# PRIME FOCUS

MAS SOCIETY JOURNAL

macarthur astronomical society

July 2012
volume 17 issue 7

magnitude -II
Image Credit: Chris Malikoff

# from the editor's desk

## Welcome to the July 2012 edition of Prime Focus - volume 17, edition 7.

***Prime Focus*** is the Society's monthly electronic journal, containing information about Society affairs and on the subjects of astronomy and space exploration from both members and external contributors.

We are constantly seeking articles about your experiences as an amateur astronomer and member of MAS, on any astronomy-related topic about which you hold a particular interest. Please submit any articles to the Editor at **editor@macastro.org.au** at any time. Original type-written material on A4 paper may also be submitted as they are able to be scanned. Please ensure that the quality of type is good so that it will scan properly.

Both "print" (large high-quality PDF) and "screen" (small low-quality PDF) electronic versions of this July edition are now available at the "*Members/Prime Focus/2012*" menu link on our website at:

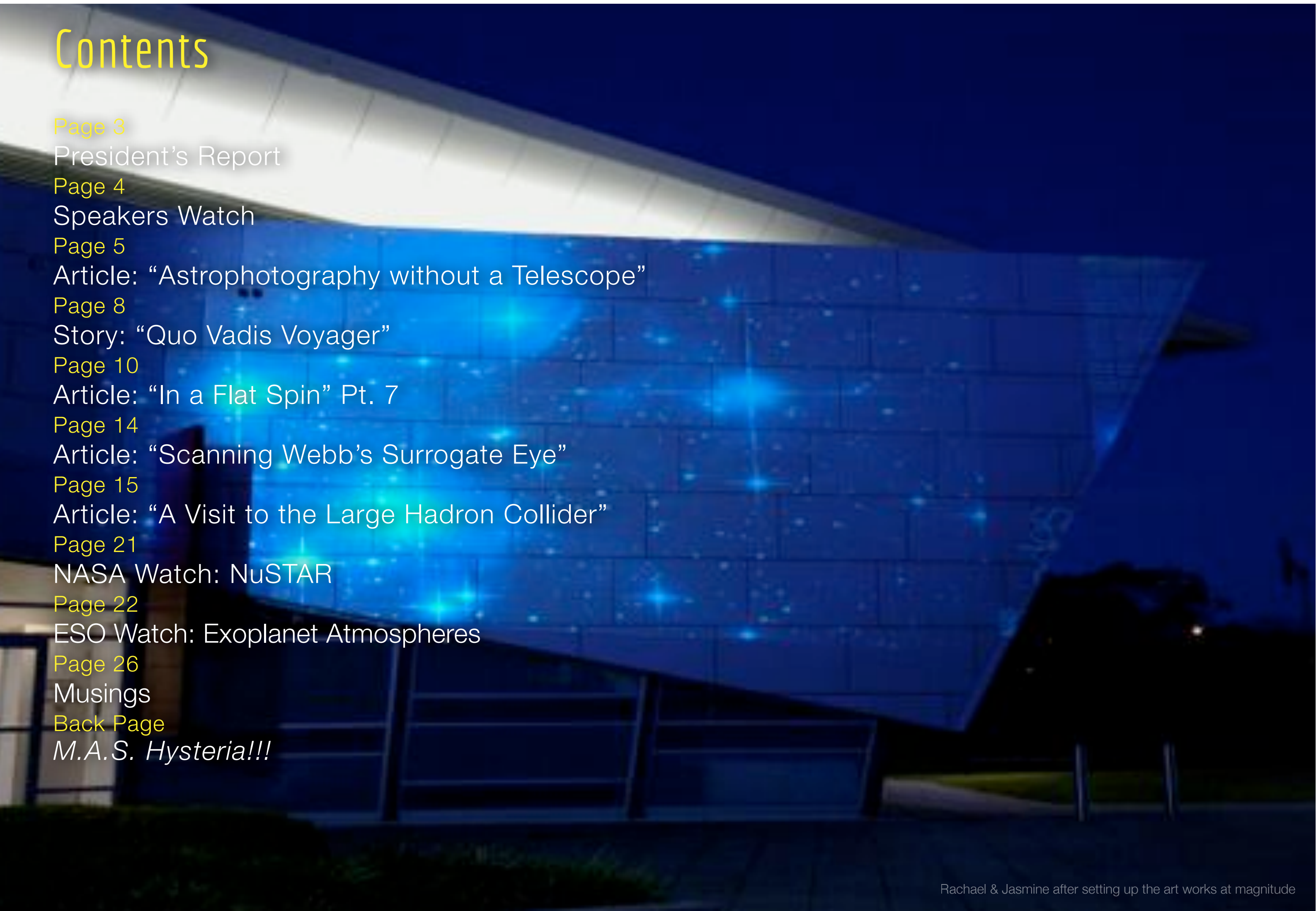
**http://www.macastro.org.au** for members to download at their leisure.

Other astronomical societies, as well as industry-related vendors, may request a copy of this edition of Prime Focus in electronic form by sending an email to **secretary@macastro.org.au**. File sizes can reach 35Mb+.

If amateur astronomy-related vendors would like to advertise in Prime Focus please send an email to the Secretary with your details, and we will endeavour to come back to you with a suitable plan.

Please enjoy this July edition - our seventh for the year 2012.

*Clear Skies!*
*Chris Malikoff*



# Contents



Rachael & Jasmine after setting up the art works at magnitude

# president's report

CHRIS MALIKOFF

Hello Members

*The skies have cleared!*

Well, sort of. Observation evenings over the past month have followed a central theme of sorts - beautiful mornings followed by idyllic days succeeded by superb afternoons superseded by fantastic sunsets supplanted by phenomenal evenings… finally displaced by dew as heavy as rain at ten or eleven o'clock. A message to Zeus if he's listening - "knock it off with the dew, eh?". That aside - the weather seems, to this observer, to be almost perfect after the months of torment we've had to endure. I often wonder why all of my main hobbies are weather-dependent. Oh well…

My thanks to everyone involved in setting up our **m a g n i t u d e - II** event held over the weekend of the 7th and 8th of July. In particular I want to thank our Patron, Prof. Bryan Gaensler for attending with his family on Saturday and Tony Law, our Vice President, for the amount of time he gave to help at every step along the way. It's easy to forget how much accumulated effort is put in by many individuals to stage an event like this. Tony consistently offers to do what ever he can, when ever it's needed, and I'm not sure that the event would have happened without him.

Secondly, I'd like to acknowledge all the members who allowed us to put their beloved telescope hardware on display for the weekend. It's easy for people to assume that the display wouldn't miss theirs and not bother - but to those who did, thank you! I'd also like to thank Roger Powell for his work to co-ordinate our efforts with the council and the Arts Centre.

I'd like to draw attention to our Observatory Committee - headed up by Tony, Roger and Trevor. They held preliminary talks with Mr. Greg Bondar, CEO of the Tharawal Local Aboriginal Land Council last week, which resulted in a better understanding between the two parties as to what our proposed observatory facility might entail if placed on land under their jurisdiction. They are, in principle, happy to discuss with the project further after we have researched potential sites. It was also suggested that we hold an observation night for the local people, in the near future, on their land at GibberGunyah near Picton. We'll keep you up to date as things progress.

Clearest of skies

Chris

## Schedule Planner

July-August 2012

| DATE | EVENT | SUMMARY | TIMES |
|---|---|---|---|
| 15th July | MAS Forum | Building 21, Room 6 University of Western Sydney | |
| 20th July | The Forest | Members Private Observing Night. $15 per person per night. | SS 17:09 MS 18:18 |
| 21st July | The Forest* | Members Private Observing Night. $15 per person per night. | SS 17:10 MS 19:20 |
| 28th July | Public Night | Dudley Chesham Oval - The Oaks | 5.00 PM |
| 11th Aug | Stargard | Members Private Observing Night. | SS 17:24 MR 01:18 |
| 17th Aug | The Forest | Members Private Observing Night. $15 per person per night. | SS 17:29 MS 17:08 |
| 18th Aug | The Forest | Members Private Observing Night. $15 per person per night. | SS 17:29 MS 18:11 |

speaker watch

*JUNE 2012*
*LISA HARVEY-SMITH*

ROGER POWELL

Dr. Lisa Harvey-Smith showing the logarithmic increase in telescope sensitivity 1940-2020

Several MAS members posing with Dr. Harvey-Smith after the conclusion of the Forum meeting.

Following the official announcement only two weeks earlier that the SKA would be shared between Australia and South Africa, it was an opportune time for astronomer Dr. Lisa Harvey-Smith - the Australian Project Scientist for the Square Kilometre Array radio telescope – to be our guest speaker at the Macarthur Astronomy Forum in June.

Lisa's talk was titled: "The SKA – What's Next?" and she was able to provide MAS with the latest update on the progress of this amazing telescope.

She began by displaying us a logarithmic graph showing the upward trend in sensitivity of radio telescopes over the last seventy years and said that if new radio telescopes did not extend the trend further upwards, then radio astronomy would fizzle out. As the SKA will be fifty times more sensitive than any predecessor we may be we safe for a while. You can see Jodrell Bank as the third square from the lower left of the graph. The proposed SKA sits at the top right:

With massive amounts of data to be provided by the SKA Pathfinder (currently being commissioned at Murchison), the SKA and other new telescopes, data processing in particular is going to have to be much smarter, as are all the other technologies involved. Astronomers will have to be innovative and internationally cooperative, to share the science, technology and cost.

Conceived as long ago as 1991, the SKA is now moving into a really exciting phase. Already the SKA headquarters are under construction at the famous Jodrell Bank radio telescope facility in Cheshire, England and the detailed design phase for the SKA is under way.

The telescope will be constructed in two stages. The first stage will consist of 10% of the overall size and will be constructed between 2016 – 2019. This stage will be used to prove satisfactory technical performance. The construction of Stage 2 will be 2018 – 2023.

