### General Education

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Sciences</td>
<td>4-6</td>
<td>2 or more courses or one 45-credit course w/lab</td>
</tr>
<tr>
<td>Humanities/Literature/Art</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Social Studies</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Communication-A</td>
<td>3-6</td>
<td></td>
</tr>
<tr>
<td>Quantitative Reasoning A</td>
<td>3-6</td>
<td></td>
</tr>
<tr>
<td>Quantitative Reasoning B</td>
<td>3-6</td>
<td></td>
</tr>
<tr>
<td>Ethnic Studies</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### BA/BS Degree Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math BA/BS</td>
<td></td>
<td>Met with Quant A &amp; B</td>
</tr>
<tr>
<td>Math BA</td>
<td></td>
<td>Two 3+ credit courses at I/A level (math comp sci, stat) Limited to one area</td>
</tr>
<tr>
<td>Language BA</td>
<td></td>
<td>4th level of a Foreign Language</td>
</tr>
<tr>
<td>Language BS</td>
<td></td>
<td>3rd level of a Foreign Language</td>
</tr>
<tr>
<td>Humanities</td>
<td>12</td>
<td>Total (L, N, X, Z) (6 of those in literature-1)</td>
</tr>
<tr>
<td>Social Science</td>
<td>12</td>
<td>Total (S, W, Y, Z)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Science BA</td>
<td></td>
<td>12 credits (B, P, N, W, X, Y) One 3+ credit in Biology, One 3+ credit physical science, remaining credits in any science</td>
</tr>
<tr>
<td>Natural Science BS</td>
<td></td>
<td>12 credits (B, P, N, W, X, Y) 6 credits in Biology and 6 credits in Physical Science</td>
</tr>
</tbody>
</table>

### Major Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td></td>
<td>Complete the BS/BA math requirements, but keep in mind Math 221 is a pre-requisite for Physics 201 and 207 and Math 222 is a pre-req for Physics 247</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td>Prior to declaring the major, students must complete 2 of the 3 classes in an Introductory Physics sequence</td>
</tr>
<tr>
<td>14 Credit series</td>
<td></td>
<td>Physics 247, 248 and 249 Recommended, Physics 201(P), 202(P), 205 or Physics 207(P), 208(P), 241 sequences are also available</td>
</tr>
</tbody>
</table>

### Core (34+ credits)

Major requires at least 6 credits in Astronomy and 28 credits in Physics

### Recommended Additional Courses

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td></td>
<td>Mathematics courses other than those required as pre-requisites for physics courses are not required for the major, but the following are recommended MATH 319(N): Ordinary Differential Equations</td>
</tr>
<tr>
<td>Ph D track</td>
<td></td>
<td>MATH 320(N): Linear Mathematics or MATH 340(N): Matrix and Linear Algebra</td>
</tr>
<tr>
<td>Computing</td>
<td></td>
<td>Computers are fundamental to astronomical research. An introduction through COMPSCI 302(N) or short courses run by the computing center should be considered.</td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
<td>A college course in physical or organic chemistry is useful for astronomy students. Physical chemistry is particularly valuable for those interested in the interstellar medium, comets, and planets.</td>
</tr>
<tr>
<td>Statistics</td>
<td></td>
<td>A background in statistics is valuable, particularly for students interested in observational astronomy. STAT 301(N), or 309(N)/310(N) for a more solid foundation, are suggested</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td>French, German, Russian, and especially Spanish are the most useful foreign languages for astronomy students, but not required</td>
</tr>
</tbody>
</table>

### Attribute Guide

<table>
<thead>
<tr>
<th>Letter</th>
<th>Code</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>COMA</td>
<td>Humanities</td>
</tr>
<tr>
<td>B</td>
<td>COMB</td>
<td>Intermediate</td>
</tr>
<tr>
<td>C</td>
<td>QUANT</td>
<td>Quantitative</td>
</tr>
<tr>
<td>D</td>
<td>ETHN</td>
<td>Ethnic Studies</td>
</tr>
<tr>
<td>E</td>
<td>ADV</td>
<td>Advanced</td>
</tr>
<tr>
<td>F</td>
<td>BIO</td>
<td>Biological Studies</td>
</tr>
<tr>
<td>G</td>
<td>LAS</td>
<td>Las Credit</td>
</tr>
<tr>
<td>H</td>
<td>IMM</td>
<td>Intermed or Advanced</td>
</tr>
<tr>
<td>I</td>
<td>ENG</td>
<td>English</td>
</tr>
<tr>
<td>J</td>
<td>HUMA</td>
<td>Humanities or Natural Science</td>
</tr>
<tr>
<td>K</td>
<td>PHYS</td>
<td>Physical Science</td>
</tr>
<tr>
<td>L</td>
<td>LIT</td>
<td>Literature</td>
</tr>
<tr>
<td>M</td>
<td>NAT</td>
<td>Natural Science</td>
</tr>
<tr>
<td>N</td>
<td>STAT</td>
<td>Statistics</td>
</tr>
<tr>
<td>O</td>
<td>BIOL</td>
<td>Biological or Social Science</td>
</tr>
<tr>
<td>P</td>
<td>HUMS</td>
<td>Humanities or Social Science</td>
</tr>
<tr>
<td>Q</td>
<td>SCIE</td>
<td>Science</td>
</tr>
<tr>
<td>R</td>
<td>BIO</td>
<td>Biology</td>
</tr>
<tr>
<td>S</td>
<td>SOC</td>
<td>Social Science</td>
</tr>
<tr>
<td>T</td>
<td>LAS</td>
<td>Las Credit</td>
</tr>
<tr>
<td>U</td>
<td>IMM</td>
<td>Intermed or Advanced</td>
</tr>
<tr>
<td>V</td>
<td>ENG</td>
<td>English</td>
</tr>
<tr>
<td>W</td>
<td>HUMA</td>
<td>Humanities or Natural Science</td>
</tr>
<tr>
<td>X</td>
<td>PHYS</td>
<td>Physical Science</td>
</tr>
<tr>
<td>Y</td>
<td>LIT</td>
<td>Literature</td>
</tr>
<tr>
<td>Z</td>
<td>HUMS</td>
<td>Humanities or Social Science</td>
</tr>
</tbody>
</table>
### Astronomy and Physics Courses

