Shoalhaven Astronomers Inc.
www.shoalhavenastronomers.asn.au

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Astro Flyer

JUNE 2022

Club News

The AGM of last month – 20 May22 – was successfully conducted resulting in a modified line-up of office holders and management committee members. Thank you to departing members for your service and welcome to incoming members!

The observatory project will start moving now that Owners Consent has been received from the University of Wollongong. To assist the association I will be calling for members willing to assist in the construction and fitout of the observatory - which will happen in the second half of this year – to register their interest

Next Meeting June 17th 6.30 for 7pm winter time.

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Keep on watching!

Best Regards,
Mark Town

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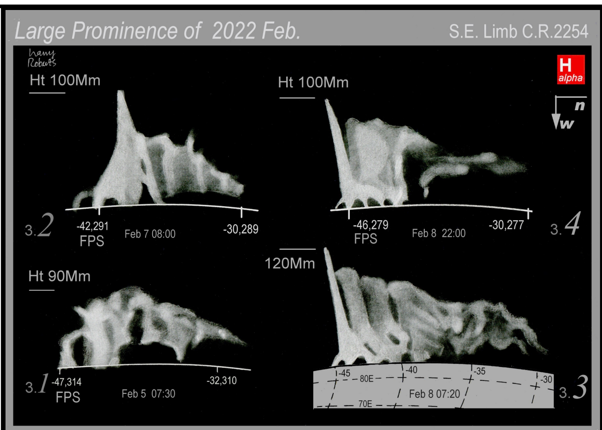


MOON PHASES

New Moon	First Quarter	Full Moon	Last Quarter
June 29	July 7	start→June14	June 21

Viewing Nights

VIEWING NIGHTS SUSPENDED UNTIL FURTHER NOTICE

Club viewing nights are selected to provide viewers with the best possible conditions for good viewing. They are held on specific Saturdays at different locations around Nowra.

More Club Information Including viewing site Directions Page 14

OUT THERE BY BOB TURNBULL
OBSERVATION OFFICER

June - July 2022

Hello once again! Well I'm not sure how to give you a firm-viewing program because of the poor visibility of our night sky, however I'll attempt to do my best.

Highlights – June

Venus and Uranus close
Mars and Jupiter close
Mars and Moon close
Moon and Uranus close (but occulation from Western Australia)

Constellations

Winter solstice on 21st gives longer darker periods to gain clear skies for at least 4 months, so if we continue to persist with our viewing it's more than likely to get at least some good sky conditions.

Looking at the three asterisms (dippers) which are visible on winter maps on 4 & 5 (pages 90 & 91) in your Astronomy Australia 2022. Pages 50 & 51 give the detailed directions.

Planets

Mercury traversing Taurus in the Eastern morning sky. It reaches its greatest elongation of 23^{o} West of the Sun on the 17th, which is an excellent time to see this small world before dawn.

Venus and Uranus are 2 degrees off each other from the 11th – 13th.

Mars rises at 2am in the Eastern sky in Pisces,

Jupiter: remains a morning object during June. Close to Mars on the 1st then splits to widen away from each other.

Saturn rises late in the Eastern sky but goes into regression.

July

Refer to pages 54 & 55 for the June and July variations of the Planets changes in apparent sizes.
Page 59 gives 4 maps of the positions of the planets and later Venus in the dawn sky.
Check out the half page of the Moon and read about the *Messier Twins.*

Good viewing of the longer, darker sky.

Bob Turnbull

Astro Events from Frank Gross

Imaginary numbers could be needed to describe reality, new studies find

By Ben Turner

If standard quantum theory holds up, imaginary numbers are critical.

To test how important imaginary numbers were in describing reality, the researchers used an updated version of the Bell test, an experiment which relies on quantum entanglement. (Image credit: Jurik Peter via Shutterstock)

Imaginary numbers are necessary to accurately describe reality, two new studies have suggested.

Imaginary numbers are what you get when you take the square root of a negative number, and they have long been used in the most important equations of quantum mechanics, the branch of physics that describes the world of the very small. When you add imaginary numbers and real numbers, the two form complex numbers, which enable physicists to write out quantum equations in simple terms. But whether quantum theory needs these mathematical chimeras or just uses them as convenient shortcuts has long been controversial.

