

LANDSCAPE ASTROPHOTOGRAPHY– THE SHOT

by Cristian Fattinnanzi

Introduction: this small guide is aimed especially at those who are passionate about photography and are interested in taking pictures of the starry sky and its wonders. Those of you who are already experienced photographers will find technical terminology that is already known to you as well as some new terms that are specific to astronomy photography, which I will attempt to explain and make clear. The final goal is to be able to create a sequence of information that will take anyone through a night-time photo session, from the choice of the right night to schedule the outing to the development and elaboration of the acquired files.

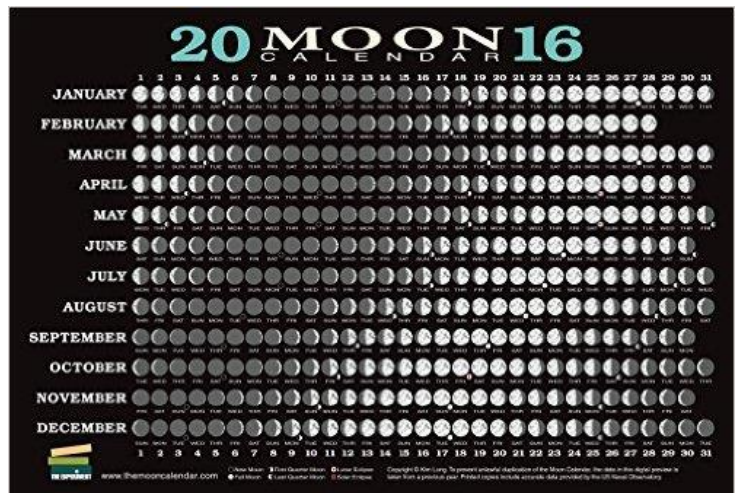
Choosing equipment

In order to start taking a few shots of the sky, one must have a camera with the option to extend the exposure time up to at least 30 minutes. Another essential accessory is a tripod to hold the camera firmly in place. If you have to buy one, avoid purchasing models that are spindly or with many plastic parts. A good tripod for night-time photography will weigh at least 1.5 kg and have a load capacity of at least 5 kg. In any case, it would be best not to exaggerate in the extension of the legs when you are using it. Often one meter is already more than enough for comfortable use without jeopardising its stability. If the tripod has a central lift column, avoid raising it. Extracting it will considerably diminish its stability. A tripod and a reflex camera (or even an advanced point and shoot camera) are enough to aim at the stars and obtain very interesting results! Other useful accessories include: spare batteries as the long exposure times and low nocturnal temperatures generally consume more energy, programmable timers for exposures that may exceed 30 minutes, and fast lenses (it would be best to have an aperture of at least F/2,8).



Choosing the day!

Not all evenings are ideal for shooting the night sky. For example, we must choose a date and time when the moon will not create disturbances in the photo with its diffused light, which makes the entire sky too bright. So, with a calendar in hand, we must identify the best days, namely those around the “**New Moon**” phase, which is generally indicated with a black dot on calendars. Using this day as a reference, we can identify the best period in the two weeks around it, the week before and the week after. Within this period the moon will not bother you during the hours in the middle of the night since it may either rise a little before dawn or set slightly after the sun sets. You must understand that the moon already limits the days that are useful in each month by about 50%. You can use a software program to help better understand the optimal periods based on the phases of the moon. I would recommend a very complete program that is free of charge and can be downloaded from the internet: **Stellarium**. Once installed, you can choose your observation point on Earth, set the date and time you are interested in and check what will be present in the sky for any given time.



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Keep an eye on the weather

When taking pictures of the heavens it is important to evaluate meteorological conditions with care. When you wish to frame the sky with earthly subjects such as mountains or characteristic buildings, a few passing clouds (that are not overly invasive) can create a nice choreography and enrich the picture's composition, but such are generally very rare situations. It is far more frequent that you will encounter evenings that are not very clear, if not completely overcast. Especially when you are in the mountains, the weather can change quickly and the weather forecasts are not always able to evaluate all the factors in play in order to provide reliable information. A beautiful, clear day is not always followed by a night that is as favourable, since the drop in temperature tends to generate water vapour that rises at night and reduces the transparency of the night sky. You must therefore acquire a certain amount of experience and try when the conditions are promising. On very humid nights the front lens of the camera can fog up. The first solution I can recommend is a lens hood. They generally provide less protection to wide-angle lenses than other lenses, but it



does do something. Then, naturally, the ideal solution is a dew heater. I remember that on evenings of astronomical observation with telescopes, someone would randomly attempt to use their iPhone to record images, but electrical devices like these require 220 V current and that is not always available. There is no way to avoid that some nights will not be favourable, and some of those times may be after rather arduous travel to reach the spot. It happens! However, you must not be discouraged. You can chalk it up to experience!

Choosing the location

A nuisance you will soon have to face is the plague of light pollution. Despite many minor attempts at regulation, infractions and exceptions are the order of the day. Add to this the lack of any kind of enforcement or sanctions, and sadly we are witness to a constant increase in nocturnal lighting. The lights that point into the sky (spotlights, reflectors, advertising, etc.) make the sky lighter than the natural darkness that is its nature. Like the moon these lights obstruct our view of the most subtle elements of the Milky Way or the nebulas we are trying to photograph. It would suffice to promote a healthy culture with regard to lighting and energy saving (pointing lights into the sky illuminates nothing but the sky itself, so the energy is pointlessly lost into infinite space) to save power and money or improve lighting where it is properly needed: on Earth. When choosing your location you can make use of the numerous maps that report the intensity of light pollution. Those sites furthest from large cities, and not necessarily at high altitude, are naturally preferred (the sky is also darker in the mountains because there are no large cities or industrial centres nearby). Remember that the most important direction is to the south, where all the astronomical objects “culminate” and can therefore be observed under the best conditions. Keep this in mind when choosing your point of observation or photography.



Getting ready!

Before leaving for the night in question, you must carefully check that you have everything you need with you. Forgetting even a simple accessory can prejudice the entire evening. If the evening is one of those “memorable” ones, it would be a pity not to be able to enjoy it fully. Obviously, the reflex camera, lenses, tripod and batteries are indispensable. What we are most often capable of forgetting are those less evident elements, such as torches, the tripod base (that might have been left attached to the bottom of some other camera or lens), the lens hoods (at night lenses can fog up, and the lens hoods prevent this problem), programmable timers for long exposures (and extra batteries for them), and memory-cards. So far we have addressed the photographic equipment, but we must not forget the “thermal” equipment needed in the mountains. Especially in the winter, but generally at night, the temperature can drop far more than we would expect. So it is best to cover up and wear hiking boots, wool socks, gloves, fleeces, hats, winter coats and all the rest. While taking astronomy photos, which often lasts for many minutes, there is very little to do. Staying still facilitates a loss of your body heat, especially if you do not take refuge in your car.



So it is a good idea to bring some further protection from the cold, such as a tent, sleeping bags or blankets. If you have chosen a somewhat out of the way location, it is a good idea to have at least one other person to help in case of more serious accidents. For the same reason, it is best to head out with your phone fully charged. Water is fundamental, as are a few snacks. A knife is always useful. A few mechanical tools or maybe a survival kit (no need to kit up like Indiana Jones) are also advisable. You must then make certain the means of transport you intend to use is suitable to reach the chosen location. Check the battery charge and the condition of the tyres, that they are winter

tyres if there is the chance of snow or ice, and if you are going on dirt roads it would be best to ensure their pressure is not too high.

Are we leaving... or are we spinning?

After this extensive series of recommendations, we can finally address the more technical aspects and specifics of night-time photography. What can we do with a tripod? Or with a star tracker if one day we wish to acquire that useful astronomy accessory? When using a simple tripod your shots will inevitably show some blurring due to the Earth's



rotation, which (apparently) moves the sky above us. In reality the sky is not moving, but rather it is we "earthlings" who are on a sort of spinning top travelling around the sun, and that movement also makes our photography tripod move. Many photographers make use of this movement to obtain particular effects due to the trailing of the stars, resulting in curious curved lines across the sky. The so called "Star-trails" (the free software "Startrails" is useful for elaborating images of this type) are easily visible in many night-time pictures thanks to their particular appearance. These images are, on one hand, testimony to the rotation of our home planet, but on the other hand can be somewhat dull in that they show very little of the true beauty of the starry sky. There are those who have employed this

phenomenon to create even stranger effects, such as vortexes, zoom effects, or star trails that increase in brightness. These are indubitably curious, but personally I care little for them as it is best to avoid artificial effects in astronomy photography (and it is sometimes quite complicated to achieve said effects) since they distance us from the actual beauty of the stars, constellations, and I dare say the scientific value of what we have achieved.

The point of view!

A beautiful photograph, whether for astronomy or not, depends very little on the quality of our equipment. Other factors, that I would define as "human" factors, are far more important: good taste, a good eye, experience, creativity and the photographer's technical skill. Post-production also is a significant contribution to the success of the image, but at the base there must be a **good idea**. In this guide we will also discuss post-production further on. Getting back to the point of view of the picture, a photographer who brings together the starry sky and the landscape follows rules that are quite the same as those of a classic landscape photographer. First and foremost among them is the famous rule of thirds. You must take care to have a clear vision of the portion of sky you wish to shoot and that the target subjects are not too close to the edges of the image. The horizon must be perfectly horizontal (however it is possible to correct this in post-production). The elements on the ground must be identifiable and interesting with intermediate subjects (so called mid-ground) placed so as to create depth and volume to the shot. Where possible, the subjects should be aligned to create vectors leading to the corners of the image. In order to get a grip on all these parameters, you must walk a bit "in the field", in order to find the ideal spot. Do not forget the altitude of the spot you shoot from has a great effect on the result, in particular when using the larger wide-angle lenses, as is common in landscape astrophotography. When fish-eye lenses are used, everything appears to be smaller. If you are trying to focus on and place earthbound objects in the foreground (a rock, a puddle, a flower, a trunk, etc.) you must get extremely close to it, even within 50 cm! That way its shape will take up more of the surface area and will become more "important" within the balance of the image. Based on this subject you can compose the rest of the image by trying to find an ordered disposition of all the elements in the frame. Over time and with experience you will learn how to better manage these aspects. In the meantime, when the weather does not cooperate or the moon is bright at night, some good photography books or astronomy magazines can be of great help in this regard.



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Let's get ready to shoot!

Have you found the right spot from which to shoot? Excellent. Place the tripod securely on the ground and mount the camera on it. But what parameters do you set on the numerous adjustments that digital cameras provide us? It's a good idea to have everything you must have set in mind, in order to avoid silly mistakes that could compromise the results of an entire night-time session! Here below is what I suggest:

-RAW image format. This format allows you to fully record the information acquired by the reflex, unlike jpeg that simplifies much of the data gathered. The RAW format also allows you to perfectly manage the image's colours in the later elaboration phase. RAW is a very heavy format, so check that there is enough memory on your cards for the number of images.



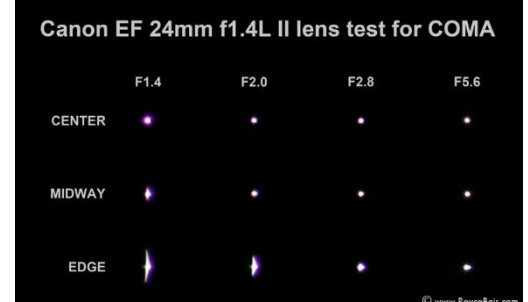
-Choice of **FOCAL LENGTH**. It is quite trivial, but clearly if you have a zoom lens you should choose a focal length best suited to what you want to photograph. If you have a "full-frame" (FF) reflex, that is with 36x24 mm image sensor like film once was, the focal length for the lens will be the actual length. If you instead are using a reflex with a reduced format (APS-C), you should multiply the focal length setting by 1.5x (Nikon) or 1.6x (Canon) to ensure it is comparable to the reference focal length, which is that of the film format (FF). So if you use a lens with a focal length of 50 mm on an FF (the generally accepted "normal"), for the same framing on an APS-C reflex camera, you will need to have a focal length of circa 32 mm (50 divided by 1.5 or 1.6).



-the exposure **TIME**. To determine the maximum exposure time in order not to have evident movement in the star trails you need only do a simple calculation: **300 divided by the FOCAL length in mm = Seconds** of maximum exposure. This way you get the number of seconds in the maximum exposure before the stars become too blurred. This formula was obtained based on the characteristics of recent digital reflex cameras, which have pixels measuring circa 5-6 microns. Applying this formula you will obtain a movement of the star trail of circa 3 pixels, which is an acceptable compromise. To lengthen the exposure time you can "modify" the rule and, for example, use 500 divided by the focal length, and you already know that, proportionally, you will have about circa 5 pixels of movement. So, if you use a 14mm wide-angle on an FF reflex, the maximum recommended time will be circa 22 seconds. If the same lens is mounted on a reflex camera with an APS-C sensor, the equivalent focal length will be $14 \times 1.5 =$ circa 21 mm, so the maximum exposure time would drop to circa 14 seconds. This is because there is greater magnification of the image on APS-C and this means the movement will inescapably become evident earlier. These rules are to be taken into account when there is no possibility to follow the sky's movement. If you have a **star tracker** the exposure times can be extended, allowing you to make multiple shots of the same subject and work with lower ISO and have cleaner files. For times over 30 seconds, set the "B" (BULB) exposure. In "B", thanks to an accessory such as a programmable timer, you can choose any exposure time (and pause) without having to press the shutter button for the entire duration of the exposure (which causes the reflex camera to vibrate).



