Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Quality Review of the School of Mathematics

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1 Overview

The School of Mathematics at Trinity College Dublin is a world-class department with a high international profile based on excellence in research and teaching. The reputation of the academic staff is especially high in both mathematics and theoretical physics. This has been strengthened in recent years by new appointments at every level.

The students at all stages, from undergraduates to MSc to Ph.D. students, were overall satisfied with the training provided by the School, and any concerns expressed were minor. They clearly perceived the opportunities provided to them to be of high quality, within both the Irish and international contexts.

We were impressed with the positive, collegial and inviting atmosphere in the School. We found that from undergraduate students to the head of School, all members of the department were proud of their association with the School of mathematics. The positive and dynamic scholarly atmosphere among the early-career academics was especially encouraging, especially given the current difficulties in research funding. We found that the relationship between the academics and administrative staff were exceptionally good.

On the whole we found the School well run and got the impression that many of the recommendations that we put below would have anyhow been addressed by the School's dedicated staff.

The dearth of research funding from the government mentioned in the previous report remains unchanged and is a major threat to the School and its research activities. However, the School has responded with resilience and has successfully attracted funding from the Simons Foundation, for example, which is a highly prestigious and competitive source. The danger of losing valuable programmes after the end of Simons Foundation grant needs to considered very carefully.

As in the previous report, the numbers of PhD students and of post-doctoral researchers remain too low for a department of this calibre, and raising funding to increase these should be a priority.

The creation of an MSc in pure mathematics appears to be a high priority, since motivated undergraduates are currently forced to seek options outside the School upon receipt of their bachelor's degree. How this might be achieved with the School's resources is a major challenge.

2 Organization and management

The School is rather small by international standards, and by our judgement is very well run and managed contributing to the positive and collegial atmosphere. The School is divided into two disciplines. The first is Pure Mathematics and the second Applied Mathematics and Theoretical Physics. Each is headed by a head of discipline and together with the head of School and several other role holders in the department, they form the School executive, meeting monthly and reporting to the school committee of all academic staff. We find this structure appropriate and well functioning with very good relationships between different sections of the School. The recent reading courses open for all PhD students and staff were noted as good cross-discipline initiatives. However, it would be good to explore ways to encourage participation in colloquia and seminars across disciplines. It would also be good if a postdoc representative participated and reported to the staff meeting.

The School hosts the Hamilton Mathematics Institute (HMI) to which all members of the School are also associated. It has its own organisational structure with a director and an executive board. The HMI runs about 6 workshops a year and hosts the Hamilton visiting professors. We were impressed with the level of activity, and the effective leadership of the director and board in selecting workshops, visiting professors and in particular fundraising. As we elaborate on below, future funding from either the College or the government should be secured so it is not dependant on the long term on the Simons Foundation funding.

The HMI directorship is meant to alternate between the University Chair professor in Natural Philosophy and the Erasmus Smith Chair of Mathematics. As the latter role has been vacant for almost 20 years, the burden of running the HMI has fallen on one person. This is not an ideal situation and though we understand the issues that arose in filling the Erasmus Smith chair. We therefore recommend to find a way that when one of the university chairs positions are vacant for an extended period, the directorship would still alternate between pure and applied mathematics with a senior professor in place of the university chair. This would give both disciplines more even representation in the Institute's management.

3 Academic Staff

The overall research reputation of the academic staff is one of the School's great strengths. The professors are leaders in their fields by international acclaim, while many of the younger staff are rising stars.

It has expanded since the last review with many new hires beyond the numbers who retired or moved to other institutions. We found this growth trajectory promising and recommend that the school continues to pursue it to try to expand and compete in size with the international standard of the department of mathematics in a leading national university. The recent hires in pure mathematics improved the balance between the two disciplines. Still, pure mathematics has far fewer senior professors and the Erasmus Smith's Chair of Mathematics is not filled, crating a seniority imbalance. We suggest to improve this with either more rapid promotion or a senior hire, in particular the Erasmus Smith's Chair.

The school has two endowed positions (Accenture and Hitachi), demonstrating impressive fund-raising abilities and we applaud the school for securing those and using them to expand the school. Other avenues for expansion, we suggest, are via joint positions with another School, like Biology or Computer Science.

Student to staff ratio is too high (20 to 1), but the funding model does not allow to fix it. We are perplexed by this situation as the School is encouraged to develop more programmes and find other cohorts for any increase in staff. This would allow for an overall increase in staff numbers, which is highly appropriate, but would not improve the student/staff ratio.

