Isaac Newton Group of Telescopes

Annual Report 2000 2001

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Front cover: True-colour image of M92 obtained using the SITe CCD on the Jacobus Kapteyn Telescope. Credit: Daniel Bramich and Nik Szymanek.

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Isaac Newton Group of Telescopes

Annual Report

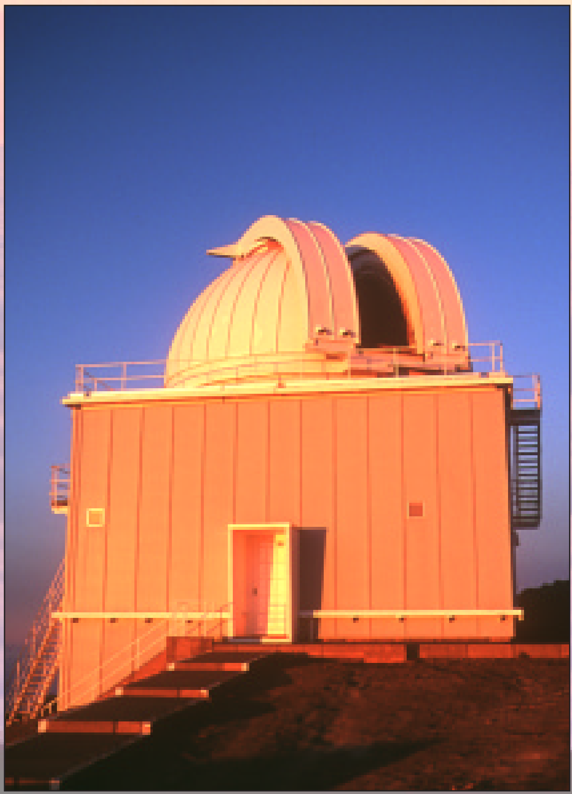
of the PPARC-NWO ING Board

2000 - 2001

Isaac Newton Group

William Herschel Telescope

Isaac Newton Telescope



Jacobus Kapteyn Telescope

OF TELESCOPES

The Isaac Newton Group of Telescopes (ING) consists of the 4.2m William Herschel Telescope (WHT), the 2.5m Isaac Newton Telescope (INT) and the 1.0m Jacobus Kapteyn Telescope (JKT). The ING is located 2,350m above sea level at the Roque de Los Muchachos Observatory (ORM) 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). On the JKT the international collaboration embraces astronomers from Ireland. 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.

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FOREWORD

Professor Tim de Zeeuw
Chairman of the ING Board

It is a pleasure to write this foreword to the 2000/2001 Bi-annual Report of the Isaac Newton Group of Telescopes, on behalf of the ING Board.

The past two years have been very interesting ones for the ING, but at the same time quite difficult. The ING telescopes continue to deliver science of the highest quality. The ING staff also carries out increasingly complex instrument enhancement and development work on island. Recent highlights include, e.g., the discovery of star streams in the halo of the Andromeda galaxy with the INT, the commissioning of NAOMI on the WHT providing spectacular image improvement in the R-band, the very well-attended conference entitled 'The central kpc of Starbursts and AGN: the La Palma Connection', organized by the ING, and the mini symposium to mark the occasion of Paul Murdin's retirement. The strong international position of the ING was confirmed by an External Review in 2001, chaired by professor Ken Freeman.

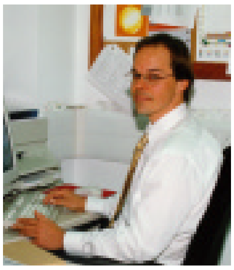
In early 2001 PPARC announced the need to reduce the UK financial contribution from 2005 onwards. Building on recommendations from the Freeman Report, the Board responded by developing a plan which would leave the Dutch contribution at its present level, and increase the proportion of Spanish (IAC) time on the telescopes by 9% (at the expense of the UK share), in return for a significant IAC contribution to operations. A revised ING agreement has now been negotiated between PPARC, NWO and the IAC, which takes into account the reduced UK contribution, the very welcome continuation of Dutch support at the same level, and the additional contribution by the IAC. While this does require a significant restructuring of the ING, it minimizes the impact of the reduced UK financial contribution without damaging the ING's ability to deliver the high priority science program, in particular on the WHT. The increased involvement of Spain through the IAC transforms the ING into a three-way partnership which will help foster the development of a Common Center for Astrophysics on La Palma.

Implementing the plans for restructuring is perhaps the most significant and serious challenge in the history of the ING, but the Board is convinced that the Director and his management team are up to this difficult and painful task. The Board has been encouraged by the progress made to date, and notes that a cooperative attitude of the respective funding agencies has been essential.

Adaptive Optics (AO) will form a critical component for the future of the ING, and the Board has encouraged the Director to further the high scientific profile and potential of the AO development work. The next step is the commissioning of OASIS, an integral-field spectrograph built by Observatoire de Lyon, which is being transferred from the CFHT, upgraded, and then moved to the WHT. Furthermore, the Board was very pleased to receive the welcome news that NWO has accepted a proposal led by the Director to provide funds towards the development of a laser guide star facility for the WHT, conditional on PPARC also supporting this project. The resulting system could be on the telescope in 2005, and produce very exciting and unique imaging and spectroscopic science in the R and I bands that will be hard to beat with 8m class telescopes for many years to come.

It has been an honour and a pleasure to serve as Board Chair for three years. I am confident that the helm is in good hands with the appointment of Professor Janet Drew as my successor, starting in July 2002, and wish her and the ING all the best for the future.

INTRODUCTION



Dr René Rutten
Director of ING

The year 2000 started on the island of La Palma as in most other places in the world with magnificent fireworks. The main 'fireworks' of the year at the Isaac Newton Group were the commissioning of our new IR camera and the first phase of the technical commissioning of the adaptive optics system. Both these developments took place at the 4.2-m William Herschel Telescope, showing clearly where the focus of ING's efforts lies.

The state-of-the-art infra-red camera, INGRID, is based around a 1024 by 1024 pixel HgCdTl Hawaii array from Rockwell. Its relatively large 4 arc-minute field of view has proven to be an important attraction for many astronomers rendering this instrument the second most popular instrument at the telescope.

The second big event at the William Herschel Telescope was the technical commissioning of a common-user adaptive optics system. Adaptive Optics (AO) is central to the development plans of the telescope. Adaptive optics experience at the ING is still limited, but we're learning fast. The often excellent seeing conditions combined with the quality of the telescope open up exciting new scientific prospects, in particular once the AO-corrected focus can be exploited with state-of-the-art instruments. Adaptive optics is often seen as the playing ground for the 8-m class telescopes but there are very good reasons to exploit AO also on medium size telescopes. Above all, there are important scientific gains to be achieved with the much better spatial sampling offered by Adaptive Optics. Laser guide star deployment will open AO techniques to many fields of astronomy. It is becoming ever clearer that adaptive optics will become an integral part of the future large telescopes, which is another reason why the astronomical community must invest time and effort in this field. The 4-m class telescopes are the ideal proving ground for AO techniques.

In recent years ING has actively pursued building strong relationships with universities. This initiative has been successful in itself and the positive effects are clearly sensed on La Palma. Stronger emphasis at the ING on in-house research activities lies at the heart of this as it underpins collaborations with universities such as the scheme of placement students that has been adopted. All in all, a very positive enterprise.

Also during the year talks have progressed very well on a formal participation of the Instituto de Astrofísica de Canarias in the ING. This development emphasizes the key role of the IAC at the observatory on La Palma. It is anticipated that a formal collaboration will be initiated in 2002.

During the year 2000 Benn and Sánchez completed their study on the scientific productivity of telescopes. It compares scientific impact of many facilities by means of the 1000 top-cited papers published over eight years during the previous decade. One of the results from this study is that the William Herschel Telescope belongs to one of the most productive observing facilities in the world. This not only is a pleasing result for the telescope, but above all is a tribute to the scientists using this facility. Even though still sizable, 4-m class telescopes are now considered of medium size. The study by Benn and Sánchez indicates that these telescopes will remain important facilities for top quality science for many years to come.

Chapter 1

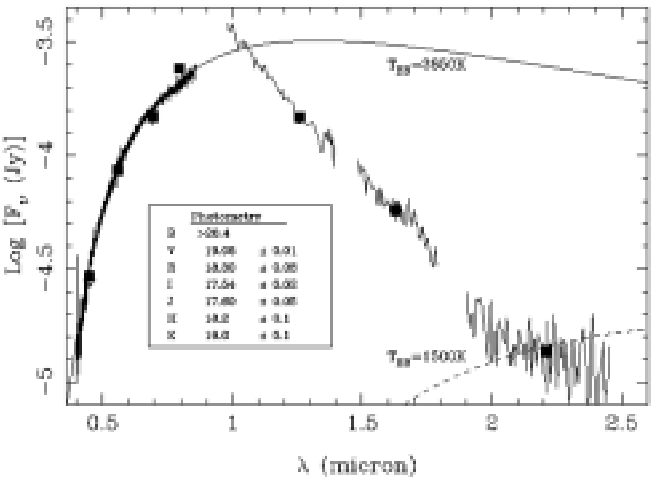
SCIENTIFIC HIGHLIGHTS

THE COOLEST KNOWN HALO WHITE DWARF

JKT+CCD, WHT+ISIS

White dwarfs are the remnant cores of stars that initially had masses of less than 8 solar masses. They cool gradually over billions of years, and have been suggested to make up much of the dark matter in the halo of the Milky Way. But extremely cool white dwarfs have proved difficult to detect, owing to both their faintness and their anticipated similarity in colour to other classes of dwarf stars.

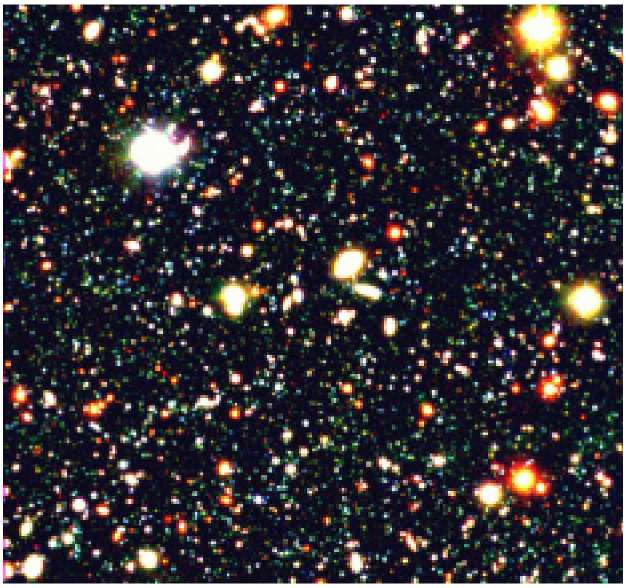
A white dwarf star, named WD0346+246, was serendipitously discovered as a faint, very fast moving star on a sequence of photographic plates. The high apparent velocity is a characteristic of stars which are very old and are traveling on inclined elliptical orbits through the Galaxy. Astronomers secured parallax measurements on the Jacobus Kapteyn Telescope to determine the distance to WD 0346+246 and confirm its low luminosity. They reported a distance of 28 parsecs. They also estimated a surface temperature of around 350 Kelvin. Thus WD 0346+246 has been shown to be one of the coolest and therefore oldest white dwarfs ever found, and has to be a member of a hitherto unobserved and possibly large population of faint stars in the Galactic halo.



This discovery has serious implications for our understanding of the Milky Way. The coolest white dwarfs provide a measurement of the age of the Galaxy, but they may also play a more important role. For the last thirty years, astronomers have found that most of our Galaxy seems to be invisible. In fact, as much as 90% of the mass in our Galaxy may be hidden in the form of dark matter. Dark matter theories fall into two broad classes. The first suggests that the dark matter is not really dark — but is composed of many faint stars such as cool white dwarfs and brown dwarfs. The second class of dark matter candidates are various elementary particles, left over from the Big Bang. Indirect evidence for the dark matter being comprised of cool white dwarfs first came from the MACHO gravitational microlensing experiment. The MACHO project monitored some ten million stars in the Magellanic Clouds in the hope of detecting the occasional brightening due to gravitational lensing effects caused by a dark halo object moving across our line of sight to one of the stars. The MACHO results suggest that these stars can be very numerous, and could contribute approximately 50% of the total mass of the Galaxy.

The discovery of one nearby, very old and cool white dwarf does not solve the dark matter problem. But it does lend weight to the MACHO scenario, and presents astronomers with an astonishing conclusion that the Galaxy may be full of extremely old white dwarf stars. The race is now on to count how many objects like WD 0346+246 exist in the Galaxy and to measure how much they weigh in total.

Figure 1. The spectrum of the halo white dwarf WD 0346+246 showing the dramatic effects of collision induced absorption by molecular hydrogen in the infrared. Thus the object appears red in the optical, but blue in the infrared.



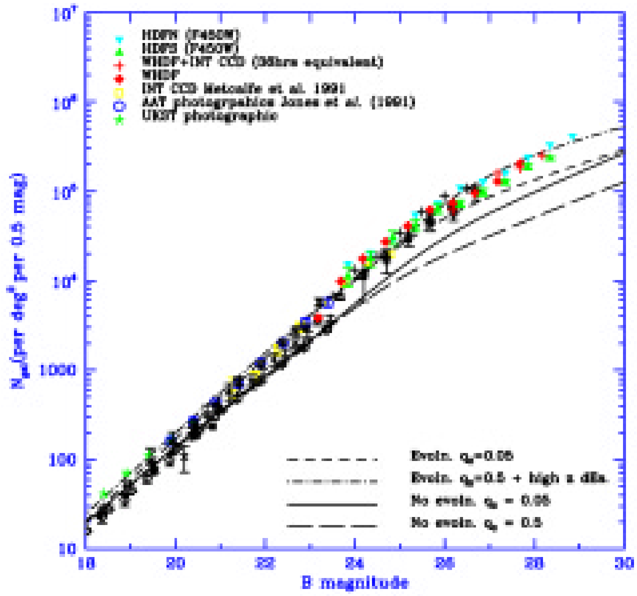


Figure 2. Left: A true colour image of the William Herschel Deep Field, formed by mapping U, B and R exposures onto blue, green and red respectively. The image covers 7×7 arcminutes. Right: This shows the B-band galaxy counts for the WHDF compared with other data, including the Hubble Deep Fields. Also shown are the predictions for a universe in which galaxies do not evolve with time, and those for which galaxies follow simple stellar population synthesis tracks. Two geometries are considered, q_0=0.05 (open) and q_0=0.5 (flat). It is clear that non-evolving models underpredict the counts from quite bright magnitudes (B~22). Even an open evolving model struggles to keep up with the sheer numbers of galaxies seen, although there are probably enough uncertainties in this model to 'tweak' it higher at faint magnitudes. Those who favour a closed universe have to relax the constraint that galaxy numbers are conserved (e.g. merging) or at the very least invoke a population at high redshift which has disappeared from view by the present day (e.g. fading dwarfs). The model shown is a version of the latter.

NEW EVIDENCE THAT GALAXIES FORMED EARLY IN THE HISTORY OF THE UNIVERSE

WHT+PFC

Ultra-deep imaging observations using powerful, ground-based telescopes such as the William Herschel Telescope have the capacity to probe the evolutionary history of galaxies back to their formation epoch. At the faintest galaxy magnitudes, we are looking out not only in distance but back in time to when the Universe was only a few percent of its current age.

Over the past few years, astronomers have used the WHT to produce the deepest ground-based image of the sky which they have called the William Herschel Deep Field (WHDF). With exposures of ~30 hrs in U and B, the resulting images reach magnitudes which are comparable to the Hubble Deep Fields (U~27, B~28) but covering a five times bigger area of the sky than the two HDFs combined.

For many aspects of the studies of high redshift galaxies, the bigger area of this Herschel Deep Field gives it a unique advantage over HST data. At intermediate redshifts ($1<z<3$) the larger numbers of galaxies means that they are more easily split into their various sub-populations by their colours. At high redshift, the big area means we have more chance of detecting candidates for galaxies in the redshift range $3<z<7$ which are within the magnitude reach of multi-object spectrographs on 8–10m class telescopes for obtaining spectroscopic confirmation of their photometric redshift. The bigger area also has advantages for studies of high redshift galaxy clustering, aimed at understanding how structure forms in the early Universe.

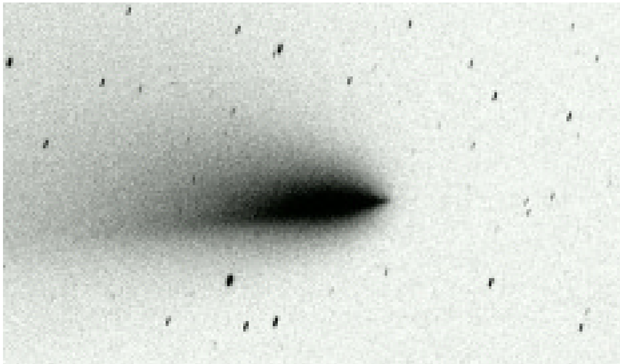
In 1996, the ultraviolet and blue pictures in the WHDF revealed so many faint blue galaxies at a redshift of 2 that they already challenged the claims of the most popular cosmological theory, which suggested that galaxies formed around a redshift of 1, when the universe was half as a big as it is now. Since then, observations carried out at other telescopes have confirmed these results by finding many galaxies at redshifts of 3 and 4. Now, applying similar techniques as before but to the new red and infra-red images from the WHT, astronomers find large numbers of galaxies at the even higher redshifts of 5 to 6 (as many galaxies as are found locally), pushing the epoch of formation of giant galaxies back even earlier.

COMET LINEAR BLOWS UP IN FULL VIEW OF THE JKT

JKT+CCD, INT+WFC

Nightly observations made since July 23, 2000 in different broadband filters with the Jacobus Kapteyn Telescope showed what appeared to be the complete disruption of the nucleus of comet LINEAR, the brightest comet of the year.

The central condensation was highly condensed and showed the typical ‘teardrop’ form in the evening of July 23rd and July 24th, although its brightness decreased by a factor of about 3 between the two nights. In the evening of July 25th something very odd was happening to the comet: the central condensation was seen to be strongly elongated, with a very flat brightness distribution. The condensation’s brightness faded further and its length increased on the following nights. On July 27 there was no evidence of any local brightness peaks that would indicate the presence of sub-nuclei. In other words, it did not appear to have broken into individual fragments in the way that Comet Shoemaker-Levy 9 did in 1993. Instead, it had completely blown apart. The expansion velocity of the condensation was about 40 m/s, indicating that it consisted of solid particles and not just gas. The gas tail, which virtually had disappeared between July 23rd and 24th, had reformed as an extension of the major axis of the central condensation.



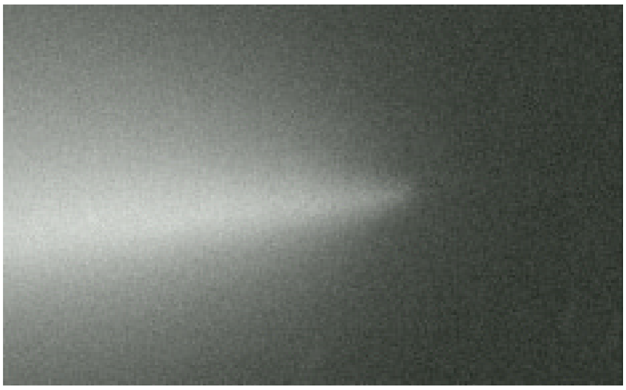


Figure 3. Above: This image, obtained on 1 August 2000 with the WFC on the INT, covers a field of view of 22 arcminutes and is processed to show the faint tail of the comet, which extends well beyond the edge of the field of view. Below: This image obtained on the same night is a 100-second exposure with the WFC on the INT. This section of the full image measures 4.5 arcminutes, equivalent to 110,000 km at the comet. Again the image was processed to show faint details in the coma of the comet. No features are seen in the image, which implied that no significant individual fragments more than a few metres across still emitted gas. This demonstrates the catastrophic disruption of the nucleus.

Further observations with the Isaac Newton Telescope confirmed the initial discovery and provided new insight into what the reason for the comet disruption could be: the evaporation of all the ice in the nucleus. Cometary nuclei are a mixture of solid lumps of material of various sizes, held together by a cement of ices. When comets pass close to the Sun during their journey across the solar system the icy elements (mainly water ice and carbon monoxide ice) sublime, leaving loose material behind that forms the dust tail of the comet, while the sublimed ice forms its gas tails. As a result of this process, or due to the strong gravitational pull from a planet such as Jupiter, or from the Sun, a comet nucleus may sometimes split into two or more fragments. What was seen in the case of Comet LINEAR, however, was different.

From analysis of the images astronomers concluded that this small comet probably ran out of ice altogether, leaving behind a loose conglomerate of particles that gradually dispersed into space. This model fitted the observations well, as measurements showed that the activity of the comet had been declining for several weeks as ice gradually sublimed away. During the comet’s closest approach to the Sun, a burst of activity was recorded. Then, when all the ice was exhausted and nothing was holding together the solids, the nucleus began to fall apart.

The images taken with the Isaac Newton Telescope after break-up showed no sign of the comet’s original nucleus, nor of any active sub-nuclei larger than a few metres across. Any large remnants of the nucleus that remained cannot be subliming significantly or they would have been detected in these images. Other comets are known to have disappeared, but Comet LINEAR is the first one to have been caught in the act.

DISCOVERY OF A TYPE IA SUPERNOVA PROGENITOR

INT+IDS

Type Ia supernovae (SNe Ia) are one of the most important tools for observational cosmology. Because these supernovae have a relatively small spread in their peak optical brightness and can be seen out to cosmological distances, they serve as standard candles and are used to measure cosmological parameters. However, the peak optical brightnesses of SNe Ia are not uniform; they are correlated with the shape of the light curve. Meaningful measurements of cosmological parameters require this variation to be calibrated. The corrections to peak brightnesses have to be empirical because the detailed physics of what causes SNe Ia is not fully understood.

All the most likely models for progenitors of SNe Ia feature an accreting white dwarf which ignites carbon in its core either because it has reached the Chandrasekhar mass or because ignition of accumulated helium causes compression of the core and a so-called 'edge-lit detonation'. This explains the fast rise times for SNe Ia, the lack of hydrogen and helium and the fairly uniform peak brightness. To initiate the explosion, the white dwarf must accrete material from a companion star. Two models for the companion star which have gained popularity in recent times are supersoft X-ray sources and double degenerates.

However, the possibility of a helium star companion to a white dwarf has not been widely considered as a source of SNe Ia. In particular, sub-dwarf B (sdB) star binaries might be good candidates. There are many white dwarfs which are known to accreate mass from a normal star, but these are made of hydrogen which causes a series of small explosions before the Chandresekhar limit is reached. This is what causes a nova explosion. To make a supernova, the white dwarf has to be supplied with helium, which explodes less easily but releases much more energy.

KPD 1930+2752 is a sdB star. It is about one fifth the size of the Sun and is about half as massive. Unlike normal stars, which are composed almost entirely of hydrogen, KPD 1930+2752 is made of helium. It is not entirely clear how sdB stars are made, but recent work suggests they are the remains of stars like the Sun which lose half their mass just before they complete the end of the red giant phase of their evolution. Only some small fraction of stars evolve this way and this is thought to be related to the fact that most sdB stars are binary stars.

KPD 1930+2752 was observed with the INT as part of a programme to study sdB stars to understand how they are formed. The Doppler shift shows that the star is orbiting an unseen companion every 137 minutes at a speed of 350 km/s. The unseen companion has almost the same mass as the Sun, but it is much smaller and fainter. The unseen companion star could be a neutron star or blackhole, but it is much more likely to be a white dwarf star.

When binary stars have orbital periods as short as two hours, they produce gravitational waves which drain energy from the orbit, so the stars gradually spiral in towards each other. KPD 1930+2752 will merge within 200 million years. The white dwarf will then gain extra mass from the sdB star and will exceed the Chandrasekhar critical mass. This is thought to lead to a Type Ia supernova explosion.

KPD 1930+2752 is the first star to be discovered that is a good candidate for the progenitor of a Type Ia supernova of this type, which may explode on an astrophysically interesting time-scale.

