

Strategic Plan Update, Physics Department May 2010

Mission

To generate and disseminate knowledge of physics and its applications.

Vision

The Department of Physics faculty will continue to conduct cutting edge research and provide outstanding education for undergraduate/graduate students and post-doctoral fellows in diverse areas of pure, applied, and engineering physics.

Goal 1: Attract and support a world-class and diverse faculty, staff, and student population

1.2 Maintain a diverse student body and faculty.

Recruit faculty members of the 'top teacher-scholar' caliber to sustain our excellence in research and teaching at the national and international levels:

Since 2001 the Department has hired seven new outstanding faculty members, including a female astrophysicist. (Appendix 1 shows the faculty demographics; Appendix 2 tracks the results of recent faculty searches, and Appendix 4 outlines in more detail the steps to be taken to support the diversification of the faculty.) Several have already established externally-funded active research programs: two received NSF CAREER awards; one a NASA New Investigator award (NASA's version of the CAREER), others are lead scientists in large international research projects; and two were among finalists for MTU Distinguished Teaching Award. Faculty personally contacted colleagues at research and teaching institutions throughout the world to help to identify and recruit the best candidates. In order to diversify our faculty we will continue to use social networking to pursue our goal of a community of committed teacher-scholars. Furthermore we will follow recommendations of US delegation to the First International Union of Pure and Applied Physics (IUPAP) Women in Physics Conference 2002 [<http://www.iupap.org/wg/wip/recommendations-02.html>].

The Department is committed to encouraging the success of faculty as both teachers and researchers. Appendix 5 outlines the elements and activities that form the unit's mentoring plan.

Nominate faculty members for awards with national recognition such as Fellow of the American Physical Society.

Faculty members who are well positioned for awards will be nominated. Two physics faculty (Beck and Hansmann) are currently Fellows of the American Physical Society.

Recruit students from broad socio-economic backgrounds, including women and minorities, and develop global diversity through targeted international collaboration.

The departmental recruiting campaign (letter, brochure, high school visits, department tours, distribution packets including a popular level book by Richard Feynman) has successfully increased the size of our undergraduate program to about 100 students. (Appendices 6 and 7 show the number of majors and degrees awarded.) The enrollment of female undergraduates (19%) and graduate students (27%) is comparable to the national averages of 22% and 17%, respectively. (Appendix 3 shows students demographics and the Appendix describes activities to be undertaken to broaden the diversity of the student population.) The relatively high percentage of female Ph.D.

students helps to create a supportive atmosphere for our female B.S. students. Many undergraduate students participate in research programs as early as their sophomore year. Such involvement increases all students' sense of connectedness and productivity in the department. Faculty and graduate students from numerous countries in Asia, Africa and Europe provide significant global diversity in the department. Last year we restarted our local chapter of the physics honor society Sigma Pi Sigma to recognize and encourage top physics students.

We are increasing physics outreach programs by designing, supporting, and supervising several Summer Youth Programs activities, running in-services for local physics teachers, supporting Society of Physics Student outreach programs, and taking physics demonstrations directly into more than 10 local high school and elementary school classrooms and other local venues. One faculty member is helping set up a physics laboratory at Cass Tech High School as a means of recruiting minority students in our undergraduate program. We also hope to secure undergraduate and graduate scholarships via the Capital Campaign.

Maintain the quality of our undergraduate education with an enrollment of about 100 students, thereby retaining a student-to-faculty ratio suitable for individualized physics instruction and research.

We are constantly expanding the research component in our undergraduate education, a required part of the B.S. degrees in physics and applied physics. In addition, we encourage all majors to become involved in research as early as their sophomore year.

We introduced a new "Qualitative Methods in Physics" class to improve GRE scores of our students. We have seen improvement in both GRE and major field tests (~90% percentile at or below) of our majors. Academic advising and program quality are carefully and continually monitored by the faculty Undergraduate Studies Committee.

Our faculty academic and research advisors closely mentor the undergraduates, and use personal connections to help place them in the best possible graduate schools. As a result of these efforts nearly all of our students go to graduate schools, some attending the very best schools in the country: JILA University of Colorado at Boulder, MIT, University of Illinois at Urbana Champaign, The University of Texas at Austin, University of Michigan, University of Wisconsin Madison, The Ohio State University, University of Arizona, etc. More important is that they perform exceptionally well in their graduate work.

These activities provide huge dividends to our students but because of the very intensive time demanded of faculty, the department must carefully monitor the faculty-to-major ratio.

Enhance the quality of our graduate student body by further strengthening our admission standards and recruiting process.

