Report of the 2022 Review Panel for the Area of Mathematics and Theoretical Computer Science at ISTA

2022 Review Panel

October 7, 2022

1 Executive Summary

A panel composed of Professors Robert Bryant (Duke University, panel chair), Maria J. Esteban (CNRS and University of Paris-Dauphine, Vice Chair of the Scientific Board of ISTA), Bassam Fayad (University of Maryland and CNRS), Kathryn Hess Bellwald (EPFL, member of the Scientific Board of ISTA), Nati Linial (Hebrew University), Moni Naor (Weizmann Institute of Science) and Don Zagier (MPIM and ICTP) was asked to evaluate the group of Mathematics and Theoretical Computer Science at ISTA. The panel met at ISTA during September 26–28, 2022.

The panel commends the ISTA staff for its efficient and comprehensive support both before and during the two-day on-site review.

1.1 Overall evaluation

The panel congratulates ISTA for the impressive group of world-class Mathematicians and Theoretical Computer Scientists they have assembled. Naturally, being so small, ISTA's group does not cover the whole realm of Mathematics and Theoretical Computer Science, focusing only on certain areas, but, in those, it exhibits impressive activity, not only in productive research but also in the training of PhD students and postdoctoral fellows. This is indeed a superb achievement.

1.2 Concerns

Despite the excellent level of the group, we noted some fundamental concerns, two of which we were specifically asked to comment on.

First, as was noted in the previous review, there is the absence of women at the professors' level among the Mathematics and Theoretical Computer Scientist group.

It is not clear how to attract more women, but the panel included a discussion of the challenges and some possible strategies in the General Report section.

Second, we were asked specifically about hiring in the area of Statistics, an extremely important area in both theoretical research and applications, especially in other areas of ISTA. A fundamental difficulty appears to be that 'Statistics' covers a very wide range of activity, from traditional 'theoretical' topics to data science and machine learning; it would be difficult to find a single person at the appropriate level who could serve all the needs of ISTA. To increase the attractiveness of the position and its usefulness to ISTA, it may be necessary to make at least two hires, one more 'theoretical' and one more closely concerned with data analysis, to serve the needs of both the Mathematics and Theoretical Computer Science group and other research areas at ISTA. We discuss this at greater length in the General Report section.

A related topic discussed by the panel members is that, given the multidisciplinary nature of the institute, there should be more professors in Mathematics and Theoretical Computer Science who are ready to interact and collaborate with groups in other scientific areas. (Of course, not *every* professor in Mathematics and Theoretical Computer Science should be expected to work in a multidisciplinary program of research.) Making appointments that increase such interactions may require some focus on interdisciplinary hiring by the administration, possibly in consultation with some external expert(s) in the area(s) of the top candidates. Some appointments may need to be 'joint' with other research areas.

Mathematics and Theoretical Computer Science are foundational to all aspects of the scientific and technological enterprise, which works both ways. Not only is it crucial to have expertise in Mathematics and Theoretical Computer Science available to researchers throughout the Institute, the challenges that arise in applications of Mathematics provide impetus for new developments within Mathematics. Significant interaction is healthy for both the Institute and the Mathematics and Theoretical Computer Science.

That said, the choice of how Mathematics and Theoretical Computer Science is going to grow as the Institute grows (dramatically, as the plan was laid out to us) will have to be a negotiation between the administration and Mathematics and Theoretical Computer Science. The professors in this group naturally want to have their say in the directions of growth, and their judgements about quality and level should be respected by the administration. Meanwhile, the Administration and the Scientific Board have the responsibility to see that the Institute's growth enhances the synergy of its scientific activities. It may be necessary to ask the Mathematics and Theoretical Computer Science group to sometimes move out of its 'comfort zone' to serve the needs of the Institute as well as to strengthen itself.

2 General Report

A panel composed of professors Robert Bryant (Duke University, chair), Maria J. Esteban (CNRS and University of Paris-Dauphine, Vice Chair of the Scientific Board of ISTA), Bassam Fayad (University of Maryland and CNRS), Kathryn Hess Bellwald (EPFL, member of the Scientific Board of ISTA), Nati Linial (Hebrew University), Moni Naor (Weizmann Institute of Science), and Don Zagier (MPIM and ICTP) was asked to evaluate the group of Mathematics and Theoretical Computer Science at ISTA. The panel met at ISTA during September 26–28, 2022.

2.1 Documentation

Before the meeting took place, the panel members were provided with a collection of informative documents in which ISTA and its overall structure and functions were described. These documents provided the panel members with a comprehensive view of ISTA, which functions in a way that departs strongly from most other universities and research institutes in Europe. The documents also contained a description of the Mathematics and Theoretical Computer Science group as a whole and a set of thorough individual presentations of all professors and groups to be evaluated.