#### Courses in Astronomy

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Attribute</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTRON 103</td>
<td>Survey of Astronomy</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. Open to all Undergrads. Stiffs may not receive or both Astron 100 &amp; either Astron 103 or 104. Not open to stiffs who meet prereq for Astron 200</td>
</tr>
<tr>
<td>ASTRON 107</td>
<td>The Evolving Universe</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. Open to all Undergrads. Stiffs may not receive or both Astron 100 &amp; 103. Not open to stiffs who meet prereq for Astron 200</td>
</tr>
<tr>
<td>ASTRON 104</td>
<td>Exploration of Solar System</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. Open to all Undergrads. Stiffs may not receive or for both Astron 100 &amp; 103. Not open to stiffs who meet prereq for Astron 200</td>
</tr>
<tr>
<td>ASTRON 113</td>
<td>Hands on the Universe</td>
<td><em>PEC</em></td>
<td>Open to all Undergrads. Intended to be taken concurrently with Astron 103. Prev Astron 100 or Astron 103 or cons inst acceptable. Satisfies QR-B only if Astron 101 and Astron 103 is also completed. Not open to stiffs who have taken Astron 110</td>
</tr>
<tr>
<td>ASTRON 150</td>
<td>Topics in Astronomy/ The Dark Side of the Universe</td>
<td><em>PEC</em></td>
<td>Astron 105, 103, or 104, as appropriate for topic, or consent of instructor</td>
</tr>
<tr>
<td>ASTRON 160</td>
<td>Life in the Universe</td>
<td><em>PEC</em></td>
<td>Open to all Undergrads.</td>
</tr>
<tr>
<td>ASTRON 199</td>
<td>Directed Study</td>
<td><em>EC</em></td>
<td>Astron 100 or equiv or cons inst. Open to Fr</td>
</tr>
<tr>
<td>ASTRON 206</td>
<td>the Physical Universe</td>
<td><em>PIC</em></td>
<td>Physics 202 or 208 or cons inst. Not open to stiffs who have taken Astron 100 or 103. Simple calculus required</td>
</tr>
<tr>
<td>ASTRON 205</td>
<td>History-Astronomy&amp;Cosmology</td>
<td><em>PIC</em></td>
<td>Sci St</td>
</tr>
<tr>
<td>ASTRON 310</td>
<td>Stellar Astrophysics</td>
<td><em>PIC</em></td>
<td>Math 222 &amp; Physics 205 or 241</td>
</tr>
<tr>
<td>ASTRON 320</td>
<td>The Interstellar Medium</td>
<td><em>AC</em></td>
<td>Math 222 and Physics 205 or 241</td>
</tr>
<tr>
<td>ASTRON 330</td>
<td>Galaxies</td>
<td><em>AC</em></td>
<td>Astron 310</td>
</tr>
<tr>
<td>ASTRON 340</td>
<td>Solar System Astrophysics</td>
<td><em>PIC</em></td>
<td>Math 222 &amp; Physics 205 or 241</td>
</tr>
<tr>
<td>ASTRON 350</td>
<td>Tech/Anal Observati Astronomy</td>
<td><em>AC</em></td>
<td>Grad st or Astron 310 &amp; cons inst</td>
</tr>
<tr>
<td>ASTRON 355</td>
<td>Astrophysics</td>
<td><em>AC</em></td>
<td>EMA 202 or 221; or Physics 311 or cons reg; or cons inst</td>
</tr>
<tr>
<td>ASTRON 820</td>
<td>Astron-Astrophysical Topics</td>
<td><em>AC</em></td>
<td>Astron 310 or cons inst</td>
</tr>
<tr>
<td>ASTRON 681</td>
<td>Senior Honors Thesis</td>
<td><em>AC</em></td>
<td>Cons inst</td>
</tr>
<tr>
<td>ASTRON 682</td>
<td>Senior Honors Thesis</td>
<td><em>AC</em></td>
<td>Cons inst</td>
</tr>
<tr>
<td>ASTRON 687</td>
<td>Senior Thesis</td>
<td><em>AC</em></td>
<td>Sr st astronomy-physics major &amp; cons inst</td>
</tr>
<tr>
<td>ASTRON 692</td>
<td>Senior Thesis</td>
<td><em>AC</em></td>
<td>Astron 691 &amp; cons inst</td>
</tr>
<tr>
<td>ASTRON 699</td>
<td>Directed Study</td>
<td><em>AC</em></td>
<td>L S &amp; Undergrad need 2.5, Jr or Sr st &amp; cons inst</td>
</tr>
<tr>
<td>ASTRON 700</td>
<td>Basic Astrophysics I</td>
<td><em>AC</em></td>
<td>Grad st in astronomy or physics, or cons inst</td>
</tr>
<tr>
<td>ASTRON 701</td>
<td>Basic Astrophysics II</td>
<td><em>AC</em></td>
<td>Grad st in astronomy or physics, or cons inst</td>
</tr>
<tr>
<td>ASTRON 715</td>
<td>Stellar Interiors&amp;Evolution</td>
<td></td>
<td>Astron 700 or cons inst</td>
</tr>
<tr>
<td>ASTRON 730</td>
<td>Galaxies</td>
<td><em>AC</em></td>
<td>Grad st in Astronomy or cons inst</td>
</tr>
<tr>
<td>ASTRON 810</td>
<td>Seminar in Astrophysics</td>
<td><em>AC</em></td>
<td>Cons inst</td>
</tr>
<tr>
<td>ASTRON 880</td>
<td>Research and Thesis</td>
<td><em>AC</em></td>
<td>Grad st in astron</td>
</tr>
</tbody>
</table>

