Acknowledgements

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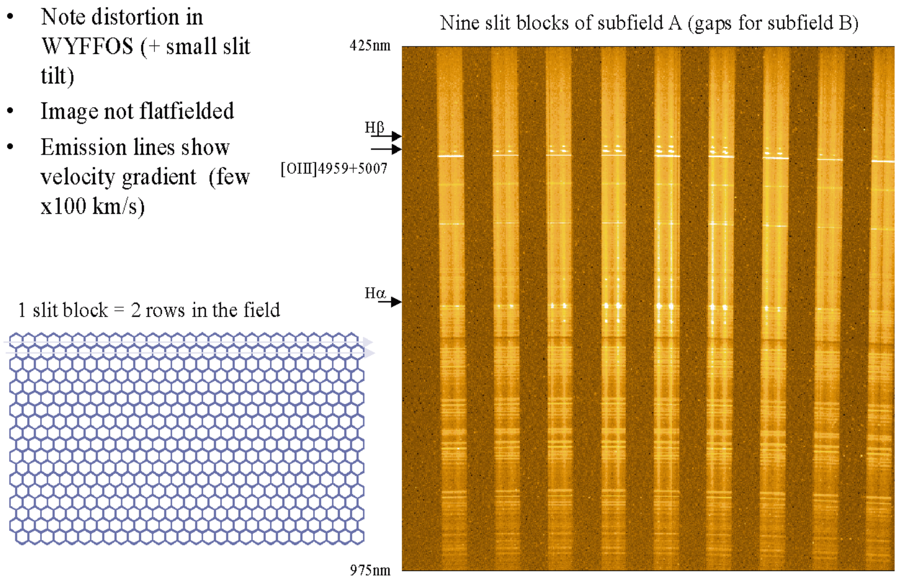

Figure 6. 3C327 raw TEIFU spectra.

INGRID: A New Near-IR Camera for the WHT

Chris Packham (ING)

The new near-IR camera to be operated at the WHT is now nearing completion ready for its commissioning date, now set for January 2000. INGRID (the Isaac Newton Group Red Imaging Device) was designed and partially built by the RGO and finished at the ING during the last year.

At INGRID's heart is a 1024×1024 pixel HgCdTe array developed by Rockwell International Science Centre and the University of Hawaii, which features good sensitivity from 0.8 to 2.5μm. The sensitivity of the Hawaii array is very competitive compared with that of a standard optical CCD from a wavelength of 0.8μm as shown in Figure 1. INGRID will typically be mounted at the folded Cassegrain focus near-IR port of the WHT, opposite to the optical auxiliary port imaging CCD camera, to provide a plate scale of 0.25 arcseconds per pixel to give a field of view of 4.27×4.27 arcminutes. This will allow rapid changes between optical to near-IR imaging facilitating colour mapping. INGRID will also be used in conjunction with NAOMI (described by Jeremy Allington-Smith et al. in this newsletter) as the imaging camera. With NAOMI, the pixel scale is 0.04 arcseconds per pixel in order to exploit the high resolution NAOMI can provide at near-IR wavelengths.

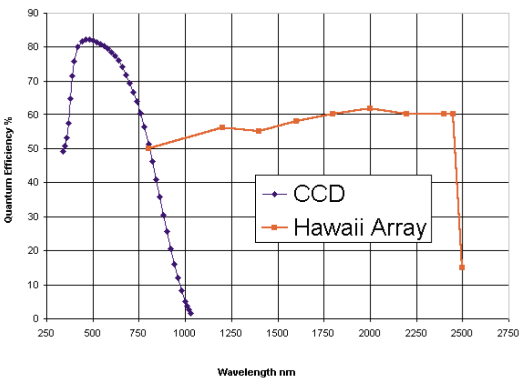

Figure 1. Quantum Efficiency of a Hawaii Array compared to that of a CCD.

Current members of the INGRID team include Gordon Talbot (project manager), Chris Packham (project scientist), Paul Jolley, Kevin Dee and Bart van Venroy (mechanical), Simon Rees & Mathieu Bec (software), Peter Moore (detector), Sue Worswick (optics) and Andrew Humphrey (librarian). The ATC and the IAC also provide valuable help as does Keith Thompson, the ex-RGO project scientist.

