ST MARY'S
COLLEGE of MARYLAND
The Public Honors College

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DEAN OF FACULTY
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November 5, 2018

James D. Fielder Jr., Ph.D.
Secretary of Higher Education
Maryland Higher Education Commission
6 North Liberty Street
Baltimore, MD 21201

Dear Dr. Fielder,

Please find the attached proposal for a Concentration in Applied Physics within the Physics major at St. Mary's College of Maryland. I believe you will find the proposal complete and compelling.

As per the proposal template, President Jordan and I confirm that the College's Hilda C. Landers Library has sufficient resources to support the proposed program and that the College has sufficient equipment and facilities to support the proposed program.

If there are any questions concerning this proposal, please contact Dr. Christine Wooley, Associate Dean of Curriculum (cawooley@smcm.edu or 240-895-3081).

Sincerely,

Michael R. Wick, Ph.D.
Provost and Dean of Faculty

Office Use Only: PP#

MHEC
Creating a state of achievement

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	St. Mary's College of Maryland

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ◉ New Area of Concentration
- ○ New Degree Level Approval
- ○ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ○ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ○ Offer Program at Regional Higher Education Center

Payment Submitted: ◉ Yes ○ No | Payment Type: ◉ R*STARS ○ Check | Payment Amount: $250 | Date Submitted: 12/7/18

Department Proposing Program	Department of Physics	
Degree Level and Degree Type	Undergraduate, Bachelor of Science	
Title of Proposed Program	Concentration in Applied Physics	
Total Number of Credits	60	
Suggested Codes	HEGIS: 1902.00	CIP: 40.0801
Program Modality	◉ On-campus ○ Distance Education (*fully online*) ○ Both	
Program Resources	◉ Using Existing Resources ○ Requiring New Resources	
Projected Implementation Date	◉ Fall ○ Spring ○ Summer	Year: 2012
Provide Link to Most Recent Academic Catalog	URL: http://smcm.edu/catalog/	
Preferred Contact for this Proposal	Name: Christine A. Wooley	
	Title: Associate Dean of Curriculum	
	Phone: (240) 895-3081	
	Email: cawooley@smcm.edu	
President/Chief Executive	Type Name: Tuajuanda C. Jordan	
	Signature: [signature] Date: 12.12.2018	
	Date of Approval/Endorsement by Governing Board:	

Revised 12/2018

Proposal for a Concentration in Applied Physics in the Physics Major at St. Mary's College of Maryland

A. Centrality to Institutional Mission and Planning Priorities

1. Description of the Concentration

Physics is the most fundamental of all of the sciences; its goal is nothing less than to figure out the most basic laws which govern the universe. Because of this, the study of physics offers deep insights into many disciplines: knowledge of physics is a foundation for understanding the fundamentals of chemistry, biology and geology. It also offers insight into other aspects of our modern world. For example, two allied problems of today are the energy crisis and the issue of global climate change. It is impossible to understand either of these issues without some knowledge of physics.

The goals of the Physics Department are to a) teach our students a basic understanding of the laws of physics and their applications; b) teach them to understand the structure of the Universe around us as generated by those laws; and c) provide our majors with an introduction to research methods in physics (both experimental and theoretical.)
To this end, we offer a rigorous major program in physics with concentrations in two areas: fundamental and applied physics. The applied physics track is meant for students interested in future work and/or graduate study in the applied sciences or technology (i.e., in disciplines such as applied physics, engineering, geology or geophysics, biophysics and bioengineering, etc.), while the fundamental physics track is a standard undergraduate program primarily meant for students who are interested in pursuing a graduate career in physics. Both programs are equally rigorous.

New concentration and the College Mission

St. Mary's College of Maryland (SMCM) is Maryland's honors college, a selective, public liberal arts college-- a vibrant community of scholars and learners. We foster a rigorous and innovative curriculum; experiential learning; scholarship and creativity; close mentoring relationships; and a community dedicated to honesty, civility, and integrity. We are committed to diversity, access, and affordability. Our students, faculty and staff serve local, national, and global communities and cultivate and promote social responsibility.
The rigor of the new Applied Physics concentration's curriculum is on par with the previously approved physics major (now called the Fundamental Physics concentration within the physics major). Applied physics programs are not common among undergraduate only institutions: our concentration is an innovative approach to helping undergraduates interested in engineering pursue a liberal arts education at a small institution like ours. Because the Applied Physics concentration requires research, this new program supports the College's commitment to experiential learning.

2. Relationship to Institutional Strategic Goals

The proposed concentration relates to the following three of the College's five strategic goals:

--Attract intellectually ambitious students who thrive in and respect a diverse, collaborative learning community.
--Engage students in a rigorous, experiential, flexible, innovative academic environment that capitalizes on our unique geographical location.
--Graduate prepared, responsible, and thoughtful global citizens and leaders.

