

MICHIGAN STATE
UNIVERSITY

January 13, 2023

MEMORANDUM

TO: Dr. Mark Largent, Associate Provost for Undergraduate Education
and Dean of Undergraduate Studies

FROM: Joy Speas, University Curriculum Administrator

RE: Request for a New Minor in Physics

For Transmittal to the University Committee on Undergraduate
Education (UCUE)

The request referenced above is being sent to the University Committee on Undergraduate Education (UCUE) in accordance with the *Bylaws for Academic Governance*, 4.4.

UCUE Response Requested:

Please ask the committee to consider the request referenced above and provide consultative commentary. Please mail the related materials referenced under the heading Attachments at the end of this memorandum to the committee members.

After receiving the committee's consultative response, the Provost will make a determination to forward or not to forward the request to the University Committee on Curriculum for its approval of curriculum and degree requirements.

If you have any questions, please call me at 5-8420.

Thank you.

Attachments:

1. Request to Establish a New Academic Program form dated January 3, 2022: Minor in Physics and attachments.



**University
Curriculum and
Catalog**

Hannah Admin. Building
426 Auditorium Road
Suite 430
East Lansing, MI 48824

517-355-8420
Fax: 517-355-9601

s:\share\ucuephymnun

COLLEGE OF NATURAL SCIENCE

1. Request to establish a **Minor in Physics** in the Department of Physics and Astronomy. The University Committee on Undergraduate Education (UCUE) will consider this request at its January 19, 2023 meeting.

- a. **Background Information:**

Physics is a fundamental science that is intimately connected to all other natural sciences, including chemistry, biology and geology. Students in many other fields also express an interest in learning physics because it emphasizes problem-solving, building mathematical models, and analytical skills. The proposed Minor in Physics will be administered by the Department of Physics and Astronomy (PA), in collaboration with the Department of Computational Mathematics, Science, and Engineering (CMSE). The minor will provide students with a deep understanding of the discipline of physics and to the fundamental physical laws at play in the world around us –and in the universe as a whole. The minor complements other majors where additional physics knowledge beyond the introductory level is beneficial. It will prepare students to apply scientific methodology, to think critically and quantitatively, and to understand the experimental and theoretical methods used in modern physics. These methods include computational skills which are increasingly essential for many 21st century jobs (see for example, <https://www.forbes.com/sites/bernardmarr/2022/08/22/the-top-10-most-in-demand-skills-for-the-next-10-years/>).

A substantial number of universities offer minors in physics, for the same reasons given above. The requirements and scope of the minor are quite similar to those offered by peer institutions. However, the inclusion of the computational course in our program sets it apart from other physics minors.

Michigan State, through the Department of Physics and Astronomy, already offers a Disciplinary Teaching Minor in Physics, in partnership with the College of Education. However, this minor is available only for students in Teacher Education. In contrast, the proposed minor is available for MSU undergraduates at large. The requirements of the Disciplinary Teaching Minor in Physics overlap substantially with the Physics minor. The most notable difference is the inclusion of the computational course.

- b. **Academic Programs Catalog Text:**

The Minor in Physics provides students with a deep understanding of the discipline of physics and to the fundamental physical laws at play in the world around us –and in the universe as a whole. The minor complements other majors where additional physics knowledge beyond the introductory level is beneficial. It prepares students to apply scientific methodology, to think critically and quantitatively, and to understand the experimental and theoretical methods used in modern physics.

The minor is available as an elective to students who are enrolled in bachelor's degree programs at Michigan State University other than the Bachelor of Arts and Bachelor of Science Degrees in Physics, the Bachelor of Science Degree in Chemical Physics, and the Bachelor of Science Degree in Astrophysics. The minor is not available to students pursuing teacher certification through the Disciplinary Teaching Minor in Physics.

With the approval of the department and college that administer the student's degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.

Students who plan to complete the requirements of the minor should consult the undergraduate advisor in the Department of Physics and Astronomy. Admission to the minor requires approval by the Physics and Astronomy undergraduate program director to ensure students are informed of the minor requirements, and have adequate preparation, including the math prerequisites.

