Instrumentation Development Strands at the Isaac Newton Group of Telescopes

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Abstract

The advent of a new generation of large optical/IR telescopes has dramatically changed the skyline of ground-based astronomy. The role and future instruments for the medium size telescopes will have to take account of these developments. An outline strategy for future development of the telescopes at the Isaac Newton Group is presented.

Key words: ING; Telescopes; Astronomical Instrumentation

1 Introduction

Observational astronomy is going through a phase of rapid change. The advent of a new generation of large ground based optical and infra-red telescopes opens up new exciting possibilities for astronomical research. At the same time technological developments have generated potential for new instruments: Adaptive Optics is becoming a standard tool, the latest generation of detectors for visible wavelengths are nearly perfect devices, infra-red sensitive detectors are now available in large formats, and new types of coatings and gratings boost efficiency and capabilities of instruments.

In this changing world of ground based astronomy the existing smaller telescopes and their instruments such as the ones pertaining to the Isaac Newton Group on La Palma will have to develop a new role, taking into account the requirements from the 8-m class telescopes. The new facilities imply a shift in scientific emphasis of the smaller telescopes. There will be a continued need for the smaller telescopes to provide data in support of projects carried out at the largest telescopes. At the same time the smaller telescopes will continue to attract world-class science projects that do not require the very largest light collecting surfaces.

This paper provides an overview of the existing instrumentation capabilities and the ongoing development programme at the 4.2-m William Herschel Telescope (WHT), the 2.5-m Isaac Newton Telescope (INT), and the 1.0-m Jacobus Kapteyn Telescope (JKT), together forming the Isaac Newton Group of Telescopes (ING). Taking the requirements of the user community as a basis, I will present what is expected to become the role of the telescopes in the foreseeable future, and what consequently are seen as key areas for development.

2 External factors

Large telescopes such as Gemini and the ESO-VLT will undoubtedly have a profound impact on many key areas of astronomical research. Equally important will be the economic impact as resources will primarily flow towards the large telescopes and consequently the operation and development programmes for small and medium size telescopes will be under more pressure.

The 2 to 4-m class telescopes are expected to fulfill an important role as target selection engines feeding the biggest telescopes through imaging and spectroscopic surveys over large areas of sky. Such preparatory work will require large amounts of telescopes time. The success of the large telescopes will depend on the ability to identify sufficiently large numbers of suitable targets and hence this service role for the medium size telescopes is likely to become important.

The resources available at ING for operation and small-scale enhancements of the instruments has already been reduced by more than 35% over the past six years. Moreover, in order to make sufficient funds available for development of new instruments, resources for operational activities will have to be reduced further, which will have an impact on the support ING is able to offer to visiting astronomers at the telescopes.

3 Existing instrument suit

The current set of instruments on the telescopes at ING has been developed over two decades. The WHT supports a variety of facility instruments, offering a wide choice of observing options. Table 1 and Table 2 present an overview of those instruments.

Currently the WHT supports eight major common-user instruments, and there are a number of developments on the horizon (see following section) that will broaden the capabilities of the WHT even further. Within the limited resources available for telescope operation it becomes ever more difficult to support the

Table 1
Imaging instruments at the ING

Telescope	Focus	Instrument	Notes
WHT	Prime	Prime Focus Camera	U to Z band; $\sim$ 16 x 16 arcmin field
	Cass.	Auxiliary Port Camera	U to Z
		TAURUS (tunable filter)	up to $\sim$ 10 arcmin field
		LDSS	$\sim$ 12 min field
	Cass.	INGRID near IR imager	I to K; $\sim$ 4 x 4 arcmin field
INT	Prime	Wide Field Camera	U to Z; $\sim$ 33 x 33 arcmin field
JKT	Cass.	CCD Camera	U to Z; $\sim$ 10 x 10 arcmin field

Table 2
Spectroscopic instruments at the ING

Telescope	Focus	Instrument	Notes
WHT	Cass.	ISIS	8 to 120 Å/mm; longslit / polarimetry
		LDSS	100 to 513 Å/mm; multislit mask
		TAURUS	R = 10000 to 40000 Fabry-Perot
	Nasm.	UES	$\sim$ 2 Å/mm; Echelle spectrograph
		INTEGRAL	33 to 480 Å/mm; integral field fibres
	Prime	AUTOFIB	33 to 480 Å/mm; multi-object fibers over 1 deg field
INT	Cass.	IDS	6.8 to 271 Å/mm; longslit spectrograph
		FOS-1	486 Å/mm; slit spectrograph
JKT		none	

growing number of instruments at the required level, and consequently less competitive instruments will have to be retired.

4 Instrument developments

The ongoing ING development programme, which was defined a number of years ago, comprises two major new instruments for the WHT: INGRID and NAOMI.

