cape Of Good Hope and The Astronomical Society of South Africa**
*Chris de Coning – ASSA*

Very early in its history, the Royal Observatory at the Cape of Good Hope (ROCGH) became a centre for intellectual pursuit in the Cape Colony. A defining feature of the first Astronomical Society in Southern Africa - the Cape Astronomical Association (CAA) - was the close ties that existed between the Professional Astronomical Establishment (ROCGH) and the amateur society. This talk will explore the relationship between the South African Astronomical Society (ASSA) and the ROCGH / SAAO.

**Tiemperos. Meteorological Specialists from the Pre-Hispanic Indigenous Cosmogony of Mexico, and the use of technology to promote Astronomy and Atmospheric Sciences in Rural Regions.**
*Cintia Durán – Tlaloque*

The cult of the mountains, the wind, and the request for “good rain” constitute today, the fusion of pre-Hispanic religious beliefs and meteorological and astronomy knowledge in the development of central Mexico. Understanding this cult of the sky, from an indigenous perspective, is a fundamental and necessary feature for the development of atmospheric and astronomic sciences and the inclusion of rural

villages in scientific research carried out in certain areas of third world countries. Understanding the world in which these specialists are inserted is complex if one does not have a joint vision of the ethnographic data and the social relevance that traditions have on the communities. In 2018 I carried out an investigation on rituals that are carried out year after year in certain areas of central Mexico. From that initiative I developed an educational model and a prototype weather station that could be designed, built, and adapted considering the traditions and teachings of the local Tiempero. Making use of microcontrollers, basic electronics, and a traditional indigenous technique, each station was built with the idea of involving and enriching scientific knowledge, which could be useful for each community. The project, included meteorological stations, built by the communities, a series of astronomical programs for children involved in the project, using the data collected by the meteorological stations, with the intention of using technology and science-based information with traditional indigenous practices giving way to new forms of research and inclusion of science in remote communities in Mexico.

**Hemelliggaam or the Attempt to be Here Now SAAO Exhibition**
*Nic Grobler & Tommaso Fiscaletti*

To celebrate the 200th anniversary of the SAAO, "Hemelliggaam Or The Attempt To Be Here Now" presents a new exhibition, “The Mirror”, with an adapted selection of photographs, audio, and video. The exploration between science and science-fiction will include a special focus on works that feature the SAAO and Cape Town. In a new experimental format the exhibition invites the audience to virtually experience part of the archive. Hemelliggaam or The Attempt To Be Here Now presents a virtual exhibition with work from the archive relating to Cape Town and the SAAO. "Hemelliggaam (Afrikaans: Heavenly Body) or The Attempt To Be Here Now” is a growing visual archive of photography and video installations, exploring the existential aspects of the human-environment-astronomy relationship, constantly moving between the reality of important scientific sites (such as the South African Large Telescope in Sutherland and the Square Kilometre Array in Carnarvon) and the imaginative fragments of old Afrikaans science fiction novels - in particular reference to one of the most existential and emblematic writers, Jan Rabie with his books 'Swart Ster oor die Karoo' (Black Star over the Karoo, 1957), Die Groen Planeet (The Green Planet, 1961) and 'Die Hemelblom' (Heaven Flower), 1971. The project (still in progress) is mainly focused on communities, landscapes and objects located in the Western and Northern Cape, South Africa, where there is a special connection with the sky. themirror.hemelliggaam.com (Chrome browser recommended) Curator: Filippo Maggia ; Sound Composer: Alessandro Gigli ; In collaboration with Mattia Vaccari, Lucia Marchetti and Michelle Cluver, Department of Physics and Astronomy, University of the Western Cape; Advisor / consultant: Davide Chinigo; Supported by

National Research Foundation Istituto Italiano di Cultura, Pretoria; Consulate of Italy Cape Town

**A Data Archive for Salt and the SAAO**

*Christian Hettlage SAAO/SALT*

In July 2020 a new data archive was launched for the Southern African Large Telescope (SALT), which allows users to easily query all observations taken by SALT and to download public and their own proprietary data. We provide an overview of its functionality and explain the technology stack used. We discuss plans for extending the archive to other telescopes in Sutherland and for making the archive searchable with Virtual Observatory tools.

**Here and There: Astronomers Circulating through South Africa**

*Jarita Holbrook UWC/Uedin*

In the lead-up to the Bicentennial activities, the NRF dedicated funds to explorations of the History of Astronomy in South Africa. The authors proposed an oral history project focused on astronomers and astrophysicists worldwide that were connected to South Africa, which was chosen for NRF support. The interviews were semi-structured with guiding open-ended questions about their family, their formative years, higher education and their professional careers. We did a combination of a sample of convenience and snowball sampling. A sample of convenience means that we interviewed people in our local sphere as well as people where we visited. For snowball sampling, after doing an interview we ask for recommendations as to other people to be interviewed. In that way, as when you roll a snowball it gets bigger and bigger, we gathered more and more names of people to interview. This poster is a discussion of the interviews collected by the authors while travelling outside of South Africa. Included are South Africans living and working abroad; as well as astronomers and astrophysicists that are not South African, but have worked in South Africa or used South African telescopes. These interviews are video recorded as well as audio recorded, they are transcribed, then will be placed on our project site with password protection. Anyone can request access for research purposes, most of the interviewees felt more comfortable under this arrangement instead of having their interview freely available on a platform such as YouTube, etc.

**Characterisation of small, close approaching Near-Earth Asteroids**

*Petro Janse van Rensburg UCT/SAAO*

I will provide a brief introduction on Near-Earth Asteroids (NEAs) and why they are important to study, especially small NEAs (diameter between 30 m and 300 m). I will describe how we observed NEAs with the South African Astronomical Observatory's 40-inch telescope and the Sutherland High-Speed Optical Camera (SHOC). Finally, I

will describe how we used multi-band lightcurves to extract the rotation period and determine the taxonomic type of the NEAs. Abstract: Near-Earth Asteroids (NEAs) are asteroids in stable orbits around the Sun that have escaped from the main asteroid belt due to resonant motion with larger planets. NEAs have orbits that bring them close to or cross the Earth's orbit and therefore some have impacting trajectories and could pose a threat. Small NEAs (diameter between 30 m and 300 m) pose a large threat because they are big enough to cause significant damage on impact but also more abundant compared to larger NEAs (diameter > 300 m), which means the impact scenario is more likely. However, the small NEA population has not been well studied because they can only be observed with ~1m-class telescopes when they pass close to the Earth and become bright enough. For this project, 14 small and 6 large NEAs were observed and characterised with the Sutherland 40-inch telescope and the Sutherland High-Speed Optical Camera (Coppejans et al., 2013). Most observations were performed remotely from the South African Astronomical Observatory facilities in Cape Town. Characterisation involved extracting the rotation period and determining the taxonomy from multi-band (SDSS g', r' and i') photometry. The taxonomic type of the asteroid, and therefore its most probable composition, was determined with the colours g'-r' and r'-i', in combination with a machine learning algorithm trained on synthetic colours from observed spectra obtained from literature. The composition is one of the critical characteristics that determine the damage zone size in case of an impact or deflection strategy in case of an impact-avoidance attempt.

**Optical and Radio Observations of the Eclipsing Polar Uz Fornacis**
*Zwidofhelangani Khangale SAAO*

We present phase-resolved spectroscopy, photometry, and circular spectropolarimetry of the eclipsing polar UZ Fornacis. Doppler tomography of the strongest emission lines using the inside-out projection revealed the presence of three emission regions: from the irradiated face of the secondary star, the ballistic stream and the threading region, and the magnetically confined accretion stream. The total intensity spectrum shows broad emission features and a continuum that rises in the blue. The circularly polarized spectrum shows the presence of three cyclotron emission harmonics at ~4500, 6000, and 7700 Å, corresponding to harmonic numbers 4, 3, and 2, respectively. These features are dominant before the eclipse and disappear after the eclipse. The harmonics are consistent with a magnetic field strength of ~57 MG. We also present phase-resolved circular and linear photopolarimetry to complement the spectropolarimetry around the times of eclipse. MeerKAT radio observations show a faint source that has a peak flux density of 30.7 ± 5.4 μJy beam-1 at 1.28 GHz at the position of UZ For.

**Properties of Galaxies in Green Valley**
*Antoine Mahoro SAAO*

Presentation synopsis: We analysed active galactic nuclei in the green valley by comparing active and non-active galaxies using data from the COSMOS field. We found that most of our X-ray detected active galactic nuclei with far-infrared emission have star formation rates higher than the ones of normal galaxies of the same stellar mass range. We study morphological properties of 103 green valley FIR active and 2609 non-active galaxies presented in Mahoro et al. (2017). The photometric data from the COSMOS survey were used, and the morphological parameters, such as Abraham and Conselice-Bershady concentration indices, Gini, M20 moment of light, and asymmetry, were analysed taking into account public catalogues. Furthermore, a visual classification of galaxies was performed. We found that the fraction of peculiar galaxies with clear signs of interactions and mergers are significantly higher in AGN (38%) than non-AGN (19%) green valley galaxies, while non-AGN galaxies from our sample are predominantly spirals (46%). We found that the largest fraction of our green valley galaxies is located on the main-sequence (MS) of star formation, independently on morphology, which is in contrast with most of previous studies carried out in optical. We also found that FIR AGN green valley galaxies have significantly higher star formation rates in all analysed morphological types. Therefore, our results suggest that interactions and mergers obtained in the high fraction of FIR AGN contribute significantly to high star formation rates observed in the selected sample, but are not the only mechanism responsible for enhancing star formation and others such as AGN positive feedback could contribute as well.

**Ultra-Diffuse Galaxies in the Subaru Hyper-Suprime Cam Wide-Field Clusters**
*Nazir-Ahmed Makda SAAO*

In my poster I will describe why UDGs are interesting objects and how we identify them in deep optical data of galaxy clusters taken with the Subaru telescope. Abstract: Ultra-diffuse Galaxies (UDGs) are low surface brightness galaxies with a very low stellar mass component, however, their sizes are comparable to Milky Way-sized galaxies. Although UDGs are expected to be cannibalised by strong tidal fields in clusters, they are nevertheless found to be abundant in cluster environments. This suggests that they contain significant amounts of dark matter. UDGs are found in lower mass galaxy groups as well and the number of UDGs in clusters/groups has been found to increase with the cluster/group halo mass. The abundance of these galaxies in clusters has only recently been recognized, therefore identifying and measuring their properties is key in understanding how they are formed and continue to exist. The main objective of this project is to investigate the distribution of UDGs in clusters, particularly, how the UDG density changes with respect to cluster radius. A

large sample of UDGs and clusters are crucial in providing statistically robust results which are less influenced by individual clusters with unique attributes. The other requirement is deep optical data which allows identification of these faint sources with extremely low surface brightnesses (mu_g > 24 mag/arcsec^2). In this poster I will outline the approach I am taking to identify and analyze UDGs in identified galaxy clusters in the deep Subaru hyper-Suprime Cam (HSC) wide-fields data.

