ISS & Satellites

Observing Guide

Predicting passes, photographing the ISS, identifying satellites in the sky.

Plus Starlink trains, lunar/solar transits, and reentries.

Why satellites are a great target

Satellite observing is the most accessible 'something to look at tonight' in astronomy. The ISS passes overhead 4–6 times per day from any given location and is the third-brightest object in the night sky after the Sun and Moon. **You don't need any equipment** — just your eyes, a phone with a satellite tracker app, and a clear horizon. From a city center with terrible skies for everything else, you can watch the ISS sail directly overhead.

Beyond the ISS, there are over 10,000 active satellites you might catch. Starlink trains have become a regular sight after fresh launches. Tiangong (China's space station) joins the ISS as a bright human-built object. Spent rocket bodies, military satellites, weather satellites, and an increasing population of CubeSats fill the sky.

> **What you can actually see**
>
> Satellites are sunlit reflections of metal and solar panels. They appear as steady-moving 'stars' that traverse the sky in 1–10 minutes. The brighter ones (ISS, Tiangong, Hubble Space Telescope, the Chinese Tianzhou cargo craft) are easily naked-eye visible. Most satellites are mag 3–6 — binocular targets. Geostationary satellites (the TV/communications ones) sit motionless above the equator and are mag 9–12 — telescope targets that don't move.

The International Space Station

Predicting and watching ISS passes

ISS basics

Altitude	About 400 km (250 miles). Decays slightly over time; periodically reboosted by visiting cargo craft.
Orbital period	About 92 minutes. Completes 15.5 orbits per day.
Speed	About 28,000 km/h (17,500 mph). Crosses the entire visible sky in about 5–6 minutes.
Brightness	Magnitude -2 to -5 at favorable passes. Only the Sun, Moon, and (rarely) Venus are brighter.
Size	About a football field (110m × 75m). The size of a soccer pitch with two American football fields stuck on either end. Largest human-built structure ever in space.
Visibility window	Visible only when sunlit. Best 1–2 hours after sunset and 1–2 hours before sunrise. During the deep middle of the night, ISS is in Earth's shadow and invisible (it 'disappears' mid-pass when entering eclipse).

How to predict ISS passes

NASA Spot the Station	**spotthestation.nasa.gov**. Official NASA prediction tool. Sign up for email/SMS alerts for passes from your location. The most reliable source.
ISS Detector app	Free Android/iOS. Push notifications for upcoming passes. Includes Starlink, Tiangong, and other satellites. Most popular satellite observing app.
Heavens-Above	**heavens-above.com**. Long-running comprehensive satellite prediction site. Used by serious observers. Lists every satellite visible from your location with star-chart visualizations of each pass.
Sky Live / Stellarium	If you already use Stellarium for astronomy, the satellites plugin (built-in) shows ISS and other satellites in real-time on the planetarium. Useful for in-the-moment 'what's that bright thing moving?'.

Reading a pass prediction

Pass predictions show several key numbers. Here's what they mean:

Time	When the pass starts. Local time is most useful — verify your app is set to your timezone.

Direction (start)	Compass direction where the ISS first appears. Usually 'WSW' or 'SW' for northbound passes; 'NW' for southbound passes.
Maximum altitude	How high the ISS gets above your horizon at the pass peak. Higher = better. **60° or more** = excellent (nearly overhead). **30–60°** = good. **Under 30°** = low pass, harder to see, often blocked by trees/buildings.
Direction (end)	Where the ISS exits your view. Usually opposite the start direction, but not always — passes can end in the east shadow.
Brightness (magnitude)	Predicted peak brightness. -3 or brighter is excellent (will dominate the sky). -1 to -2 is normal. -0 or fainter is dim (still visible but unimpressive).
Pass duration	How long the ISS will be visible. Usually 4–7 minutes. Shorter passes are lower altitude or eclipsed mid-pass.

> **The 'disappearing ISS' phenomenon**
>
> Sometimes the ISS appears to suddenly fade and vanish mid-pass, even though it's still high in the sky. This is the ISS entering Earth's shadow — it's no longer being lit by the Sun. From a ground observer's perspective, it just blinks out. Common during late-evening passes when the Sun has already set far enough that low orbits are in eclipse. The reverse — a satellite suddenly appearing where it wasn't a moment before — is the same thing, the satellite emerging from Earth's shadow into sunlight.

Photographing the ISS

From simple trail shots to detailed imaging

Trail across the sky (easy)

The most accessible ISS photo. Camera + tripod. Long exposure captures the ISS as a bright streak across the stars.

Lens	Wide-angle, 14–35mm. Wider captures more of the pass.
Settings	ISO 400–800, f/4 to f/5.6, 30 seconds to 4 minutes (depending on pass duration). Take multiple shots back-to-back if longer than your camera allows; stack with StarStaX (lighten mode) to combine into a single trail.
Composition	Include a foreground (tree, building, mountain). The ISS trail crossing a recognizable horizon makes the image.
Timing	Start exposure right before the pass begins. The trail will appear as a bright unbroken line — bright stars also leave faint trails, but the ISS dramatically outshines them.

ISS lunar/solar transit (advanced, spectacular)

Catch the ISS silhouetted against the Moon or Sun. The transit lasts about 1 second. Requires precise prediction and being at the right location to within ~1 km.

