AOH OBSERVER

Spring 2018

www.astrohum.org

The Newsletter of the Astronomers of Humboldt

AoH Annual Potluck

Our 2018 AOH Potluck (aka sixty-one year anniversary) was a great success, and quoting from our Secretary Ken Yanosko, "There was plenty of good food, good companionship, and good intellectual stimulation." Our keynote speaker Professor Paola Rodriguez Hidalgo delivered an enlightening talk about quasars and quasar-driven outflows, supermassive black holes, and galaxy structure and evolution. The other highlight of the evening was our drawing for door prizes where almost everybody came out a winner. The evening ended with a surprise award ceremony honoring Past President Grace Wheeler, Secretary Ken Yanosko, and Treasurer Bob Zigler. Our co-masters of ceremonies Mark Mueller and Ken Yanosko did a wonderful job of introductions and coordinating the evening's events. We are grateful to the members who came early to help set up and those who stayed late to clean up. Finally, a huge thank you to all who attended and made the evening a stellar event. Save the date for February 2019 when we celebrate the "Big Sixty-Two"! (Photo Credits: G. Wheeler and panorama by Ken Yanosko)

The Thomas Family

A good turnout of our members

Secretary Ken Yanosko introducing Professor Paola Rodriguez Hidalgo

Eva, Kathy, Becky, Bea, and Sharon

Lou Lutticken, V.P. Mark Wilson, and Treasurer Bob Zigler

Past President Grace Wheeler with V.P. Mark Wilson and President Mark Mueller.

AoH Observer Staff

Editor/Staff Writer
Grace Wheeler

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Ken Yanosko
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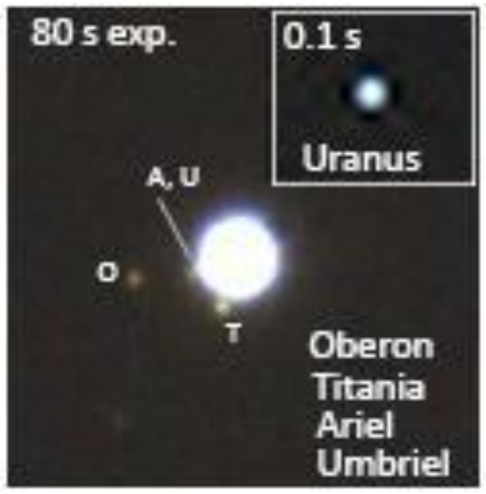
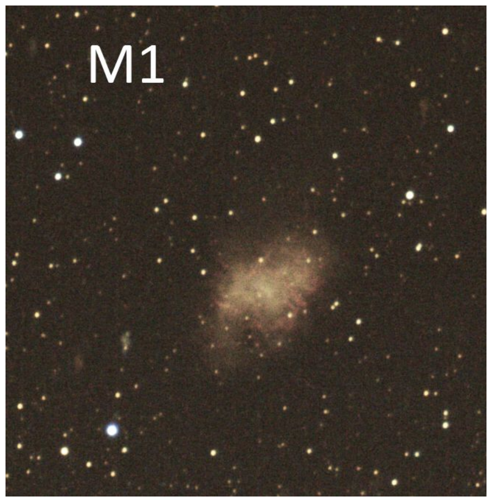
AoH Activities Jan-Mar 2018

Monthly Meeting: January 13, 2018

The sky was nicely transparent for our for January meeting. Telescopes that were set up: C14 in the observatory (Ken), Mark Mueller (Dob), Russ Owsley (Newtonian), Bea and Becky (Astroscan), Grace (C-6), Don (5 inch apo-refractor). We looked for galaxies (M31, M33, M81, M82), Orion Nebula, and open clusters in Auriga and Cassiopeia. We outfitted Don's apo-refractor with the Atik Infinity camera and did some observations of the deep sky objects M74, Crab Nebula, Owl Nebula, and Horsehead Nebula. Although not a deep sky object, the Atik camera did a good job of detecting Uranus and its moons. Other members in attendance: Jeff, John and Stormy, Bernie, and new members Cat and Sean. Some photos from our evening observations are shown below.



Uranus and its moons on 1/13/18 at 9 p.m. PST (determined with Starry Night Pro). Uranus is shown in the top right.



M1 is a supernova remnant in Taurus. We could see the tendrils of reddish gas.

Arts Alive: January 6, 2018

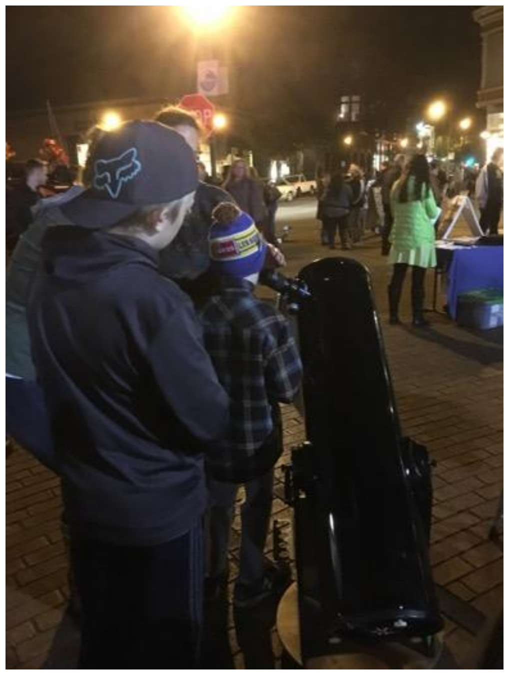
For our January Public Observing at Arts Alive, Mark M., Sharon, and Ken set up two telescopes at the Gazebo. It was mostly cloudy but a few stars were observed through the gaps in the "Great Humboldt Nebula". There were 20 to 30 people who stopped by to chat and a few looked at and through our scopes.

Mark Mueller, Sharon Seagraves, and Ken Yanosko braved the cold weather to set up telescopes at Arts Alive.

Arts Alive: February 3, 2018

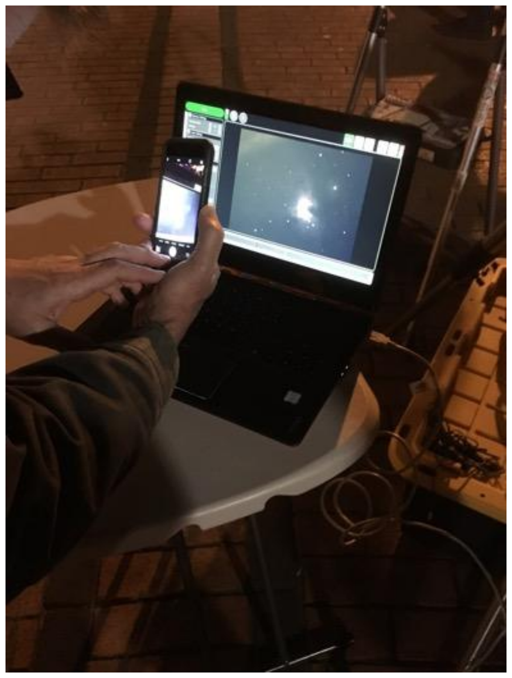
We had a very busy night at the February Arts Alive with a good turnout of members (Ken, Russ, Mark W., Mark M., Sharon, Grace). The skies were relatively clear and we had a large crowd of stargazers come by to view the Orion Nebula and the Pleiades through the telescopes. The constellation Orion was conveniently located in the skies above Old Town and we could see the stars making up the shoulders (Betelgeuse, Bellatrix), belt, and foot (Rigel). Orion's Sword, where the Orion Nebula resides, was lost in the haze of the city lights. With direct telescope viewing (Mark M., Ken Y., Russ O.), visitors could see the Trapezium and wispy gas clouds in the heart of the Orion Nebula. Using a video camera that was attached to a C-6 telescope (GW), we were able to view a detailed and enhanced image of the Orion Nebula on a laptop computer.

Ken's C8 was pointed at Orion.

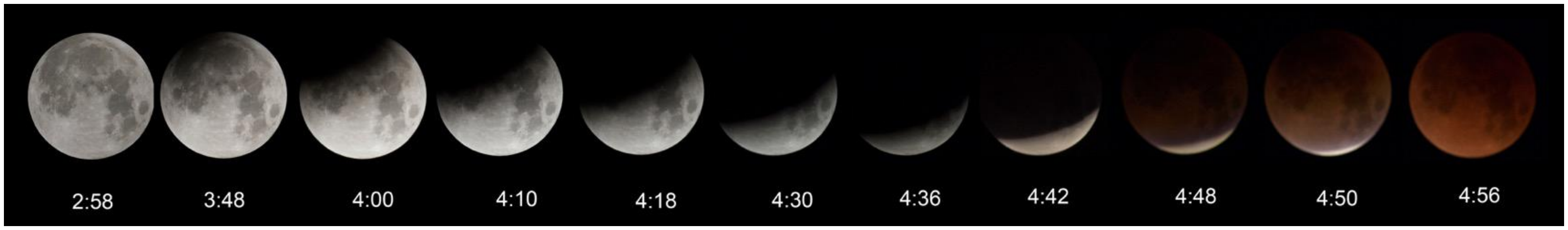


There was a line to look through Mark M.'s Dob.

A large crowd of visitors gathered around the AoH telescopes.



Viewing an enhanced image of the Orion Nebula on a laptop computer.



The progression of the January 31, 2018 lunar eclipse. The penumbral phase started at 2:51 a.m. The partial eclipse started at 3:48 a.m. Totality was from 4:52 to 6:08 a.m. (image credit: GW)

Super Blue Blood Moon: January 31, 2018

Although the AoH did not have anything formally planned for viewing the lunar eclipse on January 31, several members were up early that morning to view this rare "cosmic trifecta." Some of us watched it from our backyards (Ken Y., Bob Z., Susie C., G.W., Bernie and Claire C.) while other members like Eva L., Kathy B., Sharon S., and Mark W. ventured to the west to view the eclipsing moon over the ocean.

While the supermoon of January 31 was not the largest in 2018 (the supermoon on January 2 was bigger), it had the distinction of being both a "blue moon" (second full moon occurring within a single calendar month), and a "blood moon" (the reddish hue of the moon during a lunar eclipse). What made this special for us Humboldtians was that it was mostly clear along the Humboldt Bay corridor. Most of us saw the eclipse up to totality. As the moon started to move out of the earth's shadow, the fog bank moved in to obscure the moon. While it was disappointing not to be able to see the entire eclipse from start to finish, we counted ourselves fortunate to witness totality.

High resolution image of the moon during totality.
Image credit: Bob Zigler

Partially eclipse moon (6:13 a.m.) just before sinking into the fog bank

Six Rivers Montessori School: February 8, 2018

We met with a small group of fourth graders for a morning of telescope viewing. Ken gave an introduction to the solar system which was followed by telescopic observations of the Moon (Ken, C-8), Sun (Becky C., Coronado PST), and Jupiter (Grace, C-6). The students (and some of the parents who arrived during our set up) were surprised to be able to see Jupiter in the daytime sky. The sun has been relatively quiet during the last few years with very few solar storms. On the morning of our visit, we were lucky to see a couple of Earth-sized sunspots (one of the students likened them to snake bites) and a small prominence on the solar limb. The students learned about moon craters and mountains, lunar phases, the sun and solar storms (sunspots), and the scale model of the solar system. Thank you to the fourth graders of the Six Rivers Montessori School for being such a great audience!

