RECENT (LATE 2011) EXAMPLES OF BAD INFORMATION BEING TAUGHT ON YAHOO GROUPS

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False, Misleading and Overly-Simplistic Information

This statement is simply false. Dark subtraction only removes dark fixed pattern noise. It does not and cannot remove dark current

This statement is sloppy, overly-simplistic and misleading. It also ignores important facts about cosmetic defects found in real sensors that have been deployed for several months or years

From: SBIG@yahoogroups.com [mailto:SBIG@yahoogroups.com] **On Behalf Of** mbarber1000
Sent: Wednesday, November 16, 2011 1:13 PM
To: SBIG@yahoogroups.com
Subject: [SBIG] Re: Announcements: New STF-8300 and New OAG-8300

--- In SBIG@yahoogroups.com, "CurtisC" <calypte..> wrote:
>
> Very interesting, Michael. In another forum, the owner of a camera
> from that "competitor" brand taunted me a few months ago with the
> claim that he can achieve -75C cooling under any conditions,
> whereas I've settled for -12.5C at my usual imaging site on the
> warmest summer nights. Usually I can do -15C at that site during
> summer. That's using an ST-2000XM.

Does this taunter have a KAI-2020 CCD in his camera? I doubt it. Did he pay $2995 or less for his camera? I doubt it. At -15C the dark current of a KAI-2020 is less than 0.02e-/p/s. While this is higher than the 8300, it is still extremely low and lets me speculate (without knowing much more about your sky conditions or telescope or exposure time) that you are most likely not limited in your exposures by dark current noise (i.e., cooling), but rather by sky background noise.

If the goal of owning a CCD camera is to win the race to the coldest temperature it can achieve, he is the clear winner. If the goal is to capture images that are not limited by dark current noise then yours will do that job just as his will, but for probably half the price.

> I've tended to assume that
> appropriate dark frames will take care of all of the dark-
> current "noise," but is that true?

Dark current is removed by subtracting dark frames, and what most people call noise (bright pixels) is removed with a dark frame, but the random element or noise associated with dark current is not. The question is how much is this noise compared to the noise from your sky bakcground (in the image) and how long are your exposures. If you typically take 20 minute exposures for instance, the total dark current is around 24e-. and the square root of this is 4.8e- noise. The read noise of your camera (and that of the competitor's camera) is roughly twice this much. I would guess your sky background is also much higher than this. If your dark current is half of your read noise in a typical long exposure, then cooling the CCD further is pretty much a waste of energy.

> Note that the
> various spectrographs and cameras they use on the Hale Telescope at
> Palomar Observatory, where I work as a volunteer, operate at temps
> like -90C to -120C (IIRC).

The sensors typically used in these instruments are thinned back illuminated CCDs which have higher dark current characteristics and other artifacts than typical front illuminated sensors. Much higher than Kodak KAI CCDs. Plus they are imaging under demanding conditions with multi million dollar instruments and this kind of cooling is required. It is simply unnecessary with a $2000 ST-8300.

Regards,
Michael Barber
SBIG

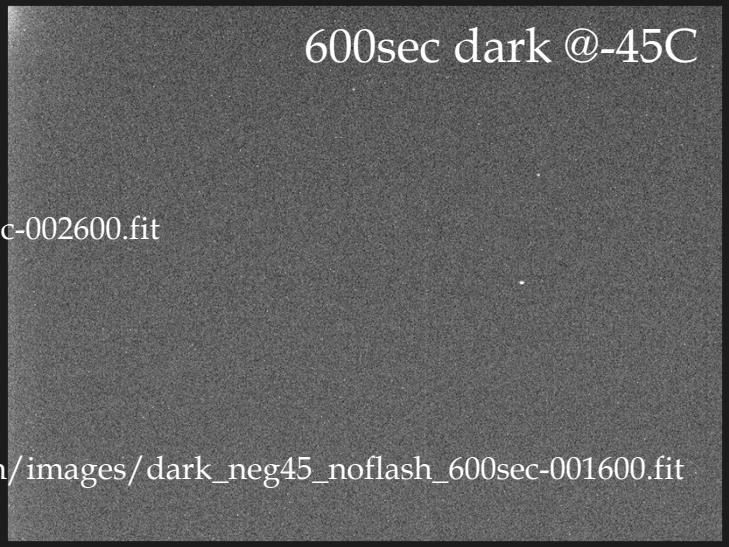
Sensor Imperfections: Managing Cosmetic Defects via Cooling

