

TO: James Toole, Chair, Senate Executive Committee
FROM: Vincent Maloney, Chair, Curriculum Review Subcommittee *Vincent Maloney*
DATE: October 2, 2019
SUBJECT: Physics Proposal

The Curriculum Review Subcommittee supports the proposal from the Department of Physics for a Concentration in Astronomy with a Track in Astrophysics for the B.S. in Physics. We find that the proposal requires no Senate review.

Approving

Not Approving

Absent

Clare Cholewa
Seth Green
Teresa Hogg
Carol Lawton
Sarah LeBlanc
Haowen Luo
Vincent Maloney
Susan Skekloff
Jin Soung Yoo

Proposal for a B.S. in physics with Concentration in Astronomy with a track in Astrophysics.

Purdue University Fort Wayne

October 25, 2019 (update)

Mark F. Masters, Ph.D., Department of Physics

Introduction: Astronomy and Astrophysics are the endeavor to understand the universe. It involves both planetary science (EAPS) and also stellar science. Astronomy and Astrophysics endeavor to explain the origin of celestial objects and phenomena.

The intention of this proposal is to create a preliminary program that will evolve. At the moment we are intending to use courses from EAPS and ASTR as well as PHYS to build the program. We are intending to have an Astrophysics track within the concentration. The difference will largely be that the Astrophysics track will require spectroscopy and instrumentation classes in addition to the astronomy core classes.

An investigation of existing astronomy programs indicates that most of the courses are physics based in any astronomy degree. IU's B.S. in Astronomy and Astrophysics requires 5 astronomy classes. We are approaching astronomy from a slightly different perspective. We will use 3 low level conceptual astronomy courses, then an additional 3 upper level astronomy classes. However, we will have special sections or directed segments of core physics classes that are oriented towards astronomy.

The primary reason that we wish to offer an astronomy concentration is recruiting. Astronomy has much better gender and race diversity than does physics. We predict we can recruit between 5 and 10 new students a year by having an astronomy concentration.

1. Name of proposed new program

Bachelor of Science in Physics with a concentration in Astronomy and Astrophysics

2. Title of degree to be conferred

Bachelor of Science

3. Field of study, department, and school involved

Astronomy and Astrophysics/Physics, Department of Physics, College of Arts and Sciences

4. Objectives of the proposed concentration

There are several objectives for this concentration:

a. Primarily, we want to use the astronomy concentration as a recruiting opportunity. This can

significantly increase our diversity AND help with growing the physics program at a greater rate. Looking at the data from the American Institute of Physics and the newly released report on Women in Physics and Astronomy we find that women make up about 35% of Astronomy Bachelor's degrees. In physics the fraction is approximately 20%. Furthermore, our current recruiting indicates that more women come in with an interest in astronomy than physics. For example, prior to the split of IPFW, in 2016 we had 8 new incoming majors of these, half were women that were interested in astronomy. At PFW, the number of incoming physics students has increased to 18 for each of the last two years with about 1/3 of the students each year expressing interest in astronomy. This is without having any astronomy program. (<https://www.aip.org/statistics/reports/women-physics-and-astronomy-2019>)

b. If we create an astronomy program, we project that we can double this number at least (advertising actually works). These would be 6 students who would not be coming to Purdue Fort Wayne otherwise PER YEAR. Over 4 years this would be 24 new students at PFW with a revenue of \$194,000. This is more than the cost of faculty necessary for the program AND because they teach much more than just those few students – teaching in physics, and general astronomy they actually can make the university money. Remember that as a university we are down by 100+ students and that is considered significant.

c. Most of our graduates work in industry and are classified as “engineers.” Because this program is very similar to the physics program, we believe student outcomes will continue to be significant. This concentration should also open new graduate school opportunities for them as well.

c. Within physics, it is critical to provide students with more options than just simply physics as is recommended by the SPIN-UP report and our last program review. SPIN-UP was a National Science Foundation sponsored project that investigated qualities that make a successful, thriving physics department. (<http://www.aps.org/programs/education/undergrad/faculty/spinup/upload/SPIN-UP-Report.pdf>) In this project, it was found that having one or more concentrations is extremely beneficial to the physics program, helping to attract more majors.

5. Proposed date of initiation of the new program

Fall 2020

6. A statement describing the relationship of the proposed program to the mission and scope of the campus

Department Mission: The relevant part of the Department of Physics Mission Statement is “producing well prepared graduates who are confident in their abilities and understanding of physics,” and “Physics Majors will gain a strong working knowledge of basic science and physics.”

The proposed concentration is clearly within this mission.

College Mission: “...the college provides students with a breadth of knowledge about the global environment and fosters an appreciation and respect for diversity. The College of Arts and Sciences equips students to think critically, communicate effectively, and develop creative solutions to future challenges.”

This proposed concentration is directly related to the college mission statement, particularly breadth of knowledge and creative solutions to future challenges. It does so by providing a concentration that is of growing importance.

PFW Mission: “We offer a broad range of high-quality undergraduate, graduate, and continuing education programs that meet regional needs ...”

The proposed concentration will be of high quality and provide a unique opportunity for students of Northeast Indiana. The PFW Physics Program has a unique approach to physics education which has made us the largest undergraduate only physics program in the state as measured by number of majors AND number of graduates.

