Shooting Sky Flats in the Daytime

Richard Crisp

12/24/2009

rdcrisp@earthlink.net

www.narrowbandimaging.com

Why shoot sky flats in broad daylight?

- Light intensity doesn’t change from frame to frame: easy to get high quality flats of near-constant signal level
- Can take your time and get all the filters done in a single sitting
  - Don’t have to rush at twilight
  - Don’t have to stay up after dawn when you are tired
- No need for expensive flat boxes, EL panels and so on

Key Challenges to Address

- Light leaks
- Focusing
- Avoiding shutter shading and saturation

Light Leaks

- You need to make sure you have no light leaks
- I put a clear filter in place and take a 5 second 4x4 binned exposure and carefully compare it to a dark
- If they look different it is time to find and fix the light leaks

Fixing Light Leaks

Use lots of aluminum foil

Cover aperture tightly

Wrap edges of filter wheel and focuser

Wrap filter pocket in camera lens

Fixing Light Leaks cont’d

The foil can look ugly

But the result is what counts

Focusing

- The telescope needs to be pretty close to focused at infinity
- But how can you do that in the daytime?
  - Use a far away power pole or building
  - Use a mountain top
  - Trees don’t work so well; the wind moves them around
- The first quarter moon is a good choice if it is up
- But the sky is so bright: how do you prevent saturation with clear or broadband filters, or even emission line filters?

Focusing: Saturation Prevention

Make a pinhole in the foil covering the aperture to “stop down” the lens or telescope

This will prevent saturation

Focusing: Target

If it is up, the first quarter moon is a great focusing target

Otherwise try for a building or a mountain’s rocky edge or a transmission tower, radio tower etc a few miles away

Avoiding Shutter Shading and Saturation

- An interline sensor can often be used with the mechanical shutter open (if you have a mechanical shutter) by using “video mode”
  - Not all camera makers support this mode (FLI does)
  - This relies on the electronic “snap shutter” so there is no mechanical shutter to shade the sensor
  - You can take very short exposures (0.01 to 0.1 seconds)
- If you have a mechanical shutter and a non-interline sensor, make sure the shutter is open for at least 3 seconds: longer for a big sensor
  - Avoids “shutter shading” artifacts in the flat (causes “dark middles” in the calibrated image due to the middle of the flat being too bright)
  - But the sky is really bright, so how do you avoid saturating the sensor with clear filter and a shutter open for 3-4 seconds?

Attenuating the Light

I use white towels folded over many times and bungee corded to the aperture end

No creases over the aperture allowed !

But we still aren’t ready: what about gradients?

