FACULTY OF MATHEMATICS AT THE NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS

SECOND REPORT TO THE INTERNATIONAL ADVISORY BOARD

APRIL 7, 2016

Approved by the Faculty of Mathematics Council

The Faculty of Mathematics at the National Research University Higher School of Economics (HSE) has been established in 2008. In 2009, a roadmap for the development of the Faculty was developed. As a particular step of this roadmap, an International Advisory Board was created in 2012. Current members of the International Advisory Board, its mission statement and regulations are posted at the webpage https://math.hse.ru/en/experts. The same page contains the reports of the Faculty to the International Advisory Board as well as reports of the International Advisory Board to the university administration. According to its mission statement, the International Advisory Board conducts an expert evaluation of research and educational activities of the Faculty of Mathematics.

An evaluation by the International Advisory Board addresses the following fields:

1) Curricula of educational programs offered by the Faculty.
2) Quality of the graduates (including the quality of the Bachelor, Master and PhD theses)
3) Research activity of the Faculty
4) Analysis of the hiring strategy of the Faculty
5) Analysis of the development plans of the Faculty and recommendations on making these plans

The International Advisory Board reports to the HSE university government on the results of the Faculty attained in the reporting period.

On November 28, 2012, we filed the first report to the International Advisory Board. This is the second report. It addresses the progress of the Faculty during the period of 2012-2015 in all fields indicated above.

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ISSUES INDICATED BY THE ADVISORY BOARD IN 2013

For the sake of convenience, some excerpts from the first report of the advisory board are copied below, together with comments on the current state. The fragments of the report are presented in slanted font. The numbering given below is different from the numbering of the original report.

HIRING

1. *While the selection process generally works well, it might be advisable to spread some of the hiring over several years, potentially increasing the quality of hires. This is not done out of the concern that those hiring lines may disappear if the Department does not use them immediately.*
   This concern has proved to be justified. The current tendency at the university level is to cut the number of faculty members. This is done by adopting more efficient teaching loads with more students per faculty member. It has been decided by the Faculty Council that keeping the currently employed faculty (unless the termination of the contract is recommended by the Faculty Council) is a top priority. The student per faculty calculation does not influence the international recruitment scheme, therefore, we still have opportunities for hiring new faculty but only within the scheme of international recruitment. We use this opportunity with some reservation because every new faculty member further decreases the student per faculty ratio thus making "domestic cuts" more likely.
2. *There is no established mechanism for hiring people on terminal (adjunct) appointments, who could cover short-term teaching needs.*
   We do have this mechanism, and it is currently used in the Faculty of Mathematics: terminal contracts w/o establishing an affiliation.
3. *Some research areas are underrepresented among current faculty, primarily in the general field of Analysis. This includes probability, harmonic and functional analysis, analytic number theory, and PDEs. Some other mathematical disciplines (admittedly the areas of strength for the department) are overrepresented.*
   In 2012-2015, the following faculty members (including part-timers) and researchers in the general field of analysis have been hired:

2012	**2013**	**2014**	**2015**
Alexey Glutsyuk Andrei Pogrebkov Ilya Vyugin	Mikhail Blank Vladimir Bogachev Vladimir Chepyzhov Igor Krichever Yury Kudryashov Alexei Penskoi Vladimir Poberezhny Stanislav Shaposhnikov Grigori Olshanski	Mikhail Skopenkov	Andrey Dymov Alexandra Skripchenko

   Some of these faculty members work part time in joint departments with RAS institutes. All of them do teaching service.
   In our ongoing international faculty search of 2016, we have indicated Logic as the preferred field of expertize.
4. *Professors are hired through an opaque process that relies on personal connections; decisions are made without consulting rank-and-file faculty. We recommend extending the hiring practices currently employed for Docent positions to the appointment of new Professors.*
   This recommendation has been supported by the Faculty Hiring Committee and by the Faculty Council. It has been implemented since 2014.
5. *There does not seem to be an established protocol (criteria, timetable) for promotion from Docent to Professor. Some faculty members would like to see it introduced. We did not observe any tensions related to the issue of*

internal promotion and difference in rank but some faculty felt that one should not wait until such tensions arise.
Although there are no explicit requirements that would be sufficient for a promotion, the procedure is determined at the university level. Docents, who apply for promotion to a Full Professorship, take part in a general (domestic) competition. Their application is considered by the Faculty Hiring Committee, then by the Faculty Council, then by the central Hiring Committee, then by the central HSE Council; the latter makes the final decision. In principle, Docents being promoted to Professors may compete for the same positions with external candidates. Qualification requirements include possessing a Doctor of Science degree (a few well-justified exceptions have been possible) and having at least 5 publications in the previous 3 years.

6. *The Department is currently transitioning from a period of fast expansion to a steady-state regime. In the future, possibly soon, this may create a demographic situation with little or no turnover of permanent faculty.*
By now, we have reached a "saturation" state, except that the international hiring scheme (see the section "Faculty rotation, single contract, and international recruitment" below) is still available for the Faculty of Mathematics.
7. *One serious deficiency in the current composition of the faculty is the lack of postdoctoral positions. We suggested, and the HSE leadership supported, an introduction of at least 3 new postdoctoral positions (with terminal two- or three- year contracts) in each of the next three years, so that in the steady state the department would have 7-10 postdocs. In our opinion, the department should not be allowed to hire its own Cand. Sci. degree recipients as postdocs.*
Postdoctoral positions were indeed introduced in 2013. We had 3 postdocs in 2013/2014, 6 postdocs in 2014/2015, and we now have 4 postdocs in 2015/2016. A more detailed description of the situation with postdoctoral positions is described in the section "Hiring" below.
8. *We are unaware of attempted raids by other institutions on HSE math faculty – but this might start happening soon. It is unclear what the department and the university are going to do to respond to outside offers.*
Neither the Faculty of Mathematics nor the central university administration has come up with a clear plan. An option that is always available to the Faculty administration or to a faculty member is to individually negotiate working conditions with the central university administration using an external offer as a tool.

FACILITIES

1. *The department has dramatically outgrown the space it currently occupies.*
It is planned that we move to a new location at 6 Usacheva Str in July 2016. Although slightly less convenient than the current one, this location is rather central; it is in a walking distance from several subway stations: Frunzenskaya, Sportivnaya, Kievskaya. We will have a separate 4-story building (the renovated building of a former middle school), in which the largest lecture hall can accommodate up to 120 people; there will be three more large classrooms for about 60 students. Although much larger than the space we currently occupy, the new space is not enough to provide separate offices for all professors.
2. *In our opinion, which seems to be shared by most people we spoke to, the ideal size of the incoming class is about 50 students. Besides space limitations, this size allows to maintain the exceptionally high standard of the student body.*
This contradicts the "effectivity" parameters introduced recently by the central university administration, see item 1 in the HIRING section above. With less than 60-70 students, we cannot have an admissible value of this parameter. On the other hand, there are no plans to increase this number.

FUNDING

1. *The HSE salary scheme depends heavily on a faculty member's publication record. Large bonuses are awarded to professors who regularly publish in foreign ISI- reviewed journals. This practice is supposed to encourage high-quality research. Within HSE, it effectively rewards the departments (including Mathematics) whose members pursue research programs that are recognized internationally. While this reward system does benefit*

the Department, it is far from optimal. In particular, it may discourage mathematicians from pursuing ambitious long-term projects which could result in gaps in their publication records. One mechanism to alleviate this problem is provided by a promotion to the rank of Ordinary Professor. These are lifetime professorial appointments that ensures top-tier pay without the publication requirement. There is currently only one Ordinary Professor in the Department. This number is way too small, given the extraordinarily high research level of several faculty members.

The current situation with academic bonuses is described in detail in section "Academic bonuses". Since 2012, the following faculty members have been promoted to Ordinary Professors:

- Boris Feigin (since 2013)
- Ossip Schwarzman (since 2013)
- Viktor Vassiliev (since 2013)
- Mikhail Finkelberg (since 2014)

We also have one tenured professor hired within the international recruitment scheme (see section "Faculty rotation, single contract, and international recruitment" for a detailed description of this hiring scheme): Vadim Vologodsky. Thus there are currently 6 tenured faculty members (including Igor Artamkin who obtained tenure in 2012). All other mathematics faculty members hold terminal positions.

2. *Another deficiency of the current bonus system is that it undervalues publications in Russian mathematical journals, including the very best ones. As these journals strive to maintain the highest scientific level, they deserve our full support. In the Board's opinion, publications in top Russian math journals should count towards salary bonuses, as much as foreign ones do.*

   The HSE Scientific Fund introduced some changes in the academic bonus system that provide a partial solution of this problem. Academic bonuses of the 3rd level (for publication in a reputable overseas journal) can now be awarded for a publication in a Russian journal that is indexed in Scopus or Web of Science and that has the first (Q1) or the second (Q2) quartile. If the language of the original publication is English, then no penalty is applied. However, if the language of the original publication is Russian, then Q1 is downgraded to Q2 and Q2 is downgraded to Q3. More details on the academic bonuses program are given below in section "Academic bonus program".

3. *The HSE appears to have a reasonably robust funding scheme for trips of faculty members and students to international conferences.*

   The funding scheme has changed. Although the rules are the same, the budget for "outgoing mobility" is now distributed between the Faculties. On the one hand, we now have more freedom in making decisions. We (the Faculty of Mathematics) decide ourselves whom to support and in what extent. On the other hand, while the funding allocated for trips of the faculty members attending conferences or other scientific events did not drop down, the short-term outgoing mobility of students is no more supported. The Faculty of Mathematics has some possibility to relocate funds and to spend them for student trips; so it does.

4. *Given the exceptionally high level of the Department, it is surprising that it has not been able to attract significant private sponsorship for its research and educational pursuits. This may be partly explained by the tendency among mathematicians to shy away from any appearance of self-promotion.*

   The Faculty of Mathematics designed some information materials for potential sponsors. We will start distributing them soon. We gratefully acknowledge a very significant contribution by Pierre Deligne, which is used, in particular, to fund outgoing academic mobility of students, organize special academic events, devise and offer courses focused on contemporary trends in mathematics and mathematical physics. A more detailed report is given below, in the "Finances" section.

RESEARCH

1. *The Department hosts a large number of vibrant and productive seminars. Unfortunately, the access to these seminars is not readily available to the Moscow mathematical community, as the entry into the building is controlled by security guards. While it is generally possible to arrange entry for visitors, such arrangements*

have to be made in advance of each visit, and depend on personal connections. Removing these obstacles would benefit both the Department and the Moscow academic community at large.
The university-wide security policy makes these obstacles hard to remove. There are two important simplifications though. First is the so-called electronic pass (e-pass). Any HSE employer can make an e-pass for any visitor for any date and time, for any room in any building of the university. The process of completing the online form takes about 1 minute; it can be done just before the visitor arrives; and the visitor has only to show his or her photo ID to the security guards. On the other hand, not all HSE employers know about this system; in order to set it up, one must file a request to the university IT department; and the online form works only from the corporate network. Another possibility is online registration for events – the IT department has ready-to-use templates; the list of all registered participants is forwarded to the security. For some events like open days, it is possible to arrange that the security allows all people in, who explain which event they would like to attend.

2. *As mentioned above, the distribution of faculty members in the Department by area (subfield) is rather uneven. This is admittedly hard to correct. It would certainly be wrong to base hiring on area quotas as opposed to overall academic strength of the candidates. Still, area diversity can perhaps be used as a secondary (tiebreaker) criterion in hiring. Research areas underrepresented in the department include:*
    - *applied mathematics (both discrete and continuous);*
    - *number theory (both algebraic and analytic);*
    - *probability, and more generally, analysis.*

    The area of applied mathematics is represented by other Faculties of HSE, notably, by the Faculty of Computer Science, the Faculty of Economic Sciences, and the Moscow Institute for Electronic and Mathematics. Because of this, the Faculty of Mathematics does not specifically plan to develop applied branches of mathematics. There is some interaction with the Faculty of Computer Science; perhaps it happens to a lesser extent than might be desirable, which is partly due to geographic reasons (our buildings are located in different parts of Moscow). In the area of Number Theory, we hired Satoshi Kondo in 2014. Analytic number theory is not represented at HSE at all. Recently hired researchers in the general area of analysis are listed above. Although none of our faculty members focuses on general theory of probability, several are working on (among other things) stochastic dynamical systems: Mikhail Blank, Vladimir Bogachev, Alexander Bufetov, Alexey Klimenko, and Alexandra Skripchenko.

UNDERGRADUATE PROGRAM

1. *Curricular changes the Department might potentially consider:*

- *Make the transition from rigid to flexible curriculum less abrupt;*
  The Academic Council of the Bachelor's program is working on this. As a step towards the implementation of this plan, one student-chosen element has been introduced into the curriculum of the first year. Namely, freshmen have a choice between the quarter year extensions of two mandatory courses: logic and discrete mathematics. The second year curriculum for the same group of students in academic year 2016-2017 will also be modified. Particular modifications will be discussed shortly. One mandatory half-year course may be shifted to the third year of study, another half-year course offers the following options: either students take it in the third year, or, instead of a "Minor", in the second year. These latter changes have yet to be formally sanctioned by the Academic Council.
- *Make the first two years less heavy on Analysis;*
  The Academic Council of the Bachelor of Science program decided to cut some of the Analysis material previously included into the mandatory minimum. For example, the following topics, although very important, have been sacrificed (they are still covered in optional courses and even, if time permits, in mandatory courses by the decision of the instructor):
    - Fourier integral and Fourier transform. Convolution of functions.
    - Applications of the Fourier-Laplace transform for solving differential equations. Green functions.

Also, some redistribution of the analysis material is happening between different courses, including non-analysis courses, and between different terms. In previous years, the most intensive period for the analysis was the Spring term (even the last half of the Spring term) of the second year; and the analysis load during this period was rather heavy. In the fourth module (the last half of the Spring term), we used to offer three analysis courses, namely, Analysis, Dynamical systems and Complex analysis. On the other hand, the first year of study used to show an opposite trend: only one analysis course and three algebra courses. The new curriculum, which takes effect for students admitted in 2015 or later, contains the second year course "smooth manifolds", whose content is a mixture of analysis and algebra. On the other hand, the fourth module of the analysis course is likely to be removed from the curriculum. The general (point-set) topology material in the first year is being expanded, it absorbs some of the analysis material.

- *Include basic Number Theory and Probability in the core curriculum;*
  Probability theory is already included in the mandatory curriculum of the Fall term, in the third year. Number theory is currently an elective course (in 2015, it was delivered in English by Satoshi Kondo). In the new curriculum, some basic number theory is included in the algebra course delivered in the 1st and 2nd years of study.
- *Teach a couple of undergraduate math courses in English.*
  There are requirements of the central university administration to the same effect. It is mandatory for every educational program at Bachelor's level to have at least one course in English in the second year of study, at least two in the third year and at least two in the fourth year. In the case of the Bachelor of Science program "Mathematics", we have the following mandatory courses: in the second year, we offer a course in "Mathematical Computing" aimed at providing basics of mathematical experimentation using computer algebra systems (we work with Wolfram Mathematica). In the third year, we have two compulsory courses delivered in English, "History of Mathematics" and "Academic Writing". In the fourth year, there are no mandatory courses at all, thus there are no mandatory courses in English. However, students may select from a variety of optional courses offered by the Math Faculty in English and joint with the Master of Science program in Mathematics (the latter is conducted entirely in English). Students may also choose from courses offered by the Math in Moscow program. The curriculum of the English taught MSc program is outlined below, in section "Master of Science Program "Mathematics"/Curriculum Outline". It is planned that students will have an opportunity to include some online courses, say, within the Coursera platform, into their individual study plans. Some of the Coursera courses are offered in English by our faculty members; some external courses (offered, say, by MIT) may be announced as electives for our students.
  The Academic Council of the Bachelors program opposes the idea of delivering more mandatory courses in English. If the course is mandatory for ALL students, then, since the background in Mathematics as well as the language proficiency of different students may differ very significantly, switching into English will reduce the academic effectivity of the course.

2. *There is no public record of the placement of Department's alumni upon graduation. It would make sense to create a web page describing the graduate programs, industry jobs, etc., for the students who graduated in each year.*
   We have this page now: http://math.hse.ru/alumni. A short version of it has been translated into English and is available at http://math.hse.ru/en/alumni/. The page describes all career paths (both inside the academia and outside) pursued by our graduates, links to their current universities (for those who continue their education), a list of industrial employers, links to interviews by alumni, links to useful resources. The central university administration puts a lot of effort into keeping warm contacts with all HSE graduates. In particular, at every Faculty, a special position of manager for communication with applicants, students and graduates has been created; it is funded from the central budget. Our Math Faculty managers contacted all graduates and found out where they study or work. There are some centralized resources for alumni created recently by HSE. This includes a special website for alumni http://math.hse.ru/en/alumni/, the "Вышка.family" online service similar to social networks, alumni accounts in Facebook, LinkedIn, Vk, Twitter.

GRADUATE PROGRAMS

1. *While the Department's undergraduate program is thriving by any measure, its graduate programs (Master's and Ph.D.) are yet to achieve a comparable level of success. They are underpopulated; the student body is a mix of people from very different backgrounds; the goals of the programs are not articulated clearly, and the overall curricular setup appears to be in flux.*
   There is some progress. 2015 was the first year, when all state-funded positions in both Master of Science programs were filled. Thus the programs are no longer underpopulated. The second issue mentioned above, namely, a huge variation in students' backgrounds, is still of concern. It is related to our attempt to attract the best mathematics students from outside of HSE and to fight the myth that it is impossible to enter the program from outside. We have to set the threshold very low as even the strongest students from other universities do not know the basics of topology (even the most fundamental point-set topology concepts such as compactness and connectivity), not even mentioning smooth manifolds and differential forms. On the other hand, some of them are able to catch up quickly. One of the most problematic groups was the group of international students (students from far abroad), who used to have especially weak backgrounds. This problem seems to be almost resolved by now: we are happy to observe that the first year international students are doing better than average. We still have to increase the number of them but the qualitative aspect is improved greatly. Some further issues with the Master of Science programs are addressed below; see the sections "Master of Science program "Mathematics"" and "Master of Science program "Mathematics and Mathematical Physics"".
2. *Recruitment of (non-Russian-speaking) foreign students is hindered by the inadequate state of departmental English-language website. To help fix this problem, individual faculty should be allowed to modify their personal web pages without getting approval from the administrators of HSE's English portal.*
   All faculty members can do that. However, very few do. There are still some obstructions on the side of the portal, about which our faculty complain. All corporate web-pages are structured in a uniform way, and this structure is very rigid. Some items are mandatory, i.e., all faculty members must fill them. Since the layout of the web-pages is changed too often, and the requests from the central administration to faculty members to put specific information on their webpages come too often as well, one of our Faculty managers has to help all faculty members with that. To give one example of how badly the portal is organized: quite a few Math Faculty members used to have their research interests shown on their corporate web-pages. Some time ago, this was not a mandatory item. Since 2015, it is. However, the portal people designed a special field for it, so that research interests of faculty members entered before that date simply disappeared, and a corporate web-robot checking for completeness of web-pages complains that this field is empty!
   The English version of the Math Faculty's webpage improved significantly: http://math.hse.ru/en/. It is now updated on a regular basis. We (the Math Faculty) have control over the content of this page, although not over the design of it. It was the initiative of the Math Faculty that informal personal pages be created at the corporate portal that would be free of the corporate design. Maintaining these pages should be optional for faculty members. We thought this option would be used by many faculty members who currently maintain their personal web-pages at other servers. This initiative has been supported by the university government, and some test versions of the "informal personal pages" have appeared. They are based on the WordPress technology (therefore, they are suitable not only for static pages but also for blogging).

GLOBAL CHANGES IN THE UNIVERSITY

THE 5-100 PROGRAM

The Russian Federation government continues its program "5-100" aimed at global competitiveness of Russian universities. Some metric parameters such as a university's standing in the global universities rankings are used as performance indicators. The very title of the initiative, 5-100, refers to 5 Russian universities entering the top 100 positions in the rankings by 2020. This by itself creates an unfortunate situation, where Russian universities compete harshly for the faster growth of metric parameters as the rate of growth determines the funding of the university.

HSE is doing well in the 5-100 program being the only university to be consistently included into the top echelon. Moscow State University and Saint-Petersburg State University are not participants of the 5-100 program and are guaranteed the same amount of funding as the top echelon in 5-100. The goal of the 5-100 initiative is that universities achieve top positions in various global rankings. Currently, there are several different rankings provided by different agencies. Among the most reputable are the Times Higher Education (THE) ranking produced in cooperation with Thomson Reuters, the QS (Quacquarelli Symonds Limited) ranking, and the Academic Ranking of World Universities (ARWU, also known as the Shanghai ranking).

The HSE has taken certain responsibilities for its promotion in the QS and THE rankings; these responsibilities are fixed in the application package of the HSE for the 5-100 program. The government 5-100 committee was satisfied with the roadmap provided by the HSE, and the HSE became a participant in the program along with 14 other Russian universities (7 more universities were included into the project later). The participating universities were selected out of 54 university applicants. The amount of funding the government of the Russian Federation gives to a university participant of the 5-100 program depends on its standing relative to the other participants. Thus it is very important that the HSE remains in the top echelon; otherwise, it will lose a significant portion of government funding. As a consequence, the 5-100 program has a strong influence on what happens in the university and all departments of it.

The QS and the THE rankings rely on expert evaluations to a large extent. These agencies issue not only overall institutional rankings but also subject rankings, rankings within a certain geographic area, rankings of young universities, employer reputation rankings, etc. The responsibilities assumed by HSE are bound to institutional and subject area rankings. Currently, Russian universities (except MSU) have low positions in institutional rankings (not in top-400). HSE has been a participant in the QS and THE rankings since 2008. In the QS subject area of Mathematics, HSE had a rather low position of 405 in 2015, which can be explained mainly by insufficient international reputation of HSE in the area of Mathematics (Moscow-based mathematicians still tend to be associated with the MSU by foreign colleagues).[1] Note also that the Faculty of Mathematics produces only 37 percent of the total HSE publication output in Mathematics but is considerably better cited.

STRUCTURAL CHANGES IN THE HSE, 2012-2015

The total number of students in various undergraduate and Masters programs of the HSE in 2015 was 27,500. This is about 3,000 students more than the previous year. 6% of these students are international, and in addition to this, over 450 students from international universities came to HSE as part of various exchange programs for at least six months during the 2014/15 academic year.

In 2013-2014, many structural changes were implemented by the university government.

THE NAME OF THE UNIVERSITY. Upon a recommendation of the International Advisory Committee, the university attempted changing its perception as a school focused exclusively at economics and social sciences. The university administration announced a new brand and even suggested to change the official name of the university to "HSE

[1] In QS universities ranking of 2016, HSE entered the range 251-300 in the subject area of Mathematics, jumping over more than 100 places.

University" (w/o expanding the abbreviation, much like the ETH Zurich is currently doing). However, the main problem with the rebranding is that most citation databases do not recognize the new name, and we are at risk of losing many of our publications due to the sudden name change. Therefore, it has been decided to keep the official name "National Research University Higher School of Economics" at least as an official form of affiliation.

AGGREGATION OF FACULTIES. In 2014 the HSE merged many existing academic departments into much larger Faculties ("mega-Faculties"). For example, the new Faculty of Economic Sciences comprises former departments of Theoretical Economics, Applied Economics, Finances, Applied Mathematics, Statistics and Data Analysis, and the International Institute for Economics and Finance. The Faculty of Mathematics now includes two associated research units. We use the term "Faculty of mathematics" although we are comparable to a large "math department" of a north-American university. Since 2015, a significant portion of activities that were used to be sponsored from the central university budget should now be funded through Faculties. These activities include incoming and outgoing mobility of students and faculty, scientific events, employing teaching assistants, etc. As a result, the average salary of a teaching assistant dropped significantly after the "decentralization" of the budget since the amount of funds given to the mega-Faculties was not enough.

All administrative staff of a mega-Faculty, apart from the students' office, should now be funded by the mega-Faculty itself (this amounts to more than 200K monthly including taxes). On the other hand, since more decisions have been delegated to the mega-Faculties, the Faculties need more administrative support. The administrative staff of the central university back-office was cut. This scheme assumes that mega-Faculties engage in commercial activities and have some income. Income may come from fee-paying students, fee-paying programs of vocational training, etc. Unfortunately, this scheme is not very suitable for the Faculty of Mathematics and leads to severe financial problems, see section "Finances" below.

