Dublin Institute for Advanced Studies

School of Cosmic Physics

Research Strategy

2007 → 2011

Vision Statement

A premier-destination academic school training scholars and conducting and leading advanced research within Ireland, Europe and globally in its areas of expertise.

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.

Strategy Statement

During the second half of the first decade of the 21st century, the school will endeavour to be Excellent, Aligned, and Linked.

Excellent: in the science that we do and the training that we undertake,
Aligned: with Irish, EU and International initiatives, and
Linked: to Irish, EU and International partners.

Process

The process of updating the School research strategy was coordinated by the School Director, Prof Alan Jones. A number of general staff meetings were held in late 2005 and early 2006 to discuss the strategic direction of the school, and in particular the question of a possible new research area was discussed at some length. There was also a number of smaller focus group meetings held to explore in depth particular areas. These meetings were facilitated by Ms Carol Beigneux MBA who was employed as a consultant on the process. The Governing Board of the School received regular reports from the Director and also provided input into the process.

Introduction – An agenda of change

This Strategic Plan updates the School's 2001 and 2003 Research Strategy documents, and should be read in conjunction with those. In particular, the mission, organization and administration of the Institute, explained in detail in the 2003 Research Strategy Update, will not be repeated here. The chronicle of the next five years will be one of change and adjustment with a bright future ahead. Changes will occur as a consequence of both internal and external factors and influences, and how well the School adjusts to these changes will determine its success over the 5 year medium term of this plan, and over the longer term. As a consequence of the 2004 School Review Committee report, the School has undergone significant internal restructuring. This leads to an opportunity to form a third Section with a related but different science focus. In addition, external initiatives provide opportunities for School growth in numbers unprecedented since its formation in 1947.

This Strategic Plan lays out the current situation we are in, and gives a roadmap for where we believe the School must travel to over the quinquennium of this plan. However, as with all such plans, it is only useful when viewed as indicative rather than totally prescriptive, as we must be responsive to the ever-changing Irish, European and international scientific landscape.

The Green Review of 2004

The most influential event during the last quinquennium was the review by an external committee chaired by Professor Alan G. Green of the Swiss Federal Institute of Technology in Zurich (ETH). In line with the Institute's overall strategic plan this review was commissioned by the Council of the Institute, in contrast to the previous reviews, the Lynden-Bell Review of 1994 and the Longair Review of 1999, which were commissioned by the School's Governing Board.

The review committee's report was generally favourable, commenting that "*the Review Panel has a high regard for the research activities of the DIAS School of Cosmic Physics*". Nonetheless, the committee made a number of specific recommendations, which have been, or are being, addressed, most notably a strong recommendation that the Astronomy and Astrophysics research work be merged at a city centre location.

Organizational Structure of the School

As a consequence of the Green Review report, described above, the Governing Board made the decision in October 2004 to merge the Astronomy and Astrophysics Sections into a single section based in the city and under the administrative leadership of Professor Luke Drury. The School now has two Sections, an Astronomy and Astrophysics section, and a Geophysics section, and there is thus an opportunity, explored below, to create a new third section within the school.

Strengths and Weaknesses, Opportunities and Threats

Strengths

The broad nature of our remit, as specified in the Establishment Order of 1947 (77/1947) is our greatest strength. We are established to carry out advanced research in any area of *cosmic physics*, and to train students as we undertake our studies.

Weaknesses

Whilst reporting directly to the Department of Education and Science is one of our strengths, the procedures put in place in 1940 are cumbersome and often inappropriate to the present day situation.

Opportunities

As a consequence of Government and EU initiatives, there are a number of opportunities that present themselves to the School over the quinquennium of this strategic plan. These are discussed at greater length in the next section, but to list them here for completeness they are:

PRTLI cycle IV: The Government's fourth Programme for Research in Third Level Institutions offers an opportunity to continue on the gains accrued under CosmoGrid.

Enhancing Ireland's 4th Level Education: The State's stated goal in the recently-published Strategy for Science, Technology and Innovation 2006-2013 of doubling the numbers of PhD graduates by 2013 offers an opportunity for School growth.

FP7: The launch of the seventh framework pogramme opens up new possibilities for European collaborative research, an area where the School has a strong track record.

Threats

The greatest external threat to the School is that we become seen as irrelevant to Irish research needs for the future. This will happen if our research is not excellent, if we do not take advantage of Government, EU and international initiatives, and if we do not enhance old linkages and create new ones with Irish, EU and international academic sector.