At present, the School relies on temporary teaching fellows and postdoctoral fellows for teaching. Many of the teaching fellows are repeatedly reappointed to their positions, which is an unsustainable model of employment. We recommend that either several of them are made permanent or enough academic staff are recruited to cover the required teaching. For the postdocs, teaching might be useful for their career development, but must be balanced against the need for pedagogical stability and consistency.

A major concern within the School is the university's process for promotions, which was uniformly viewed as overly complex and lacking in transparency. In particular, the university-wide scoring system for senior promotions appeared to be disadvantageous to mathematics.

The School has a small number of very dedicated administrative support staff. It is clear that they are overburdened and academics staff have to fulfil many tasks that could otherwise be covered by administrative staff which is hurting their research. In particular the admissions to the Columbia joint programme and post-graduate taught degrees, mark entry and timetabling are very cumbersome. These processes should be improved by the College and until then more support staff should be recruited to allow academics to focus on their jobs.

4 Undergraduate Education

The School offers a comprehensive curriculum in mathematics and mathematical sciences: In addition to service teaching, there are three direct entry courses (BA in Mathematics, BA in Theoretical Physics, and Joint Honors) and a dual BA with Columbia University. The Theoretical Physics degree is unique worldwide. It is offered in combination with the School of Physics, and this leads to a degree of extremely high quality with students formed in a wide spectrum of both Physics and Mathematics.

In all of the School of Mathematics undergraduate teaching, non-EU students are 9% of the total student body (not including visiting students) while just in Mathematics, including Joint Honours, and TP combined it is 6%. These figures could be increased, which would bring more diversity but also would help in the funding of the School through School fees.

We met with representatives of academic and administrative staff and students. Since the last report in 2014, the academic staff has increased significantly, with four new assistant professors appointed since 2019, which means that undergraduates are now offered a large choice of modules close to the research of the faculty: this helps in achieving the goal of the School for research-led teaching. The number of contact hours is stable since the last report: 140 hours (including project supervision meetings), which is rather high but in line with a lot of international institutions. Sabbaticals are encouraged, which is of course very important.

We found the staff very dedicated and motivated: the main concern that was expressed was in time-tabling issues, which seem to be quite serious: Not only are they extremely time-consuming, but they have led to a reduction in the choices of courses offered to students due to incompatibility problems. On the other hand because of time-tabling, some modules that are on offer can be taken by very few students The problem is intricate of course, but some solutions will be implemented, which hopefully will help reduce the pressure.

The administrative load linked to Exchange programs (and in particular the dual BA with Columbia) also seems heavy, and a solution should be found to avoid this load resting on one member of staff only.

The students gave the impression of being highly engaged and motivated. While they expressed overall happiness with their degree and praised their professors, they raised some issues, many of which were mentioned also by academic staff and School leadership, that we feel should be addressed. Apart from the time-tabling issues, they noted a difficulty with the Analysis courses and in particular in the introduction to proofs (which is a difficult step to take after having been used rather to computations). Overall, they found that the chain of courses in Analysis required to follow the General Relativity course in the 4th year is too long - actually, some assistant professors seem to share this idea and are willing to work on a modified curriculum. Perhaps such a modified curriculum could lead to offering fewer UG modules, which would help in time-tabling, and also could give more flexibility in offering MSc modules (see the next section). The panel recommends that the School reviews the organisation of the undergraduate curriculum.

More generally, Theoretical Physics students found that the curriculum has too much pure mathematics, which prevents from following other Physics courses like Fluid Dynamics. Finally concerning the general organization, the BA in Mathematics offers less tutorials than the Theoretical Physics one, and this could be changed to a more standardized system.

The Capstone Project in 4th year is appreciated by all the students, who nevertheless regret that sometimes their last choice (out of 7) is chosen in the end. They have actually come up with an allocation algorithm to be submitted to the staff. We suggest that postgraduate students be incited to propose projects in order to increase the number of options, and that more than one student would be allowed to take the same project and start the required study in tandem.

Concerning retention, the point raised in the previous report does not seem to be an issue now: the figures are roughly the same as in other STEM programs

Finally, we understand that some courses have been taught by the same faculty member for many years and in some cases there is only one staff member who has the expertise to cover a module. We feel it is important to make sure that more than one person can teach each module, so the panel recommends that lectures be regularly rotated, for instance ideally every 4 years, and not more than 6.

5 Postgraduate Education

The school offers two taught MSc programmes: High Performance Computing (HPC) and Quantum Fields Strings and Gravity (QFSG). The former has been running for many years with a steady stream of students and a stable curriculum. The latter programme is a relatively new addition, as suggested in the previous report, and still rather small.

