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# **mnassa**

monthly notes of the astronomical society of southern africa

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<b>CONTRIBUTIONS</b>	<i>MNASSA</i> mainly serves the Southern African astronomical community. Articles may be submitted by members of this community or by those with strong connections. Else they should deal with matters of direct interest to the community. <i>MNASSA</i> is published on the first day of every second month and articles are due one month before the publication date.
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Cover: Image of M16 in Serpens, by ASSA member Dale Liebenberg (see *Sky Delights* by Magda Streicher, p. 193).



# mnassa

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## News Notes

### Administration of Astronomy in South Africa

The National Research Foundation announced on 31 July that Prof Nithaya Chetty has been appointed as Deputy Chief Executive of the National Research Foundation for Astronomy with effect from 1 October 2014. As such, he will be responsible for coordinating the national strategy for astronomy. This will include supervision of the astronomy national facilities and the SKA-SA Project, developing synergies between the various astronomy departments, the astronomical facilities and the community at large, promoting public awareness and liaising with international partners,

Prof Chetty is currently a Professor of Physics at the University of Pretoria and has been seconded on a part-time basis to the NRF as Group Executive for Astronomy since 2011 (see *MNASSA* **70**, pp125-6, 2011). He is well-known in the physics community as a computational and solid state physicist and has been the recipient of several prestigious awards. Inter alia, he has served as the President of the Institute of Physics.

Last year, an Astronomy Advisory Council was set up to provide advice to the Astronomy sub-Agency of the NRF. Its membership, following their appointment by the NRF based on the nominations put forward by the South African astronomical community, is as follows:

R Kraan-Korteweg (Chair), S Colafrancesco , R Davé, D Davidson, T Medupe, G Miley, K Moodley, B Peng , M Phakeng, F van Niekerk  
*Ex officio:* N Chetty (NRF; [nithaya.chetty@nrf.ac.za](mailto:nithaya.chetty@nrf.ac.za)), B Fanaroff (SKA), T Williams (SAAO), M Gaylard (HartRAO) (unfortunately now deceased), V Munsami (DST), Y Manjoo (Secretariat; NRF).

Meanwhile, Dr Albert van Jaarsvelt, who had been re-appointed as CEO of the NRF on July 17 2014 for a second five-year term, announced suddenly on 14 August that he will be leaving to become Vice-Chancellor of the University of Kwa-Zulu Natal.

He will be remembered by SAAO as having to apologize to Prof Phil Charles for his unjust suspension in 2010 (see *MNASSA* **69**, 48-54, 201; **69**, 114, 2010).

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## **Obituary Dr Michael Gaylard**

It is with a great sense of loss that we have to announce the passing of Dr. Mike Gaylard, Director of the Hartebeesthoek Radio Astronomy Observatory, a National Facility of the National Research Foundation.

Mike was born on 1 July 1952 in what was then Salisbury, Rhodesia (now Harare, Zimbabwe). He attended school in Salisbury and did his B.Sc. at the University of Rhodesia, followed by his B.Sc. Honours. He then came to Rhodes University in South Africa, and completed his M.Sc. on “The Performance of a 22 GHz Radio Telescope” in November 1976.

He joined the staff of the NITR (National Institute for Telecommunications Research), the parent institute of HartRAO on 1 December 1976. During 1977-78 he worked at NITR in the ionospheric propagation section and joined the HartRAO staff in January 1979. His first project at HartRAO was to commission the recently completed digital correlation spectrometer.

He used this for his initial research work at HartRAO which was in the field of HII regions and recombination lines at 2.3 GHz. He was also the system manager for the HP computers used for controlling the telescope and associated equipment. He developed much of the software for automating observations and for analysing spectral line data.



He completed his Ph.D. on “Radio Studies of Ionised Hydrogen in the Southern Milky Way”, using the HartRAO 26m telescope, in 1989. His work branched out into the field of 1612 MHz OH masers with the installation of the 18cm receiver in 1985. His field of work then enlarged to include methanol masers in star forming regions, where he collaborated extensively with Dr. Gordon Macleod (then of HartRAO)

and Dr. Johan van der Walt of University of the North West. With the expansion of staff members at HartRAO, he became the leader of the Spectral Lines Programme and had some 70+ publications to his name. He supervised M.Sc. and Ph.D students, especially with Dr. Johan van der Walt at NWU, and then expanded to other universities as well. Some research staff members from HartRAO have gone on to become part of the SKA project.

He also headed the Science Awareness Outreach Programme at HartRAO from 1991. Creating an awareness of science in young people was one of his passions. Several staff members from the HartRAO Science Awareness Programme have also gone on to be part of the SKA project.

Mike was instrumental in the conceptualisation of the African Very Long Baseline Interferometry (VLBI) Network (AVN), a vision to have a network

of radio astronomy telescopes throughout Africa, and actively participated in and championed its development. The AVN has the potential to spread radio astronomy as a science across the African continent.

He was among the key people who helped get the National Astronomy and Space Science Programme (NASSP) started. The NASSP school at HartRAO was something he enjoyed organizing and which has helped introduce a generation of SA astronomers to the practicalities of radio observing. He also understood that South African astronomers would do so much better working together than in their individual silos.

In an international context, Mike was the driving force behind South Africa's membership of the Joint Institute for VLBI in Europe (JIVE), which carries out a wide range of research and development activities in VLBI-related fields, including radio astronomy data processing and applications of VLBI and radio astronomy technologies.

Mike Gaylard had the ability to make time to talk to and encourage students, even within a very busy schedule. To many young people he set a great example as a leader and a scientist. He will be sorely missed by family, colleagues and students. (Ludwig Combrink)

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## **ASSA Annual General Meeting**

Our AGM was held on 6 August at 19h30 at the Johannesburg Observatory and hosted by the Johannesburg Centre, for which we extend our thanks.

### **Reports**

Unfortunately, some reports, such as the President's and Hon Treasurer's, have not been received but will be published when available.

## **Astrophotography Section**

*Allen Versfeld*

Updated the section page on the ASSA website, and organised the gallery page.

Established an archive of user-submitted images on Flickr. Flickr is a free service which grants a full terabyte of storage space, and a set of tools to share and display those images. This has allowed me to create indexes of images which are embedded in the Gallery page on the ASSA website which make it easy for visitors to find the specific images, or just to browse through them. This is still a work in progress, and the design will be tweaked according to feedback from visitors.

Established a mailing list for the section. Membership of the mailing list is currently at 12. Members are quite passive, not responding to official posts or making posts of their own. I will urge members to use the list to ask for advice, share their images and discuss astrophotography in general.

Began issuing challenges to astrophotographers, to capture specific events or subjects. These have had a good response - only failure was a target that was persistently clouded out for most of the country!

### **Future Plans / ideas:**

Begin formally recognising member's achievements: Issuing of certificate to those who successfully image whole of Deepsky section's Top 100 objects list, for example.

Accordingly I would like to award a Director's Commendation for *Photographic Observations recorded during 2013 14* to four section members:

There are four members whose contributions to the ASSA archive have stood out. Johan Moolman, Johan Retief, Richard Ford and Kos Coronaios have all shared a significant number of images, and while Richard deserves

special mention for the sheer volume of work he puts into his imaging (he has submitted over 300 images, and requested feedback and advice on every single one), the others also deserve mention for the high quality of their work.

Run special imaging events - annual workshops similar to what Dale Liebenberg presented at the 2012 symposium, or dedicated imaging starparties where expert photographers can provide hands-on guidance to less experienced members. I'm wide open to suggestions on how to organise such an event, how often, which experts to invite, or whether there would be enough interest to make it worthwhile.

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## **Cosmology Section**

*Frikkie de Bruyn*

### **Purpose**

The purposes of the Cosmology Section of the Astronomical Society of Southern Africa are:

- To disseminate news of importance in the field of cosmology to members;
- To circulate scientific papers in the field of cosmology to members; and
- To do research and promote the study of cosmology as a science.

### **Membership**

Since the Cosmology Section was established in 2008 with a membership of 28, membership has grown to 53.

### **Activities**

The number of submissions/discussions has grown to a total of 896 during 2013. The discovery of the Higgs boson at the LHC at CERN was the highlight of the year. In fact the Higgs is essentially a field, through its interaction with other particles giving mass to all matter in the universe. Its existence was hypothetically predicted by Dr. Peter Higgs.

The discovery of the Higgs boson again created a debate about physics beyond the Standard Model which is of great importance for cosmology and particle physics. The origin of the universe from a singularity was disputed by new studies which mainly had its origin in the string theory. The result of these studies showed that the Big Bang may not be necessary. Critics of the string theory argued convincingly that the theory cannot be proved through observation and experiment.

A subtle distortion of the Cosmic Microwave Background Radiation has been detected by the South Pole Telescope. This may shed more light on the earliest moments of the universe. The most distant quasar and galaxy have been observed. Reports of an interesting study of magnetic fields at the heart of gamma rays have been circulated among members. There is still one aspect of Einstein's General Relativity Theory which has not yet been proved; gravity waves. In this regard the European Space Agency is going to launch an X-ray telescope in an attempt to detect gravity waves.

Mr. Soltynski introduced members of ASSA's Cosmology Section to access, via the internet, and to download lectures on physics and quantum physics and an online course (Massive Open Online Course) in "The Greatest Mysteries of the Universe". A textbook could also be downloaded free of charge. In the latter case a certificate is also awarded. A big thank you goes to Mr. Soltynski for introducing members to these courses.

The Director was interviewed by the local newspaper which resulted in an in-depth report on ASSA's Cosmology Section and enquiries received from members of the public and learners from various schools.

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## **Dark Sky Report**

*Johan Smit*

Everything rather quiet on the dark sky front.

Included information at every possible outreach opportunity.

No requests for information, or advice, received from private individuals or industry.

Regular posts were placed on social media and received good exposure via Alan Versveld and his urban astronomer web site.

One positive report received from the Western Cape area. A newly built garage had lights that spoil the neighbourhood's dark sky. After negotiating with the owner and the fuel company, a mutually acceptable solution was reached to switch off the offending lights when they were not needed late at night. Good to hear that large corporations are prepared to listen to private individuals.

My advice is--inform people and speak up when lights bother you. By being quiet we will not win the fight.

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## **Deep-Sky Observing Section**

*Auke Slotegraaf*

The Section has experienced a very active year, not least because of the reorganizing of observing groups such that deep-sky, double stars, and variable stars now resort under one banner. The Section's pages on the newly-launched ASSA website now contain a great deal of material that will be of interest to observers.

Regular and new observers are thanked for their support.

