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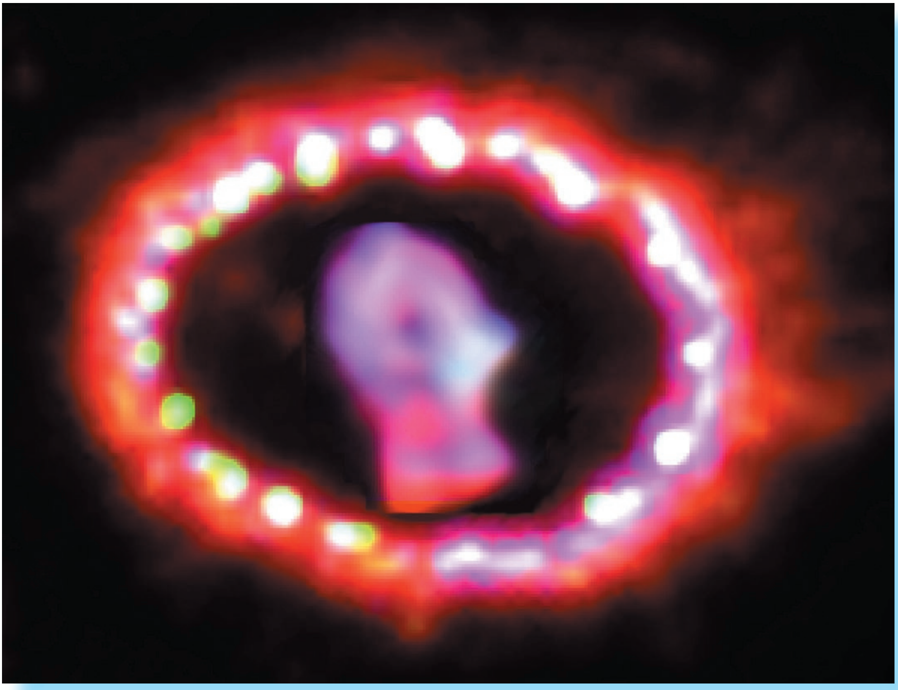
mnassa

monthly notes of the astronomical society of southern africa

Vol 71 Nos 3 & 4 April 2012



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contributions

MNASSA mainly serves the Southern African astronomical community, professional and amateur. Articles and papers may be submitted by members of this community and by those with strong Southern African connections, or else the papers should deal with matters of direct interest to this community. Due dates for contributions are:

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SN 1987A

This recent Hubble Space Telescope image of SN 1987A shows the brightening ring of supernova debris and reached its brightest about 25 years ago (see Article by Dr Robin Catchpole on p.65). The closest supernova explosion seen in almost 400 years, it is located in the Large Magellanic Cloud. (Credit: Pete Challis)

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Monthly Notes of the Astronomical Society of Southern Africa

Vol 71 Nos 3 & 4 April 2012

assa news

ASSA Symposium

Christian Hettlage

ASSA is pleased to announce this year's symposium, which will be held from 12 to 14 October 2012 at the South African Astronomical Observatory in Cape Town.

The theme of the symposium, "Looking back, looking forward", reflects the significance of 2012. On the one hand, organised amateur astronomy turns 100 this year, which will be duly celebrated at the symposium. On the other hand, hopefully by October a decision on the Square Kilometre Array will have been made. So the symposium focuses on past and future of astronomy alike.

Participants of the symposium will have the opportunity to engage in some outreach activities on 12 October. The symposium itself will start officially with a welcome evening on that day. Talks and workshops will take place throughout 13 and 14 October. In the evening of 13 October there will be a special Open Night commemorating 100 years of amateur astronomy in Southern Africa.

Online registration will be possible from 1 June, but you may submit abstracts for proposed talks before that by sending an email to *assa-symposium2012@assa.saao.ac.za*. Talks concerning the history of astronomy, the SKA project and science with the Southern African Large Telescope are particularly encouraged. Submissions for proposed workshops are very welcome as well.

The symposium website is at http://assa.saao.ac.za/symposium2012, and any queries about the symposium should be addressed to *symposium2012@assa.saao.ac.za*.

The organisers of the ASSA Symposium 2012 are looking forward to welcoming you in Cape Town! ☆

Anysberg Cape Centre - Students Star Party

Kechil Kikham

Thirty Astronomy enthusiasts, half of which were Cape Centre members, the other half made up of UCT and UWC students, left for Anysberg Nature Reserve on 17 March 2012 for two nights of star-gazing. Two coaches were hired from UCT Transport and Cape Nature's reserve was taken over for the duration. This venue was chosen by organiser Kechil Kirkham as being ideal, having worked on the development of astronomy-based facilities at the reserve with Chris de Coning. The trip was subsidised by the SAAO and by the Cape Centre.

As well as two nights of excellent seeing with many and various telescopes, there were demonstrations and talks centred on the practicalities of star-gazing and the use of telescopes.

The central purpose of the trip was to effect knowledge transfer between seasoned amateur astronomers in the Cape Centre and the students, who are keen amateurs but who have not had the opportunity for intensive star-gazing in a dark location. In turn, students enlightened Cape Centre members on pertinent subjects they had recently studied.

One of the students, UCT Astronomy Club Chair Kerry Paterson, was studying Astronomy as an undergraduate. There was one Astronomy PhD student, Solohery Randriamampandry. The rest were studying Physics (with electives in Astrophysics), Computer Science, and

Students with Marius Brand, Reserve Manager – tall man in the back row!

John Richards giving a Dobsonian demonstration.

Pictures: Kechil Kikham

various branches of Engineering with one exception, Stefano Moreira, who was studying Anthropology, Psychology and Politics.

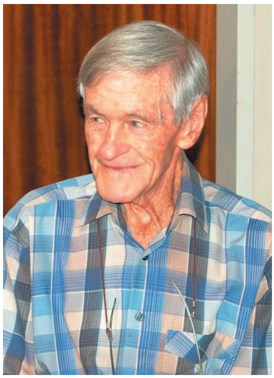
It was altogether an enjoyable and successful trip, and one which all wish to repeat. We all learnt a tremendous amount. ☆

Getting ready for a night of observing, from L to R: Stefano Moreira, Chris de Coning, John Richards and Wim Filmalter.

Jannie Smit receives a special award from the AAVSO

Brian Fraser

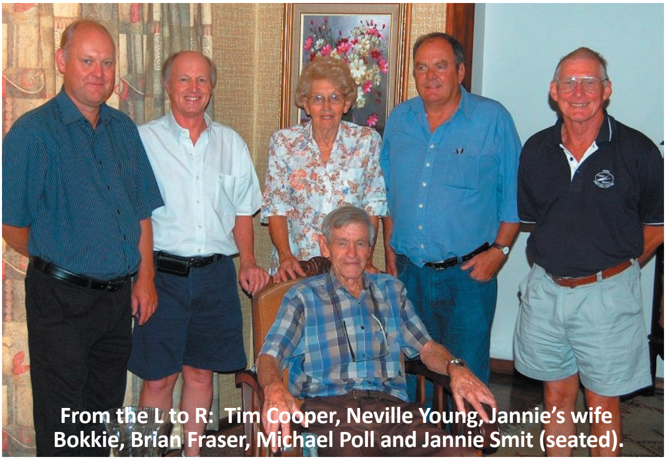
Dr Jannie Smit has been a member of the Pretoria centre for many years, and has been involved in many of their activities. But due to health problems Jannie has decided that he can no longer continue with his variable star observations. At the age of 87 and after seven major operations since his 70th birthday, he has now hung up his eyepieces, after contributing more than 19 000 observations to the AAVSO data base in a period stretching from 1986 to 2010.



To acknowledge and celebrate his contribution, the AAVSO organized a special award in the form of a plaque which was handed over to Jannie at an informal tea party at his home on 25 February 2012. Joining in the party were five members of the Astronomical Society of Southern Africa, including three past-presidents, Tim Cooper, Michael Poll and Brian Fraser, who, incidentally, are all AAVSO contributors. They were joined by Johan Smit and Neville Young, members of the Pretoria centre of ASSA, where Jannie was a long-time member.

The citation of the award reads as follows:

"...in recognition of his valuable contribution to the AAVSO International Database since 1986 of 19 027 visual observations of Southern Hemisphere variable stars; his contributions to minor


From the L to R: Tim Cooper, Neville Young, Jannie's wife Bokkie, Brian Fraser, Michael Poll and Jannie Smit (seated).

planet occultation work; his mentoring of many younger observers in the art of variable star observing; and his public education efforts in introducing basic astronomy to the public during the open evenings and star parties at the Pretoria Centre of the Astronomical Society of Southern Africa."

Other AAVSO Awards to South African observers

Solar Observer Awards at the AAVSO 100th Annual Meeting, Woburn, Massachusetts, 2011

In order to recognize the contributions of AAVSO Solar Section contributors, the AAVSO Solar Observer Awards (sunspots only) were initiated at the 1999 Annual Meeting. Sunspot awards are presented to solar observers who have reached milestones of 1 000, 1 500, 2 000, or subsequent increments of 500 sunspot observations by September of a given year. In 2004 a SID awards program was implemented to give equal recognition to SID observers. SID awards are presented to solar observers who have reached milestones of submitting 40 months of SID reports or subsequent increments of 40 SID reports by September of a given year.

The citation of the Sunspot award reads: "For a cumulative contribution since 1999 of 1 500 sunspot observations in support of the American Relative Sunspot Number program and service to the AAVSO Solar observing program."

The citation of the SID award reads: "For a cumulative contribution of SID data reports for at least 40 months in support of the National Geophysical Data Center SID Database and service to the AAVSO Solar observing program."

1 000 Observations – Jacques van Delft South Africa.
2 500 Observations – James & Shirley Knight South Africa. ☆

Spring SSP at Night Sky: 21-23 October 2011

Edward Foster

After the success of the first Southern Star Party (SSP) (see *MNASSA* 70, 3&4, Apr 2011, p.49) the organizing committee, Auke Slotegraaf Edward Foster and Lynnette Foster, set out to hold another Star Party at the same venue from 21 to 23 October 2011. These dates were decided on after being assured by local farmers (all self-confessed experts on local weather conditions of course) that October was perfect. It was, except for the mini-gale on Friday evening and most of Saturday, which had all the locals shaking their heads and muttering about how unusual and unpredictable the weather was!

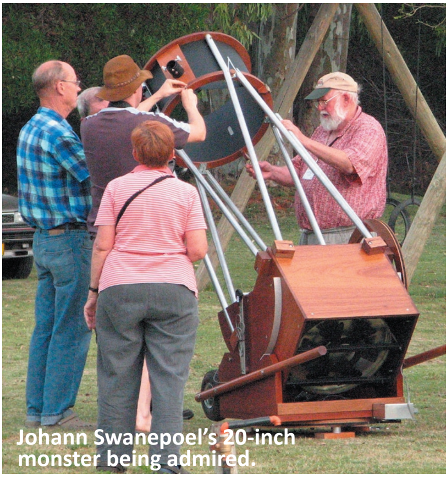
Each person at the Star Party received a "goody bag" containing all the information about the weekend, as well as a nifty key ring and a pen with the compliments of Eridanus Optics. The attendance was not as good as for the first SSP in March as we were competing with the finals of the Rugby World Cup, but what we lacked in numbers we certainly made up for in enthusiasm. The lectures by Christopher Middleton (SKA), Kos Coronaios (Practical Astrophotography), Wim Filmhalter (Astronomy Outreach Demo), Martin Lyons (Video Astrophotography), Evan Knox-Davies (Introduction to radio telescopes and SKA/KAT) and Edward Foster (Fossils, Light and Time) were all very well attended.

The Astro Quiz was once again popular, with John Richards becoming the new holder of the coveted floating rosette held by Evan Knox-Davies since the March SSP. During the course of the

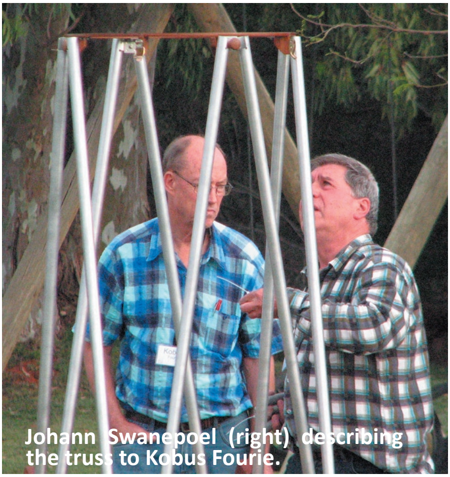
Wim Filmalter's 8-inch *BikeScope*, which fits into his backpack packed.

Wim's *BikeScope* being assembled!

