

## Introduction

Over the past week I have been working with Tony George from IOTA to test my video capture system for the upcoming occultation of Regulus on March 20. The objective of this testing was to determine which camera / lens combination and video format would produce the best data for photometric analysis of the occultation.

The tests were conducted with Canon 60D and 60Da cameras using:

- a Sigma 18-200 mm f/6.3 lens, set at 200 mm and f/6.3
- a Nikkor 135 mm f/2.8 lens
- a SkyWatcher ED 80 telescope (600 mm f/7.5)

The camera was mounted on a Losmandy GM8 mount. Tests with the drive running, and turned off were conducted.

Tests were conducted using the following ISO settings:

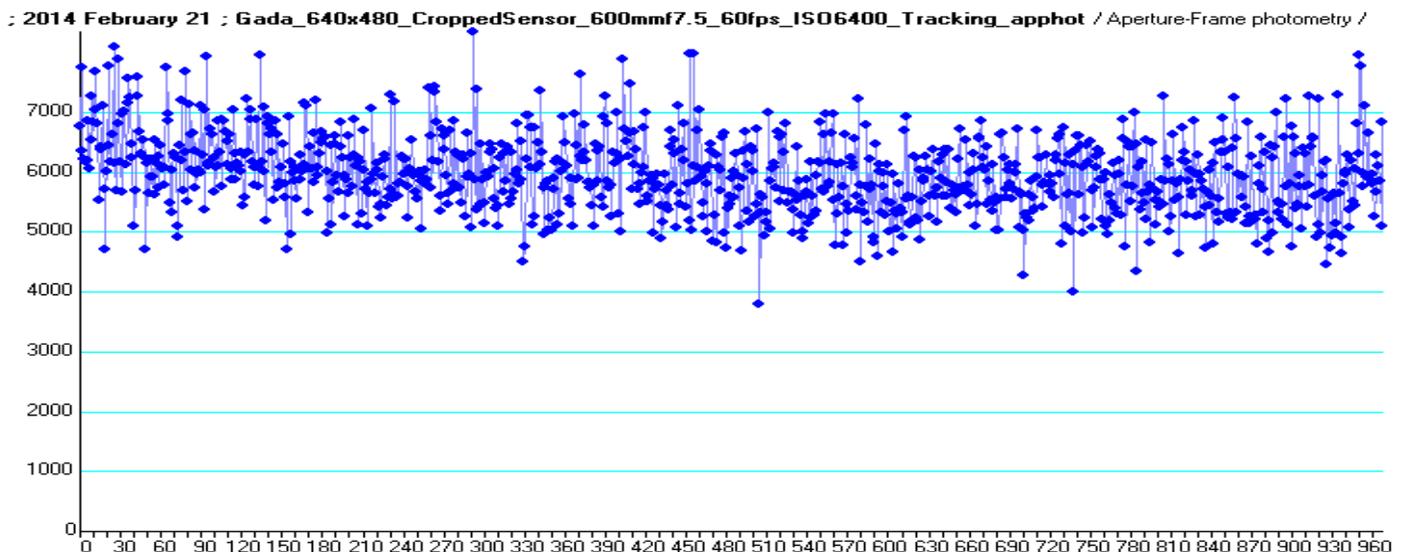
- 800
- 1600
- 3200
- 6400

The following video modes were tested using the manual exposure shooting option:

- 1080p at 30 fps,
- 720p at 60 fps
- 640 x 480 SD at 60 fps
- Cropped 640 x 480 SD at 60 fps (available in some Canon DSLR's).

