FieldNotes: The Core PixInsight Workflow (OSC)

Flatten, calibrate, correct, separate, denoise, stretch, recombine. The fixed order I run on every one-shot-colour stack before any creative work starts.

Rig context: ASI585MC Air or Seestar data on the FRA400 or 107PHQ, captured through ASIAIR, stacked in WBPP or Siril. PixInsight 1.9.x with the RC Astro suite (BlurXTerminator, StarXTerminator, NoiseXTerminator). MultiscaleAdaptiveStretch ships with PixInsight; ImageBlend is a free add-on.

The workflow at a glance

STAGE 0 OPEN AND SOLVE — linear

1 Open the cropped master, auto STF
Ctrl/Cmd+A. Close any crop mask that opens beside it. Ugly colour is normal.

2 Plate solve if not already solved
Script > Image Analysis > ImageSolver. SPCC will not run without it.

STAGE 1 FLATTEN AND CALIBRATE — DBE, SPCC

3 DynamicBackgroundExtraction
Samples on empty sky, Tolerance 1 to 2, Subtraction for light pollution. MGC for frame-filling nebulae.

4 SpectrophotometricColorCalibration
Pick the real filter per channel. Dual-band: Photon Flux white reference. Unsure: defaults.

STAGE 2 CORRECT, SHARPEN, SEPARATE — BXT, StarX

5 BlurXTerminator, Correct Only
Rounds stars, fixes colour offsets, no sharpening. Run on everything.

6 BlurXTerminator, nonstellar only
Sharpen Stars 0, Halos 0, Sharpen Nonstellar 0.50 to 0.90 by target.

7 StarXTerminator, generate star image
Unscreen off (linear). Rename windows **stars** and **nebula** immediately.

STAGE 3 DENOISE — NXT on the starless image

8 Over-stretch the screen to see the noise
STF: zoom the histogram, black point right, midpoint left. Preview only, nothing is changed.

9 NoiseXTerminator
Iterations 5. Both separation modes on, sliders from zero: HF Colour, HF Intensity, LF Colour, LF Intensity.

STAGE 4 STRETCH — now permanent

10 Stars: STF into HistogramTransformation
Drag the STF triangle to the bottom bar of HT, apply to stars, reset both.

11 Starless: MultiscaleAdaptiveStretch
Screen stretch OFF first. DRC 0, tune Aggressiveness and Target Background, Colour Amount low.

12 CurvesTransformation, light touch
Optional. RGB/K contrast, per-channel balance. Finishing only.

STAGE 5 RECOMBINE AND SAVE — ImageBlend

13 ImageBlend, Screen mode
Base = starless, Blend = stars. Midtones below 0.5 bigger stars, above 0.5 smaller.

14 File > Save Project
Tidy the desktop, keep every window open, save beside the master as Target v1.

15 Export
16-bit TIFF master, then JPEG at quality 100 into the JPEG folder.

Optional: the TIFF from step 15 is the hand-off to Photoshop or Affinity for colour, contrast and texture work. Do that on the starless layer, bring it back, and recombine the stars in ImageBlend as in step 13.

Two habits that make everything else work. The blue tick on each tool must be on and the image you want to edit must be the last one clicked. And use the undo and redo arrows after every step: if you cannot see the improvement, question the step.

The logic in one line: gradients out before colour is fitted, deconvolution before any noise reduction, stars out before the hard stretch, and nothing permanent happens to the pixels until step 10.

NON-NEGOTIABLE

- Astrometric solution in the header before SPCC.
- Gradient removal **before** SPCC, not after.
- BlurXTerminator before NoiseXTerminator. Never sharpen smoothed noise.
- BXT, StarX and NXT all run on **linear** data.
- Screen stretch off before MultiscaleAdaptiveStretch.
- Reset STF and HT after the star stretch or the next preview will blow out.
- Save Project before closing any window.

YOUR CALL

- DBE versus MultiscaleGradientCorrection. DBE when there is clean sky to sample; MGC when the nebula fills the frame.
- Subtraction or Division in DBE. Decided by the residual, not the site.
- Sharpen Nonstellar amount. 0.90 on soft dust, 0.50 to 0.60 on hard filaments.
- The NXT single-slider route versus the four-slider manual route.
- MAS Aggressiveness, Target Background and how much saturation to leave for later.
- Star weight in ImageBlend.

Why this order

The sequence is not arbitrary. Gradient removal goes before colour calibration because SPCC neutralises the background as part of its fit; if a light-pollution gradient is still in the image, the fit is made against a sky that is not flat and the colour drifts. Deconvolution goes before any noise reduction because sharpening smoothed noise creates structure that was never there. Stars come out before noise reduction and stretching so the starless layer can be stretched hard without bloating them. Everything up to step 9 happens on linear data; the only stretching you see on screen before then is a ScreenTransferFunction preview, not a change to the pixels.

