

# Creating Meteor Shower Composites

This writeup describes the process I use (it's not the only way) to capture shots of meteors and combine them into a composite shot.

## Taking the Shots

My meteor shots are usually done with a fast wide angle camera lens (28mm or shorter) with a full-frame camera on a stationary tripod. Fast lenses are needed to capture the usually dim meteors, and also to get to the background light level in a short time while still minimizing trailing of stars. The exposure length is a compromise of the constraints which partially depends on the shooting location and presence of moonlight and light pollution, but as a starting point, I shoot 20 second exposures at ISO 1600 with an f/2.8 lens setting. Note that the presence of moonlight or light pollution doesn't necessarily eliminate the chance to shoot meteors. It just means that more shots of shorter exposure need to be taken. And it goes without saying... Raw shooting mode is necessary to be able to pull dim meteors (or meteor trails) out of the sky background.

Using a tracking mount is also possible, and will reduce the problems of registering frames for the composite, but I generally don't use a tracking mount since really wide lenses almost always will include some of the horizon, or will run into it at some point during the night. A tracking mount is desirable when using longer lenses to eliminate star trailing.

Also required for meteor shooting is an intervalometer. I favor cameras with an internal intervalometer function over external ones because the external ones use a separate set of batteries which are just one more component to worry about during the shoot. I should also mention that it's best to use a fast memory card to minimize the dead time between shots when the image is stored onto the card as well as to speed up copying files from your card to a PC afterwards.

When possible I also use an external power source for the camera. Standard camera batteries do not have enough capacity to last the night, especially at low temperatures.

## Finding the Meteors

At the end of the night you'll end up with hundreds of files to look through to find (usually) just a handful of meteors. On average, I find that with my standard setup using a 15mm lens, I find a meteor in about 1% of the frames. Don't be discouraged! Perhaps in the future we'll have an artificial intelligence tool to make thing easier.

For an efficient workflow, a program which can handle a set of images as a group is necessary. I use Lightroom myself. This allows me to import raw camera images in a whole batch. Once imported, for an "inspection" pass, I adjust the contrast and brightness of a representative frame for best viewing to hunt for meteors, then apply the adjustment setting to the entire set of frames.

Because the process of inspecting the frames is tedious, it's important to be able to go through frames sequentially without any lag, so a fast computer with fast disk access (ideally SSD) is best. In addition, it's best to not have to resize the images on the fly, so I first use Lightroom to output a set of down-sized jpeg images (highest quality setting) to an inspection subdirectory. I set the image size to match my monitor size (1920x1080).

I then use the standard image viewer (Photos) in Windows 10 to view the inspection image in full-screen mode. This is a fast viewer with the capability of easily going backward or forward in the set of frames as well as allows zooming in. You may prefer some third-party image viewers, but the most important feature should be the ability to move from frame to frame without any lag.

## Eliminating Garbage

Another big task is to separate the frames with real meteors from the “junk.”

Airplanes should be obvious – at night they leave trails of red, green, or white dots from navigation lights. When far away on the horizon, this may not be obvious, but if the trails go from one frame to the next, it's too slow for a meteor. And if the trail curves, clearly that's not a meteor either.

Satellites are a bit harder to eliminate as they don't have flashing navigation lights. Sometimes they have bright parts of their trail as they rotate and reflect sun glints to us. Just as for aircraft, if they appear on two or more frames, they are too slow to be meteors.

Unless a meteor is very dim, generally a meteor will show a bit of color in its trail as it ionizes air in its path. Look for pink/green/yellow color transitions along the trail to be sure it's a real meteor. Another clue is that the trail can be traced back to the radiant of a meteor shower, though sometimes it can look like a meteor doesn't match a shower. These may be random (sporadic) meteors unassociated with the shower of interest, or there may be one or more additional showers in progress. Check a program like Stellarium to see meteor shower radiants plotted against the sky.

## Organizing Frames for the Composite

At this point you should have a short list of frames with meteors to be composited. At this point we can go back into Lightroom and “mark” these frames. Usually I use the “star” marker for a frame (e.g. 3 stars for a frame with a meteor).