-The **APERTURE**. Earlier we stated that when photographing at night, with low light conditions, it is highly recommendable to have a fast optics, so with a low focal ratio. This means that an F/2.8 would be very good, while an F/5.6 would have some difficulties because it is optically "slower". There are optics that are faster than F/2,8, such as some F/1.4 or F/1.8 lenses, that at times are not even expensive. These would appear to be optimal for this kind of use. There is a "but" though: when used at full aperture, very fast lenses often are not very sharp, especially in the corners of the photograph. Indeed, it is in the corners where, despite a precise focus in the centre of the image, you may see some stars of a rather curious aspect, as though they were swallows, little balls, or butterflies. Careful: it is not a problem with your particular optics, but a characteristic of the lens design, which is a combination of unavoidable compromises. These aberrations are in general not very pretty to see, but fortunately there is a quite simple solution: close the aperture! However, now you may be asking: is it better to buy a Canon 50mm F/1.2 for 1100 euros, that you have to close to F/2.8 to have sharpness in the corners, when you could just buy a Canon 50mm F/1.8 for 120 euros, that for the same F2.8 value is practically the same? The answer is almost always no. In this case it is not better! It should, however, be remembered that faster lenses are not designed for the particulars (and demands) of night-time use. In general, they are used in order to have notable blurring effects in portrait photographs, and were designed for uses that are not judged on how the corners are rendered. Nevertheless, it should be pointed out that the recently designed optics often have a quality of image in the corners that is good



when the shutter is fully opened, thanks to their more modern and sophisticated technology. The costs are often rather high, but the quality they provide is decidedly elevated.

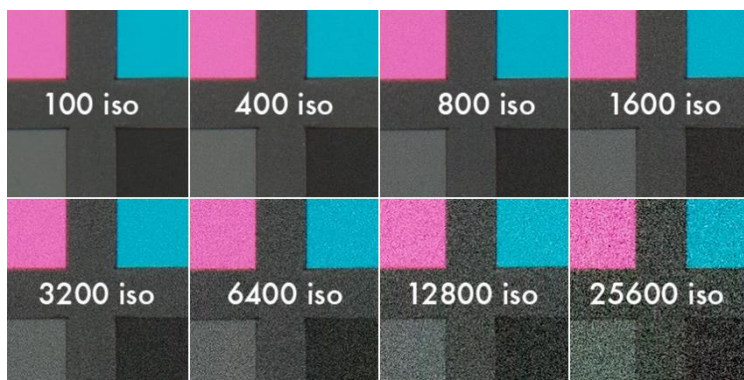
So, to conclude the discussion on the regulation of the aperture, what we recommend is to close the shutter enough that the image at the edge of the optics will meet your expectations.

The **ISO**. Another fundamental parameter to adjust with care is the ISO sensitivity.

Increasing the ISO means electronically increasing the brightness in an artificial manner.

This amplification is clearly not without cost, but it is paid in the quality of the details, the general grain of the image, the fullness of the colours and the softness in the shading. Recent reflex cameras have made considerable progress in this regard. Despite the increase in the number of pixels (which necessarily have become ever smaller and therefore less sensitive to light), their performance at high ISO is far better than in the past. Currently, taking shots with an FF reflex camera at 6400 ISO or an APS-C reflex camera at between 1600 and 3200 ISO provides notably interesting results, especially after careful post-production work.

What I can recommend is that when evaluating the histogram, you set a value that is approximately with the top of the bell slightly skewed to the shadows.



All graphics programs can display a histogram like that above. In Photoshop you simply press “ctrl + L”. Regardless, it is still a good idea not to exceed the above stated maximum ISO values since doing so would increase the brightness at the cost of greater noise (grain), which is more difficult to fix. Naturally, if you have a star tracker, you can lengthen the exposure time and still work at a lower ISO (generally between 400 and 1000 ISO) in order to obtain files that are clean and easier to work with. If you want to photograph the sky (with tracking) combined with the landscape (without tracking), I highly recommend using the same setting for time, ISO and aperture. Later we will see how this simplifies things in the elaboration phase during the fusion of the images.

-FOCUS. The final aspect to check is the focus. The focus should be done in **Manual Focus** with the “**Live-view**” function activated. This function is now extremely common on more recent model reflex cameras. When framing a bright star at the centre of the image, it will be easy to verify the focus as it is when it achieves the smallest

dimensions possible. Forget about the ease of autofocus, which makes this operation so simple in the daytime. At night the light will never be enough to guarantee the reliable function of this convenient device. So you must get used to doing it manually, taking care not to touch the lenses' follow focuses in the later phases.

Another thing which you absolutely must remember is to **deactivate the image STABILIZER**, if there is one on your lens. When the reflex camera is on its tripod, this mechanism could cause an effect opposite to the one it was designed for and create a movement that is seriously harmful to our images.

And now? What do we aim at?

At first glance, a clear dark sky can be daunting. There are thousands of stars, from the largest to the faintest. They can easily bewilder a less than expert observer. You must not get discouraged. Even without the advice of a friend with more experience than you, you will need very little to get your bearings among this myriad of bright dots. Furthermore, technology will help you, since smartphones are nearly ubiquitous and it is possible to install applications on them that can guide you and suggest the names of the stars or constellations we are observing. The most useful are indicated in the table below, divided according to the type of smartphone you have:

Some virtual planetariums to simulate the motion of celestial objects:

Stellarium (PC)

Google Sky (Android)

Sky Map (Apple)

Sideralis - Solun (Nokia)

Astronavigator (Windows Mobile)

Some examples of what we can do with a reflex camera mounted on a tripod

If you wish to make a **star trail** around the North Star (which serves as a fulcrum around which the whole sky swivels, since it is located along the axis the Earth is spinning), you must aim to the north and take exposures for a total of at least one hour, split up into exposures of 2-5 minutes each. Aiming to the south will give you a different star trail, with stars arranged into lines that are almost parallel and together form concentric circles. This is because when facing south we are aiming towards the celestial equator, and therefore quite away from the centre of the sky's rotation.

If you instead wish to record the figures of the **constellations** without any apparent movement, you must limit the exposure time according to the rules stated on page 4. Since you cannot make the time too long it is best to open the aperture as much as possible (so long as it is compatible with the corner sharpness of your optics) and raise the ISO to obtain a good exposure.

If you want to shoot the **Milky Way**, you must first go to a site with a clear, dark sky, then aim the camera in the appropriate direction. This direction changes over the course of the year, so the suggestions of the planetary guides above may be of use. Usually, the brightest part of the Milky Way, the nucleus, is visible in the summer when facing SOUTH. The nucleus will never be very high above the horizon at the latitudes found in Italy, so you must be certain to have a horizon that is free of any obstacles that could impede your view. In the summer, the Milky Way is clearly visible above our heads, so you can photograph these areas as well, obviously forgoing including the earthly landscape in the frame, unless you create a mosaic of images.

A few notes on "Dark-frame", for the most expert among you

At the end of the evening, perhaps as you are putting away your equipment, you can allow the reflex camera to shoot a few dark-frames. Many of you may have heard of this, but what is it exactly? The dark frame is a shot made with the same settings as our normal shots (the same exposure times and ISO, but also the same external temperature) taken **with the lens cover in place**. Naturally this provides almost black photos, but it is precisely that "almost" that makes the difference. Actually, each of the normal photos you take with those settings contains a real light signal that is laid over the underlying noise. This noise is caused by the characteristics of the camera itself, such as defective pixels or rings due to heat or electrical disturbances. This noise signal is almost invisible on normal shots, but is isolated in the "dark" pictures. In the elaboration phase, using the appropriate programs, it will be possible to "clean" your files using the information from these dark-frames. The operation can also be done manually with Photoshop, as we shall see later. Usually, dark frames are advantageous when using high ISOs (more than 800) and long exposure times (over 30 seconds). Many reflex cameras have a function that automatically shoots a dark-frame after each shot, (so after a 2 minute exposure, the camera will take another 2 minute dark-frame during which you must wait), in order to clean the noise caused by the shot just taken.

LANDSCAPE ASTROPHOTOGRAPHY – ELABORATION

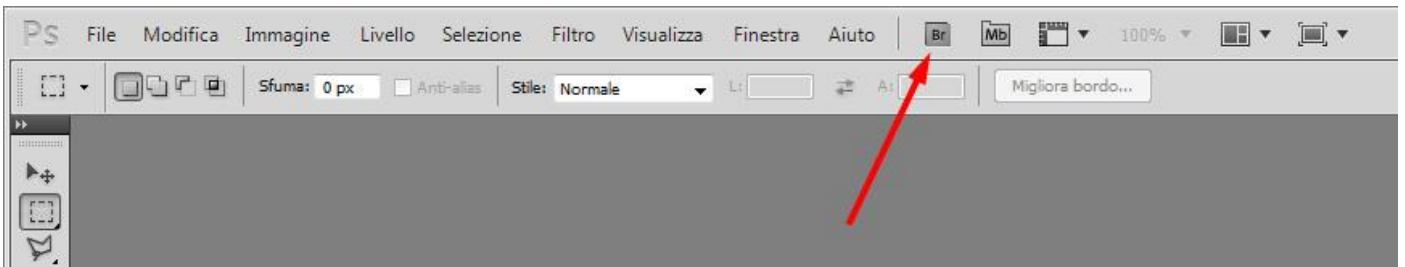
by Cristian Fattinnanzi

In this second section we provide the principal information needed to develop your astronomy pictures. The elaboration is fundamental, but remember that its primary scope is to eliminate the problems and defects linked to the presence of light pollution, to limit its disturbance and restore the visibility of the most subtle nuances of the sky. Making too many invasive interventions, such as excessive contrast or cartoon level saturation, may provide results that are appealing at first glance, but is often very far from reality and certainly subject to negative criticism from a technical point of view. Here, experience will be of great aid. If you have a doubt, it is always better to carry out more delicate interventions than those that the elaboration programs allow.

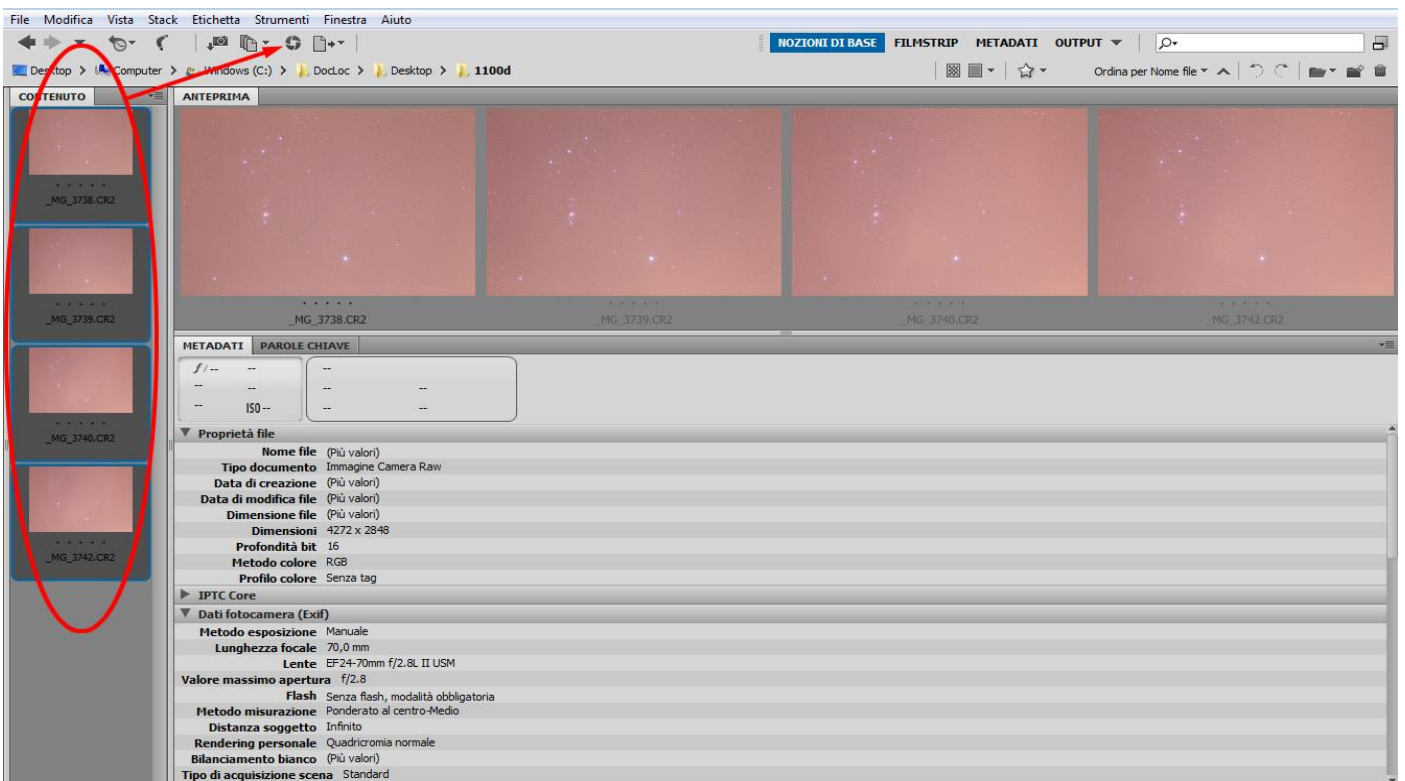
Download your RAW files... and then what?

You have come back from a wonderful session of night-time astronomy photography. Now, what is the most logical work flow to follow? First of all, download your files and **archive them** in an ordered manner on a safe support device (better yet, on two different support devices so that there is a backup in case of a problem on one of them). At this point, depending on what kind of photo you have taken, there are two different options. The main factor you must take into consideration is the number of photographs of the same subject that must be processed. If we have no more than 3 or 4 shots of the same celestial subject we can carry out the entire process with **Camera RAW** and **Photoshop**. Beyond this number, or if there are dark-frames, we recommend using a specific and free program such as **DSS** (Deep Sky Stacker), or **Iris** (more complex but more effective). This guide describes how to elaborate photos with Photoshop and with DSS, as well as providing information on fusing photos of the sky and of the landscape for those who want to use photo montage to obtain landscape astronomy photographs.