THE FIRST BLACK HOLE IN THE HALO OF OUR GALAXY

WHT+ISIS

X-ray novae or soft X-ray transients constitute a subset of low-mass X-ray binaries (LMXBs) that consist of a late-type secondary star and a neutron star or black hole exhibiting bright optical and X-ray outbursts that are recurrent on time scales of decades. During their outbursts, they resemble persistent LMXBs in which the light of the secondary star is overwhelmed by a luminous accretion disk surrounding the compact object. After a year or less in some objects, the system returns to quiescence. The secondary star now contributes a much larger fraction of the total light, and its atmospheric absorption lines become visible in optical spectra. Thus, quiescent X-ray novae provide the ideal opportunity to study the nature and dynamical properties of the binary system. These studies have demonstrated so far that the mass of the compact object in 10 X-ray novae exceeds the theoretical maximum mass of a neutron star and thus must evidently harbour a black hole.

A previously unknown X-ray transient, XTE J1118+480, was discovered by the Rossi X-Ray Timing Explorer all-sky monitor on 2000 March 29. An optical counterpart was then identified and confirmed spectroscopically. The shape of the light curve and its temporal evolution resembled those of superhumps observed during superoutbursts of short-period cataclysmic variables and outbursts of some other soft X-ray transients. The binary system was found at a distance of about 6000 light years in a direction pointing 62 degrees away from the Galactic plane.

From spectroscopic observations carried out by an international team of astronomers using a number of telescopes, including the WHT, and spanning a couple of months, the mass of the compact object was determined to be at least 6 times the mass of the Sun. This lower limit to its mass firmly implies that it is a black hole, the first one firmly identified in the Galactic halo.

Most compact objects are found close to the Galactic plane, which makes this discovery particularly interesting. It opens questions as to how this object was formed. The black hole could either have formed where it currently is found, or it could have been kicked out of the galactic plane during a violent stage of its evolution.

A SEARCH FOR PLANETARY NEBULAE IN M33

INT+WFC

Extragalactic Planetary Nebulae (PNe) are known in almost all galaxies of the Local Group. Most of them were discovered in the last decade by means of continuum-subtracted images in the bright nebular line of [OIII]. M33, one of the two other large spiral galaxies of the Local Group besides the Milky Way, was the only major nearby galaxy which had not been searched for PNe yet. Astronomers aimed to fill up this gap taking advantage of observational capabilities offered by the Wide Field Camera at the Isaac Newton Telescope. [OIII], Hα and continuum images allowed astronomers to detect 134 candidate PNe in M33 and a large number of other emission line objects (mostly HII regions).

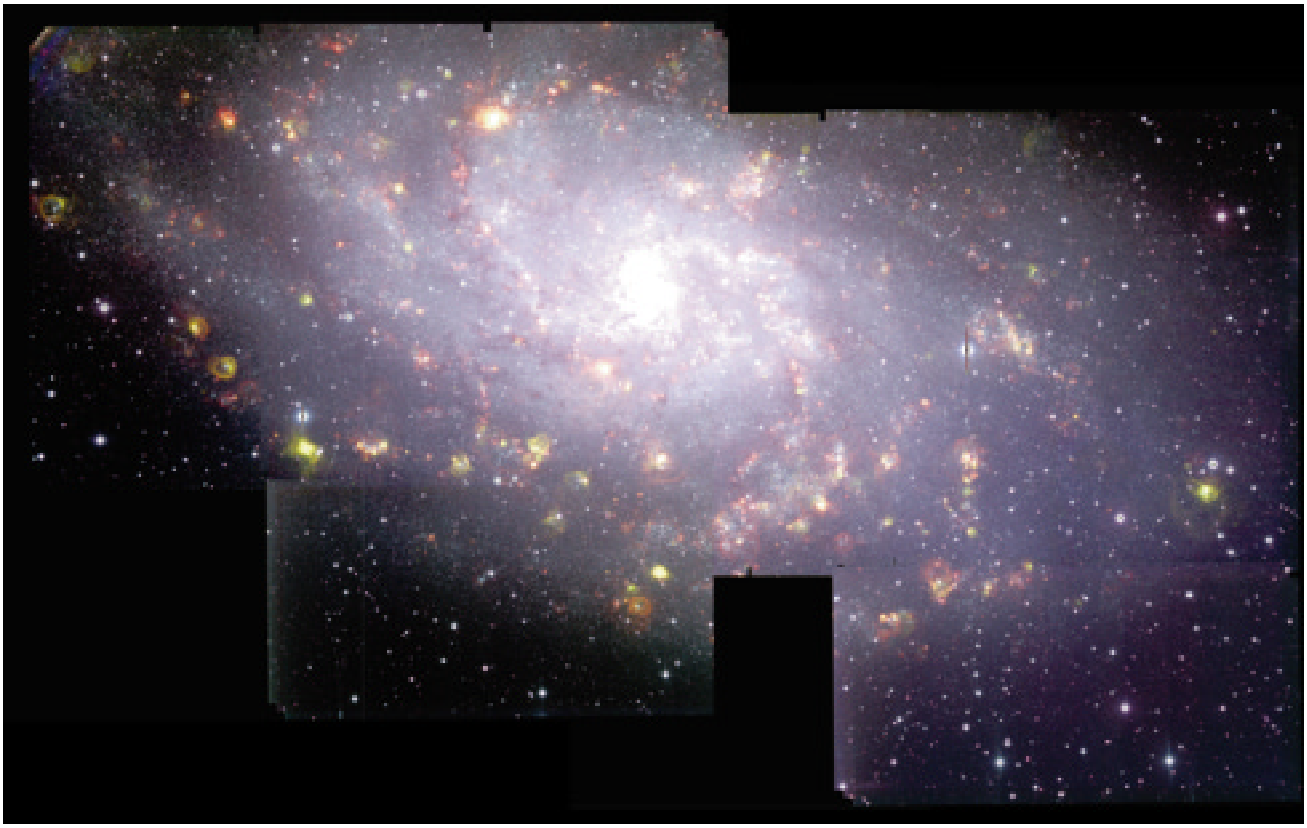


Figure 4. This image is a composition of frames taken in three narrow bands: the green colour represents the galaxian emission in a filter centred on the [OIII] nebular line at 500.7 nm, red is the Hα emission at 656.3 nm, while blue is mainly stellar light taken through a continuum filter centred at 555.0 nm (Stromgren Y). In only one observing night, and with two positionings of the telescope, it was possible to cover nearly the whole galaxy which has a size of approximately one degree in the sky.

FIRST CLEAR SIGNATURE OF AN EXTENDED DARK MATTER HALO IN A DWARF SPHEROIDAL GALAXY

WHT+AF2/WYFFOS

The central velocity dispersions of many Local Group dwarf spheroidal (dSph) galaxies are significantly larger than expected for self-gravitating systems. Assuming virial equilibrium, the implied mass-to-light (M/L) ratios reach as high as 250, making the dSph galaxies among the *most* dark matter-dominated systems in the universe. Given the apparent absence of dark matter in globular clusters, dSph galaxies are also the *smallest* dark matter-dominated stellar systems in the universe. As such, they have emerged as crucial testing grounds for competing theories of dark matter.

Despite their importance, dynamical models of dSph galaxies to date have been quite simple. Most analyses have relied on the use of single-mass isotropic King models, with their associated assumptions that mass follows light and that the stellar velocity distribution is isotropic. Hitherto, the validity of such assumptions has remained unchallenged because of the small size of the data sets. When only small numbers of radial velocities are available, there is a well-known degeneracy between mass and velocity anisotropy. An increase in the line-of-sight velocity dispersion at large radii may by due to either (1) the presence of large amounts of mass at large radii or (2) tangential anisotropy in the velocity distribution. This degeneracy could be broken by means of improved modelling and a larger data set with many more stars in the outer parts.

Observations were conducted from 2000 June 23 to 26 at the William Herschel Telescope using the AF2/WYFFOS multifiber positioner and spectrograph. A total of 284 stars were observed, spanning the magnitude range of V 17.0-19.8. Of these, 159 were Draco members (extending to 25') with spectra of sufficient quality to be included in the dynamical analyses. The median velocity uncertainty for these 159 stars was 1.9 km s-1. These are the first observations to probe the outermost regions of a strongly dark matter-dominated dSph galaxy.

From subsequent analysis, astronomers found that the velocity dispersion profile is flat or slowly rising at large radii, which provides the first clear signature of an extended dark matter halo in any dSph galaxy.

Further studies of this cocoon, whose composition remains a mystery, promise to illuminate the early history of our own Galaxy, which presumably built up from such dark-matter quanta. This result also fits with the bottom-up view of galaxy formation, in which the gravitational fields of big galaxies shred smaller ones and assimilate their stars, gas, and dark matter.

DISTANT GALAXIES ARE IN THE RED

INT+CIRSI

The panoramic IR camera, CIRSI has been used to carry out a large-scale survey of distant galaxies in the prime focus of the INT. The main goal of the project was to study the Universe when it was 7 billion years old, or around half its current age.

The recently completed infrared sky survey has detected over 50,000 galaxies in a patch of sky covering roughly the area of a full Moon. Although only one fifth of the data has been analysed so far, already three times as many very red galaxies have been found as was expected.

One possibility is that these galaxies have more old stars in them than expected. Old stars tend to be large and relatively cool, hence the red colour. A second possibility is that the galaxies are very dusty, where scattering by dust particles causes objects to appear red.

A second significant result is the discovery that these red galaxies seem to clump together much more than galaxies in the nearby Universe. One possible explanation is that these red galaxies are merging with each other to form single more massive galaxies.

This merging process would explain why astronomers are seeing more galaxies in the past than expected. If galaxies merge, their total number will decrease to the present-day value.

HIGH-SPEED ENERGY-RESOLVED STJ PHOTOMETRY OF THE ECLIPSING BINARY UZ FOR

WHT+SCAM

UZ For is a member of the AM Herculis type cataclysmic variables (CVs), in which a strongly magnetic white dwarf accretes material from a late-type companion that fills its Roche lobe. As material passes through the inner Lagrange point of the system towards the white dwarf, the magnetic field does not initially dominate the motion of the material. Closer to the white dwarf surface, beyond the stagnation region, the field threads and disrupts the flow, channelling infalling material into a funnel which terminates in a shock front at or near the magnetic pole(s). Shock-heated plasma cools via bremsstrahlung, Compton cooling, and cyclotron emission as it settles onto the white dwarf, with the accretion stream also contributing to the optical and ultraviolet emission. Magnetic interaction between the white dwarf and its companion keeps the white dwarf in rotational synchronism with the M dwarf companion, and the system rotation then leads to the coherent variability observed in these systems.

The orbital period of UZ For is 126.5 min, of which the white dwarf is eclipsed for approximately 8 min. The simultaneous rapid intensity and spectral variations which are characteristic of the eclipses of cataclysmic variables make these objects ideal targets for study with advanced photon-counting detectors which record the time of arrival and the energy of each incident photon. Although such detectors have long been available for high-energy studies (e.g. proportional counters or CCD detectors operated in X-ray photon-counting mode), they are only now becoming available for optical work, based on the new development of Superconducting Tunnel Junction (STJ) devices.

A photon incident on an individual STJ breaks a number of the Cooper pairs responsible for the superconducting state. Since the energy gap between the ground state and excited state is only a few meV, each individual photon creates a large number of free electrons, in proportion to the photon energy. The amount of charge thus produced is detected and measured, giving an accurate estimate of the photon arrival time as well as a direct measurement of its energy. Arrays of such devices provide imaging capabilities.

A 6×6 array of 25×25 μm^2 tantalum STJ device built at ESA was incorporated into a cryogenic camera operated at the Nasmyth focus of the William Herschel Telescope. The projected pixel size of 0.6×0.6 $arcsec^2$ results in an array covering a sky area of 4×4 $arcsec^2$. This camera, S-Cam2, is a development of the system first applied to observations of the Crab pulsar in 1999. Several modifications, including a new detector array, and improved detector stability and uniformity, result in an improved wavelength resolution of $\Delta\lambda$=30, 60, and 100 nm at λ=350, 500, and 650 nm respectively.

For each individual detected photon, the arrival time, x, y array element (or pixel), co-ordinate and energy channel are recorded. Photon arrival times are recorded with an accuracy of about ±5μs with respect to GPS timing signals, which is specified to remain within 1μs of UTC.

The characteristics of STJ arrays are ideally suited to the observation of CVs. The high time resolution, high efficiency, large dynamic range, and modest energy resolution afforded by the S-Cam2 system allow a direct probing of the energy dependence of the intensity variations across the eclipse, and investigation of the

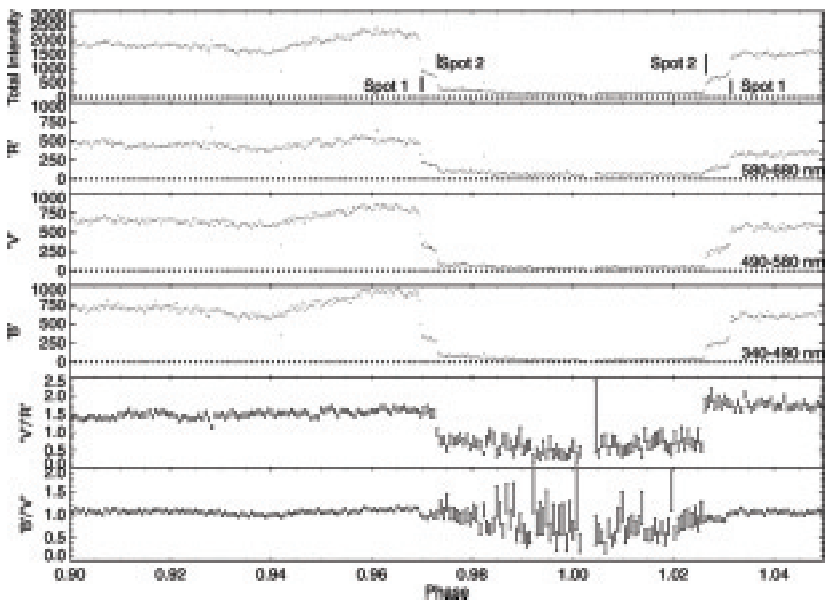


Figure 5. Sky-subtracted and flat-fielded total count s^{-1} (top), count s^{-1} in three bands: 340-490 nm (labelled 'B' for ease of reference), 490-580 nm ('V') and 580-700 nm ('R'), and two colour ratios constructed from the three energy-resolved light curves for the first observed eclipse of UZ For.

details of the ingress and egress light curves, whose structure provides important diagnostics of the emission mechanism.

Astronomers obtained data for three eclipses of UZ For. They attributed two sharp changes in brightness to the eclipse of two small accretion regions and localize them on the surface of the white dwarf primary. The first of these is in the lower hemisphere at the location seen by others in the optical, and in the EUV and X-rays. The second is in the upper hemisphere, near the rotation axis, and there is no evidence for any emission from this region in X-rays. The diameter of the accretion spots is less than about 100 km.

A NEW LOCAL GROUP GALAXY

INT+WFC

The Wide Angle Survey, one of the ING Wide Field Survey programmes, brings together a diverse range of scientific topics, merging the observational programme to increase scientific effectiveness.

As part of the Virgo survey component some 25 square degrees of Virgo were obtained in the B photometric band, and the pipeline processed object catalogues were analysed. More than 500 Low Surface Brightness galaxies $B_{tot}<21$ were discovered by comparing the light profiles of the millions of objects in the data frames with those of previously known template LSB galaxies.

Using this data astronomers at Cambridge discovered a new member of the Local Group of Galaxies in the constellation of Cepheus. This LSB dwarf galaxy is a typical example of previously unknown nearby galaxies, and it had been previously overlooked because of its low surface brightness relative to the night sky.

Most Local Group galaxies are satellites of the Milky Way and Andromeda systems leaving only a few outliers to use as probes of the dynamical evolution of the Local Group and for characterizing the unperturbed evolution of nearby dwarf galaxies.

The luminosity function in Virgo, when combined with the much flatter function found in the field, will enable the efficiency of low mass galaxy formation in differing environments to be investigated. First results are indicating a strong environmental dependence, which would need to be taken into consideration by Cold Dark Matter theories.

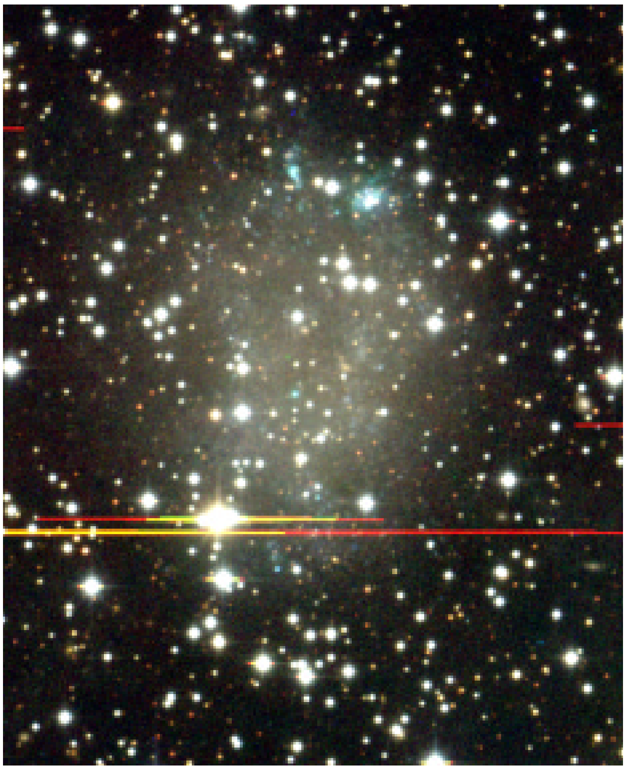


Figure 6. Colour composite of Cepheus galaxy created from 1200 second exposures in g', r' and i'-band images taken in sub-arcsec conditions using the Wide Field Camera on the INT.

A GIANT STREAM OF METAL-RICH STARS IN THE HALO OF THE GALAXY M31

INT+WFC

Within the framework of hierarchical structure formation, large spiral galaxies like the Milky Way or Andromeda arose from the merger of many small galaxies and protogalaxies. Later in their evolution, spiral galaxies become the dominant component in such mergers, cannibalizing smaller systems that fall within their sphere of influence. The complete destruction of the victim is usually progressive, and may take several orbits. However, the stellar debris from the destroyed dwarf galaxy follows a similar orbital trajectory to the progenitor, which is likely to have started life far away from the place of its final demise, and so the tidally disrupted matter tends to be deposited over a broad range in distance from the larger galaxy. Over time, with the accumulation of many such mergers, large galaxies develop an extensive stellar and dark-matter halo, the latter being by far the most massive component of the galaxy. Meanwhile, part of the (dissipative) gas component of the smaller galaxies

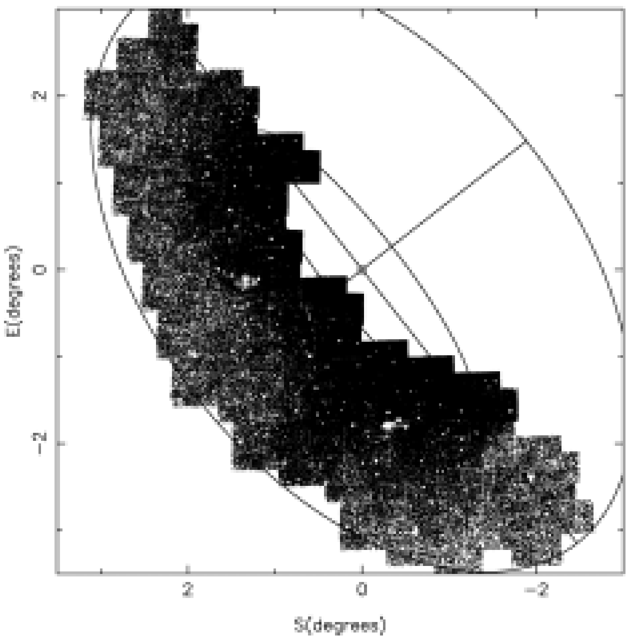


Figure 7. Surface density of RGB stars over the southeastern halo of M31. The over-density of stars is seen as a stream extending out of M31 close to, but distinct from, the minor axis.

feeds the growth of the disk of the larger galaxy. This is seen in numerical simulations of galaxy formation, which result in galactic haloes comprising clumps of dark matter. If this prediction is correct, then haloes should possess significant substructure — in contrast to previous suggestions, which predict the dark and luminous components of haloes to be distributed smoothly.

Andromeda or M31 galaxy is our Galaxy's "big sister", twice as large but otherwise very similar. It is the nearest large galaxy, lying only 2.2 million light-years away. Astronomers have known for some years that our own Galaxy is a cannibal. Its outer parts are threaded with tell-tale streams of stars from small galaxies it has engulfed.

The first sensitive panoramic wide field imaging survey of M31 using the Wide Field Camera on the Isaac Newton Telescope has unambiguously revealed the presence of a giant stellar stream within M31's halo. The source of the stream is likely to be either, or both, of the peculiar dwarf galaxies M32 and NGC205, close companions of M31, which may have lost a substantial amount of stars, gas and dust due to their tidal interactions with the massive host galaxy. The broad agreement of the metallicity distribution of the stream stars with these two dwarf satellites together with their alignment, physical proximity, and distorted morphological appearance, point to a common origin. The well-known disparity in properties between the Milky Way and M31 stellar haloes would be understandable if the majority of M31's stellar halo arose as relatively recent tidal debris from prolonged bouts of aggressive tidal interaction with its two nearest neighbour satellites. Together with recent observations of tidal debris in the Milky Way halo, these results clearly demonstrate that the epoch of galaxy building still continues, and that substructure in the form of huge, recently-deposited tidal streams, could be a generic feature of large galaxy haloes.

The new survey was possible only because the digital detector arrays such as the Wide Field Camera now cover fairly large areas of sky. Even so, more than fifty long exposures had to be pieced together to give a panorama of the halo on one side of Andromeda.

COMPLETELY DARK GALAXIES

INT+WFC

The universe could be harbouring numerous galaxies that have no stars at all and are made entirely of dark matter. Astronomers may ultimately discover that completely dark galaxies outnumber the familiar kind populated by shining stars and gas, perhaps by as many as 100 to 1. There is already a considerable amount of evidence that bright galaxies contain large amounts of dark matter, often ten times more than the mass of all their stars put together. There must be extra mass that we do not see to account for the observed movements of the stars under the influence of the gravity of the whole galaxy. In some galaxies we see so few stars they are incapable of holding themselves together as a galaxy. They would have long since scattered through space without the gravity of unseen matter to keep them together. But the question is: how do we look for these largely or even completely dark galaxies?

It's a difficult challenge, and the best technique will depend on the nature of the dark matter, which is still unknown. If the dark matter is composed entirely of fundamental particles, dark galaxies may act as gravitational lenses, distorting the appearance of distant galaxies that happen to lie behind them. If the dark matter includes some brown dwarfs their infrared radiation may be detectable. The same will be true if the galaxies contain any dead stars, such as white dwarfs or black holes. If they are nearby, it might be possible to detect these stellar remnants acting as gravitational lenses on the light of individual stars in other galaxies

Figure 8. From observations carried out as part of the ING Wide-Field Survey astronomers have been able to identify one place where a dark galaxy may exist. They noticed that the galaxy called UGC 10214, shown above, has a stream of material flowing out of it, as if it is interacting with another galaxy. In this case, the stream of material is apparently flowing towards nothing.

beyond them. Several lensing events in a small area of sky would suggest the presence of a dark galaxy.

One place where a dark galaxy may exist has been identified using images taken with the INT Wide Field Camera. A galaxy called UGC 10214 has a stream of material flowing out of it, as if it is interacting with another galaxy. But in this case, there is no other galaxy or source of visible light present, hence the companion galaxy may be completely dark.

TIDAL STREAMS IN THE GALACTIC HALO

INT+WFC

Standard cosmology theory predicts that dwarf protogalaxies were the first to born as individual systems in the universe. Afterward, many of these merge to form larger galaxies such as the Milky Way. The way in which this process takes place has consequences for the present-day structure of the Milky Way. The significant issues are how the merging efficiency compares with the star formation efficiency in the protogalactic fragments and how the fragment merging and disruption compare with the age of the Milky Way. If fragments are able to form stars before merging, they will collapse nondissipatively. If disruption was not complete, Galactic precursors should be visible today as dwarf galaxy satellites or as stellar streams within the Galactic halo.

