

Financial Implication Form

**Illinois State University Request for New Program Approval**

**Purpose:** Proposed new undergraduate and graduate programs (degrees, sequences, minors, and certificates) must include information concerning how the program will be financially supported to proceed through the curricular process.

**Procedure:** This completed form is to be approved by the Department/School Curriculum Committee chair, department chair/school director, college dean, and Provost prior to submission of the proposal to the College Curriculum Committee.

**Definition:** A "program" can be a degree, a sequence within a degree, a minor, or a certificate. This form is to be used for both undergraduate and graduate programs.

Division	College/Unit	Department/School
VP and Provost	College of Arts and Sciences	Physics

Department/School (if not listed above)

Primary Contact ULID	Primary Contact First Name	Primary Contact Last Name	Primary Contact Email Address
dlholla	Daniel	Holland	dlholla@ilstu.edu
Secondary Contact ULID	Secondary Contact First Name	Secondary Contact Last Name	Secondary Contact Email Address
umanna	Uttam	Manna	umanna@ilstu.edu

Proposed New Program

Master of Science Degree in Physics

Brief Description of the Proposed Program

The physics department currently offers a BS in four separate degree sequences within the major. Despite the physics department being one of the smaller departments at ISU, according to three-year average for Classes of 2016 through 2018 from the American Institute of Physics (AIP), ISU Physics is ranked one of the largest Bachelor's-only physics department nationwide. ISU physics has a long history of involving undergraduates in research. In last five years, the department faculty members and students have published more than 70 peer reviewed articles in reputed journals, and made more than 100 presentations. The undergraduates from ISU physics have gone on to enroll in graduate programs in prestigious public and private universities, as well as secured jobs in private sectors. Moreover, ISU physics has an exceptional track record of securing external funding. About 50% of our current faculty has active external grants, both federal and private, with a total amount of about \$2M secured in the last five years. The proposed MS program will facilitate growth and build on the tremendous success of our department and its mentorship of undergraduates by offering opportunities for education and research to graduate students, and contribute to a "Thriving Illinois".

Brief Description of the Curriculum

The proposed MS program will build on the success of our department and its mentorship of undergraduates by offering opportunities for education and research to graduate students, and contribute to a "Thriving Illinois". As ISU becomes a more comprehensive university that includes engineering and other STEM disci-

plines, physics has the opportunity to grow into a department that not only supports these efforts but thrives because of them.

#### Master of Science (MS) in Physics Program:

Nationwide, the most successful MS programs in physics in the nation, have the following aspects:

- A minimum of 30 credit hours is required to graduate with a MS degree in physics.
- 4-5 traditional graduate only physics courses make up a core curriculum.
- Rather than “tracks”, electives provide an opportunity for students to specialize.
- Students are required to complete a research thesis toward fulfillment of the “MS by research”.
- Students are required to complete additional course work for a “MS by coursework”.

Our plan requires four-core courses (14 credits): Math Methods (3 credit), Electricity & Magnetism (4 credit), Quantum Mechanics (4 credit), and Statistical Mechanics (3 credit). These courses are taught each year of a two-year MS degree. Students are required to take 2 electives (6 total credits). Students are also required to complete Research Development (4 credits), and a thesis (4 credits) for fulfillment of the MS by research, and take Graduate Seminar/Research (2 credits).

The program will offer 5 new courses per year, allowing for a graduate elective to be offered once a year. In addition, students need to complete 4 hours of research development in the first year, and 4 hours of thesis work in their final year. The students will have the opportunity to specialize in “Experimental Physics” or “Computational Physics” by choosing to take relevant electives. Some electives will be cross-listed with their undergraduate counterparts. The table shows a plan of study for the proposed MS program.

#### Plan of Study for the MS program:

Students need 30 total credit hours (14 graduate only core courses, 6 electives, 8 from research and 2 from seminar). The core courses and some of the 400 level electives will need to be developed. Existing 300 level classes will be cross listed as 400 level with additional requirements for the graduate level courses and offered as Electives. Cross-listed courses will cover significantly more material than a purely undergraduate course and deliver an appropriate graduate-level curriculum.