In fact, even the founders of quantum mechanics themselves thought that the implications of having complex numbers in their equations was disquieting. In a letter to his friend Hendrik Lorentz, physicist Erwin Schrödinger — the first person to introduce complex numbers into quantum theory, with his quantum wave function (ψ) — wrote, "What is unpleasant here, and indeed directly to be objected to, is the use of complex numbers. Ψ is surely fundamentally a real function." Schrödinger did find ways to express his equation with only real numbers alongside an additional set of rules for how to use the equation, and later physicists have done the same with other parts of quantum theory. But in the absence of hard experimental evidence to rule upon the predictions of these "all real" equations, a question has lingered: Are imaginary numbers an optional simplification, or does trying to work without them rob quantum theory of its ability to describe reality?

Now, two studies, published Dec. 15 in the journals Nature and Physical Review Letters, have proved Schrödinger wrong. By a relatively simple experiment, they show that if quantum mechanics is correct, imaginary numbers are a necessary part of the mathematics of our universe.

"The early founders of quantum mechanics could not find any way to interpret the complex numbers appearing in the theory," lead author Marc-Olivier Renou, a theoretical physicist at the Institute of Photonic Sciences in Spain, told Live Science in an email. "Having them [complex numbers] worked very well, but there is no clear way to identify the complex numbers with an element of reality."

To test whether complex numbers were truly vital, the authors of the first study devised a twist on a classic quantum experiment known as the Bell test. The test was first proposed by physicist John Bell in 1964 as a way to prove that quantum entanglement — the weird connection between two far-apart particles that Albert Einstein objected to as "spooky action at a distance" — was required by quantum theory.

In their updated version of the classic Bell test, the physicists devised an experiment in which two independent sources (which they called S and R) would be placed between three detectors (A, B and C) in an elementary quantum network. The source S would then emit two light particles, or photons — one sent to A and the other to B — in an entangled state. The source R also would emit two entangled photons, sending them to nodes B and C. If the universe were described by a standard quantum mechanics based on complex numbers, the photons that arrived at detectors A and C wouldn't need to be entangled, but in a quantum theory based on real numbers, they would.

To test this setup, the researchers of the second study performed an experiment in which they shone laser beams onto a crystal. The energy the laser gave to some of the crystals' atoms was later released as entangled photons. By looking at the states of the photons arriving at their three detectors, the researchers saw that the states of the photons arriving at detectors A and C weren't entangled, meaning their data could be described only by a quantum theory that used complex numbers.

The result makes intuitive sense; photons need to physically interact to become entangled, so those arriving at detectors A and C shouldn't be entangled if they're being produced by a different physical source. The researchers stressed, however, that their experiment only rules out theories that forgo imaginary numbers if the reigning conventions of quantum mechanics are correct. Most scientists are very confident that this is the case, but this is an important caveat nonetheless. The result suggests that the possible ways we can describe the universe with math are actually much more constrained than we might have thought, Renou said.

"Just by observing what's coming out of some experiments, we can rule out many potential descriptions without making any assumptions [on the] reliability of the physical devices used in the experiment," Renou said. In the future, this could mean that it might just take a small number of experiments, building from first principles, for physicists to arrive at a complete quantum theory.

Beyond this, the researchers also said their experimental setup, which was a rudimentary quantum network, could be useful for outlining the principles on which a future quantum internet might operate.

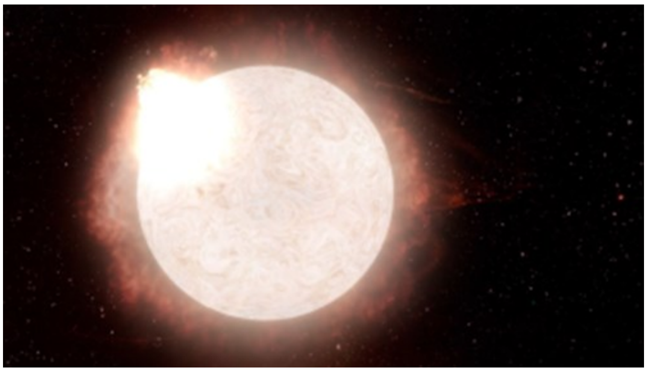
Astro Events from Frank Gross

Cont...3

Scientists watched a star explode in real time for the first time ever

By Brandon Specktor

Supernovas may be way more violent than we thought.



