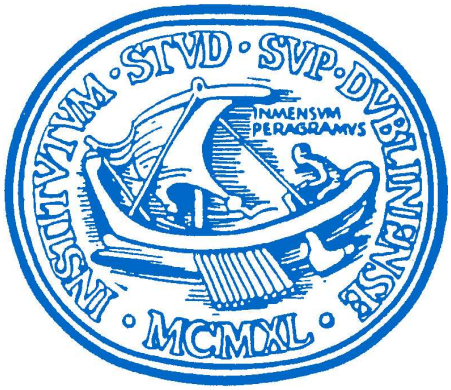
Cosmic Physics Research Strategy Update

2003 → 2007

2003 Work Plan

School of Cosmic Physics



Mission Statement

The School of Cosmic Physics promotes the use of Physics in increasing our knowledge and understanding of the world around us by:

- being a leading international centre for studies of the Earth and the Universe;
- providing a focus within Ireland for these areas of research;
- facilitating Irish involvement in relevant international programmes;
- providing specialised advanced training;
- and by publishing and publicising advances in Cosmic Physics.

Research Strategy Update 2003-2007
School of Cosmic Physics
Second revised draft

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1 Introduction

This document updates the School's 2001 detailed research strategy statement as adopted by the Governing Board of the School on 31 July of that year and the Institute's general strategy statement launched by the minister for Education and Science in March 2002. It should ideally be read in conjunction with these documents which contain much detailed background information and general discussion, however we have repeated enough of the basic content to enable it to be read in isolation.

2 The Institute

The mission of the Dublin Institute for Advanced Studies is to push back the frontiers of human knowledge. From this one basic principle follows the Institute's threefold commitment to

- original research,
- scholarship of the highest standard,
- and training in advanced research methods.

The vision is of an Institute that is highly regarded in the international scholarly community, attractive to the ablest of researchers, and valued nationally both in its own right and as an integral part of the Irish cultural and research system.

Original research is meant as a generic term covering what is also often described as fundamental, or basic, or "blue skies" research. The key point is that it is research driven primarily by the researcher's natural curiosity and the intrinsic interest of the subject rather than by external factors.

Scholarship of the highest standard is an essential requirement in working at the frontiers of knowledge. The checks and balances which the international community of scholars has evolved over the centuries, and the conventions it uses to communicate its discoveries, have to be scrupulously observed when advancing into new and uncharted territory. Otherwise, not only will the results not be taken seriously, they are almost certain to be erroneous. The principles of scholarship are more than arbitrary social constructs; they represent experience hard-won from past mistakes.

Training in methods of advanced research is essential if these principles of scholarship are to be inculcated in the next generation of scholars. This can only really be done by practical example, by involving the ablest of young scientists in actual research projects where they collaborate with experienced researchers. In addition, it is a universal and sometimes uncomfortable experience, that critical questioning by young and agile intellects is an important factor in keeping experienced researchers alert and in driving research forward.

The Institute is organised as a federation of independent Schools sharing a common legal identity and central administration. The Council of the Institute is the legal body corporate, holds the assets of the Institute and administers them on behalf of the constituent schools as well as overseeing the central administration. However the schools retain complete autonomy in all academic matters including, subject to ministerial approval, academic staffing levels.

The Institute's mission is very broad; any subject can be treated academically and thus, at least potentially, the Institute could study anything. Some specialisation is clearly needed and this is provided by the system of constituent Schools, each of which has an establishment order specifying a well-defined area of knowledge in which it is to operate. At present the Institute has three constituent schools. The Schools of Theoretical Physics and Celtic Studies were established in 1940 and the School of Cosmic Physics was added in 1947. Under the 1940 Institute for Advanced Studies Act the decision as to which schools to establish, and what level of support in terms of finance and personnel each is to be granted, rests not with the Institute but with the Government. While the Institute is strictly only interested in research as an activity worth pursuing for its own sake, it is clear that the Government will be influenced in its decisions by many other factors including economic and political aspects.

The Schools all share a basic common structure specified in the original 1940 Act. Each has a number of Senior Professors and a Governing Board which includes the Senior Professors. One of the Senior Professors is nominated for a period of three years as Director of the School. Each School Board nominates two representatives, only one of whom can be a Senior Professor, to represent the School on the Council of the Institute.

2.1 Organisation and Administration

The basic organisational model of the Institute is a federal one. Authority resides primarily with the Governing Boards of the constituent Schools, but in the interests of efficiency and economy certain common areas are transferred by the Act to joint control under Council. The Council has four main functions:

- to provide appropriate accommodation for the constituent Schools of the Institute and the Central Administration;
- to provide the legal identity required to enter into contracts and engage in activities such as publishing;
- to hold and administer financial and other assets;
- and finally, to supervise the common administration.

Apart from the two representatives of each constituent school the Council has three *ex officio* members, the Provost of Trinity, the President of UCD and the President of the RIA, and an appointed Chairman. The intention is clearly that the Council provides a neutral forum where the potentially conflicting interests of the various schools can be discussed and reconciled under an independent chairman and with the benefit of advice from three experienced external members.

The act envisages the actual executive authority being exercised through a chief executive officer, the Registrar of the Institute, who performs a central coordinating function being secretary to Council, secretary to each Governing Board, accountant of the Institute and head of the administration. The Registrar may not hold any other office within the Institute or any of the constituent schools which, as well as emphasising the importance of the office, is clearly designed to ensure a neutral and independent administration at the service of the Schools and the Council.

