



**PROVOST'S REPORT TO COUNCIL ON
THE REVIEW OF THE
DEPARTMENT OF PHYSICS**

1. INTRODUCTION

This report presents the outcome of a departmental review exercise undertaken by Trinity College Dublin in relation to its Department of Physics. The report is based on (i) feedback from an external peer reviewer visitation, conducted on the 14th and 15th of October, 2003 by Professor Donal Bradley, The Blackett Laboratory, Imperial College of Science, Technology & Medicine, University of London and Professor Margaret Murnane, Joint Institute for Laboratory Astrophysics, University of Colorado at Boulder, received on 19th January 2004, (ii) a submission from the Faculty Dean received on 13th February, 2004, and a submission from the Department, received on 9th February, 2004.

As Council is aware, the main purpose of the departmental review exercise is (a) to provide a structured opportunity for the Department to reflect on its activities and plans for development, while benefiting from a constructive commentary by senior colleagues external to the college; and (b) to ensure that quality and standards in teaching, research and administration are being maintained and enhanced, and that any areas of concern in this regard are identified and addressed within an eighteen month timescale. This review process ensures that each academic department in College will have its undergraduate and postgraduate provision reviewed systematically once every five years.

2. OVERVIEW OF THE DEPARTMENT

2.1 Aims and Objectives of the Department

1. To develop its international reputation as a recognised centre of excellence in optics, condensed matter physics and nanophysics.
2. To provide a high quality learning and training environment with excellent academic standards in physics and materials science at both undergraduate and postgraduate levels, leading to professionally recognised qualifications.
3. To sustain excellence in basic and applied research and, where appropriate, encourage industrial exploitation of the results, facilitating industrial innovation and technology transfer and providing resources of knowledge and skill to society in general.

2.2 Programmes to which the Department provides teaching

Key Programmes:

Undergraduate

Physics 'Moderatorships' (BA Degree Courses)

- Physics within the Science moderatorship
- Astrophysics as an option within Physics
- Theoretical Physics (joint course with Mathematics)
- Computational Physics (joint course with Computational Chemistry)
- Physics and Chemistry of Advanced Materials

Postgraduate

Diploma/M.Sc. in Polymer Science and Technology

2.3 Research

Almost all research activities fit well into the general theme of 'Materials Physics.' The activities of most staff members span more than one area. This leads to synergies, fostering internal and external collaboration. Members of the Department publish 100-150 peer-reviewed articles in international journals annually, plus books. They regularly participate and contribute to major international conferences. About 30 percent of all TCD Physics publications involve joint authorship between several academics in College. Research teams carry out a great deal of technology-driven research in collaboration with other departments and with other major centres nationally and internationally. The new Sami Nasr Institute of Advanced Materials is an exemplary interdisciplinary research centre pioneered by the Physics Department together with Chemistry and Electronic Engineering. The Department has an international reputation for excellence in research, with achievements in the following areas: Condensed Matter and Surface Science, Photonics and Modern Optics, Computational Physics, Magnetism, and Nanotechnology. A Centre for Research on Adaptive Nanostructures and Nano devices (CRANN) is under development with proposed Science Foundation Ireland (SFI) funding. In the Photonics area, two further SFI research centre proposals are in development.

2.4 Summary statistical profile of the Department for the academic year 2002-2003¹

Staff FTE	Undergraduate FTE	Postgraduate FTE	Staff: Student Ratio
24.30	199.59	85.00	12

¹ Figures from Senior Lecturer's Annual Report.

2.5 Accommodation and Facilities (Physical Resources)

The new 6,000 m² Sami Nasr Institute for Advanced Materials houses many of the Physics Department's laboratories and offices. Others are in the older Fitzgerald building. In 2003 the newly refurbished SFI Nanoscience laboratory was opened at the rear of the Chemistry Building. It now houses a part of the Department's SFI Fellows' laboratories and offices. Additional study space for postgraduate students and postdoctoral fellows is provided in areas adjacent to the Department.

3. EXTERNAL PEER REVIEW REPORT

In their introduction to their report, after noting the impressive history of the TCD Physics Department, the reviewers say *'Very dramatic developments have occurred more recently and in the last couple of years there has been a step change in [the Department's] space envelope, teaching and research infrastructure, and most dramatically research volume and income.'* They continue, *'The step change is clearly a consequence of the Department's irrefutable success in pursuing a number of exciting research opportunities, especially those afforded by the advent of Science Foundation Ireland (SFI).'* The report from the external reviewers continues with comments and recommendations for the Department related to teaching, research, resources, and organisation and management.