Pictures: Kos Coronaios



Johann Swanepoel's 20-inch monster being admired.



Johann Swanepoel (right) describing the truss to Kobus Fourie.

Pictures: Ed Foster

get together various spot prizes, lucky draws and a raffle saw attendees walking away with solar filters and a lens cleaning pen (both courtesy of Eridanus Optics), a Galileo scope (courtesy of Kos Coronaios) and a 5-inch telescope with all the trimmings (courtesy of Auke and Edward), various book prizes, bottles of wine and SSP coffee mugs (courtesy of the organizing committee).

Friday night was not at all kind to us as far as stargazing was concerned with wind, loose clouds and high level haze playing havoc with all attempts at serious viewing or photography and also hampering the efforts of the participants in the observing challenge. Even the Orionids let us down and in particular frustrated Kos no end as he seemed to consistently have his camera pointed in the wrong direction when the odd one did appear.

Saturday night was clear, with no wind and good viewing conditions even though there was some moisture in the air to the South as a result of the cold front sliding past other side the Riviersonderend Mountains. Auke reported that it was not possible to resolve the two lobes of eta Carinae's "Homunculus" due to the moisture. On the other hand people were getting excellent views of Jupiter over to the north. The much improved weather on Saturday night enabled Pierre de Villiers and his son Andrè, as well as Wim Filmalter to complete the observing challenge and receive certificates for their efforts. On Sunday Kos and Ketchil left early as they had early commitments elsewhere, while the rest of us packed up and departed in a more leisurely fashion.

The Autumn 2012 SSP (Friday, 20 April to Sunday, 22 April) promised to be bigger and better! ☆

New Directors for SA Observatories

Ian Glass

The uncertainties over which country is to get the SKA and various other matters have left both our national observatories without permanent heads.

There were four candidates for the directorship of SAAO (South African Astronomical Observatory) when it was advertised but negotiations with the preferred candidate could not be concluded satisfactorily. Pending a new search, Prof Patricia Whitelock has been appointed for one year as Director of SAAO, effective 1 February 2012.

During the sabbatical leave of Prof Peter Dunsby, Director of the NASSP (National Astronomy and Space Science Programme), Prof Whitelock was acting in his place. Dr Kurt van der Heyden will take over from her until Dr Dunsby returns.

According to an announcement from the National Research Foundation, Dr Mike Gaylard has been appointed Managing Director of HartRAO on a fixed term of one (1) year commencing 1 April 2012, pending the finalization of decisions regarding future arrangements related to the management of astronomy facilities in the country.

National Astronomy Meeting

A national astronomy meeting of the professional community will be held in Pretoria on 8 and 9 July. This is being timed to precede the South African Institute of Physics meeting. Note that abstract submissions closed on 13 April. No further details were available at the time of writing. ☆

News from the SKA

Canada joins the SKA Organisation

The world's largest radio telescope project receives further international support as Canada signs up.

19 March 2012, Manchester, UK – The Board of Directors of the Square Kilometre Array Organisation has formally welcomed Canada, represented by the National Research Council of Canada, as the eighth member of the organisation. The members plan to spend €69M to fund the project in the period leading up to the construction phase of the SKA telescope which starts in 2016.

Dr Gregory Fahlman from the National Research Council of Canada, and Professor Russ Taylor from the University of Calgary, have been appointed to represent Canada on the SKA Board. Several research organisations across Canada are already involved in research and development for the SKA and will continue to work with the SKA Organisation.

"The international partners in SKA are extremely pleased that Canada has now formally joined the project. Our Canadian colleagues bring a history of technical and scientific strengths to the partnership and we very much look forward to working with them to make SKA a reality," says John Womersley, chair of the Board of Directors of the SKA Organisation.

As a member, Canada, along with China, Italy, the United Kingdom and the Netherlands, is eligible to vote on the location of the SKA. Member countries that are involved in bids to host the SKA (Australia, New Zealand and Southern Africa) will not take part in the selection process.

Final Decision on SKA delayed

4 April 2012, Amsterdam, the Netherlands – The Members of the SKA Organisation met at Schiphol, the Netherlands, on 3 April 2012, for their first General Meeting. They noted the site selection advisory committee's report and the associated commentary that had been passed to them by the SKA Organisation's board following the board meeting in Manchester last month.

The Members wished to move ahead with the site selection process, and recognised that it is desirable to maintain an inclusive approach to SKA. They noted that it is important to maximise the value from the investments made by both candidate host regions. They therefore agreed to set up a small scientific working group to explore possible implementation options that would achieve this. This working group will report back to the Members at a meeting in mid-May; its report will provide additional information to facilitate the site decision for SKA.

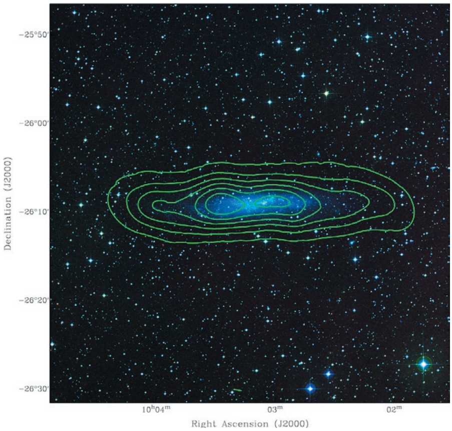
The Board of the SKA Organisation met on 4 April, following the Members meeting, and discussed progress of the project. The Board approved an application for Associate Membership in the SKA Organisation from India (represented by the National Centre for Radio Astrophysics).

http://www.skatelescope.org/news/ska-members-meet-discuss-site-selection/

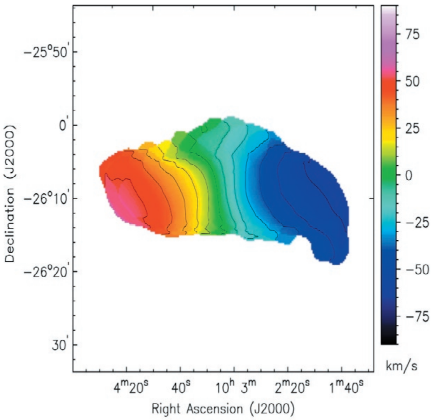
Extra-galactic milestone for South Africa's KAT-7 telescope

First atomic hydrogen spectral line images of a nearby galaxy, 14 March 2012.

South Africa's KAT-7 telescope, a seven-dish array which is a precursor to the



The green contours in this image show the distribution of the atomic hydrogen gas overlaid on an optical image of the same galaxy - showing clearly that the emissions from the hydrogen gas come from a much larger region than that seen by the optical image. (The Digital Sky Survey was produced at the Space Telescope Science Institute under US Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope.)



This image shows that the galaxy is rotating with the blue towards the viewer and the red away. The rotation is not uniform and the structure can be used by astronomers to model the distribution of matter in the galaxy. Current thinking is that most of the matter is actually dark matter, which can't be seen but whose presence can be confirmed by these kinds of observations.

much larger MeerKAT telescope in the Karoo and to the Square Kilometre Array, has reached another major milestone by observing the radio emission from the neutral hydrogen gas (HI) in a nearby galaxy. Hydrogen gas emits radio emission in a spectral line at a very specific frequency of 1420 MHz.

The astronomers pointed the telescope towards a galaxy called NGC 3109 - a small spiral galaxy, about 4.3 million light-years away from Earth, located in the constellation of Hydra. The observation allowed them to see the HI radio emission of this galaxy, as well as to see how this galaxy is moving. Where the gas is moving towards us, the frequency of the spectral line is Doppler-shifted upwards; where the gas is moving away, the frequency is shifted down. In this way, astronomers can map the way in which all of the gas in the galaxy is moving.

"These exciting results achieved by KAT-7 have given us confidence that we know how to build a cutting-edge radio telescope in Africa to answer some of the fundamental questions in radio astronomy", says Dr Bernie Fanaroff, director of SKA South Africa. "Our team in the SKA South Africa Project and universities has again shown that they can deliver cutting-edge technology and do excellent science on a very tight schedule."

"A large proportion of the science planned for the SKA - and MeerKAT - involves mapping of the universe using neutral hydrogen. Because of the ongoing expansion of the universe, distant galaxies are moving away from us. Measuring the frequency of the spectral line from neutral hydrogen in those galaxies allows us to work out how far away they are. By finding billions of distant galaxies, astronomers will be able to map the structure of the universe and how it has changed over time. This cosmic census of the neutral hydrogen in galaxies - far and near - is essential in understanding the deeper physics of the universe, by answering fundamental questions such as the nature of dark matter and dark energy."

"Observations of the neutral hydrogen content of galaxies also help to form a picture of how galaxies have evolved over cosmic time and show how our own galaxy, the spiral galaxy called the Milky Way, has developed," Fanaroff adds.

The radio waves which KAT-7 picks up from the galaxy were processed in the correlator, the first stage of computing. The correlator currently allows measurement of the gas velocity to an accuracy of 10 km/s. Further upgrades during 2012 will enable astronomers to study this galaxy with a velocity resolution of 1 km/s.

"Such a high velocity resolution will allow us to distinguish between the conventional models which suppose the presence of an important quantity of dark matter (matter that cannot be seen but that is detected by its gravitational influence) and the Modified Newtonian Dynamics (MOND) models which suppose that no dark matter is present but that it is instead the laws of gravity that change on galaxy scales," explains Prof Claude Carignan, South African SKA Research Chair in Multi-Wavelength Astronomy at the University of Cape Town (UCT).

"We also speculate that an unusual warp in the disk of this galaxy could be caused by a tidal interaction with its dwarf companion galaxy known as Antlia," Carignan adds. "Future KAT-7 observations should reveal more information on this possible interaction."

"It is particularly exciting that we will soon be able to derive new scientific results with a relatively small precursor array," says Bradley Frank, PhD student at UCT and lead researcher for the HI imaging of nearby galaxies with KAT-7. ☆

Atacama Large Millimetre Array (ALMA)

High up in the Atacama desert, 5 000 m above sea level, trucks stall on the road to this plateau where scientists are installing one of the world's largest ground-based astronomical projects, until SKA gets built! Heads ache, noses bleed and dizziness overcome scientists working here. The lack of oxygen gives you jelly-legs, just like you've run a marathon! This is even higher than Mauna Kea in Hawaii.

Still, the same conditions that make the Atacama, Earth's driest desert, (Antartica is drier) so inhospitable make it beguiling for astronomy. In northern Chile, it is far from big cities, with little light pollution. Its arid climate prevents radio signals from being absorbed by water droplets. The altitude, as high as the Himalaya base camps for climbers preparing to scale Mount Everest, places astronomers in an ideal position to do sub-millimetre work.

Opened last October, the Atacama Large Millimetre/submillimetre Array, known as ALMA, will have spread 66 radio antennas near the spine of the Andes by the time it is completed next year. Drawing more than $1 billion in funding mainly from the United States, European countries and Japan, ALMA will help the oxygen-deprived scientists flocking to this region to study the origins of the universe.

The project also strengthens Chile's position in the vanguard of astronomy. Observatories are already scattered throughout the Atacama, including the Cerro Paranal Observatory, where scientists discovered in 2010 the largest star observed to date, and the Cerro Tololo Inter-American Observatory, which was founded in 1961

But ALMA opens a new window for astronomy in Chile, which is favoured by international research organizations for the stability of its economy and legal system. Like other radio telescopes, ALMA does not detect optical light but radio waves, allowing researchers to study parts of the universe that are dark, like the clouds of cold gas from which stars are formed.

A panoramic view of progress at the ALMA Operations Support Facility.

Loading a telescope onto OTTO.

OTTO taking one of the telescopes to the Site Erection Facility.

Still, scientists believe ALMA will make transformational leaps possible in the understanding of the universe, enabling a hunt for so-called cold gas tracers, the ashes of exploded stars from a time about a few hundred million years after the Big Bang that astronomers call "cosmic dawn."

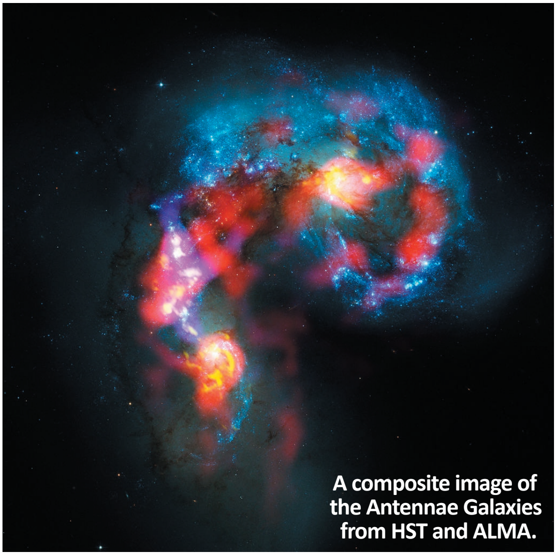
Chile is not the only country luring big investments in astronomical projects. South Africa and Australia are competing to host an even bigger radio telescope, the Square Kilometre Array, which would be fully operational by 2024. China has begun building its own large radio telescope in a craterlike setting in the southern province of Guizhou.

