Irish Research Council for the Humanities and Social Sciences

Irish Research Council for Science, Engineering and Technology

JOINT CALL FOR GRADUATE RESEARCH EDUCATION PROGRAMME EXPLORATORY GRANTS

APPLICATION FORM 2006/2007

Please consult the Terms and Conditions for the Scheme, complete this application form in accordance with the instructions and check that you have included the following:

TEN COPIES EACH OF:

		Yes	No
*	Short description of the Graduate Research Education Programme (max. 300 words)	●	o
*	The application form (10 copies including top copy)	o	o
*	Summary CVs of the Proposed Project Team	o	o

APPLICATIONS WHICH ARE EITHER LATE OR INCOMPLETE WILL BE AUTOMATICALLY DISQUALIFIED

Applicants are required to submit an electronic copy of their application to grep@egrants.edu.ie . Applicants must also send 10 hard copies (including the original) to the address below to meet the deadline of 5pm on 4th September 2006.

Joint Call for Graduate Research Education Programme Exploratory Grants
IRCHSS/ IRCSET
Brooklawn House
Shelbourne Road
Ballsbridge
Dublin 4

Any generic issues will be posted to a Frequently Asked Questions (FAQs) section on www.irchss.ie and www.ircset.ie
All other queries should be directed to grep@egrants.edu.ie.

For Applicant
Contact Person Dr. Brian Espey, School of Physics, TCD
Title of Graduate Research Education Programme Space Science & Astrophysics Education (SSAGE)
Institutional Affiliation Trinity College Dublin

For Office Use Only	Yes	No
Completed Application (10 copies)	o	o
Summary CVs	o	o
Short Description	o	o
Electronic Version	o	o

PART I – PROJECT TEAM

SECTION A: CONTACT PERSON

1. NAME

Title	Forename(s)	Surname
Dr.	Brian Russell	Espey

2. POSITION HELD

Senior Lecturer

3. DEPARTMENT/INSTITUTION OF CONTACT PERSON (i.e. where the prospective grant will be held and administered)

FULL ADDRESS School of Physics Trinity College College Green Dublin, 2	
CONTACT TELEPHONE NO. (01) 896-2680 / (01) 896-1675	FAX NO. (01) 671-1759
E-MAIL Brian.Espey@tcd.ie	

One Page Summary CV attached – this guideline must be strictly adherred to.

Curriculum Vitæ for Brian R. Espey

Name: Brian Russell Espey
Date of birth: 26th January 1961
Place of Birth: Dublin, Ireland
Qualifications: B.A. (Mod) Experimental Physics, University of Dublin, 1983 (class II_1)
Ph.D. in Astronomy, University of Cambridge, 1990

Memberships: Fellow, Royal Astronomical Society; Member, International Astronomical Union, Member, American Astronomical Society

Employment

Oct 2006 Senior Lecturer, School of Physics, Trinity College Dublin
Nov 2001 Permanent Lecturer, Physics Department, Trinity College Dublin
– *present* *also:* Research Associate, Dublin Institute for Advanced Studies

May 1998 Assistant Astronomer, European Space Agency, stationed at Space Telescope Science
– Oct 2001 Institute, Baltimore, MD, USA; *also:* adjunct Associate Research Scientist, Department of Physics & Astronomy, The Johns Hopkins University, Baltimore, MD, USA; a*lso:* Academic Visitor, Queen's University of Belfast, Northern Ireland

Jan 1994 Associate Research Scientist, Department of Physics & Astronomy,
– Apr 1998 The Johns Hopkins University, Baltimore, MD, USA; *also:* adjunct Research Assistant Professor, University of Pittsburgh, Pittsburgh, PA, USA

Oct 1990 Postdoctoral Research Associate, Department of Physics & Astronomy, University of
– Dec 1993 Pittsburgh, Pittsburgh, PA, USA

Oct 1989 Royal Society European Science Exchange Fellow, Leiden Observatory,
– Sep 1990 The Netherlands

Oct 1983 Scientific Officer, Laser Division, Rutherford Appleton Laboratory, Chilton, UK
– Dec 1985

Fellowships

Oct 1989 Royal Society European Science Exchange (Leverhulme) Fellow
– Sep 1990 position held at Leiden Observatory, The Netherlands (Dfl 45,592 or ~€20,700)

Current major grant funding

- 2006-2009 SFI Research Frontiers Programme €156,873 awarded for "Understanding the Origins of the Common Elements: Mass-Loss from Red Giant Stars"
- 2002-2006 Enterprise Ireland BRGS grant SC/2002/370 €171,070 for "Studying the Outer Atmosphere and Wind of a Red Giant Star with Doppler Tomography".
- Total funding to date as PI only from all sources is equivalent to ~€500,000. My research proposals continue to be competitive: recent proposals to NASA over the past few years have achieved a success rate of ~50% (compared with an overall community average of ~16% for the instruments proposed).