The School is eager to expand the HPC programme, something we fully endorse. This would seem to be a rather straight-forward task, yet encounters issues of classroom size and other administrative hurdles. It is a great strength of the School to have taken their expertise in Lattice Quantum Chromodynamics and turned it into an applicable MSc degree. This is something the College should celebrate and encourage.

We were impressed with the efforts put into starting the QFSG programme given the

high teaching load in the School. This was achieved by relying on a new staff member whose salary is supported by an external grant and some teaching by post-doctoral fellows. This is a precarious situation and we hope the student numbers can increase such that the school gets more income from the programme and can dedicate to it the required teaching resources, such that the students get more contact hours with the academic staff. While there is competition in this field from the UK and Europe, we think that with targeted recruitment, the numbers can stabilise in the mid teens or up to 20, which will be sustainable.

We heard of the recruitment process and that students who accept the offer do not show up ("melt" in the local terminology). Given the rolling offer structure and tight deadlines, we did not find this particular unusual, but if it is possible to invest more in direct contact with the offer holders, a lower rate of melting can be achieved.

The cost (to EU and international students) of the QFSG MSc degree is more than that of HPC. This is due to some historical reasons, but should be amended. Proper market analysis should be undertaken to find the price point that will attract more QFSG students. The price of the HPC programme can be probably raised, given that it is more of a technical degree with real-life applications.

There is currently no MSc programme for Pure Mathematics, so that motivated undergraduates are seeking options abroad. It is lamentable that the premier institution for higher education in the country cannot offer such a basic educational resource to its students. We suggest the School work towards the goal of establishing such a degree.

The school has a steady, if modest, stream of PhD students. Every new staff member gets one and the rest are funded via various grants and fellowships. As most of the grants are in theoretical physics, there is a serious imbalance in the number of PhD studentships in the two disciplines, which the school should try to address. This also reflects in the number of tutorials offered, since there are not enough PhD students to serve as tutors for all pure maths modules.

The success rate of the PhD students is high and many continue to postdocs (or choose to exit academia), which is commendable.

We found that PhD students are not always aware of official structures that exist in case they encounter problems with their advisor for instance. This is not unusual for phD students to be fully immersed in their research and not be too familiar with the workings of the university. Every student has a thesis committee that follows them with yearly reports, which is good, but we recommend that members of these committees (other than the supervisor) try to meet the students more often to check on their general well-being and offer advice.

6 Research

The School has research strengths in a number of important areas in pure mathemat- ics, including geometry, analysis, and mathematical physics. In the AMTP discipline, the school is more specialised, but has world leading research groups in the key areas of gravity/stings/quantum field theory, lattice QCD, and scientific computing. Because many of the pure mathematicians are working in mathematical physics or related areas, there is great synergy between the two disciplines. Research topics where the School is particularly active include the AdS/CFT correspondence (holography), Physics of Black Holes, Finite Temperature Quantum Field Theory, N = 4 Super Yang Mills and Integrability, Physics of Amplitudes, Methods in Feynman Integrals, Several Complex Variables, Algebraic Geome-

try, and Modular Forms. Many new recruits in recent years have broadened the spectrum in pure maths. Nevertheless, it was felt that some important areas of mathematics could be strengthened, such as global analysis, differential geometry (on the analytic side), algebraic number theory, and algebraic topology.

The school has been quite successful in attracting external funding, including grants from the ERC, the SFI, and the Simons Foundation. Chair Professor Samson Shatashvili was recently awarded the prestigious Dannie Heineman Prize for Mathematical Physics.

Among the research-active faculty, there was a strong feeling that protected time for research was lacking. It seems that the summer months are the only protected period, and these are also under threat. Within the 'pillar' system for avoiding time-tabling issues for core educational activities, the School and the College might examine ways to incorporate research time.

The Hamilton Mathematics Institute is an important driver of research activity in the School, since it brings in truly world-class mathematicians to the university. Nevertheless, it was felt that the HMI visitors could have more interaction with the School as a whole, especially PhD students and postdocs. For example, the HMI could organize special lectures to introduce the visitors to students and members of the school who do not work in the immediate subject area of the expert, thereby contributing more fully to the research culture of the School as a whole.

A further recommendation in this vein, it seems important for the activities and resources of the HMI, as great a resource as it is, to be as accessible as feasible to other institutions in the country. Steps in this direction are on the mind of the Director of the HMI and other faculty, but should be nonetheless encouraged. This would be consistent with the image of the School of Maths at TCD as the premier institutions for mathematics in the country.

