Physics Major Handbook
Welcome to Hopkins! This handbook was written by student members of the JHU Society of Physics Students (our department’s undergraduate club) to tell new physics majors all the things we all wish someone had told us when we were freshmen. All the opinions laid out below are those of SPS alone – they don’t necessarily represent the views of the JHU Physics department. We hope you find this useful!

Chapter 1: The Major
This chapter of our guide will give information about courses that physics majors at Hopkins take. We recommend reading it carefully, since our coursework can get fairly complicated at times.

Section 1: Courses in Physics (and when to take them)
One of the greatest defining characteristics of the Physics major at Johns Hopkins is its (mostly) linear organization. You are generally expect to complete a three-year sequence of courses in a specific order, and take electives in your fourth year to specialize. Because of that structure and the small number of students in the major, you’ll see all the same people in each of your classes and never be without others to collaborate with. Assignments for our courses tend to be geared towards group work, and the department supplies us with plenty of open study space. Physics majors at Hopkins struggle together and triumph together.

The above is usually true, but there are some exceptions. Some students with extensive high school preparation choose to skip the first two courses and in essence start the physics track with sophomore year. Some students also skip some lower level courses so they can take courses at the graduate level earlier. Speak with the faculty if you’re interested in either of these things.

You should note that you should expect to see much lower grades in your college physics classes than what you’re used to in high school. Our department is filled with very intelligent individuals, so our exams are accordingly difficult. Half the total number of points is not bad for some of the physics exams you’ll take, and for a few, 30% could mean an A+. Remember that you’re graded on a curve, so your professors may have some fun with you on exams!

Another note: one downside to our linear arrangement of classes is that you have to schedule other classes around your physics courses. Our department really favors the prime time slots – 9am and 11am – so don’t be surprised if you’re blocked from taking an elective you wanted at some point down the line.

Course information below is arranged as follows:
Required for the Major:
Below, the courses we’re required to take as physics majors are listed. In addition to these classes in the physics department, we’re required to take or have credit for Calculus I, II, and III, Linear Algebra, and Differential Equations, all of which are described in the ‘Math’ section further down.

171.105 Classical Mechanics I
N. Peter Armitage
Freshman Fall
This course is designed to introduce you to being a physics major. Depending on the rigor of your high school physics classes, you may be familiar with a lot of material here already, but the math is probably a bit more sophisticated, so don’t underestimate it. You’ll learn about all the standard topics in intro classical mechanics, from energy potentials to oscillations.
Recommendations: This is your first college physics course! The following advice will carry through to all your future classes. First, this isn’t high school; there’s no penalty for missing class. However, we don’t recommend it – you’ll quickly fall behind. You were probably top of your class in science and math in high school, but here, everyone was. Don’t underestimate the work. Homework works a bit differently here, too. You’ll probably have less than a dozen problems per week, but they will be quite lengthy and challenging. You cannot leave them for the night before the due date! Start them early – not because it’s better to get them done early, but because they will often take several sessions to complete. We recommend working with your classmates on homework, too – this is encouraged, it’s not cheating. Mechanics I is also a great time to meet the classmates you’ll be working with for the next four years. Also, don’t be surprised when your grades on exams are quite a bit lower than what you’re used to - that’s what is expected of you.

173.115 Classical Mechanics Lab
TAs + Morris Swartz
Freshman Fall
This course is a required co-requisite for 171.105. It meets once a week in the evening, and you have to stay for as long as it takes you to complete the lab assignment. The labs are basically the same as those assigned to students taking general physics, so they may
be somewhat easy at times, but the class is a good way to get to know the other physics majors with whom you'll be working for the next four years.
Recommendations: Make sure you pick lab partners you'll work well with! And be sure you can bring a laptop every week – you'll definitely need it.

171.106 Electricity & Magnetism I
Mark Robbins
Freshman Spring
Even if you took AP Physics C: E&M in high school, this course will probably contain a lot of material you haven't seen before. Math from Calculus III is everywhere, and this course can get quite challenging sometimes, but you'll spend a lot of time collaborating with your classmates to solve complicated problems and should get a sense for what upper-level classes might be like. Maxwell's Equations are the topic of focus.
Recommendations: Try to read the book, but don't spend too much time on every word. Purcell explains things well but can be long-winded. Reading more advanced texts, like Griffiths E&M or online course notes from MIT, can be useful because they often include shorter 'review' sections on lower level material. You'll have a much easier time in this class if you've already taken Calculus III (or are taking it at the same time, but you'll find that new topics tend to show up earlier in this class than they will in Calc).

173.116 E&M Lab
TAs + Morris Swartz
Freshman Spring
This course is simply a continuation of 173.115. We found the E&M labs to be somewhat more interesting than the mechanics labs, though.