Supervision experience

I jointly supervised 4 doctoral students while at the University of Pittsburgh and Johns Hopkins University. Since returning to Ireland one student has successfully completed his PhD in 3 years, and I will take on another PhD student starting this year. At TCD I have also supervised 4 postdocs.

SECTION B: LIST OF MEMBERS OF PROJECT TEAM

***We have selected three team members from our list for this section who represent the other three provinces**

TEAM MEMBER 1

4. NAME

Title	Forename(s)	Surname
Dr.	Paul	Callanan

5. POSITION HELD

Lecturer

6. DEPARTMENT/INSTITUTION OF TEAM MEMBER 1

FULL ADDRESS Dept. of Physics National University of Ireland University College Cork Cork	
CONTACT TELEPHONE NO. (021) 490-3211	FAX NO. (021) 427-6949
E-MAIL paulc@ucc.ie	

One Page Summary CV attached - this guideline must be strictly adherred to.

Curriculum Vitae
Dr Paul J. Callanan

Address Department of Mathematical Physics, UCD, Dublin 4, Ireland
e-mail paulc@ucc.ie
Telephone (021) 490-3211

Biographical Summary

1996-present College Lecturer, University College Cork, Department of Physics
1991-1996 Harvard-Smithsonian Center for Astrophysics, USA,
Hubble Fellow and Research Associate
1987-1991 Oxford University, Department of Astrophysics, Research Associate

Education

1987 Ph.D. in Physics Dublin Institute for Advanced Studies and NUI Galway

1983 B.Sc. in Physics National University of Ireland, Galway

Publications

- Authored and co-authored 73 peer-reviewed publications in international journals; e.g. The Astrophysical Journal (Letter), The Astrophysical Journal, Monthly Notices of the Royal Astronomical Society, Astronomy and Astrophysics
- 107 non-refereed publications (mainly conference proceedings)

Current Research Group

- Three postgrad students

TEAM MEMBER 2

7. NAME

Title	Forename(s)	Surname
Dr.	Christopher Simon	Jeffery

8. POSITION HELD

Senior Research Astronomer

9. DEPARTMENT/INSTITUTION OF TEAM MEMBER 2

FULL ADDRESS Armagh Observatory College Hill Armagh BT61 9DG ARMAGH Northern Ireland	
CONTACT TELEPHONE NO. +44 28 3751 2958	FAX NO. +44 28 3751 7174
E-MAIL csj@arm.ac.uk	

One Page Summary CV attached - this guideline must be strictly adherred to.

Curriculum Vitae of Christopher Simon Jeffery

Date of Birth 8 July, 1958, Newcastle-upon-Tyne, England, UK Citizen

Employment

1996 –	Senior Research Astronomer, Armagh Observatory, The Armagh Observatory, College Hill, Armagh BT61 9DG, Northern Ireland 028 3752 2928
1988 – 1996	Senior PDRA, Dept of Astronomy and Astrophysics, University of St Andrews
1986 – 1987	Institut für Theoretische Physik und Sternwarte, Universität Kiel, Germany Royal Society / SERC European Science Exchange Programme Research Fellow.
1982 – 1986+ 1987 – 1988	PDRA, Dept of Astronomy and Astrophysics, University of St Andrews

Education

1979 – 1982	PhD (July 1983), Dept of Astronomy & Astrophysics, University of St Andrews
1976 – 1979	BSc/ARCS (Physics) II[1] (July 1979), Imperial College, University of London

Teaching

Postgraduate	6 PhDs to completion 1992 – 2006 3 PhDs due to complete 2006 – 2008
Examining	9 PhD and 2 MPhil theses
Undergraduate	Lecturing, Tutorials, Lab demonstrating, BSc/MSci projects and summer students: St. Andrews University, Queens University Belfast, Trinity College Dublin(1983 – 2006)

Research

Interests	Observational, Theoretical and Computational Astrophysics. Stellar Physics: Structure and Evolution, Pulsation and Asteroseismology, Atmospheres and Radiative Transfer. The Late Stages of Stellar Evolution: Subdwarf B stars, Extreme Helium Stars, Post-AGB stars, Binary stars.
Publications	78 refereed journal papers (MNRAS, A&A, ApJ, Obs) 3 edited conference proceedings, 1 technical manual, 20+ refereed conference papers, 50+ other conference papers, 26 technical articles, 10 book reviews
Grant income	1999 – 2007 : £ 426430
Other awards	424 nights (equivalent) peer-reviewed telescope time
Talks	6 invited reviews, 40+ conference papers, 70+ research colloquia, 20+ public talks

Other Professional Experience

Professional bodies and committees	Fellow of the Royal Astronomical Society, Member of the International Astronomical Union Formerly: PPARC Fellowships panel. ESA/SERC IUE time allocation committee. Northern Ireland STARLINK node (chair). Astronomical Science Group of Ireland (secretary) Organization of 27 national and international conferences.