7 Resources

There is a serious shortage of space throughout the School as a whole. Many of the early-career staff do not have private offices. The School lacks adequate space for academic discussions. It is possible that space in HMI is underutilized, especially when it comes to space for spontaneous discussion. In addition to the lack of space, with the exception of the HMI, much of the School building is badly in need of refurbishment. The current layout makes it difficult for the staff to interact. Barring the possibility of a new building with a better layout, it seems essential for the existing space to be refurbished in a manner that facilitates pedagogical and scholarly exchange. Amid the overall strengths of an outstanding School, the quality of space stood out as a significant weakness, which could contribute to obstacles in recruiting the best faculty or students.

HMI receives a significant portion of its budget from the Simons Foundation. The grant has been renewed several times already, attesting to the research strength of the School and the Institute. However, we express serious concern that this situation is highly likely to change in the future, given the difficulty of obtaining the highly competitive Simons grant. If this vaulable resource is not to be lost, other ways of financing the institute need to be found. The School must be supported in efforts to keep this essential resource running in a manner comparable to the current level. In fact, given the contribution of HMI to the College profile, it would be desirable to even expand the current operations substantially. The current Director of the HMI has been making strenuous efforts to reach out to the government for

financial help with the HMI. It is hoped that the College will actively support him in this effort.

It was called to our attention that newly appointed researchers each have a PhD student as a startup but no funds. Thus, applying for grants is mandatory in order to be able to maintain their collaborations abroad, making the first few years following appointment difficult. It is recommended that this situation be systematically improved in order to maintain the vitality of the research programmes of the young faculty.

The School library was run by an academic staff member who left the School a few years ago. There is no longer any plan for buying books, nor for keeping record of the existing books. Students are hired occasionally to reorganize the books. A plan is underway to reorganize the library. A library committee should be reconstituted in order to take over the running of the library.

The long-term stablity of the IT system was cause for concern. For maintenance, the College system runs on service tickets, which we are told can be quite erratic response times. An independent, local system was implemented as early as the 1990's and seems to run reasonably. However, this relies on considerable donation of time by a few academic staff, which could well be untenable in the long run.

8 Administration

One of the areas in which the School truly suffers is the amount of administrative support. On the one hand, it is clear the existing staff is very dedicated and relations between the academic staff and the support staff are excellent. However, there are currently 3.5 support staff and 23 permanent academic staff and a student intake of around 100 undergraduates per year (excluding students in service modules). This might be compared to the University of Edinburgh, where over 50 support staff are available for about 120 academic staff. Among the consequences is that the academic staff find it difficult to receive help, for example, for research activities.

Our impression was that even when the resource for appointment of extra staff is available, the university's administrative process for approving appointment appears to be very complex and time-consuming. One instance was mentioned in which the appointment of IT staff shared with physics has been delayed now by more than a year.

We recommend some simplification in procedures for the appointment of support staff. At least one more general administrative staff member who could help with research activities, for example conferences, as well as alleviate pressure at busy times should be prioritised.

As it is, in spite of dedication and heroic effort, the Head of School appears to spend a good deal of his time and energy playing the role of additional support staff, a quite undesirable allocation of expertise.

In spite of these deficiencies of structure, we stress again that the current staff struck us as truly excellent and dedicated to the good of the School.

9 Relationships and External Engagement

The academic staff has held positions in many different institutions around the world, and this guarantees a large number of international connections, assessed by many invitations and ollaborations abroad. However, we recommend that scientific interactions with colleagues throughout the country and in the Dublin area, be strengthened. The School expects that increased funding for research activities at the HMI would enable the creation of larger

research networks that benefit the whole nation and create synergistic opportunities.

We encourage the School to enhance such collaborations, for instance by facilitating access of outside colleagues to seminars held in TCD, and by attending seminars in other Dublin institutions such as DIAS or UCD. We suggest finding a way to allow members of UCD and DIAS to gain access cards to the School of Mathematics building and vice versa, to facilitate visits to seminars and closer collaboration. More collaborations could actually lead postgraduate students to benefit from modules given in other institutions, and undergraduate students could find other sources of projects for instance.

The Hamilton Mathematics Institute is a key asset for the School of Mathematics, and we find this could be enhanced even more: PhD students could benefit more from the presence of visitors: for instance, as mentioned earlier they could be offered introductory seminars or mini-courses prior to the visit. HMI should eventually also be seen as a key asset for the country itself: We find that outside institutions could also benefit more from HMI activities. For example, they could be systematically invited to host HMI visiting professors in their department for short stays. Expanding the influence of HMI is important also for funding reasons: The possible end of the Simons Foundation funding is a source of concern, and the government could be interested in funding an institute with a nation-wide influence. These resources are also important for establishing and maintaining contact with peer institutions around the world, such as the Simon Center in the US and the IHES in France. HMI does not appear to be part of ERCOM, and joining such a group, if possible, could be a way of being more visible and in turn gain funding.

