



The Armagh Observatory
Business Plan
2007/2008

Business Plan for Period 2007 April 1 to 2008 March 31

Prepared by the Director

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2007 April 10

Executive Summary

Introduction

1. This Business Plan provides brief information on the Armagh Observatory's principal achievements during the previous year (Calendar Year 2006 and Financial Year 2006/2007), and presents the organization's key objectives for 2007/2008 and the resources required to achieve them. At the time of writing (2007 April 10), figures for financial year 2006/2007 are still unaudited and therefore may differ slightly from those published in the final audited accounts.
2. The Armagh Observatory is a modern astronomical research institute with a rich heritage, the oldest scientific institution in Northern Ireland. Founded by Archbishop Richard Robinson around 1790 as part of his dream to see the creation of a university in the City of Armagh, its principal function is to carry out front-line scientific research in astronomy and related sciences, with important secondary objectives to pursue a high-profile, high value-for-money programme of education and public outreach.
3. The Vision of the Armagh Observatory is:

“To maintain and build on its position as a thriving astronomical research institute, and to continue to expand our understanding of the Universe and of humanity's place in it.”

The Mission is:

“To advance the knowledge and understanding of astronomy and related sciences through the execution, promotion and dissemination of astronomical research nationally and internationally in order to enrich the intellectual, economic, social and cultural life of the community.”

4. The statement of Income and Expenditure for 2007/2008 (see Table 3, p.9) projects a balanced budget. In the medium to long term the Observatory is expecting to obtain a continuing high level of external grant income, but is likely to require an uplift in support from the DCAL or other government sources to maintain its present levels of research activity.

Results for Financial Year 2006/2007

1. The Armagh Observatory has maintained a high level of research and other outputs during the year. Staff have produced 44 publications in refereed scientific journals during 2006, 10% above the target of 40 for the year; the number of identified media citations, namely 300, is well above the business-plan target of 200; and the number of Distinct e-Visitors (DEVs) to the Observatory websites (<http://star.arm.ac.uk/>, <http://climate.arm.ac.uk/> and <http://arpc65.arm.ac.uk/~spm/>), i.e. 1,539,000, continues to grow at a significant rate. The number of DEVs was 50% higher in 2006 than the previous year.
2. Staff at the Armagh Observatory obtained external grants and other income totalling approximately £170,900 during the period (£156,900 in external grant receipts). This is lower than in previous years, owing to the stiff competition for external grants and the presence of only three Research Astronomers in post during the year.
3. In the same period, Armagh Observatory staff have delivered 55 public talks and scientific contributions at meetings both locally and abroad, and have maintained an active programme of 21 formal seminars and internal colloquia, many of which were delivered by external visiting speakers.
4. In addition to pursuing front-line astronomical research, the Armagh Observatory presents a strong, positive image of Armagh and Northern Ireland on the national and international stage. Members of staff play a full role in the astronomical community, for example by reviewing grant and research proposals on behalf of external funding agencies, reviewing scientific papers, editing international academic journals, and serving on the committees of bodies such as the Particle Physics and Astronomy Research Council, the Royal Astronomical Society, and the Royal Irish Academy.

5. The Observatory's principal web-sites, namely <http://star.arm.ac.uk/>, <http://climate.arm.ac.uk/> and <http://arpc65.arm.ac.uk/~spm/>, which record the level of external interest in the Armagh Observatory and its facilities, have attracted record numbers of Distinct e-Visitors (DEVs) and web-page 'hits', and provided a rapidly growing volume of data to external users. During 2006 these indicators of external interest in the Armagh Observatory were recorded as 1.539 million DEVs, 16.2 million hits, and 3.43 TB data exported (1 TB = 1,000 GB). In addition, more than 35,000 physical visitors were recorded passing through the Observatory Grounds and Astropark during 2006.
6. Table 1 shows the trends of various performance indicators over the last 15 years. It is noteworthy that despite the difficult financial climate in which the Observatory has been operating for much of this time (and the first part of 2006 in particular), the Observatory has maintained a high level of scientific and other outputs and has achieved a correspondingly high public profile at regional, national and international level.
7. The Observatory's performance in all these areas reflects the strength of public interest in astronomy and space science. Astronomy is an area that attracts people (both young and old) into science and towards a more scientific way of thinking, and one that strongly supports the Government's objective to develop a 'knowledge' economy, i.e. one where we compete internationally not on wages but on intelligence, innovation and creativity. In the words of the Prime Minister (2006 November 3), this is so much easier if "science has a much broader reach into our culture and society", and "... Human capital is what it's about."
8. The support for astronomy provided by the Northern Ireland Department of Culture, Arts and Leisure (DCAL) is a key factor in the Observatory's success. In return, astronomical research at Armagh contributes significantly to the Department's mission to protect, nurture and grow Northern Ireland's cultural capital for today and tomorrow. Astronomy at Armagh is a significant part of Northern Ireland's heritage. It projects this cultural capital and a positive image of Northern Ireland on the world stage.

Objectives for Financial Year 2007/2008

The key tasks for the year are to (1) complete the Observatory's RAE submission; (2) complete the planned Skills and Science activities for the period; and (3) develop a Business Case for the new Library, Archives and Historic Scientific Instruments Building. There is a growing need to secure modern, long-term storage for the nationally significant collection of books, archives and historic scientific instruments in the Observatory's care, and to ensure that the Observatory's unique library and archives can be properly accommodated and displayed in the best possible setting. Completion of these tasks will lay a strong foundation both for the preservation of the heritage and the development of front-line research astronomy at Armagh.

The principal objectives during 2007 and the coming Financial Year 2007/2008 are to:

- maintain and expand existing high-quality research programmes;
- obtain grants and additional external funding to support new research projects;
- prepare for the Research Assessment Exercise (RAE2008), which has a census date 2007 October 31, and make a high-quality RAE submission;
- promote and develop the Armagh Observatory Grounds and Astropark, and widen access to astronomy at Armagh by expanding the Observatory's Education and Public Outreach (EPO) programme; and
- progress plans for a new Library, Archives and Historic Scientific Instruments Building.

The Key Performance Indicators (Key PIs) for these objectives are indicated in Table 2 (p.7).

