Reflections

Journal of the Northern Sydney Astronomical Society Inc.

Volume 25 Number 3 July 2014

In this issue

President's Message

Hello all Members and Prospective Members,

One way or another there has been quite a deal of activity within NSAS.
But to start, it has to be said that this fine journal, Reflections, is suffering this year from a lack of contributions. We have prided ourselves over the several decades of our existence on our ability and capacity to put forward editions based almost wholly on the original work of our members.
Our makeup have changed over the last few years and we may not have the same depth of members who seemed to be able to turn out original, researched articles as previously.
So what the membership has decided is that we should still produce regular editions, even where the number of contributions may not be as extensive as before.

What this means, of course, is that we change. And we change by calling on the changing abilities of our members.
If we are not going to have as many articles explaining the complete and utter story of the meaning of life or the birth of galaxies or an astounding and controversial theory of the beginning of the universe itself, then we should be able to put together many articles from our members who joined from the 2013 NAG, or from our longer serving members who have been thinking of writing an article on that topic they have been mulling over for a decade.
Come on, do it!

Speaking of the 2013 NAG, and the need for involvement, we are now well into the 2014 program.
Building on the experience particularly from 2013 but also from previous programs, the 2014 program is a refined, improved version.
New members have already begun to join NSAS and we look forward to getting to know you and learn of your interests.
The program is just two sessions in, and there is plenty of time for anybody to participate, contribute and learn.
The NAG program has become one of the most important functions and operational assets of NSAS and the group mainly responsible – Paul Byrne, Chris Anderson, Bob Fuller and Gordon Ogborne are to be warmly congratulated.

As a group, we must ensure the benefits are not lost to us, that we warmly receive our new members into our midst and that we do whatever is necessary to capitalise on the valuable skills and abilities our members bring.

And as for skills and abilities, how about the Lawrie Webb / Ken Jones efforts in establishing a new operational function of NSAS – solar observing.
To be known as the SAG or the SOG (neither of which quite grabs just yet), Lawrie and Ken have set up this new group that will no doubt compete with the more established observing group.
Traditionalist members were unduly and inappropriately chuffed with Lawrie and Ken's early reports that the sun was obscured for the first two scheduled observation events. But he who laughs last...

Outreach events are going well, and it is especially pleasing to see that several new members have taken up the challenge to take part in these functions, which give much joy to the school kids, other youth groups such as Cubs and the community in general.
Keep in mind our next event, which will be the Cammeraygal Festival to be held 2 September at Kingsford Smith Oval, Lane Cove: it is one of our major events of the year.
For social gatherings please pencil in 14 or 21 September for the annual BBQ at the College for members, family and friends.
And for the observers, keep a watch on your emails and the NSAS website for the Linden visits, which we had hoped would have commenced by now. But it's happening.

And from now on, please also keep in mind the upcoming AGM.
All committee and support positions are available and it is inevitable there will be vacancies occurring.
A great effort has been put into spreading the workload of the organization amongst the members and it is working well but new blood is always needed and a mix of established and new members is best.
So please give thought to helping out by volunteering for a position.
Don't be put off.
There will always be help to assist as you become familiar with how NSAS works.

Best wishes to all

Bruce Retallick
President

Calendar

General Meetings:	July 15th	Speaker: Jim Jackson (CSIRO) - The hidden structure of the Milky Way
	August 19th	Speaker: Doug Milne - Early history of radioastronomy
	September 16th	Speaker: Tara Djokic - TBA
NAG Meetings:	Every fourth Tuesday of the month	
Observing Nights:	Consult NSAS' web site at http://nsas.org.au/observing/	
Deadline:	Please send your contributions to the October issue of Reflections in time to reach the editor **before September 15th** to nsas.editor@ozemail.com.au	

Normanhurst Cubs explore the Night Sky

Taking advantage of the beautiful weather Normanhurst cubs had a double treat last Pack meeting, moving their adventures from the ground to the sky.

Wade Fairclough of "WadeintoScience" set the standard for the evening providing a gripping show on the origins of the universe from the Big Bang through to star formation and their eventual death.

