PRIME focus

MAS SOCIETY JOURNAL

macarthur astronomical society

NASA celebrates 30 years of Hubble
NGC2014/2020 - Image Credit: NASA

may 2020
volume 20 issue 02

contents

top of each page:
return to menu

from the editor

Hello, and welcome back to our re-booted PRIMEfocus. M.A.S. presents to you our May 2020 edition - volume 20, edition 2. In this edition, we start to enjoy contributions from several external sources.

To those of you who are connected to M.A.S. via our website, FaceBook group, Twitter or elsewhere, welcome to our Society and please feel free to join in. For the first time, this magazine will now be made available to all who'd like a copy each month, not just our financial member base.

I'd like to welcome, and sincerely thank, some new contributors this month. We have our patron Prof. Geraint Lewis, professional astronomer Emil Lenc and Jackie from the One Giant Leap Australia Foundation. We thank you all and trust that your association with us if mutually enjoyed and beneficial.

We'll see you all for the June edition.

Clear Skies!
Chris Malikoff

Image: Eta Carinae Composite© Chris Malikoff (MAS)
A composite image made up of data from various cameras and telescopes.

president's report

JOHN ROMBI

Dear Members,

Well, Covid-19 continues to rule our lives, but there are ways to break the monotony. Astronomy is a versatile hobby, and you certainly can't go past the excellent information available in PRIMEfocus. I would like to thank all our contributors for their excellent articles in our first PRIMEfocus edition.

Speaking of PRIMEfocus, our Patron Professor Geraint Lewis (Sydney University) has agreed to pen an article each month. I'm looking forward to Geraint's articles, his research has you thinking all the time.

There maybe an opportunity for you the readers, to ask questions of our contributing editors. Hopefully for the next edition!

Like most of you, I miss observing at our dark sky sites at Stargard and the Forest. To keep myself busy, I have decided to completely strip my 14 year old Meade Lightbridge 12". It involves repainting, checking the fidelity of wiring, washing both mirrors and generally passing a dedicated eye over everything. It's a labour of love, and I hope to have the job finished in the next couple of weeks.

What have you been up to, astronomically speaking?

ALL our outreach is again on hold, and will continue along this vein until the end of the year. Member observation at our dark sites is also on hold for the foreseeable future.

Thank you to all the members that attended our AGM last month, great to catch up with you. Our next Forum night will be on Monday May 18th, our speaker from Western Sydney University will be Dr Luke Barnes. His topic will be "The Cosmic Revolutionary's Handbook (Or: How to Beat the Big Bang)". The Forum will be broadcast via the Zoom app, and only be available to financial members of the MAS.

If you have questions please don't hesitate to contact me at president@macasto.org.

Until next month, Keep your feet on the ground, but keep reaching for the sky.

John Rombi
President, MAS

patronage

PROF. GERAINT LEWIS

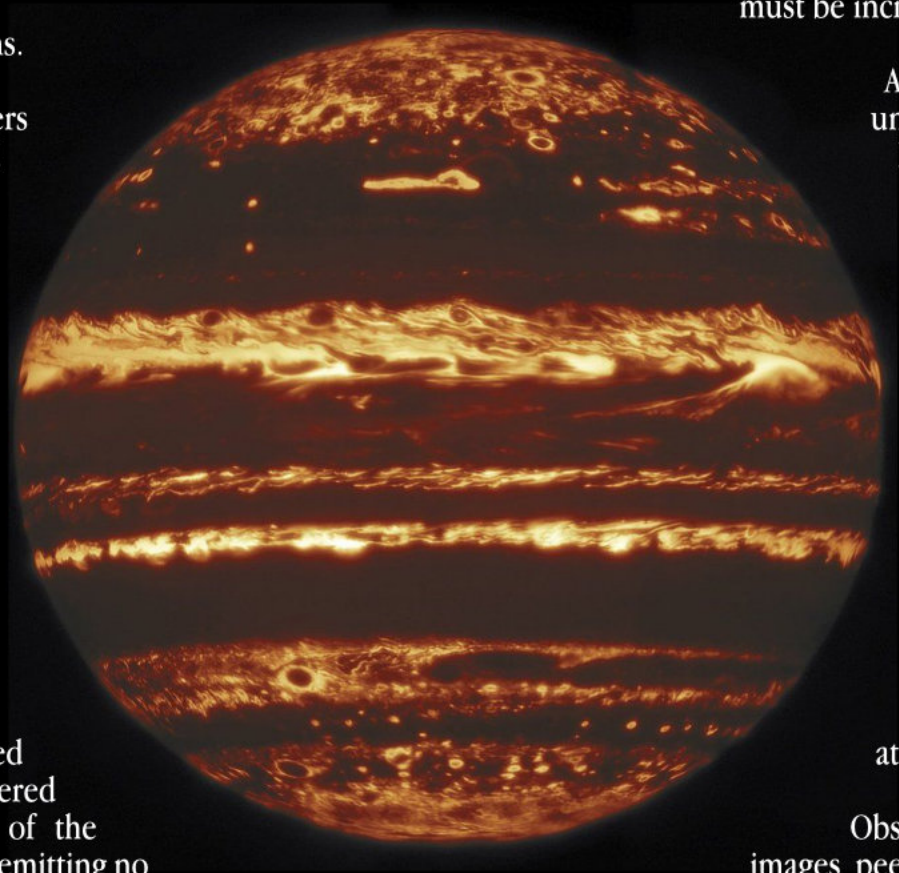
View from the Trenches: Issue 1

In the last few months, the world has been unexpectedly turned upside-down. Astronomy has not been spared, with most of the major observatories around the globe closed as part of national lockdowns. But, there is a glimmer on the astronomical horizon, as telescopes are slowly and carefully restarting operations.

Research never stops. Astronomers continue to pore over their data and work on their theories. Like the universe, our understanding continues to expand, exciting discoveries are still being made. Let's take a look at a few of them.

Recently, European astronomers claim the discovery of the nearest black hole to the Earth. At only 1000 light-years and being about four times the mass of the Sun, this black hole revealed itself through its gravitational pull on orbiting stars. Some astronomers think that there could be more than a hundred million of these black holes scattered through the Milky Way - the result of the explosive death of massive stars. But, by emitting no light, they are very difficult to find. This new result could mean that, galactic-ally speaking, black holes are just around the corner.

Also hidden within the Milky Way was the detection of an extremely energetic events, one of the most intense in the universe. This immense outpouring of energy was seen by CHIME, the Canadian Hydrogen Intensity Mapping Experiment (who said astronomers ain't cool with acronyms) and was linked to a neutron star with an intense magnetic field, known as a magnetar. As well as radio waves, astronomers also saw a burst of X-rays and gamma-rays, the most intense forms of light, showing that these tiny objects, only 10 to 20 km across, must be incredibly violent places.



Astronomers are still struggling to understand the physics of what is happening in these extreme environments, but solving this mystery is likely to reveal details about the fundamental make-up of the universe.

And, finally, American astronomers have used the Gemini Telescope in Hawaii to observe Jupiter. This should not be a surprise, as we all know Jupiter is a beautiful thing to look at, but these astronomers used "lucky imaging", where thousands of short exposure images are taken, keeping only the sharpest ones where atmospheric distortion is minimal.

Observing in the infra-red, these spectacular images peer deep into the clouds and reveal the swirls and whirls in Jupiter's thick atmosphere. Check them out, they are quite wonderful!

https://phys.org/news/2020-05-gemini-lucky-deep-jupiter-clouds.html

Geraint

GEMINI OBSERVATORY/M.H.WONG ET AL

the armchair radio astronomer

EMIL LENC

Welcome to what I hope will be regular news updates in the field of radio astronomy with a focus on SKA (Square Kilometre Array) and ASKAP (Australian SKA Pathfinder).