An artist's rendition of a red supergiant star transitioning into a Type II supernova, emitting a violent eruption of radiation and gas on its dying breath before collapsing and exploding. (Image credit: W. M. Keck Observatory/Adam Makarenko)
Astronomers have watched a giant star blow up in a fiery supernova for the first time ever — and the spectacle was even more explosive than the researchers anticipated.

Scientists began watching the doomed star — a red supergiant named SN 2020tlf and located about 120 million light-years from Earth — more than 100 days before its final, violent collapse, according to a new study published Jan. 6 in the Astrophysical Journal. During that lead-up, the researchers saw the star erupt with bright flashes of light as great globs of gas exploded out of the star's surface.

These pre-supernova pyrotechnics came as a big surprise, as previous observations of red supergiants about to blow their tops showed no traces of violent emissions, the researchers said.
"This is a breakthrough in our understanding of what massive stars do moments before they die," lead study author Wynn Jacobson-Galán, a research fellow at the University of California, Berkeley said in a statement. "For the first time, we watched a red supergiant star explode!"

When big stars go boom

Red supergiants are the largest stars in the universe in terms of volume, measuring hundreds or sometimes more than a thousand times the radius of the sun. (Bulky though they may be, red supergiants are not the brightest nor the most massive stars out there.)

Like our sun, these massive stars generate energy through the nuclear fusion of elements in their cores. But because they are so big, red supergiants can forge much heavier elements than the hydrogen and helium that our sun burns. As supergiants burn ever more massive elements, their cores become hotter and more pressurized. Ultimately, by the time they start fusing iron and nickel, these stars run out of energy, their cores collapse and they eject their gassy outer atmospheres into space in a violent type II supernova explosion.

Astro Events from Frank Gross

Cont...4

Scientists have observed red supergiants before they go supernova, and they have studied the aftermath of these cosmic explosions — however, they've never seen the whole process play out in real time until now.

The authors of the new study began observing SN 2020tlf in the summer of 2020, when the star flickered with bright flashes of radiation that the team later interpreted as gas exploding off of the star's surface. Using two telescopes in Hawaii — the University of Hawaii Institute for Astronomy Pan-STARRS1 telescope and the W. M. Keck Observatory on Mauna Kea — the researchers monitored the cranky star for 130 days. Finally, at the end of that period, the star went boom.
The team saw evidence of a dense cloud of gas surrounding the star at the time of its explosion — likely the same gas that the star ejected during the prior months, the researchers said. This suggests that the star started experiencing violent explosions well before its core collapsed in the fall of 2020.

"We've never confirmed such violent activity in a dying red supergiant star where we see it produce such a luminous emission, then collapse and combust, until now," study co-author Raffaella Margutti, an astrophysicist at UC Berkeley, said in the statement.