MINORS, MAGOLEGO AND OTHER ELECTIVE COURSES. In 2014 the new concept of major-minor curriculum model at the Bachelors level was introduced. Majors and minors at HSE are roughly modeled on the practice of north-American universities but with some regional peculiarities. A minor at HSE consists of 4 courses offered in the second and the third years of a Bachelors program. Courses offered within a minor may have certain prerequisites. The Faculty of Mathematics welcomed minors but opposed them being mandatory for all students. We have obtained a partial exemption for roughly 30 percent of its students. Students of a given mega-Faculty are not allowed to take minors offered by the same mega-Faculty. In particular, mathematics students cannot take a minor offered by the Faculty of Mathematics. Our Faculty suggested a minor in Mathematics in 2014, however, our suggestion was declined by the central university administration. In 2015, we came up basically with the same suggestion, and, this time, the minor was approved (the only change we were asked to make was in the title, so that the minor is now called "Mathematical structures"). To actually take place, a minor must have at least 60 students signed up. Since, in order to take a minor, students have to commute (different HSE buildings are located in different parts of Moscow, sometimes far from each other), it was decided by the central university administration to allocate a special day for minor, a day, on which no mandatory courses can be scheduled. Since another day is used for military training, there remain only working 4 days out of 6 for studying disciplines of the major. This is a very serious restriction that forces Bachelor programs to tighten their curricula.

MAGOLEGO is the name given to a compulsory general set of elective subjects that must be chosen by first-year Masters students in all educational programs. The name of the project is a reference to LEGO construction sets that allow nonstandard objects to be created from standard elements. The set of open optional courses from which students can choose 'blocks' for their individual curriculum includes courses offered by all HSE faculties and schools. A MAGOLEGO subject is studied during the second half of the academic year (modules 3 and 4); it is worth 3 credits, and it is part of the educational program's core (credits for the subject are part of the 60 credits of the core program). A MAGOLEGO subjects are chosen independently from a general set, which includes over 40 subjects. The choice of subjects is not particularly representative; fundamental subjects tend to be underrepresented. The Faculty of Mathematics has obtained an exemption from the mandatory character of MAGOLEGO: Mathematics students may opt

not to choose a MAGOLEGO subject replacing it with a course offered by their home program. A great majority of math students do go for this option.

Open optional courses are an old HSE tradition going back more than 10 years. Each academic year, the university offers courses on various topics and of various lengths, from purely theoretical courses to workshops by renowned professionals. An open optional course is designed not only to give knowledge, but to create a certain view of the world and to produce additional competences required for further professional work. 50 open optional courses are available for students outside HSE. They are also available via video conference. About 35,000 applications were made to these courses in Moscow, and four of these open optional courses are taught in English.

ONLINE COURSES. Since 2013, the university started to offer a significant number of open online courses within two platforms, Coursera and a national educational online platform.

Coursera is the world's largest international educational website offering online courses. Students from all over the world have free access to educational courses via Coursera, including those delivered by professors of the Higher School of Economics. The HSE offers several courses in economics, humanities, mathematics in English and in Russian on Coursera's website. Coursera offers open online courses from the world's top universities, featuring video lectures, assignments, tests, and exams. The Higher School of Economics joined the project on October 23, 2013 as one of the first Russian universities to partner up with Coursera. Most Coursera's partners are European and American universities. In 2014, HSE offered 22 courses on Coursera. Among them, there were several English-taught courses. The full list of courses is available at https://www.coursera.org/hse.

The Faculty of Mathematics is currently recording three Coursera courses:

- Galois Theory (E. Amerik)
- Modular Forms (V. Gritsenko)
- General Relativity Theory (E. Akhmedov)

In 2015, the university continues to launch new courses on Coursera. There are currently about 30 of them available. HSE has also presented its first courses at the National Open Education Platform this year. The university aims to launch even more online courses in 2016, with 80 new courses planned; 54 on Coursera, and 26 through the National Open Education Platform.

DOCTORAL SCHOOLS In order to foster the implementation of structured PhD program model, 13 Doctoral Schools have been founded in 17 academic fields, and new original educational standards for PhD programs, developed by Faculties and departments of the HSE, were adopted. In particular, the HSE original educational standard for the doctoral school of mathematics was developed mainly by the Faculty of Mathematics. In all, there are more than 700 PhD students, and 103 students are studying at the structured PhD program. There are 60 specializations. The Doctoral School of Mathematics is now responsible for all PhD students in mathematics; these students are affiliated to different departments, not only to the Faculty of Mathematics. It has four specializations: "Geometry and topology", "Probability and Statistics", "Algebra, logic, and number theory", and "Mathematical physics". We plan to open the specialization "Differential equations, dynamical systems and optimal control" in 2016. According to the new federal regulations, the PhD program has become an educational program (previously, it was regarded as a form of employment). Thus, separate educational standards and qualification requirements were needed. The original educational standard of HSE for the doctoral school in mathematics has been developed by the Faculty of Mathematics. Students now have to sign up for courses, earn credits, etc. An important change is that the program now takes 4 years (previously, it used to take 3 years). One of a university's performance indicators is the so-called defense rate, the ratio of the number of defenses within a graduate program to the total number of PhD students accepted to the program. Thus there is a very strong desire on the part of the central university administration that all PhD students defend their theses.

It is a federal requirement that a PhD thesis in Mathematics be based on at least two published papers. This leads to a very restrictive submission timeline of PhD students: basically, the first paper should be submitted in the second year of the program at the latest.

Within the PhD program, there is a certain initiative called the “academic PhD”, or a “structured PhD program”, or a “full-time advanced PhD program”. It is created by the university administration to support the “best” PhD students who aim at an academic career. The university offers rather generous financial support to “academic PhD” students: the monthly scholarship is currently 30 000 rubles. Moreover, “academic PhD” students often work as teaching assistants and/or have paid research assistant positions. Combined with the fact that a room in a student dorm is offered almost free to all students from outside of Moscow, this financial package looks competitive at an international level. Each “academic PhD” student has to make a study and work visit to a foreign HSE partner university. Selection of “academic PhD” students happens in late October and November, after the general competition to the PhD program and after all admission orders have been signed. Thus, at the time PhD positions are offered, there is no guarantee of the financial package. In order to apply for an “academic PhD” position, a candidate must have a recent TOEFL or IELTS certificate.

Regular PhD students, i.e., those, who are not “academic PhD” students, have a state-funded scholarship of about 1500 rubles monthly, which is 20 times less than the scholarship of an “academic PhD” student.

FACULTY ROTATION, SINGLE CONTRACT AND INTERNATIONAL RECRUITMENT. According to a federal law, all faculty members are subject to periodic contract renewal procedures that are typically announced as open competitions for faculty positions, for which both internal and external candidates are invited. On the other hand, traditionally (the tradition goes back to Soviet times), these competitions were not taken seriously as all participants knew that the positions were not really open. As a result, faculty positions were generally regarded as permanent, although formally they could not be such. Faculty members felt secure as nobody applied for their positions. The HSE decided to break this tradition. Now it puts a lot of effort into convincing everybody in the reality of competition. In several Faculties of the HSE, professors have been replaced by external candidates. This, of course, makes university professors feel less secure as the prospect of losing their jobs becomes real. If there is a “better” candidate than you, then you’ll have to give up your position to him or her. Now “better” means mostly research parameters such as quality of recent publications (evaluated by experts, fortunately). There are formal minimal thresholds for participation in these faculty competitions dealing both with the number of publications in three previous years and the amount of teaching service done. This is one of the mechanisms the university introduced for faculty rotation.

The university undergoes a transition to a new type of contract for faculty members called “single contract”. Old contracts of professors were focused on their teaching. In particular, it was possible to violate the contract for not showing up in class but it was impossible to violate the contract by not publishing or not doing service to the university. In this new single contract, various activities of faculty members are stipulated such as teaching, research (measured by the number of publications in journals of a certain level) and service.

Internationalization of teaching and research is an important strategic initiative within the overall HSE strategic development plan, aimed at achieving higher recognition of HSE as a reputable research university within the broader international academic community. The university introduced the same uniform procedure for international recruitment in all Faculties and departments. This procedure is supervised by the so called Center for Advanced Study, a university-wide formation. Within the “international hiring” initiative, the HSE offers tenure-track or tenure positions at levels of Assistant, Associate or Full Professor, as well as postdoctoral positions. Contract conditions (including but not limited to salaries) within the “international hiring” and within the “domestic hiring” are drastically different. It is important to stress that Russian citizens can be hired internationally, and foreign nationals can be hired domestically (this is what actually happened with the international faculty members of the Mathematics Faculty employed before 2014).

Since this issue is very important for the Faculty of Mathematics, we now give an overview of the differences between the domestic and the international contracts. Domestic contracts are terminal (except those of Ordinary Professors), with possibility of extension. Every time the contract needs to be extended, the faculty member must participate in a general competition, along with external candidates. In fact, there is one category of domestically hired faculty, the so called “ordinary professors”, whose positions are extended automatically. Only a small percentage of the HSE faculty are ordinary professors. Out of 1487 faculty members, only 104 are ordinary professors. With very few exceptions, international faculty members are hired at the level of assistant professor. They sign a 3-year contract. After these three years, they undergo an interim review. After three more years, they undergo a tenure review. If successful in both interim and tenure reviews, international faculty members can obtain tenure. The process can be expedited somewhat by the request of the international faculty members. The interim and tenure reviews are conducted with participation of external experts. If, as a result of the interim review or the tenure review, it is decided to terminate the contract, the employee is given one more year to look for other jobs.

The base-level salary of a domestically recruited faculty member is rather low: 37000 rubles monthly for a Docent (Assistant/Associate Professor) and 40000 rubles monthly for a (Full) Professor. This is the only part of the salary guaranteed in the working contract. On the other hand, domestic faculty members are eligible for various bonuses. The most significant bonus is awarded for publication in reputable international academic journals. In 2015, this bonus could reach 120K rubles monthly for one publication in a top rank journal in 2013-2014 with 20 additional percent for every subsequent publication in a top rank journal (see more details below, in the section “Academic bonus program”). Thus having a salary level of 150-200K was quite realistic for a domestic faculty member in 2015. This situation is very far from being uniform across different disciplines. It is not uniform even in mathematics. In 2016, the bonuses have been reduced because of budget restrictions. On the other hand, salary levels of the international faculty members have been increased to partly compensate for the weakening of the ruble. Contracts made within the international hiring scheme come with much more significant level of remuneration, namely, it is 200-250K for an assistant/associate professor (it used to be 160-180K in 2014). It also comes with a “social package” (medical insurance, institutional support of visa applications, etc.) and some travel grants. On the other hand, international faculty members are not eligible for bonuses. The teaching load stipulated in an international contract is much lower than that of a domestic professor. Dropping the details, one may say that an internationally hired assistant professor has much higher salary and much less teaching than a domestic full professor.

The very selection process is also very different for the two hiring schemes. There are two rounds of domestic hiring each year – one in the winter and one in the summer. The position openings are announced at the HSE web portal, are also published in some domestic newspapers, and are advertised through some domestic media. Every candidate must satisfy certain minimal requirements on the number of recent publications (for example, a qualification requirement for a professorship position includes having at least 5 publications during the last 3 years). Recent publications by a candidate are forwarded to members of the Faculty Hiring Committee and external experts, who evaluate each of the presented publications. Every candidate is also invited for an interview, during which they are asked to present their scientific results. Based on the evaluation and the interviews, the Faculty Hiring Committee gives a recommendation. This recommendation has also to be approved by the Faculty Council. Upon the recommendations of the Faculty Hiring Committees, the Central HSE Council makes the final decision. In principle, it may or may not follow the recommendations.

International recruiting is conducted once a year, with openings being announced in September-November, and application deadlines in late December. International openings at HSE are advertised widely. For example, open positions in mathematics are announced through mathjobs.org. In contrast to the domestic hiring, the first step of the process, namely, the long-listing, is done by external experts. There are very few (2-3) external experts in the subject search committee, and the decision of the committee is made by consensus. After the long list is formed, a Faculty Selection Committee creates a short (invite) list. Short-listed candidates are invited for interviews; their travel expenses are paid for by the university. The Faculty Selection Committee makes a recommendation based on the application packages and the interviews. The final decision is made by the central Selection Committee.

Some specific problems the Faculty of Mathematics experiences because of the coexistence of the two schemes (domestic and international) are described in the section “Hiring”.

ACADEMIC BONUS PROGRAM. This program provides competitive salaries to researchers who publish in reputable international journals. The program is implemented by the HSE Scientific Fund and aims at boosting the academic impact of the university at an international level, including citation parameters. As was mentioned before, for many faculty members, the “bonus” part of the salary is much larger than the base part guaranteed by the working contract. This creates an unhealthy situation, where the changes in the rules of academic bonuses (happening every year) and some random factors (say, publication delays on the part of the publishers) may create a lot of tension. Although there are several types of academic bonuses, the most relevant type for the Faculty of Mathematics is the third, which comprises the bonuses for publications in reputable international journals. International journals are taken from the lists of Scopus and Web of Science (WoS) and are evaluated according to their quartiles. There are four quartiles: Q1-Q4, where Q1 generally means higher impact and Q4 means lower impact. In 2015-2016, the bonuses are given only for Q1-Q3. The monthly amount of the bonus depends on the quartile.

The quartiles in Scopus and WoS may be different. The same journal titles may be associated with different quartiles even within the same database (Scopus or WoS) b/c quartiles are assigned within each subject area, and the same journal may be associated with several (sometimes many) subject areas. Thus there is a lot of ambiguity in determining quartiles. In former years, the Scientific Fund used the maximum quartiles in almost all cases. For 2016, it has been decided to use the “most relevant” quartile. This means that experts (internal and external) will be asked to establish a correspondence between a publication and one of the subject areas associated with the title of the journal. One problem is that this procedure lacks objectivity. Another problem is that neither of the subject areas listed for the journal, say, in Scopus may appear to be relevant. The classification of journals into subject fields may be inadequate in both WoS and Scopus. This seems to be the case for mathematical physics, logic, and number theory. This leads to the effect that in these fields there are few Q1-Q2 journals as other Q1-Q2 journals listed in the same subject category focus in fact on something different. Starting from 2017, the Scientific Fund plans to use WoS exclusively, and to stop awarding bonuses for Q3 publications. It is possible to get bonuses for several (normally, up to 3) publications, each subsequent publication adding 20 percent to the bonus.

The number of affiliations listed in a publication may reduce the bonus, e.g., in certain cases, the bonus may be divided by the number of affiliations. Publications with more than 4 authors are punished similarly. Before 2014, the bonuses were not given for papers published originally in Russian, even if they were translated into English and if the journal was in top tier. Now the situation improved somewhat. It is possible to get a bonus for a publication in Russian. However, a penalty for domestic publishing applies unless the language of the original publication is English. Many of our faculty members view this rule as discrimination against Russian journals, harmful not so much to the HSE Mathematics Faculty as to Russian scientific publishing. Another common complaint is that the situation with academic bonuses is not stable: the rules change every year, which makes it impossible to plan ahead.

STUDENT EVALUATION. Regular student evaluations of teaching have been conducted every year for long time. Unfortunately, they failed to provide sufficient feedback for planning future courses for several reasons. The main reason was insufficient participation. Evaluations were offered as online polls, and less than 20 percent of the students took care to participate. The alternative of using paper forms (the one that was implemented originally) was discarded as it led to an excessive amount of cheating (student representatives or even educational program managers filling the forms for all students). Another issue was that the form only contained numerical evaluations of instructors’ performance w/o evaluations of particular courses and w/o input “text fields”, in which students can place informal comments to instructors. The situation changed rapidly, and in different ways.

The student evaluation is now conducted every module (quarter year) for all courses that end in this module. All students must participate, and punishment for repeated failure to participate is provisioned, up to being expelled. On the other hand, the questions are now meaningful, they address not only instructors but also the organization of particular courses, and it is possible to answer “hard to evaluate” to any question. The student evaluation started in Fall

2015 in experimental mode. In 2016, it becomes mandatory. The (anonymous) results of the student evaluation are available to instructors via their corporate online accounts, and also to the administration of the Faculty. Informal feedback may be useful to instructors. Formal grades (in fact, only bad grades, namely, less than 3 out of 5) may play a role when the working contract with an instructor is extended.

FACULTY OF MATHEMATICS: CURRENT STATE

As of December 2015, there are 74 Mathematics faculty members, including 38 full professors, 36 assistant/associate professors; there are also 4 postdocs and 18 administrative staff members (including students' office). A significant number of faculty members work part-time. There are two research units closely associated with the Faculty of Mathematics, the so called "international laboratories": the Laboratory of Algebraic Geometry and its Applications (directed by F. Bogomolov) and the Laboratory of Representation Theory and Mathematical Physics (directed by A. Okounkov). Henceforth, we will refer to these associated laboratories as the AG lab and the RTMP lab. There are 48 researchers in the AG lab and 33 researchers in the RTMP lab. The total number of faculty members and researches (including the associated laboratories) is about 140 (the laboratories and the Faculty have a significant overlap). Fourteen of them have been invited speakers at the International Congress of Mathematicians (ICM), including 3 speakers at the last ICM (Seoul, August 2014):

- Misha Verbitsky (Algebraic and Complex Geometry)
- Aleksandr Kuznetsov (Algebraic and Complex Geometry)
- Grigory Olshansky (Combinatorics)

The Faculty of Mathematics collaborates with the following research institutes of the Russian Academy of Sciences: Steklov Mathematical Institute, Kharkevich Institute for Information Transmission Problems, Lebedev Physics Institute. This collaboration takes the form of joint departments. Joint departments with research institutes provide a mechanism, by which researches from these institutes can teach courses at HSE and supervise students.

International partnerships and student exchange programs in Mathematics include: École Polytechnique, Kyoto University, Leiden University, University of Tokyo, École normale supérieure, University of Nantes, University of Luxemburg.

Faculty members and researchers hold PhDs from: Moscow State University, Steklov Institute, Harvard University, Princeton University, Massachusetts Institute of Technology, University of Toronto, University of Leiden, Queen's University (Kingston, Ontario), Paris 7 Denis Diderot, Université Cergy-Pontoise, University of Luxembourg, Université Claude Bernard – Lyon 1, University of Tokyo, École Normale Supérieure de Lyon, Université Joseph Fourier - Grenoble I, University of Manchester, Université de Montréal, Ruhr-Universität Bochum, Université de la Méditerranée - Aix Marseille II, Johns Hopkins University, University of Tel-Aviv, University of Amsterdam.

The Faculty of Mathematics maintains a close connection with the Independent University of Moscow (IUM). Traditionally, many HSE faculty members also teach core courses at the IUM. Formally, there are the following joint projects of the HSE and the IUM:

- Moscow Mathematical Journal, one of the most frequently cited Russian mathematical journals.
- Math in Moscow, a study abroad program (mostly) for North American students.

Both these projects are described in special sections below.

PRINCIPAL CHALLENGES AND GOALS

The Faculty of Mathematics reached its current state as a result of the implementation of the roadmap established in 2010. By now, we occupy one of the leading positions in Russian mathematical (university level) education. We also have been recognized, and thought of highly, by many distinguished international researchers. However, our international recognition is not yet as widespread as we would wish. In the view of many colleagues abroad, HSE is not

distinguishable from Moscow State University ("if it's a state university in Moscow, then it must be Moscow State University"). In fact, even those mathematicians who know our faculty members by name, often tend to include them into a general pool of Moscow mathematics, traditionally associated with MSU.

Among the most significant goals of the mathematics Faculty are the following:

- Adequate representation of the current state of the HSE Faculty of mathematics by formal university rankings (for example, the QS ranking agency started to rank the HSE in the subject category "mathematics" as late as in 2014; appearing in the top-100 of the QS subject ranking by 2018 would fairly represent the international level of the Faculty)
- Attracting highly motivated international students (at all levels, including PhD) with solid background to the HSE graduate programs in mathematics (as it stands now, some good students come from abroad but they are too few to create an international atmosphere)
- Attracting prominent researchers in the field of mathematics (this problem has always been on the agenda, and it is being solved continuously; on the other hand, the challenge is higher now as there are new administrative and economic barriers)
- Finding external funding for teaching and research in mathematics. The way we teach students is largely based on individual interaction between students and instructors; it requires a lot of resources; and the state funding we receive can only partially cover the required expenses.

Attaining these goals will secure a leadership position for the HSE mathematics Faculty at an international level.

HIRING

Hiring to the Faculty of mathematics is based on general open competition. We advertise our positions widely, including via mathjobs.org and other commonly viewed jobs portals. This principle took effect in 2009 (the first year after the foundation of the department) for positions of Docent (Assistant/Associate professor), and in 2014 for positions of Professor as well. The latter change was a decision of the Faculty Council based upon recommendation of the International Advisory Board and of the Faculty Hiring Committee. The initial composition of the Faculty was formed by professors of the Independent University of Moscow; initially, there were less than 10 faculty members. All further hiring was done through open international competitions. Another key feature of our hiring policy, very similar to the policies of European and North American universities but different from those of many Russian universities, is that equally high selection criteria are applied to teaching and research.

During several years, we had one competition for domestic and international candidates. Apart from many Russian citizens, who applied from abroad, one British, one German, and two Japanese citizens joined the faculty through this unified competition. Many times we had more than 10 qualified applications for each vacant position, after the preliminary filtration based on formal qualifications and publication records. This indicates that faculty positions in mathematics are viewed as attractive. Apart from the scientific reputation of the Mathematics Faculty, this may be explained by a combination of the following factors.

- Very strong and highly motivated mathematics students. The concentration of students interested in and capable of producing genuine mathematical research is arguably higher in Moscow than elsewhere in the world.
- Attractive working conditions. The teaching load is modest, and it is closer to the European and North American tradition than to Russian university tradition (were faculty members are generally regarded merely as instructors rather than researchers). The salary level is high, although, at domestic positions, it is less secure than in western universities as only a small portion of the actual salary is guaranteed by the working contract.
- Flexible curriculum. This creates an opportunity for every instructor to actively participate in curriculum development and to offer original courses.

In 2013-2015, other hiring schemes were introduced by the central administration. First, in 2013, the Mathematics Faculty joined the university-wide search for PostDocs. Then, in 2014, this procedure (called “international recruitment”) has been extended to Assistant/Associate Professorship positions. The principles of international recruitment and the relationships between the two hiring schemes – domestic hiring and international hiring – are described above in more detail, in the section “Faculty rotation, single contract, and international recruitment”.

In 2013, we hired three postdoctoral fellows. Hiring postdocs is formally a part of the university-wide international recruitment scheme, and is also coordinated by the central administration. For example, all applications are collected by a central office (called the Center for Advanced Study and abbreviated as CAS), and only then are forwarded to the departments. Postdoc positions have a 1-year term, with possibility of extension. Some preference is given to candidates with international experience. In 2013, there was an unfortunate episode of misunderstanding between the Faculty of Mathematics and the central administration. At the request of the central administration, the Faculty provided a short list of candidates, in order of preference. Unfortunately, all candidates with domestic degrees were removed from the list by the central committee. The candidates who received the offers, were among the short-listed candidates (thus, the Math Faculty was interested in having them) but as top preferences. Luckily, in 2014, the misunderstanding was resolved. That is,

1. considering domestic candidates (candidates with domestic degrees) for international positions is now allowed (although some international experience is still desirable);
2. the central administration agreed that the only possible decision of the central committee may be on the number of top-listed candidates, to whom the positions will be offered; the central committee cannot change the order of the candidates, neither can it skip some of the candidates (say, offer a position to candidate 2 without offering it to candidate 1).

The salary level of a postdoc is rather high (110-120K monthly). In previous years, postdocs were also offered accommodation and travel grants. Now the HSE stopped offering this support while slightly increasing the salary. Overall, we are happy with the level of our postdocs.

A major problem with a centralized recruitment scheme is that many steps (however formal and technical) are done without participation of or even consultation with the Faculty. For example, only the CAS can directly communicate with the candidates and solicit their contract conditions. Offers are sent directly to the candidates; we have almost no say on their content.

RESEARCH

The faculty members are working in several research areas of mathematics and mathematical physics. We have strong groups focused on various problems of the following research areas:

- Algebraic geometry
- Dynamical systems
- Mathematical logic
- Mathematical physics
- Representation theory
- Low-dimensional topology

Here is a list of some members of the groups and of some important results obtained by faculty members and researchers of the associated laboratories (the lists are by no means exhaustive, they are only aimed at giving a general picture); many faculty members belong in fact to several groups:

1. Algebraic geometry:

Keywords	**Faculty members**	**Selected publications**

Hyperkähler manifolds, derived categories, Fano varieties, Gromov-Witten invariants	E.Amerik, F.Bogomolov, S.Galkin, A.Kuznetsov, M.Rovinsky, M.Verbitsky, V.Vologodsky	E.Amerik, M.Verbitsky. Teichmüller space for hyperkähler and symplectic structures // Journal of Geometry and Physics. 2015. Vol. 97, 44-50.
		M.Verbitsky. Ergodic complex structures on hyperkähler manifolds // Acta Mathematica. 2015 (no.1), 161-182
		A. Kuznetsov. Height of exceptional collections and Hochschild cohomology of quasiphantom categories // Journal für die Reine und Angewandte Mathematik, 2015, 213-243
		S.Galkin, L.Katzarkov, A. Mellit, E.Shinder. Derived categories of Keum's fake projective planes // Advances in Mathematics. 2015, 238-253

PhD students: A. Tomberg (advisor M.Verbitsky).