**Digital Immersion Research at the IDIA Visualisation Lab**
*Lucia Marchetti UCT*

Presentation synopsis: The audience will have the opportunity to learn what IDIA Visualisation Lab (IVL) projects are under development and see the capabilities of iDaVIE-v, a new VR software developed at the IVL in collaboration with INAF-Catania, that allows researchers to visualise, explore, and interrogate data cubes from an immersive perspective. With the advent of SKA and other TB-scale data facilities, both the data storage and the data visualisation/exploration represent two new challenges facing the astronomical community worldwide. The Inter-University Institute for Data Intensive Astronomy (IDIA) Visualisation Lab at UCT (IVL; https://vislab.idia.ac.za/) is a cutting-edge research facility in Cape Town focusing on these challenges. Within international collaborations, the IVL research team is leading the way to develop new approaches and technologies, such as Virtual Reality tools, to handle the exploration and detailed interrogation of big astronomical (and multi-disciplinary) data sets. As project scientist in the IVL, I will briefly present the facility, its initiatives, and how this fits in the context of the International BigData Science framework.

**What About Kolb?**
*Karsten Markus-Schnabel*

Presentation synopsis: I will give a very brief overview about an international research project for which observations at the Cape were conducted. Amongst others, the presentation will cover the first South African astronomer, the first South African Observatory, the often-misinterpreted visit of Peter Kolb to the Cape, and what consequences the failed project had for astronomy at the Cape and otherwise.Abstract: Before this poster was published, for you to be able to skim through it, I could have assured you this: When asked about the early times of astronomical research in southern Africa, only two persons in the world (ignoring the referees that read this before publication) would have recalled the names of Peter Kolb, Bernhard Friedrich von Krosigk, Adolf Reusch, Johann Wilhelm Wagner and Nicolaus von Willich. Maybe a few would have remembered the name Peter Kolb, and if so, this would mostly have been for Kolbs bad reputation today. The deterioration of his reputation over time is an interesting subject to study by itself. Here, however, I will give a few reasons, for why one should start thinking positively again, about Kolb

and about what he and the other persons are standing for. To begin with, Adolf Reusch was planned to be the first South African astronomer, he died in 1705, before his arrival at the Cape. Nicolaus von Willich took his place and became the founding father of the von Willich family branch of southern Africa. Peter Kolb himself was considered to be the best suited German candidate for establishing a permanent observatory at the Cape, which he set up in 1705. Johann Wilhelm Wagner was conducting observations in Berlin, simultaneously to the ones Kolb and von Willich did at the Cape while Bernhard Friedrich von Krosigk initiated, organised and financed this research.

**Astronomy Development in Namibia: Astro-Tourism**
*Getachew Mekonnen Mengistie University of Namibia*

Astronomy is one of the pillars of development in the Southern Africa region. In Namibia, the impact of astronomy in the development of socio-economy is greatly improved in the last couple of years. To work more on this, the University of Namibia in collaboration with the University of Oxford is trying to use astronomy as a tool for capacity building and improve the socio-economy of tour guides in particular and Namibia in general. Namibia is well known in its sustainable tourism: astronomy provides a great potential to expand and diversify the tourism market with less environmental impact. With the availability of some of the darkest skies in the world, astro-tourism can be immensely important in improving tour guides' incomes. This talk will focus on the impact of astronomy in the tourism sector in Namibia with an emphasis on astro-tourism.

**Confirmation of two New Galactic Bulge Globular Clusters: Fsr19 And Fsr25**
*Casmir Obasi*

We use deep near-IR photometry from the VISTA Variables in the Via Lactea eXtended Survey (VVVX) in combination with the Two Micron All Sky Survey (2MASS) and Gaia DR2 catalog to confirm the physical nature of the candidate globular clusters (GCs) FSR19 and FSR25, located in the Galactic bulge. We determine their reddenings and red-clump distances, which are E(J-Ks)=0.33 mag, E(BP-RP)=1.30 mag and E(J-Ks)=0.40 mag, E(BP-RP)=1.60 mag, D=7.3$\pm$ 1 kpc and D=7.6$\pm$1 kpc for FSR19 and FSR25, respectively. We also derive their integrated luminosities MK (FSR19) = -7.72 and MK(FSR25) = -7.31. Their red giant branches are tight, and narrower than the red giant branches of the neighbouring fields. By comparing with single stellar population models we estimate mean metallicities of [Fe/H]= -0.50 and -0.55 dex and ages of 11 Gyr for FSR19 and FSR25. Finally, we also obtain their structural parameters. They have core-radii Rc of 2.76 pc and 1.92 pc and tidal radii Rt of 5.31 pc and 6.85 pc for FSR19 and FSR25 respectively. Therefore, these are new low-luminosity relatively metal-rich old GCs in the bulge of the Milky Way.

**Search for remnant Radio Active Galactic Nucleus in the MeerKAT/MeerKAT International Gigahertz Tiered Extragalactic Exploration Survey Xmm-Large Scale Structure Field**

*Tombo Fitahiana Rarivoarinoro University of Antananarivo*

Active galactic nuclei (AGN) radio remnants are dying radio galaxies with a nuclear activity either significantly reduced or temporarily switched off due to a shortage of material accretion onto the central supermassive black hole (SMBH). Since they are believed to represent the final stage in the evolution of a radio galaxy, they are important objects for understanding of the radio galaxy life cycle. Because of the rapid time scale of particle energy decay, and the paucity of high resolution and sensitivity observations at multiple wavelengths, only a handful steep spectrum dying radio sources have been observed to date. Therefore, we aim to discover these elusive objects in the XMM Large Scale Structure (XMM-LSS) field. In this work, we use observations between 74 MHz and 1.5 GHz from LOFAR, the GMRT, MeerKAT and the VLA radio telescopes. We visually inspect the radio images of the XMM-LSS field since the absence of compact structures in sources with extended emission is a potential evidence of the central AGN switch off. We then use PyBDSM to extract and measure the flux density of each source in order to compute selection parameters such as spectral index, spectral curvature and core prominence. Finally, we run BRATS to estimate the source synchrotron age. We hope to detect at least a dozen new remnant radio galaxies. This research is therefore relevant for expanding the catalogue of the few existing dead radio galaxy populations.

**Celebrating South Africa's Full Moons**

*Auke Slotegraaf Centre for Astronomical Heritage*

The Full Moon is a striking sight, and features in the art, myths and cultural traditions of most, if not all, peoples of Earth. A recent (c.300 years) popular phenomenon is to associate particular Full Moons with concepts rich in symbolism, such as Wolf Moon and Snow Moon. This practice probably originates from North America, possibly associated with certain American Indian traditions. More recently, due in part to the ease of access to information of dubious quality via the Internet, some South Africans (including members of the public, journalists, and science communicators) have been confused by these names since wolves never roamed the veldt and it’s unlikely to snow in February. Not only are these names irrelevant to South Africans, but an opportunity to celebrate what is iconic and proudly South African is lost with each setting Full Moon. To remedy this, the Centre set out to identify 24 concepts representing essential cognates to “South Africa”. A rationally determined set of primary factors was compiled, from which second-order factors were deduced. These second-order factors were instantiated and then assigned to specific months as determined by South African conditions (e.g. seasons, human activities, animal

behaviours). This poster presents these 12 + 12 essential concepts and their associated Full Moons, along with explanatory material. Not only are these names specifically (and in some cases uniquely) South African, they create the opportunity to promote our nation's diverse yet inclusive cultural heritage and our connection with the Universe.

**AMOS - Global Meteor Network**

*Juraj Toth Faculty of Mathematics, Physics and Informatics, Comenius Univ. In Bratislava*

The All-Sky Meteor Orbit System (AMOS) is an automated system used for the detection and orbit determination of meteors. AMOS has been developed and is operated by the Faculty of Mathematics, Physics and Informatics of the Comenius University in Bratislava, Slovakia (FMPI CU) and the system currently consists of two major parts, the all-sky AMOS-Cam and AMOS-Spec. AMOS-Cam is a global system of cameras which monitor meteor activity around the world, nowadays five stations are located in Slovakia, two in Canary Islands, two in Chile and two in Hawaii. The AMOS-Spec is a video system connected to AMOS-Cam for the systematic spectroscopic observations and detection of meteor spectra. It is currently worldwide distributed with one station in Slovakia, one in Canary Islands, two in Chile and one in Hawaii. Expansion of the observation network is planned in the future in central and eastern Slovakia as well as in South Africa and Australia. Network distribution secures large sky coverage, Northern and Southern hemispheres observed simultaneously, and the trigonometry used by two stations helps to accurately determine the atmospheric trajectory, which then leads to the pre-atmospheric heliocentric orbit and characterised meteor showers and meteor sporadic background from dynamical and physical aspects. The main goals and results of AMOS meteor network will be presented.

**Capturing Transients: an application of Biostatistics to Astronomy**

*Anke Van Dyk SAAO/UCT*

We aim to transcribe the Capture-Recapture methodology for astronomy. Capture-Recapture is a well-established method within the fields of biostatistics for the study of animal populations as well as epidemiology for the analysis of the spread of disease. We hypothesise that this method can successfully be applied to transient astronomy for the estimation of the underlying populations of transients. Up until now, efforts in transient astronomy have focused on finding and following up transients. This work broadens the field of transient astronomy by attempting to measure underlying populations and would be complementary to population synthesis, as selection effects due to the observational sampling strategy are built-in. Exploration of the topic has been aimed at simulations of lightcurves of X-ray binaries

(following the work of Laycock (2017)) and applying population estimators such as the Schnabel estimator on strategically sampled lightcurves of various cadences. These early simulations do show promise of recovering the input population to an accuracy of about 20% within 10-15 observations, even with low cadences between 120 and 240 days. The work is being extended to apply these techniques to real astronomical data to explore population recovery rates given different sampling strategies. Transient surveys that are synoptic, such as the upcoming LSST, will provide higher (and deeper) completeness to population studies of transient and variable stars and will be of great use for this study. We also aim to characterise the selection biases of this population estimation introduced by sampling strategy in future projects, such as the LSST.

**Length and thickness of Edge-On Disks in Cosmos: Measures of Galaxy Assembly**
*Brian Bichang'a SAAO/UCT*

Presentation synopsis: I will present a poster on the disk oblateness of a sample of Edge-On galaxies in the COSMOS (Cosmic Evolution Survey) field The presentation will include preliminary estimates of their disk size and thickness. I will also show results obtained from comparing the measured values to those of the Milky Way. Abstract: We present the disk size and thickness of eighteen Milky Way-mass edge-on galaxies at an inter-mediate redshift range (z∼0.12 to z∼0.39) and compare them to the Galaxy's values. We use publicly available COSMOS field data taken by HST's Advanced Camera for Surveys(ACS)/Wide Field Channel(WFC). The instrument's spatial resolution of 0.05''/pixel allows us to resolve physical scales of 0.27 kpc out to z∼0.4. We select our sample from the COSMOS2015 photometric catalog (Laigle et al., 2016) and fit standard models to its radial and vertical light profiles. From the preliminary results obtained, we find evidence of multiple disc components. We aim to increase our luminosity range, conduct similar work in the LADUMA field(Holwerda et al., 2011), and study the correlation of stellar-disk properties with H1 properties. We will then select low redshift sources in the LADUMA field that are resolved in ground-based seeing for future follow-up integral-field spectroscopy with SALT(Southern African Large Telescope).

