The ING Instrumentation Conference Discussion

Options for a Competitive Observatory

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Abstract

An expert panel initiated discussion on a number of key questions facing the role of 4-m and small telescopes in the new era of 8-m telescopes. The panel and audience agreed that the 4-m class telescope role would necessarily evolve, but would still be important in the coming years. The need for an active development programme of competitive instrumentation for 4-m class telescopes, and in particular the William Herschel Telescope (WHT) was stressed. In conjunction with this, the need to decommission instrumentation made redundant by 8-m class telescopes was noted. New operational modes, including greater emphasis on survey programmes, and possibly queue scheduling, coupled with changes to the procedures for allocating time were seen as desirable. The panel and audience supported the Isaac Newton Group's emphasis on the development of instrumentation to exploit its imminent deployment of the WHT's facility Adaptive Optics system.

Key words: Telescopes; Spectroscopy; Photometry; Surveys; Adaptive Optics; Wide Field Astrometry; Observatory operations

1 Introduction

In order to gauge the views of the Isaac Newton Group's (ING) [2] user community, a general discussion session was organised on the afternoon of Thursday, 8th April 1999. The discussions covered a range of topics, and provide some

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

interesting insights on issues currently facing the ING. These may be of use when considering the development of other sub-8-m telescope facilities in the coming decade. The discussions were chaired by Prof. Phil Charles from the University of Oxford. An expert panel (see Table 1) was assembled who initially responded to each of the discussion points before inviting input from the conference attendees.

For ease of editing, and accuracy, the discussion session was recorded on audio tape. The editors have transcribed the audio tapes, and edited the text in particular drawing out important arguments and pruning repetition and side issues raised. The discussions flowed in a fairly logical fashion, and the editors have added discussion point titles at the start of each new discussion section. However there are some inevitable transgressions and asides.

The editors take full responsibility for this text, and apologise if they may have in any way mis-interpreted or mis-understood any of the contributors comments.

Table 1
Members of the discussion panel and affiliations

Name	Institution
Phil Charles (Chair)	Oxford
Mike Edmunds	Cardiff
Jim Emerson	Queen Mary & Westfield, London
Roger Davies	Durham
Pat Roche	Oxford & UK Gemini Office
René Rutten	Director, Isaac Newton Group

2 The Discussion Session

2.1 Opening Comments

Phil Charles: I am standing in for Carlos Frenk who unfortunately could not attend this meeting. We had agreed several things with Carlos and that was the original initial list of topics up there (see Table 2). The panel is here to help keep discussion going. It's your opportunity to take part in this discussion as well.

In preparing for this, we came up with this list of questions. We have decided to drop the first one since we could go on for a week without ever getting an agreement on it. And obviously we want to be aware of the underlying science, but we want to concentrate here on the instrumentation and the future direction of our facilities. You are the users and this is your opportunity to provide input into this whole process.

Table 2
Questions posed to the Expert Panel during the discussion session

What are the current major astronomy science issues?

What instrumentation is needed to address these issues?

What science is best carried out on 4-m or 2-m class telescopes?

What facilities might now be redundant?

La Palma and GranTeCan, the Spanish 10-m telescope.

What role for 'robotic' telescopes?

Which telescope/instrument operational modes should be developed?

The position of 'survey' programmes?

Opportunities for 'networking' European sub 8-m telescopes

Operational Modes and Scheduling the ING and other UK telescopes: the Impact of Gemini.

Phil Charles: With Gemini [*two 8-m telescopes constructed by a multinational consortium including the UK*] [3] coming along and hopefully GranTeCan [*The Spanish 10-m telescope currently in the early stages of construction*] [4] not too far afterwards, this will have an impact on the way we operate and the way we allocate time. The first question is about the PATT [*the UK's Panel for the Application of Telescope Time*] mode, the way we propose for telescope time, the role of the separate time allocation committees [*TACs*]. We heard this morning that we have a lot of TACs handling our telescopes. And yet space based facilities allocate time according to strategic priorities. At the ING, the Joint Steering Committee [*the management board of the ING, and now re-constituted as the ING Board*] have decided to target a certain fraction of the 2.5-m Isaac Newton Telescope [*INT*] time for survey work. Is that the direction we should be going? Is it enough? Is it too much?

Jim Emerson: At this meeting, people from the NOAO [*The USA's National Optical Astronomical Observatories*] [5] and Dr. Roland Bacon from Lyon have told us that both at the NOAO and in France time was allocated via thematic TACs. Danny Lennon talked about the difficulties of assigning time and the

[3] http://www.gemini.edu
[4] http://www.gtc.iac.es
[5] http://www.noao.edu

disparity between getting either three hours via an ING service programme or a week from a PATT application.

Pat Roche(7) mentioned Gemini programmes; a science project may need a combination of imaging and spectroscopy, perhaps utilizing instruments on smaller telescopes as well. At present this would need multiple applications to the varying TACs. I would like to propose that PPARC [*the UK's Particle Physics and Astronomy Research Council*][6] appoint a small working party to look at the possibility of restructuring PATT to allocate time to specific projects, allocating time on whichever facilities are needed. I can see some difficulties but it sounds like there would be many advantages.

Phil Charles: I think it was Richard [Bower] who asked about the problem that you can not get more than 3 hours in service mode. Danny [Lennon] mentioned the expense of running queue [*Q*] scheduling which you could describe as an enhancement of service. The additional cost of the queue mode is one I recall from my time on La Palma — if you do use people then it may be more expensive because you have to pay for them to be there, lets say, you used two or three nights a month for this type of work, so 30, 35, 40 nights a year. But that's 40 nights of time for which the observers have not had to travel out.

But this is money saved from a non-observatory budget to which the ING has no access. If Q scheduling is activated in a significant fashion, the observatory needs to be compensated with the savings in travel & subsistence. Roger, does that agree with what has been agreed or discussed in Gemini?

