"The mountains are calling and I must go."
—John Muir

CELESTIAL MARIPOSA

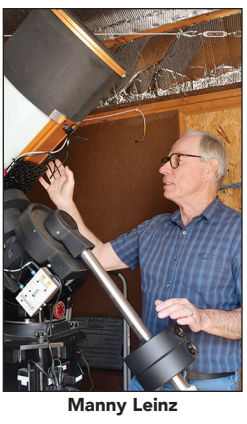
It's a bird, it's a plane ... it's the ISS

By MANNY LEINZ

Have you ever gone out at night and seen the International Space Station arc slowly across the sky? It's quite a sight!

The station is so large — about the size of a football field — that it can be brighter than the brightest stars. It's almost impossible to miss, if you know when and where to look.

This month is a great time to see the ISS and other satellites fly overhead. So let's learn a little more about the ISS, satellites in general and how best to see them, as well as the planets and other celestial highlights, in the dark skies above Mariposa.



Manny Leinz

Satellites 101

I think most of us have a pretty good concept of what a satellite is. A satellite (of Earth) is quite simply an object that is in orbit about our world. The Moon is a satellite — a natural one — that has been our constant companion for billions of years.

But of course there are also artificial satellites — many of them — that have or are currently orbiting the Earth at various altitudes. The concept of putting an artificial body in orbit around the Earth is an old one.

Sir Isaac Newton postulated in 1687 that if a cannonball could be fired from a mountaintop with enough speed, it would fall toward the Earth at the same rate that the planet's surface curves away from it, putting it into a stable orbit. Newton was right; of course the key is that the object must be lofted high enough — about 100 miles — to escape the vast majority of drag from our atmosphere.

The first successful satellite, Sputnik 1, was launched by the Soviet Union on Oct. 4, 1957. The device was small, just 23 inches in diameter, but with the Cold War in full swing, and with nuclear missiles in the U.S. and USSR pointed at each other, it caused significant public anxiety.

As a result, here in the U.S. we rapidly increased funding for science, and the space race was on. NASA was born, and the race culminated with the U.S. landing the first humans on the Moon on July 20, 1969.

Gradual, then explosive growth

Satellite launches started slowly, with a total of about 55 by end of the 1950s. By the end of the 60s nearly another 1,000 were launched and that number per decade held relatively steady until the mid 2010s.

The first components of the ISS were launched in 1998. Conceived as an international orbital laboratory, the ISS is a collaboration of multiple countries, including the U.S., Russia, Canada, the European Union and Japan.

More than 40 launches after that first component was delivered in 1998, the station was finally completed in 2011. As of Nov. 2 of this year, the station will have been continuously occupied for 25 years, visited by 290 astronauts from 26 countries. Current plans are to safely de-orbit the aging station into the sea in 2030.

Since the mid 2010s, with the advent of so-called "mega-constellations," the number of satellites launched — and remaining in orbit — has increased dramatically.

In 2020 alone, nearly 1,300 satellites were launched, increasing to nearly 3,000 per year in 2023 and 2024. Today, there are over 13,000 active satellites circling the Earth. By far the largest contingent — over 8,000 — belong to SpaceX's Starlink internet communications constellation.

Many orbits, many missions

The vast majority of satellites today — about 90 percent — are in what is called Low-Earth Orbit (LEO). These satellites are typically used for Earth observation and communications — commercial and military — and operate at altitudes of up to 1,200 miles.

They travel at over 17,000 mph — much faster than a rifle bullet — and circle our planet in as little as 90 minutes! The ISS is in LEO, which is why you can sometimes — including several times this month — see it fly overhead twice in the same night.

Some satellites fly much higher than LEO, however. The vast majority that are used for navigation — including 31 operational GPS satellites — are in Medium Earth Orbit (MEO), or about 12,000 miles in altitude.

