monthly notes of the astronomical society of southern africa
Vol 71 Nos 1 & 2 February 2012

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mnassa

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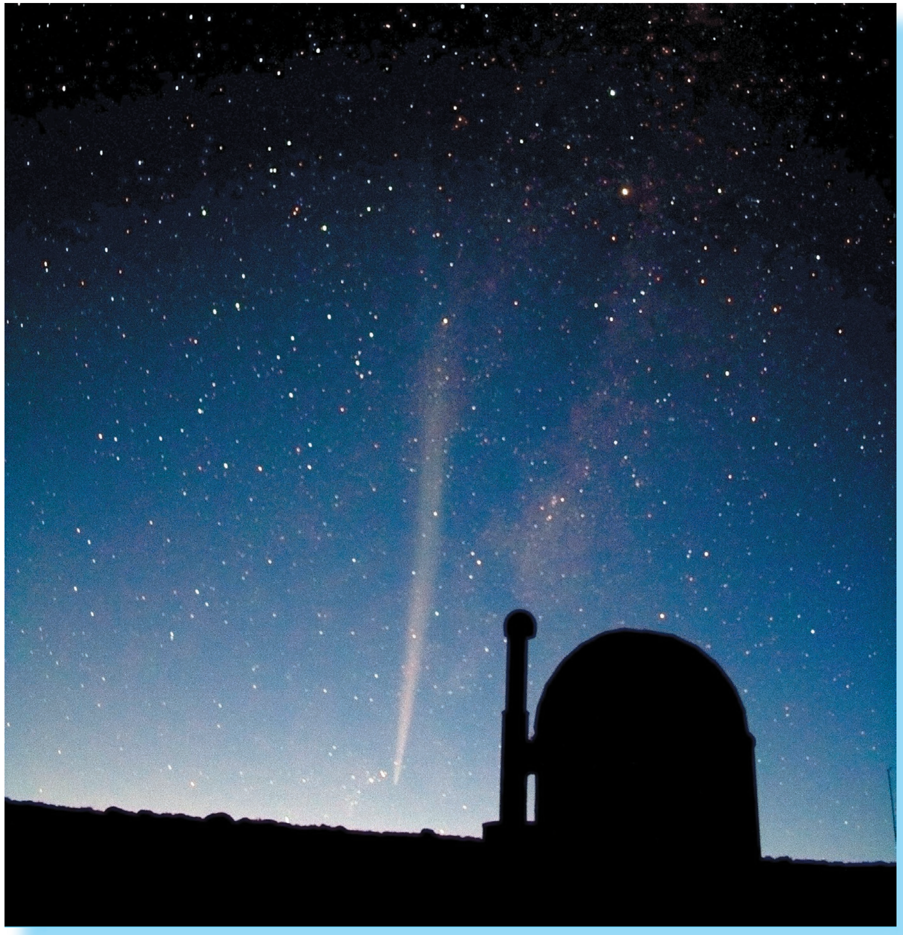


• Surprise Comet Lovejoy • Bronberg Observatory Report •
• Stephen Hawking turns 70 • A Shadow Transit of Jupiter •
• Amazing rocket fuel dump • W UMa star systems observed •

Comet Lovejoy (C/2011 W3)

Simon Fishley framed this picture of Comet Lovejoy next to SALT on Christmas morning 2011. Simon happened to be in Sutherland, doing standby duty, during the time when this surprise comet made its brief but spectacular appearance.

Source: http://www.fishley.co.za

astronomical society of southern africa

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.

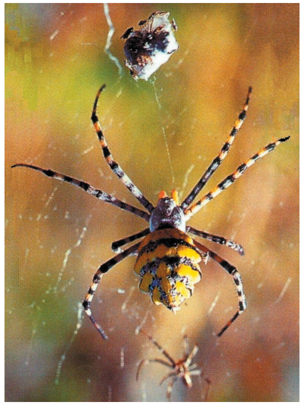
Publications: The Society publishes its own electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bimonthly and an annual printed *Sky Guide Africa South*.

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.

Internet contact details: e-mail: *assa@saao.ac.za* homepage: *http://assa.saao.ac.za* of haze, which is quite impressive. There are so many facets to this object situated in this beautiful, full field of delight. The object with its nickname brings to mind the Golden Garden Orb-Web spider found in the northern parts of South Africa. When the sun shines on the spider and its web the golden colour is reflected and creates an amazing shiny impression. It is incredible that the male which is one-tenth the size of the female, lives on the outer edge of the web. As soon as the female feeds, the tiny little male will quickly impregnate her before she possibly sees him as potential prey to be devoured (see picture). Explore the spider's web and its numerous silky smears of light which are saturated with tiny little star clusters and numerous delicate streaks of haze.



A close neighbour to NGC 2070 is **NGC 2074**, situated further south. It is a rich cluster of stars embedded in the diffuse nebula which extends slightly southwards away from the stars.

The small open cluster **NGC 2100** is situated within the very extreme eastern edge of the LMC. It is bright and outstanding against the busy star field with a relatively tight core. Higher magnification shows off a few brighter stars embedded in the misty glow of the object. Fainter stars can be glimpsed around the edges that complement the cluster to its full.

The LMC is one of a kind, and what a feast to the eye of us humans, who can only gaze in wonder at the starry skies with their amazing objects. ☆

Object	Type	RA (J2000.0)	Dec	Mag.	Size
NGC 1711	Open Cluster	04^h50^m6	-69°50′	10	2.3′
NGC 1737	Emission Nebula	04 54 0	-69 10	9-10	50″
NGC 1743	Diffuse Nebula	04 54 5	-69 12	8-9	2′
NGC 1782	Open Cluster/Neb	04 57 8	-69 23	8-9	3′
NGC 1809	Galaxy	05 02 5	-69 34	12	3.2′x0.8′
NGC 1854	Globular Cluster	05 09 3	-68 51	10.4	1′
NGC 1910	Open Cluster	05 18 7	-69 14	11.2	8′
NGC 2070	Bright Nebula	05 38 6	-69 06	1-5	30′x20′
NGC 2074	Bright Nebula	05 39 3	-69 30	8	4.0′x2.5′
NGC 2100	Open Cluster	05 42 2	-69 13	9.6	2.8′

Astronomical Society of Southern Africa
ASSA

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Monthly Notes of the Astronomical Society of Southern Africa
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New Members

The following have been accepted as new members:
Mr Shuaib Akoojee, 454 Johann Straus St, Christoburg, Pretoria
Mr Robert Gordon Anderson, PO Box 107, Homeleigh, East London
Mr Raymond Appiah-Baiden, 6 Warren St, Grahamstown
Mr Alex Bernatzky, Rhodes University, PO Box 94, Grahamstown
Mr James Michael Carkeek, 11 Mkhula Rd, Westville, Durban
Mr Gregory Carter, 17A African St, Grahamstown
Mr Simon Lincoln Goddard, 22 Southey St, Grahamstown
Mr Stuart Honour, 17A African St, Grahamstown
Mr Kieran Richard Hunt, 20 Cullen Bowles House, Rhodes University, Grahamstown
Mr Yuvan Jugessur, Piet Retief House, Rhodes University, Grahamstown
Mr St. John Benedict Kleinbooi, 3 Caldicott St, Grahamstown
Mr Kyle John Lloyd, 16 Vaarlandswilg, Richards Bay
Mr Ben Marais, Rhodes University, PO Box 94, Grahamstown
Ms Consliah Tebogo Masebe, B7 New House, Rhodes University, Grahamstown
Ms Asanda Siphokazi Menta, Margret Smith House, Rhodes University, Grahamstown
Mr Selokwane Thabang Morake, 413A Mojalefa St, Naledi, Soweto
Ms Megan Marie Mulcahy, Olive Schreiner House, Rhodes University, Grahamstown
Ms Aimee-Jade Smith, Olive Schreiner House, Rhodes University, Grahamstown
Ms Martha Soteniades, 2 Benson Place, Northcliff Ext 12, Johannesburg
Mr Gregory Woolf, 49 Rutland Rd, Parkwood, Johannesburg
Rhodes Astronomical Society, Rhodes University, PO Box 94, Grahamstown
Dr Dieter Willasch ,17 Rembrandt Rd, Somerset West
Mr Sabake Mahlangu, PO Box 12962, Mowbray
Mr Kenneth Brian Nevill, PO Box 4199, Witbeeck
Mr Reinhard Le Roux, 28 Bowers St, Gonoubie, East London ☆

Contributions to *MNASSA*

Submission of papers for publication

The aim of the Monthly Notes of the Astronomical Society of Southern Africa (*MNASSA)* is to serve the Southern African astronomical community, professional and amateur. 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.

Layout

Our layout editor, Willie Koorts is a busy man, and I as editor, really appreciate the hours he puts into *MNASSA*. It would save us both a huge amount of time if contributors to *MNASSA* could submit their material using a standard format style sheet. Willie has drawn up such a guide, which also appears on the website (http://assa.saao.ac.za/html/mnassa.html), and it would be appreciated if future contributors could use it. I appreciate that initially it sometimes appears difficult, but as with most things, you quickly get used to it! I look forward to many articles in future and really appreciate your cooperation.

Editor

Concise Style Guide for contributions of articles to *MNASSA*

General

Since *MNASSA* is typeset using *Adobe InDesign*, the Word document should really be as simple and plain as possible since the formatting gets done in InDesign. Please refrain from elaborate formatting – all such efforts are in vain since it gets stripped anyway when transferring to InDesign and such hidden formatting fragments complicates the layout enormously.

Please **DO NOT**:

- Use spaces to pad out text in an attempt to line up text, columns, picture captions, etc.
- Use 'Enters' to force page breaks to try and make the document look nice.

Consistency is of utmost importance throughout an entire article, but also each issue. Ensure you use the official spelling/capitalisation of a particular item and stick to this spelling/capitalisation throughout, e.g. "ScopeX" is not spelled "SCOPE-X" or "Scope-x", etc. Also note that we hyphenate "deep-sky" and don't use "deep sky" or "deepsky" – the same with "double-star".

Fonts and Text size

Article title: Century Cothic – 12 pt **Bold**. (Do not use <u>Underline</u>) Keep the title short, do not exceed a line on the page.

(optional) Author name: Calibri – 11 pt

(optional) Author address, etc.: Calibri – 10 pt

(optional) Author email address: Calibri – 10 pt *Italic*

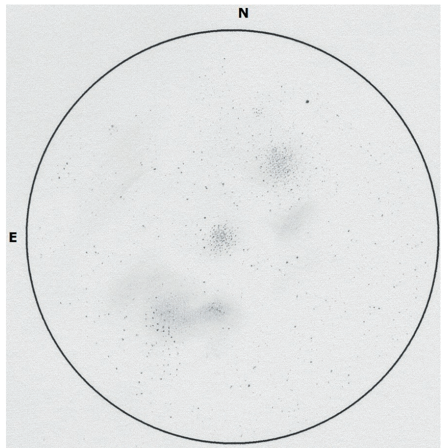
Body text: Calibri – 10 pt

stars. It is by no means an easy object to find in such a busy, hazy star field, and I found averted vision to be my best way of discerning this galaxy.

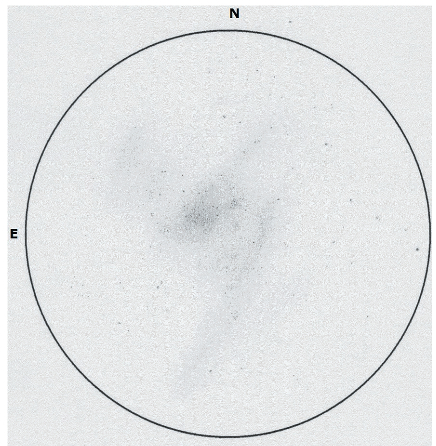
Favourites among many of us are the very popular globular clusters, of which quite a few can be found in the LMC. **NGC 1854** rides comfortably towards the very dense middle area covered with many faint stars embedded in the obvious nebulosity. The globular cluster is relatively bright, round in shape, with a small dense core and surprisingly outstanding against the background star field. It is difficult to resolve any stars which cling tightly together. The relatively large open cluster NGC 1850 is situated 6' towards the north-west, with the smaller cluster NGC 1858 just to the south of NGC 1854 (see sketch below). The larger and very much more gaseous glow of both NGC 1856 and NGC 1858 towards the south is a feast to the eye, with faint stars embedded in the pieces of nebulosity.