#### Fall Year 1

Core: 417 Math Methods (3)

Core: 440 E&M (4) Research Development: PHY 490 (2)

#### Spring Year 1

Core: 484 Quantum (4)

Core: 425 Statistical Mechanics (3) Research Development: PHY 490 (2)

#### Fall Year 2

Thesis: PHY 499 (2) Elective-1 (3)

Grad seminar/research (1)

Spring Year 2 Thesis: PHY 499 (2) Grad Seminar/research (1) Elective-2 (3)

#### Possibility of MS by Coursework

An “MS by coursework” option is also a possibility, although additional cross-listed or graduated electives may need to be offered. For example, the table below shows a list of potential graduate-only and cross-listed electives. In addition to the 2 Electives as described above, for MS by coursework, additional 8 credits (three electives) will need to be offered.

#### Potential Graduate Only Electives

470 Advanced Experimental Physics (3) 418 Computational Physics (3)

4XX Nanotechnology (3)

420 Classical Mechanics (3)

Potential Cross Listed Electives 380a08-480a08 Astrophysics (3) 371-471 Biophysics (3)

355-455 Solid State I (3)

361-461 General Relativity (3)

Note on Graduate Seminar/research: In addition to attending the weekly department seminar, the students will actively analyze, construct/create, and evaluate information presented in technical and/or scientific journals. The students will examine best practices and implement them for designing, developing and presenting a quality scientific presentation using a presentation software such as PowerPoint, LaTeX, MS-word etc. The students will also have the opportunity to practice critical evaluation of other students' work.

Possibility of an Accelerated MS program:

Our program will offer students maximum flexibility, allows a straightforward path for 4+1 BS/MS dual degrees, and gets all required classes finished early so that research and electives can be the primary focus in year 2. Here, we provide an example of how a 4+1 dual degree can be offered with 150 credit hours over 5 years (30 credit hours per year, on average). This would translate to the students requiring 138 credit hours (120 + 30 – 12 shared credits) to graduate in an accelerated MS program.

- 52 hours - PHY 107, 110, 111, 112, 217, 220, 240, 284, 270, 307, 325, 340, 370, 384, 417, 425, 440, 484
- 18 hours – senior/grad physics electives and research
- 22 hours - MAT 145, 146, 147, 175, 340, senior math elective
- 6 hours - ENG 101/COM 110
- 8 hours – CHE140&141
- 8 hours – foreign language
- 4 hours – computer programming (IT 165/166)
- 32 hours – other gen eds/electives

In addition, it would be easier to expand into a full PhD program in the future via the addition of new core classes in the second year.

Anticipated Impact of the MS program – A Thriving Illinois:

Our MS program will contribute to the Illinois Board of Higher Education (IBHE) mission of creating and sustaining a world-class educational system in Illinois that will contribute to a “Thriving Illinois”. Our program will help develop an inclusive economy and broad prosperity with equitable paths to opportunity for all, especially those facing the greatest barriers, and thereby provide higher education paths to Equity, Sustainability, and Growth as outlined below.

Equity – We note that Illinois' population is becoming more and more diverse, and the labor market increasingly demands post-high school education and ongoing training for all but entry-level jobs. We need broad paths and specific strategies to progress for all regardless of race, ethnicity, class, gender, geography, or age—for high school graduates and adult learners—so all can contribute to and benefit from economic growth. Amongst the 10 universities in central Illinois (Bradley, Eastern Illinois, ISU, Illinois Wesleyan, Lincoln Christian, Millikin, Quincy, UofI Springfield, UofI Urbana-Champaign, Western Illinois University (WIU), only Western Illinois has a MS granting department in physics. While WIU MS program continues to grow and thrive, several students travel out of state to pursue MS degree in physics resulting in loss of valuable intellectual and economic capital in those students. The MS Physics program at ISU will make higher education more accessible, and thereby create new pathways students for all regardless of race, ethnicity, class, gender, geography, or age and contribute economic growth

