



Department of Physics

Office of Undergraduate Studies  
1040K Physics Research Building  
191 West Woodruff Avenue  
Columbus, OH 43210-1117

Phone (614) 292-3885

Fax (614) 292-7557

[www.physics.ohio-state.edu/undergraduate](http://www.physics.ohio-state.edu/undergraduate)

David Andereck  
Senior Associate Dean  
Biological, Mathematical and Physical Sciences  
Professor of Physics  
The Ohio State University  
425 Stillman Hall  
1947 College Road  
Columbus, Ohio 43210

February 17, 2010

Dear David,

The Ohio State University Department of Physics would like to implement a combined Bachelor's degree and Master's degree program in our department. This would allow students to double count upper division coursework, therefore graduating from the University with a Master's degree in physics after an estimated 5 years. We are hoping this program will act as both a recruiting tool and an additional career option for physics undergraduates.

The program has been discussed and approved in both the Physics Department's Undergraduate and Graduate Studies Committees, as well as by the full Physics Faculty.

The following pages provide the details of the program. Also included are sample curriculae, as well as a comparison with our current Masters program in Physics.

Please let us know if you have any questions.

Regards,

A handwritten signature in black ink, appearing to read "Richard E. Hughes".

Richard E. Hughes  
Vice-Chair for Undergraduate Studies  
Department of Physics  
The Ohio State University

A handwritten signature in black ink, appearing to read "Lindsey N. Perry".

Lindsey N. Perry  
Assistant Director of Undergraduate Studies  
Department of Physics  
The Ohio State University

## Proposal for a New Combined BS/MS Program in Physics

### Purpose

There are several high achieving physics undergraduate students who would be eligible for this program. Although we are not expecting more than 2 or 3 students to apply to this program each year, it will be beneficial to those who decide to pursue it. There are several reasons a physics undergraduate would choose to pursue a Master's degree in physics which include:

- To get a better job
- Uncertainty about career plans
- Lack of job opportunities
- Received financial support
- To learn more physics
- To increase starting salary

Figure 1 compares starting salaries between recipients of physics bachelor's degrees and recipients of physics master's degrees. The average starting salary for a person with a master's degree is about \$14,000 more per year than the average starting salary for a person with a physics bachelor's degree.

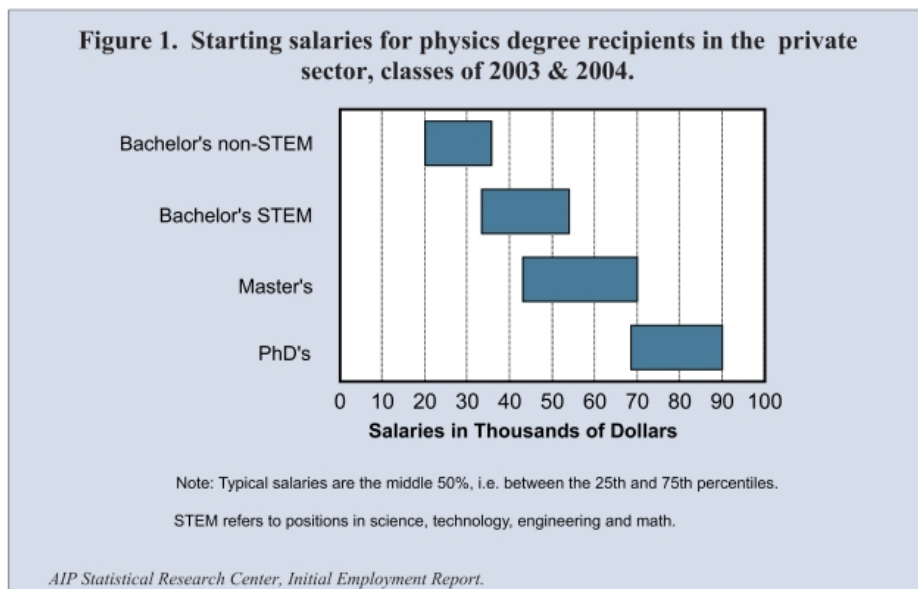


Figure 1: Starting employment for bachelor's and master's degrees in physics

Having a master's degree will also affect the type of job a student will get after graduation. Figure 2 shows the fields that employ recent physics graduates. Physics bachelors who went on to earn physics masters are most commonly employed either in software or in science or lab jobs.

