NWASNEWS

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May2017

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies and Salisbury Plain Observing Group

Committee Changes?

Welcome to Martin Griffiths, our speaker for tonight, talking about nebulae and how to do a one night nebulae marathon akin to the messier marathon.

He was certainly entertaining our visitors to GEO this last fortnight. And he has another new book published, Dark Land and Dark Skies, discussing the myths behind the stars we see.

Next month is the AGM and there will be changes. I have Keith Bruton put his name forward for Chair person, and, if possible, it would be great to get some else to work on the newsletter as very few now pick up even the meeting copy the facebook page and web page can cover most of what is going on, so a small 4page newsletter every month may be enough. Volunteers for editor?

Next would be committee positions, does the committee need 'new blood'? Are our current committee prepared to stand, particularly speaker sec, treasurer etc.

Hopefully with Nick's repair going well we will be seeing more of him at meetings.

Last month was a busy month for space news, and I have tried to keep us up to date using the Facebook page. Space X not only relaunching used first stage rockets, and landing again, a Spanish couture designer has come up with space proof armour chain mail for those long trips, NASA delayed the launch of the next big booster until 2019, announced 'Life Probabilities' on Saturn and Jupiter moons (or chasing funding???), Juno producing some stunning images from Jupiter and Cassini going out with a big wow factor as it drops through the gap between Saturn and the inner ring.

Even here on Earth meteor impact long suspected near Ullapool has been traced to an impact 1.5 BILLION years ago.

To keep up with these newfeeds is difficult using just the newsletter.

Meanwhile viewing has been variable but 3 binocular comets have been visible, and we are about to start the summer observing season, perhaps some early noctilucent clouds towards the end of May.

Plenty of space station passes but from June to mid July no passes will be visible.

Clear Skies

Andy

Star trails from April 22nd. Jupiter is the bright streak to right, the handle of the Plough asterism on left. 200 exposures of 20seconds with 2 second gap. 20mm lens on full frame DSLR. Stacked using Startrails free software. Note the two curves to the left and to the right because the equatorial zone is just to the left of Juptier where the straight lines run across. Andy

Wiltshire Society Page

Wiltshire Astronomical Society
Web site: www.wasnet.org.uk
Meetings 2015/2016Season.
NEW VENUE the Pavilion, Rusty Lane, Seend
Meet 7.30 for 8.00pm start
2017

2 May	Martin Griffiths, Planetary Nebulae
Marathon	
6 Jun	Mark Radice, Observing from the Carib-
bean + AGM	

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns (Chairman, and Editor) Tel: 01249 654541, email: anglesburns@hotmail.com

Vice chair: Keith Bruton

Bob Johnston (Treasurer)

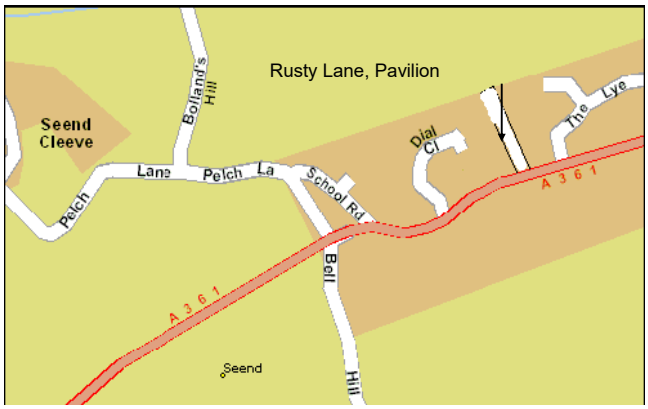
Philip Proven (Hall coordinator)

Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

Observing Sessions coordinators: Jon Gale, Tony Vale

Contact via the web site details. This is to protect individuals from unsolicited mailings.

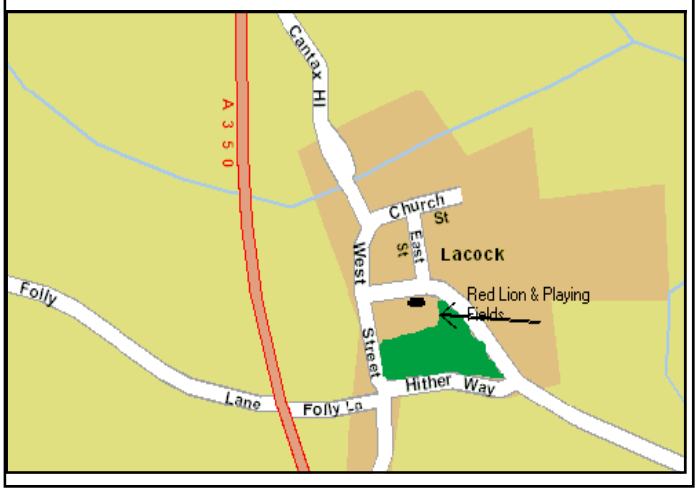


Observing Sessions

The Wiltshire Astronomical Society's observing sessions are open, and we welcome visitors from other societies as well as members of the public to join us.
We will help you set up equipment (as often as you need this help), and let you test anything we have to help you in your choice of future astronomy purchases.

Please treat the lights and return to full working order before leaving. With enough care shown we may get the National Trust to do something with them!

PLEASE see our proposed changes to the observing sessions, contacting and other details. Back Page



broadcasts regularly on BBC Wales radio and has appeared on science programmes for the BBC, Einstein TV, Granada TV and the Discovery Channel. He is also a member of the Honourable Society of Cymmrodorion, dedicated to promoting the science, arts and literature of Wales.

He is now working for Dark Sky Wales in their outreach work to schools and adult learning groups. He has now written four books in the Springer Astronomy Series. And completed another book on the myths in the skies.

Martin Griffiths BSc. (First Class Honours) MSc. (Distinction) FRAS. FHEA.

Martin Griffiths is an enthusiastic science communicator, lecturer, writer and professional astronomer utilizing astronomy, history and science fiction as tools to encourage greater public understanding of science.

He was a founder member of NASA's Astrobiology Institute Science Communication Group, active between 2003-2006 and managed a multi-million pound ESF programme in Astrobiology for adult learners between 2003-2008. Martin has written and presented planetarium programmes for key stages 1, 2 and 3 and has been an adviser to several museum projects

Martin continues to promote cross-disciplinary links between science and culture that reflect his educational background and interests. He has written monographs on the science communication of the proto-feminist Margaret Cavendish, Duchess of Newcastle; and the 18th century scientist, assay master and political adviser Joseph Harris of Breconshire. He is also a regular contributor to the online science journal LabLit: the culture of science in fiction and fact. Recently he assisted the Brecon Beacons National Park in surveying the darkness of the night sky for their successful bid for the International Dark Sky Association's Dark Sky Reserve Status – the first such reserve in Wales.

Martin is a Fellow of the Royal Astronomical Society; a Fellow of the Higher Education Academy; a member of the British Astronomical Association; the Webb Deep-Sky Society; the Society for Popular Astronomy, The Astronomical Society of the Pacific and the Astronomical League. He is also a local representative for the BAA Campaign for Dark Skies. Martin

Swindon Stargazers

Swindon's own astronomy group

The club meets once a month at Liddington Hall, Church Road, Liddington, Swindon, SN4 0HB at 7.30pm. See programme below.

The Ancient Egyptians and their Astronomy

This month we welcome Dr Pauline Norris to our club meeting.
Pauline obtained a Master of Philosophy degree in Agricultural Science at the University of Aberystwyth in Wales. She then changed to Egyptology and passed her MA at the University of Birmingham, focusing on the horse and chariot in the Eighteenth and Nineteenth Dynasties. After this, she graduated with a Doctorate in Egyptology from the University of Manchester, researching the association of the god Min with the lettuce plant and is continuing this research whilst currently writing a book about the god.

She is a member of the Newtown Astronomy Society in Powys, Wales and has given talks throughout England, Wales and in Egypt on a variety of topics connected with the ancient Egyptians.

All welcome!

Ad-hoc viewing sessions

Regular stargazing evenings are being organised near Swindon. To join these events please visit our website for further information.

Lately we have been stargazing at Blakehill Farm Nature Reserve near Cricklade, a very good spot with no distractions from car headlights.

We often meet regularly at a lay-by just outside the village of Uffcott, near Wroughton. Directions are also shown on the website link below.

When we use East Kennett, we meet at the public car park just below The Red Lion pub at Avebury; we usually hang on for 10 minutes and then move on to our viewing spot at East Kennett. Information about our evenings and viewing spots can be found here:

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

If you think you might be interested email the organiser Robin Wilkey (see website). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.
We are a small keen group and I would ask you to note that you DO NOT have to own a telescope to take part, just turn up and have a great evening looking through other people's scopes. We are out there to share an interest and the hobby. There's nothing better than practical astronomy in the great cold British winter! And hot drinks are often available, you can also bring your own.

Enjoy astronomy at it's best!

Members of the Wiltshire Astronomical Society always welcome!

At Liddington Village Hall, Church Road, Liddington, SN4 0HB – 7.30pm onwards

The hall has easy access from Junction 15 of the M4, a map and directions can be found on our website at:

http://www.swindonstargazers.com/clubdiary/directions01.htm

Meeting Dates for 2017:

Friday 19 May 2017

Programme: Martin Griffiths - Contact with extraterrestrials, how will it affect us

Friday 16 June 2017

Programme: Paul Roche - Robotic Astronomy

---------SUMMER BREAK--------

Friday 15 September 2017

Programme: Prof. Richard Harrison MBE BSc Phs FRAS FinstP - Space Weather

Friday 20 October 2017

Programme: Steve Tonkin - Binocular Astronomy

Friday 17 November 2017

Programme: Mike Leggett: Exploration of Mars

Friday 15 December 2017

Programme: Christmas Social

Website:
http://www.swindonstargazers.com
Chairman: Peter Struve

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Swindon, SN1 2JW

NOAA's Joint Polar Satellite System (JPSS) to monitor Earth as never before

By Ethan Siegel

Later this year, an ambitious new Earth-monitoring satellite will launch into a polar orbit around our planet. The new satellite—called JPSS-1—is a collaboration between NASA and NOAA. It is part of a mission called the Joint Polar Satellite System, or JPSS.

At a destination altitude of only 824 km, it will complete an orbit around Earth in just 101 minutes, collecting extraordinarily high-resolution imagery of our surface, oceans and atmosphere. It will obtain full-planet coverage every 12 hours using five separate, independent instruments. This approach enables near-continuous monitoring of a huge variety of weather and climate phenomena.

JPSS-1 will improve the prediction of severe weather events and will help advance early warning systems. It will also be indispensable for long-term climate monitoring, as it will track global rainfall, drought conditions and ocean properties.

The five independent instruments on board are the main assets of this mission:

- The Cross-track Infrared Sounder (CrIS) will detail the atmosphere's 3D structure, measuring water vapor and temperature in over 1,000 infrared spectral channels. It will enable accurate weather forecasting up to seven days in advance of any major weather events.
- The Advanced Technology Microwave Sounder (ATMS) adds 22 microwave channels to CrIS's measurements, improving temperature and moisture readings.
- Taking visible and infrared images of Earth's surface at 750 meter resolution, the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument will enable monitoring of weather patterns, fires, sea temperatures, light pollution, and ocean color observations at unprecedented resolutions.
- The Ozone Mapping and Profiler Suite (OMPS) will measure how ozone concentration varies with altitude and in time over every location on Earth's surface. This can help us understand how UV light penetrates the various layers of Earth's atmosphere.
- The Clouds and the Earth's Radiant System (CERES) instrument will quantify the effect of clouds on Earth's energy balance, measuring solar reflectance and Earth's radiance. It will greatly reduce one of the largest sources of uncertainty in climate modeling.

The information from this satellite will be important for emergency responders, airline pilots, cargo ships, farmers and coastal residents, and many others. Long and short term weather monitoring will be greatly enhanced by JPSS-1 and the rest of the upcoming satellites in the JPSS system.

Want to teach kids about polar and geostationary orbits? Go to the NASA Space Place: https://spaceplace.nasa.gov/geo-orbits/

Caption: Ball and Raytheon technicians integrate the VIIRS Optical and Electrical Modules onto the JPSS-1 spacecraft in 2015. The spacecraft will be ready for launch later this year. Image Credit: Ball Aerospace & Technologies Corp.

BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Website www.beckingtonas.org

General enquiries about the Society can be emailed to chairman@beckingtonas.org.

Our Committee for 2016/2017 is

Steve Hill----------Chairman- 01761 435663

John Ball----------Vice Chairman- 01373 830419

…….john@abbeylands1.freeserve.co.uk

Sandy Whitton---- Secretary-07974-841239

……..sandy.whitton@blueyonder.co.uk

Jacky Collenette---Treasurer… collenettejacqueline@yahoo.co.uk

Mike Witt---------- Membership-…… mjwitt@blueyonder.co.uk.

John Dolton------ Committee…. member@jdolton.freeserve.co.uk

Meetings take place in Beckington Baptist Church Hall in Beckington Village near Frome.

See the location page for details of how to find us on our website……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm.

Programme details for 2016/2017

2016

May 19th: Imaging Colloquium `Open discussion bring your kit along`……. Steve Hill.

All are welcome to come along for a chat from beginners to experts.

Dear Herschellians,

SPACE NEWS

SpaceX Stages Stupendous NRO Spysat Sunrise Liftoff and Land Landing

Article Updated: 2 May , 2017

by Ken Kremer

SpaceX Falcon 9 rocket carrying classified NROL-76 surveillance satellite for the National Reconnaissance Office successfully launches shortly after sunrise from Launch Complex 39A on 1 May 2017 from NASA's Kennedy Space Center in Florida. 1st stage accomplished successful ground landing at the Cape nine minutes later. Credit: Ken Kremer/Kenkremer.com

KENNEDY SPACE CENTER, FL – SpaceX today staged the stupendously successful Falcon 9 rocket launch at sunrise of a mysterious spy satellite in support of U.S. national defense for the National Reconnaissance Office (NRO) while simultaneously accomplishing a breathtaking pinpoint land landing of the boosters first stage that could eventually dramatically drive down the high costs of spaceflight.

Liftoff of the classified NROL-76 payload for the NRO took place shortly after sunrise this morning, Monday, May 1, at 7:15 a.m. EDT (1115 GMT), from SpaceX's seaside Launch Complex 39A on NASA's Kennedy Space Center in Florida.

The weather was near perfect and afforded a spectacular sky show for all those who descended on the Florida Space Coast for an up close eyewitness view of the rockets rumbling thunder.

The rocket roared off pad 39A after ignition of the nine Merlin 1D first stage engines generated some 1.7 million pounds of thrust.

The Falcon sped skyward darting in and out of wispy white clouds and appeared to head in a northeasterly direction from the space coast.

"A National Reconnaissance Office (NRO) payload was successfully launched aboard a SpaceX Falcon 9 rocket from Launch Complex 39A (LC-39A), Kennedy Space Center (KSC), Florida, at 7:15 a.m. EDT, on May 1, 2017," the NRO said in a post launch statement.

"Thanks to the SpaceX team for the great ride, and for the terrific teamwork and commitment they demonstrated throughout. They were an integral part of our government/industry team for this mission, and proved themselves to be a great partner," said Betty Sapp, Director of the National Reconnaissance Office.

The launch of the two stage 229 foot tall Falcon 9 was postponed a day after a last moment scrub was suddenly called on Sunday by the launch director at just about T minus 52 seconds due to a sensor issue in the first stage.

