

mnassa

monthly notes of the astronomical society of southern africa
Vol 69 Nos 5 & 6 June 2010

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- subscription rates** Non-members of the Society can obtain its publications by applying to the Business Manager at the editorial address. Within South Africa, the subscription rate for 2010 is R100 per volume (6 issues). Overseas subscription (via airmail only) is US \$45.00 per volume. Back numbers, if available, are US \$10.00 per copy.
- advertising rates** Advertisements may be placed in *MNASSA* at the following rates per insertion: full page R400; half page R200; quarter page R100; classified R2.00 per word. Enquiries and copy should be sent to the Business Manager at business@assa.sao.ac.za.
- contributions** Contributions for the respective issues should reach the editorial address by the due dates below. **Please include the word *MNASSA* in the subject line of all e-mail communication.** A *Style guide and instructions to authors* is available from the editor on request, or from the website.
- Deadlines:**
 Vol 69 Nos 7 & 8 (Aug 2010 issue), 01 Jul 2010
 Vol 69 Nos 9 & 10 (Oct 2010 issue), 01 Sep 2010
 Vol 69 Nos 11 & 12 (Dec 2010 issue), 01 Nov 2010
- recognition** Articles in *MNASSA* appear in the NASA/ADS data system.

Cover picture: Jupiter, while missing its SEB, got hit

After emerging from its February conjunction with the Sun, Jupiter's SEB (South Equatorial Belt) had disappeared – actually the 17th such disappearance since 1901. Furthermore, at 20h31:29 UT on 3 June 2010 Jupiter, while two amateurs were busy videoing Jupiter, it got hit in a visible flash. Picture by veteran planetary imager Anthony Wesley from Broken Hill, Australia (<http://www.acquerra.com.au/astro/>).

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 journal, the *Monthly Notes of the Astronomical Society of Southern Africa* (*MNASSA*) (bimonthly) and an annual astronomical handbook, *Sky Guide Africa South*.

Membership: Membership of the Society is open to all. Enquiries should be addressed to the Membership Secretary, ASSA, PO Box 9, Observatory, 7935, South Africa or to the e-mail address below. Entrance fees are R25. Full members paying R100 per annum receive *MNASSA* and the *Sky Guide*. The subscription year runs from 1 July to 30 June. Persons joining during January to June need to pay only half the annual subscription, plus the entrance fee.

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

Sky & Telescope: Both Full and Local members (proof of Centre membership required) may subscribe to *Sky & Telescope* at a significant discount. Please contact membership secretary for details.

Internet contact details: e-mail: assa@sao.ac.za homepage: <http://assa.sao.ac.za>

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antlia, the machine pneumatique

Object	Type	RA (J2000.0)	Dec	Mag	Size
S Antliae	Variable Star	09 ^h 32.3	-28°38'	6.4 - 6.9	Per. 7h
NGC 2997	Galaxy	09 45.6	-31 11	9.1	10.0'x6.3'
ESO 435 SC09	Open Cluster	09 55.5	-28 59	9	15'
NGC 3132	Planetary Nebula	10 07.1	-40 26	8.2	30"
Streicher 8	Asterism	10 13.8	-40 20	9	3.1'
NGC 3175	Galaxy	10 14.7	-28 52	11.3	5.0'x1.3'
O'Neal 10	Open Cluster	10 21.5	-32 44	10	11'
NGC 3267	Galaxy	10 29.8	-35 19	12.5	1.9'x0.9'
NGC 3268	Galaxy	10 30.0	-35 20	11.6	3.2'x2.4'
NGC 3269	Galaxy	10 30.0	-35 13	12.2	2.5'x1.1'
NGC 3271	Galaxy	10 30.5	-35 22	11.7	2.8'x1.5'
NGC 3347	Galaxy	10 42.8	-36 22	11.4	3.7'x1.9'
NGC 3354	Galaxy	10 43.1	-36 22	13	0.9'x0.8'
NGC 3358	Galaxy	10 43.6	-36 23	11.5	3.8'x1.7'

classified

FOR SALE

Observatory Contents of the Late Tony Hilton (11th April 2009)

Complete Planetary Imaging System

This system was assembled based entirely on Martin Mobberley's recommendation "*Lunar and Planetary Webcam User's Guide*"

Consisting a Celestron C91/4S-GT with XLT incl. Head and Tripod
Wm. Optics Megrez 80mm APO Refractor finder scope plus Mounting O-Rings
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Plus various Accessories – Meade Pictor 216XT CCD Camera and Autoguider
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And various other items which compliment this system, all in excellent condition

For pricing please enquire by email – astro@toad.co.za
Or visit www.toad.co.za/astro for a full listing of miscellaneous items available.



mnassa

Monthly Notes of the Astronomical Society of Southern Africa
Vol 69 Nos 5 & 6
June 2010

assa news

MNASSA Editor position vacant

After four and a half years I have decided to step down as editor of *MNASSA* at the end of the current election year. I have been finding it increasingly more and more difficult to get issues out on time due to other commitments. I want to thank those who kept encouraging me to continue, despite deadlines falling increasing behind in the last year or so.

We are therefore looking for a suitable person to fill the position of editor. Keeping in mind that there are tentative plans to move towards electronic publication, experience in this field would be a great advantage. Interested persons are encouraged to write to the editorial address (mnassa@sao.ac.za) with details. ☆

ASSA Symposium 2010

First announcement and invitation to submit papers

The Society will hold its 2010 Symposium on 7, 8 & 9 October 2010 in Pretoria. The event will be hosted by the Pretoria Centre of ASSA.

The Symposium will be focusing on light/spectrum pollution, but will not be limited to these topics. All other aspects of astronomy will be allowed during the Symposium. We hereby wish to invite both professional and amateur astronomers to present papers at the Symposium. The organizing committee

is calling for abstracts (non-technical overviews of the papers that will eventually be presented. No mathematical or diagrammatic content required).

Verbal papers may be submitted in two categories:

- Short papers, for delivery in 20 minutes, with 10 minutes for discussion and questions.
- Long papers, for delivery in 40 minutes, with 20 minutes for discussion and questions.

A third available category is:

- Presentations in the form of displays. These may use one standard folding table (about 1 800 x 600 mm in size) and a poster board behind it to display any subject pertaining to astronomy.

Authors should indicate in the abstract in which category the paper is being submitted. Please make submissions in .doc (MS Word) or Adobe PDF format. Only e-mailed submissions, with the file attached, will be accepted. Full contact details (including e-mail address) and the full title of the paper MUST be submitted with the abstract. The latest date for submission is 31 July 2010. Please indicate a preferred date and time-slot to present your paper.

The Symposium committee reserves the right to accept or reject papers and to decide in which session it will be placed, although all efforts will be made to accommodate presenters.

Persons interested in attending, delivering a paper or presenting a display should contact the Symposium committee at: symposium2010@pretoria-astronomy.co.za

More details and a subscription form can also be downloaded from: <http://www.pretoria-astronomy.co.za>

Alternatively contact Andrie van der Linde at: 083 632 4894 ☆

Karoo Star-party update

Arrangements for the second National Karoo Star-party which will be held over the weekend of 6 to 9 August 2010 are progressing well. The Kambro Padstal, about 20 km north of Britstown in the Karoo, where the event will be held, is nearly booked out but accommodation in nearby Britstown offers alternative options. Chris de Coning from the Cape Centre has arranged a luxury bus from Cape Town to Britstown and has advertised amongst the local astronomy clubs there. Bookings for this bus, which includes accommodation in Britstown, is progressing well with some seats still available.

A bit more structure is being planned for the event which was initiated by Auke Slotegraaf (Deep-sky Section Director) who offered to present a "Deep-sky Observing Workshop" on the Saturday afternoon.

For more information, please contact the organisers:

Johan Smit: 0728062939, johans@pretoria-astronomy.co.za

Danie Barnardo: 0845886668, danieb@pretoria-astronomy.co.za

is elongated in a north-south direction and NGC 3358 in a north-west to south-east direction. The smallest of the three galaxies, **NGC 3354**, occupies the middle seat between the above-mentioned galaxies and appears as a very small out-of-focus spot (see sketch). Again the trio can be spotted in a 12 arc minute field. If you feel like hunting down galaxies of all sorts, this is definitely the area to spend some time. What amazes me most every time I lay eyes on a galaxy is the fact that one is looking back millions of years into the past, making me realise the unfathomable vastness of space.

The Antlia Dwarf Galaxy is situated virtually on the border with Hydra. It is believed to be tidally interacting with the barred spiral NGC 3109. This dwarf galaxy was discovered by research students Alan Whiting and George Hau of Cambridge University in England while visually inspecting UK Schmidt Telescope photographic survey plates. The discovery was announced on 10 April 1997.

Take a moment to glance at υ Antliae, situated 50 arc minutes north of the constellation Vela, more or less midway along the southern Antlia border. This variable star displays a lovely warm rusty colour and changes magnitude from 8.1 to 9.7 in 302 days.