Avoiding Gradients in the Flats

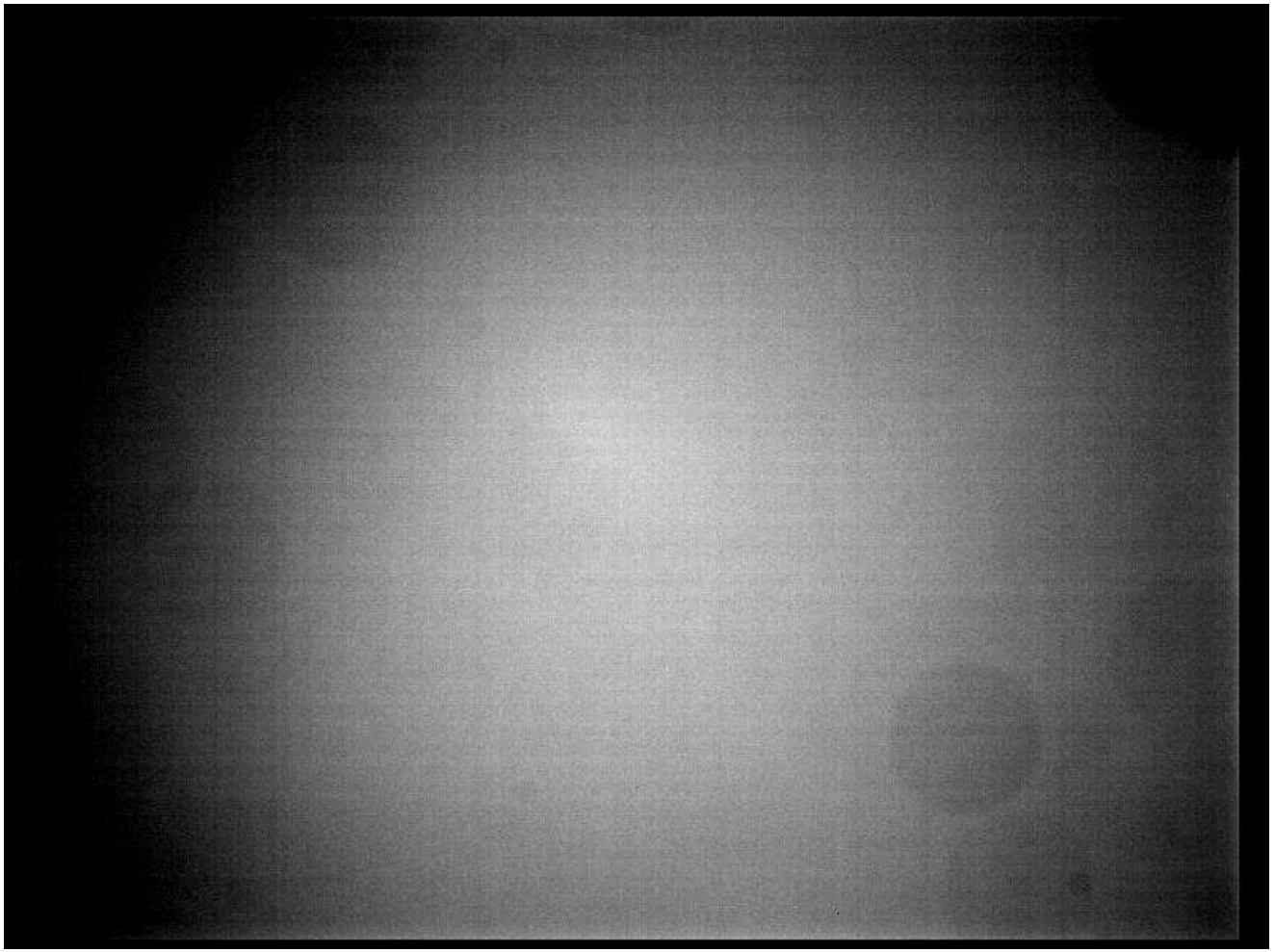
I use aluminum foil to create a sun shield around my towels to keep the sun from hitting the side of the towels and having a built-in gradient

Now the telescope is ready to shoot flats

How I read my laptop screen in the daytime

I put my telescope cover over my laptop and stick my head inside to let me see the display