The new concentration in Applied Physics will attract intellectually ambitious students by offering them another option for studying physics, one that focuses on applications. The curriculum will be rigorous, paralleling the Physics curriculum already approved by MHEC for the major, treating core physics topics but also diversifying students' academic experience through the required chemistry or computer science course, and introducing application via an electronics course and applied topics courses. The research requirement ensures an experiential component. We expect many students will complete their research at the nearby Patuxent River Naval Air Station. Students who complete the Physics major with the Concentration in Applied Physics will be prepared to enter the workforce in a wide range of technical and analytical jobs, and they will be prepared to enter graduate school in engineering or a variety of applied science programs.

3. **Program funding**
   The Patuxent Partnership, a regional non-profit, donated $1,000,000 to support the new Applied Physics concentration. This money, along with investment returns that it earns, will provide start-up research funds and salary for one new faculty member for over a decade; this additional faculty line has been allocated to support the concentration, increasing the physics department faculty from four to five. Otherwise, no additional resources are needed in order to fund this program.

4. **Institutional Commitment**
   - **a.** SMCM has approved the Applied Physics concentration via its Curricular Review Committee, faculty senate, faculty, and Board of Trustees. Because the concentration shares administrative, financial, and technical support with the existing physics major, these supports are adequate.
   - **b.** The concentration will operate as part of the physics major, certainly for more than a decade. The physics major itself has existed since the 1990's, and it will operate in the long term-- now with both the new Applied Physics concentration and the existing structure to be called the Fundamental Physics concentration.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

1. **Demand and need for the program in terms of meeting present and future needs of the region and the State**
    a. **Advancement and Evolution of Knowledge:** Applied Physics takes the techniques and understanding accrued in physics, and it applies them toward developing new technologies and improving existing ones.
    b. **Societal Needs:** On a spectrum from the fundamental studies of physics to the entirely applied field of engineering, applied physics serves as a bridge. Graduates from this program can work in certain engineering jobs, as well as a wide range of other technical and scientific positions. These jobs are very much in demand in the state, forming an important part of the tech economy; workforce demand for people with this background employed by the Navy at Patuxent River Naval Air Station and for defense contractors is what motivated the Patuxent Partnership to donate funds for the program. As an institution with a commitment to access and diversity as well as a rigorous educational experience, St. Mary's supports a wide range of learners in their efforts to pursue higher education. To the extent that the applied physics concentration offers such an experience and a clear pathway to post-graduation employment, the concentration is expanding educational opportunities and providing practical choices for students who may need the assurance of employment in order to invest in a college education.

2. **Consistency with the Maryland State Plan for Postsecondary Education**
    The Maryland State Plan for Postsecondary Education[1] identifies increasing STEM degrees awarded to students as a key goal. This concentration is designed to do so, attracting more students by broadening the physics options offered to them.

    Among the enumerated goals of the State Plan, this concentration directly related to the following:

    GOAL 1: QUALITY AND EFFECTIVENESS: Maryland will enhance its array of postsecondary education institutions and programs, which are recognized nationally for academic excellence and more effectively fulfill the evolving educational needs of its students, the state, and the nation.
    The concentration in Applied Physics connects physics to technological applications, and it helps meet the scientific and technical workforce needs of employers in Southern Maryland, the State as a whole, and the nation.

    GOAL 3: DIVERSITY: Maryland will ensure equitable opportunity for academic success and cultural competency for Maryland's population.

[1] *Maryland Ready: 2013 - 2017 Maryland State Plan for Postsecondary Education*, Maryland Higher Education Commission, http://mhec.maryland.gov/institutions_training/Documents/acadaff/acadproginstitapprovals/MHECStatePlan_2014.pdf.

While not directly related to the concentration in Applied Physics, SMCM's Physics Department's initiatives on diversity, inclusion, and equity have been been presented in a national publication as a case student of effective practices.[2]

Goal 4: INNOVATION: Maryland will seek to be a national leader in the exploration, development, and implementation of creative and diverse education and training opportunities that will align with state goals, increases student engagement, and improve learning outcomes and completion rates.

Applied Physics programs are relatively rare at institutions that do not also have a doctoral program in the field. The proposed program presents a special opportunity for students to combine a liberal arts education with an applied science. Additionally, the Department of Physics at SMCM was featured as a role model of best practices and innovation in the national report *Phys21: Preparing Physics Students for 21st-Century Careers*.[3]

GOAL 5: ECONOMIC GROWTH AND VITALITY: Maryland will stimulate growth, innovation, and vitality by supporting a knowledge-based economy, especially through increasing education and training and promoting the advancement and commercialization of research.

