## Bachelor of Science

# Physics with a Major in Astrophysics (BS)

The Bachelor of Science in physics with a major in astrophysics is designed primarily for students preparing to do graduate study in astrophysics and related fields.

## Requirements

### Lower-Division General Education

| | |
|---|---|
| Written Communication (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#written) | 6 |
| Oral Communication (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#oral) | 3 |
| Mathematics (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#math) | 3 |
| Language and Culture (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#language) | 0-6 |
| Information Literacy and Research (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#information) | 3 |
| Human Behavior (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#behavior) | 3 |
| Human Creativity (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#creativity) | 3 |
| Interpreting the Past (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#interpret) | 3 |
| Literature (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#literature) | 3 |
| Philosophy and Ethics (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#philosophy) | 3 |
| The Nature of Science (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#nature) | 8 |
| Impact of Technology (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#impact) | 3 |

Mathematics: Satisfied by the major

Information Literacy and Research: CS 120G or CS 121G or OEAS 130G

Nature of Science: satisfied by the major

### Upper-Division General Education

- Option A. Approved Disciplinary Minor (a minimum of 12 hours determined by the department), or second degree or second major.
- Option B: Interdisciplinary Minor (specifically 12 hours, 3 of which may be in the major)
- Option C. An approved Certification Program such as teaching licensure
- Option D. Two Upper-Division Courses from outside the College of Sciences and not required by the major (6 hours)

### Requirements for Graduation

All majors for the BS degree in physics require completion of a minimum of 120 credit hours (150 credit hours for the dual degree in physics and electrical engineering and the dual degree in physics and the Master of Business Administration), which must include both a minimum of 30 credit hours overall and 12 credit hours in upper-level courses in the major program from Old Dominion University, completion of ENGL 110C, ENGL 211C or ENGL 231C, and the writing intensive (W) course in the major with a grade of C or better, and Senior Assessment. Additionally, physics majors require completion of the Physics Exit Exam with a minimum score of 20$^{th}$ percentile, and the astrophysics major requires completion of the Astrophysics Exit Exam with a minimum score of 20$^{th}$ percentile. Additional hours may be required to meet the foreign language requirement. All majors require a minimum grade of C in PHYS 261N-PHYS 262N, PHYS 231N-PHYS 232N, or PHYS 226N-PHYS 227N. Except for the secondary physics education major, physics majors require a minimum cumulative grade point average of 2.00 overall and in the major. The secondary physics education major requires a minimum 2.75 grade point average overall, in the major, and in the professional education core, with no grade less than a C- in the major and professional education core. The professional education core satisfies the upper-level general education requirement.

### Math Minor

Astrophysics majors wishing to complete a minor in applied mathematics can do so with just two additional math courses. Please consult the Department of Mathematics section of the Catalog for details.

## Astrophysics Major

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|---|---|---|
| **General Education** | | |
| Complete lower-division requirements | | 30-36 |
| Complete upper-division requirements (minimum of 6 credit hours) | | 6 |
| **Astrophysics** | | |
| MATH 211 | Calculus I | 4 |
| MATH 212 | Calculus II | 4 |
| MATH 312 | Calculus III | 4 |
| or MATH 285 | Transfer Credit for Calculus III | |
| MATH 307 | Ordinary Differential Equations | 3 |
| or MATH 280 | Transfer Credit for Ordinary Differential Equations | |
| Select one of the following: | | 3 |
| MATH 316 | Introductory Linear Algebra | |
| MATH 401 | Partial Differential Equations | |
| MATH 421 | Applied Mathematics II: Mathematical Modeling | |
| MATH 422 | Applied Complex Variables | |
| CHEM 121N & CHEM 122N | Foundations of Chemistry I Lecture and Foundations of Chemistry I Laboratory | 4 |
| CS 151 | Introduction to Programming with Java | 4 |
| or CS 153 | Introduction to Programming with Python | |
| Select one of the following: | | 4 |
| PHYS 103N | Introductory Astronomy of the Solar System | |
| PHYS 104N | Introductory Astronomy of Galaxies and Cosmology | |
| PHYS 120 | Physics in the 21st Century | 1 |
| or PHYS 309 | Physics on the Back of an Envelope | |
| PHYS 261N | Advanced University Physics I | 4 |
| or PHYS 231N | University Physics I | |
| or PHYS 226N | Honors: University Physics I | |
| PHYS 262N | Advanced University Physics II | 4 |
| or PHYS 232N | University Physics II | |
| or PHYS 227N | Honors: University Physics II | |
| PHYS 303 | Intermediate Experimental Physics | 3 |
| PHYS 319 | Analytical Mechanics | 3 |
| PHYS 323 | Modern Physics | 3 |
| PHYS 355 | Mathematical Methods of Physics | 3 |
| PHYS 420 | Introductory Computational Physics | 3 |
| PHYS 425 | Electromagnetism I | 3 |
| PHYS 452 | Introduction to Quantum Mechanics | 3 |
| PHYS 454 | Thermal and Statistical Physics | 3 |
| PHYS 499W | Senior Thesis * | 3 |
| or PHYS 489W & PHYS 490W | Senior Thesis I and Senior Thesis II | |
| ASTP 313 | Elements of Astrophysics | 3 |
| ASTP 414 | Relativity and Cosmology | 3 |

