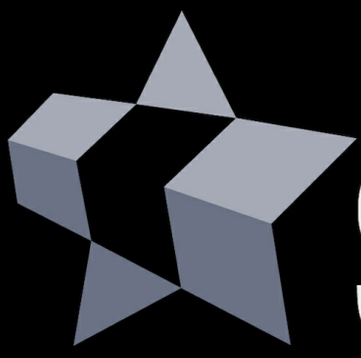


StarTools

Introduction

Do not be fooled by StarTools' simple interface. You are forgiven if, at first glance, you get the impression StarTools offers only the basics. Nothing could be further from the truth!

StarTools goes deep - very deep in fact. It is just not "in your face" about it, and you can still get great results without delving into the depths of its capabilities. It is up to you how you wish to approach image processing.

If you are a seasoned photographer looking to get more out of your data, StarTools will allow you to visibly gain the edge with novel, brute-force techniques and data mining routines that have only just become viable on modern 64-bit multi-core CPUs, GPU compute power, and increases in RAM and storage space.

If you are a beginner, StarTools will assist you by making it easy to achieve great results out-of-the box, while you get to know the exciting field of astrophotography better.

Whatever your situation, skills, equipment and prior experience, you will find that working with StarTools is quite a bit different than any software

you may worked with prior. And in astrophotography, that tends to be a *good* thing!

Quick Start Tutorial: a quick generic work flow

Getting to grips with new software can be daunting, but StarTools was designed to make this as painless as possible. This quick, generic work flow will get you started.

While processing your first images with StarTools, it may help knowing that the icons in the top two panels roughly follow a recommended workflow when read top to bottom, left to right.

The screenshots in this quick start tutorial, use an intentionally modest, flawed DSLR dataset to demonstrate some common pitfalls. If, however, you process high quality OSC, mono CCD, space telescope or space probe datasets, whether they be narrowband or visual spectrum datasets, you will be happy to know that the general workflow and considerations are substantially the same.

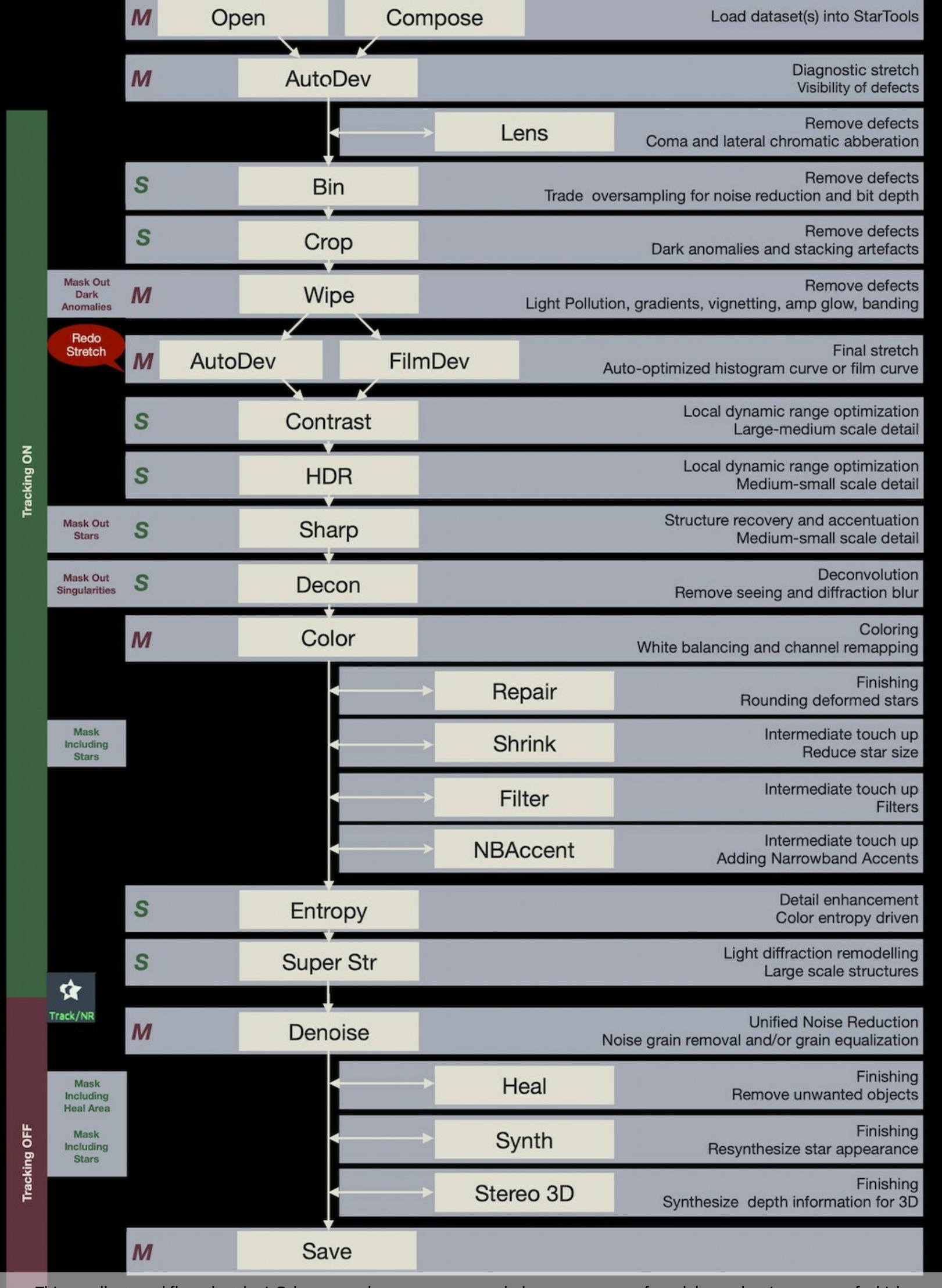
The icons in the top two panels roughly follow a recommended workflow when read left to right, top to bottom.

