SACRAMENTO STATE
Department of Physics and Astronomy

Orientation Handbook

Department of Physics and Astronomy
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Introduction

Physics is the most fundamental science and underlies our understanding of nearly all areas of science and technology. In a broad sense, physics is concerned with the study of energy, space, matter, and the interactions between them. Specific areas of study that physicists pursue include atomic physics, nuclear physics, condensed matter physics, electricity and magnetism, particle physics, optics, thermodynamics, gravitation, relativity, and mechanics.

Astronomy, the search to understand our place in the Universe, motivated the development of modern science. Recent advances in observational technology and space exploration have greatly extended the reach of planetary science, astrophysics, and cosmology, resulting in important fundamental discoveries in these areas. Using the physics toolbox, astronomers probe the origin of the elements, the formation and nature of stars and galaxies, and the 95% of the Universe made up of dark matter and dark energy.

Students who graduate from our programs have the opportunity to experience several tracks of study. Common to these tracks is a solid background in the fundamental laws of physics as well as a strong component of practical skills that are beneficial in a wide range of careers.

All of our full-time faculty members hold PhD degrees in physics or astrophysics. All of our part-time faculty members hold an advanced degree (Masters or PhD) in physics or astronomy. Graduates regularly praise the effectiveness, dedication, and availability of our faculty in our alumni and exit interviews. Our faculty has a long tradition of excellence, winning several Outstanding Teaching, Scholarly Activity, and Service Awards over the years.

Our program is growing. Over the last several years, we've graduated on average about 18 students per year and expect this number to hold steady in the next several years. As such we are well within the top 10% of bachelors-only programs in the country. We have also hired eight new faculty members since 2014 and hope to hire more in the coming few years. About half of our graduates have continued their studies in graduate programs; including alumni who have continued their studies at Berkeley, Harvard, University of California (several campuses), Northern Arizona, University of Alaska, Oregon, Princeton, and others. Our graduates who go on to earn their teaching credentials are being hired immediately by regional high schools – some being offered jobs before their credential is even finalized! Those that go into industry are finding themselves in successful careers in a wide range of places. Some employers you may know are: Intel, Pixar, Google, Facebook, Apple, the United States Air Force, and the State of California's Radiological Health Branch.

Academic Programs

Majors

Bachelor of Science in Physics – The Bachelor of Science (BS) in physics is geared for those who wish to pursue further studies in physics and/or astrophysics. It is a rigorous, broad, and versatile degree.

Bachelor of Science in Physics, Applied Physics Concentration – This concentration within our BS degree prepares graduates for productive careers in industry with a strong physics core coupled with practical skills and elective flexibility. Those interested in advanced study in related field (Material Science, Engineering, etc.) may find value in this program.

Bachelor of Science in Physics, Biophysics Concentration (coming soon!)– This concentration within the BS degree provides a strong background in both physics and biology relevant both for future graduate study, or working in the field of biotechnology.

Bachelor of Arts in Physics – The Bachelor of Arts (BA) in physics is designed to be a flexible, liberal arts degree for those planning on careers in industry, government, or other fields.

Bachelor of Arts in Physics, Teacher Preparation Concentration – This concentration in our BA degree prepares graduates for a career in teaching with additional lower division coursework and classroom experience.

Certificates/Minors

Certificate Program in Scientific Instrument Development – Students earning this certificate will be prepared to design, prototype, and construct instruments for a wide range of scientific applications. Open to all majors.

Certificate Program in Scientific Computing and Simulation – Students earning this certificate will acquire a good grounding in computer-based skills of formulating and solving science and engineering problems. This program will better prepare students for today's industrial and academic careers. Open to all majors.

Minor in Astronomy – A secondary field of study open to all majors, including Physics. With this minor, you'll learn about our universe, galaxies, and the solar system. This minor is also good preparation for graduate studies in astrophysics.

Minor in Physics – A secondary field of study taken most often by Chemistry and Engineering majors, it is not available to Physics majors.