SpaceX engineers were clearly able to fully resolve the issue in time for today's second launch attempt of the super secret NROL-76 for the NRO customer.

Barely nine minutes after the launch, the 156 foot tall first stage of the SpaceX Falcon 9 rocket made an incredibly precise and thrilling soft touchdown on land at Cape Canaveral Air Force Station's Landing Zone 1, located a few miles south of launch pad 39A.

SpaceX Falcon 9 deploys quartet of landing legs moments before precision propulsive ground touchdown at Landing Zone 1 on Canaveral Air Force Station barely nine minutes after liftoff from Launch Complex 39A on 1 May 2017 from NASA's Kennedy Space Center in Florida. Credit: Ken Kremer/Kenkremer.com

The quartet of landing legs attached to the base of the first stage deployed only moments before touchdown – as can be seen in my eyewitness photos herein.

Multiple sonic booms screamed across the space coast as the 15 story first stage plummeted back to Earth and propulsively slowed down to pass though the sound barrier and safely came to rest fully upright.

This counts as SpaceX's first ever launch of a top secret US surveillance satellite. It also counts as the fourth time SpaceX landed a first stage fully intact on the ground.

As is typical for NRO missions, nothing is publically known about the satellite nor has the NRO released any details about this mission in support of national security other than the launch window.

NASA's Space Chainmail to Give Astronauts the Edge in Space Duels

Published: 1 May , 2017

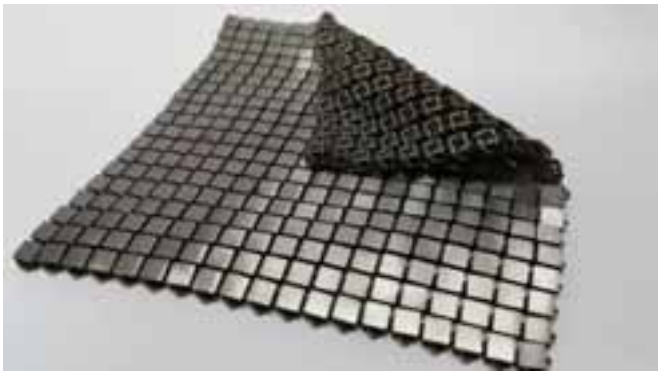
by Matt Williams

One would think NASA was preparing for a some sword fights in space! At least, that's the impression one might get when they see the new armor NASA is developing for the first time. Officially, they are referring to it as a new type of "space fabric", one which will provide protection to astronauts, spaceships and deployable devices. But to the casual observer, it looks a lot like chain mail armor!

The new armor is the brainchild of Polit Casillas, a systems engineer from NASA's Jet Propulsion Laboratory. Inspired by traditional textiles, this armor relies on advances made in

additive manufacturing (aka. 3-D printing) to create woven metal fabrics that can fold and change shape quickly. And someday soon, it could be used for just about everything!

As the son of a fashion designer in Spain, Casillas grew up around fabrics and textiles, and was intrigued by how they are used for the sake of design. Much in the same way that textiles are produced by weaving together countless threads, Casilla's prototype space fabric relies on 3-D printing to create metal squares in one piece, which are then strung together to form a coat of armor.



Another example of a 3-D-printed metallic "space fabric." The bottom and top sides of the fabric are designed to have different functionality. Credits: NASA/JPL-Caltech

In addition to his work with this new space fabric, Casillas co-leads JPL's Atelier workshop, which specialized in the rapid-prototyping of advanced concepts and systems. This fast-paced collaborative environment works with different technologies and looks for ways to incorporate new ones (such as 4-D printing) into existing designs. As Casillas described this concept in a NASA press release:

"We call it '4-D printing' because we can print both the geometry and the function of these materials. If 20th Century manufacturing was driven by mass production, then this is the mass production of functions."

The space fabrics have four essential functions, which includes reflectivity, passive heat management, foldability and tensile strength. With one side reflecting light and the other absorbing it, the material acts as a means of thermal control. It can also fold in many different ways and adapt to shapes, all the while maintaining tensile strength to ensure it can sustain forces pulling on it.

These fabrics could be used to protect astronauts and shield large antennas, deployable devices and spacecraft from meteorites and other hazards. In addition, they could be used to ensure that missions to extreme environments would be protected from the elements.

LEGO Apollo Saturn V: Tallest LEGO Ideas Set Ever Made

Article Updated: 29 Apr , 2017

by Fraser Cain

LEGO Saturn V in launch configuration. Credit: LEGO

Yesterday LEGO announced that their new LEGO Apollo Saturn V set will be available to buy on June 1, 2017. And let me tell you, this thing is going to be a monster. In fact, it'll be the tallest LEGO set ever made from their crowdsourced LEGO Ideas competition, with a total height of 1 meter (39 inches). It's going have a total of 1969 pieces (got to assume this isn't a coincidence), and it contains all the separate parts to run your own simulated Moon mission (LEGO Moon not included).

The LEGO Ideas competitions allow LEGO builders to propose construction ideas to the LEGO community. Fans vote up their favorite designs, and then winning sets are chosen by LEGO to be turned into actual sets. At any time, there are a bunch of space-related LEGO sets in the running, including a Hubble Space Telescope (not approved), Cassini-Huygens (expired), and the Mars Curiosity Rover (approved and in stores now).

LEGO NASA Apollo 11 Set. Credit: LEGO

The NASA Apollo Saturn V set was originally created by Felix Stiessen (saabfan) and Valérie Roche (whatsuptoday), and pitched to the LEGO Ideas community back in 2014. It gained enough votes to pass through each stage of approval, and yesterday, LEGO announced it'll be available as a full set on June 1, 2017.

What's going to be in the set? According to LEGO, it can be stacked up in its original launch profile, with all the stages attached, service module and command module attached. Or, you can display it horizontally, with the three stages separately on stands. You'll actually be able to extract the lunar lander, dock it with the various modules, descend to your own LEGO Moon (again, you're going to need to supply your own Moon here, maybe that'll be a future set?), and return the command module back to an ocean landing on Earth (again, Earth not supplied).

Command, Service and Lunar Lander Modules in various configurations. Credit: LEGO

This is the tallest set to ever come out of the LEGO Ideas Community, and the one with the most pieces – 1969, which coincidentally, was the same year that humans first walked on the Moon with Apollo 11. The initial prototype set was created by Stiessen and Roche, but then the LEGO team took over when the idea was approved, enhancing it and preparing it for its final release as an official LEGO set.

It's going to have a scale of 1:110. Since the set will be 1 -metre high, that'll give you a sense of just how big the original Saturn V rocket really was: 110 metres (or 363 feet). Regular LEGO minifigs have a scale of 1:47 or so, which means that regular minifigs won't fit as astronauts into the set, but LEGO is planning to release a team of 3 new astronaut minifigs so you can play out the lunar landings.

This won't be the tallest LEGO set ever built, though, that honor goes to the Eiffel Tower which is 7cm taller. That's not much, though, they should have considered building the launch pad too, but now I'm just getting greedy.

Story credit: LEGO Ideas

Pardon My Vomit: Zero G Ettiquette In the Age Of Space Tourism

Article Updated: 28 Apr , 2017

by Matt Williams

It's a new era for space travel. And if there's one thing that sets it apart from the previous one, it is the spirit of collaboration that exists between space agencies and between the public and private sector. And with commercial aerospace (aka. NewSpace) companies looking to provide everything from launch services to orbital and lunar tourism, a day is fast-approaching when ordinary people will be able to go into space.

Because of this, many aerospace companies are establishing safety and training programs for prospective clients. If civilians plan on going into space, they need to have the benefit of some basic astronaut training. In short, they will need to learn how to go safely conduct themselves in a zero-gravity environment, with everything from how to avoid blowing chunks to how to relieve oneself in a tidy fashion.

In recent years, companies like Blue Origin, Virgin Galactic, Space Adventures, Golden Spike, and SpaceX have all expressed interest in making space accessible to tourists. The proposed ventures range from taking passengers on suborbital spaceflights – a la Virgin Galactic's SpaceShipTwo – to trips into orbit (or the Moon) aboard a space capsule – a la Blue Origins' New Shepard launch system.

Virgin Galactic's SpaceShipTwo's performing a glide flight. Credit: Virgin Galactic

And while these trips will not be cheap – Virgin Galactic estimates that a single seat aboard SpaceShipTwo will cost $250,000 – they absolutely have to be safe! Luckily, space agencies like NASA already have a very well-established and time-honored practice for training astronauts for zero-g. Perhaps the most famous involves flying them around in a Zero-Gravity Aircraft, colloquially known as the "Vomit Comet".

This training program is really quite straightforward. After bringing astronaut trainees to an altitude of over 10,000 meters (32,000 feet), the plane begins flying in a parabolic arc. This consists of it climbing and falling, over and over, which causes the trainees to experience the feeling of weightlessness whenever the plane is falling. The name "vomit comet" (obviously) arises from the fact that passengers tend to lose their lunch in the process.

The Soviet-era space program also conducted weightlessness training, which Roscomos has continued since the collapse of the Soviet Union. Since 1984, the European Space Agency (ESA) has also conducts parabolic flights using a specially-modified Airbus A300 B2 aircraft. The Canadian Space Agency (CSA) has done the same since it was founded in 1989, relying on the Falcon 20 twin-engine jet.

Given the fact that NASA has been sending astronauts into space for nearly 60 years, they have certainly accrued a lot of experience in dealing with the effects of weightlessness. Over the short-term, these include space adaptation syndrome (SAS), which is also known as "space sickness". True to its name, the symptoms of SAS include nausea and vomiting, vertigo, headaches, lethargy, and an overall feeling of unease.

Hawking has experienced zero gravity before, when he flew on Zero Gravity Corp's modified Boeing 727 in 2007. Credit: Jim Campbell/Aero-News Network

Roughly 45% of all people who have flown in space have suffered from space sickness. The duration of varies, but cases have never been shown to exceed 72 hours, after which the body adapts to the new environment. And with the benefit of training, which includes acclimating to what weightlessness feels like, both the onset and duration can be mitigated.

Beyond NASA and other space agencies, private companies have also offered reduced gravity training to private customers. In 2004, the Zero Gravity Corporation (Zero-G, based in Arlington, Virginia) became the first company in the US to offer parabolic flights using a converted Boeing 727. In 2008, the company was acquired by Space Adventures, another Virginia-based space tourism company.

Much like Virgin Galactic, Space Adventures began offering clients advance bookings for sub-orbital flights, and has since expanded their vision to include lunar spaceflights. As such, the Zero-G experience has become their training platform, allowing clients the ability to experience weightlessness before going into space. In addition, some of the 700 clients who have already booked tickets with Virgin Galactic have used this same training method to prepare.

Similarly, Virgin Galactic is taking steps to prepare its astronauts for the day when they begin making regular flights into sub-orbit. According to the company, this will consist of astronauts taking part in a three day pre-flight preparation program that will be conducted onsite at Spaceport America – Virgin Galactic's spaceflight facility, located in New Mexico.

Aside from microgravity, their astronaut training will also emphasize how to function when experiencing macrogravity (i.e. multi-g forces), which occur during periods of acceleration. The training will also include medical check-ups, psychological evaluations, and other forms of pre-flight prepation – much in the same way that regular astronauts are prepared for their journey. As they state on their website:

"Pre-flight preparation will ensure that each astronaut is mentally and physically prepared to savor every second of the spaceflight. Basic emergency response training prescribed by our regulators will be at the forefront. Activities to aid familiarity with the spaceflight environment will follow a close second."

Blue Origin, meanwhile, has also been addressing concerns with regards to its plan to start sending tourists into suborbit in their *New Shepard* system. After launching from their pad outside of El Paso, Texas, the rocket will fly customers to an altitude of 100 km (62 mi) above the Earth. During this phase, the passengers will experience 3 Gs of acceleration – i.e. three times what they are used to.

Once it reaches space, the capsule will then detach from the rocket. During this time, the passengers will experience a few minutes of weightlessness. Between the intense acceleration and the feeling of freefall, many have wondered if potential clients should be worried about space sickness. These questions have been addressed by former NASA astronaut Nicholas Patrick, who now serves as Blue Origin's human integration architect.

During an interview with Geekwire in January of 2017, he indicated that they plan to provide barf bags for customers to tuck into their flight suits, just in case. This is similar to what astronauts do aboard the International Space Station (see video above) and during long-term spaceflights. When asked about what customers could do to prepare for space sickness, he also emphasized that some training would be provided:

"It's a short flight, so we won't be asking people to train for a year, the way NASA astronauts trained for a shuttle flight, or three years, the way they train for a long space station mission. We're going to get this training down to a matter of days, or less. That's because we don't have very many tasks. You need to know how to get out of your seat gracefully, and back into your seat safely.

"We'll teach you a few safety procedures, like how to use the fire extinguisher – and maybe how to use the communication system, although that will come naturally to many people. What we'll probably spend some time on is training people how to enjoy it. What are they going to take with them and use up there? How are they going to play? How are they going to experiment? Not too much training, just enough to have fun."

"Getting sick to your stomach can be a problem on zero-G airplane flights like NASA's "Vomit Comet," but motion sickness typically doesn't come up until you've gone through several rounds of zero-G. Blue Origin's suborbital space ride lasts only 11 minutes, with a single four-minute dose of weightlessness."

Bezos also addressed these questions in early April during the 33rd Space Symposium in Colorado Springs, where his company was showcasing the *New Shepard* crew capsule. Here too, audience members had questions about what passengers should do if they felt the need to vomit (among the other things) in space.

"They don't throw up right away," he said, referring to astronauts succumbing to space sickness. "We're not going to worry about it… It takes about three hours before you start to throw up. It's a delayed effect. And this journey takes ten or eleven minutes. So you're going to be fine."

On April 27th, during a special Q&A session of Twitch Science Week, Universe Today's own Fraser Cain took part in a panel discussion about the future of space exploration. Among the panelists were and Ariane Cornell, the head of Astronaut Strategy and Sales for Blue Origin. When the subject of training and etiquette came up, she described the compact process Blue Origins intends to implement to prepare customers for their flight:

"[T]he day before flight is when we give you a full – intense, but very fun – day of training. So they are going to teach you all the crucial things that you need. So ingress, how do you get into the capsule, how do you buckle in. Egress, how do you get out of the seat, out of the hatch. We're going to teach you some emergency procedures, because we want to make sure that you guys are prepared, and feel comfortable. We're also going to teach you about zero-g etiquette, so then when we're all up there and we're doing our somersaults, you know… no Matrix scenes, no Kung Fu fighting – you gotta make sure that everybody gets to enjoy the flight."

When asked (by Fraser) if people should skip breakfast, she replied:

"No. It's the most important meal of the day. You're going to want to have your energy and we're pretty confident that

you're going to have a good ride and you're not going to feel nauseous. It's one parabola. And when we've seen people, for example, when they go on rides on NASA's "Vomit Comet"… What we've seen from those types of parabolic flights is that people – if they get sick – its parabola six, seven, eight. It's a delayed effect, really. We think that with that one parabola – four minutes – you're going to enjoy every second of it."

Another interesting issue was addressed during the 33rd Space Symposium was whether or not the New Shepard capsule would have "facilities". When asked about this, Bezos was similarly optimistic. "Go to the bathroom in advance," he said, to general laughter. "If you have to pee in 11 minutes, you got problems." He did admit that with boarding, the entire experience could take up to 41 minutes, but that passengers should be able to wait *that* long (fingers crossed!)