Calendar Year	DCAL Grant-in-Aid (£000s)			External Grant Income (£000s)	Refereed Scientific Journal Publications		Distinct e-Visitors (000s)	Identified Media Citations		RAE Grade	Days Absence Per Person Per Year	
	Core Resource	Core Capital	Additional Funding		Total	Actual		Target	Actual		Target	Actual
1992	374.0	83.3	0	457.3	14					4		
1993	399.0	46.0	0	445.0	13	35.0		11				
1994	369.5	33.6	22.5	425.6	22	58.0		14				
1995	412.5	56.0	0	468.5	19	172.0		47		4	0.4	
1996	424.0	56.0	0	480.0	45	264.0						
1997	428.0	37.7	7.5	473.2	42	275.0	66	109			3.8	
1998	418.0	25.0	0	443.0	43	195.0	80	147			0.3	
1999	452.0	6.5	0	458.5	32	293.0	134	238	100		0.5	
2000	452.0	6.5	80.0	538.5	31	212.0	174	235	100		0.3	
2001	466.0	7.5	240.0	713.5	32	221.3	318	302	100	4	1.8	
2002	616.0	7.5	110.0	733.5	33	305.7	354	267	200		0.2	
2003	660.0	6.5	115.0	781.5	34	270.4	470	226	200		0.4	
2004	660.0	6.0	218.0	884.0	41	239.4	576	284	200		0.4	
2005	660.0	6.5	125.0	791.5	47	207.9	1012	349	200		0.4	13
2006	660.0	6.5	144.5	811.0	44	156.9	1539	300	200		0.2	12
2007	660.0	6.5	175.0	841.5	45	300	1800	250	250			11

Notes to Table of Historic Key Performance Indicators:

1. Financial figures refer to the corresponding financial year, so that Core Resource funding for 2006 refers to the core resource funding received in cash terms during 2006/2007 and so on. All other figures are per calendar year.
2. Total DCAL grant-in-aid received in cash terms during each financial year is broken down into Core Resource, Core Capital and Additional Funding (both Resource and Capital). The latter represents additional funding provided by the DCAL in response to competitive bids from the Observatory to support specific in-year projects and other activities. The additional funding included £125k and £175k for Skills and Science activities in 2006/2007 and 2007/2008 respectively.
3. Figures for External Grant Income refer to income received in cash terms during each financial year.
4. The Table includes the Sickness Record for Armagh Observatory staff, defined as the ratio S/N , where S is the total number of days lost due to staff sickness per calendar year, and N is the total number of staff in post at the end of the corresponding year. Results under this heading are many times better than the best recorded in any government department or higher education institution (these figures range between 3 and 17 days per person per year). The DCAL sickness targets for 2005/2006, 2006/2007 and 2007/2008, which refer to the percentage of working days lost, are 5.8%, 5.3% and 5.0%. Assuming 220 working days in a year, these DCAL targets correspond respectively to $S/N = 12.8$, 11.7 and 11.0.
5. Targets for calendar year 2007 (or financial year 2007/2008), including the identified Additional Funding (e.g. £175,000 from the Skills and Science Funding Package), are in the main expressed in round figures.

Table 1: Trends of historic key performance indicators (PIs) versus calendar year. Table last updated 2007 April 10.

1 Review of Performance in Financial Year 2006/2007

1. As shown in Table 4 (p.13), the number of Research Astronomers in post at the end of both 2005 and 2006 was three, the lowest for 25 years. Despite ‘running empty’, so far as senior research staff were concerned, the Observatory has returned a very satisfactory performance during 2006/2007.
2. Armagh Observatory staff produced 44 publications in refereed scientific journals during 2006, 10% above the target of 40 for the year. The number of identified media citations, namely 300, was well above the target of 200; and the number of Distinct e-Visitors to the Observatory web-sites was in excess of 1.5 million. However, total external grant receipts to 2007 March 31 were approximately £156,900, reflecting the significantly lower grant-earning potential of an Observatory with just 3 Research Astronomers.
3. At the start of the year, the Observatory’s element of the total DCAL recurrent grant was £660,000, the same in cash terms as it had received the previous year, the year before that, and the year before that as well. Inflation in salaries and other running costs is inexorable, and it is simply not possible to maintain a continuously high level of research activity without additional income. Inevitably, the decline in real terms of the Observatory’s core funding (and also the number of Research Astronomers) led to missed opportunities for attracting external grant income. Thus, although additional funds have been obtained from various external sources (such as CosmoGrid and PPARC), the DCAL has become an increasingly important source of the necessary additional funding required to maintain specific in-year projects and other activities. It is, of course, important to try to break this pattern, and the significant grant-earning capacity of Research Astronomers, indicated by Key PI (A) (see Section 1.2) or column 6 of Table 1, shows that with more such staff this should in principle be possible.
4. The additional DCAL funding in 2006/2007 was particularly welcome. In this case, the Armagh Observatory and Planetarium were together awarded funds totalling £600k from the Government’s Skills and Science Funding Package, announced by the Secretary of State towards the end of February 2006. The overall objective of this funding programme is:

“To enhance investment in skills and training programmes for employment for young people, to tackle economic inactivity, increase the skills of the working age population and improve the science base to compete more effectively in highly skilled international markets and to complement this with targeted investment in research and development and promoting greater links between industry and the research base”.

The £300,000 per annum in each of 2006/2007 and 2007/2008 was shared so that the Observatory would receive £125,000 in 2006/2007 and £175,000 in 2007/2008.

5. The Observatory’s contribution to the DCAL’s component of the Skills and Science initiative is to (i) deliver a work-experience programme between May 2006 and June 2008; (ii) provide an education and outreach programme catering for a minimum of 1,000 children per annum between October 2006 and June 2008; and (iii) deliver three highly trained PhD graduates into the workforce in each of the next two years. Although this programme only began in 2006, significant progress has been made towards meeting these new Skills and Science targets.

1.1 Performance Against Business Plan Objectives for 2006/2007

As a result of the award of Skills and Science funding, the Observatory’s Business Plan for 2006/2007 was revised in-year and updated in 2006 October. The revised Business Plan (2006 October 23), see <http://star.arm.ac.uk/FOI/>, identified the principal objectives to be achieved in order for the Observatory to maintain its Vision and Mission as an international front-line astronomical research institute. These were to:

- maintain existing high-quality research programmes — maintained;
- obtain grants and additional external funding to support new research projects — done;
- strengthen the Observatory’s research capability in solar system and stellar astrophysics in readiness for the next Research Assessment Exercise (RAE 2008; census date 31 October 2007) — done;

- enhance the Observatory’s use of research infrastructure such as CosmoGrid, the Southern African Large Telescope (SALT), and the Northern Ireland Regional Area Network (NIRAN) — done;
- promote use of the Armagh Observatory Grounds and Astropark, and widen access to astronomy at Armagh by continuing to develop the Observatory’s Education and Public Outreach (EPO) programme — done;
- progress plans for a new Library, Archives and Historic Scientific Instruments Building — not done owing to lack of funding; and
- deliver the Skills and Science programme, the targets for which are outlined above — on-going.

Relevant targets for these objectives, which together span the Observatory’s principal functions, namely to carry out front-line scientific research, to preserve and expand Northern Ireland’s scientific and built heritage in astronomy and related sciences, and to develop a high-profile programme of education and public outreach, are summarized in Table 1 and Table 2.