Faculty and Staff

Full-time Faculty Name	Ph.D. Institution	Research Interests	Email @csus.edu	Phone 916-278-xxxx
Rodolfo Barniol Duran Assoc. Professor	University of Texas	Theoretical High Energy Astrophysics	BarniolDuran	5827
Matt Block Assoc. Professor	University of California, Santa Barbara	Theoretical condensed matter, computational methods	Matthew.Block	7237
Jérôme Bürki Professor	University of Fribourg	Nanophysics, theoretical condensed matter, computational tools	Buerki	6540
William DeGraffenreid Professor	University of Maryland	Laser spectroscopy, atomic physics, instrumentation, scientific professionalism	DeGraff	5938
Mikkel Jensen Assoc. Professor	Boston University	Biophysics, soft condensed matter	Mikkel.Jensen	7687
Vera Margoniner Professor	National Observatory of Brazil	Astronomy, physics and science education	Vera.Margoniner	6268
Eliza Morris Assoc. Professor	Harvard University	Biophysics, Environmental Physics	Eliza.Morris	7687
Joshua Moss Assoc. Professor	College of William and Mary	High energy physics	Joshua.Moss	5600
Alexander Pettitt Asst. Professor	University of Exeter	Structure and Evolution of Galaxies	Pettitt	6362
Michael Ray Assoc. Professor	University of Massachusetts, Amherst	Low temperature physics, quantum solids, instrumentation	Ray	6501
Brianna Santangelo Asst. Professor	North Dakota State University	Physics Education Research	Brianna.Santangelo	tba

Full-time Faculty Name	Ph.D. Institution	Research Interests	Email @csus.edu	Phone 916-278-xxxx
Tatiana Sergan Professor	Institute of Physics, Ukrainian Academy of Sciences	Liquid crystalline materials and applications, ordered layers, holography	TSergan	5908
Vassili Sergan Professor	Institute of Physics, Ukrainian Academy of Sciences	Physics of anisotropic fluids, electo-optical devices	VSergan	5908
Gary Shoemaker Professor Emeritus	University of California, Davis	Theoretical physics, medical physics, metamaterials	Shoemaker	5829
Lynn Tashiro Professor Director, Center for Teaching and Learning	Stanford University	Science education	TashiroL	5945
Christopher Taylor Professor, and Department Chair	University of Minnesota	Radio astronomy, galaxy evolution, dwarf galaxies	CTaylor	6480

Staff Name	Title	Email @csus.edu	Phone 916-278-xxxx
Andrew Lozano	Instructional Support Technician II / Stockroom Supervisor	A.Lozano	6138
Heidi Yamazaki	Department Office Manager / Administrative Support Coordinator,	Yamazaki	6518
Claire Shudde	Planetarium Events Coordinator / Academic Support Assistant	Shudde	4586

Student Life

Society of Physics Students

The Department of Physics and Astronomy has an award winning chapter of the Society of Physics Students (SPS). SPS members volunteer in the Physics Tutoring Center, go on field trips, host monthly Physics and Pizza sessions, have social events, and perhaps most importantly, bring coffee and cookies to our colloquia. Members of SPS have access to Sequoia 140, the Electronics and Instrumentation Laboratory, as a place to hang out between classes and study in groups.

Women in Physics and Astronomy

The Department's official student organization to support women Physics majors as they start their careers in science. WiPA holds both informal chats and organizes attendance at professional development workshops, as well as being a vital part of the Department's public outreach efforts. In recognition of this work, WiPA received a grant from the American Physical Society.

Astronomy Club

The Astronomy Club is a student organization on campus open to any student interested in astronomy. The club holds biweekly meetings and organizes astronomy events. The club has recently organized planetarium shows and telescope use training for its members. The club has also organized stargazing opportunities and solar observing for the general public. All are welcome to join the astronomy club.

