



## PROVOST'S REPORT TO COUNCIL ON THE REVIEW OF THE SCHOOL OF MATHEMATICS

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### 1. INTRODUCTION

This report presents the outcome of a school review exercise undertaken by Trinity College Dublin in relation to its School of Mathematics. An external peer review visitation was conducted on the 4<sup>th</sup> and 5<sup>th</sup> of April, 2007 by Professor John Toland, University of Bath, Professor Robbert Dijkgraaf, University of Amsterdam, and Professor Nigel Hitchin, University of Oxford. During the site visit the reviewers met with all staff of the School, staff of cognate schools and departments, members of Science Foundation Ireland, representatives of undergraduate and postgraduate students and research fellows in the School, and senior officers of the College.

The report is based on (i) feedback from the external reviewers, received on Tuesday 29<sup>th</sup> May, 2007, (ii) a submission from the School of Mathematics received on Tuesday 26<sup>th</sup> June, 2007.

The main purpose of the School review exercise is (a) to provide a structured opportunity for the School to reflect on its activities and plans for development, while benefiting from a constructive commentary by senior colleagues external to 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 respect are identified and addressed within an eighteen month timescale, having regard to the resources available. This review process ensures that each academic school in College is reviewed systematically once every seven years.

### 2. OVERVIEW OF THE SCHOOL

#### 2.1 Aims and Objectives

The aims and objectives of the School of Mathematics are:

- (i) To reach a level of international standard in specific subject areas, both in research and teaching, comparable with departments of universities such as Cambridge, Imperial College and Edinburgh.
- (ii) To publish, in leading journals, high quality papers which will impact modern developments in the mathematical sciences.
- (iii) To establish new undergraduate and postgraduate courses within the School as well as cross-disciplinary courses.
- (iv) To increase the size of graduate student population.
- (v) To actively seek outside funding for research and graduate students.
- (vi) To increase the School's income from College funds.
- (vii) To make new appointments both in Pure Mathematics and Theoretical Physics.

#### 2.2 Programmes to which the School provides teaching

*Key undergraduate programmes*

- Mathematics
- Theoretical Physics
- Two – Subject Moderatorship Degree Programme

*Postgraduate (taught) programmes*

- M.Sc in High Performance Computing

### 2.3 Research

The School provides for postgraduate degrees by research in a range of Mathematical Topics reflecting the research profiles of the staff of the School.

### 2.4 Summary Statistical Profile of the School for the Academic Year 2005-2006<sup>1</sup>

Full-time staff FTE	Part-time Staff FTE	Undergraduate FTE	Postgraduate FTE	School Staff: Student Ratio	Faculty Staff :Student Ratio
18.40	3.69	395.27	25	19	15

<sup>1</sup> Figures approved by Council at its meeting on 6<sup>th</sup> December 2006

### 2.5 Accommodation and Facilities (Physical Resources)

The School is located in the Hamilton Building, East End 4/5, Trinity College Dublin.

## 3. EXTERNAL PEER REVIEW REPORT

### SUMMARY OF REPORT

As a background to their Review Report the reviewers noted that the 1998 Review of the Mathematics Department recommended the filling of the then two vacant chairs "... in order to enhance the research profile and cater for the sharply increasing number of students." These chairs have been filled and the reviewers commended the "...focused, aggressive recruitment campaign which has resulted in some very good young appointments." This has in turn improved the research performance of the School and has "put it on the map with respect to the chosen disciplines...for example, the string theory group should be considered among the leading groups in Europe." The reviewers add the proviso, however, that since 1998 other issues have arisen "often common to universities around the globe, which now need to be dealt with."