The Sagittarius dwarf galaxy, the closest Milky Way satellite in an advanced state of tidal disruption, provides a "living" test for tidal interaction models and for galaxy formation theories. It was soon apparent that its extent was larger than at first assumed, and dynamical models predict that the stream associated with the galaxy should envelop the whole Milky Way in an almost polar orbit.

Using the Wide Field Camera on the Isaac Newton Telescope, astronomers detected a very low density stellar system at 50±10 kpc from the Galactic centre that could be related to a merger process.

The newly found system is 60° north and 46±12 kpc away from the centre of the Sagittarius dwarf galaxy. If it is really associated with this galaxy, it would confirm predictions of dynamical interaction models indicating that tidal debris from Sagittarius could extend along a stream completely enveloping the Milky Way in a polar orbit. However, the possibility that it corresponds to a hitherto unknown galaxy, also probably tidally stripped, cannot be rejected.

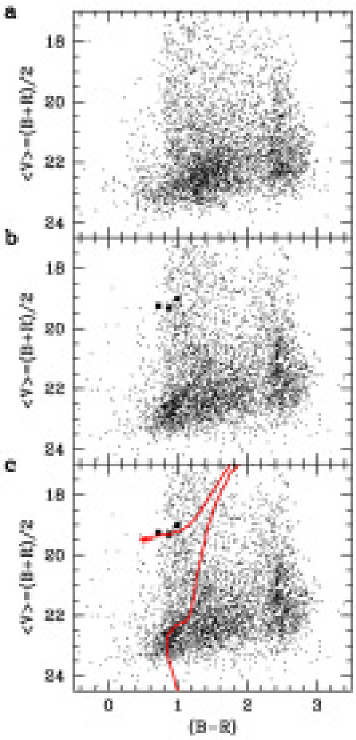


Figure 9. Color-Magnitude Diagrams (CMD) of the control (panel a) and target fields (panels b and c). Panel a provides the distribution of the foreground Milky Way stars. The overdense strip at (B–R)≃0.8, 22 ≤ V≤ 23.5 in panel b CMD is interpreted as produced by a stellar system at a distance of 51±12 kpc from us, which could make it part of the Sagittarius northern stream or, alternatively, could be the trace of a hitherto unknown tidally disrupted dwarf galaxy. Panel c shows the CMD of the target field with an old, low-metallicity (age: 12 Gyr; metallicity: 1/20 solar). The isochrone main sequence shape shows good agreement with the hypothetical target field main sequence.

THE LOCAL STAR FORMATION RATE

WHT+AF2/WYFFOS

There has been considerable progress in recent years in determining observational constraints on the cosmic history of star formation. Inevitably, most attention has focused on the contribution to the global history from the most distant sources, presumably seen at a time close to their formation. At more modest redshifts (z<1), it might be assumed that the cosmic star formation history is fairly well determined. However, the addition of further data to the low-redshift component of the cosmic star formation history has confused rather than clarified the situation. Using Autofib-2 on the William Herschel Telescope astronomers have conducted systematic spectroscopy of 305 low-redshift sources within two selected areas, updating the analysis of the ultraviolet luminosity function and star formation density presented in previous work.

The luminosity function measures the number of galaxies of different brightness in the sky, and, from such measurements, the density of ultraviolet light can be measured. Ultraviolet light is generated by massive short-lived stars, and consequently traces the star-formation rate of the surveyed galaxies. By combining with measurements of another star-formation tracer, Hα emission lines, the two tracers of star-formation can be compared. This allows astronomers to place constraints on how the star-formation rate of the universe has evolved over time, or redshift.

One of the main conclusions of this survey is that the local volume-averaged star formation rate is higher than indicated from earlier surveys. Moreover, internally within the sample, astronomers do not find a steep rise in the ultraviolet luminosity density with redshift over 0<z<0.4. These new data are more consistent with a modest evolutionary trend.

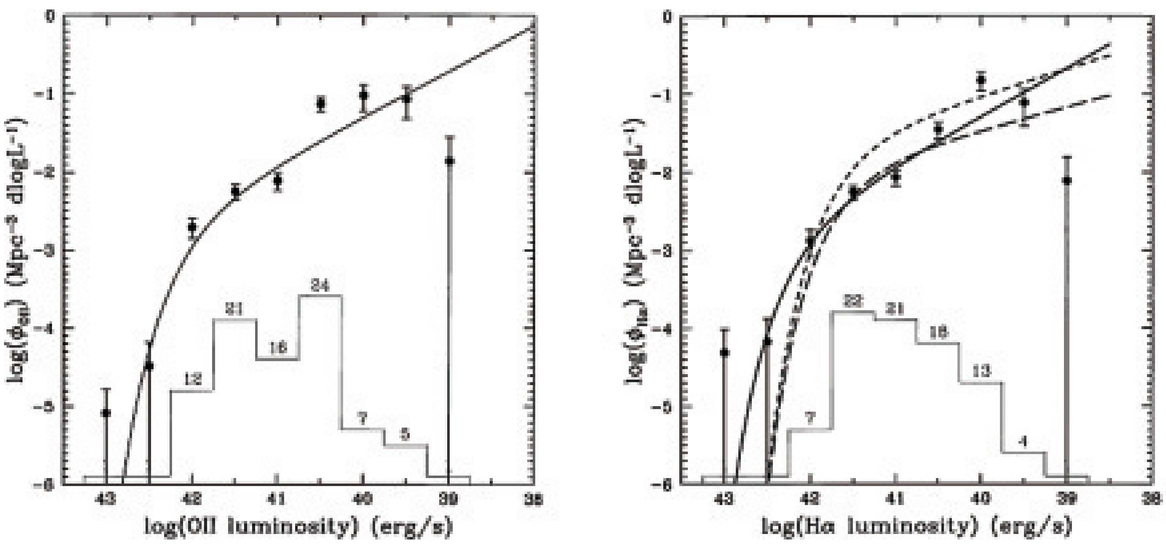


Figure 10. Left: The dust-corrected [O II] luminosity function derived from the AF2/WYFFOS sample (dots). The best fit is shown by the solid line. Right: The dust-corrected Hα luminosity function. The best fit is shown by the solid line. The short-dashed line is the Hα luminosity function derived by Tresse & Maddox, 1998 (ApJ, 312, 691) in a similar redshift range, while the long-dashed line shows the z≅0 estimate of Gallego et al., 1995 (ApJ, 312, L1).

Chapter 2

OPERATION, MAINTENANCE AND ENHANCEMENTS

TELESCOPE OPERATION

Day-to-day telescope operations activities are carried out by a single Operation Team covering the three telescopes. Efforts of day-time and night-time support activities focus on the WHT. On this telescope six main common-user instruments are offered, and many observing teams pass the scene. The INT on the other hand operates in a much simpler fashion and is essentially a two-instrument facility, while the JKT only supports one instrument. For the night time operation a telescope operator is present each night on the WHT and some of the nights on the INT. At the JKT no night time operator support is available to visiting observers. Astronomy support is offered to all visiting astronomers on the first night of their observing run, and at night engineering support is always around. Modernisation and integration of the various control systems have resulted that the INT and JKT can now easily be operated by a single person. On the JKT astronomy support is largely carried out by students.

Care of ING's prime optical components, the telescope mirrors, remains an important recurrent aspect of the day-to-day work at the observatory. We continued to CO_2 snow-clean the WHT primary mirror. However, in line with findings at other observatories, tests have shown that regular mirror washing in combination with snow cleaning helps keep reflectivity high, reduces scatter of light, and relaxes the need for regular re-aluminising. During the year the first experiments with mirror washing were carried out with good results. In situ mirror washing offers a significant engineering challenge in order to protect the telescope and ancillary equipment against water.

INFRASTRUCTURE

The implementation programme of the new San Diego controllers (SDSU-2) and control software and hardware to replace the older generation of controllers has progressed well. The new system was taken in use with all science detectors available on the INT and with nearly all detectors at the WHT. It provides much faster readout of CCDs and significantly improves observing efficiency. The same system has now also been implemented for operation with the IR Hawaii array in the new infrared camera on the WHT, INGRID.

The CCDs currently available at ING have overall excellent characteristics, but one weakness in the suite of CCDs offered to astronomers is the relatively low quantum efficiency beyond 800 nm and interference fringes between the front surface and the back plane of the detector, hampering accurate flat field calibration. To resolve this weakness ING has joined a consortium effort for the development of a new generation of MIT/Lincoln laboratory CCDs with nearly twice the quantum efficiency at far red wavelengths and very little fringing. The first of the science grade devices are expected for delivery in 2002.

In previous years ING's Differential Image Motion Monitor (DIMM) had provided valuable information on the site seeing conditions. The operational overheads in operating the DIMM have meant that this system could only be operated on a campaign basis. In view of the adaptive optics observations, in particular when carried out in queue scheduled mode, the need for continuous information on the actual seeing condition becomes essential. But also for other types of observations it has been found useful to have an accurate measure of the free atmosphere seeing. For this reason the ROBODIMM project was initiated to provide continuous seeing measurements using a system that can operate in an unassisted, robotic fashion. ROBODIMM will become operational in 2002.

Over the two reporting years the legacy computer network infrastructure was successfully replaced with a 100 megabit per second network using structured cabling. Due to the complexity of the computer infrastructure and the requirement not to interrupt telescope operation this took more than a year to complete. This network enhancement not only provides an increase in network capacity of an order of magnitude, but it also provides a backbone upon which further increases in network capacity may be realised. This new network has brought many advantages to the ING in terms of network management and security, and these improvements have also been appreciated by visiting astronomers.

In line with the network enhancements, data archiving and storage within the ING has witnessed a number of disparate but crucial changes such as the successful testing of a system to automatically create "D" tapes, the introduction of an elaborate backup system, which was developed in-house, and the inauguration of two new RAID systems. These projects are complemented by the introduction of a Pioneer library system capable of writing to and reading from CDs and DVDs. These towers each have the capability of housing 6.8Tb of double-sided medium allowing data to remain on-line for ten times longer than was previously possible. This is not only advantageous for visiting observers, but also reduces much of the day-to-day pressure to manage and guarantee a secure data flow as raw data from the ING telescopes is now automatically recorded on DVD-R disks for eventual transfer to the ING archive at Cambridge. With these enhancements in place ING can keep abreast with the ever growing quantity of data generated by our observing systems.

On the INT the Wide Field Camera is used much of the time for carrying out a wide field survey of the sky. This survey project prompted the initiation of a project to vastly improve the data processing capability for pipeline data reduction. This so-called Beowulf system is based upon a specialised parallel processing Linux-PC cluster running the pipeline data processing software developed at the Cambridge Astronomy Survey Unit in the UK. The introduction of a Beowulf system complemented ING's data handling strategy and in particular consolidated the above mentioned new computer network with the new CD/DVD systems. The pipeline offers fully automatic quick-look reduction for immediate quality assessment at the telescope, and a science pipeline offers a reduced data product shortly after the end of the observing run. Observers can submit their observations to the pipeline at the end of the night and allow them to view fully processed data — including object catalogues — the following afternoon. The science pipeline requires only a small amount of human intervention in order to ensure use of the best possible calibration frames.

The consumption of liquid nitrogen has gradually increased over the years and is expected to increase further in the future as more detectors and instruments come on line. The production capacity of the existing plant had become insufficient to meet future demands, as the plant supplies not only the ING telescopes but also other telescopes at the observatory. To resolve this problem, jointly with the Galileo Telescope and Nordic Optical Telescope groups a second liquid nitrogen production unit was purchased and installed. The new plant together with the old unit and enhanced storage capacity will be able to meet current and future demand.

An initiative has been started to implement a number of low-cost house-keeping measures in the INT building with the aim to reduce locally induced seeing and hence improve image quality. Experiments with the Differential Image Motion Monitor in previous years provided firm quantitative evidence for the popular belief that seeing at the INT is worse than the quality of the sky would allow. On the basis of this it was decided to implement a number of simple measures to reduce the heat input into the dome, such as ventilation of cold air into the building below the observing floor.

The ageing Westinghouse acquisition TV system on the WHT was replaced by a modern commercial CCD-based TV system. The new system, although somewhat limited in capability, provides much improved image quality and allows acquisition of much fainter objects.

During the summer of 2000 both the WHT and INT domes were painted externally. This major maintenance work was managed so not to affect the observing programme in any way.

Figure 1. A view of the ING liquid nitrogen plant with the new production unit in the foreground.

INSTRUMENTATION

The WHT supports a versatile set of common-user instruments, ranging from optical and IR imagers, to medium and high resolution spectrographs. But apart from the facility-class instruments, as in previous years the WHT has remained popular with visiting instruments. Most notable *visitors* have been the ESA/ESTEC's super conducting-tunnel-junction camera S-Cam, the SAURON integral field spectrograph, and the Planetary Nebula Spectrograph.

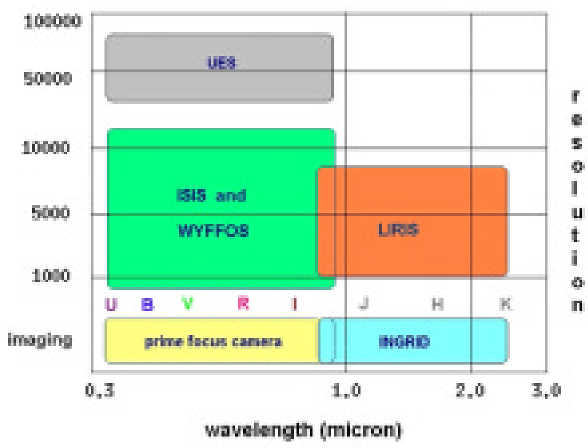


Figure 2. Instrument capability of the William Herschel Telescope.

Of these visiting instrument, the ESA/ESTEC's innovative super conducting-tunnel-junction camera S-Cam was probably the most technologically exciting. The unique technology deployed in this camera permits measurement of both the energy and time of arrival of each photon striking the detector array at very high detection efficiency. During three observing runs technical commissioning was combined with science observations. The detector deployed in S-Cam had only 6 by 6 pixels, but it is expected that in the near future S-Cam will feature a larger format detector with better wavelength resolution.

The SAURON integral field spectrograph had several visits to the WHT. This instrument is a collaborative project between research groups in Leiden, Lyon and Durham. The instrument uses a lenslet array to dissect the telescope focal plane in many apertures, and in one exposure a spectrum for each aperture is obtained. A huge multiplexing advantage is thus obtained, which makes this spectrograph highly suitable for measuring the kinematics of nearby galaxies.

The Planetary Nebula Spectrograph, PN.S, designed and built by an international consortium with groups from Australia, The Netherlands, Italy, the UK and the USA, is an instrument that has been designed with a very specific scientific objective in mind. This slit-less spectrograph produces counter-dispersed images of galaxies in the OIII line. This setup allows very easy and efficient detection of planetary nebulae in galaxies through their emission line nature. The images obtained provide not only the position of the PNe, but also the radial velocity of the objects that can then be used to study the dynamics in galaxies.

Apart from these new visitors, also other visiting instruments that had been to the telescopes before, like the MUSICOS fibre-fed echelle spectrograph, the CIRSI panoramic IR camera, and the Texas-Tromso Photometer, returned to the ING telescopes.

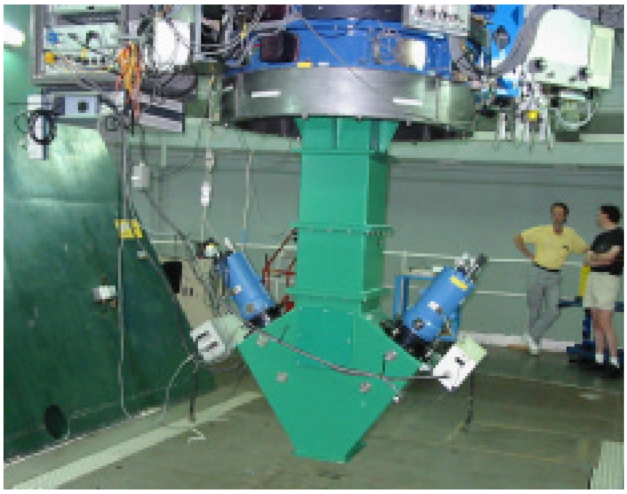


Figure 3. The Planetary Nebula Spectrograph fully assembled and integrated with the WHT, and EEV CCDs and controllers mounted on each arm of the spectrograph.

INSTRUMENT DEVELOPMENTS

Instrumentation development activities now strongly involve ING's engineers and astronomers on La Palma, a trend that has become more apparent during the reporting years. Reorganisation of the operational activities has enabled ING staff to gradually become more involved in development projects than used to be the case. The following main projects came to fruition.

Early 2000 saw the completion and commissioning of ING's new infra-red imager, INGRID, for the WHT. The system performed well from the very start. INGRID is made available at a new port on the Cassegrain focus and is also used as the premier imaging system for adaptive optics. This camera at its heart has a Rockwell 1024 by 1024 pixel HgCdTl array detector covering a

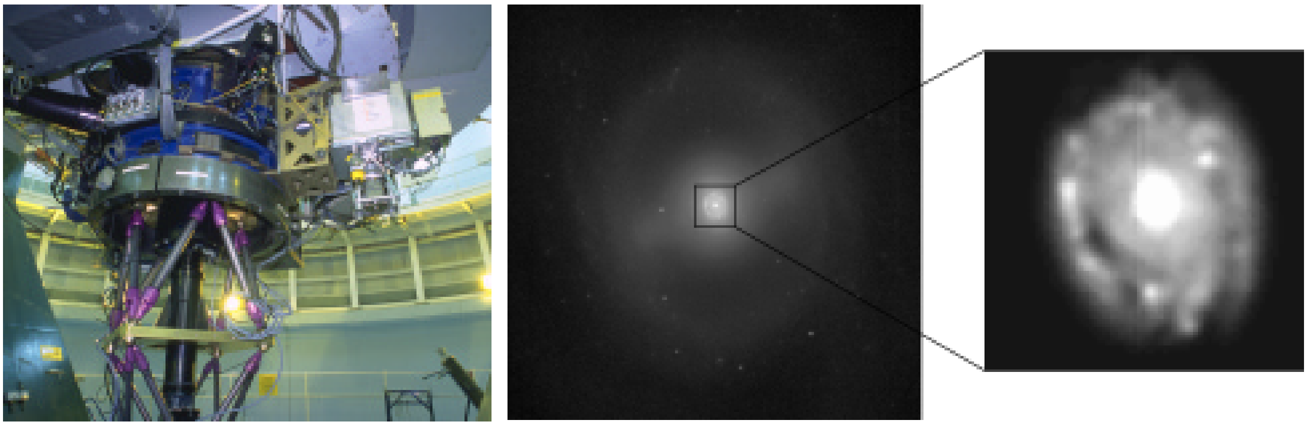


Figure 4. Left: INGRID mounted on one of the WHT folded Cassegrain foci (top right). The instrument on the Cassegrain focus is SAURON. Right: This image acquired using INGRID on the first nights is a J-band image of M95. The inset on the right shows the nuclear ring of enhanced star formation.

field of over four minutes of arc. It has been very popular within the user community, judging from the number of applications and post-observing feedback received. In particular the field of view has proven to be an attraction to observers.

A second important project carried out at the ING was the design and construction of a new fibre module for the AUTOFIB multi-object fibre spectrograph in the prime focus of the William Herschel Telescope. AUTOFIB has considerably increased in popularity, most likely due to the fact that this instrument fulfils a pivotal role for spectroscopic follow-up observations of ongoing imaging surveys such as the ones being conducted at the INT. The new fibre module with smaller, 1.6 arcsec diameter fibres has the advantage of reduced sky background contamination and higher throughput. Design and manufacturing work on the new fibre module was fully carried out at ING. A further enhancement of the fibre spectrograph has been initiated, with the design and construction of a new spectrograph camera that will allow imaging more fibres and deployment of larger format CCDs.

Arguably the most important development project that came to fruition was the technical commissioning and first science observations of the common-user adaptive optics system for the WHT, NAOMI. The Adaptive Optics (AO) programme is a corner stone development area for the WHT. The 4-m class telescopes will more readily be able to effectively exploit AO techniques at relatively short wavelengths and over moderately wide fields than the larger telescopes, in particular on a good observing site such as La Palma. The WHT AO system was designed and built by a team from Durham University and the UK-Astronomy Technology Centre in Edinburgh. The advent of NAOMI required a range of modifications and improvements to be made to the Nasmyth focal station and telescope performance in order to make the telescope ready for the 0.1 arcsecond world of adaptive optics.

During pre-commissioning tests diffraction-limited images were readily obtained in the J, H and K bands with a small pinhole illuminating the focal plane. And also on celestial objects in the K band the diffraction limit was reached. Most of the commissioning goals

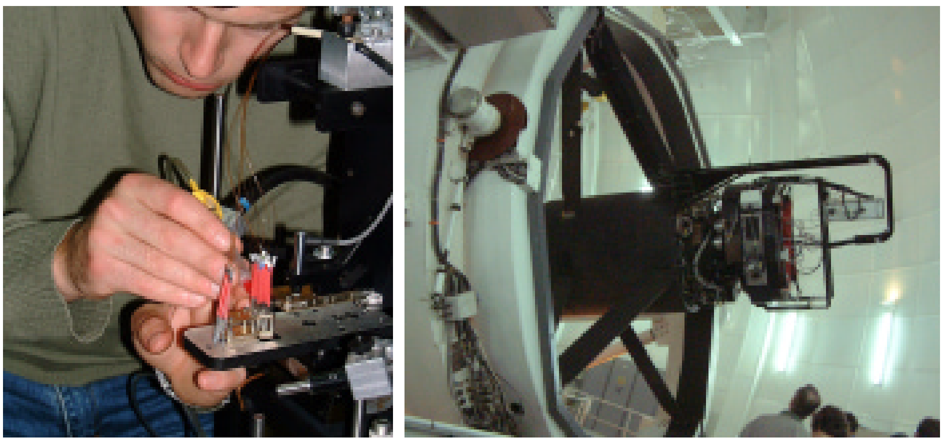


Figure 5. Left: Alignment of fibres into micro-lens finger holder at ING. Right: The Small Fibre Module at WHT prime focus.

were met, proving basic functionality of the system. Particularly impressive was the quality of optical alignment achieved with the modular NAOMI design and the success of largely automated methods for determining and correcting for so-called non-common path error (differential optical aberrations between wavefront sensor camera and science camera). The complex interplay between the segmented deformable mirror, the fast steering mirror, and the telescope tracking was achieved reliably.