2.2 Schedule of the Visit

The first day of the visit started with a working dinner at which the panel was given a presentation of the nature, structure, and functioning of the institute by the ISTA president, Tom Henzinger, and by the Chair of its Scientific Board, Peter Fratzl. They delivered a clear and comprehensive view of the Institute, its foundation, its aims, and how it is financed and organized.

The second day started with presentations on the PhD program and the activity and organization of the Mathematics and Theoretical Computer Science group at ISTA, followed by 20-minute presentations by the 12 faculty being evaluated, a graduate student poster session and discussions with the various postdoc groups led by members of the panel, and concluded with a working dinner.

The third day featured meetings between individual faculty members and panel members, lunch with the PhD students, a group meeting with the evaluated faculty members, a group meeting with the non-evaluated faculty members, and a meeting with the two Area Chairs (ISS and MPS), and concluded with a meeting of the panel with the Chair of the Scientific Board, Peter Fratzl, the current ISTA President, Tom Henzinger, and the next ISTA President, Martin Hetzer.

2.3 Findings and Recommendations

The panel congratulates ISTA for having succeeded in assembling and supporting a world-class group of researchers in Mathematics and Theoretical Computer Science. Moreover, the program for training PhD students and postdoctoral fellows is well-planned, and there is good evidence that they are successfully building a reputation commensurate with the quality of its faculty.

We will report on a number of issues that we discussed in the course of our visit. Some of these issues are connected in ways that may not be obvious at first glance, and a combination of approaches may be needed.

2.3.1 Hiring women faculty

We were asked specifically to comment and advise on the hiring of women faculty in Mathematics and Theoretical Computer Science.

As we learned in our conversations with the administration and the faculty, there has already been a concerted (though, so far, unsuccessful) effort to identify and recruit women faculty in the Mathematics and Theoretical Computer Science group. That this would be difficult is not surprising; the competition for senior women of the level that the Institute wants is intense, and for junior women of great promise (who would come as Assistant Professors without tenure) there are many other opportunities at places that have a longer history (and hence are more of a 'known quantity' in terms of community and expectations). Moreover, women in academia tend to have partners who are also academics, and the well-known '2-body problem' is difficult to solve at an institute that does not have flexibility in the kinds of appointments it can make.

For many women, a sense of community is an important part of what makes a place attractive, and, in this sense, the Institute's relatively short history is something of a handicap. While the individual members of the Mathematics and Theoretical Computer Science group are very well-known, the environment of the Institute itself may not be. One way of building this 'community knowledge' would be to make it a practice to host conferences, summer schools and workshops, making sure to invite many women (for example, to make it a point to host EWM (European Women in Mathematics) and/or AWM (Association for Women in Mathematics) research conferences or workshops of the increasingly numerous Research Communities for Women). Emphasizing that the Institute provides a supportive environment for research and training will impress both the speakers and the attendees and will also give the faculty here more chances to cultivate relationships with women researchers. The payoff of building relationships over time cannot be overestimated.

Another possibility to make the institute better known in the mathematical community (and, in particular, to reach to young women), would be to advertise the institute in a very visible way (one or one-half page) in newsletters with wide circulation, such as the Notices of the AMS, SIAM News, and the EMS Magazine. This would make ISTA

better known among women who are looking for places to go, or among mathematicians who could advise their students or post-docs or young colleagues about possible places to apply.

2.3.2 The Institute's hiring policy and faculty structure

The Institute has the admirable policy of creating an equitable environment, a society of equals, at least among the tenured professors. It also simplifies administration. However, procedures that are designed to implement this 'equality', if too rigidly followed, can be both limiting and self-defeating.

Because the professorial structure is essentially 'flat', it is more difficult to solve '2-body problems' with Institute resources. Some thought should be given as to whether there might be ways to incorporate new kinds of positions in the Institute's research structure that would give more flexibility. For instance, one possibility would be to have a program of independent postdoc/junior researcher/non-tenure-track, perhaps with an attractive title such as Lise Meitner or Karl Menger Investigator.

Another point along these lines that is particularly relevant to Mathematics and Theoretical Computer Science is that, unlike the laboratory sciences, not all young researchers in theoretical disciplines need or want to establish a 'group' of postdoctoral fellows and graduate students in order to pursue their research goals. It was explained to us that young faculty are not *required* to build a group upon arrival, which is good, but it should, in addition, be made clear that not building a such group will not be viewed negatively when assessing their development. If a young person sees that their colleagues are all busily recruiting PhD students and postdoctoral fellows to build their groups, it is hard to avoid the conclusion that this is an essential part of their job as an Institute faculty member.