The deep inner part of the LMC can only be described as impressive, with nebulosity and haze woven like braid that mingling well with faint splinter stars. One of the most outstanding clusters, **NGC 1910**, shares this field, displaying a mass of faint stars. Higher magnification will bring out faint knots and strings of just visible starlight. The cluster, which is truly a showpiece, is larger and brighter than most of the clusters in the Cloud. With careful observation dark areas can be detected in the misty surroundings. It is one of the most beautiful regions inside the LMC (see sketch below).

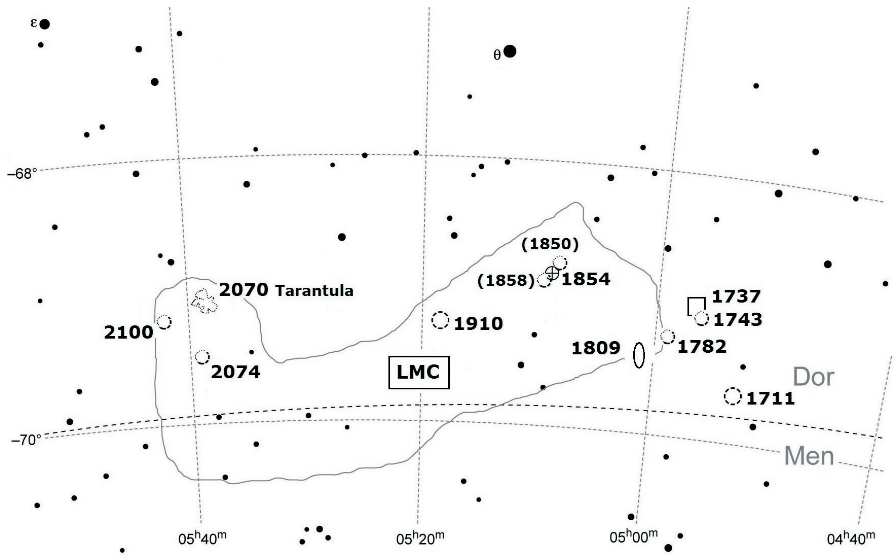
NGC 2070 is situated in a rich and impressive part of the LMC, and is one of the most outstanding objects against our southern hemisphere skies. It is easy to see why this object is nicknamed the Tarantula Nebula as it appears to sit in its delicately woven web. The object is saturate with faint, flimsy nebulosity strings and wisps



NGC 1858 - NGC 1854 - NGC 1850



NGC 1910 - Open Cluster and Nebulae - Dorado



A few emission nebulae are situated towards the north-west fringes of the cloud, an area which latterly has been covered in nebulosity. **NGC 1737** appears small but obvious, with a few knotted patches in its midst. On the outer edge faint stars are visible and various filters will improve the view in a magnificent way.

NGC 1743 is just slightly brighter than its neighbours, situated just to the south of NGC 1737. The core of this cluster is bright and very tight, and an obvious star in the embedded nebulosity draws the eye slightly away. NGC 1740 towards the east is not at all easy to separate against the misty objects which share the field of view. In the vicinity the objects NGC 1745, NGC 1748 and NGC 1756 can also be found.

Moving deeper into the flimsy outer northern edge of the LMC, the open cluster **NGC 1782** is embedded in a piece of nebulosity. It is a small cluster interwoven with haze but, strangely, easily seen – although, sadly, with no stars resolved. The clusters NGC 1767 towards the west and NGC 1772 slightly further south can also be glimpsed in a wide field of view.

Would you have guessed that you might discover a galaxy in the misty cloud? Well, the edge-on galaxy **NGC 1809** could be confused with a piece of cloudy nebulosity situated just 24′ south-east from the clusters above. However, careful observation through a telescope will reveal its elongated north-south spindle. The magnitude 8 star (HD 33031) can serve as a guide just 4′ towards the north. This area is dotted with knots of faint

Section headings: Calibri – 10 pt **Bold**
Picture and Table captions: Calibri – 9 pt **Bold**

Paragraphs and Sections
MS Word *Paragraph* Setting: This **MUST BE set to 0 pt** as follows:

- Select all the text in the document (Ctrl-A).
- Select Home-Paragraph-Spacing – set both "Before" and "After" to 0 pt (Office 2010 defaults to 12) – also set Line Spacing to 'Single'. (Pre-Word 2003: Format-Paragraph-Spacing ...)

Paragraphs are separated by an empty line and the first text line is not indented.
Justification of paragraphs must be "Full" (Ctrl-J).
Sections are separated by a full empty line (like paragraphs).
Section Headings are on a line of their own and in Calibri 10 pt Bold. Keep short.

Punctuation
Between sentences, always use **TWO SPACES** after a:

- full stop (.)
- question mark (?)
- exclamation mark (!)
- colon (:)

(Note: DO NOT blindly use *Find&Replace - Replace All* in MS Word to try and fix these in and existing document - this often creates havoc.)

Units:

- Separate numbers and their units by a **space** (e.g. 15 km, 130 mm),
- **exceptions** are for temperature (e.g. 22°C or 300K) – Note: use Alt-248 as degree sign,
- also no space in angular units (e.g. 12° or 45′ or 15″). Also see "Quotes" below.
- For dimensions in inches, instead of 12", use 12-inch. Similarly, use "1.9-m telescope".
- Use the **metric system** as far as **possible** – add converted metric dimensions in brackets where imperial units are quoted, like quoting text from a reference.
- Use **SI-units** whenever possible.

Numbers:

- Write numbers from 1 – 10 in words, except when used with a unit.
- Use non-breaking spaces (Shift-Ctrl-Spacebar) to separate thousands, e.g. 12 000 (not 12,000).
- Use a full stop as decimal point (e.g. 12.3 cm).

Date, time and angles:

- Date format
  - In words: 20 November 2010 – no commas, no abbreviations (NOT: November 20, 2010 or 20th November 2010 or 20th of November, 2010 or 20, Nov. 2010, etc.)
  - In numbers: 2010-11-20 (used less frequently).
- Time format:
  - Use 24-hour format (not AM or PM). Note: midnight is 24:00
  - Use Colon as separator, e.g. 23:15 or 22:33:45
- Angles expressed as time: Use 'h' when writing RA angles, e.g. RA = 12h (no space). Also see "Quotes" below.

Titles and initials:

- Titles start with a Capital and do not end in a full stop, e.g. Mr Jones, Mrs Nel, Dr Glass, Prof Swart.

- Initials are without spaces or full stops, e.g. Prof WL Brown, Mr WEG du Plessis, John F Bolden, etc.

Quotes:

- Use "curly quotes" (" and ' on keyboard) when quoting in the text.
- Use "straight quotes" for angular measures, i.e. arcminutes (Alt-39 ') and arcseconds (Alt-34 ") respectively.

Use of *Italics*:

Words are only italicised when referring to publications, books and periodicals, e.g. *MNASSA, Cape Times, Sky and Telescope*, etc. Do not italicise quoted text – use quotes instead.

Pictures and captions:

- **Pictures and illustrations** are welcomed and encouraged when submitting articles.
- Do not include pictures in-line in the text, but send them separately as **individual image files**.
- To indicate to the typesetter (roughly) **where** pictures belong in the article, please include references in red, e.g. (see Table. 2) or (Fig. 1 goes here) or (Jupiter_moons.jpg), etc.
- Avoid descriptions referring to Fig. xx **below** or **above** – these are likely to change in typesetting.
- **File formats** such as .JPG are acceptable/best suited for photographs. For illustrations, graphs, etc. where contrast is normally high, the .PNG format is better since it does not suffer the typical jpg-artefacts surrounding lines and text. The .BMP-format does not suffer from any artefacts but the files can be huge because there is no compression.
- File/picture sizes should at least be ~300kBytes or 1024x768 pixels.
- **Captions**:
  - o Include appropriate captions for each picture, illustration, graph, table, etc. at the end of the document.
  - o It is OK to repeat some of the text in the caption which is already in the article text – remember, readers are often drawn into reading your article when reading the captions and so getting interested.
  - o Indicate which caption belongs to which picture by referencing its filename or figure/table number.
  - o Do not use copyrighted pictures and always indicate picture credits/permissions for each picture.

References:

References are listed (un-numbered & un-bulleted) at the end of an article and in the following format:

Author surname, initials, year of publication, "Title in quotes", *Publication italicised*, **Volume bold**, page(es).

e.g. Luyten, WJ, 1935. "The Puzzle of Proxima", *The Observatory*, **58**, 89-90.

In the article text, it is then referred to as follows:

- "... the parallax of Proxima Cen was confirmed (Luyten 1935)."

or

"In a letter to the University of Minnesota, Luyten (1935) indicated that..." ☆

of gas by supernova explosions, galaxy merging and associated growth of central black holes are all key processes that remain poorly understood. In this talk, I will highlight how surveys of the gas and the stars in nearby and distant galaxies are shedding light on some of these key processes.

Title: Music of the Stars - Probing Stellar Interiors Through Analysing the Surface Vibrations of Stars

Date: 9 February 2012

Time: 11:00

Venue: 1986 Building

Speaker: Karen Pollard

Abstract: In this talk I will present an overview of our research project to observe and analyse the non-radial pulsations in selected stars. We are concentrating on gravity mode pulsators such as gamma Doradus stars and slowly pulsating B stars. I will describe the facilities we use at the Mt John University Observatory and well as presenting the results from some recent analyses. ☆

deep-sky delights

A Misty Cloud

by Magda Streicher
magdalena@mweb.co.za

It is common for us as star-lovers always to be looking up at the starry skies and absorbing the wonder of them, but they always warrant a deeper look – and especially now, during the southern summer months, when the Large and Small Magellanic Clouds can be seen suspended against the night sky. Not only is the sight of these two Clouds a clear indicator of our place in the universe, but we are also privileged to be able to study these satellite galaxies situated relatively close by.

The Clouds are named after the Portuguese explorer Ferdinand Magellan who sailed the seas on behalf of the King of Spain. The Magellanic Clouds, also known as dwarf galaxies, are headed for an unavoidable meeting with Mother Milky Way, which will shatter and engulf the two satellite systems – fortunately in cosmic time that will not point to an immediate disaster.

The ghostly glow of the LMC has bright objects in its midst and more than enough delights to enjoy even through binoculars alone. To study these objects it is best to search out very dark skies and have a good star map and a lot of time.

NGC 1711 is located in the upper northern fringes of the LMC, one of many open clusters to be found in the Cloud. Although relatively small in size it displays a dense star-rich core with an uneven shape and featureless surface. With higher magnification many faint stars can be seen trailing out of the field of view.

Title: Water Masers Spatio-kinematics & Astrometry of Massive Star-forming Regions (Water Maser Research in Japan)
Date: 6 February 2012
Time: 11:00
Venue: 1896 Building
Speaker: James Chibueze
Abstract: High angular resolution (within milli-arcseconds) very long baseline interferometric (VLBI) water (H2O) maser observations toward massive star-forming regions is gradually improving our understanding of how massive stars are formed. In this direction, Japanese VLBI Network (JVN) which incorporates the VLBI exploration of radio astrometry (VERA) array has made some significant contributions. Cepheus A at ~ 700 pc and NGC 6334I(N) at ~1.7 kpc are typical sites of massive star formation activities. The relative proper motions of H2O masers in those regions trace various star-formation activities ranging from violent ejections to wide-angle outflows from young stellar objects. The dual beam system of the VERA enables the measurement of the annual parallax, thus the parallax distance to the sources.

Title: The Formation and Evolution of Galaxies: Recent Progress
Date: 8 February 2012
Time: 15:00 - 16:00
Venue: RW James B
Speaker: Guinevere Kauffmann (MPG)
Abstract: Galaxy formation is concerned with the processes that formed a heterogeneous Universe from a homogeneous beginning. It encompasses an enormously rich range of different physical phenomena - from the growth of primordial fluctuations in the early Universe, through the cooling and condensation of gas into molecular clouds and stars, to the formation of supermassive black holes that emit copious radiation as they grow within galactic bulges. Galaxy formation has remained one of the most active research areas in astrophysics for the past 50 years. Remarkably, the evolution of galaxies appears to be quite different from that of the dark matter. The largest dark matter halos form from the “bottom up” through merging and accretion of smaller systems and most are still assembling at the present day. In contrast, the most massive galaxies in the Universe (the giant ellipticals) formed their stars at early epochs. Galaxy growth then somehow shuts down. This quenching process, a kind of “galaxy death”, increasingly affects lower mass systems with time and may soon be the fate of our own Milky Way. Galaxies less massive than the Milky Way actively form stars at all cosmic epochs. In fact, the majority of the stars in galactic disks formed in the last 7-9 billion years.

