



Master's degree program

GEOMETRY AND QUANTUM FIELDS

MSU Department of Mechanics and Mathematics & ITMP MSU



Course pamphlet



MSU DEPARTMENT OF MECHANICS AND MATHEMATICS



The Department of Mechanics and Mathematics was established in 1933 and is considered one of the most esteemed departments at MSU. The department is recognized worldwide as one of the leaders in mathematical sciences. Today the department comprises 26 subdivisions, 15 research laboratories and around 350 academic faculty members

Learn more about the department at www.math.msu.ru

ITMP MSU



The Institute for Theoretical and Mathematical Physics (ITMP) is a division of Lomonosov Moscow State University. The goal of the Institute is to advance high-level research and education in fundamental areas of theoretical and mathematical physics. At present, the activity of the Institute is focused on the following areas: string theory and quantum gravity, conformal field theories and holography, integrable systems, quantum field theory and mathematical methods, modified theories of gravity and cosmology.

Learn more about the Institute at www.itmp.msu.ru/en/



ABOUT THE UNIVERSITY

Lomonosov Moscow State University, founded in 1755, is the highest-ranked university in Russia. Since its foundation, the university has been the center of academic life of the country. As of 2019, 13 Noble laureates, 6 Fields Medal and 1 Turing Award winners have been affiliated with the Moscow State University.

The university includes 41 faculties, 40 research institutes and centers, 6 museums, 8 branches, more than 380 departments, a science park, a botanical garden and a library which houses over 9 million printed volumes.

MSU is a university with a young and international character - the total number of MSU students exceeds 40,000, 20% of whom are hailing from outside of Russia. Located at the heart of Moscow, the university offers international students an opportunity to submerge oneself into the unique Russian culture as well as to feel a dynamic pulse of Moscow, a modern European metropolis

Learn more about MSU at www.msu.ru/en/

ABOUT THE PROGRAM

Program Information

Duration:	2 years (4 semesters)
ECTS:	120
Starting date:	September 1
Language:	English
Enrollment Capacity	15 tuition-free
Funding:	10 monthly stipends, 10 grants for tuition fee coverage
Housing:	Available

Program Directors:

Professor Andrei Shafarevich	Dean of the Department of Mechanics and Mathematics
Professor Arkady Tseytlin	Director of ITMP MSU, Professor of Theoretical Physics (Imperial College London)

The Master's degree program **GEOMETRY AND QUANTUM FIELDS** features courses in mathematics, theoretical physics and their applications. The focus of the program is on the physics and mathematics of the fundamental interactions, with a special emphasis on quantum gravity. A unique aspect of the program is its aim to integrate a variety of mathematical disciplines, with special attention to geometry, along with courses in quantum field theory, gravity, string theory and holography.

The program provides students with a strong starting point for an academic career in mathematics or physics or in their real-world applications. Irrespective of the career choice, the program trains students to think originally and helps them develop abstract reasoning skills, which are instrumental for a successful career.

More information at the official webpage
<https://itmp.msu.ru/en/mscgeometry>

GRADUATE PROGRAM COURSE OUTLINES

Year 1

- Symmetries and Integrability of Differential Equations;
- Introduction to Supergeometry;
- Lie Groups and Lie Algebras;
- Differential Geometry and Topology;
- Conformal Geometry and Riemann Surfaces;
- Principles of QFT/Modern QFT;
- Functional Analysis and Theory of Operators;
- Introduction to CFT in Two Dimensions;
- Symplectic Geometry and Quantization;
- Batalin-Vilkovisky Quantization

Year 2

- Introduction to String Theory;
- Conformal Field Theories and Holographic Dualities;
- Mathematical Theory of Black Holes;
- Topological QFT;
- Homological Algebra;
- Seiberg-Witten Invariants;
- Higher Spin Theory and Holography;
- Selected Topics of General Relativity;
- Superstring Theory and Sigma Models;
- Theory of Dynamical Systems;
- Quantum Integrable Models;
- Topology of Integrable Systems;
- Geometric Theory of Nonlinear Differential Equations

MASTER'S THESIS

The program culminates in a Master's thesis and an oral presentation of the work at a public colloquium. The students will have an opportunity to perform cutting-edge research and work on a Master's thesis under the supervision of world-class experts in mathematics and physics. These include researchers from the Institute for Theoretical and Mathematical Physics (ITMP), faculty members from the Department of Mechanics and Mathematics, as well as researchers from the Russian Academy of Sciences (RAS) and other reputable scientific research institutes (in or outside Russia).