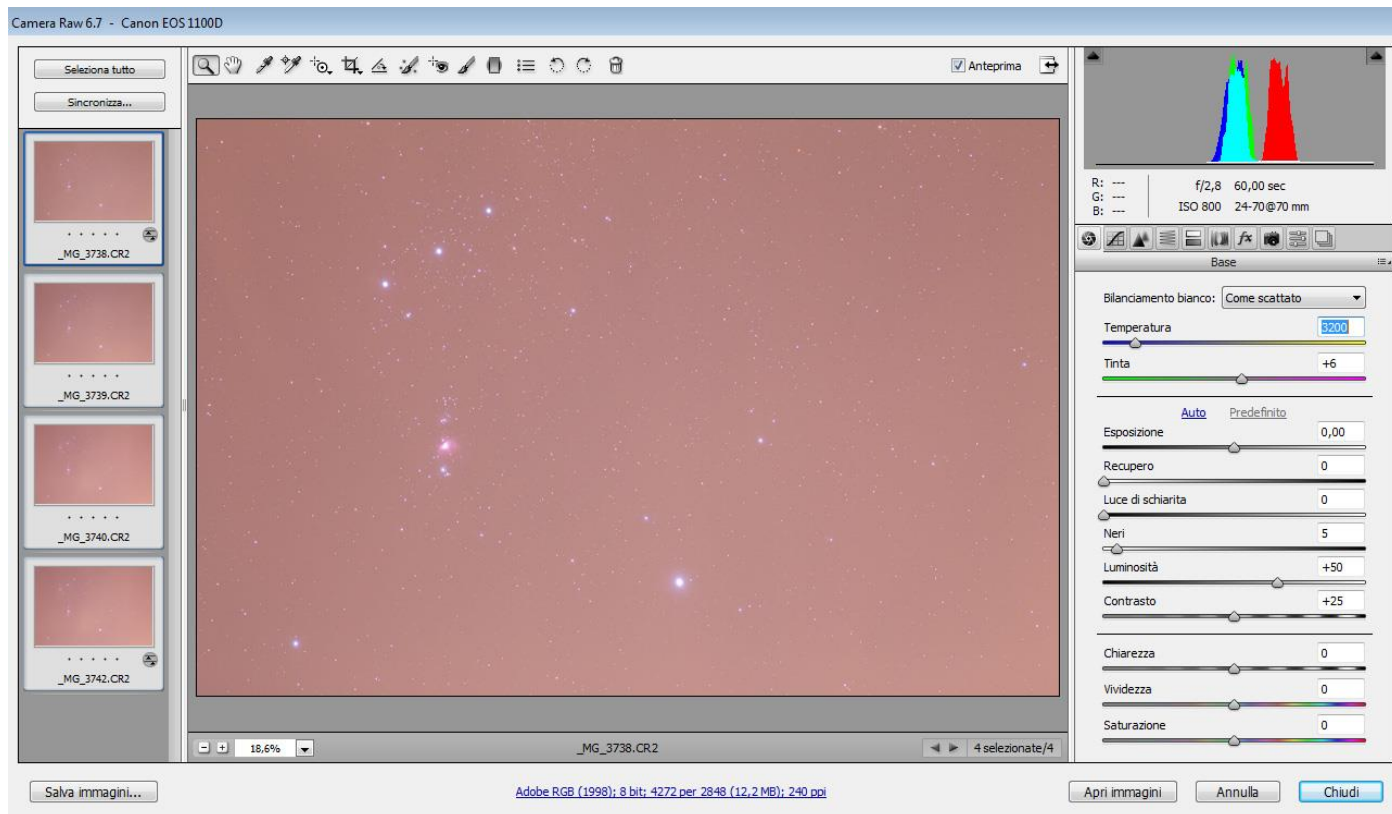
To start with, you should check whether your version of Photoshop can open the RAW files from the camera. If you have an up to date version of Photoshop and **“Bridge”** there should not be any problems.



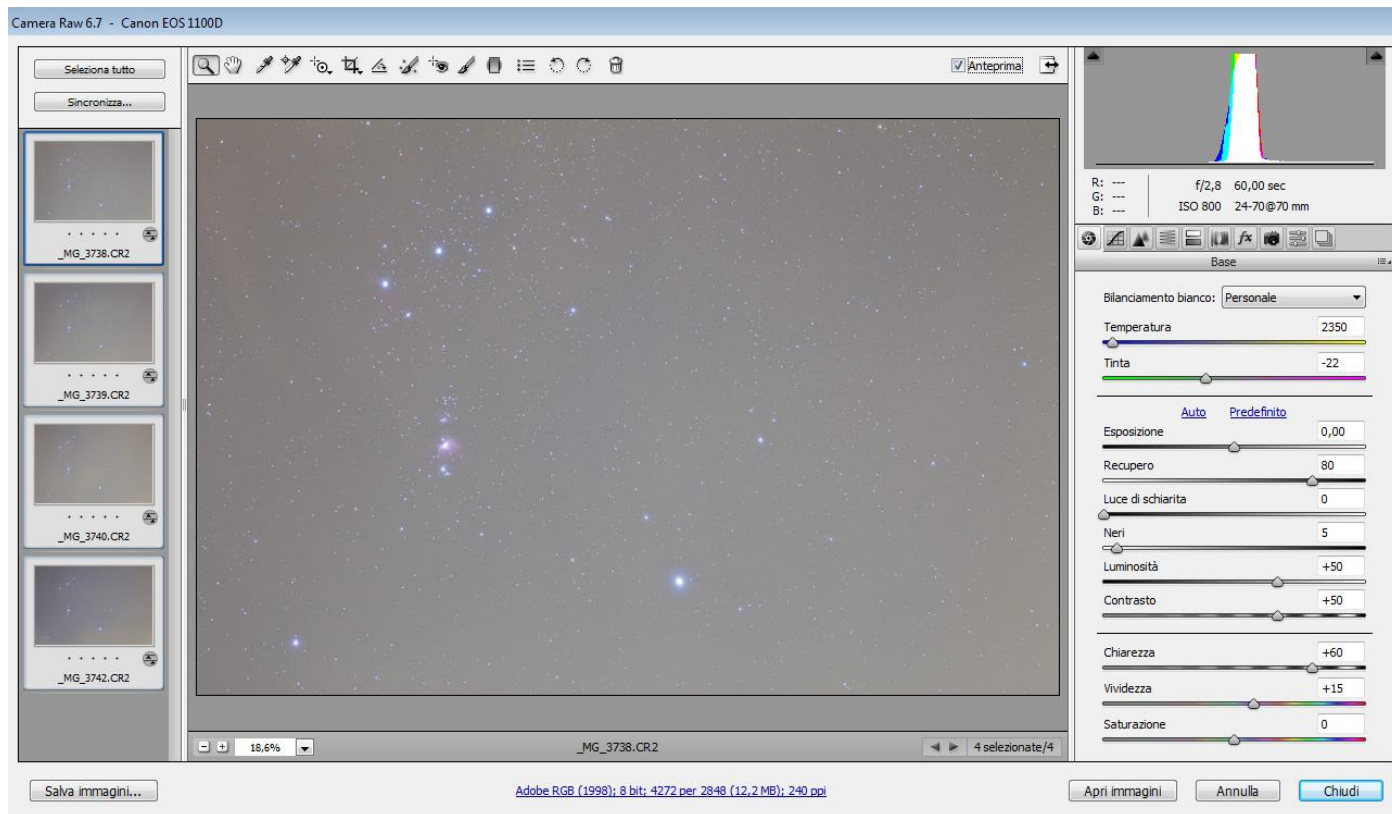
If instead you are unable to open the RAW files because your version of Photoshop is a bit out of date, you can download free Adobe “DNG converter” software to convert them into “DNG” (digital negative) format. This allows you to open RAW files even when using dated versions of Bridge and Camera RAW.



In Bridge (see above), you can select the images you want to process and open them by clicking on the shutter icon (Camera RAW). If all the images of the sky and landscape were taken with the same exposure times, ISO and aperture, then before starting the adjustments they should all be selected, by clicking on **"Select all"** on the top left, so that the adjustments are simultaneously applied to all the files. Then you can start to adjust the white balance and all the exposure parameters available in order to refine the files as much as possible.



The end goal is to obtain a result that has no dominant colours and provides the best view of the image's details. The **histograms** on the top right will help you, since they show the colours that are lacking or in excess.



Once this phase is completed, keep all the files selected, and press **"Save images"** on the bottom left and save all the images in PSD format, so that there will not be any compression and loss of information.

Let's work with Photoshop some more, on the alignment

Once you have completed this phase of optimizing the files, you can see how to “sum up” (although more precisely it is an average) the images in order to further reduce the electronic noise and enrich the details. So open your files with Photoshop. If you have multiple files of the sky (tracked) and the ground (not tracked), you must calculate the sums separately, using the same procedure here below.

-Open all the files. For example let's say there are 4 and they are called “A”, “B”, “C”, and “D”.

Select and copy the content of “B” by using the menus to “Select>All” or by pressing “ctrl+a” and copying it with “ctrl+c”. Then close the “B” file without saving it.

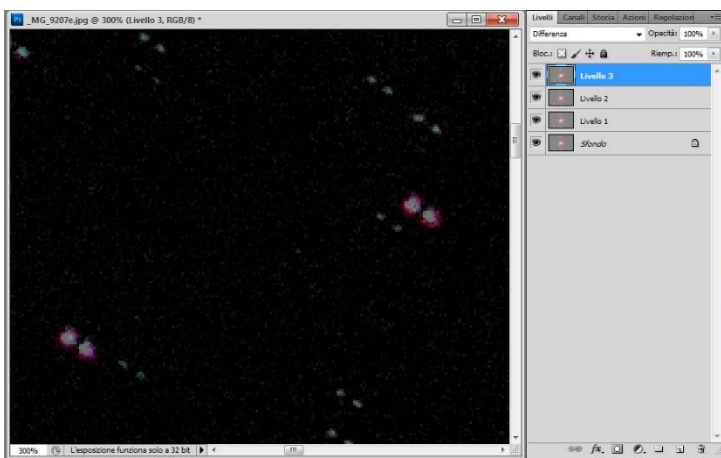
-Select the “A” file and paste it over the “B” file by pressing “ctrl+v”. In the layer settings, select the “difference” mode. In that mode you can align the two layers with the move command (V) by pressing “ctrl” and the arrow keys. The two layers will be aligned when the screen goes completely black. Once you have found the best position, go back to “normal” fusion mode and set the opacity level to **50%**.

-Select and copy the content of “C”, using the menus to “Select>All” or by pressing “ctrl+a” and copying it with “ctrl+c”. Then close the “C” file without saving it.

-Select the “A” file and paste it over the “B” file by pressing “ctrl+v”. In the layer settings, select the “difference” mode. In that mode you can align this third layer with the move command (V) by pressing “ctrl” and the arrow keys. The layer will be aligned when the screen goes completely black. Once you have found the best position, go back to “normal” fusion mode and set the opacity layer to **33%**.

-Select and copy the content of “D”, using the menus to “Select>All” or by pressing “ctrl+a” and copying it with “ctrl+c”. Then close the “D” file without saving it.

-Once again select the “A” file and paste it over the “D” file by pressing “ctrl+v”. In the layer settings, select the “difference” mode. In that mode you can align this fourth layer with the move command (V) by pressing “ctrl” and the arrow keys. The layer will be aligned when the screen goes completely black. Once you have found the best position, go back to “normal” fusion mode and set the opacity level to **25%**.

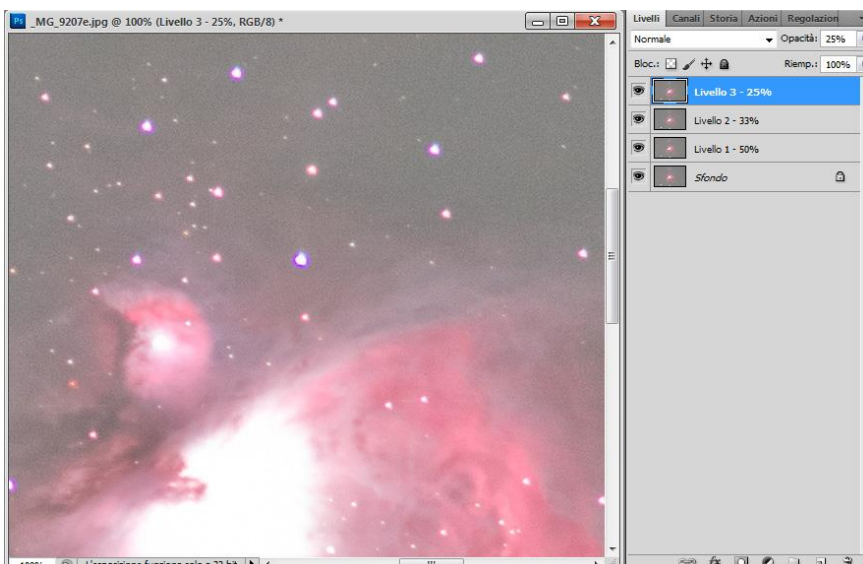


If there should happen to be a fifth layer, the percentage of opacity will be 100 divided by 5, so 20%, and likewise for a possible sixth layer it should be set to 17%, for a seventh to 14%, for an eighth to 12%, for a ninth to 11% and for a tenth to 10%.

So, to summarize, the sequence of opacity is:

100%, 50%, 33%, 25%, 20%, 17%, 14%, 12%, 11%, and then 10%.

Beyond 10 images I recommend using more specific programs, such as the above mentioned DSS, which also allow you to elaborate dark-frames and flat-fields.



Once aligned and all the layers have the right opacity, set the dynamic to 16 bit so that the image can be saved and contains the greatest amount of information due to its multiple layers.

The command is reached through the following path:

“Images>Mode>16 Bit/Channel”.

At this point you can bring together all the selected layers (Layer>Single layer) and save this file as “Master”, since it contains all the information from our shots.

