LOYOLA UNIVERSITY MARYLAND

Vice President for Academic Affairs

— 1852 —

17008

February 18, 2018

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

Dear Secretary Fielder:

Please find attached a proposal from Loyola University Maryland for a Bachelor of Arts in Physics. This program will complement our B.S. in Physics, allowing students greater flexibility to pursue a range of curricular experiences that can prepare them for an array of careers and/or graduate education opportunities, including teaching, finance, and other domains.

Loyola University Maryland looks forward to working with the Commission on the recommendation of this proposal. Accompanying this letter you will find payment of $850 for the program review fee. Should the Commission have any queries on the proposal, please contact Dr. Westley Forsythe, Director of Academic Assessment and Compliance, at 410-617-2317 and wforsythe@loyola.edu.

Sincerely,

Amanda M. Thomas, Ph.D.
Interim Vice-President for Academic Affairs

cc: Dr. Steven Fowl, Dean, Loyola College of Arts and Sciences.
Dr. Jenny Lowry, Associate Vice-President for Academic Affairs

MARYLAND HIGHER EDUCATION COMMMISSION
ACADEMIC PROGRAM PROPOSAL

PROPOSAL FOR:

X ____ **NEW INSTRUCTIONAL PROGRAM**

____ **SUBSTANTIAL EXPANSION/MAJOR MODIFICATION**

____ **COOPERATIVE DEGREE PROGRAM**

____ **WITHIN EXISTING RESOURCES or** X ____ **REQUIRING NEW RESOURCES**

(For <u>each</u> proposed program, attach a <u>separate</u> cover page. For example, two cover pages would accompany a proposal for a degree program and a certificate program.)

Loyola University Maryland
Institution Submitting Proposal

Fall 2018
Projected Implementation Date

B.A.
Award to be Offered

Physics
Title of Proposed Program

1902-01
Suggested HEGIS Code

40.0801
Suggested CIP Code

Physics
Department of Proposed Program

Dr. Andrea Erdas
Name of Department Head

Westley Forsythe
Contact Name

wforsythe@loyola.edu
Contact E-Mail Address

410-617-2317
Contact Phone Number

Amanda M. Thomas
Signature and Date

President/Chief Executive Approval

2/14/2018
Date

Date Endorsed/Approved by Governing Board

Summary: B.A. in Physics

Loyola University Maryland proposes the offering of a B.A. in Physics. This distinct degree will complement its existing B.S. in Physics and provide students with a major that explicitly accommodates potential students' career path, or academic interest in another area.

Students will complete the same Physics core as those who complete the B.S. However, following the completion of the institution's Loyola Core (general education) requirements, ten courses remain available to individuals to pursue alternative electives and interdisciplinary studies, or indeed to potentially double major. This flexibility permits students to complete the required pre-medical school courses and/or to take business courses with the intent of pursuing an MBA.

Teaching is another possible track for the B.A. recipient. To complete the coursework required to become certified to teach on the secondary level, there are two options: complete the additional courses that fulfill a minor in secondary education; or enroll in Loyola's five-year combined B.A.-M.A.T. program where the participant receives a Master of Arts in Teaching and a certification to teach physics at the secondary level.

A. Centrality to mission and planning priorities, relationship to the program emphasis as outlined in the mission statements, and an institutional priority for program development;

Loyola's most recent strategic plan includes a renewed focus on the classical liberal arts and sciences that challenges the university to address the prejudices and misconceptions that motivate the assault on a liberal arts education. However, success in this endeavor requires acknowledging and addressing those anxieties that have, in part, prompted the increasingly vociferous attacks on the liberal arts.

> The University will make a compelling case for the integral synergies between the liberal arts and career and vocational planning. We will reiterate that initial call of Ignatius and ensure that the education we provide remains deeply committed to the liberal arts, offering students the foundation they need for any and every opportunity they will encounter. At the same time, we must ensure that they gain knowledge and experience through interdisciplinary connections among the liberal arts, STEM, and business, to help them graduate with a deeper understanding of how to respond to the needs of current times.[1]

This program's focus on curricular flexibility permits students to explore complementary areas of study that could engender professional application of a Physics education in diverse employment sectors and is significantly informed by the call to seek the 'integral synergies between the liberal arts and career and vocational planning.'

