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prime focus

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MAS Committee

President's Report: John Rombi

Welcome to the November (and final edition for 2010) of *Prime Focus*.

Wow, another year has passed by; I have a lot of people to thank for the great successes of this year, firstly Roger Powell. He has been a great support to me, helping to navigate the difficulties that such a busy year can bring.

The rest of the committee including our Webmaster Chris and PF editor Geoff have worked tirelessly to achieve these successes.

Magnitude was a great success, we learnt a lot about organising and presenting a project of this type and there is a whiff in the air that we may take it on the road in the New Year.

More about this, over the next couple of months.

As president, I am privy to personal confidential information conveyed to me by the membership.

I am overwhelmed by the great generosity between members (some anonymous)

What we have at MAS is the true essence of what a club should be, Friendship, a willingness to share a passion for our hobby and true feeling of family.

Don't ever lose it!!

Last Month

I would like to thank Chris Malikoff (our webmaster) for bringing us up to date with the use of our website.

If you have questions concerning the use of our site please contact Chris or myself for assistance.

Our "Golden Tonsils", Bob Bee, took us for a tour of the great observatories of Europe, with a tantalising peek into The Large Hadron Collider in Switzerland.

A big thank you to both for a very informative evening.

Patron

MAS have been privileged to have World-renowned Australian Astronomer, Prof Bryan Gaensler as our speaker on a number of occasions over the past two years.

Bryan has paid great compliments to MAS on its personal approach and

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MAS Dates 2010

November 2010

06/11/10	The Forest
13/11/10	Public Night; The Oaks
15/11/10	General Meeting

December 2010

04/12/10	The Forest
11/12/10	Stargard

President's Report: John Rombi

presentation.

The greatest compliment was directed to you the members, *"a very challenging and friendly group."*

Bryan accepted our invitation to become MAS Patron this time last year and I am very honoured to present Bryan tonight.

Public Nights

Hopefully our night (November 13th) will be/has been a great success. Along with our regular observing nights, the weather has not been favourable for these events.

Members private Observing Nights

Have unfortunately been hit again by the dreaded cloud. It has been at least FOUR months since our last clear night ANYWHERE!!

Observing sessions will continue as normal over the Christmas/ New Year break. **I will be compiling the dates very soon.**

What's on?

Keep an eye on our "What's on" link of our website for all the latest member information.

Committee Positions

As I mentioned at the last meeting, I will be not be nominating for a committee position at the next AGM in April 2011. This will leave a vacancy that needs to be filled to hold the committee at seven.

Please consider putting up your hand to join a group of hard working people, helping to guide MAS into the future.

Deep Sky Section.

Has unfortunately been neglected by me over the last couple of years. After the AGM, I would like to overhaul this area and encourage members to take up this very challenging, but exciting area of astronomy. Watch this space!!

Tonight

Prof. Bryan Gaensler (Sydney University) will be presenting "The Square Kilometre Array"

Since this is the last Prime Focus of 2010, On behalf of my family, I would like to wish you all, A very Holy & Merry Christmas and a Prosperous 2011!!

Until next year,

Clear Skies, John Rombi.

Secretary's Column: Roger Powell

While I was growing up (a long time ago) in North London, the opening topic of any conversation was usually "Dreadful weather we're having," although there were occasions when the sun came out and the temperature reached above fifteen degrees Centigrade. Then it was "lovely weather we're having".

I moved to Sydney and the weather was much warmer and consistently sunny. After the initial greeting of "G'day, owyergoin?" the conversation rarely touched the weather conditions. Unless, that is, you happened to be an amateur astronomer!

The clouds seem to have closed in on South West Sydney in recent months and the only official observing night to go ahead since August was at The Forest (in September). Since then, all four scheduled observing nights have been cancelled. Each occasion brings hope, followed by blind optimism after seeing the long term forecast, followed by disappointment and yet another depressing Saturday evening at home.

I reckon when we do eventually get some starlight to look at, there will be a record attendance of frustrated MAS members wanting to make the most of it.

