Astrophotography with a Canon EF 70-200mm f/2.8L IS USM Lens

By Dr. James Dire

Image 1 - Gardner-Webb University senior David Montgomery fields a punt in Buffalo, NY in a game against the University of Buffalo. The author used the Canon EF 70-200mm f/2.8L IS USM Lens at 200mm on a monopod from the sideline to take this picture.

In three decades of doing astrophotography, I have attached a single-lens reflex (SLR) or digital SLR (DSLR) camera to just about every type of telescope possible: achromatic refractors, apochromatic refractors, Newtonians, Schmidt-Cassegrains, Ritchey-Chrétien Cassegrains, Maksutov-Cassegrains and Maksutov-Newtonians, ranging from 60mm to 0.5m in aperture. While each type of telescope has advantages and disadvantages for astrophotography, they all have one thing in common. They magnify a small region of the sky and capture light that the human eye is unable to see.

Like many astrophotographers, my first pictures where taken using an SLR camera on a tripod with a cable release, capturing circumpolar star trails, the moon, or planet alignments. Next I mounted the camera with various lenses (28mm, 50mm, and telephoto) piggybacked on a polar aligned tracking telescope to take long exposure images of constellations or total lunar eclipses. These techniques are easy for beginners to learn and good to retain because sometimes you don't want to image a small region of the sky, but desire a wide-field photo.

Over the years as my photography skills improved, I upgraded to better equipment. I have used pocket digital cameras and CCD cameras for years, but it wasn't until 2008 that I purchased a DSLR camera, namely a Canon 30D. This model is considered a professional camera, but it only came with an off-the-shelf 18-55mm lens. As a serious photography buff, I needed a professional quality lens to use for most of my daytime photography.

After months of research, I settled on the Canon L-series EF 70-200mm

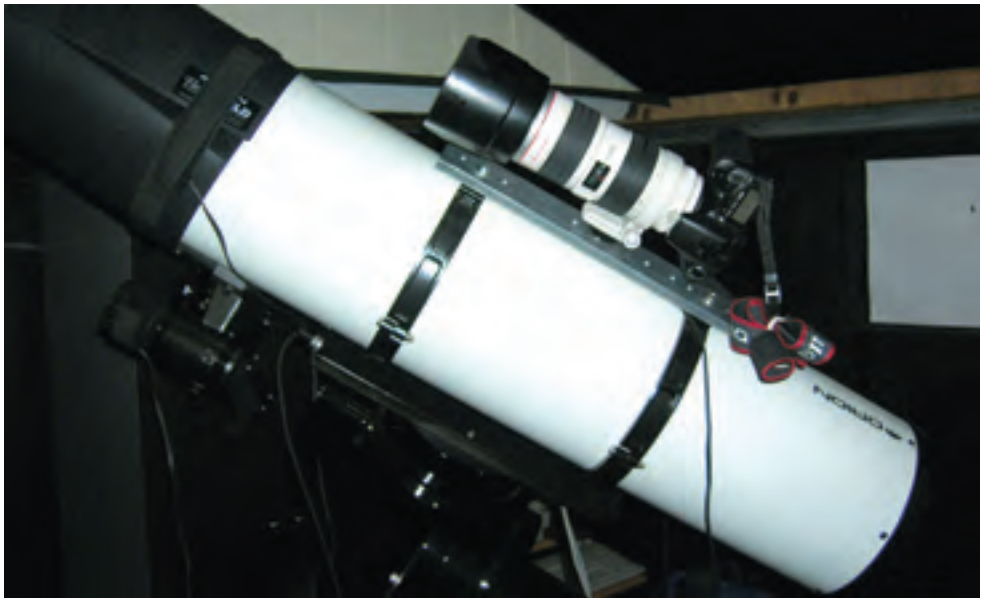

Image 2 - The Canon EF 70-200mm f/2.8L IS USM Lens mounted atop the telescope in the author's observatory, www.wildwoodpines.org.