The ING Red Imaging Device, INGRID is a camera for near IR imaging (J, H, K band) using on a 1k x 1k pixel HgCdTe detector. This camera will be deployed as a stand-alone imager in the (folded) Cassegrain focus on the

WHT. Since it will be attached to a side port on the acquisition and guiding unit the instrument will be available most of the time without the need of a major instrument change. The camera has exchangeable fore-optics, which allows it to be used also in conjunction with the Adaptive Optics system at much higher spatial resolution. Commissioning is currently scheduled to take place towards the end of 1999.

The second ongoing development project, NAOMI, will deliver an Adaptive Optics corrected focal plane of the WHT in the Nasmyth focus. This collaborative development between the University of Durham and the UK-ATC in Edinburgh is in an advanced stage and expected to be commissioned before the summer of 2000. The advent of this complex instrument will provide competitive high resolution imaging capability, in particular at short wavelengths. NAOMI provides the WHT with a very exciting route for further development by exploitation of the AO corrected focus at optical and near-IR wavelengths, for both imaging and spectroscopic observations.

Apart from these instrument developments, recently a study was initiated to assess the atmospheric characteristics of the Sodium layer for future laser guide star deployment.

Various enhancements on a smaller scale are also being carried out to existing infrastructure and facilities. In the timeframe of approximately two years ING expects to complete the upgrade of the network and computing infrastructure, commission a new data acquisition system, commission a new generation of red sensitive low fringing CCDs, commission a new fibre unit for AUTOFIB with smaller fibres, and build a long focal length camera for the fibre spectrograph which will allow for large format CCDs and more fibres to be deployed. All the enhancements are of relatively low cost, and provide much improved scientific return.

5 Future role of the telescopes

Given that the WHT now has a well-established range of instruments, and that resources are constrained, the future development programme for the WHT needs to focus on specific target areas. These targets must address areas where 4-m class telescopes will be competitive, either because medium size telescopes offer a unique advantage over the larger telescopes, or because these telescopes provide the required observing time for larger scale projects. The areas for development identified for the WHT focus on:

- High spatial resolution imaging and spectroscopy through adaptive optics, in particular at shorter wavelengths, and

- Exploitation of the wide field at prime focus for multi-object spectroscopy at visible and near IR wavelengths.

Besides these target areas for further development it is anticipated that at least in the foreseeable future there will remain a clear need from the user community to retain a relatively wide range of instrument options. It is also expected that the WHT will remain an important platform for visiting instruments. These requirements imply that the level of engineering and astronomy support for the WHT needs to remain at a relatively high level.

The role of the INT in the coming years will focus on the exploitation of the Wide Field Camera. Survey activities, both in support of observations on 8-m class telescopes as well as for individual science projects are expected to become more important. The recently initiated survey activities are a good example of this trend.

There are currently no specific development plans for the INT, although within the core function of the INT would fit the development of the very wide field imager, or the development of a fibre fed echelle spectrograph for variability studies of relatively bright objects.

The operational support for the INT will reduce. The modernised control systems now allow easy and safe operation of the telescope and instruments by a single user. Recently, Telescope Operator support was withdrawn from the INT for part of the nights.

No developments are envisaged either for the JKT. Operational support will be at a minimum level. This telescope still provides a useful tool for photometric studies of various relatively bright objects, and it is an appropriate training platform for students.

6 Retiring instruments

As mentioned above, the pressure on the operations budget combined with the arrival of new instruments on the WHT requires us to consider retiring instrument that are less competitive. Having many instruments to support requires a large pool of specialist knowledge, more maintenance work, more instrument changes, and it reduces the overall efficiency of the use of telescope time.

The existing suite of instruments on the WHT can be grouped into three classes:

- Workhorse instruments (ISIS, UES, and PF imager) covering a range of ba-

sic observing tools. These instruments should be maintained and enhanced to retain their competitive status.
- New instruments (AUTOFIB/WYFFOS, INGRID and NAOMI), providing new observing opportunities are still being developed and enhanced to provide cutting edge science capability.
- Niche instruments (TAURUS and LDSS) providing very useful capability but have a relatively small user group.

Non of the instruments currently in operation are obviously obsolete and all enjoy a reasonable level of interest from the community. The three workhorse instruments are most popular with users, and also produce the bulk of the published papers. The newly developed instruments enjoy a growing number of users, as one would expect. These instruments form also the key to the development programme on the WHT as presented above.

The two niche instruments, LDSS and TAURUS are used by a small but active group of astronomers. LDSS combines high efficiency with the advantages of multi-slit spectroscopy, which is important for studies of densely packed clusters of stars or galaxies. TAURUS with its Fabry-Perot etalon imaging is still a useful tool for studies of kinematics in nearby galaxies and nebulae. The recently developed tunable narrow band imaging mode for TAURUS offers a new and unique tool for a wide range of studies. The status of LDSS and TAURUS will be the subject of further investigation in the light of developments at ING and other observatories. Up to date details of the instrumentation suite and its evolution in the future can be found on the ING web site [1].

[1] http://www.ing.iac.es