[1] Loyola University Maryland, *The Ignatian compass: guiding Loyola University Maryland to ever greater excellence, strategic plan 2017-2022,* (Baltimore, 2016), p. 9.

B. Critical and compelling regional or Statewide need as identified in the State Plan;

Maryland Ready, the state's plan for higher education, 2013-17, places especial significance upon the importance of STEM disciplines and increasing the number of graduates from such disciplines, on the assumption that increased numbers of such graduates will enhance the Maryland economy's economic growth and productivity. It declares, 'increasing the number of STEM degrees awarded to students is another key goal for Maryland postsecondary education. STEM related occupations are critical because they are closely tied to technological innovation, economic growth, and increased productivity.'[2]

The Bachelor of Arts in Applied Physics also supports the plan's assertion that

> To promote the State's competitive, knowledge- based economy, the postsecondary segments need to provide quality education and training to members of the workforce. It is not enough to simply have more students enter and complete academic or occupational programs, but they must have access to high-caliber and effective training that meets the evolving needs of the workplace.[3]

[2] Maryland Higher Education Commission, *Maryland ready: 2013-17 Maryland state plan for postsecondary education,* (2014), p. 12.
[3] Ibid., p. 52.

C. Quantifiable and reliable evidence and documentation of market supply and demand in the region and service area;

Market demand

The Statistical Research Center of the American Institute of Physics provides annual data on the number of physics degree recipients and their initial careers following graduation. The latest set of data is from 2014 and reflects a survey of the classes of 2011 and 2012 and their career outcomes one year after graduation.[4]

Fifty-seven percent of physics bachelor's degree recipients, from the combined classes of 2011 and 2012, were enrolled in graduate school in the winter following the year they received their degrees; the remaining 43% entered the workforce. Of those who pursued graduate studies, 61% enrolled in physics or astronomy programs and 18% enrolled in engineering programs; the remainder were spread across diverse fields.

Of those who entered the workforce following their Bachelor's degree, 61% were employed in the private sector; 13% worked in higher education; 8% as high school teachers or administrators, and high school, 6% serve in the armed forces, 5% in civilian governments and national labs and 7% other.

Seventy percent of physics bachelor's degree recipients employed in the private sector work in STEM fields with the majority working in engineering and computer or information science.

[4] American Institute of Physics, Statistical Research Center, https://www.aip.org/statistics

Specific to Maryland, a recent *Maryland Teacher Staffing Report* declared Physics teachers in K-12 a critical shortage area,[5] that a B.A. in Physics with the ability to fulfil licensure requirements for high school teaching could help address. Additionally, this report found that almost one in five Physics classes taught in Maryland in 2013-14 were by teachers who did not possess a Physics degree,[6] something that this B.A. could help address.

In summary, the best approach to preparing undergraduate physics majors for graduate studies as well as creating options for career paths that best serves the diverse needs of students is to offer various physics degree options. A B.A. in Physics provides opportunities for interdisciplinary studies and multiple career outcomes that are not necessarily in scientific research or development.

[5] Maryland State Department of Education, *Maryland Teacher Staffing Report, 2014-2016*, p. ii.
[6] Ibid., p. 19.