Sustainability – We recognize the necessity to create educational paths that are financially sustainable for students and for higher education institutions to meet the vision of a thriving Illinois. Our financial model is based on offering graduate/teaching assistantships for approximately half of the enrolled students. Moreover, as mentioned above, ISU physics has an exceptional track record of securing external funding (both federal and private), with a total amount ~ \$2M secured in the last five years. Often this amount is limited by the fact that we don't offer any graduate options. Therefore, we would be able to offer research assistantship to the enrolled students. Thereby, our program will be affordable for students and families, and create a financially sustainable education system for the future

Growth – We understand that Illinois cannot thrive without a future-ready workforce plus the institutional research and innovation that are crucial to driving economic growth. Upon completion of their degrees, the students are expected join the STEM work in various areas that include but not limited to data analytics, energy

materials and technology in industries (such as State Farm, Caterpillar, and Rivian) in Illinois as well as join top-class PhD programs in the nation. If successful, our program may also grow to encompass a PhD option. Moreover, our MS program is expected to attract international students, which will enhance the talent pool, and thereby contribute to economic growth. Therefore, our effort will contribute towards a strong, nimble, and innovative higher education system, including career education, inclusive talent development, innovation and job creation for tomorrow.

Is this a Teacher Education program?

No

Is this a graduate program?

Yes

## Enrollments

Summarize enrollment and degrees conferred projections for the program for the first- and fifth-years of operation. If possible, indicate the number of full-time and part-time students to be enrolled each fall term in the notes section. If it is not possible to provide fall enrollments or fall enrollments are not applicable to this program, please indicate so and give a short explanation.

### Student Enrollment and Degree Projections for the Proposed Program

Fall Headcount of Program Majors/Minors (1st year)

10

Fall Headcount of Program Majors/Minors (5th year or when fully implemented)

20

Annual FTE Program Majors/Minors (1st year)

10

Annual FTE Program Majors/Minors (5th year or when fully implemented)

20

Annual Degrees Awarded (1st year)

0

Annual Degrees Awarded (5th year or when fully implemented)

10

### Relevant Notes for Enrollment

There are currently only 53 programs in the US where the MS degree is the highest degree awarded by the physics department. Only two of these (DePaul and Western Illinois) are in the state. In 2019 the average enrollment in all of the MS programs was about 17 students. However, this included 13 programs with fewer than 10 students. We agree that programs with fewer than 10 students are untenable, but both the Illinois located schools are above this (13 and 15). Both of these programs also have much smaller undergraduate programs than ISU.

With our current staffing-level we believe that 20-25 student would be the optimal size for the program. This would correspond to about 2 grad students per faculty member for research theses. If the program proves to be very popular, we would certainly be open to expanding it.

We are anticipating approximately half of the students would be recruited through Graduate Assistantship (both TA and RA); and the other half to pay full tuition.

We also anticipate 2-4 students to enroll in MS by coursework option.

## Budget Rationale

Estimated Costs of the Proposed Program - **For all sections below, only NEW resources not currently available to the program.**

### Operating Expenses

Including but not limited to: Contractual, Commodities, Equipment, etc.

Is the unit's (College, Department, School) current operating budget (contractual, commodities, equipment, etc.) adequate to support the program when fully implemented?

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No

Please explain.

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We will need funds for purchasing new experimental setups for graduate labs as well as computational facilities for running simulations. On average, one new experiment costs approximately \$10,000. The \$40,000 will be used for purchasing three new experiments and purchasing computers.

The \$5,000 in future years will be used to purchase consumable supplies and maintaining software licenses.

If new resources are to be provided to the unit to support the program, what will be the source(s) of these funds?

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AEF would be appropriate funds for this.

Operating Expenses (1st year)

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\$40,000.00

Operating Expenses (5th year or when fully implemented)

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\$5,000.00

### Personnel

What impact will the new program have on faculty assignments in the department?

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All current loads should be the same, but several 300 level classes will be cross listed as 400 level with additional requirements for the graduate level courses. Some general education sections will be combined into larger sections. For example, some of our PHY 102 sections are offered with a maximum enrollment of 85 students, whereas some other sections are offered with a maximum enrollment of 171 students. We plan to combine some of the sections with 85 students into section with 171 students. Moreover, Lower enrolled gen ed courses will be offered once a year rather than every semester. All current T/TT faculty have terminal degrees in the field and can teach graduate level courses.