http://www.narrowbandimaging.com/images/dark_neg15_noflash_600sec-001600.fit

Accumulated radiation-induced defects from 9 months use

KAF6303

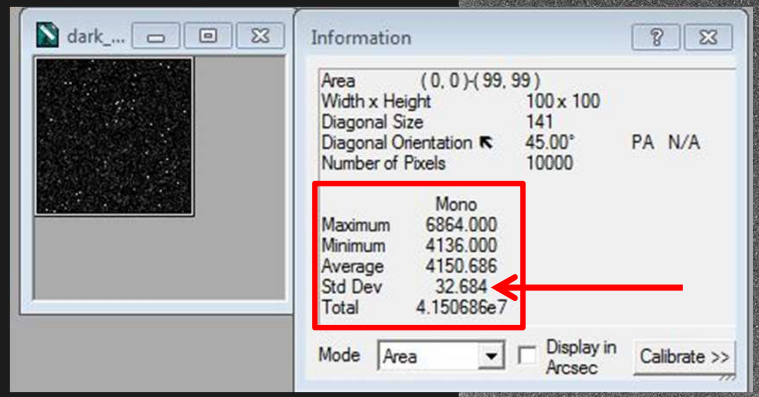
http://www.narrowbandimaging.com/images/dark_neg30_noflash_600sec-002600.fit



http://www.narrowbandimaging.com/images/dark_neg45_noflash_600sec-001600.fit

Sensor Behavior: Managing Dark Shot Noise by Cooling

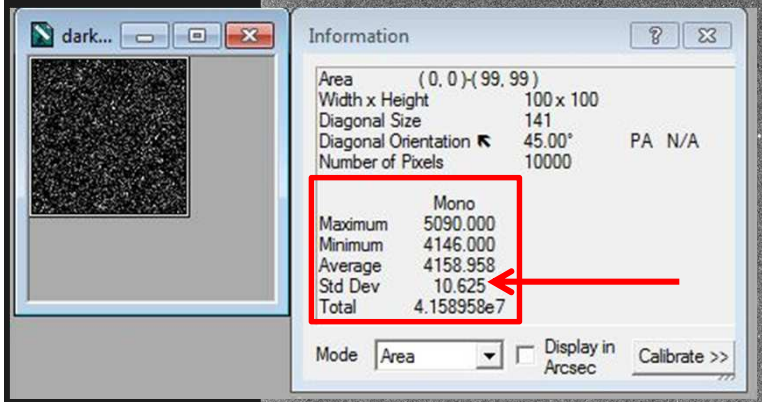
600sec dark @-15C



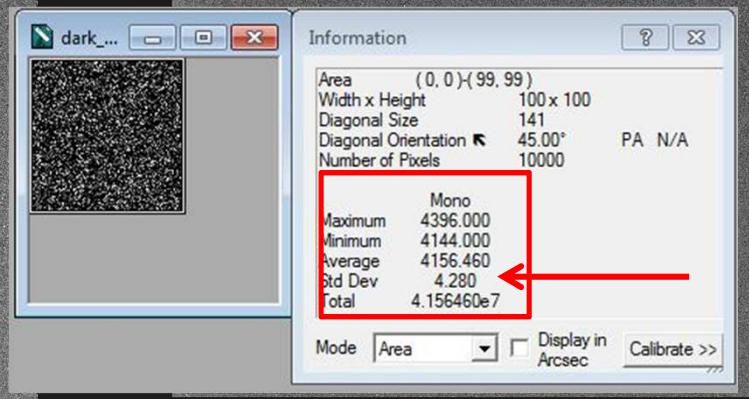
Read noise is 7 e-
Camera gain is 2e-/ADU

KAF6303

600sec dark @-30C



600sec dark @-45C



Sensor Issues: Residual Bulk Image (RBI)

