PCI interface between the CCD controller and DAS computer, however due to delivery delays it is initially being implemented using an S-BUS card. With the S-BUS interface the system produces typically a threefold decrease in un-windowed readout cycle time over previous ING systems, with the PCI interface this will improve to sixfold, potentially offering an overall 5% increase in telescope observing time. The project is currently being expanded to include infra-red detectors, first in support of INGRID, and eventually the LIRIS spectrograph being developed by the IAC. ULTRADAS has been commissioned on the INT Wide Field Camera and WHT Prime Focus 4k×4k 2 chip mosaic.

– A new UNIX based Guide Star Server will be implemented. This work has been placed at the UKATC (to begin in FY 2000/2001) and it is expected it will be based on the porting of an existing system.

– The above improvements will remove several obsolete, failing and unsupportable systems, including the Network Interface Units (NIUs) and Data Management System (DMS) both dependent on bespoke hardware and software and both the causes of much lost time while requiring a large support effort.

– Improvements to GHRIL (Ground based High Resolution Imaging Laboratory) for NAOMI which include:

  – Reducing telescope vibration by tuning and modifying the oil damping system with extra dampers near to the bearing surfaces.

  – A new cooling system with glycol lines routed through the telescope to an external heat exchanger. This system was installed and operated for the last ELECTRA adaptive optics run. Extension is planned to the UES cooler — thus removing a further source of vibration in the telescope structure and heat within the dome.

  – A new optical bench for NAOMI. The previous two ELECTRA runs identified that the original, although adequate for other instruments was insufficiently damped for NAOMI and so will be replaced.

  – Improved access for instruments, including NAOMI through a roof hatch.

  – Improvements to GHRIL seeing by re-coating and adding CaF_2 windows to the infrared de-rotator. The windows will prevent airflow through the unit, eliminating turbulence in the light path and stopping the deposition of dust on the reflecting surfaces. Additionally, once the sealed unit is fitted, airflow within the optical bench room will be studied in an effort to understand and improve local seeing.

  – Improvement in telescope tracking/positioning ready for NAOMI, by the elimination of glitches seen by ELECTRA

After only 11 years of operation the WHT is still a young telescope. These measures ready it for common user adaptive optics, will offer better performance for observers together with improved reliability/reduced maintenance operation. In short they take it into the new millennium, and as they are being implemented over the next two years, fit in with either 2000 or 2001 as defining the start of the next millennium. ¤

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New Instrumentation for the WHT

René Rutten (Director ING)

In order for the William Herschel Telescope to keep offering the best possible instrumentation in the future, it is important that new ideas and instruments are developed. For that reason, in June 1999 an announcement was sent out inviting novel ideas for new instrumentation for the WHT to be brought forward. The following four proposals for new instruments were received:

– Bacon (Lyon): *OASIS — an Adaptive Optics (AO) optimised integral field spectrograph.*

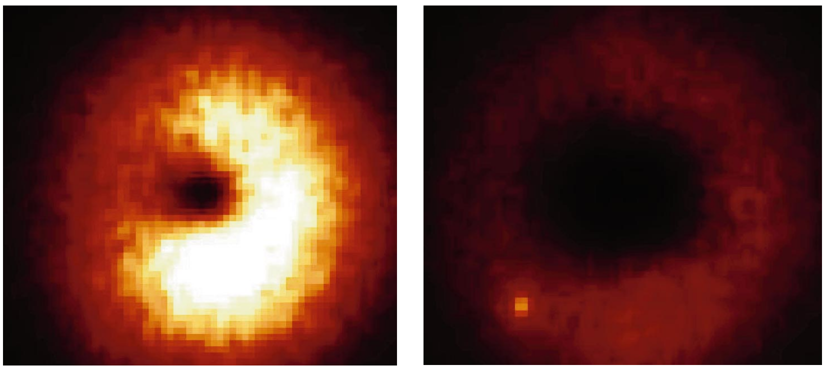

Figure 1. Simulated H-band coronagraphic PSFs with a secondary star 1.0 arcsec away from the central object (Δm= 7m) without (left) and with adaptive optics correction (right). The diameter of the focal plane stop was 1.0 arcsec and the uncorrected seeing was ~0.7 arcsec.