Following initial commissioning in 2000, further on-sky tests have focussed on optimising and characterising system performance. Key achievements included regular diffraction limited 0.12 arcsec FWHM performance in the K band, closing the loop on a 15th-mag star, and automatic dithering with the AO loop closed. In September 2001 tests were conducted to gauge NAOMI's performance in the optical, in

The NAOMI AO instrumentation relies on natural guide stars to measure wavefront distortions. Optimal exploitation of AO would require the deployment of artificial guide stars produced by a laser beam, as this would provide nearly full sky coverage. Large sky coverage enables a much wider range of astronomical applications of adaptive optics to be carried out. A sodium laser produces a fluorescent spot high in the Earth's atmosphere, at an altitude of approximately 90 km that can then be used as an artificial star. In preparation for possible future sodium beacon deployment on La Palma a study has been completed to investigate whether the atmospheric conditions above the observatory are suitable for this technique and to learn about the technical complexities of sodium laser guide star deployment. This programme, led by the Imperial College in London, resulted in a number of laser firings during several nights over the period of one year. The very successful trials gave invaluable

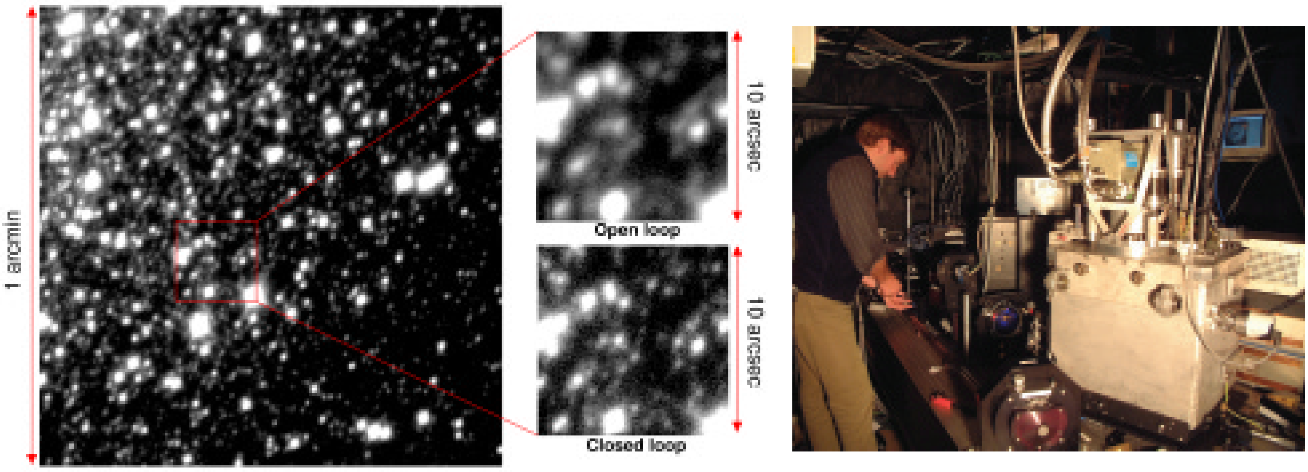


Figure 6. Left: H-alpha image of globular cluster M13 obtained using NAOMI. The FWHM has been improved from 0.8 arcsec (natural seeing) to 0.4 arcsec, allowing many faint stars to be resolved. The image was taken during September 2001 tests of NAOMI's performance at optical wavelengths, and provides a realistic outlook of the AO potential at the William Herschel Telescope. Given that the median natural seeing on La Palma is about 0.7 arcsec, an image quality of ~0.3 arcsec in the R and I bands should be achieved regularly. Right: NAOMI in GHRIL, with INGRID in the foreground.

preparation for the OASIS integral-field spectrograph that will come to the WHT in 2003.

Further development of the adaptive optics programme at the WHT includes deployment of a coronagraph (OSCA), built at the University College London, and of an integral field spectrograph (OASIS) in collaboration with Centre de Recherche Astronomique in Lyon, France. Both instruments will provide important new science capability to the adaptive optics system and are expected to be commissioned in 2003.

information and experience on both technical and atmospheric parameters. For instance the tests allowed measurement of the temporal variation of the mesospheric sodium layer thickness and profile, as is shown in the adjacent figures.

An exciting instrument under development at the Instituto de Astrofisica de Canarias that will likely serve a large user community in the future is the LIRIS IR spectrograph and imaging system. This versatile system, designed for the Cassegrain focus of the WHT,

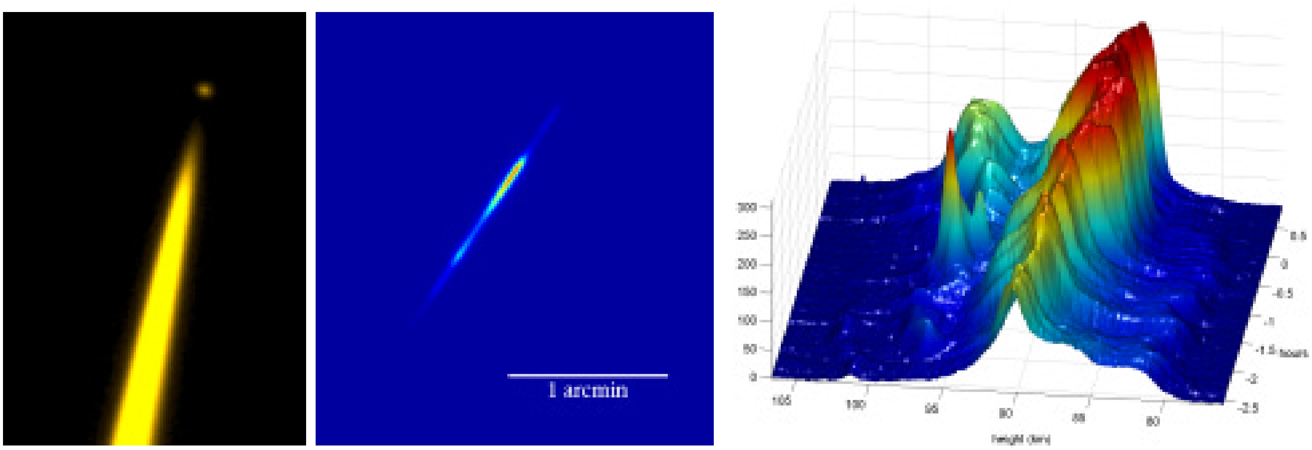


Figure 7. Left: Sodium laser beam projected in the sky. Clearly visible are the low altitude Rayleigh back scatter plume and the sodium 'spot' at some 90 km above the observatory. Middle: The Sodium spot at 90 km as seen from the Jacobus Kapteyn Telescope. Due to projection effects the spot is seen elongated against the sky. Right: Temporal and spatial profile of the sodium spot during one observing night.

will be capable not only of high quality imaging from 0.9 to 2.4 micron, but also of long-slit and multi-slit spectroscopy, coronography and polarimetry. Commissioning is expected to take place in 2003.

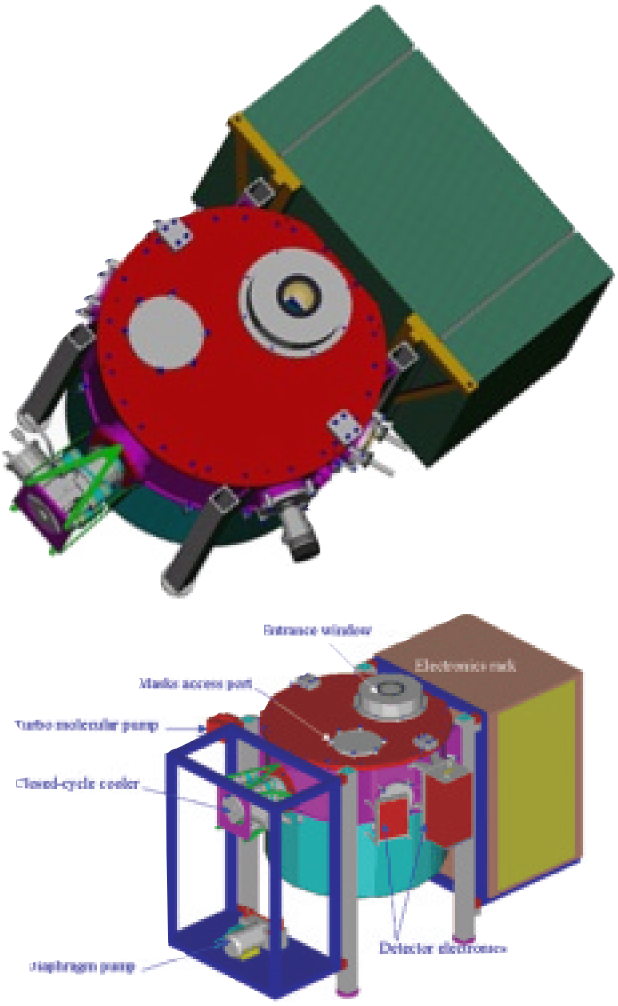


Figure 8. LIRIS external schematic view.

THE INT WIDE FIELD SURVEY PROGRAMME

On the 2.5-m Isaac Newton Telescope survey activities with the Wide Field Camera continued to fulfil an important role in the scientific exploitation of this telescope. Survey proposals ranged from deep galaxy surveys to a census of the Local Group and an extensive investigation of time-dependent phenomena. Sky coverage of the main science programme of the survey passed the 150 square degrees mark.

The first round of proposals for the Wide Field Survey has completed a full three years, and a second call for proposals was send out as a continuation of the scheme. Following this second announcement of opportunity for Wide Field Survey activities, six proposals were selected by the time allocation committee. The principal investigators and the titles of the selected proposals are:

— Dalton (Oxford), *The Oxford deep WFC survey*

— Davies (Cardiff), *Multi-coloured large area survey of the Virgo cluster*

— Van den Heuvel (Amsterdam), *The faint sky variability survey*

— McMahon (Cambridge), *The INT wide angle survey*

— Walton (Cambridge), *The Local Group census*

— Watson (Leicester), *An imaging programme for the XMM-Newton serendipitous X-ray sky survey*

Clearly the offer of survey time has again inspired the principal investigators to request large blocks of observing time over several semesters that would otherwise be difficult to get approved through the normal time allocation procedures.

Chapter 3

USE OF OBSERVING TIME AND SCIENTIFIC PRODUCTIVITY

USE OF TELESCOPE TIME

The available observing time on the ING telescopes is allocated between British, Dutch and Spanish time allocation committees, the CCI International Time Programmes (ITP), service and discretionary nights, and scheduled stand-down and commissioning time.

The ING Board has delegated the task of time allocation to British astronomers to the PPARC Panel for the Allocation of Telescope Time (PATT), and to Dutch astronomers to the NFRA Programme Committee (PC). It is the responsibility of the Instituto de Astrofísica de Canarias (IAC) to allocate the Spanish time via the Comité para la Asignación de Tiempos (CAT). For committee membership please see Appendix I.

The ratio of UK PATT : NL NFRA PC : SP CAT : ITP is nominally 60 : 15 : 20 : 5. This ratio is monitored and small differences in these proportions in any one year are corrected over a number of observing seasons.

The PPARC makes 27 nights per year of its share on the JKT available to the National Board of Science and Technology of Ireland (NBST) and the Dublin Institute for Advanced Studies (DIAS).

The aim of the ING service programme is to provide astronomers with a way to obtain small sets of observations, which would not justify a whole night or more of telescope time. For each telescope and instrument several nights per month are set aside especially for this purpose. During those nights, ING support astronomers perform observations for several service requests.

Stand-down and discretionary nights are used for major maintenance activities, minor enhancements, calibration and quality control tests, etc., and partly for astronomy, for example, as compensation for breakdowns or for observations of targets of opportunity. A careful record of service observations per nationality is kept.

The way the available observing time on the ING telescopes has been shared in 2000 and 2001 is summarised in Table 1.

	WHT		INT		JKT	
	2000	2001	2000	2001	2000	2001
UK PATT	176	177	135	145	183	198
NL NFRA PC	42	43	34	35	48	51
SP CAT	62	66	71	70	68	72
UK/NL WFS	—	—	77	70	—	—
ITP	16	16	18	18	16	18
Service	26	24	21	18	16	16
Instrument Builders' Guaranteed Time	1	6	—	—	—	—
Commissioning	25	16	4	3	5	0
Discretionary	16	17	3	6	15	10
Stand-down	2	0	3	0	15	0
Total	366	365	366	365	366	365

Table 1. Allocation of nights from semester 2000A to semester 2001B. UK PATT allocation on the JKT includes Irish time, and Portuguese time to semester 2000B. Service nights include UK and NL service time, and SP CAT time includes also Spanish service time.

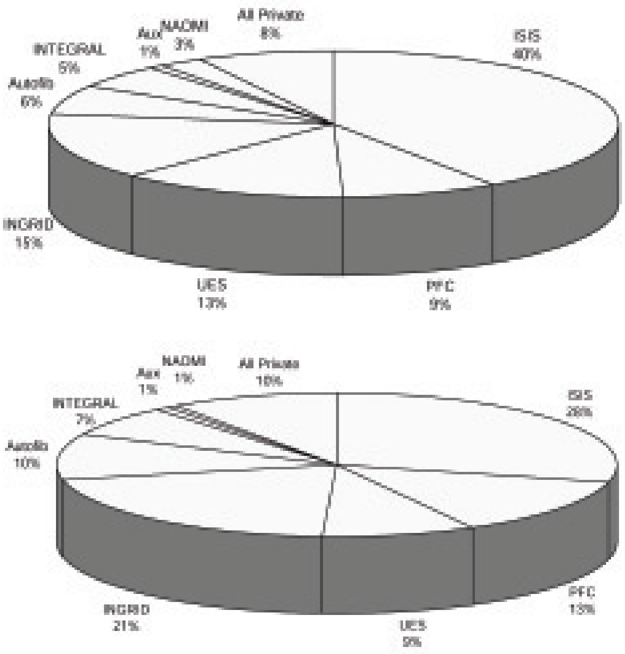


Figure 1. Above: Use of instrumentation in semesters 2000A and 2000B on the WHT. Below: The same for semesters 2001A and 2001B. Commissioning nights are excluded. The abbreviations are explained in Appendix K.

USE OF INSTRUMENTATION

Figure 1 shows the allocation of nights per instrument on the WHT in 2000 and 2001. As in previous years, the ISIS spectrograph and polarimeter was the most popular instrument but also remarkable is the increase in the use of the ING infrared imager INGRID, which became the second most popular instrument in 2001. Private instruments included LDSS, SAURON, and SCAM.

On the INT, dark time periods were almost exclusively used for CCD imaging with the Wide Field Camera (60.3% and 52.9% in 2000 and 2001 respectively). The rest of the time was for the use of the IDS spectrograph (33.4% and 39.9%) and ocassional private instruments like CIRSI, Musicos or the Texas Photometer (6.3% and 7.2% all private instruments). The JKT was a single instrument telescope for CCD imaging.

TELESCOPE RELIABILITY

During the year 2000 and 2001 the ING telescopes again performed very well, with downtime figures due to technical problems averaging at 2.1%, 3.0%, and 2.7% in 2000 and 3.3%, 1.1% and 1.2% in 2001 on the WHT, the INT, and the JKT respectively. These figures meet the target value of a maximum of 5 percent technical downtime. Down time due to poor weather averaged 22.8% in 2000 and 24.6% in 2001. The historical trends of technical down time and weather down time by semester are plotted in Figures 2 and 3. Figure 4 shows the seasonal average.

SCIENTIFIC PRODUCTIVITY

An important metric of the success of ING telescopes is the publication rate in refereed journals and for this reason the ING Bibliography (see Appendix I) is updated

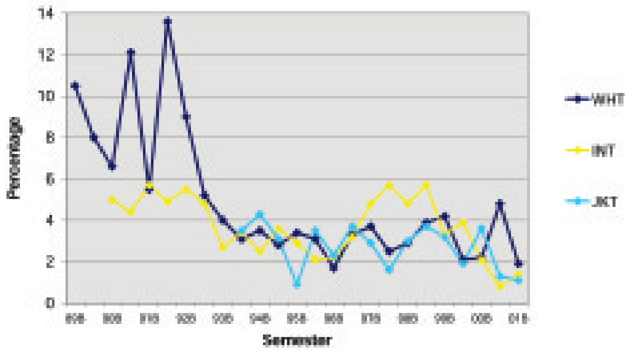


Figure 2. Technical downtime per semester.

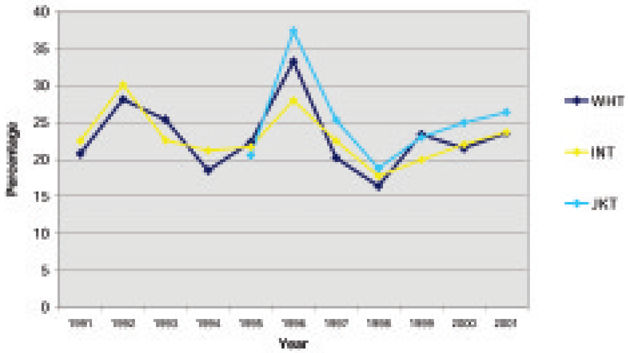


Figure 3. Weather down time per year.

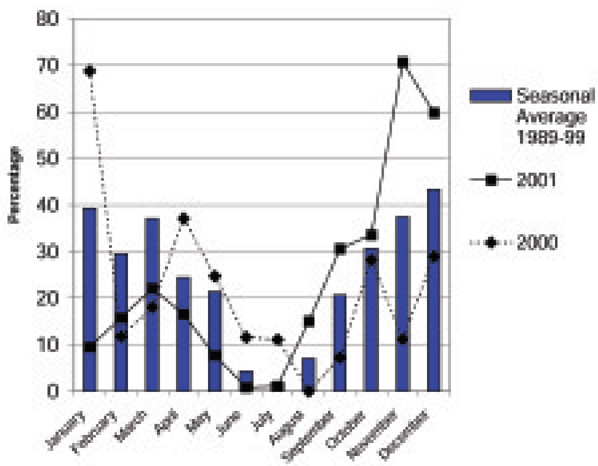


Figure 4. Monthly weather down time.

on a yearly basis. Traditionally this bibliography has been compiled by visually scanning all articles in many journals and identifying those which make use of data from our telescopes. However most journals are now published electronically and often have quite sophisticated search engines associated with them and it is therefore appropiate to conduct the search with the help of these facilities.

Our selection process identifies papers that make direct use of observations obtained with the ING telescopes. in order to qualify. Papers which refer to data presented in earlier papers (derivative papers) are not counted.

When we analyse ING publications for the five years between 1995 and 1999 inclusive it can be seen that more than 95% of articles are published in a small number of core journals. These core journals consist of the British journal MNRAS, the American journals ApJ, ApJL, ApJS, AJ and PASP, plus the European journal A&A (including the now defunct A&AS). We also include Nature and Science as core journals due to their perceived high impact. Journals making up the remainer of publications are widely spread among such journals as Icarus and the Irish Astronomical Journal to name a few. The bibliography for the years 2000 and 2001 was compiled from only the core journals listed above for reasons of efficiency. Search engines were used to select papers and the resulting list of papers visually inspected to ensure that they satisfied the selection criteria described above (the journal Astronomy & Astrophysics still had to be visually inspected).

Our initial results indicated a fall in the total number of journals compared with the previous few years, with 162 being found for 2000 and 162 for 2001 compared to the typical total of more than 220 found for the previous four years.

An analysis of these results indicated that this drop was due largely to a fall in the ApJ publication rate for 2000 by a factor of about 2. An immediate concern was that the electronic search process was missing articles. However, a check against previous years indicates that only few papers, if any are missed this way.

An analysis of these numbers follows (see Figures 5 – 9 and Table 2). Note that if a paper makes use of more than one telescope we count that paper for each telescope. Also, concerning perceived nationality we use the nationality of the first author's institution although

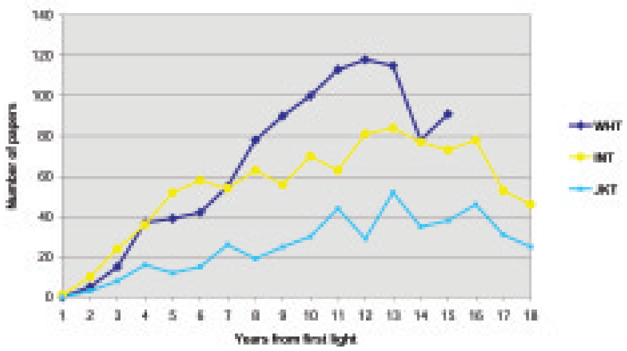


Figure 5. Number of refereed papers per telescope since first light.

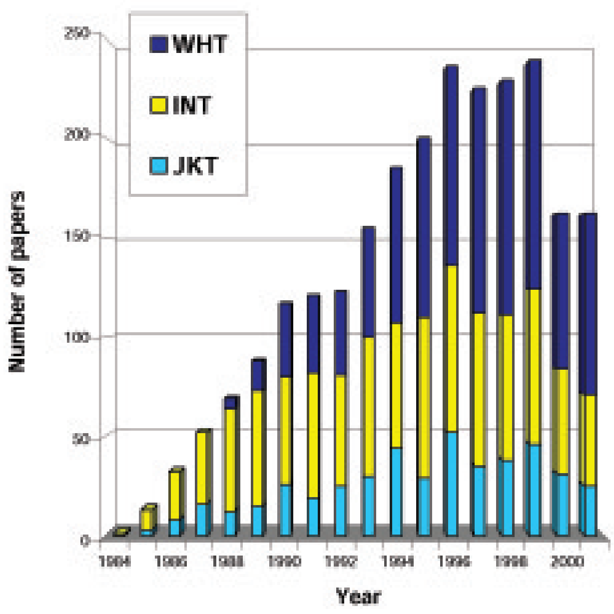
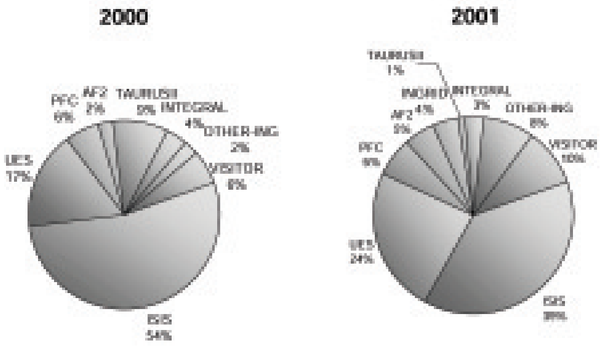
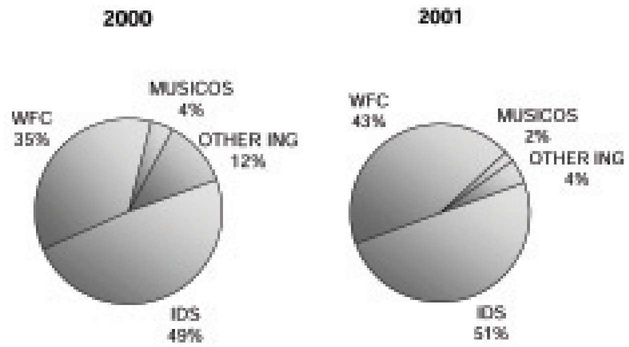


Figure 6. Total number of refereed papers per year and telescope.

	WHT	INT	JKT	Total
1984	—	1	—	1
1985	—	10	3	13
1986	—	24	8	32
1987	—	36	16	52
1988	5	52	12	69
1989	15	58	15	88
1990	37	54	26	117
1991	39	63	19	121
1992	42	56	25	123
1993	55	70	30	155
1994	78	63	44	185
1995	90	81	29	200
1996	100	84	52	236
1997	113	77	35	225
1998	118	72	38	228
1999	115	78	46	239
2000	78	53	31	162
2001	91	46	25	162
Total	976	978	454	2408

Table 2. Number of refereed papers per year and telescope.





Above: Figure 7. Use of instrument data in WHT papers. Below: Figure 8. Use of instrument data in INT papers.

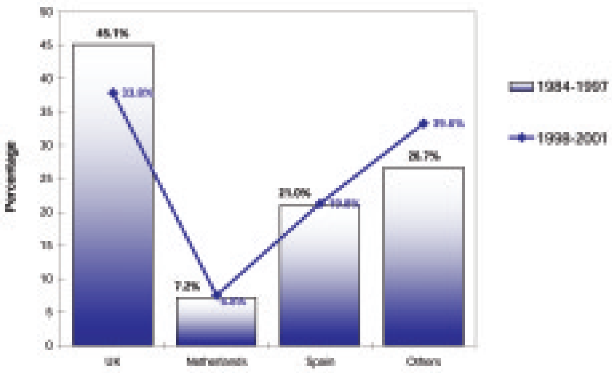


Figure 9. Paper authorship.

in a few cases two institutions are credited. Similarly, if a paper makes use of more than one instrument, that paper is counted against each instrument.

The fraction of papers attributed to the ISIS spectrograph from 1998 until 2001 (the years for which this information exists) varied from 39%, 50%, 54% to 39%. Clearly ISIS is still our most productive instrument by a long way. Over the same period the UES echelle spectrograph figures are 20%, 15%, 17% and 24% indicating the continuing demand for high resolution spectroscopy by our community. Papers from the newly

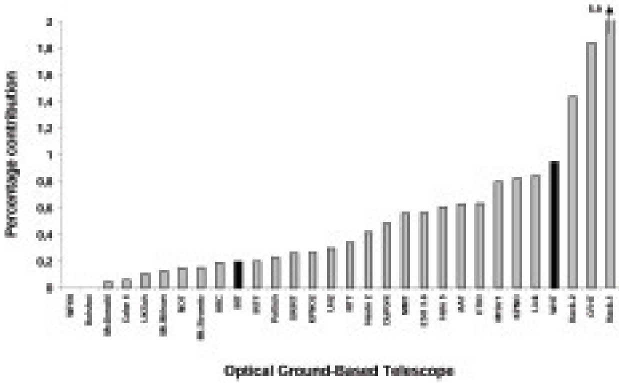


Figure 10. Result from a citation index study of the 1000 top-cited astronomy papers (125 top papers per year) from 1995 to 1998.

commissioned IR imager INGRID made a welcome appearance in 2001 with a total of 4 papers being attributed to this instrument. Interestingly the number of papers from visitor instruments on the WHT has increased from a few in previous years to 5 or 9 papers a year.

