NWASNEWS

Volume21, Issue 10

June 2016

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

Into the Summer

Before we get on with tonight's matters, can I ask you all to thank our committee for the work they have done this year, Peter for the excellent speaker programme with one bit of sweating mid term but we made it, I know Bob has had a heck of a time trying to get the bank to add signatures for cheque signatureries, as asked for at the last AGM. It has taken us 10 months and the ban k are still mucking us around. I included his email to the committee so you can see the headaches. I even went in and got assurances everything was OK on the paper work for the bank to reject it again!

John and Tony on organising the observing sessions, but also adding their knowledge with deep sky observing lists and efforts helping out at outreach observing sessions, along with Dave B, Peter C, Peter E, Martin and others as occasional help they have helped a lot of people see more in our skies.

Keith B as vice chair, and stand ins as vice treasurer… it may not seem a lot, but it is a tremendously load off the duties of chair if there is good back up for all positions. Also thanks to Philip P for keeping the hall available and even coming out of 'retirement' to help Keith and Dave behind the kitchen getting coffees etc.

The accounts look slightly inflated but we have more panels to be printed for outreach at Nibley, and the hire of the hall in January at Lacock.

Lots more uses to be made of the small grant we received.

Thank you all for turning up… without the members of a society we are nothing.

I personally would like to step down soon, perhaps next year, as some complications with the arthritis cures may be wrecking my kidneys. I am still having tests but it could be a choice of painful kidneys or very painful arthritis. I would stay in support for a new chair, and will continue the newsletter until the complayent abut mi spleling mishtaiks.

On to tonight, not too for removed from the search for a new chair is the search for Extraterrestial Life.

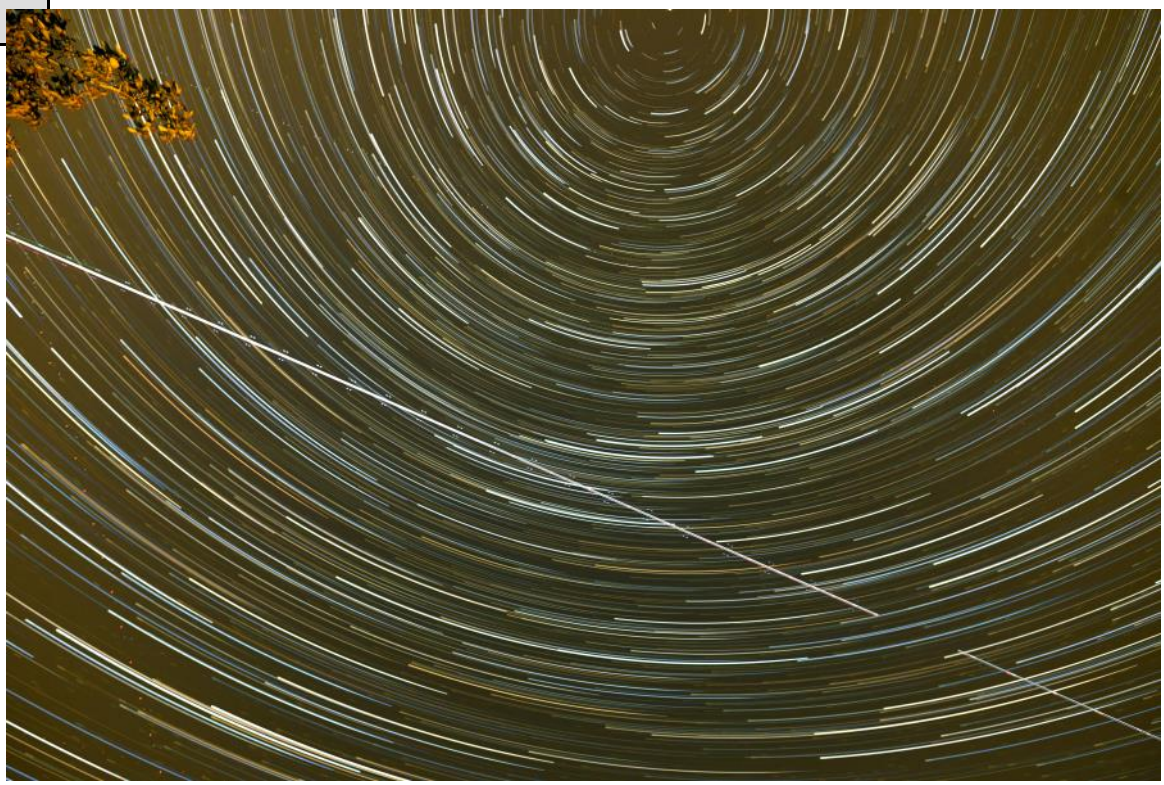
In Martin Griffiths we have someone who worked a lot in America and Europe on Astrobioligical research, and the hunt for life out there is just part of the SETI quest.

He is here to update us on the current moves and financing issues that may affect our listening for life out there.

He will be joined tonight by his colleague and the director of Dark Sky Wales, Allan Trow. Together we have had many adventures in sky watching in Portugal, Spain and Wales… very few of which are repeatable in mixed company!

Have a great summer, and keep looking at the skies. We will try to arrange a Perseid viewing session for Friday 12th August so keep in touch.

Clear skies Andy



Star trails and the International Space Station from the 5th May.

The centering of the concentric star arcs is just at top centre of the picture, so this marks the point of Polaris.

Around 2 hours of exposures (some had to be deleted due to icing up on the lens.

250 pictures were then compiled using a free piece of software called 'Startrails'. The original is in German but an English download made.

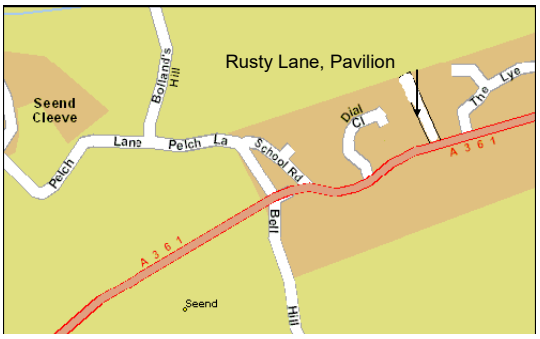
Andy Burns

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

2016

June 7th *The Current State of SETI : Martin Griffiths*
NEW SEASON
6/9 Professor Chandra Wickramasinghe 'Efforts of Space Microbes on Earthly life'
4/10 Paul Money 'Images of the Universe'
1/11 Philip Perkins 'Imaging the Cosmos'
6/12 Andrew Lound 'TBN'
2017
3/1 TBN
7/2 Professor David Southwood '10 years of Space Science at the European Space Agency'
7/3 Steve Tonkin 'And yet it Moves!'
4/4 Doctor Chris North 'Telescopes through the Ages'
2/5 TBN
6/6 Mark Radice 'Observing from the Caribbean'

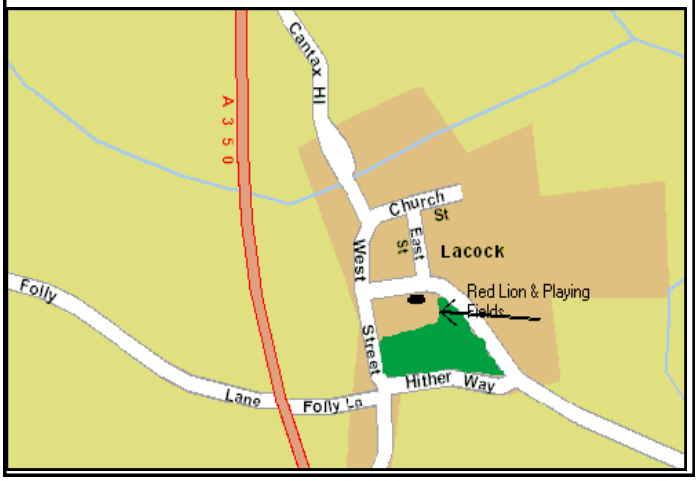


Observing Sessions

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



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.

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

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

He was a founder member of NASA's Astrobiology Institute Science Communication Group, active between 2003-2006 and managed a multi-million pound ESF programme in Astrobiology for adult learners between 2003-2008. Martin has written and presented planetarium programmes for key stages 1, 2 and 3 and has been an adviser to several museum projects on the interface between science and science fiction. He was consultant to the University of Glamorgan computer graphics team on their development of the Alien Worlds multimedia tools, (now available free at the iTunesU store) which won the Alternative Learning Technologies second prize in 2008.

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

Martin is a Fellow of the Royal Astronomical Society; a Fellow of the Higher Education Academy; a member of the British Astronomical Association; the Webb Deep-Sky Society; the Society for Popular Astronomy, The Astronomical Society of the Pacific and the Astronomical League. He is also a local representative for the BAA Campaign for Dark Skies. Martin broadcasts regularly on BBC Wales radio and has appeared on science programmes for the BBC, Einstein TV, Granada TV and the Discovery Channel. He is also a member of the Honourable Society of Cymmrodorion, dedicated to promoting the science, arts and literature of Wales.

He is now working for Dark Sky Wales in their outreach work to schools and adult learning groups. He has now written three books in the Springer Astronomy Series.

Swindon Stargazers

Swindon's own astronomy group

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

The Transit of Mercury

We were set up at Avebury on time for Mercury to commence its journey across the face of the Sun. The weather was not great and earlier in the morning there were actually a few spots of rain. It was very over cast, but now and then the Sun did shine through. The Sun did manage to burn through to allow us to see the first ingress of Mercury. Although I have seen this before, back in 2003, I was still surprised how small Mercury appeared. The Sun exhibited two sunspots, which Mercury seemed smaller than.

For the next few hours the clouds taunted us with breaks every now and then. When a breakthrough happened we all frantically tried to line our scopes up. But once we did we ended up spending more time allowing passing public to view, than getting the chance to observe ourselves!

(Report by Rob Slack)

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

Friday 17 Jun 2016

Programme: James Fradgely: How (on Earth) Did Life Start

Friday 16 Sep 2016

Programme: Guy Hurst: Star Clusters

Friday 21 Oct 2016

Programme: Paul Roche: Robotic Astronomy

Friday 18 Nov 2016

Programme: Mike Leggett: Exploration of Mars

Friday 16 Dec 2016

Programme: Christmas Social

Website:

http://www.swindonstargazers.com

Chairman: Peter Struve

Tel No: 01793 481547
Email: peter.struve@sky.com
Address: 3 Monkton Close, Park South, Swindon, SN3 2EU

Secretary: Dr Bob Gatten (PhD)
Tel Number: 07913 335475

Email: bob.gatten@ntlworld.com
Address: 17, Euclid Street,

Swindon, SN1 2JW

BECKINGTON ASTRONOMICAL SOCIETY

We also have a new website www.beckingtonas.org where details of our programme and other useful information can be found. General enquiries about the society can be emailed to chairman@beckingtonas.org

So our committee is now:

Steve Hill, Chairman/Imaging 01761 435663
John Ball, Vice Chairman 01373 830419
Alan Aked, Treasurer 01373 830232
Rosie Wilks, Secretary 01225445814
Mike Witt, Membership 01373 303784
John Dolton, Telescope Hardware 01225335832

Meetings take place in Beckington Baptist Church Hall (see the location page for details of how to get to us) and start at 7:30pm.

Date	Title	Speaker
17th June	Annual General Meeting	

The programme and details of how to contact the society are at www.beckingtonas.org

SOFTWARE AND APPS

Here is my first foray into this for some time. Where possible I choosing readily available and free software for PCs Macs or Apps for phones.

This first list is for YOU to check and report if it is the software you want me to review, otherwise I will run with my own software choice.

Firstly how do find what is up in the sky at any particuly day/night/time.

There are many sorts of app for the phone (Android or iPhone)

Google Sky Map

Planets

Starmap

Astronomist

Sky Safari Pro (it does have a free version and runs on Macs and iPhones plus Android… not PCs yet.)

How Aurora warnings: Aurora Watch alert works very well this year and gives audable warnings.

Satellite prediction

ProSat, SatelliteAR, ISS Detector

There is even an excellent weather predictor for viewing

Clear Outside for Android showed Fridays viewing window from days in advance.

For Deep Sky Objects, DS Browsers tells you what is up.

And the Moon, Moon HD is OK but for the sky I much prefer the bigger screen versions for the PCs and Macs.

Sky Charts:

Cartes du Ciel

Stellarium both free

Sky Safari Pro

Or the Sky are the expensiveoptions but give you so much more information.

The Moon on PCs and MACs there is one standout programme and it is free. Virtual Moon Atlas.

There are others I know, but these keep me informed and allow viewing session planning. Next month some image processing software.

Andy

SALISBURY PLAIN OBSERVING GROUP

Where do you meet?

We meet at a variety of sites, including Pewsey Downs, Everleigh, Bratton Camp, Redhorn Hill and Whitesheet Hill. The sites are cold in winter so you will need warm clothing and a flask. We are always looking for good sites around the edge of the Plain.

Do I join?

No. We are not a club. We meet informally, so aside from contacting our friends to give a yes or no to meeting up, that's it.

I am a beginner—am I welcome?

Of course you are — whether you have a telescope, binoculars or just your eyes, there will be someone to observe with. We have a variety of equipment and are always happy for newcomers to look through.

So I just turn up?

Essentially yes, but please drop us an email as parking can be an issue at some of the meeting areas or at the pubs.

I am more experienced—what's in it for me?

If you have observing experience we prepare a monthly observing list chosen in rotation by the group. We pick some easy objects, some moderate and some tough ones. If you are experienced, why not share what you know?

Any ground rules for a session?

Common sense applies in the group; red light is essential to preserve night vision; we park cars so you can leave when you wish and not disturb others with your headlights.

Contact Details

Our Website

www.spogastro.co.uk

Our Email

spogastro@googlemail.com

Twitter

http://twitter.com/SPOGAstro

Facebook

http://www.facebook.com/group.php?gid=119305144780224

NOAA's Joint Polar Satellite System (JPSS) to revolutionize Earth-watching

By Ethan Siegel

If you want to collect data with a variety of instruments over an entire planet as quickly as possible, there are two trade-offs you have to consider: how far away you are from the world in question, and what orientation and direction you choose to orbit it. For a single satellite, the best of all worlds comes from a low-Earth polar orbit, which does all of the following:

orbits the Earth very quickly: once every 101 minutes,

is close enough at 824 km high to take incredibly high-resolution imagery,

has five separate instruments each probing various weather and climate phenomena,

and is capable of obtaining full-planet coverage every 12 hours.

The type of data this new satellite – the Joint Polar Satellite System-1 (JPSS-1) -- will take will be essential to extreme weather prediction and in early warning systems, which could have severely mitigated the impact of natural disasters like Hurricane Katrina. Each of the five instruments on board are fundamentally different and complementary to one another. They are:

1. The Cross-track Infrared Sounder (CrIS), which will measure the 3D structure of the atmosphere, water vapor and temperature in over 1,000 infrared spectral channels. This instrument is vital for weather forecasting up to seven days in advance of major weather events.

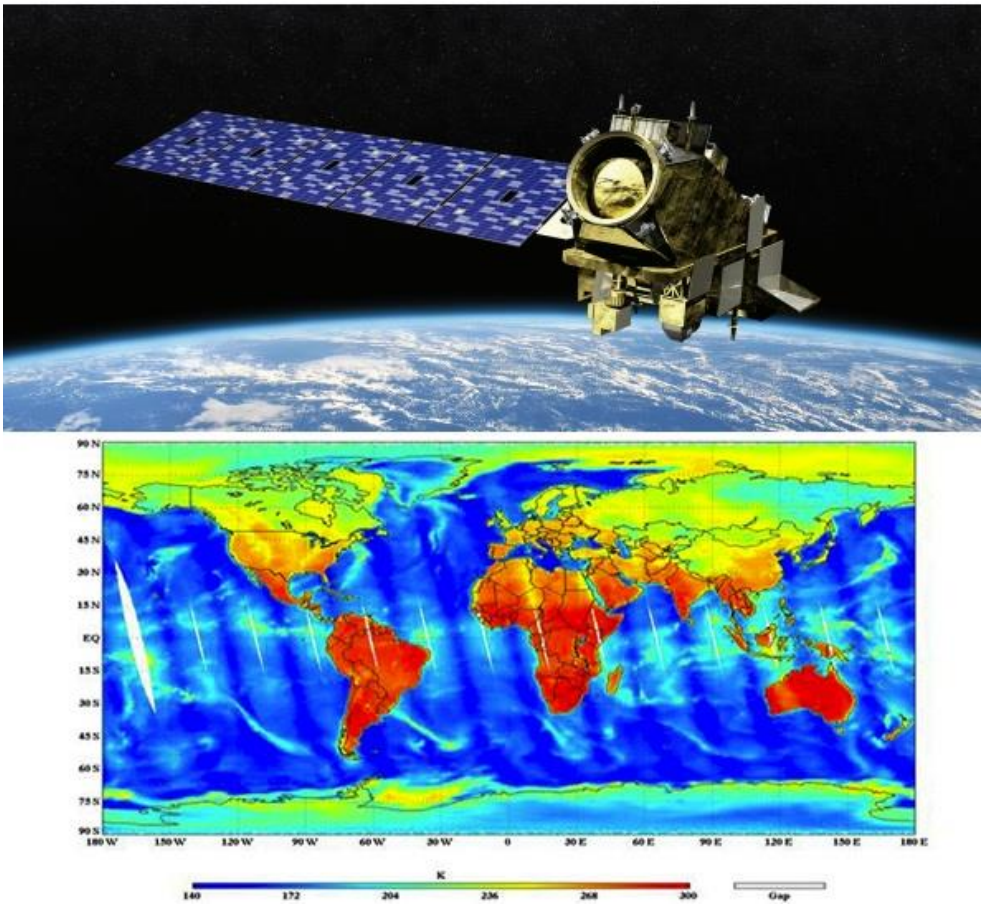
2. The Advanced Technology Microwave Sounder (ATMS), which assists CrIS by adding 22 microwave channels to improve temperature and moisture readings down to 1 Kelvin accuracy for tropospheric layers.

3. The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, which takes visible and infrared pictures at a resolution of just 400 meters (1312 feet), enables us to track not just weather patterns but fires, sea temperatures, nighttime light pollution as well as ocean-color observations.

4. The Ozone Mapping and Profiler Suite (OMPS), which measures how the ozone concentration varies with altitude and in time over every location on Earth's surface. This instrument is a vital tool for understanding how effectively ultraviolet light penetrates the atmosphere.

5. Finally, the Clouds and the Earth's Radiant System (CERES) will help understand the effect of clouds on Earth's energy balance, presently one of the largest sources of uncertainty in climate modeling.

The JPSS-1 satellite is a sophisticated weather monitoring tool, and paves the way for its' sister satellites JPSS-2, 3 and 4. It promises to not only provide early and detailed warnings for disasters like hurricanes, volcanoes and storms, but for longer-term effects like droughts and climate changes. Emergency responders, airline pilots, cargo ships, farmers and coastal residents all rely on NOAA and the National Weather Service for informative short-and-long-term data. The JPSS constellation of satellites will extend and enhance our monitoring capabilities far into the future.



Images credit: an artist's concept of the JPSS-2 Satellite for NOAA and NASA by Orbital ATK (top); complete temperature map of the world from NOAA's National Weather Service (bottom).

SPACE NEWS

SpaceX's latest booster back home as company mulls pricing, proof tests

June 3, 2016 Stephen Clark

A Falcon 9 first stage booster returned to Port Canaveral aboard SpaceX's landing barge Thursday, six days after touching down following liftoff with the Thaicom 8 telecom satellite. Credit: SpaceX

A Falcon 9 rocket core recovered after last week's launch of a Thai communications satellite returned to port in Florida on Thursday as SpaceX preps a separate rocket structure for tests to prove it can withstand multiple missions and mulls pricing of a previously-flown rocket, targeting a re-flight of a used booster by the end of the summer.

Standing with a slight tilt after a hard landing at sea, the 15-story booster arrived at Port Canaveral for inspection and potential reuse.

It will join three other recovered Falcon 9 first stages in SpaceX's inventory.

The first Falcon 9 booster landed by SpaceX in December at Cape Canaveral will go on vertical display later this year outside the company's headquarters in Hawthorne, California. A rocket core that achieved the first landing at sea in April is tagged to be the first previously-flown booster to launch a second time.

Speaking at Code Conference 2016, a tech industry meeting held this week near Los Angeles, SpaceX chief executive Elon Musk the company plans to re-fly the used rocket again in two or three months.

"Something like that," Musk said. "It will be an important milestone. So far, the stages are looking quite good, even though they are coming through a really difficult re-entry situation, but they're looking in good shape. We now have four of them, so we want to start re-flying them towards the end of the summer."