3 The School of Cosmic Physics

The School of Cosmic Physics is the largest of the three constituent schools of the Institute and is currently located in 5 Merrion Square (Astrophysics and Geophysics sections) and at Dunsink Observatory (Astronomy section).

3.1 Objectives and Justification

Cosmic Physics is not a generally used term, but the meaning is quite clear from the establishment order which specifies it as including "the theoretical, observational and experimental investigation of [...] astronomy and astrophysics, cosmic rays, geophysics, meteorology and oceanography". The examples given make it plain that what is intended is the application of physics to the study of the external environment and natural phenomena as distinct from laboratory studies of carefully controlled experiments. Undoubtedly were the establishment order to be written today the list would also include such topics as climate change, pollution dynamics, environmental physics and comparative planetology.

It is interesting to note that this focus on the application of Physics to the understanding of the Cosmos, that is the natural order and structure of the Universe, strikes a remarkably modern note for a document written in 1947 when most physicists saw the goal of physics in strictly reductionist terms. Of course this view still has powerful adherents but there is also a much greater appreciation that interesting, and often qualitatively new, effects arise in complex systems and that this is a proper subject of study for physicists. Combined with the general increase in concern for the environment and the recognition that catastrophic events have influenced the Earth in the past and will most probably do so again, this means that the study of Cosmic Physics has never been more topical. It is also an area of research large parts of which can be immediately grasped, at least in general terms, by the non-specialist. Everyone has some interest in how the stars work, what determines the weather, how likely we are to be hit by an asteroid, how old the universe is, whether a major Irish earthquake can occur, how the Atlantic Ocean was formed and so on. Understanding the external environment has obvious survival advantages, so it is not surprising that we are born with an innate urge to ask the sort of questions to which Cosmic Physics attempts to provide answers.

The justification for a School of Cosmic Physics is thus, firstly the intrinsic interest of the subject, secondly the increasing political importance of environmental questions and the necessity of having a source of informed advice on these matters, thirdly the economic advantages resulting from a better understand-

ing of natural resources and finally its popular appeal and potential for improving the public understanding of science.

3.2 Organisation of the School

The School has traditionally operated as three, fairly distinct, sections. This has no formal basis, however as there have been, at almost all times, three senior professors with very different interests such a division was essentially inevitable (it should be noted that all three sections have changed the direction and nature of their work several times, often radically, mostly in response to the appointment of a new senior professor as head of section). A further consequence of this division and the rotation of the directorship among the senior professors is that the role of the Director can only be that of *primus inter pares*; indeed it would probably be more sensible and in line with modern practice to designate all the senior professors "directors" and the Director "managing director", as is done, for example, in the Max-Planck Institutes, but for the moment the terminology is fixed by the Act.

Modern research tends to be very much a cooperative process carried out by teams or groups. Different individuals bring different abilities to a group and the whole can be substantially more effective than its parts. Particularly in the observational and experimental areas, but also very commonly in theoretical studies, almost all work is now done in this way rather than by isolated individuals; serious world-class research involves specialist skills and problems of scale which can only really be handled with the support of a group. Thus the academic work of the School is naturally organised in groups based around particular problems or problem complexes.

The groups should not be thought of as purely static or as mutually exclusive. Particularly in the support areas, eg computing and information technology, one individual may naturally belong to several research groups, and transient groups can form and dissolve around particular projects. Nor should they be limited to members of the Institute. External members play a vital role in bringing specialist skills and connections to a group. The challenge is to develop a structure for the School which promotes and facilitates this more flexible approach to research.

3.3 Strengths and Weaknesses

Major strengths of the School are :-

- Independence and flexibility. The School has no duties other than the advancement of Cosmic Physics. In particular teaching (as distinct from training through research which is a statutory duty) is done on a voluntary basis and staff are not constrained by the requirement to lecture at specific times (this can be a major problem for some of our University colleagues in planning field work or observing campaigns). And although the budgets are relatively small, the School enjoys considerable discretion in how it chooses to spend its resources.

- Tradition. This should not be dismissed; fifty years of research in Cosmic Physics is a proud record, and a long-established organisation has a definite advantage in attracting funding and good applicants for positions.

- Popular support. Cosmic Physics, especially Astronomy, is one of the most accessible areas of science for the lay person and one of the few to have a significant amateur community. Dunsink Observatory is the only part of the Institute with a significant public profile.

- Light-weight scientific administration. One revealing thing to emerge from the internal discussions with postdocs and staff who have worked in other institutions is that they greatly appreciate the fact that decisions are generally taken quickly with a minimum of bureaucratic delays and form filling.

However these are offset by weaknesses:-

- Staff numbers and structure. It is generally felt that the groups within the School are currently too small, and the School itself is below the critical size needed to guarantee a vigorous internal intellectual discourse and level of activity (being split over two sites exacerbates this problem). There is also a serious lack of mid-level positions, especially in the Astronomy and Geophysics sections, and the modern concept of the time-limited postdoctoral position does not fit easily into the existing staff structure and appointment procedures.

- Low profile. Despite the significant achievements listed in the 2001 strategy statment and a generally excellent international reputation, the School, and indeed the Institute, is not well-known within Ireland (even in academic circles outside our specific research areas).

- Inadequate funding. The non-pay portion of the grant in aid for the School decreased from 41% in 1976 to 20% in 1996. *The 2003 budget allocates a mere 11% of the school's grant in aid to non-pay.* Admittedly the year is abnormal, much of this is due to wage inflation, and some non-pay costs are absorbed in central administration, but the situation is clearly not improving.