On the INT the papers are split very evenly between IDS spectrograph and the Wide Field Camera as might be expected from the split of observing time between these instruments, roughly 50–50.

It is heartening to note that the JKT still contributes to 25 to 30 scientific papers per year.

Concerning the nationality of the first author's institution, there is little change, at least considering the fluctuations from year to year. The UK share is steady around 40%, the Spanish share increased to 25% in 2000 but in 2001 was back at 20%. The NL share also showed little systematic change.

There is a clear decrease in the total number of papers published with a nearly 30% drop for the WHT. We believe our selection methods are sound but maybe more strictly applied than in previous years. Although some papers may have been missed by our more restrictive search, we expect that the main reason for the reduced publication rate is related to the advent of the 8-m class telescopes.

Encouragingly, ING telescopes continue to play an important role and in this respect we note the impact which the Wide Field Camera has had with an important paper in *Nature* concerning the merger of a satellite galaxy M31 (Ibata et al, 2001, *Nature*, **412**, 49).

In an attempt to measure the quality of the ING science, an analysis of the scientific productivity of large telescopes over the last decade (Benn and Sánchez, 2001, *PASP*, **113**, 385) puts the WHT in the lead over all other 4-m class and smaller telescopes, judging by counts of papers in *Nature*; and in close second place, after the Canada-France-Hawaii Telescope, judging by counts of citations to the 1000 most-cited astronomy papers world-wide (see Figure 10). This study also showed that during the 1990s, smaller telescopes accounted for half as much scientific output as did 4-m class telescopes, which bodes well for the continued productivity of the WHT in the era of 8-m telescopes.

THE ING ARCHIVE

All data taken with the ING telescopes is archived in the UK, at the Institute of Astronomy, Cambridge. The data archive is managed by the Cambridge Astronomy Survey Unit.

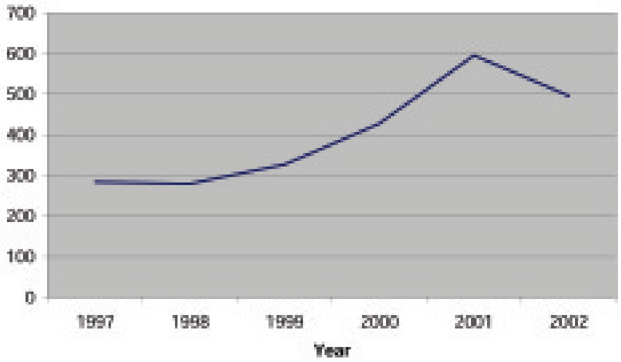


Figure 11. Number of archive requests.

Archival data from the ING telescopes is made available to anyone upon request, after a one-year proprietory period. The number of archive retrieval requests has remained high over the past two years, with around 500 requests per year. The historic trend of the archive requests can be seen in Figure 11. This level of archive use underlines the importance of the ING archive as a general tool for astronomy research.

Chapter 4

IN-HOUSE RESEARCH

In response to one of the findings of the International Visiting Committee report of 1998 that in-house research activities should be strengthened, PPARC agreed to fund two research fellows at ING and towards the end of 1999 both Johan Knapen and Romano Corradi joined the observatory in this capacity. These two new appointments brought the formal research allowance at ING to 3 full-time equivalent staff spread over 9 research active staff; the Head of Astronomy (UK), 2 (UK) research fellows, 5 (UK) support astronomers and 1 (NL) support astronomer.

In a further development, during 2000 the ING (Rutten/Lennon) successfully applied to the European Community to become a Marie Curie host training facility and were awarded funding for three fellowships in the area “Exploiting Adaptive Optics in Astronomy”. The first of these Marie Curie fellows, Roy Østensen, joined the ING during 2001, with the additonal fellows expected in 2002.

Also in 2000, Johan Knapen was awarded a PATT rolling grant while Romano Corradi was awarded a grant from the European Commission in 2001 as partial funding for a High Level Scientific Conference to be held in 2002.

The impact of these changes on the scientific atmosphere and productivity of the observatory can be gauged from the scientific publications produced by ING astronomers. In 1999 the total number of staff publications was 40, 23 of which were published in refereed journals. During 2000 these numbers rose to 62 and 31 respectively, while in 2001 there were further rises to a total of 105 publications of which 50 were in refereed journals (see appendix F for the complete list of papers). Highlights of individuals’ research is reported on below. A welcome aspect of this activity is that ING astronomers are active participants in observing programmes which make use of ING facilities, accounting for approximately 50 nights on each telescope as principal investigators or co-investigators, competitively applied for through the normal time allocation process.

Figure 1. INT true-colour image of Sextans B galaxy from the ING-led Local Group Census Wide Field Survey programme.

As an example of the synergy such activity creates with operational activities one can point to the fact that in the second round of Wide Field Survey programmes, the ING-led proposal “The Local Group Census” (spearheaded by Nic Walton and Romano Corradi) was approved. Furthermore, our adaptive optics specialist Chris Benn has been one of the most successful applicants for time on the WHT with NAOMI.

Our astronomers have also had marked success with other non-ING facilities, some successes worth highlighting are the 85 orbits of HST time won by Lennon (64 as principal investigator), 34 HST orbits by Corradi (8 as principal investigator) and 8 HST orbits by Knapen.

Other facets of the improved scientific atmosphere at ING are the impressive seminar programme detailed in Appendix G (typically over 30 talks per year including

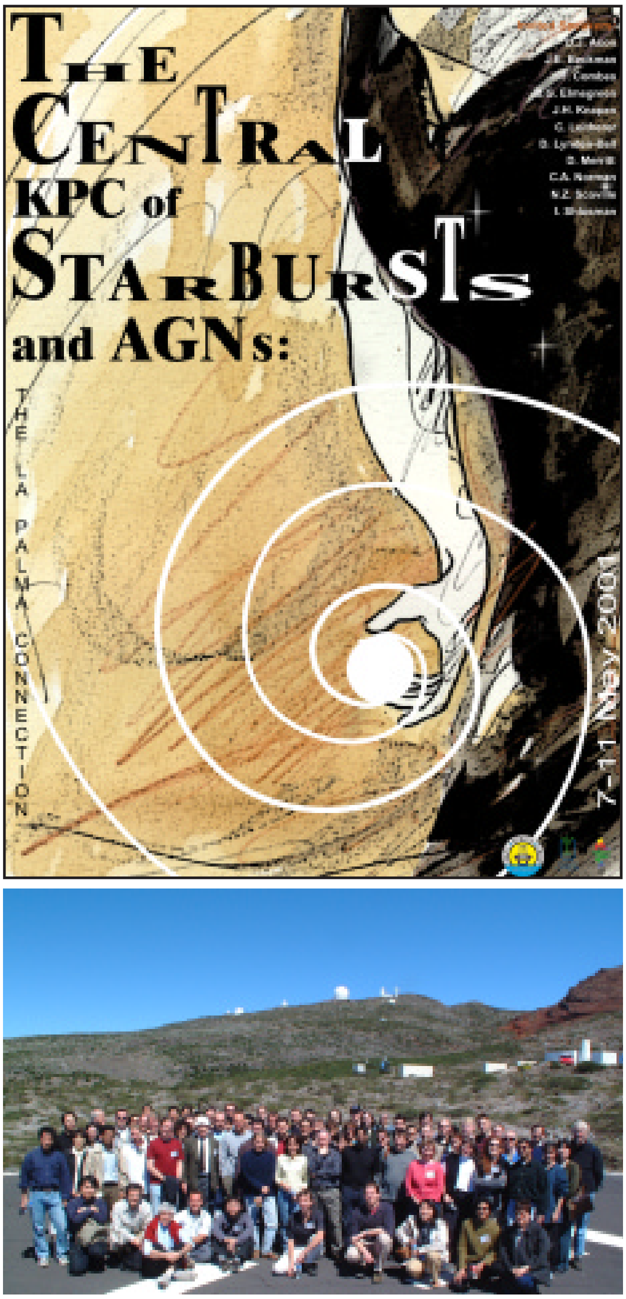


Figure 2. Above: Announcing poster of the "The Central Kpc of Starbursts and AGNs: The La Palma Connection" conference. Below: Conference attendants at the Observatory.

speakers such as Ellis, Pettini, Foy, Davies, Charles and de Zeeuw), a vigorous visitor programme, and staff effort available for long-term student supervision. The last point is noteworthy as long-term students provided support for the JKT, releasing valuable effort for ING projects and research.

In May 2001, over 100 astronomers from around the globe attended the first ING astronomical research conference on "The Central Kiloparsec of Starbursts and AGN: The La Palma Connection". The conference was held from May 7 to 11, 2001, in Hotel Hacienda San Jorge in the small resort town of Los Cancajos, located near Santa Cruz de La Palma. The scientific programme included nine oral and two poster sessions, with a dozen invited reviews setting the scene. Long lunch breaks were used for further discussions or collaborative work. The social programme included a lecture on the geography and biology of La Palma and a guided tour of the telescopes at the Observatory.

The fact that many high-resolution studies of galaxies have been made using data obtained on La Palma makes the island a fitting "connection" to the field of study. The central kiloparsec regions of nearby disk galaxies often show profound starburst and/or nonstellar (AGN) activity, accompanied by intricate gas and dust morphologies and kinematics.

The conference was supported financially mainly by the ING, but the Excelentísimo Cabildo Insular de La Palma (Island Government), and its Patronato de Turismo (Tourist Board) made very generous contributions to the social programme. The scientific and local organising committees were chaired by Knapen, with the latter committee made up entirely by ING staff and students. The proceedings of the conference were published at the end of 2001 as a 750-page volume in the conference series of the Astronomical Society of the Pacific, edited by Knapen et al.: "The Central Kiloparsec of Starbursts and AGN: the La Palma Connection", eds. J. H. Knapen, J. E. Beckman, I. Shlosman and T. J. Mahoney, 2001, *ASP Conference Series*, **249**.

INDIVIDUAL RESEARCH ACTIVITIES

Thomas Augusteijn identified the infrared counterpart of the X-ray source 4U 1630-47 and concluded that the source is a black-hole X-ray binary containing a relatively early-type secondary. He has also been involved in an extensive monitoring campaign of the cataclysmic variable TV Columbae, detecting the longest known superhump period. He also continued to work on the Faint Star Variability Survey, one of the Wide Field Survey programmes, and the Calán-Tololo and Hamburg-ESO objective prism surveys. One of the important aims of this work is to derive the true space density of the CVs.

Chris Benn discovered 5 QSOs at redshifts greater than 3.8 from INT observations of QSO candidates from the FIRST radio survey. A subsequent search, again with the INT, yielded a total of 18 QSOs with redshifts greater than 4. He also worked on the use of microJy radio sources as a measure of star formation rate as a function of redshift, dust extinction in QSOs, and the lunar atmosphere. Chris also produced a citation-based analysis of the relative impact of telescopes worldwide (Benn & Sánchez, 2001) which was widely cited in the literature and was discussed in *Nature* (2000, Nov. 2), **6808**, 12.

Romano Corradi focused on several aspects of the late stages of evolution of single and binary (symbiotic) stars, including the formation of bi-polar nebulae, the formation of small-scale low-excitation microstructures, and understanding the dynamical evolution of PNe. One of the main highlights is the discovery of 'false' haloes around PNe — shells which are not signatures of mass-loss events but rather are the result of the effect of a drop in luminosity of the central star. Romano also led searches for new PNe in other galaxies such as M33 and M81, finding 120 new candidates in the latter galaxy.

Begoña García Lorenzo investigated the circumnuclear regions of Seyfert galaxies finding that the stellar kinematical behaviour corresponds to stellar disks while the ionised gas is strongly perturbed by radial motions. She also derived the first measurement of an extinction curve at a cosmological distance, finding evidence for a strong 2175Å feature implying that the widely adopted SMC extinction law for such cases is erroneous. Begoña also continued to work on Blue Compact Dwarf galaxies.

Johan Knapen worked on the morphology and dynamics of disk galaxies, interrelations between the disk and bar, and between the circumnuclear and nuclear regions. A near-IR survey of galaxies obtained with INGRID was used to estimate the gravitational torques of the embedded bars. Knapen also found that Seyfert hosts are preferentially barred as had long been expected but never proven. He also investigated the stellar populations in the nuclear regions of galaxies and found evidence for sequential star formation in the nuclear ring of M100.

Danny Lennon produced the definitive high resolution spectroscopic survey of massive metal poor O-stars in the SMC. The data were used to improve spectral synthesis models of starburst and starforming galaxies. An analysis of the surface of the central star of Sher25, a B-supergiant with a bipolar nebula, demonstrated that this is not a post red-supergiant star as had been supposed. Lennon was also involved in using massive stars as probes of nearby galaxies, examining the abundance gradients in M31 and M33, as well as producing the first stellar abundances in the nearby dwarf irregular galaxy NGC6822.

Roy Østensen worked on pulsations in subdwarf B stars, discovering several new examples of this rare type of short period pulsating star. This work was the photometric follow-up of candidate subdwarf stars selected from the Hamburg-Schmidt survey.

Ian Skillen collaborated on aspects of the distance scale with the aim of investigating abundance effects on distances derived from Cepheids. Preliminary radial velocity curves for 16 field Cepheids derived from echelle spectra have been published.

John Telting found non-radial pulsations in the primary of a close binary system comprising two B-type stars in a 2.5 day period. The pulsational behaviour is similar to single non-rotating stars in the spectral class region of the Beta Cephei stars. The system is the most likely candidate for tidal excitation of pulsations possibly leading to loss of angular momentum. As such it is a key system for understanding close binary evolution and tidal capture.

Nic Walton was the principal investigator on a new Wide Field Survey programme, the Local Group Census, continuing his deep involvement with survey programmes in general. This survey, with strong ING representation, aims at uncovering populations of emission line objects in nearby resolved galaxies. Walton also continued his work on SN, both as cosmological probes and to study their physical processes, and continued to work on extragalactic PNe, in particular studying abundances in Centaurus-A.

Almudena Zurita found that HII regions are the most probable sources of ionisation of the diffuse ionised gas in spiral galaxies. She has also worked on the H-alpha luminosity function, and the calibration of the glitch in its behaviour in HII regions of spiral and irregular galaxies with the aim to using the luminosity function as a standard candle.

In addition to the above, a number of ING scientific and technical staff in zero research time posts contribute to the research atmosphere of the ING through their own interests. Such staff include Robert Greimel (Astronomy Software; high precision radial velocity measurement), Peter Sorensen (Telescope Operator; planetary nebulae), Javier Méndez (Librarian and Public Relations Officer; type Ia supernovae), Marco Azzaro (Telescope Operator; galaxy evolution and mergers), Neil O'Mahoney (Telescope Operator; adaptive optics), Saskia Prins (Astronomy Administration; supernova remnants).

Chapter 5

PUBLIC RELATIONS

Public outreach activities have continued to play an important role at ING. A summary of the main activities is given here.

Outreach to the general public focussed on many group visits to the telescopes throughout the year, and general observatory open days for the public during the summer months. In these ways thousands of interested visitors passed through the WHT and INT domes, saw the facilities, and received an explanation of ING's activities.

The visiting groups included many school pupils. But for more specific exposure of students to astronomy ING have been working closely with students from the Cornwall Astronomy School Project who came to La Palma to assist in an observing programme to get hands-on experience at the JKT. This visit was an outstanding success and demonstrated the potential of the JKT as an educational tool. Following this success, also students from a local school on La Palma and from a second school in the UK observed on the JKT.

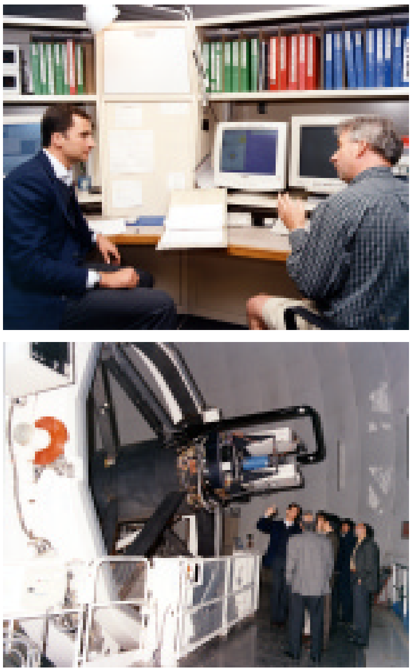


Figure 1. Above: Prof Richard Ellis explaining his observing programme to look for the Cosmic Shear to SAR Don Felipe. Below: The visiting group at the WHT Prime Focus. Next page: Image of M51 Galaxy obtained by SAR Don Felipe using the new mosaic Prime Focus camera.

Figure 2. Filming of BBC's Final Frontier programme.

Having press material available, and in particular having good photographic material for the press on-line helps attract quality press interest. For that reason we started to build an archive of superb astronomical images for publicity purposes. This work relies on the assistance from the renowned amateur astronomer Nik Szymanek. The results are shown as collections of images on the public information web pages.

A number of important guests visited the observatory. Most notably, on June 1st 2000 the Crown Prince of Spain, Su Alteza Real Don Felipe de Borbón visited the WHT. He was shown the telescope, met the observer (Prof Richard Ellis) and took an image of the galaxy M51. On the following day the prince laid the first stone of the GTC telescope, which was the prime reason for visiting the observatory. Furthermore, the European Commissioner for Scientific Research, Philippe Busquin, members of the European Parliament, the president of the commission of Industry, Energy, External Trade and Research, and members of the Centre for Research in Economics and Statistics (CREST) visited the telescopes on various occasions.

Also various television teams filmed the ING telescopes, amongst them the Spanish national television TVE, the German ZDF, the Hungarian TV and the popular BBC programmes "Blue Peter" and "Final Frontier".

Appendix A

THE ISAAC NEWTON GROUP OF TELESCOPES

The Isaac Newton Group of Telescopes (ING) consists of the William Herschel Telescope (WHT), the Isaac Newton Telescope (INT) and the Jacobus Kapteyn Telescope (JKT). The WHT, with its 4.2m diameter primary mirror, is the largest in Western Europe. It was first operational in August 1987. It is a general purpose telescope equipped with instruments for a wide range of astronomical observations. The INT was originally used at Herstmonceux in the United Kingdom, but was moved to La Palma in 1979 and rebuilt with a new mirror and new instrumentation. It has a 2.54m diameter primary mirror and is mostly used for wide-field imaging and spectroscopy. The JKT has a primary mirror of 1.0m diameter. It is mainly used for observing relatively bright objects. Both the INT and the JKT were first operational in May 1984.

The WHT has an altazimuth mount with a f/2.5 parabolic primary mirror. The WHT is of classical Cassegrain optical configuration. The paraboloidal primary mirror is made of a glass-ceramic material (Cervit) having near-zero coefficient of expansion over the operating temperature range. Instruments can be mounted at the corrected f/2.81 prime focus, f/11 cassegrain focus, or either of two f/11 Nasmyth foci. The WHT is of classical Cassegrain optical configuration. The primary mirror is made of a glass-ceramic material (Cervit) having near-zero coefficient of expansion over the operating temperature range, and it weighs 16.5 tonnes. When not operating at prime focus, a convex hyperboloidal secondary mirror, made of Zerodur, 1.0m in diameter, directs the light through a central hole in the primary mirror to the main instrumentation mounted at the Cassegrain focus beneath the primary mirror cell. The telescope also incorporates a third main mirror, a flat, angled at 45 degrees, which can be motor-driven into position at the intersection of the axes, just above the primary mirror, so that the light from the secondary is diverted sideways either through one of the altitude bearings to the Nasmyth platforms.

The INT has a primary mirror with a focal ratio of f/2.94. It uses a polar-disc/fork type of equatorial mount. Instruments can be mounted at the corrected f/3.29 Prime or f/15 Cassegrain foci. The optical system of the INT is a conventional Cassegrain with a paraboloidal primary mirror and a hyperboloidal secondary. It weighs 4.4 tonnes and it is made of Zerodur.

The JKT has a parabolic primary mirror of diameter 1.0m and a focal length of 4.596m. It weighs 215kg. It is equatorially mounted, on a cross-axis mount. The JKT has two optical configurations: Harmer-Wynne and Cassegrain. The former one uses a f/8 spherical secondary and the latter one a f/15 hyperbolic secondary. The two optical systems share the same parabolic primary mirror. At present only the Cassegrain configuration is available and instruments mount at the Cassegrain focus.

The ING operates the three telescopes on behalf of the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom and the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) of the Netherlands.

The following table shows each telescope's location:

	Latitude	Longitude	Ground Floor Height
WHT	28° 45' 38.3" N	17° 52' 53.9" W	2,332 m
INT	28° 45' 43.4" N	17° 52' 39.5" W	2,336 m
JKT	28° 45' 40.1" N	17° 52' 41.2" W	2,364 m

The ING is located at the Observatorio del Roque de Los Muchachos (ORM), on the island of La Palma. The ORM, which is the principal European northern hemisphere observatory, is owned by the Instituto de Astrofísica de Canarias (IAC). The operation of the site is overseen by an International Scientific Committee, or Comité Científico

Internacional (CCI). Financial and operational matters of common interest are dealt with by appropriate subcommittees.

The observatory also includes the Carlsberg Meridian Telescope, the 3.6m Italian Galileo National Telescope, the 2.5m Nordic Optical Telescope, the 60cm telescope of the Swedish Royal Academy of Sciences, the 0.97cm New Swedish Solar Telescope, the 45cm Dutch Open Solar Telescope, the German High Energy Gamma-Ray Array and the Belgian 1.2m Mercator Telescope.

The observatory occupies an area of 1.89 square kilometres approximately 2,350m above sea level on the highest peak of the Caldera de Taburiente National Park, in the Palmeran district of Garafía. La Palma is one of the westerly islands of the Canary Archipiélago and the Canary Islands are an autonomous region of Spain.

The site was chosen after an extensive search for a location with clear, dark skies all the year around. All tests proved that the Roque de Los Muchachos is one of the best astronomical sites in the world. The remoteness of the island and its lack of urban development ensure that the night sky at the observatory is free from artificial light pollution. The continued quality of the night sky is protected by law. The mountain-top site has a remarkably stable atmosphere, owing to the local topography. The mountain has a smooth convex contour facing the prevailing northerly wind and the air-flow is comparatively undisturbed, allowing sharp and stable images of the night sky.

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. A further 75 per cent is shared by the United Kingdom and the Netherlands. On the JKT the international collaboration embraces astronomers from Ireland. The remaining 5 per cent is reserved for large scientific projects to promote international collaboration between institutions of the CCI member countries.

Many of the state-of-art telescope and instrument components are custom-built. New instruments are designed and built by technology groups mainly in the United Kingdom, the Netherlands, and Spain, with whom the ING maintains close links, and by astronomers and engineers working at ING.

THE INTERNATIONAL AGREEMENTS

The international agreements by which the Roque de Los Muchachos and the Teide Observatories were brought into existence were signed on La Palma on 26 May 1979. The participant nations at that time were Spain, the United Kingdom, Sweden and Denmark. Later other European countries also signed the agreements. Infrastructural services including roads, communications, power supplies as well as meals and accommodation facilities have been provided by the Spanish side. In return for the use of the observatory and its facilities all foreign user institutions make 20 per cent of time on their telescopes available to Spanish observers. Representatives of the participant institutions meet together as the International Scientific Committee, or Comité Científico Internacional (CCI).

The inauguration of the Canary Islands observatories took place on 29 June 1985 in the presence of the monarchs and members of the Royal Families of five European countries, and the Presidents of another two.

