Spring 2018 Number 19

Kielder Observatory Newsletter





NEWS New observatory opens!

SCIENCE Gravitational waves

OBSERVING

Highlights May/Jun/Jul **10 YEARS** ON How the observatory came to be



EDITORIAL

It seems remarkable that on April 26th we will be celebrating 10 years of running the Observatory. A lot has happened in that time and I suspect few of those at the opening ceremony in 2008 would have envisaged what a resounding success the Observatory would become just a few years later. It is perhaps fitting that at our 10th anniversary celebration we will be officially opening the new building, thereby beginning another chapter in the story of Kielder Observatory.

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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It hardly seems like a year ago when we opened the Kielder Observatory and here we are now some 10 years later. It's fair to say through the concerted efforts of all of the team we have produced what is now



known nationally as a superb observatory dedicated to outreach in astronomy. We have excelled in so many ways too, from the sheer number of visitors and occupancy levels to the development of the infrastructure at the observatory. Guest satisfaction levels are remaining high and our team of dedicated astronomers are still delivering quality events all year round in whatever the weather.

A WORD FROM THE CEO

This year has seen a real step change in how we convey our message, with the introduction of more formalized educational outreach events. Working with one of our trustees, Tom Grieveson, I looked into the possibility of delivering bespoke astronomy education sessions to member schools and this scheme is now well and truly running at a pace. I expect through meticulous planning that this project will continue to develop and get the science team into the community to help assist the teachers in their classroom endeavours.

This will, of course, serve to utilise the new observatory, which was opened last month. I fully expect the observatory to be running continuously in supporting our guests, the staff and the schools. The new facility with its array of telescopes aimed at digital observations will be an asset that will take us into this new period and help get the message about astronomy out there. It also raises the proposition of doing research; it's not for now, but certainly once the kit is all calibrated, add those killer skies lying overhead and it's a recipe for discovery!

So here's to the next 10 years.

Gary Fildes (FRAS MSc Hon.Caus.)



KOAS NEWS

TRUSTEE NOTES

As we mentioned in the last newsletter, the trustees held an 'Away Day' in February. The event was very successful and will probably be repeated in the future. One thing that indirectly resulted from that day is that Peter Standfield has joined us as a trustee and taken over the vacant position of chair.



The trustees (well most of them) at the Away Day in February.

Peter is an economist by background, with extensive management experience. Educated at the universities of Bradford, Hamburg and Durham, he enjoyed a successful period of military service, including appointments in a variety of operational units and at the Ministry of Defence. He followed this with several vears in the NHS in the North East of England before transferring into the private sector, where he was appointed Chief Executive of a joint venture company, developing capital projects for NHS and local authority clients. He has spent the last ten years supporting clients involved with capital projects, business development, organisational change and value-for-money initiatives in the construction, healthcare, tourism/leisure and charitable sectors. Since 2015 he has been working on a national programme to help ease financial pressures in the NHS by releasing £1bn of value whilst improving outcomes for patients.

Peter attended the opening of the Kielder Observatory in 2008 as a representative of Arts Council England, of which he's a former trustee. He has been an independent adviser to KOAS since 2010 and a director of its trading company since its creation in 2014. Peter's other voluntary commitments include being a primary school governor, a member of the College Council of St Cuthbert's Society at Durham University and a volunteer with the Cranfield Trust.



OBSERVATORY NEWS



Alexander Dickinson opens the new observatory, with CEO Gary Fildes and the new Chair of the Trustees Peter Standfield looking on.

On April 26th, 10 years and one day since the Observatory first opened, Alexander Dickinson opened our new observatory building on behalf of the Gillian Dickinson Trust. The building is to be known as "The Gillian Dickinson Astro-imaging Academy". The event was covered by the press and by BBC Look North TV. It was actually touch and go as to whether the building would be finished on time, as the "Beast from the East" in February and the "Mini-Beast" in March saw the observatory closed to visitors for the best part of 2 weeks. The opening of the new building will bring with it our new late night "Physics in the Forest" series of events starting with 'Exoplanets: The search for Earth 2.0' on May 4th and 5th, followed by 'Cosmology' on May 11th and 12th. These events are designed for the guest who wants to learn that little bit more, but there is still, of course, good old observing and



OBSERVATORY NEWS

so on the clearest nights we will be using our new, high tech instruments to probe the universe...



