NWASNEWS

Volume22, Issue 10

June 2017

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

The chart to the right is the path of the International Space Station tonight.
At 22:30:22seconds from a line the rune NW to SE just north of Avebury for centre line (passing SW of Marlborough).
It means from Silbury Hill or Avebury we have a good chance of catching this event.
Worth a go, so I want to finish AGM by 9:45.

Andy.

AGM and ISS slides past the Moon!

Firstly some very sad news to pass on. Paul Barrett, a long serving member who used to come to all meetings and many observing sessions, lost his long, and a fear painful battle with cancer just over a week ago.

His funeral will be at the Semington Crematorium on 16th June. Donations to Dorothy House.

Very sorry to here this and condolences to his family.

Tonight's meeting should be our AGM, and we have a speaker Mark Radice, a local a occasional speaker to the society, this time he will be telling us about his experiences in the Caribbean doing astronomy.

I will ask Mark to speak first.

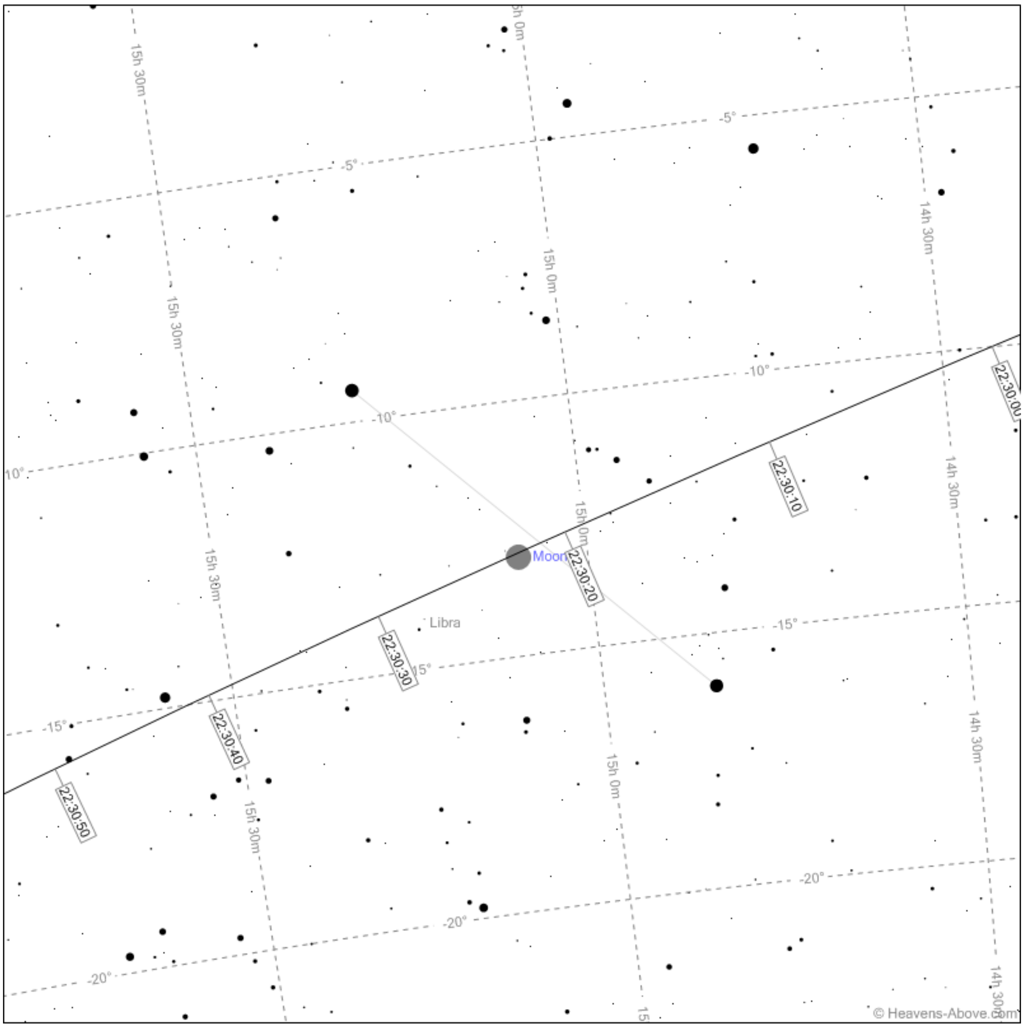
The next item should be the AGM BUT tonight the ISS will pass in front of the Moon from a line running through central to southern Wiltshire.

The time will be 10:30:22 seconds at Avebury, it will miss Devizes, Calne, Swindon, Salisbury and Marlborough (see map on page 2.

To catch this we need to leave at 9:45, no later. I am asking that the AGM be moved to September, as we have done in the past. It may be necessary, as I am also aware of three committee members who will be unable to make the meeting. We can run through the accounts, but need detailed discussions on officers, web site, and constitution so the new chair can run with a clean sheet and positive bank balance.

Clear Skies

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

6 Jun Mark Radice, Observing from the Caribbean + 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)

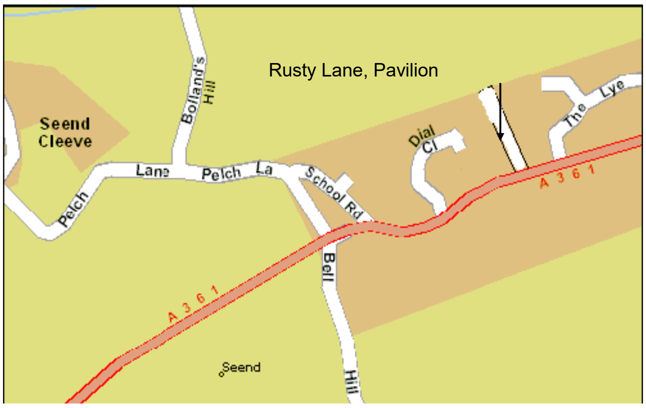
Philip Proven (Hall coordinator)

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.



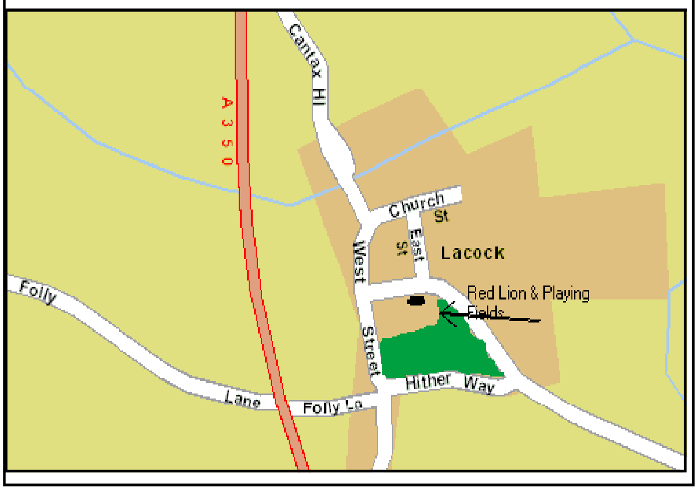
Observing Sessions

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



Mark Radice

Observing from the Caribbean

Mark is a very accomplished practical viewer, building his own telescope, binocular viewing platform, an excellent Astro sketcher, and now getting into imaging.

He is a qualified pilot and lives in Wiltshire.

MAP of 6th June Transit of the Moon be the ISS

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.

Our Next Meeting: Dr. Paul Roche

At our next meeting we welcome Dr. Paul Roche, MSc Astrophysics Programme Coordinator at Cardiff University, who will be speaking on Robotic Astronomy and the Faulkes Telescope.

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 16 June 2017

Programme: Dr. Paul Roche - Robotic Astronomy

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

Friday 15 September 2017

Programme: TBA

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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Email: peter.struve@sky.com
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The Fizzy Seas of Titan

By Marcus Woo

With clouds, rain, seas, lakes and a nitrogen-filled atmosphere, Saturn's moon Titan appears to be one of the worlds most similar to Earth in the solar system. But it's still alien; its seas and lakes are full not of water but liquid methane and ethane.

At the temperatures and pressures found on Titan’s surface, methane can evaporate and fall back down as rain, just like water on Earth. The methane rain flows into rivers and channels, filling lakes and seas.

Nitrogen makes up a larger portion of the atmosphere on Titan than on Earth. The gas also dissolves in methane, just like carbon dioxide in soda. And similar to when you shake an open soda bottle, disturbing a Titan lake can make the nitrogen bubble out.

But now it turns out the seas and lakes might be fizzier than previously thought. Researchers at NASA's Jet Propulsion Laboratory recently experimented with dissolved nitrogen in mixtures of liquid methane and ethane under a variety of temperatures and pressures that would exist on Titan. They measured how different conditions would trigger nitrogen bubbles. A fizzy lake, they found, would be a common sight.

On Titan, the liquid methane always contains dissolved nitrogen. So when it rains, a methane-nitrogen solution pours into the seas and lakes, either directly from rain or via stream runoff. But if the lake also contains some ethane—which doesn't dissolve nitrogen as well as methane does—mixing the liquids will force some of the nitrogen out of solution, and the lake will effervesce.

"It will be a big frothy mess," says Michael Malaska of JPL. "It's neat because it makes Earth look really boring by comparison."

Bubbles could also arise from a lake that contains more ethane than methane. The two will normally mix, but a less-dense layer of methane with dissolved nitrogen—from a gentle rain, for example--could settle on top of an ethane layer.

In this case, any disturbance—even a breeze—could mix the methane with dissolved nitrogen and the ethane below. The nitrogen would become less soluble and bubbles of gas would fizz out.

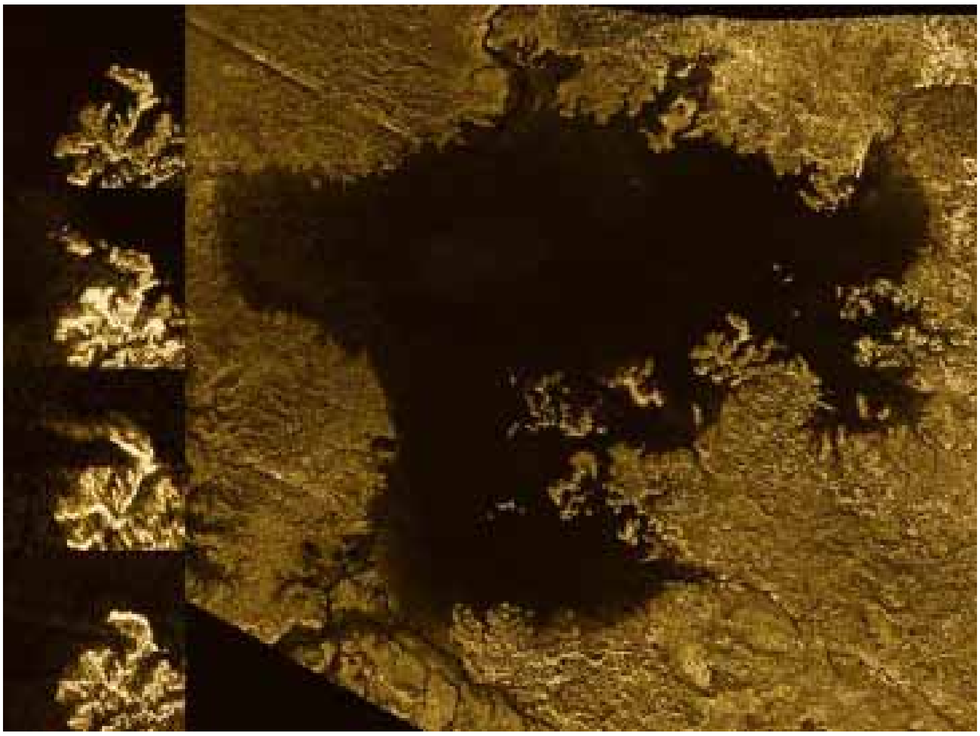
Heat, the researchers found, can also cause nitrogen to bubble out of solution while cold will coax more nitrogen to dissolve. As the seasons and climate change on Titan, the seas and lakes will inhale and exhale nitrogen.

But such warmth-induced bubbles could pose a challenge for future sea-faring spacecraft, which will have an energy source, and thus heat. "You may have this spacecraft sitting there, and it's just going to be fizzing the whole time," Malaska says. "That may actually be a problem for stability control or sampling."

Bubbles might also explain the so-called magic islands discovered by NASA's Cassini spacecraft in the last few years. Radar images revealed island-like features that appear and disappear over time. Scientists still aren't sure what the islands are, but nitrogen bubbles seem increasingly likely.

To know for sure, though, there will have to be a new mission. Cassini is entering its final phase, having finished its last flyby of Titan on April 21. Scientists are already sketching out potential spacecraft—maybe a buoy or even a submarine—to explore Titan's seas, bubbles and all.

To teach kids about the extreme conditions on Titan and other planets and moons, visit the NASA Space Place: https://spaceplace.nasa.gov/planet-weather/



Caption: Radar images from Cassini showed a strange island-like feature in one of Titan's hydrocarbon seas that appeared to change over time. One possible explanation for this "magic island" is bubbles. Image credits: NASA/JPL-Caltech/ASI/Cornell

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 Sir/Madam

I am writing to ask if you would kindly send the details of our part-time, online Postgraduate Diploma in Astronomy to members of your society. If you are able to hand out some flyers at your next meeting please let me know by replying to this email with your postal address.

Thank you very much.

Postgraduate Diploma in Astronomy at the University of York

- Starts September
- Two years
- Part-time
- Taught wholly online
- Six distinct modules
- Highly interactive programme
- Optional residential weekends
- Supportive environment

The programme is taught wholly online, for maximum flexibility of learning, with optional residential weekends in York for the opportunity to meet your fellow students and staff, engage in discussion and share your knowledge of railway studies.

This programme will offer home astronomers, who may have graduated in subjects other than physics, the opportunity to gain a formal postgraduate qualification in Astronomy and Astrophysics, and is designed to give students a robust and up-to-date background in these areas. Over the course of two years, we will explore the solar system, stellar physics, infrared, radio and high energy astronomy, as well as discussing the foundations of cosmology.

The Centre for Lifelong Learning has provided high-quality distance learning opportunities for almost a decade. Aimed at anyone wishing to learn in a flexible fashion, and requiring only basic IT skills to engage, our provision has attracted students from across the globe. We'd very much like to welcome you to our growing community of learners.

For further information about the course and how to apply please see our website. Should you have any questions please do not hesitate to get in touch.

Thank you.

Best wishes

Emily

Emily Limb
Courses Administrator
Centre for Lifelong Learning
University of York
Heslington
YORK YO10 5DD

SPACE NEWS

1st Recycled SpaceX Dragon Blasts Off for Space Station on 100th Flight from Pad 39A with Science Rich Cargo and Bonus Booster Landing

For the first time in the history of commercial spaceflight, a used spacecraft has blasted off on a mission to deliver cargo to the International Space Station (ISS).

