

NICMOS Calibration Lamp Stability

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ABSTRACT

The NICMOS internal calibration lamp #1 has shown a small decrease in its output over its lifetime. We have measured the amount of this decrease and found that it is correlated with the number of hours that the lamp has been in a powered-on state (on-time).

1. INTRODUCTION

While measuring the change in the detector DQE with temperature using the NICMOS End Of Life (EOL) flat-monitor data, it was apparent that data taken prior to the EOL period did not fall exactly on the EOL DQE curve. This data (taken as part of the NICMOS Focus Monitor program to monitor the location of the coronagraphic hole) spans a broad range of temperatures, including the pre-SMOV period where the detectors were significantly colder than nominal. This data fell above the DQE curve as measured using the data above 62 K, and came down in steps, or monotonically in time, with the oldest data having the largest residuals. The maximum amplitude of the residual was ~5% (Fig 2, upper panel). The reason for this residual was most likely a change in the output of the lamp used to make the flatfield images.

To test this theory we compiled a list of the Lamp1 usage statistics and correlated them with the residuals of the DQE curve. Fig 1 shows the Lamp1 usage stats for the lifetime of the instrument through Feb 1, 1999. The DQE change with temperature is quite significant (~5%/deg K). This must be accounted for in order to measure any real changes in the lamp. A fit to this temperature dependence was made using only the data > 62 K. This fit was then subtracted from all the data and the residuals measured. The residuals were then plotted against the accumulated number of hours that the lamp had been on, and a correlation was found (Fig 2, middle panel). This correlation was fit with a 2nd order polynomial. A first-order fit is also of equal significance given the uncertainty on the measurements, but the 2nd order gave slightly smaller residuals. This model for the lamp output change was then applied to the data, and then the process was iterated a number of times, to separate the DQE vs Temp dependence from the real lamp changes. The solution converged

rapidly after just 3 or 4 iterations (not surprising, since the lamp change over the 62+ K range - 85-95 hours of on-time - where the DQE curve was measured is quite small). The equation relating lamp output (I) to Lamp on-time (OT) is:

$$I = I_0 * (1 + (-0.00091137501 * OT) + (3.7594437e-06 * OT^2))$$

where I_0 is the lamp output at $OT=0$.

The final fit is then applied and the residuals are shown in the bottom panel of Fig 2. The small bump seen in the residuals from 72-75 K is mostly likely a residual from the 2nd order DQE fit. The DQE curve is probably rolling over more rapidly at the higher temps than a 2nd order can follow. A 3rd order DQE fit removes this completely. but is not statistically different from a 2nd order (That is, the bump is small relative to the uncertainty in the data).

2. CONCLUSION

The output of the NICMOS Quartz-Halogen calibration Lamp #1 has changed slightly with usage over time. The change amounts to a decrease of 0.05% per hour of on-time for the first 100 hours of usage, and appears to have flattened significantly. Any impact on future NICMOS/NCS operations should be minimal.

3. Additional Note

Note that the absolute photometric calibration of the NICMOS is made using standard star observations. The calibration lamps are *NOT* used to measure absolute photometry, and so their absolute output with time is not critical, as long as it is high enough to enable normalized FLATFILE reference file generation.