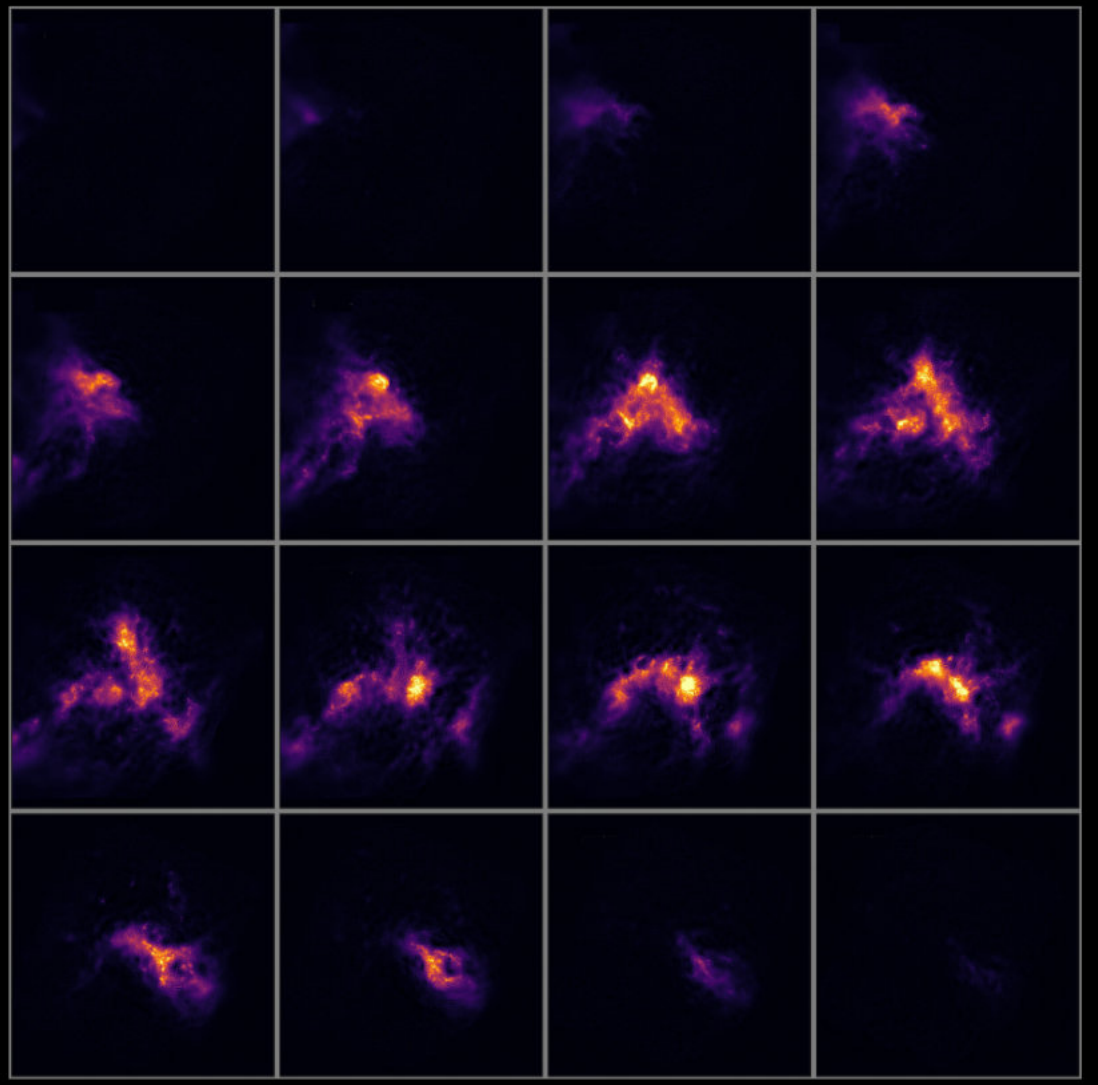
Despite being a shocker year with drought, fires and now COVID-19, progress with ASKAP has continued with operations and science being performed remotely. Currently, ASKAP is taking pilot survey observations for the science teams so they can test their (and the telescope's) readiness in preparation for full survey science.

The first team up to bat is GASKAP - they aim to study neutral hydrogen gas (the raw fuel for stars) in the Milky Way and our nearest neighbours the Small and Large Magellanic Clouds (SMC and LMC). Neutral hydrogen emits at a very specific radio frequency (1.420405752 GHz) but this increases or decreases depending on whether the gas is moving towards or away from us - just like a passing train changes pitch.

To study this gas, GASKAP uses both the wide field-of-view available with ASKAP and a feature that allows very fine frequency tuning to distinguish between small changes in velocity. This particular observing mode generates data at a rate of 4 Terabytes per hour and so pushes networks and high performance computing systems to their limits.

As part of the pilot survey, GASKAP observed the SMC - a peculiar satellite galaxy of the Milky Way. Using advanced image processing techniques they mapped the density and velocity of neutral hydrogen in the SMC.

Each frame in the image shown highlights parts of the SMC that are moving at specific velocities with velocity decreasing from left to right and from top to bottom. These new observations will provide insights into how the SMC rotates and interacts with our own galaxy.



tony's law
the local group

TONY LAW

Seeing Roger Powell's recent images of the Large and Small Magellanic clouds, our neighbouring dwarf galaxies, prompted me to investigate further.

What is our Local Group of galaxies, how can I see them?

The term "The Local Group" was introduced by Edwin Hubble in his 1936 book The Realm of the Nebulae. There, he described it as "a typical small group of nebulae which is isolated in the general field"

and delineated, by decreasing luminosity, its members to be M31, Milky Way, M33, Large Magellanic Cloud, Small Magellanic Cloud, M32, NGC 205, NGC 6822, NGC 185, IC 1613 and NGC 147.

He also identified IC 10 as a possible part of the Local Group.

By 2003, the number of known Local Group members had increased from his initial 12 to 36.

Two massive bright spirals, the Milky Way and the Andromeda Galaxy (M31, NGC 224), dominate this gravitationally-bound group of around which spans a volume approximately 10 million light years in diameter.

Also prominent is the Triangulum galaxy (M33, NGC 598), a smaller spiral which (under very dark, clear conditions) is the most distant naked-eye object visible.

The rest of the Group is made up of smaller, fainter dwarf galaxies, many of which are satellites of the Milky Way or M31. However, the group is very dynamic and membership of the Group is probably changing over time as galaxies interact with, and move between, other nearby groups such as the Maffei 1 Group, the Sculptor Group, and the M81 and M83 Groups. Although the position and radial velocity of local galaxies can be measured accurately, their distances can be difficult to determine, and the total membership of the Local Group remains uncertain.

The Large and Small Magellanic Clouds (LMC and SMC) are small well-known Milky Way companions, but nearer to our Galaxy are the more recently discovered Canis Major Dwarf and Sag DEG (Sagittarius Dwarf Elliptical Galaxy). Sag DEG is apparently being disrupted by tidal gravitational forces in its close encounter with the Milky Way. Local Group galaxies and subgroups are interacting gravitationally with each other (and with neighbouring groups) and mergers and collisions are thought to have happened in the past and speculated for the future. For example, Andromeda and the Milky Way are approaching each other at around 120 km/s and astronomers suggest that in several billion years they may merge to form a giant elliptical galaxy.

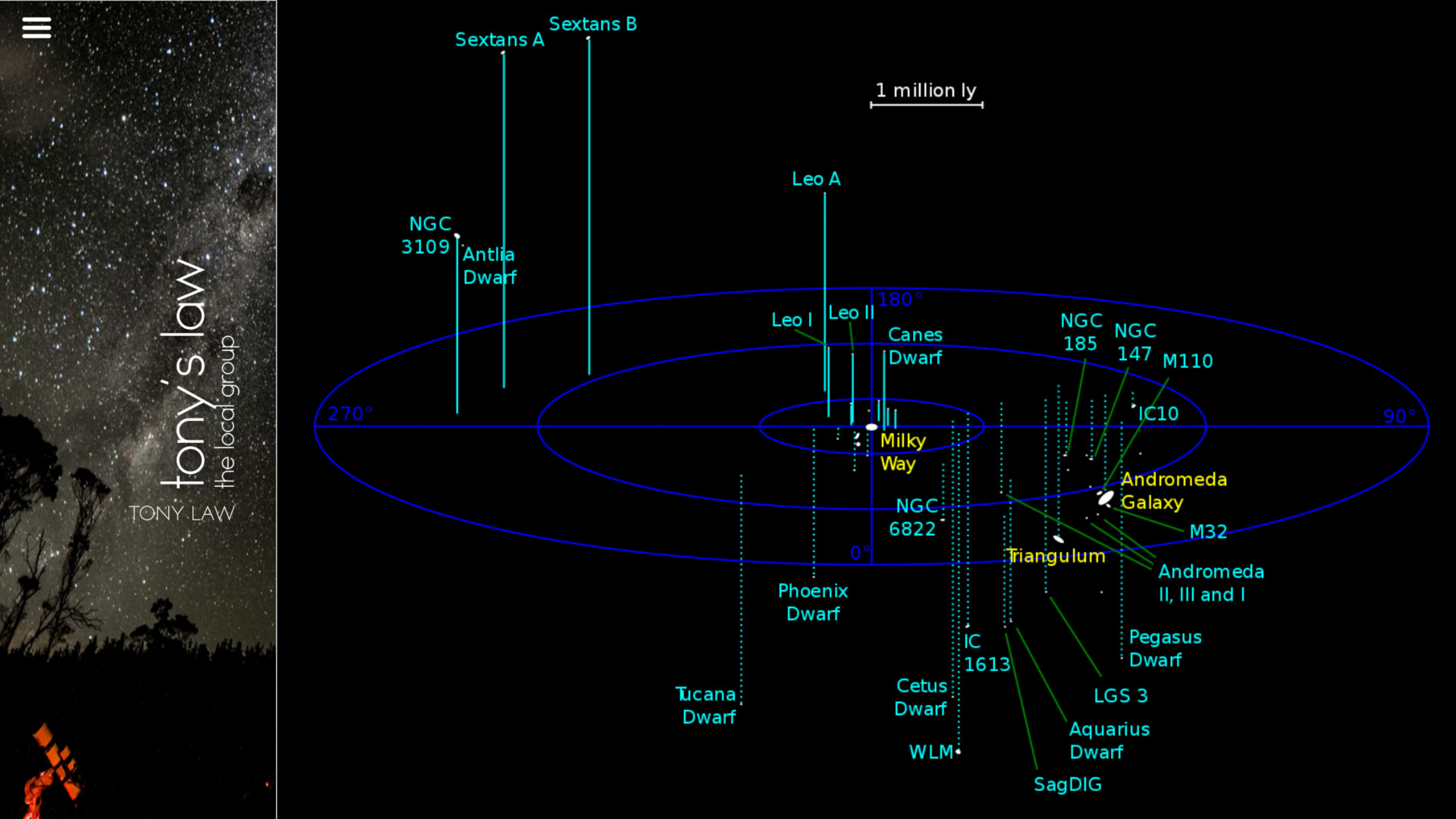
Some members of the Local Group:

Galaxy name	Approx distance (ly)	Approx diameter (ly)
Milky Way (MW)		100,000
Canis Major Dwarf	42,000	5,000
Sag DEG	50,000	10,000
LMC	179,000	30,000
SMC	210,000	16,000
Andromeda (M31)	2,650,000	140,000
M32 M32 (NGC 221)	2,600,000	8,000
M110 (NGC 205)	2,650,000	15,000
Triangulum Galaxy (M33)	2,850,000	55,000

Though gravitationally bound it appears that the Milky Way and Andromeda are heading towards each other at 123km/sec, but don't worry at that speed it will be about four billion years before they may merge to form a giant elliptical galaxy!