TEAM MEMBER 3

10. NAME

Title	Forename(s)	Surname
Dr.	Andrew	Shearer

11. POSITION HELD

Lecturer

12. DEPARTMENT/INSTITUTION OF TEAM MEMBER 3

FULL ADDRESS Astrophysics and Scientific Computing Group NUI, Galway Galway	
CONTACT TELEPHONE NO. (091) 493114	FAX NO. (091) 750501
E-MAIL andy.shearer@nuigalway.ie	

One Page Summary CV attached - this guideline must be strictly adherred to.

* See attachments for CVs of additional team members listed in Appendix 2

Curriculum Vitae for Andrew Shearer, BSc, MSc, PhD, M Inst P, C Phys

Publications - over 100 papers 5 recent papers

High-speed, multicolour optical photometry of the anomalous X-ray pulsar 4U 0142+61 with ULTRACAM, Dhillon, V. S., Marsh, T. R., Hulleman, F., van Kerkwijk, M. H., Shearer, A., Littlefair, S. P., Gavriil, F. P., and Kaspi, V. M. , Monthly Notices of the Royal Astronomical Society, 363, 609, (2005) *Synchrotron Self-Absorption in Pulsar Magnetospheres: Implications for Optical Emission*, O'Connor, P., Golden, A., and Shearer, A. , Astrophysical Journal, 631, 471, (2005)
Enhanced Optical Emission During Crab Giant Radio Pulses, Shearer, A., Stappers, B., O'Connor, P., Golden, A., Strom, R., Redfern, M., and Ryan, O. , Science, 301, 493, (2003) *TRIFFID observations of the cores of the three globular clusters M15, M92 and NGC 6712*, Tuairisg, S. Ó., Butler, R. F., Shearer, A., Redfern, R. M., Butler, D., and Penny, A. , Monthly Notices of the Royal Astronomical Society, 345, 960, (2003) [5] *Implications of the Optical Observations of Isolated Neutron Stars*, Shearer, A. and Golden, A. , Astrophysical Journal, 547, 967, (2001)

PhD Sudents 9 PhD students successfully supervised since 1996, 5 more in preparation.

Major Grants as PI

1996	Forbairt Basic (45k)	Pulsar Observations
1997	Forbairt Strategic (40k)	Medical Imaging
	INTAS (40k for former USSR institutions)	Collaboration with former USSR Republics on studies of Isolated Neutron Stars
	Forbairt Software PAT (72k)	Medical Imaging
	Digital (33k)	Medical Imaging & Pulsar Modelling
1998	Forbairt Basic (77k)	Pulsar Observations and Theory
1999	HEA(80k)	High-Performance Computing and Ultra-Sound Imaging
	HEA (1.2M)	High Performance Computer for BMES
2000	Enterprise Ireland (28k)	Establishing Grid Ireland
	Enterprise Ireland (100k)	Medical Imaging
2002	HEA (PRTLI) (250k)	Marine Science Data Mining and Visualisation
	HEA (PRTLI) (1.5M)	Grid-Enabled Computational Physics of Natural Phenomena
	IRCSET(187k)	Observations of Neutron Stars and Magnetars
2003	SFI (1.52M)	Investigator Award Grid Computing WebCom-G
	EI Grant (13k)	Grid-Ireland
2004	SFI (2.6M)	Irish Centre for High-End Computing
2005	INTAS (100k for former USSR institutions)	Collaboration with former USSR Republics on studies of Isolated Neutron Stars

PART II – THE PROJECTED GRADUATE RESEARCH EDUCATION PROGRAMME

13. PROGRAMME TITLE

Space Science & Astrophysics Graduate Education (SSAGE)

14. SHORT DESCRIPTION OF PROGRAMME (Maximum 300 words)

There has been remarkable growth over the past decade in the level of professional astronomical and astrophysical activity in Ireland. All the Irish University physics departments now have at least one permanent staff member whose professional training was in Astronomy (broadly defined to encompass astrophysics and space science), and with one exception they all offer explicit CAO course choices and options involving Astronomy and/or Astrophysics. Matching this growth in undergraduate interest and teaching, there has been a steady growth in the number of PhD students undertaking various types of astronomical research throughout the third level sector. In view of this growth, we seek to enhance the quality of the PhD student experience by providing a mechanism to widen the range of advanced courses available to all our students, thereby providing them with the sort of well-rounded professional astronomical education at fourth level that is on offer in the major international programmes. Collectively, we plan to combine our strengths, to produce a comprehensive graduate level programme encompassing the essential computational, theoretical and observational aspects.

With this exploratory grant we will develop a model of best practice for a Graduate Research Education Programme in space science and astrophysics, incorporating institutions both North and South to bring a critical mass of lecturers and students together. Our ambitious, and unprecedented, programme involves collaboration between twelve institutions – Armagh Observatory (ARM), CIT, DIT, DCU, DIAS, GMIT, NUIG, NUIM, QUB, TCD, UCC, UCD. The aim of the programme is to harness the extensive research and teaching expertise present at the various institutions to significantly increase the quality of the PhD programme in space science, astronomy and astrophysics. As a consequence, the postgraduates' transferrable skills will be enhanced, enabling their full participation in our knowledge- and technologically-intensive economy, while raising the international profile of astronomy research in Ireland.