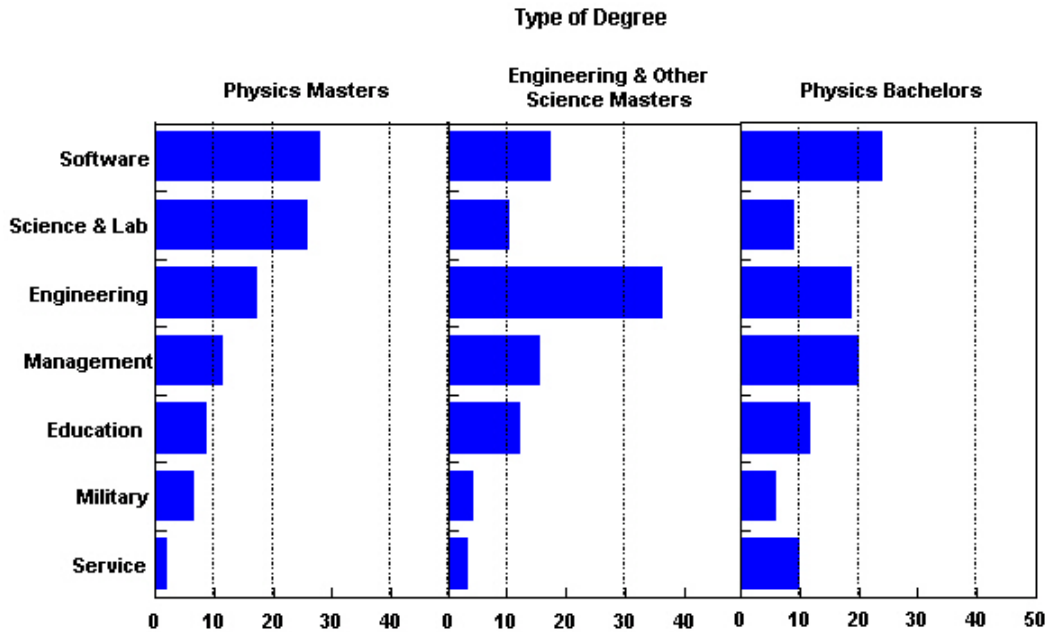


Figure 2: Fields of employment 5 – 8 years after receiving physics degree.

A master's degree in physics will also allow a student to pursue a career more related to their undergraduate and graduate work. Figure 3 shows how important physics related skills are to a student's post-graduation job.

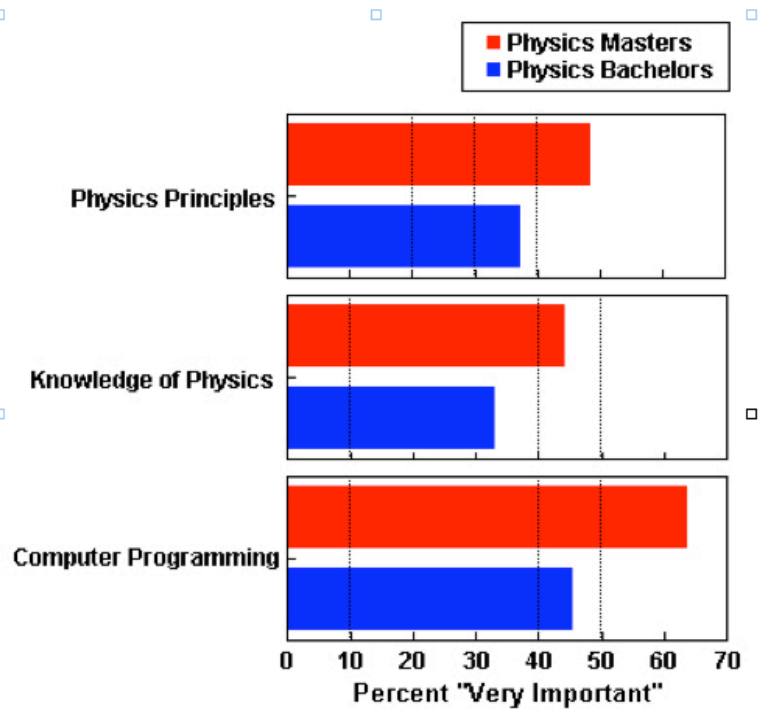


Figure 3: Physics masters use more computer programming and physics on the job than physics bachelors, even when working in the same field of employment for the same amount of time

