NWASNEWS

Volume21, Issue 8

April 2016

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

Of Stars and Light Pillars

We have been very successful in recent years with our out reach activities within the Wiltshire area and slightly beyond.

Schools have been frequent recipients of visits, but the timing has changed a lot for the terms the do their space study weeks, and the tend to all do them within a 4 week period, which means we have too many requests in November/December, and barely anything through the summer.

However a couple of events are coming up, especially the transit of Mercury on Monday 9th May. I was hoping for a little more details from them and I am awaiting e mail responses, but I know they are changing management structures again, and my senior contact is on holiday through the school holiday…

A review of the site earlier this month has confirmed that it will be difficult to transfer scopes to nearer the stones after normal visiting hours (not such a bad thing), as the height of the Sun at the end of transit is around 15º, to high to get a good stone with transit image.

We also have some requests for visits to give talks to clubs and sites in Wales.

It during in one of these visits in early March that I caught some rare ice pillars rising up over mountains blocking the source of the lights. Picture below… it was a flare off of gases from the ore smelting unit that draw our attention, but images showed a multitude of light. Ice on the cars told us that a clearing mist froze vapour out of the sky, just the unique conditions for pillars of light to be seen. Use of maps and stars for the direction confirmed they were from the Port Talbot steel works, now very much in the news…

Finding our way around the sky has become easier in the last 10-15years, with the advent of phone apps to tell us what is up in the sky and star maps on our computers. But what are all those weird names for the stars? What language are they in? Why do we still use ancient names?

Hopefully our speaker tonight will help us through some of the details behind star naming. Mark Hurn is librarian at the Cambridge University and is well placed to take us through the ancient knowledge sources, and in doing so will begin to help us look at the stars again with a little more knowledge and appreciation than we had before.

I am off to Spain to check telescope alignment out there after a 4.3 magnitude earthquake centered within 2 miles of the observatory, but hopefully all will be well.

I have to air my home observatory after my poor old cat become incontinent and has left her mark in there to catch the summer warmth… but she was 19years old and blind. Named after Cassiopeia, I spent last Thursday imaging the Herschel Objects and Messier items in that constellation (about 28 objects in all) and one star that only has a modern name. Navi, γ Cass. Ivan backwards—after Gus Grissom's middle name.

Clear skies Andy

A rare sighting from the mountains at the head of the valleys (above the Rhonnda source at Rhigor.

Happened to be imaging through a low power 80mmtelescope at the time as mist cleared in Orion, then we were hit with a sudden flare in the sky. Readjustment in focus and zone and got these vertical streaks in the sky.

Investigation later showed we were viewing light pillars above a cold air band that pulled the lights of the Port Talbot steel works to streaks above the hills from 14 miles away.

The flare was the gassing of from the ore smelting… less than one month later and the closure of the ore smelting looks a certainty. The rare will become more rare.

Andy. Nikon D810a

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

Apr 5th *The Story of Star Names : Mark Hurn*
May 3rd *Oddities of the Solar System : Bob Mizon*
June 7th *The Current State of SETI : Martin Griffiths*

Membership Changes in fees to be discussed. Could be lowered!

Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

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

Vice chair: Keith Bruton

Bob Johnston (Treasurer)

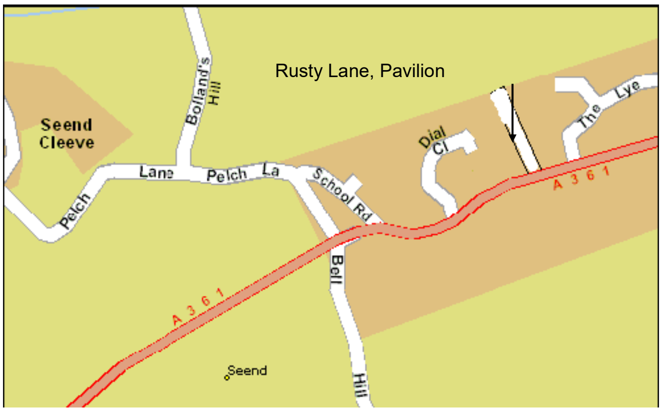
Philip Proven (Hall coordinator)

Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

Observing Sessions coordinators: Jon Gale, Tony Vale

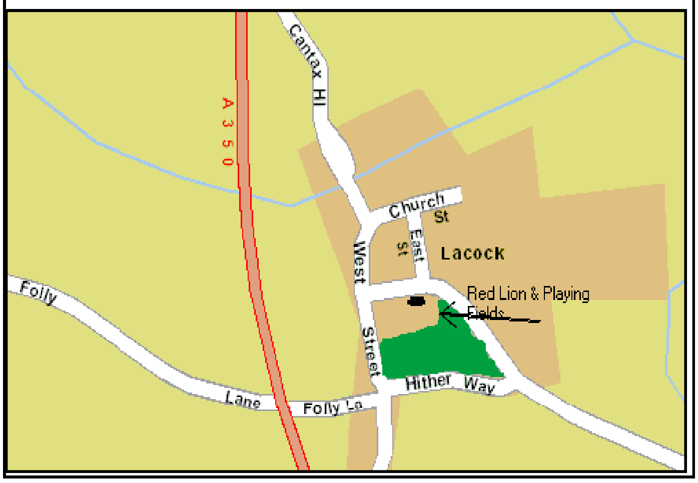
Contact via the web site details. This is to protect individuals from unsolicited mailings.



Observing Sessions

The Wiltshire Astronomical Society's observing sessions are open, and we welcome visitors from other societies as well as members of the public to join us.
We will help you set up equipment (as often as you need this help), and let you test anything we have to help you in your choice of future astronomy purchases.
Please treat the lights and return to full working order before leaving. With enough care shown we may get the National Trust to do something with them!

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



Mark Hurn
Research

The Library of the Institute of Astronomy/Cambridge Observatory. Providing books, journals and other resources to support research in astronomy, astrophysics and cosmology. Particular responsibility for subscriptions to electronic jounals.

History of Astronomy, in particular the history of the Cambridge Observatory, the Institute of Astronomy, associated organizations, the people who worked, lived, were born, died on this site. Notable astronomers associated with our site, such as George Biddell Airy, James Challis, John Couch Adams, Robert Ball, Arthur Stanley Eddington, Fred Hoyle etc. Also the observatories, telescopes, clocks, instruments, buildings on the site.

Support for public outreach through participation in public observing nights (Wednesdays) October to March.

The Story of Star Names

Star names is a fascinating subject which has its origins in the mists of time. Names derive from words in many different languages, both ancient and modern, eg Arabic, Greek, Latin, and numerous legends surround these names.

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.

Jupiter!

It was fitting this month that Ian Smith (chairman of Abingdon Astronomical Society) gave a talk to Swindon Stargazers on the planet Jupiter, and a very interesting talk in March where Jupiter reached opposition and the transits of two of its moons were prominent.

This gas giant of a planet is probably one of the most observed objects in the night sky, closely observed by Aussie Anthony Wesley, an amateur astronomer who often observes and reports on changes in its appearance, so its worth keeping a regular eye on it.

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
NOTE NEW START TIME!

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 15 Apr 2016

Programme: Mark Radice: Observing the Moon

Friday 20 May 2016

Programme: Owen Brazell: Shrouds of Night - Observing Dark Nebulae

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.co

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.co.uk
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
15th April	*Seven Moons*	Bob Mizon
20th May	*Tales from the Dark*	Mike Witt
17th June	Annual General Meeting *Member Talks*	

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

Gravitational Wave Astronomy Will Be The Next Great Scientific Frontier

By Ethan Siegel

Imagine a world very different from our own: permanently shrouded in clouds, where the sky was never seen. Never had anyone see the Sun, the Moon, the stars or planets, until one night, a single bright object shone through. Imagine that you saw not only a bright point of light against a dark backdrop of sky, but that you could see a banded structure, a ringed system around it and perhaps even a bright satellite: a moon. That's the magnitude of what LIGO (the Laser Interferometer Gravitational-wave Observatory) saw, when it directly detected gravitational waves for the first time.

An unavoidable prediction of Einstein's General Relativity, gravitational waves emerge whenever a mass gets accelerated. For most systems -- like Earth orbiting the Sun -- the waves are so weak that it would take many times the age of the Universe to notice. But when very massive objects orbit at very short distances, the orbits decay noticeably and rapidly, producing potentially observable gravitational waves. Systems such as the binary pulsar PSR B1913+16 [the subtlety here is that binary pulsars may contain a single neutron star, so it's best to be specific], where two neutron stars orbit one another at very short distances, had previously shown this phenomenon of orbital decay, but gravitational waves had never been directly detected until now.

When a gravitational wave passes through an objects, it simultaneously stretches and compresses space along mutually perpendicular directions: first horizontally, then vertically, in an oscillating fashion. The LIGO detectors work by splitting a laser beam into perpendicular “arms,” letting the beams reflect back and forth in each arm hundreds of times (for an effective path lengths of hundreds of km), and then recombining them at a photodetector. The interference pattern seen there will shift, predictably, if gravitational waves pass through and change the effective path lengths of the arms. Over a span of 20 milliseconds on September 14, 2015, both LIGO detectors (in Louisiana and Washington) saw identical stretching-and-compressing patterns. From that tiny amount of data, scientists were able to conclude that two black holes, of 36 and 29 solar masses apiece, merged together, emitting 5% of their total mass into gravitational wave energy, via Einstein's $E = mc^2$.

During that event, more energy was emitted in gravitational waves than by all the stars in the observable Universe combined. The entire Earth was compressed by less than the width of a proton during this event, yet thanks to LIGO's incredible precision, we were able to detect it. At least a handful of these events are expected every year. In the future, different observatories, such as NANOGrav (which uses radiotelescopes to the delay caused by gravitational waves on pulsar radiation) and the space mission LISA will detect gravitational waves from supermassive black holes and many other sources. We've just seen our first event using a new type of astronomy, and can now test black holes and gravity like never before.

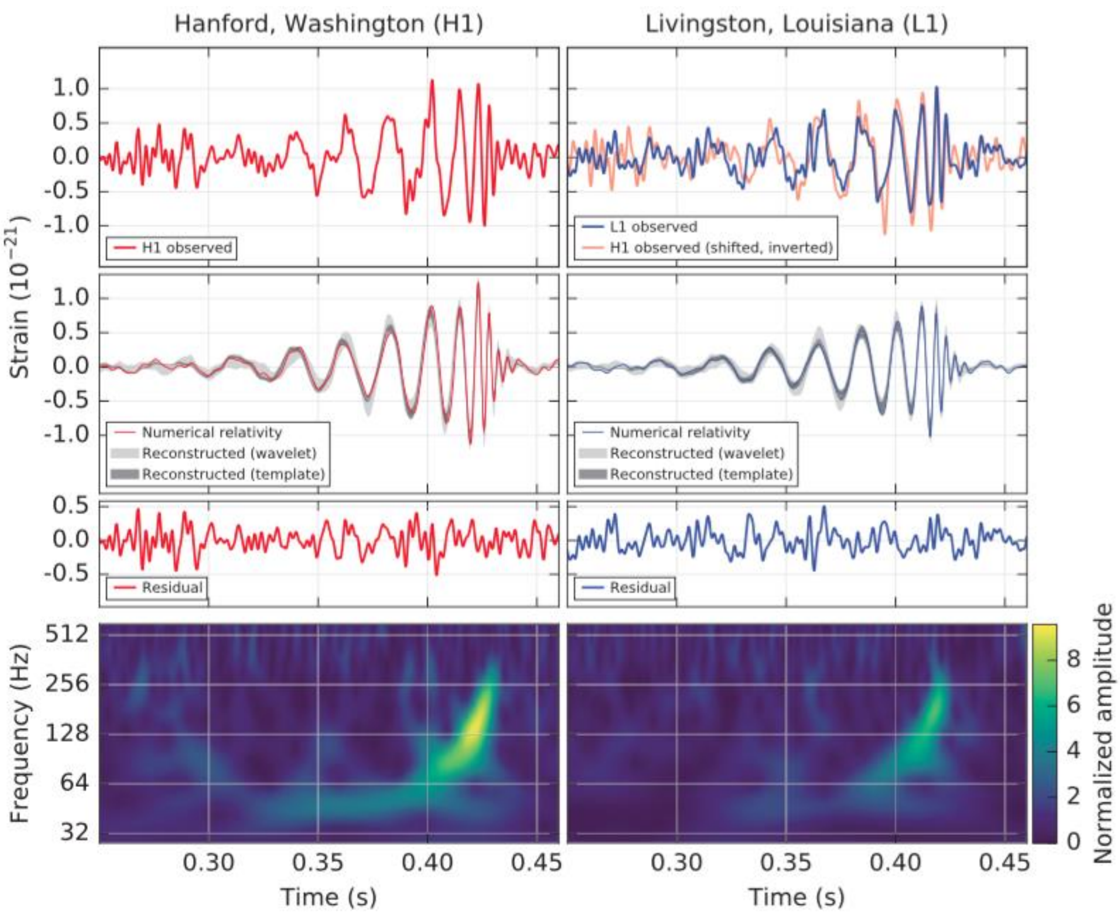
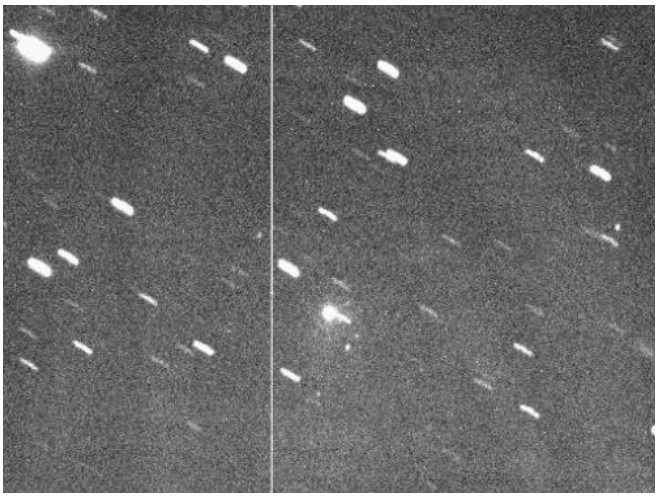


Image credit: Observation of Gravitational Waves from a Binary Black Hole Merger B. P. Abbott et al., (LIGO Scientific Collaboration and Virgo Collaboration), Physical Review Letters 116, 061102 (2016). This figure shows the data (top panels) at the Washington and Louisiana LIGO stations, the predicted signal from Einstein's theory (middle panels), and the inferred signals (bottom panels). The signals matched perfectly in both detectors.

