MALLINCAM SKYRAIDER DS287C

THE LITTLE CAMERA THAT COULD

By Matt Harmston

Image 1 - The Mallincam DS287c and a US 25-cent coin for scale

Like so many of us, my interests in astronomy range far and wide. Deep sky, solar system, faint fuzzies and supernovae - you name it, we want to see it. In detail!

Though my CMOS cameras have paired nicely with my beloved Sky-Watcher Pro 100ED refractor (native f/9), I've found myself longing for large image scales without digital zoom and/or slow focal ratios (with concomitant longer exposures). And then I heard about the MallinCam SkyRaider DS287c.

After watching online demonstrations of both the DS287c (color) and its even more sensitive cousin, the DS287m (monochromatic), I was intrigued. Yes, I like to capture images and share them via social media. However, at heart, I am more of an observer than a photographer - and the DS287c seemed like what I was looking for.

The Arrival

Fast forward a little bit (patience may be a virtue, but not with images of galaxies dancing in my head), and the DS287c arrived on my doorstep. Complete with the supplied 15' USB3 cable, guider cable, and nosepiece, I was all set to grab photons with this 81g, 1.25" dynamo. For scale, I've included a picture of the camera (**Image 1**) next to a US 25-cent coin.

In interest of space, I will simply refer you to the DS287c user manual for all the camera's details which are available on the Mallincam website. Having a chip with 6.21mm diagonal, 6.9 micron pixels, and a 4,584mv sensitivity rating for the color model, this small camera was designed for large image scale and quick image acquisition.

The camera's free downloadable software, MallinCamSky, comes with its own suite of tools. Again, I refer you to the DS287c manual for details. But, as you'll see in the course of this article, I find particular value in average stacking and dark field correction functionality with the DS287c.

My Observing System

I conducted my testing using the aforementioned Sky-Watcher Pro 100ED doublet at f/5.2 (using a Mallincam 0.5x focal reducer) and f/9, and controlled the DS287c with an HP Pavilion laptop, equipped with an Intel Core i7-7500U CPU, 12GB of RAM, and Windows 10 Home.

At times, I applied an Orion Skyglow Astrophotography filter (noted in text where appropriate). Though my computer has far more capability than needed to run MallinCamSky, I've battled software freeze-up with my other SkyRaiders. Thanks to advice from Rock Mallin, Jack Huerkamp, and the helpful community participating in MallinCam's online user group, I found that using a powered USB3 strip, regular application of dielectric grease in ports (i.e., maintenance), and avoidance of random Windows updates/quirks and antivirus/ firewall activity during viewing sessions was important.

In short, not all PC operating systems, antiviral/firewall bundles, nor USB3 ports are created equal. With a powered USB3 strip now in use, I take a quick minute and go through the following checklist for every viewing session: a) disable internet; b) disable antiviral and firewall scanning (after disabling internet…and don't forget to start it up before reconnecting!); c) plug in the camera and start MallinCamSky; and d) set Windows 10 to run MallinCamSky on a single processor (i.e., affinity=1). Doing so makes for a stable viewing experience.

Performance - Noise/Amp Glow

All observing was conducted under rural Bortle 4.0-4.5 Iowa skies with temperatures ranging from 11F to 24F. All bench-testing, however, was done at 32F and 67F ambient temperatures, with testing using both video and trigger modes. When bench-testing, 32F and 67F ambient temperatures saw stable sensor temperatures of 53F and 103F per MallinCamSky metadata, contrasted with sensor temperatures consistently under 30F when observing. As a learned friend joked, my viewing sessions used a SkyRaider "DS287-cryo". Well played, my friend. Well played.

With a bench-testing ambient temperature at 67F, I could detect very faint noise at one second with gain of 30%. Very faint amp glow was first seen at 3 seconds/40% gain and/or 4 sec/30% gain. As one would anticipate, longer exposure and/or higher gains resulted in more noise. Noise was more pronounced at 67F than when the ambient temperature was 32F. Average stacking and appropriate darks effectively mitigated amp glow and, in combination with judicious use of average stacking and other MallinCamSky functions, mitigated much of the noise.

Control over amp glow and noise is critical for me, as exposures are typically measured in seconds (rather than milliseconds) given my small Sky-Watcher. Of the 43 deep sky objects studied/observed for this review, exposure times ranged from 197ms (NGC 6543/Cat's Eye Nebula) to 40 seconds (IC 5146/Cocoon Nebula, seen in **Image 2** with no post-processing), both using an Orion SkyGlow Astrophotography Filter.

