PRIME FOCUS

MAS SOCIETY JOURNAL

macarthur astronomical society

Jun 2012

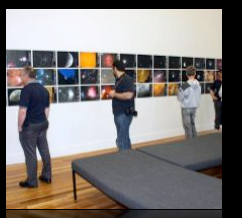
volume 17 issue 6

SDO image of Venus transit - 6th June 2012
Image Credit: NASA

macarthur astronomical society

magnitude II
Macarthur Astronomical Society's members are proud to present a gallery of photographic images of our solar system's planets and deep space objects taken from in and around the Macarthur area.

View our Image Gallery
Dozens of high-quality prints will be on display in the gallery. MAS amateur astronomers will be on hand to answer your questions and delight your sense of wonder. Dusk 'till midnight, Fri, Sat & Sun: spectacular image projections onto the outside wall of the gallery.



Equipment on Display
Member's telescopes and astrophotographic imaging cameras will be on display to let you in on the secrets of photographing our stars. Merchandise and prints available to order.

Sat 7th to Sun 8th July 2012

macarthur astronomical society presents...

magnitude II

skies over macarthur

astrophotography exhibition

M42 - Humayun Qureshi

Image Credit: Humayun Qureshi

Campbelltown Arts Centre
Art Gallery Road, Corner Camden and Appin Roads
CAMPBELLTOWN, NSW 2560

www.macastro.org.au

campbelltown city council

from the editor's desk

Welcome to the June 2012 "Venus" edition of Prime Focus - volume 17, edition 6.

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 June 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 June edition - our sixth for the year 2012.

Clear Skies!
Chris Malikoff

Contents

Lunar eclipse, June 2012 - Image Cedit: Daniel Ross

president's report

CHRIS MALIKOFF

Hello Members

Not a bad month for Macarthur astronomy eh? A Venus transit, lunar eclipse, SKA announcements, sausage sizzles, Scouts. What next? Decent weather?

This time around, the June 2012 transit of Venus piqued the interest of people the world over. Most had probably never paid any attention to the phenomenon before, and its previous significance to new science. There were reports of queues of excited first-time astronomers grabbing their very own glimpse at telescope eye pieces from Hobart all the way to Boston. Even after all the discussion on news channels, and "oohs and aahs" thrown about on Twitter and Facebook, I wonder how many were familiar with the purpose of Cook's voyage of discovery to Tahiti in 1769 to view and analyse the transit of that year? So much time, money and equipment were spent to better-define that fundamental yardstick of solar system astronomy: the value of the solar parallax (P) - and hence establish a more accurate figure for the astronomical unit. For its day, I think that it was akin to a modern-day Mars mission in scale. Dr Ragbir Bhathal discusses it this month in Prime Focus.

At the conclusion of our committee meeting last month, we walked outside into crisp, cool air to see what remained of the partial lunar eclipse in full view against a black sky. The Moon was about one third covered by the Earth's northern umbral shadow at maximum eclipse. We are so conditioned to think nothing of the fact that part of the moon is missing nearly every night as it progresses through its various phases. This usually presents as the terminator - a shadow line from pole to pole. Seeing an off-set concave chunk out of the side is always very interesting and a bit different. Excellent show, Moon - more please!

The decision is in. Both the South African and Australia/New Zealand consortia have earned the right to host their respective parts of the Square Kilometer Array. We host the low-frequency aperture array package in association with ASKAP and South Africa the mid-frequency in association with MeerKAT. In my mind, this was a sound decision. I'm not sure why many saw it as a "win" or "no win" competition. I'm glad it was not. We welcome Dr. Lisa Harvey Smith to explain it all at this month's Macarthur Astronomy Forum.

Clearest of skies

Chris

Schedule Planner

June-July 2012

DATE	EVENT	SUMMARY	TIMES
15th June	The Forest	Members Private Observing Night. $15 per person per night.	SS 4.53 MR 3.44
16th June	The Forest	Members Private Observing Night. $15 per person per night.	SS 4.53 MR 4.38
17th June*	The Forest*	Members Private Observing Night. $15 per person per night.*	SS 4.53 MR 5.31
18th June	Macarthur Astronomy Forum	Guest Speaker: Dr. Lisa Harvey-Smith.	7.30 PM
23rd June	Stargard	Members Private Observing Night.	SS 4.54 MS 8.25
7th July	Magnitude II	MAS Photographic Exhibition at Campbelltown Arts Centre - Day 1.	10:00 AM - 4:00 PM
8th July	Magnitude II	MAS Photographic Exhibition at Campbelltown Arts Centre - Day 2.	10:00 AM - 4:00 PM
14th July	Stargard	Members Private Observing Night.	SS 5.04 MR 3.24

speaker watch

ROGER POWELL

Professor Fred Watson is always a very entertaining speaker, easily comprehended by all who are present. He has visited MAS numerous times and last month's talk, entitled "In the Face of The Sun", was a lively romp through the upcoming transit of Venus, also touching on exo-planets, eclipses and aurorae.

Fred explained that transits occur in repeating patterns every 243 years when the orbital planes of Venus and Earth coincide. During this period, only four transits occur, in two pairs. The first pair comes in December and the second in June. There were no transits of Venus during the twentieth century and the first of the current transit pair came eight years ago.

The 1631 and 1639 transits were believed to be the first ever observed (following the invention of the telescope) and Fred took us through the scientific opportunity that the earliest transits gave astronomers to accurately establish the scale of the Solar System, using the parallax method from data gathered from varying global observation sites. The first scientific observations were of the 1639 event, predicted by Jeremiah Horrocks and the first transit photographs were taken in 1882, making this year's transit only the third to be photographed and only the eighth to be observed visually.

Fred told us that transits were currently being used to discover exo-planets around other stars, and he also talked about the aurorae, inviting anyone interested to join him on a tour of Sweden, Norway and Iceland, in pursuit of the Northern Lights, next January.

He also talked about the coincidence that both the Moon and the Sun appear the same size to us, suggesting that this may perhaps be a contributing factor in the evolution of mankind. He advised that eventually the Moon's orbit will have receded so that we only see annular solar eclipses, rather than total eclipses. Coincidentally, the day after Fred's talk, I read an article published at http://astrobob.areavoices.com/2012/05/20/561667292-a-d-date-of-earths-last-solar-eclipse/ which predicted that the last ever total solar eclipse would occur in approximately the year 561,667,292 A.D.

As usual our members came up with a series of great questions but Fred was stumped by ex-President Noel Sharpe's incisive question about whether the early transit observers used protection!

Another good question which Fred was unable to provide a definitive answer to was whether transits of Venus and Mercury could occur together. To that, I now refer you to the following Wikipedia page http://en.wikipedia.org/wiki/Transit_of_Mercury which predicts that the last simultaneous occurrence of Mercury and Venus transits occurred in the year 373,173 BCE and the next will not occur until the year 69,163 CE, 'closely followed' by another in 224,508 CE. Wouldn't that be a sight?

So how did Transit Day work out for MAS?

We obtained very late approval to set up our solar telescopes at Eagle Vale Leisure Centre and we are very grateful to the Centre Management and to Campbelltown City Council for allowing us to do that. However, we were unable to promote the event as much as we would have liked.

The weather outlook leading up to the event was very poor and I awoke that morning with that awful sinking feeling you always get when you realise that things are not going to plan. Thick clouds! It was obvious that it would not be a good day for astronomy. However, as it was (almost) a unique event in our lives, seven of our members still turned up and we had four solar telescopes on duty with one more in reserve.

The poor visual conditions persisted throughout the transit but we had some occasional short breaks in the clouds to observe it. We were able to show it to everyone who had the patience to wait for a glimpse. Some of the patrons came to the telescopes dripping wet, straight out of the pool! Many were amazed to see how tiny Venus is, compared to the size of the Sun and we were asked a lot of questions about the Solar System.

It worked out well, under the circumstances, although 95% of the period was spent looking at clouds.

The next big astro-event locally will be a partial eclipse of the Sun in November (total eclipse in North Queensland).

Flying Elephants About

A quick "trip report" from the pilot of the 747 that flew the shuttle back to Florida after the Hubble repair flight. A humorous and interesting inside look at what it's like to fly two aircraft at once . . .

A NASA pilot's account.

Well, it's been 48 hours since I landed the 747 with the shuttle Atlantis on top and I am still buzzing from the experience. I have to say that my whole mind, body and soul went into the professional mode just before engine start in Mississippi, and stayed there, where it all needed to be, until well after the flight...in fact, I am not sure if it is all back to normal as I type this email. The experience was surreal. Seeing that "thing" on top of an already overly huge aircraft boggles my mind. The whole mission from takeoff to engine shutdown was unlike anything I had ever done. It was like a dream...someone else's dream.