**Procedure**

The Graduate School has specific requirements for students who wish to enter in dual BS/MS programs at Ohio State. Specifically, upon acceptance into the program, a student applicant must:

- i. Have senior status (135 completed credit hours)
- ii. A Grade Point Average minimum of 3.5

Interested students will be expected to complete both the general GRE (Graduate Record Examination) and the Physics GRE the spring of their junior year. Students will apply to the physics graduate program the summer between their junior and senior year. Several factors will determine whether the student will be accepted. Those factors include: GRE scores, previous research experience, GPA, and statement of purpose. Once the student is admitted to both the physics graduate program and the OSU Graduate School, they will begin taking graduate level courses at the start of their senior year. Although there is some possibility of financial support through teaching assistantships for students in the BS/MS program, traditional graduate stipends from Teaching Assistant positions are not expected to be available. This will be made very clear to students before they apply. Students are also required to submit a letter of recommendation from a Physics faculty member agreeing that the student may work under their supervision in order to complete the research component of the program.

No thesis is required, but the candidate must demonstrate satisfactory competence in individual research work. This individual work shall form a coherent program which will be the subject of a final written report. The requirement that the student demonstrate competence in individual work will normally be fulfilled by the satisfactory completion of 14 quarter hours of Physics 816 (see the Additional Requirements section below). Each BS/MS student must submit a satisfactory written report of the work and pass the Final Oral Examination administered by the student's advisor and a faculty member approved by the Departmental Studies Committee.

**Academic Requirements:** See appendix A for current requirements for master's program in physics.

- A minimum of 50 credit hours of graduate work.
- Methods of Theoretical Physics, Physics 730, or Math 601, 602 for students deficient in mathematical preparation
- Five courses from the following list, including two at the 800 level:
  - 6XX (including: 616 Advanced Lab; 631/2/3 Quantum; 656/7 E&M; 621/2 Thermo; 664 Theoretical Mech; 681/2 Astrophysics/Cosmology)
  - 780.XX (we strongly encourage 780.20: Computational Physics)
  - 821 (Classical Dynamics)
  - 846, 847 (Statistical Mechanics)
  - 827, 828, 829 (Quantum Mechanics)
  - 834, 835, 836 (E&M)
- 14 or more credit hours of Physics 816

- 2 or more graduate level courses in an area approved by the BS/MS program advisors. These could be physics graduate courses or graduate courses in other programs. Example courses include CS&E 621 (Introduction to High-Performance Computing); Stat 610 (Statistical Theory), 632 (Applied Stochastic Processes), 625 (Applied Bayesian Analysis); BUS-MHR 890 (Technology Entrepreneurship & Commercialization); ACCT&MIS 838 (Emerging Technologies & Electronic Commerce); ME 682 (Product Design Fundamentals), and other courses in a variety of graduate minor programs.

**Sample Curricula:**

\*see Appendices B and C for full 5 year sample schedules, and Appendix D for the undergraduate Physics major requirements.

Year 1 of the BS/MS Program:

16 credit hours of coursework; 6 credit hours of research

<u>Autumn</u>	<u>Winter</u>	<u>Spring</u>
Phys 621 (4)	Phys 622 (4)	Phys 664 (4)
Phys 816 (4)	Phys 780.20 (4)	Phys 816 (2)

Year 2 of the BS/MS Program:

Example 1: 21 credit hours of coursework; 8 credit hours of research

<u>Autumn</u>	<u>Winter</u>	<u>Spring</u>
Phys 821 (4)	Phys 816 (4)	Phys 816 (4)
Phys 827 (5)	Phys 828 (5)	780.XX (4)
Phys 834 (4)		

Example 2: 20 credit hours of coursework; 8 credit hours of research

<u>Autumn</u>	<u>Winter</u>	<u>Spring</u>
Phys 821 (4)	Phys 816 (4)	Phys 816 (4)
BUS-MHR 890(4)	ACCT&MIS 838 (4)	Phys 780.xx (4)
Phys 834 (4)		

**Additional Requirements:**

In addition to the courses, a student in this program must demonstrate competence in individual work which will be fulfilled by the satisfactory completion of 14 credit hours of Physics 816 (no less than 3 and no more than 6 credit hours per quarter).

