

REPORT of the INTERNATIONAL ADVISORY BOARD

FACULTY OF MATHEMATICS

NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS (MOSCOW)

Naming conventions:

- Department = Faculty of Mathematics, Higher School of Economics
- Board = International Advisory Board for the Department.

Members of the Board:

- *Pierre Deligne* (Institute for Advanced Study, USA);
- *Sergey Fomin* (University of Michigan, USA);
- *Tetsuji Miwa* (Kyoto University, Japan);
- *Nikita Nekrasov* (Simons Center, Stony Brook, USA);
- *Stanislav Smirnov* (University of Geneva, Switzerland, and Chebyshev Lab, St. Petersburg State University, Russia), **Chair** (elected February 17, 2013);
- *Vladlen Timorin* (HSE, Dean of the Department, *ex officio*).

Members of the Board visited the Department in December 2016. They held several meetings with the departmental leadership team, including the Dean, several Associate Deans, and representatives of the main educational programs. Lively and substantive discussions concerned all aspects of departmental life, as well as the Department's prospects for the future.

The visiting members of the Board (P. Deligne, S. Fomin, N. Nekrasov, S. Smirnov) met with faculty members of all ranks; postdocs; and students, both undergraduate and graduate. During these meetings, conducted in the absence of departmental officials, the students and professors freely expressed their opinions regarding the current state of affairs in the Department, commenting on its achievements, its goals, and its most pressing needs and challenges.

On December 16, 2016, five members of the Board (*P. Deligne, S. Fomin, N. Nekrasov, S. Smirnov, and V. Timorin*) had a two-hour-long meeting with the leadership of the HSE, including the Rector Prof. *Ya. I. Kuzminov*, First Vice-Rector *V. V. Radaev*, and Vice-Rectors *S. Yu. Roshchin* and *M. M. Yudkevich*.

Members of the Board met with the leaders of the Strategic Academic Unit (StrAU) comprising the Department, the Faculty of Computer Science, and the Moscow Institute of Electronics and Mathematics. This StrAU was created in response to the governmental 5-100 program.

All four visiting members of the Board gave lectures at the Department. These talks attracted large audiences of students and professors.

This report outlines the Board's general impressions from the visit, provides an assessment of the current state of the Department, and makes recommendations for the future. A brief summary of the principal recommendations is provided at the end of the report.

1. GENERAL ASSESSMENT

The Board is generally happy with the performance of the Department over the last few years, and with the progress made since the last report. The Department came out of infancy and developed into an adolescent, on the track to a stable and sustainable state. While the growing pains continue, for reasons both internal and external to the Department and the University, the Board is generally optimistic about the long-term prospects.

During its first several years, the Department faced a *proof of concept* challenge: it had to demonstrate the possibility of creating, within the constraints of modern Russian realities, a mathematics department that can successfully compete with its best counterparts worldwide. Now that the attainability of this goal is no longer in doubt, the challenge is to develop, and then implement, a long-term strategy for achieving it. While at the moment the Department may feel fortunate to find itself on a firm ground, it is not the time to rest on the laurels.

A number of rules and traditions inherited from the Soviet and perestroika eras are hindering further progress of the department, making it difficult to compete with foreign peers. It is crucially important to align departmental practices with the accepted international standards. The Board members were happy to hear that the Rector's office shares our concern, and is supportive of making moves in the right direction. In fact, several decisions stemming from the Board's recommendations were made by the Rector on the spot, at the conclusion of our meeting with the University leadership on December 16, 2016.

To ensure that the upcoming reforms are coherent and comprehensive, we suggest that the Department creates a road map for its development over the next ten-year period. This road map would outline a vision for the future of the Department (including bringing its practices in line with the world standards), and a strategy for implementing these transformations. This idea received support from the Rector, who in particular considers it realistic to arrive, within this time frame, at a situation where 70-80% of the faculty work under western-style contracts. As the Department is developing rapidly, and the context in which it operates keeps changing, the road map should be regularly updated.