The Applied Physics concentration will help meet the technological workforce demands of the knowledge-based economy. Students in the concentration must participate in research. Most students participate in external internships, including at the nearby labs of the Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

Not required for liberal arts and sciences.

D. Reasonableness of Program Duplication

Not required for liberal arts and sciences.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

1. Program's potential impact on the implementation or maintenance of high-demand programs at HBI's

The proposed program does not replicate or directly compete with similar programs at any of the four Maryland public Historically Black Institutions. Morgan State University has programs in Physics and Engineering Physics but these programs do not substantially overlap with the proposed Applied Physics concentration.

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[2] "Common Challenges Faced by Women of Color in Physics, and Actions Faculty Can Take to Minimize Those Challenges," Angela Johnson et al., *The Physics Teacher* **55**, 356 (2017).

[3] Paula Heron and Laurie McNeil (co-chairs), *Phys21: Preparing Students for 21st-Century Careers* (American Physical Society, 2016).

F. Relevance to the identity of Historically Black Institutions (HBIs)

1. **Program's potential impact on the uniqueness and institutional identities and missions of HBIs.**
   The proposed Applied Physics concentration will have no impact on the uniqueness, institutional identities, or missions of any Historically Black Institution.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10):

1. **Describe how the proposed program was established, and also describe the faculty who will oversee the program.**
   The proposed programs was designed by faculty in the Physics Department at St. Mary's College of Maryland. It was reviewed and approved in succession by the faculty Curriculum Review Committee, the faculty Senate, the College faculty, and the Board of Trustees.

   The Physics Department faculty will oversee the program; each faculty member holds a doctoral degree in physics. They include chair Joshua Grossman, Charles Adler, Erin De Pree, Michelle Milne, and Katsunori Mita.

2. **Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.**
   The goals of the concentration in Applied Physics in the Physics major are to teach students a basic understanding of the laws of physics and their application and to provide our majors with an introduction to research methods in physics (both experimental and theoretical).

   At the completion of the Physics major with a concentration in Applied Physics, students will be able to…
   - integrate the many laws of physics to explain the phenomena of a specific real-world problem.
   - produce new knowledge by application of appropriate physical models to real-world situations.
   - construct clear and concise written explanations and oral presentations of their work at a level appropriate for the audience.
   - build a useful model of a real-world situation.
   - locate relevant information sources for use.
   - seek new and unexpected situations to analyze and understand.

3. **Explain how the institution will:**
   a. **provide for assessment of student achievement of learning outcomes in the program**

   St. Mary's College of Maryland has a three-year assessment cycle for institutional as well as programmatic learning outcomes. The assessment cycle of programmatic

learning will necessarily include this new concentration. Just as outcomes for the Physics major and minor are assessed over a three-year cycle, so to will the new concentration in Applied Physics be assessed.

Programmatic assessment at St. Mary's is organized by the Department Chair in consultation with the Assessment Implementation Team and the Coordinator of Transparent Teaching and Assessment, who helps departments conduct curricular mapping that links course-level outcomes to programmatic outcomes. In order to assess the programmatic outcomes for the Concentration in Applied Physics, the chair will create an assessment cycle that identifies courses in which learning outcomes map to outcomes from the concentration, each of which will be assess over a three year period. In addition, the department regularly uses research-based assessment tools, such as the Force Concept Inventory,[4] Conceptual Survey of Electricity & Magnetism,[5] the Wave Diagnostic Test,[6] etc.

b. document student achievement of learning outcomes in the program
Currently, assessment data generated by programmatic assessment cycles are logged into Campus Labs Outcomes, an assessment software package. Faculty members evaluate students' achievement via a designated course artifact and assessment instrument, such as a rubric. These data provide faculty with information about student performance that can inform the future iterations of their classes. At the same time, by entering these data into Outcomes, programs can track the percentage of students in a given course who have met (or not met) a course learning outcome; taken together, data from course learning outcomes linked to a program learning outcome tells us how many student have met the program learning outcome. The Assessment Implementation Team, with the support of the Provost's Office, works with faculty members and chairs to make sure that these achievements are documented.

4. Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements

Degree Requirements for the Physics Major - Concentration in Applied Physics
To earn a bachelor of science degree with a major in physics, concentration in applied physics, a student must satisfy the following minimum requirements:

General College Requirements
Introduction to the Liberal Arts Liberal Arts Seminar

[4] D. Hestenes, M. Wells and G. Swackhamer, "Force Concept Inventory," *Phys. Teach.* **30**, 141-158 (1992).
[5] D.P. Maloney, T.L. O'Kuma, C.J. Hieggelke, and A. Van Heuvelen, "Surveying students' conceptual knowledge of electricity and magnetism," *Am. J. Phys.* **69**, S12 (2001).
[6] A. Tongchai, M. Sharma, I. Johnston, K. Arayathanitkul, and C. Soankwan, "Developing, Evaluating and Demonstrating the Use of a Conceptual Survey in Mechanical Waves," *Int. J. Sci. Educ.* **31** (18), 2437 (2009).

CORE 101 or CORE 301 (4 credits)
International Languages, one course beyond entering proficiency (4 credits)
Liberal Arts Approaches to Understanding the World (24 credits)
Arts (4 credits)
Cultural Perspectives (4 credits)
Humanistic Foundations (4 credits)
Mathematics (4 credits)
Natural Sciences with Lab (4 credits)
Social Sciences (4 credits)
Experiencing the Liberal Arts in the World (0-4 credits, depending on the experience)

Total Credits for General College Requirements: 32-36

Students completing the *Physics Major - Concentration in Applied Physics* will satisfy their Mathematics and Natural Sciences with Lab requirements.

Required Courses for the Physics Major - Concentration in Applied Physics
Physics Core Courses (32 credit hours)
PHYS 151: Fundamentals of Physics I (recommended) or PHYS 141 General Physics I
PHYS 152: Fundamentals of Physics II (recommended) or PHYS 142 General Physics II
PHYS 251: Fundamentals of Physics III
CHEM 106: General Chemistry 2 or COSC 120 Introduction to Computer Science
PHYS 311: Electronics
PHYS 312: Advanced Physics Laboratory
PHYS 351: Electricity & Magnetism
PHYS 462: Quantum Mechanics
Cognate Courses (16 credit hours)
MATH 151: Calculus I
MATH 152: Calculus II
MATH 255: Vector Calculus
MATH 256: Linear Algebra
Elective Courses (four credit hours selected from the following list of courses)
PHYS 342: Mechanics
PHYS 382: Optics
PHYS 473: Statistical Mechanics
PHYS 490: Senior Seminar
CHEM 451: Physical Chemistry
COSC 301: Software Engineering 1
MATH 312: Differential Equations
MATH 411: Partial Differential Equations

Senior Seminar in Applied Physics
Every physics major with concentration in applied physics must successfully complete

two semesters of the senior seminar in Applied Physics, PHYS 475: Topics in Applied Physics, with two separate topics. Topics will typically be different in fall and spring semester. Majors with this concentration do not need to do a St. Mary's Project, but may do so if they wish. If they choose to do so, requirements for the St. Mary's Project are the same as for students with a concentration in fundamental physics.

Research Experience
Research is integral to the practice of physics. Every physics major with concentration in applied physics must successfully complete a research experience in one of the following three ways:
1) St. Mary's Project. This project may be in physics or in another major discipline or a study area. The guidelines established in the selected area apply. The project must be proposed to a mentor and to the chair of the Department of Physics at least three weeks before the last day of classes of the second semester of the student's junior year, and it must be approved by the mentor and the department chair.
2) Directed Research in Physics at an upper level. To use Directed Research to satisfy the research requirement for the concentration in applied physics, students must successfully complete a total of four credits of upper-level Directed Research in Physics (PHYS 397 or 497). Concurrent with the final credit of Directed Research, the student must also register for PHYS 350 and complete its presentation requirement.
3) Other research experience. Students with a concentration in applied physics may satisfy the research requirement with another approved research experience, such as a Research Experience for Undergraduates or a research assistantship at another institution, so long as the research experience is in physics or a related discipline and it occupies at least 160 hours. Concurrent with the research experience, the student must also register for PHYS 350 and complete its presentation requirement.

Minimum Grade and GPA Requirements
Students must earn a grade of C- or better in all courses listed in items 2-3 above, and maintain an overall GPA of 2.0 or better in these required courses.

Total number of credits: 60 - 68

Courses Descriptions
PHYS 151. Fundamentals of Physics I (4F)
In-depth introduction to Newton's laws of motion, including 1-D kinematics, vectors, dynamics of motion, rotational motion and the universal law of gravitation. This course represents a more in-depth analysis of introductory physics than PHYS 141. Recommended for physics majors and minors. This course satisfies the Core Curriculum requirement in Natural Science with Laboratory. Formerly PHYS 131. Not open to students who have received credit for PHYS 131. Corequisite: MATH 151

PHYS 152. Fundamentals of Physics II (4F)

In-depth introduction to waves, optics, quantum mechanics and relativity. Topics include transverse/longitudinal waves, interference, wave/particle duality, the Bohr atom, the Schrodinger equation, time dilation/length contraction, and relativistic energy/momentum. Recommended for physics majors and minors. This course satisfies the Core Curriculum requirement in Natural Science with Laboratory. Lecture and laboratory. Formerly PHYS 231. Not open to students who have taken PHYS 231. Prerequisite: PHYS 141 or PHYS 151. Corequisite: MATH 152.

