Summertime Blues

Or too hot to image faint targets?

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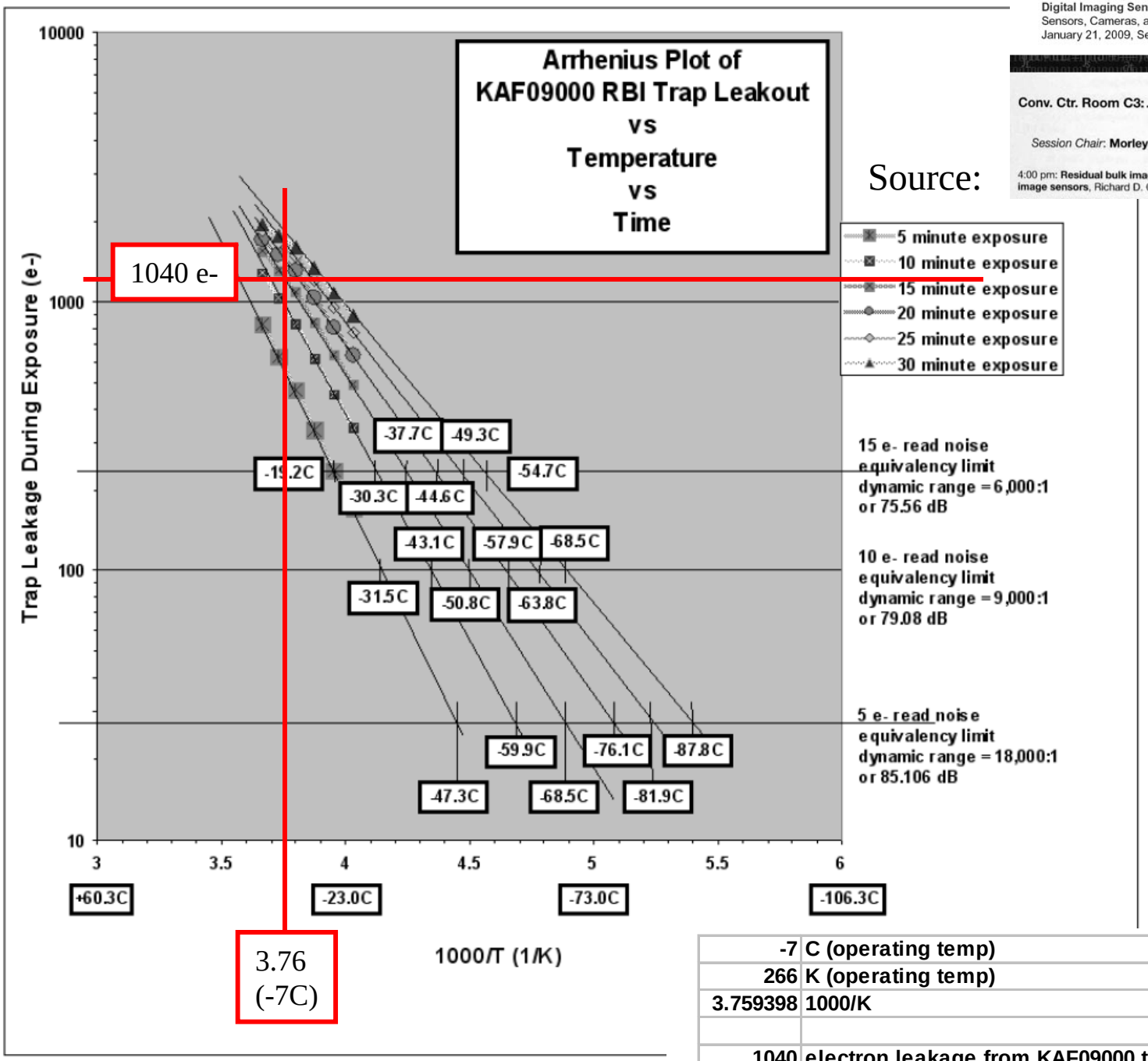
Problem: high temperatures at night = poor cooling
toss in RBI and you have a potential large increase in noise

