Astrophotography for Beginners

Equipment · Software · Getting Started · Upgrade Paths

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Astrophotography for beginners

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The Golden Rules

- Know your sky first
  - Light pollution is your biggest obstacle — find a dark site before spending anything
  - Use a light pollution map to check Bortle ratings for sites near you
    - Stargard – Bortle 4, Wooglemai – Bortle 3, The Forest – Bortle 2 (*ref. Clear Outside*)
- Start with what you already have
  - A smartphone on a tripod can capture the Moon, star trails, and the Milky Way
- Decide your target before buying anything
  - Planets, deep sky, and wide-field Milky Way each need very different equipment
- **Mount quality is the single most important purchase**
  - Spend as much of your budget on the mount as possible — a shaky mount ruins everything else
- Buy used wherever possible
  - Quality used gear is available at 40–60% off retail
    (Ice In Space classifieds; Australia Astronomy Buy and Sell astrobuysell.com/au)
  - Borrow before you buy - MAS loan equipment

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01

Starting from Zero

What complete beginners need to know before spending anything

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Your First Night Out

- Use your smartphone to begin
  - Any modern smartphone in manual or pro mode can photograph the Moon and star trails
  - Download a dedicated night photography app for more control over ISO and shutter speed
- A tripod is non-negotiable
  - Even an inexpensive tripod eliminates camera shake
  - Use the self-timer or a remote shutter to avoid pressing-the-button blur
- Find the Milky Way
  - A free planetarium app shows exactly what's in the sky from your location tonight
  - Sydney's Milky Way core is best June–September, looking south toward the galactic centre
- The 500 Rule — avoiding star trails without a tracker
  - Divide 500 by your lens focal length (mm) to get max exposure before stars trail
  - Example: 18mm lens → 500 ÷ 18 = ~27 seconds maximum before trailing begins

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Camera Options for Beginners

- Smartphone
  - Pros: no extra cost, always with you, improving every generation
  - Cons: small sensor, limited manual control, struggles with faint deep-sky objects
  - Best for: Moon, star trails, wide Milky Way from dark sites
- DSLR or mirrorless camera
  - Pros: full manual control, large sensor
  - Mirrorless offers better live view for star focusing and lighter weight
  - Best for: all-round beginner imaging — the best value path
- Smart telescope (e.g. Seestar, Dwarf)
  - All-in-one unit: built-in camera, motorised mount, smartphone app control
  - Pros: minimal setup, no polar alignment, automatic finding and stacking
  - Cons: fixed optics, limited manual control, lower image quality ceiling
  - Best for: absolute beginners who want impressive results immediately

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What Can You Actually Photograph?

- The Moon — any camera, any tripod
  - Bright, large, forgiving. Fast shutter speed, low ISO. No tracking needed
- Planets — telescope required
  - Short video clips stacked in free software; requires a planetary or webcam-style camera
- Milky Way — wide-angle lens, tripod or star tracker
  - Best June–September from dark sites; use 500 Rule without tracking
- Star Trails — any camera, tripod, intervalometer
  - Stack hundreds of short exposures; no tracking needed; the South Celestial Pole makes circular trails
- Star Clusters — telephoto lens or small telescope
  - Bright enough to image from suburban skies; good for learning focus and framing
- Nebulae & Galaxies — equatorial mount, telescope, dedicated camera
  - Requires tracking, stacking, and processing — the deep end of the hobby

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02

Budget Tiers

What you get at each level of investment

Entry Level — Getting Started

What you can shoot: Moon, star trails, fixed wide-field Milky Way

- Camera: your existing smartphone, or an entry-level DSLR or mirrorless body
  - Buy used — plenty of capable bodies available at low cost
- Support: a basic but **solid** tripod
  - Must lock firm with no flex; check head movement is smooth before buying
- Accessories: remote shutter release and a spare battery
  - The remote prevents shake on long exposures; spare battery essential for cold nights
- Software: free planning and weather apps
  - (Stellarium, Telescopius, Clear Outside, Light Pollution Map)
- Key advice: shoot RAW; use whatever lenses you already own; practice, practice, practice