Higher still, at almost precisely 22,236 miles in Geostationary orbit (GEO), are telecom, TV broadcast and weather satellites. These satellites orbit at the same rate as Earth's rotation, so they always remain nearly stationary over one region, providing continuous coverage.

See for yourself

You can see satellites fly overhead on any given night when the sky is clear and dark. But not every moving dot is a satellite; aircraft constantly crisscross our sky and can generally be discerned by their flashing red and green navigation lights — if it's got red and green lights, it's not a satellite. And if it flashes quickly across the sky and then disappears, it's most likely a meteor.

By far the easiest satellites to see are those in LEO. Since they are illuminated by sunlight, these satellites can only be seen for one to two hours after sunset or before sunrise, while the sun is shining at their altitude, but it is dark at the Earth's surface.

The process for viewing satellites is similar to that for observing meteors, or other celestial objects: go out to dark place, get comfortable in a lounge chair and let your eyes adapt to the dark for 20-45 minutes.

You'll soon spot tiny dots marching across the sky in multiple directions. Unlike meteors, however, satellite orbits are highly predictable; we know exactly when and where they will appear.

An excellent source for this information is the website www.heavens-above.com

You can set up a free account, enter your latitude and longitude (Mariposa is 37.4931° N and 119.9727° W, respectively), and then get a list of satellites for the night. The list will provide information about the particular satellite, rise, transit and set times, and a map showing its path through the sky.

You can also filter by expected brightness — magnitude — satellite type, name or ID number. There is a very convenient app for Android phones, and although there is no heavens-above app specifically made for iPhones, there are third party apps, including Satellite Tracker, Satellite Chasers and Orbitrack available in the App Store. (Note: As an Android user, I can't vouch for the utility of any of these apps. Give them a try and let me know!)

Object	Magnitude	Notes
Sun	-26.7	Brightest object in our sky
Full Moon	-12.7	~400,000× fainter than the Sun
ISS	–2 to –6	Brightest satellite
Venus	-4.9	At its brightest
Jupiter	-2.9	At its brightest
Sirius	-1.5	Brightest star
Magnitude Reference	0	Bright stars (Vega)
Naked Eye Limit – City	<4	~200 stars (light polluted sky)
Naked Eye limit – Rural	5–6	>5,000 stars (very dark sky)
Binocular limit – Rural	10	7×50 binoculars (very dark sky)
Pluto	14	Needs large telescope
Hubble Space Telescope	28–30	Very faint galaxies

Brightness of various objects in the night sky.

What's a magnitude?

As we are now five months into our astronomical journey — this is my fifth article — it's high time we understand magnitude, the way that the brightness of things in the sky is measured. In astronomy there is a vast difference in the brightness of objects that we want to study: from our blazing Sun, down to the faintest objects at the edge of the known universe, which are over 100 quintillion — that's 1 with 20 zeroes after it — times dimmer.

To cover such a huge range, astronomers developed a logarithmic scale, where each magnitude represents an increase or decrease of about 2.5 times in brightness, and a change of five magnitudes represents a factor of exactly 100 times. With this scale in hand, it's easy to catalog some familiar objects (note that brighter objects have lower — even negative — magnitudes):

You can see from the accompanying table that theoretically, if your sky is very dark, you could see satellites — or stars — down to magnitude 5 or 6. This really requires pristine conditions and an experienced observer.

In practice, I find that magnitude 3-4 is a more reasonable number to set as a limit in your satellite app. There are literally hundreds of satellites in LEO that are brighter than magnitude 3.

Since satellite passes are very predictable, you could even use binoculars or a small telescope to expand your reach to thousands of satellites! A few of the brighter GEO satellites are within this range, too.

Current oddities and future concerns

Once you've been watching satellites for awhile you are bound to see some strange things. Sometimes, a satellite will dramatically change brightness as it crosses the sky.