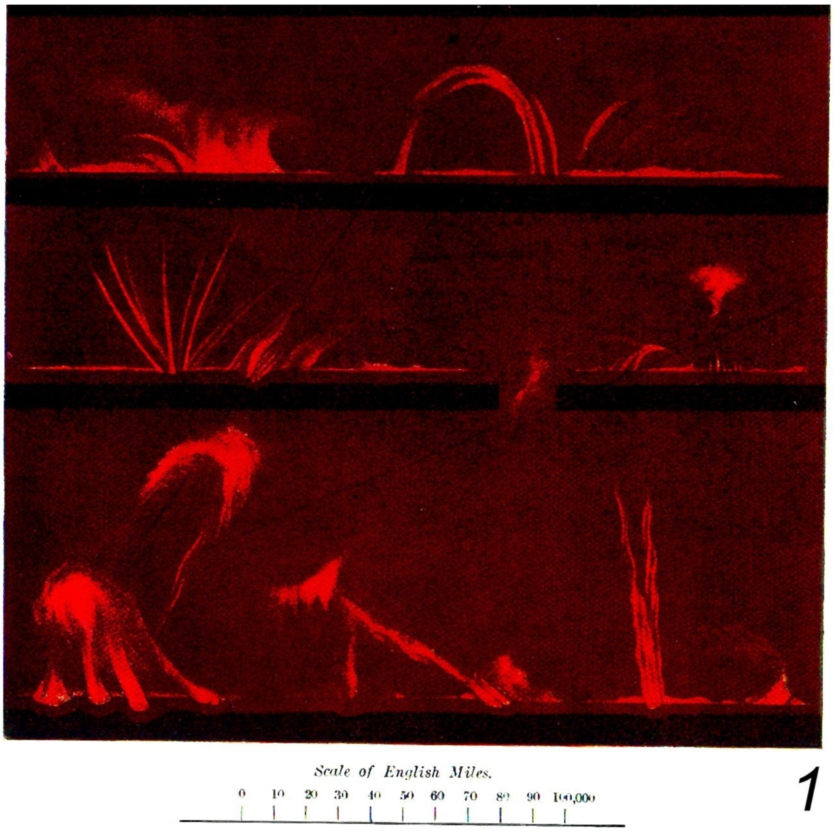
These observations suggest that red supergiants undergo significant changes in their internal structures, resulting in chaotic explosions of gas in their final months before collapsing, the team concluded.

Solar Observing by Harry Roberts

“Big Prom” of February 2022

In H-alpha the Sun rarely fails to impress, with crimson solar disc against a jet-black sky! At times huge shapes loom above the solar limb: *astonishing prominences!*
Brief History. The first recorded solar prominence dates from the total eclipse of 1185AD when, during “totality”, some were seen and described as *“flame-like tongues of live embers”!* An impressive sight apparently.

In 1868 spectroscopes showed the H-alpha band was responsible for the prominences. Fig1 shows several sketched by Trouvelot, 1872, with a Harvard spectroscope and widened slit. Note the scale. Waiting for eclipses is time-consuming, so H-alpha filters were soon invented, along with coronagraphs and spectroheliographs. The first filters, it seems, were by Fabry-Perot, two French opticians of the 1890’s. In the 20th C, by astronomer Bernard Lyot, 1933. Rapid developments followed (Zirin, pp24-29.)



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SOLAR PROMINENCES

(DRAWN BY TROUVELOT AT HARVARD COLLEGE, CAMBRIDGE, U.S.A., IN 1872)

