2001

MASS PROGRAM AT PENN STATE

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ABSTRACT

The MASS program--Mathematics Advanced Study Semesters--at Penn State's Mathematics department was founded in 1996. MASS is a unique, innovative, intensive program for select groups of undergraduates recruited every year from around the United States and brought to Penn State's campus for the fall semester. This program provides a unique and mutually reinforcing blend of learning and research activities for its participants.

PROGRAM ELEMENTS

MASS is unique among mathematics programs for undergraduates in the U.S., quite distinct from honors programs, math clubs, and summer educational or research programs. The principal difference is the comprehensive character of the program: all academic activities of the participants for a semester are specially designed and coordinated to enhance their learning and introduce them to research in mathematics. A key feature of the MASS experience is the intense and productive interaction that takes place among the students. The environment is designed to encourage such interaction: a classroom is dedicated to MASS and furnished so as to serve as a lounge and a computer lab outside of class times. The students live together in a contiguous block of dorm rooms, they eat together, and they pursue various social activities together. The effect of such conditions is dramatic: the students find themselves members of a cohesive group of like-minded people sharing a special formative experience. They quickly bond, and often remain friends after the program is over. They study together, attack problems together, debug computer programs together, collaborate on research projects, and, most importantly, talk about mathematics all the time.

The main components of MASS are:

- **Three core courses** designed exclusively for MASS students on topics chosen from the areas of Algebra/Number Theory, Analysis, and Geometry/Topology. Each course features three, 1-hour lectures per week, a weekly meeting conducted by a MASS Teaching Assistant, weekly homework assignments, a written midterm exam, a final project, and an oral final examination/presentation. For example, the core courses taught in fall of 2001 were:
  Geometry and Relativity: An Introduction (Nigel Higson),
  Combinatorics (George Andrews),
  Mathematical Analysis of Fluid Flow (Andrew Belmonte).
- **Individual student research projects,** which range from theoretical mathematics research to computer implementation. Some projects are related to the core courses while others are developed independently according to the interests and abilities of the student.

- **A weekly 2-hour working seminar** run by the director of the MASS program (the author of this article), devoted to selected topics in mathematics, and helping to unify all other activities.
- **MASS Colloquium**, a weekly lecture series by distinguished mathematicians, visitors, or Penn State faculty. These lectures are instrumental in focusing interest of the MASS participants on various research areas of mathematics both during their participation in the program and later in their selection of graduate programs.

No account nowadays would be complete without a reference to a web page; the reader is invited to visit the MASS web site for the list of the core courses that have been offered in the MASS program, previous MASS Colloquium talks, and a wealth of other information: **www.math.psu.edu/mass**

PROGRAM SUPPORT AND RECRUITING

The MASS Program is funded by Penn State and the National Science Foundation. Penn State provides fellowships for out-of-state students that reduce their tuition to the in-state level. Further support comes through the NSF VIGRE grant. In particular, MASS participants whose tuition in their home institution is lower than Penn State in-state tuition receive grants for the difference. Starting the fall of 2000, merit scholarships are awarded too.

A new feature of the MASS Program is its close relation with the Schreyer Honors College at Penn State. Starting the fall of 2001, all MASS courses are offered to Schreyer students. They have two options: either to take the full MASS course load that amounts to 16 credits (in which case the students are very strongly encouraged not to take other classes) or to be part-time MASS participants (to take one core course and the Seminar and/or the Colloquium).

Another summer program in mathematics for undergraduate students is called REU (Research Experience for Undergraduates). REU at Penn State is by no means unique--there are about 45 similar programs offered by various US universities. REU is formally independent of MASS but it is run by the same pool of instructors, and about half of the REU participants stay at Penn State for MASS. Moreover, some REU participants continue their research projects at MASS.

PROGRAM SUCCESS

Some REU/MASS participants have produced significant pieces of mathematical research. For example,

- James Kelley, a MASS-98 participant, studied the representation of integers by quadratic forms, a classical problem in number theory. Kelley made significant progress in this hard problem, and his paper has been submitted for publication in a refereed journal. James Kelley is currently a mathematics graduate student at UC Berkeley; he has been awarded an NSF Graduate Research Fellowship.
- Jaclyn (Kohles) Anderson (University of Nebraska, Lincoln, MASS-98) is a winner of the Alice T. Schafer Prize For Excellence in Mathematics by an Undergraduate Woman.

- Benjamin Chan (University of Rochester, REU and MASS-2000) is a winner of the Undergraduate Student Poster Session in New Orleans, January 2001.

Further evidence that the MASS program is working as hoped is provided by the students' assessments. For example, Suzanne Lynch, a MASS-96 participant, who is now a graduate student at Cornell and about to obtain a doctoral degree in mathematics, wrote in an unsolicited letter:

The MASS program has been the best semester of my life. I was immersed in an environment of bright motivated students and professors and challenged as never before. I was pushed by instructors, fellow students and something deep inside myself to work and learn about mathematics, and my place in the mathematical world. I loved my time there, and never wanted to leave. I believe the MASS program helped to prepare me for the rigors of graduate school, academically and emotionally. The MASS program has been very instrumental in opening grad school doors to me, and giving me the courage to walk through them.

Another evaluation, from Jared Speck, MASS 99, University of Maryland stated,

My overall impression of MASS was WOW! This has been the best academic program of my life. Thanks to the program, I am now sure that I want to go to grad school in mathematical physics. It was wonderful to be around so many intelligent people who are my age.

AUTHOR BIOGRAPHY

Serge Tabachnikov has a Ph.D. in mathematics from Moscow State University (1987), specializing in geometry and topology. He was head of the Mathematics Department of *Kvant* magazine, 1988-90. *Kvant* (which means Quantum) was a popular magazine on physics and mathematics for high school and college students in the USSR with circulation of 200,000-300,000. From 1990 to 2000 he was professor of mathematics at the University of Arkansas, Fayetteville, and, since 2000, professor of mathematics, MASS, and honors Director at Penn State. He is author of more than 60 research and expository papers and books.