### 3.1 TEACHING

#### 3.1.1 Undergraduate Teaching

The reviewers note that the current degree programme consists of intensive year-long courses "which are deep and serve well those students that find them interesting." Citing the theoretical physics course as an example, the reviewers observed that such courses "are hard to find at other institutions and contribute to the special character of the education at Trinity." They also agree with the External Examiners who commended "the very high academic standard of examinations and the quality of the students who took them." The reviewers felt that some basic subjects were peripheral to the course and question "whether the right balance is being struck" stating in particular that algebra was being taught "on an ad hoc basis," and suggested a new appointment in this subject, if the resources become available.

#### 3.1.2 Undergraduate Students

The reviewers considered the undergraduate students to be "a great asset to the School" and commented that "the best students in Mathematics are absolutely excellent." In this context they noted that reports of External Examiners "repeatedly mention the high level of academic excellence in the examinations." The reviewers, however, consider "the unacceptable dropout rate of between 20% and 30%" at undergraduate level to be a matter of concern and feel that the School "needs to seriously question why this should be." Noting that the developed world has seen a move away from physical sciences and mathematics by students and that "widening access to education is leading to changes in the skills of school leavers," the reviewers feel that the School of Mathematics should follow the example of the best universities and begin to adjust "...their curricula and teaching methods accordingly..." They advise that the structure of the undergraduate courses needs to be re-examined, and suggest that "modularisation of courses, and the breaking up of the current structure using ECTS..." as one way to address the high level of student attrition.

#### 3.1.3 Taught M.Sc Course

The reviewers were very impressed by the quality of the M.Sc Course in High Performance Computing and by the organisation of that programme in spite of the limited resources available to it. The students on the programme also impressed the reviewers and having met many students with varied academic backgrounds and differing plans for the future, the reviewers felt that *"it was clear that there was a demand for an enlarged programme, both in terms of available students and the eagerness of staff."* They noted that a way of increasing enrolment *"would be to devolve admissions to the Department so that offers, particularly to overseas students, could be made earlier in order to compete internationally."*

In the matter of physics, the reviewers advise that in light of a pending retirement that *"careful preparation for one of the younger generation of staff to give this course should start soon."*

Generally speaking the reviewers emphasise the need for *"a consensus on policy about future appointments."*

### **3.2 RESEARCH**

The reviewers note that there is now *"an unusually strong theoretical physics group comprising slightly more than half the department and a strong group in partial differential equations led by the Pure Chair."* They note that the strongest publication records during the last five years *"belong to the new appointees."* They consider the predominance of research activity amongst staff members in the 30-40 age bracket to be normal and believe that the strong performance of younger staff will continue. The reviewers feel that the opportunity now exists to increase the number of research students in the areas of research strength *"and thereby also strengthen the international visibility"* of the School.

#### **3.2.1 Research Students**

The reviewers state that the quality of the School's Ph.D. students appears to be good and that interesting publishable research is being done. They also expressed the view, however, that the number of Ph.D. students *"have not yet caught up with the research activity of the staff and their numbers are not commensurate with the reputation of the College."* Noting that this situation seems to have changed very little in the last ten years, the reviewers consider that the School should pursue more enthusiastically *"the recruitment of research students and inspect it's current procedures more closely."* Observing that current research students seem to emerge mainly from the undergraduate programme, the reviewers suggest that *"it would be good to see, in the course of time, the exciting pure mathematics that is involved in string theory becoming attractive to more graduate students."* They also recognised that this may require a wider range of pure courses at advanced level, with the consequent need for staffing issues to be addressed.