SPACE NEWS

ExoMars Mission Narrowly Avoids Exploding Booster

24 Mar , 2016 by Bob King



At least nine moving objects, all thought to be related to a possible explosion of the Breeze-M upper stage after separation from the ExoMars spacecraft, move across the sky in this animation made late on March 14. ExoMars is further ahead and outside the frame. Credit and copyright: OASI Observatory team; D. Lazzaro, S. Silva / ESA

On March 14, the **ExoMars mission** successfully lifted off on a 7-month journey to the planet Mars but not without a little surprise. The **Breeze-M** upper booster stage, designed to give the craft its final kick toward Mars, exploded shortly after parting from the probe. Thankfully, it wasn't close enough to damage the spacecraft.

Michel Denis, ExoMars flight director at the European Space Operations, Center in Darmstadt, Germany, said that the two craft were many kilometers apart at the time of the breakup, so the explosion wouldn't have posed a risk. Still, the mission team won't be 100% certain until all the science instruments are completely checked over in the coming weeks.

All went well during the takeoff and final separation of the probe, but then something odd happened. Breeze-M was supposed to separate cleanly into two pieces — the main body and a detachable fuel tank — and maneuver itself to a **graveyard or "junk" orbit,** where rockets and spacecraft are placed at the end of their useful lives, so they don't cause trouble with operational satellites.

But instead of two pieces, tracking photos taken at the OASI Observatory in Brazil not long after the stage and probe separated show a cloud of debris, suggesting an explosion occurred that shattered the booster to pieces. There's more to consider. Space probes intended to either land or be crashed into planets have to pass through strict sterilization procedures that rocket boosters aren't subject to. Assuming the Breeze-M shrapnel didn't make it to its graveyard orbit, there exists the possibility some of it might be heading for Mars. If any earthly bugs inhabit the remains, it could potentially lead to unwanted consequences on Mars.

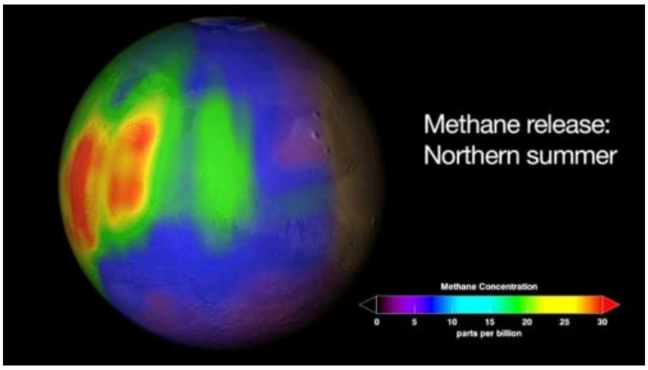
And this isn't the first time a Russian Breeze-M has blown up.

According to Russian space observer Anatoly Zak in a **recent article** in Popular Mechanics, a Breeze-M that delivered a Russian spy satellite into orbit last December exploded on January 16. Propellant in one of its fuel tanks may not have been properly vented into space; heated by the sun, the tank's contents likely combusted and ripped the stage apart. A similar incident occurred in **October 2012**.

Artist view of the ExoMars craft releasing the Schiaparelli lander in October. Credit: ESA

For now, we'll embrace the good news that the spacecraft, which houses the **Trace Gas Orbiter** (TGO) and the **Schiaparelli** lander, are underway to Mars and in good health.

ExoMars is a joint venture between the **European Space Agency** (ESA) and the **Russian Federal Space Agency** (Roscosmos). One of the mission's key goals is to follow up on the **methane detection** made by ESA's Mars Express probe in 2004 to understand where the gas comes from. Mars' atmosphere is 95% carbon dioxide with the remaining 5% divided among nitrogen, argon, oxygen and others including small amounts of methane, a gas that on Earth is produced largely by living creatures.

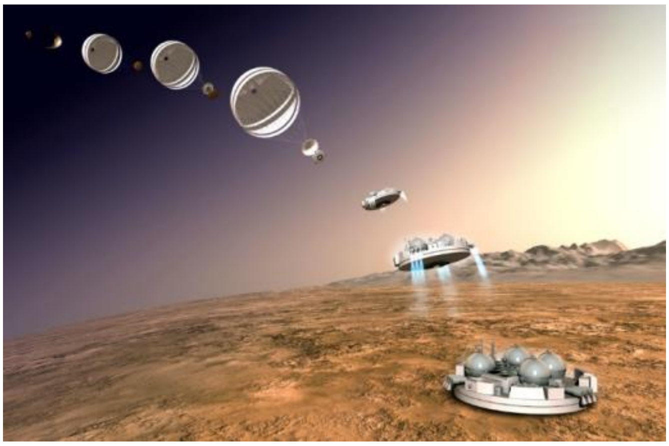


NASA researchers using telescopes right here on Earth also detected multiple methane plumes coming from the surface on Mars in 2003. Credit: Trent Schindler/NASA

Scientists want to know how martian methane got into the atmosphere. Was it produced by *bi*ology or *ge*ology? Methane, unless it is continuously produced by a source, only survives in the Martian atmosphere for a few hundreds of years because it quickly breaks down to form water and carbon dioxide. Something is refilling the atmosphere with methane but what?

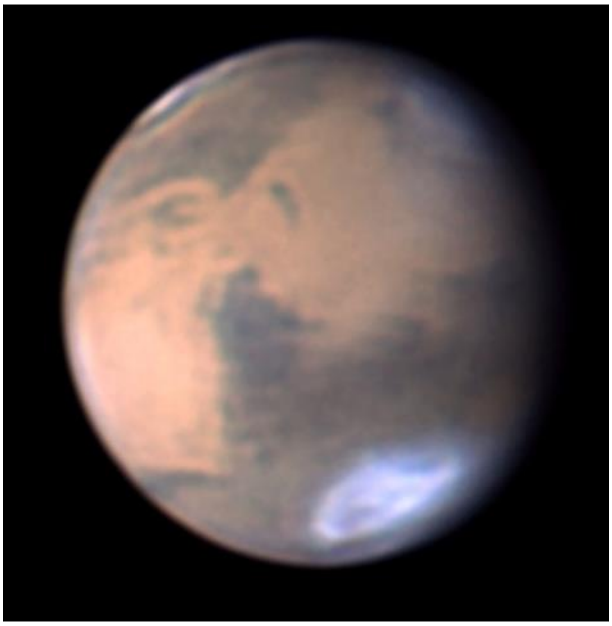
TGO will also look at potential sources of other trace gases such as volcanoes and map the planet's surface. It can also detect buried water-ice deposits, which, along with locations identified as sources of the trace gases, could influence the choice of landing sites of future missions.

The orbiter will also act as a data relay for the second ExoMars mission — a rover and stationary surface science platform scheduled for launch in May 2018 and arriving in early 2019.



Schiaparelli will demonstrate the capability of ESA and European industry to perform a controlled landing on the surface of Mars. It will also gather data on Mars' atmosphere. Credit: ESA

On October 16, when the spacecraft is still 559,000 miles (900,000 kilometers) from the Red Planet, the Schiaparelli lander will separate from the orbiter and three days later parachute down to the Martian surface. The orbiter will take measurements of the planet's atmosphere (including methane) as well as any atmospheric electrical fields.

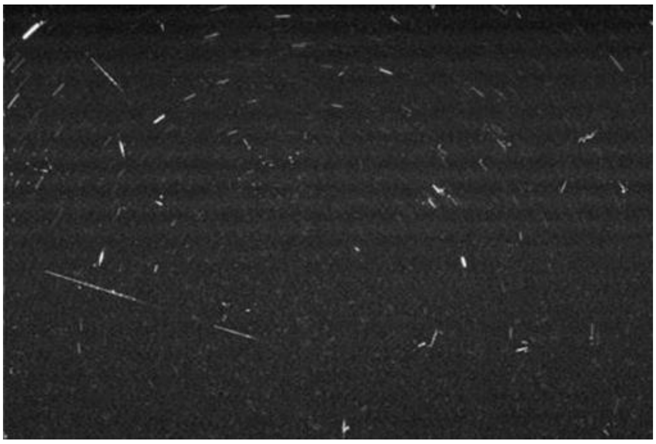


Clouds gather over Mars' Hellas Basin in this photo taken March 23. The Red Planet has intrigued humankind for centuries. Credit: Anthony Wesley

Mars is a **popular place**. There are currently five active orbiters there: two European (Mars Express and Mars Odyssey), two American (Mars Reconnaissance Orbiter and MAVEN), one Indian (Mars Orbiter Mission) and two rovers (Opportunity and Curiosity) with another lander and orbiter en route!

Did Mars' Methane Come from Comets?

By Irene Klotz, Discovery News | March 22, 2016 03:57pm ET



NASA's Spirit rover on Mars spotted these "shooting stars," or meteors in the Martian night sky.

Credit: NASA/JPL-Caltech/Cornell/Texas A&M/SSI

One of the most provocative questions about Mars today is what is causing periodic spikes in the amount of methane in the planet's atmosphere.

On Earth, methane is strongly tied to biological activities, raising the prospect that colonies of methane-emitting microbes might be living on Mars. Another option is that the gas stems from geological activities, though so far attempts to match the methane spikes with the seasons have not panned out.

NASA scientist Marc Fries and colleagues have another idea – meteor showers.

Curiosity Detects Mysterious Methane Spikes on Mars

Fries, who studies meteorites, comet samples other extraterrestrial materials, says there is a correlation between when the methane plumes appear and Mars' transit through a region of space littered by remnants of a comet, the source material for meteor showers.

"Carbonaceous solids such as those of cometary origin can generate a significant volume of methane … under UV (ultraviolet) radiation," Fries and colleagues wrote in a paper presented Monday at the Lunar and Planetary Science Conference in The Woodlands, Texas.

The scientists found that all known methane detections occurred within 16 days of Mars' orbit encountering the orbit of a comet capable of producing a meteor shower.

Photos: 10 Years On Mars: Opportunity's First Sols

"You have a mechanism that produces methane and a time correlation between the occurrence of meteor showers and the appearance of methane," Fries told Discovery News.

Not everyone is convinced. NASA planetary scientist Michael Mumma, who led a team that made the initial findings of methane spikes on Mars, said there have been many more times when Mars approached known meteor streams and methane was not detected.

"Our team searched (for methane) on more than 30 multi-day campaigns since 2002, and detected methane on only three (Jan 2003, March 2003 and May 2005)," Mumma wrote in an email to Discovery News.

Leak in Curiosity's Wet Chemistry Test Finds Organics

"Other teams report similar rare detections. In short, no systematic correlation with meteor streams," he said.

Fries points out ground-based telescopes have to account for methane in Earth's atmosphere, and that NASA's Mars rover Curiosity, which has chemical sniffers to hunt for the gas, has a very local sampling field. Also, not all comet streams end up triggering meteor showers.

The final word may come from Europe's Trace Gas Orbiter, which was launched last week for a seven-month journey to Mars. Once it puts itself into orbit, the spacecraft will need about another year to properly position itself for observations.

Mars Microbe Traces Spotted by Rover? Probably Not

"We can basically test this hypothesis of whether or not the methane plumes are coming from meteor showers," Fries said.

"We know when the meteor showers are supposed to happen … and we can measure and see if there's a significant amount of material dropped onto Mars. Then we can turn around and watch for methane."

Ghostly galaxies are light on stars but heavy on dark matter

Virgo cluster: not so starry but a lot of the dark stuff

Royal Observatory, Edinburgh/AATB/Science Photo Library

There's more than meets the eye. Astronomers have weighed a so-called ultra-diffuse galaxy for the first time, and found that it is over 99.96 per cent dark matter.

An ultra-diffuse galaxy can be as large as the Milky Way but as dim as a dwarf. The galaxy's few stars are spread out, so it looks ghostly, making it hard to study.

Although observers spotted the first few examples three decades ago, they didn't have a name until 2014, when a team led by Pieter van Dokkum at Yale University discovered 47 of them in the Coma galaxy cluster. Other astronomers studied this cluster with the giant Subaru Telescope in Hawaii and found hundreds more.

Van Dokkum's team argued that the galaxies had to consist of at least 98 per cent dark matter for gravity to hold them together. Otherwise, the many other galaxies in the Coma cluster would tear them apart.

Dark matter is thought to make up about 80 per cent of the mass in the universe overall, so that would be an impressively dense concentration of the stuff in a small space. But until now no one had directly measured an ultra-diffuse galaxy's mass.

Now Michael Beasley at the Institute of Astrophysics of the Canary Islands, Spain, and his colleagues have weighed an ultra-diffuse galaxy in the Virgo cluster named VCC 1287. The galaxy's main body is too dim to study easily, so instead they observed seven of its globular clusters – bright, tight-packed gatherings of stars that move around the galaxy.