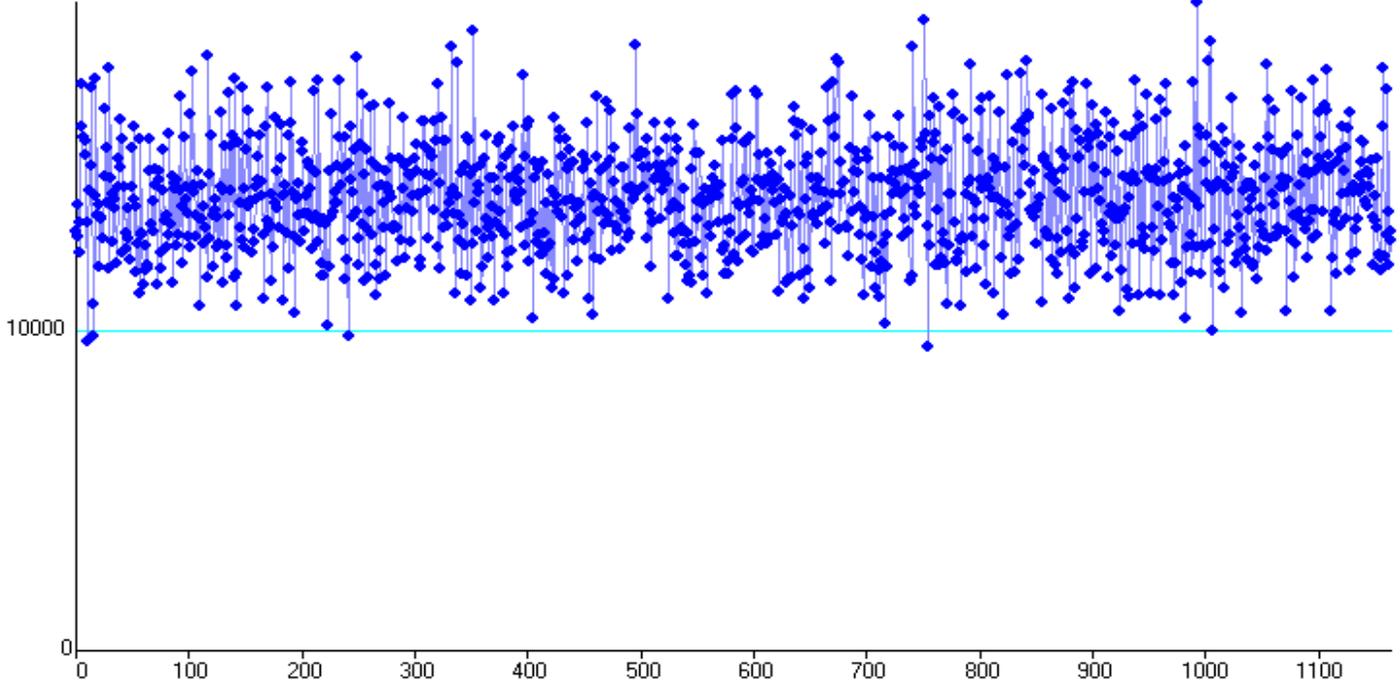
## Results

The best results were obtained using the SkyWatcher ED80 (600mm f/7.5) telescope on a Losmandy GM8 mount with a Canon 60D camera using the 640 by 480 cropped sensor video mode at 60 fps, 1/60 second exposure at ISO 6400.