TEACHING

The reviewers commend the Department for running successful undergraduate degree programmes and feel that the Department takes its teaching mission very seriously. They note that *'the Department's Teaching Committee is very much in tune with current thinking and practice in the teaching of Physics.'* The curriculum has undergone a detailed review and updating to improve cohesion. Students have a wide choice of areas of emphasis. A number of teaching strategies are used to help students' conceptual understandings, including small group tutorials, scene setting overview lectures, intranet-based resources, group projects, poster presentations, and laboratory investigations that require student engagement in design and planning. Students expressed appreciation to the reviewers regarding the year coordinators, particularly those who are highly visible at the start of term to provide an overview of the course matter. The external reviewers also remarked, *'The Department's "Lecture Courses and Syllabus" booklet provides a clear and concise summary of the courses, recommended texts and methods of assessment in a handy format.'*

In commenting on the courses and students, the reviewers noted differences between those in the Theoretical Physics course and those in the Moderatorship in Physics, with the Theoretical Physics students having considerably higher entry points. For those in the Moderatorship, *'the median degree classification appears to be somewhat variable with only a third of students gaining first or II.1 in the last two years compared to 50 percent three years ago and 77 percent four years ago.'* Most of these students tend to continue their education at TCD. In contrast, those in the Theoretical Physics course are *'an identifiably distinct group with a quite different experience in terms of their workload and course structure and also seemingly in respect of their choices for subsequent destination upon graduation.'* These students tend to go abroad for work or further study after graduation. The reviewers expressed concern that Computational Physics has *'suffered from a drastic downturn in applications'* which may be related to *'the waning interest in the computer sector of the economy.'* The Physics and Chemistry of Advanced Materials course strongly mirrors the research interests of the Department and *'serves an important role in providing prospective students for the Department's postgraduate research activities.'* Finally, the reviewers expressed interest in the new course in Astrophysics which is under consideration. They felt that this subject often appeals to a wider group of prospective students and the appointment of a lecturer in this area will strengthen links with the Dublin Institute for Advanced Studies (DIAS).

In relation to graduation, the reviewers expressed some concern that *'there seems to be some fragility in respect of maintaining a healthy cohort year on year with quite large fluctuations in the number of graduating students.'* They note that in 2003 there was a total of 35 graduates, but there is an expectation of nearly 70 graduates in 2004. This brings concerns related to funding and student recruitment. The reviewers suggest that it may be possible to increase student numbers through overseas recruitment, and they commend the Department for being *'forward thinking in its approach to recruitment and . . . outreach activities with the Trinity Access Programme and ESAT/BT Young Scientist of the Year exhibition.'*

Regarding teaching loads, the reviewers felt that the distribution of teaching across staff members was *'fairly well spread'* but teaching loads are slightly lower than Imperial College. The reviewers expressed concerns about the high load of service teaching resulting from the relatively small specialist Physics student numbers. They also expressed concerns about the low numbers of students in the M.Sc. in Polymer Science, and say *'it is not then clear that there really is a strong need for this course.'*

In addition, the reviewers note that *'the Department also runs internal postgraduate level courses for its research students.'* They feel that these courses *'serve an important role in developing the knowledge of the postgraduate students in ways that are likely to enhance their attractiveness to subsequent employers.'* The reviewers recommend *'a rethink on the subject material and mode of delivery'* and note that similar courses are well established in the UK.

Regarding teaching methods and structure, the reviewers note that the JF Science course students have *'very little time to cover much of the core Physics that will be needed in later years'* and that generally speaking *'there would be a larger component of laboratory work in the UK and substantially more tutorial based teaching.'* They commend the Department on the good opportunities provided for study abroad, the process for student feedback on the courses, and the quality of the project work undertaken by students as expressed by the external examiners.

The reviewers commend the excellent staff-student relations within the Department, as evidenced by comments from the students, the external examiners' reports and discussions with staff. However, the reviewers express concern that the Department's rapid growth may put a strain on this situation, particularly in the postgraduate area. They note that *'The introduction of a Director of Graduate Studies is a timely addition to the Department's support structure.'* They also commend the staff open door policy for office hours and note that this is appreciated by students.

