

## **90Prime CCD System Final Report**

**15-Mar-04  
Michael Lesser**

All four CCDs are running through two amplifiers each. This makes maximum use of the 8 channel video system we purchased.

To further decrease readout time, we can increase the number of video channels to the maximum supported 16 channels. Four new video cards would have to be purchased for about \$20,000, some new software is needed, and the focal plane would have to be removed and jumped internally for the new channels.

Timing:

- Clearing the array takes 3 seconds.
- Reading the full mosaic, unbinned, takes 50 seconds.
- Deinterlacing the image takes 15 seconds.
- Writing the image to a local disk on the server takes 15 seconds.
- Writing the image to a remote Linux disk at ITL takes 39 seconds.
- So, it takes about 100 seconds to read the image out and write it to a remote disk.

The average read noise is 12 electrons. Noise varies among amplifier sections from 10 to 14 electrons. The readout rate is about 170 kpix/sec per amp, or 1.36 Mpix/sec total. At this speed, the expected readout noise is about 13 electrons, scaling from 7 electrons at the slow speed we normally run in the lab.

The gains and bias offsets are now matched. The mean gain is 1.71 +/- .06 e/DN. The mean bias offset is 1091 +/- 17 DN.

- Amp 1: 1.78 e/DN, bias offset 1074 DN
- Amp 2: 1.81 e/DN, bias offset 1080 DN
- Amp 3: 1.68 e/DN, bias offset 1126 DN
- Amp 4: 1.67 e/DN, bias offset 1091 DN
- Amp 5: 1.71 e/DN, bias offset 1100 DN
- Amp 6: 1.72 e/DN, bias offset 1090 DN
- Amp 7: 1.62 e/DN, bias offset 1076 DN
- Amp 8: 1.71 e/DN, bias offset 1084 DN

The full well is between 36,000 and 45,000 DN, or 60,000 electrons minimum. The actual value is spatially dependent, with CCD4 being the worst. This full well is lower than expected, but I made extensive changes trying to improve the capacity with little success. Conceivably the controller is reducing well capacity due to current limitations when parallel clocking. I know each chip can be made to have higher full well, but not with all running at the same clocking.

The dewar hold time is typically longer than two days, but should be filled daily while in operation.

Software:

- AzCam is used to acquire the data. The server AzCamServer runs on bokccd2 which is normally installed in the rack at the 90inch.
- The client AzCamTool now runs under both Windows and Linux.
- I have modified the image format so that both ds9 (using Open Mosaic Image) and msdisplay can directly display a 90Prime image.

Known CCD Issues:

- CCD3 has a trap which degrades CTE above it. This CCD should be replaced when a device or funding to buy a device becomes available.
- There is some pickup noise which varies temporally.
- There is no mask over the non-active imaging area visible through the window. If scattered light off this area is a problem, a mask should be made. It might be several thousand dollars.