Federation of Astronomical Societies

Editor: Michael Bryce

Newsletter

No 131: April 2023

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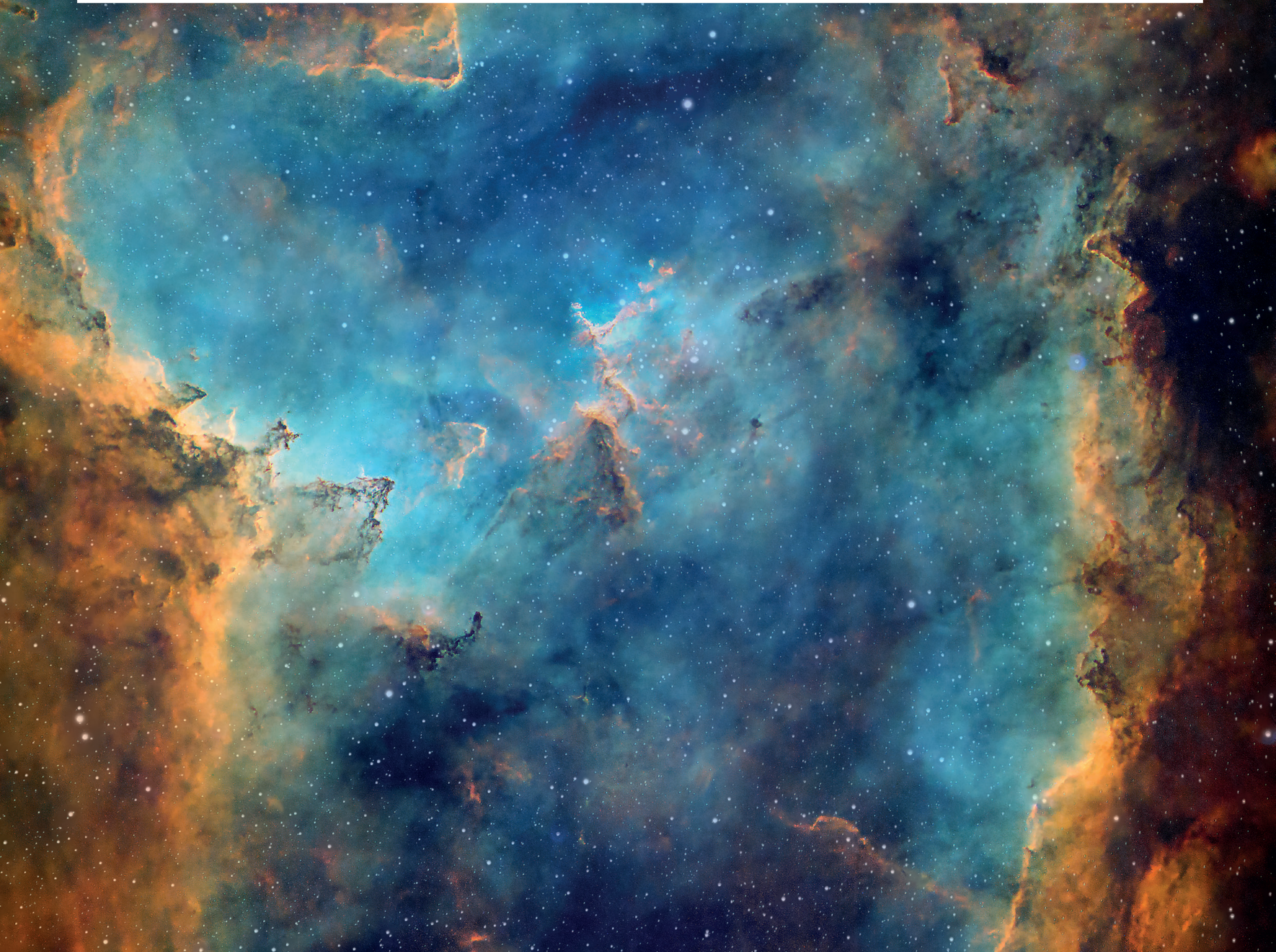

Cover Image Credit: Jonathan Wood and Rachael Wood from Doncaster Astronomical Society. See Readers' Images on page 4

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Newsletter No 131, April 2023, Published by the Federation of Astronomical Societies --- ISSN 2755-9777

President's Spot: Dr Paul A. Daniels FRAS

Some of you may have managed to observe the 'Green Comet' that appeared in our skies recently. Its proper designation is C/2022 E3 (ZTF) (see sidebar) and was discovered by the Zwicky Transient Facility at Mount Palomar in the USA. In some ways the comet turned out to be a bit of a disappointment as, when discovered, it was expected to become a very bright spectacle near perihelion but it didn't live up to the hype. Comets have often turned out to be unpredictable but we live in eternal hope and, even now, there are some pundits predicting that comet C/2023 A3 (Tsuchinshan-ATLAS) will wow us all in mid-October 2024!

Of course, it's always possible that the comet will surprise us and actually be brighter and more spectacular than first anticipated. As a young lad of 14 years (and when I should have been sound asleep), I remember hanging precipitously upside down out of my bedroom window to see C/1969 Y1 (Bennett) just above our roof guttering. It was a spectacular sight that stayed with me and later led me to my chosen PhD research topic. More recently we've been treated to amazing sights of C/1995 O1 (Hale-Bopp) and C/2020 F3 (NEOWISE).

One spectacular flop that some of you may recall was C/1973 E1 (Kohoutek). Discovered at about 16th magnitude when it was at a then unprecedented distance of 4.7 AU from the Sun and 4 AU from the Earth it was at one point predicted to brighten to nearly -12th magnitude: that's nearly as bright as the full Moon! In fact the viewing public only saw it reach about +2nd magnitude although it did manage -3rd magnitude when behind the Sun (observed using a coronagraph).

Comets are bodies composed of dust and frozen gas with the composition and proportions of each not known at discovery. The bodies were formed over millennia by a process of accretion where smaller 'dirty snowballs' successively stuck together causing the dust and frozen gas to be intimately mixed within the body which could eventually grow to a size of, perhaps, a few kilometres in diameter.

As the comet body (the nucleus) approaches the Sun the more volatile of the gases start to sublime (the vacuum of space doesn't allow for a liquid phase) and produce a gaseous cloud (the coma) around the nucleus. The gas in the coma is almost instantly ionised by the action of UV light from the Sun and electron collisions from the solar wind and the magnetic field embedded in the solar wind rapidly carries the ionised gas in a direction streaming approximately away from the direction of the Sun; this is known as the Type I tail and is typically straight with features in it (*e.g.* bright spots, kinks and disconnects) produced by unevenness in the solar wind's magnetic field caused by turbulence. Typically the ionised gas will glow with a colour characteristic of its composition; blue-green is commonly produced by diatomic carbon, pale yellow by sodium ions and white by molecular carbon dioxide.

At the same time as the frozen gas is subliming, the intermixed dust particles are released into the comet's orbit to form a dust tail known as the Type II tail. The Type II tail is typically broad and diffuse with few features and is curved along the comet's orbit. The dust tail will have a pale yellow-white colour simply produced by the reflected sunlight.

