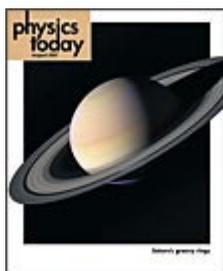


[About AIP](#)
[Publications](#)
[Physics Resources](#)
[Services for Societies](#)

SEARCH AIP



## Physics Resources

[Jobs](#)
[Statistical Research](#)
[Science News](#)
[Public Policy](#)
[History](#)
[Physics Education](#)
[Industrial Outreach](#)

[Current issue](#)

## Programs that Match Every Interest - Master's Degrees in Physics

[Roman Czujko](#) & Megan Henly

April 2005

### Introduction

Variety and flexibility are clearly among the strengths of physics master's degree programs. Over half of physics departments offer at least one master's degree option in a specialized area. Many departments have multiple options offering a general academic program as well as one or more specialized options. Additionally, nearly half of physics departments offer only a traditional academic curriculum that is intended to prepare students for advanced study.

Some physics departments offer what have been called "Professional Master's Degree Programs". These differ from a traditional master's program in terms of both structure and features. Structural differences in programs include the type of physics department and the type of requirements for a master's degree. Whether a program is housed in a department where the highest physics degree is a master's or a PhD may influence the environment. If it is a PhD-granting department, then there is an academically oriented atmosphere by default and this may influence the master's program. In terms of options, some departments have multiple degree tracks that include both academic and employment-oriented degrees. Beyond structural differences, there are also differences in areas of specialization, especially among the employment-oriented programs.

A Professional Master's Program is one that addresses the needs of its students as well as the current needs of the economy by providing both fundamental knowledge and specialized skills. Fundamental knowledge is the foundation upon which students build throughout their working lives. Specialized skills, on the other hand, help advance students' careers immediately by enabling them to transition smoothly into the workplace upon graduation.

The Alfred P. Sloan Foundation supported this study. The original intent of the study was to build on the research published by Norton, Hammer, and Czujko (2001) in the report *Mastering Physics for Non-Academic Careers*. The latter study, which was also supported by the Sloan Foundation, represented the first attempt to distinguish between Academic Master's Degree programs and Professional Master's Degree programs. The study identified a set of features that were commonly part of a Professional Master's Degree, but seldom part of a more general or Academic Master's Degree program in physics.

As occasionally happens, the more one learns about a phenomenon, the more subtle differences emerge. As the current study evolved, it became clear that physics master's programs were not easily categorized. The original classification scheme appeared to be too rigid and did not account for the full variety of programs that were available even in a field as comparatively small as physics.

In this report, we categorize the master's offerings at physics departments in the United States

into five general groups. First, we list those Professional Science Master's programs that are supported by the Alfred P. Sloan Foundation in physics departments. We also describe other strong Professional Master's Programs in physics departments, as well as small and new Professional Master's Programs in physics.

Finally, we identify the accredited programs that offer master's degrees in medical physics. It should be noted that the latter are not offered by physics departments, but rather are typically housed in university medical schools. However, a master's degree is an entry into the medical physics profession and, in fact, half of all Board Certified Medical Physicists in the U.S. have master's degrees.

### Historical Overview of Master's Degrees in Physics

Prior to describing the specific features of Professional Master's Degree Programs in physics, it is important to have an accurate view of the larger system of physics education. In 2003, there were 764 physics degree-granting departments in the U.S (see Table 1). Fewer than 10% of them (N=68) offered a master's as their highest degree.

Over the past decade there has been a great deal of discussion about reinvigorating the master's degree as an educational option of significant potential. Many labor force analysts believe that the master's degree could be an effective way of addressing the needs of an increasingly complex science and engineering workforce. It should be noted that, despite this growing emphasis, the number of master's granting departments in physics has declined steadily for the last 30 years. Compared to today, nearly twice as many (N=129) physics departments offered a master's as their highest degree in 1974.

Table 1. Number of physics departments by highest degree offered, 2003.	
	Number
Bachelor's	511
Master's	68
PhD	185
<b>Total</b>	<b>764</b>

*Source: AIP Statistical Research Center*

Nearly 30% of all physics PhD-granting departments indicate that they have parallel master's and PhD programs, that is, students apply separately to either the PhD or the master's programs. We estimate that more than 50 of the 185 PhD physics programs have a stand-alone master's option. We cannot be more precise since we did not receive responses from 100% of graduate physics departments, although we did hear from more than 80%. Many physics departments have PhD programs where a master's is optional en-route (63%), some require a master's degree en-route (7%), and a couple of PhD physics departments do not award master's degrees under any circumstances (1%).

During 2003, physics PhD programs awarded about 650 master's degrees en-route and about 450 master's degrees to students who left the department. Many of the latter dropped out of the PhD program, while some graduated from the master's program that existed in parallel to the PhD program. We do not have accurate data on the relative split between these two groups among the

program. We do not have accurate data on the relative split between these two groups among the 454 master's degree recipients who left a PhD-granting department. By comparison, the 68 master's-granting departments awarded 218 master's degrees.