Murchison, in WA, an area larger than Holland but with a population of only 150, is already home to the ASKAP radio telescope and the Wide-field Array telescope. SKA Stage 1 will see a hundred 15m dia. dishes and low frequency antenna deployed at Murchison and the Meerkat installation expanded to 250 high frequency dishes in South Africa. SKA Stage 2 will see the completion of the low frequency antennae at Murchison and Southern Africa will see the high frequency installation expanded to make a total of 3000 dishes. The mid-frequency arrays will be constructed in Southern Africa as part of Stage 2.

The most astonishing part of this project is that it expects to use technology which is expected to be available in a few years when needed - but which does not yet exist! The SKA will not only be utilising the most modern data processing and communications equipment that can be developed, it will actually be instrumental in driving that development.

Make no mistake, this massive instrument is going to improve many facets of global technological expertise over the next few years and will then be providing the kind of scientific data about the Universe that astronomers have been dreaming of since 1991.

Following refreshments after Lisa's presentation, several members returned to the auditorium to pose for a picture with her:

I don't know about other MAS members but I can't wait to find out what this amazing instrument has in store for us towards the end of the decade and beyond. These are very exciting times for radio astronomy and I am sure Lisa will provide us with updates along the way.

<u>Footnote</u>: This was Lisa's third visit to MAS. Her first talk in 2008, prior to her appointment as SKA Project Scientist, was called "Massive Stars: Live Fast and Die Young." She returned twelve months ago to talk about: "A New Generation Telescope - The SKA."

# astrophotography without a telescope

*Roger Powell*

During the final year of my period as MAS Secretary, I was "adopted" by a gentleman who found my phone number in The Macarthur Chronicle. He had a Powershot camera with a 35X zoom and occasionally he would wander outside into his front garden at night and point the camera at something bright. He would then take hand-held images at full zoom and send them to me with a request to identify them for him. The exposure times varied from about half a second up to fifteen seconds and - needless to say – most of the images showed all the hallmarks you would expect from an unsteady hand-held camera and were usually over-exposed and sometimes poorly focused.

I usually managed to identify the objects for him – as much from the details he sent as from the image itself. After all, when he told me it was a very bright object setting in the West in the early evening, Venus had to be the chief suspect. The satellites of Jupiter are easily identifiable too, even when slightly out of focus and with obvious vibration.

*Lunar Crescent. Canon 60D, 200mm, 1/15 sec, f/5.6, ISO 100 (R.P.)*

His images alone would have been totally unidentifiable without the time-stamp and his brief description of where the camera was aimed. However, I wanted to encourage him, so rather than be too critical, I would tell him what his image had captured and advised him politely to go out and buy a cheap tripod so he could keep the camera steady when taking exposures of a hundredth of a second or more.

That is the focus of this article, because anyone can be an astro-imager, if you can just keep the camera still while taking a night sky photograph. Using a tripod is the best way to do this and you can buy a flexible "GorillaPod" for as little as $20.00 or a more conventional extendable aluminium tripod starting at around $60.00. That's a cheap way to start off in astro-imaging and you don't need a telescope to do it.

What you do need is a camera which (a) has a tripod mounting socket; (b) allows you take exposures of up to thirty seconds; and (c) has a manual focus, as most cameras have trouble focussing when aimed at the night sky. A cable shutter release attachment is also very desirable, allowing you to completely eliminate all camera vibrations when depressing the shutter button, if the camera is on a tripod.

If your camera meets this basic criteria and you have a tripod mount, then you can get started as an astro-imager!

What can you image from a tripod-mounted camera? Well, the various Moon phases for a start and I have also seen some wonderful Lunar images taken with a cityscape foreground. The Moon can occasionally look good among the clouds. I am still waiting to snap my first Lunar halo.

The planets Venus, Mars, Jupiter (and it's four Galilean Moons) and Saturn are easy targets. Mercury is possible, if you can track it down in the early evening glare. I haven't tried Uranus yet without a telescope (but it's on the list). Planetary conjunctions look great and you can take long-exposure images of the International Space Station and catch the next Lunar eclipse.

With a good zoom lens you can also pick up quite a few deep-sky objects such as M42 and Omega Centauri. Wide double stars are easy and if you have a good wide-angle lens you can snap some great Milky Way images.

*Milky Way. Canon 60D, tripod, 10mm lens, 30 sec, f/3.5, ISO 6400 (RP)*

My first astro-images were of Comet Halley, taken on ISO 1600 film in 1986. Despite my best efforts, they are not very good images but at least I tried - and not too many people I know have their own images of the famous comet. After a long time gap, I started taking Lunar images in 2005.

Of course, it always helps if you can shoot in a dark-sky location, well away from the city lights! Oh, yes, you also need clear skies!

So, how did my friend go with his hand-held images? Most were not up to scratch but he got some half-decent images of Venus, Jupiter and it's Moons and Alpha Centauri – but at least he's having a go! So check your camera, buy yourself a tripod and a remote shutter release and start snapping the Solar System. Not all astro-photographs have to be faint wispy, deep-sky nebulae!

It's easier than you think and it's never been so cheap!

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# public events & outreach

John Rombi doing what he does best - explaining what's in the eyepiece to members of a curious public attending m a g n i t u d e - II

Our Patron, Prof. Bryan Gaensler and his son inspect some of the images on display at m a g n i t u d e - II


Our images looked fantastic projected on to the side of the Arts Centre at night.

Arts Centre technicians Racheal Samuels and Jasmine Kean did a great job mounting the art work in what they dubbed a "Nebula" arrangement

# “Quo Vadis Voyager”

*Bob Bee*

The freezing water with its hapless denizens streamed off the deck through the gunnels on its journey back to the ocean’s bottom from which the SS Voyager had just emerged.

The surfacing ship glistened in the sun like a huge multi-eyed whale, venting fumes stored during its four hour excursion into the depths of the ocean trench. Sombre grey stabilising fins and pressure resistant shielding slowly retracted to reveal the festive colours of a Pacific cruise ship, once more suited for surface level pressures.

As the deck dried and robot servants scurried to erect deck chairs and umbrellas, passengers emerged to see the Sun again, as if a long lost friend.

“Struth, that beat scoring the winning goal against Liverpool,” exclaimed a tall athletic man leaning over the railing, watching the last of the phosphorescent water sink out of sight. Brad Calder, known to his world-wide soccer fans as “Lightning,” selected a cocktail from a passing tray held by a scantily clad waitress and contemplated making a pass of a non-soccer ball type.

“I wouldn’t bother,” drawled the chisel faced man who had joined Calder at the railing. “They haven’t ironed out the glitches in the Pentium 10 Eros chip in that model yet.”

Calder eyed the departing waitress’s undulating posterior, shrugged, then turned to his fellow passenger, Joseph F. Riche. Those in the know thought the ‘F’ stood for ‘filthy,’ which could be taken whichever way you wanted.

“And how would you know, Joe? Personal experience?”

Riche flinched at the crude abbreviation of his name. “Yes, but not the kind you mean. My company makes most of the word’s robots. We’ve had a few million returned with complaints about the … responsiveness… of that model. Cost us heaps in warranty.”

Calder grinned. “What’s a few hundred million to your billions..?” He paused, noticing Rice’s amused smile. “Trillions?”

Bored with this direction of conversation, Riche cast his glance around the deck. A large throng of sun-seeking passengers were occupied in the 3 Ss of cruise pursuits – sunning, sipping and sleeping. His manner brightened instantly. “Ah, 22nd century technology can’t beat the real thing. Here’s Celeste.” He quickly checked his reflection in a saloon window, fluffed his cravat into a more jaunty arrangement. “Don’t you have some goal posts to polish? I have company.”

Calder admired the beautiful redhead approaching. “It’s a free deck, I’ll stay. Besides… Joe… I believe Miss duPree has company of her own.”

“Who on Earth..?” Riche stared at the pale skinned man talking animatedly to Celeste duPree as they walked towards him.

“Not a clue,” answered Calder, “though I’ve seen him about ship. An odd one if you ask me.”

“Odd?” Riche couldn’t take his eyes off Celeste. He’d been captivated by her the first time she performed on the cruise. While billed as a cabaret singer, she was far more than that to Riche. She was… what? More than the most talented multi-voicer he’d ever heard, her dulcet second and third altos joining her exquisitely pure soprano in harmonies that thrilled his long lost soul. She was… the most beautiful woman he had ever seen. And she was going to be his. He had trillions of reasons for absolute confidence, and he had a ring worth an emperor’s ransom waiting for her perfect finger. “Why odd? Ah… I see.”

Celeste’s pale companion had suddenly dropped to the deck, turned onto his back and slithered beneath a life boat, poking his head into the flare of its anti-grav drive. His muffled voice could be heard in snatches of frustration, then amazement. Celeste stood bemused, then saw Riche and Calder. She strolled over, her smile driving another arrow through Riche’s smitten heart.

“Joseph, Lightning. Have you met Ulysses?” She gestured back towards the life raft, where only a pair of sandalled feet could be seen poking out.

“Ulysses!” both men blurted. “And what’s he doing over… or under… there,” Riche continued. “Checking out the engine of the good ship Argo?”

“Probably,” Calder agreed. “That’s what I was saying before. Ever since he came on board, he’s had his head into every bit of machinery. Anyone would think he’s never seen an anti-grav drive before. And the way he eyes the robo-waitresses… and the waiters, come to think of it. Do you suppose he might be bi…”

“Forget whatsisname,” Riche said. “Celeste, I wanted to ask you…”

“Shostak,” Celeste said.

“What?”

“That’s his name. Ulysses Shostak. He’s a pilot.”

“A pilot who’s never seen an anti-grav drive? No, he’s a con artist, Celeste. Avoid him. Look, let’s have a quite drink, I have something to ask you.”

* * *

“First I have something to ask you, Joseph.” Celeste stared at the beautiful diamond ring on the table. “Do you think it possible for two people to meet for the first time, on a cruise, people from worlds apart, and to genuinely fall in love and be together forever?”