#### Courses in Physics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Attribute</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 103</td>
<td>General Physics</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. High school algebra, geometry and some trig; Not open if you've taken Physics 201, 207, or 247; Open to Fresh. For students who don't need a calc level course; Not recommended for students in the physical sc.and engr</td>
</tr>
<tr>
<td>PHYSICS 104</td>
<td>General Physics</td>
<td><em>PEC</em></td>
<td>Physics 103. Not open to those who have taken Physics 202, 208, or 240; Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 107</td>
<td>Ideas of Modern Physics</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. High school algebra &amp; geometry. Not open to students who have taken an intermediate or advanced level physics course. Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 109</td>
<td>Physics in the Arts</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. High school algebra &amp; geometry. Not open to students who have taken an intermediate or advanced level physics course, including Physics 371. Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 115</td>
<td>Energy</td>
<td><em>PEC</em></td>
<td>Completion of QR-A. High school algebra and geometry. Not open to students who have taken Physics 100, 201, 207, or 247</td>
</tr>
<tr>
<td>PHYSICS 199</td>
<td>Directed Study</td>
<td><em>EC</em></td>
<td>Cons inst. Open to Fr</td>
</tr>
<tr>
<td>PHYSICS 201</td>
<td>General Physics</td>
<td><em>PIC</em></td>
<td>Math 211 or 221 or 1 year high school calculus or instructor consent. Not open to students who have taken Physics 207 or 247; Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 202</td>
<td>General Physics</td>
<td><em>PIC</em></td>
<td>Physics 201, 207, or EMA 201 and EMA 202, or EMA 201 and ME 240; or equivalent. Not open to students who have taken Physics 208 or 248</td>
</tr>
<tr>
<td>PHYSICS 205</td>
<td>Mod Physics for Engineers</td>
<td><em>PIC</em></td>
<td>Physics 202, 208 or 248. Not open to students who have taken Physics 241, 244, or 249</td>
</tr>
<tr>
<td>PHYSICS 206</td>
<td>Special Topics in Physics</td>
<td><em>JC</em></td>
<td>Prepara vary according to topic</td>
</tr>
<tr>
<td>PHYSICS 217</td>
<td>General Physics</td>
<td><em>PIC</em></td>
<td>Math 221 or 211 or 1 year high school calculus or instructor consent. Not open to students who have taken Physics 201 or 247; Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 228</td>
<td>General Physics</td>
<td><em>PIC</em></td>
<td>Physics 201, 207, or 247. Not open to students who have taken Physics 202 or 248; Open to Freshmen</td>
</tr>
<tr>
<td>PHYSICS 233</td>
<td>Intro-Solid State Electronics</td>
<td><em>JC</em></td>
<td>Open to Fr. Math 222 &amp; Physics 202</td>
</tr>
<tr>
<td>PHYSICS 241</td>
<td>Intro to Modern Physics</td>
<td><em>PIC</em></td>
<td>Physics 202 or 208 or Math 222. Not open to students who have taken Physics 205, 244, or 249</td>
</tr>
<tr>
<td>PHYSICS 247</td>
<td>A Modern intro to Physics</td>
<td><em>PIC</em></td>
<td>Math 222 or concurrent registration or instructor consent; Open to Freshmen. Intended primarily for physics, AMEP, astronomy-physics majors; Also suitable for those majoring in science or mathematics</td>
</tr>
<tr>
<td>PHYSICS 248</td>
<td>A Modern intro to Physics</td>
<td><em>PIC</em></td>
<td>Physics 247. Math 234 or concurrent enrollment. Open to Freshmen. Intended primarily for physics, AMEP, and astronomy-physics majors</td>
</tr>
<tr>
<td>PHYSICS 249</td>
<td>A Modern intro to Physics</td>
<td><em>PIC</em></td>
<td>Physics 248 &amp; Math 234, or consent of instructor; concurrent registration in Physics 307 required. Not open to students who have taken Physics 241; Open to Freshmen. Intended primarily for physics, AMEP, astronomy-physics majors</td>
</tr>
<tr>
<td>PHYSICS 250</td>
<td>Intro-Medical Physics</td>
<td><em>PIC</em></td>
<td>A jr. cors of college level intro physics</td>
</tr>
<tr>
<td>PHYSICS 298</td>
<td>Directed Study</td>
<td><em>JC</em></td>
<td>Intro physics and cons inst</td>
</tr>
<tr>
<td>PHYSICS 298</td>
<td>Directed Study</td>
<td><em>JC</em></td>
<td>Intro physics and cons inst</td>
</tr>
</tbody>
</table>
PHYSICS 301 Physics Today
PHYSICS 307 Introductory Lab-Mech&Mod Physics
PHYSICS 308 Intermediate Lab-Electromag
PHYSICS 311 Mechanics
PHYSICS 321 Elect Circuits & Electronic
PHYSICS 322 Electromagnetic Fields
PHYSICS 325 Wave Motion and Optics
PHYSICS 371 Acoustics for Musicians
PHYSICS 406 Special Topics in Physics: General Relativity
PHYSICS 407 Advanced Laboratory
PHYSICS 444 Atomic and Quantum Physics
PHYSICS 448 Atomic and Quantum Physics
PHYSICS 498 Directed Study
PHYSICS 499 Directed Study
PHYSICS 501 Radiological Physics&Dosimetry
PHYSICS 522 Introduction to Plasmas
PHYSICS 577 Plasma Confinement&Heating
PHYSICS 531 Intro to Quantum Mechanics
PHYSICS 535 Intro-Particle Physics
PHYSICS 545 Intro to Atomic Structure
PHYSICS 549 lasers
PHYSICS 551 Solid State Physics
PHYSICS 563 Fundamentals of Allied & Biology
PHYSICS 601 Scientific Presentation
PHYSICS 603 Wesley College Physics Tchg
PHYSICS 619 Microscopy of Life
PHYSICS 623 Electronic Aids to Measurement
PHYSICS 625 Applied Optics
PHYSICS 661 Senior Honors Thesis
PHYSICS 662 Senior Honors Thesis
PHYSICS 691 Senior Thesis
PHYSICS 711 Theoretical Physics Dynamics
PHYSICS 715 Statistical Mechanics
PHYSICS 717 Relativity
PHYSICS 721 Theor-Physics- Electrodynamics
PHYSICS 724 Waves/Instabilities-Plasmas
PHYSICS 728 Plasma Magneto-hydrodynamics
PHYSICS 731 Quantum Mechanics
PHYSICS 732 Quantum Mechanics
PHYSICS 735 Particle Physics
PHYSICS 736 Nuclear, ParticleAstrophysics
PHYSICS 740 Linear Waves
PHYSICS 751 Adv Solid State Physics
PHYSICS 796 Independent Study
PHYSICS 801 Topics- Theoretical Physics / Superconductivity
PHYSICS 805 Special Topics in Physics: Laboratory Plasma Astrophysics
PHYSICS 831 Advanced Quantum Mechanics
PHYSICS 832 Advanced Quantum Mechanics
PHYSICS 850 Collider Phys Phenomenology
PHYSICS 859 Seminar in Astrophysics
PHYSICS 862 Seminar in Plasma Physics
PHYSICS 889 Research
Additional Information for Astronomy-Physics Majors

