# Ph.D. Program in Mathematics

The Ohio State University

## Overview and Updates

## Faculty & Research

The Doctor of Philosophy degree enables its recipients to conduct independent research, produce original scholarly work, and serve in faculty position at colleges and universities. Nothing is therefore more important in the formation of a Ph.D. student than the guidance and training by researchers and faculty advisors. We believe that the Mathematics Graduate Program at the Ohio State University provides a tremendously broad and exciting range of high caliber research opportunities and a faculty that is uniquely dedicated to graduate advising.

### Graduate Faculty

The Ohio State mathematics department comprises currently **62** graduate faculty on the main Columbus campus. Additional there are 24 faculty on branch campuses who can and frequently do supervise main campus dissertations. There are thus about **86** professors that a doctoral students can ask to serve as their dissertation advisor.

Our faculty members are actively engaged in supporting a vigorous research environment through top-level research publications, an abundance of research seminars, numerous sources of grant support, a large visitor and post-doctoral program, frequently hosted conferences of national reach, and research collaborations all over the world. In addition, several joint faculty appointments support interdisciplinary research projects with other departments at Ohio State, such as several life science disciplines, computer science, and statistics. Other OSU units collaborating with our department include, for example, the medical center, physics, engineering, and education.

An increasing number of our faculty are involved in developing new graduate degree programs or improving existing ones, organizing working groups that integrate student, post-doc and faculty participation around a topic, as well as seeking funding for graduate student support from many sources. Graduate advising is also a major factor in the evaluation of faculty in our department.

### Opportunities in Breadth

Thanks to the large size of of our faculty nearly every area of mathematics is represented in our program. One immediate implication is that our program is able to offer on a regular basis a wide variety of courses that provide our students with a broad intellectual formation and solid skill sets in many disciplines of mathematics.

At a more advanced level the breadth in mathematical research in our program offers unique opportunities for students who would like to explore directions before committing to a research area as well as students who would like to combine or work at the interface of several fields of mathematics.

### New Hires and Directions

New faculty hires over the last few years have additionally invigorated our research program by strengthening core areas and adding original new research directions. Recent additions have emphasized research that combines computational methods with topics in pure mathematics,

often with novel cross-disciplinary components.

As a result, our program has now boasts, for example, the premier center in the world in Topological and Geometric Data Analysis, a new area that draws both from sophisticated methods in algebraic and geometric topology as well as cutting edge research in computer science. Other examples of hires at the interface of computation, statistics, and pure mathematics are in computational number theory, statistical graph theory, and probabilistic topology.

Additionally, several faculty with very active research programs have joined our program in the last couple of years, strengthening research directions that are already represented in our program by well established and renown research groups. These areas of expansion include algebraic geometry, combinatorics, ergodic theory, dynamical systems, complex analysis, mathematical biology, and topology.

## Traditional Strengths

Among the better known traditional strengths of our program is number theory, as our department houses the premier research journal in the area and has hosted numerous special programs and conferences in recent years. Several activities focus especially on deep and exciting connections with ergodic theory, another strongly represented area in our program with equally many students and renown faculty. Moreover, our topology group has a traditionally strong presence with many students, faculty, and post-docs, particularly in the specialties geometric group theory, low-dimensional topology, and various other directions in algebraic and differential topology.

The *Mathematical Biosciences Institute* (MBI, see http://mbi.osu.edu/) at Ohio State – one of the seven major NSF-funded mathematical sciences institutes in the United States – is the focal point of our large research group in mathematical biology. It includes about ten mathematics professors in addition to numerous interdisciplinary appointments and affiliated faculty from other departments. Much of the mathematics involved in this area ties into our prolific research groups in PDE, dynamical systems, and applied mathematics, but also benefits from collaboration with life science departments, medical units across campus, as well as large number of post-docs visiting the MBI each year. Similarly, other faculty working in applied mathematics and numerical analysis maintain lively collaborations with Ohio State's large engineering and computer science departments.

Many more smaller, but nonetheless very active, research groups complement the wide spectrum of mathematics represented in our program. These encompass, for example, logic and foundations, real and complex analysis, differential geometry and geometric analysis, non-commutative geometry and operator algebra, representation and Lie theory, ring and group theory, as well as mathematical physics and financial mathematics.