But in the event of longer flights, bathroom etiquette will need to be an issue. After all, its not exactly easy to relieve oneself in an environment where all things – solid and liquid – float freely and therefore cannot simply be flushed away. Luckily, NASA and other space agencies have us covered there too. Aboard the ISS, where astronauts have to relieve themselves regularly, waste-disposal is handled by "zero-g toilets".

Similar to what astronauts used aboard the Space Shuttle, a zero-g toilet involves an astronaut fastening themselves to the toilet seat. Rather than using water, the removal of waste is accomplished with a vacuum suction hole. Liquid waste is transferred to the Water Recovery System, where it is converted back into drinking water (that's right, astronauts drink their own pee… sort of).

Solid waste is collected in individual bags that are stored in an aluminum container, which are then transferred to the docked spacecraft for disposal. Remember that scene in *The Martian* where Mark Watney collected his crew members solid waste to use as fertilizer? Well, its much the same. Poo in a bag, and then let someone remove it and deal with it once you get home.

When it comes to lunar tourism, space sickness and waste disposal will be a must. And when it comes to Elon Musk's plan to start ferrying people to Mars in the coming decades – aboard his Interplanetary Transportation System – it will be an absolute must! It will certainly be interesting to see how those who intend to get into the lunar tourism biz, and those who want to colonize Mars, will go about addressing these needs.

In the meantime, keep your eyes on the horizon, keep your barf bags handy, and make sure your zero-g toilet has a tight seal!

Is Another Universe Sitting Too Close To Us On The Multiverse Bus?

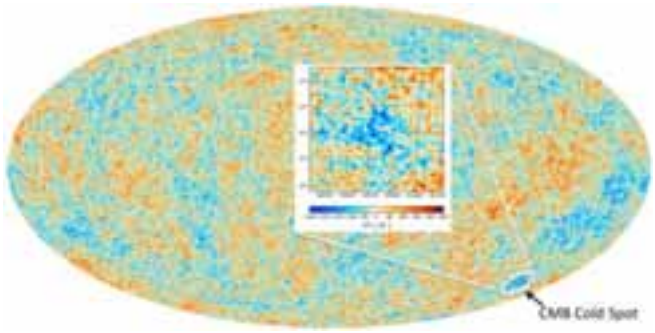
Article Updated: 28 Apr , 2017

by Matt Williams

Since the 1960s, astronomers have been aware of the electromagnetic background radiation that pervades the Universe. Known as the Cosmic Microwave Background, this radiation is the oldest light in the Universe and what is left over from the Big Bang. By 2004, astronomers also became aware that a large region within the CMB appeared to be colder than its surroundings.

Known as the "CMB Cold Spot", scientists have puzzled over this anomaly for years, with explanations ranging from a data artifact to it being caused by a supervoid. According to a new study conducted by a team of scientists from Durham University, the presence of a supervoid has been ruled out. This conclusion once again opens the door to more exotic explanations – like the existence of a parallel Universe!

The Cold Spot is one of several anomalies that astronomers have been studying since the first maps of CMB were created using data from the Wilkinson Microwave Anisotropy Probe (WMAP). These anomalies are regions in the CMB that fall beneath the average background temperature of 2.73 degrees above absolute zero (-270.43 °C; -460.17 °F). In the case of the Cold Spot, the area is just 0.00015° colder than its surroundings.



Map of the cosmic microwave background (CMB) sky produced by the Planck satellite. The Cold Spot is shown in the inset, with coordinates and the temperature difference in the scale at the bottom. Credit: ESA/Durham University.

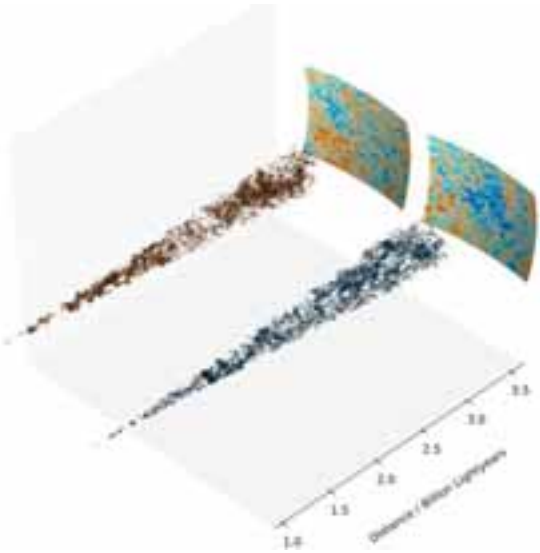
And yet, this temperature difference is enough that the Cold Spot has become something of a thorn in the hip of standard models of cosmology. Previously, the smart money appeared to be on it being caused by a supervoid – and area of space measuring billions of light years across which contained few galaxies. To test this theory, the Durham team conducted a survey of the galaxies in the region.

This technique, which measures the extent to which visible light coming from an object is shifted towards the red end of the spectrum, has been the standard method for determining the distance to other galaxies for over a century. For the sake of their study, the Durham team relied on data from the Anglo-Australian Telescope to conduct a survey where they measured the redshifts of 7,000 nearby galaxies.

Based on this high-fidelity dataset, the researchers found no evidence that the Cold Spot corresponded to a relative lack of galaxies. In other words, there was no indication that the region is a supervoid. The results of their study will be published in the *Monthly Notices of the Royal Astronomical Society* (MNRAS) under the title "Evidence Against a Supervoid Causing the CMB Cold Spot".

As Ruari Mackenzie – a postdoctoral student in the Dept. of Physics at Durham University, a member of the Center for Extragalactic Astronomy, and the lead author on the paper – explained in an RAS press release:

"The voids we have detected cannot explain the Cold Spot under standard cosmology. There is the possibility that some non-standard model could be proposed to link the two in the future but our data place powerful constraints on any attempt to do that."



The 3-D galaxy distribution in the foreground of the CMB Cold Spot, where each point is a galaxy. Credit: Durham University.

Specifically, the Durham team found that the Cold Spot region could be split into smaller voids, each of which were surrounded by clusters of galaxies. This distribution was consistent with a control field the survey chose for the study, both of which exhibited the same "soap bubble" structure. The question therefore arises: if the Cold Spot is not the result of a void or a relative lack of galaxies, what is causing it?

This is where the more exotic explanations come in, which emphasize that the Cold Spot may be due to something that exists outside the standard model of cosmology. As Tom Shanks, a Professor with the Dept.of Physics at Durham and a co-author of the study, explained:

"Perhaps the most exciting of these is that the Cold Spot was caused by a collision between our universe and another bubble Universe. If further, more detailed, analysis of CMB data proves this to be the case then the Cold Spot might be taken as the first evidence for the multiverse – and billions of other Universes may exist like our own."

Multiverse Theory, which was first proposed by philosopher and psychologist William James, states that there may be multiple or an even infinite number of Universes that exist parallel to our own. Between these Universes exists the entirety of existence and all cosmological phenomena – i.e. space, time, matter, energy, and all of the physical laws that bind them.

Whereas it is often treated as a philosophical concept, the theory arose in part from the study of cosmological forces, like black holes and problems arising from the Big Bang Theory. In addition, variations on multiverse theory have been suggested as potential resolutions to theories that go beyond the Standard Model of particle physics – such as String Theory and M-theory.

Another variation – the Many-Worlds interpretation – has also been offered as a possible resolution for the wavefunction of subatomic particles. Essentially, it states that all possible outcomes in quantum mechanics exist in alternate universes, and there really is no such thing as "wavefunction collapse'. Could it therefore be argued that an alternate or parallel Universe is too close to our own, and thus responsible for the anomalies we see in the CMB?

As explanations go, it certainly is exciting, if perhaps a bit fantastic? And the Durham team is not prepared to rule out that the Cold Spot could be the result fluctuations that can be explained by the standard model of cosmology. Right now, the only thing that can be said definitively is that the Cold Spot cannot be explained by something as straightforward as a supervoid and the absence of galaxies.

And in the meantime, additional surveys and experiments need to be conducted. Otherwise, this mystery may become a real sticking point for cosmology!

Did A Comet Impact Push Humans Into Technological Overdrive?

Article Updated: 29 Apr , 2017

by Matt Williams

About 14,500 years ago, Earth began transitioning from its cold, glacial self to a warmer interglacial state. However, partway through this period, temperatures suddenly returned to near-glacial conditions. This abrupt change (known as the Younger Dryas period) is believed by some to be the reason why hunter-gatherers started forming sedentary communities, farming, and laying the groundwork for civilization as we know it – aka. the Neolithic Revolution.

For over a decade, there have been scientists who have argued that this period was the result of a comet hitting Earth. Known as the Younger Dryas Impact Hypothesis (aka. the Clovis Comet Hypothesis), the theory is largely based on ice core samples from Greenland that show a sudden global temperature change. But according to a new study by a research team from the University of Edinburgh, archaeological evidence may also prove this hypothesis correct.

The Younger Dryas period takes its name from a species of flower known as *Dryas octopetala.* This plant is known to grow in cold conditions, and became common in Europe during the period. Because of the way it began abruptly – roughly 12,500 years ago – and then ended just as abruptly 1200 years later, many scientists are convinced it was caused by an external event.

Göbekli Tepe, structures A-D of the site, located in southern Turkey. Credit: Wikipedia Commons/Teomancimit

For the sake of their study – which was recently published in the journal *Mediterranean Archaeology and Archaeometry* under the title "Decoding Göbekli Tepe With Archaeoastronomy: What Does the Fox Say?"- the team found an astronomical link to the stone pillars at Göbekli Tepe. Located in southern Turkey, this archaeological find is the oldest known temple site in the world (dated to ca. 10,950 BCE).

This site, it should be noted, is contemporary with the Greenland ice core samples, which are dated to around 10,890 BCE. Of the sites many features, none are more famous than the many standing pillars that dot the excavated grounds. This is because of the extensive pictograms and animal reliefs that decorate these pillars, which include various representations of mammal and avian species- particularly vultures.

Pillar 43, which is also known as the "vulture stone", was of particular interest to archeologists, as it is suspected that its representations (associated with death) could have been intended to commemorate a devastating event. The other images, they ventured, were meant to depict the constellations, and that their placement relative to each other accorded to the positions of the then-known asterisms in the night sky.

This theory was based on images they took of the site, which they then examined using the planetarium program stellarium

0.15. In the end, they found that the images bore a resemblance to constellations that would have been visible in 10,950 BCE. As such, they concluded that the temple site may have been an observatory, and that the images were a catalog of celestial events – which include the Taurid meteor stream.

Wall pillars with three animal symbols in series. Part a) is pillar 2 from Enclosure A, while part b) is pillar 38, Enclosure D. Credit: Travel The Unknown

As they state in their study:

"We begin by noting the carving of a scorpion on pillar 43, a well -known zodiacal symbol for Scorpius. Based on this observation, we investigate to what extent other symbols on pillar 43 can be interpreted as zodiacal symbols or other familiar astronomical symbols… We suggest the vulture/eagle on pillar 43 can be interpreted as the 'teapot' asterism of our present-day notion of Sagittarius; the angle between the eagle/vulture's head and wings, in particular, agrees well with the 'handle','lid' and 'spout' of the teapot asterism. We also suggest the 'bent-bird' with downward wriggling snake or fish can be interpreted as the '13th sign of the zodiac', i.e. of our present-day notion of Ophiuchus. Although its relative position is not very accurate, we suggest the artist(s) of pillar 43 were constrained by the shape of the pillar. These symbols are a reasonably good match with their corresponding asterisms, and they all appear to be in approximately the correct relative locations.

Similarly, they suggest that a carved circle at the center of pillar 43 could be interpreted as the Sun. They call this image the "date stamp" because it can be seen as communicating a specific date by indicating which part of the zodiac the Sun was in at the time of carving. By comparing the age of the site (based on carbon dating) to the apparent position of the Sun, they found that it was consistent with the Summer solstice of 10,950 BCE.

Of course, the team fully acknowledges that an astronomical interpretation is by no means the only possibility. In addition to the possibility of them being mythological references, they could also be representations of hunting or migration patterns. It's also entirely possible they were not meant to convey any specific meaning, and were merely a description of the local environment, which would have been rich in flora and fauna at the time.

Pillar 43, Enclosure D, also known as the Vulture Stone of Göbekli Tepe. Credit: Martin B. Sweatman and Dimitrios Tsikritsis

In addition, the way vultures are commonly featured could be an indication that the site was a burial ground. This is consistent with iconography found at the archaeological sites of Çatalhöyük (in central, southern Turkey) and Jericho (in the West Bank). During the time period in question, Neolithic peoples were known to conduct sky burials, where the bodies of the deceased were left out in the open for carrion birds to pick over.

In such practices, the head was sometimes removed from the deceased and kept (for the sake of ancestor worship). This is consistent with one of the characters on Pillar 43, which appears to be a headless human. However, as the team go on to explain, they are confident that the connection between the site's images and the Taurid meteor stream is a plausible one.

"[O]ur basic statistical analysis indicates our astronomical interpretation is very likely to be correct," they write. "We are therefore content to limit ourselves to this hypothesis, and logically we are not required to pursue others." And of course, they acknowledge that further research will be necessary before any conclusions can be made.

Despite the availability of other (and perhaps more plausible) explanations, one has to admit that the astronomical theory is appealing. Civilization as we know it being a response to a meteor impact, and ancient people cataloging it in their stone carvings. It's got a real *Deep Impact* meets *2001: A Space Odyssey* feel to it!

Juno Sees Overlapping Colliding Clouds on Jupiter

Published: 11 Apr , 2017

by Matt Williams

The Juno mission has made some remarkable finds since it reached Jupiter in July of 2016. During the many orbits it has made around Jupiter's poles – which occur every 53 days – some stunning imagery has resulted. Not only have these pictures revealed things about Jupiter's atmosphere, they have also been an opportunity for the public to participate in the exploration of this giant planet.

The latest feature that was publicly selected to be photographed is known as "STB Spectre". This feature was photographed on March 27th, 2017, at 2:06 a.m. PDT (5:06 a.m. EDT), when Juno was 12,700 km from the planet. During this pass, the JunoCam captured a series of light and dark clouds coming together in Jupiter's South Tropical Region (STR).

The left side of the photograph corresponds to the South Temperate Belt (STB), a prominent belt in Jupiter's Southern Hemisphere which is typically darker. It is here that "the Spectre" – the wide bluish streaks on the upper right side of the photograph – can be seen, and which represent a long-lived storm that was taking place when the area was photographed.