Results

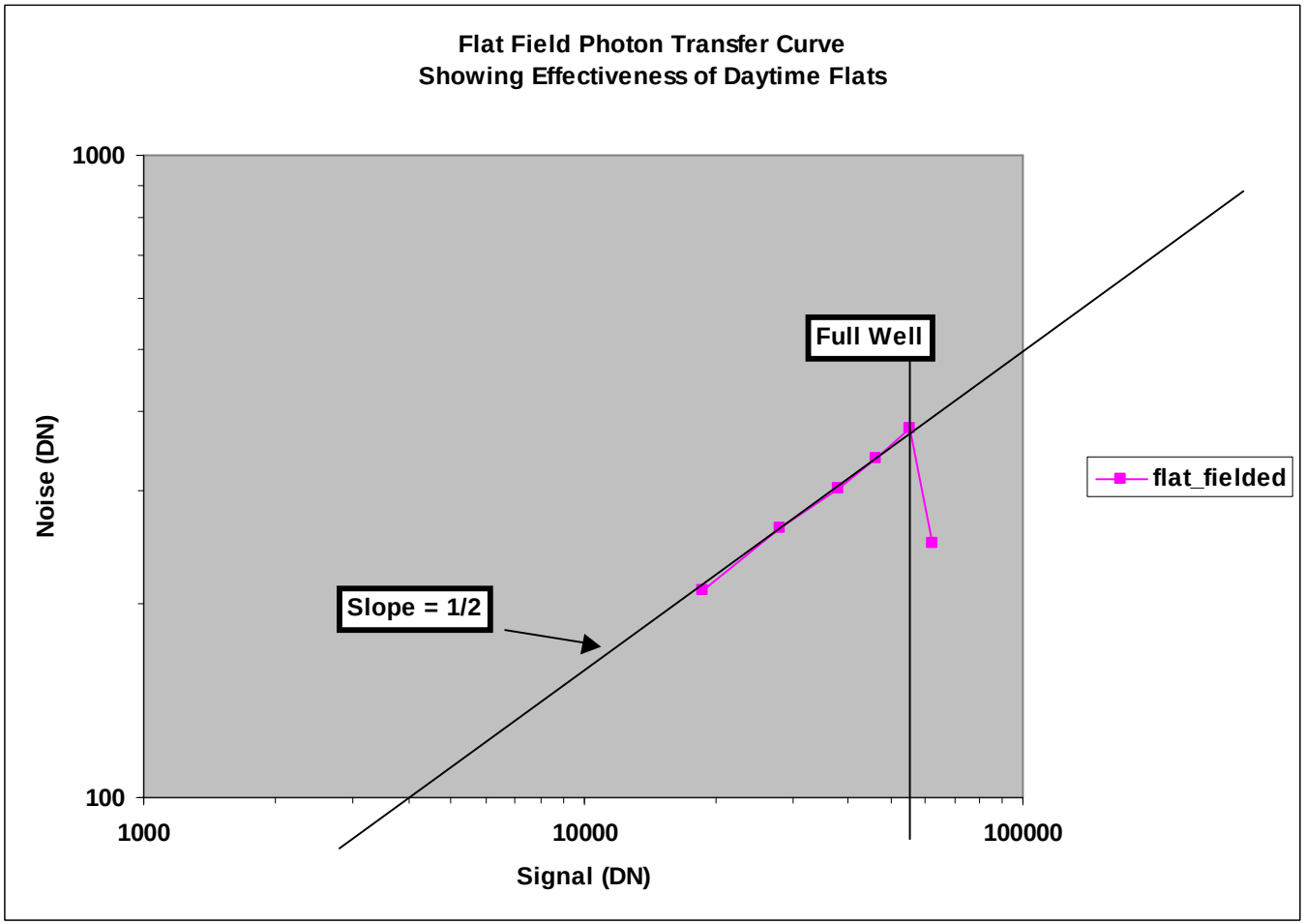


The crosshatch pattern is classic fixed pattern noise from the sensor

The circular shapes are dust motes

The dark column to the right is overscan

Flat Field Photon Transfer Curve Showing the Flats Work Correctly



Backgrounder on Photon Transfer analysis:
http://www.narrowbandimaging.com/ptc_method_wsp2009_page.htm

Image calibrated with the flats

Yes there are haloes around the bright stars

That’s not a result of the flat fielding operation!

