Physical Science

(*Co-Directors*)
Professors Colleen Byron, Dean Katahira;
Assistant Professor Leah Simon

The physical science major is an interdisciplinary program designed for students interested in material science, engineering, science teaching, and any other field in which a good background in both physics and chemistry is required. Physical science majors must also take basic courses in mathematics (see requirements below) with MTH 206 recommended. Students interested in material science should consider taking CHM 321.

Requirements for a major in physical science: PHY 171 and PHY 172 (preferred for all and required for anyone planning to use the physical science major as preparation for engineering study) or combinations including PHY 151 and PHY 152 or PHY 171 and PHY 152, or PHY 151 and PHY 172 (with permission of the instructor); PHY 251, and four additional credits in physics chosen from 330, 340, 360, or 412; CHM 111 and 112, 211, 214, and 334; MTH 202 or higher; two credits of seminar (PHY 500 and CHM 501). A senior thesis is required. Students majoring in physical science may not major or minor in chemistry or physics.

Requirements for a teaching major in physical science: all courses for the physical science major listed above including PHY 360, the senior thesis, plus the course *Teaching of Physical Science* (cross listed as PHY 401 and CHM 401) and BIO 120.

Requirements for Broad Field Sciences Teacher Licensure (Grades 6-12/EA-A Licensure): students are required to complete distribution requirements, a minor in educational studies and either the 1) chemistry-biology major plus the following courses; PHY 251, PHY 360, either BIO 219 or BIO 247 (depending on the emphasis in the major), or 2) the physical science major including PHY 360 plus the following courses: BIO 121, BIO 219, BIO 247, either BIO 211 or BIO 216, and both BIO 401 and PHY/CHM 401. Teaching methods coursework (PHY/CHM 401 and BIO 400) is required for licensure but will not count toward the major.

Physics

Associate Professor Sarah J. Desotell (*on leave 2014-15*);
Assistant Professor Leah E. Simon (*Chair*);
Visiting Assistant Professor Derek J. Thuecks

Departmental Mission Statement: Students studying physics interact with, measure, and explain systems in the universe from subatomic particles to galactic clusters. They learn to apply principles of physics to concerns of society.

Communicating Plus - Physics: Students completing a major in physics develop skills in four Communicating Plus areas: problem solving, written communication, oral communication, and critical thinking. These skills develop in all courses required for the major and are refined with experience. Solving problems systematically is a significant component of each physics course and the mathematical sophistication of problem solutions as part of written assignments and laboratory work increases from first-year work to sophomore and junior courses. Students are given opportunities to apply use of numerical methods and computer modeling as well as differential and integral calculus, algebra, and analytic geometry to the solution

of problems. Error analysis is a vital part of laboratory work from the very beginning. By the time students are working in the Modern Physics or other advanced laboratory setting, they are expected to apply their understanding of error analysis to experimental design. Most written communication requires the integration of mathematical expressions, figures, tables, and other graphics into text. Students are expected to practice combining these elements not only in laboratory reports but also in problem solution papers. As students progress from first-year to more advanced courses, their reports increase in length, detail, and mathematical sophistication. More emphasis is placed on derivations as well as on literature searches for background. Critical thinking is central to effective experimental design. Oral communication in beginning courses occurs mostly among peers during group laboratory and problem-solving sessions. Some quizzes make use of group formats to encourage effective exchange of ideas. A poster session during the first-year and Power Point presentations of projects in advanced courses help develop both oral communication and graphics skills. All of these skills are brought to bear on the senior thesis project that involves both written and oral presentations of an individually designed research project that must involve literature searches and project design.

Requirements for a major in physics: PHY 251, 330, 333, 340, two semesters of physics seminar (PHY 500), plus eight additional credits in courses numbered above 200 (excluding 401). Additionally, physics majors must complete MTH 206. Majors must also complete a substantial research project that culminates in a written thesis as well as a seminar presentation. Students majoring in physics may not major in physical science.

****Requirements for a teaching major in physics:** PHY 251, 330, 333, 340, 360, 401; two semesters of physics seminar (PHY 500); plus four additional credits in courses numbered above 200. Teaching majors must also take at least eight credits in another science as well as ENV 120. Teaching majors must complete a substantial research project that culminates in a written thesis as well as a seminar presentation.

Requirements for a minor in physics: PHY 171 and 172 (preferred beginning sequence), but combinations such as PHY 151 and 152 or PHY 171 and PHY 152 or PHY 151 and PHY 172 (with permission of the PHY 172 instructor) are also possible; PHY 251, 500, and at least eight additional credits in physics courses numbered higher than 200 (excluding 401) chosen in consultation with the department chair. Students minoring in physics may not major in physical science.

****Requirements for a teaching minor in physics**: PHY 171 and 172 (preferred beginning sequence), but combinations such as PHY 151 and 152 or PHY 171 and PHY 152 or PHY 151 and PHY 172 (with permission of the PHY 172 instructor) are also possible; 251, 360, 401, 500 and at least four additional credits in physics courses numbered above 200 chosen in consultation with the department chair.

