

## **LDSS Focus Readout Upgrade**

The focus readout on LDSS was replaced on July 16, 2008. A temperature sensor was also installed inside LDSS so focus changes with temperature could be measured more reliably. A complete description of the changes is at

[http://ldss.baade-clay.org/focus\\_encoder/LDSS\\_Focus\\_Encoder\\_TechDoc.html](http://ldss.baade-clay.org/focus_encoder/LDSS_Focus_Encoder_TechDoc.html).

### ***New focus numbers***

The new focus numbers are in microns with an arbitrary offset. This is similar to the previous system. For the SDSS *r* filter at 9 C, the focus number is near 5700 (but this might change if we decide to eliminate a shim in the system).

### ***Temperature sensor***

The temperature sensor is mounted on the spectrograph camera. Previously, temperatures from MIKE were used to anticipate LDSS focus changes. We noticed that the new LDSS temperature sensor lagged the MIKE temperatures by about 3 hours, no doubt because the LDSS camera is embedded deep inside the heavy steel LDSS body.

### ***Best focus assumptions***

The LDSS output focal plane is curved so best overall focus is defined as minimizing the Hartmann spot separation at about 2/3 radius from the center. Larger focus numbers moves best focus towards the center of the CCD. At +50 microns off best overall focus, the interior 1/2 radius is in excellent focus. One might consider this for imaging work. This effect is shown in the plots following.

### ***Focus tolerance***

Measurements by Jorge Bravo show that  $\pm 5$  units (microns) in focus are irrelevant. Going  $\pm 10$  microns is only subtly noticeable and you probably would not care. Going to  $\pm 20$  is noticeable.

### ***Moving off focus***

Focus softening is gradual in both directions, that is, it does not suddenly go bad in either direction. You can move the best focus radius from center to edge by going from +50 units to -50 units away from best overall focus.

### ***Filter offsets***

Different filters require different focus values. Jorge Bravo found that the old focus offsets were not correct. One reason may be that the offset values were temperature-compensated for temperatures at MIKE, not LDSS. Because the LDSS camera tracks ambient temperature slowly, the estimates using MIKE temperatures could be off.

## ***Temperature sensitivity***

The adjustment for temperature is roughly 10 microns per degree Celsius (this rate needs refinement). LDSS focus is thus sensitive at about the  $\pm 2$  C level.

## ***Focus plots***

The following are focus plots for the SDSS *r* filter taken by Jorge Bravo over a few hours.

## ***Acknowledgments***

Many site staff assisted with this operation. Mauricio Navarrete and Victor Merino helped disassemble LDSS. Mauricio installed the new LVDT encoder and Felix Quiroz and Juan Alfaro drilled and tapped new mounting holes for the electronics. Patricio Jones soldered the LDSS side of the cables and performed minor surgery on the EtherTRAK module to remove the blinking lights. Victor and Felix reassembled LDSS and as assisted in rolling it to the telescope by Juan and Mauricio.

Jorge Bravo, Emilio Cerda, and Henry Cortes installed LDSS on the telescope and Jorge obtained many many focus measurements.

Alan Uomoto  
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