# Seestar & Mak PixInsight Cheat Sheet



## WORKFLOW

| | Process | Seestar S50 | MK127 + 585MC |
|---|---|---|---|
| 1 | Blink / SubframeSelector | Cull cloud, dew, soft frames | Same; FWHM for focus drift |
| 2 | WBPP | Lights only · drizzle only if FWHM < ~2 px · autocrop · solve | Darks + flats + dark flats · no drizzle · solve |
| 3 | IntegerResample | — | 2× average (optional) |
| 4 | DynamicCrop | Rotation edges | Dither edges |
| 5 | GradientCorrection / GraXpert | Defaults | Structure protection on galaxies |
| 6 | BXT Correct Only | ✔ before SPCC | |
| 7 | SPCC | IMX462 or Seestar-LP curves · Ideal QE | IMX585 curves · or Duo-Band → HOO |
| 8 | BXT sharpen | Stars 0.25 · halos 0 · nonstellar 0.5 | Stars 0.25 · halos –0.05 · nonstellar 0.6 |
| 9 | StarXTerminator | Star image ✔ · Unscreen off on linear · skip for galaxies | |
| 10 | MAS / ArcsinhStretch | Starless: MAS · stars: gentle arcsinh | |
| 11 | NoiseXTerminator | 0.7–0.8 | 0.5–0.7 |
| 12 | Curves / LHE + mask | S-curve · saturation · LHE 0.2–0.4 | |
| 13 | PixelMath | `~((~starless)*(~stars))` | |
| 14 | Save As | XISF master · 16-bit TIFF · sRGB JPEG | |

Steps 1–9 **LINEAR** (physics) · 10–14 **NON-LINEAR** (aesthetics). No noise reduction before BXT. Gradients before colour.

## TROUBLESHOOTING

| | |
|---|---|
| Green cast | Normal OSC → SPCC |
| SPCC: no catalog | Configure Gaia DR3/SP; check solve focal length |
| Walking noise | Dither every 1–3 frames |
| Dark rings after BXT | Lower Sharpen Stars, raise halos |
| Hole round galaxy | Lower GC high threshold / protection on |
| Drizzle noisy | Stars not undersampled → Scale 1 |
| Plastic background | Lower NXT |
| Dust donuts | Reshoot flats, add dark flats |
| Mak stars bloated | Refocus every 1–2 °C; cull by FWHM |
| Blown out after stretch | STF still on → reset |

## PLANETS & DOUBLES (MK127)

| | |
|---|---|
| Train | No reducer · ADC · Q-Barlow 1.3× · UV/IR cut · 585MC |
| Scale | Native 0.40″ · 1.3× 0.31″ (f/15.4) · 2.25× 0.18″ (excellent seeing only) |
| Capture | SharpCap/FireCapture SER · 3–15 ms · high gain · ROI · Jupiter ≤ 3 min |
| Process | AutoStakkert! best 5–20% → wavelets → WinJUPOS · no WBPP/BXT |
| Jupiter | Opp ~11 Feb 2027 · 45″ · belts, GRS, moons |
| Mars | Opp ~20 Feb 2027 · 13.8″ · cap, albedo |
| Saturn | Evenings now · opp ~18 Oct 2027 · 20″ globe |
| Venus | Mornings · elongation ~4 Jan 2027 · phases |
| Ice giants | Uranus opp ~26 Nov 2026 3.8″ · Neptune ~29 Sep 2027 2.3″ |
| Key | Seeing > darkness · image near transit · cool the Mak 45–60 min |
| Doubles | Dawes 0.91″ · < 3″ at 0.31″/px lucky · Mak ring 1.45″ · PA N→E · try ε Ari 1.4″, 52 Ori 1.0″ |

## HISTOGRAMS

| | |
|---|---|
| Range | 0.0 black … 1.0 white; masters 32-bit float |
| Main peak | Sky = **median**. Linear 0.001–0.005 · stretched aim 0.10–0.15 |
| Peak width | Noise = **MAD** (Statistics) |
| Spike at 0 / 1 | Clipped shadows (lost) / saturated cores |
| RGB peaks apart | Colour cast; aligned after SPCC |
| Linear tools | Gradients, SPCC, BXT, rejection |
| Stretched tools | Curves, LHE, saturation, RangeSelection |
| STF auto | `black = median − 2.8·MAD · bg → 0.25` |
| STF linked | True colour; unlinked hides casts |