Physics departments tend to be small, but those that offer a master's as their highest degree are especially small. On average, they award 3 master's degrees per year. Over the last 5 years, eleven physics departments that awarded a master's as their highest degree averaged less than 1 master's degree per year. Only 9 master's granting physics departments averaged 5 or more master's degrees (see Table 2).

<b>Table 2. Master's-granting physics departments that awarded the largest number of degrees from 1999 through 2003.</b>	
	<b>Master's Degrees 5 Year Totals</b>
San Diego State U (CA)	38
U of MA, Dartmouth	35
U of Louisville (KY)	32
San Francisco State U (CA)	30
Ball State U (OH)	29
U of Akron (OH)	27
U of MA, Boston	27
U of Miami (FL)	26
Christopher Newport U (VA)	26

*Source: AIP Statistical Research Center*

### **Initial Career Choices of Physics Master's**

The career choices made by master's degree recipients immediately after leaving their physics departments fall into three general categories: about one-third transfer to another physics graduate program, about one-eighth enter a graduate program in another field, and more than half enter the workforce (see [Initial Employment Report](#), Mulvey and Langer, 2005). Within these trends, there are differences by citizenship. For example, about half of foreign citizens who leave a physics department with a master's degree transfer to another graduate physics program. By comparison, only about one-fifth of U.S. citizens do so. Similarly, U.S. citizens are significantly more likely than foreign citizens to enter the workforce immediately after earning a physics master's degree.

Physics master's degree recipients find employment throughout the economy. Nearly half are employed in industry, largely doing design, development, research, programming, modeling and simulation, and system administration. About one-sixth of physics master's are employed in colleges and universities, mostly in technical positions in laboratories or Information Technology. About one-eighth of the master's work as high school teachers and the rest are evenly split among civilian government, the active military, and other positions.

### **About the survey**

This study was conducted on-line using a two-stage questionnaire. The goal of the first stage was to identify departments that were within the scope of the study and to screen out those PhD

departments that did not have separate, stand-alone master's degree program. Departments meeting these criteria received the second stage of the questionnaire that asked about specific features of their program as well as information on both current students and recent graduates.

In October 2003, e-mail invitations to complete a web-based questionnaire were sent to the chairs of all departments offering a graduate degree in physics. In January and again in February of 2004, follow-up requests were e-mailed to department chairs who had not responded. Of 253 graduate physics departments, 206 responded by March 2004 for a response rate of 82%.

The issues covered by the questionnaire were based, in part, on the study conducted by Norton et al in 2001. The content of the questionnaire was further refined and focused based on discussions during a one-day conference of selected department chairs convened in Philadelphia in April of 2003. This conference was also supported by the Alfred P. Sloan Foundation. The participants included the chairs from all of the Sloan-supported Professional Science Master's programs in physics, as well as an equal number of chairs of departments that were identified as having strong Professional Master's Degree programs in the report, *Mastering Physics for a Non-Academic Career* (2001).

### **Features of Professional Master's Programs**

To be categorized as a Professional Master's Degree Program a department had to offer an area of specialization that was employment-oriented. In addition, the department also had to meet at least one of the following criteria:

- have an active external advisory committee,
- require coursework outside of the physics department,
- require an internship off-campus, or
- cater to part-time students by admitting them and offering most courses in the evening.

If a graduate program has an advisory committee that meets regularly and that consists, in part, of employed scientists, we feel this indicates a strong link with labor market. An external advisory committee is one way of identifying the needs and opportunities in the market place. It can be used to evaluate the relevance of the curriculum to potential employers. The needs of the scientific workforce change regularly and the committee can help the faculty keep their program up to date. The committee can also meet with students to provide them with general advice about career options and practical advice about specific opportunities.

Course requirements outside of the physics department reflect the need to train students in business, communications, and technical areas not typically taught by physics faculty as a way of preparing for the industrial workforce. Cross-disciplinary or inter-disciplinary coursework is not often required of traditional programs designed to prepare the student for employment in academia. Course requirements outside of physics are an indicator that the program is preparing students for employment rather than further advanced training.

Internships are a good way to incorporate and build on what is learned in the classroom, develop hands-on experiences, and provide an opportunity for students to make contacts with people working in industry. Requiring such training is the hallmark of a professional master's program, as traditional programs rarely do so.

Finally, offering courses at times that are conducive to a working student's 9 to 5 schedule is a good strategy to recruit professional master's students. These students are already employed and are typically looking to sharpen their skills to advance in their non-academic careers.