Will current faculty be adequate to provide instruction for the new program?

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No

Will additional faculty need to be hired, either for the proposed program or for courses faculty of the new program would otherwise have taught?

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Yes

Please indicate whether new faculty members will be full-time or part-time faculty, tenure track or non-tenure track faculty.

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Tenure Track Full Time

We will begin the program with existing T/TT faculty and then add the new faculty member once you have 10 students, most likely in the second year of the program

Will current staff be adequate to implement and maintain the new program?

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Yes

Please explain.

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NA

Will current advising staff be adequate to provide student support and advisement, including job placement and or admission to advanced studies?

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Yes

Will additional staff be hired?

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No

Please elaborate.

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For the MS program, we have created a "Graduate Committee". The Committee would be responsible for reviewing applications and admission. The "Graduate Program Chair" will be responsible for coordinating the admission process with the Graduate School and International Office, and helping students identifying faculty mentors who would act as thesis advisers (with whom the student will be conducting research). Once a thesis adviser is identified for a student, the adviser would largely be responsible for advising the student. This should only be ~ 2 students per faculty member. Until recently, we used faculty advisors for all our undergraduate students.

Faculty FTE (1st year)	Faculty FTE (5th year or when fully implemented)
1	0
Faculty Salary Dollar(s) (1st year)	Faculty Salary Dollar(s) (5th year or when fully implemented)
\$70,000.00	\$0.00
Other Personnel Costs (1st year)	Other Personnel Costs (5th year or when fully implemented)
\$75,000.00	\$166,000.00

Facilities

Including but not limited to rental, maintenance, etc.

Are the unit's current facilities adequate to support the program when fully implemented?

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No

Will there need to be facility renovation or new construction to house the program?

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Office space for graduate students has been identified and evaluated by Facilities, but the room needs to be renovated to make it usable. The department needs additional funds to renovate space for graduate student offices (space has been identified and cleared out. An estimate has been obtained from Facilities for constructing a wall to separate the space.) We are requesting \$25000 to renovate MLT 207 for graduate student offices.

For a new degree program describe in detail the facilities and equipment available to maintain high quality in this program including buildings, classrooms, office space, laboratories, equipment and other instructional technologies for the program.

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We are equipped with state-of-the-art computational and experimental facilities are are being currently used to conduct world-class research. For all the details, please visit our department research and facilities page.

<https://physics.illinoisstate.edu/research/>

<https://physics.illinoisstate.edu/facilities/>

Are library resources adequate to support the program when fully implemented? Please elaborate.

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Yes. Milner Library already possesses several graduate level physics textbooks, such as Classical Electrodynamics by Jackson, Advanced Quantum Mechanics by Sakurai, etc. Milner Library also subscribes to several journals that would be required to conduct research, and thereby complete thesis. These include American Physical Society, American Chemical Society Journals. Furthermore, Milner Library also provides Interlibrary Loan services for print materials that are not available through the I-Share Catalog, and for articles that are not available through the library print or electronic journals.

Facilities Costs (1st year)

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\$25,000.00

Facilities Costs (5th year or when fully implemented)

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\$0.00

#### Other Costs

Are there any additional costs not addressed above?

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No

Please explain.

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None

Are any sources of funding temporary (e.g., grant funding)?

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No

How will the program be sustained once these funds are exhausted?

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NA

If this is a graduate program, discuss the intended use of graduate assistantships and where the funding for assistantships would come from.