The mobile planetarium awaits its guests at Thornhill Academy.

Our mobile planetarium had a successful outing to Thornhill Academy, Sunderland in March, as part of British Science Week. This included a live Facebook broadcast.

The observatory sent Hayden to the National Astronomy Meeting in Liverpool at the beginning of April, in order to raise awareness of KOAS amongst the professional community. A number of useful contacts were made. Meanwhile Gary and Dan made a visit to Tenerife to explore the possibilities for some exciting new options for the Observatory, and to test out some of the equipment going in the new building.

The observatory made an appearance on CBeebies on March 29th, featuring on the 'My First - Stargazing' episode, whilst Gary Fildes' film 'Searching for Light' featured as part of the inaugural Newcastle International Film festival on March 31st.



A group of guests stand by as Orion rides high over the Observatory.

Our ever popular 'Space Kids' events will be running on Tuesday 29th and Thursday 31st May. Book soon if you want a place, as these sell out quickly.



OBSERVATORY NEWS



Inside the new observatory on opening day: Gary Fildes, Operations Director John Holmes (now well on the mend following his unfortunate accident) and Alexander Dickinson.

STOP PRESS: it has come to our attention that there are a lot of unused gift vouchers bought from the Observatory in Christmas 2016 which are due to expire in June. Can we remind everyone that the vouchers have a finite life, so if you have one, or have bought one for someone else, could we encourage you to check the expiry dates and use them up in time!







NIGHT SKY MAY 2018 (times in BST)

Lunar phases

Last quarter	08/05/2018	03:08
New moon	15/05/2018	12:47
First quarter	22/05/2018	04:49
Full moon	29/05/2018	15:19

PLANET SUMMARY

Mercury is not visible in dark skies this month and is a daylight object, too close to the Sun to observe. Venus will be visible low in the west after sunset. Mars is a morning object visible for about 1 hour in moderately dark skies in the east during twilight. Jupiter is a morning object visible from around midnight until 0330. Saturn is also a morning object visible low in the east before sunrise. Uranus is too close to the Sun to observe this month.

THE STARS AT 10PM (BST)

North – Perseus, Cassiopeia and Cepheus are nicely placed. Andromeda, Cygnus and Lacerta are near the horizon. East – Bootes, Hercules and Lyra are nicely placed, with Ophiuchus and

The Planets 15/05/2018

Sun Mercury Uranus Venus Mars Jupiter Saturn Rise 05:08 05:55 07:01 03:01 22:44 02:45 06:39 07:42 10:25 20:40 Set 20:56 18:39 22:01 10:31

Serpens near the horizon along with Libra containing Jupiter in the south east South – Coma Berenices, Leo and Cancer are high up, Virgo is nicely placed. The southerly constellations of Crater – the Cup, Corvus the Crow, Sextans and Hydra the Water Snake hug the horizon. West – Cancer, Gemini and Auriga are nicely placed, along with Perseus. Orion skirts the horizon.

METEOR SHOWERS

There are no bright meteor showers this month.

COMETS

There are no bright comets this month. However, Comet C/2016 M1 PANSTARRS may be visible at magnitude 8.5 in the constellation of Aquila the Eagle, which rises just before midnight.



May night sky looking north.







NIGHT SKY JUNE 2018 (times in BST)

Lunar phases

Last quarter	06/06/2018	19:31
New moon	13/06/2018	20:43
First quarter	20/06/2018	11:50
Full moon	28/06/2018	05:53

PLANET SUMMARY

Mercury will be a very difficult object low in the west after sunset. Venus will be visible in the western sky for about 2 hours after sunset. Mars is a morning object visible from around 0200 until 0300 when it will be lost in twilight. Jupiter is visible from around 2300 until just after 1 am in moderately dark skies. Saturn is near opposition and will be visible from about 2330 until 0230. Uranus is a morning object visible low in the eastern twilight.