Roger Davies: This is not only possible but it has been done already. 2dF [*a multi-object fibre spectrograph*] on the Anglo Australian Telescope [*AAT*][7] has an observer who is paid for by PATT — you can't go and observe with 2dF even if you want to. If people wanted to do this it could be decided and done I think. Would you agree Colin?

Colin Vincent: That's correct. It is also done for SCUBA on the JCMT [*James Clark Maxwell Telescope*][8].

Vik Dhillon: If thematic panels are instigated for various subject areas, how do you decide how much time to give each subject?

Jim Emerson: That would be hard to decide. Initially you could go through the last few rounds of PATT and divide it up in the same proportions. But clearly the problem would be that you would then have philosophical arguments over whether cosmology was more important than stars before you got to the thing.

[6] http://www.pparc.ac.uk
[7] http://www.aao.gov.au
[8] http://www.jach.hawaii.edu

You could have some rolling average. The working group should explore the approach taken by the Americans and the French.

Bruce Bohannan: Go and look at HST [*Hubble Space Telescope*][9], go and look at what NOAO is doing, starting this semester. Look at what the French do, and take what works best.

Phil Charles: Yes, the HST takes a strategic approach. The panels allocate certain fractions of time between different scientific areas. Now I would actually say that has many strong points going for it. And it would prevent a small TAC ignoring particular scientific areas, perhaps because that TAC has a group of people who all think, CVs [*Cataclysmic Variables*] for instance are important, and thus give all the time to CVs.

Tim Hawarden: Colin mentioned that SCUBA on the JCMT has been operating about three different forms of high intensity Q scheduling for some time. Of which the Dutch system seems to me to be working best — here the mode is that visiting astronomers plus resident astronomers do the work. Everyone goes there and does service mode observing and sometimes it's your work and sometimes it's somebody else's work.

Clive Tadhunter: If allocation is done by dividing it up by subject, then to make it efficient you would have to do it for all the telescopes. Ground based telescopes represent a more complex scheduling situation than for instance the HST. They have many instrument configurations, and there are weather variables to consider. I find it very difficult to see how you would get a workable Q system with so many instruments, so many different colours of the night, etc.

Peter Sarre: The discussions seem to have been a question of all or nothing. Some of the research councils have a blend of themes and response mode. I wonder if there are themes which can be time dependent in their size and vary after a couple of years when they are reviewed, but then half the time is also freely available for the innovative programmes that don't naturally fall into those modes.

Konrad Kuijken: ESO [*European Southern Observatory*][10] have been running seven to eight telescopes in the last years with six or so subject panels. These all get together, the different panels give away surplus time on some telescope they didn't need on that particular round and they buy other time with it. In the end it seems to work reasonably well.

Phil Charles: Also the panels handle more than one telescope.

[9] http://www.stsci.edu
[10] http://www.eso.org

Konrad Kuijken: The panels cover all the telescopes including the VLT [*ESO's Very Large Telescope*][11]. What happened at the last VLT round was that, for instance, the planetary scientists got three nights of VLT time to divide among them in proportion to the amount of time that was solicited. And it worked on a historical basis, based on a rolling average.

Phil Charles: Would the majority of people here like to see significant changes to the PATT allocation method? Who thinks that moving to this kind of thematic approach is a good idea? Who thinks the present PATT mode is working well?

[Ed's note: on a show of hands ∼70% of the attendees agreed that the present PATT allocation system should be revised in the light of the arrival of the Gemini telescopes.]

The position of survey programmes.

Richard Bower: Isn't that a bit of an unfair choice? I don't see how having thematic panels would help with this decision between putting forward surveys and response mode. Because the surveys are very often multi-disciplinary and thus would fall between different thematic panels.

Phil Charles: I saw 'surveys' as being one of the themes.

Roger Davies: I think they are unrelated issues.

Pat Roche: The fundamental question is, are we putting ourselves at a competitive advantage or disadvantage. The way we operate now sets up the telescopes in competition rather than a collaboration. I believe that this is bad and we are going to pay very dearly if we continue to operate in that mode. We can help to try and overcome this is by blurring the boundaries between telescopes, encouraging the telescopes to operate corporately in order to facilitate significant scientific progress.

Further, it is clear that the number of programmes which are done on a multi telescope basis is going to increase and therefore allocating small packets of time on individual telescopes will make less and less sense. This is inevitable and I believe that we risk putting ourselves at a significant disadvantage unless we change the way time is allocated across telescopes.

Andy Longmore: I agree with Pat. We have seen examples of this in the past. Years ago when surveys of high red shift galaxies were popular, the University of Hawaii [*UH*] dedicated significant UKIRT [*United Kingdom Infra Red Telescope*] time to this project. UK groups used to complain that they could

[11] http://www.eso.org/vlt

not get enough time to compete with the UH block allocation. Thus, at a time when the UK were leading in a field, we couldn't compete with our own telescope.

I think perhaps the advent of the of the 8-m telescope is really bringing this to a head. This forum here enables people to say what they think the pros and cons of the various time allocation options are. It is essential to decide on how to take these discussions forward.

Phil Charles: Ten years ago I had a conversation with the Chairman of PATT. The handful of top proposals were obvious. The very bad proposals were even fewer. The committee then spent the majority of its time trying to separate out the 2.3 versus the 2.4 versus the 2.5 average proposals. The Chairman suggested that one could randomly decide on these by drawing from a hat, and have no impact on the quality of the science being allocated. I don't know if the Chairman of PATT of the time wants to say anything?

Mike Edmunds: You summarised that very well. There is no ideal system. The new problem we are facing is really co-ordination between allocation of time. That's the critical issue, not whether it is one particular subject or whatever, it's how you co-ordinate between awarding time on different facilities. You've just got to find a way that does allow you to co-ordinate well.

