Winter 2018/9 Number 22

Kielder Observatory Newsletter





2019

NEWS

accommodation

Staff

NIGHT SKY

Highlights Feb/Mar/Apr ASTROPHOTOGRAPHY SPECIAL

The dark arts are explained!



EDITORIAL

We have delayed this edition to bring you the press release about the departure of our CEO, Gary Fildes, which you will find on page three. This was released to the public on Monday February 25th. However, it is business as usual at the observatory. We had the excitement of the lunar eclipse last month, which brought coverage for Kielder on the national news - we have also popped up on the local north east news at various times. We give much of this edition over to a couple of articles by our own science staff on astrophotography. Enjoy!

Nigel Metcalfe

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Kielder Observatory Astronomical Society

Registered Charity No: 1153570. Patron: Sir Arnold Wolfendale 14th Astronomer Royal

Kielder Observatory Astronomical Society is a Charitable Incorporated Organisation. Its aims are to

- * Promote interest in the science of astronomy to the general public
- * Facilitate education of members of the public in the science of astronomy
- * Maintain an astronomical observatory in Kielder Forest to support the above aims

http://www.kielderobservatory.org

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KOAS NEWS

STOP PRESS - ANNOUNCEMENT FROM THE TRUSTEES:

Gary Fildes, the former brickie turned astronomer who founded Kielder Observatory 11 years ago, is leaving to pursue new projects.

Outside of his role at the Observatory, which is recognised as one of the UK's most popular dark skies attractions, Gary recently acted as a consultant for The Eden Project and regularly guest lectures at Sunderland University, which awarded him an honorary degree in 2017 after he received a similar accolade from Durham University in 2012. As well as driving forward a new national astronomy project, Gary will take up more consultancy work, continue his ongoing educational programmes with schools, colleges and universities, and increase the number of speaking opportunities he delivers. Gary's profile has risen significantly since the publication of his book "An Astronomer's Tale: A Bricklayer's Guide to the Galaxy" in 2016. Three years prior to that, he spent two months in Chile filming at some of the world's most cutting-edge facilities in astrophysics. A feature-length documentary filmed during this visit called "Searching for Light" is currently in post-production and expected to be broadcast later this year.

Gary leaves behind a talented and enthusiastic team that will continue to develop the inspirational visitor experience at the award-winning observatory and further extend its current programme of educational outreach in the Tees Valley into other schools across the North East. Gary said: "Kielder Observatory has been my life and my passion project and to have built it to where it is today is a matter of huge pride to me. However, as the saying goes, keep your eyes on the stars and your feet on the ground and now seems a natural time for me to explore new possibilities, while the projects I have been involved with offer a great springboard. Kielder Observatory is in capable hands, with a staff team and board of trustees who share my vision of making the wonders of the universe more accessible for everyone. While leaving is hard, the observatory will always be a very special place and I'm delighted to think that my work there has enabled so many people to discover the delights of the night sky in the glorious Kielder Forest and will continue to do so long into the future."

Peter Standfield, chair of the board at Kielder Observatory, said: "Gary's vision and drive have been the inspiration behind the observatory's phenomenal success in its first ten years. With the addition of the Gillian Dickinson Astro-imaging Academy to our already award-winning facilities last year, planning approval now granted for development of a planetarium next to our observatory buildings and the ongoing expansion of our educational programme, Gary can rest assured that his Kielder legacy will continue to inspire and educate people for many years to come. The trustees wish Gary every success in his new undertakings and look forward to opportunities for further collaboration in the future as his career develops."





In the event of the observatory being cut off, visitors can now view the skies from Kielder Castle

It has been a while coming but we finally have some overnight accommodation for the observatory staff, albeit in the form of two hired-in 'pods' in the car park. Each pod has two bedrooms, a small kitchen area and a shower and WC. Heating and power are provided by an adjacent generator. There are even TV screens fitted! The pods will give staff the option of not having to travel home in the early hours of the morning when the weather is bad. On the subject of bad weather, there are some times during the winter when the track up to the observatory is impassable. Previously this has meant cancelling events, even when the skies are clear. However, we have now teamed up with the Forestry Commission to move such events to Kielder Castle, which is just off the main road through Kielder village. We will be keeping some equipment permanently down there, so guests will still be able to view the skies through our



telescopes. And rest assured that the castle is still in the Dark Sky Park, so the night sky will still be spectacular.