Requirements for the Minor in Physics

CREDITS

Students must complete a minimum of 20 credits from the following:

1. One of the following (5 credits):
 - (a) PHY 173 Studio Physics for Scientists and Engineers I 5
 - (b) PHY 183 Physics for Scientists and Engineers I 4
 - PHY 191 Physics Laboratory for Scientists, I 1
 - (c) PHY 191 Physics Laboratory for Scientists, I 1
 - PHY 193H Honors Physics I – Mechanics 4
2. One of the following (5 credits):
 - (a) PHY 174 Studio Physics for Scientists and Engineers II 5
 - (b) PHY 184 Physics for Scientists and Engineers II 4
 - PHY 192 Physics Laboratory for Scientists, II 1
 - (c) PHY 192 Physics Laboratory for Scientists, II 1
 - PHY 294H Honors Physics II – Electromagnetism 4
3. The following course (3 credits):
PHY 215 Thermodynamics and Modern Physics 3
4. One of the following courses (3 or 4 credits):
PHY 431 Optics I 3
PHY 440 Electronics 4
PHY 451 may be substituted for PHY 431 or PHY 440.
5. The following course (4 credits):
CMSE 201 Computational Modeling and Data Analysis I 4

Effective Fall 2023.



View a Program

Joy Speas, Office of the Registrar

Thursday, 1/5/2023

Program Name: Physics
Degree: MNUN Sequence Number: 1

Program Request ID: 4775

Effective Dates: Spring 2023 - Open Status: Interim Initial Action: New

Requested Date: 7/30/2022 6:44:53 PM

1. Department/School/College:

10032666 Department of Physics and Astronomy

2. Name of Program:

Physics

3. Name of Degree:

MNUN

4. Type of Program:

Minor

5. Effective Start Semester:

~~Spring 2023~~ Summer 2023

6. Target student audience for the program:

Undergraduates at MSU

7. Enrollment:

What is the expected enrollment per year: 20

What is the minimum enrollment acceptable: 0

8. Source of budget for the program:

To align academic planning and curricular change, ALL requests for NEW funds must be included in the College's annual planning letter. Provost approval of new funds and the effective date for the new program must align. If funding is not approved, then the program request will not be forwarded to Faculty Senate.

Internal reallocation

If new funds, was this request included in the College's annual planning letter? Indicate yes or no. If no, then this is a department or college fund reallocation (If the program is implemented, no additional resources are required.).

NA

9. Projected Costs as compared to other programs in unit:

Lower

10. Staff requirement:

How many additional staff will be required: 0

Who will provide the primary instruction. Describe any external linkages(industry, government, etc.):

Existing faculty in the Department of Physics and Astronomy. No additional staff are required as all of the courses already exist and are adequately staffed as part of the existing degree programs in physics and astrophysics.

11. Will additional equipment be required:

Approximate cost: 0

Source of funding:

12. Will additional library materials be required:

Approximate cost: 0

Source of funding: NA

13. Will additional space be required:

Type: NA

Approximate amount: NA

14. If the program requirements contain a named concentration, do you wish for the concentration to be noted on the student's transcript?:

No

15. Detailed Description:

A. Background information: (including the considerations which precipitated the development of the program, and its relationship to similar programs offered at MSU and by other educational institutions. Supply a copy of standards of accrediting agencies and federal regulations related to the request as appropriate.) B. Rationale for offering the program at MSU:

Physics is a fundamental science that is intimately connected to all other natural sciences, including chemistry, biology and geology. Students in many other fields also express an interest in learning physics because it emphasizes problem solving, building mathematical models, and analytical skills. The Minor in Physics proposed here will be administered by the Department of Physics and Astronomy (PA), in collaboration with the Department of

Computational Mathematics, Science, and Engineering (CMSE). The minor will provide students with a deep understanding of the discipline of physics and to the fundamental physical laws at play in the world around us – and in the universe as a whole. The minor complements other majors where additional physics knowledge beyond the introductory level is beneficial. It will prepare students to apply scientific methodology, to think critically and quantitatively, and to understand the experimental and theoretical methods used in modern physics. These methods include computational skills which are increasingly essential for many 21st century jobs (see for example, <https://www.forbes.com/sites/bernardmarr/2022/08/22/the-top-10-most-in-demand-skills-for-the-next-10-years/>)

A substantial number of universities offer minors in physics, for the same reasons given above. The requirements and scope of the minor proposed here are quite similar to those offered by peer institutions. However, the inclusion of the computational course in our program sets it apart from other physics minors.

Here at Michigan State, the Department of Physics and Astronomy already offers a Disciplinary Teaching Minor in Physics, in partnership with the College of Education. However, this minor is available only for students in Teacher Education. In contrast, the minor proposed here is available for MSU undergraduates at large. The requirements of the Disciplinary Teaching Minor in Physics overlap substantially with the Physics minor proposed here. The most notable difference is the inclusion of the computational course in the proposed minor.