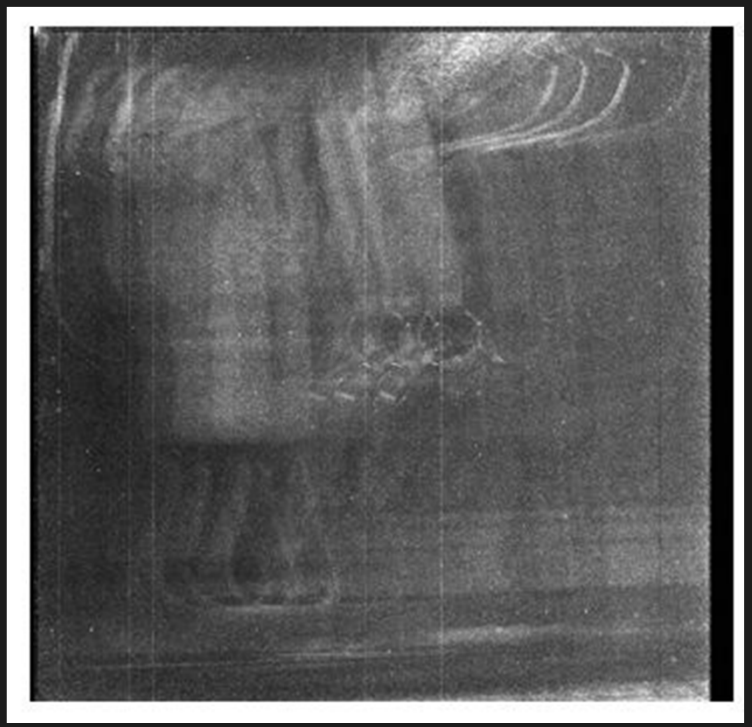
KAF09000 @-20C operating temperature

Image

5 Minute Dark
Immediately
following image

5 Minute Dark
One hour
following image

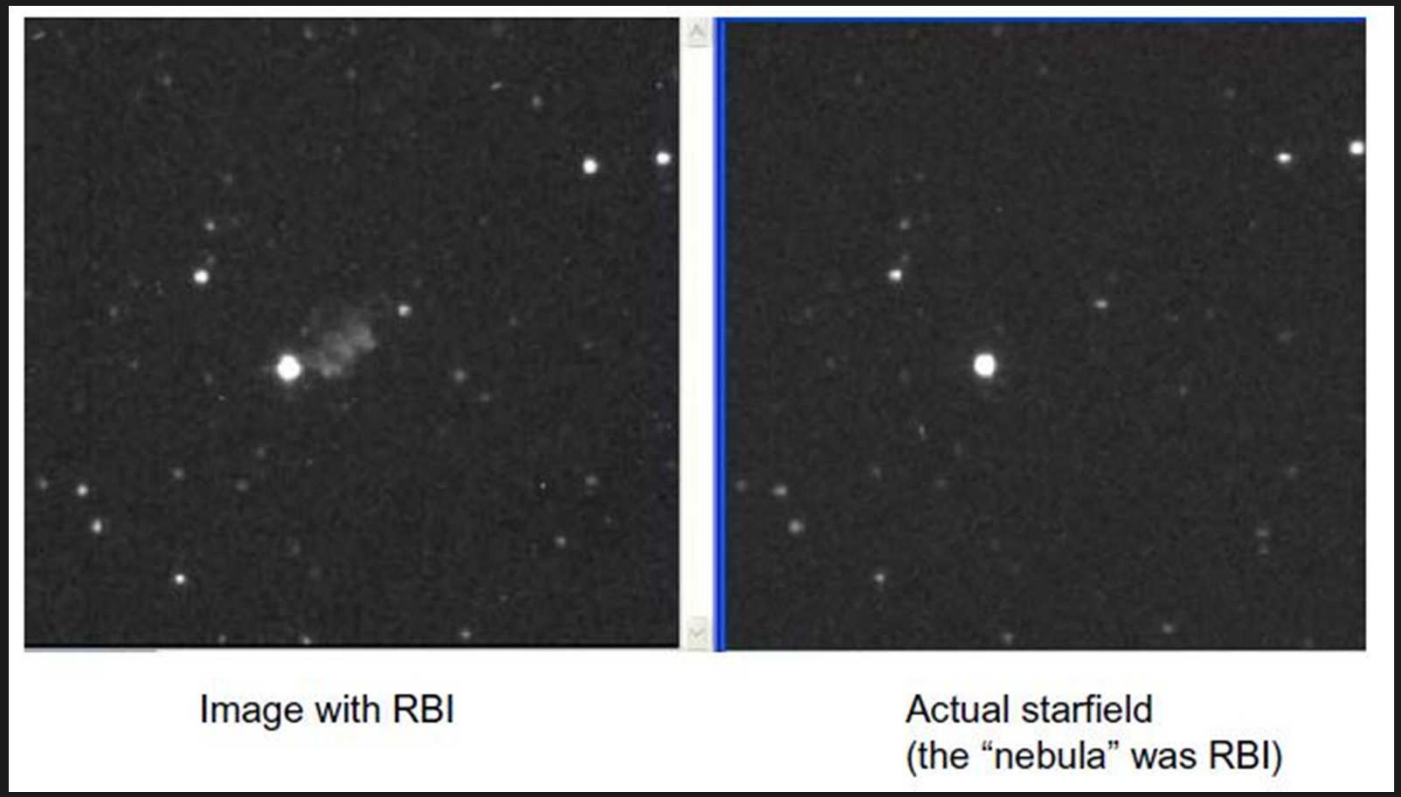
RBI: Ghost Images from Image Lag



This happens when you take an image following focusing on typical "Focusmax-friendly" star

5 Minute dark exposure immediately following four 0.1 second images. The dark shows the image lag clearly. It is not solved by avoiding taking darks after an imaging session. The same image lag appears in "light exposures" as well. Darks are easier to study the phenomenon.