We took off from Columbus AFB on their 12,000 foot runway, of which I used 11,999 1/2 feet to get the wheels off the ground. We were at 3,500 feet left to go of the runway, throttles full power, nose wheels still hugging the ground, copilot calling out decision speeds, the weight of Atlantis now screaming through my fingers clinched tightly on the controls, tires heating up to their near maximum temperature from the speed and the weight, and not yet at rotation speed, the speed at which I would be pulling on the controls to get the nose to rise. I just could not wait, and I mean I COULD NOT WAIT, and started pulling early. If I had waited until rotation speed, we would not have rotated enough to get airborne by the end of the runway. So I pulled on the controls early and started our rotation to the takeoff attitude. The wheels finally lifted off as we passed over the stripe marking the end of the runway and my next hurdle (physically) was a line of trees 1,000 feet off the departure end of Runway 16. All I knew was we were flying and so I directed the gear to be retracted and the flaps to be moved from Flaps 20 to Flaps 10 as I pulled even harder on the controls. I must say, those trees were beginning to look a lot like those brushes in the drive through car washes so I pulled even harder yet! I think I saw a bird just fold its wings and fall out of a tree as if to say "Oh just take me". Okay, we cleared the trees, duh, but it was way too close for my laundry. As we started to actually climb, at only 100 feet per minute, I smelled something that reminded me of touring the Heineken Brewery in Europe ....I said "is that a skunk I smell?" and the veterans of shuttle carrying looked at me and smiled and said "Tires"! I said "TIRES??? OURS???" They smiled and shook their heads as if to call their Captain an amateur...okay, at that point I was. Th! e tire s were so hot you could smell them in the cockpit. My mind could not get over, from this point on, that this was something I had never experienced. Where's your mom when you REALLY need her?

The flight down to Florida was an eternity. We cruised at 250 knots indicated, giving us about 315 knots of ground speed at 15,000'. The miles didn't click by like I am use to them clicking by in a fighter jet at MACH .94. We were burning fuel at a rate of 40,000 pounds per hour or 130 pounds per mile, or one gallon every length of the fuselage. The vibration in the cockpit was mild, compared to down below and to the rear of the fuselage where it reminded me of that football game I had as a child where you turned it on and the players vibrated around the board. I felt like if I had plastic clips on my boots I could have vibrated to any spot in the fuselage I wanted to go without moving my legs...and the noise was deafening. The 747 flies with its nose 5 degrees up in the air to stay level, and when you bank, it feels like the shuttle is trying to say "hey, let's roll completely over on our back"..not a good thing I kept telling myself. SO I limited my bank angle to 15 degrees and even though a 180 degree course change took a full zip code to complete, it was the safe way to turn this monster.

Airliners and even a flight of two F-16s deviated from their flight plans to catch a glimpse of us along the way. We dodged what was in reality very few clouds and storms, despite what everyone thought, and arrived in Florida with 51,000 pounds of fuel too much to land with. We can't land heavier than 600,000 pounds total weight and so we had to do something with that fuel. I had an idea...let's fly low and slow and show this beast off to all the taxpayers in Florida lucky enough to be outside on that Tuesday afternoon. So at Ormond Beach we let down to 1,000 feet above the ground/water and flew just east of the beach out over the water Then, once we reached the NASA airspace of the Kennedy Space Center, we cut over to the Banana/Indian Rivers and flew down the middle of them to show the people of Titusville, Port St.Johns and Melbourne just what a 747 with a shuttle on it looked like. We stayed at 1,000 feet and since we were dragging our flaps at "Flaps 5", our speed was down to around 190 to 210 knots. We could see traffic stopping in the middle of roads to take a look. We heard later that a Little League Baseball game stop to look and everyone cheered as we became their 7th inning stretch. Oh say can you see...

After reaching Vero Beach , we turned north to follow the coast line back up to the Shuttle Landing Facility (SLF). There was not one person laying on the beach...they were all standing and waving! "What a sight" I thought...and figured they were thinking the same thing. All this time I was bugging the engineers, all three of them, to re-compute our fuel and tell me when it was time to land. They kept saying "Not yet Triple, keep showing this thing off" which was not a bad thing to be doing. However, all this time the thought that the landing, the muscling of this 600,000 pound beast, was getting closer and closer to my reality. I was pumped up! We got back to the SLF and were still 10,000 pounds too heavy to land so I said I was going to do a low approach over the SLF going the opposite direction of landing traffic that day.

So at 300 feet, we flew down the runway, rocking our wings like a whale rolling on its side to say "hello" to the people looking on! One turn out of traffic and back to the runway to land...still 3,000 pounds over gross weight limit. But the engineers agreed that if the landing were smooth, there would be no problem. "Oh thanks guys, a little extra pressure is just what I needed!" So we landed at 603,000 pounds and very smoothly if I have to say so myself. The landing was so totally controlled and on speed, that it was fun. There were a few surprises that I dealt with, like the 747 falls like a rock with the orbiter on it if you pull the throttles off at the "normal" point in a landing and secondly, if you thought you could hold the nose off the ground after the mains touch down, think again...IT IS COMING DOWN!!! So I "flew it down" to the ground and saved what I have seen in videos of a nose slap after landing.

Then I turned on my phone after coming to a full stop only to find 50 bazillion emails and phone messages from all of you who were so super to be watching and cheering us on! What a treat, I can't thank y'all enough. For those who watched, you wondered why we sat there so long. Well, the shuttle had very hazardous chemicals on board and we had to be "sniffed" to determine if any had leaked or were leaking. They checked for Monomethylhydrazine (N2H4 for Charlie Hudson) and nitrogen tetroxide (N2O4). Even though we were "clean", it took way too long for them to tow us in to the mate-demate area. Sorry for those who stuck it out and even waited until we exited the jet.

I am sure I will wake up in the middle of the night here soon, screaming and standing straight up dripping wet with sweat from the realization of what had happened. It was a thrill of a lifetime. Again I want to thank everyone for your interest and support. It felt good to bring Atlantis home in one piece after she had worked so hard getting to the Hubble Space Telescope and back.

Triple Nickel
NASA Pilot

Captain Henri D. (pianoman)

"Galactic Dogs" coming off the assembly line at another successful Bunnings sausage sizzle fund raiser for MAS.

MAS members showing patrons of Eagle Vale Leisure Centre glimpses of Venus as it crosses the Sun's disk during the transit. One constant during the day was, as Cook put it, "Clowd".

MAS members show Cobbitty Scouts what's up there - again, through breaks in constant cloud and rain. Brave? Yes.

“We Come in Peace”

Bob Bee

The shadow moved. It was blacker than the deepest umbra cast by the moonlight bathed trees. Deeper than the blackest nothingness of nightmares.

“What was that?” whispered Sergeant Logan, hunkered behind a gnarly tree. He was just fifty metres off the field at the head of the vanguard. Only two men on point were further in than him. The remainder of the platoon were spread out behind him, each to their own tree. They were waiting for his signal to advance.

“What was what, Sarge?” Corporal Brin, the left point, whispered back to him.

“Something up ahead, a shadow. Moved,” Logan said, then cursing his own breach of the ‘silence on patrol’ rule, made a shushing signal, hoping Brin could see it in the dark of the forest.

Brin saw it. Not the signal. The shadow. But he was too late. Before he could move, before he could scream, it was upon him. For a moment, the shadow’s edge coruscated across the full spectrum of black, appeared to swell, then returned to its basket ball size.

Logan stared into the dark, his eyes straining to sort out the shadows, his mouth dry. He decided to risk another whisper. It came out a croak. “Brin?” He strained his senses.

But Brin was gone.

Porter? Logan looked towards the position of the right point man. He rose to a crouch, took a deep breath, then moved quickly in that direction, giving a low warning whistle as he approached. A soft reply whistle told him Porter knew he was coming.

Logan dropped down beside Porter’s tree. “Brin’s gone,” he whispered.

“Dead?”

“Gone. Probably dead. For his sake, hopefully dead,” Logan said, weariness creeping into his voice. He looked up through the branches of the strange trees. Like those back on Earth, they had wood and leaves. Otherwise, totally unlike them. This place would be a botanist’s dream, he thought.

That brought him back to the present. Through the branches he could see the stars, but not a familiar constellation amongst them. Not surprising, he knew, as they were one hundred and forty four light years from Earth. Patterns changed.

“How?” Porter was saying, breaking into his thoughts.

Logan shrugged in the dark. “The natives are restless.”

* * *

The three ships of the Exodus expedition had landed on the fourth planet of Alpha Eridani with all the attributes of their names – Faith, Hope and Charity. Due to the ruggedness of the terrain, they couldn’t land close together, but managed to touch down a few kilometres

apart, exchanging mutual congratulations for a safe arrival on a strange new world. The planet was christened 'Beulah Land'.

Then they lost contact with Charity.

Faith and Hope triangulated Charity's landing site and to their amazement, found a large gravitational anomaly at the location. To their further amazement, as they watched, the anomaly receded until levels returned to normal.

"We must re-establish contact," Captain Crookes of Faith said. "One third of our expedition…"

"Right," Captain Ghandi of Hope said. "Sounds like my soldiers are going to hit the ground running."

"Better take some medics with them," Crookes said. "Just in case…"

"… it's more than just a broken radio," Ghandi agreed grimly. "Welcome to Beulah Land."

* * *

It had taken Sergeant Logan's platoon three hours to reach Charity's landing site. They arrived while the sun – it was easier to think of their new star, Alpha Eridani, by the old star's name – was still an hour from setting.

Charity's landing site was quite beautiful. A wide flat field covered in a lush dark green grass with patches of vivid orange wild flowers. There was a dense forest of tall trees on the western edge. Charity's party of botanists were going to have a ball, Logan thought in passing. Then it struck him. Charity – a colonising space ship over ninety metres tall and thirty metres diameter at its base – was nowhere to be seen.