On the staffing front, the post of Finance Assistant, mentioned in the last newsletter, has been filled by Alison Booth. Alison has excellent credentials and is already proving an invaluable asset to our treasurer (who, like all the trustees, is a volunteer of course)! Meanwhile, although he retired from his full-time role with KOAS at the end of

2018, John Holmes continues to work with us in a part-time consultancy capacity,



The new staff accommodation is now on site.

with a particular focus on securing the agreements and funding that we need to develop a 25-seat planetarium on the observatory site and expand our evolving educational offer into Northumberland and the wider region.



The smart interior of one of the new staff accommodation pods.

In January, over 70 teachers and families spent a weekend at Calvert Kielder, which included visits to the observatory and an outline of what KOAS can offer to schools. This was a 'taster' event - the idea being to give those staying at the Calvert the opportunity to be involved in a science evening at the observatory. John Holmes and some members of the science team used the portable planetarium to show the teachers what we have been doing on Teesside and John then gave tours of the observatory to show off the facilities. This



is primarily aimed at schools undertaking residential fieldwork at the Centre. The weekend was a great success and generated a significant amount of interest.



Adam and Dan take our planetarium on the road to Grangefield Academy.

The Teesside education initiative is progressing very well. All 20 slots have been taken up and the programme runs until Easter. There is much interest in maintaining the provision next academic year. We are awaiting the outcome of our bid for additional funding to the Tees Valley Combined Authority.

We were fortunate that it was clear for the night of the total lunar eclipse on January 20/21, so some of the team were able to get some great pictures (see the front cover by Dan Pye!) and generate some excellent publicity.



Early in the morning of January 21st the science team enjoy the lunar eclipse.

Speaking of which, we have had plenty of coverage in the media recently, including an appearance by Dan Monk on the BBC national news on January 21st, discussing the lunar eclipse, and then Dan appeared again on BBC Look North on January 29th discussing an image he had taken



The lunar eclipse, glowing red due to sunlight refracted through the Earth's atmosphere.



Not been to Kielder Observatory yet? Then why not book one of our events for you or your family?

Advanced booking is essential. Weekend events can fill up several weeks in advance. Please book online at http://www.kielderobservatory.org/events/ or call us on 0191 265 5510. We can also be contacted at admin@kielderobservatory.org



Blending nicely with the evening sky is the Forestry Commission's new artwork at Blackhope Nick, at a height of 1500ft on Kielder Forest Drive.

with a 'SolarCan'. We also got a sneaky glimpse of Hayden Goodfellow publicising the North Yorkshire Dark Skies event at the Tan Hill Inn.



Credit: Neil Denham



FEBRUARY 2019 (times in GMT)

Lunar phases

New moon	04/02/2019	21:03
First quarter	12/02/2019	09:32
Full moon	19/02/2019	15:53
Last quarter	26/02/2019	11:29

PLANET SUMMARY

Mercury is in conjunction with the Sun. Venus is a morning object visible in twilight. Mars is an evening object visible until around 2200. Jupiter is a morning object visible for a few hours and is close to Venus, following its nearby pass in January. Saturn visible in the morning twilight. Uranus is an evening object visible until around 10pm.

THE STARS AT 9PM (GMT)

North – Cassiopeia and Cepheus are nicely placed with the two Bears. Cygnus and Hercules are low down. East – Gemini is high up with Leo and Cancer nicely placed. Virgo is just beginning to rise. South – Auriga is high up. Orion and

Monoceros are nicely placed. Canis major

and Lepus are low down.

West – Taurus and Perseus are high up. Andromeda is nicely placed. Pisces and Pegasus are low down.

METEOR SHOWERS

There are no bright meteor showers this month.

COMETS

Comet Wirtanen is an 9th magnitude object visible all night in Ursa Major, but fades during the month. Comet C/2018 Y1 Iwamoto is a 9th magnitude object starting the month in Virgo and moving rapidly through Leo, Cancer and Gemini, brightening as it does so - it will be visible after 1am as Virgo rises, then progressively earlier. There are no other Comets brighter than 12th magnitude visible this month.