15. TOTAL BUDGET REQUESTED (to a maximum of €60,000)	€ 59,474.44

16. DETAILED PROGRAMME DESCRIPTION (maximum 3,000 words). Please refer to section 10 of the Terms and Conditions/Assessment Procedures for guidance. The proposal should incorporate the following areas:

    a) the broad aims and objectives of the programme;
    b) the main area(s) of research to be covered in the programme;
    c) the applicants' research and research supervision expertise relevant to the programme proposal (this should include plans for the enhancement of research supervisor capabilities);
    d) the contribution of the programme to graduate research education;
    e) the specialised and/or transferrable skills which graduate students acquire in the context of the programme and the expected subsequent career opportunities;
    f) the scope for recruitment of well-qualified graduate students to the programme
    g) its linkage to current research projects and/or graduate education programmes (national and/or international) and benefits to be derived from proposed collaborations;
    h) how the Exploratory Grant will contribute to the development of the programme.

****** The following draft of the envisaged scheme is an outline only, and substantial changes may take place in the Exploratory Grant phase when full consultation on the details occurs******

a) <u>Broad Aims and Objectives of the programme</u>

The aim is to improve the quality and scope of space science and astronomy/astrophysics graduate research, to better prepare them with transferable skills, and to increase the number trained. We believe that these goals can be best accomplished through a collaborative programme encompassing the whole island of Ireland – as a result achieving critical mass in terms of both lectures and students – and using existing international best-practice ideas. By utilising the pool of expertise available in the entire community we will develop a varied and efficient graduate school programme which *no one institute can succeed in providing by itself*. We plan both school and students becoming internationally known and respected, and graduates to have improved career prospects.

b) <u>Main area of research to be covered in the programme</u>

The research area is Space Science and Astronomy/Astrophysics.

c) <u>Applicants' research and research supervision expertise relevant to the programme proposal</u>

Research and supervision expertise can be judged from the CV sections and covers the full range of modern astrophysics as well as space science applications. Subjects and techniques covered at the contributing institutions are as follows:

<u>Subjects:</u>

Solar systems (ARM, QUB, TCD)
- Sun, asteroids, near Earth objects, comets, meteor physics, Kuiper belt, dynamics, extrasolar planets...

Galactic (ARM, DCU, DIAS, NUIG, QUB, TCD, UCC, UCD)
- star formation, molecular astrophysics, clusters, stellar evolution, brown dwarfs, compact stellar remnants, stellar winds and atmospheres, variable stars, shocks, nebulae, interstellar medium,...

Extragalactic (CIT, DCU, DIAS, GMIT, NUIG, NUIM, TCD, UCC, UCD)

- active galactic nuclei, comic microwave background, Gamma ray bursters and TeV sources, starburst galaxies,...

Techniques :

Instrumentation (CIT, DIAS, GMIT, NUIG, NUIM, QUB, UCD)

- adaptive optics for large telescopes, high time resolution and polarimetric instrumentation, mm-wave optics for ESA Herschel, TeV gamma ray detectors/Veritas telescopes, James Webb Space Telescope infrared spectrometer, wide field extrasolar planet detectors, detector development, robotic telescope development e.g. Watcher

Observations (Armagh, CIT, DIAS, GMIT, NUIG, QUB, TCD, UCC, UCD)

- the subjects above are investigated observationally at various frequencies and techniques:
  - radio, mm, IR, optical, UV, X-ray, gamma rays, gravity waves, cosmic rays
  - imaging, spectroscopy, time-resolved polarimetry, interferometry
  - space telescopes (e.g. HST, FUSE, Chandra, XMM, Swift), ground-based facilities (SALT, Hawai'i, Chile etc.), intercontinental radio interferometry

Theory (ARM, DCU, DIAS, NUIG, QUB, UCC, UCD)

- many of the subjects above, particularly star formation, cosmology, shock physics, astrochemistry
- analytic, semi-analytic, computational approaches, dynamics

Computational techniques (ARM, DCU, DIAS, NUIG, QUB, TCD, UCD)

- Numerical modelling of many of the subjects above, particularly star formation, sun, near Earth objects, molecular astrophysics, compact stellar remnants, stellar winds and atmospheres, shocks, interstellar medium
- Data reduction and pipeline processing
- Instrument and telescope design and modelling
- Grid and cluster high end computing and development
- Intelligent software applications to large databases

d) the contribution of the programme to graduate research education

Contributions to the student experience

In terms of student experience, the school will aim to broaden the students' skill base and better prepare them for subsequent employment or research through developing both personal and professional skills. A high standard of graduate education will also bring in graduates of foreign institutes. In outline the programme aims to:

- Raise both the standard and numbers of students
- Improve student experience through a better, more extensive, and more inclusive experience in conjunction with their peers, as well as provision for both laboratory and workplace experience
- Enable students to obtain an MSc after one year, should they decide against continuation into the PhD programme
- Kick-start PhD research by providing better educated and motivated students after the initial one-year training period
- Broaden a student's skill-base, both in their final specialisation as well as in wider areas
- Better prepare professional scientists for R&D in industry and academia through a combination of teaching and practical experience
- Attract high ability international students
- Expose Irish students to the international community through travel as well through guest high-calibre lecturers from abroad
- Further build student community spirit through communal field/observing trips and regular meetings where they will present short papers, building on existing practice at current

Astronomical Science Group of Ireland (ASGI) twice-yearly meetings, while simultaneously honing large-group presentation skills

Contributions to the researcher/lecturer experience

There are also benefits in terms of the researcher/educator side of the equation:

- Current researchers are very involved in ESA, NASA, etc. through both direct and indirect collaborations as well as in the form of instrumental programmes. There are also many links abroad in Max Planck, Berkeley, etc. and further development of contacts with international institutes may lead to more exchange visits for teaching and/or research
- Visiting lecturers will be encouraged to lecture on their research elsewhere in the country, improving contact with as wide a community as possible
- The Exploratory Grant phase will be used to survey international sites of best practice. Dissemination of the report from this phase will fuel further discussion and, subsequently, improvements in teaching around the country. The logistical challenges of teaching in a national graduate context will also focus researchers on developing and improving their teaching methods, both indirectly through consultation with colleagues teaching other modules, and more directly through supervision of the teaching standard through student appraisals as well as annual reviews by the School's supervisory board
- A national mentoring scheme will aid researcher/educators by encouraging better teaching techniques and skills – particularly for young researchers – but will improve the skills of researchers generally, improving presentations at international conferences, and opening or improving future career paths. As an example, we envisage a proportion of modules could be taught by postdocs or young faculty with the assistance of a mentor, thus ensuring dependable standards of teaching for the School, as well as providing experience which is sometimes neglected in a university context where staff with minor (or no) previous teaching experience have to work up their own techniques and skills
- Mentoring would be encouraged in the research context, to ensure a better standard of both student and researcher. In addition mentoring could provide young or returning faculty the experience and support to move into independently-funded research where track records are required

Other contributions

- By changing to the 1+3 year graduate school, it should be possible to reduce the number of students dropping out of funded PhD positions, as well as result in increased motivation for those students continuing on, improving completion rates at that stage, as well as leading to a better results for student, supervisor, host instituion and government sponsor
- Improved standards, broader experience, and international links will raise Ireland's international profile

e) <u>the specialised and/or transferrable skills which graduate students acquire in the context of the programme and the expected subsequent career opportunities</u>

Through course work, students will be exposed to both domestic and international researchers working at the forefront of their fields, and the programme content will include practical experimental experience as well as placements in industry and other research-intensive sites. It is considered important that practical exposure occur early in each student's career so there can be a clear focus on the post-PhD destination, as well as providing a counterpoint to more didactic teaching. Coursework will improve student standards in practical mathematical and statistical tools, computing (including high performance computing via. HEA-and SFI-funded facilities), national (e.g., CosmoGRID) and international projects (e.g., EU FP6, and JETSET), and report generation and presentation – all skills of importance in the workplace.

In summary we aim to:

- Provide advanced teaching courses and resources
- Provide Irish and international travel opportunities for lab visits and observing trips
- Expose students to advanced topics e.g. High Performance Computing, adaptive optics etc. and expose students to spin-off applications e.g. development of improved medical imaging devices
- Provide industrial experience possibilities, where possible, in a range of high-tech companies or: NASA/ESA facilities e.g., ESTEC (in all ~30 companies in Ireland have contracts with ESA)
- Encourage student and staff participation in outreach activities (such as SFI's STARS programme) to encourage the take-up of physical sciences at 3rd level
- Develop student professional/transferable skills e.g. networking, presentational skills, critical thinking
- Broadening of topics to include developing subjects such as astrochemistry/astrobiology

f) <u>the scope for recruitment of well-qualified graduate students to the programme</u>

By focussing on a national programme we will have access to the best students in the country, both North and South and we also aim to attract international students through high standards and increased international exposure.

All Irish Universities run physics courses with substantial space science/astrophysics components. Hence a potential pool of over 150 students with good physics (or related) degrees already exists. A more coherent course structure which ehances skills, as well as introducing broader experience, will attract more students who have not taken the astrophysics route at the undergraduate level.

g) <u>linkage to current research projects and/or graduate education programmes (national and/or international) and benefits to be derived from proposed collaborations</u>

Our proposal covers all space science and astrophysics sites in the entire island, so:

- Draws on existing expertise – see c) above
- Exposes students to a wider range of research and teaching experience
- Benefits from increased scale and resources over individual institute programmes
- Student exposure to a greater number of national (and international) peers
- An attempt to halt the decline in physics and mathematics take-up at third level - Astro degrees have resulted in the growth in number and quality of students
- A national graduate school will allow us to attract high-quality international students

h) <u>contribution of the Exploratory Grant to the development of the programme</u>

We have outlined our vision of how the graduation school might be set up and work, but much detail needs to be determined. Funding under this exploratory grant will permit study of best practice at other sites and to learn from their experience. For example, we may plan a series of courses that run in much the same way as undergraduate courses, insomuch as they are laid out in a logical progression, or we could adopt a summer school approach, in which many different topics are given in a short space of time. Additionally, courses may be provided by experienced Irish lecturers and/or supplemented by experts from overseas (the latter being preferable in that it increases contact for both students and lecturers with the best experts in the field – possibly leading to improved employment prospects for the students), though we would have to mesh with the pre-existing lecturing of the foreign lecturers.