With ALMA, astronomers hope to see where the first galaxies were formed and perhaps even detect solar systems with the conditions to support life, like water-bearing planets. But the scientists here express caution about their chances of finding life elsewhere in the universe, explaining that such definitive proof is likely to remain elusive. Thijs de Graauw, a Dutch astronomer who is ALMA's director says that they might see life's signatures, but not life!

At the same time, the financial crisis in rich industrialized countries has raised concerns that funding for some ambitious astronomy projects could face constraints. In the United States, a Congressional panel last year proposed killing NASA's James Webb Space Telescope before a compromise spending plan saved the project.

ALMA's Operations Support Facility, at an altitude of about 2 700 m, houses about

500 researchers and other staff in shipping containers turned living quarters. In a system similar to that on offshore oil platforms, scientists have daily shifts lasting up to 12 hours for 8 days straight, which means there are quiet zones for those who sleep during the day. Supervisors enforce other rules, ensuring a work environment is austere: alcohol is prohibited, and those found drinking after trips into San Pedro de Atacama, a town about 30 minutes away by car, must dry out at a security checkpoint before entering the futuristic complex.



A composite image of the Antennae Galaxies from HST and ALMA.

Developments elsewhere in Chile occasionally raise eyebrows here, like anti-government protests that have rocked remote regions of the country this year and spread in March to the nearby mining city of Calama de Graauw, is not concerned, he sees them as part of a democratic process, not a revolution.

Still, it seems at times that the astronomers stationed here are as far removed from the world around them as the miners working beneath other parts of the Atacama. English predominates as the observatory's language, tying together scientists from dozens of countries.

A sense of awe still accompanies the installation of each new antenna. Two giant German-manufactured transporters, each with 28 tires and engines equivalent to two Formula 1 racing vehicles, are used to transport the antennas. Called Otto and Lore, they look like massive mechanized centipedes making their way across the arid landscape.

By the summer of 2011 sufficient telescopes were operational during the extensive program of testing prior to the Early Science phase for the first images to be captured, (see Fig 4; HST and ALMA composite image). These early images give a first glimpse of the potential of the new array that will produce much better quality images in the future as the scale of the array continues to increase.

Edited from the *New York Times* and Wikipedia. ☆

McClean Telescope back in service

Ian Glass

The group "Friends of the Cape Town Observatory" has been concerned for a long time about the deterioration of the older telescopes and their buildings. The McClean telescope that dates from the late 1890s had suffered particularly from neglect. No money and little technical effort were available to attend to buildings and instruments that are not in active use for research. This in spite of the fact that the McClean telescope is one of the most popular items shown to visitors on open nights and that many schoolchildren visit the Observatory, particularly this telescope and the Astronomical Museum next to it.

The rising floor, a highlight for many visitors, was no longer functional because the hydraulic accumulator that stores the energy to raise it was leaking faster than its feed pump could supply high-pressure water. The shutters could no longer be opened because of rusted, seized and distorted parts. The dome was black with algae. But where was the money for repairs to come from?

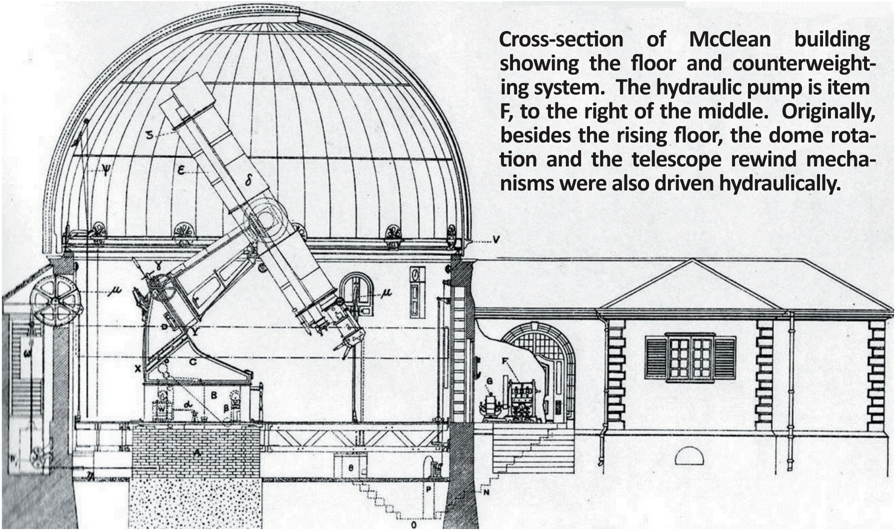
In August last year the miracle happened. The Department of Science and Technology decided that the ideal place for a reception for Science ministers of the Group of Eight Countries would be the former Royal Observatory, in particular the McClean telescope. They had to be told that the then condition of the installation was hardly a credit to South Africa. Fortunately, they agreed to finance the needed refurbishment.

The Rising Floor

The rising floor weighs twelve tons and is supported by three counterweights, each of 3.5 tons. By admitting water under a pressure of 500 psi (35 Bar), a hydraulic slave cylinder can lift the remaining 1.5 tons, plus the weight of eight to ten people on the floor. A maximum height of just under three metres can be reached and can be adjusted to within a few mm.

The system was built by the Glenfield Company in Kilmarnock, Scotland which still exists today. However, on being contacted by Dougie Metcalfe of the instrument workshop, it turned out that they did

Re-fitting the seals of the McClean's floor hydraulic accumulator. All pictures by W.Koorts



Cross-section of McClean building showing the floor and counterweighting system. The hydraulic pump is item F, to the right of the middle. Originally, besides the rising floor, the dome rotation and the telescope rewind mechanisms were also driven hydraulically.

not have records earlier than 1910. Some information was available from Sir David Gill's *History and Description of the Royal Observatory, Cape of Good Hope*. It was not easy to find a contractor to quote on repairing such ancient equipment, similar to that used until recent times to raise the bascules of Tower Bridge in London. Seven companies were approached by Dougie. Eventually Marvan Hydraulics were located and its owner Tienie Maritz became an enthusiastic partner in the overhaul. On removal of the massive steel piston of the hydraulic accumulator, it was obvious that the seals were in a poor state. A complete new system of chevron seals and guides using modern materials that could take up some of the wear was manufactured and installed. Though the slave cylinder could still receive attention, the repair was highly successful and the floor is once again delighting and surprising visitors.

The Dome

The next problem was to get the dome back into working order. This item is large. It is of 36 feet (11 m) internal diameter and was constructed by T. Cooke and Sons of York. The framework is of angle-steel, attached to a circular cast-iron girder. The covering was originally of papier mâché.

An examination of the dome conducted about two years ago by one of the Friends, Wim Filmalter, showed that serious maintenance would have to be performed.

The shutters roll on a rail on the opening side of the dome and are hinged near the bottom on the opposite side, additional support being provided by another rail near the top of the structure.

When the money for repairs became available, DCD Dorbyl Marine was en-

Lifting off the first shutter.


Wim contemplating the scene.


Wim at work on the dome.

Pictures: Willie Koorts

gaged under the supervision of Wim, as Project Manager for the job. It was necessary to remove them using a crane and to dismantle them in part so that they could be transported to workshops in the docks for replacement of rusted metal parts and rotten covering material. They were returned for re-installation only just in time for the visit of the Science ministers.

It was up to Wim Filmalter to him to get everything re-adjusted and working properly in time. The reconstructed shutters did not fit well or move easily at first and required considerable work to get operating smoothly. The building was repainted externally and, in part, internally. Even the blackout shuttering of the laboratory had to have sash cords replaced. Wim cleaned the dome with a high-pressure spray. He replaced the cover sheeting and added waterproofing where necessary and finally put on a new coat of paint.

Happily the repairs were completed on time and the reception went off smoothly.

On 24 March the Friends organized a special event in the dome to celebrate the successful refurbishing and thank those who had contributed. Presentations were made to Wim and the contractors. The following Saturday night lecture was on the history of the telescope and dome. ☆

STATION 13 – South Africa's Area 51?

Greg Roberts
grr@telkomsa.net

Anyone who has watched a bit of television will no doubt have heard of Area 51. A top secret military base in the United States rumoured to have captured UFOs and home of top-secret high speed aircraft. Even more secret is the so called STATION 13 that was situated near Babsfontein between Johannesburg and Pretoria during the 1960s to mid 1980s. Despite an intensive search on the Internet and in literature covering space activities in South Africa during that period, there is no specific mention of this station.

So what was STATION 13?

In April 1966 I managed to have a first encounter with it and what follows is what I have been able to glean/deduce. How it came about was that I was looking for the Baker-Nunn satellite tracking camera at Olifantsfontein where I was to present myself for an interview for the position of a camera operator/observer. So on the Saturday afternoon I drove from Pretoria in the general direction of Olifantsfontein.

As is customary with me, I always get lost the first time I'm going somewhere. Realising I was lost, I looked for somewhere to ask directions and eventually came to a dirt road that branched off the main road which had a prominent STRICTLY NO ADMITTANCE sign! Next to the closed gate was a long trailer about 3-4 metres high and probably about 12 metres long. I could not see any antennas at the trailer, but in the distance, probably 6-8 km away, hidden by a dip in the terrain, one could see the top of a large radio dish. I immediately knew this was the Babsfontein tracking station about which I had heard rumours. Since I do not usually take notice of signs like these, I opened the gate and entered the trailer. I was met by a young man in US military uniform and behind him were racks of electronic equipment with several other men in uniform. I immediately realised this was a unit setup for the radio tracking of satellites.

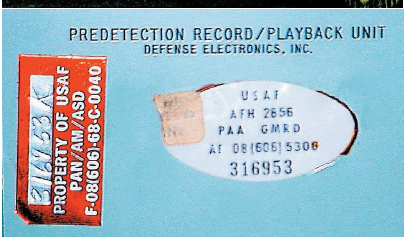
I explained my predicament and asked for directions and if I could use their telephone to inform the Baker-Nunn station that I would be late. This he agreed to and led me into a small office with a telephone. As I made the phone call I had a good look around. On the desk was some letter-head paper which identified the place as belonging to the United States Air Force, operated by Pan American Airways (PAA) and was part of the Eastern Missile Test Range (which was used for launches from Cape Canaveral in the United States.)

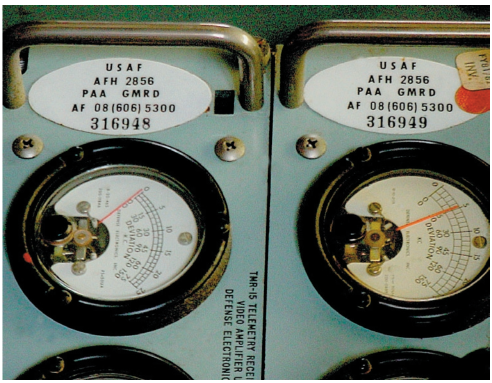
I now had a good idea which objects they were tracking as I was familiar with most of the satellites transmitting at the time, as I had been tracking them myself with my homemade setup. But anything I asked the soldier was met with a non-committal "No comment" to each question even when I specifically told him which satellites they were tracking. He would not allow me to take any photographs nor travel further along the road in the direction of the large dish on the horizon. I had to leave somewhat unsatisfied.

Now step forward to 1982-1983

As a result of political pressure applied by various governments against South Africa's apartheid policies, the United States closed down all tracking facilities in South Africa. Since it was apparently too expensive to return everything back to the United States, most of the equipment was sold as scrap – in many cases intact and still operational. No doubt the more sensitive equipment was either destroyed or otherwise disposed of. I was unable to attend the auction – I was living in Durban at the time and anyway had no money. A friend was able to purchase a fair amount of equipment for the Wits University Physics Department and in due course some of the surplus came into my hands – which I still have. I am reasonably certain that what was sold as scrap was basically obsolete, as by the 1980s the use of certain frequencies had been or were being phased out.

Most of the equipment has various labels stuck on it. One is for obvious audit purposes, showing that the inventory was last checked in Fiscal Year 1981-1982, so this must have been just prior to the station being closed down. Other labels state "Property of USAF", "PAA GMRD" (Pan American Airways Guided Missile Range Division) and "ETR" (Eastern Test Range).