Performance - Viewing

Like most cameras, images from the DS287c can be impacted/improved upon by image processing software. However, unless otherwise specifically identified as such, images in this review used dark field correction, were snapped during live viewing, and received no post-processing. I wanted the images to represent snapshots of what was on my screen during the MallinCamSky viewing sessions.

With my goal of going deep with a small telescope, I went after some relatively challenging objects. For instance, the filtered image of NGC 7635 (the Bubble Nebula) as shown in **Image 3** required a 30 second exposure using 60% gain at f/9 after inserting the Orion filter. To mitigate noise, I incorporated on-the-fly average stacking of 11 frames. While there is some residual graininess (expected due to pixels of 6.9 microns), my goals of getting close-up, quality detail in a reasonable amount of time were certainly met. A fun side note, it was refreshing to see that application of a dark frame didn't introduce distracting image artifacts.

A smaller object meeting my filtered gaze was Messier 76, the Little Dumbbell Nebula. In **Image 4** of M76, you can clearly see color and structure within the nebula's bar and faint lobes extending above and below the bar. Given that the bar spans less than 2' side-to-side, this level of detail was exactly what I was hoping to see.

While not methodically tested, I viewed several smaller objects as a means of getting a feel for lower limits on angular diameter. After all, at some point pixilation will undermine our viewing. Granted, this issue is impacted by many factors, one of them being focal ratio. Since I had control over focal ratio, I allowed it to vary between f/5.2 and f/9.

At f/9, the filtered 1.3 second capture of NGC 7009 (the Saturn Nebula) shown in **Image 5** takes on an oblong shape and reveals patterns in shading/color, despite being 41" in width. Though the image was not processed, I cropped it so readers wouldn't need a magnifying glass to see the nebula. This angular diameter was about as small as I could go at f/9 with my little scope under below-to-average seeing conditions while still making out some detail. With small, relatively high surface brightness objects such as NGC 7009, I prefer to use low gain in order to minimize noise, and subsequently, enhance detail. Here, I used 10% gain.

At f/5.2, color was visible in NGC 7009, but it appeared as a pixelated bluish oblong blob - not really what I'd consider much detail. At f/5.2, the filtered image of the Eskimo Nebula (NGC 2392) shown in **Image 6** revealed a little more structure and color variation than NGC 7009 at this focal ratio given its 48" diameter. Longer exposure time was used because NGC 2392 was fainter and 8% gain was used. As expected, opting for longer exposures and lower gain settings (coupled with average stacking) enhanced views of small objects, both at f/9 and f/5.2, by mitigating noise and drawing out detail.

With more extended objects, the image scale delivered by the DS287c revealed a wealth of detail. With broader fields in mind, my focal reducer resulted in a focal ratio of f/5.2, giving me a 33' x 24' field of view (per nova.astrometry.net image statistics).

For the first of our more extended objects, we turn our attention to Messier 1 (the Crab Nebula). As seen in the unprocessed, unfiltered image offered in **Image 7**, onscreen viewing contained a great deal of color and structure. On the other hand, processing via post-hoc wavelet application and slight gamma tweaks reveal impressive detail (see processed image shown in **Image 8**).

I was especially curious to see what could be revealed in Messier 82, a starburst galaxy in Ursa Major (see filtered image shown in **Image 9**). Having seen ample structure and color in presentations with other cameras and larger scopes, would I see something similar with my little scope and the DS287c? Indeed - as can be seen in the image, structure is clearly delineated, as is the red core. You could say that this is a showpiece galaxy - and I'd agree with you.

The final example of more extended objects nearly maxes out my field of view at f/5.2: NGC 253 (the Sculptor Galaxy, seen unfiltered in **Image 10**). The DS287c revealed distinct detail without significantly blowing out the core. Given the evening's poor seeing and the galaxy being fairly low in the southern sky, onscreen rendering of the galaxy was quite exciting.

"A great galaxy hunting camera - ideal for super nova search"...?

To this point I've used well-known objects that best exemplify my experience with the DS287c. But, I continue to hear the MallinCam.net description in my head: "A great galaxy hunting camera - ideal for supernova search!" When I read words like "great" and "ideal", I raise the proverbial eyebrow, as this sets a tough (albeit subjective) standard. So, why not look for evidence to support the ad copy?

