

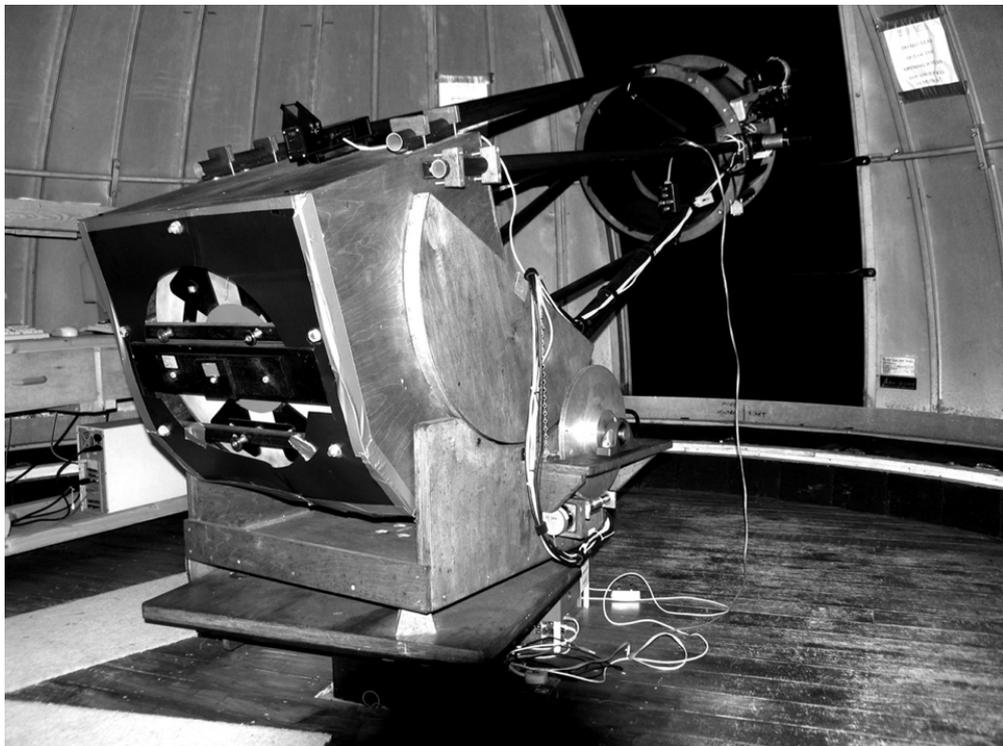


Breckland Astronomical Society

Affiliated to the British Astronomical Association and the Federation of
Astronomical Societies

EXTRA ***TERRESTRIAL***

Newsletter October 2020



Registered Charity no, 1044478

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Copy is always needed for this newsletter. Articles with an astronomical theme are welcome but anything of likely interest to the membership will be considered. Text or Word documents preferred but handwritten submissions also welcome.

Chris Bailey is the newsletter editor. newsletter@brecklandastro.org.uk

Mick Ladner has kindly stepped in as visitor organiser. visitors@brecklandastro.org.uk

The society would benefit greatly from having a local area advertiser, please contact the chairman if you are interested.

Chairman's Notes October 2020

I would prefer to not have more than 6 at the observatory, even if we may be exempt in some way, so we're arranging on email via me and facebook so we don't go over 6 on a Tuesday night.

If anyone who isn't a member wishes to visit, send Mick an email on visitors@brecklandastro.org.uk. We however, cannot accommodate more than a couple or so visitors at a time. Open nights on last Friday's of the month are off for the time being due to the surge in COVID-19 cases, even though not many are around here at the time of writing.

We had new member Anthony visit the observatory in September, it was a pleasure to meet you and hear about your expertise in astrophotography and building your own observatory. With only 4 at the observatory, we were safely distancing and I did some Jupiter and Saturn imaging on the 20". The scope tracks well but has developed a bit of a squeak on the altitude rubber belt drive unit. It would benefit from someone with experience in engineering taking a look.

Great Ellingham Recreation Centre is still pre-school only and so no other groups can use it due to the risk of spreading the virus. The Google Meet web interface worked well for Andy's talk and the AGM. An interesting change has happened during this online period, where institutions have been inviting each other to talks. This has resulted in a lot of potential talks to go to and a widening of the 'area' that influences us, but we still feel part of our local community somehow, by connecting like this.

Observatory rules October 2020:

- Outdoor based meetings but now no more than 6 by arrangement.
- Sign in/out required – we'll delete your data after the 21 day period is up.
- Shared use of Observatory Eyepieces not permitted. In addition, we can record label and assign one of our existing collection of old eyepieces to each person/household, and quarantine for 72 hours.
- Maximum 2 persons with social distancing still in place in main room, dome, 1 in kitchen/toilet area.
- Hand sanitiser should be used and hand washing at sinks.
- Disposable or own brought mugs for coffee and disposable cutlery/towels.
- One keyholder to open up and prepare outdoor space and to manage sign in book.

The facebook group keeps growing at 270 followers, and is here:
<https://www.facebook.com/groups/176906152365752/>

The Sky in October

Isn't the sky fantastic after dark? When the moon is not in the sky, we have Milky Way Stretching overhead most of the evening. It is a great time to learn those constellations and get your head round the mental rotations you'll need to make. It is a great experience to look overhead in a field and become detached from this world. I feel it makes one wiser, but that is just my opinion.

Jupiter and Saturn hover low in the South and Mars looms in the East, at opposition this month and a combined close approach AND good northerly declination for us here in the UK.

Amazing news about Venus! The detection of Phosphine, PH₃, while not seeming a particularly alien compound, has led to a strange conclusion that alien life may exist! There are all sorts of discussion points when you start looking into phosphine chemistry. Phosphine forms only deeply inside Jupiter and Saturn. 'Manufactured' Phosphides can react with acid to produce it. The Phosphate backbone of DNA here on Earth can be broken down in anoxic places to produce it. Phosphine gets destroyed by ultraviolet sunlight. See September's Sky at Night. This may be worth chatting about at some point. Venus is also visible in a crisp dawn sky, with dazzling Mars the other side of the sky.

Talks

We had Andy Jones, our hard-working treasurer and membership secretary, deliver a talk about Planet Vulcan. Richard Harmon has edited and uploaded it and put it on to our new Youtube channel.

You can view it here:

<https://www.youtube.com/watch?v=rQhJfd13CNw>

We had some good comments and we thank Andy for what became quite a deep bit of research that went in to finding out the story of how a planet could be discovered then disappear.

Nik Szymanek is back with us again (but virtually) on October 9th talking about what he knows best. While technology is racing ahead and astro-imaging has become more widespread, Nik was one of the amateur pioneers of the field in the UK and produced shockingly good quality images of today's standard many years ago. Nik is still considered the UK's authority on astro-imaging and will share some of his wisdom. You can come with questions or specific issues to chat about, as the question session is a great opportunity to get tips or ideas.

A link will follow to members and a post will go on the facebook group.

I'm rejigging the quiz in November so we can have an individual/household battle of the brains with fewer questions per round. As with pupils taking online exams, of course we can't see what you've got behind your screens or whether you have a separate google window open! I'm thinking what astronomical surprises I can throw in, but as usual the quiz will be general knowledge, and while free to join this year we will still send a prize out to the winner!

AGM

The AGM worked well online, thank you to all that stayed after the talk and answered 'Yes' in the text comments. We will keep the details for members, but as a comment, I think we all felt it is great to be hearing such stimulating monthly talks now. What I didn't mention is that I would like to have another committee member so we are back up to 6, and this shouldn't entail any particular role. There is no hurry for this as we want the right person who shares the passion. It is for the purpose that in case someone can't make it, becomes indisposed, and to increase the democracy of decisions. If anyone is interested the nomination and proxy vote form was given out in August for the AGM, but we can send you a copy that can be emailed back to us.

Dan Self

Observatory Maintenance

By Mick Ladner

Just a short update this month.

After a couple of cancelled work party's this month we at last made a start on cutting back the hedges to the rear of the observatory on Sunday 27th.

Three of us turned up (4 if you include Rohan), me, Martin and Dan.

It was quite hard work to get close enough from both our side and the allotment side.

There is a ditch on our side which stops you from getting enough height, I should have brought my large a frame ladder so will do for the next one.

Martin also had his strimmer with him so also trimmed back the vegetation around the observatory.

That's all for this time but watch this space for the next work party.



JOHN'S NEWS BITS October 2020

An international team of researchers led by Jane Greave of Cardiff University have detected phosphine in the clouds of Venus. Phosphine is a trace gas associated with anaerobic life. Phosphine is made up of one atom of phosphorus and three of hydrogen. The atmosphere of Venus is made up of dense clouds of carbon dioxide and sulfuric acid with traces of nitrogen. Although the surface temperature of Venus is 467 C, the upper clouds temperature can vary from minus 43C to minus 173C. A private company based in California, Rocket Lab, plans to launch a mission to Venus in 2023 to look for signs of life in its clouds.

China has launched 9 satellites into orbit on a Long March rocket from an ocean platform in the Yellow Sea on September 15th. This is keeping pace with the Elon Musk's SpaceX programme.

ESA has just awarded 129.4 million euros for a contract covering the design, manufacturing and testing of Hera, the agency's first mission for planetary defence from asteroid impact. Launch expected in 2024. It will gather scientific data to better understand composition of asteroids for future missions. As reported on science daily.

Scientists have updated investigations into a gargantuan supermassive black hole weighing 34 billion times the mass of our Sun. First discovered in 2018 and dating some 1.2 billion years after the BB and named J2157. A researcher at the Australian National University commented that the black hole at the centre of the Milky Way would have to gobble up two thirds of the stars in the Milky Way to get to that size.

The Sun is nine months into the new solar weather cycle, much like the previous cycle from 2008 to 2019. It follows an 11 year cycle with an expected 115 sunspots in July 2025. So expect more of a quiet Sun since the usual number for an active period is more like 200.

The TESS satellite along with the Gemini North telescope has been used to detect a massive planet orbiting a dead white dwarf star. Surprising that this planet survived the star's red giant phase that would have engulfed it.

The exoplanet is the size of Jupiter and designated WD1586b.
The white dwarf is about the size of the Earth with the exoplanet orbiting it every 34 hours which is closer to the star than Mercury from Earth..

The merger of two supermassive black holes first detected in May 2019 with the Ligo and Virgo gravitational wave detectors took place some 17 billion light years away.

One black hole the size of 85 Suns slammed into one the size of 66 Suns creating a massive black hole of size 142 Suns with the missing Solar mass turned into energy.

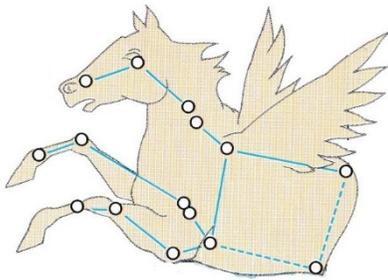
The event named GW190521 was the biggest cosmic bang that sent the gravity waves across the universe.

John Gionis

Myths and legends of the cosmos

Pegasus and Andromeda

Clear of the eastern horizon and high in the sky at this time of year are the constellations Pegasus and Andromeda. Both mythological

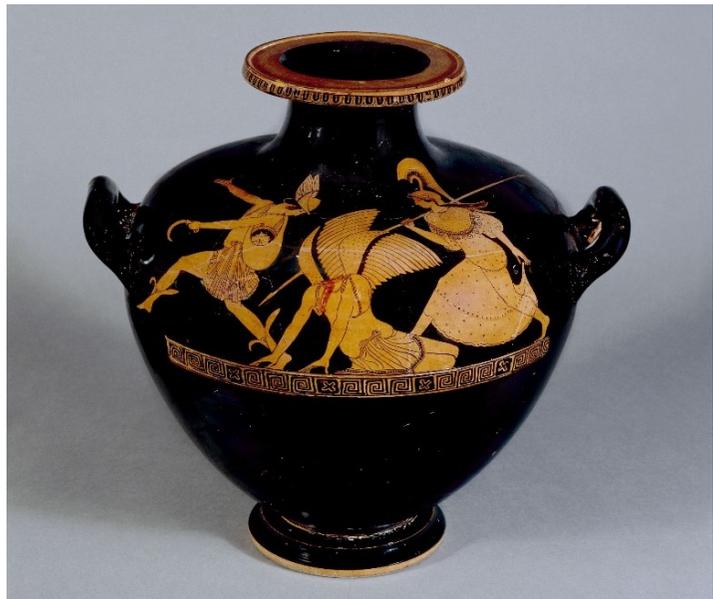


characters feature in the adventures of the hero Perseus. (N.B. in this account I have used the Greek names of the gods.)