Selected publications of PhD students:

- Tomberg A. Twistor spaces of hypercomplex manifolds are balanced // Advances in Mathematics. Vol. 280 (2015), P. 282-300.

2. Dynamical systems:

Keywords	Faculty members	Selected publications
Hyperbolic systems, ergodic theory, probability theory, stochastic processes	M.Blank, A.Bufetov, A.Glutsyuk, Y.Ilyashenko, A.Klimenko, A.Kolesnikov, A.Skripchenko, V.Timorin	Bufetov A. I. Limit theorems for translation flows // Annals of Mathematics. 2014. Vol. 179. No. 2. P. 431-499
		Skripchenko A., Troubetzkoy S. Entropy and complexity of polygonal billiards with spy mirrors // Nonlinearity. 2015. Vol. 28. No. 9. P. 3443-3456.
		(monograph) Bogachev V., Krylov N. V., Roeckner M., Shaposhnikov S. Fokker-Planck-Kolmogorov equations // Providence : American Mathematical Society, 2015.

PhD students: N.Goncharuk (advisor Y.Ilyashenko), D.Zaev (advisor Kolesnikov),

Selected publications by PhD students:

- Buff, X.; Goncharuk, N. Complex rotation numbers. // J. Mod. Dyn. 9 (2015), 169-190.
- Goncharuk, N.B. Rotation numbers and moduli of elliptic curves. // Functional Analysis and its Applications, Volume 46, Issue 1, March 2012, Pages 11-25.
- Zaev, D. A. On the Monge–Kantorovich problem with additional linear constraints // Mathematical Notes, Volume 98, Issue 5-6, 1 November 2015, Pages 725-741

3. Mathematical logic

Keywords	Faculty members	Selected publications
Modal logic, proof theory, provability logic.	L.Beklemishev, Yu.Savateev, V.Shehtman	L.Beklemishev. Positive provability logic for uniform reflection principles // Annals of Pure and Applied Logic. 2014 (no.1), 82-105.
		D.Gabbay, I.Shapirovsky, V.Shehtman. Products of modal logics and tensor products of modal algebras. Journal of Applied Logic. 2014 (no.4), 570-583
		Y.Savateev. Proof internalization in generalized Frege systems for classical logic // Annals of Pure and Applied Logic, 2014 (no.1), 340-356

4. Mathematical physics

Keywords	Faculty members	Selected publications

Integrable systems, gauge theories, statistical physics	V.Chepyzhov, I.Krichever, A.Marshakov, S.Natanzon, A.Okounkov, P.Pyatov, P.Saponov, A.Zabrodin	E.Carlsson, N.Nekrasov, A.Okounkov. Five dimensional gauge theories and vertex operators // Moscow Mathematical Journal. 2014 (no.1), 39-61.
		A.Marshakov. Lie groups, cluster variables and integrable systems // Journal of Geometry and Physics. 2013, 16-36.
		A.Gorsky, A.Zabrodin, A.Zotov. Spectrum of quantum transfer matrices via classical many-body systems // Journal of High Energy Physics. 2014 (no. 1): 070 L
		Natanzon S. M., Zabrodin A. Symmetric solutions to dispersionless 2D Toda hierarchy, Hurwitz numbers and conformal dynamics // International Mathematics Research Notices. 2015. Vol. 2015, 2082-2110

PhD students: P. Gavrilenko

Selected publications by PhD students:

- Gavrylenko P. Document Isomonodromic τ-functions and W N conformal blocks // Journal of High Energy Physics. 2015. No. 09. P. 167.
- Gavrylenko P., Marshakov A. Residue Formulas for Prepotentials, Instanton Expansions and Conformal Blocks // Journal of High Energy Physics, No. 5 (2014), P. 97.

5. Representation theory

Keywords	**Faculty members**	**Selected publications**
Flag and Schubert varieties, representations of Kac-Moody algebras, quantum groups	B.Feigin, E.Feigin, M.Bershtein, M.Finkelberg, V.Kiritchenko, A.Khoroshkin, S.Khoroshkin, A. Okounkov, G.Olshanski, L.Rybnikov	B.Feigin, M.Jimbo, T.Miwa, E.Mukhin. Document Quantum toroidal gl1 and Bethe ansatz // Journal of Physics. A. Mathematical and Theoretical, 2015 (no.24), Art. No.244001
		A.Braverman, M.Finkelberg. Semi-infinite Schubert varieties and quantum k-theory of flag manifolds // Journal of the American Mathematical Society. 2014 (no.4), 1147-1168
		A.Borodin, Alexey Bufetov, G.Olshanski. Limit shapes for growing extreme characters of U(∞) // The Annals of Applied Probability. 2015 (no.4), 2339-2381
		Cherednik I., Feigin E. Extremal part of the PBW-filtration and nonsymmetric Macdonald polynomials // Advances in Mathematics. 2015. Vol. 282. P. 220-264.

PhD students: A.Bufetov (advisor G.Olshanski), E.Makedonskyi (advisor E.Feigin)

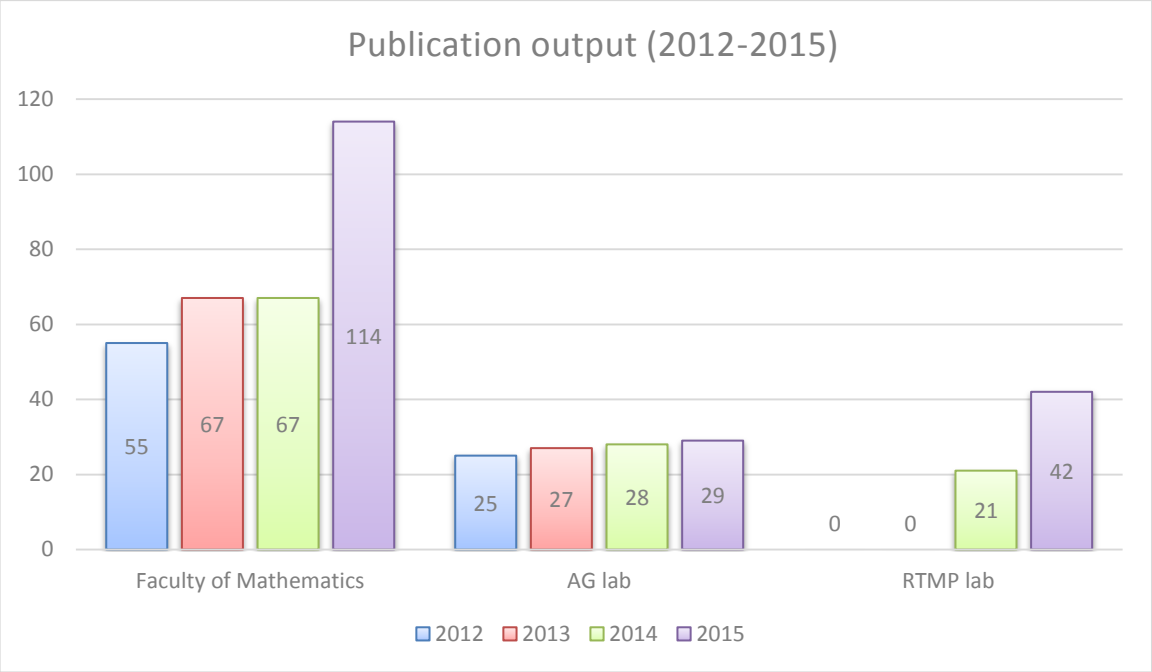
Selected publications by PhD students:

- Bufetov, Alexey; Petrov, L. Law of large numbers for infinite random matrices over a finite field. // Selecta Math. (N.S.) 21 (2015), no. 4, 1271-1338.
- Bufetov, Alexey; Gorin, Vadim. Representations of classical Lie groups and quantized free convolution. // Geom. Funct. Anal. 25 (2015), no. 3, 763-814.
- Bufetov, Alexey, Gorin, V. Stochastic Monotonicity in Young Graph and Thoma Theorem. // International Mathematics Research Notices, Volume 2015, Issue 23 (2015), Pages 12920-12940.
- Borodin, Alexei; Bufetov, Alexey. Plancherel representations of U(∞) and correlated Gaussian free fields. // Duke Math. J. 163 (2014), no. 11, 2109-2158.
- Makedonskyi I. On Noncommutative Bases of Free Modules of Derivations over Polynomial Rings // Communications in Algebra, Vol. 1., No. 44 (2016),
- Feigin E., Makedonskyi I. Nonsymmetric MacDonald polynomials and PBW filtration: towards the proof of the Cherednik-Orr conjecture // Journal of Combinatorial Theory, Series A. 2015. P. 60-84.
- Makedonskyi I., Petravchuk A.P. On nilpotent and solvable Lie algebras of derivations // Journal of Algebra, Vol. 401 (2014), P. 245-257.

6. Topology

Keywords	Faculty members	Selected publications
Knot invariants, toplological recursion, Hurwitz numbers	P.Dunin-Barkowski, A.Esterov, A.Gorinov, E.Gorsky, M.Kazarian, S.Lando, V.Vassiliev	E.Gorsky, A.Neguţ. Refined knot invariants and Hilbert schemes // Journal de Mathématiques Pures et Appliquées. Neuvième Série, 2015 (no.3), 403-435
		P.Dunin-Barkowski, M.Kazarian, N.Orantin, S.Shadrin, L.Spitz. Polynomiality of Hurwitz numbers, Bouchard-Mariño conjecture, and a new proof of the ELSV formula // Advances in Mathematics. 2015, 67-103.
		P.Dunin-Barkowski, A.Sleptsov, A.Smirnov. Kontsevich integral for knots and Vassiliev invariants // International Journal of Modern Physics A. Particles and Fields. Gravitation. Cosmology. 2013 (no.17)
		Esterov A. I., Takeuchi K., Ando K. Monodromies at infinity of confluent A-hypergeometric functions // Advances in Mathematics. 2015. Vol. 272, 1-19.

The following chart shows the publication output of the Faculty of Mathematics (74 faculty members), and the associated laboratories (the AG lab with 48 researchers and the RTMP lab with 33 researchers). Since the RTMP lab was founded in 2014, the data are available only for 2014-2015.



It is our strategic goal to raise the average impact of a publication, measured formally or informally. On the other hand, we do not plan increasing the number of publications or at least creating special stimuli to this effect.

Faculty members hold a significant number of external grants; see Appendix 1 for a list of grants awarded in 2015. Some awards of the faculty members are also listed there.

ADMINISTRATION

The Faculty's administrative body consists of the Dean, several Deputy Deans and the Faculty Council. From the foundation of the Mathematics Faculty and till April 2015, Sergey Lando served as a Dean. Before 2015, the structure of the Faculty government was the following:

- Sergey Lando, Dean
- Igor Artamkin, Deputy Dean for Educational Programs
- Alexey Gorodentsev, Deputy Dean for Science
- Vera Kuznetsova, Deputy Dean for Administration

- Vladlen Timorin, Deputy Dean for International Cooperation

Educational programs of the Faculty were also under the jurisdiction of the Faculty administration; in particular, the Faculty Council was responsible for the organization of the teaching process. However, admission orders were (and still are) signed by the Rector. The Faculty could not assume any financial obligations; in particular, only the central administration was (and still is) in a position to negotiate conditions of the working contracts. Agreements with other institutions, including student exchange agreements with universities abroad, could only be signed by a Vice Rector with a valid power of attorney provided by the Rector.

In 2014-2015, the structural changes implemented at the university level influenced the structure of the local administration. One important novelty is that now every educational program has its own management team and governing body. The Faculty Council is no more responsible for the content and the organization of the courses. Every educational program has its own academic director and its own academic Council.

The new composition of the Faculty administration (since 2015) is the following:

- Vladlen Timorin, Dean
- Igor Artamkin, Deputy Dean for Educational Programs
- Alexander Esterov, Deputy Dean for New Admission and External Relations
- Evgeny Feigin, Deputy Dean for Science
- Vera Kuznetsova, Deputy Dean for Administration

In contrast to what happens in many departments of other Russian universities, the administration of the Faculty of Mathematics is not isolated from the faculty. This is implemented not only by the fact that the Dean and the Deputy Deans hold professorships in the Faculty of Mathematics but also by the rotation of their administrative duties as well as by the participation of all faculty members in administrative and organizational activities.

The Faculty Council plays a role of legislature for the Faculty of Mathematics; this is similar to other Faculties of HSE. The Dean and Deputy Deans play a role of the executive government; they are also responsible for the relationships between the Faculty and the central administration. Overall, the cooperation between the Faculty administration and the central administration is constructive; the fact that the central university government trusts us is supported by almost automatic confirmations of our decisions on the central level (this is true for the hiring process, regulating admission parameters, etc.). It is a general tendency at HSE that more and more principal decisions are delegated to the level of Faculties.

FINANCES

As of December 2015, the Faculty owes about 5 million rubles to the central budget. The debt is structured as follows. Three million were spent as vacation pays of the faculty members whose salary included external funding from scientific grants in 2012-2015. According to the Russian legislation, vacation pay is calculated as the average salary over the 12 months preceding the starting date of the vacation. The part of the salary funded by external grants has therefore some influence on the amount of vacation pay; on the other hand, these extra payments were not planned by the central budget. It was a centralized decision to charge the Faculties. This is how 0 became minus three million.

Two million were spent on salaries of four administrative staff members whose positions were moved to the budget of the Faculty by a centralized decision of the university Council. According to this decision, all administrative staff except for students' office managers and several precisely determined job titles such as the secretary of the Dean are funded by the Faculties rather than the central budget. The Faculty of Mathematics has only few fee-paying students, and is not involved in any commercial activities. Therefore, it is impossible for us to cover this debt.

The university central administration proposed a plan to restructure the debt of the Faculty of Mathematics. The plan is, roughly speaking, that the four administrative positions are returned to the central funding till September 1st of

2016, and by then the Faculty must find a way of earning money. Possible sources of income that the Faculty is suggested to consider include: finding sponsors, opening fee-paying vocational training programs, offering fee-paying special topics courses to all HSE students and to the general public. The repayment can be amortized and co-funded by the central budget, provided that the Faculty's income exceeds one million annually. Although the prospect of having sufficient income does not seem feasible to the Faculty administration, we do plan to 1) increase the number of fee-paying students, 2) open vocational training courses for high-school teachers of mathematics, 3) look for sponsors.

The donation by Pierre Deligne cannot be used to cover the debt because this is explicitly stipulated in the donation agreement. This is lucky for us since we still have a possibility to use this money on science and education. Here is a short report on how the donation was spent.

The following workshops, schools and conferences have been (co)funded:

- The XIII international conference in theoretical and mathematical physics (May 2014)
- International school and conference "Integrable systems in quantum field theories" (February – March, 2015)
- Conference and winter school "String theory, integrable models, and representation theory" (February – March, 2016)
- The Arnold Day (June 2014, June 2015)

Academic mobility:

- Outgoing academic mobility of undergraduate and graduate students (participation in scientific and educational events): trips of 11 students have been funded
- Incoming mobility of researchers: 3 research visits have been funded
- Outgoing academic mobility of faculty: a trip to Nizhny Novgorod of one faculty member has been funded.

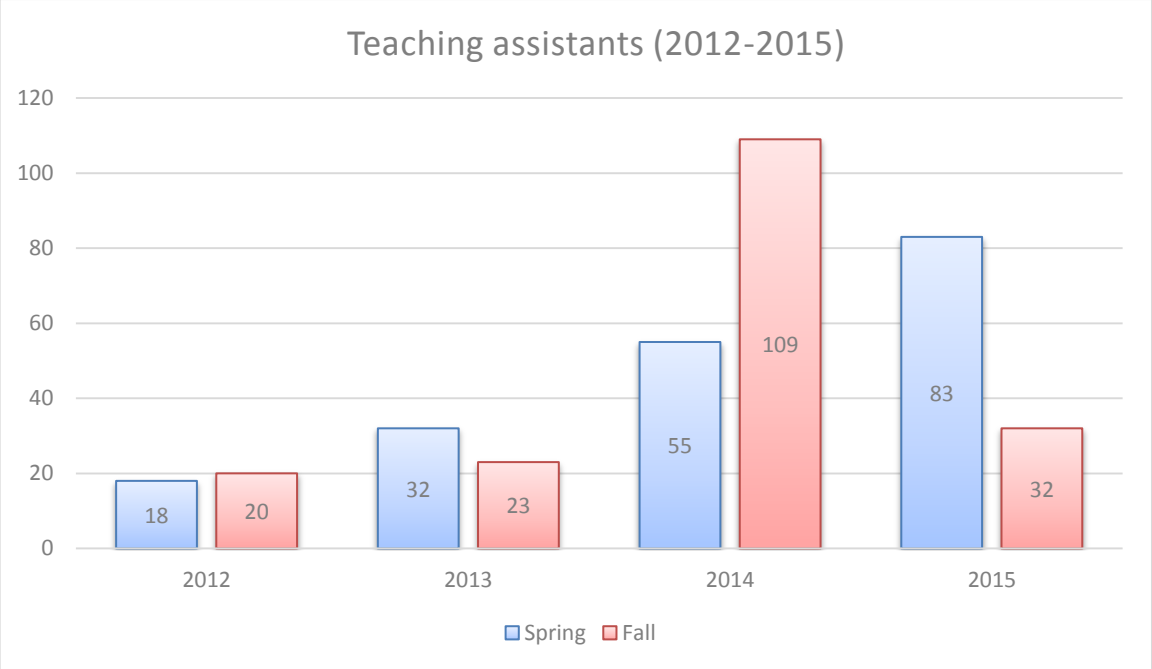
Miscellaneous:

- Mathematical books which were presented to students at the graduation ceremony
- Online platform for building and registering individual study plans

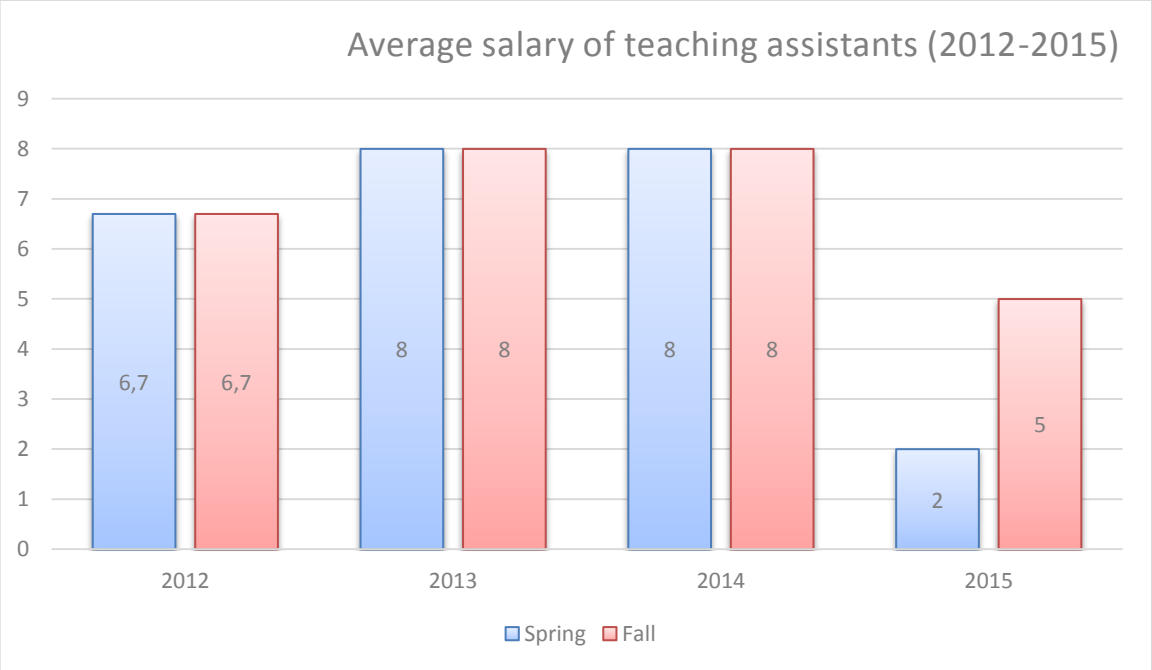
As was mentioned above, a part of the central university budget has been given to the mega-Faculties, in particular, to the Faculty of Mathematics. These funds are reserved for specific purposes and cannot be used otherwise. Basically, there are two parts of this new budget of the Faculty: funding of Science and funding of Education. The "Science" part is about the same as what faculty members used to receive before in form of travel grants and support for organizing scientific events. The "Education" part is significantly less now than it used to be. This is most painful in case of teaching assistantships and "outgoing student mobility".

TEACHING ASSISTANTS

Teaching assistantships are important both to students, for whom these are a source of practice and a source of income, and to the instructors, for whom these are important tools of teaching and evaluation. Until recently, the number of teaching assistants (TAs) was growing. A recent change is related to the "decentralization" of the university budget. As a part of this initiative, funding of teaching assistantships has been distributed between Faculties, however, some Faculties received less money for TAs than they used to have from the central budget. In particular, the funding of TAs working in the educational programs of the Faculty of Mathematics has been reduced to a third of what it was. The following diagram shows the dynamics of the number of teaching assistants by term.



We see that, in the Fall 2015, the number of TAs dropped to less than one third of the level of the Fall 2014. This decision was taken by the Faculty based on a lower estimate of the salary that each individual TA must receive. The dynamics of the salary of TAs is shown in the diagram below.



The figures of the salary are given in thousands of rubles monthly. In this diagram, we see the reason for hiring fewer teaching assistants in the Fall 2015. With the number of teaching assistants close to that of the Fall 2015, the salary level is way too low, certainly not adequate given the amount of work done by the TAs.

MAJOR CONCERNS

According to the Mathematics Faculty administration, there are several levels of problems obstructing the development of the Faculty: global (having to do with federal rules), university-wide (communication between the Faculty of Mathematics and the central administration), and internal (having to do with the Faculty itself).

There is no point of discussing global issues in detail since we can do little to resolve them. Only two of them are worth mentioning here, and these two are closely related: 1) the lack of job opportunities in mathematical research, and 2) the lack of qualified candidates for graduate-level positions.

Speaking of university-wide problems, we need to mention the following:

1. All numeric parameters of teaching plans (total hours for a course, the minimum number of students in a group, the maximum number of midterms and final exams, etc.) are controlled by the central administration in the same way for all educational programs. Thus the rules are the same for mathematics, economics, design, psychology, eastern studies. As a result, the Faculty administration, while attempting to resolve internal curriculum issues, has to cope with significant external restrictions.

2. In 2015-2016 the set of external restrictions changed drastically. The most important parameter now is the so-called "effectivity" of an educational program that is computed as the ratio of two numbers. The numerator is the number of students enrolled in the program. The denominator is the number of instructors teaching full time with the maximum teaching load that would suffice to cover all courses. It is now imposed that the effectivity of a Bachelors program should not be less than 13, and the effectivity of a Masters program should not be less than 10. This value of the "effectivity" parameter rules out the possibility of individualized education trajectories.

3. Retakes of examinations are restricted so that oftentimes giving a failing grade for a course means that the student will automatically be expelled. In Soviet tradition, exams were a way of learning. We cannot follow this tradition. Another consequence is that sometimes the instructors give the minimal pass grade in order not to lose a capable student who for some reasons did not make enough effort to master the subject. This in turn sends a wrong signal to students that working hard is not necessary.

4. A general feeling of many HSE faculty members is that the central administration considers research much more important than teaching. The only measurement of the quality of teaching is done through a compulsory evaluation by students. The numeric results of students' evaluation may play some role in extending or not extending a working contract with an instructor. On the other hand, the contents of the courses are not evaluated at all.