The greatest internal threat is complacency. We must ever be vigilant about the externally-changing research landscape, and react and modify appropriately.

The School of Cosmic Physics – Quo Vademus

The strategic objectives of the period 2006-2010 are presented below (the goals being marked by bold face type). These goals consolidate and enhance the School's research activities, and are also consistent with Irish needs as articulated in the Strategy for Science, Technology and Innovation and complementary to Irish science undertaken at the Third and Fourth Levels.

Growing the School

Given the advantages that the School has, and given the opportunities at the national, European and international levels, now is the time **to grow the School and to consolidate its position as a significant, recognized and respected institution on the Irish and international research landscape.**

Adoption of the European Charter for Researchers

In September, 2006 the Governing Board of the School adopted, at the suggestion of the Senior Professors, the European Charter for Researchers (www.europa.eu.int/eracareers/europeancharter). The School is the first academic body in Ireland to adopt this Charter, and **the general principles and requirements will be implemented over the next two years.**

These include:

- Professional responsibility and attitude,
- Accountablity,
- Safe working practices,
- Dissemination of results,
- Public engagement,
- Supervision and managerial duties,
- Stimulating research training environment, and
- Evaluation/appraisal system.

A new research area

Given that the School must be dynamic and respond to changing times, we believe that scientific flexibility comes from having more than the two focus areas of astrophysics and geophysics. Clearly impossible at present would be to envision a School with many (>5) focus areas. The attendant dilution of resources would result in small, sub-critical groups with little possibility of global impact. However, consistent with the other Schools in the Institute we believe that the School should have at least a third focus area. The question that then arises is what should be the nature of the new third focus area?

Sensibly, the new third area should complement the School's current strengths, whilst simultaneously be designed for success, as in be amongst the world leaders in its designated field. The current strengths of the School are in theory (Drury, Aharonian) and observational science (Jones, Meurs, Ray, Aharonian). Traditionally, science rested on the two support pillars of theory and observation. However, modern science

now also has a third pillar to support it, which is numerical simulation and the computer-assisted analysis of extremely large data sets.

After much deliberation, particularly with all School members as part of the process for developing this Strategy document, we suggest that a new third area that maximises and enhances the School's current activities is numerical computation and simulation of physical processes. Through CosmoGrid and ICHEC, the School has access to world-class computational facilities, and thus is in a position to attract high quality applicants.

We propose that, as a major thrust in the quinquennium period of this strategy, the School should seek to establish a third section focussed on "Computational Cosmic Physics".

We further propose that the actual research focus of the Senior Professor should be open-ended, from those undertaking numerical simulation studies of tectonic processes to mantle dynamics to core dynamics and dynamo theory to atmospheric dynamics to planetary dynamics to solar dynamics to solar system dynamics to computational astrophysics and computational cosmology, and we should hire the most capable and outstanding candidate we can find to lead this section. We emphasise that in addition to the traditional simulations on high performance computers, we see computational cosmic physics as increasingly involved with the problems of handling very large volumes of data, often distributed over many sites and heterogeneous in organisation and nature. This is perhaps the area where Grid-technology will make its first significant advance in enabling such concepts as virtual observatories and data mining to move from computer science concepts to real tools used by working scientists. The section would naturally also be involved in the visualisation of these large datasets leading to the need for a high specification 3D visualization room that would be of benefit to the whole Institute and the wider community.

While it should not be a major determining factor in choosing this as the third research area, the fact that this is an area which is obviously relevant to the economic development of Ireland and which is strongly supported by national research funding policy makes it easier to argue the case with Government for the new positions and resources that will be needed to develop Computational Cosmic Physics as the third focus area for the School. In addition, this research area will contribute significantly to the growth of 4th Level education in Ireland.

Enhancing 4th Level Education

Ireland is moving towards a four-year PhD training programme. This model would depart from the traditional 3-year research-only PhD programmes to date in the State, and move towards the North American model of training during studies for a graduate degree. In particular, University College Dublin is accepting students this year for a four year programme, with a loosely structured training/learning component lasting approximately a year. While many details remain unclear, there is a strong drive towards multi-institutional graduate schools. Both Geophysics and Astrophysics are natural candidates for all-island graduate schools and proposals were put forward in both areas for the exploratory grants programme of the research councils. **The**

school will work hard to participate in, and preferably to lead, graduate schools in Astronomy and Geophysics.