A rocket that touched down on SpaceX's landing barge shortly after a launch with the Japanese JCSAT 14 communications satellite May 6 survived extreme conditions on re-entry, withstanding high speeds and scorching temperatures at the outer edge of the rocket's operating envelope. While SpaceX founder Elon Musk says that rocket could conceivably fly again, SpaceX engineers intend to transport it to the company's facility in McGregor, Texas, to use it as a ground test article.

The fate of the first stage that launched the Thaicom 8 communications satellite Friday has not been announced by SpaceX.

A camera aboard SpaceX's drone ship captured this view of the Falcon 9 booster descending to landing May 27. Credit: SpaceX

The latest booster touched down on SpaceX's drone ship, dubbed "Of Course I Still Love You" after a sentient starship in author Iain Banks' sci-fi universe, about 420 miles (680 kilometers) east of Cape Canaveral less than 9 minutes after liftoff Friday.

The purpose of the the reusability program is to reduce the cost of SpaceX's launches, which are already less expensive than any of its major competitors.

The last two Falcon 9 missions deployed telecom spacecraft into geostationary transfer orbit, a type of orbit where a satellite takes an oval-shaped path around Earth, with a low point just above the atmosphere and a high point tens of thousands of miles above Earth.

The Falcon 9 placed the Thaicom 8 satellite, which weighed less than 6,700 pounds (about 3,025 kilograms) at launch, into an exceptionally high "supersynchronous" orbit with its most distant point more than 56,000 miles (90,000 kilometers) above Earth.

Lofting satellites to such high altitudes requires more speed than putting a payload into low Earth orbit — with the first stage reaching speeds as high as 5,000 mph (8,000 kilometers per hour — meaning the Falcon 9's booster comes back to Earth with more velocity, subjecting the vehicle to higher aerodynamic and thermal stresses.

The extra velocity needed by such missions eliminates any possibility of the rocket reversing course and returning to a landing at the launch base, as a Falcon 9 carrying 11 small Orbcomm satellites to a low-altitude orbit did in December.

The Falcon 9 first stage, standing 15 stories tall, returned to Port Canaveral on Thursday after launching the Thaicom 8 communications satellite. Credit: James Murati/Bionetics

After detaching from the Falcon 9's upper stage about two-and-a-half minutes after liftoff, the descending rocket stage that sent Thaicom 8 toward space last week sailed hundreds of thousands of feet over cloud tops in a dramatic time lapse video released by SpaceX. Three of the rocket's nine Merlin

engines ignited to slow down for re-entry, then aerodynamic grid fins maneuvered the rocket over the drone ship, when the booster conducted a propulsive landing burn for a vertical on-target touchdown.

The landing speed was close to the Falcon 9's design limit, but a crushable aluminum honeycomb core embedded inside the booster's four carbon-fiber landing legs absorbed the impact, causing the rocket to settle on to the barge with a noticeable lean.

Musk said the "crush core" is inside the landing legs to take the force of rough landings. It will be replaced if first stage ends up flying again.

"The crush core in the Falcon legs is reusable after soft landings, but needs to be replaced after hard (landings)," Musk wrote on Twitter.

In the meantime, SpaceX engineers in Texas will put the rocket stage recovered after the May 6 launch of JCSAT 14, which went through the Falcon 9's most stressing descent yet, through a stringent series of tests to confirm other vehicles can reliably fly again.

Called delta qualification tests, the checks on the ground will help SpaceX prove to itself, customers and the insurance community that a rocket flying for the second time is as reliable as a vehicle just out of the factory.

"That's probably more the long pole in getting to flight than doing anything to the vehicle itself," said Gwynne Shotwell, SpaceX's president and chief operating officer, in an April interview with Spaceflight Now.

File photo of Gwynne Shotwell, SpaceX's president and chief operating officer. Credit: NASA/Jay Westcott

She said SpaceX does not want to tinker much with the rocket slated to fly again, so officials selected a separate booster to put through ground testing. Musk initially suggested the Falcon 9 rocket slated for the first reuse mission would be fired on the ground at Kennedy Space Center's launch pad 39A, a facility SpaceX is readying for flights later this year, but it is now unclear if that is still the plan.

"What we would like to do is demonstrate life margin as well as amplitude margin," Shotwell said in April. "I don't think we're going to pull components off and vibrate them — shake them and bake them — although we may. If we feel like we have to do that, we will go do that."

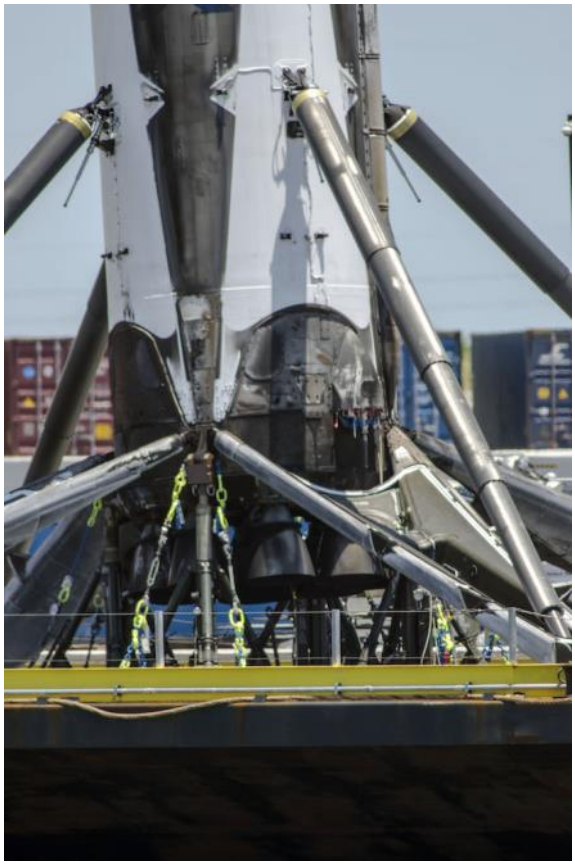
Burning a mixture of super-chilled RP-1 kerosene and liquid oxygen, the Falcon 9's Merlin 1D engines are already qualified to fly more than once. The entire first stage structure, including tanks and avionics systems, may still need extra testing.

"I think there's enough margin built into our qualification program that we could at least fly another time on the boxes and such, and our engines have already been qualified for more than one flight," Shotwell said.

In parallel with the engineering tests, SpaceX's management and sales team is working behind the scenes to assuage insurance underwriters on the risks of reusing Falcon 9 boosters.

Jonathan Hofeller, SpaceX's vice president of commercial sales, said earlier this week that the launch company is meeting with insurance firms in the next couple of weeks, according to a report in Space News.

Hofeller made his remarks at the CASBAA Satellite Industry Forum in Singapore. The meetings with insurance providers will help "make sure they understand our process for certifying these (previously-flown boosters) and getting them ready for flight," Hofeller said in the Space News report.



A close-up of restraints installed at the base of the Falcon 9 booster for stabilization as the rocket returned to Port Canaveral on Thursday. Credit: James Murati/Bionetics

Shotwell told Spaceflight Now in April that it will take some time to satisfy concerns in the insurance community. In the Space News report, an unnamed insurer said the risk management community is more than willing to underwrite Falcon 9 launches, presumably with used components, but wants more information.

"But we would like to know exactly what we are insuring," the official said, according to Space News. "They have move rather quickly through design modifications for the rocket and it's not always clear what new elements have been introduced."

Shotwell outlined SpaceX's relationship with the insurance industry in April.

"They've already gotten the qualification of the Merlin engine (for multiple missions), which tends to drive the insurance community," Shotwell told Spaceflight Now. "Structures is a little more definitive analytically. You can kind of get through that. I think it's the engines, and they already know that they've been qualified for more than one flight. I don't think it's

going to be a big lift with the insurance community, but it's certainly going to take work."

SpaceX has not identified a mission for the first flight of a reused rocket, but Hofeller said it will probably be a commercial mission. Shotwell said in April the top two candidates will likely be missions with enough excess capacity to allow the rocket to return to a landing on land, implying they might be destined for relatively low orbits.

The company has also not confirmed whether the launch will originate from Cape Canaveral or Vandenberg Air Force Base, California.

The price of a launch with a reused booster, at least initially, is also an open question, SpaceX officials said.

Shotwell said she hopes SpaceX can realize a 30 percent cost reduction when flying Falcon 9 missions with a first stage out of the company's inventory, and not fresh off the assembly line. SpaceX currently offers Falcon 9 missions for about $62 million on the commercial market.

SpaceX launched the Thaicom 8 communications satellite from Cape Canaveral on May 27, marking the 25th flight of a Falcon 9. Credit: SpaceX

"The ultimate goal is just the cost of re-fueling and re-launching, which is way more than 30 percent," Shotwell told Spaceflight Now in April when asked to clarify the pricing strategy. "Near-term, I hope I don't have refurbishment, but I certainly have inspection, and I have to recover the investment that I made in that rocket, so we won't see the 30 percent (reduction) right away.

"Over time, I think we will probably get there, and then ultimately I'd like to be substantially less, but we'll have to see," she said earlier this year.

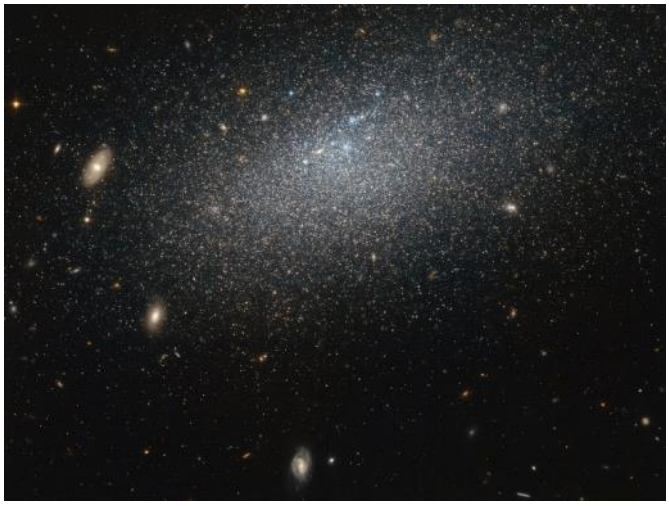
The second stage of the Falcon 9, powered by a single Merlin engine, will continue to be expendable on each mission. SpaceX is working on a scheme to recover the clamshell-like payload fairing mounted on the nose of the rocket in a bid to reuse that part along with the first stage.

And what about a discount for the first customer to fly on a used Falcon 9 booster?

"My guess is we'll have to do something for them, but I don't know," Shotwell said.

A mysterious solitary galaxy in Ursa Major

6 June 2016 Astronomy Now



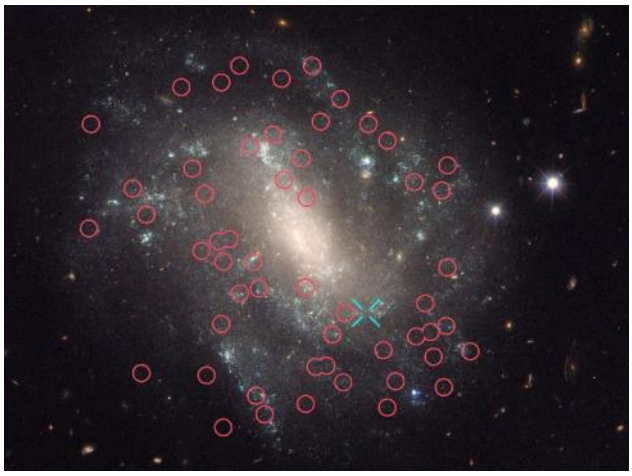
Irregular dwarf galaxy UGC 4879 lies about 4 million light-years away in the constellation of Ursa Major. Image credit: NASA & ESA.The drizzle of stars scattered across this image from the NASA/ESA Hubble Space Telescope forms a galaxy known as UGC 4879. UGC 4879 is an irregular dwarf galaxy — as the name suggests, galaxies of this type are a little smaller and messier than their cosmic cousins, lacking the majestic swirl of a spiral or the coherence of an elliptical.

This galaxy is also very isolated. There are about 2.3 million light years between UGC 4879 and its closest neighbour, Leo A, which is about the same distance as that between the Andromeda Galaxy and the Milky Way.

This galaxy's isolation means that it has not interacted with any surrounding galaxies, making it an ideal laboratory for studying star formation uncomplicated by interactions with other galaxies. Studies of UGC 4879 have revealed a significant amount of star formation in the first 4-billion-years after the Big Bang, followed by a strange nine-billion-year lull in star formation, ended 1-billion-years ago by a more recent reignition. The reason for this behaviour, however, remains mysterious, and the solitary galaxy continues to provide ample study material for astronomers looking to understand the complex mysteries of starbirth throughout the universe.

Hubble finds universe is expanding faster than expected

2 June 2016 Astronomy Now



A NASA/ESA Hubble Space Telescope image of the galaxy UGC 9391, one of the galaxies in the new survey. UGC 9391 contains the two types of stars — Cepheid variables and a Type 1a supernova — that astronomers used

to calculate a more precise Hubble Constant. The red circles that mark the locations of Cepheids. The blue "X" denotes the location of supernova 2003du, a Type Ia supernova. The observations for this composite image were taken between 2012 and 2013 by Hubble's Wide Field Camera 3. Image credit: NASA, ESA, and A. Riess (STScI/JHU).Astronomers have obtained the most precise measurement yet of how fast the universe is expanding at the present time, and it doesn't agree with predictions based on other data and our current understanding of the physics of the cosmos.

The discrepancy — the universe is now expanding 9 percent faster than expected — means either that measurements of the cosmic microwave background radiation are wrong, or that some unknown physical phenomenon is speeding up the expansion of space, the astronomers say.

"If you really believe our number — and we have shed blood, sweat and tears to get our measurement right and to accurately understand the uncertainties — then it leads to the conclusion that there is a problem with predictions based on measurements of the cosmic microwave background radiation, the leftover glow from the Big Bang," said Alex Filippenko, a UC Berkeley professor of astronomy and co-author of a paper announcing the discovery.

"Maybe the universe is tricking us, or our understanding of the universe isn't complete," he added.

The cause could be the existence of another, unknown particle — perhaps an often-hypothesised fourth flavour of neutrino — or that the influence of dark energy (which accelerates the expansion of the universe) has increased over the 13.8 billion year history of the universe. Or perhaps Einstein's general theory of relativity, the basis for the Standard Model, is slightly wrong.

"This surprising finding may be an important clue to understanding those mysterious parts of the universe that make up 95 percent of everything and don't emit light, such as dark energy, dark matter and dark radiation," said Nobel Laureate Adam Riess, the leader of the study from the Space Telescope Science Institute and The Johns Hopkins University, both in Baltimore, Maryland. Riess is a former UC Berkeley postdoctoral fellow who worked with Filippenko.

The results, using data from the NASA/ESA Hubble Space Telescope and the Keck-I telescope in Hawaii, will appear in an upcoming issue of The Astrophysical Journal.

Afterglow of Big Bang

A few years ago, the European Space Agency's Planck observatory — now out of commission — measured fluctuations in the cosmic background radiation to document the universe's early history. Planck's measurements, combined with the current Standard Model of physics, predicted an expansion rate today of 66.53 (±0.62) kilometres per second per megaparsec. A megaparsec equals 3.26 million light-years.

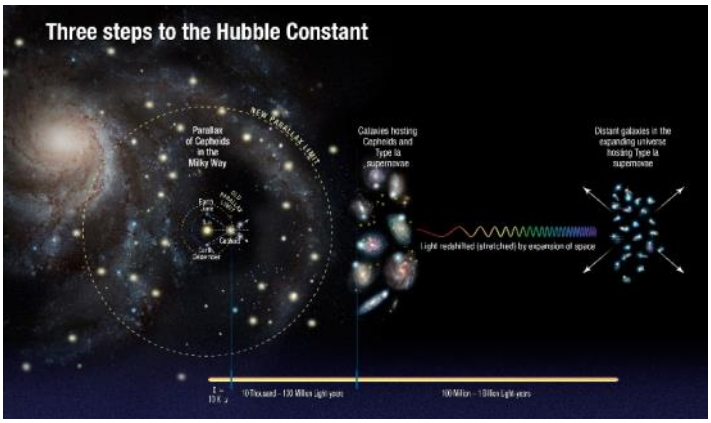
Previous direct measurements of galaxies pegged the current expansion rate, or Hubble Constant, between 70 and 75 km/sec/Mpc, give or take about 5-10 percent — a result that is not definitely in conflict with the Planck predictions. But the new direct measurements yield a rate of 73.24 (±1.74) km/sec/Mpc, an uncertainty of only 2.4 percent, and clearly incompatible with the Planck predictions, Filippenko said.

The team, several of whom were part of the High-z Supernova Search Team that co-discovered the accelerating expansion of the universe in 1998, refined the universe's current expansion rate by developing innovative techniques that improved the precision of distance measurements to faraway galaxies.

The team looked for galaxies containing both a type of variable star called a Cepheid and Type Ia supernovae. Cepheid stars pulsate at rates that correspond to their true brightness (power), which can be compared with their apparent brightness as seen from Earth to accurately determine their distance and thus the distance of the galaxy. Type Ia supernovae, another commonly used cosmic yardstick, are exploding stars that flare with the same intrinsic brightness and are brilliant enough to be seen from much longer distances.

By measuring about 2,400 Cepheid stars in 19 nearby galaxies and comparing the apparent brightness of both types of stars, they accurately determined the true brightness of the Type Ia supernovae. They then used this calibration to calculate distances to roughly 300 Type Ia supernovae in far-flung galaxies.

"We needed both the nearby Cepheid distances for galaxies hosting Type Ia supernovae and the distances to the 300 more-distant Type Ia supernovae to determine the Hubble Constant," Filippenko said. "The paper focuses on the 19 galaxies and getting their distances really, really well, with small uncertainties, and thoroughly understanding those uncertainties."



Astronomers used the Hubble Space Telescope to measure the distances to a class of pulsating stars called Cepheid variables to calibrate their true brightness, so that they could be used as cosmic yardsticks to measure distances to galaxies much farther away. This method is more precise than the classic parallax technique. Click graphic for a full-size version. Image credit: NASA, ESA, A. Feild (STScI), and A. Riess (STScI/JHU).**Calibrating Cepheid variable stars**

Using the Keck-I 10-metre telescope in Hawaii, Filippenko's group measured the chemical abundances of gases near the locations of Cepheid variable stars in the nearby galaxies hosting Type Ia supernovae. This allowed them to improve the accuracy of the derived distances of these galaxies, and thus to more accurately calibrate the peak luminosities of their Type Ia supernovae.

"We've done the world's best job of decreasing the uncertainty in the measured rate of universal expansion and of accurately assessing the size of this uncertainty," said Filippenko, "yet we find that our measured rate of expansion is probably incompatible with the rate expected from observations of the young universe, suggesting that there's something important missing in our physical understanding of the universe."

"If we know the initial amounts of stuff in the universe, such as dark energy and dark matter, and we have the physics correct, then you can go from a measurement at the time shortly after the Big Bang and use that understanding to predict how fast the universe should be expanding today," said Riess. "However, if this discrepancy holds up, it appears we may not have the right understanding, and it changes how big the Hubble Constant should be today."

Aside from an increase in the strength with which dark energy is pushing the universe apart, and the existence of a new fundamental subatomic particle — a nearly speed-of-light particle called "dark radiation" — another possible explanation is that dark matter possesses some weird, unexpected characteristics. Dark matter is the backbone of

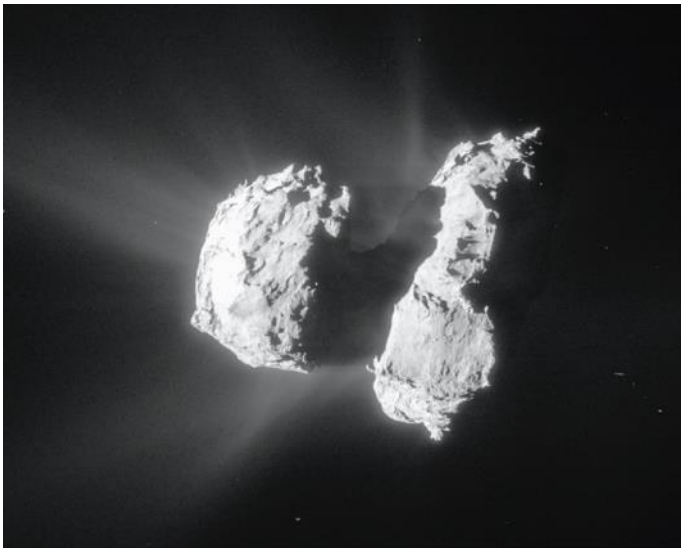
the universe upon which galaxies built themselves into the large-scale structures seen today.