The Planets 15/02/2019

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	07:28	12:17	07:57	05:30	09:02	04:01	05:51	09:07
Set	17:10	03:51	18:19	13:13	23:33	11:23	13:20	23:19



February 15th night sky at 8pm, from Newcastle-upon-Tyne.

The team were brilliant and answered all questions with a great depth of knowledge and enthusiasm. It's a shame the sky was so hazy but the work we did on the moon and meteorites was great. The fact that you can't rely on the weather and still put on a great show demonstrates the skills of the team and the fascinating equipment they have to work with.

Peter, Durham



MARCH 2019 (times in GMT)

Lunar phases

New moon	06/03/2019	16:05
First quarter	14/03/2019	10:28
Full moon	21/03/2019	01:44
Last quarter	28/03/2019	04:11

PLANET SUMMARY

Mercury and Venus are too close to the Sun to view this month. Mars is an evening object visible from around 1930 until 2200. Jupiter is a morning object visible from around 0330 until lost in twilight at around 0500. Saturn is a morning object visible in the dawn twilight. Uranus is an evening object visible low in the west after sunset.

THE STARS AT 10PM (GMT)

North – The two Bears are high up. Cepheus and Draco are nicely placed. Cygnus, Lyra and Hercules are low down. East – Leo and Coma Berenices are nicely placed. Virgo is low down. You can also find Hydra, Crater and there is Corvus near the horizon. South – Virgo, Leo, Cancer and Gemini are nicely placed. Orion, Canis Major, Monoceros and Lepus are low down. West – Gemini, Auriga, Perseus, Orion and Canis Major are nicely placed. Pisces is near the horizon.

METEOR SHOWERS

There are no major meteor showers in March.

COMETS

Comet 46P/Wirtanen moves from Ursa Major to Leo Minor but continues to fade during March.

Comet C/2018 Y1 Iwamoto moves through Auriga and Perseus during the month and is starting to fade, although it is well placed during the first half of the night.

There are no other comets brighter than 10th magnitude visible during March.

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	06:21	10:59	05:58	05:22	07:43	02:26	04:09	07:18
Set	18:07	02:49	18:13	14:17	02:49	09:45	11:42	21:36

The Planets 15/03/2019



March 15th night sky at 9pm GMT, from Newcastle-upon-Tyne.

"Very knowledgeable and engaging, adapting their style to each individual and their questions/comments. Three hours flew by, even with the cloud cover and no star gazing to be done. Inspired to learn more about space and astrophysics!"

Rachel, Leeds



APRIL 2019 (times in BST)

Lunar phases

New moon	05/04/2019	09:52
First quarter	12/04/2019	20:07
Full moon	19/04/2019	12:13
Last quarter	26/04/2019	23:20

PLANET SUMMARY

Mercury and Venus are still too close to the Sun to observe. Mars is visible in the evening twilight from around 9pm until 11pm. Jupiter is a morning object visible for about 2 hours in reasonably dark skies from 0300. Saturn is visible low in the east before sunrise. Uranus is in conjunction with the Sun and hence not visible this month.

THE STARS AT 10PM (BST)

North – Perseus, Cephues and Cassiopeia are nicely placed with the two Bears high up. East – Draco, Bootes and Virgo are nicely placed. Lyra, Hercules and Serpens Caput are near the horizon. South – Virgo, Leo, Cancer and Gemini are all nicely placed. Corvus, Crater,

The Planets 15/04/2019

Sextans and Hydra are near the horizon. West – Monoceros, Canis Minor, Gemini, Auriga, Perseus and Cassiopeia are all nicely placed. Canis Major, Orion and Taurus are all near the horizon with Venus in Aries just setting.

METEOR SHOWERS

There are the April Lyrids, active between the 16th and 25th of April. The Moon will be last quarter on the 26th so will interfere somewhat with observing this shower. Lyra is visible all night but early morning is best for this shower. The moon will be in the sky throughout the night of the 20th April, so only the brightest shooting stars of this shower will be visible in 2019.

COMETS

There are no bright comets expected in April.