Enhancing Scientific visibility

The School will maintain and enhance its scientific visibility through leadership and membership of national, European and international initiatives. These are discussed in more detail in the strategies for each Section.

Enhancing Public visibility

The School will **enhance its public profile through expanded outreach programmes**, such as

- Greater visibility of the Statutory Lecture series.
- A public role for Dunsink Observatory.
- Involvement in Science Foundation Ireland's "Bringing Science to Schools" programme.

Expanding and consolidating the Schrödinger Fellows program

As part of the previous Strategic Plan, the School has brought on four Schrödinger Fellows, three in Astrophysics and one in Geophysics, with a second one in Geophysics to be appointed shortly. These fellowships are designed as longer-term (max. 5 year) advanced post doctoral fellowships awarded to emerging rising stars in fields related to the focus of the School. Such long term fellowships for senior fellows are relatively rare, not only in Europe but around the globe, and provide an excellent springboard for the Schrödinger Fellows to launch their careers whilst simultaneously offering to the School the opportunity to undertake research in different areas from those of the senior academics.

This programme has been highly successful at attracting a high number of high quality candidates for the respective competitions. Also, the present incumbents have had some success in launching their career interests. Given this success we are encouraged **to seek to grow the numbers of Schrödinger Fellows to the total of twelve envisaged in the Longair review of 1999.**

Longer terms for PostDoctoral Fellows

The standard term of externally funded PostDoctoral Fellows tends to be two years. This is, in the main, governed by the nature of the funding of the fellowships. Two years is rather short; the first year the Fellow is often working on writing up PhD thesis work, and the second year the Fellow is searching for the next position. **The School will seek to obtain longer term postdoc positions.**

Capital Replacement Plan

The School needs to have a Capital Replacement Plan. The lifetime of our capital resources varies from 3 years, for IT infrastructure, to 5-10 years for field geophysical equipment, to 10-15 years for our research facilities. **As part of a general review of relations with the Department and funding procedures the case for a separate capital equipment budget will be made.**

Enhanced Visitor Programme

The School's Visitor Budget is a resource that must be enhanced and more fully utilised to augment and expand School activities. In particular, senior academics

engaged in research aligned with that of the School, or of interest to the School, should be enticed to spend sabbaticals for extended periods under **a new, high-profile Senior Visiting Professorship programme.**

Expanding Geophysics

The Geophysics Section has undergone considerable growth since the hiring of Professor Alan Jones as Head of Section in May, 2003. The numbers are now approaching those of the Astronomy and Astrophysics Section.

Professorships

During 2007 the Mallet Professor of Seismology should be appointed. This will re-energize the School's long-term (since mid-1970s) interests in seismological studies of the Earth.

Over the 5 year period there will be a retirement of one of the academic members of staff. This will open the opportunity for Geophysics to expand into other areas of relevance to the mandate of the School by hiring a professor in a designated field. Two fields of geophysics suggest themselves as appropriate for the Section. One of these would be a Professorship in Marine Geophysics. Nine tenths of Ireland's national territory is beneath the Atlantic Ocean, and is "undeveloped, undiscovered and under water" (Marine Institute). The Section has been involved in offshore active and passive seismic surveys since the mid-1980s, and our interpretations of the extent of continental crust form the basis of Ireland's claim, under the United Nations Convention on the Law of the Sea, for 900,000 square kilometres of territory. This huge contribution by DIAS to Irish society is arguably the most significant in DIAS's history. **It would be appropriate to maintain DIAS's involvement in the offshore in a major way by appointing a senior, high profile, scientist to the position of Professor in Marine Geophysics.**

The second area of desired growth is in numerical simulation of tectonic and geodynamic processes through a Professorship in Numerical and Computational Geophysics. Through CosmoGrid support the Section has seen the initiation of such activity with a Postdoctoral Fellow and a graduate student. **Given the availability of ICHEC/CosmoGrid resources and our desire for a third Section focussed on simulation of general cosmic physics problems, a Professorship in advanced simulation of geophysical phenomena would be highly appropriate.**

Both of these envisaged professorships complement well the existing geophysical expertise within Ireland, both north and south, and both would build programmes and activities that are broadly-based and inclusive in nature.