THE STARS AT 11PM (BST)

North – Cepheus is nicely placed with the two Bears high up. Near Cepheus are the not-well known constellations of Lynx and Camelopardalis. Auriga, Perseus and

The Planets 15/06/2018

Andromeda skirt the horizon.

East – Hercules, Lyra and Cygnus are nicely placed. Ophiuchus along with both parts of the Serpent are nicely placed in the south-eastern sky.

South – Hercules, Bootes and Coma Berenices are nicely placed along with Ophiuchus, Libra – with Jupiter - and Virgo. To the lower LHS of Libra can be found the claws of the Scorpion. West – Virgo, Leo , Cancer and Gemini cut a swathe across this view. Auriga is low in the NW.

METEOR SHOWERS

There are no major meteor showers in June.

COMETS

There are no bright comets this month, but Comet C/2016 M1 PANSTARRS, although moving rapidly south, may still be visible at around magnitude 8.5 low down in the constellation of Sagittarius.

	Sun	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	04:37	05:11	07:33	00:27	17:39	22:09	02:22
Set	21:38	22:39	00:07	08:12	03:01	05:50	16:37



June night sky looking east.

"Took wife and two children (9,6) to the Space Kids 2 hours session and was not disappointed at all. Obviously was aware we could not do much star gazing between 4-6pm as its daylight but they still managed to get us a star to view through the telescopes. The interactive rocket making was fun and to touch meteorites (not meteors...as they have landed!) was great fun along with touching a piece of moon rock was great for the kids and adult geeks! Great place.....middle of nowhere of course so bit of a drive of the main road and nothing but the observatory around so don't arrive too early for your event."



David, Bolton



JULY 2018 (times in BST)

Lunar phases

Last quarter	06/07/2018	08:50
New moon	13/07/2018	03:47
First quarter	19/07/2018	20:52
Full moon	27/07/2018	21:20

PLANET SUMMARY

Mercury is lost in the evening twilight. Venus will be low in the west after sunset. Jupiter is an object visible from around 2300 until midnight. Saturn is close to opposition and will be visible from around 2300 until 0200. Uranus will be visible from around 0200 until 0330 low in the east and south.

THE STARS AT 10PM (BST)

North – Corona Borealis and Bootes are high up, with Coma Berenices and Canes Venatici nicely placed. Virgo and Leo are close to the horizon.

East – The Milky Way cuts a swathe across the sky at this time. From Perseus in the east, through Cassiopeia, Cepheus, Cygnus – in the south - into Sagitta and

The Planets 15/07/2018

	Sun	Mercury	Venus
Rise	04:56	07:33	09:03
Set	21:28	22:21	23:08

Vulpecula, towards Aquila, Scutum and Sagittarius in the west. Low down are Andromeda and Pegasus. South – Cygnus, Lyra, Hercules and Bootes are nicely placed with Aquila, Ophiuchus and Virgo still worth a look. You may see the body of Sagittarius and the head of the Scorpion near the horizon. West – The two Bears, Corona Borealis and Hercules are well placed. Libra – with Jupiter, Virgo and Leo are still visible with Cancer setting. Venus, the Moon and Mercury make a nice group close to the horizon, in the constellation of Leo.

METEOR SHOWERS

There are no major meteor shows in July.

COMETS

There are no bright comets this month.

Night Sky credits:

Data sourced from Cybersky 5, apart from lunar phases (https://www.timeanddate.com/moon/phases/)

and planet events (https://in-the-

sky.org/data/planets.php).

Mars	Jupiter	Saturn	Uranus
22:41	15:36	20:03	00:45
05:53	01:03	03:42	14:44



July night sky looking SSW.







Gravitational Waves

Gravitational waves are a topical subject in astrophysics at the moment. They were predicted by Einstein's Theory of General Relativity in 2016, but their existence was not confirmed until they were first observed in 2015 by LIGO (the Laser Interferometer Gravitational-Wave Observatory). It is a measure of the huge significance of this observation that the three lead scientists for this project were jointly awarded the Nobel Prize for Physics in 2017.