Advising

Each of our majors is assigned an academic advisor and is required to meet with them prior to registering each semester. This ensures that the students are making good decisions in their class choices and are satisfactorily progressing toward their degree. It also reinforces the "family" atmosphere that we value and promote. Advisors can provide information about summer internships, graduate programs, and career opportunities.

Physics Colloquium Series

The Physics Colloquium Series is one of the longest running programs at Sacramento State. We host approximately ten speakers from around the country and the department each semester. Through this series, students are exposed to timely topics in physics and astronomy, history of physics, career opportunities, and the research activities of fellow students and professors. All physics majors are required to attend at least twenty talks before graduation.

Research

Many of our majors are involved in research during their studies. Students earning the traditional BS in Physics are required to do a Senior Project as part of their degree (it is an option for those in the Applied Physics Concentration). The Senior Project can also be used to satisfy the upper-division elective requirements in the BA degrees. Some students will use a summer internship at a national laboratory or research university to satisfy this requirement, but the majority do their work on campus with a faculty member. Students work closely with faculty members in areas of instrumentation, biophysics, spectroscopy, liquid crystals, low temperature physics, computational physics, physics education research, cosmology, compact stellar remnants, and galaxy evolution.

Tutoring Center / Physics Library

The Department operates the Tutoring Center in Sequoia 238 for students who need help with their studies in lower-division physics. The center is staffed by physics faculty and upper-division physics majors. The tutoring is free. The room also has a broad collection of textbooks at all levels that have been donated to the Society of Physics Students for use by students.

Awards and Scholarships

We are fortunate to be able to offer a number of scholarships to our majors. Most years, we award over $18,000 in scholarship funds to Physics majors. While many of these scholarships are only open to juniors and seniors (such as the Vanderberg Scholarship and Senior Award), others are open to "younger" students (Maxwell Awards, Fenton, Iloff) as well. Juniors and seniors who have demonstrated high achievement in physics may be eligible to be inducted into our chapter of Sigma Pi Sigma, the National Physics Honor Society. The Summer Undergraduate Research Experience (SURE) program, administered by the College of Natural Sciences and Mathematics, provides summer employment for about a dozen students in the college; Physics and Astronomy majors have been well represented in this program. In addition to the college program, the department has created two additional programs for employing students working on research projects, the Partovi Summer Undergraduate Research Experience (P-SURE) and the Wrightson Summer Undergraduate Research Experience (W-SURE). These programs recognize the long contributions of two late physics faculty members, Dr. Hossein Partovi and Dr. Frances Wrightson. These programs are limited to physics majors.

Employment

We occasionally are able to hire students to work as stockroom assistants, learning assistants in introductory classes, astronomy teaching assistants, and Planetarium field trip hosts. Many of these positions are under the federal work-study program; see the Financial Aid office for more details on applying for work-study positions. Check with the Department Office before the start of the semester to see if any positions are available.

Physics Major Checklist

Use the following table to keep track of your graduation requirements within the Department of Physics and Astronomy based the most recent "Catalog Rights." If you have older rights, please see your advisor for the difference between what is below and what you are entitled to. Please see the University Catalog for details about General Education and University graduation requirements. Remember, you are responsible for knowing the policies of the University.

Course Number		2014 – Present[1]			
		BA	BA - TPC	BS[2]	BS[2] - AP
Lower Division	PHYS 11A				
	PHYS 11B				
	PHYS 11C				
	MATH 30				
	MATH 31				
	MATH 32				
	MATH 45				
	CHEM 1A				
	CHEM 1B				
	CHEM 1E[3]				
	ENGR 45[3]				
	CSC 25				
	BIO 1				
	ASTR 4B / 4A				
	GEOL 10				
	GEOL 10L				
	PHYS 30				
Upper Division	PHYS 105 / MATH 105A+B				
	PHYS 106				
	PHYS 110				
	PHYS 115	Choose One			
	PHYS 145				
	PHYS 124				
	PHYS 135				
	PHYS 136				
	PHYS 150				
	PHYS 151				
	PHYS 156				
	PHYS 162				
	PHYS 175				
	PHYS 191				
	116/163/191				Choose One
	UD Electives[4]	8 units		3 units	9 units
Seminar Attendance		Must attend at least 20 seminars			

Notes:

1. The prior catalog period (2008 – 2014) only differed with the requirement of a Senior Project for the BA programs.

2. Students earning a BS degree in Physics are exempted from the University Foreign Language requirement. Both BA programs retain this University graduation requirement.