The next thing to do is to find a base reference frame for the composite. Ideally, this would be one of the meteor frames in the middle of the collection, but can actually be any frame. Usually I'll select a frame with the background looking good (e.g. Milky Way or foreground), remembering that the meteors will have to appear against the reference star field. Often some meteor frames have to be thrown out because they appeared so early or so late that the sky area where they appeared was rotated outside the base reference frame. In some cases, it's possible to extend the base frame a little by compositing it with a later or earlier frame to extend the sky coverage.

Once the base frame and frames with meteors that will fall within the base frame have been determined, I flag them in Lightroom with a color tag (e.g. apply green to selected frames). Then just these frames can be selected in Lightroom and processed as a group to adjust colors and curves, reduce noise, etc. When finalized, I then output this set as full-resolution 16-bit TIFF images into a subdirectory.

## Registering Frames

Registering wide-angle star images can be a real problem because of lens distortion. As stars move across the field of view, they don't move in a linear fashion and shapes can be distorted near the edges. If you've used a tracker, some of these problems can be reduced, but not completely eliminated because atmospheric refraction near the horizon can have a big effect. Consequently, most star registration programs won't work. It's possible to manually register the frames in Photoshop using the free transform function, because as described later, only the sky in the vicinity of the meteor trail is important. However, this can be tedious!

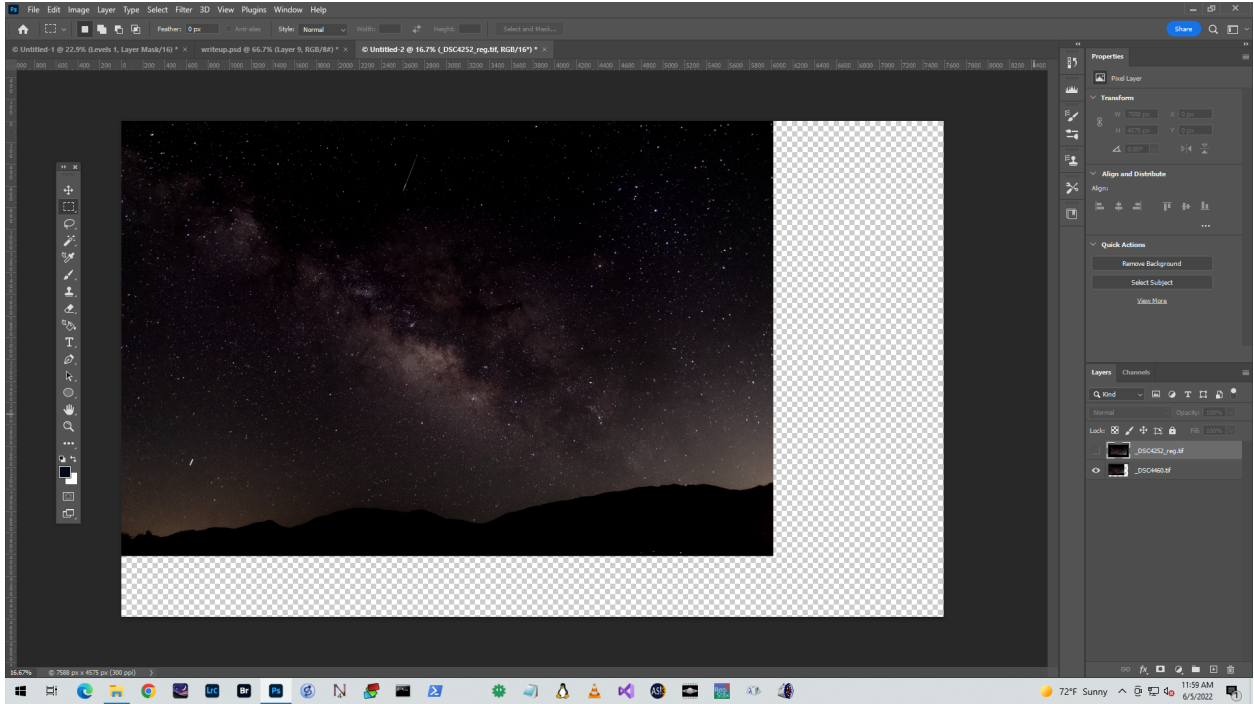
The program I've had the most success with is Registrar. This program runs independent of Lightroom/Photoshop, is not free, but in most cases does an excellent job of automatically finding stars and registering frames. This program was originally designed to register scanned film images, which are subject to warping or stretching, but also does a great job for compensating for lens distortion and atmospheric distortion. It can be fooled by a bright light in the foreground, but pre-processing of the input frames to remove foreground point sources takes care of that.