(June 1), lingering storm clouds parted just enough for SpaceX's Falcon 9 rocket to safely lift off from NASA's historic Pad 39A at the Kennedy Space Center in Florida today (June 3).

The Falcon 9 rocket, topped with SpaceX's first refurbished Dragon cargo craft, took to the skies at 5:07 p.m. EDT (2107 GMT). About 8 minutes after liftoff, the first-stage rocket booster returned to Earth to stick a landing at nearby Cape Canaveral Air Force Station. [Launch Photos: SpaceX's 1st Reused Dragon Spacecraft]

A little over 10 minutes into the flight, the Dragon separated from the Falcon 9's second stage, deployed its solar arrays and began its three-day trek to the ISS. On Monday (June 5), the spacecraft will dock at the space station's Harmony module, delivering close to 6,000 lbs. (2,700 kilograms) of supplies and science experiments to the Expedition 52 crew.

Today's launch marked the 100th mission to lift off from Launch Complex 39A, where NASA's Apollo missions and dozens of space shuttle missions were also launched. "For [SpaceX], it's the seventh launch this year, and you can tell that we picked up the rate significantly," Hans Koenigsmann, vice president of flight reusability at SpaceX, said in a prelaunch briefing on Wednesday (May 31).

"We are hoping to stay at this rate through the rest of the year and work our backlog down. We're hoping to also fly more and more refurbished Dragons, and the same is true for the first stages," he said. "The next launch after this is also refurbished first stage."

A SpaceX Falcon 9 rocket carrying a used Dragon cargo craft blasts off from NASA's Kennedy Space Center in Florida on June 3, 2017.

Credit: SpaceX

Another historic 1st for SpaceX

Today's mission is the latest in a series of historic firsts for SpaceX, the private spaceflight company founded by billionaire entrepreneur Elon Musk. In March, the company successfully launched and landed a used rocket booster for the first time. SpaceX is also the first and only company to have landed a rocket booster during an orbital mission (though Jeff Bezos' Blue Origin has achieved this multiple times on suborbital journeys). And in 2012, SpaceX's Dragon capsule became the first private spacecraft to dock at the ISS.

With the ultimate (and highly ambitious) goal of being able to reuse all major components of their launch vehicles, SpaceX is now putting the Dragon to the test. The capsule first flew on a cargo mission to the space station on Sept. 21, 2014, for the cargo resupply mission CRS-4, and it returned to Earth with a splashdown in the Pacific Ocean one month later.

"Once this capsule landed, we refurbished it, inspected it, made sure everything is qualified for the next flight," Koenigsmann said.

But the capsule isn't 100 percent reused parts, Koenigsmann added. Certain parts had to be replaced for a number of reasons, such as exposure to seawater during splashdown, he said, and the heat shield needed to be replaced for safety. "But I can tell you the majority of this Dragon has been in space before and has been docked to the station for a couple of weeks."

The next steps toward full reusability for SpaceX involve figuring out how to refurbish the second-stage rocket booster and the payload fairings — an ambitious but important goal, Koenigsmann said.

"This whole notion of reuse is something that's very important to the entire space industry and NASA as well as Space X and others," Kirk Shireman, manager of NASA's ISS program, said in the briefing. "The idea of reuse is **Science on board**

Along with food, water, clothing and other gear for the astronauts at the space station, the Dragon will deliver plenty of science experiments.

The experiments on board will support about 220 investigations currently happening at the space station. "They span a multitude of scientific disciplines, including biological research, the physical sciences, the human research that we're doing with the astronauts, the technology demonstration studying Earth and space from the ISS, and then last but not least, the educational activities that students have an opportunity to participate in," Camille Alleyne, an associate space station program scientist at NASA's Johnson Space Center in Houston, said at the briefing.

One astrophysics experiment, called the Neutron star Interior Composition ExploreR (NICER), will investigate the possibility of utilizing neutron stars — the ultradense cores of dead stars — to develop a type of interstellar GPS navigation system.

A new, experimental type of solar panel is also flying to the space station on the Dragon. Called the Roll Out Solar Array (ROSA), these new solar arrays are smaller, lighter and more efficient than the current solar panels that power the ISS.

The Dragon also contains some live passengers, including 40 mice and thousands of fruit flies. For a project called Rodent Research-5, the mice will help researchers study a new drug for osteoporosis, or bone density loss. The fruit flies will help investigators study the prolonged effects of spaceflight on the human heart.

More Earth-observation instruments are also on their way to the ISS. The Multiple-User System for Earth Sensing (MUSES) facility, developed by Teledyne Brown Engineering, contains new high-resolution digital cameras and hyperspectral imagers, bringing new capabilities to the space station's suite of Earth-observing technologies.

Email Hanneke Weitering at hweitering@space.com or follow her @hannekescience. Follow us @Spacedotcom, Facebook and Google+. Original article on Space.com.

Third Gravitational Wave Event Detected

Published: 1 Jun , 2017

by Evan Gough

A third gravitational wave has been detected by the Laser Interferometer Gravitational-wave Observatory (LIGO). An international team announced the detection today, while the event itself was detected on January 4th, 2017. Gravitational waves are ripples in space-time predicted by Albert Einstein over a century ago.

LIGO consists of two facilities: one in Hanford, Washington and one in Livingston, Louisiana. When LIGO announced its first gravitational wave back in February 2016 (detected in September 2015), it opened up a new window into astronomy. With this gravitational wave, the third one detected, that new window is getting larger. So far, all three waves detected have been created by the merging of black holes.

The team, including engineers and scientists from Northwestern University in Illinois, published their results in the journal Physical Review Letters.

When the first gravitational wave was finally detected, over a hundred years after Einstein predicted it, it helped confirm Einstein's description of space-time as an integrated continuum. It's often said that it's not a good idea to bet against Einstein, and this third detection just strengthens Einstein's theory.

Like the previous two detections, this one was created by the merging of two black holes. These two were different sizes from each other; one was about 31.2 solar masses, and the other was about 19.4 solar masses. The combined 50 solar mass event caused the third wave, which is named GW170104. The black holes were about 3 billion light years away.

"…an intriguing black hole population…" – Vicky Kalogera, Senior Astrophysicist, LIGO Scientific Collaboration

LIGO is showing us that their is a population of binary black holes out there. "Our handful of detections so far is revealing an intriguing black hole population we did not know existed until now," said Northwestern's Vicky Kalogera, a senior astrophysicist with the LIGO Scientific Collaboration (LSC), which conducts research related to the twin LIGO detectors, located in the U.S.

"Now we have three pairs of black holes, each pair ending their death spiral dance over millions or billions of years in some of the most powerful explosions in the universe. In astronomy, we say with three objects of the same type you have a class. We have a population, and we can do analysis."

The Laser Interferometer Gravitational-Wave Observatory (LIGO)facility in Livingston, Louisiana. The other facility is located in Hanford, Washington. Image: LIGO

When we say that gravitational waves have opened up a new window on astronomy, that window opens onto black holes themselves. Beyond confirming Einstein's predictions, and establishing a population of binary black holes, LIGO can characterize and measure those black holes. We can learn the holes' masses and their spin characteristics.

"Once again, the black holes are heavy," said Shane Larson, of Northwestern University and Adler Planetarium in Chicago. "The first black holes LIGO detected were twice as heavy as we ever would have expected. Now we've all been churning our cranks trying to figure out all the interesting myriad ways we can imagine the universe making big and heavy black holes. And Northwestern is strong in this research area, so we are excited."

This third finding strengthens the case for the existence of a new class of black holes: binary black holes that are locked in relationship with each other. It also shows that these objects can be larger than thought before LIGO detected them.

"It is remarkable that humans can put together a story and test it, for such strange and extreme events that took place billions of years ago and billions of light-years distant from us." – David Shoemaker, MIT

"We have further confirmation of the existence of black holes that are heavier than 20 solar masses, objects we didn't know existed before LIGO detected them," said David Shoemaker of MIT, spokesperson for the LIGO Scientific Collaboration . "It is remarkable that humans can put together a story and test it, for such strange and extreme events that took place billions of years ago and billions of light-years distant from us."

An artist's impression of two merging black holes. Image: NASA/CXC/A. Hobart

"With the third confirmed detection of gravitational waves from the collision of two black holes, LIGO is establishing itself as a powerful observatory for revealing the dark side of the universe," said David Reitze of Caltech, executive director of the LIGO Laboratory and a Northwestern alumnus. "While LIGO is uniquely suited to observing these types of events, we hope to see other types of astrophysical events soon, such as the violent collision of two neutron stars."

A tell-tale chirping sound confirms the detection of a gravitational wave, and you can hear it described and explained here, on a Northwestern University podcast.

Sources:

LIGO Detects Gravitational Waves For Third Time

GW170104: Observation of a 50-Solar-Mass Binary Black Hole

What Exactly Should We See When a Star Splashes into a Black Hole Event Horizon?

by Evan Gough

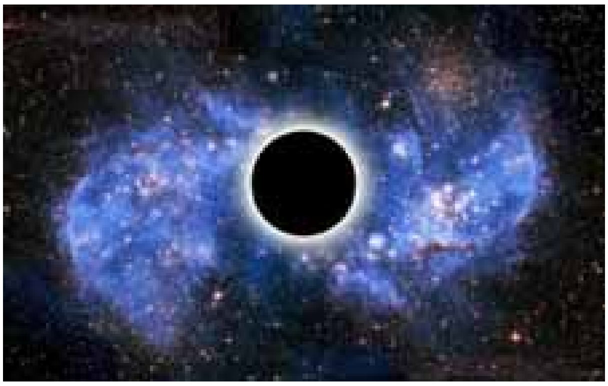
At the center of our Milky Way galaxy dwells a behemoth. An object so massive that nothing can escape its gravitational pull, not even light. In fact, we think most galaxies have one of them. They are, of course, supermassive black holes.

Supermassive black holes are stars that have collapsed into a singularity. Einstein's General Theory of Relativity predicted their existence. And these black holes are surrounded by what's known as an event horizon, which is kind of like the point of no return for anything getting too close to the black hole. But nobody has actually proven the existence of the event horizon yet.

Some theorists think that something else might lie at the center of galaxies, a supermassive object event stranger than a supermassive black hole. Theorists think these objects have somehow avoided a black hole's fate, and have not collapsed into a singularity. They would have no event horizon, and would have a solid surface instead.

"Our whole point here is to turn this idea of an event horizon into an experimental science, and find out if event horizons really do exist or not," – Pawan Kumar Professor of Astrophysics, University of Texas at Austin.

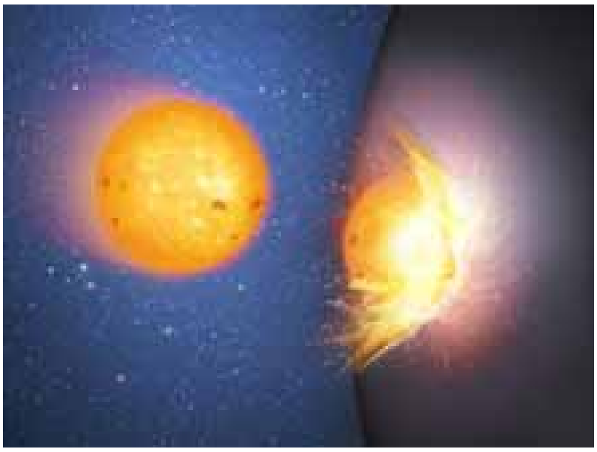
A team of researchers at the University of Texas at Austin and Harvard University have tackled the problem. Wenbin Lu, Pawan Kumar, and Ramesh Narayan wanted to shed some light onto the event horizon problem. They wondered about the solid surface object, and what would happen when an object like a star collided with it. They published their results in the Monthly Notices of the Royal Astronomical Society.



Artist's conception of the event horizon of a black hole. Credit: Victor de Schwanberg/Science Photo Library

"Our whole point here is to turn this idea of an event horizon into an experimental science, and find out if event horizons really do exist or not," said Pawan Kumar, Professor of Astrophysics at The University of Texas at Austin, in a press release.

Since a black hole is a star collapsed into a singularity, it has no surface area, and instead has an event horizon. But if the other theory turns out to be true, and the object has a solid surface instead of an event horizon, then any object colliding with it would be destroyed. If a star was to collide with this hard surface and be destroyed, the team surmised, then the gas from the star would enshroud the object and shine brightly for months, or even years.



This is the first in a sequence of two artist's impressions that shows a huge, massive sphere in the center of a galaxy, rather than a supermassive black hole. Here a star moves towards and then smashes into the hard surface of the sphere, flinging out debris. The impact heats up the site of the collision. Image:
Mark A. Garlick/CfA

In this second artist's impression a huge sphere in the center of a galaxy is shown after a star has collided with it. Enormous amounts of heat and a dramatic increase in the brightness of the sphere are generated by this event. The lack of observation of such flares from the center of galaxies means that this hypothetical scenario is almost completely ruled out. Image: Mark A. Garlick/CfA

If that were the case, then the team knew what to look for. They also worked out how often this would happen.

"We estimated the rate of stars falling onto supermassive black holes," Lu said in the same press release. "Nearly every galaxy has one. We only considered the most massive ones, which weigh about 100 million solar masses or more. There are about a million of them within a few billion light-years of Earth."

Now they needed a way to search the sky for these objects, and they found it in the archives of the Pan-STARRS telescope. Pan-STARRS is a 1.8 meter telescope in Hawaii. That telescope recently completed a survey of half of the northern hemisphere of the sky. In that survey, Pan-STAARS spent 3.5 years looking for transient objects in the sky, objects that brighten and then fade. They searched the Pan-STARR archives for transient objects that had the signature they predicted from stars colliding with these supermassive, hard-surfaced objects.

The trio predicted that in the 3.5 year time-frame captured by the Pan-STAARS survey, 10 of these collisions would occur and should be represented in the data.

"It turns out it should have detected more than 10 of them, if the hard-surface theory is true." – Wenbin Lu, Dept. of Astronomy, University of Texas at Austin.

"Given the rate of stars falling onto black holes and the number density of black holes in the nearby universe, we calculated how many such transients Pan-STARRS should have detected over a period of operation of 3.5 years. It turns out it should have detected more than 10 of them, if the hard-surface theory is true," Lu said.

The team found none of the flare-ups they expected to see if the hard-surface theory is true.

"Our work implies that some, and perhaps all, black holes have event horizons…" – Ramesh Narayan, Harvard-Smithsonian Center for Astrophysics.

What might seem like a failure, isn't one of course. Not for Einstein, anyway. This represents yet another successful test of Einstein's Theory of General Relativity, showing that the event horizon predicted in his theory does seem to exist.

As for the team, they haven't abandoned the idea yet. In fact, according to Pawan Kumar, Professor of Astrophysics, University of Texas at Austin, "Our motive is not so much to establish that there is a hard surface, but to push the boundary of knowledge and find concrete evidence that really, there is an event horizon around black holes."

"General Relativity has passed another critical test." – Ramesh Narayan, Harvard-Smithsonian Center for Astrophysics.