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The primary use of GTAs will be in covering labs and discussion sections in the Physics for Scientists and Engineers Courses (PHY 110,111, and 112). Once the Engineering program is operating, all engineers will be required to take all three courses in the sequence. Assuming that we take 150 engineering students per year, even if we are able to balance the load, it would have 75 engineering students in each of the three classes every semester. We currently have approximately 60 students per semester in PHY 110, 25 in PHY 111 and 10 in PHY 112. This gives a ballpark figure of 135 students in PHY 110, 100 students in PHY 111 and 85 students in PHY 112. For the calculus-based course, it is traditional for the professor to teach the large lecture sections and the break the class out into discussion sections of 25-35 students that are lead by GTAs. For PHY 110 this requires 4 discussion sections and for PHY 111/112 it would require 3 each for a total of 10 discussion sections. In addition to the discussion sections, we need to have lab sections. These are capped at 24 students per lab so we will need instructors for 5/6 labs for PHY 110, 4/5 labs for PHY 111 and 3/4 labs for PHY 112 for a

total of 12-15 lab sections. A traditional load for a GTA in physics programs is leading one lab section and one discussion section, as well as holding 3-4 office hours per week.

With these numbers, we would require 10-12 GTAs for covering the Physics for Scientists and Engineers sections alone.

As discussed above, the GTAs would be primarily used for discussion sections, labs, office hours and grading in support of the calculus-based physics sequence of classes. If we assume that each lab takes three hours of class time plus an hour of preparation and two hour for grading, each discussion section is one hour in class plus one hour of preparation plus two hours for grading, plus four hours of office hours. We would also have the GTAs work two hours per week in the general physics tutoring center that supports all of the physics classes offered by the department and is the subject of a recently submitted PIE grant proposal. This comes to 16 hours per week per UTA.

Assuming the current Chemistry GA rate of \$1416 per month for 10 months (approximately 0.5 FTE, 18.75 hours/week), one GTA would cost ~ \$14.160K per year. If there are a total of 5 GTAs this would be ~ \$75K per year (assuming 2% raise per year with anticipated start of the program in Fall 2024).

The minimum GA pay rate is currently \$1300 per month for 20 hours per week. The Physics Department is planning to pay the variance of \$116 per month using out IDC account.

In addition, for meritorious students, we will create scholarship opportunities using endowed funds that physics department has received recently. Note that students accepted as Research Assistants (RA) through individual faculty's research grant would cover for the expenses for 12-month period possibly at a higher rate. Therefore, the research assistantship will be sufficient for RAs.

#### Itemized Costs

1. Description	1. Cost (1st year)	1. Cost (5th year or when fully implemented)
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#### Total Costs

Please subtotal the Operating, Personnel, Facilities, and Other Costs.

Total Cost (1st Year)	Total Cost (5th year or when fully implemented)
\$210,000.00	\$171,000.00

#### Notes

#### Other Attachment/Documentation

[Revised Responses to Provost Question 10-04-2022.pdf](#)

#### Approval Signatures

Department/School Curriculum Committee Chair

DSCCC Signature



Electronically Signed by David Marx (dtmarx@ilstu.edu) - October 6, 2022 at 9:59 AM (America/Chicago)

Department Chairperson/School Director

DCSD Signature

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Electronically Signed by Daniel Holland (dlholla@ilstu.edu) - October 8, 2022 at 11:06 PM (America/Chicago)

College Dean

CD Signature

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Electronically Signed by Heather Dillaway (hedilla@ilstu.edu) - October 12, 2022 at 4:58 PM (America/Chicago)

Provost

Provost Signature

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Electronically Signed by Aondover Tarhule (tarhule@ilstu.edu) - October 17, 2022 at 4:03 PM (America/Chicago)

College Curriculum Committee Chairperson

CCCC Signature

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Electronically Signed by Christopher Hamaker (chamake@ilstu.edu) - October 20, 2022 at 4:40 PM (America/Chicago)

Graduate Curriculum Committee Chair

GCCC Chair

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Electronically Signed by Jeffrey Wagman (jbwagma@ilstu.edu) - April 19, 2023 at 1:07 PM (America/Chicago)

University Curriculum Committee Chairperson

UCCC Signature

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No Response

Chairs and Deans - Routing Steps  
To be completed by the Provost's Office.

The ULID is the part of your Illinois State University email address before the @ symbol.