As far as outreach towards the general public is concerned, the School of Mathematics organizes open days, talks, and events : 2025 was a special year with the 220th anniversary of W.R. Hamilton and 20th anniversary of the Hamilton Mathematics Institute which attracted a wide audience. Faculty members are involved in a variety of actions, taking part in open days for instance, and contributing to podcasts and short articles for the general public.

Finally the School is engaged with international exchange for students: not only is there the joint BA with Columbia, but the Erasmus exchange opportunities have increased significantly in the last few years. We encourage the School to pursue these efforts, although the lack in funding and in dedicated staff makes any expansion difficult.

10 Summary of Recommendations

1. The Review Team recommend that some teaching fellows are made permanent or academic staff are recruited to cover required teaching (pg.3).
2. The Review Team recommend that the School reviews the organization of the undergraduate curriculum.
3. The Review Team recommend that lectures should be regularly rotated among staff members, ideally every 4 years, and not more than 6 (p.4).
4. The Review Team recommend that members of thesis committee (other than the supervisor) meet with PhD students more frequently to check on their general well-being and offer advice (pg.5).
5. The Review Team recommend that the School should find a way that when one of the university chairs positions are vacant for an extended period, the directorship of the HMI would still alternate between pure and applied mathematics with a senior professor in place of the university chair. (pg.2).
6. The Review Team recommend that the activities and resources of the HMI are made accessible as feasible to other institutions in the country (pg. 6).
7. The Review Team recommend that the interaction between HMI visitors and the

School is strengthened, especially with early career researchers (pg. 6)

8. The Review Team recommend that Scientific interactions with colleagues throughout the country and in the Dublin area be strengthened (pg. 8).
9. The Review Team recommend that the School's existing space is refurbished to
10. facilitate pedagogical and scholarly exchange (pg.6).
11. The Review Team recommend that the startup situation for new lecturers be systematically improved, beyond the currently offered single PhD student in order to maintain the vitality of the research programmes of the young faculty (pg.7).
12. The Review Team recommend that a library committee be reconstituted in order to take over the running of the library (pg.7).

11 Comments to University Management

1. Future funding from either the College or the government should be secured so that the HMI is not dependant on the long term on the Simons Foundation funding (pg.2, 6).
2. Within the 'pillar' system for avoiding time-tabling issues for core educational activities, the School and the College might examine ways to incorporate research time (pg.6).

The Review Team recommend some simplification in procedures for the appointment of support staff (pg.7).

Response from School of Mathematics to the Reviewers' Report

On behalf of everyone in the School of Mathematics, I sincerely thank our external reviewers Professors Isabelle Gallagher, Minhyong Kim and Nadav Drukker for the time, attention and hard work they invested in studying our School, carrying out a thorough review and offering their very helpful recommendations. I am grateful for the friendly and co-operative atmosphere in which the review was conducted, and I am impressed by the level of detail provided in the report.

The reviewers' report is extremely positive, emphasizing the high international profile of our School, based on excellence in research and teaching. The reviewers underline the specially high reputation of the academic staff, which as they acknowledge has been further strengthened by recent appointments at every level, and they emphasize the positive, collegial and inviting atmosphere in the School and the encouraging dynamic scholarly cooperation among the early-career academics. They also praise our administrative staff as truly excellent and dedicated to the good of the school, finding their relationship with the academics exceptionally good. The reviewers emphasize that students at all stages receive high quality training and opportunities, and that any concerns expressed were minor.

The report contains a wealth of recommendations, all of which are very welcome and in line with the School's aims and strategies for its future development. I am happy to review the list of concrete recommendations listed in Section 10 in the following. I look forward to working with staff in the School and with College to make the most of the opportunities highlighted in the report.

Organization and Management

The reviewers confirm that the School's organization and management are appropriate and well func-tioning with very good relationships between different sections of the School. While they acknowledge the recent reading courses as cross-discipline initiatives, they encourage more participation in collo-quia and seminars across disciplines. This is entirely in line with the School's strategy, and we are continuing to work on improving colloquium participation. From this year on, the two colloquia will be held back to back with a joint coffee break in between, involving the graduate students as well. This is hoped to increase participation and to stimulate cross-disciplinary discussions.