In spite of significant progress in delineating this basic picture, significant pieces of the puzzle remain to be understood. Gravitational collapse is only one of many processes at work in the formation of a galaxy. Gas dissipation and infall, star formation, heating and ejection

Scholarship News

Maciej Soltynski

ASSA Scholarship holder for 2011, Claire Antel, obtained her B.Sc. degree at UCT with distinction in Astrophysics and Physics, and the degree with distinction - congratulations! In 2012 she has embarked on a B.Sc. Honours in Astrophysics and Space Science in the National Astrophysics and Space Science Programme (NASSP) at UCT.

Fawaaz Davids, who held a SAAO-ASSA scholarship in 2011, successfully completed the first year of his 4-year B.Sc. degree at UCT, and will continue his studies in 2012. He has been awarded a SAAO-ASSA scholarship for 2012.

Allen Versveld, who held a SAAO-ASSA scholarship in 2011, progressed with his B.Sc. studies, including Astronomy, at UNISA, and in 2012 he will carry on with his studies at UNISA.

News of previous scholarship holders
This year Rocco Coppejans is undertaking the second year of his M.Sc. in the NASSP at UCT. Having completed his course work, he is now working on a project titled ‘A SHOCing new instrument’ under the supervision of Dr Amanda Gulbis of SAAO. Rocco’s project involves commissioning and characterising the new Sutherland High-speed Optical Cameras (SHOC for short) that will be used on the 30", 40" and 74" telescopes at Sutherland. These are two new cameras that will replace older instruments currently in use. The SHOC cameras are specifically designed to have high timing precision and a large field of view. Additionally they also have higher quantum efficiency and sensitivity than older generation instruments.

Wendy Williams is now in her second year of studies towards her doctorate in radio astronomy at the University of Leiden. She is at Leiden Observatory, currently working on low frequency (150 MHz) data taken with the Giant Metrewave Radio Telescope (GMRT), located in India, which covers a large area of the NOAO Bootes deep field. The radio source populations at lower frequencies and fluxes will inform about the growth and evolution of massive black holes. This year her work will extend to survey data taken with LOFAR (Low Frequency Array for radio astronomy).

Renée Hlozek in January underwent her viva (oral examination) at Oxford University to defend her DPhil thesis (successfully – congratulations!) and has been appointed a Lyman Spitzer Jr. Postdoctoral Fellow in the Astrophysics department of Princeton University, where she will be for the next three years. Her latest research paper may be downloaded at http://arxiv.org/abs/1111.5328 One of the paper’s co-authors is Adam Riess, who shared the 2011 Nobel Prize in Physics for his work on Dark Energy. ☆

Errata

In the previous edition of *MNASSA* (Vol 70, nos 11 & 12, December 2011) in the article by J Caldwell entitled *Moonset Lag with Arc of Light Predicts Crescent Visibility* there was an editing error. Please replace the last sentence at the end of paragraph 2 on page 230, with:

"This second simulated range is shown by the left boundary dotted with circles and the bottom right bottom along the lag = 0 axis. The low lags that can potentially result emphasize that for geographically middle to high latitudes, very different sighting geometries with descent angles much compressed to the horizontal prevail, in contrast with the customarily familiar sightings from latitudes below 40(deg) with their characteristically substantial descent angles." ☆

Stephen Hawking at 70

George Ellis
University of Cape Town

Stephen Hawking is a major scientific icon who has made a huge worldwide impact as a public figure, as well as having made major scientific contributions. He has had a remarkable life, celebrated by many on the occasion of his 70th birthday celebrations in Cambridge in January (which he himself missed, as he was in hospital then).

After his undergraduate career at Oxford, his research supervisor at Cambridge was Dennis Sciama, who shaped the highly successful Cambridge research group in DAMTP that included also luminaries such as Brandon Carter and Martin Rees. This group was strengthened by its interaction with relativists in London such as Hermann Bondi, Felix Pirani, and Roger Penrose, and by visits to Cambridge in particular of John Wheeler from Princeton and Charles Misner from Maryland.

In broad terms there have been four epochs in Hawking's career. The first was his very careful highly technical work on general relativity and cosmology, starting with his critique of the Hoyle-Narlikar action at a distance gravitational theory, and continuing with subsequent work on anisotropic cosmologies and structure formation in the expanding universe. The highlight was the cosmological singularity theorems, developing from Roger Penrose's ideas about black holes, showing that (under reasonable assumptions) classical general relativity necessarily implies there was a start to the universe: a space-time singularity that is the boundary to where normal physics applies. The first key insight was that closed trapped surfaces, discovered by Roger Penrose in the black hole case, would occur in a time reversed sense in cosmology; and the second was

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. *Ed*

At SAAO

Title: Mass Assembly of Galaxies over the last 10 Gyr
Date: 17 November 2011
Time: 12:30
Venue: SAAO Auditorium
Speaker: Philippe Amram (Laboratoire d'Astrophysique de Marseille)
MASSIV - Mass Assembly Survey with VLT/SINFONI in VVDS

Abstract: Understanding how galaxies evolve and assemble their mass across cosmic time is still a fundamental unsolved issue. Processes driving mass assembly are expected to evolve on different timescales along cosmic time. A transition might happen around z=1 as the cosmic star formation rate starts its decrease. To get insight into the various processes of galaxy mass assembly, the Mass Assembly Survey with SINFONI in VVDS (MASSIV) aims at probing the kinematical and chemical properties of a significant and representative sample of high-redshift ($0.9 < z < 1.8$) star-forming galaxies. This sample contains 84 star-forming galaxies, selected from the VIMOS VLT Deep Survey (VVDS) and observed with the SINFONI integral-field spectrograph at the VLT. The MASSIV selection function, based on star formation criteria provides a good representation of "normal" star-forming galaxies. I will present preliminary results of this survey.

Title: Finding the True Sizes of Other Worlds
Date: 3 February 2012
Time: 11:00
Venue: 1896 Building
Speaker: Elisabeth Adams

Abstract: Observations of transiting planets run the risk of being contaminated by blends with nearby, unresolved stars. These blends can result in false positives, or can dilute the transit signal, causing the planet to appear smaller than it really is. This is particularly problematic for small, Earth-sized planets. I will discuss the efforts to obtain high spatial-resolution AO images of planetary candidates discovered by the Kepler space mission. Of particular interest is being able to confirm potentially habitable Earth-sized candidates, but all transiting planets benefit from improved knowledge of the surrounding stars. Without high resolution images to search for nearby stars, we cannot know the true sizes of other worlds.

Fig. 4: Five 15-second exposures were stacked to produce this image, showing the satellite leaving a streak as it moved. The Moon was deliberately obscured by the building to try and reduce its glare.

I saw. At that time the comet-like cloud was 8.1 degrees above the horizon and at a range of about 11 500 km. I eventually managed to follow it to just 2.6 degrees elevation and 18 800 km distant, then at an altitude of 13 700 km above the Earth. The fact that it was still visible to the naked eye at this enormous distance, gives an idea of how bright it was. It is actually surprising that no sightings from further east were reported.

Before getting a little more sleep, I sent off a quick report and pictures to Ted, Mike and Greg who were all very thrilled. Ted's final report, posted to the SeeSat mailing list (http://satobs.org/seesat/Jan-2012/0270.html), sums up this remarkable "collaboration" nicely: "Thank you, Willie for getting up in the middle of the night to make these observations and for sharing them with us. Thank you also to Mike McCants who noticed the opportunity and alerted Greg Roberts, who alerted Willie about it. Greg also stayed up for the event in the faint hope that his overcast sky would clear; alas it did not." But to give credit where it's due, Ted's element set was virtually spot on which was the key to making this observation possible. ☆

that one could show such closed trapped surfaces would exist because of the existence of the cosmic microwave blackbody radiation. These ideas were consolidated in a major joint paper with Roger Penrose in 1970. With Jim Bardeen and Brandon Carter he also did important work on black hole uniqueness theorems and the four laws of black hole thermodynamics. This is absolutely solid detailed work that built his scientific reputation. Most of it was presented in the book *The Large Scale Structure of Spacetime* that I co-authored with him (it took some years to write, and appeared in 1973); this has become a standard reference work in the area.

The second epoch was further work on black holes, and his adventurous and highly successful work on quantum field theory in a curved spacetime. The core is the hugely important paper "Particle creation by black holes" (*Communications in mathematical physics* **43**:199-220, 1975), integrating effects from quantum field theory, general relativity, and thermodynamics, establishing that black holes emit black body radiation ("Hawking radiation"). This was initially controversial, indeed various people initially denied it was true, but has since been amply vindicated. This quite unexpected result is uniquely his, and is a major achievement that has stood the test of time: it has now been derived in many different ways, and its derivation is regarded as an important test of quantum gravity theories. He also made important contributions studying perturbations during the inflationary early universe expansion.

The third epoch was his much less rigorous speculative era, testing big ideas in a creative way, causing much interest and stimulating much activity, but not achieving the same level of acceptance as the previous two eras. This includes his work with Jim Hartle on the no-boundary idea for the start of the universe (based in the idea of the wave function of the universe), his proposals for spacetime wormholes (which may or may not happen) and for tunnelling to give an open universe (which gives the wrong answer for the amount of matter in the universe). It includes his proposal of a quantum information loss paradox associated with black hole explosions, that has led to much interest in the quantum gravity community, and proposal of the chronology protection conjecture (closed timelike lines cannot exist).

The fourth epoch (partially overlapping the previous one) is his emergence as a major public figure, producing many popular books (starting with the legendary *Brief History of Time*) and giving many talks involving an extraordinary amount of worldwide travel, and receiving much public adulation. He has received numerous awards in this period, and been received by many major world figures, including the Pope, President Obama, and Nelson Mandela. He has also appeared in many television features and various films, including famously an appearance in *The Simpsons*. An aspect of this epoch is his advocacy of space travel as a necessity for survival of the human race, and discussion of life elsewhere in the universe. On the scientific side it includes his proposal of "top down" cosmology, and a proposed resolution of the black hole information paradox (which has not yet been developed satisfactorily in full detail).

He has done all this despite his physical handicap, caused by motor neuron disease, which has confined him to a wheelchair for most of his life. Indeed it is truly remarkable that he has lived as long as he has done, given the debilitating nature of his disease and various consequent emergencies. He has been kept alive by sheer willpower, and has been a huge inspiration to handicapped people worldwide through his great achievements in the face his illness. Through all this he has always displayed his impish sense of humour and delight in saying provocative things. But above all he is an example of incredible determination and adventurousness, as for example when he went in a zero-gravity flight in an aircraft (see photo).

His recent publications have included a series of very successful children's science books written jointly with his daughter Lucy. These have included scientific explanations, fact sheets, photographs, and adventure stories in an excellent mix. He has also written a number of recent popular books about the universe and science. These are interesting and provocative, but one should note that Hawking's major status as a public figure has led to public pronouncements on a series of other issues that are not as well considered as his scientific work. These include his reductionist views on the way the mind works, his controversial proposals on the philosophy of science, and his somewhat confusing varying statements on religion. One can treat these statements with caution. Regarding the multiverse solution to the anthropic problem presented in his new popular book, the reader should be aware that string theory is not an experimentally confirmed part of physics, neither is the connection with inflation that says different string vacua will be realised in different expanding universe domains. This is innovative and productive exploration of what might be, but it is not established physics in the same sense as the earlier work, *Caveat emptor*.

His personal life has been one of incredible determination that has enabled him to succeed in the face of huge odds, particularly with the help of his first wife Jane. This is an inspirational story that has made a huge impact worldwide. ☆

Stephen Hawking enjoying zero gravity aboard the Zero Gravity Corp modified Boeing 727 in 2007. The plane flies in steep parabolic arcs between 24 000 feet and 32 000 feet, inducing about 25 seconds of free-fall at a time. Photo Credit: Zero Gravity Corp.