THE ING BOARD AND THE INSTRUMENTATION WORKING GROUP

The PPARC and the NWO have entered into collaborative agreements for the operation of and the sharing of observing time on the ING telescopes. The ING Board has been set up to oversee the operation of this agreement, to foster and develop collaboration between astronomers of the United Kingdom and the Netherlands and to ensure that the telescope installations are maintained in the forefront of world astronomy. In particular, the ING Board oversees the programme of instrumentation development, determines the programme of operation and maintenance of the installations, approves annual budgets and forward estimates and determines the arrangements for the allocation of observing time.

The Instrumentation Working Group (IWG) provides scientifically informed advice on the instrumentation programme for the ING telescopes. The IWG fulfils an important function as intermediate between ING and the user community.

TELESCOPE TIME AND DATA OWNERSHIP

Spain has at its disposal 20 per cent of the observing time on each of the three telescopes, and it is the responsibility of the IAC to make this time available to Spanish institutions and others, via the Comité para la Asignación de Tiempos (CAT). A further 5 per cent of the observing time is for international collaborative programmes between institutions of the CCI member countries. It is intended that this time be used for the study of one, or a few, broad topics each year by several telescopes. This time is allocated by the CCI.

The remaining 75 per cent of the time is distributed as follows. The PPARC and NWO share the time on all three telescopes with 80 per cent being allocated to PPARC and 20 per cent to NWO. The PPARC-NWO ING BOARD has delegated the task of time allocation to astronomers to the PPARC Panel for the Allocation of Telescope Time (PATT) and the NFRA Programme Committee (PC), which have set up procedures for achieving the 80 : 20 ratio whilst respecting the separate priorities of the United Kingdom and Dutch communities. The PPARC has made 27 nights per year of its share on the JKT available to the National Board of Science and Technology of Ireland (NBST) and the Dublin Institute for Advanced Studies (DIAS). The Irish Advisory Committee for La Palma set up by the two Irish Institutions has decided that JKT proposals by Irish astronomers should also be submitted to PATT. Irish astronomers are not however discouraged from applying for use of the other telescopes of the ING. PATT includes representatives from the Republic of Ireland. All the above agreements envisage that observing time shall be distributed equitably over the different seasons of the year and phases of the Moon.

Notwithstanding the above, any astronomer, irrespective of nationality or affiliation, may apply for observing time on the ING. Astronomers who are working at an institute in one of the partner countries should apply through the route appropriate to their nationality or the nationality of their institute.

Time is allocated in two semesters, from 1 February to 31 July (semester A) and from 1 August to 31 January (semester B). The corresponding closing dates are in September and March respectively. Decisions on time allocations are made on the basis of scientific merit and technical feasibility of the proposed observations.

The PPARC-NWO ING Board and the CCI have decided that ING policy is that data belongs exclusively to those who collected it for a period of one year, after which it is available in a common archive for all astronomers. It may be used at any time for engineering or instrumental investigations in approved programmes carried out to improve facilities provided at the observatory.

Service observations which are made by support astronomers at the request of others are similarly treated. However, calibration data may well be used for more than one observation and may therefore be available in common to several groups. It may happen that identical or similar service observations are requested by two or more groups. Requests which are approved before the data are taken may be satisfied by requiring the data to be held in common by the several groups. It is up to them how they organise themselves to process, analyse, relate to other work, and eventually publish the data.

Requests for observations from programmes already executed on the telescopes should be referred to the original owners of the data, and/or to the data archive. This is the policy whether or not the data were obtained by PATT, NFRA PC, or CAT scheduled astronomers, or by service requests.

Appendix B

TELESCOPE INSTRUMENTATION

The INT and JKT are equipped with a restricted set of instruments that match the capabilities of the telescopes whilst satisfying the requirements of a large percentage of users. The number of instrument changes on these telescopes is kept to a minimum in order to reduce costs and increase reliability. The design of the WHT allows much greater flexibility, since it is straightforward to switch between the Cassegrain and the two Nasmyth focal stations, and a much greater variety of instruments may be left on the telescope. A broad functional division between the WHT, INT and JKT during 2000 and 2001 was as follows:

William Herschel Telescope	Spectroscopy and spectropolarimetry over a wide range of resolving powers
	Multi-object spectroscopy
	Areal spectroscopy
	CCD and infrared imaging
	High-resolution imaging and other projects in a laboratory environment
Isaac Newton Telescope	Intermediate- and low-dispersion spectroscopy
	CCD imaging
Jacobus Kapteyn Telescope	CCD imaging

The following table summarises the common-user instruments which were available during 2000 and 2001.

Focus	Instrument	Detector
William Herschel Telescope		
Cassegrain	ISIS double spectrograph	Tektronix and EEV CCDs
	Acquisition and Guidance Unit Auxiliary Port Camera	Tektronix CCD
	Isaac Newton Group Red Imaging Device (INGRID)	Rockwell HgCdTl array
Nasmyth	Ground Based High Resolution Imaging Laboratory (GHRIL)	Tektronix and EEV CCDs
	Utrecht Echelle Spectrograph (UES)	SITe CCD
	INTEGRAL spectrograph	Tektronix CCD (WYFFOS at GHRIL)
Prime	Prime Focus Camera (PFC)	2 × EEV CCD
	Autofib Fibre Positioner (AUTOFIB-2)	Tektronix CCD (WYFFOS at GHRIL)
Isaac Newton Telescope		
Cassegrain	Intermediate Dispersion Spectrograph (IDS)	Tektronix and EEV CCDs
Prime	Wide Field Camera (WFC)	4 × EEV CCDs
Jacobus Kapteyn Telescope		
Cassegrain	CCD camera	SITe CCD

Appendix C

STAFF ORGANISATION

Staff at ING fall into three categories based on their conditions of employment: UK contracted staff by PPARC, NL contracted staff by NWO and staff contracted under Spanish contracts directly by ING.

Despite some anxieties amongst staff about the financial implications for ING of the proposed UK membership of the European Southern Observatory (ESO) the staffing position at ING during 2000 remained relatively stable, as was also reflected in the previous annual report. There was a small decrease, overall, in the total number of approved UK posts on-island from 38.9 to 36 direct staff year. A small number of staff employed on local contracts also left during the course of the year and, as not all were replaced, there was a small decrease in the number of staff under this category too. The level of UK based staff effort also decreased during 2000 to 4.7 direct staff year following a scheduled decrease in numbers. The total approved staff effort for the Netherlands remained at 6.9 on-island and 1.0 in Cambridge.

The year 2001 was dominated by the expected UK membership of the ESO and the implications this would have on ING's budget. Ahead of the decision being made, a restructuring plan was developed to establish the ING's future scientific direction and how it would absorb the reductions in funding. Inevitably, this would mean a reduction in staffing levels and by the end of the year plans had been put in place to call for volunteers for redundancy.

However, the level of on-island UK staff effort was also decreased during 2001 for 2 reasons. Firstly the additional direct staff year funded from the restructuring budget following the closure of RGO were exhausted. More significantly, the numbers were reduced under a plan agreed by the ING Board in 1999 aimed at reducing the level of contributions from the funding agencies. This meant that the approved UK direct staff year on island dropped from 36 in 2000 to 29.6 in 2001.

There was also a significant decrease on UK home-based effort. Firstly this was because PPARC agreed to provide the funding they had previously provided for 4.7 direct staff year in the UK as cash in order to provide ING with greater flexibility over how it was used to support the programme. Secondly, the 1 direct staff year previously provided by the NL was withdrawn following the resignation of the individual concerned. The list of staff in post on La Palma during 2000 and 2001 is set out below.

DIRECTORATE

R G M Rutten, *Director*
R L Miles, *Bilingual Secretary*

ADMINISTRATION

L I Edwins, *Head of Administration*
M Acosta
J M Batista (from 19.3.01)
E C Barreto (until 12.9.00)
T E Dorward (from 23.10.00)
A Felipe
I García (until 29.10.00)
N L González
S S Hunter (until 30.6.00)
L A Lawler (from 23.10.00)
M Lorenzo (until 12.12.00)
J Martínez
H J Watt (until 29.2.00)

Student:
G Leeks (from 1.9.01) Hull

ASTRONOMY

D J Lennon, *Head of Astronomy*
T Augusteijn

M Azzaro
C R Benn
M Broxterman (until 1.4.00)
R Corradi
B M García (from 1.1.00)
J N González
R Greimel
J H Knapen
C Martín
J Méndez
N O'Mahoney (from 17.1.00)
Roy Østensen (from 1.1.01)
C Packham (until 31.8.00)
J C Rey
V Reyes (until 13.1.00)
S Sánchez (until 10.11.00)
W J I Skillen
P Sorensen
J H Telting
N A Walton (until 31.10.01)
A Zurita (from 1.3.01)

Support astronomer from the University of Porto:
P Garcia (from 1.1.00 until 31.1.01)

Students:
D Batcheldor (until 31.8.00) Hertfordshire
D Bramich (from 1.9.00 until 31.8.01) Cambridge
C Crowley (from 1.9.00 until 1.3.01) Trinity College Dublin
R Curran (until 31.8.00) Herts
S Folkes (from 1.9.01) Hertfordshire
R Hijmering (from 1.9.01) Nijmegen
J Holt (from 1.9.00 until 31.8.01) Sheffield
A Tayal (from 1.9.00 until 31.8.01) Hertfordshire
C Trundle (from 1.9.01) Belfast
H Worters (from 1.9.01) Sheffield

ENGINEERING

R G Talbot, *Head of Engineering*

Computing Facilities:
D-C Abrams
L Hernández
N R Johnson (until 31.5.00)
G F Mitchell
J Piñero (from 31.5.01)
P G Symonds (until 31.8.01)
P v d Velde

Control Software:
D Armstrong
R Bassom
M Bec (until 31.8.00)
C Bevil
C Brodie (from 19.2.01 until 29.5.01)
R Clarke (until 3.1.01)
S M Crosby
F J Gribbin
S G Rees
R Rutherford (from 31.10.01)

Electronics:
C Benneker
T Gregory
A Guillén
C W M Jackman
K Kolle
S Magee (until 3.9.01)
R Martínez
E J Mills
P C Moore
R J Pit
A Ridings
S J Tulloch
G Woodhouse (until 31.3.01)

Mechanical Engineering:
M Blanken (from 3.8.00)
F Concepción
K M Dee
K Froggatt (until 1.4.00)
D González (from 5.9.00)
P Jolley
P S Morrall (until 4.11.01)
S Rodríguez
J C Pérez
M v d Hoeven
B v Venrooy (until 1.4.00)

Site Services:
C Alvarez
P Alvarez (until 1.9.00)
A K Chopping
J R Concepción
J M Díaz
I García (from 30.10.00)
D Gray
M V Hernández
C Ramón
M Simpson

Appendix D

TELESCOPE TIME AWARDS

The UK Panel for the Allocation of Telescope Time (PATT), the Dutch NFRA Programme Committee (PC), the Spanish Comité para la Asignación de Tiempos (CAT) and the Comité Científico Internacional (CCI) made time awards to the following observing proposals in 2000 and 2001. The principal applicant, his or her institute, the title of the proposal, and the proposal reference are listed below. Semester A runs from February to July and semester B from August to January.

SEMESTER 2000A

ITP Programmes on the ING Telescopes

– Barcons (Santander), An XMM international survey —AXIS: the origin of the hard X-ray background
– Pérez-Fournon (IAC), Optical and near-infrared follow-up of the European large area (ELAIS) and ISOCAM Lockman Hole (ILHS) ISO surveys

William Herschel Telescope

UK PATT

– Bower (Durham), Galaxy evolution in poor clusters
– Burleigh (Leicester), The mass distribution, magnetic field function and origin of magnetic white dwarfs
– Cameron (St Andrews), The albedo spectrum of the giant exoplanet orbiting τ Boo
– Clements (Cardiff), Arp 220 integral field spectroscopy: supporting CHANDRA observations
– Davies (Durham), Mapping early type galaxies along the Hubble sequence
– Haswell (OU), Outbursts in black hole X-ray transients: coordinated WHT/RXTE/HST observations (99A, long-term)
– Jeffery (Armagh), Asteroseismology of pulsating subdwarf B stars and a DB white dwarf
– Jeffries (Keele), The true lithium abundance in halo stars
– Kleyna (IoA), Dark matter in the UMi and Draco dwarf spheroidal galaxies
– Knapen (Herts/ING), Star formation in arm and interarm environments in spiral galaxies
– Knapen (Herts/ING), Hα survey of nuclear star-forming rings in spirals
– Mathieu (Nottingham), Dynamics of superthin galaxies
– Maxted (Southampton), Testing theories of common envelope evolution with double degenerates
– Merrifield (Nottingham), Mapping elliptical galaxy mass distributions using gravitational redshift
– McHardy (Southampton), Deep R-band imaging of very deep XMM survey fields
– McMahon (IoA), Probing the ionization state of the universe at $z>5$
– Morales-Rueda (Southampton), What distorts the radial velocity curves of accretion disks?
– Pettini (IoA), The large-scale structure of galaxies at redshift $z\approx3$
– Pollacco (QUB), Restarting the fast wind in the Sakurai object (V4334 Sagittarii)
– Rawlings (Oxford), The cosmic evolution of radiosources using the TEXOX 1000-radiosource redshift survey (99B, long-term)
– Rawlings (Oxford), Evolution of $z\sim1$ 6C galaxies: discerning the role of the radio source
– Refregier (IoA), Measuring the cosmic shear arising from large-scale structure
– Ryan (OU), The primordial lithium abundance
– Sarre (Nottingham), Search for diffuse band carriers in the circumstellar shell of IRC+10°216
– Serjeant (ICSTM), Optical wide field imaging of CHANDRA/ISO/UK sub-millimetre survey area
– Skillen (ING), Rapid observation of gamma–ray burst optical afterglows
– Smail (Durham), A joint WHT/HST survey of the galaxy populations within lensing clusters
– Storey (UCL), H-deficient knots as the cause of spatial abundance variations in planetary nebulae
– Tadhunter (Sheffield), The physics of the narrow line region in powerful radio galaxies
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– Terlevich (Birmingham), The triggering mechanism for the Butcher-Oemler effect
– Walton (ING), Lambda – Omega: The low redshift Type Ia SN connection

NL NFRA PC

– van den Berg (Utrecht), High-resolution spectroscopy of two blue straggler binaries in M67
– Best (Leiden), Emission line gas inside and outside CSS radio sources: determining the origin of the gas
– Best (Leiden), Evolution of z~1 6C galaxies: discerning the role of the radio source
– Bézecourt (Kapteyn), R and Z band imagery of cluster A2219 for the determination of photometric redshifts
– Douglas (Kapteyn), Planetary nebulae in Virgo cluster galaxies
– Kregel (Kapteyn), The stellar velocity distribution in the thin disk of NGC 5529
– Luu (Leiden), Rotational properties of Kuiper Belt objects
– Pickering (Kapteyn), Near-IR imaging of low surface brightness galaxies
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– van der Werf (Leiden), Distant submillimeter galaxies — their nature and their redshift distribution
– de Zeeuw (Leiden), Mapping galaxies along the Hubble sequence

SP CAT

– Aretxaga (INAOE), The QSO–host galaxy luminosity relationship at z=2
– Cairós (IAC), Infrared photometry of blue dwarf galaxies: the low surface brightness component
– Colina (IFCA), Integral field spectroscopy of ultraluminous infrared galaxies
– Colina (IFCA), A study of galaxies under star formation at high redshift
– Díaz (UAM), Determination of the velocity dispersion in starforming circumnuclear regions
– González (IAC), Star formation history in galaxies from mid-infrared measurements
– Israelian (IAC), Searching for the evidence of supernova events in the low mass X-ray binary systems Her X-1 and Cyg X-2
– López (IAC), Kinematics of the nuclear bar of NGC 5850
– Pérez (IAA), Stellar dynamics and circumnuclear structure in isolated galaxies
– Pérez-Fournon (IAC), Mach disks and bow shocks in NGC 4258: testing the role of mechanical energy in AGN NLR's
– Rodríguez (IAC), Fe abundance in blue compact galaxies

Isaac Newton Telescope

UK PATT

– Benn (ING), Extinction of background radio galaxies by foreground spirals
– Croom (ICSTM), A photometric redshift survey in deep X-ray fields
– Ellis (IoA), Comparisons of star formation diagnostics in the local and intermediate redshift universe
– Howarth (UCL), Colliding winds in massive close binaries
– Keenan (QUB), Identification of hot stars in globular clusters
– Maxted (Southampton), Are sub-dwarf B stars the result of common-envelope evolution?
– McMahon (IoA), A public near IR imaging survey on the INT
– Morales-Rueda (Southampton), Spectroscopy of dwarf novae in outburst
– Naylor (Keele), Does magnetic activity drive mass transfer in cataclysmic variables?
– Stetson (DAO), Helium burning variables in Ursa Minor and Draco dwarf spheroidals
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– Terlevich (Birmingham), The photometric properties of galaxy groups
– Watson (Leicester), Wide field imaging for the XMM serendipitous sky survey

NL NFRA PC

– Jimenez (Kapteyn), A much-improved stellar library for stellar population synthesis
– Orosz (Utrecht), Atmospheric parameters of subdwarf binary stars
– Tschager (Leiden), The optical hosts of young radio sources – redshifts (3)
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

UK/NL WFS PROGRAMMES

– Dalton (Oxford), The Oxford deep WFC imaging survey
– Davies (Cardiff), Multi-coloured large area survey of the Virgo cluster
– Driver (St Andrews), The Millenium galaxy catalogue
– McMahon (IoA), The INT wide angle survey
– Groot (Amsterdam), The faint sky variability survey

SP CAT

– Aparicio (IAC), The north-west tidal current in Sagitarius
– Caon (IAC), The environment's influence on the ionised gas in elliptical galaxies
– González-Serrano (IFCA), Redshifts of bright galaxies from the Westerbork radio survey

– Hammersley (IAC), A deep multi-wavelength survey of the galactic plane
– Marín (IAC), Globular cluster systems in Coma
– Martínez-Delgado (IAC), Structure of tidal residuals in the Ursa Minor galaxy
– Nebot (Barcelona), Physical parameters of the open clusters NGC 1817, NGC 1807 and NGC 2548
– Pérez-Fournon (IAC), Near-infrared imaging of a deep CHANDRA X-ray survey
– Rosenberg (IAC), Galactic globular cluster relative ages and the Milky Way formation (II)
– Vazdekis (Durham), Horizontal branch effects in the spectra of globular clusters
– Vega (IAC), Search for galaxies with orthogonal rotating bulge and disk
– Vílchez (IAA), An Hα survey of the Coma and A1367 Clusters

Jacobus Kapteyn Telescope

UK PATT

– James (LJMU), A survey of star formation in the local universe
– Knapen (Herts/ING), Star formation in arm and interarm environments in spiral galaxies
– Norton (OU), Photometric study of the newly discovered intermediate polar 1WGA J1958.2+3232
– Seigar (Gent), Optical properties of the disks of spiral galaxies
– Shahbaz (Oxford), Probing the accretion disc in SW Sex type stars
– Sorensen (ING), The binary frequency in planetary nebula central stars: short period objects
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB–related optical/IR transients
– Tsapras (St Andrews), A search for planetary anomalies on high amplification microlensing events
– Walton (ING), Lambda – Omega: the low redshift Type Ia SN connection
– Warren (ICSTM), Remote halo blue horizontal branch stars and the mass of the Milky Way
– Woolf (Armagh), Photometry of pulsating helium stars

NL NFRA PC

– van den Berg (Utrecht), Photometric monitoring of an X-ray blue straggler in M67
– van der Hulst (Kapteyn), R-band imaging of galaxies in the WHISP sample
– Pickering (Kapteyn), B-band imaging of LBS galaxies
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

SP CAT

– Delfosse (IAC), Accurate optical and infrared photometry of field very low mass stars and brown dwarfs
– de Diego Onsurbe (IAUNAM), Spectral characterisation of quasar microvariavility
– Nebot (Barcelona), Physical parameters of the open clusters NGC 1817, NGC 1807 and NGC 2548

SEMESTER 2000B

ITP Programmes on the ING Telescopes

– Barcons (IFCA), An XMM international survey —AXIS: the origin of the hard X-ray background
– Pérez-Fournon (IAC), Optical and near-infrared follow-up of the European large area (ELAIS) and ISOCAM Lockman Hole (ILHS) ISO surveys

William Herschel Telescope

UK PATT

– Barstow (Leicester), Metal abundances and the temperature scale of hot H-rich white dwarfs
– Benn (ING), Adaptive-optics imaging of QSO host galaxies $1<z<3$
– Bower (Durham), The High Redshift INGRID Cluster Survey
– Cameron (St Andrews), Spectroscopic detection and characterisation of extra-solar planets
– Cropper (MSSL), High Time-Resolution, Energy-Resolved Photometry of Magnetic Cataclysmic Variables
– Dhillon (Sheffield), Mass-transfer stability in semi-detached binary stars
– Haswell (OU), Outbursts in black hole X-ray transients: coordinated WHT/RXTE/HST observations (99a, long-term)
– Hynes (Soton), Pinning Down Spectral Variability in A0620–00: Advective Flow or Accretion Disk?
– Ivison (UCL), Star-Forming Galaxies in High-Density Environments in the Early Universe
– Ivison (UCL), A Multi-Colour Search for Galaxies in High-Density Environments in the Early Universe
– Knapen (Herts/ING), Star formation in arm and interarm environments in spiral galaxies
– Lucas (Herts), A Search for the bottom of the IMF with Adaptive Optics
– Metcalfe (Durham), A Photometric Search for $z>4.5$ Galaxies
– Morales-Rueda (Soton), What distorts the radial velocity curves of accretion discs?