Solar observing can be a great way to alleviate some of the frustration. I had my telescope out one afternoon recently with the solar filter attached and in between the clouds I managed to image some great sunspots. Unfortunately, an ordinary solar filter will only reveal sunspots and planetary transits, which are rare but I am looking forward to a Venus transit in 2012. I forecast a cloudy day!

To see prominences and other solar disturbances, you need a Ha filter or even a dedicated Ha solar telescope. Lloyd took his Lunt solar telescope to "Magnitude" at the Arts Centre last month and I thought we were in for a treat but it turned out to be mostly cloudy all week. However, in one brief sunny period Lloyd was able to show me my first solar prominence, an awesome outburst on the solar rim, several Earth diameters high.

It is great to see our members travelling around the world and coming back to share their astronomical experiences with MAS. At the last meeting, Bob Bee gave a great talk about the European observatories he toured

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Secretary's Column: Roger Powell

earlier in the year. In January, Tony Law will give a talk about his visit to the Mauna Kea Observatories, including the dual ten metre Keck instruments. In April we will hear from Daniel Ross about his experiences at Space Camp in the USA. You can see a sample of images taken by Tony and Daniel on the Members Photography Gallery of the website.

This month I am really looking forward to the return of Professor Bryan Gaensler, an elite astronomer from Sydney University who was recently recognised in the 2010 NSW Scientist of the Year Awards, as the winner in the *Physics, Earth Sciences, Chemistry and Astronomy* category for his achievement of building the world's leading research group for studying neutron stars and supernova remnants.

As many of you now know, John has announced that he will be stepping down from the committee at the next AGM, in April. This is a big disappointment to me and also to the rest of the committee, as John has been a superb leader of MAS. However, after four years as President John wants to hand over the reins to someone else and we need to accept that.

Our meeting on 15th November will be held in Building 21, at the opposite end of the Campus to our usual location. As always, thanks to the University of Western Sydney for making a meeting room available to us.

We've probably all forgotten how to use our telescopes but let's hope the weather is a bit kinder to us over the next few months.

Cosmological Distances the Then, the Now, and In-Between

Bob Bee

I've always had a fascination with things cosmological. That is, how does the whole Universe work? Not just the bits we can see with our own telescopes (maybe out to galaxies a few tens of millions of light years away), but everything back to the Big Bang, even past the Cosmic Microwave Background (CMB).

Apart from all the other fascinating aspects of cosmology, one particular question that has constantly plagued me is that of the 'true' distances to vastly distant galaxies and, in particular, the actual size of the 'observable' Universe.

It's common wisdom amongst us amateur astronomers to say that such and such a star cluster or nebula (within our Milky Way galaxy) is, say, 1,000 light years away, and so we see its stars as they were 1,000 years ago. Ditto for the closer galaxies, like M31 and M33 etc. We'll say the same thing about a galaxy (as maybe seen through the Hubble Space Telescope) say, 5 billion light years away, saying we are seeing it as it actually was 5 billion years ago. But is that correct? As we live in an expanding Universe, how far away from us was it when its light left it? How far did the light travel to us? How far away is it now?

We also say the Universe is 13.7 billion years old, so the Big Bang is 13.7 billion light years away, implying our Observable Universe is like a sphere 13.7 billion light years radius.

But, I often thought, how does all that fit with an ever expanding Universe? Surely galaxies have moved since the light left those distant objects. What are the 'true' distances? Think about this too much and one can easily get a head-ache.

I recently had my 'Eureka!' moment. Not by any cleverness of my part, but by way of a recent 'gold mine' of information on cosmology. I bought a 36 Lecture course (6 DVDs) from The Teaching Company, called **"Cosmology: The History and Nature of Our Universe"**, taught by Professor Mark Whittle, University of Virginia. Brilliant stuff! It covers anything an amateur could ever want to know about Cosmology. The course Guidebook gives an overview of all the lectures, and an Appendix at the back gives copious details of the relevant maths and physics of each lecture, if one is inclined that way.