Alan Cassells continues with his personal observing projects, and having recently acquired a 12-inch Dobsonian has created much anticipation. Alan received a Merit Award (presented at the 2014 Autumn Southern Star Party) for a series of observations he made last year.

Carol Botha is well underway with a constellation-by-constellation observing programme, and since regularly using a 12-inch Dobsonian has become enamoured with the sky's multitude of very tiny bluish-greenish dots (i.e. planetary nebulae).

Hannes Pieterse (Bloemfontein Centre) always has something up his sleeve, including novel designs for an observing shelter, a deep-sky sketching apparatus, and plans to carry out an ASSA Top-100 Marathon.

Richard Ford continues to work towards his Bennett Certificate, a catalogue of comet-like deep-sky objects identified by past ASSA President and comet hunter Jack Bennett.

Magda Streicher's regular deep-sky writings continue to appear in *MNASSA*, *Canopus*, and elsewhere. Following the successful publication of her compilation volume "Astronomy Delights", she is considering compiling a second volume. With the relocation of her observatory completed, she is now using her 16-inch to observe the brighter objects, as well as review particularly curious objects she had noted in previous years.

Michael Poll and Johan Smit, through their efforts at the Pretoria Centre's observing evenings, are thanked for continuing to ensure that deep-sky objects remain popular public targets. Similarly, the various star parties held across the country are also popular platforms to showcase the deep-sky. The director welcomes reports of all deep-sky observations made at these, and other, events.

Last year, George Dehlen became the first observer to formally complete the "ASSA Top-100" deep-sky list. It is a pleasure to report that Percy Jacobs, Louis Kloke and Michael Moller (all of the Pretoria Centre) can now be added to the list. And Percy is to be thanked for continuing to drive this project at the Centre.

New observers, of whom a great deal is expected, include Nigel Rotherham, Bruce Tomalin, Brett du Preez and Kyle Vorster.

Several months of planning and discussion have resulted in an exciting new deep-sky project, still under wraps, to be launched before the end of 2014. Kos Coronaios and Carol Botha are heartily thanked for their significant input and continued support.

During the year contact was made with Dr Wolfgang Steinicke, noted astronomy historian and deep-sky expert. He will be presenting a talk in Cape Town in September, and later that month at the Symposium in Durban.

Imaging of the deep-sky continues to be a popular pursuit, and the re-established Astrophotography Section is doing a great job of curating the images.

The on-going digitisation of historical deep-sky observations and published sketches has been sadly neglected; work will hopefully resume in the not too distant future, hopefully as one or more volunteers are identified.

An updated and expanded version of the deep-sky book "Pearls of the Southern Skies" (by Dieter Willasch and Auke Slotegraaf) was prepared, and will be published by Firefly Books (Canada) before the end of this calendar year.

The Double Star Group, under the guidance of Dave Blane, has experienced a surge of activity during the year. A dedicated web page on the new ASSA website is regularly updated with articles and observations by Dave and Magda Streicher.

Dave is engaged in a programme to measure all of James Dunlop's discoveries, while Magda is re-measuring the double stars she first observed more than a decade ago.

The highlight in the Variable Stars Group has been the monitoring of Nova Cen 2013 (V1369 Cen), with members (including Cliff Turk, Peter

Wedepohl, Dave Blane and Auke Slotegraaf) logging over 100 observations and images. The results were published on the ASSA website and submitted to the AAVSO.

Dave Blane's variable star observations for the year total 759.

News articles, by Dave Blane, were published on the group's web page on the ASSA website.

Some DSLR photometry has also been attempted, an exciting development that, with further guidance and experimentation, is certain to yield good results. With Jerome Jooste and Kos Coronaios' involvement, a tentative photographic nova search project has been outlined.

In closing, Director's Awards for deep-sky observing have been issued to Percy Jacobs, Louis Kloke and Michael Moller.

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## **Historical Section**

*Chris de Coning*

### **Introduction:**

During the past year (Calendar Year 2013) the following has happened concerning the History of Astronomy.

### **Archive:**

The following material was added to the archive:

- Jan Hers collection, his personal notebooks
- Natal Midlands

The University of Cape Town archive, which houses the A.S.S.A. collection finished indexing the collection

### **MNASSA:**

Sabinet contacted ASSA in 2012, requesting a full set of JASSA and MNASSA in order to scan the material to a digital format and then to make

it available on the internet. NASA did the same a couple of years ago in order to place the material on the Harvard network. Since NASA published only a few top articles from *MNASSA* and nothing else (see *MNASSA*, Vol72, nos 3&4, April 2013, p43), the Council of ASSA agreed to the request to also supply Sabinet with a set. Since a complete set does not exist any more in the Archive of ASSA the missing copies were tracked down from the SAAO library. Those copies were then scanned to the archival standards required by Sabinet. a great thank you to Shireen Davies from SAAO for her patience. In 2013 Sabinet completed the project and our publications are now available on the internet. A digital copy burned onto a CD was added to the archive.

### **Publications:**

Individuals in their private capacities wrote articles with historical content. Please note my appreciation to the following people:

- Finsen, W.S.: IGY Reminiscences, *MNASSA*, Vol72, nos 5&6, June 2013.
- Ian Glass and Willie Koorts, *MNASSA* and the SAO/NASA Abstract Service. *MNASSA*, Vol72, nos 3&4, April 2013.
- Glass, I.S., The nearest Stars. (Presidential address), *MNASSA*, Vol72, nos 7-10, October 2013.
- Glass, I.S.: Tercentenary of Nicolas-Louis de La Caille, *MNASSA*, Vol72, nos 11&12, December 2013.
- Hers, J.: Moonwatch in South Africa, *MNASSA*, Vol72, nos 5&6, June 2013.
- Roberts, G.: Amateur Optical Tracking in South Africa, *MNASSA*, Vol72, nos 7-10, October 2013
- Slotegraaf, A.: African Star-Lore, *MNASSA*, Vol72, nos 3&4, April 2013.
- Spargo, P.E.: Johannesburg Moonwatch Recalled, *MNASSA*, Vol72, nos 1&2, February 2013.

## **Obituaries:**

*MNASSA* published obituaries on the following:

- Edmund Ziegler, *MNASSA*, Vol72, nos 3&4, April 2013.
  - Margaret Thatcher, *MNASSA*, Vol72, nos 3&4, April 2013
  - Roy Smith, *MNASSA*, Vol72, nos 5&6, June 2013
- 

## **Instrumentation Section Report**

*Chris Stewart*

Activities of the Instrumentation Section largely revolve around communication, outreach, guidance and education, plus the important aspect of encouraging people in the pursuit of their personal instrumentation projects. To date there has been no drive to formally induct members into the Section; rather, the approach has been to address ASSA members' needs for information on a case by case basis.

In support of the Society's general communication efforts, which equally support the instrumentation Section's goals, the following have been performed and are largely ongoing:

- Reviewed & provided feedback on the ASSA website during and after construction.
- Initiated and moderate the ASSA FaceBook page.
- Established and moderate the Yahoo! Group mail lists.
- Initiated and moderate the Telescope Making FaceBook page.
- Publicized the ASSA communication channels by mail, FaceBook & word of mouth.
- Contributed links and suggestions for website, posted content on FaceBook

The Section directly supports the needs of both ASSA members and the general public regarding construction, purchase, maintenance and use of their instrumentation, Inter alia, this is done via: the telescope making

class; the Telescope Making SA FaceBook page; e-mail correspondence, telephonic discussion, and ScopeX.

The Telescope Making SA Facebook group - whilst predominantly South African - has at the time of writing attracted 285 members from around the world, including such luminaries as Harrie Rutten, Richard Berry, Mel Bartels and Scott Losmandy. This international involvement produces an energetic bidirectional flow of ideas, information, technical assistance and encouragement.

The telescope making class, which has been continuously active for over 20 years, attracts a steady stream of newcomers to the art, with a good success rate of people finishing their first instruments. In addition, there is a significant proportion of “return business”, i.e. people staying on after completion of their first telescope or returning later, in order to tackle more advanced projects.

ScopeX, which grew out of the telescope making class, is currently ramping up for the 13<sup>th</sup> annual event. In addition to the primary goals of general astronomy outreach and publicizing the Society, it provides a platform for the telescope making community to exhibit their work and encourage newcomers to engage in this fascinating hobby. Having a plethora of instruments at one place (both commercial and amateur-built/modified), enables visitors and members alike to see and touch a variety of instruments. This sparks discussion of ideas, approaches and relative merits, thus enabling them to make informed choices.

The Director has nascent ideas for communal projects within the section, and asks those interested collaborative development to get in touch with him to discuss.

## **Observing Section Report**

### *Kos Coronaios*

This newly formed position by Council is still in the developmental stage, creating exciting challenges for the Director.

The position was filled for the first time, by myself, in October 2013, after much introspection having never been an ASSA Director before. It has been an exciting time with the setting up of the new communication channels (ASSA Discussion Group / Info Group), web site and Facebook presence which were finally all in place towards the end of 2013. It is here that I would like to give my heartfelt thanks to Auke Slotegraaf (ASSA Deep-Sky Director, Sky Guide Editor) for his invaluable support, comments, criticism, and his availability at all times when my ship seemed to be sinking on the high seas, as well as Christian Hettlage the ASSA web master.

Observable and other astronomical related events are posted via various channels and include sightings, images, comments and questions from the public, to which I respond or pass on to the relevant ASSA Sections, specialists and collaborators. For this I would like to thank, Dave Blane (Shallow Sky Director), Tim Cooper, Greg Roberts, Brian Fraser, Allen Versfeld (Astrophotography Director), Auke Slotegraaf and many other ASSA office bearers and members for their assistance.

Thank you to Michael Poll (ASSA Pretoria Centre) for sending the Centre's observing reports since February this year. These will be archived on the ASSA web page. I would like to encourage the Centres to submit their observing reports.

The ASSA Facebook page as well as the new ASSA web site were up and running by early November 2013, on line for an eight month period to date. During this time numerous sightings, comments and questions have poured in and have been successfully addressed. These can be found on

the ASSA web site, and of late have also been included on the Facebook page.

It is encouraging to see how many of the public are noticing these night-sky phenomena and reporting their sightings to the ASSA website/Facebook.

Two of the ASSA communication channels (Yahoo groups) on the web site, namely the ASSA Discussion group and ASSA Info Group have the following statistics since inception.

**The ASSA Discussion group** is a means for members to interact, pose questions and have general discussions. To date it has 50 members.

In the last week of June, eight messages were posted with a total of 219 posts to date, at an average of 27 posts per month.

