The Astronomical Society of Las Cruces (ASLC) is dedicated to expanding public awareness and understanding of the wonders of the universe. ASLC holds frequent observing sessions and star parties and provides opportunities to work on Society and public educational projects. Members receive electronic delivery of *The High Desert Observer,* our monthly newsletter, plus, membership in the Astronomical League, including their quarterly publication, *Reflector,* in either paper or digital format. ASLC members are also entitled to a $5 (per year) discount on *Sky and Telescope* magazine.

Annual Individual Dues are $30
Annual Family Dues are $36
Annual Student (Full Time) Dues are $24

Annual Dues are payable in January. Prorated Dues are available for new members. Dues are payable to ASLC with an application form or note to: Treasurer ASLC, P.O. Box 921, Las Cruces, NM 88004. Contact our Treasurer, Patricia Conley (treasurer@aslc-nm.org) for further information.

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Member Info Changes

All members need to keep the Society informed of changes to their basic information, such as name, address, phone number, or email address. Please contact Treasurer@aslc-nm.org with any updates .

April Meeting

Our next meeting TBD later, as circumstances permit. The ASLC will not be holding meetings, gatherings or public outreach events until it is deemed safe to do so. Wash your hands!

Events

ASLC hosts deep-sky viewing and imaging at our dark sky location in Upham. We also have public in-town observing sessions at the Pan Am Plaza (on University Ave.) and at Tombaugh Observatory (on the NMSU campus) All sessions begin at dusk.
At our Leasburg Dam State Park Observatory, we hold monthly star parties. Located just 20 miles North of Las Cruces, our 16" telescope at this site is used to observe under rather dark skies.

Masthead Image: Moon rising over the Organ Mtns. Las Cruces, in Penumbral Eclipse, February 10, 2017.

From the Desk of the ASLC President

Tracy Stewart

One more piece of evidence to support Einstein's General Relativity. In 1918 (three years after Einstein published) two Austrian mathematicians Lense and Thirring realized that if Einstein was right then rotating bodies should literally drag the fabric of space-time around with them. The effect is so small for ordinary objects that it is impossible to measure.

Enter Professor Mathew Bailes from the ARC Center of Excellence of Gravitational Wave Discovery and his team. Twenty years ago he and his team began observing a unique binary system composed of a white dwarf and a neutron star. The dwarf is the size of the Earth but 300,000 times its density and the neutron star is only 20 kilometres in diameter but 100 billion times Earth density. Dr. Vivek Venkatraman Krishnan was given the task of unraveling all of the competing relativistic effects as part of his PhD at Swinburne University of Technology. He noticed that unless he allowed for a change in orientation of the plane of orbit General Relativity did not make sense.

Dr. Paulo Friere realized that "frame-dragging" of the entire orbit could explain the perturbations in the tilting of the orbit. Once again, another prediction of General Relativity is exhibited. Chalk another one up for Albert.

It's a good thing that as astronomers we are used to working alone while observing the fantastic universe, we inhabit that way the shelter in place should be tolerable. Do miss the chance to get together at least once a month. It looks like there will not be an April meeting. Stay safe and enjoy the night sky.

The answer is 42.

Some Useful Links

https://www.youtube.com/watch?v=ZEMSVgGb38I

https://www.youtube.com/watch?v=wZTGh35kioQ

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

https://www.youtube.com/watch?v=LL8ccdst1fs

Outreach Events, by Jerry McMahan

Sunrise, Elementary, Thursday, March ?

Yes, I forgot the date, but at least I do remember going. The school is the closest one to home for me. I took the ETX 125. Steve Wood brought his 8 Tracy Stuart operated his 8 inch Meade. Glen Brookshere (I know I spelled his last name wrong, but I don't count off for spelling, mostly numbers, in my classes).

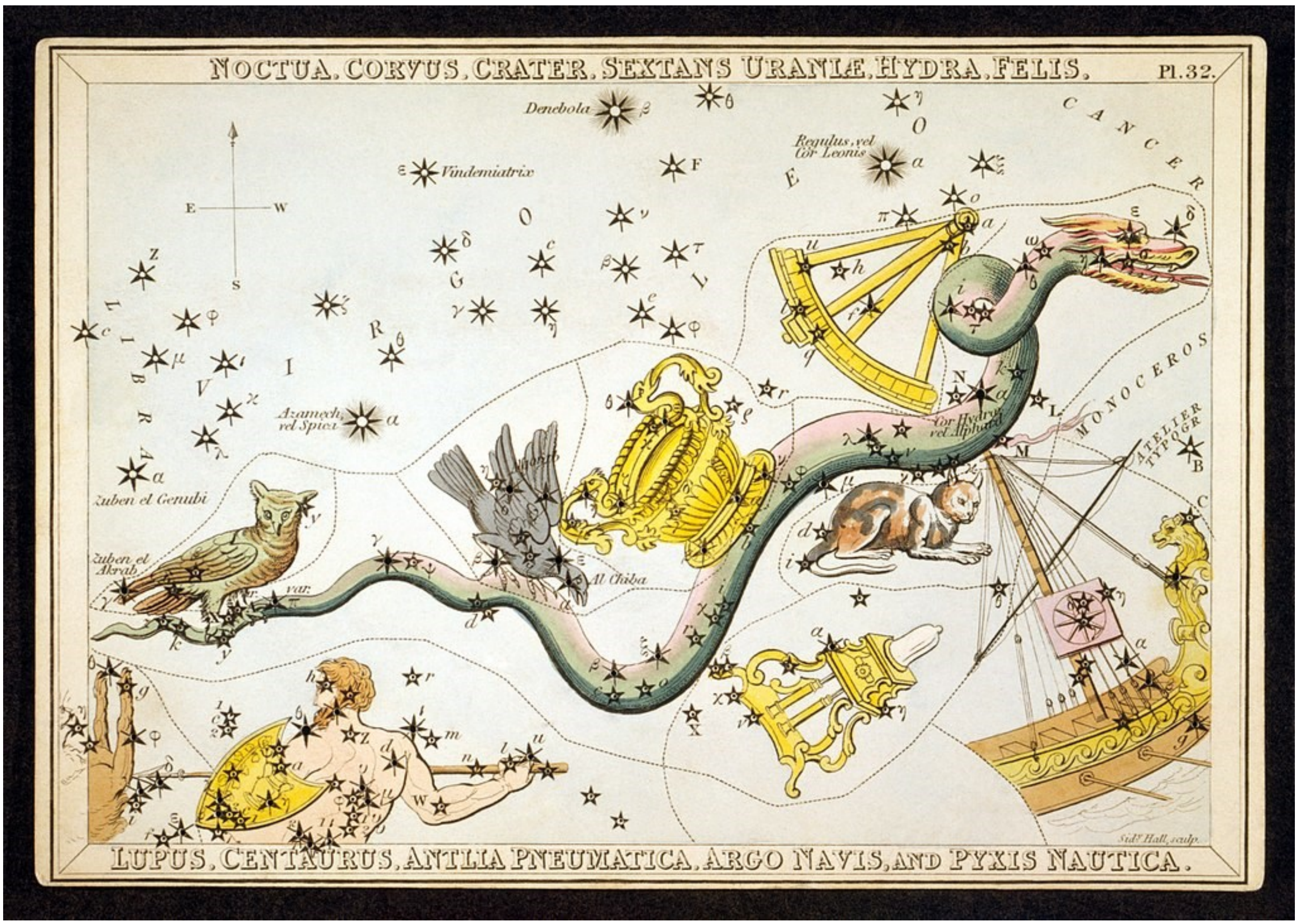
It was clear, but cold due to the wind. Glen set up a Dobsonian and taught a friend to identify constellation. His friend intends to join the club, so I will get his name eventually.