**Resolving Atomic Hydrogen in Galaxies in Next-Generation Radio Surveys using High-Resolution Optical-Near-Infrared Imaging**
*Andrew Firth SAAO*

Presentation synopsis: Our poster will provide a description of the sample of galaxies on which the initial algorithm was performed, as completed during the BSc (Hons) degree of 2019, and the results thereof. An animation showing how the algorithm works, with each step of the pipeline illustrated also featuring, along with a narrated explanation. A description of how optical properties are used to predict the HI

properties, and how this is used in our algorithm. Abstract: Multiwavelength analyses of galaxies is a vital component of studying galaxy evolution. In the radio regime, the intrinsically weak flux of the neutral hydrogen (HI) signal often requires stacking of multiple sources; this is commonplace for the statistical detection of HI line profiles in deep-fields from SKA precursor-surveys. In contrast, we are developing algorithms for 3D data-cube stacking to take advantage of wide-field surveys to study the resolved spatial distribution and kinematics of neutral hydrogen at moderate redshifts. Our aim is to develop a stacking algorithm based solely on optical and near-infrared (OIR) measurements. These OIR measurements are used to infer HI properties through a variety of well-known scaling relations, with the addition of shape parameters that better characterize both spatial and spectral distributions of HI emission. The algorithm makes use of these scalings to co-align galaxies in 3D to optimize spatially-resolved flux-distribution matching during stacking. We demonstrate our algorithm using Westerbork HI survey of spiral and irregular galaxies (WHISP) datacubes and ground-based imaging of nearby galaxies. The algorithm will be applied to HI deep-fields with HST imaging (e.g., CHILES/COSMOS and LADUMA/GEMS). Construction of higher-resolution Hα data-cubes (observed with the SAAO 1.9m), will be used to augment the HI data that will arrive from MeerKAT; resulting in a deeper investigation of extended rotation-curves (through stacking) in an attempt to better constrain the dynamical masses of galaxies.

**Neutral Hydrogen in the Hubble Frontier Field Clusters: A Deep Meerkat Search**
*Shilpa Ranchod  University of Pretoria*

Presentation synopsis: This poster presentation will address predicted HI flux for cluster members of Abell 2744, Abell S1063, and Abell 370; and HI stacking results for members of each cluster. Abstract: Neutral hydrogen (HI) is a key ingredient in galaxy formation and an excellent tracer for studying galaxy evolution and environmental drivers thereof. However, due to sensitivity limits, HI has not been studied in detail beyond $z \sim 0.2$ except for objects at the extreme high-end of the HI mass function. This is changing with the exceptional sensitivity of MeerKAT, and we are now able to probe HI at higher redshifts (up to z~0.5 with L-band receivers). In this project, we use MeerKAT to search for HI emission in the Hubble Frontier Field (HFF) clusters. These intermediate redshift ($0.3 < z < 0.4$) clusters are of the most massive ($M \sim 10^{15}$ M_sun) known systems. Each has an extensive suite of high-resolution, multi-wavelength data, including hundreds of spectroscopic redshifts. The MeerKAT Galaxy Cluster Legacy Survey sample includes three of the HFF clusters, Abell 2744, Abell S1063 and Abell 370. The precise redshifts from the HFF programme make these clusters excellent candidates for targeted HI emission searches, and HI spectral stacking, a statistical technique used to amplify the signal of low S/N spectra. We aim to use these methods to explore the HI content of galaxies in dense environments at intermediate redshifts. In this poster, we present the predicted HI fluxes for HFF

cluster members, and the results of spectral-line stacking with MeerKAT HI cubes, including a 7σ stacked detection in Abell S1063. A final, more ambitious objective of this work is to search for gravitationally lensed HI emission behind these clusters.

## News Note: SA Astronomer discovers new comet

On Sunday 20 September 2020 the International Astronomical Union (IAU) Minor Planet Center announced the discovery of a comet (magnitude ~18.5) by SAAO Astronomer Dr Nicolas Erasmus. The discovery was made from four 30-second exposures taken on Sep 17 UT by ATLAS-MLO at Mauna Loa, Hawaii, in the course of the "Asteroid Terrestrial-Impact Last Alert System" (ATLAS) search program. In general, comets are named after their discoverer and thus the new comet has been designated C/2020 S3 (Erasmus).

The discovery images were taken at around 16:40 SAST (close to sunrise Hawaii time) and ATLAS's automated algorithms initially flagged it as a potential near-Earth asteroid. This was because the initial orbit calculation showed that the orbit came close to Earth's orbit. The automated software then posted the images on the nightly discovery page of ATLAS's internal system. At this point, a scientist stepped in to monitor and vet the observations before making the final submissions to the Minor Planet Centre (MPC). The algorithm generates many false-positives every night and the human eye and brain are still the best "asteroid detector".

Dr Erasmus, talking about the discovery said, "While doing the nightly vetting (which I do every ~3 weeks, a duty shared with two others) I noticed that the object in the discovery images had a faint coma and after double-checking with my other ATLAS colleagues that they also see a coma (our agreed procedure) I notified the MPC around 18:30 SAST that this was a potential comet discovery."

The MPC confirmed the discovery on Sunday 20th September 2020. The comet will reach perihelion (the closest approach to the Sun) around 12 Dec 2020 and will be at its brightest at that point. How bright it becomes will depend on how much it starts outgassing as it approaches the sun but it will most likely not visible to the naked eye.

In early 2021, the SAAO will be installing a new ATLAS telescope in Sutherland. The ATLAS is a NASA-funded automated system of telescopes designed for searching for incoming Near-Earth asteroids (that is, asteroids on a trajectory towards an impact or close approach with Earth). The ATLAS project is a collaboration between the University of Hawaii ATLAS Project and SAAO. The telescope will be similar to the two 0.5-m ATLAS telescopes currently in operation in Mauna Loa and Haleakalā in Hawaii.

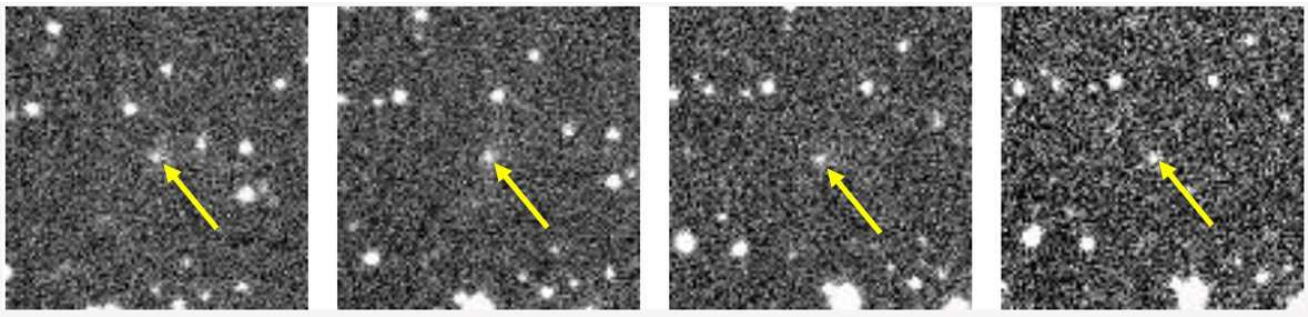

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*Fig1. The four 30 second exposures taken on Sep 17 UT by ATLAS-MLO at Mauna Loa, Hawaii.*
(Credit – SAAO)

## News Note: Physics Nobel Prize goes to astronomers

The 2020 Nobel Prize has been awarded to three astronomers, Roger Penrose, Reinhard Genzel and Andrea Ghez, for their work relating to the black hole in the centre of the Milky Way galaxy.
It was an astronomer, Karl Schwarzschild, who first pointed out in 1915 that black holes would exist as a consequence of Einstein's theory of General Relativity. Further, in 1971, Donald Lynden-Bell and Martin Rees suggested that the centre of the Milky Way might contain a massive one.

One of the three prizewinners, Roger Penrose, showed that there was no way out of Schwarzschild's conclusion that black holes should exist The other two led groups that demonstrated observationally that there is indeed a black hole at the centre of the Galaxy and determined its mass.

The observations were extremely difficult from a technical point of view because the Galactic Centre is hidden from us in ordinary light and the work had to be done in the infrared. It also required the use of techniques of interferometry and large telescopes to give the necessary spatial resolution. Further, to obtain the orbits of the stars in the neighbourhood of the black hole required many years of observations.

Genzel's group worked with the Very Large Telescope of the European Southern Observatory in Chile while Ghez's group worked with the Keck interferometer in Hawaii

Astronomers have won the Nobel prize before. In recent years one can mention James Peebles, a theoretician, and Michel Mayor and Didier Queloz, the discoverers of the first extra-solar planets, who won it in 2019. In 2017 Rainer Weiss, Kip Thorne and Barry Barish won it for the discovery of gravitational waves (ISG).

## News Note: New SALT Brochure

There is an interesting new SALT brochure of 40 pages available online at:
https://www.salt.ac.za/news/strategic-objectives/

This new brochure addresses SALT's strategic objectives on Science, Science & Industry, and Science & Society: It describes what they are and how SALT is fulfilling them. For example, it shows how SALT's scientific output (that is, publications) compares to that of other large observatories. Regarding Science & Industry, it shows how SALT's design was improved here over the design of its twin, the Hobby-Eberly Telescope in the USA. Also included are examples of skills transfer, some case studies and how SALT is taking the lead on the African continent (ISG)

## News Note: SAAO "Annual Review"

The "SAAO Annual Review 2019|2020" is available from;

https://www.saao.ac.za/2020/10/13/saao-annual-review-2019-2020/

This 51-page publication covers such items as descriptions of the various facilities, general news, science highlights, operations, Outreach & Education, publication lists, staff and students.

Among the innovations is a plan to convert the large room of the Cape Town library into a control room for the "Intelligent Observatory", involving the conversion of more of the Sutherland telescopes to remote operation and enhancing the ability to react to transient events detected by the various automatic monitoring instruments (ISG).

# Photometric measurements of three eclipsing binary stars

*by Dave Blane*

**Introduction**

Photometric phase plots of three southern eclipsing binary stars are presented.

- BL Telesopium is an Algol-type eclipsing binary
- TU Muscae is beta Lyrae type overcontact binary.
- R Arae a strongly interactive binary with some characteristics of an Algol-type.

Careful monitoring of close eclipsing binaries may reveal period changes, the presence of apsidal motion and other physical parameters of the system.
There are several possible causes, including perturbations by other bodies; mass transfer between the stars; tidal effects due to the elliptical shape of stars in a close binary; and relativistic effects.

**Equipment and procedure.**

Images were obtained with a 150mm f5 refractor and a Canon 1300D DSLR camera mounted on a GEM goto mounting. Aperture photometry was facilitated using the IRIS software package. The camera "g" magnitudes were linearly transformed to the Johnson V band using MS-Excel .

Differential extinction was not applied. Each adopted measurement was the average obtained from 10 separate field images.