The Hubble observations were made with Hubble's sharp-eyed Wide Field Camera 3 (WFC3), and were conducted by the Supernova H0 for the Equation of State (SHOES) team, which works to refine the accuracy of the Hubble Constant to a precision that allows for a better understanding of the universe's behaviour.

The SHOES Team is still using Hubble to reduce the uncertainty in the Hubble Constant even more, with a goal to reach an accuracy of 1 percent. Current telescopes such as the European Space Agency's Gaia satellite, and future telescopes such as NASA's James Webb Space Telescope (JWST), an infrared observatory, and the Wide Field Infrared Space Telescope (WFIRST), also could help astronomers make better measurements of the expansion rate.

Rosetta's Comet 67P contains ingredients for life

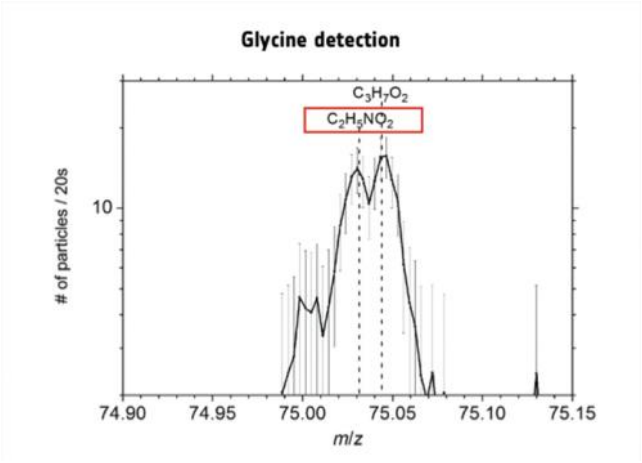
28 May 2016 Astronomy Now



The measurements were made when ESA's Rosetta spacecraft was between 10 and 200 kilometres of Comet 67P/Churyumov-Gerasimenko. Image credit: ESA/Rosetta/NavCam.Ingredients crucial for the origin of life on Earth, including the simple amino acid glycine and phosphorus, key components of DNA and cell membranes, have been discovered at Comet 67P/Churyumov-Gerasimenko.

The possibility that water and organic molecules were brought to the early Earth through impacts of objects like asteroids and comets has long been the subject of important debate.

While Rosetta's ROSINA instrument already showed a significant difference in composition between Comet 67P/C-G's water and that of Earth, the same instrument has now shown that even if comets did not play as big a role in delivering water as once thought, they certainly had the potential to deliver life's ingredients.



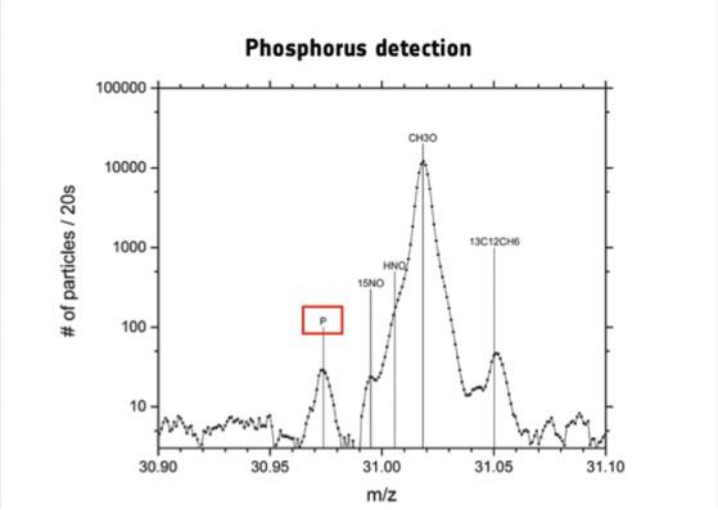
Spectrum indicating glycine ($C_2H_5NO_2$) detection on 9 July 2015. The simple amino acid glycine is a biologically important organic compound commonly found in proteins. Illustration credit: Altwegg et al.While more than 140 different molecules have already been identified in the interstellar medium, amino acids could not be traced. However, hints of the amino acid glycine, a biologically important organic compound commonly found in proteins, were found during NASA's Stardust mission that flew by Comet Wild 2 in 2004, but terrestrial contamination of the collected dust samples during the analysis could not be ruled out. Now, for the first time, repeated detections at a comet have been confirmed by Rosetta in Comet 67P/C-G's fuzzy atmosphere, or coma.

The first detection was made in October 2014, while most measurements were taken during the perihelion in August 2015 — the closest point to the Sun along the comet's orbit while the outgassing was strongest. "This is the first unambiguous detection of glycine in the thin atmosphere of a comet," says Kathrin Altwegg, principal investigator of the ROSINA instrument at the Center of Space and Habitability of the University of Bern and lead author of the study. The results are now being published in Science.

Primordial chemistry in the ice

Glycine is very hard to detect due to its non-reactive nature: it sublimates at slightly below 150 °C, meaning that little is released as gas from the comet's surface or subsurface due to its cold temperatures. "We see a strong correlation of glycine to dust, suggesting that it is probably released from the grains' icy mantles once they have warmed up in the coma, perhaps together with other volatiles," says Altwegg. At the same time, the researchers also detected the organic molecules methylamine and ethylamine, which are precursors to forming glycine. Unlike other amino acids, glycine is the only one that has been shown to be able to form without liquid water. "The simultaneous presence of methylamine and ethylamine, and the correlation between dust and glycine, also hints at how the glycine was formed," says Altwegg.

Phosphorus, a key element for terrestrial life

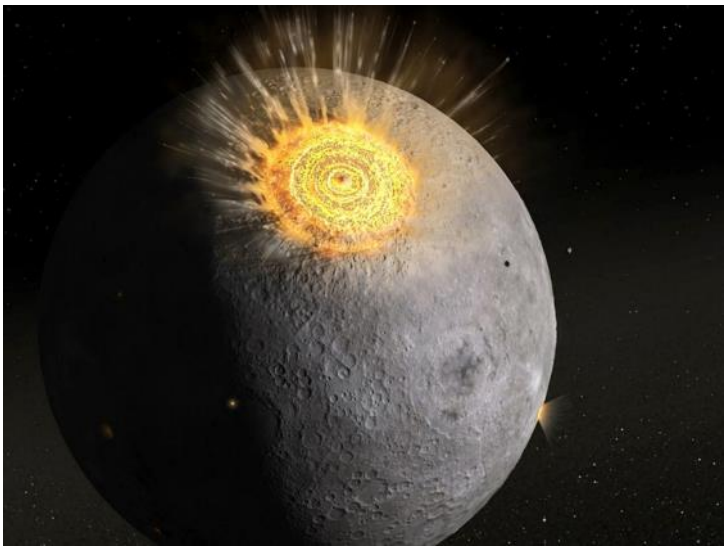


Spectrum indicating phosphorus (P) detection, along with other gases, on 26 October 2014. Phosphorus is a key element in all living organisms. It is found in DNA, RNA and in cell membranes, and it is used in transporting energy within cells for metabolism. Illustration credit: Altwegg et al.Another exciting detection by ROSINA made for the first time at a comet is of phosphorus. It is a key element in all living organisms and is found in the structural framework of DNA and RNA.

“The multitude of organic molecules already identified by ROSINA, now joined by the exciting confirmation of fundamental ingredients like glycine and phosphorous, confirms our idea that comets have the potential to deliver key molecules for prebiotic chemistry,” says Matt Taylor, Rosetta project scientist of the European Space Agency, ESA. “Demonstrating that comets are reservoirs of primitive material in the solar system, and vessels that could have transported these vital ingredients to Earth, is one of the key goals of the Rosetta mission, and we are delighted with this result.”

Asteroids identified as source of Moon’s water

1 June 2016 Astronomy Now



An artist’s impression of how the early Moon was reshaped by an intense period of bombardment. A new study reveals that most of the water inside the Moon was delivered by asteroids (not comets) during our natural satellite’s early evolution, approximately 4.5—4.3 billion years ago. Illustration credit: Daniel D. Durda/FIAAA.In the Apollo era, the Moon was often described as being devoid of water. As analytical techniques improved, scientists realised that water resided in the lunar interior, but in quantities that had simply been impossible to detect when lunar samples were originally returned to Earth. The discovery of water in lunar samples prompted a new question: what was the source of the Moon’s water?

In the current study published in Nature Communications, an international science team compared the chemical and isotopic composition of lunar volatiles (including water) with those of volatile materials in comets and meteoritic samples of asteroids. They then calculated the proportion of water that could have been delivered by those two populations of objects. Their results indicate that most (>80%) of the water in the lunar interior was derived from asteroids that are similar to carbonaceous chondritic meteorites. That water was delivered when the Moon was still surrounded by a magma ocean and before a massive crust (now seen as the bright white highlands of the Moon) prevented impacting objects from delivering significant amounts of material to the lunar interior. A similar delivery of water to the Earth would have been occurring within this same interval of time.

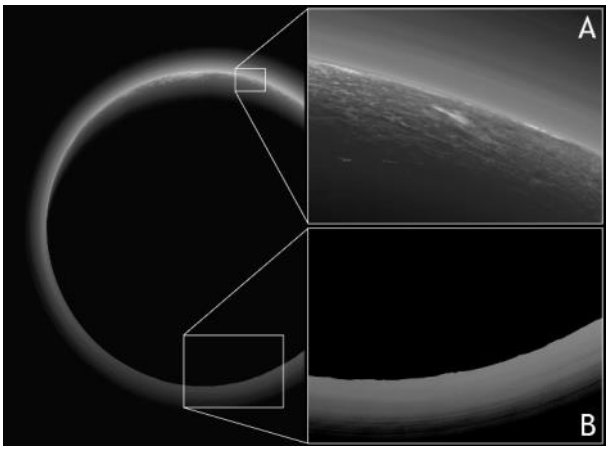
These results were derived by an interdisciplinary team with extensive experience studying both the Moon and meteoritic samples of impacting asteroids. The first author on the paper is Dr. Jessica J. Barnes (a postdoctoral researcher at The Open University, Milton Keynes, U.K.). Her co-authors are Dr. David A. Kring (Senior Scientist in the Center for Lunar Science and Exploration (CLSE), Lunar and Planetary Institute, Houston, Texas), Dr. Romain Tartèse (a postdoctoral researcher at the Muséum National d’Histoire Naturelle, Paris, France), Dr. Ian A. Franchi (Senior Research Fellow, The Open University, Milton Keynes, U.K.), Prof. Mahesh Anand (Reader/Associate Professor, The Open University, Milton Keynes, U.K.), and Prof. Sara S. Russell (Head, Division of Mineral and Planetary Sciences, The Natural History Museum, London, U.K.).

The first author, Dr. Barnes, is a former graduate student intern in the CLSE Lunar Exploration Summer Intern Program, is currently a CLSE postdoctoral international partner, and is an incoming postdoctoral researcher at the NASA Johnson Space Center and the Lunar and Planetary Institute, which is managed by USRA for NASA.

Dr. Kring’s portion of the work was supported at the Lunar and Planetary Institute by cooperative agreements to the Universities Space Research Association from NASA’s Planetary Science Division and NASA’s solar system Exploration Research Virtual Institute.

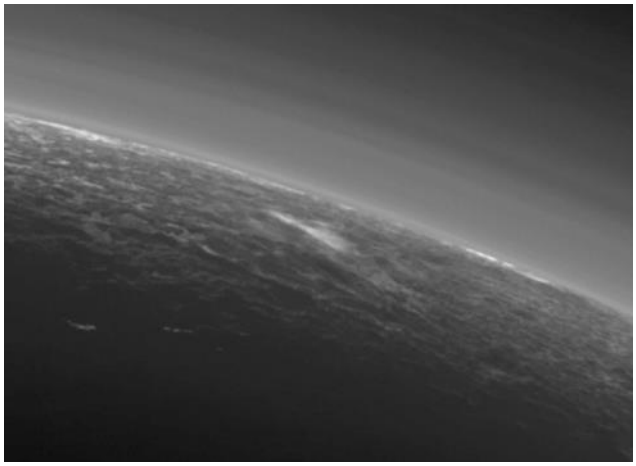
Pluto’s “Twilight Zone” reveals its secrets

3 June 2016 Astronomy Now



NASA’s New Horizons spacecraft took this stunning image of Pluto only a few minutes after closest approach on 14 July 2015. The image was obtained at a high phase angle — that is, with the Sun on the other side of Pluto, as viewed by New Horizons. Seen here, sunlight filters through and illuminates Pluto’s complex atmospheric haze layers. The southern portions of the nitrogen ice plains informally named Sputnik

Planum, as well as mountains of the informally named Norgay Montes, can also be seen across Pluto's crescent at the top of the image. Image credit: NASA/JHUAPL/SwRI



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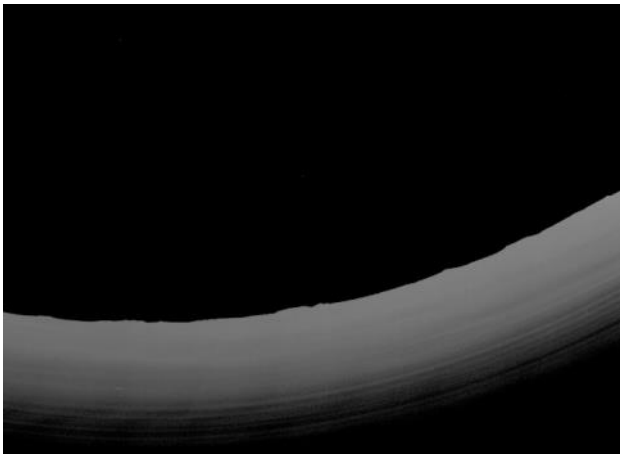
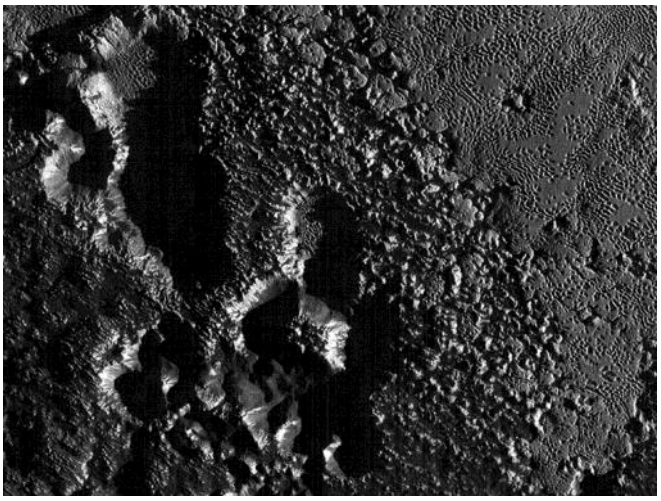
Inset A shows a detail of Pluto's crescent, including an intriguing bright wisp (near the centre) measuring tens of miles across that may be a discreet, low-lying cloud in Pluto's atmosphere; if so, it would be the only one yet identified in New Horizons imagery. This cloud — if that's what it is — is visible for the same reason the haze layers are so bright: illumination from the sunlight grazing Pluto's surface at a low angle. Atmospheric models suggest that methane clouds can occasionally form in Pluto's atmosphere. The scene in this inset is 140 miles (230 kilometres) across. Image credit: NASA/JHUAPL/SwRI.



Inset B shows more detail on the night side of Pluto. This terrain can be seen because it is illuminated from behind by hazes that silhouette the limb. The topography here appears quite rugged, and broad valleys and sharp peaks with relief totalling 3 miles (5 kilometres) are apparent. This image, made from closer range, is much better than the lower-resolution images of this same terrain taken several days before closest approach. These silhouetted terrains therefore act as a useful "anchor point," giving New Horizons scientists a rare, detailed glimpse at the lay of the land in this mysterious part of Pluto seen at high resolution only in twilight. The scene in this inset is 460 miles (750 kilometres) wide. Image credit: NASA/JHUAPL/SwRI.Looking back at Pluto with images like this gives New Horizons scientists information about Pluto's hazes and surface properties that they can't get from images taken on approach. The image was obtained by New Horizons' Ralph/Multispectral Visual Imaging Camera (MVIC) approximately 13,400 miles (21,550 kilometres) from Pluto, about 19 minutes after New Horizons' closest approach. The image has a resolution of 1,400 feet (430 metres) per pixel. Pluto's diameter is 1,475 miles (2,374 kilometres).

New Horizons' best close-up of Pluto's surface

29 May 2016 Astronomy Now



The rugged dark highlands of Pluto as revealed by NASA's New Horizons spacecraft at 80 metres (260 feet) per pixel resolution during its close flyby of 14 July 2015. Click the image to see the full mosaic strip and zoom in. Image credit: NASA/JHUAPL/SwRI.This is the most detailed view of Pluto's terrain you'll see for a very long time. This mosaic strip – extending across the hemisphere that faced the New Horizons spacecraft as it flew past Pluto on 14 July 2015 – now includes all of the highest-resolution images taken by the NASA probe. (Be sure to zoom in for maximum detail.) With a resolution of about 260 feet (80 metres) per pixel, the mosaic affords New Horizons scientists and the public the best opportunity to examine the fine details of the various types of terrain on Pluto, and determine the processes that formed and shaped them.

"This new image product is just magnetic," said Alan Stern, New Horizons principal investigator from Southwest Research Institute, Boulder, Colorado. "It makes me want to go back on another mission to Pluto and get high-resolution images like these across the entire surface."

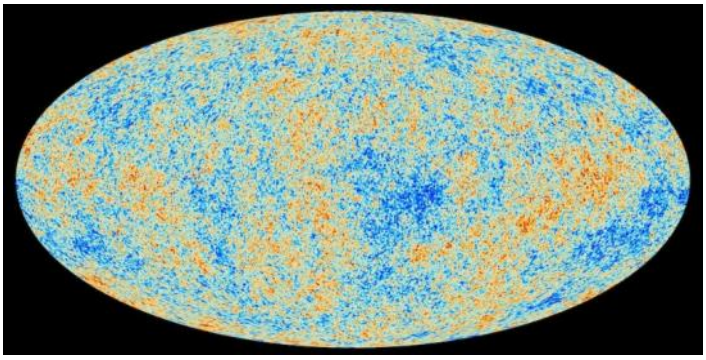
The view extends from the "limb" of Pluto at the top of the strip, almost to the "terminator" (or day/night line) in the southeast of the encounter hemisphere, seen below. The width of the strip ranges from more than 55 miles (90 kilometres) at its northern end to about 45 miles (75 kilometres) at its southern point. The perspective changes greatly along the strip: at its northern end, the view looks out horizontally across the surface, while at its southern end, the view looks straight down onto the surface.

The movie above moves down the mosaic from top to bottom, offering new views of many of Pluto's distinct landscapes along the way. Starting with hummocky, cratered uplands at top, the view crosses over parallel ridges of "washboard" terrain, chaotic and angular mountain ranges, cellular plains, coarsely "pitted" areas of sublimating nitrogen ice, zones of thin nitrogen ice draped over the topography below, and dark mountainous highlands scarred by deep pits.

The pictures in the mosaic were obtained by New Horizons' Long Range Reconnaissance Imager (LORRI) approximately 9,850 miles (15,850 kilometres) from Pluto, about 23 minutes before New Horizons' closest approach.

What Is the Big Bang Theory?

By Elizabeth Howell, Space.com Contributor | June 22, 2015 09:47pm ET



A 2013 map of the background radiation left over from the Big Bang, taken by the ESA's Planck spacecraft, captured the oldest light in the universe. This information helps astronomers determine the age of the universe.

Credit: ESA and the Planck Collaboration.

The Big Bang Theory is the leading explanation about how the universe began. At its simplest, it talks about the universe as we know it starting with a small singularity, then inflating over the next 13.8 billion years to the cosmos that we know today.

Because current instruments don't allow astronomers to peer back at the universe's birth, much of what we understand about the Big Bang Theory comes from mathematical theory and models. Astronomers can, however, see the "echo" of the expansion through a phenomenon known as the cosmic microwave background.

The phrase "Big Bang Theory" has been popular among astrophysicists for decades, but it hit the mainstream in 2007 when a comedy show with the same name premiered on CBS. The show follows the home and academic life of several researchers (including an astrophysicist).

The first second, and the birth of light

In the first second after the universe began, the surrounding temperature was about 10 billion degrees Fahrenheit (5.5 billion Celsius), according to NASA. The cosmos contained a vast array of fundamental particles such as neutrons, electrons and protons. These decayed or combined as the universe got cooler.