## Exploring our Faculty

The attached list of current and incoming graduate faculty at our department contains keyword descriptions of their research as well as their contact information. Interested students should feel free to contact faculty directly with questions about their research. (The organization by subject areas in the list may at times be arbitrary since research areas have become more and more cross-disciplinary).

In addition, our program runs the *Invitations to Mathematics*, a weekly student colloquium with lectures delivered mostly by our graduate faculty and targeting beginning doctoral students who are looking for research areas and advisors. Browsing the lecture announcements and abstracts may serve as an additional source of topics that are researched at our department.

### Miscellaneous Highlights

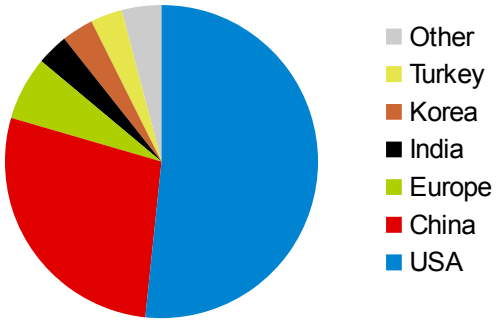
Here a few more facts that underline the high level and significant impact of the research conducted at our department:

- Over the past seven years **five** of our incoming faculty were awarded the prestigious *Sloan Fellowships*, see for example this article . Moreover, **two** of our young faculty have recently won prestigious *NSF-CAREER* awards.
- The *Mathematics Research Institute* (MRI, see http://www.mri.osu.edu) combines department and college resources as well as external grants to fund a variety of conferences, special years on selected topics, visitor programs, seminars, and travel support.
- In the last three years **four** *Field Medalists* have visited our department for special lectures, namely, *Edward Witten*, *Elon Lindenstrauss*, *Alain Connes*, and *Terence Tao*.
- **Thirteen** of our faculty members are *Fellows of the American Mathematical Society*.
- Moreover **four** faculty in our program are *AAAS Fellows*, one of whom is serving as chair-elect of the mathematics section of AAAS. Also **one** of our faculty is a member of the *National Academy of Science,* and several more members of our program have had prestigious invitations as speakers to the *International Congress of Mathematicians* in recent years.

## Graduate Students & Program Facts

### Demographics

There are currently about 125 students in our graduate program of which about 105 are pursuing a doctoral degree and around 20 are in the MMS program. Nearly a quarter of our graduate students are female. The nationalities represented in our department are illustrated in the chart on the right. Students enter the program coming from wide range of institutions from small liberal arts colleges to large research universities with similarly diverse educational backgrounds including both Bachelors and Masters degrees. Our program has thus ample experience and resources to accommodate students widely varying academic and personal backgrounds.




### Academic Progression & Curricular Changes

The path to the Ph.D.-degree is roughly divided into two parts separated by the candidacy exam. During the first part students are expected to pass the two qualifying requirements and fulfill a few basic course requirements. As doctoral candidates students focus in the second part entirely on research and writing their dissertation. The details of the various pre-candidacy requirements can be found at

https://math.osu.edu/grad/current/phd

In the past year the department has substantially revised its pre-candidacy requirements in our doctoral program with the aim of leading students more quickly to research and reducing average times to graduation, while still guaranteeing a thorough training in core mathematical subjects.

In outline, our real analysis and abstract algebra qualifying requirements may be fulfilled by

passing the year-long course sequences in analysis and algebra with sufficient grades. As an alternate option the course work can be replaced (or remedied) by passing annually offered exams as well, and the graduate committee may count additional course work in borderline situations. The candidacy examination will focus entirely on the proposed research area, and aims to provide the students with a headstart into the subsequent dissertation topic.

As a result of these adjustments we expect all students to complete their degree in under six years. Faculty committees are also currently considering curricular options that are more closely tailored to students with interests in applied mathematics. The effort reflects our commitment to existing and newly emerging interdisciplinary areas in mathematics – both at the level of faculty hiring and graduate education.