The reviewers are impressed with the level of activity and the effective leadership of the director and board of the Hamilton Mathematics Institute (HMI), but they do express worries about the participation of both disciplines. With reference to the statutes of the HMI, by which the director is appointed from the School of Mathematics chaired professors, that is, the Chair of Natural Philosophy and the Erasmus Smith's Chair of Mathematics for the School, with the latter having been vacant since 2008, they recommend to alternate the directorship between pure and applied mathematics with a senior professor in place of the university chair instead (**Recommendation #5**). To clarify, the Hamilton Mathematics Institute already is the cross-disciplinary backbone of all research happening in our School, and both disciplines are benefiting from it equally. Filling the Erasmus Smith's Chair of Mathematics remains a priority, however to attract candidates of sufficient international

standing the School is dependent on College support. The School maintains the view that this post is an established chair, as is the Chair of Natural Philosophy, and hence the financial responsibility for it should not be left to the School. We are continuing to work with College to resolve this difficulty. While the idea to allow all senior professors to participate in the directorship is an interesting recommendation, such change to the statutes of the HMI would require careful deliberation and justification. Of the School's three senior professors, currently one is the Director of the HMI, one is the Head of School and one is the Dean of Research, and we find it advisable to keep these three roles assigned to three different people. Moreover, the directorship of the HMI being voluntary, we stand by the idea of the founding board of the HMI, that the holders of the established chairs should provide leadership to the HMI. Another one of our prime goals, at this point, is to strengthen the role and recognition of the HMI within the School and College. Among the ideas under discussion is a more formal association of all postdoctoral fellows to the HMI, which would raise their awareness of the benefits and opportunities that the HMI can offer them.

Academic Staff

I thank the reviewers for their extremely positive appraisal, confirming that the overall research reputation of the academic staff is one of the School's great strengths with professors who are leaders in their fields by international acclaim and younger staff who are rising stars. Within the School, this is regarded as a strength that we are particularly proud of, as is the promising growth trajectory since the last review that is emphasized by the reviewers. We welcome the recommendation to continue to pursue this strategy, in particular to continue to improve the balance between the two disciplines.

The reviewers remark that the student to staff ratio is too high. They are perplexed by the situation where the School is encouraged to develop more programmes and find other cohorts for any increase of staff. Indeed, this is a simple calculation: while the current model would allow for an overall increase in staff numbers which is highly appropriate, this would not improve the student/staff ratio. These observations are in full agreement with the School's view, and we hope that College will support us in growing in a way that improves the student to staff ratio. A related point made by the reviewers is the unsustainable model of employment that our teaching fellows, who are a great asset to our teaching staff, are currently suffering from (**Recommendation #1**). Whether some of our teaching fellows should be promoted from their temporary positions to permanent ones is already under discussion within the School, but it's a decision that requires careful deliberation. The School does not currently have the resources that would allow to increase the number of academic staff in a way that would sustain our teaching without the teaching fellows and without increasing the standard teaching load, which is too high already.

Undergraduate Education

The reviewers address the high number of contact hours as well as the serious time-tabling issues, which have been leading to a reduction in choices of courses in the UG programmes. They acknowledge the solutions that the School has already implemented and which will hopefully reduce the pressure; we are grateful to the reviewers for confirming to us that our

current model of teaching with three hours of lecturing per week and per 5ECTS module should not be changed. During the discussions in the on-site review they have given plenty of reasons why a decrease to only two hours of lecturing per week would have a dramatic negative impact, from a pedagogical point of view, and we fully agree with the reviewers.

Independently of that, the reviewers are encouraging the School to revise the curriculum, as was also discussed during the on-site review: several staff members, as well as the reviewers, have observed that for example in the field of Analysis the curriculum should be revised, and that this could lead to offering fewer UG modules and maybe give more flexibility in offering MSc modules (**Recommenda-tion #2**). Concrete plans for such a revision have already been developed within the School and are currently under discussion; at this point, these discussions involve a small group of academic staff in our School, including all those experienced senior staff members who have been active in timetabling and curriculum design over the years, trusting that they will spot any potential compatibility issues within the many pathways offered by our School and within the Common Architecture. The revisions will involve severe changes to the curriculum and therefore require careful planning and cross-checking. The aim is to reduce repetitions between distinct modules, thereby opening space for more diverse topics. This should result in more module choices for the UG students in Pure Mathematics and free some capacity to eventually be able to offer an MSc in Pure Mathematics. However the plans do not involve any changes in our programme learning outcomes, programme titles, modes of delivery, ECTS credit volumes or award titles, and the aim is to implement the desired changes without affecting the existing pathways. From the Undergraduate Programme perspective we therefore view these changes as moderate, requiring approval at School-level only. Nonetheless, we will seek feedback and advice from the Academic Affairs Office as well as the Central Timetabling Unit, as soon as our plans are at a stage where they are presentable to externals. We have not yet reached that stage.