Ken demonstrating phases of the Moon with a Styrofoam ball

Student observing the sun through the solar telescope

New outreach volunteer Becky Chambers answering students' questions

Earth-sized sunspots on the photosphere (C6 with white solar filter)

Stephen Hawking: Martin Rees looks back on colleague's spectacular success against all odds

Martin Rees, Emeritus Professor of Cosmology and Astrophysics, University of Cambridge

Soon after I enrolled as a graduate student at Cambridge University in 1964, I encountered a fellow student, two years ahead of me in his studies, who was unsteady on his feet and spoke with great difficulty. This was Stephen Hawking. He had recently been diagnosed with a degenerative disease, and it was thought that he might not survive long enough even to finish his PhD. But he lived to the age of 76, passing away on March 14, 2018.

Lwp Kommunikáció/Flickr, CC BY-SA

It really was astonishing. Astronomers are used to large numbers. But few numbers could be as large as the odds I'd have given against witnessing this lifetime of achievement back then. Even mere survival would have been a medical marvel, but of course he didn't just survive. He became one of the most famous scientists in the world – acclaimed as a world-leading researcher in mathematical physics, for his best-selling books and for his astonishing triumph over adversity.

Perhaps surprisingly, Hawking was rather laid back as an undergraduate student at Oxford University. Yet his brilliance earned him a first class degree in physics, and he went on to pursue a research career at the University of Cambridge. Within a few years of the onset of his disease, he was wheelchair-bound, and his speech was an indistinct croak that could only be interpreted by those who knew him. In other respects, fortune had favoured him. He married a family friend, Jane Wilde, who provided a supportive home life for him and their three children.

Early work

The 1960s were an exciting period in astronomy and cosmology. This was the decade when evidence began to emerge for black holes and the Big Bang. In Cambridge, Hawking focused on the new mathematical concepts being developed by the mathematical physicist Roger Penrose, then at University College London, which were initiating a renaissance in the study of Einstein's theory of general relativity.

Using these techniques, Hawking worked out that the universe must have emerged from a "singularity" – a point in which all laws of physics break down. He also realised that the area of a black hole's event horizon – a point from which nothing can escape – could never decrease. In the subsequent decades, the observational support for these ideas has strengthened – most spectacularly with the 2016 announcement of the detection of gravitational waves from colliding black holes.

Hawking was elected to the Royal Society, Britain's main scientific academy, at the exceptionally early age of 32. He was by then so frail that most of us suspected that he could scale no further heights. But, for Hawking, this was still just the beginning.

He worked in the same building as I did. I would often push his wheelchair into his office, and he would ask me to open an abstruse book on quantum theory – the science of atoms, not a subject that had hitherto much interested him. He would sit hunched motionless for hours – he couldn't even to turn the pages without help. I remember wondering what was going through his mind, and if his powers were failing. But within a year, he came up with his best ever idea – encapsulated in an equation that he said he wanted on his memorial stone.

Scientific stardom

The great advances in science generally involve discovering a link between phenomena that seemed hitherto conceptually unconnected. Hawking's "eureka moment" revealed a profound and unexpected link between gravity and quantum theory: he predicted that black holes would not be completely black, but would radiate energy in a characteristic way.

This radiation is only significant for black holes that are much less massive than stars – and none of these have been found. However, "Hawking radiation" had very deep implications for mathematical physics – indeed one of the main achievements of a theoretical framework for particle physics called string theory has been to corroborate his idea.

Indeed, the string theorist Andrew Strominger from Harvard University (with whom Hawking recently collaborated) said that this paper had caused "more sleepless nights among theoretical physicists than any paper in history". The key issue is whether information that is seemingly lost when objects fall into a black hole is in principle recoverable from the radiation when it evaporates. If it is not, this violates a deeply believed principle of general physics. Hawking initially thought such information was lost, but later changed his mind.

Hawking continued to seek new links between the very large (the cosmos) and the very small (atoms and quantum theory) and to gain deeper insights into the very beginning of our universe – addressing questions like "was our big bang the only one?" He had a remarkable ability to figure things out in his head. But he also worked with students and colleagues who would write formulas on a blackboard – he would stare at it, say whether he agreed and perhaps suggest what should come next.

He was especially influential in his contributions to "cosmic inflation" – a theory that many believe describes the ultra-early phases of our expanding universe. A key issue is to understand the primordial seeds which eventually develop into galaxies. Hawking proposed (as, independently, did the Russian theorist Viatcheslav Mukhanov) that these were "quantum fluctuations" (temporary changes in the amount of energy in a point in space) – somewhat analogous to those involved in "Hawking radiation" from black holes.

He also made further steps towards linking the two great theories of 20th century physics: the quantum theory of the microworld and Einstein's theory of gravity and space-time.

Declining health and cult status

In 1985, Hawking contracted pneumonia. He had to undergo a tracheotomy, which removed even the limited powers of speech he then possessed. It had been more than ten years since he could write, or even use a keyboard. Without speech, the only way he could communicate was by directing his eye towards one of the letters of the alphabet on a big board in front of him.

Hawking at the University of Cambridge.
Lwp Kommunikáció/Flickr,

But he was saved by technology. He still had the use of one hand; and a computer, controlled by a single lever, allowed him to spell out sentences. These were then declaimed by a speech synthesiser, with the androidal American accent that thereafter became his trademark.

His lectures were, of course, pre-prepared, but conversation remained a struggle. Each word involved several presses of the lever, so even a sentence took several minutes to construct. He learnt to economise with words. His comments were aphoristic or oracular, but often infused with wit. In his later years, he became too weak to control this machine effectively, even via facial muscles or eye movements, and his communication – to his immense frustration – became even slower.

At the time of his tracheotomy operation, he had a rough draft of a book, which he'd hoped would describe his ideas to a wide readership and earn something for his two eldest children, who were then of college age. On his recovery from pneumonia, he resumed work with the help of an editor. When the US edition of A Brief History of Time appeared, the printers made some errors (a picture was upside down), and the publishers tried to recall the stock. To their amazement, all copies had already been sold. This was the first inkling that the book was destined for runaway success reaching millions of people worldwide.

And he quickly became somewhat of a cult figure, featuring on popular TV shows ranging from the Simpsons to The Big Bang Theory. This was probably because the concept of an imprisoned mind roaming the cosmos plainly grabbed people's imagination. If he had achieved equal distinction in, say, genetics rather than cosmology, his triumph probably wouldn't have achieved the same resonance with a worldwide public.

As shown in the feature film The Theory of Everything, which tells the human story behind his struggle, Hawking was far from being the archetype unworldly or nerdish scientist. His personality remained amazingly unwarped by his frustrations and handicaps. He had robust common sense, and was ready to express forceful political opinions.

However, a downside of his iconic status was that that his comments attracted exaggerated attention even on topics where he had no special expertise – for instance, philosophy, or the dangers from aliens or from intelligent machines. And he was sometimes involved in media events where his "script" was written by the promoters of causes about which he may have been ambivalent.

Ultimately, Hawking's life was shaped by the tragedy that struck him when he was only 22. He himself said that everything that happened since then was a bonus. And what a triumph his life has been. His name will live in the annals of science and millions have had their cosmic horizons widened by his best-selling books. He has also inspired millions by a unique example of achievement against all the odds – a manifestation of amazing willpower and determination.

Hawking in zero gravity. NASA

http://hubblesite.org/news_release/news/2018-17

Release ID: STScI-2018-17

Arrested Development: Hubble Finds Relic Galaxy Close to Home

NASA, ESA, M. Beasley (Instituto de Astrofísica de Canarias), and P. Kehusmaa

Hubble Space Telescope image of galaxy NGC 1277. The galaxy is unique in that it is considered a relic of what galaxies were like in the early universe. The galaxy is composed exclusively of aging stars that were born 10 billion years ago. But unlike other galaxies in the local universe, it has not undergone any further star formation. Astronomers nickname such galaxies as "red and dead," because the stars are aging and there aren't any successive generations of younger stars. Credit: NASA, ESA, and M. Beasley (Instituto de Astrofísica de Canarias)

Astronomers have put NASA's Hubble Space Telescope on an Indiana Jones-type quest to uncover an ancient "relic galaxy" in our own cosmic backyard.

The very rare and odd assemblage of stars has remained essentially unchanged for the past 10 billion years. This wayward stellar island provides valuable new insights into the origin and evolution of galaxies billions of years ago.

The galaxy, NGC 1277, started its life with a bang long ago, ferociously churning out stars 1,000 times faster than seen in our own Milky Way today. But it abruptly went quiescent as the baby boomer stars aged and grew ever redder.

The findings are being published online in the March 12 issue of the science journal Nature.

Though Hubble has seen such "red and dead" galaxies in the early universe, one has never been conclusively found nearby. Where the early galaxies are so distant, they are just red dots in Hubble deep-sky images. NGC 1277 offers a unique opportunity to see one up close and personal. "We can explore such original galaxies in full detail and probe the conditions of the early universe," said Ignacio Trujillo, of the Instituto de Astrofísica de Canarias at the University of La Laguna, Spain.

The researchers learned that the relic galaxy has twice as many stars as our Milky Way, but physically it is as small as one quarter the size of our galaxy. Essentially, NGC 1277 is in a state of "arrested development." Perhaps like all galaxies it started out as a compact object but failed to accrete more material to grow in size to form a magnificent pinwheel-shaped galaxy.

Approximately one in 1,000 massive galaxies is expected to be a relic (or oddball) galaxy, like NGC 1277, researchers say. They were not surprised to find it, but simply consider that it was in the right place at the right time to evolve — or rather not evolve — the way it did.

The telltale sign of the galaxy's state lies in the ancient globular clusters of stars that swarm around it. Massive galaxies tend to have both metal-poor (appearing blue) and metal-rich (appearing red) globular clusters. The red clusters are believed to form as the galaxy forms, while the blue clusters are later brought in as smaller satellites are swallowed by the central galaxy. However, NGC 1277 is almost entirely lacking in blue globular clusters. "I've been studying globular clusters in galaxies for a long time, and this is the first time I've ever seen this," said Michael Beasley, also of the Instituto de Astrofísica de Canarias.

The red clusters are the strongest evidence that the galaxy went out of the star-making business long ago. However, the lack of blue clusters suggests that NGC 1277 never grew further by gobbling up surrounding galaxies.

By contrast, our Milky Way contains approximately 180 blue and red globular clusters. This is due partly to the fact that our Milky Way continues cannibalizing galaxies that swing too close by in our Local Group of a few dozen small galaxies.

It's a markedly different environment for NGC 1277. The galaxy lives near the center of the Perseus cluster of over 1,000 galaxies, located 240 million light-years away. But NGC 1277 is moving so fast through the cluster, at 2 million miles per hour, that it cannot merge with other galaxies to collect stars or pull in gas to fuel star formation. In addition, near the galaxy cluster center, intergalactic gas is so hot it cannot cool to condense and form stars.

The team started looking for "arrested development" galaxies in the Sloan Digital Sky Survey and found 50 candidate massive compact galaxies. Using a similar technique, but out of a different sample, NGC 1277 was identified as unique in that it has a central black hole that is much more massive than it should be for a galaxy of that size. This reinforces the scenario that the supermassive black hole and dense hub of the galaxy grew simultaneously, but the galaxy's stellar population stopped growing and expanding because it was starved of outside material.

"I didn't believe the ancient galaxy hypothesis initially, but finally I was surprised because it's not that common to find what you predict in astronomy," Beasley added. "Typically, the universe always comes up with more surprises that you can think about."