This early soup would have been impossible to look at, because light could not carry inside of it. "The free electrons would have caused light (photons) to scatter the way sunlight scatters from the water droplets in clouds," NASA stated. Over time, however, the free electrons met up with nuclei and created neutral atoms. This allowed light to shine through about 380,000 years after the Big Bang.

This early light — sometimes called the "afterglow" of the Big Bang — is more properly known as the cosmic microwave background (CMB). It was first predicted by Ralph Alpher and other scientists in 1948, but was found only by accident almost 20 years later. [Images: Peering Back to the Big Bang & Early Universe]

Arno Penzias and Robert Wilson, both of Bell Telephone Laboratories in Murray Hill, New Jersey, were building a radio receiver in 1965 and picking up higher-than-expected temperatures, according to NASA. At first, they thought the anomaly was due to pigeons and their dung, but even after cleaning up the mess and killing pigeons that tried to roost inside the antenna, the anomaly persisted.

Simultaneously, a Princeton University team (led by Robert Dicke) was trying to find evidence of the CMB, and realized that Penzias and Wilson had stumbled upon it. The teams each published papers in the Astrophysical Journal in 1965.

Determining the age of the universe

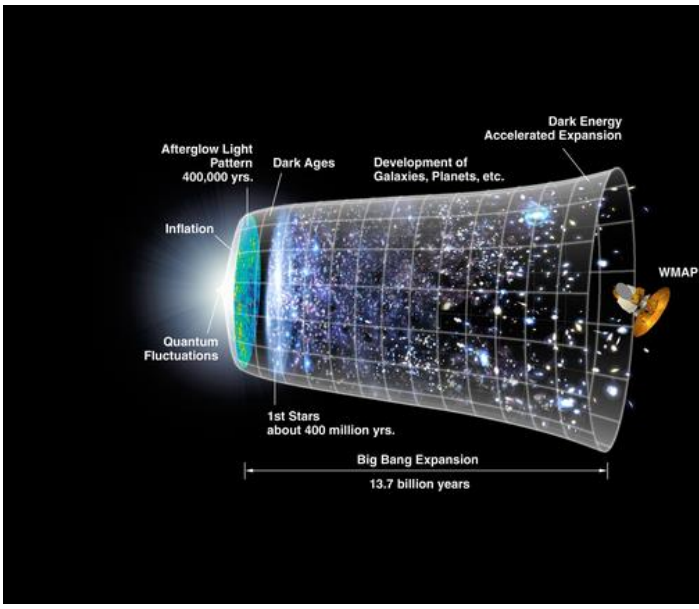
The cosmic microwave background has been observed on many missions. One of the most famous space-faring missions was NASA's Cosmic Background Explorer (COBE) satellite, which mapped the sky in the 1990s.

Several other missions have followed in COBE's footsteps, such as the BOOMERanG experiment (Balloon Observations of Millimetric Extragalactic Radiation and Geophysics), NASA's Wilkinson Microwave Anisotropy Probe (WMAP) and the European Space Agency's Planck satellite.

Planck's observations, released in 2013, mapped the background in unprecedented detail and revealed that the universe was older than previously thought: 13.82 billion years old, rather than 13.7 billion years old. [Related: How Old is the Universe?]

The maps give rise to new mysteries, however, such as why the Southern Hemisphere appears slightly redder (warmer) than the Northern Hemisphere. The Big Bang Theory says that the CMB would be mostly the same, no matter where you look.

Examining the CMB also gives astronomers clues as to the composition of the universe. Researchers think most of the cosmos is made up of matter and energy that cannot be "sensed" with conventional instruments, leading to the names dark matter and dark energy. Only 5 percent of the universe is made up of matter such as planets, stars and galaxies.



This graphic shows a timeline of the universe based on the Big Bang theory and inflation models.

Credit: NASA/WMAP

Gravitational waves controversy

While astronomers could see the universe's beginnings, they've also been seeking out proof of its rapid inflation. Theory says that in the first second after the universe was born, our cosmos ballooned faster than the speed of light. That, by the way, does not violate Albert Einstein's speed limit since he said that light is the maximum anything can travel within the universe. That did not apply to the inflation of the universe itself.

In 2014, astronomers said they had found evidence in the CMB concerning "B-modes," a sort of polarization generated as the universe got bigger and created gravitational waves. The team spotted evidence of this using an Antarctic telescope called "Background Imaging of Cosmic Extragalactic Polarization", or BICEP2.

"We're very confident that the signal that we're seeing is real, and it's on the sky," lead researcher John Kovac, of the Harvard-Smithsonian Center for Astrophysics, told Space.com in March 2014.

But by June, the same team said that their findings could have been altered by galactic dust getting in the way of their field of view.

"The basic takeaway has not changed; we have high confidence in our results," Kovac said in a press conference reported by the New York Times. "New information from Planck makes it look like pre-Planckian predictions of dust were too low," he added.

The results from Planck were put online in pre-published form in September. By January 2015, researchers from both teams working together "confirmed that the Bicep signal was mostly, if not all, stardust," the New York Times said in another article.

Faster inflation, multiverses and charting the start

The universe is not only expanding, but getting faster as it inflates. This means that with time, nobody will be able to spot other galaxies from Earth, or any other vantage point within our galaxy.

"We will see distant galaxies moving away from us, but their speed is increasing with time," Harvard University astronomer Avi Loeb said in a March 2014 Space.com article.

"So, if you wait long enough, eventually, a distant galaxy will reach the speed of light. What that means is that even light won't be able to bridge the gap that's being opened between that galaxy and us. There's no way for extraterrestrials on that galaxy to communicate with us, to send any signals that will reach us, once their galaxy is moving faster than light relative to us."

Some physicists also suggest that the universe we experience is just one of many. In the "multiverse" model, different universes would coexist with each other like bubbles lying side by side. The theory suggests that in that first big push of inflation, different parts of space-time grew at different rates. This could have carved off different sections — different universes — with potentially different laws of physics.

"It's hard to build models of inflation that don't lead to a multiverse," Alan Guth, a theoretical physicist at the Massachusetts Institute of Technology, said during a news conference in March 2014 concerning the gravitational waves discovery. (Guth is not affiliated with that study.)

"It's not impossible, so I think there's still certainly research that needs to be done. But most models of inflation do lead to a multiverse, and evidence for inflation will be pushing us in the direction of taking [the idea of a] multiverse seriously."

While we can understand how the universe we see came to be, it's possible that the Big Bang was not the first inflationary period the universe experienced. Some scientists believe we live in a cosmos that goes through regular cycles of inflation and deflation, and that we just happen to be living in one of these phases.

- See more at: http://www.space.com/25126-big-bang-theory.html#sthash.EpRhZhzf.dpuf

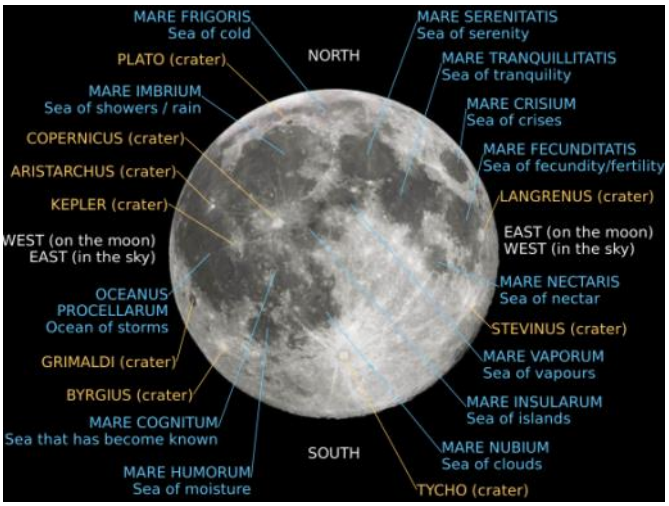
Looking for Lunar Letters

6 Jun , 2016 by David Dickinson

Ready for some astro-pareidolia? This week, we look no further than Earth's Moon, which reaches 1st Quarter phase this coming Sunday.

The Moon reaches First Quarter phase for lunation 1156 (which dates synodic cycles of the Moon using what's called the Brown Lunation Number all the way back to January 17, 1923) this weekend on Sunday, June 12th, at 9:10 EDT/13:10 UT.

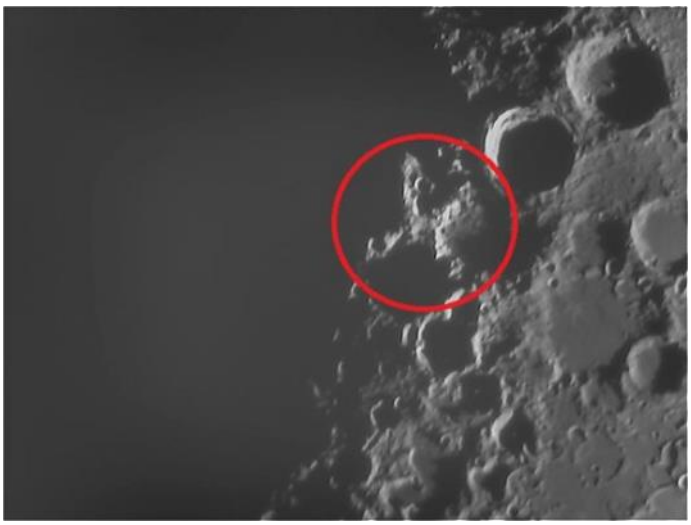
Every culture sees something different in the face of the Moon. The Chinese saw a rabbit, and named the Yutu 'Jade Rabbit' rover in honor of the myth. In Longfellow's *The Song of Hiawatha*, it's the body of the Iroquois Indian chief's grandmother we see, flung up against the Moon. The Greeks believed the Moon was a large polished mirror, reflecting back a view of the Earth below. Of course, if this *were* the case, it would be hard to explain just how the image doesn't shift during the night, as the Moon moves across the sky.



The annotated features on the lunar nearside. Image credit: Wikimedia Commons/ Peter Freiman(Cmglee). Background photograph by Gregory H. Revera.

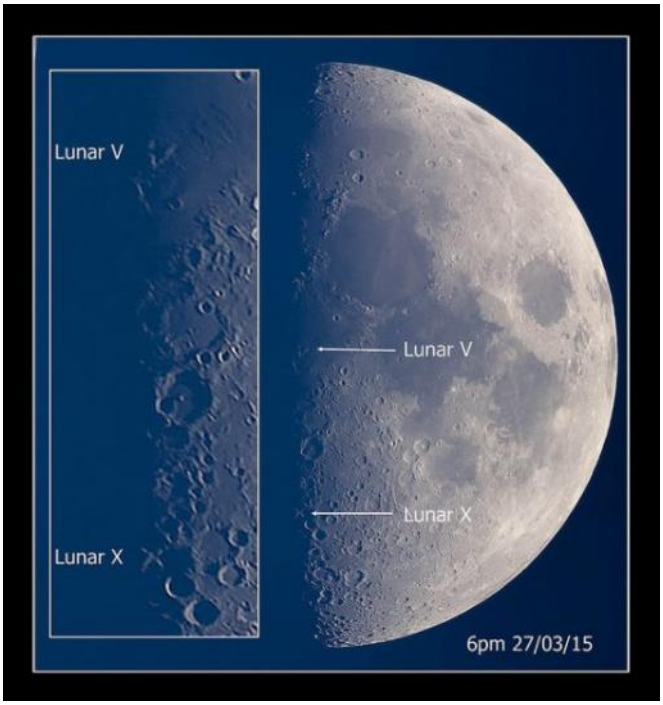
A cosmic Rorschach test, the Moon is tidally locked in the Earth's embrace, keeping its far side forever hidden from our terrestrial vantage point. The subtle rocking motions known as libration and nutation allow us to peer over the edge just a bit, allowing us to see 59% of the Moon's total surface. A glimpse of the far side had to wait until the Soviet Luna 3 spacecraft flew past the Moon on October 7th, 1959 and returned the first blurry images.

One of the most famous of the lunar letters is the Lunar X, also referred to as the Werner X or Purbach Cross. This is the confluence of the rims of the craters La Caille, Blanchinus and Purbach located in the lunar highlands. The Lunar X becomes visible as the waxing gibbous Moon reaches seven days illumination, about 6 to 10 hours (depending on the incident sun angle) after First Quarter phase, and 6 to 10 hours before Last Quarter. The Lunar X can stand out in dramatic contrast against the darkness just beyond the lunar terminator, if you can catch it just as the first rays of sunlight hits the top of the ridge. Remember, the span of sunrise to sunset lasts two weeks on the Moon, and looking Earthward, you'd see the Earth in an opposite phase.



All hail the 'Lunar X'… image credit: Dave Dickinson.

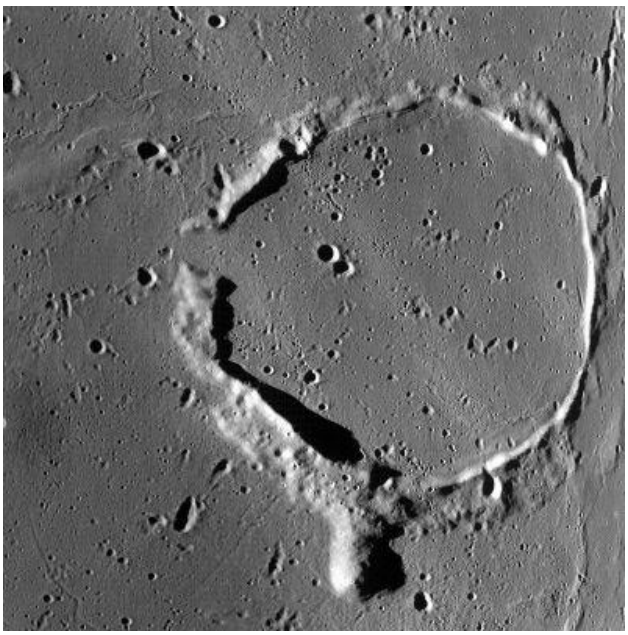
Sometimes, the Curtiss Cross feature is referred to as a lesser known Lunar X; the confluence of two or more crater rims on the battered surface of the Moon is far from uncommon.



The Lunar X and the Lunar V features. Image credit and copyright: Mary Spicer

Sweeping northward, the Lunar V feature in the Mare Vaporum is also sometimes prominent around the same time as the Lunar X, and it's possible to nab both in the same image.

Other lunar letters of note include the Lunar S in Sinus Asperitatis (visible at 47% illumination just before First Quarter), the Lunar W located near Mons Rümker on the lunar limb in the Oceanus Procellarum, and our favorite of the lesser known lunar letters, the Lunar Q of crater Kies in the Mare Nubium reaching favorable illumination 10 days after New. You can see a partial listing of lunar letters in the WikiMoon article here.



The 'Lunar Q' feature… Image credit: NASA/LROC.

Of course, circular craters provide a wealth of candidates for the 'Lunar O,' and straight line features such as the Rupes Recta lunar straight wall feature in the Mare Nubium could easily pass for the 'Lunar I'. Veteran lunar observer Charles Wood made a call in *Sky and Telescope* magazine to fill out the visual lunar alphabet in a similar fashion akin to Galaxy Zoo… hey, who wouldn't love to spell out their name in craters? Maybe some of the recently mapped worlds such as Mercury, Pluto or Ceres could come to the rescue, filling in the final letters?

Many of these are optical illusions, tricks of lighting as the angle of the rising Sun slowly changes, casting shadows across the lunar landscape. Two illumination effects that are at work here straight out of art class are what's known as the *Clair-obscur* or chiaroscuro phenomenon of light and shadow, and the Trompe l'Oeil effect, a three-dimension illusion of forced perspective. Follow features such as the Lunar X night to night as the Moon heads towards Full, and you'll notice they nearly vanish amid the glare, as the Sun shines down from high overhead. The vanishing 'face on Mars' was the result of the same trick of light seen in the early Viking 1 orbiter images. The 'face' vanished once the Mars Global Surveyor re-imaged the region during a pass at near-full illumination in 2001. Hey, why don't conspiracy theorists ever cite the 'Man in the Moon' as an artificial construct?

Why lunar letters? Well, I think its neat, to see something as familiar yet improbable as a gleaming letter on the lunar surface staring back at you at the eyepiece. If you look long and hard enough, the universe will produce just about anything, including telescope-building primates with language, and an accidental alphabet written in the heavens.

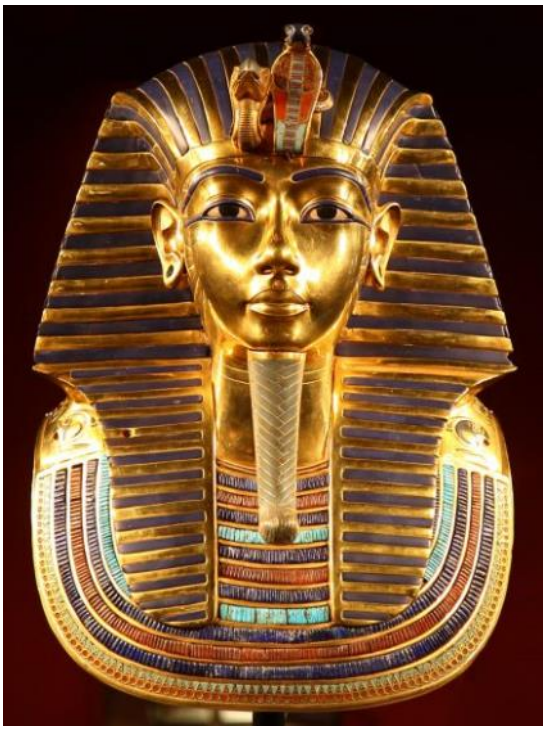
Tutankhamun's Meteorite Blade

2 Jun , 2016 by Evan Gough

The spread of metallurgy in different civilizations is a keen point of interest for historians and archaeologists. It helps chart the rise and fall of different cultures. There are even names for the different ages corresponding to increasingly sophisticated metallurgical technologies: the Stone Age, the Bronze Age, and the Iron Age.

But sometimes, a piece of evidence surfaces that doesn't fit our understanding of a civilization.

Probably the most iconic ancient civilization in all of history is ancient Egypt. Its pyramids are instantly recognizable to almost anyone. When King Tutankhamun's almost intact tomb was discovered in 1922, it was a treasure trove of artifacts. And though the tomb, and King Tut, are most well-known for the golden death mask, it's another, little-known artifact that has perhaps the most intriguing story: King Tut's iron dagger.



King Tutankhamun's Golden Death Mask, one of the most stunning human artifacts in existence. Image: Carsten Frenzl, CC BY 2.0

King Tut's iron-bladed dagger wasn't discovered until 1925, three years after the tomb was discovered. It was hidden in the wrappings surrounding Tut's mummy. It's mere existence was a puzzle, because King Tut reigned in 1332–1323 BC, 600 years before the Egyptians developed iron smelting technology.

King Tut's iron dagger was concealed in the wrappings surrounding the boy-king's mummy. Image: Daniela Comelli/ Polytechnic University of Milan

It was long thought, but never proven, that the blade may be made of meteorite iron. In the past, tests have produced inconclusive results. But according to a new study led by Daniela Comelli, of the Polytechnic University of Milan, and published in the Journal of Meteoritics and Planetary Science, there is no doubt that a meteorite was the source of iron for the blade.

The team of scientists behind the study used a technique called x-ray fluorescence spectrometry to determine the chemical composition of the blade. This technique aims x-rays at an artifact, then determines its composition by the spectrum of colors given off. Those results were then compared with 11 other meteorites.

In the dagger's case, the results indicated Fe plus 10.8 wt% Ni and 0.58 wt% Co. This couldn't be a coincidence, since iron meteorites are mostly made of Fe (Iron) and Ni (Nickel), with minor quantities of Co (Cobalt), P (Phosphorus), S (Sulphur), and C (Carbon). Iron found in the Earth's crust has almost no Ni content.

Testing of Egyptian artifacts is a tricky business. Egypt is highly protective of their archaeological resources. This study was possible only because of advances in portable x-ray fluorescence spectrometry, which meant the dagger didn't have to be taken to a lab and could be tested at the Egyptian Museum of Cairo.

Iron objects were rare in Egypt at that time, and were considered more valuable than gold. They were mostly decorative, probably because ancient Egyptians found iron very difficult to work. It requires a very high heat to work with, which was not possible in ancient Egypt.

Iron meteorites like this one would have attracted the attention of ancient Egyptians. This one is the Bendego meteorite from Brazil. Image: Jorge Andrade – Flickr: National Museum, Rio de Janeiro CC BY 2.0

Even without the ability to heat and work iron, a great deal of craftsmanship went into the blade. The dagger itself had to be hammered into shape, and it features a decorated golden handle and a rounded rock crystal knob. It's golden sheath is decorated with a jackal's head and a pattern of feathers and lilies.