The ASSA Info group is a means to distribute news from Council, Centres, Section Directors and their Specialists. To date it has 76 members.

A total of 26 posts to date, at an average of 3 posts per month.

Below are some statistics for the ASSA Facebook page as at 30<sup>th</sup> June 2014: Total Likes 454, translating to a total of 46% women and 54% men.

### **Country Breakdown**

South Africa (305), USA (21), India (13) and Brazil (12). The following countries had more than 3 each: Spain, United Kingdom, Australia, Colombia, Tunisia, New Zealand, Botswana, Peru, Iran, Canada, Venezuela, Mexico, Namibia and Belgium.

There were 38 visitors from 27 other countries across the globe, as diverse as Argentina to Lithuania.

Some of the Facebook visitors were from cities around the world.

**Some of the posts that attracted the most engagement:**

- 18/11/2013 Comet Ison flyby of Spica, reached **848** visitors.
- 01/01/2014 Best stargazing events of the year, reached **1 300** visitors.
- 09/01/2014 Review of the 2014 Sky Guide, reached **365** visitors.
- 13/01/2014 Observers in Cape Town can enjoy the first bright occultation....., reached **282**.
- 18/03/2014 The Moon occults Saturn....., reached **312**.
- 16/04/2014 Upcoming observing evening and starparties....., reached **512**.
- 18/05/2014 Meteor shower alert....., reached **547**.
- 05/06/2014 Saturn is occulted by the Moon....., reached **1 000**.

Memorable observations so far during this term kicked off with Comet ISON and its demise, the erratic behaviour of Nova Cen 2013, the first and second occultation of Saturn by the Moon, two fireball reports, massive sunspot activity at the beginning of the year and Comet PanSTARRS (C/2012 K1) now putting on a show.

In conclusion, a productive first term putting to good use the communications technology now available, enabling ASSA to reach an even bigger audience, Southern African astronomy should go from strength to strength. And in the pipeline is an exciting deep-sky, imaging and observing development, a collaboration between Auke Slotegraaf, Carol Botha, Allen Versveld and the Observing Director, soon to be revealed.

**Awards**

Upon the recommendation from the Deep-Sky Section Director, I would like to propose a Merit Award to Percy Jacobs for *his initiative in promoting the ASSA Top-100 observing list and co-ordinating the top-100 observing programme at the Pretoria Centre.*

## **Outreach Section Report**

*Johan Smit*

26 June 2013. Dagbreek TV interview. Comet information and Scope-X information.

30 July 2013 Magalies voetslaan klub. General astronomy talk including dark sky information. About 100 visitors.

9 to 11 August 2013. Karoo star party, Britstown.

17 August 2013. Public viewing event in Zita Park, Garstfontein, Pretoria. About 50 visitors.

5 September 2013. Astronomy information evening. River Place Restaurant, About 100 visitors.

17 September 2013. School astronomy evening. Michael Mount Waldorf School Bryanston. 100 plus learners and parents. Viewing and talk, including dark sky information.

21 September 2013. School astronomy evening. Grayston Preparatory school, Grayston. More than 100 learners and parents.

28 September 2013. ASSA/ESSA/ATM Stargazing, Bushtrails. Magaliesburg. Annual event. About 100 visitors.

4 and 5 October 2013. Voortrekkers astronomy talk and viewing practice. Dark sky information included. About 60 learners and officers.

13 January 2014. Private community function, Tiegerpoort, Pretoria. About 40 visitors.

1 to 4 May 2014. Karoo star party, Britstown.

14 May 2014. Pretoria region honorary rangers. About 150 visitors. Talk including dark sky information session.

23 and 24 May 2014. Voortrekkers astronomy talk and viewing practice. Dark sky information included. About 70 learners and officers.

6 June 2014. Private community function, Tiegerpoort, Pretoria. About 60 visitors.

## **ASSA Scholarships Report**

*Maciej Soltynski*

The ASSA Scholarship was established in 2000 to encourage the study of Astronomy at any Southern African university at the 2nd and 3rd year level. The Scholarship is funded by ASSA with occasional financial support from the ASSA Endowment Trust.

The Scholarship for 2014 was awarded to Freya Bovim, who is in the second academic year of her studies for the B.Sc. degree at UCT.

Emma Platts, who held the ASSA Scholarship in 2013, obtained her B.Sc. from UCT in three majors: applied mathematics (with distinction), astrophysics and physics. This year she is studying for her B.Sc. (Honours) in applied mathematics at UCT and is presently visiting the USA as part of the Hope-Princeton Summer exchange programme. The research topic for this programme is cosmic strings, and the aim is to update the constraints on string tension using the new ACTPol spectrum data (ACTPol is the polarization-sensitive receiver at the Atacama Cosmology Telescope).

Claire Antel (2011) is back at UCT from CERN and plans to submit her M.Sc. thesis in physics this year. Wendy Williams (2006 and 2007), continues working towards her PhD on the Giant Metrewave Radio Telescope (GMRT) and LOFAR observations of radio galaxies at the University of Leiden.

Dr Renée Hlozek (2005), is a Lyman Spitzer Jr. Postdoctoral Fellow in the Astrophysics department of Princeton University, and has been appointed a TED Senior Fellow for 2014 & 2015.

### **South African Astronomical Observatory - Astronomical Society of Southern Africa Scholarships**

The purpose of the three SAAO - ASSA Scholarships is to encourage current or intending undergraduates (i.e. 1st, 2nd or 3rd year) studying for a B.Sc. degree at any university in South Africa, who have a stated interest in

astronomy, to prepare for furthering their interest. The Scholarships are financed by SAAO and are administered by ASSA. The value of each Scholarship in 2014 was R12 000, up from R10 000 in 2013.

In 2014 the Scholarships were awarded to:

- Francois Botha, who is taking astronomy, physics, mathematics and applied mathematics modules at the second year level for the B.Sc. degree at UNISA.
- Dean De Villiers, who is undertaking physics and mathematics modules at the first year level, and astronomy, physics and mathematics modules at the second year level for the B.Sc. degree at UNISA.
- Verlon Etsebeth, who is undertaking astronomy and mathematics modules at the second year level for the B.Sc. degree at UNISA.

Yusri Dollie (2013) continues with his B.Sc. at UCT, focusing on computer science.

Jaco Brink (2013) continues with the 3rd academic year of his B.Sc. at UNISA.

Izak van der Westhuizen(2013) obtained his B.Sc. with distinction from UFS and this year he is undertaking a B.Sc. (Honours) in astrophysics at the same university.

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### **Council Members for 2014/15**

<b>Title</b>	<b>Name</b>
President	Prof Matie Hoffman
Vice President	Pierre de Villiers
Outgoing Vice Pres.	Dr Ian Glass
Treasurer	Adv AJ Nel
Secretary	Lerika Cross
Membership Sec.	Vacancy – to be handled by AJ Nel supported by L Cross until replacement can be found
Council Member	Chris Stewart

Council Member	Maciej Soltynski
Cape Chair	Frank Jacobs
Durban Chair	Peter Dormehl
Garden Route Chair	Case Rijdsdijk
Johannesburg Chair	Jerome Jooste
Pretoria Chair	Bosman Olivier
Hermanus Chair	Pierre de Villiers
Bloemfontein Chair	AGM results not yet known

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## **Awards and Citations**

### **McIntyre Award to Dr Ian Glass**

Upon the recommendation of this Society Dr Ian Glass has been awarded a McIntyre Award for his publication, Nicolas-Louis de La Caille - Astronomer and Geodesist, which meets the criteria for academic standard, originality and literary presentation.

### **Merit Award to Auke Slotegraaf**

Upon the recommendation of this Society Auke Slotegraaf has been awarded a Merit Award for his sterling contribution to the modernisation of the ASSA website, as well as establishing the new ASSA communication channels, whilst maintaining his normal high standard as Deep Sky Section Director.

### **Long Service Award to Maciej Soltynski**

Upon the recommendation of this Society Maciej Soltynski has been awarded a Long Service Award in appreciation for his many valuable contributions made to furthering ASSA interests over 25 years.

### **President's Award to Chris Stewart**

Upon the recommendation of this Society Chris Stewart has been awarded a President's Award for his contribution to the art of telescope making in South Africa for a period of 20 years.

## Amateur Optical Tracking in South Africa from 1957 – 2014. Part 4

*Greg Roberts*

**Abstract:** This article will cover the activities of the Cape Town MOONWATCH team that was situated in the grounds of the then Royal Observatory at the Cape (later the South African Astronomical Observatory) and operated from 1957 to about 1968.

Additional information for Bloemfontein: In a report to MOONWATCH headquarters dated 15 September 1957 Dr Evans provided the following :

Team leader: Mr G N Walker

Deputy Team leader: Mr W L Browne

Secretary: Mr P Coetzee

Early in 1957 Dr David Evans of the then Royal Observatory at the Cape, Cape Town investigated the possibility of organising, through the astronomical Society of South Africa, a team of amateur observers, to be stationed at the Royal Observatory but had delayed further action until more was known regarding the availability of optical equipment.

Dr Evans was invited to attend a meeting of the steering committee of the South African National Committee for the International Geophysical Year program on March 26, 1957 and was appointed Coordinator for the South African MOONWATCH programme. He was asked to supply specifications for the optical components needed for tracking to the CSIR who would then fund and order the components from the United States.

Dr Karl Henize of the Smithsonian Astrophysical Observatory attended a meeting at the Union Observatory (Johannesburg) on 2 April, 1957. A memorandum was drawn up afterwards in which South African amateur

astronomers, both individually and as members of the Astronomical Society of Southern Africa, were willing to assist in making visual observations as proposed by the US authorities. The Directors of the Observatories at Johannesburg, Pretoria and Cape Town stated that they were willing to grant site facilities as well as technical advice and to assist the efforts of the South African amateurs (source for above "Hers report on MOONWATCH 1957-1958").

Dr Evans gave a talk on the radio (no TV in those days) about the United States' plans for satellites. He described the MOONWATCH program followed by an appeal for volunteer observers. As a result of this, as well as local newspaper coverage, CAPE TOWN MOONWATCH was formed in March 1957. By May it had recruited 40 observers, most of whom had little or no knowledge of astronomy or satellites.

The MOONWATCH station was sponsored by the then Royal Observatory and situated along the north mark path of the Reversible Transit circle. The geographical coordinates of the central point of the station was east longitude 1h 13m 54.5s, latitude 33 deg 56' 00.44" and at an altitude of 22 feet above mean sea level. A high positional accuracy was possible because of the very close proximity of the station to the point of origin of the South African Survey system. The accurate timing system was to be based on the Short standard clock of the Observatory which was regularly compared with the Union Observatory, Johannesburg and other radio time

signals.