The team has 10 other candidate galaxies to look at with varying degrees of "arrested development."

The upcoming NASA James Webb Space Telescope (scheduled for launch in 2019) will allow astronomers to measure the motions of the globular clusters in NGC 1277. This will provide the first opportunity to measure how much dark matter the primordial galaxy contains.

The Hubble Space Telescope is a project of international cooperation between NASA and ESA (European Space Agency). NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute (STScI) in Baltimore, Maryland, conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy, in Washington, D.C.

Upper right inset: Hubble Space Telescope image of galaxy NGC 1277

Background image: The galaxy lives near the center of the Perseus cluster of over 1,000 galaxies, located 240 million light-years away from Earth. NGC 1277 is moving so fast through the cluster, at 2 million miles per hour, that it cannot merge with other galaxies to collect stars or pull in gas to fuel star formation. In addition, near the galaxy cluster center, intergalactic gas is so hot it cannot cool to condense and form stars.

Credit: NASA, ESA, M. Beasley (Instituto de Astrofísica de Canarias), and P. Kehusmaa

To see video associated with this press release, go to http://hubblesite.org/videos/news/release/2018-17

Related Link: Michael M. Beasley

Visible Planets in Spring/Summer 2018

GD Wheeler

Venus. The evening apparition of Venus actually began in February, but because Venus was so low on the horizon, it could not easily be seen at our northern latitude. Since March, Venus has been climbing eastward from the sun and is now higher in the sky at sunset. For the rest of spring and most of the summer, Venus will be setting well after sunset. For the next several months, observers of Venus will see the planet's disc increase in diameter while going from gibbous (early spring) to quarter (late summer) to crescent (mid-October) phase (Fig. 1). Venus disappears from the evening sky on October 17, and will reappear shortly after as a morning planet.

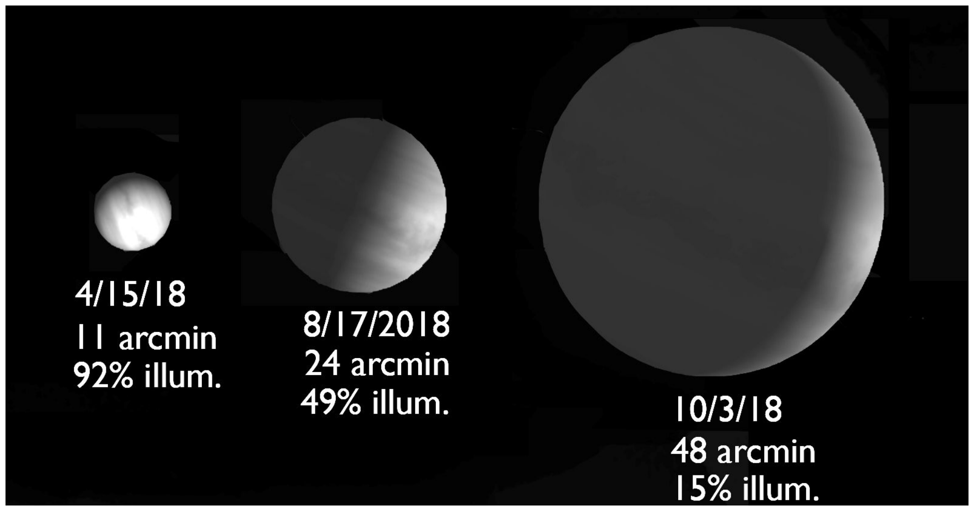


Figure 1. Venus phase change and growth of the disk. Composite image created with Starry Night Pro.

Jupiter is at opposition on May 8, 2018 and will be visible in the early evenings until October. The best viewing of Jupiter will be from May to June when the planet is seen throughout the night or at least until predawn. Along with Jupiter, the four Galilean moons (Fig. 2) are bright and visible through a telescope. A list of Galilean moon occultations, eclipses, and shadow transits can be found here.

August 14th is the date of the only double shadow transit (DST) visible in our time zone. The Ganymede shadow transit starts at 9:46 p.m. The DST starts as the shadow of Io begins its transit at 10:39 p.m. Both shadows will be seen moving across the Jovian disk (Fig. 3). The shadow transits take place as Jupiter is setting so a clear view of the western horizon is required.

Figure 2. The Galilean Moons
Image credit: G.Wheeler

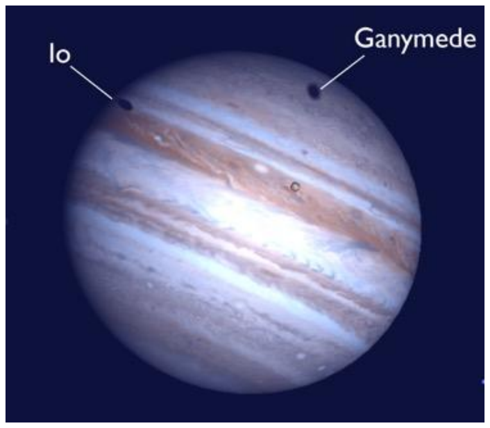


Figure 3. Double shadow transit (DST) on 8/14/2018. The location of the shadows of Ganymede and Io at the start of the DST is shown.
Image credit: Starry Night Pro

Mars. 2018 is a notable year for astronomy because of the Martian opposition which will be the closest encounter with Mars since 2003. Mars currently rises at predawn and can be seen as a red "star" in the constellation Sagittarius. April is the start of "Mars watching" when the planet will be as bright as Sirius as it rises shortly after midnight. Mars will continue to grow in brilliance and by late July will be the fourth brightest object in the sky (the Sun, Moon, and Venus are brighter). As Mars comes closer to Earth, it will be a good time to observe the planet as it will be possible to view the Martian surface with medium-sized telescopes (Fig. 4).

Figure 4. During the 2016 Martian opposition, the planet's surface could be seen with a telescope.
Image credit: G.Wheeler

Figure 5. Mars, the bright orange object in the lower right, sharing the same field of view as the Trifid Nebula (Sagittarius).
Image credit: Slooh

Saturn. Currently, Saturn rises in the predawn hours and is a golden-colored "star" in the constellation Sagittarius. Saturn has been rising 4 minutes earlier each day and will eventually transition from a morning planet to an evening one. By mid-May, Saturn will be rising shortly before midnight, and by June 27, the date of Saturn's opposition, the planet will rise at sunset. During the Saturn opposition, the Earth comes between Saturn and the Sun. During this close approach, we will not only see Saturn brightening, but we will be able to see greater detail in the planet's disk and rings. The two weeks before and after Saturn's opposition are the best time for viewing this planet. From July until mid-August, Saturn will be out during the evening and will set in the predawn hours.

Figure 7. Saturn on 3/21/2018 from the Canary Islands.
Image credit: Slooh

Night Sky Observing Notes: Spring Galaxy Season

G.D. Wheeler

Figure 1. The spring constellations Bootes, Canes Venatici, Coma Berenices, Ursa Major, Leo, Corvus, and Virgo**.** The number of Messier galaxies found with each constellation is shown in parenthesis. The star chart was generated in Stellarium with modifications.

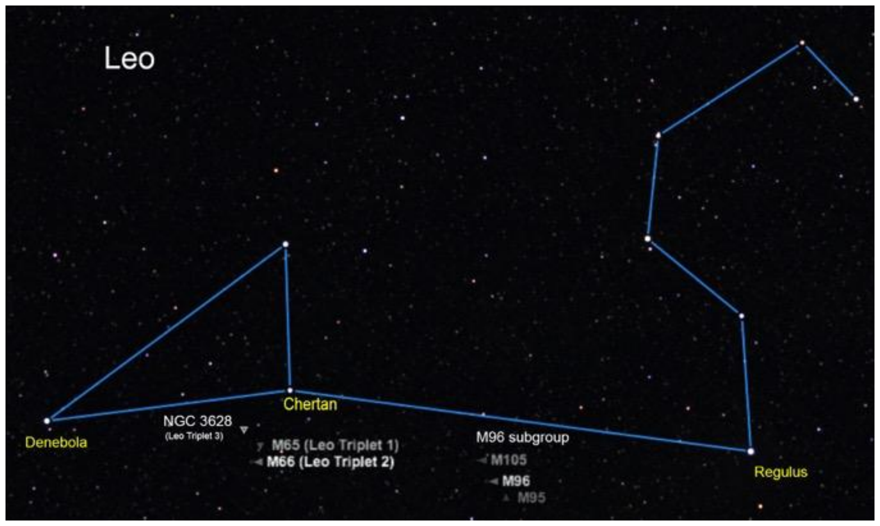


Figure 2. The constellation Leo with the location of the Leo Triplet (M66 subgroup) and the M96 subgroup of the Leo I Galaxy Cluster (Starry Night Pro)

The constellations that can be found in the spring night sky include Bootes, Canes Venatici, Coma Berenices, Ursa Major, Virgo, and Corvus (Fig. 1). While the Messier objects in the winter night sky are dominated by open clusters and nebulae, the majority of Messier objects found in the spring night sky are galaxies. Out of the 36 Messier objects in these constellations, 32 are galaxies while the other four objects include two globular clusters (M52, and M3), a planetary nebula (M97), and a double star (M40). In the northern hemisphere, late March is the start of "galaxy season" as clusters of galaxies, particularly in Coma Berenices and Virgo, come into prime viewing position. During the spring, the Milky Way lies low on the horizon for much of the night. As a result, the dust from the arc of the Milky Way does not obscure our view of the sky overhead. It is possible to see many faint and distant galaxies.

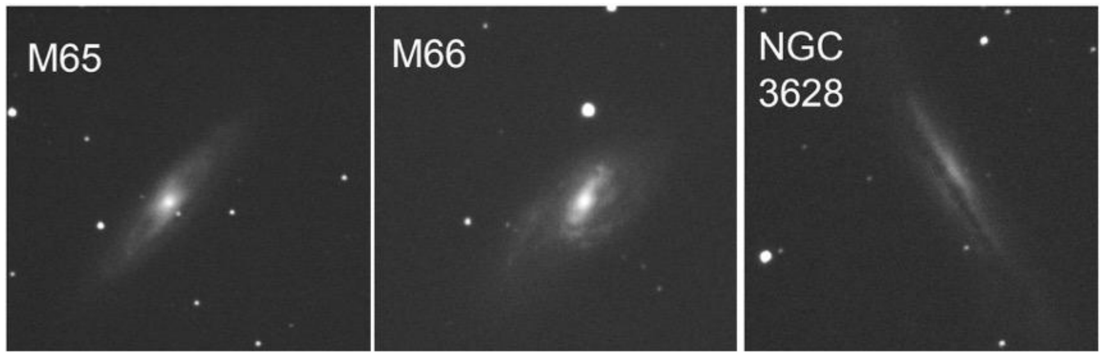


Figure 3: The Leo Triplet (35 Mly) are interacting spiral galaxies bound by gravity. M66 and NGC 3628 show the greatest distortion from this interaction.
http://www.messier-objects.com/leo-triplet/

Leo

Leo the lion) belongs to the zodiac family of constellations and lies on the ecliptic. The brightest stars are Regulus at the head of the lion, and Denebola at the rear of the hindquarter. Leo is rich in galaxy clusters (Leo Cluster, Leo I, and Leo II), but apparently contains no nebulae, planetary nebulae, or open star clusters. The Messier Galaxies are part of the Leo I galaxy cluster and are found in two subgroups: M66 (aka the Leo Triplet) and M96 (Fig. 2).