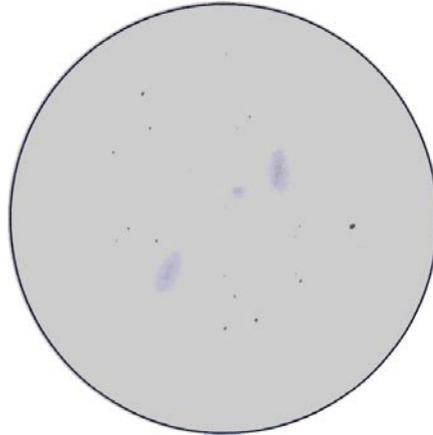
The planetary nebula **NGC 3132** is bisected by the division between Antlia and Vela. Although listed as an object within Vela, I decided to borrow the Vela half for

this article. This outstanding ring nebula appears quite round in shape, with a sharply defined edge, slowly dimming towards the centre. The nebula reveals a structure that brings to mind a clown face of sorts. The north-western edge seems fainter and weaker. NGC 3132 is also known as Bennett 43, with nicknames like the 'Eight Burst' and the 'Southern Ring'. Instead of the characteristic blue colour, this planetary displays a soft pale grey to white. Higher power reveals the magnitude 10 central star quite well, although it is not the one which is illuminating the nebula; that honour belongs to a magnitude 16 dwarf companion, 1.65 arc seconds away. It appears that a cup of faint stars towards the north-east holds this planetary nebula in its palm.

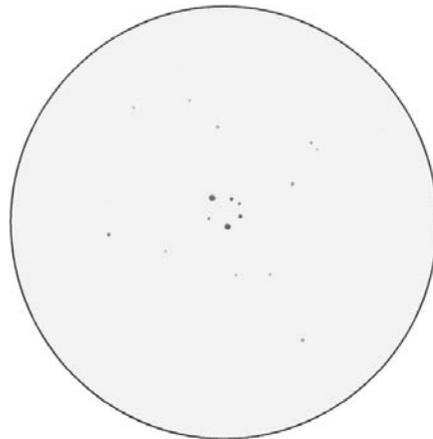
Just 1.3 degrees east of NGC 3132 is another asterism which really appeals to me and is a great pleasure to share with you. **Streicher 8** (*Deep Sky Hunters Catalogue*) exercises a firm grip on the southern edge of the border with the constellation Vela. Outstanding against the background star-field, this grouping consists of only a handful of stars in a half-moon shape with a difference. It reminds me of a set of headphones with bright stars at the north-eastern and south-western ends. Fainter stars connect the shape to strengthen the impression (see sketch).

Whatever the shape of this scientific starry pump, allow it to breathe new motivation into your observations when next you compile a deep-sky "to-do" list. ☆

axies is also part of the Hydra-Centaurus Supercluster of galaxies, the third nearest to our Local Group. [George Ogden Abell (1927-1983) was an astronomer at UCLA. He worked as a research astronomer, teacher, administrator and populariser of science and education. Abell received his BSc (1951), MSc (1952) and PhD (1957) from the California Institute of Technology].



NGC 3347 (above) is part of the Antlia group of galaxies while the asterism Streicher 8 (below) resembles a set of headphones.



The main focus of the galaxy group Abell S0636, however, weaves around NGC 3268, by far the largest and brightest galaxy in this field, with various other members. The round to oval glow of NGC 3268 is easily seen rising evenly to a slightly brighter nucleus. What held my eye was the very soft hazy envelope around the edge of the galaxy. Hanging on the western edge of NGC 3268 is a smaller dust speck indicating the companion galaxy NGC 3267, surprisingly quite easily seen. A pair of faint stars separates these two galaxies from each other. NGC 3269 is situated 6 arc minutes north, slightly elongated in a north-south direction, with a barely brighter nucleus. NGC 3271 is another galaxy member, situated 5.5 arc minutes south-east of NGC 3268, displaying an elongated oval in an east-to-west direction. Outstanding is the fact that this galaxy consists of a nice bright nucleus. This group fits quite easily into something as little as a 12 arc-minute field of view.

Situated 3.8 degrees north-west of iota Antliae, is yet another galaxy grouping

which is also part of the Antlia group of galaxies: NGC 3347, situated towards the northern brink of a galaxy trio. NGC 3347 is very similar in appearance to NGC 3358 situated at the southern end of the three star cities. These two galaxies display soft ovals, slightly hazy and barely brighter towards the middle. NGC 3347

For information about the bus from Cape Town, contact Chris de Coning: 0834485889, sirusa@absamail.co.za

To enquire/book accommodation at Kambro, contact the Manager, Wilma Strauss, directly at: 0833056668, kambro@worldonline.co.za

For info about the Kambro Padstal facilities, including a report on the 2009 star-party, visit <http://www.kambroaccom.co.za/> ☆

UCT Astronomy Club formed

An astronomy club has finally been created at the University of Cape Town (UCT) this year. Astronomy is intriguing to all, whether it is the keen academic endeavours of astronomers and astrophysicists or the appreciative glances at the night-time sky of the ordinary individual. The awe-inspiring vastness of our universe brings up questions of who and what we are, where we are exactly in the great scheme of things and why we are and everything is. Astronomy is the pursuit to answer some if not all of those questions. The human fascination with the heavens is timeless and will be the cornerstone of the success of the UCT Astronomy Club.

The aims of the UCT Astronomy Club are as follows:

- To promote and encourage a greater interest and participation in the sciences, engineering and, specifically, astronomy & astrophysics at the University of Cape Town.
- To provide a platform for amateur and professional astronomers to meet and observe.
- To conduct a schools outreach programme, namely, *The Stellar Club*, to develop maths and science skills in underprivileged schools in the Western Cape; encourage a greater interest in school-learners in the sciences, engineering and, specifically, astronomy.





The UCT Astronomy Club committee. At the back are Tafadzwa Mukwashi (Chairperson), Sally Macfarlane (Vice-Chairperson), Priscilla Chauke and Riona Ramraj (Secretary). Front: Teboho Makhabane (Treasurer), Bradley Frank (Committee Advisor). Absent: Moses Mogotsi. Credit: Katherine Traut and the Communications & Marketing Department, UCT.

This new society was founded and is chaired by an Electrical Engineering student, Tafadzwa Mukwashi, and is run by a dedicated committee (see picture).

The club meetings are a great way for students to make new friends whilst casually picking up some cosmic facts. The society currently has a membership of 70 students, undergraduates and postgraduates, from across various faculties including the Science Faculty and the Faculty of Engineering and the Built Environment.

Speakers this semester have included Mr Kevin Govender from the South African Astronomical Observatory; Mr Simon Ratcliffe from the South African Square Kilometre Array, SA SKA/ MeerKAT Project – the

latest and most exciting radio astronomy project to date in the world; Mr Bradley Frank, the UCT Department of Astronomy Postgraduate Representative of the Astrophysics, Cosmology and Gravity Centre; Associate Professor Patrick Woudt; and Professor Bruce Bassett, a leading cosmologist.

Stargazing on the roof top of the RW James Building follows each evening's talk. Members are guided through the night-time sky and can view various constellations and planets through the three telescopes available.

The schools outreach programme of the club, the Stellar Club, is focusing on producing free self-teach tutorials in high school mathematics and physical science. The Stellar Club will also incorporate astronomy related activities and articles. In addition, the club is bringing out an annual publication, the *Astronomy Gazette*, which is to be freely distributed. The club's website is at www.ast.uct.ac.za and on Facebook as "UCT Astronomy Club".

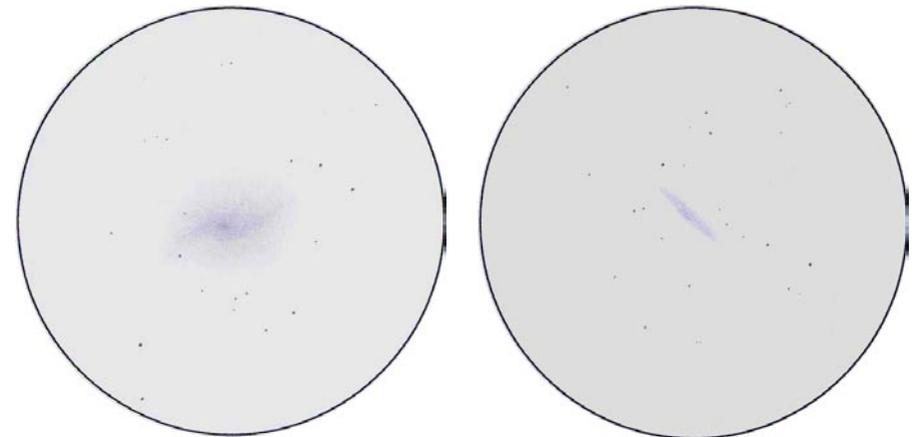
UCT has the privilege of being not only the only university in South Africa to have an Astronomy Department but has also in recent months been awarded the Chair in Extragalactic Multi-Wavelength Astronomy, part of the South African Research Chairs Initiative along with the SA SKA. This makes UCT a leader in the African Astronomical Community. ☆

Alpha Antliae is an easy star to spot with the naked eye in the far north-west of the constellation. It displays a lovely warm orange colour – spectral type K4. This beautiful magnitude 4.2 star signals the portals to the many galaxies situated mainly to the south within the constellation.