This may be the last event that we attend for a while, due to a virus that spreading around the world.

The Uranograph

By Bert Stevens

Constellation of the Month: Hydra, The Water Snake



The constellation Hydra is spread out over a large portion of our April sky. This is card 32 from *Urania's Mirror; or, a view of the Heavens* published in November 1824. This card shows twelve constellations. Nine are official IAU constellations: Corvus, Crater, Sextans (Sextans Uraniæ), Hydra, Lupus, Centaurus, Antlia (Antlia Pneumatica), and Pyxis (Pyxis Nautica). Two others are the obsolete constellations Noctua and Felis. Finally, Argo Navis, the other huge constellation here, has been subdivided into three official constellations: Carina, Puppis and Vela.

The largest constellation in the sky, Hydra, The Water Snake, slithers though our April evenings. Hydra is also known as a dragon-serpent or a sea monster. This constellation is surrounded on the north by Cancer, Leo, Sextants, Crater, Corvus and Virgo. The southern boundary of Hydra abuts Centaurus, Antlia, Pyxis and Puppis. As you can see, this is a big constellation.

Hydra did not make it into the sky because of any great deed or participation in an epic adventure, but because he was used as an excuse. Zeus had a pet raven, Corvus, with him at Olympus. One day he sent the raven down to earth with a cup to retrieve spring water to quench his thirst. The raven took the cup and flew down to a cool spring. Near the spring were fig trees that were just starting to ripen. The raven decided that he could wait a few days for the fruit to be ready to eat.

After the figs finally ripened, the raven ate them all, using up a few more days. The raven then filled the cup from the spring to take back to Zeus. Realizing that Zeus would not be happy with his slowness, the raven cast around for something to be used as an excuse. Spying a water snake, he grabbed it with his claws and with the cup in his mouth, he flew back to Olympus.

The raven told Zeus a story about the water snake keeping him from returning earlier. Zeus saw through this fabrication and threw the cup, the raven and the water snake into the sky where they became Crater (The Cup), Corvus (The Raven or Crow) and Hydra (The Water Snake). Hydra has also been associated with the Lernaean Hydra, a nine-headed water snake that Hercules defeated as one of his Twelve Labors. The Hydra's blood was used to tip Hercules' arrows, which made even a small scratch from those arrows instantly fatal and which eventually killed Hercules.

Winding its way across the southern part of our spring sky, Hydra is a whopping 1,303 square degrees. With all this real estate in our sky, you would think that there would be many bright stars in this constellation, but most of them are rather faint. The brightest star is Alphard at magnitude +1.98. The only thing that makes this star stand out is paucity of stars in this area of the sky.

Alphard is a red giant star, so big that if it were in placed in our Solar System, it would stretch half way out to the orbit of Mercury. Imagine seeing a sun in the sky fifty times larger than our own. Alphard is about three times the mass of our Sun and it has been fusing hydrogen into helium for about 420 million years.

This star has aged through its main sequence phase where fusion was confined to the core and into its red giant phase where hydrogen fusion occurs in a sphere around the even hotter helium-fusing core in these massive stars. The extra energy from the two fusion sources heats the atmosphere, forcing it to expand outward, cooling the surface as it enlarges. Even with a cooler red surface, the much larger surface area allows Alphard to emit seven-hundred and eighty times more energy than our Sun. A planet orbiting Alphard would be bathed in a reddish glow, like an eternal sunrise.

A star's color is a measure of the temperature on its surface. Just like a metal being heated will start glowing with a dull red, changing from red to yellow and finally to white hot, so too does the surface of a star. So just seeing the color of a star tells us something about its physical characteristics.

If the light from a star is separated into its individual colors with a prism, just like raindrops do with sunlight to form a rainbow, a rainbow of star's light will appear, called a spectrum. The spectrum produced will not be of uniform brightness, but will be skewed based on the color of the star. Reddish stars emit more energy at the red end of the spectrum, making the red end of the spectrum brighter and the blue end fainter.

Blue stars are just the reverse, the blue end of the spectrum is brighter and the red end fainter. Yellow stars like our Sun spread their energy out across the entire spectrum, which is what would be expected of a visible spectrum seen by eyes that evolved under its yellow glow. Using other sensors, the spectrum can be expanded through the entire electromagnetic spectrum from the very short gamma rays to very long radio waves.

In addition to the continuous spectrum of a star, there are dark lines. The dark lines are the signature of various elements (in gaseous form) above the surface of the star. When astronomers first started recording the spectrogram, as the pictures of these stellar rainbows are called, they were not sure what all the dark lines meant, how they related to the structure of the star and its evolution.

Spectroscopists had already observed a hot gas here on Earth emits bright lines at unique colors. Hydrogen, for example has a prominent line in the red called Hydrogen Alpha ($H\alpha$), which gives emission nebulae their red color. The dark lines seen in stellar spectra matched the bright lines generated by a hot gas. Cooler gas above the star's bright surface absorb the particular colors of the elements in the gas, providing the dark lines in the star's spectrum. The most common elements in the spectrum are hydrogen and helium.