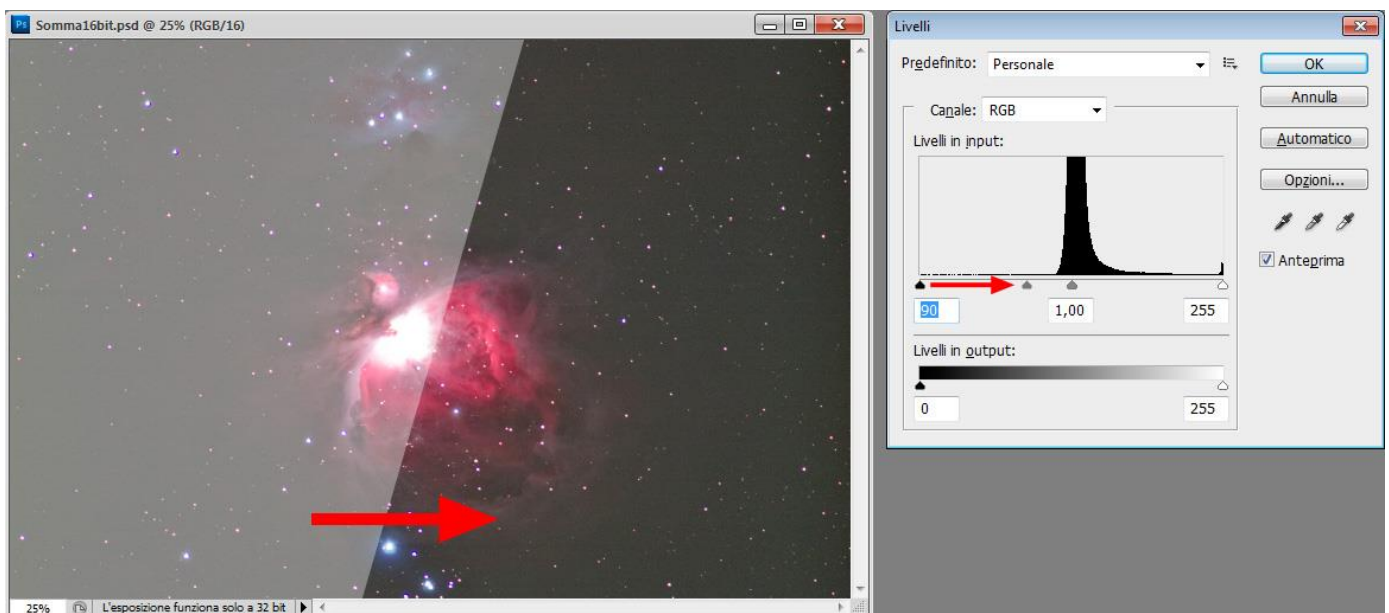
This procedure to achieve an average of the photograms may be intricate and a bit boring to carry out, but it is fundamental for reducing the noise and grain in the image. Its function is simple enough to explain. Grain appears substantially as a casual sequence of luminous irregularity in the pixels that is overlaid with the “good” light signal from the subject. When the percentage of the various layers is entered, the “good” signal is confirmed (and remains intact) while the noise is displayed at 50%, 33%, 25%, etc. every time another layer is added. A file obtained with many shots therefore has less grain. This means you can elaborate it with greater use of the Photoshop filters without the anti-aesthetic amplification of the electronic noise that is typical of images taken at above 800 ISO. Another advantage, although it is secondary and less salient, of the average is the improvement of the stars' aspect.



This is because the law of probability means you will have stars that are more rounded and aesthetically pleasing (except if there are periodic tracking problems and optical aberrations).

Finally! Let's elaborate the files

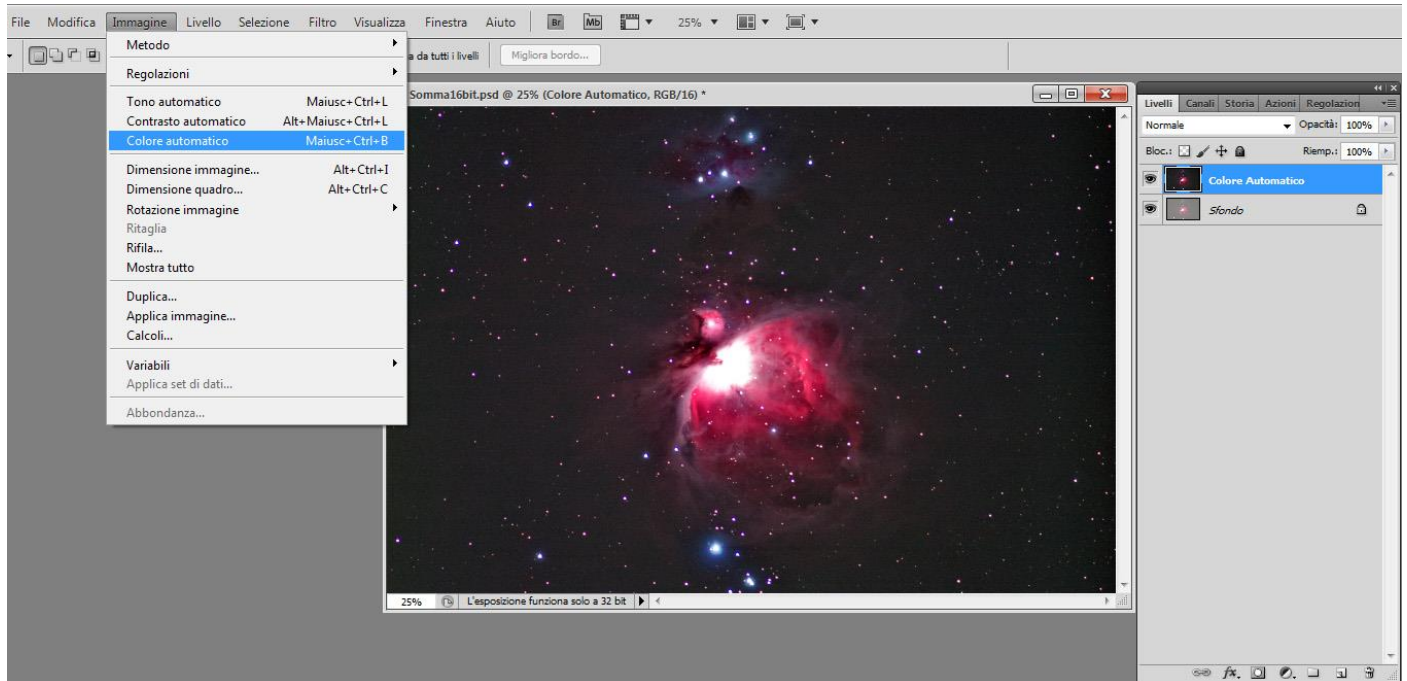
You made it! You finally have your files ready to be optimized! Personally, I recommend always working on **duplicated layers** (ctrl>J), in order to be able to partialise the interventions, if the result is not desired throughout the image. This “partialisation” is carried out by adjusting the **opacity of the layer**, or by using the gradient erase tool, or working with more developed layer masks that can be reached through “Layer>Layer Mask>Show all”. These means allow you to have a separate layer with your intervention that can then be joined to the starting layer at any time. The first command to balance the image might be “**Image>Adjustment>layers**”, and then you can slide the cursor to achieve the correct overall luminosity. Sliding the cursor to black (on the left) makes it possible to significantly limit the glare caused by light pollution.



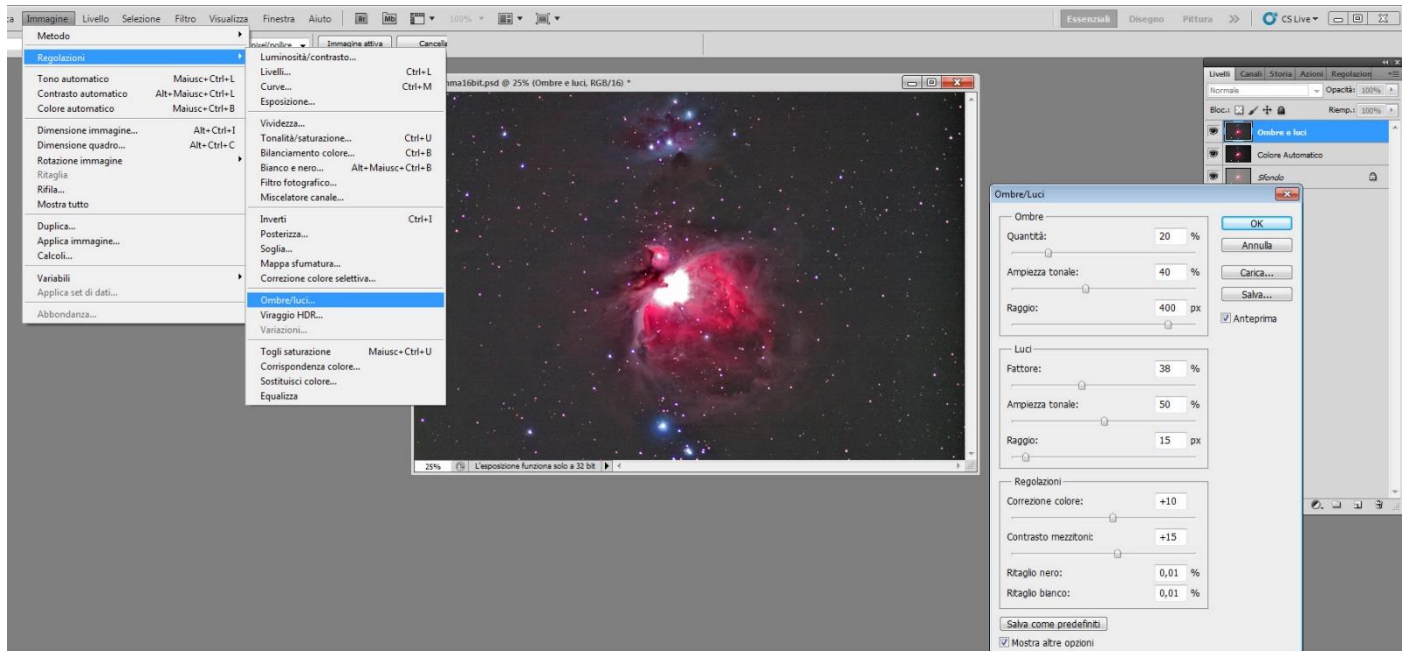
You must never overdo it and attempt to be delicate. If you allow yourself to rush or lose control of the instrument's power it can lead to the generation of an unnatural appearance that is not pleasant to look at. Always keep the background sky under control and never let it become completely black. If it does, you have probably sacrificed a few weak nebulas to the darkness.

Adjust the general colour of the image

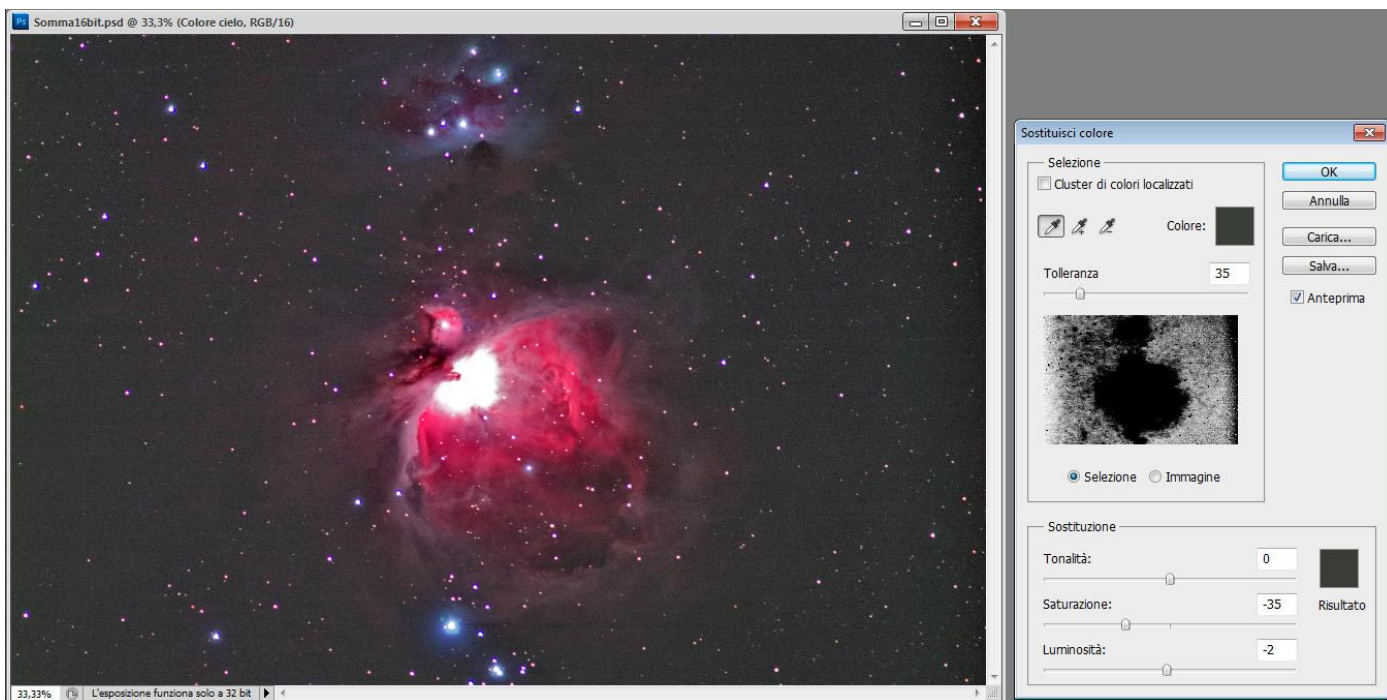
After this intervention there may be some irregular colour dominance. A command which may surprise you in this regard is **"Image>Automatic colour"** (Shift+Ctrl+B). In the most difficult case you can use **"Image>Adjustments>Substitute colours"**, or **"Selective Colour Correction"** or **"Colour balance"**. Do not ever forget to always work on **duplicate layers**, in order to optimize the areas and the nature of the intervention.