Riche’s heart pounded with realisation of unhoped for joy. He had expected his wealth to win her body, but her heart as well? “Of course I do, Celeste.”

“Thank you Joseph, you’ve made me so happy.” She touched his hand. “I will marry him then.”

“Celeste, you’ve made… what?”

“I’m going to marry Ulysses.”

“That pale skinned, ignorant pilot who doesn’t even know what century he’s in? I can show you the world, take you to tops of mountains, meet kings and presidents. What can he show you?”

Celeste picked up the ring and handed it back to Riche. “Before yours and my grand-parents were born, Ulysses Shostak left Earth in the first star ship, travelled at near light-speed to distant stars and civilisations, and now, thanks to Einstein’s relativity, is back only ten years older. After this cruise, he’s taking me back to Tau Ceti. I think that trumps your mountains and presidents.”

Celeste kissed Riche gently on his forehead, then walked gracefully from the salon toward the sunshine, her beautiful trio voice trilling a joyful song in her wake.

* * *



# "in a flat spin"

## Part 7 - Competing Forces

A SERIES OF ARTICLES BY
MAS MEMBER **DAVY JONES**

*According to American Indian mythology: One day, Coyote was playing in someone's kitchen among the cooking utensils. He was trying to find some food to eat, but then he heard someone coming. He grabbed the first thing he saw, which was a bag of flour, and ran. He thought the best way to escape was by going into the sky. As he ran into the sky, the bag tore open. The flour flew everywhere, creating the Milky Way galaxy.*

Mankind has struggled over the years, to comprehend the incomprehensible. Mythology offered substitute, fairy-tale images, granting temporary sustenance to seeking minds. Charlatans promulgated ideas of terrestrial perpetual motion. Generation by generation, science, whilst more often than not, creating more complex questions, slowly peeled back the layers of cosmic obscurity. The satisfaction gained from such scientific knowledge, whilst frustratingly slow in arriving, at least provides a logical sequence of sustainable answers. Where those answers will eventually lead - who knows - but those answers certainly offer a good deal more than mythology or other forms of fairy-tale explanations ever did.

*Something Unknown Is Doing We Don't Know What!*
*Sir Arthur Eddington (1885-1944)*

Solar systems twirl, galaxies rotate turbulently; galaxy clusters and galaxy super-clusters move and intermingle in tandem, through what we are led to believe is an ever-expanding universe. Science suggests the analogy best suited, is that of a giant expanding fruit loaf in which the fruit represents matter, and the intervening space or dark energy, the ever-expanding dough. Thus, the celestial bodies are depicted not so much as physically moving apart, but rather, the intervening space as growing between the heavenly bodies. Sadly, even this remarkably precise image tends to be misleading. As with the myths of old - the resulting mental images - generate a permanency of 'fixed ideas'. Such inflexible ideas create even more bewilderment when attempting to conceptualize an entity as ancient, boundless, and complex as the universe.

How can 'we' as a galaxy, a local galaxy group, or even a massive super-cluster, be moving together, in a coordinated group if the universe is expanding? Recent Hubble estimates suggest the current rate of universal expansion to be 80 km/sec/Mpc (statistical error = 17 km/sec/Mpc). In simple terms, on average, objects are seen to be moving away from 'us' at 80 km/sec for every megaparsec they are distant from us. Even this 'expansion' cannot be regarded as completely 'smooth' or 'regular' because of the inconsistencies between distance and velocity brought about by the gravitational relationships between galaxies and galaxy clusters.

The Internet offers a variety of justifications for this seemingly intractable anomaly. Davis (2009), a cosmologist and research fellow at the University of Queensland (UQ), provides a succinct outline of what actually occurs. In the first instance she suggests that the motions of the universe are directed by competing forces. The power of these forces varies greatly with scale. Most importantly, local forces can dominate universal forces in discrete regions. That is to say, on scales greater than galaxy clusters, all galaxies are indeed moving apart at an escalating rate. The common gravitational attraction between any two galaxies on a universal level is simply too small to have any impact; therefore, galaxies per se, in essence, just follow the flow of expansion. However, the story is completely different on a 'local level', where the gravitational attraction can be significant, and therefore cosmic relations much more exciting.

As a general scientific consensus, dark energy is thought to be the driving force behind the accelerated expansion of the universe. Dark energy, it is supposed, supplies the invariable outward force - a force that never dilutes - as the universe expands. It is important to grasp this not insignificant detail because herein lies much of the dilemma that surrounds the concept of this mysterious 'dark energy'. A force that never dilutes, at least suggests a fountainhead from which it eternally springs!

Opposing this dark, unstoppable universal force, is the gravitational pull from the rest of matter and energy in the universe. When the universe was much younger and denser than it is today, the attractive force of gravity reigned supreme, on all scales. Clouds of ancient gas condensed, forming the first stars and galaxies; and accordingly the galaxies drew together, thus forming the first clusters.

On balance, if at that time there had been a greater abundance of matter, it is possible the universe may have re-collapsed, before acceleration ever got going!

Davis indicates that matter and energy obviously did dilute as the volume of the universe increased, and over time, dark energy increasingly began to dominate. This expansion, as far as can be ascertained, began about six billion years ago - a billion years before our Earth was formed.

Notably, galaxies which had been pulled together before the universe started to expand exponentially, still have the ability to collide! The reason for this is that collectively, they form much denser areas within the universe - areas where gravity can still exert its intrinsic power. As an example, Davis cites the Andromeda galaxy in our own local galaxy group. Andromeda, our largest galactic companion, she states, is actually 'falling toward us', and we will have our first close encounter with Andromeda in just a few billion years' time. (Sic)

Here I feel a bit of illumination might go a long way. Again, we have a statement that creates a locked in, doomsday scenario in the human psyche. As much as the human race loves a good disaster story, in reality the facts are often not half as exciting - nor terminal. A couple of points then; in the first instance we must try and imagine both the Milky Way and the Andromeda galaxies both having their own unimaginably large elliptical orbits. These orbits intermingle, as two Hula-Hoops locked together. Whilst Andromeda can be portrayed as falling toward the Milky Way - the Milky Way in turn can be portrayed as 'rising toward' Andromeda. It is speculated that there are a number of viable orbital paths available to the rotating galaxies. Certain paths would no doubt cause both galaxies to merge; other paths would simply bring about a celestial close shave. Also, one should remember, we are speaking here of enormous time spans - billions of years. If we assume such a merger might occur in three or possibly four billion years time - we must take into account that by then our own Sun - now halfway through its lifespan - must have greatly reduced its own available fuel source. In effect, that would mean our Sun might indeed have started its own expansion, out into the solar system. The zone, so romantically named, the Goldilocks or Habitable Zone, (HZ), even assuming the human race made it that far, might not be quite so conducive to life anyway. One last point on this particular subject; should our two galaxies not collide or merge, they will then pass each other relatively unscathed. Should this happen, both galaxies will surely then be travelling not toward - but away from each other - at whatever relative speeds their respective elliptical orbits have caused them to achieve. I welcome reader's comments or further clarifications on these points.

In the meantime of course, our local galactic group and super-cluster, will continue to travel on together through the expanding universe. Far from being black and empty, the heavens will still contain our familiar but remote cosmic relatives. They will accompany us on our lonely journey through a universe now deeply divided into varying pockets of gravitational, galactic interaction. As Davis concludes: "like revelers on a ship, the galaxies in our group will continue to collide and interact in countless interesting ways. But we will be forever separated from the revelers on other ships sailing away from us in the vast universe".

*T'was ever thus! To be continued..*

*Refs:*

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# MAS 2013: mauna kea countdown

## MAS Field Trip

Tony Law

Another reminder to MAS members - we are arranging a trip to the 'Big Island" of Hawaii in 2013.

Planned itinerary is for 5 nights viewing on Mauna Kea, Hawaii (Hilo) and four days on Oahu (Honolulu). Hilo is the start point for visiting the major telescopes on the summit and observing from the Onikuza Visitors centre. A trip to the Kilauea Volcano is also envisaged.

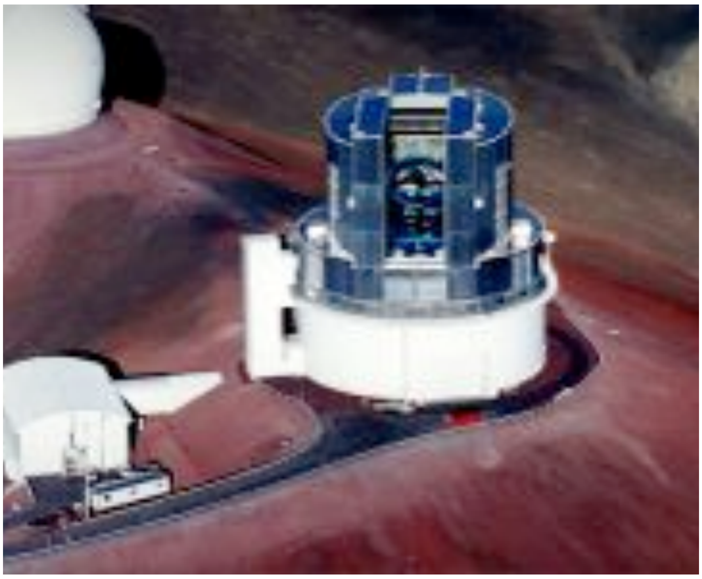
On Oahu we will stay in Waikiki and visit Pearl Harbor, the Polynesian cultural centre, Pipeline (surf beach), etc ...... However itinerary here is flexible, some may wish to go elsewhere from here, we will discuss closer to the time.

The anticipated total cost will be around $1,250.00 for airfares, $1,000 for accommodation and $500.00 for food etc. Another couple of hundred for transport so about $3,000.00 in total. Add a couple of hundred for incidental tours. We'll provide more details much closer to the time.