Students registered in this course may (a) do advanced experimental work under the supervision of the student's advisor using special facilities available in the advisor's laboratory, (b) do advanced theoretical work under the supervision of the student's advisor or (c) design, construct, and test a new experiment for use in a class or laboratory setting. This work may be completed under the supervision of a faculty course supervisor.

Finally, the student must submit a satisfactory written report of their research work and pass the Final Oral Examination administered by the student's advisor and a faculty member approved by the Departmental Graduate Studies Committee. The certification to the Graduate School of the successful completion of the requirements shall be made by the student's advisor and the Vice Chair for Graduate Studies and Research.

**Double-counting Courses:**

The courses that will count towards both the undergraduate degree and the graduate degree are any upper level physics course (600 level and above) taken while enrolled in the BS/MS program.

Maximum # of double-counted hours: 20 credit hours

Minimum # of graduate credit hours for the Physics BS/MS program: **50**

**References**

American Institute of Physics Statistics and Research. Retrieved December 18, 2008 from <http://www.aip.org/statistics/>

## Appendix A: Comparison of Current/Proposed Courses for the Physics Masters Program

### Current Academic Requirements for Master's Program in Physics

(Located on page 8 of the Graduate Student Handbook)

M.S. programs are planned on an individual basis by the student and her/his advisor. Each program, however, is expected to reflect competencies represented by the following minimum requirements, including a minimum of 50 credit hours of graduate work.

#### Courses:

Methods of Theoretical Physics P730, or Math 601, 602 for students deficient in mathematical preparation  
Physics 795 (twice)

At least five courses from the following list including two at the 800-level:  
617; 780.XX; 821, 822; 846, 847; 827, 828, 829; 834, 835, 836

GPA: The student must attain a minimum GPA of B (3.00) in these courses.

The student together with her/his advisor will be responsible for the development of a program of course work and research appropriate to her/his background, abilities, and goals. This will include a minimum of 10 credit hours of research (i.e., P999 on Plan A or P816 on Plan B).

The student must submit a satisfactory written report of their research work and pass the Final Oral Examination administered by the student's advisor and a faculty member approved by the Departmental Graduate Studies Committee. The certification to the Graduate School of the successful completion of the requirements shall be made by the student's advisor and the Vice Chair for Graduate Studies and Research.

### Proposed Requirements for the new BS/MS Program

M.S. programs are planned on an individual basis by the student and her/his advisor. Each program, however, is expected to reflect competencies represented by the following minimum requirements, including a minimum of 50 credit hours of graduate work.

#### Courses:

Methods of Theoretical Physics P730, or Math 601, 602 for students deficient in mathematical preparation

At least five courses from the following list including two at the 800-level:

6XX (616, 631/2/3; 656/7; 621/2; 664; 681/2); 780.XX

821; 846, 847; 827, 828, 829; 834, 835, 836

2 or more graduate level courses in an area approved by the BS/MS program advisors

GPA: The student must attain a minimum GPA of B (3.00) in these courses.

The student together with her/his advisor will be responsible for the development of a program of course work and research appropriate to her/his background, abilities, and goals. This will include a minimum of 14 credit hours of research using Physics 816.

The student must submit a satisfactory written report of their research work and pass the Final Oral Examination administered by the student's advisor and a faculty member approved by the Departmental Graduate Studies Committee. The certification to the Graduate School of the successful completion of the requirements shall be made by the student's advisor and the Vice Chair for Graduate Studies and Research.