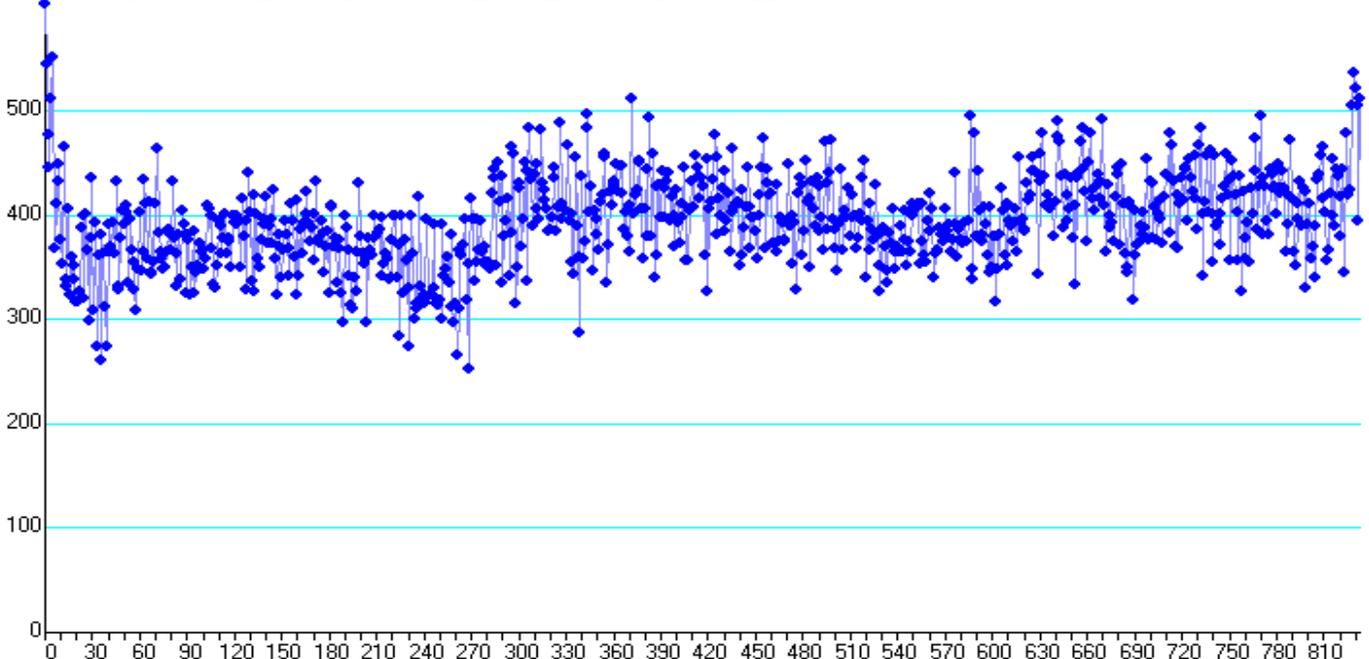
The second best results were obtained using the Sigma 18 - 200 mm lens set at 200 mm and f/6.3 using the GM8 mount to track the star with a Canon 60D camera using the 640 by 480 cropped sensor video mode at 60 fps, 1/60 second exposure at ISO 6400.