Fig. 1. The position of the Moonwatch site at the Royal Observatory (now SAAO).

Mr William (Bill) P Hirst, Chief Chemist at the Shell Company of South Africa, an avid amateur astronomer as well as author of

frequent contributions to the *Monthly Notes of the Astronomical Society* as well as being known for his orbital work on asteroids and comets at the Royal Observatory, was appointed the Station Leader with Dr Evans as his Deputy. By June 1957, 40 observers had been recruited and by September this had increased to 67. It was planned to have 16 telescopes operational.

Finance for the venture consisted of a Grant-in-Aid from the Cape Centre of the Astronomical Society of £5. There were also grants from the Shell Company of South Africa for £25 and from the Caltex Company of South Africa of £52 10s. In addition, donations of material and machine time had been made by the Observatory, etc. Through the courtesy of the Director of the SA Trigonometrical Survey Office (Mr Boonzeier) sixteen concrete pillars were constructed by the Trig Surveyor Beacon Building section along the line for the mounting of the telescopes. These pillars can still be seen today. It was also reported that the South African Air Force would consider favourably the provision of night flights across the line at agreed times for the training of observers, however there is no record of whether this was actually done or not.

Two sets of telescope components for the ordinary two-inch aperture telescopes were sent by air freight from the United States and were received 21 May 1957. It was possible to build prototype telescopes at Johannesburg and Cape Town. In addition the mechanical parts for a further 15 telescopes were manufactured in the observatory workshop. The Skalnate Pleso Charts were also supplied to be used for making positional observations.

Towards the end of 1957 it was realised that the standard 2-inch aperture MOONWATCH telescopes were too small to be able to see the planned United States satellites when at the highest point of its orbit (known as apogee) since the satellite had decreased in size from that originally planned. Dr Evans was approached by MOONWATCH HQ and asked whether he could use 20 APOGEE scopes at each of the four South African

stations. This was later increased by US Naval Research Laboratory (who manufactured the so called Apogee telescopes) to 49 each for Cape Town and Bloemfontein. However, none were allocated for Johannesburg and Pretoria as these stations were considered "too far north to observe the Vanguard satellite" (a rather odd statement!). This was not well received by Johannesburg or Pretoria!

Fig 2. The 5-inch Apogee telescope.



When Sputnik 1 was launched in October 1957, Cape Town MOONWATCH was ready to make observations of the rocket (and the satellite itself). Although not required by the MOONWATCH program, the results were reported to the Soviet Union as well as the United States.

By early 1958 the four MOONWATCH stations at Cape Town, Johannesburg, Pretoria and Bloemfontein had been completely equipped with the ordinary two-inch instruments for some time. This produced a flow of Sputnik observations, notably from Johannesburg. In planning their work, other stations found the predictions given to the press by the Union Astronomer (Dr W S Finsen) to be invaluable as this was the only source of data on the Russian satellites.

During January 1958 two consignments of additional instruments were delivered to the teams at Cape Town and Bloemfontein. This consisted of 49 five-inch and 18 two-inch telescopes, complete with mountings. Fortunately, by 1 February when the US satellite EXPLORER 1 was launched, the installation was well under way at Cape Town. By herculean efforts the work was substantially completed within a week or two. The scale of these operations was of a different order from the operation of an ordinary MOONWATCH station. Cape Town, which mounted 16 morning watches with an average compliment of 20-25 observers between 2

February and 22 February, found it necessary to recruit over 100 observers!



Fig 3 (left). 5-inch Apogee telescopes ready for use.

Fig 4 (right). The Apogee telescopes in use.

On 1 February 1958 a newly installed telex machine at the Royal Observatory began stuttering out predictions for the first successful American launching of Explorer 1.

Clouds and dewing up of the eyepieces interfered with the work. Until the morning of 8 February, when the first sighting outside the USA was made by Mr C J Loon, a student of the Cape Town University Survey Department. Further sightings were made from Cape Town on 10, 12, 14, 15 and 16 February after which bad weather and the northwards movement of the transits of the Cape Town meridian put a stop to work. This was satellite 1958 Alpha 1 – also known as EXPLORER 1 – for which the 4th sighting in the world was made from Cape Town (the first three were all from America). The eighth sighting was also made from Cape Town – the only team in the world to provide two observations used in the first determination of an American satellite in orbit.

An article by Joseph C Loon, called "Remembering Explorer 1" (from ACSM Bulletin Feb 2008) makes interesting and amusing reading:

"At the time of the launching of Sputnik 1 and Explorer 1 , I was a member of the Cape Town MOONWATCH team in South Africa. On the grounds of

the Royal Observatory in Cape Town, special telescopes were set up on pillars so as to cover a meridian, that is, a north-south imaginary line in the sky. This is described as an "optical fence". Fifty years ago satellite tracking was in its infancy and this optical fence ensured that any object crossing the meridian in Cape Town could be observed. I was fortunate enough to observe Explorer 1 in the telescope that I manned. The Johannesburg newspaper *The Star*, in its Saturday, 8 February, 1958 edition, reported: "There was a dramatic moment in the grounds of the Royal Observatory when the quiet of the early morning was broken by Mr Loon shouting "I've got it". He followed this up with the prearranged shout of "pip". Immediately five stop watches clicked as one – the reading given by the stopwatches was 4hr 54m 34s South African Standard Time on 8 February 8 1958. The other readings were altitude 72 deg 20 min at azimuth 0.4 degrees east of north. The local newspapers thought that I was the first person in the world to see the satellite, and I had my 15 minutes of fame! But it later turned out that I was indeed the first person outside the USA to see the satellite at that time. These exciting times were not without some amusing incidents. We would go out for practice sessions a few hours before dawn. My neighbour in the apartment complex where I lived (a single mother with a teenage daughter) was having trouble with her daughter who kept admitting her boy-friend into her room and locking the door so that the mother could not enter. Early one morning, at about 3 AM, I was standing outside the apartment complex waiting for a friend to pick me up to go to the Royal Observatory for MOONWATCH duties. Suddenly, someone came running down the steps with his shoes in his hands. A few minutes later, a police car pulled up in front of me, two policemen jump out and grabbed my arms. "If you are looking for someone, he just ran down the street," I said. They laughed and manhandled me upstairs, where the mother said she did not think that I was her daughter's boyfriend! But, she wasn't sure! But when I explained to the police what I was doing outside the building at three in the morning, being cautious, they decided to take me to the Royal Observatory to check out my story. It caused a mild sensation to arrive at the MOONWATCH team with a police escort!

During the first few months of the Space Age several satellite passes were observed by Cape Town MOONWATCH as follows:

### 58 Alpha 1 EXPLORER 1

0402 Feb 08 02h54m34s El 72d 20' N offset  
0402 Feb 10 02h45m19.8s El 79d 24' N offset  
0402 Feb 12 02h35m37.6s El 84d 00' N offset  
0402 Feb 14 02h25m27.2s El 85d 36' N offset  
0402 Feb 15 03h21m17.0s El 76d 00' N offset.0402 Feb 16 02h14m56.8s El 82d 55' N offset  
0402 Feb 26 20h03m01.8s El 41d 00' N meridian, very difficult through cloud  
0402 Mar 03 18h37m16.2s El 66d 15' N offset  
0402 Mar 07 18h10m07.0s El 82d 50' N offset  
0402 Mar 08 19h05m02.8s El 82d 45' N offset  
0402 Mar 10 (18h51m El 79d 15' N Not timed-inexperienced observer  
0402 Mar 14 18h19m26.3s El 67d 39' N offset; magnitude 10  
0402 Mar 15 19h13m23.1s El 37d 00' N offset; magnitude 8  
0402 Apr 24 04h05m26s Az 000d 24' El 40d 41'

### 58 Gamma 1 EXPLORER 3

0402 Mar 28 18h33m25s Az 000d 24' El 81d 22' mag +9 +10  
0402 Apr 09 18h01m48s Az 000d 24' El 67d 30' mag +10  
0402 Apr 10 18h29m12s Az 000d 24' El 53d 06'

The note "offset" refers to the fact that the apogee telescopes had a cross-wire offset by 0.4 degree to the east of the meridian, and that the timing refers to transit over this wire.

During 1957-1958 observations of satellites were made as follows: Johannesburg 467, Pretoria 195 Cape Town 91 and Bloemfontein 52.

In a report by team leader Bill Hirst on 4 March 1959 to MOONWATCH headquarters, it is stated that "Cape Town MOONWATCH had 49 Apogee telescopes, 8 Small elbow telescopes, 2-inch OG field ~6 deg not presently in use and 16 MOONWATCH telescopes 2-inch OG field ~12 deg with the elbow telescopes used on the prime vertical for polar satellites. Time signals were provided by the standard clock of the Royal Observatory. It was also mentioned that Apogee mountings were not as stable as they could be (a fault of the mountings provided ) and that there were plans to construct improved ones.

The station had about 90 observers. Most of them were scattered over an area of about 6 miles radius, but most (~70) had their own transport. Bill stated that he could probably get 20-30 observers on site in one hour or less without previous notice. About 50 observers were available on a "panic stations" call.

The team was organized as follows; Team leader, Deputy and 7 other sub-team leaders between whom the personnel were divided up. The sub teams (10-12 each) were in readiness on successive days on a roster. They were called up as required and supervised by a "sergeant". Members were asked to give one night a week on which they would be available. There were attempts at recruiting personal through occasional press advertisements, etc. Numbers seemed fairly static - gaining roughly as many as were lost. A poll taken at the time showed that all present members intended to continue. New recruits were instructed "on site" by Sub-team leaders.

A short item in *MNASSA* stated that during the period February - May 1960 the Cape Town MOONWATCH made 26 observations on 20 days.

A report to Smithsonian Headquarters on 2 June 1961 gave a summary of the situation. At that time the MOONWATCH team had been in existence for over three years and had proved to be one of the most productive stations in the MOONWATCH network.

There were actually three stations in the grounds of the Royal Observatory (1) the old meridian fence pole-reticle site for the 2-inch, 12 degree field MOONWATCH scopes which were no longer operated.

(2) 53, 3" pipe posts in concrete with meridian-apogee scope mounts which were not used any more unless a large fan was needed for searches (the team now had 10 apogee scopes).

(3) Two alt-azimuth mounts with apogee scopes mounted on them which were used to make nearly all of Cape Town's observations.