Perseus was sent by a king who wished to get rid of him to find and kill the Gorgon Medusa, bringing back her head to prove it. Medusa was one of three sisters who were once very beautiful. But

Medusa had slept with the god Poseidon in a temple belonging to Athena. The goddess was so angry that she changed Medusa into a winged monster, with glaring eyes, protruding tongue, huge teeth and snaky hair. Her gaze turned men instantly to stone.

Perseus found the Gorgons in the Land of the Hyperboreans (a mythical land in the far north). They were surrounded by the shapes of men and wild animals turned to stone by Medusa. With the help of some useful gifts given by Athena and Hermes he



managed to decapitate Medusa. (These gifts were winged sandals, a sickle, a helmet of invisibility and a magic bag.) From her dead body

sprang the winged horse Pegasus and the warrior Chrysaor, the children of Medusa and Poseidon.



The name of Pegasus derives from a Greek word 'pegae' (πηγαί) meaning 'springs' and Pegasus is supposed to have produced two of them merely by stamping his hoof. He created the fountain named Hippocrene especially for the Muses who lived on Mount Helicon.

At one time Pegasus belonged to Bellerephon, another hero sent to kill a monster by a king who hoped he wouldn't return. In this case the monster was the Chimaera, a fire-breathing she-monster with a lion's head, goat's body and serpent's tail.

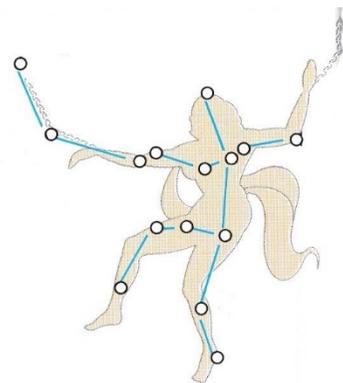


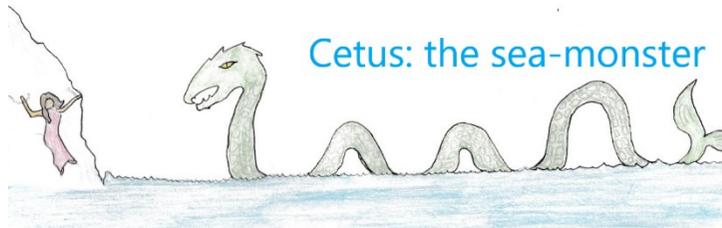
Bellerophon was advised, before setting out, to catch and tame Pegasus. He found the horse at Corinth drinking from another of his wells (Peirene) and threw over his head a golden bridle, a gift from Athena. Bellerophon flew on Pegasus over the Chimaera's back, riddled her with arrows and then thrust between her jaws a lump of lead which he had fixed to the point of his spear. The Chimaera's fiery breath melted the lead and it trickled down her throat, killing her.



Later on, Bellerophon became full of pride in his exploits and flew up to heaven to join the gods. Zeus was outraged and sent a gadfly to sting Pegasus under the tail. The horse reared and Bellerophon fell to earth. Pegasus continued on his way to heaven and there lived with the gods. He pulled the chariot which brought Zeus his thunder and lightning. As a reward Zeus immortalised him in the stars as a constellation.

Andromeda was the beautiful daughter of Cepheus, king of Joppa, and his wife Cassiopeia. Poseidon had sent a sea-monster to ravage their coastline and Cepheus had been told by an oracle that the only way to deal with this menace was to sacrifice Andromeda. She was chained to a rock, and everyone was waiting for the sea-monster (Cetus) to emerge and devour her. Just then Perseus flew over on his way back from killing Medea. He was carrying her head in his magic bag. He saw Andromeda and fell in love with her, so landed near her parents and asked what was happening. He promised to kill the sea-monster on condition that he could marry the lovely princess. Therefore, when the ferocious monster emerged from the waves and headed towards the shore, Perseus swooped down on his winged sandals and beheaded it, using his sickle.





Andromeda was very grateful, but her parents went back on their promise and in the ensuing struggle Perseus was forced to produce Medusa's head and turn everyone to stone. He and Andromeda married and had a large family, including a very famous great-grandson: Hercules.

Alison Chapman

Astrophotography (Part 5)

Stacking and Calibration frames

With stacking and calibration frames what we are really trying to do is reduce the effects of what is called “noise”. Noise occurs in any electrical circuit and is caused by the flow of electrons through a conductor. With electronic sensors (CCD & CMOS) we have a vast array of electronic circuits all contributing to the noise. What we need is to reduce the noise such that the ratio of noise to the signal (the image data) is as low as possible. This ratio is called the signal to noise ratio and is often written as SNR.

The signal is the photons hitting the individual wells (which become the pixels in the final image). In astrophotography these photons are very infrequent compared to a normal daytime photograph. This is why we need to make very long exposures and during this time the noise has a long period to disrupt the image. When the picture is downloaded from the sensor to the storage medium (camera card or laptop) it passes through amplifiers and other electronic devices all of which add to the noise levels

This may sound like an impossible situation, but if we can control the noise or understand how it is affecting the final image we can work to reduce its effect as much as possible.

The first possibility is to reduce the temperature of the sensor. Noise is dependent on temperature so if we reduce the temperature we will reduce the noise in both the sensor and the amplifiers that are on the edge of the sensor. This is why for high end astrophotography cooled cameras are used. In theory if we reduced the temperature to absolute zero there would be no noise but for our purposes this is not possible.

Although some DSLRs have been modified to cool the sensor this is not common. With a normal DSLR we will have to go with what we have. Having said this there is a marked difference in image quality from using an uncooled camera on a hot summer night to a similar length image taken on a very cold winter night with an uncooled camera.

Stacking

Some noise is random and will vary from frame to frame, so we take a series of frames and then look at each pixel value and average the result. Doing this should reduce any sudden random noise. So the next question is how many frames should we stack? It actually works on an inverse square law such that 2 frames would halve the random noise . To halve it again will take 4 frames and to reduce by half again would require 16 frames. After this it will take 256 to reduce by half again. In theory it will never be completely removed.

Stacking Software

For stacking Sun, Moon or Planetary images Registax or Autostackert are the most common programmes. AviStack and CCD Commander are programmes that had a strong following but now appear to be not so well supported.

There are several programmes available for stacking deep sky objects; probably the easiest to use is Deep Sky Stacker which is available as a free download. Another which was popular but appears less so now is IRIS. This has developed into more of a spectroscopic programme. At the more advanced end are Pixinsight and MaximDL both of which are paid for programmes and have a lot of features to assist processing.

Concentrating on Deep Sky Objects, I would recommend Deep Sky Stacker (DSS) and probably the best guide to this programme is from Dave Eagle who has visited Breckland. This is available from his website: <https://www.stargazing.co.uk/WebPage/shop/>

Calibration Frames

Calibration frames are used to correct problems with the camera and imaging stream. The most common types of calibration frames are:-

1/ Dark Frame

2/ Bias Frame

3/ Flat Field Frame

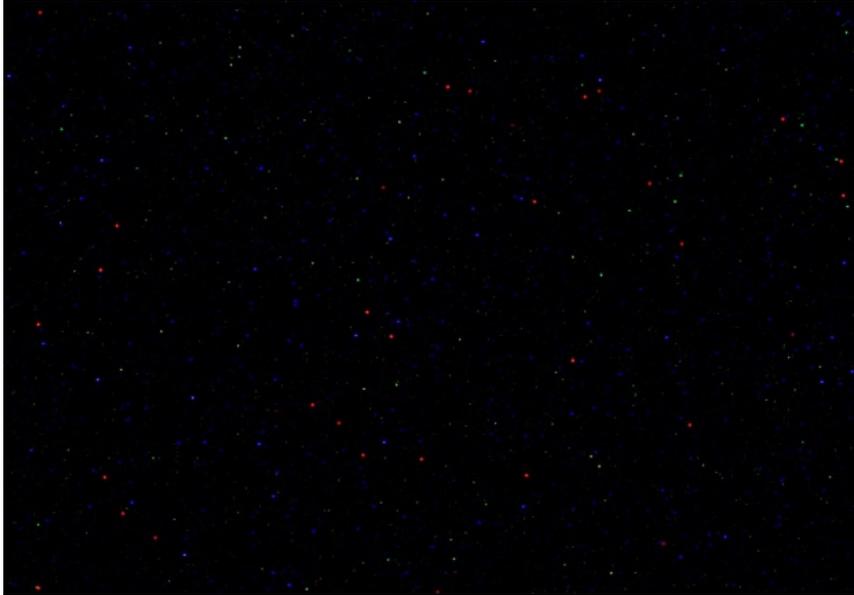
The original frame taken will be referred to as the RAW frame (this is sometimes called the light frame)

Calibrated frame = $\frac{\text{Raw Frame} - \text{Dark Frame}}{\text{Flat Field Frame} - \text{Bias Frame}}$

The above is taken care of in the stacking programme and is just shown here to assist in understanding the process.

Dark Frame

This is a series of frames taken at the same temperature and ISO as the Raw Frame and for the same length of time. It is taken with the lens cap on. As this also contains the random noise which is reduced by stacking there is a mathematical argument that there should be the same number of Dark Frames as Light Frames. The purpose of these frames is to remove the problems with the sensor and sensor amplifiers. All sensors have defects even at time of manufacture. It is possible to get graded CCDs that have been tested to be below a certain value but these are very expensive and only normally used for research grade work. Also, as the sensor is used individual pixels may fail.



This is a cropped image from an old camera and shows a considerable number of failed pixels. Some have gone hot (failed completely) and others are warm (showing above the background.) These defects would also be on the raw image and so if the Dark image is subtracted from the Raw image then these defects are effectively removed.

Bias Frame.

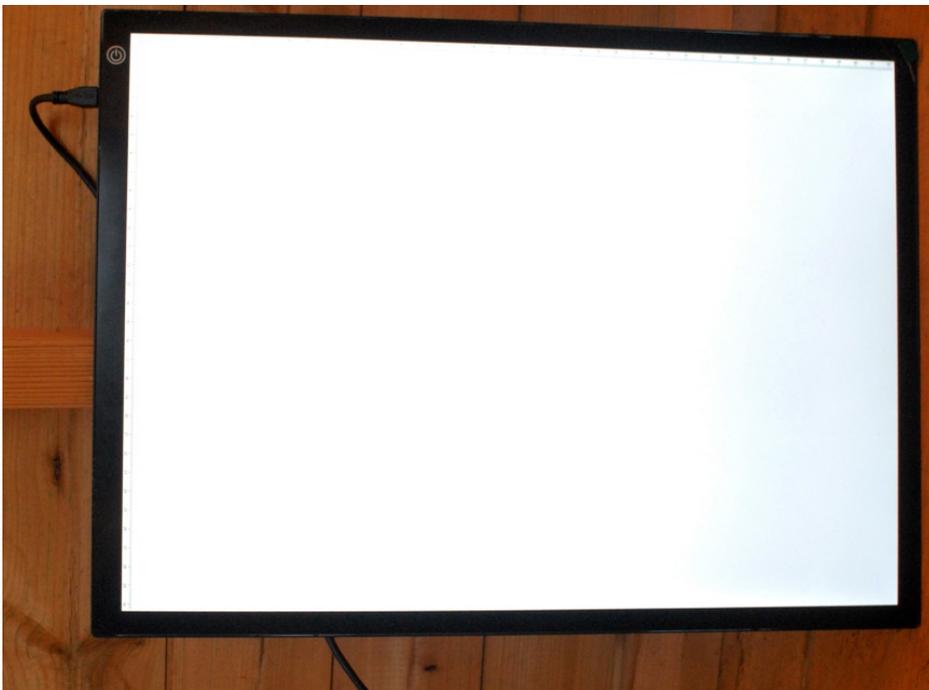
This is a zero length or minimum length frame at the same ISO setting and camera temperature as the images to be calibrated. The purpose is to correct the non-zero offsets of the pixel values, which vary from pixel to pixel. Bias Frames are needed if a Dark Frame is to be scaled to a different exposure time. They are not needed if the Dark Frames match the exposure time and ISO settings of the images from which they are to be subtracted, since Dark Frames contain the bias information.