"Our work implies that some, and perhaps all, black holes have event horizons and that material really does disappear from the observable universe when pulled into these exotic objects, as we've expected for decades," Narayan said. "General Relativity has passed another critical test."

The team plans to continue to look for the flare-ups associated with the hard-surface theory. Their look into the Pan-STARRS data was just their first crack at it.

An artist's illustration of the Large Synoptic Survey Telescope with a simulated night sky. The team hopes to use the LSST to further refine their search for hard-surface supermassive objects. Image: Todd Mason, Mason Productions Inc. / LSST Corporation

They're hoping to improve their test with the upcoming Large Synoptic Survey Telescope (LSST) being built in Chile. The LSST is a wide field telescope that will capture images of the night sky every 20 seconds over a ten-year span. Every few nights, the LSST will give us an image of the entire available night sky. This will make the study of transient objects much easier and effective.

More reading: Rise of the Super Telescopes: The Large Synoptic Survey Telescope

Sources:

Do Stars Fall Quietly into Black Holes, or Crash into Something Utterly Unknown?

Stellar disruption events support the existence of the black hole event horizon

Best Jupiter Images From Juno … So Far

Published: 31 May , 2017

by Nancy Atkinson

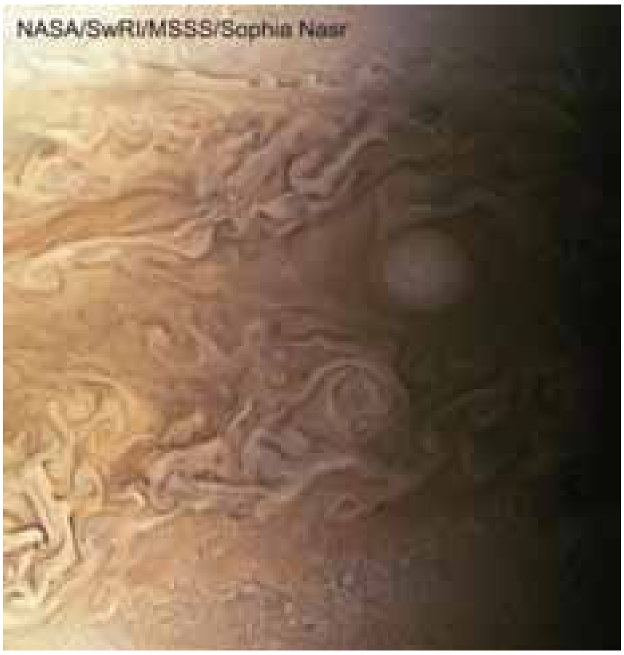
The original plans for the Juno mission to Jupiter didn't include a color camera. You don't need color images when the mission's main goals are to map Jupiter's magnetic and gravity fields, determine the planet's internal composition, and explore the magnetosphere.

But a camera was added to the manifest, and the incredible images from the JunoCam have been grabbing the spotlight.

As an instrument where students and the public can choose the targets, JunoCam is a "public outreach" camera, meant to educate and captivate everyday people.

"The whole endeavor of JunoCam was to get the public to participate in a meaningful way," said Candy Hansen, Juno co-investigator at the Planetary Science Institute in Tucson, Arizona, speaking at a press conference last week to showcase Juno's science and images.

And participate they have. Hundreds of 'amateur' image processing enthusiasts have been processing raw data from the JunoCam, turning them into stunning images, many reminiscent of a swirling Van Gogh 'starry night' or a cloudscape by Monet.



The swirling cloudtops of Jupiter, as seen by Juno during Perijove 5 on March 27, 2017. Credit: NASA/JPL-Caltech/SwRI/MSSS/Sophia Nasr.

"The contributions of the amateurs are essential," Hansen said. "I cannot overstate how important the contributions are. We don't have a way to plan our data without the contributions of the amateur astronomers. We don't have a big image processing team, so we are completely relying on the help of our citizen scientists."

Jupiter as seen by Juno during Perijove 6 in May, 2017. Credit: NASA/SwRI/MSSS/Gerald Eichstädt / Seán Doran.

Click on this image to have access to a 125 Megapixel upscaled print portrait.

Featured here are images processed by Seán Doran, Sophia Nasr, Kevin Gill and Jason Major. Like hundreds of others around the world, they anxiously await for data to arrive to Earth, where it is uploaded to the public Juno website. Then they set to work to turn the data into images.

"What I find the most phenomenal of all is that this takes real work," Hansen said. "When you download a JunoCam image and process it, it's not something you do in five minutes. The pictures that we get that people upload back onto our site, they've invested hours and hours of their own time, and then generously returned that to us."

This video shows Juno's trajectory from Perijove 6, and is based on work by Gerald Eichstädt, compiled and edited by Seán Doran. "This is real imagery projected along orbit trajectory," Doran explained on Twitter.

Many of the images are shared on social media, but you can see the entire gallery of processed JunoCam images here. The Planetary Society also has a wonderful gallery of images processed by people around the world.

Intricate swirls on Jupiter Jupiter, from Juno's Perijove 6 pass on May 19, 2017. Credit:
NASA/JPL-Caltech/SwRI /MSSS/Kevin M. Gill.

Details of Jupiter's swirling gas clouds, as seen by Juno during the Perijove 6 pass in May, 2017. Credit:
NASA / SwRI / MSSS / Gerald Eichstädt / Seán Doran.

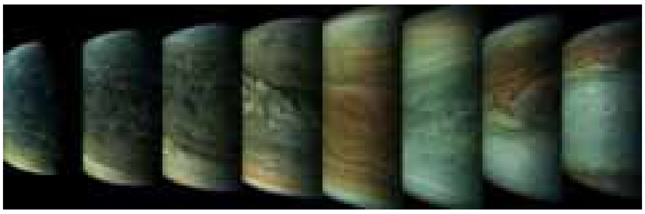
JunoCam was built by Malin Space Science Systems, which has cameras on previous missions like the Curiosity Mars Rover, the Mars Global Surveyor and the Mars Color Imager on the Mars Reconnaissance Orbiter. To withstand the harsh radiation environment at Jupiter, the camera required special protection and a reinforced lens.

Whenever new images arrive, many of us feel exactly like editing enthusiast Björn Jónsson:

Even the science team has expressed their amazement at these images.

"Jupiter looks different than what we expected," said Scott Bolton, Juno's principal investigator at the Southwest Research Institute. "Jupiter from the poles doesn't look anything like it does from the equator. And the fact the north and south pole don't look like each other, makes us wonder if the storms are stable, if they going to stay that way for years and years like the the Great Red Spot. Only time will tell us what is true."

Read our article about the science findings from Juno.



A sequence of images of Jupiter from Juno's Perijove 6 pass during May, 2017. Credit:
NASA / SwRI / MSSS / Gerald Eichstädt / Seán Doran.

Part of what makes these images so stunning is that Juno is closer to Jupiter than any previous spacecraft.

"Juno has an elliptical orbit that brings it between the inner edges of Jupiter's radiation belt and the planet, passing only 5,000 km above the cloud tops," Juno Project Manager Rick Nybakken told me in my book 'Incredible Stories From Space: A Behind-the-Scenes Look at the Missions Changing Our View of the Cosmos.' "This close proximity to Jupiter is unprecedented, as no other mission has conducted their science mission this close to the planet. We're right on top of Jupiter, so to speak."

Juno engineers designed the mission to enable the use of solar panels, which prior to Juno, have never been used on a spacecraft going so far from the Sun. Juno orbits Jupiter in a way that the solar panels are always pointed towards the Sun and the spacecraft never goes behind the planet. Juno's orbital design not only enabled an historic solar-powered mission, it also established Juno's unique science orbit.

White oval on Jupiter during Juno's Perijove 4 pass on February 2, 2017. Processed from raw data. Credit: NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill.

Uncalibrated, processed raw image from Juno's Perijove 6 pass of Jupiter on May 19, 2017. Credit: NASA/SwRI/MSSS/Jason Major.

Juno spacecraft launched from Cape Canaveral on August 5, 2011. After traveling five years and 1.7 billion miles Juno arrived in orbit at Jupiter on July 4, 2016. The mission will last until at least February 2018, making 11 science orbits around Jupiter, instead of the 32 laps originally planned. Last year, engineers detected a problem with check valves in the propulsion system, and NASA decided to forego an engine burn to move Juno into a tighter 14-day orbit around Jupiter. The current 53.4 day orbit will be maintained, but depending on how the spacecraft responds, NASA could extend the mission another three years to give Juno more flybys near Jupiter.

The next science flyby will occur on July 11, when Juno will get some close-up views of the famous Great Red Spot.

Thanks to everyone who works on these images.

Animation of six images acquired by NASA's Juno spacecraft on March 27, 2017. Credit: NASA/JPL-Caltech/SwRI/MSSS/Jason Major.

This enhanced color view of Jupiter's south pole was created by citizen scientist Gabriel Fiset using data from the JunoCam instrument on NASA's Juno spacecraft. Oval storms dot the cloudscape. Approaching the pole, the organized turbulence of Jupiter's belts and zones transitions into clusters of unorganized filamentary structures, streams of air that resemble giant tangled strings. The image was taken on Dec. 11, 2016 at 9:44 a.m. PST (12:44 p.m. EST), from an altitude of about 32,400 miles (52,200 kilometers) above the planet's beautiful cloud tops. Credits: NASA/JPL-Caltech/SwRI/MSSS/Gabriel Fiset

Lunar Orbiter Takes a Meteorite Strike Right in the Camera

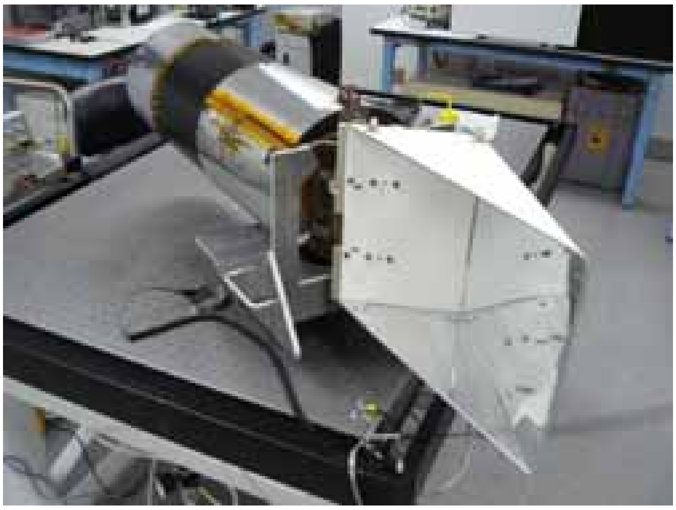
Published: 29 May , 2017

by Matt Williams
On October 13th, 2014, the Lunar Reconnaissance Orbiter

(LRO) experienced something rare and unexpected. While monitoring the surface of the Moon, the LRO's main instrument – the Lunar Reconnaissance Orbiter Camera (LROC) – produced an image that was rather unusual. Whereas most of the images it has produced were detailed and exact, this one was subject to all kinds of distortion.

From the way this image was disturbed, the LRO science team theorized that the camera must have experienced a sudden and violent movement. In short, they concluded that it had been struck by a tiny meteoroid, which proved to a significant find in itself. Luckily, the LRO and its camera appear to have survived the impact unharmed and will continue to survey the surface of the Moon for years to come.

The LROC is a system of three cameras that are mounted aboard the LRO spacecraft. This include two Narrow Angle Cameras (NACs) – which capture high-resolution black and white images – and a third Wide Angle Camera (WAC), which captures moderate resolution images that provide information about the properties and color of the lunar surface.



The NAC on a bench in the clean room at Malin Space Science Systems. Credit: Courtesy of Malin Space Science Systems/ ASU SESE

The NACs works by building an image one line at a time, with thousands of lines being used to compile a full image. In between the capture process, the spacecraft moves the camera relative to the surface. On October 13th, 2014, at precisely 21:18:48 UTC, the camera added a line that was visibly distorted. This sent the LRO team on a mission to investigate what could have caused it.

Led by Mark Robinson – a professor and the principal investigator of the LROC at Arizona State University's School of Earth and Space Exploration – the LROC researchers concluded that the left Narrow Angle Camera must have experienced a brief and violent movement. As there were no spacecraft events – like a solar panel movement or antenna tracking – that might have caused this, the only possibility appeared to be a collision.

As Robinson explained in a recent post on the LROC's website:

"There were no spacecraft events (such as slews, solar panel movements, antenna tracking, etc.) that might have caused spacecraft jitter during this period, and even if there had been, the resulting jitter should have affected both cameras identically… Clearly there was a brief violent movement of the left NAC. The only logical explanation is that the NAC was hit by a meteoroid! How big was the meteoroid, and where did it hit?"

To test this, the team used a detailed computer model that was developed specifically for the LROC to ensure that the NAC would not fail during the launch of the spacecraft, when severe vibrations would occur. With this model, the LROC team ran simulations to see if they could reproduce the distortions that would have caused the image. Not only did they conclude it was the result of a collision, but they were also able to determine the size of the meteoroid that hit it.

LROC Narrow Angle Camera (NAC). Credit: ASU/LROC SESE

The results indicated that the impacting meteoroid would have measured about 0.8 mm in diameter and had a density of a regular chondrite meteorite (2.7 g/cm^3). What's more, they were able to estimate that it was traveling at a velocity of about 7 km/s (4.3 miles per second) when it collided with the NAC. This was rather surprising, given the odds of collisions and how much time the LRO spends gathering data.

Typically, the LROC only captures images during daylight hours, and for about 10% of the day. So for it to have been hit while it was also capturing images is statistically unlikely – only about 5% by Robinson's own estimate. Luckily, the impact has not caused any technical problems for the LROC, which is also something of a minor miracle. As Robinson explained:

"For comparison, the muzzle velocity of a bullet fired from a rifle is typically 0.5 to 1.0 kilometers per second. The meteoroid was traveling much faster than a speeding bullet. In this case, LROC did not dodge a speeding bullet, but rather survived a speeding bullet! LROC was struck and survived to keep exploring the Moon, thanks to Malin Space Science Systems' robust camera design."

It was only after the team deduced that no damage had been caused that prompted the announcement. According to John Keller, the LRO project scientist from NASA's Goddard Space Flight Center, the real story here was how the imagery that was being acquired at the time was used to deduce how and when the LRO had been struck by a meteoroid.

Artist's rendering of Lunar Reconnaissance Orbiter (LRO) in orbit. Credit: ASU/LROC

"Since the impact presented no technical problems for the health and safety of the instrument," he said, "the team is only now announcing this event as a fascinating example of how engineering data can be used, in ways not previously anticipated, to understand what is happening to the spacecraft over 236,000 miles (380,000 kilometers) from the Earth."

In addition, the impact of a meteoroid on the LRO demonstrates just how precious the information that missions like the LRO provides truly is. Beyond mapping the lunar surface, the orbiter was also able to let its science team know exactly and when its images were comprised, all because of the high-quality data it collects.