Logan signalled 'caution', then 'eyes open'. With a final signal to 'spread out', he advanced slowly towards the field's centre, unease rising in his gut.

He saw something at his feet and stopped. He waited till all the platoon had passed him, circling, then also stopping. He looked up and found, like in an old B-grade sci-fi movie, his platoon stood in a wide circle, on the perimeter of a large empty patch of burnt grass. The landing site. But… where was Charity?

Had it relaunched? No, not enough fuel.

Exploded? What was there to explode? Besides, he looked around him. Where was the debris?

"Sarge, over here." Corporal Brin was waving from across the circle.

Logan strode quickly over the scorched ground and joined Brin who was looking down at a strange object. Brin tapped it with his steel capped boot. "Metal," he said.

"What is it?" Private Janson asked, as the whole platoon gathered to stare.

It was about five metres long and just one centimetre wide. Flat as sheet iron. Straight as a flag pole, but the last metre at one end had four long prongs, like teeth in a hair comb. There was nothing like that on Hope.

Suddenly Private Sullivan gasped. "My god, I know what that is… was."

"Well?" Logan snapped.

"It's a dinner fork."

* * *

"Damned strange natives," Porter muttered. "Wide eyed bandits with AK-47s I can fight. But we haven't seen anything since we found that crazy stretched fork."

Not quite true, Logan thought. They'd seen some movement at the forest edge, strange dark shapes. He wanted answers. He'd had his platoon check their weapons, then moved towards the forest. The sun had set as they entered it amid the deep shadows of the alien trees.

Then he'd lost Brin.

What were they facing, Logan agonised. What could make a whole space ship disappear and stretch a fork like a piece of spaghetti? Better find out or the colony's sunk before it starts.

He whistled 'advance' and, watching for moving shadows, they slowly edged deeper into the forest. By the time they reached the clearing, Logan had lost three more men. Without a sound. Without a shot fired. They were just … gone.

Logan stared at the clearing and, finally, understood why.

At its centre hovered a huge black sphere, as big as a bull elephant. It had no solid surface. It was just an area of empty nothingness, a spherical shadow.

Logan checked his remaining troops. Like him, they seemed to be holding on to a nearby tree, as if fighting a rip in the surf, drawing them towards the clearing.

Then, to his horror, out from under the giant sphere, emerged a swarm of smaller black spheres, basket ball sized, like chicks from under a mother hen.

Suddenly, in the clearing, a small sapling which had been leaning sharply towards the sphere, was uprooted and flew to it. With a brief flash of violet light, it disappeared.

Logan bellowed "Get the hell out" and started to claw his way backwards, against the rip. One of his men, Baker, he thought, lost his grip and slid across the ground, screaming into the clearing until, impossibly, stretching like a bloody straw, he disappeared into one of the baby spheres.

Logan groaned. Using all his strength to hold onto a sturdy tree, he jabbed his transmitter and called Hope.

Captain Ghandi answered. "What's your status…?"

"Desperate. I need to know something urgently," Logan yelled.

"What?"

"How do you say 'we come in peace' in Black-Hole-ese?"

*

"in a flat spin"

Part 6

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

Estimates indicate the formation of the Milky Way began some 12 to 13 billion years ago; around 300,000 years after the so-called, "Big Bang". Different articles disclose an assortment of theories relating to the actual processes that took place during this early turbulent formation epoch. Several basic scenarios dominate. All, or a mixture of all, have elements of feasibility.

It is, however, generally accepted that the first proto-galaxies formed from swirling gas clouds; clouds principally consisting of the primal mix of hydrogen and helium gas. Small variations in these primordial gas clouds are observed in WMAP-CMB results. These variations led to conclusions that areas with slightly higher density had enough gravitational attraction to triumph over the rapid expansion of the universe - ultimately collapsing to form the first super-massive proto-galaxies. As swirling masses of gas came together within these newly formed 'proto-galaxies' the first protostars appeared. These stars became gravitationally attracted to each other, building yet larger formations of stars, swathed in clouds of gas. These first 'globular clusters' coalesced and began to rotate about a common centre of mass. As the rotation increased the clusters of stars became 'squashed', ultimately forming the now familiar galactic disc, with a bulge at its centre. Of course, we mustn't forget the possibility that at some time in this process, massive supernovae events may have occurred - creating the central - gravity providing - super-massive black holes assumed to be at the heart of so many (if not all) galaxies.

In June of 2010 a research team of astronomers, led by Dr P Kroupa - Bonn University - carried out studies that led to significant advances in our understanding of the earliest evolutionary history of our own Milky Way. Their studies included investigations of globular clusters - the spherical group of stars located in the halo of our galaxy. The results indicated that the early Milky Way evolved from a smooth proto-galaxy and then developed into a more clumpy one (sic) in a matter of only a few hundred million years; in cosmic terms, a somewhat short period.

Points of reference are arguably difficult to establish 'in space' - in an environment where everything is in motion relative to everything else. Nevertheless, if viewed from 'above' - on Earth the direction we call North - the Milky Way spins in a counter-clockwise direction. Naturally - it is worth noting - if the galaxy were viewed from 'the other side', it would be seen to be spinning in a clockwise direction. In determining the actual rotation rate of the Milky Way, astronomers mapped star-forming regions using the Very Long Baseline Array (VLBA) - mentioned in last month's article. Molecules in these star-forming regions amplify naturally occurring, traceable radio emissions. Monitoring these emissions allowed scientists to record just how far these regions moved over time. The resulting data not only provided accurate measurements of the rotational speed of the entire galactic disc - it also enable the mass of the Milky Way to be calculated in its entirety.

"The Milky Way is nothing else but a mass of innumerable stars planted together in clusters"

Galileo

The Galaxy Zoo Project, launched in July of 2007, has added more valuable information to our current scientific understanding. Information, gathered by the public and a dedicated group of professionals, has succeeded in creating the largest database of galaxy shapes ever assembled. Combined with information from the Hubble Space Telescope, and the Sloan Digital Sky Survey (SDSS), scientists now think that on larger scales the Universe is both homogenous and isotropic. That is, of a similar nature and 'the same' in all directions. That statement must, one should imagine, be taken

in the widest possible terms. The resulting conclusions are, from our perspective at least, half of all spiral galaxies should spin 'clockwise' and the other half spin 'counter-clockwise'.

It is impossible to explore the complexities of motion within the Universe without attempting at least to retain a grasp the vast distances involved. As mentioned in a previous article, the human race has a propensity to reduce unimaginable distances to more understandable terrestrial terms.

It is estimated that the stellar disc of the Milky Way is some 100,000 light-years in diameter and on average, about 1000 light-years thick. The expression - kilo-parsec - is another term that allows our earthly intellects to cope with such unimaginable celestial distances. Reduced to kilo-parsecs then - the Milky Way is: in the order of 30 kilo-parsecs ($9x10^{17}$ km) in diameter by 0.3 kpc thick. To clarify this terminology - a parsec is about 3.26 light-years - or 31 trillion kilometres. One kilo-parsec then equals 1000 parsecs, or approximately 3,260 light years.

For further discussion of this unit see: http://www.daviddarling.info/encyclopedia/P/parsec.html

Standing in a darkened field on a clear cold night, gazing across immeasurable distances, it is difficult to comprehend how one object, or group of objects, is inextricably linked to all other celestial objects. The Milky Way Galaxy is thought to consist of at least 100 billion, and possibly even as many as 400 billion stars. Exact figures depend on too many variables for accuracy. Nevertheless, from its super-massive black hole centre, to the furthest reaches of its assumed dark energy or dark matter outer reaches, our galaxy spins 'never-endingly', according to the laws of physics. Each object in the system exercising its gravitational influence on its neighbours, apparently ad-infinitum. Motion within various regions of the galaxy fluctuate with the changes in density or viscosity of local environments. The actual complexity of more localized motion is well beyond the scope of this article - but nonetheless worth reading up on if it piques personal interest. Suffice to say, the whole galaxy does not simply rotate in the well-regulated centrifugal manner of classic mechanics; rather, our galactic system, in many respects, maintains its primeval quality of swirling localized turbulence(s) that create constant change. In spite of this cosmic hurly burly, the Milky Way, according to Hammer et al (2007), can be considered 'an exceptionally quiet galaxy' when compared to other similar spiral galaxies.

A rudimentary overall picture of the Milky Way then, indicates a system with no defined edge beyond which stars cease to exist. The concentration of stars seems to drop 'smoothly' with distance from the galactic centre. For reasons that are not yet fully understood, outside a radius of some 40,000 ly (12 kpc), the number of stars per cubic parsec drops much faster with radius,. Gravitational microlensing and planetary transit studies signify that there may be at least as many planets bound to stars as there are stars in the Milky Way. Similarly, studies also suggest there may indeed be more unbound rogue planets than there are stars! So much to learn - so little time...