False "Nebula" from RBI



KAF6303 @ -25C

RBI Traps were "loaded up" during focusing
Result was "false nebula" appearing in subsequent image

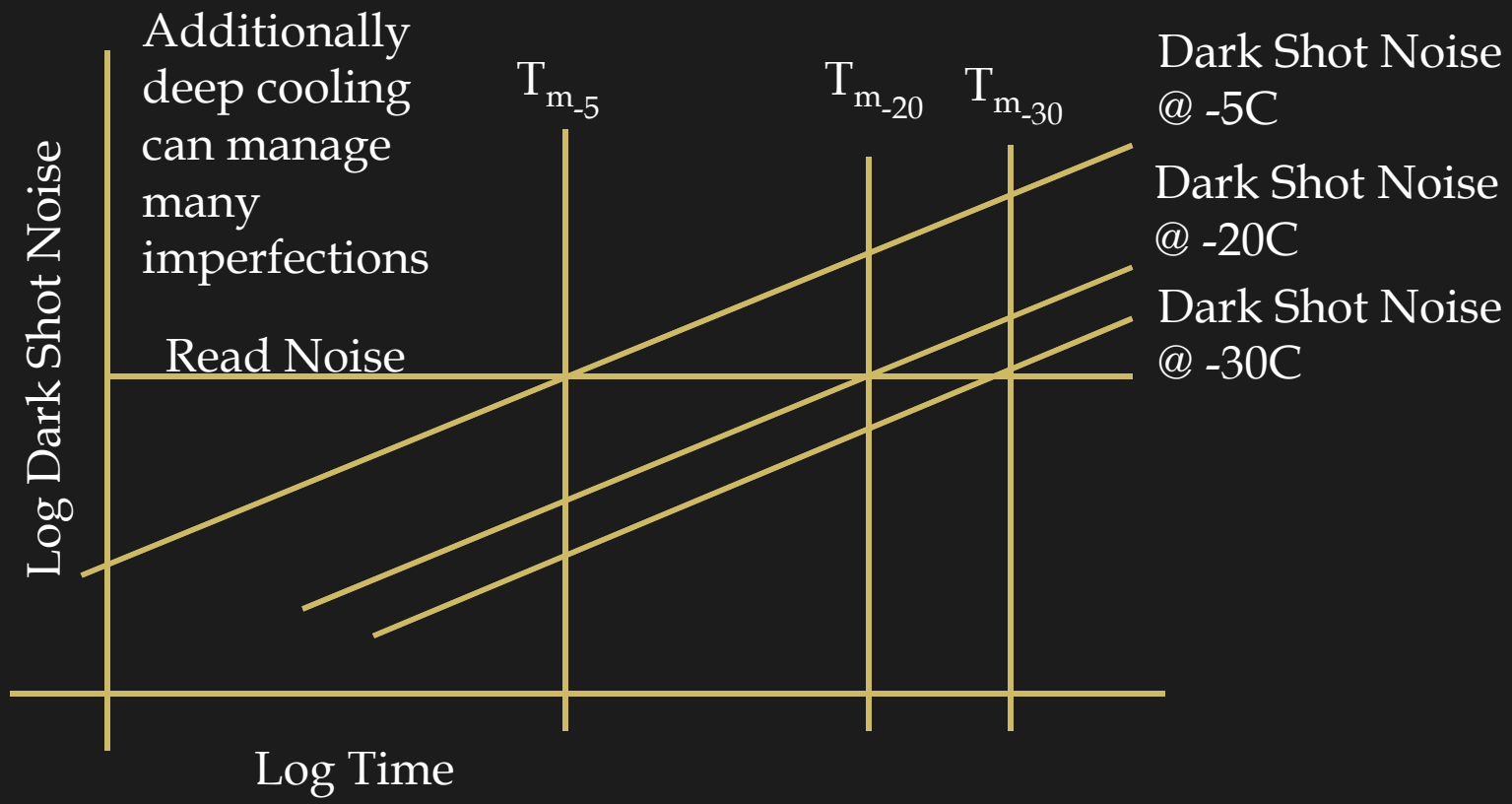
More Overly-Simplistic and Misleading Advice

--- In SBIG@yahoogroups.com, "Stan" <stan_ccd@...> wrote:
>
> --- "Dale" <dale.liebenberg@> wrote:
> > In summer ... I only manage -15.
> > ... temperature indeed has a major influence on residual
> > bulk image for long exposures.
>
> That influence actually works in your favor.
> RBI is weaker and dissipates faster at warmer temps.
> If you were operating at -30 then RBI might be a serious issue.
>
> Stan

Colder operating temperatures slows the charge leakage from the traps. The best known method (flew on JPL Cassini and Galileo probes) for managing RBI is to fill the traps by optically flooding the sensor prior to exposure and to operate so cold that the total amount of dark shot noise resulting from trap leakage and thermally generated charge during the planned maximum exposure time remains less than the read noise of the camera.