Since it launched in June of 2008, the LRO has collected an immense amount of data on the lunar surface. The mission has been extended several times, from its original duration of two years to the just under nine. Its ongoing performance is also a testament to the durability of the craft and its components.

Be sure to enjoy this video of the images obtained by the LRO, courtesy of the LROC team:

Further Reading: ASU/LROC

There's a Hard Rock Rain on the Moon, We Can See it From Earth

Article Updated: 29 May , 2017

by Matt Williams
In February of 2015, the National Observatory of Athens and the European Space Agency launched the Near-Earth object Lunar Impacts and Optical TrAnsients (NELIOTA) project. Using the 1.2 meter telescope at the Kryoneri Observatory, the purpose of this project is to the determine the frequency and distribution of Near-Earth Objects (NEOs) by monitoring how often they impact the Moon.

Last week, on May 24th, 2017, the ESA announced that the project had begun to detect impacts, which were made possible thanks to the flashes of light detected on the lunar surface. Whereas other observatories that monitor the Moon's surface are able to detect these impacts, NELIOTA is unique in that it is capable of not only spotting fainter flashes, but also measuring the temperatures of they create.

Projects like NELIOTA are important because the Earth and the Moon are constantly being bombarded by natural space debris – which ranges in size from dust and pebbles to larger objects. While larger objects are rare, they can cause considerable damage, like the 20-meter object that disintegrated above the Russian city of Chelyabinsk in February of 2013, causing extensive injuries and destruction of property.

The two main smoke trails left by the Russian meteorite as it passed over the city of Chelyabinsk. Credit: AP Photo/ Chelyabinsk.ru

What's more, whereas particulate matter rains down on Earth and the Moon quite regularly, the frequency of pebble-sized or meter-sized objects is not well known. These objects remain too small to be detected by telescopes directly, and cameras are rarely able to picture them before they break up in Earth's atmosphere. Hence, scientists have been looking for other ways to determine just how frequent these potentially-threatening objects are.

One way is to observe the areas of the lunar surface that are not illuminated by the Sun, where the impact of a small object at high speed will cause a bright flash. These flashes are created by the object burning up on impact, and are bright enough to be seen from Earth. Assuming the objects have a density and velocity common to NEOs, the brightness of the impact can be used to determine the size and mass of the object.

As Detlef Koschny – the co-manager of the near-Earth object segment of the ESA's Space Situational Awareness Program, and a scientist in the Science Support Office – said in an ESA press release:

"*These observations are very relevant for our Space Situational Awareness program. In particular, in the size range we can observe here, the number of objects is not very well known. Performing these observations over a longer period of time will help us to better understand this number.*"

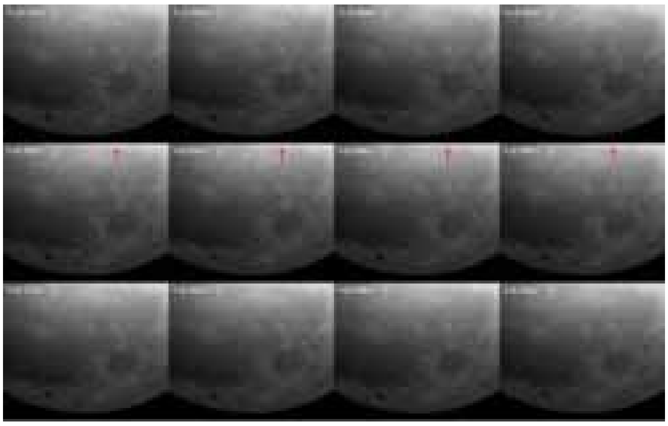
Tiny pieces of rock striking the Moon's surface were witnessed by the NELIOTA project, which was monitoring the dark side of the Moon. Credit: NELIOTA project

After being taken offline in 2016 for the sake of making upgrades, the NELIOTA project officially began conducting operations on March 8th, 2017. Using this refurbished telescope, which is operated by the National Observatory of Athens, NELIOTA is capable of detecting flashes that are much fainter than any current, small-aperture, lunar monitoring telescopes.

The telescope does this by observing the Moon's night hemisphere whenever it is above the horizon and between phases. At these times – i.e. between a New Moon and the First Quarter, or between the Last Quarter and a New Moon – the surface is mostly dark and flashes are most visible. Incoming light is then split into two colors and the data is recorded by two advanced digital cameras that operate in different color ranges.

This data is then analyzed by automated software, which extrapolates temperatures based on the color data obtained by the cameras. As Alceste Bonanos – the Principal Investigator for NELIOTA – explained, all this sets the 1.2 meter telescope apart:

"*Its large telescope aperture enables NELIOTA to detect fainter flashes than other lunar monitoring surveys and provides precise color information not currently available from other project. Our twin camera system allows us to confirm lunar impact events with a single telescope, something that has not been done before. Once data have been collected over the 22-month long operational period, we will be able to better constrain the number of NEOs (near-Earth objects) in the decimetre to metre size range.*



Images showing the lunar impact flash caught by NELIOTA. Credit: NELIOTA project

The NELIOTA project scientists are currently collaborating with the Science Support Office of ESA to analyze the flashes and measure the temperatures of each flash. From this, they hope to be able to make accurate estimates of the mass and size of each impactor, which they will further corroborate by analyzing the size of the craters these impacts leave behind.

The study of impacts on the Moon will ultimately let scientists know exactly how often larger objects are raining down on Earth. Armed with this information, we will be able to make better predictions on when and how a potentially-threatening object could be entering our atmosphere. As the Chelyabinsk meteor demonstrated, one of the greatest dangers posed by meteorites is a general lack of preparedness. Where people can be forewarned, injury, damage and even deaths can be prevented.

NELIOTA is also contributing to public outreach and education through a number of initiatives. These include public tours of the Kryoneri Observatory – in which the details of the NELIOTA project are shared – as well as presentations to students and the general public about Near-Earth Asteroids. The project team are also training two PhD students in how to operate the Kryoneri telescope and conduct lunar observing, thus creating the next-generation of NEO observers.

This summer (Friday, June 30th), the Observatory will also be hosting a public event to coincide with Asteroid Day 2017. This international event will feature presentations, speeches and educational seminars hosted by astronomical institutions and organizations from all around the world. Save the date!

Further Reading: ESA

New Zealand's First Rocket Launch to Space!

Article Updated: 26 May , 2017

by Matt Williams

Earlier this week, the island nation of New Zealand accomplished a historic first. On Wednesday, May 24th at 16:20 p.m. NZST – 00:20 a.m. EDT; May 23rd, 21:20 p.m. PDT – the country joined the small club of nations that have space launch capability. Taking off from a launch pad located on the Mahia Peninsula (on the North Island), the test flight was also a first for the US/NZ-based company Rocket Lab.

With the successful launch of their test rocket, Rocket Lab has become the latest aerospace firm to join a burgeoning market, where private companies are able to provide regular launch services to Low-Earth Orbit (LEO). Whereas other companies like SpaceX are looking to restore domestic heavy-launch capability, companies like Rocket Lab are looking to fill a niche market which would make space more accessible.

The launch was originally pushed back to this past Wednesday, which was the fourth day in a ten-day launch window (running from May 21st to May 30th), due to bad weather. And while no spectators or media outlets were permitted to witness the event, the company recorded the launch and posted it to their website and official Twitter account (shown below).

Though the rocket did not quite reach orbit, it successfully flew along the trajectory that future launches will follow. This test launch was the first of three planned, and carried sensor equipment rather than a conventional payload in order to let engineers on the ground gather data on the flight. As chief executive Peter Beck said in a statement after the rocket took off from Rocket Lab's Launch Complex 1:

"It was a great flight. We had a great first stage burn, stage separation, second stage ignition and fairing separation. We didn't quite reach orbit and we'll be investigating why, however reaching space in our first test puts us in an incredibly strong position to accelerate the commercial phase of our program, deliver our customers to orbit and make space open for business."

The rocket in question was a prototype disposable vehicle known as the Electron rocket. This two-stage rocket is composed of carbon fiber, which allows for durability and reduced weight, and is manufactured in-house. It also relies on a "plug-in payload" design that allows for the separation of the main assembly and payload integration processes.

In short, in the future, customers will be able to load the payload fairing themselves at their own facilities. This is especially useful wherever environmentally-controlled or sealed cargo is involved. They will then be able to have the second stage transported to the Rocket Lab facility for integration. This design is also intended to allow for flexibility, where the launch vehicle can be tailored to meet specific mission requirements.

The dedicated payload fairing of the Electron rocket. Credit: rocketlabusa.com

The first stage of the vehicle is powered by nine Rutherford engines – an oxygen/kerosene pump-fed engine designed and built by Rocket Lab – while the second stage is powered by a single Rutherford. In addition to reducing mass, the engine is also the first oxygen/kerosene engine to make use of 3-D printed components. Each engine offers a liftoff thrust of 18 kilo Newtons, or 4000 pound-force (lbf), and a peak thrust (in vacuum) of 22 kN (41,500 lbf).

Once testing is complete, Rocket Lab intends to maintain a fleet of these rockets, which will be capable of launching payloads of between 150 and 225 kg (330 to 496 lbs) to a 500 km Sun-synchronous orbit. With these parameters in mind, Rocket Lab is clearly aiming to cater to telecommunications companies, internet providers, research institutions and universities.

In short, small satellites are a fast-growing market, but the current space launch environment can be prohibitive to small companies and researchers. As it stands, booking a space launch is a complicated matter, subject to flight schedules, the availability of cargo space, and costs that are outside of many customers' price range. By developing rockets that are relatively cheap and can be built quickly, those looking to launch small satellite will have increased options.

"We're one of a few companies to ever develop a rocket from scratch and we did it in under four years. We've worked tirelessly to get to this point," said Beck. "We've developed everything in house, built the world's first private orbital launch range, and we've done it with a small team.

New Zealand was selected as the location of the company's launch facility for a number of reasons. Compared to the US and other potential launch sites, New Zealand has less air traffic, which ensures that air carriers don't need to reroute their flights during a launch. The country is also well-situated to get satellites into a north-to-south orbit around Earth, and launches take place over open water (away from population centers).

On top of that, Rocket Lab CEO and founder Peter Beck is a native of New Zealand. In the coming weeks, the company he founded will be looking over its test flight data to prepare for its second test launch, which will take place in a few months. This launch will attempt to reach orbit and maximize the payload the rocket can carry. All told, Rocket Lab has three test flights scheduled for 2017.

Once the company reaches full production, they hope to be conducting a record-setting 50 to 120 launches a year. If possible, this will significantly reduce the costs associated with small payload launches.

"We have learnt so much through this test launch and will learn even more in the weeks to come," said Beck. "We're committed to making space accessible and this is a phenomenal milestone in that journey. The applications doing this will open up are endless. Known applications include improved weather reporting, Internet from space, natural disaster prediction, up-to-date maritime data as well as search and rescue services."

Rocket Lab is joined by companies like ARCA, which is seeking to lower the costs of small-payload launches through the development of single-stage-to-orbit (SSTO) rockets. Their SSTO rocket concept, known as the Haas 2CA, was unveiled in March and is scheduled to begin launch testing next year.

Star Should Have Gone Supernova, But it Imploded Into a Black Hole Instead

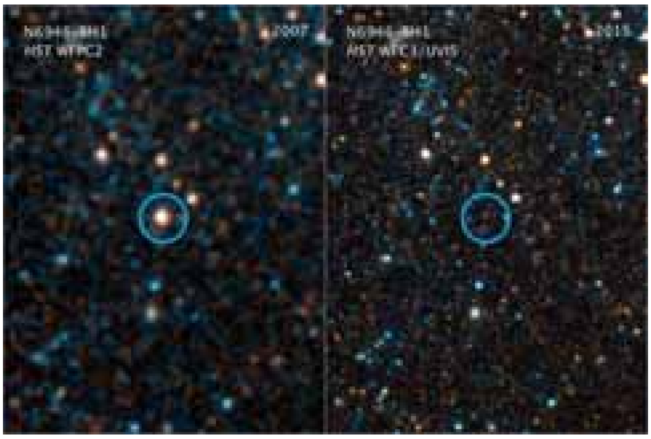
Article Updated: 27 May , 2017

by Matt Williams

Collapsing stars are a rare thing to witness. And when astronomers are able to catch a star in the final phase of its evolution, it is a veritable feast for the senses. Ordinarily, this process consists of a star undergoing gravitational collapse after it has exhausted all of its fuel, and shedding its outer layers in a massive explosion (aka. a supernova). However, sometimes, stars can form black holes without the preceding massive explosion.

This process, what might be described as "going out not with a bang, but with a whimper", is what a team of astronomers witnessed when observing N6946-BH1 – a star located in the Fireworks Galaxy (NGC 6946). Originally, astronomers thought that this star would exploded because of its significant mass. But instead, the star simply fizzled out, leaving behind a black hole.

The Fireworks Galaxy, a spiral galaxy located 22 million light-years from Earth, is so-named because supernova are known to be a frequent occurrence there. In fact, earlier this month, an amateur astronomer spotted what is now designated as SN 2017eaw. As such, three astronomers from Ohio Sate University (who are co-authors on the study) were expecting N6946-BH1 would go supernova when in 2009, it began to brighten.



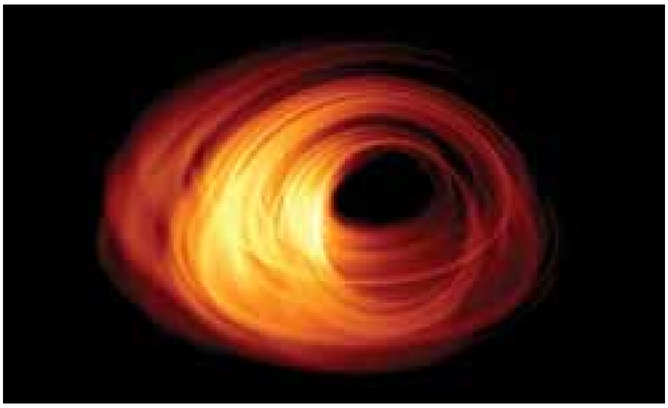
Visible-light and near-infrared photos from NASA's Hubble Space Telescope showing the giant star N6946-BH1 before and after it vanished out of sight by imploding to form a black hole. Credit: NASA/ESA/C. Kochanek (OSU)

However, by 2015, it appeared to have winked out. As such, the team went looking for the remnants of it with the help of colleagues from Ohio State University and the University of Oklahoma. Using the combined power of the Large Binocular Telescope (LBT) and NASA's Hubble and Spitzer space telescopes, they realized that the star had completely disappeared from sight.

The details of their research appeared in a study titled "The Search for Failed Supernovae with the Large Binocular Telescope: Confirmation of a Disappearing Star", which recently appeared in the *Monthly Notices of the Royal Astronomical Society*. Among the many galaxies they were watching for supernovas, they had their sights set on the Fireworks Galaxy to see what had become of N6946-BH1.