Solar Observing by Harry Roberts

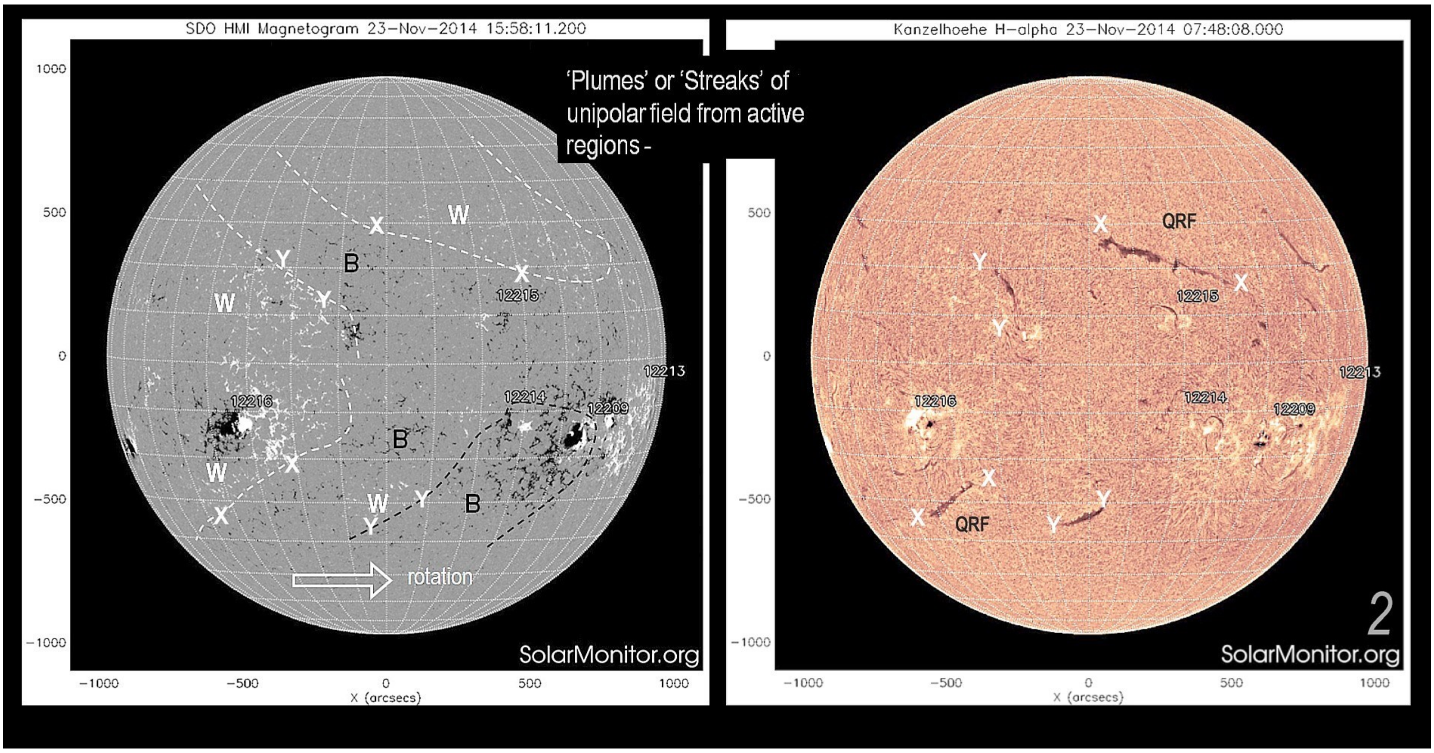
Cont...2

Prominences. Anything protruding above the solar limb may be loosely called a “prominence”. However, research shows that prominences arise in ‘Quiet Regions’ as linear features between two zones of opposite magnetic polarity. When on the solar disc they are seen as long thin dark objects called ‘filaments’.

Magnetograms. Around 1971 Bill Livingston et al. (Zirin, p30) developed the full disc solar magnetogram, revealing the Sun’s complex clusters of emerging magnetic flux (of spots etc) and its older ‘streaks’[1] or ‘wakes’ of weak bipolar field. They showed that Filaments come in two types: Quiet Region Filaments (QRF) and Active Region Filaments (ARF) (Zirin. p411). The much longer and higher ‘quiet’ ones are discussed here. Their field is ~10G or 1mTesla.

Active Regions are best defined as the latitude zones currently hosting spots, flares etc, mostly in the Sun’s ‘lower’ latitudes. Quiet Regions are those latitudes not hosting sunspots and transients, the ‘higher’ solar latitudes. Fig 2 has two co temporal SDO images from SC24 showing the boundaries between regions of opposite polarity deformed by differential rotation or ‘streaks'(dotted RHS). QRF form along these lines and are tagged X-X in both North and South hemispheres.

As noted they arise from the Sun’s differential rotation rates, i.e. 32days at polar latitudes and just 27 at the equator.