We also fully agree with the reviewers' recommendation to encourage a more regular rotation of lectures between faculty, ideally every 4 years, and not more than 6 (**Recommendation #3**), and we will begin implementing this in our teaching assignments in the future.

Postgraduate Education

I am very grateful for the praise that the reviewers give to our taught MSc programmes. The reviewers fully endorse and in fact recommend the expansion of both programmes, and this is entirely in line with the School's strategy. The reviewers explicitly recommend the creation of an MSc in Pure Mathematics with high priority, while they appreciate that this will be a challenge; discussions within the discipline on how to do so have commenced, but we are aware that setting up such a programme will require a detailed and thought-through business plan, taking into account the serious resource implications that such a programme will have.

The reviewer's recommendation that members of PhD thesis committees other than the supervisors should meet students more often to check on their general well-being and offer advice (**Recommenda-tion #4**) is well in line with the School's strategy. To a large degree, this is carried out already. Apart from the formal documented annual meetings, there is a

lot of interaction on an informal basis, and we will work towards ensuring a more regular contact of this sort, through joint lunches, participation in joint research seminars and informal chats during the colloquium coffee, which PhD students are encouraged to attend. However, we refrain from introducing a more formal or bureaucratic system, since in our experience, and also according to the feedback that we have received from our students, forced meetings which require minutes or follow a protocol tend to be rather counter productive.

Research

While we are proud of the positive development of the Discipline of Pure Mathematics which the reviewers recognize, we do agree with them that some important areas of mathematics could still be strengthened. Among the areas listed by the reviewers, global analysis and the analytic side of differential geometry are now covered by the most recent addition to the School, Nikhil Savale, who was hired shortly after the on-site review took place. The School continues to explore funding opportunities to also strengthen areas like algebraic number theory and algebraic topology.

The reviewers state that the HMI visitors could have more interaction with the School as a whole, especially PhD students and postdocs; they recommend to organize special lectures to introduce the visitors to the students and members of the School who do not work in the immediate subject area of the expert (**Recommendation #7**). While we already do ensure that our visitors present their work to the members of the School in special talks, we appreciate the criticism that these talks are often mainly targeted at the experts in the immediate subject area. We will arrange for more colloquium style talks and lecture series, to reach a larger audience, and in accord with our plans to improve the School's colloquia. We will also work on publicizing the HMI more actively within the country; all HMI events are already fully accessible to other institutions in the country, however we will work on being more proactive in inviting our colleagues to join. This will be facilitated once the HMI canstart populating all floors of House 16, which will allow us to open the entrance door to the HMI to the public instead of having a coded door as is currently the case. We count on College's support in handing the two ground floors of House 16 to the HMI in the near future, and the director of the HMI is in regular contact with the bursar about this issue.

Resources

The reviewers have correctly observed the serious shortage of space throughout the School as a whole; the School is currently at breaking point and urgently needs additional space, given the recommended growth trajectory. Moreover, the reviewers state that much of the School building is badly in need of refurbishment and that the current layout makes it difficult for the staff to interact (**Recom-mendation #9**). This view is shared by the School, however for most of the problem it is beyond the School's power to fix this, given that most of the School's accommodation is located in historic housing. Nonetheless, in the summer of 2025, some serious refurbishments were carried out in Houses 17-20: carpets were replaced, walls and ceilings were repainted, and lights were improved in most of the building, and this process will be completed in the months to come. Furthermore, major parts of the School

library have been refurbished, space for a new accessible helproom in the School library has been created, and a new accessible entrance through the School library is built and almost complete. This has already tremendously improved the quality of the School's space. But the School's request to divide an office in the Lloyd Building (to accommodate two staff members as well as a couple of PhD students, and to create a communal HPC area) was denied by the Space Allocation Group, despite an identified budget. The School is actively seeking an alternative solution to optimize its space in the Lloyd Building.

The reviewers' recommendation to systematically improve the start up funding for newly appointed researchers (**Recommendation #10**) has already been implemented; apart from a PhD student, every new permanent academic staff member receives a start up of 10.000 EUR that can for example be used for equipment, travel and visitors. In addition, every academic staff member receives a 700 EUR Conference Travel Fund per year, and an additional fund has been created to support travel activities of staff without research grants beyond what is covered by the Conference Travel Fund.

The reviewers also recommend to reorganize the School library, for example by reconstituting the library committee (**Recommendation #11**). This recommendation is highly welcome and will be tackled as soon as the refurbishments around the School library mentioned above have been completed.

