

November 18, 2005

To: Sheila Dickison, Chair  
University Curriculum Committee

From: S. Yumiko Hulvey, Associate Dean  
College of Liberal Arts and Sciences (CLAS)

Re: Proposal to add BA option to Existing BS degree in Astronomy

The College of Liberal Arts & Sciences Curriculum Committee reviewed and approved the proposal to add a BA option to the existing BS degree in Astronomy. The BA option will serve a different student body, the most significant being students that might consider becoming certified as teachers in the critical shortage areas of science (and mathematics) education. Another potential source of students might be those interested in pursuing careers that require further training in professional schools such as law and business, among others. In the College of Liberal Arts & Sciences, there are BA and BS options in Geography, Geology, Mathematics, Physics, and Statistics. The addition of Astronomy to this list would offer students further career paths in which a strong foundation in the sciences is valued.

## **BACHELOR OF ARTS IN ASTRONOMY (CIP 40.0201)**

### **Introduction**

The Department of Astronomy proposes a Bachelor of Arts (BA) degree option to the existing Bachelor of Science (BS) in Astronomy. The faculty perceives a need for an astronomy degree that is broader and less specialized than the existing Bachelor of Science degree. The BS is designed primarily for students who will pursue careers in a scientific or technical field by continuing to study astronomy, astrophysics, physics, or a related field at the graduate level. This requires an extensive list of courses in physics as well as astronomy. On the other hand, the proposed BA option is conceived as a mark of a liberal education, with the goals of developing and sharpening analytical and quantitative reasoning but also of being wider-ranging and cultivating a broader knowledge that can be applied towards a number of career options.

Graduates of the BA option would be trained with a balance of the hard sciences and the humanities that could be applied to a host of careers. The BA option would be useful for students considering law school or other professional schools as well as for those seeking careers in business. Law schools particularly value students with analytical reasoning skills, as for example those honed by the sciences. Graduates of the BA option could enter upon careers in business with a solid foundation in the physical sciences and a firm command of analytical reasoning that could help develop the economic diversification that Florida needs. Furthermore, the BA option could help prepare students for medical school provided they take additional courses in biology, general chemistry, organic chemistry, and biochemistry required by the medical schools. Another function of the BA option is to contribute to the pool of future leaders for the state and nation, since many of those are drawn from the ranks of the legal and medical professions as well as business. By so doing the program would fulfill a key part of the University of Florida Strategic Plan.

With suitable additional course work in education, graduates of the BA option could pursue careers in secondary education, thereby helping to alleviate the absolutely critical shortage of science teachers in Florida and the nation. Secondary education physical science teachers with solid foundations in astronomy in addition to physics would be able to leverage that training into a high degree of engagement on the part of their students. The reason is that astronomy has an appeal on a wide range of levels and thus may seem more accessible to the ordinary student than physics or chemistry. At the same time it is presently a field brimming with exciting discoveries in areas such as other planetary systems and cosmology that excite the brightest students. While there is often not a separate course in astronomy in the high school curriculum, relevant material could be incorporated into secondary education physics courses.

### **Rationale**

Demand for the BS degree will continue among those students who plan to pursue graduate study in astronomy, astrophysics, or physics. However, the number of such students is unlikely to increase dramatically in the near future. The substantial number of physics courses required for the BS degree makes it a poor fit for students with the wider career goals described above. The BA degree option provides greater curricular flexibility to produce students trained for a wider range of careers. This is achieved primarily by dropping 12 credits of required physics courses. As will be made plain below, the BA option would use existing courses taught by the present faculty and thus not require a significant commitment of university resources.

Currently a number of institutions offer a BA in astronomy. In the Ivy League, Yale and Columbia offer it, and Cornell has recently added it. Yale's rationale is the same as ours; as stated on their Website, "The B.A. degree program is designed for students who may not intend to do graduate work in astronomy but who are interested in the subject as a basis for a liberal education or as a background for a career in medicine, teaching, journalism, business, law, or government. It allows greater flexibility in course selection than the B.S. program because the emphasis is on breadth of knowledge rather than on specialization." The University of Virginia and the University of Texas at Austin, two of the top public universities in the South whose astronomy departments are our main regional rivals in both quality and size, offer the BA in astronomy. Naturally there are differences among these programs' degree requirements, but the conception is similar to ours. Within CLAS, the Departments of Geological Sciences, Geography, Mathematics, Physics, and Statistics offer both BS and BA degree options. As of September 2005, no other State University System institution offers either a BA or BS in astronomy.

