Prospects for the William Herschel Telescope

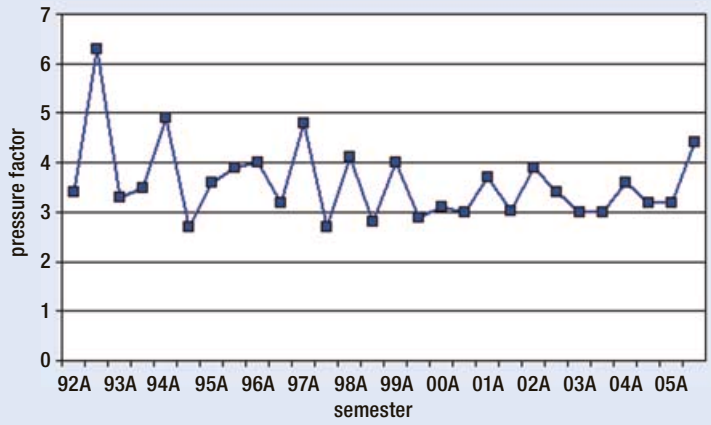
1: Telescopes of the Isaac Newton Group at Roque de los Muchachos Observatory.

René Rutten, Director of the Isaac Newton Group of Telescopes, sets the scene for future developments in international astronomy on La Palma.

The Roque de los Muchachos Observatory on the island of La Palma has grown over the last two decades to become one of the world's leading astronomical observatories – and the main observatory on European soil. The generally excellent weather conditions in the Canary Islands combined with the good infrastructure provided by the Spanish hosts has promoted investments in large observing facilities by many countries. Over the years the UK astronomical community has played a key role in the developments on La Palma. Current UK-led facilities include the 4.2 m William Herschel Telescope (WHT), the 2.5 m Isaac Newton Telescope (INT), the 2 m Liverpool robotic telescope, and the SuperWASP planet search experiment. Of these facilities, the WHT and INT are operated in collaboration with the Netherlands Organisation for Scientific Research and the Instituto de Astrofisica de Canarias, working together through the Isaac Newton Group of Telescopes (ING) and serving a large community of astronomers.

But this is a time of uncertainty for astronomy in the UK and elsewhere. National financial constraints may affect the international team involved in astronomy on La Palma, but there is scope for changes that will benefit European astronomy as a whole. Wider European access to the facilities of the Roque de los Muchachos Observatory, in the form made possible by closer and more efficient collaboration between the various telescope groups already established there, could continue the success of this thriving astronomical community.

2: The over-subscription factor of UK observing time on the WHT.



Advances from technology

Since the early days of the observatory, major advances in astronomy have often resulted from new technological developments. At ING the telescopes have kept abreast of these, with many developments carried out in-house. New instruments combined with the latest generation of detector technology have been deployed and the infrastructure has kept pace with modern standards. Therefore the telescopes still fulfil an important role in observational astronomy, borne out by the very high demand for observing time and the continued high level of scientific output. Their impact on front-line research is underpinned by the fact that the WHT is one of the most productive telescopes of its class in the world, with continued high citation impact, and also by the fact that one in every two observing proposals for the ING telescopes is in support of PhD student research.

The ING telescopes also serve an important role as a platform for deploying university-led instruments and as a training ground for young astronomers. In recent years significant scientific discoveries have come from such instruments that are developed by university groups to answer specific astrophysics questions. Examples are:

PRESENT SUCCESS AND FUTURE POTENTIAL FOR THE ING

The current status and future roles of the Isaac Newton Group, following the major funding changes of the past few years, has been evaluated by an international board comprising Jeremy Mould (NOAO, chair), Brian Boyle (ATNF), Bruce Carney (UNC) and Bruno Leibundgut (ESO). Their report shows a healthy state of affairs at the ING, with instruments and facilities in demand, a superb site and infrastructure, and research success. The board identified elements in the current successful operations that have potential for the future:

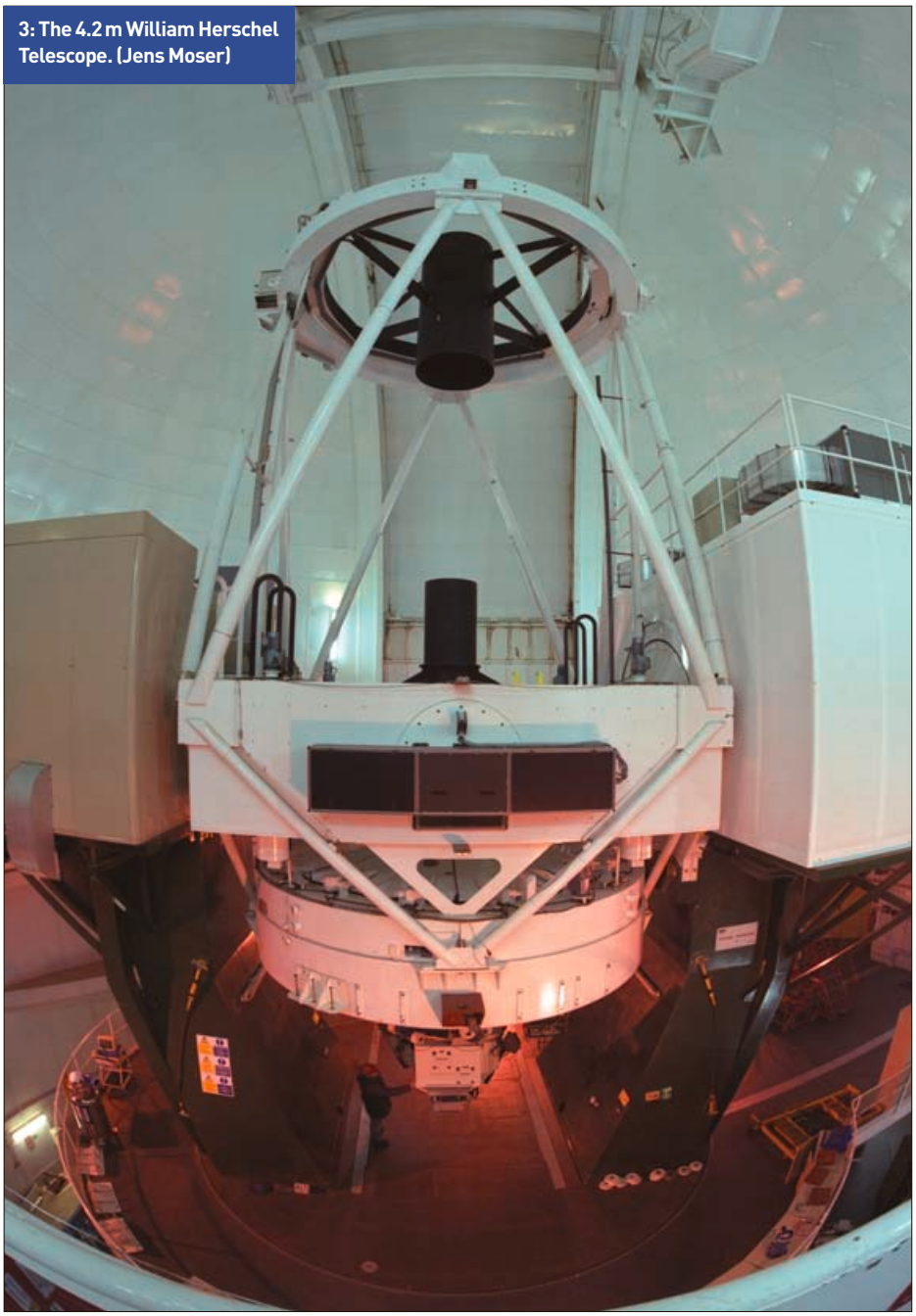
- the excellent site, in the northern hemisphere, with skilled support, technical and engineering staff;
- success achieved with "visitor instruments", such as SAURON;
- and the potential for experimentation using instruments provided by ING partners.

These are areas where a 4 m telescope such as the William Herschel Telescope can be part of the development of systems for larger instruments, facilitating the development of new techniques by university groups, for example.

In order for the ING to remain competitive in a world of 8 m and larger telescopes it is important to focus on specific areas. The board recommended three:

- develop the wide-field observational capabilities, especially of the WHT;
- continue adaptive optics work to make the most of the excellent site;
- develop detectors such as L3CCD.