Flat field

This is an exposure of a blank white surface taken through the same telescope as the astronomical images (Raw Frames), with the same camera at the same ISO settings and preferably on the same occasion so that dust particles will be in the same positions. Ideally the Flat Field

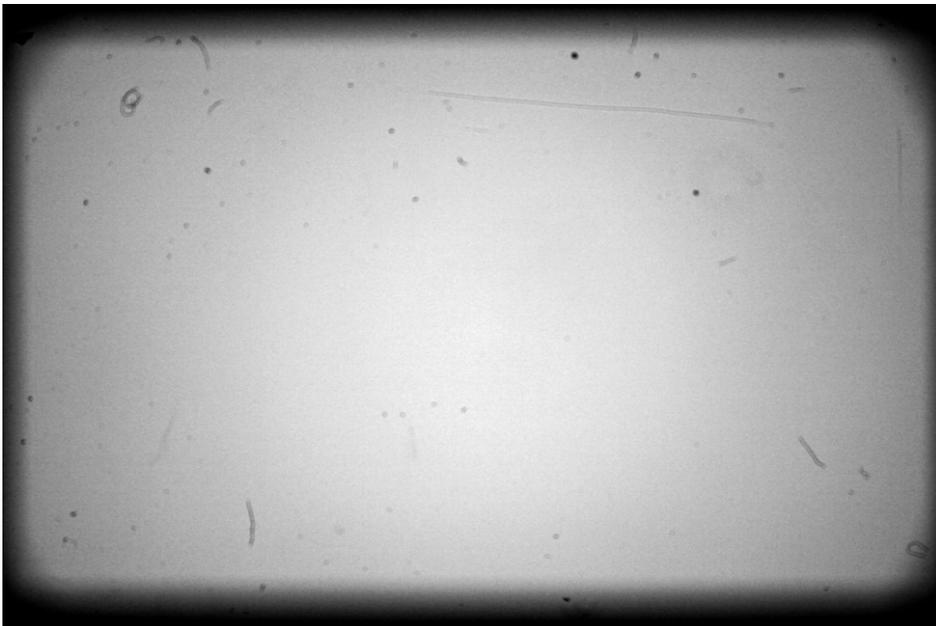
image should be Dark Frame adjusted so take a Dark Frame to match it. The purpose of Flat Field is to correct for dust, vignetting, and unequal light sensitivity of the pixels This is often unnecessary if your sensor is clean and vignetting is not a serious problem. It is also possible to correct vignetting in other ways (Pixinsight).

The traditional method of taking Flat Frames is to put a white sheet over the end of the telescope and point it at a blue sky. This would mean waiting until it was light enough and then without changing the orientation of the telescope taking the Flats. This is often not possible so other methods may need to be used. It is possible to buy so called special Flat Field Panels from Astronomical suppliers; as an example one for 120mm telescope is about £170. An alternative which I have found works fine is to use an artist's tracing pad. These are easily available and are dimmable and very even. The one shown is an A3 size to cover the end of my 91/4" SCT. The cost of this was less than £40. They are also available in smaller sizes, A4 or A5, at reduced costs.





The result is as shown below.



This has again been made worse case to illustrate the effects. There is vignetting visible and dirt on both the sensor and filter.

Conclusions

From the above it would appear that more time would be taken making calibration frames than actually imaging the deep sky objects themselves. This is theoretically true but if we ignore the need for Bias Frames, Flat Frames can either be corrected in software, or if marks on

sensors are not a problem a library Flat Frame can be made for one camera/field flattener/camera combination and used for all processes. Also it is possible to use Dark Frames that have been taken previously so long as the ISO/Gain and imaging time are the same and the temperature very similar. There is one proviso on this in that as CCDs/CMOS chips get older they will have more failed pixels so the darks will need to be updated.

Dithering

As suprising as it may sound, when taking a series of images of an object, positioning them all at the same place is not the best technique. We will look at tracking in a future part of this series. A slight shift of a few pixels in a random direction between successive images is better. Without this some defects may remain even after calibration and stacking (for example weak columns, hot pixel residues, thermal artifacts). Some tracking programs allow dithering to be done automatically but must be synchronised to make the move between individual images.

I know that some of this will offend the purists in the astrophotography world but it is intended to give the relative beginner an understanding of what is involved and what may be possible to improve their images. I present this after a considerable time imaging with various cameras (including film) and using a large array of software over the years.

Please either post your images on the facebook page or send to me at newsletter@brecklandastro.org.uk for inclusion in future issues. Also if there are any questions I will always try to answer them as soon as possible.

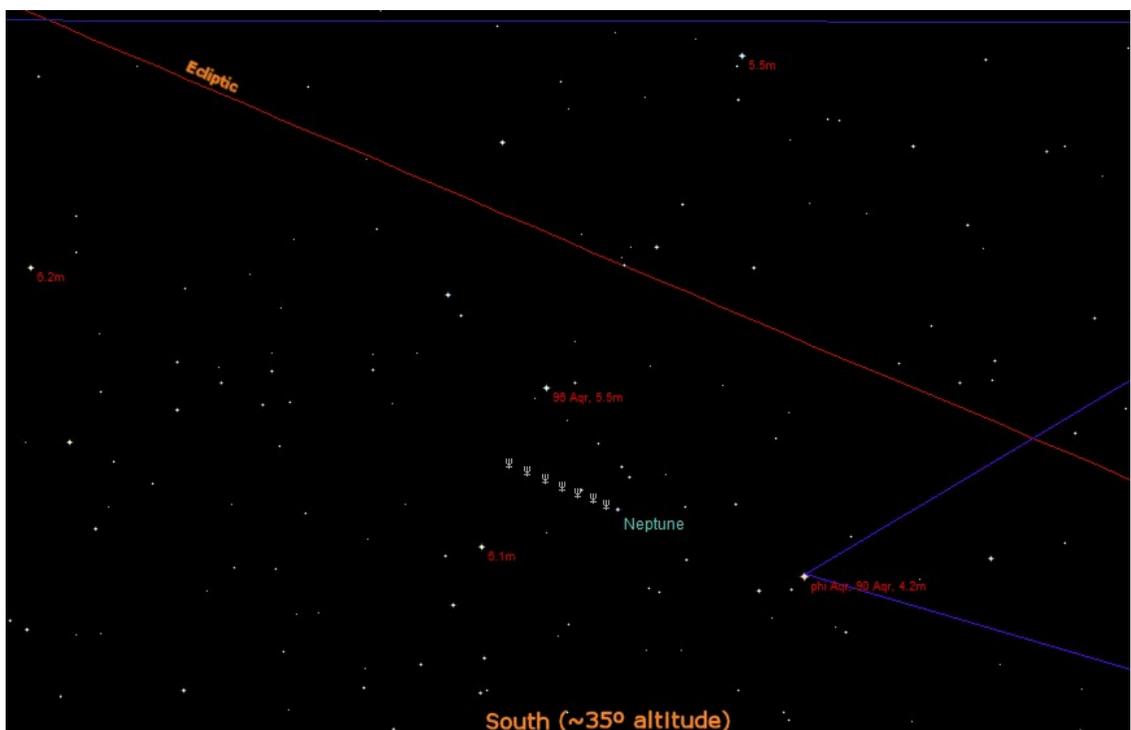
Chris Bailey

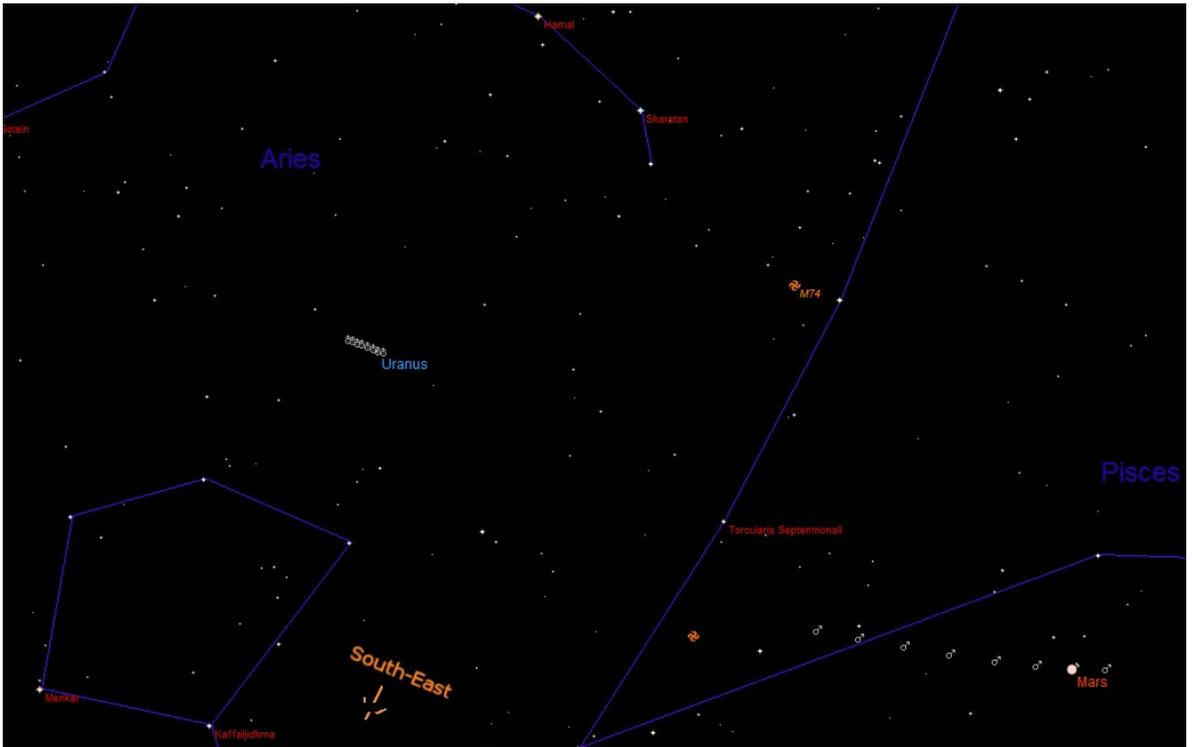
Finding the Outer Planets in October 2020

Uranus is theoretically visible to the naked eye, but UK skies are too poor to be able to pick it out. I even couldn't pick it out from La Palma, as it was still too light polluted. It needs a lot of magnification, to bring out the grey-green blank disc when the seeing and telescope allow you to get that moment. The moons are much harder to see, requiring really steady skies, huge magnification and a large aperture to collect enough light. The magnitude of the planet is 6 and moons are about 14, so they can be imaged with the right kit.