Workflows

With a suitable dataset, workflows in StarTools are simple, replicable and short. Most modules are visited only once, with a clear purpose.

If you are familiar with other processing applications, you may be surprised with the seemingly erroneous mixing of modules that operate on linear vs non-linear data.

In StarTools, this important distinction is abstracted away, thanks to the signal evolution Tracking engine. In fact, it lets you do things, with ease, that are hard or impossible in other applications.



This excellent workflow chart by J. Scharmann shows a recommended core sequence of modules and actions some of which are (M)andatory, while others are merely (S)uggested. See links & tutorials section for more elaborate workflows.

Step 1: Import, start Tracking

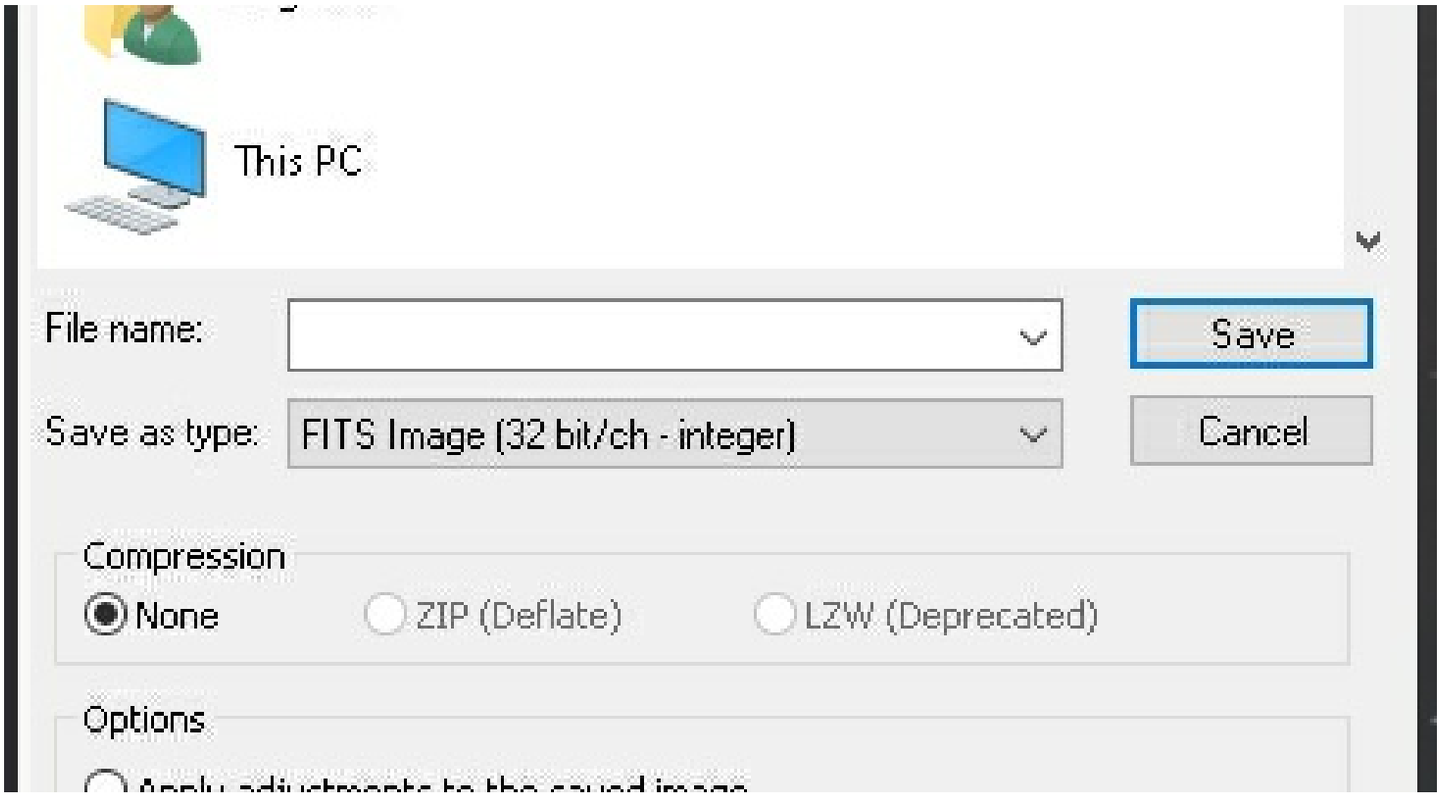
Open an image stack (''dataset''), fresh from a stacker. Make sure the dataset was stacked correctly, as StarTools, more than any other software, will not work (or work poorly) if the dataset is not stacked correctly or has been modified beforehand. Your dataset should be as ''virgin'' as possible, meaning unstretched, not colour balanced, not noise reduced and not deconvolved. Please consult the ''starting with a good dataset'' section in the ''links & tutorials'' section.