### Pathways into the Program
1. **Interest from High School**
2. **Current UW Students from Intro Courses**
3. **Interested Transfer Students**

### UW Application Requirement
1. **Application**
2. $60.00 Fee
3. **All Transcripts**
4. Test Scores ACT/SAT
5. Two essays
6. One letter of recommendation

### Advising for Astro-Physics
- **Academic Advisor** - Eric Schueffner
  - elschueffner@wisc.edu
  - 608.890.3231
- **Astronomy Faculty Advisors**:
  - Richard Townsend
    - townsend@astro.wisc.edu
    - 608.262.1752
  - Snezana Stanimirovic
    - stanimirovic@astro.wisc.edu
    - 608.890.1458

### During your First and Second Year:
- **Complete Core Courses (34+ credits):**
  - During your First and Second Year:
  - Complete Core Courses (34+ credits):
  - By senior year, you should have a good idea as to the career you want.

### Requirements to Declare:
- Complete 2 of 3 classes in an intro Physics Sequence
  - 247, 248, 249 (recommended) or 207, 208, 241
  - or 201, 202, 295; prior to declaring major

### First and Second Year Tips:
- Consider taking Astro 200 (The Physical Universe)
  1. Attend Astronomy Open House
  2. Meet Major Advisors
  3. Attend Majors Fairs / Career Fairs
  4. Connect and join student organizations - UPS
  5. Explore internships and career options

### Junior Year:
- **Complete Core Courses (34+ credits):**
  - See Checklist lab

### Research and Internships
- Work with faculty, L&S career services and your advisor

### During Jr/Sr years:
- 1. Plan ahead for research projects
- 2. Get involved with department/faculty
- 3. Present Research at UW Undergraduate Symposia or AAS
- 4. Work as an Astronomy Tutor
- 5. Take part in Summer REU (Research Experience for Undergrads)
- 6. Connect with Alumni & potential graduate programs, employment
- 7. Attend Career Fairs, Stellar Careers Workshop, & REU/Grad-school workshop
- 8. Get internship experience
- 9. Attend Astronomy Colloquium
- 10. Work on cover letter and resume
- 11. Apply for Jobs or Graduate Schools
- 12. Utilize L&S Career Development

### Senior Year:
- By senior year, you should have a good idea as to the career you want.
- You should be completing your major while planning for your career or further schooling (GRE, networking, applications etc.)

### L&S Career Services
- 711 State St. (Bookstore)
  - 608-262-3921
  - careers@ls.wisc.edu

### Honors Program
- https://honors.ls.wisc.edu/

### Advising in Letters & Science
- **Letters and Science Advising**
- **L&S Academic Advising Services**
  - 608-262-5858
  - 101 Ingraham Hall - 8:00-4:30 M-F
- **General:** acac@saac.ls.wisc.edu
- **Freshman advising:** ls.advising@ls.wisc.edu
- **Transfers:** transfers.advising@ls.wisc.edu

### Requirements to Declare:
- Complete 2 of 3 classes in an intro Physics Sequence
  - 247, 248, 249 (recommended) or 207, 208, 241
  - or 201, 202, 295; prior to declaring major

### Steps to Declare:
- 1. Contact Astro Faculty Advisors to organize a meeting
- 2. Meet with Eric Schueffner (Academic Advisor)

### Professional Societies
- **University Physical Society (UPS)/Physics Club**
  - 2328 Chamberlin Hall
  - ups-officers@googlegroups.com
  - 608-263-2805

### High School Tips
- 1. Attend Astronomy Open House
- 2. Meet Major Advisors
- 3. Attend Majors Fairs / Career Fairs
- 4. Connect and join student organizations - UPS
- 5. Explore internships and career options

### UW Application Requirement
- 1. Application
- 2. $60.00 Fee
- 3. All Transcripts
- 4. Test Scores ACT/SAT
- 5. Two essays
- 6. One letter of recommendation