### **Recruitment, Sustainability and Placement**

Programs can recruit graduate students based on any number of strengths including: the physics department's national or international reputation, curricular options that meet the students' interests, support for students, and information about the career paths commonly pursued by the department's graduates. Physics PhD programs in research universities often have a distinct advantage in terms of reputation and visibility at an international level. However, some master's-granting departments have a strong reputation within the regional work force.

The issue of graduate student support reflects opportunity costs from the student's point of view and the competition for the best students from the department's point of view. Physics bachelor's degree recipients are sought after and, thus, they often have many options. When the U.S. economy is strong, over 80% of physics bachelor's degree recipients who seek employment after their degree find work within the science and engineering enterprise. About half of those who are not employed in the S&E workforce report that the reason was a personal change in interest. Those physics bachelor's who work in science and engineering are rewarded with starting salaries that are \$10,000 higher than those who work in low-tech jobs. In light of the pull of the economy, graduate physics departments find that they must offer financial support to attract the best students.

Of physics bachelor's degree recipients who enter physics PhD programs, virtually all are supported on assistantships (research or teaching) and fellowships through the first 8 years of graduate study. Thus, master's granting programs that are trying to recruit very good students are competing financially against PhD programs that support such students and an economy that rewards them handsomely should the students decide to work rather than pursue an advanced degree.

Sustainability is a critical issue for many reasons. As mentioned earlier, most master's degree programs in physics are small. As will be evident in the program descriptions, very few departments have a Professional Master's Degree Program that graduates 3 or more master's degree recipients per year. Superimposed over these issues is the question of how big does a program need to be in order to be vibrant and sustainable over the long term. There is no agreed upon answer to this question, but it is an especially important issue when discussing a field like physics that is comparatively small and whose master's-granting departments are historically small.

Placement intersects with both sustainability and recruitment. Departments have several reasons to keep track of their graduates, although few actually allocate the resources to do so systematically. Placement information can be a form of self-evaluation. If the program has an excellent record of having its graduates placed in positions that are both financially and intellectually rewarding, then this information reflects well on the relevance of the curriculum.

Placement information can also be used as a powerful recruitment tool. Students use a complex decision matrix when deciding on which graduate program to attend. Many students base their decisions in part on information about the career paths commonly pursued by the graduates of specific programs.

### **Summary of Master's Programs Survey**

There are about 120 physics departments that either award a master's degree as their highest degree or are PhD departments with stand-alone master's programs. The survey results reflect the variety of options that are available in physics master's-granting programs. The 5 features described in Tables 3 through 7 can be viewed as reflecting an employment-oriented focus. No department has all 5 features. Instead, departments focus on the one or more features that best match their strengths, the types of students that the program wants to recruit, and the niche within the science and engineering workforce that the curriculum is designed to address.

Over half of these physics departments offer at least one master's degree option in a specialized area. Many of these departments offer an academic option as well as one or more specialized options. Most of the programs with employment-oriented options require some coursework outside of the physics department. Only 6% of master's programs require an off-campus research experience, but nearly half of departments report that, although not required, such experiences are available.

Department chairs in nearly 40% of master's programs report that the majority of their students plan to go to work and over 60% of the master's degree recipients do join the workforce. Only one in seven master's programs have an External Advisory Committee made up of employed scientists who meet at least once a year. External Advisory Committees are intended primarily to offer advice to departments on curricular options and changes in the demands of the workforce. However, master's programs with such committees tend to offer multiple opportunities for the students to meet and network with the members of the committee.

Some master's programs are designed to address the needs of students who are full-time employed. One fifth of all master's programs have some evening courses and at least 25% of their students are attending part-time. By contrast, about one in six master's programs report that they offer no evening courses and do not allow part-time students.

**Table 3: What is the programmatic emphasis?**

	%
Master's program is described as "general"	48
Master's program has at least one specialized option	15
Master's program is specialized and requires coursework outside physics	37

*Source: AIP Statistical Research Center*

**Table 4: What is the goal of students after graduation?**

	%
Most students plan to go on to earn a PhD	36
Half or more plan to work and about half end up working immediately after graduation	27
Half or more plan to work and most end up working immediately after graduation	37

*Source: AIP Statistical Research Center*

**Table 5: Is off-campus research available?**

	%
Off-campus research is not available	10

Off-campus research is not available	75
Off-campus research is available, but not required for Master's	45
Off-campus research is required	6

*Source: AIP Statistical Research Center*

<b>Table 6: Does advisory committee facilitate bridge-building?</b>	
	%
No advisory committee or advisory committee does not meet with students	86
Advisory committee meets with students; two or fewer networking activities occur	8
Advisory committee meets with students; three or more networking activities occur	6

*Source: AIP Statistical Research Center*

<b>Table 7: Does academic schedule conform with working student's schedule?</b>	
	%
Program has no evening courses and no part-time students	17
Program has at least some evening courses and allows part-time students	63
Program has at least some evening courses and at least 25% of students attend part-time	20

*Source: AIP Statistical Research Center*

### **SLOAN-FUNDED PROFESSIONAL SCIENCE MASTER'S PROGRAMS, 2004**

Over the last several years, the Alfred P. Sloan Foundation has provided grants to institutions in order to develop professional master's programs in the sciences. The goal is to prepare students for a career in industry in technical fields that may either be new as a discipline or may be interdisciplinary. The curriculum typically includes an internship and/or training in the area of business and communications.