PHYS 199/299/399/499. Independent Study (1-4E)
This course consists of an independent creative or research project designed by the student and supervised by a physics faculty member. The nature of the project, the schedule for accomplishment, and the means of evaluation must be formalized in a learning contract prior to registration.

PHYS 251. Fundamentals of Physics III (4F)
Electrostatics, magnetostatics, electromagnetism, and DC circuits. This course satisfies the Core Curriculum requirement in Natural Science with Laboratory. Lecture and laboratory. Formerly PHYS 132. Not open to students who have completed PHYS 132. Prerequisite: PHYS 142 or PHYS 152. Corequisite: MATH 255

PHYS 297/397/497. Directed Research in Physics (1-4E)
Under the direct supervision of a faculty member, a student participates in physics research. A learning contract that specifies the research goals and methodology must be filed with the Office of the Registrar. May be repeated for credit. Prerequisite: Learning contract filed in the Office of the Registrar.

PHYS 311. Electronics (4F)
Methods of dc & ac analog circuits (network analysis, superposition, and equivalent circuits; impedance; power; diodes, transistors, and operational amplifiers). Digital logic (Boolean algebra and optimization techniques), number systems and codes (binary, octal, hexadecimal, Gray codes), and circuit implementations of digital logic (discrete gates and functional blocks). Students will design and analyze circuits in the laboratory. Prerequisite: PHYS 251.

PHYS 312. Advanced Physics Laboratory (4S)
Set-piece experiments as well as directed experimental projects to study selected phenomena in modern physics. These experiments and projects serve as an introduction to the contemporary instrumentation and the precise measurement techniques used in physics research laboratories. One lecture and four hours of laboratory a week. Formerly PHYS 451. Not open to students who have received credit for PHYS 451. Prerequisite: PHYS 231 or PHYS 251.

PHYS 342. Mechanics (4S)

Fundamental concepts of mechanics, kinematics, dynamics of a particle, oscillators, planetary motion, systems of many particles, statics, rotation of rigid bodies. Formerly PHYS 301. Not open to students who have received credit for PHYS 301. Prerequisite: PHYS 231 or PHYS 251.

PHYS 350. Physics Research Experience & Presentation (0E)
In order to complete a physics major with a concentration in applied physics, as described in the requirements for the major, students must complete an approved research experience and present their research in public. This course is a co-requisite for the fourth credit of upper-level Directed Research in Physics (PHYS 397/497) or for other approved research experiences. It is not required when a student undertakes a St. Mary's Project. Students will receive a grade of "Pass" or "Fail." Requires permission of the instructor.

PHSC 351. Electricity and Magnetism (4S)
Electrostatics, magnetism, direct currents and associated networks, oscillations, alternating current theory, Maxwell's equations. Formerly PHYS 302. Not open to students who have received credit for PHYS 302. Prerequisite: PHYS 251.

PHYS 382. Optics (4AS)
Analytical treatment of geometrical and physical optics. Topics include light wave propagation, reflection, refraction, mirrors, thin lenses, interference, coherence, diffraction, and polarization. Formerly PHYS 321. Not open to students who have received credit for PHYS 321. Prerequisite: PHYS 231. or PHYS 251.

PHYS 385/485. Classroom Assistantship in Physics (1-2E)
Supervised experience in the understanding and explanation physics concepts and reasoning. Activities may include, but are not limited to, organizing problem sessions outside of class time, correcting (but not grading) assignments, promoting group work in class or laboratory, and other specific tasks assigned by the instructor. This course will follow the general college guidelines (see "Classroom Assistantships" under "Academic Policies" section). May be repeated for credit. Prerequisites: Student must have a minimum GPA of 2.5, be of junior or senior standing or completed 2 courses of 200-level work or above in Physics. Learning contract must be filed in the Office of the Registrar.

PHYS 398/498. Off-Campus Internship (4-16E)
A variety of off-campus learning opportunities can be arranged through the Career Development Center. The off-campus internship is an individually designed experience that allows the student to explore the relationship between learning in the classroom and the practical application of knowledge in everyday work situations. Prerequisites: Admission to the Internship Program and approval of the academic adviser and department chair. Credit/no credit grading.