As touched on last month, the Milky Way is only one small part of an even greater system - the Virgo Cluster and Virgo Super Cluster - all components of which have their own local motions. Whilst playing its part within each galaxy, gravity appears to play a part in binding such colossal galactic systems. The speed of the Milky Way Galaxy as a body - traveling through space, varies when measured against diverse objects in space. It is a matter of record, however, that the Milky Way and the Andromeda Galaxy - both members of the Local Virgo Group - are actually approaching each other at the speed of approximately 130 km/s. At this speed, the two bodies are expected to 'collide' - or at least merge - in around 5 billion years. Our local galactic group - comprising of more than 54 galaxies - appears to be moving as a group at some 600 km/s in the general direction of the constellation Hydra. The size of the Local Virgo Group is estimated to be, a staggering 4 million light years. across. The Virgo Supercluster, calculated to consist of at least 100 galactic groups and clusters, is all located within a diameter of some 33 mega-parsecs - or 110 million ly. The Virgo Supercluster is considered to be a final frontier, after which a 'space traveller' would encounter a nearly galaxy free region, called a cosmic void. This whole incredible supercluster structure travels through space in accord, as one, signifying a likely common origin.

The transient nature of human life guarantees we never intellectually get to grips with the vastness of our galaxy, let alone the universe. In our favour is the enormous and growing reservoir of collective information, gleaned and tested patiently over many years. Modern technology plus information gathering and sharing increase our eventual chances of collectively understanding the workings of the cosmos. However, sheer distance, alone will prohibit our ability to see for ourselves for at least the foreseeable future - and probably well beyond.

To be continued...

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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.

MAS Outreach - Cobbitty Scouts 10th June 2012

TONY LAW

We were invited to attend this gathering by Nepean District Scout Leader Dennis Conroy as some the Scouts would be preparing for their 'Astronomy Badge'. There were over about 50 scouts, aged 11-15, and Leaders camping out over the long weekend.

Seven MAS members attended - John Rombi, Trevor Rhodes, Noel Sharpe, Barry Moore, Jack Goralewski, Aaron Fordham and I. We set up our telescopes under threatening skies from 4.15pm. Of course the previous couple of nights had been cloud-free.

By the time we finished setting up supper was served and the clouds began to darken. After an excellent meal we were able to show the Scouts views of Mars, Saturn, Crux, Scorpio and a couple of other objects before the clouds came in and rain came down. We all made a dash for the hall where we had set up projector and screen.

Plan “B” was invoked, John gave the seated gathering an overview of MAS and answered some preliminary questions and then we showed part one of the Magnitude II DVD, deep sky objects. The Scouts were enthralled and John had to field many questions. To give him a rest we ran part two of the DVD – the solar system and by the time this finished there were a few more questions and we wrapped up the evening.

After packing up our soggy scopes we retired to the hall or campfire with a cup of coffee, around the camp fire the heat of seemed to evaporate the rain!

To a rousing BRAVO, and response from Barry, we left them at 9pm watching animated movies.

May22nd - 2012
Dragon Splashdown Marks End of Landmark Flight

SpaceX completed a landmark mission on May 31st that saw its Dragon capsule deliver half-a-ton of supplies and equipment to the International Space Station and return safely to Earth.

The flight made history as the first privately built spacecraft to rendezvous with the International Space Station. Its true impact is expected to be seen in coming months as the company sends regular re-supply missions to the orbiting outpost and continues work to launch astronauts into orbit in a few years.

"We are hoping to continue working with NASA and hopefully flying crew within three years," said Elon Musk, the founder, CEO and chief designer for the Hawthorne, Calif.-based Space Exploration Technologies, better known as SpaceX. "This was a crucial step and makes the chances of becoming a multi planet species more likely."

NASA engineers worked closely with SpaceX throughout preparations for the uncrewed demonstration mission.

"As a country, we should be very proud," said Mike Suffredini, NASA International Space Station program manager. We took a capability that this agency has nurtured over many years, combined that with a different thought process in spacecraft design and created a team that worked very well. The SpaceX team learned a lot and so did our NASA engineers."

The SpaceX mission combined the goals of two separate flights under NASA's Commercial Orbital Transportation Services Program, known as COTS. Originally slated to fly by the station and then come back to Earth, SpaceX and the NASA agreed to let the Dragon connect to the laboratory as long as a string of performance tests were successful.

SpaceX launched the Dragon capsule on top of the company's Falcon 9 rocket at 3:44 a.m. EDT on May 22 to begin the chase of the space station. Working with an instantaneous launch window, the SpaceX launch team executed a flawless countdown that culminated with the Falcon lifting off from Space launch Complex-40 at Cape Canaveral Air Force Station in Florida.

ImageCredit: NASA

The Dragon began accomplishing a long list of operational "firsts" soon after reaching space, including the first use of the trunk, a small module attached to the bottom of the capsule. The trunk holds a pair of solar arrays that generate electricity for the Dragon capsule. On operational missions, the trunk can be loaded with cargo that can be exposed to the vacuum of space.

Doors on the Dragon opened as-planned to reveal the navigation instruments and other hardware the spacecraft would need to pick out the International Space Station in the void of space and then fly to it.

The first approach came on day three of the mission, when Dragon steered itself around the station remaining 1.5 miles clear. Numerous tests were run on the spacecraft and its communications with the crew on the station.

Astronaut Don Pettit guided the historic link-up the next day, Friday, May 25, when he reached the station's 32-foot-long robotic arm, Canadarm 2, out to the Dragon as it hovered near the station.

"Looks like we caught a Dragon by the tail," the astronaut radioed from the station to ground controllers in Houston and at SpaceX's Hawthorne control center after the arm connected to a fitting on the side of Dragon.

Pettit steered the capsule to the Earth-facing port on the Harmony module while fellow station crewmember Joe Acaba locked the hatches together. The crew unloaded the Dragon's cargo over the weekend and placed used equipment back inside for the return to Earth. The Dragon is the only cargo-carrying spacecraft designed to return safely to the planet rather than burn up in the atmosphere.

"We all remember the transcontinental railroad that opened the Western frontier," Pettit told reporters. "It was celebrated and completed by a golden spike. This is kind of the equivalent. No one remembers who pounded it in, but its completion was important and remembered."

Reversing the process a few days later, Pettit pulled Dragon away from its port on May 31 and released it to fly on its own again. As planned, the Dragon fired its thrusters to move away from the station's vicinity. Dragon released the trunk and its solar arrays before turning its heat shield toward Earth for the fiery plunge through the atmosphere.

Descending under a canopy of parachutes, the Dragon splashed down hundreds of miles west of Baja California to be recovered by ships and taken to port.

Musk said the ambitious mission should ease concerns people had about the rocket, spacecraft and future plans.

"There was reason to doubt that we would succeed because there wasn't a precedent for what we achieved," Musk said. "I think those reasons no longer remain having done what we have done so I hope those doubts are put to rest."

Steven Siceloff
NASA's John F. Kennedy Space Center

ImageCredit: NASA


ImageCredit: Project Dorothy

A Visit to Nançay Radio Astronomy Facility

AN ARTICLE & PHOTOGRAPHS BY MAS MEMBER
ROBERT BEE

In May/June 2010, I was fortunate to go on Stargazer II, Fred Watson's tour of European astronomical observatories, as well as many other beautiful tourism attractions. Accompanied by David Malin, we visited many historical optical telescope observatories, each with its own physical characteristics and rich historical significance. However, as a variation on the theme, we also visited two unique installations that had huge impacts on my senses, each for completely different reasons. One was the Large Hadron Collider which I hope to write a separate article on in the near future. The other was the Radio Astronomy Facility at Nançay, located in the quaint countryside just a two hour drive south of Paris.

Up to that time, as we were nearing the end of the sixteen day tour, we had walked around and through a large assortment of classic observatories with their long winding staircases and amazingly long brass telescope tubes centred under towering domed roofs. So it was a welcome change to walk under the sunny French country sky and inspect at close range a very different type of telescope. This article tells a little of that experience.

The Radio Observatory at Nançay forms a part of the broader Paris Observatory, along with the Meudon Observatory in the south-west suburbs of Paris (which we visited on a later day). The Nançay Radio Astronomy Facility is jointly operated by the Paris Observatory, by the National Research Council for Scientific Research and by the Université d'Orléans. In 2009, Nançay was one of the three founding laboratories of a new research institute called the *Observatoire des sciences de l'Univers de la région centre* (OSUC).

First created in 1953, the Nançay site contains three separate radio telescope installations, each completely and uniquely different. The broad layout of the huge site is shown in the picture below. That is NOT an aircraft landing strip in the centre.

In the centre left is the huge Nancay Radio Telescope. The strip running down the centre is one leg of the Radio Heliograph instrument. The other leg which crosses at a right angle is out of picture at the bottom. The rectangular area at bottom right, larger than four football fields, is the Low Frequency Array (LOFAR).

On the day of our visit, we were fortunate with the weather and hats, 30+ sun cream and insect repellent were the order of the day.

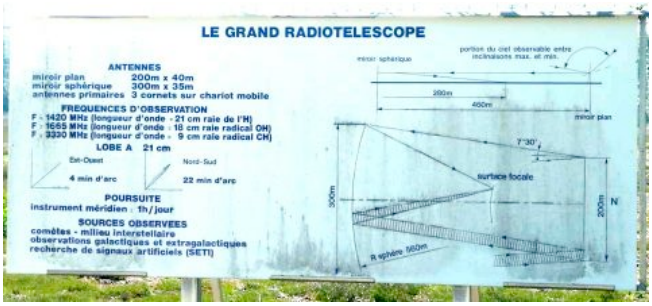
We were met on arriving at the facility's entrance, near the top of the 'strip', by our guide Steven, a local radio astronomer. The first thing we noticed, before taking in the huge reflector screens across the way, was this quaint old building, completely surrounded by a metal mesh.