### First and Second Year Tips:
- Consider taking Astro 200 (The Physical Universe)
  1. Attend Astronomy Open House
  2. Meet Major Advisors
  3. Attend Majors Fairs / Career Fairs
  4. Connect and join student organizations - UPS
  5. Explore internships and career options

### UW Application Requirement
- 1. Application
- 2. $60.00 Fee
- 3. All Transcripts
- 4. Test Scores ACT/SAT
- 5. Two essays
- 6. One letter of recommendation

### High School Tips
- 1. Attend Astronomy Open House
- 2. Meet Major Advisors
- 3. Attend Majors Fairs / Career Fairs
- 4. Connect and join student organizations - UPS
- 5. Explore internships and career options

### UW Application Requirement
- 1. Application
- 2. $60.00 Fee
- 3. All Transcripts
- 4. Test Scores ACT/SAT
- 5. Two essays
- 6. One letter of recommendation

### High School Tips
- 1. Attend Astronomy Open House
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### UW Application Requirement
- 1. Application
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- 5. Two essays
- 6. One letter of recommendation
EDUCATIONAL AND RESEARCH OPPORTUNITIES IN ASTRONOMY AND ASTROPHYSICS
AT THE UNIVERSITY OF WISCONSIN-MADISON
http://www.astro.wisc.edu

THE DEPARTMENT OF ASTRONOMY AT THE UNIVERSITY OF WISCONSIN-MADISON OFFERS A PROGRAM OF STUDY AND RESEARCH LEADING TO THE B.S. DEGREE IN ASTRONOMY-PHYSICS

FACULTY AND CURRENT RESEARCH INTERESTS

Amy Barger: Observational cosmology, distant galaxies and supermassive black holes, star formation and accretion histories of the universe.
Matthew A. Bershady: Extragalactic astronomy and cosmology, galaxy kinematics and image structure; quasars, optical and infrared spectra and instrumentation.
Elena D’Onghia: Cosmology, nature of dark matter, large scale structure formation, dynamics and galaxy formation.
John S. Gallagher: Multi-wavelength observational investigations of evolutionary processes in galaxies, stellar populations, classical novae.
Sebastian Heinz: Relativistic jets, black holes, AGN, X-ray binaries, galaxy clusters, gamma ray bursts, interstellar and intergalactic medium.
Alex Lazarian: Theoretical astrophysics, e.g. magnetic turbulence, magnetic reconnection, cosmic rays, star formation, physics of dust.
Robert D. Mathieu: Observational studies of star formation, binary stars, and open star clusters; high-resolution optical and infrared spectroscopy.
Snezana Stanimirovic: Galactic disk/halos, dust properties in low-metallicity environments, physics of the ISM, radio techniques and applications.
Richard H. Townsend: Stellar astrophysics, magnetic fields, stellar winds, massive stars.
Christy Tremonti: Galaxy and AGN co-evolution, galactic chemical evolution.
Eric M. Wilcots: Studies of the structure and evolution of galaxies through radio and optical observations; distribution and kinematics of gas in and around galaxies.
Ellen G. Zweibel: Theoretical astrophysics, especially plasma astrophysics; evolution of astrophysical magnetic fields, interstellar astrophysics, star formation, stellar physics.

SENIOR SCIENTISTS AND EMERITI

Joseph P. Cassinelli: Structure of stellar winds, high resolution X-ray observations, effects of rotation and magnetic fields on the circumstellar envelopes of hot stars.
Edward B. Churchwell: Star formation, hot molecular cores, UC HII regions, atomic abundances; radio and infrared astronomy.
Matt Haffner: Milky Way structure and dynamics; physics of the interstellar medium; extended galactic halos; diffuse emission-line spectroscopy; remote observing.
Kenneth H. Nordsieck: Stellar and extragalactic optical/ultraviolet spectropolarimetry, ground-based instrument control, space astronomy.
Marina Orio: Transients' populations, interacting binaries, accreting and hydrogen burning white dwarfs.
Jeffrey W Percival: Instrument control software, telescope control systems, guidance and navigation for suborbital rockets.
Ronald J. Reynolds: High-resolution spectroscopy of diffuse sources, development of high throughput spectrometers, physics of the interstellar medium.
Blair D. Savage: Physical properties of the interstellar medium, gas in galactic halos and the intergalactic medium; high-resolution ultraviolet spectroscopy.
Linda Sparke: Structure and dynamics of galaxies, modeling of warped disks and polar rings; dynamical models for bars; circumstellar and circumbinary disks.
Bart Wakker: High-velocity clouds and low-redshift intergalactic medium.
Barbara Whitney: Radiative transfer models of planets, forming stars, and galaxies; infrared surveys of our Galaxy and the Magellanic Clouds.

ASSOCIATED FACULTY
The Department works closely with the members of the Department of Physics in the Space Physics, Optical Spectroscopy, and Atomic Physics groups. Active researchers and programs include: Dan McCammon, X-ray astronomy, soft X-ray background, the hot interstellar medium; James Lawler, laboratory measures of atomic transition probabilities; Peter Timbie, measurements of cosmic background radiation; Francis Halzen and Robert Morse, neutrino astronomy; Cary Forest, plasma astrophysics.
UNDERGRADUATE ACADEMIC PROGRAM
Astronomy, the oldest of the sciences, has been one of the most exciting fields of modern scientific research for the last several decades. New discoveries concerning the solar system, stars, galaxies, and the origin of the universe continue to be made by both ground and space telescopes. To understand and pursue modern astronomy, one must have a solid background in physics and mathematics as well as in astronomy. The Astronomy-Physics major (soon to be Astronomy-Astrophysics), administered by the Astronomy Department, provides undergraduates the opportunity to develop an appreciation of our current understanding of the astronomical universe, while developing the necessary physics and math background. Astronomy majors frequently participate in various research projects in the Department, experiencing a real research environment while developing technical and writing skills.