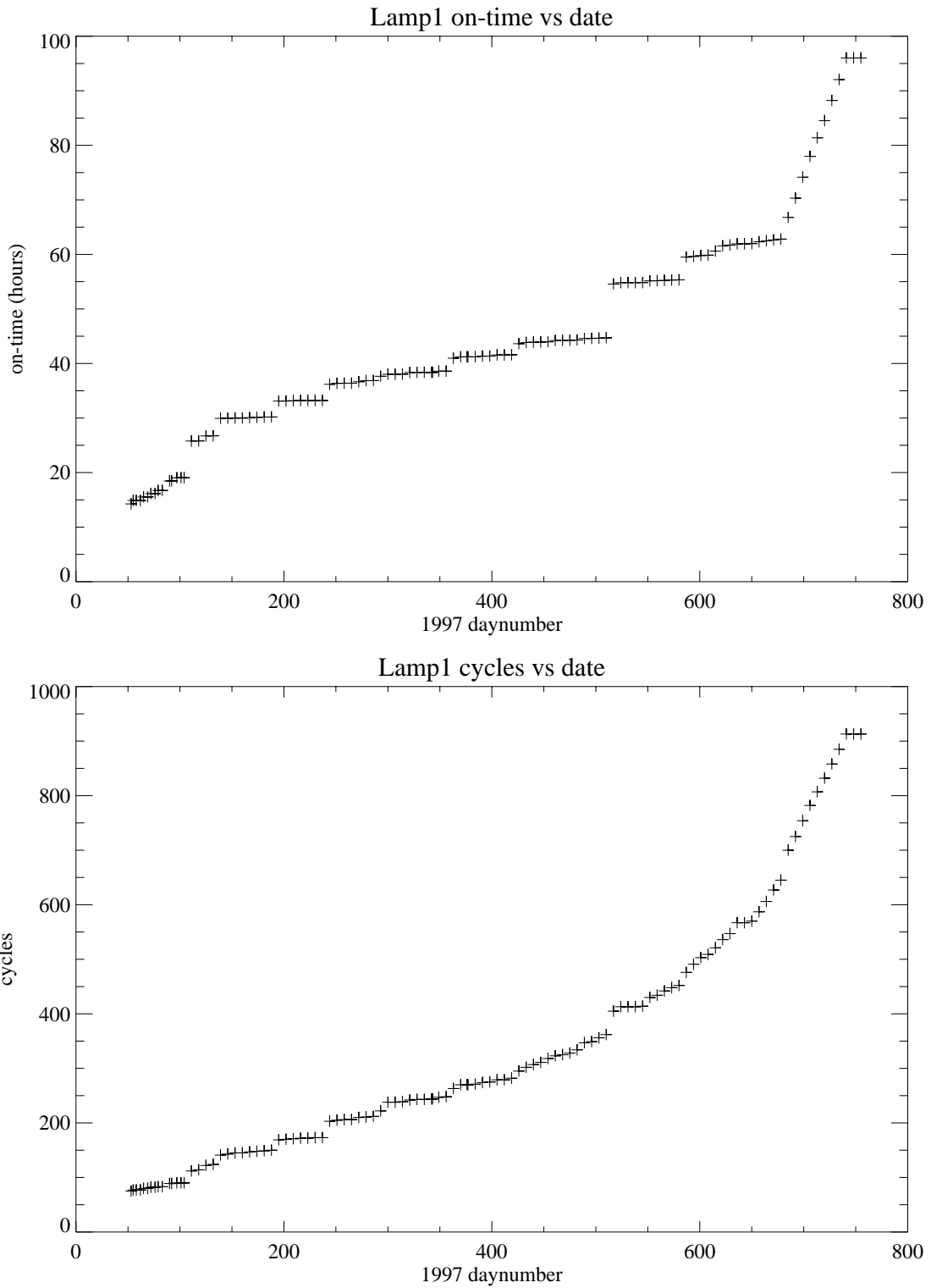
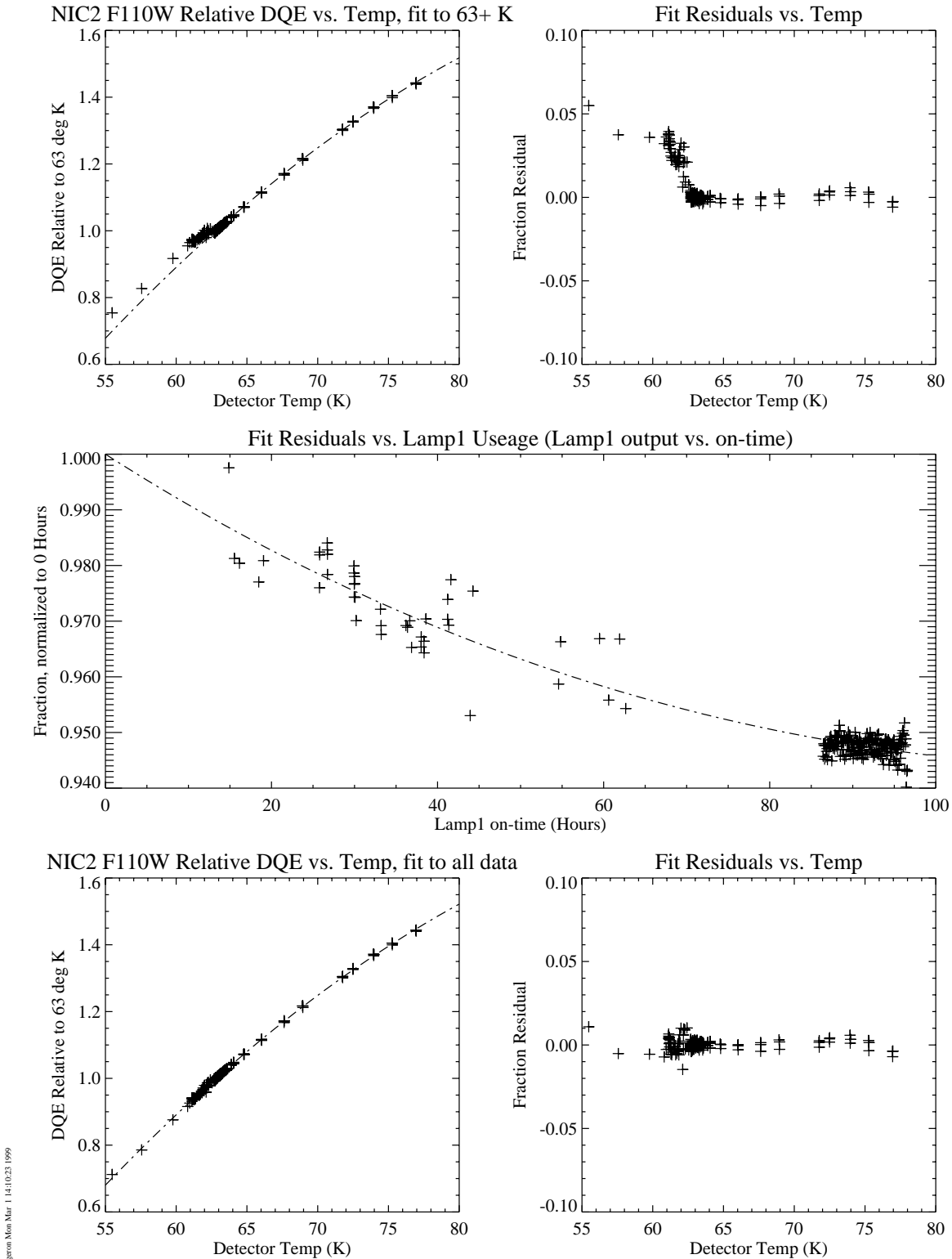


Figure 1. Lamp1 on-time and number of cycles vs time.



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Figure 2. (*top panel*) Measured relative DQE vs. temperature, and the residuals to 2nd order fit. (*middle panel*) Change in Lamp1 output vs. time, normalized to 0 hours. (*bottom panel*) Measured relative DQE vs. temperature after applying the lamp1 output function, and the new residuals.