RESEARCH

The reviewers begin by commending the Physics Department on building up the level of research in the last few years. They recognised that research funding has increased significantly since 1998, and noted that the Physics Department now generates the largest amount of external grant funding of any department in TCD. They said that *'funding levels per faculty [staff member] in TCD Physics are comparable to those per faculty in Research 1 tier Physics Departments in the U.S.'* The reviewers continued, *'the excellent track record of TCD Physics in terms of publication output and concentration on research and teaching excellence put the Department in a great position to benefit from the new funds available through Science Foundation Ireland.'* They were impressed with the Sami Nasr Institute for Advanced Materials and indicate that the research strength of the Department is in materials science.

The reviewers noted that the TCD Physics Department is *'the most active and internationally recognised department in the country'* and felt that *'a Grade 5 rating would be very likely in the UK Research Assessment Exercise (RAE)'* and that a subset of staff *'could be expected to be rated 5*.'* The reviewers felt that it would be difficult to make a direct comparison of the TCD Physics Department with those in the U.S. due to the wider range of colleges and universities and non-uniform standards. In addition, the reviewers noted, *'An issue that contrasts strongly with the situation in the UK and US is the level of overhead return on research grants and contracts.'* They continue by pointing out that in the U.S. *'the overhead rate for most public universities is 48%, and around 65% for private institutions such as MIT. The standard Research Council rate in the UK is 46 % on staff . . . and this rate is expected to rise substantially in the next couple of years.'*

The reviewers felt that it is important to update the policies regarding contract staff to ensure that they are not overburdened with administrative duties and they suggest that contract staff should be allowed *'to take equipment they buy for their research programs through their own grants to another university if they do not get tenure.'* In addition, with the rapid rise of research activity, the reviewers felt that it is important for *'the College to allow the Physics Department significant freedom to decide who they will hire and when a new hire is needed.'*

Regarding research students, the reviewers were impressed with the students they met and felt they were *'articulate, motivated, well able to describe their exciting research projects, and happy with the research opportunities they had in the Department.'* The reviewers were impressed with the activities of the research students, noting that they attend conferences to present their work and network with others. The reviewers commented on the very high quality of research postgraduates, noting that there were about 90 postgraduate students are pursuing postgraduate degrees in Physics at TCD, supported either by research grants or fellowships. The reviewers felt that *'the time taken to obtain a Ph.D. degree is reasonable at 4.5 to 5 years.'*

In terms of a research strategy, the reviewers noted concerns that '*SFI is creating a two-tier research structure.*' They went on to say that SFI may have too much influence in the future directions of research in Physics rather than the Department identifying the next growth areas.

RESOURCES

The reviewers observed that the Department feels that the number of support staff (technical and administrative) should have risen in line with the increases in postdoctoral research associates and MSc/PhD students. The reviewers noted, '*in comparison with Imperial College, however, the provision does not seem anomalous.*' In fact, they continue to suggest that '*the administrative complement in the Department is low rather than the technical complement.*' However, they also observed that '*reinstatement of the lost Chief Technician 2 post would go a long way to addressing concerns*' related to technical support. In addition, the reviewers noted that the reorganisation that has taken place with the refurbishment of the Fitzgerald Building and other moves has been disruptive.

Related to facilities, although the reviewers did not have an opportunity to see the teaching laboratories, they observed that the computer suite for Computational Physics and Chemistry looked very good. They went on to note that the lecture/seminar rooms appeared to be in a good state of repair, and were well equipped with audio/visual facilities. They noted that '*the Department has been making a strong effort to build a database of computer based teaching illustrations and to make these available to all staff.*' The reviewers thought that the research facilities were '*excellent in terms of laboratory space and equipment provision*' as a result of the SNIAM building and the Department's success with grants. Through recent updating of laboratory space in the Fitzgerald Building and the old Chemistry extension, the reviewers felt that '*the result is very much an internationally competitive space in which to undertake research.*'

ORGANISATION AND MANAGEMENT

The reviewers commended the Department for creating a Director for Graduate Studies and for the recent instigation of a new Deputy Head of Department post. However, they felt that it may be difficult to make decisions in the Departmental Committee, a rather large body in comparison to the executive committee which exists in similar departments in the UK and US. The reviewers also questioned '*whether there was any duplication of function amongst the Department's committees. How do the roles of the Staff Meeting, Administrating and Technical Staff Meeting and Departmental Committee differ?*' Finally, the reviewers commented that '*there appears to be no staff-student committee with elected representatives from the undergraduate and postgraduate bodies.*' They note that these committees are integral to physics departments in the UK and US and felt that it helps to address issues that arise from students.