We note that:
- All universities and institutes in astrophysics/space science/related fields are represented here

- Fits within existing education programmes and provides a unifying educational structure
- Will formalise Armagh and DIAS links with University graduate programmes and provide a single point of contact through which to efficiently teach in a national context, rather than providing a range of similar courses of different length to individual institutions

i) How the Grant will contribute to the development of the programmes

Our budget includes salary for two team members to buy out their academic commitments to enable them to dedicate themselves to the preparation of a report and a full proposal for the next round. Funding has also been provided for a number of meetings with proposal participants, as well as for travel for a foreign expert to assist in report generation. The final grant proposal will be written by a core group for approval by the entire group.

Travel has also been costed based on a number of visits by a number of team members to sites having graduate schools or similar structures – examples chosen for budget estimates being: Centre for Astrophysics (Harvard University), University of Cambridge, the NOVA School (The Netherlands), Max Planck Institutes. Travel & subsistence has also been assessed for domestic travel to permit a series of meetings around the country to work up intermediate results and to keep in close contact. In addition travel & subsistence has been requested to have a foreign expert sit in on a meeting towards the final stages of report preparation. We have assumed that this person can contribute time, and hence will not require a consultancy rate – one such person we have identified is Prof. George Miley of Leiden University who is knowledgeable of the Irish situation and was instrumental in setting up the Dutch NOVA graduate school (see attached letter of support and CV).

Finally, funding has been requested for administrative support from someone with budgetary experience in order to help with the preparation of both report itself as well as the costings.

Outline of possible graduate school mechanism and structure

Student body

Currently there are over 40 postgraduate students per year entering astrophysics or an astrophysics-related discipline in the entire island of Ireland. In Northern Ireland students are funded from a variety of schemes, whilst in the Republic most of the ~30 students are funded from SFI or IRCSET sources. We aim to include students from the whole island in the graduate school and students will be strongly encouraged to attend in order to provide them with a broadly-based mix of topics to supplement their undergraduate studies. Provision of an interesting mix of topics may prove attractive to physics students in general, particularly if they get expertise in high-tech laboratory work or high end computing as a result. Hence students coming from a more mathematical background – such as theoretical physics – may be attracted in on the basis of courses in computational astrophysics and cosmology – providing practical computational skills for subsequent life in the workforce.

We would aim to increase the total number (North and South) of graduate students from 40 to at least 50, in line with government proposals to increase numbers. The dominance at undergraduate level of students registered for astrophysics-related courses relative to their non-astro peers suggests that such a number is both attainable and potentially sustainable.

Teaching body

We have identified 47 possible staff members who work in astrophysics and space science or instrumentation fields who may be drawn upon to assist. Of course, not all of the staff members will be able or necessarily willing to participate, but our pre-proposal already identifies a representative from each of a dozen institutions, so there is broad support in favour of a national graduate school.

Management

With a national scheme involving so many participating institutions it will be vital to have a

representative and transparent management structure. One idea under consideration is to have a board of the graduate school be representative of the stake-holder insitutions, but with additional oversight provided by appointments by the RIA National Committee for Astronomy & Space Research, as well as at least one representative from an international graduate school. Participation by student representatives would also increase the involvement of students in the graduate school and help ensure success. The precise legal details of how the management structure would be implemented will require further study.

Courses to be offered

A wide range of courses is possible, based on the large number of institutions and staff members represented on this pre-proposal. We propose courses that break down into three broad areas –

- primary science courses in astrophysics [e.g. advanced course in magnetohydrodynamics]
- methodology courses [e.g. data reduction techniques]
- background courses [e.g. in statistics, mathematical methods or high-performnace computing]

Each module would have a number of credits attached – such as those based on the ETC system – to ensure easy student interchange with other European institutes (both inward and outward). Courses can be based on existing teaching where appropriate, reducing the effort required in formulating an entirely new set of lectures.

An exciting possibility opened up by combining national talents is to permit cross-over topics (e.g., Maths/General Relativity/Cosmology/Space-craft instrumentation, astro-chemistry, astro-biology) not currently available.

Training

The programme basis is a 1+3 year structure, with students being registered at their home institutions, but with courses taught jointly by all stakeholders. The initial year is designed to provide the basic tools necessary for successful research and completion of the 3-year PhD stage of the programme but will include some research/laboratory work.