## STRETCHING

| | |
|---|---|
| MTF | `(m−1)x ÷ ((2m−1)x − m)` |
| | x = m → 0.5 · m 0.5 = no change · first stretch m ≈ 0.005 |
| Example | Sky 0.002 → 0.285 (×143) · star 0.9 → 0.999 |
| Starless (MAS) | bg 0.15 · aggr 0.7 · DRC 0.4 · contrast recovery on |
| Faint/short | bg 0.22 · aggr 0.9–0.95 · DRC 0.3 |
| Galaxy core | DRC 0.6 · saturation 0.6 |
| Stars | Arcsinh 10–50, protect highlights; or HT midtones |
| Costs | Noise gain = signal gain · black clip permanent · stars whiten |
| Rules | Save linear · stretch starless & stars apart · 2 moderate > 1 extreme · judge at 1:1 with STF off |

## NARROWBAND & FILTERS

| | |
|---|---|
| Lines | H-α 656 · O III 501 · S II 672 nm |
| Filter | None: galaxies, clusters · Duo: nebulae, any sky |
| HOO | `R=Ha G=B=OIII` |
| SHO | `R=SII G=Ha B=OIII` → SCNR green |
| Ha→RGB | `Ha−k(R−medR)` → add to R |
| Process | DBXtract · stretch apart · RGB stars · time 1:2:2 |

# Sky, Angles, Time & Mosaics



## ARCSECONDS

| | |
|---|---|
| `1° = 60′ = 3600″` | Eye ~60″ · 1″ = dime at 3.7 km |
| `206.265 × px(µm) ÷ f(mm)` | Seestar 2.39″ · MK127 0.61″ · bin 1.23″ · guider 6.4″ |
| `FOV = scale × px ÷ 60` | Seestar 76′×43′ · MK127 39′×22′ |
| `FWHM ≈ √(Σ blur²)` | Seeing, diffraction, guiding, focus |
| `Airy ≈ 1.03 λ/D` | Seestar 2.3″ · MK127 0.92″ |
| `ideal = FWHM ÷ 2…3` | <2 px drizzle · >3 px bin. Seestar measured ~3 px |
| `FWHM ≈ 2 × HFR` | N.I.N.A. HFR → FWHM |
| `blur ≈ 2.35 × RMS` | RMS ≤ scale ÷ 2: Mak 0.3″ / 0.6″ binned |
| `15.04″/s × cos δ` | Sky drift · Mak px in 0.04 s |
| `1 mas = 0.001″` | Gaia parallax / proper motion |

## COORDINATES

| | |
|---|---|
| DMS → dec | `d + m/60 + s/3600` |
| Dec → DMS | remainder × 60 → ′, remainder × 60 → ″ |
| Trap | 41° 30′ = 41.5°, **not** 41.30° |
| Signs | N, E positive · S, W negative · –0° 30′ = –0.5° |
| RA | $1^h = 15° \cdot 1^m = 15′ \cdot 1^s = 15″ \times \cos\delta$ |
| M31 | $00^h42^m44.3^s$ +41°16′09″ = 10.6846°, +41.2692° |
| FITS | `RA/DEC` decimal · `OBJCTRA/OBJCTDEC` text |
| Ground | 1° ≈ 111 km · 1′ ≈ 1.85 km · 1″ ≈ 31 m (lon × cos lat) |
| Site | 2–3 decimals enough · polar axis = latitude · N.I.N.A. ↔ GSS agree |

## MOSAICS

| | |
|---|---|
| Coverage | `frame × (N − (N−1)·overlap)` |
| Frames | Seestar 0.72°×1.27° · Mak 39′×22′ · 585+135 4.7°×2.7° · R8+135 15°×10° |
| Capture | 15–20% overlap · same rotation, subs, total per panel · Mak: Center each panel |
| Route A | Solve subs → MosaicByCoordinates → integrate |
| Route B | Stack panels (no autocrop) → BXT correct → solve → MBC → GMM shrink 10, feather 30+ |
| Seams | Gradients → depth → feather |