171.201 Special Relativity & Waves
Nadia Zakamska
Sophomore Fall
This course is often considered by SPS members to be one of the hardest in the major. It consists of three weeks of special relativity with an exam at the end, followed by ten weeks of waves and oscillations. The concepts, homework assignments, and math content in this course are all especially intense. Both linear algebra and differential equations topics will appear, and most students complete linear algebra before taking this class and take differential equations at the same time. Other combinations are possible, and different SPS members will offer different advice, but regardless of your choice, this class will probably require a nontrivial amount of external study.
Recommendations: The books for this course are not comprehensive. Missing lectures is definitely a bad idea, and extra help with the TAs can prove invaluable.
172.203 Contemporary Physics Seminar
Natalia Drichko
Sophomore Fall
The actual format of this class tends to vary year to year, but it usually consists of one small group of students per week giving a presentation on a current research topic in physics. The course acts as a tour of the field you’ll enter if you become a research physicist. Recommendations: Just start your presentation a couple of weeks in advance and this course should be no trouble.

171.202 Modern Physics
Nina Markovic
Sophomore Spring
This course is your first full introduction to the world of physics being researched today. A lot of it acts like a sort of pre-Quantum Mechanics class, but you’ll also be exposed to particle physics, statistical physics, condensed matter physics, cosmology, and more. The class takes it easy on math content so that you can really focus on acquiring the conceptual ideas you’ll need in more advanced classes. It’s a great way to decide whether physics is really the subject for you, because you’ll get a taste for all the topics addressed by the field today.
Recommendations: Follow the Krane textbook carefully; most of what you need to complete the homework is there. But don’t be surprised if you need to spend some time with Google to find some particle masses and other facts!

171.204 Classical Mechanics II
Barry Blumenfeld
Sophomore Spring
This course covers Lagrangian Mechanics – a mathematical formulation of classical mechanics that makes complicated kinematics problems much easier. (One old SPS President called the course “It Spins: The Class”.) The course is pretty math-intense, and will involve lots of differential equations and some linear algebra. Partial differential equations show up sometimes, but you’ll learn all you need to about them from Professor Blumenfeld.
Recommendations: The homework for this class often doesn’t take very long, but it can be very rewarding to spend extra time with the problems and really think about what the Lagrange Equations imply. Many of us also really liked John Taylor’s textbook.

*Note: The authors of this handbook have not yet taken these next three courses, so the below information is currently rather incomplete!
171.301 Electromagnetic Theory II  
Andrei Gritsan  
Junior Fall  
This course continues the material begun in 171.106. It’s mathematically rigorous, and can be a lot of work at times. Be prepared for a lot of study.

171.303 Quantum Mechanics I  
Chia-Ling Chien  
Junior Fall  
This course covers the full versions of the topics introduced to you in Modern Physics.

173.308 Advanced Physics Lab  
Tobias Marriage  
Junior or Senior Spring  
In this course, you’ll recreate four famous physics experiments. The work you do here is a lot closer to experimental research than that seen in the introductory lab sequence. You’ll spend a significant amount of time programming, especially in LabView. Don’t underestimate the workload just because this is a lab course – it actually tends to be heavier than most other physics classes.  
Note: You can take this junior or senior year. Some laboratory material appears on the Physics GRE (grad school entrance exam), though, so you may want to take it junior year if you can.

Other Courses:  
First, we should mention two courses that are not required, but are highly recommended for all physics majors:

171.312 Statistical Physics / Thermodynamics (Statmech)  
Tobias Marriage  
Senior Fall  
Covers physics of many-particle systems. Important for research and recommended for everyone, especially those planning to go to grad school for physics.  
Note: Thermodynamics is a topic on the Physics GRE (the graduate school entrance exam), which is usually taken in the Fall of senior year. It is debated whether it is advantageous to complete Statmech before taking the exam, as that would require taking the class in the Fall of junior year- a semester in which you’ll already be taking E&M II and Quantum Mechanics I.
171.304 Quantum Mechanics II
Oleg Tchernyshyov
Junior Spring
A continuation of the material covered in 171.303. Highly recommended for everyone, especially if planning to go to grad school for physics.

The rest of these courses are completely elective. Some are designed for non-STEM majors at Hopkins, but if they look interesting, you are welcome to sign up. This is not a comprehensive list; we’ve included most of the courses that SPS members have recently taken. Note: We are allowed to sign up for graduate level courses as electives if we obtain instructor permission.

171.101-2,103-4,107-8 General introductory physics courses
If for some reason you need to do so, you are permitted to take any of the general intro physics classes instead of the 105-6 sequence. We don’t recommend this; the classes for physics majors will benefit you more in a number of ways! However, you do have the choice of taking physics for engineering, physics for biological sciences, or active learning physics instead.

173.111-2 General introductory physics lab
In the same way, you can substitute general lab for physics majors lab. Again, we don’t recommend this, as 115-6 are great ways to get to know your fellow majors. However, the scheduling is much for flexible this way, so this option may be useful.

171.118 Stars and the Universe
Adam Riess
This course is intended for non-majors, but can still be pretty fun if you have an interest in astrophysics. You’ll get to use multiple telescopes, and Professor Riess even passes his Nobel Prize around once per semester! Note: This course was not available last year, and we’re not sure whether it’s returning.

171.321 Intro to Space Science and Technology
Stephen McCandliss and Stephen Murray
This course is a requirement for the Space Science & Technology minor.

171.405-6 Condensed Matter Physics
Nina Markovic / Peter Armitage
This course sequence covers the physics useful for condensed matter research.
171.310 Biological Physics
Mark Robbins
This course can be substituted for the second half of 171.201. It is recommended only if you plan to pursue a career in biology-related fields.

