# ASTRONOMY

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J. Murphy, department head, Ph.D. (Washington)-planetary atmospheres and exploration; K. S. Anderson, Ph.D. (Cal Tech)-extragalactic astronomy and peculiar galaxies; R. F. Beebe, Ph.D. (Indiana-Bloomington)-planetary astronomy and stellar spectra; N. Chanover, Ph.D. (New Mexico State)-planetary astronomy; C. Churchill, Ph.D. (California-Santa Cruz)-specialty galaxies and intergalactic medium; T. Harrison, Ph.D. (Minnesota)- cataclysmic variables and gamma-ray burst sources; J. Holtzman, Ph.D. (California-Santa Cruz)-stellar populations in galaxies and theoretical cosmology; A. Klypin, Ph.D. (Moscow)-cosmology; B. J. McNamara, Ph.D. (California-Santa Cruz)-stellar photometry, star clusters, and gamma-ray astronomy; N. Vogt, Ph.D. (Cornell)-galaxy evolution; R. Walterbos, Ph.D. (Leiden)-interstellar medium, star formation, and structure and evolution of galaxies; W. Webber, Ph.D. (Iowa)-high energy astrophysics

The Department of Astronomy offers graduate work leading to the Doctor of Philosophy and Master of Science degrees. An undergraduate astronomy minor degree is offered as well. To be admitted as a regular student to the NMSU Graduate School as a major in astronomy, a student must present a suitable undergraduate background with emphasis (12-16 credits) on junior-senior level physics, and mathematics through differential equations. The prospective student is also required to take aptitude and physics (or approved specialized field) sections of the Graduate Record Examination.

Information on assistantships and fellowships in teaching and research can be obtained from the department.

Each entering graduate student will be assigned a committee that will guide the student in choice of courses, suggest training needed to remedy deficiencies (possibly to be taken without credit), and determine specific degree requirements in accord with the student's needs and objectives, and in agreement with departmental policies.

In addition to courses and research in astronomy (including 27 traditional course credit hours and 4 seminar-class credit hours), the Ph.D. student is required to take at least 6 credits of graduate-level coursework outside of the Department of Astronomy, beyond any deficiencies. These outside courses are most appropriately taken in the student's research focus area and are historically taken in the Physics, Electrical Engineering, Geology, and Mathematical Sciences departments. Each student must demonstrate no later than during the second year sufficient academic and research ability to qualify for continuation in doctoral studies.

It is possible, through arrangement with the Department of Physics, to obtain a Master of Science degree in physics during progress toward the Ph.D. in astronomy. See the "Department of Physics" section in this catalog for details of that program.

The M.S. degree in astronomy is closely connected with the astronomy Ph.D. program, and questions concerning requirements should be directed to the department.

Qualifying, Comprehensive and Final examinations are described elsewhere in this catalog. Questions concerning styles of the examinations should be directed to the department head.

The department operates three observatories. The first is the Apache Point 3.5-m telescope, which is run by the Astrophysical Research Consortium. The second is a 1-m telescope also at Apache Point, which is solely operated by NMSU and has a wide-field CCD-imaging system. The third observatory at Tortugas Mountain has a 24-inch telescope with a CCD imager for planetary research. The department is also a participant in the Sloan Digital Sky Survey project at Apache Point Observatory. The department is home

to NASA's Planetary Data System's Planetary Atmosphere Node, at which solar system exploration data are archived.

ASTRONOMY

ASTR 461. Astronomy for Teachers, 3 cr.
Methods of presentation and illustration of concepts of astronomy. Identification of interesting celestial objects. Adjustment and use of small telescopes. Prerequisite: ASTR 110 or ASTR 111.

ASTR 500. Seminar, 1 cr.
Organized group study treating selected topics.

ASTR 505. Astronomy and Astrophysics I (f), 3 cr.
Application of physical principles to problems in modern astronomy. Emphasis will be on radiation mechanisms and radiation transfer in astronomical systems. Prerequisite: consent of instructor.