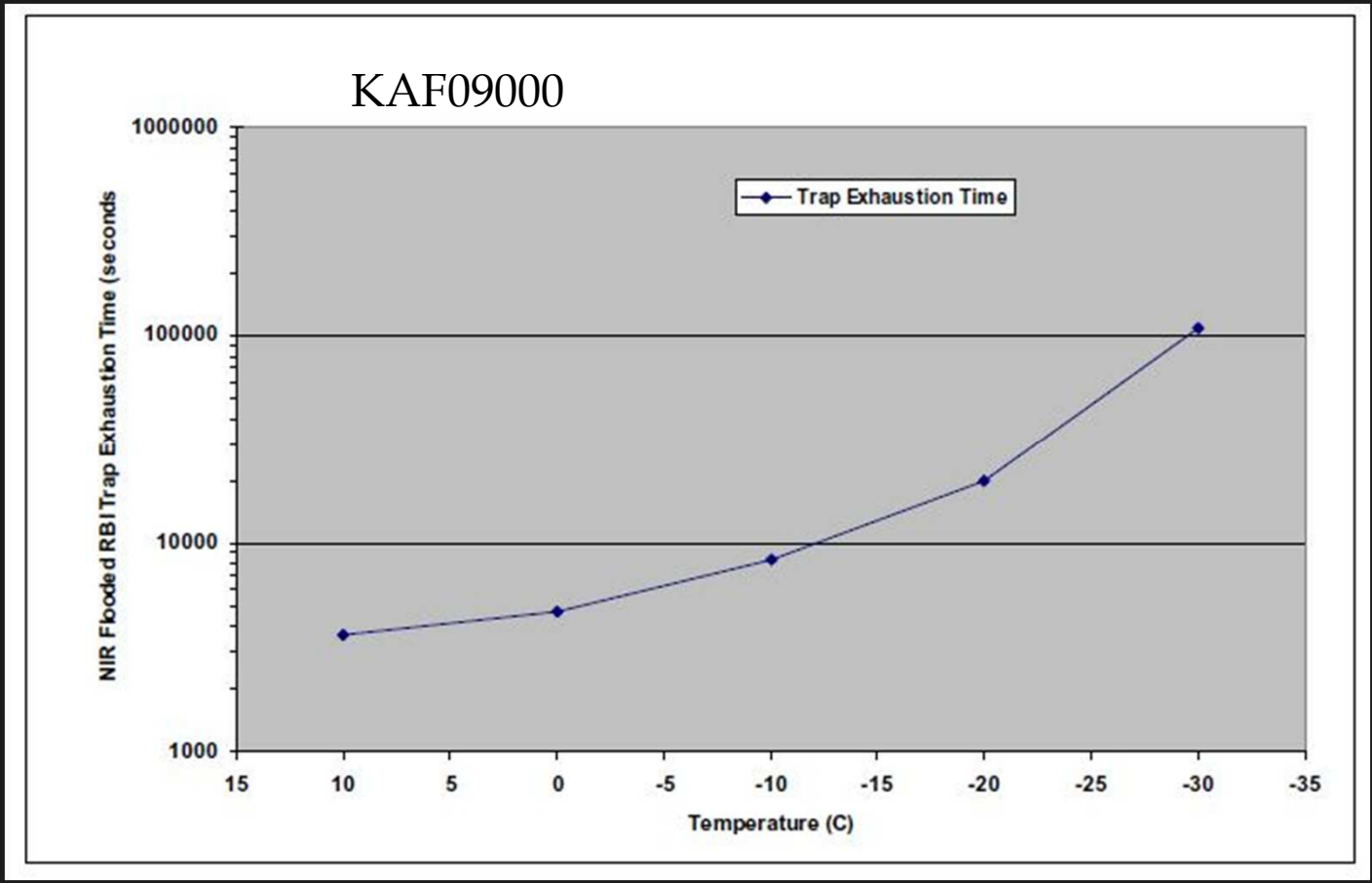
Warm operating temperatures cause the trapped charge to leak into the image as it is read out and can lead to measureable image lag causing vertical smearing of brighter features (vertical charge tails behind bright stars etc). Warmer temperatures also limit the maximum exposure time: takes less time before the dark shot noise exceeds the read noise.