> **Check: confirmed by RC Astro.** The NoiseXTerminator manual states that noise reduction of any kind should never be applied before deconvolution of any kind, including BlurXTerminator. The BlurXTerminator technical manual describes the two-pass approach used here: Correct Only first, then a second application with the sharpening settings.

Stage 0: Open and solve

Step 1. Open and inspect. Open the cropped, registered master from your stacking output. Some stackers save a crop mask beside the master; if a second window opens showing only a rectangle, close it. Press Ctrl/Cmd+A to auto-stretch the screen. Expect a teal or green cast. Look at the per-channel histograms and you will see why: each channel has a different black point and contrast, so the combined view is skewed. Nothing is wrong with the data.

Step 2. Plate solve. SPCC needs an astrometric solution in the header. WBPP writes one when solving is enabled, and ASIAIR and Seestar masters usually arrive solved. If not, Script > Image Analysis > ImageSolver with the target coordinates, focal length and pixel size:

Field	FRA400	107PHQ	Seestar S30 Pro
Pixel size	2.9 um	2.9 um	2.9 um
Focal length	400 mm (280 reduced)	749 mm	150 mm
Image scale	1.50”/px (2.14 reduced)	0.80”/px	3.99”/px

Stage 1: Flatten and calibrate

Step 3. DynamicBackgroundExtraction. Click the image to see the crosshair, then click to place samples on parts of the frame with no nebulosity, galaxy or dust. You are mapping empty sky. A dozen well-spread samples is usually enough. If sample boxes turn red the tolerance is too tight; the default of 0.5 is often too low for real data, so raise Tolerance to 1, then 2 if boxes are still dark or rejected. Click outside the field to refresh the previews. Leave Smoothing Factor and Shadows Relaxation at default.

Under Target Image Correction, choose the correction type by the shape of what is wrong:

Residual	Correction	Why
Sky brighter on one side, colour cast across the frame	Subtraction	Light pollution and moonlight add signal. Subtract it.
Bright centre, dark corners after calibration	Division	Vignetting and flat errors scale signal. Divide it out.
Not sure	Try both, compare	Wrong choice shows as a colour shift where the gradient was strongest.

Apply with the green tick. You get the extracted background model (look, then close) and the corrected image. Auto-stretch the corrected image and the cast should be gone.

The refinement trick. Drag the DBE triangle onto the PixInsight desktop to create a process icon holding your sample positions. Close DBE. Select the corrected image and double-click the icon: same samples on the cleaner image, where mistakes are easier to spot. Move or delete any sample sitting on faint nebulosity, add a couple more, drag a second icon out and rename it `DBE v2` (right-click the icon, or the small N). Go back to the original master,

double-click `DBE v2`, apply. The second pass on the original data with better samples is usually the keeper.

When DBE cannot find sky. On a frame-filling emission nebula there is nowhere clean to sample. Use MultiscaleGradientCorrection with the MARS reference data instead; it needs the plate solve from step 2 and no samples at all.

> **Check: confirmed by PixInsight.** The DynamicBackgroundExtraction documentation states that the background model must be subtracted to correct additive effects such as gradients from light pollution or the moon, and divided to correct multiplicative effects such as vignetting or differential atmospheric absorption. Site darkness is not the deciding factor.

Step 4. SpectrophotometricColorCalibration. Search `spectro` in Process Explorer. The tool looks intimidating and is not.

Setup	What to set
Colour camera, no filter	Defaults. Apply.
Colour camera with a dual-band or multi-band filter	Pick the filter in each of the Red, Green and Blue dropdowns. White Reference to Photon Flux. For the most accurate result enable Narrowband Filters Mode with per-channel wavelength and bandwidth, the Ideal QE curve, and a background reference ROI.
Mono, RGB filters	Pick the actual filter set per channel (Astronomik Deep Sky Red, Green, Blue).
Mono, SHO	Narrowband Filters Mode. SII 672.0 nm, Hα 656.3 nm, OIII 500.7 nm, with your filter bandwidth (6 nm for the Astronomik 6 nm set). Photon Flux white reference.
Cannot remember what you shot with	Reset to defaults and apply. Wrong filter is worse than no filter.

Common dual-band filters are in the stock list. If yours is missing (some multi-band filters have to be added by hand in the filter manager) it is a one-off job worth doing.

Apply by dragging the triangle onto the image. The fit graph opens: detected stars should cluster along the fitted line. Stars scattered well above or below it mean the wrong filter selection or a gradient still in the frame. Close the graph, auto-stretch, compare with the DBE output. Hα should now read red with a neutral background.