– Naylor (Keele), How many brown dwarfs are there?
– Perryman (ESTEC), Physical conditions of isolated neutron stars
– Pettini (IoA), The Large Scale Structure of Galaxies and the Intergalactic medium at z~3
– Pinfield (QUB), The white dwarf initial-final mass relation and the age of Praesepe
– Pollacco (QUB), Restarting the fast wind in the Sakurai object, V4334 Sagittarii (00a, long-term)
– Rawlings (Oxford), The cosmic evolution of radiosources using the TEXOX 1000-radiosource redshift survey
– Ryan (OU), The Primordial Lithium Abundance
– Skillen (ING), Rapid Observation of Gamma-Ray Burst optical afterglows
– Smail (Durham), Disentangling the ERO Population: A Survey with INGRID of Archival WFPC2 Fields
– Smartt (IoA), Quantitative spectroscopy of luminous blue supergiants in M33
– Steeghs (Soton), Calcium emission from quiescent accretion discs
– Storey (UCL), Extending the diagnostic power of planetary nebulae — ultra-deep UV spectra of NGC 7027
– Tadhunter (Sheffield), Intrinsic and jet-induced emission line kinematics in radio galaxies
– Tadhunter (Sheffield), The nature of the far-IR/sub-mm excess in powerful radio galaxies
– Tanvir (Herts), The metallicity dependence of the Cepheid Period-Luminosity relation
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– Terlevich (IoA), Probing abundance discontinuities and local enrichments in young starburst galaxies
– Vazdekis (Durham), Accurate mean luminosity-weighted age determination for early-type field galaxies
– Warren (ICST), Remote halo blue horizontal branch stars and the mass of the Milky Way

NL NFRA PC

– Bottema (Kapteyn), The distribution of dark matter in late-type Spiral Galaxies
– van Kerkwijk (Utrecht), Is the Anomalous X-ray Pulsar 4U 0142+614 a Magnetar or an Accretor?
– Kregel (Kapteyn), Dynamical stability of the thin disk of NGC 891
– Oosterloo (NFRA), The origin of the gaseous halo of NGC 2403
– Orosz (Utrecht), A dynamical study of the pulsating binary subdwarf B star KPD 1930+2752
– Rutten (ING), The distance to cataclysmic variables
– Tschager (Leiden), The Optical hosts of faint compact-steep-spectrum radio sources - REDSHIFTS
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– van Woerden (Kapteyn), Distances of HVC Anticenter complexes and of HCV complex H
– de Zeeuw (Leiden), Mapping early-type galaxies along the Hubble sequence

SP CAT

– Casares (IAC), Measuring the Mass Function in J1859+226: Black-Hole or Neutron Star?
– Castellanos (UAM), Determination of the electron temperature in HII regions
– Centurión (OAT/IAC), Deuterium abundance in high redshift QSO absorption systems
– Corral (IAC), Interactions of stellar objects and the ISM: LBV stars and HII regions in M33
– Delfosse (IAC), Visible spectroscopy of the DENIS field L dwarfs
– Erwin (IAC), Stellar dynamics, gas-flow, bar disruption, bulge formation in multi-barred galaxies
– Esteban (IAC), Chemical abundances in HII extragalactic giant regions from recombination lines
– Herrero (IAC), Quantitative spectroscopy in bright B-stars in M33
– Mediavilla (IAC), Extinction laws in intermediate redshift galaxies (z<1)
– Pérez (IAA), The magnetic field in HII extragalactic regions: the case of NGC 604
– Prada (CAHA), Searching for satellite galaxies at medium redshifts: a probe of galaxy formation models on 100 kpc scales
– Prieto (IAC), Galaxies with extreme star formation at high redshift
– Rebolo (IAC), Sulphur abundances in metal-poor stars: test of hypernova nucleosynthesis in the early galaxy
– Rodríguez (IAC), Fe abundance in compact blue galaxies
– Zapatero (IAC), Giant planets in Orion

Isaac Newton Telescope

UK PATT

– Carter (Liverpool), The nature of the dark halo of M31
– Dhillon (Sheffield), Testing the disrupted magnetic braking model of CV evolution
– Driver (St Andrews), Do clusters have extended dwarf haloes?
– Hewett (IoA), Probing the Dark Halo of M31 with Pixel Microlensing
– Horne (St Andrews), Open Cluster Survey for Hot Jupiters (and Neptunes)
– Jameson (Leicester), Exploring the bottom of the stellar mass function
– Maxted (Soton), RXJ2130+4709 —a new eclipsing white dwarf–M-dwarf binary
– McMahon (IoA), The Cambridge-Carnegie Deep Optical-Infrared Galaxy Survey
– McLure (Oxford), A photometric redshift study of the environments of powerful radio galaxies

– Morales-Rueda (Soton), Spectroscopy of dwarf novae in outburst
– Naylor (Keele), A new method of determining component masses in CVs
– Puchnarewicz (MSSL), Optical spectroscopy of extragalactic objects in the MSSL XMM-Newton GT programme
– Sutherland (Oxford), The MEGA Survey: Mapping Microlensing in M31
– Tanvir (Herts), A CCD Survey of the Halo and Outer Disk of M31
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

NL NFRA PC

– Groot (CfA), A Variability Survey
– Jiménez (Kapteyn), A much-improved stellar library for stellar population synthesis
– Noordermeer (Kapteyn), Optical spectroscopy of galaxies in the WHISP sample
– Sackett (Kapteyn), The MEGA survey: Mapping microlensing in M31
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

UK/NL WFS PROGRAMMES

– Dalton (Oxford), The Oxford deep WFC imaging survey
– McMahon (IoA), The INT wide angle survey

SP CAT

– Aparicio (IAC), Old halos in dwarf galaxies
– Fernández (UCM), Chromospheric activity in extreme active stars
– Gallego (UCM), Evolution of the Star Formation Rate density of the Universe at intermediate redshift
– García (IAC), Stellar activity and the lithium-rotation connection in ROSAT-discovered members of a-Persei and Taurus
– Kidger (IAC), A Test of a New Method for Separating K Giants and Dwarfs
– Moles (IMFF), Photometric survey of nearby galaxy clusters
– Ribas (Barcelona), Direct determination of the distance to M31 from eclipsing binaries
– Rosenberg (IAC), Formation and evolution of the Milky Way (III): Galactic disk
– Sánchez (OAN), Long-slit spectroscopy of the proto planetary nebula M 2-56
– Vega (IAC), Measuring velocity dispersion anisotropies in S0 galaxies
– Zapatero (IAC), Rotation of brown dwarfs

Jacobus Kapteyn Telescope

UK PATT

– Davies (JAC), Lightcurves of Near Earth Objects
– Dhillon (Sheffield), Testing the disrupted magnetic braking model of CV evolution
– Fitzsimmons (QUB), The size and composition of Near-Earth Asteroids
– Folha (Porto), Pulsations in Pre-Main Sequence Herbig Ae stars
– Hynes (Soton), Pinning Down Spectral Variability in A0620–00: Advective Flow or Accretion Disc?
– James (LJMU), A survey of star formation in the local universe (00a, long-term)
– Lago (Porto), The true connection between line and continuum emission in very active young stars
– Maxted (Soton), RXJ2130+4709 —a new eclipsing white dwarf–M-dwarf binary
– Morales-Rueda (Soton), A Narrow-Band Survey for Cataclysmic Variable Stars
– Norton (OU), Optical identification and outburst monitoring of transient X-ray binaries
– Smith (Cardiff), The dwarf galaxy contribution to galaxy haloes
– Steele (Liverpool), IZ Photometry of L dwarfs
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

NL NFRA PC

– Noordermeer (Kapteyn), R band imaging of galaxies in the WHISP sample
– Orosz (Utrecht), A photometric study of the pulsating binary subdwarf B star KPD 1930+2752
– Rutten (ING), The distance to cataclysmic variables
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

SP CAT

– Barrena (IAC), Calibration of wide-field images (WFC/INT) obtained in October 1999
– Calderón (OAN), Surface photometry of compact groups of galaxies; 2.– Photometry of late-type galaxies with multiple nuclei
– Cuesta (IAC), Astronomical photography for public information
– López (IAC), Co-rotation pattern in a sample of barred early galaxies
– Oscoz (IAC), U-band study of interacting galaxies

– Pérez (IAC), Atlas of Starburst Galaxies through H recombination lines imaging
– Rosenberg (IAC), Formation and evolution of the Milky Way (III): The galactic disk

SEMESTER 2001A

ITP Programmes on the ING Telescopes

– Barcons (IFCA), An XMM-Newton international survey (AXIS-II): unveiling the hard X-ray source populations
– Doressoundiram (OP), Multi-color taxonomy of trans-Neptunian objects
– Molés (CSIC), A photometric wide-field survey of low-z clusters

William Herschel Telescope

UK PATT

– Balogh (Durham), K-Band Luminosities of CNOC2 Group Galaxies.
– Benn (ING), Dust-free star-formation rate at z<0.5 from sub-mJy radio sources
– Charles (Southampton), An Optical/UV/X-ray Study of a Luminous LMXB in a Globular Cluster
– Davies (Durham), Galaxy Evolution in Rich Clusters: Preparing for GMOS
– Davies (Durham), Mapping Early Type Galaxies along the Hubble Sequence
– Ferguson (IoA), A Search for Recent Massive Star Formation in Gas-Rich Ellipticals/SOs
– Hynes (Southampton), Weighing the Black Hole in XTE J1118+480
– Ivison (UCL), Star-Forming Galaxies in High Density Environments in the Early Universe
– Ivison (UCL), A Multi-colour Search for Galaxies in High Density Environments in the Early Universe
– James (LJMU), Extinction corrections for an Hα galaxy survey using the Brg line
– Keenan (QUB), Early type stars in the Galactic halo from the Palomar-Green Survey
– Knapen (Herts), Studying Star Formation Triggering via Age-Dating of Circumnuclear Hotspots
– Kodama (Durham), The K-band Luminosity Function of the Highest Redshift Clusters
– Kuntschner (Durham), An INGRID/HST Study of Early-type Galaxies in the Outskirts of Distant Clusters
– Marsh (Southampton), Cataclysmic Variable Stars from the 2dF QSO Survey
– Merrifield (Nottingham), Planetary nebula kinematics of round elliptical galaxies
– McMahon (IoA), The contribution to the metagalactic ionising UV background from z=3 and z=5 quasars
– Outram (Durham), Do QSOs trace the same structures as their absorption systems?
– Pettini (IoA), Star-forming Galaxies and Lya forest at 1.5<z<2.5: the Galaxy-IGM Connection
– Pollacco (QUB), Restarting the fast wind in the Sakurai Object (V4334 Sagittarii)
– Rawlings (Oxford), The cosmic evolution of radio sources using the TEXOX 1000-source redshift survey
– Refregier (IoA), Measuring Cosmological Parameters with Weak Gravitational Lensing
– Ryan (OU), Angular momentum transfer in ultra-Li-depleted halo dwarf stars and blue stragglers
– Smail (Durham), Disentangling the ERO Population: A Survey with INGRID of Archival WFPC2 Fields
– Steeghs (Southampton), The structure of AM CVn binaries and their discs
– Tadhunter (Sheffield), The early evolution of powerful radio sources
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transits
– Ward (Leicester), The Nature and Environment of Galactic Super Eddington Sources
– Warren (ICST), Remote halo blue horizontal branch stars and the mass of Milky Way

NL NFRA PC

– Higdon (Kapteyn), Tidal dwarf galaxies in Arp 143’s Plume
– Kuijken (Kapteyn), Planetary nebula kinematics of round elliptical galaxies
– Lacerda (Leiden), Rotational Properties of (smaller) Kuiper Belt Objects
– Orosz (Utrecht), The mass of the black hole in the X-ray nova XTE J1118+480
– Spruit (Amsterdam), Circumbinary material in Cataclysmic Variables
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical transients
– de Zeeuw (Leiden), Mapping Early-Type Galaxies along the Hubble Sequence

SP CAT

– Arribas (STScI), 2D spectroscopy of the inner regions of AGNs and QSOs
– Balcells (IAC), Study of galaxies under extreme star formation at high redshifts
– Battaner (Granada), Stellar system rotation in the peripheries of spiral galaxies
– Castro-Tirado (IAA/LAEFF), Rapid detection of the optical counterparts of GRBs
– Colina (IFCA), Integral field spectroscopy of ultraluminous galaxies
– Erwin (IAC), Inner Bars, Disks, and Nuclear Rings Along the Hubble Sequence
– García-Lario (ESA), High resolution spectroscopy of peculiar cool stars of young planetary and proto-planetary nebulae

– Gorgas (UCM), The initial mass function of stellar formation in elliptical galaxies and bright spheriodals
– Israelian (IAC), Have the extra-solar parent stars engulfed planets?
– Lipari (OAC), 2D spectroscopy of a sequence of IR mergers
– Martínez-Delgado (IAC), Destruction of dwarf galaxies in the galactic halo: Sagitario North current kinematics
– Mora (UAM), Characterization of protoplanetary disks
– Muñoz (IAC), Limits on the cosmological parameters (Ω_0, λ_0) from statistics of gravitational lenses
– Ruiz-Lapuente (Barcelona), Stellar companions of supernovae
– Ruiz-Lapuente (Barcelona), Supernovae at z=0.36–0.65: a study of the nature of dark energy

INSTRUMENT BUILDERS' GUARANTEED TIME

– Packham (Florida), The initial conditions to star formation

Isaac Newton Telescope

UK PATT

– Benn (ING), Search for z~4 radio QSOs
– Benn (ING), Extinction of background radio galaxies by foreground spirals
– Feltzing (Lund), Metallicity distribution functions in Local Group dwarf spheroidal galaxies
– Maxted (Southampton), Subdwarf-B stars are the result of common-envelope evolution
– McHardy (Southampton), Deep U,B,I-band Imaging of a Very Deep XMM/Chandra Survey Field
– McMahon (IoA), A Public Near IR imaging survey on the INT
– Morales-Rueda (Southampton), Spectroscopy of dwarf novae in outburst
– Rawlings (Helsinki), Diffuse Interstellar Bands toward the early-type Stephenson stars
– Ray (DIAS), The Dynamics of Large Scale Outflows from Young Stars
– Steeghs (Southampton), A search for AM CVn binaries among DB white dwarfs
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– Warren (ICST), Accurate measurement of the mass of the Milky Way dark halo

NL NFRA PC

– Jimenez (Kapteyn), A much-improved stellar library for stellar population synthesis
– Lacerda (Leiden), Rotational Properties of (larger) Kuiper Belt objects
– Noordermeer (Kapteyn), Optical spectroscopy of galaxies in the WHISP sample
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

UK/NL WFS PROGRAMMES

– Dalton (Oxford), The Oxford Deep WFC Survey
– Davies (Cardiff), Multi-Coloured Large Area Survey of the Virgo Cluster
– van den Heuvel (Amsterdam), The Faint Sky Variability Survey II
– McMahon (IoA), The INT Wide Angle Survey
– Walton (ING), The Local Group Census
– Watson (Leicester), An Imaging Programme for the XMM-Newton Serendipitous X-ray Sky Survey

SP CAT

– Aparicio (IAC), The Sagitario dwarf galaxy destruction
– Caon (IAC), Exploring the links between ionized gas and peculiar stellar kinematics in early-type galaxies
– González (IAC), Photometric redshift and star formation history on the ELAIS deep fields
– Gorgas (UCM), A much-improved stellar library for stellar population synthesis
– Kidger (IAC), A Test of a New Method for separating K giant and dwarfs
– López (IAC), Planetary nebulae in the Virgo intracluster medium
– Martínez-Delgado (IAC), The building-blocks of the Milky Way: Searching for dwarf galaxy remnants around globular clusters
– Montes (UCM), Multi size continuous spectroscopy (MUSICOS) of flare stars
– Negueruela (Strasbourg), The pre-main sequence population in the open globular cluster NGC 1893
– Sánchez (ING), Search for the 2175Å dust-absorption feature in red QSOs

Jacobus Kapteyn Telescope

UK PATT

– Davies (Cardiff), Limits on the stellar content of Compact High Velocity Clouds (CHVCs)
– Davies (UKIRT), Lightcurves of Near Earth Objects
– Disney (Cardiff), CCD Imaging of Gas Rich Low Surface Brightness galaxies found at 21cm
– Fitzsimmons (QUB), The size and composition of Near-Earth Asteroids

– Green (OU), Physical properties of MUSES-C target asteroid, 1998 SF36
– Hambly (Edinburgh), Photometric Calibrators for the Palomar Sky Survey
– Hynes (Southampton), Weighing the Black Hole in XTE J1118+480
– James (LJMU), A survey of star formation in the local universe
– Knapen (Herts), Star formation in arm and interarm environments in spiral galaxies
– Marsh (Southampton), Starspots on magnetic white dwarfs
– Norton (OU), Optical identification and outburst monitoring of transient X-ray binaries
– Tanvir (Herts), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

NL NFRA PC

– Orosz (Utrecht), The mass of the black hole in the X-ray nova XTE J1118+480
– Schoenmakers (Dwingeloo), R-band imaging of a sample of high-z giant radio galaxy candidates
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

SP CAT

– Castro-Tirado (IAA/LAEFF), Rapid detection of the optical counterparts of GRBs
– Carraro (Padova), Formation and evolution of the Milky Way
– Díaz (UAM), Determination of the fundamental morphological parameters of the nearby active and normal galaxies
– Oscoz (IAC), Detection of the fast fluctuations in the gravitational lens Q0957+561
– Pérez (IAC), Atlas of starburst galaxies through H recombination lines imaging
– Sánchez (ING), NIR photometry of the B3-VLA quasar sample

SEMESTER 2001B

ITP Programmes on the ING Telescopes

– Barcons (IF Cantabria), An XMM-Newton international survey (AXIS-II): unveiling the hard X-ray source populations
– Doressoundiram (Paris), Multi-color taxonomy of trans-Neptunian objects
– Moles (IMAFF Madrid), A photometric wide-field survey of low-z clusters: defining the local reference sample for distant cluster studies

William Herschel Telescope

UK PATT

– Bower (Durham), The outer-cluster environment at z=0.4
– Bridges (AAO), A spectroscopic study of globular clusters in M31: Part II
– Carter (Liverpool), The nature of the dark halos of the Local Group galaxies M31 and M33
– Davies (Durham), Mapping early type galaxies along the Hubble Sequence
– Dhillon (Sheffield), Imaging star-spots on the secondary stars in cataclysmic variables
– Edge (Durham), Emission line kinematics in central cluster galaxies in cooling flows
– Farrah (Imperial College), The environments of hyperluminous infrared galaxies
– Green (Open University), Lightcurves of massive EKBOs — Binaries or icy spots?
– Harries (Exeter), A search for Zeeman polarization in the emission lines of classical T Tauri stars
– Howarth (UCL), Line formation in O-type stars
– Irwin (Cambridge), Kinematics of a giant tidal stellar stream in the halo of M31
– Jeffries (Keele), Wide binary brown dwarfs
– Keenan (Belfast), High spatial and spectral resolution observations of high velocity cloudlets towards M15
– Knapen (Hertfordshire, ING), A check of the theory of bar driven spirals based on deep K-band images of nearby galaxies
– Marsh (Southampton), The low luminosity cataclysmic variable, GD552 W/2001B/35
– Meikle (Imperial College), Detection and study of supernovae in nuclear starburst regions
– Merrifield (Nottingham), Planetary nebula kinematics of flattened early-type galaxies
– Metcalfe (Durham), Infra-red photometry of Chandra sources on the extended Herschel Deep Field
– Peroux (Cambridge), Tracing Galactic haloes at $3.0<z<4.5$ using CIV absorption lines
– Pettini (Cambridge), Star-forming galaxies and the Ly-alpha forest at $z \cong 3$: the Galaxy–IGM connection
– Pollacco (QUB), Restarting the fast wind in the Sakurai Object (V4334 Sagittarii) W/2001A/12 LT
– Rawlings (Oxford), Tracing large scale structure with radio galaxies
– Refregier (IoA), Measuring cosmological parameters with weak gravitational lensing
– Ryan (Open University), Carbon nucleosynthesis in the first stars
– Shanks (Durham), A spectroscopic test of anomalous two-colour diagrams of cepheid open clusters
– Smail (Durham), Testing photometric redshifts using cluster lenses
– Smail (Durham), The role of dark matter in cluster formation and galaxy evolution: Wide-field IR imaging of the cluster Cl0024+1654
– Smartt (Cambridge), A complete survey of the Wolf-Rayet content of M33

– Smartt (Cambridge), Wolf-Rayet content of the starburst galaxy IC10: an anomaly for stellar and galactic evolution?
– Tadhunter (Sheffield), The nature of the far-IR/sub-mm excess in powerful radio galaxies
– Tanvir (Hertfordshire), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– Vink (Imperial College), Could Herbig stars be magnetic accretors?
– Ward (Leicester), The nature and environment of Galactic super-Eddington Sources
– Willott (Oxford), The Fundamental Plane and black hole masses of z=0.5 radio galaxies
– Wills (Sheffield), Triggering the activity in giant elliptical galaxies

NL NFRA PC

– Förster Schreiber (Leiden), Near-infrared snapshot survey for bright lensed red high-redshift galaxies
– Ferguson (Groningen), A search for recent massive star formation in gas-rich ellipticals/SOs
– Hulleman (Utrecht), What powers the anomalous X-ray pulsar 4U 0142+61?
– Kuijken (Groningen), Planetary nebula kinematics of flattened galaxies
– Lacerda (Leiden), Rotational properties of (smaller) Kuiper Belt objects
– Mengel (Leiden), Star formation history in nearby mergers
– Nelemans (Amsterdam), Identification of low-luminosity cataclysmic variable candidates in the Faint Sky Variability Survey
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients
– de Zeeuw (Leiden), Mapping early-type galaxies along the Hubble Sequence

SP CAT

– Castro-Tirado (IAA), Rapid optical and IR detection of GRB counterparts
– Colina (IF Cantabria), Integral field spectroscopy of ultraluminous infrared galaxies
– Delgado-Sánchez (IAA), Spectroscopy of Pre-Main Sequence candidates in young clusters
– Erwin (IAC), Inner bars, disks and nuclear rings along the Hubble sequence
– Esteban (IAC), Chemical abundances based on recombination lines in ionized nebulas
– López (Barcelona), Kinematic structure of the transversal part of stellar jets
– Mampaso (IAC), Chemical gradients and evolution in M33 based on PN and HII regions
– Martínez (Valencia), The mass and extent of halos in elliptical galaxies
– Neguerela (Strasbourg), The orbit of V0332+53
– Paredes (Barcelona), Search for new microquasars: spectroscopic confirmation of candidates
– Pérez (IAA), Kinematic corrugations in spiral galaxies
– Prieto (IAC), A study of high redshift galaxies with extreme star formation
– Rebolo (IAC), A search for isolated Jovian planets in Orion
– Rebolo (IAC), Sulphur abundances in metal-poor stars
– Sulentic (IAA), The physics of the ISM in past and present interaction events
– Zurita (ING), Dust in regions of massive star formation

INSTRUMENTS BUILDER'S GUARANTEED TIME

– Packham (Florida), The initial conditions to star formation GT/2001B/1

Isaac Newton Telescope

UK PATT

– Benn (ING), An extinction map of M31
– Bonnell (St Andrews), Inflow and outflow in T Tauri systems: splashback or disc-wind?
– Boyce (Bristol), CCD imaging of gas-rich low surface brightness galaxies found at 21cm
– Burleigh (Leicester), Asteroseismology of a pulsating helium-atmosphere white dwarf
– Hewett (Cambridge), Probing the dark halo of M31 with pixel microlensing
– Liu (UCL), A deep optical recombination line abundance survey of northern hemisphere planetary nebulae
– Marsh (Southampton), Subdwarf-B stars: tracers of binary evolution
– Marsh (Southampton), Subdwarf-B stars: traces of binary evolution. II. Galactic plane sample
– McLure (Oxford), A photometric redshift study of radio galaxy environments spanning 3 decades in luminosity
– North (Southampton), The ages of cataclysmic variables
– Pinfield (Liverpool John Moores University), An intermediate age population of very low-mass stars & brown dwarfs
– Sharples (Durham), The disk galaxy population in nearby clusters
– Tanvir (Hertfordshire), A CCD Survey of the halo and outer disk of M31
– Tanvir (Hertfordshire), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

NL NFRA PC

– Jimenez (Groningen), A much-improved stellar library for stellar population synthesis
– Lacerda (Leiden), Rotational properties of (larger) Kuiper Belt objects
– Nelemans (Amsterdam), Follow-up of possible type Ia supernova progenitors
– Sackett (Groningen), The MEGA Survey: Mapping microlensing in M31
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

UK/NL WFS PROGRAMMES

– Dalton (Oxford), The Oxford Deep WFC Survey
– van den Heuvel (Amsterdam), The Faint Sky Variability Survey II
– McMahon (IoA), The INT Wide Angle Survey
– Walton (ING), The Local Group census
– Watson (Leicester), An imaging programme for the XMM-Newton Serendipitous X-ray Sky Survey

SP CAT

– Balcells (IAC), Deep U & I imaging of high-redshift galaxies with extreme star formation
– Castro-Tirado (IAA), Rapid optical and IR detection of GRB counterparts
– Gallego (Comp. Madrid), Evolution of the Star Formation Rate density of the Universe at intermediate redshift
– Gonçalves (IAC), The nature of low-ionization microstructures in PNe: determination of the physical parameters
– Magrini (Florence), PN and the intergalactic stellar population in the M81 system
– Popovic (Belgrade), Disk emission in AGN
– Rebolo (IAC), The rotation of brown dwarfs
– Ribas (Barcelona), Direct determination of the distance to M31 using eclipsing binaries
– Vílchez (IAA), Constrants to the evolution of ring galaxies from abundance gradients
– Villamariz Cid (IAC), CNO abundancies in galactic OB stars: rotation and mixing processes

Jacobus Kapteyn Telescope

UK PATT

– Boyce (Bristol), H-alpha imaging of gas-rich low surface brightness galaxies found at 21cm
– Bucciarelli (Turin), Photometric calibrators for the Palomar Sky Surveys
– Burleigh (Leicester), Optical variability of cool stars in the Galactic Plane
– Davies (JAC), Lightcurves of Near Earth Objects
– Dhillon (Sheffield), Imaging star-spots on the secondary stars in cataclysmic variables
– Fitzsimmons (Belfast), The size and composition of Near-Earth Objects
– Folha (Porto), Pulsations in pre-Main Sequence Herbig Ae stars
– James D (St Andrews), Rotation period determinations in the intermediate-aged open cluster NGC2168
– James P (LJMU), A survey of star formation in the local Universe
– McBride (Open University), Physical and thermal properties of Earth crossing asteroid 1998 WT24
– Pollacco (Belfast), Central stars of bipolar Planetary Nebula: ~100% binarity?
– Schönberner (Potsdam), The mass loss history of planetary nebulae with ‘normal’ and WR-type nuclei
– Smith (Cork), A search for optical variability in radio intermediate quasars
– Tanvir (Hertfordshire), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

NL NFRA PC

– Ferguson (Groningen), Star formation in nuclear and outer regions in barred spirals
– Noordermeer (Groningen), Multi-color imaging of galaxies in the WHISP sample
– Vreeswijk (Amsterdam), Rapid imaging of GRB error boxes and spectroscopy of GRB-related optical/IR transients

SP CAT

– Baes (Vienna), Tracing the dynamic interplay between the gas-dominated and star-dominated disk components in barred spirals
– Carraro (Padova), Formation and evolution of the Milky Way: the Galactic disk
– Castro-Tirado (IAA), Rapid optical and IR detection of GRB counterparts
– Kidger (IAC), Definition of an accurate 1–30µ flux calibration system for GTC
– Lara (IAA), The dust and gas coma of comet C/2000 WM1 (Linear)
– López Aguerri (Basel), Restriction on the amount of dark matter in SAB galaxies
– Pérez García (IAC), Atlas of starburst galaxies through H recombination lines imaging

Appendix E

ING BIBLIOGRAPHY

Below is the list of research papers published in 2000 and 2001 that resulted from observations carried out at the telescopes of the Isaac Newton Group. Only papers appearing in refereed journals have been included, although many other publications have appeared elsewhere, notably in workshop, conference proceedings and PhD theses.