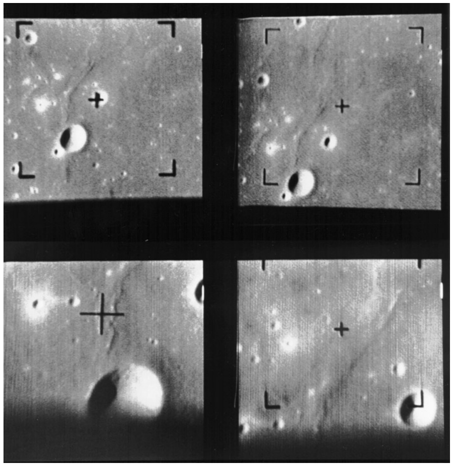


Some of the pieces of equipment recovered by the author showing the USAF lables.

Frequency coverage

From the frequency coverage of the receivers, I doubt very much that I have a complete set, as the United States had a fair number of classified satellites in orbit for which no frequency information was publically available (nor has been made available subsequently). Some of the tracking activities covered the SECOR (Sequential Correlation of Range) satellites which transmitted a series of musical tones. This gave the accurate distance to the satellite and was used for more accurate mapping of the Earth's surface – this was before the advent of the Global Positioning System (GPS) satellites. The early NAVY navigation satellites (150/400 Mhz) were also tracked – probably for accurate time. One receiver covered the frequencies used by the MERCURY/GEMINI missions as well as the STS (Space Transportation System), more commonly known as the Space Shuttle.

Of more particular interest is the equipment covering 960 MHz. The only spacecraft ever to use this frequency (as far as I know) was the early RANGER craft (1961-1965) – and possibly other lunar missions – where a spacecraft was deliberately crashed into the moon and a sequence of photographs transmitted until the moment of impact. The Ranger craft transmitted in two channels on 960 MHz, one transmitter at 3 W and one at 50 mW, using two antennae – one high gain and the other omnidirectional. I have both the receiver and the preamplifier used for this mission. The pre-amp was located at prime focus of the large dish.



A typical RANGER series of images. This one was taken by RANGER 7 at an altitude of about 250 km above the floor of Mare Numbium and about 90 seconds before impact.

Antennae

Just how large was their main dish and what happened to it? From what I recall it was 84 feet (~26 m) in diameter. This makes it a twin of the dish at Hartebeesthoek, which was originally part of the DEEP SPACE TRACKING NETWORK and is now HartRAO. According to what literature I could find, all 84-foot dishes manufactured were accounted for, so where did this one come from? Unfortunately I never got close enough to it to see if it was similar to the one at HartRAO. I understand it was sold as scrap for R3 000 with the proviso that the buyer remove it from site. Apparently the new owner soon found out that he had bitten off more than he could chew. I have no idea what eventually happened to it.

A large antenna array for 136 - 138 MHz was sold to an electronics company in the Johannesburg area and was erected at the entrance to their premises, purely for impressive cosmetic effect. One (or maybe more) fully equipped tracking vans were “sold as is” – I have no details of the purchaser/s, etc. No doubt antennae for other frequencies were also disposed of.

Some of the equipment obtained by the Wits Physics Department was modified and set up at a Weather Bureau site. This included a dish of a few metres in diameter that had been used for hail research and was to be used for radio astronomy. I have no information if this project ever came to fruition.

More clues, more questions

I do not recall where I got the station identification as STATION 13. It might have been a confusion by someone else, as the Baker-Nunn station at Olifantsfontein had a station identification number of 9013.

The involvement of Pan American Airways was initially puzzling but the Internet solved that. The Pan American Airways Guided Missiles Range Division (PAA GMRD) was a prime contractor to the USAF and was responsible for providing operations and maintenance for the Eastern Test Range. But a little more confusing is that South Africa was not part of the eastern test range. This station was so secret there does not appear to be any mention of it in the descriptions of the Goddard Missile Range or the Eastern Test Range to be found on the Internet today.

What was such a big dish used for, apart from lunar missions? Was it used for deep space missions? All in all there is virtually no information available on this station. Is there anyone in South Africa still alive today who can shed more light on this? From the little I saw, only people in United States uniform were employed – so did this exclude locals?

Conclusion

To conclude, I don’t think they had any captured UFOs – but who knows? But what seems certain, is that we had our own Area 51! ☆

25 Years after Supernova 1987A

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At 07:35 UTC (09:35 SAST) on Monday morning, 23 February 1987, a wave of neutrinos swept through the Earth, heralding the appearance of the brightest supernova (SN) to be observed for almost 400 years and since the invention of the telescope. After passing through the Earth, a total of 13 neutrinos were detected over a period of about 10 seconds, in Japan, the USA and Russia. They were only noticed when records were examined after the optical detection.

The neutrinos came from the photo dissociation and collapse of the iron core, forming a densely packed neutron core, in the centre of a star, 163 000 light-years away in the Large Magellanic Cloud (LMC). The resulting shock wave, created when the in-falling outer layers of the star bounced off the neutron core, raced back to the surface, releasing an enormous flash of UV light, about three hours later.

When the neutrinos arrived, it was already Monday night in New Zealand and within two hours Albert Jones was looking at variable stars in the LMC and saw nothing unusual. Almost three hours after the arrival of the neutrinos, Robert Mc Naught in Australia, unknowingly first detected the supernova, when he took a photograph of the LMC, which, sadly, he did not develop until after the official discovery of the SN. Meanwhile, Southern Africa swept into Monday night and although it was clear at Sutherland, the astronomers were too busy to notice the LMC.

Later that night at 05:40 UTC on the morning of 24 February, Ian Shelton a night assistant at the Las Campanas Observatory in Chile, pulled his recently exposed photographic plate out of the fixer and saw a dark spot. After a quick look at the sky and consultation with his colleagues, he knew he was looking at a supernova. Communication problems meant a message had to be taken by car to La Serena, 100 km to the SW, before it could be relayed to the USA and announced in an IAU telegram.

By then New Zealand had returned to night and at 08:53 Albert Jones independently discovered the SN. Word spread fast in New Zealand and on to Australia.

As the Sun set over South Africa on the evening of the 24th, Brian Warner, then in Texas, passed the news by phone to John Menzies at Sutherland, who took the first spectrum and photometric observations, commenced almost simultaneously in Sutherland and Cape Town.

That evening I received a phone call from SAAO Director, Michael Feast, instructing me to proceed to Sutherland the next morning and begin *JHKL* infrared photometry. I went outside, looked up at the sky and even without binoculars, could see the supernova, although I do remember thinking it was a bit fainter than I expected.

SN1987A was indeed fainter than a normal type II supernova. The total energy released depends on the mass of the star, while the optical manifestation, which only accounts for about 0.01 per cent of the total energy, depends on the radius of the star. A blue supergiant has a much smaller radius than a red supergiant. This means for a given expansion velocity, the radius and surface area increase proportionally much faster and so the surface cools much faster. The neutrinos carry away about, 99 percent of the Supernova energy, leaving about one percent in the kinetic energy of the expanding debris.

Although the details of the explosion and the subsequent rapid neutron-capture that creates most of the elements beyond iron in the periodic table, are very complex and difficult to model, the total energy of the event can be equated to the release of the gravitational potential energy, when an Earth sized, solar mass iron core, collapses to form a neutron star about 20 km in diameter. In this case it is about 3 x 10^{53} erg. It is the one percent of this energy that drives the observed SN explosion.

Thanks in part to observations by the International Ultraviolet Explorer (*IUE*) satellite, it was soon established that the progenitor star was the blue supergiant, Sanduleak -69^{o} 202. It showed a slightly distorted image on photographic plates, because it was blended with two fainter stars, that were subsequently clearly resolved by the Hubble Space Telescope (HST).

Having a spectral type and magnitude for a SN progenitor was another first, although no one expected it to be a blue supergiant, as all the

The author demonstrates how he occasionally had to observe the SN with the 0.75m telescope at Sutherland. Although the SN is circumpolar, at some seasons it had to be observed at large air-mass.

theoretical models predicted that only red supergiants became type II SN.

Within a day and a half of core collapse, the SAAO was obtaining $UBV(RI)_{Cousins}JHKL$ and after day 135, *M* (4.8 µm) photometry.

At the end of the first week a meeting was held at SAAO, under the direction of Michael Feast, where it was decided to obtain as complete as possible spectroscopic and photometric coverage, not only by using local expertise, but through the donation of time from the stream of visiting astronomers, who's contributions would be acknowledged by co-authorship. These data would then be made available to the community as soon as possible.

The first paper, covering the first 50 days, was accepted for publication in less than 4 months after core collapse. A total of seven papers were published, giving data up to day 1770, with a total of 70 different authors, receiving 543 citations to date. This marked the end of useful ground-based observations, because by then, the flux from the remnant was comparable with that from the ring and the nearby stars.

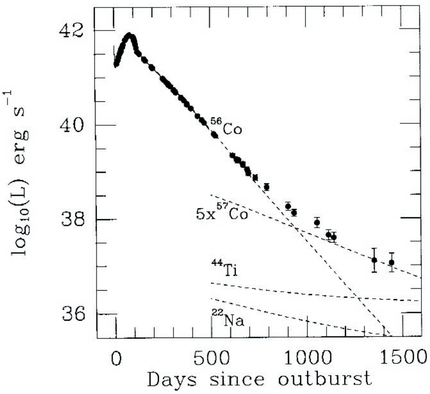
The broad coverage of the photometric bands made it possible to estimate the total, or bolometric flux, being radiated by the SN, which is the parameter most easily compared with theoretical models. It also enabled estimates of the radius and surface temperature to be made, assuming the SN radiates like a black body, which it does in its early stages. At its most luminous, 90 days after core collapse, the photosphere was about the temperature of the Sun and almost three times the diameter of Neptune's orbit. After that the photosphere grew smaller as the expanding debris became more transparent and was no longer a useful concept after day 120.

Polarization observations made at SAAO suggested the expanding fireball was not circularly symmetric, which can be seen in the shape of the debris now visible inside HST images of the ring.

The SN reached a maximum visual magnitude of *V*=2.95, 75 days after core collapse, which meant it could only be observed with the Sutherland 0.5-m telescope, using 5 neutral density filters, including a mechanical mask with two 10 cm holes in it. This meant the 0.5-m telescope, effectively became a 5 cm telescope. We were fortunate the SN was not in our own galaxy!

On one occasion I remember going up to the telescope plateau at Sutherland on a completely overcast night, without a star in sight and seeing the 1.9-m telescope shutters wide open, while the observers happily obtained a spectrum, without having to use neutral density filters.

Major bodies of data were also obtained



Bolometric light curve for SN1987A, from Fig. 2 in Suntzeff et al. (1992), compared with that expected from radioactive decay. The SAAO data matches within the size of the symbols.

in Australia at MSSSO and in S America by the ESO/CTIO observers.

By the time the first observations were made, the flash from the shock wave was already fading rapidly and the SN would have soon faded out of sight if it were not for the ^{56}Ni created during the explosion. This decayed to ^{56}Co and then to stable ^{56}Fe. In fact one of the valuable outcomes of the SAAO work was to show that, between days 122 and 265, the exponential decay in the flux very closely matched the radioactive decay-rate of ^{56}Co. This confirmed theoretical predictions that these elements are produced in SN explosions.

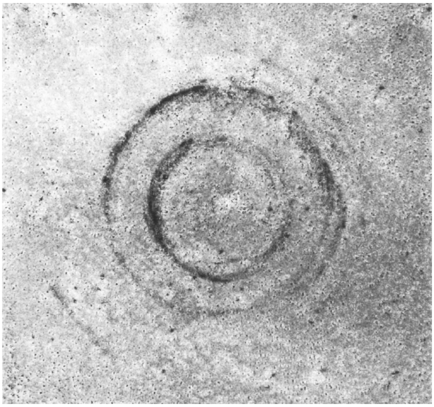
Utrobin (2005), fitted his theoretical models to our data and the Cerro Tololo data, for the first 150 days and shows the progenitor had an initial radius of 35 R_{Sun} , ejected 18 M_{Sun} of which 0.075 M_{Sun} (80 $M_{Jupiter}$) was ^{56}Ni. He also finds the energy in his explosion model is 1.5 x 10^{51} erg, which is about 0.5 percent of that carried away by the neutrinos.

After day 400 the expanding debris became increasingly optically thin and it was necessary to include γ and X-ray observations, as well as the emission from dust, to account for the total flux.