The report presented to the Board by the Department provides an impressive record of achievement and growth since the time of the previous review. The Board is happy to see that many of its recommendations have been implemented by the Department and the University.

The Board's visit in December 2016 included meetings with the members of academic staff, postdocs, and graduate students. Unfortunately, we did not have many interactions with the undergraduate students, and were not able to meet with the younger ones (those in the first 3 years of study) at all. In the Board's opinion, subsequent site visits should be planned so as to include meetings with representatives of every demographic stratum within the Department.

2. ADMINISTRATION, GOVERNANCE, AND CLIMATE

Sergei Lando, the founding Dean of the Department, left his post in April 2015. The Board would like to express its deepest appreciation for Professor Lando's outstanding service to the Department during its critically important formative period. His wise leadership played a key role in the successes achieved by the Department over the last several years.

By all accounts, the transition to the new leadership of the Department went smoothly. The new Dean Vladlen Timorin is universally praised by the faculty. His first major challenge involved

overseeing, together with Deputy Dean Vera Kuznetsova, the relocation of the Department to the new building at Usacheva, 6; this task has been successfully completed in Summer 2016.

While the Board very much appreciates the managerial skill and effectiveness of the new Dean, we feel that the Department would benefit from some *decentralization* of its organizational structure. Delegating some of the Dean's authority to his deputies and other colleagues (who should be adequately rewarded for this work) would reduce the administrative burden on the Dean, and increase the involvement of faculty members in the governance of the Department. The University would be wise to support a thoughtful implementation of such a decentralization effort by providing additional salary supplements to professors serving in administrative roles.

The Board would like to emphasize the importance of improving *organizational climate* in the Department. There is much to like about the departmental culture overall. Most importantly, the students, the faculty, and the administration display a remarkable level of professional dedication. At the same time, there are lingering climate issues in need of attention. Ignoring them carries the risk of future conflicts which could prove damaging to the Department.

Some of these issues came to the forefront in 2015, when a collective of current students sent a letter to the Board and the departmental administration. While the letter focused on the undergraduate curriculum, advocating a number of changes in the latter, it was symptomatic of the lack of proper channels of communication between the students and the administration. Likewise, some of the complaints expressed by postdocs and faculty members appear to be rooted in misunderstandings caused by broken lines of communication with the administration. Improving the departmental climate would go a long way towards strengthening the morale among all categories of departmental citizens.

We feel that it would be beneficial to introduce new formats of interaction between the students and the faculty; between the faculty and the administration; and between the postdocs and the professors. Well-designed social events would help create the sense of community within the department, breaking the walls separating different “castes” from each other.

The uncertainty of teaching assignments, which are frequently made at the last moment, is a major source of frustration among faculty members. Better communication, as well as better organization of this side of the departmental enterprise, would help a lot.

The Department should do a better job integrating its postdocs and other newcomers into the community. Some of them appear isolated, and a bit lost. One possible strategy is to organize a series of short talks during the first weeks of the academic year. This would allow the new postdocs, faculty members, and visitors to introduce themselves and their research topics.

3. FACILITIES AND INFRASTRUCTURE

The visiting members of the Board were impressed by the new building housing the Department. Several critical problems that existed at the old location, such as overcrowding, lack of office space, and absence of large classrooms, have now been solved.

Another area of improvement is the departmental website. It has a crisper and more consistent look, is easy to navigate, and does a good job presenting the department to the outside world.

We list below some of the remaining issues (admittedly, of smaller magnitude) which were brought to our attention.

The rules governing the entry into the building are too restrictive compared to international universities. The guards ask the visitors to show passes. On Sundays, access is only possible by a special arrangement made in advance by a faculty member. These and other restrictions should be eased, for the benefit of both the Department and the Moscow mathematical community at large. The HSE administration appears to be receptive to this request. While the Board received assurances from the Rector that the access to public academic events (lectures, seminars, workshops, etc.) held at the Department would be open to all attendees, this directive is yet to be fully implemented in practice. In addition, the building access rules should be clearly described on the departmental website and/or the intranet pages for faculty and students.