3. Students in the Applied Physics Concentration that completed CHEM 1A or CHEM 1B prior to declaration/change of major will be allowed to use these courses in lieu of CHEM 1E and ENGR 45, respectively.

4. Eligible courses include most upper-division courses in Physics not specifically required by your degree program in the above table (i.e. 150 for the BA), and others in other departments with the approval of your adviser and Department Chair.

Sample Four-Year Physics Schedules

The following tables should be used as a guide for choosing your courses. It assumes a four year graduation plan and is based on the 2014 catalog rights. Transfer students generally enter between the second and third years. If you are interested in obtaining a minor, are not prepared to take Math 30 at the start of your first year, or must work more than fifteen hours per week, a four year graduation plan is generally not recommended. Most graduates from our program do not graduate in four years due to such circumstances.

General education (GE) courses in areas A and B are listed specifically in the tables. It is advisable to complete them as early as possible, as they serve as prerequisites for many courses. There are a total of nine additional GE requirements in areas C, D, and E. Take them as available; we have no specific suggestions for these classes. English 20 is a university graduation requirement. There is a University Foreign Language requirement for students in our BA programs (FL); please see the Catalog for details on how to satisfy this requirement.

Below, courses in parenthesis are prerequisites. The number in brackets indicates the number of units for the course. This schedule is based on historical offerings; they are subject to change. Check with the Physics and Astronomy Department for the most current schedule.

Bachelor of Science (Traditional)

Year	Fall		Spring	
1	GE B4 - Math 30	[4]	Math 31 (M30)	[4]
	GE A1 - Oral Communications	[3]	GE B1/B3 - Physics 11A (M30)	[4]
	GE B2 - Life Science	[3]	English 20	[3]
	GE A2 - English 1A	[3]	GE A3 - Physics 30 Recommended	[3]
	GE C-E	[3]	GE C-E	[3]
2	Math 32 (M31)	[4]	Math 45 (M31)	[3]
	Physics 11C (M31, P11A)	[4]	Physics 11B (M31, P11C)	[4]
	GE B5 - Chemistry 1A	[5]	Chemistry 1B (C1A)	[5]
	GE C-E	[3]	GE C-E	[3]
3	PHYS 105	[4]	Physics 110 (M45, P105)	[3]
	Physics 106 (M31, P11ABC)	[3]	Physics 124 (M45, P11ABC)	[3]
	Physics 115	[4]	Physics 135 (M45, P11C, P105)	[3]
	GE C-E	[3]	Physics Elective or GE C-E	[3]
	GE C-E	[3]	GE C-E	[3]
4	Physics 136 (P135)	[3]	Physics 151 (P150)	[3]
	Physics 150 (P106, P110)	[3]	Physics 175 (See Catalog)	[2]
	Physics 156 (P110, P124)	[3]	Physics 191 (See Catalog)	[2]
	Physics 191 (See Catalog)	[1]	Physics Elective or GE C-E	[3]
	Physics Elective or GE C-E	[3]	GE C-E	[3]

Bachelor of Arts (Traditional)