After it experienced a weak optical outburst in 2009, they had anticipated that this red supergiant would go supernova – which seemed logical given that it was 25 times as massive as our Sun. After winking out in 2015, they had expected to find that the star had merely dimmed, or that it had cast off a dusty shell of material that was obscuring its light from view.

Their efforts included an LBT survey for failed supernovae, which they combined with infrared spectra obtained by the Spitzer Space Telescope and optical data from Hubble. However, all the surveys turned up negative, which led them to only one possible conclusion: that N6946-BH1 must have failed to go supernova and instead went straight to forming a blackhole.



Simulated view of a black hole. Credit: Bronzwaer/Davelaar/Moscibrodzka/Falcke, Radboud University

As Scott Adams – a former Ohio State student who is now an astrophysicist at the Cahill Center for Astrophysics (and the lead author of the study) – explained in a NASA press release:

"N6946-BH1 is the only likely failed supernova that we found in the first seven years of our survey. During this period, six normal supernovae have occurred within the galaxies we've been monitoring, suggesting that 10 to 30 percent of massive stars die as failed supernovae. This is just the fraction that would explain the very problem that motivated us to start the survey, that is, that there are fewer observed supernovae than should be occurring if all massive stars die that way."

A major implication of this study is the way it could shed new light on the formation of very massive black holes. For some time now, astronomers have believed that in order to form a black hole at the end of its life cycle, a star would have to be massive enough to cause a supernova. But as the team observed, it doesn't make sense that a star would blow off its outer layers and still have enough mass left over to form a massive black hole.

As Christopher Kochanek – a professor of astronomy at The Ohio State University, the Ohio Eminent Scholar in Observational Cosmology and a co-author of the team's study – explained:

"The typical view is that a star can form a black hole only after it goes supernova. If a star can fall short of a supernova and still make a black hole, that would help to explain why we don't see supernovae from the most massive stars."

This information is also important as far as the study of gravitational waves goes. In February of 2016, scientists at the Laser Interferometer Gravitational-wave Observatory (LIGO) announced the first detection of this strange phenomena, which were apparently generated by a massive black hole. If in fact massive black holes form from failed supernova, it would help astronomers to track down the sources more easily.

Trump Proposes $19.1 Billion 2018 NASA Budget, Cuts Earth Science and Education

Article Updated: 26 May , 2017

by Ken Kremer

NASA acting administrator Robert Lightfoot outlines NASA's Fiscal Year 2018 budget proposal during a 'State of NASA' speech to agency employees held at NASA HQ on May 23, 2017. Credit: NASA TV/Ken Kremer

The Trump Administration has proposed a $19.1 Billion NASA budget request for Fiscal Year 2018, which amounts to a $0.5 Billion reduction compared to the recently enacted FY 2017 NASA Budget. Although it maintains many programs such as human spaceflight, planetary science and the Webb telescope, the budget also specifies significant cuts and terminations to NASA's Earth Science and manned Asteroid redirect mission as well as the complete elimination of the Education Office.

Overall NASA's FY 2018 budget is cut approximately 3%, or $560 million, for the upcoming fiscal year starting in October 2017 as part of the Trump Administration's US Federal Budget proposal rolled out on May 23, and quite similar to the initial outline released in March.

The cuts to NASA are smaller compared to other Federal science agencies also absolutely vital to the health of US scientific research – such as the NIH, the NSF, the EPA, DOE and NIST which suffer unconscionable double digit slashes of 10 to 20% or more.

The highlights of NASA's FY 2018 Budget were announced by NASA acting administrator Robert Lightfoot during a 'State of NASA' speech to agency employees held at NASA HQ, Washington, D.C. and broadcast to the public live on NASA TV.

Lightfoot's message to NASA and space enthusiasts was upbeat overall.

"What this budget tells us to do is to keep going!" NASA acting administrator Robert Lightfoot said.

"Keep doing what we've been doing. It's very important for us to maintain that course and move forward as an agency with all the great things we're doing."

"I want to reiterate how proud I am of all of you for your hard work – which is making a real difference around the world. NASA is leading the world in space exploration, and that is only possible through all of your efforts, every day."

"We're pleased by our top line number of $19.1 billion, which reflects the President's confidence in our direction and the importance of everything we've been achieving."

Lightfoot recalled the recent White House phone call from President Trump to NASA astronaut & ISS Station Commander Peggy Whitson marking her record breaking flight for the longest cumulative time in space by an American astronaut.

Thus Lightfoot's vision for NASA has three great purposes – Discover, Explore, and Develop.

"NASA has a historic and enduring purpose. It can be summarized in three major strategic thrusts: Discover, Explore, and Develop. These correspond to our missions of scientific discovery, missions of exploration, and missions of new technology development in aeronautics and space systems."

Lightfoot further recounted the outstanding scientific accomplishments of NASA's Mars rover and orbiters paving the path for the agencies plans to send humans on a 'Journey to Mars' in the 2030s.

"We've had a horizon goal for some time now of reaching Mars, and this budget sustains that work and also provides the resources to keep exploring our solar system and look beyond it."

Lightfoot also pointed to upcoming near term science missions- highlighting a pair of Mars landers – InSIGHT launching next year as well as the Mars 2020 rover. Also NASA's next great astronomical observatory – the James Webb Space Telescope (JWST).

"In science, this budget supports approximately 100 missions: 40 missions currently preparing for launch & 60 operating missions."

"The James Webb Space Telescope is built!" Lightfoot gleefully announced.

"It's done testing at Goddard and now has moved to Johnson for tests to simulate the vacuum of space."

JWST is the scientific successor to the Hubble Space Telescope and slated for launch in Oct. 2018. The budget maintains steady support for Webb.

The 18-segment gold coated primary mirror of NASA's James Webb Space Telescope is raised into vertical alignment in the largest clean room at the agency's Goddard Space Flight Center in Greenbelt, Maryland, on Nov. 2, 2016. The secondary mirror mount booms are folded down into stowed for launch configuration. Credit: Ken Kremer/kenkremer.com

The Planetary Sciences division receives excellent support with a $1.9 Billion budget request. It includes solid support for the two flagship missions – Mars 2020 and Europa Clipper as well as the two new Discovery class missions selected -Lucy and Psyche.

"The budget keeps us on track for the next selection for the New Frontiers program, and includes formulation of a mission to Jupiter's moon Europa."

"SLS and Orion are making great progress. They are far beyond concepts, and as I mentioned, components are being tested in multiple ways right now as we move toward the first flight of that integrated system."

NASA is currently targeting the first integrated launch of SLS and Orion on the uncrewed Exploration Mission-1 (EM-1) for sometime in 2019.

Top NASA managers recently decided against adding a crew of two astronauts to the flight after conducting detailed agency wide studies at the request of the Trump Administration.

NASA would have needed an additional $600 to $900 to upgrade EM-1 with humans.

Unfortunately Trump's FY 2018 NASA budget calls for a slight reduction in development funding for both SLS and Orion – thus making a crewed EM-1 flight fiscally unviable.

The newly assembled first liquid hydrogen tank, also called the qualification test article, for NASA's new Space Launch System (SLS) heavy lift rocket lies horizontally beside the Vertical Assembly Center robotic weld machine (blue) on July 22, 2016. It was lifted out of the welder (top) after final welding was just completed at NASA's Michoud Assembly Facility in New Orleans. Credit: Ken Kremer/kenkremer.com

The budget request does maintain full funding for both of NASA's commercial crew vehicles planned to restore launching astronauts to low Earth orbit (LEO) and the ISS from US soil on US rockets – namely the crewed Dragon and CST-100 Starliner – currently under development by SpaceX and Boeing – thus ending our sole reliance on Russian Soyuz for manned launches.

"Working with commercial partners, NASA will fly astronauts from American soil on the first new crew transportation systems in a generation in the next couple of years."

"We need commercial partners to succeed in low-Earth orbit, and we also need the SLS and Orion to take us deeper into space than ever before."

Orion crew module pressure vessel for NASA's Exploration Mission-1 (EM-1) is unveiled for the first time on Feb. 3, 2016 after arrival at the agency's Kennedy Space Center (KSC) in Florida. It is secured for processing in a test stand called the birdcage in the high bay inside the Neil Armstrong Operations and Checkout (O&C) Building at KSC. Launch to the Moon is slated in 2018 atop the SLS rocket. Credit: Ken Kremer/kenkremer.com

However the Trump Administration has terminated NASA's somewhat controversial plans for the Asteroid Redirect Mission (ARM) – initiated under the Obama Administration – to robotically retrieve a near Earth asteroid and redirect it to lunar orbit for a visit by a crewed Orion to gather unique asteroidal samples.

"While we are ending formulation of a mission to an asteroid, known as the Asteroid Redirect Mission, many of the central technologies in development for that mission will continue, as they constitute vital capabilities needed for future human deep space missions."

Key among those vital capabilities to be retained and funded going forward is Solar Electric Propulsion (SEP).

"Solar electric propulsion (SEP) for our deep space missions is moving ahead as a key lynchpin."

The Trump Administration's well known dislike for Earth science and disdain of climate change has manifested itself in the form of the termination of 5 current and upcoming science missions.

NASA's FY 2018 Earth Science budget suffers a $171 million cut to $1.8 Billion.

"While we are not proposing to move forward with Orbiting Carbon Observatory-3 (OCO-3), Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), Climate Absolute Radiance and Refractivity Observatory Pathfinder (CLARREO PF), and the Radiation Budget Instrument (RBI), this budget still includes significant Earth Science efforts, including 18 Earth observing missions in space as well as airborne missions."

The DSCOVR Earth-viewing instruments will also be shut down.

NASA's Office of Education will also be terminated completely under the proposed FY 2018 budget and the $115 million of funding excised.

"While this budget no longer supports the formal Office of Education, NASA will continue to inspire the next generation through its missions and the many ways that our work excites and encourages discovery by learners and educators. Let me tell you, we are as committed to inspiring the next generation as ever."

Congress will now have its say and a number of Senators, including Republicans says Trumps budget is DOA.

Stay tuned here for Ken's continuing Earth and Planetary science and human spaceflight news.

Ken Kremer

Space Station-Based Experiment Might Have Found Evidence of Dark Matter Destroying Itself

Published: 19 May , 2017

by Matt Williams

Since it was first proposed in the 1960s to account for all the "missing mass" in the Universe, scientists have been trying to find evidence of dark matter. This mysterious, invisible mass theoretically accounts for 26.8% of the baryonic matter (aka. visible matter) out there. And yet, despite almost fifty years of ongoing research and exploration, scientists have not found any direct evidence of this missing mass.

However, according to two new research papers that were recently published in the journal *Physical Review Letters*, we may have gotten our first glimpse of dark matter thanks to an experiment aboard the International Space Station. Known as the Alpha Magnetic Spectrometer (AMS-02), this a state-of-the-art particle physics detector has been recording cosmic rays since 2011 – which some theorize are produced by the annihilation of dark matter particles.

Like its predecessor (the AMS), the AMS-02 is the result of collaborative work and testing by an international team composed of 56 institutes from 16 countries. With sponsorship from the US Department of Energy (DOE) and overseen by the Johnson Space Center's AMS Project Office, the AMS-02 was delivered to the ISS aboard the Space Shuttle Endeavour on May 16th, 2011.

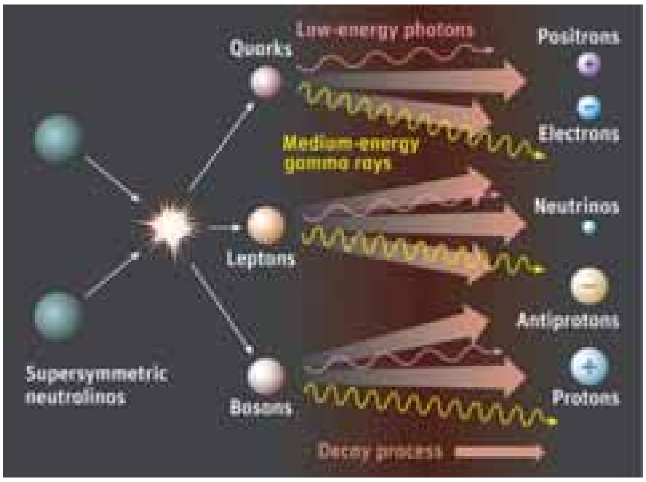
Artist's impression of the AMS-02 instrument. Credit: NASA/JSC

Ostensibly, the AMS-02 is designed to monitor cosmic rays to see how much in the way of antiprotons are falling to Earth. But for the sake of their research, the two science teams also been consulted the data it has been collecting to test theories about dark matter. To break it down, the WIMPs theory of dark matter states that it is made up of Weakly-Interacted Massive Particles (WIMPS), protons and antiprotons are the result of WIMPs colliding.

By monitoring the number of antiprotons that interact with the AMS-02, two science teams (who were working independently of each other) hoped to infer whether or not any of the antiprotons being detected could be caused by WIMP collisions. The difficulty in this, however, is knowing what would constitute an indication, as cosmic rays have many sources and the properties of WIMPs are not entirely defined.

To do this, the two teams developed mathematical models to predict the cosmic ray background, and thus isolate the number of antiprotons that AMS-02 would detect. They further incorporated fine-tuned estimates of the expected mass of the WIMPs, until it fit with the AMS-02 data. One team, led by Alessandro Cuoco, was made up of researchers from the Institute for Theoretical Particle Physics and Cosmology.

Using computer simulations, Cuoco and his colleagues examined the AMS-02 data based on two scenarios – one which accounted for dark matter and one which did not. As they indicate in their study, they not only concluded that the presence of antiprotons created by WIMP collisions better fit the data, but they were also able to constrain the mass of dark matter to about 80 GeV (about 85 times the mass of a single proton or antiproton).



According to supersymmetry, dark-matter particles known as WIMPs annihilate each other, creating a cascade of particles and radiation. Credit: Sky & Telescope / Gregg Dinderman.

As they state in their paper:

"[T]he very accurate recent measurement of the CR antiproton flux by the AMS-02 experiment allows [us] to achieve unprecedented sensitivity to possible DM signals, a factor ~4 stronger than the limits from gamma-ray observations of dwarf galaxies. Further, we find an intriguing indication for a DM signal in the antiproton flux, compatible with the DM interpretation of the Galactic center gamma-ray excess."

The other team was made up of researchers from the Chinese Academy of Sciences, Nanjing University, the University of Science and Technology of China, and the National Center for Theoretical Sciences. Led by Ming-Yang Cui of Nanjing University, this team made estimates of the background parameters for cosmic rays by using prior data from previous boron-to-carbon ratio and proton measurements.

These measurements, which determine the rate at which boron decays into carbon, can be used to guage the distance that boron molecules travel through space. In this case, they were combined with proton measurements to determine background levels for cosmic rays. They incorporated this data into a Bayesian Analysis framework (i.e. a statistical model used to determine probabilities) to see how many antiprotons could be attributed to WIMP collisions.