; 2014 February 21 ; Gada\_640x480Cropped\_200mmf6.3\_60fps\_ISO6400\_Infocus\_Tracking\_apphot / Aperture-Frame photometry /



The third best results were obtained using the SkyWatcher ED80 (600mm f/7.5) telescope on a Losmondy GM8 mount with a Canon 60D camera, 1080p video mode at 30 fps, 1/30 second exposure and ISO 6400.

; 2014 February 21 ; Gada\_1080p\_600mmf7.5\_30fps\_ISO6400\_Tracking\_apphot / Aperture-Frame photometry /

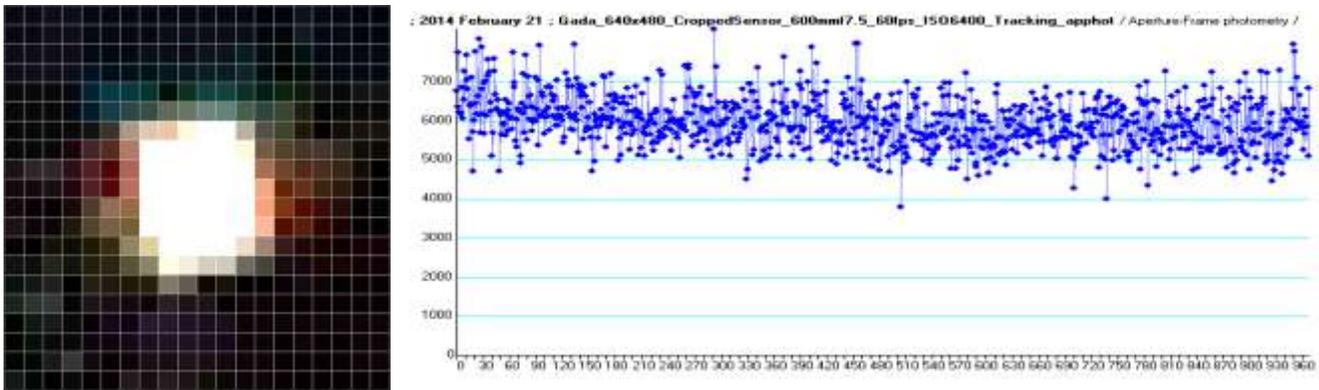


## Understanding DSLR Video Modes

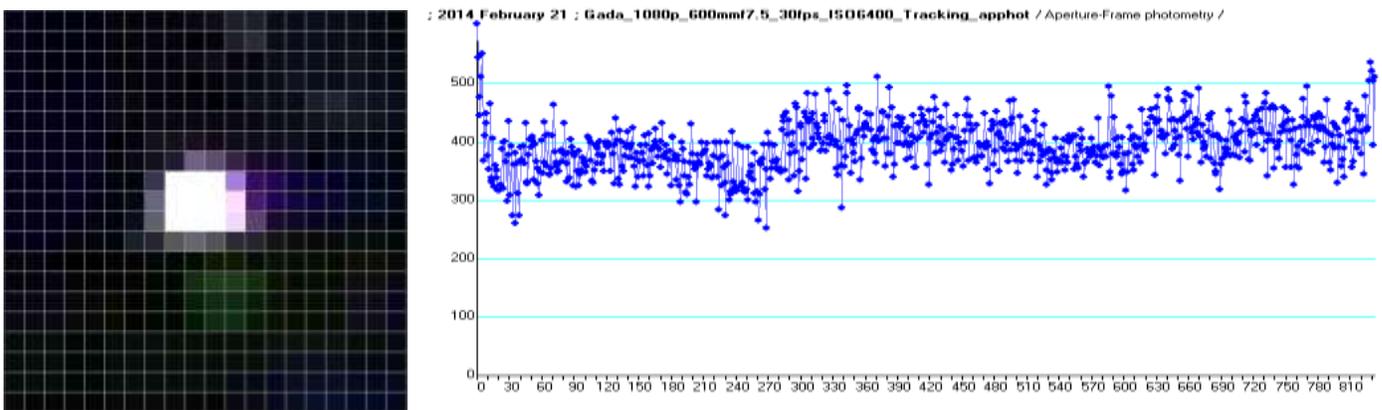
The sensor in modern DSLR camera has a much higher resolution (more pixels) than is required by the various video modes. As a result when a DSLR is used to record a video the camera uses only a portion of the sensor and then resizes the image to fit the video mode selected. The video modes available and how this conversion takes place varies by manufacturer (Canon, Nikon, etc.) and the camera model.

The Canon 60D, for example, has a sensor that is 5184 x 3456 pixels in size (3:2 aspect ratio). When recording a 1080p movie only the centre 5184 x 2916 pixels (16:9 aspect ratio) are used and the resulting image is then downsized 2.7x to create the final 1920x1080 pixel image required for 1080p format. This implies that if you start out with an object that covers an area of 270 x 270 pixels on the sensor, that object would only cover an area 100 x 100 pixels on the final image. This is not an issue for “normal stuff”, but when dealing with images of stars, they may be resized out of existence.

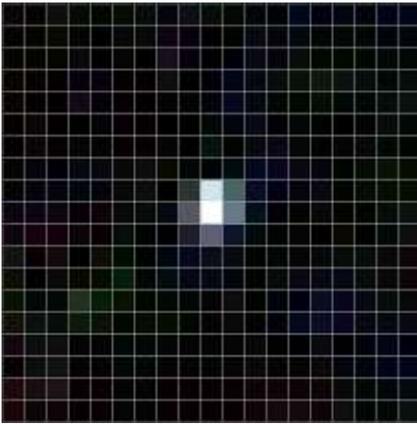
To illustrate this point below are some images of Regulus taken with a SkyWatcher ED 80 using a Canon 60D, cropped 640 x 480 movie format, 1/60” exposure at ISO 6400. This format only uses the 640 x 480 pixels in the center of the sensor resulting in 1 to 1 pixel scaling in the video. Hence the stars image size on sensor is the same as in the video, approximately 8 by 8 pixels.



With 1080p format this image was downsized 2.7x reducing the stars pixel size in the video to 3 by 3.