The doctoral completion rate (from entry to degree) has steadily improved over recent years and we currently estimate this ratio to be around or exceeding 70% – which is significantly above the national average of about 50%. The majority of those leaving before degree do so for reasons not directly related to academic requirements but more often due to personal reasons or because they develop career interests outside of doctoral studies in mathematics.

## Financial Support

All graduate students in good academic standing are supported either as graduate teaching associates (GTAs), graduate research associates (GRAs), or as University Fellows during the regular academic year. In all cases support includes a full tuition waiver. Students who have been supported in the nine months of the preceding academic year also have an automatic summer tuition waiver regardless of summer support. Additionally GA and fellowship support includes a generous (85%) subsidy of health insurance premiums as detailed in http://hr.osu.edu/hrpubs/index.aspx#student. Beyond first year fellowships for selected students fulfilling university criteria, there are additional fellowship and support opportunities for more advanced students:

Every year the department offers around 20 SGA/RGF Fellowships that support students for one semester without teaching duties at regular stipend levels in order to allow them to focus on their research, complete thesis or other academic projects, or travel to workshops and conferences.

Many faculty in our department also hold research grants that can support students on GRAs, especially during the summer months. In addition a limited number of teaching and research positions are available for summer support each year. Typically over 90% of all students who remain enrolled over the summer and apply receive financial support from one of these sources.

Students in their dissertation years can also compete for the highly prestigious Presidential Fellowships which our graduate school awards to the very best students in the entire university. Our program the top six or seven program on campus that win most of these awards every year.

Finally, the department makes travel funds available that allow students to visit conferences, workshops, and collaborators. Many students take advantage of this opportunity to connect to the larger scientific community, collaborate outside of the program, present their work, and thus improve their chances in securing academic jobs.

## Academic and Social Life

The community of graduate students in our department is not only characterized by its diversity but also by a pronounced cooperative and supportive atmosphere among peers. Shared offices provide the environment in which groups form that work together on course assignments, exams preparations, or grading in the beginning years. Graduate students show support by helping each other through courses and examinations, peer-mentoring incoming students, and nominating

each other for teaching awards.

There are many settings for more research oriented interactions as well. Particularly, in recent years students by themselves or students together with faculty and post-docs have been organizing informal working seminars around numerous special topics, for example, in number theory, algebraic geometry, several in topology, ergodic theory, probability theory, or applied mathematics. Students often collaborate with faculty from Ohio State but also other institutions as well as other students in our program on research projects and articles.

Besides these academic interactions graduate students also meet up socially both in the department in the lounge rooms and tea areas, departmental picnics and special events, as well as outside the department for a wide range of extracurricular activities.

## Graduations and Job Placements

Over the past four years our doctoral program has awarded on average about twenty Ph.D.-degrees per year. An ever increasing number of our graduating students have articles published or in submission as well as active outside collaborations by the time of their graduation.

In recent years about half of our Ph.D.-graduates placed in post-doctoral positions in major research oriented programs both in the US and other countries. Among the institutions where our students found research positions over the last five years are *Princeton University (2), IAS Princeton, University of Chicago, Yale University (2), MSRI, University of Michigan, Cal-Tech (3), University of Minnesota (2), Rutgers University (2), University of Utah, University of Bristol, Duke University, Vanderbilt University (2), York University, UC Irvine, Purdue University (2), Texas A&M University, University of Illinois at Chicago, University of Iowa, University of Connecticut, University of Nottingham, University of British Columbia, University of Southampton, Northeastern University, SUNY Binghampton*, as well as numerous other international institutions. Among these recent graduate some have already gone on to tenure track professorships at schools such as *SUNY Stony Brook* and *Texas A&M*.

Other graduates continue academic careers as professors in smaller more teaching oriented colleges and universities. Each year a few of our students also enter private industry careers such as in software development, finance, and R&D, and occasionally some enter government agencies such as NSA. Still others pursue additional doctoral degrees, for example, in physics or financial mathematics.

The department typically accommodates its recent graduates who are still looking for academic jobs with lecturer positions for at least a year until they found employments that align with their career goals.

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