This was followed by the fired up cubs traipsing up to Normanhurst oval (thanks due to Hornsby council for turning the field lights off) to view stars and planets.

Volunteer Phil Angilley of the Northern Sydney Astronomy Society, a former Scout himself, set up and supervised two telescopes for the cubs to view the heavens.
One was an 8" Schmidt Cassegrain allowing for amazing detail of the rings of Saturn.
The highlight however was a viewing of the Jewel Box siting just next to the Southern Cross, the key navigation constellation of the Southern sky.

The unanimous comment from the evening was that it was just so gratifying hearing the cubs excited remarks to each other.
It was truly an evening enjoyed by all and a special thank you to Wade and Phil for volunteering their time on a chilly Monday evening.

Ross Yelland
Cub Leader

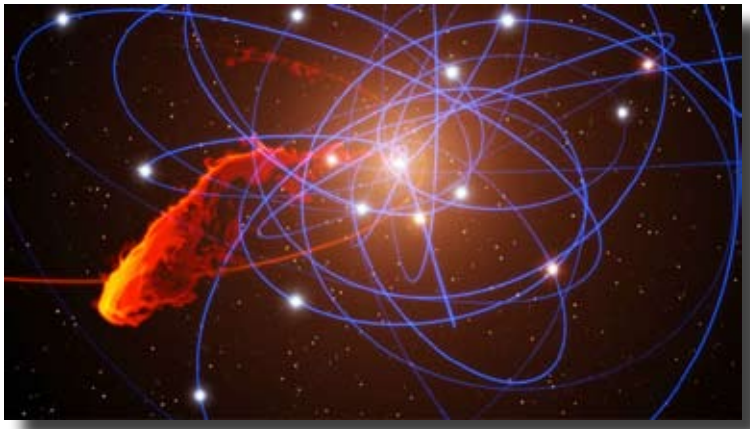
Phil Angilley fires up the telescope so that Normanhurst Cubs can look at the night sky.

Photos credit: Alan Draper

The Milky Way's Super-Massive Black Hole Uncovering the Mystery

Black holes are invisible. Seemingly, they're just spots of nothingness. Why, then, would anyone think something is there?
The answer is the effect these spots have on their surroundings. Even so, ask some experts and they'll say they're still not 100% certain that black holes exist [1].

In the centre of our own galaxy, the Milky Way, and some 26,000 light years away, is believed to be a supermassive black hole. It's in an area called Sagittarius A* (abbreviated to Sgr A* and pronounced A-Star) and is estimated to be four million solar masses.
How this and other supermassive black holes formed is still being researched, but one thing that astrophysicists agree upon is that once a black hole is in place in the centre of a galaxy it can grow either by accretion of matter (i.e. through the addition of external matter) or by merging with other black holes [2].



A simulation of the G2 dust cloud approaching the black hole at the center of the Milky Way. Stellar orbits around the black hole are traced in blue.
Credit: M. Schartmann and L. Calcada/ European Southern Observatory and Max-Planck-Institut fur Extraterrestrische Physik

Black holes affect their surroundings just like any other massive body such as a star. Objects can orbit them, just as the planets orbit the sun in our solar system [3].
However, if the objects get too close and cross over an invisible boundary known as the event horizon there is no escape.

Based on the estimated current mass of the black hole at the centre of the Milky Way, its event horizon is now (or to be technically correct: the event horizon was, 26,000 years ago) 12.9 million kilometers from its centre [1] [5].
Once inside that boundary nothing can escape, not even light, because of the powerful pull of the black hole's gravity. An object would have to travel more than the speed of light to escape and, according to Einstein's theory of special relativity, it is impossible to exceed the speed of light [5].

In 2011 astrophysicists made a discovery. They saw an object, believed to be a small cloud of gas and dust, near the centre of our galaxy and heading towards Sgr A* at speeds approaching eight million kilometers per hour. It was dubbed G2.
Astronomers are hoping to be able to watch what happens if, or when, G2 reaches the black hole's event horizon [4].
In a joint effort some dozen or so radio telescopes around the world will focus on Sgr A* in synchronization using a technique called Very Long Baseline Interferometry to form a planet-sized observatory called the Event Horizon Telescope (EHT) [6].