C. Rationale for the program being housed in the primary administrative unit:

The Department of Physics and Astronomy is the appropriate primary administrative unit for this minor because almost all of the required courses are administered by the department. The only required course administered by another department is CMSE 201, offered by the Department of Computational Mathematics, Science, and Engineering. The two departments will collaborate to ensure that students working on the minor will have access to one of more sections of CMSE 201 that do not interfere with the required physics courses.

D. Educational objectives of the program and their relationship to those of the college and the University.

Broadly speaking the goals of the Physics Minor are:

- (1) Provide a solid foundation in the core principles of mechanics, electromagnetism and modern physics.
- (2) Prepare students to engage in science practices to apply these principles.

With respect to fundamental principles, the Physics Minor is centered on the following core ideas: interactions can cause changes in motion; energy is conserved; exchanges of energy increase total entropy; interactions are mediated by fields; energy, momentum, angular

momentum and information can be transported without the net transfer of matter. Moreover, students will be introduced to the foundations of modern physics including relativity, wave-particle duality and quantum mechanics. With respect to science practices, students will apply the core ideas to conduct practices, such as constructing mathematical and computational models that describe the behavior of physical systems, and analyzing and interpreting data.

The goals of this minor are closely aligned with the University's Undergraduate Learning Goals (<https://undergrad.msu.edu/programs/learninggoals>), particularly those in the "Analytical Thinking," "Effective Communication," and "Integrated Reasoning" categories.

E. Faculty who were instrumental in developing the program and faculty who will be responsible for implementing the program

The Physics Minor presented here was developed by Stuart Tessmer, PA Director of Undergraduate Studies, and Devin Silvia, CMSE Director of Undergraduate Studies, in consultation with Marcos (Danny) Caballero and Paul Gueye, both of whom are professors in the Dept. of Physics and Astronomy. Following departmental bylaws, the rational and detailed curriculum of the Physics Minor were presented to the PA faculty, which unanimously supported the program.

F. Plan for evaluating the program. Plan for assessing student outcomes. For academic major programs, indicate the learning objectives/goals for students and how outcomes will be assessed

The Minor in Physics will be monitored primarily by the Department of Physics and Astronomy. The educational objectives described in (D), above, are met in the specific courses listed in part (G). Students will be assessed on their achievement of the minor-wide learning goals as part of the assessments of these courses, which are reviewed periodically by the PA Teaching Evaluation Committee. These evaluations include a written report based on classroom visits and course materials, to ensure that the educational goals, including core ideas and science practices are met. For the CMSE 201 requirement, Physics and Astronomy will coordinate with the Undergraduate Director in CMSE for the assessment of the learning goals within that course and student achievement in these areas.

G. Program description including statement and specific requirements of the program

The proposed minor will be available as an elective to students who are enrolled in bachelor's degree programs at Michigan State University, except students who are pursuing the following degrees: (1) Bachelor of Arts in Physics (CNS), (2) Bachelor of Science in Physics (offered by both CNS and LBC), (3) the Bachelor of Science Degree in Astrophysics (offered by both CNS and LBC), (4) Bachelor of Science in Chemical Physics (offered by both CNS and LBC); moreover, the minor is not available to students working on (5) Disciplinary Teaching Minor in Physics.

With the approval of the department and college that administer the student's degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.

Students who plan to complete the requirements of the minor should consult the undergraduate advisor in the Department of Physics and Astronomy. Admissions to the minor requires approval by the PA Undergraduate Program Director; this mechanism will ensure that the students are informed of the minor requirements, and have adequate preparation, including the math prerequisites.

Minor Requirements

PHY 173 or (PHY 183 & PHY 191) or (PHY 193H & PHY 191) – Physics for Scientists and Engineers I and accompanying lab, 5 units

PHY 174 or (PHY 184 & PHY 192) or (PHY 294H & PHY 192) – Physics for Scientists and Engineers II and accompanying lab, 5 units

PHY 215 – Modern Physics, 3 units

PHY 431 or PHY 440 – Optics or Electronics, 3 or 4 units

CMSE 201 – Computational Modeling and Data Analysis I, 4 units

Comments: Total credits above are 20-21. Hidden requirements are prerequisite courses MTH 132, MTH 133, and MTH 234. Advanced Lab, PHY 451, would be accepted as a substitution for PHY 431/440.

H. If the program will be offered in a location other than the main campus in East Lansing, specify the location (s).

This program will only be offered on MSU's Main Campus.