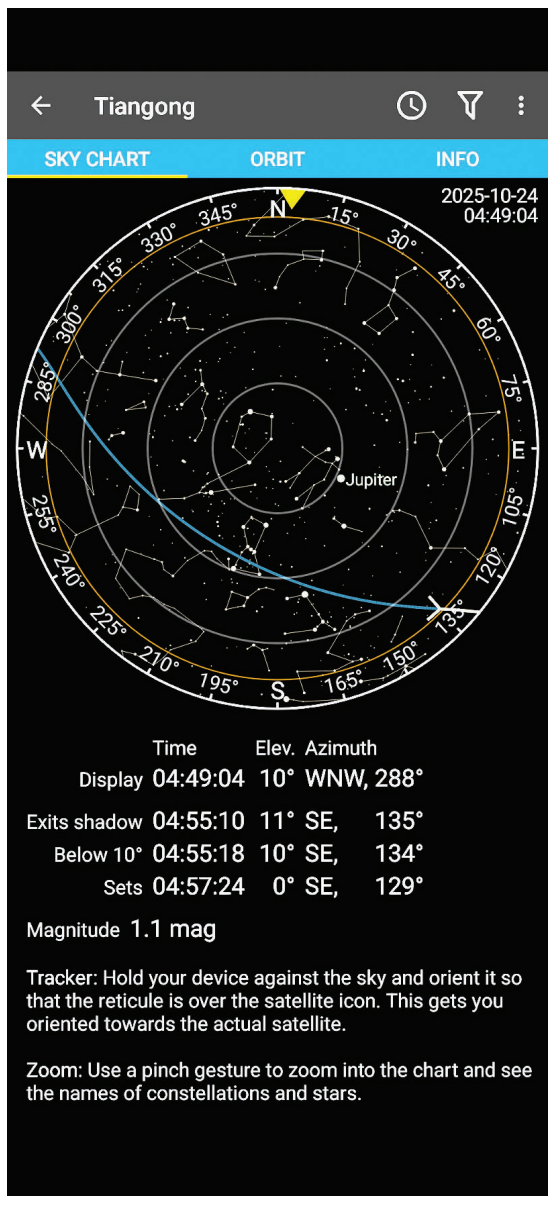
This is most likely a "tumbler," a dead satellite that is no longer stable or being actively controlled. And in these days of frequent Starlink launches, you can sometimes, in the days immediately following a launch, see a "train" of over 20 satellites strung out in line. If you are interested in more information or to see a train, checkout www.heavens-above.com or www.findstarlink.com

Satellites are so ubiquitous these days that they are causing some issues. Space — particularly LEO — is getting crowded, and collisions, or even intentional interceptions, have happened.

The debris from these collisions threatens astronauts and could impact other satellites, which would cause even more debris, leading to a runaway scenario, the so-called Kessler Effect, that would threaten all LEO satellites and potentially make some regions of space unusable.

Satellite optical and radio emissions also cause problems for astronomers. Giant new Bluewalker satellites from the company AST SpaceMobile are extremely bright, potentially disrupting observations of deep space.

Meanwhile, observatories are taking steps to try to reduce the effects of satellite streaks in their images and radio noise in their data. To their credit, some satellite manufacturers, including SpaceX, are working to make their satellites quieter, and reflect less light to the ground.



The Heavens-Above Android app is very useful for tracking satellites.