In 2009 the Physics faculty adopted new graduate admission guidelines for incoming students. These include requiring higher scores on standardized exams, and minimum course work and research experience:

- (a) TOEFL score: (total) 88 (570 paper)
- (b) GRE general test; GRE2 (quantitative) 720, GRE4 (analytical writing) 3.0
- (c) "B" average in Physics or equivalent major.
- (d) Course work: Mathematics through Differential Equations; Mechanics, Electricity and Magnetism (or equivalents).
- (e) Recommendation letters addressing students' ability to do graduate work, and previous research experience

1.3 Provide exceptional infrastructure and a welcoming, aesthetically pleasing environment.

The renovation of Fisher Hall has made an enormous improvement in the atmosphere of the department. It is a top priority to complete this renovation (Fisher Phase II), especially the updating of ground floor research laboratories and the necessary upgrading of compressed air, water, and other utilities.

Goal 2: Deliver a distinctive and rigorous discovery-based learning experience grounded in science, engineering, technology, sustainability, the business of innovation, and an understanding of the social and cultural contexts of our contemporary world.

2.1 Provide dynamic discovery-based learning that integrates instruction, research and innovation in undergraduate and graduate programs.

Continue innovative teaching improvements and commitment to teaching excellence.

Significant improvements have been introduced in the teaching laboratories. These include a complete rewrite and publication of new lab manuals, the creation of separate algebra-based physics labs, and the use of state-of-the-art instructional technology. One faculty members has initiated and works as the principal advisor of the Nanotech Innovations Enterprise, which includes several physics majors on its interdisciplinary team of 15 to 20 students. Ongoing improvements in the lecture portion of the introductory classes have also been developed using new interactive technologies (“iclickers”).

Work toward introducing B.A. in physics and enhancing our Secondary Education Certification program in physics.

Initial discussion at the committee level has been started toward introduction of a B.A. degree in physics, comparable to that offered at many liberal arts colleges. Such an alternate route from the existing B.S. program can help us expand our undergraduate enrollment. We are also looking at recruiting more secondary education physics majors in collaboration with the NSF-funded Noyce Scholarship Program. In order to better prepare high school teachers we have developed a new course “Methods of Teaching Physics,” which is planned for initial offering in 2010-11. Many opportunities exist for our students to experience effective teaching methods in physics through employment in the Physics Learning Center and as undergraduate teaching assistants in undergraduate laboratories.

Improve and diversify our laboratory-demonstration facilities:

Learning in the classroom is greatly enhanced with "live experiments". We are working constantly on the design and development of new demonstrations, especially for the introductory physics courses.

Expand funded summer research opportunities for undergraduate students

We are seeking new external funding, such as NSF Research for Undergraduate Experience grants and Michigan Space Consortium grants for undergraduate students. Faculty also encourage and assist majors in the preparation of Michigan Tech’s Summer Undergraduate Research Fellowships (SURF).

Goal 3: Establish world-class research, scholarship, innovation, and creative work that promote sustainable economic and social development in Michigan, the nation, and the world.

3.1 Improve our stature as a research university and PhD granting institution.

Move into the top 10% of US Ph.D.-granting physics departments of similar size and work toward attaining the faculty size and resources commensurate with a top 100 Ph.D. granting physics departments in the US.

Federal research funding for last 3 years of our department are given in Table 1 (See also Appendix 9. Total (average) research expenditures (including internal university funds) total \$3.7 M. Our (average) externally

supported research funding can be compared with number of national universities ranked in the top 100 US schools in Table 2. Table 3 is a comparison with physics departments of similar size (faculty ~ 20). Both tables are below.

Table 1: Physics at Michigan Tech

	2006-07	2007-08	2008-09
External Funding	\$2.3 M	\$1.9 M	\$1.6 M
Publications	72	73	68
Students Graduated			
BS	8	15	22
Masters	4	5	2
PhD	2	12	3

Table 2 :FY 2006 Ranking of Physics Departments

Rank ^a	Name	# of Faculty	# of Grad. Students ^b	# Undergrad Students ^b	Total Funding (06) (dollars)	Total Fed. Funding (06) (dollars)
92	Northern IL University	31	35	-	4,443,000	2,636,000
93	Dartmouth C	16	55	32	4,426,000	2,294,000
94	University of MA Amherst	27	86	19	4,306,000	2,638,000
95	Univ. of C (Riverside)	26	101	-	4,260,000	4,164,000
96	UT Arlington	21	26	-	4,121,000	3,315,000
97	Ohio Univ				4,036,000	2,593,000
98	Oklahoma State University (all campus)	19	58	-	3,872,000	2,076,000
99	MS State University	21	-	-	3,871,000	2,503,000
100	University of Kentucky	28	64	57	3,763,000	2,376,000