4 The External Environment

It is obvious that major changes are taking place in the Irish research system. For many years almost wholly dependent on European funding, there is at last a recognition that national resources must be committed to support basic research and that we should be offering opportunities for good Irish students and postdocs to train and work in Ireland. The recent establishment of PRTLI, SFI and IRCSET is proof of this. Funding still tends to be directed towards what are perceived as "economically important" areas, but the trend is clearly towards increased support of fundamental research (despite some current turbulence). The recent policy address by the Tánaiste to the Royal Irish Academy[1] was relatively encouraging in this regard, but did emphasise the necessity of science to win the trust of citizens by engaging more with the public and the political process.

Internationally a major factor is clearly the increasing unification and imminent Eastward enlargement of the Europe Union. Student mobility within Europe is now at unprecedented levels and a genuine community of European scholars and scientists is emerging who have worked and studied in several European countries. The opening of calls under FP6 represents a signficant opportunity for the Institute to capitalise on its international links; even more important, should it materialise, will be the establishment of a genuine European Research Council promoting quality basic research throughout the European Research Area. The Lisbon declaration by the European Council (March 2002) sets Europe the challenging goals of becoming the most competetive knowledge economy in the world by 2010 and of raising the general level of research and development funding in the union to 3% of GDP.

Another important factor, of a rather different nature, is what has been well called the "democratisation of computing". Computer power is now so cheap and readily available that techniques and analyses which would previously have been impossible, or the preserve of a few, are now routinely available. In general numerical simulations and data analysis techniques are now constrained more by the imagination and programming ability of the scientists involved than by any shortage of processing power.

Related to the last point, but qualitatively different, is the astonishing development of electronic networks and communications. The World Wide Web, a small private project by a few high energy physicists a mere decade ago, is now a global system shared by a significant part of the population in developed countries. Already this has radically changed the way scientific information is distributed and accessed. Developments in Grid computing promise to take this to a further level where, not just information, but general computational resources are transparently shared across the network.

Finally, in almost all countries there is concern about the falling numbers of students taking Physics and Mathematics. At the moment this is not a serious problem for the Institute, but if the trend continues we will be faced with a significant shortage of students in the future. Already it is becoming increasingly difficult to get good postgraduate students. In a few years postdoctoral fellows will be in short supply and we may be forced increasingly to recruit from the former Soviet Union countries and Asia (as is already happening in North America for example).

In summary, in planning for the future it is reasonable to assume:

- That national funding for research will increase, but that this will have to be obtained by peer-reviewed proposals against stiff competition from the rest of the third level sector and successful projects will be expected to have a "civic dimension".

[1] *Towards a Civic Science: A Mission for the* 21st *Century*, 20 January 2003

- That international, and particularly European, partnerships and alliances will be increasingly important as the European research area takes shape.
- That computational resources are not a serious constraint and that the dynamic sharing of general computational resources through the "Grid" by virtual collaborations of scientists will become the norm in advanced research.
- That good students may become a scarce resource.

4.1 Opportunities and Threats

Clearly this changing environment offers both opportunities and threats to the School. The major opportunities are that:

- One can, even if there are temporary problems, plan for growth both in personnel and in resources. This will allow a rationalisation of the staff structure.
- Good international contacts place the School in a very favourable position to build international, and particularly European, alliances.
- Developments in computing and networking technology considerably reduce the disadvantages previously suffered by small and peripherally located research organisations.

However there are also serious threats:

- The School, and indeed the Institute, lives or dies on the quality of its academic staff and the work they produce. There is excellent work being carried out, and the Longair review was generally favourable, but it is clear that more, and more importantly better, work could be done with a rational staff structure based on research groups bringing together a range of expertise. At the moment we are much too dependent on a few individuals working largely without support.
- Equipment, facilities and accommodation are beginning to look poor and dated by comparison with the massive expansion and investment in the University sector. Without continuing investment in modern facilities it will prove increasingly difficult to attract good scholars, especially in view of a projected global shortage of physics graduates.
- The School, and the Institute generally, is still rather isolated within Irish society - greater civic participation is required at all levels.

5 General strategic issues

5.1 Staffing

Staffing remains the single largest obstacle to achieving the School's strategic goals. As has been emphasised many times our approach is based on the concept of building research groups which bring together the range of skills and knowledge required for modern research. The Governing Board's 1999 plan called for each section to have a core establishment of three permanent academic positions and this was endorsed by the Longair review. However, as a result of the 2001 synthesis of the different school positions, this was slightly modified and the current concept is that each section should have as a minimum a senior professor and a professor to provide high-level long-term direction, and that the former assistant professor and research assistant grades should be absorbed into a new and expanded range of senior postdoctoral fellows on medium-term contracts. Particularly where a number of projects are being run simultaneously the senior professor needs the back-up of a professor to act as second in command.

The Longair report made a very strong recommendation that the number of postdoctoral fellows supported by the School *out of its own resources* should be not less than 6 and preferably 9 to 12 (*ie* between 2 and 4 per group). To achieve the goals listed in its major 2001 strategic review the School estimated would require about 20 postdoctoral positions. It was suggested that half of these positions could be funded from external contracts, leaving ten to be funded from own resources, a figure in line with that recommended by Longair. PRTLI has already delivered five externally funded positions, or 50% of our target, and the rest of the externally funded positions should be attainable through a mixture of FP6 contracts, Marie Curie positions, IRCSET fellowships and Basic Research grants.

