Astronomy and Astrophysics

Graduate Student Adviser: Kyle M. Cudworth, Yerkes Observatory, 262.245.5555
Student Affairs Assistant: Laticia Rebeles, AAC 122, 702.9808
Departmental Secretary: Stacy Cummings, AAC 118, 702.8203
Web: astro.uchicago.edu/

Astrophysics deals with some of the most majestic themes known to science. Among these are the evolution of the universe from the Big Bang to the present day; the origin and evolution of planets, stars, galaxies, and the elements themselves; the unity of basic physical law; and the connection between the subatomic properties of nature and the observed macroscopic universe.

Three sequences of courses present the study of these topics in different scope and depth:

(1) PHSC 11900-12000 is a two-quarter sequence that satisfies the general education requirements in the physical sciences. It covers the formation and evolution of stars, the galaxy, and the extragalactic universe. NTSC 10100-10200-10300-10400 is a four-quarter sequence that satisfies the general education requirements in physical sciences and biological sciences. NTSC 10200 deals with the evolution of the universe.

(2) For students seeking a more in-depth examination of selected astrophysical topics, astronomy courses numbered in the 18000s are offered, usually to be taken in their second year or later. These courses are intended for students from throughout the College.

(3) For students considering graduate work in astrophysics, the Department of Astronomy and Astrophysics recommends the program leading to a degree of BA in Physics with Specialization in Astrophysics. For details, see the Physics section of this catalog. Tutorial and research courses are available in addition to more informal opportunities for work and study in the Department of Astronomy and Astrophysics. Participation in a weekly seminar on current topics in astrophysical research is also recommended.

Faculty

J. Carlstrom, F. Cattaneo, H.-W. Chen, J. Cronin, K. Cudworth, S. Dodelson, J. Frieman, M. Gladders, N. Gnedin, D. Harper Jr., R. Hildebrand, L. Hobbs, C. Hogan, D. Hooper, W. Hu, S. Kent, A. Khokhlov, E. Kibblewhite, E. Kolb, A. Königl, A. Kravtsov, R. Kron, D. Lamb Jr., S. Meyer, T. Oka, A. Olinto, P. Palmer, P. Privitera, R. Rosner, N. Swerdlow, S. Swordy, J. Truran, M. Turner, P. Vandervoort, D. York

Courses: Astronomy and Astrophysics (ASTR)

18100. The Milky Way. (=PHSC 18100) *PQ: Any two-course 10000-level general education sequence in chemistry, geophysical sciences, physical sciences, or physics.* In

this course, students study what is known about our galaxy, the Milky Way. We discuss its size, shape, composition, location among its neighbors, motion, how it evolves, and where we are located within it, with an emphasis on how we know what we claim to know. *N. Gnedin. Spring. L.*

18200. The Origin and Evolution of the Universe. (=PHSC 18200) *PQ: Any two-course 10000-level general education sequence in chemistry, geophysical sciences, physical sciences, or physics.* This course discusses how the laws of nature allow us to understand the origin, evolution, and large-scale structure of the universe. After a review of the history of cosmology, we see how discoveries in the twentieth century (i.e., the expansion of the universe and the cosmic background radiation) form the basis of the hot Big Bang model. Within the context of the Big Bang, we learn how our universe evolved from the primeval fireball. *A. Olinto. Autumn.*

18300. Searching between the Stars. (=PHSC 18300) *PQ: Any two-course 10000-level general education sequence in chemistry, geophysical sciences, physical sciences, or physics.* With the advent of modern observational techniques (e.g., radio, satellite astronomy), it has become possible to study free atoms, molecules, and dust in the vast space between the stars. The observation of interstellar matter provides information on the physical and chemical conditions of space and on the formation and evolution of stars. *D. Harper. Winter.*

