

invisible at optical wavelengths because of intervening absorption at rest wavelengths $\lambda < 1216 \text{ \AA}$. A versatile capability is the *near-infrared* out to the onset of the thermal IR at $2 \mu\text{m}$ is thus extremely important.

- We are frequently looking for evolutionary changes in a very large population of objects (literally the contents of the Universe in some cases) and thus the most productive studies are usually statistical in nature. This sets a high premium on efficient *multiplexing* of survey-type observations so that large numbers of objects can be observed.
- Distant sources seen at large look-back times are necessarily faint, so the amount of information that can be gathered, even with very efficient instrumentation, is quite limited. Furthermore, working effectively at wavelengths longer than $2 \mu\text{m}$ has been shown to be very difficult from ground-based 4-m class telescopes.
- Typical velocities for structures within galaxies are 10^2 km s^{-1} requiring resolutions of up to 3000. Those in clusters of galaxies are ten times larger.
- Many of the most interesting spectral lines for abundance studies in stars and gas clouds are at ultraviolet wavelengths.

3. Dark Matter

I suspect that the growing awareness over the last 15 years of the importance of Dark Matter in the Universe will prove, in retrospect, to have been one of the great revolutions in astronomy and so I thought it merited a section of its own. In discussing the future of CFHT, this may seem paradoxical, since the telescope can by definition study only luminous matter! Such a point of view is illusory of course and CFHT has already made major contributions to this field.

Specific questions that we would like to address might be:

- What can we learn about the distribution of Dark Matter on the scales of galaxies and clusters of galaxies?

- What can we learn about the origin of the density fluctuations that produce structure in the Universe, and assuming they are primordial, what do they tell us about the physics of the very early Universe?

The Science Requirements are very similar to those of (2) above since the required observations are usually either of the internal structure of galaxies or, most revealing, of the gravitational lensing effects of intervening mass on galaxies and quasars.

Several common threads emerge from the previous discussion: The two most important are the need for the *highest possible spatial resolution* and the need for a strong *capability at infrared wavelengths*, particularly in the $1-2 \mu\text{m}$ waveband. We are fortunate that at CFHT we have a fine telescope on an outstanding site that should guarantee us competitive image quality in the future. Furthermore, the Corporation appears determined to stay abreast of developments in Adaptive Optics that will enable maximal exploitation to be made of these natural advantages.

The CFHT is also at last making an, in my view belated, effort to acquire state of the art detectors in the near-IR that should in short order catch up much of the lost ground in this vital area and a number of imaginative proposals for near-infrared instrumentation have been discussed at this meeting.

Summary: *The user communities of the CFHT are well-placed to make very productive use of the telescope in to the next century and should be able to make substantial progress towards answering some of the most important and fundamental questions in astronomy.*

Acknowledgements: *In preparing for this presentation, I benefited greatly from the perspectives of C. Pritchett, J. Bergeron and F. Boulanger. I am also grateful to the organizers for making this meeting so enjoyable and, I hope, ultimately successful in directing the future of the CFHT.*

S. Lilly

Note: This talk has been presented at the CFHT Users' Meeting, held in Victoria (Canada) in May 1992.

LATEST NEWS ON INSTRUMENTATION

Status of the Coudé F/4 Spectrograph Project

A great deal of progress has been accomplished on the Coudé f/4 high resolution spectrograph since the publication of the last Information Bulletin. The support pedestals, mirrors supports, filter wheel unit, grating and grism tables, as well as the motorized mosaic cell were delivered to CFHT from DAO in May, 1992. The CFHT Electronics group carried out the [extensive] wiring of these units in Waimea prior to their installation at the summit in August-September, 1992. The control system software was contracted to William Rambold, who spent all of September, 1992, installing and verifying the software, and training CFHT staff on its detailed workings. The Software Group has created a Pegasus session that provides control over all of the spectrograph functions as well as the detectors used for data-taking.

The mirrors and lenses were installed at the summit in September and first light on stars was achieved on the night of September 17-18, 1992, thanks to much hard work, long hours, and admirable dedication of the many members of "Team Coudé". Since the grisms had not been received, order sorting filters were used for these tests as well as additional tests on the nights of October 3-4 and 4-5, 1992.

Following these nights, the mirrors and the mosaic were removed, the pedestals supporting them were permanently bolted to the floor, and the optics were reinstalled in anticipation of additional software development and optical alignment.

First spectra with the Coudé F/4 spectrograph were taken during the evening of September 17, 1992, using the Red optics, just before the first stellar spectra. Additional observations were made on October 3-4 and 4-5, using the UV as well as the Red optics, and included initial tests with the new image slicers.