The results, as they state it in their paper were quite favorable and produced similar mass estimates to the study led by Cuoco's team. "Compared with the astrophysical background only hypothesis, we find that a dark matter signal is favored," they write. "The rest mass of the dark matter particles is ?20 – 80 GeV."

The AMS being delivered to the ISS by the Space Shuttle Endeavour in 2011. Credit: NASA

What's more, both scientific teams obtained similar estimates when it came to cross-section measurements of dark matter – i.e. the likelihood of collisions happening based on how densely dark matter is distributed. For example, Cuoco's team obtained a cross-section estimate of 3 x 10^{-26} per cm³ while Cui's team obtained an estimate that ranged from 0.2 – 5 × 10^{-26} per cm³.

The fact that two scientific teams, which were operating independently of each other, came to very similar conclusions based on the same data is highly encouraging. While it is not definitive proof of dark matter, it is certainly a step in the right direction. At best, it shows that we are getting closer to creating a detailed picture of what dark matter looks like.

And in the meantime, both teams acknowledge that further work is necessary. Cuoco and his team also suggest what further steps should be taken. "Confirmation of the signal will require a more accurate study of the systematic uncertainties," they write, "i.e., the antiproton production cross-section, and the modeling of the effect of solar modulation."

While scientists have attempted to find evidence of dark matter by monitoring cosmic rays in the past, the AMS-02 stands apart because of its extreme sensitivity. As of May 8th, the spectrometer has conducted measurements on 100 billion particles. As of the penning of this article, that number has increased to over 100,523,550,000!

Late News

Tim Peake may miss out on second space flight because UK contributions to ESA (NOTHING TO DO WITH BREXIT) is too low. UK puts in just 12.9% compared to well over 20% from Germany and France, and Italy 19.4%.

MEMBERS VIEWING LOGS and IMAGES

Tony Vale

Variable star log

57 variable star observations made and loaded up to both the BAAVSS and the AAVSO databases and 7 so far for June although short nights and poor weather have constrained observing opportunities as always in the summer months. Nevertheless, the summer sky has been on show throughout the month in the early hours and this brings a large number of my target stars back into view. I have also added a few new ones this month - EY Cyg which is a UGSS type dwarf nova with very few observers following it so I can now help to increase the number of observations from now on. The other addition is the new supernova, SN 2017EAW discovered by an AAVSO member during the month on the Cygnus/Cepheus border. It is a type IIP supernova which means it was a massive star whose core collapsed once it was no longer able to fuse material to heavier elements. The 'P' signifies that the light curve shows a plateau in its decline from brightness as opposed to type II L which declines steadiiy. The plateau is believed to be caused by a shell of hydrogen which becomes ionised by the shock wave of the explosion and becomes opaque for a time. As it expands and cools, atomic hydrogen re-forms and light is able to pass through once again. I will continue to follow it for as long as possible.
I observed Jupiter on several occasions during the month. Although it was well placed, the seeing was extremely variable, sometimes the view was excellent, at other times hardly anything was visible on the disc. The same applied to Saturn which although it is much lower in the early morning sky, the Cassini division and detail on the disc as well as four of the brighter moons (Titan, Dione, Rhea and Tethys) were sometimes all easily visible, at other times little could be seen.

Tony

Viewing Log for 24th of May

As I had no planned work for Thursday and the sky was clear and it was very warm (for time of day, 19° C in Swindon) I thought I would go out and do some viewing at Uffcott which is not far from the Science Museum at Wroughton, this would probably be my last session for the current season as the sun did not set until approx. 21:10?

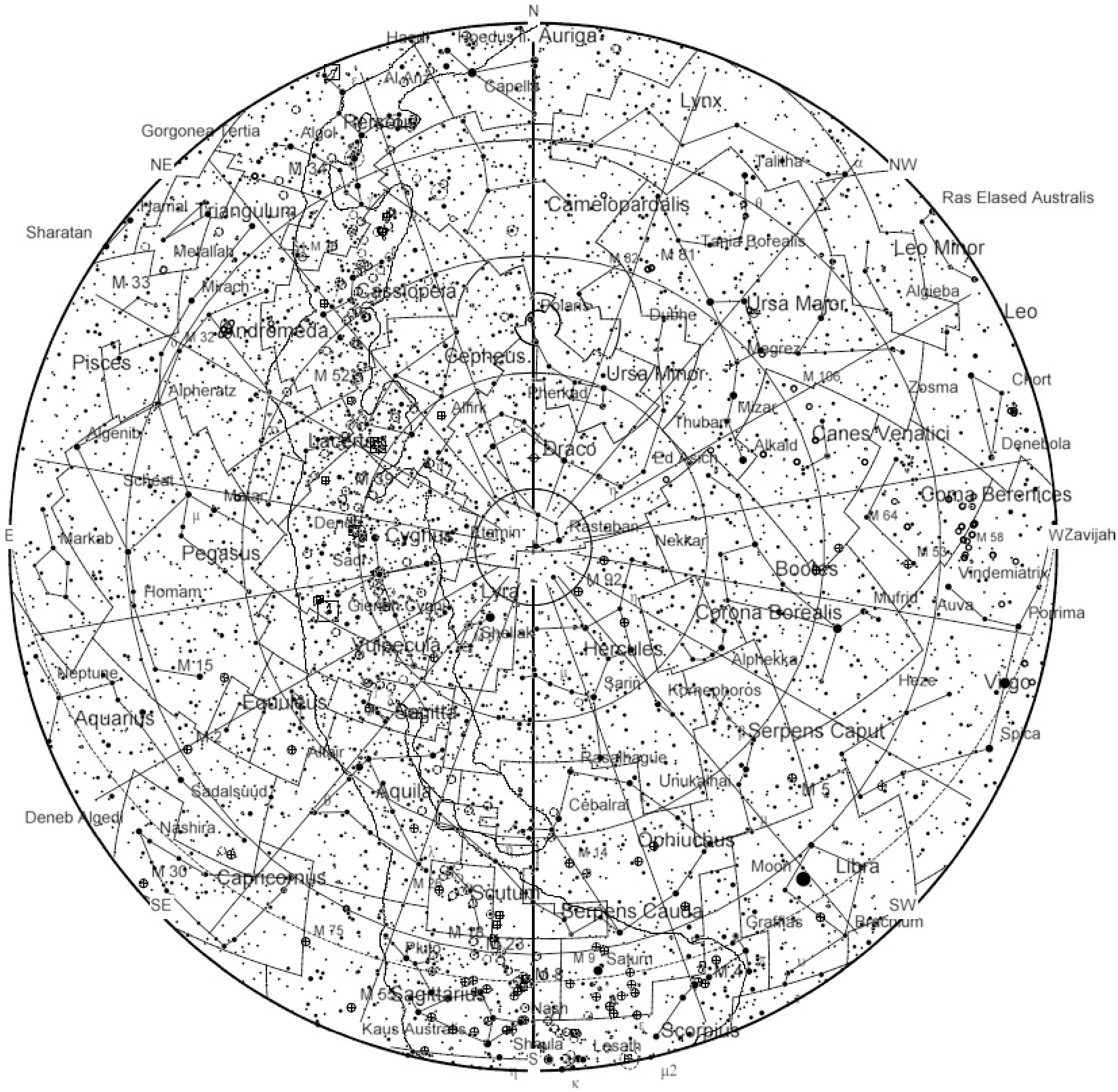
With the sun not being far below the horizon I had my Skywatcher EQ3-2 Pro Mount set up and ready to use by 22:41, the temperature was still a very good 15° C at my viewing spot. As like the last time I had this mount out (22nd of April) I would be using a William Optics 98 mm refractor and a 14 mm Pentax WX eye piece.

I could see Jupiter shining quite brightly in the southern sky so this would be my first port of call. The Great Red Spot was this time on the far side of the planet so all I would be able to make out is the two main weather belts and the four major moons: namely Calisto, Ganymede and Europa on the east side of the planet and Io by itself on the western side, also there was no shadow transits in progress while I was watching. After Jupiter it was time to carry on with my list of Caldwell (C) objects, first up was C 27, the Crescent Nebula in the constellation of Cygnus which I have been having a lot of trouble seeing (just like NGC 3079 in Ursa Major while I was doing the Herschel 400 list a few years ago), again I was not positive I had bagged this Emission Nebula, must try with either an OIII or UHC filter next time? I tried various ways of looking, using adverted, tapping the eye piece (gently) or moving the scope around the area to see if it would come out for me! Cannot say I have really bagged it, might have to wait until August nights (which will be still warm but a bit darker at the same time?). So off to my next target and C 45 in Bootes, again I could not make this Spiral Galaxy out? Coming in a magnitude 11.0 it might be beyond the limit of the scope or need really dark skies, at least the moon would not rise for several hours yet! Going on to my next target and C 35 in the constellation of Coma Berenices, the scope ended up pointing to the northern horizon when it should have been nearly overhead! Problem I think, could be major? Switched off the scope and re did the alignment checks, seemed okay so off I went again when it stopped again! Looking at the hand controller it was still slewing in one axis but hardly moving? Power problem, maybe? Tried the test button on the power tank and it read empty, no more viewing tonight! So I packed the equipment up and started to return home by 23:56. Even though I had not done much viewing I still had to put all of the equipment used out to dry for the night.

I had forgot but Skywatcher mounts use a lot more power than the Meade mounts, hopefully with a fully charged power tank the Skywatcher mount will work okay next time?

Clear skies.

Peter Chappell



June 9 - **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 13:10 UTC. This full moon was known by early Native American tribes as the Full Strawberry Moon because it signaled the time of year to gather ripening fruit. It also coincides with the peak of the strawberry harvesting season. This moon has also been known as the Full Rose Moon and the Full Honey Moon.

June 15 - **Saturn at Opposition.** The ringed planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Saturn and its moons. A medium-sized or larger telescope will allow you to see Saturn's rings and a few of its brightest moons.

June 21 - **June Solstice.** The June solstice occurs at 04:24 UTC. The North Pole of the earth will be tilted toward the Sun, which will have reached its northernmost position in the sky and will be directly over the Tropic of Cancer at 23.44 degrees north latitude. This is the first day of summer (summer solstice) in the Northern Hemisphere and the first day of winter (winter solstice) in the Southern Hemisphere.

June 24 - **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 02:31 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.

July 9 - **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 04:07 UTC. This full moon was known by early Native American tribes as the Full Buck Moon because the male buck deer would begin to grow their new antlers at this time of year. This moon has also been known as the Full Thunder Moon and the Full Hay Moon.

July 23 - **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 09:46 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.

July 29, 30 - **Delta Aquarids Meteor Shower.** The Delta Aquarids is an average shower that can produce up to 20 meteors per hour at its peak. It is produced by debris left behind by comets Marsden and Kracht. The shower runs annually from July 12 to August 23. It peaks this year on the night of July 29 and morning of July 30. The crescent moon will set by midnight, leaving dark skies for what should be a

good early morning show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.
July 30 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 27.2 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 evening sky. Look for the planet low in the western sky just after sunset.
August 7 - **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 18:11 UTC. This full moon was known by early Native American tribes as the Full Sturgeon Moon because the large sturgeon fish of the Great Lakes and other major lakes were more easily caught at this time of year. This moon has also been known as the Green Corn Moon and the Grain Moon.
August 7 - **Partial Lunar Eclipse.** A partial lunar eclipse occurs when the Moon passes through the Earth's partial shadow, or penumbra, and only a portion of it passes through the darkest shadow, or umbra. During this type of eclipse a part of the Moon will darken as it moves through the Earth's shadow. The eclipse will be visible throughout most of eastern Africa, central Asia, the Indian Ocean, and Australia. (**NASA Map and Eclipse Information**)
August 11,12 - **Perseids Meteor Shower.** The Perseids is one of the best meteor showers to observe, producing up to 60 meteors per hour at its peak. It is produced by comet Swift-Tuttle, which was discovered in 1862. The Perseids are famous for producing a large number of bright meteors. The shower runs annually from July 17 to August 24. It peaks this year on the night of August 11 and the morning of August 12. The waning gibbous moon will block out many of the fainter meteors this year, but the Perseids are so bright and numerous that it should still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Perseus, but can appear anywhere in the sky.
August 21 - **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 18:30 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.
August 21 - **Total Solar Eclipse.** A total solar eclipse occurs when the moon completely blocks the Sun, revealing the Sun's beautiful outer atmosphere known as the corona. This is a **rare, once-in-a-lifetime event** for viewers in the United States. The last total solar eclipse visible in the continental United States occurred in 1979 and the next one will not take place until 2024. The path of totality will begin in the Pacific Ocean and travel through the center of the United States. The total eclipse will be visible in parts of Oregon, Idaho, Wyoming, Nebraska, Missouri, Kentucky, Tennessee, North Carolina, and South Carolina before ending in the Atlantic Ocean. A partial eclipse will be visible in most of North America and parts of northern South America. (**NASA Map and Eclipse Information** | **Detailed Zoomable Map of Eclipse Path**)

2017 Perseid Meteor Shower

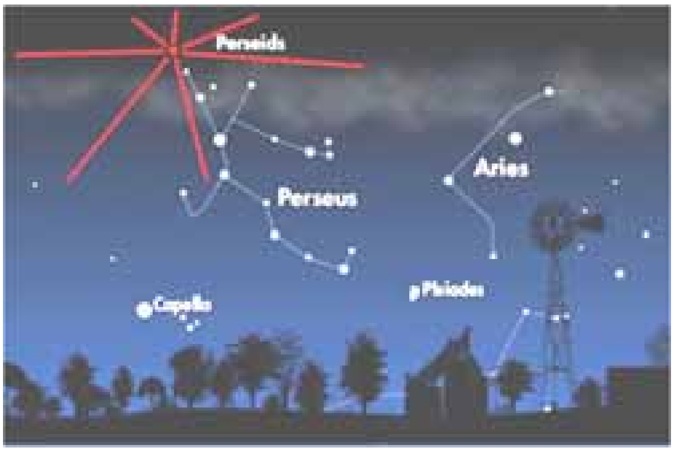
The 2017 Perseids will peak on the night of August 12 and early morning hours of August 13. This year, a Waning Gibbous Moon may hinder a good view of the meteor shower.

The Perseid meteor shower, one of the brighter meteor showers of the year, occurs every year between July 17 and August 24. The shower tends to peak around August 9 -13.

The best time to view the Perseids, and most other meteor showers, is when the sky is the darkest. Most astronomers suggest that depending on the Moon's phase, the best time to view meteor showers is right before dawn.

Sunrise & sunset in your city

Comet Swift-Tuttle



Radiant of the Perseid meteor shower.

The Perseids seem to come from the direction of the Perseus, a constellation in the north-eastern part of the sky

Based on NASA illustration

Made of tiny space debris from the comet Swift-Tuttle, the Perseids are named after the constellation Perseus. This is because the direction, or radiant, from which the shower seems to come in the sky lies in the same direction as the constellation Perseus, which can be found in the north-eastern part of the sky.