Thematic Time Allocation Committees.

Roger Davies: I don't really agree with many of the things Mike said in the sense that I think that the division now is a facility based division which has historical roots. When I started my career, PATT was only the AAT and the INT. Telescopes have come on-line one at a time, each added to PATT with its own separate panel TAC.

I've done a lot of programmes that need, for example, optical photometry, infrared photometry, and optical spectroscopy. It takes a lot of PATT rounds to get one project finished that requires those simple observations on many telescopes.

We are now in a situation where we're going to have our competitors coming forward to the Gemini international TAC and they will be able to say 'we've already allocated time on the Kitt Peak 4-m, on WIYN [12], on CTIO [13], for this programme and we now need the infrared spectroscopy with Gemini'. They will get the time because they've got the backing and they will get the programme finished in one shot.

[12] http://www.noao.edu/wiyn/
[13] http://www.ctio.noao.edu

The TACs need to service the science programmes, and not the telescopes. From the point of view of competitiveness, and getting the science done and into the journals, we'd be better off allocating the time for a scientific programme on the telescopes it needs, in more or less one go. The way we think about this problem need to change. We need to alter the way in which we apply for telescope time so that you apply to solve a scientific problem and not to get nights on a 3-m telescope.

Jim Emerson: Can I re-iterate my suggestion at the beginning that this meeting suggests that PATT convene a working group because we are not going to solve this here. Does the meeting feel that is a sensible thing to do, as long as they weren't on the panel of course.

Pat Roche: It would be helpful to know if most people feel this is an issue or not.

Mike Edmunds: I think is very important that there is the option of keeping the status quo. You've got to think very carefully before implementing a new allocation system, to ensure that it really does work as you want.

Phil Charles: I think both Pat and Roger have outlined that there are significant problems with the current system which are: we get by at the moment but we are going to be at a severe disadvantage as we move into the Gemini and then GranTeCan area.

Reynier Peletier: So what about the other telescopes? What about UKIRT, Gemini, in the future. If you combine things do you want to limit yourselves to one site?

Mike Edmunds: No, This would include AAT and UKIRT and Gemini and everything.

Richard Bower: What about weather. Roger's point was a very valid one — you would want to be allocated the time to complete the project within one semester. But you often loose so many nights due to the weather that you need to come back for another semester. So if we are going to revise the way the telescopes are allocated are we going to revise the way that weather is taken into account.

Pat Roche: That is already happening of course at UKIRT and some other optical telescopes, the highest rated programmes are started and there is a reactive schedule programme.

Roger Davies: To correct what you said Richard, I didn't say that people should do their programmes in one semester, rather they need to plan them better. I wouldn't suggest it is sensible to try and complete a programme in one semester because you learn as you go along. The first semester can be used to confirm the method, before significant progress in the second and following semesters.

You need applicants to think about how they are going to implement their programme scientifically rather than writing a telescope time application to justify 'x' nights of time. I think that we should just be presenting the science programme and trying to get the science done and trying to take away a little bit of the lottery effect in time allocation.

Colin Vincent: It seems like the consensus of the meeting is that you would like see this taken forward so I would be happy to take it back to PPARC and suggest to them that some sort of group is set up to consider it further.

Operational Modes: Q scheduling.

Phil Charles: What would the ING need or how they would they change to create the infrastructure to handle significant amounts of Q scheduling.

Reynier Peletier: At some telescopes, instead of applying for nights, you apply for objects, as for the HST. With Q scheduling, the observatory could guarantee that your object gets done. Basically twice the amount of time is scheduled for the amount.

Phil Charles: With the Q scheduling you don't have to allocate twice the amount of time. High priority programmes get done during the first clear night(s).

Reynier Peletier: No, I am saying they guarantee it is done, not with a priority because then you may not get your data.

Instrumentation Rationalisation at the ING.

Phil Charles: Do we have too many instruments on the WHT [*William Herschel Telescope*] and should we retire LDSS-2 [*Low Dispersion Survey Spectrograph*] and TAURUS-2 [*an imaging fabry-perot spectrograph*]? Does LDSS-2 provide particular capabilities that WYFFOS [*a fibre fed spectrograph at the WHT*] doesn't. We heard about the developments for the future, meaning more instrumentation. Yet the ING are going to be limited in the number of instrument changes that they are allow because of the cost associated with that. Hence rationalisation of the ING instrument suite may be needed.

Andy Longmore: If we are making the case that the science for these instruments is really good and there is an excellent niche that is worth supporting, are we giving up a bit too soon. If the science is there and it may justify more staff resource to support the extra instruments.

René Rutten: My fear is that a year from now, we will have NAOMI [*the facility Adaptive Optics (AO) system for the ING*][14] which potentially could be a major drain on ING resources. We can't wait for another year to make a decision on instrument rationalisation, because the de-commissioning process can take two years. Something has to happen now in order to free the resources of the ING to enable adequate resource to be available to support upcoming new instrumentation.

Roger Davies: I would like to thank René and his staff for the support they gave to SAURON [*an Integral Field Spectrograph*][15] when it was commissioned on the WHT. The team on the site did an outstanding job. SAURON was scheduled in a single observing block. However during the run there was a problem with the A&G [*Acquisition & Guidance unit*] and SAURON needed to be removed. The team were outstanding, replacing a broken bearing in one day, and having SAURON aligned and ready for the evening. This illustrates that you are not always in control of the level of support that you might need. We always have to deal with the inevitable support problems like those I have just described. Thus, it seems restricting to be discussing de-commissioning instruments for the sake of the few extra days of effort needed to put them on and off the telescope.

