

DSLR Astrophotography with Lenses

A guide to high quality portable image acquisition

Objective

- Discuss effective utilization of DSLR cameras with lenses for wide field deep sky imaging in acquiring one night's worth of data to achieve a high quality print output.

Jeff Ball Bio Brief

- Pharma rep for 21 years
- Father of two teenagers
- Huntington, WV
- Primarily landscape photographer studying intensively the past 4 years
- First astro image taken in 1997 (Hale Bopp)
- Been out of astrophotography since Dec. 2004
- Imaged with Meade SCT, AP, and Televue refractors and AP 600 and 900 GOTO mounts.
- Pentax 6x7, Nikon F3, SBIG ST10XME
- Hap Griffin Modified Canon 350XT with Canon lenses (135mm f2)

My Motivations

- inspired by DSLR work of Chuck Vaughn
- capture quality data to produce a quality print with one night's worth of imaging,
- do not want to use a computer in the field,
- do not want to use a guide-scope/auto-guider, and
- compositions must either be unique or interpreted in a different and meaningful way.

Why Lenses?

- The FOV that I want is captured with lenses.
- Lenses come in fast f-ratios as low as f2
- An "L" collection of 3-4 lenses that covers a wide focal length can be purchased for approximately the cost of a 500mm f6 APO refractor (and the lenses can be used in the daylight, too!)

Assumptions

- Part-time imager
- No permanent setup
- One night a month imaging

Photographic Heritage

- inventors of photography William Henry Fox Talbot and John Herschel-early 1800's

Identify Your Motivation

- Why do you want to do astrophotography?
- What is it you want to say?
- What work inspires you?
- How can you do something unique?

The "Magic" of DSLRs

- I believe the DSLR affords us the opportunity to be more creative and create new work that is different from other dedicated CCDs.

Equipment Overview

- Modified DSLR camera
- Lens
- Tracking mount
- Cable release
- Dew control
- Polar scope
- Mounting hardware (rings, plates, adapters)

Camera selection

- No big debate...simply select the camera that matches up with your current lens selection and have it modified for filter replacement by either Hutech or Hap Griffin. (My camera is a factory refurb from Hap Griffin.)
- I believe only live preview available on Canon 20Da and the 1DMarkIII.

Lens selection: Fast!!!

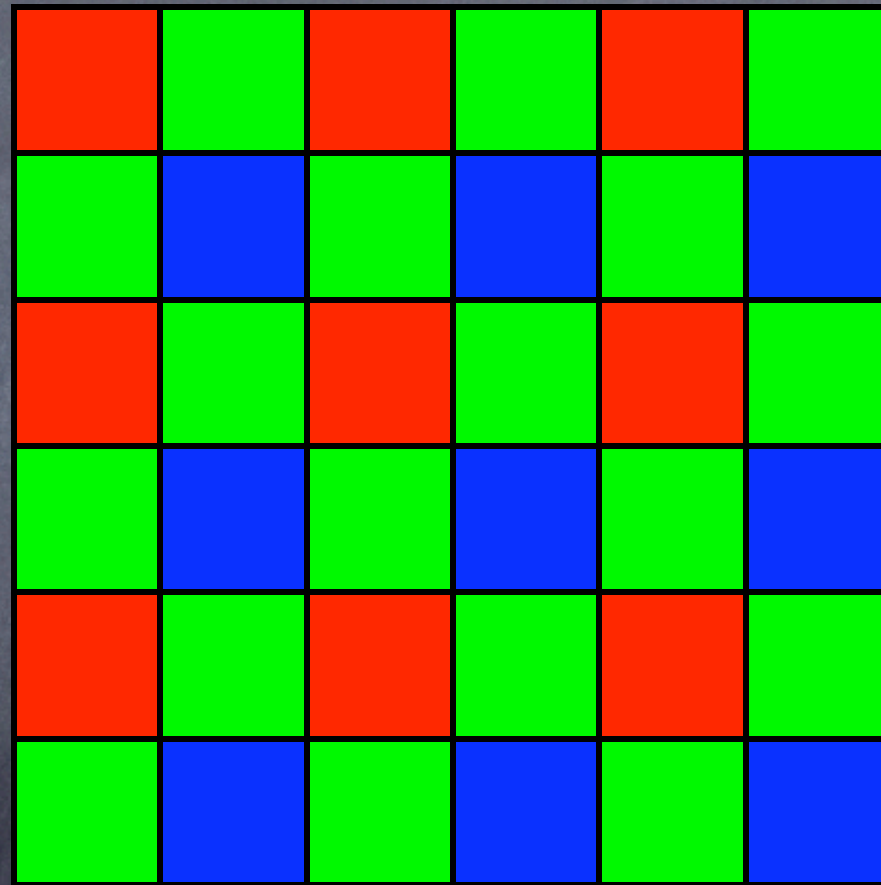
- The optical system must be fast for one night's imaging. Anything less than $f5.6$ is probably OK at ISO 800. Preferably imaging at $f2-4$ max.
- Fast prime lenses are preferred so that wide open apertures or near wide open can be utilized.
- Zooms and IS lenses suffer from aberrations that can affect image quality at their largest apertures (see Lodriguss' tests online).