Sloan-funded Professional Science Master's programs have all been developed in PhD-granting departments at major research universities. The curriculum at these programs all has several features in common. The programs are cross-disciplinary and students are required to complete a set of specific courses in another department. The programs emphasize the employability of its

students, in part, by providing them with hands-on experiences such as off-campus internships. Each program has an active external advisory committee comprised of employed scientists. Finally, the Professional Science Master's program must be completed within 24 months and departments are discouraged from supporting students during their studies.

To date, 45 institutions now have at least one dedicated professional science master's program separate from any "traditional" academic graduate program. Below are the Sloan programs based in physics. See <http://www.professionalsciencemasters.com/> for more information.

- University of Arizona – Industrial and Applied Physics
- Case Western Reserve University – Physics Entrepreneurship
- Illinois Institute of Technology – Health Physics
- Oregon State University – Applied Physics
- Rice University – Nanoscale Physics
- University of South Carolina – Modeling for Corporate Applications
- University of Southern California – Physics and Business

## Program descriptions

### University of Arizona

The University of Arizona offers a master of science in Industrial and Applied Physics. This program is advertised as a professional master's program for those interested in combining science or science policy with business. The department chair reports that 85% of their 6 graduates over the past two years began working in industry upon completion of the program.

This is a multidisciplinary program, with coursework required in the business department. An internship off-campus is a requirement towards the degree. Students already employed in industry can substitute their work experience towards this requirement. Part-time students are allowed and business courses are typically offered in the evening. However, most of the physics courses are available only during the day. Currently, none of their 7 students are part-time. Most (5 students) do receive some type of financial support from the department, either in the form of research or teaching assistantships with tuition waivers.

### Case Western Reserve University

CWRU has a unique Master's program in Physics Entrepreneurship. This is a new program that just admitted its first students in the fall of 2000. Already it had 8 graduates between 2002 and 2003, 75% of whom went on to careers in industry. Part-time students are permitted and, in fact, 3 of the current 12 master's students do attend classes part-time. Most classes are in the evening, which makes attending part-time possible for the working student. Financial support is available for some full-time students in the form of fellowships. While an off-campus internship is not required, students must complete a thesis and take courses outside of the physics department, including classes in management, as part of the degree requirements.

While their advisory committee has not been active in the last year, they do have one with employed scientists elected to it. They are currently reconstructing this committee to help with the expansion of the program.

### Illinois Institute of Technology

IIT's master of science in Health Physics is designed to be convenient for the working student. It is a part-time program that can be completed in two years. Most courses are available through distance learning and no student thesis is required. Outside coursework is required in math, the humanities, and psychology.

This program had 6 graduates between 2002 and 2003, 100% of whom entered (or continued on)

This program had 6 graduates between 2002 and 2003, 100% of whom entered (or continued on) in the workforce after graduating. Currently, they have 41 students in the program. None receive financial support through the department. Their advisory committee is active and consists, in part, of employed scientists.

#### **Oregon State University**

In addition to a traditional academic physics master's and PhD, Oregon State just began offering a specialized Applied Physics program sponsored by the Sloan Foundation. This professional master's program combines specialized coursework in physics with courses in communication, ethics, and entrepreneurship. In addition, all students complete internships for credit towards the degree. Graduates also must pass an oral examination, but no thesis is required.

Financial aid is typically not available to students entering the professional master's track. Part-time admission is permitted, however, courses are not offered in the evenings. The first cohort of students was admitted in fall 2003, so no information on degree recipients is available. The degree is designed to prepare graduates for the workforce.

#### **Rice University**

While Rice has a strong academic program leading to a PhD in physics, it also offers a professional master's in Nanoscale Physics that requires 9 technical courses as well as courses in management, science policy, entrepreneurship, and writing with an internship and weekly seminars.

The goal of the program is to prepare students for technical positions outside of academia. No financial support through assistantships is available because Rice provides this support only for degrees where a thesis is required.

#### **University of South Carolina**

In addition to offering an academic master's degree and PhD in physics, the Department of Physics & Astronomy at the University of South Carolina now grants a professional master's in Modeling for Corporate Applications.

In addition to physics courses, students are required to take classes that incorporate business, law, and finance in order to prepare students for management positions. A 150-hour internship is also required.

We have no information on the students in the program. However, this degree is specifically designed to prepare students for the high-tech workforce.

#### **University of Southern California**

PhD program

Physics for Business Applications

This program is being re-evaluated.