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Mid Range — Adding a Star Tracker

What you can shoot: tracked Milky Way, large nebula fields with a telephoto lens

- The key upgrade: a star tracker mounted on top of your tripod
  - Cancels Earth's rotation — transforms 15-second exposures into 2 – 5 minute ones
  - Requires polar alignment toward the South Celestial Pole
- Camera: a mirrorless body is ideal — lighter weight helps balance on a tracker arm
- Lens: a fast wide-angle lens (f/2.8 or wider) maximises light gathering
- Support: upgrade to a tripod rated for at least 5kg payload
  - Stability is more important now — the tracker sits on top and amplifies any wobble
- Polar alignment: use the tracker's built-in polar scope, or a software alignment tool

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Enthusiast Level — Going Deep Sky

What you can shoot: deep-sky nebulae, galaxies, long guided exposures

Build in this order — mount first, always

- Priority 1 — GoTo equatorial mount: finds and tracks objects automatically
  - Buy used — these are robust and widely available
- Priority 2 — Imaging telescope: a short, fast refractor is ideal for beginners
  - Low chromatic aberration and wide field make it forgiving and versatile
- Priority 3 — Dedicated astronomy camera: cooled sensors reduce noise significantly
  - One-shot colour cameras are the easiest starting point
- Priority 4 — Autoguiding: a second camera and guide scope watches a star and corrects drift
  - Enables 5–15 minute exposures; free software (PHD2) handles the corrections
- Don't overlook: dew heater strips — humid summer and cold winter nights cause condensation on optics

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Essential Software

Plan, capture, guide, stack, and process — mostly for free

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The Astrophotography Software Workflow

- Five stages: Plan → Capture → Guide → Stack → Process
  - Start with free tools at every stage — upgrade only when you've outgrown them
  - The most important rule: never upgrade a poor capture with better software

- Planning tools
  - Planetarium app (e.g. Stellarium, Telescopius, Sky Safari) — find targets and preview framing before you leave home
  - Weather and seeing forecast app — more useful than a general forecast for astronomy
  - Light pollution map — identify the nearest genuinely dark site for your latitude https://djlorenz.github.io/astronomy/lp/overlay/dark.html

- Capture & control software
  - Dedicated imaging software automates sequences, plate-solves, dithers, and restarts after clouds – NINA, Sharpcap, Astro Photography Tool (APT), Backyard EOS / Backyard Nikon, KStars / Ekos, Voyager
  - Hardware – ASIAir (ZWO ecosystem, StellarMate (open)
  - Polar alignment tools are built into some capture apps — easier than using a polar scope

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Stacking and Processing Software

- Always shoot calibration frames — darks, flats, and bias frames
  - These frames subtract sensor noise, dust shadows, and vignetting from your final stack

- Stacking software (free options available, eg Deep Sky Stacker, Siril)
  - Combines many short exposures to reduce noise; the more frames, the better
  - Entry-level stacking tools: drag-and-drop simplicity, good for first results
  - Advanced stacking tools: cross-platform, more powerful, handle calibration and stretching

- Processing software
  - Start with a free tool, eg Siril; move to paid software only when you've hit its limits
  - Paid processing platforms offer advanced noise reduction, colour calibration, and HDR, eg PixInsight
  - A general photo editor (e.g. Lightroom, Affinity Photo) works well for final colour grading
  - Seti Astro Suite Pro

- Specialist tools
  - AI star-removal tools separate stars from nebulosity for cleaner processing of each (eg StarNet++)
  - Gradient removal tools (eg GraXpert)
  - Plate-solving tools identify exactly where your camera is pointed from the star field

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Field Control: Replacing the Laptop

- The problem: running a laptop in the field is awkward, power-hungry, and dew-prone (???)
- The solution: a small dedicated controller that runs everything from a smartphone app
  - Examples: ZWO ASIAir, StellarMate
- What it does
  - Controls your camera, mount, guide camera, focuser, and filter wheel
  - Handles polar alignment, plate-solving, sequencing, dithering, guiding and image storage
  - All managed wirelessly from a tablet or phone
- Advantages
  - No Windows laptop required in the field
  - Compact, low power, purpose-built for astronomy
- Limitations
  - Only compatible with ZWO cameras, filter wheels, auto focusser (but with all makes of mount)
  - Less flexible than a full laptop for complex or non-standard setups
  - Wifi connction can be finnicky