The M66 subgroup is a small group of interacting galaxies located below the star Chertan, in the hindquarter of the Lion. The three largest galaxies make up the Leo Triplet: M66 (the largest and brightest of the three), M65, and NGC 3628. In a small telescope, all three can be seen in the same field of view.

The M96 group of galaxies lies halfway between Regulus and Chertan and is made up of 12 galaxies which include the Messier galaxies M96 (largest and brightest), M95, and M105. M95 and M96 are both spiral galaxies, and M105 is an elliptical galaxy.

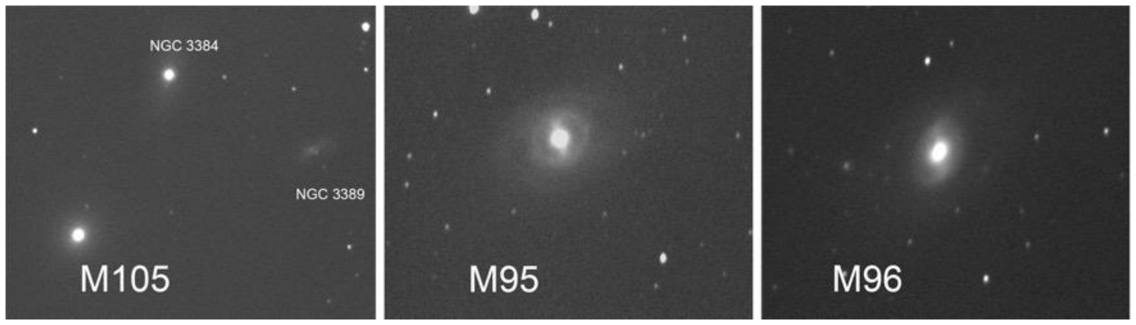


Figure 4. The M96 subgroup of Leo I (36 Mly). M105 is an elliptical galaxy (shown with lenticular galaxy NGC 3384 and spiral galaxy NGC 3389). M95 is a barred spiral with an inner ring surrounding the bar; the ring is a star forming region. M96 is an intermediate spiral galaxy.
http://www.atlasoftheuniverse.com/galgrps/leoi.html

Editor's note: All photos unless otherwise stated were contributed By G.D. Wheeler. Images were acquired using a C6, C8, or 5 inch apo-refractor using an Atik Infinity web camera. Photos were stacked with the Infinity software, with post-processing in Photoshop.

Ursa Major Family of Constellations

The Ursa Major family is made up of Ursa Major and the nearby constellations Bootes, Canes Venatici, and Coma Berenices. Bootes does not contain any Messier objects, but its brightest star Arcturus is often used as a guide to star hop to these objects.

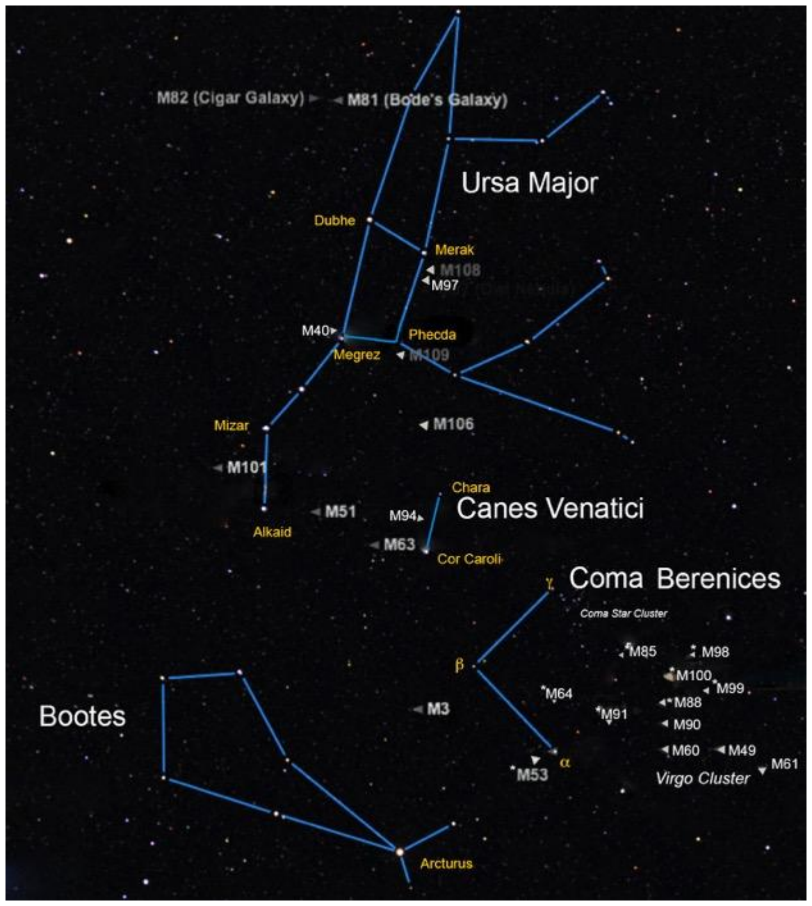


Figure 5. The Ursa Major family of constellations and the location of the Messier objects. Asterisk* indicates Messier objects belonging to Coma Berenices.

Ursa Major

Ursa Major (The Great Bear; UMa) is the third largest constellation in the sky and is best known for the “Big Dipper” asterism. UMa is always above the horizon in northern latitudes, but it is best viewed in the spring when it is higher in the sky. UMa contains several Messier objects; the stars forming the handle and bowl of the Big Dipper can be used to star hop to these objects (Fig.5).

M97 and M108: M97, the Owl Nebula, is a planetary nebula (Fig. 6) located about 2.5 degrees southwest of Merak. M108, the Surfboard Galaxy (Fig.7), is just northeast of M97. The separation between M97 and M108 is less than a degree, and both can be seen in the same wide-field view of a small telescope.

M101 is the Pinwheel Galaxy (Fig. 8). It is grand design spiral galaxy located above the handle of the big dipper between Alkaid and Mizar. M101 forms a nearly equilateral triangle with Alkaid and Mizar.

M109 is a barred spiral galaxy (Fig. 9). It is less than a degree southeast of Phecda.

M81 (Fig. 10) and M82 (Fig. 11) are located about 10 degrees northwest of Dubhe (Phecda and Dubhe can be used as pointer stars for finding M82/M81.) M81 and M82 are separated by half of a degree and can be viewed in the same field with a small telescope.

M40 is a double star that is found just northeast of Megrez (Fig.5).

Figure 6. M97 (Owl Nebula) is a planetary nebula (2030 ly, mag. 9.0) that has an age of 8,000 years. The radiation from the central star (between the eyes) excites the gas which causes the nebula to glow.
http://www.messier-objects.com/messier-97-owl-nebula/

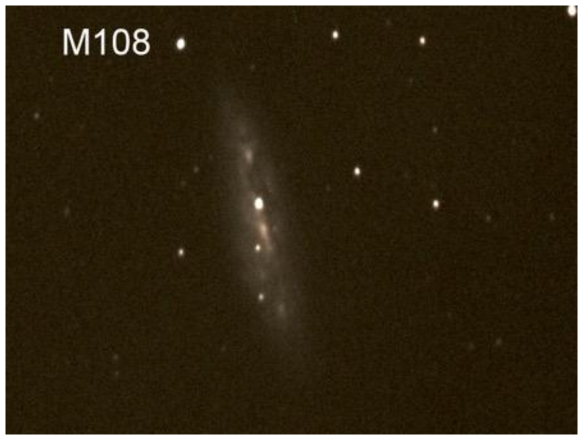


Figure 7. Messier 108 (Surfboard) is an edge-on barred spiral galaxy (46 Mly, mag. 10.7). It can be viewed in the same wide-field view as the Owl Nebula.
http://www.messier-objects.com/messier-108-surfboard-galaxy/

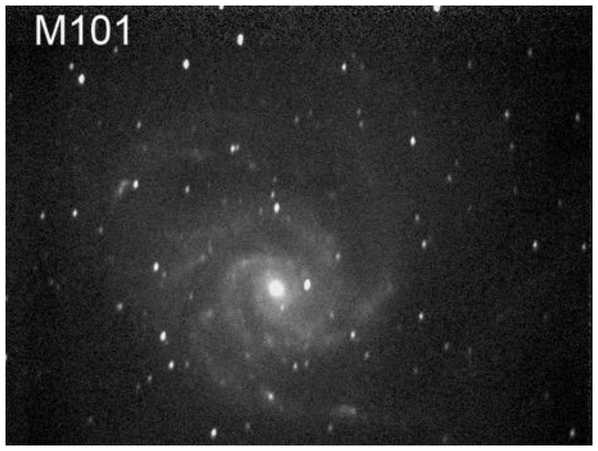


Figure 8. M101 (Pinwheel) is one of our closest grand design spiral galaxies. It is located 21 Mly from earth and has a magnitude of 7.9.
http://www.messier-objects.com/messier-101-pinwheel-galaxy/

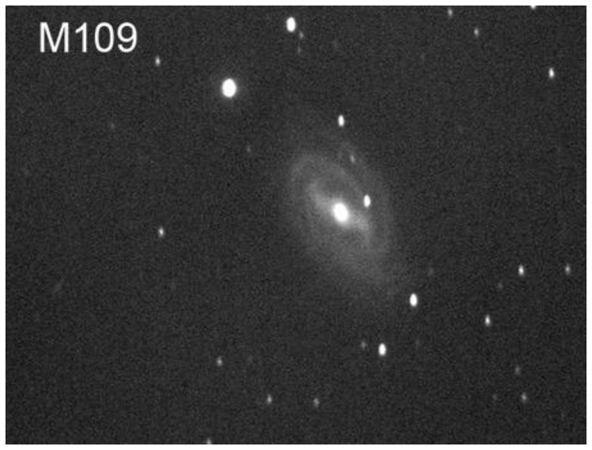


Figure 9. M109 is a barred spiral galaxy (55 Mly, mag. 9.8). The spiral arms are quite faint, but the central bar can be seen with a medium telescope.
https://www.universetoday.com/50202/messier-109/

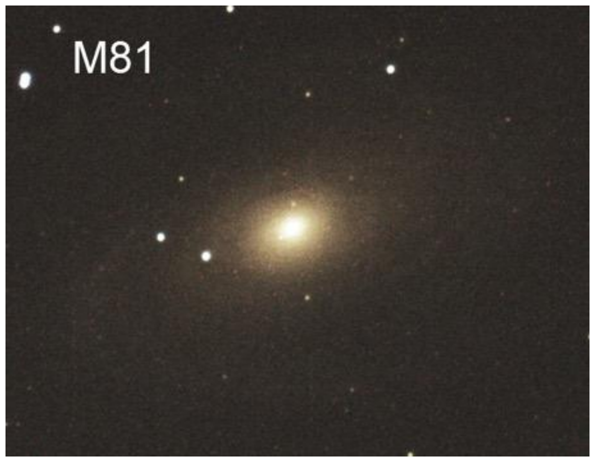


Figure 10. M81 (Bode’s Nebula) is a barred spiral galaxy (12 Mly, mag. 6.9). It is one of the best studied galaxies due to its large size, active galactic nucleus, and supermassive black hole.
http://www.messier-objects.com/messier-81-bodes-galaxy/

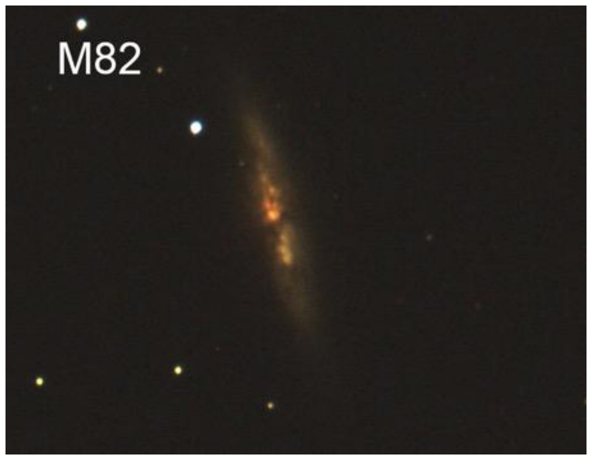


Figure 11. M82 (Cigar) is an edge-on spiral galaxy (12 Mly, mag. 8.4) with high starburst activity. The high rate of star formation is due to its gravitational interaction with M81.
https://www.nasa.gov/feature/goddard/2017/messier-82-the-cigar-galaxy

Canes Venatici

Canes Venatici (Hunting Dogs, CVn). The brightest stars of CVn are Cor Caroli (double star, mag. 3) and Chara (mag. 4); these stars lie beneath the handle of the Big Dipper. Messier objects belonging to CVn can be found by star hopping with Cor Caroli and Chara along the bright stars from Ursa Major and Bootes (Fig. 5).