ING already has an aggressive adaptive optics programme and work is already advanced on GLAS (Ground-layer Laser Adaptive optics System). Adaptive optics has so far been successful for objects close to a bright natural guide star; GLAS, which provides a Rayleigh laser beacon for NAOMI, means that the benefits of high spatial resolution and/or sensitivity can be applied across the sky, making faint and extended sources observable. This new facility will keep the WHT in its good observing site, in a highly competitive position compared to the larger



3: The 4.2 m William Herschel Telescope. (Jens Moser)

- the SAURON integral field spectrograph, which has shed new light on the kinematics of gas and stars in the centres of nearby galaxies;
- the Planetary Nebula Spectrograph, which has discovered hundreds of sources tracing the stellar velocity fields in galaxies;
- and ULTRACAM, which has opened up a previously inaccessible part of the time domain for the study of rapidly varying sources.

The most recent addition is PLANETPOL, which is designed to detect the polarization signature from planets around distant stars. Assisting in the deployment of such fast-track instruments is a strategic and unique role for the ING telescopes.

Development of new instrumentation is crucial for the continued scientific health of any telescope facility. At the WHT a vibrant development programme is in place, currently focusing on providing the widest possible science use of adaptive optics, a technique that greatly improves image quality by correcting for the degradation due to turbulent motions in the Earth's atmosphere.

Adaptive optics is now well established at several telescopes around the world; so also at the WHT. The potential of adaptive optics is huge because the improved spatial resolution allows the detection of sources and fine structures in complex systems that would otherwise not be resolved. Examples are the study of dense stellar clusters, cores of relatively nearby galaxies, and complex star-formation regions.

The technique of adaptive optics, although of huge potential, has its limitations. The requirement that a bright point source lies very close to the object of interest implies that less than 1% of the sky is accessible for the technique. There is, however, a solution to this problem, which is to create an artificial "star" by projecting a bright laser beam on the sky. Such a laser beacon assumes the role of the bright star, hence opening virtually all of the sky to observation with

telescopes, and open the way to radical progress, as most of the sky opens up to adaptive optics sensitivity.

But the development of GLAS also highlights another area where the ING can remain competitive over the next few years: as a platform for the development of new techniques. GLAS will be working on the WHT primarily at short wavelengths significantly before anything comparable will be in place on an 8 m telescope, giving a useful window of opportunity for its use. In addition, this illustrates the potential of the WHT as a testbed for development of novel instrumentation for larger classes of telescopes.

Looking ahead to 2012 the board saw opportunities for the ING. The WHT could be a world-class instrument-development platform for university groups. ING could have a skills base for building and commissioning small-scale instrumentation, playing a significant role in developing the next generation of instrument scientists. These specialisms would put the ING in a strong position to develop specialist instrumentation to respond quickly to new scientific issues.

Further possibilities for the future depend on how organizational and funding possibilities develop over the next few years, including involvement in Europe-wide projects such as OPTICON (http://www.astro-opticon.org/), and projects based on La Palma, such as the 10 m GTC (Gran Telescopio Canarias, a Spanish initiative with support from Mexico and the USA; http://www.gtc.iac.es/home.html). An exciting possibility is the formation of a Common Northern Observatory on La Palma, involving existing national and international groups working together to provide a northern-hemisphere observatory for Europe. If such a proposal turns out to be workable, it could involve much simplified access to the range of telescopes, with the benefits of wider scientific opportunities and more competition among scientists from across Europe.

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adaptive optics. The current developments at the WHT focus on the design and construction of such a laser beacon system, which will result in a dramatic enhancement of the science prospects of the telescope.