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	06:03	23:03	05:42	05:29	07:30	01:29	03:12	06:19
Set	20:07	07:04	17:13	16:52	00:38	08:47	10:48	20:45





April 15th night sky at 11pm BST, from Newcastle-upon-Tyne.

Night Sky credits: Data sourced from Cybersky 5, https://www.timeanddate.com/moon/phases/ and https://in-the-sky.org/ .



Beginners Guide to Landscape Astrophotography



The Milky Way at Kielder Observatory

Introduction

With such a wide range of affordable digital cameras now available, landscape astrophotography is becoming extremely popular and more accessible. The rapid advancement in camera technology is allowing us to push night sky photography further than ever before, producing some marvellous results. A simple scroll through social media will display the wide range of creative and interesting results achieved

by astrophotographers. Whether you're imaging the Milky Way, starry sky-scapes or startrails, this article will give you some essential tips on getting started with your DSLR camera.

Setting up and planning your shot

Astrophotography requires long exposures, meaning a stable camera is vital. Camera shake will cause trailing or squiggly stars, so a sturdy tripod is a



must. Having a good tripod will also help with the framing of your shot.

Thinking about the type of image you want to achieve will help you decide on the conditions necessary for your shot. Location/foreground, orientation of the sky, weather forecast, New Moon or Full Moon, getting all these things to line up perfectly is often an astrophotographer's biggest frustration.

Example 1: If you want to image the Milky Way above a certain landmark, use night sky software to check it is visible and in the correct position at the given date and time. Moonlight will wash out the fainter stars making it harder to pick up the fine detail of the Milky Way. Pick a dark location well away from light pollution.

Example 2: You may want to use moonlight to your advantage, it is a great source of illumination for your foreground/subject if you're doing a starry sky-scape or a star-trail.

Choosing a lens

As always with camera lenses, there are pros and cons to each lens when using them for astrophotography. Generally for wide field landscapes a fast, short focal length lens does the trick.

Focal length:

The focal length of a lens is determined by how far the light has to travel from the primary lens to the point of focus. A short focal length lens (10-24mm) gives a wide field of view, allowing for more sky in your image. Longer focal lengths (100-500mm) give you a lot of zoom, they are best for moonrises/moonsets and sunrises/sunsets.

A short focal length is best!

I use a 14mm lens which gives me an incredibly wide view, but this also introduces distortion and vignetting around the edges of the image. This isn't a huge issue as these can be corrected in post processing. The pros of a wide field far outweigh the cons. I also use a fast 35mm lens which gives less distortion, but with it being a longer focal length the field of view is smaller. I use this to produce higher resolution mosaics of the Milky Way.

Shoot in RAW not JPEG

The first setting to think about is the type of image file you need to capture. Always shoot in RAW as this will maximise the



amount of information in your image. This will be beneficial when processing.

The Exposure Triangle



Aperture

Once you have your camera and tripod set up its time to think about your camera



Trailing stars due to over exposure.

settings. Aperture, Shutter Speed and ISO make up the exposure triangle. They are the three adjustable settings that contribute towards a correctly exposed image. If one is adjusted, another side of the triangle will have to be adjusted to compensate. There are pros and cons to each setting. The exposure triangle is the fine balancing act of the three settings to produce the best possible results with your equipment.

Shutter Speed:

The shutter speed is the amount of time the camera sensor is exposed to light. Longer exposure times will give you a brighter image than shorter exposure



Correctly exposed pin-point stars.

times. Long exposures are needed in night photography because of the low light conditions. The amount of time you should expose your image when doing astrophotography will depend on the focal length of your lens. The night sky appears to move around us due to the rotation of the Earth, which causes a problem when doing landscape astrophotography. The stars will move across the camera sensor during the exposure producing star trails. This isn't a problem if you're trying to achieve star trails, but if your aim is to produce pin sharp stars then you will have to ensure you are using the correct exposure for your lens. The longer the focal length of your lens the more

apparent star trails will be.

Example: With my 14mm lens I can usually expose up to 30 seconds before getting any noticeable trailing. This will vary depending on the type of camera used and on the direction of sky you're facing. Using my longest lens (300mm) I get trailing stars after only 2 seconds! Play around with your exposure and see what works best with your particular set up.