Anyway, in one lecture Prof. Whittle covers in detail the very issues above that have bugged me. I sat up afterwards and said to the ceiling: **"So that's how it works!"**

I thought it may interest you, so here is a brief explanation as I understand it. I hope I can do it justice. Before I start, the good news is that for the Milky Way and our local cluster of galaxies, the expansion rate is so insignificant that the old idea is accurate. 1,000 (or 10 million) light years away means we see them as they were pretty much that many years ago, and they are still, effectively, that far way. Nearby galaxies can be described by Hubble's Law. This explanation is about much bigger distances.

Let's get a few terms defined first.

When a very distant galaxy is observed, there are three

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Cosmological Distances the Then, the Now, and In-Between

Bob Bee

types of distances to consider:

- d_{emit} = the distance to the galaxy when its light was emitted, that is, set out towards us. This happened at time t_{emit}.
- d_{now} = the distance the galaxy is from us now, when its light reached us, at time t_{now}.
- d_{LT} = the distance the light from the galaxy travelled to reach us, equals $c * (t_{now} - t_{emit})$.

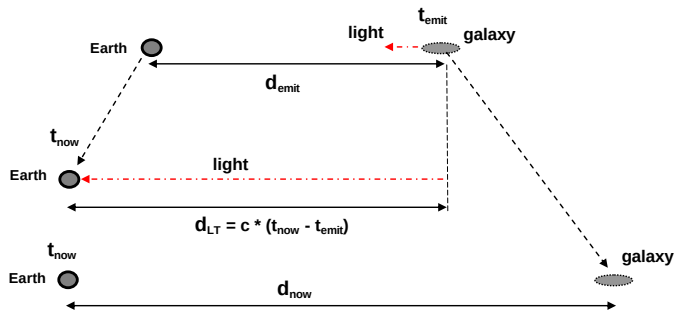
Intuitively, as the Universe is expanding, you can guess that $d_{emit} < d_{LT} < d_{now}$.

It can get complicated at this stage. To do proper calculations, you need to bring in:

rsf = redshift stretch factor. That is, the spacial stretching of the Universe between two points in time. In this case, **rsf** = d_{now} / d_{emit}, the increase in spacial scale between times t_{emit} and t_{now} that are under consideration. (Note: These times are taken from the beginning. That is, at the time of the Big Bang, t_{emit} = 0. Our current t_{now} = 13.7 Byrs.); and

S = Scale (or size or separation) Factor, which describes the history of the Universe's expansion. It starts from 0 (zero) at the Big Bang and is one (1) now. It's a curved line that is a function of time S(t) (where t is measured from the Big Bang) that takes into account the various rates of expansion with gravity slowing it down initially, then dark energy starting to speed it up again. Cosmologists (of course), have precise quantitative values for this curve for any given value of **t**, using it to compute the value of t_{emit} for a given value of **rsf**.

I have attempted to represent the overall affect with the diagram below. Please note it is definitely NOT TO SCALE. It just illustrates the concept.



In the diagram, a galaxy that is d_{emit}, say 3 billion light years, distant from us at time t_{emit}, sends out its light towards us.

After that, the space between stretches with universal expansion, so the galaxy's light is 'chasing' us as we mutually recede. Ultimately it catches up with us at time t_{now}.

The distance the light has actually travelled to us, d_{LT} is given by the formula:

$d_{LT} = c * (t_{now} - t_{emit})$, where c = speed of light.

For this example, d_{LT} = 5 billion light years. That is NOT the distance to the galaxy. It really means "we are seeing it 5 billion years ago". That is, we are seeing a look-back time of 5 billion years.

So how far is the galaxy actually away from us at t_{now}? In this example, it would be 6 billion light years.

My 'eureka!' moment came after I worked though this, plus the more complex calculations involving **rfs** and **S** which I have left out of this article. It's not super difficult, but involves a lot of algebra and a bit of calculus.

As we look at even greater look-back times, the numbers grow more extreme (and interesting). Another example for when **rfs = 3**, without the derivations, is:

- d_{emit} = 5 billion light years
- d_{LT} = 10.5 billion light years (look-back time = 10.5 billion years)
- d_{now} = 15 billion light years. (Notice that this is MORE than 13.7 billion light years?)