I set up the camera in a clear spot amongst the domes. It has a function to shoot a sequence up to 10 consecutive pictures which I set up to do 15 second exposures at full aperture. Since no satellite could be seen, I just aimed the camera blindly along the predicted path, shooting through scattered cloud all the time. It was rather disappointing when I reached the end of the predictions and still saw nothing. At about the time when the hydrogen and oxygen dumps were scheduled to be finished, I reached the end of an of exposure sequence. I was ready to give up and head back to bed. Conditions due to cloud and the Moon in the target area were not ideal. However, for good measure, I decided to shoot one last series of exposures for incase the orbital elements or predictions were off.

Then, suddenly I noticed it! A bright blob appeared to the left and below the Moon, in between the cloud layers! Checking the camera's display as every new picture appeared, it was seen to be slowly moving! The rapidly expanding gas plume, back-illuminated by the sun, created a brilliant cloud. It was still getting brighter. An easy naked eye object, even though right next to the Moon, behind thin cloud and very low on the horizon. In order to reduce the glare of the Moon, I placed the camera such that a dome was obscuring it. I continued shooting until nearly 04h00 by which time it was starting to disappear into the cloud and had dimmed substantially.

I was now wide awake and before sharing the excitement with the others, back at the hostel, I first downloaded the pictures from my camera to scrutinise them thoroughly. No trace of the satellite during the early part of the orbit was recorded. The first appearance of the fuel dump on my pictures was at 03:35. Comparing this to the launch schedule, both the hydrogen and oxygen dumps had just finished by then. Hydrazine depletion was scheduled to finish at 03:56 SAST which was obviously what

Fig. 3: A single 15 second exposure shows the fuel dump as a bright 1 degree blob (arrowed), easily visible, even with the crescent Moon close by and through thin cloud. This picture was taken at about 03:50 SAST when the 2nd stage was only at elevation 3.7 degrees and 16 700 km range. At 16 700 km radius, one degree is about 290 km, giving an idea of the actual size of the fuel cloud.

Avoidance Manoeuvre (CCAM – see Fig. 2) is intended to put a bit of distance between the two and enable the 2nd stage to dump any remaining propellant without risk of colliding with its payload or spraying it with fuel. Such dumps of excess hydrogen, oxygen and hydrazine have become standard these days to completely depressurise spent rocket bodies, minimising any possibility of an explosion or involuntary orbital changes. Visibility for me was however far from ideal, due to the predicted ultra-low elevation of the 2nd stage above my horizon at the time of the fuel dump. At this point the rocket would be almost halfway to Australia so observing it from the Sutherland SAAO observing plateau with its unobstructed horizons and dark conditions was thus very fortunate.

I set my alarm for 02:15 and upon getting up, I immediately checked the weather which looked fair, as seen from the hostel. Since the predictions were only valid if the launch occurred on time it was very useful (and exciting) to watch it live on the Internet. A textbook launch set the scene for some great viewing. As I headed up the plateau at 03:00, two possible obstacles became apparent; some scattered cloud along the flight path and a crescent Moon rising in the east, just about where the fuel dump should happen.

Since I was not aware of the launch when I packed for my Sutherland trip, I was ill prepared and only "armed" with my camera and a small tripod that lives in my locker. After an unsuccessful search to borrow a pair of binoculars from one of the domes,

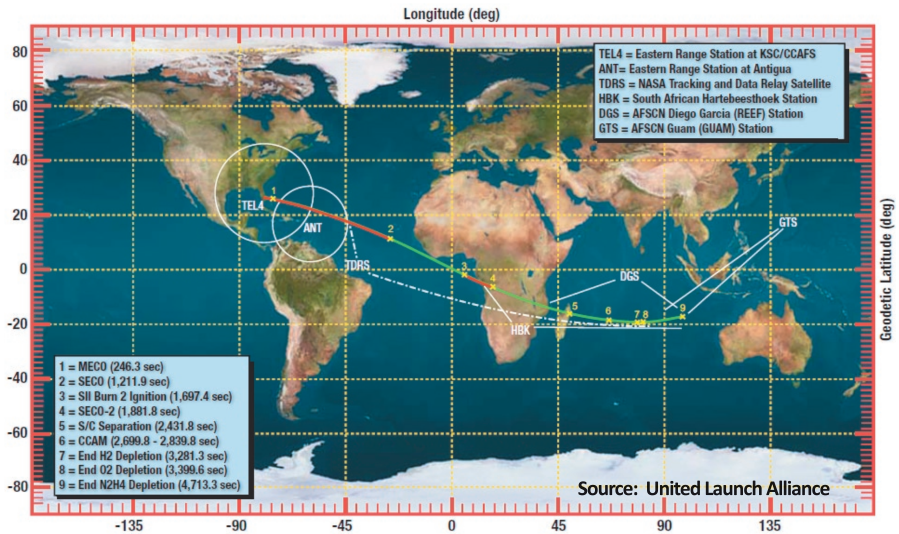


Fig. 2: Ground track of the launch with all the trajectory burns as well as the telemetry downlinks indicated. The observed fuel dump happened between points 8 & 9.

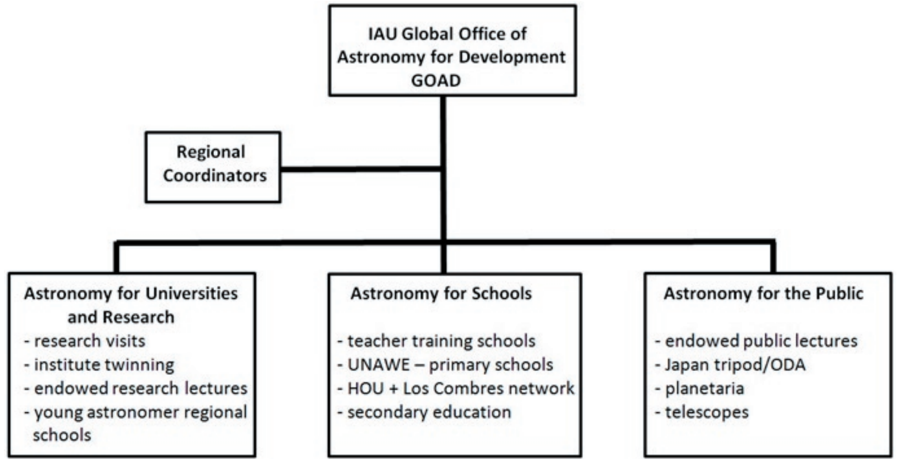
Global Office of Astronomy for Development, Workshop 2011

Case Rijsdijk

The IAU Strategic Plan, SP, started with a consultative process in Paris in January 2008 and there was considerable feedback and input, leading to several drafts of the plan, which was finally adopted at the IAU General Assembly in 2009. A key element in this plan was the creation of an IAU Office of Astronomy for Development, OAD, to plan and coordinate the extended programme. After a global competition the SAAO was selected to host the OAD as a joint venture between the IAU and the South African National Research Foundation, NRF.

The official opening of the OAD took place on 11 April 2011 (*MNASSA* Vol. 70 Nos 5 & 6, June 2011) and now the time has come to address several issues of the implementing and transition of the SP that need defining and discussion.

The stakeholders workshop held in the Auditorium at the SAAO from 12 – 14 December 2011 was held to provide input for the implementation of the SP and do some detailed planning of the new organizational structure, was provided by the 60 odd participants from around the world, and many others who "attended" via *ustream*. In order to realise the vision of "Astronomy for a better World", Regional Nodes would be set up to coordinate the many existing and planned IAU activities in the areas of school level education, the public understanding of science and tertiary level education and research. These three sub-divisions would interact with a Task Force of volunteers and many of the programmes that were successful during the International Year of Astronomy, IYA, and others, would be incorporated into the new organizational structures.



The workshop was timetabled to ensure that there was ample discussion of how the task forces would work, some best practices examples, past experiences, what did work and didn't! There was also extensive discussion on the Regional Nodes, what they were, what their function would be, how and where they would operate and be set up. In order to optimise the time available, there were the usual "breakaway sessions" followed by "feedback sessions" to give the steering committee ample material to take the process forward. They were intense and busy days and it was clear all along that the delegates were totally committed to making this work! It wasn't always easy, we don't live in an ideal world, but the workshop was a huge success and the organizers are to be congratulated, and evidence of this success was that about a month later, the OAD Director, Kevin Govender was able to present an Announcement of Opportunity to host Regional Nodes of the OAD. ☆

SN1987A – 25 years on

On 23 February 1987, Ian Shelton took a photograph the Large Magellanic Cloud at the Las Campanas Observatory in Chile. When he developed it he noticed a bright star where there wasn't one before. He immediately told his colleagues and within hours news of the discovery of a supernova (SN) went round the world. Since it was the first one discovered that year it was labelled 1987A. It reached maximum brightness in May 1987 and was the brightest one to be seen since 1604 CE, when Johannes Kepler observed a supernova in our own galaxy.

SN1987A's progenitor star is thought to be a blue supergiant known Sanduleak –69° 202, and that SN1987A was a core collapse SN. A unique feature of SN1987A was the detection of a neutrino

Delta IV launch fuel dump observed out to nearly 20 000 km

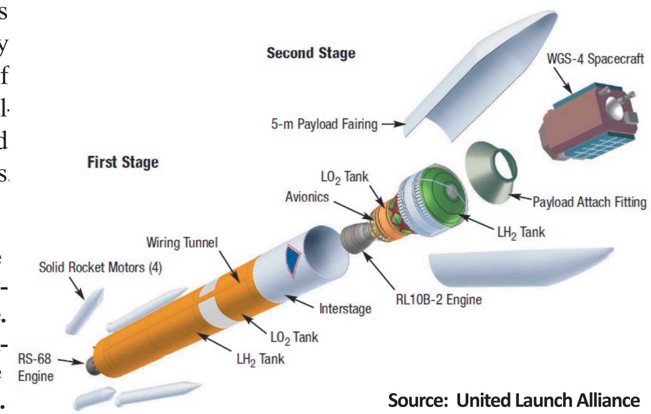
Willie Koorts

As with many launches from the United States, South Africa was downrange along the ground track (see Fig. 2) of the launch of the military WGS 4 mission on a Delta IV rocket from Cape Canaveral, Florida, planned for 20 January 2012 at 00:38 UTC. At 01:09:36 UTC, the second stage burn was scheduled to insert itself and its payload into a highly elliptical orbit of approximately 440 X 67 000 km with the payload separating about 10 minutes later into a supersynchronous transfer orbit. The Boeing-built satellite would then use its onboard propulsion to reach geostationary orbit, matching the Earth's rotation and appear fixed above the equator to cover the Middle East and Southeast Asia. The payload was part of a network of the U.S. Air Force's Wideband Global SATCOM 4 communications spacecraft to route essential communications to U.S. military forces and improve data links to unmanned aerial drones.

With their vast knowledge and experience of previous launches and with the limited information published on this mission, orbital analysts Ted Molczan and Mike McCants calculated a probable orbit. Using this element set, Greg did a detailed prediction for Sutherland where I happened to be at the time and this showed that the rocket would come out of the Earth's shadow at about 03:12 SAST, 18 degrees above my northern horizon, at a range of about 2 600 km. It would still climb a few degrees as it moved NE, before starting to dip towards the eastern horizon.

A very exciting prospect that presented an interesting viewing possibility, was a series of scheduled propellant dumps. After payload separation the 2nd stage rocket would first perform a short burn to separate itself from WGS 4. This manoeuvre, called the Collision and Contamination

I was alerted to this viewing opportunity by Greg Roberts' group of enthusiasts who specialise in tracking classified launches and payloads.



Source: United Launch Alliance

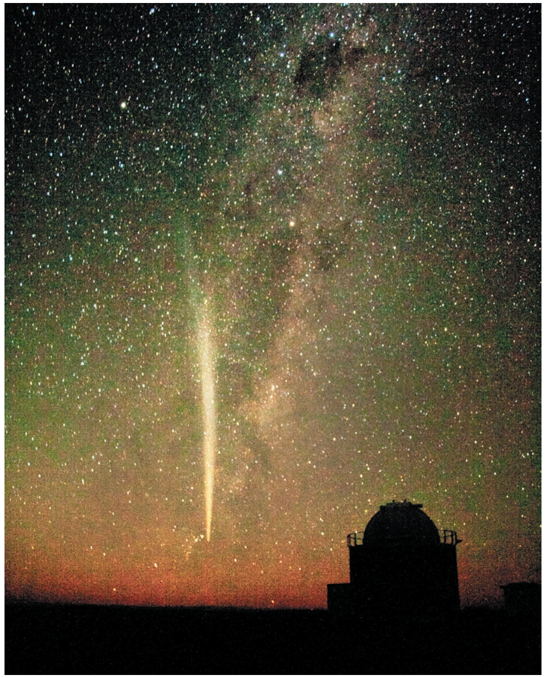
Fig. 1: Details of the rocket stages and payload are shown here. The fuel dump originated from the 2nd stage after payload separation.