Information gleaned from Wikipedia, Swinburne Astronomy, NASA et al

Image Tony Law and diagram attributed to Richard Powell

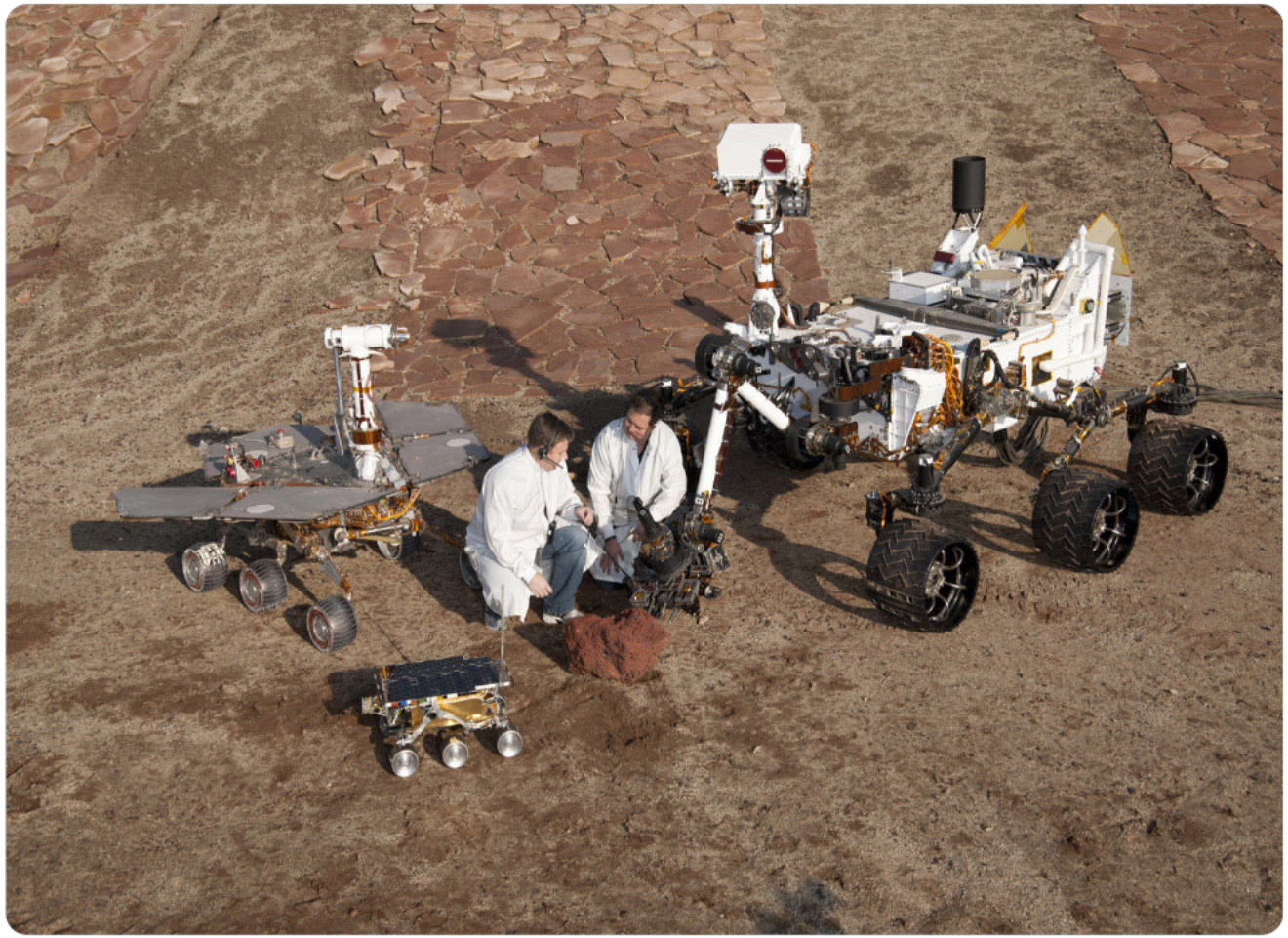

tony's law
the local group
TONY LAW
Sextans A
Sextans B
1 million ly
Leo A
NGC
3109
Antlia
Dwarf
180°
Leo I
Leo II
Canes
Dwarf
NGC
185
NGC
147
M110
IC10
270°
90°
Milky
Way
Andromeda
Galaxy
NGC
6822
M32
0°
Triangulum
Andromeda
II, III and I
Phoenix
Dwarf
IC
1613
Pegasus
Dwarf
Tucana
Dwarf
Cetus
Dwarf
LGS 3
Aquarius
Dwarf
WLM
SagDIG

Perseverance and Ingenuity!

My early memories of robots and space are of the Thunderbirds, Jetsons and the space family Robinson – "Danger, Will Robinson!". Whilst in 2020 we use treadmills to walk dogs, and we have a robot that vacuums the floor, plus experimental drone taxis and other remarkable things – the real advances are being driven by our urge to 'boldly go where no man has gone before'.

Robotics is a branch of engineering that involves the conception, design, manufacture and operation of robots; devices that operate autonomously or under pre-programmed control.

Many people think that the Mars rovers can be driven much like you drive a toy radio-controlled car. They imagine a rover driver watching a computer screen showing the rover on Mars and moving a joystick to make it go. The reality is not so!



The time it takes for a command to reach the surface of another planet (such as Mars) varies with the distance between the planets involved. This prevents any "joy-stick" driving in real time. The commands travel via radio waves at the speed of light and can take many minutes to reach their destination.

A lot can happen to an interplanetary robotic vehicle during this time interval. If, for instance, a command was given from the Earth-base for it to go forward on Mars and the Earth-base got a reply (say 12 minutes later) saying that the rover was indeed traveling forward. It would then take another 12 minutes to send a command from the earth-base to stop the rover. If the rover runs into trouble, crashes, or flips over, there is no one there to fix the situation. The rover mission is over!

In real remote sensing operations using robotic vehicles, NASA uses "smart rovers." Rovers are programmed with Artificial Intelligence that helps to keep it out of trouble. In fact, just last week NASA JPL announced a citizen science project that we can all contribute to. Register and assist in creating the algorithms for the Mars Rovers. Here is the link to get you started! http://ow.ly/tloO50zryDR

As you can see from the main photo, there

one giant leap

ONE GIANT LEAP
FOUNDATION AUSTRALIA

have been huge developments in the capability of the Mars rovers. You just need to look at the plans for the Mars 2020 launch and then subsequent landing on Mars around February 2021.

https://mars.nasa.gov/mars2020/

The rover mission is part of the NASA Mars Exploration program which is a long-term effort of robotic exploration of the red planet.

In fact, NASA is sending a rover AND a helicopter. The rover has been named 'Perseverance' and the helicopter is 'Ingenuity'.

If you are interested in creative Mars Rover ideas, here are some activities that you might like to try:

This is a free online Mars Rover game where you direct the rover.

https://spaceplace.nasa.gov/explore-mars/en/

You can design and build a rover out of pasta:

https://www.jpl.nasa.gov/edu/teach/activity/planetary-pasta-rover/

Make a cardboard rover:

https://www.jpl.nasa.gov/edu/learn/project/make-a-cardboard-rover/

One Giant Leap Australia Foundation specialises in space STEM education. Presently we have an opportunity for students 15 years to graduate level to operate robots on the International Space Station for free.

The challenge: A meteor has crashed into the International Space Station (ISS) and the air is leaking out somewhere. As a team, create your own program to operate Astrobee and Int-ball and stop the ISS air leakage. Find out more here: www.kiboaustralia.com.au

You will find plenty of fun activities if you follow our Facebook page: https://www.facebook.com/onegiantleapoz/

For information on our programs, head to our websites:

One Giant Leap Australia Foundation: https://onegiantleapfoundation.com.au/

One Giant Leap Australia: www.onegiantleapaustralia.com

Image source: jpl.nasa.gov

cosmic focus

the universe, and all that...

ROGER POWELL

Exomoons and Double Planets

I wrote last month about how and why the Moon was defined as a natural satellite by the International Astronomical Union. The IAU does not classify objects simply by size. If it didn't take other factors into account, then the sheer size of Ganymede, Titan and even Callisto would require consideration as planets.

I posed the thought that the Earth-Moon System, which is of course defined as a planet/satellite system, could easily be thought of as a double planet system. If the Moon were orbiting the inner solar system in it's own right, it would most likely be defined as a planet.

It got me wondering whether any exoplanets had yet been discovered which had natural satellites orbiting them - and how they would be classified.

There are over 4,100 known exoplanets but no exosatellites have been listed yet. That's not surprising when you consider that Pluto was thought to have no Moons until Charon was discovered in 1978 by the United States Naval Observatory.