National activities - CHIGI

Professor Jones, as Head of the Geophysics Section, is a member of the recently-formed Committee of Heads of Irish Geocience Institutes (CHIGI). Other members includes the Chairs of Geosciences at TCD, UCD, Cork, Galway and Coleraine, and the Heads of the two geological surveys, GSI and GSNI. To date, CHIGI has provided the Government with arguments for a Geoscience Initiative, some of which appear in the recent Strategy for Science, Technology and Innovation 2006-2013, and has

submitted a proposal to form the Irish Geoscience Graduate Programme (IGGP). Under IGGP students would undertake their training in Short Course modules given where the relevant expertise lies, and their research at their home institute.

European and international activities

The Section **will continue its tradition of leading and being involved in major European and international geoscientific programmes**.
Professor Jones will continue to promote EuroArray (www.euroarray.org), which is now an activity beneath the umbrella of TOPO-Europe, accepted as a EUROCORES in 2006. The pilot project for EuroArray/TOPO-Europe is PICASSO, for Program to Investigate Convective Alboran Sea System Overturn. This is a multi-national, multi-institutional, multi-disciplinary geoscientific study centred on southern Iberia and Morocco. Irish involvement is facilitated through a Science Foundation Ireland grant to Professor Jones for the magnetotelluric deployments. In addition, DIAS' seismological equipment will be made available to Spanish colleagues.
The SAMTEX project, for Southern African Magnetotelluric Experiment, has completed three phases of acquisition resulting in data from almost 500 sites in an area of greater than a million square kilometres in South Africa, Namibia and Botswana. Another phase is anticipated in Namibia and Botswana in 2007, and extension into Zambia and Zimbabwe in 2008 is under negotiation.
DIAS is a member of the AfricaArray initiative (http://africaarray.psu.edu), a unique programme for geophysical research and research training in Africa. The Geophysics Section of the School is attempting to secure funding to aid an African member state of AfricaArray by installing a seismic station or stations, and provide relevant training in that country and at DIAS.

Marine activities

The Section will continue to contribute to the State's knowledge-based economy by conducting geophysical surveys of the crust and mantle beneath the waters of the Atlantic Ocean. In particular, the Section will grow a strong marine electromagnetism group to complement the traditional seismic activities.

The Irish National Seismic Network

The seismic network in Ireland is woefully inadequate to meet societal needs in the broadest sense. The 3 station short period array run by the Section, in operation since the mid-1970s, provides essential seismicity information for predominantly the east-central part of Ireland. The broadband station at Valentia (VAL), run in cooperation with Met Eirean, and the broadband station in the Dublin mountains (DSB), run as part of the German GEOFON network, provide data, but are not reporting in real-time. None of these stations provide real-time information, and Ireland has the unique distinction of being the only western European nation without a modern national seismic network.
Within the first two years of this period, the VAL station will be upgraded to a real-time reporting system using the internet for transmission. A similar upgrade for DSB, but using cellular transmission, may occur. However, for compelling scientific, State and societal reasons, the whole network needs to be upgraded to modern standards with data transmission, analysis and archive coupled with automatic alerting of potentially damaging events). **The School will attempt to obtain funding and support for a modern national seismic monitoring network, perhaps using "sensor grid" concepts.**

Expanding Astronomy and Astrophysics

With the recent appointment of Professor Felix Aharonian, the Astronomy and Astrophysics Section has a good permanent academic complement of two senior professors and two professors. In addition, a third Schrödinger Fellow is being appointed to work in the areas of interest of Professors Aharonian and Meurs. The key interests are in high energy astronomy (Meurs, Aharonian), theoretical high energy Astrophysics and Astroparticle Physics (Aharonian, Drury), star formation (Ray, Meurs) and interstellar gas dynamics (Drury, Ray). The section has been very successful in attracting external funding from national (in particular the PRTLI funded CosmoGrid programme) and European (the research training network JETset, the Km3NeT design study, Marie Curie fellowships) sources. **A key objective is to maintain this position by making strong bids in the upcoming cycle 4 round of PRTLI and under FP7.**

Membership of ESO

Irish membership of the European Southern Observatory (ESO) is seen as a key national objective of the Irish Astronomical Community, and has been identified as an important strategic aim of the School. Membership of ESO would allow access to the best optical observing facilities in the world as well as the pioneering ALMA millimetre wave radio telescope (of particular relevance to studies of star formation). It would also provide access to the full range of ESO support services in such areas as software development and public outreach. Of particular interest, in connection with the aim of developing computational cosmic physics and data science, is the role of ESO as coordinator of the European Virtual Observatory project. **The School will initiate an Irish virtual observatory project linked to the EVO which will both strengthen the Irish case for membership and make our application more interesting to ESO.**

