Measurement plan Atik 414EX mono

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Preliminary testing, via a measurement series carried out by varying the temperature, and taking dark frames at the office, confirms that dark current is strongly dependent on temperature. Since the camera cooler is only able to cool to a temperature gradient of $\Delta T = 30°$C, it was chosen to carry out measurements at $-10°$ C (since we cannot be sure that we can feasibly stay at a lower temperature, if room temperature is varying), for measurement sequences that do not vary temperature as a variable.

For all light exposures the ambient room lighting was used, and the camera (with a pinhole) was pointed into a white screen (wooden plate coated with white pain). For all dark frames, the same configuration was used, but with no ambient light, and computer screens turned off.

1 Bias measurement

- $T = -10°$ C
- Acquire 300 dark frames at the minimum exposure time (0.001s)
- Mean them to construct **master bias frame**

2 Flat field measurement

- $T = -10°$ C
- Acquire 300 flat field frames at 10.0s, as this exposure time was deemed to be sufficient (qualitatively) to see contrasts in the image.
- Mean them to construct **master flat field frame**

3 Linearity

- $T = -10^\circ$ C
- Acquire 100 lit frames at different exposure times to test linearity curve
- The pinhole configuration was tested at a 100 second exposure time interval, in order to find a breakpoint at which the camera would begin to saturate. 100 second exposure frames showed considerable saturation, so this was chosen as the final exposure time in the time sequence
- The sequence $[0.001s, 10s, 20s, 30s, 40s, 50s, 60s, 70s, 80s, 90s, 100s]$ was carried out.
- Ambient light was the same **however considerations about the tability of this light source lead me to believe i might have to do $[0.001s, 1s, 10s, 1s, 20s, 1s, 30s\dots]$, using $1s$ as a reference (can be plotted as a function of measurement no. to see if light source is stable, maybe do seperately)**.
- At each exposure time, 100 frames were acquired and meaned to reduce noise **(reduces by factor $1/\sqrt{N}$)**.
- Correct each exposure mean frame by bias and flat field (dark current should not matter at this temperature!)
- Compute mean ADU for each frame, and plot as function of temperature
- **NEXT: Do residual plot of distance to ideal relationship (double exposure time should double ADU!) and obtain our precision!**
- Linearity was tested at 20° C as well to look for temperature dependancy

4 Dark current and Readout noise (RON) as function of temperature

- $T = -10^\circ$ C
- Acquire 100 bias frames at 0.001s, and 100 dark frames at $10.0s$ for each temperature.
- The temperature sequence used was $[-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20]$ all in $^\circ$C. For each temperature setpoint, the 100 frames were meaned to reduce noise.
- For dark current we use

$$\text{Dark current} = \text{ADU} \cdot \text{gain}/\text{exposure time} \tag{1}$$

- This produces plot

5 Hot pixels

- $T = -10^\circ$ C
- Acquire a long and short exposure dark frame. Compute the dark current in each, and plot each pixel in the long exposure as a function of its value in the short, to see if linear. Anything that is weird or non-linear is hot in some way