Most likely our ability to detect them has not yet developed sufficiently but if exoplanets with large diameter natural satellites do not exist, what implication would that have on the search for extra-terrestrial life? The Moon is believed to have played an integral part in the evolution of living organisms on Earth.

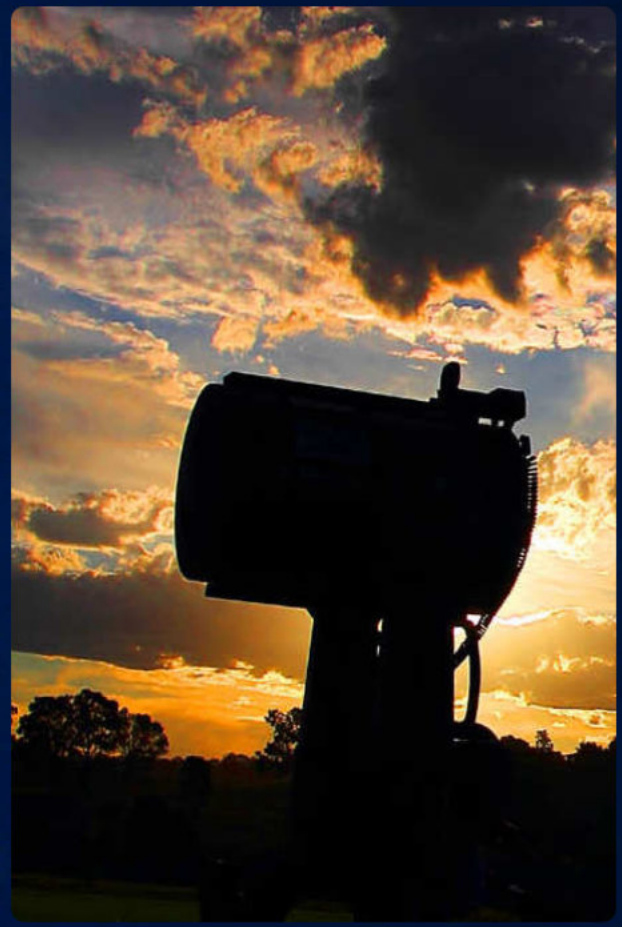
The question of double exoplanets is bound to come up eventually and the IAU will need to define the difference between (a) exoplanets with exosatellites and (b) double exoplanets.

That definition would need to be consistent with the current definition of the Moon as a satellite of Earth. So a double exoplanet might be defined to require, for example, (a) the barycentre to be external to both objects; and/or (b) a satellite/planet size ratio of perhaps no less than 0.5.

In the Earth-Moon system, the barycentre (common centre of gravity) lies about 1,700 km below the Earth's surface and the Moon's diameter is only 0.27 of Earth's.

Whilst accepting the IAU definition of a planet, I reckon any aliens observing our solar system from afar would be saying, "look at that, a double planet!"

Reference:
https://en.wikipedia.org/wiki/Barycenter#Gallery



Main Background image: Moon by Day © Roger Powell (a Astronomical Society)
Silhouette © Roger Powell (Macarthur Astronomical Society)

back to basics

NOEL "richard stargard" SHARPE

These articles are written to assist those of us who are very new to this hobby, so just to quickly recap last month's column.

Always dress as if it's winter when heading out, even the warmest of summer days nights can turn cold. Jackets and beanies can be left in the car, ready to go if needed.

Bring insect repellent, the mozzies are relentless. Take a chair, a thermos of a warm beverage, some snacks. Cheese and crackers are my favourite. A red torch or, in lieu, several layers of red cellophane taped over any torch will do for now.

Using your telescope, insert the highest numbered eyepiece into the focuser, that will give the lowest magnification and a wider field of view. Locate the Moon and adjust the focus knobs for a clear view. Make sure all the nuts and bolts are tight so the scope won't wobble about too much on its base or tripod. I have had so many discussions with people who find these simple steps to be on the difficult side. The result being a telescope ends up in a cupboard and rarely used. So why does this happen?

Let's get down to some really simple basics. Like everything in life, you get what you pay for. Very few things meet your total expectations and disappointment comes easy if you're not prepared. And, there's a lack of real help when you need it. I am describing my experiences with my first telescope.

Those fantastic and wonderful images on the box draw so many in - yet it is false advertising. In my case I went for the thing that looked like a beast in the army disposal store, Westfields Parramatta in 1995.

On display was this scope that had weights, cables, knobs and things, shiny black in colour on a large wooden tripod and it was huge! Well, I thought so. Did I know how to use it? No, I didn't.

***

I think in the last article I mentioned that we would talk about the finder scope, but I'm postponing that for now. Instead, let's talk about the different types of scopes available. One has a lens at the top of the tube, and you put the eyepiece at the rear of the tube, that's called a "refractor." The other main type has a mirror at the bottom of the tube and you put the eyepiece at the top of the tube. That's called a "reflector". All telescopes need to sit on something - either a tripod, or what I like to call a "rocker box" design called a "Dobsonian".

For now, I'm assuming with respect that you know nothing, and that's a great place to start. I think that it's important to gain some enthusiasm, and a view of the moon through any telescope is amazing. I would also like you to just see stars. Any stars will do, but remember that you need to turn the focus knobs until the stars are tiny points of light. But sadly, even these tasks can be difficult, and that's why its so important to only insert the highest numbered eyepiece you have into the focuser. So please ignore anything labelled "Barlow". I might clarify - if you have a refractor you will need to insert the "star diagonal" first into the draw tube, then the eyepiece otherwise you will not reach any focus.

Let's try your 25mm eyepiece. The number is written on the barrel. Most entry-level scopes will have a focal length of around 1,000mm. Divide 1,000 by 25 and you get 40x magnification. That's four times more power than most binoculars. Just for now, hunt around the night sky with that sort of power, it will give a wider view of the stars and some crisp and bright lunar craters.

Happy Scoping
Noel Sharpe
The Novice Astronomer

Important: NEVER look at the Sun through a telescope - severe eye damage or blindness will result. This is NOT a "maybe".

tech stuff

CHRIS MALIKOFF

"Perfect Software?"

Whilst I admit that I haven't sampled **all** of the astrophotography-relevant imaging software previously or currently on offer (because there's been quite a lot of it), I've been searching for years to find the most suitable to my own needs as I downsize my equipment for travel. Those requirements have constantly changed as my astronomy and computer equipment evolves, but I think that I've may have settled on a package that will satisfy for years to come.

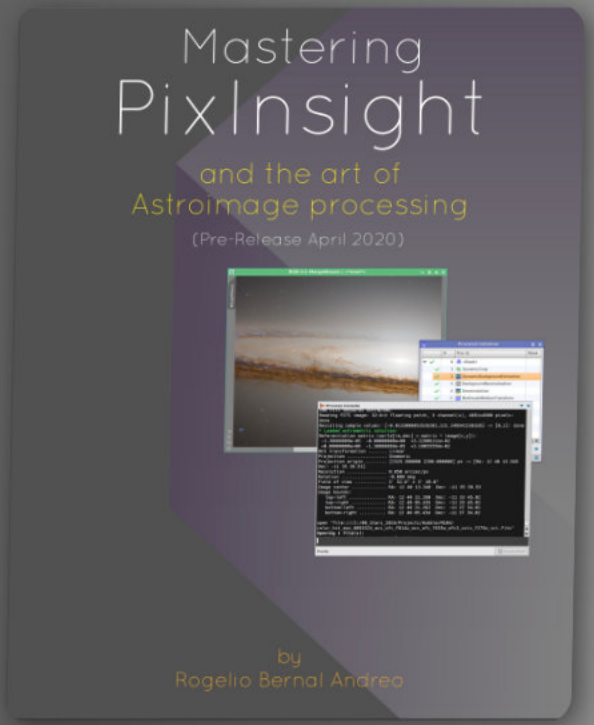
My main interest is in pursuing wide-field deep-sky photography at this juncture. Come to think of it, it always has been. Therefore, I have no need for short-exposure video stacking software such that you'd apply to planetary photography. As I've gone down the dedicated astro camera route, yet again, I do however need to stack .FITs (Flexible Image Transport system) still image files that astronomy cameras produce, as opposed to standard RAW or JPG files coming out of a terrestrial DSLR or mirrorless cameras.

To add a second complication to this, I prefer Macintosh computers over Windows. MacOS is heavily-related to the Unix/Linux world, so it suits my modus operandi and work requirements more-so than Windows. Linux is fine as well, also being Unix-like, but I use it to run servers and web applications rather than as a desktop environment. It works just fine, but you don't see Adobe and other major software manufacturers offering their suites for it just yet.

There's still a plethora of other image editing suites out there, from Adobe's ubiquitous Photoshop and associated Lightroom subscription-based applications, to one-off purchases such as Capture One from Phase One, and then to the free open-source stuff - the GIMP project as an example. Whilst there are tons of Windows-based applications out there, there aren't quite as many for native MacOS. There are even fewer for Linux.

All have their pros and cons. Some are far more expensive, but are incredibly capable and are considered professional-level applications. You really get what you pay for here. If you make money from it, you use these. Some are less expensive, but lack ultimate stability, polish and features. There are plenty of free packages around as well, and while there are gems in the pack there are also those which will cause you all sorts of unscheduled headache time. Most of these only run on Windows because their developers usually don't see the other markets worthwhile in terms or return for effort.