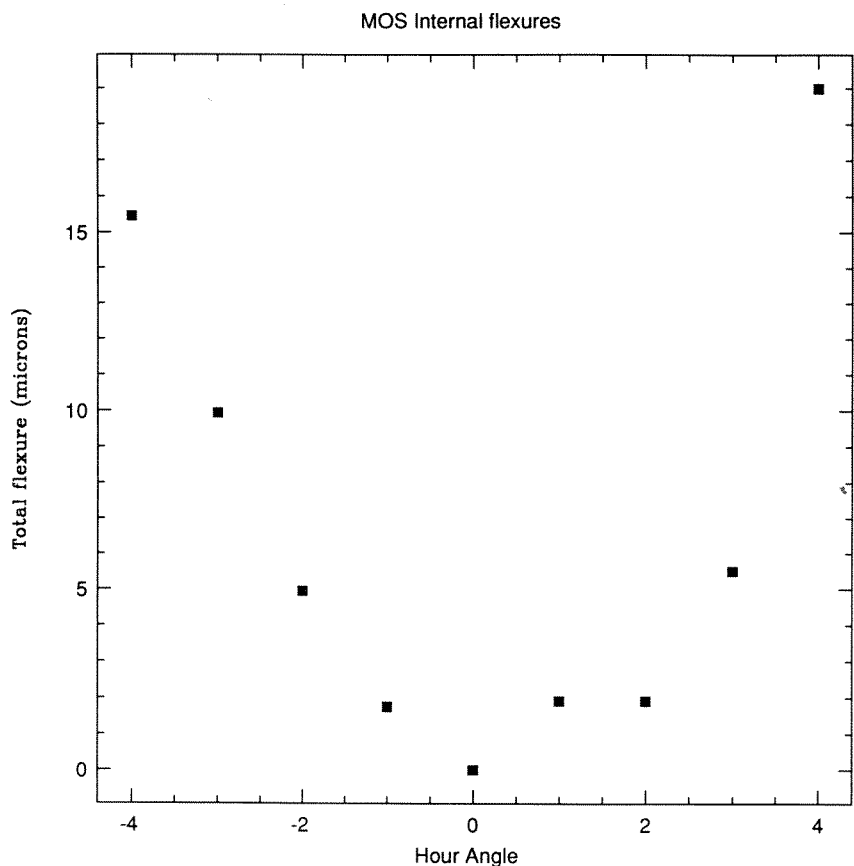


Figure 2.

The full-widths at half-maximum (FWHM) of comparison emission lines observed with three of the four separate echelles of the mosaic and with both the UV and the Red optics are excellent, giving 2.5 pixels FWHM, identical to the original specifications.

There is clearly a problem with Grating #2, however, which gives FWHMs around 4 pixels. Separate tests have shown that the FWHM of grating #2 can be improved dramatically by refocussing the spectrograph, but this degrades the lines for the other three gratings. The source of this serious problem is still under investigation.

Plots of the positions of comparison lines observed with each grating, relative to the positions for grating #1 show a puzzling behavior. With the Red optics the dispersions for gratings #1 and #3, the left side of the mosaic, agree well, but give different dispersions from gratings #2 and #4, on the right-hand side. With the UV optics, however, the upper pair of gratings agree but differ from the lower pair. As with the FWHM results, the source of this problem is still under investigation.

Only a few exposures on stars were accomplished on the one (apparently) photometric night using the LICK2 CCD, the Red optics, a wide slit, and an interference order-sorting filter. The throughputs estimated from these few exposures are not as good as were reported for the Reticon plus CFHT image slicers that are reported in the f/8.2 Coudé Spectrograph Observers Manual. Additional data will be needed before real comparisons

can be made of the relative efficiencies of the f/4 and f/8.2 spectrographs.

The only major hardware items still waiting for fabrication and completion are the exposure meter hardware and improvements to the M7 environment.

The Coudé f/4 spectrograph is probably the first large instrumentation project for which CFHT has had direct responsibility for major parts of the project. We wish to acknowledge and to give credit to the many CFHT staff members who have contributed immensely to the progress made on this project: Mike Buckles, Dave Bohlender, Bill Cruise, Dave Cowley, John Horne, Wiley Knight, Mark Laurence, Grant Matsushige, Derrick Salmon, Eric Willett, Jim Wright.

J. Glaspey, J. Kerr

MOS-SIS Status Report

Summary

The MOS-SIS spectrograph has been successfully shipped and integrated into the CFHT fleet of instruments. Testing both in the lab and on the sky showed excellent properties of the optics, mechanics, electronics control system, and user interface for both MOS and SIS. First tests on the sky happened June 19 1992, and MOS was successfully released to visiting observers scheduled with MARLIN or the UH/FOS on August 21st. The Fabry-Perot mode on MOS was successfully released to visiting observers September 4th (see accompanying article by R. Arsenault). One major problem remains with the SIS guiding efficiency, only stars brighter than $V=14$ can successfully be used for guiding with the active mirror (compared to $m=17$ for HRcam with same PMTs), and therefore SIS with active image correction will not be available until the ongoing replacement of the guide optics is completed. Final commissioning will happen in December 1992, after 2 science qualification runs to fully assess the instrument performances.

1. Integration at CFHT

After much efforts by the DAO team, final acceptance tests with CFHT, and the successful completion of the MOS camera optics, MOS-SIS was shipped to CFHT and arrived at the summit the week of April 20th in the form of 9 crates.

The integration then proceeded at an accelerated pace at the summit and down in Waimea. All of the vital components were carefully inspected and none appeared to have suffered from shipment. The MOS-SIS was reassembled and installed on its handling cart, and handling of the whole unit across the