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Discussion and conclusions

In this chapter the results and conclusions of the preceding work will be presented. A discussion of how these findings relate to prior missions such as Kepler, among others.

1.1 Summary

This study has been focused with the payload of the proposed astronomical space mission STEP. The mission goals and objectives were outlined, and STEP is expected to acquire time-series photometric observations of stars in the near UV and visible light range. The payload is expected to be a CCD type photosensitive detector, of which a thorough theoretical description has been provided above. The main goal of this work was to establish technical hardware requirements related to the payload, from the mission requirements that arise from mission objectives.

Knowledge of the physical effects and processes of the CCD are hence important, as these are presupposed in the characterization of the detector. On this knowledge various correction procedures have been developed, these being the bias, flat field and hot pixel corrections. A measurement procedure that will adequately characterize the noise levels, both photonic, thermal and readout noise has been developed. Knowledge of first and last are crucial in the experimental procedure to determine the pointing accuracy, while the thermal noise effects are simply to be eliminated by cooling if possible. Most importantly is the linearity curve, as knowledge of this is very important if we are to study planetary transits. A procedure to construct this curve to an arbitrary level of precision has been presented. This outputs, from a mission requirement on the photometric precision, a requirement on the measurements of the linearity curve

Lastly an experimental test procedure simulating stellar photometry was developed, to study the effects on the differential flux levels, due to movement of light centroids on the chip. This outputs a technical requirement related to the ADCS system, that is the pointing stability requirement, from a scientific requirement on allowable the flux level deviation.

1.2 Consequences

The linearity curve was measured using a simple setup as seen in figure **??**. In this setup a flourescent light bulb was used. This light sources was simply the ambient light in the ceiling. The intensity of such a light source was found to vary with time (cf. figures **??**, **??** and **??**). This temporal variation of the light source did not impact the measurement of the linearity curve, since the effect, under the assumption that the variation is linear between any two data points, may be corrected for as described in section **??**. In addition, the precision of the measurement of this curve, may be arbitrarily small as it only depends on the number of repeats of the experiment. These considerations lead to two important conclusions. The first is that the measurement of the linearity of the detector may be performed using very simply, inexpensive equipment. This makes it practically feasible to always perform such an experiment before launching the payload in question into space, and the constraining factor is the time available to perform such measurements. If budget constraints detector choice, the necessary precision may be achieved with enough measurements. The second conclusion is, that since the test procedure is not reliant on a very stable and calibrated lightsource, we can repeat the test in space once the payload is in orbit. We simply need to point the telescope at a *relatively* flat field and acquire the necessary frames to measure the curve. In addition we must take care not to choose a light source that is too bright, such that we are too reliant on a very precise calibration of the exposure time. One such light source could be the moon. The moon is significantly dimmer than the earth will be in orbit, while at the same time being a very stable light source in comparison to that of the experimental procedure. Since the linearity curve will be known to the desired precision before launching the payload into orbit, it is not necessary to redo the entire experiment. It will be sufficient to test a single datapoint on the linearity curve, to ensure that it lies within the accepted range of deviation from the original curve, to ensure that the curve has not deviated from that which was measured on the ground. Such tests could be repeated every few days, in order to keep track of any changes in the linearity of the detector over time.

1.3 Comparison with other astronomical satellite missions