In addition, two key tasks were identified for the year, namely those to:

- recruit additional, high-quality senior research staff – done; and
- deliver the Observatory’s commitments under the Skills and Science programme — on-going.

The first of these additional tasks was to maintain the heritage of front-line astronomy at Armagh and lay a strong foundation for the forthcoming Research Assessment Exercise. Replacing at least the senior research staff who left the organization during 2005 would ensure that the Observatory’s capacity to obtain external research grants and respond to new Government initiatives in research and education was not undermined in the long term.

The second task was to ensure an appropriate focus on delivery of the DCAL’s component of the Skills and Science Funding Package, which under the heading “The Appliance of Science” is aimed primarily at encouraging young people to consider careers and opportunities in science in Northern Ireland. This is an important economic and social goal, and the Observatory’s success in this area demonstrates the importance of a flagship science, such as astronomy, in attracting young people towards science in general. The Observatory’s principal activities under the Skills and Science programme have therefore been primarily directed in support of this important Government target.

1.2 Key Performance Indicators

Key performance indicators (Key PIs) provide a means to assess the Observatory’s performance in different spheres of activity, ranging from front-line scientific research in astronomy and related sciences, to the preservation and restoration of Northern Ireland’s scientific, cultural and built heritage, and the promotion of public understanding of science through a vibrant programme of education, lifelong learning and public outreach.

Four Key PIs have been used in the past to span all these objectives (see Table 1 and Figure 1). These were: (1) External Grant Income; (2) Refereed Scientific Journal Publications; (3) Distinct e-Visitors to the Observatory’s web-sites; and (4) Identified Media Citations in the press, digital media and on radio and television. Data referring to each of these measures have been collected systematically over several years, and so the interpretation and analysis of any resulting trends is relatively straightforward. However, during 2006 the DCAL requested that four new Key PIs be identified. These are defined as follows:

- A: Total external income as a percentage of overall income, per financial year, representing the economic ‘rate of return’ on DCAL investment in astronomy at Armagh (a high value is better).
- B: Total administration costs as a percentage of total costs, per financial year, representing the economic ‘efficiency’ of the Observatory’s governance and administration systems in delivering high-quality astronomical research for the lowest reasonable cost (a low value is better).
- C: Average number of days absence per person per calendar year (d/p/yr), representing staff morale and the motivation and commitment of the Observatory staff to their work (a low value is better).
- D: Total number of scientific papers in refereed scientific journals, per calendar year, representing the volume of highest quality scientific output of Observatory staff per calendar year (a high value is better).

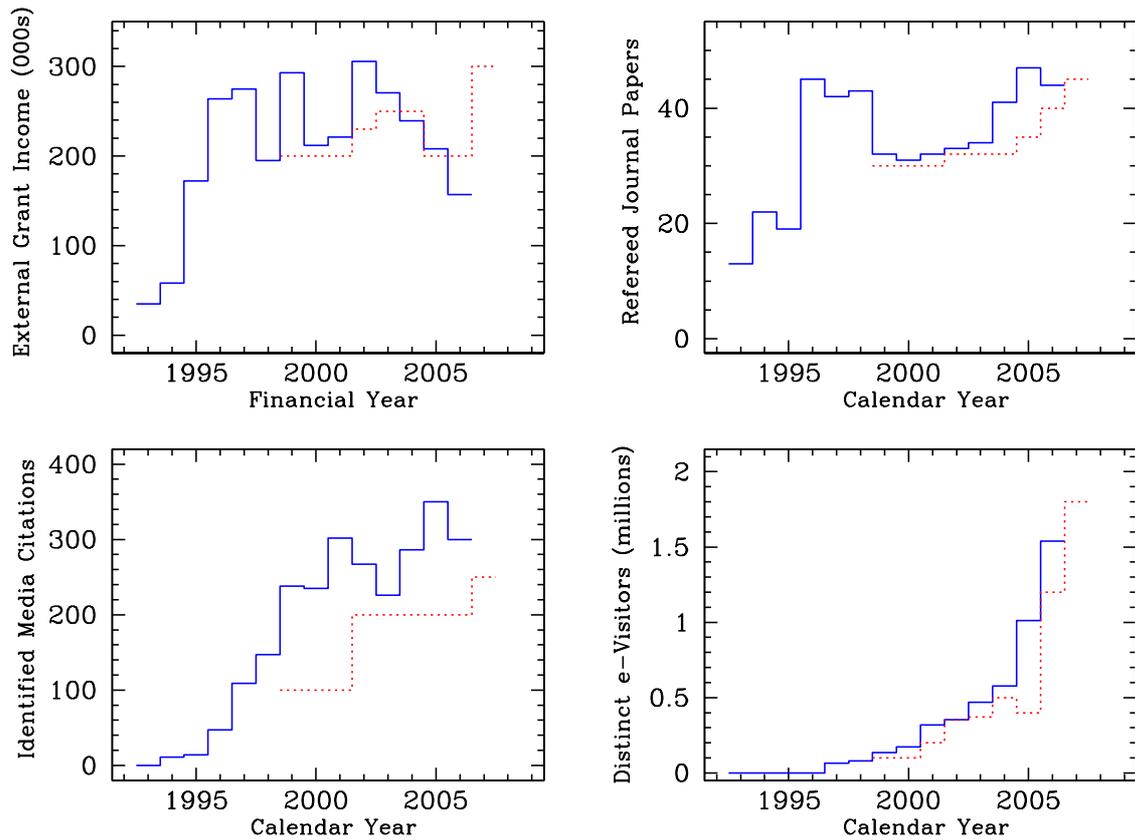


Figure 1: Histograms showing the trends of various performance indicators for the Armagh Observatory during the past decade. The different panels show External Grant Income (£000s) received in cash terms per financial year; and Refereed Journal Publications, Identified Media Citations, and Distinct e-Visitors (millions), all per calendar year. Solid lines denote actuals, dotted lines prior-year business-plan targets. Note that, with the exception of External Grant Income for 2006/2007 (1 April 2006 to 31 March 2007), the actual performance throughout the past decade has been close to or above the business-plan target for essentially every key performance indicator, a significant achievement.

