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Reflector

MORE ON SATELLITE MEGACONSTELLATIONS

AMATEUR CORONA OBSERVATION

AN ARTIST WITH A SCIENTIST'S MIND

JAIPUR'S ANCIENT OBSERVATORY

along with data from the Mercury Laser Altimeter, allowed astronomers to determine the shape of Mercury's gravitational field. This, in turn, exposed Mercury's internal structure, since the planet's internal structure shapes the gravitational field. The observations showed that Mercury has a large iron core, occupying the central 55 percent by volume of the planet. This is unusual, since Earth's iron core occupies only 17 percent. Mercury's core is very dense, implying it is mostly iron. It has a higher percentage of iron than the Earth's core. In addition, Mercury's magnetic field indicates that the core is at least in part molten.

It is believed that the central core of Mercury is solid, surrounded by a very thick layer of molten material with a rocky mantle floating on it. The top crust is just 22 miles thick. Many narrow ridges are distinctive features on Mercury's surface, extending up to several hundred miles long. These most likely formed after the surface solidified but the core and mantle continued to cool and contract.

Four hypotheses provide possible explanations for Mercury's high iron content. One model has Mercury forming with two-and-a-quarter times its current mass. It was impacted by a planetesimal one-sixth this size, which stripped away much of the rocky material, leaving the enhanced iron content. A second has Mercury forming at twice its current mass, but the early Sun had not stabilized and its heat vaporized much of the surface rock. The vapor was then carried away by the solar wind.

A third option has the proto-solar nebula creating a drag on the particles that Mercury was accreting during its formation. This drag caused the lighter particles to fall toward the Sun, leaving the heavier iron-rich particles to form the planet. The final possibility, based on models developed at the University of Maryland, has the Sun's early magnetic field pulling iron-rich particles nearer the Sun. The particles forming Mercury would then have been iron-rich, giving the planet its high iron content.

The European Space Agency (ESA) and the Japanese Space Agency (JAXA) launched the BepiColombo probe toward Mercury on October 20, 2018, to help determine how it got its rich iron content. The spacecraft has already made one flyby of Earth and two of Venus, and then it made the first of six Mercury flybys on October 1, 2021. It will attain orbit around Mercury on 2025. We may them learn how this unique planet formed.

—Berton Stevens

Deep-Sky Objects

A TRIO OF GALAXIES IN LEO

You know spring has arrived when the constellation Leo is high above the eastern horizon as twilight fades to darkness. The Lion is one of the oldest recognizable constellations due to bright stars including Regulus, Algeiba, and Denebola forming its feline shape. Visual astronomers migrate to Leo to spy myriad double stars and a plethora of galaxies.

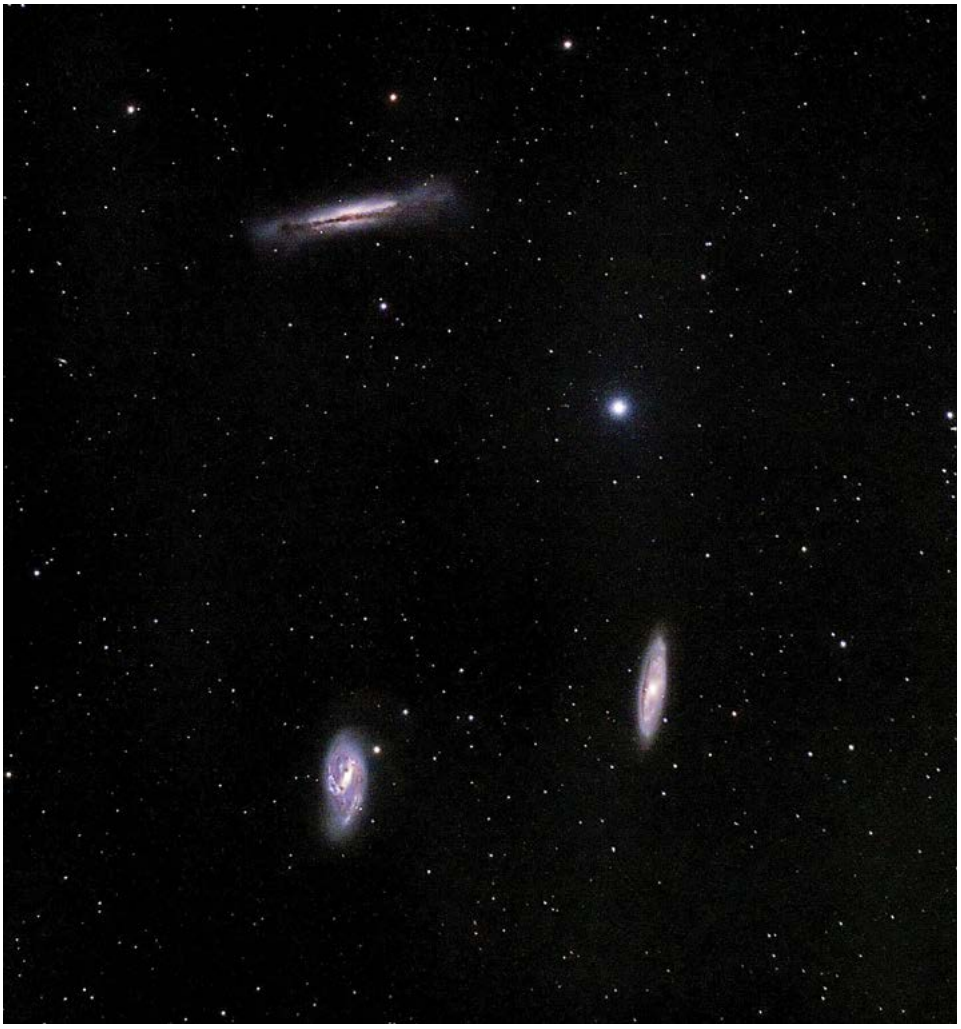
Arguably the best set of galaxies the constellation has to offer is a trio known by the catalog designations M65, M66, and NGC 3628. The first two are found in Charles Messier's catalog and the third is only in the New General Catalog. These spiral galaxies reside midway between the stars Theta Leonis and Iota Leonis.