Upon opening an image, the Tracking dialog will open, asking you about the characteristics of the data. Choose the option that best matches the data being imported. If your dataset comes straight from a stacker, the first option is always safe. The second option may yield even better results if certain conditions are met. Depending on what you choose here, StarTools may work exclusively on the luminance (mono) part of your image, bringing in color later; StarTools is able to seamlessly process color and detail separately (yet simultaneously).

Tracking is now engaged (the Track button is lit up green). This means that StarTools is now monitoring how your signal (and its noise component) is transformed as you process it.

Once imported, counter-intuitively, a good stacker output will have a distinct, heavy color bias with little or no apparent detail. Worry not; subsequent processing in StarTools will remove the color bias, while

restoring and bringing out detail. If, looking at the initial image, you are wondering how on earth this will be turned into a nice picture, you are often on the right track.



Please make sure you calibrate, stack and save your images correctly. See the links & tutorials section for more information.

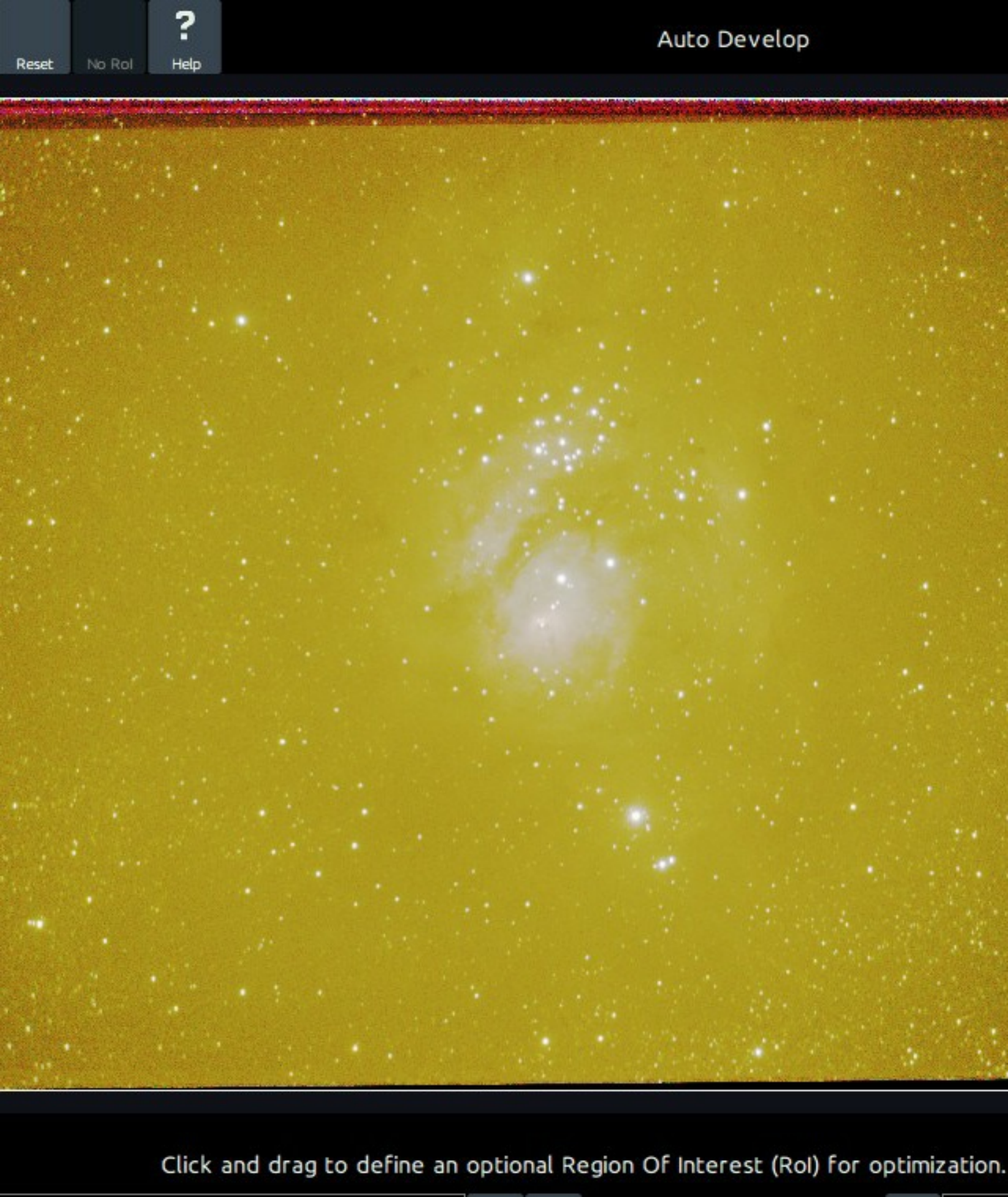
Step 2: Inspect your dataset

Launch AutoDev to help inspect the data. Chances are that the image looks terrible, which is - believe it or not - the point. In the presence of problems, AutoDev will show them until they are dealt with. Because StarTools constantly tries to make sense of your data, StarTools is very sensitive to artefacts, meaning anything that is not real celestial detail (a single color bias, stacking artefacts, dust donuts, gradients, terrestrial scenery, etc.). Just 'Keep' the result. StarTools, thanks to Tracking, will allow us to redo the stretch later on.