| | | |
|---|---|---|
| Select two of the following: | | 6 |
| PHYS 413 | Methods of Experimental Physics | |
| PHYS 453 | Electromagnetism II | |
| PHYS 456 | Intermediate Quantum Mechanics | |
| ASTP 495 | Special Topics in Astrophysics (Exoplanets / Atmospheric Spectroscopy / Satellite Remote Sensing ) | 3 |
| **Total Credit Hours** | | **117-123** |

* Grade of C or better required in PHYS 499W or both PHYS 489W and PHYS 490W

## Elective Credit

Elective credit may be needed to meet the minimum requirement of 120 credit hours.

# BS Degree with Honors

Qualified students may receive the BS degree with honors (to be noted on their diplomas) by completing specified additional requirements. At the time of application for this designation, a student must have a GPA of 3.50 or higher in physics, a GPA of 3.25 or higher overall, must have completed two contract honors courses, and must have completed 60 credit hours (of which at least 54 must be in grade-point graded courses) at Old Dominion University. (Contract honors courses are specialized courses of individual study under the direct supervision of a professor. Permission to take these courses is granted jointly by the Department of Physics and the Honors College.)

# Degree Program Guide

The Degree Program Guide is a suggested curriculum to complete this degree program in four years. It is just one of several plans that will work and is presented only as broad guidance to students. Each student is strongly encouraged to develop a customized plan in consultation with their academic advisor. Additional information can also be found in Degree Works.

| Course | Title | Credit Hours |
|---|---|---|
| **Freshman** | | |
| **Fall** | | |
| ENGL 110C | English Composition (Grade of C or better required) | 3 |
| MATH 211 | Calculus I | 4 |
| CHEM 121N and CHEM 122N | | 4 |
| Elective or Language & Culture I (May be waived; See requirement details) | | 3 |
| | **Credit Hours** | **14** |
| **Spring** | | |
| MATH 212 | Calculus II | 4 |
| Select one of the following: | | 4 |
| PHYS 261N | Advanced University Physics I | |
| PHYS 231N | University Physics I | |
| PHYS 226N | Honors: University Physics I | |
| PHYS 103N or PHYS 104N | | 4 |
| ELective or Language & Culture II (May be waived; See requirement details) | | 0-3 |
| | **Credit Hours** | **12-15** |
| **Sophomore** | | |
| **Fall** | | |
| ENGL 211C or ENGL 231C (Grade of C or better required) | | 3 |
| MATH 312 or MATH 285 | | 4 |
| Select one of the following: | | 4 |
| PHYS 262N | Advanced University Physics II | |
| PHYS 232N | University Physics II | |
| PHYS 227N | Honors: University Physics II | |
| Select one of the following: | | 3 |
| CS 120G | Introduction to Information Literacy and Research | |
| CS 121G | Introduction to Information Literacy and Research for Scientists | |
| OEAS 130G | Research Skills and Information Literacy for the Natural Sciences | |
| Oral Communication | | 3 |
| | **Credit Hours** | **17** |
| **Spring** | | |
| PHYS 319 | Analytical Mechanics | 3 |
| MATH 307 or MATH 280 | | 3 |
| CS 151<br>or CS 153 | Introduction to Programming with Java<br>or Introduction to Programming with Python | 4 |
| PHYS 120 or PHYS 309 * | | 1 |
| Human Creativity | | 3 |
| Interpreting the Past | | 3 |
| | **Credit Hours** | **17** |
| **Junior** | | |
| **Fall** | | |
| PHYS 355 | Mathematical Methods of Physics | 3 |
| PHYS 303 | Intermediate Experimental Physics | 3 |
| PHYS 323 | Modern Physics | 3 |
| PHYS 425 | Electromagnetism I | 3 |
| Literature | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| ASTP 313 | Elements of Astrophysics * | 3 |
| Select one of the following: | | 3 |
| PHYS 413 | Methods of Experimental Physics | |
| PHYS 453 | Electromagnetism II * | |
| PHYS 456 | Intermediate Quantum Mechanics * | |
| PHYS 499W or PHYS 489W & PHYS 490W (Grade of C or better required) | | 3 |
| Select one of the following: | | 3 |
| MATH 316 | Introductory Linear Algebra | |
| MATH 401 | Partial Differential Equations | |
| MATH 421 | Applied Mathematics II: Mathematical Modeling | |
| MATH 422 | Applied Complex Variables | |
| Human Behavior | | 3 |
| | **Credit Hours** | **15** |