Finally, the reviewers observed that '*the Department makes a significant contribution to College management and its committees.*' The current Provost came from this Department, as have previous Bursars and Deans. In addition, the reviewers felt that the wide representation of Department staff in other college roles, including tutors and committees, is '*fully commensurate with the Department's leading status within the College.*'

RECOMMENDATIONS

The reviewers started their recommendations with the statement, '*It is the overwhelming sense of the reviewers that the Department of Physics at Trinity College has done an outstanding job in increasing its research profile, while at the same time maintaining its traditional excellent teaching standards and positive departmental morale. This is a very difficult task, and the Physics Department deserves to be rewarded for this great achievement.*'

The reviewers set out a number of recommendations:

1. *It is important for a department to identify the next great areas of growth. At present this is difficult for TCD Physics to do, because obtaining funding in such new areas might be difficult in Ireland. If research funding is directed only at certain priority research areas, and future funding levels are uncertain, this will limit the intellectual breadth of the Department. Inadequate*

overhead return to the Department and the College will make it difficult to maintain the research infrastructure. Perhaps the Department can work in a coordinated way with others to influence SFI to diversify the research focus. A long-term strategy is needed within Ireland to overcome limitations so that forward-looking departments like Physics at TCD can attain their full potential.

- 2. We believe that policies regarding the contract staff need to be updated. Some rethinking of the career path for contract staff should happen – either allowing the Department to convert contract staff to permanent positions given how well it has done, or in allowing these people to build up a research program that they can use to get their next job.*
- 3. Because research and office space within Physics is spread over many buildings, and with the creation of a new Nano-Bio institute (CRANN), the Department will have to work to compensate for this physical separation in order to maintain cohesiveness. TCD should have as a priority in the long term the location of all areas of Physics in close proximity.*
- 4. If Astrophysics is deemed a desirable one in which to launch a new full blown course then it may be prudent to seek TCD-based or TCD-DIAS joint appointments to ensure sufficient control over teaching resources.*
- 5. The number of students in the Postgraduate Diploma/MSc in Polymer Science is small and it is not clear that there really is a strong need for this course. However, this course was developed in recognition of the growth in polymer related industry. Enhancing uptake is highly desirable and probably requires strong involvement from the relevant professional organisations in Ireland.*
- 6. A specific social space in the Department for use by the undergraduate (and postgraduate) students would be much appreciated and help to keep students in touch with each other and with Department staff. This is an important request that we believe is worthy of best endeavour to put in place.*
- 7. The students would like some organised opportunities for social interactions, particularly in view of the fact that the Department office and research space is fragmented. Such social interactions provide opportunities for senior students and postdoctoral researchers to advise junior students and for all students to compare experiences and motivate each other. It also prevents isolation of new students. An annual research poster exhibition for the students in the Department would provide an excellent opportunity for student socialising, and provides opportunities for junior students to practice explaining their work to colleagues. Finally, it might be good to encourage the students to form their own student council, to provide opportunities for planning their own social events.*
- 8. If there is currently no staff-student committee with elected representatives from the undergraduate and postgraduate bodies, we would strongly recommend that the Department set one up.*
- 9. Currently there seems to be some disparity in the rate at which postgraduate research students are paid, where students funded by SFI receive higher stipends than do other students. The Department should set a reasonable range for student stipends for the sake of equity.*
- 10. The Department should address concerns expressed by postgraduate students related to the current location and quality of their office space (the Arches) and the computing facilities in this space.*
- 11. Because of the larger postgraduate student body, some career seminars would seem appropriate each term.*
- 12. As the Department grows, a wider selection of courses might be made available, and more flexibility about which courses can be taken would be good. The Department should continue to provide courses for postgraduate research students.*
- 13. As the postgraduate research effort at TCD transitions from a growth phase and becomes self-sustaining, students should be encouraged to go elsewhere for their postgraduate and postdoctoral*

training experiences. This will give them a broader exposure to different research areas and research style, and increase their networking opportunities for future job prospects.