Often after these adjustments in luminosity and colour, there is a risk that the contrast is slightly emphasised, with excess light and shadow, and this takes away from the mid tones that usually contain the most interesting subtleties. A command that can help with this is the adjustment of **"Lights and Shadows"**. Used in a measured manner this command can restore a lot of interesting information.



A new optimization of the colours may be necessary, which you can carry out as described earlier. For example, you may notice slight dark green coloured halos at the sides of the nebulas. The command best suited to eliminating them is **"Image>adjustments>Substitute colour"** (the following figure): you must select the colour to be treated (by clicking on it), adjust the extension of the selected area with the **"Tolerance"** slide cursor and lower the available gauges to obtain the desired effect. Usually it suffices to remove saturation, but it is good to know that you can use all the slide gauges available. This command is very useful in wide field photos as well, where there are often halos or bothersome zones of luminosity on the horizon caused by light pollution.

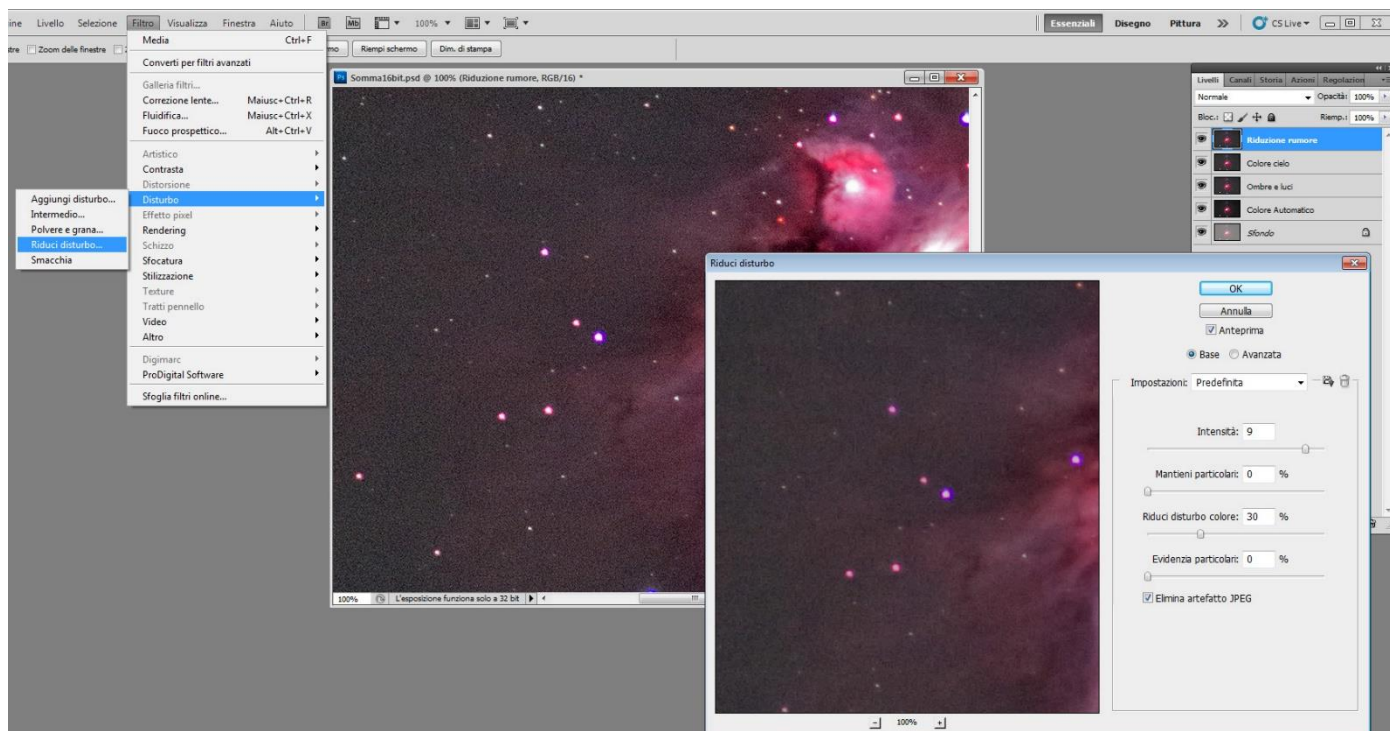


The reduction of noise

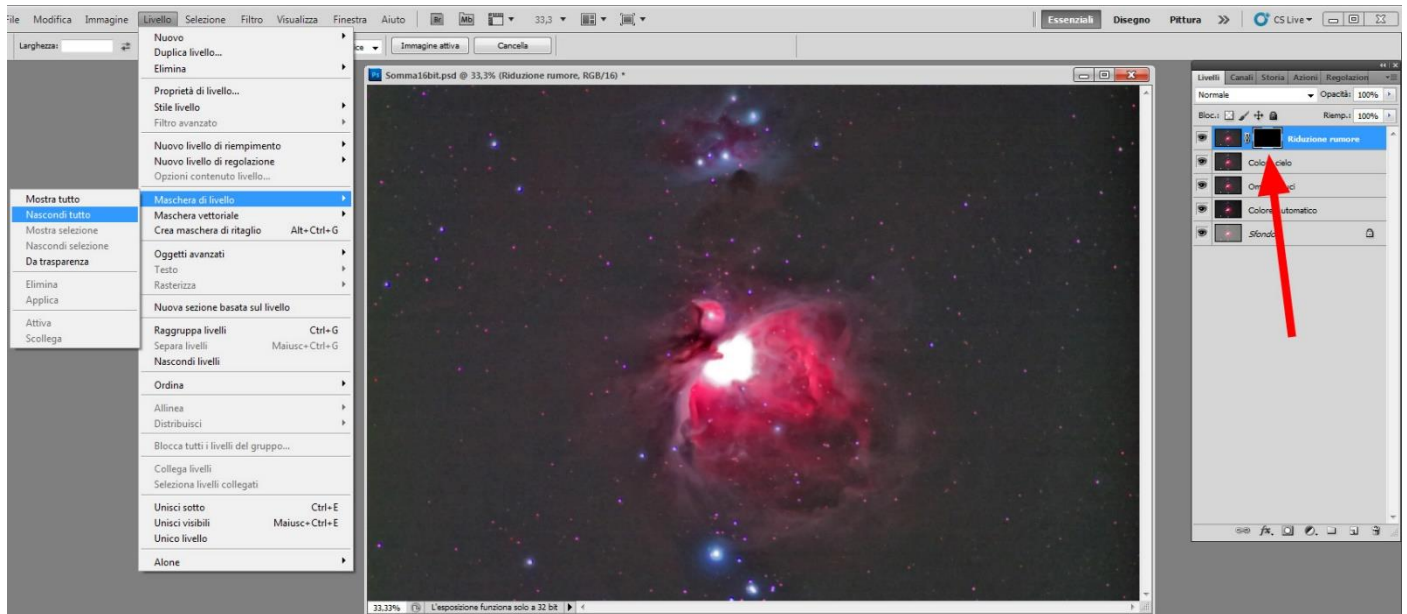
All of these operations almost always end up providing an image that is good with regard to the chromatic and luminosity point of view, but rather poor with regard to the grain profile. The problem is not due to your error, but rather that you are “squeezing” the collected light signal, which inevitably causes the effects to be brought out as well. The solution may be to shoot more photos of the object in the shooting phase, but this is not always possible, especially if you are already elaborating the image! Photoshop offers optimal noise reduction options, but you must also use them with the proper care. Often the noise is concentrated in the darkest zones of the image, so we must use targeted processing. My advice is to create a layer mask that contains the dark zones of the image, and apply it to the layer that has been subject to robust noise reduction. Let's look at the steps:

-Create a “Noise reduction” overlay layer by duplicating the latest state of the image (be careful with the opacity of the layers. If the last layer is not complete join those necessary to obtain a full image).

-Apply the noise/disturbance reduction filter (Filter>Noise>Reduce Noise...)



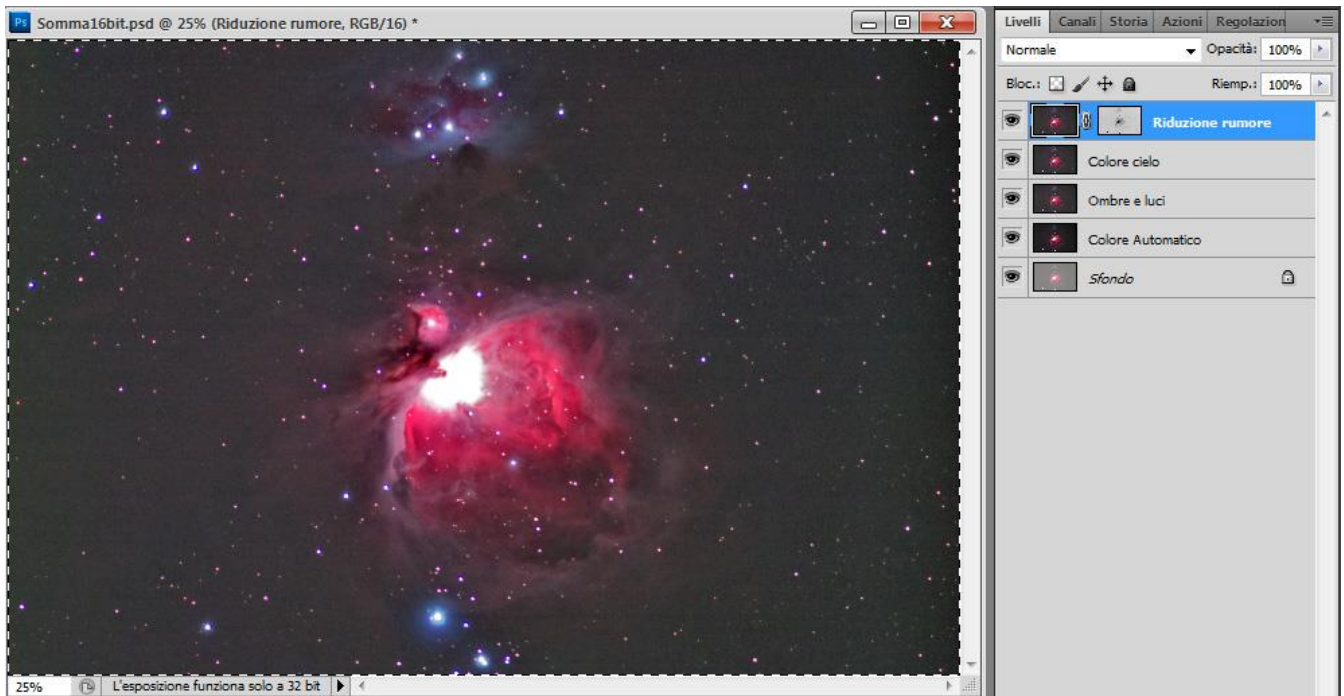
-On this layer, create a layer mask using the “Hide all” option.



-Now turn off the display of this layer and go back to the one below where you started, “Sky Colour”, and select all (ctrl>A), and copy it (ctrl>C).

-Turn the eye back on and click to select on the “Noise Reduction” layer. Then hold down the “Alt” key and click on the black box of the layer mask.

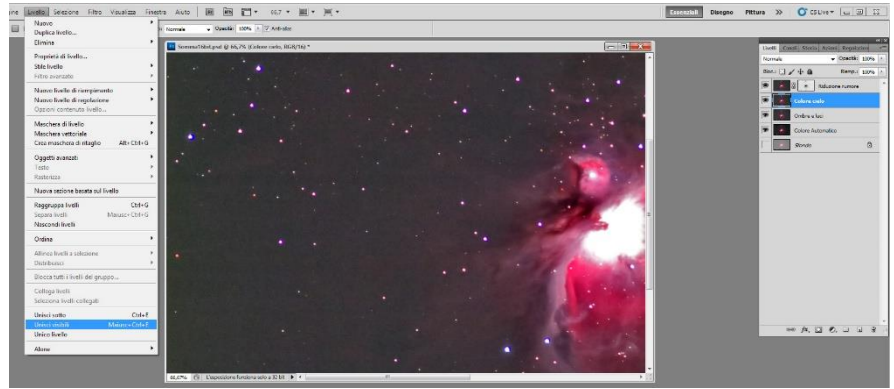
-This brings you to the layer mask and by using “ctrl>v” you paste the previously copied image on it. The image will appear in black and white. It allows the signal to pass in the white areas, while it does not in the black areas. Since what you need is the contrary, that the layers with the disturbance reduction act on the dark tones of the background sky, you must invert them to negative. Just click on the mask icon and press “ctrl>i”.



-At this point it will probably be necessary to deselect the image (by pressing “ctrl>d” you deselect all), and turning the layers view back on by clicking the eye on the top layer. If you enlarge it quite a bit, you will then notice how the filter has adjusted the dark areas alone. To accentuate this effect, you can intervene on the layer mask. If you click it you can regulate its layers in order to make the background sky white and the parts in question grey/black. If the noise reduction operation is still insufficient, you can continue applying other filters, such as a “blur” or even another “reduce noise”, making sure to apply it to the “noise reduction” image and not the layer mask.

-Whenever it might be necessary, you can exclude or include certain zones from/in an operation by clicking on the layer mask and using smudge brush and reduced opacity (usually 50% works well) in white to accentuate the reduce noise effect, or in black to reduce the effect.