I would like to speak about LDSS-2. We are not going to get time on 10-m and 8-m telescopes to take spectra of 21st and 22nd magnitude objects. It's not competitive. We do that with 4-m telescopes. And we have to have spectrographs that are effective at those quite faint levels.

I think the AAO have shown what can be done if you put a little bit of investment in an old instrument. By replacing the CCD and implementing charge shuffling, they increased the efficiency of LDSS-1 [*LDSS on the AAT*] which is much less automated that LDSS-2 by a factor of 2–3 [*the upgraded instrument is named LDSS++*]. The charge shuffling allows the number of object that can be obtained simultaneously to be increased from a few tens to a few hundreds, an astonishing efficiency game. This was done for a few tens of thousands of dollars and some of Karl Glazebrook's and a few others time.

What I would like to see is for the ING to apply a similar transformation to the LDSS-2 — we make a modest investment to bring it back up to competitive standards. Mask cutting for LDSS-2 is proving difficult and it is not quite as accurate as it used to be. Perhaps one can learn from the systems that will be put in place for GMOS [*Gemini Multi-Object Spectrograph*] and other mask cutting spectrographs to learn how to do that. I don't think there needs to be a big investment in LDSS-2, but it does need to be kept on the telescope and supported. I think if you loose that you have lost your faint light spectroscopy.

[14] http://www.ing.iac.es/∼crb/wht/ao.html
[15] http://www-obs.univ-lyon1.fr/∼ycopin/sauron.html

The 4.2-m WHT is still a big telescope.

René Rutten: To provoke the discussion a bit further with a bold statement, which I do not necessarily agree with personally. There is a wonderful LDSS and TAURUS on the AAT, both more capable currently than the similar systems on the WHT. Thus, let's do that work at the AAT, and forget about it at the WHT.

Richard Bower: The advantage we have in the northern hemisphere is the INT wide field camera. The role of the 4-m telescopes is following up spectroscopically the objects that are found on the INT using the wide field camera. Those objects are going to be potentially faint and are going to be over a wide field of view. LDSS-2 has some very strong advantages in following those objects up, in particular if you want to look at distant clusters. WYFFOS has some other advantages but you can't get the close packing of the objects that you can on LDSS-2. So we need to think strategically on what is the right way to go to provide the spectroscopic instrumentation for the next decade.

Paul Groot: From the discussion this morning and yesterday, the feeling appears to be there should only be one instrument on the WHT for faint object spectroscopy. I would like to put a pro-WYFFOS statement. WYFFOS is a flexible system in the sense that it can be fed from different instruments. It may be possible to upgrade WYFFOS to give the equivalent performance of LDSS++.

Are there too many instruments? I know from experience that the INT wide field camera is now working very well. Why not de-commission prime focus imaging at the William Herschel and have only prime focus spectroscopy there.

Nic Walton: For the ING instrumentation, developments can be put forward at differing resource levels. Various low cost incremental upgrades can be made in the AF2/WYFFOS area [*AF2 is the WHT's fibre feed unit to WYFFOS*]. The packing issue can be addressed by employing IFUs. At another level TAURUS-2 with a TTF could be combined with LDSS to deliver increased functionality — along the lines suggested by Joss Bland-Hawthorn at the AAO, this might be a proposal to the GBFC.

Richard Bower: I agree with Nic. What is required for LDSS is just a collimated space in which you put the grism. That fits in very well with improvements to TAURUS-2. Combining the two instruments is an extremely efficient way to go. You can even use it for polarimetry.

Mike Edmunds: If you have a limited budget with which to operate and instrument a telescope, then you have to prioritise which instruments to support and/or develop. What are the most important instruments, what will do most of the science we want to do at the present time? How much can we afford?

How efficiently can we keep these instruments running and up to specification and reliability. It is much better to have three instruments that work extremely well than ten or more, poorly supported, instruments.

Phil Charles: If you are going to demand that the science for all the instruments is essential and that you do need the manpower to maintain them and operate them with that frequency, then we may wish to divert money from building new instruments towards maintaining those that we have.

Clive Tadhunter: It is not just manpower, its also *scientific efficiency* because every time you change an instrument you need an extra night to set it up. There is a limit as to how many runs you can have, and I think we have reached that limit on the WHT.

Phil Charles: Frequent changes also impact on the reliability of the instrumentation.

Tim Hawarden: We've run on UKIRT with a minimum number of instruments principally for historical reasons. We too, in an era of shrinking budgets, now have to accommodate more instruments than we have right now. But we do normally have more than one instrument on the telescope, where these instruments remain ready for use for long periods of time. We work with instruments that have to be extremely reliable. They stay cold and ready for use for months and months on end, and perhaps there is a way forward here for simplification. If you have got something like eight instruments which are moved on and off the telescope at regular intervals and need alignment every time and adjustment every time they go on and off, perhaps a new fundamental approach to placing instruments on the telescopes is needed.

René Rutten: To explain the situation. The problem concentrates on the Cassegrain focus where there is one very popular instrument and a number of less popular instruments and a number of visitor instruments. So it is that focus which is particularly pressured and complicated regarding instrument changes.

Phil Charles: This discussion has so far focussed on the need to reduce instruments in order to accommodate NAOMI and the other extra instruments that are coming on line next year. But in the longer term, say four years, UK involvement with GranTeCan will force us to make very serious choices on how to operate the WHT.

Roger Davies: Mike [Edmunds] outlined a clear scheme for prioritising the use of instruments, emphasising high reliability by reducing the number of times you change instruments. But nobody mentioned doing world class science. It is relatively easy to devise a way of running the observatory to stay within a budget. The *big problem is that we are not competitive if we do that with-*

out maintaining world class instrumental capabilities. I think that only after prioritising the science, can you make the trade-off as to which instruments/capabilities are needed.