Dim but heavy

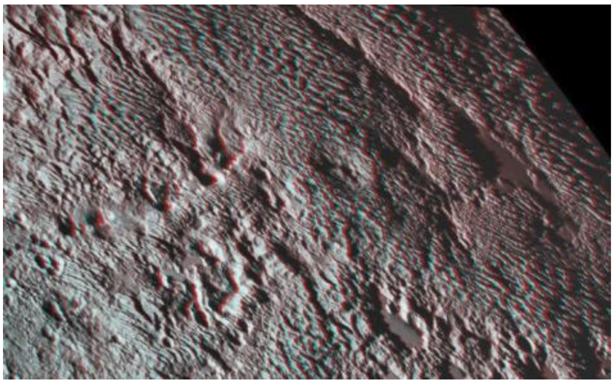
Using the 10.4-metre Great Canary Telescope in La Palma, Beasley's team measured the clusters' speeds. They found that the clusters orbit the galaxy so fast that it must have about 80 billion times more mass than the sun. That's only 8 per cent of the Milky Way's total mass, but an impressive figure for a galaxy that has so few stars that it emits less than a thousandth as much light. It also means the galaxy has 3000 times more dark matter than stellar mass. The Milky Way's ratio is just 15 to 1 .

"It's a very clever method," says van Dokkum. "It's a great achievement."

Beasley speculates that the galaxy he studied was born with both dark matter and gas but lost the latter as the galaxy fell into the Virgo cluster. Without gas, the galaxy couldn't create new stars, so it ended up with lots of dark matter but little light.

New Horizons Snaps Amazing 3-D View of Pluto's Mysterious 'Bladed' Terrain

4 Apr , 2016 by Ken Kremer



Kuiper Belt, Missions, NASA, New Horizons, Pluto, Science, Solar System, Space Exploration

The amazing stereo view of a broad area informally named Tartarus Dorsa combines two images from the Ralph/ Multispectral Visible Imaging Camera (MVIC) taken about 14 minutes apart on July 14, 2015. The first was taken when New Horizons was 16,000 miles (25,000 kilometers) away from Pluto, the second when the spacecraft was 10,000 miles (about 17,000 kilometers) away. Credits: NASA/JHUAPL/SwRI

It's time to whip out your 3-D glasses to enjoy and scrutinize the remarkable detail of spectacular terrain revealed in a new high resolution stereo image of Pluto – King of the Kuiper Belt! – taken by NASA's New Horizons spacecraft.

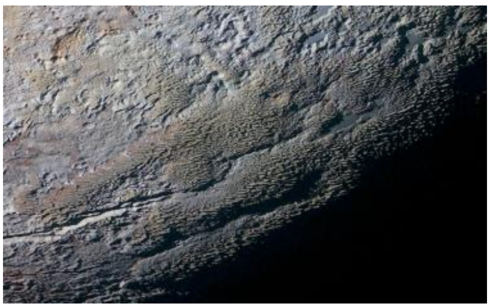
The amazing new stereo Plutonian image focuses on an area dominated by a mysterious feature that geologists call 'bladed' terrain – seen above – and its unlike anything seen elsewhere in our solar system.

Its located in a broad region of rough highlands informally known as Tartarus Dorsa – situated to the east of the Pluto's huge heart shaped feature called Tombaugh Regio. The best resolution is approximately 1,000 feet (310 meters).

The stereo view combines a pair of images captured by New Horizons Ralph/Multispectral Visible Imaging Camera (MVIC) science instruments. They were taken about 14 minutes apart on during history making first ever flyby of the Pluto planetary system on July 14, 2015.

The first was taken when New Horizons was 16,000 miles (25,000 kilometers) away from Pluto, the second when the spacecraft was 10,000 miles (about 17,000 kilometers) away.

The blades align from north to south, typically reach up to about 550 yards (500 meters) high and are spaced about 2-4 miles (3-5 kilometers). Thus they are among the planets steepest features. They are "perched on a much broader set of rounded ridges that are separated by flat valley floors," according to descriptions from the New Horizons science team.

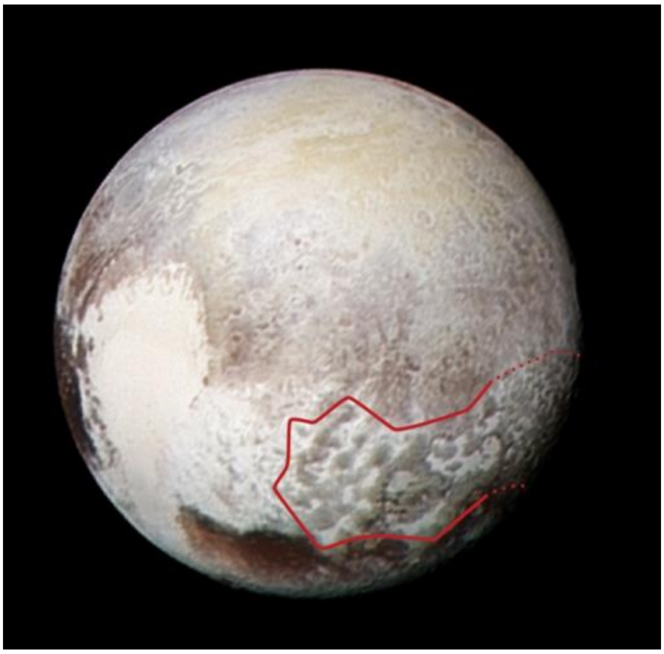


This color image of Pluto taken by NASA's New Horizons spacecraft shows rounded and bizarrely textured mountains, informally named the Tartarus Dorsa, rise up along Pluto's terminator and show intricate but puzzling patterns of blue-gray ridges and reddish material in between. This view, roughly 330 miles (530 kilometers) across, combines blue, red and infrared images taken by the Ralph/Multispectral Visual Imaging Camera (MVIC) on July 14, 2015, and resolves details and colors on scales as small as 0.8 miles (1.3 kilometers). Credits: NASA/JHUAPL/SWRI

Mission scientists have also noted that the bladed terrain has the texture of "snakeskin" owing to their "scaly raised relief."

In the companion global image from NASA (below), the bladed terrain is outlined in red and shown to extend quite far to the east of Tombaugh Regio.

The composite image was taken on July 13, 2015, the day before the closest approach flyby, when the probe was farther away thus shows lower resolution. It combines a pair of images from two of the science instruments – a Ralph/Multispectral Visible Imaging Camera (MVIC) color scan and an image from the Long Range Reconnaissance Imager (LORRI).



This global view of Pluto combines a Ralph/Multispectral Visible Imaging Camera (MVIC) color scan and an image from the Long Range Reconnaissance Imager (LORRI), both obtained on July 13, 2015 – the day before New Horizons' closest approach. The red outline marks the large area of mysterious, bladed terrain extending from the eastern section of the large feature informally named Tombaugh Regio.
Credits: NASA/JHUAPL/SwRI

The MVIC scan was taken from a range of 1 million miles (1.6 million kilometers), at a resolution of 20 miles (32 kilometers) per pixel. The corresponding LORRI image was obtained from roughly the same range, but has a higher spatial resolution of 5 miles (8 kilometers) per pixel, say officials.

Scientists have developed several possible theories about the origins of the bladed terrain, including erosion from evaporating ices or deposition of methane ices.

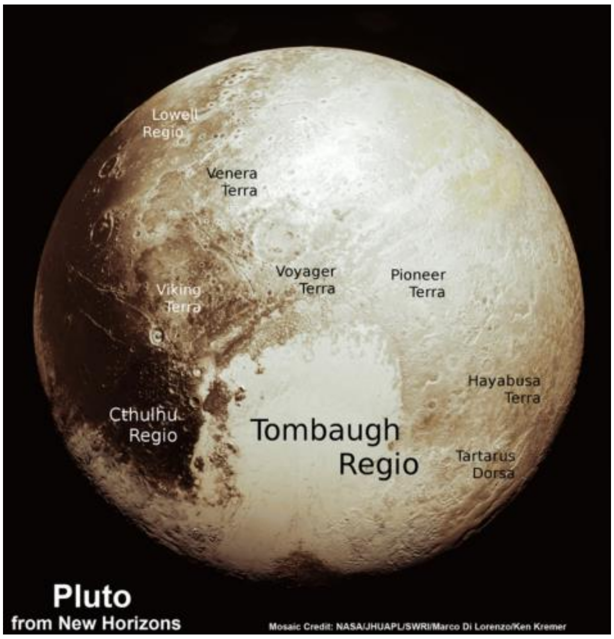
Measurements from the Linear Etalon Imaging Spectral Array (LEISA) instrument reveal that that this region "is composed of methane (CH4) ice with a smattering of water," reports New Horizons researcher Orkan Umurhan.

He speculates that "the material making up the bladed terrain is a methane clathrate. A clathrate is a structure in which a primary molecular species (say water, or H2O) forms a crystalline 'cage' to contain a guest molecule (methane or CH4, for example)."

But the question of whether that methane ice is strong enough to maintain the steep walled snakeskin features, will take much more research to determine a conclusive answer.

Umurhan suggests that more research could help determine if the "methane clathrates in the icy moons of the outer solar system and also in the Kuiper Belt were formed way back before the solar system formed – i.e., within the protosolar nebula – potentially making them probably some of the oldest materials in our solar system."

Pluto continues to amaze and surprise us as the data streams back to eagerly waiting scientists on Earth over many more months to come – followed by years and decades of painstaking analysis.



This new global mosaic view of Pluto was created from the latest high-resolution images to be downlinked from NASA's New Horizons spacecraft and released on Sept. 11, 2015. The images were taken as New Horizons flew past Pluto on July 14, 2015, from a distance of 50,000 miles (80,000 kilometers). This new mosaic was stitched from over two dozen raw images captured by the LORRI imager and colorized. Annotated with informal place names. Credits: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute/Marco Di Lorenzo/Ken Kremer/kenkremer.com

During New Horizons flyby on July 14, 2015, it discovered that Pluto is the biggest object in the outer solar system and thus the 'King of the Kuiper Belt."

The Kuiper Belt comprises the third and outermost region of worlds in our solar system.

Pluto is the last planet in our solar system to be visited in the initial reconnaissance of planets by spacecraft from Earth since the dawn of the Space Age.

New Horizons remains on target to fly by a second Kuiper Belt Object (KBO) on Jan. 1, 2019 – tentatively named PT1, for Potential Target 1. It is much smaller than Pluto and was recently selected based on images taken by NASA's Hubble Space Telescope.

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

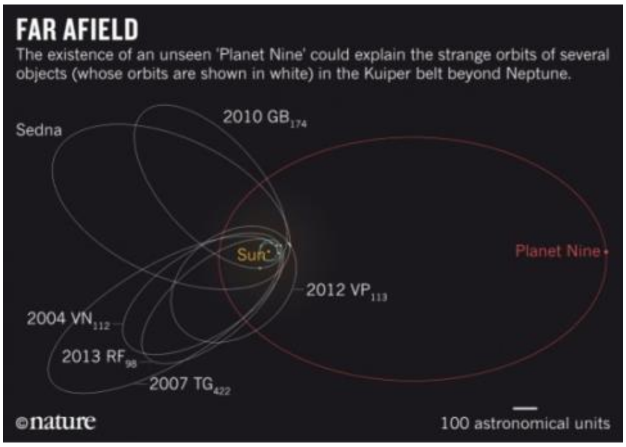
Ken Kremer

Did the Sun Steal Planet Nine?

4 Apr , 2016 by Jason Major

One of the biggest new mysteries in our Solar System is the purported presence of a large and distant "Planet Nine," traveling around the Sun in a twenty-thousand-year orbit far beyond Pluto. Although this far-flung world's existence has yet to actually be confirmed (or even detected) some scientists are suggesting it might have originally been an exoplanet around a neighboring star, pilfered by our Sun during its impudent adolescence.

In January 2016 the remorseless "planet killer" Mike Brown — a Caltech professor and astronomer whose discovery of Eris in 2005 prompted the IAU's reclassification of planets, thereby knocking Pluto from the official list — announced evidence for the existence of a "real" ninth planet orbiting the Sun four times farther than Pluto…and possibly even farther out than the Kuiper Belt is thought to extend. According to Brown and co-researcher Konstantin Batygin their Planet Nine may be almost as massive as Neptune, but they're still on the hunt for it within the regions where they *think* it should be.



The calculated 10,000–20,000-year-long orbit of Planet Nine. The green circle is the orbit of Pluto. Credit: Nature/ K. Batygin and M. E. Brown Astronom. J. 151, 22 (2016)

Formed five billion years ago in a cluster of other stars, our Sun once had hundreds if not thousands of stellar siblings (now long since dispersed through the nearby galaxy.) As the stars developed many likely had planets form around them, just as the Sun did, and with all the young star systems in such relatively close proximity it's possible that some planets wound up ejected from their host star to be picked up — or possibly even outright stolen — by another.

Our Sun formed within a star cluster similar to this, NGC 346 in the neighboring Small Magellanic Cloud. Credit: NASA, ESA and A. Nota (STScI/ESA).

Brown and Batygin's Planet Nine could be one of these hypothesized adopted worlds. A team of researchers, led by Alexander Mustill at the Lund Observatory in Sweden, recently investigated the probability of this scenario, described in an April 4, 2016 article on New Scientist.

What is the Earth's Mantle Made Of?

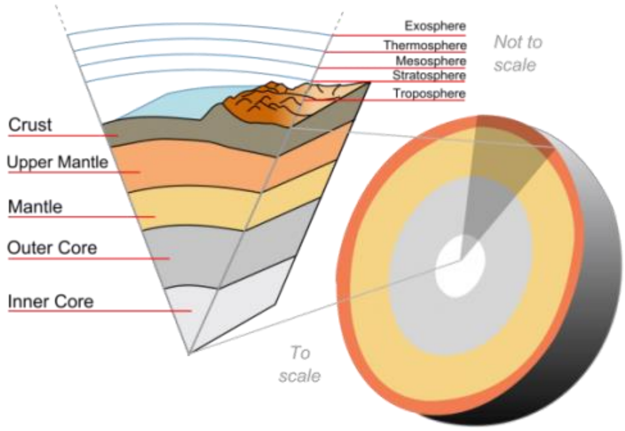
26 Mar , 2016 by Fraser Cain

Like all the other terrestrial planets, (Mercury, Venus, and Mars) the Earth is made up of many layers. This is the result of it undergoing planetary differentiation, where denser materials sink to the center to form the core while lighter materials form around the outside. Whereas the core is composed primarily of iron and nickel, Earth's upper layer are composed of silicate rock and minerals.