The Leo Trio, as astronomers affectionately call them, can all be seen in a 3-inch telescope in dark skies. But 8-inch and larger telescopes are required to bring out their spiral galaxy nature. All three galaxies lie within a half-degree field of view. So any telescope-eyepiece combination providing a field of view wider than half a degree will show all three simultaneously.

Charles Messier discovered the two brighter galaxies, M65 and M66, on March 1, 1780. Messier's comet of 1773 passed right through the Leo Trio on November 2, 1773, but Messier did not note the galaxies then. Perhaps it was a cloudy week and Messier did not have the opportunity to spy his comet on November 2 that year, thus delaying discovering M65 and M66 by more than six years. William Herschel discovered the fainter NGC 3628 on April 8, 1784.

At magnitude 9, M66 is the brightest galaxy in the trio. M66 is on the southeast side of the trio, and is approximately 9.1 by 4.2 arcminutes in size. We see M66 more face-on than the other two galaxies. The galaxy has a bright core with two main spiral arms. The galaxy has an asymmetrical shape, and in amateur telescopes may appear teardrop- or comma-shaped. This asymmetry may be the result of a close interaction with one of its neighbor galaxies. The core of M66 appears elongated, which may be a result of the angle at which we see it, compounded with dark dust lanes obscuring parts of the core.

It is also possible that the galaxy may be



intermediate between a normal and barred spiral galaxy.

M65 is slightly fainter and smaller than M66. It is listed at magnitude 9.2 and measures 7.6 by 1.9 arcminutes in size. We see M65 part way between edge-on and face-on, and in small telescopes it appears elongated in the north-south direction. Both M65 and M66 are classified as Sb spiral galaxies. However, M65 appears to be more symmetrical in shape than M66, including its core and spiral arms. Photographs of M65 show a dark dust lane circling the east side of the galaxy, that is, the side closest to us. Typical of spiral galaxies, this dust lane probably surrounds the entire galaxy. Both galaxies are approximately 35 million light-years away.

At magnitude 10.2, NGC 3628 is the northernmost and faintest of the triplet of galaxies. It is also the largest, measuring 13 by 3.4 arcminutes in size. Because it is fainter and its light is spread out over a more extended region, NGC 3628 is more difficult to see than M65 or M66. The galaxy is seen edge-on with its brighter galactic disk split in half by a dark dust lane. Since the galaxy resembles a hamburger patty with a bun, astronomers call NGC 3628 the Hamburger Galaxy.

Like its neighbors, NGC 3628 is an Sb spiral galaxy 35 million light-years away. This means the galaxies are actually cosmic neighbors! M65 and M66 may be as little as 200,000 light-years apart with NGC 3628 a mere 300,000 light-years away from the Messier pair. Those distances are comparable to the Milky Way and its satellites, the Large and Small Magellanic Clouds. The big difference is the Magellanic Clouds are much smaller galaxies than the Milky Way while all the galaxies in the Leo Trio are big galaxies like the Milky Way! At those small distances, the views of the other two galaxies from any one are undoubtedly more impressive than the Magellanic Clouds are from Earth.

The image (previous page) of M65, M66, and NGC 3628 was taken with a William Optics 132 mm f/7 refractor with a 0.8× focal reducer/field flattener to yield f/5.6. The 120-minute exposure was taken with a SBIG ST-4000 color CCD camera. In the image, north is up and east is to the left. The brightest star in the image is magnitude 7.1, whereas the faintest stars are magnitude 16.5. The detail in this image should allow visual observers to test their optics and observing location to see how much detail can be captured with the eye at the telescope!

—Dr. James Dire

Women in Astronomy

A GUIDE FOR EDUCATORS AND OUTREACH SPECIALISTS

Just in time for Women's History Month, this newly expanded and updated guide to resources for teaching about the challenges that face women in astronomy, and the achievements that women have made despite those challenges, is now available at *bit.ly/womenastronomers.*

The materials have been selected so they can also be assigned to students at the Astro 101 level. The guide was compiled by Andrew Fraknoi, emeritus chair of astronomy at Foothill College and the former executive director of the Astronomical Society of the Pacific.

After sections listing resources on general history and issues related to women's roles in astronomy, the guide features more specific books, articles, videos, and webpages on 19 women of the past and 21 women of today. At the end of the 28-page document, there is a list of one or two resources about 27 other women whose work may interest students and the public.

(NOTE: Given the growing number of women who are making important contributions to astronomy, this guide could only be representative, and not comprehensive. One important criterion for inclusion was that non-technical materials about each woman had to be available for non-science majors.)

—from press release

Become an Author!

The *Reflector* Team encourages you to write and submit an original 500 to 2,000-word article on any astronomical topic of interest. Longer articles are considered on a case-by-case basis. Your article should be submitted as a simple text file (MS Word or any rich text format application) to editor Kris Larsen *(larsen@ccsu.edu)*. Figures, tables, and photos should NOT be embedded within the text, but instead attached to your submission email as individual files.

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