Dark signal is important



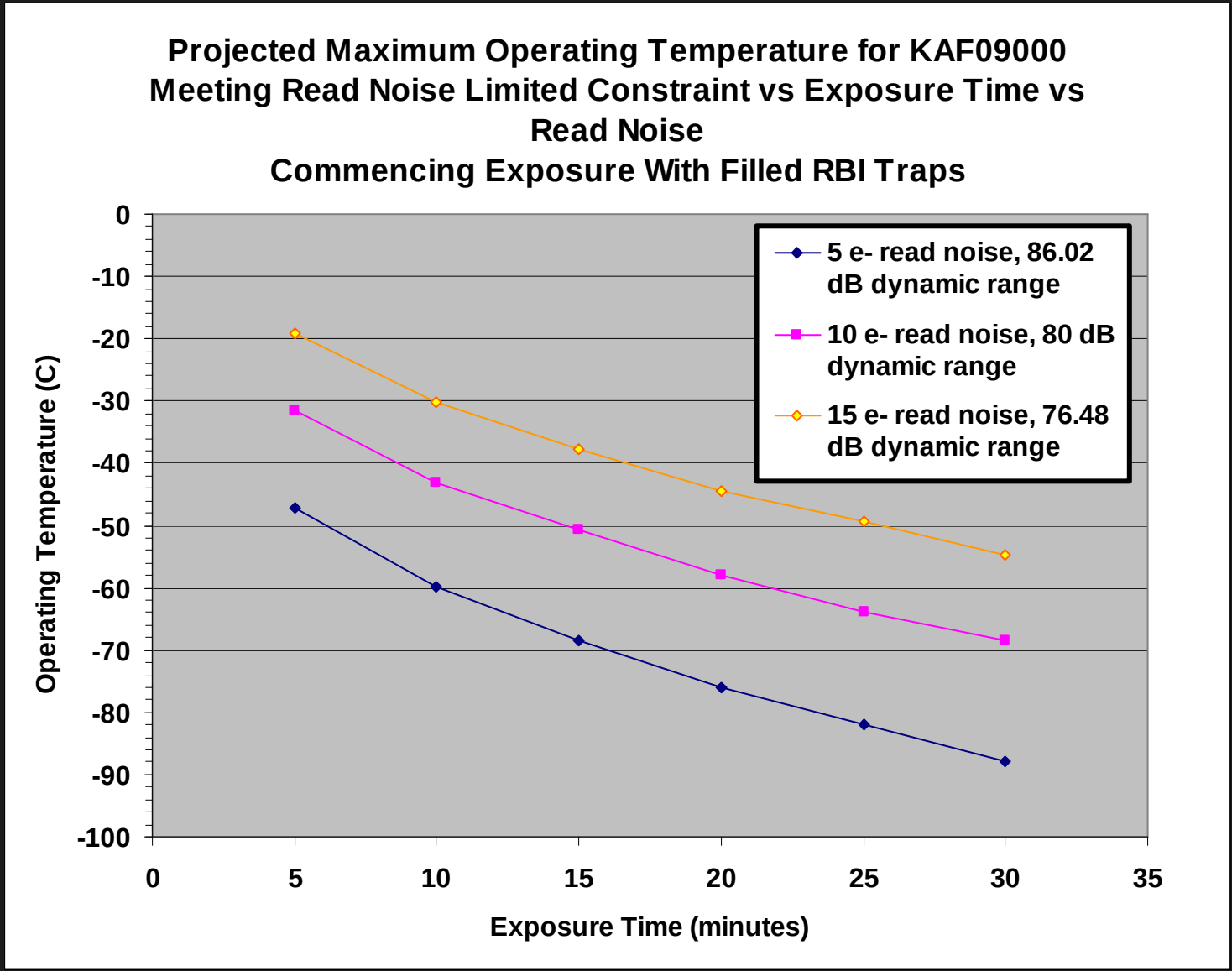
If you run warm to decrease the RBI time constant you limit your exposure time