M3 (Fig.12) is a globular cluster located halfway between Arcturus (Bootes) and Cor Caroli.

M51 (Fig. 13), aka the Whirlpool Galaxy, is a grand design spiral galaxy located about four degrees southwest of Alkaid (UMa) in the direction of the midpoint between Cor Caroli and Chara.

M63 (Fig 14), the Sunflower Galaxy, is a flocculent (short discontinuous arms) spiral galaxy located about two-thirds of the way from Alkaid (UMa) to Cor Caroli.

M106 (Fig. 15) is an Intermediate spiral galaxy found at the midpoint between Phecda (UMa) and Cor Caroli.

M94 is a barred/oval spiral found halfway between Cor Caroli and Chara.

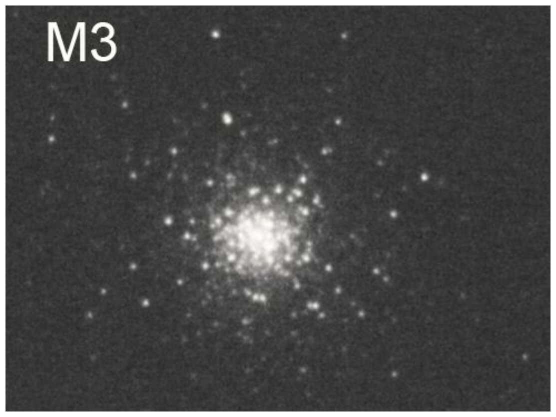


Figure 12. M3 (34 Kly, mag. 6.2) is one of the brightest globular clusters in the night sky. http://www.messierobjects.com/messier-3/

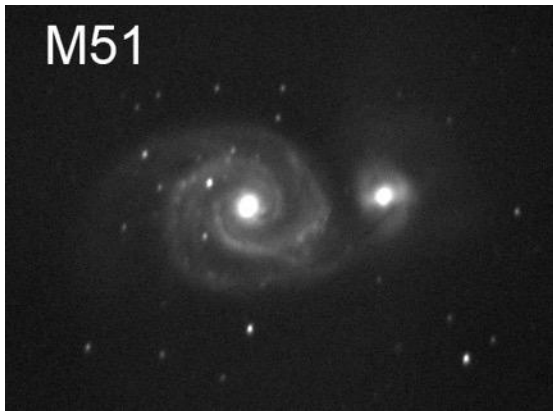


Figure 13. M51 (23 Mly, mag. 8.4) aka the Whirlpool Galaxy Is shown with its smaller companion M51a. These are Interacting galaxies connected by a bridge of dust and gas http://www.messierobjects.com/messier-51-whirlpool-galaxy/

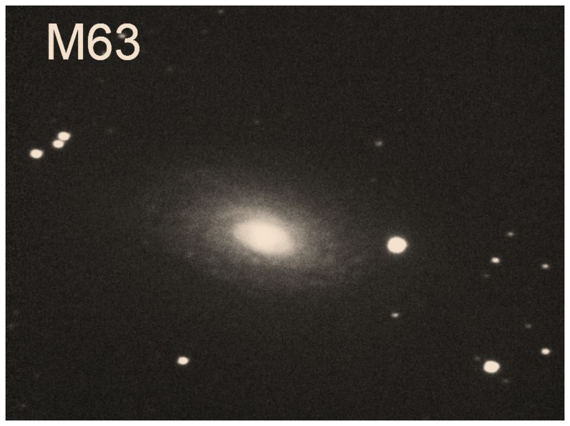


Figure 14. M63 (Sunflower) is a flocculent spiral galaxy with many short discontinuous arms. It is 37 Mly from earth with a magnitude of 9.8. http://www.messier-objects.com/messier-63-sunflower-galaxy/

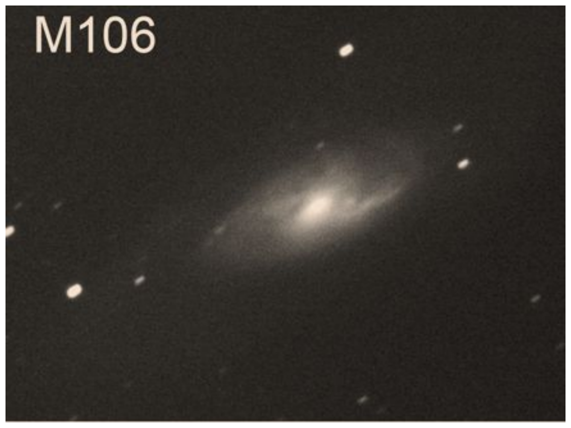


Figure 15. M106 (24 Mly, mag. 9.1) is an intermediate spiral galaxy with four spiral arms. Two of the arms are thought to be hot gases emanating from near the supermassive black hole at the galactic center. http://www.messierobjects.com/messier-106/

Coma Berenices

Coma Berenices (Berenice's Hair, Com) is a small faint constellation with its three brightest stars (α−, β−, γ-Com) forming a triangle from which hangs Berenice's hair, i.e. the Coma Star Cluster near γ−Com (Fig. 5). Messier Objects found within Coma Berenices are found by star hopping with α-, β-, γ-Com and the bright stars from Bootes and Leo (Fig. 5).

M53 is a globular cluster (Fig. 16) that can be found a degree northeast of α-Com (α-Com is about 10 degrees west of Arcturus).

M64, aka the Black Eye Galaxy, (Fig. 17) lies midway between α-Com and γ-Com (use the Coma Star Cluster to find γ-Com).

The galaxies M85, M88, M91, M98, M99, M100 are located in the northern part of the Virgo Cluster, a region between Denebola (Leo) and Vindemiatrix (Virgo). The galaxies are a mix of elliptical (M85, Fig. 18) and spiral (M88, Fig. 19) galaxies. Finding galaxies in the Virgo Cluster involves a combination of star hopping and "galaxy hopping".

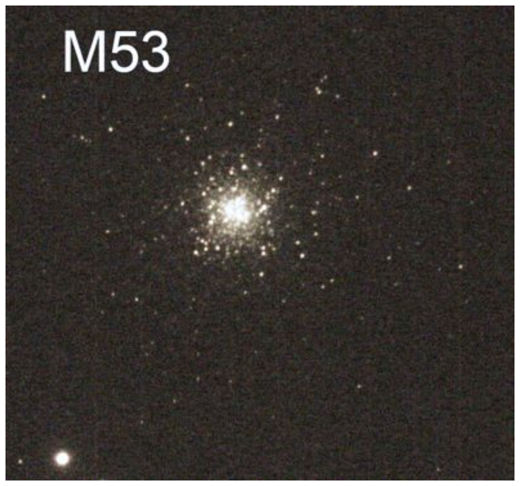


Figure 16. M53 (60 Kly, mag. 8.3**)** is the northernmost globular cluster and lies away from the galactic center. http://www.messier-objects.com/messier-53/

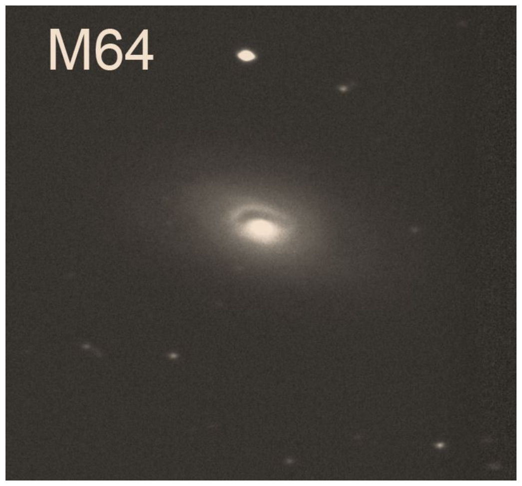


Figure 17. M64 (24 Mly, mag. 9.4) is also called the Black Eye Galaxy for the wide dust lane in front of its bright central core. http://www.messier-objects.com/messier-64-black-eye-galaxy/

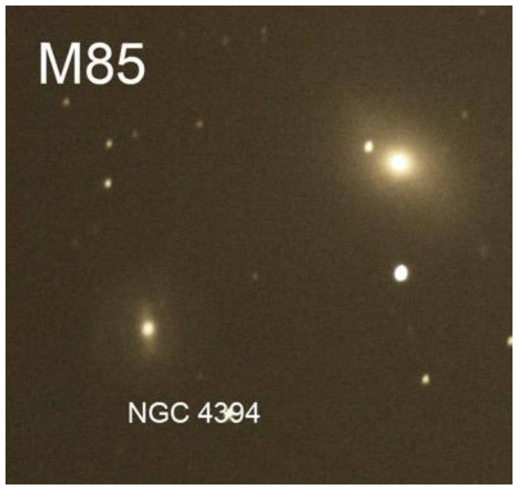


Figure 18. M85 (60 Mly, mag. 9.1) is a lenticular galaxy that is on the northern edge of the Virgo Cluster. https://www.universetoday.com/47166/messier-85/

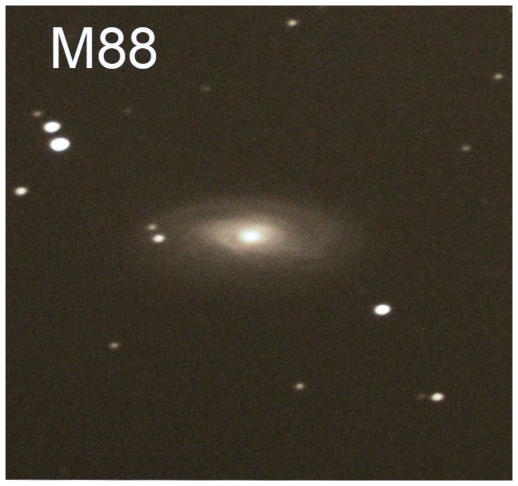


Figure 19. M88 (47 Mly, mag.10.4) is one of the brighter spirals in the Virgo Cluster. http://www.messierobjects.com/messier-88/