In 1872, astronomer Henry Draper made the first stellar spectrogram. He realized what a powerful tool the spectrum was and started a project to catalog the spectra of all the stars in the sky. Draper died before he could finish the project, but his widow donated a large sum of money to Harvard College Observatory to continue the project.

Harvard College physicist Edward Charles Pickering began the project in 1886. By placing a large prism in front of the objective lens, Pickering was able to take the spectra of all the stars in the field of the telescope simultaneously, greatly increasing the amount of data to be analyzed.

Pickering hired a group of "Lady Computers" to analyze the spectra that were coming in rapidly from the telescope. This was not unusual for this time. The lady computers made more money than they would working in a factory, but less than that of clerical help in an office. One of the founding members of the group, also called the Harvard Computers, was Pickering's former maid, Williamina Paton Stevens Fleming.

Fleming categorized the spectra depending on the strength of the hydrogen lines in the spectrum of the star. The strongest lines were in the A-type star, the B-type star had slightly weaker lines. The line strength continued down the alphabet to the almost non-existent lines in M-type stars. In addition, O-type stars had mainly bright lines. P-type were planetary nebula and Q-type were other spectra.

Later, another lady computer, Annie Jump Cannon, was looking through some of the 350,000 spectra she analyzed and noticed similarities in their spectra and began resequencing the alphabetic sequence into a new spectral classification sequence.

Ms. Cannon regrouped the stellar spectra into seven categories going from the hottest to coolest. These were based on Fleming's letter groups (in order from hottest: O, B, A, F, G, K, M). She also added a number to further divide these categories. In her system, an O0 star is the hottest star, while an M9.9 is the coolest. While it is not usual to use a fractional in the spectral class, it is allowed. Our Sun is known as a class G2 star, while Alphard is a K3, which from the above sequence has a cooler and redder surface than our Sun.

The width of these dark lines also provides additional information about the density of the star's atmosphere. This provides more information to augment the star's spectral class. This additional information is called the luminosity class and it is designated in Roman numerals appended to the spectral class. This nomenclature is called the Morgan-Keenan (MK) system.

Luminosity classes start at Ia+ for hypergiant stars, the largest stars in the universe with masses more than twenty-five solar masses. These include P Cygni (B1Ia+) and RW Cephei (K2Ia+). Luminosity class Ia and Ib are for supergiant stars between ten and twenty-five solar masses that have evolved off the main sequence. Rigel (B8Ia) is a blue-white supergiant while Betelgeuse (M2Ia) is a red supergiant.

Bright giant stars are class II, which are stars that also have evolved off the main sequence. They have masses between 0.4 and 10 solar masses, usually toward the higher end. These include Canopus (A9II) and Beta Capricorni (K0II). Class III are regular giants, with the same mass range that are also evolved off the main sequence and near the end of their lives. These included Pollux (K0III) and Omega Serpentis (G8III).

Sub-giant stars are evolving off the main sequence and becoming larger but have not become giants yet. They are designated class IV and include Procyon (F5IV) and Beta Aquilae A (G8IV). The main sequence stars, properly designated dwarf stars, are class V, with our Sun being G2V.

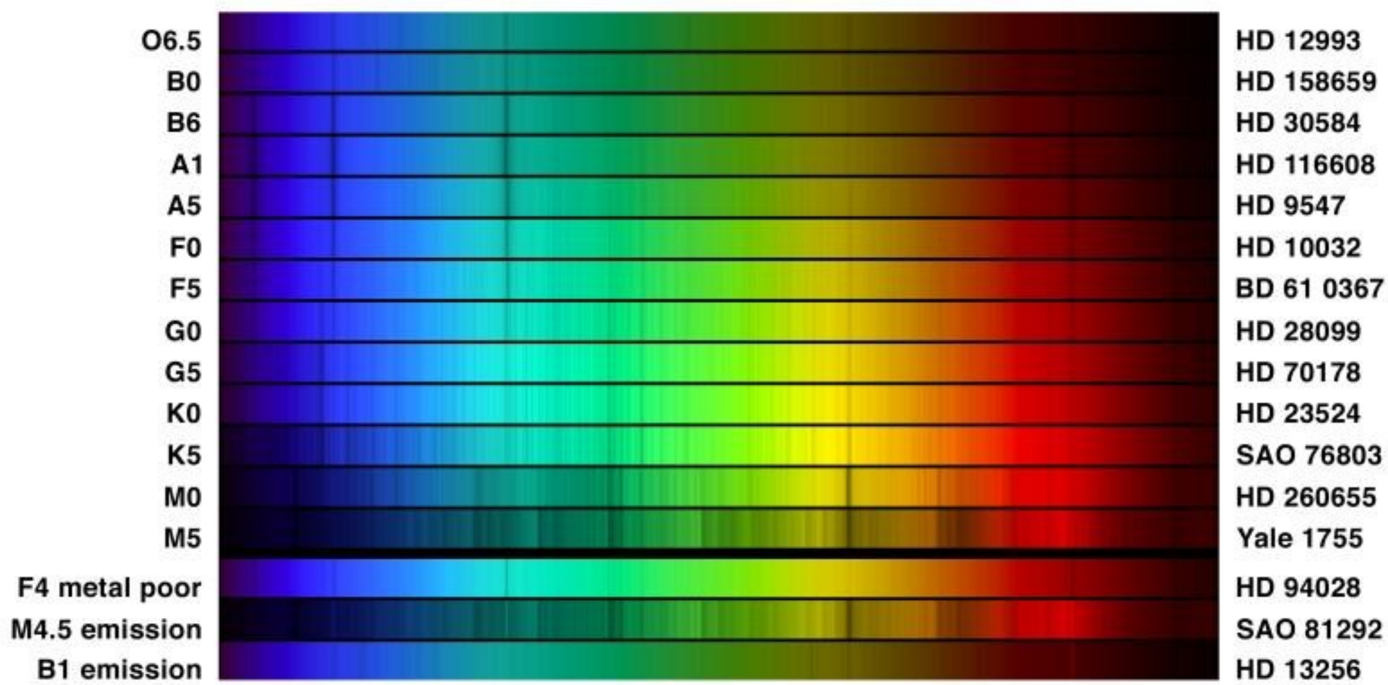
Subdwarfs (class VI) are similar to dwarfs, but are less luminous due to a lack of metals in their composition. Kapteyn's Star (M1VI) and Groombridge 1830 (G8VI) are examples of subdwarf stars. The final class, VII, is composed of white dwarf stars. These now have a different spectral classification system than the MK system used by other stars.