At the time of writing we are preparing to enter the performance and science verification stage. We envisage this stage to take around three months for precise characterisation and alignment of all elements of INGRID. Some initial verification has already been successfully achieved but many hurdles remain to be overcome. Shortly after the commissioning phase the ING will offer several nights of service time earmarked for INGRID observations to allow rapid science exploitation of the unusual capabilities INGRID can deliver. Please watch the INGRID's WWW for more information on this:

http://www.ing.iac.es/IR/INGRID/ingrid1_home.htm

The main design criteria for INGRID is excellent optical quality ready for the integration with NAOMI. The optics are all-refractive in design and are split into two parts. The camera is placed within the cryostat to minimise thermal background, and requires an alignment accuracy of 20μm between the four lenses. As ING will offer INGRID at two focal station, two warm collimators are available which enable a change of focal station without thermally cycling the cryostat. In order to minimise thermal background, selectable pupil stops are included which effectively undersize the secondary mirror and obscure the virtual image of the Cassegrain hole. Precise alignment of INGRID to the WHT science beam is achieved through a retractable pupil imaging mechanism that will allow alignment during the day.

A filter set is available which includes the standard Z, J, H, K and Ks broad band and 10 narrow band filters (see WWW page for details). All of these filters were purchased through the Gemini filter buying consortium and hence will provide INGRID users with data that is completely comparable to data obtained at many of the 8 m class telescopes. The filters are of excellent optical quality and are fully adaptive optics compliant for use with NAOMI.

During runs at the folded Cassegrain focus, INGRID will use a closed cycle cooler to remain cold. For rapid cool-downs and completely vibration free observations during NAOMI runs, we will use liquid nitrogen cooling. There are several read-out modes available for INGRID but all feature a full frame readout in 1.5 seconds. The typical readout mode will be double correlated sampling, but others include windowing (for high-speed observations), multiple non-destructive reads (for reduced read noise), image co-average (for reduced dead-time) and movie mode (for target acquisition). The dark current is low and as the read-noise of a double correlated sample is low (expected to be ~10 e^- or lower per read), most exposures will be sky noise limited. All images are automatically displayed on an IRAF display tool that also plots the seeing and sky background against time. Pixel saturation is notified to the observer via a colour change of the affected pixels as seen on the display tool.

Estimates of the throughput of INGRID suggest a similar sensitivity to that of WHIRCAM but with a much lower thermal background and a gain in sky coverage of a factor greater than 17. The limiting magnitude, based on a 9000 second on-sky observation of a stellar source in 1″ seeing, is 24.3, 23.1 and 22.1 mag at J, H and Ks respectively. Observing is facilitated via the use of pre-prepared observatory and user generated UNIX scripting.

The potential science applications for INGRID are numerous, especially when integrated with NAOMI. Applications include quasar host detection, probing the centres of active galactic nuclei, brown dwarf detection, planetary nebulae, young stellar objects, crowded field photometry, etc. At the folded Cassegrain focus INGRID will be able to improve on the observations of WHIRCAM as well as providing the opportunity to observe from U to K. As INGRID will typically be mounted cold at the folded Cassegrain focus, target of opportunity observations (such as gamma ray bursts, supernova, etc.) are ideal for this instrument. ¤

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Super Cool Technology

Peter Moore (ING), Nicola Rando (ESA)

Historically, technological advances have literally opened up the sky for groundbreaking discoveries in astronomy. Such examples of this are the impact of CCD technology on photon-starved spectroscopy and the extension of the observable universe through infrared detectors. We here at Isaac Newton Group are privileged to be part of just such a technological advance, which promises to allow a more complete understanding of the universe.

On the evening of February 2nd this year, ‘First Astronomical Light’ was seen by a novel photon detector device, an array of superconducting tunnel junctions. These junctions, arranged into a small array, allowed us to measure simultaneously the time of arrival, the energy, and the spatial distribution of photons arriving from the Crab nebula. In contrast to current astronomical detectors, the Superconducting Tunnel Junction (or STJ) allows these three crucial parameters to be measured by one detection device in real time with very good quantum efficiency across a large wavelength range. The results of this first light technology proving run are published in *Astron & Astrophys*, **346**, L30 (1999). Figure 1 shows an extracted light curve of the Crab pulsar derived from this work.

A dedicated team of scientists and engineers at the Astrophysics Division of the European Space Agency (ESA) have brought this technology to fruition by adapting materials and techniques from X-ray detector technology to the visible and infrared spectrum. The instrument built by this team to demonstrate the STJ technology is called S-CAM (Figure 2) and combines the 6×6 pixel STJ array with stand alone support and acquisition equipment. This instrument couples to the Ground Based High Resolution Imaging Laboratory (or GHRIL) focal station of the William Herschel telescope and provides a limited field of view of 4×4 arcseconds within 36 pixels.

The principle of operation for the STJ detector, electron tunnelling, is exploited by sandwiching a thin insulating layer between two superconducting layers with attached electrodes. The energy gap of the superconducting material determines the intrinsic energy resolution as well as the operating temperature of the detector. In the S-Cam case, with Ta based STJs, the intrinsic resolving power ($\Delta\lambda$ fwhm) corresponds to 17 at λ = 500 nm, at an operating temperature of about 300 mK. The actual instrument energy resolution is degraded by