171.610 Numerical Methods for Physicists (graduate level)
Colin Norman
While not all SPS members enjoyed this course, the content is extremely useful. If you’re not going to take it, at least consider picking up and reading Numerical Recipes by William Press. Its content is the standard for scientific computing used in research.

171.646 General Relativity (graduate level)
Julian Krolik
Feeling brave? This course is among the most challenging available in our department. Math content, homework, and exams are all as tough as it gets. A rewarding subject, but not for the faint of heart.

Section 2: Courses Outside of Physics (and when to take them)

Math:
Your math courses will serve as the foundation for a lot of the physics you learn. It’s important to take them at the appropriate times, and to have a very strong grasp on what you learn. Important: **We highly recommend that you take the most advanced math courses possible as soon as you can!** Being ahead in math will make physics much easier.

110.106 Calculus I
Not recommended
*We don’t recommend that any physics major take this course. If you have not previously taken Calc I or do not have credit for it, seriously consider instead taking 110.115.* If you take this class your freshman fall semester alongside Classical Mechanics I, you will not learn the math necessary for the following physics courses in time. Academic advising may recommend that you retake Calculus I, even if you got credit for it in high school with an AP or IB exam. *Do not listen!* If you are feeling unsure of your grasp on Calc I, you may wish to take the course described next. Do not take Calc I – in the past, SPS members did not know this would be a problem and ended up behind and had no choice but to take summer courses to catch up. Calculus III is everywhere in E&M I, and both linear algebra and
differential equations appear in Special Relativity & Waves. Those are already hard courses, and they don’t need to be made any harder!

110.115 Honors One Variable Calculus
Freshman Fall
If you would like some review of Calc I in college, or if you’d like to get a feel for what it’s like to study mathematics for theory, this is a good course for you to take during your Freshman Fall. It fulfills prerequisite requirements for both Calculus I and II. You’ll work in a ‘flipped classroom’ setting – no lectures, you learn all the concepts by working out proofs for yourself. Additionally, if you’ve never seen mathematical proofs before (not in the high school geometry sense), there’s probably no better way to learn good practices for rigor than this course.

110.109 Calculus II
Freshman Fall
Many physics majors take this course during their first semester at Hopkins. The main takeaway is probably Taylor approximations. The course is pretty standard, lecture style, weekly problem sets, etc. Don’t fret if your exam grades are lower than what you’d expect from high school – Hopkins math classes curve scores, with the average often sitting at around 65%.

110.202 Calculus III
Freshman Spring
This course covers multivariable calculus, a topic that will appear everywhere in Electricity & Magnetism I. You should take it during Freshman Spring at the latest, but take it during your first semester if you place in! It’s always to your benefit to be ahead in math. Pay special attention when learning about gradient, divergence, and curl, as those topics will appear again and again in physics.

110.201 Linear Algebra
Freshman Spring or Sophomore Fall
This course provides a deep understanding of vector mathematics. Every topic is extremely useful for physics. You will see a lot of this course material in Special Relativity & Waves, so we recommend you take it before starting your sophomore year if you can. Many majors choose to take it concurrently with E&M and Calculus III during their Freshman Spring semester. However, putting it off until Sophomore Fall is not an unreasonable option.

110.212 Honors Linear Algebra
Not recommended
A theoretical understanding of linear algebra can be extremely useful to a physicist. However, SPS members have been dissatisfied with this course in the past. We recommend asking SPS members about the professor teaching the course when you intend to take it before signing up.

110.302 Differential Equations
Freshman Spring or Sophomore Fall
Study of equations involving functions and their derivatives. Critically useful for any scientist or engineer. We recommend taking it as soon as possible. Most physics majors take it sophomore fall, concurrently with Special Relativity & Waves – a class that contains a multitude of differential equations.

110.311 Complex Analysis
Whenever possible
This course covers the use of complex variables, and some miscellaneous topics in analysis, all of which can be very useful to a physics major. Take this class if you have time.

110.417 Partial Differential Equations
Whenever possible
SPS members have in the past been dissatisfied with this course, but a study of the subject is certainly useful. Take the course if you're happy with who's teaching it that particular semester (math courses change instructors every semester).

110.401-2 Advanced Algebra
Whenever possible
This subject is very useful for theoretical particle physics. If high-energy theory is your interest, these courses are a must.

Applied Math:
Courses in the Applied Math department can be useful for many applications of physics, as well as research. They’re often very well taught and can be extremely useful to a physics major. Some important courses offered are:

Probability and Statistics
You have a few options here. Many physics majors take 550.310, which is a one-semester course on probability and statistics for application in the physical sciences. It’s relatively simple, but teaches a lot of useful material. Physicists interested in a more rigorous view of
the subjects can instead take 550.420-430, a two semester course that dives into more theoretical aspects of the subjects. The teaching for those two courses is really fantastic!

550.361-2 Intro to Optimization
This two semester course sequence covers optimization methods. Computation techniques are emphasized. You’ll learn MATLAB, as well as many useful techniques for research. The first course in the sequence is probably sufficient for physics purposes.