So far, so good but, clearly, comets and their features are complex physical systems!

Most of you will be familiar with the concept of absolute magnitude for stars (how bright a star would appear if placed at 10 parsecs distance) with the goal of being able to compare the intrinsic luminosity of different stars rather just their apparent brightness. It turns out there's also an absolute magnitude for comets – how bright the comet would appear to be if placed at 1 AU from Earth and 1 AU from the Sun. For this we usually consider only the combined brightness of the comet's nucleus and coma and *not* the tail but, for *very* bright comet tails, its contribution may also be included. Again, the hope is that we can compare different comets' intrinsic brightness's separately from how far they are from the Sun or Earth.

First, let's do a quick review of the relationship between light flux, the amount of light energy passing through a square metre (Watts *per* metre^2), and magnitude. In 1856 Norman R. Pogson proposed the magnitude scale we use now. He decided to use the old Greek scale of dividing the difference between the brightest stars (1st mag) and faintest naked-eye stars (6th mag) into five equal magnitude intervals representing an overall factor of exactly 100 in brightness. If there are five intervals between 1st and 6th magnitudes with a ratio of f in brightness for each interval then $f \times f \times f \times f \times f = 100$. So the value of f,

Basically, the modern, post-1994, IAU-approved convention for naming comets is:

- The prefix 'P/' is used for comets with either an orbital period of 200 years (or less) or which have been observed to pass perihelion more than once.
- The prefix 'C/' is used for comets with an orbital period greater than 200 years. They're misleadingly classed as 'non-periodic' even though many have an orbital period!
- The prefix is followed by the year of discovery.
- The year is followed by the half-month of discovery. This starts with 'A' for the first fifteen days of January, 'B' for the rest of January, 'C' for the first fifteen days of February and so on up to 'Y' for the last half of December (it skips letter 'I' to avoid confusion with number '1').
- The letter is followed by a number for the order of discovery in that half-month.
- The number is optionally followed by the names of one or more discoverers (or discovery teams) and usually placed in parentheses.

For example, C/1995 O1 (Hale-Bopp) is a non-periodic comet and the first one discovered in the last half of July 1995.

The naming of comets has a long and varied history; there's a good Wikipedia article describing the past and present naming conventions in more detail.

known as Pogson's Ratio, is the fifth-root of 100 = 2.512 so that a 1st magnitude star is 2.512 times brighter than a 2nd magnitude star. More generally this is shown as:

$$m_1 - m_2 = -2.512 \times \log_{10}(F_1 / F_2)$$

where m_1 and m_2 are two magnitudes with light fluxes F_1 and F_2 respectively.

So, armed with this, how do we determine a comet's absolute magnitude and use it to make predictions of a comet's future brightness? The simplest part of our thinking is the change in magnitude due to Δ, the comet's distance from Earth, measured in AU. Here the usual inverse-square law applies.

The other part is how much outgassing/dust-releasing activity does the sunlight produce in the comet as r, the comet's distance from the Sun, varies? A first stab at this would simply assume it's related to the amount of sunlight falling on the comet's nucleus so this would also be an inverse-square relationship based on r.

An early formula proposed by Johann Holetschek and others in the early 1900s was:

$$m = H + 5 \times \log_{10} \Delta + 2.5 \times n \times \log_{10} r$$

where *m* is the comet's apparent magnitude and *H* is a value for the comet's absolute magnitude. The '5' is Pogson's Ratio, 2.512 (approximated to 2.5), times 2 due to the second-power in the inverse-square relationship for Δ as described above. The *n* (similarly multiplied by 2.5) was considered by Holetschek and others to be 2 (assuming comet activity varying as inverse-square from the Sun) but later work by Sergej K. Vsekhsvyatskij in 1928, based on *a lot* of earlier comet observations, found that $n = 4$ gave a better fit. This led to the formula more commonly used up to the present day:

$$m = H_{10} + 5 \times \log_{10} \Delta + 10 \times \log_{10} r$$

where H_{10} is the comet's absolute magnitude for n = 4.

However, the problematic part of the above is the term 'better fit' with the suspicion that a mathematical fudge or subterfuge has been used: not only is there the question of why different comets have different absolute magnitudes, why comets' absolute magnitudes have been found to vary during their journey through the inner solar system and, for periodic comets, why there's some variation in absolute magnitude between successive apparitions. 'Absolute' may not be so absolute after all!

Surrounding the solar system at a distance of 10^4 - 10^5 AU is the Oort cloud, a reservoir of pristine comets created when the solar system formed. This distance is of the same order as the gap between stars and, as those distant comets are only loosely bound to our solar system, passing stars may perturb their orbits and cause some of them to either fall towards the Sun or be completely ejected or, possibly, captured by those passing stars. It may also be that some of the comets in our Oort cloud were previously captured *from* a passing star's own Oort cloud!

Comets from the Oort cloud arriving at the inner solar system for the first time will likely have a higher proportion of more volatile frozen gases than comets in shorter period orbits that may have passed perihelion several times and lost those more volatile gases. In addition, the comet's gas and dust will be more evenly mixed with fresh frozen gas on the surface of the nucleus more easily illuminated and warmed by sunlight than older comets which may have lost some of their surface gas and left a layer of dust partially obscuring some of the underlying frozen gas. When new comets are discovered, therefore, it's not unreasonable to assume that they will, initially at least, release more gas than a returning comet and so appear brighter.

Some comets may have their orbits perturbed by the solar system's planets, typically Jupiter or Saturn, such that they become shorter-period orbits and the time for which the comet is exposed to sunlight increases.

Another consideration is the rate at which the nucleus rotates on its axis. A faster rotation rate combined with a thick layer of dust on the comet's surface will reduce the ability of the Sun's heating effect to penetrate the dust layer before the spinning comet rotates the heated dust away from the Sun and the surface cools again.

Comets have a *very* low surface gravity: if someone were to use the same effort to hop 1 centimetre into the air from the surface of the Earth when on the surface of a typical comet they would reach an altitude above the comet's surface of about 4 kilometres! Not only can this low gravity cause material to move around on the surface of the comet due to escaping gas pressure providing aerodynamic lift to boulders and so expose fresh frozen gas surfaces but the low cohesion of the dust/gas mixture making up the nucleus combined with internal gas pressure and high spin rate may cause some more major rearrangement of the comet and release outbursts of gas.

As the comet gets older (and having made several perihelion passes) it will have reduced in radius as it loses material. In the case of 67P/1969 R1 (Churyumov-Gerasimenko) it's estimated from Rosetta observations that each perihelion passage causes 1 ± 0.5 metres to be lost from the surface. This shrinkage will gradually reduce the surface area for gas release as well as causing the build-up of a relatively thicker layer of dust. From the Giotto fly-by of the nucleus of Halley's comet it's been estimated that gas is only being released from about 10% of its surface. From the images of the Rosetta mission we can see that the nucleus emits gas jets from specific places rather than all over the surface. Typically, over the lifetime of a comet, its absolute magnitude will fade by several magnitudes causing the comet to become fainter.