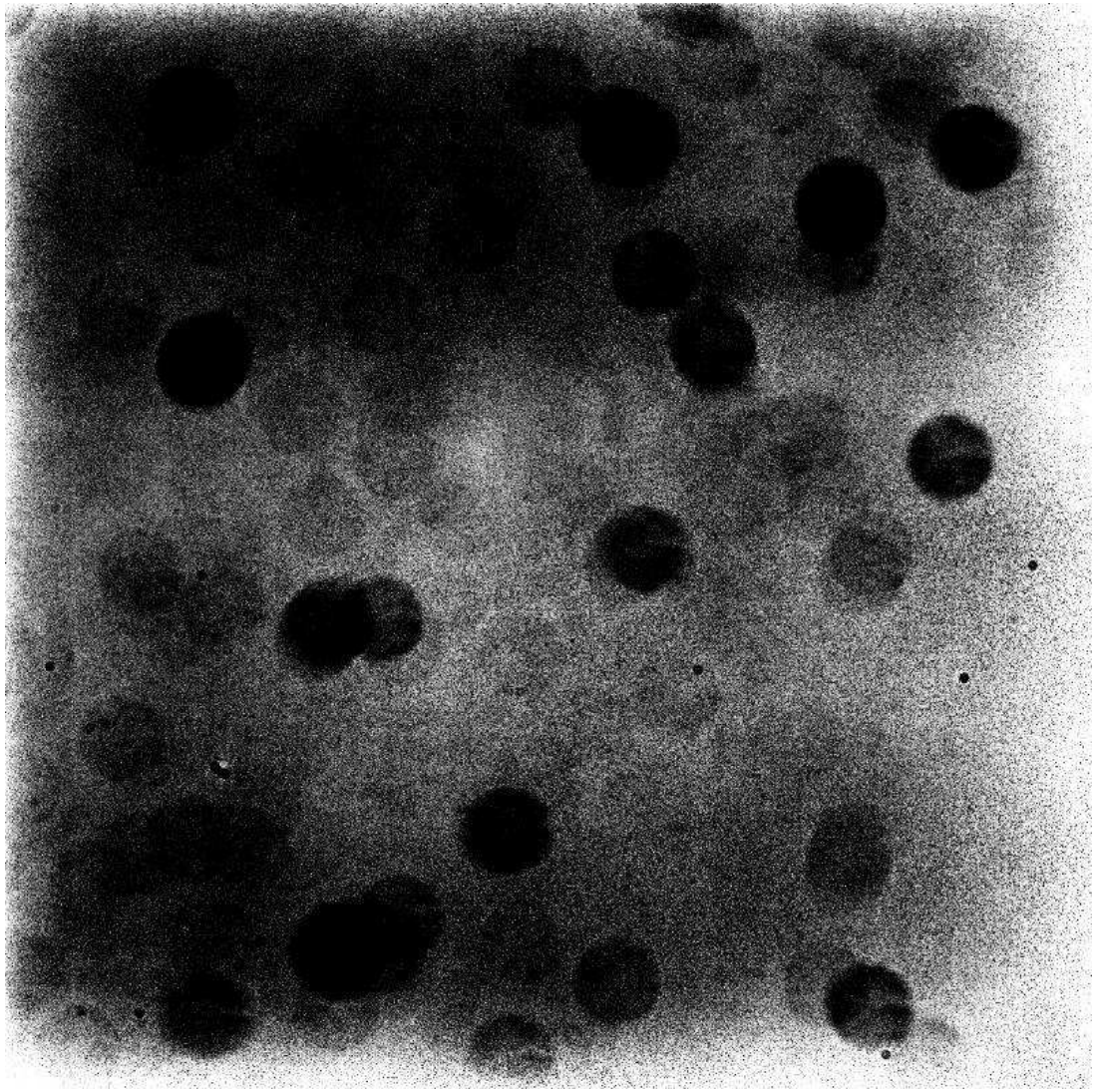
First light Pentax 6x7 400mm f/4 ED(IF) with FLI ML8300
7 hours RGB+Ha

Image calibrated with the flats

Pentax 6x7
400mm f/4 ED(IF)
with FLI ML8300
2.5 hours Ha +
[OIII]

Red = Ha
Green = [OIII]
Blue = [OIII] +
Hbeta ≅ [OIII] +
0.3 Ha

Results (from AP155/ML4022) with [OIII]



The crosshatch pattern is classic fixed pattern noise from the sensor

The circular shapes are dust motes

Image calibrated with the flats

AP155EDF f/7
with 4” flattener
FLI ML4022
CS 4.5nm
S2/Ha/O3
9 hours total