The team then had twelve members. Bill Hirst was Team Leader and with three assistant team leaders, each of whom had two or three persons in their team. Each night a different team was "on duty". They averaged twenty observing sessions per month.

The timing of observations was considered accurate to be within 1/3sec and positional accuracy to within 20' of arc.

As regards communication, special instructions, new launches and position reporting went through the teletype link at the observatory to the Baker-Nunn tracking camera at Olifanstfontein as well as by telephone.

Using the EPHEMERIS VI data provided by MOONWATCH headquarters, Bill Hirst made all the local team predictions. In addition Hirst personally paid for most of miscellaneous items.

A comment made by Hirst describes Cape Town weather perfectly: "Cape Town weather is unusually bad. Even when skies appear clear, seeing is poor. Only one of three observing sessions produces an observation or two. If the weather were always clear, Cape Town would produce three times the number of observations. The morale of observers is high, even though they often leave the observing site more than half the time without an observation due to the bad weather."

When Hirst was asked by MOONWATCH Headquarters if they could count on continued routine observations and participation in special assignments for his team, he replied: "I expect to live another twenty or thirty years, and you can expect MOONWATCH observations from Cape Town for at least that long". He kept his word.



Fig 5. Mr E J Richardson.

In February 1963 Hirst resigned as team leader of Cape Town MOONWATCH as he had moved to Johannesburg. He was replaced by Edward J Richardson who was previously the deputy team leader. A newspaper clipping from that time (undated) gave a short summary of the situation then from which the following is a summary:

In the early days of satellites, 30 to 40 people used to regularly attend the MOONWATCH sessions. Sometimes 70 to 80 people were there and on one occasion more than 100. The team leader, Mr Edward J Richardson, received data from the Smithsonian about a satellite. This came either in the form of a telegraphed message or predictions by mail. Although there were about 130 objects in orbit, Cape Town only receives orbital data for about 12 satellites.

Cape Town originally had about 50 telescopes but by about 1963 only three were in regular use. Consequently only three or four observers were needed to make an observation so the size of the team had shrunk considerably. The objectives of tracking had also changed as launches were now more likely to achieve their planned orbit and prediction accuracy had improved, so there was no longer a need for a large number of observers to form an "optical fence". One of the Cape Town observing projects was now the tracking of satellites nearing the end of their life by

plunging back to earth through the Earth's atmosphere. Observing such satellites was (and still is) especially difficult because prediction accuracy was often erratic (due to variations in solar activity and air density etc) and their positions could not be predicted with accuracy. Being at a low altitude they were not observable over a large area and also the satellites moved rapidly from horizon to horizon.

The article was accompanied by pictures of A Longhurst-Murphy, Rupert F Hurly, G R Atkins and E J Richardson.



Fig 6 (left). Mr Rupert Hurly

Fig 7 (right). Mr G R Atkins.

Rupert Hurly was one of the Deputy team leaders, and Cape Town MOONWATCH team leader during 1960 for a short period (whilst Bill Hirst was overseas on



holiday). In 1964 he wrote an account of MOONWATCH at the Royal Observatory in *MNASSA*:

Initially fifty 5-inch refractors were installed but by the end of the IGY a number were dispatched to Australia and Japan and only ten remained on the site. By the time Echo 1 was launched (in August 1960) prediction accuracy had improved so that only three telescopes were setup on prelaunch predictions. By 1964 two telescopes were normally adequate for tracking routine satellites. Normally observing was done from the grounds of the Royal Observatory where the team had erected a small hut

housing a chronograph and clock and equipment store. Three telescopes were mounted on pillars, carefully calibrated. These could either be used in predicted positions or else, with bright unpredicted or erratically behaving satellites, the satellites can actually be "chased". Then the telescope was clamped and the settings read. For the use of Observatory grounds and time facilities the team was indebted to Dr R Stoy, who took a keen interest in satellite operations. For some well tracked satellites no positional observations were required. When only tumble rates were required, observations on satellites as faint as sixth magnitude could be done with binoculars. Such observations were made from a members home. Shadow times were also frequently observed using binoculars, again from observers homes.



Fig 8. The site today.

It is not clear when the site finally became inactive. It appears to have been around 1968-1969, probably as a result of other MOONWATCH stations appearing in the vicinity. These were Station 0413 at Kenilworth (Greg Roberts) and Station 0414 at Bergvliet (Bill Hirst who had returned to South Africa after his spell as leader of the MOONWATCH program at the Smithsonian Astrophysical Observatory in the USA). In addition, a Photokine satellite tracking theodolite had been set up in the grounds of the Royal Observatory under control of Walter Grimwood. There were thus plenty of observations coming from this part of the world so probably CAPE TOWN MOONWATCH station 0402 felt it no longer necessary to operate. The last observations MAY have been made in June and August 1968. All that remains of station 0402 today is the small hut which housed the clock and where instruments were stored, and the row of concrete pillars close to the SAAO Auditorium. Cape Town

MOONWATCH station 0402 played a major role in the early history of the Space Age – a record of which they could truly be proud.

## **Acknowledgements**

In compiling this report I would like to sincerely thank the following for their input and assistance (either directly or indirectly)

Ellen Alers - reference archivist at the Smithsonian Institute.

Various items from *MNASSA* - mostly "dug-up" by Willie Koorts (SAAO).

The late Jan Hers for his excellent article on early MOONWATCH in South Africa.

The late Peter Smits photographic collection for the colour photographs of Cape Town MOONWATCH.

*Cape Times* clippings and black and white photographs extracted from the clippings.

Cliff Turk e-mail messages in answers to some of my queries.

The next article will deal with JOHANNESBURG MOONWATCH station 0403.

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## **Pretoria Centre reaches out.**

*Bosman Olivier*

On 5 July 2014 the six members of the Pretoria Centre of ASSA braved the light pollution of one of the shopping malls in Centurion to reach out to shoppers *a la* John Dobson and to show them the moon, Mars and Saturn. Although the centre hosts regular monthly public observing evenings, it was felt that we should take astronomy to the people rather than wait for the people to come to us. This was borne out with "Astronomy in the Mall" initiative.



Fig 1. The people came to us.

It was not all plain sailing, however. When we initially approached the Centurion Lifestyle Centre's management, they referred us to their events organizers. This turned out less than satisfactory, mainly

because of a misunderstanding. The events company wanted to charge us for the use of four parking bays.

Fig 2. The parking bays we were given.

We discussed the matter with the management again and they in turn offered to take the matter to their head office. Head Office immediately saw the merit of our request and we eventually were given free access to a number of parking bays.



The Pretoria Centre then had roll-up banners made and printed a number of pamphlets, which was distributed to shoppers and restaurant clients. Some restaurants welcomed our outreach and even supported us by providing coffee during the evening.



Figure 3. This is our *Sky Guide*.

The crowds started arriving even before the Sun set, as the Moon was nearing first quarter and visible in daylight. We were kept fairly busy until around 21:00 when most people went home. In all we probably reached more than 300 people during the course of the evening.

Fig 4. Johan Smit's "Longdrop" telescope.

The most popular telescope was Johan Smit's *Longdrop* and nobody minded to climb the ladder to some of the most spectacular views of the Moon, Mars and especially Saturn.



The event was deemed to be a success and we were invited back to the mall on 1 August 2014 for another outreach.

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## Colloquia and Seminars

These form an important part of a research facility, often as a sort of pre-publication discussion or a discussion of an individual's current research, and as such it is virtually impossible to "publish" this material. However by recording the topics discussed in the form below does indicate to those, who are unable to attend, what current trends are and who has visited to do research: it keeps everyone 'in the loop' so to speak.

Also included in this section are the colloquia/seminars at the SAAO, UWC and the Astrophysics, Cosmology and Gravity Centre at UCT, ACGC. Also included are the SAAO Astro-coffees which are 15-20min informal discussions on just about any topic including but not limited to: recent astro-ph papers, seminal/classic publications, education/outreach ideas and initiatives, preliminary results, student progress reports, conference/workshop feedback and skills-transfer.

Editor.

## **SAAO**

### **Title: Rapidly growing black holes and host galaxies in the distant Universe**

Speaker: Dr. Guillaume Drouart (Onsala Space Observatory)

Date: 17 July

Time: 11h00 – 12h00

Venue: 1896 Building

**Abstract:** Powerful high redshift radio galaxies (HzRGs) exhibit strong AGN and star formation activities making them ideal candidates to gain insights into the so-called AGN-SF connection. Thanks to the HeRGE project, a comprehensive survey of 70 HzRGs covering the 3 – 870  $\mu\text{m}$  range, we are able to disentangle the IR SED into a AGN and a starburst (SB) component. This suggests that the supermassive black holes may be out growing or have outgrown their host galaxies when compared to the local  $M_{\text{BH}}-M_{\text{Gal}}$  relation. Extending the SED to the optical for a subsample of 12 HzRGs and making use of a AGN torus model and the PEGASE evolutionary code, we show that three components are necessary to reproduce the observed SED: a AGN, an evolved stellar population and a starburst. If HzRGs have formed the bulk of their stars at very high redshift (evolved component), they are still experiencing intense star forming episodes representing a significant fraction of the total mass of the system.

**Title: Galaxy Evolution and Cosmology Studies with SALT**

Speaker: Dr Catherine Cress

Date: 28 August

Time: 11h400 – 12h00

Venue: SAAO Auditorium

**Abstract:** I'll discuss three SALT projects dealing with galaxies and cosmology. The first involves spectroscopic follow-up of clusters of galaxies detected in CMB experiments, the aim being to measure masses of clusters so they can be used for cosmology. The second involves age-dating luminous red galaxies so they can be used to constrain time intervals associated with various redshift intervals. These measurements can then be used to infer the expansion rate of the universe directly at redshifts around  $z \sim 0.5$ , providing new constraints on cosmological parameters. In the third project, we study the Tully-Fisher relation by measuring rotation curves for galaxies where Type Ia supernovae have been observed.

**ACGC**

**Title: Modifications of gravity and CMB observables**

Speaker: Professor Carsten van de Bruck (The University of Sheffield)

Venue: M111 Maths Building, UCT

Date: 22 July

Time: 12h00

**Abstract:** Scalar tensor theories are simple extensions of General Relativity and studied in the context of dark energy and/or modified gravity theories. Given that fifth forces have not been detected, the force mediated by an additional scalar degree of freedom has to be either short-ranged or the (effective) coupling has to be very small (in the laboratory and solar system at least). Several screening mechanisms have been suggested, such as the chameleon, the symmetron or the Damour-Nordvedt mechanism. More recently, more complicated models with both

conformal and disformal couplings have been put forward. In this talk I will discuss in how far the properties of the CMB can test such modifications of gravity present either in the radiation dominated epoch or at late times. Both conformal and disformal couplings to matter and radiation will be discussed.