### **STRONGEST PROFESSIONAL MASTER'S DEGREE PROGRAMS, 2004**

The following are the 13 institutions Professional Master's Degree Programs that were identified as having the strongest Professional Master's Degree Programs in physics. These programs report at least six graduates from their master's programs over a two-year period (academic year 2001-02 and 2002-03). At least two-thirds of these graduates entered the workforce immediately after completing the program. In addition, they have some type of specialized degree that is employment-oriented. Next to each institutions name are the areas of specialization that the physics department offers at the master's degree level. These departments also meet at least one of the following criteria:

of the following criteria.

- have an active external advisory committee,
  - require coursework outside of the physics department,
  - require an internship off-campus, or
  - cater to part-time students by admitting them and offering most courses in the evening.
- 
- Columbia University – Medical Physics, Materials Science
  - University of Arkansas – Microelectronics-Photonics, Physics Education
  - University of Central Oklahoma – Engineering Physics
  - Cleveland State University – Optics, Materials Science
  - Christopher Newport U – Applied Physics, Computer Systems Engineering and Instrumentation
  - Appalachian State University – Applied Physics
  - University of Oregon – Applied Physics
  - Washington State University – Opto-electronics
  - University of Washington, Seattle – Applications of Physics
  - East Carolina University – Medical Physics
  - Rose-Hulman Institute of Technology – Optics
  - Ball State University – Physics Education
  - California State University, Long Beach - Physics

## Program descriptions

### Columbia University

Separate from its physics PhD program, Columbia reports offering master's degrees in Medical Physics and in Materials Science from their physics department. This larger department had 16 grads in 2003, 95% of whom entered the workforce after completing the program. They currently have 51 master's students. Part-time students are permitted and the class schedule accommodates them by offering most classes in the evening. None of the students is supported financially by the department, which may be an indicator that students are both employed and being supported by their employers.

The program does have an advisory committee but it has not met in the last year. Coursework is required outside of the physics department, but an internship is not a requirement for the master's degree.

### University of Arkansas

The University of Arkansas offers a master's in Physics and Applied Physics. These degrees can be terminal, or students can go on to earn a PhD. These degrees have a more traditional academic focus than the other programs mentioned. However, students in this section desiring to find employment after earning a master's rather than staying in academia may find this program useful.

University of Arkansas also offers a master's in physics education as a terminal degree designed to support the students wishing to teach in the high school or junior college environment. By itself, this program would likely qualify as a strong professional master's program. However, our survey did not collect information on this offering.

In addition, the University has a graduate program in Microelectronics-Photonics which is separate from the Physics Department. Here one can receive an interdisciplinary MS or PhD with

coursework in physics, engineering, and business. This program had 19 graduates in the last two years. Eighty percent of these grads found employment after graduation rather than continuing on to a PhD. Currently there are 30 students in the program, most of whom are supported financially through teaching and research assistantships with tuition waivers. This program is not designed for the working student, as part-time applications are not considered and most courses are taught during the day.

The microelectronics-photonics program has an active advisory committee with members from the industrial sector providing input to the program. A thesis is required for the master's degree, but an internship is not.

#### **University of Central Oklahoma**

The highest degree offered by University of Central Oklahoma's physics graduate program is a master's degree. The primary goal of UCO's master's of engineering physics is to prepare students for careers in industry. There are thesis and non-thesis options, but the course requirements are all within the department of physics. Research projects may be incorporated into the curriculum, but none is required. There is no internship or work experience requirement for the degree.

The program does offer admission to students on a part-time basis and offers courses in the evenings to accommodate the working student. In fact, eight of their current 12 students are part-time. Some students are supported by the department through teaching and research assistantships, scholarships, and student employment. Most students (about 80% of their seven graduates from the past two years) go on to work in industry after graduating.

The active advisory committee consists of a diverse group in terms of experience, including industrial scientists.

#### **Cleveland State University**

Cleveland State has an academic physics graduate program with options in optics or materials. The Physics Department also offers a professional master's degree in medical physics. CSU does not offer a PhD. As such, these are both terminal degrees and are generally designed to prepare the student for the workforce. All 7 of its graduates from the last two years found employment after graduation.

Eighty percent of their ten current medical physics students are part-time. Courses are often offered in the evening, which is accommodating of those students who work during the day. Typically about half of students receive financial support in the form of teaching assistantships or through a fellowship for those in the medical physics specialization.

The medical physics program requires a 2-semester practicum at the Cleveland Clinic. No thesis is required, but there is a non-thesis research project. There is no external advisory committee.

#### **Christopher Newport University**

The Department of Physics, Computer Science, & Engineering at CNU has a master's in applied physics and computer science as its highest offering. Here one can specialize in applied physics, computer science, or computer systems engineering and instrumentation. The department touts its proximity to labs and companies involved in applied research in these areas. Master's students have many opportunities to participate in real-world research at some of these locations, although neither an off-campus internship nor a research project is an explicit requirement for the degree. There are both thesis and non-thesis options.