While I do not actively hunt for supernovae, Messier 77 conveniently produced supernova 2018 ivc during my DS287c review window. As you can see the filtered f/9 image offered in **Image 11** (unprocessed except for identification hash marks and cropping), we can clearly make out an early stage of the supernova. While fireworks are always exciting, this was the first supernova to have graced my cameras and/or eyepieces, making it particularly memorable.

With respect to hunting galaxies, I dream of Hubble Deep Fields and the like. And yet, I wake up to the reality of earth-bound small aperture. As you can see in **Image 12**, an unfiltered image of Abell 1367 (edited only to include labeling), many faint fuzzies (and a satellite) are seen. With the availability of online tools and generous astronomers willing to help out an unfortunate soul frozen to his observing chair, additional faint fuzzies were confirmed.

Among the more interesting are a couple for which I have applied labels: Dwarf spiral galaxy 2MASX J11434983+1958343 (per SIMBAD, 'r' and 'g' magnitudes of 16.556 and 17.039, respectively) and PGC 1609226 (per SIMBAD, 'r' and 'g' magnitudes of 16.659 and 17.259, respectively).

Seeing galaxies pushing magnitude 17 and at least one nearly 1.5 billion light-years distant (PGC 1609226), much less with my little scope using 20 second exposures, just might qualify the DS287c as a galaxy hunter.

Some Miscellaneous Concerns that I Had to Resolve

To this point, I've talked about what the camera can do, and admittedly shared many positive experiences. However, I started down the review journey with some distinct concerns in mind that I'd like to address here. First and foremost, my mount is a Celestron AVX, which has served me well under sometimes quite unpleasant conditions. However, would the mount's goto accuracy be sufficient given the DS287c's narrow field of view?

After standard alignment procedures, I was pleased to find objects in my field of view even after trans-meridian slews at f/9. An interesting follow-up investigation would be whether automated alignment via something akin to Celestron's StarSense system would result in sufficiently accurate gotos with a chip this small, especially with longer focal length telescopes.

I was also concerned about camera redundancy, as my camera case contains, among other things, a MallinCam SkyRaider DS10c. Granted, cameras are like bicycles and telescopes, in that you can never have too many. But, redundancy has its drawbacks. Given that the DS10c is built around a chip with a diagonal dimension some 3.4x larger than that of the DS287c, zoom must exceed 3x for DS10c images to match the DS287c scale at comparable focal ratios.

Though DS10c image quality holds up very well when zooming in, increasing image scale by a factor of 3 or more would mean grappling with zoom during live views, cropping/resizing each image after capture to maintain scale, and/or necessitate using the DS10c at f/18 and f/27 (and concomitant longer exposure times) to approach my f/6 and f/9 image scales observed with the DS287c. I like simplicity, and the simplicity with which the DS287c generates larger scale images puts my redundancy concern to rest.

An additional concern was background noise. During presentations on NightSkiesNetwork.ca, the relationship between exposure time, gain setting, and noise levels was quite clear. Given my small aperture, would noise overwhelm my images given longer exposures and/or higher gain? As evidenced by images presented earlier, noise levels were reduced markedly by functionality within MallinCamSky, rendering noise a non-issue for me.

That said, I need to make an important caveat: Every night during which I used the camera, temperatures started out no higher than 24F, and dropped into the mid-teens (one night, 11F) by the end of viewing sessions - thereby keeping the sensor below 30F (remember my friend's DS287-cryo joke?). Not being able to review the camera under warm conditions represents a limitation to this review. Applying what I saw during bench testing, I suspect that frigid conditions improved viewing via reduction in noise, particularly with longer exposures and higher gain settings. However, I cannot quantify this improvement because I was limited to cold viewing sessions.

In the End…

Rock Mallin has made very clear during online demonstrations that this camera is intended to render rapid, quality imagery within live viewing sessions. Yet, while it is intended to put a smile on an observer's face, it is not designed to deliver pin-point stars and complete absence of noise as might be seen in high-end astrophotographs.