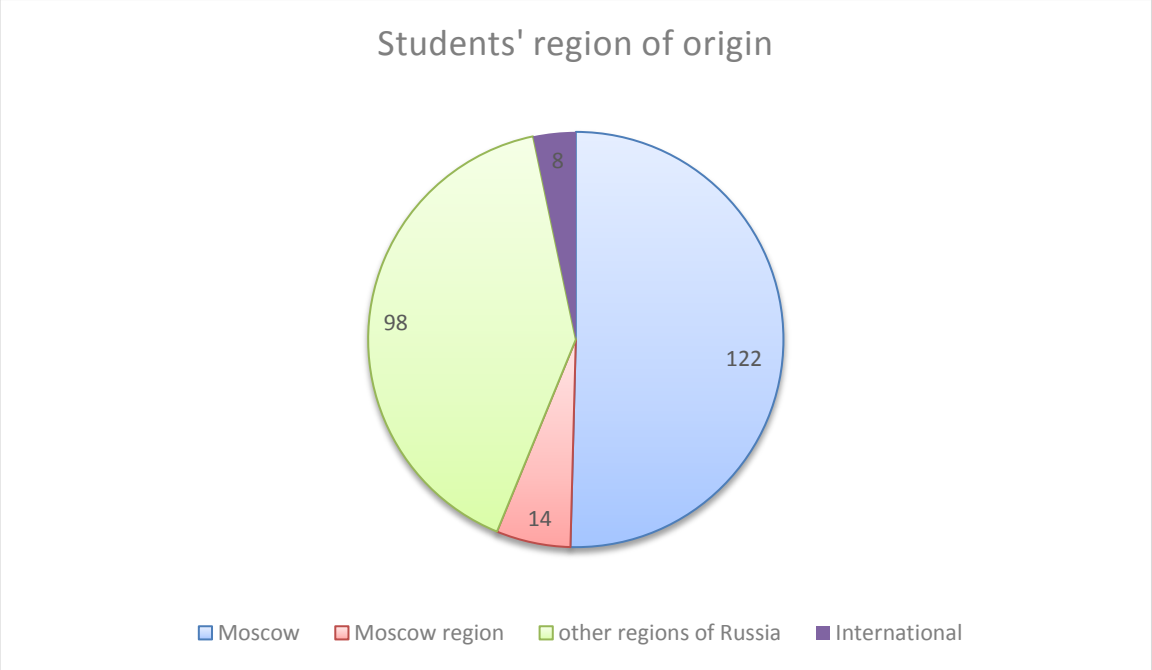
5. The nominal teaching load is way too high. De facto we are allowed to have 70-75 percent of the nominal teaching load. This is based on an informal arrangement and may change at any time. From the very beginning, the Faculty of Mathematics viewed individual and interactive work with students as a top priority. In order to implement this, in particular, an extra-curricular study or a research project is included in the study plan for every year of study. The workload of advisors is very significant but unfortunately it counts only as a tiny fraction of the full teaching load except for projects done in the year of graduation. Supervising one non-senior student is worth 1/140 of the full teaching load.

The interior problems of the Faculty have to do with the fact that the workload is very far from being uniform. This mostly concerns doing service and teaching core courses. Unfortunately, we still do not have good mechanisms for distributing the workload fairly.

BACHELOR OF SCIENCE PROGRAM IN MATHEMATICS

HSE Faculty of Mathematics invited its first Bachelor students in 2008. The program aims at providing a fundamental mathematical background as well as wide opportunities for its application: from physics, economics and computer science to actuary and financial analysis. The academic director of the program is Sergey Khoroshkin.

As of December 2015, there are 242 students enrolled. A great majority of them hold state-funded positions. There are only 17 fee-paying students. Diagram below shows the regions of origin of Bachelor of Science students. We see that about a half of the students are from Moscow, slightly less than a half of students are from outside of Moscow region.



The following are the top high schools by the number of graduates currently enrolled in the program:

1. Moscow school No 57.
2. The Kolmogorov Boarding School.
3. Moscow school No 179.
4. Specialized Educational Scientific Center of the Novosibirsk State University, Novosibirsk;
5. Moscow boarding school «Intellectual».
6. Moscow school No 2.

Selected publications of Bachelor of Science students in 2012-2015:

- **Kalinov D.** Radiation due to homogeneously accelerating sources // Physical Review D - Particles, Fields, Gravitation and Cosmology, Volume 92, Issue 8, 22 October 2015, Article number 084048
- **Matdinov M.** Size of Components of a Cube Coloring // Discrete and Computational Geometry, Volume 50, Issue 1, 2013, Pages 185-193

In 2013, Lev Sukhanov who was then a BSc student, was awarded an honorable mention at the Moebius contest. In 2014, he was a winner. In 2015, Rodion Deev, our BSc student, also received a Moebius prize. Another student of ours, Alexey Golota, received an honorable mention. Several BSc students have been awarded the “Silver nestling” prize of the HSE for their outstanding academic performance:

- Rodion Deev (2015)
- Svetlana Makarova (2014)
- Alexey Pakharev (2014)

STRUCTURE OF THE CURRICULUM

The Faculty of Mathematics has chosen a format of education at the Bachelor level that merges some traits of the Soviet tradition with those of the Anglo-Saxon tradition. This format looks as follows: the first two years of the 4-year

BSc program consist of mandatory basic courses, including both those traditional for Soviet mathematical education and "innovative" ones (topology, representation theory, Galois theory). The mandatory curriculum of the last two years is limited to academic writing, history of mathematics, and probability theory. All the rest is an "individual study plan" chosen from a large pool of courses offered by Faculty of Mathematics, other HSE departments, or external programs (first of all, Independent University of Moscow (IUM) and the Yandex School of Data Analysis).

Mandatory courses are conducted in the form of lectures, tutorials (more resembling the North-American rather than the Soviet ones) and "mathematical practicum" sessions. The latter are individual discussions of theoretical problems between students and instructors; this kind of educational activity follows the best practices of IUM and mathematically oriented high-schools. Optional courses can be basic ("elective courses"), taught in the same format as mandatory courses, or advanced ("special topics courses"), taught in the form of lectures. Thus, there are two major differences that distinguish the new scheme from the traditional one:

- "Mathematical practicum" and coursework for freshmen and sophomores provide intensive student-faculty interaction;
- Juniors and seniors build their own study plans choosing from a large pool of elective courses and adding non-mathematical courses from other departments if desired.

These features create the following advantages:

- Students who are half-way through their BSc program and decide to concentrate on a particular applied subject may take non-mathematical courses in their chosen field complemented by relevant advanced mathematical courses; these students do not waste their time on mathematical background unnecessary for them personally;
- Students wishing to pursue an academic career may first specialize in their chosen research field, and then, parallel to their own research agenda, strengthen their background in other mathematical subjects;
- FM can dynamically adjust the range and contents of elective courses without touching the mandatory part;
- The range of advanced courses can be expanded without increasing the teaching load: some courses may be offered bi-annually, so that students can take them either in their 3rd or 4th year of study.

Currently (academic year 2015-16) the following courses are mandatory for undergraduate students:

<u>1st year (= 4 modules = 3 trimesters)</u>

- Algebra (1st – 4th modules): basic algebraic structures, linear/multilinear algebra, modules over p.i.d.
- Geometry (1st – 3rd modules): Euclidean, affine, convex, projective and hyperbolic geometry, conics, quadrics
- Analysis (1st – 4th modules): topology of R and R^n, differential calculus of one and several variables, integral calculus in dimension one, functional and power series.
- Logic (1st trimester): set theory, axiom of choice, first order logic
- Discrete mathematics (2nd trimester): combinatorics, generating series, graphs
- Topology (3rd trimester) metric spaces and general topology, examples and constructions of topological spaces
- Logic+ (4th module): elements of model theory, computability **or**
- Discrete mathematics+ (4th module): Möbius functions, trees, discrete probability
- History (1st – 2nd modules)
- Philosophy (3rd – 4th modules)
- English (1st – 4th modules)

<u>2nd year</u>

- Algebra (1st - 3rd modules): representations of finite groups and SL(2), Galois theory, categories

- Analysis (1st – 4th modules): smooth manifolds, measure theory and Lebesgue integration; multiple integral in Euclidean space, Hilbert space, Fourier series, elements of functional analysis
- Dynamical systems (1st – 2nd modules): ODEs, Picard–Lindelöf theorem, vector fields, linearization
- Topology (1st – 2nd modules): homotopy equivalence, fundamental group, coverings, singular homology
- Smooth manifolds (3rd module): Sard lemma, differential forms, Stokes formula, De Rham cohomology
- Mechanics (4th module): Classical mechanics, Lagrangian formalism, calculus of variations
- Complex analysis (3rd – 4th modules): holomorphic and harmonic functions, their integrals and analyticity, meromorphic functions, residues, Riemann surfaces
- Mathematical computing (4th module): mathematical experiments, Wolfram Mathematica computer algebra system
- English (1st – 4th modules)

3rd year

- Probability theory (1st – 2nd modules): Random variables, their convergence, important distributions, LLN, CLT, elements of statistics
- Mathematical writing (2nd module)
- History of mathematics (3rd module)

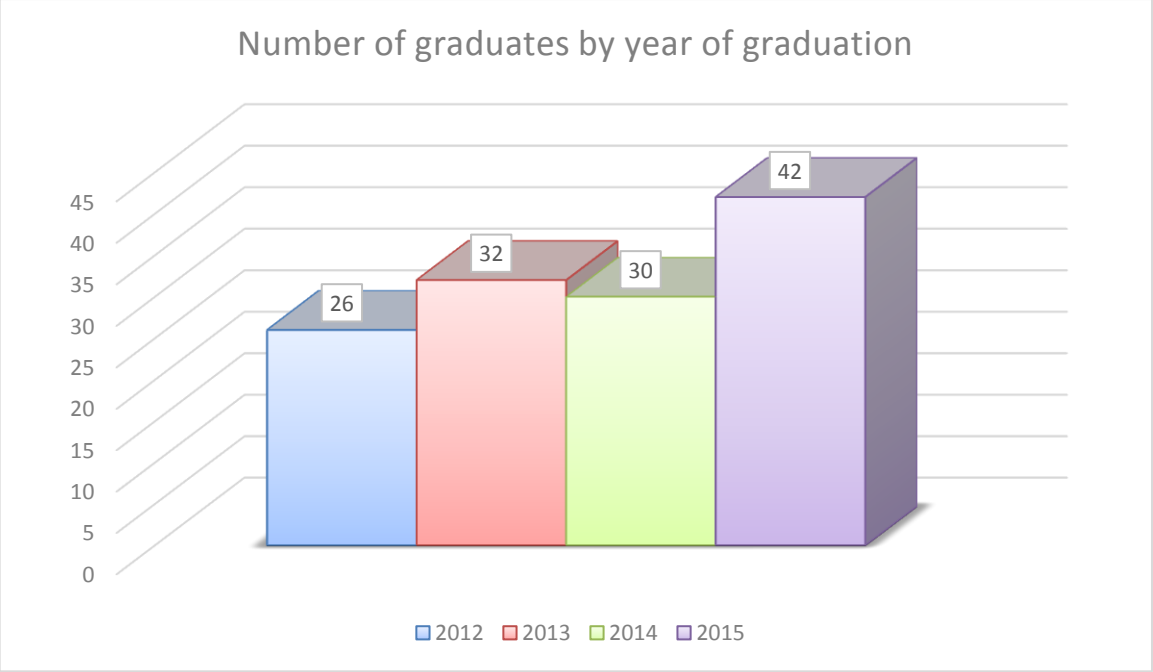
There are no mandatory courses in year 4. Students choose most of the courses they take in years 3 and 4 from a list of courses offered by the Faculty, which is the same for all educational programs. Students may also take external courses offered by other educational organizations in Moscow and beyond. Individual study plans must be approved by the students' advisors and curator.

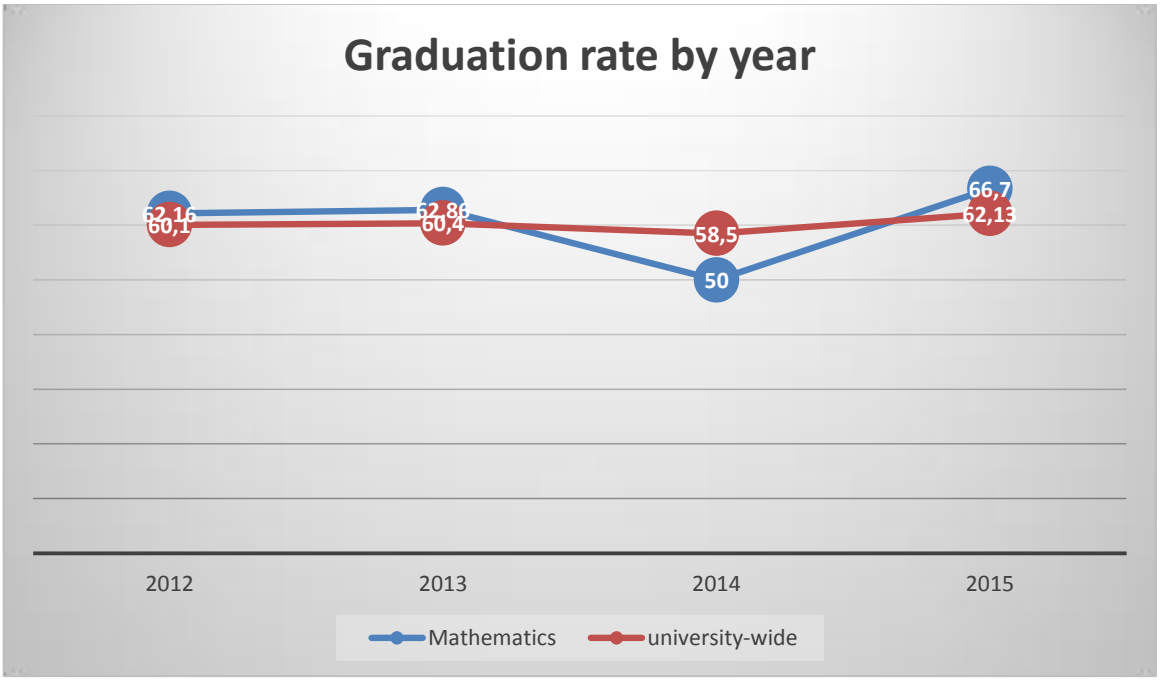
Optional courses and seminars cover a wide range of topics in mathematics and mathematical physics. A full list of optional course/seminar titles offered in 2015/2016 is given in an Appendix 5. It is too long to be copied here. Having a significant variety of courses and seminars allows students to build their truly individual educational trajectories during their 3rd and 4th years of study.

Every student of every year of study has to complete an independent study project. Projects of junior and senior students are expected to have some research part. Projects of year 4 are called Bachelors Theses and are defended in form of seminars. A Bachelors Thesis is a mandatory part of the degree.

GRADUATES

The graduation rate is defined as the ratio of the number of the students who successfully graduate (this includes students who successfully completed the entire program plus students who joined the program at a later stage and fulfilled all the degree requirements) to the students initially admitted to the program. The graduation rate is regarded by the university administration as one of the key indicators of the success and the stability of the program. In 2015, the graduation rate of the Bachelor's program is 66.7 percent (2/3). At the university level, this value is slightly above the average but not near the top. Diagram below shows the number of graduates by year of graduation. Although the number of graduates grows, the graduation rate decreases.





Graduates of the BSc program are successful in getting PhD offers from the best universities including Harvard, Princeton, MIT, Columbia, Yale, Toronto, etc. For example, in 2015, only three students from Russia entered the PhD program in Mathematics at MIT. All three are graduates of the HSE Faculty of Mathematics. University of Toronto issued 3 offers to our students; only one of these was accepted. One should also mention that after graduating some of our former students choose to specialize in economics, physics and computer science, and they have been able to enter some of the world's top programs in these fields. Table below shows the programs, in which our graduates study.

USA and Canada	**Russia**	**Europe**

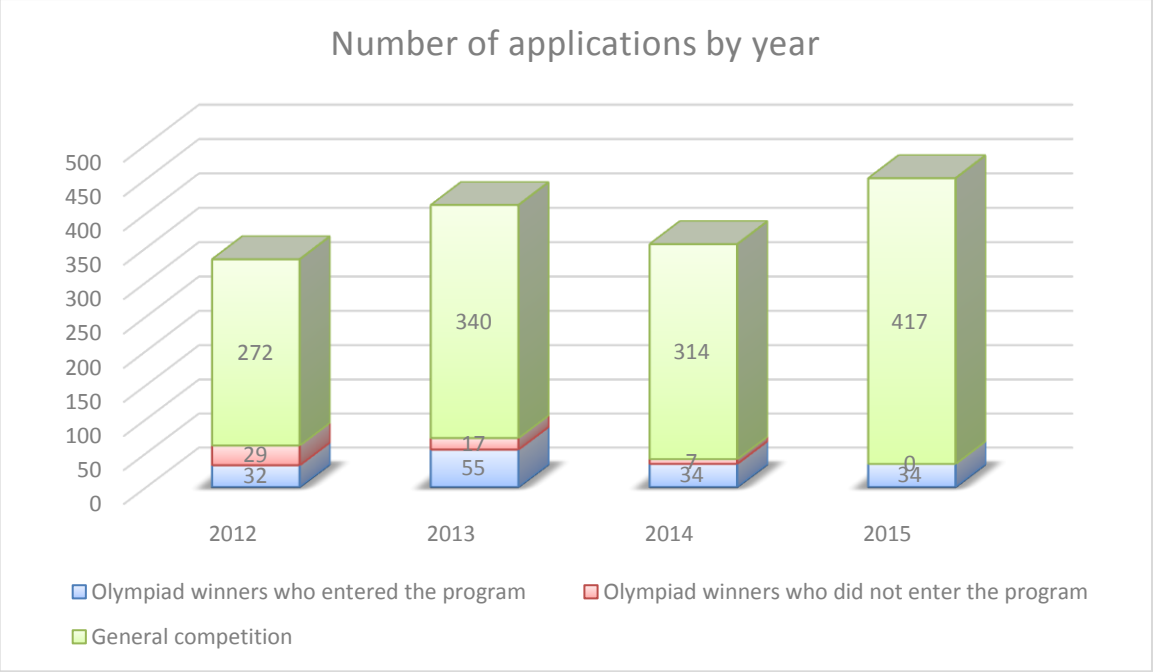
• Mathematics, California Institute of Technology • Mathematics, Columbia University • Mathematics, Harvard University • Mathematics, Northeastern University • Economics, Princeton University • Mathematics, Massachusetts Institute of Technology • Mathematics, University of Michigan • Applied Mathematics, University of Maryland • Mathematics, University of Toronto	• Mathematical Physics, Keldysh Institute of Applied Mathematics (Russian Academy of Sciences) • Mathematics, Independent University of Moscow • Mathematics, Economics, Computer Science, Linguistics, National Research University Higher School of Economics • Economics, New Economic School • School of data analysis, Yandex • Biology, Skolkovo Institute of Science and Technology	• Mathematics, ETH Zürich (Switzerland) • Mathematics, Leiden University (Netherlands)

The following table shows the list of companies in which are graduates are currently employed. It is important to note that most graduates of the BSc program still continue their education.

Finances	**IT**	**Science and Education**	**Other**
• AT Consulting • Axes Management • Bank «Otkrytie» • Bank of Moscow • Central bank of the Russian Federation • «Leto» Bank • Mezhtrastbank • TCS Bank	• PayOnline • Geometry Global • Yandex • incsecurity.ru • JSC FCS&HT “SNPO “Eleron”	• National Research University Higher School of Economics • Moscow School No 179 • Skoltech university • Moscow School No 2 • University of Maryland	• Zurich (Insurance company) • Renaissance Insurance • VimpelCom • SIBUR Holding • Coca Cola Hellenic • Ministry of Economy of the Republic of Sakha (Yakutia) • KPMG

ADMISSIONS CAMPAIGN

The diagram below shows the number of applications to the BSc program “Mathematics” by year. According to the federal regulations, every applicant to Bachelor’s programs can simultaneously apply to at most 5 universities in Russia. Moreover, every applicant can apply to educational programs in at most 3 subject areas within the same university.



This means, in particular, that a program may not be the top choice for many of its applicants. Basically, there are two tracks of admission: an applicant may be admitted as an Olympiad winner or take part in a general competition based on the results of the Unified State Examination (USE). There is a third track, for the so called quota students, however, since there are very few of those in the program, we do not describe this track here (there are different quotas: for international students, for people with disabilities, etc.). The criteria for Olympiad winners to be admitted without taking part in the general competition are based on two parameters: the level of the Olympiad (determined by the Ministry of Education and Science) and the prize (1^{st}, 2^{nd}, 3^{rd}) won by the applicant. These criteria are being developed every year by the Faculty Council and the central Admission office. They are approved by the central Academic Council of the university. To be admitted, Olympiad winners must get a mark above a certain threshold for the USE in mathematics. However, winners of All-Russian mathematical and physical Olympiads are exempt from this rule. The general competition is based on the sum of the USE results in three subjects: mathematics, physics, Russian language. One subject is graded out of 100 points, thus the sum of three results cannot exceed 300. To this sum, some points for "special achievements" are added; more details are given below.

Our practice shows that students admitted to the program as Olympiad winners are, on average, doing better academically than those admitted after the general competition.

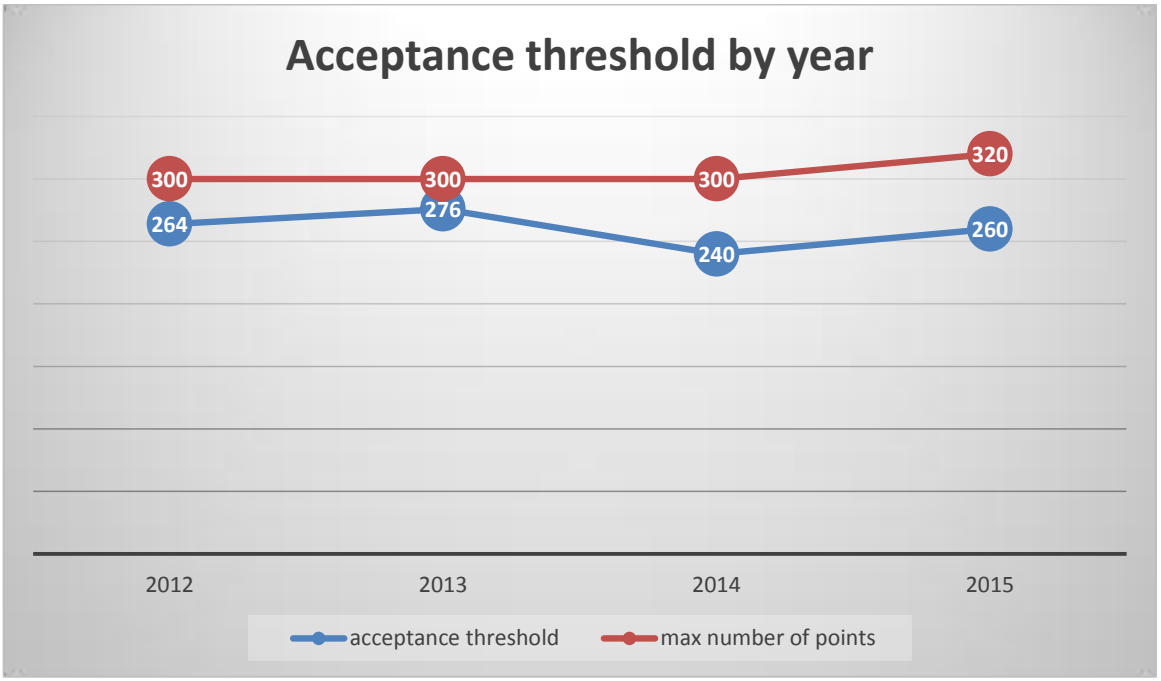
Every year, the university (upon recommendations of educational programs) sets an acceptance threshold and makes a public promise to admit all applicants with the USE results plus special achievements at this level or higher who submit a complete application package, including the originals of their high-school diplomas. This is an initiative of the university, and it is not mandated by the federal regulations. In order to make this work one needs a realistic estimate of the number of applicants for whom our program is a first choice or who will join the program after failing the admission process in the program of their first choice. For example, in 2015, there were 274 applicants ranked at or above the acceptance threshold. We had to contact all these applicants by phone, even several times, to find out what their preferences are.

The BSc mathematics program has 60 free (state funded) positions and 10 fee-paying positions every year (from 2012 onwards). In 2015, the university administration transferred 12 free positions from the campus in Nizhny Novgorod to the Moscow program, since the newly founded mathematics program in Nizhny Novgorod failed to attract more than 8 students. Therefore, in 2015, we aimed at accepting 72 state funded students, and we got exactly this number of applicants, out of 274, who submitted the originals of their diplomas. It is worth mentioning that in 2015 the ranking

used in the general competition, apart from the results of the USE, included so called special achievements, in particular the result of an essay (these essays are written by the applicants at their home high schools but are graded by the universities during the admission campaign). Thus the maximum number of points available in 2015 was 320 rather than 300 (the total mark available for each of the three USE tests is 100). Apart from the 72 state funded positions, we also filled two "quota scheme" positions for foreign nationals (these are basically equivalent to the free positions for Russian citizens) and three fee-paying positions.