Physics majors and minors usually begin their course of study in their first year with PHY 171 and PHY 172 unless they can demonstrate significant advanced study. Those students intending to use a physics major as a basis for work in engineering are recommended to take at least two semesters of chemistry. Those students preparing to do graduate work in physics are recommended to consider studying at the Swansea University or St. Andrews University during the second semester of their

junior year. MTH 201, 202, and 206 or equivalent background are necessary pre- or corequisite for courses beyond PHY 172 or 152. MTH 224, 303, and 343 are highly recommended for students preparing to do graduate work in physics.

****Note:** students interested in Broad Field Sciences licensure with an emphasis in physics should refer to the information on physical science.

101. Physics: Matters of Matter **Staff**

Four credits.

This course explores the behaviors of solids, liquids, and gases to explain observations in our daily lives through laboratory investigations, demonstrations, current events, and problem solving. Atomic structure, nuclear reactions, and plasmas are also included in this course. This course is intended for non-science majors with little or no prior experience in physics. It does not count toward the physics major or minor.

102. Good Vibrations: Waves and Energy **Staff**

Four credits.

Physics phenomena in our everyday lives are explored in this course, including light, sound, electromagnetism, and motion. The course includes laboratory investigations, demonstrations, current events, and problem solving activities. This course is intended for non-science majors with little or no prior experience in physics. It does not count toward the physics major or minor.

111. Exoplanets: Discovering Alien Worlds **Simon**

Four credits.

Exoplanets are planets orbiting stars other than our Sun. Exoplanet detection techniques, along with the physics of planet formation are investigated in this course. Detection of conditions required for life and comparisons between exoplanets and planetary bodies in our solar system are also explored. Course components include laboratory activities, problem-solving activities, projects, demonstrations and discussion of current events and relevance to everyday lives. This course is intended for non-science majors with little or no prior experience in physics. It does not count toward the physics major or minor.

120. Astronomy **Simon**

Four credits.

This course offers a brief historical development of astronomy and explores the properties of light and light sources, astronomical instrumentation, properties of stars, stellar evolution, galaxies and cosmology. The course includes laboratory introduction to telescopes, optical spectra, and the night sky. Activities include lecture, laboratory, and projects. It does not count toward the physics major or minor.

151. Introductory Physics I **Staff**

Five credits. Offered fall semester yearly.

Algebra and trigonometry based. Mechanics: linear and rotational motion, forces, momentum, work. Lecture, laboratory, and problem-solving sessions. Intended for students with interest in science and/or mathematics but with little or no previous experience with physics.

152. Introductory Physics II **Staff**

Five credits. Offered spring semester yearly.
Algebra and trigonometry based. Thermodynamics, electricity, electromagnetism, and light. Lecture, laboratory, and problem-solving sessions. Intended for students with interest in science and/or mathematics but with little or no previous experience with physics. *Prerequisite: PHY 151 or PHY 171 or permission of the instructor.*

171. General Physics I **Simon**

Five credits. Offered fall semester yearly.
Calculus based. Mechanics: linear and rotational motion, forces, momentum, work. Lecture, laboratory, and problem-solving sessions. Intended for students of physics, pre-engineering, chemistry, and mathematics. *Prerequisite: high school physics or the equivalent. Corequisite: MTH 201.*

172. General Physics II **Simon**

Five credits. Offered spring semester yearly.
Calculus based. Thermodynamics, electricity, electromagnetism, and light. Lecture, laboratory, and problem-solving sessions. Intended for students of physics, pre-engineering, chemistry, and mathematics. *Prerequisites: PHY 151 or 171. Corequisite: MTH 202.*

200. Exploring, Learning and Teaching the Solar System **Staff**

Two credits.
Formation, structure, content, and dynamics of the solar system as discovered and explored from early times until the present. Emphasis on learning through laboratory activities such as those in the NASA Aerospace Educational Services Project (AESP) toolkits. Intended for in-service elementary teachers and Ripon College students seeking EC/MC teaching certification. Laboratory activities, group projects, classroom visits and presentations.

251. Modern Physics **Simon**

Five credits. Offered fall semester yearly.
Historical development of quantum physics. Introduction to quantum mechanics, structure and behavior of atoms, nuclei and solids, special and general relativity, quantum statistics. Applications of modern physics to current technology. Lecture, laboratory, and problem-solving sessions. *Prerequisites: PHY 172, or PHY 152 and MTH 202, or consent of the instructor.*

263. Flight and Floating **Staff**

Two credits
This is an In Focus (formerly Maymester) course, including theoretical and experimental studies of a variety of flight applications. Fundamental principles of buoyancy, lift, drag, and thrust will be applied to understand the flight of airplanes, kites, hot air balloons, rockets, weather balloons, and more. Topics will be covered through hands-on experiments, mathematical modeling, and field trips. The course has no prerequisites, but will contain a significant mathematical component for theory and modeling.