RESEARCH FACILITIES
The Department has a 26% share in the WIYN 3.5m Telescope, an advanced technology optical telescope located on Kitt Peak in Arizona. WIYN is instrumented with a multi-object and two integral-field fiber spectrographs, a mosaic CCD camera, a tilt-tip imager, and a high-resolution near-infrared imaging camera. Remote observing is done routinely from the Department. Graduate and undergraduate students frequently travel to WIYN to make their own observations. The Department also has a major share in the nearby 0.9m telescope.

The University of Wisconsin-Madison is also a major partner in the Southern African Large Telescope (SALT), an 11m spectroscopic telescope located outside Sutherland, South Africa. The Robert Stobie Spectrograph (RSS) that is the primary first light instrument for SALT (first light was summer 2006) was designed and built in our Department. Today, RSS-NIR, its sibling spectrograph for near-infrared spectroscopy, is also being designed and built on campus.

On Cerro Tololo in Chile is the remotely operable Wisconsin H-Alpha Mapper (WHAM) observatory dedicated to studies of the diffuse interstellar medium.

Watchburn Observatory, which opened in 1878, pioneered in the development of photoelectric astronomy, and our Space Astronomy Laboratory led in the birth of ultraviolet astronomy. Wisconsin astronomers served on instrument teams responsible for the Hubble Space Telescope (HST) high-resolution spectrograph, the wide field planetary camera and the cosmic origins spectrograph. Today instrumentation remains a strong component of our programs for observational research from the ground and in space. The Department also operates the Pine Bluff Observatory, which is located 15 miles west of Madison, a site historically used as a test-bed for innovative instrumentation.

Astronomers at Wisconsin use a wide variety of observatories to obtain data for their observational programs. In addition to our own facilities, astronomers are also frequent visitors to U.S. national astronomical research facilities at the National Optical Astronomy Observatories, the National Radio Astronomy Observatory, the Infrared Telescope Facility, and NASA (e.g., HST, Chandra and Spitzer). As astronomy has become increasingly international in scope, more of our staff and students are working with unique facilities run by other countries, such as the Australia Telescope Compact Array and the James Clerk Maxwell Telescope.

Astronomy at Wisconsin combines strong traditions in observational, instrumental, and theoretical research. The analysis and interpretation of astronomical data require specialized tools, and the Department operates a powerful network of image processing workstations. Theory programs currently focus on stellar atmospheres and mass loss, interstellar matter, radiative transport, compact objects and jets, plasma astrophysics, and computational astrophysics. Theorists use both national high performance computing facilities and several large departmental computer clusters.

SKILLS THAT YOU WILL LEARN AS AN ASTRONOMY-PHYSICS MAJOR
Astronomy majors gain proficiency in physics and math. They develop good computer and programming skills, data collection and analysis skills, and good communication and teamwork skills. Some students become involved with building instruments, learning electronics, materials fabrication, machining, and other skills in the process. Most importantly, astronomy majors develop analytical skills and an ability to solve complex problems that insures success in any field.

WHO Hires ASTRONOMY-PHYSICS BACHELORS?
About half of new astronomy bachelor’s recipients enter the workforce after earning their degree. The other half continues in PhD programs in astronomy, physics or related disciplines. Astronomers with advanced (PhD) degrees, work at national observatories, national laboratories, federal research agencies, and astronomy and physics departments at universities and colleges.

Astronomers with bachelor degrees find jobs mainly in three sectors:
• College/University (e.g. research assistant, technician, planetarium, science museums);
• Private Sector in STEM fields (e.g. engineering fields, information technology, software developers);
• Private Sector in Non-STEM fields (e.g. associates in retail, finance or business); Other positions, including high school and elementary teachers, science journalism, and non-profit organizations.

UNDERGRADUATE FACULTY ADVISOR: To get involved in research projects, discuss your course choices, resolve an academic issue or declare a major, call or email Prof. Richard Townsend (Fall) or Prof. Stanimirovic (Spring) to set an appointment: Prof. Richard Townsend, 4550 Sterling Hall, 608-890-1458, townsend@astro.wisc.edu
Prof. Snezana Stanimirovic, 4514 Sterling Hall, 608-890-1458, ststanimi@astro.wisc.edu

UNDERGRADUATE COORDINATOR: Sheri Pittman, 2554 Sterling Hall, 608-890-3775; pittman@astro.wisc.edu.
See Sheri to fill out forms to declare the astronomy major or register for independent study.

DEPARTMENT OF ASTRONOMY CONTACT INFORMATION:
ASTRONOMY UNDERGRADUATE LOUNGE: 3527 Sterling Hall
ASTRONOMY UNDERGRADUATE RESEARCH ROOM: 3321 Sterling Hall
WOODMAN ASTRONOMY LIBRARY: 6515 Sterling Hall
Astronomy Requirements for the Major

The major requires a minimum of 34 credits in the field of specialization, with at least 6 of these credits in astronomy and at least 28 credits in physics. Before declaring the major, students must complete Physics 247, 248, and 249 (recommended sequence), or 207, 208, and 241, or Physics 201, 202, 205. In addition, the specific course requirements for the major are (these also count toward the 15 credits of upper-level courses as required by the College of Letters and Science):

**Astronomy:**
At least two of the following (but note that 310 is a prerequisite for 330, 335, and 500):
- 310 Stellar Astrophysics, 3 cr
- 320 The Interstellar Medium, 3 cr
- 330 Galaxies and Cosmology, 3 cr
- 335 Cosmology, 3 cr
- 340 Solar System Astronomy, 3 cr
- 500 Techniques of Modern Observational Astrophysics, 3 cr

Note: Astronomy 103 and 104 are not required for majors.