– Doel (UCL, London): *Coronagraph for the NAOMI AO system.*

– Sharples (Durham): *MOSAIC – Multi-Object Spectrograph with Adaptive Optics Image Correction.*

– Vick (ATC, Edinburgh): *High-resolution spectral imaging facility for the NAOMI AO system.*

Each of these proposals was of high quality, which made it difficult to set priorities. It is noteworthy that all four proposals focus on adaptive optics, which is conceived as a key development area for the WHT.

Following a review by the Instrumentation Working Group (IWG) the ING Board discussed the various submissions and recommendations in December 1999, and I will present here what the outcome was.

The ING Board considered that the proposal by Doel et al. to build a coronagraphic unit to work with NAOMI should be supported on the shortest possible time scale. Examples of science areas where the coronagraph would be particularly useful are the study of brown dwarfs and substellar companions, proto-planetary disks around young stellar objects, QSO host galaxies, and mass outflow from objects such as symbiotic stars and luminous blue variables.

This development has a clear set of science applications and can be delivered at a modest cost. This instrument would be able to exploit the capability of NAOMI with natural guide stars, as it will be used in the investigation of faint sources around bright objects. It would help increase the early scientific impact of NAOMI.

The proposal by Bacon et al. to deploy an existing instrument, OASIS (currently available on the CFHT) on the WHT with NAOMI was considered extremely attractive. OASIS is a state-of-the-art and unique integral field spectrograph using a lenslet array. Its design allows very fine spatial sampling to take full advantage of an Adaptive Optics system. The

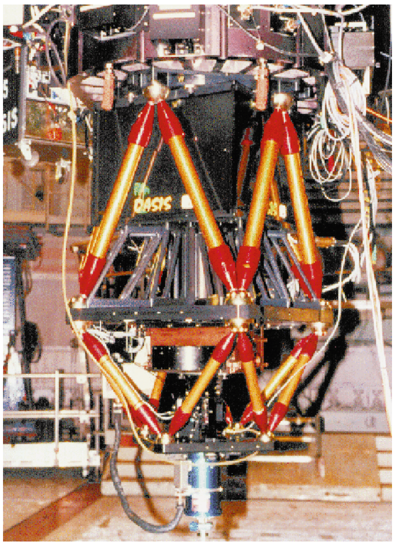

Figure 2. OASIS on the CFHT.

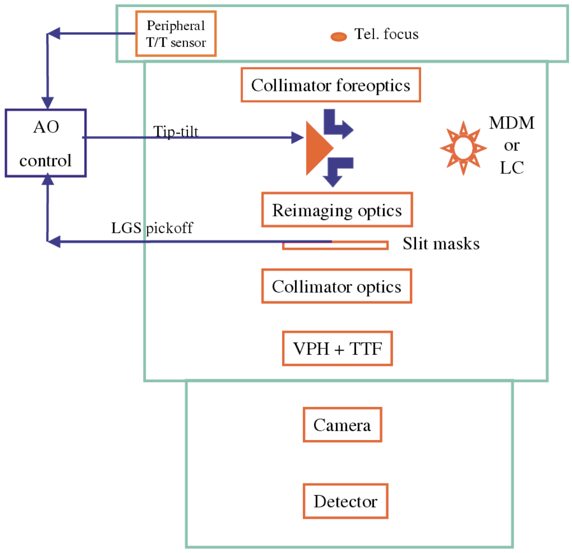

Figure 3. MOSAIC layout.

instrument is fully developed and operational, but would have to be adapted to work with NAOMI. An assessment is being undertaken to see whether both systems can be made compatible.

OASIS is a versatile spectrograph allowing a wide range of science projects to be carried out, and therefore it is anticipated that the interest in its exploitation will be large.

The MOSAIC proposal by Sharples is for an AO-corrected multi-object spectrograph and imager for the WHT Nasmyth focus. This system is distinct from the NAOMI AO system and would have its own (restricted conjugate) AO system, which aims to achieve not so much the best possible image quality over a small field, but instead aims for significant improvements in image quality over a wide field. The AO feature in combination with a multi-object spectrograph would present important gains over existing facilities, and be unique.

MOSAIC would have an important impact on the WHT. It would be mounted at the Nasmyth focus where currently UES is mounted. (UES would have to be positioning elsewhere and fed by a fibre from MOSAIC). The AO correction would also involve installing a Rayleigh laser system to generate the artificial guide star.

