of the night. Images are taken every couple of minutes, and exposure times are up to a few minutes during moonless periods. Data is automatically transferred to Michigan, and immediately bias corrected and flat fielded. The reduced data and nightly movies are then made available on the web through the on-line CONCAM archive at Michigan (see `www.concam.net`). Copies of the reduced (and compressed) nightly movies are archived locally on La Palma and available at `catserver.ing.iac.es/weather/ /archive/index.php` (follow the link to the archive and select the required day).

Currently, CONCAM systems are installed not only on La Palma, but also at Mauna Kea, Kitt Peak, Mt Wilson, Wise Observatory (Israel), Rosemary Hill (Florida), South Africa and Siding Spring.

The initiative leading to the development of CONCAM was centred around the idea of monitoring the brightness of relatively bright objects and to permanently look for bright transient events across the whole sky. Besides these primary goals, CONCAM also offers very good possibilities for stimulating public interest, as the sequence of CONCAM images very clearly demonstrate how the sky varies during nights. CONCAM images can show a number of interesting atmospheric and night-sky features. CONCAM shows of course the position of planets and the moon, but also shows the zodiacal light, it announces sunrise and sunset, and even makes visible the patterns in the OH night sky lines. An excellent set of examples of what CONCAM sees is shown at `www.concam.net/phenomena.html`. For ING, however, the main role it serves is that of all-sky cloud monitor.

The all-sky movies that are automatically generated give a very good visual impression of transparency variations across the sky, and how it varies in time. Clouds can be seen rolling in, allowing the astronomer to take advantage of the best parts of the sky and plan the observing programme. Together with the weather maps, the meteorology data, and the robotic seeing measurements, ING now possesses a comprehensive set of tools for planning observations and assessing post-observing data quality.

We are very grateful for the superb collaboration and assistance received from the team at Michigan Technical University, in particular from Robert Nemiroff and David Crook.¤

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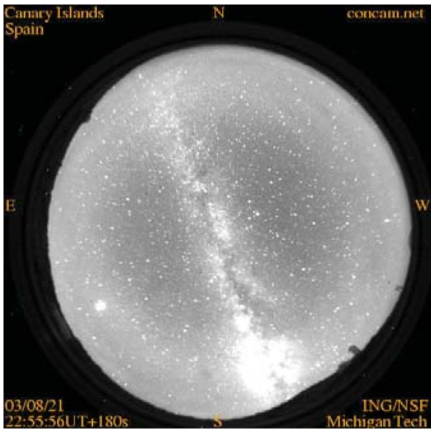


Top left: CONCAM on the roof of the liquid nitrogen plant. Top right: A closer view of CONCAM. Above: CONCAM image of the Palmeran night sky.

L3 CCD Technology

Simon Tulloch (ING)

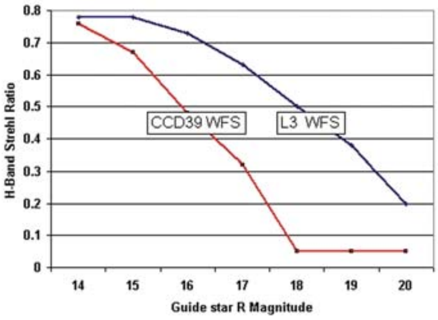
Low Light Level (L3) CCD technology is a recent development from E2V that opens up interesting new observational regimes. The technology allows production of scientific CCDs in which the read noise of the on-chip amplifier becomes negligibly low. Additionally, this effective zero-noise performance is decoupled from readout speeds and the almost zero noise performance holds up to frame rates of 1 KHz. E2V achieve this by using an avalanche multiplication mechanism in the horizontal register of the CCD. A single photo-electron entering this register exits as a substantial charge packet; the exact gain being variable and determined by the level of a high voltage multiplication clock. At gain levels of around 500 it becomes possible to identify individual photon events in the image. The downside of L3 technology is that the multiplication process degrades the SNR at higher signals by a factor of $\sqrt{2}$. There is also a small additional noise contribution from spuriously generated electrons within the device.

L3 CCDs should be useful in any observing regime currently limited by detector noise. Wavefront sensing is an obvious application and E2V have produced the 128×128 pixel frame transfer CCD60 with this in mind. We have purchased one of these and are currently working on an upgrade to the Naomi WFS. Figure 1 shows the kind of gains we can expect once this system is commissioned. For comparison, the performance of Naomi's current WFS, the CCD39, is also shown.

Other applications for L3 technology are currently being evaluated on the WHT using a cryogenic test camera in which we have mounted the CCD60 (see Figure 2).

This camera was mounted on the Auxiliary port in November where we tested its performance as a fast photometer. On the 10th we observed 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.

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`.



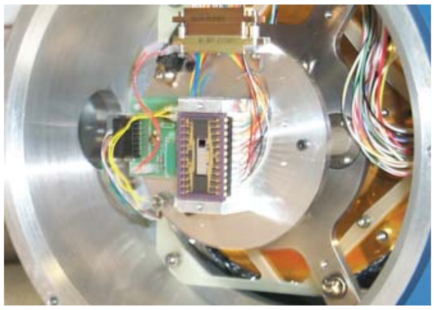


Figure 1 (left). Potential L3 gains in NAOMI. Thanks to Richard Wilson for providing Figure 1. Figure 2 (right). The L3 Test Camera.

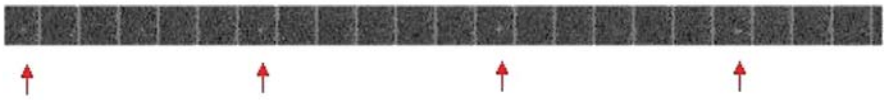


Figure 3. The Crab Pulsar indicated by the red arrows in this series of frames.

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

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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 8–10m class telescopes.

The optical fibre connection between GMOS and bHROS consists of 18 fibres; 9 fibres with a 120µm core diameter and 9 fibres with a 160µm 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 (632nm).

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