Aperture/F-Stop:

The aperture controls the amount of light that passes through the lens and onto the camera sensor. A wider aperture allows



Example of using a lens at widest aperture. This is a crop of the top right corner of a night sky image. Notice to the right the stars are distorted. This is because it is a wide lens.



more light and a smaller aperture less light. Camera lenses with a wide aperture are often called fast lenses. This is exactly what you want for collecting light from the faint night sky. Aperture is also knows as f-stop. The f-stop value is the focal length of the lens divided by the diameter of the lens.

f/stop = focal length/diameter.

Example: f/1.4 f/2.0 f/2.8 f/4.0 f/5.6 f/8.0 The lower the f-number the wider the aperture.

The 14mm lens that I use can get down to f/2.8 and the 35mm down to f/1.4. An issue with using a lens at its widest aperture is distortion around the edge of the image. To reduce distortion you can close your aperture a few stops and



A lot of noise.

compensate by adjusting the other settings in the exposure triangle.

ISO:

The ISO is the final part of the exposure triangle. ISO can be thought of as the sensitivity of the digital sensor.

ISO scale - 100 200 400 800 1,600 3,200 6,400 12,800...

A lower ISO value will give lower sensitivity meaning more light will be needed for a correctly exposed image. A high ISO will give higher sensitivity which will mean shorter exposures are needed for a correctly exposed image. If only we could use the highest ISO possible that would be great! Unfortunately the drawback of a high ISO is also a high amount of digital noise in the image.



A stacked image to reduce noise.



Noise is caused by the digital amplificationAnof the light hitting the sensor. It is thecolunpleasant grainy structure across theyouimage which obscures a lot of detail.useNoise can be reduced by using a lowerexISO or stacking multiple images usingintereststacking software. Try to keep the ISO aspelow as you possibly can, but not so lowstacking

White Balance

that you can't pick up any stars!

After mastering the exposure triangle the next setting to look at is the white balance or temperature of the image. White balance is expressed in Kelvin usually between 3000K - 7000K and can be adjusted on your camera. A cooler white balance will produce more of a blue image and a warmer white balance orange. It is personal preference when choosing a white balance but night sky images tend to look better when slightly on the blue side. Shooting in RAW will allow you to adjust white balance in post processing.

Accessories

To make imaging easier it is worth thinking about accessories that will help combat certain problems with astrophotography. Intervalometer:

An intervalometer is a small handset that connects to your camera which will give you more control when shooting. It can be used to make your camera take exposures continuously with an adjustable interval between exposures. This is perfect for shooting a time-lapse or a startrail where you need many images.

Dew Heater:

When shooting at night for a long period of time a big problem can be moisture settling on the camera lens. Dew has ruined many of my time-lapses and startrails! A good way to combat dew is to strap a hand warmer to your lens or you can buy a dedicated dew heater.

Conclusion

This is a very simple introduction to starting out with astrophotography. Remember to play around with all of the settings mentioned above until you master the art. Good luck!

> Dan Monk Astronomer, Kielder Observatory



How to Get Started: Deep Sky Astrophotography



Fifteen minute stacked exposure of M31, Nikon D810

There is nothing quite as exciting for the amateur astronomer as taking your first image of a deep sky object. Suddenly, your favourite nebula or galaxy is apparent in much greater detail on the back of the camera, and in beautiful colour too! Deep sky astrophotography is the natural progression for many photographers and astronomers and can be a satisfying and wonderous undertaking - but also frustrating. How do you get started? There are several elements to put into practice to take successful deep sky images. The aim is to find, track and collect data from a distant object for a period of time, and then use software to enhance the data you have to portray the object at its best. Although a broad and at times complicated topic, we can arm you with the basics to take your first exposures using a telescope. You will need a DSLR with an intervalometer, a t-adapter, a motorised equatorial mount, a laptop to process and of course a telescope.

The Kit:

Any DSLR camera is perfectly capable of taking great astrophotography, particularly as you are starting out. You may read online about the strengths of particular cameras, but to begin with, whether you have a crop sensor or a full frame DSLR, all you need to know is how to set it to manual and how to adapt it to the telescope. We would not advise to "mod" your DSLR as this will invalidate any warranty you have and isn't necessary when just starting off.