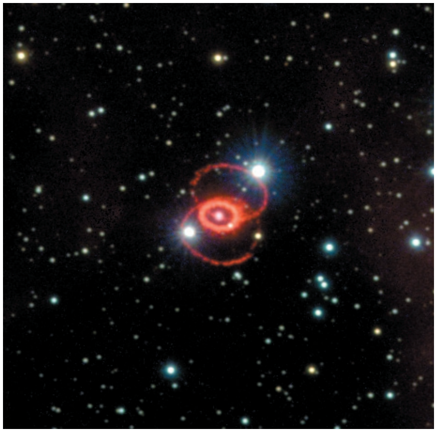
The neutrinos obviously travelled the 163 000 light-years from the LMC, at close to the speed of light, but uncertainties in how long the shock wave took to reach the surface and exactly when this happened, meant their arrival time could not be used to refine the mass of the neutrino, but did provide a strong counter-argument to the recent suggestion now withdrawn, that neutrinos can travel faster than light.

Light Echoes

One of the more elegant observations was of slowly expanding concentric rings of light around the SN. At any moment, after the light has arrived along the shortest path between the SN and us, there is an expanding ellipse with the SN at one focus and us at the other, that defines a surface of equal light travel time between the two foci. Where clouds of dust and gas, close to the SN, intersect this ellipse, we can see the reflected light of the SN as it was at maximum brightness. A



The light echoes from SN1987A. Fig 1 from Xu, Crotts and Kunkel, (1995). The field of view is 8.9 minutes of arc on each side.



HST observation of SN1987A, obtained in February 1994, showing the three rings. The inner ring is 1.35 light-years in diameter and is currently much brighter, while the central source has faded. Seen from the ground, the two stars close to the rings blend with the SN and are not connected to it.

ring of light, implies there is a sheet of gas perpendicular to the line of sight. Although the first light echo to be seen was around Nova Persei in 1901, SN1987A is a much more spectacular example. By following the change in the brightness and position of the rings with time, it is possible to map the three-dimensional distribution of dust and gas close to the SN. It is also possible to obtain a spectrum of the light at maximum brightness, as was recently done for the 1838 to 1858 eruption of η Carina. An unsuccessful attempt was made to obtain the spectrum of the initial UV flash of the SN, by setting the slit just ahead of the position of the light echo.

The Rings

The HST observed the SN eight years after outburst and clearly showed the previously known triple ring system. The initial UV flash caused the rings to fluoresce within hours of the explosion. The inner and brightest ring, continued to do so until the mid nineties, when it started to brighten at all wavelengths from X-ray to microwave, as the expanding debris began to impact it.

The triple ring system may hold the clue as to why the progenitor was a blue rather than a red supergiant. The three rings lie in three almost parallel planes, with the progenitor star in the centre of the central ring. The whole system is inclined at about 45° to the line of sight.

Philipp Podsiadlowski, in a series of papers well summarized in Morris and Podsaidlowski (2009), shows that the blue supergiant and the rings can be explained as the result of the merger of a 15-20 solar mass primary and a five solar mass secondary, about 20 000 years before the explosion. In their model, the initial high angular momentum of the common system forms an equatorial disk. Subsequent mass loss at mid-latitudes provides the material for the outer rings. These are then sculpted into their present form by the fast blue-supergiant wind. The inner ring is formed from the disk. Their models also explain the mysterious over-abundance of helium found in the rings and even the slight offset of the rings from the central star. The rings will eventually disappear and be replaced with something resembling the 1000-year-old Crab nebula.

The Neutron Star

It is well known that the end point of a Type II, core collapse SN is a neutron star and since the earliest times, we expected to detect the pulsar signature and its energy output in our bolometric light curves. On 18 January 1989, a 1968 Hz pulsar was detected at CTIO. Theoreticians hastily explained how it was possible to have such a high frequency pulsar in such a young object. Then on 8 February 1990 the same frequency was found, while observing the Crab nebula and it was realized the pulses were coming from a guide star camera.

Twenty-five years later no pulsar has been detected. The most obvious explanation is that we are not within the cone of pulsar radiation, which for radio pulsars, is estimated to cover 20 per cent of the sky. Even so the pulsar should be contributing to the bolometric flux, which to date, is entirely accounted for by radioactive decay. Another possibility is that it is obscured by large-particle dust that formed within the debris cloud and is obscuring our view. Other possibilities, summarized by Chan T. C., et al. (2009) are, either that the neutron star has not yet developed a strong enough magnetic field, or it became a black hole with a very low accretion rate, or that it underwent a phase transition and became a quark star. Chan predicts this would have been accompanied by rapid fluctuations in the initial neutrino flux, leaving an object currently radiating about 0.1 per cent of the energy coming from radioactive decay. The clue may lie in the energies and arrival times of the 13 neutrinos.

What did SN1987A do for me?

First and foremost, it gave me the opportunity to participate in one of the more important astronomical events of the 20th century. It took me to meetings in Taiwan, Japan and the USA, where I met theoreticians, who took time off from modeling nuclear explosions and eagerly sought our latest data. I also got the opportunity to address over 1 000 people, including several Nobel laureates, at the 1988, Baltimore IAU. It was an exciting time.

SN1987A is now 10 million times fainter than it was at maximum light 25 years ago. But once again it is brightening, as some of the kinetic energy is converted into radiation, guaranteeing we will continue to study it for years to come, as we try and understand exactly what happened and search for the remnant.

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Light echoes from η Carinae; Rest A., et al. 2012, "Light echoes reveal an unexpectedly cool η Carinae during its nineteenth-century Great Eruption", *Nature*, **482**, 375.

A recent discussion of the rings can be found in; Morris T, Podsiadlowski Ph., 2009, "A binary merger model for the formation of the Supernova 1987A Triple-ring Nebula", *MNRAS*, **399**, 515.

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Alternatives to a neutron star are discussed in; Chan T. C., et al. 2009, "Could the compact remnant of SN 1987A be a Quark Star", *ApJ*, **695,** 732. ☆

NT Aps, a southern sky W UMa stellar system with a decreasing period

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Abstract: NT Aps, a W UMa star in the southern hemisphere was observed in white light in 2007 and B and V filter in 2008 using personal telescopes from South Africa. From the Hipparcos ephemeris of 1991 a decrease in period of ~ 125 seconds year^{-1} for the binary is detected. Furthermore, software modeling packages of BINARY MAKER 3 and PHOEBE were employed to constrain the parameters of the binary components. The result of the modeling exercise is presented.

Key words: NT Aps, W UMa stars, contact binaries

Introduction

This is the third in a series of reports of observations of antipodean W Uma contact binaries.

W UMa stars

I refer the reader to *MNASSA*, Volume **71** Nos. 1 & 2 wherein a comprehensive summary of W UMa contact binaries is presented.

Observations

NT Aps observations began in 2007 in white light with 10 943 images captured. During the observing season of 2008 approximately 8 000 V filter and 10 000 B filter images were captured to fits files.

The discovery of the variability of NT Aps is attributed to Strohmeier, Knigge and Ott (1965).

Candidate selection

Candidates for the observational cam-

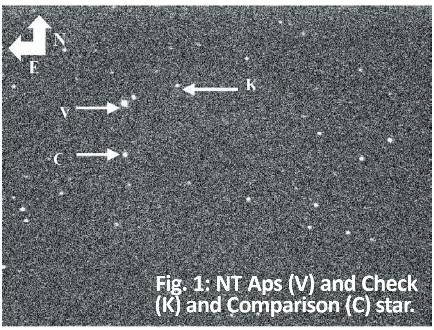

Fig. 1: NT Aps (V) and Check (K) and Comparison (C) star.

Program star details

STAR	NT Aps
SPECTRAL TYPE	G4V

RA	Dec	GSC	2MASS		
(2000)	(2000)			B-V	V
14 42 42.57	-74 18 41.57	09269-00122	J14424257-7418414	0.59	8.46

paign were chosen according to:

1. 14 > m_V >8. The candidates are all in the vicinity ~ - 60 degrees and have had no previous in depth research undertaken on them. (Exhaustive web searches: NASA ADS site, Simbad etc.)
2. The candidates display "high" Δmagnitude amplitude, which is vital considering the size and sensitivity of the equipment deployed.
4. Observations within the 14 > m_v > 8 band should not be adversely affected by bright moon nights

Equipment and observations

A Starlight Xpress MX716 self-guiding camera was coupled to a pier mounted Meade LX200GPS 30cm PT at a light polluted site on the northern outskirts of Johannesburg, South Africa. Images including the program star were captured to fits files with a field of view (FOV) of ~ 660 x 600 $arcsec^2$ and a resolution of about 110 arcsec mm^{-1}. Control of the PT and camera was done using MSB Astro-Art. Computer time is set every 4 minutes, automatically via the net from Dimension 4 using a local time server.

Table 1: Month of observation and integration time, V Filter Observations 2007/8.

Star	Observing period	Integration time
NT Aps	May 2007 May/June 2008	10 seconds

Image reductions

Astronomical Image Processing 4 Windows (AIP4Win). http: //www.willbell.com/aip/index.htm was utilised in data reduction. AIP4Win uses two dimensional aperture photometry in the reduction process. Reduction of the data included the processing of dark frames and flat frames.

Analyses of reductions

NT Aps: B filter observations were not utilised in this paper. IBVS bulletin, number 5713 of 2006 lists primary and secondary minima of NT Aps calculated by BBSAG observers. Table 2 tabulates their results.

A period of 0.294765 days is given by OEJV 0073 (Paschke, 2009).

Table 3 lists the observed and calculated times of minima from the BBSAG and Middleton 2007/8 data using the ephemeris and period from the Hipparcos Catalogue. In figure 2 the O-C values are plotted against the observed times.

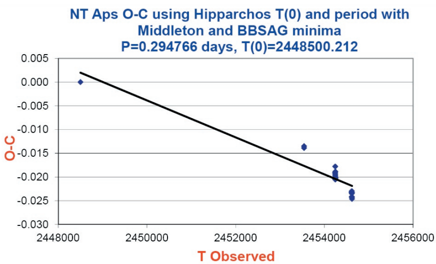

Figure 2: O-C Diagram using Hipparcos T_0 and period including BBSAG and Middleton minima.

Table 2: Minima calculated by BBSAG observers.

NT Aps	Primary	53543.350	Δ0.001
	Secondary	53543.497	Δ0.002

Table 3: This table presents minima of NT Aps in white light from 2007 and V filter during 2008 (Middleton data) and BBSAG with Hipparcos T_0 and period. Cycles with fractional values are secondary minima.

Cycle	Calculated	Observed	O-C	Observational Error	Reference
0.00	2448500.212000	2448500.212000	0.0000000	0.00100	Hipparcos
17109.00	2453543.363494	2453543.350000	-0.0134940	0.00100	BBSAG
17109.50	2453543.510877	2453543.497000	-0.0138770	0.00200	BBSAG
19483.50	2454243.285361	2454243.266256	-0.0191050	0.00148	Middleton 2007
19484.00	2454243.432744	2454243.413616	-0.0191280	0.00133	Middleton 2007
19484.50	2454243.580127	2454243.560054	-0.0200730	0.00139	Middleton 2007
19490.50	2454245.348723	2454245.330937	-0.0177860	0.00114	Middleton 2007
19491.00	2454245.496106	2454245.475915	-0.0201910	0.00105	Middleton 2007
19491.50	2454245.643489	2454245.624044	-0.0194450	0.00116	Middleton 2007
19497.00	2454247.264702	2454247.244166	-0.0205360	0.00127	Middleton 2007
19497.50	2454247.412085	2454247.392340	-0.0197450	0.00142	Middleton 2007
19498.00	2454247.559468	2454247.539072	-0.0203960	0.00116	Middleton 2007
19501.00	2454248.443766	2454248.423549	-0.0202170	0.00106	Middleton 2007
19501.50	2454248.591149	2454248.572299	-0.0188500	0.00155	Middleton 2007
19504.00	2454249.328064	2454249.307633	-0.0204310	0.00096	Middleton 2007
19504.50	2454249.475447	2454249.455333	-0.0201140	0.00119	Middleton 2007
19505.00	2454249.622830	2454249.602775	-0.0200550	0.00102	Middleton 2007
20725.50	2454609.384733	2454609.361504	-0.0232290	0.00122	Middleton 2008
20759.00	2454619.259394	2454619.235230	-0.0241640	0.00127	Middleton 2008
20759.50	2454619.406777	2454619.383808	-0.0229690	0.00113	Middleton 2008
20760.00	2454619.554160	2454619.529924	-0.0242360	0.00112	Middleton 2008
20762.50	2454620.291075	2454620.267591	-0.0234840	0.00127	Middleton 2008
20763.00	2454620.438458	2454620.414178	-0.0242800	0.00123	Middleton 2008
20772.50	2454623.238735	2454623.215440	-0.0232950	0.00110	Middleton 2008
20776.00	2454624.270416	2454624.245798	-0.0246180	0.00114	Middleton 2008

It is clear that there has been a decrease in period of approximately 36 minutes over the last 17 years. This suggests a period decrease of ~125 seconds year^{-1}.

