# ASTRONOMY (ASTR)

## 100 Level Courses

**ASTR 103: Astronomy. 3 credits.**
Introduction to origin of life, Earth, planets and sun, stars, galaxies, quasars, nature of space radiation, and general theory of relativity. Note: ASTR 103 with ASTR 112 or ASTR 114 can be used to fulfill a 4-credit lab science requirement. Not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science Overview (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 111: The Solar System. 3 credits.**
Topics include history of astronomy, evolution of the solar system, properties of planets, scientific method, critical thinking, nature of light, and principles of telescope design. Notes: ASTR 111 and 112 can be used to fulfill a 4-credit lab science requirement; not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science with Lab, Natural Science Overview (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 112: The Solar System Lab. 1 credit.**
Laboratory course associated with ASTR 111. Notes: ASTR 111 and 112 can be used to fulfill a 4-credit lab science requirement; not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science with Lab (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 113: Stars, Galaxies, and the Universe. 3 credits.**
Topics include electromagnetic radiation, stellar evolution, interstellar medium, galaxies, cosmology, scientific method, and critical thinking. Notes: ASTR 113 and 114 can be used to fulfill a 4-credit lab science requirement; not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science with Lab, Natural Science Overview (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 114: Stars, Galaxies, and the Universe Lab. 1 credit.**
Laboratory course associated with ASTR 113. Notes: ASTR 113 and 114 can be used to fulfill a 4-credit lab science requirement; not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science with Lab (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 115: Finding New Worlds. 4 credits.**
Topics include the search for planets outside the solar system, and new developments in the theory of solar system formation with an emphasis on student-led investigation using public data sources. Notes: ASTR 115 can be used to fulfill a 4-credit lab science requirement; not for physics majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Mason Core:** Natural Science with Lab (http://catalog.gmu.edu/mason-core/)

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

**ASTR 124: Introduction to Observational Astronomy. 1 credit.**
Practical introduction to observational astronomy using the campus observatory. Introduces the basic principles of light, telescopes, astrophotography, and image analysis. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

## 200 Level Courses

**ASTR 210: Introduction to Astrophysics. 3 credits.**
Introduction to astrophysics for scientists. Topics include astronomical measurement, celestial mechanics, electromagnetic radiation, stellar structure and evolution, the interstellar medium, galaxies, and a selection of topics at the forefront of astrophysics including space physics, exoplanets, galaxies, and cosmology. Offered by Physics & Astronomy
Astronomy (ASTR)

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300 Level Courses

ASTR 301: Astrobiology. 3 credits.
Physical science perspective on origin and evolution of life on Earth and how life, in turn, has significantly influenced Earth's evolution. Topics include origin of Earth, mechanisms and sites for origin of life, co-evolution of life and Earth's atmosphere, habitability of planets, and the search for extraterrestrial life. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Recommended Prerequisite: MATH 108 or 113.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 302: Foundations of Cosmological Thought. 3 credits.
Examines scientific, historical, and philosophical foundations and development of cosmological thought from antiquity to the present. Emphasizes qualitative understanding of the development of cosmology concluding with the present concept of origin and evolution of universe. Notes: No advanced background in mathematics or natural sciences required. This course does not satisfy elective-category requirements for the physics and astronomy majors. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Recommended Prerequisite: MATH 108 or 113.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 328: Computer Simulation in Astronomy. 3 credits.
Techniques and methods to simulate astronomical phenomena using a computer. Examples taken from a wide variety of astronomical phenomena, including radiation transfer in astrophysical objects, self-gravitating systems, hydrodynamics, and stellar models. Notes: Emphasizes hands-on projects. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

400 Level Courses

ASTR 401: Computer Simulation in Astronomy. 3 credits.
Techniques and methods to simulate astronomical phenomena using a computer. Examples taken from a wide variety of astronomical phenomena, including radiation transfer in astrophysical objects, self-gravitating systems, hydrodynamics, and stellar models. Notes: Emphasizes hands-on projects. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)
ASTR 402: RS: Methods of Observational Astronomy. 4 credits.
An introduction to the observational, statistical, and computational techniques used by observational astronomers. The course covers some of the basic skills needed to pursue a career in astronomy and is designed around preparing for and executing an observational research project. Fulfills writing intensive requirement in the major. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Mason Core: Capstone (http://catalog.gmu.edu/mason-core/)

Specialized Designation: Research/Scholarship Intensive, Writing Intensive in Major

Registration Restrictions:
Required Prerequisites: (PHYS 260C, 260XS or 270C) and (ASTR 124C or 124XS) and (ASTR 210C or 210XS) and ASTR 401C and (ASTR 328C, 328XS, 403C, 420C, 420XS, 480C or 480XS).