Ancient Egyptians probably new what they were working with. They called meteorite iron from the sky in one hieroglyph. Whether they knew with absolute certainty that their iron meteorites came from the sky, and what that might have meant, they did value the iron. As the authors of the study say, "…our study confirms that ancient Egyptians attributed great value to meteoritic iron for the production of precious objects."

The authors go on to say, "Moreover, the high manufacturing quality of Tutankhamun's dagger blade, in comparison with other simple-shaped meteoritic iron artifacts, suggests a significant mastery of ironworking in Tutankhamun's time."

The logo of the METI International Puerto Rico workshop. At the center is Charles Darwin, the nineteenth century British naturalist whose theory of evolution is central to assessing the likelihood and nature of extraterrestrial intelligence. To the left is the octopus, a creature that evolved sophisticated cognition and perception along an evolutionary path quite different from that of humans. To the right is the peacock, whose elaborate tail feathers evolved by sexual selection, a process that may also have been of central importance to the evolution of human intelligence. METI International, used with permisson.

Astrobiology, Science, SETI

Alien Minds Part III: The Octopus's Garden and the Country of the Blind

2 Jun , 2016 by Paul Patton

In our galaxy, there may be, at least, tens of billions of habitable planets, with conditions suitable for liquid water on their surfaces. There may be habitable moons as well. On an unknown number of those worlds, life may have arisen. On an unknown fraction of life-bearing worlds, life may have evolved into complex multicellular, sexually reproducing forms.

During its habitable period, a world with complex life might produce hundreds of millions of evolutionary lineages. One or a few of them might fortuitously encounter special circumstances that triggered runaway growth of their intelligence. These favored few, if they exist, might have built technological civilizations capable of signaling their presence across interstellar distances, or detecting and deciphering a message we send their way. What might such alien minds be like? What senses might they use? How might we communicate with them?

METI International

The purposes of the newly created METI (Messaging to ExtraTerrestrial Intelligence) International include fostering multidisciplinary research in the design and transmission of interstellar messages, and building a global community of scholars from the natural sciences, social sciences, humanities, and arts concerned with the origin, distribution, and future of life in the universe.

On May 18 the organization sponsored a workshop which included presentations by biologists, psychologists, cognitive scientists, and linguists. This is the third and final installment of a series of articles about the workshop.

In previous installments, we've discussed some ideas about the evolution of intelligence that were featured at the workshop. Here we'll see whether our Earthly experience can provide us with any clues about how we might communicate with aliens.

Many of the animals that we are most familiar with from daily life, like humans, cats, dogs, birds, fishes, and frogs are vertebrates, or animals with backbones. They are all descended from a common ancestor and share a nervous system organized according to the same basic plan.

Molluscs are another major group of animals that have been evolving separately from vertebrates for more than 600 million years. Although most molluscs, like slugs, snails, and shellfish, have fairly simple nervous systems, one group; the cephalopods, have evolved a much more sophisticated one.

The common octopus, Octopus vulgaris, Is a cephalopod mollusc, has evolved sophisticated cognition and perception along a very different evolutionary path than have human beings and our relatives. The brain is located between the eyes. The large bulbous structure below the eyes is the mantle, a muscular organ involved in swimming. Public domain.

Cephalopods include octopuses, squids, and cuttlefishes. They show cognitive and perceptual abilities rivaling those of our close vertebrate kin. Since this nervous system has a different evolutionary history than of the vertebrates, it is organized in a way completely different from our own. It can give us a glimpse of the similarities and differences we might expect between aliens and ourselves.

David Gire, an associate professor of psychology at the University of Washington, and researcher Dominic Sivitilli gave a presentation on cephalopods at the Puerto Rico workshop. Although these animals have a sophisticated brain, their nervous systems are much more decentralized than that of familiar animals. In the octopus, sensing and moving are controlled locally in the arms, which together contain as many nerve cells, or neurons, as the brain.

Dr. David Gire is an Assistant Professor in the Department of Psychology at the University of Washington and a behavioral neuroscientist. He presented at the Puerto Rico workshop on cephalopod intelligence.

The animal's eight arms are extraordinarily sensitive. Each containing hundreds of suckers, with thousands of sensory receptors on each one. By comparison, the human finger has only 241 sensory receptors per square centimeter. Many of these receptors sense chemicals, corresponding roughly to our senses of taste and smell. Much of this sensory information is processed locally in the arms. When an arm is severed from an octopus's body, it continues to show simple behaviors on its own, and can even avoid threats. The octopus's brain simply acts to coordinate the behaviors of its arms.

Cephalopods have acute vision. Although their eyes evolved separately from those of vertebrates, they nonetheless bear an eerie resemblance. They have a unique ability to change the pattern and color of their skin using pigment cells that are under direct control of their nervous systems. This provides them with the most sophisticated camouflage system of any animal on Earth, and is also used for social signaling.

Dominic Sivitilli is a post-baccalaureate researcher in the laboratory of David Gire, studying responses to chemical signals by the octopus. He is the co-presenter of a talk on cephalopod cogntition at the METI International Puerto Rico conference. METI International used with permission.

Despite the sophisticated cognitive abilities it exhibits in the lab, the octopus is largely solitary.
Cephalopod groups exchange useful information by observing one another, but otherwise exhibit only limited social cooperation. Many current theories of the evolution of sophisticated intelligence, like Miller's sapiosexual hypothesis, which was featured in the second installment, assume that social cooperation and competition play a central role in the evolution of complicated brains. Since cephalopods have evolved much more impressive cognitive abilities than other molluscs, their limited social behavior is surprising.

Maybe the limited social behavior of cephalopods really does set limits on their intelligence. However, Gire and Sivitilli speculate that perhaps "an intelligence capable of technological development could exist with minimum social acuity", and the cephalopod ability to socially share information is enough. The individuals of such an alien collective, they suppose, might possess no sense of self or other.

Besides Gire and Sivitilli, Anna Dornhaus, whose ideas were featured in the first installment, also thinks that alien creatures might function together as a collective mind. Social insects, in some respects, actually do. She doubts, though, that such an entities could evolve human-like technological intelligence without something like Miller's sapiosexuality to trigger a runaway explosion of intelligence.

But if non-sapiosexual alien technological civilizations do exist, we might find them impossible to comprehend. Given this possible gulf of incomprehension about social structure, Gire and Stivitilli suppose that the most we might aspire to accomplish in terms of interstellar communication is an exchange of mutually useful and comprehensible astronomical information.

Workshop presenter Alfred Kracher, a retired staff scientist at the Ames Laboratory of the University of Iowa, supposes that "the mental giants of the Milky Way are probably artificially intelligent machines… It would be interesting to find evidence of them, if they exist", he writes, "but then what?" Kracher supposes that if they have emancipated themselves and evolved away from their makers, "they will have nothing in common with organic life forms, human or extraterrestrial. There is no chance of mutual understanding". We will be able to understand aliens, he maintains, only if "it turns out that the evolution of extraterrestrial life forms is highly convergent with our own".

Peter Todd, a professor of psychology from Indiana University, holds out hope that such convergence may actually occur. Earthly animals must solve a variety of basic problems that are presented by the physical and biological world that they inhabit.

They must effectively navigate through a world of surfaces, barriers and objects, finding food and shelter, and avoiding predators, parasites, toxins. Extraterrestrial organisms, if they evolve in an Earth-like environment, would face a generally similar set of problems. They may well arrive at similar solutions, just as the octopus evolved eyes similar to ours.

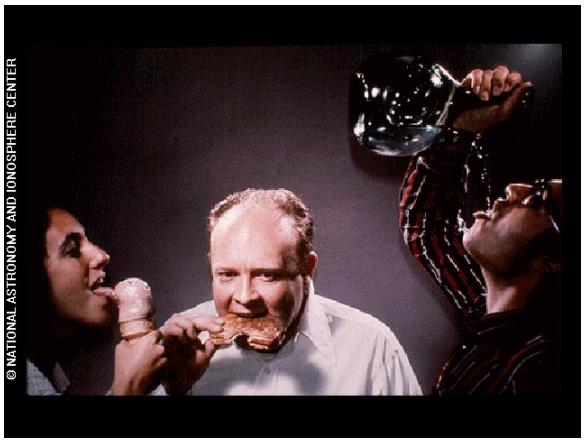
In evolution here on Earth, Todd notes, brain systems originally evolved to solve these basic physical and biological problems appear to have been re-purposed to solve new and more difficult problems, as some animals evolved to solve the problems of living and finding mates as members of societies, and then as one particular age species went on to evolve conceptual reasoning and language. For example, disgust at bad food, useful for avoiding disease, may have been become the foundation for sexual disgust to avoid bad mates, moral disgust to avoid bad clan mates, and intellectual disgust to avoid dubious ideas.

If alien brains evolved solutions similar to the ones our brains did for negotiating the physical and biological world, they they might also have been re-purposed in similar ways. Alien minds might not be wholly different from ours, and thus hope exists for a degree of mutual understanding.

In the early 1970's the Pioneer 10 and 11 spacecraft were launched on the first exploratory missions to the planet Jupiter and beyond. When their missions were completed, these two probes became the first objects made by humans to escape the sun's gravitational pull and hurtle into interstellar space.

Because of the remote possibility that the spacecraft might someday be found by extraterrestrials, a team of scientists and scholars lead by Carl Sagan emplaced a message on the vehicle, etched on a metal plaque. The message consisted, in part, of a line drawing of a man and a woman. Later, the Voyager 1 and 2 spacecraft carried a message that consisted, in

part, of a series of 116 digital images encoded on a phonographic record.



The use of images in interstellar communication. In 1977, NASA launched the Voyager 1 and 2 spacecraft on a mission to explore the outer solar system. Destined to wander interstellar space forever following the completion of their mission, each spacecraft carried an interstellar message encoded on a phonographic record. The message, designed by SETI pioneers Carl Sagan and Frank Drake and their collaborators, included 116 digital images. This image is intended to show extraterrestrials how human beings eat and drink. Will extraterrestrials understand such images? The limited quality of the image reflects the state of digital imaging technology in the 70's National Astronomy and Ionosphere Center, public domain.

The assumption that aliens would see and understand images seems reasonable, since the octopus evolved an eye so similar to our own. And that's not all. The evolutionary biologists Luitfried Von Salvini-Plawen and Ernst Mayr showed that eyes, of various sorts, have evolved forty separate times on Earth, and vision is typically a dominant sense for large, land dwelling animals. Still, there are animals that function without it, and our earliest mammalian ancestors were nocturnal. Could it be that there are aliens that lack vision, and could not understand a message based on images?

In his short story, The Country of the Blind, the great science fiction writer H. G. Wells imagined an isolated mountain village whose inhabitants had been blind for fifteen generations after a disease destroyed their vision.

A lost mountain climber, finding the village, imagines that with his power of vision, he can easily become their king. But the villagers have adapted thoroughly to a life based on touch, hearing, and smell. Instead of being impressed by their visitor's claim that he can 'see', they find it incomprehensible. They begin to believe he is insane. And when they seek to 'cure' him by removing two strange globular growths from the front of his head, he flees.

The Mexican blind cavefish (Astyanax mexicanus) has lived in the total darkness of a cave system in central Mexico for more than a million years, and has evolved the loss of its eyes. Astyanax possess a sense that land dwelling animals lack. The lateral line sense, which is present in all fishes, allows these animals to sense their near surroundings based on pressure differences in fields of water flow around their bodies. They also have an acute sense of taste, with taste receptors on their bodies as well as in their mouths. The evolution of cave dwelling intelligent life is probably unlikely, since large brains are metabolically expensive, and food is scarce in caves. On the surface, plants capture energy from sunlight and form the base of the food chain. State Museum of Natural History, Karlsruhe.

Could their really be an alien country of the blind whose inhabitants function without vision? Workshop presenter Dr. Sheri Wells-Jensen, an associate professor of Linguistics at Bowling Green State University, doesn't need to imagine the country of the blind, because, in a sense, she lives there. She is blind, and believes that creatures without vision could achieve a level of technology sufficient to send interstellar messages. "Sighted people", she writes, "tend to overestimate the amount and quality of information gathered by vision alone".

Dr. Sheri Wells-Jensen is an associate professor of linguistics at Bowling Green State University. She presented at talk at the Puerto Rico workshop on alternative perceptual systems and interstellar communications. METI International, used with permission.

Bats and dolphins image their dimly lit environments with a kind of naturally occurring sonar called echolocation. Blind human beings can also learn to echolocate, using tongue clicks or claps as emitted signals and analyzing the returning echoes by hearing. Some can do so well enough to ride a bicycle at a moderate pace through an unfamiliar neighborhood. A human can develop the touch sensitivity needed to read braille in four months. A blind marine biologist can proficiently distinguish the species of mollusc shells by touch.

Wells-Jensen posits a hypothetical civilization which she calls the Krikkits, who lack vision but possess sensory abilities otherwise similar to those of human beings. Could such beings build a technological society? Drawing on her knowledge of the blind community and a series of experiments, she thinks they could.

Finding food would present few special difficulties, since blind naturalists can identify many plant species by touch. Agriculture could be conducted as modern blind gardeners do it, by marking crops using stakes and piles of rock, and harvesting by feel. The combination of a stick used as a cane to probe the path ahead and echolocation make traveling by foot effective and safe. A loadstone compass would further aid navigational abilities. The Krikkits might use snares rather than spears or arrows to trap animals, making tools by touch.

Mathematics is vital to building a technological society. For most human beings, with our limited memory, a paper and

pencil or a blackboard are essential for doing math. Krikkits would need to find other such aids, such as tactual symbols on clay tablets, abacus-like devices, or patterns sewn on hides or fabric.

Successful blind mathematicians often have prodigious memories, and can perform complex calculations in their heads. One of history's greatest mathematicians, Leonard Euler, was blind for the last 17 years of his life, but remained mathematically productive through the use of his memory.

The obstacles to a blind society developing technology may not be insurmountable. Blind people are capable of handling fire and even working with molten glass. Krikkits might therefore use fire for cooking, warmth, to bake clay vessels, and smelt metal ores. Initially there only astronomical knowledge would be of the sun as a source of heat. Experiments with loadstones and metals would lead to a knowledge of electricity.

Eventually, the Krikkits might imitate their sonar with radio waves, inventing radar. If their planet possessed a moon or moons, radar reflections from them might provide their first knowledge of astronomical objects other than their sun. Radar would also enable them to learn for the first time that their planet is round.

The Krikkits might learn to detect other forms of radiation like X-rays and 'light'. The ability to detect this second mysterious form of radiation might allow them to discover the existence of the stars and develop an interest in interstellar communication.

What sorts of messages might they send or understand? Well-Jensen believes that line drawings, like the drawing of the man and the woman on the Pioneer plaque, and other such pictorial representations might be an impenetrable mystery to them. On the other hand, she speculates that Krikkits might represent large data sets through sound, and that their counterpart to charts and graphs might be equally incomprehensible to us.

Images might pose a challenge for the Krikkits, but perhaps, Wells-Jensen concedes, not an impossible one. There is evidence that bats image their world using echolocation. Kikkits might be likely to evolve similar abilities, though Wells-Jensen believes they would not be essential for making tools or handling objects.

Perhaps humans and Krikkits could find common ground by transmitting instructions for three dimensional printed objects that could be explored tactually. Wells-Jensen thinks they might also understand mathematical or logical languages proposed for interstellar communication.

The diversity of cognition and perception that we find here on Earth teaches us that if extraterrestrial intelligence exists, it is likely to be much more alien than much of science fiction has prepared us to expect. In our attempt to communicate with aliens, the gulf of mutual incomprehension may yawn as wide as the gulf of interstellar space. Yet this is a gulf we must somehow cross, if we wish ever to become citizens of the galaxy.

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Image Credit: Breakthrough Initatives

Astronomy

Will SETI's Unprecedented New Program Finally Find E.T.?


3 Aug , 2015 by Laura Vican Haney

Stephen Hawking, Frank Drake and dozens of journalists gathered at the Royal Society in London last week to hear astronomers announce a ground-breaking new project to search for intelligent extraterrestrial life called "Breakthrough Listen." They will be using two of the world's largest radio telescopes (Green Bank Telescope in West Virginia and the Parkes Radio Telescope in Australia) to listen for radio messages from intelligent alien species. Scientists have chosen to target the nearest million stars as well as the nearest 100 galaxies. This project will also monitor the Galactic plane for months at a time. This unprecedented effort is a collaboration between UC Berkeley and the Breakthrough Prize Foundation, and employs an international team of astronomers and data scientists, including Frank Drake – the father of SETI (Search for ExtraTerrestrial Intelligence).

It is perhaps fitting that this new program will make use of the Green Bank Telescope (GBT), since Green Bank, West Virginia was the site of the first modern SETI experiment, called "Project Ozma." In 1960, Frank Drake pointed the Tatel telescope at two nearby stars to search for the telltale signs of intelligent life; radio signals near 1.420 GHz. He listened on-and-off for four months, collecting 150 hours of data. He heard nothing.

In 1963, astronomers began the first ever continuous monitoring program using the Ohio State University Radio Observatory. Called the "Big Ear," this observatory was used to monitor the sky continuously for 22 years. They heard nothing. The "Big Ear" was dismantled in 1998 to make room for the expansion of a nearby golf course.

In 2009, UC Berkeley launched the latest incarnation of the Search for Extra-Terrestrial Radio Emissions from Nearby Developed Intelligent Populations (SERENDIP), which employs the Arecibo telescope in Puerto Rico. The idea is to effectively "piggy-back" on other planned radio observations and to use the same data that other astronomers are taking to

study galaxies, but search those radio channels to find messages from ET.

The new program will be “a factor of 100 times more powerful than any current or past SETI program” says astronomer Geoff Marcy, a leading member of the team that will be organizing this search. He goes on to say that the 1.5 GHz bandwidth used for this program will be “like tuning your radio in your car, but instead of collecting the music from just one station, you collect the transmission from 1.5 billion stations.”

Finding funding for SETI projects has been a challenge ever since NASA pulled their support in 1993. Scientists have relied on large private donations for years. Between 2000 and 2007, SETI pulled in nearly $49 million to build the Allen Telescope Array in northern California. Such donations have been sufficient to support some of the smaller projects, but there hasn’t been a new, big-budget SETI endeavor in years. Many scientists are hopeful that the influx of funding from investor Yuri Milner for this program is only the beginning. Jill Tarter, former director of the Center for SETI Research and currently holding the Bernard M. Oliver Chair for SETI at the SETI Institute believes that the time is right for the public to re-invest in SETI. In the past, astronomers have had an uphill battle convincing investors that the search for “little green men” is a legitimate, scientific endeavor, and worth significant attention. Some investors have even been laughed at for spending money on the search for intelligent alien life. Tarter hopes that the public attitude toward SETI is about to change: “The more people like Yuri openly and generously support this endeavor, the more you remove the possibility for being embarrassed or being ridiculed. The people who have funded [SETI] in the past, like Paul Allen, have been very bold. We need more Paul Allens. We need more Yuri Milners.”

Will we find intelligent life?

The question that everyone wants to know is this: How likely is it that this or any other SETI program will actually find evidence of intelligent alien life, either in our galaxy or another? As it turns out, that is a very difficult question to answer. Remember, this SETI program will be searching for *intelligent* life in the universe. Even if our galaxy is full of planets teeming with microbes, none of them will be sending out radio signals that we could intercept. What are the odds that another planet hosts an intelligent alien species?

Drake Equation (image credit: Colin A Houghton)

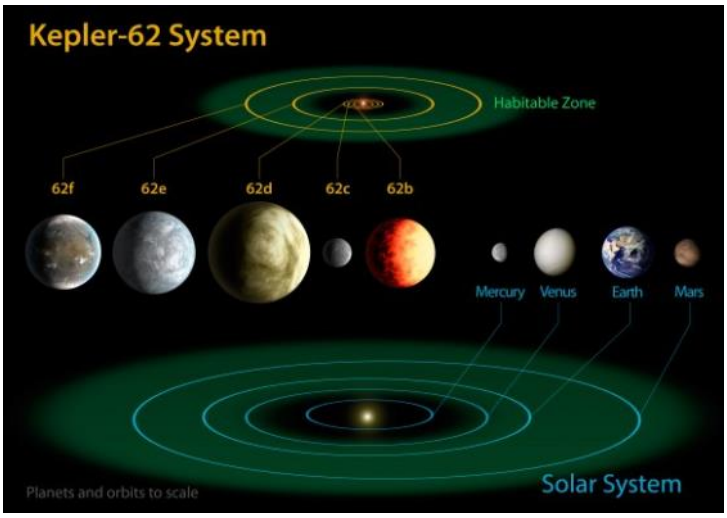
To even begin to answer that question, we have to look at the Drake Equation. This is a simple and elegant equation, first proposed by Frank Drake, to calculate the number of intelligent alien species that should reside in our Milky Way galaxy based on a series of probabilities. While the first few factors of this equation are relatively well-known quantities, we have to make educated guesses about some of them.