--- In apogee@yahoogroups.com, "coyote+rim+ranch" <coyyote@...> wrote:
>
> Hmmm,the other brand of camera I have in that observatory that is not supposed to cool as well as as the U16 has no problem maintaining -15C. Yep it struggles to get there, but once there is in the low to mid 80s in terms of % cooling and then drops through the evening.
>
> --- In apogee@yahoogroups.com, "Douglas B. George" <dg@> wrote:
> >
> > coyote+rim+ranch wrote:
> > > Not sure we resolved this issue that Don brought up. I am not happy with the
> > > software deciding that it is too hard to make -15C and reset of -7C. When
> > > you have a run setup with a program like CCDAP and -15 C is set it is very
> > > dissappointing to find your camera has decided on -7C which of course does
> > > not match your darks.
> >
> > In defense of Apogee, the failure to reach -15C is due to the ambient
> > temperature being too high. The camera simply cannot reach the temperature that
> > was dialed in.
> >
> > It is better to regulate at a *known* temperature higher than you expect, than
> > to NOT regulate at an *unknown* temperature higher than you expect.
> >
> > Doug

Issues to consider

- High ambient temperatures (80s Fahrenheit) force Apogee U16 to operate at –7C due to driver issues
- It is essential to operate at a constant temperature, especially at higher operating temperatures=> provide reliable and effective despiking of the dark fixed pattern noise (what dark subtraction accomplishes).
- Some KAF sensors (such as 09000 and 16803, 3200ME and 6303) exhibit significant RBI.
- Some camera vendors are including a flood/flush/integrate protocol for managing RBI.
  - But aren't improving the cooling system to ensure the trapped charge remains trapped throughout the integration
  - Result can be a significant increase in random noise



Source:

IS&T/SPIE Symposium on Electronic Imaging
Digital Imaging Sensors and Applications
Sensors, Cameras, and Systems for Industrial/Scientific Applications X
January 21, 2009, Session 5: Modeling

SESSION 5

Conv. Ctr. Room C3: . . . . . **Wed. 4:00 to 5:40 pm**

Modeling

Session Chair: **Morley M. Blouke,** Ball Aerospace & Technologies Corp.

4:00 pm: **Residual bulk image characterization and management in CCD image sensors**, Richard D. Crisp, Tessera, Inc. (United States) . . . . . [7249-22]

-7	C (operating temp)
266	K (operating temp)
3.759398	1000/K
1040	electron leakage from KAF09000 traps
	with a 15 minute exposure operating at -7C

Computation of noise component from KAF09000 trap leakage for 15 minute exposure at –7C

-7	C (operating temp)
266	K (operating temp)
3.759398	1000/K
1040	electron leakage from KAF09000 traps
	with a 15 minute exposure operating at -7C
32.24903	noise component from the trap leakage
	for a 15 minute exposure operating at -7C

If the camera in question on page 1 was using the KAF09000 and you consider the need for the RBI management (preflood and flush prior to integrations) you need to be concerned with the leakage from the filled traps and that is a lot worse than thermally generated dark current and the trap leakage is very sensitive to temperature.

Using a 15 minute exposure with a KAF09000 and the RBI preflood/flush and a -7C operating temperature you will have noise from the trap leakage of 32 electrons (see the chart on page 2).

While I applaud the camera makers for attempting to address the RBI issue, solving the problem necessitates a significant improvement to the cooling system in order to not significantly increase the noise in images. With the comparative high signal levels associated with broadband imaging such as RGB it may be tolerable to have this noise increase. However with the very low signal levels attainable after comparatively long exposures using narrowband emission line filters on the typical nebular target, such a significant increase in the noise may dictate a requirement to take significantly more exposures in order to average away this increased random noise.

Taking a factor of four more exposures will cut random noise by a factor of two (the noise is inversely proportional to the square root of the number of exposures) you may find that your planned 4 hours total integration may need to increase to 16 hours to reach an acceptable noise level.

Reference:

“Residual bulk image characterization and management in CCD image sensors”, Crisp, R.D., Paper 7249: SPIE Symposium on Electronic Imaging, San Jose, Ca., January 2009

http://www.narrowbandimaging.com/rbi_paper_crisp_page.htm

http://www.narrowbandimaging.com/rbi_nasa_tech_briefs_crisp_april2009_page.htm