I would be astonished if instruments with a ten arc minute field of view and bigger on 4-m telescopes working at the sky background limit are not competitive into the 8-m age. This will still be competitive. Not many of the 8-m telescopes have large field of views, and those that do have as yet have limited instrumentation there. And it's inefficient to use those 8-m telescopes to take 21st and 22nd magnitude spectra.

Mike Edmunds: I wasn't suggesting that we don't do world class science. I didn't say which three instruments or for what. One of those could be extremely innovative and extremely new. You fully exploit it, get it working well until you've used it then put something else on as your next instrument development. I do wonder whether we really should be looking more towards programme orientation. We have one general purpose spectrograph, an imager and something completely novel. You can't do all science though.

Clive Tadhunter: Yes but we are nowhere near three instruments yet on the WHT. We've got something like ten to thirteen. And I think that's a bit too much.

Pat Roche: There is also the parallel with the AAT. There is 2dF & WYFFOS, the two TAURUSs and the two LDSSs. Duplicated instruments, with the last two not getting a lot of time at the moment. In general these instruments don't care where they look as they support cosmological wok.

Roger Davies: That's absolutely not true. If you try and find clusters of galaxies whose red-shifts put absorption lines between the night sky lines long wards of 700 nanometers, there are not that many clusters. I think it's a great strength of our UK programme that we have instruments that are duplicated in both hemispheres. It means you can do the same experiment in both hemispheres, you can do surveys with similar instrumentation. That's one of the great strengths of Gemini. I think it would be a pity if the AAT or the WHT diverge in that capability.

The AAT solution to the same problem is the proposal of the ATLAS spectrograph (2) It combines a replacement in the WHT context for ISIS [*the long slit spectrograph at the WHT*], with LDSS and TAURUS, and increases the field to 24 arcmin. The AAT Board is very interested in this, and perhaps could be an instrument for development at the WHT as well.

René Rutten: The discussion has so far focused on LDSS-2. I also mentioned TAURUS-2 as having some uncertainty regarding its future. Could the TAURUS-2 users say something about what they see as the long term future of TAURUS-

2.

Clive Tadhunter: I would just like to echo what Nic [Walton] said, that TAURUS-2 needs to be upgraded if it is to be effective in the future. Perhaps combining it with LDSS is the thing to do.

Johan Knapen: In my talk tomorrow(5) I will give some advantages of TAURUS-2. It is ground breaking in certain areas where it's really unique for the UK at the moment.

Longer Term Instrumentation Development: addressing major astronomical science with sub 8-m telescopes.

Phil Charles: I should remind you that we would also like peoples input into the longer term ING instrumentation development.

René Rutten: People asked me about the percentage of time used for the different instruments and I have a table of statistics here, slightly out of date covering the two years, 1996/97.

WHIRCAM [*the near infra-red camera for the WHT*] was used about 8% of the time, with its replacement, INGRID [*the new near infra-red camera for the WHT*] that will go up substantially. AF2 is only 6% because it was then being commissioned: for 1998 and 1999 its use is much higher. The more established instruments are approximately stable in their percentage use. ISIS is the workhorse instrument, prime focus is used ∼10% of the time, LDSS-2 and TAURUS-2 lie a little below that.

Concerning LDSS and TAURUS-2. We can't have everything all the time, in the North and the South, and at no cost. We need to understand our priorities. Both these instruments have opto-mechanical problems and need serious overhauls. This can't be done in the short term with out delaying the commissioning of INGRID with the AO system, and the development work on AF2/WYFFOS. These are the priorities we are looking at. Is it worth it — yes or no?

There is also an impact on the development programme. I would like to go away from this meeting with an indication from the community whether the *priorities* for the development programme, *adaptive optics (focusing on the optical) and wide field multi-object spectroscopy (optical and the non-thermal near IR)*, are correct for the mid term future. I need to know what the community wants us to bid for within GBFC and NWO [*UK and NL*] funding routes. There is money earmarked for a major new WHT instrument, if we don't have a proposal for it, that finance will be lost to the ING.

Is imaging on the WHT at the prime focus important? I made an explicit statement (8) that the current development plan for the WHT envisages no enhancement to the prime focus imaging capability. Some other 4-m telescopes (e.g. CFHT, [*Canada France Hawaii Telescope*][16]) are pursuing these developments rigorously and therefore it may be too late for the WHT to catch up in this area.

Finally, we have a re-vamped instrumentation working group. We had the first meeting of the new instrumentation working group two days ago [6 April 1999]. I would like to invite everybody to channel their instrumentation suggestions and ideas to this instrumentation working group. We'll then get a better understanding of what the user community wants us to do in the future. The current chairman of the Instrumentation Working Group (IWG) is Richard McMahon at the Institute of Astronomy and Nic Walton is the Secretary. [Eds. Note: more information can be found at the link to the ING Instrumentation Development web pages at http://www.ing.iac.es/Astronomy/astronomy.htm]

Roger Davies: I thought that the reason that you were thinking of standing down LDSS-2 was that you couldn't afford to operate it, not that it was a candidate, necessarily, for new instrumentation money.

René Rutten: The operations cost is one thing. Both LDSS-2 and TAURUS-2 are in need of a major overhaul, simply because they are now mature instruments. The AAO has upgraded its LDSS-1 to LDSS++, making it more competitive.

Roger Davies: Can the observatory support LDSS-2, even in its current form, to keep it running as it is.

René Rutten: Everything can be done, but at a cost.

Roger Davies: In answer to your question, *your priorities for new instrumentation should be INGRID and NAOMI*, they go together. That's absolutely vital. That would be my personal opinion.

But I was talking about a different thing before. I have heard several times that LDSS-2 might be stood down because of the operating problems, so I was very keen that it shouldn't be stood down. I was quite surprised by your numbers, because your numbers can be summarised as: 40% ISIS, 20% prime focus, 20% collimating beams—LDSS-2 and TAURUS-2, and 20% high resolution. It is not clear which of those 20%s you would stand down from a scientific point of view.