It is important that the School have available to it a roughly equal number of positions not tied to specific research projects or funding agencies which it can use to explore new ideas.

5.2 Accommodation

The current accommodation of the School is inefficient, cramped and in many ways unsuitable for the needs of a modern research institute. Plans for expansion are clearly contingent on either a move to new and larger premises, or a redevelopment of the existing site(s) to provide additional space. The concentration of all sections of the School, and preferably of the whole Institute, on one single site is highly desirable. The arguments formerly advanced against the use of the Dunsink site for this purpose have lost much of their weight with the closure of the tiphead and the opening of the new roads; should the proposed improvement in public transport infrastructure for the area go ahead (as a consequence of the stadium development at Abbotstown) it would be a very good location and there would be a very significant public relations advantage in being able to capitalise on the Dunsink name and associations. However there is no doubt that, other things being equal, a city centre location offers significant advantages in terms of easy access to transport, interaction with the universities, proximity to government ministries and general visibility (the later provided provision is made for public access).

If Dunsink is not to be the unitary site of the Institute, careful thought needs to be given to its future use. It is obvious that the historical buildings and instruments at Dunsink are a valuable national asset whose potential is currently underutilised. One idea is to operate Dunsink as a high-visibility window to the outside for the Institute, another suggestion would be to develop a proper science centre for Dublin based around the facilities at Dunsink with the Institute represented on the management board of the centre. However any transfer of responsibility for the routine operation of the historical part of Dunsink to another body would have to take account of the requirement in the School's establishment order to make the facilities of Dunsink Observatory available on request for undergraduate instuction by the Universities.

5.3 Funding

A return of the non-pay funding to levels closer to the pay budget, as was the case in the early seventies, should be aimed at. This could be achieved by an annual increase of the non-pay budget of the existing groups by 15% above inflation over the next five years, although a somewhat faster rate would be preferable. This will allow proper investment in general facilities and provide a core of own resources which can be used as "seed capital" in seeking external research contracts and in starting new projects. At the moment we are so dependent on external funding for any significant project that in effect the direction of the school's research is being determined not by the scientists, nor by the Governing Board, but by the assessment panels of the funding agencies and the areas they choose to fund. Of course a certain amount of this is positive, in that fighting for funds by peer review is one way of guaranteeing quality, but if the idea of an Institute for Advanced Studies means anything, we must have some autonomy to pursue projects which are a bit outside the main stream or ahead of their time; the peer review process is excellent, but notoriously conservative.

5.4 Public Relations

The Longair report recommends that the Director develop a prominent profile for "the School and all its activities at all levels, from Government, through the academic community to the general public". This is easier said than done, but the idea is certainly correct and addresses one of the major weaknesses of the School. The series of science week lectures presented in conjunction with the school of theoretical physics in 2002 was a successful example of what can be achieved with even limited resources. The NAM2003 conference should bring considerable media exposure to the School and the Institute as will the IAU symposium planned for 2004 and the Hamilton events planned for 2005.

5.5 Relationships to other Organisations

The 2001 statement recommended that relationships with the Universities should be put on a more formal basis as long as this did not interfere with the succesful

system of research associates. The Institute has succeeded in establishing contacts with CHIU, and the profile of the Institute is definitely higher than two years ago, but much work still remains to be done here. In particular the question of how the many contributions by the Institute to undergraduate education are recognised has not been adequately addressed.

In high profile cases it may be appropriate to expand the research associate concept and consider the introduction of a category of "adjunct professor" or "honorary professor" as in many American Institutions (the "external scientific members" of Max-Planck Institutes offer another example of a similar concept). Another way in which links could be strengthened would be to offer Irish researchers from the rest of the third level sector the chance to spend sabbatical periods in the Institute.

The 2001 statement further recommended that the School seek to position itself so that it is seen by the Irish research community as the natural focus for fundamental research work in Cosmic Physics throughout Ireland and as a facilitator of international contacts. The work on campaigning for ESO membership and the leadership role in the PRTLI application have definitely advanced this aim as will the co-hosting of the NAM2003 conference. The organisation and administration of a common instrument pool for Irish Geophysics would be another possible way to further this aim.

Finally, the School should seek to establish a reputation for itself as a provider of expert and impartial advice in its subject areas to government and the media. Particularly as areas of environmental concern, such as climate change, are developed as new research areas within the School this should become an increasingly important aspect. The Tánaiste's remarks about civic science are of obvious relevance here.

6 Progress in implementing the 2001 strategy

Significant progress has been made in implementing the strategic aims identified two years ago, but unfortunately the general economic down-turn has delayed or frustrated several key items. *In particular it is most regrettable that there has been no movement as yet towards reforming the staff structure by introducing the Schödinger fellows and filling the crucial vacancies at professorial level in the Geophysics and Astronomy sections. It cannot be emphasised enough that without these positions many of the scientific aims of the strategy statement will simply not be attainable.*

In the following we discuss each of the specific goals identified in 2001 and comment on the progress, or lack of it, in the intervening period as well as the staffing requirements.

6.1 High Performance Computing

Aim to be internationally recognised as a centre for the use of high performance computing in Cosmic Physics.