Celestial Highlights for November, 2025

Nov 1		The waxing gibbous Moon is about four degrees to the upper right of Saturn. Watch them slowly draw closer together as the evening wears on. They will be about three degrees apart by 2:00 AM on the 2nd when they are low in the west.
Nov 5		The Full Moon rises at 4:53 PM on November 5th and sets at 8:07 AM on the 6th. It will be visible all night in the constellation *Aries*.
Nov 11		The Last Quarter Moon rises in the Constellation *Leo* at 11:17 PM, reaches its highest point in the sky (transit) at 6:23 AM on the 12th and sets at 1:17 PM. Also tonight, don't miss the International Space Station (ISS), which will rise in the SW at 6:26 PM. It will reach an altitude of 72 degrees at 6:29:46 PM at which point it will rapidly fade as it enters Earth's shadow. The Chinese Space Station, Tiangong, is also visible tonight: it rises at 6:32 PM in the WNW, and reaches an altitude of 54° in the SW
Nov 12		Tonight you'll have an opportunity to see the ISS – *twice!* It rises at 5:38 PM in the SSW, reaches an altitude of 37° then fades into Earth's shadow at 5:43 PM in the ENE. The station will appear a second time at 7:15 PM in the west, reaching an altitude of 16°, and fades again at 7:16 PM in the WNW. Tiangong is again visible, rising at 5:32 PM in the WNW, and reaching an altitude of 88°.
Nov 14		You can see the ISS twice once again: It rises at 5:37 PM in the WSW, reaches an altitude of 65° then fades at 5:44 PM in the NE. You'll have to look carefully – and quickly! - for the second pass, though. The station will appear at 7:16:49 PM in the NW, reaching an altitude of just 10°, and then fading again just six seconds later at 7:16:56 PM.
Nov 16-17		Checkout the Leonid Meteor Shower. Go away from bright lights, get a lawn chair and a warm blanket, and give yourself time to let your eyes adapt to the dark – ideally 45 minutes. You can expect to see 10-15 meteors per hour from a dark site. The best times will be after midnight.
Nov 19		Our Milky Way Galaxy is easiest to see around this date of the New Moon. It will be fully dark by 6:17 PM. Jupiter rises at 8:44 PM and will be visible all night in the constellation *Gemini*.
Nov 27		The First Quarter Moon rises in the constellation *Capricornus* at 12:23 PM, and sets at 11:33 PM. Saturn will be visible in the constellation *Aquarius* until after midnight. Jupiter will rise at about 8:00 PM and be visible all night in the constellation *Gemini*.

What else is up this month — planets, another shower and two comets

The giant planets Saturn and Jupiter are the stars of the show this month. Visible as soon as it gets dark until well after midnight, Saturn shines brightly in the constellation Aquarius throughout November.

Its rings, normally easily seen in any small telescope, will be a bit more challenging now, because we see them nearly edge on. Jupiter, in the constellation Gemini, rises a bit earlier each night — around 11 p.m. on Nov. 1 and by 8 p.m. at the end of the month. Binoculars or a small telescope will reveal its four largest moons.

There's yet another opportunity to see a meteor shower this month. The Leonid shower peaks on the moonless nights of Nov. 16 and 17. See some meteors while you are satellite hunting!

Last month I talked about comet C/2025 R2 (SWAN), which was discovered in September. It didn't turn out to be as bright as expected — comets are fickle beasts — but is should be visible as a small smudge in the south in the constellation Aquarius. The comet is currently at magnitude 6.4, so you are definitely going to need a telescope for this one.

There is another comet, C/2025 A6 (Lemmon), currently in the night sky as well. It made its closest approach to Earth on Oct. 21 and is still visible very low in the west after sunset. It's currently estimated at magnitude 4.4, so you'll want binoculars or a small telescope. You can get a finder chart for both comets online at https://theskylive.com/