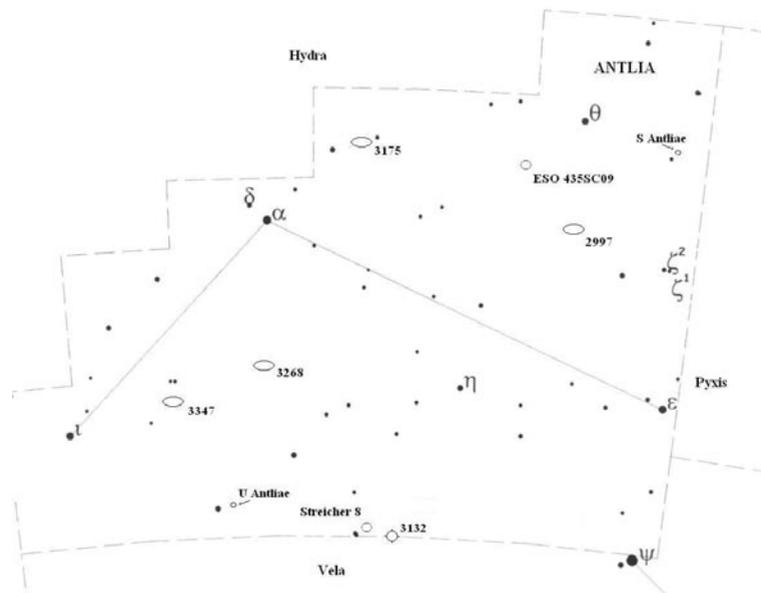
Nearly two degrees south-west of alpha Antliae, Jay O'Neal picked up an asterism in this galaxy-strewn area. "Exciting" is the word when asterisms are found in many forms that represent images of sorts. It would be difficult to find anything closer to a mini Scorpius constellation if one looks at the shape of the grouping **O'Neal 10** (*Deep Sky Hunters Catalogue*). The cluster consists of around a dozen stars with the imaginary starry head of the scorpion pointing north. A lovely magnitude 8 star resembles the famous Antares in the real Scorpius constellation. The main body of the asterism runs from north to south.

NGC 3175, one of the most outstanding spindles in appearance, is situated in the far eastern part of Antlia, 1.3 degrees from Hydra. The galaxy displays with pride an elongated soft beam of light in a north-east to south-west direction. Furthermore, it has an uneven surface brightness with a faint, barely seen nucleus. A short arch-shape of a few faint stars curls out from the galaxy's western side (see sketch). This nearly edge-on spindle is approximately 50 million light years distant.

Moving into the real deep world of galaxies, **Abell S0636**, also known as the Antlia galaxy cluster, is situated in the south-eastern part of the constellation. Abell S0636, which contains about 234 galaxies, is dominated by the two massive ellipticals, NGC 3268 and NGC 3258, with the northern subgroup gravitating around the former and the southern subgroup centred around the latter. The Antlia group of gal-



Galaxies NGC 2997 (left) and NGC 3175 (right) sketched with my 16-inch S/C at 290x. North is up and east to the left.



east of S Antliae and is certainly outstanding in appearances. Although not that bright, this galaxy is easily seen as a north-west to south-east oval. Higher power reveals that it gradually brightens towards a well-defined, but small nucleus. The north-eastern and south-western outer edges appear gaseous and bulge slightly, almost like drooping shoulders, with a hint of spiral structure towards the western side. A few faint stars can be seen close to the south-eastern and western rim of the galaxy (see sketch). NGC 2997 was discovered by William Herschel in 1793. He noted it as a nebulous atmosphere, extremely dilute and little brighter towards the middle. Other observers disagree about the appearance of the galaxy's nucleus. John Herschel records it as a fairly distinct, round nu-

cleus. Walter Scott, the late American amateur, recorded it as a glow with little central condensation while Ernst Johannes Hartung notes it as having a well-defined, much brighter nucleus. Hartung produced a comprehensive and highly respected guide for southern observers in 1968.

One of the few open clusters in Antlia, **ESO 435SC09**, can be found if one draws an imaginary triangle between NGC 2997 and the magnitude 4.7 theta Antliae. About a dozen mixed-magnitude stars group together in an elongated north-west to south-east direction. It appear almost as two rows of stars running more or less parallel to each other in a slightly oval shape with fainter stars to fill in the gaps.

SAAO Selected as Host for the IAU Office for Astronomy Development

The Executive Committee of the International Astronomical Union (IAU) has selected the SAAO, a national facility of the South African National Research Foundation (NRF), to host the IAU Office for Astronomy Development (OAD). The Office is the key component of the decadal global strategy plan, Astronomy for the Developing World, launched at the 2009 IAU General Assembly in Rio de Janeiro, Brazil, and is aimed at using astronomy to foster education and capacity building throughout the world.

At its 88th meeting, on Thursday, 13 May 2010 in Baltimore, USA, the International Astronomical Union selected a proposal submitted by the Director of the SAAO, Professor Phil Charles, from 20 excellent proposals that were carefully assessed over several months. This was an extremely difficult process, given the high quality of so many of the proposals, and its successful outcome represents a milestone in a new era of astronomy development activities for the IAU.

“Finding a home for the OAD is the first step in the execution of the most ambitious global plan ever conceived in astronomy for development. On the behalf of the IAU, I congratulate the SAAO and wish the new OAD every success in this exciting and important new venture,” says the IAU President Robert Williams.

“With its links to technology, science and culture, astronomy is a unique tool for capacity building. The IAU has long had a vigorous education programme through its Commission 46. The strategic plan takes it a step further and establishes global capacity building as a core mission for the IAU. The SAAO is the prestigious home of several world-leading research telescopes, such as SALT, and has pioneered a unique programme of education and outreach at all levels. Located at the SAAO, the IAU Office of Astronomy for Development will be in a position to learn from the South African experience and make a fundamental contribution to furthering sustainable development globally,” says IAU Vice-President George Miley, responsible for astronomy development and education.

The Director of the SAAO, Professor Phil Charles, said, “We are delighted at the confidence expressed in us by the IAU and very excited to have the opportunity to extend what we have been doing locally to a global scale. Astronomy is all about partnerships, and we look forward to strengthening those we already have, as well as to building new ones, as we use astronomy as a vehicle to introduce science and technology to a new generation. South Africa has been visionary in exploiting the country's natural strategic advantage in astronomy and using it as an integral part of its science and technology strategy — we aim to show that the skies are not the limit.”

The IAU's decadal strategic plan, Astronomy for the Developing World, is built upon the unparalleled success of the IAU and UNESCO initiative, the International Year of Astronomy (IYA2009). The strategic plan was developed over two years and its implementation was approved during the August 2009 IAU General Assembly, in Rio de Janeiro, Brazil. By building on the momentum from the IYA2009 and its large network of 148 countries, this ambitious plan represents the long-term commitment of the IAU to expanding development programmes through astronomy over the next decade.

The OAD is the key component of this challenging mission and will play a central role in the coordination and management of all the existing IAU educational activities, as well as in the recruitment and mobilisation of participating volunteers. The OAD will also be a vital liaison between the IAU Executive Bodies and the IAU National Members, as well as the main contact point between the IAU and the national authorities.

The IAU jointly with the SAAO will soon appoint a Director to lead the OAD on behalf of the IAU Executive Committee. ☆

GPS Time

Brian Fraser

Accurate time signals are extremely important for various astronomical observations, including occultations. For many years we have relied on the WWV time signal broadcast on various short-wave frequencies, including 5MHz, 10 MHz and 15 MHz stations. That after the South African signal, ZUO, was discontinued about 15 years ago.

However, many devices are now available to extract an accurate time signal from the GPS network, which is supposedly accurate to about 1ns (nanosecond = 1 thousand millionth of a second). It is not easy to verify this, so you have to take their word for it.

Imagine my surprise when I recently turned on my GPS device and checked it against the WWV signal and found that it was out by 15 seconds!

After many emails and question-asking I found out that the GPS system has its own time base and does not keep to UT. When you switch on a GPS device it will relay to you GPS time which drifts away from UT every time a leap second is inserted into our calendar. It is currently 15 seconds behind. The GPS system then transmits an "almanac" to your device so that your device can make the correction but this takes some 14.5 minutes to happen. Then your GPS device corrects itself and gives you true UT.



Antlia, the Machine Pneumatique

by Magda Streicher
magda@pixie.co.za



Image source: Stellarium.org

The apparently insignificant constellation Antlia lies just south of Hydra and borders Vela to the north, lying along the branches of the Milky Way. French astronomer and celestial cartographer Nicolas-Louis de Lacaille was responsible for creating some of the newer southern constellations when he visited the Cape of Good Hope from 1751 to 1753. Antlia, the baby of the Lacaille constellations, was originally named by him as the *Machine Pneumatique*, commemorating the air pump, which had recently been invented by Robert Boyle. However, I just love the German name *Luftpumpe*. Antlia is the Greek word for pump. It is difficult even to visualise a pump-shape amongst the star-formation with Antlia containing no stars brighter than magnitude 4.2. This southern treasure however, should by no means be underestimated. To start with, it hosts a huge number of galaxies.