It is imperative to improve the quality of wi-fi infrastructure within the building, by installing routers capable of providing the required coverage, bandwidth, and number of connections.

One notable change to the worse, *vis-a-vis* the Board's previous visit, concerns reduced accessibility of online resources such as electronic databases (e.g., *MathSciNet*) and journal subscriptions. Making these resources readily accessible by faculty and students is paramount for maintaining the research and educational missions of the Department. It is also important to properly educate the students and faculty members on these matters: some of them appear to be unaware of existing electronic subscriptions, and of ways to access them.

We were pleased to learn that soon after our visit, the Department's *MathSciNet* subscription has been restored. It is crucial to ensure that no further interruptions occur in the future.

4. ACADEMIC PERSONNEL

The Department utilizes several types of employment contracts (authorized by the University) for regular faculty positions. The three main ones are:

- (a) *domestic* hires;
- (b) *international recruitment* hires;
- (c) “*ordinary*” (*tenured*) *professors*.

Faculty members hired under the domestic hiring scheme constitute the bulk of instructional workforce. They receive relatively low base salary (not indexed for inflation) plus considerable bonuses for publications in reputable international journals. Currently, such a bonus is awarded for a one- or two-year period only. Worse yet, the rules of the bonus system change every year in unpredictable ways. This environment breeds anxiety and insecurity among faculty members, hurts their morale and productivity, and motivates some of them to leave HSE altogether. Unless bold countermeasures are enacted quickly, we expect the latter problem to become even more serious in the near future.

The professors recruited through the international scheme enjoy compensation guarantees secured by individual contracts, in the form of higher salaries which are adjusted for inflation. Their teaching duties are typically reduced as well.

The “ordinary” professors receive a guaranteed higher salary (in addition to a reduced teaching load), so they are protected from the volatility of the bonus system. Unfortunately the number of ordinary professors in the Department is rather small, currently seven, with a handful more promised by the University administration.

A very small number of faculty members serving in major administrative roles receive additional salary bonuses. This practice should be broadened to include everyone who is carrying a significant administrative burden; cf. the discussion of decentralization in Section 2 above.

Domestic recruitment is generally determined by the teaching load. The University uses complicated rules (such as bounds on student/faculty ratios) to determine the “required” number of instructors. International recruitment appears to be driven by the University's long-term goals and ambitions (tempered by the constraints of its budget).

Our previous report contained a recommendation to establish procedures for internal promotions from Docent to Professor. In response, the Scientific Council decided to simply extend the procedures governing external hiring to also cover internal promotions. Under this system, a promotion must be initiated by the faculty member in question, placing him/her into an awkward position, and increasing stress in the workplace.

In the opinion of the Board, the practices described above are far from optimal. We strongly recommend the following improvements:

1. For the long term, the Department needs a road map outlining a gradual transition to stable and attractive contracts for the regular faculty, structurally similar to the employment contracts currently offered to international hires and Ordinary Professors.
2. For the short term, regular domestic positions should be made more attractive and secure, with a clear and predictable system of bonuses. The current bonus system appears to be working worse than it did several years before. As long as this system is in place, it is imperative to make it less stressful and more predictable.
3. Bonuses are currently tied to publication dates, which can be several years removed from the date of submission; using acceptance dates would be a little better. Furthermore, as these dates depend on various circumstances beyond the author's control, some smoothing over a longer time interval would be advisable.
4. The hiring strategy should take a better account of the balance of areas within the Department. In particular, such areas as Probability and Analysis should be prioritized.
5. Recent departures of several faculty members have shown that more needs to be done to retain the best mathematicians, especially the younger ones. The Department and the University need to put in place effective “rapid response” retention procedures, ready to be deployed whenever the need arises.
6. More effort needs to be invested into proactive recruitment of former graduates after they complete their Ph.D. and/or postdoctoral training abroad.
7. There needs to be a clear process for internal nominations to the rank of an Ordinary Professor. One option is to ask the current OP's to select the nominees.
8. Some foreign professors are frustrated by the hassles of obtaining visas and other documents required by various levels of bureaucracy. The University should do more to assist foreigners in adjusting to the realities of life in the Russian society.