While the skies are lit up several times a year by other meteor showers, the Perseids are widely sought after by astronomers and stargazers. This is because, at its peak, one can see 60 to 100 meteors in an hour from a dark place.

The Perseids can be seen in the Northern Hemisphere. Look between the radiant, which will be in the north-east part of the sky, and the zenith (the point in the sky directly above you).

While you can easily see a shooting star with the naked eye just looking straight up, the table below shows the exact direction of the Perseids from your location.

Location in the Sky

The Perseids meteor shower is visible at this time of year. Maximum for the shower is on Saturday, 12 August 2017, 19:46; but the radiant will not be high in the sky until gone 11pm

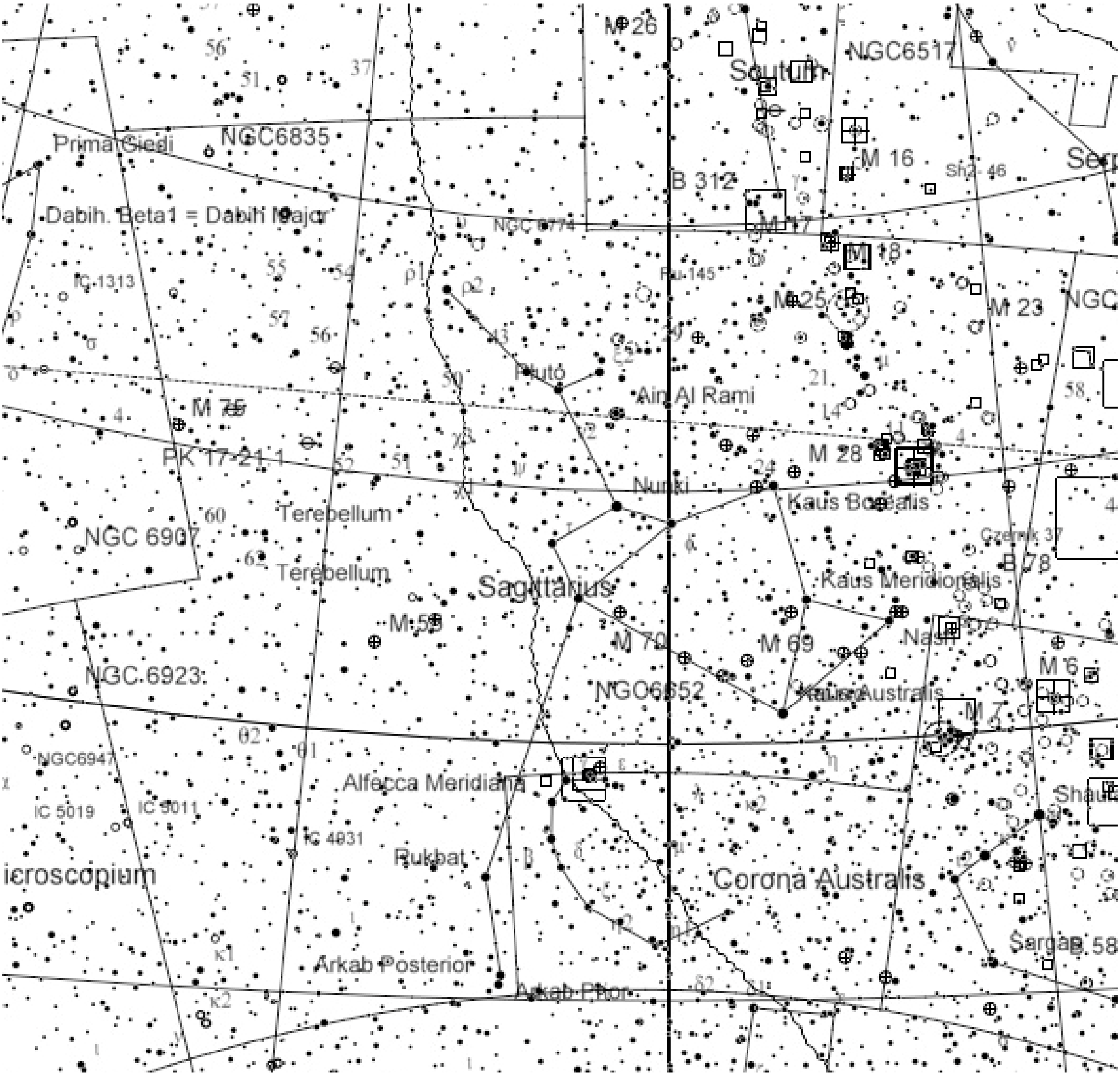
How to Watch Meteor Showers

Check the weather: Meteors, or shooting stars, are easy to spot. All you need is clear skies and a pair of eyes.

Get out of town: Find a place as far away as possible from artificial lights.

Prepare to wait: Bring something to sit or lie down on. Star gazing is a waiting game, so get comfortable.

CONSTELLATIONS OF THE MONTH: SAGITTARIUS



The zodiacal constellation of Sagittarius resides on the ecliptic plane and was one of the original 48 constellations charted by Ptolemy to be later adopted as a modern constellation by the IAU. It spans 867 square degrees of sky and ranks 15th in constellation size. It has 7 primary stars in its main asterism and 68 Bayer Flamsteed designation stars within its confines. Sagittarius is bordered by the constellations of Aquila, Scutum, Serpens Cauda, Ophiuchus, Scorpius. Corona Australis, Telescopium, Indus, Microscopium and Capricornus. It is visible to all observers located at latitudes between +55° and ?90° and is best seen at culmination during the month of August.

The easily recogniged “tea pot” shape of Sagittarius was well known in mythology as being represented by the half-man, half-horse – the Centaur. According to some legends, he was the offspring of of Philyra and Saturn. Named Chiron, he turned himself into a horse to hide from his jealous wife and was eventually immortalized in the stars. He is often depicted as an archer as well, with his arrow pointed directly at the red heart of the Scorpion – Antares. Sagittarius may represent the son of Pan, who invented archery and was sent to entertain the Muses who threw a laurel wreath at his feet. No matter what identity you choose, one thing is for certain – there’s no mistaking the presence of the nearby Sagittarius arm of the Milky Way!

(Since the constellation of Sagittarius is simply slopping over with deep sky objects, creating a small, workable chart here would be very confusing. For this reason, I have only chosen a few of my favorite objects to highlight and I hope you enjoy them, too!)

Let’s begin our binocular tour of Sagittarius with its alpha star – the “a” symbol on our map. Located far south in the constellation, Alpha Sagittarii is far from being the brightest of its stars and goes by the traditional name of Rukbat – the “knee of the Archer”. It’s nothing special. Just a typical blue, class AB dwarf star located about 170 light years from Earth, but it often gets ignored because of its position. Have a look at Beta while you’re there, too. It’s the “B” symbol on our map. That’s right! It’s a visual double star and its name is Arkab –

the “hamstring”. Now, power up in a telescope. Arkab Prior is the westernmost and it truly is a binary star accompanied by a 7th magnitude dwarf star and seperated by about 28 arcseconds. It’s located about 378 light years from Earth. Now, hop east for Arkab Posterior. It is a spectral type F2 giant star, but much closer at 137 light years in distance.

Now turn your attention towards Epsilon Sagittarii – the backwards “3” symbol on our chart. Kaus Australis is actually the brightest star in the bottom righthand corner of the teapot and the brightest of all the stars in Sagittarius and the 36th brightest in the night sky. Hanging out in space some 134 light years from our solar system, this A-class giant star is much hotter than most of its main sequence peers and spinning over 70 times faster on its axis than our Sun. This rapid movement has caused a shell to form around the star, dimming its brightness… But not nearly as dim as its 14th magnitude companion! That’s right… Epsilon is a binary star. The disparate companion is well seperated at 32 arc seconds, but will require a larger telescope to pick away from its bright companion!

Ready for more? Then have a look at Gamma – the “Y” symbol on our map. Alnasl, the “arrowhead” is two star systems that share the same name. If you have sharp eyes, you can even split this visual double star without aid! However, take a look in the telescope… Gamma-1 Sagittarii is a Cepheid 1500 light year distant variable star in disguise. It drops by almost a full stellar magnitude in just a little under 8 days! Got a big telescope? Then take a closer look, because Gamma-1 also shows evidence of being a close binary star, as well has having two more distant 13th magnitude companions, W Sagittarii B, and C separated by 33 and 48 arcseconds respectively. How about Gamma-2? It’s just a regular type-K giant star – but it’s only 96 light years from Earth!

Located just slightly more than a fingerwidth above Gamma Sagittarii and 5500 light-years away, NGC 6520 (RA 18 03 24 Dec -27 53 00) is a galactic star cluster which formed millions of years ago. Its blue stars are far younger than our own Sun, and may very well have formed from what you don’t see nearby – a dark, molecular cloud. Filled with dust, Barnard 86 literally blocks the starlight coming from our galaxy’s own halo area in the direction of the core. To get a good idea of just how much light is blocked by B 86, take a look at the star SAO 180161 on the edge. Behind this obscuration lies the densest part of our Milky Way! This one is so dark that it’s often referred to as the “Ink Spot.” While both NGC 6520 and B 86 are about the same distance away, they don’t reside in the hub of our galaxy, but in the Sagittarius Spiral Arm. Seen in binoculars as a small area of compression, and delightfully resolved in a telescope, you’ll find this cluster is on the Herschel “400” list and many others as well.

Are you ready for a whirlwind tour of the Messier Catalog objects with binoculars or a small telescope? Then let’s start at the top with the “Nike Swoosh” of M17.
Easily viewed in binoculars of any size and outstanding in every telescope, the 5000 light-year distant Omega Nebula was discovered by Philippe Loys de ChÃ©seaux in 1745-46 and later (1764) cataloged by Messier as object 17 (RA 18 20 26 Dec -16 10 36). This beautiful emission nebula is the product of hot gases excited by the radiation of newly born stars. As part of a vast region of interstellar matter, many of its embedded stars don’t show up in photographs, but reveal themselves beautifully to the eye at the telescope. As you look at its unique shape, you realize many of these areas are obscured by dark dust, and this same dust is often illuminated by the stars themselves. Often known as “The Swan,” M17 will appear as a huge, glowing check mark or ghostly “2” in the sky – but power up if you use a larger telescope and look for a long, bright streak across its northern edge with extensions to both the east and north. While the illuminating stars are truly hidden, you will see many glittering points in the structure itself and at least 35 of them are true members of this region, which spans up to 40 light-years and could form up to 800 solar masses. It is awesome…

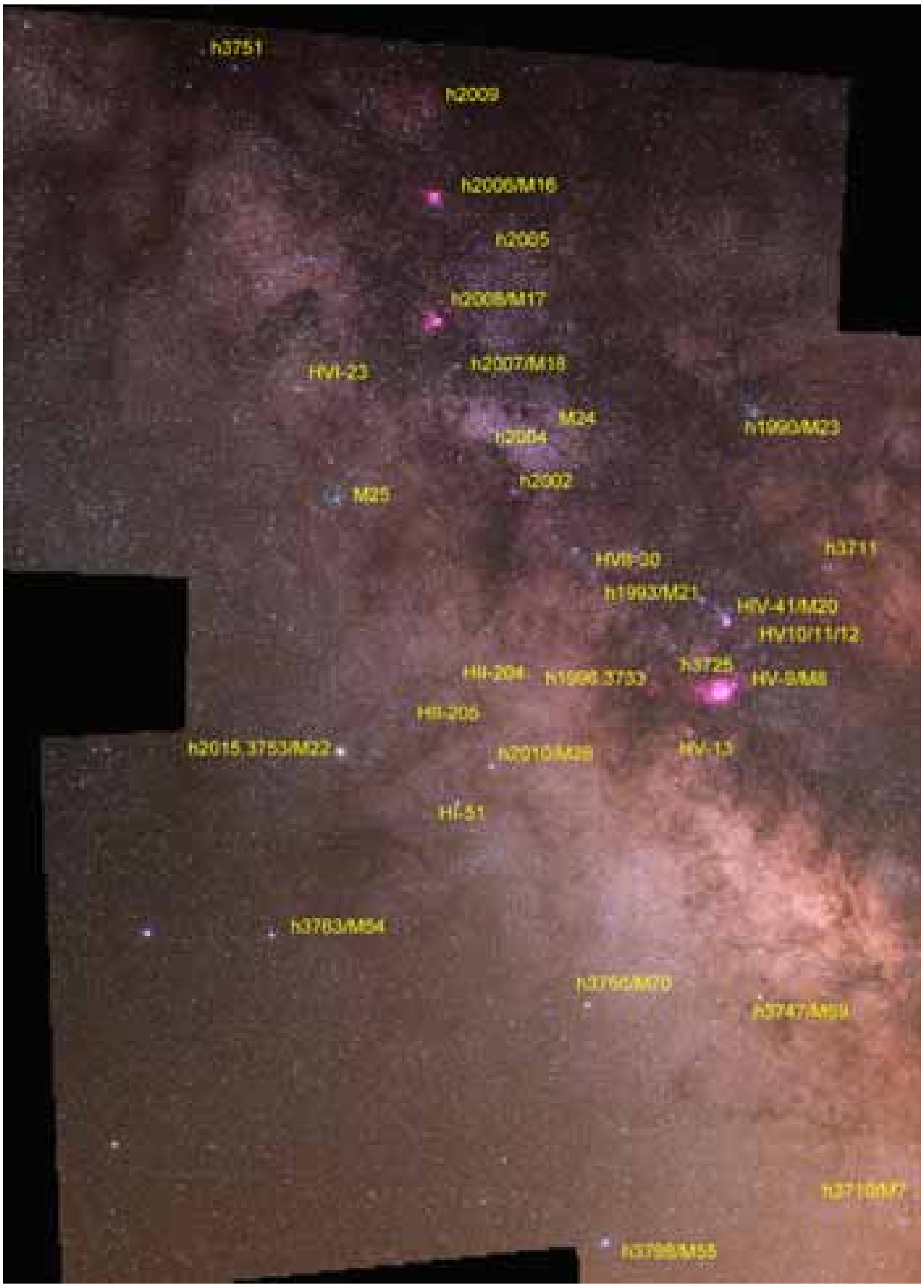
Keeping moving south and you will see a very small collection of stars known as M18, and a bit more south will bring up a huge cloud of stars called M24. This patch of Milky Way “stuff” will show a wonderful open cluster – NGC 6603 – to average telescopes and some great Barnard darks to larger ones. M24 is often referred to as the “Small Sagittarius Star Cloud”. This vast region is easily seen unaided from a dark sky site and is a stellar profusion in binoculars. Telescopes will find an enclosed galactic cluster – NGC 6603 – on its northern border. For those of you who prefer a challenge, look for Barnard Dark Nebula, B92, just above the central portion.