Virgo

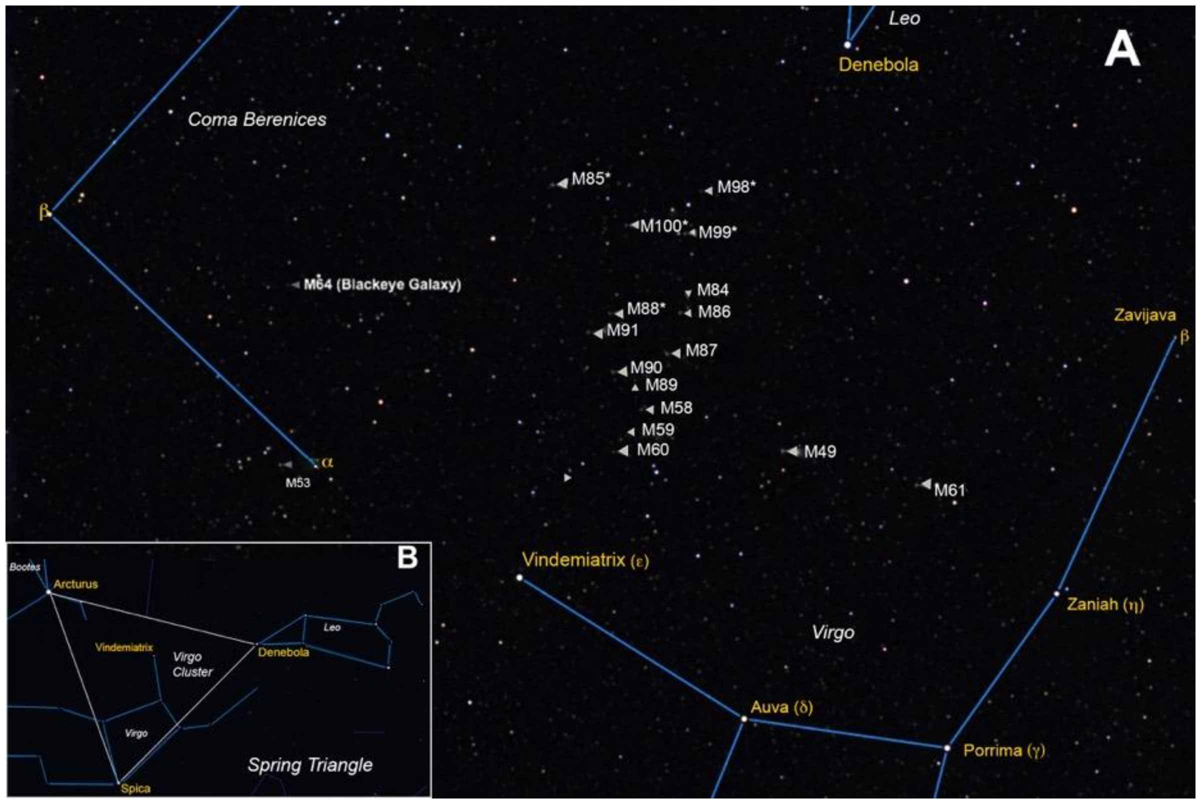


Figure 20A. The Messier Objects in the Virgo Cluster. The star chart shows the Messier objects in the Virgo Cluster between Vindemiatrix (Virgo) and Denebola (Leo). The asterisk denotes those Messier objects belonging to Coma Berenices. (Starry Night Pro). *Figure 20B.* The Spring Triangle (lower left) is formed by Arcturus, Spica, and Denebola. The Virgo cluster lies between Vindemiatrix (near the center of the triangle) and Denebola.

Virgo (the Virgin) is the second largest constellation and is found in the southern skies. Its brightest star is Spica. Messier noted that there was an unusually high concentration of nebulae in the "northern wing of Virgo". Edwin Hubble in the 1920's established that these nebulae were galaxies that lay at great distances from the Milky Way. This region which is found between the stars Vindemiatrix (Virgo) and Denebola (Leo) is called the Virgo Cluster, and it is home to hundreds of gravitationally interacting galaxies. The Virgo Cluster is of astronomical importance because of its close proximity to our local group, and because of its variety of galaxy types: spirals, ellipticals, and dwarf ellipticals. Edwin Hubble used the Virgo cluster extensively to create the "tuning fork scheme" for the classification of galaxies. The Virgo Cluster is unique for the number of giant elliptical galaxies which are thought to have grown through multiple galaxy mergers.

The Virgo Cluster can be found using the "Spring Triangle", an asterism with the stars Arcturus (Bootes), Denebola (Leo), and Spica (Virgo) at the vertices (Fig. 20B). The star Vindemiatrix is near the center of the triangle, and the Virgo Cluster can be found in the "Bowl of Virgo" between Vindemiatrix and Denebola. Within the Virgo Cluster are sixteen Messier objects, all of which are galaxies. Ten of these galaxies are in the constellation Virgo: M49, M58, M59, M60, M61, M84, M86, M87, M89, M90. Tips for navigating the Virgo Cluster to find the Messier galaxies can be found here.

Within the Virgo Cluster are the three sub-clusters that are gravitationally centered on three giant elliptical galaxies: M87, M86, and M49. M87 (Fig. 21) is the dominant sub-cluster and sits in the center of the Virgo Cluster. M87 is an order of magnitude more massive than either M86 (Fig. 22) or M49 (Fig. 23).

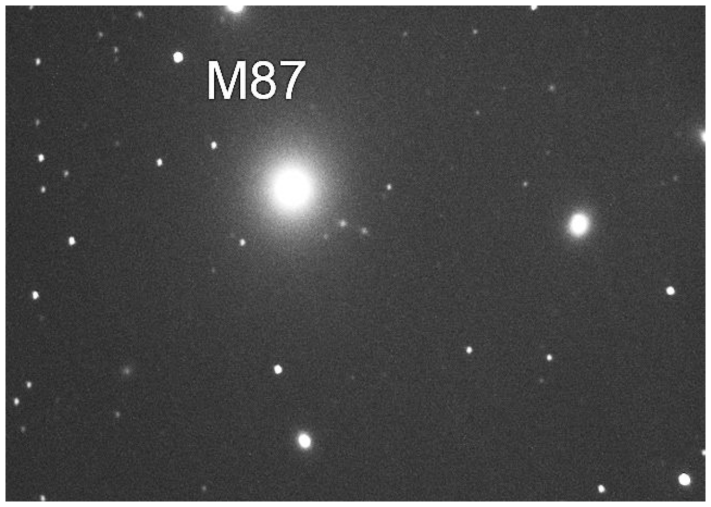


Figure 21. M87 (56 Mly, mag. 10) is a super-giant elliptical galaxy containing a supermassive black hole and is a powerful source of radio-energy and x-rays. It contains over 12,000 globular clusters. M87 lies at the center of the Virgo Cluster and is the second brightest elliptical galaxy in the cluster.
https://en.wikipedia.org/wiki/Messier_87

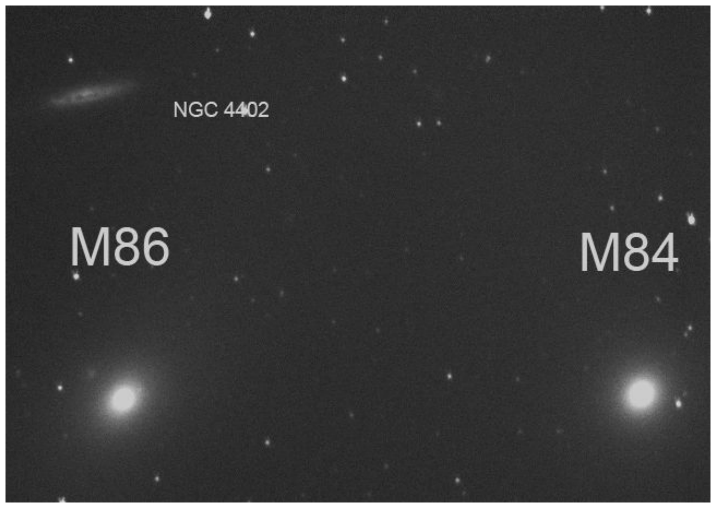


Figure 22. M86 and M84 are elliptical galaxies that are part of the Markarian chain (Fig. 24). M86 and M84 are separated by 0.3 degrees and can be seen in the same field of view with a small telescope.
http://www.messier-objects.com/messier-84/
http://www.messier-objects.com/messier-86/

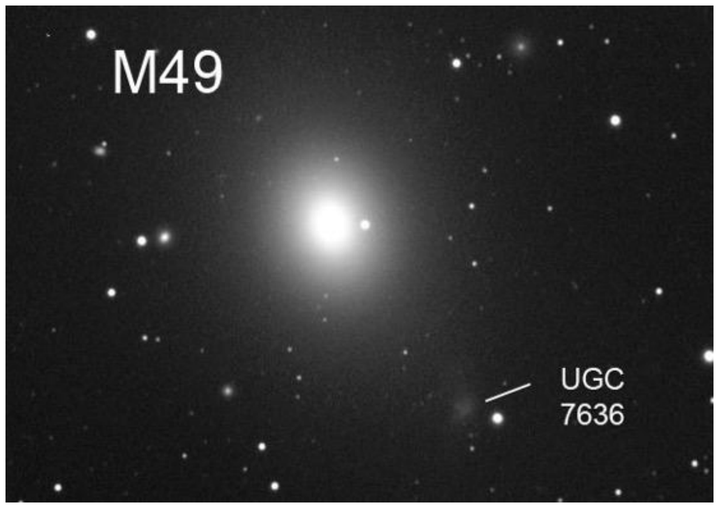


Figure 23. M49 (56 Mly, mag. 9.4) is the brightest galaxy in the Virgo Cluster (it is only slightly brighter than M87). It is located in the southern part of the Virgo Cluster. M49 is described as "elliptical with nearby fragments". The irregular dwarf galaxy UGC 7636 (shown above) has been tidally disrupted by M49. Image Credit: Ole Nielson, Wikipedia CC BY-SA 2.5
http://www.messier-objects.com/messier-49/