**Programming & Computer Science:**
We recommend that every physics major learn how to program as soon as possible! It’s the easiest way to quickly open doors into research for yourself. For simple utility in research, you can probably teach yourself a language like Python on your own time using a website like www.codecademy.com. However, if you want a more formalized education in programming and/or computer science, think about taking these courses:

580.200 Intro to Scientific Computing in Python, Matlab, and R
Although this class is designed for BMEs, the programming experience can be good for everyone. Python, Matlab, and R are three languages physicists use frequently, for general programming, matrix manipulation, and statistics respectively. Just be aware that many of the example problems will be BME-related.

*More course recommendations to come!

**Writing Courses:**
As a physics major, Hopkins requires you to complete 12 credits (usually four courses) of writing classes. Our Advanced Lab course is writing intensive, so that will fulfill 3 credits. If you choose to write a senior thesis, that will fulfill 3 more. To complete the remaining requirements, you have many options in departments like Writing Seminars or History. However, if you’re looking for something less traditional / essay focused, SPS members have finished their writing requirements using courses such as:

661.150 Oral Presentations
A weekly course on public speaking. Practicing this skill is important for nearly every profession, and the course is lighthearted and is often tailored to your interests.

661.105 Intro to Business
General practices for working in the corporate world. Useful to any physicist considering a career in industry, and relatively easy writing assignments.
220.206 Becoming a Science Journalist
Science communication is a growing field, and discoveries must be reported to have impact. This course is an introduction to that style of writing.

Other Courses:
To round out our course listing, here are a few courses SPS members took as electives that they found particularly interesting as supplemental material to their physics major:

180.101-2 Intro to Economics
Learning about economics can be rather informative for a physicist, since it's a completely different way of thinking from what we're used to. The intro level courses should be a breeze if you're mathematically inclined, and who knows, you might learn something to help supplement your salary someday.

376.242 Intro to Popular Music
Looking for an elective credit? This course is plain fun. You'll learn about the progression of American culture through the twentieth century by way of classic rock-filled Spotify playlists. Laid back, interesting, and listening to music for homework can be a nice break from physics problem sets.

More courses to come!

Section 3: Degree Options and Double Majoring
Currently, Physics undergrads at Hopkins have five degree options: a BS, a BA, a four-year combined BA/MA for the truly ambitious, and two minors, one in physics and one in space science. The requirements are as follows:

The BA degree is designed to be flexible, and is usually pursued by students who do not plan to have a physics-intensive career. It requires the physics classes listed above under “Required for the Major”, the five required math courses also listed above, and two 300+ level approved electives.

The BS degree option offers a chance to become more specialized. It is meant for students who are planning to spend their careers in a very physics-related field, and is usually selected by students planning to pursue a PhD in physics. It requires the same “Required for the Major” physics classes and five math classes as the BA, but then also demands six upper-level elective courses, at least four of which must come from an approved sciencey department on campus. See the department website for details.

The BA/MA program was just recently created by the department at the request of SPS members. To complete this rigorous program and begin your
graduate studies early, you'll need to pass six approved graduate-level physics courses with a B- or better, and write a research thesis. If you are considering this program, SPS advises you to sit down with Collin Broholm, our Director of Graduate Studies, and chat about what it would entail for you.

The physics minor is often pursued by students who take the introductory physics sequence and discover that the world of modern physics doesn't interest them as much as they expected. Students in engineering or other related majors also complete it if they want a more fundamental understanding of their area of specialization. The requirements are simple: any version of classical mechanics and E&M, Contemporary Physics Seminar, and four physics department 200+ level courses.

The space science minor is usually pursued by physics majors interested in astronomical instrumentation, or engineers who want to specialize in space technology. 171.321 Space Science and Technology is a required course, and the minor also requires four additional courses which must be discussed with an advisor who will be assigned to you when you declare your intent to complete the minor to the Academic Advising office and the Registrar. Professor Charles Bennett is in charge of this degree program. He is a good resource for more information, as is the department website.

The department does not offer ‘area of focus’ tracks for astrophysics or particle physics or any other specialization. Many other departments at Hopkins do this, especially in the School of Engineering, but our philosophy is that an undergraduate program in physics should cover all of physics. Your research and your elective courses should be used to crack into your chosen field when you choose one, and grad school is where you'll really specialize if you choose to go.

Many Hopkins physics students choose to double major. Since Hopkins lets you double count classes, it's not very difficult in most cases. The most common choice is Mathematics, since doing a physics major completes half of the math major automatically. Other common choices include Applied Math and Computer Science. Psychology seems to be done fairly often, and we’ve recently even seen things like Writing Seminars, Economics, or History. If you do choose to double major, do it in a field that supports what you’d like to do with your physics degree. If you want to be a high energy theorist, for example, doing a math degree will probably help you.

Note that physics majors are required to take at least 18 credits of Humanities or Social Science courses, which usually translates to 6 classes. Many SPS members chose to take all of those classes in the same department, and finished a minor such as Classics or Music.

If you end up doing exceptionally well in physics, there are a few ways that the department will acknowledge that. If you graduate with a GPA of 3.5 or better in the
courses required for your physics major, you’ll be rewarded with Departmental Honors. If you accomplish [goals not currently set in stone], you’ll be inducted by SPS into ΣΠΣ, the national physics honors society. Disclaimer: The department has recently been discussing possible changes to these requirements with SPS.