Now we’re going to shift to the southeast just a touch and pick up the M25 open cluster. M25 is a scattered galactic cluster that contains a cephid variable – U Sagittarii. This one is a quick change artist, going from magnitude 6.3 to 7.1 in less than seven days. Keep an eye on it over the next few weeks by comparing it to the other cluster members. Variable stars are fun! Head due west about a fist’s width to capture the next open cluster – M23. From there, we are dropping south again and M21 will be your reward. Head back for your scope and remember your area, because the M20 “Triffid Nebula” is just a shade to the southwest. Small scopes will pick up on the little glowing ball, but anything from about 4″ up can see those dark dust lanes that make this nebula so special. The “Trifid” nebula appears initially as two widely spaced stars – one of which is a low power double – each caught in its own faint lobe of nebulosity. Keen eyed observers will find that the double star – HN 40 – is actually a superb triple star system of striking colors! The 7.6 magnitude primary appears blue. Southwest is a reddish 10.7 magnitude secondary while a third companion of magnitude 8.7 is northwest of the primary.

Described as “trifid” by William Herschel in 1784, this tri-lobed pattern of faint luminosity broken by a dark nebula – Barnard 85 – is associated with the southern triple. This region is more brightly illuminated due to the presence of the star cluster and is suffused with a brighter, redder reflection nebula of hydrogen gas. The northern part of the Trifid (surrounding the solitary star) is fainter and bluer. It shines by excitation and is composed primarily of doubly ionized oxygen gas. The entire area lies roughly 5000 light-years away. What makes M20 the “Trifid” nebula, are the series of dark, dissecting dust lanes meeting at the nebula’s east and west edges, while the southernmost dust lane ends in the brightest portion of the nebula. With much larger scopes, M20 shows differences in concentration in each of the lobes along with other embedded stars. It requires a dark night, but the Trifid is worth the hunt. On excellent nights of seeing, larger scopes will show the Trifid much as it appears in black and white photographs!

You can go back to the binoculars again, because the M8 “Lagoon Nebula” is south again and very easy to see. Easily located about three finger-widths above the tip of the teapot’s spout (Al Nasl), M8 is one of Sagittarius’ premier objects. This combination of emission/reflection and dark nebula only gets better as you add an open cluster. Spanning a half a degree of sky, this study is loaded with features. One of the most prominent is a curving dark channel dividing the area nearly in half. On its leading (western) side you will note two bright stars. The southernmost of this pair (9 Sagittarii) is thought to be the illuminating source of the nebula. On the trailing (eastern) side, is brightly scattered cluster NGC 6530 containing 18 erratically changing variables known as “flare stars.” For large scopes, and those with filters, look for small patches of dark nebulae called “globules.” These are thought to be “protostar” regions – areas where new stars undergo rapid formation. Return again to 9 Sagittarii and look carefully at a concentrated portion of the nebula west-southwest. This is known as the “Hourglass” and is a source of strong radio emission.

This particular star hop is very fun. If you have children who would like to see some of these riches, point out the primary stars and show them how it looks like a dot-to-dot “tea kettle.” From the kettle’s “spout” pours the “steam” of the Milky Way. If you start there, all you will need to do is follow the “steam” trail up the sky and you can see the majority of these with ease.



At the top of the “tea kettle” is Lambda. This is our marker for two easy binocular objects. The small M28 globular cluster is quite easily found just a breath to the north/northwest. The larger, brighter and quite wonderful globular cluster M22 is also very easily found to Lambda’s northeast. Ranking third amidst the 151 known globular clusters in total light, M22 is probably the nearest of these incredible systems to our Earth, with an approximate distance of 9,600 light-years. It is also one of the nearest globulars to the galactic plane. Since it resides less than a degree from the ecliptic, it often shares the same eyepiece field with a planet. At magnitude 6, the class VII M22 will begin to show individual stars to even modest instruments and will burst into stunning resolution for larger aperture. About a degree west-northwest, mid-sized telescopes and larger binoculars will capture the smaller 8th magnitude NGC 6642 (RA 18 31 54 Dec -23 28 34). At class V, this particular globular will show more concentration toward the core region than M22. Enjoy them both!

Now we’re roaming into “binocular possible” but better with the telescope objects. The southeastern corner of the “tea kettle” is Zeta, and we’re going to hop across the bottom to the west. Starting at Zeta, slide southwest to capture globular cluster M54. Keep heading another three degrees southwest and you will see the fuzzy ball of M70. Just around two degrees more to the west is another globular that looks like M70’s twin. The small globular M55 is out there in “No Man’s Land” about a fist’s width away east/south east of Zeta .

Ready for a big telescope challenge? Then try your hand at one the sky’s most curious galaxies – NGC 6822. This study is a telescopic challenge even for skilled observers. Set your sights roughly 2 degrees northeast of easy double 54 Sagittarii, and have a look at this distant dwarf galaxy bound to our own Milky Way by invisible gravitational attraction…

Named after its discoverer (E. E. Barnard – 1884), “Barnard’s Galaxy” is a not-so-nearby member of our local galaxy group. Discovered with a 6″ refractor, this 1.7 million light-year distant galaxy is not easily found, but can be seen with very dark sky conditions and at the lowest possible power. Due to large apparent size, and overall faintness (magnitude 9), low power is essential in larger telescopes to give a better sense of the galaxy’s frontier. Observers using large scopes will see faint regions of glowing gas (HII regions) and unresolved concentrations of bright stars. To distinguish them, try a nebula filter to enhance the HII and downplay the star fields. Barnard’s Galaxy appears like a very faint open cluster overlaid with a sheen of nebulosity, but the practiced eye using the above technique will clearly see that the “shine” behind the stars is extragalactic in nature.

Now look less than a degree north-northwest to turn up pale blue-green NGC 6818 – the “Little Gem” planetary. Easily found in any size scope, this bright and condensed nebula reveals its annular nature in larger scopes but hints at it in scopes as small as 6″. Use a super wide field long-focus eyepiece to frame them both!

Be sure to get a good star chart and enjoy the constellation of Sagittarius to its fullest potential – there’s lots more out there!

Sources:
Universe Today
SEDS
Chandra Observatory
Wikipedia
Chart Courtesy of Your Sky.

ISS PASSES For July August 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.

08 Jul	-1.5	04:13:23	10°	S	04:15:14	14°	SE	04:17:05	10°	ESE
10 Jul	-2.3	04:03:38	10°	SSW	04:06:23	25°	SSE	04:09:08	10°	E
11 Jul	-1.8	03:12:54	14°	SSE	03:14:04	17°	SE	03:16:14	10°	E
12 Jul	-1.3	02:22:12	10°	SE	02:22:12	10°	SE	02:22:21	10°	SE
12 Jul	-3.2	03:54:49	12°	SW	03:57:35	41°	SSE	04:00:43	10°	E
13 Jul	-2.7	03:04:03	23°	S	03:05:10	28°	SSE	03:08:03	10°	E
14 Jul	-2.0	02:13:15	18°	SE	02:13:15	18°	SE	02:15:11	10°	E
14 Jul	-3.8	03:45:52	12°	WSW	03:48:50	64°	SSE	03:52:06	10°	E
15 Jul	-3.5	02:55:01	28°	SSW	02:56:19	46°	SSE	02:59:29	10°	E
16 Jul	-2.9	02:04:08	31°	SE	02:04:08	31°	SE	02:06:49	10°	E
16 Jul	-3.9	03:36:50	10°	WSW	03:40:06	85°	S	03:43:24	10°	E
17 Jul	-1.6	01:13:13	14°	ESE	01:13:13	14°	ESE	01:14:00	10°	E
17 Jul	-3.9	02:45:49	26°	WSW	02:47:31	70°	SSE	02:50:47	10°	E
17 Jul	-3.8	04:20:42	10°	W	04:23:59	86°	N	04:27:16	10°	E
18 Jul	-3.7	01:54:50	51°	SSE	01:54:57	52°	SSE	01:58:09	10°	E
18 Jul	-3.8	03:28:05	10°	W	03:31:21	85°	N	03:34:38	10°	E
19 Jul	-2.3	01:03:48	24°	ESE	01:03:48	24°	ESE	01:05:28	10°	E
19 Jul	-3.9	02:36:24	18°	W	02:38:43	89°	S	02:42:00	10°	E
19 Jul	-3.9	04:11:55	10°	W	04:15:12	80°	SSW	04:18:29	10°	ESE
20 Jul	-4.0	01:45:16	47°	WSW	01:46:05	75°	SSE	01:49:21	10°	E
20 Jul	-3.9	03:19:16	10°	W	03:22:34	88°	NNE	03:25:51	10°	E
21 Jul	-3.5	00:54:01	48°	ESE	00:54:01	48°	ESE	00:56:42	10°	E
21 Jul	-3.9	02:26:37	10°	W	02:29:53	84°	N	02:33:11	10°	E
21 Jul	-3.8	04:03:05	10°	W	04:06:19	57°	SSW	04:09:31	10°	ESE
22 Jul	-2.4	00:02:26	24°	E	00:02:26	24°	E	00:03:59	10°	E
22 Jul	-3.9	01:34:57	19°	W	01:37:13	88°	N	01:40:30	10°	E
22 Jul	-4.0	03:10:25	10°	W	03:13:41	75°	SSW	03:16:57	10°	ESE
22 Jul	-3.0	23:05:31	10°	SSW	23:08:21	28°	SSE	23:11:12	10°	E
23 Jul	-4.0	00:41:16	10°	WSW	00:44:32	80°	S	00:47:49	10°	E
23 Jul	-3.9	02:17:44	10°	W	02:21:01	89°	S	02:24:18	10°	E
23 Jul	-3.3	03:54:16	10°	W	03:57:18	36°	SSW	04:00:20	10°	SE
23 Jul	-2.4	22:13:31	10°	S	22:15:51	18°	SE	22:18:12	10°	E
23 Jul	-3.9	23:48:38	10°	WSW	23:51:52	63°	SSE	23:55:07	10°	E
24 Jul	-3.9	01:25:02	10°	W	01:28:19	85°	N	01:31:36	10°	E
24 Jul	-3.8	03:01:31	10°	W	03:04:42	52°	SSW	03:07:54	10°	SE
24 Jul	-3.6	22:56:06	10°	SW	22:59:15	45°	SSE	23:02:24	10°	E

25 Jul	-3.9	00:32:19	10°	W	00:35:36	86°	N	00:38:52	10°	E
25 Jul	-4.0	02:08:48	10°	W	02:12:04	70°	SSW	02:15:19	10°	ESE
25 Jul	-2.6	03:45:34	10°	W	03:48:09	21°	SW	03:50:43	10°	SSE
25 Jul	-3.1	22:03:43	10°	SW	22:06:39	31°	SSE	22:09:35	10°	E
25 Jul	-4.0	23:39:37	10°	WSW	23:42:53	85°	S	23:46:09	10°	E
26 Jul	-4.0	01:16:05	10°	W	01:19:21	85°	SSW	01:19:34	76°	ESE
26 Jul	-3.9	22:46:55	10°	WSW	22:50:11	69°	SSE	22:53:26	10°	E
27 Jul	-3.9	00:23:21	10°	W	00:26:38	86°	N	00:27:50	36°	E
27 Jul	-1.5	01:59:50	10°	W	02:00:24	14°	W	02:00:24	14°	W
27 Jul	-3.6	21:54:19	10°	SW	21:57:29	50°	SSE	22:00:41	10°	E
27 Jul	-3.9	23:30:36	10°	W	23:33:53	85°	N	23:36:28	15°	E
28 Jul	-2.7	01:07:04	10°	W	01:09:03	33°	W	01:09:03	33°	W
28 Jul	-3.9	22:37:50	10°	W	22:41:07	88°	S	22:44:24	10°	E
29 Jul	-4.0	00:14:19	10°	W	00:17:35	81°	SSW	00:17:48	75°	SE
29 Jul	-3.9	21:45:06	10°	WSW	21:48:21	74°	SSE	21:51:38	10°	E
29 Jul	-3.9	23:21:32	10°	W	23:24:49	88°	N	23:26:37	25°	E
30 Jul	-1.8	00:58:02	10°	W	00:59:12	19°	W	00:59:12	19°	W
30 Jul	-3.8	22:28:45	10°	W	22:32:02	84°	N	22:35:19	10°	E
31 Jul	-3.6	00:05:13	10°	W	00:08:03	53°	SW	00:08:03	53°	SW
31 Jul	-3.8	21:35:58	10°	W	21:39:14	89°	N	21:42:31	10°	E
31 Jul	-4.0	23:12:26	10°	W	23:15:42	77°	SSW	23:16:55	35°	ESE
01 Aug	-1.2	00:49:05	10°	W	00:49:30	12°	W	00:49:30	12°	W
01 Aug	-3.9	22:19:38	10°	W	22:22:54	90°	SW	22:25:47	13°	E
01 Aug	-2.7	23:56:08	10°	W	23:58:23	31°	WSW	23:58:23	31°	WSW
02 Aug	-3.8	21:26:48	10°	W	21:30:05	85°	N	21:33:21	10°	E
02 Aug	-3.7	23:03:16	10°	W	23:06:28	53°	SSW	23:07:16	40°	SSE
03 Aug	-3.9	22:10:26	10°	W	22:13:41	72°	SSW	22:16:12	16°	ESE
03 Aug	-1.9	23:47:10	10°	W	23:48:47	19°	WSW	23:48:47	19°	WSW
04 Aug	-2.9	22:54:08	10°	W	22:57:07	33°	SSW	22:57:43	31°	S
05 Aug	-3.4	22:01:12	10°	W	22:04:22	48°	SSW	22:06:40	17°	SE
05 Aug	-1.2	23:38:41	10°	WSW	23:39:15	12°	WSW	23:39:15	12°	WSW
06 Aug	-2.1	22:45:09	10°	W	22:47:37	20°	SW	22:48:14	19°	SSW
07 Aug	-2.6	21:52:01	10°	W	21:54:55	30°	SSW	21:57:14	14°	SSE
08 Aug	-1.3	22:36:56	10°	WSW	22:37:57	11°	SW	22:38:53	10°	SSW
09 Aug	-1.7	21:43:02	10°	W	21:45:20	18°	SW	21:47:36	10°	S

There are no more night time passes until mid September.

END IMAGES, OBSERVING AND OUTREACH

Peter Chappell I took some pictures last night with the ISS going past the Moon and Jupiter, could you put these together for me and if any good put them in the magazine? I only did the pictures at 3.2 seconds each so the ISS does not come up as much .

I had a shutter speed of 0.3 second as I did not want to really overexpose the Moon otherwise I could get a wash out? Was using a wireless remote system, not very long between shots probably less than a second and the f number was 5. Probably need more work on this type of shot with more time between taking pictures?

Stacked using star trails, 12 images. Shows the path of the ISS. And I was able to pull out some of the stars in Virgo in processing.

Right is recording of successive ISS passes on 25th May, without the Moon I could use 30 second exposures and wide 20mm Nikkor lens.

Andy

Date	Moon Phase	Observing Topic
2017 August Friday 11th ???	Waning gibbeous	Perseid Meteor Shower

OUTREACH ACTIVITIES

Nothing committed