Training will be provided through a combination of coursework, short research topics, and laboratory or observational experience, depending on whether the individual has a goal in observational, theoretical or computational astrophysics, or space science.

All students will take a core set of courses (possibly three: one laboratory based, one theoretical, and one observational), of 24 hours apiece, and also choose three further courses from a module set that will change on an annual basis. Laboratory practice and observing experience will be provided through the graduate school, achieving efficiency of numbers, as well as lowering the workload for individual lecturers. The trend towards modularisation in universities encourages a similar approach at the graduate school level, and this would also facilitate visits by international lecturers. However, there are benefits in providing lectures in smaller doses e.g., providing 4 lectures/course each week, and repeating the structure after 2 months to cover the entire course over a year.

Teaching method

Regular lectures will be in the format of classroom lectures, whether in person, or via. video-presence for wider audience dissemination. New video-conferencing techniques as have been successfully attempted in the High Performance Computing community and such teaching can involve learning resources available to us in the university context e.g., teaching and learning practise facilities at each site, as well as in computer science departments

Degree awards

Students will register at a host institution, but receive teaching and credits via. the graduate school.

Year 1 student credits will be assessed at the host institution and a degree (either nominal MSc or actual, depending on each institution's regulations) awarded. Continuation to the research phase will depend on results, and the possibility of appeals etc. will need to be addressed, as will permitting student flexibility in terms of changing research topic after Year 1. A formal year-end review will also provide the students with the focus of a short-term goal to achieve.

Appendix 1: Budget numbers for graduate school start-up:

Details of budget estimates must await the final report, but basis costs are split between fixed costs and scaleable costs.

Fixed costs:

- Visting lecturer costs (~1 week for each of two lecturers ~€10k)
- Buy-out of part salary for an existing staff member in order to manage the graduate school (~€25k)
- Staff travel and subsistence for 3 supervisors in support of one week field trip/year (~€6k)
- Administrative support (~50% of administrator ~€26k)

Total fixed costs: ~€67k/year

Scaleable costs:1
Over the four years of a PhD programme (1+3), each student will need:

- a good computer
- one field trip (observing or laboratory)
- one summer school
- software licence (e.g., data reduction or mathematical package)
- at least one conference trip
- national mobility (~€9k per student per 4 year programme)

Total scaleable costs ~ €70k/year for 30 students (assuming all SFI + IRCSET students are registered initially)

Total costing for first year: ~€140k

A *rough* costing of the initial requirements of a graduate school has lead to the following figures, assuming 6 courses (modules) of 24 lectures provided to 20 students:

- €20k data analysis licences/software
- €20k visiting/summer school lecturers
- €20k experimental equipment
- €20k computers
- €50k international observing field trips
- €50k national student mobility
- €25k project coordinator
- €26k 50% secretarial time (senior administrative assistant)

Total: €435,000

Note: Funding above does not include student stipends, though IRCSET has indicated that full costs will be provided, as well as possible cost-of-living funding for students supported by other means. We expect new equipment costs to be met by the Strategic Initiative Fund.

Appendix 2: Contact information and CVs for additional team members:

*The contact person at each site is indicated with a (c) Note that the four team members listed in the body of this proposal were chosen as representatives of each province.

Armagh Observatory (ARM)
Prof. Gerry Doyle
Simon Jeffery (c)

Cork Institute of Technology (CIT)
Prof. Niall Smith

Dublin City University (DCU)
Turlough Downes (c)

Dublin Institute for Advanced Studies (DIAS)
Prof. Tom Ray (c)

Dublin Institute of Technology (DIT)
Justin Donnelly (c)
James Walsh

Galway-Mayo Institute of Technology (GMIT)
Pat Moriarty (c)

National University of Ireland, Galway (NUIG)
Dr. Ray Butler
Prof. Mike Redfern
Dr. Matt Redman
Dr. Andy Shearer (c)

National University of Ireland, Maynooth (NUIM)
Dr. Creidhe O'Sullivan (c)
Prof. Anthony Murphy

Queen's University Belfast (QUB)
Prof. Philip Dufton (c)

Trinity College Dublin (TCD)
Dr. Brian Espey (PI, c)
Dr. Peter Gallagher

University College Cork (UCC)
Dr. Paul Callanan (c)

University College Dublin (UCD)
Dr. Peter Duffy
Dr. Lorraine Hanlon (c)

17. GRADUATE RESEARCH EDUCATION OUTPUTS ENVISAGED
State how the projected programme will make a contribution to the research area and to the strategic development of graduate research education in the institution(s)/discipline(s)/ research area(s) concerned (max 500 words).

1) Contribution to the Research Area:
Closer collaboration among institutions/sub-disciplines is an important result, as is more efficient utilisation of funding and staffing resources. Co-ordination makes the school internationally competitive, and provides a recognisable Irish 'brand' for incoming international students and the wider community.

No single institution in Ireland could host such a programme and existing expertise is distributed across the country. Students willl be exposed to a wide range of key topics in modern astrophysics, delivered by experts in their fields. Similarly, coherence and structure will stimulate deeper research collaboration between institutes and they will be better placed to apply to FP7 programmes such as the successors to the 'Training site' and 'Transfer of knowledge' instruments.

