This is an important exchange of messages about how to avoid saturated images of Titan and SAO 164648 during the July 9th occultation, conducted on the IOTAoccultations groups.io list server. I have gathered the messages here in approximate chronological order, starting with the oldest. The last messages discuss filters, which decrease overall sensitivity, which is what you want to avoid saturation, but they also have the benefit of increasing contrast, and then S/N.

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From "Steve Messner via groups.io" <stevem2=zohomail.com@groups.io>
To "IOTAoccultations" <IOTAoccultations@groups.io>
Date 7/3/2022 7:49:35 PM
Subject Re: [IOTAoccultations] July 9th Titan occultation, saturation

I don't see mentioned where saturation could be a concern with even a mid sized 6" or so scope. I was going to stop down the 18" to about 7" to help keep the saturation down, thinking that it will still need to be defocussed a bit with the 910hx. Am I correct in that thinking? Steve M.

Steve --

It is important to avoid saturation, because saturation simply causes loss of data. You will not be able to discern saturation in your light curve -- it never causes a flat top on the curve. You have to look at individual pixel brightnesses to detect it.

I don't recommend stopping down an aperture to avoid saturation, because that will worsen the scintillation noise. It is better to use a large aperture, and for most amateurs this means that one should use the largest aperture available for photometric observations of rapidly changing brightnesses. For measurement of brightnesses that do not change appreciably during a night, a long exposure with a small aperture will likely suffice.

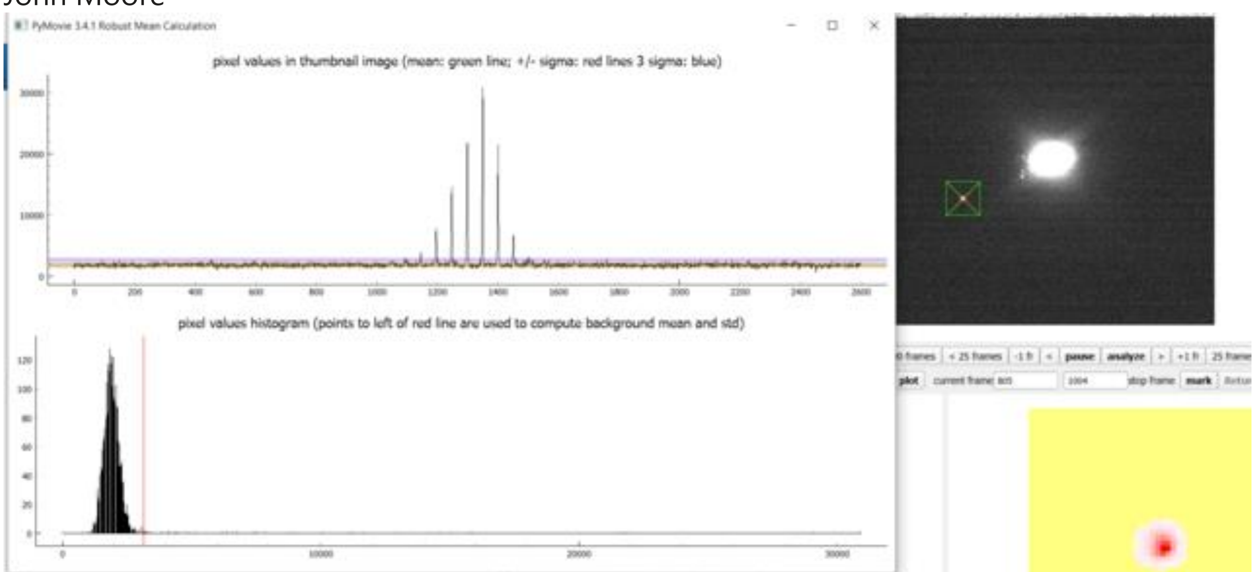
One way to decrease saturation is to lower the gain setting of the camera. (High gain can make objects appear brighter but it does not increase the signal to noise ratio. The accuracy of an observation is related to the signal to noise ratio rather than to the brightness itself.) Another way to decrease saturation is to defocus to the extent that the brightest, transient parts of the defocused, scintillating image are less bright than the white of the timing letters that your VTI puts onto the video images. IOTA Video Capture has a facility to color the saturated pixels so that you can easily detect most of them on the fly, and use the presence of color in the image to adjust your settings of defocus or gain. (Note that IOTA Video Capture allows you to adjust the limiting brightness of non-colored pixels -- You can make it, say, 210 rather than 235 if you have a reason to do so. Also, note that all-digital cameras use various brightness ranges but often 0 to 255, while video cameras, including the Watecs we use, usually use a brightness range of 16 to 235. This should affect your colored-pixel saturation setting in IOTA Video Capture.)