The success of the PRTLI application for "Grid-enabled computational physics of natural phenomena", now called CosmoGrid, directly addresses this strategic aim and has placed the School firmly at the centre of the development of Grid computing in Ireland. Delays in releasing the funding, and excessive bureaucracy in filling positions, have impeded a speedy implementation of this project, but the situation is now largely resolved. The main aim for 2003/4 must be to implement this programme speedily and make this a model project. Around 2005/6 a major effort will then have to be made to obtain a follow-on project, probably in a European context.

6.2 Irish membership of ESO

To facilitate Ireland becoming a member of the European Southern Observatory.

While the economic turn-down has definitely had a negative influence here considerable progress has nevertheless been achieved. A remarkable degree of consensus has been obtained in the professional community that this is the best way forward for Ireland; a favourable review was obtained in the Georgia Tech assessment of Irish participation in International research organisations; a Royal Irish Academy discourse by the Director General of ESO is being organised for May 2003; and the case has been and is being made at high levels.

This debate has acquired a new urgency from the fact that the international agreement (usually called the La Palma agreement) under which Irish Astronomers have obtained access to ground-based optical observ-

ing facilities for the last twenty years is expected to terminate in 2004.

6.3 High-energy Astrophysics

Aim to be an internationally recognised centre for research in particle acceleration theory and the origin of cosmic rays.

The work involved in setting up the CosmoGrid has delayed progress in this area as also have delays in the construction of the HESS telescopes. However our reputation remains strong. The 2001 strategy statement identifies a need for three research fellows to work in this area; one with observational interests to work with HESS, one more theoretical, and one computational to work on CosmoGrid. As in other areas the basic philosophy is to build a research group of individuals with complementary skills working together on a common set of problems.

6.4 Star formation

Aim to be an internationally recognised centre for research on phenomena associated with young stellar objects and star formation.

This is the other main area where the astrophysics section has a significant reputation to build on. Again the aim is to build a research group combining a range of observational, theoretical and computational skills. Ideally a star formation goup needs expertise in theory, computation, optical observations, infra-red observations, sub-mm and radio observations, even occasionally X-ray observations! At a minimum this requires three fellows, two observational and one computational. For the observational side of the work access to good ground-based facilities is important as is access to the HST and the its follow-on mission, the Webb telescope. Involvement with the design of the MIRI instrument is an important long-term element of this strategy giving the group an inside track in making proposals for what will probably be the most significant instrument on the Webb telescope, at least in terms of star formation studies.

6.5 Multi-wavelength Observations

To develop the broad range of expertise required for modern multi-wavelength observational studies of evolving extragalactic stellar populations and active galactic nuclei.

Two main areas of interest were identified in the 2001 strategy statement: evolving extragalactic stellar populations and Active Galactic Nuclei and Supermassive Black Holes, with five or six staff to cater for the various areas of observational and interpretational expertise required. Some development of interpretational work on evolving populations was possible, but with only the help of one Research Associate. This area has been strengthened by a new Postdoc starting Fall 2002, with a background in InfraRed observations of Starburst galaxies. At least another two fellows should be contributing to work in this area. Most affected by the lack of positions are at the moment the studies of Active Galactic Nuclei; this is highly regrettable because this is an area where there are many opportunities and two-three staff should be involved here. For both areas of research the exciting prospects to extend the investigations to high redshifts will only materialise with the staff additions referred to above. Truly multi-wavelength is however also the work on Gamma Ray Bursts, an area mentioned in the 2001 strategy statement with reference to the need for a small automatic telescope. Participation in just such a telescope project has been secured (the Rapid Eye Mount telescope) and some interpretational research could be pursued (although only with a Summer Student). This again is a highly productive line of research with clear opportunities for a couple of staff.

6.6 Data Mining in Astronomical Archives

To establish a group using modern networks, database techniques and statistical tools to "mine" astronomical archives and engage in activities as a "virtual observatory".

Progress to date has been nearly impossible due to lack of manpower. It is possible that the new funding mechanisms of Science Foundation Ireland can be helpful here, but the indications so far are that they would require restricting the scope rather narrowly to the computer science aspects to the detriment of the astronomical research substance of the undertaking. Ideally, a group of 4-5 persons would be employed in such an enterprise.

6.7 Lithospheric and crustal geodynamics

Aim to reinforce and improve our position as a leading centre for research in crustal and lower lithospheric geodynamics.

The introduction of magneto-telluric studies with the appointment of Alan Jones as senior professor brings a new aspect to this work and will complement our existing work with seismic and potential field studies. The professor post should be filled with a seismologist who can provide the seismic interpretation needed to fully exploit magneto-telluric data and continue the section's strength in seismic studies. Together with the inhouse expertise in potential field interpretation this will form an outstanding research group with broadly based strengths in all the areas relevant to crustal studies. With the addition of fellows and students this will then be a model of the type of research group motivating the School's group-based staffing policy.

Offshore seismic data in the Hatton Basin and Continental Margin, and in the Porcupine basin has been acquired as part of the National Seabed Survey and research grants for the processing and interpretation of this data have been finalised with the Geological Survey of Ireland and the Rockall Studies Group. This work will integrate with and extend our previous work in the Rockall area (RAPIDS1,2,and 3). The projects are planned to fund two post-doctorate positions (shared with UCD) with two postgraduate students funded by DIAS/UCD. Detailed modelling of the sedimentary sequence in the offshore basins will be undertaken as part of the CosmoGrid project.

6.8 Deep Earth Structure

Aim to make a leading contribution to the study of deep Earth structure, with particular emphasis on mantle structure and plumes.