Dept/School Curriculum Committee Chair ULID	First Name	Last Name	Email Address
dtmarx	David	Marx	dtmarx@ilstu.edu

Dept/School Chair ULID	First Name	Last Name	Email Address
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College/Dean ULID	First Name	Last Name	Email Address
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College Curriculum Committee Chair ULID	First Name	Last Name	Email Address
chamake	Christopher	Hamaker	chamake@ilstu.edu

Graduate Curriculum Committee Chair ULID	First Name	Last Name	Email Address
kacar1	Kristin	Carlson	kacar1@ilstu.edu

For Workflow Purposes Only

Primary Contact ULID (HCM Link)	Secondary Contact ULID (HCM Link)
dlholla	umanna

D/S Curr-Comm Chair ULID (HCM Link)	D/S Curr-Comm Chair Name (Kuali Link)	D/S Chair ULID (HCM Link)	D/S Chair Name (Kuali Link)
dtmarx	David Marx	dlholla	Daniel Holland

College/Dean ULID (HCM Link)	College/Dean Name (Kuali Link)	College Curr-Comm Chair ULID (HCM Link)	College Curr-Comm Chair Name (Kuali Link)
hedilla	Heather Dillaway	chamake	Christopher Hamaker

Graduate Curr-Comm Chair ULID (HCM Link)	Graduate Curr-Comm Name (Kuali Link)
kacar1	Kristin Carlson

## Form Submission - Proposer

Submitted for Approval | Proposer

Daniel Holland - October 4, 2022 at 2:01 PM (America/Chicago)

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## Submission Notification

Notification Sent

Daniel Holland - October 4, 2022 at 2:02 PM (America/Chicago)

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## Provost (Update)

Approved

J Cooper Cutting - October 6, 2022 at 9:55 AM (America/Chicago)

Ani Yazedjian

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## D/S Curr-Comm Chair

Approved

David Marx - October 6, 2022 at 9:59 AM (America/Chicago)

The physics department currently offers a BS in five separate degree sequences within the major.

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## D/S Chair

Approved

Daniel Holland - October 8, 2022 at 11:07 PM (America/Chicago)

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## College Dean

Approved

Heather Dillaway - October 12, 2022 at 4:58 PM (America/Chicago)

Approved

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## Status Update Email

Notification Sent

Curriculum Forms - Registrar Office - October 12, 2022 at 4:58 PM (America/Chicago)

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## Provost (Approve)

Approved

Aondover Tarhule - October 17, 2022 at 4:03 PM (America/Chicago)

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Approval Email

Notification Sent

Daniel Holland - October 17, 2022 at 4:04 PM (America/Chicago)

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Approval Email

Notification Sent

David Marx - October 17, 2022 at 4:04 PM (America/Chicago)

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Approval Email

Notification Sent

Daniel Holland - October 17, 2022 at 4:04 PM (America/Chicago)

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Approval Email

Notification Sent

Heather Dillaway - October 17, 2022 at 4:04 PM (America/Chicago)

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Approval Email

Notification Sent

J Cooper Cutting - October 17, 2022 at 4:04 PM (America/Chicago)

Ani Yazedjian - October 17, 2022 at 4:04 PM (America/Chicago)

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Coll Curr-Comm Chair

Approved

Christopher Hamaker - October 20, 2022 at 4:40 PM (America/Chicago)

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Graduate Curriculum Committee Chair

Reassigned

Cathy Savitzky - January 20, 2023 at 7:40 AM (America/Chicago)

Kristin Carlson is on sabbatical and Jeff Wagman is her temporary backup.

Kristin Carlson

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Graduate Curriculum Committee Chair

Approved

Jeffrey Wagman - April 19, 2023 at 1:07 PM (America/Chicago)

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Approval Email

Notification Sent

Daniel Holland - April 19, 2023 at 1:07 PM (America/Chicago)

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Approval Email

Notification Sent

dlholla@ilstu.edu - April 19, 2023 at 1:07 PM (America/Chicago)

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Approval Email

Notification Sent

umanna@ilstu.edu - April 19, 2023 at 1:07 PM (America/Chicago)

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Approval Email

Notification Sent

J Cooper Cutting - April 19, 2023 at 1:07 PM (America/Chicago)

Ani Yazedjian - April 19, 2023 at 1:07 PM (America/Chicago)

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Approval Email

Generating PDF

Curriculum Forms - Registrar Office

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