It is quite fascinating to watch the SOHO footage of Lovejoy's near-death plunge. The comet actually lost its tail as it passed behind the satellite's occulting disk but grew it back soon after it popped out the other side. It was also observed in detail by NASA's STEREO satellites, actually showing the comet's tail wiggling wildly in transit through the solar corona.

Even Lovejoy's appearance in the sky was strange as Fiona Hobson remarked: "I got up early one morning to see Comet Lovejoy. I saw a long straight diffuse white tail reaching up towards Alpha Centauri – but the comet had no distinct head. Most unusual I thought. I waited at least an hour outside in the dark hoping for something to rise, but after a while realised that this comet had no bright head at all. Never seen a comet like that before!"

The comet was widely observed from South Africa although cloudy weather countrywide did hamper visibility. Probably most fortunate was Simon Fishley, IT Systems Administrator at SAAO, who managed to photograph the comet while it was still bright. He wrote: "I found myself in Sutherland for the Christmas weekend, on standby duty at SAAO, so I was able to photograph the comet early this morning [23 December 2011]. I did not have a long window as a bank of cloud rolled in shortly after I began setting up." Simon managed to get his best shots on Christmas morning (see cover picture).

The comet was even captured in the all-sky camera at SAAO in Sutherland. One of the most striking pictures of Lovejoy was taken by NASA astronaut Dan Burbank from the vantage point of the International Space Station. ☆



Simon Fishley got his best pictures on Christmas morning. Here he framed Lovejoy next to the 20-inch telescope dome in Sutherland, with the Milky Way as a backdrop.

burst when two neutrino observatories, Kamiokande II and IMB, detected 11 and 8 antineutrinos respectively and this event arguably led to the beginning of neutrino astronomy.

The SN has been observed regularly ever since by many telescopes, both on Earth and in space, and a great deal about this type of SN has been learnt, but there are also some enigmas: normally the remnant of a core collapse SN is a neutron star or pulsar. The remnants of 1987A show neither yet and there is quite some speculation about this.

The next edition of *MNASSA* will carry a full article on this remarkable SN. ☆

CCD activities at the Bronberg Observatory (CBA Pretoria) in 2010

Berto Monard

The Bronberg Observatory (25° 54′ 32″ S, 28° 26′ 18″ E, alt. 1590 m) is situated 40 km south-east of Pretoria, on plot 39, Rietfontein JR 395, which is located on top of the Bronberg ridge, which stretches from Pretoria to just East of the observatory. The Observatory, which is run by the author, is also the African participant in the global CBA (Centre for Backyard Astrophysics) network under the name of CBA Pretoria and the dedicated observing station for the microlensing follow up network (uFUN).

The observatory houses a Meade 12-inch RCX400, which is permanently mounted on a pier and polar wedge. This telescope is used with a CCD camera, SBIG ST-7XME and a focal reducer that produces an effective f/5. A filter wheel with BVRI filters is part of the system.

The main types of observation at the Bronberg Observatory / CBA Pretoria were explained in the 2002 and 2004 reports.

2010 was the final year of the existence of the Bronberg Observatory. Due to our move to the Little Karoo in the Western Cape, no observations were done during the period Oct-Dec 2010. The following observing activities were done in 2010:

1. Timeseries Photometry (part or full night) on cataclysmic variables (CVs)
Most of the timeseries were done as participation in the CBA around the globe monitoring network and VSNET campaigns. The following targets were monitored over four or more nights or part there-of. Observations were unfiltered CCD unless stated differently.

- 2QZ J222416.2-292421: Sep 12-18 // 7 nights
- BW Scl: Aug 8, 9, 13, 31, Sep 1-4 // 8 nights
- CSS 112253-111037: Jun 5-7, 9, 12 // 5 nights
- EX Hya (V): May 22-25 // 4 nights
- GW Lib: May 5, 8, 12, 22, Jun 5, 8, 18-20, Jul 3, 9-13, 16, 17 // 17 nights

Proxima Cen in different filters: Jun 22-27, Jul 2 // 7 nights
RX j165443-1916: Jun 11-16 // 6 nights
V4743 Sgr: Jun 9, 21, Aug 1, 3, 7, 9, 14-17, 6, 7, 9 // 13 nights
VSX J115113.0-623729: Jul 29, 30, Aug 1-7, 9-11, 15 // 13 nights
WX Cen: May 6, 9, 10, Jun 21 // 4 nights

Other targets with timeseries photometry were done on fewer nights. They are listed alphabetically with the number of observed nights (or part thereof) in brackets: FO Aqr (3), HP Lib (1), OT J234440-0012 (3), RXS J0154-5947 (1), U Sco (2), V591 Cen (3), V1017 Sgr (V, 1), VW Tuc (1)

2. Snapshot Observations of faint CVs and X ray Transients.
With an ever smaller number of selected targets, the coverage of those was quite dense.

3. Supernova Searching activities yielded 17 SNe in 2010:

SN 2010W in ESO 320-35, Type ?, discovered on Feb 7.075 at 16.7CR
SN 2010aa in NGC 692, Type ?, discovered on Feb 9.771 at 16.4CR
SN 2010bp in ESO 221-32, Type Ia, discovered on Apr 13.979 at 15.2CR
SN 2010bt in NGC 7130, Type IIn, discovered on Apr 17.105 at 15.9CR
SN 2010co in NGC 6862, Type IIp, discovered on May 6.105 at 16.1CR
SN 2010da in NGC 300, erupting LBV, discovered on May 23.169 at 16.0CR
SN 2010do in NGC 5374, Type Ic, discovered on Jun 1.787 at 17.2CR
SN 2010dv in NGC 3903, Type ?, discovered on Jun 4.723 at 17.3CR
SN 2010dx in NGC 7038, Type II, discovered on Jun 9.051 at 17.6CR
SN 2010eb in NGC 488, Type Ia, discovered on Jun 12.149 at 14.0CR
SN 2010el in NGC 1566, Type Ia-p, discovered on Jun 19.142 at 16.8CR
SN 2010fy in anon. galaxy near ESO 253-1, Type Ia, discovered on Jul 7.163 at 17.7CR
SN 2010fz in NGC 2967, Type Ia, discovered on Jul 9.693 at 15.8CR
SN 2010gt in ESO 187-21, Type ?, discovered on Aug 2.867 at 18.0CR
SN 2010hg in NGC 3001, Type Ia, discovered on Sep 1.143 at 15.0CR
SN 2010hq in UGC3691, Type IIp, discovered on Sep 8.136 at 15.2CR
SN 2010hx in NGC 3258, Type Ia, discovered on Sep 16.122 at 15.3CR

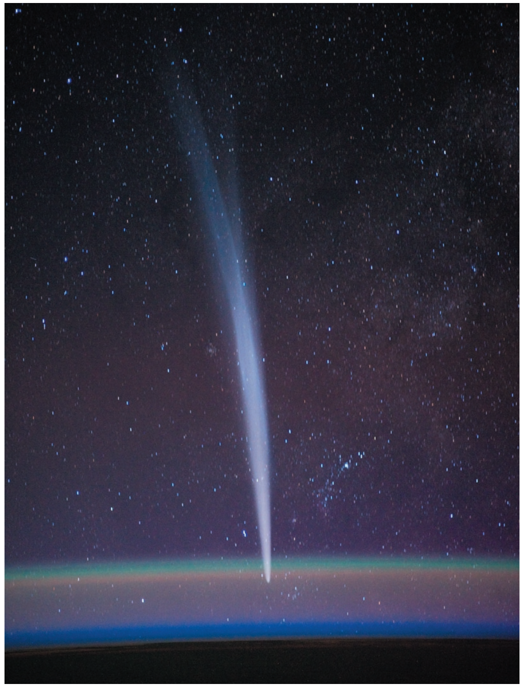
Note: Quite a number of the listed 2010 SNe were discovered low near the horizon and most of them just before dawn. This yield was made possible by the low horizon offered at the Bronberg location. It will be missed.

SN 2010da in NGC 300 turned out to be a SN impostor and originated from an explosion/active state of a LBV in this nearby galaxy. This brings the total number of SN discoveries from the Bronberg Observatory to 106 up to its closure. More on the above SNe and their notifications in the circulars of the International Astronomical Union can be found at: http://www.supernovae.net/snimages/ and

of new sungrazing comets, some just a few metres across. About 83% of the sungrazers found by SOHO are members of the Kreutz group. Before Lovejoy, none of the sungrazers seen by SOHO has survived their perihelion passage. Some may have plunged into the Sun itself, but most are likely to have simply evaporated away completely.

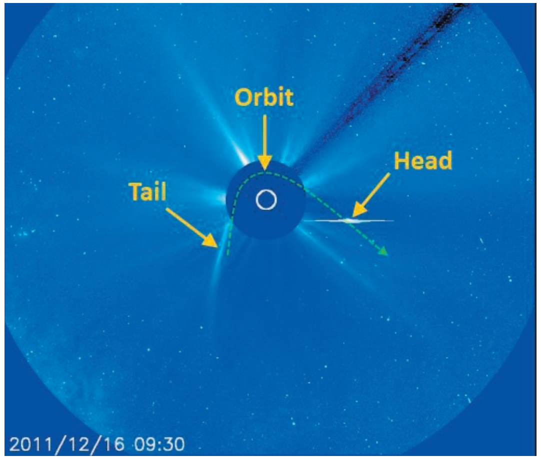
On Christmas morning the author observed the comet from the lovely setting of the Strandveld Museum at Franskraal, overlooking the ocean, unfortunately not in perfect conditions.

More than 75% of the SOHO sungrazers have been discovered by amateur astronomers analysing SOHO's observations via the Internet. Terry Lovejoy's discovery is the first Kreutz-group comet discovered by ground-based observation in 40 years. This discovery also makes him the only person to have discovered Kreutz sungrazers both from ground based observation and from images obtained by spatial telescopes. He discovered his first comet on 15 March 2007, designated C/2007 E2 (Lovejoy), using one of his cameras. This was followed by C/2007 K5 (Lovejoy), a mere two months later.



From the (unfair ad)vantage point of the International Space Station, astronaut Dan Burbank got one of the best pictures of Comet Lovejoy. Credit: NASA

Lovejoy is quite a remarkable comet. Unlike most Kreutz-comets which end up being consumed by the Sun, Lovejoy survived after passing approximately 140 000 kilometres above the Sun's surface! This is about one third the lunar distance from Earth, and effectively inside the Sun's corona where temperatures are a few million degrees Centigrade. Before perihelion, the nucleus of Comet Lovejoy had been estimated to be up to 500 metres in diameter. During the coronal passage, it is believed that a significant fraction of the comet's mass was burned off.



The small central white circle in this SOHO frame indicates the Sun behind an occulting disk (the dark blue central circle), resulting in a permanent solar eclipse which makes it possible to see objects very close to the Sun. The remains of Comet Lovejoy's tail can still be seen disappearing behind the occulting disk (left) while the head of the comet (right) is well clear of the disk already (the horizontal line structure radiating from the bright comet head is a CCD saturation artefact).

The Kreutz-group comets are a family of sungrazing comets, characterized by orbits taking them extremely close to the Sun at perihelion. Believed to be fragments of one large comet that broke up several centuries ago, they are named for German astronomer Heinrich Kreutz, who, in a paper in 1888, first demonstrated their relationship. Several members of the Kreutz family have become Great Comets, occasionally visible near the Sun in the daytime sky. The most recent of these was Comet Ikeya–Seki in 1965, one of the brightest comets in the last millennium, reaching visible magnitude −11. Of particular interest to South Africa is that the Great Comet of 1882 is also a member. This comet was photographed from the Royal Observatory in the Cape and eventually put David Gill on the idea of employing photography in astronomy. Good news for comet watchers is the possibility that another cluster of bright Kreutz system comets may begin to arrive in the inner Solar System in the next few years to decades.

Since the launch of the SOHO satellite in 1995, it has been possible to observe comets very close to the sun at any time of year. The satellite provides a constant view of the immediate solar vicinity. SOHO has now discovered hundreds

http://cfa-www.harvard.edu/cfa/ps/lists/RecentSupernovae.html

4. Follow-up observations on alerts for Gamma Ray Bursts (GRBs)

No GRB afterglows were imaged in 2010.