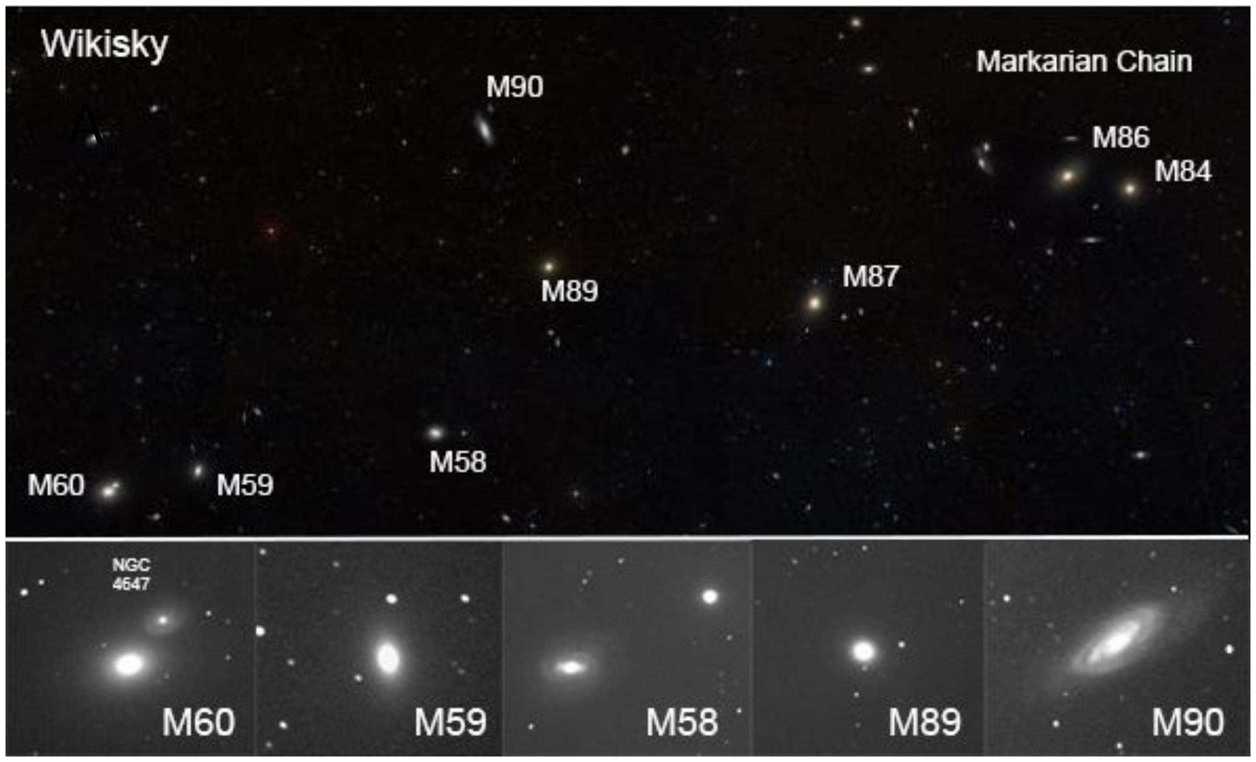


Figure 24. A Wikisky map of the central part of the Virgo Cluster showing the location of Messier galaxies belonging to the constellation Virgo. Not shown are M49 and M60 which are located in the southern part of the cluster. A detailed image of each of the Messier galaxies is shown below the map.

Selected Messier Galaxies in the Virgo Cluster (Fig. 24)

M60 (55 Mly, mag. 9.8) is a giant elliptical galaxy and third brightest galaxy in the Virgo Cluster (M49 followed by M87 are the brightest). NGC 4647 is the nearby spiral galaxy (above M60) which may be merging with M60 (or at least there is some evidence of tidal interaction).
http://scienceblogs.com/startswithabang/2013/02/04/messier-monday-the-gateway-galaxy-to-virgo-m60/

M59 (60 Mly, mag.10.6) is an elliptical galaxy that has a disproportionately large number of globular clusters for its size. It has an inner ring of stars that is counter-rotating to the rest of the galaxy; this is thought to be caused by a supermassive black hole.
https://medium.com/starts-with-a-bang/messier-monday-an-elliptical-rotating-wrongly-m59-3228197387ac

M58 (62 Mly, mag. 10.5) is a barred spiral galaxy and the most distant of the Messier objects in this catalog. With a small telescope, M58 appears to be an elliptical galaxy; larger telescopes will show the barred galactic center and faint spiral arms.
http://www.messier-objects.com/messier-58/

M89 (50 Mly, mag. 10.7) is a relatively dim giant elliptical galaxy and is difficult to find with a small telescope. It is almost perfectly spherical.
https://medium.com/starts-with-a-bang/messier-monday-the-most-perfect-elliptical-m89-8d6b87325a4b

M90 (59 Mly, mag. 10.2) is one of the larger spirals in the Virgo cluster. In medium sized telescope, it is possible to see the bright center and nebulosity. The spiral structure can be seen with large telescopes. M90 is “blue-shifted” and is moving towards our galaxy.
http://www.messier-objects.com/messier-90/

Virgo, Corvus, and M104

Corvus (the Crow, Crv) is a small constellation that lies to the south of Virgo. Its four brightest stars Algorab (δ), Gienah (γ), β, and ε form a trapezoid (Fig. 25). Corvus does not contain any Messier objects, but the spiral galaxy M104 lies nearby, and stars from Corvus can be used to star hop to this galaxy.

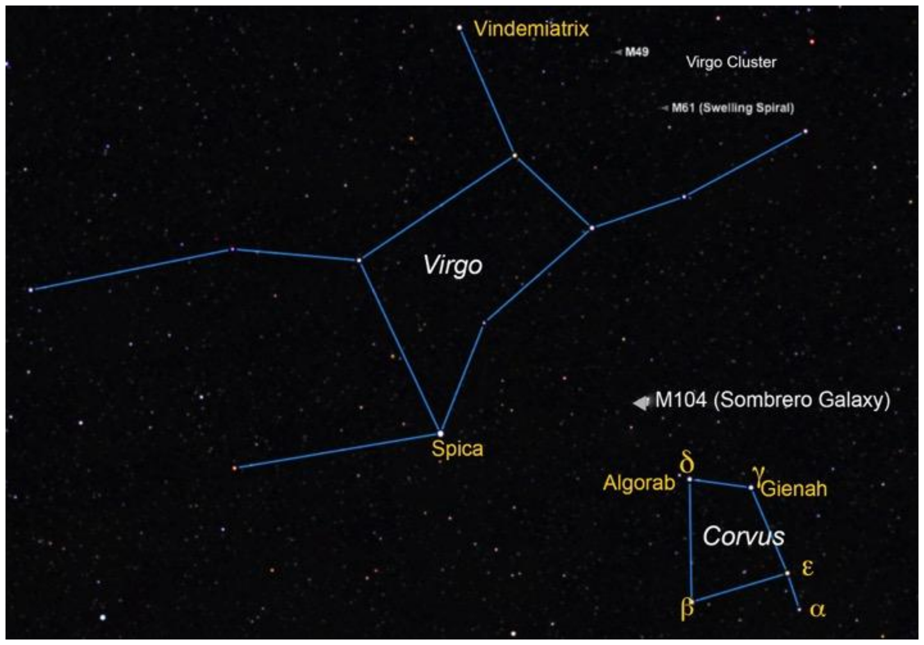


Figure 25. Star map showing the constellations Virgo and Corvus, and the location of M104 (Starry Night Pro)

M104 is an edge-on spiral galaxy (Fig. 26) that is found in the constellation Virgo, and it is the only one that is found outside the Virgo Cluster. M104 lies in the southern part of Virgo midway between the star Spica and the constellation Corvus (Fig. 25). M104 can be found by star hopping about 11 degrees due west of Spica (about a fist-length). Alternatively, M104 can be found about 5 degrees northeast of Algorab, the star in the northeast corner of the constellation Corvus.

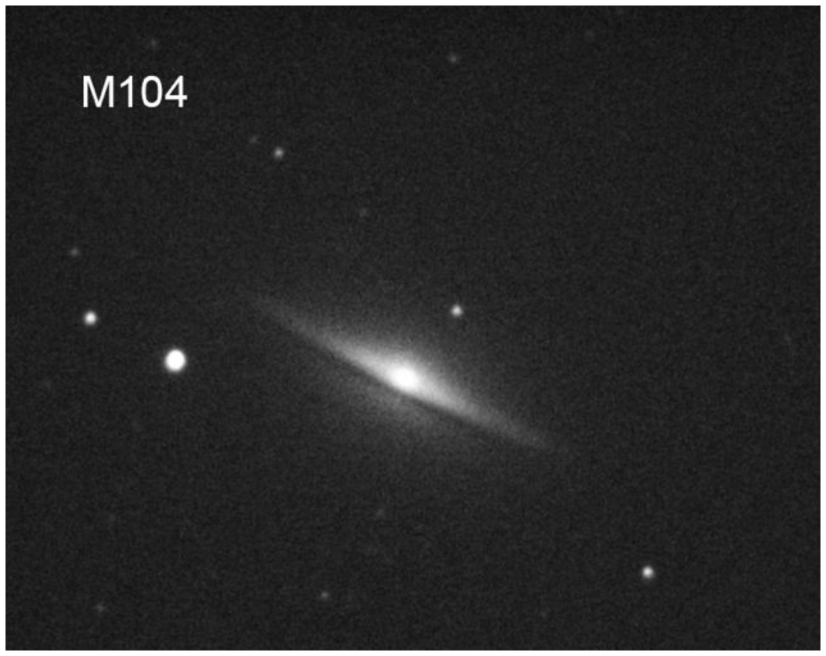


Figure 26. M104 (29 Mly, mag. 9) is an edge-on spiral that is notable for its prominent dust lane and large central bulge.
http://www.messier-objects.com/messier-104-sombrero-galaxy/

https://theconversation.com/scientists-have-worked-out-how-dung-beetles-use-the-milky-way-to-hold-their-course-75666

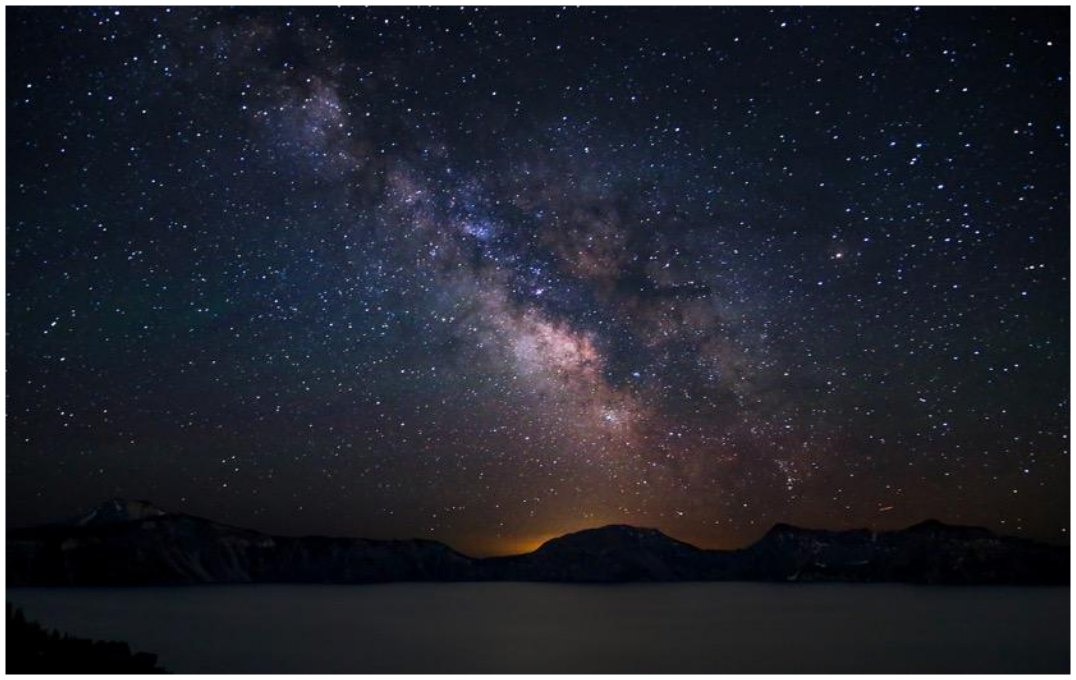
Scientists have worked out how dung beetles use the Milky Way to hold their course

James Foster, Postdoctoral Fellow, Functional Zoology, Lund University

Insects navigate in much the same way that ancient humans did: using the sky. Their primary cue is the position of the sun, but insects can also detect properties of skylight (the blue light scattered by the upper atmosphere) that give them indirect information about the sun's position. Skylight cues include gradients in brightness and colour across the sky and the way light is polarised by the atmosphere. Together, these sky "compass cues" allow many insect species to hold a stable course.