5. RESEARCH

The Board reaffirms its assessment of the overall level of research activities at the Department as outstanding, both in volume and in quality. The Department continues to retain its leading position among university mathematics departments in the country. Publications (co-)authored by the members of the Department appear in some of the most prestigious international journals. Researchers working here continue to be in high demand at numerous conferences throughout the globe. Departmental alumni continue their education at some of the best graduate programs in the world. The worldwide reputation of the Department continues to rise.

Much of the Department's research is managed and supported through three large **research laboratories** which operate as semi-independent units associated with the Department:

- The *Laboratory of Algebraic Geometry and its Applications* (F. Bogomolov/A. Kuznetsov);
- The *Laboratory of Representation Theory and Mathematical Physics* (A. Okounkov/B. Feigin);
- The *Laboratory for Mirror Symmetry and Automorphic Forms* (L. Katzarkov/A. Levin).

The original external grants for the Algebraic Geometry lab have now expired. The first two labs are currently financed entirely by the University, and have proven extremely successful. The third lab, which opened in December 2016, is still in its infancy. Its initial funding comes through a “mega-grant” from the Ministry of Science and Education.

Cooperation agreements with foreign academic institutions provide an effective framework for fostering collaborations between research units within the Department and their counterparts worldwide. The Board supports extending the 5-year agreement between HSE and *Kyoto University*, which would strengthen the links between the Laboratory of Representation Theory and Mathematical Physics and the Research Institute for Mathematical Sciences (RIMS) and Kyoto University's Math Department. Both Kyoto and Moscow have strong traditions in representation theory, and share a remarkable history of productive collaborations. The new agreement could also support exchange programs for graduate students and postdocs, including mini-courses and summer schools.

Several mathematicians at the *Kavli Institute for the Physics and Mathematics of the Universe* (IPMU) are actively working on the topics which fall within the research scope of the Laboratory for Mirror Symmetry and Automorphic Forms. It would make sense to set up a program of scholarly exchanges between the two groups.

There are currently 5 **postdocs** in the Department. While the Board views the introduction of postdoctoral fellowships as an excellent development, the current system has serious flaws.

The postdocs are hired on 1-year contracts. The job offers (and potentially, renewal decisions) arrive much later than most of the deadlines for postdoctoral offers abroad. As a result of this unfortunate timeline, the Department has no access to the bulk of the foreign applicant pool.

The Board proposes allocating several postdoctoral hiring lines (say 5 new hires every year, with 2-year contracts) to the Department. The hiring schedule should be synchronized with the worldwide practices. Unfilled positions should be allowed to roll over to the next year.

6. STUDENT BODY & ADMISSIONS

The **undergraduate program** continues to thrive, maintaining its leading status in the country. At the same time, its rapid expansion over the last few years created a number of problems.

In its previous report, the Board advised against increasing the undergraduate enrollment, and recommended stabilizing it around 50 students per grade level. In spite of this recommendation, the expansion process continued unabated. In 2016, 92 students entered the undergraduate (Bachelor's) program. By comparison, during the years preceding our previous report, the size of each year's undergraduate cohort rose gradually from 30 to 60.