Unprocessed JunoCam image showing the points of interest (POIs) known as "STB Spectre" and "The White Solid". Credit: NASA/SwRI/MSSS

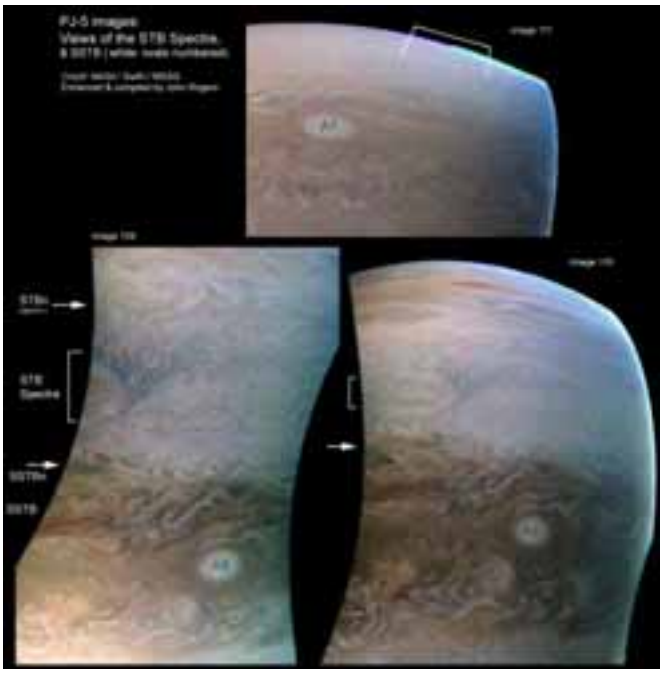
On the right side of the image, we see the neighboring Southern Tropical Zone (STropZ), one of the most prominent zones on the planet. Here, we see another atmospheric condition colliding with the Spectre, one which is characterized by a series of anticyclonic storms (the small white ovals). Not surprisingly, it is within these two bands that part of the large anticyclonic storms known as the "Great Red Spot" and "Red Spot Junior" also exist.

Like all images snapped by the JunoCam since the probe began orbiting Jupiter, this image was made available to the public. In this case, the image was processed by Roman Tkachenko, an amateur astronomer, image processor, and 3D artist who's body of work includes images and visualizations for the New Horizons mission. The description was produced by John Rogers, the citizen scientist who identified the point of interest.

As Tkachenko Universe Today via email, working with these missions pictures is all about bringing raw images to life:

"This image is based on a raw image. Working with raw data you can get a higher resolution than we can see in already constructed, and map-projected official versions. I worked with colors, sharpness and dynamic range to show more details and variety."

This is something new for a space mission, where the public has a direct say in what features will be photographed for study, and can help process them as well. "The participation of amateur astronomers and citizen scientists in this mission is an opportunity to be involved in something gorgeous," said Tkachenko. "They can also show their skills to the public and help the Juno team look at all these data from different angles.



JunoCam closeups of the STB Spectre, with adjacent image showing the SSTB ('string of pearls'). Credit: NASA/SwRI/MSSS

The STB Spectre was one of five Points of Interest (POIs) that were selected by the public to be photographed during Perijove 5 – Juno's fifth orbit of the planet, which began on March 27th, 2017. Before the next maneuver (Perijove 6) commences on May 19th, 2017, the public will once again be able to vote on what features they want to see photographed.

Things that have been captured during previous orbits include the stunning image of the "Jovian pearl", a detailed view of Jupiter's northern clouds, breathtaking images of the swirling clouds round Jupiter's northern and southern poles. Many more are sure to follow between now and July 2018, as Juno conducts its seven remaining perijove maneuvers before being de-orbited and burning up in Jupiter's atmosphere.

Cassini's Final Mission to Annihilation Starts April 22

Article Updated: 5 Apr , 2017

by Nancy Atkinson

Grab the tissues. This video nearly had the Cassini team all choked up during today's press briefing, and virtual sobs and sniffs were abundant on social media posts sharing the video.

"We get goosebumps and get emotional every time we see it," said Earl Maize, Cassini project manager at JPL.

On April 22 the Cassini spacecraft will begin its 'Grand Finale' — the beginning of the end of this tremendous mission that has provided breathtaking images and so many new discoveries of Saturn, its rings and moons. The mission will end on September 15, 2017, when it makes a dramatic plunge into the gas giant.

Here's the video that had everyone teary-eyed. Be prepared for some stunning visuals:

Today, Maize talked about how nineteen countries and three space agencies contributed to the success of the Cassini/

Huygens mission, saying the mission has been truly an international triumph and a phenomenal achievement.

“Cassini’s legacy is assured. We are in the books!” Maize said. “But the best is yet to come. We are going to dive into the gap between the rings of Saturn and Saturn’s atmosphere, a place where no spacecraft has ever gone. We’ll be going 70,000 mph (112,634 km/hr) into a 1,500-mile-wide (2,400-kilometer) gap, operating the spacecraft from a billion miles away.”

Cassini has been a relatively trouble free mission, and has made many discoveries about the Saturn system. So why crash the spacecraft?

Cassini is running out of fuel, basically running on fumes at this point.* And NASA needs to follow the protocol of planetary protection, and not allow a spacecraft with possible microbes from Earth to crash into a potentially habitable moon such as Enceladus or Titan.

“Cassini’s own discoveries were its demise,” Maize said. “Enceladus has a warm, salt water ocean. We can’t risk an inadvertent contact with this pristine body. The only choice was to destroy it (Cassini) in a designed fashion.”

Maize said that back in 2010, the team decided they would make the mission last as long as possible and use every last kilogram of propellant to explore the Saturn system as thoroughly as they could.

Cassini vs. Saturn. As depicted in this illustration, Cassini will plunge into Saturn’s atmosphere on Sept. 15, 2017. Using its attitude control thrusters, the spacecraft will work to keep its antenna pointed at Earth while it sends its final data, including the composition of Saturn’s upper atmosphere. Credit: NASA/JPL-Caltech

The final flyby of Titan on April 22 will ultimately alter Cassini’s trajectory and push it toward the spacecraft’s final demise. Maize described the gravity slingshot from Titan as a “last kiss goodbye that will push Cassini into Saturn. This is a roller coaster ride that we’re not coming out of.”

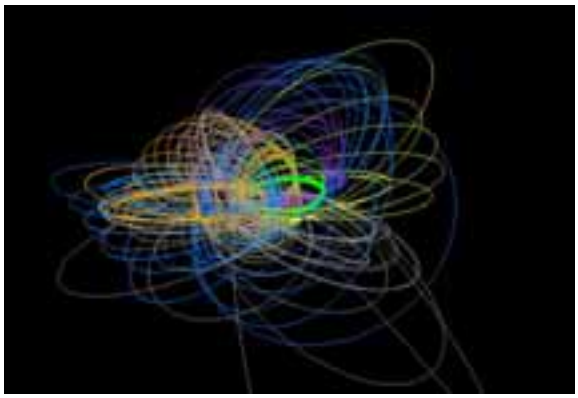
You can plot Cassini’s trajectory in JPL’s “Eyes on Cassini” special section of their Eyes on the Solar System website.

Cassini will make 22 passes through the gap, and in doing so, further our understanding of how giant planets, and planetary systems everywhere, form and evolve.

Project Scientist Linda Spilker said Cassini will be able to make close up measurements of Saturn and its rings to finally help us understand the mass and internal structure of Saturn. And the images should be absolutely stunning.

There’s the risk of dust or debris hitting the spacecraft, potentially crippling Cassini. But the risk is worth it, because if the spacecraft survives through even just a few of the close passes, the scientific payback will be incredible. However, even if the spacecraft is crippled and can’t send back its final science observations, the end is inevitable, as the path toward destruction will be written by the final ‘kiss’ from Titan.

“This is something we couldn’t try at any other time,” Maize said. “But now is time.”



A computer-generated representation of all Cassini’s Saturn orbits -affectionately called the “ball of yarn” by mission planners. The time frame spans Saturn Orbit Insertion on July 1, 2004 to the end of mission on Sept. 15, 2017. Credit: NASA/JPL-Caltech.

The Cassini team said the end of the mission will likely be a combination of excitement, pride and a sense of loss.

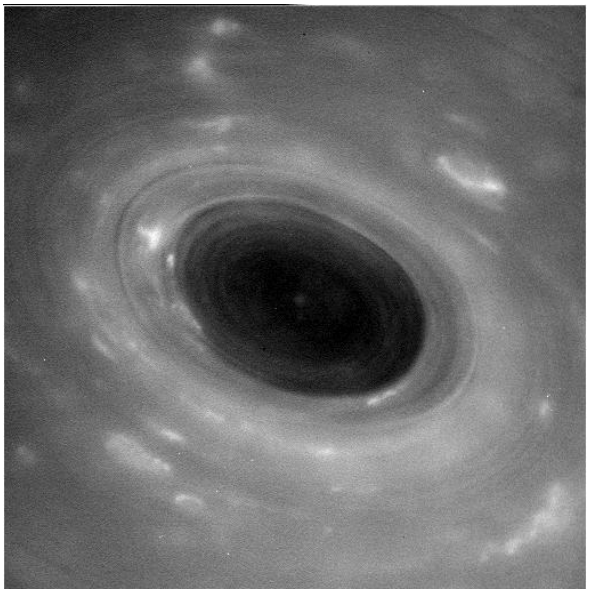
“I think that once the signal is lost, it would mean the heartbeat of Cassini is gone,” said Spilker. “I think there will be tremendous cheers and applause for the completion of an absolutely incredible mission. Hugs, tears — the Kleenex box will be passed around — but we will rejoice at being part of such a wonderful mission.”

See more images and information about the Grand Finale here.

For more of an inside look at Cassini, I devote a chapter of my book to the mission, with more insight from Earl Maize, Linda Spilker and others about the history and discoveries of the Cassini/Huygens mission, and additional details about the Grand Finale. “Incredible Stories From Space: A Behind-the-Scenes Look at the Missions Channging Our View of the Cosmos.”

Artist’s concept of Cassini orbiter crossing Saturn’s ring plane.
Credit: NASA/Jet Propulsion Laboratory.

*One of the Cassini team members said that as of today (April 4, 2017) Cassini has 36kg of hydrazine left for the thrusters, which are used everyday to orient the spacecraft, point the antenna towards Earth, point the instruments to their desired targer, etc. For the Titan flyby on April 22, about 10-15 kg. As for the bipropellant that runs the main engines, that's a little more unknown and the one the team is worried most about running out of fuel. The team member said there is about 10 kg of that fuel left, "plus or minus 20 kilos [meaning there is true uncertainty about how much of this fuel remains]. We could run out today, or we could have 30 kilos left."



This unprocessed image shows features in Saturn's atmosphere from closer than ever before. The view of Saturn's pool hurricane was captured by NASA's Cassini spacecraft during its first "Grand Finale" dive past the planet on April 26, 2017. Credit: NASA/JPL-Caltech/Space Science Institute

Ground controllers at NASA's Jet Propulsion Laboratory confirmed Thursday the Cassini spacecraft survived its first trip between Saturn and its rings, the closest any probe has ever come to the planet.

Cassini was out of contact with Earth as the spacecraft passed inside Saturn's rings at 0900 GMT (5 a.m. EDT) Wednesday, using its high-gain dish antenna as a shield against icy particles engineers feared could lurk in its path.

The spacecraft radioed home around 0700 GMT (3 a.m. EDT) Thursday, around 22 hours after zipping between Saturn's D ring and the planet's cloud tops at a relative speed of about 77,000 mph (124,000 kilometres per hour), fast enough to travel from New York to Los Angeles in less than two minutes.

"In the grandest tradition of exploration, NASA's Cassini spacecraft has once again blazed a trail, showing us new wonders and demonstrating where our curiosity can take us if we dare," said Jim Green, director of NASA's planetary science division.

A 230-foot (70-metre) antenna at NASA's Deep Space Network facility in Goldstone, California, received the first signal from Cassini early Thursday.

Engineers were confident the spacecraft would make the trek through the ring gap unscathed. The trajectory took Cassini around 200 miles (300 kilometres) from the visible edge of Saturn's innermost D ring, and pictures showed no sign of any icy ring particles in the craft's path.

Models suggested that if any particles were present where Cassini flew, they would be similar in size to microscopic smoke particles, according to NASA.

But managers took no chances with Wednesday's flyby, pivoting the spacecraft to point its 13-foot (4-metre) radio antenna in its direction of travel to take the brunt of any debris impacts, which could have damaged or destroyed the probe.

This illustration shows NASA's Cassini spacecraft about to make one of its dives between Saturn and its innermost rings as part of the mission's Grand Finale. Credit: NASA/JPL-Caltech

"No spacecraft has ever been this close to Saturn before. We could only rely on predictions, based on our experience with Saturn's other rings, of what we thought this gap between the rings and Saturn would be like," Earl Maize, Cassini project manager at NASA's Jet Propulsion Laboratory in California. "I am delighted to report that Cassini shot through the gap just as we planned and has come out the other side in excellent shape."

Cassini's closest approach to Saturn came at a distance of about 1,900 miles (3,000 kilometres) from the planet's cloud tops.

The long-lived space probe is in the final months of a 20-year mission, heading for a Sept. 15 crushing plunge into Saturn's atmosphere as it runs on low on fuel. Cassini will make similar flights between Saturn and its rings once per week until the destructive dive in September, with the next ring passage set for May 2.

"The gap between Saturn and its rings is no longer unexplored space – and we're going back 21 times," NASA tweeted from the Cassini mission's official Twitter account.

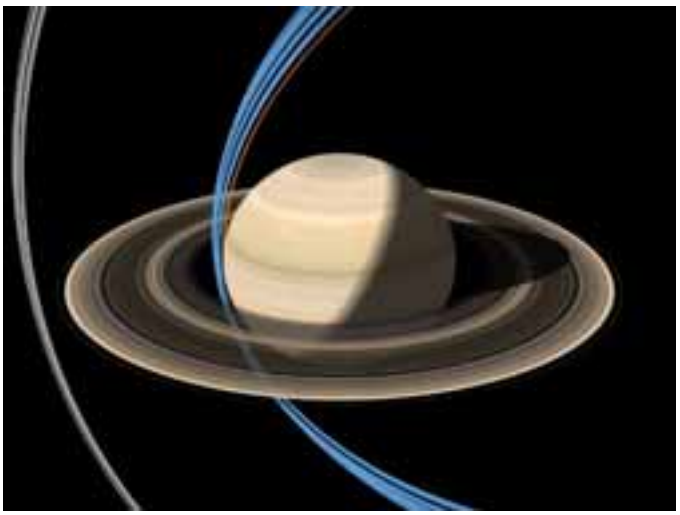
One of Cassini's instruments, the radio and plasma wave subsystem, was programmed to collect data on the size and density of ring particles encountered by the spacecraft during Wednesday's approach.

Other scientific objectives planned around Wednesday's flyby included creating a high-resolution near-infrared movie of Saturn's north pole, giving scientists their best view of the motion of a mysterious six-sided cloud pattern first observed by NASA's Voyager probes in the early 1980s.

Cassini's cameras were to capture a series of images of features in Saturn's atmosphere, scientists said, returning views 10 times sharper than previously available.

Raw imagery from the Cassini cameras were downlinked to Earth early Thursday, showing parts of Saturn's hexagonal hurricane at the north pole, and other atmospheric features.

During Cassini's next trip near Saturn on May 2, the spacecraft's science instruments will look at ringlets embedded within the main rings while the sun is hidden behind the planet, a viewing geometry that makes faint ring features more visible. Cassini will also conduct long-range observations of Saturn's moon Rhea and calibrate the craft's magnetometer for future magnetic field investigations.



The blue arcs represent Cassini's orbits through Saturn's ring gap. Credit: NASA/JPL-Caltech

Cassini will again use its antenna as a shield on four future passes near Saturn from late May through early July when the spacecraft will come closest to the D ring, the innermost of the planet's main rings. The exact placement of Cassini's journey through the ring gap changes with each orbit.

Launched from Cape Canaveral on top of a Titan 4 rocket Oct. 15, 1997, the Cassini spacecraft arrived in orbit around Saturn on July 1, 2004, to begin a planned four-year tour of the planet's moons.