**Appendix B: Sample Schedule for Combined BS/MS Program in Physics**

5 year schedule for sample 1

Year	Autumn	Winter	Spring
1	Physics 131 Math 151	Physics 132 Math 152	Physics 133 Math 153 CS&E 202
2	Physics 261 Math 254 Physics 295	Physics 262 Math 513	Physics 263 Math 415 Physics 416
3	Physics 555 Physics 631 Math 568	Physics 656 Physics 632	Physics 657 Physics 633 Physics 517
4	Physics 621 Physics 816	Physics 622 Physics 780.20 Physics 816	Physics 664 Physics 816
5	Physics 821 Physics 827 Physics 834	Physics 816 Physics 828	Physics 816 Physics 780.xx

Courses in GREEN are counted only toward the undergraduate degree

Courses in RED are double counted toward the undergraduate and graduate degrees

Courses in BLUE are counted only toward the graduate degree

5 year schedule for sample 2

Year	Autumn	Winter	Spring
1	Physics 131 Math 151	Physics 132 Math 152	Physics 133 Math 153 CS&E 202
2	Physics 261 Math 254 Physics 295	Physics 262 Math 513	Physics 263 Math 415 Physics 416
3	Physics 555 Physics 631 Math 568	Physics 656 Physics 632	Physics 657 Physics 633 Physics 517
4	Physics 621 Physics 816	Physics 622 Physics 780.20 Physics 816	Physics 664 Physics 816
5	Physics 821 BUS-MHR 890 Physics 834	Physics 816 ACCT&MIS 838	Physics 816 Physics 780.xx

### Appendix C: Example Implementation for Combined BS/MS Program in Physics

The sample schedule below includes actual course choices for the GEC component from a student who graduated recently. The placement of the GEC courses into a given quarter is intended to be representative of what this student actually did.

The number of total hours for the undergraduate portion, included Physics Major requirements, prerequisites and GEC is 188, and is completed by Spring of the 4th year.

The total number of hours for the graduate portion is 57.

The total number of hours which count towards both graduate and undergraduate programs is 20.

Year	Autumn	Winter	Spring
1	Physics 131 (5) Math 148 (4) Engl 110 (5)	Physics 132 (5) Math 152 (5) Psych 100 (5)	Physics 133 (5) Math 153 (5) CS&E 202 (4)
2	Physics 261 (4) Math 254 (4) Physics 295 (1) Ling 371 (5)	Physics 262 (4) Math 513 (3) Politsc 101 (5) Antrhop 200 (5)	Physics 263 (4) Math 415 (4) Physics 416 (4) Hist 530 (5)
3	Physics 555 (4) Physics 631 (4) Math 568 (3) Medieval 216 (5)	Physics 656 (4) Physics 632 (4) Geog 200 (5) Germ 101 (5)	Physics 657 (4) Physics 633 (4) Physics 517 (4) Germ 102 (5)
4	Physics 621 (4) Hist 505 (5) Germ 103 (5) Physics 816 (3)	Physics 622 (4) Physics 780.xx (4) Germ 104 (5) Physics 816 (3)	Physics 780.xx (4) Physics 664 (4) Art 350 (5) Physics 816 (3)
5	Physics 821 (4) BUS-MHR 890 (4) Physics 830 (4)	Physics 816 (6) ACCT&MIS 838 (4)	Physics 816 (6) Physics 780.xx (4)
Courses in GREEN are counted only toward the undergraduate degree Courses in RED are double counted toward the undergraduate and graduate degrees Courses in BLUE are counted only toward the graduate degree			

## Appendix D: Current Undergraduate Physics Major Requirements

The B.S. requirements are composed of a core, which all physics students must take, and a set of technical and other electives chosen arranged in six possible options depending on the interests of the student. The requirements listed below are those for Option A, Advanced Physics Track. The total required credit hours for this track is 181.

### Required Courses:

Physics 51 hours: 131-2-3; 261-2-3; 295; 416; 555; 596; 621; 631; 616

Math 27 hours: 151-2-3; 254; 513; 415;

Prerequisite 4 hours: CSE 202

GEC 65 hours: Assumes drop-a-course and double counting of writing requirement.