> **Check: confirmed by PixInsight.** The SPCC documentation requires a valid astrometric solution and recommends applying it to gradient-corrected linear data. The Photon Flux white reference is the documented choice for narrowband and dual-band data.

Stage 2: Correct, sharpen, separate

Step 5. BlurXTerminator, Correct Only. Tick Correct Only and apply. This rounds the stars, fixes chromatic offsets and mild coma, and does no sharpening. Undo and redo to compare; on any rig with a hint of tilt the difference is obvious.

Step 6. BlurXTerminator, nonstellar sharpening. Untick Correct Only. Sharpen Stars 0, Adjust Star Halos 0: the stars are as tight as I want after step 5 and more looks artificial. Automatic PSF on. Sharpen Nonstellar to taste:

Target type	Start	Notes
Soft dust, reflection nebulae, faint broadband fields	0.90 (default)	Effect is subtle. Use a preview to see it at all.
Galaxies	0.70 to 0.90	Watch the core for ringing.
Hard filaments (Veil, Crescent, Cygnus Loop)	0.50 to 0.60	Responds hard. Default over-cooks it.

> **Check: confirmed by RC Astro.** Sharpen Nonstellar is a 0 to 1 control with a default of 0.90. The 2.0/AI4 release notes state the Correct First convenience option is disabled and that the same effect is achieved by running BlurXTerminator twice, Correct Only first and then with the desired sharpening.

Step 7. StarXTerminator. Tick Generate star image and apply. The data is linear, so leave Unscreen stars off; that option is for stretched images. Rename the two windows at once by double-clicking the name tab: `stars` and `nebula`. Later tools reference images by name and tidy naming saves real confusion in steps 10 to 13.

With the stars gone you can see what they were hiding: residual cast, faint gradient, vignetting. If anything is obvious, a second DBE pass on the starless image is fair game.

Stage 3: Denoise

Step 8. Make the noise visible first. STF is what Ctrl/Cmd+A has been driving all along; the pixels are still linear and dark. Open the STF tool and it is a levels control: black point, midpoint, white point. On linear data the two left points sit almost on top of each other, so click the magnifier and click repeatedly at the far left of the histogram to zoom in. Drag the black point right and the midpoint left. You are deliberately over-stretching so the grain is obvious before you remove it. This is also the best way to inspect a frame for dust shadows and gradient remnants. Lost? The 1:1 zoom button and the radioactive auto-stretch button put you back.

Step 9. NoiseXTerminator. Defaults are Denoise 0.90, Iterations 2. Raise Iterations to 5; slower, better noise estimate. The single Denoise slider is the quick route: towards 0.70 on well-integrated data, 0.90 on short integrations.

For proper control tick both Intensity/Colour separation and Frequency separation. Open a Real-Time Preview (hollow circle at the bottom of the tool), use the select-preview box-in-a-box button to zoom into a noisy patch, set all four sliders to zero, then bring them up one at a time:

Order	Slider	What it removes	Typical
1	Denoise HF Colour	Sand-like chroma grain, most of what you see in OSC	0.90
2	Denoise HF Intensity	Fine luminance grain	0.90
3	Denoise LF Colour	Blotchy colour mottle	0.60 to 0.80
4	Denoise LF Intensity	Luminance blotches	Lighter. This is the one that turns nebulosity into watercolour.

HF/LF Scale sets the pixel scale that splits the two bands; leave it unless you are working at unusual sampling. Zoom back out (bottom left of the preview), close the preview, apply, compare. The screen is still over-stretched from step 8, so residual noise looks worse than it will in the finished image.

> **Check: confirmed by RC Astro.** The NoiseXTerminator 2/AI3 manual describes the Intensity/Colour and Frequency separation modes, the HF/LF Scale parameter, and notes that reducing colour noise more than intensity noise keeps a natural appearance. Iterations applies to AI version 3 only. The separation modes need a colour image, which OSC data already is.

Stage 4: Stretch

Step 10. Stars. Select `stars`. Open ScreenTransferFunction and HistogramTransformation, confirm the blue tick is on in both and both title bars say `stars`. The auto STF on the stars is usually a good stretch already; you are making it permanent.

1. Drag the STF triangle and drop it on the thin bar at the bottom of the HT window. Nowhere else works.
2. Apply HT to `stars` (square icon, or drag the HT triangle onto the image).
3. The image blows out, because STF is now previewing an already stretched image. Reset STF and reset HT.

Drag, apply, reset, reset. The stars are now permanently non-linear.

Step 11. Starless, MultiscaleAdaptiveStretch. Select `nebula`. Turn the screen stretch off first (monitor icon in the toolbar) or you get the same blown-out preview. Search `multi` in Process Explorer, open MultiscaleAdaptiveStretch, click the nebula image, open the Real-Time Preview.