Predict transits	**Transit Finder** (transit-finder.com) by ISS-Transit.com creator. Enter your home location, see all upcoming ISS lunar and solar transits visible within driving distance. May require driving 10–50 km to be in the narrow visibility track.
Equipment	Camera + telephoto lens (300mm+) or telescope. For the Sun: **solar filter required** (see Solar Observing Guide). For the Moon: any aperture works.
Settings	Pre-focus on the Moon or Sun. High frame rate burst (10+ fps) covers the ~1 second transit. ISO 400, fast shutter (1/1000+ for the Sun, 1/250 for the Moon).
Result	Single dramatic image of the ISS as a recognizable silhouette (you can sometimes make out the solar panels) crossing the lunar or solar disk.

Detailed ISS imaging (very advanced)

Resolving structural details on the ISS — the solar panels, the modules, even individual segments. Requires a tracking telescope with manual or automated pointing fast enough to follow the ISS, plus a high-frame-rate camera. The premier names in this field (Thierry Legault, Sebastian Voltmer) produce images that resolve sub-meter features from the ground.

Equipment: 8-inch+ telescope on a fast altazimuth or specialized satellite tracking mount. Camera at 100+ fps. Stacking from the best frames during the brief seconds the ISS is in view and well-resolved. Not beginner work —

but the achievable level of detail from amateur equipment is genuinely remarkable.

Beyond the ISS

Tiangong, Starlink, Hubble, and the rest

Tiangong (Chinese Space Station)

China's space station, completed 2022. Smaller than the ISS but increasingly visible — peak magnitude around -1, comparable to a bright star like Sirius. Predictions in any satellite tracking app. Often passes within hours of the ISS at similar orientations because of similar orbital parameters.

Starlink trains

After SpaceX launches a fresh batch of Starlink satellites (typically 60+ at a time), they deploy in a tight string and spread out over the next few weeks. For the first 2–7 days after launch, the string appears as a dramatic line of evenly-spaced bright dots crossing the sky — the famous 'Starlink train.' Visible to the naked eye, very photogenic.

Where to predict	**findstarlink.com** — free site dedicated to Starlink predictions. Lists every recent launch and visibility times for your location.
Best timing	Days 2–7 after launch. Day 1 the satellites are in deployment configuration; after a week they've spread out and are no longer dramatic.
Photography	Same as ISS trails — long exposure, wide lens. The line of dots leaves a 'string of pearls' trail rather than a single line.
Controversy	Starlinks are bright enough to interfere with astronomical imaging (they leave streaks across long-exposure photos). The astronomy community has been critical; SpaceX has implemented dimming measures with limited success. Still, they're an unavoidable part of modern night skies.

Hubble Space Telescope

Mag 1–3 at favorable passes. Visible from latitudes 28°N–28°S — north of that you may not see it because of its low orbital inclination. Tracking apps include it.

Iridium flares (mostly historical)

The original Iridium satellite constellation was famous for spectacular brief flashes ('Iridium flares') as their flat antenna panels reflected sunlight directly to a tiny ground location. Could briefly reach mag -8 — brighter than Venus. **Most are now defunct** — the original constellation was retired by 2019 and replaced with Iridium NEXT satellites that don't produce the same flares. A few legacy satellites still occasionally flare. RIP one of the great satellite observing experiences.

Reentries

Decommissioned satellites and spent rocket stages occasionally reenter Earth's atmosphere, creating dramatic fireball-like displays. Predictable to within hours but the exact reentry track is uncertain to within a few minutes (during which the satellite has moved thousands of kilometers). Track upcoming reentries at **aerospace.org** or

satview.org.

Geostationary satellites (telescope target)

Communications and TV satellites at 35,786 km altitude — at this distance, their orbital period matches Earth's rotation, so they appear to hang motionless in the same spot above the equator. From northern latitudes, they're seen low in the southern sky. Magnitude 9–12 — telescope target. When pointed at one and using a clock-driven equatorial mount, the geostationary 'star' stays still while real stars drift through your field of view.

Tools and apps

Get the predictions you need

Heavens-Above	**heavens-above.com**. The encyclopedic satellite tracking site. Lists every visible satellite from your location for the next 10 days. Star-chart pass visualizations. Free, no login required.
NASA Spot the Station	**spotthestation.nasa.gov**. Official ISS pass predictions with email/SMS alerts. Simpler than Heavens-Above but ISS-only.
ISS Detector	Mobile app (iOS/Android). Push notifications for ISS, Tiangong, Starlink, and other notable satellites.
Sky Tonight / Star Walk 2	Mobile planetarium apps with built-in satellite tracking. Useful when you see a moving object and want to know what it is — point your phone at it and the app identifies it.
findstarlink.com	Dedicated to Starlink train predictions. Updated within hours of each SpaceX launch.
Transit Finder	**transit-finder.com**. Predicts ISS lunar and solar transits visible within driving distance of your location. Essential for transit photography.
Stellarium (with satellites plugin)	Built-in satellite plugin. Useful integrated with general astronomy planning.
CelesTrak	**celestrak.org**. The source of orbital elements (TLEs — Two Line Elements) that all the prediction software uses. Useful for advanced users who want to feed orbital data into custom tools.

Quick start: see the ISS tonight

1. Visit spotthestation.nasa.gov and enter your location. 2. Note the time and direction of the next pass with a peak altitude over 30°. 3. Be outside 5 minutes early. Look in the direction the pass starts (usually western sky). 4. Watch for a bright moving 'star' — fast, steady, no blinking. It crosses overhead in 4–6 minutes. 5. Wave. There are 7 humans up there.