At this point, things to look out for are;

- Stacking artefacts close to the borders of the image. These are dealt with in the Crop or Lens modules
- Bias or gradients (such as light pollution or skyglow). These are dealt with in the Wipe module.
- Oversampling (meaning the finest detail, such as small stars, being ''smeared out'' over multiple pixels). This is dealt with in the Bin module.
- Coma or elongated stars towards one or more corners of the image. These can be ameliorated using the Lens module.

Make mental notes of any issues you see.



Click and drag to define an optional Region Of Interest (RoI) for optimization.

0 pixels	+	?	RoI Y1	-	
2664 pixels (-0)	+	?	RoI Y2	-	
Off	+	?	Outside RoI Influence	-	
1.00	+	?	Shadow Linearity	-	

Pre-colour balanced DSLR or OSC datasets like this modest one, will exhibit yellow, red or brown light pollution. However ideally you will want your stacker to not colour balance your dataset at all.

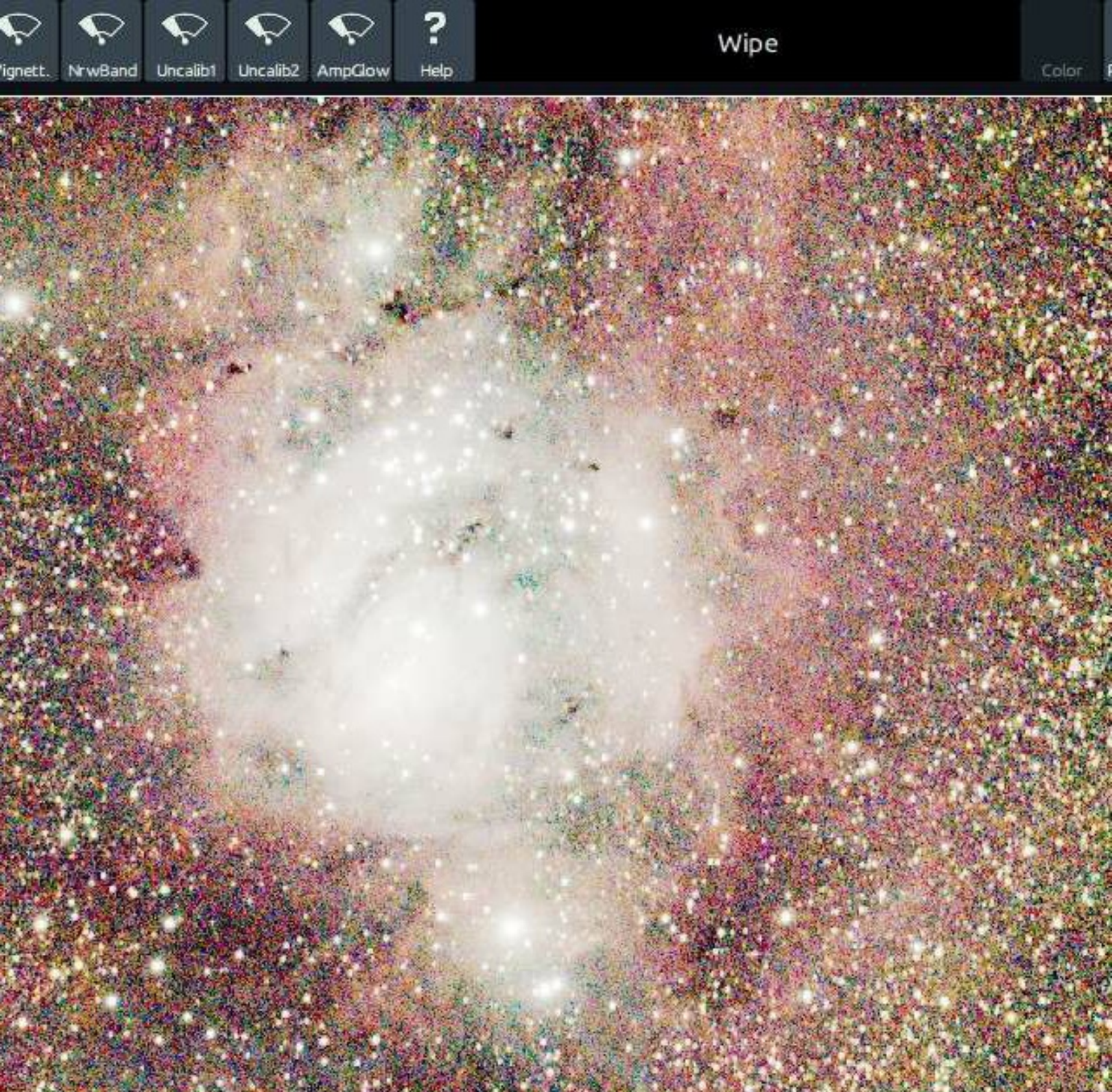
Step 3

Step 3: Prep

Fix the issues that AutoDev has brought to your attention;

1. Ameliorate coma using the Lens module.
2. Crop any remaining stacking artefacts.
3. Bin the image up until each pixel describes one unit of real detail.
4. Wipe gradients and bias away. Be very mindful of any dark anomalies - bump up the Dark Anomaly filter if dealing with small ones (such as dark pixels) or mask big ones (such as large dust donuts) out using the Mask editor.