When doing the star registration in Registrar, I open the reference frame in Registrar first, then have it register all of the other frames to the reference frame. The registered (warped) frames can then be saved to new TIFF output files. Note: when registering, I use the "Union" mode to ensure the output can easily be overlaid onto the reference in subsequent processing.

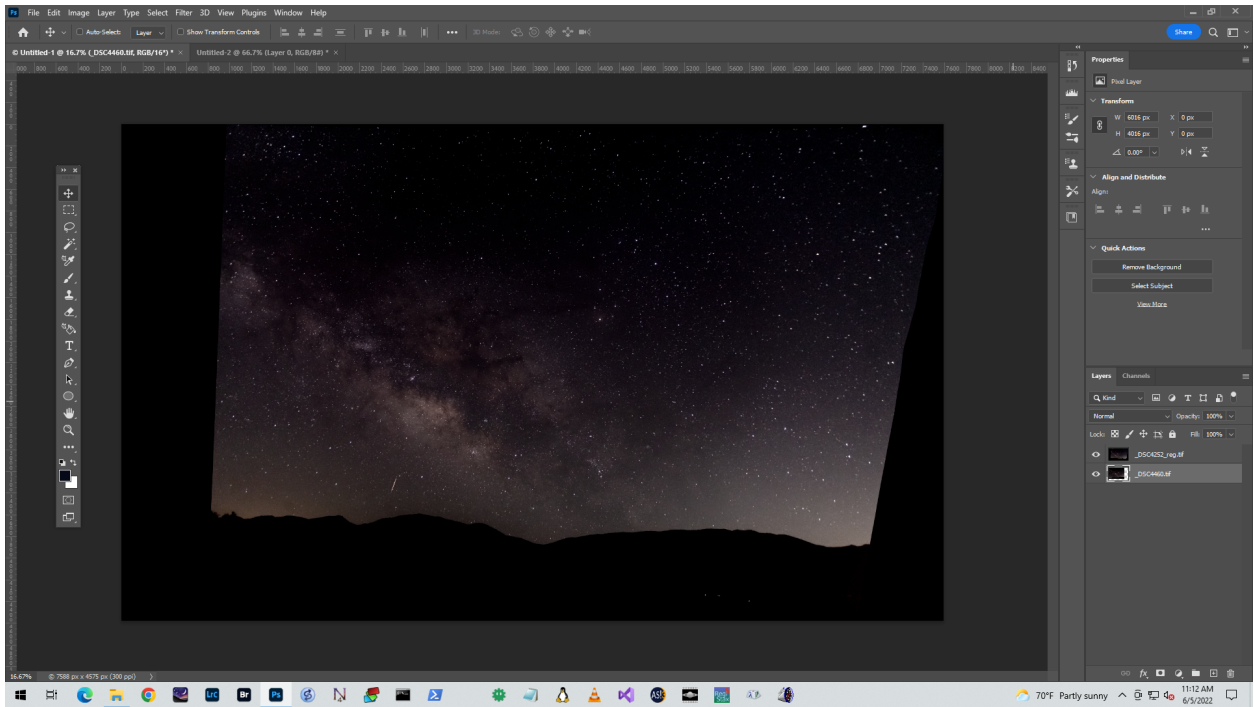
## Creating the Composite

The composite is created in Photoshop as follows:

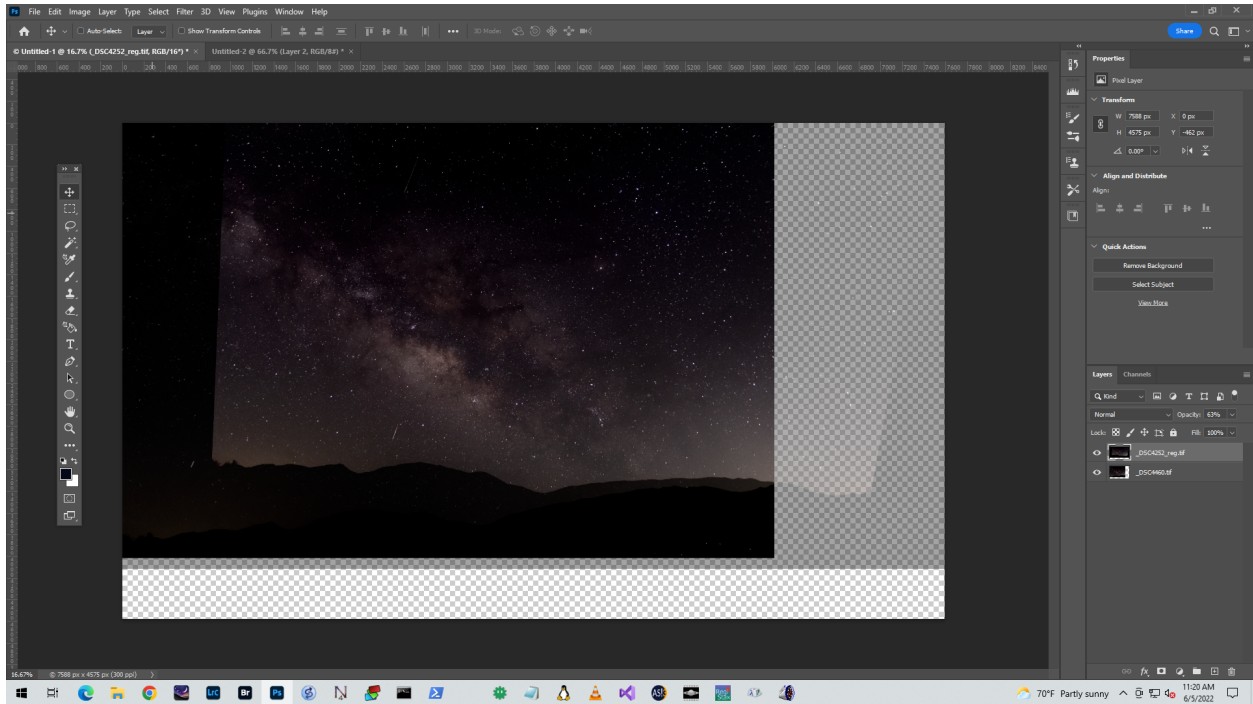
- The reference image and the registered meteor frames are opened as layers in Photoshop using **File / Scripts / Load Files into Stack...** If the reference frame is not at the bottom of the stack, move it to the bottom layer.
- Turn off visibility of all frames except the reference frame and one of the meteor frames.
- Reduce the visibility (transparency) of the meteor frame to about 65% with the reference frame at the bottom, which should be left at 100% visibility.