One problem that hasn't been mentioned about making dark field and flat field images is that the telescope and camera settings used for such exposures should be the same as the settings used for the images you are studying. Keep in mind that, if your gain setting is automatic, such as the "auto high gain" that is used for many of our occultation recordings, the gain may be automatically adjusted upward when you cover your aperture or camera for the dark field, and automatically adjusted downward when you image a blank twilight sky for the flat field. Use a manual gain setting, not an automatic one, for your object images and your darks and flats. Some early video cameras retained some automatic adjustment of gain even when in manual mode, but I don't think that the Watec 902H2 Ultimate or the Watec 910HX have this problem. The problem with the latter camera is that it has a gamma greater than 1.0, so I prefer the 902H2 Ultimate for observations in which more accurate photometry is important.

-- Roger Venable, rjvmd@progressivetel.com

Guys,
I was curious about the same issue so I captured a quick test from my front porch at event time in Tulsa (light pollution) with my 8" f/8 RC and the QHY at 100ms - gain 300 - 16 bit setting (actually 12 bit)

This is my longest FL scope at 1600mm and gives enough separation to stay away from the image bloom of Saturn.
I was just below saturation but I had a very strong signal. I'll likely try 75ms to give myself some more headroom. YMMV
Good luck! I'm afraid our forecast isn't very positive, but I'll be ready if the skies cooperate. You can see three of the closer satellites that are around Mag 10+ just to the left of Saturn.

John Moore


John Moore, john@jmooreou.com

Hello David,

I really like your spirit of: if the optimal conditions don't come to you, you go to the optimal conditions!

Kevin Harnett and I discussed this event yesterday and will observe it, weather permitting, from here in Maryland about 15 miles apart.

One question we discussed was using a filter to block out much of the sky light, which as you indicate presents a big challenge. I have used a red filter on Venus when the sun was above the horizon and had a nice black sky and good contrast. Of course, that's an extreme case since Venus is so bright. I am going to load a filter wheel with a couple of different filters that absorb blue light and let the longer wavelengths through. This may not work, as it may remove as much sky light as it does light from Titan and the star, but even if it does, does this approach potentially diminish the scientific usefulness of the disappearance/reappearance profiles? I found a plot of the albedo of Titan's atmosphere from Karkoschka,1995 (figure attached), and it shows that all of the absorption features are at wavelengths greater than about 600nm, so using a filter might be acceptable as long as there is enough contrast to actually see the event. I was going to try a Baader 495nm long pass and a 610nm long pass. If you have tried using filters for events in twilight, or have thoughts on the viability, please let us know.

Best wishes on your expedition!

Thank you very much.
Richard Kelley

While on the subject of filters, I'd add an 850nm long-pass to the list of "will this help/hinder" questions. I have a ZWO ASI462C camera with extended red sensitivity that ships with the 850nm filter. Where I am (west coast) skylight won't be much of an issue, so the question is more about whether there is a potential science benefit from having a light curve in the near-IR.

With the ASI462C, the passband would be limited on the short-wavelength end by the filter, but by the camera response on the long end. It looks like the 940nm window in Richard's figure would be included in that passband, as would the 889nm band. Sensitivity would be greater at 889nm where the atmosphere is more transparent. I'm guessing that would result in a light curve more representative of the edges of Titan itself rather than the atmosphere, which might have some value when compared to full-spectrum light curves?

I would probably use that camera with a C14 if I include the filter.

Bob Jones, jones.robert@verizon.net

Neutral density filters might be a good bet on larger telescopes. I just ordered a 12.5% transmission ND filter from Agena Astro. This will reduce brightness by about 2.25 magnitudes.
Baader Neutral Density Filter ND-0.9 12.5% Transmission - 2" # FND1-2 2458322 (https://agenaastro.com/)

Using an ND filter seems like a good alternative to stopping down the aperture. I also have a Baader ND 1.5% filter, which may be too aggressive as it reduces brightness by about 4.5 magnitudes.

A related question is integration time. Shorter exposure reduces saturation and gives greater time resolution but at the cost of more scintillation. Is there a suggested integration time for this long-duration Titan occultation event? I'm using the QHY174GPS.

Andy Howell
Gainesville, FL, andyho49@gmail.com, July 5