Large Format Astrophotography

by Suk Lee

What is large format?

Film currently breaks out into three families of film formats. The most familiar is "135 format rollfilm" which is the familiar 35mm film in a canister. It's the smallest of the "normal" film formats although there is a smaller format called APS which film manufacturers tried, unsuccessfully, to popularize just as megapixel digicams were becoming affordable (as an odd coincidence, the sensors in the non-full-frame digital SLRs are about the same size as APS frame).

The next step up is medium format "120 format rollfilm" and "220 format rollfilm". The difference between the two is the length of the film - 120 format gives you about 15 shots/roll when shot as 645 (we'll come to that). 220 format gives you about 30 645 shots/roll. 120 format is also backed in paper, but 220 film has a short paper leader only, in order to be able to fit all that film on the same size spool as 120. For those of us old enough to remember, these are the film-on-a-spool that you used for your venerable Brownie Camera. Medium format cameras are built to frame 120/220 in different sizes. The common sizes are 645 (6cm x 4.5cm e.g. Maimya 645), 6x6 (6cm x 6cm, the size espoused by Hasselblad until just recently with the introduction of their new 645 camera), 6x7 (6cm x 7cm, e.g. Pentax 67) and 6x9 (6cm x 9cm). Speciality film backs area available to shoot even wider (e.g. Canham makes a 6x17 roll film back) formats when attached to a large format camera.

The last category is "large format sheet film". There are various film sizes ranging from 2" x 3" all the way up to 20" x 24" (Yikes. Imagine the size of *that* camera. B&H lists 20x24 film, 25 sheets, at $365!), although the most popular sizes today are 4x5 and 8x10. As the name implies, the film is cut into individual sheets. These sheets must be loaded into a light-tight film holder, which in turn is loaded into the large format camera's back. Think of the big old bellows cameras on a wooden tripod with the photographer huddled under a black cloth and you're thinking of large format.

Why large format?

For non-astronomical photography, large format is used because of the versatility of large format cameras in terms of their ability to control perspective (buildings don't look like they're falling backwards) and the plane of focus (e.g. can create VERY deep focus in widefield shots), and because of the quality of image possible with the inherently large piece of film. No matter how fine your lens, film granularity limits how big you can make prints -- the less magnification required, the higher the final quality.

The swing/tilt capabilities of large format cameras are irrelevant for astrophotgraphy, where everything is at infinity. The quality aspect of large format is what's interesting for wide-field astrophotography. To get a really wide field (most of the sky) on 135 format film, you have to use a pretty short lens, say 24mm. It's asking a LOT of the lens and film to blow up the print to a aesthetically satisfying (OK, I mean ***large***) size that captures the feeling of the widefield shot, still retains sharpness across the shot, and isn't excessively grainy. Also, 24mm @ f4 is going to be a pretty small aperture which limits the maximum magnitude that can be captured. For 4x5 an 80mm lens will give approximately the same FOV as a 24mm lens on 135 format film, but the aperture will be much larger, giving higher resolution (smaller stars) and capturing fainter stars.

To illustrate, let's compare film sizes and how much you can blow up the image:

35mm scanned @ 3200DPI can be printed 10" x 14" @ 300DPI

645 scanned @ 3200 DPI can be printed 19" x 25" @ 300DPI

4x5 scanned @ 3200 DPI can be printed 40" x 50" (!!) @ 300DPI

(If displayed at 72 DPI on your screen these are life-sized)

The top image of star trails on 135 is nice to look at printed as a moderately large 8x10" print. The 645 (the smallest of the medium formats) shot can be satisfyingly blown up to a the size of a small poster. BUT, the large format can be blown up to a truly stunning giant poster and still retain the sharpness of the 8x10, assuming the lens is up to the task. For wide-field images, large format also offers lots of cropping versatility without sacrificing image quality.

Why NOT large format?

Despite the theoretical benefits of large format, there's a bunch of downsides.

Everything, because of scale, is expensive. Really. The lenses have to be of very high quality to cover

such a wide piece of film (large format lenses are designed to cover more than the film in order to accomodate swings and shifts) and are often $1k+ for a single "normal" lens. In addition the lenses are SLOW, with f4 being the fastest large format lens currently available (Nikon 65mm). Since the cameras were not designed for multi-hour exposures, they're not as rigid as astrophotgraphy requires, which limits you to either special cameras, or wide-field imaging.