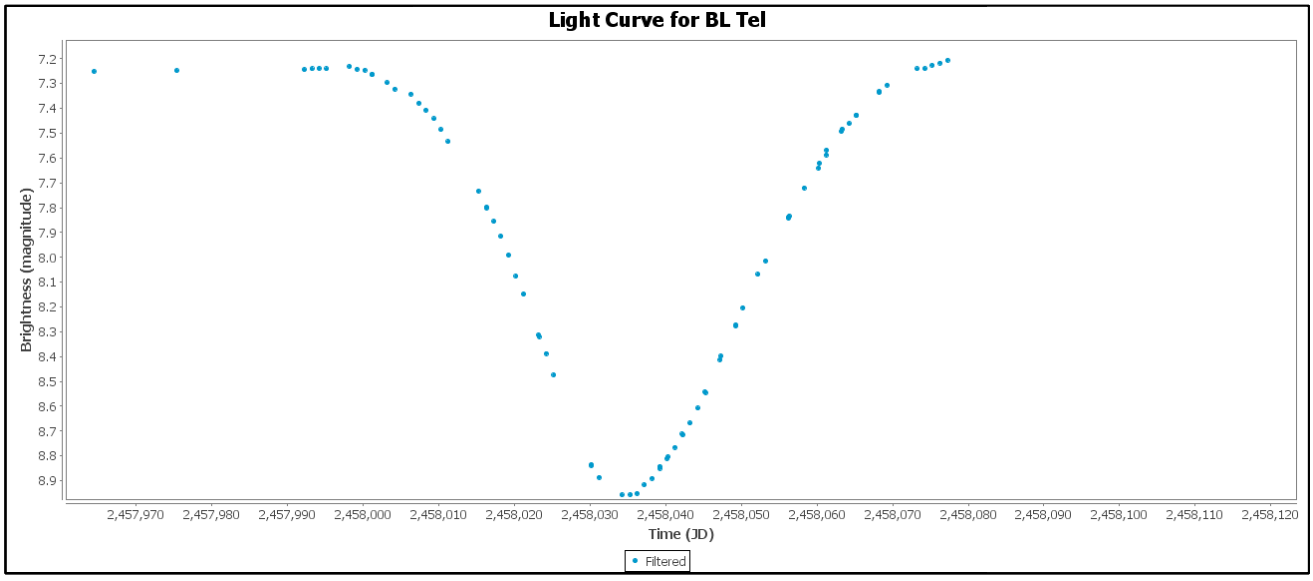



*Fig 1. Light curve for BL Telescopii showing the 2017 eclipse.*

**BL Telescopii**

The BL Telescopii system lies about 11000 light-years (3.3 kiloparsecs) away from the galactic plane. This, coupled with its high velocity, indicates it is a runaway star, and that some violent event catapulted it on its current trajectory. One possibility is that the secondary star was once a very massive star that underwent huge mass loss, such as a supernova explosion, and catapulted the system outwards.
An Algol-like eclipsing binary, the star system varies between magnitudes 7.1 and 9.0 (V) in 778 days. The eclipse duration is about 104 days. The minimum of the 2017 eclipse occurred on JD 2458035.36 (8/10/2017)

**TU Muscae**

TU Mus consists of blue main sequence stars, an O7 primary with M1=23 $M_{\odot}$ and an O9 secondary with M2=15.3 $M_{\odot}$ in an overcontact configuration. The orbital period has remained constant over the three decades of observations and these results might imply that the mass transfer seen in late-type overcontact binaries does not occur in their early-type counterparts.

The system varies in brightness from 8.25 to 8.85 (V) with a period of 1.3873 days.

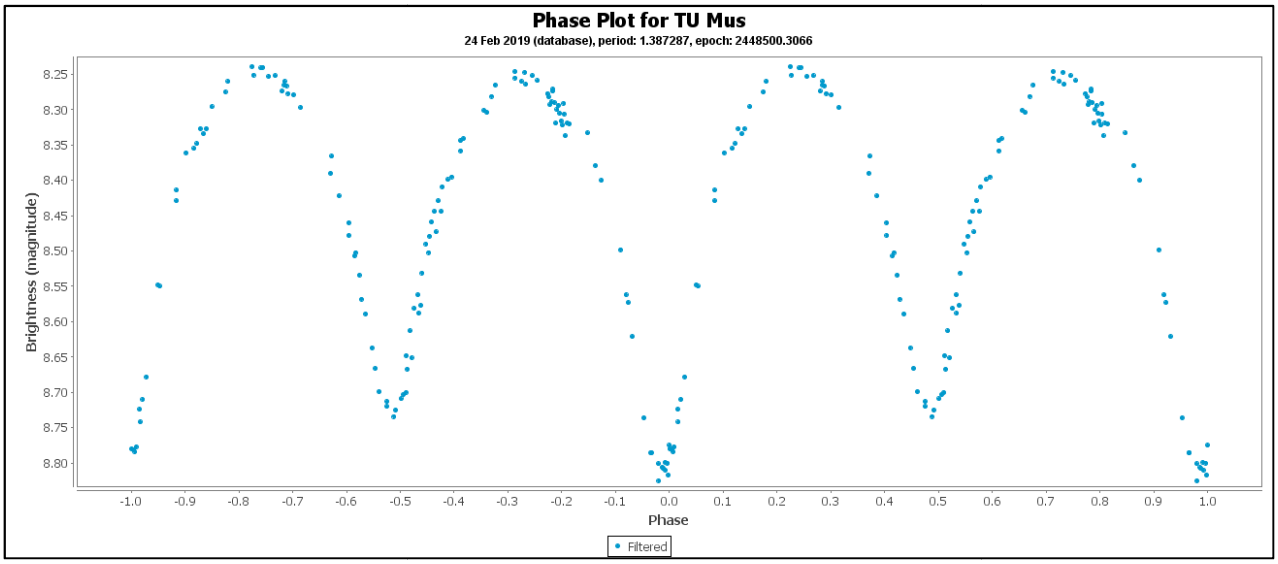



*Fig 2. Phase plot of TU Muscae*

R Arae superficially resembles a 'classical' Algol, but with mass transfer on a more enhanced scale than typical, and with additional photometric peculiarities that may be related to relatively dense, irregular and eccentric accretion disc.
R Arae consists of a B5V primary and an F1IV secondary and is in a very active and short-lived stage of its evolution.

The out-of-eclipse variations of 0.01 magnitude (see figure 3) are consistent with previous studies of this star and various models have been proposed the explain this phenomenon.

The period is steadily increasing with the mean rate of period variation dP/dt = $5.24 \times 10^{-9}$ days/day, and the corresponding `conservative' mass exchange rate dM/dt = $3.1 \times 10^{-7}$ $M_{\odot}$ / year. (Reed 2011)


*Fig 3. Phase plot of R Arae from measures by D Blane. The solid line is a best fit theoretical light curve for an Algol-type system (E Budding, Variable Stars South)*

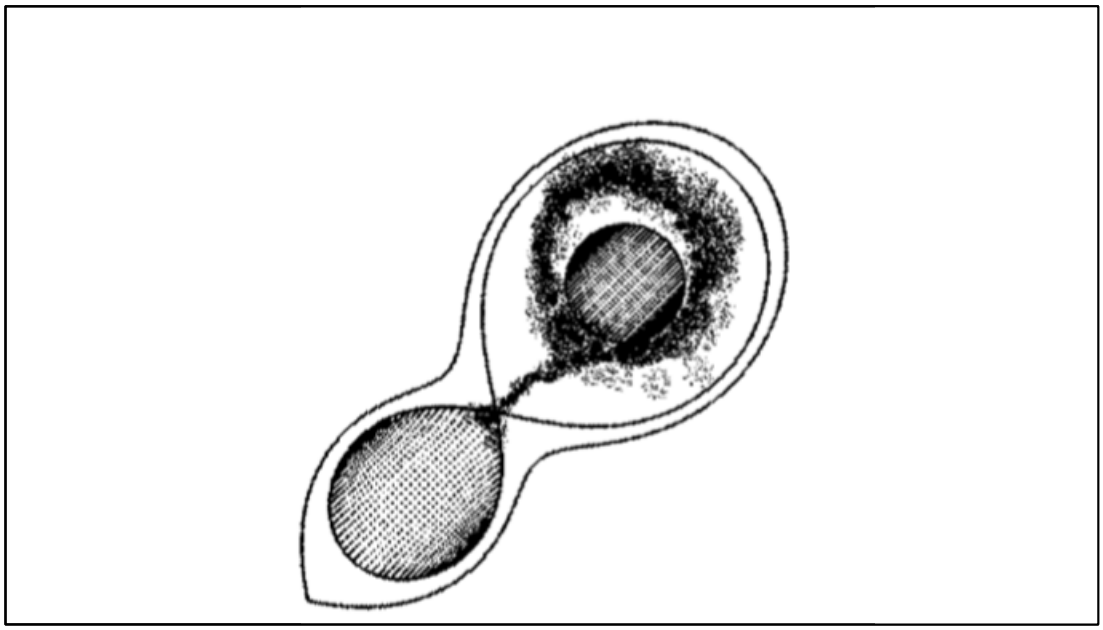


*Fig 4. An overhead view of the model of R Arae, illustrating the eccentric accreting structure. (Reed et al. 2011)*

**References.**

Reed, P.A., 2011, IBVS, 5975
Blane, D et al., New Light on R Arae, IBVS 6267

# Southern African Fireballs: Events 364-371

*Tim Cooper, Comet, Asteroid and Meteor Specialist, Shallow Sky Section*

This article continues the sequential numbering of reported fireball sightings from southern Africa. By definition, a fireball is any meteor event with brightness equal to or greater than visual magnitude ($m_v$) –4. The following events were reported to the author and details are reproduced as given by the observer [any comments by the author are given in brackets]. All times were converted to UT unless stated, and all coordinates are for epoch J2000.0. Descent angles are given in degrees, with directly upwards = 0°, horizontally left to right = 90°, directly downwards = 180° and horizontally right to left = 270°.

**Event 364 – 2020 August 18 – Greenside, Bredell and Hartebeeshoek Observatories, Gauteng**

Observed by CAMS@SA at 19h53m10.62s UTC. Using images from camera 6001 at Bredell and camera 6027 at Hartebeesthoek the apparent radiant was determined as RA = 255.11 ± 0.01°, Dec. = +2.69 ± 0.01°, apparent speed $V_{inf}$ = 13.95 ± 0.01 km/s. The image from camera BR6001 is shown in

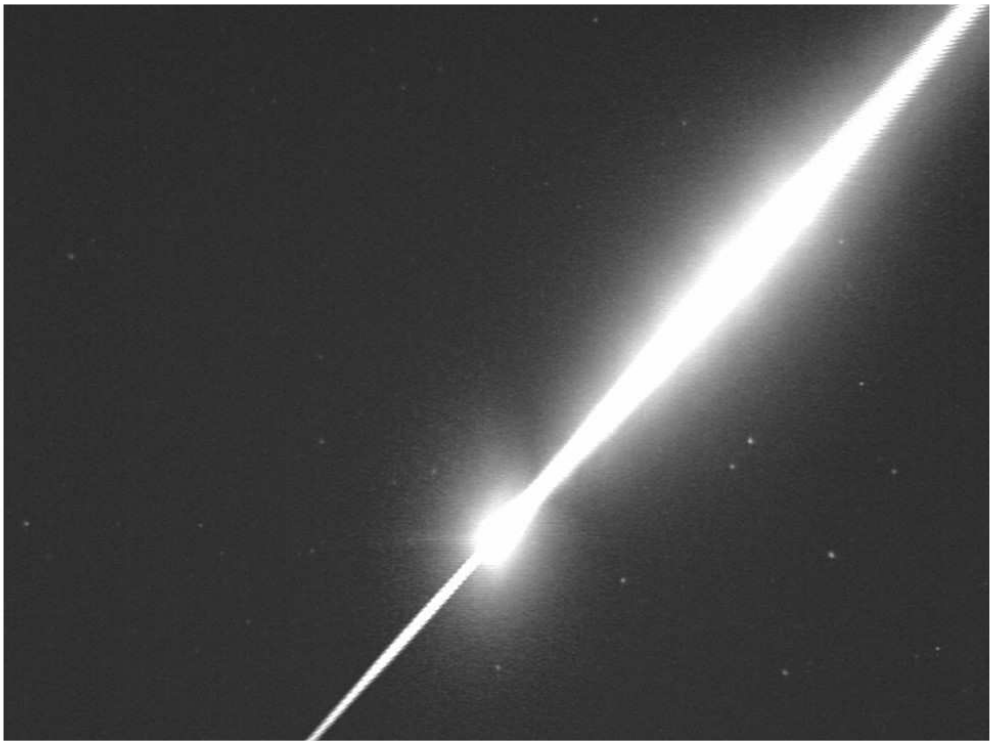


*Fig 1. Event 364 Video capture from station BR camera 6001. The stars to the right of the fireball are in the constellation of Ara.*

The ground path was from 26.1176° S, 27.8077° E at 87.9 km altitude to 26.2680° S, 28.0779° E at 58.3 km altitude and is shown in Figure 2.