1. **Number of Stars Born Each Year – 1.0**

By studying the light emitted by young stars, astronomers are able to estimate that about 1 new star is born every year in the Milky Way galaxy, though some estimates have gone as high as 7 new stars per year.

2. **Fraction of Stars with Planets – 0.50**

The latest studies using results from the Kepler Space Telescope indicate that nearly 100% of stars like the Sun have at least one planet. Many planetary systems we have observed so far appear to be packed with 3 or more planets! Even the most skeptical analysis of the available data leads us to believe that ~50% of all stars have at least one planet.



Kepler 62 contains multiple planets in the habitable zone of the host star. Image credit: NASA Ames/JPL-Caltech

3. **Number of Habitable Planets per Planetary System – 0.2**

This number is also motivated by the most recent Kepler data. It is difficult to assign a value to this parameter, since Sun-like stars have more habitable planets than, say, high-mass stars. However, conservative estimates say that there are 0.2 habitable planets around each star, since 1/5 stars host at least one planet in the habitable zone of its star.

4. **Fraction of Habitable Planets that Actually Develop Life – 1.0**

From here on, our estimates are much more sketchy. For instance, how many planets that could host life actually do? We have tried to recreate the conditions of the early Earth in laboratories to try to replicate the development of life on our planet, and have been unsuccessful. We don’t entirely understand how life on Earth actually got its start. Geological evidence suggests that life started immediately after the Late Heavy Bombardment – a period of time when Earth was pummeled by comets and asteroids from the outer Solar System. As soon as it was safe for life to begin, it did.We believe that life may have existed on Mars billions of years ago, but have not found any direct evidence (fossils) yet. Such a discovery would suggest that life is created easily on any planet with the right conditions. Since the only habitable planet in our Solar System did develop life, we could estimate that this number is 100%.

5. **Fraction of Life Systems that Develop Intelligence – 0.50**

Recall that the mission of SETI is to discover intelligent life on another planet. Human beings are the only species on our

planet that could send and receive radio signals. So, how likely is it that life will evolve to become intelligent? There are some who would argue that intelligence is an inevitable consequence of evolution, but this is a highly debated issue. Since probability that a species will develop intelligence is somewhere between 0-100%, we will say that it is 50%.

6. Fraction of Intelligent Species that Develop Interstellar Communication -0.10

There are different levels of intelligence, and not all intelligent species will be able to send radio signals across interstellar space. Chimpanzees share much of their DNA with humans, but they have not built their own space program. So we need to examine the fraction of intelligent species that will actually develop the ability to communicate with us across space. We might assume that any intelligent species would eventually seek out fellow residents of the Milky Way in an attempt to share knowledge. Conservatively, we might estimate that 10% of intelligent species will develop interstellar communication.

7. Broadcasting Lifetime

Of course, it is not useful for us if there was an intelligent, broadcasting alien species in our Milky Way 2 billions years ago that has since died off. We want to communicate with ET here and now. Therefore, we have to take into consideration the length of time during which a civilization can broadcast signals into space. Our galaxy is only 10 billion years old, so even if life began on a planet at the moment our galaxy was formed, it could only have been broadcasting for 10 billion years. The first intentional broadcast from Earthlings into space with the intention of reaching alien species was in 1974 from the Arecibo Radio Telescope in Puerto Rico. Let's assume (conservatively) that intelligent species are able to broadcast radio signals for 10,000 years.

When we plug these numbers into the Drake Equation, we find that there should be about 100 intelligent alien species currently capable of communicating with Earth in our Milky Way galaxy alone. Since there are approximately 150 billion galaxies in the visible universe alone, that means that there should be 15,000,000,000,000 intelligent alien species in our universe.

But what if these numbers are wrong? What if there's no one out there? When do we pull the plug and stop spending money on a program that hasn't had any success? Jill Tarter says that the most important results from SETI have nothing to do with extraterrestrial intelligence, but everything to do with our cosmic perspective. "SETI being discussed….SETI being pursued around the globe has this phenomenal ability to make us stop in our day-to-day lives and look at the big picture. And that picture is the 'Pale Blue Dot.' That's us. We're all the same to someone 'out there'." she said in an interview with Universe Today. She went on to explain that the most precious short-term benefit of SETI is the perspective it gives us, which can help us as a species to solve big problems here on Earth. "The ability to trivialize the differences among human beings is something that is incredibly important, because it will help us when we step up and try to solve the challenges we have in our future and when we try to manage our planet as a global civilization."

With the new SETI initiative, astronomers are betting that there is someone out there, trying to communicate with us right now, and all we have to do is listen. As astronomer Geoff Marcy put it, "Every explorer has ventured out. They have crossed a river…or gone over a hill, not knowing what they would find. The most exquisite and fantastic types of exploration are journeys where you don't know what you're going to find. SETI is like that. We don't know if we will find anything. But we are explorers, crossing a cosmic ocean, and these two radio telescopes are our ocean liner."

One of the 42 dishes in the Allen Telescope Array that remains trained on KIC gathering data that will appear soon in a published paper. Credit: Seth Shostak / SETI Institute

Astronomy, Blog

SETI Institute Undertakes Search for Alien Signal from Kepler Star KIC 8462852

21 Oct , 2015 by Bob King

"We either caught something shortly after an event like two planets crashing together or alien intelligence," said **Dr. Gerald Harp**, senior scientist at the **SETI Institute** in Mountain View, California, referring to the **baffling light variations** seen by the **Kepler Observatory** in the star KIC 8462852 .

And he and a team from the Institute are working hard at this moment to determine which of the two it is.

Gerald Harp of the SETI Institute is involved in gathering and studying data from the mysterious Kepler star. Credit: SETI Institute

Beginning last Friday (Oct. 16), the Institute's **Allen Telescope Array** (ATA) was taken off its normal survey schedule and instead focused on KIC 8462852, one of the 150,000-plus stars studied by NASA's Kepler Mission to detect Earth-sized exoplanets orbiting distant stars.. The array of 42 dishes comprises a fully automated system that can run day and night, alerting staff whenever an unusual or interesting signal has been detected.

A swarm of comets has been proposed to explain the erratic and non-repeating light variations seen in the star located nearly 1,500 light years from Earth in the constellation Cygnus the Swan. But no one really seems satisfied with the explanation, and the chances that we'd catch a huge event like a comet breakup or planetary collision in the short time the star has been under observation seems unlikely. Collisions also generate dust. Warmed by the star, that dust would

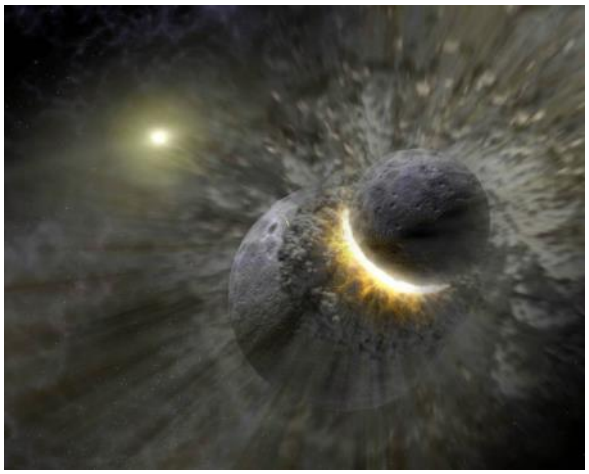
glow in infrared light, but none beyond what's expected has been detected.

The Allen Telescope Array (ATA) is a "Large Number of Small Dishes" (LNSD) array designed to be highly effective for simultaneous surveys undertaken for SETI projects (Search for Extraterrestrial Intelligence) at centimeter wavelengths. Credit: Seth Shostak / SETI Institute

The ATA picks up radio frequencies in the microwave range from 1-10 gigahertz. For comparison, your kitchen microwave oven produces microwaves at around 2 gigahertz. Although Harp couldn't reveal the team's results yet — that will come soon when a paper is submitted in few weeks in a science journal — he did share the excitement of a the hunt in a phone interview Tuesday.

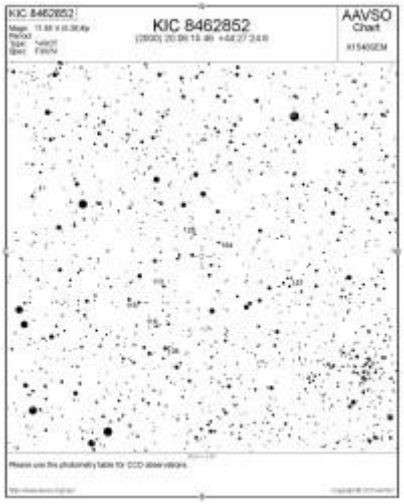
The array normally looks for a very narrow wave or specific frequency when hunting for potential "ET" signals. But not this time.

"This is a special target," said Harp. "We're using the scope to look at transmissions that would produce excess power over a range of wavelengths." Perhaps from a potential alien power source? Maybe. Harp believes the star's peculiar, a-periodic light variations seen by Kepler are "probably natural and definitely worth looking at" but considers an intelligent source a possibility, however remote.



This artist concept illustrates how two large, planet-sized objects could collide to create clumps of material in orbit around a star. They'd also create a lot of dust, which would glow in infrared light, something *not* seen around the Kepler star. Credit: NASA/JPL-Caltech/T. Pyle (SSC)

During our conversation, he emphasized how special the light variations from the star were, adding how the "big gob" of material orbiting KIC (stands for Kepler Input Catalog) 8462852 is unusual in that it's "clumped". "We expect it to spread into a ring," he said.



AAVSO chart of KIC 8462852. Click to enlarge or go to the **website** to make your own customized version. Credit: AAVSO

Meanwhile, the American Association of Variable Star Observers (AAVSO) published an **Alert Notice** this week requesting amateurs and professional astronomers around the world to immediately begin observing KIC 8462852 now through the end of the current observing season. To locate the star, you can either use the charts provided in our **previous story** or go to the **AAVSO site** and type in KIC 8462852 in the "*Pick a Star*" box to create a chart of your own.

I'm a variable star observer, so naturally I thought of variables with irregular fluctuations in light when I first heard about this stellar mystery. Time to talk to an expert. According to **Elizabeth Waagen**, senior technical assistant for science operations at the AAVSO, KIC 8462852 is different.

"Based on the information so far, it doesn't seem to fit the criteria for an irregular variable," said Waagen in a phone interview this morning. "It's doesn't add up."

She encouraged an open mind. "It's a big puzzle, so we sent out the notice," referring to the alert described above.

All quite exciting, and I'm as eager as you to see the published results on the signals, which Harp said would appear or link from the SETI website soon. Stay tuned …

MEMBERS VIEWING LOGS and IMAGES

Gentlemen,

Fresh back from my latest embezzling course here are the latest WAS Accounts for season 2015/2016.

If anyone has any comments changes, questions or proposals or indeed any abuse please forward them at the earliest opportunity. If you can't read it due please let me know.

If nothing is forthcoming I will get some copies run off in time for next week's meeting.

I am concerned that we have not paid any Website hosting fees during the financial year or the previous one.

Last of all an update. That fifth rate banana republic bank that our account is with have written me two letters this month and I have spoken to them on the phone several times.

First letter asked me to ring them about updating the signatories. I wasted half an hour of my life convincing them that all we required was the addition of two signatories and the deletion of two others who would not be requiring to access the account again. In the end all was sweetness and light and everyone was happy and things were progressing again.

About a week later I had our "Business Manager" phone me up repeat all the same as in the above paragraph and saying that we had to fill in more forms which he would send in the post.

I was also asked to complete a customer satisfaction survey on the phone and I said that as we had had no customer satisfaction at this stage it would be impossible to answer any of the questions at that time. I did say that we were at 9 months and counting since the start of this saga. She beat a hasty retreat and said she would ring again. "Something to look forward to I suppose"!!!!

The good news is that the letter has arrived with more forms.

See you next week

Bob

I just wanted to say thanks so much for coming to Stonehenge on Monday. I'm really sorry I couldn't make it in the end – had a poorly child at home!

Sounds like the set up worked well – I'm just sorry we couldn't organise the cloud! Did you manage to see anything?

I sent out a few tweets with images – see below – which were well received.Let's keep in touch – in case there are other occasions you would like to come along to Stonehenge.

Jess

Log May 2016

It was first light for the 16" telescope this month. It can be used now with assistance but will need to be permanently housed outside before it can be used regularly.
Jupiter and Mars both showed plenty of detail although the sky was still light. The red spot was prominent and a much deeper colour I have seen it before. Mars showed detail on the disc but is too low in the sky to be seen well especially before it culminates. The Ring nebula, the globulars in Hercules, M 13 and M92, M5 in Serpens and M51, the Whirlpool galaxy in Ursa Major and the Leo Trio were all spectacular compared to the views of them I am used to with the 10".
The faintest stars I have observed with my 10" from my back garden have been about magnitude 14 so I am hoping to reach magnitude 15.0 with the 16". To try this out I made an observation of R Crb which is currently close to the limit for the 10". It was easily visible in the 16" at magnitude 13.9 and comparison stars down to mag 14.8 were also visible.

Tony Vale

Viewing Log for 14th of May

Had a free Saturday evening and the sky was clear, this equals a viewing session for me J. So I packed up my eight inch Meade LX90 GOTO telescope and headed off to my usual viewing spot at Uffcott off the A3641 to the south of Swindon.

As it was now the middle of May, I could not start viewing until 22:10, even at this late hour I could still make out the twilight sky to the north west! With the Moon being 8.11 days old (or 62 % lit) I knew I could have trouble spotting some deep sky objects but I would give it a go? To go with the telescope I would be using a 14 mm Pentax XW eye piece, this would give me a magnification of about 143. While setting up the gear I noticed a bright red object low to the south east, this I assumed was Mars, a planet I had not seen in quite a long time and would have a look at later on? First object on my list was Jupiter, now well past it bests but still bright in the southern part of the sky, even with the Moon close by I could still make out the main weather belts and the four biggest moons, going from Jupiter they were Callisto, Europa Io and finally Ganymede, the biggest moon in the whole Solar System.
This would probably be my last go at getting some Messier objects before my summer break from night time astronomy? First target was M83 in Hydra, this Spiral galaxy I could not get from Lacock as it was too low and hiding in some trees. Like most Spirals it was a faint blob to view, probably did not help being so low down and a bright Moon around? One of my more favourite Open Clusters (O C) is M29 in Cygnus; the other O C in Cygnus, M39 was very loose to look at? The first Planetary nebula to be discovered was M27 and probably the best to look at with the eye ball? My final object for the session was M71 in Sagitta; this Globular cluster was very faint to look at. I now turned my attention to Mars, not being far up it did not give away any details on the surface to me, hopefully later on when it is at its closest on 30th of May it will give me some surface details?

While I was doing my viewing I also had a go at doing some astro images of the Moon and Jupiter, hopefully you will be able to see some of my efforts elsewhere in the magazine. I attached the camera directly to the telescope giving me lots of magnification which hopefully would not degrade the pictures, should be okay with the Moon but not sure about Jupiter? I did have a quick look at Saturn, just above the horizon before I packed up at 23:18 but got nothing but the rings could not even make out Titan, the second largest moon in the Solar System!

Clear skies.

Peter Chappell

Hi Andy,

Some of my efforts from the last month which fellow members might be interested in?

Picture of Jupiter: taken at 1/60 of a second at f25 (2.5 Televue Barlow attached to telescope).

Picture of part of the Moon with major craters named: taken at 1/8 of a second with camera attached to 14 mm Pentax eye piece.

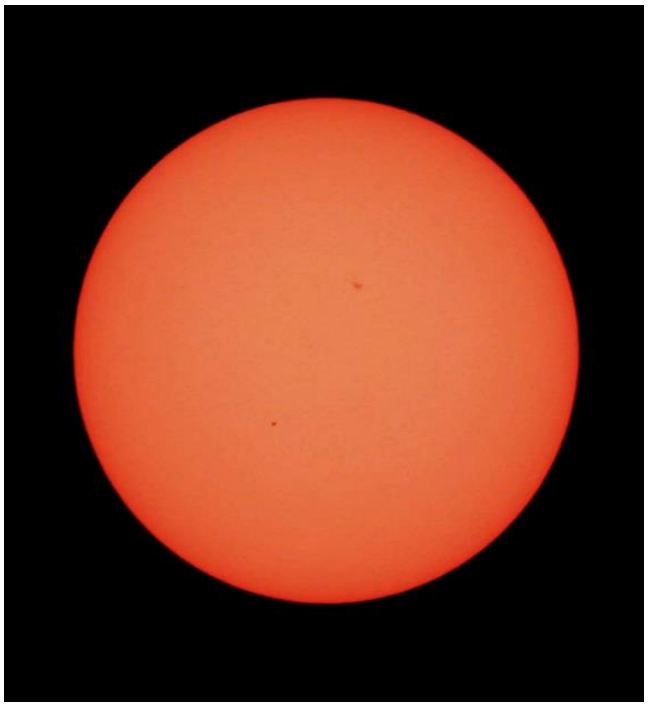
Picture of the terminator of the Moon (first time I have done a stitched job): again camera attached to eye piece, 1/13 of a second.

All pictures taken with a Canon 60 Da DSLR at ISO 1000.

Peter Chappell

Also some pictures Peter took from an impromptu session at Avebury and Uffcott….

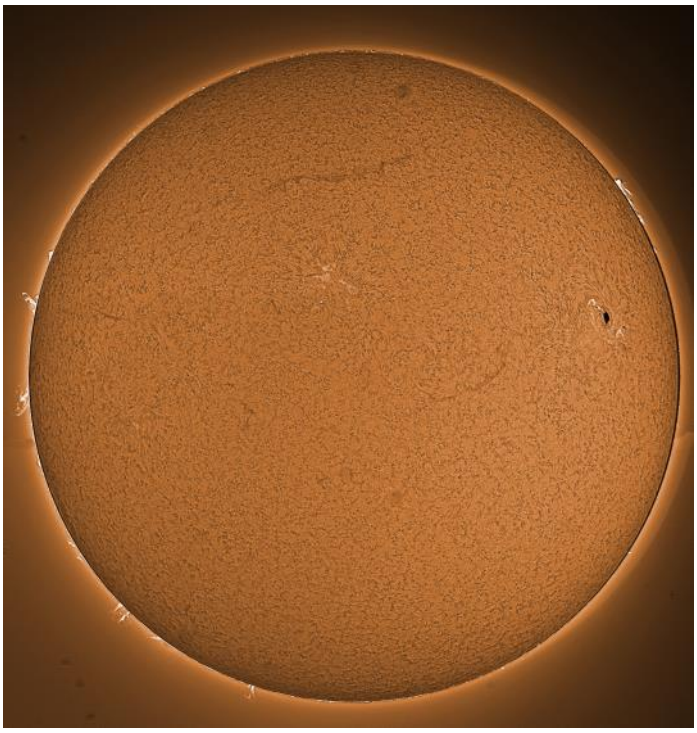
And also he travelled far enough north of May 9th to get a clear view of the transit of Mercury….



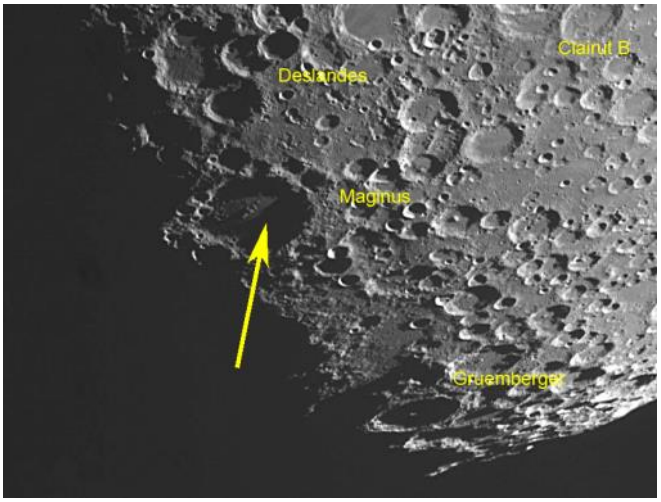
Thanks Peter.

Here is my shot of Saturn from mid May. DMK video camera, through 7inch Maksutov. Andy.