Neptune is physically smaller, bluer and more massive than Uranus and lives 50% further out from the sun. The disc is smaller still but the colour is a more pleasant blue hue. It is satisfying to find Neptune and recognise the tiny tiny disc. It is not easy to separate it from a star unless you have at least 150x magnification. It is almost as challenging as Uranus's moons to spot Neptune's big moon, Triton, but it can be done with a decently large scope. I have seen it in a well collimated 10 inch dob. Triton appears pinkish in comparison to the bluish Neptune when imaged carefully, and the atmosphere (seeing) can affect the image strongly. It orbits about as far from Neptune as our moon is from us. Neptune is 8th magnitude and Triton is 13½.

I have made some charts from Redshift for Neptune and Uranus, also Mars. Neptune is quite near Phi Aquarii still, as it was last year, which is on the left hand side of the pattern of Aquarius. The dates of the position symbols are October 2, 6, 10.. etc up to the 30th on the right, at about 10pm BST every evening. The Moon shouldn't put you off observing these planets, unless very near, as they are sufficiently bright.



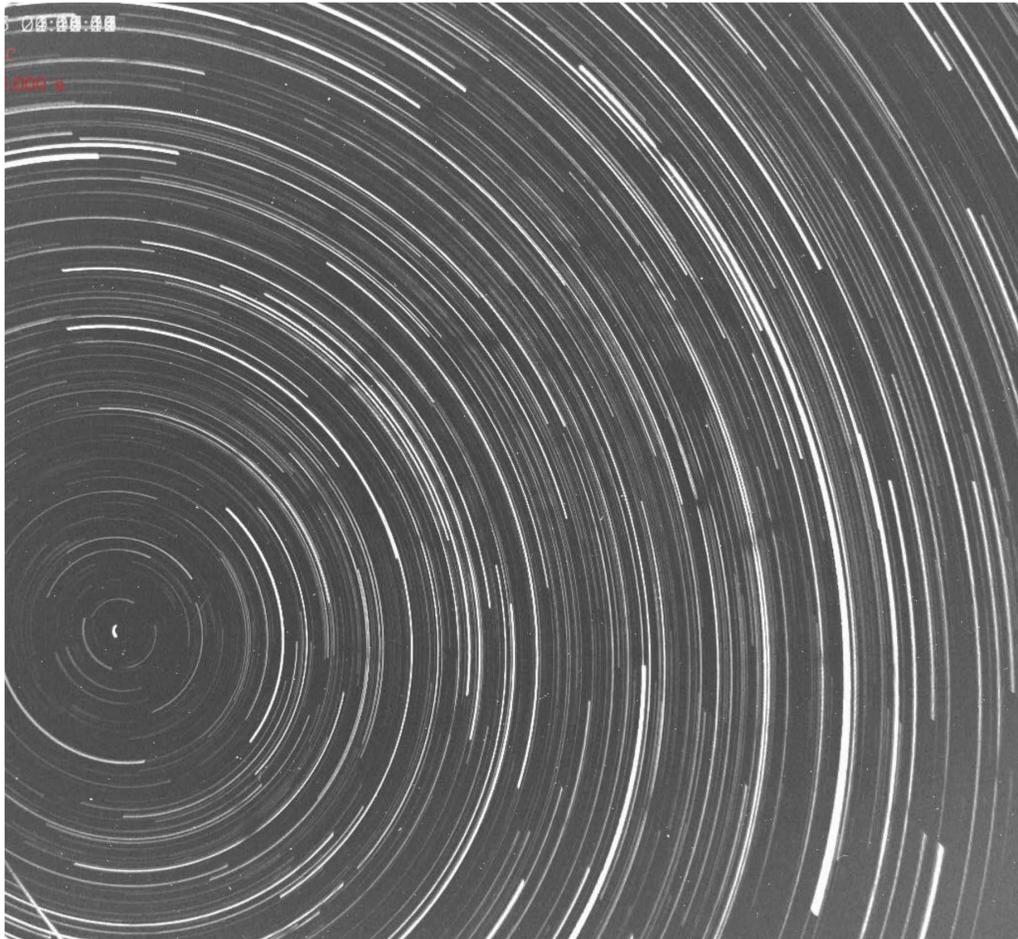


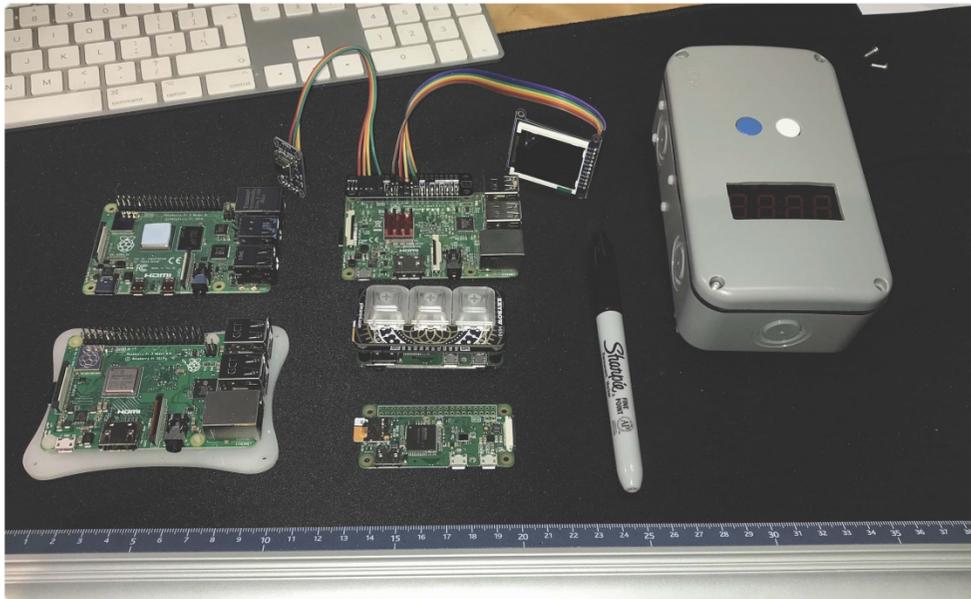
Uranus and Mars

Good luck with this challenge. In early November, Mercury becomes visible in the morning, so it is possible to see all 7 other planets in one night.

Dan Self

Raspberry Pi
All-Sky Camera
Anthony Cross
Part 1





Introduction & Aim

The aim of this project was to build a small, fully enclosed, computer driven night camera, based on the Allsky Camera system, written by Thomas Jacquin. Using a Raspberry Pi computer and a ZWO camera, the Allsky system takes long-exposure photos at intervals all night. At the end of the night the images are collated into a stop-frame movie, a time-lapse single image and a keogram slice image. The results and the interface for the settings are then published to a local web page on the Raspberry Pi and accessed by wifi.

I wanted only a single power cable to connect to the camera housing that held the camera, computer, heater controller board, heater ring and thermostat. This meant that everything had to be powered by 12v supply

(with a fairly long cable) and this called for a little extra equipment. It was going to be a tight fit as I had already selected a small all-weather enclosure and the smallest acrylic dome I could find.

The camera box sits high up on a pole at the end of my barn and collects images all night, every night, without any intervention. It has been useful to check for cloud cover whilst observing with my telescope as it can see the sky and wispy clouds far easier than my eyes can. There are plans to link the device with my NAS drive but that is another time...



For those that are unfamiliar with Raspberry Pi flavoured computing,

these are small, single board computers, with a low price-tag and a hefty amount of power. Currently the most expensive Model 4 has a quad-core processor, 4GB ram, gigabit ethernet, USB3.0, twin 4k video output, Bluetooth 5.0 and costs only £54 from thepihut.com. This model is somewhat over-specified for this task so I chose to use the smaller Raspberry Pi 3 Model A. This is a cut-down version of the larger board, without the ethernet but it does have a full-size usb connector that I needed for the camera. This model has only a single-core CPU, 512MB ram, Bluetooth 4.1 and WIFI (802.11 b/g/n - for the nerds among us). There is no ethernet built onto this board so all communication goes via the WIFI.

As you can see from the photo on the previous page, these are not very large boards, approximately the size of a credit card for the large ones and the small Zero W only measures 30 x 65mm. The 3 A model that I chose is 56 x 65mm and cost £23.00. I had considered the Zero model but was not convinced it would have the power to drive everything - I might try one of my spare Zeros one day and test it out.

PART 1: Hardware

Ok, enough of the geekiness.

Here is a basic list of equipment that I used and the price paid:

Raspberry Pi 3A	£23.00
Pimoroni Wide Input Shim	£10.50
Dew Heater Module	£15.00
Programmable Temperature Controller	£9.50
Enclosure Box	£10.00
2.9" Acrylic Dome	£12.00
12v power supply adapter	£18.00
ZWO ASI 120-MM (monochrome) camera	£181.00
Various fixings, grommet, glue, nuts and bolts	£10.00
Total	£289.80

www.thepihut.com www.thepihut.com www.dewcontrol.com

www.dewcontrol.com www.dewcontrol.com www.dewcontrol.com

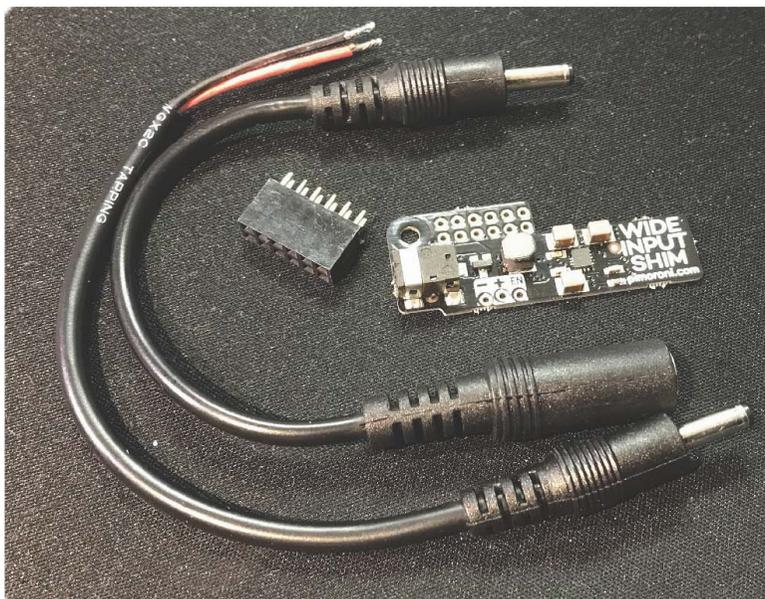
www.amazon.co.uk www.365astronomy.com mostly amazon.co.uk

As you can see, the camera was the most expensive single item. I opted

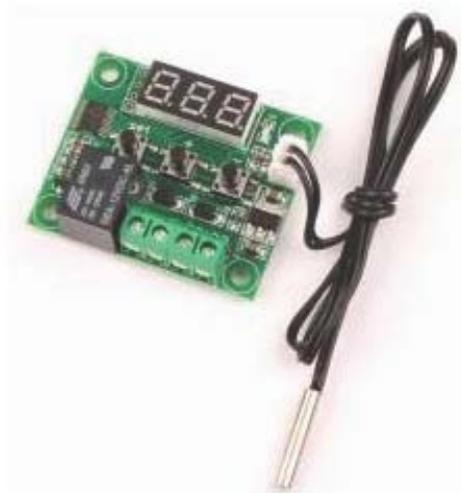
for the monochrome camera as it is more sensitive to light and I preferred the idea of capturing more light than seeing the colour of the surrounding light pollution - we don't get aurora this far south very often. That said, the colour model is around £30 cheaper and there are some good results to be had from it with the right settings, with colour of the stars visible.

Elements

The ide Input shim is a small board that fits onto the double row of pins, called the GPIO (general purpose input & output) interface. The shim comes with a small header connector and a couple of cables for connecting the power supply. This little card allows the Raspberry Pi to be powered by the 12v supply.



The Dew Heater Module and Controller provides gentle heat into the dome to prevent dew from forming. Its simple and works from the same 12v supply, drawing very little current.