Chapter 2: Research

Section 1: Doing Undergrad Research
Chances are, if you’re a student at Johns Hopkins, you’ll be doing some kind of research before you graduate. Usually, for physics students anyway, this means getting involved with a professor on an existing project. Research usually functions similarly to an on-campus job, and you may end up doing it for credit, cash, or nothing at all. Since you’re still learning, a lot of what you work on at the beginning will be learning specifics about your group’s project, but later on you can make serious contributions and maybe even get your name on a paper or two. Research is a great asset to have on your resume, for grad school or otherwise. SPS encourages you to start getting involved as soon as you want to!

Section 2: How to Get Started
So, how do you find a research project that you can join? The most general answer is to talk to people around the department. Getting started on a project is usually as simple as letting the right person know that you’d be interested and motivated to work with them. To do that, though, you need to figure out who you’d like to work with! Spend some time exploring the “People” page on the department website – you’ll find a description of each professor’s research there. The department also hosts open houses and research fairs (often aimed at grad students but open to everyone), which can be a great way to see who’s doing what. You’ll also hear about a lot of professors’ research projects at SPS talks, so definitely attend all of those!

Once you’ve narrowed it down to a few choice projects, start contacting professors. Sending emails can work, but many of us have found that simply walking down the hall and knocking on someone’s door can be more effective. SPS events, department talks, and even after classes are also great places to start a conversation with a someone. Let the professor know that you’re interested, and why. Most of them have worked with tons of undergrads before, so just be yourself. They’re looking for genuine interest in a project – don’t try to work with someone just because they’re a big deal. One of the greatest things about our department is that the faculty treats undergrads like colleagues, and will respect you. No need to be over-excited; you’re a Hopkins physicist, and that makes you a pretty big deal, too. Not all professors in the department are looking for undergrad help at any given time, but often they’re willing to work something out with you. You might not get paid, but you can always get credit for research.
That said, it's really helpful if you have something to contribute to a research project. If you want to start working in your first year or two, programming skills are usually a must. We recommend you sharpen your skills as soon as you can, through a class or simply teaching yourself with the assistance of online resources (ask us for website recommendations!). Python is usually the language of choice for physicists, with C++ a close second. It’s just often hard to understand everything involved with a project before taking quantum mechanics, but there’s almost always programming work you’ll be able to do. It’s all very project-dependent.

Section 3: Types of Physics at Hopkins
There are many large fields of study contained under the umbrella of ‘physics’. At Hopkins, we focus mainly on three. Below, we’ve described what kinds of work our department is known for, and listed a few friendly faculty members you can try talking to if you’re interested in learning more or getting involved early on. If you’re looking for a particular person’s office, check out the department directory, on the wall near the large ascending concrete staircase in the rotunda.

Subsection A: Astrophysics
This is the stuff that our department is most known for. The Space Telescope Science Institute (HUBBLE) located across the street, and many members of our faculty are true leaders in the field right now. There are many listable names here, but we’ll name a few who often interact with SPS or take on undergrads:
Charles Bennett led the WMAP experiment and is now working on constructing the CLASS telescope array.
Tobias Marriage is also working on CLASS, and employs many undergrads to help build his telescope experiments.
Julian Krolik studies astrophysical black holes and is also always happy to offer advice to undergraduates.
Adam Riess, 2011 Nobel Prize winner, is famous for his studies of Dark Energy and calculation of the Cosmological Constant.
Nadia Zakamska studies active galactic nuclei and supermassive black holes physics.

Subsection B: Particle Physics
Many members of our faculty are involved in the CMS collaboration and work with scientists at CERN. If you’re interested, a few faculty members to talk to are:
Petar Maksimovic, our SPS advisor, works on Z- and W-Boson tagging.
Morris Swartz is the department point-person for collaborations with CMS.
Andrei Gritsan has undergraduates help him analyze LHC data from CMS.
David Kaplan recently made waves in the world of physics with his movie, Particle Fever!

Subsection C: Condensed Matter Physics
Condensed Matter Physics is the study of materials in interesting new states of matter. This includes semiconductor physics, friction, low-temperature physics, superconductors, device physics, and lots more. Some people to talk to in our department:
Nina Markovic works mostly on low-temperature device physics but often runs many experiments at once.
Peter Armitage recently worked on topological insulators and also does low-temperature work.
Daniel Reich, our department chair, works on soft (biological) condensed matter physics.
Robert Leheny, our Director of Undergraduate Studies, works on liquid crystals and soft condensed matter physics.
Collin Broholm is an expert in neutron scattering experiments and is also our Director of Graduate Studies.

Subsection D: Other Work
While most of our department’s work falls into the above three categories, you can find some faculty doing other types of physics if you look hard enough:
Michael Finkenthal researches plasma physics and teaches a class on it every year.
Alex Szalay studies astrophysics, but from a very computer-sciency standpoint.
Gregory Eyink has a joint appointment with the Applied Math department. He works in statistical physics, studying turbulence. His office is in Whitehead Hall.
Jack Morava is a joint professor in the Mathematics department and is probably the only string theorist you will find at Hopkins. His office is in Krieger Hall.