The work on the Hawaiian Plume was a particular interest of the late Prof. Brian Jacob and work on its upper mantle structure is being finalised by collaborators in Potsdam. With the change of direction following the appointment of Alan Jones as Brian's successor this area of research will be given less emphasis and replaced by: *Aim to become a leading centre for the study of electromagnetic effects associated with seismic behaviour.*

6.9 Rheological processes

Aim to develop a capability in computational studies involving the rheology of the Earth.

The necessary resources for this are included as subproject of the CosmoGrid project and will form the nucleus of a computational Geophysics group.

6.10 Profile of the School

Aim to raise awareness of the School among the general public, academia, the media and at political level.

In the area of linkages to the Universities CosmoGrid has certainly played a major role in raising our profile with the rest of the third level sector. The question of gaining proper recognition for the contributions that the School makes to undergraduate and postgraduate education still needs to be addressed. There has been some success in promoting the work of the School more effectively, but much still remains to be done. In particular, and in the light of the Tánaiste's comments at the RIA, we should aim at greater involvement with civic society generally (the regular talks, media coverage and open nights associated with Dunsink form a good starting point for this). The Hamilton bicentenary in 2005, which has also been declared international year of physics, will certainly offer excellent opportunities in this regard.

7 Work plan for 2003

The basic grant-in-aid allocation for 2003, by itself, would only allow for a continuation of activities at current levels, or slightly below. Further, a large part of the budget is already committed to power, heating, library costs etc. Fortunately, mainly through successful applications for project funding, we have been able to include a number of significant new elements in the School's work plan for 2003 and of course the computational aspects of our work are set to benefit greatly from CosmoGrid support.

7.1 CosmoGrid

A major task, already under way at the end of 2002, is the full implementation of CosmoGrid. Five grid gateways have been ordered and are undergoing testing prior to acceptance and installation in the five main

Figure 1: The five grid gateways and the executive group of COSMOGRID in the boardroom of the Institute during acceptance testing of the gateways. From left to right; Andy Shearer (NUIG), Adrian Ottewill (UCD), Brian Coghlan (TCD), Luke Drury (DIAS) and Thibaut Lery (DIAS)

sites (DIAS, TCD, UCD, NUIG and UCC). The aim is to have a working computational grid by the end of the first quarter of 2003 and to have filled all major positions. If the capital funding position is resolved, the purchase of the first (UCD) cluster can then proceed, but for the moment the Grid will operate with the existing resources available in the participating institutions. Starting from Q2/3 onwards the Project Scientist will develop the training programme and seminar series in advanced scientific computing which forms an integral part of the project.

7.2 Conference organisation

The organisation of the NAM2003 conference, in collaboration with Armagh Observatory, will be a major activity in the first quarter culminating in the conference itself in early April. Currently registrations are running at over 500 and the conference will be one of the largest in the series. The Institute is providing most of the local logistical support including registration and help-desk staff, managing accounts and contracts, on-site IT support, insurance cover and liason with the Dublin Castle conference centre.

It is proposed that DIAS and UCD will jointly host an IAU symposium in 2004. This will require preliminary planning activity in the first quarter for submission to the IAU and initial organisation in the final quarter if approved by the IAU.

7.3 Hamilton Bicentenary

In 2005 we will be celebrating the 200th anniversary of the birth of Ireland's greatest scientist, William Rowan Hamilton, who lived and worked for most of his life in Dunsink. Many events are being planned to mark this year (which has also been designated the international year of physics by IUPAP to mark the 100th anniversary of Einstein's three greatpapers of 1905) by the Institute, the RIA and other bodies. An Institute planning group involving the two science schools will be established to liase with other organisations involved in the Hamilton year and to plan specific Institute events.

7.4 Outreach and Public Relations Activities

The Institute will contribute to the National Science Week as in previous years, but will also actively consider how it can improve its outreach activities and contribute more to "civic science". Greater use of Dunsink will form an important part of this activity. Media contacts will be developed and the web site improved.

7.5 High energy astrophysics research

The HESS experiment started operating in single telescope mode last year. First stereo events were recorded on 5 March 2003 and routine stereo operations will commence as soon as the central stereo trigger is implemented in the data acquisition software. With the much improved resolution (both spatial and spectral) of stereo mode operation now available a number of reported southern hemisphere sources, most notably the remnant of SN1006, are being observed. This puts

Figure 2: The Namibian minister for science, Mr N Angula, and Prof W Hofmann from the Max-Planck-Institut für Kernphysik at the official inauguration of the HESS telescopes, 3rd September 2002. DIAS is one of the nineteen institutions participating in this international collaboration

pressure on the High energy astrophysics group to develop appropriate models for interpretation of the data and to participate in target selection etc. From the theoretical side a promising new idea is to explore the implications of the Bell-Lucek magnetic field amplification mechanism for particle acceleration in supernova remnants. An application has been made for a Basic Research Grant to support this work, but some at least of the theoretical work and computational modelling will be done as part of CosmoGrid. On the observational side, an observing proposal in collaboration with German colleagues to search for optical synchrotron radiation from SN1006 with the ESO VLT has been accepted and data will be taken in May 2003; this should provide further valuable constraints on the models.

The long-running experimental programme to determine the abundance of the ultra-heavy actinide nuclei in the cosmic rays is being wound down and the only remaining task is the completion of the final definitive publication scheduled for Q2/3 and the completion of his PhD thesis by Justin Donnelly, the student working on this project.