2.9” Acrylic Dome & Enclosure

I chose the smallest dome and nearly regretted it; there was barely enough room for the heater ring, thermometer probe and fixings. You can see in the build photos later that it was rather tight. Chatting with

Tim Duke, who owns dewcontrol.com , the smallest box he supplied, was approx 150mm x 150mm and 100mm deep. Two important factors: it must fit and be completely weather tight.

12v Power Supply.

This needs to be powerful enough to run the heater and the RPi but these two draw very little current and a 5amp unit has proven to be more than sufficient - I estimated total current to be around 2.6amps at most but its always safer to apply a safety factor.



ZWO ASI120MM-C.

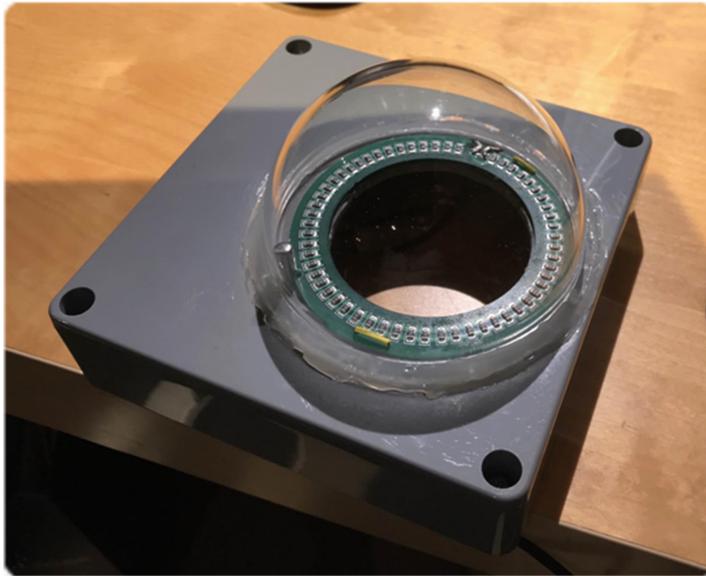
This was chosen as it was the fastest and cheapest ZWO camera that would work with the Thomas Jacquin software (only ZWO cameras are supported at present). In hindsight there are better options for only a little more money. Do your research on these before committing yourself. The camera comes with a 150° lens that I have fitted but many people chose to purchase a 180° lens to cover more of the sky from horizon to horizon. I have buildings all around me and didn't feel the need to look at them any more than necessary.



Assembly

Below is a sequence of photos that show how I shoe-horned everything into place. As I say, it was a tight fit: cable plugs needed trimming, the camera only fits at an angle and if the box is opened there is a surprising amount of electrical spaghetti that flies out!

Dome and dew heater.



Box top with camera opening cut, heater ring fitted and dome glued on. You can just make out the thermometer probe poking up on the left of the heating element.

Internal view (note the metal staples holding the heater in place).



Internal view of the base showing the numerous fixing points for the Raspberry Pi, power connection board and the heater controller.

Component mounting

This arrangement took many hours of planning, correcting, coffee drinking and starting again. I used Aryldite two-part epoxy to secure nylon bolts to the inside and used more nylon nuts to hold the boards in place



This small board with screw terminals is a simple distribution board. It was not essential but made my numerous connection attempts much easier than twisted cables held with tape.



Heater Control

Heater controller board is fitted to the side of the box base. This was the only place that the thermostat probe could easily reach. Ideally this board would have been fitted to the top section, near to the probe; it is a real pig to disconnect the probe each time the box is opened.

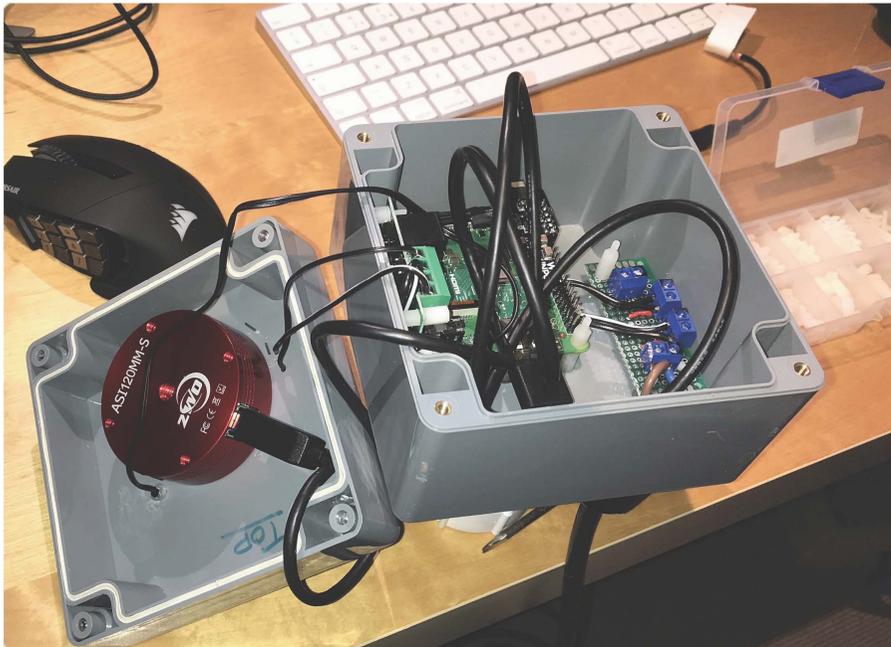


Fitting the Raspberry Pi

This image shows the RPi fitted and you can see the Wide Input Shim sitting on top, with the power cable connected, fed from under the board. If you look closely you may see numerous glue circles from failed efforts.

The lower image shows how the RPi is offset from the metal screw fixings below. There are lots of small electrical connections on both sides of these circuit boards, that can damage and short out. It is essential to take care and isolate the delicate parts of the boards from any exposed metal. Static electricity can also build up in your clothes and discharge through your fingers; try to only touch the boards by their edges and also make a habit of touching something metal like a radiator or computer casing to earth yourself. Better yet invest a few pounds in an anti-static wrist strap.

The almost finished system. All I have to do now is press down all the cables with one hand, close the top with the other, hold it all in place whilst screwing in the fixings. Where is a small-handed child when I need one? My daughter was actually helpful in this part - again consider a larger box because Jennifer can't be there for anyone else!



I found some old plumbing parts, metal clips, a scaffold pole and some 8mm metal rods lying around in my barn and fashioned a fixing to the

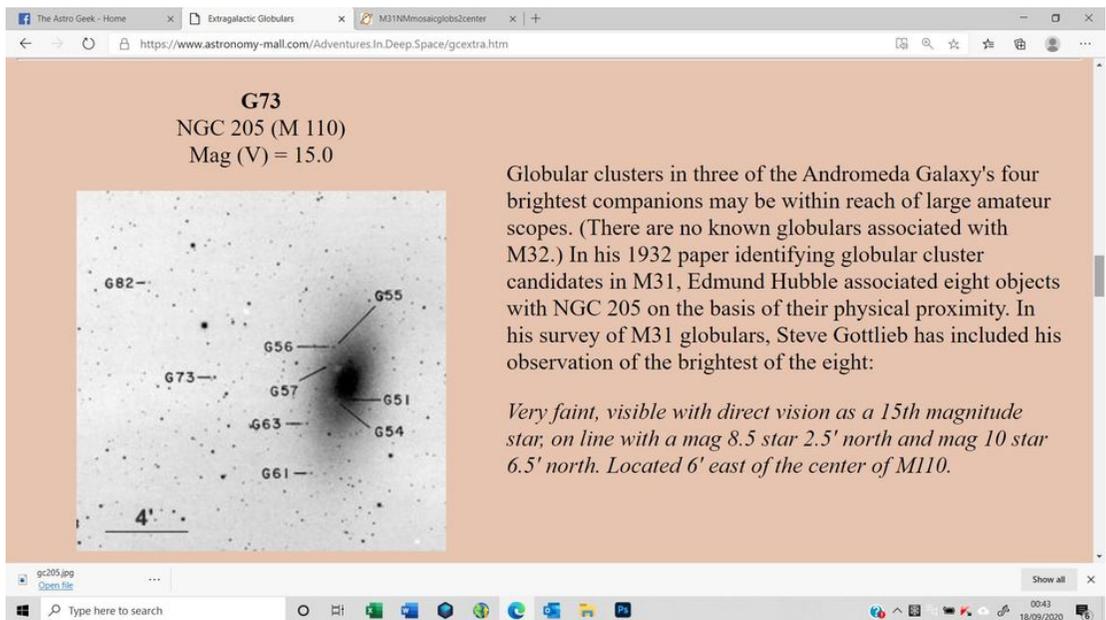
side of the building. Sorry but for this part you are on your own. Here is a view of the heathrobinson fixing that I made at the base of the box - imagine this sitting on top of a cut (and polished) scaffold pole, attached to the guttering fascia. Odd thing is, it works!



Malcolm James Dent

Globular clusters in M110

I stumbled across a great website by Steve Gottlieb who has spent some time studying the globular clusters of M31. Several hundred were found categorised and published first by Edwin Hubble in 1932, As many as 509 globulars in M31 have been catalogued based on spectra plates taken at Mauna Kea with the 3.6 meter Canada-France-Hawaii telescope, (Crampton et al, 1985), although recent work indicates that some of these are faint background galaxies. In any case, the M31 globular cluster system does appear to be more numerous than our own galaxy by roughly a 2:1 ratio. This important article provides identifications, positions, magnitudes, colours and radii although no finder charts are given.



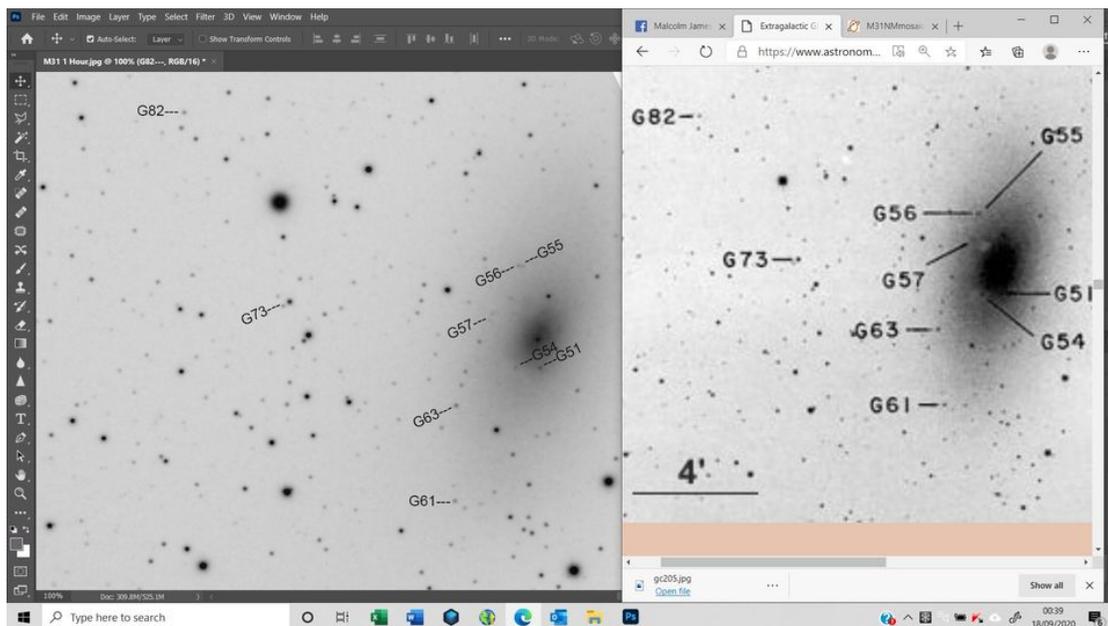
G73
NGC 205 (M 110)
Mag (V) = 15.0

Globular clusters in three of the Andromeda Galaxy's four brightest companions may be within reach of large amateur scopes. (There are no known globulars associated with M32.) In his 1932 paper identifying globular cluster candidates in M31, Edmund Hubble associated eight objects with NGC 205 on the basis of their physical proximity. In his survey of M31 globulars, Steve Gottlieb has included his observation of the brightest of the eight:

Very faint, visible with direct vision as a 15th magnitude star; on line with a mag 8.5 star 2.5' north and mag 10 star 6.5' north. Located 6' east of the center of M110.