PHYS 462. Quantum Mechanics (4F)
Postulates of quantum mechanics and operator formalism, Fourier techniques, correspondence principle, angular momentum theory, matrix representations, central force problems. Formerly PHYS 471. Not open to students who have received credit for PHYS 471. Prerequisites: PHYS 231 or PHYS 251, MATH 256, and consent of the instructor. Students with several chemistry courses may seek the instructor's permission to have the PHYS251 prerequisite waived.

PHYS 473. Statistical Mechanics (4F)
Statistical and microscopic treatment of thermodynamical systems. Topics include probability concepts, heat and temperature, thermal interaction, work, internal energy, entropy, and canonical distribution. Formerly PHYS 421. Not open to students who have received credit for PHYS 421. Prerequisite: PHYS 231. or PHYS 251.

PHYS 475. Topics in Applied Physics I (4F)
An in-depth exploration of a topic in applied physics. Lectures, discussion, readings of appropriate papers and texts. Student presentations and papers will be required. Example topics include medical imaging; the physics of music; the physics of flight; and applications of atomic physics. Prerequisites: Four courses in physics and permission of the instructor.

PHYS 490. Senior Seminar in Physics (4AS)
An in-depth exploration of a topic in physics. The topic is broad enough to integrate several areas of physics. Lectures, discussion, readings of appropriate papers and texts. Student presentations and papers will be required. Prerequisites: 20 credit hours in physics and consent of the instructor.

PHYS 494. St. Mary's Project (1-8E)
The project, which may take many forms, draws on and extends knowledge, analytical skills, and creative achievement developed through previous academic work in physics. The student initiates the project, identifies an area of physics to be explored, and proposes a method of inquiry appropriate to the topic. It must be shared with the College community through posters, presentations, or other means. The project may be within physics, across disciplines, or in a cross-disciplinary studies area. The project is supervised by a physics faculty mentor. PHYS 494 may be repeated for up to a total of eight credit hours. Prerequisite: Approval of faculty mentor and department chair of the student's major(s). Consult faculty mentor for project guidelines.

5. **Discuss how general education requirements will be met, if applicable.**

The program will be subject to the general graduation requirements of St. Mary's of Maryland for the bachelor of science degree, as published in the course catalog.[7] These are

- Completion of at least 128 credit hours (credits), including at least 44 credit hours of upper-level (300- and 400-level) courses, with a cumulative grade-point average of at least 2.00, both on an overall basis and in those courses that meet major requirements.
- At least 30 of the last 36 credit hours of academic work toward the degree at St. Mary's College must be completed by credits earned from St. Mary's College courses. With the permission of the Academic Policy Committee, this provision may be waived for students engaged in departmentally approved off-campus learning experiences.
- The Core Curriculum requirements.
- The requirements for a major field of study.

The Core Curriculum requirements include completion of the following:

- A Liberal Arts Seminar
- One international language course
- One Arts course
- One Cultural Perspectives course
- One Humanistic Foundations course
- One Mathematics course
- One Natural Sciences course with laboratory
- One Social Sciences course
- Experiencing the Liberal Arts in the World, which may be
    - Study Abroad
    - Internship
    - Independent Study or Directed Research with a community focus
    - Experiential or Service Learning course

6. **Identify any specialized accreditation or graduate certification requirements for this program and its students.**
   None.

7. **If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**
   None.

8. **Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction,**

[7] http://www.smcm.edu/catalog

assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies.
Course and degree requirements will be published in the course catalog and on the college website. St. Mary's College of Maryland publishes information on its website on the nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies. It also communicates this information by email and hard copy mailing, and through advising appointments. Each student is assigned a faculty advisor.

9. **Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.**
   As with all of its programs, St. Mary's College of Maryland will ensure that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.

H. Adequacy of Articulation

1. **If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.**
   Not applicable / None.

I. **Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).**

1. **Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach (in this program).**
   Five faculty will teach in the program. All of them have doctorates in physics. They have published peer-reviewed research in the field.
   - Charles Adler; PhD in physics; Professor; full-time; specializes in optical and atomic physics, but conducts scholarship and publishes across a wide range of sub-fields. Professor Adler has taught every course in the program and can do again so as needed.
   - Erin De Pree; PhD in physics; Associate Professor; full-time; specializes in theoretical/computational particle physics and observational radio astronomy, but has also published on physics education. Associate Professor De Pree can teach just about every course in the program, and she has taught most of them at some point already. In the only exception, she would need a partner with whom to team-teach Advanced Physics Laboratory (PHYS312).
   - Joshua Grossman; PhD in physics; Associate Professor; full-time; specializes in atomic physics but has also published on optics and physics education.

Associate Professor Grossman can teach every course in the program, and he has taught most of them at some point already.