The long leg between alpha and epsilon Antliae spans nearly 13 degrees in a westerly direction. It appears as if this part represents the base of the pump with the shorter attached tripod stretching south-east to iota Antliae. The lever of the pump seems to be projected by the double-star zeta¹ & zeta² Antliae, situated 4 degrees north

of epsilon Antliae and virtually on the border with the constellation Pyxis. Zeta¹ Antliae is a magnitude 6.2 silvery white primary with a magnitude 7.1 companion. The separation is 8 arc seconds and the position angle 212. John Herschel measured the star in 1836 and there has been no observable change since then. The double-star was previously identified as multiple in the *Hipparcos Input Catalogue*.

A special type of star can be found 3.3 degrees further north of zeta Antliae along the western border with Pyxis. **S Antliae** is an eclipsing binary of the EW Ursa Majoris type, a system of two dwarf stars in close orbit around each other. S Antliae varies by half a magnitude from 6.4 to 6.9 over a period of only 7 hours – quite easy to follow during the course of an observation session – as noted in 1888 by a man known only as Paul of Washington (*Star names*, Richard Allen). At the time of its discovery it was the variable star with the shortest period known.

Notwithstanding the fact that galaxies are some of the faintest objects, observing them remains an unbelievable privilege. The beautiful **NGC 2997**, also known as Bennett 41b, is situated 4 degrees south-

This orbit was then despatched to several key members of the Group that had morning visibility, enabling more observations to be obtained to refine the orbit.

Meanwhile the *New York Times* became aware that I was searching for it and requested an exclusive story which the members of the Group agreed to. However that newspaper was more interested in the big picture than the amateur aspect. I therefore felt it appropriate that we also share our story with space journalist Leonard David who had contacted me whilst the search was still in progress and had expressed interest in the story of the search. David, reporter of space activities for some five decades, has given the Group excellent coverage in the past, so I provided “off the record” information to enable him to prepare his article. The *New York Times* article appeared early 23 May. Within a very short time David had his article on the internet which gave a complete account of what had occurred. He followed this up with a subsequent article and after this numerous stories have appeared in a wide spectrum of media about the discovery.

Meanwhile, www.heavens-above.com has added the Spaceplane to their list of satellites the public can track and the orbital data derived is now freely available on the internet for anyone who wishes to see it. One email I received was from a retired engineer who had worked on the related X-34 project. He was thrilled to be able to go outside and see the X-37B sail by overhead from his home in Florida. From reports on the internet it would appear that the Spaceplane has



Artist's rendition of how the X-37B will deploy on orbit, including the solar panels used for electrical power. Image credit: Boeing

already been widely observed and photographed in the United States during their first spell of morning visibility.

What is there to see? The Spaceplane is not particularly big so do not expect to see anything as bright as the International Space Station or the Space Shuttle. At best it might only reach magnitude +2. However on account of its low orbiting altitude it is not that easy a target and in practice one can expect magnitudes as faint as +5 (depending on several factors).

The question does arise as to how long the Spaceplane will stay in its current orbit. At the time of writing it does not appear to have made any major changes since launch, but it could still be in the testing phase so has not yet begun to show off its capabilities. I fully expect it to make large changes, causing it to be lost until it can be rediscovered. I am confident that, provided we are able to make frequent observations, we will be able to keep up with the “cat and mouse game” of following this interesting satellite. ☆

I presume this applies to the circuitry on GPS telescopes and any other device that uses the GPS signal. So next time you use your GPS telescope or GPS device, switch it on about 15 minutes before you want to use it. You will then get a much more accurate reading.

I bounced Brian's contribution off Geoff Evans, Head Electronics, SAAO, who developed SAAO's GPS-based time service as well as SALT's more recently. Although Geoff agreed with all the facts stated by Brian, he said that, from his experience, the 14.5 minute time delay seems quite long and may be device-specific or circumstance-specific and not always necessarily exactly 14.5 minutes. He therefore suggests that you should determine the time that your specific GPS receiver takes

to download the almanac for yourself by comparing it to an accurate time service or another GPS which has already synchronized its timing. Since some commercial GPS devices are not too meticulous on timekeeping (their primary purpose is yielding position information after all) one should really check the time behaviour of your specific unit if you intend using it for accurate timekeeping. During tests evaluating suitable GPS units for a time service, Geoff found that one model allowed its time output to drift by as much as 1 ms before correcting it again. The unit finally selected for the SAAO's time service allows an EPROM change to alter its algorithm from position-priority to time-priority, yielding nano-second absolute time accuracy.

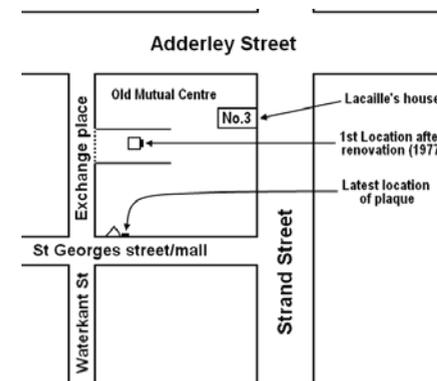
Ed. ☆

Correction

Referring to p. 46 of the article *Disappearance of Lacaille Plaque* in the April issue, Cliff Turk has written to us as follows (with reference to the attached sketch):

The 1977 unveiling of the “replaced” plaque at which Michael Feast spoke was not at the corner of Waterkant Street and St Georges Mall for the following reasons:

1. The “pillar” referred to was inside the building at an entrance from Exchange Place.
2. There has never been a pillar at the corner of the two streets you mention.
3. Waterkant Street does not cross to that



- side of what was then St Georges Street.
4. The name St Georges Mall was only introduced later when the thoroughfare

became a walkway in place of the original traffic bearing street.

The plaque was moved from the pillar inside the Exchange Place entrance to the building when that entrance was closed up.

This would have made the plaque inaccessible to the public, so it was moved to its final position at the corner of Exchange Place and St Georges Street/Mall, facing the latter. (I do not know exactly when St Georges became a Mall.) ☆

classified

FOR SALE

Hyperion 8 & 13mm eyepieces for sale. Like new, in original boxes. R1 250 each.

Canon EOS 400D and 18-55 zoom. 1 year and 4 months old. R4 500.

Celestron 102 SLT GOTO Telescope. Hard case for ota. Motofocus. 9 and 25 mm eyepieces. R5 000.

Roy (Johannesburg) 082 560 3064

FOR SALE

Due to the move of the Bronberg Observatory and household from a small holding in Gauteng to a smaller setting in the Klein Karoo, some items related to telescopes are to be sold before end Sep 2010.

It includes the following:

- * an upgraded 12.5" Meade Dobsonian Starfinder on wheels
- * several quality eyepieces, some of them never used
- * Barlow lens, focal reducers
- * 2" diagonals for Meade RCX400 (12"/14") or compatible telescope
- * Heavy tripods for above telescopes
- * Polar superwedge for Meade LX200 12"

Also: Tele Rokkor 135mm for Minolta SLR camera (1976-) in good condition

A detailed list of items and suggested prices can be requested from lagmonar@nmisa.org

Berto Monard, Bronberg Observatory

set up two cameras on the same mounting, but pointing at two different elevations, with a slight overlap. I also had to make trade-offs in terms of the field of view and sensitivity of the cameras, but eventually settled on a 14.6 x 10.8° field that showed stars down to about magnitude +10 in "real time". The other camera covered 29 x 21.5° down to about magnitude +9 with an exposure of several seconds.

During the period 4-18 May about six planar searches were conducted through bad weather which interrupted or aborted several runs. I also experienced unusual hardware problems with the computer that controlled the system. Eventually I was convinced that the negative results indicated the satellite could not possibly be in an orbit inclined 33.5° to the equator.

Meanwhile Ted became aware of several rumours suggesting that, shortly before orbital insertion, the Atlas booster must have had a large inclination shift and put the satellite in a 40° inclination orbit. There was no concrete evidence to support this and the rumours were second/third hand. Since we were now convinced it was not at 33.5°, there was no harm in trying 40°, especially as the satellite was now moving into the daylight sky and I had little time for more searches.

On 19 May I did a planar search for a 40° inclination, 500 km altitude orbit, but saw nothing unexpected. So, on 20 May I did a search at same inclination but altitude 450 km. Meanwhile, on 20 May Kevin Fetter,

one of the team members in Canada, reported that he had accidentally captured a fast moving bright satellite which he could not identify.

To quote Ted's report:

"Knowing our history of fortuitous sightings, I quickly checked and confirmed that the object was not among those in known orbits, and then checked the time and sky co-ordinates against our search orbits. It was sufficiently close to the new 40° search plane to be highly interesting, so I set about reducing the video imagery into time and sky coordinates and evaluating possible orbits. After several hour's analysis, I became convinced that Kevin probably had captured OTV-1 and that it was in an approximately 39 to 41° orbit, with 40° fairly likely.

"The result of Kevin's video came too late to assist Greg who was busy performing his second planar search of the new 40° search orbit. At 18:51 UTC I received his report that at 16:31UTC he had recorded an object of about the expected brightness, and direction and speed of travel relative to the stars.

"I quickly determined that Kevin and Greg had independently observed the same satellite, in approximately a 410 km orbit, inclined at 40° to the equator, in an orbital plane consistent with the circumstances of the launch of OTV-1. I was also able to confirm that our North American colleague had indeed seen OTV-1 back on April 24."



(left) The X-37 in a vertical attitude, the position in which it gets launched.