NASA extended the nearly $3.3 billion Cassini mission multiple times, and officials in 2010 announced plans for the spacecraft to jump inside Saturn's rings this year before heading into the atmosphere in September.

Cassini got a gravitational nudge from Saturn's largest moon Titan on Saturday, reshaping the craft's trajectory to begin flying inside the rings. Saturday's flyby with Titan was the mission's last opportunity to see the moon close-up.

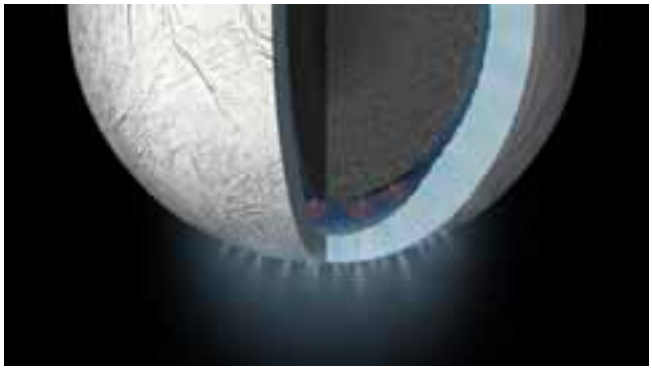
Scientists will use Cassini's final 22 orbits to measure the mass of Saturn's rings for the first time, inspect the planet's atmosphere, and derive Saturn's interior structure by studying its gravity field.

"One of the things we can do with the rings is, in the grand finale orbits, for the first time address the question of the origin and the age of the rings," said Linda Spilker, Cassini project scientist at JPL. "We'll do this by measuring the mass of the rings very accurately.

"If the rings are a lot more massive than we expect, perhaps they're old, as old as Saturn itself, and they've been massive enough to survive the micrometeoroid bombardment and erosion and leave us with the rings we see today," she said. "Now, on the other hand, if the rings are less massive, perhaps they're very young, maybe forming as little as 100 million years ago. Maybe a comet or a moon got too close, got torn apart by Saturn's gravity and we have the rings that we see today."

New discoveries raise prospects for life on moons of Jupiter and Saturn

13 April 2017 Stephen Clark



This diagram of Saturn's moon Enceladus shows its interior structure, with an icy shell and a subsurface ocean of liquid water over a rocky core. Credit: NASA/JPL-Caltech

Scientists announced Thursday that measurements from NASA's Cassini spacecraft detected hydrogen gas, a key energy source for microbial life, in a plume gushing from a vast liquid water ocean buried beneath the icy shell of Saturn's moon Enceladus.

The hydrogen is coming from hydrothermal vents at the bottom of Enceladus's subsurface ocean, scientists said, similar to geologic features found deep underwater on Earth.

"This is a very significant finding because the hydrogen could be a potential source of chemical energy for any microbes that might in be in Enceladus's ocean," said Linda Spilker, project scientist on the Cassini mission at NASA's Jet Propulsion Laboratory in Pasadena, California.

Cassini measured the hydrogen during a high-speed pass through jets of ice and dust spewing from Enceladus's south pole in October 2015, the deepest dive through the plumes since the spacecraft found them them in 2005.

The fountains erupt through fractures, dubbed tiger stripes, visible in the moon's icy crust.

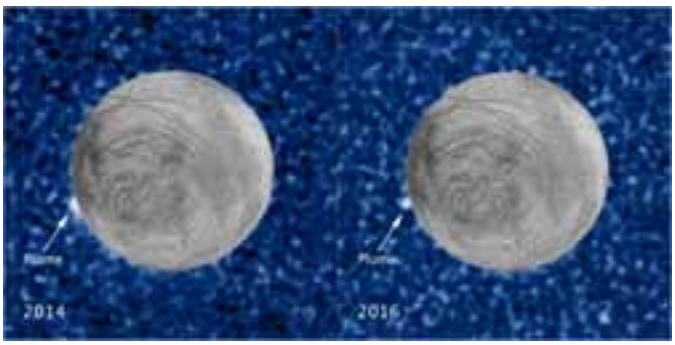
While Cassini does not have the instrumentation to directly confirm the presence of microbes in the ocean of Enceladus, the latest data from the space probe reinforces the notion that the icy moon of Saturn — one-seventh the size of Earth's moon — is one of the best places to look for extraterrestrial life in the solar system.

Researchers also presented new evidence that Jupiter's moon Europa — more than six times bigger than Enceladus — could have periodic eruptions similar to ones coming from Saturn's moon.

William Sparks, an astronomer who analyzed imagery from the Hubble Space Telescope, said his research team has linked the location of a likely plume found by Hubble with thermal maps from NASA's Galileo spacecraft, which orbited Jupiter and made repeated flybys of Europa in the late 1990s and early 2000s.

It turns out the plume near Europa's equator is at the same location of a hotspot identified by Galileo, said Sparks, who works at the Space Telescope Science Institute in Baltimore, Maryland.

The latest Hubble imagery builds on previous observations in 2012 and 2014 that suggested Europa might have intermittent plumes streaming as high as 60 miles — 100 kilometers — above its surface.



These composite images show a suspected plume of material erupting two years apart from the same location on Jupiter's icy moon Europa. Both plumes, photographed in UV light by Hubble, were seen in silhouette as the moon passed in front of Jupiter. Credit: NASA/ESA/STScI/USGS

"In 2014, we used the Hubble (telescope) and detected evidence of what are probably water vapor plumes emerging form the surface of Europa," Sparks said. "That's important because it could be giving us access to subsurface liquid water without having to drill through miles of ice.

"In 2016, the new observations that we're just publishing, we saw a similar candidate almost identical in appearance, and at the identical location, to one of the 2014 candidates," Sparks said. "It's very important in an intermittent phenomenon to establish repeatabilty. It gives us a lot more faith in the observation."

"The plumes of Enceladus are associated with a heat source, and its very distinctive signature, so we looked to see if we could find thermal imaging of the surface of Europa, and we did," Sparks said. "The peak hottest point on the Europa night side is right where our plume candidate is."

The strong tug of gravity from Jupiter and Saturn is responsible for the churning and heating inside Europa and Enceladus that maintain their liquid water oceans.

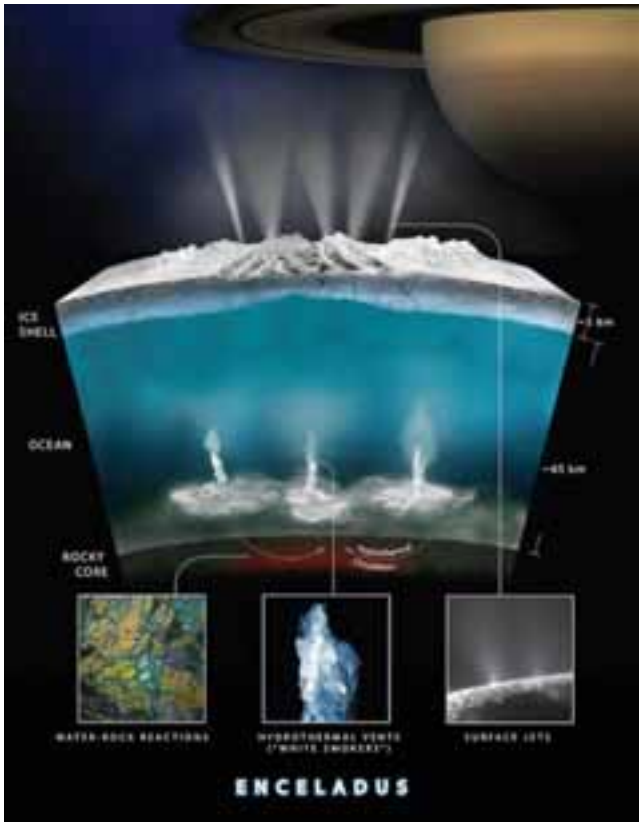
With the discovery from Cassini announced Wednesday, scientists know Enceladus has the water and chemicals needed to support life, according to Mary Voytek, a senior scientist in astrobiology at NASA Headquarters in Washington.

"Certainly, this finding suggests that there is a significant amount of hydrothermal activity to produce such a strong signal of hydrogen, and this hydrogen is a good source of chemical energy to support life," Voytek said.

Cassini's ion and neutral mass spectrometer identified molecular hydrogen as Cassini zipped through the plumes at around 19,000 mph (8.5 kilometers per second). Researchers were eager to make the hydrogen detection, knowing such a finding would bolster the chances that life may lurk hidden beneath Enceladus's icy shell.

"This sampling is extremely important for detecting trace species, and we were able to, from the previous flybys and previous measurements, find out that the plume is 98 percent water," said Hunter Waite, head of the ion and neutral mass spectrometer team at the Southwest Research Institute in San Antonio. "It has traces of ammonia, carbon dioxide, and methane, as well as some organics. The part that had been elusive to us before was the hydrogen."

Waite is lead author of a paper in the journal Science outlining the hydrogen discovery.



This graphic illustrates how Cassini scientists think water interacts with rock at the bottom of the ocean of Saturn's icy moon Enceladus, producing hydrogen gas.
Credit: NASA/JPL-Caltech

The hydrogen is made in a chemical reaction between warm water, carbon dioxide and rock at Enceladus's seafloor, a geochemical process called serpentinization found in hydrothermal vents at the bottoms of Earth's oceans.

Like the vents in terrestrial oceans, hydrothermal environments on Enceladus — a billion miles farther from the sun than Earth — are starved of sunlight, and any life forms that took hold there would have evolved to seek an alternative source of energy, like hydrogen.

"These vents on the Earth support teeming communities of organisms anchored by microbes that feed on chemical energy rather than sunlight," said Chris Glein, a research scientist working on the Cassini mission at the Southwest Research Institute. "An important reaction at the base of the food chain is called methanogenesis. This is where microbes combine hydrogen with carbon dioxide to make methane, and they get a jolt of energy out of the process."

Scientists calculated the energy available to potential alien microbes living in Enceladus as roughly equivalent to 300 pizzas per hour, according to Glein.

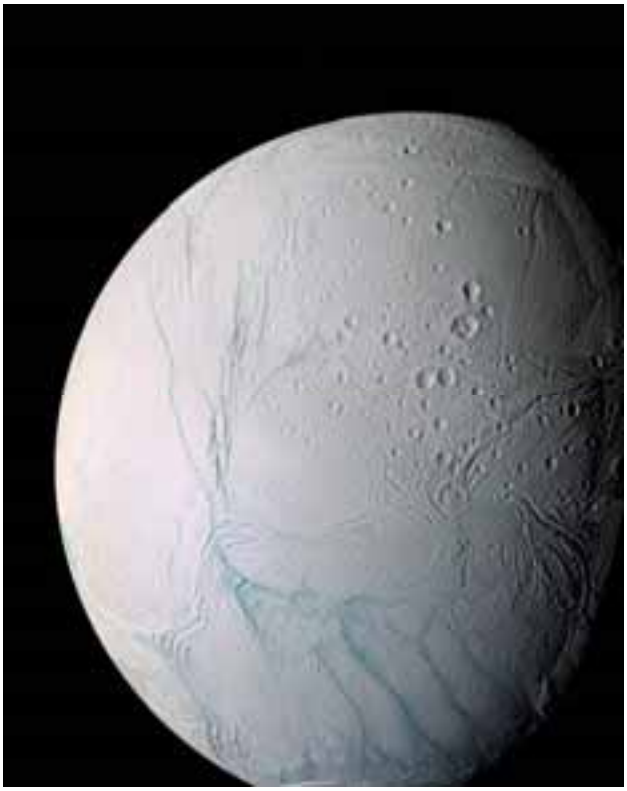
"We have made the first calorie count in an alien ocean," Glein said. "This is a key step towards understanding the habitability of Enceladus."

"If, indeed, there's life in there, it has to be completely different than ours, in the sense that it's generated in a way that's not related to our life," said Jim Green, head of NASA's planetary science division. "We call that a second genesis."

Conceived in the 1980s and built in the 1990s, the Cassini spacecraft was not designed to search for life at Enceladus. The mass spectrometer that made the hydrogen detection at Enceladus was originally intended to sample the atmosphere of Titan, Saturn's largest moon, but managers repurposed the instrument to examine the icy moon's polar plumes after

Cassini discovered the geysers streaming into space in 2005, soon after the probe arrived in orbit around the ringed planet.

“This finding is the result of 12 years of Cassini investigations, and it really represents a capstone finding of the mission because we now know that Enceladus has almost all of the ingredients that you would need to support life as we know it on Earth,” Spilker said.



The enhanced color view of Enceladus comes from NASA’s Cassini spacecraft. The moon’s bluish tiger stripes are visible at the bottom of the image. Credit: NASA/JPL/ Space Science Institute

Cassini is in the final year of its mission, heading for a plunge into Saturn’s atmosphere Sept. 15 after a series of passages between the planet’s cloud tops and rings set to begin later this month.

The plutonium-powered spacecraft will not fly by Enceladus again, and a final swing by Titan on April 22 will use the moon’s gravity to reshape Cassini’s orbit to fly inside Saturn’s rings.

Launched in 1997, Cassini is running low on fuel, and officials want to ensure it does not crash into moons like Enceladus that could harbor life. NASA decided in 2010 to steer Cassini into Saturn, destroying the spacecraft to avoid plowing into the habitable moons while capturing unprecedented data on the planet’s rings and atmosphere.

“When Cassini was first built, we never thought we would see an active ocean world like Enceladus at Saturn,” Spilker said. “So Cassini can look for habitability, but we don’t have the instruments to look for life. We’ve come as far as we can go, so it remains for a future mission to detect life at Enceladus.”

NASA has no more missions to Saturn on the books, but scientists are finalizing proposals for new interplanetary robotic probes to be submitted to the space agency by April 28.

The competition is for the next mission in NASA’s New Frontiers program, a set of medium-cost planetary missions that has so far included the New Horizons probe that flew by Pluto in 2015, the Juno spacecraft now orbiting Jupiter and the OSIRIS-REx asteroid sample return mission that launched in September 2016.

Senior NASA officials will select one mission from the New Frontiers proposals for full funding in mid-2019, with a launch targeted by the end of 2025.

NASA has restricted the types of missions eligible for the next New Frontiers selection, including concepts to explore Enceladus and Titan.

Other candidates are a comet surface sample return mission, a project to extract and return specimens from a basin near the lunar south pole, a mission to investigate the atmosphere of Saturn, a spacecraft to visit the Trojan asteroids sharing an orbit with Jupiter, and a probe to study the atmosphere and surface of Venus.

Scientists believe Enceladus, with its constant eruptions, is an easier target to look for the existence of life. A mission with the right sensor package could fly through the plumes and search for materials like amino acids and other biosignatures thrown into space from Enceladus’s ocean.

For Europa, with its supposed intermittent plumes and an ocean containing twice the water in all of Earth’s seas, looking for life is more tricky and may require a lander.

“If we’ve got a salty ocean in contact with a rocky core and energy from a variety of sources … We have many of the ingredients thought to be necessary for life,” said Sparks.

NASA has officially approved development of a sophisticated flyby craft named Europa Clipper to make dozens of close approaches with Jupiter’s icy moon at altitudes as low as 16 miles (25 kilometers). Europa Clipper is set for launch as soon as 2022 and could arrive in Jupiter’s neighborhood in the late 2020s.

A team of scientists and engineers at the Jet Propulsion Laboratory is also designing a robot lander that could touch down on Europa in the early 2030s, assuming Congress funds the mission.

