Local "Seeing" At CFHT

Optical tests and a recent study of correlations between the image quality obtained with HRCam and "environmental parameters", such as temperature differences in and around the telescope and zenith distance, have yielded the following findings:

1. A primary mirror warmer than the dome air produces 0.4"/°C FWHM of image spread (Fig. 9);
2. Each °C of temperature difference between dome air and outside air leads to ~0.1" FWHM of image spread (Fig.10).
3. Optical tests, and the sec z dependence of image size when local seeing is weak show that aberrations in the primary mirror (and in HRCam) produce a PSF of 0.38" FWHM;
4. Stabilized images from a telescope free of aberrations and local seeing on Mauna Kea would have a median FWHM of 0.32", the 10 and 90 percentiles of the distribution being at 0.2" and 0.6" (Fig.11).

The actual images currently recorded are two times larger that these natural values.

R. Racine

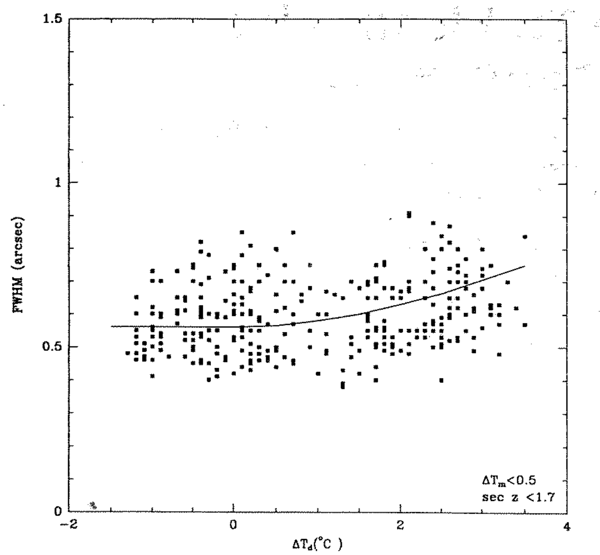

Figure 10: Image quality as a function of the temperature difference across the dome slit.

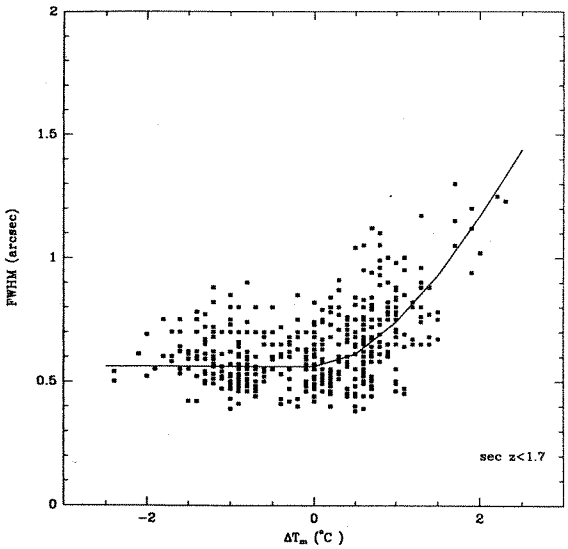

Figure 9: Image quality as a function of the mirror-to-air temperature difference.

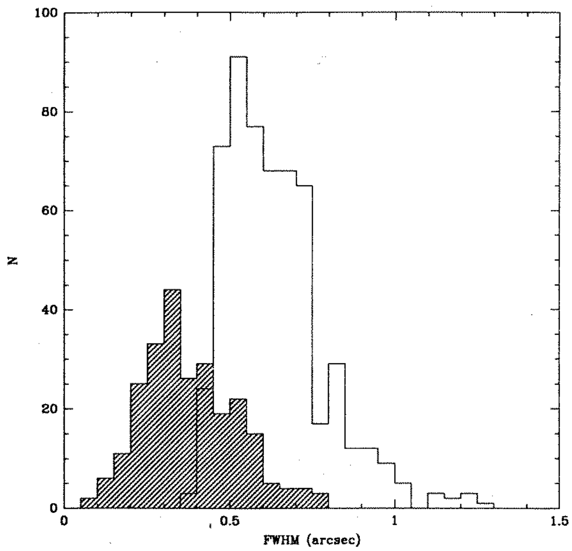

Figure 11: Distribution of image quality for all actual HRCam data (open histogram), and for weak local seeing conditions after correction for optics spread (hatched histogram).

TCS IV Progress Report

TCS IV is progressing at a slow, but steady pace. Due to a lack of available manpower, all work is being concentrated on the Real Time Computer (RTC), and its interface to the existing TCS hardware. When more manpower becomes available, work can start on the User Interface Computer (UIC) portion of the project.

The RTC consists of a Sun Sparcengine 1e running the vxWorks real time operating system. A development system, with VME crate, Sparcengine, and several VME I/O cards is currently installed in the Waimea electronics lab, for development purposes. Bill Cruise and Steve Smith have attended a vxWorks training workshop at the Wind River Corporation headquarters in Alameda, California, in order to quickly get up to speed with vxWorks. VxWorks software has been installed on the new CCD III development system, titan, which runs Sun OS, and TCS development work is using that computer system as a base of operations.