Market supply

Table 1: total annual graduations from Maryland institutions with programs in Physics[7]

School Name	Degree Level	Program Name	CIP	2007	2008	2009	2010	2011	2012	2013	2014	2015
Frostburg State University	Bachelors	Physics	400801	14	5	3	3	8	4	5	7	5
Salisbury University	Bachelors	Physics	400801	8	13	6	8	7	5	11	9	12
Towson University	Bachelors	Physics	400801	8	7	6	11	11	12	17	12	12
Univ. Of Md, Baltimore County	Bachelors	Physics	400801	12	20	8	15	16	16	16	15	12
Univ. Of Md, College Park	Bachelors	Physics	400801	42	37	57	51	48	39	58	45	63
Morgan State University	Bachelors	Physics	400801	2	6	0	1	1	1	2	1	1
St. Mary's College Of Maryland	Bachelors	Physics	400801	1	6	7	6	5	5	7	8	11
Goucher College	Bachelors	Physics	400801	2	1	2	2	4	1	1	2	2
Johns Hopkins University	Bachelors	Physics,General	400801	6	15	16	9	22	14	17	25	15
Loyola University Maryland	Bachelors	Physics	400801	4	2	1	0	5	4	2	4	5
McDaniel College	Bachelors	Physics	400801	10	2	4	6	7	0	3	2	6
Notre Dame Of Maryland University	Bachelors	Physics,General	400801	2	1	3	0	1	2	0	1	2
Washington Adventist University	Bachelors	Physics	400801	0	0	0	0	0	0	0	0	0
Washington College	Bachelors	Physics,General	400801	1	2	1	1	0	6	4	4	7
Total annual graduations				**112**	**117**	**114**	**113**	**135**	**109**	**143**	**135**	**153**

[7] Maryland Higher Education Commission, *Degree Trends*, retrieved on August 22, 2016 from https://data.mhec.state.md.us/

D. Reasonableness of program duplication, if any;

Many institutions offer a Bachelor degree in Physics, but not all offer a Bachelor of Arts. Additionally, the program will help address both workforce needs in STEM broadly, and potentially in helping ameliorate teacher shortages in STEM disciplines that the state of Maryland recently identified as an ongoing 'area of critical shortage'.[8]

E. Relevance to the implementation or maintenance of high-demand programs at HBIs;

Considering this proposal reflects state, regional, and national trends, it is not anticipated that it will have any impact upon the implementation or maintenance of programs at HBCUs.

F. Relevance to the support of the uniqueness and institutional identities and missions of HBIs;

Loyola does not envisage this program having an impact upon the uniqueness or institutional identity and mission of a Historically Black College or University.

[8] Maryland State Department of Education, *Maryland teacher staffing report, 2016-18,* (Baltimore, 2016), p. 3. Retrieved on November 10, 2017 from http://www.marylandpublicschools.org/about/Documents/DEE/ProgramApproval/MarylandTeacherStaffingReport20162018.pdf

G. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation .10 of this chapter;

Table 2 below outlines the curriculum necessary to complete the B.A. in Physics. It includes a major totaling forty-five credits, and six lab courses totaling eight credits.

Table 2: B.A. Physics curriculum

Course code	Course name	Credits
PH201	General Physics I	4
PH202	General Physics II	4
PH291	General Physics Lab I	1
PH292	General Physics Lab II	1
PH293	Intermediate Lab I	1
PH294	Intermediate Lab II	1
PH307	Mathematical Methods	3
PH312	Modern Physics	3
PH316	Classical Mechanics	3
PH317	Thermal Physics	3
PH397	Experimental Methods I	2
PH398	Experimental Methods II	2
PH415	Quantum Mechanics I	3
PH417	Electricity & Magnetism I	3
MA251	Calculus I	4
MA252	Calculus II	4
MA304	Differential Equations	3

Course code	Course name	Credits
MA351	Calculus III	4
CS151	Computer Science I	4

Other potential curricula are possible dependent upon students' interests and the departments in which they take the required 300 level courses and could include a focus in computer science, engineering, chemistry, biology, or an interdisciplinary combination.

Allied with the above is Loyola's Core Curriculum. This is Loyola's general education curriculum and more than fulfils the COMAR 13B.02.02.16E general education requirements. The Core also imparts a significant element of Loyola's Jesuit liberal arts education and requires instruction and learning in Philosophy, History, Mathematics, Natural and Applied Sciences, Writing, Ethics, Foreign Language, Social Science, Theology, Fine Arts, and Literature. The curriculum at Loyola University Maryland requires a minimum of forty, three, four, or five-credit courses and at least 120 credits for an undergraduate degree.[9]

H. Adequacy of any articulation;

The program does not anticipate a requirement for articulation agreements, and the institution's standard credit transfer policy, found in its catalogue, will apply to students seeking to transfer credits.