Voytek said Enceladus is thought to be younger than Europa, and the levels of hydrogen detected by Cassini mean a lot of energy is not being consumed by potential organisms living in the moon’s ocean, raising questions about whether microbes actually exist there.

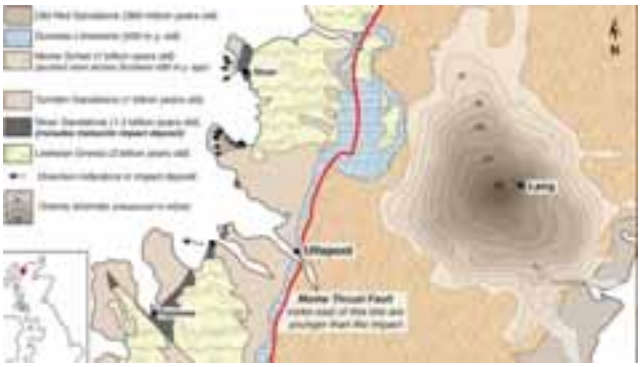
According to Voytek, Europa may be the better candidate for life if it has the same types of hydrothermal activity as Enceladus. “There’s no reason to think it wouldn’t be happening on Europa,” she said.

“We know that Europa and the moons around Jupiter were formed 4 billion years ago,” Voytek said. “That’s a lot more time for life to have emerged and start taking advantage of these energy sources.

“So my money, for the moment, is still on Europa, but (life) could be on any of these moons, and certainly it would be great if it was on all of them.”

UK's biggest meteorite impact rocked Scotland

Prehistoric Ullapool enjoyed 'quite a show'



26 Mar 2008 at 13:00, Lester Haines

It's lucky for the good burghers of Ullapool in Scotland that they weren't around 1.2 billion years ago, because it was around then that the biggest meteorite ever to hit the British Isles would have made a bit of a dent in local house prices.

That's according to the combined forces of the University of Oxford and the University of Aberdeen, who say that "unusual rock formations" previously thought to have volcanic origins are actually the debris ejected from a meteorite strike which threw material over an area 50km across.

The volcanic theory has always had geologists scratching their heads, since there are "no volcanic vents or other volcanic sediments nearby". The researchers moved in for the kill by taking rock samples in 2006, and have now published their revelations in the journal *Geology*.

Ken Amor of Oxford Uni's Department of Earth Sciences, explained: "Chemical testing of the rocks found the characteristic signature of meteoritic material, which has high levels of the key element iridium, normally only found in low concentrations in surface rocks on Earth. We found more evidence when we examined the rocks under a microscope; tell-tale microscopic parallel fractures that also imply a meteorite strike."

Professor John Parnell, head of Geology & Petroleum Geology at the University of Aberdeen, chipped in with: "These rocks are superbly displayed on the west coast of Scotland, and visited by numerous student parties each year. We're very lucky to have them available for study, as they can tell us much about how planetary surfaces, including Mars, become modified by large meteorite strikes. Building up the evidence has been painstaking, but has resulted in proof of the largest meteorite strike known in the British Isles."

Amor added: "If there had been human observers in Scotland 1.2 billion years ago they would have seen quite a show. The massive impact would have melted rocks and thrown up an enormous cloud of vapour that scattered material over a large part of the region around Ullapool. The crater was rapidly buried by sandstone which helped to preserve the evidence."

The researchers hope that the evidence they've gathered will help them to "understand the ancient impacts that shaped the surface of other planets, such as Mars", Amor concluded.

Removing light pollution from images.

. Now let's look at the second step alluded to in the column: subtracting the light pollution from your results to get a natural color image.

This shot of M42 was taken from a reasonably dark observing site. It is compromised by light pollution in the "foreground sky," which produces the red-brown color.

The Color of the Night Sky

Contrary to what you might think, the night sky is not black. Even at the darkest observing site in the world, you can still easily distinguish between the sky and the horizon. The sky is actually quite bright at observing sites with even mild light pollution.

For deep-sky astrophotography, we need to expose long enough to get the faintest detail up out of the noise of the camera. In these results, the sky will not be black. Indeed, if you expose so that the sky is black, or even adjust it to be black later in processing, you'll lose the faintest details in deep-sky objects that are just above the brightness of the sky background.

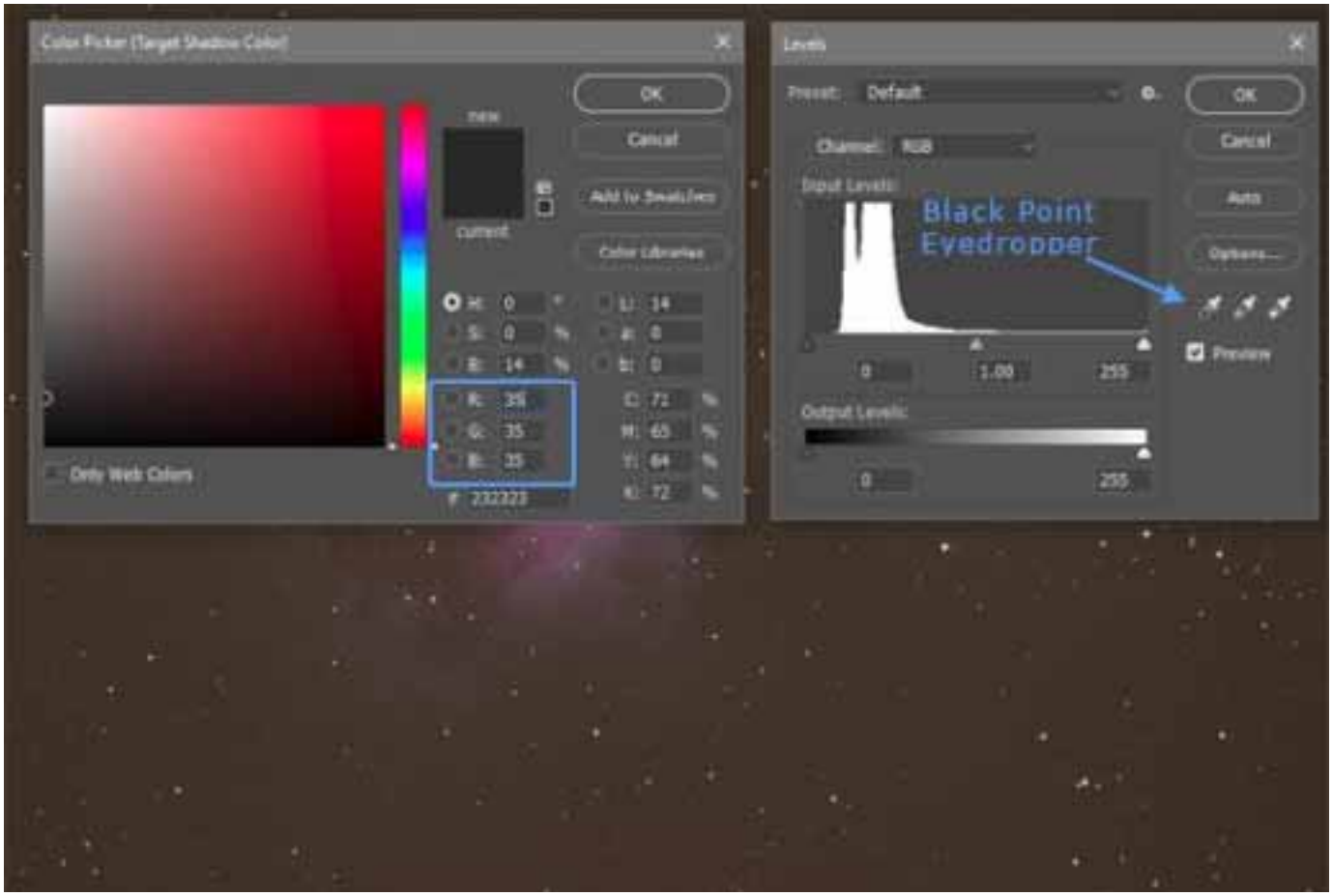
The problem is, these long exposures reveal the true color of the nighttime sky, which is usually an ugly red-brown color. This color comes from what I call the "foreground sky." The foreground sky color is created in Earth's atmosphere, usually due to light pollution at urban and suburban observing locations. Even at the darkest observing sites in the world, the sky can be a reddish-brown or sometimes green color due to airglow, a naturally occurring emission of light from Earth's atmosphere. The images of deep-sky objects must pass through Earth's atmosphere, and the color of the foreground sky is added to them.

Subtracting Light Pollution

To correct this foreground sky in our images, we can subtract it in Adobe Photoshop. Technically, subtracting this colorcast should be done to linear (unedited) data, though I've found

that it doesn't make much difference if it's done after non-linear adjustments are performed.

Adjusting the black point in Adobe Photoshop. Double click on the eyedropper tool and set it to 35,35,35, then click it in a blank area of sky background.



Here is how you do it.

1. Select the eyedropper tool from the tool palette and change the sample size to 31 by 31 average.
2. Call up the levels dialog from the pull-down menu (Image > Adjustments > Levels).
3. Double click on the black-point eyedropper at left.
4. In the Color Picker (Target Shadow Color) window, set the R,G,B values to 35,35,35 and click OK.
5. Now simply click on an area of blank sky background with no stars or nebulosity.

That's it!

This method will remove that ugly red-brown color of the foreground sky by subtracting it from the image, resulting in a nice dark-gray sky background.

MEMBERS VIEWING LOGS and IMAGES

"April Log

Just 44 observations of variables so far this month. As I write (29th April), I am at the Griffon Educational Observatory in El Bosque but after nearly a week here, it has to be said that the weather has been less than kind with only one night of observing possible so far. The coming week looks much more promising though. Using the 12" Dobsonian I managed just 7 observations on the night of the 24/5 April but this included a first observation this season of AM Herculis, the polar dwarf nova. Dwarf novae usually consist of a white dwarf surrounded by material being drawn off the secondary red dwarf forming an accretion disc. This allows material from the red dwarf to lose angular momentum and fall onto the surface of the white dwarf. In the case of polars, such as AM Her, the magnetic field of the white dwarf is so strong that plasma is pulled straight on to the surface of the white dwarf without the formation of an accretion disc. Charged particles spiralling around the field lines of the white dwarf's magnetic field generate polarised, synchrotron radiation (hence the name "polars"). As the plasma crashes onto the white dwarf, x-rays are generated because of the very high energies involved. Unfortunately, AM Her was too faint to see in the conditions, so in fact I had to record a negative observation, (ie I recorded it as fainter than the faintest comparison star visible) which was disappointing but the observation has value nonetheless.

29th to 30th April
The few gaps in the clouds tempted me to set up the 12" again. The view of Jupiter was surprisingly good, even when barely visible with the naked eye, likewise the Sombrero galaxy. I didn't attempt any observations of variables as the fast moving clouds would have probably obscured the target before I could complete the observation. Kathy Griffiths using 15x70 binoculars was able to see NGC 4559, the edge on spiral in Coma Berenices, NGC 4565 (Berenice's hairclip), Melotte 111, the Beehive (M44) and the globular cluster in Cancer, M67 which is a good illustration of the value and flexibility of binoculars and also, that in spite of patchy cloud cover, the seeing can sometimes be surprisingly good. Better weather to come I hope."

Tony

Viewing Log for 22nd of April

Had a free Saturday evening (wife had gone home to visit her mother) and the sky was very slightly cloudy, so I thought I would go out and have a viewing session? With the days now getting longer by about three minutes a day, I did not get to my usual viewing place of Uffcott until 21:45 as the sky was not that dark! This time I would be using my Skywatcher Eq 3-2 Pro mount but with the 98 mm William Optics refractor instead of the 80 mm William Optics refractor. Using the 98 mm scope was about the limit for this mount, so I made sure it was in good balance in both the Dec and RA planes. The last time I used this mount was 2nd of February, nearly eight weeks ago! At 22:01 everything was ready, as usual I would be using my 14 mm Pentax eye piece (which later would be changed to a 10 mm).

I was surprised Mars was still up at this time of the evening, it must have been within 10 ° of the horizon and coming thru so much atmosphere I could not even see any red in the planet! Only other planet on view was Jupiter, so I tracked the scope around to the king of the planets and noticed two moons either side of the planet, from the east it was Calisto, Europa, Io and finally Ganymede. With the solar system now out of the way (Moon was four days before New Moon and would not raise until early morning) I decided I would carry on with my Caldwell (C) list. First was C 21 an Irregular galaxy in Canes Venatici, this galaxy looked like a fuzzy blob (F B) to view. On to C 24, an Elliptical galaxy in Perseus, I had a lot of trouble locating this very faint fuzzy. Had to use adverted vision and then I was not sure I bagged it? Back in Canes Venatici and C 26, a Spiral galaxy (S G), as usual most S G's for me are grey blobs of nothing, this one was no different! C 27 was too low to view so I will have to come back to this Emission nebula when Cygnus is higher in the sky (probably August onwards?). C 29 in Canes Venatici is an edge on Spiral galaxy but unfortunately to me it was no more than an F B? Had better looking at C 32 an edge on Barred Spiral galaxy, this is also known as the Whale galaxy and I could see how it got its name? About 23:14 I could hear movement coming down the road while I was viewing but could not make anyone out? Turns out it was a black Labrador dog going from one farm to another (over the years Jon Gale and I have viewed from here during late summer and this dog has gone past us on a few occasions, sometimes with the owner following by a while later when they found out the dog has gone missing!). Back to my Caldwell list and to C 36, another S G in Coma Berenices, this galaxy was a faint fuzzy blob to look at! C 38, the Needle galaxy also in Coma Berenices was another edge on S G, looked similar to C 32? The next couple of objects I would like to bag before my summer break as when I resume in late July they will have gone for another season? So it was off to Sextans and bag C 53 a Lenticular galaxy which looked no more than an F B? My finally object on the C list was C 59 a Planetary nebula in Hydra which also goes by the name of the Ghost of Jupiter, to me it looked like an out of focus star?

I would have a quick look at some Globular clusters (G C) in Hercules namely M 13 (probably best G C in the northern sky) and an often over looked one in M 92 which would get a good billing if M 13 was not nearby? Both of these looked good in the eye piece. While doing the C list I had a hunt for comet P41 (Tuttle-Giacobini-Kresak) using the telescope and 15x80 binoculars. Neither of these found the comet which according to Stellarium had a magnitude of 6.7, I had a good star guide to help me out so I knew I was in the right area and this time there was no Moon light to affect the search, maybe next time assuming it has not got too faint? Before I packed up I thought I would have one final look at Jupiter and I was glad I did as I finally found the Great Red Spot (G R S) [Symbol]. I changed the eye piece to a Televue Delos 6 mm and with the help of various filters I finally found it. In all the time I have been doing astronomy this is one object I could not bag, M97 (Jon Gale called this planetary nebula the Nemesis of Peter Chappell and how right he was!) and NGC 3079 in Ursa Major had been trouble to me for years but they finally lost, even seen two Transits of Venus which not many people have seen but no G R S?

By now it was 23:51 and the car had a slight covering of frost, so I knew it was time to pack up and go home to a nice warm cup of coffee. During my two hour session here at least six or seven cars drove past me which did affect my night vision for a while, while packing up a taxi decided to stop and have a look at me, maybe they have never seen somebody out with a telescope before?

Clear skies.

Peter Chappell

Hi Andy,

Here are some of my efforts from 28th April while watching a setting Moon near Hook.