(right) An artist's rendition of the X-37B on its Atlas launch vehicle and in orbit. Images: Boeing



sighting was made by a North American colleague on 24 April. This observation was made under extremely poor sky conditions which made it difficult to identify the stars in the vicinity of the rapidly moving spacecraft. Only one accurate time and position could be determined.

I tried again the next morning with negative results. After this no further morning tracking was possible as the spacecraft had now passed into earth's shadow. My next visibility spell was only around 4-5th May, in the evening. By now the satellite could be just about anywhere and it was pointless hoping that any of the assumed orbits would result in a sighting. It therefore became necessary to use searches of the whole 33.5° plane. A planar search essentially involves staring at a point on the search orbit for a period of at least one revolution of the satellite about the Earth (about 90-91 minutes), while tracking the

orbit as it precesses. If the satellite is there, and is sufficiently bright, it will be seen. It is simple in principle but difficult and tedious to do manually.

I realised that if the Amateur Group was to have any chance in finding this satellite, I would have to conduct such searches. Fortunately my automated system is ideal for planar searching. In fact, it is believed to be the only system, either amateur or professional, that can perform such a search and has been successfully used on several occasions to find lost satellites etc. Incidentally, a by-product of this particular search was the recovery of a satellite (in highly elliptical orbit) that the amateurs had lost for almost a year

I also realised that, using my normal optical set-up, I would not have too much chance of success because the search plane was merely an educated guess. I therefore

University of Cape Town

Astronomy Department, 2009 Annual Report

Personnel

Academic staff: The permanent academic staff consists of the Chair and Head of Department, Professor Renée C. Kraan-Korteweg, Professor Erwin de Blok (SARChI Chair), Professor Patricia A. Whitelock (joint SAAO/UCT position), Associate Professor Patrick A. Woudt, Senior Lecturers Dr Thebe Medupe (on a joint SAAO/UCT position) and Dr Kurt van der Heyden, and Lecturer Dr Sarah-Louise Blyth (SA-SKA funded). Distinguished Emeritus Professor Brian Warner and Honorary Professor Michael W. Feast both remain highly active members of the department. Dr Ian Stewart is an Honorary Research Associate.

Affiliated staff: Professor Phil Charles, Director of the SAAO, is an Honorary Professor. Professor Peter Dunsby (Dept. of Mathematics and Applied Mathematics, UCT), Director of NASSP (National Astrophysics and Space Science Programme), continues as Honorary Academic Member of the Department.

Postdoctoral fellows: The current postdoctoral fellows are: Dr Benne Holwerda (SARChIpostdoc), Dr Antoine Bouchard (SKA-SApostdoc), Dr Matthew Church (UCT postdoc, started in 2009, previously at University of Southampton, UK), Dr Se-Heon Oh (SKA-SA postdoc, started in 2009, previously at the Australia National University, AUS).

Academic support staff: Ms. Carol Marsh, administrative officer. Mr. Brian Kuck, IT support.

Graduate students: PhD students: Michelle Cluver, (graduated in 2009 June, recipient of the UCT Science Faculty PhD award in 2009 for best PhD in the Faculty), Ed Elson, Abiy Getachew (joint UCT/SAAO), Marissa Kotze (UCT/SAAO, upgraded to PhD in 2009), Paul Kotze, Rudy Kuhn (UCT/SAAO, upgraded to PhD in 2009), Viral Parekh, Andry Rajoelimanana (UCT/SAAO, upgraded to PhD in 2009), Ihad Riad, Mellony Spark (UCT/SAAO), Bonita de Swardt (graduated in 2009 December); MSc students: Oyirwoth Abedigamba (UCT/SAAO), Janus Brink (UCT/SAAO), Bradley Frank, Roger Ianjamasimanana, Tana Joseph (graduated in 2009 June), Kosma von Maltitz, Zolile Mguda, Bishop Mongwane, Tom Mutabazi, Francois Nsengiyumva (UCT/SAAO), Nikki Pekeur (graduated in 2009 June), Zara Randriamanakoto (UCT/SAAO), Thuso Simon, Wendy Williams.

Visitors: In 2009 the following visitors spent time at the Department: Dr Wim van Driel (Observatoire de Paris Meudon, France), Prof Lister Staveley-Smith (University Western Australia, AUS), Prof Malcolm Longair (University of Cambridge, UK), Dr Takahiro Nagayama (Kyoto University, Japan), Dr Shogo Nishiyama (Kyoto University, Japan),

Prof Trish Henning (University of New Mexico, USA), Dr Marc Verheijen (Rijksuniversiteit Groningen, NL), Dr Mat Jarvis (University of Hertfordshire, UK), Dr DJ Pisano (National Radio Astronomy Observatory, USA).

Teaching

Undergraduate Level: In 2009 44 students were registered at UCT for the undergraduate specialisation in Astrophysics. The first year course “Introduction to Astronomy” (AST1000F: course convenor(s)/lecturer(s): Drs van der Heyden and Blyth) was taught to 110 students. The second year course “Introduction to Modern Astrophysics” (AST2002S: course convenor/lecturer: A/Prof Woudt) was given to 30 students. At third year level two courses were offered to 6 and 4 students, respectively. These are advanced undergraduate courses on “Stellar Astrophysics” (AST3002F: course convenor/lecturer: Dr Medupe) and “Galactic and Extragalactic Astrophysics” (AST3003S: course convenor/lecturer(s): Prof Kraan-Korteweg and Dr Holwerda).

Graduate Level: Postgraduate teaching falls under the National Astrophysics and Space Science Programme. For full details of the Astronomy Department’s involvement and structure of NASSP, see our 2008 Annual report (MNASSA Vol 68, Nos 7 & 8, August 2009).

NASSP BSc Honours: The BSc (Hons) AST4007W course was followed by 16 students. Seven additional students took

part in the Extended Honours Programme (EHP). Prof Saalih Allie (CHED, UCT) was the coordinator of the EHP. Prof de Blok taught the module on “Galaxies and Large-Scale Structures” and A/Prof Woudt taught the “General Astrophysics 1” module. 15 NASSP Honours students graduated in 2009.

NASSP MSc coursework component: A further 15 students (partly former NASSP Honours students) participated in AST5003F, the taught component of the MSc in Astrophysics and Space Science. Prof Kraan-Korteweg taught the module on “Extragalactic Astronomy”, Prof Warner the module on “Cataclysmic Variables” and Dr Medupe the module on “Advance Stellar Structure and Evolution”. Dr Stewart taught the module on “Computational Astrophysics”.

NASSP MSc research component: Eight students newly registered with the Astronomy Department in 2009 for their NASSP MSc research component. These are: Roger Ianjamasimanana, Bishop Mongwane, Tom Mutabazi, Thuso Simon, Kosma von Maltitz, Francois Nsengiyumva, Zara Randriamanakoto and Oyirwoth Abedigamba. The latter three are jointly supervised by staff members at UCT and the SAAO. Continuing NASSP MSc students in the Astronomy Department are Zolile Mguda and Janus Brink.

MSc research by dissertation alone: Two students newly registered in 2009 to start their MSc by dissertation alone,

the Buck Rodgers/Star Trek type of behaviour.

The Spaceplane was launched on an Atlas V rocket from Cape Canaveral on 22 April 2010 (23:52 UT). Launch was perfect and the first few minutes of its flight were broadcast over the Internet. But, as is usual with coverage of classified missions, the flow of information stopped just before things got interesting. Virtually no information was released on the planned orbit, so amateur satellite trackers were pretty much in the dark as to where to look for the satellite. Normally it is possible to deduce a probable orbit from the initial flight trajectory shortly after launch and the orbital capabilities of the launch vehicle. In this instance the Atlas V rocket was somewhat overpowered for launching such a relatively small, lightweight satellite, which added to the confusion. In fact, the upper stage of the rocket was shot off into Solar orbit, making it the first classified object to orbit the Sun! This made it even more difficult for us to estimate the satellite’s original trajectory.

Ted Molczan (Canada) – one of our Satellite Tracking Group’s orbital experts – prepared several sets of possible orbital elements based on a suspected orbit of about



(above) The X-40A technology demonstrator was a 90% scale unpowered version of the SMV vehicle. The first flight of the X-40A was on 11 August 1998 when it was released from a UH-60 helicopter over Holloman AFB. In 2000 the X-40A was transferred to NASA for tests as part of the X-37 development. The tests comprised seven drop flights from a CH-47 over Edwards AFB. The X-40B program was terminated and, it is assumed, was merged with the X-37B program.

(below) During an earlier stage of development, designated X-37A, a number of captive flights as well as approach and landing tests were made during 2004 through 2006 using the White Knight vehicle.



33.5° inclination and an orbital altitude of between 400 and 500 km. Shortly before dawn on 23 April I got out of a warm bed to set up my equipment and search for this orbit but I failed to see it. Not surprisingly, since it subsequently turned out that it was nowhere near where it was expected. The next day was cloudy, so no observations could be attempted, but an early probable

Sleuthing the new Spaceplane

Greg Roberts

On 22 April 2010 the United States of America launched the first of a new type of satellite that has been identified as a BOEING X-37B “Spaceplane” or OTV (Orbiting Test Vehicle). The exact purpose of the whole mission has been deeply shrouded in secrecy. It therefore proved a great challenge for our Amateur Satellite Tracking Group, specialising in tracking down classified payloads and it took us almost a month to bag this extremely elusive spacecraft.