To that end, his assessment was right on the money. Live video astronomy, the intended use of the DS287c, presented me with detailed images of small, faint objects using moderately short exposures. And, it did so even with a scope as small as my 100mm Sky-Watcher Pro ED. For the seasoned observer, newcomers of all ages, and even those with varied impairments, the SkyRaider DS287c serves up a very real, very vivid, live experience. For me, it is the little camera that could. ATT

Image 2 – IC 5146 (Cocoon Nebula): 40 sec, gain 18%, avg stack of 6 at f/5.2

Image 3 – NGC 7635 (Bubble Nebula): 30 sec, gain 60%, avg stack of 11 at f/9

Image 4 – Messier 76 (Little Dumbbell Nebula): 20 sec, gain 30%, avg stack of 10 at f/9

Image 5 – NGC 7009 (Saturn Nebula): 1300ms, gain 10%, avg stack of 15 at f/9, cropped

Image 6 – NGC 2392 (Eskimo Nebula): 10 sec, gain 8%, avg stack of 9 at f/5.2, cropped

Image 7 – Messier 1 (Crab Nebula): 20 sec, gain 30%, avg stack of 10 at f/5.2 UNPROCESSED

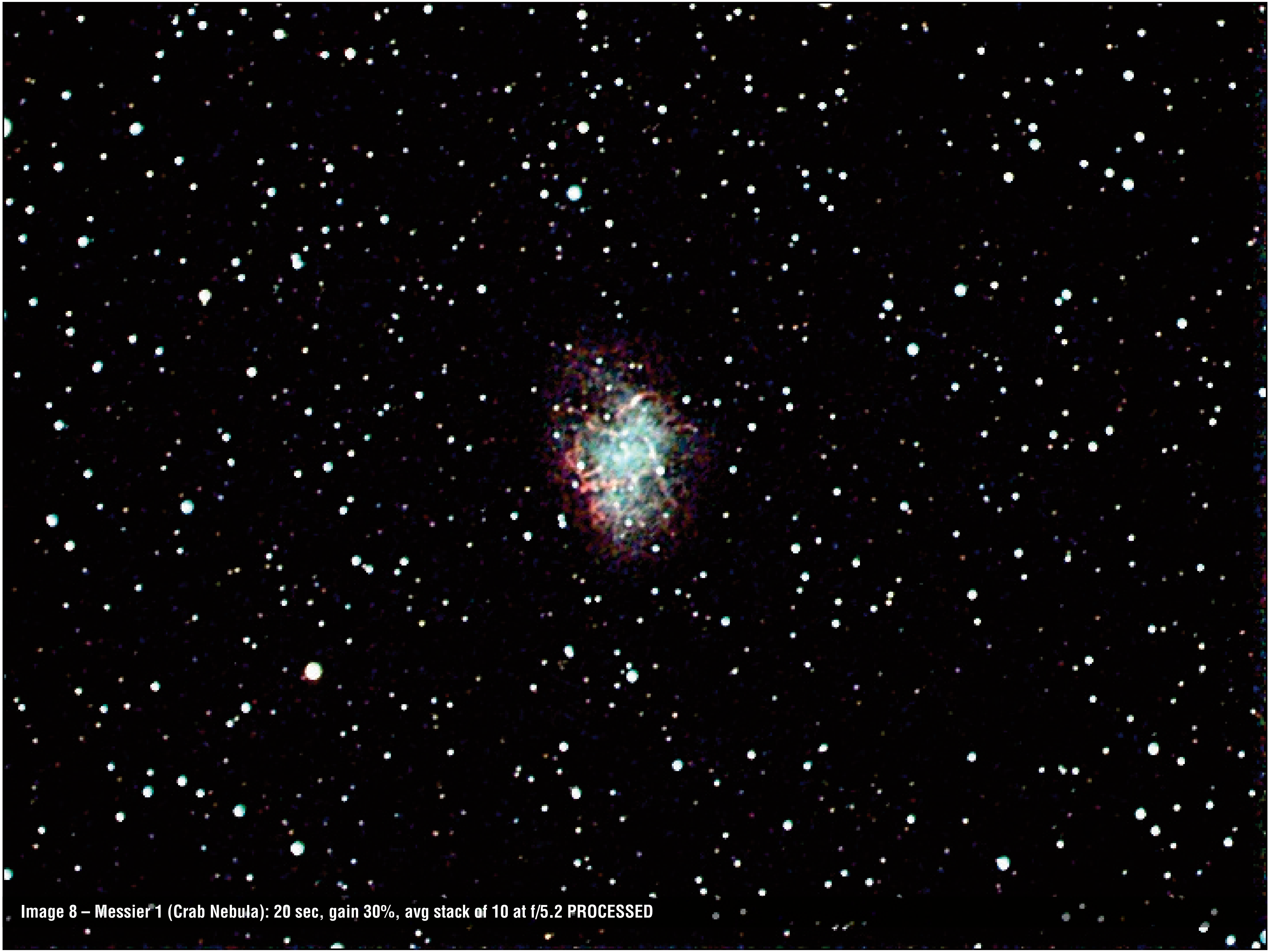

Image 8 – Messier 1 (Crab Nebula): 20 sec, gain 30%, avg stack of 10 at f/5.2 PROCESSED