The manual setting (designated "M" on the dial on the top of your DSLR) allows vou full control of how the camera takes an image. The two settings we are interested in for deep sky astrophotography are shutter speed and the ISO. The shutter speed, or exposure time, for your images will be set by the intervalometer, and the ISO should usually not exceed half the ISO capability of the camera. However, as ISO doubles the brightness of the image each time you increase its value, you will find higher ISOs introduce a lot of noise into your image, lowering the quality. Exercise caution with ISO - we recommend between 1600 and 3200. Shoot in RAW. Intervalometers are inexpensive

accessories that allow you to set the delay before exposing, the number of exposures necessary, their length and the interval between them. You can attach it to the camera, set the shutter speed to bulb, and then programme an exposure time and number of exposures of your choice. Using an intervalometer gives you control over the amount of data you collect, and vitally does not allow any vibrations to be transferred to the imaging system from pressing the shutter.

To adapt the camera to the telescope you will need to buy a 2" t-adapter, which locks on where the lens would usually sit on the body of the camera. They are inexpensive, specific to brand and can be bought from a variety of online stores. Once the adapter is attached to the camera, it can be attached to the telescope.

The telescope we would probably recommend for starting astrophotography is a refracting telescope- these give a wide field of view, so you can image large, bright objects such as the Andromeda Galaxy. They also require little to no maintenance so will take away a source of worry when setting up your equipment. Arguably the most important piece of equipment is the mount. The mount has to do three things: bear the weight of the



imaging train and provide a solid, stable system (important for image quality); track the chosen object through the sky at sidereal rate for those longer exposures; and prevent field rotation (the object rotating around the centre of the field of view) while it does so. There are two main types of mounts, equatorial (EQ) and Altitude/Azimuth. A motorised equatorial mount is the overall best choice, and we'd recommend buying one with a high payload capacity so that you can place whatever you want on it and the system will work smoothly, particularly useful for when you want to undertake more ambitious astrophotography using different telescopes and accessories. An Alt/Az mount can be modified with a wedge to achieve the same result as an EQ mount, but it is easier overall the use the equatorial system.

Setting up the equipment

To successfully take long exposures of a deep space object, the object needs to stay completely still, with no trailing or stars or rotation of the object. To ensure this you must align the polar axis of your EQ mount to the north celestial pole, the point around the which the sky will appear to rotate as the earth rotates on its axis. The north star, Polaris, is very close to the NCP and acts as your guide for polar alignment. The polar axis of the mount does not move when you move the telescope. Polar alignment is done by moving the mount, not the telescope. First, find Polaris. Polaris can be found by locating the asterism of the The Plough or The Big Dipper and drawing a straight line through the right-hand stars in the box of the Big Dipper to the next brightest star visible.

Next, level your tripod. Orientate it correctly facing north, and Polaris, and use a spirit level to ensure it is completely level. You can use a compass to assist you during daytime, or Polaris as your guide at night time. Most EQ mounts have a bubble meter on the tripod, but I'd still advise using a spirit level.

Place the mount on the tripod and adjust the altitude, in degrees, to your current altitude (we are 55 degrees in Kielder) using the altitude bolts. Be sure to loosen one as you tighten the other to prevent bending the bolts.

Position Polaris in the polarscope of the mount (sometimes you need to rotate the declination axis of the mount through ninety degrees to see through the polarscope). By crouching down and looking through the polarscope, you should see Polaris, and a circular reticule with a crosshair in the middle. The





Seven-minute stacked exposure of M42, Nikon D810

crosshairs represent the NCP and the circle the transit of Polaris around the NCP. Use a mobile app, such as PolarFinder, to find the correct position on Polaris relative to the NCP and use the azimuth bolts on the side of the mount to move Polaris in the viewfinder of the Polarscope to the correct position on the reticule. Remember to loosen one bolt as you tighten the other.

You are now polar aligned. The more accurately you position Polaris relative to the NCP, the better your alignment and the longer you can expose for. Your aptitude for polar alignment with improve with time, and there are several advanced techniques to increase the accuracy of the **OBSERVERS' SLOT**

tracking mount, such as autoguiding. Next you can mount your telescope, along with your camera. Ensure you balance the mount with the full weight of the equipment you intend to use, in both right ascension and declination.