The really interesting calculation, though is: What is the current radius of our Observable Universe? What are the distances to the CMB? The calculations using an **rsf ≈ 1000** for the CMB and t_{emit} **= 0**, gives:

- d_{LT} ≈ **13.7** billion light years (look-back time to CMB ≈ 13.7 years)
- d_{now} ≈ **46 billion light years. That** is the Observable Universe's current radius, not 13.7 billion light years.

Eureka!

(***Reference***: The Teaching School Course Guidebook, "Cosmology – The History and Nature of our Universe" 2008 - Mark Whittle Ph.D.)

Large Binocular Telescope

Davy Jones

So – what do you do whilst bored out of your skull sitting in a hospital bed? Answer – watch TV at $8 per day! At least there was a decent choice of channels on offer. I love a silver lining. J

One program of particular interest concerned the LBT – the *Large Binocular Telescope*. For those who are familiar with this 'scope' – it is certainly worth another look at the moment and into the foreseeable future. For those not familiar with the 'scope' – all I can say is 'fill yer boots'. This one is certainly worth watching as developments unfold. Whilst I do not intend to either "teach granny to suck eggs" – nor instruct the uninterested – I would like to at least provide a list of easy references for those fascinated in such magnificent paraphernalia.

The National Geographic show actually follows the construction of the LBT from its inception. Because of its location – 3,300 m up on Mount Graham, in the Pinaleno Mountains of southeastern Arizona (actually part of the Mt Graham International Observatory) – in virgin country – the wishes of conservationists had to be taken into account during construction. Environmentalists and local Indian tribes actually filed some forty lawsuits in an attempt to thwart the construction of the LBT on its preferred site. This led to some extraordinary technical and mechanical acrobatics to avoid environmental damage of any kind.

Likewise, the manufacture of the mirrors took place on the east coast of the USA – whilst the actual site for the telescope is on the west coast. Thus, the logistics of the transportation of the mirrors – one of the longest journeys involving such a huge load ever to be undertaken – is also discussed in detail. Not least of the considerations for the rail journey was the need to provide bullet-proof protection for the precious cargo! Thus – if you ever come across the DVD – grab it – it is worth watching. *(Although I can't trace a DVD at the time of writing)*

In the meantime I enclose a short list to start you off on an interesting and currently unfolding story of amazing cosmological exploration:

http://en.wikipedia.org/wiki/Large_Binocular_Telescope

http://www.physorg.com/news195838118.html

http://www.astronomy.com/en/sitecore/content/Home/News-Observing/News/2010/06/Large%20Binocular%20Telescope%20achieves%20major%20optics%20breakthrough.aspx

This one's a cracker: http://medusa.as.arizona.edu/lbto/

Pamphlet: http://medusa.as.arizona.edu/lbto/LBT%20Brochure/LBTbrochure%20January2010.pdf

National Geographic: http://ngm.nationalgeographic.com/2009/07/telescopes/ferris-text

http://www.atomicmpc.com.au/News/151868,large-binocular-telescope-better-than-hubble.aspx

I've no doubt there are more – but if this doesn't whet your appetite then nothing will. Enjoy.

It Is Amazing Who You Meet on the Moon Pt 10: Lunar Crater Maxwell

David M Jones

The special theory of relativity owes its origins to Maxwell's equations of the electromagnetic field. Albert Einstein (1879-1955)

Lunar crater Maxwell is a crater on the far side of the Moon named after the physicist James Clerk Maxwell (1831-1879). Situated in the southwestern part of the larger crater Richardson, the southern part of Maxwell is overlain by the partly flooded Lomonosov. Attached to the exterior along the south-southeastern rim is the smaller crater Edison. Less than one crater diameter to the southwest is the larger Joliot. The remaining outer rim of Maxwell is uneven and ill-defined where it overlies crater Richardson. Whilst worn and eroded, the western edge is fairly well organised. The interior floor is reasonably level with patches of low-albedo (*low-reflective*) material; usually indicative of basaltic lava. The floor shows evidence of material from the ray system of Giordano Bruno, located to the north-northeast, which has lightened the surface. (Encyclopedia, 2010)