Uranograph cont…

This overview of spectral classifications is just a start. There are additional codes that can be added to indicate other characteristics of the star. In addition, some of the classifications may be uncertain and multiple designations my be indicated, such as IV-V would indicate that the star may be a subgiant or a dwarf star.

Since the creation of the MK system, more letters have been added. These include C-type stars that have an excess of carbon in their atmosphere and S-type stars that are a bridge between M-type stars and C-type stars. The letters L, T and Y represent objects that are not big enough to start nuclear fusion in their core. These brown dwarfs have only been observed starting in 1988 due to their very low luminosity, mostly in the infrared part of the spectrum. The hottest brown dwarfs are type L, with cooler ones being type T. In 2009, even cooler brown dwarfs were discovered which have been assigned to type Y.

Every star is unique, even though they can be grouped on their similarities. Some characteristics are not even measured by the MK system, so even two stars with the same spectral class can be quite different in other ways.



Spectra of different stars ranked from the hottest stars at the top the coolest stars at the bottom. The dark lines mark where energy is being absorbed by the cooler gasses in the outer atmosphere of the star. A particular line may strengthen and then decline as the temperature of the star drops. By comparing the strength of the various lines to the lines in a new star's spectrum, the new star's spectral type can be determined.

Table 1. Spectral Classes for Stars

Spectral Class	Color	Approximate Temperature (K)	Principal Features	Examples
O	Blue	> 30,000	Neutral and ionized helium lines, weak hydrogen lines	10 Lacertae
B	Blue-white	10,000–30,000	Neutral helium lines, strong hydrogen lines	Rigel, Spica
A	White	7500–10,000	Strongest hydrogen lines, weak ionized calcium lines, weak ionized metal (e.g., iron, magnesium) lines	**Sirius, Vega**
F	Yellow-white	6000–7500	Strong hydrogen lines, strong ionized calcium lines, weak sodium lines, many ionized metal lines	Canopus, Procyon
G	Yellow	5200–6000	Weaker hydrogen lines, strong ionized calcium lines, strong sodium lines, many lines of ionized and neutral metals	**Sun**, Capella
K	Orange	3700–5200	Very weak hydrogen lines, strong ionized calcium lines, strong sodium lines, many lines of neutral metals	Arcturus, Aldebaran
M	Red	2400–3700	Strong lines of neutral metals and molecular bands of titanium oxide dominate	**Betelgeuse**, Antares
L	Red	1300–2400	Metal hydride lines, alkali metal lines (e.g., sodium, potassium, rubidium)	Teide 1
T	Magenta	700–1300	Methane lines	Gliese 229B
Y	Infrared[1]	< 700	Ammonia lines	WISE 1828+2650

A photograph of the Harvard Computers, the human computers that classified the thousands of spectra taken at Harvard College Observatory. Edward Pickering (left) hired this team on the basis that women were better suited to such repetitive drudgery." His maid, Williamina Fleming (standing) was hired to supervise the work and later became the preeminent woman astronomer in the United States at the time.

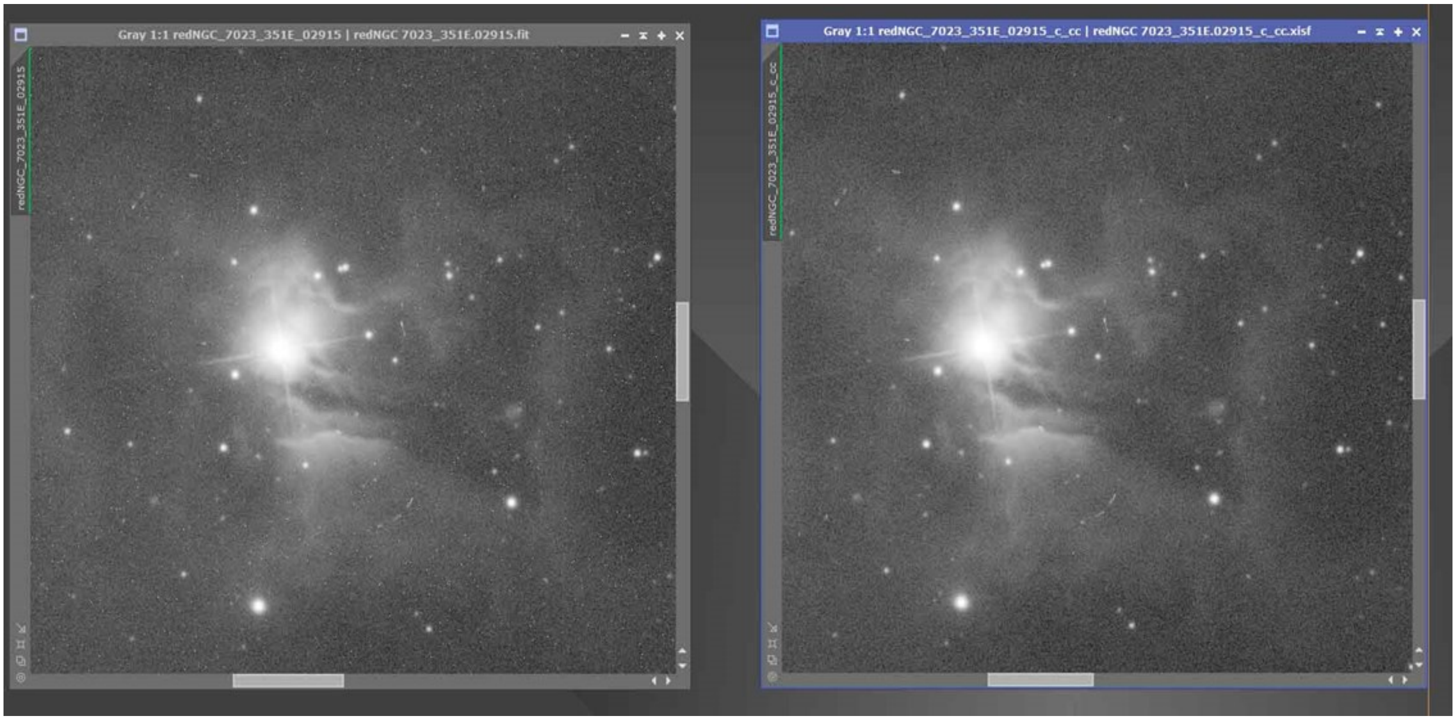
Image Processing Notes- Removing CCD sensor defects