All pictures taken with a Canon 70D DSLR camera attached to a tripod with 70-300mm zoom lens for the close ups of the moon and 18-55mm zoom lens for the widefield view.

Peter.

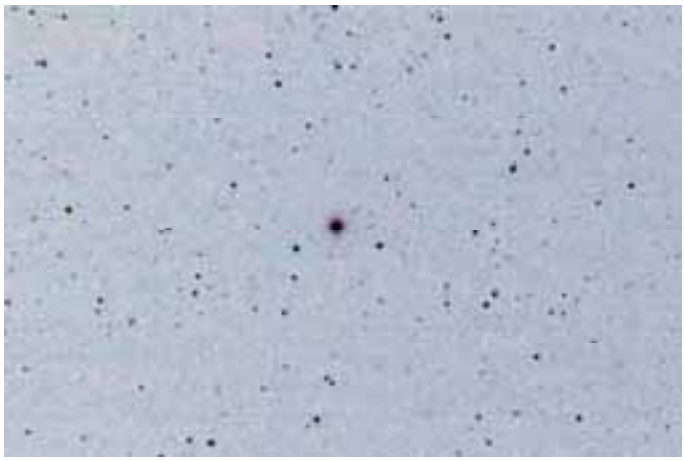
Hi Andy

Attached are two images of Comet 41P Tuttle Giacobini Kresak taken at 02:06 BST on 27th April 2017.

It was so faint I could not see 41P TGK with binoculars.

I quartered the area of sky taking images. Even then it was not visible on the camera screen so I did not take multiple images to stack. I only found an image with 41P TGK when reviewing images the following morning.

The image was processed in Photoshop CC and GIMP 2. The second image is heavily cropped.



(Editors note, in the second image I have converted the file into negative, it helps isolate the comet, a technique frequently used in galaxy and faint comet hunting).

Image details are Canon 1200D, ISO 6400, 5 sec, F3.5, Olympus OM Zuiko 135mm (effective focal length 216mm) .

Regards,

John Dartnell

5.5 day old Moon, 1st May, 9:30pm.
Nikon D7200, using Televue 127 and Big Barlow.

Exposed so I can show the eastern limb features which were at full libration at this stage. Note the seas of Mare Marginius and Mare Smythii.

The Sun on the 23rd April, small scattering of Sunspots but also a large filament area looking like a telescope/camera blemish in the top left corner, this is a coronal mass ejection caught happening.

Using 60mm Solarscope with DMK 31au at the Griffon Educational Observatory.

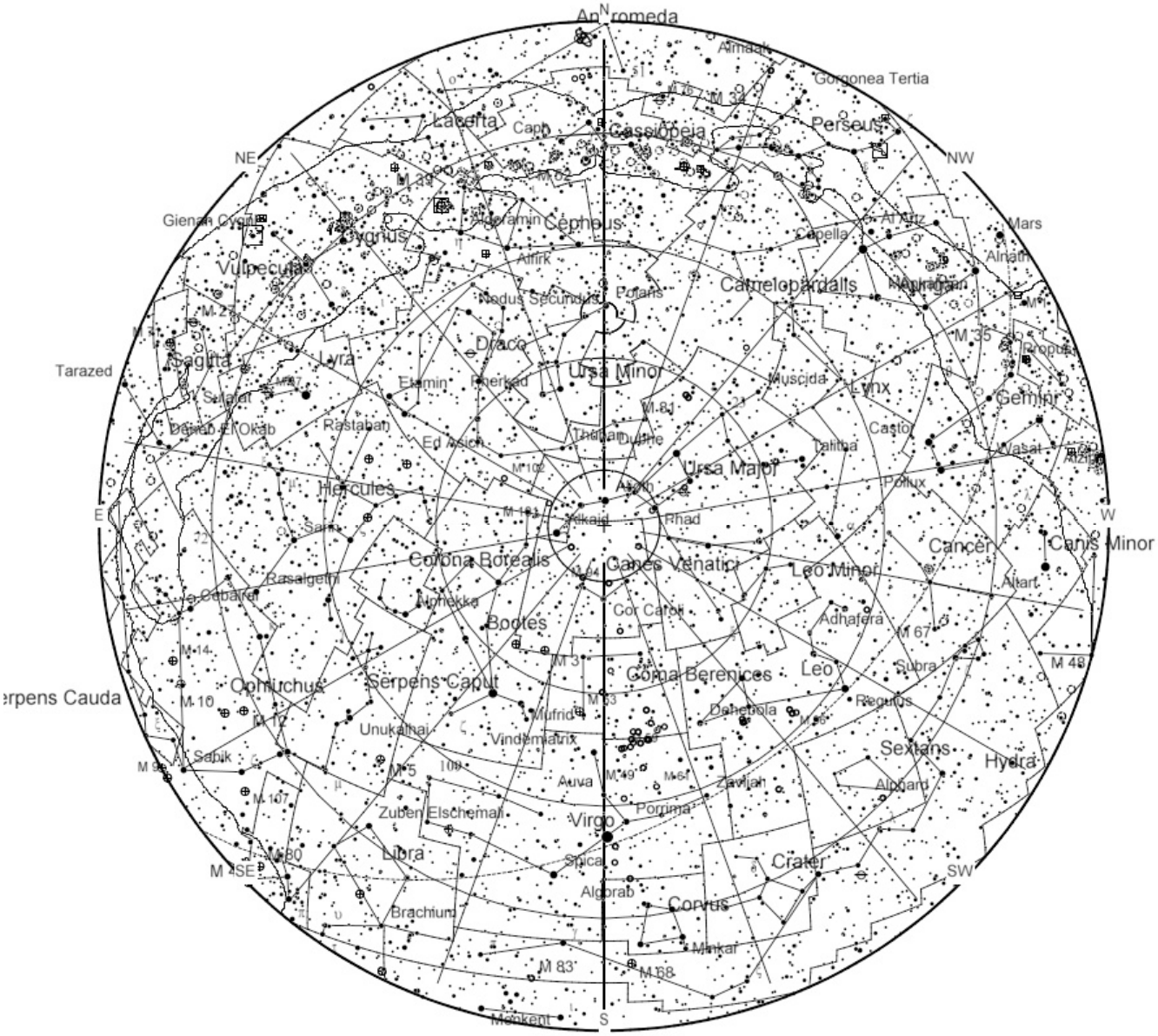
Most of my time (along with Allan Trow and Martin Griffiths of the Dark Sky Wales) was spent helping newcoming Astrotourists to the site. Helping them image, frequently seeing 4am in the morning, lots of Lyrid and sporadic meteors and struggling with some high cloud issues and Saraa dust, but still managed to image some of the summer galaxies.

The Milky Way from the village with mixture of lights, the Owl

nebula, Messier 101 in Ursa major and the Sombrero Galaxy M104 from the observatory.

Below the ‘Pink’ full Moon with Jupiter on the 10th April through cloud, the pink colour has been added as a joke...

WHATS UP, May 2017



Deep sky. May is the month for galaxy viewing. Above Jupiter, running into the handle of the plough asterism is the region of the sky looking out from our own galaxy where it is least obscured by the halo of stars and dust. This opens up the Virgo and Coma Berenices cluster of galaxies, our home major group of galaxies.
Also the Leo group are high in the sky as it gets dark. Galaxy hunting for some of these can be done with binoculars and moderate telescopes, but for an idea of the quantity of galaxies imaging equipment through a small refractor or big light collecting Newtonian Dobsonian telescopes are ideal.

May 6, 7 - Eta Aquarids Meteor Shower. The Eta Aquarids is an above average shower, capable of producing up to 60 meteors per hour at its peak. Most of the activity is seen in the Southern Hemisphere. In the Northern Hemisphere, the rate can reach about 30 meteors per hour. It is produced by dust particles left behind by comet Halley, which has known and observed since ancient times. The shower runs annually from April 19 to May 28. It peaks this year on the night of May 6 and the morning of the May 7. The waxing gibbous moon will block out many of the fainter meteors this year. But if you are patient, you should be able to catch quite a few of the brighter ones. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.

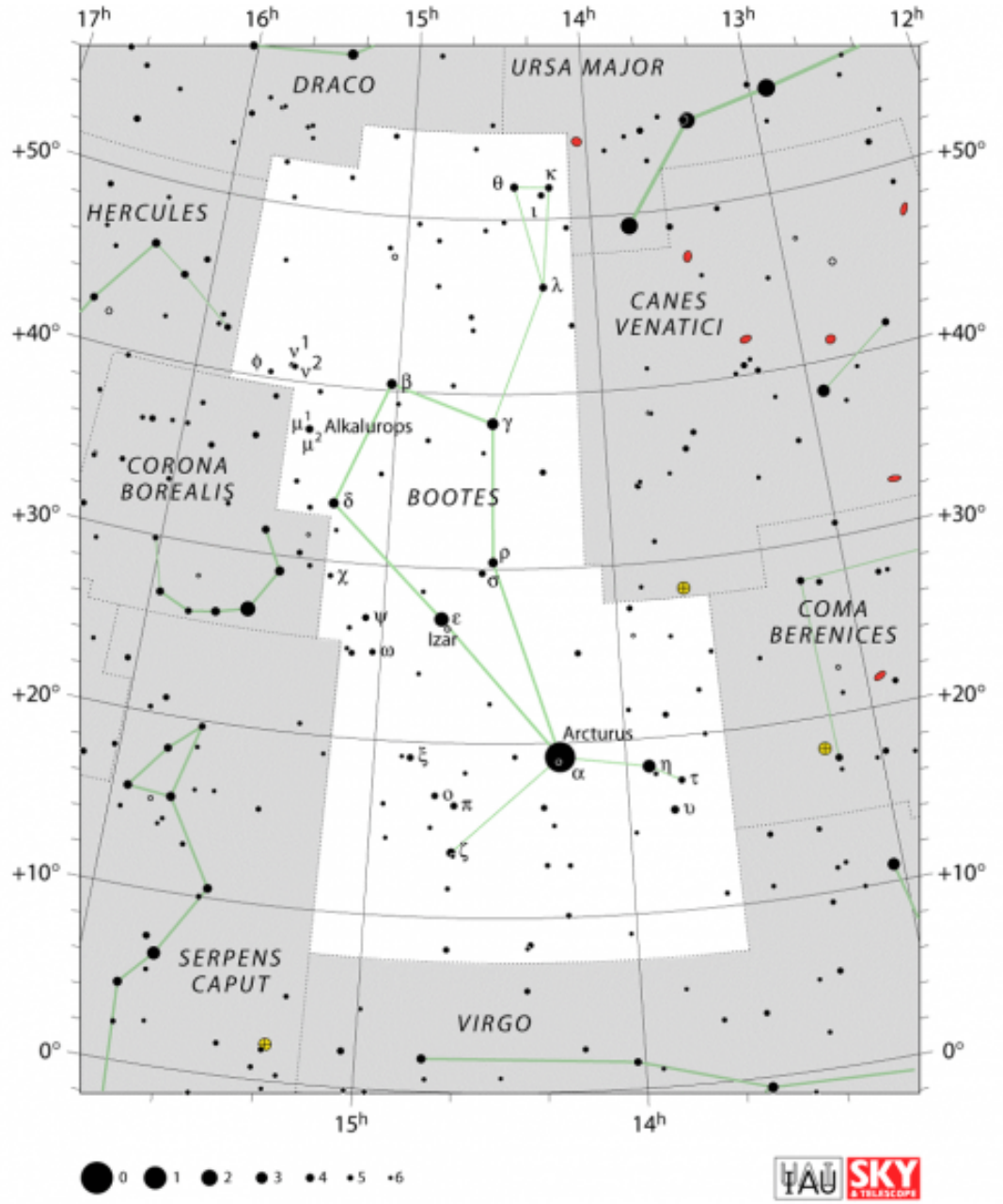
May 10 - Full Moon. The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 21:42 UTC. This full moon was known by early Native American tribes as the Full Flower Moon because this was the time of year when spring flowers appeared in abundance. This moon has also been known as the Full Corn Planting Moon and the Milk Moon.

May 17 - Mercury at Greatest Western Elongation. The planet Mercury reaches greatest western elongation of 25.8 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the morning sky. Look for the planet low in the eastern sky just before sunrise.

May 25 - New Moon. The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 19:45 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere. Clear skies

Andy

CONSTELLATIONS OF THE MONTH: BOOTES



Callisto father, the Arcadian king Lycaon. One day, Lycaon decided to test Zeus by serving him his own son for a meal. Zeus saw through Lycaon's intentions and transformed the king into a wolf, killed his sons, and brought Arcas back to life.

In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) compiled a list of the then-known 48 constellations. Until the development of modern astronomy, his treatise (known as the *Almagest*) would serve as the authoritative source of astronomy. This list has since come to be expanded to include the 88 constellation that are recognized by the International Astronomical Union (IAU) today.

The constellation Boötes (pronounced Bu-Oh-Tays) is one of these constellations, and was also among those listed in the *Almagest.* It is frequently called the "Watcher of the Bear", guarding over the northern constellations of both Ursa Major and Ursa Minor (the Greater and Lesser Bears). It is bordered by Canes Venatici, Coma Berenices, Corona Borealis, Draco, Hercules, Serpens Caput, Virgo and Ursa Major.

Name and Meaning:

According to myth, Boötes is credited for inventing the plough, which prompted the goddess Ceres – a goddess of agriculture, grain crops, fertility and motherly love – to place him in the heavens. There are also versions where Bootes represents a form of Atlas, holding up the weight of the world as it turns on its axis (yet another of Hercules' labors).

Most commonly, Boötes is taken to represent Arcas, the son of Zeus and Callisto. In this source, Arcas was brought up by

Boötes as depicted in Urania's Mirror, a set of constellation cards published in London c.1825. Credit: Wikipedia Commons/Sidney

Having heard of her husband's infidelity, Zeus' wife Hera transformed Callisto into a bear. For years, she roamed the woods until she met her son, who was now grown up. Arcas didn't recognize his mother and began to chase her. To avoid

a tragic end, Zeus intervened by placing them both in the sky, where Callisto became Ursa Major (aka. The Big Dipper, or "Great Bear") and Arcas became Boötes.
In another story, Boötes is taken to represent Icarius, a grape grower who was given the secret of wine-making by Dionysus. Icarius used this to create a wonderful wine that he shared with all his neighbors. After overindulging, they woke up the next day with terrible hangovers and believed Icarius had tried to poison them. They killed him in his sleep, and a saddened Dionysus placed his friend among the stars.

Notable Features:

Bootes contains the third brightest star in the night sky – Arcturus (aka. alpha Boötis) – whose Greek name "Arktos" also means "bear", and is associated with all things northern (including the aurora). Arcturus is quite important, being a type K1.5 IIIpe red giant star. The letters "pe" stand for "peculiar emission," which indicates the spectrum of the star is unusual and full of emission lines. This is not uncommon in red giants, but Arcturus is particularly strong.