This region is known as the mantle, and accounts for the vast majority of the Earth's volume. Movement, or convection, in this layer is also responsible for all of Earth's volcanic and seismic activity. Information about structure and composition of the mantle is either the result of geophysical investigation or from direct analysis of rocks derived from the mantle, or exposed mantle on the ocean floor.

Definition:

Composed of silicate rocky material with an average thickness of 2,886 kilometres (1,793 mi), the mantle sits between the Earth's crust and its upper core. The mantle makes up 84% of the Earth by volume, compared to 15% in the core and the remainder being taken up by the crust. While it is predominantly solid, it behaves like a viscous fluid due to the fact that temperatures are close to the melting point in this layer.



The layers of the Earth, a differentiated planetary body. Credit: Wikipedia Commons/Surachit

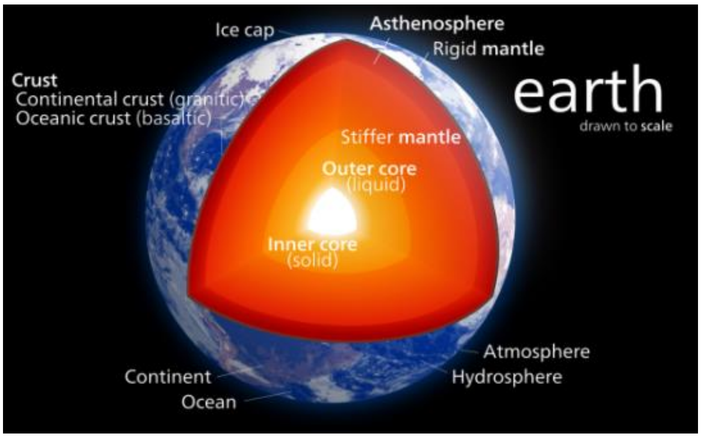
Our knowledge of the upper mantle, including the tectonic plates, is derived from analyses of earthquake waves; heat flow, magnetic, and gravity studies; and laboratory experiments on rocks and minerals. Between 100 and 200 kilometers below the Earth's surface, the temperature of the rock is near the melting point; molten rock erupted by some volcanoes originates in this region of the mantle.

Structure and Composition:

The mantle is divided into sections which are based upon results from seismology. These are the upper mantle, which extends from about 7 to 35 km (4.3 to 21.7 mi) from the surface down to a depth of 410 km (250 mi); the transition zone, which extends from 410 t0 660 km (250 – 410 mi); the lower mantle, which reaches from 660 km to a depth of 2,891 km (410 – 1,796 mi); and the the core-mantle boundary, which has a variable thickness (~200 km or 120 mi on average).

In the upper mantle two main zones are distinguished. The innermost of these is the inner asthenosphere, which is composed of plastic flowing rock of that averages about 200 km (120 mi) in thickness. The outer zone is the lowermost part of the lithosphere, which is composed of rigid rock and is about 50 to 120 km (31 to 75 mi) thick.

The upper part of the lithosphere is the Earth's crust, a thin layer that is about 5 to 75 km (3.1 to 46.6 mi) thick, which is separated from the mantle by the Mohorovicic discontinuity (or "Moho", which is defined by a sharp increase downward in the speed of earthquake waves).



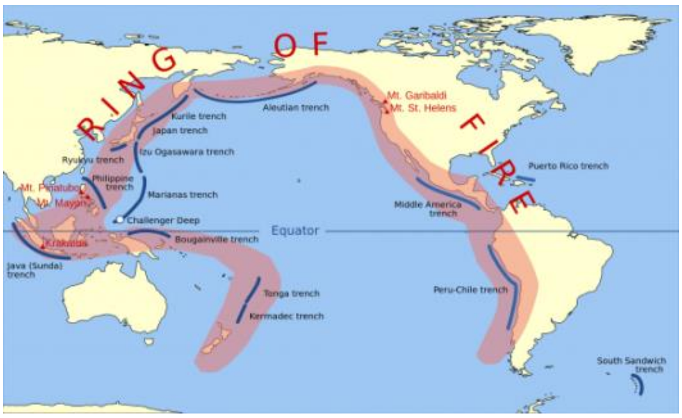
The internal structure of Earth. Credit: Wikipedia Commons/ Kelvinsong

In some places under the ocean, the mantle is actually exposed. There are also a few places on land where mantle rock has been pushed to the surface by tectonic activity, most notably the Tablelands region of Gros Morne National Park in Newfoundland and Labrador, Canada, St. John's Island, Egypt, or the island of Zabargad in the Red Sea.

In terms of its constituent elements, the mantle is made up of 44.8% oxygen, 21.5% silicon, and 22.8% magnesium. There's also iron, aluminum, calcium, sodium, and potassium. These elements are all bound together in the form of silicate rocks, all of which take the form of oxides. The most common is Silicon dioxide (SiO_2) at 48%, followed by Magnesium Oxide (MgO) at 37.8%. Examples of rocks that you might find inside the mantle include: olivine, pyroxenes, spinel, and garnet.

Convection:

Because of the temperature difference between the Earth's surface and outer core, there is a convective material circulation in the mantle. This consists of the slow, creeping motion of the Earth's silicate mantle across the surface, carrying heat from the interior of the Earth to the surface. Whereas hot material rises to the surface, cooler, heavier material sinks beneath.



The Pacific Ring of Fire, a string of volcanic regions extending from the South Pacific to South America. Credit: Public Domain

The lithosphere is divided into a number of plates that are continuously being created and consumed at their opposite plate boundaries. Downward motion of material occurs in subduction zones, locations at convergent plate boundaries where one mantle layer moves under another. Accretion occurs as material is added to the growing edges of a plate, associated with seafloor spreading.

This chaotic process is believed to be an integral part of the motion of plates, which in turn gives rise to continental drift. Subducted oceanic crust is also what gives rise to volcanism, as demonstrated by the Pacific Ring of Fire.

Exploration:

Scientific investigations and exploration of the mantle is generally conducted on the seabed due to the relative thickness of the oceanic crust compared to the continental crust. The first attempt at mantle exploration (known as Project Mohole) achieved a deepest penetration of approximately 180 meters (590 feet). It was abandoned in 1966 after repeated failures and cost over-runs.

In 2005, the ocean drilling vessel *JOIDES Resolution* achieved a borehole that was 1,416 meters (4,646 ft) in depth below the sea floor. In 2007, a team of scientists aboard the UK research ship RRS *James Cook* conducted a study on an exposed section of mantle located between the Cape Verdr Islands and the Caribbean Sea.

The scientific drilling ship JOIDES Resolution, pictured at sea in 2009. Credit: William Crawford/IODP/TAMU

In recent years, a method of exploring the Earth's layers was proposed using a small, dense, heat-generating probe. This would melt its way through the crust and mantle and communicate via acoustic signals generated by its penetration of the rocks. The probe would consist of an outer shell of tungsten with a core of cobalt-60, which acts as a radioactive heat source.

It was calculated that such a probe will reach the oceanic Moho in less than 6 months and attain minimum depths of well over 100 km (62 mi) in a few decades beneath both oceanic and continental lithosphere. In 2009, a supercomputer application created a simulation that provided new insight into the distribution of mineral deposits from when the mantle developed 4.5 billion years ago.

While the Earth's mantle has yet to be explored at any significant depth, much has been learned from indirect studies over the past few centuries. As human exploration of the Solar System continues, we are sure to learn more about terrestrial planets, their geological behavior, and their formation.

We have written many articles about the Earth's interior here at Universe Today. Here's one about the Earth's Mantle, Discovery of the Earth's Inner, Inner Core, What Is The Difference Between Magma And Lava, and an article about how the Earth's Core Rotates Faster Than Its Crust.

For more information, check out the United States Geological Survey (USGS).

What Are The Benefits Of Volcanoes?

19 Mar , 2016 by Fraser Cain

Volcanoes are renowned for their destructive power. In fact, there are few forces of nature that rival their sheer, awesome might, or have left as big of impact on the human psyche. Who hasn't heard of tales of Mt. Vesuvius erupting and burying Pompeii? There's also the Minoan Eruption, the eruption that took place in the 2nd millennium BCE on the isle of Santorini and devastated the Minoan settlement there.

In Japan, Hawaii, South American and all across the Pacific, there are countless instances of eruptions taking a terrible toll. And who can forget modern-day eruptions like Mount St. Helens? But would it surprise you to know that despite their destructive power, volcanoes actually come with their share of benefits? From enriching the soil to creating new landmasses, volcanoes are actually a productive force as well.

Soil Enrichment:

Volcanic eruptions result in ash being dispersed over wide areas around the eruption site. And depending on the chemistry of the magma from which it erupted, this ash will be contain varying amounts of soil nutrients. While the most abundant elements in magma are silica and oxygen, eruptions also result in the release of water, carbon dioxide (CO^2), sulfur dioxide (SO^2), hydrogen sulfide (H^2S), and hydrogen chloride (HCl), amongst others.

In addition, eruptions release bits of rock such as potolivine, pyroxene, amphibole, and feldspar, which are in turn rich in iron, magnesium, and potassium. As a result, regions that have large deposits of volcanic soil (i.e. mountain slopes and valleys near eruption sites) are quite fertile. For example, most of Italy has poor soils that consist of limestone rock.

The area around the volcano is now densely populated. Credit: Wikipedia Commons/Jeffmatt

But in the regions around Naples (the site of Mt. Vesuvius), there are fertile stretches of land that were created by volcanic eruptions that took place 35,000 and 12,000 years ago. The soil in this region is rich because volcanic eruption deposit the necessary minerals, which are then weathered and broken down by rain. Once absorbed into the soil, they become a steady supply of nutrients for plant life.

Hawaii is another location where volcanism led to rich soil, which in turn allowed for the emergence of thriving agricultural communities. Between the 15th and 18th centuries on the islands of Kauai, O'ahu and Molokai, the cultivation of crops like taros and sweet potatoes allowed for the rise of powerful chiefdoms and the flowering of the culture we associate with Hawaii today.

Volcanic Land Formations:

In addition to scattering ash over large areas of land, volcanoes also push material to the surface that can result in the formation of new islands. For example, the entire Hawaiian chain of islands was created by the constant eruptions of a single volcanic hot spot. Over hundreds of thousands of years, these volcanoes breached the surface of the ocean becoming habitable islands, and rest stops during long sea journeys.

This is the case all across the Pacific, were island chains such as Micronesia, the Ryukyu Islands (between Taiwan and Japan), the Aleutian Islands (off the coast of Alaska), the Mariana Islands, and Bismark Archipelago were all formed along arcs that are parallel and close to a boundary between two converging tectonic plates.

The island of Santorini, Greece. Credit: EOS/NASA/ Public Domain

Much the same is true of the Mediterranean. Along the Hellenic Arc (in the eastern Mediterranean), volcanic eruptions led to the creation of the Ionian Islands, Cyprus and Crete. The nearby South Aegean Arc meanwhile led to the formation of Aegina, Methana, Milos, Santorini and Kolumbo, and Kos, Nisyros and Yali. And in the Caribbean, volcanic activity led to the creation of the Antilles archipelago.

Where these islands formed, unique species of plants and animals evolved into new forms on these islands, creating balanced ecosystems and leading to new levels of biodiversity.

Volcanic Minerals and Stones:

Another benefits to volcanoes are the precious gems, minerals and building materials that eruptions make available. For instance, stones like pumice volcanic ash and perlite (volcanic glass) are all mined for various commercial uses. These include acting as abrasives in soaps and household cleaners. Volcanic ash and pumice are also used as a lightweight aggregate for making cement.

The finest grades of these volcanic rocks are used in metal polishes and for woodworking. Crushed and ground pumice are also used for loose-fill insulation, filter aids, poultry litter, soil conditioner, sweeping compound, insecticide carrier, and blacktop highway dressing.

The roof of the Pantheon, as seen from nearby rooftops in Roe. Credit: Public Domain/Anthony Majanlahti

Perlite is also used as an aggregate in plaster, since it expands rapidly when heated. In precast walls, it too is used as an aggregate in concrete. Crushed basalt and diasbase are also used for road metal, railroad ballast, roofing granules, or as protective arrangements for shorelines (riprap). High-density basalt and diabase aggregate are used in the concrete shields of nuclear reactors.

Hardened volcanic ash (called tuff) makes an especially strong, lightweight building material. The ancient Romans combined tuff and lime to make a strong, lightweight concrete for walls, and buildings. The roof of the Pantheon in Rome is made of this very type of concrete because it's so lightweight.

Precious metals that are often found in volcanoes include sulfur, zinc, silver, copper, gold, and uranium. These metals have a wide range of uses in modern economies, ranging from fine metalwork, machinery and electronics to nuclear power, research and medicine. Precious stones and minerals that are found in volcanoes include opals, obsidian, fire agate, flourite, gypsum, onyx, hematite, and others.

Global Cooling:

Volcanoes also play a vital role in periodically cooling off the planet. When volcanic ash and compounds like sulfur dioxide are released into the atmosphere, it can reflect some of the Sun's rays back into space, thereby reducing the amount of heat energy absorbed by the atmosphere. This process, known as "global dimming", therefore has a cooling effect on the planet.