When it comes to astronomical images, what you settle on ultimately comes down to the hardware that you've chosen to use in accordance with the type of objects you're attempting to capture. Luckily, most astro camera hardware works just as well on MacOS as it does on Windows - and in many cases far for simply because there are very few (if any) driver-related issues with the MacOS architecture.



Getting your windows machine to talk to a camera can, in the wort cases, be an absolute nightmare. Mac? Plug & play.

If you've gone and attached a video camera on the end of a long focal length, slower focal ratio telescope for planetary use then you'll be using something such as the free "Registax" product that can take sequential video frames and analyse and reject bad frames, and then align and stack the rest to produce a final output image. Pity it runs only on Windows. There are MacOS equivalents, of sorts, but I've never had an easy time finding one that works out of the box. You can always set up a virtual Windows

tech stuff

CHRIS MALIKOFF

environment within, but I don't use these.

If you're imaging deep sky, you have more issues, irrespective of the computer platform you choose to use. In addition to controlling the imaging camera by specifying exposure times, gain (ISO) and other parameters to suit the telescope's optics and actual celestial object at hand, you also need to control the motion of the mount guiding the telescope via a guide camera. That's two cameras to futz around with, and there are two ways to do this.

1) Your computer (laptop or other) can control both guiding and imaging duties - either using separate software running simultaneously for each or a single package that can do both.

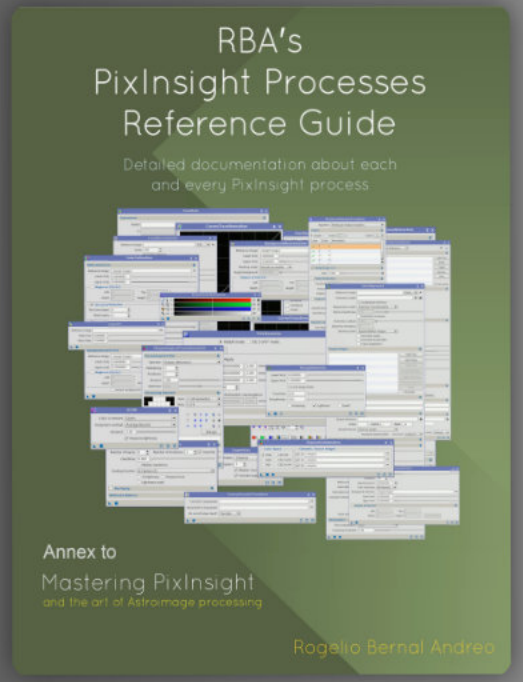
2) You employ a dedicated device to talk to both cameras and cut the computer out altogether. Such a device is the relatively new "ASIair" from ZWO. It's a Raspberry-Pi based chunk of plastic that has dedicated logic and software built into it which manages both guiding and imaging duties via a simple WiFi connection to your phone or tablet. No computer required. Yippee!

Either way - multiple images in FITs format are produced as a result of your exposures, and these files still need to be processed to see the ANY result. Unprocessed FITs images are what are referred-to as "linear". The information held within them is specifically suited to scientific use because they are comprised of data built from reading real photons hitting the sensor, along with noise and other unwanted artefacts. This data requires to be "stretched" before it can be visualised, unlike the data held within a JPG or RAW file that you will be used to.

Problem: "Standard" image editing suites such as PhotoShop, Lightroom, Capture One, GIMP, etc, etc, don't have a clue when it comes to FITs file format. These files are considered non-entities as far as they are concerned. There are a few free programs and online services such as "FITs Viewer" and NASA/ESO's "FITs Liberator" and MatLab's "Open FITs" that will allow you to at least view what you've spent hours capturing. They don't do any more than that though. There are plug-ins for Photoshop, at least, to allow you to import FITs images - such as FITSPlug. It's a one-way import though, and will only output to TIFF, JPG, etc.

To process these files you need to find an image editor suited to the task. There are very few. Again, there are a couple here and there for Windows machines, as well as for MacOS units. I won't list them all this time around, but will go into some of them in next month's instalment. For this month, I'll mention only the one I chose to use after many years of un-used ownership - "PixInsight" from Spanish developer Pleiades Astrophoto.

PixInsight has always had a reputation for being extremely difficult to learn as it employs an object-oriented rather than linear workflow. In other words, An open image can be addressed by a number of simultaneous non-destructive scripts that alter it in parallel - rather than the do "this", then "that" approach that, for instance, Photoshop uses.



The kicker with PixInsight is that it is a truly cross-platform package. It works just the same on MacOS as it does on Windows, and dare I say it Linux or Unix. For once, major-league software that's available to all. Who woulda think it, eh?

Next month - lets have a look at its main features and try to get our heads around the way it works. I'll touch on a new book on the subject from our friend Rogelio Bernal Andreo.

the lazy astronomer

DAVE MANNING

“Size does matter”... but not the way you may think.

When I started in this sport called “Astrophotography” about 3 years ago and was looking into buying my first telescope, I had it in my head that I NEEDED to have the largest scope with the longest focal length I could afford and ultimately, physically handle.

That telescope was the Celestron C11 Schmidt Cassegrain Telescope or SCT with a whopping focal length of 2.8 metres! As great as that scope was for imaging things like individual galaxies, portions of the Moon and planets (I’ll probably talk about that in a future column) it only allowed me to see a small section of some of the larger, more beautiful celestial objects like the Eta Carinae, Eagle, Running Chicken and War and Peace Nebulae.

I knew I NEEDED more, and by “more” I mean less. Less focal length that is. It didn’t take me long to understand that with a decent aperture, having a shorter telescope, i.e. a shorter focal length, it would allow me to see and image a larger portion of the sky. EUREKA! Here’s a classic example of what I’m talking about.

Part of the Lagoon Nebulae taken with the Celestron C11 SCT and focal length of 2800mm. >>

the lazy astronomer

DAVE MANNING

<< Left - Most of the Lagoon Nebulae taken with Skywtacher 120mm Esprit Triplet Refractor with a focal length of 840mm

Right >> These days, I'd rather see and image as much of the sky as I possibly can. To absorb as much of the majesty of our southern skies with all its colours, shapes and complexity as is possible, which is probably what led me to start mucking around with making mosaics of my astro images.

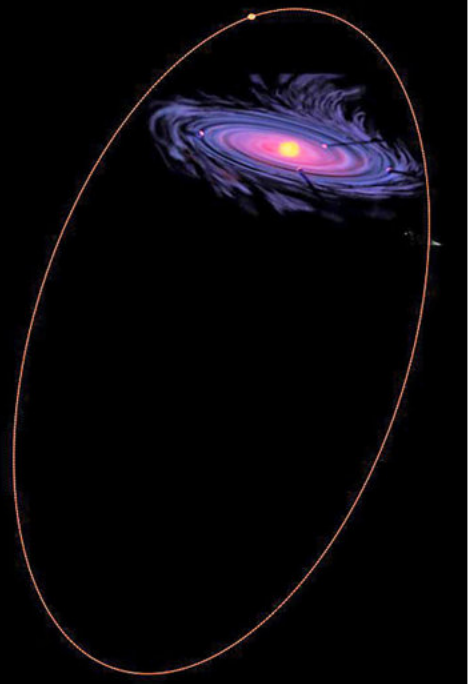
That's definitely for another Prime Focus article. So, if you're aiming to see as much of the heavens as you can in one image, give some thought to going smaller with your telescope.

Clear skies

Dave Manning

invaders

DENNIS OVERBYE – NYT



April 28th, 2020: A pair of astronomers announced last week that they had identified 19 alien asteroids circling our sun.

The rocks were probably stolen from other nearby stars 4.5 billion years ago, during the birth throes of the sun. Today they mingle in the sky with a class of asteroids called Centaurs that inhabit outer realms of the solar system between Jupiter and Neptune.

But unlike the rest of the Centaurs, the aliens' orbits take them far out of the plane in which the planets go around the sun, suggesting that they were once circling other stars.

Fathi Namouni, of France's Observatoire de la Côte d'Azur, and Maria Helena Morais, of Brazil's Universidade Estadual Paulista, published their results last week in the Monthly Notices of the Royal Astronomical Society.

In a statement from the Royal Astronomical Society, Dr. Morais said studying these oddball asteroids "will give us clues about the sun's early birth cluster, how interstellar asteroid capture occurred, and the role that interstellar matter had in chemically enriching the solar system and shaping its evolution."

The new work follows on a rash of discoveries of outsider rocks and comets invading or even occupying our space, more evidence that seemingly disparate and isolated realms of the universe are in fact mixing it up over the vast span of cosmic time.

First came Oumuamua, a barren cigar-shaped rock later identified as a mostly inert comet, found sailing past the planets in 2017.

Last year brought a more familiar looking comet, 2I/Borisov, of interstellar origin to our neighbourhood. It now seems to be breaking into pieces as it attempts to escape our corner of the Milky Way.

Those were only temporary invaders. But two years ago, Dr. Namouni and Dr. Marais first identified an alien with permanent residency status, circling the sun near Jupiter, but in the opposite direction.

At the time, they suggested that there were probably other "extrasolar" occupants out there, most likely in orbits that take them over the poles of the sun.

That is what they say they have now confirmed, using computer simulations to rewind the cosmic clock back to the beginning of the solar system.

"We chose them because they were unusual in the first place," Dr. Namouni said by email, explaining that their orbits took them far out of the ecliptic, the tilted plane along which the planets travel around the sun. "They're known as high-inclination asteroids," he explained.