Section 4: Internships & Summer Work
Many freshmen don’t realize that the way you spend your summers can be as important to a successful college career as what you do during the semester. Summers are your time to begin getting experience in the field you’ve chosen.

Physics majors often accomplish this with research jobs or internships. These (sometimes very competitive) positions can be difficult to come by, but early planning combined with a good track record at Hopkins has proven to be successful in landing positions. You can find internships called Research Experiences for Undergraduates (REUs) at many major universities. REUs usually pair you with a faculty member for work on a new or, more often, existing research project. REUs are paid, and usually include
housing at the host university. You’ll also find very similar programs, called Science Undergraduate Lab Internships (SULI), at the country’s national labs, such as Brookhaven and Lawrence Berkeley. SULI programs tend to be much larger than REUs. You can find other internship listings on the National Science Foundation website, the National SPS website (SPS usually offers some unique science policy internships, too), and other places online. Don’t be afraid to look outside of your comfort zone, either – internships overseas or in areas other than physics research can be extremely rewarding. If you have no idea where to start, check out the internship listings hosted on the JHU Career Center website, or go chat with those advisors in person in Garland Hall.

If you want a summer internship, start looking in the fall. Many application deadlines are January 1st, and some are as early as November. If you want until the Spring, you’ll be scrambling and probably won’t find what you want. Get it out of the way really early so you don’t have to worry!

Doing research with a professor at Hopkins can be very helpful to your application for internships. You’ll be able to show that you have lab experience, you’ll have some applicable skills, and you’ll be able to ask that professor for a much more in-depth letter of recommendation.

Another summer option is sticking around Hopkins to do research. If the kind of work you want to do is available at Hopkins, see if you can find a professor who would be willing to take you on for summer work. You won’t make as much money this way, and it can be great to make connections outside of Hopkins, but this kind of summer will allow you to get really deeply involved in a research project that can continue throughout your undergraduate career that can lead to a senior thesis or other desirable results. Plus, our professors usually love the help, since summer is when they really get to focus on their research.

If you do something exciting with a summer, let SPS know right away – we usually hold an event every fall where returning members can tell the new ones about their research or other work.

Chapter 3: SPS & Other Resources

Section 1: SPS

Alright, this is our big chance to advertise. Listen up!

The Society of Physics Students is a national organization for undergrads studying physics. Its national goals are to connect physics students everywhere and give them opportunities to take their educations to a higher level.

Our chapter at Hopkins is a student club meant for every physics major (and others with interest) to join. We hold meetings, events, talks, and more so that our physics majors can be a part of a community beyond simply seeing each other in classes. Our department is a lot more close-knit than many others at Hopkins, and SPS is a big reason why!
SPS holds weekly meetings, plus some extra events. Our meetings usually alternate between a talk geared towards undergrads and a social event. We’ve had talks on subjects from cosmology to differential equations, and events including laser tag, barbecues, physics jeopardy, murder mysteries, and more. We always serve pizza at our meetings, too.

A few of our events deserve some extra attention. Our most significant event each year is probably the annual Feedback Session, held at the very end of each Spring semester. There, members of the department join us for refreshments and listen to our suggestions for changes around the department. They always deeply consider everything we have to say, and some really important changes have taken place as a result of these events, from textbook changes to the allowance of double-counting classes for two majors all around Hopkins.

SPS is also generously given the opportunity to tour national lab or other physics-related location each Spring break. We’ve traveled to SLAC, Kennedy Space Center, and even CERN, all on the budget of our department. This opportunity is always offered to the most active SPS members first!

We also recently began a tradition of concluding each semester with a LAN Party, hosted in the PUC Lab (explained below). Our tech officer sets up servers, everyone brings laptops and Steam accounts, food is delivered, and everyone has a good time.

SPS also offers its members many resources. In addition to providing you with connections to knowledgeable upperclassmen, the club coordinates tutoring efforts and also provides homework help in our website-hosted chatroom. Additionally, active SPS members are allowed access to the SPS office, located adjacent to PUC Lab. It contains a large science library, a computer, and a coffee machine, fridge, and microwave.

In addition to our own chapter’s services, many benefits are available to members from the National SPS organization. Becoming a member costs around $30, but includes membership in the American Physical Society and subscriptions to two journals of choice. Being a member allows you to apply for SPS scholarships and internships, and can connect you to other schools around the country.

We’d love it if, even if you don't become a member of our chapter, you came to at least one SPS meeting. Join our mailing list so you can get updates about what’s going on, too. We hope we’ll be seeing a lot of you!

Section 2: PUC Lab
Our department is very kind to us. Room 478, called the Physics Undergraduate Computing Lab, is a lounge area on the fourth floor of Bloomberg set aside for undergrads to use. It houses nearly endless whiteboard space, couches and armchairs, and about a dozen computers equipped with useful software for physics work. More importantly, though, the PUC Lab is where you’ll find most physics majors doing all of their studying. Older
students, especially those you’ve met in SPS, can be a great resource for homework help, as they’ve already made it through whatever class you’re taking. Everyone is friendly, so just ask!