By David Doctor

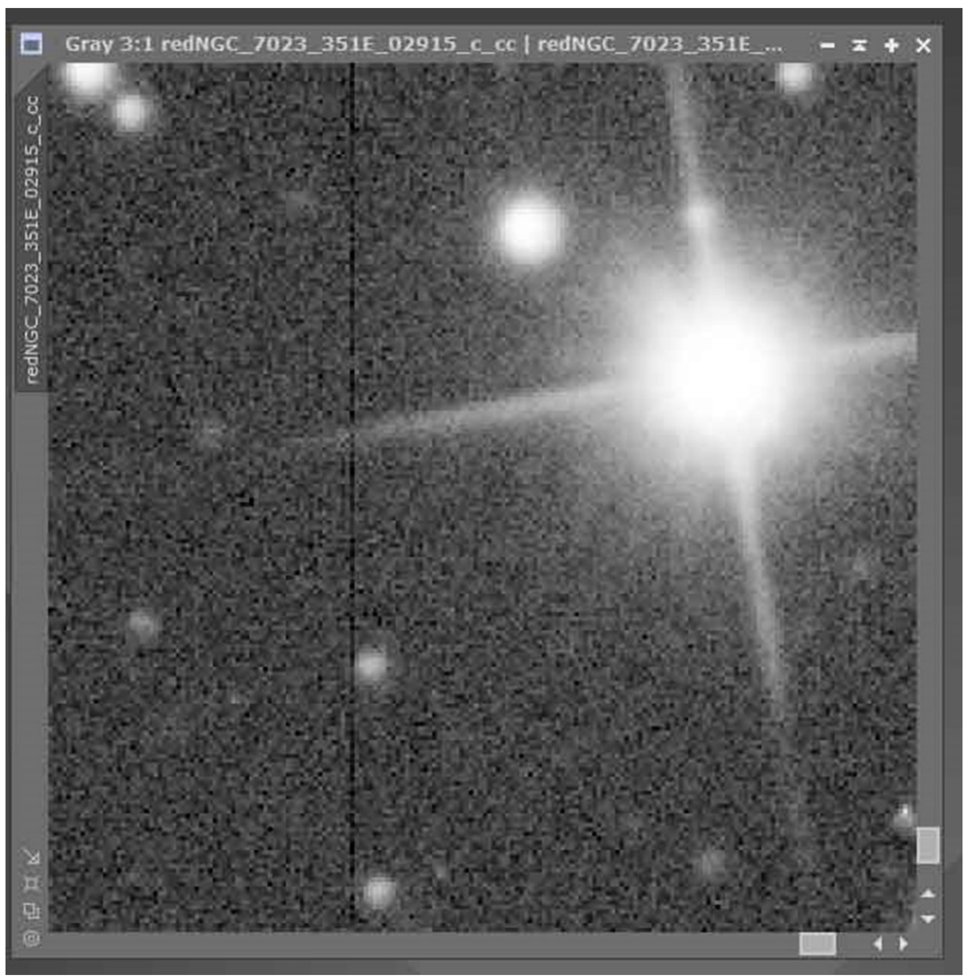
Those of us who are still using ccd sensors for imaging are familiar with the so-called "column defects" which we think of typically as a single white vertical line, maybe one or two, either full length or partial, that appear in our standard raw images. In the past I would ignore them, expecting routine calibration to remove them. Unfortunately, the more image processing I did, the more often I would get to the end only to see an ugly black or white line cutting right across a busy field of bright nebulosity! Ouch! It took me awhile to realize that in your average ccd sensor there can be quite a number of these defects which often are next to impossible to see because they often lie very close to the dimmest noise detectable in your image, i.e. the "noise floor". Most of us are familiar with hot pixels which are single pixels or clusters of pixels that have a much higher dark current than their neighbors. Black pixels have a lower response than their neighbors. These types of defects are fairly easily removed with standard "cosmetic correction" methods that many processing programs offer. Much more potentially damaging are the column abnormalities. In a similar manner to individual pixels you can have a whole column of pixels that are either "hot" or "black". These are next to impossible to remove cleanly. Even the ones you can obviously see are not easily suppressed.

Of course there is a happy ending to all of this as I recently stumbled across a script in the processing program Pixinsight which addresses this very problem! As I looked into this and tried it out I was floored honestly by how many of these types of defects there really are. The bottom line is that the process takes a few simple steps with absolutely pristine results! The strategy is a combination of multiscale and statistical methods rather than simply painting the columns with adjacent pixels which can lead to artifacts. Here is basically what you do and how it works:

First off you can see in this master dark frame already 3 column abnormalities which are 2 partial hot columns and 1 black column. Believe me there are a lot more in there you can't see!



Let's ignore the defects for now and just go ahead with usual calibration. The above left image is uncalibrated while the one on the right has the dark, flat correction and basic hot pixel removal. Looks decent but we're not going to trust it.



And as you can see it's a good thing we did not trust it because there is at least one culprit right here! This obvious black column is going to be a major problem because when you do your image integration things like this will be enhanced which we do not want.

