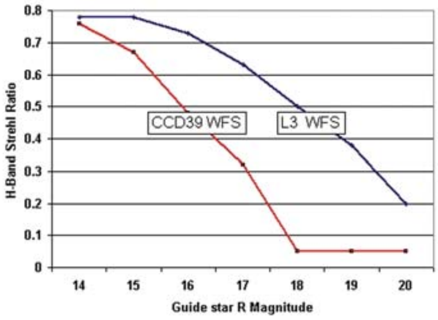
the Crab Nebular pulsar and were able to directly distinguish its 30 Hz variability. The camera used its own data acquisition system based around a Linux PC and a slightly modified SDSUII controller. This DAS combined the functions of an acquisition TV and a science camera. This was important given the rather small 14 arcsec field of view. Once the image was acquired, the camera switched to its fast photometry mode in which it made a rapid sequence of 1024 windowed readouts at a rate of 180 frames per second. The resultant image format consisted of a 'movie strip' of consecutive frames, a short section of which is shown in Figure 3.



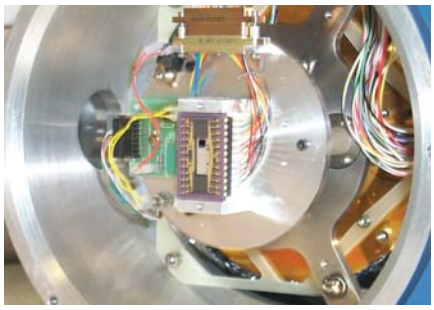


Figure 1 (left). Potential L3 gains in NAOMI. Thanks to Richard Wilson for providing Figure 1. Figure 2 (right). The L3 Test Camera.

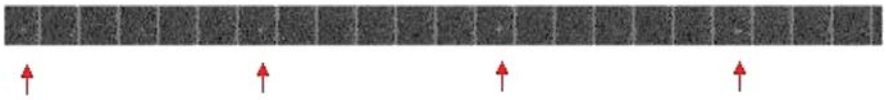


Figure 3. The Crab Pulsar indicated by the red arrows in this series of frames.

Although faint, the pulsar is visible. The red arrows indicate the frames in which the brightness peaks. An animated GIF of these pulsar observations can be found at: `http://www.ing.iac.es/~smt/WFS/ /CrabMovie.gif`.

We currently have on order a larger engineering grade L3 CCD measuring 512×512 pixels. This will be incorporated into a second test camera and mounted on ISIS where its suitability for rapid spectroscopy will be investigated .

Thanks to Durham University's RLGS team and to Vik Dhillon for their cooperation in the testing of this new camera.¤

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GMOS / bHROS Fibre Connection

M. F. Blanken (ING), G. Talbot (ING), M. Aderin (UCL)

Over the last year (2002–2003) ING was subcontracted by University College London (UCL) to produce a module of 18 science fibres for the bHROS instrument, one of the instruments on the Gemini South telescope.

bHROS is a high-resolution ($\Re$=150,000) prism cross dispersed echelle spectrograph, situated in the pier of Gemini-South. It is fed by optical fibres mounted on the GMOS instrument located at the Cassegrain focus of the telescope. bHROS will have the highest spectral resolution among the optical spectrographs currently being designed and built for 8–10 m class telescopes.

The optical fibre connection between GMOS and bHROS consists of 18 fibres; 9 fibres with a 120 μm core diameter and 9 fibres with a 160 μm core diameter. Both types of fibre had to be ground and polished at both ends. The GMOS end also had to be mounted and aligned in an optical assembly (a body plate). 10 fibres of each type were delivered by UCL to the ING out of which 9 of each were to be used for science. The 10th fibre of both types was manufactured in case of any breakage.

The first stage after receiving the fibres was cutting them to the desired length. After this metal tubes were glued over the fibre ends to make the grounding, polishing and handling easier. The metal tubes were also connected to the outer PTFE sleeve of the fibre, using heat shrinks, to give extra strength and reduce the risk of breaking. Both ends of the fibres were ground and polished to a flatness of <¼ of a wavelength (632 nm).

The body plate for the GMOS end consists of 18 sapphire ball lenses of two sizes (3 mm and 4 mm diameter) and 18 silica optical windows (3 mm diameter, 300 μm thick and 4 mm diameter, 400 μm thick). The balls and the windows were glued in the body plate using UV-optical curing glue. Before the fibres were aligned in the body plate a throughput test was done to check the relative transmission of the 20 fibres. The best 18 fibres were aligned on top of the silica windows and the sapphire ball lenses in the body plate. The alignment was done using a target that simulates the Gemini telescope pupil (fibre positioning tolerances were 0.02 mm). After the alignment, the fibres were glued in the body plate by using the UV-optical curing glue and super glue.