The EU funded programme measuring cosmic ray exposure as it affects flight crew on commercial aircraft (DOSMAX) is now entering its final year and preparations are under way for the writing of the final report. Strong interest has been expressed by NASA in using the detectors and technical expertise of the DIAS group to monitor cosmic ray exposure of astronauts on the Space Shuttle and the International Space Station. While the Columbia disaster clearly places some question over when this work can continue, NASA have made it clear that if and when they resume manned space flights they will be looking to us to assist with specialist dosimetry.

7.6 Research in Star Formation

Alex Rosen has been offered a CosmoGrid funded postdoctoral position in DCU (which he is expected to take up at the start of Q3) to work on the joint DIAS/DCU programme developing improved magnetohydrodynamical models of jets and outflows from star forming regions. A second postdoctoral position in DIAS has been offered to Dirk Froebrich who will work on modelling infrared and molecular line observations for comparison with theoretical models, also starting in Q3. In addition, we have recently heard that an IRCSET funded postdoctoral fellowship has been offered to Mike Redman to work in DIAS on radiative transfer calculations for molecular lines; his work will nicely complement the work of the group and other participants in CosmoGrid.

Funding has been approved under the PRODEX programme for joint DIAS and University of Stockholm work on the specification, procurement, testing and calibration of the filters for the Mid-Infrared Instrument (MIRI) on board the James Webb Space Telescope (JWST, the successor mission to the Hubble Space Telescope). Assuming that MIRI is included in the final package agreed between the European Space Agency and NASA (a decision will be taken by the end of Q2), work will commence in Q3/4 and will give the

Figure 3: The new Senior Professor, Alan Jones, with magneto-telluric field equipment being deployed on Baffin Island in Northern Canada

DIAS group the opportunity to have a significant input into the JWST core programme in the area of star formation.

7.7 Introduction of magnetotelluric studies

In the Geophysics section there will be a major effort involved in establishing the new Senior Professor, Alan Jones, in post and providing support for his work in magneto-tellurics. To facilitate a smooth transition an agreement has been made with his former employer, the Geological Survey of Canada, allowing him to work half time for DIAS and half time for the Canadian Geological Survey from April 2003 until the end of 2003 and then full time in DIAS from 1st January 2004. The existing technical staff will need time to become familiar with the new techniques and equipment being intoduced and it is proposed that an experienced field worker be engaged on a two year contract to provide additional support during this period and to oversee the purchase, commissioning and deployment of the new equipment.

Professor Jones comes with two major magnetotelluirc field projects already funded; one in southern Africa studying the diamond-bearing "Kaapvaal craton" and the other in Ireland as a complement to the currently running ISLE project. The Kaapvaal project is funded by the U.S. National Science Foundation and supported logistically by DeBeers. It is a major international collaboration involving Irish, American, South African, Zimbabwean, Botswanan and German scientists. The ISLE-MT project has been funded by IRCSET as one of the five Earth science projects funded in the last cycle of research grants. Deep-probing MT measurements will be made at each of the ISLE seismic stations to complement the teleseismic data. In addition he plans to use the CosmoGrid resources to develop grid-enabled inversion techniques for magnetotelluric data.

7.8 Passive seismic studies

The ISLE (Irish Seismic Lithospheric Experiment) project has started and the Institute's portable broadband seismic stations have been deployed in the southwest of Ireland during late 2002 and part of Q1. These have now been augmented, in a collaboration with the University of Karlsruhe, by a set of instruments from Potsdam to extend the project to include tomography and receiver function studies. Data collection will continue throughout 2003. The data will be processed and checked for quality and when sufficient high quality teleseismic events have been recorded the stations will be moved to new sites to increase the coverage of the experiment. The monitoring of global and regional seismic activity using the DIAS seismic fixed network continues and forms part of the dataset used in ISLE project.

7.9 Marine controlled source seismic studies

The modelling and interpretation of marine wide-angle seismic data collected during 2002 will commence in Q3. This ocean bottom seismometer data from the Hatton Basin and Hatton Continental Margin (the HADES project) and the Porcupine Basin (RAPIDS4) continues the work of the Geophysics Section in the offshore region around Ireland. The projects are a collaboration between DIAS, UCD and the University of Hamburg. A postdoc has now been funded by PIPCO RSG as part of the Irish National Seabed Survey, and a further postdoc jointly attached to DIAS and UCD will work on these projects with two PhD students funded by DIAS and UCD.

7.10 Offshore basin kinematics

A model for the large-scale kinematic development of Mesozoic basins in the north Atlantic is being devel-

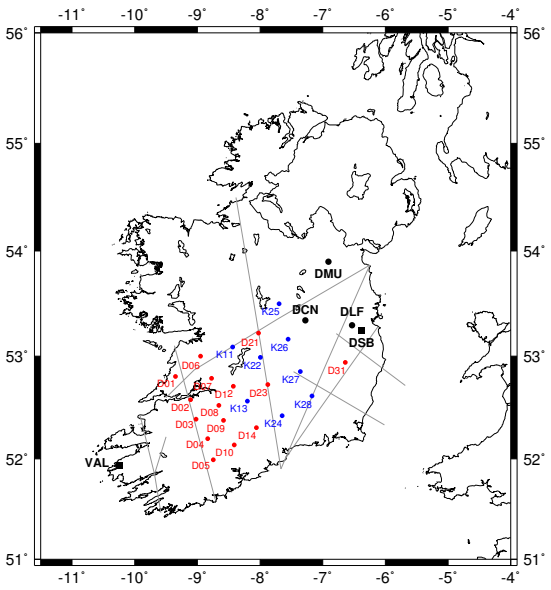

Figure 4: Location of stations for the ISLE experiment; the DIAS mobile stations are indicated in red, the Karlsruhe stations in blue and the DIAS permanent stations in black

Figure 5: The REM Telescope at the acceptance test at the Halfmann factory in Germany. Included in the picture are the project leaders, Prof. G. Chincarini (Project Scientist, sitting in front) and Dr F. Zerbi (Principal Investigator, rightmost), both from the Brera Observatory in Milan.

oped. This study uses deep seismic and potential field data, industry seismic data and information from drill cores. Analysis of sidescan data collected during the TRIM project will be incorporated into a study of submarine canyon development in the Rockall Trough. This work links with a study of Tertiary drainage patterns in Ireland being undertaken in TCD and other work in UCD.