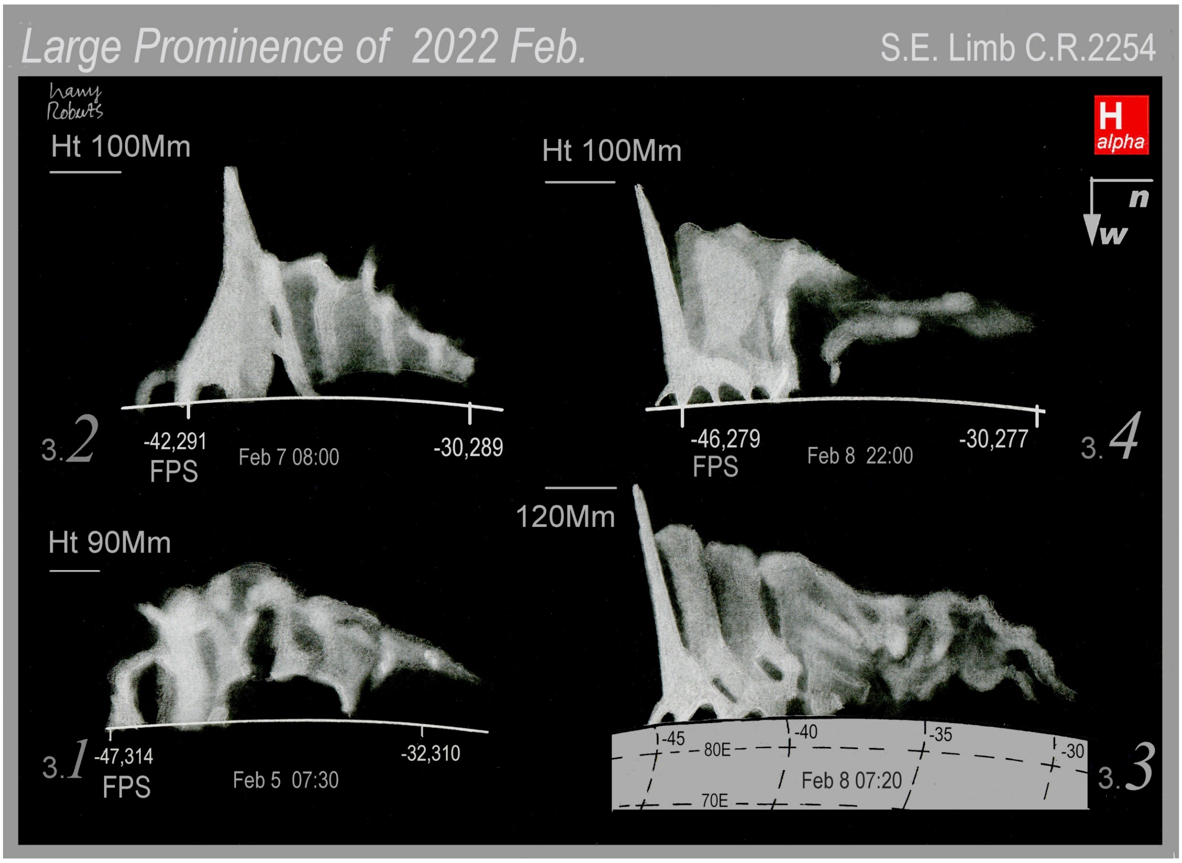
Big Prominences. These QR filaments are not the product of sunspots. To the contrary, they form at higher latitudes where no spots occur “...over polarity inversion zones between weak magnetic network: (they) are higher, ~50Mm, with an intricate, dynamic fine structure”. (“Solar and stellar..” p197). And the “overall shape of a quiescent prominence appears as a bridge, supported by one or more arches”... “40Mm high but no more than 6 Mm thick”, “..a typical length is 200Mm”.

Zirin adds (p267): “Virtually every prominence that rises above 50,000Km (50Mm) will erupt in 48 hours.”

“Big Prom” Feb 2022. The first hint of an unusual prominence was Feb 5 (4thUT) with a huge “Hedge” on the solar SW limb (despite “cloud, storm likely”. Fig3.1). Timings put its Ht at 90Mm(!) with footpoints: FPN -32,310 to FPS-47,314. No QRF was seen on the disc.

Solar Observing by Harry Roberts

Cont...3



Logged Feb 6: (6thUT) "...much cloud" yet Ht now at 100Mm! Feb 7: (still 6thUT) Ht = 100Mm, coords: -30,289 (N) and -42,291 (S). Fig3.2. "Rain at times"!

Logged Feb 8: (7thUT) "cloud free", Ht= 116Mm. Four FPs timed. Fig3.3. At max ht. as session ended, with "ejection signs"! Width is now 16deg lat. at limb in ln278. Much of its northern extent is fading and rising above the limb. With no QRF seen the longitude length remains unknown.

'Pillars'. QRF possess "claw-like" feet or 'pillars' (Schrijver et al p197) where they attach to the chromosphere and several are seen in Figs 3.3 and 3.4 at FPS. 'Big Prom' may be seen "head-on" with its northern parts following? Yet more likely the faint/fading N end is preceding the bright S end and the faint streamers are all that is left of the rising and fading QR filament!