Here you are doing it on the basis that the instruments in the collimated beam area need more technical attention. That is a perhaps a *dangerous way*

[16] http://www.cfht.hawaii.edu

to prioritise, the scientific priorities might suggest another set of instruments for de-commissioning. I would say that LDSS is a very important scientific instrument for a lot of people, and maybe, at least should be kept going.

But in the area of new instrumentation I would absolutely agree that you *have to get INGRID and NAOMI into a world competitive state in the next year*, and that would be my priority ahead of LDSS.

René Rutten: My fear with LDSS is that if we just keep it going, it will slowly become less reliable, less competitive. Users will get less science from it, and eventually it will no longer be in demand. Lets decide now that we don't want to use it anymore.

Phil Charles: Is it scientifically essential to have LDSS and TAURUS in both hemispheres?

Richard Bower: We are using the wide-field camera to do surveys to find distant clusters. We want to be able to follow them up. The nature of ROSAT pointings are that they are at high latitude so they simply can not be followed up from the south.

Ray Sharples: It is not the only area that is duplicated. There is the clone of UES [*the Utrecht Echelle Spectrograph on the WHT*] at the AAT. There is a proposal for an 8k mosaic at the AAT. I think the argument that this is the only duplicated area is not appropriate at all.

Paul Groot: Could you do your follow-ups with an instrument like AF2+WYFFOS if you used two pointing instead of one to get round the cluster crowding problems when placing fibres?

Richard Bower: It's possible in five pointings, with half an hour dead-time between fields, thus with hour or two hour exposures you have large overheads.

Steve Smartt: One of the arguments against LDSS on the WHT is that GMOS with Gemini will go a lot deeper, thus LDSS will not be competitive.

Roger Davies: You should not be using 8-m telescopes to take spectra of twenty-first and twenty-second magnitude galaxies. Thus LDSS will still have a role.

Nic Walton: Some 8-m instruments have a large field, with high multiplex. VIRMOS/NIRMOS on the VLT will be able to observe hundreds of objects at a time, and with their high dynamic ranges, could observe the bright 'LDSS' type objects as well.

Roger Davies: The field of view on 4-m telescopes is linearly twice that off 8-m telescopes. You can do four with Gemini, or one pointing with LDSS. You get deeper in the same integration time with Gemini but it takes four pointings.

Nic Walton: OK, but with the upgrade to LDSS++ at the AAT, the multiplex has increased by a factor of ten. If LDSS isn't given this type of upgrade it becomes uncompetitive, even against similar instruments on a 4-m.

Phil Charles: This comes down to the resources. As René said, we are going to have to put the resources either in the manpower or face the consequences in terms of the implication for what Roger has admitted ought be the top priority. There is only so much that we can do with the resources available now.

Reynier Peletier: Is the prime focus really essential on the WHT, because over half the INT time is now devoted to wide field imaging.

Phil Charles: What do people feel about dispensing with WHT prime focus imaging, user facility.

Clive Tadhunter: This was discussed on the GBFC and I think it was felt there that really we are too behind the competition. There are so many other similar facilities elsewhere on 4-m telescopes that it wasn't really worthwhile developing this for the WHT.

Simon Hodgkin: What is the point of developing Cassegrain infrared imaging on the WHT when it can be done so much better from UKIRT for example.

René Rutten: The INGRID development, the camera, is essential for the adaptive optics system. Thus it can be used, as a no-cost extra, for direct imaging at the Cassegrain focus.

Nic Walton: AF2+WYFFOS could be developed to give a J+H near IR capability at low cost. Extending this further into the thermal K region would require significant investment. Is there any desire for this in the community?

Jim Emerson: Isn't it the case that the fibres don't transmit much at K anyway?

Nic Walton: We wouldn't use fibres with K, probably an image slicer design feeding a spectrograph at the 24 arcmin Cassegrain focus.

Pat Roche: We should point out that IRIS-II is coming on-line at the AAT, sometime in the next year or two. Which gives you an eight arc minute field at K using multi-slits.

Nic Walton: The WHT's Cassegrain field is significantly larger than this.

Jim Emerson: When we have limited resources we perhaps should not be trying to do exactly the same thing on two different telescopes. Getting into niches where other telescopes already are, be they UKIRT or indeed the AAO, is very dangerous. Clearly there are two hemispheres and may be very important to have similar facilities in both, but INGRID and AO seem the thing to go for. You have to be very careful not to add more things on when you are saying that you can not run what you already have got.

Nic Walton: You can leverage your present capabilities by small investments: AF2+WYFFOS for example can be enhanced in obvious directions into the J+H bands via the upgrade to TEIFU(9) giving a significant new capability at low cost. You have to think about continuous renewal(1), you can't stand still with instrumentation, you must make incremental upgrades to give quite significant performance improvements. Make use of new technological breakthroughs to give big performance improvements at fairly low cost.

There is a much bigger question mark in going to K for spectroscopy on the WHT — that is major new investment that may not give a significant capability when compared to Gemini.

Paul Groot: I think *you are right in not pursuing wide-field imaging on the prime focus of the WHT* when you already have the wide-field camera on the INT. Why offer the prime focus camera on the WHT, de-commission it now and use the saved resources in other areas.

New Instrumentation: Superconducting Tunnel Junctions.

Phil Charles: Seeing that Tony Peacock is here, what sort of time scale are we looking at before superconducting tunnel junctions [*STJ's*] [17] become a productive instrument?

Tony Peacock: I think we are talking about a 6×6 pixel array at the moment, we would be into 12×8 by about the middle of next year and we would have a 1000 element array ready by the third quarter of next year. This would be running at 350 milli-kelvin with a resolving power of about 10 at 500 nanometers, with a waveband coverage of 300 nanometer to two microns.