From ~8 000 observations over 6 nights I derive an epoch in V filter of:

HJD 2454619.235628 (±0.0002) + *E**(0.294750d) ± 0.00001d

My ephemeris was used in folding the data to phase. Once the data was phase folded the ~8 000 data points were binned producing approximately 1 000 points to be included in PHOEBE for modeling of the W UMa binary. Figure 3 shows the phase binned data with the primary minimum offset by approximately 0.3 of phase. This offset is adjusted within PHOEBE as the phase parameter can be adjusted to fit input data.

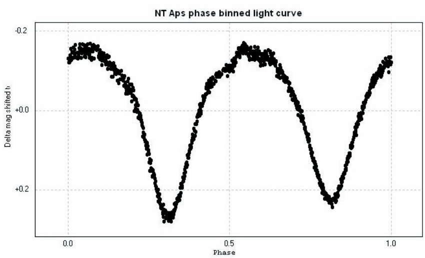

Figure 3: NT Aps phase binned light curve. Note the primary minimum is offset here by ~0.3 of the phase.

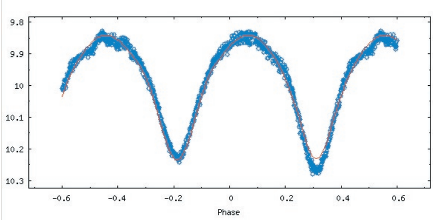

Figure 4: NT Aps V Filter 2008. Fitted the phase binned.

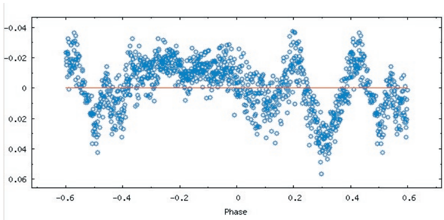

Figure 5: NT Aps residuals of the synthetic light curve (red) on PHOEBE model.

These data were initially modeled using BINARY MAKER 3 (Bradstreet, 2005) to generate rough input parameters for later refined modelling in PHOEBE (Prsa 2006). PHOEBE models stellar atmospheres using Kurucz's (1970) code. Both software platforms are based on the Wilson-Devinney code (1971). The models are not unique as spectra are required to constrain the component masses and temperatures.

NT Aps

Figure 4 shows the best fit to the phase binned data. From figure 4 at 0.5 of phase a dip in the light curve prior to maximum is evident. As this binary has a spectral classification of G4V I suggest the dip in the light curve is due to chromospheric activity. This was not included in the model as PHOEBE (private communication from Andrej Prsa) encounters problems when working with spotting activity, which is evident from the synthetic light curve.

It is also evident from the synthetic fit that the primary minimum is too shallow. This poor fit is magnified in figure 5 wherein the residuals are not centered about the zero line at ~0.3 of phase. Adjusting the inclination (*i*), or mass ratio (*q*), to force a fit on the data results in a substantial increase in the residuals generated.

Lucy and Wilson (1979) introduced a class B type system of W UMa, which are in geometrical but not, in thermal contact. Without thermal contact there is a large difference between the surface temperatures of the components. (B systems are sometimes referred to as Poor Thermal Contact (PTC) systems (Rucinski and Duerbeck 1997). I suggest that NT Aps is a PTC system or B type. Full parameters of the model are tabulated in table 4.

Conclusion

A period decrease is evident from the O-C diagram. Further observations of this contact system are planned for 2012 to confirm the period decrease calculation. Spectral data of this contact system would constrain the parameters of the binary and would aid in accurate modelling of this W UMa star. As the V filter is 8.46 mag high spectral resolution could easily be obtained.

Table 4: Final Model parameters determined by Phoebe. Passband luminosities are the ratio of flux to the integral of the passband transmission function.

	Description	NT Aps
$\Delta\Phi$	Phase shift (arbitrary user interface)	0.312 ±0.003
q	Mass ratio	0.242 ±0.006
i	Inclination of orbit	71.9 ±0.06
T_{eff1} T_{eff2}	Effective temperature	6930K ±353K 4818K ±240K
Ω_1 Ω_2	Surface potentials	2.323 ±0.0013 2.188 ±0.0013
A_1 A_2	Surface albedoes	1.00 0.5
g_1 g_2	Gravity darkening coefficients	1.00 0.32
L^i_1 L^i_2	Passband luminosities	11.12 ±0.0054 12.56 ±0.05
$x^{1d,i}_1$ $x^{1d,i}_2$	Linear limb darkening coefficients	0.583 0.702

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Wilson, R.E., Devinney E.J.: 1971, *ApJ* 166, 605

tdc-www.harvard.edu/catalogs/hipparcos.html

www.willbell.com/aip/index.htm

www.fiz.uni-lj.si/phoebe ☆

Another W UMa stellar system of the antipodean sky

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Email: cmiddleton@uj.ac.za

Abstract: UV Grus, a W UMa star in the southern hemisphere was observed in V filter using personal telescopes in South Africa during the 2006/7/8 season. An ephemeris of UV Grus is presented. Software modeling packages of BINARY MAKER 3 and PHOEBE were employed to constrain the parameters of the binary components. The result of the modeling exercise is presented.

Key words: UV Grus, W UMa stars, contact binaries

Introduction

This is the second in a series of reports of observations of antipodean W Uma contact binaries.

W UMa stars

I refer the reader to *MNASSA* Volume **71** Nos 2 & 3 wherein a comprehensive summary of W UMa contact binaries is presented.

Observations

Observations of UV Grus began in white light in September 2006. Observations in V and B Filter were conducted in both 2007 and 2008. Reduced data for 2007 has proved very noisy and as a result only data for 2008 in V filter is presented.

Discovery of the variability of UV Grus was made by Meinunger (1976)

Candidate selection

Candidates for the observational campaign were chosen according to:

1. 14 > m_V >8. The candidates are all in the vicinity ~ - 60 degrees and have had no

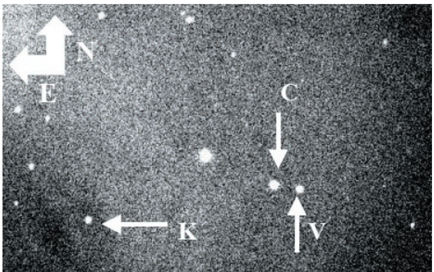

Fig. 1: UV Grus (V) and Check (K) and Comparison (C) star.

Program star details

STAR	UV Grus
SPECTRAL TYPE	N/A

RA	Dec	GSC	2MASS	SV	
(2000)	(2000)				B
22 19 53.9	-47 41 36.8	08442-00056	J22195389-4741368	SON 6483	13.3

previous in depth research undertaken on them. (Exhaustive web searches: NASA ADS site, Simbad etc.)

2. The candidates display "high" Δmagnitude amplitude, which is vital considering the size and sensitivity of the equipment deployed.
4. Observations within the $14>m_V>8$ band should not be adversely affected by bright moon nights

Equipment and observations

V filter data from 2008 is presented. A Starlight Xpress MX716 self-guiding camera was coupled to a pier mounted Meade LX200GPS 30cm PT at a light polluted site on the northern outskirts of Johannesburg, South Africa. Images including the program star were captured to fits files with a field of view (FOV) of ~660 x 600 $arcsec^2$ and a resolution of about 110 arcsec mm^{-1}. Control of the PT and camera was done using MSB Astro-Art. Computer time is set every four minutes, automatically via the net from Dimension 4 using a local time server.

Table 1: Month of observation and integration time, V Filter Observations 2008.

Star	Observing period	Integration time
UV Grus	September 2008	50 seconds

Image reductions

Astronomical Image Processing 4 Windows (AIP4Win). http://www.willbell.com/aip/index.htm was utilised in data reduction. AIP4Win uses two dimensional aperture photometry in the reduction process. Reduction of the data included the processing of dark frames and flat frames.

Analyses of reductions

UV Grus: B Filter data of UV Grus had high noise levels and has not been analysed.

Figure 3 depicts an O-C graph of UV Grus V Filter for the 2008 season using the authors period. Table 2 lists the times of minimum determined by the extremum fitting method with figure 2 presented as an example. Cycles with

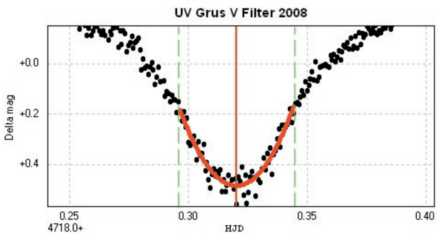

Figure 2: Spline fitting UV Grus, V Filter HJD 2454718.319521.

Table 2: This table presents minima from UV Grus V Filter 2008. Cycles with fractional Values (1, 2, 4 and 6) are secondary minima.

Cycle	Calculated	Observed	O-C	Observational Error
-5.50	2454714.479941	2454714.480002	0.000061	0.0020
-2.50	2454715.576964	2454715.576721	-0.000243	0.0018
0.00	2454716.491149	2454716.491794	0.000645	0.0024
2.50	2454717.405335	2454717.404492	-0.000843	0.0021
5.00	2454718.319521	2454718.320026	0.000505	0.0022
5.50	2454718.502358	2454718.502232	-0.000126	0.0019

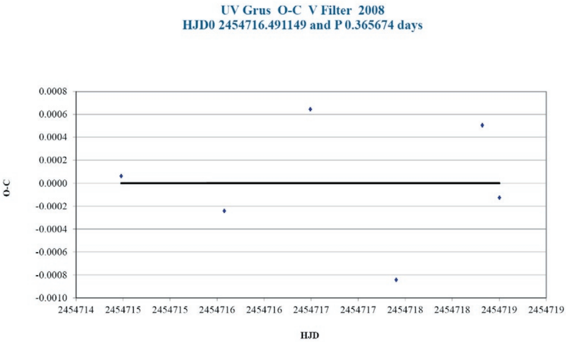

Figure 3: O-C graph of UV Grus V Filter 2008 season. Points 1, 2, 4 and 6 are secondary minima.

fractional values (1, 2, 4 and 6) are secondary minima. From 1921 observations over 5 nights we derive an epoch in V filter of:

HJD 2454716.491149 (±0.0003) + *E**(0.3657d) ± 0.0001d

The period suggests a W-type over-contact system.

Modeling of the data

These data were initially modeled using BINARY MAKER 3 (Bradstreet, 2005) to generate rough input parameters for later refined modelling in PHOEBE (Prsa 2006). PHOEBE has the advantage of modelling stellar atmospheres using Kurucz's (1970) code. Both software platforms are based on the Wilson-Devinney code (1971). These models, whilst producing low residuals from good fits to the light curves are not unique as spectra are required to constrain the component masses and temperatures.

UV Gr

The model of UV Grus plotted in figure 4 is sound despite a reasonably high noise value in the data. This noise is as a result of the star being observed at the end of the Highveld winter when smoke and dust particulates in the atmosphere are very high. The residuals presented in figure 5 show a high incidence of points around the zero line which is indicative of a sound model. Full parameters of the model are tabulated in table 3.

Of significance from a light curve in white light from 2006 is the flat bottomed primary minimum presented in

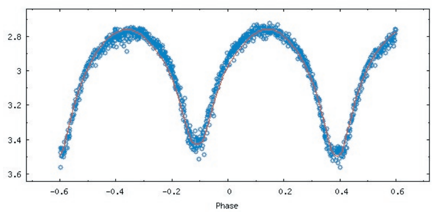

Figure 4: UV Grus V Filter 2008. Fitted curve (red) on the phase binned light curve.

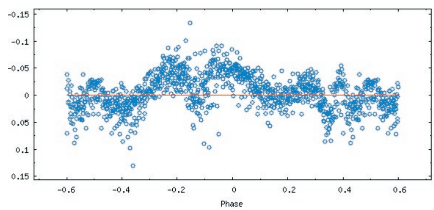

Figure 5: UV Grus residuals of the synthetic light PHOEBE model.

Table 3: Final Model parameters determined by Phoebe. Passband luminosities are the ratio of flux to the integral of the passband transmission function.