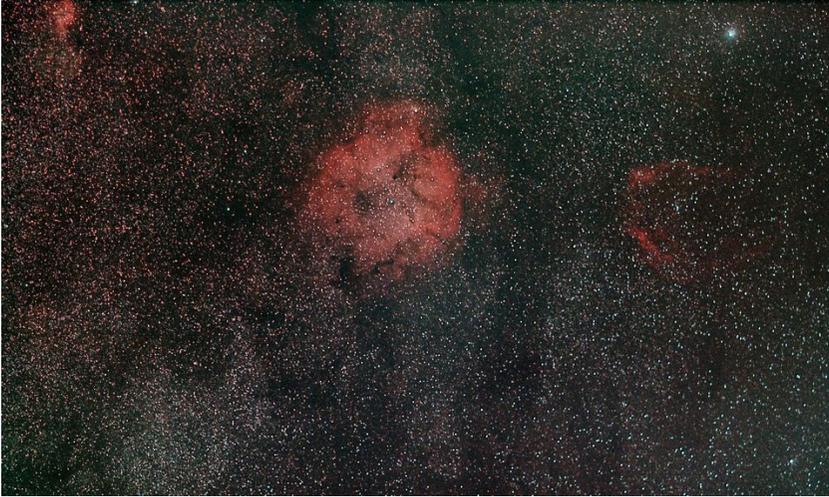
A few nights ago I was testing the ASI AIR Pro auto focus and aligned on The Andromeda Galaxy. An hour later I stacked an hours' worth of data and stretched it. I was truly amazed I was able to resolve 2' clusters @ >mag15. Resolving deeper &

longer is a passion of mine and my project a few years ago labelled hundreds of PGC galaxies in the Coma Cluster, this intrigued me from the outset and I had to see how many I could find in M110(NGC205)



Member's Astrophotography

Dan Self



Optolong L-Enhance tri band filter with the 100mm lens in Cygnus. After a bit of testing and finding the best focus, I left it running 3 minute exposures (x12) from my light polluted back garden in Norwich, with the moon above the horizon.

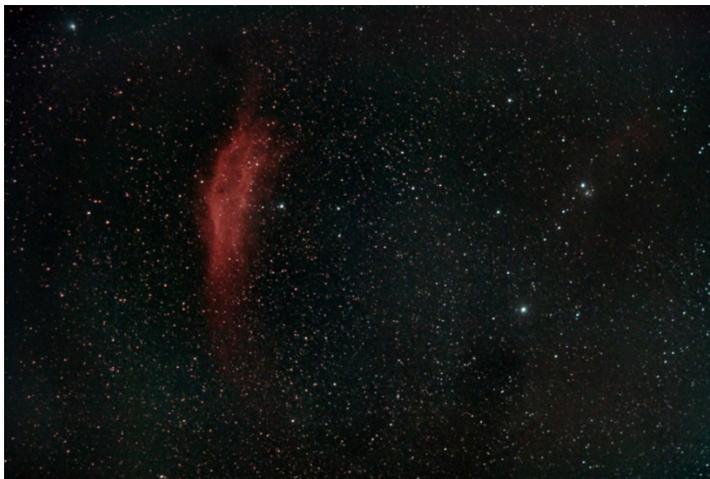


Mars, Best 1500 x 0.049s frames out of 3100.



Several 2 minute exposures mosaiced together along the Milky Way central region of Sagittarius/Scutum/Serpens as it set in a claggy sky (mag 5 overhead limit). Optolong L-Enhance filter through slightly dodgy 100mm f/2 lens. My good old modified Canon 1000D. Why get a close up when you can get all the nebulae!?

Sharpless2_54 (NGC6604) featuring Simeis3_132 "The Egg", then the Eagle Nebula (M16), the Swan Nebula (M17), Sharpless2_44/ (IC 4701), M24 bent around Sharpless 2_37 and Sharpless 2_35 running at 90 degrees to that like a weird celestial set-square! As you approach the Lagoon, Sharpless 2_34 streaks across (top), then M21 cluster and M20 the Trifid Nebula, and the Lagoon M8, with Sharpless 2_32,31 and 29. There's even a fuzzy globular at the bottom. Right is Down as you can see I was starting to look through a deep murky atmosphere.



California Nebula 12X3 #9 med



DS M25,M24,M23top and lagoon and Trifid Sagittarius LEnh filter 100mm F2
15X2



DC Scutum to Sagittarius nebula Optolong L-Enhance filter 100mmF2 15X2

John Gionis



Saturn imaged with a ZWO120 and x2 Barlow on the society's 20" reflector.
1000 frames processed with Registax6 and photoshop

Malcolm James Dent



Eastern Veil Nebula NGC 6992. 3 hours of data using the dual bandpass filter.

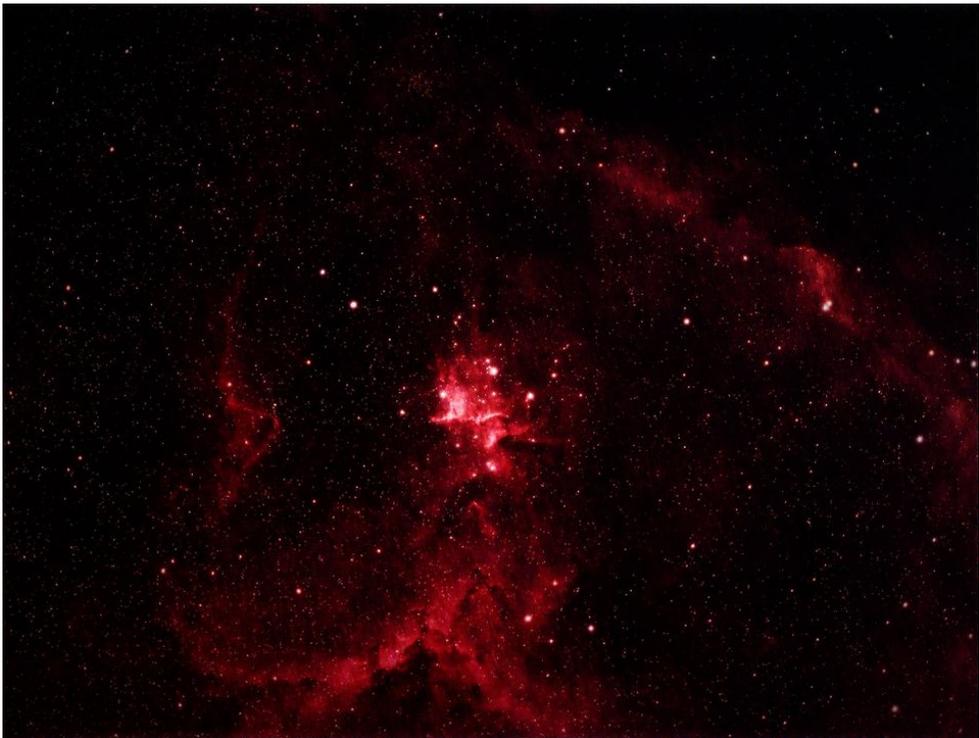


M33, 5 hours of data. Captured using the ED100 and ASI 294mc Pro all controlled with the ASIAIR pro.



Hubble palette visualisation of the Heart Nebula. 4 hours and 39 minutes of capture using the Optolong L-Enhance filter. Controlled by the ASI AIR portable computer,