The Board recognizes the difficulty of controlling the size of an incoming class within the current perplexing format of undergraduate admissions mandated by the state. It is nevertheless imperative to find a way to keep these numbers in check. The demographic explosion of recent years created severe logistical and financial challenges, and increased administrative and instructional burdens on the faculty. If this trend continues, it can potentially transform the very identity of the Department: what is today a *Grande École* grooming future academic elite might become a much more conventional, and less exciting, educational outfit. The road map for the Department should include a coherent long-term vision for its educational mission and profile (e.g., a small institution with an ambitious and well-defined academic focus; or: a larger school catering to students pursuing diverse career paths both within and outside the academia). This vision would in turn determine the optimal admissions strategy.

The current attrition rates for the Bachelor's program appear to be reasonable.

Approximately one-half of the students come from Moscow, one-quarter from the Moscow region, and the rest from elsewhere in Russia. The number of foreign undergrads is minuscule.

In contrast to the undergraduate programs, the **graduate** ones (both Masters and Ph.D.) continue to be under-populated. The shortage and unreliability of funding for these programs make it exceedingly difficult for the Department to recruit strong applicants. The current admission packages do not look attractive against enticements offered by the private sector. Judging by the feedback provided by graduate students, the situation worsened in recent years: the teaching assistant (TA) pay got reduced, and the same number of positions at the research labs are competed for by a larger number of students.

Recruitment into graduate programs is further complicated by the unfortunate timeline of the admissions process. Regular entrance exams to the Ph.D. program are held in October following the summer graduation. (The classes start in November thereafter.) By this time, anyone potentially interested in graduate study abroad, or in taking up a job in the private sector, has already accepted an offer of admission or employment.

Graduate students receive tuition waivers, in addition to heavily subsidized lodging.

The regular Ph.D. stipend nearly matches the minimum wage established by the state. A small number of fairly attractive "academic stipends" are awarded on the basis of special exams which used to be held in October; this is now done in the Spring.

The Board recommends the following changes in the management of the graduate programs.

1. Financial packages to Ph.D. admits should be offered at the time of admission.
2. The TA fellowships should be scaled up. More Ph.D. fellowships are needed.

3. Masters fellowships should be awarded well in advance to attract the best students.
4. If possible, set up a career/placement office, and/or enlist faculty career counselors.

Some positive actions in these directions have already been taken by the University administration following the Board's visit.

7. UNDERGRADUATE PROGRAM

Collective Letter by the Students

On March 15, 2015, the Board received a letter from a group of 45 undergraduate students. This letter was also circulated throughout the Department, and posted online. The letter focused on the academic curriculum, expressing a number of concerns, both general and specific, and suggesting many changes.

On March 31, 2015, a large group of students who have signed the letter met with the Chairman of the Board, Stanislav Smirnov; the outgoing Dean, Sergei Lando; and the incoming Dean, Vladlen Timorin. A lively and substantive discussion lasted several hours.

The key points of the students' letter, the departmental response to it, and the aforementioned discussion have been aptly summarized in the Second Report submitted by the Department to this Board (dated April 7, 2016). We do not attempt to present a substantive overview of all these developments in the current report.

On December 14, 2016, the members of the Board met with a large group of students and faculty members for another extended discussion of these topics.

Our general opinions on the matter can be succinctly outlined as follows:

- The Board acknowledges the importance of the curricular issues raised in the Collective Letter from the students. The Board applauds the students for initiating this discussion, and for expressing their concerns in a professional and constructive way, showing mathematical maturity and genuine concern for the betterment of the Department.
- The Board appreciates the response by the Department to the Collective Letter, both in its tone and in its substance. Both sides of this debate showed respect for each other, genuinely trying to arrive at a mutually agreeable compromise.
- The Board is reluctant to serve as an arbiter in this debate, and more generally to pass judgment on specific curricular issues. We are happy to listen, to advise, to mediate the ensuing discussions, and to express our personal (non-binding) opinions.
- The Board favors making the curriculum more flexible. As the student population gets more diverse in its career aspirations, several distinct curricular tracks will be in demand. To satisfy these competing interests, the number of mandatory courses will have to be reduced. This will likely ease some of the pressures that led to the current debate.
- The Board encourages all faculty members to continue their efforts towards improving communication with the students on curricular matters. Increasing the students' involvement in the process of course development and design will benefit everyone.

