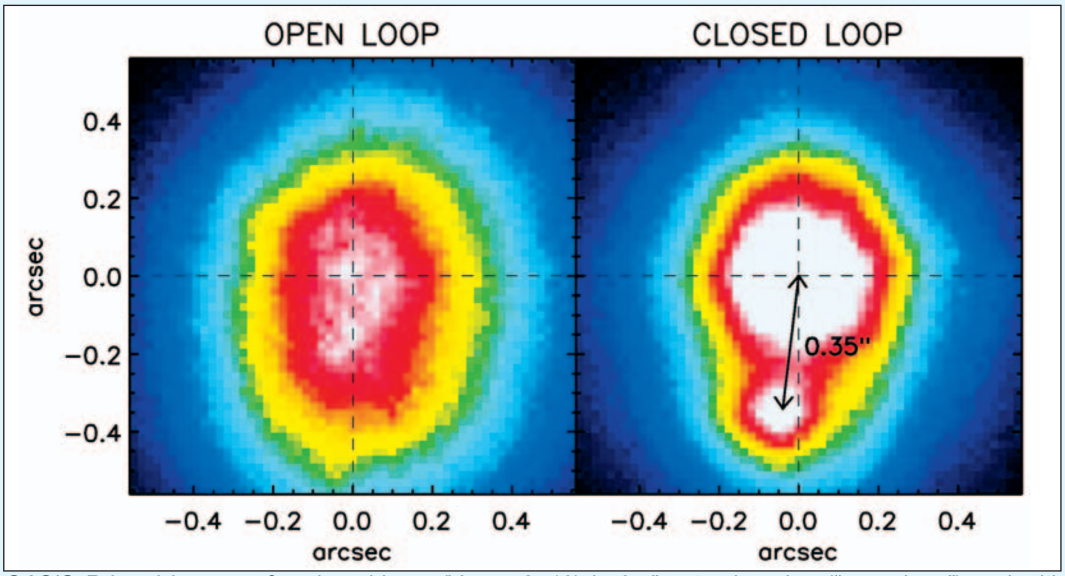
No. 8, September 2004

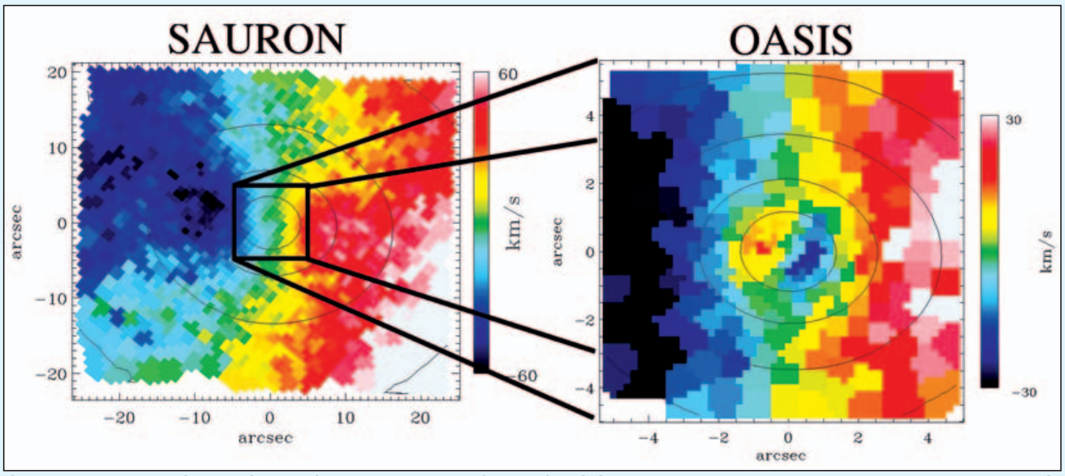
THE ISAAC NEWTON GROUP OF TELESCOPES

NEWSLETTER

Science Prospects with OASIS



OASIS R-band images of a close binary (V_{mag}~ 9+10) in 0.5" natural seeing ("open loop") and with NAOMI correcting the PSF ("closed loop") to 0.2" FWHM.



Spatially binned SAURON (left map) velocity field of NGC 4382 (Emsellem, E., et al., 2004, MNRAS, **352**, 721) showing the outline of the OASIS field (right map) as obtained at CHFT (see article by Richard McDermid et al. on page 3).

Message from the Director

Dear Reader,

In some aspects the last several months at the observatory, since the previous issue of this Newsletter, have been similar to previous years, and in other aspects there has been major change. To start with the latter, I refer to the very welcome news that the long-sought development of a laser beacon for adaptive optics at the William Herschel Telescope has been approved. Coincidentally, receiving 'green-light' for the project will take on a literal meaning when some two years from now the projection of green laser light will become a regular feature above the telescope. The scientific potential of having the full sky available to adaptive optics exploitation rather than only about 1% as in the case of 'classical' adaptive optics, is excellent. Now it is our task to build a working system, and then to scientifically exploit it. An introductory

THE ISAAC NEWTON GROUP OF TELESCOPES

The Isaac Newton Group of Telescopes (ING) consists of the 4.2 m William Herschel Telescope (WHT), the 2.5 m Isaac Newton Telescope (INT) and the 1.0 m Jacobus Kapteyn Telescope (JKT), and is located 2350 m above sea level at the Roque de Los Muchachos Observatory on the island of La Palma, Canary Islands, Spain. The WHT is the largest telescope of its kind in Western Europe.

The construction, operation, and development of the ING Telescopes is the result of a collaboration between the United Kingdom and the Netherlands. The site is provided by Spain, and in return Spanish astronomers receive 20 per cent of the observing time on the telescopes. The operation of the site is overseen by an International Scientific Committee, or Comité Científico Internacional (CCI).

A further 75 per cent of the observing time is shared by the United Kingdom, the Netherlands and the Instituto de Astrofísica de Canarias (IAC). The remaining 5 per cent is reserved for large scientific projects to promote international collaboration between institutions of the CCI member countries.

The ING operates the telescopes on behalf of the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom, the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) of the Netherlands and the IAC in Spain. The Roque de Los Muchachos Observatory, which is the principal European Northern hemisphere observatory, is operated by the IAC.

(Continued from front cover)

article on this exciting new project can be found on the following pages. I would very much welcome ideas and suggestions from the user community towards this project.

Coming back to the first sentence of this introduction, activities at the observatory have been as intense as ever. The last several months have once again seen a range of visiting instruments. Three of them were first-time visitors, each with their own very significant technical and astronomical challenges. There was CIRPASS, the near IR spectrograph from Cambridge operating in multi-object mode. There was PLANETPOL from Hertfordshire, measuring polarisation with remarkable acuracy in an attempt to detect planets around stars. And there was S-CAM2, deploying the second-generation of super-conducting tunnel junction detector technology for a range of science programmes. So yes, work at ING has gone on as normal and hasn't been boring for a single moment.

Enjoy this issue of the Newsletter, and note that the editorial team would love to receive contributions from our readers!

René G. M. Rutten

The ING Board

The ING Board oversees the operation, maintenance and development of the Isaac Newton Group of Telescopes, and fosters collaboration between the international partners. It approves annual budgets and determines the arrangements for the allocation of observing time on the telescopes. ING Board members are:

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The ING Director's Advisory Group

The Director's Advisory Group (DAG) assists the observatory in defining the strategic direction for operation and development of the telescopes. It also provides an international perspective and act as an independent contact point for the community to present its ideas. DAG members are:

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The ING Newsletter is published twice a year in March and September. If you wish to submit a contribution, please contact Javier Méndez (`jma@ing.iac.es`). Submission deadlines are 15 July and 15 January.

SCIENCE

Under the Microscope: Galaxy Centres with OASIS

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Early-type galaxies are thought to be among the oldest known stellar systems, and as such have experienced the full diversity of evolutionary mechanisms at work in the universe. They are crucial laboratories for understanding how galaxies form and evolve from early epochs until the present day. A key aspect of unlocking their fossil evidence is by studying the dynamics of stars and gas, and characterising the stellar populations. To this end, the SAURON survey (de Zeeuw et al., 2000, Peletier et al., 2001, de Zeeuw et al., 2002) has undertaken a study of 72 representative nearby early-type galaxies and spiral bulges using the SAURON integral field spectrograph at the WHT (Bacon et al., 2001).

The SAURON survey has a spatial sampling of 0.94″×0.94″ per lenslet, therefore often undersampling the median seeing at La Palma (0.7″ FWHM). Towards the galaxy nucleus, however, there are often sharp, localised features in the kinematics, such as decoupled cores or central disks, as well as distinct stellar populations and ionised-gas distributions. Such features may only be partially resolved in the SAURON data, or perhaps not visible at all.

Additionally, at Hubble Space Telescope (HST) resolution, elliptical galaxies exhibit power-law central luminosity profiles. The slope of this power-law shows clear trends with certain global properties, such as the degree of rotational support, isophotal shape, and stellar populations. It is therefore crucial to fill the gap between the medium (few 100s of pc) to large-scale (few kpc) structures probed with SAURON and the inner (<200 pc) components probed by HST. We have thus begun a complementary study on a subset of the SAURON sample using the OASIS spectrograph, during its former life mounted on the Canada-France-Hawaii Telescope (CFHT), Hawaii. This follow-up survey is being continued with OASIS at the WHT, with the aim of completing all E/S0s of the SAURON survey by spring 2005. Here we give an overview of this follow-up survey, and future prospects for using OASIS in this field.

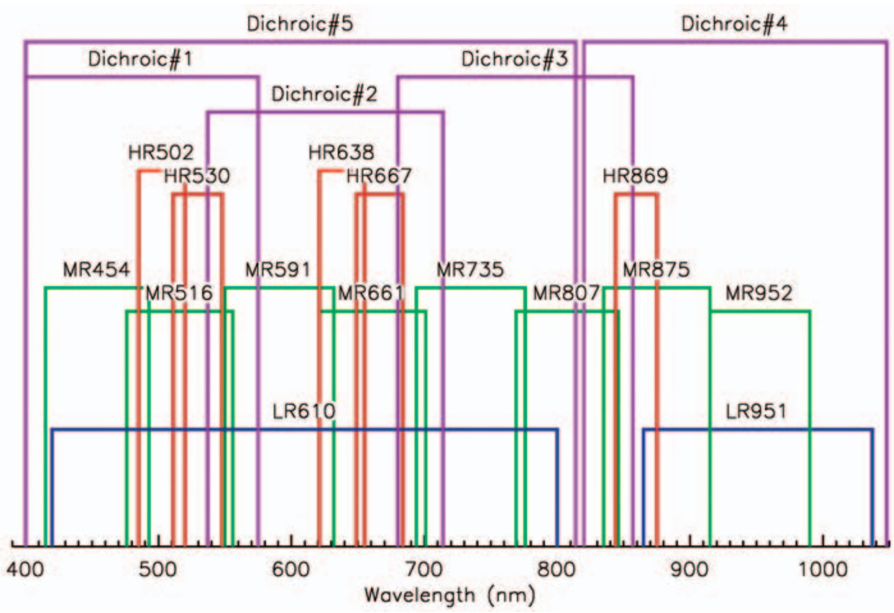

Figure 1. Spectral configurations of OASIS. Blue lines indicate the low-resolution (LR) modes (R~1000); green lines indicate medium-resolution (MR) modes (1000<R<2000); and red lines indicate high-resolution (HR) modes (R>2000). The dichroics are required to isolate the science light from the NAOMI AO system.

The OASIS Spectrograph

The OASIS integral-field spectrograph, mounted behind the NAOMI Adaptive Optics (AO) system (Benn et al., 2002, 2003) in the GRACE Nasmyth enclosure of the WHT (Talbot et al., 2003), was offered to the ING community in semester 2004B, and was awarded time during 15 nights for a variety of science projects. OASIS is based on the TIGER lens-array concept (Bacon et al., 1995) and is designed for high-spatial resolution observations, specifically with the assistance of AO. There is a selection of gratings and filters available, giving low and medium spectral resolution modes within the 0.43µm to 1µm wavelength range. Via the use of different enlargers, there is also a range of spatial samplings which can be adapted to suit the available PSF. Figure 1 and Table 1 summarise the

Mode	Enlarger (mm)	Sampling (")	FOV (")
Spectral	8.5	0.09	2.7×3.7
	12.5	0.14	4.0×5.5
	22	0.26	7.7×10.3
	33	0.42	12.0×16.7
Imaging	62	0.02	37.6

Table 1. OASIS spatial configurations.

available instrument modes. With the addition of AO capabilities provided by NAOMI, OASIS is one of the most versatile optical integral-field spectrographs currently in operation.

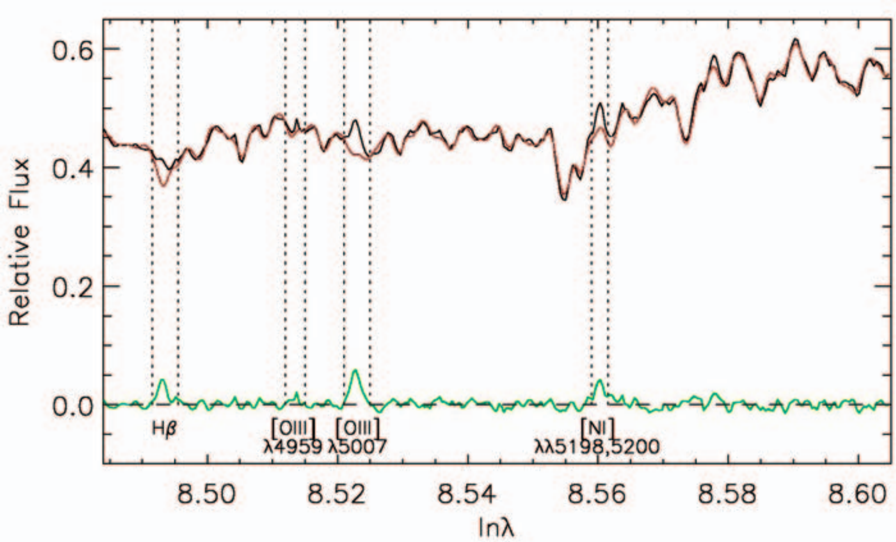

Figure 2. Optimal template fit to the central spectrum of NGC 2768. The lower spectrum shows the residual emission lines after the template-fit, which are fitted using single Gaussians to obtain the gas properties. Vertical lines show regions around the emission that are excluded from the fit.

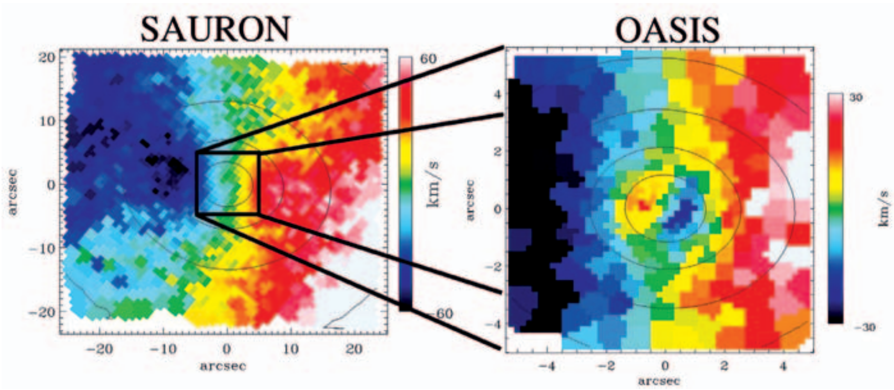

Figure 3. Spatially binned SAURON (left map) velocity field of NGC 4382 (Emsellem et al., 2004) showing the outline of the OASIS field (right map).

Observations

For this project, OASIS was configured to give similar spectral coverage and resolution as SAURON by using the MR516 configuration. The data were reduced using the publicly available `XOasis` software (Rousset, 1992) developed at CRAL (Lyon). Galaxy observations were composed of two or more exposures, which were merged by first aligning the galaxy nucleus of the separate reconstructed images. Co-spatial spectra were then combined, taking into account the error spectra that are propagated through the reduction. In order to provide reliable, unbiased measurements, the data cubes are binned in the spatial dimension to a minimum signal-to-noise ratio of 60 per pixel using the Voronoi 2D-binning developed by Cappellari & Copin (2003).

Results

From the 2D-binned data cubes, it is possible to derive the following properties:

Stellar Kinematics: These are derived by directly fitting the spectra in pixel-space (Cappellari & Emsellem, 2004), which avoids contamination by nebular emission lines, which can often be strong in the central regions of early-type galaxies (Figure 2). Template mismatch was minimised by building an 'optimal template' from a library of stellar population models from Vazdekis (1999).

Gas Kinematics: By subtracting the optimal template, one obtains a residual spectrum in which the emission-line features are revealed. We then determine the distribution and kinematics of the ionised-gas, by fitting the emission-line profiles of these continuum-free spectra with simple Gaussians.

Line Strengths: The OASIS spectral range contains a number of key absorption features which can be used as diagnostic tools to determine the age and metallicity of the stellar populations within a galaxy. To remove the contaminating emission lines, the Gaussian fits are subtracted from the original data before measuring the absorption line strengths. Finally, the absorption line strengths are calibrated onto the well-established LICK/IDS system (e.g. Trager et al., 1998).

Figure 3 shows an example of how the OASIS data can be used to reveal central features of galaxies in the SAURON survey. The left panel of this figure presents the SAURON velocity field of NGC 4382. There is a low-level 'kink' in the zero-velocity (green) contour near the galaxy centre. The OASIS data (right panel) clearly reveal this as a counter-rotating decoupled component.

Figure 4 presents the OASIS stellar (left panel) and gas (right panel) velocity fields for NGC 2768. The stellar component rotates around the apparent short-axis of the galaxy. The gas, however, rotates around the apparent long-axis, perpendicular to the stars. This illustrates how we can separate the stellar and gas properties, using the optimal template fit. There is some evidence of non-axisymmetry in the stellar velocity field, which may indicate the presence of a bar.