With all of this complex activity it's not surprising that the intrinsic activity of a comet may change not only during a single apparition but also between apparitions. Nor is it surprising that a comet, just coming into warming range of the Sun for the first time or, possibly, on a subsequent return, may release a brief burst of gas, temporarily brightening its absolute magnitude and improving the chances of its detection or recovery and also raise hopes that the comet will continue to be as active throughout its apparition.

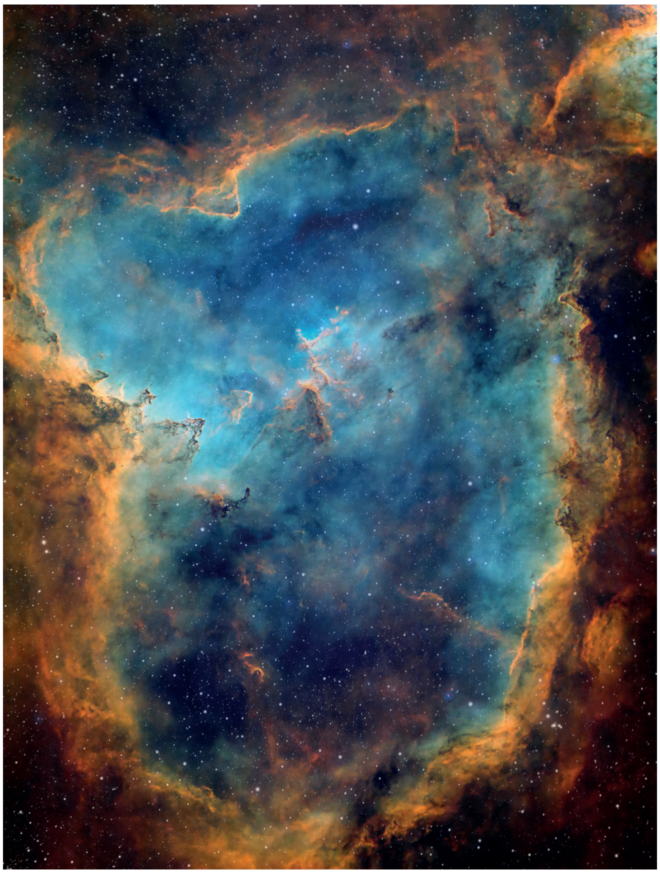
Comets are fascinating solar system objects with an intricate interplay between several physical processes that make it almost impossible to be certain what a new comet's brightness will be near perihelion when it has only just been discovered. We can all hope that C/2023 A3 will be spectacular – but don't hold your breath!

Stay safe and clear skies!

Paul
16 March 2023

Readers' Images

Jonathan and Rachael Wood



Rachael Wood says: Both images were taken by and credited to Jonathan Wood and Rachael Wood, from our back garden in Auckley, Doncaster.

Image left (and cover): IC1805 - Heart Nebula (Cassiopeia)
Skywatcher Evostar ED80. EQ6 AZGT. ZWO294 mm Pro imaging camera. ZWO120mm pro guide camera. 3nm Filters by Optolong_ filter: Ha 3hrs; Oiii 5hrs; Sii 4.5 hrs. 12.5 hrs total integration. Taken over 3 nights in January 2023. Stacked in Astro Pixel Processor. Processed in Adobe Photoshop CC.

Image below: IC410 - Tadpole Nebula (Auriga)
Skywatcher Evostar ED80. EQ6 AZGT. ZWO294 mm Pro imaging camera. ZWO120mm pro guide camera. 3nm Filters by Optolong_ filter: Ha 3hrs, Oiii 5hrs, Sii 4.5 hrs. 12.5 hrs total integration. Taken over 3 sessions between January and February 2023. Stacked in Astro Pixel Processor. Processed in Adobe Photoshop CC.

Jonathan and Rachael Wood
Doncaster Astronomical Society
donastro.org.uk

Do you have some excellent images to share?

Readers can have their own images published on these pages, or even showcased on the cover. Please send a high quality jpeg image with a full explanation of how it was obtained and equipment used to:

newsletter@fedastro.org.uk

Fusion In the Sun

Barry Jackson

The stages by which hydrogen is turned into helium within the Sun to create nuclear fusion and liberate huge amounts of energy along the way are known as the proton - proton (pp) chain.

A proton is a positively charged particle in the centre of atoms, they are so small that it would take a quadrillion (10^{15}) protons sitting side by side to span a metre. The Sun itself is over a billion kilometres wide and appears to be a giant contradiction in so much that although it's the biggest and brightest object near us, it couldn't shine without particles so tiny that 100 million would fit in the full stop at the end of this sentence.

The Sun is too hot for whole atoms to exist, so the individual parts of atoms - protons - fly around solo. The first stage of the chain is when two of these free protons stick together, or 'fuse', as they are both like charges, they don't want to do this and have to be corralled to a trillionth (10^{12}) of a millimetre apart in order to fuse. Believe this!

For every ten thousand trillion, trillion (10^{28}) pairs of protons that get that close, only one pair actually gets close enough to fuse together. A single proton will come close to billions of protons every second, but will take an average of a billion years to experience fusion, and yet the Sun shines. It has been doing so for 4.6 billion years and will do so for billions more to come.

How? The Sun has an awful lot of protons, total number is 1 with 57 zero's after it (10^{57}). Just 0.000000000000000036% (3.6×10^{-19}) of the Sun's protons fuse every second, but that's still 360 trillion, trillion, trillion (3.6×10^{38}) protons! It's only in the Sun's core that temperatures and pressures are extreme enough to force protons so close together, 15.7 million degrees Celsius and a pressure 100 billion times the atmospheric pressure at the surface of the Earth. (The Sun's core is 8 times denser than gold.) The light produced by fusion slowly makes its way to the surface where it can flood out into the Solar System to warm the planets. This light only travels one millimetre before it knocks into something, it can go forward, sideways or even back towards the core, so the time it takes to make it out of the maze can be 170,000 years.

Even though the Sun is slowly eating itself by converting it's mass into energy through fusion, these reactions are what sustain it. The Sun is massive and gravity is doing its best to collapse it, and yet it remains stable because the energy produced by fusion is pushing the other way.

Reproduced from "**Event Horizon**", the newsletter of the [Mansfield & Sutton Astronomical Society]. With Permission from the Editor.

Barry Jackson
Mansfield and Sutton Astronomical Society

Comment

To explain the diagram on the right, we should mention that only Hydrogen has a single proton in its nucleus. Heavier elements also have neutrons. The diagram clearly shows Deuterium nuclei, He^3 nuclei and He^4 nuclei.

Deuterium is a single proton and a single neutron together in the nucleus, He^3 is two protons and a neutron and He^4 is two protons and two neutrons.