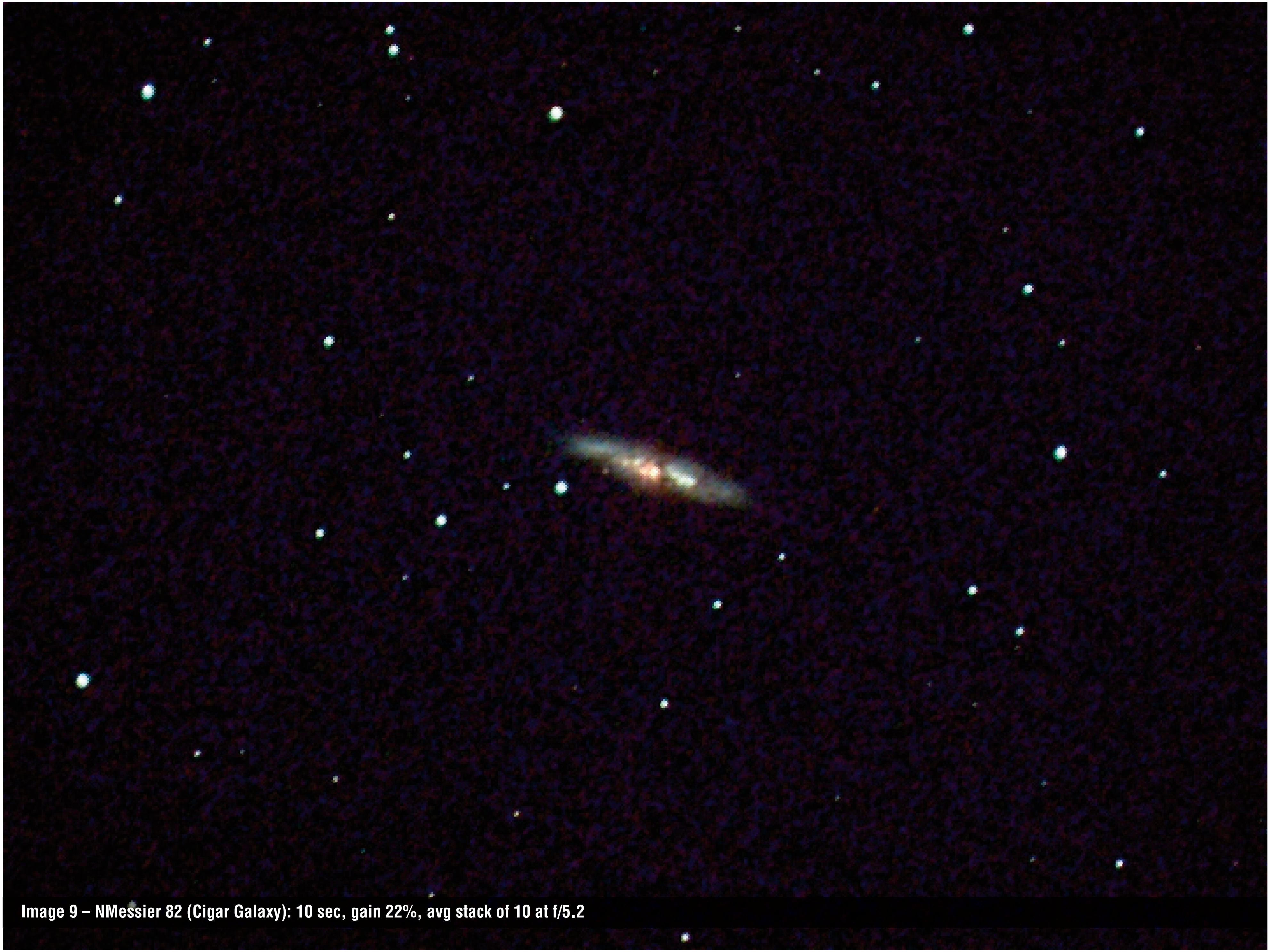

Image 9 – NMessier 82 (Cigar Galaxy): 10 sec, gain 22%, avg stack of 10 at f/5.2