Figure 5 presents a map of Hβ absorption strength (after emission subtraction) for the galaxy NGC 3489 (left panel) showing a strong peak in the central 1″, indicating a young stellar population. The right panel of Figure 5 quantifies this, plotting Hβ absorption strength against the abundance-insensitive metallicity indicator [MgFe50]' (Kuntschner et al.) from the OASIS data. The young population in the core of this galaxy indicates that it is in a post-starburst phase, with a luminosity-weighted age of around 1.5 Gyr. Equivalent SAURON data are also shown, illustrating that both data sets are consistent.

Future Prospects: NAOMI

The integral-field capabilities of OASIS are ideal for exploiting the corrected PSF delivered by the NAOMI AO system, and commissioning results indicate that NAOMI is performing well at optical wavelengths (Figure 6). There are several objects in our sample which have a suitable guide star nearby, for which we have been allocated observing time to push the limits of spatial resolution, and measure stellar motions close to the putative central supermassive black hole residing at the galaxy centres. There are few targets in the sky with such conveniently placed bright stars, and so this project provides a glimpse of what will be possible on many targets when the GLAS laser guide-star system becomes available in 2006. More information on GLAS can be found on the web page: http://www.ing.iac.es/About-ING/Strategy/glas_web_announcement.htm.

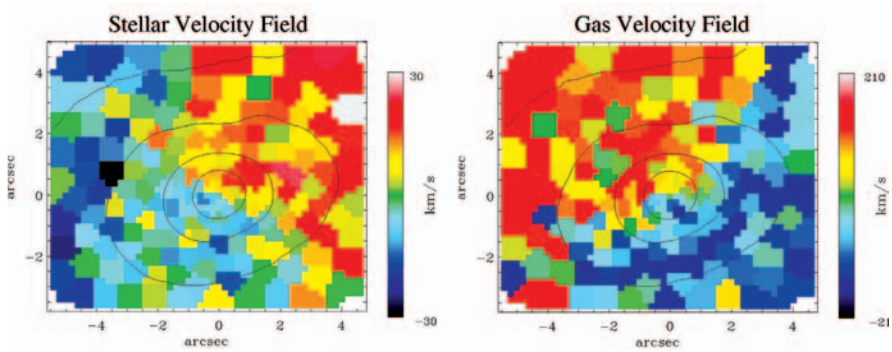

Figure 4. OASIS stellar (left) and ionized-gas (right) velocity fields for NGC 2768 showing the decoupled rotation of the stars and gas. Isophotes from the reconstructed image are overplotted, showing the total flux within each OASIS spectrum. Distortion of these isophotes indicates dust features.

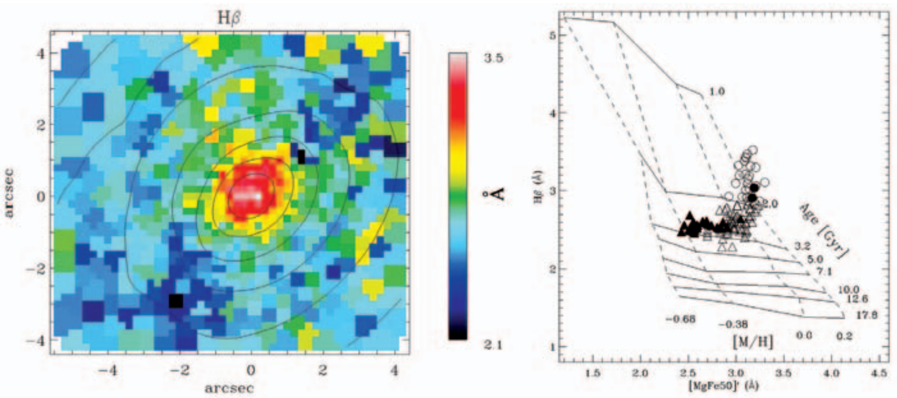

Figure 5. Left panel: OASIS map of Hβ absorption strength in NGC 3489. Right panel: Hβ absorption strength versus an abundance-insensitive metallicity index, overplotted with a grid of stellar population models from Vazdekis (1999). Open symbols: OASIS measurements; filled symbols: SAURON measurements, binned in 1" circular annuli. Circles indicate measurements inside a 1" radius of the centre; triangular symbols indicate measurements outside this radius.

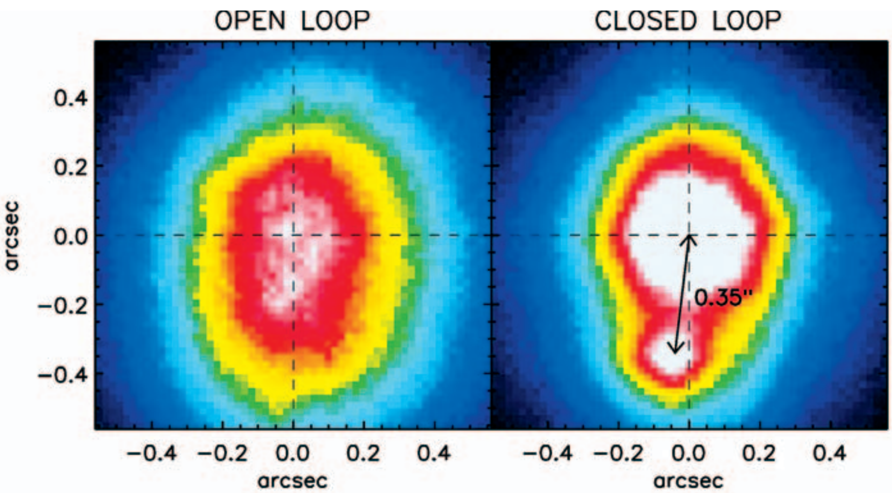

Figure 6. OASIS R-band images of a close binary (V_{mag}~ 9+10) in 0.5" natural seeing ("open loop") and with NAOMI correcting the PSF ("closed loop") to 0.2" FWHM.

Summary

The central regions of nearby early-type galaxies contain a wealth of structure and detail that we are only just beginning to uncover. Galaxy properties show connections on vastly different scales, and by understanding these relationships, we gain insight into galaxy formation mechanisms. The OASIS follow-up of the SAURON survey will provide a unique data set for a large sample of objects, complementing the panoramic view delivered by SAURON, and giving a comprehensive picture of galaxy structure.

Acknowledgments: It is a pleasure to thank the staff of the ING and CRAL for all their hard efforts in ensuring an efficient transfer and installation of OASIS at the WHT. Thanks also to the CFHT staff for their support of OASIS during its time there. ¤

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The Largest Known Planetary Nebula on the Sky

Paul Hewett and Mike Irwin (IoA, Cambridge)

The enormous Sloan Digital Sky Survey (SDSS) spectroscopic catalogue has many applications but the discovery of Planetary Nebulae (PN) had not been recognised as among the potential scientific returns. However, the INT recently played a key role in the identification of a record breaking PN discovered serendipitously from the SDSS.

The vast majority of PN in our own galaxy have been identified via wide-field narrow-band Hα surveys of the type currently ongoing using the INT (`http://astro.ic.ac.uk/Research/Halpha/North/`) or through wide-field low-resolution slitless spectroscopic surveys, with both techniques attempting to isolate objects showing very high equivalent width emission lines that are characteristic of PN. The potential of the relatively high-resolution, pointed spectra that make-up the SDSS spectroscopic database involved a serendipitous observation during the course of a search for high-redshift gravitational lenses. The idea behind the gravitational lens search is to target luminous (massive) galaxies at intermediate redshifts, $0.2<z<0.6$, which constitute the optimal line-of-sight for detecting gravitationally lensed background sources (Hewett et al., 2000). The population of high-redshift star-forming galaxies, many of which possess strong Lyα emission, provide a high surface density of readily detectable background sources. The first such object was discovered by Warren et al. (1996) and the application of the SDSS survey for lenses at lower redshifts has been demonstrated by Bolton et al. (2004).

Examining the results of an automated search of the SDSS DR1 spectroscopic database for emission lines from putative high-redshift sources, one particular galaxy showed an unambiguous emission line detection with a somewhat weaker feature to the blue. The emission line pair was immediately identifiable as emission from [OIII] 4959, 5007. Not an entirely unexpected occurrence but the unusual feature of the detection was that the wavelength of the detection placed the emission at essentially zero radial velocity. Querying the output of the emission line search for similar detections produced more spectra showing a similar signature. All of the objects possessing [OIII] emission occurred in an approximately circular region with a diameter of ~1.5°, with not a single detection anywhere else on the sky. Investigation of SDSS spectra of stars, quasars and even sky fibres revealed further detections, all concentrated in the same region of sky.

A series of checks fairly rapidly eliminated the majority of instrumental artifacts or transient phenomena as the cause of the emission. Discrete enquires of the SDSS team produced the news that [OIII] emission had occasionally been detected but this was due to auroral activity. However, the detection of the [OIII] emission in two SDSS spectroscopic fields observed on different nights and confirmation

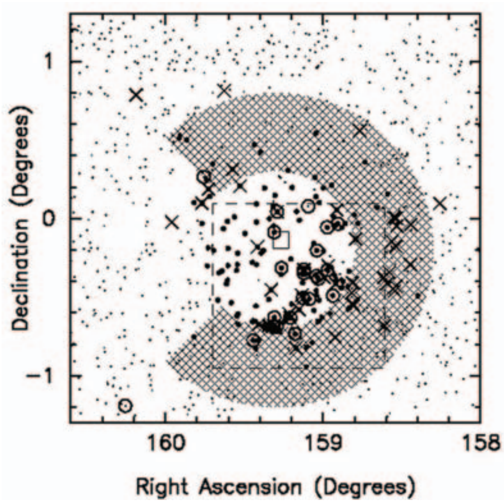

Figure 1. Spatial distribution of spectra with detectable [OIII] 4959, 5007 (dots), Hα (circles), and [NII] 6583 (crosses). The hatched area indicates a region where composite spectra also show unambiguous evidence of [OIII] 4959, 5007 emission. Positions of objects with SDSS spectra for which no individual detections were obtained are also indicated. The dashed outline shows the area included in the narrow-band images of Figure 2. The location of the white dwarf PG 1034+001 is marked by a box.

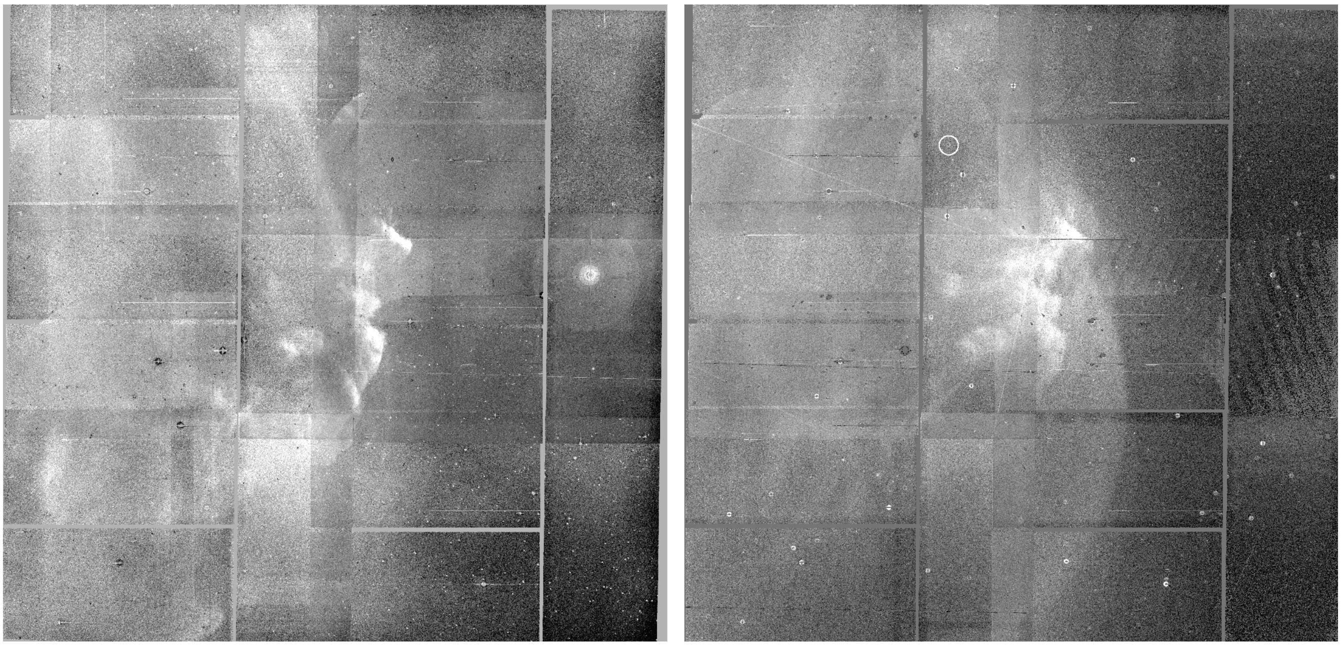

Figure 2. The left hand panel shows a mosaic of 6 INT WFC continuum–subtracted pointings in Hα+[NII] while the right panel shows the equivalent for [OIII]. The images are approximately 0.8° on a side with North to the top and East to the left. The location of the white dwarf PG 1034+001 is indicated by a circle in the [OIII] image. Emission with complex structure is evident in the central regions of the images in both passbands. A well–defined arc, or boundary, is visible at center–right in the [OIII] image.

of the continued presence of [OIII] emission from a spectrum obtained at the MMT Observatory ruled out an explanation due to a transient phenomenon. Combining spectra beyond the boundaries of the region where [OIII] emission was detected in individual produced clear detections of [OIII] emission extending over a region more than 2° in diameter.

A smaller number of individual spectra also showed the presence of emission from Hα and [NII] 6548, 6583. The spatial distribution of the individual emission line detections revealed clear trends and composite spectra, made up from objects contiguous on the sky, confirmed the trends and even allowed the detection of [SII] 6718, 6732. Figure 1 shows the spatial distribution of line emission as derived from the SDSS spectra.

Narrowband imaging of the central part of the region was undertaken during a WFC survey run on the INT in 2003 May. The object is hard work, with integrations of 1200 and 2700 s in Hα and [OIII] 4959, 5007 respectively, necessary to allow the detection of emission over the majority of the field. However, the results were unambiguous, with excellent agreement between the surface brightness distribution evident in the INT images (Figure 2) and the emission line detections from the SDSS spectra. A striking feature of the images was the presence of a well-defined arc-like feature, perhaps suggestive of some form of shock.

A wide range of possible explanations for the emission line region were considered without success. Then, following the INT observations, a search of the region using SIMBAD revealed the presence, close to the region with the strongest [OIII] emission, of a very nearby, extremely hot DO white dwarf (PG 1034+001). The location of the white dwarf clinched the identification of the emission region as a PN. The diameter of more than 2° makes the object the largest known PN on the sky and Rauch et al. (2004) have identified evidence for an ionised halo some 10° across.

PG 1034+001 does not yet possess a parallax distance but the spectroscopic distance estimate of 155^{+58}_{-43} pc (Werner et al., 1995) means the PN is certainly the second closest known and a parallax distance could confirm the nebula as the nearest PN to the Solar System. The unambiguous detection of a PN associated with a non-DA white dwarf is also a first. Determination of a reliable age for the PN will help constrain timescales associated with the late stages of evolution of post-asymptotic giant branch stars and the origin of helium-rich white dwarfs. The PN is certainly old, an estimate of the expansion age and a kinematic age estimate, derived from extrapolating the observed proper motion of PG 1034+001 back to the origin of the radius of curvature of the arc feature, both suggest an age of ≅100,000 yr. The strongly enhanced [NII] emission evident along the south western boundary of the PN is also indicative of the interaction of an old PN with the surrounding interstellar medium.

The strength of the [OIII] emission suggests that imaging of other hot non-DA white dwarfs might be rewarding and we have begun such a programme with the INT in collaboration with Matt Burleigh (Leicester). The first run earlier this year suffered from poor conditions but preliminary results suggest the detection of at least one new PN. ¤

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Exploring Andromeda's Halo with the INT

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The structure of the outer regions of galaxies is a key area in which to look for fossil remnants of the accreted masses from which the galaxies that we see today are thought to be built (Searle, 1978, White, 1978). The importance of these regions has increased in recent years as cosmological theories of structure formation become more exact in their predictions, and the observational instrumentation required to conduct these detailed analyses becomes more sophisticated. Currently composed of 165 individual pointings of the Isaac Newton Telescope Wide Field Camera (INT WFC), the M31 halo survey consists of photometry for over 7 million sources, on a photometric system accurate to 2% over ~40 square degrees on the sky, in some places probing the halo of Andromeda out to 6° (~80 kpc). Observations of 800–1000 seconds in the Johnson V (V′) and Gunn i (i′) passbands are deep enough to detect individual RGB stars down to V′= 0 and Main Sequence stars down to V′=−1. This unique dataset has provided, for the first time, a panoramic deep view of the stellar halo of a giant galaxy *thought* to be similar to our own Milky Way (Irwin, 2004).

The initial results of this survey could not have been more surprising: despite exhibiting a near pristene disk, M31's halo is full of substructure and points to a history of accretion and disruption (Ferguson, 2002). Figure 1 shows an image of M31, constructed from the WFC photometry, which shows the inhomogeneity of this system. Metal-poor/young stars are coded blue whilst metal rich/older stars are coded red. This spectacular image shows in amazing detail the wealth of information that the INT is helping to reveal about the structure of this previously invisible region of galaxies. The most obvious piece of substructure visible in Figure 1 is the giant stellar stream (visible in the south-east). This extends to near the edge of our survey —a projected distance of some 60 kpc (Ibata, 2001). In fact, by examining the systematic shift in the luminosity function of the stream as a function of galactocentric radius, we find its actual length is much greater than 100 kpc (McConnachie, 2003). The similarity of the colour of this feature with the loop of material at the north of the survey suggests a connection: deep follow-up imaging using HST/ACS confirms that they possess the same stellar population (Ferguson, 2004a). It seems likely that the northern feature is an extension of the stream, after it has passed very close to the centre of the potential of M31 (Font, 2004; Ibata, 2001).