Calendar or Financial Year	New Key PI A		New Key PI B		New Key PI C		New Key PI D	
	Actual (%)	Target (%)	Actual (%)	Target (%)	Actual (d/p/yr)	Target (d/p/yr)	Actual #	Target #
2006 or 2006/2007	18.4	20.0	8.8	10.0	0.2	12.0	44	40
2007 or 2007/2008		20.0		8.8		11.0		45

Table 2: New key performance indicators agreed with the DCAL during 2006. The first column denotes the calendar or financial year. Key PI ‘A’ represents the percentage rate of return on DCAL investment in astronomy at Armagh (a higher value is better); Key PI ‘B’ represents the percentage efficiency of the Observatory’s governance and administration systems (a lower value is better); Key PI ‘C’ is the average number of days absence per person per year (d/p/yr) (a lower value is better); and Key PI ‘D’ is the number of publications in refereed scientific journals per year (a higher value is better).

The first three Key PIs (A, B, and C) were chosen so as to align with those of other DCAL-funded NDPBs. It is expected that this will allow a comparison to be made between the performance of the Armagh Observatory in these areas and those of different government-funded organizations. The fourth Key PI (D), in common with the first (A), provides a proxy measure of the Observatory’s success as a third-level astronomical research institute.

For ease of reference, the 2006 results against business-plan targets for these new Key PIs are presented in Table 2. Results are also presented for the various historic Key PIs in Table 1 (p.3). All items, with the exception of financial matters, refer to calendar year. Note that, in general, the total external grant income received in cash terms per financial year is not the same as the total external grant income per financial year shown in the accounts and calculated on an accruals basis following Resource Accounting procedures.

In addition to these specific performance indicators, various other data are routinely recorded for statistical or internal management purposes, many of which are presented in tabular or narrative form in each year’s Annual Report (see <http://star.arm.ac.uk/annrep/>).

Two important factors to be considered in interpreting these results are the number of senior research staff available to obtain external grants and direct research projects, and the amount of core funding provided by the sponsor government department. Table 1 shows that although the DCAL has been generous in providing the Observatory with additional development funds, the level of core funding to meet the Observatory’s needs has often been insufficient. Table 2 illustrates the high rate of return on DCAL investment in front-line astronomical research at Armagh; the very high ‘efficiency’ of the Observatory’s governance and administration systems; the exceptionally strong commitment of Armagh Observatory staff to their work; and the continuing high level of high-quality refereed scientific journal publications.

1.3 Summary of Performance in 2006/2007

As described in Section 1.2, in the past the performance of the Observatory in the round has been assessed primarily against four historic key performance indicators. Taken together, these span all the Observatory’s principal areas of activity, namely research, education and public outreach, and heritage. They were: (1) External Grant Income (per financial year); (2) the number of Publications in Refereed Scientific Journals (per calendar year); (3) the number of Identified Media Citations (per calendar year); and (4) the number of Distinct e-Visitors (DEVs) to its web-sites (per calendar year). These and other data (e.g. numbers of presentations, seminars and invited talks) are recorded for internal management and statistical purposes, and many are presented under relevant headings in each year’s Annual Report (see <http://star.arm.ac.uk/annrep/>). However, as a result of the introduction of new Key PIs, the Observatory’s performance must also be considered against these (see Table 2).

Thus, the total external income during 2006/2007, namely £170,900, was somewhat below the target figure of £200,000 for external grant income set in 2006 April. Nevertheless, most (i.e. £156,900) of this figure is attributable to external grants, and during 2006 the Research Astronomers at Armagh continued to bring into the Observatory more external funding in terms of non-DCAL grant income than their gross DCAL-funded salary costs, a remarkable achievement. This statistic illustrates the potential

for resonant growth of the Observatory's primary research function through the recruitment of additional research staff, once those staff have settled into a full cycle of research grant application, project execution, refereed journal publication, and review.

It is gratifying to note that the number of refereed journal publications has, each year, risen above the monotonically increasing target figure. In 2006, this figure represents an excellent achievement by the current research staff. Similarly, the number of identified media citations has remained at a high level, resulting in a figure of 300, again substantially above the target of 200 per year. The number of DEVs continues to grow at a significant rate, reaching a new record figure of 1.539 million in 2006.

These results demonstrate a remarkable performance by the Observatory during 2006, considering the number of senior research staff, both in research output and external impact. The new Key PIs and the old (cf. Table 2 and Figure 1) show that the Observatory has maintained a high level of research activity whilst attracting substantial external grant income to support its work and generating an exceptionally high public profile.

2 Objectives and Resources for Financial Year 2007/2008

The key tasks for the year are to (1) complete the Observatory's RAE submission; (2) complete the planned Skills and Science activities for the period; and (3) develop a Business Case for the new Library, Archives and Historic Scientific Instruments Building. There is a growing need to secure modern, long-term storage for the nationally significant collection of books, archives and historic scientific instruments in the Observatory's care, and to ensure that the Observatory's unique library and archives can be properly accommodated and displayed in the best possible setting. Completion of these tasks will lay a strong foundation both for the preservation of the heritage and the development of front-line research astronomy at Armagh.

The principal objectives during 2007 and the coming Financial Year 2007/2008 are to:

- maintain and expand existing high-quality research programmes;
- obtain grants and additional external funding to support new research projects;
- prepare for the Research Assessment Exercise (RAE2008), which has a census date 2007 October 31, and make a high-quality RAE submission;
- promote and develop the Armagh Observatory Grounds and Astropark, and widen access to astronomy at Armagh by expanding the Observatory's Education and Public Outreach (EPO) programme; and
- progress plans for a new Library, Archives and Historic Scientific Instruments Building.

The Key Performance Indicators (Key PIs) for these objectives are indicated in Table 2 (p.7).

2.1 Required Resources

The announced parliamentary grant-in-aid for 2007/2008 for the Armagh Observatory and Planetarium is again £1,050k (Resource) and £13k (Capital), with the Observatory receiving £660,000 Resource Funding and £6,500 Capital. This is substantially less than that required to maintain current levels of activity in the long term. The amount is the same in cash terms as in 2003/2004, and the effective year-on-year cut in the Observatory's core funding makes it very difficult to plan strategically and for the long term. This difficulty and the associated uncertainty whether bids for research grants or additional DCAL funding may or may not be successful represent two of the highest perceived business risks faced by the organization. For example, while a successful business must generate financial headroom for new projects, a very large fraction of the Observatory's overall costs is related to fixed overheads such as salaries and essential items such as heat, light, power, insurance etc. It is inevitable, therefore, that the announced funding for 2007/2008, were it not augmented by additional funds, would put a severe strain on the Observatory's capacity to sustain its planned programmes of research, outreach and public understanding of science beyond 2007/2008.

In practice, the Skills and Science programme has provided additional funding and an opportunity for the Observatory to expand its education and public outreach programme. This has strengthened the 'educational' side of the Observatory's activities and has provided significant relief in what would otherwise be a bleak picture. Thus, the additional Skills and Science funding has provided the Observatory with a respite in which the expanded research staff can work to obtain more external grant income to support their primary research function.