**Physics:**
- 247-248-249 A Modern Introduction to Physics (or 201-202-205; or 207-208-241) 14 cr
- 311 Mechanics, 3 cr
- 322 Electromagnetic Fields, 3 cr
- 415 Thermal Physics, 3 cr
- 448 Atomic and Quantum Physics, 3 cr
- 449 Atomic and Quantum Physics, 3 cr
- 531 Introduction to Quantum Mechanics (3) may be substituted for the 448-449 sequence.

A 300-level or higher laboratory course must be taken; Astronomy 510 or Physics 308 (Intermediate Laboratory-Electromagnetic Fields and Optics) or 321 (Electric Circuits and Electronics) are recommended to satisfy this requirement.

**Recommended Additional Courses:**

**Math:** Mathematics courses other than those required as prerequisites for physics courses are not required for the major, but the following courses are recommended:
- Math 319 (Ordinary Differential Equations)
- Math 321 and 322 (Applied Analysis)
- If a student plans to work toward the PhD degree the student should also take:
  - Math 320 (Linear Mathematics) or
  - Math 340 (Matrix and Linear Algebra)

Additional mathematics (or statistics) courses should be chosen after consultation with the undergraduate advisor.

**Computing:** Computers are fundamental to astronomical research. An introduction through Comp Sci 302 or short courses run by the computing center should be considered.

**Chemistry:** A college course in physical or organic chemistry is useful for astronomy students. Physical chemistry is particularly valuable for those interested in the interstellar medium, comets, and planets.

**Statistics:** A background in statistics is valuable, particularly for students interested in observational astronomy. Statistics 301, or Statistics 309/310 for a more solid foundation, are suggested.

**Languages:** French, German, Russian, and especially Spanish are the most useful foreign languages for astronomy students, but are not required.

**Honors in the Major**
Students wishing to receive Honors in the Major must satisfy the following requirements:
1. A minimum grade point average of 3.5 in all 300 or higher level courses is required for the major.
2. Completion of four 300 or higher level astronomy courses with a minimum grade point average of 3.5 and an overall GPA of at least 3.3 in all courses taken at UW–Madison at the time of graduation.
3. Completion of a Senior Honors Thesis (Astron 681/682) with a grade of AB or better. Students wishing to pursue Honors in the Major should contact the undergraduate advisor to seek guidance about planning the best possible Honors in the Major curriculum that reflects their special interests.
ASTRONOMY–PHYSICS, B.S.

Astronomy, the oldest of the sciences, for the last several decades has been one of the most exciting fields of modern scientific research. New discoveries concerning the solar system, stars, galaxies, and the origin of the universe continue to be made by both ground and space telescopes. To understand and pursue modern astronomy, one must have a solid background in physics and mathematics as well as in astronomy.

The astronomy–physics major, administered by the Department of Astronomy, provides undergraduates the opportunity to appreciate our current understanding of the astronomical universe, while developing the necessary physics and math background. Students who intend to continue astronomy in a graduate program are strongly encouraged to do a Senior Thesis (ASTRON 681 Senior Honors Thesis/ASTRON 682 Senior Honors Thesis (honors) or ASTRON 691 Senior Thesis/ASTRON 692 Senior Thesis). The experiences of actual research and of writing a major paper develop both technical and writing skills.

HOW TO GET IN

Students are encouraged to declare their major as early as possible. Before declaring the major, students must complete the first two of the three classes in the Introductory PHYSICS sequence.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

Requirements Detail

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE

BREADTH AND DEGREE REQUIREMENTS:

BACHELOR OF SCIENCE (B.S.)

Students pursuing a bachelor of science degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

Requirements Detail

Mathematics

- Two (2) 3+ credits of intermediate/advanced level MATH, COMP SCI, STAT
- Limit one each: COMP SCI, STAT

Foreign Language

- Complete the third unit of a foreign language

L&S Breadth

- Humanities, 12 credits: 6 of the 12 credits must be in literature
- Social Sciences, 12 credits
- Natural Sciences, 12 credits: must include 6 credits in biological science; and must include 6 credits in physical science

Liberal Arts and Science Coursework

- 108 credits

Depth of Intermediate/Advanced work

- 60 intermediate or advanced credits

Major

- Declare and complete at least one (1) major

Total Credits

- 120 credits

UW-Madison Experience

- 30 credits in residence, overall
- 30 credits in residence after the 90th credit

Minimum

- 2,000 in all coursework at UW–Madison

GPAs

- 2,000 in intermediate/advanced coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above.

REQUIREMENTS FOR THE MAJOR

The major requires a minimum of 34 credits in the field of specialization, with at least 6 of these credits in ASTRON and at least 28 credits in PHYSICS.

COURSE REQUIREMENTS FOR THE MAJOR ARE:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy 1</td>
<td>Select at least two of the following:</td>
<td>6</td>
</tr>
<tr>
<td>ASTRON 310</td>
<td>Stellar Astrophysics 2</td>
<td></td>
</tr>
</tbody>
</table>
ASTRON 320  The Interstellar Medium
ASTRON 330  Galaxies
ASTRON 335  Cosmology
ASTRON 340  Solar System Astrophysics
ASTRON 500  Techniques of Modern Observational Astrophysics

Physics
Select one of the following sequences for Introductory Physics:

Option 1 (Recommended Sequence):

PHYSICS 247  A Modern Introduction to Physics
PHYSICS 248  A Modern Introduction to Physics
PHYSICS 249  A Modern Introduction to Physics

Option 2:

PHYSICS 201  General Physics
PHYSICS 202  General Physics
PHYSICS 205  Modern Physics for Engineers

Option 3:

PHYSICS 207  General Physics
PHYSICS 208  General Physics
PHYSICS 241  Introduction to Modern Physics

Additional PHYSICS to reach minimum of 34 credits, to include the following:

PHYSICS 311  Mechanics
PHYSICS 322  Electromagnetic Fields
PHYSICS 415  Thermal Physics
PHYSICS 448  Atomic and Quantum Physics
& PHYSICS 449  and Atomic and Quantum Physics
or PHYSICS 531  Introduction to Quantum Mechanics

Select a 300-level or higher laboratory course:

ASTRON 510  Radio Astronomy Laboratory
PHYSICS 308  Intermediate Laboratory-Electromagnetic Fields and Optics
PHYSICS 321  Electric Circuits and Electronics

Total Credits 34

1 ASTRON 103 The Evolving Universe: Stars, Galaxies, and Cosmology and ASTRON 104 Our Exploration of the Solar System are not required for majors.