A second large stellar stream candidate has also been identified with the INT WFC photometry (McConnachie, 2004c). The visible part of this feature

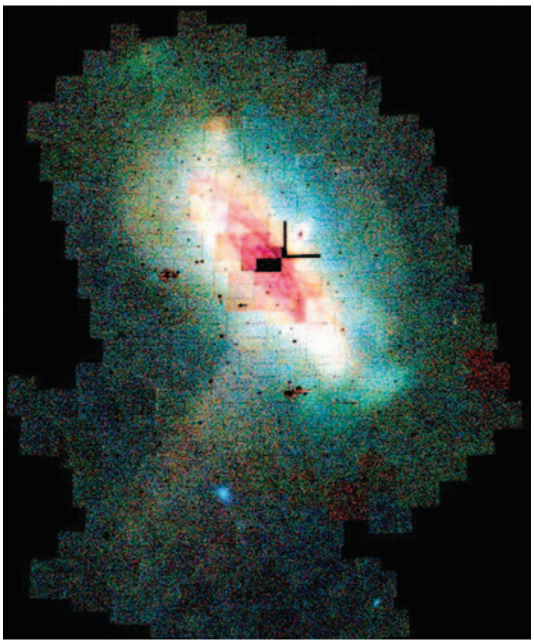

Figure 1. A multi-colour mosaic of the INT WFC survey of M31, involving 165 individual pointings over 40 square degrees of the sky. North is at the top, and East is to the left of this image. Metal poor/young stars are coloured blue, while metal rich/old stars are coloured red. The (colour-dependant) substructure is obvious, and surprising given the pristene nature of the Galactic disk. The dwarf galaxies Andromeda I & III are visible at the bottom left of this figure; the newly discovered dwarf spheroidal, Andromeda IX, is just visible at the top left as a small blue dot. NGC 205 is also visible in this figure, at the right-hand side of the disk.

is some 15 kpc long and Figure 2 shows a cartoon of its location. The progenitor of this feature appears to be the satellite galaxy NGC 205, although this awaits spectroscopic confirmation. This object has long been known to be tidally perturbed (Choi, 2002; Hodge, 1973) but it is only now that the full extent of its disruption is becoming clear. Considerable amounts of other substructure exists in addition to these streams. For example, near the position of the famous M31 globular cluster, G1, lies a large blue clump of stars (bottom right of Figure 1) and opposite this across the minor axis, near the position of the famous HI warp, lies a redder one. The origin of both these features is currently undecided, as is the origin of the curiously sparse cloud of stars at the far north of our survey region.

As well as these and many other obvious substructures, the INT WFC is allowing the identification of previously unknown globular clusters in the halo of M31 (Huxor, 2004). These include some of the most distant so far discovered, at projected radii of

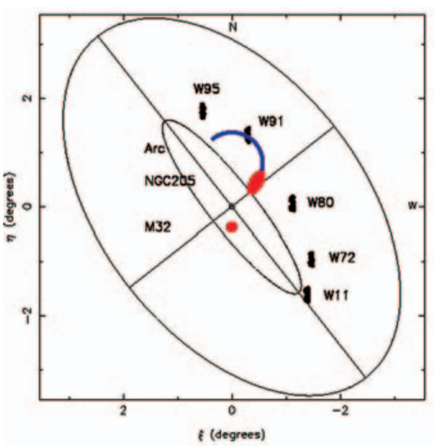

Figure 2. Cartoon showing the path of the new stellar steam candidate, the progenitor of which is thought to be NGC 205 (large red ellipse). Also highlighted are the location of several fields being used to probe the kinematics of the halo, as well as the dwarf elliptical galaxy M32. The stellar arc is some 15 kpc in length and may be able to shed light on the dynamical evolution of NGC 205, and provide a useful probe of the potential of M31. Although previously known to have been tidally perturbed, this is the first detection of a probable significant extra-tidal component of NGC 205.

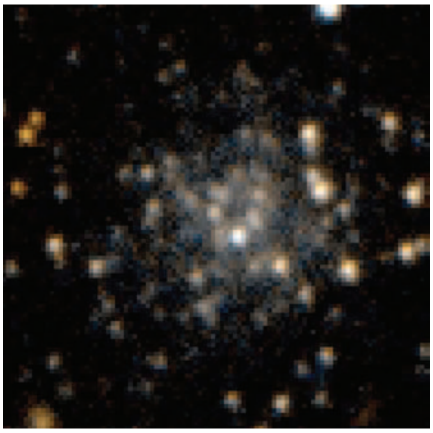

Figure 3. An example of a new class of globular cluster around M31, much sparser than typical globular clusters, being discovered by the INT WFC survey. Fourteen new globular clusters have so far been discovered, many at large projected radii.Three of these objects have morphologies similar to the above.The half- light radii of these clusters are significantly larger than normal. Follow-up spectroscopic observations should yield important information as to their true nature.

~80 kpc. So far 14 have been found, including a whole new class of cluster, much sparser than typical globulars. These objects, of which three candidates have currently been identified, are far less concentrated and have larger half-light radii than normal, making their appearance fuzzy and diffuse. A colour image of one of these objects, created from our photometry, is shown in Figure 3. The identification and quantification of the globular cluster system provides yet another valuable handle on the accretion history of this giant galaxy.

The other spiral in the Local Group, the Triangulum Galaxy (M33), has also been surveyed with the INT WFC (Ferguson, 2004b). The structure of this galaxy is striking in comparison to M31. Figure 4 shows the distribution of stars in this object and the *lack* of substructure is immediately obvious. It appears that not all spiral galaxy haloes need look like M31, and it raises the question: is there such a thing as a 'typical' stellar halo?

There is then the question of the M31 dwarf satellite galaxies, several of which are visible in Figure 1. In total, we now have INT WFC photometry for all of M31's satellites visible from La Palma. A three dimensional map of the Andromeda subgroup, created from our measurements, is shown in Figure 5. The homogeneous nature of our data has allowed accurate and internally self-consistent distances and metallicities to be measured for each of these galaxies(McConnachie, 2004a, 2004b). This allows us for the first time to reliably probe the three dimensional spatial distribution of these objects, revealing that far from being isotropically distributed and unbiased indicators of the potential of Andromeda, there are strong indications that these objects are preferentially located on the near side of Andromeda, towards the Galaxy. This result is unexpected, and intriguing.

The INT WFC survey of M31 and its environs has revealed, and continues to reveal, startling surprises about the faint surroundings of otherwise normal galaxies. Its tendency to raise more questions than answers seems to be continuing, and it offers a warning to studies of our own Galactic halo: given our position *inside* the Galaxy, how would we interpret our stellar halo if it looks in the least bit like M31? ¤

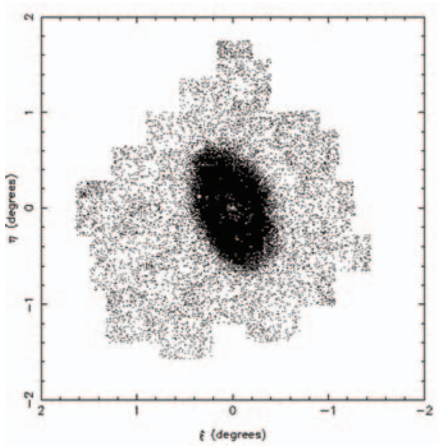

Figure 4. The spatial distribution of stellar sources in the INT WFC survey of M33, the Triangulum Galaxy. This is a small spiral, approximately one-tenth the size of Andromeda. The lack of substructure in this galaxy is in startling contrast to M31 —virtually no spatial inhomogeneities are present in this galaxy's outer regions.

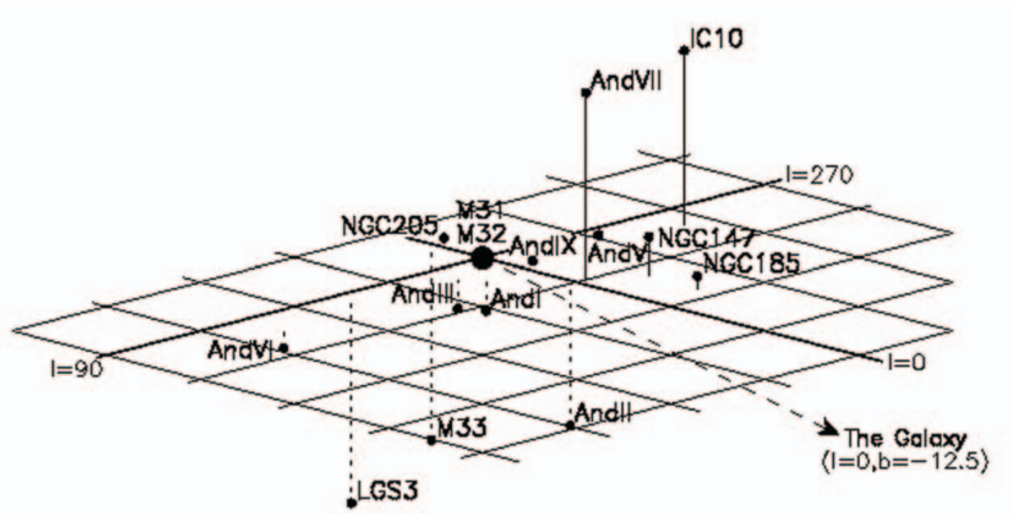

Figure 5. The distribution of the satellite galaxies of M31, as derived from our INT WFC photometry of these objects. The coordinate system is an M31–centric system. The plane is the plane of the disk of M31, and each cell corresponds to 100 kpc×100 kpc. l is a longitude measured around the disk of M31, such that l=0 is the longitude of the Galaxy. b is a latitude, measured from the disk of M31. Solid lines indicate objects located above the plane of the disk, while dashed lines indicate objects below the plane of the disk. A clear tendency for the satellites to lie on the near side of M31 can be observed, and suggests an intriguing correlation between the M31 satellites and our own Galaxy.

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The Bull's Eye Pattern in the Cat's Eye and Other Planetary Nebulae

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The end-point of the evolution of solar-type stars is essentially determined by the onset of a strong stellar wind, which, in a few hundred thousand years completely removes the star's gaseous envelope, thereby removing the fuel that has previously maintained the thermonuclear energy source in its interior. This phenomenon occur during a (second) phase in which the star becomes a red giant, the so-called the Asymptotic Giant Branch (AGB) stage. In the last million years of the AGB, the red giant is dynamically unstable and pulsates with typical periods of few hundred days: a prototypical star in this phase is Mira in Cetus. The mechanical energy of the pulsations pushes large amounts of material far away enough from the core of the star for it to cool down and condense into dust. This newly formed dust is further accelerated out of the gravitational bounds of the star by the pressure of the radiation coming from the hot stellar remnant. Gas, which is coupled to dust by collisions, also leaves the star in this process.

In the last hundred thousand years of the AGB, this mass loss process is so strong that the star is completely surrounded by a thick, expanding dust shell that makes it very difficult to observe what is going on inside it. One way to recover valuable information about this critical phase of stellar evolution is to study the progeny of AGB stars, i.e. planetary nebulae (PNe). These are nothing but the ejected AGB envelopes, heated by the radiation of the hot stellar core, and therefore emitting at the specific wavelengths (emission-lines) typical of the gas that they are composed of.

PNe are fantastic laboratories in which to study a variety of physical phenomena, for example, in the past many aspects of atomic and molecular physics have been addressed by studying PNe. More recently, PNe have become laboratories for investigating the (hydro)dynamical formation of shock waves produced by collisions between stellar winds, with the consequent formation of thin gaseous shells, and bipolar flows or jets which closely resemble those observed in other type of stars or in the nuclei of active galaxies. Now we know that if we understand the formation of the complex and spectacular shapes displayed by PNe, a lot can also be understood about the very late AGB evolution. A few years ago, we have in fact shown that a large fraction of PNe, perhaps the majority, are surrounded by large ionized haloes, one to ten thousand times fainter that their inner regions (Corradi et al., 2003). Figure 1 shows the halo of the well-studied Cat's Eye nebula (NGC 6543); other examples of PNe haloes can be found in the ING Newsletter No. 6, p. 35. These haloes are the fossil remnants of the strongest mass loss phase during the AGB, their edge corresponding to the last thermonuclear runaway (helium shell flash) which occurred in a thin shell inside the stellar envelope before the star left the AGB. These shell flashes are also called "thermal pulses" and occur every 100,000 years for a solar-like star. In thermal pulse, mass loss from the star is first significantly enhanced, and then quickly decreases. Therefore mass loss during the AGB is modulated by the thermal pulses, the last of which leaves an observable signature in the edge of the PNe haloes (the gas loss during the previous thermal pulses

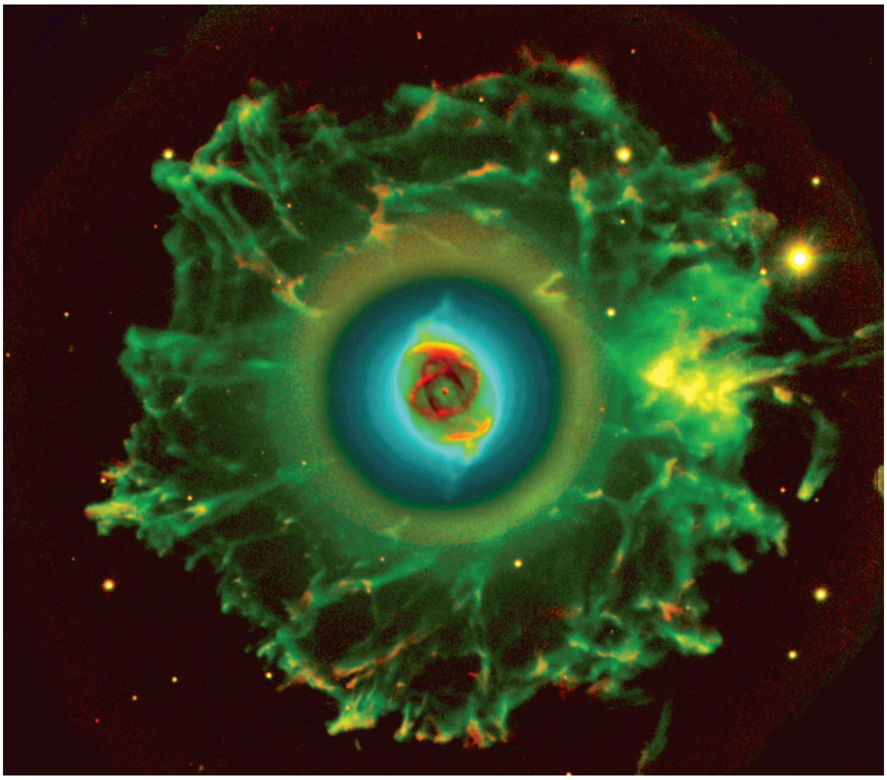

Figure 1. Image of the Cat's Eye Nebula obtained with the Nordic Optical Telescope at La Palma. Rings (displayed in blue in order to better visualise them), are located in the inner regions of the large filamentary halo of the nebula.

Figure 2. Image of Cat's Eye obtained with the Advanced Camera for Surveys (ACS) of the Hubble Space Telescope. Image credit: ESA, NASA, HEIC and the Hubble Heritage Team (STScI/AURA). See also `http://www.spacetelescope.org/images/html/zoomable/heic0414a.html`.

has already diluted so much that is hardly detectable).

In 1999, HST images of the Cat's Eye revealed the presence of a series of shells in the inner regions of its halo (Balick et al., 2001). They appeared to be produced by mass ejected from the star in a series of pulses at about 1500 years intervals during the last 20,000 years of the AGB evolution. Each shell contains about one hundredth of the mass of the Sun, i.e. approximately the mass of all the planets in the Solar System combined. When projected in the sky, these shells appear as "rings" (or sometimes "arcs") composing a sort of "bull's-eye" pattern. A new image of the Cat's Eye, showing the full beauty of the rings, was recently obtained with the ACS camera on the HST, and is displayed in Figure 2.

Discovery of these rings came as a surprise, as mass-loss modulation on a timescale of 1000 years was not predicted by theory (compare with the 100 times longer timescale of the recurrence of thermal pulses). First, it was thought that rings were a rare phenomenon, but recent observations taken with telescopes at ESO and La Palma, and mainly with the Wide Field Camera of the 2.5 Isaac Newton Telescope, have instead shown that these structures are likely the rule rather than the exception (Corradi et al., 2004). They are thus of general relevance to understanding the large mass loss increase that characterises the end of the evolution of a star like the Sun. Figure 3, left, shows examples of these rings in three PNe; these structures are better highlighted by appropriate image processing (e.g. logarithmic derivatives or variations of this method, as shown in Figure 3, right).