Physics majors can access the PUC Lab 24/7, any day of the year. A quick Google search for “JHU PUC Lab” should bring you to a webpage where you can request JCard encoding for access. So they can enter the building at night, physics majors can also obtain a key to the Bloomberg building for a deposit of $5 by talking to Brian Schriver in the office suite on the 3rd floor.

**Section 3: Physics Resources**

If your physics classes aren’t far more challenging than what you experienced in high school, something’s not right. Everyone in our department is brilliant, and the course difficulty is adjusted as such. With that in mind, don’t be surprised if you need some help on the side from time to time! The physics department has put a ton of educational resources at your disposal:

- Your first line of defense should always be your classmates! Physics is a collaborative field, and working together with someone will probably boost your problem solving abilities more than you’d expect. Just make sure you’re not letting them solve all the problems for you!

- Next up, try the TA for the class in question. They’re almost always graduate students, and are literally hired to help you. Send them emails, go to their office hours, ask lots of questions in section meetings. It can be especially useful to go over homework problems you solved incorrectly with them.

- You can also stop by the Physics Help Room, located on the ground floor of Bloomberg across from the elevator. There you’ll find TAs who should be able to help you with questions from any part of physics, although they most commonly deal with students taking the non-major introductory courses.

- If you’ve got a particularly strange question or are confused about a lecture, try stopping in to see the course’s professor. They’re often pretty busy and can be hard to pin down sometimes, but no one can answer your questions better than they! The office hours they have scheduled are for your benefit, and some will even be pretty sad if nobody comes to visit.

- If all else fails, we’ve often learned things by leaving problems on the whiteboards in PUC Lab with a note asking for help. You may come back a day or two later and find a response from another student whose thoughts can push you in the right direction.

Most useful of all, though, are the resources SPS can offer you. Wink wink. First, being a member will introduce you to a lot of upperclassmen who have probably already completed whatever course you’re in the midst of. They’re usually very willing to work on a problem
since it'll serve as a refresher for them. SPS members also have access to a large library
of physics textbooks not used in class, and you may be able to find a good answer to a
question if you flip through a volume or two. Additionally, SPS maintains an IRC chatroom,
linked from our website, in which members are asked to help anyone who stops by with a
question. Finally, SPS coordinates tutoring services in physics for students throughout
Hopkins. Contact the SPS President if you’d like to hire a tutor, but note that if you require
more than a small amount of face time, this may not always work out to be free.

Section 4: Other On-Campus Resources
In addition to those around our department, there are many resources available around
Hopkins that may prove useful to physics students. If you’re looking for some additional
academic help, there are a few places you can try. If the mathematical side of physics is
giving you trouble, try stopping by the Math Help Room on the second floor of Krieger Hall,
where math department grad students will help you work through any problem. If a specific
class is giving you trouble, you have a few options. First, if that class is one of the big
courses required by a lot of majors (lower level science and math courses), you can sign up
at the beginning of each semester for PILOT, a program in which you’ll meet weekly with
other students in your class for undergrad-guided problem practice. Many SPS members
have found PILOT extremely helpful. You can also stop by the Learning Den, a peer tutoring
area located in the Hut reading room across the café in Gilman Hall, for some quick help in
a wide variety of subjects. Also located inside the Hut is the Writing Center, a great
resource for any student who’d like some feedback on any kind of writing.

Accomplishing anything at Hopkins can take a lot of planning, which is why the
school assigns us so many advisors. All freshmen in Krieger School are assigned a
general academic advisor prior to arriving at Hopkins, who will sign off on your first
schedules, and explain general school degree requirements. After you declare your majors
and minors, you’ll be assigned one advisor per degree program you enroll in, all of whom
will have to speak with you at least once per semester. They are a great resource for
advice about which classes to take and how to proceed academically. You’ll also receive
an advisor for pre-professional programs and for study-abroad endeavors. Make use of
their experience as often as you feel necessary.

If you need to do some background reading for a research project, you can ask for a
librarian knowledgeable in physics at the circulation desk in MSE Library. They’ll be very
happy to help you navigate the extensive science collections located on C Level of the
library, and can also show you how to access online journal databases using Hopkins
access codes.

While you’re at Hopkins, you’re not just a physicist; you’re a college student, and that
often comes with a lot of stress stemming from both academic and social sources. It’s so
hard to study a complicated subject like physics when you're not feeling your best, so we encourage you to keep yourself relaxed. Hopkins knows how stressful our work can be, so it offers undergrads a ton of resources to reduce stress levels. On Mondays, for instance, you can head to Brody Learning Commons for a free backrub from the JHU Stressbusters. If you’d like to talk our your troubles, A Place To Talk is a student organization that trains peer counselors, who will listen to anything you have to say every weekday evening in AMRII or Wolman. You can also chat with your Resident Advisor anytime you need to – that’s why they’re there! Additionally, SPS is always ready to help its members, and you can always send an email to the board if you’d like to chat with us – we stood where you did once, and we might have shared your experiences.

One of the best ways to keep stress down at Hopkins is to take your mind off your work with some fun club activities or events. Many SPS members are also a part of other interesting clubs, such as improv comedy, quidditch, pen and paper gaming, and more. Chat with some members if you’re looking for something fun to take your mind off your homework!