2 ASTRON 310 Stellar Astrophysics is a prerequisite for ASTRON 330 Galaxies, ASTRON 335 Cosmology, and ASTRON 500 Techniques of Modern Observational Astrophysics.

3 E M A 201 Statics, E M A 202 Dynamics and M E 240 Dynamics count toward the 28 credits of PHYSICS requirement.

HONORS IN THE MAJOR
Students may declare Honors in the Astronomy–Physics Major in consultation with the Astronomy–Physics undergraduate advisor(s).

HONORS IN THE ASTRONOMY-PHYSICS MAJOR REQUIREMENTS
To earn a B.A. or B.S. with Honors in the Major in Astronomy–Physics, students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 overall university GPA
- Earn a 3.500 GPA for all ASTRON courses, and all courses accepted in the major, at the 300 level or higher
- Complete the following coursework:
  - Four 300-level or higher ASTRON courses
  - A two-semester Senior Honors Thesis in ASTRON 681 Senior Honors Thesis and ASTRON 682 Senior Honors Thesis, with a grade of AB or better, for a total of 6 credits.

UNIVERSITY DEGREE REQUIREMENTS

Requirements Detail

Total Degree To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. Learn how astronomical observations are made and how astronomical data are analyzed. Become acquainted with basic principles of astronomical imaging and spectroscopy, detectors, and interferometry. Apply simple statistical concepts learned previously in required laboratory courses to astronomical data. Use simple scientific computing methods to plan astronomical observations and analyze astronomical data.

2. Become familiar with current astrophysical theories and observations of basic systems such as planets, stars, interstellar gas, galaxies, and structure of the Universe (cosmology). Learn to apply physical principles and mathematical techniques learned previously in required courses to understand the natural laws governing these systems. Use simple scientific computing methods to analyze and physically interpret numerical models of astronomical systems.
3. Learn how to read and critically evaluate scientific literature. Students should be able to grasp the main points, scientific goals, and research methods used in an article and should be able to discern whether the article supports or conflicts with material presented elsewhere.

4. Learn the basics of oral and written scientific communication. Written coursework will be assessed on the basis of clear writing, appropriate level of detail in reporting calculations, and computations and appropriate bibliographic references and citations as well as on scientific accuracy. Learn to give clear and accurate short oral presentations with appropriate supporting materials.

5. Be trained in principles and standards of professional and ethical conduct. Learn when and how to cite references and when it is appropriate to credit the contributions of others or claim credit for one's own work. Learn what constitutes a professional or unprofessional demeanor and how to apply principles of equality in an educational or workplace setting. Learn how to address a breakdown of professional ethics and standards if experienced or observed.

6. Develop the skills to carry out a small independent research project. Learn to define the scope of the project, how to conduct an effective literature search, and perform computations, analyze data, and report on the literature as appropriate. Learn the basics of presenting the results of the project, whether as a paper, poster, talk, or some combination. The project may involve group work, or teamwork, depending on logistics and the nature of the project. Note: Not all Astronomy majors engage in independent research; this learning goal applies only to majors who have a formal research advisor to perform the assessment.

Chemistry: A college course in physical or organic chemistry is useful for astronomy students. Physical chemistry is particularly valuable for those interested in the interstellar medium, comets, and planets.

Statistics: A background in statistics is valuable, particularly for students interested in observational astronomy. STAT 301 Introduction to Statistical Methods, or STAT/MATH 309 Introduction to Probability and Mathematical Statistics I/STAT/MATH 310 Introduction to Probability and Mathematical Statistics II for a more solid foundation, are suggested.

Languages: French, German, Russian, and especially Spanish are the most useful foreign languages for astronomy students, but are not required.

PEOPLE

Professors Barger, Bershady, Gallagher, Heinz, Lazarian, Mathieu, Stanimirovic, Wilcots, Zweibel

Associate Professors Townsend, Tremonti

Assistant Professor D’Onghia

ADVISING AND CAREERS

ADVISING

For pre-major advising, or to declare the astronomy–physics major, students should contact Professor Townsend at townsend@astro.wisc.edu. Additional information and handouts on the major are available in the office of the undergraduate coordinator at 2554 Sterling Hall.

Please contact Professor Richard Townsend, townsend@astro.wisc.edu, 4550 Sterling Hall or Prof. Snezana Stanimirovic, sstanimi@astro.wisc.edu, 4514 Sterling Hall to schedule an appointment to declare the major; or contact department office for an advisor.

RECOMMENDED ADDITIONAL COURSES

Math: Mathematics courses other than those required as prerequisites for PHYSICS courses are not required for the major, but the following courses are recommended: MATH 319 Techniques in Ordinary Differential Equations, MATH 321 Applied Mathematical Analysis and MATH 322 Applied Mathematical Analysis. If a student plans to work toward the Ph.D degree the student should also take MATH 320 Linear Algebra and Differential Equations or MATH 340 Elementary Matrix and Linear Algebra. Additional mathematics (or statistics) courses should be chosen after consultation with the undergraduate advisor.

Computing: Computers are fundamental to astronomical research. An introduction through COMP SCI 302 Introduction to Programming or short courses run by the computing center should be considered.