	Description	UV Grus
$\Delta\Phi$	Phase shift (arbitrary user interface)	0.390017 ±0.000302
q	Mass ratio	0.496376 ±0.001158
i	Inclination of orbit	85.524218 ±0.294634
T_{eff1} T_{eff2}	Effective temperature	8957 ±89 7087 ±70
Ω_1 Ω_2	Surface potentials	2.722266 ±0.02722 2.780446 ±0.0278
A_1 A_2	Surface albedoes	0.304110 ±0.00304 0.5 ±0.005
g_1 g_2	Gravity darkening coefficients	0.302143 ±0.00302 0.32 ±0.0032
L^i_1 L^i_2	Passband luminosities	12.566371 ±0.12566 12.566371 ±0.12566
$x^{1d,i}_1$ $x^{1d,i}_2$	Linear limb darkening coefficients	0.5 ±0.005 0.5 ±0.005

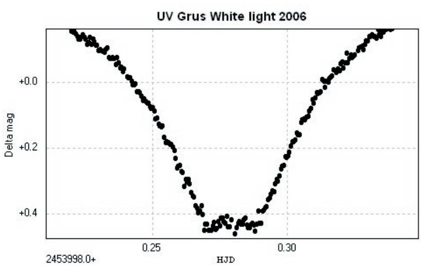

Figure 6: Light curve of a total eclipse within the UV Grus system.

figure 6. This suggests a total eclipse within the system which, with spectral observation could constrain the "radii" of both stars with high accuracy. The "radii" of both components, under these circumstances, would include the *filled Roche lobes*, as the system is an *over contact system*. Spectra of the system would also provide stellar temperatures and radial velocity values which in turn would provide an accurate q value and hence a unique solution to the binary parameters.

The temperatures of the individual components are probably too high. This will affect the surface albedo, gravity darkening coefficient and linear limb darkening coefficient values.

Conclusion

Spectral data of this over contact system would constrain the parameters of the binary and would aid in an accurate classification of this W UMa system.

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www.willbell.com/aip/index.htm

www.fiz.uni-lj.si/phoebe ☆

Astronomical Colloquia

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 are the SAAO Astro-coffees which are 15-20 min 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 sessions. *Ed*

SAAO ASTRO-Coffee

Topic: Is the Cosmological Coincidence a Problem or a Selection?
Host: Navin Sivanandam, postdoc (AIMS). PhD at Stanford, postdoc at UT Austin.
Date/Time: 8 March, 10:45
Venue: 1896 Building, SAAO
Discussion: The matching of our epoch of existence with that of dark energy and dark matter equality is an apparent further fine-tuning beyond the already troubling 120 orders of magnitude that separate dark energy from the Planck scale. However, the much feared and loathed anthropic principle can provide an escape from the discomfort. I shall describe one particular anthropic selection mechanism as well as (hopefully) convincing you that anthropic reasoning is a valuable tool in the arsenal of any cosmologist.

Topic: Eris; a Pluto twin?
Host: Amanda Gulbis
Date/Time: 29 March/10:45
Venue: 1896 Building
Paper: http://www.nature.com/nature/journal/v478/n7370/full/nature10550.html
Discussion: The discovery of the large Kuiper Belt object Eris led to significant debate about the uniqueness of Pluto and the eventual redefinition of the word "planet". In 2011, results from the observation of a stellar occultation by Eris provided the most accurate physical characteristics of Eris to date. This paper presents the occultation prediction, observations, and derivation of Eris' size, density, and albedo. The possibility of a seasonal atmosphere is also discussed. Ironically, the results are unable to answer the fundamental question of whether Eris is actually larger than Pluto. Come to the talk to learn why!

Colloquia

Global Lightning Detection with WWLLN
Speaker: Dr Andrew Collier
Venue: RW James Lecture Hall C
Time: 12:00
Date: 8 March 2012
The World Wide Lightning Location

Network (WWLLN) is a rapidly evolving experimental lightning location network. This talk will address the following questions:
* How does WWLLN work?
* How does it differ from a "normal" lightning detector?
* Can it be used to predict hurricanes?
* Where does that strange whistling noise come from?
* What can WWLLN tell us about gamma rays in outer space?

Investigating the Universe with the "New Computer"
Speaker: Dr Bruce Becker, Coordinator, South African National Grid, Meraka Institute, CSIR
Date/Time: 13 March, 11:00 - 12:00
Venue: TBC
Abstract: It is a well-known fact that most aspects of observational and theoretical study of the universe make large demands in terms of computing and data. Due to the collaborative and global nature of astronomy and related fields, researchers build for themselves a network of collaborators and associated resources all over the world, during the lifetime of a project or career. These resources may be computing facilities, observational or Monte-Carlo data, but also people, software applications, etc. Efficiently using these resources, let alone maintaining them, can be a daunting and discouraging task - wouldn't it be easier if there were just one interface to all of the resources you would like to use? This is the problem that grid computing tries to solve.

The South African National Grid is a federation of resources at institutes around the country. It is a platform for collaboration and research, providing a service-oriented e-infrastructure, allowing users to seamlessly execute their applications, manage data and collaborate with others.

I will give a short nontechnical introduction to the grid paradigm and describe the state of the national e-Infrastructure in South Africa, as well as how it integrates with the rest of the world. I will provide some use cases where of special attention will be given to those of the astronomy, astrophysics and cosmology communities. A summary of how data management can be improved and the impact of SANReN in this regard will also be given. Finally, I will show how you, the astronomer, can benefit from this "new computer" - outlining the procedures to start using it and the additional support services at your disposal to use it to your best advantage.

Experimental Tests of General Relativity
Speaker: Dr Jeandrew Brink (NITheP, Stellenbosch)
Venue: RW James Lecture Hall C
Date: 14 March 2012
Time: 13:00
Abstract: This talk reviews some of the seminal experimental tests of Einstein's theory of General Relativity.
I then focus on questions that can be answered with new instruments such as the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Laser Interferometer Space Antenna (LISA)

and radio telescopes such as the Square Kilometre Array (SKA). I conclude by taking a detailed look at the idea of mapping space-time around a quiescent compact object, using extreme mass ratio inspirals (EMRI's).

Hot Stars in Brno - First Decade of Research

Speaker: Jan Janik, Masaryk University, Czech Republic

Date/Time: 15 March, 12:30

Venue: SAAO Auditorium

Abstract: More than 10 year is in Brno group of Astrophysicists which is focused on study of hot stars. In my talk I would like to introduce why we like mainly these stars and our results in this field from the point of view of theoretical and observational results. I will show examples of exploring stars, our next interesting targets and also problems not yet solved.

Joys of Convection and Magnetism in Stars

Speaker: Professor Juri Toomre, University of Colorado

Date/Time: 22 March, 11:00

Venue: 1896 Building

Abstract: Stellar convection zones in most settings should be able to build magnetic fields through dynamo action, especially if the flows are turbulent and the stars rotate. There is much more subtlety as to whether the resulting magnetic fields also exhibit large-scale structure and possible temporal flips and even cycles. We have been studying through 3-D global simulations the nature of both differential rotation and dynamo action that can be achieved in G-type stars like the sun by turbulent convection in their outer envelopes, and also by core convection in more massive A-type stars. The richness of structures realized will be discussed, along with their implications to seismic probing of these stars.

MONET Workshop

Presenter: Dr Frederic Hessman

Date/Time: 28t March, 9:00 - 11:00

Venue: SALT boardroom

Agenda:

- Brief introduction to MONET
- Obtaining an account
- Signing up for time
- Simple access (demonstration)
- Comfortable access with Claude (demonstration by Tim-Oliver)
- Perspectives for MONET/North and /South

Mass Transfer in Accreting X-ray Pulsars

Speaker: Dr Vanessa McBride.

Venue: RW James Lecture Hall C

Date: 28 March 2012

Time: 13:00

Abstract: When a massive star goes supernova, the collapsed core remains as a neutron star. Neutron stars provide unique laboratories where we can test physics under strong gravity and immense magnetic fields. Accretion of material from a companion star onto a highly magnetic neutron star provides us with an X-ray and optical 'fingerprint' by which we can identify some of the properties of both the neutron star and the accretion

process. I will discuss observations of accreting magnetic neutron stars with particular focus on mass transfer.

Type Ia Supernova Rates in Intermediate Redshift Galaxy Clusters

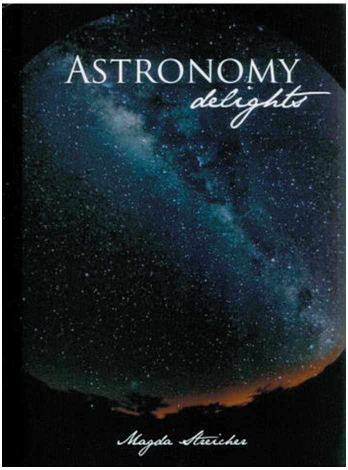
Speaker: Eli Kasai, NASSP (MSc), University of Cape Town

Date/Time: 5 April / 11:00

Venue: SAAO Auditorium

Abstract: Type Ia supernova (SN Ia) rate measurements in galaxy clusters can tell us about the metal enrichment of the intra-cluster medium, progenitor systems, star formation histories of cluster galaxies, formation and evolution of intra-cluster stars and can be used for cosmological studies. In this talk, I will discuss the importance of SN rate measurements, give an overview of the methods employed in searching for supernovae/transients in cluster images and present a result we found to be consistent with expectations from the literature for one of the clusters. I will briefly also talk about the Dark Energy Survey that is planned to start in September this year and the potential involvement of SALT in the survey.. ☆

book reviews



Astronomy Delights

by Magda Streicher

Published 2012

Hard cover, 353 pages

ISBN 978-0-620-51154-4

Price: R480 (+ R40 postage in South Africa)

Available from the author:

magdalena@mweb.co.za,

phone 083 276 8128

All those who know Magda's charming series of `Deep sky Delights' that has been running for several years in *MNASSA* will relate to this book, which can best be described as a labour of love. Deep-sky observing is very much an amateur interest and on paging through this delightful text a good sense of what it is that attracts people to this activity is conveyed.

There are star maps for each of the constellations, and drawings that show the ancient mythological figures, as well as the eighteenth-century scientific instruments that La Caille somehow imagined in the sky. For each constellation there are diagrams that show how to find the brighter NGC objects as well as some of the variable stars, asterisms and clusters. Individual objects are illustrated by Magda's own drawings. At the end of each chapter there is a table giving the coordinates of the objects mentioned. Many objects are additionally illustrated by colour photographs taken by Lucas Ferreira, Dieter Willasch and others.

Magda is fortunate to live on a farm with wonderfully dark skies in the Bushveld, in the northern part of South Africa, and she shows in her book her obvious love for this part of the world. There are pictures of local animals, such as the chameleon (constellation Chamaeleon), the hyena (representing the wolf, Lupus) and birds such as the dove (Columba) , the crow (Corvus), the crane (Grus), and the hornbill (representing Toucan). Even the humble mopani worm is pressed into service to illustrate one of Magda's own asterisms.

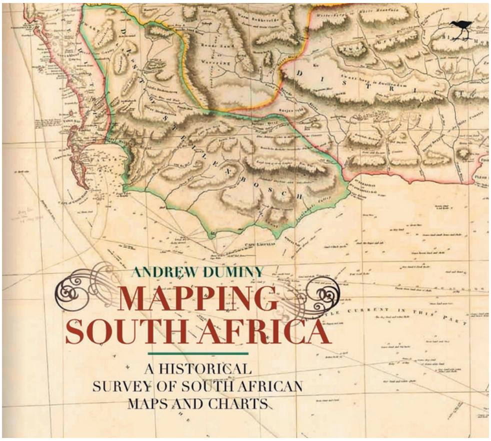
Magda has travelled widely in her search for the places that were once the homes of the great astronomers. Among many of the personal touches in the book, she tells us of her visits: to Bath, the home of William Herschel; to the house in Oxford where Halley lived; and to China for an eclipse expedition. She has also visited La Palma and gone in search of Vasco da Gama relics in Portugal.

There are many excellent pencil sketches of astronomers executed by Kathryn van Schalkwyk, especially of the lady astronomers, but also including such well-loved local figures as Jack Bennett and Danie Overbeek. Cyril Jackson, comet discoverer, who lived in retirement near Magda's territory at Haenertsburg is also shown, at the ruins of his observatory.

The book runs to fifty-eight chapters, starting with a section on deep-sky observing containing many tips on how to get the best out of one's site and equipment and then mostly concentrating on individual constellations. She lists the features of each type of object which are worth looking for and recording. Hints on how to sketch deep sky objects are provided.

The book is a real glimpse into Magda's special world and it contains lots of intimate observations and comments that only she would think of putting into an astronomy book. I can recommend *Astronomy Delights* as a pleasant experience as well as a useful guide to deep-sky observing. Be aware that only 150 copies have been printed! The production is to a high standard, on thick paper that shows the illustrations to the best effect. I did notice two or three misprints (such as spelling our Editor's name incorrectly!), but these are minor and hardly detract from the overall effect.