With regard to the facilities available for graduate students, the reviewers consider that *"computer provision appears to be adequate"* despite limitations on space. They also note that there is a Mathematics Library *"which, though small, fulfils an important role."*

The reviewers believe that the School should engage more in the Bologna process at postgraduate level, noting that prospective students need *"to know what they want to do before they arrive..."* The School should address *"the further implications of the Bologna process for the recognition of PhD programmes across Europe, and for the teaching of undergraduate and postgraduate Mathematics at Trinity, more generally."* The reviewers feel that it should be possible for the School to work with other Dublin universities in organising basic Masters' level courses for all their students pointing out that this option is mentioned in the Department's Strategic Plan *"but there seemed to be little progress so far."* In general, the reviewers were of the opinion that Bologna should be a motivating *"force to put in place joint activities which make the postgraduate course more attractive to outsiders."*

The reviewers note that a flexible use of funding from various sources has *"enabled a number of highly active postdoctoral researchers to come to the School, mainly in the research areas of the two Chairs and Lattice QCD."* They also believe that the presence of these individuals is important in helping to provide an encouraging environment for postgraduate research as well as *"contributing to the research projects for which they were employed."* The reviewers are further of the view that the Hamilton Mathematics Institute (HMI) has the potential to be similarly beneficial.

### 3.2.2 Research Funding

The reviewers were reminded repeatedly that resources for the funding of scientific research in a small country were, by necessity, at a different level from that of larger countries. They point out, however, that the situation has changed considerably since the last review with the introduction of funding organisations such as the SFI (Science Foundation Ireland).

Commenting on the view of the School that there may be geographical and institutional bias in the allocation of funds to mathematics, the reviewers noted that they were assured that this was not the case, and observed that the SFI *“had made a special case for significant funding of mathematics outside its core agenda which is to support nanoscience, biotechnology and information technology,”* and that Trinity’s School of Mathematics *“has been notably successful in obtaining”* grants under the SFI’s Research Frontiers Programme. Commenting on the School’s view that it was being automatically excluded from large awards under SFI control due to the School’s *“narrow research portfolio”* and *“lack of industrial partners,”* the reviewers acknowledged *“that there is truth in this,”* but suggest that *“possibilities do exist for existing staff to take advantage of what is available, particularly in collaboration with other departments in Trinity and colleagues in other universities.”*

The reviewers believe that the School *“should explore more actively resources available for funding of research students in mathematics and coordinate planning of other departmental activities in order to create resources for research.”*

### 3.2.3 Hamilton Mathematics Institute

The reviewers noted that the stated purpose of the Hamilton Mathematics Institute (HMI) is *“to foster mathematics and related disciplines ... and to improve the public understanding of mathematics.”* It is their stated view that the HMI has served as *“a useful focal point for specialised conferences and for an impressive programme of outreach and public awareness activities”* involving collaborations with outside bodies. In order for it to be sustained the reviewers feel that the Institute needs to secure more stable funding *“and to do this means winning national support for its aims and objectives.”* They suggest that *“even local support, beyond the existing DIAS link, is necessary”* citing as an example the creation in 1992 of the International Centre for Mathematical Sciences in Scotland through cooperation between Heriot-Watt and Edinburgh Universities.

## 3.4. MANAGEMENT AND ORGANISATION

The reviewers feel that it is important for the School *“to stabilize its income from all sources if it is to maintain its current size, or increase it.”* Noting that there was a high level of concern about the resources available to the School, they urge a greater willingness to address the cause of the problems. The reviewers identified the main factors which they considered the most obvious current threats to resources and the potential for long-term planning. These are *“the erosion of service teaching, the drop out rates from undergraduate courses”* and failure to recruit the requisite intake, *“the failure to recruit postgraduate students in sufficient numbers and the research profile of the School being out of line with current SFI schemes.”* The reviewers observed that the burden of dealing with all these issues, as well as all other strategic planning, *“currently falls overwhelmingly on the two Chairs”* and noted that this *“does not seem appropriate given the significance for Trinity of the issues involved.”* The reviewers observed a high level of commitment to the School among staff but found that planning, even for the School’s research profile *“is more opportunistic than strategic.”* Amongst the support staff, the reviewers felt there was enough work for another part-time employee and recommended the appointment of a systems administrator.