Image 3 - A close-up view of the Canon EF 70-200mm f/2.8L IS USM Lens on the Canon 30D body

f/2.8L IS USM. "EF" is the code for the Canon's electronic lens mount; "IS" means the lens has image stabilization which allows use at shutter speeds three stops longer than most people can hold the camera steady; and "USM" means it uses an ultrasonic motor for focusing. Because of its versatile zoom feature, fast focal ratio (f/2.8) and high optical quality, this is one of Canon's top selling L-series lenses.

The L-series is Canon's professional line of EOS EF autofocus 35mm SLR and DSLR still camera lenses. Most of the L-series lenses are white in color to minimize heating when used outdoors under the sun. Scan the sidelines at the next professional sporting event you watch and look for white L-series lenses with a red stripe around the end of the lenses. These lenses use ultra-low dispersion glass, super low dispersion glass, fluorite elements, and aspherical elements to "truly push the optical envelope", as Canon advertises.

The image quality of the Canon L-series lenses is outstanding. I have used them to photograph NFL and college football games (**see Image 1**). The contrast, sharpness, and color are excellent. The L-series lenses are on average significantly sharper toward the edges of the frame compared to lesser lenses and have virtually no vignetting. To do all of this in a zoom lens with a fast f/2.8 focal ratio requires 28 elements in 18

Image 4 - The Andromeda Galaxy, M31, taken with the Canon L-series lens at 200mm, f/2.8. This image was the sum of 12 ten-minute exposures.

groups, roughly a third more pieces of glass than in Canon's fixed focal length 200-mm L-series lens.

I have used many types of telephoto lenses for astrophotography. They vary considerably in quality and price. Fast fixed focal length lenses (say under f/4) typically are the most expensive. Slow (above f/4) zoom lenses seem to be the least expensive due to the fact that they sell more and the longer focal lengths are cheaper to manufacture.

For astrophotography, fixed focal length lenses tend to produce better results because they have fewer elements than zoom lenses. The more elements, the greater the chances one might have an aberration or to be out of alignment, especially since zoom lenses move the glass around more (since they zoom and focus). Faster lenses (smaller f/#s) are more desirable for astrophotography since they collect light more readily, shortening exposure times. My L-series lens is fast, but it is a zoom lens and I wondered whether it would provide quality wide-field astro-images.

I attached the camera and lens onto my observatory's telescope (**see Images 2 and 3**). I guided using an SBIG CCD camera on the telescope. My targets were the Andromeda Galaxy (M31) and the Pleiades (M45). Each was imaged for two hours using ten-minute subframes. The images were processed using *ImagePlus 3.0* and *Adobe Photoshop CS4*.

For both objects, the lens was set at the maximum focal length which is 200mm. The camera was attached to a PC and focusing was done with *ImagePlus 3.0* camera control. Flat field images were sky shots taken during twilight. They were so incredibly "flat" they probably were not needed in the image processing. Since the camera was always at ambient temperatures, I took dark frames every hour as the temperature dropped during the night.

Typically in the past when I did astrophotography with a telephoto lens, I would decrease the aperture a couple of stops, preventing light from passing through the edges of the lens. The edges are where most of the aberrations occur. For these test images, I set the aperture all the way open to f/2.8 to truly test the quality of the optics.

Image 5 - The Pleiades, M45, taken with the Canon L-series lens at 200mm, f/2.8. This image was also the sum of 12 ten-minute exposures.

As you can see from the images of M31 and M45 (**Images 4 and 5**), the lens performed like a top dollar APO. The sharpness and color are excellent. There is a slight amount of what I think is astigmatism on the left edges of the images, but it is barely noticeable. I have to say this is the finest 200-mm lens I have ever used.

Now I have a high quality piece of glass that I can use for all of my daytime photography calling for focal lengths of 70-200mm, plus a great lens to use for wide-field astrophotography. I might get slightly better results with a 200-mm fixed focal length L-Series lens, but it would cost 3-4 times as much and would not be a versatile as the zoom lens. Other celestial objects I would like to photograph with this lens include the Orion Loop, the Rosette Nebula, M33, total lunar and solar eclipses, the North America Nebula, and the Magellanic Clouds. ATT