20000. Tutorial in Astronomy and Astrophysics. *PQ: Any 10000-level general education sequence in chemistry, geophysical sciences, physical sciences, or physics. Class limited to six students. Available for either quality grades or for P/F grading.* Students in this tutorial read topics in astronomy and astrophysics under the supervision of a faculty member. Instructors meet with one to three students for approximately two hours each week to discuss readings on topics they choose together. *Summer, Autumn, Winter, Spring.*

22000. Origin and Evolution of the Solar System. (=GEOS 22000) *PQ: Consent of instructor required; knowledge of physical chemistry recommended.* Representative topics include abundance and origin of the elements; formation, condensation, and age of the solar system; meteorites and the historical record of the solar system they preserve; comets and asteroids; the planets and their satellites; temperatures and atmospheres of the planets; and the origin of the Earth's lithosphere, hydrosphere, atmosphere, and biosphere. *L. Grossman. Winter. L.*

23000. Looking for Ourselves Elsewhere: Cosmos and Conscience. (=BPRO 23000, RLST 23603) *PQ: Third- or fourth-year standing.* Science and religion are two ways, among many others, that people can seek to know about reality: how do we construct ordered pictures of the whole—cosmos or civilization—and how do we relate to them in terms of action? How do we know what we do not know, and what does that kind of "knowledge" mean for the orientation and direction of human existence? How would cultural biases be affected by knowing that there are others "out there" in the universe, should we discover them? From various perspectives, this course addresses these questions of the origins, structures, and ends of reality as we look for ourselves—seek understanding of the human condition—in the cosmos but also in complex religious and cultural traditions. Whereas in our popular culture, science is often identified with the realm of knowledge and religion is simply "belief" or "practice," the course also seeks to trace the rational limits of science and the rational force of religion with respect to the ethical problem of the right and good conduct of human life. *W. Schweiker, D. York. Autumn.*

24100. The Physics of Stars and Stellar Systems. *PQ: PHYS 23400 or consent of instructor.* Building upon a student's previous knowledge of physics, this course introduces the astrophysics of stars and stellar systems with an emphasis on the physical nature of stars. Topics include the tools of astronomy, both observational and theoretical Hertzsprung-Russell diagrams, structure and evolution of stars, binary stars, star clusters, and end states of stars (e.g., white dwarfs, neutron stars, black holes). *H.-W. Chen. Autumn. L.*

24200. The Physics of Galaxies and the Universe. *PQ: ASTR 24100 or consent of instructor.* Physical laws are applied in the study of the structures and evolution of galaxies, quasars, clusters of galaxies, and the universe at large. *M. Turner. Winter.*

28200. Current Topics in Astrophysics. *PQ: ASTR 24100 and 24200, or consent of instructor.* This course explores in considerable detail an area of current research interest in astrophysics. The topic varies, but recent examples include the early universe, high-energy astrophysics, magneto-hydrodynamics in astrophysics, and observational cosmology. *D. Harper. Spring.*

29700. Participation in Research. *PQ: Third- or fourth-year standing and consent of instructor and departmental counselor. Students are required to submit the College Reading and Research Course Form. Available for either quality grades or for P/F grading. Students may register for this course for as many quarters as they wish; they need not work with the same faculty member each time.* Students are assigned to work in the research group of a member of the faculty. Participation in research may take the form of independent work on a small project or assistance to an advanced graduate student or faculty member in his or her research. *Summer, Autumn, Winter, Spring.*

Other Courses of Interest

PHSC 11900-12000. Introduction to Astrophysics. *Autumn, Winter, Spring.*

PHYS 29100-29200-29300. Bachelor's Thesis. *PQ: Open to fourth-year students who are majoring in physics with consent of instructor.* This yearlong sequence is designed to involve the student in current research. The student works on a research project in physics or a closely related field, such as astrophysics, leading to the writing of a bachelor's thesis. The project may be one suggested by the instructor, or one proposed by the student and approved by the instructor. *Autumn, Winter, Spring.*

Qualified College students may register for 30000-level courses with consent of instructor. For more courses, visit astro.uchicago.edu.