Astronomers believe that the sun and other stars were born when a dense cloud of proto-stellar material, gas and dust, collapsed some 4.5 billion years ago, perhaps as a result of a nearby supernova explosion.

When the sun formed it was already accompanied by a swirl of gas and dust orbiting in that ecliptic plane that the planets and most asteroids would eventually occupy.

But the 19 asteroids that the astronomers tracked were not part of that disc back then. They were in fact orbiting in a plane perpendicular to the sun's system, and in orbits that took them much farther from the sun than the other objects that would become our planets.

They probably belonged to other stars, each of which would have been born with its own retinue of worldly crumbs of planets and asteroids and comets.

In the close quarters of the birth cluster, however, it was easy for stars to steal wandering asteroids from one another. Any more details of this cosmic history are lost for now.

"We can't say they were snatched from a single star," Dr. Namouni said. "They could have been snatched from different stars at different times."

He said their next research goal is see if they can distinguish families in the asteroids, indicating that some of them were captured in the same event.

We were once all brothers in the same nebula, as the late astronomer and cosmologist Allan Sandage of Carnegie Observatories liked to say. Some of our cousins got to come home and live with us.

*** STOP PRESS *** by Lachlan Gilbert, UNSW

New findings suggest laws of nature 'downright weird,' not as constant as previously thought

Not only does a universal constant seem annoyingly inconstant at the outer fringes of the cosmos, it occurs in only one direction, which is downright weird.

Those looking forward to a day when science's Grand Unifying Theory of Everything could be worn on a t-shirt may have to wait a little longer as astrophysicists continue to find hints that one of the cosmological constants is not so constant after all.

In a paper published in Science Advances, scientists from UNSW Sydney reported that four new measurements of light emitted from a quasar 13 billion light years away reaffirm past studies that found tiny variations in the fine structure constant.

UNSW Science's Professor John Webb says the fine structure constant is a measure of electromagnetism—one of the four fundamental forces in nature (the others are gravity, weak nuclear force and strong nuclear force).

"The fine structure constant is the quantity that physicists use as a measure of the strength of the electromagnetic force," Professor Webb says. "It's a dimensionless number and it involves the speed of light, something called Planck's constant and the electron charge, and it's a ratio of those things. And it's the number that physicists use to measure the strength of the electromagnetic force."

The electromagnetic force keeps electrons whizzing around a nucleus in every atom of the universe—without it, all matter would fly apart. Up until recently, it was believed to be an unchanging force throughout time and space. But over the last two decades, Professor Webb has noticed anomalies in the fine structure constant whereby electromagnetic force measured in one particular direction of the universe seems ever so slightly different.

"We found a hint that that number of the fine structure constant was different in certain regions of the universe. Not just as a function of time, but actually also in direction in the universe, which is really quite odd if it's correct ... but that's what we found."

Looking for clues

Ever the sceptic, when Professor Webb first came across these early signs of slightly weaker and stronger measurements of the electromagnetic force, he thought it could be a fault of the equipment, or of his calculations or some other error that had led to the unusual readings. It was while looking at some of the most distant quasars—massive celestial bodies emitting exceptionally high energy—at the edges of the universe that these anomalies were first observed using the world's most powerful telescopes.

"The most distant quasars that we know of are about 12 to 13 billion light years from us," Professor Webb says.

"So if you can study the light in detail from distant quasars, you're studying the properties of the universe as it was when it was in its infancy, only a billion years old. The universe then was very, very different. No galaxies existed, the early stars had formed but there was certainly not the same population of stars that we see today. And there were no planets."

He says that in the current study, the team looked at one such quasar that enabled them to probe back to when the universe was only a billion years old which had never been done before. The team made four measurements of the fine constant along the one line of sight to this quasar. Individually, the four measurements didn't provide any conclusive answer as to whether or not there were perceptible changes in the electromagnetic force. However, when combined with lots of other measurements between us and distant quasars made by other scientists and unrelated to this study, the differences in the fine structure constant became evident.

A weird universe

"And it seems to be supporting this idea that there could be a directionality in the universe, which is very weird indeed," Professor Webb says.

"So the universe may not be isotropic in its laws of physics—one that is the same, statistically, in all directions. But in fact, there could be some direction or preferred direction in the universe where the laws of physics change, but not in the perpendicular direction. In other words, the universe in some sense, has a dipole structure to it.

"In one particular direction, we can look back 12 billion light years and measure electromagnetism when the universe was very young. Putting all the data together, electromagnetism seems to gradually increase the further we look, while towards the opposite direction, it gradually decreases. In other directions in the cosmos, the fine structure constant remains just that—constant. These new very distant measurements have pushed our observations further than has ever been reached before."

In other words, in what was thought to be an arbitrarily random spread of galaxies, quasars, black holes, stars, gas clouds and planets—with life flourishing in at least one tiny niche of it—the universe suddenly appears to have the equivalent of a north and a south. Professor Webb is still open to the idea that somehow these measurements made at different stages using different technologies and from different locations on Earth are actually a massive coincidence.

"This is something that is taken very seriously and is regarded, quite correctly with scepticism, even by me, even though I did the first work on it with my students. But it's something you've got to test because it's possible we do live in a weird universe."

But adding to the side of the argument that says these findings are more than just coincidence, a team in the US working completely independently and unknown to Professor Webb's, made observations about X-rays that seemed to align with the idea that the universe has some sort of directionality.

"I didn't know anything about this paper until it appeared in the literature," he says.

"And they're not testing the laws of physics, they're testing the properties, the X-ray properties of galaxies and clusters of galaxies and cosmological distances from Earth. They also found that the properties of the universe in this sense are not isotropic and there's a preferred direction. And lo and behold, their direction coincides with ours."

Life, the universe and everything

While still wanting to see more rigorous testing of ideas that electromagnetism may fluctuate in certain areas of the universe to give it a form of directionality, Professor Webb says if these findings continue to be confirmed, they may help explain why our universe is the way it is, and why there is life in it at all.

"For a long time, it has been thought that the laws of nature appear perfectly tuned to set the conditions for life to flourish. The strength of the electromagnetic force is one of those quantities. If it were only a few percent different to the value we measure on Earth, the chemical evolution of the universe would be completely different and life may never have got going. It raises a tantalising question: does this "Goldilocks' situation, where fundamental physical quantities like the fine structure constant are 'just right' to favour our existence, apply throughout the entire universe?"

If there is a directionality in the universe, Professor Webb argues, and if electromagnetism is shown to be very slightly different in certain regions of the cosmos, the most fundamental concepts underpinning much of modern physics will need revision.

"Our standard model of cosmology is based on an isotropic universe, one that is the same, statistically, in all directions," he says.

"That standard model itself is built upon Einstein's theory of gravity, which itself explicitly assumes constancy of the laws of Nature. If such fundamental principles turn out to be only good approximations, the doors are open to some very exciting, new ideas in physics."

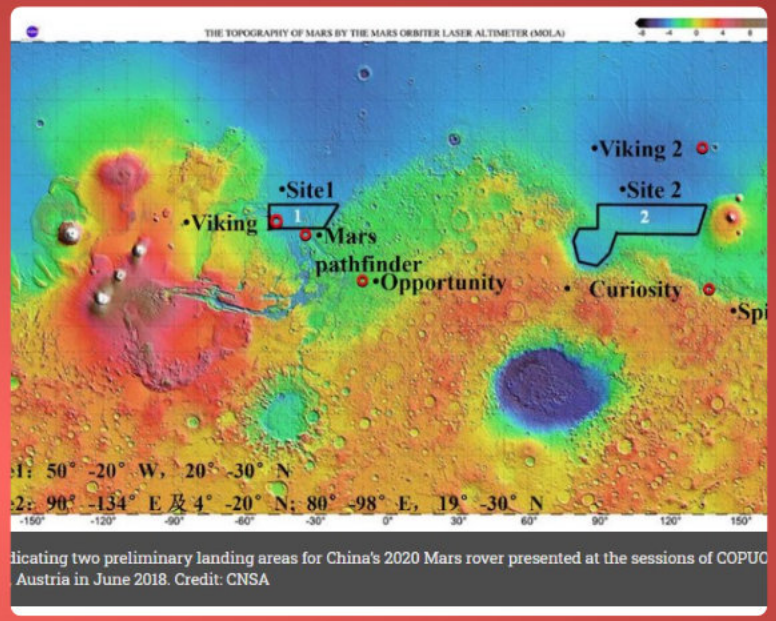
Professor Webb's team believe this is the first step towards a far larger study exploring many directions in the universe, using data coming from new instruments on the world's largest telescopes. New technologies are now emerging to provide higher quality data, and new artificial intelligence analysis methods will help to automate measurements and carry them out more rapidly and with greater precision

More information: Michael R. Wilczynska et al. Four direct measurements of the fine-structure constant 13 billion years ago, Science Advances (2020). DOI: 10.1126/sciadv.aay9672

K. Migkas et al. Probing cosmic isotropy with a new X-ray galaxy cluster sample through the LX–T scaling relation, Astronomy & Astrophysics (2020). DOI: 10.1051/0004-6361/201936602

*** STOP PRESS *** by Tony Law

China heading for Mars



dicating two preliminary landing areas for China's 2020 Mars rover presented at the sessions of COPUC Austria in June 2018. Credit: CNSA

China has named its first independent interplanetary mission Tianwen-1, with the combined Mars orbiter and rover spacecraft apparently proceeding towards launch in July this year.

The name and mission logo were unveiled at a China National Space Administration online ceremony to mark the 50th anniversary of the launch of the country's first satellite.