The time taken for photons to get from the solar centre to the surface depends very much on the assumed mean free path for photons plus it's a function of radius – the MFP is small in the solar centre (~1mm) and much larger (~100km) in the chromosphere. There's a good explanation here: https://astronomy.stackexchange.com/questions/43795/why-are-there-different-time-estimates-for-a-solar-photon-to-reach-the-surface-o

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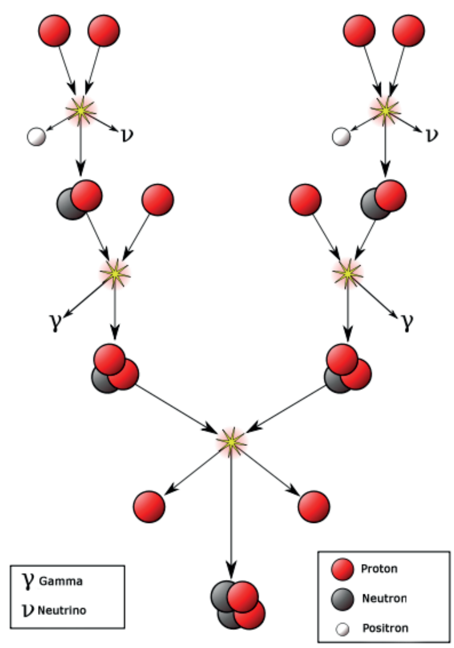


Image Above: The proton-proton fusion process that is the source of energy from the Sun.

Reproduced from Wikimedia Commons

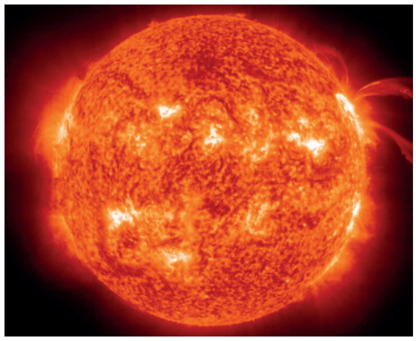
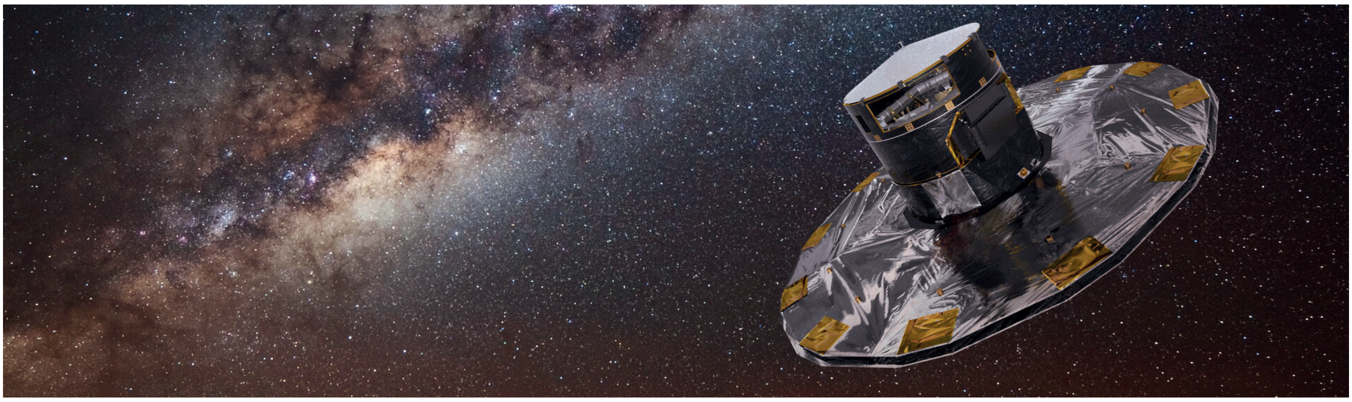


Image Above: An EIT 304Å image captures a pair of curving erupting prominences on 28 June 2000 -- Prominences are huge clouds of relatively cool dense plasma suspended in the Sun's hot, thin corona. At times, they can erupt, escaping the Sun's atmosphere. Emission in this spectral line shows the upper chromosphere at a temperature of about 60,000 degrees K. Every feature in the image traces magnetic field structure. The hottest areas appear almost white, while the darker red areas indicate cooler temperatures.

Solar and Heliophysical Observatory
soho.nascom.nasa.gov

Amateur astronomers needed: help classify stars with Gaia's data



ESA's Gaia mission has been collecting data on millions of space objects like stars and asteroids to build an extensive cosmic record. Now, to take it up a notch, it needs your eyes.

Gaia's data is already an invaluable resource for astronomers and scientists. The mission was launched in late 2013 and now lies some 1.5 million km from Earth. With its two powerful telescopes and three science instruments, Gaia is creating the largest and most precise 3D map of the Milky Way. It does so by determining the position of its target stars and registering how they change throughout time.

So far, Gaia has measured 1.8 billion stars with unprecedented precision, the richest star catalogue to date. Gaia's third major data release, published in 2022, includes 10.5 million variable sources over the entire sky, identified using machine learning methods in a supervised classification scheme.

We have learned a great deal about the Milky Way as a whole too. Thanks to the mission, we now know our galaxy merged with another galaxy in its early life, around 10 billion years ago. We have also learned more about our neighbour galaxy, Andromeda, and how it will collide with the Milky Way billions of years from now.

Though Gaia's telescopes are incredibly powerful, researchers within the mission still need the help of the oldest visual tool on the planet: your eyes. In its almost 10 years since launch, Gaia has contributed massively to our understanding of the cosmos, and now you can take part in furthering the discoveries.

Within Gaia Vari, an ESA-funded citizen science project, you can help classify Gaia's variable stars — stars that change in brightness over time. These observations are key to better understand these celestial bodies better.

As analysing individual sources is beyond the scope of the Gaia consortium, you, as a citizen scientist will look over images and graphs to classify stars' brightness changes, colours, and other variables over time. You may also identify incorrect classifications made by the automated algorithms. This will help scientists organise and categorise what we know of the millions of stars Gaia has observed, toward the next Gaia data release in 2025. You may actually discover the most interesting stars!

Do you wish to take part in a citizen science project?

If the scientist in you wants to help, ESA has got you covered. From monitoring light pollution to classifying images of Mars, you can help us advance peaceful space exploration. We also hope that by opening up ESA data and tools to the public, we are improving the openness of our work, increasing citizen engagement in scientific research, and building stronger connections between science and society.

To participate in the Gaia Vari project, go to Zooniverse, a platform with projects where people power the research. There's no need for you to sign in or create an account. After entering the platform, you can learn how to look at the graphs and data and classify each variable.

"Gaia is deepening our understanding of the universe as we know it, and both professional and amateur astronomers have been amazed with the results analysed so far. Now we need help from the wider amateur astronomy community to better understand how stars change throughout the years", says Pedro García Lario, Community Support Scientist at Gaia Science Operations Centre.

Gaia Vari is a project funded by ESA, developed jointly by Sednai and Science Now.