May be taken concurrently.
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 403: Planetary Science. 3 credits.
Introduction to the physics and chemistry of planets and their natural satellites, asteroids, and comets. Topics include history of the solar system; origin and evolution of planets, their internal structure and atmospheres; and analytical techniques used in remote and in situ study. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisites: ((ASTR 210C or 210XS) and (PHYS 260C, 260XS or 270C)).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 404: Galaxies and Cosmology. 3 credits.
The structure of the Milky Way as the basis for our knowledge of galaxies; the properties of galaxies from our local neighborhood out to the youngest galaxies in the far distant universe; observational and theoretical approaches to the structure and evolution of galaxies; the basics of cosmology and the formation of structure in the universe. Computational tools introduced in ASTR 328 are developed further. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisites: (ASTR 328C or 328XS).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 405: Honors Thesis in Astronomy I. 3 credits.
Project chosen and completed under the guidance of a faculty member, resulting in a written thesis. An oral progress report is required for ASTR 405. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisite: ASTR 405C.
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Enrollment is limited to students with a major in Astronomy.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 406: Honors Thesis in Astronomy II. 3 credits.

Registration Restrictions:
Required Prerequisite: ASTR 405C.
C Requires minimum grade of C.

Enrollment is limited to students with a major in Astronomy.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 408: Senior Research. 3 credits.
Independent work under guidance of faculty member on research project in experimental, observational, or theoretical astronomy. Notes: Students may not receive more than 6 credits of ASTR 408 and 409. Written report on project required. May be taken twice with department permission. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 6 credits.

Registration Restrictions:
Required Prerequisites: (ASTR 210C or 210XS) and (ASTR 328C or 328XS, 402C, 402XS, PHYS 303C, 303XS, 305C or 305XS).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Research

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)
ASTR 409: Astronomy Internship. 3 credits.
On-the-job experience for astronomy majors in industry or government laboratories, including summer research programs. Students work in observational, experimental, or theoretical astronomy, and prepare written report at end of internship. Notes: See department for other requirements and application procedure prior to enrollment. Students may not receive more than 6 credits of ASTR 408 and 409. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisites: (ASTR 210C or 210XS) and (ASTR 328C, 328XS, 402C, 402XS, PHYS 303C, 303XS, 305C or 305XS).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Internship

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 420: Exoplanets. 3 credits.
Survey of exoplanet science. Topics include techniques for detecting and characterizing exoplanets, including their composition, atmospheres, and demographics. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisites: (ASTR 210C or 210XS).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 480: The Interstellar Medium. 3 credits.
Physical processes in the interstellar medium. Topics include the production and transfer of radiation, ionization and recombinaton, atomic and molecular excitation, dust physics, gas heating and cooling, and star formation. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). Limited to three attempts.

Registration Restrictions:
Required Prerequisites: ((ASTR 210C or 210XS) and (PHYS 260C, 260XS or 270C)).
C Requires minimum grade of C.
XS Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

500 Level Courses

ASTR 532: Phys Interplanetary Med. 3 credits.
Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

Recommended Prerequisite: PHYS 303, 305, 308; MATH 214.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 590: Selected Topics in Astronomy and Astrophysics. 1-6 credits.
Advanced topics from recent theoretical or observational developments and their applications. Satisfies needs of professional community to keep abreast of current developments. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 6 credits.