DFH-1 launched on a Long March 1 rocket from Jiuquan April 24, 1970, making China the fifth country to independently launch a satellite.

Tianwen-1, meaning 'questions to heaven', is taken from the name of a long-form poem by Qu Yuan, a poet born in the fourth century B.C., according to CNSA chief engineer Ge Xiaochun.

It will require the test launch of the Long March 5B, currently expected in early May, to succeed for the Tianwen-1 mission to proceed.

The Tianwen-1 orbiter will be equipped with a high-resolution camera comparable to HiRise on board NASA's Mars Reconnaissance Orbiter. It also carries a medium-resolution camera, subsurface radar, mineralogy spectrometer, neutral and energetic particle analyzers and a magnetometer. The orbiter will also play a relay role for the mission rover.

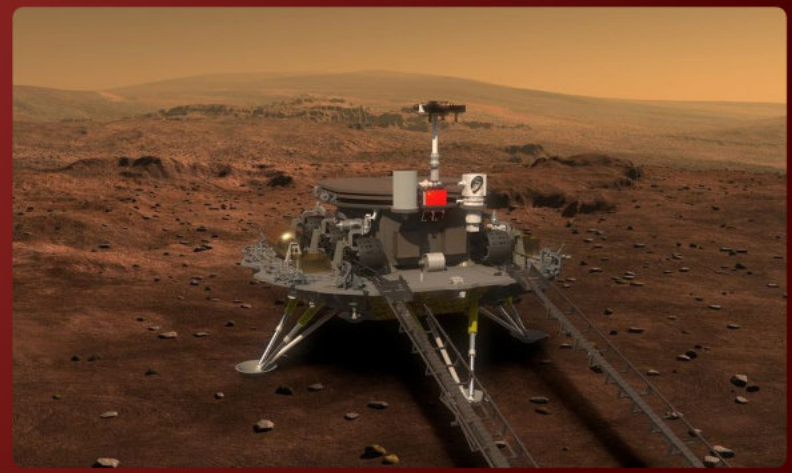
The roughly 240-kilogram solar-powered rover is nearly twice the mass of China's Yutu lunar rovers. It will carry a ground-penetrating radar, multispectral camera, a Laser Induced Breakdown Spectroscopy instrument and payloads for detecting the climate and magnetic environment. The rover has a mission design lifetime of three Earth months. The rover will receive a name through a public vote closer to launch.

China has outlined two landing areas, with a candidate landing site in Utopia Planitia. The landing ellipse is understood to be around 100 x 40 kilometres. Site selection was driven by a range of factors including flight system engineering constraints and the challenges of entry, descent and landing (EDL) on the Red Planet, and the science goals of the mission.

The Tianwen-1 spacecraft is expected to reach Mars around February 2021. However, the rover landing attempt may not take place immediately. There are suggestions that the landing segment of the mission will be conducted months later, in April. This would allow mapping and observation of the landing site, despite the availability of high-resolution NASA imagery from HiRise.

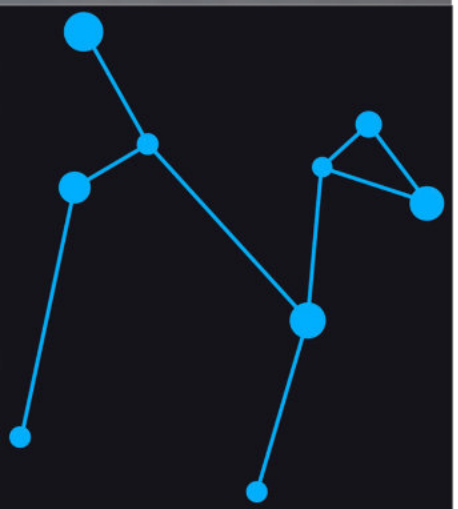
Edited from an article at Spacenews.com by Andrew Jones

中国行星探测
Mars



"the dog star"

RICHARD STARGARD



In last month's Prime Focus, I exclaimed the virtues of our loyal canine companions, although I still haven't forgiven the dog that urinated on my tripod. Since time began, our barking-mad friends have been our constant companions. Dogs are multi-skilled, from herding the flocks and hunting game, sniffing for drugs and truffles, pulling sleds in the snow, navigating for the blind and of course are wonderful companions. So, what better way to reward such a relationship than to bestow the honour of an orbital space flight.

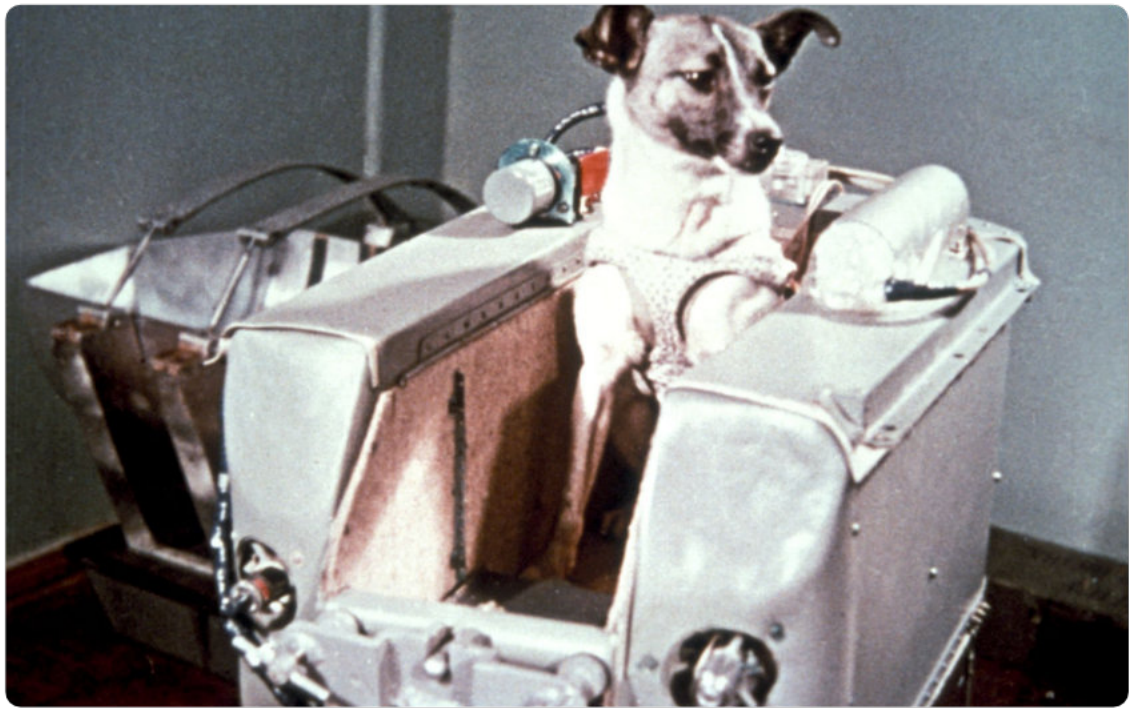
No Virgin Galactic or Elon Musk back in 1957, the entrepreneurs back then where the Russians eyeing off space supremacy, much to the annoyance of the Americans. After the great success of Sputnik 1 in October that year a follow up was needed asap, so "Mutnik" was given the green light and blasted off in the 3rd of November 1957.

The dog chosen for this honour was a stray, like the many thousands of strays calling Moscow home, and even though other dogs were blasted off they never reached orbit. Laika can lay claim to be the first living creature to orbit the Earth. Some fruit flies did blast off in 1947 but I doubt if they orbited.

Reports vary widely as to when this brave "Cosmomut" succumbed to some very poor Occupational Health and Safety regimes. The craft's batteries failed a week into the flight, so the scientific instruments also failed. She may have died from dehydration as the cooling system failed, overheating might have been fatal to her, and even if she did survive all of that re-entry would have been unpleasant.

Laika whizzed around the earth just over 2,500 times, and the flight duration was 5 months, Laika endeared herself to some of the scientists as she had a very calm and friendly nature, upsetting as they new it was a one way trip. My conclusion is that Laika is truly the one and only Dog Star.

Richard Stargard



Editor: Did you know that "dog" in Russian is "собака" (sobaka)?

Ode to Ned

We're all made of Star Stuff, and to Star Stuff we'll return
You've left us far too early mate...
But your fire will always burn
Like the fire of the Sun you showed me
At The Forest where our friendship started and the rum you introduced me to

I'll image your light from way down here then show it to the people
I'll tell them of the man you were and of all the things you showed us
Of all your scopes and knowledge to. Of strange and distant objects
Of both your dogs, companions 2 who kept you on the level.
Of asteroids and minor planets these things are part of you.

If space and time are truly one, then for sure we'll meet again
The Cosmos has your being now so that will never end
We'll see your star shine bright and blue or maybe just a dwarf
But that won't be, cause' your heart's so huge.
Most likely like a giant star, massive, colossal, vast.

There's lots of things I think about when I look back at our friendship
Your knowledge, your cigars, your rum and cinnamon sticks
But most of all I see your smile when you're cuddling your dogs
Then turn to your telescopes and watch the heavens above.

We're all made of star stuff and to star stuff we'll return.

Dave Manning

© Damian Peach. Comet C/2020 F8 (SWAN) on May 2nd.

http://www.damianpeach.com

We obtained another run on this impressive comet. What a tail it has developed these past days. Field here is 10deg wide.
The galaxy close to the comet is Wolf-Lundmark Melotte - a nearby galaxy 3 million l.y. away.