Text and Image: European Space Agency
esa.int

Thanks to Pål A. Hvistendahl for notifying us about this.
Pål A. Hvistendahl, NGO Liaison Officer
ESA HQ Bertrand
pal.hvistendahl@esa.int | www.esa.int/spaceforearth

Stratford-upon-Avon Astronomical Society

The Stratford upon Avon Astronomical Society meet every 1st and 3rd Tuesdays at 8pm (doors open at 7.30pm) at Alderminster Village Hall. Everyone is welcome, especially beginners and those wanting to learn more. The first Tuesday is a Club Night, in April that will be on 4th April and the speaker on the third Tuesday, which is on 18th April is due to be Les Fry who is from Newtown Astronomical Society, with a talk about 'Asterisms and Lost Constellations'. Please note that the speakers usually start quite promptly at 8pm.

Each month one of our members offers pointers to what to look for in the sky during the coming weeks.

The Spring Stars

As the nights begin to shorten, the spring constellations come more visible. Orion is dropping towards the western horizon. Above it and to the east, are 2 lines of stars with 2 bright stars at the east end. This Is Gemini (the Twins), and the stars are Castor and Pollux. (With a big telescope, you would be able to see these are multiple stars).

Continue east, you'll see a constellation that is supposed to look like an old flat iron (I think it looks like a mouse) This is Leo.

Between them are 3 faint stars, and a fuzzy bit in the middle of them. With binoculars you'll see a lovely star cluster, this is the Beehive cluster in Cancer.

Carry on east, past Leo, and you will arrive at a double V or Y shaped constellation. This is Virgo with its brightest star Spica. Another route to spica is to find the plough, move down the pan handle, continue in that arc to Arcturus, a yellow giant in the constellation of Boötes, before spiking off and slightly upwards to Spica.

With a big telescope, multiple galaxies can be seen in Virgo. These are part of the Virgo super cluster of which Our Milky Way Galaxy is part.

Dave Benton
Stratford-upon-Avon Astronomical Society
astro.org.uk

Mid Kent Astronomical Society

Mid Kent Astronomical Society Events are as follows:

14 April: Dr. Jenifer Millard - The Hidden Universe

ZOOM ONLY:- Please visit our website for information on how to join this meeting.

Did you know that more than 99% of the Universe is invisible to the human eye? In this talk, we will explore the electromagnetic spectrum, chronologically following the discovery of different wavelengths of light and how they are used to uncover secrets of the cosmos.

28 April: Annual General Meeting

The AGM is open to all MKAS Members and Visitors, however only Members are entitled to vote.

12 May: Dr. Rodney Buckland - Exoclock - opportunities for all

ExoClock is a project to monitor the ephemerides of transiting exoplanets. Everyone with a telescope and a CCD camera can participate!

26 May: Steve Cookson - The search for dark matter continues

Over the last 2 years, Steve has worked with Professor Xavier Hernandez, from the National University of Mexico (UNAM), to investigate whether there are indications of Dark Matter to be found in widely separated Binary Star systems as well as in other more commonly known areas such as galaxies. Their first co-authored scientific paper was published in the 'Monthly Notices of the Royal Astronomical Society' in 2022 and they are continuing to collaborate on further areas of interest.

All Regular meetings are held at Bredhurst Village Hall unless otherwise stated. Bredhurst Village Hall : Hurstwood Road, Bredhurst, Gillingham, Kent ME7 3JZ. These meetings are open to everyone of all ages and levels of expertise, including complete beginners.

There is a small entrance fee for each meeting to cover refreshments and other meeting costs.

For more details please visit: midkentastro.org.uk

Cardiff Astronomical Society

BBC Wales 100 at the National Museum of Wales, Cathays Park 11th February 2023

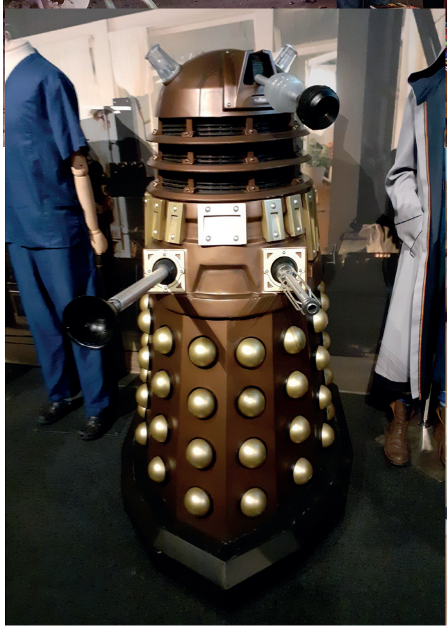
First contact! Who would have though that the first contact with alien life would be at the National Museum in Cardiff. And despite having all the star charts with us, knowing around way around the sky we didn't manage to identify where he/she/it came from!

Cardiff Astronomical Society were invited to have a stand because of our past work with every BBC Stargazing Live series and because the first landing on the Moon was the BBC's biggest outside broadcast.

There were over 2000 people of all ages through the door, our stand was kept very busy answering many queries, helping people to get started and giving them an idea of what it is like to look through a telescope. Phill our Chairman presented two talks to a full audience, on Dr Who and Time Travel.

Theresa Cooper
Public Events Coordinator for Cardiff Astronomical Society
cardiff-astronomical-society.co.uk

All Images Credit: Edward and Theresa Cooper



Hertford Astronomy Group

Hertford Astronomy Group Events are as follows:

Wednesday, 12 April at 8:00 pm (In-person and Online)

Andrew Norton FRAS FInstP SFHEA:
The New Cosmology - or How the Universe Works

In this talk I will describe how the Universe works! I will explain how astronomers measure the distance to, and speed of, galaxies, leading to the idea of expanding space and what this tells us about the age of the Universe. I'll talk about the cosmic microwave background and what this tells us about how the Universe is cooling. Then I'll look at what the future of the Universe may involve – touching on the ideas of dark matter & dark energy, before concluding with a consideration of the fate of the Universe.

About Andrew Norton FRAS FInstP SFHEA:

Professor of Astrophysics Education, School of Physical Sciences, Open University
open.ac.uk/people/ajn3

Wednesday, 10 May

Oliver Shorttle: Rocky Planet Atmospheres

Wednesday, 17 May

Annual General Meeting

Wednesday, 14 June

Helen Mason: Reaching for the Sun

Meeting Charges:

Members are free
Visitors are charged at £2.00 each
Under 18 are free
Students are free - bring ID with you

For more details and to book tickets please visit our Website at

hertsastro.org.uk

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The International Olympiad on Astronomy and Astrophysics (IOAA)

Answers to Our Observational Challenge

Following on from the IOAA Observational Challenge in the last issue, Dr Calverley has sent in the answers with an explanation of how they are achieved.

Explained answers:

The first thing to do is the identify Polaris as the bright object on the meridian (the line from N to S), from here you can identify the location of Ursa Major ("the Plough"), which gives a way in to answering the first few questions and hence later ones.

