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.

Following the mercury spill last year, we purchased a Jerome 411 Gold Film Mercury Vapor Analyzer and proceeded to log readings of twelve locations in our Summit building. With a permissible exposure level of 0.05 mg/m^3 the readings ranged from a high of 0.099 mg/m^3 last October to an absolute <u>zero</u> in February this year. When we dismantle the Cassegrain environment during our July shutdown, we must look carefully for any minute drops of mercury which may be lurking away in some nook or cranny.

Last month I attended an employer workshop at the Consultation and Training Branch, Division of Occupational Safety and Health, located in Honolulu. The topics for discussion ranged from an overview of OSHA and DOSH activities, enforcement policies and procedures, DOSH consultative services, safety and health programs, hazard communication and introduction to DOSH standards. From what I learned at the workshop, I am presently working on a safety policy statement and would appreciate advice and input toward this objective from any member of our staff. The three main components of a good safety and health policy statement should be management's concern and interest, direction, and expectations.

Interesting to note that in the violation and penalties section of our workshop, we learned that OSHA has already increased its penalties seven-fold and DOSH will introduce the same increases in 1992. The Congressional Budget Office estimate the fines could net $180 million a year, up from $30 million in fiscal 1990.

Here in Hawaii, DOSH's Safety and Health Compliance Officers found six of every ten employers guilty of worksite hazards in fiscal year 1990. They conducted 2,704 inspections and uncovered 7,649 violations, 791 serious. Penalties assessed totalled $241,521 vs. the previous year's $164,510.

Back on the Mainland, laboratories such as Lawrence Livermore and Oak Ridge National are not amused by the latest crack down on violations of the federal regulatory code. A special inspection force called "Tiger Teams" have been set loose to stalk and destroy bad old habits and enforce a new ethic of strict compliance with federal rules on environmental purity, worker safety and public health. In Oak Ridge National Lab's case, there were 413 adverse findings which would require somewhere in the region of $1 billion to comply (i.e. the Lab's estimated costs spread over several years).

And finally, my emphasis in the next few months will be on *work site analysis:*

1. Identify existing and potential hazards;
2. Perform periodic inspections;
3. Provide a reliable system for employees to report hazards and to receive timely and appropriate responses;
4. Investigate accidents and "close-calls" to determine causes and corrective actions. Use the "3 W approach:"
   - What happened
   - What caused it to happen
   - What can be done to prevent recurrence
5. Analyze injury and illness trends, so patterns and common causes can be identified and eliminated.

Good Health & Safety

Peter Sydserff

Image Quality and High-Resolution Imaging at CFHT

CFHT is one of the telescopes that provides the best image quality obtainable from the ground. Figure 1 (cover) shows statistics of image quality for the second semester 1990 and the first semester 1991. Histograms of the full-width-at-half-maximum (FWHM) of stellar profiles measured on images obtained during HR Cam and FOCAM runs are presented. Median values of FWHM are given for each run. The FWHM was measured on all the images containing at least one suitable unresolved object, whatever the airmass, the time of the night, the external seeing conditions, etc..., i.e., there is no data selection. The images are long exposures, with integration times of 100 to 1800 seconds. All the HR Cam images were obtained at full telescope pupil.

The median seeing is 0.79" with FOCAM, and ranges from 0.56 to 0.66" with HR Cam, an image stabilization device which, at times, provides images with a FWHM as low as 0.4". The gain in image quality obtained with HR Cam thus roughly amounts to 0.2". Part of it, typically 0.05", comes from the larger F/ratio used with this instrument (F/7.8 versus F/4.3 for FOCAM), which provides a better sampling of the stellar profiles on the detector; the rest (typically, 0.15") results from image stabilization. Note the steep gradient in the histograms at 0.4" for HR Cam (0.55" for FOCAM). The lack of lower FWHM values may reflect the current limit set by telescope optics on "passive" image quality.

Optical tests and studies of the properties of turbulence above the site have led to the following estimates: the telescope optics contributes some 0.35" to image degradation (primary mirror surface defects), while the dome and mirror seeing enter for typically 0.4", and the free atmosphere contribution varies between 0.25 and 0.50".

Closely linked to the development of an adaptive optics (AO) system, the reduction of local sources of image degradation has been defined as a primary goal at CFHT. This decision was motivated by the fact that an AO system will yield the best results when the seeing "starting value" is the lowest. The two major sources of local image degradation are mirror and dome seeing, the latter being much less significant (typically 0.40" and 0.1", respectively, see R. Racine's previous contribution).

In an attempt to reduce local "seeing," a cooling experiment has been carried out during the last HR Cam run, from April 11 to 23, 1991. The experiment essentially consisted in activating the air cooling units on the mezzanine level in the dome during day-time, so that, from 7am to 5pm, the air in the dome was actively cooled. The volume of air throughout the dome was simultaneously mixed by actionning the fans. The aim of the experiment was to prevent the primary mirror to heat-up during day-time, so that its temperature hopefully remains lower than that of the ambient air at night, thus preventing mirror seeing.

The results of this experiment are illustrated in Figure 12. Figure 12a shows the vertical thermal structure in the dome at 2pm, 8pm, 12am, and 4am, averaged over the period when the day-time air cooling was activated (13 days). This figure is to be compared with Fig. 12b which shows the vertical thermal structure in the dome at 2pm, 8pm, 12am, and 4am, averaged over the period when the day-time air cooling was <u>not</u> activated (fiducial period, 12 days). The 1σ temperature variations around