Sarychev volcano, (located in Russia's Kuril Islands, northeast of Japan) in an early stage of eruption on June 12, 2009. Credit: NASA

The link between volcanic eruptions and global cooling has been the subject of scientific study for decades. In that time, several dips have been observed in global temperatures after large eruptions. And though most ash clouds dissipate quickly, the occasional prolonged period of cooler temperatures have been traced to particularly large eruptions.

Because of this well-established link, some scientists have recommended that sulfur dioxide and other be released into the atmosphere in order to combat global warming, a process which is known as ecological engineering.

Hot Springs And Geothermal Energy:

Another benefit of volcanism comes in the form of geothermal fields, which is an area of the Earth characterized by a relatively high heat flow. These fields, which are the result of present, or fairly recent magmatic activity, come in two forms. Low temperature fields (20-100°C) are due to hot rock below active faults, while high temperature fields (above 100°C) are associated with active volcanism.

Geothermal fields often create hot springs, geysers and boiling mud pools, which are often a popular destination for tourists. But they can also be harnessed for geothermal energy, a form of carbon-neutral power where pipes are placed in the Earth and channel steam upwards to turn turbines and generate electricity.

Steam rising from the Nesjavellir Geothermal Power Station in Iceland. Credit: Gretar Ívarsson/Fir0002

In countries like Kenya, Iceland, New Zealand, the Phillipines, Costa Rica and El Salvador, geothermal power is responsible for providing a significant portion of the country's power supply – ranging from 14% in Costa Rica to 51% in Kenya. In all cases, this is due to the countries being in and around active volcanic regions that allow for the presence of abundant geothermal fields.

Outgassing and Atmospheric Formation:

But by far, the most beneficial aspect of volcanoes is the role they play in the formation of a planet's atmosphere. In short, Earth's atmosphere began to form after its formation 4.6 billion eyars ago, when volcanic outgassing led to the creation of gases stored in the Earth's interior to collect around the surface of the planet. Initially, this atmosphere consisted of hydrogen sulfide, methane, and 10 to 200 times as much carbon dioxide as today's atmosphere.

After about half a billion years, Earth's surface cooled and solidified enough for water to collect on it. At this point, the atmosphere shifted to one composed of water vapor, carbon dioxide and ammonia (NH^3). Much of the carbon dioxide dissolved into the oceans, where cyanobacteria developed to consume it and release oxygen as a byproduct. Meanwhile, the ammonia began to be broken down by photolysis, releasing the hydrogen into space and leaving the nitrogen behind.

Another key role played by volcanism occurred 2.5 billion years ago, during the boundary between the Archaean and Proterozoic Eras. It was at this point that oxygen began to appear in our oxygen due to photosynthesis – which is referred to asthe “Great Oxidation Event”. However, according to recent geological studies, biomarkers indicate that oxygen-producing cyanobacteria were releasing oxygen at the same levels there are today. In short, the oxygen being produced had to be going somewhere for it not to appear in the atmosphere.

Roughly 2.5 billion years ago, towards the end of the Archaean Era, oxidation of our atmosphere began. Credit: ocean.si.edu

The lack of terrestrial volcanoes is believed to be responsible. During the Archaean Era, there were only submarine volcanoes, which had the effect of scrubbing oxygen from the atmosphere, binding it into oxygen containing minerals. By the Archaean/Proterozoic boundary, stabilized continental land masses arose, leading to terrestrial volcanoes. From this point onward, markers show that oxygen began appearing in the atmosphere.

Volcanism also plays a vital role in the atmospheres of other planets. Mercury’s thin exosphere of hydrogen, helium, oxygen, sodium, calcium, potassium and water vapor is due in part of volcanism, which periodically replenishes it. Venus’ incredibly dense atmosphere is also believed to be periodically replenished by volcanoes on its surface.

And Io, Jupiter’s volcanically active moon, has an extremely tenuous atmosphere of sulfur dioxide (SO^2), sulfur monoxide (SO), sodium chloride (NaCl), sulfur monoxide (SO), atomic sulfur (S) and oxygen (O). All of these gases are provided and replenished by the many hundreds of volcanoes situated across the moon’s surface.

As you can see, volcanoes are actually a pretty creative force when all is said and done. In fact, us terrestrial organisms depend on them for everything from the air we breathe, to the rich soil that produces our food, to the geological activity that gives rise to terrestrial renewal and biological diversity.

We have written many articles about volcanoes for Universe Today. Here’s an article about extinct volcanoes, and here’s an article about active volcanoes. Here’s an article about volcanoes.

Want more resources on the Earth? Here’s a link to NASA’s Human Spaceflight page, and here’s NASA’s Visible Earth.

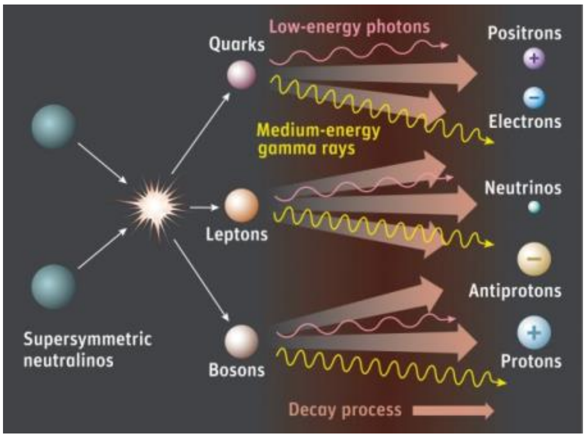
Beyond WIMPs: Exploring Alternative Theories Of Dark Matter

21 Mar , 2016 by Matt Williams

The standard model of cosmology tells us that only 4.9% of the Universe is composed of ordinary matter (i.e. that which we can see), while the remainder consists of 26.8% dark matter and 68.3% dark energy. As the names would suggest, we cannot see them, so their existence has had to be inferred based on theoretical models, observations of the large-scale structure of the Universe, and its apparent gravitational effects on visible matter.

Since it was first proposed, there have been no shortages of suggestions as to what Dark Matter particles look like. Not long ago, many scientists proposed that Dark Matter consists of Weakly-Interacting Massive Particles (WIMPs), which are about 100 times the mass of a proton but interact like neutrinos. However, all attempts to find WIMPs using colliders experiments have come up empty. As such, scientists have been exploring the idea lately that dark matter may be composed of something else entirely.

Current cosmological models tend to assume that the mass of dark matter is around 100 Gev (Giga-electrovolts), which corresponds to the mass scale of a lot of the other particles that interact via weak nuclear force. The existence of such a particle would be consistent with supersymmetric extensions of the Standard Model of particle physics. It is further believed that such particles would have been produced in the hot, dense, early Universe, with an a matter mass-density that has remained consistent to this day.



According to supersymmetry, WIMPs annihilate each other, creating a cascade of particles and radiation that includes medium-energy gamma rays. Credit: Sky & Telescope / Gregg Dinderman.

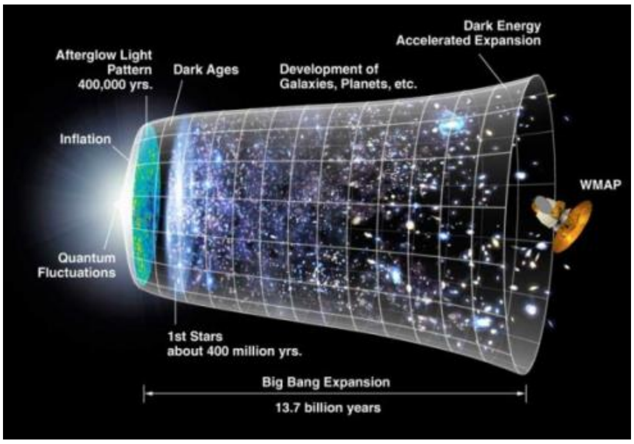
However, ongoing experimental efforts to detect WIMPs have failed to produce any concrete evidence of these particles. These have including searching for the products of WIMP annihilation (i.e. gamma rays, neutrinos and cosmic rays) in nearby galaxies and clusters, as well as direct detection experiments using supercolliders, like the CERN Large Hadron Collider (LHC) in Switzerland.

Because of this, many researcher teams have begun to consider looking beyond the WIMPs paradigm to find Dark Matter. One such team consists of a group of cosmologists from CERN and CP3-Origins in Denmark, who recently released a study indicating that Dark Matter could be much heavier and much less interacting than previously thought.

As Dr. McCullen Sandora, one of the research team members from CP-3 Origins, told Universe Today via email:

“We can’t rule out the WIMP scenario yet, but with each passing year it’s getting more and more suspect that we haven’t seen anything. In addition, the usual weak scale physics suffers from the hierarchy problem. That is, why all the particles we know about are so light, especially with respect to the natural scale of gravity, the Planck scale, which is about 10^{19} GeV. So, if dark matter were closer to the Planck scale, it wouldn’t be afflicted by the hierarchy problem, and this would also explain why we haven’t seen the signatures associated with WIMPs.”

Using a new model they call Planckian Interacting Dark Matter (PIDM), the team has been exploring the upper limit of mass of dark matter. Whereas WIMPs place the mass of dark matter at the upper limit of the electroweak scale, the Danish research team of Marthias Garny, McCullen Sandora and Martin S. Sloth proposed a particle with a mass near another natural scale entirely – the Planck Scale.



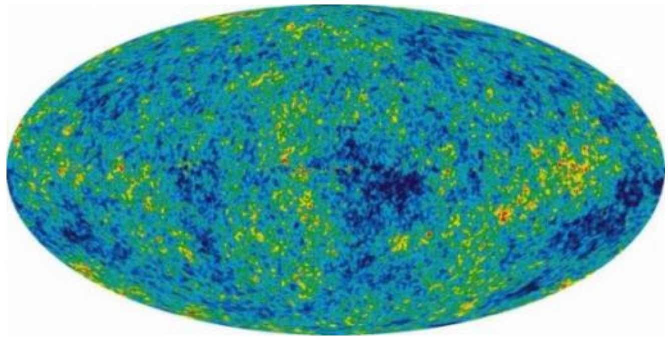
Cosmic timeline, from the Big Bang to the present day. Credit: NASA

On the Planck Scale, a single unit of mass is equivalent to 2.17645 × 10^{-8} kg – roughly a microgram, or 10^{19} times greater than the mass of a proton. At this mass, every PIDM is essentially as heavy as a particle can be before it becomes a miniature black hole. The team also theorizes that these PIDM particles interact with ordinary matter only through gravitation and that large numbers of them formed in the very early Universe during the "reheating" epoch – a period that occurred at the end the Inflationary Epoch, some 10^{-36} t0 10^{-33} or 10^{-32} seconds after the Big Bang.

This is epoch is so-named because, during Inflation, cosmic temperatures are believed to have dropped by a factor of 100,000 or so. When the inflation ended, the temperatures returned to their pre-inflationary temperature (an estimated 10^{27} K). At this point, the large potential energy of the inflation field decayed into Standard Model particles that filled the Universe, which would have included Dark Matter.

Naturally, this new theory comes with its share of implications for cosmologists. For example, for this model to work, the temperature of the reheating epoch would have to have been higher than is currently assumed. What's more, a hotter reheating period would also result in the creation of more primordial gravitational waves, which would be visible in the Cosmic Microwave Background (CMB).

"Having such a high temperature tells us two interesting things about inflation," says Sandora. "If dark matter turns out to be a PIDM: the first is that inflation happened at a very high energy, which in turn means that it was able to produce not just fluctuations in the temperature of the early universe, but also in spacetime itself, in the form of gravitational waves. Second, it tells us that the energy of inflation had to decay into matter extremely rapidly, because if it had taken too long the universe would have cooled to the point where it would not have been able to produce any PIDMs at all."



Future studies of the Cosmic Microwave Background (CMB) could tell us more about the true nature of dark matter. Credit: NASA/WMAP

The existence of these gravitational waves could be confirmed or ruled out by future studies involving Cosmic Microwave Background (CMB). This is exciting news, since the recent discovery of gravitational waves is expected to lead to renewed attempts to detect primordial waves that date back to the very creation of the Universe.

As Sandora explained, this presents a win-win scenario for scientists, as its means that this latest candidate for Dark Matter will be able to proven or disproven in the near future.

"[O]ur scenario makes a concrete prediction: we will see gravitational waves in the next generation of cosmic microwave background experiments. Therefore, it's a no-lose scenario: if we see them, that's great, and if we don't see them, we'll know dark matter is not a PIDM, which will mean that we know it has to have some additional interactions with ordinary matter. And all this will happen within the next decade or so, which gives us plenty to look forward to."

Ever since Jacobus Kapteyn first proposed the existence of Dark Matter in 1922, scientists have been searching for some direct evidence of its existence. And one by one, candidate particles – ranging from gravitinos and MACHOS to axions – have been proposed, weighed, and found wanting. If nothing else, it is good to know that this latest candidate particle's existence can be proven or ruled out in the near future.

And if proven to be correct, we will have resolved one of the greatest cosmological mysteries of all time! A step closer to truly understanding the Universe and how its mysterious forces interact. Theory of Everything, here we come (or not)!

OPPORTUNITY SEES DUST DEVIL

known as "Knudsen Ridge" on the western rim of Endeavour Crater, which spans 22 kilometres (14 miles) across, making it the largest impact site ever visited on Mars.

The rover attempted to scale Knudsen Ridge last month to reach a rock target for analysis by its on-board instruments, but the six-wheeled vehicle fell short, spinning its wheels on a 32-degree incline. Ground controllers re-routed Opportunity to a nearby rock target. that likely formed when Mars was warmer, wetter, and potentially habitable.

MEMBERS VIEWING LOGS and IMAGES

Hi Andy,

These Aurora images from my recent trip to Reykjavik, Iceland may be of interest for the NWASNEWS.

All taken with a Canon G16.

The first on 6th March was handheld F2, ISO 800 and 0.5 seconds which shows how bright it was to capture with a such a short exposure!