Overall the reviewers feel that there is a need for *“a clearer view of the future shape of mathematics at Trinity and a prioritization of objectives which reflects the overall needs of the School.”*

## 3.5. RECOMMENDATIONS

### 3.5.1 Teaching

- (i) Attend to the problem of undergraduate retention by course restructuring.
- (ii) Build out from the research strengths of the School to offer undergraduates a wider choice of core knowledge and research study opportunities.

### 3.5.2 Research

- (iii) Explore more flexibly research funding opportunities together with other departments and external bodies.

### 3.5.3 Management / Organisation

- (iv) Reactivate the committee structure to involve more of the School staff in decision-making; produce a record of decisions made; and create an ordered list of School priorities, developed in the light of both teaching and research considerations, to be executed if and when opportunities arise.
- (v) Provide a more efficient system for applications to the High Performance Computing M.Sc course to increase numbers of students.

## 4. RESPONSE FROM THE SCHOOL

The School of Mathematics welcome the reviewers assessment and believe “... *that the spirit of the entire report, including its positive and critical parts, clearly shows that the authors consider the School as a serious competitor*” on the international stage. The School feels that it has accomplished its mission of rebuilding the School in the last five years, noting that the report gives “*an extremely strong rating to the School in activities that have been prioritized...during the last five years.*” The School management has “*focused on bringing top level academics to TCD in Mathematical Sciences and this has occupied almost all their efforts.*”

In response to the reviewers concern about the high attrition rates, the School comments on its commitment to set up a “...*a special committee to study this question.*” in order to understand the explicit reasons why students are leaving. The School strongly believes that in order to have “*quality and visibility*” in mathematics, it needs to build strengths in core subjects such as algebra and geometry, but feels that this will be difficult under the current funding allocation model within Trinity College.

With regard to the low number of Ph.D. students in Mathematics, the School comments that this is largely due to funding limitations and eligibility restrictions for some funds, as well as the fact that 75% of the academic staff was recruited within the past few years and younger members of staff need time to develop their research and attract funding in order to take on Ph.D. students. The School is, nonetheless, planning to increase Ph.D. student numbers to the “*maximum possible level of two PhD students per active permanent member,*” and to “*use aggressively the opportunities of the Bologna Process*” with emphasis on recruitment to its Masters’ Programme.

The School emphasises that income for research activity has increased fourfold in the last four years, “*and will increase even more in years to come.*” While “*members of the School are funded by every possible agency that funds research in the School’s profile,*” there is no large scale funding mechanism in Ireland that would support the School’s areas of strength - areas in which they are among the world leaders. The School stresses the importance of College’s role in supporting it and in convincing national policy makers and funding bodies of the importance of the School’s research areas.

Commenting on the reviewers’ observations about the School’s management, the School concurs with the reviewers’ summation of the main issues facing the School, and stress the need for assistance from the College in order to tackle these. The School acknowledges that its members have not been as active as they could be at committee level, and the Head of School has already advised the chairs of committees to meet “*on a regular basis in order to contribute to the Schools’ planning*” as advised in the Report.

In conclusion, the School requests that mathematics is recognised as one of the core disciplines for prioritisation within the College’s research strategy so that the School can “*...grow in future in accordance with its current level and potential reflected in the Report.*”

## 5. RECOMMENDATIONS TO COUNCIL

In addition to the School of Mathematics addressing the detailed recommendations outlined in the review report, the following recommendations are made to Council in light of the review report, the response from the School, and the new academic organisational structure.

1. Working within the new three Faculty structure and closely with the Research and Innovation Office, the School should develop a research strategy that is line with the Schools' and College's overall strengths, and that will help the School attract funding from the major government funding agencies.
2. The School should review its governance structure and operations to ensure compliance with College policies.
3. The Senior Lecturer's Area, together with other central administrative offices, should prioritise the implementation of a full postgraduate online admissions facility
4. College should prioritise the procurement and implementation of a new finance system that will enable Schools to conduct their business in an efficient and effective manner within a devolved financial organisational model.

John Hegarty

*Provost*

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