Among the Olympiad winners accepted in 2015, there are three 1st prize and four 2nd prize winners of the All-Russian Olympiad in mathematics, two 1st prize and one 2nd prize winners of the All-Russian Olympiad in physics. We also have nine 1st or 2nd prize winners of HSE's own mathematical Olympiad. There is still room for improvement. For comparison, the following figures refer to some of our principal competitors. The MSU "mekhmat" (the Faculty of Mechanics and Mathematics of MSU) has 36 Olympiad winners (out of the 250 students admitted to their mathematics program; this includes two 1st prize and eight 2nd prize winners of the All-Russian mathematical Olympiad). The HSE program in applied mathematics and informatics (offered by the Faculty of Computer Science) has 104 Olympiad winners, more than the nominal number of free positions; among them there are one 1st prize and seven 2nd prize winners of the All-Russian Olympiad in informatics, five 2nd prize winners of the All-Russian Olympiad in mathematics). The joint Bachelor's program of the New Economics School and HSE (offered by the Faculty of Economic Sciences) attracted fourteen 1st prize and fifty four 2nd prize winners of the All-Russian Olympiad in economics, and also seven 1st prize winners of 1st tier Olympiads in mathematics. There are some students who entered our program even though their first choices were different (mostly, these were the HSE Faculty of Computer Science and the MPTI); this happened because the competing programs had higher admission requirements.

In 2016, the "special achievements" part will be lowered to 10 points maximum; thus the maximal total number of points available will be 310. Some Olympiad results, apart from those which guarantee a position offer or a 100-points bonus, can also count as "special achievements" in 2016.



The fact that the acceptance threshold dropped down significantly in 2014 has the following explanations:

- In 2013, many Olympiad winners were admitted thus making the general competition much tougher; in 2014, we raised the criteria for Olympiad winners and, as a consequence, more applicants were admitted by the general competition.
- Grading policy of the USE changed in 2014; the average grades in all Russia dropped down significantly.

- The number of state-funded positions was increased in 2014.

Top high schools by the number of applicants:

1. Moscow school No 57;
2. Kolmogorov Boarding School;
3. Moscow school No 179;
4. Specialized Educational Scientific Center of Novosibirsk State University, Novosibirsk;
5. Boarding school «Intellectual».

COLLECTIVE LETTER OF STUDENTS

In 2015, a group of students sent a letter to the International Advisory Board and to all math faculty members. The letter was signed by 45 people including students of all educational programs, except the Master's program in Mathematical Physics, and one alumnus. The letter has been translated into English by its authors. As a supplement to the letter, some (much smaller) group of students offered their own version of the curriculum for the 1st -2nd year of the Bachelor's program. The full text of the letter is available at

http://vk.com/doc-89279255_374458258 (Russian version)

Below, certain parts of the letter are cited, and responses to students' suggestions are given. The excerpts from the letter are shown in italics. The students start the letter with a general evaluation of the Math Faculty and its programs and indicate the objectives:

> *All in all, we like our department very much. The experience of some of us and of many our friends suggests that the mathematical department of NRU HSE is the most suitable place to study mathematics in Russia. Unfortunately, it also seems that the present educational program suffers from several serious and persistent problems. These problems are present every year, but they also sometimes get worse. Second-year program is affected the most. The department was created very recently, so the problems could hopefully be fixed before they would earn the status of traditions. In fact, this letter is designed to explicate our opinion on various aspects of the educational program. We concentrate on the mandatory part of the curriculum, since it is our major concern. The first part of the letter (this document) discusses the current curriculum. Here we describe the problematic parts of both the idea and the implementation of the curriculum. We also suggest ways to remedy the situation. The second part, available only in Russian, is an example of a curriculum (designed by several of supporting students) which feels realistic and follows all our advice. It was written first and foremost as an illustration for the ideas presented in this letter. For this reason we decided not to translate our approach to curriculum to English, as the translation would require a lot of work for a relatively small gain. Beyond the lists of definitions and topics, the Russian text of the curriculum contains important notes about the decisions the authors made when creating it. However, most valuable insights are mentioned in this letter as well.*

Critical remarks by students mostly concern the mandatory part of the curriculum in the first two years of study. They make the point that, since courses are mandatory, the material must be selected very carefully and include only those concepts and results that are absolutely a must for any working mathematician.

> *Our experience shows that the inclusion of some specialized topics favored by the professor into the mandatory part of the course is perceived very negatively by the majority of students. There are many basic things which the aspiring mathematician would like to understand. Not all of them are paid the required attention in our present curriculum.*

Thus the authors of the letter seem to have a consensus on which topics are really basic and which are "more specialized". We lack this kind of consensus among the faculty. There are ongoing and very difficult discussions on which topics must be included into the necessary minimum. It is impossible to unite all such topics mentioned by

different faculty members because of the restrictions on the classroom hours. Instead, the Academic Council of the program decided to take the intersection and to declare this intersection the minimum required curriculum, which every instructor is obliged to follow. In other words, every instructor of a 1^{st}-2^{nd} year basic mathematical course must cover all topics mentioned in the minimal curriculum, and supplement them by topics that are considered to be a must by the instructor. Although this does not resolve all disputes on curricular issues, it helps to minimize the tension between different viewpoints.

As the two most problematic courses of the first year, students mention the course of "Logic" and the course of "Discrete mathematics". Problems with "Logic" have to do with the difficulty of the material: students complain that it is hard to grasp the fundamental concepts of predicate logic and model theory that are being covered in the last module of the course. The "Discrete mathematics" course, according to the letter, contains optional material that may be suitable for special topics courses but not for a mandatory course of the first year. Students suggest to remove all the advanced topics, and make Discrete Mathematics a one-module rather than a one-semester course. The Academic Council of the Bachelor of Science program agrees with this evaluation. It has been decided to shorten both courses and to abandon the most advanced topics contained in them.

> *We are approaching the most important problem in the current curriculum. Dynamical Systems, Analysis and Complex Analysis take more than a half of all time spent in compulsory courses during the second year. However, we firmly believe that the way they are taught is seriously demotivating many students. The main problem is probably the way calculus on manifolds is covered, and this subject is crucial for further mathematical courses. For example, in IUM students usually spend the entire third semester of Analysis course studying only manifolds and calculus on them. Compare with our department: we have a "minimal program" (in Russian) of topics which should be included in compulsory courses and there calculus on manifolds is present only in 3rd and 4th modules of Dynamical Systems, too late to be used in Complex Analysis.*

The Academic Council had been aware of the problem long before the letter appeared. Some variant of a solution has been recently adopted: namely, a new mandatory course "Calculus on manifolds" was introduced at the expense of some topological material. For example, all topics related with homology have been removed from the mandatory curriculum of the first two years. This material will still be covered, of course, but in elective format. Basic point-set topology stays (and is even slightly expanded) as well as coverings and the fundamental group. These changes will take effect in 2016 (for students admitted in 2015).

The following is a special remark by students aiming at illustrating the importance of "Calculus on manifolds" at early stages of the education:

> *Complex Analysis, studied in the second semester of the second year, also benefits greatly from a familiarity with differential forms and Stokes formula. Currently the majority of students in the third module of the second course don't know Stokes formula, so, for example, Cauchy's theorem requires a special proof instead of just pointing out that df is exact*.

Although the following remark is not of universal importance, it is placed below simply as a response to students' argument. On the one hand, it is certainly true that knowing the general Stokes formula helps to appreciate the Cauchy integral formula (note that the converse is also true: knowing the Cauchy integral formula helps to appreciate the general Stokes formula as it provides a motivation and a perspective). Formally speaking, the Cauchy integral formula uses a more general version of the Stokes formula (D^1 rather than C^1) than what is usually covered by a "Calculus on manifolds" course. Within complex analysis, this level of generality is well justified, which is not the case for "Calculus on manifolds".

> *The current version of the curriculum for some reason doesn't even have measure theory, which is necessary for Lebesgue integral, functional analysis and probability theory. Fortunately, for last several years the professors decided to include measure theory in their courses.*

Even by the time the letter was written, measure theory had been included into the minimal curriculum. This reveals a problem with informing all interested parties about the key decisions of the Academic Council. This problem is addressed now by publishing these decisions on the webpage of the program.

Further curricular changes that the students suggested to consider are the following (suggestions themselves are shown in italics; a response of the Academic Council to each of these suggestions follows in a regular font):

1. *The curriculum should include calculus on manifolds in depth similar to those of a standard IUM course*

This will be implemented starting with students admitted in 2015.

2. *The programs of Dynamical Systems, Analysis, and Complex Analysis should be reconstructed to allow better consistency and stronger connections between these courses. One of major goals is to prevent situations where one course uses a topic which will be thoroughly explored in the other course but later.*

Although the minimal curriculum developed by the Academic Council (and significantly revised every year using feedback from students and instructors) aims at coordinating material between different courses, it is impossible to stipulate at once and for all instructors that, say, a general theory should always precede particular applications of this theory – a viewpoint opposed vigorously by many distinguished mathematicians.

3. The proportion of analytical courses in the second year curriculum should be decreased by re-forming and coordinating the existing courses. In the current curriculum the fourth module of the second year consists purely of analytical courses, which makes quite a few students unhappy.

This is resolved in the current version of the curriculum, after a redistribution of some analytical material between different courses of the first two years.

Students also suggest shortening the geometry course by placing it after linear algebra. They also suggest enlarging the topology course by including more point-set topology and more algebraic topology. The Academic Council took these suggestions into the account but did not implement them in full for the following reason. The group of students who authored the letter is not representative in the sense that they are much more advanced mathematically than an average student. Although the instructors should care about the strongest students and strive to keep them motivated, it is necessary that all mandatory material be accessible to all students. Currently, this is not the case for some of the algebraic topology topics, as instructors point out. It is also difficult for many students to grasp the general ideas of linear algebra without any prior exposure to some particular linear-algebraic problems that can be solved by hand as, say, problems about lines and planes in the 3-space or conics in the plane.

Apart from curricular issues, students also raise organizational and technical issues. Among them are the following: insufficient rotation of instructors, insufficient information on course web-pages. The students suggested conducting student evaluations of courses and instructors every module and to include opportunities to express opinions regarding problem sets, hand-outs etc. Although the suggestion concerned just the Faculty of Mathematics, it is now largely addressed by the university-wide initiative of student evaluation. The only (unfortunate) deviation is that the student evaluation of courses and instructors is now a mandatory action for all students. Students also complain that the protocols of the Faculty Council meetings are no longer posted on the web-site of the Faculty. This is in fact not the case. All protocols are continuously posted to the web-site; the problem was that the organization of the site has changed, because of which students failed to find the protocols. It is interesting that they did not check with the Faculty administration or with the managers responsible for maintaining the site before placing this complaint into the letter addressed to the International Advisory Board. Finally, students requested that water coolers be placed somewhere in the building. This is now implemented in all buildings of the HSE; there are several water coolers in the Math building. Although it happened after the letter by students was released, this was a result of a long-term effort, in which the administration of the Faculty took an active role and which started long before the letter.

On March 31, 2015, the authors of the letter met the chair of the International Advisory Board Stanislav Smirnov, the Dean of the Math Faculty Sergey Lando, and the Deputy Dean for international cooperation Vladlen Timorin. About 30 students (who were among the 45 signatories) took part in the meeting, as well as two faculty members, Professors Ekaterina Amerik and Leonid Rybnikov. Several days before this meeting, the authors of the letter also met with representatives of the Academic Council. During this preliminary discussion that lasted about three hours, the participants shared some particular suggestions about the content of basic mathematical courses.

On March 31, the discussion was around general principles, according to which particular course syllabi should be developed. Sergey Lando described the starting points, on which teaching plans of the Faculty of Mathematics are based and which were adopted by the Academic Council of the Bachelor's program. The first point is that the program is designed not only for future mathematical researchers but rather for people who want to have the widest opportunities of using their mathematical skills for solving hard real-life problems. By way of experiment, Stanislav Smirnov asked which students wished to pursue an academic career in pure mathematics – almost all raised their hands.

Overall, students agreed with the points made by Sergey Lando. The most objections were against the principle, according to which an instructor of a basic course must have significant freedom in the choice of the material and of the way the material is covered. The students insisted (and in that, they were partially supported by Stanislav Smirnov) that at least two thirds of the material should correspond to a fixed curriculum carefully selected by a program council rather than a particular instructor. In the second part of the student's letter (this part has not been translated into English, and the set of authors of this second part is much smaller than that of the first part), they proposed a version of such a mandatory curriculum for the 1^{st}-2^{nd} years. Students, who took part in the meeting, agreed that the proposed list of key mathematical concepts and results needs additional discussion and revision. They wanted to continue the negotiations in order to reach a consensus with the Academic Council of the Mathematics Bachelor of Science program.

The Faculty administration suggested that students create some sort of organization – possibly but not necessarily a student council of the Faculty – for participation in the control over the Faculty including its educational programs. It was promised to students that all their future concerns, as well as those already expressed, would be carefully studied and taken into account. A stable correspondence channel would be created, through which the student organization would learn about particular steps in the curriculum development, taking part in expert evaluation of this development. Of course, the final decision is up to the Academic Council of the program or the Faculty Council. The latter government bodies would take all factors and all professional opinions into account. This promise is now fulfilled except for the stable correspondence channel. What the Academic Council is doing is described on its web page, and students can always communicate directly with the director of the Academic Council; however, they are not invited at the Council meetings. It is also unfortunate that students failed to create a representative student government body. The very first step towards this goal, namely, democratic elections, was opposed by the most active authors of the letter and did not find understanding in the wider student community either.

There was another effect that needs to be mentioned. The collective letter of students led to an activization of the ongoing tense discussion of the content and methodology for basic mathematical courses. It happened that this discussion became public and leaked into the outside world. Would the discussion be less emotional, this would not be as bad. Unfortunately, some of our colleagues expressed their opinions on how and what to teach students in a strong language. Some of the viewpoints were significantly distorted when being quoted in personal conversations and social media. These distortions and inaccuracies were related both to the content of the letter and to the response of the faculty members. One characteristic example is the interpretation that "students wrote a letter about Bessel functions being unimportant" (whereas in fact students do not mention Bessel functions at all; this topic first appeared in a subsequent discussion among the faculty).

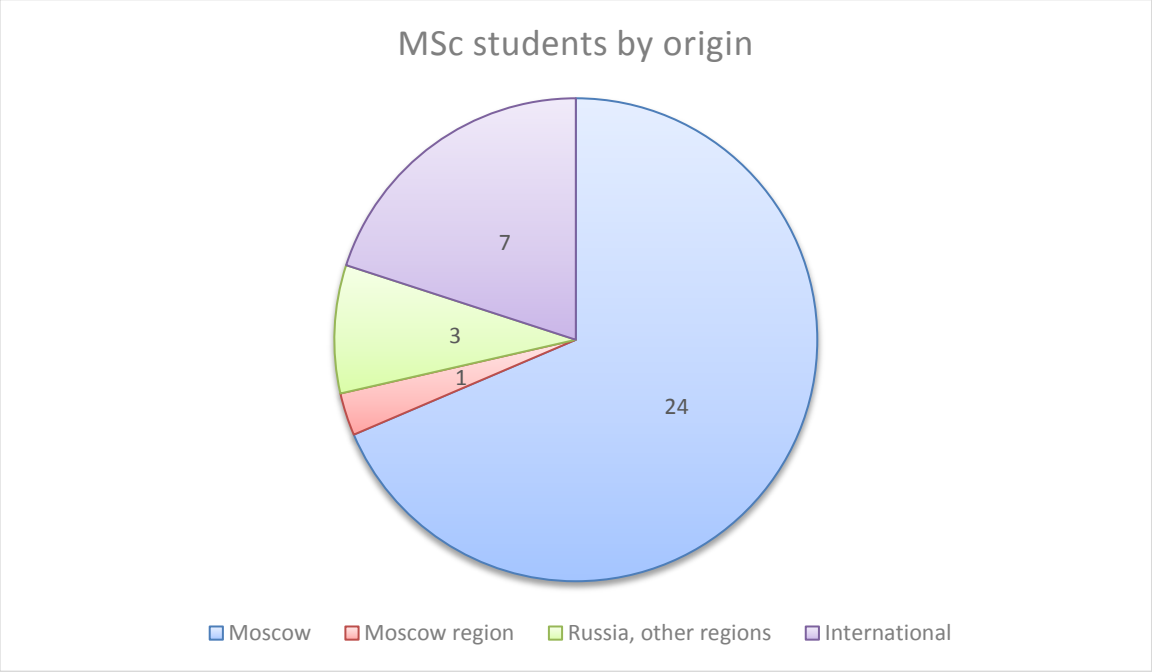
The Faculty of Mathematics is proud of the fact that our students not only demonstrate a high research potential but also initiative and organization skills. We are all confident that, despite different viewpoints, both within the community

of teachers and within the student body, we will work together as a team to improve the mathematical curriculum. While doing so, we will always respect each other's viewpoints and adhere to the principles of academic ethics.

MASTER OF SCIENCE PROGRAM «MATHEMATICS»

The Master of Science program in mathematics was created in 2010. Since 2012, it has positioned as international and has conducted in English although students can choose Russian taught courses. Currently, there are 35 students enrolled in the program, including international students. The academic director of the program is Yulij Ilyashenko.

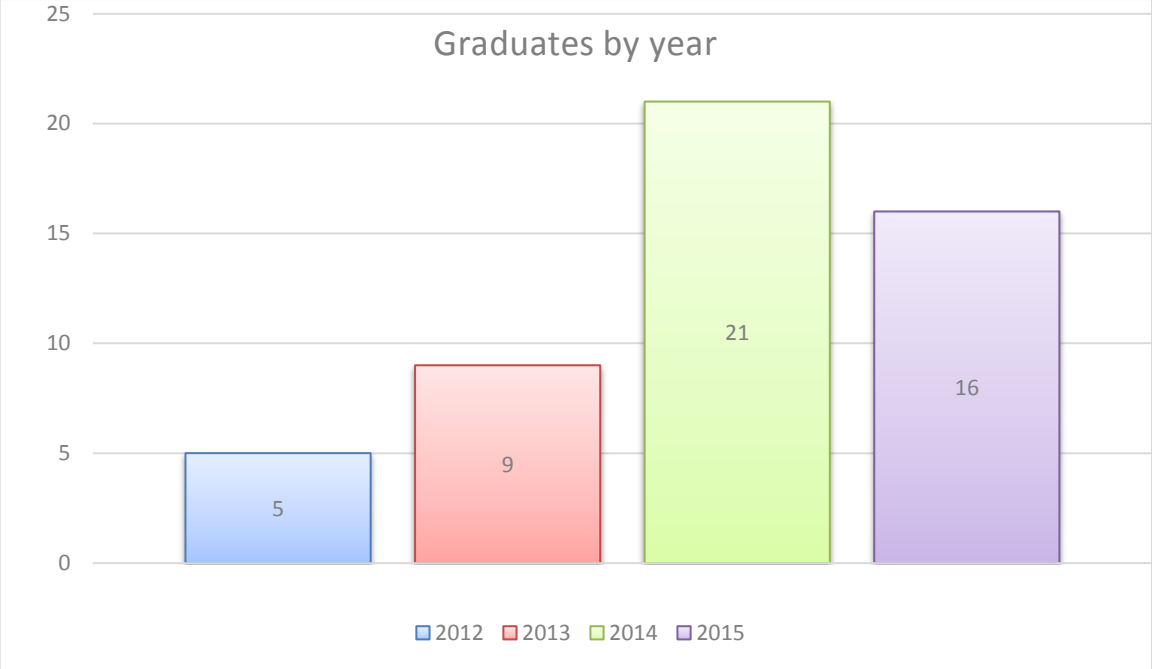
The following diagram shows where the MSc students come from.



Master of Science students (of all years, including those who already graduated) in the program "Mathematics" are graduates of the following universities:

Domestic	**International**
• Higher School of Economics • Moscow Institute of Physics and Technology • Moscow State Pedagogical University • Moscow region State Social-Humanitarian institute • Saint Petersburg State Electrotechnical University • S.P.Korolev State Aerospace University, Samara • Voronezh State University	• Armenia: Yerevan State University • Canada: L'Université de Sherbrooke • China: Beijing University of Posts and Telecommunications. • China: Sun Yat-sen University • Pakistan: Lahore University of Management Sciences • USA: University of Florida • Ukraine: Taras Shevchenko National University, Kyiv • France: Paris 7 • USA: University of North Carolina Asheville

There are fee-paying positions available in the program but currently there are no fee-paying students. The following diagram shows the dynamics of the number of graduates in 2012-2015:



Graduates of the program study in the following programs (mostly, of the PhD level) of the following universities:

Domestic	International
• Applied Mathematics: Keldysh Institute of Applied Mathematics (Russian Academy of Science) • Mathematics: National Research University Higher School of Economics (Russia) • Computer Science: School of data analysis Yandex (Russia) • Mathematics: St.Petersburg Department of V.A.Steklov Mathematical Institute of the Russian Academy of Science • The Institute of Numerical Mathematics of the Russian Academy of Sciences (INM RAS)	• Mathematics: Columbia University Mathematics Department (USA) • Mathematics: Leiden University (Netherlands) • Mathematics: McGill University (Canada) • Pennsylvania State University (USA) • • Economics: Princeton University (USA) • Mathematics: University of Nice Sophia Antipolis (France)

Some of the graduates of our MSc program work in industry or higher education, see the next table. One should keep in mind though that the program is relatively young and we have had few graduates so far, and a majority of these continue their studies at the PhD level.

Finances	IT	Science and Education	Other
TCS Bank	1C Company RadiumOne Yandex	HSE Laboratory of electronic textbooks	KPMG

The following are selected publications of the students currently enrolled in the program (the students' names are shown in boldface):

- **Kononov Y.**, Morozov A. Colored HOMFLY and generalized Mandelbrot set // Journal of High Energy Physics, Volume 2015, Issue 11, 1 November 2015, Article number 151, Pages 1-22
- **Kononov Y.**, Morozov A. Factorization of colored knot polynomials at roots of unity // Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics, Volume 747, July 01, 2015, Pages 500-510

- **Kononov Y.**, Morozov A. On the defect and stability of differential expansion // JETP Letters, Volume 101, Issue 12, 24 June 2015, Pages 831-834

Alexander Berdnikov received the HSE "Silver nestling" prize in 2014, when he was a 1st year student of the Masters program.

STRUCTURE OF THE CURRICULUM

The program offers courses in the following subject areas:

- Analysis, probability and dynamical systems (APDS)
- Algebra, logic and number theory (ALNT)
- Geometry and topology (GT)

Students normally focus on one subject area (called the major specialization) but are also required to take courses in other fields. Students are expected to take at least one semester course in each subject area (APDS, ALNT, GT) during the first and the second years of study. In addition to the courses listed below, the Faculty of Mathematics offers a wide range of research seminars. MSc students can take each of these seminars and receive credits for that.

The following graduate level courses are taught in English.

Analysis, probability and dynamical systems (APDS)	**Algebra, logic and number theory (ALNT)**	**Geometry and topology (GT)**
• Complex analysis • Ordinary differential equations • Introduction to probability • Stochastic dynamics and ergodic theory • Functional analysis • Equations of mathematical physics • Partial differential equations and distributions • Introduction to dynamical systems • Analysis of several complex variables • Integrable systems	• Basic algebra • Advanced algebra • Basic representation theory • Commutative algebra • Introduction to number theory • Arithmetic/Diophantine geometry • Logic and computability • Lie groups and Lie algebras • Sheaves and cohomology	• Topology I • Topology II • Riemann surfaces • Differential geometry • Algebraic geometry: a start-up course • Differential topology • Symplectic geometry and topology • Singularity theory • Hodge theory and complex algebraic geometry • Riemannian geometry

We also offer a course in academic writing which is focused on how to write a mathematical paper in English. Some of the courses are joint with the Math in Moscow (MiM) program. The courses listed above are offered either every year or at least once in every two years. All courses offered by the Math in Moscow program are also available to HSE mathematics students free of charge.

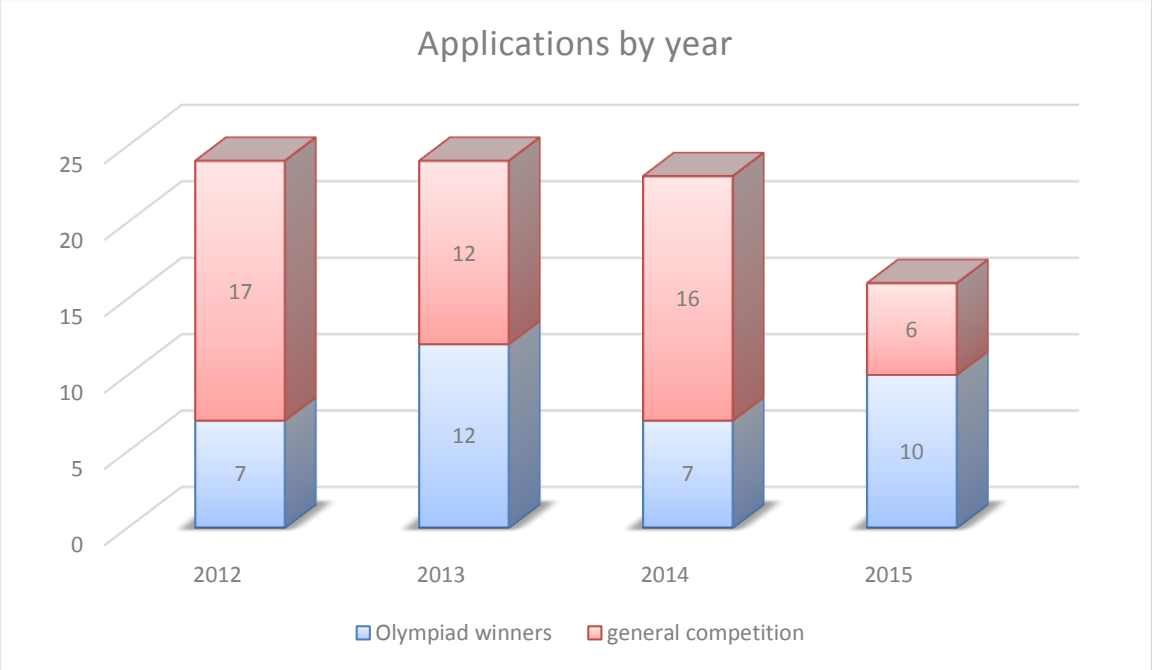
All students must submit Individual Study Plans (ISP). The ISP includes several mandatory items; however, most courses are chosen by students (students can choose from a certain number of optional courses and a certain number of research seminars). Every student has an advisor, who supervises the student's MSc 1st year research project and the Masters thesis. The advisor helps the student with the ISP and approves the final version of it. First year students are assigned "first year advisors", who are regular faculty members of the Mathematics Faculty.