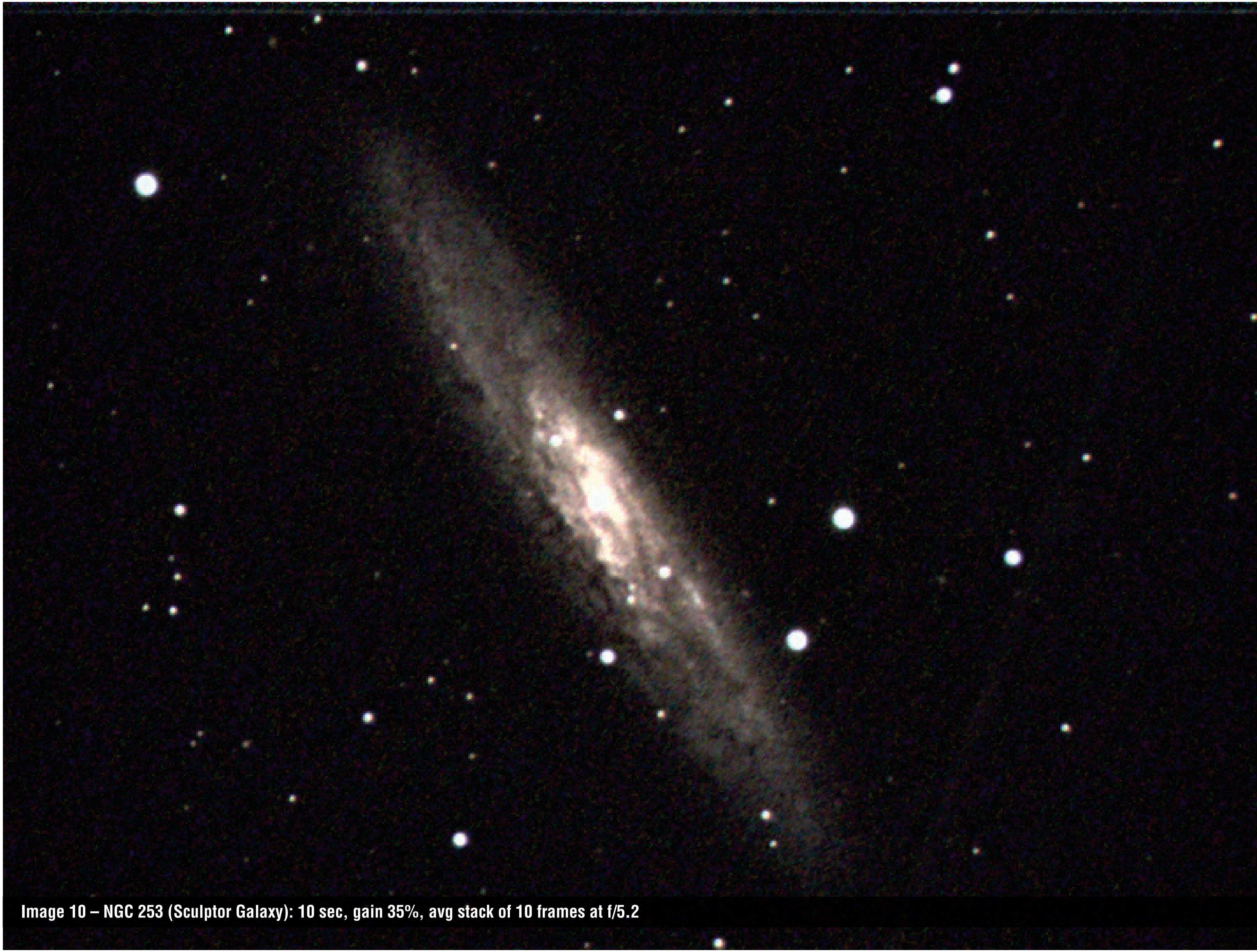

Image 10 – NGC 253 (Sculptor Galaxy): 10 sec, gain 35%, avg stack of 10 frames at f/5.2