There are VERY few telescopes that have sufficient field flatness or coverage to evenly illuminate a 4x5 piece of film (the Astro-Physics 155 EDFS with 4" focuser is one of the exceptions that comes to mind - I'm on the wait list, are you?). Besides, for deep-sky objects, large format is overkill. A regular Pentax 67 medium format camera will provide a HUGE blowup of an object like the North American Nebula.

Film choices are very limited. Unless you're willing to develop yourself, you may not be able to easily have the film developed (I'm lucky to have a professional lab around the corner from work that will both process and print to the full capability of large format).

Despite these challenges, the allure of a really BIG widefield picture lead me down the large-format path...

Vacuum Film Holder

One of the challenges of large format astrophotgraphy is keeping the film flat during a long exposure. For regular photography, this isn't normally an issue. The exposure is short enough that the film isn't going to absorb moisture from the air and buckle. However, with astrophotography, particularly at night with moist dew-ey are around, film buckling is a real possibility.

Cruising the net, I came across the JSP astrocamera. While I didn't buy the astrocamera itself, they offer a vacuum film holder and pump at a very reasonable price.

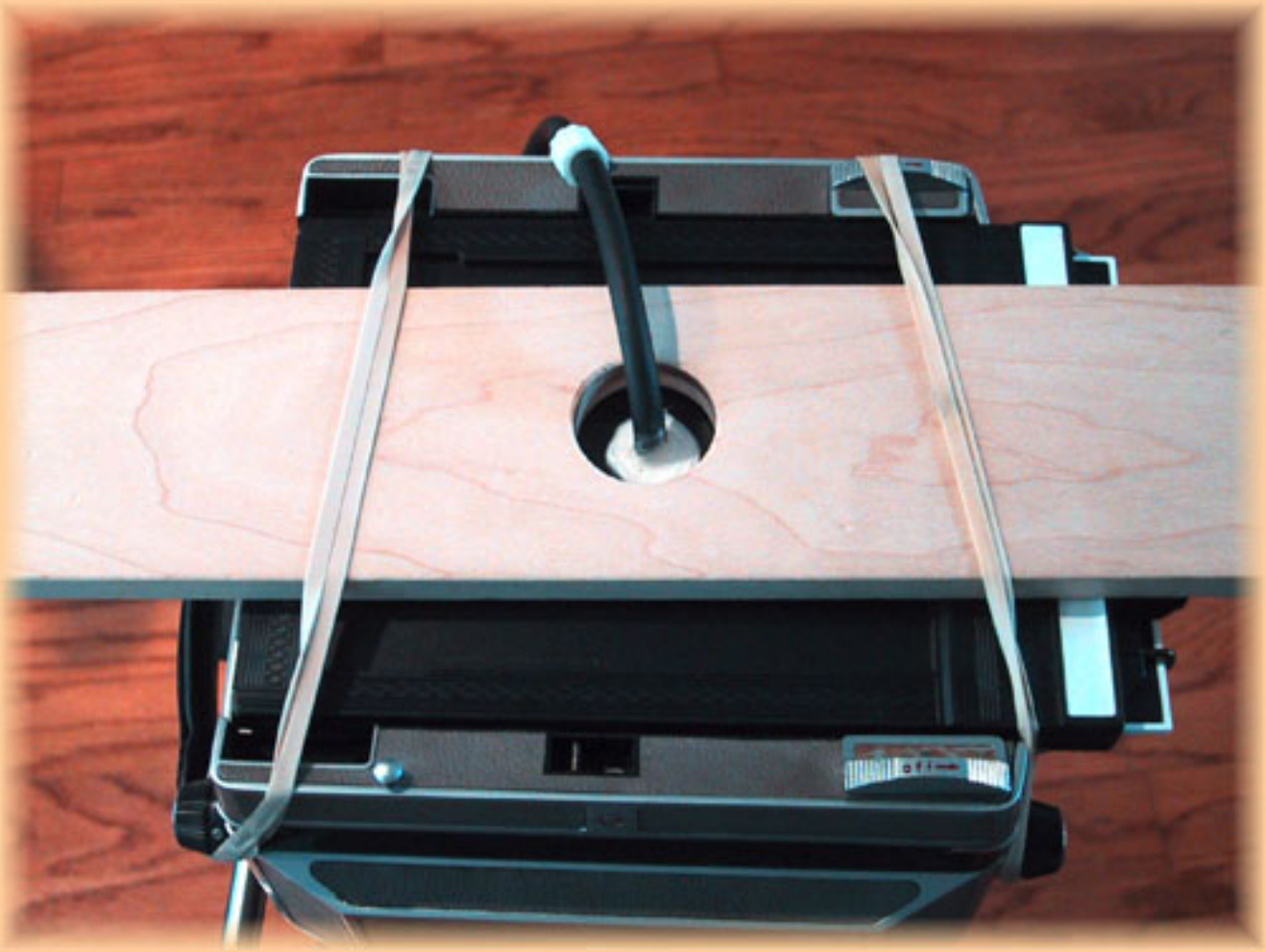
The vaccum film holder is a standard 4x5 sheet film holder modified to suck the film down to the pressure plate. The vacuum pump is a modified aquarium pump. This film holder normally holds two pieces of film, one on each side. In the modification, one side is sacrificed to create a vacuum chamber and then the pressure plate is perforated to suck the film down on the other side:

Camera

The camera I use is a Linhof Technika 4x5 field camera, currently with a 150mm f5.6 lens. The Technika is noted for it's stiffness: despite having some large format adjustments (lens swings, tilts, etc.) everything locks down good and solid. Technika's have been made forever, and are still being made, so if something breaks (unlikely) it's easy to get fixed. Another other advantage was I didn't have to pay for it: it was my father's.

With large format cameras there's a groundglass at the back of the camera that you use to compose and focus on. Once you're satisfied you lift up the spring loaded groundglass, which becomes the film-holder holder, and slide the film holder underneath it. Usually no problem as the film holder is normally flat on both sides. However, the JSP modified holder has a tube sticking up out of it.

The Linhof back comes off, and the Schmidling film holder is strapped on with rubber bands:



Focusing

Focusing for astrophotography is always challenging, knife-edge is the most accurate, but a focus microscope can be equally effective. To use a focus microscope, you first focus the microscope on the camera groundglass, then use the camera's focus to bring a star to focus in the microscope. The magnification of the microscope accomplishes two things: make the out-of-focus star easier to see, and eliminates the possibility that the eye's focus accomodation will cause you to focus on some other plane than the groundglass.

To be effective, you want to use at least 25x magnification. Edmund Scientific sells a 50x pocket microscope for a great price of $20:

As it comes the focuser base is a little too tall, so the end needed to be trimmed off a bit:

Developing the Film

So, you've got this huge piece of exposed film, now what? Your local photolab-in-a-tiny-shed won't be able to do anything with it, but if you're in a large city, there'll be professional photolabs that can process your film. With care you can do E-6 slide processing at home, but for the low volume of film I shoot, I just use a professional lab. I use Calypso Imaging in San Jose to do my developing.