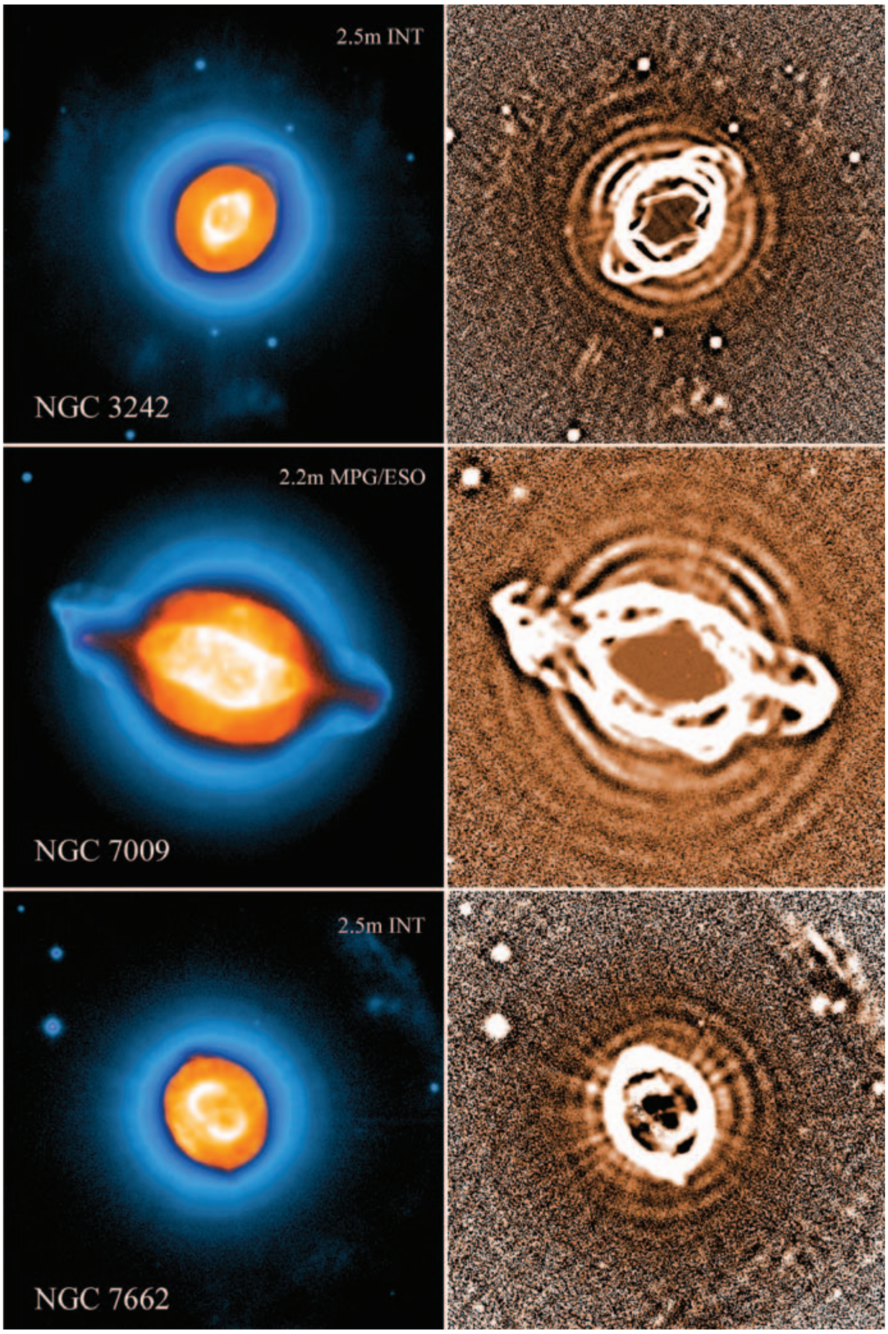

Figure 3. Images of rings recently detected in PNe. Left: [OIII] images. Right: the same images processed to enhance the rings (Corradi et al., 2004, adapted from the A&A cover, April 2004 issue).

Several mechanisms have been proposed for the formation of these rings. They include binary interaction (but the large detection rate weakens this hypothesis), magnetic activity cycles, or stellar pulsations caused by instabilities in the hydrogen burning shell inside the AGB envelope. Another possibility is that gas is ejected smoothly from the star, and rings are created later on due to formation of hydrodynamical waves in the outflowing material that are caused by a complex coupling between gas and dust. This is an appealing hypothesis, as it comes out naturally from our present knowledge of the physics of the AGB mass loss. In any case, whatever the correct explanation, it is clear that any AGB mass loss theory should now confront the evidence that these rings are frequently found in PNe, and thus contain important information relating to the very late evolution of a large fraction of stars in the Universe. ¤

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TELESCOPES AND INSTRUMENTATION

GLAS: A Laser Beacon for the WHT

René Rutten (Director, ING)

In January 2004 the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) announced its full support for the proposed development of a laser beacon for the NAOMI Adaptive Optics (AO) system on the 4.2-m William Herschel Telescope (WHT). Such a laser guide star system will amplify the fraction of sky available to AO observations at visible and infrared wavelengths from about one percent to nearly 100%. In terms of astronomical research, this translates into radical progress as it opens up high spatial resolution observations from the ground to nearly all types of science targets. In combination with the existing and planned instrumentation, the WHT will offer a highly competitive facility to the astronomical community, exploiting a window of opportunity before similar capability will exist on 8-m class telescopes.

AO techniques allow ground-based observers to obtain spatial resolutions better than a tenth of an arcsecond by correcting the image blurring introduced by the Earth's atmosphere. Hence the resulting image sharpness not only carries the advantage of distinguishing finer structure and avoiding source confusion in dense fields, but it also allows observations to go significantly fainter, as the sky background component reduces with the square of the angular resolution. For these reasons, AO instrumentation is being planned for nearly all large telescopes, and it is at the heart of the future generation of extremely large telescopes.

At the WHT, AO recently came to fruition with the commissioning of the common-user AO system, NAOMI, and an aggressive instrument development programme. A main practical limitation for AO is the availability of bright guide stars to measure the wavefront distortions, which has caused AO in general to produce fewer science results than one might have expected from its potential. By using an artificial laser guide star this limitation is largely taken away, thus opening up AO to virtually all areas of observational astronomy and to virtually all positions in the sky. In particular, it opens up the possibility of observing faint and extended sources, and will enable observations of large samples, unbiased by the fortuitous presence of nearby bright stars. With a laser guide star facility, a 4-m class telescope situated on a good observing site like La Palma is highly competitive for AO exploitation next to the larger telescopes. Examples of science areas that may profit from the laser facility are the search for brown dwarfs and disks around solar type stars in obscured star formation regions, super-massive black holes, dynamics of nearby galaxy cores, circumnuclear starbursts & AGN, gravitational lenses, and physical properties of moderately high redshift galaxies.

Since January this year work started on designing the various components of the laser beacon system. Although maybe not a project of a very large scale, the complexity is quite significant and offers various challenges for engineers and astronomers alike. The project will be a joint endeavour with, besides ING, participation from the University of Durham, the ASTRON institute in the Netherlands, the University of Leiden, and the Instituto de Astrofísica de Canarias. Below we will set out the main components and challenges of the laser system and summarise the performance prospects.

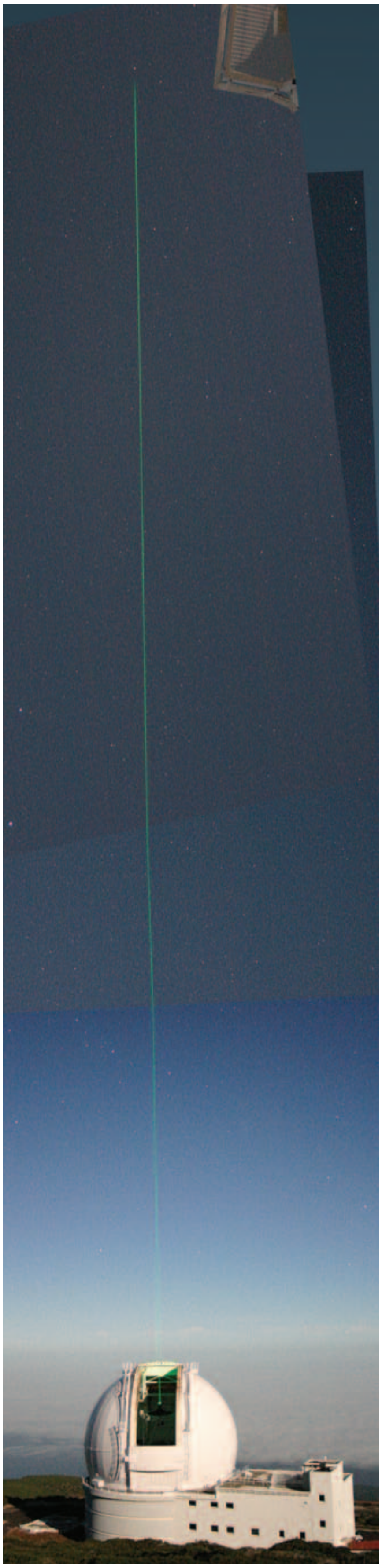

Figure 1. The Durham laser experiment in action at the WHT in April 2004.

Laser Guide Stars Basics

The idea is simple: a laser beam is used to generate a point source as high as possible in the sky, projected towards the same area as where the telescope is pointing. That laser beacon illuminates the atmospheric turbulence above the telescope and is used for sensing the corrugation of the wavefront caused by that turbulence. The higher the laser beacon is projected the better it is, as in that way it best approximates a source from infinity.

There are basically two ways to produce a laser beacon: either exploiting a layer of relatively high sodium density in the atmosphere at some 90 km, or 'just' using back scatter in the atmosphere. The sodium laser option is technologically very demanding for reason of laser technology and for the implications it has on the design of the AO system. The Rayleigh laser, however, is somewhat easier as it can use existing off-the-shelf laser technology which is also much less expensive and easier to maintain. The Rayleigh has however the disadvantage that the beacon will at best be at an altitude of some 20 km. The lower elevation implies that atmospheric turbulence very high in the atmosphere will not (properly) be sensed. Turbulence close to observatory will be well measured, and therefore it is often referred to as ground-layer AO. This feature has given the name to the laser project for the WHT: GLAS, for Ground layer Laser Adaptive optics System (or better in Dutch, Grondlaag Laser Adaptieve optiek Systeem).

Evidence built up over the years indicate that ground-level turbulence often dominates, a nice example of which is shown in the paper in this Newsletter by García et al. Over the next several months more solid experimental data will be gathered about the turbulence characteristics.

System Overview

First of all, the Rayleigh laser system is designed to work in conjunction with existing AO equipment (NAOMI) and its ancillary instrumentation and infrastructure like the INGRID IR camera and the OASIS integral-field spectrograph. A powerful 25 to 30W pulsed laser will be focussed to some 20 km altitude from a launch telescope mounted behind the secondary mirror. The pulse will produce a short (tens of meters) column of light that travels through the atmosphere. The Rayleigh back scattered light from this pulse will find its way back to the telescope. About 10% of all the light is scattered into the atmosphere, but of course in all directions and along the full depth of the atmosphere. Only a very small fraction of the laser light returns to the telescope and can be used to sense the turbulence, hence the need for a powerful laser in order to produce a beacon that is bright enough to serve for AO.

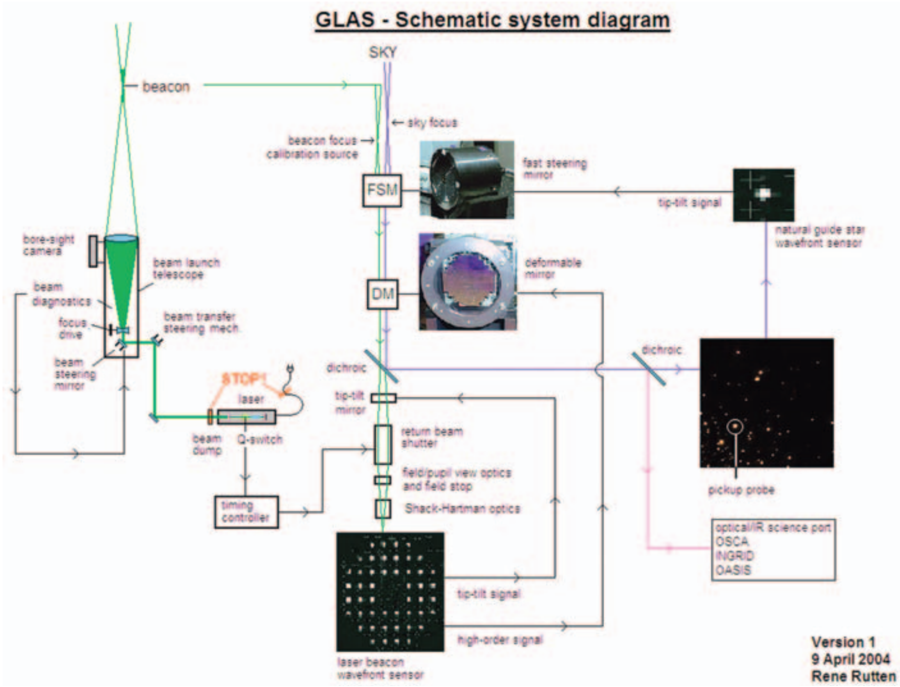

Figure 2. System diagram for the GLAS and NAOMI system.

Only photons returning from a certain set altitude range are useful to us. Hence unwanted photons have to be blocked from entering the detector. This will be done using a combination of a geometric filter that will obstruct most of the unwanted light, and a very fast electro-optical Pockels cell shutter. The timing of this Pockels cell shutter opening will be slaved to the laser pulse signal, and open exactly when the Rayleigh scattered light from an altitude of 20 km returns to the telescope. The very short period during which the shutter remains open sets the length in the atmosphere over which the laser beacon will extend.

Having passed the shutter, the Rayleigh back-scattered light will be detected by a wavefront sensor system that measures the instantaneous wavefront shape from the laser guide star. The results from this measurement, some 300 times per second, will provide the demanded shape that the deformable mirror of the AO system will have to take in order to correct for the wavefront corrugation.

So far the situation is very similar to a 'standard' natural guide star AO system, except that laser light is used rather than light from a star. However, as the laser light travels through the atmosphere twice along more or less the same path, the measured wavefront does not contain information on the overall image shift (tip-tilt) caused by the atmosphere. Hence to measure the tip-tilt component still a natural guide star is required, but such star can be quite faint and may be relatively far away from the science object.

The existing wavefront sensor system will be dedicated to tip-tilt measurements on a star. The requirement for having such star near the science object still poses a limitation on the effective sky coverage. To maximise our chances of finding a suitable star even more, the existing wavefront sensor will be upgraded with a Low-Light-Level CCD that has virtually zero read noise and would give us an extra magnitude in faintest detectable star. As can be seen in the adjacent figure (courtesy Remko Stuik, Leiden) the *conservatively estimated* sky coverage will be extremely good, even at the galactic pole.

The laser light scattered into the atmosphere of course has to be blocked from entering the science instruments, both at the WHT as at other telescopes at the observatory. Within NAOMI a dichroic mirror will block the laser light from going into the science beam. But the situation with other telescopes is more complicated and requires a coordination of laser operation and the pointing of all telescopes that might be affected in order to avoid that some telescope will inadvertedly cross the laser beam. Much experience with this problem has been obtained at Mauna Kea observatory where such a laser traffic control system has been put into operation. A similar system will be put into operation at La Palma. The system will collect pointing information and inform all telescopes whether or not there is a risk of crossing the laser beam. If necessary the laser beam will automatically be intercepted.

Performance Expectations

In preparation for this project, various performance predictions were carried out by Richard Wilson at Durham University. As the main scientific niche for AO at the WHT rests with the visible light OASIS integral-field spectrograph the focus is on achieving moderate but significant improvements of image quality down to 0.6 nm. It is unrealistic with current technology to aim for high Strehl ratios at these wavelengths. But as the calculations below show, image FWHM will improve very significantly at short wavelengths and performance in the near IR is even better.

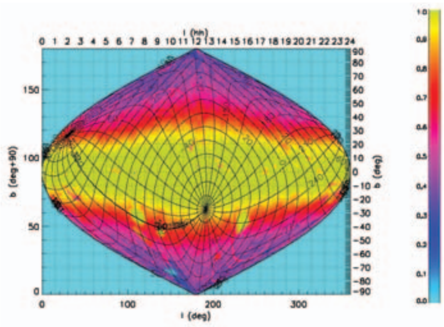

Figure 3. Representation of the sky coverage for finding a star brighter than R=18 within a search diameter of 1.5 arcminutes (courtesy Dr Remko Stuik, Leiden University).

The model calculations were designed to deliver realistic figures for the expected improvement of image quality as a function of seeing, wavelength, natural guide star brightness, and distance of the natural guide star to the science object. A typical profile of atmospheric turbulence strength with height was assumed. The following table shows a few of the model results. The model calculations indicate very attractive improvements in image quality when NAOMI will be used with a laser beacon. But of course above all, the laser enhancement will provide such performance for nearly any point in the sky, thus opening up the exploitation of AO to surveys of large number of targets.

	R-band FWHM (")	H-band FWHM (")
Faint tip-tilt star on-axis		
Typical seeing (0.74")	0.28	0.14
Good seeing (0.54")	0.17	0.12
Faint tip-tilt star at 60 arcsec		
Typical seeing (0.74")	0.32	0.17
Good seeing (0.54")	0.21	0.15

Scientific Invitation

The GLAS project will open up a new exciting area of astronomical exploitation for the William Herschel Telescope. There is much work ahead, and much to learn on how to optimally use the future new facility. Moreover, an added attraction of the laser system is that it can serve as a testbed for concepts of future laser systems at much larger telescopes.

Progress on this project will be reported in future articles in this Newsletter. If you are excited about the prospects as we are, and interested in working with us to define detailed scientific plans, don't hesitate to contact us. ¤

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Cute-SCIDAR: An Automatically Controlled SCIDAR Instrument for the Jacobus Kapteyn Telescope

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In February 2004 the Cute-SCIDAR instrument was installed at the 1m Jacobus Kapteyn telescope (JKT) for a systematic monitoring of the atmospheric turbulence at the Observatorio del Roque de los Muchachos (ORM). The proper knowledge of the atmospheric turbulence structure is crucial for optimising the efficiency of adaptive optics systems. SCIDAR has proved to be the most contrasted and efficient technique from ground level to obtain the optical vertical structure of the atmospheric turbulence. The classical (Vernin & Roddier, 1973; Rocca, Roddier & Vernin, 1974) and generalised SCIDAR (see e.g. Klueckers et al., 1998; Ávila, Vernin & Masciadri, 1997; Fuchs, Tallon & Vernin, 1994) techniques analyse the scintillation patterns produced at the telescope pupil by the light coming from the two stars of a binary system. Turbulence profiles as a function of height, C_N^2 (h), are derived through the inversion of the autocorrelation of scintillation patterns. Wind vertical profiles, V(h), are derived from the cross-correlation of a series of scintillation patterns relative to a reference pattern. Figure 1 sketches the SCIDAR technique.