5. Follow up on X ray sources

None were observed in 2010.

6. Observations of microlensing events

As African participant in the Microlensing Follow up Network (MicroFUN), many microlens events were observed in 2010.

Microlensing events detected by the OGLE or MOA groups in the galactic bulge are studied for caustic behaviour in the microlensing lightcurve to detect the presence of planets around the lens star. Such planets have been discovered thanks to the global monitoring network. In 2010 OGLE observations were still interrupted to allow for the upgrade. For more info see: http://www.astronomy.ohio-state.edu/~microfun/

The following events were observed:

MOA-2010-BLG-092: Jun 2-7
MOA-2010-BLG-189: May 6
MOA-2010-BLG-274: Jun 3-4
MOA-2010-BLG-285: Jun 6-7
MOA-2010-BLG-311: Jun 16-17
MOA-2010-BLG-349: Jun 30
MOA-2010-BLG-364: Sep 3-18
MOA-2010-BLG-394: Jul 13-14
MOA-2010-BLG-446: Aug 4-5
MOA-2010-BLG-455: Jul 27
MOA-2010-BLG-542: Sep 15-17

Some of the microlensing events turned out to be anomalous. Publications on those events follow usually within two years after the event. As can be seen in the publication list below quite a number of anomalous events of previous years were published on.

7. Symbiotic stars monitoring

This project has continued to produce interesting information on the select group of symbiotic stars.

8. Conclusions for the Bronberg Observatory in 2010

2010 was another successful year for the Bronberg Observatory with 17 SN finds, a successful continuation of the faint CV and symbiotic star observing programmes and a valued participation in the microlens follow-up network. SN 2010el was celebrated as the 100th SN discovery from the Bronberg Observatory.

At the end of September the Bronberg Observatory was closed and its equipment taken to our new residence in Calitzdorp, Western Cape. A new observatory was built there and observations resumed on 26 December. The new observatory was named the Klein Karoo Observatory after the name for the region.

9. References/publications to date

Observing data, contributed to campaigns resulted in co-authorship in publications. They are listed in the Appendix. IAUCs and GCNs are not included.

Appendix: List of publications in 2010

Sumi, T.; Bennett, D. P.; Bond, I. A.; Udalski et al. 2010 "A Cold Neptune-Mass Planet OGLE-2007-BLG-368Lb: Cold Neptunes Are Common" *ApJ...710.1641S*

Janczak, Julia; Fukui, A.; Dong, Subo; Monard, L. A. G. et al. 2010. "Sub-Saturn Planet MOA-2008-BLG-310Lb: Likely to be in the Galactic Bulge" : *ApJ...711..731J*

Pagnotta, Ashley; Schaefer, Bradley E.; Handler, Gerald et al. 2010. "An Apparent Second Plateau in the UBVRIJHK Eruption Light Curve of the Recurrent Nova U Sco" *ATel.2507....1P*

Schwieterman, Edward W.; Wood, Matt A.; Piwowar, Dan et al. 2010. "Time-Series Photometry of GW Librae One Year After Outburst" *JSARA...3....6S*

Fouqué, P.; Heyrovský, D.; Dong, S.; Gould, A. et al. 2010. "OGLE 2008-BLG-290: an accurate measurement of the limb darkening of a galactic bulge K Giant spatially resolved by microlensing" *A&A...518A..51F*

Patterson, J.; Halpern, J. P.; Stockdale, C.; Bolt, G. et al. 2010. "8.6 Hour Period in XMMU J115113.3-623730" *ATel.2777....1P*

Gould, A.; Dong, Subo; Gaudi, B. S.; Udalski, A. et al. 2010. "Frequency of Solar-like Systems and of Ice and Gas Giants Beyond the Snow Line from High-magnification Microlensing Events in 2005-2008" *ApJ...720.1073G*

Parsons, S. G.; Marsh, T. R.; Copperwheat, C. M. et al. 2010 "Orbital period variations in eclipsing post-common-envelope binaries" *MNRAS.407.2362P*

Ryu, Y.-H.; Han, C.; Hwang, K.-H.; Street, R. et al. 2010. "OGLE-2009-BLG-092/MOA-2009-BLG-137: A Dramatic Repeating Event with the Second Perturbation Predicted by Real-time Analysis" *ApJ...723...81R*

Kato, Taichi; Maehara, Hiroyuki; Uemura, Makoto et al. 2010. "Survey of Period Variations of Superhumps in SU UMa-Type Dwarf Novae. II The Second Year (2009-2010)" *PASJ...62.1525K* ☆

Karoo Starparty, Britstown – 21 to 25 March 2012

The Pretoria Centre is continuing their annual National Karoo Starparty which was started in 2009 at the Kambro Padstal, about 20 km north of Britstown in the Karoo, next to the N12 National Road. Visit http://www.kambroaccom.co.za or call Wilma Strauss at 083 305 6668 for info and bookings.

Southern Star Party, Bonnievale – 20 to 22 April 2012

The third Southern Star Party (SSP), the *Autumn 2012 SSP* will be held at Night Sky Caravan Park near Bonnievale, Western Cape. Visit http://www.southernstarparty.org for information and booking details. ☆

Fig. 5: Camera mounted for afocal photography.

Fig. 6: A daytime view of the system, here set up for solar photography, showing a section of the Sun's disk on the computer screen.

The camera used is a Canon EOS 550D mounted with a T-piece, fitted to the eyepiece of the telescope (Fig. 5). The camera lens used is a 50mm fixed focal length lens. The camera is controlled from a computer in the observatory. (Fig. 6). The connection is by means of a USB cable.

It was realised that, due to the confusion with the timing, that the fact that the shadows were captured was more due to luck. It would seem that the transit was seen 1h 25m later than the estimated time of the shadow entering the planet, as predicted by the animation. Whether this is a correction that could be applied to the values derived from SkyMap Lite for Jupiter should be tested. The *Sky Guide* publishes a most helpful monthly table of the times of the occultations and transits of the Galilean moons and their shadows. ☆

Comet Lovejoy, the Great Christmas Comet of 2011

Willie Koorts

As with a gift you never expected to get for Christmas, so surprised were southern hemisphere observers around 21-28 December 2012 when a bright naked-eye comet, sporting a tail some 30 degrees long, graced the morning skies in a brief, but excellent performance.

Designated C/2011 W3 (Lovejoy), it was discovered on 27 November 2011 by amateur astronomer Terry Lovejoy of Thornlands, Queensland, during a comet survey using a 20 cm Schmidt–Cassegrain telescope, fitted with a CCD camera. He described the comet as "a rapidly moving fuzzy object" of 13th magnitude. After confirmation by the Mount John University Observatory in New Zealand, Comet Lovejoy was formally announced on 2 December 2011, exactly on the 16th anniversary of the SOHO satellite's launch. The comet was therefore also referred to as "The Great Birthday Comet of 2011".

was to commence with the shadow entering the planet at 19:22 SAST. There was a great deal of uncertainty as to what this time meant. Did it include the time for the light to travel to earth? I assumed it did not and that at least 36 minutes should be added.

A fair amount of trouble was experienced in acquiring the image in the camera, and an even greater amount in focusing – I realised that I was still quite inexperienced in this regard. By the time I was ready to commence taking the photos it was 20:47 and it was assumed that I had missed the transit. However, the *Sky Guide* indicated that the egress of Europa's shadow may be as late as 21:31. For good measure, a series of photos were taken from 20:47 to 21:00 at one minute intervals. On processing the photos it was found that the shadow was actually captured in photos no 2, 3 and 4 – see Figures 1, 2 and 3.

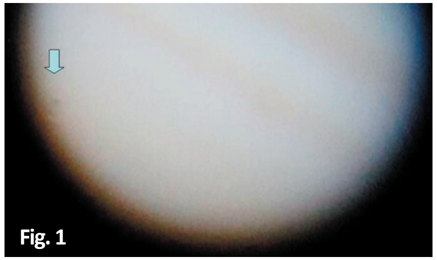


Fig. 1

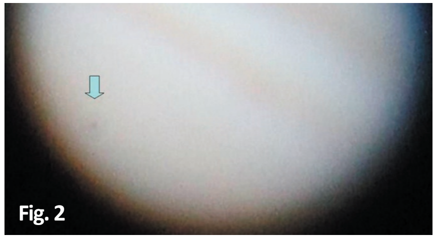


Fig. 2

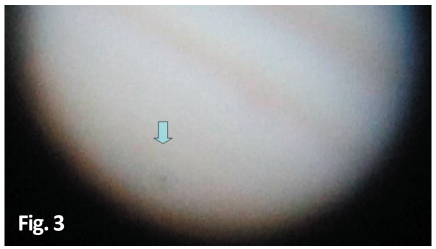


Fig. 3

Fig. 1-3: Enlarged images, taken between 20:48 and 20:49, showing the shadow appearing as a faint dot (arrowed) with a faint circle (the penumbra) around it, moving along the edge of the Jovian disk.

Some Comments

The photographs were taken from my custom-built Wendy-house observatory which has a sliding roof, mounted on rails. The telescope is permanently mounted on a pier fixed in a block of concrete below the floor of the observatory (Fig. 4). The telescope is a 180 mm Maksutov with a focal length of 2.7 m. The telescope was fitted with a zoom eyepiece set at a focal length of 21 mm.

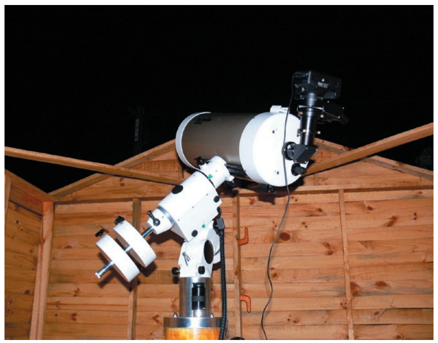


Fig. 4: Telescope and mounting.

Selected W UMa stars of the antipodean sky

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Abstract: Candidate W UMa stars from the southern hemisphere were observed in V filter using personal telescopes in South Africa during the 2008 season. Ephemeris of V839 Cen, V637 Cen and V653 Ara are presented. Software modeling packages of Binary Maker 3 and Phoebe were employed to constrain the parameters of the binary components. The results of the modeling exercise are presented.

Key words: V839 Cen, V637 Cen, V653 Ara, W UMa stars, contact binaries

Introduction

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

W UMa stars

W Ursae Majoris stars are members of a class of eclipsing variable stars in which the components are of spectral type late A to mid K; though a recent discovery of Koen and Ishihara (2006) suggest a unique contact binary of spectral type "later" than M4.

They are named after the prototype W UMa. The variability of the prototype was discovered by Muller and Kempf (1903). The components of W UMa stars are similar in brightness and are in contact. Primary and secondary minima of the light curves are nearly equal. Contact binary W UMa stars, display continuous changing brightness because of tidal distortion of the components (Paczynski et al. 2006). An energy transfer from the larger more massive of the two to the smaller less massive one results in an almost equal surface temperature over the entire system. They are therefore cooler/warmer than they would be if solitary. The mass ratio q of the two stars is always different from unity and it is this q value that determines the energy transfer rate (Mochnaki 1981). Liu and Yang (2000) confirmed this result and added that the transfer rate is also dependent on the evolutionary factor (the ratio of the present radius to the zero age radius of the primary component). In 2001, Kalimeris and Rovithis-Livaniou found the observed rate of transfer is a function of the luminosity of the secondary.

The two components are low and intermediate mass Main Sequence (MS) stars surrounded by a common envelope. The convective common envelope model was developed by Lucy (1968b) and has the secondary deriving most of its luminosity by "sideways convection". Mochnacki

(1971) and Moses (1974) suggest that up to a third of the energy generated by the primary is transferred to the secondary. In a contact binary the similarity between the components means that at some point their envelopes come into direct contact as they evolve at a similar rate.

A contact binary is a close binary star in which both components fill their Roche lobes. The components of such a system rotate very rapidly ($v \sin i \sim$ 100-200 km s^{-1}) from the spin-orbit synchronisation due to strong tidal interactions between the stars. They are very common (Eggen, 1967). Duerbeck (1984) and Rucinski (1993) suggest the level of at least one such binary per one thousand stars. Studies of open (Kaluzny and Rucinski 1993; Rucinski and Kaluzny 1994) as well as globular clusters (Hut et al. 1992) are showing a much higher relative frequency of occurrence than in the field.