Year	Fall		Spring	
1	GE B4 - Math 30	[4]	Math 31 (M30)	[4]
	GE A1 - Oral Communications	[3]	GE B1/B3 - Physics 11A (M30)	[4]
	GE B2 - Life Science	[3]	English 20	[3]
	GE A2 - English 1A	[3]	GE A3 - Physics 30 Recommended	[3]
	GE C-E	[3]	GE C-E	[3]
2	Math 32 (M31)	[4]	Math 45 (M31)	[3]
	Physics 11C (M31, P11A)	[4]	Physics 11B (M31, P11C)	[4]
	GE B5 - Chemistry 1A	[5]	Chemistry 1B (C1A)	[5]
	GE C-E	[3]	GE C-E	[3]
3	PHYS 105	[4]	Physics 110 (M45, P105)	[3]
	Physics 106 (M31, P11ABC)	[3]	Physics 135 (M45, P11C, P105)	[3]
	Physics 115	[4]	Physics Elective	[3]
	GE C-E / FL	[3]	GE C-E / FL	[3]
	GE C-E	[3]	Elective	[3]
4	Physics Elective	[3]	Physics 175 (See Catalog)	[2]
	Physics Elective	[3]	Physics 124 (M45, P11ABC)	[3]
	GE C-E	[3]	Physics Elective	[3]
	Elective	[3]	GE C-E	[3]

The Bachelor of Science degree requires three units of upper-division physics electives, while the Bachelor of Arts requires eight units of upper-division physics electives. The BA program has some free-electives that must be taken to meet the university requirement of 120 units for a degree.

For the BA with the Teacher Preparation Concentration, please schedule an appointment with Prof. Margoniner, the TPC Coordinator, to discuss the additional lower-division requirements and elective opportunities.

For the BS with the Applied Physics Concentration, please see your major advisor for questions about the requirements and elective opportunities.

Keys to Success

Physics is a challenging major that requires not only the ability to understand complex theories, but also to use advanced mathematics, sophisticated instrumentation, and computers. You must also be able to explain the results unambiguously. Our suggested strategies for success are:

Be realistic about time – Being a full-time student is a full-time job. For every hour in class, you should be spending *at least* 2 hours outside of class studying. For a typical fifteen unit load, this means that you should be spending over 30 hours a week studying outside of class. If you must work more than 15 hours a week, select your schedule wisely so that you're not overcommitted.

Take your math seriously – Be aware that the *first* mathematics course that we require is significantly beyond the minimum University GE requirement. Students who struggle through the calculus series are more likely to struggle in their physics courses. Math (calculus and algebra) is the language of physics; you need to know it thoroughly.

Practice, practice, practice – You will never learn to speak a foreign language without speaking it. Physics is no different. To succeed, you must do problems, lots of them – then do some more. Don't take short cuts using solutions manuals. Don't assume that the algebra that follows the first few steps is trivial; grind them out. If problems are too easy, find harder ones! Challenge yourself!

Show up to class – Physics is hard to learn from books alone. Participate in classroom discussions and don't be afraid to ask questions.

Team up – Studying in groups and working out problems together is a great way to reinforce what you're learning, if done right. Just sitting in a group and copying what others say is unproductive. Explaining problems to others strengthens your own understanding of the subject.

Attend the weekly colloquia – See how the theories that you're learning in classes are applied in the "real world." Pay attention to how the talks are given: what makes them effective, what makes them ineffective? Use them to think about research opportunities.

Get comfortable with computers – Learn how to effectively use software packages like Microsoft Word and Excel. Learn how to make productive tables and graphs: these skills will make you stand out in your career, no matter what it is. As you move along further in your studies, use tools like Mathematica and Wolfram Alpha to check your work or solve problems that are impossible with pencil and paper.

No surprises! – While we do our best to keep you informed, ultimately you are responsible for knowing University policies. They can be found in the Catalog: read and understand them. Check your Saclink email (the official email used by the University) frequently for important announcements and updates. By being well-informed, you can avoid issues that may lead to wasted time, extra cost, or unnecessary stress.

Learning Outcomes

Our graduates leave Sacramento State with a broad set of skills that will prepare them for a wide range of career paths, including: graduate school, industry or government jobs, or teaching. Our focus is in preparing students in the following areas:

Physics Content – Graduates acquire a broad understanding of the basic principles of physics and have a firm foundation for acquiring new knowledge and applying it in a variety of situations.