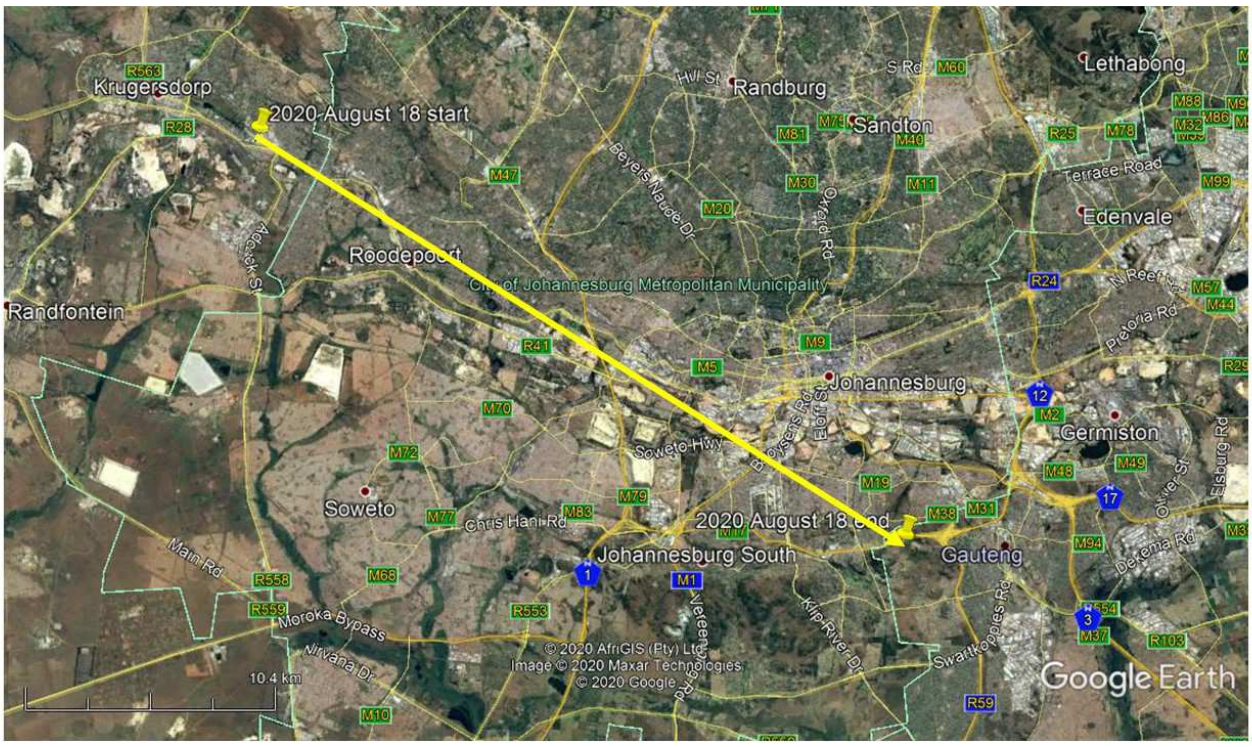



*Fig 2. Ground path of Event 364, ablation started 88 km above a point just east of Krugersdorp and ended at 58 km above Alberton, about the location of the N12/R59 Reading Interchange.*

Orbital elements were determined as q = 1.01105 ± 0.00001 AU, a = 2.2550 AU, e = 0.5516 ± 0.0002, i = 6.878° ± 0.005°, peri = 184.483° ± 0.06°, Node = 146.0424° ± 0.0001° (J2000), and the orbit is typical of an asteroid. Seeing the orbit was asteroidal and entered the atmosphere with a slow velocity of only 14 km/s, there was a chance that fragments may have reached the earth's surface. Based on prevailing winds at the time, a potential strewn field location was determined, and a low-level search was carried out by the author, but did not produce any fragments. The fireball was also captured on an all-sky camera operated by Cory Schmitz, and is shown in Figure 3.

**Event 365 – 2020 August 25 – Malgas and George, Western Cape**

Observed by Stephen Palmer who gave the time as approximately 13h15, he was paddle skiing on the Breede River at the time, when he saw an object about half the size of the moon falling directly downwards in azimuth 110°, from altitude 30° to 25°, intensely bright, 'like a mercury vapour lamp', cool white/blue light, short duration of about 1 second, and suddenly disappeared. The sky was blue, and the fireball was seen between two cloud masses, which were patchy, less than 1/8 coverage. No sound heard.

*Fig 3. Event 364 captured on all-sky camera frame from Cory Schmitz. Path is from Sagittarius to Grus. Jupiter is the bright object just above the start of the trail and shows the accumulated brightness of an eight second exposure. Saturn is immediately left of Jupiter.*

Observed by Marco Charles at 13h24, which time he checked as accurate, he was ascending a ladder when it passed almost overhead, moving in azimuth 100°, duration 3-4 seconds and burning out just above the roof of his house, so altitude perhaps 30-40°. Appeared as a bright ball with a tail, initially silver, but then changed to various colours at the end of its path. Marco thought he heard sounds, likened to a banging sound.

The fireball probably terminated offshore, south of the area between St Francis Bay and Port Elizabeth. No reports were received from that area, but the fireball occurred during daylight.

**Event 366 – 2020 September 10 – Harare, Zimbabwe**

Observed by Peter Morris through an open window at 03h10, brighter than Venus which was then magnitude –4.2, duration 1-2 seconds, colour greenish, no train. Path was from approximately az/alt 39°, 14° to azimuth 25° on the horizon, that is RA/Dec 08h00, +40° to 08h18, +60°, descent angle 225°. The start point was below left of Venus which was altitude 23° in azimuth 61°.

**Event 367 – 2020 September 13 – Djuma, Sabie Sands, Mpumalanga**

Bright bolide caught on a webcam overlooking the dam at Djuma Private Game Reserve. The fireball enters the frame at 20h23m35s, and descends at a steep angle of 166°. The time stamp was calibrated and verified accurate to within 1 second.

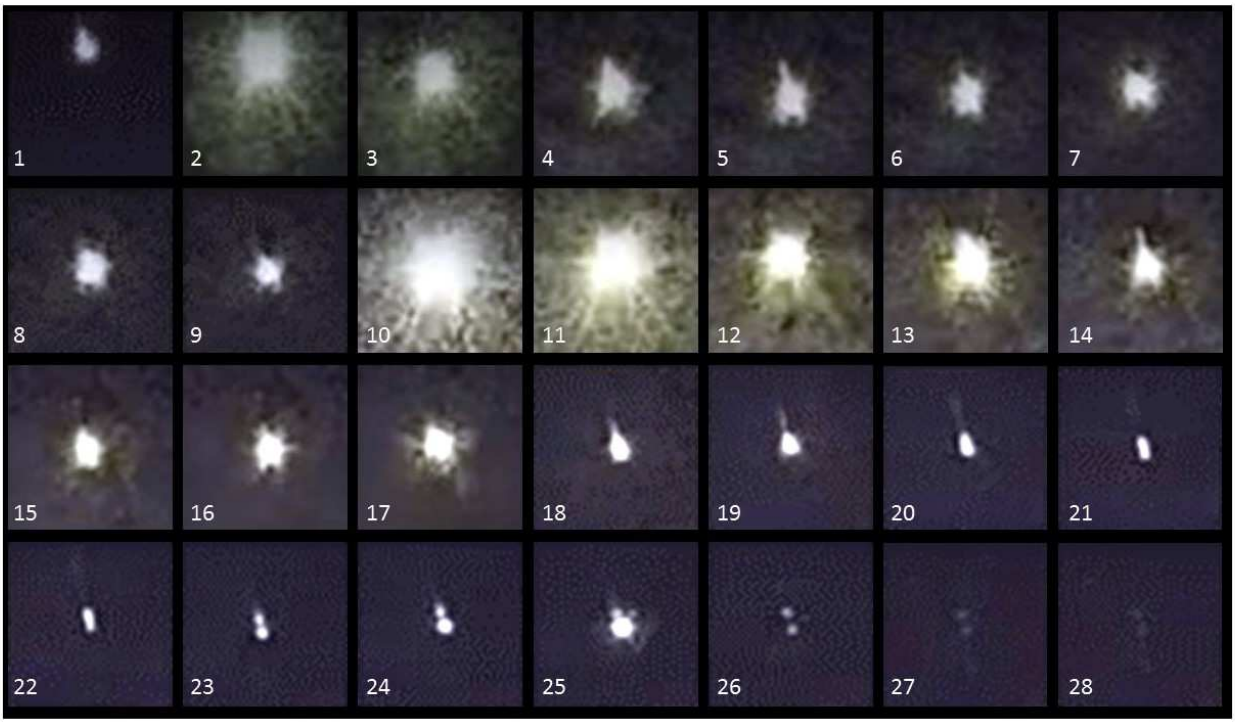



*Fig 4. Event 367 changing appearance shown in intervals of approximately 0.2 seconds. Two outbursts commencing frames 2 and 10, splitting in frame 17, outburst of leading fragment in frames 24-25 followed by rapid fade from view.*

The changing appearance of the bolide is shown in Figure 4, which is a montage of screen grabs taken at approximately 0.2 second intervals along the path. Duration of the meteor in the video is 4.8 seconds, during which time the fireball shows two outbursts in brightness (see frames 2 and 10), followed by a third smaller outburst, when the object is seen to split into two fragments (frame 17). The leading fragment undergoes a further outburst (frames 24-25), following which the two fragments rapidly fade from view.

Astrometry on frames showing prominent celestial objects shows the fireball was first visible at az/alt 83°09′, 10°07′, last visible at 84°30.6′, 6°36′, that is from RA/Dec 03h13m54s, +1°53′40″ to 03h28m30s, +2°13′20″, descending steeply at descent angle 160° from below right of the constellation of Cetus towards the horizon. Path length 3°35′, angular velocity 0.75°/sec.