There were, until 1979, two subclasses of W UMa stars. These were suggested by Binnedijk (1965):

A type: effective temperature of the primary and secondary are not the same (i.e. not in thermal equilibrium).The temperature difference is larger and the secondary appears hotter (Mochnacki 1972, Whelan 1972). In A type the primary is hotter or almost the same temperature as the secondary. Also in the A type the systems are of earlier spectral type (Mochnacki 1980) and appear to be more evolved (Wilson 1978).

W type: have shorter periods, are cooler, are generally closer to the Zero Age Main Sequence (ZAMS), have a smaller total mass and a larger mass ratio and are in poorer contact (Rucinski 1973). In 1975 Mullan suggested the primary in W type appear cooler relative to the secondary as a result of magnetic star spots on the surface. Doppler imaging techniques have revealed that both components can be covered in star spots, with the primary to be more active than the secondary (Maceroni et al, 1994; Hendry and Mochnacki, 2000; Barnes et al, 2004) Also, W type systems have thinner necks (Mochnaki 1980) and accordingly have higher energy transfer rates and luminosity ratios. This is counter-intuitive, but has proven to be the case (Csizmadia and Klagyivik 2004).

Lucy and Wilson (1979) introduced a class B type system 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)).

A third type of contact binary has recently been introduced by Csizmadia and Klagyivik (2004), the H type, having a large mass ratio ($q > 0.72$). These systems show very different behaviour in the luminosity ratio-transfer parameter diagram. They suggest that the energy transfer rate is less efficient in these systems than in other types of contact binary stars.

A Shadow Transit of Jupiter

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Ever since I have acquired Chris Marriott's commercially available software "SkyMap Lite" and saw that one could predict, by means of an animation, a transit of the shadow of one of Jupiter's Galilean moons, the desire grew to actually observe such a transit. A number of attempts were made during the past three years but they were all unsuccessful. This left some questions:

- Are the shadows of the moons actually visible through a small telescope?
- How accurate are the predictions by SkyMap?
- How long do the shadows take to transit the planet?

During the past year, my acquisition of a Digital Single Lens Reflex (DSLR) camera, enabled a new approach to be followed. This time the intention was to take photos of the transit. The T-piece, to fit the camera for afocal photography was, made by Mr Steve Kleyn of the Hermanus Astronomy Centre. In preparation, a number of photos of Jupiter were taken.

A calculation was also made of the size of the shadows of the four moons on Jupiter. This was a very basic calculation, placing the centres of the Sun, a moon and Jupiter on the same line. The results are shown in Table 1.

This table was later expanded to include the penumbras only after the photos were taken because it was not initially expected that the penumbra would be as visible, as it turned out on the photos.

The decision was made to target the transit of Europa on the evening of 31 December 2011, observing from Fisherhaven, Western Cape. Sunset was at 19:58. The weather and seeing were good.

The software used (SkyMap Lite) does not produce tabular predictions for Jupiter events ("SkyMap PRO" does, but it was not available). The best that could be done was to do an on-screen animation of the passage of Europa and its shadow. According to this animation the transit

Table 1: The calculated shadow diameters of Jupiter's Galilean moons.

	Io	Europa	Ganymede	Callisto
[1]Diameter of Moon (km)	3 630	3 138	5 262	4 800
Diameter of Umbra (km)	3 004	2 067	3 481	1 542
[2]Angular diameter of Umbra (arc secs)	0.93	0.63	1.06	0.47
Diameter of Penumbra (km)	4 259	4 213	7 057	8 058
[2]Angular diameter of Penumbra (arc secs)	1.29	1.28	2.14	2.45

1 From JH de Klerk's *Dictionary of Astronomy*.
2 Based on the geocentric distance of Jupiter on the day of the observation.

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

	Description	V448 Cen
$\Delta\Phi$	Phase shift (arbitrary user interface)	0.408 ±0.0005
q	Mass ratio	0.723 ±0.003
i	Inclination of orbit	75.256 ±0.102
T_{eff1} T_{eff2}	Effective temperature	6433 K ±630 K 5100 K ±510 K
Ω_1 Ω_2	Surface potentials	3.22 ±0.005 2.98 ±0.01
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	12.46 ±0.014 12.57 ±0.02
$x^{1d,i}_1$ $x^{1d,i}_2$	Linear limb darkening coefficients	0.52 ±0.02 0.71 ±0.02

the primary an f ~ 0.142. The red crosses indicate the centres of mass of the components with the central cross the centre of mass of both systems.

Conclusion

Once again spectra of this system would aid in constraining the mass ratio and temperatures of the components. Of significance in this system is the large mass ratio and high fillout factor of the secondary.

References

Bradstreet, D.: 2005SASS...24...23

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Kurucz, R.L.: 1970; SAO *Special Report 309*

Prsa, A.: 2006, Phoebe reference manual.

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

www.willbell.com/aip/index.htm

www.fiz.uni-lj.si/phoebe ☆

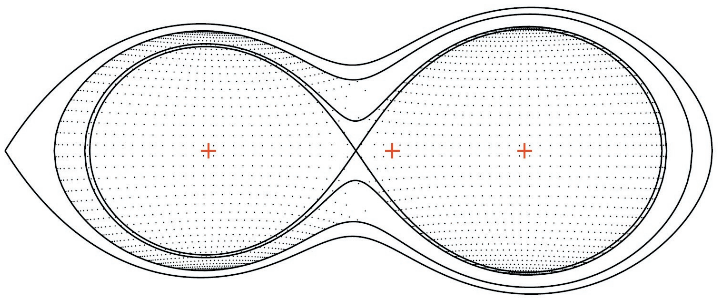

Figure 5: Roche lobe fillout of V448 Cen at 0.15 of phase.

Observations

An observation campaign from light polluted skies using personal telescopes (PT) on the outskirts of Johannesburg, South Africa, began in winter 2006. The objective of the campaign was the determination of periods of selected antipodean W UMa stars and the modeling of their components.

Program star details

V839 Cen

STAR	V839 Cen
SPECTRAL TYPE	G5V (Simbad)

RA	Dec	ASAS	HIC/ALT	SIMBAD	
(2000)	(2000)			B-V	V
12 58 48	-36 58 33	125850-3658.5	HIC63347	0.62	9.64

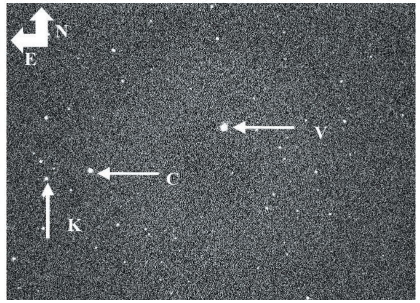

Figure 1: V839 Cen (V) and Check (K) and Comparison (C) star

Hoffmeister reported the variability of V839 Cen in 1949.

V637 Cen

STAR	V637 Cen
SPECTRAL TYPE	N/A

RA	Dec	ASAS	HIC/ALT	SIMBAD	
(2000)	(2000)			B-V	B
14 16 35	-40 00 27	141635-4000.2	SVHV7383		12.5

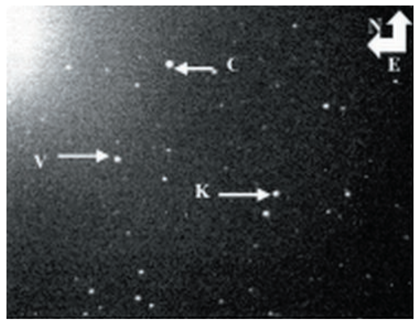

Figure 2: V637 Cen (V) and Check (K) and Comparison (C) star

Harvard sky photometry discovered the variability of V0637 Cen (2002IBVS.5298....1W).

V653 Ara

STAR	V653 Ara				
SPECTRAL TYPE	N/A				
RA	Dec	ASAS	HIC/ALT	SIMBAD	
(2000)	(2000)			B-V	V
16 45 03	-54 59 12	164503-5459.2	SVSON5877		N/A

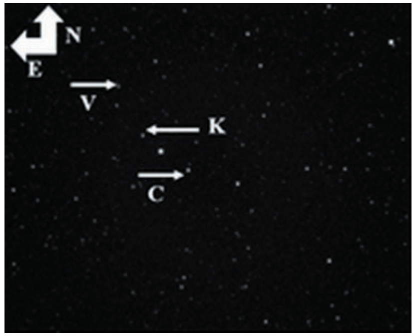

Figure 3: V653 Ara (V) and Check (K) and Comparison (C) star

Gessner and Meinunger (1974) reported the discovery of this star.

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 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 4 minutes, automatically via the net from Dimension 4 using a local time server.

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.

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

Star	Observing period	Integration times
V839Cen	April/May	25 sec
V637 Cen	April/May	55 sec
V653 Ara	June	40 sec

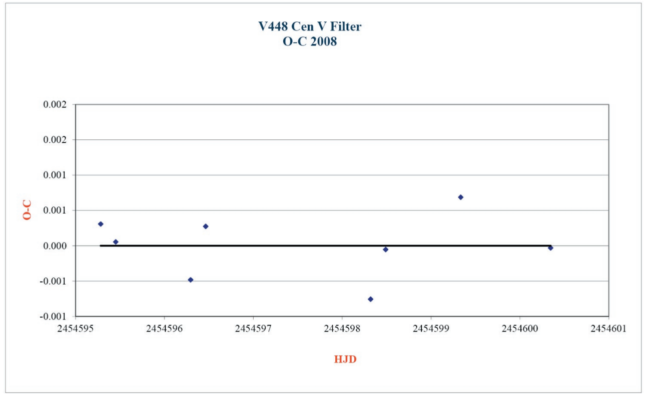

Figure 2: O-C graph of V448 Cen V Filter 2008 season. Points 1, 3, 5,7and 8 are secondary minima.

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.

V448 Cen

Csizmadia and Klagyivik (2004) introduced the H type W Uma system, having a large mass ratio (q > 0.72). V448 Cen will require spectra to confirm this mass ratio.

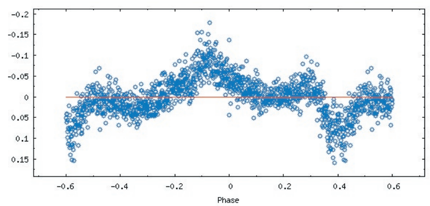

Figure 3: V448 Cen V Filter 2008. Fitted synthetic light curve (red) on binned light curve.

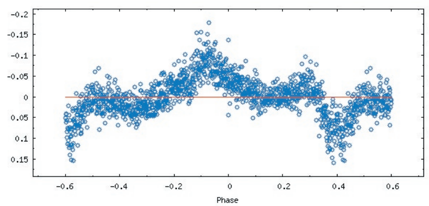

Figure 4: V448 Cen residuals of the PHOEBE model.

Full parameters of the model are tabulated in table 3.

The secondary and primary minima are the best fits that can be attained with these data. The secondary minimum is marginally deep whilst the primary too shallow. Both mass ratio and inclination are the best fit that can be achieved. The values of these parameters converged on the tabulated values.

Also of interest here is the large temperature difference between the two components. The difference of ~ 1300 K could be interpreted as unusual considering the two components share a common gas envelope.

Figure 5 shows the Roche lobes of V448 Cen at phase 0.15. The secondary component shows a fillout factor *f* ~ 0.725 whilst

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

Star	Observing period	Integration time
V448 Cen	June 2007 White light June 2008 V	20 seconds 40 seconds

sidering the size and sensitivity of the equipment deployed.

3. 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.

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

Figure 2 depicts an O-C graph of V448 Cen V Filter for the 2008 season using the calculated period. Table 2 lists the times of minimum determined by the extremum fitting method. Cycles with fractional values (1, 3, 5, 7 and 8) are secondary minima. From 3500 observations over 12.3 nights we derive an ephemeris in V filter of:
HJD 2454595.451239 (±0.000267) + E*(0.337522d) ± 0.00033d

Modeling of the data

These data were initially modeled using BINARY MAKER 3 (Bradstreet, 2005) to generate rough input parameters for later

Table 2: This table presents minima from V448 Cen V Filter 2008. Cycles with fractional values are secondary minima.