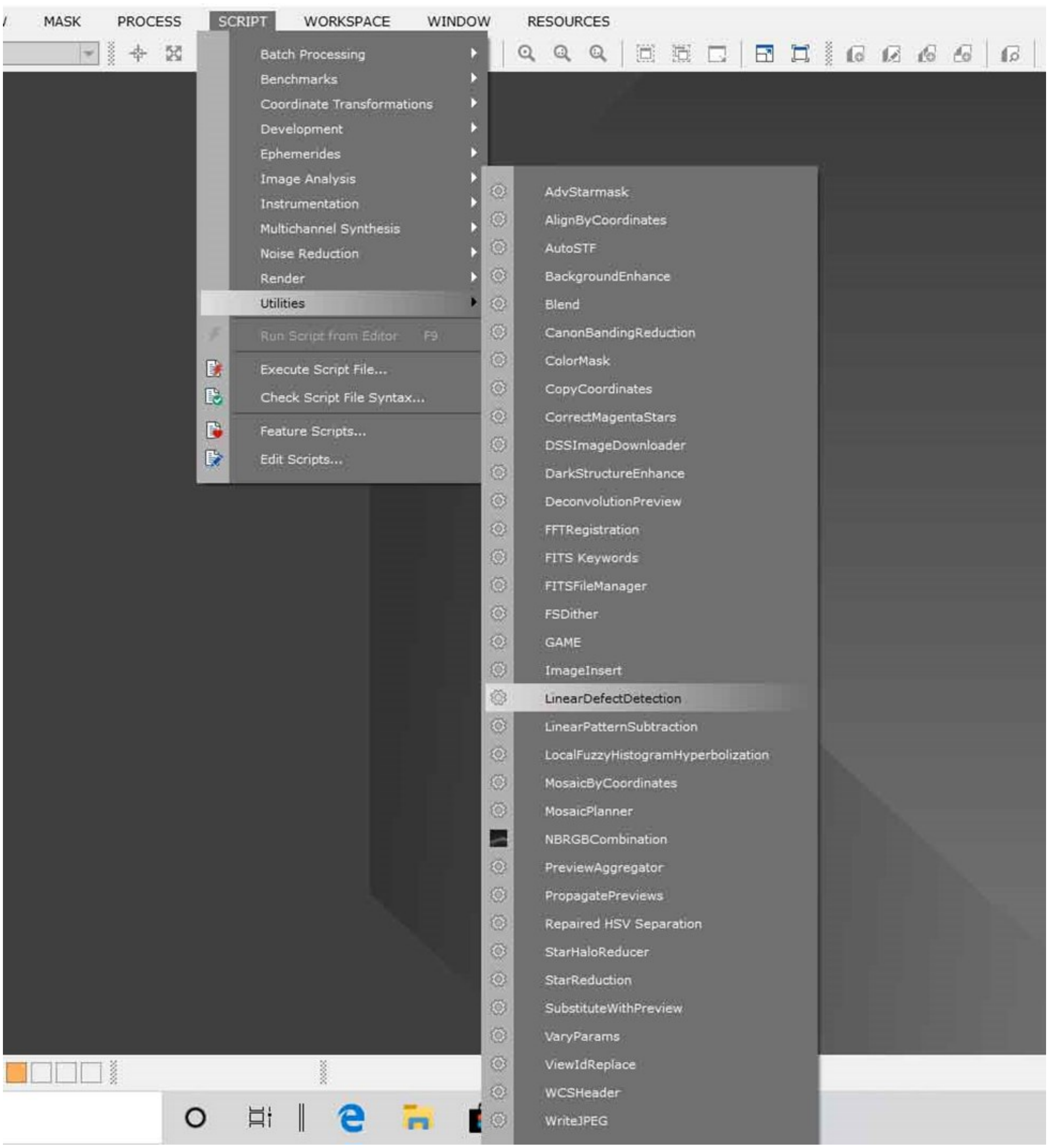
So let's see how this defect correction works.

You will need to use the most current version of Pixinsight which at the time of this writing is 1.8.8-5.

CCD Defect Removal cont...

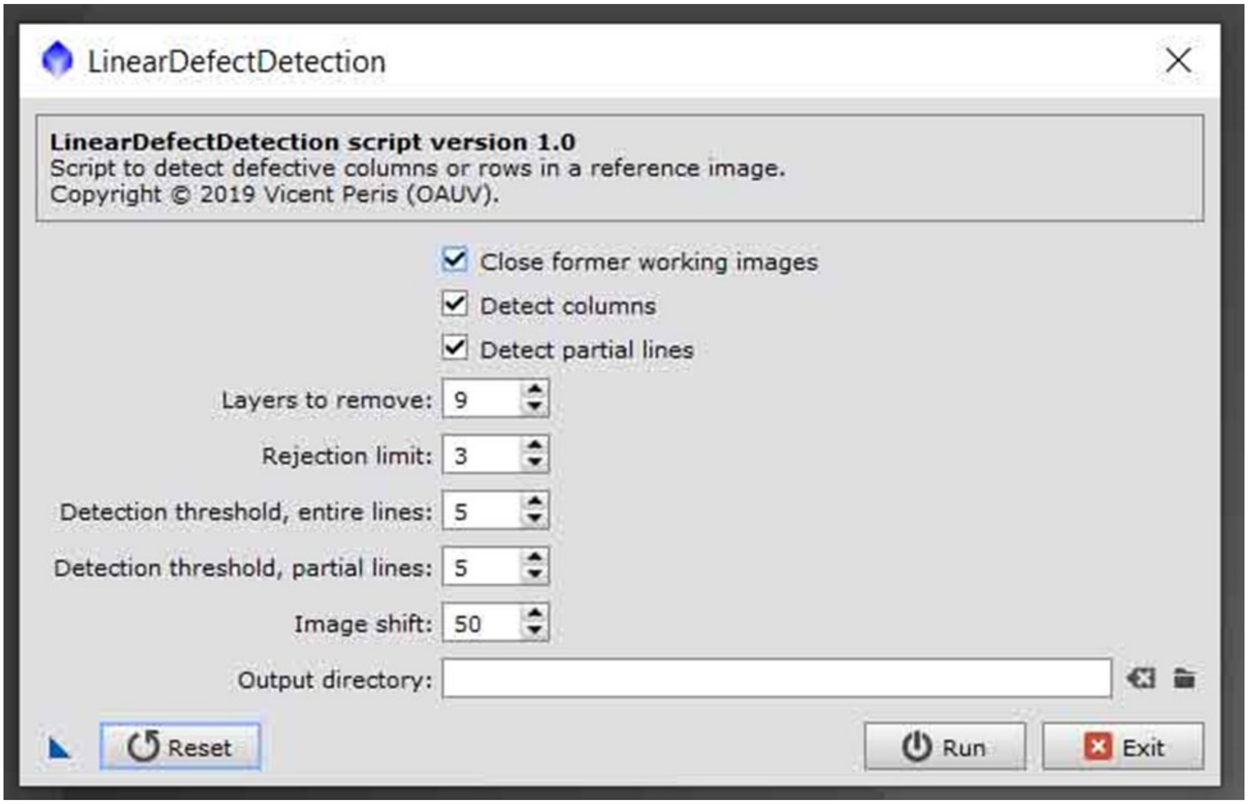
Here are the steps:

1) Calibrate your images as you would normally with darks, flats, etc
2) Do an image integration without registering your images. This is very important because this is how the linear defects are best seen by the script. The integrated result looks weird, like you didn't focus properly but this is correct!
3) Make sure your integrated image is already open in Pixinsight before opening the script
4) Go to "script"> "utilities" > "linear defect detection" as shown here:

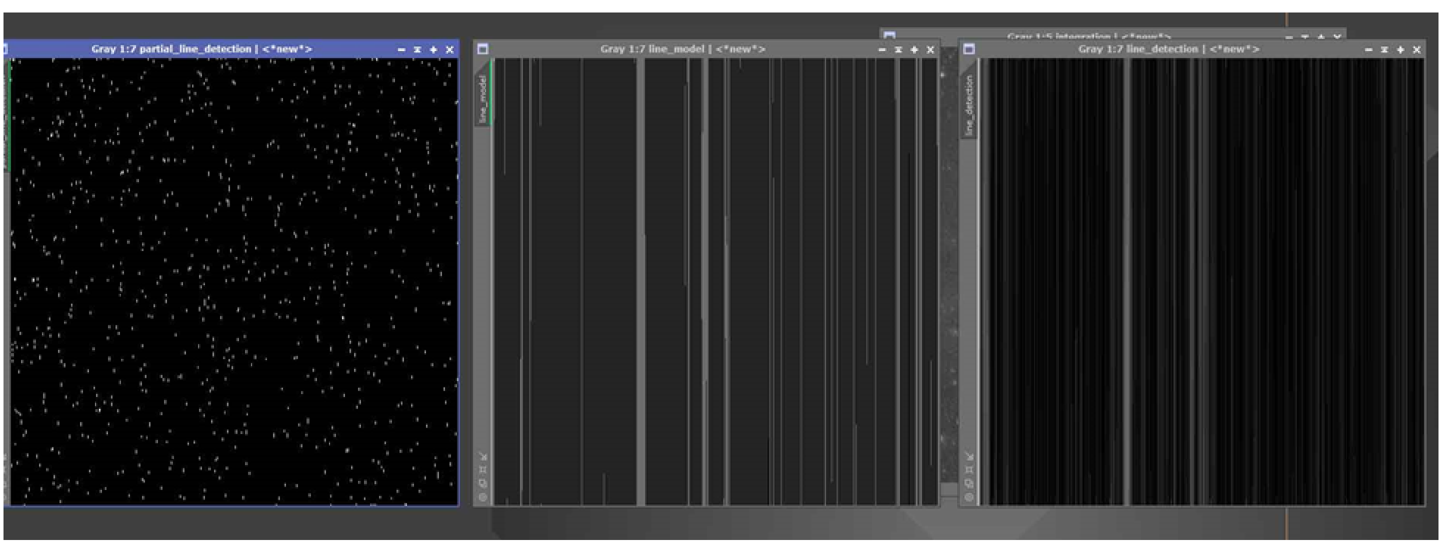


The script will open and look like this:

You do NOT have to change anything here. Just enter a location for the output text file which will list the x, y coordinates and length of each column defect. This file will be used for the next step.

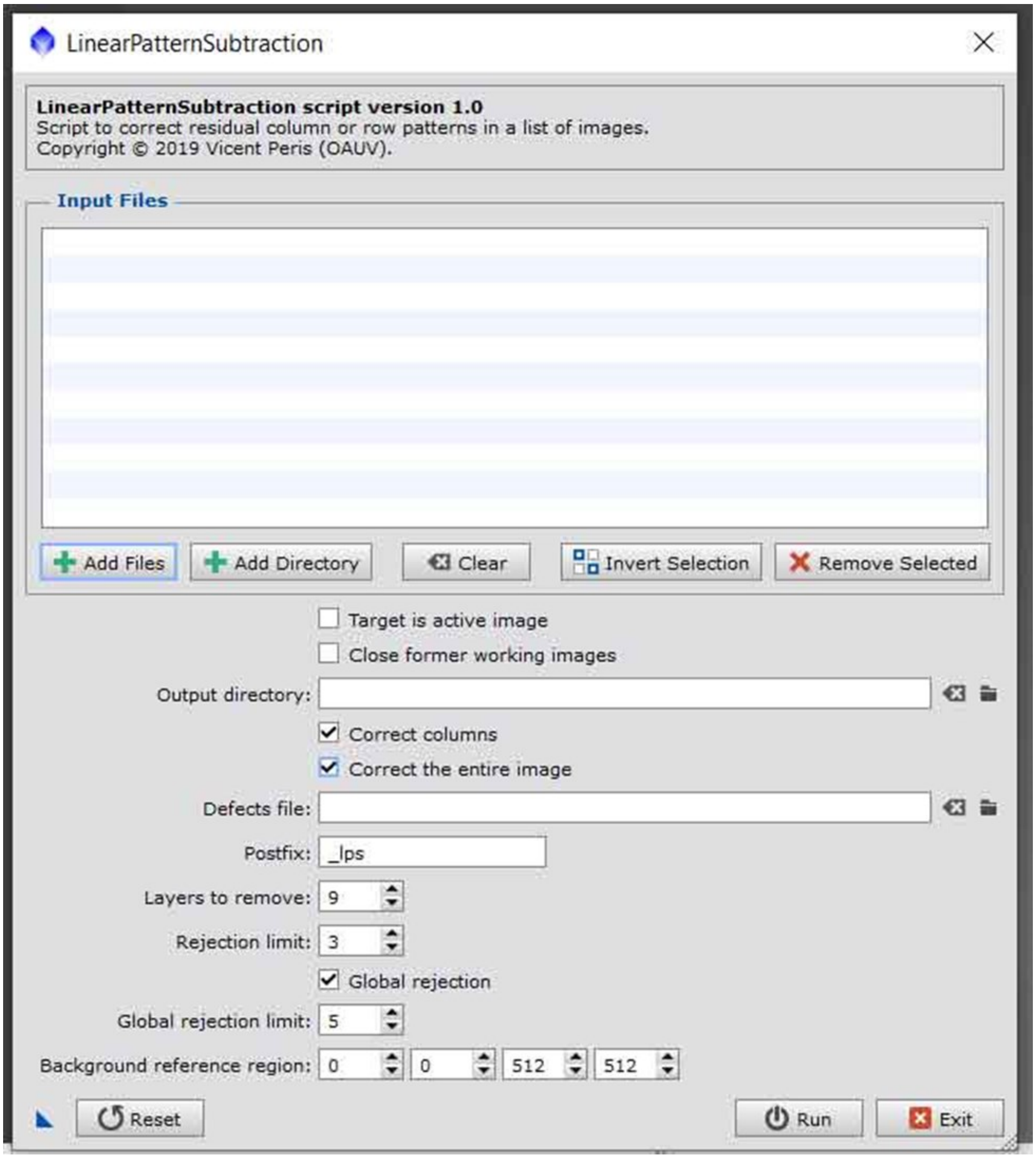


5) Click on "run" and the script will generate the text file as well as 3 other image files: line model, line detection and partial line detection. The only purpose of these 3 other image files, for me anyway, was to graphically demonstrate the scope of the defect problem!