7.11 Gamma-ray Burst Observations

The Rapid Eye Mount (REM) robotic infra-red telescope is currently (Q2) being prepared for shipping to the European Southern Observatory site in Chile. Commissioning is scheduled for Q3 with scientific verification in Q4 and routine operations from the start of 2004. The GRB observations resulting from automatic triggering by spacecraft monitors, although the main science objective for the project, will only occupy part of the available observing time. The remaining telescope time will be used for valuable long-term photometric monitoring of several classes of interesting astrophysical objects, in particular Galactic Black Hole candidates and certain classes of Active Galactic Nuclei.

Dunsink's participation in Gamma Ray Burst (GRB) research will be supported with a couple of interpretative projects, dealing with the optical lightcurves of GRB afterglows, the possible existence of optically dark bursts and inferences on the distance scale of the bursts. An attempt is being made to set up a modest observing facility at Dunsink that may be used for quick follow-up work on new bursts, in order to search for possible starting flashes.

To complement the REM telescope in the Southern hemiphere it had been planned to install a CCD camera on an existing Northern hemisphere telescope in Abastumani Observatory, Georgia. However an upsurge of political unrest in this region of the former Soviet Union has forced us to postpone this plan until the situation is clearer. The situation will be reviewed in Q3 and, if circumstances allow, the camera will be taken to Abastumani for installation and operation. Otherwise alternative locations will be investigated, or it may be put in store until next year.

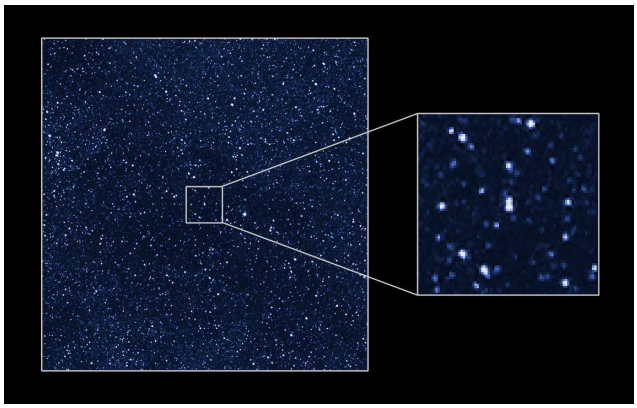

Figure 6: The "first light" view of the cygnus region (centred on the X-ray source Cyg X-)1 taken by the Optical Monitoring Camera instrument on the International Gamma-ray Astronomy Laboratory (INTEGRAL) satellite of the European Space Agency in November 2002. The electronic workshop in Dunsink Observatory helped to construct the onboard electonics for this instrument in collaboration with the Physics Department in UCD.

7.12 Integral

The INTEGRAL spacecraft has completed its checkout and verification phase and is now starting routine scientific operations during which it will, *inter alia*, survey our Galaxy for evidence of recent nucleosynthetic activity and high-energy X-ray emission. The most profitable use of INTEGRAL data for us will be to exploit the instrument databases that are going to be built up.

7.13 ESO/La Palma

The campaign for ESO membership will continue. Specific actions will be targeted around the visit of the Director-General of ESO on 29th May 2003 and the formal notice of termination of the La Palma agreement expected for Q3 of this year.

7.14 Evolving population studies

The high-energy population synthesis simulations will be further refined by including the rotation history of stars, which has a close connection with their level of X-ray emission, and by including further details of binary evolution. Applications of this will be pursued for Galactic starclusters of various ages. Another interesting application of the simulation programme is to the detailed shape of the high end of the stellar mass distribution of certain giant starforming regions. Besides the ongoing model simulations, the research activities in this general area have been expanded to include a study dedicated to so-called runaway stars, involving advanced computer modelling. This is an interesting development because the runaway stars can be thought of as providing a special probe of evolution mechanisms of the young, massive stars in a stellar population.

With the recently started postdoc with expertise in InfraRed observations several studies will be undertaken which focus on the so-called Wolf-Rayet galaxies, objects in which a recent strong burst of starformation has produced large numbers of young massive stars at an advanced stage of their evolution.

7.15 X-ray Astronomy

Several projects in observational X-ray astronomy wil progress, which deal with supermassive black holes and other individual X-ray sources in galaxies, the spectral characteristics of stars and clusters of galaxies. It is intended to make the spectral tools that derive physical parameters from the X-ray colours of objects generally available.

7.16 Targets of opportunity

Finally we wish to emphasise strongly that, as a research organisation, we reserve the right to follow-up any unexpected target of opportunity or startling new result which may occur during the year irrespective of what the plan may say; the best science is more often the result of a serendipitous discovery than of a carefully planned research strategy.