7. A statement describing the relationship of the proposed program to already existing programs at the campus.

There are no Astronomy and Astrophysics programs at PFW. However, we have taught low level courses in Astronomy for a long time. Furthermore, we have had the minor, but minors are not good recruiting tools.

8. A statement describing the relationship of this program to similar programs in other regional and Indiana post-secondary educational institutions.

Ball State, IU, and Valparaiso are the only schools in Indiana that have astronomy programs. PUWL physics astrophysics listed under the applied physics option.

9. A statement describing cooperative endeavors explored and/or intended with other institutions particularly those located in the same geographic region.

PFW Physics with a concentration in Astronomy with a track in Astrophysics would be a good contribution for the region. Space science contributes significantly to the local economy (see Harris).

10. A statement indicating need for the concentration in terms of manpower supply and demand.

This concentration adds courses, specialization and focus to a physics degree which is inherently a general program. Looking at www.hoosierdata.in.gov, there is no astronomy/astrophysics category. Choosing Space Science and Physicist leads to some moderate demand predictions. However, the employment success of our graduates is a better measure.

Our majors consistently achieve 100% employment in good paying positions. Physics is very general. It is not a training program. However we prepare our students for work in industry (as well as graduate school if they so choose). The astronomy concentration is no different. The types of jobs they would pursue would be the same as those with physics degrees.

We have not had many minors in astronomy: of the two that graduated one is a systems engineer at Harris. The other is an astronomy educator. Minors are not a good measure of a program because minors really do not add much beyond some courses.

11. A statement describing resources over and above present levels required to initiate the program

The Astronomy and Astrophysics concentration consists of core physics courses in combination with astronomy classes. However, for this to succeed, we will need an **astronomer in a TT position**. A visitor cannot be used to build the program. **The astronomer will also teach physics courses (not just astronomy courses).**

Some context: The physics program (# majors) has grown by 300% in the last decade. A decade ago, we had 6 T/TT faculty. Now we have 5. As a department physics has been significantly under-resourced. While we are the largest undergraduate only program in the state, we are also the smallest number of faculty. As it stands, faculty are regularly on overloads. We have large groups of research students. The chair of the department has 18+ research students this semester not to mention teaching at least 4 hours beyond load.

We have a total teaching staff of 10. Two of these are visitors. One of the visitors (an astronomer) has been a visitor for the past 3 years. We have 3 continuing lecturers (one is a geophysicist). If you count VCAA Drummond, we have 6 T/TT faculty. **The request for a TT line for an astronomer is because we are under resourced and even if not an astronomer, we need two TT positions.**

Our most recent program review indicated that to continue our growth we need AT LEAST 3 positions: two TT and one CL. This has been communicated to the administration and they recognized the need.

As stated previously, the ability to attract new students to PFW is important and brings new revenue to the university.

12. Proposed Curriculum

The proposed curriculum starts with a physics core common to all specializations.

COAS Requirements: 14 credit hours.

Second semester writing	(3)
Foreign Language	(8)
Speaking	(3)

General Education: 21 credit hours

Core Physics courses: 20 credit hours

PHYS 15200 – Mechanics	(5)
PHYS 25100 – Heat, Electricity, Magnetism and Optics	(5)
PHYS 34200 – Modern Physics	(3)
PHYS 34300 – Modern Physics Laboratory	(1)
PHYS 44200 – Quantum Mechanics	(3)
PHYS 48001 – Senior Thesis I	(2)
PHYS 48002 – Senior Thesis II	(1)

Core Supplementary Courses: 16 credit hours

CHM 11500	(4)
MA 16500	(4)
MA 16600	(4)
MA 26100	(4)

Additional Physics Classes: 20 credit hours

PHYS 30500 – Mathematical Methods	(3)
PHYS 31000 – Intermediate mechanics	(3)
PHYS 31200 – Intermediate Electricity and Magnetism I	(3)
PHYS 32201 – Intermediate Optics for Astronomy (proposed)	(3)
PHYS 34501 – Optics Laboratory for Astronomy (proposed)	(1)
PHYS 32500 – Scientific Computing	(3)
PHYS 34600 – Advanced laboratory	(1)
PHYS 41800 – Statistical mechanics	(3)

Additional supporting classes: 4 credit hours

CHM 11600 Chemistry II	(4)
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Core Astronomy/Astrophysics Classes: 18 credit hours

ASTR 10000 – The Solar System	(3)
ASTR 10500 – Stellar Astronomy	(3)
PHYS 13500 – The Big Bang (currently the first 3 minutes)	(3)
ASTR 36400 – Stellar Astronomy	(3)
ASTR 37000 – Cosmology	(3)
ASTR 40100 – Astrophysics	(3)

Astrophysics Track

PHYS 36100 – Electronics for Scientists	(4)
PHYS 53600 – Instrumentation	(4)
PHYS 52400 – Spectroscopy	(4)

The laboratories (PHYS 343, 345 and 346 will also have investigations specific for Astronomy students that will provide synthesizing experiences).

Library Resources

A quick search of the e-journal list indicates more than 40 journals available.