Irish collaborative research is crucial to the implementation and exploitation of future large-scale infrastructure projects, examples being membership of the European Southern Observatory and construction of a national radio telescope. Co-ordination of instrumentation activity would also benefit (e.g. see the contributions to the recent Galway high-time resolution workshop). There are bona fide technical and industrial spin-offs (as occurred with ESA membership) from these projects, and researchers will be better positioned to exploit these with growth in graduate student number and quality. Furthermore, an internationally competitive graduate programme and improved access to world-class research facilities, will lead to an enhanced international research profile which will further fuel development by serving as an attractor for talented students, both Irish and international.

2) Contribution to the strategic development of graduate research education in Space Science & Astrophysics:
Many Irish universities have introduced astronomy-related primary physics degrees to attract motivated students to the physical sciences, at a time when declining numbers of students are studying physics and chemistry in secondary school. IBEC (among others) has stressed the importance for Irish competitiveness of counteracting this decline (e.g. http://www.ibec.ie/ibec/press).

Roughly 40 astronomy/astrophysics students graduate nationally and in many institutions they dominate the total physics numbers. Roughly half of physics honours graduates pursue further study, and half research-based higher degrees in physics-related areas. A goal of 20 SSAGE candidates/year is attainable from current undergraduate astrophysics-related programmes. A final target of ~30 students per year could be achieved by recruiting additional students from non-astronomy based physical/mathematical sciences degrees as well as recruiting internationally.

We do not intend to populate the country with professional astronomers, but to provide an attractive, stimulating, and internationally competitive programme in which talented students can confront intellectual challenges posed by frontline astrophysics research; develop the necessary instrumentation, computational and theoretical tools to make quantitative developments in understanding, and hone critical thinking, problem-solving and presentation skills. Strategic development of a graduate school is timely in view of the significant number of domestic research-active academic experts in many of key fields of modern astrophysics who are committed to collaborating in a programme which no single institution could conduct independently.

Finally, graduates will gain skills needed by Irish industry: not just hi-tech computing skills and familiarity with state-of-the-art electronics and instrumentation, but also a 'can-do' attitude when confronted with new and unfamiliar situations in the workplace.

PART III – FINANCIAL DETAILS

18. PROGRAMME BUDGET	Amount €:	Detailed Breakdown of Costs:
Staff Costs Team salary Admin/Finance supt. **Sub-Total:**	 € 14,043.32 € 8,543.11 € 7,078.80 €29,665.23	 Senior Lecturer, Step 4: 0.125 FTE spread over 9 months Senior Lecturer, Step 3: 0.08 FTE spread over 9 months Admin 1, Step 3: 0.08 FTE spread over 9 months
Travel and Subsistence **Sub-Total:**	€ 14,474.40 € 2,160.00 € 780.00 € 17,414.40	Site visits for 2 people to visit each site of best practice [travel costed for Harvard (Center for Astrophysics) in Boston (USA), Cambridge (UK), NOVA school in Leiden (The Netherlands), Strasbourg (France)], subsistence assumed to be at 'B' rate 4 days of T&S for domestic meetings for 6 people – Travel €50, Subsistence €40 2 days T&S for one foreign expert to visit and & prepare report - €250 travel, €140/day subsistence (subsistence at 'A' rate)
Consumables	€ 500	Phone/fax/mail/DHL courier/paper/report preparation
Other Direct Costs (Please specify)		No cost allocated for consultancy as expert will be fellow astrophysicist

Total direct costs: €47,479.63 Overheads on above costs: €11,894.91 Total request: €59,474.44

The following text is required in all TCD submissions:

Social Benefits Clause: Fixed term contract workers have entitlements to benefits equivalent to full time permanent staff. Obligations arising from legislation associated with the employment of fixed term contract workers on the grant (including but not limited to pension provision, sick pay, redundancy pay, paid maternity leave or other paid or non-paid leave or entitlements) should be borne by the sponsor. Acceptance of the grant contract is predicated on the understanding that funding will be made available by the sponsor to cover such existing and any future pay costs that arise because of legislation and/or pay awards applied which are outside the control of the university.'

CONTACT PERSON'S DECLARATION

I declare, on behalf of the Programme Team, that the above particulars are correct and understand that the circulated 'Terms and Conditions' apply. We accept that failure to abide by the 'Terms and Conditions' may disqualify us from this Scheme

Signature of Contact Person: _____

Date: _____

ENDORSEMENT BY INSTITUTIONAL AUTHORITIES

Please complete details for Contact Persons's School or Department:

I hereby endorse this application to the Joint Call For Graduate Education Programme Exploratory Grants in accordance with the 'Terms and Conditions'.

Signature of Department Head:

_____

Date _____

Signature of Vice-President/Dean of Research/ Dean of Graduate Studies
or authorised signatory:

_____

Date _____

Institutional Stamp

Stamp of Institution