This is an exciting opportunity to observe a black hole in action. The black hole itself will not be seen, but there is the potential of seeing a ring of debris from G2 outlining the hole at the point of the event horizon as the gas cloud is stripped of its contents [1].If G2 passes by Sgr A* further out from the event horizon it may continue on its orbit and be catapulted around the black hole [4].

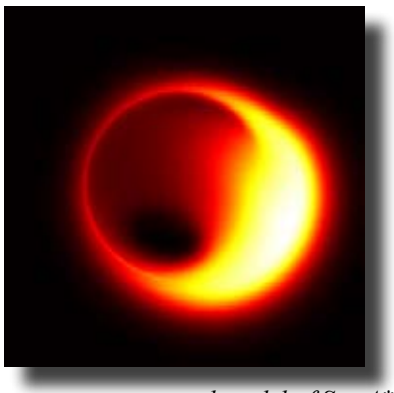
In the meantime, the dust cloud G2 is already throwing up some surprises.
Some astronomers now believe that within G2's gas cloud and at its centre is a star [3].
How did this star come to be in this area of the Milky Way?
Was it once a member of a binary system whose mate has already been consumed by the black hole?
How will it interact with Sgr A* in the months and years ahead?
Will a stellar cloud produce an entirely different outcome from what was expected of a gas and dust cloud?

Whatever G2 is, the Event Horizon Telescope project is an exciting opportunity for scientists to study fundamental black hole physics and to test Einstein's theory of general relativity [6]. It could also give us a better insight into the evolution of galaxies and of the formation of the Milky Way's supermassive black hole [4] and, once and for all, quell any doubts about the existence of black holes [1].

The Event Horizon Telescope is planned to be in full operation by 2016 [4] but already EHT astronomers are tracking G2's approach towards Sgr A* and some key science results have been recorded (see www.eventhorizontelescope.org/science/index.html).
For those readers who are interested in following this remarkable project, information can be found on the web and in print, and particularly on the above website and its links.

Josephine Lindquist

Sources:
1. *National Geographic March 2014, "Star Eater", Pages 88-103*
2. *wikipedia.org/wiki/Supermassive_black_hole*
3. *Scientific American Dark Star Diaries , a blog by senior editor Seth Fletcher: blogs.scientificamerican.com/dark-star-diaries/2014/05/02/cloud-bound-for-milky-ways-black-hole-puzzles-astronomers/*
4. *www.wired.com/2014/03/black-hole-snack-time/*
5. *www.sydneyobservatory.com.au/?s=black+holes*
6. *www.eventhorizontelescope.org*



A computer-generated model of Sgr A, the black hole at the centre of the Milky Way Image courtesy Avery Broderick at the Perimeter Institute for Theoretical Physics and the University of Waterloo*

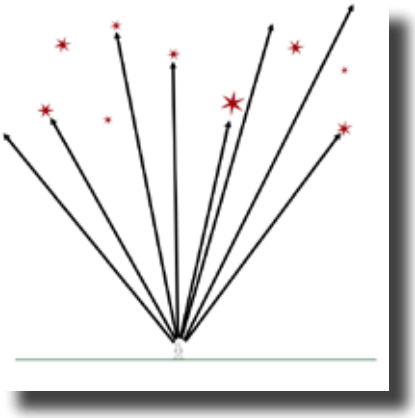
The Olbers Paradox

Those of you who attended the May General Meeting may remember that, during the course of his talk, Paul Byrne mentioned the Olbers Paradox aka The Dark Night Paradox.
I remembered vaguely that it was about the apparent contradiction between the fact that the sky is dark at night and that the universe was thought, at that time, to be static, infinite and isotropic.
And so, it enticed me to do a bit of research to refresh my memory.

