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| Testing and Tuning CCDs for ZTF |
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**Testing and Tuning CCDs for ZTF**

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Caltech

# Introduction

After the control electronics for the focal plane CCDs has been characterized, the CCDs themselves must be characterized. Many parameters can be adjusted (e.g. Clock levels, bias levels, and clock overlap) to improve the performance of the CCDs. This document outlines the tests which will be performed to characterize the CCDs along with the parameters to adjust to optimize the performance of the CCDs for ZTF. With a large mosaic such as ZTF, this process must be automated in order to efficiently arrive at the final configuration of the clocks, biases, and waveforms.

# Photon Transfer Curve

A photon transfer curve can be extremely useful in determining many characteristics of a CCD. In the case of ZTF, an illuminator board will be mounted at the front face of the cryostat. This illuminator board will be used as the source for photon transfer curves for the CCDs.

The LEDs will be programmed to turn on for a specified amount of time, and then notify the controllers to read out the CCDs. We will collect three images for each light level and use for the plotting of the PTC.

We can use the trigger output from the controllers as the gating for the illuminator board. The output signal from the controller is the same signal that will be used for the shutter. This signal will be input into the Arduino which controls the illuminator board. From this, we can measure the gain, the read noise, the linearity, the full well, and the dynamic range of the CCD.

## Gain (e-/DN)

The gain can be changed by changing the preamplifier setting of the A/D Module, but a loss of dynamic range would occur. Therefore, the gain will be measured, but not affected.

## Read Noise

The read noise can be improved with a slower readout. It can also perhaps be improved with shorter cables. This result will be compared with the result of the VIB amplifier test, the published CCD amplifier noise result, and the A/D Module noise test result. This read noise should be equal to those contributions added in quadrature.

## Full Well

The full well can be affected by the voltage level on the parallel and serial clocks. The measurement should be compared with the published test results for each specific CCD to determine if the full well is acceptable.

## Dynamic Range

The dynamic range can be increased or decreased due to the gain in the preamplifier on the A/D Module. Compare against a specification for the dynamic range. How can we affect this other than electronic gains through the signal chain?

## Linearity

# Charge Transfer Efficiency

Use 55Fe to test this? Or will we use an illumination and several extra transfers?

## Parallel

## Serial

# Quantum Efficiency

Need an optical setup with a known wavelength

# Crosstalk

# Dark Current

# Clock Induced Charge