The importance of binning your dataset cannot be overstated. It will trade "useless" resolution for improved signal, making your dataset much quicker and easier to process, while allowing you to pull out more detail.


Vignett.
NrwBand
Uncalib1
Uncalib2
AmpGlow
Help
Wipe
Color
Temporary diagnostics stretch in effect.
Dark Anomaly Filter
Synthetic Flats
Synthetic Dark/Bias
Adaptive M
The Wipe module will keep showing you the warts in your data through a temporary, specialised 'diagnostics' stretch. The goal in Wip
is to clean up any gradients, vignetting and some other calibration defects.

Step 4: Final global stretch

Once all issues are fixed, launch AutoDev again and tell it to 'redo' the stretch. If all is well, AutoDev will now create a histogram stretch that is optimised for the ''real'' object(s) in your cleaned-up dataset.

If your dataset is very noisy, it is possible AutoDev will optimise for the fine noise grain, mistaking it for real detail. In this case you can tell it to Ignore Fine detail.

If your object(s) reside on an otherwise uninteresting or ''empty'' background, you can tell AutoDev where the interesting bits of your image are by clicking & dragging a Region Of Interest (''RoI''). There is no shame in trying multiple RoIs. AutoDev will keep solving for a global strecth that best shows the detail in your RoI.

Understanding how AutoDev works is key to getting superior results with StarTools.


RoI
Help
Auto Develop
A Region Of Interest (RoI) is active. You can click 'No RoI' to reset RoI.
412 pixels
72 pixels (-374)
3.2 pixels
RoI Y1
RoI Y2
Outside RoI Influence
1.00
Shadow Linearity
A second launch of AutoDev should show a much more reasonable image, free of gradients. Click & drag a region of interest ('RoI') to optimise the stretch for a specific area.

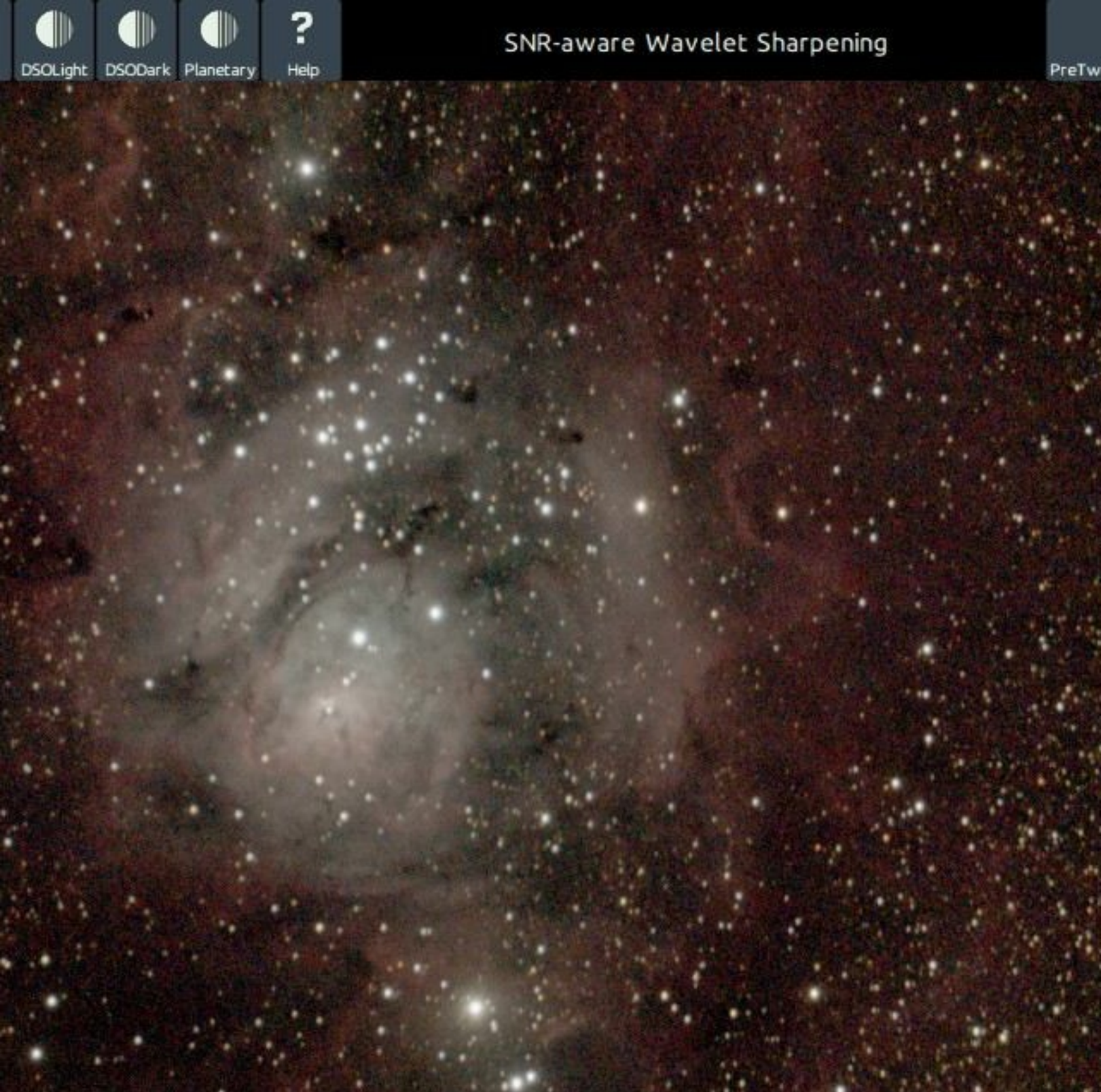
If even visible, don't worry about the colouring just yet - focus getting the detail out of your data first. If your image shows very bright highlights, know that you can "rescue" them later on using, for example, the HDR module.