To help MAS Members save for this trip, we have set up a special bank account. You may pay in whatever and whenever you wish by direct debit or by cash over the counter. You must ensure that you include your name in the reference when you make the deposit so that it can be refunded if required. This is a non-interest-bearing account.

We look forward to hearing from all interested.

Contact Barry via email or call Tony on 0419 215199 if you have any questions or would like to know the bank account details.



## Planned Itinerary

**Depart:** Sydney Tuesday 4th September 18.00

**Arrive:** Honolulu Tuesday 4th September 07.45 - we cross the dateline!

**Depart:** Honolulu Tuesday 4th September 11.48

**Arrive:** Hilo Tuesday 4th September 12.50

**Accommodation:** see http://www.seasidehotelshawaii.com/HotelHilo.aspx

Nights of 5-9th on Mauna Kea. See weather forecasts: http://mkwc.ifa.hawaii.edu/forecast/mko/

Thursday 6th September – Special visit to Gemini North and one of IRTF, CFHT, or the UH 2.2 meter, plus the Keck visitors observation room.

Saturday 8th and Sunday 9th September – drive Mauna Kea summit in convoy for night time viewing

Bus trip to Volcanoes National Park is 12 hours and costs $179.00 - probably not advisable as we want to do MK each night! By Helicopter 1hour $230.00. See http://www.hawaiiactive.com/activities/bigisland-paradise-helicopter.html

**Depart:** Hilo Monday 10th September 13.18

**Arrive:** Honolulu Monday 10th September 12.07

**Accom:** http://www.outrigger.com/hotels-resorts/hawaiian-islands/oahu-waikiki/ohana-waikiki-east#tab-prop-detail-rooms

**Tuesday 11th:** Pearl Harbour, Arizona, Missouri etc $70.00

**Wednesday 12th:** Polynesian Cultural Centre, tour, dinner and show $150.00

**Thursday 13th:** Shopping/sightseeing in Honolulu/Waikiki

**Depart:** Honolulu Friday 14th September 12.45 (or your own itinerary from here)

**Arrive:** Sydney Saturday 15th September 19.30 -dateline crossed!

**Tentative total:**

| | |
|---|---|
| Flights | $ 1200.00 |
| Accom. | $ 500.00 based on twin share |
| Heli tour | $ 230.00 optional |
| Pearl Hbr. | $ 70.00 optional |
| PCC | $ 150.00 optional |
| Meals | $ 400.00 |
| Veh Hire Hilo | $ 100.00 |
| **Total Cost** | **$2650.00 excluding discretionary shopping!!!** |

In order for MAS Members to save for this trip we have set up a special bank account. You may pay in whatever and whenever you wish by direct debit or by cash over the counter. Account is at the Commonwealth Bank, name is Macarthur Astronomical Society BSB 062656 a/c no. 10243417. You must ensure that you include your name in the reference when you make the deposit. Please advise me when you make your initial deposit so that we can start a spreadsheet with all those making payments.

# Scanning Webb's Surrogate Eye

Engineer Erin Wilson adds aluminum tape to electrical cables to protect them from the cold during environmental testing of special optical equipment. These tests will verify the alignment of the actual flight instruments that will fly aboard NASA's James Webb Space Telescope.

"Because the flight science instruments detect infrared light, they must be extremely cold to work, and so the environment we test them in must be extremely cold too," Wilson says.

Wilson is working in the Space Environment Simulator thermal-vacuum chamber at NASA's Goddard Space Flight Center in Greenbelt, Md. The subject of the testing is the Optical Telescope Element (OTE) Simulator, or OSIM. The hardware seen in the background is the Beam Image Analyzer, which will be used to measure OSIM. It sits above the OSIM, which is under the platform that Wilson is working on. The OSIM is about two stories tall and almost as wide as the whole test chamber.

The job of the OSIM is to generate a beam of light just like the one that the real telescope optics will feed into the actual flight science instruments. Because the real flight science instruments will be used to test the real flight telescope, their alignment and performance have to be verified first, using OSIM, and before that can happen, the OSIM has to tested and verified.

In space, the telescope optics act as Webb's eye, and on the ground, the OSIM substitutes for the telescope optics, says Robert Rashford, manager for the OSIM as well as the Integrated Science Instrument Module (ISIM) Electronics Compartment. This hardware is being tested in an environment that mimics the hard vacuum and cold temperatures that Webb will experience in space. After Erin and others were done setting things up in the test chamber, Goddard engineers sealed it up, evacuated all the air and lowered the temperature of the equipment being tested to 42 Kelvin (-384-point-1 Fahrenheit or -231-point-1 Celsius).

"It has taken a little over a month to get temperatures cold enough to duplicate the temperatures that Webb will see in operation in space," Rashford says.

In the next couple weeks Rashford and the team of Goddard engineers will measure the OSIM with the Beam Image Analyzer. This extremely cold or "cryogenic" optical testing and verification process will likely take 90 days to complete.

ImageCredit: NASA

ImageCredit: Project Dorothy

# A Visit to the Large Hadron Collider

AN ARTICLE & PHOTOGRAPHS BY MAS MEMBER
ROBERT BEE

On 1st June, 2010, as part of Fred Watson's Stargazer II tour, we visited the most complex and expensive individual machine in the entire world – The Large Hadron Collider at CERN in Switzerland. I confess, as an avid reader of cosmology and the other end of the scale, particle physics, I was in a high state of anticipation, like a child having all his Christmases come at once. Or more prosaically, like a pig in mud.

I recognise that particle physics is not everyone's cup of tea. Okay, it's not most people's cup of tea. But even if you were of that mind, you could not go away, after a walking tour over the whole facility (excluding the 27 km of tunnel 100 meters below ground) with expert commentary from local physicists without having gained a sense of awe at the sheer complexity of the facility, the genius of engineering that went into designing and building it and the knowledge that, at that very moment, 100 metres beneath your feet, two beams of super high energy protons were rushing effectively at the speed of light to collide in titanic showers of exotic fundamental particles. Needless to say, I was 'impressed'.

When we arrived at the LHC, we were met by our personal guide for the day – Klaus Batzner. Klaus is a 'legend' at CERN and the LHC in particular, having worked at CERN as a particle physicist for 30 years, then after retiring, as a volunteer guide for 10 years. What Klaus didn't know about the LHC wasn't worth knowing. We were privileged to have him as our guide.

*Klaus Batzner – our LHC guide*

It would take a much longer article than this to convey, even at the simplest possible level, details of all the systems that combine to make this 'machine' work. There are so many of them, every one of which has to be operating at optimum levels. If any one sub-system falters, the whole LHC shuts down, potentially with catastrophic results. At such high energies and magnetic fields and low temperatures, there is no margin for error or failure. But I will attempt to give a summary overview. I hope you will be as impressed as I was, and still am.

Remember, it is this very machine which produced the recent much heralded breakthrough in knowledge of how our universe works – the discovery of the long illusive Higgs Boson, the 'giver of mass'. However, there is still much work for it to do.

**What is the Large Hadron Collider?**

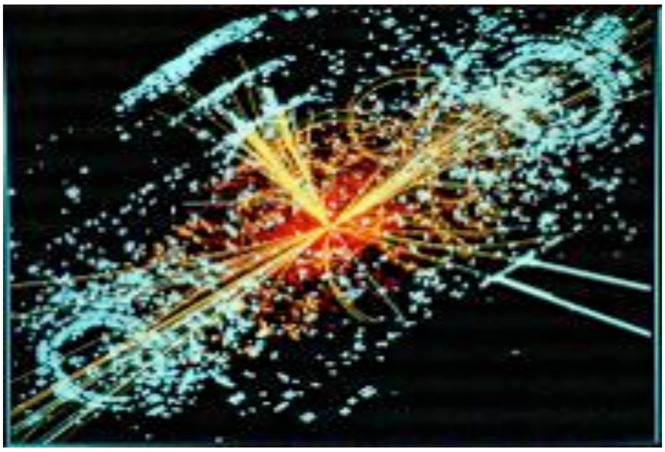
Firstly, it is a large 'collider of hadrons', not a collider of 'large hadrons'. The hadron is a class of atomic particle which are made up of quarks, the particle in question here being protons (made up of three quarks). The LHC is also designed to use lead nuclei which are much much heavier. Another description of the collider is 'particle accelerator'. It accelerates atomic particles to incredible speeds so they can be made to collide at high energies. Large? Well, comprising a 27 km long tunnel (in a circle 8.5km diameter) running 100 metres beneath Switzerland and France near Geneva, the entire tunnel containing continuous super-conducting magnets, interspaced with four absolutely huge (by any standard) detectors, I think 'large' is a fair description.

*The path of the LHC tunnel between Lake Geneva and France's Jura mountain range.*

The LHC is a machine of superlatives. There is nothing 'ordinary' about it. In fact it is a miracle it was ever built. A consortium of 20 nations agreed to spend around 8 billion euros in 1995 to build a fantastic machine for pure research purposes, to answer the biggest questions of science. Is there a Higgs boson? What is Dark Matter? (The question "what is dark energy" wasn't even thought of at the time but can be addressed now.) Why were there more particles than anti-particles after the Big Bang? And many more. What was even more amazing, they went into it fully aware that there were, at that time, no known engineering and IT solutions to the problems they knew would arise. They would have to be solved on the way. Can you imagine that happening today? Yet they succeeded.

**The LHC – a big picture:**

In simple terms, two streams of 'packets' of protons travel near the speed of light in opposite directions in small 65mm diameter tubes around a 27 km long circuit, held on course by superfluid helium cooled superconducting magnets. The proton packets are progressively accelerated to near light speed by sophisticated superconducting RF cavities at one point of the circuit. At four other circuit points there are huge particle detectors, each of a specific and unique design. Using magnets, the contra-rotating beams are brought to cross and collide at the centre of each detector, resulting in showers of fundamental, particles generated by the energy of the collisions. The data collected from all the particles from each of the collisions is collected in an unimaginably huge supercomputer system for future analysis. Here's an example of a typical collision incident.