At night, as visual cues become harder to detect, this process becomes more challenging. Some can use the light of the moon but one insect, the nocturnal dung beetle *Scarabaeus satyrus*, uses light from the Milky Way to orient itself. To find out exactly how this process works, my colleagues and I constructed an artificial Milky Way, using LEDs, to test the beetles' abilities. We found that they rely on the difference in brightness between different parts of the Milky Way to work out which way to go.

Scarabaeus satyrus holds its course with apparent ease every night. They take to the air at dusk in the African Savanna, in search of the fresh animal droppings on which they feed. But they are not alone and, to escape competition from other dung beetles, they construct a piece of dung into a ball and roll it a few meters away from the dung pile before burying and consuming it.



Milky Way. Credit: Joe Parks, Flickr CC BY-NC 2.0

Where am I supposed to take this thing? Credit: Shutterstock

To avoid returning to their starting point, they maintain a straight path while rolling their ball. Scientists discovered that the beetles could do this even on moonless clear nights. So in 2009, a group of researchers took some beetles on a trip to the planetarium in Johannesburg, and watched them try to orient themselves under different star patterns.

They found the beetles could hold their course well when the planetarium displayed just the Milky Way, the streak of light across the night sky produced by the disc-shaped arrangement of the stars in our galaxy. But the beetles became disoriented when only the brightest stars in the sky were shown.

What was still unclear was exactly what kind of compass cue the beetles extracted from the Milky Way. We knew, for example, that night-migrating birds learn the constellations surrounding the sky's northern centre of rotation, much as sailors did before the advent of modern navigation systems. These constellations remain in the northern part of the sky as the Earth rotates, and so are a reliable reference for north–south journeys.

The planetarium experiments had shown that the beetles don't use constellations of bright stars, but perhaps they could learn patterns within the Milky Way instead. My colleagues and I then proposed that the beetles might perform a brightness comparison, identifying either the brightest point in the Milky Way or a brightness gradient across the sky that is influenced by the Milky Way.

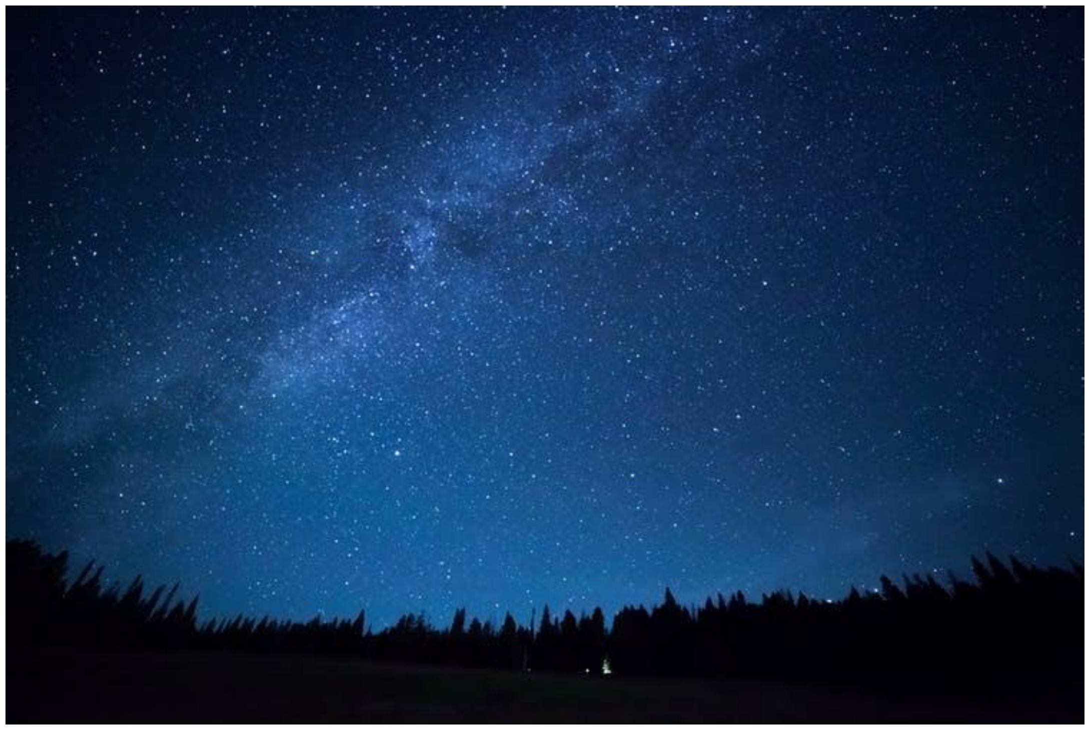
Artificial Milky Way

We used our artificial night sky to test this theory, constructing a simplified Milky Way streak that simulated different patterns of stars and brightness gradients. We found that the beetles became lost when given a pattern of stars within the artificial Milky Way. The beetles only maintained their heading when the two sides of the streak differed in brightness.

This suggests nocturnal beetles do not use the intricate star patterns within the Milky Way as their compass cue, but instead identify a brightness difference across the night sky to set their heading. This is similar to what their day-active relatives do when the sun is not visible but instead orient themselves using the brightness gradient of the daytime sky.

This brightness-comparison strategy may be less sophisticated than the way birds and human sailors identify specific constellations, but it's an efficient solution to interpreting the complex information present in the starry sky—given how small the beetles' eyes and brains are. In this way, they overcome the limited bandwidth of their information processing systems and do more with less, just as humans have learnt to do with technology.

This straightforward brightness comparison strategy is particularly effective over short distances. So although *Scarabaeus satyrus* is the only species known to hold its course in this way, the technique may also be used by many other nocturnal animals that perform short journeys at night.



Night-time compass. Image Credit: Shutterstock

A Dung Beetle runs into an Astronomer.....

Heavenly Bodies
by Susie Christian

What Is the Ionosphere?

By Linda Hermans-Killiam

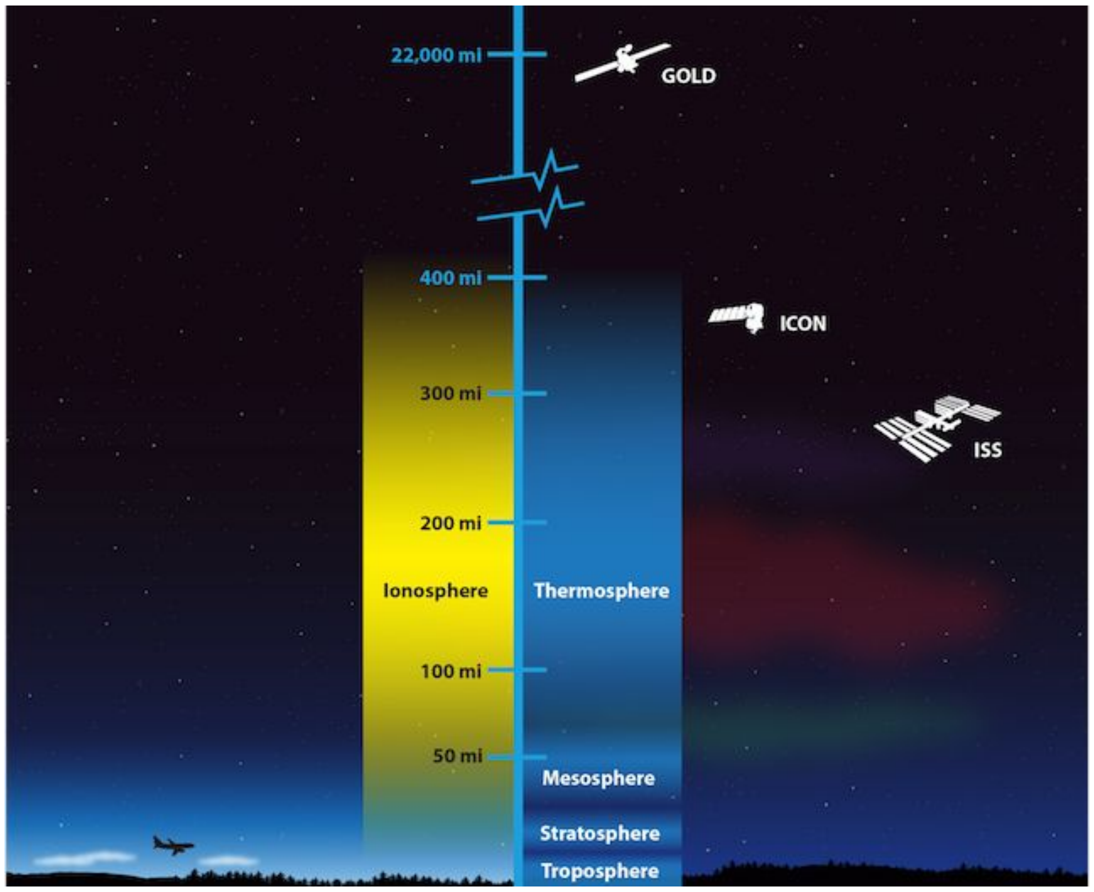
High above Earth is a very active part of our upper atmosphere called the ionosphere. The ionosphere gets its name from ions—tiny charged particles that blow around in this layer of the atmosphere.

How did all those ions get there? They were made by energy from the Sun!

Everything in the universe that takes up space is made up of matter, and matter is made of tiny particles called atoms. At the ionosphere, atoms from the Earth's atmosphere meet up with energy from the Sun. This energy, called radiation, strips away parts of the atom. What's left is a positively or negatively charged atom, called an ion.

The ionosphere is filled with ions. These particles move about in a giant wind. However, conditions in the ionosphere change all the time. Earth's seasons and weather can cause changes in the ionosphere, as well as radiation and particles from the Sun—called space weather.

These changes in the ionosphere can cause problems for humans. For example, they can interfere with radio signals between Earth and satellites. This could make it difficult to use many of the tools we take for granted here on Earth, such as GPS. Radio signals also allow us to communicate with astronauts on board the International Space Station, which orbits Earth within the ionosphere. Learning more about this region of our atmosphere may help us improve forecasts about when these radio signals could be distorted and help keep humans safe.



This illustration shows the layers of Earth's atmosphere. NASA's GOLD and ICON missions will work together to study the ionosphere, a region of charged particles in Earth's upper atmosphere. Changes in the ionosphere can interfere with the radio waves used to communicate with satellites and astronauts in the International Space Station (ISS). Credit: NASA's Goddard Space Flight Center/Duberstein (modified)

In 2018, NASA has plans to launch two missions that will work together to study the ionosphere. NASA's GOLD (Global-scale Observations of the Limb and Disk) mission launched in January 2018. GOLD will orbit 22,000 miles above Earth. From way up there, it will be able to create a map of the ionosphere over the Americas every half hour. It will measure the temperature and makeup of gases in the ionosphere. GOLD will also study bubbles of charged gas that are known to cause communication problems.

A second NASA mission, called ICON, short for Ionospheric Connection Explorer, will launch later in 2018. It will be placed in an orbit just 350 miles above Earth—through the ionosphere. This means it will have a close-up view of the upper atmosphere to pair with GOLD's wider view. ICON will study the forces that shape this part of the upper atmosphere.

Both missions will study how the ionosphere is affected by Earth and space weather. Together, they will give us better observations of this part of our atmosphere than we have ever had before.

To learn more about the ionosphere, check out NASA Space Place:
https://spaceplace.nasa.gov/ionosphere