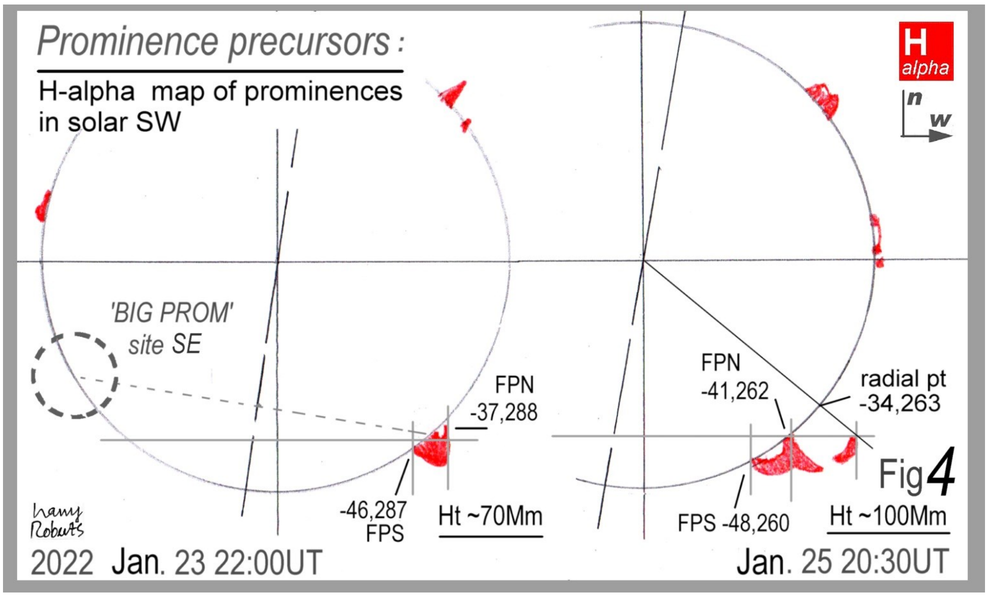
Quiet Region Filament. At no stage was any dark QRF seen on the disc! Yet at FPS there has been 35 degrees of solar rotation in approach (33 deg at north end). Such a bright prominence must have a very dark filament (QRF). The 'pillars' noted suggest the filament is now very near the current SE limb. All longitudes are for the current limb only. The longitude length (LL) remains unknown but is likely ~35deg.

Ejection. Log Feb 8: (8th. 02:00UT) Ht=100Mm, shows impending ejection. Fig3.3. The bright "node" above S36deg is perhaps a detached 'claw' rising and fading. Fig3.4 shows much of its northern parts have faded. GONG Learmonth (WA) recorded the ejection. The event starts ~06:00 Feb 8 UT. It has all but gone by Feb 8th.11:00UT (After sunset in Nowra.) GONG scopes can only record proms to ht. 100Mm. Likely the ejecta went very much higher, unrecorded it seems.

Logs for Feb9 (8thUT) show no sign of 'Big Prom' but for a faint wedge-like mark at the SE limb at -41,265 (not shown),likely a 12deg long QRF remnant on the disc?

Solar Observing by Harry Roberts

Cont...4



Precursors. A log search for earlier signs of 'Big Prom' showed prominences >80Mm high in the solar SW on Jan 23 and 25UT (Fig4).Their coordinates were a good fit for Big Prom's reappearance at the solar SE limb half a rotation later. Indeed, logs for 2021 Dec 29 and 30 also fit well for an even earlier epoch for 'Big Prom' (not shown). Height on Dec 30 was 80mm sited at -53,246 and showing some activity. '*Big Prom' it seems had some ancestors!*

Length of Big Prom? Foot Points on Fig3 suggest the 'prom' stretched across 16 degrees latitude. That is a length of 195Mm. Yet it's unlikely the prom lay N-S on the disc. QRF seldom do that, as they arise in regions where the magnetic fields are much stretched E to W (Fig2). Its real length may have been twice as great!