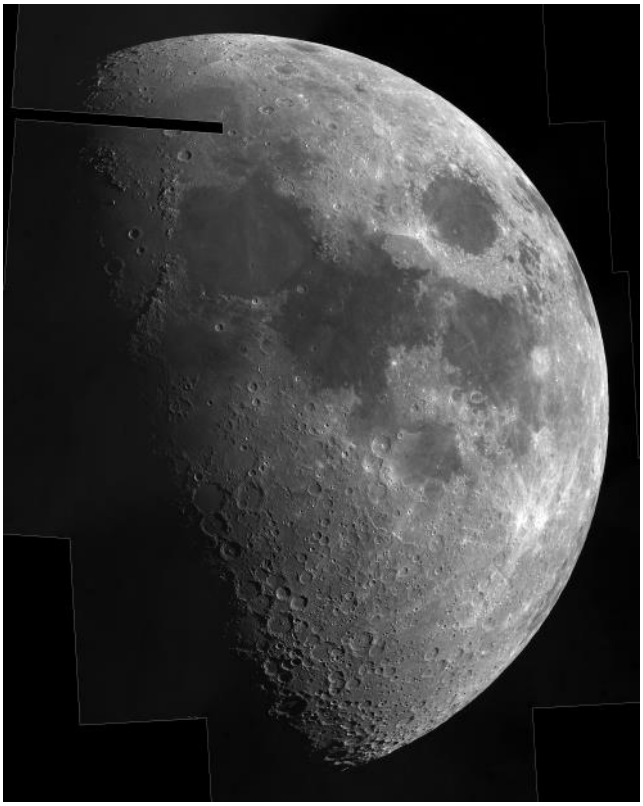
The Sun quite quiet for sunspots the a coronal hole did open up at the end of last week producing some big auroral activity but not reaching this far south, and happening in very short nights of northern latitudes.



Lunar pictures from through the month…

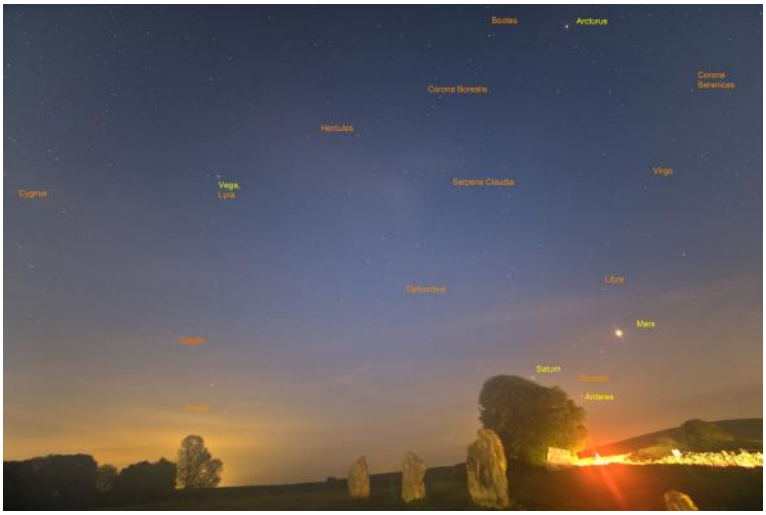


The Deslandes part of the Moon and crater Magnus showing a spectacular sun light shaft through a valley of the crater rim.



A small missing portion caused by failure to overlad properly when taking multiple frames. All these pictures through 7” Maksutov telescope and DMK camera.

Jupiter from the middle of May using DSLR on Maksutov 7” telescope.



Some of the summer constellation we are due to see through the summer, Mars and Saturn will slowly move apart but will not get very high in the evening skies.

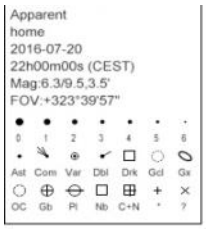
Get a good dark sky and we can expect some good Milky Way views. Here is the Swan nebula is it appeared just from

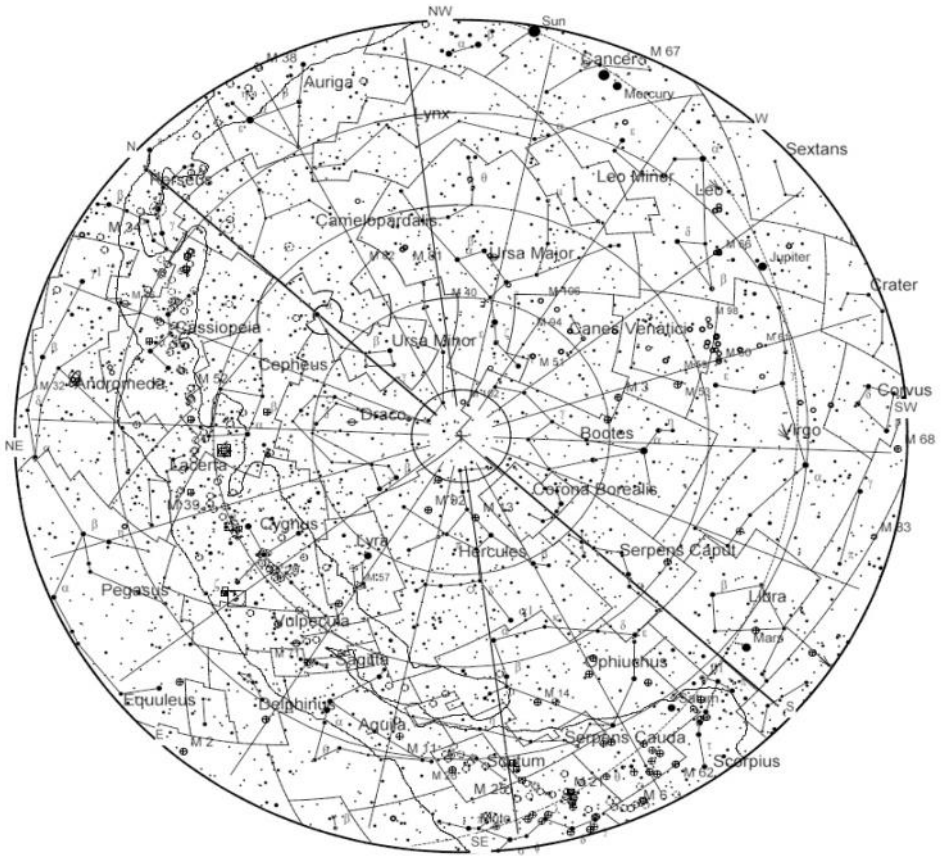
behind my house edge, the darkening on the left edge.

Nikon D810A.

Tried to capture Mars at closest approach but the seeing was too unsteady to get any satisfactory image.

WHATS UP, Summer 2016





C**June 20** - **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 11:02 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 20 - **June Solstice.** The June solstice occurs at 22:34 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.

July 19 - **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 22:57 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 28, 29 - **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 28 and morning of July 29. The second quarter moon will block most of the fainter meteors this year but if you are patient you should still be able to catch quite a few good ones. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.

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 waxing gibbous moon will set shortly after midnight, leaving fairly dark skies for should be an excellent early morning 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 16 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 27.4 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 18 - **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 09:26 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 27 - **Conjunction of Venus and Jupiter.** A spectacular conjunction of Venus and Jupiter will be visible in the evening sky. The two bright planets will be extremely close, appearing only 0.06 degrees apart. Look for this impressive pairing in the western sky just after sunset.

September 1 - **Annular Solar Eclipse.** An annular solar eclipse occurs when the Moon is too far away from the Earth to completely cover the Sun. This results in a ring of light around the darkened Moon. The Sun's corona is not visible during an annular eclipse. The path of the eclipse will begin off the eastern coast of central Africa and travel through Gabon, Congo, Tanzania, and Madagascar before ending in the Indian Ocean. A partial eclipse will be visible throughout most of Africa and the Indian Ocean. ClearSkies Andy

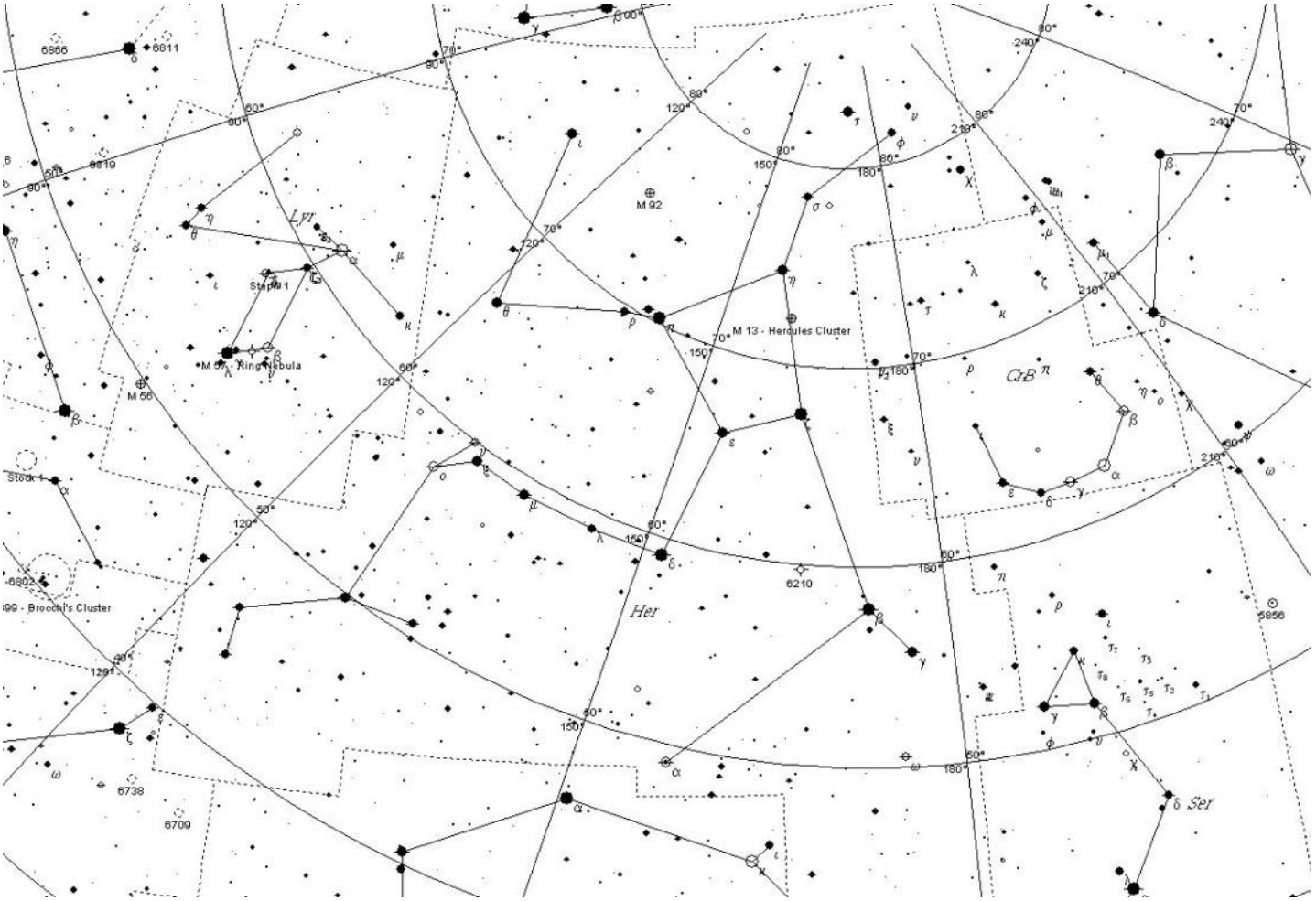
Wiltshire Astronomical Society Observing List & Sky Notes May 2016

Deep Sky Objects

Object Ref / Name	Type	Position	Constellation	Observing Notes
Cat's Eye Nebula (NGC 6543)	PN	RA 17h 58m 33s Dec 66° 38m	Leo	There are stunning Hubble images of this object, however little detail is visible in most amateur telescopes. Instead a small, bright electric blue planetary nebula can be seen. It was discovered by William Herschel on Feb 15th 1786. William Huggins spectroscopic observation on 29th August 1864 showed the light to be made up of discreet emission lines from which he concluded that the nebula was gaseous and not simply unresolved stars. It lies very close to the North Ecliptic Pole, not far from Omega Draconis.
Pinwheel Galaxy (M 101)	GX	RA 14h 3m 37s Dec 54° 17m 57s	Ursa Major	This is a beautiful spiral galaxy as seen in images taken with large apertures. The spiral arms are reputed to be visible in excellent conditions with an 8" aperture although I have never seen them with a 10". It is one of a group of at least nine galaxies, about 24m ly away and about 170k ly across.
Alkalurops (μ Boötis)	DS	RA 15h 24m 29s Dec 37° 22m 37s	Boötes	Binoculars will reveal this to be a double star with a separation of 109" but a medium telescope (or a small telescope with good seeing) will show the secondary to be itself a double separated by 2". B and C are separated from the primary by about 4k AU and the system is about 120 ly away. The name, Alkalurops refers to the shepherds crook of Boötes, the Herdsman.
M53	GC	RA 13h 12m 55s Dec 18° 10m 8s	Coma Berenices	The stars in Globular clusters are among the oldest in the universe. Their low metallicity is consistent with their formation from the debris of the earliest stars to form after the Big Bang. They are usually found in halos surrounding the nuclei of many spiral galaxies. M53 is one of the more outlying globulars in the Milky Way, being about 60k ly from the galactic centre and about 58k ly from us.
Black Eye Galaxy (M64)	GX	RA 12h 56m 44s Dec 21° 40m 57s	Coma Berenices	The distinctive appearance of this galaxy is caused by large dust lanes which partly obscure the nucleus. Distance estimates range from around 20 to 30 million ly. It is believed to be about 50 to 80 thousand ly across.
Melotte 111	OC	RA 12h 22m 30s Dec 25° 51m	Coma Berenices	The constellation takes its name from this cluster (Coma Berenices means Berenices hair). The constellation commemorates the legend of Queen Berenice of Egypt who cut off her hair when her husband returned safely from war. Zeus took her hair and placed it in the sky. To the naked eye the cluster has a shimmering appearance. It extends over a large area of sky and so is best seen in binoculars.
Ras Algethi (α Herculis)	DS	RA 17h 14m 38s Dec 14° 23m 24s	Hercules	The primary is a semi regular, pulsating red supergiant, approaching the end of its life. It is about 400 times the diameter of the sun – bigger than the orbit of Mars. The strong red colour of the primary contrasts with the green secondary from which it is separated by 500 AU, corresponding to a separation of 4.6" at a distance of 360 ly.
Silver Needle (NGC 4244)	GX	RA 12h 17m 30s Dec 37° 48m	Canes Venatici	This is an edge-on spiral galaxy about 10m ly from us. It is an unusual object with little or no central bulge. It is a challenging target and may be difficult to see with apertures of 6" or less or in poor conditions.

KEY	PN planetary nebula	EN emission nebula	BN bright nebula	DN dark nebula	RN reflection nebula	OC open cluster	GX galaxy	AST asterism	VS variable star	DS double star	SNR supernova remnant	GC Globular Cluster		

CONSTELLATIONS OF THE MONTH: Hercules



Unless you are an avid stargazer, you might not be sure just where to look for Hercules. While the fifth largest constellation, it isn't very obvious.

And yet Hercules boasts one of the finest collection of binary stars, and two Messier objects as well.

We will make a fine distinction here: the constellation name is *Hercules,* while the Greek hero is *Heracles*.

Heracles was named after the greatest of Greek goddesses, Hera. Her name means "Lady" and she was the daughter of Cronus, and sister of Zeus (they were twins). Zeus later changed into a cuckoo and seduced his sister (he had that kind of reputation), and the two were married.

Hera became the Queen of the Heavens: goddess of childbirth, marriage, and of women, she was the most widely beloved of goddesses in antiquity. It would only be natural that the greatest of Greek heroes would be named after her: Heracles means "the glory (or honour) of Hera".

Although named after Hera, Heracles didn't have her immediate respect. Heracles was the son of Zeus and a mortal woman (Alcmene). Hera resented Zeus' philandering nature, and tried to have the child killed. She sent two monstrous snakes to his crib, but the infant strangled them both with his pudgy little hands.

Heracles became a favourite with the gods. Apollo made his bow and arrows; Athene gave him a magnificent robe; Hermes provided him with a sword, and Castor (the greatest warrior) taught him how to use it. Hephaestus, the smithy of the gods, made a golden breastplate for Heracles. Thus armed and protected, Heracles paraded through Greek mythology, performing eight heroic deeds and the Twelve Labours.

In fact, the very word "hero" has links with the names Hera and Heracles. The Romans would change his name to Hercules (and hers to Juno, and Zeus to Jupiter).

"Hercules" came to Italy in his tenth labour. He would later be given credit for abolishing human sacrifice in the land.

The constellation was originally represented as a kneeling man, with a foot on the neighbouring dragon (Draco). Some star names reflect this earlier association.

Hercules is a sprawling constellation just to the west of Lyra. From Vega (alpha Lyrae) swing to the west-southwest eight degrees. This is *theta Herculis*, a 3.86 magnitude star - which is about typical brightness for the main stars of this constellation.

The principal stars are found farther south. Star hop from theta over to pi Herculis, and then to the southwest (about the same distance from pi Herculis to Vega) is *beta Herculis*, which is actually the brightest star in the constellation.

Now look southeast and you will come across alpha Ophiuchi (Ras Alhague), at 2.1 magnitude, the brightest star of the region. Alpha Herculis is northwest of this star.

Alpha Herculis is better known as *Ras Algethi: The kneeler's head.* It is estimated to be from 430 to about 650 light years. Some authorities believe the star to be as large as 400 solar diameters.

This is a fine double: a red (or orange) supergiant and a blue-green giant (see below). The primary is also an irregular variable (see below).

Double stars in Hercules:

Hercules has several binaries with contrasting colours, as well as several close binaries, challenging those with larger telescopes.

Alpha Herculis is a visual binary with a very long period, something like 3600 years. 3.2, 5.4; PA 104, separation 4.6".

Zeta Herculis is a rapid binary with colour contrast, a yellow primary and red companion with a period of 34.45 years: 2.9, 5.5. The 2000 values: PA 12º degrees, and the separation 0.7".

Kappa Herculis is an easily resolved binary: 5.3, 6.5; PA 12 degrees, separation 28.4".

Rho Herculis: two white stars which make a lovely double. 4.6, 5.6; PA 326, separation 4.1".

95 Herculis is a very attractive double with contrasting colours, often described as gold and silver (although you may disagree): 5.0, 5.1; PA 258 degrees, separation 6.3".

99 Herculis is a very close rapid binary: 5.1, 8.4; currently the PA is 92 degrees and the separation 0.3".

100 Herculis is another gorgeous binary of two equal white stars easily resolved. 5.9; 5.9; PA 183 degrees, separation 14.2"

Struve 2319. This is a very beautiful binary of two rather faint stars: 7.2, 7.6; PA 191 degrees, separation 5.4".

Variable stars in Hercules:

Alpha Herculis is an irregular variable with a range from 2.7 to 4.0, with a period of roughly three months.

S Herculis is the brightest long-period variable in Hercules, with a visual magnitude range of 6.4-13.8 every 318.14 days. The maximum for the year 2000 should occur in mid July.

Deep Sky Objects in Hercules:

There are two Messier objects in Hercules: M13 and M92.

*M13 (*Almost seventy years ago, radio was exciting. People were still adjusting to its instantaneous connection with events from around the world as soon as they happened. Therefore, many listeners believed the dramatic presentation, presented as news during the radio play,

was real. The broadcast has been followed by countless books, television shows and motion pictures which, combined, helped the notion of intelligent alien life to take firm roots in our culture. Science was also invaded by the possibility of extraterrestrial beings. In 1974, a carefully crafted message was transmitted from the world's largest radio telescope and directed towards stars in M13, pictured here, in hopes someone or something would be listening.

M13 is one of the most prominent and best-known globular clusters in the night sky. It is the brightest that can be easily seen with a small telescope or pair of binoculars from most places in the northern hemisphere. Located in the constellation of Hercules, M13 is visible this time of year. It is twenty thousand lights years from Earth and its 100,000 stars form a ball so immense that it takes light 150 years to travel from one side to the other. The age of M13 is estimated at about 14 billion years.

The 1974 three minute message to M13 was beamed into space from the Arecibo Radio Telescope, in Puerto Rico, and was spearheaded by Dr. Frank Drake, a leading SETI proponent and colleague of the late Carl Sagan. A much longer three-hour message to other carefully selected stars was subsequently transmitted in 2001 from a radio telescope in the Ukraine. Of course, if anyone is around when our 1974 message arrives at a hypothetical planet orbiting a star in M13, their response will not return here until fifty thousand years have transpired.