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Upgrade Paths

Logical next steps from wherever you are now

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Four Starting Points — Where to Go Next

From a Smart Telescope	From a Smartphone	From a Visual Scope	From a DSLR + Tripod
Step 1 Learn processing with exported files	**Step 1** Entry DSLR or mirrorless body, or Smart Telescope	**Step 1** Camera adapter + dedicated cooled astronomy camera	**Step 1** Star tracker
Step 2 Add a DSLR + star tracker for wide-field	**Step 2** Star tracker for tracked Milky Way	**Step 2** GoTo upgrade for your mount	**Step 2** Dedicated cooled astronomy camera
Step 3 Progress to a GoTo EQ mount + scope	**Step 3** GoTo EQ mount + imaging scope	**Step 3** Autoguiding for long exposures	**Step 3** Narrowband filters for suburban skies

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Camera Upgrade: When to Move Beyond a DSLR

- Don't rush this — your DSLR/mirrorless will take you much further than most beginners expect
  - Only upgrade when sensor noise in long exposures is consistently your limiting factor
- DSLR or mirrorless (what you own)
  - Pros: no extra cost, full manual control, works for daytime photography too
  - Cons: warm sensor increases thermal noise; standard IR filter reduces sensitivity to emission nebulae
- Dedicated cooled astronomy camera — one-shot colour (OSC)
  - Sensor cooling reduces noise by 50–80% — a significant improvement for long summer nights
  - Designed for imaging automation; integrates with sequencing software
- Mono camera with filter wheel
  - Maximum sensitivity; enables narrowband imaging from suburban skies
  - Complex workflow — only consider after 12+ months of colour/OSC imaging

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05

Mounts in Detail

Tripods, star trackers, and equatorial mounts explained

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Why the Mount is the Most Important Decision

- The mount's job is to cancel Earth's rotation so stars appear stationary during a long exposure
  - If the mount drifts, stars trail — no amount of processing will fix a trailed exposure
- **A poor mount under a great telescope gives worse results than a great mount under a modest telescope**
- If possible, spend at least 50% of your total rig budget on the mount
- The four types of mount — in order of capability
  - 1. Tripod — fixed, no tracking
  - 2. Star tracker — single-axis rotation, camera only
  - 3. Alt-azimuth GoTo — two-axis motorised, good for visual and planetary
  - 4. Equatorial GoTo — aligned to Earth's rotation axis, essential for deep-sky imaging

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The Tripod — Fixed Support

- What it is: a fixed three-legged support — the camera does not move during an exposure
  - Earth's rotation causes stars to trail; the 500 Rule limits you to 15–30 second exposures
- What you can shoot
  - The Moon (fast shutter, no trailing visible at normal focal lengths)
  - Star trails — hundreds of short exposures stacked into circular trail images
  - Wide-field Milky Way using the 500 Rule
  - Landscape and foreground compositions with stars
- What to look for
  - Legs that lock solid — no flex or wobble under the camera's weight
  - A ball head or pan-tilt head that can point upward without flopping
  - Minimum 5kg payload rating if you plan to add a star tracker later
  - Avoid: ultra-cheap plastic leg locks — they loosen in the cold
- Note: a good tripod is still needed after you buy a mount — the mount sits on top of it

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The Star Tracker

- What it is: a motorised wedge that sits on your tripod and rotates the camera at Earth's rotation rate
  - Allows exposures of 2–5 minutes with a wide-angle lens before errors become visible
  - Does NOT find objects automatically — you aim the camera yourself
- How polar alignment works
  - The tracker's rotation axis must point toward the South Celestial Pole (SCP)
  - From Sydney, the SCP is roughly 34° above the southern horizon
  - Most trackers include a built-in polar scope for alignment (usefulness for SCP ???)
  - Software polar alignment (using a guide camera) is more accurate and easier for beginners
- What you can shoot
  - Wide-field Milky Way with 2–5 minute exposures — transformative improvement over a fixed tripod
  - Large nebula regions with a telephoto lens up to ~200mm
- Limitations
  - No GoTo — cannot automatically locate faint objects
  - Limited payload — not suitable for a full telescope and camera combination
  - Tracking accuracy degrades beyond ~200mm focal length without autoguiding