QRF unseen? Since the recent QRF transit passed West to East across the solar back- side it went unseen until emerging at the East limb (dotted Fig4, LHS).

'Big Prom'. This 'term' is appropriate, since the prominence achieved heights of ≥100Mm and a length of at least 200Mm. Both are at the 'big end' of QRF 'specs'. It persisted for at least half a solar rotation and likely more than one. Will it return? Likely it will. Solar quiet regions do not host much activity and the QR fields that shape prominences are persistent.

Some clearer weather would be a help!
Harry

Fig1. "Story of the Heavens", Ball, R.S. Dunsink Obs. Dublin 1886. P57.
Zirin, H. "Astrophysics of the Sun" 1986.
1.Schrijver & Zwaan, 2008. "Solar and Stellar Magnetic Activity", pp154. 162.

Easy Lunar Photography by Andrew Wood

The digital photography revolution has enabled the taking of sophisticated astronomical images by amateur astronomers using specialised equipment. It has also enabled the taking of more basic images with off the shelf digital cameras used for general photography.

Many of these cameras have telephoto zoom lenses of long focal length. The obvious target if you want to use such a camera for a bit of astrophotography is the Moon. I have been imaging the Moon using a Panasonic Lumix FZ300 camera, which enables telephoto out to 600mm. (This is the same camera I used to take solar-filtered images of sunspots in the May 2022 Astro Flyer).

Even with a long focal length, the Moon will only take up a small area of the photo, as shown in Figure 1. By taking the image in RAW, and cropping and processing in a photo editor, the resulting JPEG images can produce reasonable results. Figures 2 to 7, images of the crescent through full phases, have been processed using ADOBE Lightroom, playing around with the exposure, contrast, and a few other settings.

Sharper photos of the Moon can be taken with better equipment, though the easy set-up of a basic camera on a tripod (it's even possible, hand-held, though since you need to use manual focus, a tripod is better, especially for stability) means that decent images can be produced without expensive imaging equipment.

Summary of Figures 2-7

Fig 2: 2 Day Moon. July 12, 2021. F2.8, 1/500th second, ISO-800
Fig 3: 3 Day Moon. September 20, 2020. F3.2, 1/250th, ISO-400
Fig 4: 6 Day Moon. May 7, 2022. F2.8, 1/1000th, ISO-100
Fig 5: 7 Day Moon. August 15, 2021. F3.2, 1/2000th, ISO-400
Fig 6: 9 Day Moon. August 17, 2021. F3.2, 1/4000th, ISO-400
Fig 7: 13 Day Moon. September 1, 2020. F2.8, 1/4000th, ISO-100

Fig 1

Easy Lunar Photography by Andrew Wood

Cont...2

Fig 2

Fig 3

Fig 4

Fig 5

Easy Lunar Photography by Andrew Wood

Cont...3

Fig 6

Fig 7

More Club News continued from page 1

Club/Social Viewing Nights

Club/Social Viewing Nights are on Saturday evenings "just" Before Sunset. Viewing nights are for members and invited guests. The contingency plan for poor weather on the proposed viewing night is to meet the next night (a Sunday night) .

Woncur Road, South Nowra (Head South down The Princes Highway, turn right at BTU Road, Woncur Road is the street first on the left).

University Viewing site. On the way to the university on George Evans Road go straight ahead through the second turning circle to the new viewing site.

Bring your scopes and or binoculars and a small folding chair, a decision on the day planned, depending on viewing conditions, by the club president and his deputy.

Email information if details are changed, to all, or contact Frank for changes.

Solar viewing BBQ lunches (BYO) may be held and these will be advised ahead of these events. Special events such as Comets, eclipses etc. may also warrant members night viewings.

The AGM was held at the May 2022 monthly meeting. Elected officials for 2022- 2023

The 2021 AGM has been postponed due to Covid.

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President: Mark Town
Vice President: John Gould
Secretary : Andrew Wood
Treasurer: Frank Gross
Public Officer; Frank Gross

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Observation Officer: Robert Turnbull
Editor: Kaye Johnston
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The deadline for Articles for the Astro Flyer is The First Friday of the Month.

Editor Kaye Johnston