Born at 14 India Street, Edinburgh, Scotland on the 13th of June 1831, James Maxwell, an only child, was last in line of the influential Scottish family of *Clerk* of Penicuik. Raised in a deeply Christian family, he was home educated by his mother until the age of eight, when she died. His talents and scientific curiosity were

It Is Amazing Who You Meet on the Moon Pt 10: Lunar Crater Maxwell

David M Jones

evident from an early age. As a boy he is recorded as having more interest in undertaking small scientific experiments over playing with toys and, curiously, memorising all one hundred and seventy-six verses of Psalm 119:1. Incidentally, this Psalm is an acrostic poem in which the verses of each stanza begin with the same letter of the Hebrew alphabet. (Biblica, 1984)

After the death of his mother, young Maxwell continued his education at the Edinburgh Academy; where on his very first day he arrived dressed in a parochial manner, complete with home-made shoes. Naturally, his peers were quick to give him an unkind schoolboy nickname – *"Daftie"*. Apparently, he never objected to being thus named and his lack of negative response eventually gained him the respect of the other students. He was known to have carried the nickname in a more kindly tone right into adulthood. Maxwell's first recorded academic paper was written in 1845 – when at the ripe old age of fourteen, he published a paper describing a mechanical means of drawing mathematical curves with a length of string.

James Maxwell's adult education continued from the age of sixteen, when in 1847 he attended the University of Edinburgh. There he studied natural philosophy, moral philosophy, and mental philosophy until the age of about nineteen. In 1850, he left to attend Cambridge University Peterhouse, but eventually moved to Cambridge Trinity House, where he believed it would be easier to gain a fellowship. Maxwell graduated from Trinity House in 1854; he graduated with a degree as second wrangler in mathematics – scoring the second highest results in the math's exams. As I understand it – a *"wrangler"* is a student who has completed the third year or Part II of the Mathematical Tripos with first-class honours. (Encyclopedia, 1999) It is noted that a substantial part of the translation of Maxwell's electromagnetism equations was completed during his time as an undergraduate at Trinity; these equations are cited as being Maxwell's most significant scientific triumph. The equations verified that *electricity* – *magnetism* – and *light* are all manifestations of the same observable fact – the electromagnetic field. *(See Maxwell's Equations)*

One recurring point of fascination for me throughout this series is the number of times I have come across instances of 'thought experiments' (German - Gedankenexperiment) carried out by various theorists. Probably the most well-known of these would be Schrödinger's cat. In Maxwell's case – read up on Maxwell's Demon. Simple soul that I am – the notion that a hypothesis can be proven by pure mathematics long before it is ever physically observed, never ceases to amaze me.

James Clerk Maxwell's scientific accomplishments were wide ranging, in addition to his work on electromagnetism he also worked on the viscosity of gases, thermodynamics, and colour – producing the world's first colour photograph.

Maxwell was also the first to make explicit use of the problem-solving method known as dimensional analysis. Maxwell is rightly considered by many in his field to be the 19th century scientist to have had the most profound influence on 20th century physics. His intellectual gifts to science are seen as being on a par with those of Sir Isaac Newton and Albert Einstein.

A point of specific interest for those who often gaze upon the wonders of Saturn and her rings; for two years Maxwell focused on a puzzle which had evaded scientists for two-hundred years: the NATURE of SATURN'S RINGS. It was unknown how the rings could remain stable without breaking up and drifting away into space or, in fact, being pulled to the planet's surface. Again – with the aid of mathematics – Maxwell concluded the rings must comprise of numerous small particles, he called 'brickbats' – each independently orbiting the planet. His work was so detailed – an essay he wrote, entitled "On the stability of Saturn's Rings" won the 1859 Adam's Prize, a grand sum of £130. His mathematical calculations were of course finally confirmed with the Voyager flybys of the 1980s. (Encyclopedia, 2010)

