

Astronomy

Professors L. Molnar, S. Steenwyk (chair)

Associate Professor D. Haarsma

Students interested in a career in astronomy or astrophysics should major in physics, minor in astronomy, and plan their program with D. Haarsma or L. Molnar. The local and remote telescopes and cameras of the Calvin Observatory are available for student

use through the director of the observatory, L. Molnar.

The physical world core requirement may be met by Astronomy 110, 111, 112, 211, or 212.

ASTRONOMY MINOR

(At least 21 hours)

Physics 133 or approved astronomy in-terim

Physics 134

Physics 246

Astronomy 211

Astronomy 212

Astronomy 384 or 395

Students pursuing a physics major and astronomy minor must follow college guidelines for overlap between a major and a minor; this is facilitated by the option in the physics major of substituting upper-level courses for introductory ones.

COURSES

110 **Planets, Stars, and Galaxies** (4). S. A survey of the major astronomical objects, including planets, stars, and galaxies; a study of their characteristics and their organization into a dynamic, structured universe; an investigation of the processes now occurring in the universe and the methods used to study them; a presentation of the history and development of the universe. The course examines scientific perspectives on the natural world, various relationships between science and culture, the role of Christianity in the development of science, and relationships between Christianity and current scientific findings. Not open to students who have taken, or wish to take, Astronomy 111 or 112. Students who meet the prerequisites of Astronomy 211 or 212 are encouraged to take one of those courses instead. Laboratory. Prerequisites: developing a Christian mind core or sophomore standing.

111 **The Solar System** (4). F. This course is similar to Astronomy 110 in providing an introduction to astronomy from a Christian perspective, but emphasizes the contents of our solar system (ranging from planets and satellites down to meteorites and dust), their interrelatedness, and their development over time. Not open to students who have taken

Astronomy 110, but open to students who have taken or plan to take Astronomy 112. Students who meet the prerequisites of Astronomy 211 or 212 are encouraged to take one of those courses instead. Laboratory. Prerequisites: developing a Christian mind core or sophomore standing.

112 **Stars, Galaxies, and the Universe** (4). F. This course is similar to Astronomy 110 in providing an introduction to astronomy from a Christian perspective, but emphasizes objects beyond our solar system (including stars, black holes, and galaxies), their function and development, and how they fit into the structure and development of the universe as a whole. Not open to students who have taken Astronomy 110, but open to students who have taken or plan to take Astronomy 111. Students who meet the prerequisites of Astronomy 211 or 212 are encouraged to take one of these courses instead. Laboratory. Prerequisites: developing a Christian mind core or sophomore standing. Not offered 2009-2010.

211 **Planetary and Stellar Astronomy** (4). S, alternate years. This course is an introduction to modern astronomy and astrophysics for students with some science and mathematics preparation. The first portion of the course includes a study of the planets and other objects in the solar system, including their physical processes and development and the formation of the solar system as a whole. The second portion of the course emphasizes the physical structure of stars, their origin and development, and their end results (white dwarfs, neutron stars, black holes). Students may take both Astronomy 211 and 212, but one is not a prerequisite for the other. Laboratory. Prerequisites: one course in college calculus (such as Mathematics 132, 161 or 171) and one course in high school or college physics, or permission of the instructor.

212 **Galactic Astronomy and Cosmology** (4). S, alternate years. This course is an introduction to modern astronomy and astrophysics for students with some science and mathematics preparation. The first portion of the course includes a study of our own Galaxy, its structure, its contents (including the interstellar medium and dark matter), and

its formation and development. The second portion of the course covers other galaxies, including their classification, clustering, and development, as well as active galaxies and quasars. The final portion of the course covers physical cosmology, including expansion of the universe, its age and ultimate fate, and the formation of elements. Students may take both Astronomy 211 and 212, but one is not a prerequisite for the other. Laboratory. Prerequisites: one course in college calculus (such as Mathematics 132, 161 or 171) and one course in high school or college physics, or permission of the instructor. Not offered 2009-2010.

384 Modern Observational Astronomy (2). S, alternate years. Students will learn techniques of modern observational astronomy by doing observing projects in each of three wavelength regimes: optical, radio, and one other (e.g., X-ray). Optical observations will use CCD detectors to do multi-color photography, photome-

try, astrometry, and spectroscopy. Radio observations made with the Very Large Array will be used for interferometric imaging. NASA archival data will be used for other wavelengths. Prerequisite: Concurrent registration in or completion of Astronomy 211 or 212.

390 Independent Study. F, I, and S. Independent readings and research in astronomy. Prerequisite: permission of the chair.

395 Astronomy Research, Writing, and Presentation (0-3). F, I, and S. Completion of an approved experimental or theoretical research with presentation of results. The research may be done entirely as part of this course or through another avenue (e.g., summer research with a faculty member). Normally, each student is required to submit a formal, written report and to present results in a department seminar and/or poster presentation. This course may be taken up to three times. Prerequisites: A faculty sponsor and approval of the department.