Taking Data

You should follow your mount's instructions to do a star alignment and then you can pick an object to slew to. M42, or the Great Orion Nebula is a popular first target in our current seasonal sky. To focus the camera, for objects that contain bright stars you can use the viewfinder of the camera or zoom in on 'live view'. You can take a test exposure the check your focus, and help you frame the image.

You are now ready to start taking data from your object to process using software on your laptop or computer. Individual exposures can be stacked to accumulate detail and retain image quality using Photoshop, DeepSkyStacker or Pixinsight (although the latter is a costly piece of software more suited to when you are wishing to advance a little). There are many excellent tutorials and resources online about how to begin processing astrophotography.



Even with stacking you may find that the frames containing the data of the object (referred to as "lights", or sub-frames) produce an image that is quite noisy, particularly after processing to bring out finer details, or it may suffer from vignetting or aggravating, so-called 'dust bunnies' on unclean camera sensors. To offset these, you can investigate the benefits of using calibration frames to reduce noise, bias and vignetting in images and create the best possible deep sky image you can.

The three basic calibration frames to combine with your lights in post processing software are known as darks, flats and bias frames. They each subtract a detrimental feature acquired in the light frames.

Dark frames are taken directly after your lights, using the same ISO, exposure time set by your intervalometer and critically at the same temperature as you have taken your lights. The only difference from your lights is that the lens cap should be on (the frame is entirely dark) as these frames will pick up the hot or cold pixels and noise introduced by temperature, ISO and exposure time. Some modern cameras calculate dark levels automatically.

Bias frames are the same as darks but

with rapid exposure times, these frames capture the base level of read out of noise from each pixel in your sensor, which you can remove.

Flat frames remove vignetting and dust bunnies, but are the biggest pain to take, as you need to cover the end of the telescope with a white T-shirt (or similar item) and take an image until the data collected peaks precisely halfway across the histogram display on the back of the camera.

All calibration frames in theory are best taken directly after your imaging session, but this is most important for darks and flats. Your ISO should remain the same for all frames, and field orientation the same for flats and darks. You should aim for at least 20 dark frames, 25 flat frames 50 plus bias frames as a very rough guide- more is always better. There are, again, various online resources and tutorial videos to help should you decide to use calibration frames.

Hopefully this article has helped shed some light on the topic of deep sky astrophotography and how you can get started taking beautiful images. I hope you have clear skies, and lots of fun! Natasha Lund Astronomer, Kielder Observatory

GALLERY

We would love to display your images here, whether they are taken up at Kielder or not - please send them to

newsletter@kielderobservatory.org along with a brief description of how and when they were taken.





The Horsehead Nebula. This little section of sky in Orion is full of multiple different nebulae - including the Flame Nebula at the top and NGC 2023 just next to the horsehead. Nikon D750, 5" Skywatcher refractor, 7 x 4 mins, 6400 ISO.



GALLERY



The Rosette Nebula is a large molecular cloud in the constellation of Monoceros. Despite being 5,200 ly away, this 130 ly wide cloud is roughly five times larger than a full moon in the sky! Nikon D750, 5" Skywatcher refractor, 10 x 4 mins, 6400 ISO.



GALLERY



With the observatory track closed by ice, guests were treated to a view of the aurora down at Kielder Castle.

"We went for New Year's Eve not really sure what to expect and we were really pleased we had gone. Though it was too cloudy on the night to stargaze we didn't feel like we had missed out on anything. All the staff were so enthusiastic and knowledgeable they guided us through a number of different presentations and we saw the whole observatory. The food was delicious and the music was great. What a brilliant atmosphere and experience to see in the new year."

Charity

The evening was absolutely fantastic. As a total beginner to astronomy I feel it was pitched perfectly. I have nothing but praise and admiration for your staff. Not only are they obviously very knowledgeable about the subject but there enthusiasm and passion was infectious. I am already looking to book a re visit in August along with my daughter for her birthday. Phillip, Durham

Whilst we could not see any stars due to thick cloud and fog the enthusiastic team gave fascinating talks. I was hoping for stars but got a middle of the night physics class and didn't want to fall asleep so well done! Charlotte, Northumberland

KOAS: Your Window to the Universe



KIELDER OBSERVATORY