This dazzling 1.2-hour exposure of M13 was produced by Cord Scholz from his imaging location in the northern German town of Hannover, which was also the birthplace of Wilhelm Herschel, the astronomer who discovered the planet Uranus. This image was taken with a 12.5 inch corrected newtonian telescope and an eleven mega-pixel camera. It also worth noting the number of far more distant galaxies that also fills this colorful picture. *M92 (NGC 6341)* is also a globular cluster, located nine degrees northeast of M13, and six degrees directly north of pi Herculis.

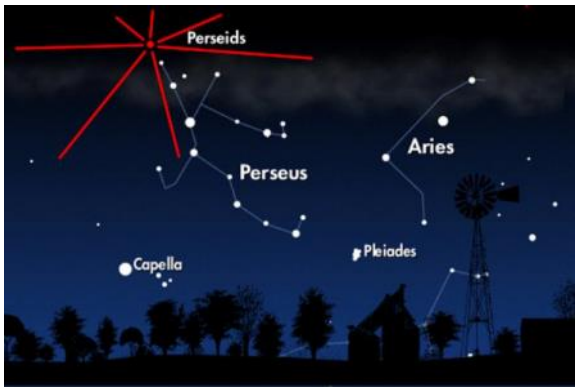
Globular cluster M92 is one of the original discoveries of Johann Elert Bode, who found it on December 27, 1777. Charles

Messier independently rediscovered it and cataloged it on March 18, 1781, the same day as he cataloged another 8 objects, all of them Virgo Cluster galaxies (M84-M91). It was William Herschel who first resolved it into stars in 1783.

M92 is also very striking and worthy of consideration, even if considerably overshadowed by M13.

Perseid Meteor Shower in 2016

The 2016 Perseid meteor shower will peak on August 12 and 13. A waxing gibbous Moon will make it harder for observers to watch the meteor shower.



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

When Can I See the Perseids?

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

The best time to view the Perseids, or 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 and Sunset in my City

Comet Swift-Tuttle

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 light up several time 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 a 100 meteors in an hour from a dark place.

Where Can I See the Perseids?

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 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 not visible at this time of year. The best date is around 13 Aug 2016, table below is for that date:

Perseids meteor shower for Bath (Night between 12 Aug and 13 Aug)		
Time	**Azimuth/**	**Altitude**
Fri 22:00	26° ↑	26.3°
Fri 23:00	34° ↑	31.0°
Sat 00:00	40° ↗	36.6°
Sat 01:00	46° ↗	43.1°
Sat 02:00	52° ↗	50.2°
Sat 03:00	56° ↗	57.7°
Sat 04:00	58° →	65.6°
Sat 05:00	56° ↗	73.5°

Note: times are for 13 Aug 2016.
Set your location

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.

Messier 4 (M4) – The NGC 6121 Globular Cluster

22 Feb , 2016 by Tammy Plotner

During the late 18th century, Charles Messier began to notice that a series of “nebulous” objects in the night sky that he originally mistook for comets. In time, he would notice that they were in fact something significantly different. With the hope of preventing other astronomers from making the same mistake, he began compiling a list of these in what would come to be known as the Messier Catalog.

Consisting of 100 objects, the catalog became an important milestone in both astronomy and the research of Deep Sky objects. Among the many famous objects in this catalog is the M4 loose globular cluster (aka. NGC 6121). Located in the Scorpius (Scorpio) Constellation, this great cluster of ancient stars is one of the closest Messier Objects of its kind to Earth.

Description:

M4 is one of the most open, or loosely constructed of globular clusters, as its high-classification of IX indicates (the higher the number, the less dense the cluster). Its central mass measures about 8 light years in diameter, but its full reach is 75 light years across. On top of that, its gravitational influence stretches for about 140 light years.

At a distance of about 7,200 light-years from Earth, M4 is also one of the closest Messier Objects to Earth (the other being NGC 6397/Caldwell 88). Based on abundance readings, it is believed that the cluster is home to two distinct classes of stars, which could indicate that M4 underwent two separate cycles of stellar formation.

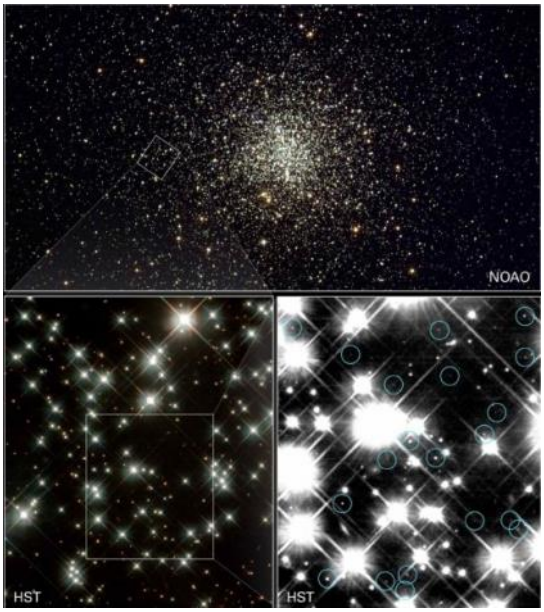
Image of the Messier 4 globular cluster, taken by Hubble Space Telescope. Credit: NASA, STScI, WikiSky

M4 follows an orbital path that takes it through the Milky Way with a period of 116 ± 3 million years. When passing through the disk, this cluster passes the center of our galaxy at a distances of less than 5000 parsecs. This causes it to undergo tidal shock (a gravitational perturbation) each time it passes through, which can cause the repeated shedding of stars. Thus, the M4 cluster may currently be much smaller than it was in the past.

The globular cluster is home to at least 43 known variable stars and to the first millisecond pulsar ever discovered inside a globular cluster. This neutron star – known as – is rotating (and pulsating) once every 3.0 milliseconds, or over 300 times per second. This about ten times faster than the Crab Pulsar, perhaps the most famous pulsar discovered.

Between 1995 and 2001, the National Optical Astronomy Observatory (NOAO) and NASA also uncovered the oldest burned-out stars in our Milky Way Galaxy within this cluster. These small, burned-out stars – called white dwarfs – are about 12 to 13 billion years old, which has given astronomers a fresh reading on the age of the universe.

By adding the one billion years it took the cluster to form after the Big Bang, astronomers deduced that the age of the white dwarfs concurs with previous estimates of the universe being between 13 and 14 billion years old. Observations of the full cluster were performed by the Kitt Peak National Observatory’s in March 1995.



The M4 cluster (top) with sections showing white dwarf stars shown in the bottom left and right. The blue circles indicate the dwarfs. Credit: NASA/JPL/NOAO/HST

Subsequent examinations of a small region of the cluster (measuring only a light-year across) were performed by the HST’s Wide Field and Planetary Camera 2 between January and April of 2001. These images revealed the presence of cool, aging white dwarf stars, which are circled in the image above (bottom right).

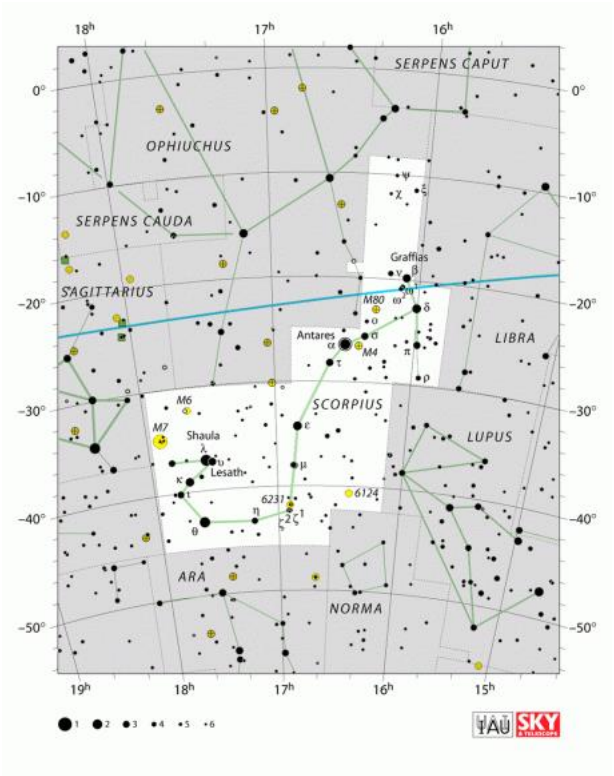
Another interesting find was the binary star system which consists of a white dwarf and a pulsar companion (PSR B1620-26). This star also has a confirmed exoplanet, one which has 2.5 times the mass of Jupiter – making it a “Super Jupiter“.

History of Observation:

Messier 4 was originally discovered by Philippe Loys de Chéseaux in 1746-46, and listed by him as Number 19 in his catalog. As he recorded of the object when first seeing it: “One which is near Antares, which I have found, for this year, at RA 242d 1′ 45″ and declination 25d 23′ 30″. It is white, round and smaller than the previous ones; I don’t know anyone who noted it previously.” It was also included in Nicholas Lacaille’s catalog as Lacaille I.9. Said he of the object: “It resembles a small nucleus of a faint comet. [1763] Observed on April 13, 1752.”

It was Charles Messier who first resolved the object into individuals stars. And M4 was the first globular cluster where individual stars were resolved. When he cataloged it on May 8th, 1764, he recorded in his notes: “On May 8, 1764, I have discovered a nebula near Antares, and on its parallel, it is a light

which has little extension, which is faint, and which is difficult to be seen: when employing a good telescope for viewing it, one can perceive very small stars. Its right ascension has been determined at 242d 16′ 56″, and its declination as 25d 55′ 40″ south.”



The Scorpius Constellation, showing M4 in close proximity to Antares. Credit: IAU.org

But again, it was English astronomer and naval officer Admiral Smyth that described it most eloquently:

A compressed mass of very small stars, in the middle of the creature’s body, with outliers and a few small stellar companions in the field. The place is carefully differentiated with Antares; from which it is only 1deg 1/2 distant to the west. This object is elongated vertically, and has the aspect of a large, pale, granulated nebula, running up to a blaze in the centre. It was discovered by Messier in the year 1764, and duly reported in the Connoissance des Temps. In 1783, Sir William Herschel resolved this object into stars; and gauging it by a modification of the method which he applied to fathom the Galaxy, he concluded that his 10-foot reflector, having the power to show stars exceeding that of the eye 28.67 times, gave the profundity of this cluster of the 344th order. He describes it as having a ridge of eight or ten pretty bright stars, running from the middle to the nf [north following, NE]; a description which I found very correct. Under the head of 80 Messier (which see, No. DLXIV [564]), a slight allusion was made to nebulae considered in their relations to the surrounding spaces. Like that singular mass, the group before us is also situated on the western edge of an area which contains no stars, i.e., none of which we can decry; and in such spaces invariably, according to the testimony of Sir William Herschel, are nebulae found.

Dominique François Jean Arago, a French astronomer who lived from the late 18th to the mid-19th century, had this to say about M4:

“Let us connect these facts with the observation which has shown that the stars are greatly condensed towards the centre of spherical nebulae, and with that which has afforded the proof that these stars sensibly obey a certain power of condensation (or clustering power), and we shall feel disposed to admit with Herschel, that nebulae are sometimes formed by the incessant operation of a great number of ages, at the expense of the scattered stars (etoiles dispersees) which originally occupied the surrounding regions; and the existence of empty, or ravaged spaces, to use the picturesque expression of the great astronomer, will no longer present anything which ought to confound our imagination.”

Red star Antares, right, and nearby star cluster M4. Credit: StargazerBob.com

Locating Messier 4:

Finding Messier Object 4 is quite easy, given its apparent luminosity and proximity to Earth. Even with the naked eye, all one needs to do is locate the red star Antares (Alpha Scorpii, aka. “the rival of Mars”), and you’ll M4 located 1.3 degrees away to the west. Even the slightest optical aid (like binoculars) will reveal this magnificent globular cluster with ease on a dark night, provided that light pollution is not a significant factor.

With favorable conditions, telescopes as small as 3″ will begin resolving this huge ball of stars. With a large enough aperture, all one needs to do is look for the central “bar” structure in M4, which was first noted by William Herschel in 1783.

For your convenience, here are the quick-facts about Messier 4:

Object Name: Messier 4
Alternative Designations: NGC 6121
Object Type: Class IX Globular Cluster
Constellation: Scorpius
Right Ascension: 16 : 23.6 (h:m)
Declination: -26 : 32 (deg:m)
Distance: 7.2 (kly)
Visual Brightness: 5.6 (mag)
Apparent Dimension: 36.0 (arc min)

Good luck seeking out this globular cluster, and may your view of it be clear and beautiful!

We have written many interesting articles about Messier Objects here at Universe Today. For instance, here’s Tammy Plotner’s Introduction to the Messier Objects, M1 – The Crab Nebula, and David Dickison’s articles on the 2013 and 2014 Messier Marathons.

Be to sure to check out our complete Messier Catalog.

For more information, check out the SEDS Messier Database.

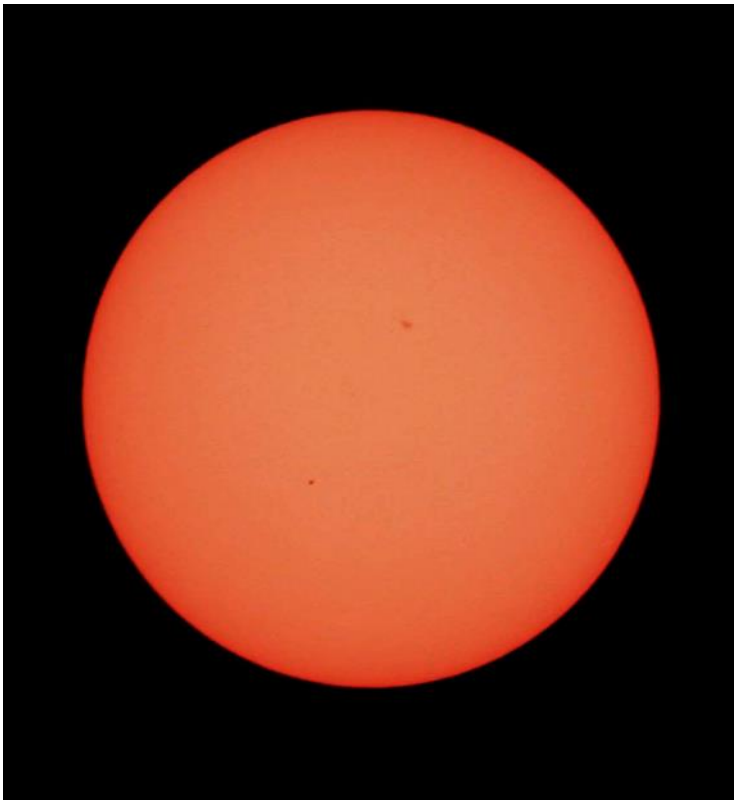
ISS PASSES For Summer 2016 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest		End					
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
06 Jun	**-2.2**	**00:21:20**	**10°**	**W**	**00:24:03**	**27°**	**SW**	**00:24:03**	**27°**	**SW**
06 Jun	-2.7	23:28:23	10°	W	23:31:29	39°	SSW	23:32:53	25°	SSE
07 Jun	-3.2	22:35:31	10°	W	22:38:44	56°	SSW	22:41:45	11°	ESE
08 Jun	-1.3	00:12:37	10°	WSW	00:14:21	15°	SW	00:14:21	15°	SW
08 Jun	-1.9	23:19:22	10°	W	23:22:04	24°	SSW	23:23:15	19°	S
09 Jun	-2.4	22:26:20	10°	W	22:29:21	35°	SSW	22:32:11	11°	SE
10 Jun	-1.1	23:10:44	10°	WSW	23:12:28	14°	SW	23:13:44	12°	SSW
11 Jun	-1.6	22:17:16	10°	W	22:19:50	21°	SW	22:22:23	10°	SSE
13 Jul	-1.2	03:38:31	11°	S	03:40:20	16°	SE	03:42:25	10°	ESE
14 Jul	-2.6	04:19:58	10°	SW	04:23:03	39°	SSE	04:26:08	10°	E
15 Jul	-2.0	03:28:16	18°	SSW	03:29:52	27°	SSE	03:32:41	10°	E
16 Jul	-1.5	02:36:48	18°	SE	02:36:48	18°	SE	02:39:01	10°	E
16 Jul	-3.2	04:09:30	10°	WSW	04:12:43	61°	SSE	04:15:57	10°	E
17 Jul	-2.9	03:17:51	23°	SW	03:19:27	43°	SSE	03:22:34	10°	E
18 Jul	-2.3	02:26:17	29°	SSE	02:26:17	29°	SSE	02:29:07	10°	E
18 Jul	-3.4	03:59:08	10°	WSW	04:02:24	82°	S	04:05:40	10°	E
19 Jul	-1.0	01:34:42	14°	ESE	01:34:42	14°	ESE	01:35:29	10°	E
19 Jul	-3.4	03:07:15	24°	WSW	03:09:04	65°	SSE	03:12:18	10°	E
20 Jul	-3.1	02:15:37	47°	SSE	02:15:44	47°	SSE	02:18:54	10°	E
20 Jul	-3.3	03:48:47	10°	W	03:52:04	86°	N	03:55:20	10°	E
21 Jul	-1.6	01:23:56	21°	ESE	01:23:56	21°	ESE	01:25:26	10°	E
21 Jul	-3.4	02:56:29	19°	WSW	02:58:40	86°	S	03:01:56	10°	E
21 Jul	-3.4	04:31:49	10°	W	04:35:06	84°	SSW	04:38:22	10°	ESE
22 Jul	-3.5	02:04:48	57°	SW	02:05:17	70°	SSE	02:08:31	10°	E
22 Jul	-3.3	03:38:25	10°	W	03:41:41	86°	N	03:44:58	10°	E
23 Jul	-2.3	01:13:03	32°	E	01:13:03	32°	E	01:15:06	10°	E
23 Jul	-3.4	02:45:36	15°	W	02:48:16	85°	N	02:51:32	10°	E
23 Jul	-3.4	04:21:25	10°	W	04:24:39	63°	SSW	04:27:52	10°	ESE
24 Jul	-0.8	00:21:16	12°	E	00:21:16	12°	E	00:21:37	10°	E
24 Jul	-3.5	01:53:49	41°	W	01:54:49	88°	S	01:58:06	10°	E
24 Jul	-3.5	03:27:59	10°	W	03:31:15	81°	SSW	03:34:30	10°	ESE
25 Jul	-3.1	01:01:56	56°	ESE	01:01:56	56°	ESE	01:04:39	10°	E
25 Jul	-3.4	02:34:32	10°	W	02:37:48	88°	N	02:41:04	10°	E
25 Jul	-3.0	04:10:59	10°	W	04:14:06	42°	SSW	04:17:11	10°	SE
26 Jul	-1.7	00:09:48	22°	E	00:09:48	22°	E	00:11:12	10°	E
26 Jul	-3.4	01:42:18	21°	W	01:44:20	84°	N	01:47:36	10°	E
26 Jul	-3.4	03:17:29	10°	W	03:20:43	59°	SSW	03:23:55	10°	ESE
26 Jul	-2.9	23:11:33	10°	SW	23:14:36	38°	SSE	23:17:40	10°	E
27 Jul	-3.5	00:47:35	10°	W	00:50:52	89°	N	00:54:07	10°	E
27 Jul	-3.5	02:24:01	10°	W	02:27:17	78°	S	02:30:32	10°	ESE
27 Jul	-2.3	04:00:37	10°	W	04:03:23	26°	SSW	04:06:09	10°	SSE
27 Jul	-2.3	22:18:30	10°	SSW	22:21:16	26°	SSE	22:24:03	10°	E
27 Jul	-3.5	23:54:07	10°	WSW	23:57:23	78°	SSE	00:00:39	10°	E
28 Jul	-3.4	01:30:32	10°	W	01:36:39	13°	E	01:37:04	10°	E
28 Jul	-2.9	03:09:52	38°	SW	03:10:04	38°	SSW	03:13:06	10°	SE
28 Jul	-3.4	23:00:42	10°	WSW	23:03:56	59°	SSE	23:07:09	10°	E
29 Jul	-3.4	00:37:01	10°	W	00:40:18	84°	N	00:40:52	58°	E

There are a few more passes until August 10th then nothing until early September.

END IMAGES

Transit of Mercury: Well we did see it from Stonehenge, but here Peter Chappell got far enough north for clear skies...



2016		
August 12th	Waxing gibbeous	Perseid Meteor Shower TBA

OUTREACH ACTIVITIES

Monday June 20th Kingston St Micheal WI

July: Nibley Music Festival