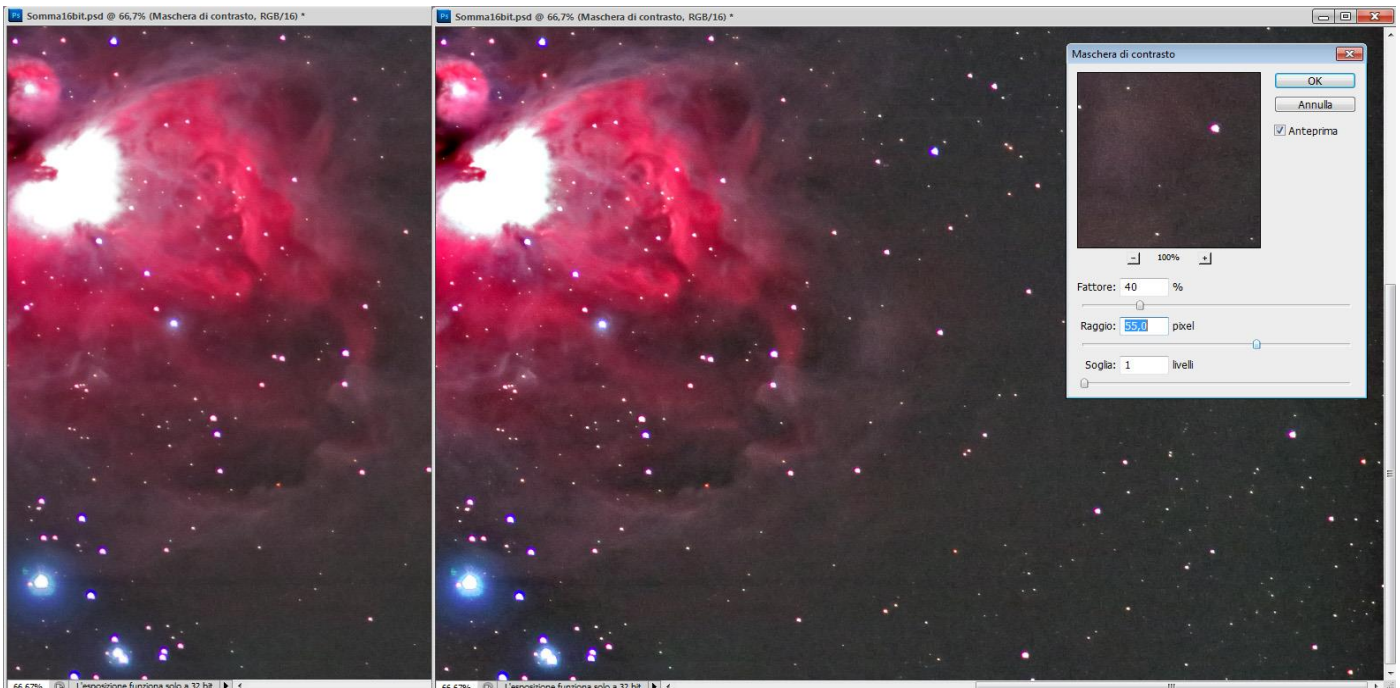
If you have reached a good point in the elaboration you can bring together the layers you have created, except for the one you started from. To do so just turn off the small eye for the “Background” layer, select one of the working layers and use the “Layers>Join views” command. This way you can also compare them, by clicking the little view eye on your result to see what you have achieved as compared to the starting image, the “Background” layer.



The contrast mask

The “Filter>Contrast>Contrast Mask” filter allows you to contrast image details that are more or less large. Likewise, in this case it is best to work on a duplicated layer in order to manage the result and possibly exclude areas where the intervention would not bring about an improvement. The filters can be adjusted using 3 parameters:

- The **Factor** basically regulates the nature of the intervention and how much strength you wish to assign to the mask.
- The **Range** is used to set the size of the elements highlighted. If you wish to emphasize the fine micro-contrast you must set very low values, typically between 0.5 and 3 pixels, while if you instead wish to have a general contrast to a wider range of elements, you must set higher values, of 15 and up.
- The **Threshold** allows you to progressively exclude dark areas from the operation, as these areas would usually show image grain. Personally, I almost always keep it at “1”, but every individual will have his or her own needs.



A problem that the contrast mask often generates is “burning” (that is, making too white) the lighter areas, including the brightest stars, so that they tend to spread out in a way that is not aesthetically gratifying. This characteristic usually makes the image less pleasant, but you must evaluate it on a case by case basis. There are many ways to avoid this problem. The two main solutions are to generate a layer mask that excludes the lights (as seen above for the reduction of noise), or, more simply, by using the “Select>Colour interval”. Then select a white point and adjust the “Tolerance”, improve the selection with “Select>Modify” “Expand” (usually 3-4 pixels) and “Blur” (usually 2-3 pixels) and then cancel it.

How to reduce the diameter of the stars

Often the elaboration of the image causes an increase in the stars' diameters. In many cases this makes the picture appear unnatural, as though they had been painted on. You can use Photoshop to reduce their diameters, thanks to the "Minimum" filter. As before, create a duplicate layer and use the tool bar to "Select>Colour interval". Then you can use the dropper to touch up the white coloured details. Photoshop will select everything in the photo that is white, such as the stars you are trying to fix. Adjust the tolerance to select the number and intensity of the stars you want to treat and then hit OK. Then use the tool bar to:

SELECT > MODIFY > EXPAND then enter 4 pixels and hit OK.

SELECT > MODIFY > BLUR then enter 2 pixels and hit OK.

This way we select not only the saturated nuclei of the stars but also the area immediately surrounding the stars, all of which will be affected by the filter. The blur command makes the action appear less aggressive along the edge of the selected area.

Then apply the minimum filter. Using the bar click:

FILTER > OTHER > MINIMUM

Set the range to 1 pixel and hit OK. Right away, you will see the stars' diameters have decreased. At this point, if the filter is too much, you can "mitigate" the filter action by going to:

MODIFY > DISSOLVE MINIMUM

Then use the cursor to set the percentage to your liking.

If the stars are still excessively dilated, repeat the operation again with another application of the filter and another dissolve.

Do not ever forget that each passage of these two operations may need to be "masked" since the intervention is not always advantageous on all pictures. The layer masks can also generate gradients. The "Gradient" icon in Photoshop is together with the bucket, and can also be selected by pressing the "G" key. This will provide a very gradual partialisation of the layer view that is practically imperceptible if properly placed. These graduated masks are often used in the wide angle photos in order to make the typical light along the horizon uniform.

The final touches

Finally, you can give a bit of colour contrast to the image by using the "Vibrance" (available in Photoshop CS5 and later versions), "Saturation", "Luminosity and Contrast", "Curve", and "Selective colour correction" commands.

If you have also taken dark-frames

Photoshop also allows you to perform **Dark-frame subtraction** procedures, so long as they are done with certain care. Remember that dark-frames must be taken exactly as the shots of your subject except that the lens cap is on. That means they must still have the same exposure time, ISO and be taken with the same external temperature. You must also be certain to cover not only the front lens but also the rear lens of the camera's viewfinder. For more reliable dark-frames, you can take a number of shots. 3 to 10 shots usually guarantees good results. Let's see how we can actually use them. First of all, the dark-frames must be subtracted **BEFORE** performing any other operation on the images in Bridge or Camera RAW. This is because the signal you are treating needs to be the one recorded by the reflex camera. If you have taken multiple dark-frames, you can get the average of them using the same method as we saw above for normal images. Having done this you will obtain a single file that you can call "Master-Dark". This file must be copied and pasted on each image taken and then the fusion method for the layer must be set to "Difference". That way the random recurrent signal that appears in all the images will be subtracted and your shots will come through cleaner. It should however be noted that in some cases the subtraction of the dark-frames could be excessively invasive and generate black pixels in light areas of the image. This problem can then be limited by reducing the opacity of the dark-frame level to a value near 50%. This makes the dark-frame less effective but the problem will be far less evident. Once the dark frame has been applied to all the images and they are saved under a new name, you can begin the processing of the images described on page "7". Personally, I can say that in the most recent reflex cameras, the noise in the sensor is far more contained and the advantages offered by dark-frames are less significant than they were in the past. Whenever you do choose to use them, Photoshop is certainly not the best program to apply them. That is why I recommend using specific programs designed for the processing of astronomy pictures, such as the above mentioned DSS.

Techniques and commands useful for landscape astrophotography

Up until now we have described elaboration techniques specific to astronomy photography, which may nevertheless be useful for any night-time photographs with the subjects in low light conditions. However, astrophotography with long focal lengths (greater than 300 mm) requires expensive and heavy equipment, such as motorised equatorial mounting suited to supporting and moving heavy telephoto lenses or telescopes with precision, parallel tracking scopes, and large power sources to provide electricity for everything. For those just starting out, this may be a bit of a risky choice. Investing in equipment is very expensive and then you may discover that long focal length astrophotography is too demanding and not your cup of tea. This would mean suffering useless expenses and losing a large part of the money even if you are able to resell the material on the second-hand market.



The best thing is to **start by using very short lenses**, a digital camera with sensors of at least APS-C (22x15 mm) and a solid tripod. Smaller sensors collect less light and are clearly not ideal for night-time photography. For the same reason fast lenses are preferable, at least F4 or better yet F2.8, with short focal lengths, somewhere below 28 mm on FF format (18 mm on APS-C format). This will allow you to lengthen the exposure time up to at least 10-15 seconds before any motion due to the Earth's rotation is shown.

With this kind of wide angle shot, you can better make your astrophotography more interesting by placing the shots within a context by including elements of the landscape, especially when these elements are aesthetically pleasing or particularly characteristic. Including landscape means you must choose from among three different photographic techniques, that affect both the amount of processing and the equipment needed:

-SINGLE fixed photo, on a tripod, taking one shot for the sky and landscape, with an exposure limited by the “300 divided by the focal length = seconds” rule to avoid the stars' movement and generally high ISO sensitivity, above 1600 (more often between 3200 and 6400).

-DOUBLE photo on a tripod but taking two shots, one of the sky with a limited time and high ISO, and another of the landscape with less extreme settings to avoid grain (at least in the terrestrial part). In this case photo montage will be required to join the two images together to achieve a single picture, in which, unfortunately, there is no way to avoid the difference in quality between the earthly and celestial parts given the much higher ISO of the latter. When taking the shot it would be a good idea to calculate the times (for example, 30 seconds at 3200 ISO for the sky and 2 minutes at 800 ISO for the landscape) so that there is the same exposure for both shots and in order to simplify the fusion in the elaboration phase.

-TRACKED DOUBLE: in this case you will need a star tracker that, when mounted on the tripod, will allow you to lengthen the exposure times for the photograph of the celestial part as well. Then you can work with a mid range ISO, typically between 400 and 1000 ISO, and obtain files that are far cleaner, more detailed and easier to elaborate. With this technique it is also advisable to keep the same exposure time for the ground and sky parts of the picture in order to simplify the delicate work in the elaboration phase and the union of the photographs. You should take the photos of the sky with the tracker running and the photo of the landscape is obviously done with the tracker turned off.

Since it runs using a clockwork mechanism, the Minitrack in particular only stops moving when it has run through its charge. The best procedure to use is first to mount it and aim at the North star, and then:



-with the timer fully unwound, compose the frame so that the desired earthbound elements are in place;

-wind the timer to the time needed to take the exposure you want of the sky (such as 15 minutes if you want to take 3 exposures of 4 minutes with a 1 minute break between them) and start a sequence of at least 7-8 exposures. That way, the tracking will guarantee the 3 shots of the sky and then the camera will take 3-4 shots of the ground with the timer already out of charge.

Now let's look at how to carry out the elaboration of the two separate images (one tracked) in order to obtain a single picture in which neither the sky nor the ground images show movement.

Convert all the files and treat them using "Bridge" and "Camera RAW" as described above. Be careful to carry out exactly the same adjustments on all the files used to make up the image.

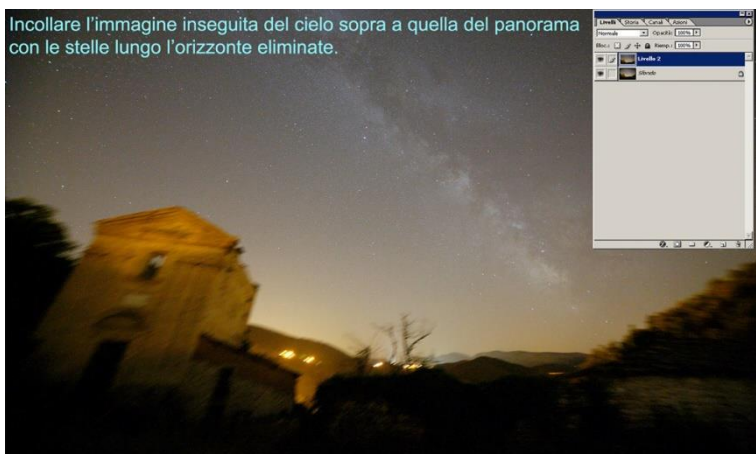
Then, if you have taken multiple shots of the tracked sky, it would be best to **make an average** as described above. It is true that working below 1000 ISO may not require you to take more shots, but if you are able to and the conformation of the horizon is favourable (without any trees, poles or large irregularities that could create problems in the fusion phase), it is not a bad idea to take 2 or 3 shots to average both the sky and the ground. This is especially true when the ground is substantially less luminous than the upper part. Another reason to take multiple shots is as a safeguard against unforeseen problems. If something happens to go wrong in a shot (movement in the image, the tripod being bumped, an aeroplane going by, undesired light in the frame, etc.), we can always discard the bad shot.

Once you have obtained two "Masters" (of the Sky and of the Earth), you can follow the directions shown in the images below in order to ensure the areas in which they meet are indistinguishable.

ELIMINATE the stars along the horizon with the "stamp-clone" tool for a band along the horizon. This operation is fundamental for "cleaning up" the "crossing" zone between the NO-TRACKED image and the TRACKED image.