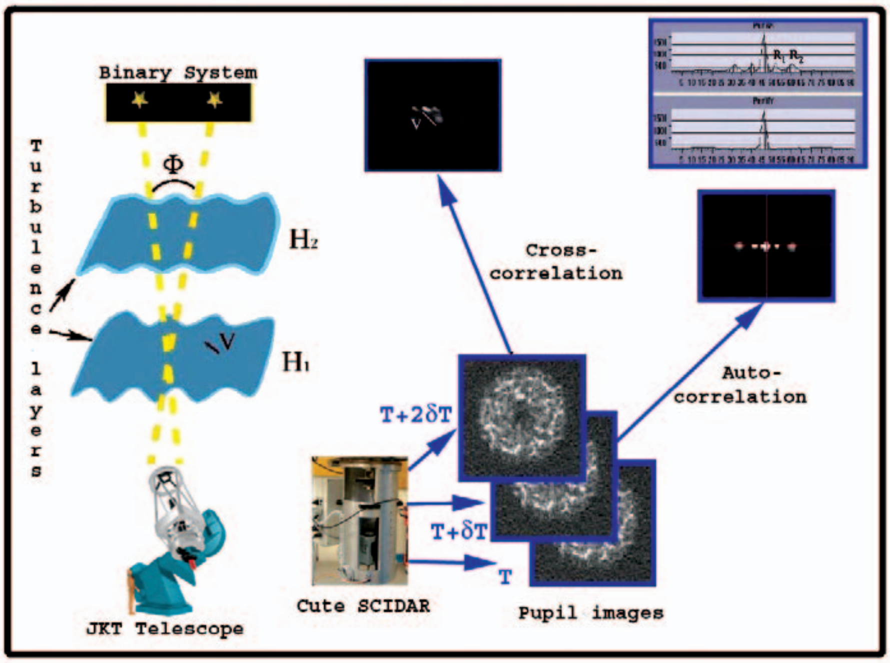

Figure 1. SCIDAR technique layout. From the observation of binary stars, we get a stack of consecutive images of scintillation. The average auto-correlation function of them gives information of the C_N^2 profiles, and average cross-correlation functions give the wind of the layers.

The main drawback of SCIDAR observational campaigns is the tedious setting up of the instrumentation and the computational effort needed to infer the nightly turbulence and wind profiles. Therefore, systematic recording of turbulence and wind structure requires a huge number of highly qualified human resources. Consequently, the development of a fully automated SCIDAR device is of increasing importance to characterise the atmospheric turbulence and fix the input requirements and limits of the future multi-conjugate adaptive optic systems to be installed at the ORM. The Instituto de Astrofísica de Canarias (IAC) has developed a SCIDAR instrument providing high performance in automatic control and data reduction, the Cute-SCIDAR. It has been designed for the 1m JKT, with the goal of monitoring the vertical turbulence with a high temporal coverage. This device is not only restricted to the JKT but can also be used on other telescopes.

Technical Description

Figure 2 presents the optical scheme of the SCIDAR instrument. From the observational point of view, the SCIDAR technique requires that the detector is able to move along the optical axis to allow selection of the different conjugated planes. Moreover, the rotation around the optical axis is most than desirable for a SCIDAR instrument: because the star beams should be properly orientated on the detector (with its rows) in order to simplify the data reduction.

The Cute-SCIDAR allows the automatic control of any of the SCIDAR instrument components. The detector is lodged in two devices permitting the motion in the XY plane (perpendicular to the optical axis) to correct the small flexure displacements in the observational plane. The maximum range in the XY plane is 25 mm. A long electronically controlled rail to place the detector in the adequate conjugated plane provides the movement along the optical axis, Z direction. This motion also facilitates the instrument focusing procedure, since it permits to easily verify (using a single star) the state of collimation of the beam. The maximum displacement in the Z direction is 300 mm. The current detector is a commercial sensitive CCD camera of PCO. The instrument can rotate up to 270° with respect to the telescope through a crown wheel. Another complementary mechanism is a diaphragm, placed in the focal plane of the telescope (see the scheme of Figure 2), and also electronically controlled. The diaphragm mechanism permits the proper alignment of the observing binary star with the instrument optical axis. After a short successful commissioning at the Carlos Sánchez telescope at the Observatorio del Teide in Tenerife, the Cute-SCIDAR was installed at the JKT in February 2004. Figure 3 (left) shows the Cute-

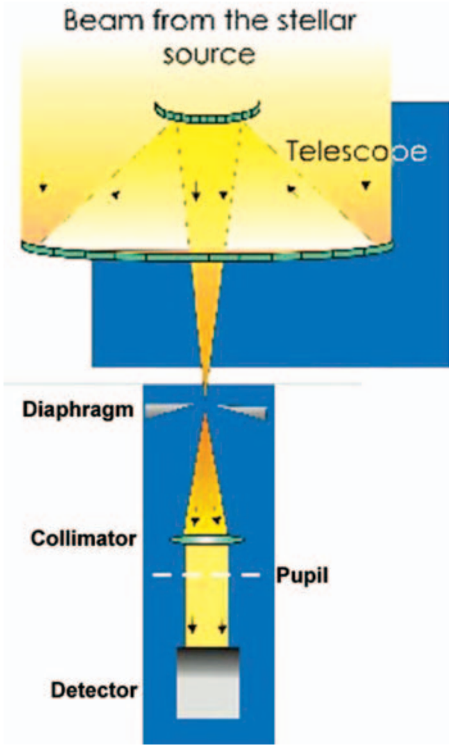

Figure 2. SCIDAR instrument optical scheme.

SCIDAR already installed at the JKT. Figure 3 (right) shows the essential instrument components. In this figure, we can see the diaphragm and collimator (1) within the instrument cover. The detector can be seen at the bottom opened door (2) and the crown wheel is the golden ring (3) connecting the instrument and the telescope. The label (4) indicates the electronic box controlling the mechanical elements of Cute-SCIDAR.

Control Software

A specific software package for the control of the different mechanical components and a pre-processing on-line data evaluator has been developed. A user-friendly interface based on MS-WINDOWS XP allows handling the different instrument components from the telescope control room. Figure 4 shows an example of the quick-look data interface: the left upper image corresponds to the pupil image of a binary star (the data recorded at the detector), and the right upper plot is the 2D normalised auto-correlation of this image; the bottom plots are cross-correlations of the left upper image and a reference image. The bottom right plot is a X-cut along the 2D autocorrelation function showing the presence of at least two turbulence layers (the two peaks to the left and right of the central brightest peak).

Observational Campaigns at the JKT

After a successful commissioning of the Cute-SCIDAR at the JKT last February 2004, we have started a monitoring program of the atmospheric turbulence. We are carrying out monthly one-week observing SCIDAR campaigns and we already have data corresponding to 30 nights of observations. On each night we can record more than 1500 different atmospheric turbulence vertical profiles above the Observatorio del Roque de los Muchachos. Preliminary results obtained from these data have been recently presented to the astronomical community (Fuensalida et al., 2004; Hoegemann et al., 2004; Fuensalida et al., 2003). Figure 5 shows the temporal evolution of the atmospheric turbulence profiles along an observing night at the JKT. In this figure, the X-axis corresponds to the time (in UT) along the night referred to midnight.

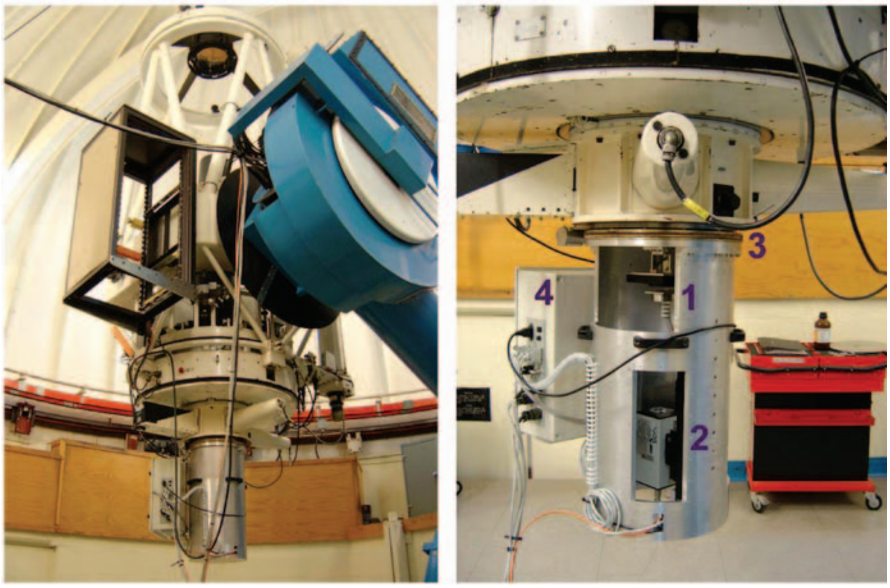

Figure 3. Views of the Cute-SCIDAR instrument installed at the Jacobus Kapteyn Telescope.

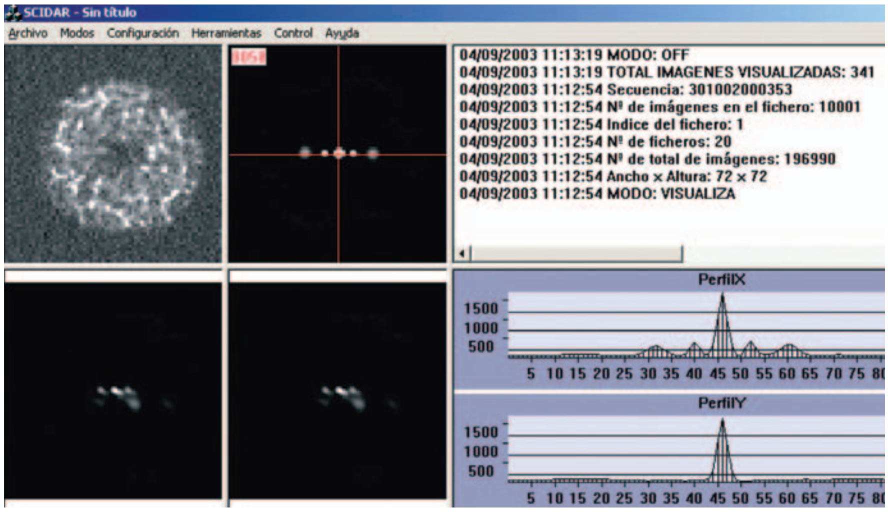

Figure 4. User interface window showing an example of the on-line data evaluator.

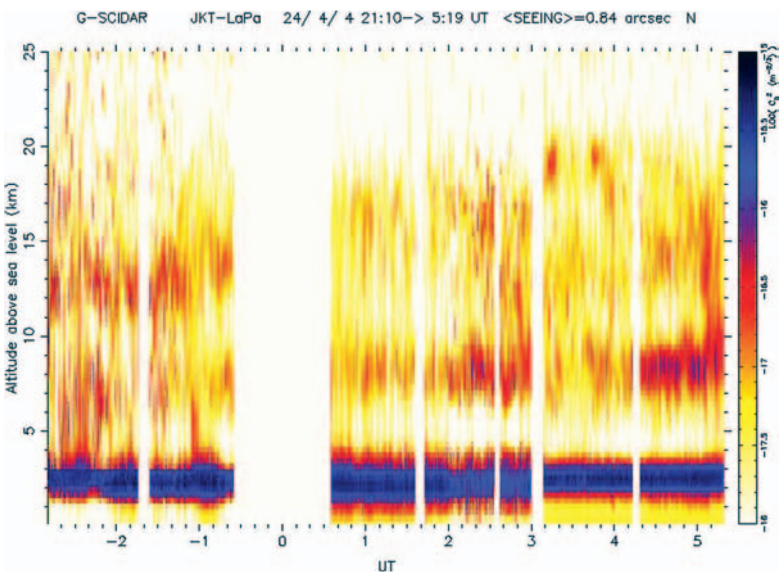

Figure 5. Evolution of turbulence vertical profiles at the Observatorio del Roque de los Muchachos during the night of 23-24 April 2004. The mean seeing derived from these profiles was 0.84 arcsec being in good agreement with the DIMM measurements.

The Y-axis is the altitude above sea level, and the colour bar on the right side indicates the values of $C_N^2(h)$. The dome seeing contribution has been rejected.

In semester 2004B we will continue the monitoring of the turbulence structure at the JKT after the extension of the agreement with the Isaac Newton Group of Telescopes. The Cute-SCIDAR team thanks the staff of the Isaac Newton Group of Telescopes for their usual high standard of service. ¤

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SuperWASP: The Trials and Tribulations of a Remote Inauguration Ceremony

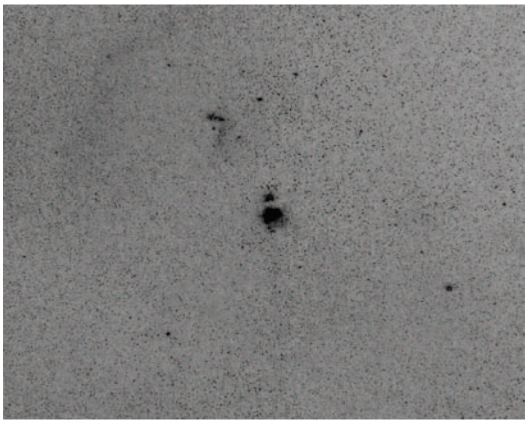
Don Pollacco (Queen's University Belfast), Ian Skillen (ING), Javier Méndez (ING) and the WASP Consortium

It is ironic that in this technical age we live in there are few professional facilities in operation that are designed to monitor the sky at optical wavelengths. Historically, this work has been left to dedicated amateur astronomers often using observatory grade equipment. Part of the reason for the absence of professional projects is the lack of reliable equipment and the huge data rates involved. The SuperWASP facility is an attempt by professionals to join in the exploitation of the time domain. It is the rapid development of robotic technology and affordable, but powerful, computing that has made this project feasible.

The main science aims of SuperWASP include the detection of extra-solar planets (the so-called *hot-Jupiters*), optical counterparts to Gamma-Ray Bursters and rapidly moving near-Earth asteroids. While the UK Particle Physics and Astronomy Research Council (PPARC) provided some seed funding for SuperWASP, the bulk of the funding came from the Queen's University Belfast (QUB). Other contributions came from the Open University, the Royal Society, Andor Technology and St. Andrews University. The QUB funding became available in March 2002.

Those of you who have been out to La Palma over the last year may have noticed the appearance of the SuperWASP enclosure on the Roque. In fact avid viewers of the CONCAM all-sky images noticed that the building was erected during the day of the 6th July 2003. Shaped like a garage sized shoe box but with a peculiar stepped-roof, it is sited on the hillside below the JKT towards the Swedish Solar Telescope. The enclosure is composed of two rooms with the instrument itself located at the southern end of the building and the control computers at the other end.

Figure 1. SuperWASP at dusk on the 27th November 2003 — first light. The WHT dome is in the background (photo courtesy Jens Moser).



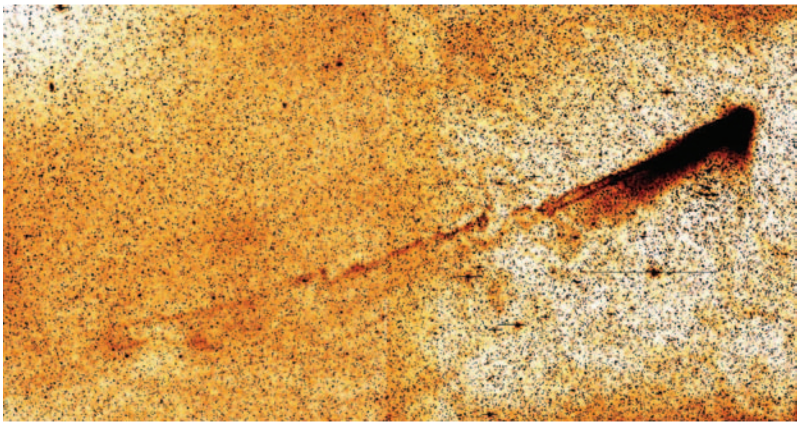


Figure 2 (left). First light mosaic image of the southern part of Orion. In this 1 second exposure the horse head nebula and Barnard loop are clearly visible along with some 35,000 stars.

Figure 3 (right). A two chip mosaic of Comet Neat on 15th May 2004 (courtesy of Alan Fitzsimmons). Wow!

During normal operations the roof above the instrument slides, under hydraulic pressure, onto the computer room end, and the cameras are exposed to the sky. The SuperWASP cameras are contained within a cradle and mounted in place of a telescope tube in an equatorial fork mount.

Compared to, for example the INT Wide Field Camera, the field of view of SuperWASP is truly awesome: currently about 1200 times larger. To achieve this SuperWASP is composed of five cameras each having a dedicated telephoto lens and CCD detector. The lenses image onto the detector at low angular resolution (14 arc seconds per pixel) hence allowing a large field of view for the camera. This design allows us to achieve accurate photometry on bright objects (<1% for stars brighter than magnitude 13 for a single 30 second integration). However, with such large angular pixels the sky level is quite bright which limits the magnitude of objects detected (3σ detection at magnitude 16.5 per 30 second integration). SuperWASP is able to accurately measure the brightness of millions of stars in a single night.

The equatorial mount, along with the observatory control software, TALON, is the heart of SuperWASP. TALON controls all observatory functions (e.g. monitoring the weather station, GPS time service, etc.), as well as indirectly controlling all CCD cameras via their data acquisition computers. The computer room is protected by a telecommunications grade air conditioning plant. The detectors themselves are the 2048×2048 pixel e2v42 CCD devices familiar to WHT users, but are thermo-electrically cooled. The optics are the now obsolete Canon 200 mm F1.8 telephoto lenses, often described as "the fastest telephoto lens available".