300. Departmental Studies **Staff**

Two to four credits.
Special subjects in physics not covered by regular courses. This course may be repeated for credit when topics change. Please see the pertinent Schedule of Courses for the listing of topics courses. *Prerequisites: PHY 172, or PHY 152 and consent of the instructor.*

310. Aerospace Studies Seminar **Staff**

One credit each semester.
Can be taken more than once for credit. Enrollment for credit limited to students with NASA Wisconsin Space Grant Consortium (WSGC) undergraduate scholarship. Grading is S-U.

330. Advanced Mechanics **Staff**

Four credits. Offered fall 2014 and alternate years.
Topics include kinematics and dynamics of particles and rigid bodies, oscillations, central-force motion, rockets, collisions, Lagrangian mechanics. Lecture, problem-solving sessions, and projects. *Prerequisites: PHY 251 and MTH 202, or consent of the instructor.*

333. Thermodynamics and Statistical Physics **Staff**

Four credits. Offered spring semester.
A study of the interrelationships between temperature, thermal energy, heat, work, and entropy, explored on both macroscopic and microscopic scales. Topics include applications of the laws of thermodynamics to idealized and actual physical systems (paramagnets, power plants, refrigeration), with statistical derivation and applications of entropy. Lecture, problem-solving sessions, and projects. *Prerequisites: PHY 172, or PHY 152 and MTH 201, or consent of the instructor. Corequistite: MTH 202.*

340. Electricity and Magnetism **Simon**

Four credits. Offered spring 2015 and alternate years.
Electrostatics, DC and AC circuits, development and application of Maxwell's equations to systems including wave optics. Lecture, problem-solving sessions, individual and group projects. *Prerequisites: PHY 251 and MTH 202, or consent of the instructor.*

360. Astrophysics **Simon**

Four credits. Offered spring 2015 and alternate years.
This course includes an introduction to astronomical methodology and cosmology. Astronomical techniques, stellar structure and evolution, galactic structure, quasars and cosmology are emphasized. The course explores a laboratory introduction to astronomical observation. *Prerequisite: PHY 251 or consent of the instructor.*

401. The Teaching of Physics **Staff**

Two credits.
Methods of teaching physics in secondary schools. Development of laboratories, lectures, problems, evaluations, demonstrations. Laboratory safety. Required for licensure in physics.

412. Quantum Mechanics **Staff**

Four credits. Offered fall 2015 and alternate years.
Solutions of the Schrodinger Equation for physical systems including atoms and nuclei. Properties of operators, commutation relationships and the Heisenberg Uncertainty Principle. Properties of wave functions. Lecture, problem sessions, and problem-solving projects. *Prerequisites: PHY 251 and MTH 206 or consent of the instructor.*

440. Advanced Laboratory and Computational Physics Problems **Staff**

Four credits. Offered spring 2015 and alternate years.
Laboratory and computational projects to investigate complex physical systems and learn to use new laboratory instruments and data analysis techniques. Experimental design and mathematical modeling. Introduction to numerical methods and application of numerical models to explore problems such as fluid dynamics, stochastic processes, and electronic structure. *Prerequisite: PHY 251 or consent of the department chair.*

500. Senior Seminar **Staff**

One credit each semester. May be taken twice for credit.

Offered on demand for senior physics majors and minors.
Student led demonstrations and problem-solving sessions. Development of senior thesis project, presentations of research results. Grading is S-U.

540. Independent Study **Staff**

Variable credit course, 2-4 credits. Offered on demand.
No more than twelve credit hours of independent study or internship may be taken, and no more than eight credit hours may be in one department. A registration form is required. *Prerequisites: PHY 251, junior or senior standing, consent of the department chair and a department project director, and 12 credits toward the major.*

Politics and Government

Professor Martin F. Farrell;
Associate Professor Lamont C Colucci (*Chair*);
Assistant Professor Henrik M. Schatzinger;
Adjunct Professor Steven R. Sorenson

Departmental Mission Statement: The curriculum in politics and government inducts students into the timeless debates of politics while also insuring that they are conversant with the actual functioning of the political systems of the United States and countries from around the world at all levels, from local to global. Simultaneously, students develop skills in problem solving, critical thinking, and written and oral communication, so that they may be effective, as well as well – informed, citizens. Throughout our curriculum and through associated co–curricular activities, we welcome students of diverse interests by creating an environment conducive to learning by all, regardless of background or beliefs.

Communicating Plus - Politics and Government: Politics and government majors address the four Communicating Plus skills areas - written and oral communication, problem-solving, and critical thinking - throughout the major. Politics is about the search for answers to problems affecting society; thus political science seeks to identify and propose solutions to these problems. In all politics courses, the often volatile and emotional issues of political life are subjected to rigorous rational analysis - that is, critical thinking is applied to the "stuff" of politics. Because political effectiveness depends on the ability to communicate accurately and persuasively, written and oral communication are significant components of most departmental courses. The culmination of the program is a yearlong senior seminar, in which students identify, research, and analyze a contemporary political problem and draft,