V448 Cen

Cycle	Calculated	Observed	O-C	Observational Error
-0.50	2454595.282478	2454595.2827860	0.0003082	0.0022100
0.00	2454595.451239	2454595.4512930	0.0000544	0.001990
2.50	2454596.295043	2454596.2945600	-0.0004827	0.0029700
3.00	2454596.463804	2454596.4640780	0.0002744	0.002720
8.50	2454598.320173	2454598.3194160	-0.0007567	0.0022800
9.00	2454598.488933	2454598.4888800	-0.0000535	0.002030
11.50	2454599.332738	2454599.3334240	0.0006864	0.001860
14.50	2454600.345303	2454600.3452720	-0.0000306	0.001800

Analyses of reductions

V839 Cen

Table 2: This table presents minima times from V839 Cen V Filter 2008. Cycles with fractional values (1, 3, 5, 7, 8, 9 and 11) are secondary minima. (2450000+).

Cycle	Calculated	Observed	Δ Observation (mag)
-0.50	4582.3482	4582.3492	0.0009
0.00	4582.5136	4582.5133	0.0012
2.50	4583.3409	4583.3410	0.0012
3.00	4583.5064	4583.5058	0.0013
5.50	4584.3337	4584.3341	0.0009
6.00	4584.4991	4584.4982	0.0011
14.50	4587.3119	4587.3122	0.0010
29.50	4592.2758	4592.2764	0.0009
32.50	4593.2686	4593.2688	0.0009
33.00	4593.4340	4593.4335	0.0009
35.50	4594.2613	4594.2617	0.0011
36.00	4594.4268	4594.4263	0.0010

From 5524 observations over 7 nights we derive an epoch of:

HJD 2454582.5136 (±0.0003) + E*(0.3309d) ± 0.0001d

V637 Cen

Table 3: This table presents minima times from V637 Cen V Filter 2008. Cycles with fractional values (1, 2, 5, 8 and 9) are secondary minima. (2450000+).

Cycle	Calculated	Observed	Δ Observation (mag)
-2.50	4572.533305	4572.5355	0.002630
-0.50	4573.289951	4573.2896	0.001730
0.00	4573.479112	4573.4792	0.001400
2.00	4574.235758	4574.2336	0.002370
2.50	4574.424919	4574.4249	0.001490
13.00	4578.397309	4578.3975	0.001500
18.00	4580.288923	4580.2877	0.002140
18.50	4580.478084	4580.4776	0.002170
20.50	4581.234730	4581.2365	0.002290
21.00	4581.423891	4581.4240	0.001610

From 3016 observations over 6 nights we derive an epoch of:

HJD 2454573.4791 (±0.0006) + E*(0.3783d) ± 0.0001d

V653 Ara

Table 4: This table presents minima times from V653 Ara V Filter 2008. Cycles with fractional values (1, 3, 6, 8, 10, 12, 13 and 16) are secondary minima. (2450000+).

Cycle	Calculated	Observed	Δ Observation (mag)
-0.50	4626.3029	4626.3031	0.0019
0.00	4626.4533	4626.4529	0.0016
9.50	4629.3102	4629.3096	0.0019
10.00	4629.4606	4629.4603	0.0020
16.00	4631.2649	4631.2638	0.0021
16.50	4631.4153	4631.4158	0.0018
17.00	4631.5656	4631.56557	0.0018
19.50	4632.3175	4632.3177	0.0020
20.00	4632.4678	4632.4675	0.0018
22.50	4633.2196	4633.2223	0.0025
23.00	4633.3699	4633.3677	0.0018
23.50	4633.5204	4633.5221	0.0023
52.50	4642.2414	4642.2423	0.0018
53.00	4642.3912	4642.3913	0.0016
56.00	4643.2939	4643.2933	0.0017
56.50	4643.4443	4643.444	0.0019

From 4588 observations over 7 nights we derive an epoch of

HJD 2454626.4533 (±0.0005) + *E**(0.3007d) ± 0.0001d

Modeling of the data

Binary modeling was undertaken using two modeling software platforms. 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.

V839 Cen

Of interest here is if the inclination or the temperature parameter is adjusted in small steps the synthetic primary minimum jumps to either the 3.25 or 3.35 magnitude position producing an unrealistic fit. Apart from the narrow eclipse at primary minimum the synthetic fit here is satisfactory (Fig. 4 & 5).

V637 Cen

The 3 data points in Figure 7 at approximately -0.3 phase, below the secondary minimum are unexplainable. They are not obvious in the unfolded data. Also of interest is the point following the primary

V448 Cen, a previously unexplored W UMa system of the antipodean sky

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Abstract: V448 Cen, a W UMa star in the southern hemisphere was observed using personal telescopes in South Africa during the 2007/8 season. An ephemeris of V448 Cen 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. Of interest in this system is the large mass ratio (q) of ~0.72.

Key words: V448 Cen, W UMa stars, contact binaries

Introduction

This is the fourth in a series of reports of observations of antipodean W Uma contact binaries observed from the northern outskirts of Johannesburg, S.A.

W UMa stars

I refer the reader to the earlier paper in this edition for a comprehensive summary of W UMa contact binaries.

Observations

Observations of V448 Cen began in June 2007. Some 4500 observations in white light were reduced. During 2008 over a time span of 12.31 days a further 3500 observations were completed in V filter.

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 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 con-

V448 Cen

STAR	V448 Cen		
SPECTRAL TYPE	N/A		
RA	Dec	SV	
(2000)	(2000)		B
12 35 40	-35 38 11	HV 10151	13.6

Program star details

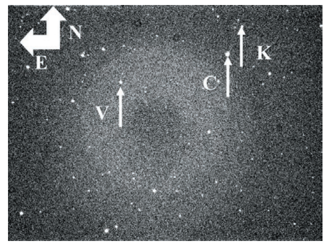

Figure 1: V448 Cen (V) and Check (K) and Comparison (C) star.

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☆

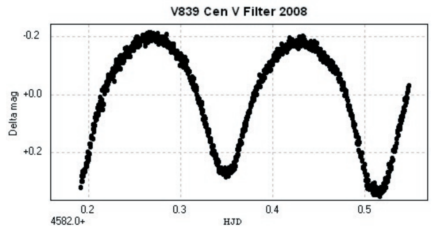

Figure 4: V 839 Cen V Filter 2008

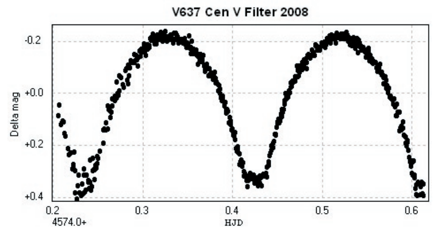

Figure 6: V637 Cen V Filter 2008

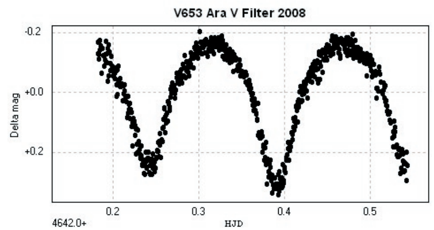

Figure 8: V653 Ara V Filter 2008.

minimum that is well away from both the data and synthetic curve at approximately 0.25 of phase. This point manifests a large residual. Apart from the slightly deep synthetic curve at the secondary minimum the fit here is also satisfactory.

The A_1 and A_2 values here are also inconsistent. We would anticipate a higher surface albedo for a hotter star. These values seem to be reversed. Other values like gravity darkening and limb darkening are input parameters.

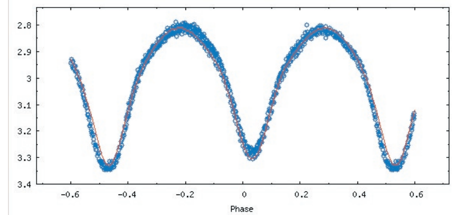

Figure 5: V 839 Cen V Filter 2008. Fitted synthetic light curve (solid line) on phase binned light curve.

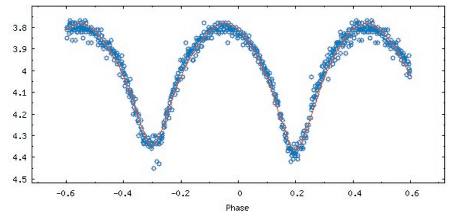

Figure 7: V637 Cen V Filter 2008. Fitted synthetic light curve (solid line) on phase binned light curve.

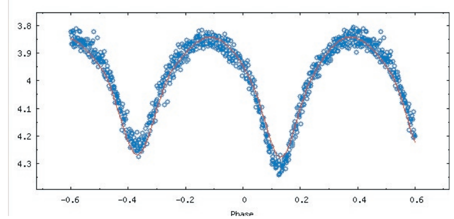

Figure 9: V653 Ara V Filter 2008. Fitted synthetic light curve (solid line) on phase binned light curve.

V653 Ara

Balancing a low χ^2 value and the best fit by "eye" produced the fit in figure 9. Again a small difference between data and synthetic curve is noted around the minima. Overall the fit is satisfactory.

The full parameters of all of the models are tabulated in table 5.

Table 5: Final Model parameters determined by Phoebe. Passband luminosities are the ratio of flux to the integral of the passband transmission function.

	Description	V0839 Cen	V0637 Cen	V653 Ara
$\Delta\Phi$	Phase shift (arbitrary user interface)	-0.4610 ±0.0003	0.1964 ±0.0003	0.1316 ±0.0005
q	Mass ratio	0.3587 ±0.0008	0.5348 ±0.0016	0.3544 ±0.0011
i	Inclination of orbit	76.87 ±0.07	74.30 ±0.08	73.71 ±0.11
T_{eff1}	Effective temperature	5384 ±102	7870 ±77	6094 ±61
T_{eff2}		5653 ±240	6000 ±60	5600 ±56
Ω_1	Surface potentials	2.533 ±0.004	2.772 ±0.003	2.537 ±0.025
Ω_2		2.224 ±0.006	2.845 ±0.003	2.532 ±0.025
A_1	Surface albedoes	0.50 ±0.02	0.57 ±0.05	0.71 ±0.01
A_2		0.50 ±0.02	0.75 ±0.06	0.50 ±0.01
g_1	Gravity darkening coefficients	0.28 ±0.01	0.34 ±0.01	0.29 ±0.01
g_2		0.32 ±0.01	0.33 ±0.01	0.32 ±0.01
L^i_1	Passband luminosities	12.59 ±0.08	12.51 ±0.01	12.58 ±0.13
L^i_2		12.57 ±0.10	12.57 ±0.02	12.57 ±0.13
$x^{1d,i}_1$	Linear limb darkening coefficients	0.53 ±0.01	0.46 ±0.02	0.50 ±0.01
$x^{1d,i}_2$		0.50 ±0.05	0.50 ±0.03	0.50 ±0.01

of the component stars. Small incremental changes to these three parameters make a significant contribution to the system fit.

χ^2 values are a reasonable gauge of parameter fits. However, eye fitting also makes a very important contribution in the overall balance of the fit. Eye estimations should never be ignored in this procedure. Spectra of the candidates would constrain temperatures of the components as well as providing radial velocities.

Until spectra of the candidates are taken we are unable to confirm temperatures and hence have limited convergence on accurate models.

Conclusion

The principal parameters of W UMa stars that have the biggest effect on the residual values of the model fits are system inclination to our line of sight *i*, mass ratio of the two components *q* and the temperature

It is important to re-iterate that binaries remain the only source of absolutely determined stellar masses and close binaries remain the only source of radii. All other methods are model dependant and utilize binary data (Rucinski private communication February 2009). Modeling of W UMa stars therefore plays a significant role in the constraint of stellar models in general. Yakut and Eggleton (2005) emphasize this fact.

The reader is directed to a recent comprehensive publication regarding new opportunities and challenges in close binary work wherein further astrophysical research is motivated in this field (Gimenez, Guinan, Niarchos & Rucinski 2006).

It is worth noting that very little theoretical work has been done on W UMa stars recently and many of the listed references are dated. Recent observations of the systems have been restricted to modelling using old theoretical models.

Rucinski has also indicated his dissatisfaction with the current "Contact Model" of W UMa stars. He believes the model does not adequately explain all of the observed parameters. Researchers eagerly anticipate developments in this regard.

Understanding of the physical processes involved in the sharing of a convective envelope, limb and gravity darkening and surface albedoes all contribute greatly to astrophysical understanding of stellar systems. Without determining and limiting parameters Astrophysicists would be unable to improve current models.

The modelling processes used were all developed on the code written in the early 1970s. This clearly indicates that more research is required in this field.

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