This, believe it or not, was the data collection and processing building for the entire facility. The wire 'bird cage' was a Faraday Cage, protecting the telescopes from radio emissions from the electrical equipment within the building. Unfortunately, time did not allow us a look inside. Steven explained to us the strict rules regarding photography on site, necessary because of the radio emission from electronic camera shutters. As well as asking that all mobile phones be switched off NOW, he advised would give us directions as to when we could or couldn't take photos, depending on our location on site and what was happening with each installation at the time. Thankfully, we were still able to take copious numbers of photos. Then the grand tour began.

The Large Nançay Radio Telescope

This is claimed (by the French) to be one of the largest radio telescopes in the world. If you consider its huge physical size, that is a claim easy to believe. The overall schematic of the telescope's design is shown on the display board below.

This telescope, which had 'first light' in 1965, is used for a wide variety of projects, mostly related to the 'local' universe. These include the study of stellar envelopes (including our own Sun) which contribute to the understanding of the evolution of stars, the study of



comets (which is not something one would usually associate a large radio telescope being used for) and extremely accurate timings of the rotations of neutron stars (pulsars). It has also participated in the SETI project. Observations are typically undertaken at frequencies of 1,400 MHz (equivalent to a wavelength of 21 cm), 1,660 MHz (18 cm) and 3,330 MHz (9 cm).

Due to its location and the limitations of the tilting and fixed 'mirrors', it is capable of observing objects with declinations greater than -39° and at any given time, within a range of 1 hour of Right Ascension. As a transit instrument of the Kraus-type design, it effectively lets the target come to it. The telescope has an effective 'dish' diameter of 96m, and a Field of View of 10'x30'.

Its three main components are:

1) The Primary mirror: A tilting flat 'mirror' 40m high and 200m wide. It is huge. This 'points' at the target object and reflects the radio waves towards the secondary mirror which is 460m away across the vast clearing.

Primary 'mirror'

2) The secondary mirror: A fixed curved mirror 300m wide, 35m high, shaped as a section of a sphere with a radius of 560m. This focuses the radio waves towards the centre of the field where the third component sits. The line from the Primary to the Secondary mirrors runs from North to South.

Secondary 'mirror'

3) The Focal Carriage: The radio waves reflected off the secondary mirror enter the carriage through an opening at the large section at the lower right of the picture above. Via a sequence of tertiary dish focusers within the carriage, the radio waves reach the receptors in the 'shed' at the top rear which record the signal. This carriage travels east-west on rails across the centre of the installation to reach the signal from the desired target. This gives it a range of 15°, or 1 hour RA. Of local interest, Steven told us that the engineer who designed the dishes and receptors in the Focal carriage was an Australian. While we watched, the carriage started to move along the rails towards us. One alert member of our group raced towards it to get a photo from in front, the only window of photo opportunity allowed as the telescope does not record data while the carriage is changing location. Unfortunately, your truly was not as quick on my feet and it stopped before I was in position. Camera off!

Focal carriage

This was a fascinating facility to observe, the sheer size of it was awesome.

The Radio Heliograph

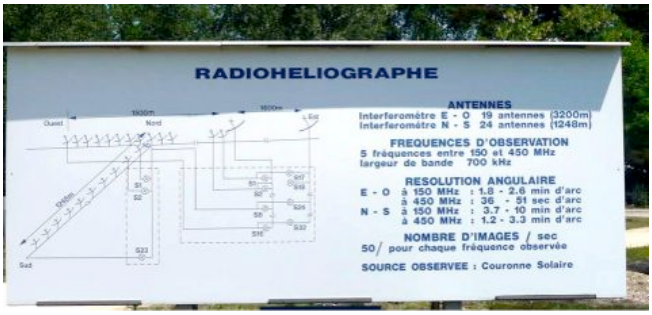
We then moved on to a very long line of dish antennae which looked unnervingly like a row of Daleks. This installation was a dedicated radio heliograph, built and operated specifically to study the coronal mass

ejections from the Sun. Operating at wavelengths between 0.6 and 2.0 metres, it makes thousands of interferometric images every day all day of the solar corona, and has been doing so continuously for the past 10 years to build up a reference data base of solar activity. This provides data on the extremely hot gas that surrounds the Sun, the corona, which can only be seen visibly during total eclipses.

'Daleks' on parade

Bob with 'Dalek'

Schematic and Data of Radio Heliograph



We walked the length of the dish array, comprising 19 antennae east-west (3.2km) and 24 antennae north-south (1.25km). We walked the north-south leg. The installation observes at five frequencies between 150 and 450 MHz, taking 50 images per second for each frequency.

As we walked the length of 'Daleks', we came to an interesting relic of the past. A well worn WWII radar dish which had been used in the observatory's early years as a radio telescope. It has been left in situ for historical interest, may it rust in peace.

Rusting radar dish

Low Frequency Array (LOFAR)

Half-way along the heliograph leg, Steven broke off the path and started along a rough and narrow dirt track through the bush. Dutifully we followed, stepping over a small dribbling creek, around bends, wondering where he was taking us. I assume that Steven told those up front near him where he was taking us. However it was all a surprise when we arrived.

There, in the middle of the bush, was this huge clearing, easily two football fields long and about half as wide. It looked (to me) like a construction site for some future huge structure, with lots of reinforcing steel meshes laid out awaiting a concrete pour for hundreds of footings. After my question "What are you building here?", Steven told us "nothing, this is it. LOFAR, the Low Frequency Array."

David Malin and Guide Steven with LOFAR antenna

At the centre of each steel mesh mat was a pole approximately 2m tall, secured by guy wires.

The pole was a low band antenna (LBA), a simple dipole mounted above a steel mesh ground screen and connected to a Low Noise Amplifier. A very low cost solution. There were 96 of these antennae arranged in a pattern around the area. After my initial puzzlement, I realized I was seeing something quite amazing. This installation at Nançay is one station of the Low Frequency Array (LOFAR) which is a European project led by the Netherlands with receiving stations distributed throughout Europe. With all stations working together, LOFAR provides exquisite sensitivity which will advance understanding in a number of areas in astrophysics. At that time, LOFAR was claimed to be the world's largest radio telescope with almost 50 stations throughout Europe, combining a total of 1600 such antennae. This, of course, was before the SKA which, to be fair, has yet to be built.

Beyond the dipole area was another set of antennae, this time High Band antennae (HBA), of completely different design to the LBA, like flat dishes all connected together into a near circular arrangement. I regret that I didn't get to see them close up as the group which had gone ahead turned back before I could join them. An aerial view is given in the site image at the start of this article. This array was still undergoing installation at the time of the tour but when completed in 2011, the 96 HBA would complement the work of their LBA neighbours.

The HBA of LOFAR – the flat grey modules behind group.

A prime function of LOFAR is to observe the universe at a very early age, detecting the neutral hydrogen just before the re-ionisation era, helping to understand the formation of the first stars and galaxies.

The fascinating feature of LOFAR is how it 'points' to its targets. Comprising multiple fixed dipoles stuck on the ground, mechanical movement is obviously not involved. In fact, the pointing is done electronically by selective analysis of the data collected. The facility continually covers the whole sky, the data being stored (the computing infrastructure being huge, just like the Large Hadron Collider and the future SKA) and kept for later processing. Effectively, with appropriate data selection and processing, it can be said that the 'telescope' can point in multiple directions simultaneously. An amazing technology. And all this from such a 'crude' instrument.

So our visit to Nançay came to an end. We was off to the chateaus of the Loire Valley. This had been a day in Stargazer II when, instead of exploring the glorious history of old telescopes and their heroic astronomers, we delved into the high tech present and even the future, courtesy of the upcoming young radio astronomers of the day. I wonder what tales tourists in Stargazer CII will be told about them?

NASA Watch:
NuSTAR to Drop From Plane and Rocket Into Space

NASA's NuSTAR mission is scheduled to launch from Kwajalein Atoll in the central Pacific Ocean on June 13, no earlier than 8:30 a.m. PDT (11:30 a.m. EDT). The observatory, which will hunt for black holes and other exotic objects using specialized X-ray eyes, will be launched from a Pegasus XL rocket carried by an Orbital Science Corporation L-1011 "Stargazer" plane. The plane will take off from Kwajalein Atoll an hour before launch, flying out over the Pacific Ocean.

About five seconds before launch, the Pegasus XL rocket -- also from Orbital -- will drop from the plane, ignite and propel NuSTAR in to space. A video showing a previous Pegasus launch is online at http://www.nasa.gov/multimedia/videogallery/index.html?media_id=128352201 .

Why launch from the air? Plane-assisted launches are less expensive than those that take place from the ground. Less fuel is needed to boost cargo away from the pull of Earth's gravity. NuSTAR is part of NASA's Small Explorer program, which builds focused science missions at relatively low costs.

If all goes as planned, the following milestones will occur on June 13. Times listed are for a launch at the start of a four-hour window.