2000

WILLIAM HERSCHEL TELESCOPE

1. W Aoki, J E Norris, S G Ryan, T C Beers, H Ando, "Detection of Lead in the Carbon-rich, Very Metal-poor Star LP 625-44: A strong Constraint on s-Process Nucleosynthesis at Low Metallicity", *Astrophys J*, **536**, 97. (UES)
2. S Arribas, L Colina, K D Borne, "Merging Process and Tidal-induced Star Formation in the Ultraluminous Infrared Galaxy IRAS 08572+3915", *Astrophys J*, **545**, 228. (INTEGRAL)
3. D J Bacon, A R Refregier, R Alexandre, R S Ellis, "Detection of weak gravitational lensing by large-scale structure", *MNRAS*, **318**, 625. (PFC)
4. C del Burgo, E Mediavilla, S Arribas, "High-Ionization Clouds in the Circumnuclear Region of M31", *Astrophys J*, **540**, 741. (INTEGRAL)
5. P N Best, H J A Röttering, M S Longair, "Deep spectroscopy of distant 3CR radio galaxies: the data", *MNRAS*, **311**,1. (ISIS)
6. P N Best, H J A Röttering, M S Longair, "Ionization, shocks and evolution of the emission-line gas of distant 3CR radio galaxies", *MNRAS*, **311**, 23. (ISIS)
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Appendix F

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"How Normal Disk Galaxies Ionize their Surroundings", Beckman, J E, ***Zurita, A***, Rozas, M, 2001, *Astron Soc Pac Conf Ser*, **230**, 299.

"HII Region Luminosity Functions: Derivation of a New Standard Candle for Extragalactic Distances", ***Zurita, A***, Cardwell, A, Beckman, J E, Rozas, M, 2001, *Astron Soc Pac Conf Ser*, **230**, 335.

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Appendix G

LIST OF SEMINARS

Date	Title	Speaker	Institution
2000			
10 Feb	The Formation of Multiple Shells in Planetary Nebulae	R Corradi	ING
15 Feb	Mid and FIR Spectral Energy Distribution of Two Active Galaxies: NGC 6090 and NGC 7582	J Acosta	IAC
21 Feb	The Stellar Content of Elliptical and Spiral Galaxies from Near-Infrared Spectroscopy	P James	Liverpool JMU
28 Feb	WHT-Integral Field Spectroscopy combined with HST-imaging of Central Regions of Galaxies	S Arribas	IAC
10 Mar	Circumnuclear Regions of Barred Spirals	D Pérez Ramírez	Hertfordshire
14 Mar	The Low Surface Brightness and Dwarf Galaxy Populations in Nearby Clusters	J Davies	Cardiff
21 Mar	High Redshift Radio Galaxies as Probes of the Early Universe	M Villar-Martín	Hertfordshire
27 Mar	The Nature of Early Type Galaxies: The SAURON Project	R Davies	Durham
7 Apr	The Close Environment of Z CMa	P Garcia	ING
19 Apr	Sleuthing Mass Loss from Cool Stars	A Dupree	Harvard
10 May	Pulsational Constraints on the Evolution of Helium Stars	S Jeffery	Armagh
15 May	Transits and Reflections: Characterising Extra-solar Planets	A Collier-Cameron	St. Andrews
19 May	All About OASIS	A Parisi	Lyon
23 May	Magnetised Accretion-Ejection Structures	J Ferreira	Grenoble
26 May	Gamma-ray Burst Afterglows	P Vreeswijk	Amsterdam
29 May	The Planetary Nebula Spectrograph for La Palma: Measuring and Modelling Galaxy Kinematics	N Douglas and A. Romanowsky	Groningen Groningen
31 May	Recent Progress in Understanding the Origin of the Hubble Sequence	R Ellis	Caltech
16 Jun	Photometric Redshifts: An Estimator for Galaxy Density	D Batcheldor	Hertfordshire/ING
4 Jul	Cygnus A: Understanding the Most Powerful Radio Galaxy in the Local Universe	C Tadhunter	Sheffield
17 Jul	Stellar Populations in Early-Type Galaxies	R Peletier	Nottingham
20 Jul	Scientific Productivity of Large Telescopes S F Sánchez	C Benn and ING	ING
26 Jun	Finding Binary Subdwarf B Stars	P Maxted	Southampton
9 Aug	Introduction to Observatories in China	J Hao	Beijing
17 Aug	The Polychromatic Laser Guide	R Foy	CRAL/Lyon
22 Aug	Physical Properties of Distant Minor Planets	J Davies	JAC, Hawaii
30 Aug	Dust Extinction at Large Radii in Spiral Galaxies	R Curran	Hertfordshire/ING
31 Aug	Models and observational predictions for the thermal structure of MHD jets	P Garcia	ING
19 Sep	NAOMI commissioning	A Longmore	ATC, Edinburgh
18 Oct	Searching for satellite galaxies at medium redshifts	F Prada	Calar Alto Obs
27 Oct	The first galaxies — clues from element abundances?	M Pettini	IoA Cambridge
9 Nov	Gigawulf: Powering the Isaac Newton Group’s Data Pipeline	R Greimel	ING
10 Nov	Application of Wavefront Sensors to the Optimisation of a 4m Telescope	N O’Mahony	ING
15 Nov	Recent Gamma Ray Burst results	N Tanvir	Hertfordshire
19 Dec	Substellar objects in Orion	P Lucas	Hertfordshire
2001			
10 Jan	The second decade of instrumentation on HST (2001-2010) and the NGST project	S Smartt	Cambridge
15 Jan	ULTRACAM — high-speed astrophysics	V Dhillon	Sheffield
17 Jan	Instrumentation for SALT	D Buckley	SALT
22 Jan	Bars and Seyferts	J Knapen	ING/Hertfordshire
29 Jan	Interactions triggering activity in Seyfert Galaxies?	B García	ING
30 Jan	Progress on GranTeCan	J M Rodríguez	IAC/GTC
2 Feb	Near-infrared spectroscopy of nearby Seyfert galaxies: first results	J Kotilainen	Turku

19 Feb	Starburst triggering and the neutral ISM in ring galaxies	J Higdon	Groningen
7 Mar	The 2.3m ARISTARCHOS telescope	E Harlaftis	Nat Obs Athens
12 Mar	Observational evidence for black holes	E Harlaftis	Nat Obs Athens
16 Mar	Status of the SAURON Project on Nearby Early-type Galaxies	T de Zeeuw	Leiden
22 Mar	The Galileo telescope and its instrumentation	E Oliva	TNG
26 Mar	Do Luminous Ellipticals Have Young Discs?	R McDermid	Durham
27 Mar	Quasar absorption lines as a cosmological probe: exploring the Lyman forest with VLT/UVES	S Cristiani	ESO
28 Mar	WFCAM, quasars, and other things	S Warren	ICL
23 Apr	Weird faint wee red beasties that make X-rays (Red counterparts to faint X-ray sources in a deep ROSAT survey)	A Newsam	Liverpool JMU
27 Apr	Spectral analysis of Galactic OB stars	C Villamariz Cid	IAC
23 May	CCD Design: Current Developments	S Tulloch	ING
31 May	Probing the Fossil Record of Galaxy Evolution in M31	A Ferguson	Groningen
27 Jun	WHT/INTEGRAL and the VLA give clues on the formation of shell galaxies	M Balcells	IAC
10 Jul	The Turkish National Observatory in Antalya	S O Selam	Ankara Obs
24 Jul	AXIS (An XMM-Newton International Survey)	X Barcons	Santander
26 Jul	Near-Earth Objects: Unanswered Questions	A Fitzsimmons	Belfast
8 Aug	Brown Dwarfs: Origins, Evolution and Fate	E Martín	IfA Hawaii
22 Aug	Results from the Palomar mirror cleaning and coating conference	J Rey & M Blanken	ING
29 Aug	Searching for obscured supernovae in nearby starburst galaxies	S Mattila	ICL
30 Aug	Two-dimensional spectroscopy of the gravitational lens SBS 0909+532	V Motta	IAC
9 Oct	Classical and multiconjugate adaptive optics: status review	C Dolores	ONERA, Toulouse
22 Oct	Dynamics of the Halo of M31 using Planetary Nebulae Velocities	C Halliday	Liverpool JMU
23 Oct	The REX survey: studying a large sample of BL Lacs	A Wolter	Obs Brera, Milan
6 Nov	Nature and Evolution of Starburst Galaxies: The Infrared Perspective	N Foerster	Leiden Univ
9 Nov	Do Galaxies Form at High Redshift?	N Metcalfe	Durham Univ
13 Nov	Searching for z=4 QSOs	J Holt	Sheffield
16 Nov	Search for Ancient Cool White Dwarfs in the Galactic Halo using GSC2 material	D Carollo	Astro Obs Turin
19 Nov	An HST Lensing Survey of X-ray Luminous Galaxy Clusters	G Smith	Durham Univ
20 Nov	The space density of cool white dwarfs from CCD imaging of the Serpens dark cloud	S Hodgkin	IoA Cambridge
26 Nov	Looking into the stars. The case of the Delta Scuti variables	T Dall	Aarhus, Denmark
17 Dec	Young Extrasolar Planets - Challenging Systems for Observations	S Els	Heidelberg

Appendix H

FINANCIAL STATEMENT

ALLOCATIONS AND EXPENDITURE FOR FINANCIAL YEAR 2000/2001

The approved funding for ING's operations and enhancements programme during financial year 2000/2001 totalled £4274k, including all staff costs and overheads, as well as an underspend from previous financial year that was carried forward. The NWO also made a contribution of 324k euros for the development of the OASIS integral field spectrograph. Details of the allocations and expenditure to the main subject headings are presented in Table 1 (costs for the international staff posts are not shown here).

Budget center	Allocation £k	Spend £k
Operations		
Administration and management	36.5	53.5
Astronomy support	64.8	54.6
Engineering support	390.1	362.5
Local staff	711.7	722.1
ORM operations	349.3	369.0
Sea-level infrastructure and services	137.8	132.0
SUBTOTAL	1690.2	1693.7
Enhancements programme	404.0	256.7
TOTAL	2094.2	1950.4

Table 1. ING operations and enhancements budget for financial year 2000/2001.

ALLOCATIONS AND EXPENDITURE FOR FINANCIAL YEAR 2001/2002

The approved funding for ING's operations and enhancements programme during financial year 2001/2002 totalled £4230k, including all staff costs and overheads, as well as an underspend from previous financial year that was carried forward. Details of the allocations and expenditure to the main subject headings are presented in Table 2 (costs for the international staff posts are not shown here).

Budget center	Allocation £k	Spend £k
Operations		
Administration and management	42.0	48.6
Astronomy support	57.0	60.3
Engineering support	390.0	368.5
Local staff	620.0	619.9
ORM operations	288.0	309.4
Sea-level infrastructure and services	140.0	128.1
SUBTOTAL	1537.0	1534.8
Enhancements programme	492.6	514.2
TOTAL	2029.6	2049.0

Table 2. ING operations and enhancements budget for financial year 2001/2002.

Appendix I

COMMITTEE MEMBERSHIP

ING BOARD

Prof P T de Zeeuw — **Chairman**	*University of Leiden*
Dr A Collier-Cameron — **Vice Chairman** (until 04.2001)	*University of St Andrews*
Prof M Merrifield — **Vice Chairman** (from 4.2001)	*University of Nottingham*
Dr W H W M Boland	*NWO*
Prof J Drew	*Imperial College London*
Dr A Mampaso Recio	*Instituto de Astrofísica de Canarias*
Dr T Marsh (from 10.2001)	*University of Southampton*
Dr P G Murdin (until 10.2001)	*PPARC*
Dr C Vincent	*PPARC*
Dr C Vincent — **Secretary** (until 10.2001)	*PPARC*
Dr S Berry — **Secretary** (from 10.2001)	*PPARC*

INSTRUMENTATION WORKING GROUP

Dr R G McMahon — **Chairman**	*University of Cambridge*
Dr G B Dalton	*University of Oxford*
Dr K H Kuijken	*University of Groningen*
Dr S Arribas (until 08.2000)	*Instituto de Astrofísica de Canarias*
Dr R García López (from 08.2000)	*Instituto de Astrofísica de Canarias*
Dr S F Green	*University of Kent*
Dr V S Dhillon	*University of Sheffield*
Dr N A Walton — **Technical Secretary**	*ING*

ING TIME ALLOCATION GROUPS

UK Panel for the Allocation of Telescope Time (PATT)

Prof F P Keenan — **Chairman** (until 09.2001)	*Queen's University Belfast*
Prof C Tadhunter — **Chairman** (from 09.2001)	*University of Sheffield*

WHT TAG

Dr R D Jeffries — **Chairman**	*University of Keele*
Dr R G Bower	*University of Durham*
Dr G Dalton (from 03.2001)	*University of Oxford*

Dr N Hambly (until 09.2001)	*Royal Observatory Edinburgh*
Dr C A Haswell	*Open University*
Dr N Jackson	*Jodrell Bank*
Dr J H Knapen (until 03.2001)	*University of Hertfordshire*
Dr R Oudmayer (from 09.2001)	*University of Leeds*

Dr A Edge (Univ. of Durham) and Dr T Harries (Univ. of Exeter) deputized for TAG members on one ocassion.

Dr I Skillen — **Technical Secretary**	*ING*

INT/JKT TAG

Dr A Fitzsimmons — **Chairman** (until 09/2000)	*Queen's University of Belfast*
Dr P A James — **Chairman** (from 09.2000)	*Liverpool John Moores University*
Dr P Callanan	*University College Cork*
Dr S P Driver	*University of St Andrews*
Dr D Folha (until 02.2001)	*University of Porto*
Dr S T Hodgkin (until 09.2001)	*University of Cambridge*
Dr A Robinson (from 09.2001)	*University of Hertfordshire*
Dr S Smartt (from 09.2001)	*University of Cambridge*
Dr D Steeghs (from 03.2001)	*University of Southampton*
Dr I Skillen — **Technical Secretary**	*ING*

NL NFRA Programme Committee (PC)

Prof T van der Hulst — **Chairman** (until 09.2000)	*University of Groningen*
Prof F Briggs — **Chairman** (from 09.2000)	*University of Groningen*

SP Comité de Asignación de Tiempos (CAT)

Dr E Mediavilla — **Chairman**	*Instituto de Astrofísica de Canarias*

Appendix J

ADDRESSES AND CONTACTS

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Tel: +34 922 425400
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Observatory:

Tel: +34 922 405 500 (Residence's Reception)
559 (WHT control room)
640 (INT control room)
585 (JKT control room)

Enquiries about the operation of the Roque de Los Muchachos Observatory can be made to: **Instituto de Astrofísica de Canarias (IAC)**. C/ Vía Láctea s/n; E-38200 La Laguna; Canary Islands; Spain; Tel: +34 922 605 200; Fax: +34 922 605 210; URL: http://www.iac.es/.

Enquiries about observing time on the ING telescopes allocated by the Panel for the Allocation of Telescope Time (PATT) should be made to the executive secretary, PATT, at the PPARC address given below, or for Dutch time to the chairperson of the Programme Committee (PC), email: nfra_pc@astro.rug.nl. Enquiries about the share of time at the disposal of Spain should be made to the Comité para la Asignación de Tiempos (CAT), at the IAC address given above. Enquiries about the International Time Scheme should be made to the Secretary, CCI, at the IAC address given above.

Particle Physics and Astronomy Research Council (PPARC). Polaris House; North Star Avenue; Swindon SN2 1SZ; United Kingdom; Tel: +44 (0)1793 442 000; Fax: +44 (0)1793 442 002; URL: http://www.pparc.ac.uk/.

Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO). P.O. Box 93138; 2509 AD Den Haag; The Netherlands; Tel: +31 (0)70 34 40 640; Fax: +31 (0)70 38 50 971; URL: http://www.nwo.nl/.

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Personal Secretary to Director	Rachael Miles	425 420	miles
Head of Administration	Les Edwins	425 418	lie
Head of Astronomy	Danny Lennon	425 440	djl
Head of Engineering	Gordon Talbot	425 419	rgt
Public Relations	Javier Méndez	425 464	jma
Telescope Scheduling	Ian Skillen	425 439	wji
WHT Manager	Chris Benn	425 432	crb
JKT and INT Manager	Romano Corradi	425 461	rcorradi
Personnel	Lucy Lawler	425 415	lal
Health and Safety	Douglas Gray	405 459	doug
Freight	Juan Martínez	425 414	juan

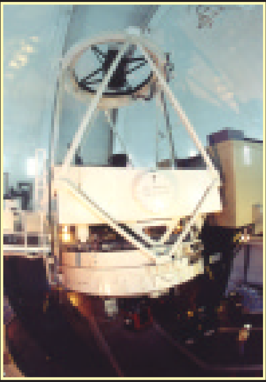
Online contact information can be found at `http://www.ing.iac.es/About-ING/`

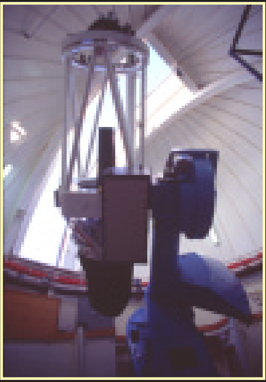
Appendix K

ACRONYMS AND ABBREVIATIONS

AAO	Anglo-Australian Observatory
Astron Astrophys	Astronomy and Astrophysics Journal
Astron Astrophys Suppl	Astronomy and Astrophysics Journal Supplement Series
Astron J	Astronomical Journal
Astron Soc Pac Conf Ser	Astronomical Society of the Pacific Conference Series
Astrophys J	Astrophysical Journal
Astrophys J Suppl	Astrophysical Journal Supplement Series
Astrophys Space Science	Astrophysics and Space Science Journal
AU	Astronomical Unit (1.496×10^8 km)
AUTOFIB	Autofib Fibre Positioner
Aux	Auxiliary Port at the WHT Cassegrain focus
Bull Am Astron Soc	Bulletin of the American Astronomical Society
Cass	Cassegrain focus
CAT	Comité para la Asignación de Tiempos (Spanish panel for the allocation of telescope time)
CCD	Charge-Coupled Device
CCI	Comité Científico Internacional (International Scientific Committee) for Astrophysics
CfA	Harvard-Smithsonian Centre for Astrophysics
CIRSI	Cambridge Infra Red Survey Instrument
DAS	Data Acquisition System
DIAS	Dublin Institute for Advanced Studies
DIMM	Differential Image Motion Monitor
ELECTRA	Enhanced Light Efficiency Cophasing Telescope Resolution Actuator
ESA	European Space Agency
ESTEC	European Space Technology Centre
Fib	AUTOFIB fibre positioner
FOS	Faint Object Spectrograph
FWHM	Full Width Half Maximum
GHRIL	Ground Based High Resolution Imaging Laboratory
HST	Hubble Space Telescope
IAA	Instituto de Astrofísica de Andalucía
IAC	Instituto de Astrofísica de Canarias
IAU	International Astronomical Union
IAU Circ	IAU Circular
IAUNAM	Instituto de Astronomía de la Universidad Nacional Autónoma de México, Mexico
IC	Imperial College
ICS	Instrument Control System
ICSTM	Imperial College of Science, Technology and Medicine
IDS	Intermediate Dispersion Spectrograph
IFCA	Instituto de Física de Cantabria
IMAFF	Instituto de Matemáticas y Física Fundamental, Madrid
INAOE	Instituto Nacional de Astrofísica, Optica y Electrónica, Mexico
Inf Bull Variable Stars	Information Bulletin on Variable Stars
ING	Isaac Newton Group
ING Newsl	ING Newsletter
INGRID	ING Red Imaging Device
Int Astron Union Symp	International Astronomical Union Symposium
INT	Isaac Newton Telescope
INTEGRAL	Integral field fibre feed for WYFFOS
IoA	Institute of Astronomy
IR	Infrared
Irish Astron J	Irish Astronomical Journal
ISIS	ISIS double spectrograph
ITP	International Time Programme
JAG	JKT Acquisition and Guiding Unit
JKT	Jacobus Kapteyn Telescope
JOSE	Joint Observatories Seeing Evaluation programme
JSC	Joint Steering Committee
LAEFF	Laboratory for Space Astrophysics and Fundamental Physics
LDSS	Low Dispersion Survey Spectrograph
LIRIS	Long-Slit Intermediate-Resolution Infrared Spectrograph
LJMU	Liverpool John Moores University
MARTINI	Multi-Aperture Real Time Image Normalisation Instrument

MCCD	Mosaic CCD camera or National Astronomical Observatory of Japan camera
Mem Soc Astron Ital	Memorie della Società Astronomica Italiana
MNRAS	Monthly Notices of the Royal Astronomical Society
MOMI	Manchester Occulting Mask Imager
MPIA	Max Planck Institute of Astrophysics
MSSL	Mullard Space Science Laboratory
MSSSO	Mount Stromlo and Siding Spring Observatories
Musicos	Multi-SIte COntinuous Spectroscopy (fibre spectrograph on the INT)
NAOMI	Natural guide star Adaptive Optics system for Multiple-Purpose Instrumentation
NBST	National Board of Science and Technology of Ireland
New Astron	New Astronomy Journal
New Astron Rev	New Astronomy Review
NRAL	National Radio Astronomy Laboratory
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek
OAN	Observatorio Astronómico Nacional
OASIS	OASIS Integral Field Spectrograph
OAT	Observatorio Astronomico de Trieste
ORM	Observatorio del Roque de Los Muchachos (Roque de los Muchachos Observatory)
PASA	Publications of the Astronomical Society of Australia
PASP	Publications of the Astronomical Society of the Pacific
PATT	Panel for the Allocation of Telescope Time
PF	Prime Focus
PFC	Prime Focus Camera
Planet Space Sci	Planetary and Space Science Journal
PP	People's Photometer
PPARC	Particle Physics and Astronomy Research Council
Proc	Proceedings
QMW	Queen Mary and Westfield College
QUB	Queen's University Belfast
RBS	Richardson-Brealy Spectrograph
RGO	Royal Greenwich Observatory
RAL	Rutherford Appleton Laboratory
SAURON	Spectrographic Areal Unit for Research on Optical Nebulae
S-Cam	Super-conducting Tunnel Junction Camera
Space Sci Rev	Space Science Reviews
SPIE	Society of Photo-Optical Instrumentation Engineers
STScI	Space Telescope Science Institute
TAG	Time Allocation Group
TAURUS	TAURUS Fabry-Perot spectrograph or imager
TCS	Telescope Control System
TRIFFID	Galway/DIAS Image Sharpening Camera
UCL	University College London
UCLAN	University of Central Lancashire
UCM	Universidad Complutense de Madrid
UES	Utrecht Echelle Spectrograph
UKIRT	United Kingdom Infrared Telescope
WHIRCAM	William Herschel Infrared Camera
WFC	Wide Field Camera
WFS	Wide Field Surveys with the WFC
WHT	William Herschel Telescope
WYFFOS	Wide Field Fibre Optics Spectrograph
ZAMS	Zero-Age Main Sequence





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