- The Board recognizes the inherent difficulties of reconciling the often conflicting needs of different categories of students, and of balancing the contrasting teaching philosophies advocated by different mathematicians: rigid curriculum vs. flexible; deductive approach vs. inductive; pure math vs. applied; platonistic viewpoint vs. empirical. As there are no right or wrong answers here, it is prudent to expose future mathematicians to different philosophies, fostering tolerance and appreciation for the diversity of thought.

Other Aspects of the Undergraduate Program

The University's recently introduced system of mandatory *minors* requires students to dedicate one day a week to taking classes in a subject different from their chosen field of specialization. These classes are typically offered at a location fairly distant from the Department. Together with military training, this setup effectively puts a 3-days-per-week upper bound on regular instruction in years 2 and 3. In the Board's opinion, such a system has a detrimental effect on the educational outcomes of the undergraduate program. It would make sense to relax the requirements of a minor, and/or reduce the commute time between the Department and the locations of the most popular minors, so that the students could attend afternoon seminars at the Department after taking morning classes elsewhere.

A common complaint from the students concerns the quality of the course syllabi, many of which tend to be cryptic and/or unreliable. It is hard for a student to make an informed choice among the courses whose content and level are a matter of guesswork. This problem is not unrelated to the fact, already mentioned above, that assignments of instructors to particular courses are frequently made at the last moment. The Department should make an effort to improve the management of teaching assignments, course enrollment, and other administrative aspects of the instructional enterprise, making it more coherent and easier to navigate.

While the number of students interested in pursuing careers outside academia is growing, the Department does not offer them a thoughtfully designed alternative track; such a track could combine the fundamentals of rigorous math with more practical, application-oriented subjects.

The Board welcomes the expansion of the University-sponsored exchange programs for students, both undergraduate and graduate, and supports their further growth.

9. GRADUATE PROGRAMS

The Department offers Masters programs in Mathematics, both in Russian and in English. There is also a Masters program in Mathematics & Mathematical Physics (in Russian), joint with Skoltech. Finally, there is a Ph.D. program (in Russian only), which now involves coursework. The M.S. and Ph.D. programs are not integrated with each other.

Several graduate students who met with the Board members voiced their displeasure with the structure of the curriculum.

The Department has not had much success with attracting capable graduate students other than its own alumni. Several factors contributed to these difficulties: insufficient resources (stipends, TA appointments, etc.); the out-of-sync timetable of graduate admissions; the limited course offerings; and the *de facto* requirement of securing a Ph.D. advisor before applying.

The Board supports the Department in its efforts to expand and improve the graduate programs in Mathematics, and recognizes the objective difficulty of achieving these goals.

PRINCIPAL RECOMMENDATIONS

Here is a brief summary of the most important recommendations contained in the above report:

1. Together with the University administration, the Department should create—ideally within a year—a "road map" for the next 10-15 years, envisioning an internationally competitive, both in research and in education, world-class department. The road map would outline a comprehensive vision of all important aspects of departmental life, from student admissions to faculty hiring and retention. It should anticipate the forthcoming challenges, addressing them in advance. We expect a presentation of the road map by the Dean and a Rector's office representative at the next site visit.
2. On the hiring/personnel front, we strongly suggest: increasing the number of Ordinary Professorships; making employment conditions more secure and predictable for everyone; and improving relocation and visa support for foreigners.
3. The timetable of postdoc hiring and graduate admissions should be synchronized with the leading academic institutions worldwide.
4. There is an urgent need to increase the support provided to students, both graduate and undergraduate. This includes stipends, teaching assistantships, and career advice.
5. In short order, the Department needs to take steps to substantially improve organizational climate, and repair the broken lines of communication.
6. The administration of the educational enterprise (assignments of courses to instructors, quality of syllabi, availability of alternative tracks of study) needs to be improved.