Darrell Brown

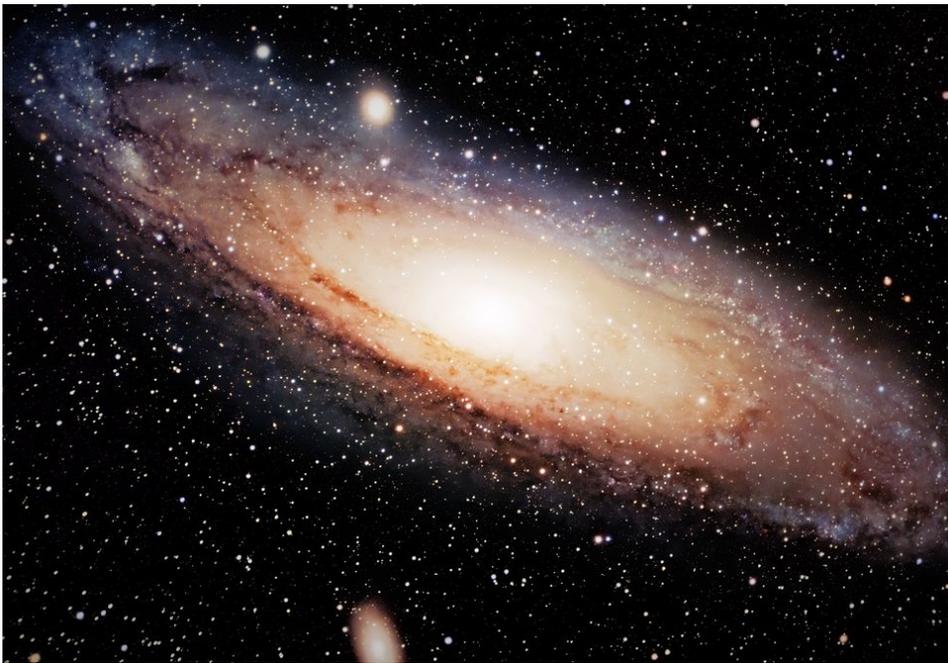




1.5hrs 269c 102 apo



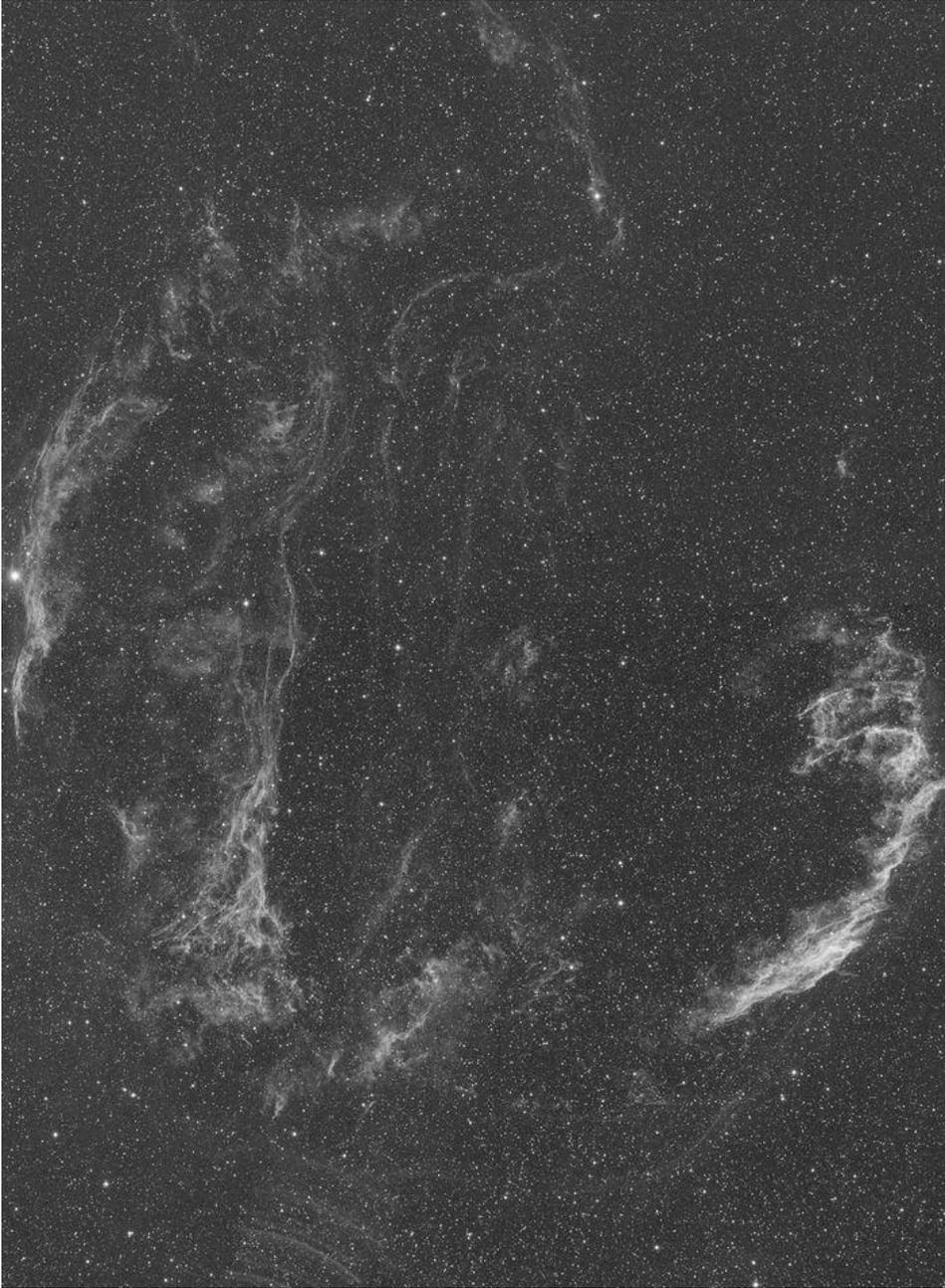
1.5 hours in the clouds



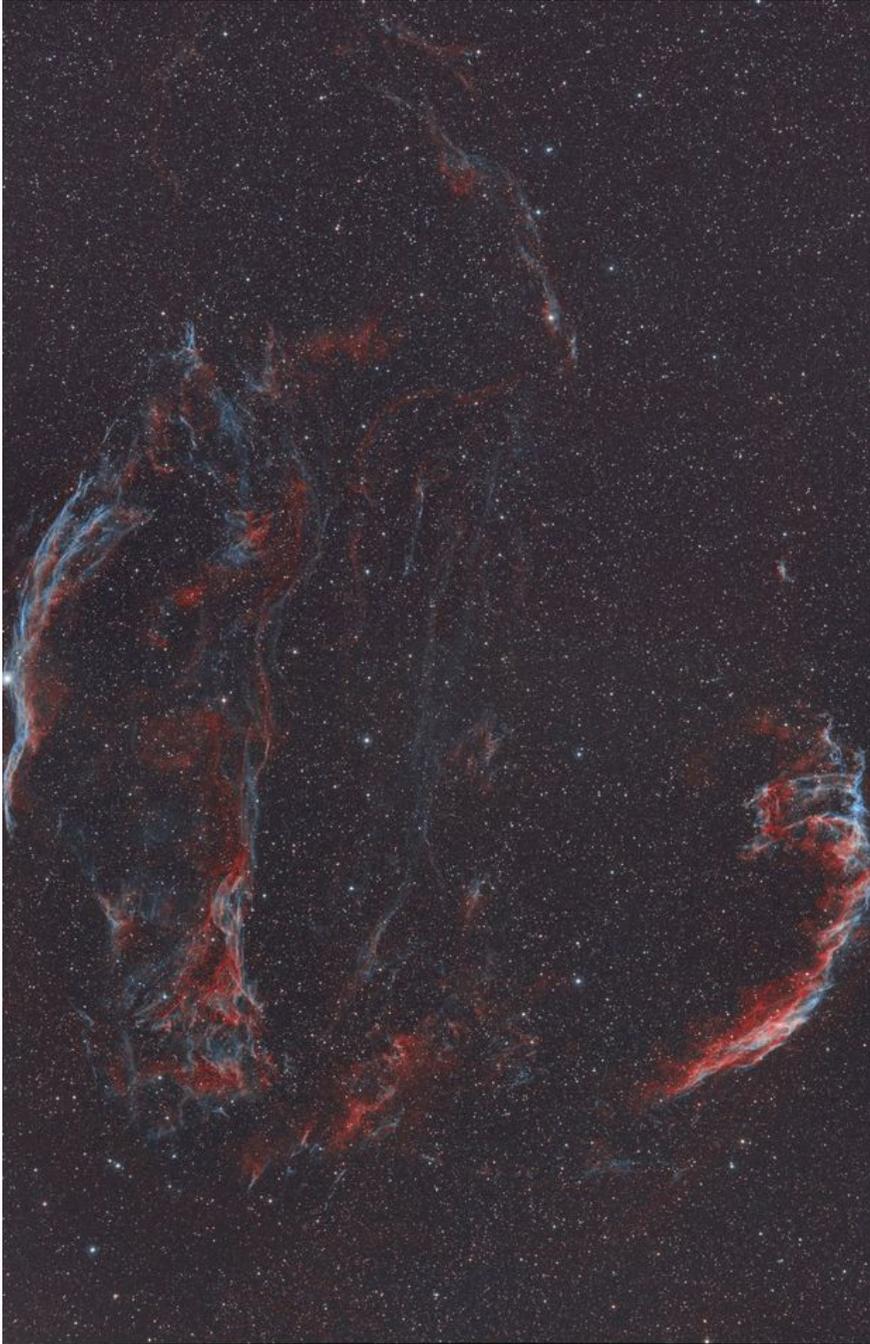
Darren Carter



First light with the altair astro 102 triplet 1hr 40 min of ha so far. Pleased with the result.



Had a chance to get some data on the second pane of the veil nebula.
Hopefully I will get a few more hours on this tonight if it's going to be clear



Added some OIII frames to my HA frames here's the result.

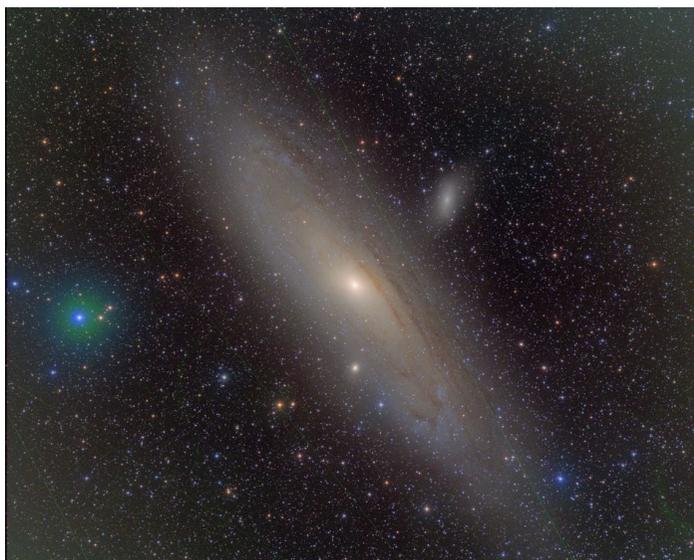
Andrew Luck



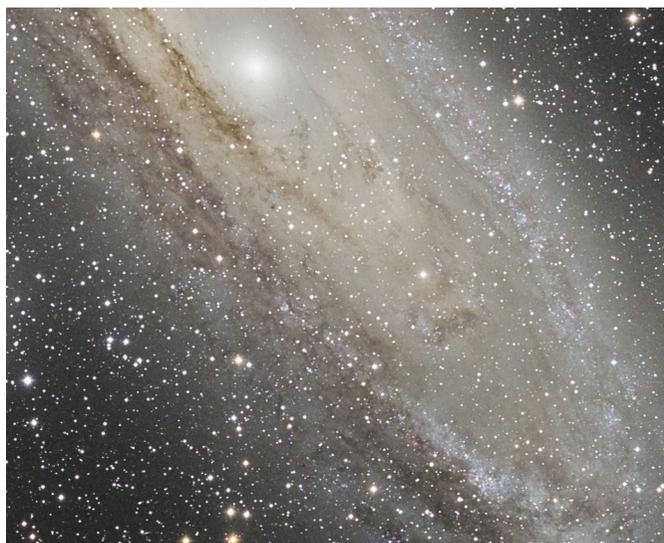
Completed data gathering for panel 1 last night. This is a couple of hours in each of RGB. Panel 2 tonight



Still looking for Oxygen in Sh2-216. This is now up to 11x 1 hour exposures with an OIII filter and there's not much there, just a very faint diffuse glow.

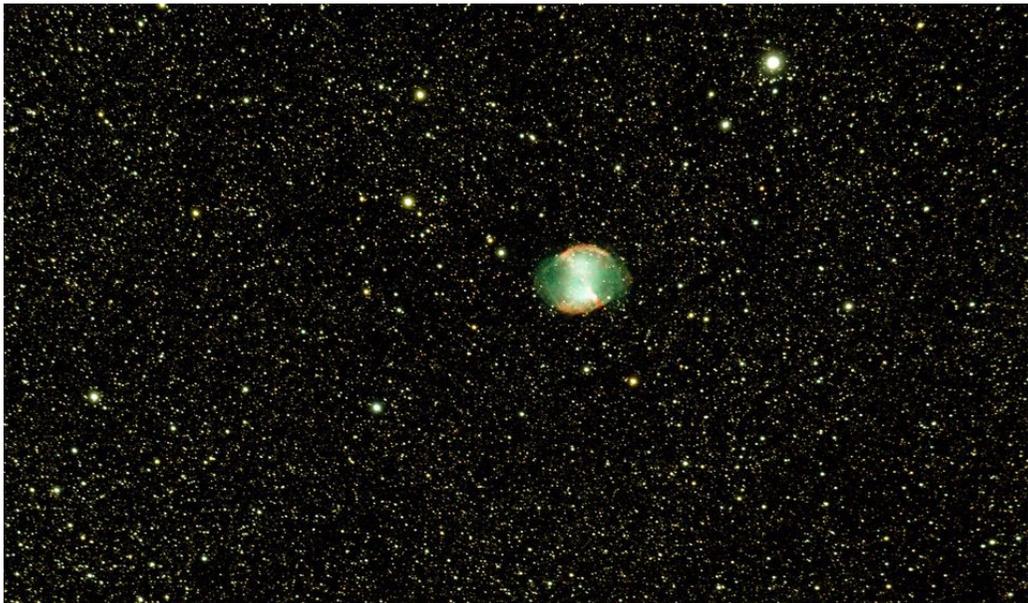


An initial stack and Arcsinh stretch of my data on M31



Some more progress on M31 trying to enhance the dark lanes. The core is stellar in appearance and probably rather harsh, I'd prefer a smoother appearance. Local Histogram Equalisation has also produced a faint dark halo around the core so lots more to do.

Mick Ladner



M27



The Witch's Broom

Peter Farmer



7 x 15 minute exposures of the Bubble Nebula. Camera used, QHY10 on 1200mm Explore Scientific scope.

THE SOCIETY FOR POPULAR ASTRONOMY

Electronic News Bulletin No. 524 2020 September 20

Here is the latest round-up of news from the Society for Popular Astronomy. The SPA is arguably Britain's liveliest astronomical society, with members all over the world. We accept subscription payments online at our secure site and can take credit and debit cards. You can join or renew via a

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HINTS OF LIFE ON VENUS?