So what is a gravitational wave? To understand this you must first get to grips with General Relativity – but only in a very basic way! Einstein's Theory says that space (or more accurately the space-time continuum) curves in the presence of mass. This is illustrated in fig. 1, but



Fig1: the diagram illustrates how a mass, such as a planet or a star, will distort space-time. The 2 dimensional equivalent would be where a large thin sheet of rubber suspended in mid-air would be distorted by, say, a few heavy snooker balls.

Credit: European Space Agency



remember this is a 2-dimensional representation of a 3-dimensional effect. It can be difficult to get your head around space becoming curved, whereas it is easy to visualise a 2-dimensional surface becoming curved, which is why this analogy is very often used.

The next step is to consider the waves. We now change our analogy to a village pond in which the water is perfectly still and flat. What happens if you then drop a stone into the middle of the pond? You get ripples in the surface of the water, moving outwards from where the stone enters the water. Gravitational waves are the space-time equivalent of these ripples. A major disturbance in the distribution of mass will generate these waves.

So the next obvious question is, what might generate such a disturbance? Gravitational waves are very difficult to detect because the "ripple" caused by an event at astronomical distances from us is extremely small by the time it gets to Earth. The event that generates the waves would have to involve extremely high energies, and this is precisely what caused the gravitational waves that were detected in 2015. They were the result of

the merger of two black holes, with masses of 29 and 36 solar masses (a solar mass is the mass of our Sun, and is a standard unit of measurement in astrophysics). The mass of the newly merged black hole was 62 solar masses, so simple arithmetic tells us that 3 solar masses have disappeared. Where did they go? Well, this is where Einstein appears again. His famous equation E=MC² relates energy E and mass M (with C being the speed of light), and if you convert mass completely into energy you get a lot of energy released; for example, this is what powers the Sun. So the release of energy from the equivalent of 3 solar masses is enormous; in fact it has been estimated that in the final fraction of a second of the black hole merger, the energy released was more than 50 times the combined power of every star in the observable universe. That is some bang! This energy was released through the propagation of the gravity waves.

The waves were detected at the LIGO facility, which is actually two separate observatories in the USA, one in Washington and the other in Louisiana. Each observatory has a laser interferometer that is 4km long, with laser





Fig. 2: the merger of two black holes and the gravitational waves that ripple outward as the black holes spiral toward each other.

Credit: Caltech/MIT/LIGO laboratory/T. Pyle

light that is split into two beams, in a nearperfect vacuum, that travel down the arms of the instrument. These beams monitor the distance between mirrors that are precisely located at the ends of the arms. When a gravitational wave arrives at the detector, the distance between the mirrors will change by a miniscule amount, and this change can be used to determine the strength of the wave. These instruments are extremely sensitive; a change in the length of the arms smaller than one-tenthousandth the diameter of a proton (10⁻¹⁹ meter) can be detected. Taking these measurements at two geographically separated instruments indicates the direction in which the originating event took place. For the 2015 observation, the black hole merger took place in the Southern Celestial Hemisphere, and about 1.3 billion light years away.

Since the first detection, the LIGO team have observed the gravitational waves from two more black hole mergers, and another one in 2017 jointly with a third interferometer, the Advanced Virgo facility in Italy.



And just a few days after that event, on 17 August 2017, LIGO and Virgo observed gravitational waves from the merger of two neutron stars (this astronomical event is referred to as GW170817), which has got the scientific community community quite excited. The main reason for this is that, unlike black hole mergers, neutron star mergers should generate detectable levels of electromagnetic radiation, which is exactly what happened in this case. The gravitational wave detection triggered other observations across the world, and in orbiting observatories. Some 70 sites reported optical and infrared detections, and the orbiting Fermi satellite detected a gamma ray burst 1.7 seconds after the gravitational wave signal (this time lag being in line with theoretical prediction).