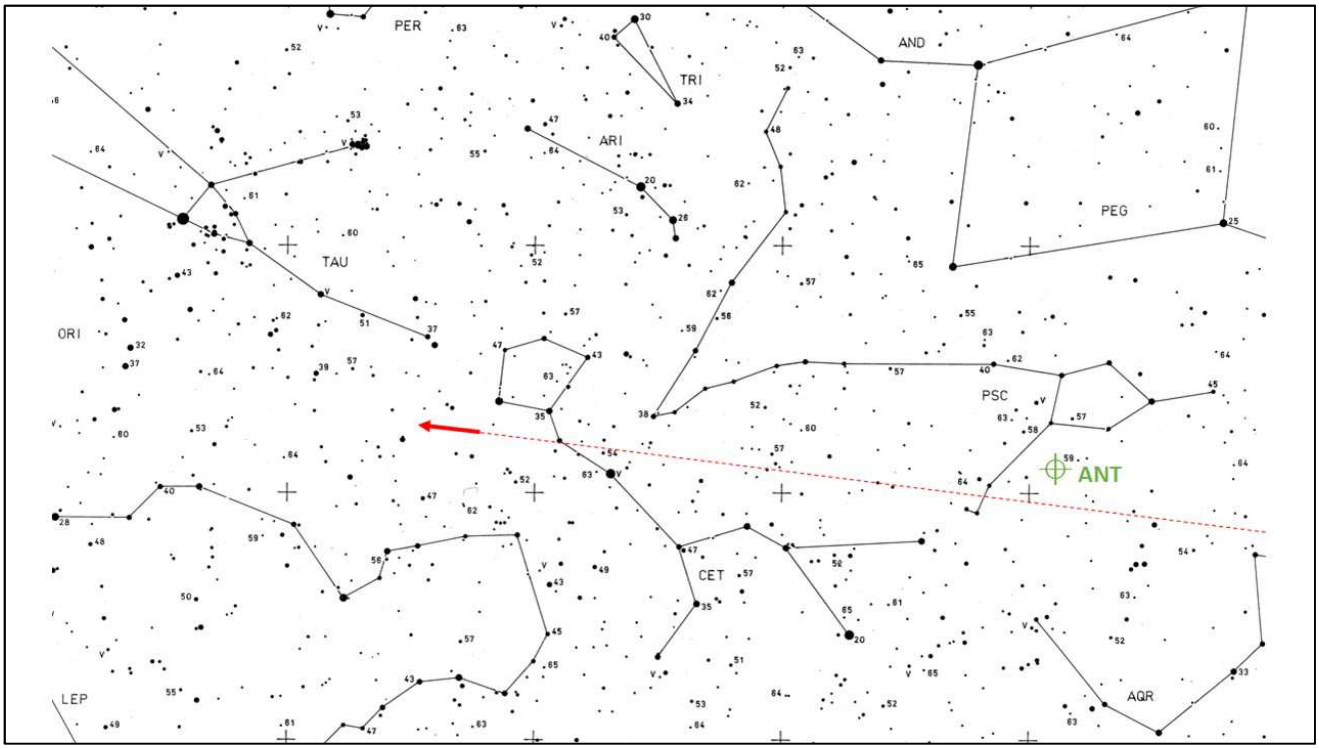



*Fig 5. Event 367 plotted in gnomonic projection on Atlas Brno map 7. The position of the Anthelion radiants (ANT) is shown labelled in green.*

The path is plotted in gnomonic projection in Figure 5, which shows a good coincidence with the radiant centre of the Anthelion meteors for the date.

The approximate brightness behaviour during the period the fireball was in the camera view is shown by the light curve in Figure 6. While clearly bright, the apparent brightness of the fireball could not be ascertained with certainty. The planet Mars which could have been used for calibration of the video was magnitude –2.1 at the time, but was just outside the field of view of the camera. Images were taken the following morning during normal camera use, and when the crescent moon (14% illuminated, magnitude –9.0) and Venus (magnitude –4.2) were both in the field of view, but unfortunately the camera was then operating in infra-red mode, so that brightness estimates when the fireball was at its brightest were not strictly comparable. Nevertheless, estimates were made using these objects for comparison, but consequently are shown with larger error bars in Figure 6.

A further opportunity presented itself when Mars was in the direct field of view on the evening of 25 September, having brightened to magnitude –2.6, and which allowed reasonable brightness estimates when the fireball was not as bright, and these estimates consequently are shown with smaller error bars. The fireball was already bright as it entered the field of view at top left, and immediately flared to $m_v$ = –8, faded to around –4, followed by a larger flare at 2.0 seconds into visible passage to a peak brightness estimated as $m_v = -10 \pm 2$. Fading occurs again over a period of

0.8 seconds. Fragmentation occurs at around 3.4 seconds with slight increase in brightness, following which the leading fragment also flares briefly before both fragments fade rapidly from view.

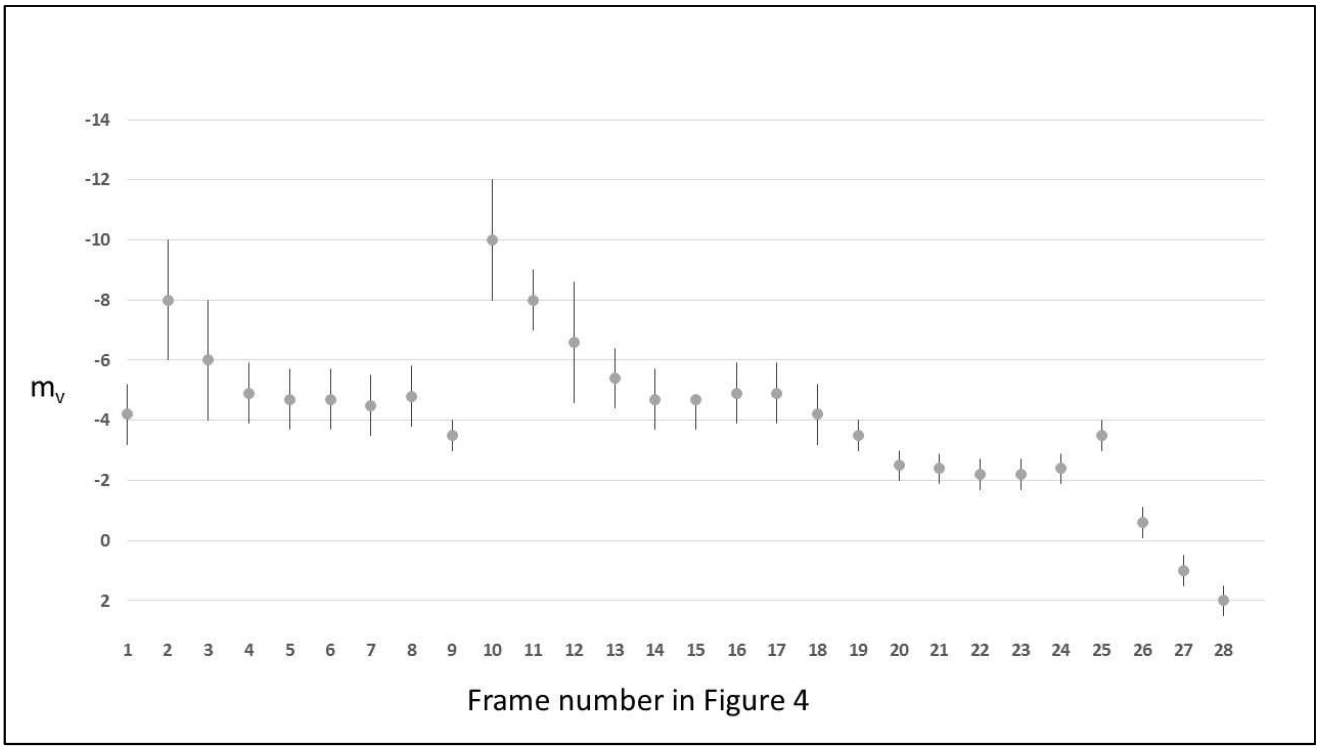



*Fig 6. Light curve for Event 367. The fireball enters the field of view already bright, followed by flares in frame 2 to $m_v$ = –8 and frame 10 when the brightness peaked at about $m_v$ = –10 ± 2. Following fragmentation and another brief flare, the remaining fragments faded quickly from view. Error bars are larger and the brightness uncertain during peak brightness due to the lack of suitable comparison objects captured under the same exposure conditions. Error bars are smaller when the fireball was fainter due to comparison with Mars at similar brightness.*

**Event 368 – 2020 July 14 – Djuma, Sabie Sands, Mpumalanga**

Bright bolide caught on the same webcam as Event 367. While the date of this fireball was earlier, video footage was made available and analysed at the same time as the previous event. The appearance time of the meteor was at 00h02, first visible reflected off the surface of the dam which the camera overlooks, before directly entering the camera field top left, the duration from first visibility of the reflection to end of meteor was 6.7 seconds.

The appearance is shown in Figure 7, from which it appears the fireball had already passed peak brightness when it entered the field of view. The fireball left a persistent train of 1.7° length and visible for several seconds before fading from view.

*Fig 7. Event 368, seven frames showing the changing appearance of fireball, the first three from left show the reflection in the water of the dam, the fireball can just be seen entering at top of the second frame. The last four frames show the fireball as it disintegrated and faded, leaving a short persistent train*

Projecting the path backwards to include the full 6.7 seconds duration gives the path from az/alt 50°16′, 11°08′ to 62°41′, 6°04′, that is from RA/Dec 01h36.4m, +29.3° to 02h24.5m, +21.6°. Descent angle 112°, path length 12.9°, angular velocity 1.9°/sec.

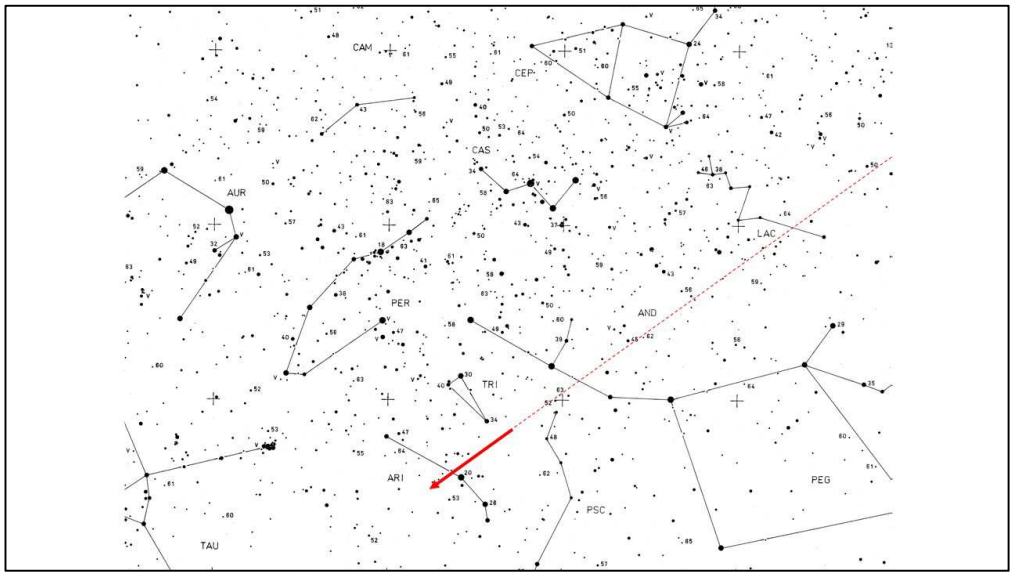



*Fig 8. Event 368 plotted in gnomonic projection on Atlas Brno map 1. The path traced backwards does not coincide with any know radiants active at this time, and the event was probably sporadic.*

The path is plotted in gnomonic projection in Figure 8 and does not coincide with any known radiants. The moon was just outside the field of view at the time, magnitude

–10.5, altitude 15° in azimuth 72°. As a result, no direct estimate of brightness of the fireball could be determined, but using the same calibration images described for event 367, the fireball peaked at about $m_v = -8$.

**Event 369 – 2020 September 17 – near Winterton, KwaZulu-Natal**

Observed by Eloise Braithwaite at around 17h35, duration 'a few seconds', pale green ball with tail, seen through north facing window, descending vertically, descent angle 180° in azimuth 38°, the first part of the path was obscured by the branches of a large Plane tree, then continued in full view until lost behind a building and hill.