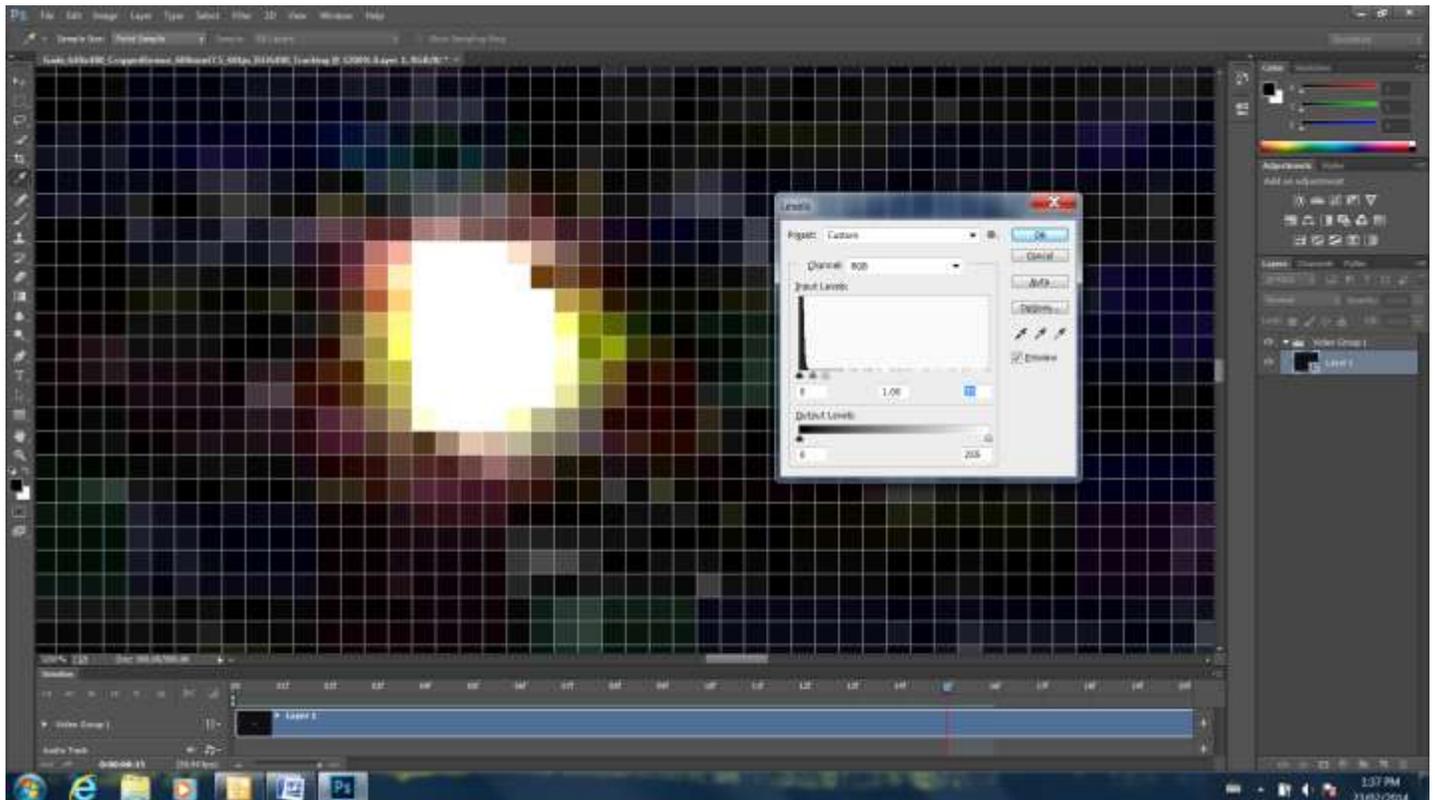
When the standard definition video format (640 by 480) was used the stars image on the video is downsized 8.1x resulting in a 1 pixel star image on the resulting video. At this size, the star's image blinks on and off as the seeing changes.



Which video mode is the best? The best video mode is the one that produces the largest and brightest image of Regulus. Based on these tests, the video mode that downsizes the image least is best. This implies that for most DSLR cameras 1080p video format is best. However, if the camera has a cropped sensor video mode, that mode is best.

To determine which video mode is best, record some test videos using the different video modes available with your camera; then analysis the results. First by playing back each video on a computer. The star will twinkle and change size and shape but should remain visible at all times. If the star flashes on and off, eliminate that format from consideration.

Of the remaining videos, open the videos on Photoshop CS6 or CC (or other video/image editing software), and step through the frames one at a time. Select a frame that is representative of the star's image, and then zoom in 3200x on that frame. Adjust the level so that you are seeing noise in the background and then count the number of pixels occupied by the stars image. Anything over 3x3 pixels is ok. But the larger (5 or more) the better; see the screen image below.



## ISO Setting And Recommendations

The test results clearly indicated that the best results were obtained when ISO 6400 was used when recording a video. Use the highest ISO setting available in video record mode. To do this, switch to manual exposure control when in video mode, and change the ISO setting to the highest value available. You should also set the shutter speed to the longest exposure possible for that video mode (1/30 for 1080p), and if you are using telephoto lens set the f-stop to the lowest value.

**Note:** The highest ISO setting available for video recording may not be the same as the highest ISO setting of the camera. The 60D for example is capable of 128000 but in video mode it is limited to 6400.

## Focal Length

Test indicated that a longer focal length lens produced better results than a shorter lens. Longer focal length lenses have better image scale. As well, by their nature, longer focal length lenses have larger apertures resulting in brighter star images. The best lens to use is the one with the largest diameter objective. The ED 80 with an 80 mm objective is better than the Sigma 200 mm with an ?? mm objective. At a minimum a 200 mm lens is recommended to record a video suitable for photometric analysis.

## Tracking

When a short telephoto lens (200mm or less) is used tracking is not an issue, a simple tripod can be used. The star's image will take several minutes to drift across the sensor and produce a video which can be used to determine the time of disappearance and reappearance.

However to produce a video that can be used for photometric analysis, the camera must be tracked either using a telescope mount or a tracking device of some type.