### Requirements

The requirements for the two degree options are compared below, with blank slots for the BA option filled in with possible course choices in italics:

| <b><u>B. S. Degree</u></b>                            | <b><u>B. A. Degree</u></b>                            |
|---|---|
| MAC 2311 Calculus 1 (4 credits)                       | MAC 2311 Calculus 1 (4 credits)                       |
| MAC 2312 Calculus 2 (4 credits)                       | MAC 2312 Calculus 2 (4 credits)                       |
| MAC 2313 Calculus 3 (4 credits)                       | MAC 2313 Calculus 3 (4 credits)                       |
| MAP 2302 Differential Equations (3 credits)           | <i>STA 2023 Intro Statistics 1 (3 credits)</i>        |
| PHY 2048+2048L Physics w Calculus 1 + lab (4 credits) | PHY 2048+2048L Physics w Calculus 1 + lab (4 credits) |
| PHY 2049+2049L Physics w Calculus 2 + lab (4 credits) | PHY 2049+2049L Physics w Calculus 2 + lab (4 credits) |
| PHY 3101 Intro Modern Physics (3 credits)             | PHY 3101 Intro Modern Physics (3 credits)             |
| PHY 3221 Mechanics 1 (3 credits)                      | <i>HIS 3463 Hist Sci to Newton (3 credits)</i>        |
| PHY 4222 Mechanics 2 (3 credits)                      | <i>HIS 3464 Hist Sci Ren to Present (3 credits)</i>   |
| PHY 3323 Electromagnetism 1 (3 credits)               | <i>PHI 3400 Philosophy of Science (3 credits)</i>     |
| PHY 4324 Electromagnetism 2 (3 credits)               | <i>PHY 3031 Dev Modern Ideas Phys (3 credits)</i>     |
| AST 3018 Astron & Astrophysics 1 (3 credits)          | AST 3018 Astron & Astrophysics 1 (3 credits)          |
| AST 3019 Astron & Astrophysics 2 (3 credits)          | AST 3019 Astron & Astrophysics 2 (3 credits)          |
| AST 3722C Observational Techniques 1 (3 credits)      | AST 3722C Observational Techniques 1 (3 credits)      |
| Five 4000-level AST courses (15 credits)              | Three 3000- or 4000-level AST courses (9 credits)     |
| One of the following:                                 | One 3000- or 4000-level AST or PHY course or          |
| PHY 3513 Thermal Physics 1 (3 credits)                | PHY 2464 Physical Basis of Music (3 credits)          |
| PHY 4422 Optics 1 (3 credits)                         |   |
| PHY 4523 Statistical Physics (3 credits)              |   |
| PHY 4604 Intro Quantum Mechanics 1 (3 credits)        |   |
| <b>Total upper division</b> <b>61 credits</b>         | <b>Total upper division</b> <b>37-40 credits</b>      |

## Tracking Plan (8 semesters)

| <b>B. S. Degree</b>                     |              | <b>B. A. Degree</b>                     |              |
|---|--------------|---|--------------|
| MAC 2311 Calculus 1 (GE-M)              | 4            | MAC 2311 Calculus 1 (GE-M)              | 4            |
| Composition (GE-C)                      | 3            | Composition (GE-C)                      | 3            |
| Humanities (GE-H,I)                     | 3            | Humanities (GE-H,I)                     | 3            |
| Social Behavioral Sciences (GE-S)       | 3            | Social Behavioral Sciences (GE-S)       | 3            |
| Biological Science (GE-B)               | 3            | Biological Science (GE-B)               | 3            |
| <b>Total</b>                            | <b>16</b>    | <b>Total</b>                            | <b>16</b>    |
| MAC 2312 Calculus 2 (GE-M)              | 4            | MAC 2312 Calculus 2 (GE-M)              | 4            |
| PHY 2048 Physics w Calculus 1 (GE-P)    | 3            | PHY 2048 Physics w Calculus 1 (GE-P)    | 3            |
| PHY 2048L Lab for PHY 2048 (GE-P)       | 1            | PHY 2048L Lab for PHY 2048 (GE-P)       | 1            |
| Biological Science (GE-B)               | 3            | Biological Science (GE-B)               | 3            |
| Humanities (GE-I)                       | 3            | Humanities (GE-H,I)                     | 3            |
| <b>Total</b>                            | <b>14</b>    | <b>Total</b>                            | <b>14</b>    |
| MAC 2313 Calculus 3                     | 4            | MAC 2313 Calculus 3                     | 4            |
| AST 3018 Astr Astrophys 1 (GE-P)        | 3            | AST 3018 Astr Astrophys 1 (GE-P)        | 3            |
| PHY 2049 Physics w Calculus 2 (GE-P)    | 3            | PHY 2049 Physics w Calculus 2 (GE-P)    | 3            |
| PHY 2049L Lab for PHY 2049 (GE-P)       | 1            | PHY 2049L Lab for PHY 2049 (GE-P)       | 1            |
| Social Behavioral Sciences (GE-S)       | 3            | Social Behavioral Sciences (GE-S)       | 3            |
| <b>Total</b>                            | <b>14</b>    | <b>Total</b>                            | <b>14</b>    |
| MAP 2302 Differential Equations         | 3            | AST 3019 Astr Astrophys 2 (GE-P)        | 3            |
| AST 3019 Astr Astrophys 2 (GE-P)        | 3            | PHY 3101 Intro Modern Physics* (GE-P)   | 3            |
| PHY 3101 Intro Modern Physics* (GE-P)   | 3            | Social Behavioral Sciences (GE-S)       | 3            |
| Social Behavioral Sciences (GE-S)       | 3            | Humanities (GE-H)                       | 3            |
| Humanities (GE-H)                       | 3            | Elective                                | 3            |
| <b>Total</b>                            | <b>15</b>    | <b>Total</b>                            | <b>15</b>    |
| PHY 3221 Mechanics 1                    | 3            | AST 3722C Observational Techniques 1*   | 3            |
| PHY 3513 Thermal Physics or elective    | 3            | AST (3000 or 4000 level)                | 3            |
| AST 3722C Observational Techniques 1*   | 3            | Elective                                | 3            |
| AST (4000 level)                        | 3            | Elective                                | 3            |
| Foreign language                        | 3-5          | Foreign language                        | 3-5          |
| <b>Total</b>                            | <b>15-17</b> | <b>Total</b>                            | <b>15-17</b> |
| PHY 3323 Electromagnetism 1             | 3            | AST (3000 or 4000 level)                | 3            |
| PHY 4222 Mechanics 2                    | 3            | Elective                                | 3            |
| AST (4000 level)                        | 3            | Elective                                | 3            |
| AST (4000 level)                        | 3            | Elective                                | 3            |
| Foreign language                        | 3-5          | Foreign language                        | 3-5          |
| <b>Total</b>                            | <b>15-17</b> | <b>Total</b>                            | <b>15-17</b> |
| PHY 4324 Electromagnetism 2             | 3            | AST (3000 or 4000 level)                | 3            |
| AST (4000 level)                        | 3            | Composition (GE-C)                      | 3            |
| PHY 4604 Quantum Mechanics 1            | 3            | Elective (or complete foreign language) | 3            |
| Composition (GE-C)                      | 3            | Elective                                | 3            |
| Elective (or complete foreign language) | 3            | Elective                                | 3            |
| <b>Total</b>                            | <b>15</b>    | <b>Total</b>                            | <b>15</b>    |