The second and third on 9th March were F1.8, ISO 1600 and 10 seconds.

Regards,

John Dartnell

Viewing Log for 28th February

Had a free Sunday night and the sky was clear as well I decided to go out and do some more viewing with my Messier marathon list.

Tonight I would be going to my usual viewing site at Uffcott just south of Swindon off the A4361 road from Wroughton to Avebury. I arrived and had my Meade LX90 set up and ready to go by 20:16, tonight I would be using a Pentax XW14 mm eye piece, this would give a magnification of 143. I trained the telescope on Uranus which was low in the western horizon, as usual this planet did not give anything up apart from the greenish hue of the disc, slewed to the eastern horizon and bagged Jupiter with Io to the west of the planet and Europa, Ganymede and Calisto to the east. Now carrying on with my Messier list, my first object was M41, an open cluster (O C) sitting about 4 ° below the star Sirius. While looking at this loose O C I noticed a satellite go thru the field of view! Further south and the east of M41 is M 93 another O C but much more compact than M 41. M46 and M 47 can be seen with a pair of binoculars in the same field of view but as I was using much more magnification I had to view them separately, M 47 is loose and M 46 more compact but dimmer. The only Messier object is Monoceros is M 50 yet another loose O C, M 48 in Hydra is much looser than M 50? The only way to view the Beehive cluster (M 44) in Cancer is with my finder scope as I am looking right thru the O C with the telescope, this is similar to M 45. Below and to the east of M 44 is M 67 a very loose and sparse O C also in Cancer. Into Leo and faint fuzzy blobs namely M 95 and M 96 (both spiral galaxies, (S G)) which I had to use averted vision to locate them. When I looked at M 105 I think I saw another galaxy in the same field of view? Checking Stellarium it could be NGC 3389 another S G coming in with a magnitude of 12.8 which is about the limit for my telescope? I could fit M 65 and M 66 (part of the triplet) in the same field of view, the other part of the triplet, NGC 3628 could not be seen. Now across to the northern part of the sky and into Ursa Major and look at M 81, this S G is bright to view, the Cigar galaxy in M 82 is a bit dimmer to view. My nemeses (as Jon Gale called it ☺) in M 97, the Owl nebula I could just make out, had to tap the eye piece and it would then pop out. M 108 is another faint fuzzy blob to look at, I find with a lot of S G's they are faint to look at, only grey bits in the sky? M 109 was even harder to find, yet it is 0.2 of a magnitude brighter to look at! Probably the most boring Messier object to look at is M 40, a double star with magnitudes of 9.6 and 10.1. This area had been reported to have some nebulosity which Messier could not find? Last object in Ursa Major is M 106, another faint S G but with a bright centre. Into Canes Vinatici and M 94, another faint fuzzy to view. The Sunflower galaxy (M 63) is a bit better to look at, I could not see any flowers in the sky unfortunately! The Whirlpool galaxy in M 51 has a bright centre to look at and its companion NGC 5195 could also be seen nearby. I have always have trouble finding M 101, this S G has a low surface brightness and being spread out makes it hard to see. My final object for the evening was M 102, some lists name this as a duplication of M 101 but according to Stellarium the object is NGC 5866?

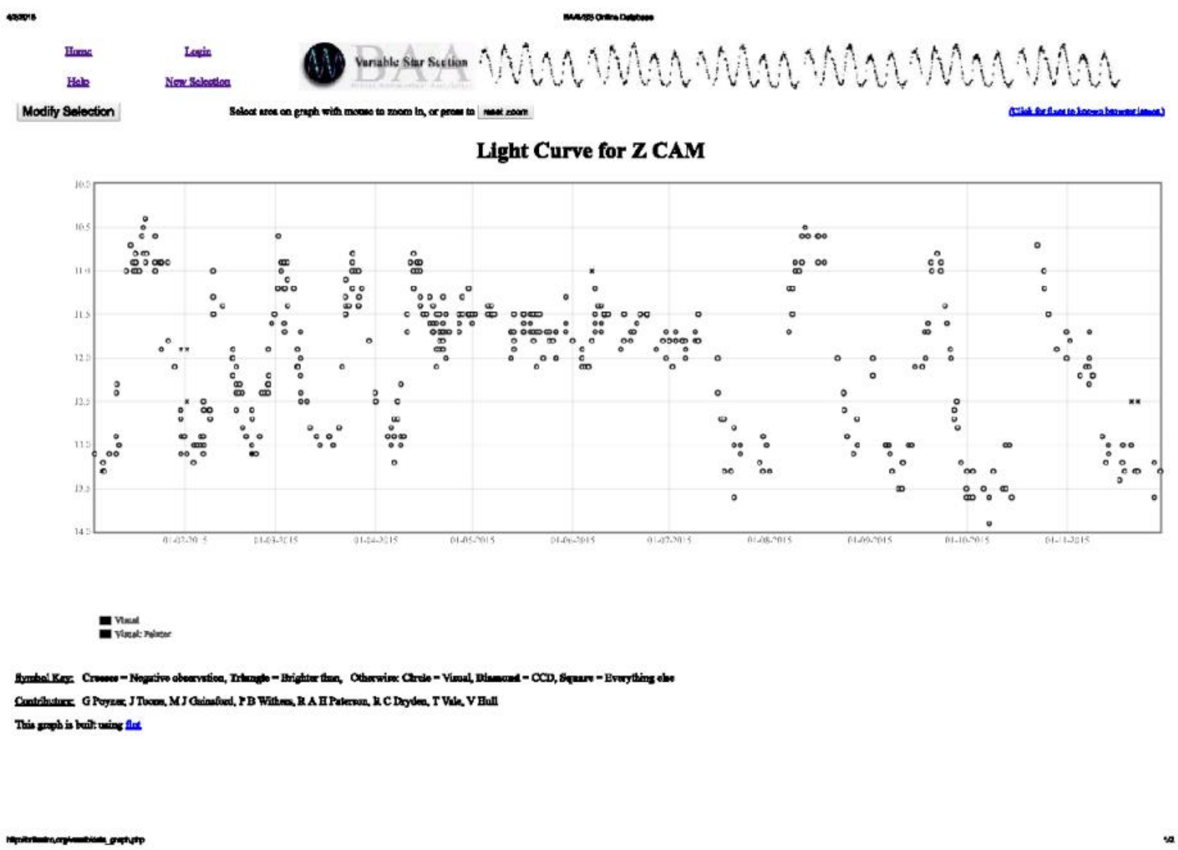
It was now 21:27 and time to pack up all the gear and go home for a cup of coffee. This was my second session at doing the Messier list and I have now covered 45 of the 110 objects on his list. My next stop is an area of the sky called 'Realm of the Galaxies' in Virgo so I will be looking at faint or even fainter objects? At least the telescope will not have to move far for these!

Clear skies.

Peter Chappell

Log March 2016

Variable star observations totalled 72 this month (with a few yet to load) bringing the overall total to 662, making March 2016 my personal best month so far ! Included in these were 6 observations of Z Camelopardalis, usually abbreviated to Z Cam. This star is the prototype of a class of dwarf novae which exhibit standstills. An example of one of these can be seen in the BAAVSS light curve for 2015 below. Note the high frequency of outbursts followed by a period of fairly stable magnitude (the standstill) then a return to high frequency outbursts again. The standstills are always preceded by an outburst and followed by quiescence.

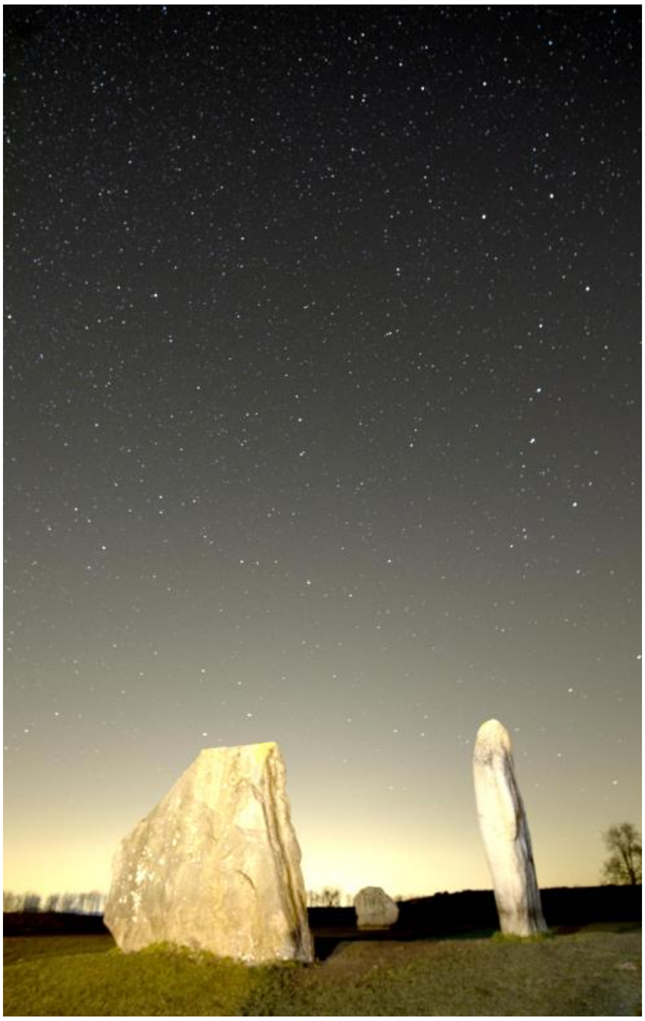


In a typical dwarf nova in its quiescent state, it is believed that the rate of mass transfer from the secondary to the accretion disc exceeds the rate of accretion onto the white dwarf so the disc slowly fills up and heats up. Once the temperature of the disc reaches a certain point, ionisation begins and the interaction between the plasma and the magnetic field of the white dwarf causes increased viscosity. Further material transfer from the secondary now causes a runaway temperature rise until the disc is fully ionised. The increased viscosity causes a loss of kinetic energy of the material in the disc and it falls more quickly onto the white dwarf, increasing the accretion rate until it exceeds the mass transfer rate, the disc begins to empty and cool and the system returns to quiescence. In this way, the average accretion rate in the quiescence and outburst cycles equals the mass transfer rate and equilibrium over the cycle is achieved.

In another group of cataclysmics called the Novalikes, the mass transfer rate is so high that the only way equilibrium can be maintained is if the disc stays in permanent outburst with high viscosity and corresponding accretion rate. (The name comes from the similarity the spectra of these stars show with spectra of Novae). Z Cam stars are believed to occupy the border between conventional dwarf novae, (such as U Geminorum) and the novalikes (such as UX Ursa Majoris). The standstills are believed to arise because of small increases in the mass accretion rate which are sufficient to show novalike behaviour and a sustained period of outburst. These increases in mass transfer rate may be caused by heating of the secondary by the accretion disc in its outburst state, which may explain why the standstills always follow an outburst. The feedback loop will be broken if something cause a drop in the mass transfer rate and it has been suggested that a star spot on the secondary might do this.

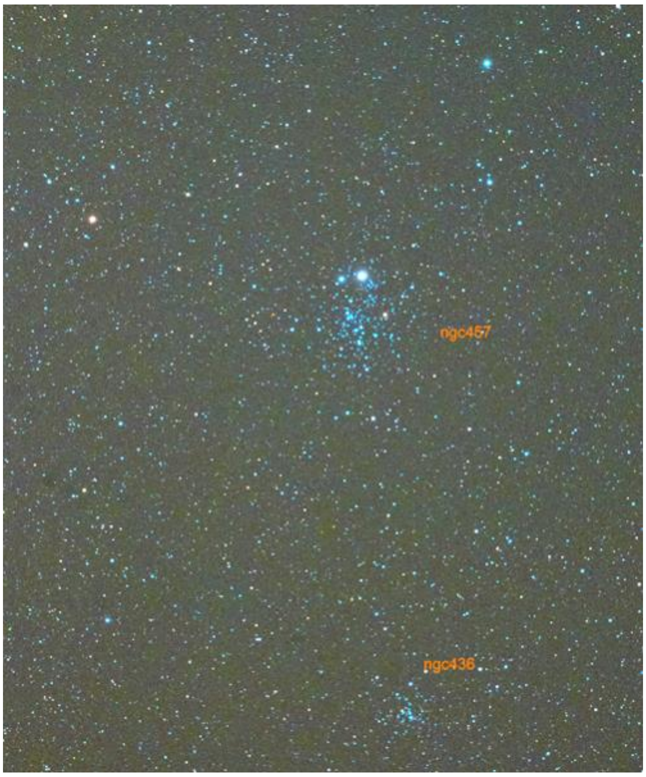
Tony Vale

The Moon in daylight (morning), 29th March. 20day phase. Andy Burns.

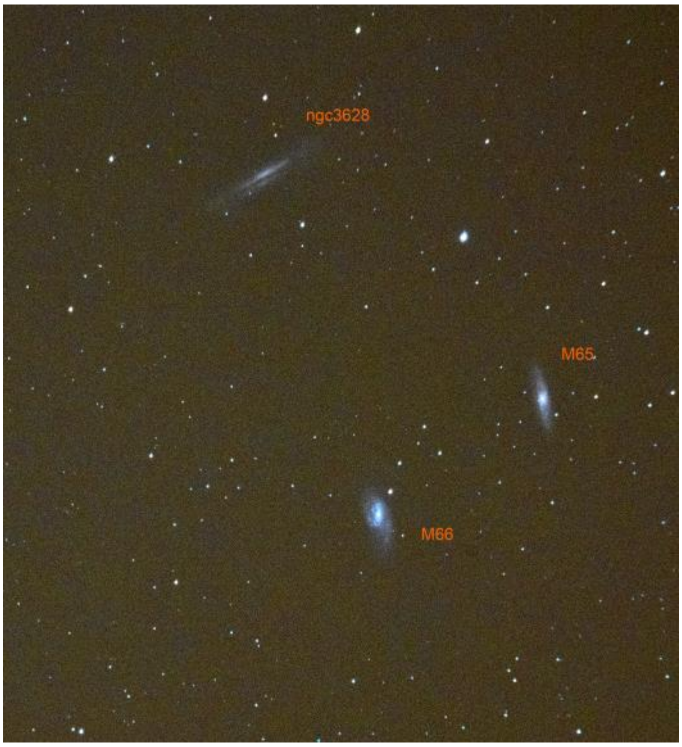


The cove at Avebury with Ursa Major, and minor. Nikon D810a with 20mm lens.