I. Certificate program:

N/A

J. Other information:

N/A

16. Are there admissions requirements for this program?:

Grade or grade-point average requirements and if so in which course(s), portfolio requirement, audition, essay, etc. If there are not admission requirements other than those required by the University policy indicate "none".

none

DEPARTMENT LEVEL APPROVAL STATUS

Approved: Department of Physics and Astronomy

12/20/2022 6:27:37 PM by Stuart Tessmer for Stephen E. Zepf, Chairperson

COLLEGE LEVEL APPROVAL STATUS

Approved: College of Natural Science

1/3/2023 11:02:24 AM by Estrella Starn for LynnMarie Posey, Associate Dean

Call us: (517) 355-3300

**Contact Information (/contact.aspx) | Site Map (/sitemap.aspx) | Privacy Statement (/privacy.aspx) |
Site Accessibility (/siteaccessibility.aspx#)**

Call MSU: **(517) 355-1855** | Visit: **msu.edu (http://msu.edu)**

MSU is an affirmative-action, equal-opportunity employer. | **Notice of Nondiscrimination (https://civilrights.msu.edu/policies/)**

SPARTANS WILL. | © Michigan State University



TEACHER CERTIFICATION OPTIONS

The physics disciplinary majors leading to the Bachelor of Arts and Bachelor of Science degrees are available for teacher certification.

A physics disciplinary minor is also available for teacher certification.

Students who elect a physics disciplinary major or the physics disciplinary minor must contact the Department of Physics and Astronomy.

For additional information, refer to the statement on *TEACHER CERTIFICATION* in the *Department of Teacher Education* section of this catalog.

MINOR IN PHYSICS

The Minor in Physics provides students with a deep understanding of the discipline of physics and to the fundamental physical laws at play in the world around us –and in the universe as a whole. The minor complements other majors where additional physics knowledge beyond the introductory level is beneficial. It prepares students to apply scientific methodology, to think critically and quantitatively, and to understand the experimental and theoretical methods used in modern physics.

The minor is available as an elective to students who are enrolled in bachelor's degree programs at Michigan State University other than the Bachelor of Arts and Bachelor of Science Degrees in Physics, the Bachelor of Science Degree in Chemical Physics, and the Bachelor of Science Degree in Astrophysics. The minor is not available to students pursuing teacher certification through the Disciplinary Teaching Minor in Physics.

With the approval of the department and college that administer the student's degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.

Students who plan to complete the requirements of the minor should consult the undergraduate advisor in the Department of Physics and Astronomy. Admission to the minor requires approval by the Physics and Astronomy undergraduate program director to ensure students are informed of the minor requirements, and have adequate preparation, including the math prerequisites.

Requirements for the Minor in Physics

CREDITS

Students must complete a minimum of 20 credits from the following:

1. One of the following (5 credits):

| | | | | | |
|--|-----|-----|------|---|---|
| | (a) | PHY | 173 | Studio Physics for Scientists and Engineers I | 5 |
| | (b) | PHY | 183 | Physics for Scientists and Engineers I | 4 |
| | | PHY | 191 | Physics Laboratory for Scientists, I | 1 |
| | (c) | PHY | 191 | Physics Laboratory for Scientists, I | 1 |
| | | PHY | 193H | Honors Physics I – Mechanics | 4 |
2. One of the following (5 credits):

| | | | | | |
|--|-----|-----|------|--|---|
| | (a) | PHY | 174 | Studio Physics for Scientists and Engineers II | 5 |
| | (b) | PHY | 184 | Physics for Scientists and Engineers II | 4 |
| | | PHY | 192 | Physics Laboratory for Scientists, II | 1 |
| | (c) | PHY | 192 | Physics Laboratory for Scientists, II | 1 |
| | | PHY | 294H | Honors Physics II – Electromagnetism | 4 |
3. The following course (3 credits):

| | | | | |
|--|-----|-----|-----------------------------------|---|
| | PHY | 215 | Thermodynamics and Modern Physics | 3 |
|--|-----|-----|-----------------------------------|---|
4. One of the following courses (3 or 4 credits):

| | | | | |
|--|-----|-----|-------------|---|
| | PHY | 431 | Optics I | 3 |
| | PHY | 440 | Electronics | 4 |

PHY 451 may be substituted for PHY 431 or PHY 440.
5. The following course (4 credits):

| | | | | |
|--|------|-----|--|---|
| | CMSE | 201 | Computational Modeling and Data Analysis I | 4 |
|--|------|-----|--|---|