**Title: Impact of quantum entanglement on spectrum of cosmological fluctuations**

Speaker: Dr. Sugumi Kanno (University of Cape Town)

Venue: M111 Maths Building, UCT

Date: 26 August

Time: 12h00

**Abstract:** We investigate the effect of entanglement between two causally separated open charts in de Sitter space on the spectrum of vacuum fluctuations. We consider a free massive scalar field, and construct the reduced density matrix by tracing out the vacuum state for one of the open charts, as recently derived by Maldacena and Pimentel. We formulate the mean-square vacuum fluctuations by using the reduced density matrix and show that the scale invariant spectrum of massless scalar field is realized on small scales. On the other hand, we find that the quantum entanglement affects the shape of the spectrum on large scales comparable to or greater than the curvature radius.

**Title: Cosmological signatures of a breaking of the equivalence principle**

Speaker: Dr. Aurélien Hees (Rhodes University)

Venue: M111 Maths Building, UCT

Date: 28 August

Time: 12h00

**Abstract:** Scalar tensor theories are extensions of General Relativity widely studied in the context of modified gravity and Dark Energy. In this talk, I will consider a class of scalar tensor theories with a multiplicative coupling between the electromagnetic Lagrangian and the scalar field. This coupling

explicitly breaks the Einstein Equivalence Principle. I will present 4 cosmological signatures produced by such a coupling: a violation of the cosmic distance-duality relation, a temporal variation of the fine structure constant, a modification of the evolution of the CMB temperature and CMB spectral distortions. These 4 signatures are intimately related to each other. Therefore, under the assumption that the coupling holds, we can transform constraints on the variation of the fine structure constant into constraints on the 3 others observables. Moreover, testing the relations between the different observables leads to a test of the coupling between the scalar field and matter.

## **UWC**

**Title: Probing the dark Universe with optical imaging surveys: Results from pre-DES, DES science verification data and the upcoming Dark energy survey**

Speaker: Dr Filipe Abdalla of University College London

Venue: Room 1.35 of the Physics Department, UWC

Date: 1 August

Time: 14h00

**Abstract:** In this talk I will show th aspirations that we have in probing the Dark Universe with optical imaging surveys, including the hurdles and the statistical advantages of such surveys. Specially I will focus on the results which we have in the path to the dark energy Survey including the science verification data from DES. The survey proper will started in Oct 2013 and spans over the next 4 years. I will give an update on the plans and prospects.

**Title: Detecting shocks in cosmological hydrodynamical simulations.**

Speaker: Daniel Cunnama, UWC

Venue: Room 1.35 of the Physics Department, UWC

Date: 15 August

Time: 14h00

**Abstract:** Cosmological shock waves are an important physical process in structure formation, heating the Universe through the thermalization of kinetic energy in gas flows. It is therefore important to identify and quantify shocks in cosmological hydrodynamical simulations. In this talk I will discuss shock finding in cosmological simulations and its implications for predictions of where to expect to observe shocked gas.

**Title: The effects of mergers on the evolution of the most massive galaxies**

**Speaker:** Dr Ros Skelton SAAO

**Venue:** Room 1.35 of the Physics Department, UWC

**Date:** 29 August

**Time:** 14h00

**Abstract:** Galaxy mergers are thought to play an important role in the growth of galaxies over time, affecting their mass and size evolution, as well as their morphologies and levels of star formation. In this talk I will discuss the influence of mergers on the most massive, red galaxies. These galaxies are thought to have formed most of their stars early on, so mergers are probably the only way to build up mass at late times, but it is still not clear when and how they assembled. I will discuss our ongoing work to measure the merger fraction using the Sloan Digital Sky Survey/BOSS data over the second half of cosmic history, and the 3D-HST/CANDELS surveys at higher redshift.

**NASSP**

**Title: Dynamo action in spiral galaxies**

**Speaker:** Dr. Luke Chamandy

**Date:** 16 July

**Time:** 13h00

**Venue:** MCB LT1

**Abstract:** Large-scale magnetic fields in disc galaxies, visible in polarized synchrotron emission and its Faraday rotation, require a generation mechanism that orders magnetic fields on scales larger than the turbulent scale; what is referred to as a mean-field dynamo. We first introduce and compare various tools for solving the non-linear dynamo problem. Motivated by observed non-axisymmetric features called ‘magnetic spiral arms’, we then present global non-axisymmetric galactic dynamo models. We discuss three physical effects that apparently contribute to the formation of magnetic arms: the delayed response of the dynamo to local variations in the fields, the evolution of the gaseous spiral arms that force the dynamo, and the connection of galactic outflows with regions of star formation. Such work will lead to detailed modelling of specific galaxies, as well as observational predictions for current and future instruments.

**Title: Asymptotic Giant Branch Stars in the Local Group**

Speaker: Prof. Patricia Whitelock

Date: 23 July

Time: 16h00

Venue: MCB LT1

**Abstract:** Towards the end of their evolution stars in the mass range 0.8 to 10 solar masses experience large amplitude pulsations and lose a large fraction of their mass over a relatively short period of time (a few hundred thousand years). Exactly how and why this happens is not well understood, but we do know that this mass-loss process is important for enriching interstellar material in various elements including carbon. My talk will describe work on these Asymptotic Giant Branch (AGB) stars in the Galaxy and the Local Group. These AGB stars also fall on various period-luminosity relations and the large amplitude AGB variables (Miras) potentially rival Cepheid variables as fundamental calibrators of the distance scale. They are therefore proving to be of interest to a

astronomers studying a range of problems.

: Assembly of stellar mass in g

**Title: Assembly of stellar mass galaxy cluster cores since  $z=1$**

Speaker: Claire Burke, post-doc from UKZN

Date: 30 July

Time: 16h00

Venue: MCB LT2

**Abstract:** The formation and evolution of brightest cluster galaxies (BCGs) is a topic of much recent debate in both observational and theoretical studies, with a range of evolutionary scenarios being reported by observers and striking disagreements being found between simulated and observed BCG properties. For example, some observational studies report no growth in mass for BCGs since  $z=1$  whilst others find a doubling in mass over this time; for the same timescale simulations predict up to a quadrupling in mass of these galaxies. Complementary to these results, it has recently become clear that the stars found in the diffuse intracluster light (ICL) form a major component of cluster stellar mass and its evolution is linked very closely with that of BCGs. Currently the general consensus is that the ICL has grown and evolved significantly, increasing in terms of its contribution to the total cluster light by more than a factor of 4 since  $z=1$ , however the mechanisms responsible for this remain unclear. I will present the results of our recent study of mergers in BCGs and the buildup of the ICL since  $z=1$  using deep multi-wavelength data from the CLASH survey. We find new evidence for very little growth of BCGs but a large growth of the ICL over the same time and we examine the merging histories within the clusters which could be responsible for this evolution.

**Title: Black hole binaries and studying in the USA**

Speaker: Dr Tana Joseph

Date: 13 August

Time: 16h00

Venue: MCB LT2

**Abstract:** First, I will discuss how to apply to a PhD program in the USA. Second, I discuss my work on black hole binaries (BHBs) in extragalactic

globular clusters (GCs). It had long been thought that stellar mass black holes would not reside in GCs because they would be dynamically ejected from the cluster. However, in 2007, the first BHB was discovered in an extragalactic GC. To date, six other BHBs have been found, with two of them residing in one Milky Way GC. The discovery of these GC BHBs has led us to rethink the way X-ray binaries and black holes form and evolve. In order to further investigate these BHBs, we need to build up a larger sample of such objects.

I will discuss my work on the first two BHBs in GCs to be discovered. I will also outline my current search for more BHBs in GCs, starting in the Virgo cluster.

**Title: Recent work on the structure of our Galaxy.**

Speaker: Prof. Michael Feast

Date: 20 August

Time: 16h00

Venue: MCB LT2

**Abstract:** A brief review will be given of the main features of our own and other spiral galaxies. An attempt to understand some very distant variable stars will then be described. This will lead to a review of models of the galactic disc based on radio frequency data and the evidence for dark matter in both the disc and halo of our Galaxy.

**Title: Bayes' Theorem for Astronomers**

Speaker: Jonathan Zwart (UCT, UWC)

Date: 27 August

Time: 16h00

Venue: MCB LT2

**Abstract:** Bayes' theorem to the rescue - why I hated stats before the revolution. Use in everyday life. Why you should consider Bayes for parameter estimation. How it goes in practice. Golden Rules for using

Bayes in your work. Occam's razor and the bayesian evidence. Fitter. Happier. More productive. Then an example: Beyond stacking - Bayesian constraints on micro-Jansky source populations from the VIDEO survey in the run-up to the SKA.

## **AIMS**

**Title:** Classification of Astronomical Light Curves - Feature Selection Strategies

Speaker: Arun Kumar

Venue: AIMS research centre

Date: 21 July

Time: 12h00.

**Abstract:** Synoptic sky surveys have enabled new frontiers in time domain astronomy, increasing the amounts of data like never before. This has posed several new object classification challenges with multidimensional feature spaces. Understanding the significance of each feature in the multidimensional feature space becomes relevant when analyzing sparse light curves like those generated by CRTS (Catalina Real-time Transient Survey). This talk will first introduce the challenges with CRTS and sparse light curve classification. Using data sets extracted from the ongoing CRTS and the Kepler Mission I will then illustrate a variety of feature selection strategies used to identify the subsets that give the most information and the results achieved applying these techniques to three major astronomical problems.

**Title: From Boot to HPC, a Quick Tour of Computer Topology**

Speaker: Kai Staats

Venue: AIMS research centre

Date: 21 July

Time: 14h00

**Abstract:** What happens when you press the power button on your personal computer? How do the layers of operating systems interact? How are embedded systems and super computers similar? What are the basic goals of high performance computing? In this talk we will answer these questions.