The mandatory items of the ISP include the core course "Mathematical Methods of Science" and the graduate student seminar "Problems of contemporary mathematics". Having at least one core course mandatory for all students is a federal requirement. We are trying to minimize the number of such courses keeping in mind the differences in the

mathematical background of our MSc students. All optional courses listed in Appendix 5 (including those delivered in Russian) are available for students of this program, as well as any external mathematical courses (subject to the approval by the advisor and the program administration). These courses may be included into the ISPs.

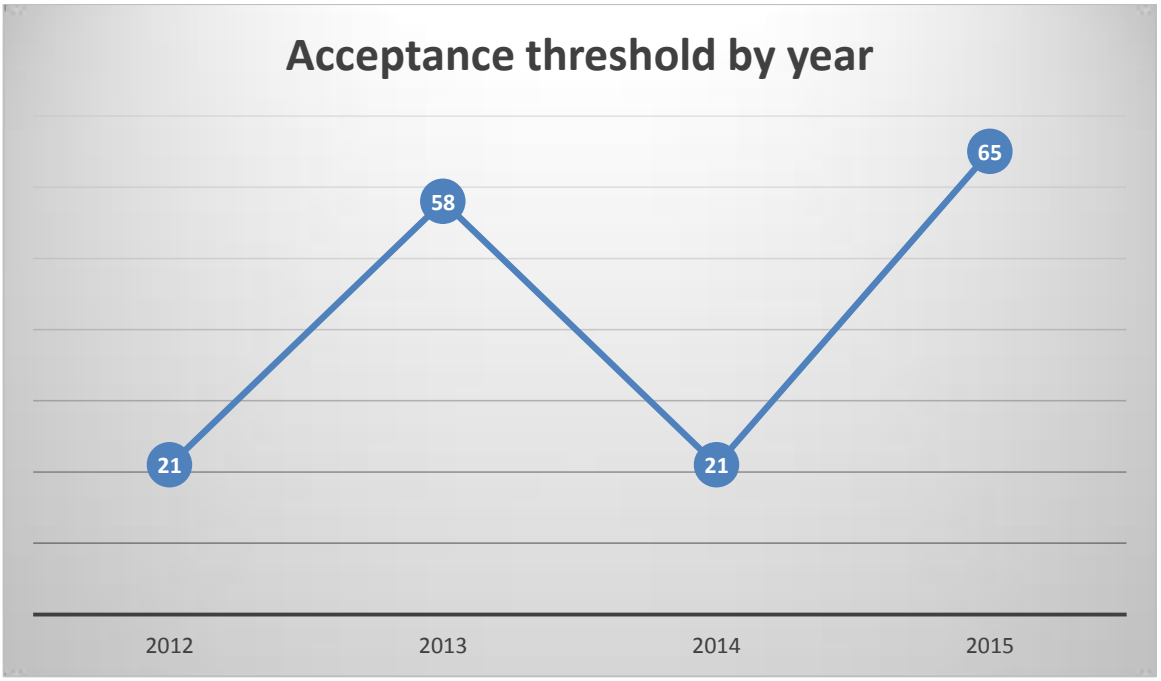
ADMISSIONS CAMPAIGN

The following diagram shows the number of applications by year.



It is important to keep in mind that the number of free positions for domestic students was reduced from 20 to 15 in 2015 because of a structural change in the other MSc program (conducted in Russian). The latter has expanded its scope, and is now called “Mathematics and Mathematical Physics” (the former title was “Mathematical Physics”). The difference between the two programs is now restricted to the language of instruction. This was the reason behind the decision to move 5 free positions from the English-taught program to the Russian-taught program. International students are admitted through the “quota scheme” – although this scheme also provides free positions, they are funded from a different source, and the selection criteria for these positions are different; these “quota scheme” positions are not included in the 15 free positions for domestic students.

“Olympiad winners” in the diagram above refer to the winners of the HSE student Olympiad. The admissions campaign consists of two steps. At stage 1 all Olympiad winners are admitted. Stage 2 is a general competition: students take entrance exams in mathematics and English. The English language exam is only a qualification test: in order to be admitted, applicants need just to pass it; the numerical grade for this exam has no further influence on the outcome of the competition. All applicants (who meet the minimal language proficiency requirements) are ranked according to their results for the written exam in mathematics. The exam is graded out of 100 points. The minimal pass grade is 21. The graph below shows the acceptance threshold by year. However, the program never had genuine competition in the sense that there were as many (or even fewer) candidates with passing grades for both exams than the number of free position. The only exception was 2015, when there were 15 free positions and 16 qualified applicants (qualified meaning having pass grades for the two exams or being Olympiad winners). However, it was decided to offer free positions to all 16 candidates (one extra position was sponsored by the university).

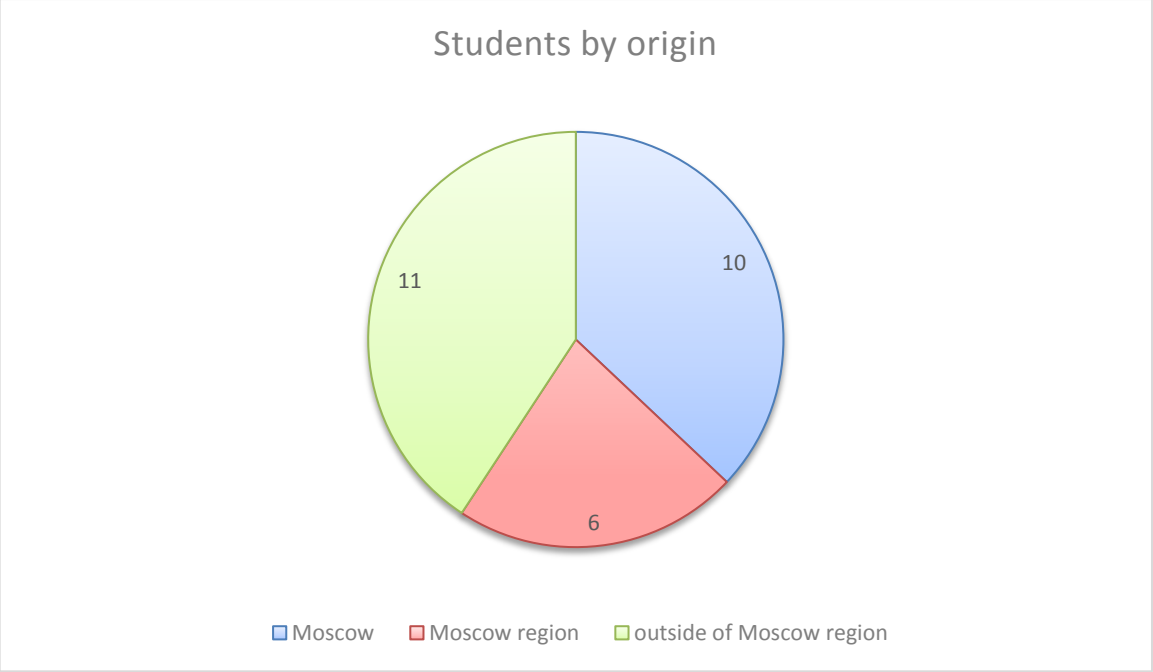


The difficulty of the entrance exams may vary from year to year. However, the fact that the acceptance threshold has increased so sharply in 2015 indicates that applicants were better prepared than before. One of the reasons for this was the expectations of the applicants: since the number of free positions in “Mathematics” program had been reduced, the applicants were expecting stiffer competition, and those who did not feel well-prepared decided to apply to a different program (mostly, to “Mathematics and Mathematical Physics”).

MASTER OF SCIENCE PROGRAM «MATHEMATICS AND MATHEMATICAL PHYSICS» (FORMER «MATHEMATICAL PHYSICS»)

The Master of Science program “Mathematical Physics” was open in 2012. In 2015, it has been decided to restructure the program and to give a new name to it, “Mathematics and Mathematical Physics”. The program is conducted in Russian, and has two educational tracks: 1) mathematics, 2) mathematics and mathematical physics. The academic director of the program is Igor Krichever.

The program currently has 29 students altogether. Although there are some students from Ukraine enrolled in the program, they were admitted through the domestic competition rather than the quota scheme. The following diagram shows the places of origin of the students.



Students admitted to the program graduated from the following universities:

- Bauman Moscow State Technical University
- Moscow Aviation Institute
- Moscow Institute of Physics and Technology
- Moscow State Pedagogical University
- National Research University Higher School of Economics
- National University of Science and Technology «MISiS»
- Novosibirsk State University
- Southern Federal University
- Taras Shevchenko National University of Kyiv

Just as in Master of Science program “Mathematics”, there are no fee-paying students. In 2015, the program had its first graduates. There are only 10 of them. All of the graduates continue their education at the PhD level. They study at HSE or at the Institute for Information Transmission Problems. They are also employed part-time there as research or teaching assistants.

Here is a selected publication by a student currently enrolled in the program:

- Bershtein M. A., **Shchechkin A. I**. Bilinear equations on Painlevé τ functions from CFT // Communications in Mathematical Physics, Vol. 339(2015), No. 3, P.1021-1061.

CURRICULUM OUTLINE

The program offers a graduate student seminar entitled “Contemporary problems of mathematical physics”, which is de facto mandatory for all students of the program. Talks are usually given by students who report on their progress and on the difficulties they encounter in their research in a form accessible to other students.

The program has two tracks: “mathematics” and “mathematical physics”. Students who take the mathematical track fill in their individual study plans, together with their advisors, using the Faculty-wide pool of elective courses and seminars. In particular, these students may attend (and register for) any courses offered by the MSc program “Mathematics” as well as the core courses listed below. Students who take the mathematical physics track do similarly.

However, certain courses in mathematical physics are called “core” and are highly recommended for all students who take this track.

These core courses are (in order of prerequisites):

- Applied Methods of Analysis
- Groups and their Representations
- Classical Mechanics
- Classical Field Theory
- Differential Geometry
- Functional Analysis
- Quantum Mechanics
- Statistical Physics
- Quantum Field Theory
- String Theory

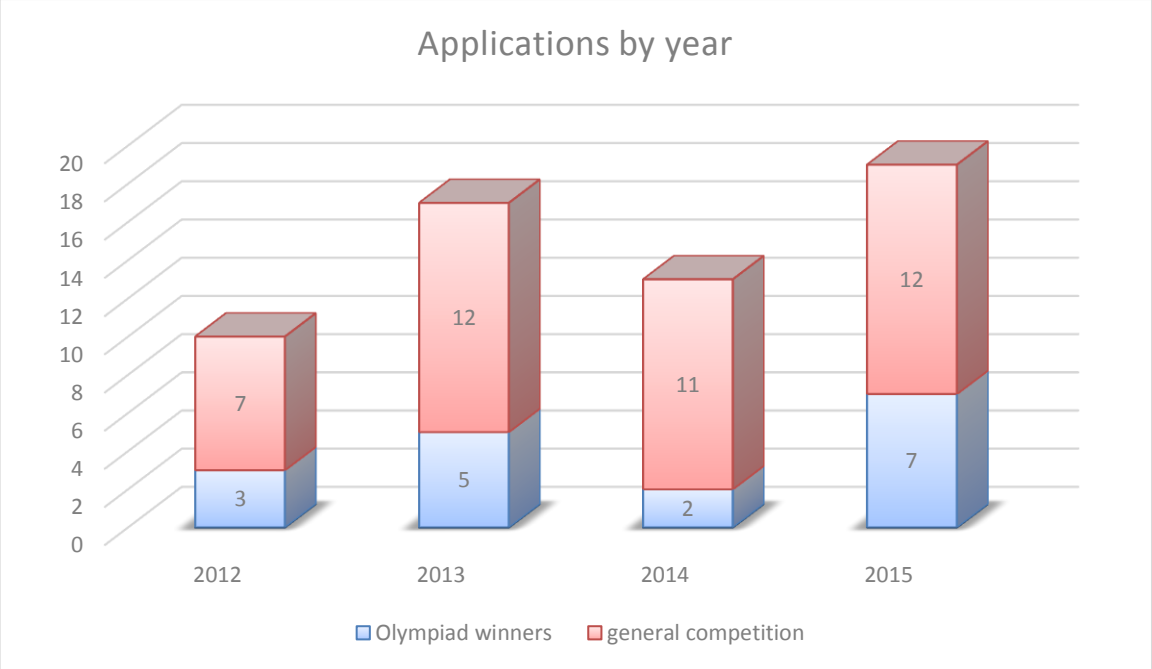
The following are optional courses offered by the program on a regular basis (every year or every other year):

- Integrable Systems
- Vertex/affine Algebras
- Quantum Integrable Systems (Bethe Ansatz and R-matrix Approach)
- Functional Integral
- Fluid Dynamics and Turbulence
- Stochastic Processes

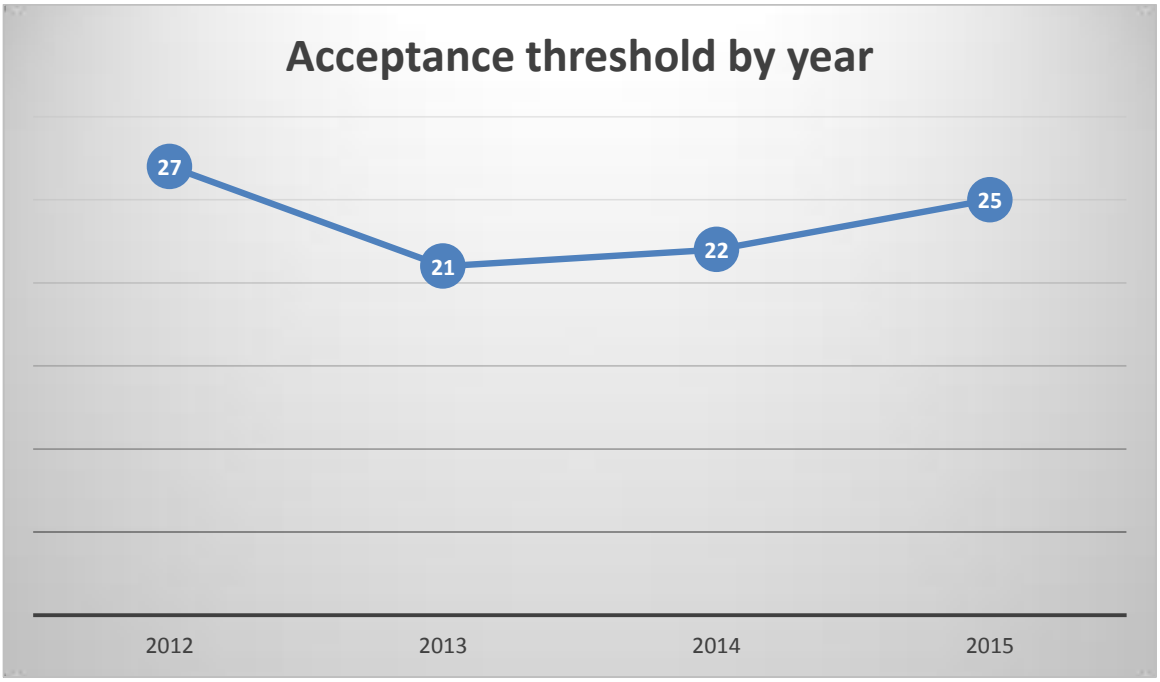
The program Academic Council considers participation by the students in seminars (first of all, the seminar “Contemporary problems of Mathematical Physics”) the most important part of their education. Students may include into their individual study plans any optional courses listed in Appendix 5 as well as any external mathematical courses (subject to approval by the advisor and the program administration).

ADMISSIONS CAMPAIGN

The following diagram shows the number of applications by year (in 2012-2015).

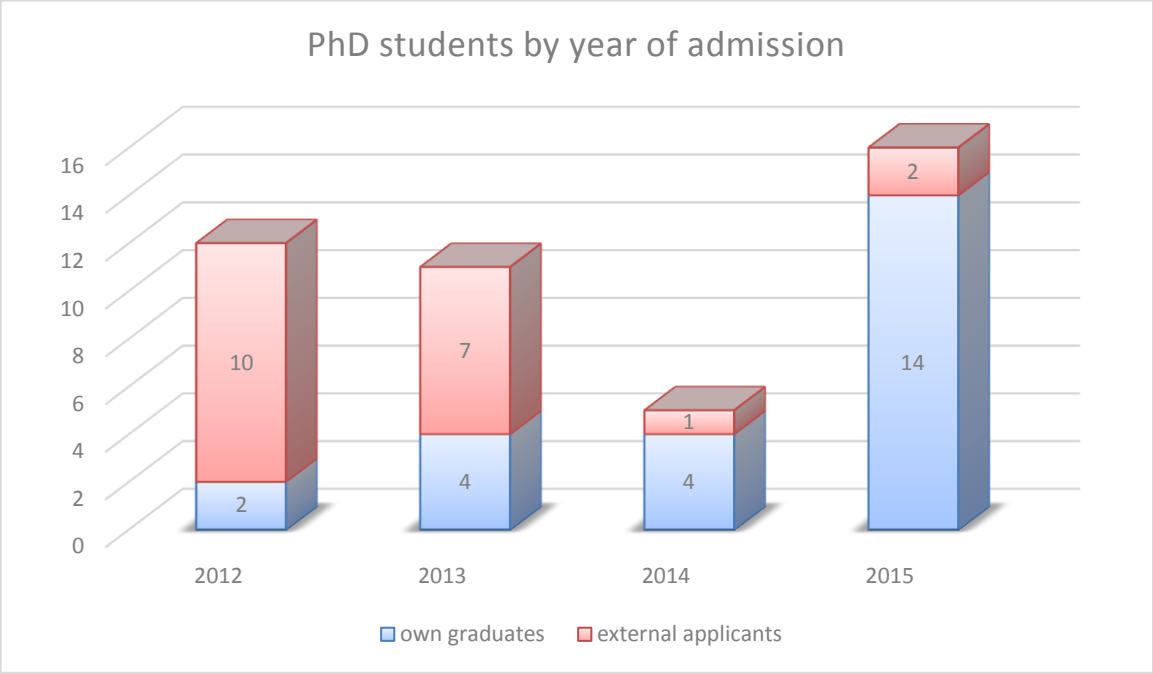


It is important to keep in mind that the number of free positions was 15 in 2012-2014 and 20 in 2015. The program never had enough qualified applicants (meaning those who passed the entrance exam in mathematics) to fill all free positions. Thus, there are also no fee-paying students. For those applicants who participate in the general competition (i.e., for those who are not winners of the HSE student Olympiad), there is only one entrance exam, namely, the exam in mathematics, which includes several problems in physics (classical mechanics and basic field theory). There is no English language test. The acceptance threshold (the graph of it by year is shown below) is rather low because there is no competition, and all applicants who obtained 21 points or higher on the mathematical entrance exam are admitted. The lack of qualified applicants can be explained by the fact that there are very few students with a solid background in BOTH Mathematics and Physics.



PHD PROGRAM IN MATHEMATICS

As noted above, the PhD School in Mathematics is not a part of the Math Faculty as it includes all PhD students in Mathematics regardless of where (at which particular Faculty or Department) they are based. So in what follows, we only refer to the graduate students based at the Faculty of Mathematics (this is not exactly the same as having an advisor from the Faculty of Mathematics). Currently there are 32 PhD students. The following diagram shows the number students admitted to the PhD program by year (only those who are based at the Math Faculty).



We see that our own graduates (those, who have completed one of the two Master of Science programs offered by the Faculty of Mathematics) start dominating. On the one hand, it is hard for us to attract international PhD candidates for obvious reasons, which have more to do with the Russian legislation than the internal regulations of the university. On the other hand, domestic applicants tend to be weaker than our own graduates. As of now, we have no PhD students from outside of the former USSR. This is partly explained by the entrance procedure, which is governed by the federal legislation and which involves entrance exams that take place in October, have to be taken in person and include an exam in philosophy.

Admission to the PhD program is based on entrance exams. We have an exam in mathematics, which has two parts: a written one and an oral one. By the federal law we are also obliged to have an exam in Philosophy and a language test. All applicants are ranked according to their results for the mathematics and philosophy exams, and admission is based on the ranking. Luckily, the philosophy exam contributes up to 2 points (it may give 0, 1 or 2 points), whereas the mathematics exam contributes up to 5 points (the exam is graded out of 10, and the results are then converted to grades from 0 to 5). The language test is also graded out of 5; alternatively, applicants may provide an international language proficiency certificate. Before 2016 the federal legislation stipulated that all entrance exams to the PhD program had to be taken in Russian. In 2016 this condition has been relaxed.

PhD students based at the Math Faculty were awarded the following scientific prizes and grants (more specifically, the list includes only those who were PhD students at the time of the award):

- Igor Makhlin was awarded a Moebius Prize in 2015
- In 2015, the “Golden Vyshka” award of the HSE was given to Arthur Tomberg for a “success of a graduate in the academy”
- Arthur Tomberg received a Dynasty Foundation grant in 2014

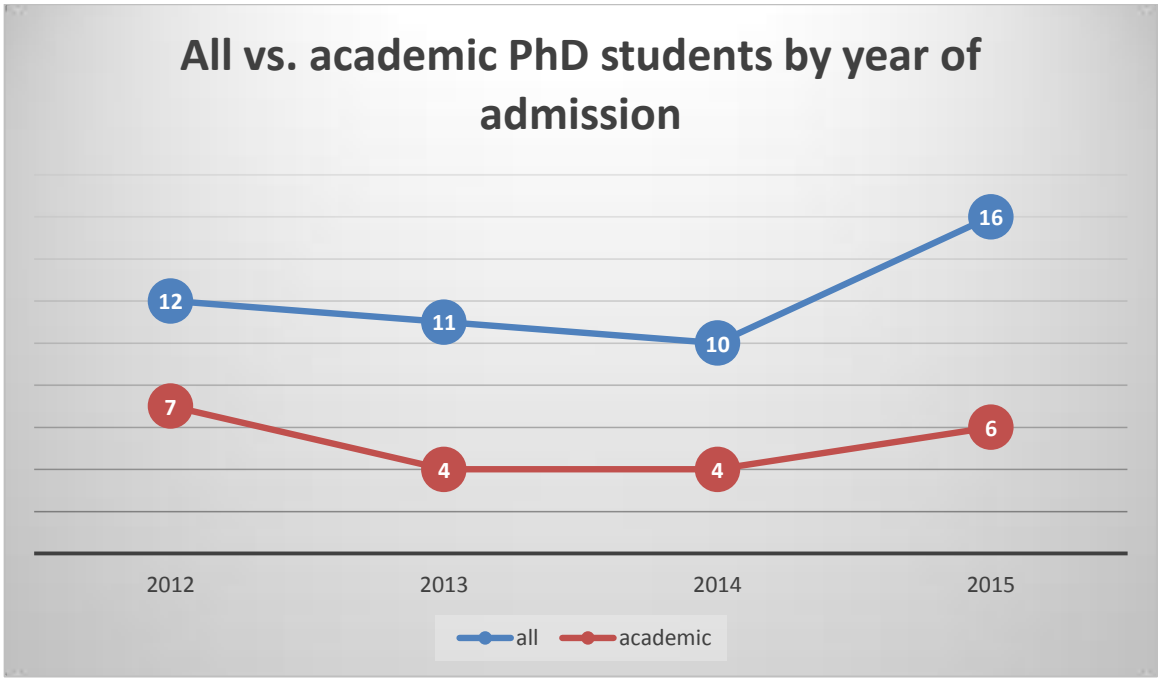
- Arthur Tomberg received a Moebius Prize in 2014
- Pavel Gavrilenko and Nikon Kurnosov were awarded a “Young mathematicians of Russia” prize in 2015 in the nomination “Mathematicians without a degree”; Evgeny Makedonsky was made part of the “reserve winners” group by the scientific Jury of the contest
- Igor Netai received a Dynasty Foundation grant in 2013
- Daniil Rudenko was awarded a Moebius Prize in 2013
- Pavel Gavrilenko holds a special scholarship of the HSE

PhD students based at the Math Faculty have publications in high ranking international journals, including Duke Mathematical Journal, Advances in Mathematics, International Mathematical Research Notices, Journal of Combinatorial Theory (Series A), Transformation Groups, Russian Mathematical Surveys. Appendix 2 lists all publications of current PhD students issued in 2012-2015.