If that sounds complicated, keep in mind that there will be 30 million 'crossings' per second, each generating about 20 collisions. That's around 600 million collisions per second. That's a lot of data to analyse.

To help grasp the concept of what is going on and how complex the machine is, let's break it down to some of its various components, or systems. We can't cover all of them here but will look at the main ones. As you read the specifics of each system, I hope you will grasp the sense of awesomeness of the scientific and engineering achievement involved. This is no ordinary machine.

**Proton Beams:**

There are two beams travelling in opposite directions in separate tubes about 65 mm diameter. Each beam consists of 2808 discrete packets of protons, each packet containing around 100 billion ($10^{11}$) protons. The packets trail each other by about 7.5 metres (or 25 microseconds). At near light speed, each packet will make 11,245 circuits each second. The process of starting the beams is, as you could imagine, quite complex. It starts from a very humble source of protons – a simple bottle of hydrogen gas.

This bottle's pressure forces the hydrogen atoms out where an electric 'stripper' strips the electrons off the atoms and the protons are then channelled via various magnetic paths outside the main circuit, sped up and ultimately injected (by what they quaintly call 'kicker' magnets) into the main beam path. There, over a period of circuits taking 20 minutes, the position and stability of each packet being maintained at high precision by finely controlled feedback loops, the packets are sped up to near light speed. This gives each beam an awesome energy of 7 TeV, approximately 340 Megajoules. Put in lay terms, each beam will have as much energy as a family car travelling at 1,600 kph. At the same time, the energy stored in the magnets maintaining the beams (more about them later) is enough to melt 50 tonnes of copper. Impressive!


*Bottled hydrogen gas – source of the proton beams*

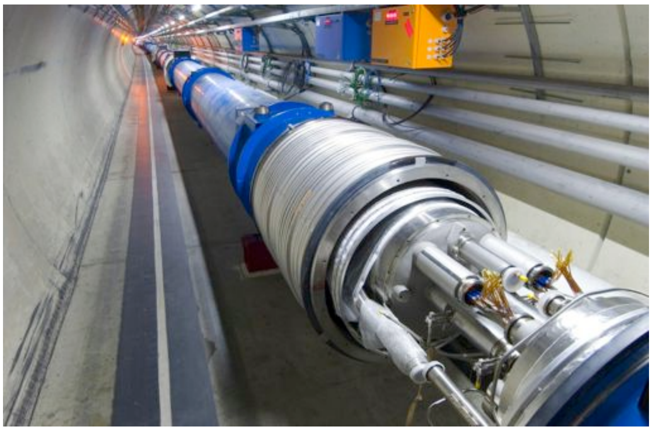
Once the beams are at this stage they can be kept in circulation (or 'stored') for up to 10 hours, during which time they have travelled a distance equivalent to Neptune and back. It is during this time when the experiments are conducted by colliding the beams at the various detectors around the beams' path.

With so many protons travelling at such high speed, obviously it is undesirable for them to encounter any stray particles in the beam tubes. This would cause proton scattering and reduce the lifetime of the beam. It can also have other more complex and undesirable consequences. For this reason, the tubes are evacuated to an extremely high level of vacuum, comparable to that in outer space. It is called Ultra High Vacuum (UHM) with values as low as $10^{-14}$ atmospheres, similar to the atmospheric pressure on the Moon.

**Superconducting Magnets:**

Contrary to some expectations, most of the LHC does not accelerate the beams. Rather, via a huge number of magnets, it guides them from the exit of the accelerating point around the whole 27 km circuit back to the entry point. The fousing of the beam and gentle bending around the huge circle is achieved by vertical dipolar magnetic fields that act via the electromagnetic force.

An icon of the LHC is its amazing superconducting magnets.



*Magnets surrounding the beam tubes in the tunnel*

These magnets come in many forms – dipoles, quadrupoles, sextupoles, octupoles, decupoles and dodecupoles (but the vast majority are simple dipoles, covering 85% of the 27 km circuit) – and encircle the beam tubes for the entire 27km, except for inside the four detectors. There are 1800 large magnets in all in the LHC, 1232 of which are 15 metre long dipoles, weighing over 30 tonnes and costing 2.5 million euros each That's over 3 billion euros in dipole magnets alone. There are a further 8,000 smaller magnets used for corrections, fine tuning and flexibility of beam manipulation.

To achieve the huge magnetic fields required to keep the tunnel at 'only' 27 km long, extra high electric currents are required and to achieve those currents in the necessary small dimensions of the magnets, superconducting materials were necessary. In the LHC niobium-titanium (Nb-Ti) is the superconducting material of choice. In an engineering marvel, huge numbers of 1mm diameter wires of 6µm dia Nb-Ti embedded in copper are woven into filaments, then the filaments into cables to carry the magnets' currents. In the magnets at the LHC, a current density of 400A/mm$^2$ was achieved, providing a magnetic field of 8.3 tesla – 150,000 times stronger than Earth's magnetic field and one of, if not the, strongest magnetic fields created in the world. Normal 'warm' magnets could achieve only a maximum of 2 tesla.

**Liquid Helium:**

To have superconducting magnets, super-cold temperatures are required. Cryogenic technology. This is achieved at the LHC using liquid helium, its normal temperature of 5.7°K being further lowered to a temperature of just 1.9°K (that's just 1.9° above absolute zero) where liquid helium enters a 'superfluid' state, pushing the Nb-Ti superconductors to new extremes. The vast majority of the hardware around the 27 km tunnel (at least all the bits inside the external vacuum filled insulating sleeves) is kept at this frighteningly low temperature. The LHC has a 'cold mass' of 37,000 tonnes cooled to 1.9°K. Nothing on this scale had ever been attempted before. The refrigeration plant to achieve this beggars belief, requiring an all-new technology.

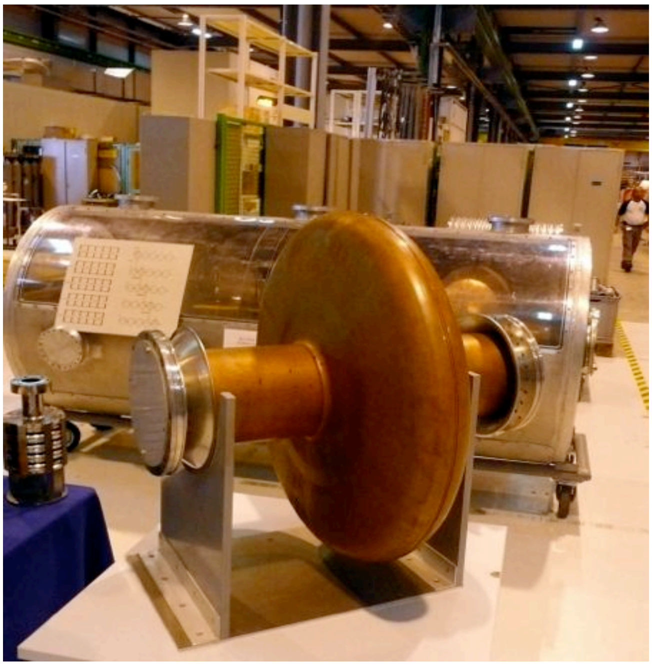
During the entire period of operation of the machine, around 80 tonnes of superfluid helium has to be maintained. But before the 'cold mass' is lowered to 1.9°K, it is pre-cooled by 10,000 tonnes of liquid nitrogen. With all this, one can only imagine the engineering challenges in designing, building and maintaining operation of such a super-cold machine. It is reasonable to claim that the interior of the LHC is one of the coldest places in the universe.

*End view of magnet, with beam tubes (centre) and helium pipes.*

**Beam RF Accelerator:**

The proton beams are accelerated at only one point in the 27 km circuit, but this happens 11,245 times each second for each of the 2808 proton packets. Over the start up period of 20 minutes, this leads to their final near light speed status of 99.9999991% of c.

This acceleration is achieved through an ingenious radio frequency (RF) technology, described modestly by CERN as a 'triumph of modern engineering'. Copper 'cavities', as shown in the photo below, using electric fields oscillating at 400Mhz, create stable volumes of space to confine the individual packets of $10^{11}$ protons. Though too complex to explain here, the principle is that the alternating current creates an alternating electric field which, when the timing of the packet's arrival is right (as it is carefully designed to be), the positive protons get a 'kick' in the forward direction and thus gain acceleration, incrementally approaching the speed of light.



*RF Cavity*

The performance of the RF cavity is greatly improved when cooled to superconducting temperatures. For purely engineering reasons, best performance was achieved by using eight RF cavities in line, resulting in a superconducting enclosed arrangement as shown below. It is through this arrangement (one for each beam tube) that the protons pass to be given their acceleration 'kicks'.

*RF module with 8 RF cavities in series.*

The eight accelerating cavities for each beam have another beneficial feature. They shorten the proton packets and make them more dense and once the maximum energy has been reached the cavities keep the packets nice and tightly packed. Clever!

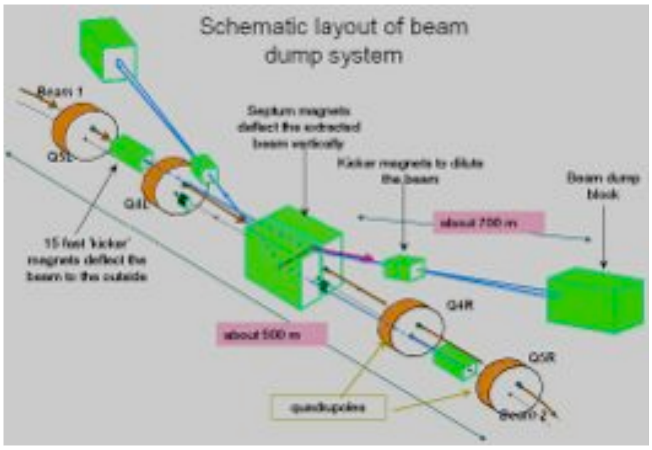
**How do I stop this thing? Beam Dump:**

We heard how the energy in the beams is that of a Toyota Camry at 1,600 kph, about 340 Megajoules. But when the experiments at the detectors are finished for the day – how do you turn then off? Where do all those protons and their energy go? I asked Klaus that question and, with a cheeky grin, he answered "Yes, we thought about that."