*Base frame example.*

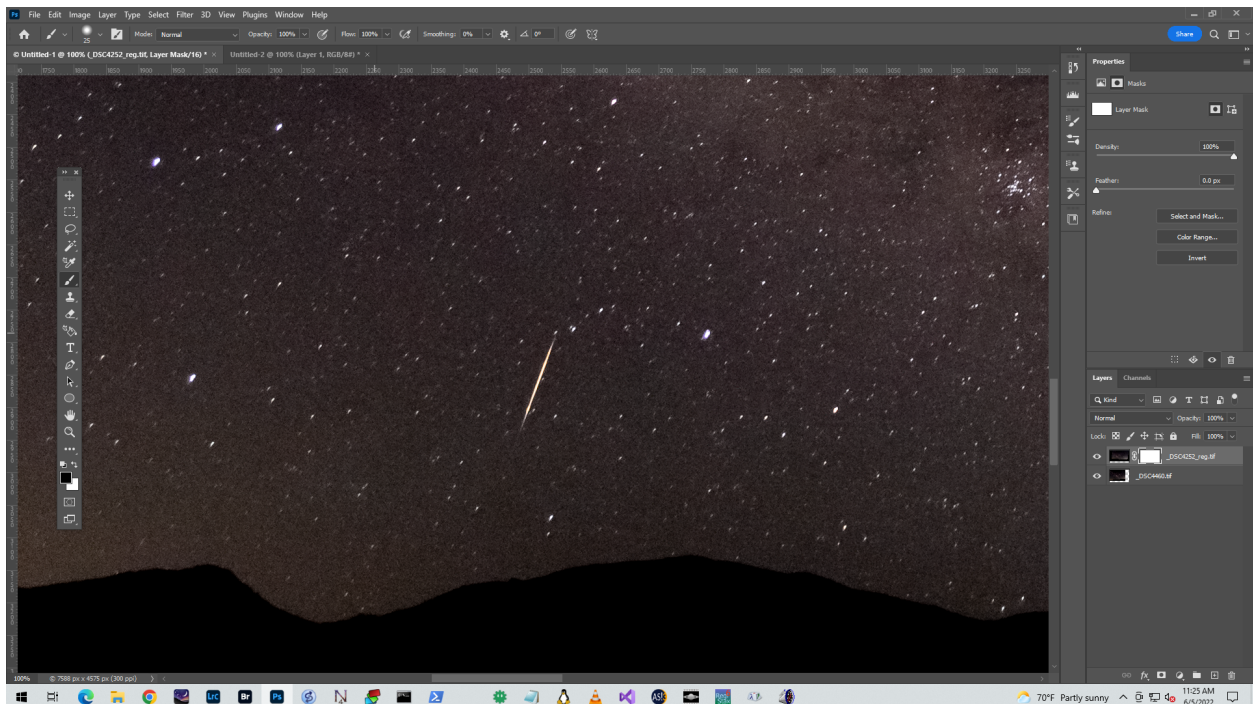


*Meteor frame, distorted due to registration step.*



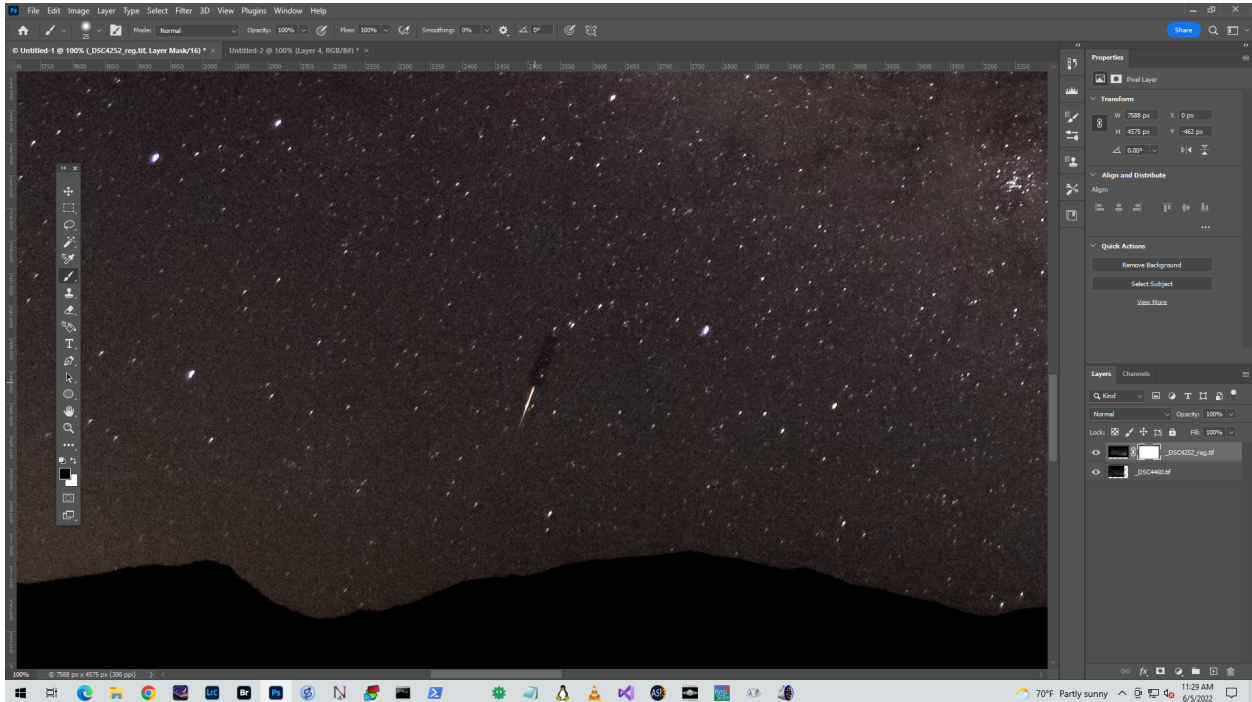
*Base frame overlaid with meteor frame at 65% transparency.*