Technical Skills – Our graduates are exposed to a broad range of technical skills. These skills include a wide range of laboratory equipment and techniques, but also advanced computer skills.

Critical Thinking– In the process of going through our curriculum, our students develop outstanding problem solving, critical thinking, and analytical skills highly desired by employers. It is no accident that people with Physics training are found in very diverse careers: engineering, computer programming, law, and finance are areas where "hidden physicists" are found.

Quantitative Reasoning – Our students learn to use higher level math to analyze and solve a variety of real-world problems, both experimental and computational.

Written and Oral Communication – Scientists must be able to share their ideas and work with others in their field, communicating complex theories, large data and research results via written reports, conference presentations and poster sessions.

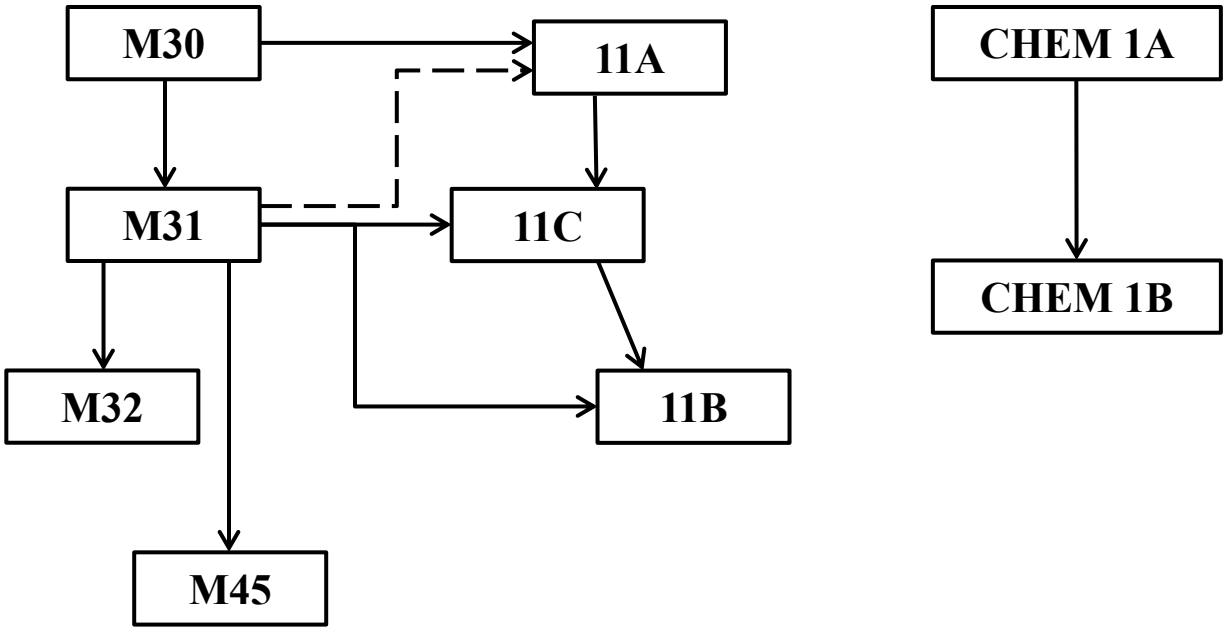
Personal and Social Responsibility – Scientific research can affect the world in many, potentially unforeseen ways. Our students are trained in the highest professional and scientific ethics.

Information Literacy – Cutting edge research draws on information sources from across the globe; our graduates know how to access and evaluate data.

Integrative Learning – Physics majors learn how to apply their physics expertise both in scientific contexts and fields beyond the sciences.

Flowcharts

Lower Division



Upper Division

*At least one of the 11-series classes. See catalog for details.

† Requires 11C only.

‡ Requires 11A only.