Response to "A Focus on Academic and Career Advising, Spring 2016"
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This document reports on the self-assessment, self-reflection, and strategic planning undertaken by the Department of Physics in the spring of 2016, in response to the Chancellor's charge. The review process and the planning exercise were carried out by the ten faculty members who comprise the department's Undergraduate Curriculum Committee (Dinsmore, Chair). These committee members also carry out the department's academic advising mission.

This review was carried out at a time when the department has seen an exciting growth in the number of majors. In the years 2007-2013, each graduating class had approximately 20-30 graduating physics majors. Starting in 2014, the number increased sharply and in 2015 we had over 40 graduating majors. We currently have more than 200 majors in total, and this number has held steady for the past two years, showing that Physics is a destination of choice. To handle the growth of majors, two years ago we doubled the number of faculty who advise students and we are engaged in a number of new activities to broaden our professional advising. Details are given below.

This document follows the organization laid out in the original document. Part One provides a "Look in in the mirror," including review and assessment of statistics from the senior survey as well as other inputs. Part Two is a list of the department's advising goals. Part Three lays out our plans to achieve these goals.

Part One: Analysis of the Current Landscape

We focus on advising in academic matters (major tracks and requirements, finding areas of student interest, flow across campus) and career (jobs, internships, graduate school).

(a) Academic advising: strengths and weaknesses

(i) Strengths:

The Physics department allocates substantial faculty time to undergraduate advising. All of the advising is done by tenure-stream faculty. Every major is assigned an advisor who typically *remains the advisor for the student's entire time* at UMass. Every primary major is required to hold a face-to-face meeting every semester (typically 15 min). Secondary majors are recommended to meet with a physics advisor and many do so.

The number of physics majors has grown very rapidly since 2010, leading to an approximately two-fold increase. (Currently we have approximately 210 majors.) In response, two years ago we doubled the number of faculty who carry out advising. We anticipate that these greater resources will help with the senior survey results.

Every student who is interested in the physics major meets first with the UPD. Every such meeting includes a discussion of career goals and options; choice of degree track (there are 3); overview of the 4-year curricular requirements and electives; specific discussion of the requirements for the following 2 semesters; and discussion of experiential opportunities (usually research). Following this meeting, students who elect to major in physics have an advisor appointed to them.

Guidance for required and optional classes works well. Once students have met with a physics advisor (UPD) for the first time, we rarely see students delayed by mis-information. (We do, however, see students graduate after 7,8,9 or 10 semesters because of their own choices or academic performance.) Academic advising personnel and requirements are posted clearly at the physics

department website (http://www.physics.umass.edu/undergraduate), which posts contact information and an extensive *Physics Majors Handbook*. The latter contains checklists for each of our 3 tracks, and each advisor has a pile of printed checklists to use during advising meetings. We find that most students have already read the Handbook before their first meeting with the UPD.

The department has been successful in providing undergraduate majors with research experience. In the past few years, a substantial majority of our students have participated in on-campus research. Advising has been a key part of our success in the goal of increasing research participation.

New-student Orientation and Transfer-student orientation: these are done almost entirely by two people in the department, Lecturer Paul Bourgeois and Prof. Dinsmore (UPD). These activities are very time-intensive but we prefer to rely on a limited number of experienced people because experience is required to handle the wide diversity of backgrounds of incoming students.

Transfer students are often one semester out of sequence with the major, and thus cannot take Physics 181-182 (which are the preferred intro courses). For these students, and for others who join the major in the spring semester, the option of Physics 151-152 in place of Physics 181-182 is a particularly valuable tool to help them graduate on time.

(ii) Weaknesses:

We lack a detailed and coherent list/guidebook for advisors to help them offer complete and consistent advice. (Such a guidebook is under development.)

In the past two years, we have noted that some new students coming from overseas countries with different languages sometimes have difficulty in their first semester's classes. These students appear to be an increasing fraction of our majors. Because of the distance from the U.S., they often do not attend NSO so that communication is entirely *via* email. Experience shows that emails are sometimes not read, possibly because the students are not yet aware of it. (Printed and mailed documents may help here.)

Our greatest challenge with on-time graduation appears to be with students who begin the Physics major in the spring and take Calc 1 (Math 131) at that time. Unless they take at least one and preferably two math classes in the summer, these students are not prepared to take Physics 287 in the following fall. This delays their ability to take Modern physics (284) and, correspondingly, most of the 400-level classes. Such students generally need one or two extra semesters.

(b) Career advising: strengths and weaknesses

In their first semester, students are introduced to career options and how to prepare for them. For this goal, we use advising and UPD meetings, and our Freshman Colloquium (Physics 185 in the fall and 186 in the spring.) The Freshman colloquium is a 1-credit class that includes career overviews and what to do at UMass to prepare (1 class), faculty presentations on research (approx. 10 classes), and 1-3 classes on aspects of professional development.