[9] Loyola University Maryland, undergraduate catalogue, retrieved on August 16, 2016 from http://catalogue.loyola.edu/content.php?catoid=8&navoid=292

I. Adequacy of faculty resources consistent with Regulation .11 of this chapter;

Table 3: faculty

Course	Description	Credits	Faculty members	Tenured/tenure-track Y/N
PH 201	General Physics I	4	Andrea Erdas	Y
	(3 sections)		Randy Jones	Y
			Mary Lowe	Y
PH 202	General Physics II	4	Andrea Erdas	Y
	(3 sections)		Randy Jones	Y
			Mary Lowe	Y
PH 291	General Physics Lab I	1	Randy Jones	Y
	(5 sections)		Charles Gehrman	N
			Bom Soo Kim[2]	N
			Inge Heyer	N
PH 292	General Physics Lab II	1	Inge Heyer	N
	(4 sections)		Charles Gehrman	N
			Bom Soo Kim	N
PH 293	Intermediate Lab I	1	Mary Lowe	Y
PH 294	Intermediate Lab II	1	Mary Lowe	Y
PH 307	Mathematical Methods in Physics	3	Bom Soo Kim	N

Course	Description	Credits	Faculty members	Tenured/tenure-track Y/N
PH 312	Modern Physics	3	Greg Derry	Y
PH 316	Classical Mechanics	3	Andrea Erdas	Y
PH 317	Thermal Physics	3	Greg Derry	Y
PH 397	Experimental Methods I	2	Greg Derry	Y
PH 398	Experimental Methods II	2	Greg Derry	Y
PH 415	Quantum Mechanics I	3	Greg Derry	Y
PH 417	Electricity & Magnetism I	3	Randy Jones	Y
MA 251	Calculus I (7 sections, fall)	4	Lisa Oberbroeckling Giselle Pile Stephen Thompson Summer Steenberg Verena Brown	Y N N N N
MA 252	Calculus II (3 sections, spring)	4	Stephen Thompson Brandon Myers	N N
MA 304	Differential Equations (2 sections)	3	Mili Shah	Y[3]
MA 351	Calculus III (2 sections)	4	Jiyuan Tao	Y[3]
CS 151	Computer Science I (formerly CS 201) (2 sections, spring)	4	Herve Franceschi	N

J. Adequacy of library resources consistent with regulation .12 of this chapter

The Loyola-Notre Dame Library (LNDL) hosts well in excess of 400,000 volumes. In 2000, LNDL acquired its 400,000th volume, bringing the library to near its total holding capacity. In 2002, the library implemented the first ENCompass Digital Library System - a federated search engine 'encompassing' most of the library's database contents - in the United States. During the next ten years, the library's digital capabilities expanded exponentially, resulting in the addition of over 250,000 digital book titles and over 56,000 online journals. By 2007, the Maryland Interlibrary Consortium (MIC) consortium of libraries had grown to include four libraries in addition to LNDL, bringing total consortium holdings to over one million volumes.

An extensive building renovation and expansion project commenced in the summer of 2006 after several years of planning to bring the library into the digital age physically. Hillier/RMJM designed the new addition and renovation to the original building; the renovations would bring the size of the library to 125,000 square feet. By July 2008, Whiting-Turner had completed the construction at a cost of $20,000,000.

The library has embarked on two strategic plans during the period from 2005-2012 that have guided the priorities and budget allocations to keep the library a vital organization for students and faculty of Loyola and Notre Dame during the early 21st century. Through all these changes, the Loyola-Notre Dame Library has held constant its underlying mission, the provision of top-quality library services and resources to the communities of Loyola University and Notre Dame of Maryland University.