Specialized Designation: Topic Varies

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

600 Level Courses

ASTR 601: Computer Simulation in Astronomy. 3 credits.
Techniques and methods to simulate astronomical phenomena using a computer. Examples taken from a wide variety of astronomical phenomena, including radiation transfer in astrophysical objects, self-gravitating systems, hydrodynamics, and stellar models. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

Recommended Prerequisite: ASTR 210, PHYS 251

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)
ASTR 602: *Methods of Observational Astronomy.* 4 credits.
An introduction to the observational, statistical, and computational techniques used by observational astronomers. The course covers some of the basic skills needed to pursue a career in astronomy and is designed around preparing for and executing an observational research project. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 603: *Planetary Sciences.* 3 credits.
Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

**Recommended Prerequisite:** ASTR 210, PHYS 260.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 604: *Galaxies and Cosmology.* 3 credits.
The structure of the Milky Way as the basis for our knowledge of galaxies; the properties of galaxies from our local neighborhood out to the youngest galaxies in the far distant universe; observational and theoretical approaches to the structure and evolution of galaxies; the basics of cosmology and the formation of structure in the universe. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

**Recommended Prerequisite:** ASTR 328 and MATH 214.

**Recommended Corequisite:** PHYS 308.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

ASTR 620: *Exoplanets.* 3 credits.
Survey of exoplanet science. Topics include techniques for detecting and characterizing exoplanets, including their composition, atmospheres, and demographics. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 660: *Plasma Physics for Space and Astrophysics.* 3 credits.
Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit. Equivalent to PHYS 660.

**Recommended Prerequisite:** PHYS 305

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 680: *Physics of Interstellar Media.* 3 credits.
Physical processes in the interstellar media. Topics include the production and transfer of radiation, ionization and recombination, atomic and molecular excitation, dust physics, gas heating and cooling, and star formation. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

**Recommended Prerequisite:** PHYS 402 or permission of instructor.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.
700 Level Courses

ASTR 730: Stellar Astrophysics. 3 credits.
Survey of contemporary astrophysics. Topics include physical concepts, stellar spectra, Hertzsprung-Russell diagram, stellar atmospheres, stellar structure, interstellar matter, stellar evolution, high-energy phenomena, hydrodynamical processes in astrophysics, accretion disk formation, and shock formation. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit.

Recommended Prerequisite: MATH 214, PHYS 303, 305, 308.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture
Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 764: Computational Astrophysics. 3 credits.
Covers statistical mechanics concepts important in astrophysics. Presents unified approach to particle acceleration and interaction theory based on analytical and numerical analysis of Boltzmann and Liouville equations. Discusses computational methods relevant to particle transport problems, with emphasis on Fokker-lanck and Monte Carlo solution techniques. Applications from space sciences include studies of cosmic ray acceleration, photon comptonization, particle transport in the near-Earth environment, energy transport in stellar atmospheres, and self-gravitating system dynamics. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May not be repeated for credit. Equivalent to CSI 764.

Recommended Prerequisite: ASTR 530.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture
Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 790: Research Project. 1-6 credits.
Directed reading and research on a specific topic in astronomy, astrophysics, or related field under direction of faculty member. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 12 credits.

Recommended Prerequisite: Admission to masters program and permission of instructor.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Research
Grading:
This course is graded on the Graduate Regular scale. (http://catalog.gmu.edu/policies/academic/grading/)

ASTR 798: Research Project. 3 credits.
Research project chosen and completed under the guidance of a graduate faculty member resulting in an acceptable technical report. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 6 credits.
**900 Level Courses**

**ASTR 998: Doctoral Dissertation Proposal.** 1-12 credits.
Covers development of a research proposal under the guidance of a dissertation director and the doctoral committee. The proposal forms the basis for the doctoral dissertation. Notes: Note: No more than 24 credits in ASTR/PHYS 998 and ASTR/PHYS 999 may be applied toward satisfying doctoral degree requirements in the physics PhD program. Out of the 24, no more than 12 credits of ASTR/PHYS 998 may be applied. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 24 credits.

**Recommended Prerequisite:** Admission to the Physics doctoral program, and permission of advisor.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy.

**Schedule Type:** Dissertation

**ASTR 999: Doctoral Dissertation.** 1-12 credits.
Doctoral research performed under direction of dissertation director. Notes: No more than 24 credits in ASTR/PHYS 998 and ASTR/PHYS 999 may be applied toward satisfying doctoral degree requirements in the physics PhD program. Offered by Physics & Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/). May be repeated within the degree for a maximum 24 credits.

**Recommended Prerequisite:** Admission to doctoral candidacy in Physics PhD program and permission of advisor.

**Registration Restrictions:**
Enrollment limited to Graduate level students.

**Schedule Type:** Dissertation

**Grading:**
This course is graded on the Satisfactory/No Credit scale. (http://catalog.gmu.edu/policies/academicgrading/)}