Control	What it does	Where I start
Target Background	Final brightness of the sky	0.10 to 0.20. Large extended nebulae 0.25 to 0.40.
Aggressiveness	Shadows clipping point. Higher pulls more out of the background at a noise cost.	Default, then nudge.
Dynamic Range Compression	How hard bright areas are held back and star profiles preserved	0 for a pure midtone stretch on emission nebulae. Raise for a bright galaxy core.
Colour Saturation Amount and Boost	Saturation curve in HSV	Low. I want the stretched image slightly flat so colour is still mine to shape.

Reset (bottom right) returns to defaults. When happy, close the preview and drag the triangle onto the image.

> **Check: confirmed by PixInsight.** The MAS 1.1 documentation describes Dynamic Range Compression at 0 as pure midtone-based stretching, gives 0.10 to 0.20 as the usual background range with 0.25 to 0.40 for large extended objects, and warns that saturation enhancement on high dynamic range images can clip highlights. The documented alternative is to stretch with saturation off, compress with HDRMultiscaleTransform, then add saturation in CurvesTransformation.

Step 12. CurvesTransformation, optional. Blue tick, Real-Time Preview. RGB/K for a gentle S-curve; individual channels to add colour in the highlights and pull it from the shadows. The blue circle at the top left of the preview toggles before and after; the red X resets. Keep it light. Anything more involved is better done in Photoshop or Affinity on the TIFF from step 15.

Stage 5: Recombine and save

Step 13. ImageBlend. ImageBlend is a free process from Cosmic Photons, not part of the core install. Add `https://www.cosmicphotons.com/pi-scripts/imageblend/` under Resources > Updates > Manage Repositories, check for updates, restart. Once installed it appears in Process Explorer search.

Base image: the stretched starless. Blend image: `stars`. Blend mode: Screen (the default is Replace). The Blend Image Midtones slider under the stars section (default 0.5) sets star weight: left of 0.5 bigger and brighter, right of 0.5 smaller and fainter. No correct value; judge it against the target. Apply with the green tick (collapse sections if you cannot see it), close ImageBlend. That is version one.

> **Check: confirmed by Cosmic Photons.** ImageBlend is distributed from the Cosmic Photons repository and requires PixInsight 1.9.4 or later for the current release. Screen is the documented mode for star replacement; the reverse, unscreen, exists for pulling stars back out of a stretched image.

Step 14. Save Project. File > Save Project takes a snapshot of every open window, process icon and history entry. Do this before closing anything. Tidy the desktop first: `stars`, master and `nebula` top left, DBE icons together. Save beside the stacked master as `Target v1`. Keep every intermediate image open in the project; if you later spot a NoiseXTerminator or DBE mistake, right-click the image tab, open History Explorer, and step back to before that process. Reopen with File > Load Project.

Step 15. Export. File > Save As. A 16-bit TIFF first; that is the master for Photoshop, Affinity and print. Then JPEG at quality 100 into a JPEG subfolder as `Target v1`. Versions two, three and four follow as the image is revisited.

Troubleshooting

Symptom	Likely cause	Fix
SPCC reports no astrometric solution	Master never solved, or a crop after solving dropped it	ImageSolver, then SPCC
SPCC graph shows stars scattered off the line	Wrong filter chosen, or gradient still present	Reset to defaults, or go back to DBE
DBE boxes red or black	Tolerance too tight	Raise to 1, then 2
Colour shift where the gradient was strongest after DBE	Wrong correction type	Swap Subtraction and Division
Tool applied and nothing happened	Blue tick off, or wrong image last clicked	Tick on, click the target image, reapply
Everything blown out after the star stretch	STF still previewing a stretched image	Reset STF and HT
MAS preview looks white	Screen stretch still on	Monitor icon off, reopen the preview
Nebulosity looks like a painting after NXT	LF Intensity too high	Back it off; the LF sliders are the culprit
Dark rings round stars after BXT	Nonstellar too high on a high-contrast target	Drop to 0.50 to 0.60
Stars doubled or haloed after ImageBlend	Blend mode still Replace, or stars unscreened when they should not be	Screen mode; Unscreen off in StarX on linear data
ImageBlend not in Process Explorer	Repository not added	Resources > Updates > Manage Repositories

Sources checked

- PixInsight Reference Documentation: DynamicBackgroundExtraction (correction types), ScreenTransferFunction, HistogramTransformation, SpectrophotometricColorCalibration.
- PixInsight development notes and tool documentation for MultiscaleAdaptiveStretch 1.1.
- RC Astro: BlurXTerminator Technical Manual and 2.0/AI4 release notes; NoiseXTerminator 2/AI3 user manual; StarXTerminator documentation.
- Cosmic Photons: ImageBlend repository and release notes.