According to Wikipedia and several other sources, the craft is basically an unpiloted Spaceplane, operated by the United States Air Force for orbital spaceflight missions intended to demonstrate reusable space technologies. It began as a NASA project and was developed by Boeing’s Phantom Works in California. In 2004 it got transferred to the US Department of Defence’s “Defence Advanced Research Projects Agency”. It then became a classified project and it is not known whether it will continue to remain so. The Pentagon has strongly denied claims that the mission supports the development of space-based weapons.

It is further reported that this vehicle has the potential to become the United States’ first operational military Spaceplane. It is not sufficiently powerful to reach orbital velocity on its own so has to be launched by a rocket. It is able to land under remote control at the conclusion of its mission, which can extend up to 250-270 days in duration.

The primary landing site is Vandenberg Air Force Base in California with Edwards Air Force Base as an alternate site. A second X-37B is currently being manufactured for a mission scheduled for 2011.

The Spaceplane is unmanned and has a length of 8.9 m and a wingspan of 4.5 m with a loaded weight of nearly 5 000 kg. It has a payload bay that can carry approximately 250 kg and it measures 2.2 x 1.2 metres. It is powered by a AR2-3 rocket engine using the hypergolic (self igniting) combination of nitrogen tetroxide and hydrazine, whilst the manoeuvring engines are fuelled by hydrogen peroxide. It is believed to have the ability to do orbit changes of magnitudes not seen before, making it the first of a new generation of satellites that comes close to



The author with the two cameras on its computer controlled mount that was used to track down the elusive spacecraft. Picture Shelley Christians, Sunday Times, 6 June 2010

namely Bradley Frank and Wendy Williams.

PhD research: Viral Parekh started his PhD in March 2009. Marissa Kotze, Andry Rajoelimanana and Rudy Kuhn all upgraded from MSc to PhD in 2009. Continuing PhD students in the Astronomy Department are: Ed Elson, Abiy Getachew, Paul Kotze, Ihab Riad and Mellony Spark.

Graduations: Two UCT Astronomy NASSP MSc students graduated in 2009: Ms Tana Joseph and Ms Nikki Pekeur. Two PhD students in the Astronomy Department graduated in 2009: Ms Michelle Cluver and Ms Bonita de Swardt.

Extramural

NASSP summer school: Prof Kraan-Korteweg gave a talk at NASSP summer school that was held at the SAAO in January titled “What secrets does the Milky Way hide?”. Dr van der Heyden gave a talk on “X-ray Astronomy”. Prof Warner gave an introductory lecture and tour of the observatory at the summer school for the new NASSP students. Prof Whitelock gave a talk entitled “Astrophysics in Southern Africa” at the same event.

NASSP-SAAO/SKA winter school: Dr Medupe organised the third NASSP/SAAO/SKA Winter School in July, which aims to increase the number of black South African students in Astronomy. He organised this winter school with fellow astronomers from SAAO and UCT.

Prof Kraan-Korteweg gave a talk at the NASSP-SAAO/SKA winter school held at the SAAO in July on “Unravelling the Mysterious Great Attractor” and Prof Whitelock gave a talk on “Astrophysics in Southern Africa”.

SAAO Colloquium Series: Dr Bouchard (Introducing ULYSS: Measuring Stellar Populations with Spectral Fitting, August 2009), Dr Holwerda (Interaction Signatures in Quantified HI Morphology of Galaxies, September 2009).

International Year of Astronomy: Prof Warner gave a talk on “324 years of stargazing: Astronomy at the Cape until 1879”. Dr Medupe gave a talk on “A crocodile eats the Sun: Indigenous Astronomy”. Marissa Kotze talked on “Black holes” and Rudy Kuhn presented a talk on “Is there somebody out there? Exoplanets and the search for extraterrestrial life”. Dr Holwerda gave a talk on “The Milky Way and Other Galaxies”. Dr van der Heyden and Prof Kraan-Korteweg gave the last of the series of talks organized by the SAAO for the International Year of Astronomy entitled “The Future of Astronomy in South Africa”.

Sutherland excursions: Prof Warner continued with taking Friends of the SA Museum and UCT Summer School participants on weekend excursions to the SAAO Sutherland site.

Planetarium: Dr Medupe is Planetarium Astronomer.

Various: Prof Kraan-Korteweg gave the Plenary Lecture with the title “What secrets of the Universe does the Milky Way hide? Unraveling the Mystery of the Great Attractor” at the 3-day event organized by SAASTA in October at the IThemba Labs directed at women science students on “Celebrating Women in Science”. A/Prof Woudt gave a talk to the Rotary Club of Claremont on 29 September 2009. He also gave a talk to the Cape Centre of the Astronomical Society of South Africa in July 2009.

Honours

Both Emeritus Prof Warner and Honorary Prof Feast received an A rating in 2009 from the National Research Foundation in recognition of their world-leading research. Emeritus Prof Warner received an honorary doctorate (DSc – honoris causa) from the University of Cape Town and was elected Fellow at the University College London. He furthermore was made a Fellow of the Third World Academy of Science.

The Astronomy Department was allocated one of the five South African SKA SARChI Chairs, entitled “Extragalactic Multi-wavelength Astronomy”, the second research chair for this department. The department has started the process of identifying suitable candidates.

Committees

Prof Kraan-Korteweg and Dr Medupe form part of the regularly meeting NASSP executive committee (exco) and

continued as members of the NASSP steering committee.

Prof Kraan-Korteweg was a member of the LOC of “Beyond 2010”, the Fifth International Conference on Beyond the Standard Models of Particle Physics, Cosmology and Astrophysics, that was held from 1-6 February 2010 in Cape Town. She was also a member of the SOC (and UCT a co-chair) of the International Meeting “Panoramic Radio Astronomy: Wide-Field 1-2 GHz research on galaxy evolution”, that was held from 2-5 June in Groningen (NL). Prof Kraan-Korteweg is co-director, together with Prof Dunsby (MAM) of the Astrophysics, Cosmology and Gravity Centre (ACGC), established in 2009 at the University of Cape Town. She is furthermore a member of the South African NRF Rating Panel for Physics in 2009 and a member of PHISCC (Pathfinder HI Surveys Coordination Committee).

Prof de Blok is a member of the MeerKAT science advisory committee. He is also member of the Science and Technology Advisory Committee of the International Centre for Radio Astronomy Research (ICRAR) in Perth, Australia. Prof de Blok is a member of the Pathfinder HI Surveys Coordination Committee.

Prof Whitelock is a member of the organizing committees for Division VII (Galactic System), Commissions 33 (Galactic Structure) and 55 (Communicating Astronomy with the Public) of the IAU and was elected to the IAU Special Nomi-

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Macfarlane, S. 2009. A UCT CCD CSS Survey of Faint Cataclysmic Variables. BScHons. Supervised by A/Prof P.A. Woudt

Master’s degrees by coursework and research

Joseph, T. 2009. Towards an HI Census of the Local Universe. MSc. Supervised by Prof R.C. Kraan-Korteweg and W. van Driel.

Pekeur, N. 2009. Investigating the Relationship between the HI and Optical Diameter for a Sample of Galaxies from the Local Volume. MSc. Supervised by Prof R.C. Kraan-Korteweg, Prof E. de Blok and Dr B.S. Koribalski.

Doctoral Theses

Cluver, M.E. 2009. The Nature and Nurture of a Starburst Supermassive HI Galaxy: HIZOA J0836-43. Supervised by Prof R.C. Kraan-Korteweg, A/Prof P.A. Woudt and Dr T. Jarrett.

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nating Committee for the next trimester. She also serves on, the African Institute of Mathematical Sciences (AIMS) Advisory Board and chairs both the SA National Committee for Astronomy and the NASSP Steering Committee. She is an Honorary Member of the SA Institute of Physics.

A/Prof Woudt is a member of Commission 19 (Astrophysics) of the International Union of Pure and Applied Physics (IUPAP). He co-chaired the scientific organising committee of the SALT/MeerKAT Science Workshop, held in Cape Town (3 November). A/Prof Woudt continues as PI on a South Africa-Japan bilateral funding agreement for the project entitled "Star formation and galaxy evolution".

Prof Feast continues as an editor of the *Monthly Notices of the Royal Astronomical Society*.

Prof Warner is a member of the organising committee of Commission 41 (History of Astronomy) of the IAU and a Vice-President of the IAU.

Dr Blyth is a member of the Pathfinder HI Surveys Coordination Committee.

Travel

Conferences/workshops:

SKA Continuum Imaging Workshop, held at the Cape Town International Convention Centre, 18-20 February and the International SKA forum (25 February): Prof Kraan-Korteweg and Dr Bouchard participated.

Prof Warner attended the 1-day meeting on "Books and the Sky" in Cambridge (UK) on 18 April 2009.