ESO membership should be seen as having a major role to play in building up Ireland's science infrastructure: *it is not necessary, nor even desirable, that all infrastructures be national*. **Towards this goal, DIAS will assist by encouraging Irish involvement in the newly formed European consortium ASTRONET**. ASTRONET itself was created by a group of European science funding agencies with the aim of producing a long-term plan for the development of European astronomy. Current membership includes ESO, CNRS/INSU for France, BMBF and PT-DESY for Germany, INAF for Italy, MEC for Spain, NOTSA for the Scandinavian countries, NWO for the Netherlands, and PPARC for the United Kingdom. There are also two associate members, ESA and the Max Planck Society. ASTRONET is currently drafting the so-called Science Vision document mirroring in Europe a process that has gone on in the U.S. for many years. After this, the Astronomy Infrastructure Roadmap will pick up speed. Membership of ASTRONET will ensure that Ireland plays a role, and is involved, in the development of astronomy infrastructure within Europe.

Afterburst studies of GRBs

It has become apparent over the last five years or so, that the afterglows associated with Gamma Ray Bursters (GRBs) provide unique and powerful tools to study the very distant and early universe. In using GRBS as probes of cosmology, early galaxy

formation and the history of star formation access to data from various robotic observatories and networks is crucial. The school has, in collaboration with Italian and other partners, invested significantly in the REM (Rapid Eye Mount) robotic telescope located in La Scilla, Chile which is now delivering data, including infra-red observations, of burst afterglows. Professor Aharonian is also a member of the ROTSE collaboration and thus has access to the data from this network of robotic optical telescopes. **The School will use GRB afterglow studies to probe starformation at early epochs.**

TeV Astronomy

The last few years have seen an astonishing transformation in high-energy astronomy with the development of the Imaging Atmospheric Cherenkov technique to the point where there is now a genuine TeV astronomy, with images, light curves, energy spectra etc and a multiplicity of both Galactic and extragalactic sources. The School, through its membership of the HESS collaboration (one of the three winners of the 2006 Descartes prize for European Collaborative research) has been a participant in this development and with Professors Drury and Aharonian is now well placed to play a central role in the organisation of the next large scale European project. **An application is currently being prepared for an FP7 design study of a future Cherenkov Telescope Array and DIAS aims to be an important member of this collaboration.**

In connection with the phase two expansion of HESS we intend **to explore the possibility that the School could bid to host the main data centre for HESS and future large TeV projects** (this would require storage capacity of at least 100TB per year). Such a development would link naturally to the data science aspects of this strategy as well as the work of ESO on virtual observatories**.**

Neutrino Astrophysics

Neutrino astronomy is potentially the most powerful probe of high-energy processes occuring in astronomical objects and provides a unique signature of hadronic processes. However the technical challenges are extreme, although possible with modern technology. On the theoretical side there is a very natural link to TeV astrophysics and the models used to explain high-energy gamma-ray production also provide constraints on the expected high-energy neutrino production. The School has recently been invited to join the EU funded Km3NeT design study which is looking at an installation instrumenting at least one cubic kilometer of water in the deep Mediterranean. There is an interesting prospect of using this infrastructure to also carry out some Marine Geophysics, an aspect which will be explored during the design study and which provides a nice example of an unexpected link between the interests of the two sections.

With its strong tradition in high-energy astrophysics and cosmic ray studies, and the new interest in neutrino astronomy and astrophysics, **the section should aim to the leading Irish centre, and one of the main European centres, for the emerging field of Astroparticle Physics.**

Particle Acceleration Theory

Underpinning all the models for Gamma-ray burst emission, TeV sources, high-energy neutrino sources, non-thermal X-ray emission etc is particle acceleration. All

of these signals and processes originate from high-energy charged particles accelerated in or near the sources. Thus an understanding of particle acceleration is the central unifying theme in all the schools theoretical work on high-energy astrophysics. Here very substantial advances have been made over the last two decades, but there is still much to be done, both at the fundamental level (eg in understanding the Lucek-Bell mechanism for magnetic field amplification) and in the appplication of fully nonlinear calculations of particle acceleration to realistic simulations of astronomical objects. **The section will seek resources, both human and computational, to pursue these studies**.