Ian Glass



Mapping South Africa: A Historical Survey of South African Maps and Charts

by Andrew Duminy

Published by Jacana Media, November 2011
Hardcover, 136 pages
Size: 240mm x 275mm
ISBN 978-1-4314-0221-2
Price R236

This beautifully printed book illustrating the history of cartography in Southern Africa fails to live up to the cover blurb that claims it ‘will long remain a standard work of its kind, admired for its informative text and for the beautiful reproductions it contains of almost a hundred maps’. Nevertheless, I found it very interesting, particularly the first chapters that deal with the earlier maps.

In spite of its defects, the book may increase general interest in the field of historical mapping, which is certainly a fascinating one. There are many colour reproductions of maps from the 15th century to the start of the 20th.

It has been criticised severely by experts in surveying and mapping for the number of inaccuracies it contains. The number of these is rather surprising in the work of a professional historian, which Professor Andrew Duminy is, though his fields are the histories of Natal and of the Cape frontier. In replying to critics, Duminy has excused himself as an ‘interested amateur’ in the field who has simply sought to provide an introduction for the general reader. He would have produced a much more satisfactory book if he had asked people with expert knowledge of the relevant fields to check the text before publication.

The accuracy of maps that cover long distances is dependent on the precision with which longitudes and latitudes can be determined, and this involves astronomy. As a consequence, Duminy's book has had to include a number of references to astronomical matters, many of which he clearly did not understand. In noting errors, I have not in general checked non-astronomical ‘facts’, and have noted only a few obvious mistakes. As Duminy has expressed irritation that previous reviewers of his book have not listed the errors they found, I provide a list below.

Chapter Titles:

Latitude, longitude and the measurement of time and distance.
Early explorers, maps and charts.
The last years of Dutch rule at the Cape.
The British take over the Cape.
The Great African Survey.
The Eastern Cape frontier.
Exploring the interior of southern Africa.
Colonial Natal.
The Transvaal and Orange Free State.
The geodetic surveys and the arc of the 30th meridian.
The Anglo-Boer War and after.
New ideas: Fourcade and Wadley.

Some errors noted:

p.5 Lithography does not involve engraving.
p.13 Mauritius was only known as Isle de France during the period 1715-1810 when it was under French control.
p.13 Rhumb lines have nothing to do with wind.
p.14 Azimuth is not 'the moment at which the Sun reaches its highest point'.
p.14 An error of one minute of time is equivalent to an error of a quarter of a degree in determining longitude.
p.14 An error of one second of time leads to an error of 40 000km/(24x3600) which is a distance error of about 0.46km at the equator.
p.15 Galileo referred to the telescope as a Perspicillum, not a Perspicullum.
p.15 Galileo observed the phases of Venus. Uranus had not then been discovered.
p.15 Edmond, not Edmund, Halley.
p.15 Cassini I was not officially the head of the Paris Observatory.
p.16-17 Hadley's octant preceded the sextant.
p.17 The picture is of an octant, not a quadrant.
p.17 The method of Lunars, for which tables began to appear around 1760, involved the distances of certain stars from the Moon.
p.17 The moons of interest for time purposes were those of Jupiter, not Venus, which does not have any moons. Furthermore, moons are not 'stellar'.
p.19 The remark about rewinding does not necessarily apply to many of the weight-driven clocks of the time.
p.29 La Caille used a zenith sector, not a zero sector (which latter does not exist).
p.29 D'Après de Mannevillette did not assist La Caille with his baseline measurements.
p.29 The map shown is not one of La Caille's maps as presented by La Caille. He did not

include the names of the Khoina tribes on his maps.

p.30 La Caille did not measure ‘vertical angles’. He wanted zenith distances

p.33 Schumacher was not a botanical artist.

p.86 The ‘Journal of the Royal Astronomical Society’ does not exist. The correct reference is *Monthly Notices of the Royal Astronomical Society*, Vol. 47, p.137, 1887

p.105 I would think that the latitude was usually determined from the meridian altitude of the Sun (which has nothing to do with azimuth). The determination of longitude requires more than a telescope and a sextant, the most important thing being the time in relation to that at some reference point such as longitude zero

p.105 Maclear was His or Her Majesty's Astronomer, not Astronomer Royal. However, many writers make this mistake.

p.106 The Maclear baseline was of similar length to La Caille's (and not 13.6 miles).

p.111 Friedrich Georg Wilhelm von Struve was a German, and not a Latvian, who worked in Dorpat for some of his career, including the geodetic part.

p.125 The accuracy of the Tellurometer is quoted as being within 3 parts in 106 over distances of 3 to 50 km. In fact, the accuracy is of the order of 10 mm in 50 km, or 1 part in 5x10^6 (one part in 5 million), depending on the model and the distance involved.

p.126 GPS satellites orbit at an altitude of about 20 200 km (or 12 500 miles).

p.126 Accurate atomic clocks were developed ca 1955.

p.126 According to Wikipedia, the length of the day is increasing at the rate of 1.7 milliseconds per century, not decreasing.

p.126 The paragraph about ‘modern science’ refers (unnecessarily) to Einstein’s theory of stimulated emission, and the sentence about quantum physics is mixed up.

Ian Glass

The Useful Triangle

by Magda Streicher
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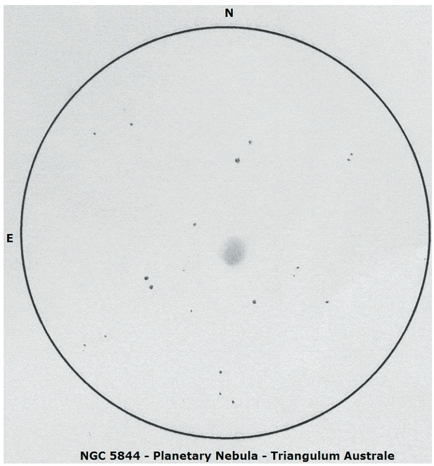
One thing that is as clear as starlight is the fact that many of the stars form triangles in the night sky. Whether the stars are faint or bright, seen with the naked eye, binoculars or through a telescope, the observer will find many triangles. The best-known by far, and pre-eminently the most outstanding, is the Triangulum Australe constellation, which definitely displays the shape most excellently.

Triangulum Australe is situated between Ara, Apus and Centaurus. The three stars alpha, beta and gamma Trianguli Australis are quite outstanding and vary between magnitudes 1.8 and magnitude 2.8. Bayer called these stars The Patriarchs – Abraham, Isaac, and Jacob of old (R. Allen, *Star Names – Their Lore and Meaning*).

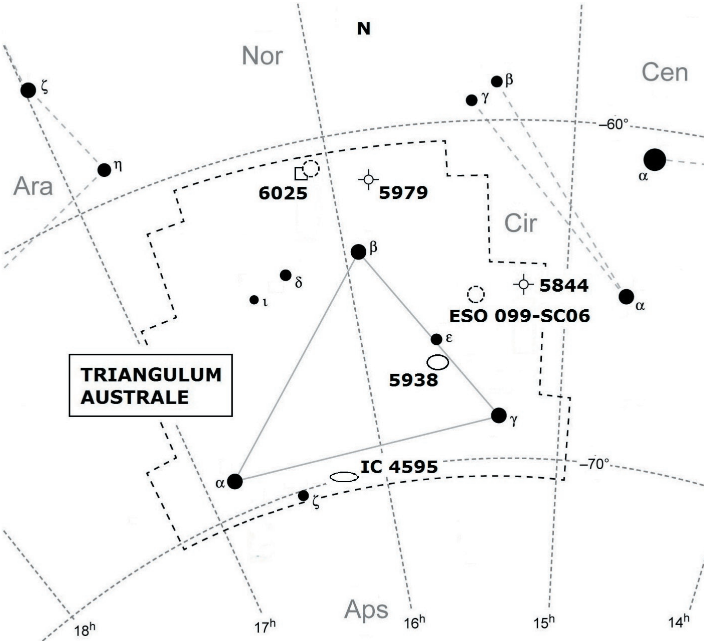
In the far western side of the constellation a special planetary nebula can be found. **NGC 5844** is a somewhat strange object which may, perhaps, give the observer the impression of being a double planetary nebula, which it is indeed with PK 317.1-05.7 situated close to the north-western edge (see sketch). The relatively bright object in a

Image source: Stellarium.org

north-west to south-east direction with a washed-out northern side, displays something of an hourglass shape. It is by no means even in structure, but contains knotty patches which become more concentrated towards the middle area of the nebula. Towards the north-east is a magnitude 9 star that appears double and lends a special effect to the field of view just 3’ away.



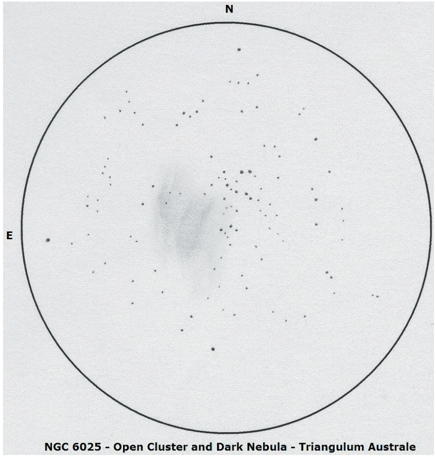
NGC 5844 - A strange looking Double Planetary Nebula.



NGC 5979 Appears as a blue spot with a stellar core. Image: Dale Liebenberg.

About 2° east a listed ESO cluster takes its place. **ESO 099-SC06** displays a tight group of about eight stars that vary from magnitude 9 to magnitude 12 in brightness in a north-south direction. The brightest member in this tight grouping is the slightly yellow magnitude 9.9 (GSC 9030 2526), which can be seen in the northern part of the cluster. However, brighter stars towards the east appear to increase the size of this grouping. The group could actually pass as an asterism.

The planetary nebula **NGC 5979** is situated 2.3° north of the lovely yellow Beta Trianguli Australis and is visible only as a dense, fuzzy soft blue dot with a stellar core (see picture). Higher magnification, however, displays a very hazy, woolly edge. A few faint stars string away from the planetary nebula in a south-eastern direction. Adding an ultra-high-contrast and oxygen filters helps define this round object in more detail against the busy star field.



NGC 6025 a stringy open cluster with a dark nebula as escort.

The famous open cluster **NGC 6025**, because of its position close to The Great Attractor, is a typical stringy grouping. The northern part of the cluster is slightly busier; with stars that displays a sort of S-shape in a north to south direction (see sketch). The cluster contains around 20 stars, with the outstanding magnitude 7 Mq Trianguli Australis, a blue-white star, at the southern tip. Careful observation brings to the fore a piece of dark nebulosity intervening among the eastern members of the cluster.

The yellow star delta Trianguli Australis is situated 2.2° east of the northern corner star beta Trianguli Australis, which is also a double star, with a magnitude 11.9 companion. The pair has a separation of 30" in a position angle (PA) of 120°.

Another double star is iota Trianguli Australis with a magnitude of 5.3, situated just 1.4° further east. The star, which shines a beautiful dark yellow, has a plain white magnitude 10.3 companion. The separation is 19.6" in a position angle (PA) of 16.

In line with the triangular shape of the constellation between the stars beta and gamma Trianguli Australis the faint galaxy **NGC 5938** takes its place in the busy star field. This object is barely seen, and then as a roundish glow with a relatively outstanding nucleus. Faint stars are more evident towards the south-eastern field of view.

Another galaxy, **IC 4595**, is situated just 40' west of the lovely deep-yellow zeta

Trianguli Australis, which shines with a magnitude of 4.8. The galaxy is very faint, and averted vision provides the best tool to discover its hidden qualities. Situated almost on the southern border with Apus, the galaxy displays a faint sliver of a light ray in a north-east to south-west direction. With care a few faint stars can be spotted on its surface, with one prominent on the north-eastern tip.

The good old triangular shape is easy to remember, and easy to describe as part of an observation with stars that splashed out in their thousands. Regard the triangle in a brand-new way from now on, and take special note of the constellation Triangulum Australe which shows off this well-known geometric shape in a very special way. ☆

Object	**Type**	**RA (J2000.0)**	**Dec**	**Mag.**	**Size**
NGC 5844	Planetary Neb	15^h10^m6	-64°40′	11.5	73″
ESO 099-SC06	Open Cluster	15 29 8	-64 52	7.9	8′
NGC 5938	Galaxy	15 36 4	-66 52	11.8	2.8′x2.5′
NGC 5979	Planetary Neb	15 47 7	-61 13	12	10″
NGC 6025	Open Cluster	16 03 3	-60 25	5	14′
IC 4595	Galaxy	16 20 7	-70 09	12.7	2.7′x0.5′

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 own electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bimonthly and an annual printed *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, Harare, Hermanus, Johannesburg, Pietermaritzburg (Natal Midlands Centre), 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 Centre membership required) . Please contact membership secretary for details.

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