The international Meeting "Panoramic Radio Astronomy: Wide-field 1-2 GHz research on galaxy evolution", held from 2-5 June in Groningen (NL), was co-chaired by UCT.Prof Kraan-Korteweg (oral presentation: "Properties of the extremely HI-massive galaxy HIZOA J0836-43"), Prof de Blok (oral presentation: "HI Science with MeerKAT"), A/Prof Woudt (oral presentation: "Galaxy transformation in dense environments: A multi-wavelength study of superclusters at $z \sim 0.1-0.5$ "), Dr van der Heyden (oral presentation: "Evolution of neutral gas in galaxies over cosmic time with SKA pathfinder instruments"), Dr Blyth (oral presentation: "Neutral hydrogen in galaxies from low to high redshifts"), Dr Bouchard (oral presentation: "The environmental impact on galaxy evolution: highlighting the structure of the local cosmic web"), Dr Holwerda (oral presentation: "HI Disks in the high-redshift Universe; size and quantified morphology"), Mr. Elson (oral presentation: "Our changing view of the blue compact dwarf NGC2915").

The international meeting on "Unveiling the Mass: Extracting and Interpreting Galaxy Masses", held from 15-19 June, Kingston, Canada. Participation from the Astronomy Department included: Prof de Blok (oral presentation: The THINGS Dark Matter Halos) and Mr Elson (poster presentation: Our Changing View of NGC2915).

The annual South African Institute of Physics (SAIP) conference, held at the University of Durban-Westville (July). Speakers from the Astronomy Department included: Prof de Blok, Prof Whitelock, A/Prof Woudt, Dr Blyth, Dr van der Heyden, Dr Holwerda, Ms de Swardt, Mr Elson (winner of the PhD prize in Astrophysics and Space Science), Mrs M. Kotze, Mr P. Kotze, Mr Kuhn, Mr Mguda (winner of the motivation prize in Astrophysics and Space Science), Mr Mongwane, Mr Parekh, Mr Rajoelimanana, Mr Simon, Ms Williams. At the SAIP, Prof Kraan-Korteweg also participated at the annual Physics and Astronomy HOD meeting.

The XXVII General Assembly of the International Astronomical Union, held on 3-14 August in Rio de Janeiro (Brazil). Prof Warner the General Assembly and took part in the EXCO meeting of the IAU. Prof Whitelock attended the IAU General Assembly where she gave an invited presentation at the special session on 'Accelerating the Rate of Astronomical Discovery' on the subject of "Astronomy and Development in Southern Africa".

The international meeting on "Astronomy and its Instruments, Before and After Galileo", held in September, Venice (I). Prof Warner participated at this meeting.

The B.V. Kukarkin Centenary Conference on "Variable Stars, the Galactic Halo and Galaxy Formation", held 12-16 October 2009, Zvenigorod, Russia. Prof

Feast gave an invited paper on "The Luminosities of Type II Cepheids and RR Lyrae Variables". At this conference Prof Whitelock presented an invited review of "AGB Variables in the Galaxy and the Local Group".

SALT/MeerKAT science workshop in association with the SALT Science Working Group meeting, 3 November, UCT Upper Campus. This meeting, organized by the Astronomy Department, welcomed over 85 participants, of whom ~25 were members of the SSWG, and ~60 were members of the South African astronomical community (staff and postgraduate students from all over South Africa). The full programme is available at <http://www.ast.uct.ac.za/node/31> Speakers from the Astronomy Department included: Prof Kraan-Korteweg, Prof de Blok, A/Prof Woudt, Dr van der Heyden and Dr Holwerda.

The XXI Canary Islands Winter School of Astrophysics on "Accretion Processes in Astrophysics", held at 2-13 November at Tenerife (Spain). Prof Warner was one of the invited lecturers of this winter school. Mrs. M. Kotze and Mr. Rajoelimanana participated in the winter school.

The 2nd ICRAR/UCT/Apertif workshop on HI Surveys with SKA Pathfinders, held at 15-18 November at Bunker Bay, Perth (Aus). At this meeting a coordination committee for Pathfinder HI Surveys was formed with representation from the Astronomy Department. Speakers from

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the Astronomy Department included: Prof Kraan-Korteweg, Prof de Blok, A/Prof Woudt, Dr van der Heyden, Dr Holwerda, Dr Oh, Mr. Frank.

The annual SKA Bursary conference, held at STIAS in Stellenbosch (2-7 December). Participants from the Astronomy Department included: Prof Kraan-Korteweg, Prof de Blok, Dr Bouchard (oral presentation), Dr Oh (oral presentation), Dr Holwerda, Dr Stewart, Mr Elson (oral presentation), Mr Frank (oral presentation), Mr Ianjamasimanana (oral presentation), Ms Rajoelimanana (oral presentation), Ms Randiramanakoto (oral presentation), Ms Williams (oral presentation).

Working visits/sabbaticals: In November Prof Kraan-Korteweg spent a 2-week working visit at ICRAR, Perth (Aus), partly supported by ICRAR, to work on data analysis of HI surveys in the Zone of Avoidance.

A/Prof Woudt spend two months at the School of Physics and Astronomy of the University of Southampton during April – May 2009. He furthermore spent one week on a working visit to Nagoya University with Prof Sato and Dr Nagayama in November 2009, following his attendance at the Bunker Bay meeting in Perth in November 2009.

From April to August Prof Warner was a Visiting Professor at the School of Physics and Astronomy, University of Southampton.

Wendy Williams visited the Infrared Processing and Analysis Center (IPAC) at CalTech from 14 September - 28 October 2009. She was hosted by Tom Jarrett and financially supported as a visiting researcher by Caltech. During this time she attended the meeting entitled “Reionization to Exoplanets: Spitzer’s Growing Legacy” from 26 - 28 October 2009.

Observing trips: Dr Blyth and Mr Elson travelled to Pune, India to perform radio observations of a galaxy cluster Abell 1437 using the GMRT (January). From 11 to 20 February 2010, Wendy observed at the Parkes Radio Telescope at Parkes, Australia.

Staff members and students of the Astronomy Department make regular use of the telescope facilities (the 0.5-m, 0.75-m, 1.0-m, 1.9-m reflectors and the 1.4-m Infrared Survey Facility) at the Sutherland site of the South African Astronomical Observatory.

Research

In 2009, the Astrophysics, Cosmology and Gravity Research Centre (ACGC) has been established at UCT (<http://www.acgc.uct.ac.za>). ACGC is a research centre incorporating members from the UCT Department of Astronomy and the Cosmology and Gravity Group from the UCT Department of Mathematics and Applied Mathematics. ACGC aims to create a research environment at UCT in which South African-led cutting-edge science projects will be discussed,

developed and taken to fruition. Maximising the opportunities for interaction between theorists and multi-wavelength observers is essential for stimulating new approaches to research.

The Department specializes in the study of galactic structure, the distance scale, large-scale structure and evolution of galaxies in the Universe, next to high-speed photometry and spectroscopy of variable stars.

Particular emphasis is being given on uncovering galaxies obscured by the Milky Way and the mapping of cosmic flow fields such as in the Great Attractor region. With the opening of SALT, the Southern African Large Telescope, new research areas were initiated in galaxy evolution (as a function of environment and redshift), the dark matter content in nearby dwarf and low surface brightness galaxies and the search for intermediate mass black holes.

In the light of the coming of MeerKAT – the large radio telescope to be built in the Karoo – the department has developed expertise in radio astronomy. In particular, neutral hydrogen studies are used to examine the dynamics – and thereby the dark matter content – of nearby galaxies.

Studies of cataclysmic variable stars (exploding stars such as novae) and pulsating white dwarf stars remain a highly active research area of the department, in which the high speed photometry capabilities of SALT also offer new unique mechanisms to learn more about the physics of these

highly interesting objects, as well as deep HI and continuum surveys. We refer to the 2008 annual report of the Astronomy Department (MNASSA, Vol 68, Nos 6 & 7, 2009), where we have given an extensive overview of research expertise of members of the department.

In the 2009 annual report we highlight research areas of new staff members and postdoctoral fellows, completed PhD projects and other research highlights.

Research profile of our new (2009) staff members: Drs van der Heyden and Blyth

Dr Kurt van der Heyden holds a PhD in Astrophysics from Utrecht University (the Netherlands). He joined the Astronomy department as a postdoctoral researcher in mid 2007 and was appointed as senior lecturer in the department at the beginning of 2009. He and Dr Blyth jointly lectured and organised the first year Introduction to Astronomy course.

Dr van der Heyden's background is in X-ray and optical spectroscopy but has recently also developed an interest in Radio Astronomy. He has an interest in multi wavelength observations of galaxy clusters & galaxy evolution and aspects of observational cosmology. He is particularly interested in observational constraints of dark energy. Dr van der Heyden is an external collaborator with the Sloan Digital Sky Survey-II (SDSS-II) Supernovae Survey. The SDSS-II is a Multi-year project to identify and measure light

Publications

Research Papers

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long-slit observations were obtained with the 10m Southern African Large Telescope (SALT) in Sutherland for the dwarf galaxy NGC 59. These pilot project data were obtained in the performance verification phase of SALT. The results of her technical analysis provided important feedback to the SALT astronomers in assessing SALT's performance. The resulting spectra were used to derive the kinematics as well as the chemical content of the galaxy. She could determine a central velocity dispersion of 80 km/s. By extrapolating the known linear relation between the Black Hole mass and the central velocity dispersion to the lower regime, this allows for an intermediate mass Black Hole of 4×10^6 solar masses. Supervisors: Prof Kraan-Korteweg, Dr Jerjen (MSO, ANU, Australia)

Research highlights in 2009

Occulting galaxies, dust in spiral galaxies: In two overlapping galaxies, one can directly measure the level of dust extinction in the foreground disk. This technique does not require any assumptions on extinction law or the relative geometry of stars and dust. The benefits of this technique are that only symmetry of the galaxies is assumed and that it is in principle applicable to galaxy pairs out to higher redshift. This way one could characterize dust extinction in spiral disks and its evolution using the same technique. In SDSS, the GalaxyZOO citizen science project has identified 1200+ galaxy pairs and

a similar number has been identified in the COSMOS deep survey. In 2009, Dr Holwerda and his colleagues published a paper on the best example of an occulting pair to date, accidentally found in the ANGST survey with HST. See the Hubble Heritage Press Release at: <http://heritage.stsci.edu/2008/33/index.html> In 2009 Dr Holwerda obtained follow-up observations on the occulting galaxy pair with the Very Large Telescope VIMOS instrument as well with the Australian Telescope Compact Array. (Reference: Holwerda et al. 2009, *AJ* 137, 3000).