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Alt-Azimuth GoTo Mount

- What it is: a motorised mount moving on altitude (up/down) and azimuth (left/right) axes
  - A GoTo computer can find and track thousands of objects automatically
  - Does NOT have an equatorial axis — cannot correct for field rotation during long exposures
- What you can shoot
  - Excellent for visual observing of planets, Moon, clusters, and bright nebulae
  - Planetary and lunar imaging — short exposures mean field rotation is not an issue
  - Short deep-sky exposures up to about 60 seconds before field rotation becomes visible
- Good for: visual astronomers adding a camera for the first time
- Limitations for imaging
  - Field rotation: stars near the edge of the frame trace arcs during long exposures
  - Cannot be used for deep-sky imaging without a field de-rotator (expensive and complex)
  - Not suitable for tracking during stacked deep-sky imaging sessions

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Equatorial (EQ) GoTo Mount — The Deep-Sky Standard

- What it is: a mount with one axis aligned parallel to Earth's rotation axis (the polar axis)
  - Rotating the polar axis alone compensates for Earth's rotation — stars stay perfectly still
  - A GoTo computer database finds and slews to any object automatically after alignment
- What you can shoot
  - Any deep-sky object — nebulae, galaxies, clusters — with guided exposures of 5–30 minutes
  - Planets, Moon, star clusters — everything the alt-az does, plus long-exposure deep sky
- Entry-level EQ GoTo mounts
  - Suitable for small to medium telescopes and dedicated astronomy cameras
  - Buy used — these are robust and widely available from members who are upgrading
- Premium EQ mounts
  - Belt-drive mechanisms reduce periodic error for sub-arcsecond guiding accuracy
  - Higher payload capacity for larger or heavier optical tubes
  - Only needed when your imaging scope and camera exceed ~5–6kg combined
- Setting up an EQ mount
  - Requires polar alignment each session — aligning the polar axis toward the South Celestial Pole
  - Then a 2 or 3-star alignment so the GoTo computer knows exactly where it is pointing
  - The above two steps can also be done with software, eg NINA, ASIAir etc

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Adding Autoguiding to an EQ Mount

- What it does: a second camera watches a guide star and sends real-time corrections to the mount
  - Turns 2-minute exposures into 5–15 minute exposures with perfectly round stars

- How it works
  - A small guide scope is mounted on top of your main telescope, pointing at the same area of sky
  - A guide camera captures a bright star at high frame rate (several frames per second)
  - Guiding software (free) analyses the star's position and calculates drift corrections
  - Tiny pulses are sent to the mount's motors to nudge it back on target continuously

- What you need
  - A small guide scope (50–60mm aperture is sufficient)
  - A small, sensitive guide camera
  - Free guiding software (PHD2 is the standard; free and cross-platform) or ASIAir etc
- When to add autoguiding
  - After you have a GoTo EQ mount and are consistently getting well-tracked 2-minute exposures
  - When you want to push to longer exposures for fainter targets

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Mount Comparison Summary

Type	Tracks?	GoTo?	Deep Sky?	Best For
Tripod	No	No	No	Star trails, Moon, fixed wide-field
Star Tracker	Yes — wide-field only	No	Wide field only	Milky Way, large nebula regions
Alt-Az GoTo	Yes	Yes	Limited	Visual observing, planets, Moon
EQ GoTo (entry)	Yes	Yes	Yes	All deep-sky imaging
EQ GoTo (premium)	Yes — high precision	Yes	Yes	Heavy or demanding setups

💡 *Buy used where possible — a quality second-hand EQ mount outperforms a new budget one.*

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Questions & Discussion

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