James Clerk Maxwell's legacies are multitude – the maxwell (Mx), a compound derived CGS unit measuring magnetic flux – Maxwell Montes, a mountain range on Venus – the Maxwell Gap in the Rings of Saturn – The JCMT – the largest submillimetre-wavelength astronomical telescope in the world, with a diameter of fifteen metres – the 1977 James Clerk Maxwell building of the University of Edinburgh – the James Clerk Maxwell Building at the King's College in London – the £4 million James Clerk Maxwell Centre of the Edinburgh Academy – James Clerk Maxwell Road in Cambridge UK – the University of Salford's main building named after him – Maxwell bridge, a bridge circuit breaker – a statue on Edinburgh's George Street – a street in Aberdeen's Kincorth area – and of course a lunar crater.

Maxwell was also known for his love of poetry – which he used to memorize. He also wrote his own verse – perhaps much like our good friend Professor Fred Watson. One of Maxwell's' best known verses is "Rigid Body sings" – based on the tune, "Comin' Through the Rye" (Burns) – to which he is said to have accompanied himself on guitar. The opening lines are thus:

Gin a body meet a body Flyin' through the air
Gin a body hit a body. Will it fly? And where?

James Clerk Maxwell married Katherine Dewar when he was twenty-seven. The union was childless. On the 5th of November, 1879, James Clerk Maxwell, then aged forty-eight, died prematurely of abdominal cancer. *Requiescat in pace*.

It Is Amazing Who You Meet on the Moon Pt 10: Lunar Crater Maxwell

David M Jones

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Astronomy on our holiday and at home.

Ursula Braatz

We went for a holiday to Queensland – Whitsunday Islands from the 16.7.10 to the 29. 9.10. It took us five days to get there. We camped on different places. It is good to be away from the lightpolluted Sydney sky and see the stars better again.

In the Whitsundays we camped in Seabreeze Caravanpark, Cannonvale, less the 3 km from Airlie Beach, which is a nice Tourist Town. There is a big lagoon, wonderful for swimming. There are a lot of other things to do like fishing, walking on the beach and in the town and so on. Sometimes I was too tired at night to do star gazing, but I always did something in Astronomy.

On the 13.8.10 I watched the sickle moon, Mars, Venus and Saturn with binoculars in the west and on other nights I observed with naked eyes. I could see the Southern Cross and Scorpio at night and Orion early in the morning. Jupiter was there around 9.00pm and very bright. Once I took my telescope out and had Jupiter with its 4 moons in focus. Sometimes I went on a computer in an internet cafe to get information from the internet. I received Physicsworld, Spaceflight now and webmaster. I received the message from John Rombi on the 21.9.10, that Jupiter is now closer to Earth, the red spot is better to see and we could see Uranus blue-green next to Jupiter. But I had bad luck; it was cloudy that night and the other night. I read about Jupiter in Spaceflight now too and I did read a lot of other interesting astronomical articles.

Now I am on my computer at home again and I can print articles too. I printed an article from webmaster ABC Science: “Study predicts end of world as we know it”. - The universe could end within the Earth's lifespan – less than 3.7 billion years from now. Our universe is like a bubble which will burst. There are other universes – multiverse bubbles, like bubbles in boiling water. It is mindbending , to think about this.

For us human beings the solar system is big, but it is small against our Milkyway galaxy. But our galaxy is little against the galaxy clusters and super clusters which look like cheese or so. This is our universe, only one bubble in a million? It is only a theory, but I can't help thinking about it; that behind our universe must be something.

With the “ Very Large Telescope” Astronomers discovered a galaxy 1.3 billion light years away, when the universe was only 600 million years old. What would we see with a telescope which can see further then 13.7 billion light years away? More galaxies, the big bang or only darkness? If there are multiverse bubbles how far away is the next bubble from our universe bubble? To think about millions of bubbles is weird and mind-bending.

Prime Focus
Article Submission

Deadline for article submissions for the next edition of Prime Focus is

Monday 10th January 2011

All Articles can be submitted via email editor@macastro.org.au
Or via snail mail to the MAS Postal address

PLEASE NOTE THE CHANGE OF EMAIL ADDRESS FOR SUBMISSIONS!!!