4. RESPONSES FROM THE DEPARTMENT AND DEAN OF FACULTY

The Dean of Science expresses appreciation to the reviewers for a very complimentary report. In relation to the reviewers' comments on the *'worrying fluctuation in the number of students who graduate in Physics at TCD,'* the Dean notes that this is true. However, he also indicates that the staff of Physics constantly works to increase interest in Physics at Second level through school visits and a very good Open Day in November. Although the interest in Theoretical Physics and in Physics of Advanced Materials is improving, the areas of Computational and Experimental Physics continue to be problematic. The Dean notes, however, that *'this pattern of interest, however, is true throughout Europe, with the exception of the top universities, such as Imperial College.'* He also states that the postgraduate numbers in Physics are very healthy.

In response to the reviewers' comments that *'SFI and EU programmes are driving the direction and scope of research,'* the Dean agrees that this is true but unavoidable. He says, *'Physics needs big teams and costly equipment. SFI is also mainly responsible for the high level of contract staff in the Department.'* He commends the physicists for being adaptable and exploiting current sources of money.

The Department is *'extremely grateful to the reviewers for the thorough and helpful job that they have done.'* They feel it is gratifying to know that this Department would command a "5" rating in the UK system. The Department is in agreement with the reviewers on the important points raised regarding threats to the Department which include the disruptive effects of loss of contract staff, fragmentation of space, and inadequate overhead returns. The Department appreciated the reviewers' positive comments about the *'efficient and well organised'* teaching activity with *'a very good rapport between the staff and students'* and they agree with the recommendation that the Department consider enhancing personal interaction with students in the educational and social contexts.

The Department has taken several steps in response to the report. In relation to undergraduate courses, the Department has a regular meeting of student representatives with the Teaching Committee; they will explore the possible extension of Small Group Tutorials as resources allow; and they are giving careful consideration to the evolution of the Astrophysics option. For postgraduate students, under the new Departmental Director of Graduate Studies, they are *'already considering all aspects of the organization of postgraduate study within the Department,'* and they will monitor the level of demand for the Diploma/MSc in Polymer Science.

Regarding staff issues, the Department states that *'We are proposing that the new CRANN centre and its relevant staff be closely associated with the Department to mitigate the tendency towards a two-tier research structure. We will actively encourage all academic staff to consider how they could contribute to the CRANN research programme.'* In relation to technical staff, the Department differs with the view of the reviewers that the level of technical support is adequate. However, there is agreement that *'the reinstatement of the recently lost 'Chief Technician 2' post would contribute to the maintenance of morale of the technical staff.'*

Finally, the Department feels that its internal organization and management structures are working well, and that the reviewers may not have appreciated that the staff committee (Academic Staff plus representatives of Technical and Administrative staff) largely fulfils the function of an executive committee, recommended by the reviewers. The Department has also recently instituted teaching and finance committees and has a flexible attitude towards the future evolution of these structures, as needs arise.

5. RECOMMENDATIONS TO COUNCIL

In addition to the Department addressing the detailed recommendations outlined in the reviewers' report, the following recommendations are made to Council in light of the reviewers' report and the responses from the Department and the Dean:

- (a) that the Department should:
 - 1. Build on its excellent achievements with regard to research and clearly identify its future direction and focus in this regard.
 - 2. Nurture the existing positive elements of its teaching programme and its approach to students and take on board the recommendations of the reviewers in relation to possible improvements.
 - 3. Reconsider the range of its teaching programmes at undergraduate and postgraduate level in light of student demand and new developments in the field.

- (b) that the Faculty should work with the Department to:
 - 1. Integrate the SFI/CRANN staff with the Department and Faculty.
 - 2. Address issues in relation to the distribution of technical and contract staff in the Faculty.

- (c) that the College should:
 - 1. Take into account the views of the reviewers and the Department in the current discussion on possible devolution of control over staff hiring and budgets.
 - 2. Make plans to address the issue of the physical separation of areas of the Physics Department in the light of the Development Control Plan.
 - 3. Continue to argue for appropriate levels of overheads in all research grants.

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