2.3.3 Directions of growth

The panel was asked to give advice about the potential areas in which the Mathematics and Theoretical Computer Science group could or should grow. Specifically, we were asked for advice about hiring in Statistics.

The Mathematical Physics, Analysis, and Probability Group (MPAP) has 5 faculty members, 21 postdoctoral fellows, and 14 PhD students. This is a good size; MPAP does not appear to have an urgent need to be expanded to make it more successful.

The Combinatorics, Computational Geometry and Topology group (CCGT) has 3 faculty members, 12 postdoctoral fellows, and 12 PhD students. CCGT, too, is well-established, close-knit, and thriving, with a lot of activity.

The Algebraic Geometry and Number Theory group (AGNT) is significantly smaller, having only 2 faculty members, 9 postdoctoral fellows, and 5 students. Moreover, the two AGNT faculty members are not that closely related mathematically. As a result, an additional one or two hires in the areas of geometry, topology, or algebra would be

a good way to invest in this group to make it more productive, cohesive, and attractive to PhD students and postdoctoral fellows.

The (evaluated) Theoretical Computer Science group (evTCS) is the smallest, having only 2 faculty members, 1 postdoctoral fellow, and 7 PhD students. Our panel did not receive any information about how much evTCS interacts with the Information and System Sciences cluster (which contains Computer Science), which would affect any recommendations about whether evTCS would also benefit from additional faculty.

We were specifically asked about hiring in Statistics, which covers a very wide range of research activity. Given the multidisciplinary nature of the institute, hiring in Statistics would be a natural way to involve M&TCS in other scientific areas. However, no single hire could adequately cover every aspect of Statistics, so some more precise goals for the hire(s) should be articulated. To build a bridge between M&TCS, which values fundamental theoretical work, and other ISTA groups who need statistical expertise in analyzing data, it seems necessary to hire more than one person in Statistics to span between theory and application. In fact, hiring only one person may be harder than hiring two.

2.3.4 The PhD and postdoctoral training program

During the meetings with the PhD students and postdoctoral fellows, the panel members heard a number of comments about their experiences. They were mostly very good (no complaints about financial support or the support services).

However, we did hear some concerns expressed:

- The postdoctoral fellows felt that their inability to initiate ERC grant applications was a significant limitation. Is the issue that ISTA cannot be the host institution?
- There is no general colloquium for Mathematics, which hinders community building. In traditional departments, a general colloquium is an important part of the communal life of the group.
- Office space for students and postdoctoral fellows is somewhat crowded. The panel observes that, in Mathematics, unlike the lab sciences, students and postdoctoral fellows spend a great deal of time in their offices, studying and working, so it's important that their offices be conducive to concentration.
- There is no good coffee machine.
- There is no traditional Mathematics common room.
- The cafeteria food was by some considered sub-standard.

- The bus service to the train is not good (overcrowded at certain times, but this may have improved recently).

- The postdoctoral fellows would have liked the opportunity to teach regular undergraduate classes, since this is an important part of job applications for their next jobs. Finding a way to achieve this would be very desirable, even if it might involve awkward negotiations with the Viennese universities or other nearby institutions that have undergraduates.

- There does not appear to be any housing officer to help with finding off-campus housing.

2.4 Other comments and recommendations

- The panel had a very positive impression of the staff. They were efficient and supportive of our visit. We heard similar unanimous comments from the faculty, the postdoctoral fellows, and the PhD students about the staff's efficiency and kindness.

- There is a burdensome restriction on the length that visitors can stay—anything longer than 10 days seems to require much more planning and lead time. It would be very desirable to have more flexibility in this, since having joint projects with outside mathematicians is one of the core ways of doing research in Mathematics. Moreover, increasing the number of visitors is an important means of making ISTA better known within the Mathematics community, so having visitors of appropriate duration should not only be made easier, it should be strongly encouraged.

- The Institute is a natural place to host conferences and thematic semesters. One of the issues facing the Institute is that, while its individual faculty in Mathematics are very well-known, the Institute itself does not appear to be. Hosting conferences and summer schools, particularly conferences that have a high percentage of women and underrepresented minority participants, is a good way to familiarize the wider Mathematics community with ISTA, and this would, in turn help with recruiting faculty, students and postdoctoral fellows (and women and underrepresented minorities in particular).

3 Individual Faculty

The following pages contain comments about the twelve individual faculty members being evaluated, arranged in alphabetical order. For convenience, we have separated them onto individual pages. [Note from Academic Affairs about pages 8-19: The sections on individual professors of the review report are treated in the same way as confidential review letters. Hence they are not included in this version of the report.]