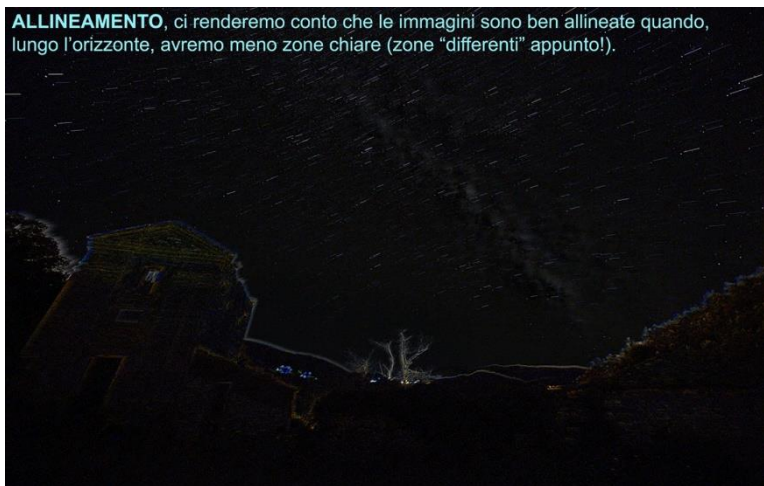
PASTE the TRACKED Sky image above the one NOT TRACKED about panorama with the stars cancelled along the horizon.



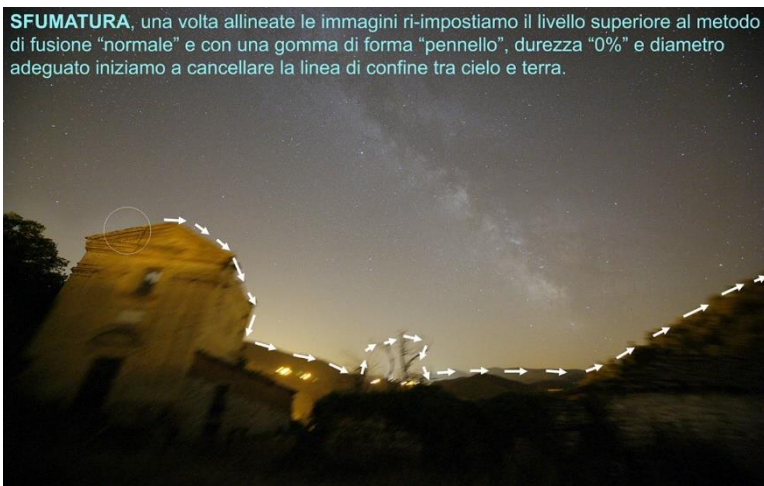
NOW, SET the sky level to "DIFFERENCE", in this way, with the command ("V") and with the directional arrows we can better align the two images.



ALIGNMENT: we will realize that the images are well aligned when, along the horizon, we will have less light areas ("different" zones indeed!)



SHADING: once align the images, reset the top layer with "normal" fusion method and with a "brush" shaped rubber, 0% hardness and adequate diameter, we start to cancel the boundary line between sky and earth.



CANCELLATION:

obviously, once the part of "crossing" between the two images is blurred, we will eliminate from the level of the traced sky, even everything that is underneath and that is displaced.



FINAL FUSION!

To conclude, all you need to do is merge the layers together and cut out the outlines that do not contain both images after alignment. The final processing will follow to balance colors, brightness, reduce noise, etc.



In the sequence just detailed the **eraser** is used to delete the part with movement. The same result can also be achieved with a **layer mask**, which also allows you to correct the selection at any time. Once these steps to align and fuse the two images have been carried out, join the layers and save the image as "Union". Then you can of course begin to elaborate that file with the techniques described above.

Here below are **some examples** of images achieved with this technique:

The star tracker used for these pictures is the clockwork driven **Minitrack-LX**. The previews are small in dimension, but despite this, it is possible to notice the points of the stars and the clean tones and colours that you would not have expected from the ISO used.



For any information or clarification of any of the subjects addressed, you can contact me through Facebook, by searching for Cristian Fattinanzi, or join the “Minitrack LX” Facebook group that I created to discuss and collect images made with this star tracker that I designed and built by hand.

The group also publishes announcements regarding events and conferences on astronomy photography organised so that we can meet under the best skies Italy has to offer. There, in good company, we photograph and practice this wonderful passion for astrophotography!

Recommendations for successful night-time photography. What equipment do you need? What settings should you use? What precautions should be taken? Find out the answers in these 10 suggestions.

1. USE MANUAL MODE

Manual is the most suitable mode because it allows you to make a series of attempts in your approach to the final result rather than having to try to interpret the values proposed by the automatic mechanism of the shot. Furthermore you have the possibility to use the B setting for times lasting over 30 seconds.

2. DELETE THE INTERRUPTIONS

Many different things can happen during a long exposure. People can stand in front of the camera. Headlights from buses and cars flash by. If you are trying to shoot in Bulb exposure, cover the lens (using a black card) until they have passed and then continue the exposure.

3. COMPENSATE FOR LIGHT SOURCES

Very intense lights on the scene can trick your camera's light meter and lead to underexposure. So, when shooting in manual, keep in mind that the correct exposure values may be different than those suggested by the camera. When shooting in automatic you should make use of the exposure compensation.

4. THE B SETTING (BULB EXPOSURE) ALSO EXISTS

The time for long exposure shots does not necessarily need to be very precise. If the typical maximum value of 30 seconds is insufficient, in manual mode we can then use the B setting. The shutter will remain open so long as the shutter release is held down. That way you can easily measure the exposure time using your watch.

5. FIND A FLAT SURFACE

What do you do if you don't have your tripod with you? Find a flat, stable surface where you can put your camera, then use the self timer and do not touch the camera while it is taking the shot to prevent any vibration.

6. GET THE CORRECT COLOURS

At night you often end up shooting with a great variety of light sources, and so it is almost impossible to find the correct White balance. Under such conditions the Auto setting often provides the best compromise, but it can be useful to shoot in RAW format in order to attempt to modify the White balance settings.

7. BRING A TORCH WITH YOU

Always bring a torch when you go out to photograph at night. It will help you set up the equipment correctly. Also you can use its light to "paint" your subject. You'd be surprised. At night a tiny light can produce grand results.

8. USE THE MIRROR LOCK-UP

The D700, and the D300s, as well as all the Nikon FX have a mirror lock up (MLU, a.k.a MUP- Mirror UP) function that comes up before the shot is taken. The vibrations of its movement can dampen prior to the first shot, thus limiting the chances of mini-movements in the image. It should also be said that the longer the exposure times are, the less evident the loss of sharpness caused by the mirror's vibration.

9. A FRIEND ALWAYS COMES IN HANDY

Photographing at night means heading out with a great deal of rather expensive equipment. Going together with a friend not only means greater safety, but also provides two extra hands that can hold a torch, a flash, or anything else you might need.

10. WHAT ISO SHOULD I SET?

The adjustment of the ISO value on reflex digital cameras is extremely useful for night-time pictures because it allows you to customise the camera's sensitivity to the level of illumination present.

7 techniques to shoot breathtaking night-time photographs



Shoot beautiful photos that are still recognizable even if transformed by nocturnal light.

When the golden light of the sun sets and makes way for darkness, many photographers put their equipment away and head home. For some, instead, it is only the beginning. The landscape transforms at night and common place, familiar scenes become unusual. This offers many unique photographic opportunities.

Thanks to technology's unstoppable march forward it is now possible to take photos in every situation, from the brilliant lights of the city to the darkness of the night sky. Cameras can be pushed to work with extreme ISO sensitivity in order to capture details even in the darkest of scenes. In this article you will discover **7 techniques to shoot breathtaking night-time photographs**, from fantastic panoramic views of the Milky Way to the timeless Star-Trail, from urban landscapes to the creative Light Painting technique using a torch. You will also learn to control the depth of field in order to create fascinating photos with sharp close-ups with wonderfully out of focus backgrounds.

Astrophotography is undoubtedly the most fascinating of photographic genres. Many of the techniques here addressed require experience and a massive dose of patience, but in the end you will realize that your efforts will be rewarded, because the pictures you get will add value to your portfolio. Continue reading and you will understand that as soon as you are out your door, there is a world to discover and you will learn the best way to use your equipment to do just that. Good light, even if there is not much of it!

Photographing at night, even for an expert photographer, opens up a new world of possibilities. Dedicating a little bit of time to prepare your equipment and study techniques will give you a greater chance of obtaining wonderful photographs. Here are some things you need to know to be able to safely shoot fantastic photos.



As ever, planning is fundamental. There are instruments that allow you to schedule your photographic outings ahead of time. [Google Earth](#) will help you find the right sites, while on [Flickr](#) you can see how your colleagues framed a particular scene. If you want to photograph the dome of the sky applications such as [PhotoPills](#) or [Stellarium](#) are useful since they provide information on when certain heavenly bodies will be in a specific position. Another equally important task for getting beautiful pictures of the stars is **evaluating the impact of light pollution**. It is often necessary to walk for a long time in sparsely inhabited areas in order to find a location from which you can successfully photograph the night sky. Scout sites out and be careful of even the smallest flashes on the horizon, since these can become extremely invasive with the long times needed for the correct exposure of the sky.

The search for dark skies is ever more difficult and may require a great deal of time, even in areas that have been classified as ideal for night-time photography. Also keep in mind that **the Milky Way is most visible in the summer**, while in the winter it nearly disappears from the sky. Alternatively, cities offer infinite possibilities to take nocturnal photos! Look for a scene with interesting elements and use the lines and shapes of the architecture to guide the observer's eyes. Once you have located an area at night, it is important to visit during the day to find out whether it can be accessed without problems. Make sure to find a route in and out that is safe when it is dark and always be certain to tell someone where you are planning to go and what time you expect to be back.

Take several different shots of the elements of interest in the preparatory outings and study the compositions of your photos. That way it will then be far easier to shoot when you return when it is dark. Remember that while a photo of the Milky Way alone can be fascinating and pleasant, if you **put in elements** that are recognizable in the foreground the viewer becomes more involved in the picture. It is also important to balance the rapport between the foreground and the sky well so that there are not any elements that would create distractions in the final image.

One thing you must consider carefully when planning a night-time outing is your **clothing**. Choose heavy clothes because staying outside 2 or 3 hours at night can become dramatic if you are not properly covered, even if the day was quite warm. Your shoes are also very important. Their soles must have a tread suited to damp and slippery ground and the shoes must be water-proof.

While a good [torch](#) is fundamental, it is just as important to use it properly. Avoid pointing at anybody you see in the distance, who might be another photographer who is trying to take an exposure at that moment and you would then ruin his or her photo! Also make sure your mobile phone has coverage in the area you are headed, as they are always useful if there happen to be any problems.



Now we come to **photographic equipment!** Speaking of cameras, we must say that models such as the [Nikon D4S](#) or the [Canon EOS-1D X](#) are the best for night-time photography, but these are professional cameras and not within the grasp of everyone's budget. Fortunately, technological progress means that even the less expensive reflex models are able to provide optimal results in the management of noise due to their high ISO. With the right lens you can start to capture the intrinsic details of the Milky way, even if you use simple settings on your reflex camera.

It almost goes without saying that night-time photography requires a **tripod** and [you can find different kinds available on the market](#), even lighter ones that allow you to move about with greater ease. It is important that it is stable enough to resist the night-time winds, since being out at night when the mistral wind is blowing is not at all pleasant. To increase the tripod's stability you can use a number of tricks, such as attaching a weight to the central column. You can even use your [photographer's backpack](#) to do this. Another trick is to ensure the tripod's feet are on solid ground rather than something less stable like ice, mud or sand.

Once you have found the location and organised the equipment it is now time to consider the setting you will use for the photos you want. **The first thing to do is set the photos in RAW format.** Cameras with a good dynamic range allow you recover details from lights that are too bright, from underexposed shadows and the luminosity that may not be apparent from the Milky Way by using touch up software.

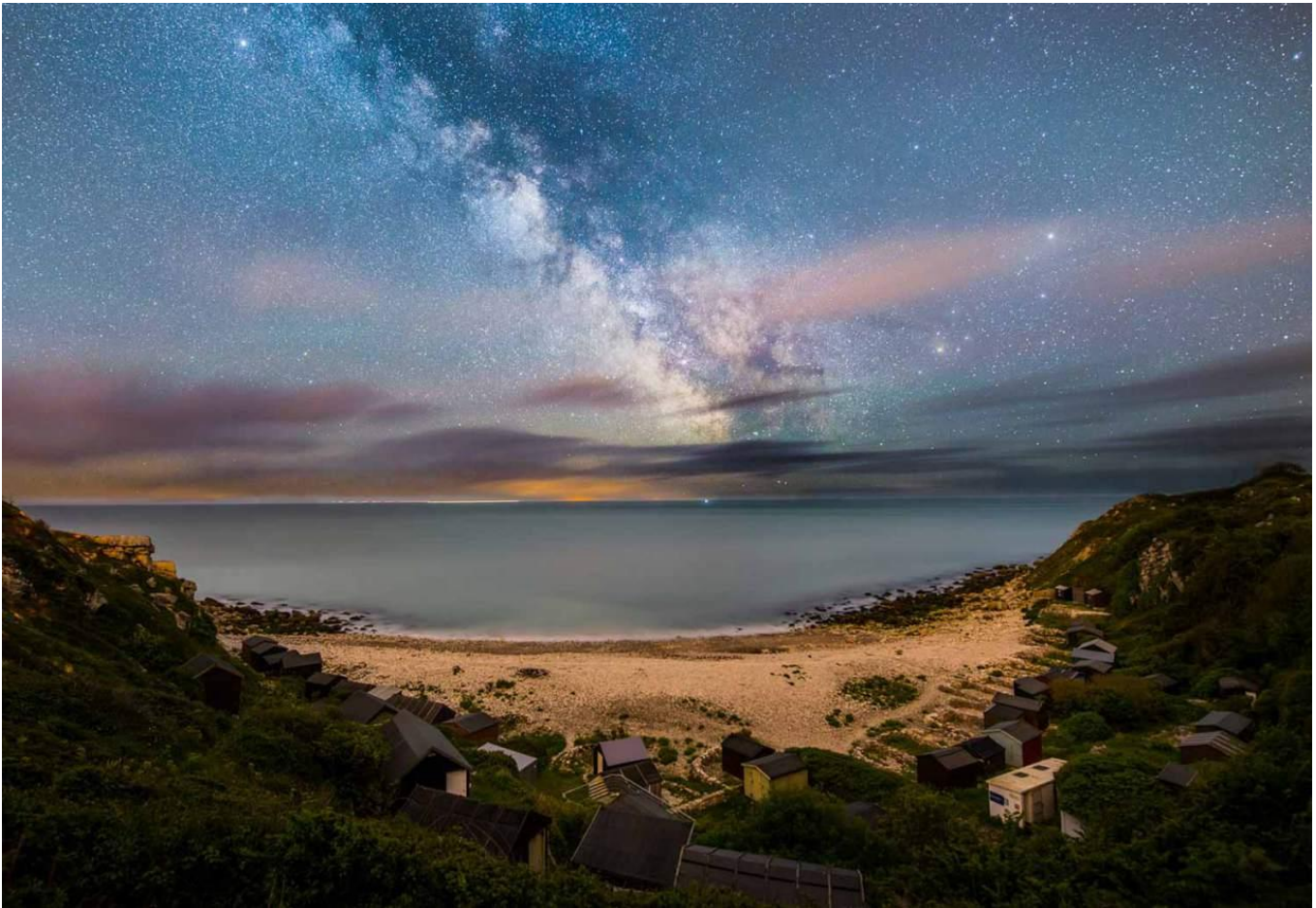
The second thing is to **always remember to work in Manual mode**, since you cannot trust the light readings for a night-time photograph taken with the camera. Start by choosing conservative options, especially in scenes where there are points of bright light.