## TRUE VS MAGNETIC NORTH

| | |
|---|---|
| True north | Along longitude to the geographic pole; celestial pole above it at altitude = latitude |
| Magnetic north | Where a compass points; drifts over the years |
| Correction | `true = magnetic + declination (E +, W −)` |
| Example | 10° W: true north is 10° right of the needle |
| Look up | NOAA/NCEI magnetic field calculator (WMM) |
| Steel | Mount, tripod, car deflect compasses: take bearings a few metres away |
| Polar error | $drift \approx error \times 7.29\times10^{-5}$ /s |
| | 10° ≈ 2.6″/s · 1° ≈ 0.26″/s · 5′ ≈ 0.02″/s |
| Target | Mak ≤ 5′: compass rough → polar scope / TPPA / SharpCap |
| Polaris | ~0.6° (37′) from the pole in 2026 |
| Seestar | Alt-az mode needs no north; wedge/EQ mode does |

## TIME

| | |
|---|---|
| UTC | `UTC = local − offset` |
| | 21:00 at UTC–5 = 02:00 UTC next day · DST ±1 h |
| FITS | `DATE-OBS` = UTC exposure start |
| SFS midnight | UTC hour of local midnight (UTC–5 → 5) |
| Sidereal day | 23 h 56 m 4 s · stars ~4 min earlier/night |
| LST | `GMST + lon/15 · HA = LST − RA` |
| HA = 0 | Transit: highest, meridian flip |
| Clock error | `1 s = 15″ · 1 min = 15′ · 1 h = 15°` |

## ALTITUDE & REFRACTION

| | |
|---|---|
| Max altitude | `90° − \|lat − Dec\|` |
| Airmass | ≈ sec z · 60° 1.15 · 45° 1.41 · 30° 2.0 · 20° 2.9 · 10° 5.6 |
| Seeing | FWHM × $X^{0.6}$ (30°: +50%) |
| Refraction | ≈ 58″ tan z · 45° 1′ · 30° 1.7′ · horizon 34′ |
| Dispersion | 30° ≈ 1.6″ blue-up/red-down · ADC for planets |
| Field rotation | $15.04 \cos\varphi \cos A \div \cos h$ °/h |
| Rules | Stay > 30° · centre on transit · Seestar < ~80° alt |

## LIGHT POLLUTION

| | |
|---|---|
| Unit | mag/arcsec² · bigger = darker · 1 mag = 2.512× |
| Bortle→SQM | 1: 22.0 · 3: 21.7 · 4: 20.5–21.7 · 5: 19.5–20.5 · 6: 18.9–19.5 · 7: 18.4–18.9 · 8–9: <18.4 |
| Time | ∝ sky brightness: 1 mag brighter ≈ 2.5× integration |
| Filters | Duo-Band/LP: emission nebulae anywhere · broadband: filter off, dark, no Moon |
| Moon | Full Moon ≈ +3 mag/arcsec² at dark sites |

## MOON & PLANNING

| | |
|---|---|
| Cycle | 29.53 d · rises ~50 min later each day |
| Phases | FQ sets ~midnight · full up all night · LQ rises ~midnight |
| Broadband | ±5 days of new Moon or Moon down · ≥ 60° from Moon |
| Narrowband | Any phase · ≥ 30° away · O III suffers first |
| Darkness | Sun > 18° down · nautical 6–12° · astro 12–18° |
| Plan | Dark window → target > 30° near transit → forecast (cloud, transparency, seeing) → filter & subs → flip time → focus & calibration |
| Next | New 9 Dec · FQ 16 Dec · full 24 Dec · LQ 31 Dec 2026 (±1 day) |

# Capture, Gear & Data



## SUB LENGTH & GAIN

| | |
|---|---|
| Rule | `sub ≥ 10·RN² ÷ sky e⁻/px/s` |
| 585MC | Gain ~252 (HCG) · RN <1 $e^-$ · one gain/offset for all rigs |
| Mak | No filter 30–60 s · Duo-Band 180–300 s |
| 135 f/2 | No filter 15–30 s · Duo-Band 60–120 s (stars, not noise, set it) |
| Seestar | LP on: 20–30 s if firmware allows (10 s ≈ 2× noise) |
| Moon | +2–3 mag sky → shorter subs fine · narrowband stays efficient |

## FOCUS

| | |
|---|---|
| CFZ | `±1.34·N² µm (550 nm)` |
| | 135 f/2 ±5 · f/2.8 ±10 · Seestar ±34 · Mak f/7.7 ±80 µm |
| Tools | Bahtinov mask · N.I.N.A. HFR minimum · tape the ring |
| Mak | Finish turning against gravity · re-centre after focusing |
| When | Every 1–2 °C or FWHM +10% · EAF for autofocus |