These are the myriads of column abnormalities discovered! Crazy! You would think maybe one or 2 but not all of this! You can discard these images as they won't be needed for the next steps.

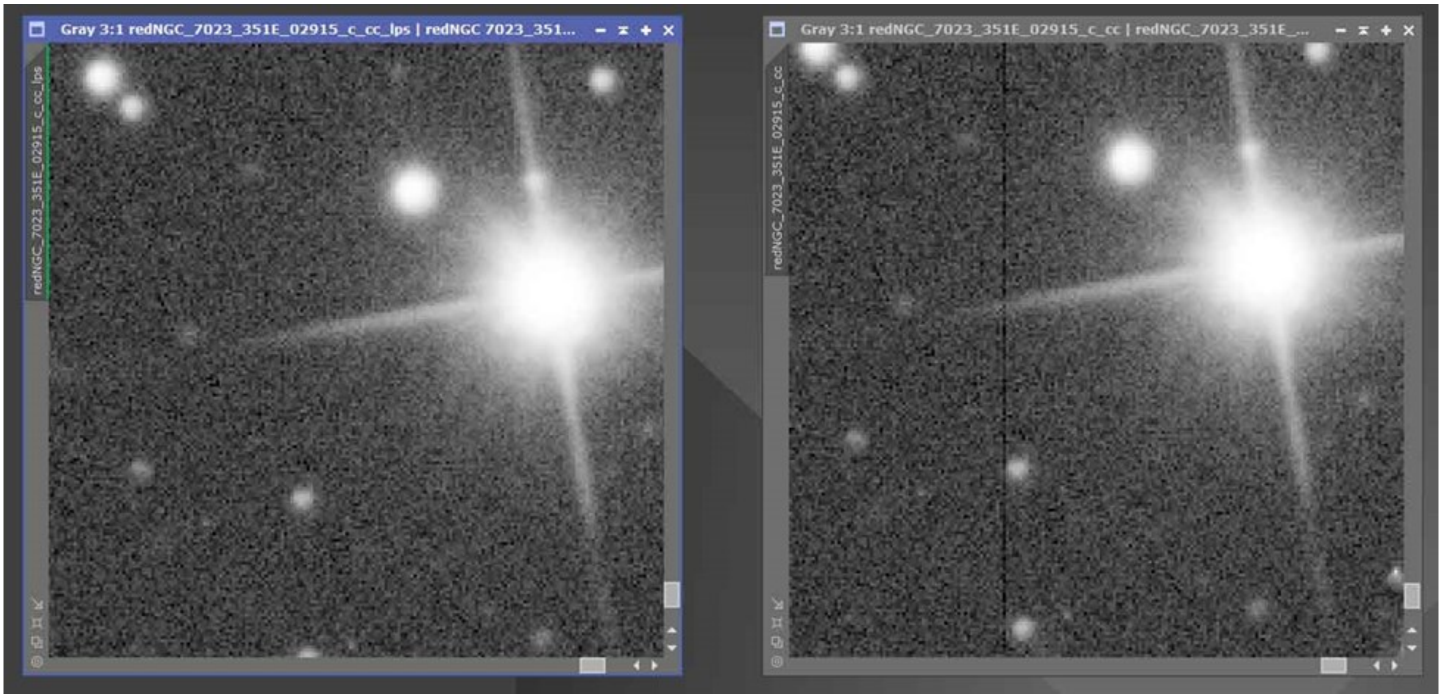
6) Next you will open the "Linear Pattern Subtraction" script found right underneath the Linear Defect Detection also under "script> utilities"
7) The script dialog looks like this:



Once again you typically will not need to change any of these default settings. When you first open the script you might see the "target is active image" box checked. Uncheck this so you can add individual files. Type in an output directory folder where the corrected files will appear with the suffix "_lps" added. Click on "add files" to add your calibrated files and also navigate to the previously generated defect text file and click on it so it will appear in the "Defects file" box.

8) Finally click on "Run"!

Now look at your fully calibrated files and you will not see any defects there!



On the right is the original image file with the black column and on the left is the corrected file after linear pattern subtraction. Amazing!

So this was a "quick start" demo and I can say that it has worked consistently as described with no additional changes. For a more detailed explanation and great tutorial you can visit the official Pixinsight page here: https://pixinsight.com/tutorials/LDD-LPS/ Thanks for reading! -Dave Doctor

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This airline thought pictograms for the steward and holding up one or two fingers for the passengers was easier communication given that they all were wearing mask. -One for chicken or two for spicy fish!

Member Astrophotos

Here (attached) is my latest backyard result from my personal (portable) setup here in Las Cruces.
This was the second target of the same night of first light"(first imaging session from the new backyard).

IC 5146 - Cocoon Nebula

Equip: Tak FS-60C, Tak EM200, QSI690wsg
Data: 7x10m L (bin1x1); 2x5m ea RGB (bin2x2); 10xdarks/flats/fdarks/bias
More details: http://jeffjastro.com/dso/IC5146_25Oct19.htm

Credit (data collection and processing): Jeffrey O. Johnson
(http://jeffjastro.com)

Member Astrophotos *cont...*

From my observatory in Mayhill NM captured this past winter.
Telescope: Tak 180 ED
Mount: Paramount MX+
Camera: SBIG 16200
Data: RGB 1,1,2 hours. 180 sec subs
Processing Pixinsight 1.8.8-5

Dave Doctor

STAY SAFE EVERYONE!!! Hope to see you in May!