Step 5: Detail enhancement

Season your image to taste. Dig out detail with the Wavelet Sharpen ('Sharp') module, enhance Contrast with the Contrast module and fix any dynamic range issues with the HDR module.

Next, you can often restore blurred-out detail (for example due to an unstable atmosphere) using the easy-to-use Decon (deconvolution) module.

There are many ways to enhance detail to taste and much depends on what you feel is most important to bring out in your image. As opposed to other software, however, you don't need to be as concerned with noise grain propagation; StarTools will take care of noise grain when you finally switch Tracking off.



The Sharp module enhances structural detail without exacerbating noise.

Step 6: Color calibration

Launch the Color module.

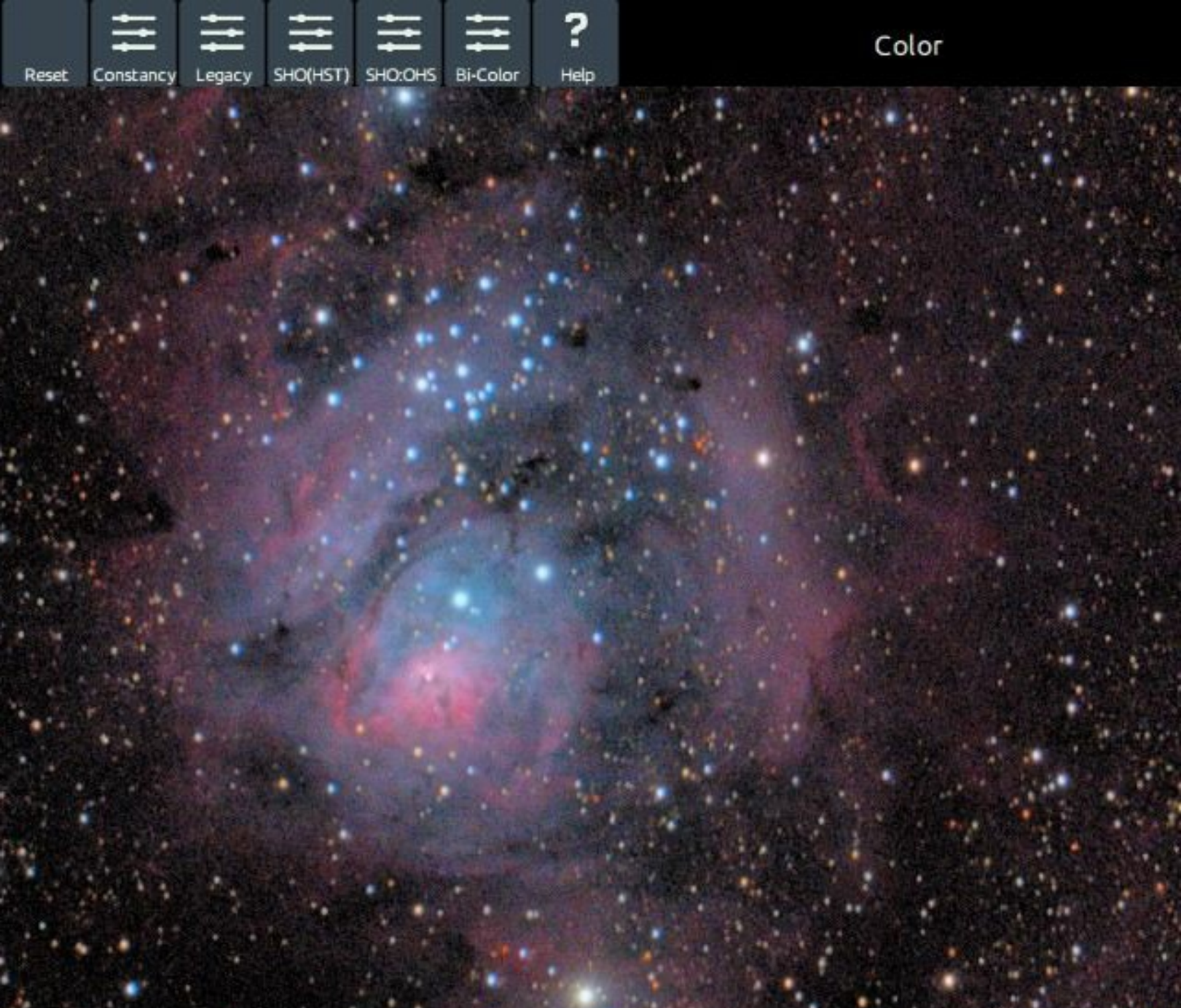
See if StarTools comes up with a good colour balance all by itself. A good colour balance shows a good range of all star temperatures, from red, orange and yellow through to white and blue. HII areas will tend to look purplish/pink, while galaxy cores tend to look yellow and their outer rims tend to look bluer.