The PhD school in Mathematics participates in the “Academic PhD” program (also called the “structured PhD program”; it is described above in the section “PhD schools”). As explained above, the difference between academic PhD positions and regular PhD positions is in the amount of financial support. Within the “Academic PhD” program, students are paid as much as 30K monthly and have access to TAships and RAships and almost free accommodation. Outside of the “Academic PhD” program, students are paid 1500 rubles monthly, i.e., the difference is twenty times. Regular PhD students (those who are not part of the “Academic PhD” scheme) are those who did not apply for the “Academic PhD” or those, who applied but failed. The most frequent reason for not applying is failing to provide a language proficiency certificate (only TOEFL and IELTS are acceptable, taking these tests costs a lot of money, and, in order to take the tests, one has to apply well in advance).

In 2015, we had many exceptionally strong applicants, and it was extremely difficult to select those who enter the “Academic PhD” program. Unfortunately but quite understandably, some preference was given to candidates who are more reliable (in terms of the likelihood of them completing their theses on time) rather than to candidates who appear stronger but less predictable.

The following graph shows the number of all PhD students based at the Faculty of Mathematics vs. the number of all “academic” PhD students by year of admission.



The graph shows that the percentage of academic PhD students dropped in 2013. This was related with the fact that the university administration gave less money to fund academic PhD students.

PhD students can take any optional courses and seminars offered by the Faculty of Mathematics (see Appendix 5). They are also offered preparatory courses for PhD qualifying exams.

"MATH IN MOSCOW" PROGRAM

Math in Moscow (MiM) is the name of a short-term (1-2 semesters) study abroad program offered in English jointly by the Independent University of Moscow (IUM), National Research University Higher School of Economics (HSE), and Moscow Center for Continuous Mathematical Education (MCCME). It was first launched in spring 2001 by IUM. Along with courses in mathematics and computer science, students can study Russian language, Russian literature, history of mathematics and science, and history of Russia. All MiM courses are credited to the students at their home institutions.

The main goals of the program are to:

- intensify the interaction between Western and Russian (not only mathematical) cultures;
- make Russian traditions of teaching mathematics available to international students;
- provide an international learning environment to IUM students;
- provide an international teaching experience to IUM instructors;
- broaden foreign students' understanding of contemporary Russia.

The biggest difficulty encountered by MiM in pursuing these goals is not program-specific; it rather applies to all internationalization efforts in Russia. Potential students have certain stereotypes about life in Moscow and Russian people that are hard to break. Thus, MiM's efforts to overcome these stereotypes may have cultural significance, not restricted to mathematics alone.

The MiM program aims at combining the best traditions of Russian and Western systems in teaching mathematics. We have adopted the North American custom of giving significant homework assignments. Grading follows Western traditions and takes into account the results of students' activity during the whole semester. Teaching methods follow Russian traditions: rigorous theory presentation with full proofs, solving meaningful rather than formal problems, involving students in collective problem discussions. Questions are welcome in class, if not required.

Teaching international students in the MiM program, as well as teaching Russian students at IUM, is very individual. The list of courses for each semester is formed in accordance with individual application forms. Each student has an opportunity to learn as much mathematics as he/she chooses. We've had students who took up to 7-8 courses per semester.

The program provides gifted foreign students with a rare opportunity to study in a big group of talented classmates. The students, chosen from leading US and Canadian universities, form an extremely strong math-oriented group they would have never seen at undergraduate level in their home universities. This stimulates their abilities and makes teaching more efficient.

In 2008, when the Higher School of Economics created the Faculty of Mathematics, MiM became a joint effort between IUM, HSE and MCCME. This gave international students even more opportunities to contact Russian students. They live in the dorms together with HSE students and may take courses offered by the Faculty of Mathematics in English. Participants of the HSE Master of Science program in Mathematics (both foreign and Russian) may take MiM courses too.

Since prerequisites for the program are rather low, we've had students of very different level. About 35% of the participants were juniors at their home universities, 35% — seniors, 15% — sophomores, 15% had just graduated. This

difference in level stimulates team work. Living in one dormitory, students often discuss math problems and lectures. Groups are extremely small in size, which allows an individual approach to each student, no matter what their level is.

Besides teaching mathematics, the program offers excursions and trips, in particular, a three-day trip to St. Petersburg and a two-day trip to the ancient Russian towns Vladimir and Suzdal.

Since spring 2001, more than 300 students from over 160 universities have participated in MiM. We have had, among others, participants from the following institutions: California Institute of Technology, Cornell University, Harvard University, Massachusetts Institute of Technology, McGill University, University of California at Berkeley, University of Chicago, University of British Columbia, University of Montreal, Yale University. Though the program is mostly oriented toward American and Canadian students, we've had six students from Europe too.

MiM started in 2001 as a pilot program between Cornell University and IUM. The first and unique student in the first semester of the program was Alex Smith from Cornell. Soon after that, the American Mathematical Society, led by its President Felix Broder, started to award NSF-sponsored fellowships to selected American students going to MiM. A few years later, the Canadian Mathematical Society, led by its President Christiane Rousseau, started to award similar fellowships sponsored by the CMS and NSERC to Canadian students.

In 2010 and 2013 we asked our alumni about the role of Math in Moscow in their education and its impact on their careers. It turned out that almost all our alumni had chosen to continue their studies at graduate or postgraduate level. Several alumni have already completed their PhDs and work at mathematics departments of different universities.

Many alumni tell that:

- MiM has had a strong impact on their decision to pursue a degree in mathematics;
- their stay at MiM determined their current field of research;
- courses they took at IUM were not offered at their home institutions;
- MiM has shown them different ways of thinking about mathematics;
- it was a wonderful experience to share the time with other mathematics students, to develop friendships and work relationships with mathematics students from all over North America. Many alumni are still in touch with some of their acquaintances from Moscow, both Russian and American.

Several former MiM students joined the Master of Science program in Mathematics offered by HSE Faculty of Mathematics. In fact, MiM keeps playing a major role in recruiting the best mathematics students to HSE. For example, 2 out of 3 international MSc students who entered this year (2015) have MiM experience. We see two main reasons for such a strong recruitment effect: firstly, students like the program and want a kind of continuation; secondly, students get a general idea that living in Moscow is a rewarding experience. Unfortunately, although the MSc program at HSE is advertised widely, and 20-30 international applications for this program are received every year, highly qualified applicants are few, and their information sources are even fewer, MiM being the only stable one.

MOSCOW MATHEMATICAL JOURNAL

The Moscow Mathematical Journal is published jointly by the Independent University of Moscow and the Higher School of Economics. It is the only journal of the HSE that succeeded to enter the first quartile (Q1) by Scopus. Among all Russian-based journals in Mathematics, it now has the highest SJR (Scopus "Scientific Journal Ranking").

Formally, the editorial office of the Moscow Mathematical Journal is a part of the Faculty of Mathematics. The journal is published in English. The distribution of the journal in North America and worldwide is done by the American Mathematical Society. The web-site of the journal is http://www.ams.org/distribution/mmj/

Editorial Board members of the Moscow Mathematical Journal are the following:

BACHELOR OF SCIENCE PROGRAM “MATHEMATICS” IN NIZHNY NOVGOROD

Some prominent mathematicians working in Nizhny Novgorod, notably representatives of Andronov's school of dynamical systems and qualitative theory of ordinary differential equations, decided to join HSE. There is a branch (campus) of HSE in Nizhny Novgorod. Having got distinguished faculty members in fundamental mathematics, the Nizhny Novgorod branch announced the opening of a new Bachelor of Science program in Mathematics in 2015. This initiative was strongly supported by the Moscow Faculty of Mathematics. There is very active research collaboration between mathematicians working in the two campuses. It was also agreed that math students in Nizhny will have options of taking some courses in Moscow either in person (through a student mobility scheme) or using distance learning technologies. The first admissions campaign of the mathematics program in Nizhny was not successful. Out of 20 allocated positions, only 8 were filled. The mathematics BSc program at the Lobachevsky University, the principal competitor of HSE, was not successful either: although all available positions there were filled, the university had to set the admission threshold as low as the lowest pass score for the mathematics USE test (27). The problem in Nizhny is insufficient demand for education in fundamental mathematics. High school graduates and their parents do not see clear career perspectives. In this respect, the situation is much worse than in big cities like Moscow and Saint Petersburg. The HSE campus in Nizhny Novgorod together with the Faculty of Mathematics conducts a large-scale information campaign in the Nizhny Novgorod region aiming both at convincing potential candidates that fundamental mathematics gives good career opportunities and at attracting interested candidates to the Nizhny Novgorod HSE branch.

APPENDIX 1: HONORS AND AWARDS OF THE FACULTY MEMBERS

The following table shows external scientific grants awarded to faculty members and researchers of the associated laboratories in 2015 and funded through HSE. It uses the following abbreviations for the grant agencies: MES RF = Ministry of Education and Science of Russian Federation, RFBR = Russian Foundation for Basic Research, RSF = Russian Science Foundation. It can be seen that the majority of external funding is attracted by the areas of algebraic geometry, mathematical physics, topology and combinatorics.

Title of the grant proposal	**Principal investigator**	**Grant agency**	**Funding period**
New algebraic methods in quantum and statistical physics	Pyatov, Pavel	RFBR	2016-2018
Spectral curve topological recursion, nonsemisimple cohomological field theories, and knot invariants	Dunin-Barkovsky, Petr	RFBR	2016-2018
Homological and homotopical methods in geometry, representation theory, and quantum field theories.	Khoroshkin, Anton	RFBR	2015 - 2017
New algebraic methods in quantum and statistical physics	Pyatov, Pavel	RFBR	2014 – 2016 (2015)
Representation theory, homological algebra and integrable models of mathematical physics	Saponov, Pavel	RFBR - Ukraine	2014 – 2016 (2015)
Algebraic geometry of symplectic manifolds	Verbitsky, Misha (LAG)	RSF	2014 - 2016
Derived categories and mirror symmetry for Fano manifolds and moduli spaces	Galkin, Sergey	MES RF	2014 - 2015
Geometry and Combinatorics of Bethe algebras	Rybnikov, Leonid	MES RF	2014 - 2015
Combinatorial and topological methods of investigating functional spaces	Lando, Sergey	RFBR	2013 - 2015
Enumerative geometry of polytopes and polynomials	Esterov, Alexander	RFBR	2013 - 2014
Polytopes, algebraic torus actions, and automorphism groups	Kiritchenko, Valentina	MES RF	2013 - 2014
Geometry of Gieseker spaces and Representation Theory	Rybnikov, Leonid	RFBR	2012 - 2014
Exactly solvable models in nonequilibrium statistical physics	Pyatov, Pavel	RFBR - DFG	2012 - 2013

Lie theory and equivariant compactifications of abelian algebraic groups	Feigin, Evgeny	MES RF	2012 -2013
Grassmannians, flag varieties, their generalizations and algebraic groups actions	Feigin, Evgeny	RFBR	2012 - 2013
Enumerative geometry of polytopes and polynomials	Esterov, Alexander	MES RF	2012 - 2013
Newton-Okounkov bodies and divided difference operators	Smirnov, Evgeny	RFBR	2012 - 2013
Arithmetic of abelian varieties over finite fields and function fields	Zykin, Alexey	RFBR	2012 - 2013
Infinitely transitive actions of automorphism groups and locally nilpotent derivations	Kuyumzhian, Karine	RFBR (LAG)	2012 - 2013
Methods of complex analysis in dynamical systems	Timorin, Vladlen	RFBR	2012 - 2013
One-dimensional dynamical systems and Techmueller spaces	Timorin, Vladlen	RFBR	2011 - 2013
New algebraic methods in quantum physics	Pyatov, Pavel	RFBR	2011 - 2013
Algebraic geometry and its applications	Bogomolov, Fedor (LAG)	MES RF	2010 – 2014

Among significant honors and awards awarded to faculty members or researches of the associated laboratories are the following:

- Anton Ayzenberg, Mikhail Bershtein, Andrey Trepalin, Anton Fonarev were awarded the “Young mathematicians of Russia” prize in 2015 in the nomination “Candidates of Science”
- Ekaterina Amerik and Alexey Penskoi were awarded the “Young mathematicians of Russia” prize in 2015 in the nomination “Doctor of Science”
- Alexander Bufetov was awarded the Kovalevskaya prize of the Russian Academy of Science in 2015 for his series of works “Ergodic theory and its applications to stochastic processes, representations and Teichmueller theory”
- Alexandra Skripchenko was awarded the Metchnikov prize of the French Embassy in the Russian Federation in 2015 for her results in dynamical systems theory
- In 2015, the “Golden Vyshka” award of the HSE was given to Sergey Lando, former Dean of the Math Faculty, for his contribution to the development of the university
- In 2014, the “Golden Vyshka” award of the HSE was given to Boris Feigin for his outstanding contributions to science
- Sergey Galkin, Arthur Tomberg, Alexandra Skripchenko were awarded Dynasty Foundation grants in 2014
- Evgeny Gorsky was awarded the prize of the Moscow Mathematical Society in 2013 for his series of works “Homology of algebraic knots”
- Yuri Eliashev, Igor Netai, Anton Khoroshkin, Konstantin Shramov, Evgeny Feigin were awarded Dynasty Foundation grants in 2013
- Vsevolod Shevchishin was given an appreciation letter from the HSE university government in 2015
- Sergey Lando given an honorable mention from the HSE university government in 2015
- Alexey Gorodentsev and Pavel Pyatov were given appreciation letters from the HSE university government in 2014

At the end of every academic year, students vote for “best teachers”. The following math faculty members were given this status:

2012-2013	2013-2014	2014-2015

Alexey Gorodentsev Yulij Ilyashenko Andrey Levin Grigory Rybnikov Leonid Rybnikov Evgeny Smirnov Vladlen Timorin	Yuri Burman Ekaterina Amerik Yulij Ilyashenko	Yulij Ilyashenko Alexander Krasnoselskii Vladimir Poberezhny Grigory Rybnikov Evgeny Feigin

Also, two of our graduates, Boris Bychkov and Nina Sakharova, who are currently teaching in the HSE, although not in the Faculty of Mathematics, have been recognized as “best teachers” of 2013-2014 and of 2014-2015.

The Faculty of Mathematics and the associated laboratories hold a significant number of international scientific events every year. Events of 2013-2015 are described below, in a separate appendix.

APPENDIX 2: PUBLICATIONS OF PHD STUDENTS

The following is the list of publications in 2012-2015 by our PhD students and recent graduates of the PhD program (the names of the PhD students are shown in boldface).

- **Abramov Ya. V.** Artin-Hasse exponential mapping, algebraic groups in positive characteristic, and the Nottingham group // Mathematical Notes, Vol.97, Issue 1-2 (2015), 3-12.
- **Abramov Ya. V.** A resultant system as the set of coefficients of a single resultant. // Funktsional. Anal. i Prilozhen. 47 (2013), no. 3, 82--87; translation in Funct. Anal. Appl. 47 (2013), no. 3, 233-237.
- **Mutafyan G. S.,** Feĭgin B. L. Characters of representations of the quantum toroidal algebra $\widehat{\widehat{\mathfrak{gl}_1}}$: plane partitions with "stands''. // (Russian) Funktsional. Anal. i Prilozhen. 48 (2014), no. 1, 46-60; translation in Funct. Anal. Appl. 48 (2014), no. 1, 36-48.
- **Mutafyan G.S.,** Feĭgin B.L. The quantum toroidal algebra $\widehat{\widehat{\mathfrak{gl}_1}}$: calculation of the characters of some representations as generating functions of plane partitions. // (Russian) Funktsional. Anal. i Prilozhen. 47 (2013), no. 1, 62-76; translation in Funct. Anal. Appl. 47 (2013), no. 1, 50-61.
- **Netaĭ I. V.** Syzygy algebras for Segre embeddings. // (Russian) Funktsional. Anal. i Prilozhen. 47 (2013), no. 3, 54--74; translation in Funct. Anal. Appl. 47 (2013), no. 3, 210-226
- **Bychkov B. S.** On decompositions of a cyclic permutation into a product of a given number of permutations. // Translation of Funktsional. Anal. i Prilozhen. 49 (2015), no. 2, 1–6. Funct. Anal. Appl. 49 (2015), no. 2, 81-85.
- **Bychkov B.S.** Dremov V.A., Epifanov E.M. The Computation of Belyi Pairs of 6-Edged Dessins d’enfants of Genus 3 with Symmetries of Order 2. // Journal of Mathematical Sciences, Volume 209, Issue 2, 23 July 2015, Article number A004, Pages 212-221.
- **Bychkov B. S.** Computation of megamaps. // (Russian) Sib. Èlektron. Mat. Izv. 10 (2013), 170-179.
- **Devyatov R.A.** Unipotent nilpotent commutative group actions on flag varieties and nilpotent multiplications // Transformation Groups, Volume 20, Issue 1, (2015), Pages 21-64.
- **Devyatov R.A.,** Commutative unipotent group actions on flag varieties and nilpotent multiplications // Russian Mathematical Surveys, Volume 69, Issue 5, (2014), Pages 927-929.
- **Devyatov R.A.** Generically transitive actions on multiple flag varieties. // Int. Math. Res. Not., no. 11 (2014), 2972-2989.
- **Soldatenkov A.**; Verbitsky M. Holomorphic Lagrangian fibrations on hypercomplex manifolds. // Int. Math. Res. Not., no. 4 (2015), 981-994.
- **Soldatenkov A.,** Verbitsky M. k-symplectic structures and absolutely trianalytic subvarieties in hyperkähler manifolds. // J. Geom. Phys. 92 (2015), 147-156.
- **Soldatenkov A.**; Verbitsky M. Subvarieties of hypercomplex manifolds with holonomy in SL(n,H). // J. Geom. Phys. 62 (2012), no. 11, 2234-2240.
- **Soldatenkov A.** Holonomy of the Obata connection in SU(3). // Int. Math. Res. Not., no. 15 (2012), 3483-3497.

- **Avilov A. A.** Existence of standard models of conic bundles over algebraically non-closed fields. // (Russian) Mat. Sb. 205 (2014), no. 12, 3-16; translation in Sb. Math. 205 (2014), no. 11-12, 1683-1695.
- **Balzin E.R.,** Resolutions of categories and derived sections. // Russian Mathematical Surveys, Volume 69, Issue 5 (2014), Pages 918-920.
- **Basalaev A**., Takahashi A. On rational Frobenius manifolds of rank three with symmetries. // J. Geom. Phys. 84 (2014), 73-86.
- **Basalaev A.** Orbifold GW theory as the Hurwitz-Frobenius submanifold. // J. Geom. Phys. 77 (2014), 30-42.
- Borodin A., **Bufetov, Alexey**, Olshanski G. Limit shapes for growing extreme characters of U(∞) // Annals of Applied Probability, Volume 25, Issue 4, 1 August 2015, Pages 2339-2381.
- **Bufetov, Alexey**; Petrov, L. Law of large numbers for infinite random matrices over a finite field. // Selecta Math. (N.S.) 21 (2015), no. 4, 1271-1338.
- **Bufetov, Alexey**; Gorin, Vadim. Representations of classical Lie groups and quantized free convolution. // Geom. Funct. Anal. 25 (2015), no. 3, 763-814.
- **Bufetov, Alexey**, Gorin, Vadim. Stochastic Monotonicity in Young Graph and Thoma Theorem. // International Mathematics Research Notices, Volume 2015, Issue 23 (2015), Pages 12920-12940.
- Borodin, Alexei; **Bufetov, Alexey**. Plancherel representations of U(∞) and correlated Gaussian free fields. // Duke Math. J. 163 (2014), no. 11, 2109-2158.
- **Bufetov, Alexey**. Kerov's interlacing sequences and random matrices // Journal of Mathematical Physics, Volume 54, Issue 11, 11 November 2013, Article number 113302
- Buff X.; **Goncharuk N.** Complex rotation numbers. // J. Mod. Dyn. 9 (2015), 169-190.
- **Goncharuk N.B.** Rotation numbers and moduli of elliptic curves. // Functional Analysis and its Applications, Volume 46, Issue 1, March 2012, Pages 11-25.
- **Makhlin I. Yu.** Characters of the Feigin-Stoyanovsky subspaces and Brion's // Translation of Funktsional. Anal. i Prilozhen. 49 (2015), no. 1, 18–30. Funct. Anal. Appl. 49 (2015), no. 1, 15-24.
- Bowen L., Bufetov A., **Romaskevich O.** Mean convergence of Markovian spherical averages for measure-preserving actions of the free group. // Geometriae Dedicata, 5 November 2015, 14p
- Klimenko A., **Romaskevich O.** Asymptotic properties of Arnold tongues and Josephson effect. // Moscow Mathematical Journal, Volume 14, Issue 2, 1 April 2014, Pages 367-384
- Zabrodin A., **Akhmedova V.** Elliptic parameterization of Pfaff integrable hierarchies in the zero-dispersion limit // Theoretical and Mathematical Physics. 2015. Vol. 185. P. 410-422.
- **Akhmedova V.,** Zabrodin A. Dispersionless DKP hierarchy and elliptic Lowner equation // Journal of Physics A: Mathematical and Theoretical. 2014. Vol. 47
- **Degtyarev D.O.**, Ilyin A.M. The asymptotics of a solution of a parabolic equation as time increases without bound // Sbornik Mathematics. 2012. Vol. 203. Issue 11. P. 1589-1610.
- **Gavrylenko P.** Isomonodromic τ-functions and W_N conformal blocks // Journal of High Energy Physics. 2015. No. 09. P. 167.
- **Gavrylenko P.**, Marshakov A. Residue Formulas for Prepotentials, Instanton Expansions and Conformal Blocks // Journal of High Energy Physics, No. 5 (2014), P. 97.
- **Gavrylenko P.,** Iorgov N., Lisovyy O. Form factors of twist fields in the lattice Dirac theory // Journal of Physics A: Mathematical and Theoretical. Vol. 45 (2012), No. 2, P. 025402.
- **Kurnosov, N.M.** Абсолютно трианалитические торы в обобщённом многообразии Куммера // В кн.: V школа-конференция по алгебраической геометрии и комплексному анализу для молодых математиков России. Математический институт им. В. А. Стеклова РАН, 2015. С. 57-58.
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- Feigin E., **Makedonskyi I.** Nonsymmetric MacDonald polynomials and PBW filtration: towards the proof of the Cherednik-Orr conjecture // Journal of Combinatorial Theory, Series A. 2015. P. 60-84.

- **Makedonskyi I.**, Petravchuk A.P. On nilpotent and solvable Lie algebras of derivations // Journal of Algebra, Vol. 401 (2014), P. 245-257.
- **Makedonskyi I.** On wild and tame finite-dimentional lie algebras // Functional Analysis and its Applications, Volume 47, Issue41. 2013. P. 271-283.
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- Aleskerov, F., **Petrushchenko, V**. DEA for heterogeneous samples // Advances in Intelligent Systems and Computing, Volume 360 (2015), Pages 15-21.
- **Rudenko D**. On equidissection of balanced polygons // Journal of Mathematical Sciences, Volume 190, Issue 3 (2013), Pages 486-495.
- **Solodovnikov N. A.** Boundary-preserving mappings of a manifold with intermingling basins of components of the attractor, one of which is open // Trans. Moscow Math. Soc. 2014, 69-76.
- **Sopin V.** Criteria of measure-preserving for p^k-Lipschitz mappings // P-Adic Numbers, Ultrametric Analysis, and Applications, Vol.7, Issue 1 (2015), P.76–79.
- **Sopin V.** Ergodic dynamical systems over the cartesian power of the ring of p-adic integers // P-Adic Numbers, Ultrametric Analysis, and Applications, Vol.6, Issue 4 (2014), P. 333–336.
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- **Shabalin T. I.** Homology of some surfaces with pg=q=0 that are isogenous to a product. // (Russian) Izv. Ross. Akad. Nauk Ser. Mat. 78 (2014), no. 6, 211-221; translation in Izv. Math. 78 (2014), no. 6, 1261-1270.
- **Shabalin T.I.** The centralizer of a 3-dimensional simple subalgebra in the universal enveloping algebra of a 7-dimensional simple Malcev algebra // Siberian Mathematical Journal, Volume 54, Issue 4, July 2013, Pages 759-768.