RBI Decay vs Temperature

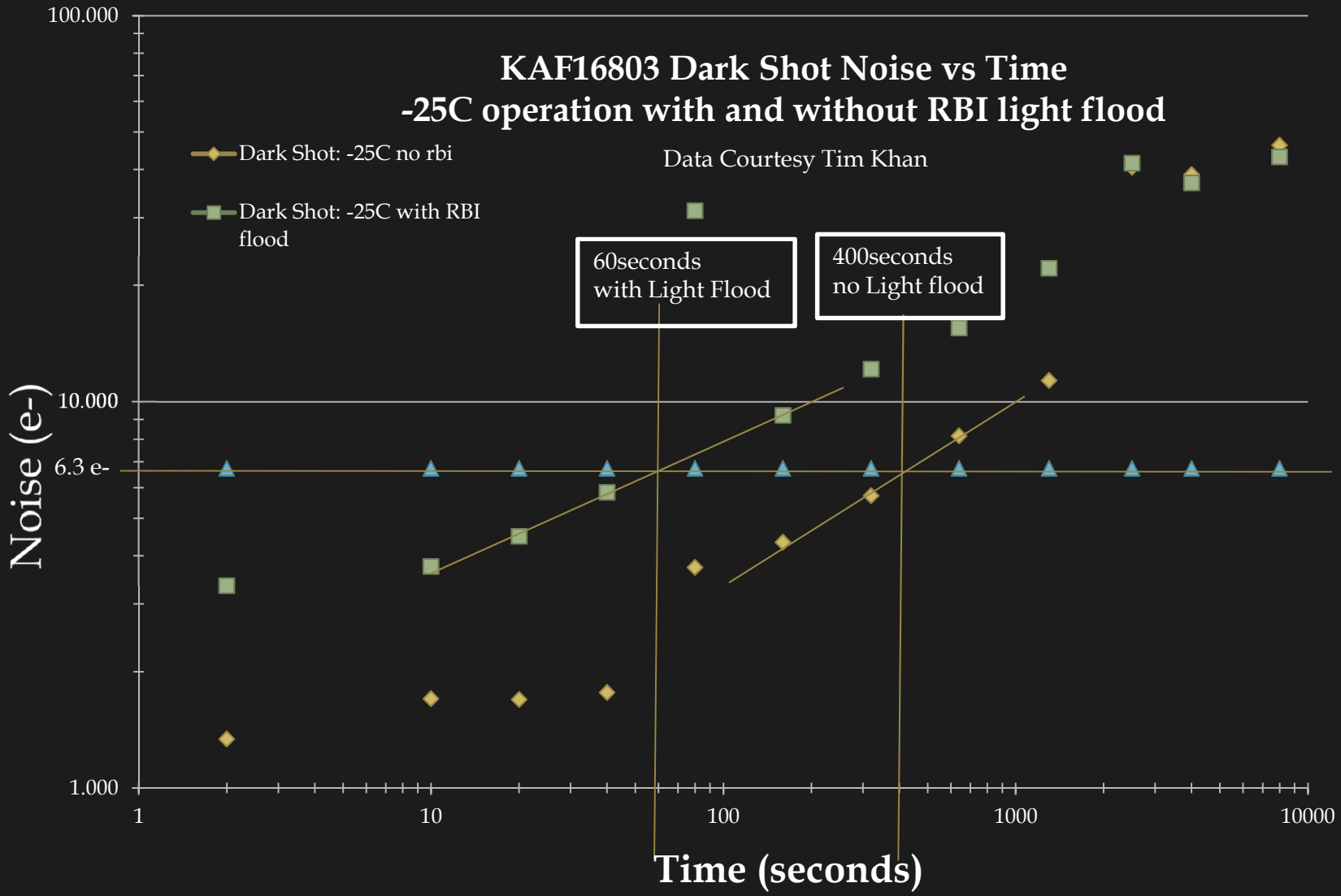


Even at +10C trap exhaustion can take tens of minutes for some sensors
The KAF09000 is particularly bad

Extrapolated Empirical Data



Empirical Data



Another Example of Bad Advice

“From: Stan <stan_ccd@yahoo.com>
Reply-To: ccd-newastro@yahoogroups.com
To: ccd-newastro@yahoogroups.com
--- "CurtisC" <calypte@...> wrote:
> it's almost impossible to do sky flats with narrowband filters.