After the polishing, aligning and gluing the fibres were sent to the UK for installation of the optics for the bHROS end. The fibres are now complete and are waiting to be installed between GMOS and the bHROS instruments in Chile. bHROS will be fully integrated with the telescope in 2004.

ING is experienced in fibre work after making several successful fibre projects. One project in particular, "Small fibres" consisted of 160 fibres with a core diameter of 90 µm for the Autofib2 (robotic positioner)/ WYFFOS (optical spectrograph) commissioned in July 2001 (see also *ING Newsl.*, **4**, 26 and *ING Newsl.*, **5**, 19 for more information and first light report). The procedures and experience of the "Small fibres" project were used in the GMOS/bHROS project. ING is actively looking for more fibre work from external institutes for the future.

For more information on the GMOS/ bHROS project please visit the following sites:

Gemini South telescope:
`http://www.gemini.edu/`

HROS project page:
`http://www.osl.ucl.ac.uk/hros/new/fm-index.html` ¤

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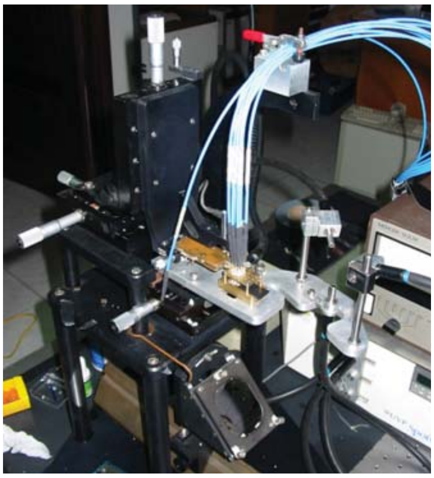

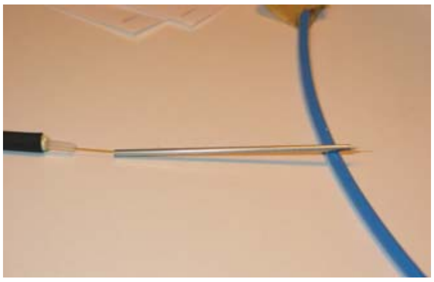

Figure 1 (left). Fibre grounding and polishing. Figure 2 (top right). Fibres in body plate gluing. Figure 3 (bottom right). Metal tube gluing.

Do It Dry... INT Primary "Vapour Cleaning"

M. F. Blanken, A. K. Chopping, K. M. Dee (ING)

In June 2003 'vapour cleaning', a concept invented by ING staff, was used to clean the Isaac Newton Telescope's primary mirror (2.5m) for the very first time.

The primary mirrors of the telescopes at the Isaac Newton Group are regularly cleaned to decrease the frequency of aluminising. Over the last few years ING has moved from annual aluminising to condition based aluminising, only doing it when the reflectivity and scatter measurements indicate it is needed. The advantage is that an extra three nights are available to observers every year that aluminising is not carried out, not to mention the real risk of damage to the primary mirrors every time they are removed from the telescope for aluminising.

Regular cleaning is currently done by a method called "snow cleaning" or "CO_2 cleaning". This cleaning method uses liquid CO_2 that forms snowflakes once it is in the open air. These snowflakes hit the mirror surface and capture dust particles. The temperature shock between the cold snowflake and the "warm" mirror will easily break the bond between the dust particles and the mirror. The particles together with the snowflakes fall down onto the telescope structure. There the dust can be wiped away from the structure. This way of cleaning the mirrors is quick and easy restoring the reflectivity by about 1–2% and decreasing the scattering.

Unfortunately stains like water and oil cannot be removed using this method. A better way of cleaning the mirror is to use water, soap and natural sponges. First we wet the mirror surface with water to flush away all the big dust particles. By dabbing and with the use of soap on the sponges the water and oil stains can be removed. The rest of the soap has to be washed away by using water before drying. The best way of drying is to keep the surface wet until the very last moment when the water is blown away with filtered clean air. All the dust and most of the heavy stains can be removed using this method. The reflectivity and scattering can be recovered to values close to those retained after aluminising. Therefore this method is much better than the "CO_2 cleaning"method.

A disadvantage of the "washing in situ" method is that it uses roughly 5–10 litres of water per square meter. This can be a problem when a copious amount of water is running around mirror cells and associated equipment. Particularly electronics have to be protected. So normally novel ideas have been developed to seal the mirror or optical component to stop the water leaking around the telescope which reduces the risk of water damage. By using the "water vapour method" only 1–2 litres of water is used per square meter. The advantage is optical results equal to "water washing" without the risk of water damage. The small amount of water used is easily controlled with sponges or towels