Green is an uncommon colour in outer space (though there are notable exceptions, such as areas that are strong in OIII such as the core of M42). If you see green dominance, you may want to reduce the green bias. If you think you have a good colour balance, but still see some dominant green in your image, you can remove the last bit of green using the 'Cap Green' function.

StarTools is famous for its Color Constancy color rendering. This scientifically useful mode shows colours (for example nebula emissions) in the same color, regardless of brightness. However, if you prefer the more washed out and desaturated colour renderings of older software you can use the Legacy preset.

If your dataset has misaligned color channels or your optics suffer from chromatic aberration, the default colour balance may be off. Consult the Color module documentation for counter measures and getting a good colour balance.

After colour calibration, you may wish to shrink stellar profiles, or use the Super Structure module ot manipulate the super structures relative to the rest of the image (for example to push back busy star fields).


Reset
Constancy
Legacy
SHO(HST)
SHO:OHS
Bi-Color
Help
Color
dominant area to neutralize. Create mask with a white reference and click 'Sample' (see he
?
LRGB Method Emulation
Straight CIELat
lor Constancy)
?
Bias Slider Mode
Sliders R
200 %
?
Red Bias Reduce
Full
?
Green Bias Reduce
2.0
?
Blue Bias Reduce
100 %
?
Mask Fuzz
The Color module tends to come up with a good colour balance by default, but may need help if there is aberrant colour present (colo
fringing, chromatic aberration, etc.). If imaging in the visual spectrum, look out for red/purple H-II areas, blue reflection nebulosity an
a good random distribution of star temperatures; from red, orange, yellow, white to blue.

Step 7: Final noise reduction, switching Tracking off

Switch Tracking off and apply noise reduction. You will now see what all the "signal evolution Tracking" fuss is about, as StarTools seems to know exactly where the noise exists in your image, snuffing it out.

The image after the Super Structure's Dim Small preset, and default noise reduction settings.

Step 8

Enjoy your final image!

If you find that, despite your best efforts, you cannot get a significantly better result in StarTools than in any (yes any!) other software, please contact us.

Video

A video is also available that shows a simple, short processing workflow of a real-world, imperfect dataset.

Please refer to the video description below the video for the source data and other helpful links.

Watch video

https://www.youtube.com/watch?v=IDY3ov2dQe4

Interface

Navigation within StarTools generally takes place between the main screen and the different modules. StarTools' navigation was written to provide a fast, predictable and consistent work flow.

There are no windows that overlap, obscure or clutter the screen. Where possible, feedback and responsiveness will be immediate. Many modules in StarTools offer on-the-spot background processing, yielding quick final results for evaluation and further tweaking.

In some modules a preview area can be specified in order to get a better idea of how settings would modify the image in a particular area, saving the user from waiting for the whole image to be re-calculated.

In both the main screen and the different modules, a toolbar is found at the very top, with buttons that perform functionality that is specific to the active module. In case of the main screen, this toolbar contains buttons for opening an image, saving an image, undoing/redoing the last operation, invoking the mask editor, switching Tracking mode on/off, restoring the image to a particular state, and opening an 'about' dialog.

Exclusive to the main screen, the buttons that activate the different modules, reside on the left hand side of the main screen. Note that the modules will only successfully activate once an image has been loaded, with the exception of the 'Compose' module. Note also that some

module may remain unavailable, depending on whether Tracking mode is engaged.

Helpfully, the buttons are roughly arranged in a recommended workflow. Obviously not all modules need to be visited and workflow deviations may be needed, recommended or suit your personal taste better.

Consistent throughout StarTools, a set of zoom control buttons are found in the top right corner, along with a zoom percentage indicator.

Panning controls ('scrollbar style') are found below and to the right of the image, as appropriate, depending on whether the image at its current zoom level fits in the application window.

Common to most modules is a 'Before/After' button, situated next to the zoom controls, which toggles between the original and processed version of an image for easy comparison. A ''PreTweak/PostTweak'' button may also be available, which toggles between the current and previous result, allowing you to quickly spot the difference between two different settings.

All modules come with a 'Help' button in the toolbar, which explains, in brief, the purpose of the module. Furthermore, all settings and parameters come with their own individual 'Help' buttons, situated to the right of the parameter control. These help buttons explain, again in brief, the nature of the parameter or setting.

Example of the main interface

The icons in the top two panels roughly follow a recommended workflow.

Zooming, panning and scaling

Even the way StarTools displays and scales images, has been created specifically for astrophotography.

StarTools implements a custom scaling algorithm in its user interface, which makes sure that perceived noise levels stay constant, no matter the zoom level. This way, nasty noise surprises when viewing the image at 100% are avoided.