## **Astro-Coffee**

**Title : An insight into genetic programming and data classification.**

Speaker: Emmanuel Dufourq from UKZN, Pietermaritzburg

Venue: SKA office - 2nd Floor Auditorium (CT)

Date: 17 July

Time: 13h00

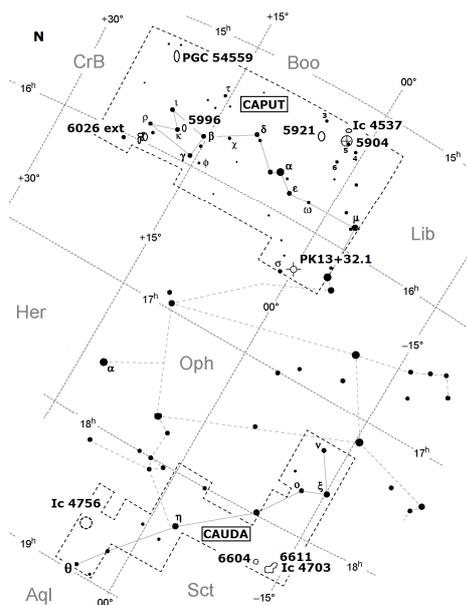
**Abstract:** Artificial intelligence (AI) has been around for many years, and has been used in a vast number of studies in which complex optimization problems have been investigated. Amongst the AI algorithms which exist lies a unique set of them which are inspired by nature. Genetic programming (GP) is an evolutionary algorithm which is inspired by Darwinian evolution, and presents itself as an interesting approach in solving optimization problems. The aim of the talk is to introduce GP and provide sufficient information to enable an individual to implement a GP algorithm for optimization problems, and to steer the discussion in a direction which will be relevant to researchers involved in mathematical sciences. Additionally, given the current information technology age in which we live in, and the enormous amount of data which is available, this talk will provide an insight into data classification and how GP can be applied to mining data.

# Sky Delights: The Slinky Serpent

*Magda Streicher*

Fortunately the serpent we're dealing with in this article is known as a constellation, because let's face it, most of us are rather more than wary of real, living snakes that share the space on Planet Earth with us!

The word "serpent" is from French. In Germany the constellation is known as "die Schlange", the very sound of which seems to embody and suggest the meaning of that creepy creature. Serpens is intertwined with the stars of the Ophiuchus constellation, which is why it is in two parts, namely Serpens Caput (the head) en Serpens Clouda (the tail), which makes it somewhat complex.



The north-eastern part of the constellation (the head) is situated south of the constellation Corona Borealis and west of Hercules. Serpens Caput is home to a few exceptional objects, most of which are galaxies. The proverbial serpent head of Serpens is easily recognisable, four fairly bright stars that are visible in the far north-eastern part of the image in the form of a cross. The northernmost star is the magnitude 4.7 rho; then there is 4.5 iota towards the west, and gamma with a

magnitude of 3.8 which shines with a lovely yellow hue towards the south-east. The super-white 3.6 magnitude beta Serpentis is situated towards the south, and is also a triple star with a wide magnitude 3.7 and 9.9 stars, and a separation of 30.6". The third companion is a magnitude 10.7 star with a 201" separation in a pair of 210. The lovely deep orange magnitude 4 star k Serpentis indicates the mid-point of the cross bar through the Serpens head. Less than a degree west from k Serpentis (which is only 74

light years away) is the soft glow of galaxy **NGC 5996**, the first to be classed as an unknown object. The galaxy displays two prominent distorted spiral arms towards north and south. The very small galaxy NGC 5994 is situated towards the southern tip arm.

Perhaps one of the most fascinating multiple objects to observe is the very close grouping of galaxies **NGC 6027** with its companions, better known as Seyfert's Sextet, situated 1.8 degree east of rho Serpentis. This 79th entry in a catalogue of compact groups of galaxies was compiled in 1892 by Paul Hickson. He completed his studies at the University of Alberta with honours in physics.

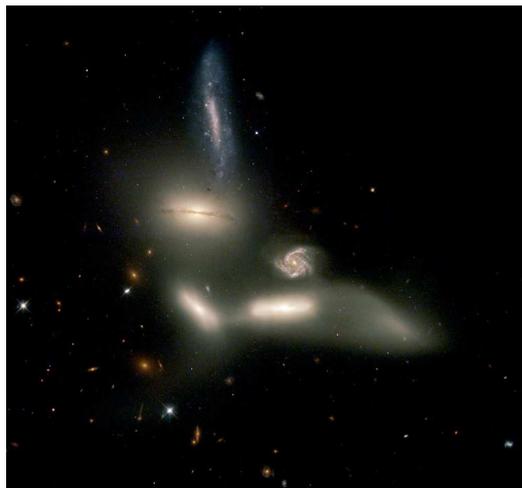


Fig 2. Hickson 79 or NGC6027, also known as Seyfert's Sextet.

However, Carl Keenan Seyfert was the American astronomer who is best known for his 1943 research paper on high-excitation line emission from the centres of some of these compact spiral galaxies, which were named Seyfert galaxies after him. Unfortunately these are also among the faintest of objects, and it requires very dark sky conditions, a reasonable size telescope, a lot of patience and an endless amount of time to find and to observe even only a few of the members, and even then they are just barely visible.



Fig 3. Carl Keenan Seyfert

The Seyfert Sextet (NGC 6027A) are bunched together in a mere 1.5' field of view. So now you can imagine the difficulty of pin-pointing individual members. A first glimpse of Seyfert's Sextet will show the combined sextet as only a very faint hazy patch, 19 million light years away, perhaps all that one can see through an

ordinary telescope. Take into account, then, that the galaxies in this group lie between magnitude 13.5 and 15. Three combined members of the group may perhaps be responsible for the oval brightness of the hazy patch. NGC 6027A, the largest, is a soft oval with an irregular nucleus in an east-west direction, the basis of the entire group. The smaller galaxy, NGC 6027B, showing virtually no nucleus, touches the northern edge. The slightly brighter NGC 6027E situated on the eastern edge has an extension further east that gives the impression of two separate objects. NGC 6027D, a face-on galaxy on the southern edge of NGC 6027E, is a very small round knot of haze, which is probably a separate galaxy and not part of this group. The further away a galaxy is, the faster it recedes from us and the more its light gets shifted towards longer wavelengths. The Seyfert's Sextet cluster of galaxies recedes at a speed that implies a distance of approximately 200 million light years from us, but the member NGC 6027D seems to be aligned by chance in the far distance, although there is also speculation that it might be a part of the cluster, due to hints of interaction. The most southern extended galaxy, NGC 6027C, is a lovely edge-on pinnacle in a north-south direction. It would probably be too difficult even to try sorting out and observing this bunch of galaxies through an amateur telescopes, but do not be too disappointed – you can still just appreciate and admire the Sextet through the eyes of a Hubble picture.



Fig 4. Édouard Jean-Marie Stephan.

Édouard Jean-Marie Stephan (31 August 1837 – 31 December 1923) was a French astronomer who discovered this group in 1882. Among others, he discovered Stephan's Quintet, also known as Arp 319, another group of five galaxies. If one ponders for a few moments the massive vastness of our own Milky Way, it is almost impossible to imagine the scale of a grouping like Seyfert's Sextet.

Serpens promises not to disappoint, with strange and much talked about objects which open the door for astrophysicists to study and understand the universe in depth. We're talking here in particular about Hoag's Object (also documented as the extremely faint galaxy **PGC 54559** in the far north-western part of Serpens Caput). Arthur Hoag discovered this faint galaxy in 1950 that at first appeared to him as a perfectly symmetrical planetary nebula, which looks indeed like a small, perfectly round haze. Heaven only knows how he found it, but what a bonus that he did, and now we can see it much more clearly through the eyes of the Hubble telescope. This face-on galaxy displays a lovely round image, with a bright, small nucleus of old yellow stars and a soft outer ring of gas and young stars. But what is strange is that another, similar, look-a-like galaxy can be seen between the nucleus and the outer ring, appearing to be situated inside the darker space – this is a very distant galaxy that we can see in this quite unique spot. I think about this small similar background galaxy as Hoag's little baby. But if all else fails, there is a nice S-shape asterism to be seen just 5' towards the west of the famous Hoag's Object. It amazes me again and again that there are so many wonderful objects to be found in space, no two of them the same – and then there's Hoag's Galaxy, which extends even further beyond the bounds of understanding.

Brian Skiff comment on this object is that it does not fade out in the "infrared Schmidt plate-scan image", and this makes him think that it is a "barred spiral", specifically one where the arms wind rather tightly into a pseudo-ring. Quote a V magnitude for the core of 15.8 (without the K-correction) and a B-V for the core of +0.96. Converting this to an ectopic magnitude using  $S = V + 0.4(B-V)$  gives 16.2.

The Serpent's lithe, slinky body slithers southwards, its path well emphasised by the magnitude 2.6 alpha Serpentis, which stands out beautifully with a slightly yellow colour. But shift you gaze westward close to the Virgo constellation boundary to get a closer view of the barred galaxy **NGC 5921**. The galaxy is known for an outstanding elongated centre bar in a north-west to south-east direction with a faint oval ring

that hints at a spiral structure east and west. But be warned: it is not at all easy to see detail through an amateur telescope. A magnitude 12 foreground star on the south-western edge of the halo can get one quite excited if you think it could be a supernova. Another star shining at magnitude 10 is situated on the south-eastern outer edge of the galaxy accompany a lovely rich star field. NGC 5921 lies about 75 million light years away from us and is also in the company of the extremely faint galaxy UGC 9830 about 36' towards the south-south-east.

Serpens is known for the beautiful globular cluster **NGC 5904** (better known as Messier 5), which is situated 3 degrees further south of NGC 5921. M5 is one of the most beautiful and brightest globular clusters in the northern hemisphere and can be easily picked out with binoculars. It is almost 13 billion light years away and about 130 light years across. In plain language, it has all the qualities of a true rich globular cluster. It displays a very dense, over-exposed core. Dark patches and lanes as well as short faint strings cover the whole of the surface and flairs out towards the outskirts of the cluster and into the star field. The edge appears like embroidery lace, with a somewhat outstanding string on the northern edge. Star members covered in nebulosity indicate more faint stars. The yellow-coloured star 5 Serpentis shines with a magnitude of 5 and could be seen as the culprit trying to take centre stage only 15' south-east of M5. It is also a double star with a magnitude 10 companion with a separation of 11". This cluster is pleasing to the eye, rich in stars and lifted out of the star field with utmost flair. A few arc minutes towards the west of M5 is a lone roundish fleck of haze indicating the galaxy **IC 4537**, barely seen, 14.5 magnitude in brightness and visible only with high power and pristine dark skies.