Scanning

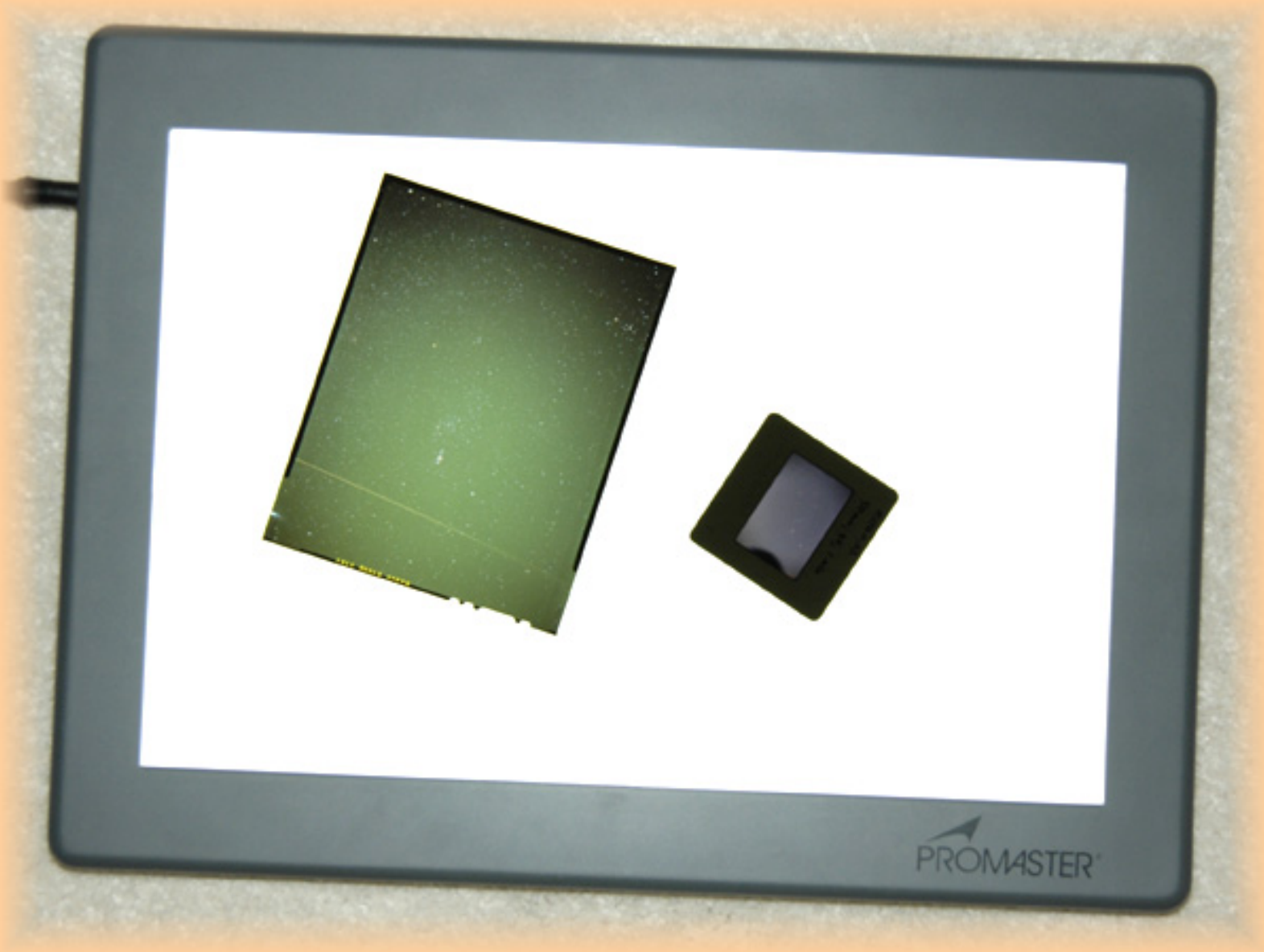
Dedicated film scanners that can handle medium or large format film are typically fairly expensive. However, Epson has a line of flatbed scanners that are specifically designed to handle both reflective and transparent media at great prices. Usually the tradeoff was the maximum density the scanner could achieve (usually expressed as DMax), however, with their most recent flatbed scanners, the DMax capability has become comparable to dedicated film scanners so I bought an Epson Photo 3200 for around $300 (at the time of writing, the Photo 3200 has already been superceded by a higher resolution model at a very slightly higher cost).

It comes with a variety of holders for 35mm slides in holders, 35 strips, and 120/220 and 4x5 format film.

There's nothing particularly magic about scanning the large format transparency - other than the amount of data generated! At 3200 DPI and 16 bits color depth, one scan generates a Gigabyte of data.

The Result

It's a Really Big Transparency:



I was going to process this shot via my normal techniques, but the sheer amount of data brings my old PC to its knees. So that's it for now. Once I upgrade my PC, it'll be off to Calypso Imaging to make a Really Big Print for my office. I am currently resisting the temptation to buy a large format wideangle lens to use once or twice a year for widefield shots.

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