The program had its first graduates just ten years ago. It had 12 graduates in the last two years, all of whom entered the workforce upon graduation. Currently, there are 39 students in the program, the majority (33) of whom attend part-time. Most courses are offered in the evening, which supports this system of part-time attendance. Some master's students receive financial

which supports this system of part-time attendance. Some master's students receive financial assistance in the form of research assistantships.

CNU's advisory committee is active and includes employed and retired industrial scientists, among others. There are no multidisciplinary course requirements outside of the department; rather the focus is on specialized training in physics or computer science.

### **Appalachian State University**

Appalachian State's graduate physics program has both academic and professional offerings. While the Applied Physics master's at Appalachian State may be suitable preparation for a PhD, the main focus of this program is to prepare students for the technical workforce. In fact, all six of their graduates from 2002 to 2003 began working after graduation. As of the 2003-2004 academic year, there were six full-time students and no part-time students. While students are permitted to attend the program on a part-time basis, none of the classes are typically offered in the evening. As such, it is not designed around the working student's schedule.

Most of the students in the program receive financial support through teaching and research assistantships but not with tuition waivers. There are course requirements outside of the physics department depending on the focus of the student's study. The program offers concentrations in applied physics, astronomical instrumentation, computer interfacing, and electronics. Thesis and non-thesis options are available, but there is a research requirement for everyone. There is no internship required and no external advisory committee for this program.

### **University of Oregon**

The University of Oregon offers a PhD in physics. However, Oregon's applied physics master's degree is focused on preparing students for the technical workforce rather than basic research in a PhD program. The internship requirement is an essential part of the program. Applicants must first be accepted into their [Industrial Internship Program](#) before seeking admission to the master's program. In addition to coursework and training in science, the program provides experience in project management--an essential tool for those who plan to work in an industrial setting.

The program had its first cohort of graduates in 2001. Between 2002 and 2003, they graduated 8 masters. Most of these students (at least 90%) found employment after graduation. Currently, there are 3 full-time students. While students are permitted to attend on a part-time basis, none currently do. No courses are scheduled in the evening, which may be a barrier to attending while employed. None of the students receives financial support through the department.

Outside coursework, theses, and research projects are not requirements in this program, as the focus is on applied work within the discipline and through hands-on training. There is currently no advisory committee serving this program.

### **Washington State University**

In addition to traditional thesis and non-thesis master's degrees leading to a PhD, WSU's physics department offers an applied master's degree with concentration in opto-electronics. This specialized program is specifically designed for the high technology workforce and not for theoretical preparation towards a PhD. The goal is to have students work in laboratory teams overseen by faculty members so that they may solve real-world technological problems. This is not an off-campus internship.

Through a combination of lab work and interdisciplinary training in physics and electrical engineering, this program meets its goals of preparing students for employment in industry. In fact, all of the ten graduates over the last two years found work after graduating. Currently, there are ten full-time students in the program, all of whom receive financial support from the department through research and teaching assistantships. The program has no external advisory committee. No thesis or research project is required.

**University of Washington, Seattle**

University of Washington at Seattle has an evening master's program geared towards the working student. This program in applications of physics has graduated 24 master's students in the last two years. Seventy percent of these graduates found or continued employment rather than continuing education toward a PhD.

Currently there are 33 students, only three of whom are not part-time. Because this is an evening program for working students, typically no financial support through the department is provided. There are no course requirements outside of the physics department. An extensive research project is required, but not a traditional thesis. An internship is not explicitly required either, although most students do work while attending the program.

The program does not currently have an external advisory committee.

**East Carolina University**

Formerly an Applied Physics option, the newly named Medical Physics master's at East Carolina University is designed for students who want to enter the workforce after graduating. The program graduated six master's students in the last two years. Of those the chair kept track of, about 75% found employment.

There are currently six master's students in the medical physics option. None of them are part-time, but part-time student status is permissible. However, no courses are held in the evening and most full-time students receive financial support from the department, so attending part-time may be less desirable.

There are options in the program that allow master's students to complete a thesis, research project and/or an internship, but none of these are degree requirements. There are multidisciplinary courses required in the Department of Radiation Oncology. The external advisory committee has not been active in the last year.

**Rose-Hulman Institute of Technology**

Rose-Hulman offers a professional master's degree in optics. Its goal is to prepare students for jobs in industry. The program requires a thesis and comprehensive exam.

**Ball State University**

In addition to an MS and PhD in physics, Ball State has a terminal master's program in Physics Education. This program currently has 16 students, only one of whom attends part-time. No courses are usually held in the evening to accommodate working students. Most students receive financial support through teaching and research assistantships with tuition waivers. Master's candidates have the option of doing a thesis, research projects, or internship, although none of these are required.