After obtaining planning permission on La Palma, construction of the facility began in June 2003. In July, we erected the enclosure using probably the most highly qualified labourers available (and the worst paid!) followed by the associated electrical and communications work. By mid-August we installed the fork mount and built up the computer systems. By September 2003 we had completed the first pointing models with the mount and started to build up the camera cradle —initially with 4 detectors included. Engineering first light occurred late in the month. After a break for engineering work (and to give a lecture course) true astronomical first light occurred in late November 2003 — some 21 months after the funding became available. SuperWASP then regularly obtained data up until Christmas. We had a scheduled break for three months to address some of the many technical issues highlighted from our operational month, as well as to re-engineer some of the camera heads. The data from that period has proved invaluable in debugging the reduction pipeline prior to commencement of normal operations scheduled for mid-April 2004.

As is common with new instruments we decided to hold an inauguration ceremony for the facility and it seemed like a good idea to hold this event at the start of operations on Friday 16th April 2004. However, as the date approached and with the detectors stuck with DHL in Madrid for several weeks (they arrived there a few days after the tragic terrorist attacks), we became more concerned that we may be forced to inaugurate the facility with just the single detector left on La Palma. Just to compound our problems, the weather on the Roque had been somewhat unpredictable with a severe cold spell. After several interventions on our behalf by various bodies, the detectors finally arrived back on the Roque on Monday 12th April, whereupon we built up the camera cradle. By Wednesday the weather had turned worse with a blizzard laying some 10 cm of snow overnight. At 3 pm the day before the inauguration was due to take place we took the decision to abandon the event at the summit, and after some discussion, to hold the event at the ING sea-level base. The IAC representatives rearranged the press and other official matters, and at the same time we rearranged the social activities.

Tests Thursday morning had shown that, in principle, provided the network traffic wasn't too high, we could run SuperWASP remotely from sea level.

Thursday afternoon we reconfigured the observing system to include streaming video from our internal network camera as well as a view of the building from our external camera. SuperWASP had always been designed to be able to be run in this way, but the weather conditions had forced us to attempt this operational mode several months before we expected to. We were surprised it worked so well! For the inauguration we would attach a red ribbon to the camera cradle which would (in principle) fall to the ground as the instrument was moved. At this time our UK based guests were also arriving, including Professor Kenny Bell (Pro-Vice-Chancellor at QUB) and Professor Martin Ward (Chair of the PPARC Science Committee).

Figure 4. A moment of the remote inauguration ceremony of SuperWASP on 16th April 2004 from ING's sea-level office in Santa Cruz de La Palma.

Surprisingly the weather on the Roque on the day of the inauguration ceremony stayed fair but cold. With the remnants of the snow still around and some ice still on the road we felt vindicated in our decision to move to sea level. The event itself went almost exactly to plan, culminating with the Mayor of Garafía moving the cameras and the ribbon falling. This was just as well: there was no reserve plan, no pre-recorded videos of the instrument running. The only slight (well amusing) flaw occurred when after the ceremony the TV cameras asked to repeat the final part of the ceremony during which the ribbon stubbornly refused to fall until discreetly helped! Ironically the weather had forced us to *remotely inaugurate a robotic instrument* —a first as far as we are aware, and most satisfying given the adverse conditions we faced at the time.

SuperWASP has now moved into the operational phase. At the time of writing the facility is running automatically but not yet robotically. During normal observing SuperWASP takes 30 second integrations which after allowing for readout and telescope movements results in, on average, about one integration every 60 seconds (for each camera). Each detector produces an image of 8.3 MB in size, hence an average night with the current system results in about 25–30 GB of science and calibration data. At the end of the night this is written to DLT tape and shipped back to QUB for analysis. After reduction the brightness measurements are stored in a database hosted (and funded) by Leicester University (LEDAS). We are currently gaining valuable information on how to run this instrument efficiently with a view to running a limited (attended) robotic mode in late 2004.

New funding, obtained by Keele and St. Andrews Universities, will allow the full expansion of SuperWASP (8 camera units giving a field of view of some 500 square degrees), as well as the construction of a clone facility destined for SAAO. In this configuration SuperWASP will be able to image the available part of the celestial sphere in only 67 pointings (with these optics), while the *visible sky can be surveyed in less than 40 minutes*. Thus SuperWASP can efficiently monitor the whole sky. Do not be deceived: it may be small but it's powerful!

The WASP Consortium is composed of astronomers from the UK Universities of Belfast, Cambridge, Keele, Leicester, Open, St. Andrews as well as the IAC and ING. We are indebted and grateful to the staff of both the IAC and ING for their enthusiasm and support for this project, and look forward to a fruitful collaboration in the months and years ahead. ¤

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WHT Auto-guider/TV Upgrades

Simon Tulloch (ING)

During the last year the ageing RGO auto-guider heads have been gradually phased out and replaced with new higher performance cameras. These new cameras use ex-science camera SDSUII controllers freed up in the wake of restructuring and the same data acquisition system (UltraDAS) used by the science cameras. This gives considerable advantages with regard to spares and maintainability.

The new heads can be loaded with two kinds of detector which are pin-compatible, differing only in their number of pixels. The small format heads contain a CCD5710 which has an image area of 512×512×13µm pixels. The larger format heads use a

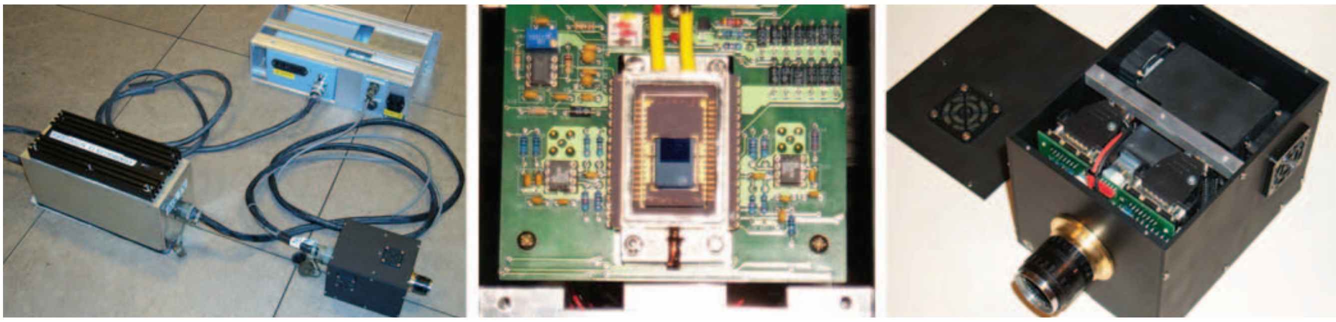


Figure 1. Left: the Auto-guider/TV hardware: Head, Controller and PSU rack. Middle: small format detector mounted on its PCB. Right: the complete Auto-guider/TV head.

CCD4720 with an image area of 1024×1024×13µm pixels. The CCDs were supplied in hermetically sealed packages with integral Peltier coolers which should improve reliability (the previous heads required a continuous dry nitrogen flush to prevent condensation forming on the detector). The Peltier cooling reduces detector dark current to well below $1e^{-}$ per second. Heat from the Peltier device is dissipated in a finned heat sink that is force cooled by two small fans located within the head. The CCDs are mounted onto a small circuit board that provides pre-amplification of the video signal as well as static protection. Even when connected to their controllers through a 2.5m cable, a read noise of $4-5e^{-}$ is obtained, similar to the level of the science cameras. The detectors are thinned backside-illuminated with mid-band AR coatings that give QEs of >90% at 600 nm.

These in-house designed cameras will eventually replace the Cryocam TV systems also. As they use Frame Transfer CCDs they will be more reliable than the mechanically shuttered Cryocams. Their smaller format, however, means that a focal reducer must be used to obtain the same field of view and allow them to view the entire ISIS slit. A replacement for the TV scale 12 slit viewing optics barrel is currently under construction and should be delivered in September 2004. Once installed at this station the new TV camera will also be capable of slit-guiding. Its images can also be archived in FITS format with full headers to accompany the spectroscopic images obtained with ISIS.

Five cameras are now currently in use at the following WHT stations: CASS Auto-guider, PFIP Auto-guider, AF2 TV, INTEGRAL Auto-guider, NAOMI Acquisition TV, NAOMI Simplexing Camera. Stations still to be filled are: CASS TV (awaiting new optics) and Integral TV (awaiting new head). Two more heads will be built; we already have the detector for the first of these.

The cameras are controlled primarily through dedicated GUIs where the auto-guiding and TV operations can be controlled by the click of a mouse. Alternatively the user can use the standard uDAS syntax to set up windows and do runs in the normal way. Below is a selection of images obtained using these cameras during the commissioning phase. ¤

Simon Tulloch (smt@ing.iac.es)

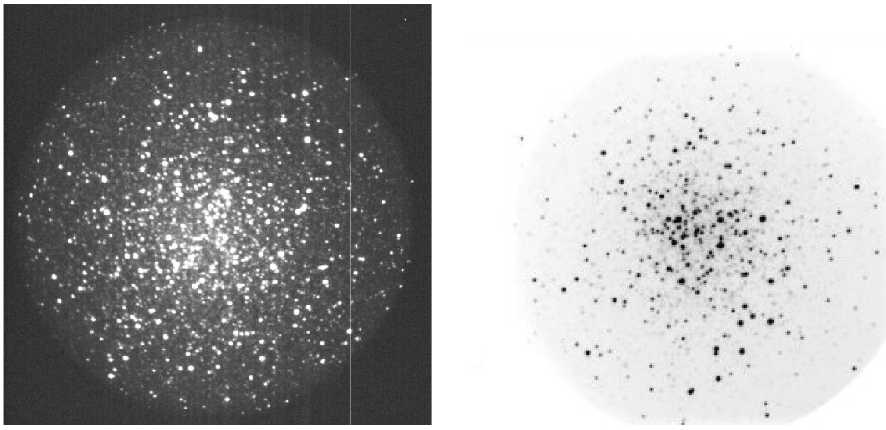


Figure 2. Left: M13, NAOMI TV. Right: M72, NAOMI TV.

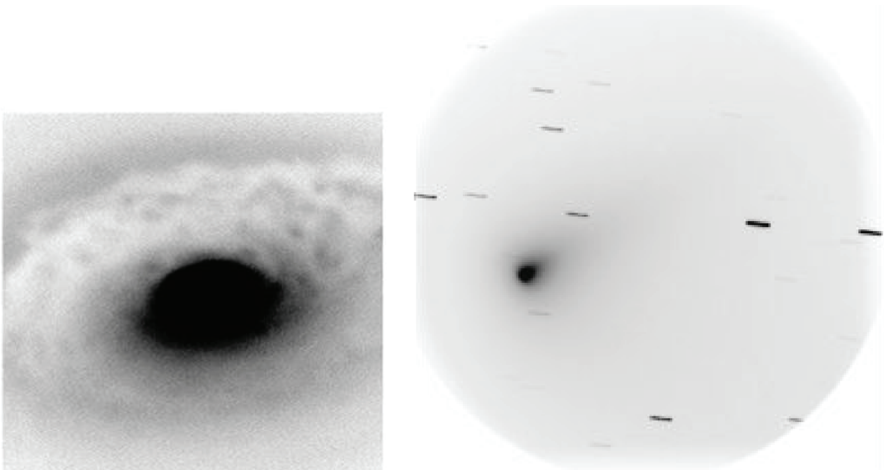


Figure 3. Left: NGC4826, CASS Auto-guider. Right: Comet C/2001 Q4 (NEAT), CASS TV (prototype optics).

OTHER NEWS FROM ING

ING Papers for SPIE's Astronomical Telescopes & Instrumentation Conference

Isaac Newton Group staff from both the astronomy and engineering groups had several papers accepted by SPIE (The International Society for Optical Engineering) for their conference 'Astronomical Telescopes and Instrumentation –The Industrial Revolution in Astronomy' held from 21 to 25 June 2004, at the Scottish Exhibition and Convention Centre in Glasgow. The range of topics reflected the range of development interests at ING, many of the papers being about various aspects of adaptive optics. The full list of papers featuring ING staff is below, all but one of them having ING staff as principal author. At the conference Chris Benn and Simon Tulloch gave oral presentations, while the remaining papers were poster presentations.

Papers given as oral presentations:

– "NAOMI: adaptive optics at the WHT".
C. R. Benn, S. Els, S. Goodsell, T. Gregory, A. Longmore[1], R. M. Myers[2], R. Østensen, I. Söchting[4], G. Talbot.
– "The application of L3 technology to wavefront sensing".
(http://www.ing.iac.es/~smt/)
S. M. Tulloch.

Papers given as poster presentations:

– "Advances in telescope mirror cleaning".
(http://www.ing.iac.es/~mfb/ing/ing.htm)
M. F. Blanken, A. K. Chopping, K. M. Dee.
– "An improved mechanism control system for INGRID".
(http://www.ing.iac.es/~sgr/poster.pdf)
S. G. Rees, P. Jolley, M. van der Hoeven, A. W. Ridings, M. F. Blanken.
– "GRACE: a controlled environment for adaptive optics at the William Herschel Telescope".
(http://www.ing.iac.es/~rgt/poster.html)
G. Talbot, D. C. Abrams, C. Benn, A. Chopping, K. Dee, S. Els, M. Fisher[3], S. Goodsell, D. Gray, P. Jolley.
– "Modelling the system performance and the final image PSF".
I. K. Söchting[4], R. M. Myers[2], C. R. Benn, A. J. Longmore[1], R. Wilson[2], S. Els, S. Goodsell, T. Gregory, R. Østensen, G. Talbot.
– "Photon counting and fast photometry with L3 CCDs".
(http://www.ing.iac.es/~smt/)
S. M. Tulloch.
– "Recent enhancements to the NAOMI AO system".
(http://www.ing.iac.es/~jolley/SPIE.html)
P. D. Jolley, S. Goodsell, C. Benn, T. Gregory, S. G. Rees, M. van der Hoeven, M. F. Blanken, R. Pit, C. Bevil.
– "The real time control system of NAOMI".
S. J. Goodsell, R. M. Myers[2], D. Buschell[7].
– "WHT auto-guider/TV upgrades".
(http://www.ing.iac.es/~smt/)
A. W. Ridings, S. M. Tulloch, R. A. Bassom.

Papers given as poster presentations with ING co-authors:

– "AO-assisted integral field spectroscopy with OASIS".
R. McDermid[5], R. Bacon[6], G. Adam[6], C. Benn.

1: UK Astronomy Technology Centre; 2: University of Durham; 3: Fisher Astronomical Systems Engineering; 4: ING and University of Oxford; 5: Leiden Observatory; 6: Observatoire de Lyon; 7: University of Cambridge.¤

Gordon Talbot (rgt@ing.iac.es)

Seminars Given at ING

Visiting observers are politely invited to give a seminar at ING. Talks usually take place in the sea level office in the afternoon and last for about 30 minutes plus time for questions afterwards. Astronomers from ING and other institutions on site are invited to assist. Please contact Danny Lennon at djl@ing.iac.es and visit this URL: http://www.ing.iac.es/Astronomy/science/seminars.html, for more details. These were the seminars given in the last 10 months:

Dec 3. Arto Järvinen (NOT), "CCD Ron Suppression Technique for Echelle Spectroscopy".

Feb 3. Dr Dehua Yang (Nanjing Institute of Astronomical Optics and Technology), "LAMOST Telescope and Instrumentation: Concept, Technologies and progress".

Feb 20. Hugo E. Schwarz (CTIO-NOAO-AURA), "Circumstellar Matter in PNe and Other Evolved Stars".

Mar 4. Silvano Desidera (Padova Observatory), "Search for extrasolar planets with SARG".

Mar 12. Laura Magrini (Dipartimento di Astronomia e Scienza dello Spazio, University of Firenze), "Planetary Nebulae in the Local Group".

Apr 6. Amir Ahmad (Armagh Observatory). "Helium-rich subdwarf B stars: binaries, mergers or bizarre?".

Apr 7. Don Pollacco (QUB), "SuperWASP: The Super Wide Angle Search for Planets".

Apr 15. Rene Duffard (Observatorio Nazional de Rio, Brasil), "Basaltic Asteroids".

Apr 21. Aaron Romanowsky (University of Nottingham), "Observing Galaxy Haloes".