There is a complete system for just that purpose. The Beam Dump. It is used in two circumstances. Firstly for the deliberate controlled ending of the beam after completion of a session. Secondly for the emergency dumping when something horrible goes wrong with the beam. The actual mechanism is both super-sophisticated and crude. That is, the control technology is like the sharpest laser scalpel while the conclusion is like a blunt axe.

Consider this: The time for one revolution of a beam is less than 0.0001 seconds. If it is stopped dead in that time (as it has to be) the instantaneous power dissipated is $4 \times 10^{12}$ watts, about 100 times the combined output of all Australia's power generators. The area density of this power is also enormous as the dimensions of the face of the beam is less than a square millimetre. This enormous power density would vaporise anything placed in its path. The damage potential of any straying of the beam from its designated path would be unthinkable. So how do they manage it? How to dispose of the beam from the main path in the time of only one beam circuit? It took CERN over twenty years to work out an acceptable system.

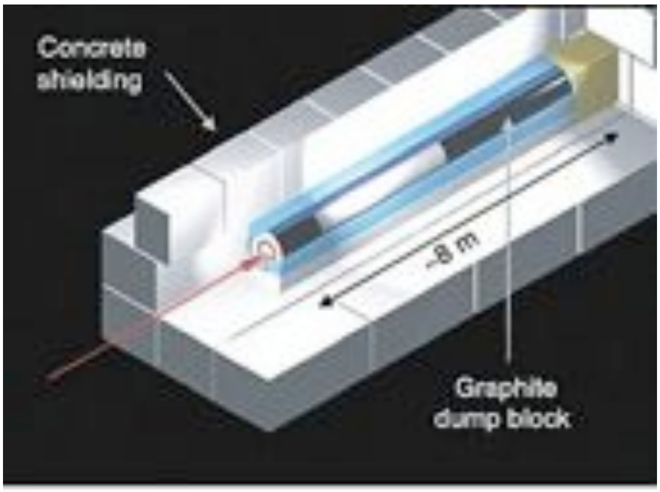
In very simple terms, there is at a specific point in the circuit a pair of 750m long offshoot tunnels, much like escape ramps on a steep road. One tunnel for each beam.




*Schematic of Beam Dump System*

At the point of departure from the true beam path to the slightly angled offshoot, there is a special magnet called the 'extraction kicker'. This kicker actually comprises 15 magnets. This is a magnet of truly special characteristics, enough to make an electrical engineer (such as myself) blanche. It has to move the beam horizontally by just 50mm, enough to move it just outside of the circulating beam aperture and into the high field aperture of the waiting Septum Magnet which remains permanently powered. The septum provides a strong vertical deflection, which after several hundred metres is enough to lift the beam above the superconducting magnets of the main LH ring and into the extraction line. While in this line, more kicker magnets ‘dilute’ the beam, effectively making an ‘e’ shape that dilutes the energy density on the target by a factor of 50. Eventually the beam arrives at an absorber block made of graphite, 700mm diameter and 7.7 metres long, shrunk fitted into a stainless steel jacket, This block is surrounded by 900 tonnes of shielding. That’s the ‘blunt axe’. Sounds simple but actually quite complicated, with many monitoring and fail-safe technologies woven into it.

*Beam Dump tunnel*




*Beam Dump design*

I said the kicker magnets were special. With a single turn coil, a current of 18,500 amps (under the pressure of 30,000 volts) is needed to reach the required magnetic field. This would be difficult enough for a normal magnet given time to build up its field over time, but for the LHC kickers, the full field of 0.34 tesla has to go from zero to full strength in less than 3 millionths of a second and stay at this value for at least one full turn of the accelerator to ensure all particles in the beam are extracted. This was an engineering triumph to achieve with a whole new technology of ultra-high switches having to be designed and built.

It was indeed an amazing experience to walk around this unique machine’s site, even if the ‘action’ was happening way beneath our feet. We were not able to enter the beam tunnel as it was now an operational facility, with all the safety and security issue involved. Pity! But as we were addressed by a young English particle physicist in a CERN meeting room, I noted the caricature portraits mounted around the room’s wall. I recognised a few names, including George Smoot. These were the current 23 Nobel Prize winners from CERN. We were in distinguished company.  After the LHC has done its ‘thing’, it makes you wonder how many more will be hung with them in the future.

**End of Part 1.**

That describes (simply?) how the LHC’s hadron beams are made, stored, maintained and disposed of. But what do they do with them? That will be addressed in Part 2, where we will look at the four gigantic particle detectors spread around the LHC circle, their designs and aims. We’ll also look at the inconceivable amount of data generated by the collisions and how that is managed.

*References:*

“The Large Hadron Collider: A Marvel of Technology” edited by Lyndon Evans.

“Destination Universe” Published by CERN

# NASA Watch:
# NuSTAR Observatory unfurls its unique mast

June 21, 2012

PASADENA, Calif. -- NASA's Nuclear Spectroscopic Telescope Array, or NuSTAR, has successfully deployed its lengthy mast, giving it the ability to see the highest energy X-rays in our universe. The mission is one step closer to beginning its hunt for black holes hiding in our Milky Way and other galaxies.

"It's a real pleasure to know that the mast, an accomplished feat of engineering, is now in its final position," said Yunjin Kim, the NuSTAR project manager at NASA's Jet Propulsion Laboratory, Pasadena, Calif. Kim was also the project manager for the Shuttle Radar Topography Mission, which flew a similar mast on the Space Shuttle Endeavour in 2000 and made topographic maps of Earth.

NuSTAR's mast is one of several innovations allowing the telescope to take crisp images of high-energy X-rays for the first time. It separates the telescope mirrors from the detectors, providing the distance needed to focus the X-rays. Built by ATK Aerospace Systems in Goleta, Calif., this is the longest deployable mast ever used on a space telescope.

On June 21 at 10:43 a.m. PDT (1:43 p.m. EDT), nine days after launch, engineers at NuSTAR's mission control at UC Berkeley in California sent a signal to the spacecraft to start extending the 33-foot (10-meter) mast, a stable, rigid structure consisting of 56 cube-shaped units. Driven by a motor, the mast steadily inched out of a canister as each cube was assembled one by one. The process took about 26 minutes. Engineers and astronomers cheered seconds after they received word from the spacecraft that the mast was fully deployed and secure.

The NuSTAR team will now begin to verify the pointing and motion capabilities of the satellite, and fine-tune the alignment of the mast. In about five days, the team will instruct NuSTAR to take its "first light" pictures, which are used to calibrate the telescope.

Why did NuSTAR need such a long, arm-like structure? The answer has to do with the fact that X-rays behave differently than the visible light we see with our eyes. Sunlight easily reflects off surfaces, giving us the ability to see the world around us in color. X-rays, on the other hand, are not readily reflected: they either travel right through surfaces, as is the case with skin during medical X-rays, or they tend to be absorbed, by substances like your bone, for example. To focus X-rays onto the detectors at the back of a telescope, the light must hit mirrors at nearly parallel angles; if they were to hit head-on, they would be absorbed instead of reflected.

On NuSTAR, this is accomplished with two barrels of nested mirrors, each containing 133 shells, which reflect the X-rays to the back of the telescope. Because the reflecting angle is so shallow, the distance between the mirrors and the detectors is long. This is called the focal length, and it is maintained by NuSTAR's mast.

The fully extended mast is too large to launch in the lower-cost rockets required for relatively inexpensive Small Explorer class missions like NuSTAR. Instead NuSTAR launched on its Orbital Science Corporation's Pegasus rocket tucked inside a small canister. This rocket isn't as expensive as its bigger cousins because it launches from the air, with the help of a carrier plane, the L-1011 "Stargazer," also from Orbital.

NuSTAR is a Small Explorer mission led by the California Institute of Technology in Pasadena and managed by JPL for NASA's Science Mission Directorate in Washington. The spacecraft was built by Orbital Sciences Corporation, Dulles, Va. Its instrument was built by a consortium including Caltech; JPL; the University of California, Berkeley; Columbia University, New York; NASA's Goddard Space Flight Center, Greenbelt, Md.; the Danish Technical University in Denmark; Lawrence Livermore National Laboratory, Livermore, Calif.; and ATK Aerospace Systems, Goleta, Calif. NuSTAR will be operated by UC Berkeley, with the Italian Space Agency providing its equatorial ground station located at Malindi, Kenya. The mission's outreach program is based at Sonoma State University, Rohnert Park, Calif. NASA's Explorer Program is managed by Goddard. JPL is managed by Caltech for NASA.

For more information, visit http://www.nasa.gov/nustar and http://www.nustar.caltech.edu/

# ESO Watch: A New Way of Probing Exoplanet Atmospheres

27th June 2012

ImageCredit: ESO

ESO is to build the largest optical/infrared telescope in the world. At its meeting in Garching on June 11th, the ESO Council approved the European Extremely Large Telescope (E-ELT) Programme, pending confirmation of four so-called for the first time a clever new technique has allowed astronomers to study the atmosphere of an exoplanet in detail — even though it does not pass in front of its parent star. An international team has used ESO's Very Large Telescope to directly catch the faint glow from the planet Tau Boötis b. They have studied the planet's atmosphere and measured its orbit and mass precisely for the first time — in the process solving a 15-year old problem. Surprisingly, the team also finds that the planet's atmosphere seems to be cooler higher up, the opposite of what was expected. The results will be published in the 28 June 2012 issue of the journal Nature.