	2007/2008 Budget	2006/2007 Projected	2005/2006 Actual	2004/2005 Actual
Income				
DCAL Recurrent Grant	660.0	660.0	660.0	660.0
DCAL Additional In-Year Recurrent Grant	0.0	4.6	90.0	94.0
DCAL Capital Grant	6.5	6.5	6.5	6.0
DCAL Additional In-Year Capital Grant	0.0	15.0	35.0	123.8
DCAL Additional Restricted Funds	0.0	13.2	21.9	74.0
DCAL Skills and Science Funding	175.0	124.9		
Total DCAL Funding	841.5	824.2	813.4	957.8
External Grants and Other Restricted Funds	321.3	171.8	167.4	226.4
Miscellaneous Income	14.2	14.0	12.9	11.0
Total External Grants and Other Income	335.5	185.8	180.3	237.4
Total Income	1177.0	1010.0	993.7	1195.2
Expenditure				
Research and Research Support Costs	813.4	642.2	769.2	847.1
Buildings, Buildings Refurbishments and Grounds Costs	102.2	152.0	137.1	251.7
Administration and Corporate Governance Costs	86.4	89.0	72.8	78.0
Skills and Science Costs				
Direct Costs: Leaflets	0.0	2.1		
Direct Costs: Salaries	37.5	28.6		
Direct Costs: Conferences	0.0	9.3		
Direct Costs: Equipment	0.0	23.4		
Direct Costs: Travel & Subsistence	0.4	0.3		
Direct Costs: Consumables	0.0	0.0		
Direct Costs: Student Costs	80.4	40.3		
Indirect Costs: Research Staff Supervision	56.7	20.9		
Total Skills and Science Costs	175.0	124.9		
Total Expenditure	1177.0	1008.1	979.1	1176.8
Surplus/–Deficit Transferred to Reserves	0.0	1.9	14.6	18.4
Balance	0.0	0.0	0.0	0.0

Table 3: Summary of Armagh Observatory Income and Expenditure, presented on an accrual basis. Income is separated into two principal categories: DCAL sources, and External Grants and Other Income. Expenditure is presented under the principal headings of Research and Research Support Costs; Buildings, Buildings Refurbishments and Grounds Costs; and Administration and Corporate Governance Costs. The Table was last updated on 2007 April 10. All tabulated values have been rounded, in comparison with the Accounts, to the nearest £100.

Skills and Science Programme The Observatory's Skills and Science programme seeks to (i) deliver a work-experience programme between May 2006 and June 2008; (ii) provide an education and outreach programme catering for a minimum of 1,000 children per annum between October 2006 and June 2008; and (iii) deliver three highly trained PhD graduates into the workforce in each of the next two years.

In order to deliver this new activity, the Observatory recruited additional staff during 2006/2007: a Skills and Science postdoctoral research fellow and postgraduate and postdoctoral assistance, and new Research Astronomers to help supervise and train the Observatory's PhD students and to participate in the Observatory's EPO programme and enhance its ability to provide periods of work experience for school children. The additional staff will strengthen the Observatory's capacity to obtain external research grants and respond to new Government initiatives in research and education, laying a strong foundation for the Observatory's future development.

2.2 Financial Notes

1. This Business Plan provides a summary, in Table 3, of the Observatory's Income and Expenditure during the past two complete prior years, the corresponding projected expenditure for 2006/2007 taking account of additional Skills and Science activities, and the budget for 2007/2008. Table 2 shows Business Plan targets for the new key performance indicators agreed during the first half of 2006. In order to maintain a link with previous Business Plans, Figure 1 shows the yearly trend of previous key performance indicators, full details of which are presented in tabular form in Table 1.
2. These data demonstrate that the Armagh Observatory has consistently achieved a high level of scientific output and an exceptionally high public profile at the regional, national and international level during recent years. Staff at the Armagh Observatory play an influential role in UK and international astronomy and make a unique contribution to projecting a positive image of Northern Ireland, and Armagh City and District, on the world stage.
3. In recent years the Observatory has spent considerable sums on refurbishing the historic buildings and telescope domes, and ensuring that the buildings and grounds are DDA compliant. During 2006/2007 further sums were spent on additional essential buildings maintenance, aimed at enhancing fire, security, and health and safety measures.
4. We note that considering the recent levels of expenditure under the heading of Buildings, Buildings Refurbishments and Grounds Costs (e.g. £251.7k and £137.1k in 2004/2005 and 2005/2006, the projected £152.0k in 2006/2007), the proposed budget figure for 2007/2008 may be too low. For example, it makes no allowance for the growing wear and tear on the outdoor exhibits and main paths in the Observatory Grounds and Astropark owing to the very large number of people now using this facility (in excess of 38,000 people per year), nor for the need to repair the path up the Hill of Infinity and renew the existing plaques and signage in the Astropark, and eventually also to create a new (DDA compliant) path around the Phenology Garden.
5. Projected figures for 2006/2007 are those before adjustments in the audited accounts for factors such as depreciation and grant amortization, notional interest and the creation of a provision for the pension deficit. There will therefore be a small difference in the final figures for 2006/2007, once the accounts have been finalized; and a possibly larger difference owing to the change in regulations affecting pensions. In this case, the Observatory's pension provider, the NILGOSC, has to provide details of each contributing institution's share of the total scheme assets and liabilities. Under Financial Reporting Statement 17, the Armagh Observatory now has to incorporate its share of the pension scheme's assets and liabilities into the audited accounts for 2006/2007, as computed by the scheme actuary.

As the overall pension scheme is in deficit, the Observatory will need to create a provision in the accounts for its share, and this will affect the balance sheet for 2006/2007. However, as the precise amount is not known at the time of writing (2007 April 10), the amount of the required pension provision is not included in this year's Business Plan. (At the beginning of the year it was estimated to be approximately £70,000.) It should be noted that if the required sum is not matched by additional in-year funds from the DCAL (as now seems likely to be the case), the accounts will show a deficit.

A Institutional Background

The Armagh Observatory (see <http://star.arm.ac.uk/>) is a modern astronomical research institute, the oldest scientific institution in Northern Ireland. Founded by Archbishop Richard Robinson in 1790 as part of his dream to see the creation of a university in the City of Armagh, the Observatory stands close to the centre of the City of Armagh together with the Armagh Planetarium in approximately 14 acres of attractive, landscaped grounds known as the Armagh Astropark. The Observatory Grounds and Astropark include scale models of the Solar System and the Universe, two sundials and two historic telescopes, as well as telescope domes and other outdoor exhibits (see <http://star.arm.ac.uk/astropark/>). A new public outreach facility, the Armagh Human Orrery (see <http://star.arm.ac.uk/orrery/>), is located close to the historic main building of the modern Observatory. The Observatory's Library and Archives, and its specialist collection of scientific instruments and artefacts associated with the development of modern astronomy over more than two hundred years, rank amongst the leading collections of their kind in the UK and Ireland.