- Michelle Milne; PhD in physics; Assistant Professor; full-time; specializes in the physics of medical imaging (ultrasound and MRI) but also conducts research on physics education. Assistant Professor Milne can teach every course in the program, and she has taught many of them at some point already.
- Katsunori Mita; PhD in physics; Professor; full-time; specializes in foundations of quantum mechanics and in acoustics but has also published in other areas. Professor Mita can teach most of the courses in the program and has done so already. The exceptions are Advanced Physics Laboratory (PHYS312), Statistical Mechanics (PHYS473), and Topics in Applied Physics (PHYS475).

2. **Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidenced-based best practices, including training in:**
   a. **Pedagogy that meets the needs of the students**
   St. Mary's provides faculty with opportunities for professional development through Teaching Excellence Workshops, offered each August; Teaching and Learning Lunches, offered throughout the academic year; and funds for professional development that faculty may use to improve their teaching effectiveness. In addition, our Assessment Implementation Team is headed by the Coordinator of Transparent Teaching and Assessment; her role explicitly connects assessment to the kinds of intentional, evidence-based strategies that improve teaching practices. As such, the Assessment Coordinator has tailored her work with faculty on assessment to include substantive discussions on ways to respond to assessment data by developing more effective pedagogical strategies.

   b. **The learning management system**
   St. Mary's utilizes Blackboard. The Office of Information Technology includes an position for an instructional technologist who trains new faculty on Blackboard and other technology-based tools for teaching. This position also provides support for faculty when they have questions about Blackboard and other such tools.

   c. **Evidenced-based best practices for distance education, if distance education is offered.**
   Distance education is not applicable to this program.

J. **Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12).**
1. **Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within existing institutional resources, include a supportive statement by the President for library resources to meet the program's needs.**
The Concentration in Applied Physics will require many of the same library resources already used by students in our Physics program; our library currently has subscriptions

to a variety of journals, including those published by the American Association of Physics Teachers. An annual budget line item is dedicated to the purchase of books to support the physics program. The college library participates in a robust Interlibrary Loan program of the University System of Maryland and Affiliated Institutions (USMAI).

K. **Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)**

1. **Provide an assurance that physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences. If the program is to be implemented within existing institutional resources, include a supportive statement by the President for adequate equipment and facilities to meet the program's needs.**
   The program does not require significant new courses. All classes are already being offered in classrooms in St. Mary's College's Schaefer Hall. There are nine shared classrooms in Schaefer Hall, ranging in capacity from 28 to 72 people, plus a seminar room (capacity of 10). Two dedicated instructional labs spaces (800 and 930 sq. ft., respectively) serve the physics major. The instructional labs are equipped with computers and apparatuses for at least eight student groups in all courses. Students also participate in research in the two atomic physics labs (290 and 350 sq. st., respectively), the ultrasound lab (520 sq. ft.), and the radio astronomy lab (200 sq. ft.). A room (160 sq. ft.) houses a metalworking machine shop. Another space serves as an electronics workshop and storage area. The Lab Coordinator's office also contains equipment storage. The five faculty each have their own offices. All of these facilities and equipment are already allocated.

2. **Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:**
   a. **An institutional electronic mailing system, and**
      All SMCM instructors and students are issued SMCM email addresses. However, we do not anticipate the Concentration in Applied Physics being taught through distance education.

   b. **A learning management system that provides the necessary technological support for distance education**
      St. Mary's utilizes Blackboard as well as a range of Google applications (including for email). However, we do anticipate this program being taught through distance education.

L. **Adequacy of Financial Resources with Documentation (as outlined in COMAR 13B.02.03.14)**

1. **Complete Table 1: Resources and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.**

TABLE 1: PROGRAM RESOURCES					
Resource Categories	**Year 1 2015/16**	**Year 2 2016/17**	**Year 3 2017/18**	**Year 4 2018/19**	**Year 5 2019/20**
1. Reallocated Funds	$0	$0	$0	$0	$0
2. Tutition/Fee Revenue (c + g below)	$41,685	$56,768	$72,480	$74,030	$76,251
a. Number of F/T Students	3	4	5	5	5
b. Annual Tuition/Fee Rate	$13,895	$14,192	$14,496	$14,806	$15,250
c. Total F/T Revenue (a x b)	$41,685	$56,768	$72,480	$74,030	$76,251
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	$195	$200	$200	$200	$205
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d x e x f)	$0	$0	$0	$0	$0
3. Grants, Contracts & Other External Sources	$0	$0	$0	$0	$0
4. Other Sources	$0	$0	$0	$0	$0
TOTAL (Add 1 - 4)	$41,685	$56,768	$72,480	$74,030	$76,251

Table 1 Narrative: No funds need to be reallocated as the concentration will operate within the existing physics major. Enrollment is based on existing numbers and then is projected to stay flat to be conservative. The budget plans do not rely on any grants, contract, or other sources of revenue. To be conservative, the table does not report the fact that the program can draw income and principal from the quasi-endowed funds from the 2012 donation of $1,000,000 by the Patuxent Partnership to support the concentration.