On June 10, 2016 the university announced that the Loyola-Notre Dame Library will become an affiliate member of the University System of Maryland Affiliated Institutions Library Consortium (USMAI). The consortium includes sixteen member libraries at Maryland public universities and colleges LNDL was chosen for membership largely because of the uniqueness of its collections, and it is the first private academic library in Maryland to join USMAI.

In summary, the university library and its services can adequately accommodate the learning needs of the proposed B.A. in Physics and it is excellently positioned to do so for this proposed online delivery.

K. Adequacy of physical facilities, infrastructure, and instructional equipment consistent with Regulation .13 of this chapter;

Loyola University Maryland, established in 1852, is accredited by the Middle States Commission for Higher Education and is entirely equipped to offer programs at all degree levels, including doctoral programs in select areas. This includes the necessary classroom resources, technology, student support and development assets and laboratory space.

L. Adequacy of financial resources with documentation consistent with Regulation .14 of this chapter;

Details on the adequacy of financial resources in detailed in Appendix A.

M. Adequacy of provisions for evaluation of program consistent with Regulation .15 of this chapter;

All programs at Loyola are required to engage in the assessment of their student learning outcomes in accordance with learning outcomes that the faculty develop. Those learning outcomes must align with and support the institution's undergraduate learning aims. The curriculum map below details what courses support which program learning outcomes and which of those support institutional learning aims.

Table 4: curriculum map

Institutional learning aim	BA program learning outcome/aim	Courses
Intellectual excellence	Students will be able to communicate and demonstrate an understanding of foundational principles of physics.	PH 201, 202, 291, 292, 293, 294, 307, 312, 316, 317, 397, 398, 415, 417
Intellectual excellence	Students will demonstrate an understanding of inter-relationships between physics and mathematics and their applications.	All PH and MA courses.

Institutional learning aim	BA program learning outcome/aim	Courses
Critical thinking	Students will be able to identify and analyze problems, breaking them down into constituent parts and applying appropriate tools of conceptual understanding, mathematics, computation, experimentation, and theory.	All PH, MA, and CS courses
Intellectual excellence	Students will demonstrate understanding of the common elements of programming languages and spreadsheet tools.	PH 293, 294, 317, 397, 398 and CS 151
Intellectual excellence	Students will demonstrate proficiency with the use of symbolic manipulation software in solving complex mathematical problems to obtain scientific solutions.	PH 293, 294, 307, 312, 316, 317, 397, 398, 415, 417
Intellectual excellence	Students will acquire proficiency in the use of data acquisition and analysis software.	PH 291, 292, 293, 294, 398
Eloquentia perfecta	Students will demonstrate proficiency in the oral presentation of scientific concepts and findings. This occurs through dialogue, participation in class, or speaking in front of an audience.	PH 293, 294, 397, 398
Eloquentia perfecta	Students will demonstrate proficiency in the written presentation of physics concepts and findings. This occurs through solutions to problems, short sentence responses, and reports.	PH 291, 292, 307, 312, 316, 317, 415, 417

The institution's Committee on the Assessment of Student Learning (CASL) coordinates, reviews, and counsels the institution's approach to assessment of student learning outcomes, including the development, consideration, and prosecution of programmatic learning aims.

Additionally, Loyola's program review process includes all programs and departments. The Physics department's most recent review took place in March 2017, and in part, its findings prompted this proposal; future program reviews will incorporate this proposed program.

N. Consistency with the Commission's minority student achievement goals; and

Loyola remains committed to an inclusive and diverse academic environment and upholding and fostering the principles enshrined in Title VI of the 1964 Civil Rights Act. This year's freshman class is Loyola's most diverse and reflects its long-term commitment to diversity and social justice. At Loyola University Maryland, diversity related programs and offices are plentiful throughout the campus. African, Latino, Asian, and Native American Services (ALANA) support programming throughout the year that is focused on multicultural diversity and student support. The Center for Community Service and Justice engages students and the broader Loyola community in education through service for a just and equitable world. OUTLoyola is a group of faculty, staff, and administrators of all backgrounds who are interested in promoting equality for the LGBT members of the campus community and informed dialogue about LGBT issues at Loyola.[10]