Clearly this instrument would have great potential and potentially keep the WHT competitive next to the 8-m class telescopes. MOSAIC, with its laser system and own AO hardware is a comparatively complex instrument that would require a major investment. Technical and performance aspects, as well as its impact on telescopes operation will need to be studied further.

LDSS and TAURUS on the WHT

A second announcement-of-opportunity was issued also in June 1999 asking interested parties to adopt the existing common-user instruments: the Low Dispersion Survey Spectrograph, LDSS, and the Fabry-Perot imaging spectrograph, TAURUS, as private instruments.

The reason to retire these less-used instruments as common-user facilities was driven by a combination of financial and operational pressures. Rather than just decommissioning the instruments they were offered to interested groups in the user community to take on as private instruments. In this way the instruments could be retained for the continued use by the astronomical community, but no longer be a burden on the observatory, which is faced to have to take care of a growing number of instruments under ever tighter financial constraints.

Four proposals were received as a result of this announcement. The proposal by Richard Bower (Durham) to adopt LDSS and by Richard McMahon (Cambridge) to adopt TAURUS were considered the strongest on the basis of their science case and ideas for developing the instruments further. The ING Board decided that these instruments would transfer to Durham and Cambridge respectively as private instruments. Both PIs indicated the possibility that the instrument may be used on other telescopes in the future. Both proposers also indicated interest in collaborating with other groups on future use of the instruments. Therefore from now on anyone interested in using either LDSS or TAURUS should contact Richard Bower or Richard McMahon, respectively. ¤

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The New WHT Mosaic Camera

Simon Tulloch (ING)

Work on this camera started at the RGO in Cambridge shortly before its closure and was continued at the ATC in Edinburgh and subsequently ING. The design incorporates two EEV42-80 CCDs mounted in a standard 2.51 Oxford Instruments cryostat normally used for single chip cameras. This camera therefore has the same mechanical interface to the telescope and could in principle be used at any port where a single chip camera is normally used. In practice it will be dedicated for use at Prime Focus (PF) and at UES on the WHT.

At prime focus this camera will double the field of view of the telescope with no vignetting from either the existing filter wheel or corrector. At UES the benefits will be from the EEVs smaller pixels (0.20″/pixel) and better blue response compared to the existing SITe detector. The EEV mosaic is marginally bigger than the SITe but since the UES output is already heavily vignetted in the outlying areas of the image, this will offer no advantage.

The camera performed well during its first science run at PF at the end of September 1999 and obtained the images that accompany this article. Some problems due to stray light were highlighted during this run and are currently being solved by the addition of extra baffling around the PF filter wheel. Some images obtained close to the celestial equator seemed to suffer some degradation due to a number of horizontal streaks extending across the full width of the images. These were later identified as geostationary satellites! Final commissioning at UES will start in late January 2000.
The CCDs were mounted on an invar baseplate that was ground flat to ±5µm accuracy. Subsequent measurement of the CCD surfaces, using an instrument developed at the RGO, showed that all pixels lay within 20µm of an optimal plane. The slight defocus that this will introduce into the small regions of the image furthest from the optimal plane, does not exceed 0.1 pixels. The physical gap between the CCDs was minimised by the use of PTFE shims. These allowed the devices to be close butted without actually touching. Once the chips were firmly screwed down to the base plate the shims were removed. The gap between adjacent image areas is only 39 pixels: approximately 1% of the total image width.

The camera was designed and built by Simon Tulloch. Dave Gellatly at the RGO was responsible for some initial mechanical design work and the ATC Mechanical Workshop was responsible for the machining.

The camera is now available as a common user instrument at Prime Focus and at UES on the WHT. ¤

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PF Performance Summary

Pixel scale: 0.24″/pixel
Field of view: 16.4′ × 16.4′
Pixel size: 13.5µm square
Image size: 4096 × 4100 pixels
Readout time: 54 s
Readout noise: 6 e⁻ rms
Gain: 2.2 e⁻/adu for chip #1
2.0 e⁻/adu for chip #2
Quantum efficiency:

	380 nm	400 nm	650 nm	950 nm
CCD1	62%	78%	75%	14%
CCD2	67%	81%	76%	13%