Evaluating Lens Quality

- Best source is actual star testing.
- MTF charts can indicate performance, but should not be relied upon exclusively. There is a loose correlation between good MTF performance and stellar performance.

Relevant peculiarities of the DSLR

Typical Bayer Matrix in DSLR



source: www.cyanogen.com

Monochrome or Narrow Band Imaging Considerations

- Two times more green pixels than red or blue.
- Green channel is much smoother in RGB capture. Consider using a hybrid Luminance channel composed of a mix that favors the Green channel with Blue and Red mixed in where necessary.
- Halpa is possible—a lot of data and dither.

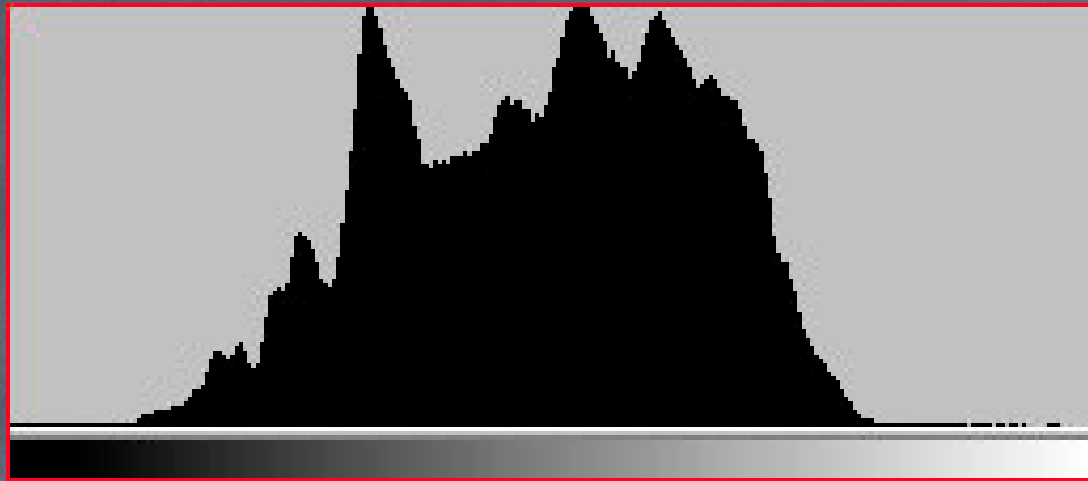
Selecting Optimum ISO

- “Expose to the Right” Do not rely on the LCD. Utilize the histogram to determine a good exposure time.

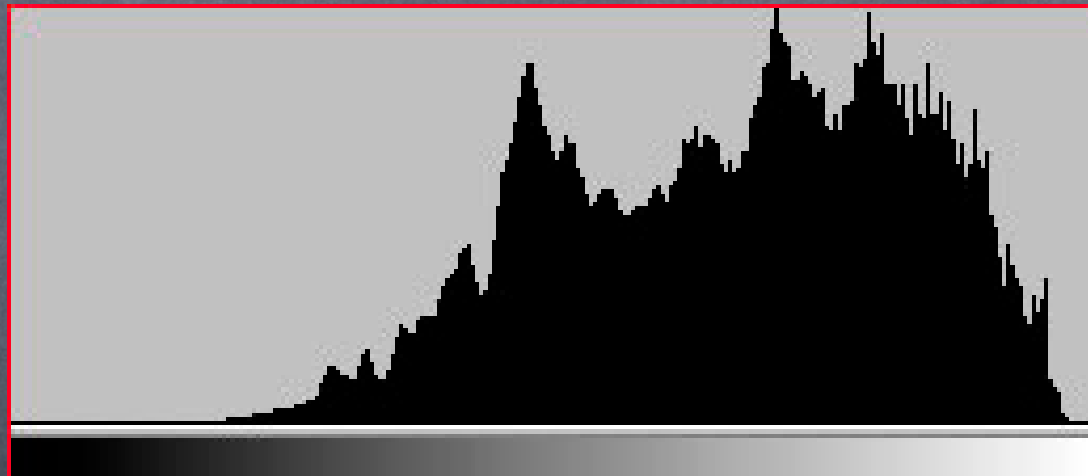
source: Michael Reichmann,
www.luminous-landscape.com