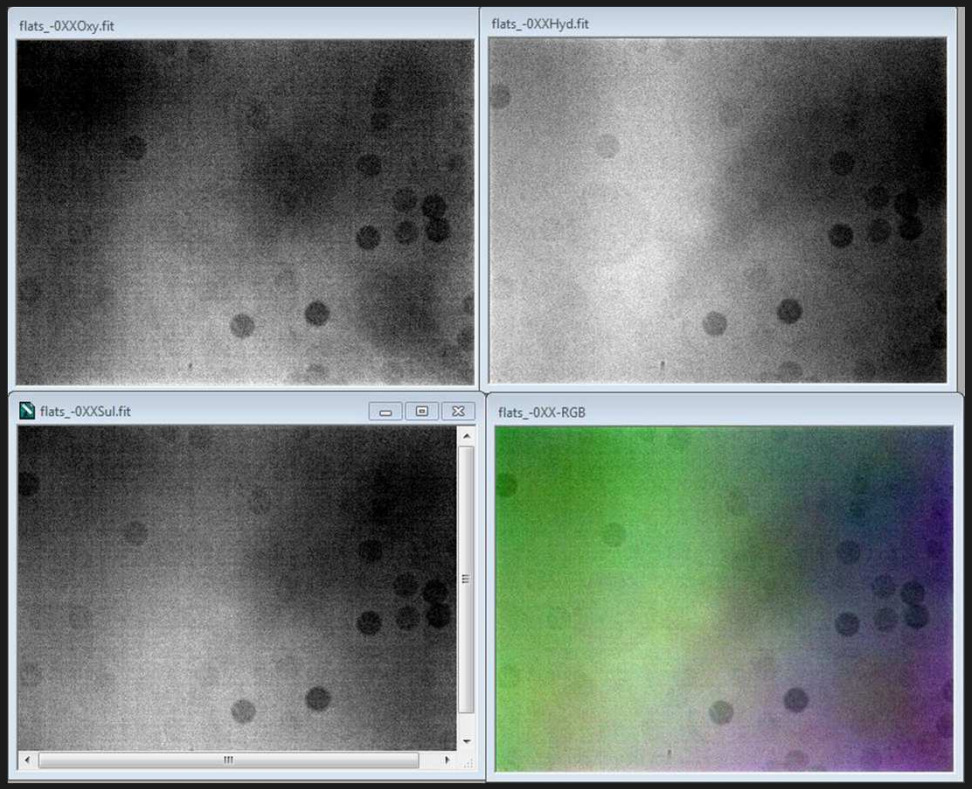
Usually flats are not all that useful for narrow-band pretty pix because
there is no significant background to be vignetted. But if the image
suffers dust spots then a simple T-shirt flat made at the end of an
imaging session will do the job.”

Flat Fielding and Narrowband Filters

- Flats MUST be used with Narrowband filters like any other filters
- Non-uniformities are in the optical path including the telescope optics, dust motes, filter characteristics and the sensor's photo-response
- If this were not true then using flats to make a color image would result in a neutral gray and uniform background
- Let's see what a color image looks like using narrowband flats for RGB channels

Why Flats are Necessary for Multispectral Emission Line "Pretty Picture" Images

Oxygen Flat



Hydrogen Flat

Sulfur Flat

Color image made from flats: note gradients

You can never have a proper neutral image background, hence a "pretty picture" with these artifacts remaining in the calibrated data: the gradients in the color image above will be in your final image

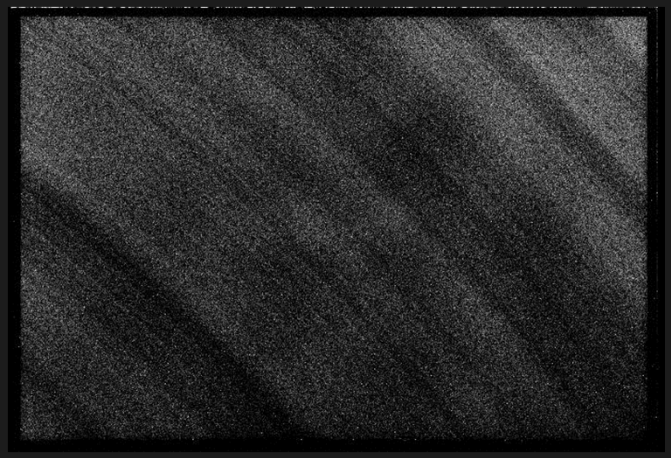
Examples of good and bad flats used for calibration

Bad flats leave gradients

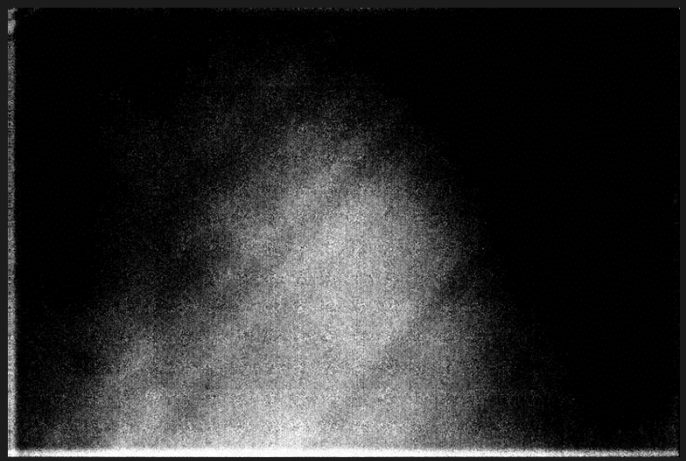
Proper flats leave no gradients

Proper Narrowband Calibration

Raw Halpha 15 minute exposure



Master Dark Image 15 minute exposure with RBI Light Flood showing dark signal non-uniformity arising from trap leakage



Flat Field Master Image

Despiked, Flat-fielded and combined with 15 other Halpha frames

Color Image using [SII], Halpha, [OIII] filters with neutral background
Cannot get neutral background without flat fielding