| | | |
|---|---|---|
| **Senior** | | |
| **Fall** | | |
| PHYS 452 | Introduction to Quantum Mechanics | 3 |
| PHYS 420 | Introductory Computational Physics | 3 |
| ASTP 414 | Relativity and Cosmology | 3 |
| Impact of Technology | | 3 |
| Upper-Division General Education Course (Option D) | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| Select one of the following: | | 3 |
| PHYS 413 | Methods of Experimental Physics | |
| PHYS 453 | Electromagnetism II * | |
| PHYS 456 | Intermediate Quantum Mechanics * | |
| PHYS 454 | Thermal and Statistical Physics | 3 |
| Philosophy and Ethics | | 3 |
| ASTP 495 | Special Topics in Astrophysics | 3 |
| Upper-Division General Education Course (Option D) | | 3 |
| | **Credit Hours** | **15** |
| | **Total Credit Hours** | **120-123** |

*PHYS 120 and PHYS 420 are offered fall semester only. ASTP 313, PHYS 309, PHYS 453, and PHYS 456 are offered spring semester only.

# BA or BS to MBA (Master of Business Administration) Linked Program

The linked BA/MBA or BS/MBA program is an early entry to the MBA program of study. The early-entry program is designed for well qualified non-business undergraduate ODU students to start their MBA program prior to completing their undergraduate degree. Well qualified non-business undergraduate students may take MBA-level courses as early as three semesters prior to graduation and count up to 12 graduate credits toward their undergraduate degree. Students participating in the early-entry program must earn a minimum of 150 credit hours (120 discrete credit hours for the undergraduate degree and 30 discrete credit hours for the graduate degree). Early-entry program students should carefully consider their undergraduate degree program requirements when planning their course of study. Students in the early-entry program work in close consultation with the MBA Program Office and should refer to information in the Strome College of Business section in the graduate catalog (http://catalog.odu.edu/graduate/stromecollegeofbusiness/) to develop an individualized plan of study based on the required coursework.

# BA or BS to MPA (Master of Public Administration) Linked Program

The linked BA/MPA or BS/MPA program provides qualified Old Dominion University undergraduate students with the opportunity to earn a master's degree in public administration while taking credits in the MPA program as an undergraduate student. The program is designed for highly motivated students with the desire to immediately continue their education after the bachelor's degree. The program is especially relevant to individuals seeking to work (or currently working) in the public or non-profit sectors, but is suitable for students from any undergraduate major. Graduate courses may be taken during the fall and spring semester of the student's senior undergraduate year. Up to 12 graduate credits can count toward both the undergraduate and graduate degree and can meet upper-level General Education requirements. After receiving the undergraduate degree, a student will continue with the MPA program, taking MPA courses until completing the required 39 credit hours. Students in the linked program must earn a minimum of 150 credit hours (120 discrete credit hours for the undergraduate degree and 30 discrete credit hours for the graduate degree).

Requirements for admission to the graduate program can be found in the School of Public Service section of the Graduate Catalog (http://catalog.odu.edu/graduate/business/public-service/). For additional information, please contact the School of Public Service in the Strome College of Business.