Even more clever, StarTools scaling algorithm can highlight latent and faint patterns (often indicating stacking problems or acquisition errors) by intentionally causing an aliasing pattern at different zoom levels in the presence of such patterns.

StarTools' astrophotography-optimised scaling algorithm can highlight latent pattern issues regardless of zoom level, as seen here. It also shows constant noise levels regardless of zoom level.

At 200% zoom level a barely distinguishable horizontal pattern can indeed be seen.

Changing parameters in StarTools

The parameters in the different modules are typically controlled by one of two types of controls;

1 A level setter, which allows the user to quickly set the value of a parameter within a certain range
2 An item selector, which allows the user to switch between different modes.

Setting the value represented in a level setter control is accomplished by clicking on the '+' and '-' buttons to increment or decrement the value respectively. Alternatively you can click anywhere in the area between the '-'' and '+' button to set a value quickly.

Switching items in the item selector is accomplished by clicking the arrows at either end of the item description. Note that the arrows may disappear as the first or last item in a set of items is reached. Alternatively the user may click on the label area of the item selector to see the full range of items which may then be selected from a pop-over menu.

An example of a levelsetter control in StarTools

An example of a selector control in StarTools. Clicking on its center will reaveal all options as a pop-over menu.

Presets

Most modules come with presets that quickly dial in useful parameter settings.

These presets give you good starting points for specific situations, and for basing your own tweaks on.

Preset buttons can be distinguished by their icons; they bear the icon of the module you launched. Most modules execute the first preset from the left by default upon opening.

Preset buttons can be distinguished by their icons; they bear the icon of the module you launched (in this case, the Wipe module)..

Mouse controls

As of 1.7, enhanced mouse controls are implemented;

Zoom in

Scroll wheel down

Zoom out

Scroll wheel up

Pan

Middle button + drag

Blink before/after

Right click

Hotkeys

As of version 1.5, StarTools implements some hotkeys for common functions;

Zoom out

- key

Zoom in

+ or = key

Zoom fit-to-screen

0 key

Back

ESC key

Cancel

ESC key

Done

D or ENTER key

Keep

K key

OK

ESC key or ENTER key

Blink before / after

B key

Undo / redo

B key

Mask editor

M key

Open

O key

Save

S key

Screenshot

X key

Touchscreen

StarTools can also be entirely operated by touchscreen with all controls appropriately sized for finger-touch operation.

Tracking

Signal evolution Tracking data mining plays a very important role in StarTools and understanding it is key to achieving superior results with StarTools.

As soon as you load any data, StarTools will start Tracking the evolution of every pixel in your image, constantly keeping track of things like noise estimates, parameters you use and other statistics.

Tracking makes workflows much less linear and allows for StarTools' engine to ''time travel'' between different versions of the data as needed, so that it can insert modifications or consult the data in different points in time as needed ('change the past for a new present and future'). It's the primary reason why there is no difference between linear and non-linear data in StarTools, and the reason why you can do things in StarTools that would have otherwise been nonsensical (like deconvolution after stretching your data). If you're not familiar with Tracking and what it means for your images, signal fidelity and simplification of the workflow & UI, please do read up on it!

Tracking how you process your data also allows the noise reduction routines in StarTools to achieve superior results. By the time you get to your end result, the Tracking feature will have data-mined/pin-pointed exactly where (and how much) visible noise grain exists in your image. I

therefore 'knows' exactly how much noise reduction to apply in each area of your image.

Noise reduction is applied at the very end, as you switch Tracking off, because doing it at the very last possible moment will have given StarTools the longest possible amount of time to build and refine its knowledge of where the noise is in your image. This is different from other software, which allow you to reduce noise at any stage, since such software does not track signal evolution and its noise component.

Tracking how you processed your data also allows the Color module to calculate and reverse how the stretching of the luminance information has distorted the color information (such as hue and saturation) in your image, without having to resort to 'hacks'. Due to this capability, color calibration is best done at the end as well, before switching Tracking off. This too is different from other software, which wants you to do your colour calibration before doing any stretching, since it cannot deal with colour correction after the signal has been non-linearly transformed like StarTools can.

The knowledge that Tracking gathers is used in many other ways in StarTools, however, the nice thing about Tracking is that it is very unobtrusive. In fact, it actually helps get you get better results from your data in less time by homing in on parameters in the various modules that it thinks are good defaults, given what Tracking has learnt about your data.

Type of dataset?

Have the pixels in this dataset bee

Choose LINEAR if the pixels in the

Choose LINEAR, FROM OSC/DSLR
with an RGGB/BGGR Bayer Matrix,

Choose NON-LINEAR SRGB SOURC
this stretch.

Linear

Signal evolution Tracking starts as soon as you load your dataset.

Log

StarTools keeps a detailed log of what modules and parameters you used. This log file is located in the same folder as the StarTools executable and is named **StarTools.log**.

As of the 1.4 beta versions, this log also includes the mask you used, encoded in base64 format. See the documentation on masks on how to easily decode the base64 if needed.

Advanced image processing software for astrophotography

SiliconFields

www.startools.org

startoolsastro@gmail.com

ABN 42 373 023 390

Download FREE trial

https://www.startools.org/downloads/