[10] Maryland Independent Colleges and Universities Association, *Cultural diversity report, 2015,* p. 14. Retrieved on June 7, 2015 from http://www.micua.org/images/2015MICUACulturalDiversityReport.pdf

Appendix A: financial resources

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Table 1: Resources

Resource categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated funds					
2. Tuition/fee revenue	18408	47400	71632	73744	75944
a. Number of full-time students	2	2	2	2	2
b. Credit hour rate	767	790	814	838	863
c. Annual credit hours	12	30	44	44	44
d. Total full-time revenue (a x b x c)	18408	47400	71632	73744	75944
e. Number of part-time students					
f. Credit hour rate					
g. Annual credit hours					
h. Total part-time revenue	0	0	0	0	0
3. Grants, contracts, and other external sources					
4. Other sources					
Total	18408	47400	71632	73744	75944

0

0

Table 2: Expenditures

Expenditure categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b+c below)	0	0	0	0	0
a. No. FTE faculty					
b. Total salary					
c. Total benefits					
2. Administrative staff	0	0	0	0	0
a. No. FTE administrative staff					
b. Total salary					
c. Total benefits					
3. Support staff	0	0	0	0	0
a. FTE administrative staff					
b. Total salary					
c. Total benefits					
4. Equipment					
5. Library					
6. New or renovated space					
7. Other expenses	1350				
Total	1350	0	0	0	0

Addendum

17008: B.A. in Physics program learning outcomes and financial narrative

Learning outcomes

Institutional learning aim	*BA program learning outcome/aim*	*Courses*
Intellectual excellence	Students will be able to communicate and demonstrate an understanding of foundational principles of physics.	PH 201, 202, 291, 292, 293, 294, 307, 312, 316, 317, 397, 398, 415, 417
Intellectual excellence	Students will demonstrate an understanding of inter-relationships between physics and mathematics and their applications.	All PH and MA courses.
Critical thinking	Students will be able to identify and analyze problems, breaking them down into constituent parts and applying appropriate tools of conceptual understanding, mathematics, computation, experimentation, and theory.	All PH, MA, and CS courses
Intellectual excellence	Students will demonstrate understanding of the common elements of programming languages and spreadsheet tools.	PH 293, 294, 317, 397, 398 and CS 151
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d. Total full-time revenue (a x b x c)	18408	47400	71632	73744	75944
e. Number of part-time students	0	0	0	0	0
f. Credit hour rate	0	0	0	0	0
g. Annual credit hours	0	0	0	0	0
h. Total part-time revenue	0	0	0	0	0
3. Grants, contracts, and other external sources	0	0	0	0	0
4. Other sources	0	0	0	0	0
Total	18408	47400	71632	73744	75944

Credit hour tuition rate is based upon a projection 3% annual increase. Credit hours are based upon the numbers of new and additional students the program expects to enroll and those who might enroll in individual courses to fulfill other major, minor, or general educaiton requirements.

Table 2: Expenditures

Expenditure categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b+c below)	0	0	0	0	0
a. No. FTE faculty	0	0	0	0	0
b. Total salary	0	0	0	0	0
c. Total benefits	0	0	0	0	0
2. Administrative staff	0	0	0	0	0
a. No. FTE administrative staff	0	0	0	0	0
b. Total salary	0	0	0	0	0
c. Total benefits	0	0	0	0	0
3. Support staff	0	0	0	0	0
a. FTE administrative staff	0	0	0	0	0
b. Total salary	0	0	0	0	0
c. Total benefits	0	0	0	0	0
4. Equipment	0	0	0	0	0
5. Library	0	0	0	0	0
6. New or renovated space	0	0	0	0	0
7. Other expenses	1350	0	0	0	0
Total	1350	0	0	0	0

This program does not anticiapte any expenditures excepting some modest marketing. The program is a reconfiguration of entirely existing curriculum but sequenced to offer a new degree program.