Relationships and External Engagement

We are proud of the positive mention of our highly international and acclaimed academic staff by the reviewers. Their recommendation to strengthen the scientific interactions with colleagues throughout the country and in the Dublin area (**Recommendation #8**) is highly welcome. We are exploring ways to facilitate this; as one step in doing so we will host the next annual meeting of the Irish Mathematical Society in 2026 in our School. It is also the 50th anniversary of the society, and we will make sure to host a memorable meeting that invites our colleagues throughout the country to return to our School for further scientific activities.

We fully agree with the reviewers' view that the HMI should eventually be seen as a key asset for the country itself - as the port of entry to Ireland for Mathematicians from all over the world. We take their recommendation seriously to allow outside institutions to benefit more from HMI activities (**Recommendation #6**), and we are exploring ideas and options to do so. That HMI could join ERCOM is a valuable comment, and we will seriously consider doing so.

Professor Katrin Wendland
Head of School
School of Mathematics

Response from the Faculty Dean to the Reviewers' Report

First and foremost, I take this opportunity to extend my sincere thanks on behalf of the Faculty, to the expert reviewers (Professor Nadav Drukker, Kings College London, Professor Isabelle Gallagher, Ecole Normale Supérieure and Professor Minhyong Kim, University of Edinburgh) and the internal facilitator (Professor Brian Broderick); all were ably supported by the staff in the Quality Office. My face-to-face meetings with the review panel were a valuable part of the process and helped me to appreciate the areas of concerns and the institutional comparisons that informed some of the recommendations in the final report.

The reviewers undertook a comprehensive assessment of all aspects of the School of Mathematics, meeting academic staff, students, researchers, technical and administrative support teams over 3 days (1-3 April 2025).

The reviewers were overall extremely impressed by the research and teaching carried out by members of the School. They found the staff to be collegiate, of high international research standing and the student learning to be similarly impressive. Among the many positives called out in the report are the dual Columbia BA programme, the increasing numbers of Erasmus students, the new MSc in Quantum Fields Strings and Gravity and the expansion plans for the MSc in High Performance Computing. By necessity the nature of this short report will focus however on the recommendations, and the proposals that prompt further consideration and action.

The reviewers found the governance and management of the school to be effective and advise that PDR representation be included on the School Executive Committee. They also found the academic:support staff ratio at 23:3.5 (numbers reported) to be too high and giving rise to excessive administrative burdens on the Head of School and research active staff in particular. This ratio once clarified, would be higher than that in other comparative schools within the Faculty. It needs further investigation and should be a priority to address. The comments on a prolonged recruitment campaign are concerning, however I note this was an isolated occurrence and specific to the job specification and categorisation of the role.

The reviewers suggest that the School consider mechanisms for appropriate expansion however they note that the 20:1 student:staff ratio prompted by the funding model is problematic. In general, the dependency on teaching fellow and PD staff in teaching is considered to be too high. It arises, as least in part, from the application of sabbatical rotations for academic staff. They reviewers; share the view, with the School, that the use of sabbaticals is worth protecting, and vital to maintaining the research prowess of staff in a lone scholar discipline such as Mathematics. The suggestion that the same capstone projects might be open to that more than one student, and be started in tandem, seems very sensible and applicable across the Faculty where student choice should be a significant factor in the allocation model.

Unique and important to the School is its establishment and leadership of the Hamilton Mathematics Institute (HMI). This offers opportunities for the promotion of colloquia and seminars across the faculty that the reviewers feel are ripe for development. The challenges

around the sustainability of HMI have been reflected on carefully in the report. Stronger connections with the Simon Centre in the US, IHES in France and membership of ERCOM are encouraged. The reviewers propose that the directorship might alternate between pure Maths and Theoretical Physics and that HMI resources might be made accessible and visible to other institutions across the country. They recognise the scope to make it an all-island/Dublin-centric resource and that it might host visiting professors in other UCD/DIAS institutions.

In teaching, the reviewers put forward well-made proposals to review the MSc course fees for the MSc in Quantum Field and String Gravity and High Performance Computing and suggest that there would be a market for a new MSc in Pure Mathematics that the School should explore. Comments on timetabling are timely and come with constructive proposals around curriculum design, which the School is actively pursuing. From an infrastructural perspective the challenges brought to the fore in the review are the long-term stability and sustainability of the IT system and the Mathematics Library. The report also questions the quality of the physical infrastructure and spaces available to staff and students; an area that the School and faculty are seeking to address as a matter of some urgency.

Overall, the report is a very valuable source of encouragement and advice. Both the School and Faculty will use it as a platform from which to build the School's future success.

Professor Sylvia Draper
Dean of STEM