(www.nsf.gov/statistics/nsf08300/pdf/tab61.pdf)

^a Rank based on federally-financed R& D expenditures in physics departments

^b Blank space implies information is not available

The NSF/NRC data shows a strong correlation between the ranking of the department and its size. Thus, expanding faculty lines from 18 to 25 and maintaining funding level per faculty will bring us to the top 100 US universities in

terms of externally funded research support. We also need improvement of research laboratories in nanotechnology, laser spectroscopy, magnetic resonance, cloud physics and quantum optics in the department.

Sustain an annual graduation rate of four doctoral students per year. Increase visibility for the department by expanding collaborative research efforts with nationally and internationally ranked research and educational institutions:

Faculty members of the department have ongoing collaborations with research institutions and investigators around the world. These include federally-funded collaborations such as the NSF-funded Materials World Network (Levy). Partner research institutions include Weizmann Institute in Israel (Kostinski), Universidad Nacional Autónoma de México (Kostinski and Shaw), University of Pune (Pati and Pandey), National Physical Laboratory, Delhi (Pandey), Peking University (Yap and Pandey), Universidad de Oviedo, Spain (Pandey), University of Torino, Italy (Perger and Pandey), Leibniz Institute for Tropospheric Research (Shaw), Max Plank Institute for Quantum Optics in Munich Germany (Borysow), a multi-national group of 70 partnering institutions from 17 countries for the Pierre Auger Cosmic Ray Observatory project (Nitz and Fick) and the International Collaboration for Turbulence Research (Shaw). The department intends to strengthen these existing collaborations and expand its network of collaborative research partners at the national and international level.

The department will also continue its investment in the long tradition of hosting weekly physics colloquia for which we invite nationally- and internationally-recognized researchers and academics as guest speakers. Our Society of Physics Students also annually invites nationally acclaimed physicists and/or astronomers to visit campus and speak.

Table 3 : The (PhD granting) physics departments of similar size (faculty ~ 20)

<i>Institution</i>	<i>Faculty</i>	<i>Grad Students</i>	<i>Fed \$</i>	<i>Total \$</i>
Michigan Tech	18	34	\$1,816,375	\$2,573,181
Colorado School of Mines	16	51	\$1,900,000	\$2,500,000
California State University, Northridge	18	35	\$2,047,578	\$2,249,334
University of California, Davis	18	43	\$5,000,000	\$5,000,000
Missouri University of Sci. & Tech.	18	22	\$866,756	\$1,091,890
Montana State University	18	59	\$6,309,097	\$6,309,097
East Carolina University	18	22	\$709,392	\$800,242
University of Texas, Dallas	18	35	\$3,241,220	\$3,311,595
Temple University of the Commonwealth	18	36	\$1,071,170	\$1,321,170
Colorado State University	19	54	\$2,373,000	\$2,373,000
University of Alabama at Birmingham	20	28	\$2,459,322	\$2,997,995
Florida International University	20	31	\$2,281,316	\$2,281,316
Illinois Institute of Technology	20	24	\$1,950,093	\$1,950,093
Northern Illinois University	20	39	\$3,854,000	\$3,854,000
Case Western Reserve University	20	46	\$5,344,305	\$6,705,963
University of North Texas	20	43	\$1,201,523	\$1,940,824
Lehigh University	20	44	\$2,600,000	\$3,000,000
University of Arkansas	21	39	\$11,955,361	\$12,738,474
University of Maryland, Baltimore	21	19	\$8,800,000	\$8,800,000
New Jersey Institute of Technology	21	31	\$6,003,648	\$6,383,811
Texas Tech. University	21	37	\$1,359,958	\$1,379,958
University of Texas at Arlington	21	41	\$3,101,842	\$3,101,842
University of Alabama, Tuscaloosa	22	40	\$1,960,000	\$1,960,000
University of Alabama, Huntsville	22	29	\$1,323,662	\$1,582,564
University of Colorado, Boulder	22	48	\$8,625,244	\$8,625,244
Drexel University	22	39	\$1,800,000	\$1,800,000
University of Maryland (Astronomy)	22	36	\$19,418,093	\$19,418,093
University of Wisc., Milwaukee	22	38	\$3,615,451	\$3,615,451

(Source: 2010 Graduate Programs in Physics – AIP)