ACADEMIC CALENDAR

Fall Semester

Duration of Fall Term:	September 1 - January 24
Fall Examination Session:	January 3 - January 24
Winter Recess:	January 25 - February 6

Spring semester

Duration of Spring Term:	February 7 - June 24
Spring Examination Session:	June 1 - June 24
Summer Recess:	June 25 - August 31

ADMISSION REQUIREMENTS AND DEADLINES

Application periods

International applicants:

November, 15
February, 15

International applicants:

June, 15 — July, 20

Russian nationals (including those living abroad) Certain foreign nationals who have a right to be admitted to state funded places:

June, 20 — July, 20

International applicants are advised to apply as early as possible due to limited capacity and funding availability.

In addition, all applicants to the program may participate in the Universiade “Lomonosov”, a competition in mechanics and mathematics, organized by MSU Department of Mechanics and Mathematics. Universiade includes four sections: mathematics, mechanics and mathematical modeling, mathematics and computer science, geometry and quantum fields (in English). Winners and laureates of the geometry and quantum fields section will have advantages upon admission to the program **Geometry and Quantum Fields**.

Candidates must submit their application package to the Admissions Office at admissions@itmp.msu.ru by 23:59pm of the above-mentioned application deadlines.

Required documents

1. An application form
(available on www.itmp.msu.ru/en/mscgeometry/for-prospective-students/admission)
2. 1 passport size photo
3. CV/resume
4. A scan of an ID document containing name and photo
5. A scan of a diploma or an academic transcript
6. A short personal statement (1 page)
7. A scan of an official English language test report or certificate
(Please refer to the [acceptable language testing systems](#))
8. An abstract of an undergraduate thesis or any research project.
This should provide a brief description of the project (up to 3 pages), stating its objectives, research materials and methods as well as results.
9. Up to 2 references. Note that references must be submitted by the referees themselves via email to admissions@itmp.msu.ru



ADMISSION REQUIREMENTS

1. Required documents

To be considered for the program, candidates must hold or expect a Bachelor of Science (B.S.) in Mathematics, Physics, or a scientific field requiring a strong background in mathematics (for example, Civil Engineering). In addition, they are expected to have a strong interest in fundamental mathematics or mathematical physics and to have a record of extracurricular activities in this field.

2. Language Requirements

The program is conducted in English. All applicants who are non-native English speakers will be asked to provide evidence of language proficiency upon application. Proficiency in the Russian language is not required. Please note that applicants who obtained their degree from an English-language Bachelor's degree program will be exempt from providing proof of language proficiency.

Here is a list of acceptable language testing systems and minimal requirements:

Language Certificate	Minimal Requirements
IELTS (Academic)	5
TOEFL (Internet Based)	72
TOEFL (Paper Based)	550
TOEFL (Computer Based)	200
Cambridge FCE, CAE, CPE	None
BEC Higher (Business English Certificate)	None
GRE general	140 (Verbal reasoning)
CET-6	430
CERF/TELC	B2
TOEIC	700
Pearson Test of English (Academic)	63

ADMISSION PROCESS

The intake to the program is a portfolio-based selection rather than an examination-based one. The Admission Committee assesses students by (1) portfolio and (2) a presentation of their research project which occurs if a candidate passes the first round of selection. There is no entrance examination to this program.



SCHOLARSHIPS AND FUNDING

B  S I S

Theoretical Physics
and Mathematics
Advancement Foundation

Scholarship of the Theoretical Physics and Mathematics Advancement Foundation «BASIS»

Applicants to the program will be considered for grants and scholarships provided by the Theoretical Physics and Mathematics Advancement Foundation «BASIS».

The scholarship aims to attract talented domestic and international students and support them in their research in the Institute's priority research areas. The scholarship will be granted for the entire duration of the program. However, each year the scholarship recipient will be required to provide evidence of good academic performance. All qualified applicants are eligible to apply for this scholarship, irrespective of nationality or ethnicity.

A total of **10 scholarships** are available. These include a monthly stipend of up to 50 000 RUB (after tax).

In addition, a total of **10 grants** are available. These cover all tuition fees for the duration of the program.

In order to qualify for this scholarship, a candidate must be accepted to the program.

In addition to scholarships and tuition grants, all students of the program are eligible to participate in the travel grants program of the Theoretical Physics and Mathematics Advancement Foundation «BASIS», which allows students, graduate students and young scientists to participate in international research projects, workshops and schools. This is aimed at supporting and strengthening scientific collaborations at the international level.

For more information about the Theoretical Physics and Mathematics Advancement Foundation «BASIS», please visit www.basis-foundation.ru/en/.





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BASIS

Theoretical Physics
and Mathematics
Advancement Foundation

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