|  |                    |   |                    |
|--|--------------------|---|--------------------|
| PHY 4422 Optics 1 or elective            | 3                  | AST or PHY (3000 or 4000 level) or PHY 2464 |                    |
| PHY 4523 Statistical Physics or elective | 3                  | Basis of Music                              | 3                  |
| AST (4000 level)                         | 3                  | Elective                                    | 3                  |
| Electives                                | 7-3                | Elective                                    | 3                  |
|  | <b>Total 16-12</b> | Electives                                   | 7-3                |
|  |                    |   | <b>Total 16-12</b> |
| <b>Total credits for degree</b>          | <b>120</b>         | <b>Total credits for degree</b>             | <b>120</b>         |

\* The 8-semester plan for the BS is the existing one, and the BA plan has been patterned after it. However, the department is in the process of moving AST 3722C Observational Techniques 1 from the Fall term to the Spring, starting next year. To do this, it will be switched with PHY 3101 Introduction to Modern Physics. Thus the final version for the BA will have the placement of those courses reversed from the above.

The BS is an amalgam of astronomy and physics courses and thus has something of the character of an integrative major. The proposed BA would also require both astronomy and physics courses, but with minimum requirements limited to a total of 24 credits combined (beyond the calculus courses and the two physics with calculus courses) with a preponderance of astronomy credits. At the same time, because of the elective slots that could be filled with a wider variety of courses, depending upon the student's intended career, it has even more of an interdisciplinary nature.

Students would be encouraged, but not required, to take courses about science from a historical or philosophical perspective such as:

HIS 3463 History of Science to Newton (3 credits)

HIS 3464 History of Science Renaissance to Present (3 credits)

PHI 3400 Philosophy of Science (3 credits) OR

PHI 4542 Philosophy of Space and Time (3 credits)

There are two physics courses that students might take which are not normally taken by astronomy majors:

PHY 3031 Development of Modern Ideas in Physics (3 credits) AND

PHY 3400 Light, Color, and Holography (3 credits)

Instead of MAP 2302 Differential Equations (3 credits), students would be encouraged to take STA 2023 Introduction to Statistics 1 (3 credits).

To estimate the number of students who might pursue such a program of study we have consulted with several other astronomy departments who already have the BA. At Yale the numbers of BA and BS students are now roughly comparable; enrollment in the BA program started off small but has gradually increased. Virginia's astronomy BA has roughly twice as many students as the program aimed at graduate study. (Texas is presently awaiting results of a survey by their College of Natural Sciences; their results will be forwarded when available.) It thus seems reasonable to expect that the numbers of BA and BS students at UF will be roughly comparable. Astronomy presently has 31 majors, including those who double major with physics.

We believe that the BA option could be implemented in Fall 2006 if approval is received without delay. With faculty and courses already in place there is no need for a building-up period.

In summary, the proposed program presents an opportunity for the department to contribute in a new way to the University and its students, the state of Florida, and the nation. It can be done, we believe, without a significant additional commitment of precious funds.