The program graduated 16 master's in the last two years. Three-quarters of these graduates went on to work in the field rather than continue on to a PhD. The program does have an active external advisory committee.

**California State University, Long Beach**

Cal State's Physics program is designed for the working students. The majority of its current 33 students attend classes part-time in the evening. About half of students receive financial support from the department through teaching and research assistantships, but with no tuition waivers.

No courses are required outside of the physics department. A thesis or a comprehensive exam is required. Internships are available but not required. There is no external advisory committee for this program.

There were six graduates of this program in the last two years. Two-thirds of them found employment after graduating.

### **SMALL AND NEW PROFESSIONAL MASTER'S DEGREE PROGRAMS, 2004**

These programs have the same features that are indicative of the strong professional master's programs mentioned above. However, these are smaller programs graduating very few students in the last two years. Some of these institutions recently began a professional master's degree program. Other departments in this list are simply small for any number of reasons.

- University of Wisconsin, Oshkosh – Computing & Instrumentation, Physics Education
- University of Alaska, Fairbanks – Computational Physics
- John Carroll University – Applied Physics
- University of New Mexico – Optical Science & Engineering
- University of Alabama, Huntsville – Applied Optics
- Virginia Tech – Applied & Industrial Physics
- University of Memphis – Computational Physics
- Georgetown University – Industrial Leadership in Physics
- Stevens Institute of Technology – Microelectronics & Photonics
- University of Texas, Austin – Applied Physics

### **Program Descriptions**

#### **University of Wisconsin, Oshkosh**

Although it has no PhD offerings, Wisconsin, Oshkosh grants a master's degree that is specifically designed to prepare students for the workforce. Here one can prepare for the technical industrial workforce by specializing in Computing & Instrumentation, or specialize in Physics Education in order to find employment in a secondary school.

While this department did not have any master's graduates in 2002 or 2003, it currently has 8 students. Of its other recent graduates, the department reports that all of them have entered the workforce after completing the program.

Seven of the current eight students are part-time. Because most of the courses are offered in the evening, this schedule is amenable to a working student's hours. Some students do receive financial support from the department in the form of assistantships without tuition waivers. A thesis is required for the master's degree, but no internship or research project is necessary. There are course requirements outside of the physics department for the physics education option. The department does not have an external advisory committee.

#### **University of Alaska, Fairbanks**

In addition to an MS and PhD in physics or space physics, this institution's graduate offerings include a terminal master's degree in computational physics designed to prepare students for the workforce after graduation. There are thesis and non-thesis options.

Because the program is new, the department reported only one graduate from their computational physics option between 2002 and 2003. He found employment after graduating. As of last fall, there were five students enrolled in the program. Although part-time status is permissive, currently all of the students attend full-time. No courses are scheduled in the evening. All students receive financial assistance from the department through tuition waivers and teaching or research assistantships.

While an ongoing research with a faculty member is a component of the program, an off-campus

while on-campus research with a faculty member is a component of the program, an on-campus internship is not required. No course offerings outside of the department are required. The program has no external advisory committee.

**John Carroll University** (link currently not working)

John Carroll's MS in Applied Physics is another example of a strong but small professional master's program. Although there were only 2 master's graduates in the last two years, both of these individuals entered the workforce. The department chair reports that, in its history, about half of students expect to continue their education and half expect to work after completing the program.

Currently there are six students in the program. One of these students attends part-time. Some courses are offered in the evening. Financial support is available to most students in the form of teaching assistantships with tuition waivers. The program has no external advisory committee.

*JCU's program is suspending admitting any new students while the program is being reevaluated.*

**University of New Mexico**

UNM's Department of Physics and Astronomy has traditional academic offerings leading to an MS or PhD in Physics. In 2001, the University of New Mexico introduced a professional master's program in Optical Science & Engineering. Because it is new, it is considered "small" since it has not had an opportunity to grant more than a handful of degrees. In 2002 and 2003, the program had 4 graduates. It appears that the program is becoming a much stronger one with 18 students enrolled as of last fall.

Three-quarters of these graduates entered the workforce after completing the program. Four of the current 18 students attend part-time. Some courses are offered in the evenings, making it possible for students to work off-campus during the semester. Most students receive financial aid through teaching and research assistantships that include tuition waivers.

The course requirements include an inter-disciplinary mix of physics and engineering courses with some chemistry and biology electives available. Students may choose either a thesis or internship option, but must complete one of these projects. No non-thesis research project is required.

This new program has an active external advisory committee that includes employed scientists from industry in addition to faculty members.

**University of Alabama, Huntsville**

In addition to an academic master's and PhD in physics, Alabama, Huntsville offers an applied master's degree in Optics & Photonics Technology. This program does not meet the en route requirements to enter the PhD program. Rather, it is designed to prepare graduates for working in optics. In fact, 90% of their recent graduates found employment immediately after graduating.