Chapter 4: Getting Involved
Section 1: In the Department
Our department is a bustling hub of activity in the world of physics. Events happen frequently, from talks by Nobel laureates to our annual holiday party. Get involved and don’t miss out!
Note: Many department activities are operated out of the main office, located on the third floor in the telescope atrium. You'll probably have to visit many times if you become involved!

Subsection A: The Physics Fair & Other Outreach Events
By far the most important department event each year is the annual Physics Fair. Every year, during the same weekend as Hopkins holds Spring Fair, our department pulls together to host a large-scale outreach event for children in the Baltimore community. Hundreds of live demos, shows, and activities are run at once by professors, grad students, and undergrads working together. Everybody volunteers for whatever they think is fun, we all get t-shirts, and show how fun physics can be to the public.

Throughout the year, SPS and the physics department hold other outreach events for the community for which your help would be much appreciated. Look out for event opportunities posted to the SPS mailing list, and contact the SPS outreach officer if you have any ideas to share.
Subsection B: Open Houses & Prospective Students
Starting to think our department is pretty great? We agree, and it’s to everyone’s benefit if you help demonstrate the department’s good qualities to our visitors. Throughout the year, Hopkins holds open house events (you may have attended some as a prospective student), and you’ll often see emails to the SPS mailing list sent by our administration asking for student help with those events. Professors attend every open house event, but undergrads tend to have an easier time communicating with prospective students, so if you can help out, you should! These events are great opportunities to toot your own horn and explain why physics at Hopkins is among the best programs you’ll find anywhere. SOHOP and Orientation are especially important!

Fairly frequently, prospective students will contact the department to request a more physics-focused tour than those provided on campus by Blue Key Society. When this happens, the department administration will usually again email the SPS list for help. It can be really fun to chat directly with high school students and their families, and they always really appreciate it, so please volunteer for this if you can!

Subsection C: Other activities
You can also make a splash in the department in other ways. For starters, definitely show your face at our frequent barbecues, holiday events, and picnics – it’s a great way to meet faculty and other students and to make a good impression. If you’d like to be involved in actually planning such events, the easiest way to accomplish that is to join SPS, as we (especially board members) are often heavily involved in planning activities that occur around the department. We can definitely use your help!

You can also help out the department more directly by applying to be a TA for the general physics courses. If you’re selected, you’ll be helping non-majors learn, grading their homeworks, and meeting with professors to discuss lesson plans. These positions are paid by Hopkins, and can be very rewarding. SPS members have become TAs as early as sophomore year in the past!

Section 2: Furthering Your Physics Education
Only a fraction of the world of physics is shown to you in the classroom. Your professors will teach you all the important laws and equations, but the stuff on the cutting-edge won’t show up very often on the blackboard. SPS encourages you to expand your view of the world of physics by going to talks, reading the literature, travelling to meetings, and taking any opportunity that presents itself.

Subsection A: Going to Talks
Attending extra lectures is a physicist's favorite way to keep current with their field. Our department (and the rest of Hopkins) hosts such talks on a daily basis. The subjects, speakers, and settings can range from broad overviews of new science from Nobel Prize-winning guests of the university given in our large auditorium to detailed looks at currently active experiments given by graduate students over coffee or wine and cheese. Undergraduates are almost always welcome to sit in for any talk. Full listings can be found on the SPS website, the department website, and posted on bulletin boards around Bloomberg.

Many of the department’s talks are targeted at an audience with high-level knowledge of physics, though, and freshman especially will likely find themselves getting lost. That’s okay, it gets better, we promise! However, SPS also seeks to solve this problem by organizing a series of talks each semester during some of our weekly meetings. Our talks are aimed at undergraduates, and usually come from professors around Hopkins doing research that could be interesting for an undergrad to become involved with. We also serve free pizza at all our talks!

Subsection B: The Literature
Physics, like so many scientific fields today, is a journal-based research discipline. When researchers today complete research projects, they seek to have their results published in one of many physics-dedicated magazines or newsletters. Once you've gained a cursory understanding of modern physics, SPS encourages you to purchase a subscription to *Physics Today* and/or other similar journals. Even if you don’t understand everything written, it’s great to keep up with the field you’re entering, and interesting articles can also serve as great topics of conversation with members of the department.

You can get your hands on these materials in a number of ways. The most sensible way is to become a member of the National SPS. This is something you should do anyway, as membership offers many scholarship and internship opportunities, as well as other benefits. But your membership fee will also cover a subscription to *Physics Today* and another journal of your choice, so it's a great deal. You can also look for copies of magazines on coffee tables around the department, and read materials in the SPS office, MSE, or online through the Johns Hopkins Sheridan Libraries system.

Subsection C: Travelling to Physics Meetings
If you happen to come up with some particularly cohesive results while doing physics research as an undergrad, you’ll probably be interested in presenting those results! You’ll have ample opportunity to do that at Hopkins, but if you’ve got something really interesting, you may be able to attend one of the many annual
physics conferences that happen around the country. You’ll really need to chat with your research advisors before doing this, but we’d like to let you know that the National SPS has a lot of travel funding available to fund members to attend such conferences.

You’ve reached the end of our handbook (we hope it helped!); here’s one last reminder of all the opportunities that will be afforded to you if you join SPS! Come to any of our meetings or events to join!