1. The handle of the Plough points to Arcturus ("arc to Arcturus") and on to Spica. Given the distance across the sky from the handle it must be Spica (we are told it is a star, rather than a bright planet)

2. So long as altitude is linear with radial distance from the centre of the map, we can measure how high above the horizon Polaris is (approximately ¼ of the diameter along the meridian [representing 180°], hence approximately 45° - using a ruler on the page and measuring to the nearest mm gets 42°). Note the altitude of Polaris is your latitude (this can be realised with a minute's thought)

3. Having identified Ursa Major we see that the upper of the two pointer stars to Polaris are missing, and that one is Dubhe (positioned to complete the quadrilateral, given the student has a good idea of its shape). We see that the handle points directly to Spica without a bright star intervening, so it must be that Arcturus is missing as well (approximately halfway between the end of the handle and Spica). Finally, we can make out Cygnus (the swan / Northern Cross – with the bright star Deneb) and Aquila (the eagle – with bright star Altair), two parts of the Summer Triangle, and so the third missing star must be the final vertex of that triangle – Vega (approximate position determined by knowing the Vega-Deneb line is roughly at 90° to the Vega-Altair line)

4. The constellations on the ecliptic will be the zodiacal ones (plus Ophiuchus). We know Spica (identified in Q1) is in Virgo so that marks the Western end of the ecliptic in this image, so we just move through the zodiac in the direction of South (towards Sagittarius) and then East (finishing with Pisces). Most students would just mention Virgo (from Spica) and then the 3 next to it (Libra, Scorpius and Sagittarius [or Ophiuchus])

5. Spica and Antares (in Scorpius) are near the ecliptic, so having identified them you have a good sense of the curve of the ecliptic. The planet would be next very bright object you encounter on the ecliptic (Capricornus and Aquarius don't have stars as bright as this object, which further gives it away)

6. The galactic equator goes through the neck and body of Cygnus the swan, through Deneb. The galactic centre (on the galactic equator) is in the steam from the teapot Sagittarius. Also, it goes through Cassiopeia. With these pieces of knowledge, we can draw a reasonably accurate curve.

7. The question really tests a knowledge of the Messier numbers – to know what object is being referred to with its designation: **M1** is the Crab nebula in Taurus – this is one of zodiacal constellations not visible on the ecliptic, so must be below the horizon; **M31** is the Andromeda galaxy – it is below the second "U" in the double-u of Cassiopeia, so it should be visible. Precise location is done by looking at the line of three bright stars in Andromeda (Almach, Mirach and Alpheratz and knowing it is on a line at 90° to that one starting from Mirach); **M42** is the Orion Nebula – as one of the most widely recognisable constellations in the sky, it is clear Orion is not in this sky map and so M42 must be below the horizon; **M44** is the Beehive cluster in Cancer – another zodiacal constellation not visible on the ecliptic, so must be below the horizon; **M45** is the Pleiades in Taurus – for the same reasons as M1 this must be below the horizon; **M57** is the Ring Nebula in Lyra – this constellation contains Vega so we know it must be visible. It is approximately halfway between the bottom two stars in the quadrilateral of Lyra

8. We're told the time is 21:30, and therefore we can estimate where the Sun is now (without knowing the time zone and longitude, we can't do this very accurately), namely, it will cross the southern meridian in roughly 14h30m (the time from now to midday the next day). We need to know additionally a coordinate of a star / point on the sky, and that the Sun was at the 'zero point' (the 'Vernal Equinox' in Pisces) on (roughly) 21st March. For example, the right ascension (RA) of Antares is about 16h30m (angular distance from the Vernal Equinox), and by eye, we estimate that around 1h30m ago, it would have been on the southern meridian. That is, stars on the southern meridian have an RA of 18h, and the Vernal Equinox will cross the meridian in 6 hours. The Sun is therefore around 8.5 hours (14h30m – 6h), or just over a third of a rotation (8.5/24 = 35.4%), behind the Vernal Equinox, where it was in March. The month is therefore just over one third of a year (35.4% of 12 = 4.25 months) after 21st March (approximately 2.75 months since 1st Jan) – this puts it into late July / early August (2.75 + 4.25 = 7.0 months since 1st Jan).

[**Note 1**: The real answer is mid-August in Georgia – we are off because Georgia are an hour ahead in local time (GMT+4) than you would expect from their longitude (about 45° so GMT+3). Correcting for this gives the Sun 9.5 hours behind the Vernal equinox and so gives a date of 7.5 months since 1st Jan]
[**Note 2**: Of course, the presence of the Summer Triangle high in the sky at this time of the evening might suggest that we were probably looking at June / July but this only applies near the Greenwich meridian – the route above is a more general way

continued at the bottom of page 11...

Stars as Points of Light

Martin Lowde

Martin Lowde, a Member of Mansfield and Sutton Astronomical Society has sent these excellent images of some single bright stars showing them as points of light.

All images taken with a 250 px GOTO Dobsonian and a Canon EOS 600D. Each image was 10 x 10 second exposures stacked from my garden in Huthwaite, Nottinghamshire. Martin used Deep Sky Stacker for stacking and a light stretch in Levels in Photoshop.

Martin Lowde ("Banger")
Mansfield and Sutton Astronomical Society
sherwood-observatory.org.uk

continued from page 10...

of working it out and conversely were you to know the month and GMT (from a sea-worthy clock) you could estimate your longitude, which is how sailors at sea could estimate where they were]

The Question and Answer maps are reproduced on the following two pages...

Dr Alex Calverley
alex.calverley@surbitonhigh.com

Speakers for Society Meetings

William Bottaci

Societies and groups need members to exist as such - it's in the name - and engaging people in activities is a means to attract, engage, and is cohesive to retain members. Activities vary but a common or core set is observing and meetings. Probably the most important attraction of meetings are speakers for talks, lectures, demonstrations etc., but not everyone has knowledge, let alone willing to engage a group. However the good news is that such people do exist and are eager, but where to find.

These people want to be found and a little organising results in various lists. We have collected a few for convenience and can be found here:

Astronomy Speakers and Astro Societies:
https://astrospeakers.org/speakers/Speakers-UK/astro_speakers_uk.html

which has also as a table:

https://astrospeakers.org/speakers/Speakers-UK/astro_speakers_list_uk.html

Royal Astronomical Society:
https://ras.ac.uk/education-and-careers/for-schools-and-teachers/1834-list-of-school-speakers

Speakernet:
https://speakernet.co.uk/talks/tagged/Astronomy

These are a selection known to the FAS, and if anyone knows of others then please do share, thank you.