The planet Tau Boötis b was one of the first exoplanets to be discovered back in 1996, and it is still one of the closest exoplanets known. Although its parent star is easily visible with the naked eye, the planet itself certainly is not, and up to now it could only be detected by its gravitational effects on the star. Tau Boötis b is a large "hot Jupiter" planet orbiting very close to its parent star.

Like most exoplanets, this planet does not transit the disc of its star (like the recent transit of Venus). Up to now such transits were essential to allow the study of hot Jupiter atmospheres: when a planet passes in front of its star it imprints the properties of the atmosphere onto the starlight. As no starlight shines through Tau Boötis b's atmosphere towards us, this means the planet's atmosphere could not be studied before.

But now, after 15 years of attempting to study the faint glow that is emitted from hot Jupiter exoplanets, astronomers have finally succeeded in reliably probing the structure of the atmosphere of Tau Boötis b and deducing its mass accurately for the first time. The team used the CRIRES instrument on the Very Large Telescope (VLT) at ESO's Paranal Observatory in Chile. They combined high quality infrared observations (at wavelengths around 2.3 microns) with a clever new trick to tease out the weak signal of the planet from the much stronger one from the parent star.

Lead author of the study Matteo Brogi (Leiden Observatory, the Netherlands) explains: "Thanks to the high quality observations provided by the VLT and CRIRES we were able to study the spectrum of the system in much more detail than has been possible before. Only about 0.01% of the light we see comes from the planet, and the rest from the star, so this was not easy".

The majority of planets around other stars were discovered by their gravitational effects on their parent stars, which limits the information that can be gleaned about their mass: they only allow a lower limit to be calculated for a planet's mass. The new technique pioneered here is much more powerful. Seeing the planet's light directly has allowed the astronomers to measure the angle of the planet's orbit and hence work out its mass precisely. By tracing the changes in the planet's motion as it orbits its star, the team has determined reliably for the first time that Tau Boötis b orbits its host star at an angle of 44 degrees and has a mass six times that of the planet Jupiter in our own Solar System.

"The new VLT observations solve the 15-year old problem of the mass of Tau Boötis b. And the new technique also means that we can now study the atmospheres of exoplanets that don't transit their stars, as well as measuring their masses accurately, which was impossible before", says Ignas Snellen (Leiden Observatory, the Netherlands), co-author of the paper. "This is a big step forward."

As well as detecting the glow of the atmosphere and measuring Tau Boötis b's mass, the team has probed its atmosphere and measured the amount of carbon monoxide present, as well as the temperature at different altitudes by means of a comparison between the observations and theoretical models. A surprising result from this work was that the new observations indicated an atmosphere with a temperature that falls higher up. This result is the exact opposite of the temperature inversion — an increase in temperature with height — found for other hot Jupiter exoplanets.

The VLT observations show that high resolution spectroscopy from ground-based telescopes is a valuable tool for a detailed analysis of non-transiting exoplanets' atmospheres. The detection of different molecules in future will allow astronomers to learn more about the planet's atmospheric conditions. By making measurements along the planet's orbit, astronomers may even be able to track atmospheric changes between the planet's morning and evening.

"This study shows the enormous potential of current and future ground-based telescopes, such as the E-ELT. Maybe one day we may even find evidence for biological activity on Earth-like planets in this way", concludes Ignas Snellen.

Top: Jupiter & Venus in Taurus - Bruce Reardon

Below: Tim Malikoff's first telescope!

Top: Deb & 16” Dob - Chris Malikoff

Below: “Sol Rises” - Chris Malikoff

Top: MAS members… circa 1997

Below: Wilton observing field, circa 1997

# Musings...

Davy Jones

Sometimes you read something you just feel should be shared. The quote below comes from a novel written by Salman Rushdie - “The Moor's Last Sigh”, in 1995. For me, it sums up so much about the human race and its relationship with the natural world and the universe.

*"Star light, star bright . . . we look up and we hope the stars look down, we pray that there may be stars for us to follow, stars moving across the heavens and leading up to our destiny, but it’s only our vanity. We look at the galaxy and fall in love, but the universe cares less about us than we do about it, and the stars stay in their courses however much we may wish upon them to do otherwise. It’s true that if you watch the sky-wheel turn for a while you’ll see a meteor fall, flame and die. That’s not a star worth following; it’s just an unlucky rock. Our fates are here on Earth. There are no guiding stars.”*

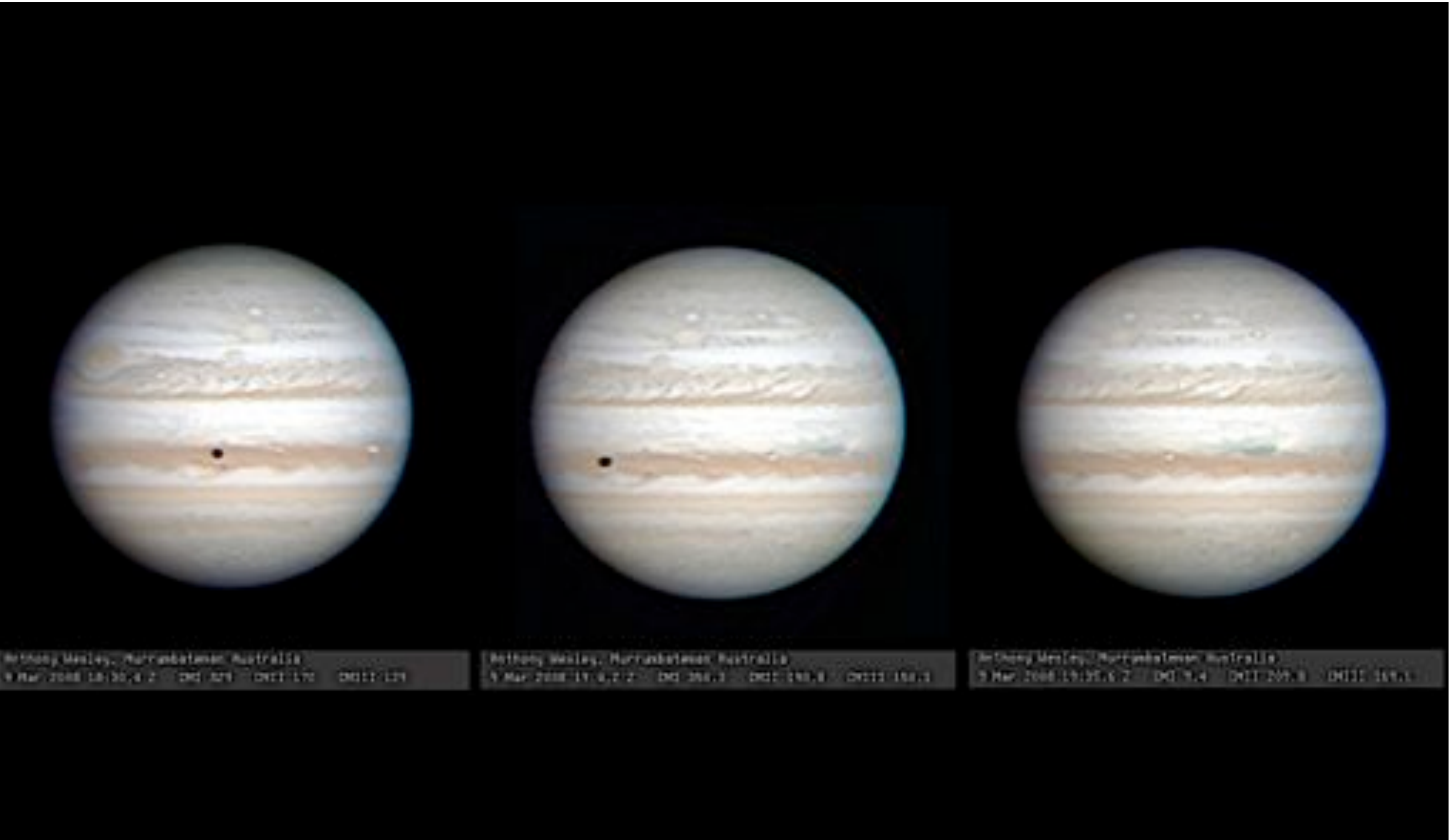


Image Credit: Anthony Wesley

# anthony wesley - july speaker

## "Jupiter & Saturn: 2009-12"

In the last three years the gas giants have turned on a spectacular show for earthbound observers, with many rare events captured in images by amateur astronomers. This talk showcases the changing faces of Jupiter and Saturn over this period.

# heavens above!

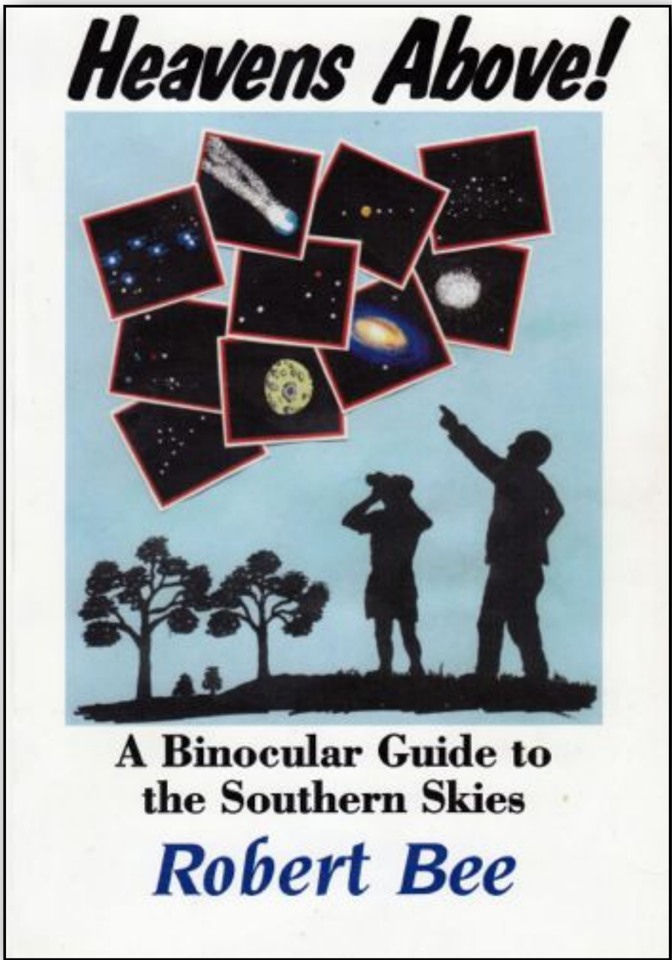


It is a very common misconception by people on the fringe of amateur astronomy that you absolutely need a telescope to "see anything interesting".