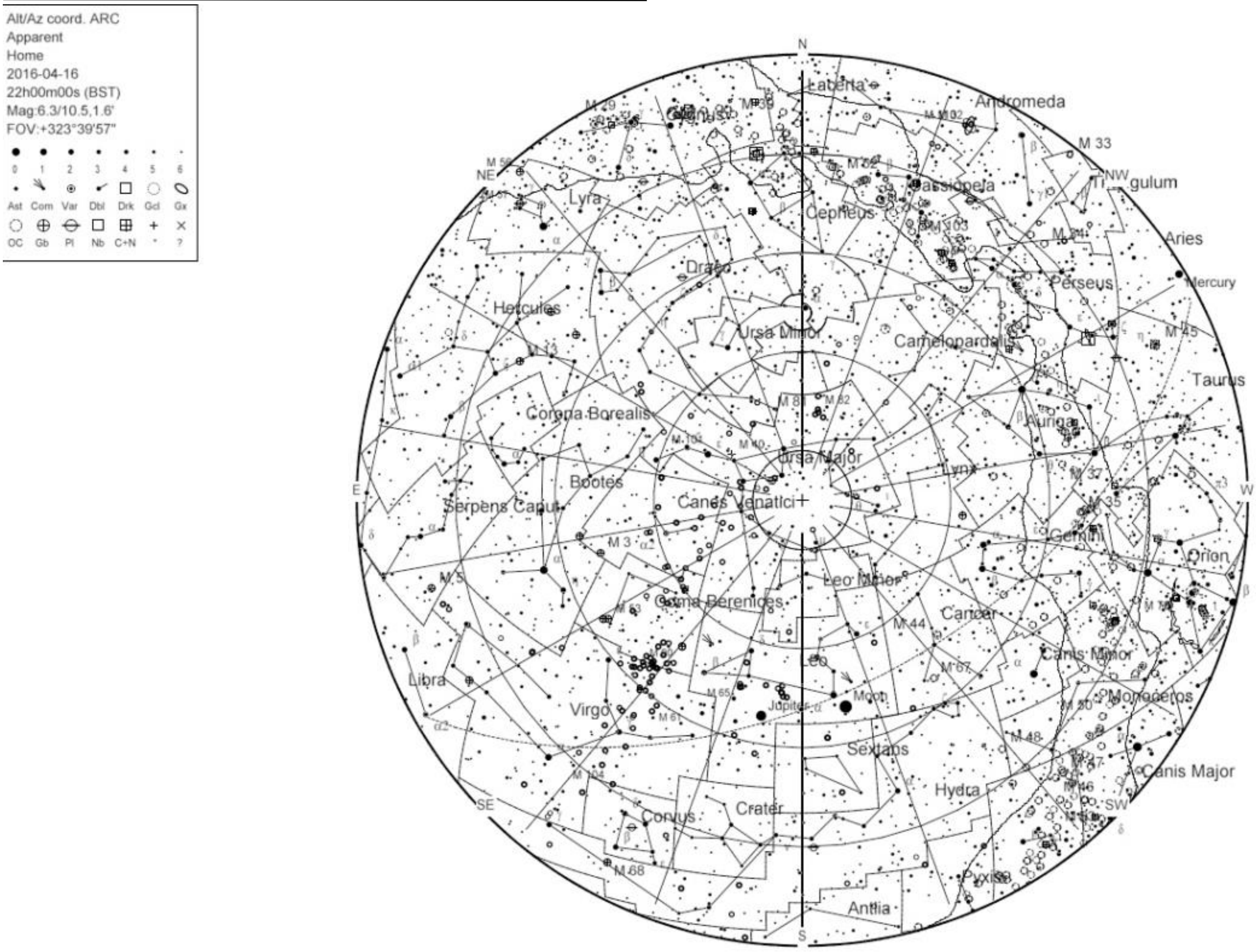
Below; Nikon D810a on 102mm telescope, ngc 457 the Owl cluster in Cassiopeia.



Above California nebula in Perseus, below the Leo triplet. Both Nikon D810a on 102 telescope, all through at 60 second exposures 800ISO. Andy Burns.



Gemini from our viewing night in Lacock. With a meteor on right. Nikon D810a using Star adventurer mount for tracking.



April is a month of goodbyes and hellos for the "inferior" (inner) planets.

April 4 – Venus, currently visible, will become invisible in the months ahead. For most of us, Venus is already very low near the eastern horizon within a half-hour of sunrise in the bright dawn sky — or perhaps a better way to describe it is that it's buried deep in the dawn light. Therefore, during April, Venus is difficult or impossible to see. The planet is best seen from the Southern Hemisphere. For the rest of us, it will stay hidden in the sun's glare for an unusually long time; not until July or August will it emerge very low in the sunset for observers around 40 degrees north.

April 8 – Mercury emerges from beyond the sun and into the evening sky this month. It can be glimpsed very low in the western sky about 30 or 40 minutes after sunset as April opens. In a telescope, Mercury appears as a gibbous disk and is shining at a brilliant minus 1.0 magnitude (making it nearly as bright as Sirius, the brightest star in the sky). This evening, look low to the west-northwest for Mercury about 7 degrees to the right and slightly lower than the slender sliver of the crescent moon. Mercury just passed the perihelion point of its orbit, when it's closest to the sun, on April 5 and is thus moving rapidly, becoming more favourably placed with each passing day.

April 17 – Jupiter was at opposition on March 8 — opposite the sun in Earth's sky — so it remains very bright, big and accessible for most of each April night from its location in south-central Leo. It's already very high in the south-southeast as evening twilight arrives, and it's the first "star" you're likely to see each evening. Even modest instruments show it brimming with a rich assortment of features in its clouds. This evening, you'll see it closely accompanying the waxing gibbous moon across the sky during the night.

April 18 – Mercury is at its greatest elongation, 20 degrees east of the sun this evening. It has dimmed considerably since its rendezvous with the moon 10 days ago, now shining at magnitude 0.2, but it's easier to observe because it's much higher in the twilight sky and sets later. It rests 10 degrees above the west-northwest horizon in midtwilight (about 45 minutes after sunset). This will be the planet's best showing in 2016 for skywatchers at mid-northern latitudes. For several evenings around this date,

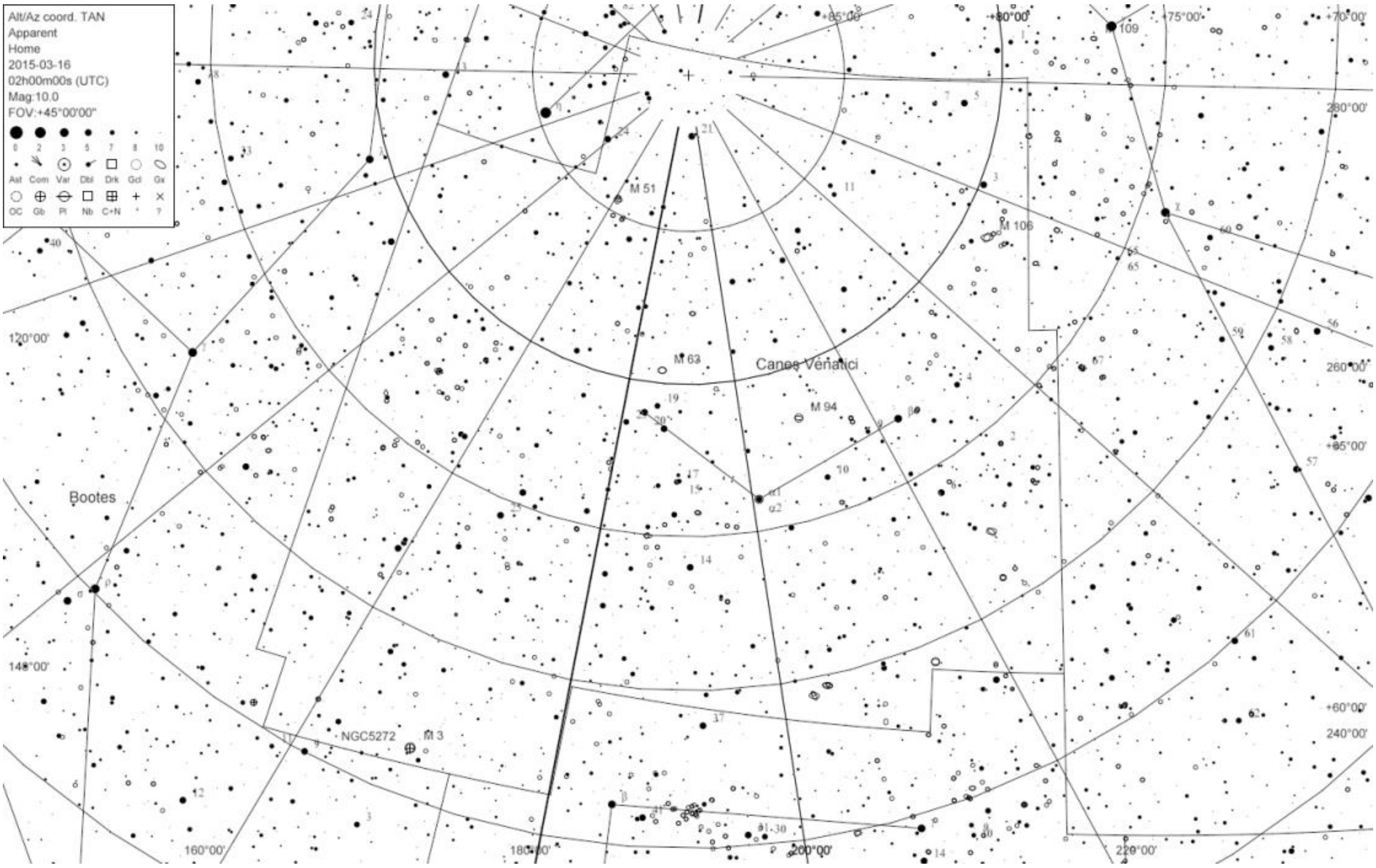
April 24 – Mars, in the constellation Ophiuchus, rises this evening before 10:30 p.m. local daylight time and dominates the south-southeastern sky the rest of the night. Already more than twice as bright as nearby Saturn as April opens, at a magnitude of minus 0.5, Mars more than doubles in brightness to a magnitude of minus 1.4 by month's end, practically matching Sirius as it continues to approach Earth. In a telescope over that time, its disk grows by some 25 percent. During the overnight hours on this night, Mars will appear as a brilliant orange-yellow "star" hanging about 5 degrees below the waning gibbous moon.

April 25 – The moon, which hovered above Mars the previous night, is noticeably farther off to its east on April 25. But almost midway between the two is a "star" shining brightly yellow; in actuality, it's the planet **Saturn**. The ringed wonder, whose opposition will occur next month, comes up at around 12:30 a.m. local time by the start of April and just before 10:30 p.m. by month's end. As with Mars, Saturn can be found in the large, dim constellation Ophiuchus, about 8 degrees northeast of the red star Antares in the neighbouring constellation of Scorpius.

ClearSkies Andy

Deep Sky Objects			
Object Ref / Name	**Type & Mag**	**Constellation**	**Biography / Observing Notes**
M81 & M82	GX (M81 6.9, M82 8.4)	Ursa Major	These can be found not far from 24 Ursa Majoris and can both be seen in the same low power field. They are 10m ly away and only 200 to 300 ly apart. M 82 is an example of a starburst galaxy. These are galaxies in which the rate of star formation is exceptionally high and which in the case of M82 may be the result of its close proximity to M81. It's about five times more luminous than our own galaxy. Look for dark dust lanes in M82 with a high power.
Castor	Triple star (1.9, 3, 9.8)	Gemini	The two brighter stars are close together but look for the third, much fainter star some way off. In fact each star in the system is itself a double star, separated by only a few million miles.
Eskimo Nebula	PN (9.2)	Gemini	The closest naked eye star is Wasat (δ Geminorum). The features which give the nebula its name (also known as the Clown Face nebula) are difficult to see except in large apertures although some structure may be visible. About 5,000 ly away and 0.7 ly across this planetary nebula is still expanding rapidly and is probably less than 2,000 years old.
Sigma Orionis	Quadruple star (mag 3.7,8.8, 6.6, 6.3)	Orion	Situated just below Alnitak in Orion's belt, the system is about 1,200 ly away. The brightest component is itself a double but too close to split in small telescopes. It is separated from the most distant component by a quarter of a light year and from the other components by about 4,000 Astronomical Units (1 AU = Earth-Sun distance)
M 79	GC (8.6)	Lepus	M79 can be found by continuing the line from α to β in the constellation of Lepus, the hare, to the south of Orion. M79 is 40k ly from us and far away from any other Globular clusters. It is thought it may have come from a neighbouring dwarf galaxy being
Crab Nebula (M1)	SNR	Taurus	Not far from ζ Tauri, this is the remnant of the supernova explosion witnessed in 1054 by Chinese astronomers and others. This is now a fairly faint object and may be difficult in small telescopes yet it is the first object in Messier's catalogue. It has expanded and faded in the time since Messier compiled his catalogue. If it had been as faint as it is today, it is unlikely he would have included it at all. At its core is a neutron star spinning at 30 times a second and sending an intense beam of radio waves towards us with each rotation – an example of a pulsar..
Meissa	DS (3.5, 5.4)	Orion	Meissa (λ Orionis) is the brightest of a group of stars which appear roughly where Orion's head would be (ie above and between the shoulders (!) marked by Betelgeuse and Bellatrix). It is an attractive double, about 1,000 ly away and the bright white components are separated by 1,300 AU - about 4.1" at that distance.
M46 & M47	Puppis	OC & PN	These two clusters are situated fairly close together to the east of Sirius. M47 is about 1,500 ly away and is the brighter and more westward of the two. M46 consists of bright blue giant stars but appears fainter because as it's over three times as far away. About halfway between us and M46 but in the same line of sight, is the planetary nebula NGC 2438
Rosette Nebula (NGC 2244)	Monoceros	EN	Can be found due south of Alhena in Gemini and on a line joining Betelgeuse and Procyon. The small cluster of about half a dozen stars should be easily visible but the glowing ring of the nebula surrounding it is more challenging, especially if the night is not particularly clear. A filter should help.