Additional required Physics 28 hours: Physics 622;632-633;664; 656-657; 517

Additional required Math 3 hours: Math 568

Free Electives: 3 hours

Total hours: 181

The requirements for all other Physics Tracks are located at:

[http://www.physics.ohio-state.edu/undergrad/bs\\_physics.php](http://www.physics.ohio-state.edu/undergrad/bs_physics.php)

**Graduate Council**  
**March 15, 2010**  
**226 University Hall**  
**Meeting Minutes**

**Graduate Council Members Present:**

Ana Azevedo, Enrico Bonello, Mark Bullimore (representing Karla Zadnik), Theresa Early, Ruth Peterson, Jim Phelan (chair), Harald Vaessin, John Sheridan, Danelle Wilbraham (representing Brian Gay)

**Graduate School Staff Present:** Shari Breckenridge, Patrick Osmer, Ann Salimbene, Elliot Slotnick, Tim Watson, Kathleen Wallace, Susan Reeser (recorder)

**A. Approval of Minutes**

- Professor Phelan called the meeting to order and asked for a review of the minutes from the February 15, 2010, Graduate Council meeting. The minutes were approved as submitted.

**B. Business**

**1. University Fellowship competition**

- Elliot reported that 606 Fellowship competition award letters of offer will be sent to prospective students on March 16. 105 fellowship letters awarding college-allocated fellowships will also be sent out. The number of fellowship offers being made is lower this year due to the higher number of acceptances in last year's competitions from college allocations.

**2. Presidential Fellowship Matching Travel Award**

- The Graduate School announced an awards program offering \$250 matching travel funds to graduate programs to offset the cost associated with Presidential Fellows presenting their research at domestic or international conferences during their fellowship tenure. Programs may be reimbursed up to \$250 per Presidential Fellow for documented travel expenses.
- The Department of English questioned whether they needed to match the Graduate School's funds for a student who had already used \$250 on a previous trip. Dean Osmer asked that the issue be addressed at a separate meeting to clarify the rules and process for administering the travel award.

**3. Semester Conversion update**

- Elliot reiterated that the Graduate School Semester Conversion Subcommittee had formed two workgroups. The group chaired by Robert Perry is continuing to review graduate associate issues along with tuition charges to grants, implementation of policies, and the challenges posed by the May Term. Elliot's group has mostly completed the "Nuts and Bolts" review of the rules and regulations, and revising the *Graduate School Handbook*.
- Elliot distributed two documents, a printout of the *Graduate School Handbook* and an annotation of the *Handbook* rules listed by section and number along with the corresponding proposed changes to the rules and policies necessitated by semester conversion.

- Elliot went over each of the rule changes with Council and discussed the reasons behind the changes and answered questions and concerns. The sections that were reviewed were: admission, registration and scheduling, course credit, course marks, and point-hour ratio, masters and doctoral degree programs. Due to time constraints, a continuation of rule/policy changes will be deferred to the next Council meeting.
- Many concerns still exist about the May Term such as number of credit hours allowed and the cost to students. The May Term will be further discussed at the next meeting.

#### **D. Graduate Council Curriculum Committee Reports and Actions**

– Theresa Early, Liaison

##### **1. Proposal to establish a combined Bachelor's degree and Master's degree program in the Department of Physics**

- The proposal was unanimously approved and will be forwarded to the Council on Academic Affairs for further processing.

##### **2. Proposal for the Specialized Masters in Business (SMB) Degree, Marketing Track at an off-campus corporate site**

- Professor Early explained the rationale behind the degree proposal and that the courses were being taught at Nationwide Insurance. Council members had many questions and expressed concern about the proposal and the process by which students were already enrolled in a program that hadn't yet been approved. The proposal was approved with two abstentions. It will be forwarded to the Council on Academic Affairs for further processing.

##### **3. Proposal for the addition of the International Veterinary Public Health Topics BPM 693 course in Veterinary Public Health Specialization**

- The proposal was unanimously approved and will be forwarded to the Council on Academic Affairs for further processing.

##### **4. Proposal to add an optometry course to the Graduate Interdisciplinary Specialization in Global Health**

- The proposal was unanimously approved and will be forwarded to the Council on Academic Affairs for further processing.

**The meeting was adjourned at 5:00 p.m.**