Takeoff: The Stargazer carrier aircraft, with the Pegasus launch vehicle and NuSTAR spacecraft strapped to its belly, will take off from Kwajalein's Bucholz Auxiliary Airfield an hour before launch, and climb to an altitude of about 39,000 feet (11,900 meters). This should occur around 7:30 a.m. PDT (10:30 a.m. EDT).

The Drop: The carrier aircraft will release the Pegasus rocket at 8:30 a.m. PDT (11:30 a.m. EDT). The rocket will free-fall for about five seconds before igniting.

Ignition: At about 8:30 a.m. PDT (11:30 a.m. EDT), the rocket carrying NuSTAR will ignite. Its first-stage motor will burn for 70 seconds and then drop away. The second-stage motor will burn for about a minute-and-a-half.

Splitting the Nose Cone: While the second stage is burning, pyrotechnic devices will be fired to release the nose cone, or fairing, that encapsulates the observatory. NuSTAR will be exposed to space for the first time. This event is scheduled to occur around 8:33 a.m. PDT (11:33 a.m. EDT).

Separating From the Rocket: At about 8:43 a.m. PDT (11:43 a.m. EDT), 13 minutes after the initial release from the Stargazer, NuSTAR will separate from the Pegasus rocket's third stage. At this point, NuSTAR will be in its final orbit -- a low-Earth equatorial orbit at an altitude of approximately 340 miles (600 kilometers) and an inclination of six degrees.

Phoning Home: When NuSTAR separates from the Pegasus, the satellite's system that controls its orientation in space, or "attitude," will begin to stabilize it, and the spacecraft solar arrays will be deployed. Around this time, its first signal will be received on the ground via NASA's Tracking and Data Relay Satellite System. Over the following week, NuSTAR personnel will perform a series of checkouts to ensure that all spacecraft subsystems are operating nominally.

Deploying the Boom: Roughly one week after launch, engineers will command NuSTAR to deploy its lengthy 33-foot (10-meter) boom, allowing the telescope to focus X-ray light into crisp images. Unlike visible-light telescopes, X-ray telescopes require a long distance between the mirrors and detectors to focus the light. It's a bit like wearing glasses a few feet away from your face.

Science operations are expected to begin about 30 days after launch.

ImageCredits: NASA

On launch day, live commentary and coverage will be broadcast online beginning at 7 a.m. PDT (10 a.m. EDT) at http://www.nasa.gov/nustar and at http://www.ustream.tv/nasajpl2 .

NuSTAR is a Small Explorer mission led by the California Institute of Technology in Pasadena and managed by NASA's Jet Propulsion Laboratory, also in Pasadena, 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.

Launch management and government oversight for the mission is the responsibility of NASA's Launch Services Program at the Kennedy Space Center in Florida.

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

ESO Watch:
Building the World's Biggest Eye On The Sky

11th 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 ad referendum votes. The E-ELT will start operations early in the next decade.

ESO's governing body, the Council, met on June 11th, at the ESO Headquarters in Garching, Germany. The main topic on the agenda was the start of the European Extremely Large Telescope (E-ELT) Programme — the world's biggest eye on the sky. The E-ELT will be a 39.3-metre segmented-mirror telescope sited on Cerro Armazones in northern Chile, close to ESO's Paranal Observatory.

All of ESO's Member States have already expressed very strong support for the E-ELT project. The Council has voted in favour of a resolution for the approval of the E-ELT and its first suite of powerful instruments, pending confirmation of the so-called ad referendum votes.

To approve the start of the programme, two-thirds of the Member States (at least ten) had to vote in favour. At the Council meeting Austria, the Czech Republic, Germany, the Netherlands, Sweden and Switzerland voted in favour of the start of the E-ELT programme. Four further countries voted in favour ad referendum: Belgium, Finland, Italy, and the United Kingdom. The remaining four Member States are actively working towards joining the programme in the near future.

Following the resolution, spending on elements of the project other than the initial civil works will not commence until the contributions pledged by the Member States, as agreed in the funding principles approved by Council in late 2011, exceed 90% of the 1083 million euro cost-to-completion (at 2012 prices).

On the current schedule the first large E-ELT industrial contracts would have to be approved and major funding committed within the next year. This is expected to provide sufficient time for the conditions to be satisfied: the confirmations of the votes from Belgium, Finland, Italy, and the United Kingdom; other Member States to join the project; and for Brazil to complete its ratification procedure.

"This is an excellent outcome and a great day for ESO. We can now move forward on schedule with this giant project," said the ESO Director General, Tim de Zeeuw.

Early contracts for the project have already been placed. Shortly before the Council meeting, a contract was signed to begin a detailed design study for the very challenging M4 adaptive mirror of the telescope. This is one of the longest lead-time items in the whole E-ELT programme, and an early start was essential.

Detailed design work for the route of the road to the summit of Cerro Armazones, where the E-ELT will be sited, is also in progress and some of the civil works are expected to begin this year. These include preparation of the access road to the summit of Cerro Armazones as well as the leveling of the summit itself.

"The E-ELT will keep ESO in a leading position for decades to come and lead to an extraordinary harvest of exciting science," concluded Council President Xavier Barcons.

Top: Venus Transit - Daniel Ross

Below: Venus Transit - Luke Williams

Top: Venus Transit - James Scott

Below: Venus Transit - Bob Monkcom

Top: Venus Transit - Roger Powell

Have you ever wondered what the Sun would look like from the different planets? On Earth, the Sun is so small that you could cover it up with your little fingernail on the end of your outstretched hand. On the other planets the Sun would be larger or smaller, depending upon how far the planet was from it. Here's a great image JPL came up with to show this.

Australia and the transit of Venus

EXTRACT FROM AN ARTICLE BY
MAS HONOURARY MEMBER
DR RAGBIR BHATHAL

Just before he died, on 24 May 1543, Nicholas Copernicus saw the first printed copy of his monumental De Revolutionibus Orbium Coelestium (Concerning the Revolutions of the Heavenly Spheres) in which he boldly stated that the Sun and not the Earth is at the centre of the solar system and the known universe. Sixty-six years later Galileo appeared on the scene with his magnificent telescope and reinforced Copernicus's "dangerous idea". Both Copernicus and Galileo had overthrown 2000 years of Aristotelian physics, which favoured the geocentric view of the universe, and ushered in the scientific revolution, in which experiment and measurement are the arbiters of truth (Butterfield 1957).

In the ensuing years physicists and astronomers developed mathematical theories and models to understand and predict the motions of planets. In fact, placing the Earth at the centre of the solar system simplified the mathematics of planetary motion. However, the accurate measurement of the solar parallax (the angle sub-tended by the radius of the Earth at the centre of the Sun), which would have allowed the distance between the Earth and the Sun to be calculated, continued to elude them. It became, as the 19th century Astronomer Royal Sir George Airy said, "the noblest problem in astronomy" (Clerke 1908). It was also the most difficult.

Halley and the transits

In 1716 the solution to the problem was presented in a paper to the Royal Society of London by English astronomer and mathematician Edmund Halley (Sheehan and Westfall 2004). He informed his distinguished audience that the solar parallax could be determined by observing and timing the duration of the motion of the planet Venus across the face of the Sun from two widely separated locations. He urged his fellow scientists that they make every effort to observe the transits of Venus in 1761 and 1769 to solve the problem that had plagued them for more than 100 years.

The results of the 1761 transit were far from satisfactory and the uncertainty in the Sun's actual distance remained. There was a wide disparity in the values, which ranged from about 125 to 154 million km. With the approach of the 1769 transit and the prospect of no further transits for more than a century, urgent preparations were made by northern hemisphere astronomers to send out expeditions to various parts of the world. As a consequence, the 1769 transit was observed by 151 astronomers at 77 locations.

1 (right): Cook's observations of the transit of Venus in 1769.

2 (below): Russell's lavish book and his observations of the transit of Venus in 1874.

The Royal Society of London petitioned King George III to provide a ship and financial aid to equip an expedition to observe the transit of Venus from the Pacific. The request was acceded to, and on 25 August 1768, Captain James Cook got under sail and put to sea from Plymouth for the Pacific with a crew of 94. On board the Endeavour he had two Swedish naturalists, Daniel Solander and Herman Deidrich

Sporing, the artists Alexander Buchan and Sydney Parkinson, and the young, wealthy and ambitious Joseph Banks who was to become the architect of imperial science as Britain acquired more and more colonies (Gascoigne 1998).

Cook arrived at Matavai Bay in Tahiti on 13 April 1769, well ahead of the transit event. At the northeast point of the bay, Cook erected Fort Venus to protect themselves and the instruments in case there was trouble with the Tahitians. He wrote: "A centinel was placed continually over the tent and observatory, with orders to suffer no one to enter the one or the other, but those whose business it was. The telescopes made use in the observations were – Two reflecting ones of two feet focus each, made by the late Mr James Short, one of which was furnished with an object glass micrometer." Finally, the much anticipated day arrived. Cook wrote in his log book for 3 June: "This day prov'd as favourable to our purpose as we could wish, not a Clowd was to be seen the whole day and the Air was perfectly clear, so that we had every advantage we could desire in Observing the whole passage of the Planet Venus over the Sun's disk" (Cook 1769).