CONSTELLATIONS OF THE MONTH:



Canes Venatici is one of those obscure constellations introduced by Johannes Hevelius in 1690. It represents the two dogs Asterion and Chara, both held on a leash by Bootes as they apparently chase the Great Bear around the North Pole.

With one exception, the constellation's stars are quite faint, fourth- and fifth-magnitude stars. There are only three Bayer stars, yet several notable binaries can be found, as well as a famous variable and a number of interesting deep sky objects as well.

Alpha Canum Venaticorum is popularly called Cor Caroli (*Heart of Charles*). Most sources give Edmund Halley the credit, naming it after King Charles II after the restoration of the monarchy in Britain in 1660. (Some say, however, that the reference was initially meant to commemorate Charles I, after his execution.)

The star has a visual magnitude of 2.9 (variable), a distance of 110 light years, and roughly the same size as our Sun. It is also a splendid double with, perhaps, a subtle colour contrast (discussed below).

Double stars in Canes Venatici:

Canes Venatici has two attractive binaries: *alpha CVn* and *25 CVn*.

Alpha^2 and *alpha^1 CVn* form a celebrated fixed double star system. Note that the primary is *alpha^2*, since it is slightly east of its companion.

While both stars are usually reported to be blue-white, some find them slightly different, perhaps soft blue and yellow, or two shades of white.

25 CVn (Struve 1768) is a visual binary with an elegant orbit of 240 years. Presently, the companion is at near maximum separation, with a PA of 100 degrees and separation 1.8".

Variable stars in Canes Venatici:

The constellation contains one of the more interesting semi-regular stars, Gamma CVn, called *La Superba* by its admirers. One look and you will understand why: the star is an unusually vivid red.

Gamma CVn is classified as an SRb star. Such stars are known to have several periodic cycles, superimposed on each other. Basically, it changes in magnitude from 7.4 to 10.0 every 157 days. (However an update published in Budapest, in the *Information Bulletin of Variable Stars*, #2271, has reassessed the period at 251.8 days.) La Superba is a semi-regular variable star, peaking at about +4.8 mag and diminishing to around +6.3 over a 160 day cycle. Known in short form as γ CVn, it is one of the reddest stars in the sky, and it is among the brightest of the giant red "carbon stars". It is the brightest J-star in the sky, a very rare category of carbon stars that contain large amounts of carbon-13 (carbon atoms with 7 neutrons instead of the usual 6). 19th century astronomer Angelo Secchi, impressed with its beauty, gave the star its common name.[1]

La Superba's temperature is believed to be about 2800 K, making it one of the coolest true stars known. γCVn is almost never visible to the naked eye since most of its output is outside the visible spectrum. Yet, when infrared radiation is considered, γ CVn has a luminosity 4400 times that of the Sun, and its radius is approximately 2 AU. If it were placed at the position of our sun, the star's surface would extend beyond the orbit of Mars.

A p p e a r a n c e

To explain its remarkable coloration, it is necessary to understand that mid-sized stars, once they have finished fusing hydrogen to helium in their core, begin to fuse helium to carbon. During this so called red giant stage, the outer layers expand and cool, causing the star's radiation output to move towards the red end of the electromagnetic spectrum. Near the end of the star's life cycle, fusion products are moved outwards from the core by convection, thus creating a carbon abundance in the outer atmosphere where carbon monoxide and other compounds are formed. These molecules tend to absorb radiation at shorter wavelengths, resulting in a remarkable spectrum with even less blue and violet compared to ordinary red giants, giving the star its distinguished red color.

O u t l o o k

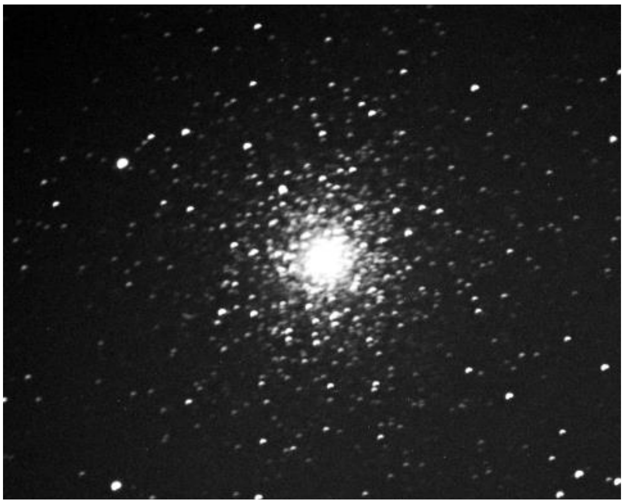
La Superba is most likely in the final stages of fusing its remaining secondary fuel (helium) into carbon and shedding its mass at the rate of about a million times that of the Sun's solar wind. It is also surrounded by a 2.5 light year-wide shell of previously ejected material, implying that at one point it must have been losing mass as much as 50 times faster than it is now. La Superba thus appears almost ready to eject its outer layers to form a planetary nebula, leaving behind its core in the form of a vanishing white dwarf.

Alpha^2 *CVn* is the prototype of a class of variables. Such stars usually have a spectrum from B9 to A5, are unusually abundant in particular heavy metals and deficient in common elements. Alpha^2 has an abundance of silicon, europium, and mercury, and oscillates in magnitude from 2.84 to 2.98 every 5.5 days.

Deep Sky Objects in Canes Venatici:

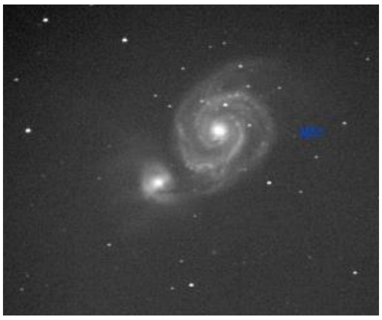
There are five Messier objects in this constellation, and many more deep sky objects worthy of attention.

M3 (NGC 5272) is a wonderful globular cluster found



roughly halfway between Cor Caroli and Arcturus (in Bootes). Considered one of the finest globular clusters in the entire heavens, you'll need a large scope to resolve its individual stars. The cluster is about 45,000 light years away.

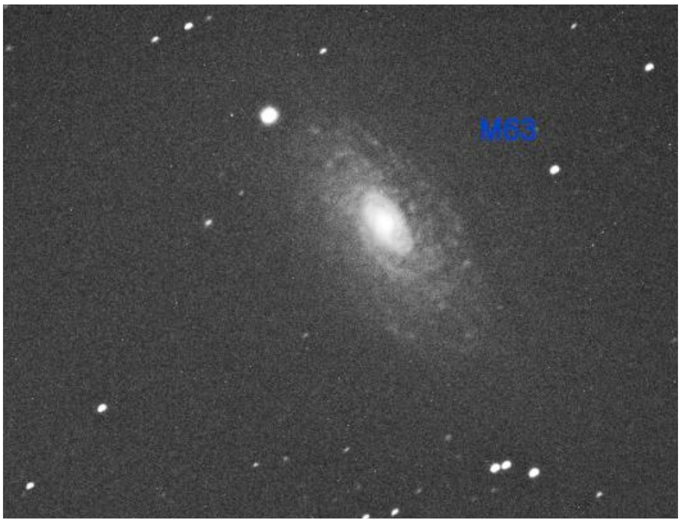
M51 (NGC 5194) or *The Whirlpool Galaxy* is the finest galaxy in Canes Venatici.



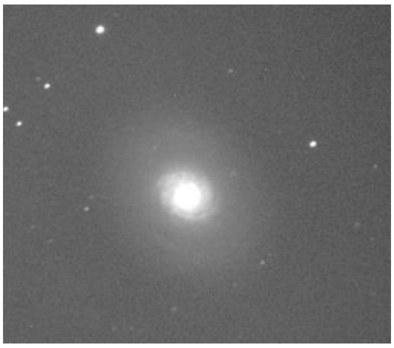
This spiral, found just southwest from the tip of the Big Dipper's handle, was the first spiral galaxy to be discovered (in 1845 by Lord Ross at his castle in Ireland).

Some say the galaxy is 14 million light years away, others that it is twice that. In any case, you'll need a large telecope and a fine evening to enjoy its delicate detail, which includes an appendage system (NGC 5195), another galaxy seemingly hanging onto one of its extended arms.

M63 is sometimes called the Sunflower Galaxy, by its numerous arms, which Burnham describes as



"reminiscent of showers of sparks thrown out by a rotating fiery pinwheel". Fairly bright, at 8.1 magnitude, it has a very condensed centre. The galaxy is found five degrees north-northeast of Cor Caroli.



M94 is another spiral, seen practically face-on, and sometimes described as "comet-like". This is a very compact circular spiral and very bright (8.1 magnitude). To find it draw a line between Cor Caroli and beta CVn, and at the half-way point draw a perpendicular off to the northeast. About two degrees up this perpendicular is found M94.

M106 (NGC 4258) is another bright spiral. Burnham doesn't list this object as a Messier, but gives a fine photograph (p 375).

The galaxy is six degrees north north-west of beta CVn.

Below are listed a selected number of galaxies considered the best of the non-Messiers.

NGC 4244: a large edge-on spiral, found eight degrees west of Cor Caroli.

NGC 4485 and *NGC 4490* are two splendid galaxies in the same field: 4485 is more compact (this one is sometimes called the Cocoon Galaxy), while 4490 is larger and brighter. Located less than one degree northwest of beta CVn.

NGC 4631: very large and bright, seen edge-on. Found in a rather barren field, six degrees south of Cor Caroli and two degrees west. In the same field are two more galaxies, NGC 4656 and 4657, just southwest of 4631.

ISS PASSES For April/May 2016

From Heavens Above website maintained by Chris Peat

Date	Brightness	Start			Highest point			End		
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
05 Apr	-3.4	20:55:07	10°	WSW	20:58:22	76°	SSE	21:01:03	15°	E
05 Apr	-2.0	22:31:35	10°	W	22:33:42	37°	W	22:33:42	37°	W
06 Apr	-3.4	21:39:06	10°	W	21:42:23	84°	N	21:43:22	42°	E
06 Apr	-0.4	23:15:36	10°	W	23:16:01	13°	W	23:16:01	13°	W
07 Apr	-3.3	20:46:38	10°	W	20:49:54	88°	NNW	20:53:00	11°	E
07 Apr	-2.6	22:23:06	10°	W	22:25:38	49°	W	22:25:38	49°	W
08 Apr	-3.4	21:30:38	10°	W	21:33:55	88°	S	21:35:13	34°	E
08 Apr	-0.6	23:07:10	10°	W	23:07:51	15°	W	23:07:51	15°	W
09 Apr	-3.3	20:38:07	10°	W	20:41:25	85°	N	20:44:42	10°	E
09 Apr	-2.7	22:14:38	10°	W	22:17:24	47°	SW	22:17:24	47°	SW
10 Apr	-3.3	21:22:06	10°	W	21:25:22	69°	SSW	21:26:57	27°	ESE
10 Apr	-0.6	22:58:54	10°	W	22:59:35	14°	WSW	22:59:35	14°	WSW
11 Apr	-3.3	20:29:35	10°	W	20:32:52	85°	S	20:36:08	10°	ESE
11 Apr	-2.2	22:06:09	10°	W	22:09:06	31°	SSW	22:09:07	31°	SSW
12 Apr	-2.7	21:13:32	10°	W	21:16:42	45°	SSW	21:18:39	20°	SE
12 Apr	-0.4	22:51:17	10°	WSW	22:51:18	10°	WSW	22:51:18	10°	WSW
13 Apr	-1.4	21:57:55	10°	W	22:00:15	18°	SW	22:00:51	18°	SSW
14 Apr	-1.8	21:05:03	10°	W	21:07:54	27°	SSW	21:10:27	12°	SSE
16 Apr	-0.9	20:56:51	10°	WSW	20:58:57	16°	SW	21:01:03	10°	S
12 May	-1.3	04:32:26	10°	SSW	04:34:51	19°	SE	04:37:17	10°	E
13 May	-0.9	03:40:47	10°	SSE	03:42:14	12°	SE	03:43:41	10°	ESE
14 May	-2.2	04:22:22	10°	SW	04:25:18	32°	SSE	04:28:17	10°	E

END IMAGES

Peter Chappell went out to Indonesia to catch the March eclipse, and here are some of his pictures. Tanjung Pandan town. — at Belitung.

Date	Moon Phase	Observing Topic
2016		
Friday 29th April	Last quarter	Lunar targets
Monday 9th May		*Transit of Mercury*
Friday 27th May	Waning gibbous	
Wiltshire Astronomical Society Observing Sessions 2015 – 2016		

OUTREACH ACTIVITIES

Some evening sessions are being arranged.

May 9th 11:30-20:00, Stonehenge, Transit of Mercury.