The location of the Bootes contellation. Credit: IAU/Sky and Telescope

Arcturus is about 110 times more luminous than our nearest star, but the total power output is about 180 times that of the Sun (when infrared radiation is considered). Arcturus is also notable for its high proper motion, larger than any first magnitude star in the stellar neighborhood other than Alpha Centauri. It is now almost at its closest and is moving rapidly (122 km/s) relative to the Solar System.
Arcturus is also thought to be an old disk star, and appears to be moving with a group of 52 others of its type. Its mass is hard to determine exactly, but it may have the same mass as Sol, or perhaps 1.5 times as much. Arcturus may also be older than the Sun, and much like what the Sun will be in its Red Giant Phase.
Arcturus achieved fame when its light was used to open the 1933 Chicago World's Fair. The star was chosen because it was thought that light from the star had started its journey at about the same time of the previous Chicago World's Fair (1893). Technically the star is 36.7 light years away, so the light would have started its journey in 1896. Arcturus' light was still focused onto a cell that powered the switch for the lights that eventually shined so bright that Arcturus was no longer visible.
Arcturus, along with its neighboring stars, also form the curious "Colonial Viper" formation, a triangular asterism invented by dedicated SkyWatcher, Ed Murray. It is so-named because it resembles a Colonial Viper being launched from a tube on the TV series Battlestar Galactica. The "Launch Tube" is formed by the intersection of Arcturus, Alphekka (Alpha Corona Borealis) and Gamma Bootis, while Izar (Epsilon Bootes) is the Viper.
Other notable stars include Nekkar (Beta Boötis), a yellow G-type giant that is 219 light years from Earth. It is a flare star, which is a type of variable star that shows dramatic increases in luminosity for a few minutes. The name Nekkar derives from the Arabic word for "cattle driver". Then there's Seginus (Gamma Boötis), a Delta-Scuti type variable star that is approximately 85 light years from Earth. It shows variations in its brightness due to both radial and non-radial pulsations on its surface.
Izar (Epislon Boötis) is a binary star located approximately 300 light years away which consists of a bright orange giant and a smaller and fainter main sequence star. Epsilon Boötis is also sometimes knows as Pulcherrima, which means "the lovieliest" in Latin. The name Izar comes from the Arabic word for "veil." The star's other traditional names are Mirak ("the loins" in Arabic) and Mizar.
Muphrid (Eta Boötis) is a spectroscopic binary star that is 37 light years from Earth and close to Arcturus in the sky. The star's traditional name is Muphrid, derived from the Arabic phrase for "the single one of the lancer." It belongs to the spectral class G0 IV and has a significant excess of elements heavier than hydrogen.
Boötes is also home to many Deep Sky Objects. This includes the Boötes void (aka. the Great Void, the Supervoid). This sphere-shaped region of the sky is almost 250 million light years in diameter and contains 60 galaxies. The void was originally discovered by Robert P. Kirshner – a Harvard College Professor of Astronomy – in 1981, as part of a survey of galactic redshifts.

The very loose globular cluster NGC 5466 located in the Boots consetllation, Credit: NASA, ESA/Wikisky

Then there is the Boötes Dwarf Galaxy (Boötes I), a dwarf spheroidal galaxy located approximately 197,000 light years from Earth that measures about 720 light years across. It was only discovered in 2006, owing to the fact that it is one of the faintest galaxies known (with an absolute magnitude of -5.8 and apparent magnitude of 13.1). Boötes I orbits the Milky Way and is believed to be tidally disrupted by its gravity, as evidenced by its shape.
And there's also NGC 5466, a globular cluster approximately 51,800 light years from Earth and 52,800 light years from the Galactic center. The cluster was first discovered by the German-born British astronomer William Herschel in 1784. It is believed that this cluster is the source of a star stream called the 45 Degree Tidal Stream, which was discovered in 2006.

History of Observation:

The earliest recorded mentions of the stars associated with Boötes come from ancient Babylonia, where it was listed as SHU.PA. These stars were apparently depicted as the god Enlil, who was the leader of the Babylonian pantheon and special patron of farmers. It is likely that this is the source of mythological representations of Bootes as "the ploughman" in Greco-Roman astronomy.
The name Boötes was first used by Homer in *The Odyssey* as a celestial reference point for navigation. The name literally means "ox-driver" or "herdsman", and the ancient Greeks saw the asterism now called the "Big Dipper" or "Plough" as a cart with oxen. His dogs, Chara and Asterion, were represented by the constellation of Canes Venatici (the Hunting Dogs) who drove the oxen on and kept the wheels of the sky turning.
In traditional Chinese astronomy, many of the stars in Boötes were associated with different Chinese constellations. Arcturus was one of the most prominent, variously designated as the celestial king's throne (*Tian Wang*) or the Blue Dragon's horn (*Daijiao*). Arcturus was also very important in Chinese celestial

mythology because it is the brightest star in the northern sky, and marked the beginning of the lunar calendar. Flanking *Daijiao* were the constellations of *Yousheti* on the right and *Zuosheti* on the left, which represented the companions that orchestrated the seasons. *Dixi*, the Emperor's ceremonial banquet mat, was north of Arcturus. Another northern constellation was *Qigong*, the Seven Dukes, which was mostly across the Boötes-Hercules border.
The other Chinese constellations made up of the stars of Boötes existed in the modern constellation's north. These are all representations of weapons – *Tianqiang*, the spear; *Genghe*, variously representing a lance or shield; *Xuange*, the halberd; and *Zhaoyao*, either the sword or the spear.

Finding Bootes:

Bootes can be found south of Ursa Major, just off the handle of the Big Dipper. Because the Big Dipper is easy for most observers to find, the handle is used to point to other important stars. Bootes' brightest star, Arcturus, is also part of a mnemonic device used to orient people, which goes: "Arc to Arcturus, speed on to Spica." This means you follow the curve in the Dipper's handle away from Ursa Major until you run into Arcturus. The other star – Spica – is part of the neighboring Virgo constellation.

Arcturus, the brightest star in the Boötes constellation. Credit: astropixels.com

For those using binoculars, check out Tau Bootis, a yellow-white dwarf approximately 51 light-years from Earth. It is a binary star system, with the secondary star being a red dwarf. In 1999, an extrasolar planet was confirmed to be orbiting the primary star by a team of astronomers led by Geoff Marcy and R. Paul Butler. Maybe you'd like to look at long term variable star R Boötis? It ranges from 6.2 to 13.1 every 223.4 days.
For those using telescopes, there are plenty of excellent binary star systems to be seen. Pi Boötis is located approximately 317 light years from our solar system and the primary component, P¹ Boötis, is a blue-white B-type main sequence dwarf with an apparent magnitude of +4.49. It's companion, P² Boötis, is a white A-type main sequence dwarf with an apparent magnitude of +5.88.
Now try looking at Xi Boötis, a binary star system which lies 21.8 light years away. The primary star, Xi Boötis A, is a BY Draconis variable, yellow G-type main sequence dwarf with an apparent magnitude that varies from +4.52 to +4.67. with a period just over 10 days long. Small velocity changes in the orbit of the companion star, Xi Boötis B – an orange K-type main sequence dwarf – indicate the presence of a small companion with less than nine times the mass of Jupiter.
The AB binary can be resolved even through smaller telescopes. The primary star (A) has been identified as a candidate for possessing a Kuiper-like belt, based on infrared observations. The estimated minimum mass of this dust disk is 2.4 times the mass of the Earth's Moon.

The location of Mu Bootis (Alkalurops) in the Bootes constellation. Credit: universeguide.com

Then there's the triple system, Mu Boötis. The primary component, Mu¹ Boötis, is a yellow-white F-type sub giant with an apparent magnitude of +4.31. Separated from the primary by 108 arc seconds is the binary star Mu² Boötis, which has a combined spectral type of G1V and a combined brightness of +6.51 magnitudes. The components of Mu² Boötis have apparent magnitudes of +7.2 and +7.8 and are separated by 2.2 arc seconds.
They complete one orbit about their common center of mass every 260 years. How about colorful yellow and blue Kappa Boötis? Kappa2 Boötis is classified as a Delta Scuti type variable star and its brightness varies from magnitude +4.50 to +4.58 with a period of 1.83 hours. The companion star, Kappa¹ Boötis, has magnitude +6.58 and spectral class F1V.
For deep sky observers with large telescopes, try checking out the globular cluster NGC 5466, which is about a fist's width north of Arcturus. This class XII, 9th magnitude globular was discovered in 1784 by Sir William Herschel and presents an nice challenge for experienced stargazers and amateur astronomers.
Or try compact spiral galaxy NGC 5248. It's about a fist width south of Arcturus and about a finger width southwest. It's part of the Virgo cluster of galaxies and could be as far as 50 million light years away. It's another great grand design spiral which shows spiral galaxy structure when viewed in long exposure photographs. You can mark it on your list as Caldwell 45.

The NGC 5248 spiral galaxy, as imaged with a 32-inch telescope. Credit and Copyright: Adam Block/Mount Lemmon SkyCenter/University of Arizona

But if you'd just like to have some fun, then why not try picking out the aforementioned "Colonial Viper and Launch Tube" asterism. If you're a longstanding Battlestar Galactica fan, then you'll recognize this ultra-cool spaceship as it sits in its triangular shaped launch tube. To find it, just draw a line between Arcturus, Alphekka (Alpha Corona Borealis) and Gamma Bootis which make up the "Launch Tube", while Izar (Epsilon Bootes) is the Viper.

ISS PASSES For May June 2017 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point		End					
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
09 May	-1.7	04:19:41	10°	S	04:21:58	18°	SE	04:24:15	10°	E
10 May	-1.3	03:29:08	10°	SSE	03:30:04	11°	SE	03:31:09	10°	ESE
11 May	-2.6	04:11:29	13°	SSW	04:13:52	30°	SSE	04:16:48	10°	E
12 May	-2.1	03:21:07	19°	SSE	03:21:51	21°	SE	03:24:23	10°	E
13 May	-1.4	02:30:43	13°	ESE	02:30:43	13°	ESE	02:31:36	10°	ESE
13 May	-3.4	04:03:21	15°	SW	04:05:50	50°	SSE	04:09:01	10°	E
14 May	-3.0	03:12:52	29°	S	03:13:43	35°	SSE	03:16:45	10°	E
15 May	-2.2	02:22:22	22°	SE	02:22:22	22°	SE	02:24:22	10°	E
15 May	-3.9	03:55:00	13°	WSW	03:57:49	74°	SSE	04:01:05	10°	E
16 May	-3.7	03:04:27	33°	SW	03:05:37	56°	SSE	03:08:51	10°	E
17 May	-3.1	02:13:49	38°	SE	02:13:49	38°	SE	02:16:34	10°	E
17 May	-3.8	03:46:31	10°	W	03:49:48	89°	NNW	03:53:06	10°	E
18 May	-1.7	01:23:10	17°	E	01:23:10	17°	E	01:24:12	10°	E
18 May	-3.9	02:55:46	25°	WSW	02:57:33	80°	S	03:00:51	10°	E
18 May	-3.8	04:30:46	10°	W	04:34:04	89°	SSW	04:37:21	10°	E
19 May	-3.9	02:05:03	59°	S	02:05:19	63°	SSE	02:08:34	10°	E
19 May	-3.8	03:38:29	10°	W	03:41:47	85°	N	03:45:04	10°	E
20 May	-2.6	01:14:15	30°	ESE	01:14:15	30°	ESE	01:16:16	10°	E
20 May	-3.9	02:46:51	15°	W	02:49:29	86°	N	02:52:47	10°	E
20 May	-3.9	04:22:42	10°	W	04:25:58	70°	SSW	04:29:14	10°	ESE
21 May	-1.5	00:23:19	14°	E	00:23:19	14°	E	00:23:53	10°	E
21 May	-4.0	01:55:55	35°	WSW	01:57:11	85°	S	02:00:29	10°	E
21 May	-3.9	03:30:24	10°	W	03:33:41	85°	SSW	03:36:59	10°	ESE
22 May	-4.0	01:04:45	68°	S	01:04:53	69°	SSE	01:08:10	10°	E
22 May	-3.9	02:38:05	10°	W	02:41:23	86°	N	02:44:40	10°	E
22 May	-3.5	04:14:36	10°	W	04:17:46	46°	SSW	04:20:56	10°	SE
23 May	-3.6	00:12:57	48°	SE	00:12:57	48°	SE	00:15:50	10°	E
23 May	-3.9	01:45:44	10°	W	01:49:02	85°	N	01:52:20	10°	E
23 May	-3.9	03:22:15	10°	W	03:25:31	64°	SSW	03:28:45	10°	ESE
23 May	-3.3	23:17:20	10°	SW	23:20:23	36°	SSE	23:23:27	10°	E
24 May	-3.9	00:53:23	10°	W	00:56:42	89°	S	01:00:00	10°	E
24 May	-4.0	02:29:54	10°	W	02:33:12	81°	SSW	02:36:30	10°	ESE
24 May	-2.9	04:06:33	10°	W	04:09:25	28°	SSW	04:12:17	10°	SSE
24 May	-2.7	22:25:27	10°	SSW	22:28:12	24°	SSE	22:30:56	10°	E
25 May	-4.0	00:01:04	10°	WSW	00:04:22	75°	SSE	00:07:39	10°	E
25 May	-3.9	01:37:33	10°	W	01:40:51	88°	N	01:44:09	10°	E
25 May	-3.5	03:14:05	10°	W	03:17:12	41°	SSW	03:20:19	10°	SE
25 May	-3.8	23:08:48	10°	WSW	23:12:02	57°	SSE	23:15:17	10°	E
26 May	-3.9	00:45:11	10°	W	00:48:29	84°	N	00:51:47	10°	E
26 May	-3.9	02:21:41	10°	W	02:24:56	58°	SSW	02:28:10	10°	ESE
26 May	-2.2	03:58:47	10°	W	04:00:55	16°	SW	04:03:03	10°	S
26 May	-3.4	22:16:37	10°	SW	22:19:45	40°	SSE	22:22:52	10°	E
26 May	-3.9	23:52:48	10°	W	23:56:06	88°	N	23:59:24	10°	E
27 May	-4.0	01:29:18	10°	W	01:32:36	75°	SSW	01:35:53	10°	ESE
27 May	-2.8	03:06:01	10°	W	03:08:45	25°	SSW	03:11:29	10°	SSE
27 May	-3.9	23:00:25	10°	WSW	23:03:43	80°	SSE	23:07:01	10°	E
28 May	-3.9	00:36:54	10°	W	00:40:13	89°	SSW	00:43:30	10°	E
28 May	-3.1	02:13:28	10°	W	02:16:03	34°	SW	02:16:03	34°	SW
28 May	-3.8	22:08:04	10°	WSW	22:11:20	63°	SSE	22:14:37	10°	E
28 May	-3.8	23:44:30	10°	W	23:47:48	85°	N	23:51:06	10°	E
29 May	-3.7	01:21:00	10°	W	01:24:14	52°	SSW	01:24:24	51°	S
29 May	-3.8	22:52:05	10°	W	22:55:23	86°	N	22:58:41	10°	E
30 May	-4.0	00:28:35	10°	W	00:31:52	70°	SSW	00:33:12	32°	ESE
30 May	-1.4	02:05:23	10°	W	02:05:47	12°	W	02:05:47	12°	W

END IMAGES, OBSERVING AND OUTREACH

A sporadic meteor from the 22nd April.

This appeared in the set of images I took for the startrails image on the front page. But the last 50 pictures had the cloud increasing and moving across the sky around 2am in the morning, Nikon D810A, ISO640, 20seconds, 20mm lens.

To the right, Jupiter and its Galilean Moons, last night 1st May. Nikon D7200, two exposures on for Jupiter and one for Moons overlaid. 5X powermate on televue 127.

Andy

Date	Moon Phase	Observing Topic
2017		
Friday 26th May	Waxing crescent (sets around 10pm)	Deep Sky & Lunar targets

OUTREACH ACTIVITIES

Paragon School, Bath Changed to May daytime meeting

May 18th Paragon school