The other development which we are trying to do in parallel is a technology development on the cooling system. We are linking up arrays of tunnel junctions to a closed cycle mechanical system which will mean that you will effectively only need a cooling procedure and power, no consumables, and this would be running also at 300 milli kelvin.

A Development which is slightly longer term is to improve the resolving power

[17] http://astro.estec.esa.nl/SA-general/Research/Stj/STJ_main.html

albeit we would then have to reduce the temperature. This would be on a time scale of the next three to five years. We are aiming at a resolving power of 500 at 500 nanometers.

Roger Davies: Is that the limit?

Tony Peacock: No that's the limit imposed by our current cooling capability.

Roger Davies: You have to get to a lower critical temperature super conductor to get the resolution?

Tony Peacock: Yes, we can do that via an adiabatic demagnetiser which goes through a mechanical cooler. This would bring us down to about something like five to ten milli kelvins.

Roger Davies: So then that resolution of 500 is as far as you can go at that temperature.

Tony Peacock: Yes it is as far as we can go with our current understanding of the filter film technology.

New Instrumentation: Adaptive optics and laser guide stars.

Pat Roche: There are also lasers. This falls within AO and would be a substantial investment.

Phil Charles: We've heard that the La Palma site is as good as Hawaii in terms of the spatial resolution as long as we are working at H band and shorter. We want to look at the relative priorities of this.

Vik Dhillon: I would like to ask Andy a question(6): the gains from an optical spectrograph with NAOMI seem amazing. Would you now say that's the highest priority instrument to develop for use with NAOMI? Is this a higher priority than the IR spectrograph which I think has been talked about by GBFC?

Andy Longmore: There are still some risks in that area. I think there are niches I would feel fairly confident about, but we need to see how NAOMI performs in the next few months. There are still some things to resolve: you are not going to be able to get a broad wave length coverage because the performance will fall off rapidly between 0.6 and 0.9 microns.

You've got to look at optimising your instrument. People should think of instruments that have 50% throughput with high resolution spectroscopy, these will beat an 8-m below the J band. These special purpose instruments will give René [Rutten] an extra problem because you'll need a few of them to service a wide user base. You may need to optimise the throughput at one micron and you want something else that's got a throughput at 0.6 microns, thus you may need two instruments.

These were just a few ideas I had for specialist instruments, some of which have been covered, for example single IFUs [*Integral Field Unit*]. I think it is very important to pursue to the Lincoln Labs high efficiency CCDs because that is exactly where you are going to make a gain in the one micron band.

Small spectrometers — if you're working with a 0.1 arc sec slit and everything else is equal, then you can have a grating or an instrument that is a fifth the size of people working with a half arc second slit. You could have a series of small optimised spectrometers. Coronographs need to be very well optimised for AO systems to get the most out of them. CIAO on Subaru [*the Japanese 8-m telescope*][18], for example, has rotating pupils to take into account the rotation of the pupil on an alt-az system.

Other areas to develop: infra-red wavelength sensors for tip-tilt corrections will help when observing in dark clouds. Higher order correction, using new wavefront sensor arrays (faster, lower readout, infrared) will give better AO performance in some circumstances.

Finally, you always may get some irregularities at the 1%, 2%, level in your point spread functions. There are ideas in terms of twin channel functions which split the wavelength to two very close neighbouring wavelengths that should have different spectral properties.

New Instrumentation: Tip-Tilt Systems.

Reynier Peletier: Would a simple tip-tilt correction system, such as the tip-tilt secondary at UKIRT which really has improved their images, that be an affordable improvement for the WHT?

Tim Hawarden: The improvement that results is not necessarily because we are doing adaptive optics. Some of the evidence suggests that we are simply taking out telescope motions at UKIRT.

René Rutten: In the optical, the gains from just tip-tilt corrections are very limited. You might get slightly sharper images but the point spread function has a very broad wing and particularly in the optical that is very bad.

Tim Hawarden: You should not underestimate the degree to which your telescope shakes. The CFHT thought they had a solid telescope but when they switched on HRCAM [*a high resolution imaging camera*] they found strong evidence for telescope shake. Every telescope should have a tip-tilt secondary

[18] http://www.noaj.org

because there is a lot of gain to be made. The vibrations that you don't know about are still affecting the optical quality of the images. Our seeing on UKIRT, in terms of the general average seeing, is better than is reported at the CFHT, so CFHT probably has some dome seeing that we don't. But we have a tip-tilt system and the other telescopes don't.

Johan Knapen: A potential problem with AO is that you can not observe any object with AO because most objects would not have a suitable point [to correct on] source either nearby or within them.

Bruce Bohannan: It's not the seeing that we want, it's the delivered image quality: it's the size of the image that is on the detector so if you took a 30 second exposure and its the same as a five minute exposure you don't need tip-tilt. But if your seeing is significantly increased over that, then a tip-tilt secondary would give you large gains in spectroscopy particularly.

Richard Myers: We've got many power spectra of image motions on the WHT over the years. In general the gains you could get from full aperture tip-tilt in the optical are simply negligible. If you look at short exposure images on the WHT, say very short millisecond exposures, and do shift analysis to simulate what a perfect noise free tip-tilt systems would give you providing it is not very windy, there really are very negligible gains.

Reynier Peletier: It could be an experiment and it could be very cheap and you could potentially gain a lot even though you think that you know everything. ESO's new understanding of their 3.6-m telescope shows that we do not always know how the telescope operates and behaves.

Tim Hawarden: The real test is, if you do millisecond exposures and then co-add a bunch of them and your image is just as small after you have co-added 10,000 of them, then you know tip-tilt isn't going to improve things.