Star formation

DIAS is a recognised leader in star formation and in particular the striking jets that young stars produce during the first million years in their lives. It coordinates a EU funded research-training network, known as JETSET (Understanding Jets through Simulation, Experiment and Theory), consisting of 10 European institutes and involving around 80 scientists. The network directly employs some 20 Early Stage (Pre-doctoral) and Experienced (Postdoctoral) researchers. Its goal is to bring together scientists working on jet physics in the laboratory, through numerical simulations and observation. The project began in February 2005 and will formally end in January 2009. During this period DIAS will have funding for 3 postdoctoral fellows, one fellow will also have a science management role. For logistical reasons, it is likely that the project will continue, with EU support, until the end of 2009. **During this period the section will seek to ensure that there are strong interactions between the JETSET personnel and other DIAS groups particularly those working in computational astrophysics.**

In the next 5 years, there will be major opportunities to carry out high spatial resolution studies in optical/near-infrared astronomy with the development of interferometers such as ESO's VLTI in Chile and the Keck Interferometer. Through our collaboration with Arcetri Observatory, one of the instrument builders for the VLTI, DIAS will have access to guaranteed VLTI time and it is hoped to exploit this to study the cores of young stars. In particular the VLTI will allow us to capture detail on scales 50 to 100 times finer than currently possible and explore distances comparable to those between the Sun and the Earth, 450 light-years away in the nearest star forming regions.

Aside from optical/near-infrared interferometers, conventional radio interferometers, such as the Very Large Array (VLA) and the Multi-Element Radio Linked Interferometer Network (MERLIN) are about to undergo an enormous enhancement in their capabilities due to the installation of inter telescope dark fibre links and vastly improved correlators. This will allow a 40-50 increase in sensitivity making it possible, for example, to image deeply embedded newborn stars that are only tens of thousands of years old. The group in DIAS have been asked to help define the star formation key programme to be undertaken by e-MERLIN in 2008-2010 and to become involved in the commissioning phase of this instrument. **The star formation group will seek to leverage long-term advantage for its research interests through these projects.**

The James Webb Space Telescope

The James Webb Space Telescope (JWST) is due for launch in 2013 as the planned replacement for the Hubble Space Telescope. With a mirror spanning over 6.5m, it will have a light collecting area 7 times greater than Hubble. As JWST will be optimised to work in the infrared, the telescope has to be kept cool (down to 7K) and, with this in mind, it will be positioned beyond the Moon far away from the heat of the Earth. JWST is a joint NASA/ESA venture, which will be launched on a European rocket; the Ariane V. Prof. Ray is a Co-Principal Investigator for one of JWST's 3 instruments, the Mid-Infrared Instrument (MIRI). MIRI will provide unrivalled imaging and spectroscopy at wavelengths between 5 to 27 microns. Its excellent sensitivity in the mid-infrared, combined with the outstanding collecting area of the JWST mirror, will open up whole new areas of study. Many programs that are, and will remain, impossible to carry out from the ground, will be feasible with MIRI. These include studies of how galaxies formed and evolved in the very early Universe, the processes by which stars and planets are born and the creation of the first heavy elements.

DIAS has already contributed to the design and procurement of the MIRI hardware; in particular all of the long wavelength filters, blocking filters and beam-splitters for the imager and spectrometer. The plan is to integrate these into the Flight Model towards the end of 2007. As testing and calibration of the instrument begins, it will be necessary to develop software for instrument assessment purposes as well as first-look and pipeline data reduction. Funding for Irish involvement in JWST to date has come from ESA's PRODEX program. **From 2007-2011, the intention is to switch the emphasis from hardware to necessary human resources. In particular we hope to employ two people to work on this project in house. Towards the end of 2010, DIAS will play a major role in defining the guaranteed time program, particularly in the star formation area, that MIRI will undertake.**

Finally it is worth noting that NASA and ESA will hold its major review of JWST in 2007 in the Royal Hospital Kilmainham at the invitation of DIAS. Some 250 people are expected to attend.

Expanding Public Outreach

Dunsink Observatory is ideally suited to be a major centre for public outreach and indeed, through the programme of open nights and special events, is already making a substantial contribution in this area. The move of the Astronomical research work into the city centre will allow the School to focus on developing Dunsink as the primary centre for its public outreach activities. **The school intends to develop this role in a more systematic and professional manner in collaboration with suitable partners and/or sponsors.**