## GTI & PHD2

| | |
|---|---|
| Mount | EQ mode on wedge · east-heavy · GS Server ASCOM |
| Polar | TPPA / PHD2 static / SharpCap · Mak <5′, 135 <10′ |
| Profile | ASI120MM Mini 3.75 µm · 120 mm → 6.4″/px |
| Calibrate | Dec ~0°, near meridian · then Guiding Assistant |
| Settings | 1–2 s · multi-star · RA Hysteresis ~70% · min-move 0.15–0.2 |
| Target RMS | Mak ≤0.3″ (0.6″ binned) · 585+135 ≤2″ · R8 ≤4″ |
| Dither | Mak 1–2 · 135 rigs 3–5 guide px · settle 0.5–1 px |
| Flip | 5–10 min past meridian · re-centre by plate solve |

## DEW & POWER

| | |
|---|---|
| Dew | Mak shield ~1.5×D + strip · lens & guide strips · Seestar heater on |
| Control | 2–3 °C above ambient (~30–50% PWM) |
| C300 | 288 Wh → ~245 usable |
| Draw | GTi 6–10 · PC 8–15 · cams 2 · dew 2–5 W each |
| Runtime | Mak rig ~8–10 h · 135 rig ~9–12 h · charging Seestar –1–3 h |

## MK127

| | |
|---|---|
| Cool | 45–60 min outside first |
| Collimate | Defocused star · 3 push-pull pairs under rear plugs · tiny steps |
| Reducer | 55 mm rear thread → sensor · ~42.5 mm spacers on 585MC |
| Solve | 955–985 mm with reducer · ~1450–1520 native |
| Diagnose | AberrationInspector · FWHMEccentricity · all corners = spacing, one = tilt |
| Native? | Reducer + 2×2 ≈ native + 3×3 signal · native for planets, doubles, tiny PNe |

## CALIBRATION LIBRARY

| | |
|---|---|
| Darks | 20–30 · per exposure · 5 °C bins · same gain/offset · redo 6–12 mo |
| Flats | 20–30 every session · peak ~40–50% · + dark flats |
| R8 | Dither, flats, bias · library darks rarely match |
| Seestar | Lights only (own darks applied) |

## DATA

| | |
|---|---|
| Size | 585MC 16.6 MB/sub · Seestar 4 MB · R8 ~30 MB · WBPP temp 3–5× |
| Folders | Target / Rig_Filter / evening date / Lights |
| N.I.N.A. | `$$TARGETNAME$$\$$DATEMINUS12$$\…` |
| Keep | Culled lights · masters · .pxiproject · TIFF · delete WBPP temp |
| Backup | 3-2-1 · session log |

## COMETS & EVENTS

| | |
|---|---|
| Comets | Register on stars → CometAlignment → stack twice → screen blend |
| Sub limit | motion (″/min) × sub (min) < scale |
| Meteors | Geminids 13–14 Dec 2026 excellent · Quadrantids, η Aquariids, Perseids 2027 good |
| Eclipse | Total solar 2 Aug 2027 (Spain, N. Africa, Egypt) |

## SCIENCE

| | |
|---|---|
| Variables | ASTAP / AstroImageJ → AAVSO |
| Exoplanets | Mak, defocused, 2–4 h → ETD, ExoClock |
| Occultations | Video + accurate time → IOTA |
| Rule | Linear, calibrated data only: no stretch, BXT or NXT |

## CAPTURE TROUBLESHOOTING

| | |
|---|---|
| Same-direction trails | Guiding, wind, balance, cables |
| Corners differ | Tilt or spacing |
| Stars swell | Focus drift or dew |
| Rain streaks | Walking noise → dither |
| Trails in subs | Satellites → ESD rejection, ≥15–20 subs |
| Flat rings | New flats each session; dark flats |
| Solve fails | Focal length / pixel size · 5–10 s exposure |

## PLANNING & EXPORT

| | |
|---|---|
| Targets | Telescopius · Stellarium · N.I.N.A. Sky Atlas |
| Weather | Clear Outside · Astrospheric · Meteoblue seeing · Windy |
| Export | Master XISF + 16-bit TIFF → ICCProfileTransformation sRGB → Resample |
| Sizes | AstroBin full · forums 2–3k px · Instagram 1080 wide, 4:5 |
| JPEG | Quality 90–95 · check 100% · check on a phone |