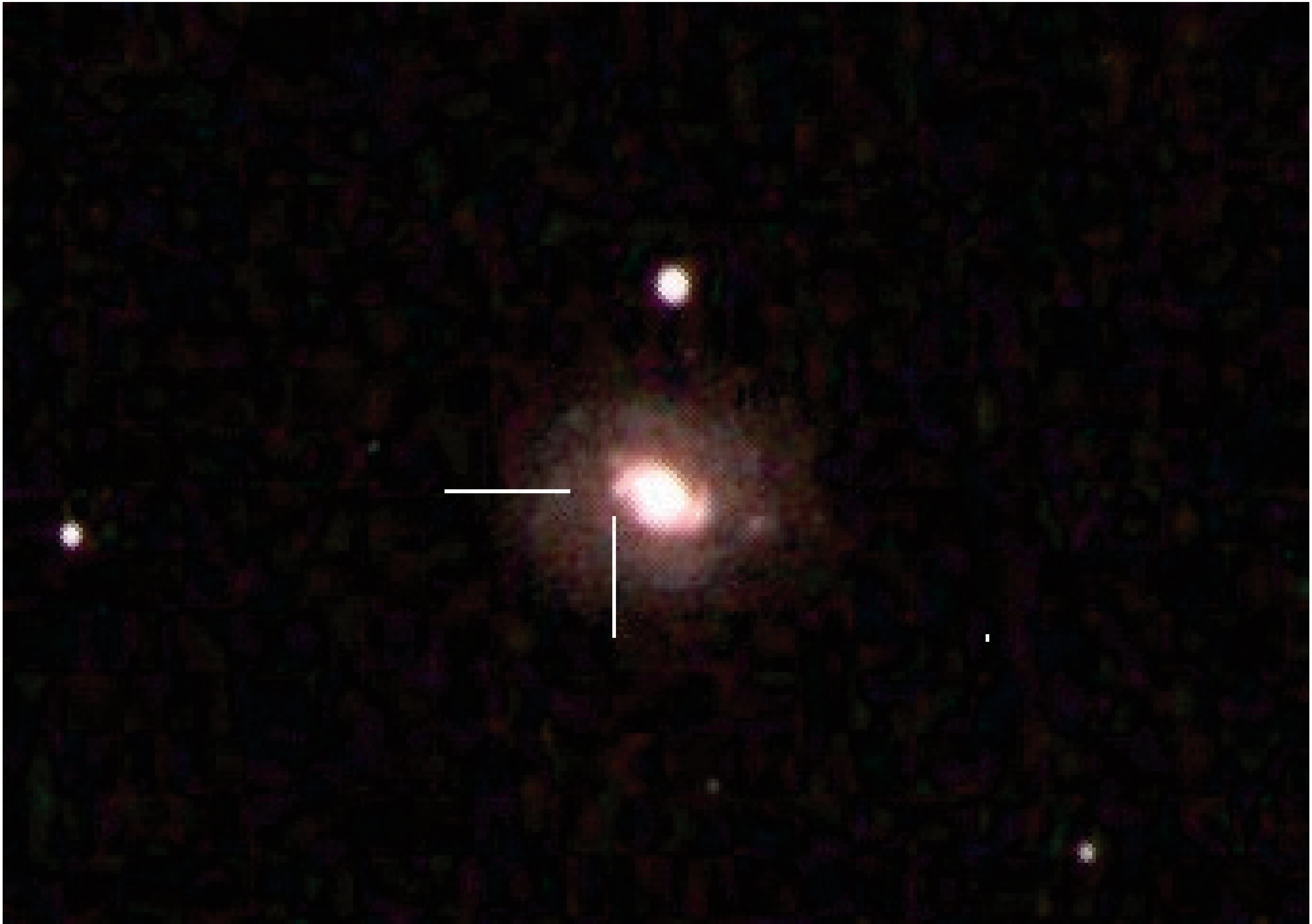

Image 11 – Messier 77, 20 sec, gain 30%, avg stack of 10 at f/9 with supernova indicated by hash marks, cropped

Image 12 – Galaxy cluster Abell 1367: 20 sec, gain 30%, avg stack of 8 at f/5.2 with PGC 1609226 and 2MASX J11434983+1958343 indicated with hashmarks