However, their observations were marred by what came to be called the Black Drop or Black Ligament effect. Instead of meeting and parting cleanly, the limbs of the Sun and the planet clung together by a dark band, which made it difficult to ascertain the time of contact accurately. While the results of the transit of 1769 were much better than those of 1761, the astronomers still needed a more accurate measurement of the Earth–Sun distance.

Cook's next mission

Having accomplished his mission, Cook opened the sealed envelope given to him by the Admiralty. His instructions were to find the great southern continent – terra australis incognita. From the time of the Greeks, European powers were attracted by the mythical lands of gold in the south. Cook sailed south and, after charting the coastline of New Zealand, he headed west. As chance or fate would have it, Cook chose to return to England via the east coast of New Holland, Java and the Cape of Good Hope. On 19 April 1770 he sighted Cape Everard near the southeast extremity of the Australian mainland.

The transits of 1874 and 1882

The next two transits occurred in 1874 and 1882. Astronomers were confident that the 1874 transit would produce better results because technical advances had been made in the 105 years since the last transit; the introduction of photography gave them another useful tool. Extensive expeditions were once again mounted, particularly by the British and Americans. Observers were carefully trained and practised on artificial transits staged with props.

In Australia, Henry Chamberlain Russell, the third Government Astronomer of Sydney Observatory and one of the most influential astronomers in its long history, made extensive preparations for the 1874 transit. In his lavishly published book on the event, he wrote, "took steps to prepare for the great astronomical event, fully realising the great importance of taking advantage of our favourable geographical position on the eastern coast of Australia for observing the egress. It was obviously for the honour of the colony, as well as for the advancement of science, that the observations and photographs of the transit should be as complete as possible" (Russell 1892).

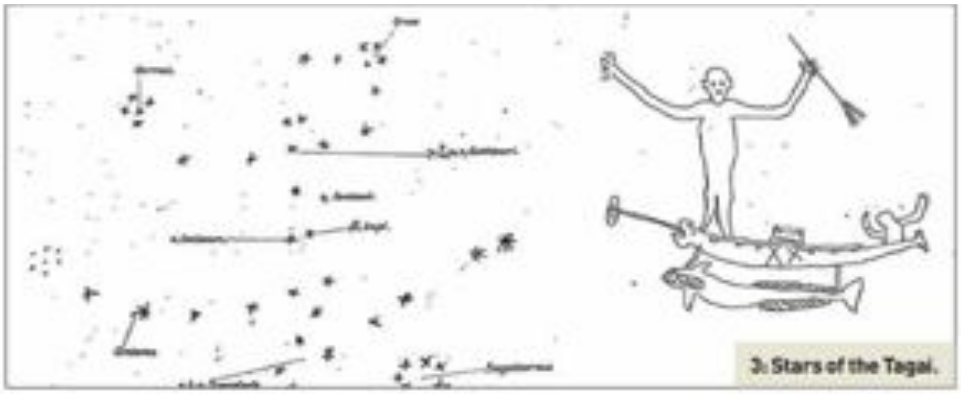
Russell organized the largest observing team in Australia, consisting of members of Sydney's scientific, bureaucratic and business elites. He arranged for four groups to observe the transit from Goulburn, Eden, Woodford (in the Blue Mountains) and Sydney Observatory. His preparations were a great success. Russsell described the day: "Never perhaps, in the world's history, did morning dawn on so many waiting astronomers as it did on the 9th of December, 1874. They were all anxiously looking for an answer to the old question, and certainly none could have expected a finer day than that which dawned on the observers of New South Wales."

The black drop effect once again plagued the astronomers. At his private observatory at Windsor, John Tebbutt also joined in the tremendous upsurge of interest in the observation of the transit. On the appointed day in December 1874 he locked all the gates to his establishment so that "perfect tranquillity reigned throughout the period of observation". It was a hot, blistering day with a hot wind and a maximum temperature which reached 43°C in the shade. He engaged the services of a young man to assist him in his observations. The plan was for his assistant to use the 8.2cm telescope while Tebbutt used the 11.4cm telescope to observe the transit. However, to Tebbutt's great disappointment his assistant forgot to remove the cap from the telescope and when he did the first contact between Venus and the Sun had taken place. Tebbutt did much better at his own telescope. He published his results in volume 47 of the Memoirs of the Royal Astronomical Society (Tebbutt 1908).

Observations of the transit were also conducted by the astronomers from Melbourne (Robert Ellery) and Adelaide (Charles Todd) observatories. Two American parties (William Harkness and Charles Raymond) observed the transit from Tasmania (Sheehan and Westfall 2004).

Russell's and Tebbutt's observations were combined with those of other British observers by Captain Tupman in England (Tupman 1878). They were given double weight. However, the results still did not give an accurate value of the distance of the Earth to the Sun. There was still a probable error of about a million kilometres. The use of photography was generally acknowledged as a failure. Airy noted that even the plates taken with the Jansen photographic revolver could not be used and "the ardour of the observers had

been much cooled by the apparent general failure of the photographic principle and they were unwilling to spend further time on … reductions" (Sheehan and Westfall 2004).



The 1882 transit of Venus gave the 19th century astronomers their last attempt to use it for finding the distance of the Earth to the Sun. Once again the British and Americans along with the Danish, Dutch, French, German and Spanish astronomers took up the challenge enthusiastically, having learned from their experiences of the 1874 transit. In Australia, the 1882 transit of Venus was again observed by Russell and the astronomers at Melbourne and Adelaide. Despite his meticulous preparations, Russell was rather unfortunate as the weather was bad. By 1882 other methods (parallaxes of Mars, parallaxes of asteroids, planetary-perturbation analysis and analysis of the aberration of starlight) of finding the distance from the Earth to the Sun were being investigated by astronomers. In 1877, David Gill, the Astronomer Royal at the Cape of Good Hope, who was disillusioned by his experience with the transit of Venus, used Mars's changing position relative to the stars at a close opposition to find the distance of the Earth to the Sun. He found the distance to be 149 840 000 km. In 1931, the Astronomer Royal Harold Spencer Jones used the occasion of Eros's approach to within 26 million km of the Earth to work out a revised distance of the Earth to the Sun. He found the mean distance to be 149675000±17000 km. Jones noted that he had reached "the goal for which astronomers have so long been striving" and he predicted that this would be the last word on the subject for many years to come (Sheehan and Westfall 2004).

The answer to the "noblest problem" in astronomy was finally provided in the late 20th century. In 1990, NASA used a radar ranging technique to determine the distance of the Earth to the Sun – 149.4593millionkm, with an accuracy of 0.00008%. The transit of Venus that takes place on 6 June 2012 will be witnessed in the eastern states of Australia from about 8.15a.m. EST to about 2.45p.m. It will be visible from the beginning to the end. •

Ragbir Bhathal is an astrophysicist at the University of Western Sydney and a Visiting Fellow at the Research School of Astronomy and Astrophysics, Australian National University. Acknowledgments. The author thanks the State Library of NSW, the National Library of Australia and the JD collection for use of their materials.

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You will find the full version, in PDF form and curtesy of Dr Bhathal, on our website under "Articles".

Musings

Ursula Braatz

NASA predicts cosmic crash.

In many articles, it is predicted that our Milky Way Galaxy and the Andromeda Galaxy will collide in 4 billion years time. I found in the magazine “Spiegel Online Nachrichten” an article about the crash of these two Galaxies, and what the measurements of the Hubble Space Telescope are showing. Our solar system will be in a new place in 4 billion years time.

Astronomers have known for a long time that our Milky Way galaxy and the Andromeda galaxy are coming closer together, both are moving 400,000 km in an hour. The Andromeda Galaxy is 2.5 million light years away from us. After nearly 100 years, speculating astronomers have a clear picture now that our galaxy and the Andromeda galaxy will have a head-on collision. This starts in four billion years time, and in another two billion years time the galaxies will merge into one big galaxy. Our solar system will not be destroyed, it will have another place.

Colliding galaxies fly differently to cars, they fly through each other. Collision of stars seldom happens. If the Earth would still exist, the night sky for human beings would be very different. The weak band of the Milky Way will be replaced by the growing Andromeda spiral galaxy. Observers could see firework of star births light up in gas and dust material. That would be a good show, but by that stage the Earth will not exist anymore, because the Sun is going to be a red giant and will eat Mercury, Venus, Earth and maybe Mars.

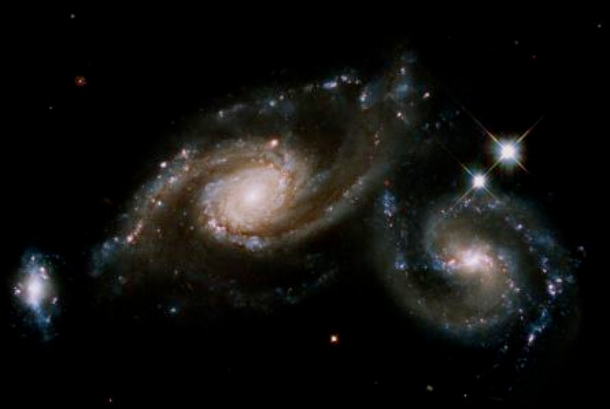

Image Credit: www.skatelescope.org.

macarthur astronomy forum

dr. lisa harvey-smith - june

"The SKA...What's Next?"