Close to the Ophiuchus border in the far south-east of Serpens Caput the magnitude 4.8 sigma Serpentis is situated on the cut-line of these two constellations. Only 1.3 degrees south of sigma the planetary nebula **PK 13+32.1** has its home. Charles Shane discovered the object and it is casually now known as Shane 1. With a magnitude of 12.8 overall it could

be difficult to pick up this pin-prick of light in an area that is home to several bright field stars. The position is also slightly confusing with the non-existent star numbered GSC 503 397 for the same position. An easier way of finding it is to start from the fact that the planetary is sandwiched between two lookalike relatively bright strings of stars, one to the east and another one to the west. An OIII filter is your best tool to bag this small nebula, but do not expect to see the magnitude 16 central star. The galaxy NGC 6100 can also serve as a pointer 1.4 degrees to the north-west.

Sail along, so to speak, with Serpens, right through the arm of Ophiuchus to the northern part of Sagittarius and probably the best way to find the pointed tail of Serpens Cauda. Without a doubt the north-western part of the Milky Way is saturated with starry splendour and a haziness almost resembling a smokey appearance, but which also beautifully highlights the rich nebulae and star groupings. The double star xi Serpentis shines in a superwhite colour half a degree north from the border line with Sagittarius. Point your view straight east from the star into the Milky Way to find another wonderful object that the scary snake holds in its sleek tail.

**NGC 6611**, perhaps better known as the Eagle Nebula, is situated on the eastern edge of Serpens Cauda and very close to the western border of Scutum. Also known as Messier 16, which is famous for many reasons and does not disappoint, with a selection of wonders in its dusty mist. The nebula needs to be observed with great care and time to lift out the variable pieces of nebulosity that intervene with starlight. The cloudy oval shows sections of dark and bright parts and together they filter out into the field of view. With higher power the overall nebula is defined in many rich parts. The north-eastern part of the cloud is brighter, cut into smaller sections with dark inlays, whereas the western section is more flimsy. However, the group of faint stars embedded in nebulosity towards the northern area is casually known as the Star Queen Cluster, although most of the member stars are covered in a hazy envelope. A magnitude 8 double star dominates the cluster towards the western edge. As difficult as it may be, try for the little dark finger inlet towards the southern edge

of the main concentration just north of the double star, identification **IC 4703** or the Eagle Nebula. It is not at all impossible to glimpse, but expect it to be just vaguely visible with the help of an H Beta filter and averted vision. The pillars are the effect of radiation pressure and stellar winds from the hot O-type cluster stars and hot gas that develop into pockets of interstellar dust. To appreciate this dark trunk of the Eagle Nebula look no further than the outstanding picture of the Hubble telescope – one of its most famous. There is speculation that this rich hazy part situated in the Sagittarius/Carina arm section could also belong to the same line of nebulosity as Messier 17, known as the Swan Nebula.



Fig 5. Eagle Nebula M16 or NGC6611 (Dale Liebenberg).

Another patch of nebulosity, although fainter, is situated 1.5 degrees further north with **NGC 6604** indicating the rich heart of starlight in the southern part of the nebula. It's a small group of stars, but very refreshing in shape. In a way, the stars of varied magnitude look like a miniature Corona Borealis open towards the west. A lovely bright 7.5 magnitude star forms part of the group and is situated on the eastern edge of the grouping, shining in a superwhite/blue color. This cluster is about the same distance from us as M16, but slightly obscured from the known dark rift in the Milky Way.

Fig 6. NGC6604 (Dale Liebenberg)

At the very end of the starry serpent's tail is the magnitude 4.5 and 4.9 double star theta Serpentis, situated close to the



borderline with the constellation Aquila in the far northern part of sky.

The open cluster **IC 4756**, which is just one degree south of the borderline with Ophiuchus is situated in a very rich star field. It is a rich, bright and large cluster close to a degree in size, easily seen through binoculars. It is not a close grouping; instead, the various magnitude members are spaced with faint stardust in between. The beauty of this sunshine cluster is in the different star colours, shining like crystals to appreciate through the eye of the beholder.

Serpens the constellation shows us its two faces in surprisingly different ways which are not expected but well appreciated.

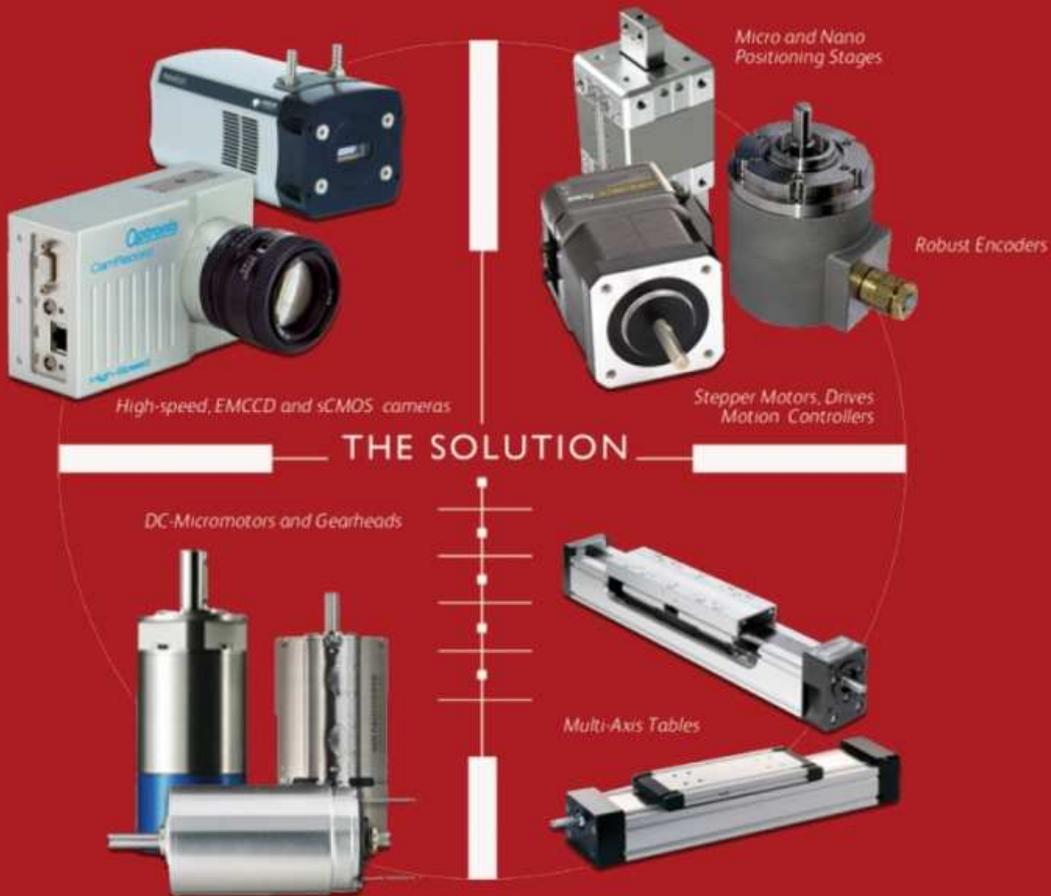
<b>OBJECT</b>	<b>TYPE</b>	<b>RA</b>	<b>DEC</b>	<b>MAG</b>	<b>SIZE</b>
NGC 6027 A/B/C/D/E	Galaxies	15h59m.2	+20°45'.2	14.3	Combine 1.3'
PGC 54559 Hoag's Object	Galaxy	15h17m.2	+21°35'.7	16	1.0'x0.9'
IC 4537	Galaxy	15h17m.3	+02°02'.8	15	0.3'x0.2'
NGC 5904 Messier 5	Globular Cluster	15h18m.6	+02°04'.8	5.7	17.4'
NGC 5921	Galaxy	15h21m.8	+05°04'.2	10.8	4.8'x4.2'
PK13+32.1 Shane 1	Planetary Nebula	16h21m.3	-00°16'.3	12.8	6"
NGC 5996	Galaxy	15h46m.8	+17°52'.2	12.8	1.8'x1.0'
NGC 6604	Open Cluster	18h18m.3	-12°14'.6	6.5	4'
NGC 6611 Messier 16	Nebula	18h18m.8	-13°47'.7	6	18'
IC 4703 Pillars	Diffuse Nebula	18h18m.6	-13°57'.2	-	120"x25"
IC 4756	Open Cluster	18h39m.3	+05°27'.2	4.6	38'

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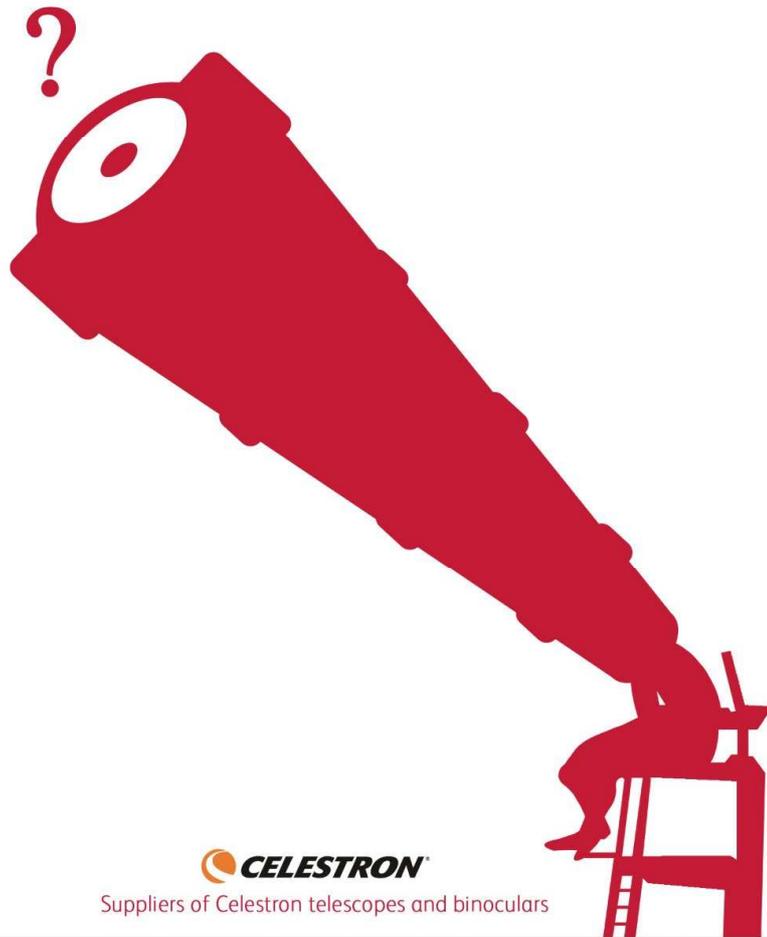


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**Publications:** The Society publishes its own electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as its annual *Sky Guide Africa South*.

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# **mnassa**

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