RAS

Astronomers have announced the discovery of a rare molecule – phosphine – in the clouds of Venus. On Earth, this gas is only made industrially, or by microbes that thrive in oxygen-free environments. Astronomers have speculated for decades that high clouds on Venus could offer a home for microbes – floating free of the scorching surface, but still needing to tolerate very high acidity. The detection of

phosphine molecules, which consist of hydrogen and phosphorus, could point to this extra-terrestrial 'aerial' life. The team first used the James Clerk Maxwell Telescope (JCMT) in Hawaii to detect the phosphine, and were then awarded time to follow up their discovery with 45 telescopes of the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile. Both facilities observed Venus at a wavelength of about 1 millimetre, much longer than the human eye can see – only telescopes at high altitude can detect this wavelength effectively. Naturally cautious about the initial findings, the team was delighted to get three hours of time with the more sensitive ALMA observatory. Both observatories had seen faint absorption at the right wavelength to be phosphine gas, where the molecules are backlit by the warmer

clouds below. Interpretation of the data showed that phosphine is present but scarce – only about twenty molecules in every billion. The astronomers then ran calculations to see if the phosphine could come from natural processes on Venus. They caution that some information is lacking – in fact, the only other study of phosphorus on Venus came from one lander experiment, carried by the Soviet Vega 2 mission in 1985. Massachusetts Institute of Technology led the work on assessing natural ways to make phosphine. Some ideas included sunlight, minerals blown upwards from the surface, volcanoes, or lightning, but none of these could make anywhere near enough of it. Natural sources were found to make at most one ten thousandth of the amount of phosphine that the telescopes saw. To create the

observed quantity of phosphine on Venus, terrestrial organisms would only need to work at about 10% of their maximum productivity, according to calculations by Cambridge University. Any microbes on Venus will likely be very different to their Earth cousins though, to survive in hyper-acidic conditions

Earth bacteria can absorb phosphate minerals, add hydrogen, and ultimately expel phosphine gas. It costs them energy to do this, so why they do it is not clear. The phosphine could be just a waste product, but other scientists have suggested purposes like warding off rival bacteria. Another MIT team-member was also thinking about searching for phosphine as a 'biosignature' gas of non-oxygen-using

life on planets around other stars, because normal chemistry makes so little of it. The discovery raises many questions, such as how any organisms could survive. On Earth, some microbes can cope with up to about 5% of acid in their environment – but the clouds of Venus are almost entirely made of acid. Other possible biosignatures in the Solar System may exist, like methane on Mars and water venting from the icy moons Europa and Enceladus. On Venus, it has been suggested that dark streaks where ultraviolet light is absorbed could come from colonies of microbes. The Akatsuki spacecraft, launched by the Japanese space agency JAXA, is currently mapping these dark streaks to understand more about this “unknown ultraviolet absorber. The team believes their discovery is significant because they can rule out many alternative ways to make phosphine, but they acknowledge that confirming the presence of “life” needs a lot more work. Although the high clouds of Venus have temperatures up to a pleasant 30 degrees centigrade, they are incredibly acidic – around 90% sulphuric acid – posing major issues for microbes to survive there. The team are now eagerly awaiting more telescope time, for example to establish whether the phosphine is in a relatively temperate part of the clouds, and to look for other gases associated with life. New space missions could also travel to our neighbouring planet, and sample the clouds in situ to further search for signs of life.

JUPITER'S MOONS COULD BE WARMING EACH OTHER

University of Arizona

Jupiter's moons are hotter than they should be, for being so far from the Sun. In a process called tidal heating, gravitational tugs from Jupiter's moons and the planet itself stretch and squish the moons enough to warm them. As a result, some of the icy moons contain interiors warm enough to host oceans of liquid water, and in the case of the rocky moon Io, tidal heating melts rock into magma. Researchers previously believed that the gas giant Jupiter was responsible for most of the tidal

heating associated with the liquid interiors of the moons, but a new study found that moon-moon interactions may be more responsible for the heating than Jupiter alone. Understanding how the moons influence each other is important because it can shed light on the evolution of the moon system as a whole. Jupiter has nearly 80 moons, the four largest of which are Io, Europa, Ganymede and Callisto.

Maintaining subsurface oceans against freezing over geological times requires a fine balance between internal heating and heat loss, and yet we have several pieces of evidence that Europa, Ganymede, Callisto and other moons should be ocean worlds. Io, the moon closest to Jupiter, shows widespread volcanic activity, another

consequence of tidal heating, but at a higher intensity likely experienced by other terrestrial planets, like Earth, in their early history. Ultimately, scientists want to understand the source of all this heat, both for its influence on the evolution and habitability of the many worlds across the solar system and beyond. The trick to tidal heating is a phenomenon called tidal resonance. Resonance creates loads more heating. Basically, if you push any object or system and let go, it will wobble at its own natural frequency. If you keep on pushing the system at the right frequency, those

oscillations get bigger and bigger, just like when you're pushing a swing. If you push the swing at the right time, it goes higher, but get the timing wrong and the swing's motion is dampened. Each moon's natural frequency depends on the depth of its ocean.

These tidal resonances were known before this work, but only known for tides due to Jupiter, which can only create this resonance effect if the ocean is really thin (less than 300 metres), which is unlikely. When tidal forces act on a global ocean, it creates a tidal wave on the surface that ends up propagating around the equator with a certain frequency, or period. According to the researchers' model, Jupiter's influence alone can't create tides with the right frequency to resonate with the moons

because the moons' oceans are thought to be too thick. It's only when the researchers added in the gravitational influence of the other moons that they started to see tidal forces approaching the natural frequencies of the moons. When the tides generated by other objects in Jupiter's moon system match each moon's own resonant frequency, the moon begins to experience more heating than that due to

tides raised by Jupiter alone, and in the most extreme cases, this could result in the melting of ice or rock internally. For moons to experience tidal resonance, their oceans must be tens to hundreds of kilometres thick, which is in range of scientists' current estimates. However, there are some caveats to the researchers' findings. Their model assumes that tidal resonances never get too extreme. The team want to return to this variable in the model and see what happens when they lift that constraint.

PECULIAR PLANETARY SYSTEM AROUND ORION STARS

Carnegie Institution for Science

The discovery that our galaxy is teeming with exoplanets has also revealed the vast diversity of planetary systems out there and raised questions about the processes that shaped them. New work published by an international team could explain the architecture of multi-star systems in which planets are separated by wide gaps and do not orbit on the same plane as their host star's equatorial centre. In our Solar System, the eight planets and many other minor objects orbit in a flat plane around the Sun; but in some distant systems, planets orbit on an incline -- sometimes a very steep one. Understanding the origins of extremely oblique orbital angles such as these could help reveal details about the planetary formation process. Stars are born in nurseries of gas and dust called molecular clouds -- often forming in small groups of two or three. These young stars are surrounded by rotating disks of

leftover material, which accretes to form baby planets. The disk's structure will determine the distribution of the planets that form from it, but much about this process remains unknown. The team found the first direct evidence confirming the theoretical prediction that gravitational interactions between the members of multi-star systems can warp or break their disks, resulting in misaligned rings surrounding the stellar hosts. Over a period of 11 years, the researchers made observations of the GW Orionis triple-star system, located just over 1,300 light-years away in the Orion constellation. Their work was accomplished using the European Southern Observatory's Very Large Telescope and the Atacama Large Millimeter/submillimeter Array -- a radio telescope made up of 66 antennas. The images reveal an extreme case where the disk is not flat at all, but is warped and has a misaligned ring that has broken away from the disk. The findings were tested by simulations, which demonstrated that the observed disorder in the orbits of the three stars could have caused the disk to fracture into the distinct rings. Scientists predict that many planets on oblique, wide-separation orbits will be discovered in future planet imaging campaigns.

UNIQUE SUPERNOVA EXPLOSION

Florida State University

One-hundred million light years away from Earth, an unusual supernova is exploding. That exploding star -- is known as "supernova LSQ14fmg". This supernova's characteristics -- it gets brighter extremely slowly, and it is also one of the brightest explosions in its class -- are unlike any other. The exploding star is what is known as a Type Ia supernova, and more specifically, a member of the "super-Chandrasekhar" group. Stars go through a sort of life cycle, and these supernovae are the exploding

finale of some stars with low mass. They are so powerful that they shape the evolution of galaxies, and so bright that we can observe them from Earth even halfway across the observable Universe. The supernova LSQ14fmg exploded in a system with a central star losing a copious amount of mass through a stellar wind. When the mass loss abruptly stopped, it created a ring of material surrounding the star. Type Ia supernovae were crucial tools for discovering what's known as dark energy, which is the name given to the unknown energy that causes the current accelerated expansion of the universe. Despite their importance, astronomers knew little about the origins of these supernova explosions, other than that they are the thermonuclear explosions of white dwarf stars. But the research team knew that the light from a Type Ia supernova rises and falls over the course of weeks, powered by the radioactive decay of nickel produced in the explosion. A supernova of that type would get brighter as the nickel becomes more exposed, then fainter as the supernova cools and the nickel decays to cobalt and to iron.

After collecting data with telescopes in Chile and Spain, the research team saw that the supernova was hitting some material surrounding it, which caused more light to be released along with the light from the decaying nickel. They also saw evidence that carbon monoxide was being produced. Those observations led to their conclusion --

the supernova was exploding inside what had been an asymptotic giant branch (AGB) star on the way to becoming a planetary nebula. The explosion was

triggered by the merger of the core of the AGB star and another white dwarf star orbiting within it. The central star was losing a copious amount of mass through a stellar wind before the mass loss was turned off abruptly and created a ring of material surrounding the star. Soon after the supernova exploded, it impacted a ring of material often seen in planetary nebulae and produced the extra light and the slow brightening observed. This is the first strong observational proof that a Type Ia supernova can explode in a post-AGB or proto-planetary-nebula system and is an important step in understanding the origins of Type Ia supernovae. These supernovae can be particularly troublesome because they can mix into the sample of normal supernovae used to study dark energy. This research gives us a better

understanding of the possible origins of Type Ia supernovae and will help to improve future dark energy research.

Bulletin compiled by Clive Down

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The Society for Popular Astronomy has been helping beginners in amateur astronomy - and more experienced observers -- for over 60 years. If you are not a member, you may be missing something. Membership rates are extremely reasonable, starting at just £23 a year in the UK. You will receive our bright bi-monthly magazine Popular Astronomy, help and advice in pursuing your hobby, the chance to hear top astronomers at our regular meetings, and other benefits. The best news is that you can join online right now with a credit or debit card at our lively website:

www.popastro.com

For Sale or Wanted

This section is for the sale of Astronomical items and any wants from members. Details of items for sale (With photographs where applicable) should be forwarded to the newsletter editor at newsletter@brecklandastro.org.uk

It is suggested that a donation of 5% of the final sale price be given to the Society to assist with funds. If sellers do not wish to make their contact details public then please make this known to me and I will field any enquiries on a box number system. Please send any sales details to me before the 26th of the month for inclusion in the next issue.

Please ensure that if any item is sold by another means prior to publication that I am advised so it can be removed to avoid confusion.

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Secretary Rebecca Greef
Contact secretary@brecklandastro.org.uk

Please check with any of the contacts in bold before visiting the observatory. Please ensure you are wearing appropriate footwear and clothing and bring a torch (preferably one showing a RED light)

Breckland Astronomical Society Events –2020

7:30pm Great Ellingham Recreation Centre, Watton Road, Great Ellingham, Attleborough, Norfolk NR17
1HX
£2 adults £1 children

Friday October 9 th	Astrophotography	Nik Szymanek
w/e Fri October 16 th	Haw Wood Star Party	Cancelled.
Friday October 30 th	Public Open Night	Observatory
Friday November 13 th	Quiz Night	Dan Self
Friday November 27 th	Public Open Night	Observatory
Friday December 11 th	Update on Norfolk's Dark Sky Reserve	Kate Dougan North Norfolk's Dark Sky Festival organiser
Friday Jan 1 st 2021	Public Open Night	Observatory
Friday Jan 8 th 2021	The Apollo 11 Mission	Jerry Workman
Friday Jan 29 th 2021	Public Open Night	Observatory
Friday Feb 12 th 2021	TBC	