In a decision made on May 26th 2012, participation in the SKA project has officially been granted to both the South African and Australia/New Zealand bids. Each group will specialise in building telescopes offering different technologies so that each location can supply data specific to the technology best suited to earn results in that environment.

Australia/New Zealand will host an array of lower-frequency, non-movable dishes which are designed to cover the entire sky at once. Western Australia's superbly-low level of ambient radio noise was one of the key factors in making this decision.

South Africa will build higher frequency, movable dishes, similar in concept to our Parkes facility to cover the rest of the targeted spectrum. These will add to the MeerKAT series of telescopes already under construction in the Karoo region of Southern Africa.

Dr. Lisa Harvey-Smith - Photograph: Chris Malikoff

heavens above!

Advertisement

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

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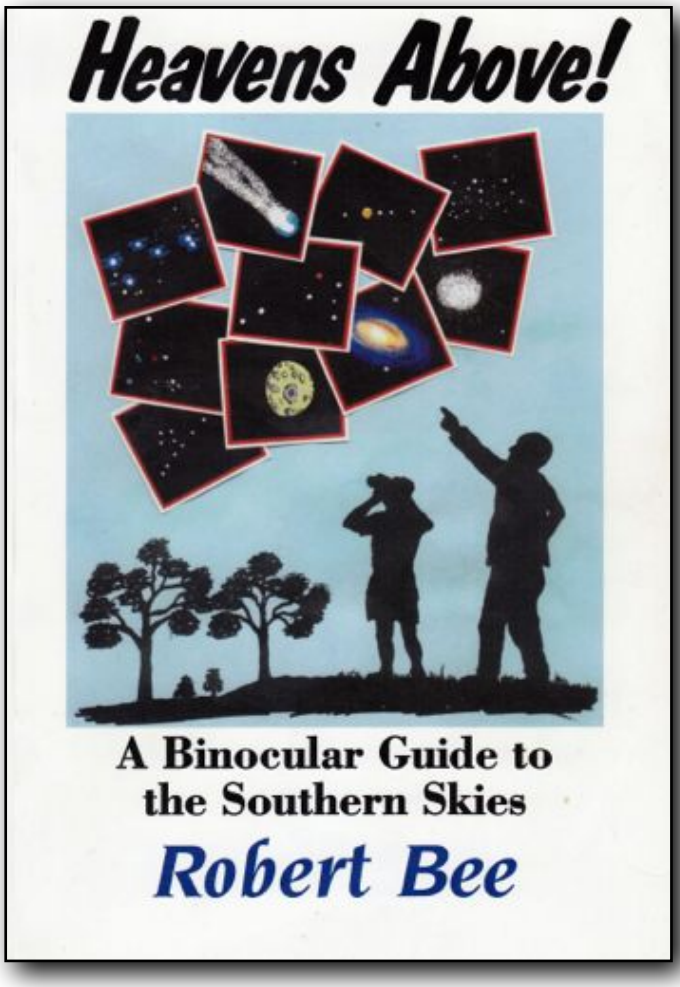

asterisms can be found with your humble field glasses.

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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.

CENTRAL WEST ASTRONOMICAL SOCIETY

INCORPORATED

PO Box 819
Parkes NSW 2870
Australia

28 May, 2012

Dear fellow amateur astronomers,

Throughout 2012, the Central West Astronomical Society is celebrating its 10th anniversary.

Since its inaugural meeting on 1 February, 2002 our society has been proud to encourage amateur astronomy throughout the Central West of New South Wales – from Parkes to Bathurst and in many towns in between.

One particularly successful way that we have achieved this has been through our annual AstroFest and the prestigious David Malin Awards for astrophotography.

On behalf of our society, I would like to warmly invite yourself and any interested members (and family) of your society to our **2012 CWAS AstroFest**, to be held **in Parkes on Saturday 14 July, 2012 and Sunday 15 July, 2012**.

Speakers will include Terry Lovejoy, about his "Christmas Comet" of late 2011/ early 2012. As NASA's latest Mars rover, Curiosity, closes in on the Red Planet, our own John Sarkissian, Operations Scientist at the Parkes Radio Observatory will also give a fascinating account of the mission and the role of the Parkes "Dish" in it. Yet another impressive speaker will be Dr Marta Burgay of the Cagliari Observatory in Sardinia, Italy.

Other highlights of the AstroFest include a civic reception hosted by Parkes Shire Council, and the annual AstroFest Dinner where the winning entries in the 2012 David Malin Awards will be announced and displayed by Dr David Malin himself.

This year, weather permitting, we will be reintroducing a practical astronomical component on the Sunday where registrants will have the opportunity to view the Sun through a range of solar telescopes or set up their own equipment if they wish. This will take place on the lawns adjacent to the Parkes Radio Telescope ("The Dish") where it will also be possible to purchase lunch at the Dish Café.

At the time of writing this, we are awaiting confirmation of several other significant speakers. For confirmation of this, and to answer any further **enquiries** that you or your members may have regarding accommodation and the like, we encourage you to visit the AstroFest link on our website at www.cwas.org.au or to email the AstroFest Coordinator, John Sarkissian, at astrofest@cwas.org.au

We look forward to welcoming you and your members to Parkes in July.

Clear skies,

Alex Abbey
President

Harmoniendum Musica Orbium – In Harmony with the Music of the Spheres

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.

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.

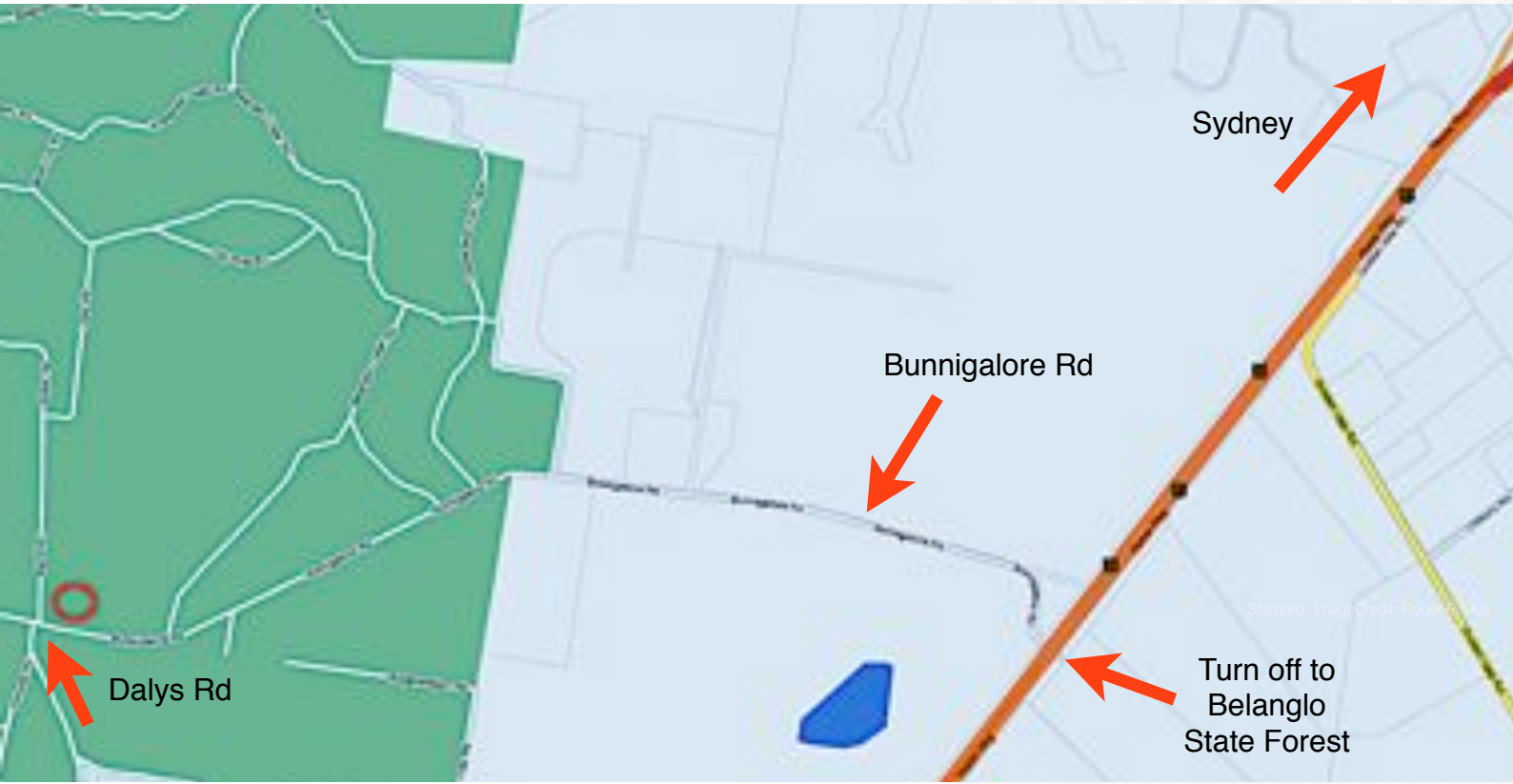
The nights are cool in summer and freezing in winter! Always ensure you have warm clothing with you and for those who intend to observe to the wee hours of the morning a freezer suit and boots is highly recommended.

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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