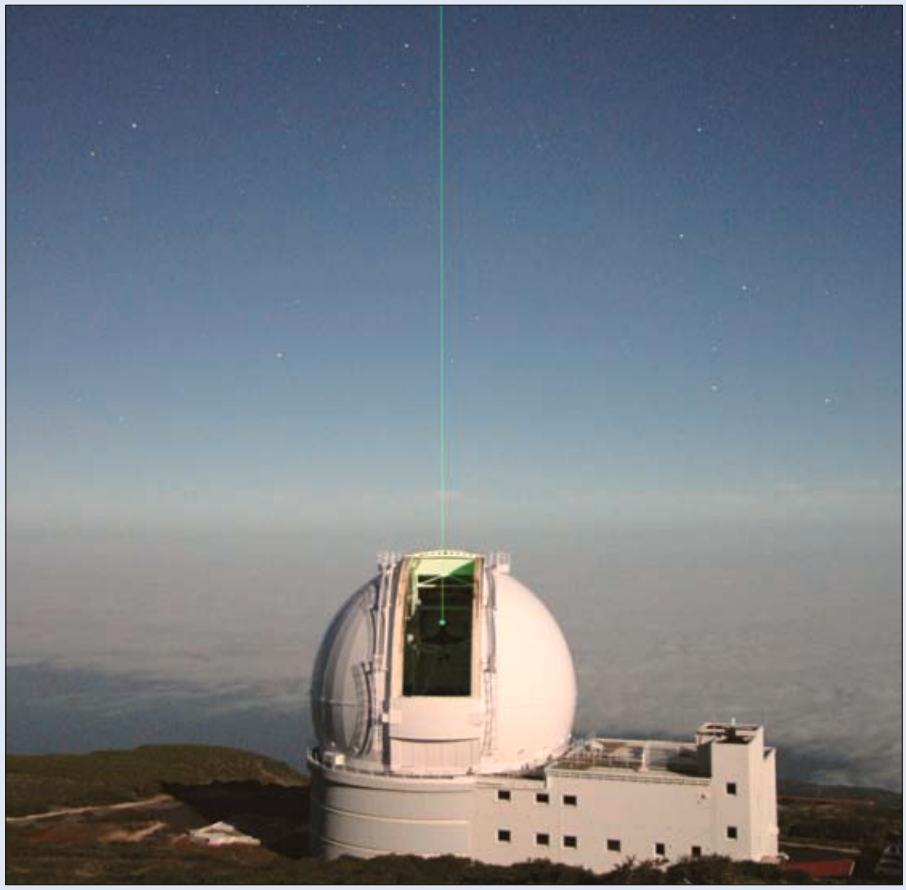
Interestingly, adaptive optics and laser beacons are crucial for the next generation of extremely large telescopes that are currently being planned. These future telescopes, with unprecedented large primary mirror diameters of 30 or even 100 m, require many solutions to be found for a range of technological problems. Thanks to the ongoing developments in this area at the WHT this telescope is well placed to play a key role as a testbed facility where techniques for these future telescopes can be explored under realistic conditions.

Crossroads

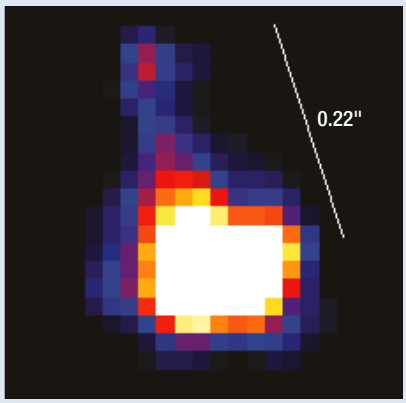
In spite of the healthy scientific situation at the observatory and the exciting prospects for the years to come, the observatory finds itself at an important crossroads. The future of the UK's involvement is being reassessed in view of the expiry in 2009 of the international agreements that form the organizational basis of the observatory. Financial pressures may result in a reduction or even full withdrawal of the UK from the partnership that has worked well for many years.

Independently of the outcome of the deliberations of the UK community, a new vision for the future is being developed, focusing on wider European collaboration between the various facilities at the La Palma Observatory site. Through such collaboration a better service can be offered to a wider international scientific community at a lower cost. It would provide new opportunities for telescope access, and the hope is that the UK will continue to play an active role on La Palma for several years to come. ●

Dr René Rutten, Director, ING.



4 (above): Experimental laser beacon deployment at the William Herschel Telescope.



5 (right): Example result of the adaptive optics system at the WHT. This image of a close binary star was taken with the OASIS instrument in the I-band. The achieved resolution of 0.1 arcsec at such short wavelengths highlights the scientific potential of this system.