The principal function of the Armagh Observatory, which is a third-level institution funded by the Northern Ireland Department of Culture, Arts and Leisure (DCAL), is to undertake original research of a world-class academic standard that broadens and expands our understanding of astronomy and related sciences. In recent years key programmes have focused on Stellar Astrophysics, the Sun, Solar System astronomy, and Solar System – Earth relationships including the Sun's influence on climate and the impact of interplanetary dust, comets and asteroids on the Earth. Other activities include maintaining the unique 210-year meteorological series and data-bank (<http://climate.arm.ac.uk/>), the longest in the UK and Ireland from a single site, and playing a key role together with the Armagh Planetarium in promoting public understanding of astronomy and related sciences.

Senior research staff at the Observatory are employed as Research Astronomers on a scale equivalent to the NICS Grade 7, which is roughly equivalent to the level of a university senior lecturer, reader or professor. Postgraduate students are registered at various UK and other European universities, but they are normally registered at the Queen's University of Belfast (QUB), which has recognized the Observatory as an approved institution for the supervision of PhD and MPhil. students. There is currently a fluctuating population of around 25 research staff including students, who are supported by a pool of 2 technical (computer-related) staff, 1 librarian, 1 secretary, 1 finance officer, and a senior administrator shared (50%) with the Armagh Planetarium. The 14 acres of landscaped Observatory Grounds and Astropark are maintained by an assistant groundsman and a senior grounds/meteorological support officer, the latter responsible also for taking the daily meteorological readings.

Research interests of Observatory staff are currently focused on four main areas of astronomy, namely:

- **Solar-System Science:** including celestial mechanics, planetary science, the dynamics of meteors and other small bodies, the origin of comets, and the interrelationships between comets, asteroids, meteoroids and interplanetary dust, and Near-Earth Objects (NEOs);
- **Solar Physics:** including the dynamic solar atmosphere, the chromosphere and corona, and Sun-Earth relationships including climate;
- **Stellar Astrophysics:** including hot stars, massive stars, stellar winds, degenerate stars and helium stars, asteroseismology, studies of binary stars (including their origins, physical properties, population studies, and the physical properties of ultra-compact binaries), and constraints on gamma-ray burst progenitors; and
- **Galactic Astronomy:** including brown dwarfs, star formation, globular and open clusters.

In addition, Observatory staff participate in a vibrant education and public outreach programme via lectures, popular astronomy articles and interviews with the press, radio and television. Further details concerning recent and current research interests of Armagh Observatory staff may be obtained from the Observatory web-site, at <http://star.arm.ac.uk/>.

The Armagh Observatory participates in the UK Research Assessment Exercise (RAE), held in 1992, 1996, and 2001. This gives external partners, such as UK charities and the research councils, information upon which to base their funding allocations. Staff at the Observatory achieved a Grade 4 in the Physics Unit of Assessment in each of the 1992, 1996, and 2001 RAEs, corresponding to "Quality that equates to attainable levels of national excellence in virtually all of the research activity submitted, showing some evidence of international excellence." **The census date for the next RAE, called "RAE 2008", is 2007 October 31.**

In addition to the institution's primary research role, the Observatory has an important responsibility to maintain and preserve the fabric of the historic buildings, the library, historic books and archives,

and the collection of scientific instruments and other artefacts built up over more than 215 years of continuous astronomical activity in Armagh. The main historic buildings of the Observatory have unique architectural features and house one of the most valuable collections of scientific books, instruments and archives in Northern Ireland. Full details about the Armagh Observatory and its current research and other activities can be obtained from recent annual reports, at <http://star.arm.ac.uk/annrep/>.

The scientific and architectural heritage provided by astronomy at Armagh is a significant asset for the region; indeed, the entire collection of artefacts, scientific instruments and historic telescopes spans virtually every aspect of modern astronomy. In many cases, the development of astronomy at a given time can be explained with reference to discoveries at Armagh, or to artefacts and other items held within the Library and Archives. This provides astronomers with a unique opportunity to explain the reasons for the development of astronomy and related sciences over more than two hundred years and the context in which modern research is carried out.

In short, the Armagh Observatory is a modern astronomical research institute with an exceptionally rich heritage. It provides a high-quality research and education environment and diverse opportunities for public outreach and public understanding of science and mathematics. The Observatory is well placed to contribute to fundamental discoveries in astronomy on the national and international stage, and to the development locally of a wider appreciation of the importance of academic scholarship and scientific research both historically and for the future economic development of the City of Armagh and the region.

A.1 Organizational Structure

The Vision of the Armagh Observatory is:

“To maintain and build on its position as a thriving astronomical research institute, and to continue to expand our understanding of the Universe and of humanity’s place in it.”

The Mission is:

“To advance the knowledge and understanding of astronomy and related sciences through the execution, promotion and dissemination of astronomical research nationally and internationally in order to enrich the intellectual, economic, social and cultural life of the community.”

The Armagh Observatory and the Armagh Planetarium are part of a single corporate entity “The Governors of the Armagh Observatory and Planetarium” described in the Armagh Observatory and Planetarium (Northern Ireland) Order 1995. This superseded the original 1791 Act of the Irish Parliament entitled “An Act for Settling and Preserving a Public Observatory and Museum in the City of Armagh For Ever”, and an Amendment of 1938 (“The University and Collegiate and Scientific Institutions Act [Northern Ireland], 1938”). The Northern Ireland Order 1995 has since been amended by the Audit and Accountability (Northern Ireland) Order 2003. The corporation is registered as a charity under Section 505 of the Income and Corporation Taxes Act 1988. The Armagh Observatory and the Armagh Planetarium operate under separate directors and receive core funding from the Northern Ireland Department of Culture, Arts and Leisure.

The Observatory Director has periodic meetings with the DCAL and reports to a Management Committee which usually meets twice a year, and (annually) to the Board of Governors. The Management Committee (up to 15 members) and Board of Governors (up to 15 members) together comprise representatives from a wide range of parties, including the Church of Ireland, the Dublin Institute for Advanced Studies (DIAS), the Queen’s University of Belfast (QUB), the UK astronomical community (e.g. members of UK universities and the Astronomer Royal for England), the Science and Technology Facilities Council (STFC), the DCAL, and other bodies. Core funding is provided by grant-in-aid from the DCAL, while variable amounts of additional funding are obtained from other grant awarding organizations.

Senior responsibility for both branches of the organization, namely the Armagh Observatory and the Armagh Planetarium, rests with the Management Committee and ultimately the Board of Governors. The two organizations share a joint administrator.