The expanding bipolar shell of the helium nova V445 Puppis: From adaptive optics imaging using the 8-m VLT and integral-field-unit spectroscopy on the 6-m Magellan telescope, a team of astronomers led by A/Prof Woudt have been able to deduce the distance to V445 Puppis through measuring the expansion parallax. The intrinsic pre-outburst luminosity of this unique system (the only known helium nova in the Milky Way galaxy to date) thus derived points to a system that likely contains a massive white dwarf accreting at high-mass transfer rate from a helium star companion. The publication of this paper received a lot of international press attention, as V445 Puppis provides a compelling new pathway to a supernova type Ia explosion, accreting from a helium-rich companion star. See the ESO Press Release at: <http://www.eso.org/public/news/eso0943/> (Reference: Woudt et al. 2009, *ApJ* 706, 738).

curves for intermediate-redshift ($0.05 < z < 0.35$) Type Ia supernovae (SNeIa). The observational aspect of the project was concluded in December 2007, but the collaboration continues to work on the science analysis. He is also exploring the idea that passively evolving luminous red galaxies (LRGs) can be used as "cosmic chronometers" for cosmological studies. Here he is collaborating with a group of astronomers from UCT, SAAO and UWC. The collaboration is interested in implementing an observational project to obtain high quality spectra with the South African Large Telescope in order to measure the Hubble parameter at $z \sim 0.5$. They are currently using simulations to test the viability of the method and plan to publish their initial results in 2009.

Dr Sarah Blyth holds a PhD in High Energy Nuclear Physics from the University of Cape Town and joined the Astronomy department as a postdoctoral researcher in 2007 after returning from Berkeley, California, where the bulk of her PhD research was performed. She became a lecturer in the department at the beginning of 2009 and jointly (with Dr van der Heyden) lectured and organised the first year Introduction to Astronomy course.

Her research interests are around extragalactic astronomy, in particular, studies of the neutral hydrogen in galaxies both in the nearby and higher redshift universe. She is also involved with proposing surveys of the neutral hydrogen content of galaxies out to high redshifts using the

SKA pathfinder instruments, MeerKAT and ASKAP with the aim to study galaxy evolution. A further area of interest is in observational cosmology and using luminous red galaxies as cosmic chronometers to investigate the evolution of the Hubble constant with redshift.

Research profile of our new (2009) postdoctoral fellows: Drs Holwerda, Oh and Schurch

Dr Benne W. Holwerda holds a PhD from the University of Groningen in the Netherlands with the research in part performed at the Space Telescope Science Institute in Baltimore. He joined the Astronomy department as a SARCHI Fellow after a three-year postdoctoral researcher position at the Space Telescope Science Institute in Baltimore.

Dr Holwerda's research interests are the Interstellar Medium, notably the dust in the interstellar medium in spiral galaxies. His three main research avenues are: morphology of atomic hydrogen disks as a merger tracer, dust lanes over cosmic times and dust extinction from occulting galaxy pairs. He is an active member in several international large collaborations: the (Galaxy Halos, Outer disks, Substructure, Thick disks and Star clusters (GHOSTS) Hubble Space Telescope project, the S4G Spitzer survey, and he is the Principal Investigator for the MeerKAT Ultra Deep HI (MUDHI) Survey, together with Dr Blyth. The MUDHI survey aims to characterize the quantity, dynamics and evolution of atomic hydro-

gen over cosmic times with single long observations with the MeerKAT radio telescope, now under construction in the Karoo.

Dr Se-Heon Oh joined the Astronomy department at the UCT in October 2009. He has been leading and involved at several projects mainly related with galaxy formation and evolution in the local universe.

Dr Oh has been working on the (dark) matter distribution in dwarf galaxies culled from “The HI Nearby Galaxy Survey” (THINGS; Walter et al. 2008) and addressing the central dark matter density problem, one of the small-scale problems in Lambda Cold Dark Matter simulations. In addition, he has been responsible for the mass modelling of dwarf galaxies from the LITTLE THINGS survey (P.I. Dr Deidre Hunter at the Lowell observatory, USA) and working on several sub-projects: (1) The effect of turbulent motions on star formation in the LITTLE THINGS galaxies; (2) Dark matter halos of the LITTLE THINGS dwarfs; (3) Baryonic Tully-Fisher relation from the LITTLE THINGS galaxies. Working with a simulation group lead by Dr Fabio Governato (Univ. of Washington, USA), Dr Oh has been performing the mass modelling of dwarf galaxies from high-resolution N-body+SPH hydrodynamic simulations in order to address the effect of baryonic feedback processes on the central dark matter distribution of dwarf galaxies in the early universe.

Dr Matthew Schurch completed his PhD in July 2009 in optical and X-ray studies of Be/X-ray binaries in the SMC under the supervision of Prof Malcolm Coe at Southampton University. He is heavily involved in several large collaborations monitoring variable systems, such as the SMC BEX Group that works on multi-wavelength data collected from all over the world.

Dr Schurch is extremely interested in the highly energetic interactions taking place in accreting binary star systems. The accreting objects in these binary systems exhibit a range of emission features that are characteristic of both the accretor and the donor star. In particular he has a strong interest in the large population (approximately 56 to date) of Be/X-ray binaries in the Small Magellanic Cloud. These systems are made up of a pulsating neutron star emitting heavily in the X-ray region, and a massive early type main sequence B star that is surrounded by a disk of material that has been lost from the star as a result of its high rotational velocity. His studies of these systems focus on two primary emission features; firstly on the specific optical emission from this circumstellar disk, how this varies with time and the orbital parameters is key if its formation and dynamics are to be fully understood. Secondly the periodic X-ray outbursts from the neutron star are studied through timing and spectral analysis. This provides us with a direct view onto the surface of the neutron star allowing the accretion processes to be evaluated.

PhD projects completed

Thesis Title: *The Nature and Nurture of a Starburst Supermassive HI Galaxy: HIZOA J0836-43*

PhD student: Michelle Elisabeth Cluver

Michelle researched the properties of one of the most gas-rich galaxies (HIZOA J0836-43). Such galaxies are scarce and only being formed now, hence important for galaxy formation scenarios. Due to its location behind the Milky Way, she studied this galaxy in the near-, mid- and far-infrared regime. For this multi-waveband images and high- and low-resolution spectra observations were obtained with the prestigious Spitzer Space Telescope, and a near-infrared survey performed with the 1.4m Japanese telescope in Sutherland. Michelle showed HIZOA J0836-43 to be a luminous infrared starburst galaxy with a fairly high star formation rate, arising from strong molecular PAH emission and far-infrared emission from cold dust. With its dominant bulge and plentiful supply of gas, it appears to be a scaled-up spiral galaxy compared to local galaxies, undergoing inside-out formation that resembles stellar disk-building processes in earlier phases of the Universe. From the analysis of the environment around the galaxy based on her near-infrared survey, the galaxy was found to be located in an underdense region. This is in agreement with the conditions required to the surroundings of this galaxy to have allowed it to evolve into such an unusual starburst

galaxy. Supervisors: Prof Kraan-Korteweg, A/Prof Woudt, Dr Jarrett (IPAC, CalTech, USA)

Thesis Title: *The Structure, Stellar Content and Dynamics of Dwarf Galaxies in the Local Volume*

Bonita de Swardt

Bonita’s research consists of an in-depth study of a sample of nearby dwarf galaxies. Dwarf galaxies form the building blocks of larger galaxies. Their study provides insight into the formation and evolution processes of these galaxies. She obtained deep near-infrared observations of six nearby dwarf galaxies with the InfraRed Survey Facility at Sutherland to determine their stellar and dark matter distribution. Half of these low luminosity galaxies were detected for the first time, while the other earlier measurements revealed underestimates by up to 0.5 magnitudes. She derived the basic structural parameters of the dwarfs. From that she determined the metallicities and stellar masses. It was found that these field dwarfs all follow the same B- versus H-band luminosity relation as the Virgo galaxy cluster. A distinct nucleus was identified in most galaxies. Surprisingly the deep near infrared images of the dwarf galaxy NGC 59 revealed a double nucleus, both with a signature of recent star formation. To study the kinematical behaviour, and to address the still controversial question whether intermediate mass black holes exist at the centre of dwarf galaxies,