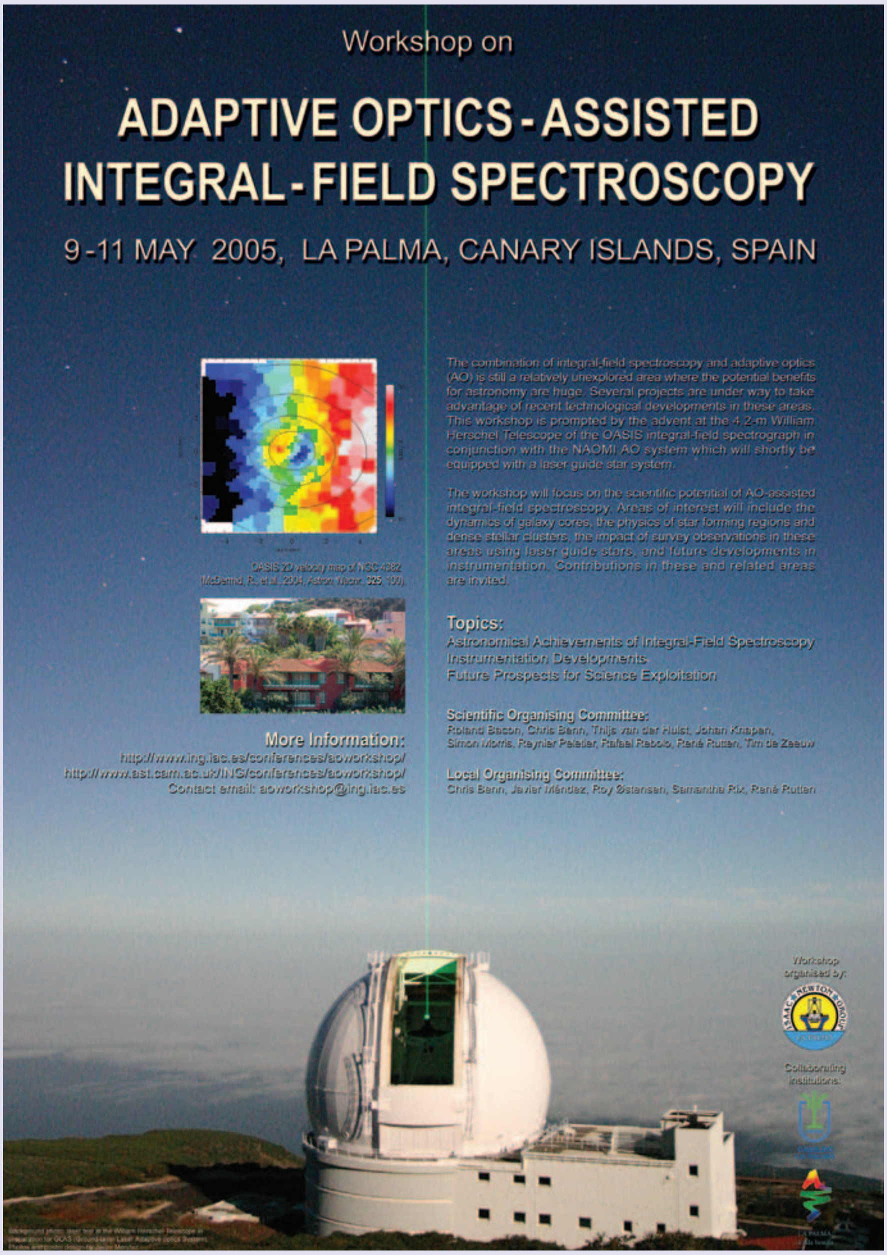
Jul 2. Phil Charles (University of Southampton). "SALT: 6 months to go!".

Jul 7. Suzanne Aigrain (IoA, Cambridge), "Planetary transits and stellar variability".

Jul 30. P. Focardi (Dipartimento di Astronomia, Università di Bologna), "What's the role of environment on galaxies?".

Workshop on Adaptive Optics-Assisted Integral-Field Spectroscopy

Integral-field spectroscopy and adaptive optics (AO) techniques are coming of age. A number of integral-field spectrographs are in operation around the world, and AO instruments are proliferating and becoming a standard feature of in particular the largest ground-based telescopes. The combination of integral-field spectrographs and AO is still a relatively unexplored area where the potential benefits for astronomy are huge. For that reason, a number of projects are under way that will take advantage of the most recent technological developments in these areas.



The advent of a new facility instrument at the 4.2-m William Herschel Telescope, the OASIS Integral Field Spectrograph, working in conjunction with the NAOMI Adaptive Optics system has prompted this initiative for holding a workshop covering this area. Moreover, a laser guide star facility is currently under development, which will open up nearly the full sky to AO exploitation. This implies a huge new potential for AO assisted spectroscopy to be carried out on large samples of objects, as there no longer will be the restriction of having to have a nearby bright guide star.

The workshop will focus on the scientific achievements and prospects for AO-assisted integral-field spectroscopy, promoting discussion and sharing of experiences and ideas. The outcome could inspire new collaborations and ideas for observing programmes, while at the same time it would provide the observatory with scientifically inspired advice on how to maximally exploit the exciting possibilities of AO at the Willam Herschel Telescope.

The workshop will be held from 9–11 May 2005 in Hotel H10 Taburiente Playa at Los Cancajos, La Palma. For further details see the workshop web pages at: `http://www.ing.iac.es/conferences/aoworkshop/`. ¤

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Other ING Publications and Information Services

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News from the Roque

The 10-m GTC project is making visible good progress. As can be seen from the web cameras on the GTC's web page the telescope mount has been completed, and the telescope structure itself is being mounted inside the dome. At the time of writing the mirror support cell is already completed. The first mirror segments have been received, as are the first instrument components such as the aquisition and guiding units and the commissioning camera. First light for this telescope is coming closer!

The large Cherenkov telescope, MAGIC, is nearly fully operational. All mirrors have been fitted, providing for an impressive sight at night as well as during the day. First detections have already been registered early in the year. The 'Counting House' has been constructed close to the telescope, also containing a dome that will host a small telescope used for calibration purposes. Furthermore, advanced plans exist for the construction of a second telescope of similar characteristics as MAGIC-1 and will be placed in the same area.

The SuperWASP (Wide Angle Search for Planets) project is now fully operational and has been collecting data already for several months, but still under the watchful eye of an observer. The telescope was inaugurated very appropriately in a remote fashion in April. The system has operated throughout summer in an automatic fashion. Later this year the telescope is expected to start full robotic operation and be fitted with the full complement of 8 cameras.

The Liverpool telescope has had its first robotic observations earlier in the year. Following an upgrade to the hydraulic system for the enclosure the telescope will be ready for full operation.¤

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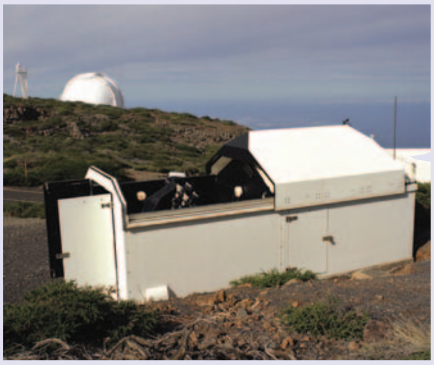


Top: MAGIC telescope and GTC (photo courtesy Francesca Phillips). Bottom: SuperWASP.

Personnel Movements

Andy Hide returned to the UK unfortunately only after having spent just over a year with ING as Head of the Telescope and Instrument Group. Andy's vacancy has been filled by **Diego Cano**, who joined ING in September.

After many years at ING **Doug Gray** also decided to returned to the UK. It will be particularly difficult to replace his vast knowledge and experience of the infrastructure that is key to ING.

Juerg Rey, who was until recently heading the group of Telescope Operators, has assumed the role of Duty Head of the Operations Group, while **Juan Carlos Guerra** has brought the Telescope Operator Group back up to strength again.

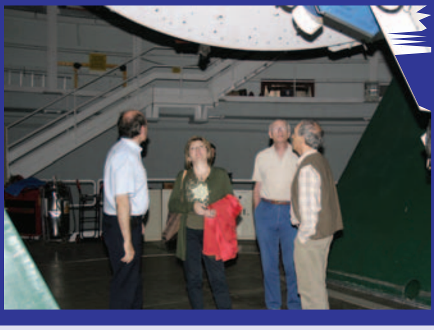
In the software group **Stephen Goodsell** decided to take up a position at Durham University to work on adaptive optics related projects and to progress his PhD. Vacant positions in the software group, some related to new development projects have been filled by **Niko Apostolakos**, **Jure Skvarc** and **Sergio Pico**.

Betty Vander Elst assisted the Administration group for some time on a part-time basis, but left ING during spring of this year.

Also the Astronomy Group has seen significant changes. Support Astronomers **Almudena Zurita** and **Paco Prada**, as well as **Marco Azzaro** (Telescope Operator) have started a new life in Granada, while **Illona Söchting** moved to Oxford to work on the Gemini telescope project. **Mischa Schirmer** and **Samantha Rix**, both with extensive experience in observational astronomy, have joined the team.

All those who have left ING and have worked hard to make ING into the successful observatory it is today are wished well in their new carreers.

Visits to ING and Open Days



On 18 July and 15 August two Open Days were organised, on which the public was invited to visit both the WHT and the INT. The total number of visitors was 2853 split into 80 tours. Also on 20 August another Garafía's Day was organised on which 160 people in 4 tours were shown round the WHT. Apart from Open Days, a total of 1862 visitors in 84 tours were shown round the WHT and occasionally the INT from December 2003 to August 2004.

Some VIP visitors in the last 10 months were: the Presidente of AURA, Bill Smith, and the NSO director (ATST-IP), Steve Keil, visited the WHT on 27 October; on 29 January the Spanish astronaut Pedro Duque visited the WHT (see photo top right); on 25 July the Spanish Education and Science Minister, María Sansegundo, visited the WHT at night accompanied by other ministry members (see photo bottom right); on 26 August the president of the Spanish Research Council, Carlos Martínez, visited the WHT. ¤

Javier Méndez (jma@ing.iac.es)

A Short Course in Adaptive Optics Organised by ING

The ING organised a Short Course in Adaptive Optics in collaboration with Imperial College London, University of Durham and the National University of Ireland. The course was held on the 12–14th January 2004 in Los Cancajos, La Palma.

It was adapted for observatory staff and designed to explain the basic principles of adaptive optics, provide an introduction to wavefront sensing techniques, describe the components currently used for adaptive optics, identify new technologies of potential importance for incorporation into adaptive optical systems, describe current applications of adaptive optics and identify new applications.

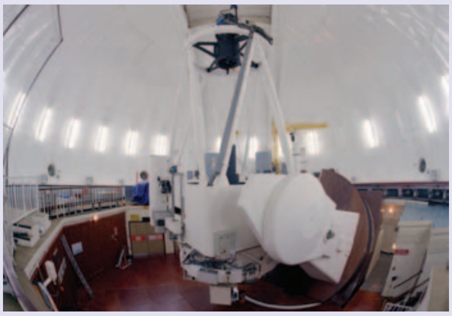
The course was taught by Prof Chris Dainty, Dr Gordon Love, Dr Richard Myers and Dr Carl Paterson and contained a trip to the WHT to look at its adaptive optics instrumentation. Local organiser was Stephen Goodsell (ING). ¤

Course lecturers. From left to right: Prof Chris Dainty, Dr Gordon Love, Dr Richard Myers and Dr Carl Paterson.

Course room at Hotel H10 Taburiente Playa, Los Cancajos.

Happy Birthday INT !

On 13 February 2004 the Isaac Newton Telescope was 20 years of continued operation on La Palma. During this period of time the INT has produced an impressive contribution to astronomy research: more than 1100 papers published in refereed journals. We thank all the staff and visiting astronomers who have made this possible! The accompanying pictures show the INT in its former location in Hertsmonceux in the late 60s, the official inauguration on La Palma on the 29th of June, 1985 and a recent picture of the telescope.



Detection of "El Niño" Effect at the Roque de los Muchachos Observatory?

Javier Méndez (ING) and Sergio Suárez (Asociación Canaria de Meteorología)

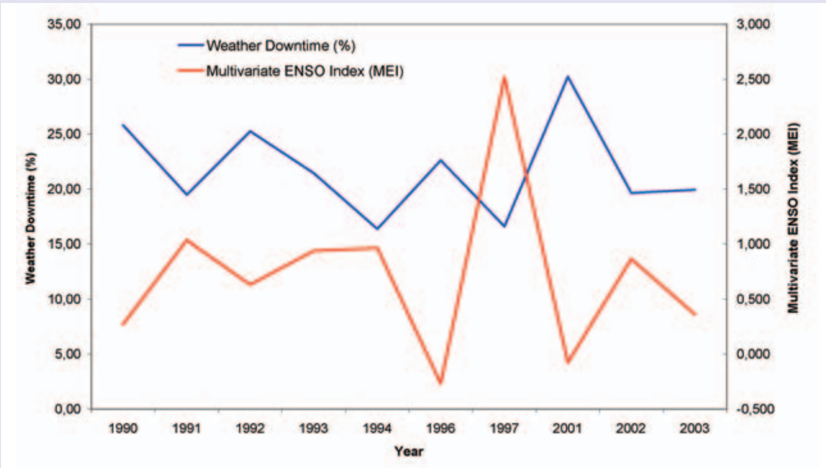
El Niño happens when tropical Pacific Ocean trade winds die out and ocean temperatures become unusually warm. There is a flip side to El Niño called La Niña, which occurs when the trade winds blow unusually hard and the sea temperature become colder than normal. El Niño and La Niña are the warm and cold phases of an oscillation referred to as El Niño/Southern Oscillation, or ENSO. Although ENSO originates in the tropical Pacific ocean-atmosphere system, it has effects on patterns of weather variability all over the world. It is believed, for instance, that El Niño conditions suppress the development of tropical storms and hurricanes in the Atlantic, and that La Niña favors hurricane formation.

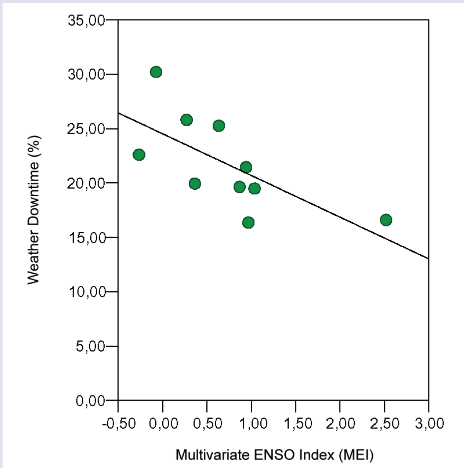
The index used to monitor the coupled oceanic-atmospheric character of ENSO is called the Multivariate ENSO Index (MEI) based on the main observed variables over the tropical Pacific. The MEI can be understood as a weighted average of the main ENSO features contained in the following six variables: sea-level pressure, the east-west and north-south components of the surface wind, sea surface temperature, surface air temperature, and total amount of cloudiness. Positive values of the MEI represent the warm ENSO phase (El Niño).

On the William Herschel Telescope weather observing downtime is recorded by observers when the following happens: humidity is higher than 90%, mirror temperature is less than 2 degrees of the dew point, wind speed is higher than 80 km/h (or gusts for more than 10 seconds are above 80 km/h), dust is clearly visible in the beam of a torch, or if the dome shows any resistance to movement due to the presence of ice.

In spite of the inaccuracies present in the process of recording weather downtime, and the fact that several elements contribute to the downtime apart from rain, it is possible to see some teleconnection between the MEI index and the percentage of weather downtime as it is shown in the accompanying plots. A study of rainfall and MEI carried out at Teide Observatory on Tenerife (Sergio Suárez Izquierdo, 2003, "Relaciones observadas entre el fenómeno de "El Niño" y las precipitaciones en la isla de Tenerife", I Encuentro sobre Meteorología y Atmósfera de Canarias, DG-INM, November 2003, p. 51.) came to a similar conclusion. ¤

Javier Méndez (jma@ing.iac.es)





Left: Comparison between the percentage of weather observing downtime at the William Herschel Telescope and the Multivariate ENSO Index (MEI) averaged from June to December inclusive (when the highest correlation is found). Only the episodes with averaged MEI positive in the period June-May are considered, ie. when the El Niño effect took place in the interannual period June-May then we averaged weather downtime and MEI index for the corresponding period June-December. Right: Same data as before. Correlation of linear regresion is $r = -68$ or confidence level of 95%.

New Additions to the ING Collection of Messier Objects

M83 Galaxy. Color images of this galaxy reveal a wide range of colors from the yellow central core of old stars to the blue spiral arms of young stars. Several red knots can also be seen These are gaseous nebulae where active star formation is taking place. Dark lanes of dust are also visible throughout the galaxy's disk. The image shown on the next page was obtained in February 2004 using the Prime Focus Camera on the William Herschel Telescope, and it is a combination of filters Johnson B, V and R. Credit: Chris Benn (ING) and Nik Szymanek (University of Hertfordshire).

M81 Galaxy. The image is a combination of exposures obtained in 2003 from Wide Field Camera on the Isaac Newton Telescope (courtesy of Jonathan Irwin) and Digitized Sky Survey 2 images. Credit: ESA/INT/DSS2.

M74 Galaxy. Its arms are traced with clusters of blue young stars and pinkish colored diffuse gaseous nebulae (HII regions), and reach out to cover a region of roughly 95,000 light years, or about the same size as our Milky Way galaxy. The image was obtained in August 2004 using the Wide Field Camera on the Isaac Newton Telescope. The colour composite was built from filters B, V and R and using Adobe Photoshop with the help of the ESA/ESO/NASA Photoshop FITS Liberator plugin. Credit: Simon Dye (Cardiff University).


M83 Galaxy


M81 Galaxy


M74 Galaxy

TELESCOPE TIME

Applying for Time

Danny Lennon (Head of Astronomy, ING)

In newsletter issue No. 6 (October 2002) we reported on the construction of the new 'long camera' for WYFFOS, the multi-object spectrograph used in conjunction with AF2 and INTEGRAL. It is a pleasure to report that this camera was successfully commissioned, in fact at the time of writing the final commissioning run is underway. First indications are that the camera is performing to specification, full details will appear on the AF2 web pages in due course. We currently use the two-chip EEV array with the long camera, which while it has excellent blue response, suffers from significant fringing in the red. We are actively pursuing the purchase of CCDs with good overall efficiency and fringing characteristics. When the array is used with AF2 the dispersion direction is aligned with the array such that one looses one central fibre and care should be taken to park this fibre when field configurations are performed. The new camera permits the placement of 150 fibres on the CCD array, and typically gives 4-pixel sampling per resolution element, equivalent to resolving powers of approximately 5000 and 1500 with the 1200R and 600B gratings respectively (depending on wavelength). When the long camera is used with INTEGRAL it is rotated by 90 degrees leading to gaps in wavelength space which need to be taken into account when defining a central wavelength.

The long-slit intermediate resolution infrared spectrograph, LIRIS, is offered in both imaging and long-slit spectroscopy modes. LIRIS in multi-slit mode is available only in collaboration with the instrument builders due to the very long lead time required with the mask creation and insertion into the cryostat. Prospective applicants for LIRIS in this mode should contact Arturo Manchado (amt@ll.iac.es) in the first instance. In the current year further commissioning will take place during which the multislit mask operations are further fine-tuned. In addition, several technical improvements have to be verified on sky (e.g. new sandwich holders for the long slits), and a thorough quantification of the image quality will be performed. Presently it is only possible to use the low resolution grism ($\Re\sim1000$), the higher resolution spectroscopic mode ($\Re\sim3000$) and the polarimetric modes of this instrument are delayed pending purchase of the relevant grisms and prisms. Since the performance of LIRIS in imaging mode is very similar to that of INGRID, we do not plan to offer the latter at the Cassegrain focal station while LIRIS is operational.