William Bottaci
FAS Membership Secretary
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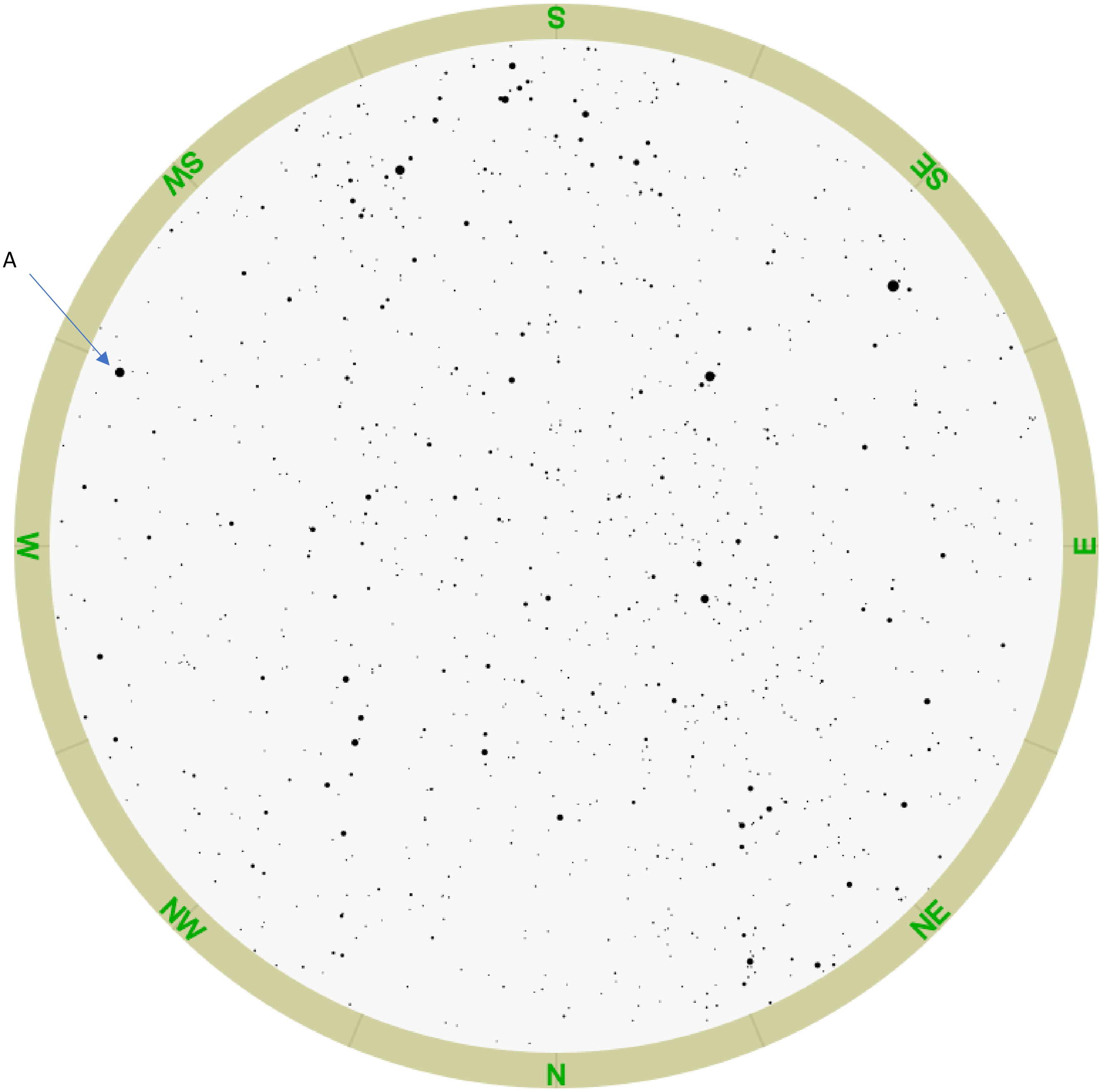
Space Oddities Live!

We are Space Oddities, a YouTube channel bringing you live astronomy and space exploration news, discussion, special guests, competitions, quizzes and more every Monday evening in a livestream at 8pm UK time on YouTube and Facebook. Each week an international panel of amateur and professional astronomers, who used to work together at the sadly now-defunct internet radio station Astro Radio, get together to chat about anything relating to the Universe and to keep our audience up to date with anything in the news, as well as present interesting presentations on a huge variety of astronomical subjects. We have a lot of fun!

We would like to become more involved helping astronomical societies and clubs in the UK and elsewhere to promote themselves and their activities. At a time when it is becoming more and more difficult to prise people away from their homes and their electronic devices in order to attend meetings, we would like to do our bit to help! If you are a member or official of an astronomical society or club and would like us to advertise your group and its events on our weekly livestream, please send an e-mail to spaceodditieslive@gmail.com with the details. We are also more than happy to show any promotional videos you might have. Promoting your society with Space Oddities is completely free – the only thing we ask in return is that you tell your members about us!

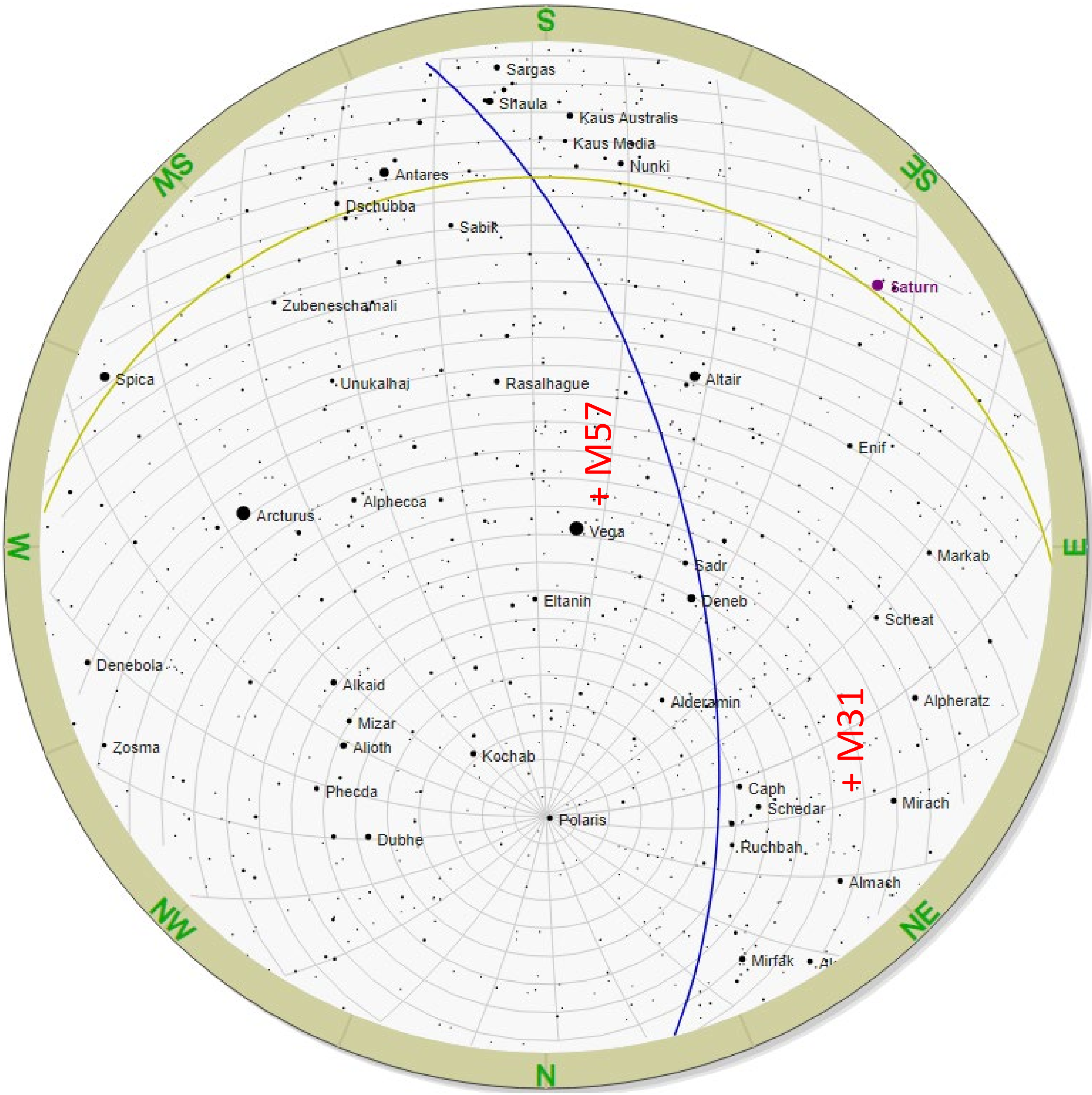
Space Oddities Live YouTube channel can be found at:
www.youtube.com/@spaceodditieslive
Our Facebook Group is at:
www.facebook.com/groups/spaceoddities
Sponsored by Rother Valley Optics
www.rothervalleyoptics.co.uk