A.2 Research Environment

Technical equipment at Armagh, which is used primarily for numerical analysis, computer modelling and data reduction, is funded by the STFC, PRTL, and the DCAL. Facilities presently comprise a number of iMac workstations, approximately 40 Linux workstations and peripherals, and a computer cluster comprising 25 dual-processor work nodes and one master node with a total of 50 GB memory.

These computer facilities are used mainly for computationally intensive research projects in observational and theoretical astrophysics (including data reduction and modelling) in areas such as solar physics, stellar atmospheres, stellar winds, radiation hydrodynamics, numerical magneto-hydrodynamics, and solar system dynamics.

The internal network is a 1 Gbps backbone ethernet linked with switched hubs. The external network is connected to the Joint Academic Network (JANET) through a 10 Mbps link provided through the Observatory's participation in the Northern Ireland Regional Area Network (NIRAN). The increase in the Observatory's network capacity together with a continuing programme of equipment upgrades provides an opportunity for the Observatory to participate in new developments such as the Virtual Observatory, the UK AstroGRID, and GRID Ireland. Access to Grid technology is currently provided via CosmoGrid (<http://www.cosmogrid.ie/>). This provides access to a high-performance supercomputer cluster at the Irish Centre for High-End Computing (ICHEC).

Armagh Observatory staff regularly obtain telescope time on national and international facilities, such as the ESO Very Large Telescope (<http://www.eso.org/outreach/ut1f1/>) and various spacecraft missions (such as SoHO, TRACE, Hinode, XMM-Newton, and HST), and attract research grants from various grant awarding bodies (e.g. the STFC, the Royal Society, the British Council etc). The Observatory is also a member of the UK SALT Consortium (UKSC), providing access to the 10-metre class Southern African Large Telescope (SALT: see <http://star.arm.ac.uk/SALT/>), located at the Sutherland Observatory, South Africa. In addition, restoration of the Observatory's historic telescopes has brought opportunities to reintroduce professional observing from Armagh for research and student training, particularly through use of the 18-inch Calver reflector equipped with a new CCD camera, and new technology has facilitated the construction of a video camera system that automatically records meteors whenever the sky is clear.

A.3 Staff

The trends in the numbers of research and other staff at the Observatory are given in Table 4. Owing to recent funding pressures (cf. Table 1, p.3), effectively the impact of five successive years of flat-cash core funding, the number of Research Astronomers fell during 2005 and 2006 to just 3. 2006 saw the lowest number of Research Astronomers in post at any time since 1981, i.e. since before the creation of the Management Committee in 1985. Such a fall in the number of senior astronomers put the Observatory in an extremely vulnerable position, and it required strenuous efforts to increase the number of such staff to at least the levels of previous years. The alternative would certainly have been a vicious circle of decline in the run-up to the Research Assessment Exercise, and this might have become irreversible. As a result of a recruitment process completed towards the end of 2006, the objective to recruit more senior Research Astronomers was substantially achieved, so strengthening the Observatory's research capacity and laying a much stronger foundation for the future.

Year	Research Astronomers	Other Academic Research Staff	Core Research Support	Core Grounds and Admin.	External/Visitors and Others	Total
1998	5	17	3	5	4	34
1999	5	18	3	4	4	34
2000	5	16	3	4	5	33
2001	6	14	3	4	4	31
2002	5	14	3	5	3	30
2003	5	14	3	5	3	30
2004	5	18	3	5	4	35
2005	3	16	3	5	3	30
2006	3	16	3	5	4	31
2007	6	16	3	5	6	36

Table 4: The number of Armagh Observatory staff present in various categories at the end of each calendar year. Values for 2007 denote staff numbers at 2007 April 1. Table last updated 2007 April 10.

B Alignment with Government Priorities

B.1 Introduction

There are many ways in which the Armagh Observatory enriches the cultural and intellectual inheritance of Northern Ireland, and — through its world-wide astronomical research mission — also that of the UK, Ireland and the rest of the world. Indeed, in the words of the Prime Minister (2006 November 3), Britain’s path to the future is “lit by the brilliant light of science”. The broadly cultural and economic arguments for the support of fundamental research in astronomy and related sciences have, of course, been well rehearsed. Fifty years ago, Professor Bernard Lovell — arguably the ‘father’ of radio astronomy — responded thus:

“The fundamental answer to this general question is written large in history. It is a matter of deep concern that succeeding generations have so often had to rediscover it for themselves — often by bitter experience. The technical devices which form the basis of the present economic and cultural strength of the Great Powers can be traced within a few generations to fundamental scientific investigations which were carried out in the abstract, without thought of direct practical benefit . . . Fundamental research in astronomy or any other subject is an essential component of the welfare of modern civilization. Unless the West overcomes its parsimonious attitude to science and technology, then the relative quality of our civilization will decline, and our influence will pass to other peoples.”

Sir Bernard Lovell’s words, written half a century ago, have a rich resonance for Northern Ireland. They highlight the wider significance of science in any modern economy, and therefore in particular for the future prosperity of the Region. And they highlight especially the value of fundamental research in astronomy (or any other subject) in underpinning the vitality and confidence of our civilization and the vibrancy of our community.

In short, *fundamental research has a fundamental role to play in the health of the community. Fundamental research implies a commitment to investment in education and skills, and especially in the types of education and skills necessary in order to improve competitiveness.*

International Perceptions of UK Research in Physics and Astronomy 2005 A recent independent review of the state of UK Physics and Astronomy research, commissioned by the Engineering and Physical Sciences Research Council, the Particle Physics and Astronomy Research Council, the Institute of Physics and the Royal Astronomical Society, has brought a number of additional points to this discussion. The report, which can be downloaded from the Institute of Physics web-site at <http://policy.iop.org/Policy/>, draws particular attention to a number of important issues for the whole of UK Physics and Astronomy research, notably:

- the value of physics and astronomy, and of their continued support to Society;
- how the trend for successive UK governments to tie new physics and astronomy money to specific government initiatives at the expense of core funding could undermine the opportunities for physicists and astronomers to follow their instincts in research and the UK’s ability to pursue curiosity-driven research at the highest level;
- the need to improve career opportunities for young research staff, and especially how to achieve the goal of increasing the number of female faculty members;
- how to improve the level of mathematical skills among postgraduate students, a problem which can be traced both to school and undergraduate degree programmes, and how generally to counter what seems to be a growing lack of adequate training in mathematics among young people.

The independent report, which has a UK-wide focus, contains important lessons for the support of physics and astronomy research in Northern Ireland, for example the importance of encouraging our young people to embrace science enthusiastically; the need to nurture our capacity for ingenuity; and the need for society as a whole to develop a more scientific way of thinking and to reject often irrational public debate on scientific issues.