Astronomers and astrophysicists are very excited about these observations, especially the neutron star merger, because they open up new ways of observing the universe and understanding the processes and mechanisms



Fig. 3: This shows LIGO's interferometers with an incoming gravitational wave depicted as arriving from directly above the detector.

Credit: Caltech/MIT/Ligo laboratory



that underlie cosmic events. For example, being able to link gamma ray bursts to a specific event, observable in other to come, and there are many plans for improving the LIGO instrumentation. LIGO is aiming to develop a third



Fig 4: An artist's illustration of a neutron star merger.

Credit: Caltech/MIT/LIGO Laboratory and NASA/Swift/Dana Berry

wavebands, is a major step forward in astrophysics research. Optical, x-ray, radio, infrared and gamma ray telescopes, as well as neutrino detectors, all participated in the post-GW170817 observations, which is thought to be the most studied single astronomical event in human history. This is quite impressive, given that it arose from measuring something considerably less than the diameter of a proton! There are undoubtedly more observations instrument based in India by 2025, and there are European Space Agency plans for a gravitational wave observation satellite (but probably not until the 2030s). One hundred years after Einstein's prediction, the study of gravitational waves looks set to become a significant part of astrophysics research.

Trevor Robinson



Ten Years of Kielder Observatory



Black Fell ten years ago. Only the presence of the digger hints at what was to come.

It all started with a meeting in a pub ...

Actually, the seeds of the observatory probably grew from the success of the first Kielder Forest Star Camps, which gave Gary the idea that Kielder would be a great place for a simple observatory. However, it was a meeting with Peter Sharpe, curator for the art and architecture project in Kielder (and still one of our trustees), that seems to have lit the blue touch paper! This fortuitous introduction was followed by the aforementioned meeting in the Manor Arms. Gary brought his astronomical ambitions, Pippa Kirkham and Richard Darn represented the Forestry Commission's interest and their own expertise in astronomy, and Peter provided a potential mechanism to make it work - an exciting and unusual design opportunity for his programme that many architects were sure to be interested in. Crucially he also had some spare cash



available that could be redirected as seed funding for the observatory project, and although it would not cover everything it provided a resource that facilitated initial project development and the costs of the design competition.



By the end of 2007 construction was well underway.

That competition, jointly organised by the Kielder Partnership and the RIBA (Royal institute of British Architects), clearly hit the spot, as we received over 230 entries from every corner of the planet, most incredible but many not so practical! However, after a lot of careful filtering, our selection panel finally shortlisted 6 entries. We then had to interview them all and get a feel for their grasp of the concept. The winner, announced in November 2005, was Charles Barclay architects from London. Charles and his team designed something quite spectacular, a 21st century timber building that aspired to be



All ready for the opening ceremony ...

architecturally dynamic, sensitive to its surroundings, practical and adaptable as a working observatory, but critically feel welcoming to the public it would serve.

Half a million pounds later, on April 25th 2008 the new observatory was officially opened by Sir Arnold Wolfendale from Durham University, a former Astronomer Royal.



The Sky At Night team dedicated the 20" dome to Sir Patrick Moore.



We then felt it necessary to form an astronomical society based around the facility under construction. So in May 2008 KOAS, the Kielder Observatory Astronomical Society, a registered charity, was born. An intrepid group of volunteers whose commitment to the project certainly guaranteed its success.

With the observatory becoming much more popular with the public than had originally been envisioned, in 2013 the decision was taken to turn KOAS into a CIO (Charitable Incorporated Organisation), which was something of a leap into the unknown, as CIOs had only just come into being.

In the same year, we welcomed the Sky At Night team to the Observatory to rename what was then simply known as the 20"



The Observatory made its presence felt in the centre of Newcastle for the 2015 solar eclipse.

turret as the 'Sir Patrick Moore Observatory'. They also filmed for the March edition of the programme.

"I had an amazing time at the Universe full of Stars evening with my husband. Sadly, the weather was really awful - cloud, snow and high winds. Needless to say this meant that there was no chance of seeing anything. Disappointing but nobody can change the weather ! Despite this, the excellent staff (full time, part time and volunteers) made the evening thoroughly enjoyable and full. From the moment we arrived and were directed to the building, to the moment we left and were waved goodbye at the gates, we felt welcome by the friendly and passionate group."