Keep the ISO low when in the city. If you must make a photo more luminous, lengthen the exposure time or open the aperture. If you want to photograph an urban landscape use a remote shutter release so that you can set times above 30 seconds without being forced to manually hold the shutter release button down the entire time. Try different exposure times to see what effect they have on elements in movement.

Many countryside locations have very little light, especially in the very early morning. Rather than avoiding shooting during these hours **take advantage of the darkness to photograph** stars that are not yet hidden by the sun's light. Do not be afraid to use more extreme settings, such as an ISO of 3200 or 6400, especially since the newer models of reflex cameras have made great strides in this field. In any case photos taken with high ISO will be grainier than those with lower ISO sensitivity. While grain is by no means the end of the world, many photographers try to avoid it at all costs. If you like you can even choose lenses with large apertures and use rather long exposure times. However, to obtain sharp photos of the Milky Way you will have to invest quite a lot of money in equipment.

On the other hand, **Long exposures** cause the appearance of **thermal noise** and **hot pixels**. Thermal noise is really tough to get rid of even in the touch up phase. The reduction of the camera's level of noise can interfere with the rhythm of the shots, since it

requires a period of time in which the camera cannot be used for taking photographs. Alternatively, you can take a shot with the lens cap on but with the same setting as the shot with hot pixels and then eliminate them with the appropriate software.



It is worth mentioning that when you use long exposure times, the Earth's rotation will cause relative movement of the stars in the picture and subsequently they will create trails of light. **To take a sharp photo of the Milky Way you can use the rule of 500**, which allows you to establish the maximum exposure time for each lens you are using. Divide 500 by the focal length you want to use and the result is the exposure time. With a 50 mm full-frame lens mounted on your camera you can use an exposure time of 10 seconds. If you have an APS-C reflex camera then use a factor of 1.6x for the focal length and you get $500/(50 \times 1.6) = 6.25$.

Another option is to acquire a **star tracker** that makes the camera follow along with the movement of the stars. This device will enable you to use much longer exposure times with more restrained ISO sensitivity. On the downside, the foreground of the earthly elements will show movement and you will have to fuse together two images, one for the stars made with the star tracker, and another without it in order to have a nice sharp foreground.

To have the stars in focus you must manually focus at infinity or better yet the sideways infinity symbol before the infinity symbol in the lens distance window. In any case, always check the photos right after they are taken and make any necessary changes to the settings. If you are unable to capture a satisfactory portion of the sky in a single photogram with the lenses you have available, try to shoot a series of photos that you can later bring together into a single picture in the post-processing phase. In Photoshop you can use the *Panorama Photomerge* command.

Once you get home you must convert the pictures into RAW files. Using a program such as [Adobe Lightroom 5](#) you can selectively apply improvements and work on specific areas of the photo. This technique is extremely useful when you have to increase the luminosity of the Milky Way or the luminosity of the landscape illuminated by the light of the stars. Making many little local modifications make it possible to make many little details of the starry sky become clear.

Photographing at night is a challenge, but it can become an addiction when you start getting valid results. The more time you spend out photographing the stars, the greater the chance you will have of capturing something truly special, such as a comet for example. Once you have learned the basic techniques, it will be your own instinct that leads you to the best conditions and locations for shots that will leave you speechless!

1. LIGHT PAINTING

Discover what you can do with a torch to make the details of a night-time scene come alive.



Your electric torch can do more than just light your way from the car to where you are taking your pictures. It can also be used in the taking of the photos themselves! With certain cameras you will be able to photograph the Milky Way so well the foreground becomes nothing more than a silhouette.

Set the self-timer and approach the elements you want to light up. When you hear the shutter point the torch at these elements and move the light beam in a regular and uniform manner without letting it stop in any one point for too long. Try not to have the torch on when you are near the camera to avoid creating reflections on the lens. It is not easy to get the right lighting and you will have to make several attempts before you get the perfect shot.

2. INCLUDE THE MOON

Make sure you expose the moon correctly in order to create a truly compelling composition.



Photographing a landscape with the moon is not simple. Creating a portrait of the moon in a serene sky is just as complicated as photographing the sun. With the expositions used for normal night-time photography you will have a moon that is definitely over-exposed. The best solution is to shoot multiple photos, in which one shows the details of the moon clearly, another shows the elements on the ground correctly, and yet another for the rest of the sky. With photo touch up software you will then have to join the three photos together to create a single picture in which they are all exposed and can be perceived perfectly.

During its orbit around the sun, the moon will reflect different amounts of sunlight due to the shadow of our planet. You can find out the phases of the moon using apps, such as [MoonPhase](#), for iOS operating systems, or [MoonPhase Widget](#), for Android.

3. MILKY WAY PANORAMA

Space in the celestial sphere.



In order to photograph the Milky Way you need specific settings. The exposure time must be short enough to prevent the Earth's rotation from showing the stars in movement. The ISO must be high enough to capture the light from the stars and the lens must have a distance window. The photographer, Bill Shupp, suggests planning the outing carefully: "Study the position of the Milky Way ahead of time and choose the location based on that data. Always try to get something interesting in the foreground to create a support for the starry sky. This may be the most important thing".

Shooting a panorama of the Milky Way is the next step. With an 18mm wide angle lens mounted on a full frame, shoot vertically to get five photographs of the galaxy. Once you have downloaded them to a computer, use a retouch program, such as *Photomerge* by *Photoshop*, to bring the various shots into a single breathtaking panoramic image.

4. STAR-TRAIL

Take advantage of the Earth's rotation to photograph the stars and create fantastic trails across the sky.



In photography, **Star-Trails** are the representation of the stars' "movement". The Earth rotates on its axis at a set speed and for this reason the heavenly bodies, that are actually still, appear to move across the sky when photographed with somewhat longer exposure times.

The longer the exposure is the longer the trails created by the apparent movement of the celestial subjects. However, these photos will also record the effects of any other lights that appear in the photo. The solution to this problem is to perform a series of brief exposures. For this technique you will need to use an intervalometer, which will allow you to set how often it should take a photograph.

Once the photos have been downloaded you can unite them into an image with layers, using an appropriate program.

CAPTURE MOVEMENT

- **SETTING THE INTERVALOMETER**

When setting the intervals between one shot and the next, remember to calculate the time in which the camera is inactive which are needed for the elaboration of each file so that you do not create gaps in the trails.

- **SHOOT THE PHOTOS**

Over the course of a couple of hours you will have enough photos to create a valid Star-Trail. Make sure you have somewhere warm to stay during this period or clothing that is warm and suited to the environment!

- **STACK THE IMAGES UP**

If you have Photoshop then you can use the File > Script > Load images in series command, otherwise try Startrails.de, which is a simple program free of charge.

5. LIGHTS BOKEH

Highlight subjects in the photo by creatively placing the background lights out of focus.



You can give your night-time photos a dreamy quality by creating bokeh in which the lights are turned into luminous coloured spheres. While generally expensive, high quality lenses have the advantage of having a fantastic ability to manage out of focus elements, which photographers refer to with the term bokeh.

Approach the subject with the camera so that the points of light in the background are arranged around it. Set the aperture open so that the background is completely out of focus and the lights are turned into glowing, pleasantly coloured bulbs.

Lenses with wide apertures, in addition to creating a bokeh, can be used with faster times in night-time shots so that there is a decreased risk of blurring.

6. CITY LIGHTS

It is difficult to see stars in the sky while in the city, but you can take advantage of the urban lights for beautiful night-time photographs.

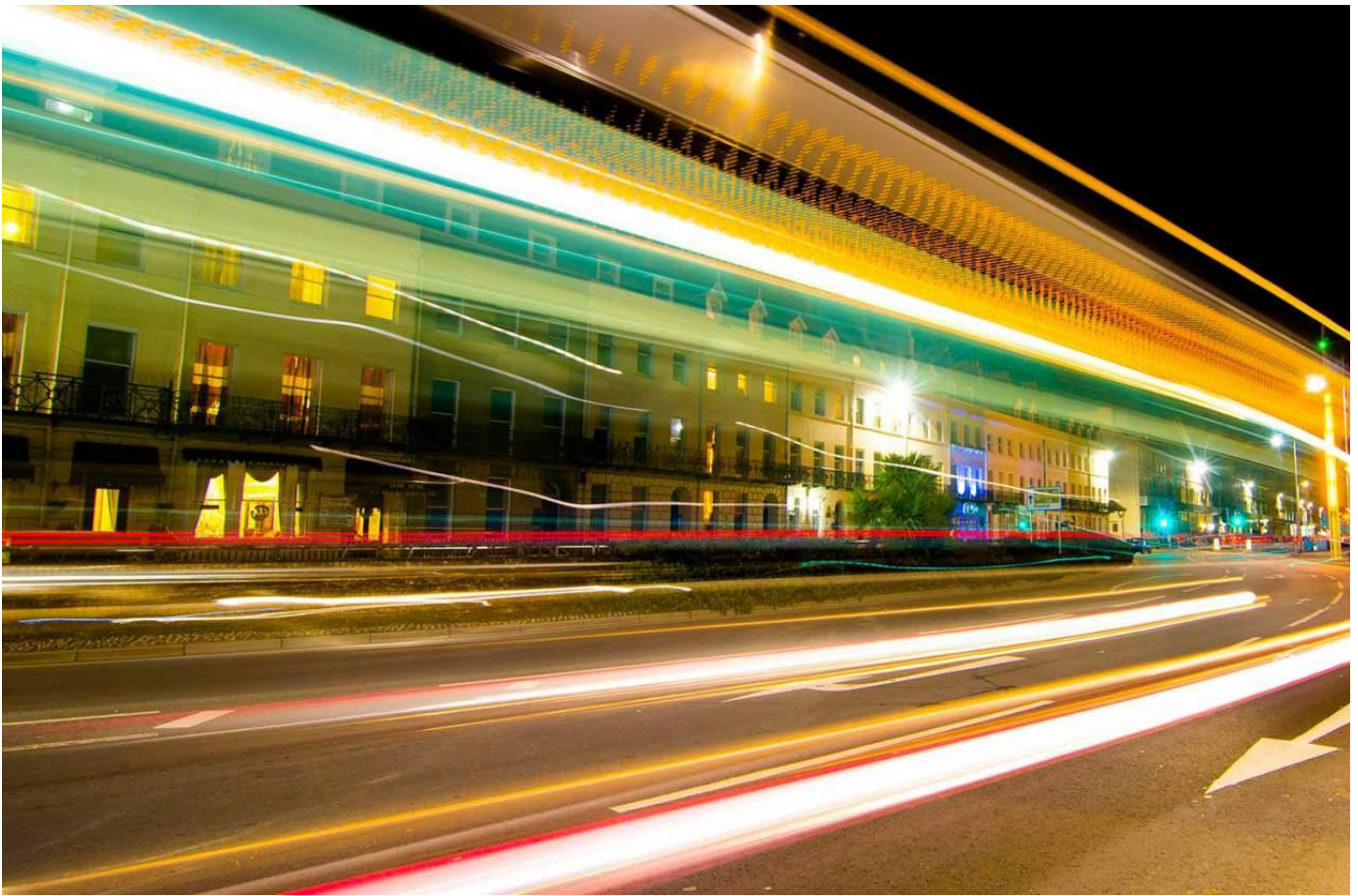


From sunset to sunlight, cities are enriched with artificial lights. From the glow shining out of windows to the harsh street lights, there is always the possibility for photographers to take interesting nocturnal photographs in the city. Furthermore, the real night owls can take advantage of the rare empty streets and squares and immortalise the scene without having to worry about passers-by.

Today's urban landscape is modified by the night-time atmosphere and the colours are changed by artificial light, but you must always keep composition in mind to achieve suggestive shots. Here are some suggestions on how to frame beautiful night-time urban pictures.

7. LIGHT TRAILS AT NIGHT

Keep the shutter open in order to record lights in movement.



LONG EXPOSURE TIMES

In order to have the light trails visible in the photo but not the cars that produced them, you must use very long exposure times and a tripod.

SPARKLING LIGHTS

If you set the camera's aperture lower than $f/11$ you will obtain lights that appear as dots in the photo that become sparkling stars.

STABILITY

With long exposures it is absolutely necessary that the camera remains stable. Attach a weight to the central column of the tripod and use a remote shutter release.