A new hardware interface, to permit connecting the existing TCS R-Buss to VME standard I/O modules, was designed by John Horne. It has been constructed by Dean Josephson, and tested by J. Horne and myself. The success of this module is a first, major step in the eventual elimination of the HP 1000 computers which have controlled the TCS since its inception. In addition, the lowest level of driver code for R-Buss control has been completed, and is essentially in final form.

Planning for the RTC software has continued, and plans for most of the low level driver and interface library software are complete. Conceptual design of the telescope emulator, shared memory access system, and error message logging are in progress. Design of the controller, essentially the heart of the RTC, is nearing completion. Details of other modules are being filled in as their interactions with the controller are determined. Actual coding of the controller is set to start in June. It is hoped that much of the low-level library coding can be accomplished by part-time, summer help. A next big step will be design and coding of the telescope emulator system, when additional help becomes available from the Software Group.

Short term plans are to take the development computer system to the summit in June, to further test the interface to the R-Buss. The next big goal for the RTC project is to be able to fully control and slew the telescope by the end of the summer. This requires a functional controller, and several subsystems. Work is also set to resume on new Digital and Analog Control Cards, as more hardware manpower becomes available. These cards will be integrated into the new software, as they are completed.

W. Cruise

Image Combination and Pre-processing During Data Acquisition

With the large amount of data being routinely acquired at CFHT and the prospect of even more bytes coming as the new generation of 2K CCDs is being phased in, CFHT is currently developing new schemes of "real time" data processing immediately after the data has been acquired. The well known pre-processing scheme for CFHT data taken with CCDs, coupled with the availability of well tested software within the IRAF environment and high performance computers lead us to set the following goals:

- Provide a combined image of large image sequences when taking bias, flat and dark frames.
- Provide a bias/flat/dark/bad pixels corrected image shortly after it has been acquired on the sky. This will not only enable the observers a better real time evaluation of the data, but will also benefit some programs, like multi-slit spectroscopy, by allowing a more careful object selection and subsequent photometric reduction at the summit.
- Reduce the amount of data transfer both within CFHT, and within the visitor's home institutions. A typical imaging run with a 2K chip will produce roughly 1 Gbyte of raw data per night, with a large amount being taken by the so-called calibration frames, i.e. biases, flats, darks.

The first step toward these goals is to provide a reliable image combine option when a bias, dark, or flat image sequence is selected.

The new scheme makes use of another computer on the network (it will be a sparc2 in a few weeks) to compute these medians and the new program calls IRAF tasks instead of a locally developed program. It is based on the IRAF/CCDRED package, namely the FLATCOMBINE, ZEROCOMBINE and DARKCOMBINE tasks for flat, bias and dark image sequences respectively. The results therefore provide the same accuracy and reliability as IRAF and should be more widely accepted by the observers. The selected algorithm to compute the combined image is the average sigma clipping. Its principal advantage, compared with the median algorithm, is that the final standard deviation is lower, with the average value being almost the same.

The user interface is similar to the current one: a "combine" option selected before the start of a sequence of image acquisition in the "expose" window will initiate the "combine" script. We plan to keep the individual images of a sequence on disc (and optical disc in Waimea) for a testing period of 3 months following the implementation, and then, provided that tests show the process to be satisfactory, keep only the resulting combined image.

A major concern was to improve the coherence between the header of the median and its name. The new program, creates only one image corresponding to one single EXPNUM card.

The pixels of the combined image are coded with 32 bits. To preserve the precision, the iraf image is converted to FITS format using automatic scaling with IRAF/WFITS. Since the ccd controllers produce a first line and column saturated, we use an image section that does not include them before the FITS scaling takes place. This new script takes about 6 minutes to combine 6 1024x680 images. It is only activated when all the images have been acquired. We are planning to speed up the process by starting the conversion of the single images from FITS to iraf format as soon as the first image is recorded. This reduces the time taken by this process, since it proceeds in parallel with the data acquisition. According to recent tests performed with the new HP/700 computers that we are planning to install at the summit, a combined image of 10 2K CCD images will be produced in 90 seconds.

This new combine scheme is the first of a series of new tools. The next step is to give the observers the ability to automatically pre-process a science frame right after it has been acquired using the standard IRAF/CCDRED package.

To pre-process the science frames, the observer will first define a set of reference images :

- 1 bias image
- 1 dark image if any
- 1 list of flats, one flat per filter (B,V,R,I, etc.)

Once a combined image has been computed, the IRAF format image coded with 32 bits will be stored in a database, which will be used by the pre-processing program.

We plan to add a "pre-process" switch similar to the "combine" one to select whether the object image has to be pre-processed. This pre-processing will be executed with an IRAF task built around the CCDPROC routine.

The new "combine" processing is now in its last testing period and will be made available for general use for the second semester 91. The pre-processing will be tested and released later in the same semester.

E. Vallauri, B. Grundseth, O. Le Fèvre

Safety Issues at CFHT

Well at long last the "drum" section of the Heavy Metal group has left CFHT! In other words, all eight drums of hazardous material from our mercury spill last year, have now been removed from the Summit by the firm Unitek Environmental Services, Inc. The drums were transported to Hilo by truck, by barge to Honolulu and then shipped to an undisclosed waste site on the Mainland.