Other broadly astronomical contributions to specific DCAL aims and objectives and to the wider Northern Ireland Programme for Government objectives are briefly summarized below.

B.2 Contribution of Astronomy to Northern Ireland Government Objectives

B.2.1 Cultural Capital

1. Cultural Capital is a key theme underlying the DCAL Strategic Plan. The DCAL Mission “to protect, nurture and grow our Cultural Capital for today and tomorrow”, is not just a major theme of the Northern Ireland Programme for Government, it is central to the work of the Armagh Observatory. The Observatory’s principal function as an astronomical research institute is to *produce and sustain* Cultural Capital.
2. The work is long-term and the Observatory makes a primary contribution to mankind’s accumulated knowledge about the world in which we live.
3. Within Northern Ireland, astronomical research contributes to the generation of a more confident, scientifically literate, informed and prosperous community, and helps to expand its rich scientific heritage whilst developing a growing cultural and educational resource for the future.

B.2.2 Education and Public Outreach

1. A secondary key responsibility of the astronomers at Armagh is to care for and maintain the Observatory Grounds and Astropark, the Historic Library, Archives, and Buildings, and to preserve and display to the best advantage the historic telescopes and scientific instruments.
2. These activities provide a rich addition to the ecclesiastical and built heritage of the City of Armagh. They also provide synergy with other specialist Libraries and Museums in the City (another DCAL responsibility), and help Armagh to achieve a “critical mass” in this area.
3. The Observatory’s active programme of education and public outreach attracts visitors to Armagh, primarily to the Armagh Observatory Grounds and Astropark, and to the Human Orrery and Phenology Garden. During 2004 approximately 20,000 visitors passed through the Observatory Grounds and Astropark; in 2006 the number was approximately 38,000.
4. The Observatory’s achievements in astronomical research, as well as its efforts to promote greater public understanding of science, align closely with the DCAL’s wider aims to improve access to Northern Ireland’s cultural heritage, to create a confident, informed and vibrant community, and to protect, nurture and grow Northern Ireland’s cultural capital for the enjoyment of both present and future generations.
5. Finally, the Armagh Observatory makes a unique contribution to projecting a positive image of Armagh City and District — and of Northern Ireland — on the world stage, and so contributes to greater awareness and economic prosperity of the whole region.

B.2.3 Social, Economic and Cultural Benefits of Astronomical Research

1. Astronomy plays an increasingly important role in modern society. As an educational tool it attracts and maintains the interest of young people in science. It provides ‘clean’ examples of the use of science and technology, and makes a major contribution to knowledge of global environmental change.
2. Modern astronomy is an involving, inspirational activity with a unique ability to spark the imagination and to attract young people towards science and engineering. It has an impact that can last a lifetime and inspire future generations. The Observatory is involved, for example, in International Heliophysical Year 2007, and will contribute to the International Year of Astronomy in 2009 (IYA 2009), for example through its involvement in the Universe Awareness (UNAWA) project, a key component of IYA 2009.
3. Scientists engaging in basic research contribute immeasurably to the intellectual vibrancy of society. They also help to provide the conditions for a strong R&D base and those for society to participate in, and sometimes lead, scientific and technological projects of global significance.
4. Research into astronomy leads naturally to increased public awareness of science and to the development of a more scientifically literate population. The fruits of astronomical research rekindle our unique ‘ability to wonder’: a faculty that in adults often lies dormant.

5. High-level scientific exchange and involvement in joint international projects puts Armagh and Northern Ireland on the international stage, for example through the Armagh Observatory's involvement in the Southern African Large Telescope project. Such projects allow the Observatory to play an ambassadorial role on the world stage and help to encourage international co-operation and greater understanding of cultural diversity.
6. Staff at the Observatory obtain significant amounts of external (i.e. non-DCAL) income to support its work. This helps to sustain a critical mass of third-level research activity in the City of Armagh, providing additional reasons for visitors to come and stay in the City, and makes a significant contribution to the regional economy.

B.2.4 Science in the Community

1. Armagh Observatory maintains a vigorous programme of school work experience and training, as well as accommodating visits by young people including school parties. Both the numbers of such children supervised, and the numbers of days involvement in Observatory activities are on ascending trajectories.
2. The Observatory sponsors public lectures and special events, sometimes in partnership with other bodies, for example the Armagh Visitor Education Committee, and encourages visits to the Observatory, and to the Observatory Grounds and Astropark, by special interest groups and schools. The Observatory also hosts a biennial Robinson Lecture and an associated biennial Robinson Schools lecture.
3. The new Human Orrery exhibit, funded largely by the DCAL with educational material supported by funding from the PPARC, also provides many innovative educational activities for school children and visitors at a variety of levels. As the first such outdoor exhibit in the world, it helps to put the Observatory 'on the map' as a leading centre for research in astronomy education.
4. Staff at the Observatory make many contributions to lifelong learning and the promotion of a deeper understanding of astronomy and related sciences amongst the general public. In addition to attracting visitors to Armagh from throughout the UK and Ireland, and abroad, they help to promote wider knowledge and understanding of the Observatory's unique meteorological record, the longest in the UK and Ireland from a single site, and of Ireland's and Northern Ireland's significant astronomical heritage.
5. Observatory staff answer many technical questions on astronomy from members of the public, and engage actively with the mass media: radio, television and the press. In addition, the Observatory web-site attracts more than a million Distinct e-Visitors every year, who together download more than 3 Terabytes of data and other astronomical information every year.
6. The Observatory is a recognized centre for providing public information on a wide range of scientific issues of public concern, ranging from the possible causes of Global Warming and the risks associated with the Near-Earth Object impact hazard to civilization, to explaining how to save energy and minimize your carbon footprint by reducing Light Pollution.
7. All these activities engage students and young people in science and help to generate the conditions necessary to create a scientifically more literate society.

B.2.5 Shared Future

1. Recognition of the UK and Ireland's shared cultural heritage in astronomy helps to improve knowledge of the history of these countries' significant contributions to this international endeavour, contributing directly to the goals of the 'A Shared Future' initiative, promoting both 'North-South' and 'East-West' collaboration, and encouraging greater mutual understanding throughout the British Isles.
2. The Armagh Observatory attracts significant numbers of staff and students to Armagh from across the world. Such people are ambassadors for their countries within Northern Ireland and the quality of their interaction with the local population helps to break down many of the barriers associated with prejudice and racism.

3. In the same way, the Observatory supplies astronomical ‘ambassadors’ from Northern Ireland to other countries. The related high-level personal and scientific exchanges, and involvement of the Observatory in joint international projects, help to put Armagh and Northern Ireland on the international stage, for example through its long-standing connections with South Africa and the Observatory’s involvement with the Southern African Large Telescope.