Caitlin, Wrexham





The new decking area was installed in autumn 2015.

In 2014 the Observatory gained a physical presence in Newcastle for the first time, opening a smart new office in Hoults Yard. We were also privileged to have a visit from Sy Lierbergot, the NASA flight controller for the ill-fated Apollo 13 mission.

In 2015 the first major external addition to the observatory took place, in the form of a new area of decking. We also won the North East England best Small Visitor Attraction of the Year award. This was also the year we did a live broadcast of the solar eclipse to several giant screens, including one in front of a large crowd in the centre of Newcastle.

In 2016 it was decided that the old office

was too small, and we moved to our new current location at Prestwick Park. This was also the year when Gary's book, 'An Astronomer's Tale' was released (I am sure any resemblance with the title of this section of the newsletter is entirely coincidental! - ed.), which resulted in a



Construction of the new observatory building was well underway in late 2017.

huge amount of publicity for the Observatory, and endless media appearances for Gary.

By 2017 it was clear that the popularity of the Observatory had outgrown its current structure, with events booked out a month and more in advance. So the construction of a completely new observatory building started, the opening of which coincided with our 10th anniversary.



By the end of its first year of operation 1,200 visitors had passed through the Observatory. Ten years on and we are attracting nearly 20,000 people every year. Our telescopes open to the skies on every clear night. We have a range of specialist solar telescopes for daytime observing during the summer months, and telescopes from 3" aperture all the way up to 16" behemoths capable of showing visitors faint galaxies, comets and much more. The telescopes themselves sit on concrete pillars that are founded separately below the observatory, maintaining outstanding levels of stability. Some are computer controlled, allowing visitors young and old, the thrill of "driving" a telescope around the skies from the click of a mouse.

The construction of the original

* * * *

Observatory was funded by the following without our partners' help, none of this would have happened:

One North East via Northumberland Strategic Partnership, European Regional Development Fund, Northern Rock Foundation, Forestry Commission, Tynedale Council, The Kielder Partnership, (the precursor to the current Kielder Water & Forest Park Development Trust), and the Department for Business, Enterprise and Regulatory Reform that put money into the observatory's renewable energy system.

All the timber came from sustainably managed forests, independently certified as well-managed by the Forest Stewardship Council.

The construction of our new building has been funded by:

HLF, LEADER, Gillian Dickinson Trust, Northumbrian Water, Northumberland County Council, EGGER (UK) Ltd.

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



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.





Believe it or not, we don't always have good weather!





Star trails over the Sir Patrick Moore observatory, with the Pole star neatly framed between the open shutters. All you need to take this sort of shot is a DSLR with bulb mode and a tripod - oh, and some nice dark skies of course!



Although rather low down in the south at the moment, so not ideally placed for observing, the planet Jupiter rises after midnight.





The Beast from the East strikes Kielder ...





... but it's all smiles from the staff at the opening of the new Observatory!







Above: the Milky Way in February. The Pleiades star cluster can be seen just above the open turret, and if you look carefully you can see the Andromeda galaxy just over the main observatory building.

Left: a crescent moon taken through the Observatory's 16" telescope in mid March.

"I went with an incredibly enthusiastic 11 year old son and he was literally buzzing all night with questions and excitement, always wanting to be first to peer through the impressive telescopes they have set up. I think their set up is perfect at the moment but noticed they are just about to open a second building there so will have more facilities soon. We will certainly go back - thanks again for encouraging my sons passion!"

Richard - Stafford

"Had a fantastic night with friends as part of my 50th celebrations. Staff and volunteers braved very cold conditions and provided a warm welcome, superb instruction/demonstration and a wonderful presentation on Orion when conditions clouded over. Everyone very friendly and patient. Left the venue very satisfied with evening's viewing and discussion - and passion for astronomy re-ignited!!"

Jim, Newcastle

KOAS: Your Window to the Universe

http://www.kielderobservatory.org

KIELDER OBSERVATORY