FAS Astro Observational Challenge



1. Name the star being pointed at with the arrow labelled A
2. Estimate the latitude of this location
3. Three stars have been removed. Name them and put a X where they should have been
4. Name 4 constellations that the ecliptic passes through in this image
5. One planet is visible. Circle it and write 'P' next to it
6. Draw on the galactic equator
7. Put a '+' on the image where any of the following are visible: M1, M31, M42, M44, M45, M57 [some of them are below the horizon]
8. This is the sky at 21:30 at the location. Estimate the month

Answers



1. Spica
2. 42° N (accept 40° to 45°)
3. Stars removed are Dubhe, Arcturus, and Vega
4. Ecliptic is the yellow line – several possible answers (any 4 from Virgo, Libra, Scorpius, Ophiuchus, Sagittarius, Capricornus, Aquarius, Pisces)
5. Saturn is visible (no need to know which planet it is – just a bright object on the ecliptic)
6. Blue line
7. M1, M42, M44, M45 – not visible
8. July / August

This is the sky above Kutaisi, Georgia, on 17th August 2022 – the day of the IOAA 2022 observational exam.

The "Right to Dark" Law

Steve Kirkman

Steve Kirkman of The West Yorkshire Astronomical Society, has drawn up a Parliamentary petition called The "Right to Dark" Law for home & business properties.

The 'Right To Dark' law would ensure that a property owner has the right to have a natural dark environment after sunset to the exterior of their property, for example: front and back gardens. The law would guarantee that the natural dark environment would not be denied or destroyed by any artificial light source from neighbouring properties. Such lighting includes: security lighting, safety lighting, and exterior lighting that could be described as decorative, ornamental or mood lighting. The need for security lighting in some settings is accepted but should not negatively impact on neighbours and should follow the idea of 'The right amount light, in the right place, at the right time'. This new law takes inspiration from the existing 'Right of Light Act' which aims to protect natural light to the inside of a property.

Furthermore for those responsible for street lighting, when requested by a property owner suitable light shades or screens must be fitted to street lighting to minimise backwash or backlighting onto private property.

In summary; 'The Right to Dark Law: No party, whilst illuminating the exterior of their own property, shall illuminate the exterior of neighbouring and/or nearby properties. The aggrieved parties shall have the legal right to demand that such light trespass be addressed and removed.

More details:

Current light pollution laws do not adequately protect the natural lighting levels to the exterior of a property. They are primarily concerned with light intrusion INTO a property, most notably bedrooms when sleep could be disturbed.

With the advent of low cost/ low energy LED lighting, light pollution is a widespread and growing problem, with many groups having concerns about it's adverse affects on their areas of interest.

Some have their own campaigns. From information freely available on the internet, these groups include: The Campaign for the Protection of Rural England (CPRE), The Commission for Dark Skies (CfDS), Royal Horticultural Society (RHS). Bat Conservation Trust (BCT), BugLife, The British Astronomical Association (BAA), The Federation of Astronomical Societies (FAS) and all the 200 or so associated societies throughout the country. And there are others.

Astronomers both professional and amateur are one of the larger groups concerned about the loss of dark skies. It would be hoped that existing Light Pollution laws as outlined in the Clean Neighbourhoods Act 2005 would provide protection for dark skies. But it does not. DEFRA publication 'Statutory Nuisance from Insects and Artificial Light', cut and pasted from page 28 is this:

> 'Statutory nuisance from artificial light and light pollution
> 90: Artificial light nuisance may be, but is not necessarily, the same as light pollution. Artificial light nuisance is a source of light that in the opinion of a trained public health professional, who makes an assessment on a case by case basis, interferes with someone's use of their property, and / or is or might be prejudicial to someone's health. Light pollution could be defined as any form of artificial light which shines outside the area it needs to illuminate, including light that is directed above the horizontal into the night sky creating sky glow (which impedes our views of the stars), or which creates a danger by glare. Although light pollution might affect the aesthetic beauty of the night sky and interfere with astronomy, it is not necessarily also a statutory nuisance. The statutory nuisance regime is not an appropriate tool with which to address light pollution per se.'

So astronomers, and the night sky, have little if any protection in law. A neighbour can illuminate their own property, and neighbouring properties without breaking any law. Yet other neighbourly intrusions are legislated for: noise; councils have noise abatement officers, plants growing over a boundary, Trees growing so tall or building extensions that would block daylight into a property (Right of Light Act), offensive smells, odours or smoke, and unsanitary properties that attract vermin or present a health hazard. All can be addressed under national or local laws and regulations.

From the DEFRA publication above is the part line ….'interferes with someone's use of their property….'. Preventing a property owner from benefiting from natural darkness, and amateur astronomers from pursuing their hobby from their home would appear to satisfy this point, but a legal view might differentiate between 'use' and 'enjoyment'. Having a definite law protecting and guaranteeing the right to a natural dark environment at one's property, for whatever reason or purpose, is clearly needed.

The Petition signature count is available at https://petition.parliament.uk/petitions/632558 along with the ability to sign the petition. Or search petition.parliament.uk and add "The Right to Dark Law".

You may also be aware of the Government APPG for Dark Skies: https://appgdarkskies.co.uk/

Also the UK Dark Skies Partnership: https://ukdarkskies.org.uk/

FAS Newsletter Copy Deadline:

Deadline for items for inclusion in the next FAS Newsletter, No 132, June 2023 is 15 May 2023