

several optical firms to quote on the fabrication of a new secondary mirror, with the hopes of putting it into operation sometime in 1990.

There are several image improvement projects still to be completed. We suspect a significant contributor to prime focus image imperfections may come from residual aberrations in the wide field corrector. Interferometric studies of this corrector are just starting.

There have been a large number of individuals involved with the testing program. Stephane Beland has written and debugged a very large fraction of the computer code, and has participated in most of the observations. Tom Gregory has designed and supervised the building of the Shack Hartmann tester at prime focus, while John Fellenstein, and Dan Sabin fabricated the Hartmann test devices.

Derrick Salmon

August '89 Shutdown

1. Introduction

Evidence garnered at CFHT over the past few years has pointed to problems in the primary mirror support systems. For example: seeing statistics yielded stellar image profiles that were not as good as expected from the original optical specifications and the as-figured results; observers often reported poor seeing, especially "in the west..."; complaints of out-of-round CCD detector images, sometimes blamed on poor autoguider performance, or TCS servo oscillations, or encoder imperfections or combinations of all of these. Throughout '85-'87, we made steady improvements in all these areas, without however, gaining significantly in image FWHM; the best values stayed at about 0.7 arcseconds. Finally, in 1988 and '89, out-of-focus CCD images taken during engineering runs at naked prime, on and off-zenith, showed pronounced astigmatism, most likely caused by mal-adjusted or improperly operating radial and axial support systems. The initial efforts were to trying to find the actual deficiencies, then trying to devise ways of correcting them.

During the August '88 primary mirror aluminizing shutdown, in attempting to install load cells at the 3 defining points, we discovered that unrecorded changes had been made to the internals, so that they did not perform as originally designed, and that they carried significantly higher than design loads. Their latest configuration allowed the whole primary mirror weight of 14 Mg, to rest on the 3 defining points instead of being equally shared with the 24 axial support pad bumpers. The load cells were thus of insufficient range to handle this extra weight, so we installed temporary aluminum spacers, intending to replace them during the next shutdown in '89. When reassembling the telescope, one of the radial support mechanisms was accidentally damaged. Interim repairs at that time, enabled the radial support to be reinstalled, and a new one was ordered from the French manufacturer.

Further careful investigations during the subsequent 6 months, uncovered further discrepancies in both radial and axial support systems, which would need to be corrected. In

addition, to take advantage of the time efficiently, we also decided to replace the somewhat undersized and obsolescent dome crane for lifting the primary mirror; and to clean and paint the telescope. The planning, scheduling, design, procurement of equipment, testing of procedures and installation devices became high priority activities for many of us, from September '88 through August '89, including Mechanical, Optical and Daycrew groups, with much needed help from most everyone else in the Corporation as well as various contractors in Hawaii.

2. Summary of the Final Outcome

Without trying to describe even a small fraction of the estimated 10,000 manhours expended leading to the shutdown by the above-mentioned staff, or the 2,700 manhours expended in the 17 days/nights during the shutdown, from August 7-23, suffice it to say that a tremendous amount was accomplished. Amongst the achievements are:

- CFHT's classical primary mirror support system has been adjusted to original design requirements. Varieties of special tooling, systems and procedures were developed to achieve high precision in locating critical components.
- Regular planning/scheduling sessions prior to and during the shutdowns, close coordination of many parallel activities, together with tolerant flexibility throughout the events, enabled meeting difficult time-tables and resolving conflicting priorities.
- The previous off-zenith primary mirror astigmatism has been essentially eliminated. Resulting stellar images are now rounder and smaller : $\approx \leq 0.5$ arcseconds FWHM for the best CCD long exposures; 0.35 arcseconds using fast guiding HR Camera. Recent work indicates that the prime focus Wide Field Corrector may now be limiting the optics portion of seeing.
- The telescope (excluding the mirrors!), three upper end structures and the handling ring all have new coats of paint, remaining with CFHT's distinctive color scheme.
- A new, up-to-date main crane hoist was installed, tested and used in earnest to lower and raise the primary mirror, including motor winches, cable, emergency fail-safe brake systems, and improved structural steel supports.
- Rigorous scrutiny and up_dating of all "as-built" documentation continues.
- At the present time, image quality contributions due to optics, mechanics, guiding, dome and atmosphere are still elusively non-quantitative. Full-time, reliable measurements of some or all components are needed to determine the potential for future seeing improvements at CFHT.

Jerry Sovka