Override observations of targets of opportunity are an increasingly important aspect of telescope operations. At any given time we have a number of active override programmes and, due to the nature of the time-split at ING between four separate TACs, the rules and restrictions applying to these programmes are rather complicated. Those interested in applying for such programmes should therefore familiarise themselves with the information on our web pages at http://www.ing.iac.es/Astronomy/observing/overrides.html. It may well be the case that a cross-TAC approach would make most efficient use of telescope time and maximise chances of a successful override campaign.

The WHT and INT are now part of the EU funded access programme managed under the auspices of Opticon. Applicants awarded time on these telescopes under the normal peer review processes, but who are not eligible for financial support from the telescopes' funding agencies, may apply to support under this access programme. The programme is funded to run from January 2004 until December 2008, and full details of the scheme can be found at http://www.otri.iac.es/eno/. ¤

Danny Lennon (djl@ing.iac.es)

Important

DEADLINES FOR SUBMITTING APPLICATIONS

UK PATT and NL NFRA PC:
15 March, 15 September
SP CAT: **1 April, 1 October**
ITP: http://www.iac.es/gabinete/cci/

SEMESTERS

A: **1 February – 31 July**
B: **1 August – 31 January**

ONLINE INFORMATION ON APPLYING FOR TIME ON ING TELESCOPES

http://www.ing.iac.es/Astronomy/
http://www.ast.cam.ac.uk/ING/Astronomy/

Telescope Time Awards Semester 2004A

Service proposals not included. For observing schedules please visit this web page: http://www.ing.iac.es/ds/sched/. University or institution of principal investigator between parentheses.

William Herschel Telescope

UK PATT

– Charles (Southampton). Determining system parameters of a Soft X-ray transient in outburst. **W/2004A/36**
– Charles (Southampton). The Mass Donor in SS43. **W/2004A/56**
– Harries (Exeter). Spectropolarimetry of symbiotic binaries. **W/2004A/6**
– Haswell (OU). Accretion Disc Precession in AM CVn. **W/2004A/49**
– Hodgkin (IoA). Spectroscopic Identification of Very Low-Mass Stars and Brown Dwarfs in Young Open Clusters. **W/2004A/54**
– Jarvis (Oxford). Quantifying the space density of radio-loud quasars at $z>5$. **W/2004A/19**
– Jeffery (Armagh). PG1544+488 and other helium-rich subdwarfs: binaries, mergers or bizarre. **W/2004A/45**
– Keenan (QUB). The space density of B-type stars in the Galactic halo. **W/2004A/3**
– Lucas (Hertfordshire). PLANETPOL polarimetry of Tau Boo Ab. **W/2004A/27**
– Marsh (Warwick). ULTRACAM observations of detached white dwarf/M dwarf binary stars. **W/2004A/35**
– Meikle (ICL). Direct detection and study of supernovae in nuclear starbursts. **W/2002B/56 LT**
– Meikle (ICL). Detailed study of the physics of nearby Type Ia Supernovae. **W/2003B/2 LT**

– Merrifield (Nottingham). Determining the dynamics of round elliptical galaxies using the Planetary Nebula Spectrograph. **W/2003A/38 LT**
– Miller (Oxford). A deep survey for cluster-lensed QSOs from SDSS and 2QZ. **W/2004A/58**
– O'Brien (Leicester). Optical identification of ultra-soft X-ray sources — searching for extreme accretion. **W/2004A/32**
– Østensen (ING). Resolving sdB binary systems with Adaptive Optics. **W/2004A/46**
– Rawlings (Oxford). FLAGS - understanding the starburst-AGN connection. **W/2004A/17**
– Roques (Observatoire de Paris). Search for small Kuiper Belt objects by stellar occultations. **W/2004A/38**
– Smail (Durham). A Lyman-break Survey in the SCUBA/BLAST Region. **W/2004A/8**
– Smith (Sussex). Mapping the surface of the secondary stars in cataclysmic binaries. **W/2004A/50**
– Snellen (IoA). The space-density of high redshift FRI radio galaxies (II). **W/2004A/23**
– Vink (ICL). Searching the environments of Herbig Be stars for clusters and discs. **W/2004A/39**
– Wilkinson (IoA). Dark matter in the Sextans dwarf spheroidal. **W/2004A/2**

NL NFRA PC

– Cole (Groningen). Calcium Triplet Spectroscopy of Galactic Open Clusters. **w04an005**
– Douglas (Groningen). Determining the Dynamics of Round Elliptical Galaxies using the Planetary Nebula Spectrograph (PN.S). **w04an012**
– Groot (Nijmegen). The missing link of cataclysmic variable evolution in the Sloan Digital Sky Survey? **w04an013**
– Groot (Nijmegen). High speed spectral eclipse mapping of accretion disks in cataclysmic variables. **w04an014**
– Groot (Nijmegen). High speed spectral eclipse mapping of accretion disks in cataclysmic variables. **w04an017**
– Nagar (Groningen). Sub-kiloparsec Kinematics in Seyferts and Non-Active Galaxies — a Comparative Study. **w04an006**
– Perryman (ESTEC). Testing the relation between magnetic field strength and QPO frequency in polars. **w04an003**
– Perryman (ESTEC). The optical counterparts of radio pulsars. **w04an004**
– Quirrenbach (Leiden). Line Bisector Variations for K Giant Stars with Possible Planetary Companions. **w04an015**
– Roelofs (Nijmegen). Measuring directly the anticipated tidal deformation of the accretion disk of AM CVn. **w04an010**
– Röttgering (Leiden). Multi-Object Spectroscopy of radio sources in the Bootes Deep Field. **w04an008**
– van der Klis (Amsterdam). Comparing a neutron star with two black hole transients in quiescence. **w04an002**
– Wijers (Amsterdam). The nature of Gamma-Ray Bursts and their use as cosmological probes. **w04an011**

SP CAT

– Alonso (IAC). Óptica adaptativa de candidatos a tránsitos de planetas extrasolares. **W29/2004**
– Beckman (IAC). La estructura vertical de las barras nucleares en galaxias con doble barra. **W11/2004A**
– Beckman (IAC). Evolución de la formación estelar en galaxias: método morfológico. **W37/2004A**
– Casares (IAC). Echo tomography of fluorescence lines in Sco X-1. **W35/2004A**
– Casares (IAC). Determining system parameters of a Soft X-ray transient in outburst. **W36/2004A**
– Castander (IEEC). Espectroscopía de parejas de cuasares en la línea de visión: estudio del efecto de proximidad. **W39/2004A**
– Castro-Tirado (IAA). La naturaleza de las explosiones cósmicas de rayos gamma (GRBs). **W33/2004A**
– Díaz (UAM). Espectrofotometría de las galaxias HII más brillantes del SDSS. **W23/2004A**
– Erwin (IAC). How Many Galactic Bulges Are Imposters? **W5/2004A**
– González (IAC). Searching for the Evidence of Supernova Event in the LMXB V404Cyg. **W21/2004A**
– Gutiérrez (IAC). Sistemas con corrimientos al rojo anómalos. **W19/2004A**
– Martín (IAC). Spectroscopic Identification of Very Low-Mass Stars and Brown Dwarfs in Young Open Clusters. **W3/2004A**
– Martínez (Valencia). Propiedades de los halos alrededor de galaxias elípticas de campo. **W30/2004A**
– Pascual (UCM). Physical properties and chemical abundances of the population of current star-forming galaxies at $z=0.24$. **W16/2004A**
– Pérez (IAA). Cúmulos estelares masivos en galaxias de disco cercanas. **W40/2004A**
– Pohlen (IAC). A Test of the Bar-Peanut Connection in a Bulge-Less Galaxy. **W7/2004A**
– Rebolo (IAC). Detección directa de exoplanetas gigantes y enanas marrones alrededor de estrellas jóvenes cercanas. **W17/2004A**
– Ruiz (Barcelona). Supernovas a $z=0.35-0.65$: estudio de la naturaleza de la energía oscura. **W1/2004A**
– Santander (IAC). El origen de las nebulosas extensas alrededor de estrellas simbióticas. **W20/2004A**
– Vazdekis (IAC). Ages and metallicities of S0 galaxies along the Colour-Magnitude Relation. **W25/2004A**

Spanish Additional Time

– Balcells (IAC). Cartografiado profundo en U para COSMOS y OTELO. **W9/2004A**
– Cepa (IAC). El Proyecto OTELO: Cartografiado profundo en B, V, R e I de los campos Groth y SIRTF-FLS. **W27/2004A**

TNG-TAC

– Fasano (Padova). Star formation and morphological evolution of galaxies in nearby clusters with WYFFOS. **T064**

Isaac Newton Telescope

UK PATT

– Alton (CEA Saclay). The dust-to-gas ratio of the intergalactic gas in the M81 group. **I/2004A/1**
– Cotter (Oxford). A complete investigation of low-redshift radio galaxies and their cluster environments. **I/2004A/20**
– Davies (Cardiff). Satellites in Nearby Galaxy Halos (M101). **I/2004A/3**
– de Blok (Cardiff). Deep BVRI surface photometry of core-dominated low surface brightness galaxies. **I/2004A/12**
– Drew (ICL). IPHAS — the INT/WFC photometric Hα survey of the northern galactic plane. **I/2004A/8**
– Feltzing (Lund). A differential study of the metallicity distribution functions in three northern dwarf spheroidal galaxies. **I/2004A/9**
– Fitzsimmons (QUB). Rapid-response astrometry of potentially hazardous asteroids. **I/2004A/6**
– Helmi (Groningen). Star streams and High Velocity Clouds in the Milky Way halo. **I/2004A/23**
– Hewett (IoA). Faint Planetary Nebulae Around Hot While Dwarfs. **I/2004A/11**
– Jarvis (Oxford). A wide-field search for Lyα haloes: A pre-requisite for massive galaxy formation. **I/2004A/17**
– Jarvis (Oxford). Quantifying the space density of radio-loud quasars at $z>5$. **W/2004A/19** *[sic]*
– Snellen (IoA). The space-density of high redshift FRI radio galaxies. **I/2004A/5**

NL NFRA PC

– Aragon (Groningen). Measuring Galaxy Spin Alignments along a void-intersection filament near AWM3. **i04an007**
– Braun (NFRA). The STARFORM/Hα survey: Probing the recent history of star formation in spirals. **i04an003**
– Habing (Leiden). Monitoring of Asymptotic Giant Branch stars in Local Group Galaxies. **i04an001**

– Oosterloo (NFRA). The mass distribution in extremely warped disk galaxies. **i04an006**
– Röttgering (Leiden). A survey for Lyα emission line halos and the properties of $z>2$ proto-clusters. **i04an008**
– Wijers (Amsterdam). The nature of Gamma-Ray Bursts and their use as cosmological probes. **w04an011** *[sic]*

SP CAT

– Casares (IAC). Los parámetros orbitales de XTE J1859+226. **I10/2004A**
– Castro-Tirado (IAA). La naturaleza de las explosiones cósmicas de rayos gamma (GRBs). **W33/2004A** *[sic]*
– Deeg (IAC). Sample Definition for Exoplanet detection by the COROT Space Craft. **I13/2004A**
– Erwin (IAC). The Outer Disks of S0 Galaxies: Clues to Disk Evolution. **I3/2004A**
– Gómez-Flechoso (UEM). Constraining the shape of the Milky Way dark matter halo with the Sgr tidal stream. **I12/2004A**
– Gutiérrez (IAC). Searching for Sunyaev-Zeldovich Clusters. **I8/2004A**
– Hammersley (IAC). A Deep Multi-Wavelength Survey of the Galactic Plan. **I9/2004A**
– Leisy (IAC/ING). IPHAS — the INT/WFC photometric Hα survey of the northern galactic plane. **I4/2004A**
– López (IAC). Morfología cuantitativa de las galaxias del supercúmulo de Hércules. **I1/2004A**
– López (IAC). Tracing the Intracluster Light in Virgo Cluster. **I2/2004A**
– Mampaso (IAC). Planetary nebulae and the intergalactic stellar population in the intragroup medium. **I6/2004A**
– Vázquez (IAC). Oscilaciones Estelares y Solares. **I5/2004A**

Spanish Additional Time

– Herrero (IAC). Detectando la población de estrellas masivas azules hasta 5 Mpc para OSIRIS. **I11/2004A**
– Vílchez (IAA). An Hα search for star-forming galaxies in nearby clusters. **I14/2004A**

Telescope Time Awards Semester 2004B

Service proposals not included. For observing schedules please visit this web page: `http://www.ing.iac.es/ds/sched/`. University or institution of principal investigator between parentheses.

ITP Programmes on the ING Telescopes

– Gäensicke (Warwick). Towards a Global Understanding of Close Binary Evolution. **ITP7**

William Herschel Telescope

UK PATT

– Bunker (Exeter). Star formation at redshift ~1. **W/2004B/56**
– de Blok (Cardiff). Deep K-band surface photometry of low surface brightness galaxies. **W/2004B/30**
– Dhillon (Sheffield). ULTRACAM observations of the transiting extrasolar planet HD209458b. **W/2004B/14**
– Dufton (QUB). Spectroscopy of $h+\chi$ Persei to support VLT/FLAMES survey of the Magellanic Clouds (payback). **W/2003B/3**
– Gaensicke (Warwick). HS2331+3905: A cataclysmic variable in its final days? **W/2004B/37**
– Hirtzig (Meudon). Titan's surface and atmosphere: in-depth diagnostic via spectro-imagery. **W/2004B/69**
– Jeffers (St Andrews). High-resolution Doppler Imaging of RS CVn SV Cam. **W/2004B/33**
– Jeffery (Armagh). Mode identification from multicolour photometry of the pulsating sdB star PG 0014+067. **W/2004B/44**
– Knigge (Southampton). Spectroscopic reconnaissance of candidate emission line stars discovered by IPHAS. **W/2004B/71**
– Kotak (ICL). Optical spectroscopic study of the physics of nearby Type Ia Supernovae. **W/2004B/16**
– Kotak (ICL). Optical spectroscopic study of the physics of nearby Type Ia Supernovae. **W/2004B/17**
– Leven (Leicester). GRBs as cosmological probes. **W/2004B/60**
– Littlefair (Exeter). The quiescent accretion disc in the dwarf nova IP Peg. **W/2004B/31**
– Lucas (Hertfordshire). PLANETPOL polarimetry of Upsilon Andromedae b. **W/2004B/6**
– Marsh (Warwick). Stochastic Variability of Accreting White Dwarfs. **W/2004B/21**
– Marsh (Warwick). Magnetism in "non-magnetic" cataclysmic variable stars. **W/2004B/66**
– Maxted (Keele). Eclipsing binaries in open clusters — spectroscopy. **W/2004B/40**
– McLure (IoA). Exploring the connection between bulge/black-hole mass and radio luminosity from $z=0$ to $z=2$. **W/2004B/34**
– Meikle (ICL). Late-time study of the nearby type IIP Supernova 2004am. **W/2004B/38**
– Meikle (ICL). Direct detection and study of supernovae in nuclear starbursts. **W/2002B/56 LT**
– Merrifield (Nottingham). Gravitational Redshift in M32 and the Properties of its Stellar Population. **W/2004B/39**
– Nelemans (IoA). Testing common envelope theory and SN Ia progenitor models with double white dwarfs. **W/2004B/47**
– Royer (Leuven). A complete survey of the Wolf-Rayet content of M33. **W/2004B/28**
– Smith (Hertfordshire). The High and Low Ionization Broad-Line Region in Quasars. **W/2004B/5**
– Tanvir (Hertfordshire). The physics of short bursts and relativistic blast waves. **W/2004B/51**
– Vink (ICL). A search for evidence of accretion in Herbig Be stars. **W/2004B/4**
– Wilkinson (IoA). Dark matter in the Sextans dwarf spheroidal. **W/2004B/70**

NL NFRA PC

– Aerts (Nijmegen). Asteroseismology of the pulsating sdB star PG 0014+067. **w04bn015**
– de Zeeuw (Leiden). Mapping the nuclear regions of SAURON early-type galaxies with OASIS. **w04bn006**
– Franx (Leiden). Infrared Spectroscopy of restframe Optically Red Galaxies at high redshift. **w04bn008**
– Groot (Nijmegen). Spectroscopic reconaissance of emission line stars discovered by IPHAS. **w04bn013**
– Groot (Nijmegen). The UV-excess and White Dwarf binary population in the Faint Sky Variability Survey. **w04bn014**
– Groot (Nijmegen). The missing link of Cataclysmic Variable evolution in the Sloan Digital Sky Survey? **w04bn016**
– McDermid (Leiden). Black hole masses from gaseous and stellar kinematics using OASIS+NAOMI. **w04bn007**
– Nelemans (Nijmegen). Testing common envelope theory and SN Ia progenitor models with double white dwarfs. **w04bn004**
– Nelemans (Nijmegen). The masses of millisecond pulsars. I. Identification of suitable white dwarf companions. **w04bn005**
– Quirrenbach (Leiden). Line Bisector Variations for K Giant Stars with Possible Planetary Companions. **w04bn011**
– Trager (Groningen). The Stellar Populations of Gas-Selected Early-type Galaxies. **w04bn003**
– Wijers (Amsterdam). GRBs as cosmological probes. **w04bn009**
– Wijers (Amsterdam). The physics of short bursts and relativistic blast waves. **w04bn012**

SP CAT

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Abbreviations:

CAT	Comité para la Asignación de Tiempo
ITP	International Time Programme
LT	Long term
NFRA	Netherlands Foundation for Research in Astronomy
NL	The Netherlands
PATT	Panel for the Allocation of Telescope Time
PC	Programme Committee
SP	Spain
TAC	Time Allocation Committee
TNG	Telescopio Nazionale Galileo
UK	The United Kingdom

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TELESCOPE TIME

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Isaac Newton Group of Telescopes

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