APPENDIX 3: SCIENTIFIC EVENTS HELD BY THE FACULTY OF MATHEMATICS AND THE ASSOCIATED LABORATORIES

The following major international events were organized or co-organized by the Faculty of Mathematics and its associated laboratories in 2013-2015:

2013

- **May 1-10, 2013:** the XIIth international school-workshop for theoretical and mathematical physics (Sevastopol, Ukraine)
- **May 13-17, 2013**: international conference “Diophantine geometry” (Moscow, Russia)
- **May 20-23, 2013**: international conference “Arithmetic Days” (Saint-Petersburg, Russia)
- **May 20-25, 2013**: summer school and workshop “Problems in algebraic geometry and complex analysis” (Yaroslavl, Russia)
- **June 13, 2015:** V.I. Arnold’s Day (Moscow, Russia)

- **July 25-31, 2013**: the 3rd summer school “Algebra and Geometry” (Yaroslavl, Russia)
- **September 2-6, 2013**: international conference “Global Fields” (Moscow, Russia)
- **September 9-13, 2013**: international workshop “Synthesis of integrabilities in the context of duality between the string theory and gauge theories” (Moscow, Russia)
- **October 7-10, 2013**: international scientific-practical conference "Mathematics in the contemporary world" dedicated to the 150th anniversary of the prominent Russian mathematician D.A. Grave (Vologda, Russia)
- **October 22-25, 2013**: international conference “Geometry of algebraic varieties” dedicated to the memory of V.A.Iskovskikh (Moscow, Russia)
- **October 28, 2013**: annual one-day memorial conference of Andrei Tyurin (Moscow, Russia)
- **December 13-19, 2013**: international conference "Representation Theory and applications to Combinatorics, Geometry and Quantum Physics" dedicated to the 60th Birthday of B.L.Feigin (Moscow, Russia)

2014

- **January 13-17, 2014:** “Attractors, Foliations, and Limit Cycles” dedicated to the 70th birthday of Yulij Ilyashenko (Moscow, Russia)
- **February 3-8, 2014:** winter school “Integrability in contemporary quantum field theory” (Moscow, Russia)
- **March 3-7, 2014**: program of professional development for professors of Syberia and Far East (Irkutsk, Russia)
- **May 1-10, 2014**: the thirteenth international school for theoretic and mathematical physics (Dubna, Russia)
- **May 11-16, 2014**: international conference "Topological and geometric methods in low-dimensional dynamical systems" (Moscow, Russia)
- **May 19-23, 2014**: workshop on the Chow group of holomorphically symplectic manifolds (Moscow, Russia)
- **May 26-31, 2014**: the 4th international workshop “Combinatorics of Moduli Spaces, Cluster Algebras and Topological Recursion”
- **June 11, 2015:** V.I. Arnold’s Day (Moscow, Russia)
- **June 23 - 27, 2014**: international conference "Algebraic geometry and number theory" on the occasion of M.A. Tsfasman's and S.G. Vladuts' 60th birthday (Moscow, Russia)
- **July 25-31, 2014**: the fourth mathematical summer school "Algebra and Geometry" (Yaroslavl, Russia)
- **September 15-18, 2014**: international scientific conference "Contemporary problems of mathematics, informatics and Science" dedicated to the 155th anniversary of I.V.Meshchersky (Koryazhma, Arkhangelsk region, Russia)
- **November 10-14, 2014**: international conference "Complex manifolds, dynamics and birational geometry" (Moscow, Russia)
- **December 1-5, 2014**: the 5th international conference "Zeta functions" (Moscow, Russia)
- **December 23, 2014**: one-day conference dedicated to the memory of V.A.Iskovskikh (Moscow, Russia)

2015

- **February 16-20, 2015**: International conference "Algebraic structures in convex geometry" (Moscow, Russia)
- **February 26 – March 3, 2015:** International Workshop "Integrable structures in quantum field theory" (Dubna, Russia)
- **February 26-March 3, 2015:** The 2nd Irkutsk international school on algebraic geometry (Irkutsk, Russia)
- **April 13-17, 2015:** The 3rd Irkutsk international school on algebraic geometry (Irkutsk, Russia)
- **May 18-22, 2015**: International workshop on rationally connected varieties (Moscow, Russia)
- **May 23, 2015:** Hyperkahler Saturday (Moscow, Russia)
- **June 1-5, 2015:** International workshop “Geometric Invariants and Spectral Curves” (Leiden, Netherlands)
- **July 6-10, 2015:** Workshop on Classical and Quantum Integrable Systems (Protvino, Russia)
- **June 17, 2015:** V.I. Arnold’s Day (Moscow, Russia)
- **July 25-31, 2015**: The 5th summer school “Algebra and Geometry” (Yaroslavl, Russia)

- **August 17-22, 2015:** The 5th school-workshop in algebraic geometry and complex analysis for young mathematicians of Russia (Koryazhma, Russia)
- **September 7-12, 2015**: International conference "Projective Algebraic Geometry" (Moscow, Russia)
- **September 14-18, 2015**: International conference "Categorical and analytic invariants in Algebraic geometry 1" (Moscow, Russia)
- **September 29 – October 2, 2015**: International Workshop “Particles, Fields and Strings” (Baku, Azerbaijan)
- **November 23-24, 2015:** Mathematics Days at the Higher School of Economics (Moscow, Russia)
- **December 9, 2015:** Number Theory Day (Moscow, Russia)
- **December 1-5, 2015**: school “Differential equations in quantum mechanics and isomonodromic deformations” (Moscow, Russia)
- **December 6-12, 2015:** International conference **“**Magadan Algebraic Geometry Conference” (Magadan, Russia)
- **December 7-11, 2015**: International conference "Arithmetic Geometry: Explicit Methods and Applications" (Moscow, Russia)

The following researchers visited the Faculty of Mathematics and/or its associated laboratories in 2015:

- **A.I. Mudrov**, Department of Mathematics, University of Leicester (Leicester, UK): delivered a series of lectures on "Quantum “samoopredelenie” classes of simple Lie groups", November 23-30, 2015
- **Paul Zinn-Justin**, Universite Pierre et Marie Curie (Paris): delivered a series of lectures on «Geometry, Integrability and symmetric functions», November 12-27, 2015
- **Michael Shapiro**, Michigan State University: delivered a series of lectures on "Introduction to the theory of cluster algebras", October 19-29, 2015
- **Sakai Hidetaka**, University of Tokyo: delivered a series of lectures on “The study of Painleve equations”, September 28 – October 3, 2015
- **Roman Travkin**, University of Chicago: delivered a series of lectures on “Quantum Geometric Langlands Correspondence in Positive Characteristic: The GL(N) Case”, July 20-27, 2015
- **Ogievetsky Oleg**, Centre for Theoretical Physics (Marseille, France): delivered a series of lectures on "Partially ordered sets and their pedestal polynomials", June 29 – August 29, 2015
- **Michael McBreen**, EPFL Lausanne (Switzerland): delivered a series of lectures "Quantum Cohomology and Intersection Cohomology", June 2-5, 2015
- **Anton Dzhamay**, School of Mathematics, University of Northern Colorado (USA): visited and gave seminar talks on May 25-26, 2015
- **Jonathan Woolf**, Department of Mathematics of Natural Sciences, University of Liverpool (Liverpool, UK): delivered a series of lectures on "Contractibility of spaces of stability conditions", April 20-24, 2015
- **Max Mornev**, Leiden University (Netherlands): visited and gave the seminar “Pro-etale cohomology theory” in April 2015
- **Liviu Ornea** (Budapest): visited several times, gave crash courses and seminars, last visit in April 2015, he gave a talk on "Zeros of conformal vector fields"
- **Alexander Duncan**, University of Michigan: gave a talk on "Equivariant unirationality of surfaces" in April 2015
- **Hamid Ahmadinezhad**, University of Bristol: gave a talk on “Classification of 3-folds after minimal model program” in May 2015
- **Paul Sacawa**, University of Toronto: gave a talk on “Coniveau, the Bloch Conjecture, and Decomposition of the Diagonal” in May 2015
- **Daniel Bergh**, Stockholm University: visited in June 2015, gave a talk on “Destackification and weak factorisation of orbifolds”, June 19, 2015
- **Evgeny Shustin**, Tel-Aviv University: visited several times and gave seminar talks, last time on “Enumerative geometry of real algebraic curves”, June 2015

- **Mauro Mariani**: visited two times and gave seminars, last time in September 2015, he gave a talk on “Quasi-stationary measures and population dynamics”
- **Koushik Ray**: visited in September 2015, gave a talk on “Partition function of β-γ system on some orbifolds”, September 23.
- **Manfred Lehn**, Johannes Gutenberg-Universität Mainz (Germany): gave a crash-course "Symplectic manifolds and moduli of rational curves" and the seminar talk "Symplectic hypersurfaces" in September 2015
- **Francesco Zucconi**, Udine: visited in October 2015, gave a talk on "The rationality of some moduli spaces of curves and the birational geometry of some Fano 3-folds", October 16 , 2015
- **Piotr Pragacz**, Institute for Mathematics of the Polish Academy of Science (IMPA), Warsaw: gave a seminar talk on “On diagonals of flag bundles” on November 20, 2015
- **Ivan Losev**, Northeastern university: visited many times and delivered several crash-courses
- **Hiraku Nakajima**, Kyoto University: visited several times and gave seminars, last time in October 2015, he gave a talk on “Questions on provisional Coulomb branches of 3-dimensional N=4 gauge theories”
- **Alexander Perry**, Harvard University: visited several times, last time in December 2015, he gave a talk on “Categorical joins”
- **Petr Zograf,** Saint-Petersburg branch of the RAS Steklov Mathematical Insitute: visited several times and gave seminars
- **Pascal Hubert**, Aix Universite Marseille: visited in May 2015 and gave a seminar "Some remarks on the windtree model"
- **Yanqi Qiu**, Aix Universite Marseille: gave a talk on “Equivalence of Palm measures of determinantal point processes associated with Hilbert spaces of holomorphic functions”, March 26, 2015
- **Nils Scheithauer**, TU Darmstadt: visited in November 2015 and gave a talk on “Borcherds products of singular weight”
- **Evgeny Shinder**, Sheffield University: visited several times and gave seminars, last time on November 13, 2015, he gave a talk on “Equivariant categories and categorical zeta-function”
- **Serge Cantat**, University of Rennes: gave a seminar talk “On Groups of Birational Transformations” in October 2015
- **Roland Abuaf**, Imperial College London: gave a talk on “Minimal compactification of the moduli space of sympletic bundles on a K3 surface”, September 18, 2015
- **Robin Hartshorne**, the University of California, Berkeley: visited in September 2015 and gave a lecture on "Algebraic Space Curves: old results and open problems"
- **Lucian-Silvestru Badescu**, IMAR: visited in September and gave a lecture on “Seshadri positive submanifolds of polarized manifolds “
- **Mikhail Shkolnikov**, University of Geneva: gave a lecture on “Tropical curves in the abelian sandpile model”, July 10, 2015
- **Jungkai Chen**, National Taiwan University: gave a lecture on “Geography of threefolds of general type”, July 1, 2015
- **Ernest Vinberg**, Moscow State University: gave a lecture on “Moduli of quartic surfaces and automorphic forms on symmetric domains of type IV”, September 13, 2015
- **John Loftin**, Rutgers University: gave a lecture on “Cubic Differentials and Limits of Convex RP^2 Structures under Neck Pinches”, July 17, 2015
- **Yuri Zarhin**, Penn State University/Weizmann Institute: gave a lecture on “Jordan groups and automorphisms of complex algebraic varieties and real smooth manifolds”, June 15, 2015
- **Kevin Ford**, Urbana-Champaign: gave a lecture “Do the primes play dice?”, June 10, 2015
- **Anatoly Vershik**, St. Petersburg branch of the Steklov Mathematical Institute: gave a lecture on “Standardness and non-standardness in the theory of projective limits of simplices”, February 20, 2015
- **Sorin Dumitrescu**, Université Nice-Sophia Antipolis: gave a lecture on “Quasihomogeneous real and complex geometric structures”, June 5, 2015

- **Jaroslaw Wisniewski** (Warsaw): Rational curves and rational homogeneous varieties
- **Justin Sawon**, University of North Carolina: gave a talk “A survey of Lagrangian fibrations”, May 13, 2015
- **Valery Lunts**, Indiana University: gave a series of lectures “Motivic measures” in May 2015
- **Taras Panov**, Moscow State University: gave a lecture on “Toric generators in U- and SU-bordisms”, March 30, 2015
- **Alexander Beilinson**, University of Chicago: gave a lecture on “Crystal periods”, February 27, 2015
- **Dmitry Gurevich**, Universite de Valenciennes (France): gave a lecture on “Quantum matrix algebras and their applications”, December 9, 2015
- **Alexander Belavin**, Landau Institute for Theoretical Physics (Chernogolovka, Russia): gave a lecture on “Dubrovin-Saito theory and exactly solvable models of string theory and topological conformal field theory” September 16, 2015
- **Alexey Litvinov**, Rutgers University: gave a talk on “Liouville reflection operator and integrable systems in conformal field theory”, June 10, 2015
- **Alexander Shapiro**, University of California Berkeley: gave a series of lectures on “Embedding of quantum groups into quantum tori and Grothendieck-Springer desingularization”, June 3, 2015
- **Ivan Cherednik**, University of Geneve, University of North Carolina at Chapel Hill: gave a talk on “The action of absolute Galois group in rigid DAHA-modules of rank one”, May 19, 2015
- **Valentin Ovsienko**, Reims University: gave a talk on “Cluster algebras and Cluster super-algebras”, February 25, 2015
- **Gerard Helminck**, University of Amsterdam: gave a talk "On integrable deformations", February 17, 2015
- **Ryoki Fukushima**, Kyoto University: gave a talk on “Counting paths in random media”, December 16, 2015
- **Alexander Bobenko**, Technische Universitaet Berlin: gave a talk on “Discrete charm of geometry”, November 23, 2015
- **Junichi Shiraishi**, University of Tokyo: visited several times and gave seminars, last time on “Eigenfunctions of Ruijsenaars model and characters of affine Laumon spaces”, October 7, 2015
- **Ilya Zharkov**, Kansas State University, USA: delivered a crash course on “Tropical geometry, real geometry, constructing examples to the Hodge conjecture”, February 10 – 27, 2015
- **Sergey Novikov**, University of Maryland/College Park: gave a lecture on “Singular Algebrogeometric Operators and Spectral Theory”, January 15, 2015

APPENDIX 4: GOVERNMENTS OF EDUCATIONAL PROGRAMS

The Academic Council of the Bachelor of Science program “Mathematics” consists of the following faculty members:

- Sergey Khoroshkin (Chair, the academic director of the program)
- Evgeny Smirnov
- Pavel Saponov
- Alexei Pirkovskii
- Alexey Klimenko
- Alexander Esterov
- Vsevolod Shevchishin

The Academic Council makes decisions on the curriculum and on day-to-day activities of the program. Materials developed by the Academic Council are publicly available on the web-site
https://www.hse.ru/ba/math/council_materials

Every year of study is assigned a “curator”, who is a member of the faculty rather than administrative staff, and who is responsible for various issues which could be related to education or the daily life of the students. For example, a curator is supposed to know how each student performs academically, as well as to help students with practical issues

such as accommodation, health care, etc. Every student must have their individual study plan approved by their curator. Curators also collect feedback and pass it on to the Academic Council.

The following faculty members comprise the Academic Council of the Master of Science program “Mathematics”:

- Yulij Ilyashenko (chair, academic director of the program)
- Ekaterina Amerik
- Yuri Kudryashov
- Sergey Loktev
- Mikhail Skopenkov

The following faculty members comprise the Academic Council of the Master of Science program “Mathematics and Mathematical Physics”:

- Igor Krichever (chair, academic director of the program)
- Igor Artamkin
- Andrey Marshakov
- Evgeny Feigin
- Sergey Khoroshkin

The academic director of the PhD school in Mathematics is Alexey Gorinov. The Academic Council of the program consists of the following HSE faculty members (they represent not only the Faculty of Mathematics but also other divisions such as the Faculty of Economic Sciences and Moscow Institute for Electronics and Mathematics):

- Lev Beklemishev (chair)
- Karine Kuyumzhiyan
- Emil Akhmedov
- Alexander Bufetov
- Alexander Gushchin
- Vladimir Danilov
- Maxim Kazarian
- Mikhail Karasev
- Valentin Konakov
- Alexander Krasnoselskii
- Igor Krichever
- Dmitry Orlov
- Anatoly Peresetsky
- Dmitri Piontkovski
- Andrei Pogrebkov
- Vladimir Popov
- Vladlen Timorin
- Nikolay Tyurin
- Evgeny Feigin

APPENDIX 5: UNIVERSITY-WIDE LIST OF OPTIONAL COURSES AND SEMINARS

The following optional courses and seminars are offered in 2015-2016:

Fall 2015, courses and seminars delivered in English:

- Differential topology. Instructor: Vadim Vologodsky

- Topology I. Instructor: Alexei Gorinov
- Algebraic Geometry I. Instructor: Vsevolod Shevchishin
- Integrable systems. Instructor: Ian Marshall
- Complex Analysis. Instructor: Takashi Takebe
- Commutative algebra. Instructor: Toshiro Kuwabara
- Introduction to number theory. Instructor: Satoshi Kondo
- Sheaves and cohomology. Instructor: Alexey Gorodentsev
- Singularity theory I. Instructor: Viktor Vassiliev
- Algebraic groups I. Instructor: Mikhail Finkelberg
- Convex and algebraic geometry I (seminar). Instructors: Alexander Esterov, Evgeny Feigin, Evgeny Smirnov
- Cohomology of algebraic varieties I (seminar). Instructors: Marat Rovinsky, Satoshi Kondo
- Introduction to infinte-dimensional analysis and stochastic processes I (seminar). Instructors: Vladimir Bogachev, Alexander Kolesnikov, Stanislav Shaposhnikov
- Topological vector spaces and distributions. Instructor: Alexei Pirkovskii
- Affine Lie algebras and applications. Instructor: Evgeny Feigin
- Visual potential theory. Instructor: Mikhail Skopenkov

Spring 2016, courses and seminars delivered in English:

- Dynamical systems and ergodic theory. Instructors: Alexander Bufetov, Alexey Klimenko
- Topology II. Instructor: Alexei Gorinov
- Variational calculus and optimal control. Instructor: Ilya Vyugin
- Analysis of several complex variables. Instructor: Alexey Glutsyuk
- Advanced theory of probability. Instructor: Alexander Kolesnikov
- Symplectic geometry and topology. Instructor: Petr Pushkar
- Singularity theory II. Instructor: Viktor Vassiliev
- Riemannian geometry. Instructor: Alexei Penskoi
- Algebraic geometry II. Instructor: Vsevolod Shevchishin
- Seminar on Elliptic Functions. Instructor: Takashi Takebe
- Algebraic groups II. Instructor: Mikhail Finkelberg
- Convex and algebraic geometry II (seminar). Instructors: Alexander Esterov, Evgeny Feigin, Evgeny Smirnov
- Cohomology of algebraic varieties II (seminar). Instructor: Marat Rovinsky
- Introduction to infinte-dimensional analysis and stochastic processes II (seminar). Instructors: Vladimir Bogachev, Alexander Kolesnikov, Stanislav Shaposhnikov
- Harmonic analysis and unitary representations. Instructor: Alexei Pirkovskii
- Visual potential theory II. Instructor: Mikhail Skopenkov

Fall 2015, courses and seminars delivered in Russian:

Course title	**Instructors**
Lie groups and their representations I	Grigori Olshanski
Differential geometry 1	Maxim Kazarian
Applied methods of Analysis I	Andrei Pogrebkov, Emil Akhmedov
Mathematical linguistics	Natalia Slioussar
Mathematical methods in economics	Mark Levin
Mechanics and field theory	Pavel Pyatov
Programming 1	Yury Kudryashov

Functional analysis 1	Vladimir Bogachev
Quantum field theory	Vladimir Losiakov, Pavel Saponov
String theory	Andrey Marshakov
Algebraic surfaces 1	Vsevolod Shevchishin
Higher dimensional algebraic geometry and introduction to Mori theory	Ekaterina Amerik
Jacobi modular forms of several variables	Valery Gritsenko
Topological vector spaces and distributions	Alexei Pirkovskii
Toric varieties	Karine Kuyumzhiyan
Categories and universal algebra 1	Valentin Shehtman
Topics in discrete mathematics	Igor Artamkin
Chevalley groups 1	Mikhail Finkelberg
Representations and probability 1	Alexander Bufetov, Grigori Olshanski, Alexey Klimenko, (Skripchenko A.)
Geometry and dynamics 1	Vladlen Timorin, Alexander Bufetov, Grigori Olshanski, Alexey Klimenko
Quantum integrable systems	Anton Zabrodin
Fundamental notions of mathematics 1	Yuri Burman, Sergei Lvovsky
Representation theory 1	Boris Feigin, Leonid Rybnikov
Visual geometry	Mikhail Skopenkov
Introduction to ergodic theory	Mikhail Blank
Projective algebraic geometry 1	Igor Artamkin, Alexander Tikhomirov
Geometric Structures on Manifolds 1	Misha Verbitsky, Sergey Galkin, Vladimir Zhgoon
Basic ideas of theoretical physics by example of the Ising model	Sergey Apenko
Introduction to Seiberg-Witten invariants	Alexei Gorinov, Vsevolod Shevchishin
Diversity of varieties 1	Sergey Galkin
Probability theory. Analytic and economic applications 1	Alexander Kolesnikov, Valentin Konakov
Differential equations and isomonodromic deformations 1	Ilya Vyugin, Vladimir Poberezhny
Methods of classical and quantum integrable systems 1	Andrei Pogrebkov (Zotov A., Slavnov N.)
Combinatorics of Vassiliev invariants 1	Sergey Lando, Maxim Kazarian
Automorphic forms and their applications 1	Sergey Galkin, Valery Gritsenko
Contemporary problems of mathematical logic 1	Valentin Shehtman, Lev Beklemishev, Andrey Kudinov, Daniyar Shamkanov

Spring 2016, courses and seminars delivered in Russian:

Course title	**Instructors**
Discrete mathematics and applications	Evgeny Feigin
Computability and logic	Valentin Shehtman
Philosophy	Alexander Mikhailovsky
Chromatic homotopy theory	Kondyrev Grigory
Lie groups and algebras and their representations II	Boris Feigin, Leonid Rybnikov
Methods of collecting and analyzing sociological data	Dmitry Schmerling
Programming 2	Grigory Rybnikov
Riemann surfaces and integrable systems	Andrei Pogrebkov, Sergey Natanzon
Probability theory	Alexander Kolesnikov

Partial differential equations	Vladimir Chepyzhov
Functional analysis 2	Alexei Pirkovskii
Econometrics	Pavel Katyshev
Quantum mechanics	Vladimir Losiakov, Andrew Semenov
Applied methods of analysis II	Sergey Khoroshkin, Vladimir Losiakov
Topology II (совместно с Math in Moscow)	Alexei Gorinov
Algebraic groups 2	Mikhail Finkelberg
General relativity theory	Emil Akhmedov
Algebraic surfaces 2	Vsevolod Shevchishin
Goedel's completeness theorem	Lev Beklemishev
Introduction to the theory of automorphic forms	Ossip Schwarzman, Andrey Levin
Chevalley groups 2	Mikhail Finkelberg
Representations and probability 2	Grigori Olshanski, Alexander Bufetov
Geometry and dynamics 2	Vladlen Timorin, Alexander Bufetov, Grigori Olshanski, Alexey Klimenko
Representation theory 2	Boris Feigin, Leonid Rybnikov
Projective algebraic geometry 2	Igor Artamkin, Alexander Tikhomirov
Geometric Structures on Manifolds 2	Misha Verbitsky, Sergey Galkin, Vladimir Zhgoon
Diversity of varieties 2	Sergey Galkin
Probability theory. Analytic and economic applications 2	Alexander Kolesnikov, Valentin Konakov
Differential equations and isomonodromic deformations 2	Ilya Vyugin, Vladimir Poberezhny
Functional integration in quantum mechanics	Vladimir Losiakov, Andrew Semenov
Geometry of complex foliations	Yury Kudryashov
Methods of classical and quantum integrable systems 2	Andrei Pogrebkov (Zotov A., Slavnov N.)
Stochastic processes, random matrices, and integrable models	Alexander Povolotsky
Fluid dynamics and turbulence	Kirill Zybin
Mathematics of physical phenomena	Petr Arseyev
Topics in QFT and string theory	Andrey Marshakov, Pavel Saponov
Combinatorics of Vassiliev invariants 2	Sergey Lando, Maxim Kazarian
Automorphic forms and their applications 2	Sergey Galkin, Valery Gritsenko
Contemporary problems of mathematical logic 2	Valentin Shehtman, Lev Beklemishev, Andrey Kudinov , Daniyar Shamkanov