ASTR 506. Astronomy and Astrophysics II (s), 3 cr.
A sequel to ASTR 505 with emphasis on basic dynamics and (magneto) hydrodynamics. Prerequisite: consent of instructor.

ASTR 508. Astronomy for Educators, 3 cr.
Assists K-12 teacher in developing pedagogy and content knowledge in the subject of astronomy. Addresses New Mexico benchmarks and standards.

ASTR 515. Stellar Atmospheres, 3 cr.
Atmospheres of the sun and stars with emphasis on current theoretical models. Prerequisite: consent of instructor.

ASTR 535. Observational Techniques I (f), 3 cr.
Up-to-date introduction to modern observational astronomy in a two-semester sequence. Topics include: introduction to computers, error analysis in data, the different types of optical telescopes, and optical and infrared photometry, image processing, and detectors.

ASTR 536. Observational Techniques in Astronomy II (s), 3 cr.
Sequel to ASTR 535. The second half of the course emphasizes observational techniques in spectroscopy, radio astronomy, and high energy astrophysics. Prerequisite: ASTR 535.

ASTR 545. Stellar Spectroscopy, 3 cr.
Observational spectroscopy including instrumentation, observational techniques, classification, radial velocity methods, properties of stellar atmospheres, and interpretation of aggregate spectra such as galaxies and QSO's.

ASTR 565. Stellar Interiors, 3 cr.
Internal constitutions of stars, computation of stellar models, and stellar evolution. Prerequisite: consent of instructor.

ASTR 598. Special Research Programs, 1-6 cr.
Individual investigations, either analytical or experimental.

ASTR 599. Master's Thesis, 0-88 cr.
Master s level research in astrophysics or observational astronomy.

ASTR 600. Pre-dissertation Research, 1-88 cr.
Research.

ASTR 605. Interstellar Medium, 3 cr.
Problems associated with gas and dust in the galaxy and with diffuse and planetary nebulae.

ASTR 610. Radio Astronomy, 3 cr.
Techniques and observations stressing the operational approach to measurement and how the observations are intimately interwoven throughout modern astrophysics. Prerequisite: consent of instructor.

ASTR 615. Galactic Structure, 3 cr.
The structure, composition and evolution of galaxies with special emphasis on our galaxy. Topics include solar motion, galactic kinematics, the structure of the disk and spheroid, star clusters, chemical evolution, and the classification of galaxies.

ASTR 616. Galaxies, 3 cr.
Structure and evolution of galaxies; galaxy types, dark matter, x-ray gas in ellipticals, interacting and starburst galaxies, active galactic nuclei and quasars, and the physics of radio jets. Prerequisite: consent of instructor.

ASTR 620. Planetary Science I, 3 cr.
Evaluation and analysis of observational data on solar system objects to determine their nature and physical conditions, with emphasis upon atmospheres (composition, structure, thermodynamics, evolution, etc.)

ASTR 621. Planetary Science II, 3 cr.
The physical processes involved in planetary system formation are addressed. Specific foci include molecular cloud collapse, disk processes, and competing theories of planet formation within disks. Additional topics to be discussed may include: the solar wind, planetary magnetic fields, planetary ring processes, and mineralogy.

ASTR 625. Cosmology, 3 cr.
Discussion of our current knowledge of the structure of the universe and current research methods. Topics include the distance scale, clustering of galaxies, large-scale structure, metrics, dark matter, and cosmological probes such as distant quasars, radio galaxies, and gravitational lenses. Prerequisite: consent of instructor.

ASTR 675. Star Formation and Evolution, 3 cr.
The beginning and ending phases of stellar evolution. Topics include star formation and bipolar outflows, the basics of stellar interiors, evolution of close double stars, stellar mass loss, and the end phases of stellar evolution; planetary nebulae, neutron stars and black holes.

ASTR 698. Special Topics., 1-9 cr.

ASTR 700. Doctoral Dissertation, 0-88 cr.
Dissertation.