This book comprises 158 pages and contains over 80 diagrams of the sky viewed from the Southern Hemisphere

In the book, the author takes you through all the constellations visible from the Southern Hemisphere which have objects visible through binoculars.

The planets and many globular clusters, open clusters, gaseous nebulae, galaxies, double stars and asterisms can be found with your humble field glasses.




*This book contains:-*

- charts showing 56 of the 88 constellations with the locations of binocular objects they contain and description and details of each object.
- maps of each month of the year showing the location of the constellations in the sky to the north and south

This is an excellent introduction to observational astronomy for beginners of all ages.

To purchase your copy of this excellent book please forward your cheque or postal order (made out to Robert Bee) for AU$19.50 to the author at the address below.

This includes postage and handling (within Australia).

Please contact Robert Bee at rmbee99@hotmail.com for more details about the book or Direct Deposit information.

**Robert Bee,**

**8 Joseph Banks Court,**

**MOUNT ANNAN, NSW, 2567**

About the Author:

Robert Bee lives at Mount Annan on the south-west outskirts of Sydney, NSW.

Robert's passion for astronomy began in his teens and has deepened over the ensuing years. With degrees in Electrical Engineering and Science, he enjoys both observing the starry sky and understanding the physical laws behind what he sees.

Robert is a member of the Macarthur Astronomical Society (MAS) and has edited and contributed to the Society's monthly journal "Prime Focus" since it commenced in 1996 up to 2006. He has carried several positions within the Society during that time.

He shares his passion for astronomy with the people of the Macarthur Region through a fortnightly column called "Heavens Above!" in the Macarthur Chronicle newspaper. This column commenced in 1998 and is aimed at those with no background in science or astronomy, just a sense of curiosity and a willingness to step outside the back door and have a look at the sky.

Robert also enjoys writing fiction, with a preference for science fiction and fantasy, and has had a number of short stories published in periodical magazines and successes in short story literary competitions. He currently has a children's science fiction novel, with an astronomy theme of course, in progress.

Robert enjoys talking to the public about astronomy and guiding them around the sky, both at public nights run by MAS and also at clubs, societies and schools.

# members observing nights

Make sure you remember to bring your cardigan.

Even in Summer, it can still cool right down at night!

On observing nights, at any venue, you must arrange your own transport and please try to arrive well before sunset, to enable you to familiarise yourself with the surroundings before darkness sets in. If arriving later, make sure that your approach to the final gate is only with parking lights and ask someone to guide you into the observing area from the gate. It is essential - for your own safety and that of others - that you bring a red torch with you to observing nights. If weather conditions look doubtful, please check the website “What’s On” page before leaving home. If Stargard is cancelled, sometimes an unscheduled observing night will be held later that week.

During the course of the evening, please consider the needs of others around you, especially when using laser pointers, camera screens, computer monitors, car boot lights etc. Please read our Field Etiquette page on our website for reference.

Stargard nights are free to members and invited guests. Please contact the President before inviting anyone. Beginners are encouraged to observe at Stargard before progressing to the Forest.

To cover our costs, the charge for The Forest is $15.00 per member per evening, whether attending just for the evening or staying all night. Experienced amateur astronomers who are non-members may be invited to attend the Forest subject to prior clearance from the President and will be charged $20.00 per visitor per evening. Please see Ned Pastor on your arrival to make your payment and please try to have the exact amount.

Limited sleeping accommodation is available but not guaranteed. 240vAC field power is available (bring your own waterproofed extension leads) as are kitchen and washroom facilities.

Stargard

# the forest

This must be the most under-utilised resource that MAS provides! It amazes us that so few visit but we suspect we may have not promoted it enough.

Where is it you might ask? See the map below (it is on the website too)

It takes approximately 50 minutes to get there from Campbelltown, along the Hume Highway until you see the Belanglo State Forest sign, just past the Sutton Forest turn off. You turn right across the highway and follow the dirt road (Bunningalore Road) for approximately 4km then turn right in to Dalys Road and the cabin is the first property on the right. Keep a close watch for kangaroos and wombats at all times!

The facility offers bunk beds for a maximum of 12 but you can also camp on the property as Ned and Chris do on most occasions. Bring your own pillows, bed linen or sleeping bags. There is hot and cold running water, showers and toilets. There is a complete kitchen with stove, fridge, two microwaves and sufficient crockery and cutlery. Just bring your own food and drink.

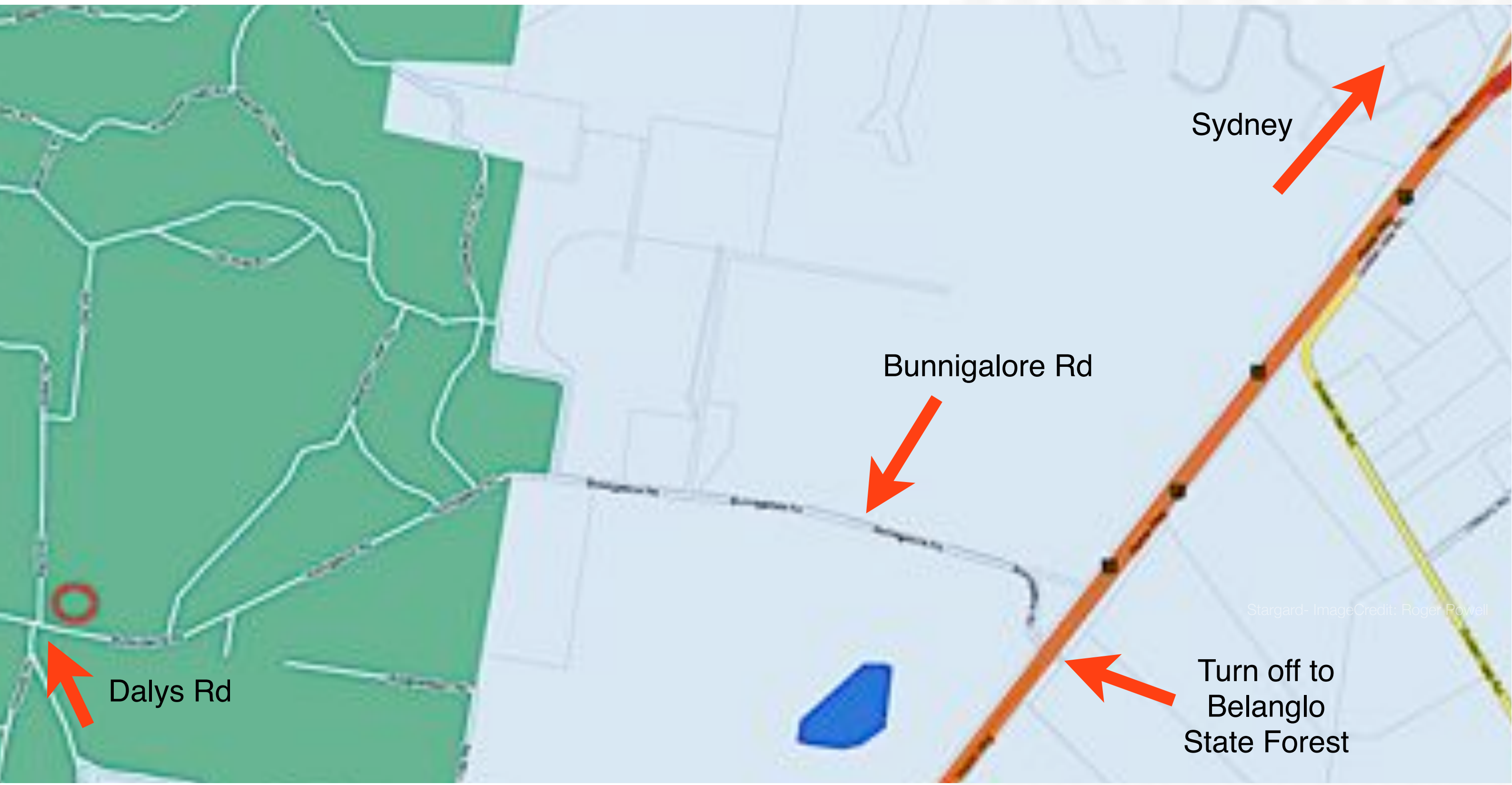
The nights are cool in summer and freezing in winter! Always ensure you have warm clothing with you and for those who intend to observe to the wee hours of the morning a freezer suit and boots is highly recommended.

Of course you do not have to stay overnight, the cabin is usually open from around 3pm on a Friday afternoon until Sunday morning but you can visit for a few hours or a few days. We need to know in advance if you are intending to stay on for three nights. You will be amazed at the dark skies – you can always call ahead to check on the viewing conditions.

The surrounding forest is full of wildlife, there are many walks you can do during the day, look out for our regular visitors to the cabin, ‘roos, wombats, yellow tailed black cockatoos (and many other birds) and we even had an echidna visit in February!

Overall, “The Forest” is a great place to unwind, relax, meet up with friends, chat about everything, eat, drink and enjoy what nature has to offer and hopefully spot those elusive galaxies, globular clusters and other favourites of the night sky.

Hope to see you there soon :)

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# M.A.S. HYSTERIA !!!


DUSTY AFTER A LONG RIDE, HIGGS STUMBLES INTO A SALOON...