Heinrich Wilhelm Olbers (1758-1840) was a German physician and a serious amateur astronomer.
Amongst other things, he is credited with the discovery of Pallas and Vesta in the asteroid belt and of a periodical comet now known as 13P/Olbers.

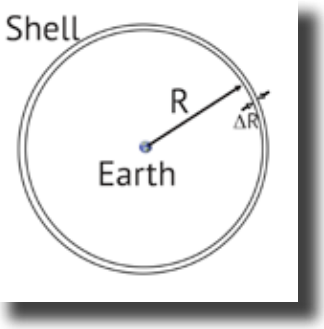
Olbers is the first to described in detail the paradox that bears his name in 1823 but Kepler had already stumbled upon it in 1610 and it was discussed by Halley in 1820 and later refined by Swiss astronomer Jean-Philippe Loys de Chéseaux.

Now, you have to crank up your time machine, get back to the early 19th century and forget all you know about modern cosmology.
At that time, the universe was considered to be static, isotropic and infinite in size and infinitely old, which means that, at night, in whatever direction you look your line of sight will eventually end up on a star.



The logical conclusion is that, if the universe is infinite and full of and infinite number of static stars, the night sky should be bright rather than dark…

De Chéseaux tried to mathematically express this paradox.



He imagined that the stars were uniformly distributed in concentric shells around Earth.
The first shell would have a radius R and a thickness ΔR, the second one a radius R+ΔR and a thickness ΔR, the third one a radius R+2ΔR and the same thickness ΔR, etc…

If we consider that ΔR is small compared to R, the volume of $shell_n$ would be $4\pi(R+n\Delta R)^2*\Delta R$.
As the universe is supposed to be isotropic, each shell contains the same number N of stars per unit of volume, so $shell_n$ would contain $N*4\pi(R+n\Delta R)^2*\Delta R$.
Now if each star has the same luminosity l the luminosity of each shell as seen from Earth is
$L=l*N*4\pi(R+n\Delta R)^2*\Delta R/(R+n\Delta R)^2$
or, after simplification:
$L=l*4\pi*\Delta R$
The first surprising result is that the luminosity of any shell is independent of the distance of that shell from the Earth. As viewed from Earth each shell produces the same luminosity (I let you ponder that result).
If the universe is infinitely large, there is an infinite number of shells and therefore the total luminosity is infinite and Earth, and you, and me should be cooked to a frazzle.
Actually, de Chéseaux estimated that the luminosity should be 180.000 times the luminosity of the Sun.
Later, Olbers remarked that the furthest stars must be hidden behind the nearest ones and he calculated that the luminosity of the sky should be equal to the luminosity of the surface of a star.
Which, obviously, is not the case as you can see for yourself on any night.

So, at least one of our hypotheses must be wrong; it could be that the universe is not infinite. In this case some lines of sight will never end on a star.
Or, it could be that the universe is not infinitely old and the light of the most distant stars has not yet reached us: in some directions there may be a star but we can't see it yet.
At the beginning of the 19th century both these hypotheses were anathema: if the universe is not infinite, where does it stop and what's beyond its boundary?
And, if it is not infinitely old it means that at one point in time, there was nothing and an instant later the universe was born out of this nothing.
So, as we said at the start, astronomers, scientists and philosophers of the early 1800s had no answer to the Olbers Paradox. However, it started the ball rolling, people began to consider that our universe might not be the immutable one their contemporaries imagined.

Jean-Luc Gaubicher

Sources: Wikipedia
Astronomes.com

PS Ok, I hear you, what if the interstellar medium was not transparent?
A certain amount of light would be lost in dust or fog clouds.
Well, not really, as these clouds would heat up as they would absorb the radiations and would ultimately reach the surface temperature and the luminosity of a star.
Back to square one…

Test Your Knowledge

Can you name this well known lunar crater and give some of its characteristics?
(Use a mirror to read the solution.)

Its diameter is approximately 109km and its wall goes up 3,000m above its floor.
Picture Jean-Luc Gaubicher.

Plato, aka the Great Black Lake, is an impact crater situated between Mare Imbrium and Mare Frigoris.
I'm sure all of you have recognized Plato.