**Event 370 – 2020 September 26 – Bothasig, Cape Town, Western Cape**

Observed by Jules Lind at between 17h45 and 18h00, bright white light with long tail, 'looked like a comet', growing larger in size, duration about 2 seconds, as bright as the moon. From a sketch provided the path was from approximately az/alt 255°, 30° to 270°, 25°, that is RA/Dec 14h42, –28° to 14h52, –13°. Descent angle 105°, path length 15.2°, angular velocity 7.6°/sec. The fireball could not be associated with any known radiants and was sporadic.

**Event 371 – 2020 September 26 – Newcastle, KwaZulu-Natal**

Observed by Nduduzo Gumede at about 19h38, duration 3-4 seconds, red colour and disintegrated at the end of its path, like 'cinders from a hot coal'. The path was from az/alt approximately 245°, 45° moving slightly down towards to 254°, 42°, that is RA/Dec 18h30, –36.5° to 18h20, –29.5°, descent angle 110°, left to right just below left of Jupiter, which was then magnitude –2.4. Fainter than the moon, which was 77% illuminated, magnitude –11.8 and nearly overhead. The path does not coincide with any known radiants and was sporadic.

**Acknowledgements**

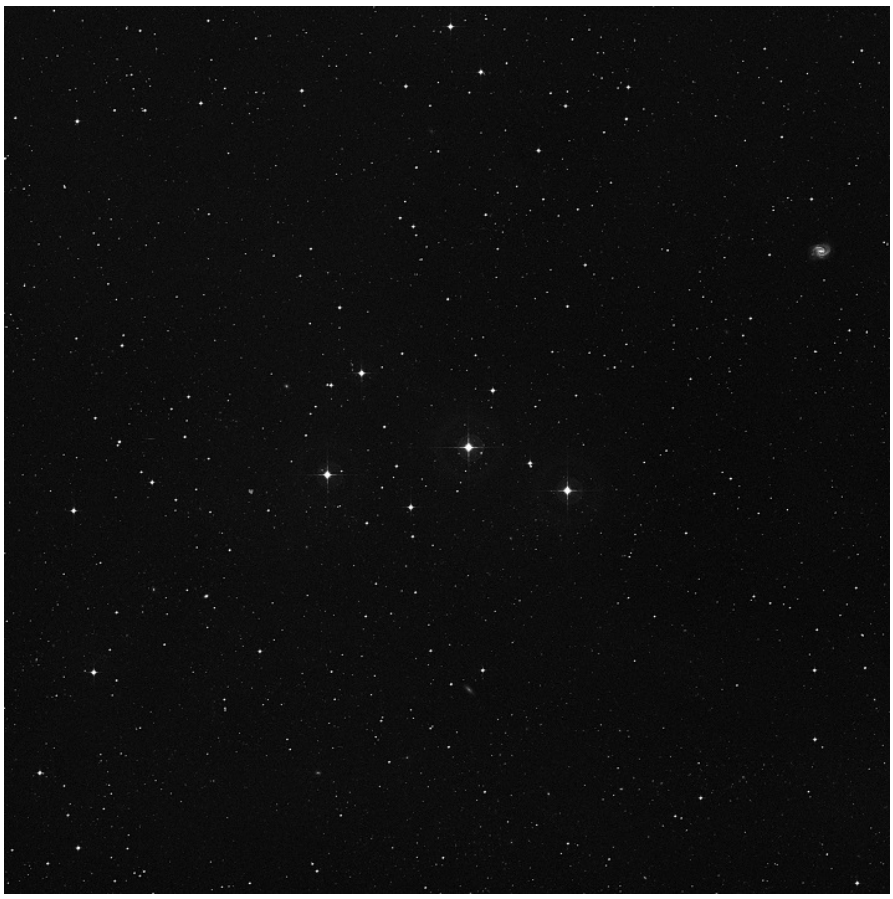
Thanks to Kos Coronaios (ASSA Observing Director) for forwarding various reports from the public. Thanks to Karen Gilliam, Administrator with WildEarth, who supplied the original video footage for events 367 and 368, and considerable further images and information enabling the analyses reported here. Note the original videos and images are copyright WildEarth, and are reproduced with their kind consent. Gnomonic paths were prepared using Gnomonic Atlas Brno 2000.0, published by the Nicholas Copernicus Observatory and Planetarium, Brno, Czech Republic in conjunction with the Czech Academy of Sciences. Figure 2 is reproduced from a Google Earth image downloaded 24 August 2020, credit to Google and AfriGIS (Pty) Ltd.

## Streicher Asterisms

*Magda Streicher*

# STREICHER 36 – DSH J1150.8-0957 Crater

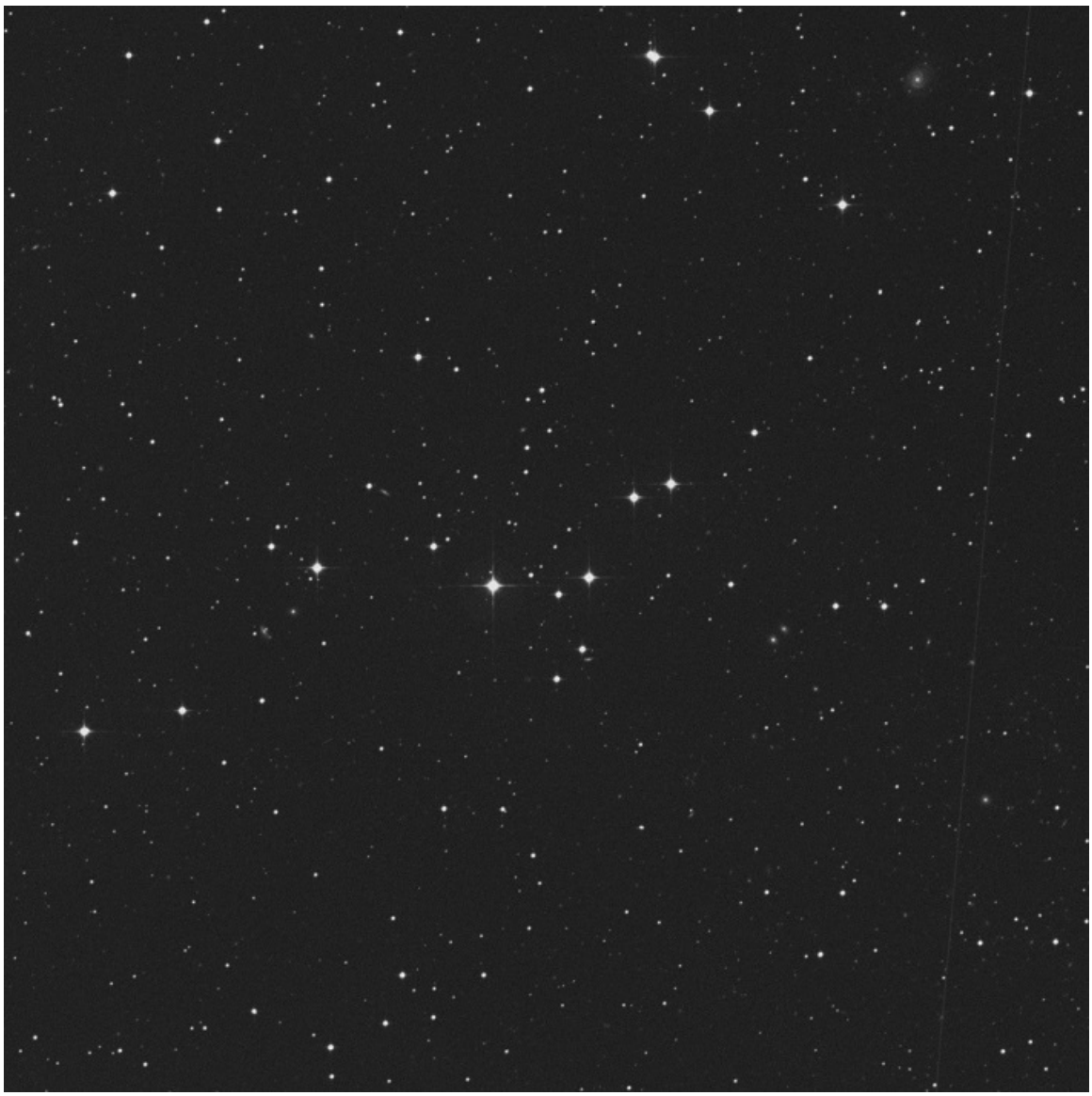
Half a degree south-east of the galaxy NGC 3905 a hand full of stars stands out from a bare and fainter star field. It could be seen in a sort of cross shape, but not particularly striking, however still outstanding in a way. The centre displays a notable starless void. The stars vary between magnitude 8 and 10, with the axis running south-west.



| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| STREICHER 36 DSH J1150.8-0957 | Asterism | 11h50m.48 | -09°57'.00 | 9 | 17' |

# STREICHER 37 – DSH J0244.3-7821 Hydrus

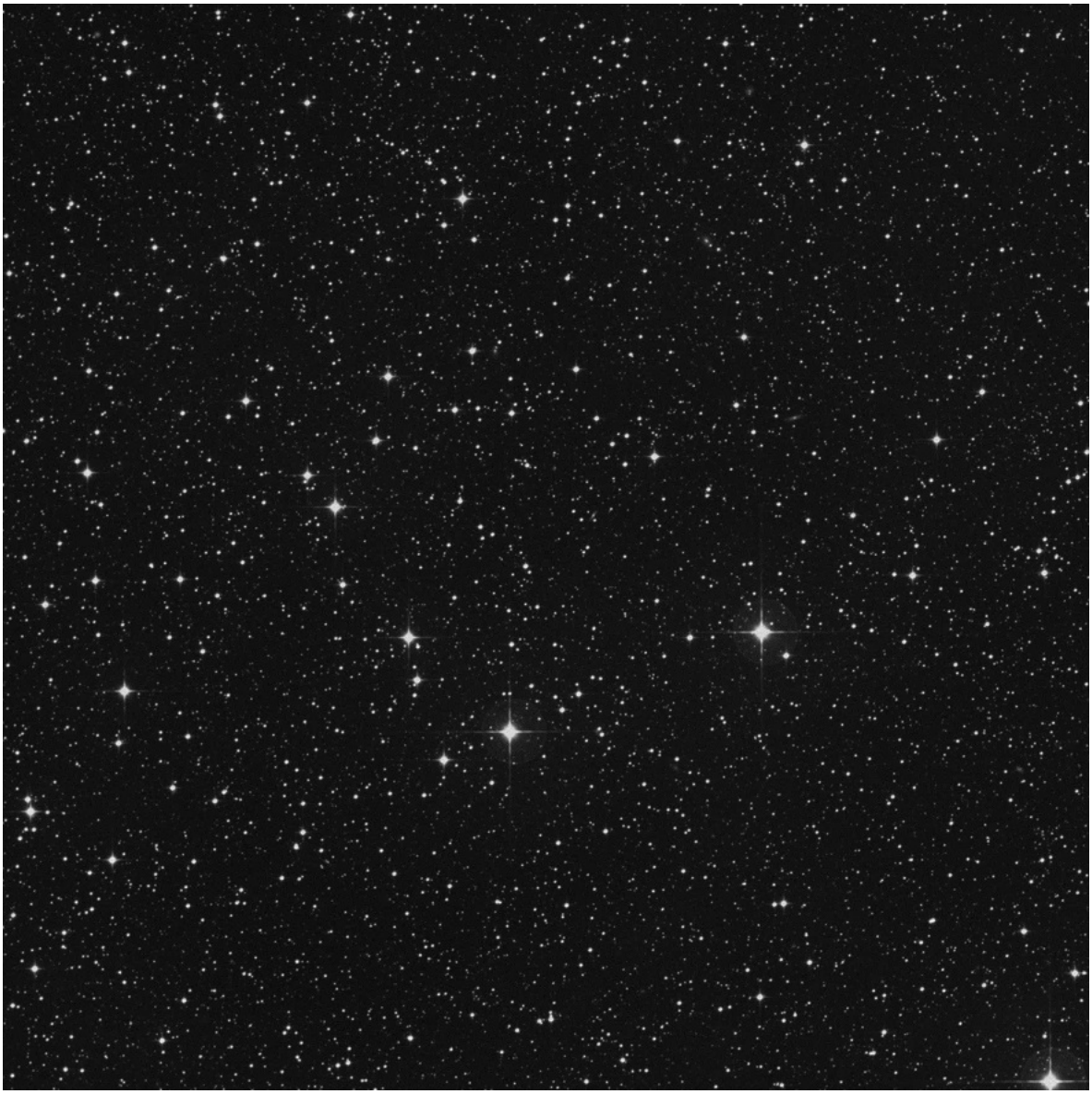
More than just a handful of varying magnitude stars splash against the fainter star field. Although the stars show proper motion in different directions, mainly south-west direction, it is a near miss for a possible open cluster. The very faint magnitude 14 galaxy PGC 10191 can just be spotted in the upper right-hand corner of the picture below. This grouping of stars is only a degree north-east from mu Hydrae.



| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| STREICHER 37 DSH J0244.3-7821 | Asterism | 02h44m.22 | -78°21'.18 | 9 | 13' |

# STREICHER 38 – DSH J2211.2-6306 Tucana

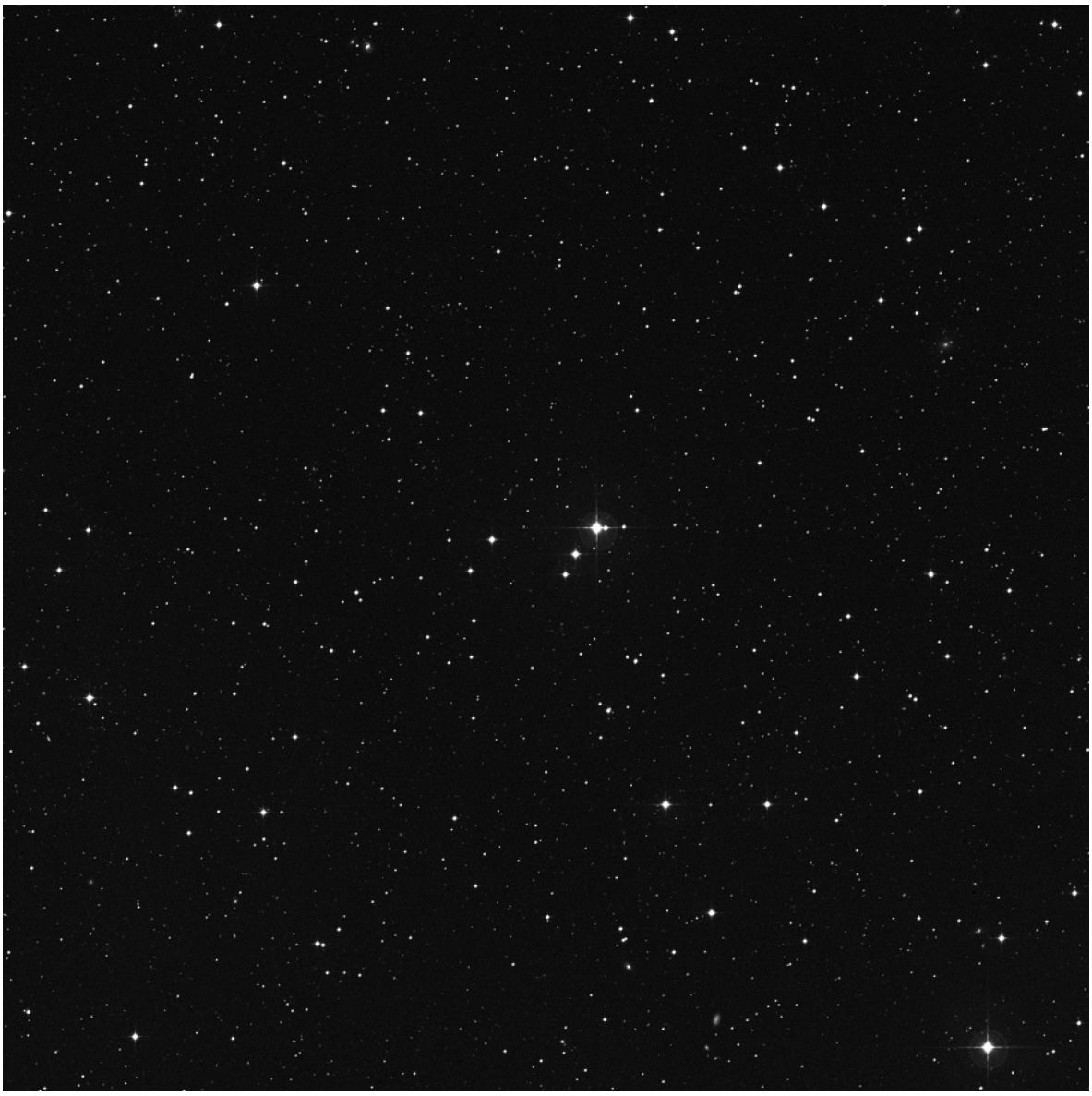
Not much of an asterism however the prominent string of three close stars catches the attention immediately, quite outstanding from the otherwise bare star field. A few numbered Leda galaxies scattered around the asterism, but they are extremely faint barely larger than an out of focus point of light. However, the brighter galaxy NGC 7179 is situating a degree south-west from this asterism.



| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| STREICHER 38 DSH J2211.2-6306 | Asterism | 22h11m.12 | -63°06'.48 | 10 | 7.5' |

# STREICHER 39 – DSH J1232.4-7521 Musca

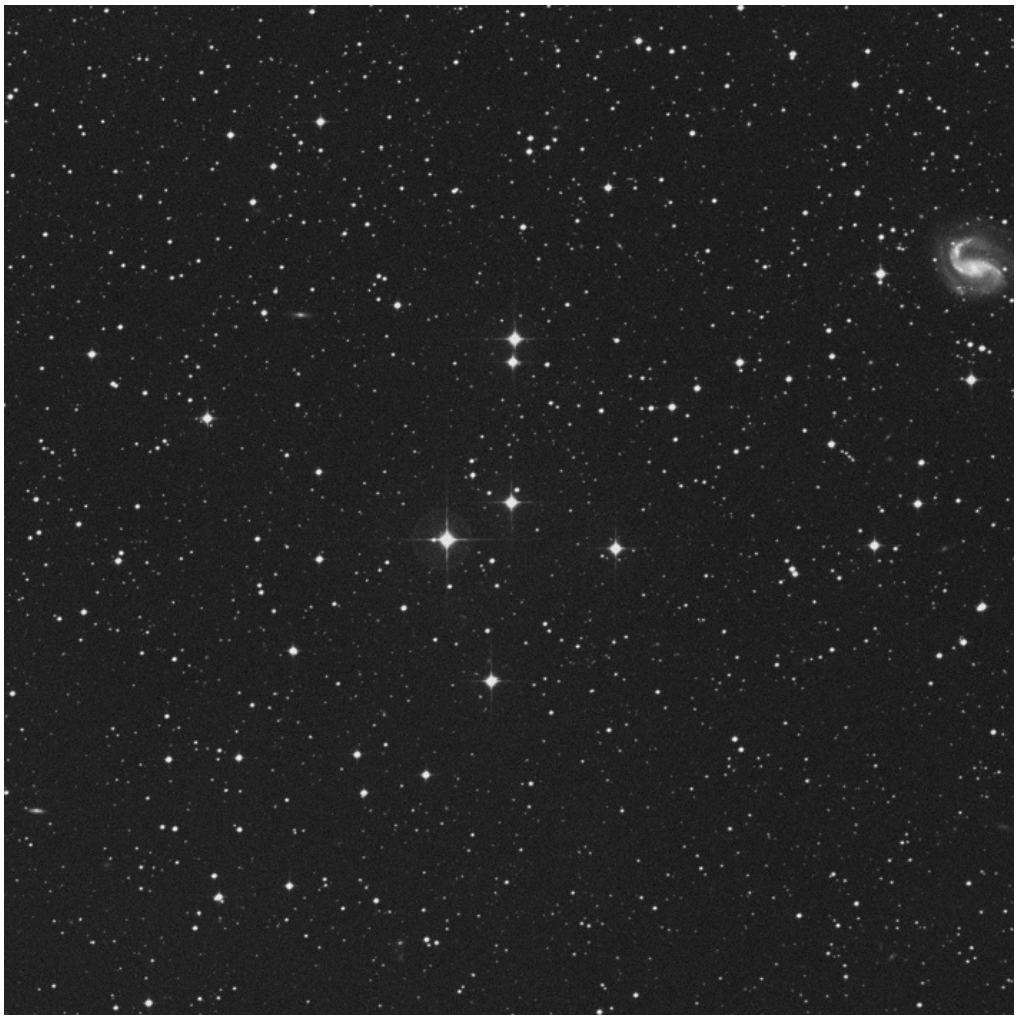
The starry sky is full of asterisms that brings to mind all kinds of shapes. This grouping is situated in the far southern part of the constellation Musca about 20' north of the border with the constellation Chamaeleon. The first impression is the outstanding V-shape pointing south filled with various magnitude stars between



| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| STREICHER 39 DSH J1232.4-7521 | Asterism | 12h32m.26 | -75°21'.06 | 9 | 13' |

# STREICHER 40 – DSH J2026.1-2455 Capricornus

Six relatively bright stars in an arrow shape pointing south, with a close pair of white coloured stars towards north. The stars are situated in a north to south direction about 10' in size. Barely 15' east the outstanding galaxy NGC 6907 shares this field of view. NGC 6907 also host a piece of nebulosity, NGC 6908, which is part of the main galaxy northern spiral arm. In shape this asterism also brings the Crux constellation to mind.



| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| STREICHER 40 DSH J2026.1-2455 | Asterism | 20h26m.07 | -24°55'.54 | 9 | 10.5' |

The **Astronomical Society of Southern Africa** (ASSA) was formed in 1922 by the amalgamation of the Cape Astronomical Association (founded 1912) and the Johannesburg Astronomical Association (founded 1918). It is a body consisting of both amateur and professional astronomers.

**Publications**: The Society publishes its electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as the annual *Sky Guide Africa South.*

**Membership**: Membership of the Society is open to all. Potential members should consult the Society's web page assa.saao.org.za for details. Joining is possible via one of the local Centres or as a Country Member.

**Local Centres:** Local Centres of the Society exist at Bloemfontein, Cape Town, Durban, Hermanus, Johannesburg, Natal Midlands, Pretoria and Sedgefield district (Garden Route Centre). Membership of any of these Centres automatically confers membership of the Society.

**Sky & Telescope:** Members may subscribe to Sky & Telescope at a significant discount (proof of membership is required). Please contact the Membership Secretary for details.

**Internet contact details:** email: assa@saao.ac.za Home Page: http://assa.saao.ac.za

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