- Select the meteor frame layer and move the entire layer (x-y translation only) until the stars line up, then restore visibility to 100%.



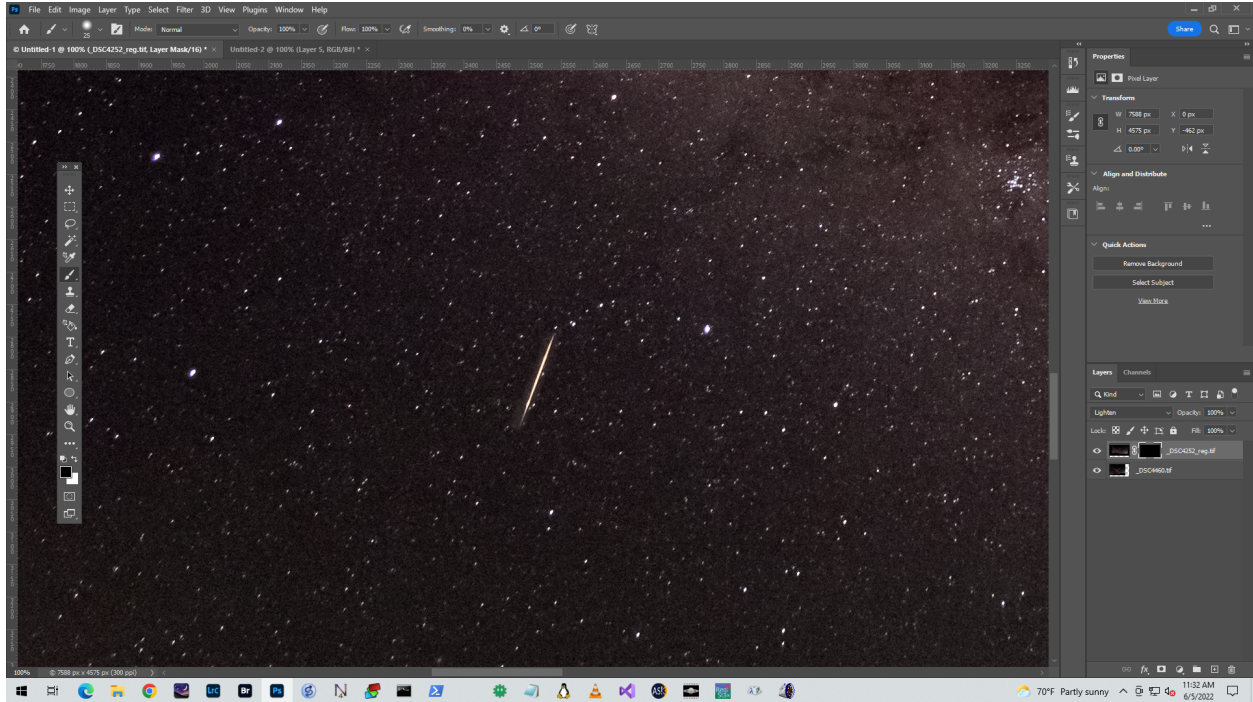
*Closeup of meteor area.*

- Zoom (100%) into the meteor and add a mask for this layer.
- Select the brush tool, set the size to a small width to use over the meteor trail, then paint over the meteor with the brush color set to black. This will erase the meteor from the meteor layer.