2. **Complete Table 2: Program Expenditures. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year.**

TABLE 2: PROGRAM EXPENDITURES					
Expenditure Categories	**Year 1 2015/16**	**Year 2 2016/17**	**Year 3 2017/18**	**Year 4 2018/19**	**Year 5 2019/20**
1. Faculty (b + c below)	$0	$0	$0	$0	$0
a. Number of FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
2. Admin. Staff (b + c below)	$0	$0	$0	$0	$0
a. Number of FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
3. Support Staff (b + c below)	$0	$0	$0	$0	$0
a. Number of FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
4. Technical Support and Equipment	$500	$500	$500	$500	$500
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$0	$0	$0	$0	$0
7. Other Expenses	$0	$0	$0	$0	$0
TOTAL (Add 1 - 7)	$500	$500	$500	$500	$500

Table 2 Narrative: No new faculty or staff are needed to support the proposed program. Under Technical Support and Equipment, we expect to see an increase in use of components in the Electronics course (PHYS311). No new library resources, spaces, or other expenses are required.

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15).

1. Discuss procedures for evaluating courses, faculty and student learning outcomes.

St. Mary's attends to student learning outcomes through the assessment procedures outlined above. For tenure-track faculty, performance is evaluated via a pre-tenure review, a tenure and promotion review, and periodic reviews (every three years until promotion to full professor, then every five years). Performance at each of these post-tenure reviews is evaluated by the provost based on a system of up to three increments of merit.

Reviews for tenure and promotion to full professor include faculty course evaluations, which are required for each course taught, and narrative evaluations, which are administered by the department chair in all courses taught by the faculty member in two of the three semesters prior to the submission of their file. Students provide detailed, written responses to questions about the faculty's member expertise and teaching effectiveness in these evaluations. Faculty members up for promotion are also observed by their colleagues who evaluate their teaching effectiveness.

Adjunct and visiting professors are also required to administer course evaluations. Results are monitored by department chairs and the Associate Deans of Faculty and Curriculum, who will discuss evaluations as needed with faculty.

2. Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.

In addition the program assessment procedures outlined above, academic programs at St. Mary's undergo a program review process every 7-10 years. These reviews include reflection on assessment procedures as well as an evaluation of curricula, student programming, and support for faculty by an external team.

Student satisfaction is tracked through various survey opportunities, including NSSE, our senior exit survey, and our alumni surveys (alums are surveyed the year after they graduate and every five years after that). Individual programs also periodically survey their students and alums and to gather data on their experience and make adjustments to curricula and programming.

Because St. Mary's is a small school, retention is primarily tracked at the institutional level. However, individual programs can request data concerning students' performance in required courses for the major, and the Office of Institutional Research, Office of the Provost, and the Office of Student Support Services work together to evaluate patterns of performance in gateway courses for majors.

Cost-effectiveness is monitored via the Provost and the President's Executive Council (which includes the Provost), with input from the Academic Planning Committee. This committee reviews line proposals and evaluates need for resources based on current class sizes.

N. **Consistency with the State's Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05).**

1. **Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.**
   St. Mary's minority enrollment has increased in recent years from 19.1% in 2010 to 26.6% in 2017. In support of this change, our current strategic plan includes goals to increase the diversity of faculty and staff by 30% over our 2015 count, and to increase the number of courses offered with a substantial focus on diversity.

   In addition, our current administrative structure includes a Chief Diversity Officer who has recently implemented a campus-wide diversity training program that includes an online training session and an in person follow up session. This training has given the campus a common language through which to discuss issues of diversity and difference.

   Finally, St. Mary's supports STEM students who are from underrepresented groups both through student-centered and evidence-based pedagogies that improve student learning in general, and more specifically, by offering students the opportunity to participate in the Emerging Scholars Programs. Emerging Scholars take a 1-credit Emerging Scholars class in addition to their regular coursework; students work with a faculty member to develop their skills by working in small groups on challenging problems, building a social identities as physicists and building a social support network of peers and faculty. The Emerging Scholars Program and other efforts to support students from underrepresented groups have been recognized nationally as models of effective practices.[2,3,8]

[8] American Physical Society's 2017 Award for Improving Undergraduate Physics Education, https://www.aps.org/programs/education/undergrad/faculty/awardees.cfm.