The program had only 3 graduates over the past two years, but it is growing and currently has ten students. Half of these students attend part-time. Some courses are offered at night which makes attending part-time feasible for the working student. The department does not offer financial support to students in this program.

In addition to courses in physics, there are requirements in optics and in management & marketing. A thesis and a non-thesis research project are required for the degree, but an off-campus internship is not.

The program does have an advisory committee with employed scientists participating, but it has not been active in the last year.

### Virginia Tech

Virginia Tech's professional master's program prepares students for the workforce through their Applied and Industrial Physics offering. They strongly encourage internships with the one of the many companies located in Virginia. No thesis is required, but an on-campus research project is. There are no multidisciplinary course requirements

In the past two years, VT has only graduated 2 students from this program. Only one of these students joined the industrial workforce after graduation. In general, the program is designed to prepare all students for work in industry. Currently there are six students in the program, two of whom attend part-time. Most courses are not offered in the evening though, which does not encourage full-time employment while in the program. Most students do receive financial support in the form of teaching assistantships with tuition waivers.

The program has an advisory committee consisting of working scientists. However, they have not met in the last year.

### University of Memphis

Memphis' Physics Department currently offers a master's as its highest degree, although they are working to implement a PhD program. For the master's, there is a traditional physics track and plans for one in computational physics. This computational physics program should appeal to students interested in a program designed to prepare them for the workforce. It will incorporate an internship with local industries.

### Georgetown University

Georgetown introduced a master's program in Industrial Leadership in Physics in 2001. They have not had any students enrolled in the program as of fall of 2003

### Stevens Institute of Technology

The microelectronics and photonics master's program began at Stevens Institute of Technology in 2002. They currently have 16 students, but are too new to have graduated any master's at the time of our study. Some students attend the program part-time. Scheduling courses in the evening helps to accommodate this. Some students receive financial support from the department in the form of teaching assistantships with tuition waivers.

Requirements for the degree include coursework in electrical engineering. A thesis, research project, and/or internship are available as degree options, but none are explicitly required. This program has an active advisory committee with working scientists.

### University of Texas, Austin

UT Austin has a small professional master's program in applied physics that compliments its academic option in physics. The applied physics option is designed to prepare students for the workforce. However, it is a small subset of its master's program, as most students are enrolled in the traditional academic option. Only two students graduated from the applied option in the last two years.

## ACCREDITED MEDICAL PHYSICS PROGRAMS, 2004

Accredited Medical Physics programs are located at medical schools rather than physics departments. For this reason, they were not included in our survey of physics department. We list them here to be inclusive, although we have no details on their students.

The following are graduate programs that are currently accredited by the Commission on Accreditation of Medical Physics Educational Programs (CAMPEP). These institutions offer master's degrees in medical physics and many also offer a PhD and a clinical residency. More information can be obtained from [CAMPEP's website](#) or from the website of the [American](#)

### [Association of Medical Physicists](#)

#### **McGill University**

McGill is a Canadian institution located in Montreal. Their Medical Physics Department offers an M.S., PhD along with a clinical residency and a postdoctoral program.

#### **University of Alberta**

U Alberta is located in Edmonton, Canada. They offer an M.Sc. and PhD in Medical Physics.

#### **University of British Columbia**

Located in Vancouver, British Columbia, this institution grants M.Sc. and Ph.D. degrees in Medical Physics from its Physics & Astronomy department.

#### **University of California – Los Angeles**

UCLA's Departments of Radiological Sciences, Radiation Oncology, and Molecular & Medical Pharmacology are jointly associated with the Biomedical Physics Interdepartmental Graduate Program. This program offers M.S. and PhD degrees in Medical Physics as well as postdoctoral fellowships.

#### **University of Florida**

U Florida's Medical Physics graduate degrees are granted by the Department of Nuclear & Radiological Engineering. They offer both a master's and doctorate in the field.

#### **University of Kentucky Medical Center**

The University of Kentucky offers an MS in Medical Physics from its Radiation Sciences Department. They also have a clinical residency program.

#### **University of Texas HSC – Houston**

U Texas has a Graduate School in Biomedical Sciences which houses the Department of Radiation Physics. This school offers both an M.S. and a PhD in Medical Physics. It also has a clinical residency program and postdoctoral fellowships.

#### **University of Texas HSC – San Antonio**

The San Antonio campus of U Texas houses the department of radiology. This school also grants both master's and PhDs in Medical Physics.

#### **University of Wisconsin**

U Wisconsin has a dedicated Medical Physics Department that grants master's and PhDs, provides postdoctoral appointments, and offers clinical residency.

#### **Vanderbilt University School of Medicine**

Vanderbilt's Departments of Radiology and Radiation Oncology together offer an MS degree in Medical Physics.

#### **Wayne State University**

Wayne State's Department of Radiation Oncology offers an MS and PhD in Medical Physics in addition to providing a clinical residency.