- Within the first F/Stop, which contains the Brightest Tones: 2048 levels available
- Within the second F/Stop, which contains Bright Tones: 1024 levels available
- Within the third F/Stop, which contains the Mid-Tones: 512 levels available
- Within the fourth F/Stop, which contains Dark Tones: 256 levels available
- Within the fifth F/Stop, which contains the Darkest Tones: 128 levels available

source: Michael Reichmann,
www.luminous-landscape.com



Middle exposure



To the right exposure

Be mindful of blowing highlights in star color. You can preserve this with an underexposure to be blended in during processing.

Capture for blown highlights

Capture a few exposures that will capture star color accurately without blowing out any color channels.

These can be blended later in post processing.

Another exposure recommenation

- Mr. Lodriguss recommends an exposure where the peak of the histogram is 20-40% from the left edge of the box.

ISO and Exposure Time

- Mr. Lodriguss recommends selecting ISO based on ambient temperature:
- Above 60 deg. F use 1600
- 40-60 use 800
- and below 40 use 400

ISO and Dynamic Range

- The higher the ISO the lower the dynamic range.
- For dim objects with low dynamic range, i.e. Antares and Rho Ophiuchus use high ISO
- For wider dynamic range and to preserve star colors, i.e. M42 or clusters, use low ISO

ISO recommendations

- For bright objects with high dynamic range select a low ISO and keep histogram peak in the 20-40% from the left edge area.
- For dim objects with low dynamic range select high ISO with the histogram peak nearer to the 50-75% from the left edge of the box.

Important Camera Settings

- RAW capture or RAW + jpg
- Color space to Adobe
- You may wish to select the LCD to remain off for image review—speculation that screen on increases heat and noise
- Autofocus “off”

Composition

- Identify your style. What do you wish to represent with your astrophotography? Consider something totally unique.
- The opportunity for high-quality wide-field imaging has never been more accessible

Field of View: Canon 350D

Focal Length	X Size	Y Size	Sampling
20	58° 3' 54"	40° 36' 43"	66.211
30	40° 36' 43"	27° 42' 54"	44.141
40	31° 1' 16"	20° 57' 50"	33.106
50	25° 2' 6"	16° 50' 20"	26.484
60	20° 57' 50"	14° 3' 47"	22.070
70	18° 1' 19"	12° 4' 12"	18.917
80	15° 48' 0"	10° 34' 12"	16.553
90	14° 3' 47"	9° 24' 7"	14.714
100	12° 40' 8"	8° 27' 54"	13.242
110	11° 31' 30"	7° 41' 53"	12.038
120	10° 34' 12"	7° 3' 29"	11.035
130	9° 45' 40"	6° 30' 58"	10.186
140	9° 4' 1"	6° 3' 7"	9.459
150	8° 27' 54"	5° 38' 56"	8.828
160	7° 56' 17"	5° 17' 46"	8.276
170	7° 28' 19"	4° 59' 6"	7.790
180	7° 3' 29"	4° 42' 32"	7.357
190	6° 41' 13"	4° 27' 40"	6.970
200	6° 21' 14"	4° 14' 17"	6.621

source: Howard's Astronomical Adventures
<http://www.howardedin.com/articles/fov.html>

Composition Aids

- I use Tirion's Sky Atlas and transparencies with respective field's of view for given focal lengths.