Nikon 200mm F2. FLI 16200. LRGB 20/3/3/3min.

Venus: Boris Muratovic

Venus - 19th April 2020 (1758hrs AST)
This evening's image of Venus.
Start(UT) = 075845.190
Mid(UT) = 080045.191
End(UT) = 080245.192
Equipment- Celestron 8SE, ZWO ASI120MC-S, 2x Barlow, IR Filter.
Focal Length = 1800mm
Camera details::
Filter = L
Profile = Venus
Diameter = 32.50"
Magnitude = -4.50
FocalLength = 1800mm
Resolution = 0.43"
Frames captured = 20277
FPS (avg.) = 84

Centaurus A: Bryan Pablo

Explore Scientific 152mm
Orion Mini 50mm Guidescope
ZWO ASI120MM
QHY178M
ZWO EFW Mini Filter Wheel
ZWO 1.25inch LRGB Filters
HEQ5 Pro Mount
Epsilon Mobile Pier
140x5minL
84x5minR
89x5minG
104x5minB

M83: Matt Watson

SkyWatcher Esprit 100 APO and modified Canon 600D.

This is around three hours of exposure, comprising 70 second lights at ISO 800.

Captured using APT, PHD2, CGX-L, DSS and PSCS6.

20 darks and 50 bias frames.

Nikon CoolPix P900

European Southern Observatory
ESO Science Newsletter May 2020

08 May 2020Cerro Armazones, the home of ESO's ELT.
This newsletter is a summary of recent ESO Science Announcement items. Follow the links or visit ESO Science Announcements to read more.

Science announcements

2020 ESO Studentships
08 May 2020:
The ESO research studentship programme provides an outstanding opportunity for PhD students to experience the exciting scientific environment at one of the world's leading observatories. ESO's studentship positions are open to students enrolled in a university PhD programme in astronomy or related fields. Students accepted into the programme work on their doctoral project under the formal supervision of their home university, but they come to ESO to work and study under the co-supervision of an ESO staff astronomer for a period of between one and two years.
Read more

ESO Cosmic Duologues
07 May 2020:
ESO is organising a web-based series of Cosmic Duologues aiming to cover the current state of some of the major questions in astronomy today in a lively way, via a duologue between two professional astronomers, each expert in their field. These events take place on Mondays at 15:30 CEST. The events are streamed live via YouTube and are open to all members of the scientific community. A list of the upcoming duologues, including information on how to access them will be provided on the dedicated website in due time. The next event on Intermediate Massive Black Holes (IMBH) will take place on Monday 11 May. Please see the event webpage for more details of the event.
Read more

Online Munich Joint Astrophysics Colloquia (JAC)
05 May 2020:
The Munich Astrophysics Colloquium (JAC) series is jointly organised by ESO, the Max Planck Institute for Astrophysics, the Max Planck Institute for Extraterrestial Physics and the Observatory of the Ludwig-Maximilians University in Munich. JAC presentations cover the most exciting topics and developments in astrophysics. A video archive of presentations given in 2020 and 2019 is available and earlier presentations can be found through the ESO Garching Seminar Web page.
Read more

Update on Status of ALMA Cycles 7 and 8
03 May 2020:
The COVID-19 crisis has continued to affect the global community, including ALMA users and staff. ALMA operations remain suspended, as announced on March 20. On behalf of the ALMA Director, with support from all Executives, a number of decisions were taken regarding the status of Cycle 7 and Cycle 8. Cycle 8 has been postponed until 2021 October. It is anticipated that the Cycle 8 Call for Proposals will open again in 2021 March. ALMA Cycle 7 will continue through 2021 September, with currently non-completed projects ranked A, B and C remaining in the observing queue.
Read more

ESO Period 106 Submission Statistics
01 May 2020:
The deadline for proposal submission for Period 106 (1 October 2020 - 31 March 2021) was 23 April, 2020, after an extension of four weeks due to the COVID-19 crisis. 1070 valid proposals were submitted, including 47 Large Programmes, which is the largest number of Large Programme proposals ever submitted in a single period. On the VLT the most requested ESO instrument was MUSE with a request of 486 nights, followed by X-shooter with 364 nights. HARPS on the ESO 3.6-metre telescope was the most demanded instrument at La Silla, with 396 nights.
Read more

ALMA Band 2 Contracts Signed
29 Apr 2020:
The contract has been signed for the production of the final set of receivers to be installed on the Atacama Large Millimeter/submillimeter Array (ALMA). Of the originally foreseen ten receiver bands, eight have already been installed, and the ninth, Band 1, is currently in production in East-Asia. Now, contracts have been signed to start the production of the final band in the original ALMA definition – Band 2 (67-116 GHz), led by ESO. The ALMA board approved pre-production of a series of six cartridges, with the goal of moving into

production of the full set, one for each ALMA antenna.
Read more

ALMA and La Silla Paranal Data Jointly Accessible from the ESO Archive Science Portal
28 Apr 2020:
ALMA data products have been integrated into the ESO Archive Science Portal along with data products from the La Silla Paranal Observatory (including APEX). Millions of datasets can be browsed jointly through a uniform set of query items, providing a unique integrated panchromatic view of the southern hemisphere extending from the near-ultraviolet to millimetre wavelengths. Queries can be carried out interactively through a web application which presents the results on the celestial sphere and provides aggregate and detailed individual information, or via direct database and Virtual Observatory access for programmatic, recurring and/or massive queries. The selected data can then be downloaded from the respective portals for ALMA and ESO. In this initial phase content from the ALMA Archive Interface is synchronised every two weeks, with the cadence progressively increasing with time.
Read more

Online Conference: Assessing Uncertainties in Hubble's Constant Across the Universe
Online, 22–26 June 2020, daily from 12:50 - 15:10 UTC
What's lurking behind the discord in the Hubble constant? This conference will discuss a wide range of observational methods, how to improve their systematics, and what H0 and other cosmological tensions tell us about cosmology and possible new physics beyond the Lambda-CDM model. The registration deadline is 29 May. Please see the conference webpage for more information.
Read more

Conference Galaxy Cluster Formation (GCF) 2020 Postponed
ESO Headquarters, Garching, Germany (postponed)
The aim of GCF2020 is to discuss cluster formation over the last roughly ten billion years, from its beginnings to the present day, with a particular focus on the progress and developments since our first GCF meeting in 2017. Given the rapidly evolving and highly uncertain situation of the COVID-19 pandemic, the second installment of the Galaxy Cluster Formation Workshop series is postponed until 2021. The workshop will most likely take place in summer 2021, although the month and dates have not been decided. Those who have already submitted an abstract will have the chance to update and resubmit. For updates and revised deadlines, please follow the workshop website.
Read more

New Issue of The Messenger Online
23 Apr 2020:
The latest edition of ESO's quarterly journal, The Messenger, is now available online. In issue 179, highlights include an article on the 2018 Visiting Committee report, imaging main belt asteroids using SPHERE, the ASPECS survey which is an ALMA Large Programme targeting the Hubble Ultra-Deep Field. In addition, all subscribers to the print edition are asked to confirm their subscriptions and update their postal addresses. Please hold on to your envelope which contains your personalised confirmation code – see the back page of The Messenger 179 for further details.
Read more

ESO Archive Science Portal 2.0 released
23 Apr 2020:
The ESO Archive Science Portal allows browsing and exploration of archive content using an intuitive interactive user interface that supports iterative queries or by direct database and Virtual Observatory (VO) access using user scripts and VO-aware tools. The latest version, released on 23 April 2020, provides the features and improvements listed below.
Read more

2020 Release of VLT/VLTI Instrument Data Reduction Software Packages
16 Apr 2020:
The annual public release of ESO VLT/VLTI instruments data reduction software packages is scheduled for the beginning of June 2020. Please note that the new pipeline packages will be released for the following operating systems: Fedora 28-31, CentOS 7 and macOS 10.11–10.14. For macOS version 10.15 we recommend using MacPorts. We expect pipelines will build and install from source in macOS 10.15, thus installations will take a bit longer than for those OS versions that are supported with binary packages. We are working toward full support for macOS 10.15, but for the time being we cannot say when we will provide MacPorts packages for the pipelines on 10.15.
Read more

Upcoming ESO or ESO-Related Workshops

- Summer Research Programme
- Online, 2 July–11 August 2020
-
- The very successful ESO Summer Research Programme continues in 2020.

This programme provides a unique opportunity to students not yet enrolled in PhD programmes to carry out a six-week research project with ESO Fellows and staff. Students can choose between a wide range of research projects, covering many areas of astronomy from exo-planets to cosmology. The programme also provides opportunities beyond research, including lectures, a mini-workshop, and many social activities. This year the workshop will be conducted online.

Pitch your research for an ESO Press Release for a chance to make the news.

ESO produces press releases based on research done with ESO telescopes or instruments, including those where ESO is a partner or that are hosted at an ESO site. At the Department of Communication, we are always searching for exciting and important research to feature in ESO press releases. If you have an interesting story of your own you'd like to pitch for an ESO press release, please send your paper to ESO's Public Information Officer Barbara Ferreira via e-mail at pio@eso.org.

Share your photos from ESO sites!

If you are visiting ESO sites and you like to capture your experience on camera, the Department of Communication invites you to share your photos with the world. If you are interested please submit your pictures for evaluation by e-mail.

European Southern Observatory

Karl-Schwarzschild-Str 2, D-85748 Garching bei München, Germany