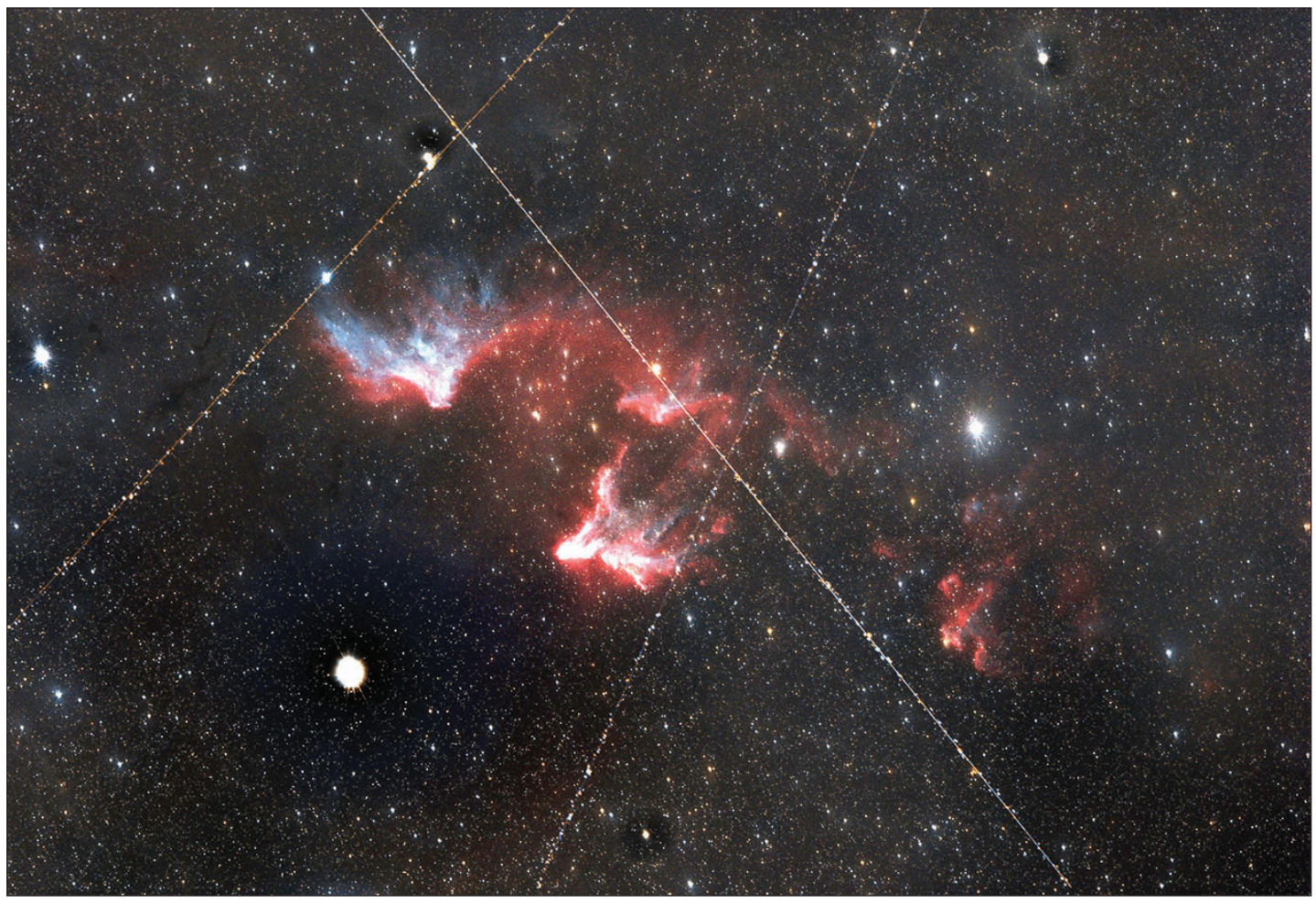
I hope you found this article informative as you continue your exploration of the night sky. You'll note that I've not included a night sky chart this month; I've found that these can be hard to read in print.

Thankfully, there are excellent resources available online: checkout https://skyandtelescope.org/interactive-sky-chart/ or https://theskylive.com/ for starters. There are also some great free apps, including Stellarium, SkySafari and SkyView.

As always, if you have questions, comments or suggestions for future articles, you can get in touch with me by email at: celestialdeep55@gmail.com. You can find my prior *Gazette* articles on my website at https://celestialdeep.space/.

If you have a question of general interest, I'll try to answer it in my next article.

Manny Leinz is a long-time amateur astronomer and night sky photographer. He and his wife live part time in Bootjack where they also have an observatory.



The author took this image of three satellites crisscrossing a nebula in the constellation Cassiopeia in 2021.