Roger Davies: René [Rutten] showed us this morning that PPARC is looking at buying into the Spanish GranTeCan at the 10% level by making some changes in the way ING operates, transferring resources from its development and operational lines to the GranTeCan. I think this group should at least consider whether 10% is an adequate amount to service our needs and whether 10% is worth the cuts to the ING that are proposed.

Phil Charles: This is why we made our JIF [*UK's Joint Infrastructure Fund*] bid to join GranTeCan at the 30% level because we recognise that we don't have enough 8-m telescope time. The 10% is the most we can afford if we get no more money, if we are unsuccessful with JIF, but exploit the investment we have in La Palma. We would need to make changes to our operation of the ING so that we can make a major contribution into GranTeCan. [*Ed's note: subsequently to this meeting it was announced that the bid to JIF to join*

GranTeCan at the 30% level failed. The bid to fund VISTA, the UK's Visible and Infra-Red Survey Telescope for Astronomy was approved.]

Tim Hawarden: What is the 10% going to cost us. How many nights of 4-m time do we have to give to get one night of 8-m time.

René Rutten: The details depend on the outcome of the negotiations between the Netherlands, UK and Spain. Broadly we are discussing a redirection of £$0.7-1$ million per year over the period of ten years. This is released from the ING budget by reducing the development programme by a factor of two and not introducing the financial cut of 10% after 2002 that PPARC has presently planned for the ING. Staff effort currently on La Palma which supports and develops the ING telescopes, will be partly channeled into GranTeCan. This means less enhancements and a lower level of development for the ING.

Phil Charles: The negotiations are ongoing, I am involved in these. We need to exploit funding opportunities outside of the PPARC area which may give us a chance to contribute to a new sea-level base to be run jointly with the GranTeCan operation on La Palma. That would help us operate more efficiently. These ideas indicate we can achieve a 10% involvement without any real additional funding.

[*Eds. note: We have edited out the discussion of operation funding which ensued on the basis that the bid to buy into GranTeCan would succeed.*]

Colin Vincent: There are a number of other bids apart form the GranTeCan which equally may be successful and they are all only capital bids. Hence PPARC will have to find the running costs if any are successful. It is not really true to say that the problem is wholly one of the ING. The GBFC will look at the whole picture if one of these bids is successful and see where the operating costs will come from.

Wilfred Boland: How attractive is the ING when you reduce the development budget by 50%.

Phil Charles: In the mid-term we have to consider a WHT which will not be operating in the work horse mode that it is now. The 4-m's will work differently in a 8-m era.

Colin Vincent: The impact would be that whatever you plan to develop would be delivered on a slower time scale. It does not mean to say that you can not deliver large instruments but that they would be delivered more slowly. If you look at other telescopes, a lot of them haven't got a long term development wedge as such, they bid on a project by project basis. The ING must bid for the resources it needs for its highest priority projects.

La Palma and GranTeCan

Phil Charles: What are the relative priorities of GranTeCan, or trying to get involved with SALT [*the South African Large Telescope*][19].

Jim Emerson: A comment about the mode of getting money. For a long time in the UK we have imagined that the only source of money is PPARC. Recently various people have got money from other sources. The Liverpool group have got money for their robotic telescope from the European community and various other places. Maybe there is some money from the JIF. People ought to explore alternative funding routes as I do not see how all the various astronomy proposals can be funded by PPARC. In this context Public Understanding of Science activities are very important in raising the profile of astronomy amongst potential financial donors.

Peter Sarre: Possible participation in SALT seems to be extraordinary good value for money both in terms Capital Investment and ongoing costs. It doesn't involve travel costs and seems to guarantee continued UK access to the SAAO's [*South African Astronomical Observatory*][20] 1.9-m telescope.

Phil Charles: We are almost at the time we thought we would finish. We haven't really talked very much about whether you feel sub 8-m telescopes have a future. I obviously feel very strongly that they do. And I think that is a very important case to get across to the funding agencies.

Matt Burleigh: You did not mention(3) that there is no capability on the ING telescopes to do *fast* photometry, a capability which has completely disappeared from the ING telescopes.

Phil Charles: We have got half a dozen major groups in the UK that want to do fast photometry. The ULTRACAM[21] instrument will fill that role(4).

Nic Walton: High speed photometry will be re-introduced in early 2000 as a by product of the ING's new new data acquisition system. This should give times resolution of 10 to 20 milli-secs.

Ron Hilditch: In the context of science subject orientated planning of the use of the telescopes I think it imperative that the JKT [*the 1.0-m Jacobus Kapteyn Telescope*] is maintained in its current operational state, preferably with a high speed photometer. The JKT is need to support very high resolution spectroscopy for which we need UES on the WHT, if you take one of those things away the whole programme is compromised.

[19] http://www.salt.ac.za
[20] http://www.saao.ac.za
[21] http://wwww.shef.ac.uk/ phys/people/vdhillon/ultracam/

Phil Charles: René was also telling me about the new data acquisition system. The advantage of the SAAO high speed photometry system is that you actually have zero dead time, and that may still make those kinds of CCDs advantageous over even just an upgraded data acquisition system.

Paul Groot: The WHT is very flexible in its ability to change instrumentation and respond to targets of opportunity. It is also excellent as a test bed for new technologies such as the STJ's. I think that is a very strong point for the future of the telescopes like the William Herschel. To give one example where a fast response paid off is the discovery of the first optical counter part to a gamma ray bust, observed at the WHT. I think it is important not to loose this flexibility when changing the way of operating these telescopes.

René Rutten: I would like to thank everybody for the input, and let the input from the user community not stop here. Let us hear what you want out of the ING telescopes, in the near future and in the distant future, speak to us and let the Instrumentation Working Group know what your needs are so that we can incorporate them into our plans.

Phil Charles: Thank you very much everybody for your contributions this afternoon. Enjoy the rest of the conference.

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