*Partially erased meteor using brush tool on the image mask.*

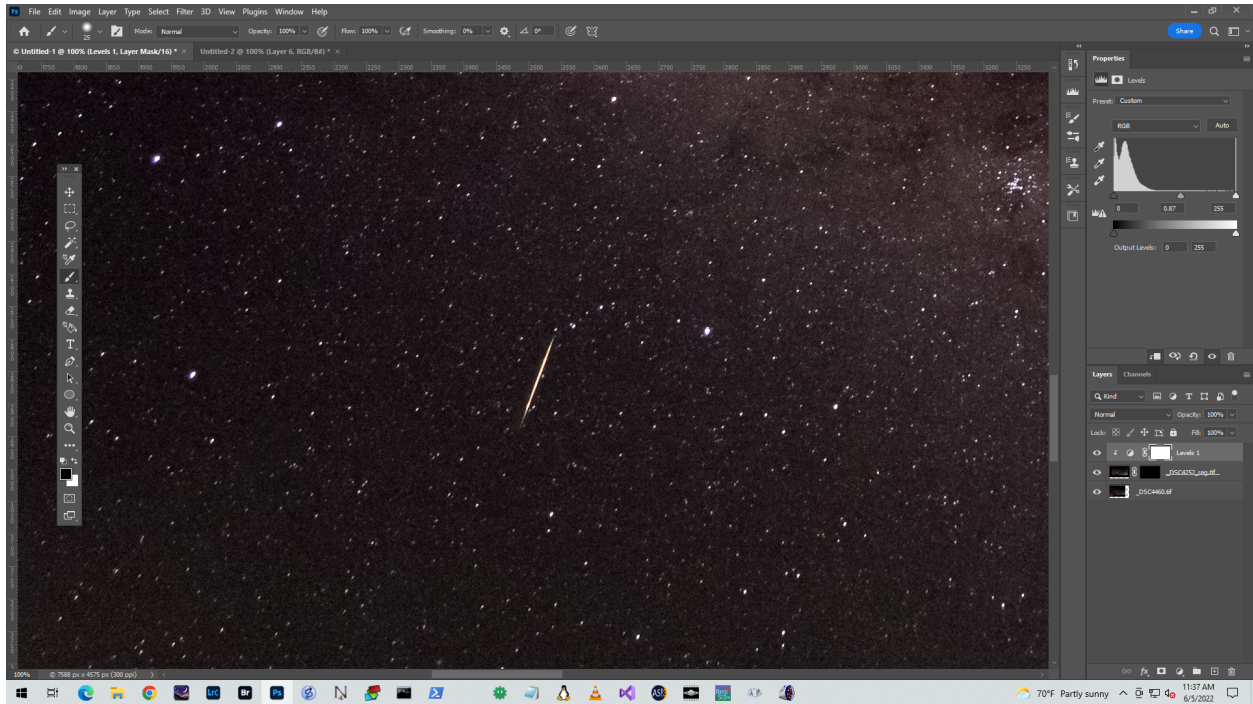
- Keeping the layer mask selected, use ctrl-I to invert the mask. The meteor should be visible again with the rest of the meteor frame erased.
- Set the blending mode for the meteor layer to “Lighten”.



*Masked meteor with “lighten” overlay mode. Note the light background around the meteor.*

- At this point, if the background region around the meteor was lighter than the reference frame, it will show through as a lighter area around the meteor. In this case, add a “Levels” adjustment layer above the meteor layer (apply only to the meteor layer) and adjust the midrange slider until the light area around the meteor disappears.





*Meteor overlay with adjusted background for better blending.*

At this point any meteor on the reference layer as well as on the meteor layer just processed will be visible. Each of the other meteor layers then need to be processed into the composite as described above.

As a final step, crop the composite down to the limits of the reference frame and save the file as a layered .psd (or .psb) format in case you want to do further adjustments in Photoshop.



*2-layer composited example.*

Now I go back to Lightroom and import the composite file so it's registered in Lightroom's database of managed files. I do final tweaking (color adjustment, framing, etc.) in Lightroom to produce the final jpeg output file, and we're done!



*Final composite with all meteor layers added and final adjustments in Lightroom.*