ARAB 15

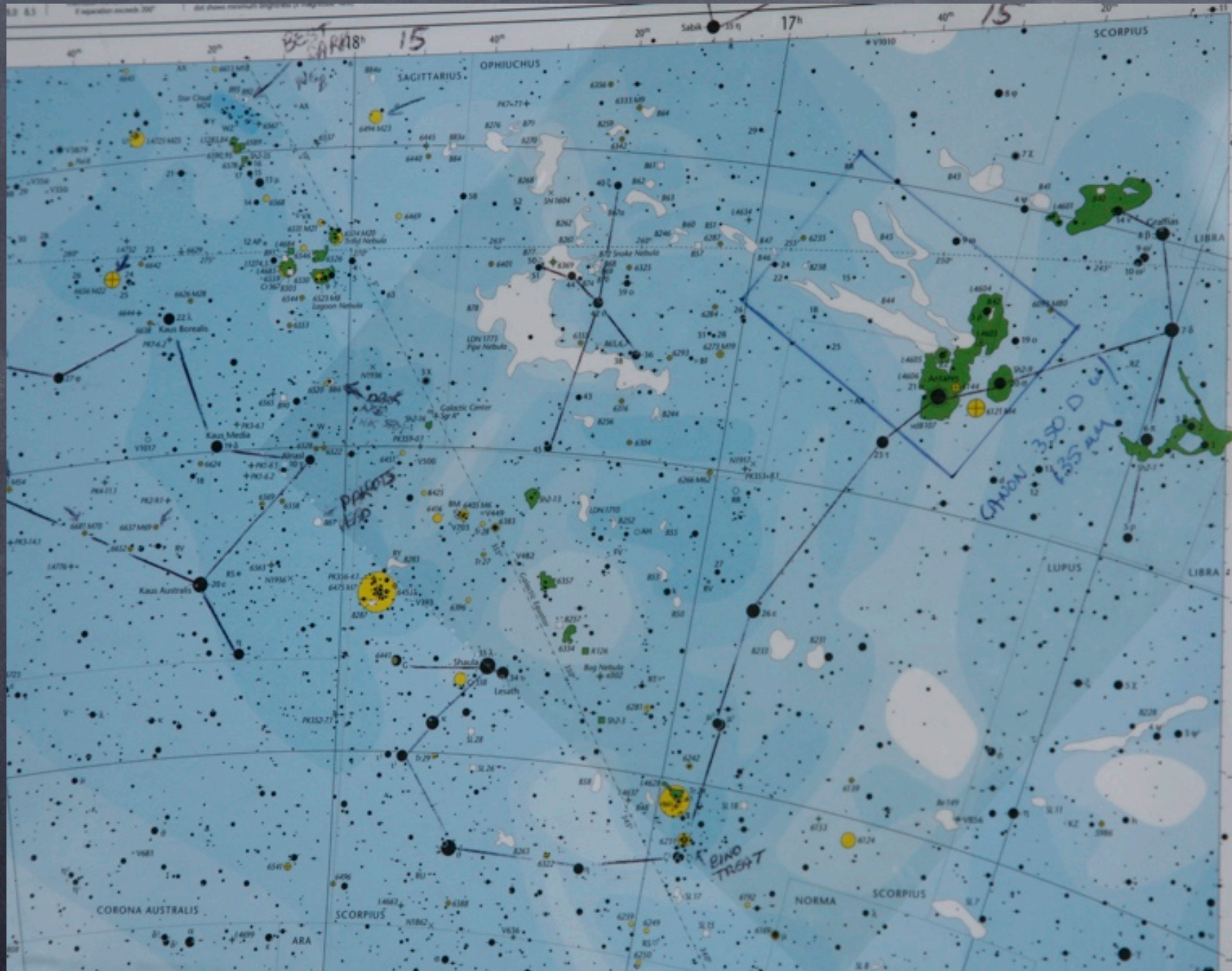
PACUS

CANTON 3-30 D 6
1-35 AM

PINO TRSAT

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Mount considerations

- Primary goal is to have a mount with Periodic Error less than the sampling rate per pixel.
- example is at 135mm the 350D samples at around 10 arc seconds per pixel. My mount needs to have a PE less than this or have a trainable PE correction to achieve this.

Frames

- Light frames are priority. Spend as much dark sky time capturing light frames.
- Dark frames can be captured during tear down. Recommendation by many is for 10 darks. Same settings as lights.
- Flats should be captured on the same night. T-shirt, twilight, light box are all possible tools. Goal is for histogram to be in the middle.

My goal is for 2-3 hours
of lights at f2-f3.5 at
ISO 800.

References

- Vaughn, C., "Going Deep with a DSLR: Using a modified Canon 20Da, one astrophotographer aims for unusually faint nebula", Sky and Telescope, November 2006.
- Lodriguss, Jerry, "A Guide to Astrophotography with DSLR Cameras", www.astropix.com