Preparing students with research experience: We have been very successful at providing opportunities for research here on campus (roughly 70% according to the most recent senior survey). The high participation rate is a result of many years of recruiting into research groups, consistent recommendations at advising meetings, and activity of the student-run Society of Physics Students (SPS). In physics, joining a research group can be considered the equivalent of an internship.

Advising and preparing for graduate school: Approximately one third of our students proceed to graduate school. These students appear to be well prepared, except that we note that scores in the GRE Physics test (notoriously difficult) could be higher. To this end, we began in Fall 2015 a 1-credit independent study class to review physics problems for the GRE. In our first time, we had at least one outstanding success (+100 points) but overall results were mixed; with feedback from the students we have a different structure in mind for Fall 2016.

Preparing students for K-12 teaching: Our G-track (B.A.) is a good option that allows students to take teaching practicum classes while at UMass. This track draws approximately one student per year but in fact many more than that are interested in K-12 teaching. Recently we have greatly expanded our options for students who are interested in teaching by creating opportunities for students to TA classes and by creating a new course (Phys390T) to guide students in teaching methodologies for team-based learning (TBL).

Preparing students for non-teaching careers without a PhD: We have not sufficiently engaged with students about career opportunities outside teaching or graduate school. In recent years, 2/3 of our majors have sought jobs in industry, including research jobs or other technical jobs. Few of our advisors are experienced in this area. We believe that this mismatch is the largest source of negative feedback in senior surveys, and we have a plan to improve this area. (Details are given below.)

Our majors' handbook has fairly limited information on career preparation. It is clear from discussions with new students that many of them read the Handbook, so that a careful revision seems likely to have a positive effect.

More effective communication about career opportunities, workshops, etc.: We find anecdotally that students do not always read broadcast emails and therefore miss out on some opportunities that are available to them – opportunities that they say they want. Plans to address this issue will be discussed in Part Three (more effective use social media; annual in-person cohort meetings).

(c) Division of Labor and Use of Personnel: (including staff, faculty, and peers)

Physics does not have a central advising office. Instead, the UPD is the first point of contact for students; after that, each student has a dedicated faculty advisor.

We do not have professional staff for career advising. However, we recognize the need to interface better with the Career Services office to get their advice on how to reach out to students. We also see a need transfer to Career Services some of the career information that we faculty have.

The physics faculty do all of the academic and career advising through meetings at least once per semester. For students who are out of the standard sequence, the UPD is the assigned advisor. For all other students (the great majority), we assign two faculty advisors per class. Each of these advisors is allocated half the students in a given class and remains with those students through graduation. The exception to this is sabbaticals and leaves of absence, which are handled *ad hoc*. These sometimes lead to substitute advisors, which can lead to advising gaps. (In the future, the Assoc. Head should appoint advisors who do not plan a sabbatical within 4 years.)

We do not systematically use peer advising, nor do we plan to because of their lack of experience. We do, however, benefit greatly from a very active undergraduate group called Society of Physics Students (SPS). This student-led group meets weekly with pizza. They organize workshops and social activities; they invite faculty to discuss research opportunities; they lead discussions on finding jobs or writing proposals, etc.

(d) Data analytics/tracking:

Advising meetings are our primary tool for identifying students who need special guidance. These meetings cover 100% of our primary majors and a smaller fraction of secondary majors. Between enrollment periods, SSC is used for an overview to catch struggling students. We are adopting a new systematic practice in which the UPD reviews SSC at the end of each semester, after grades are posted, and sends a note to advisors when necessary.

Specific interventions: We find that students who earn grades of C or below in Math 131-132 and in the first two semesters of Physics systematically have trouble in their later years. We do not have a standard intervention (such as a review math course). Interventions based on grades in "marker" courses such as M131-132 and P181 are being considered by the Physics Undergraduate Curriculum Committee. (No plan is in place yet.) Specifically, the goal of such interventions would

be to avoid problems with failing grades in the 6th semester, which is late for students to remedy math problems or to switch to another major.

(e) Experiential opportunities:

We support students with double majors and minors. We offer individualized programs in the form of 3 tracks (two B.S. and one B.A.). We also accommodate *iCons* students smoothly.

The great majority of our students take up internships, international opportunities, or research experiences, which part of the credit-bearing curriculum. These activities are very rarely recorded as internships by Career Services because they are handled within Physics or with other universities. Myriad opportunities for on- and off-campus research are taken by physics majors, as described above. These are usually in the form of summer programs (for pay, not credit) or semester programs (for indep. study credit). In AY15-16, 35 physics majors are engaged in research-based independent study, 11 are completing Capstones, and at least 14 are gaining experience as teaching assistants. As will be described in Part Three, our goal is to engage all students through their choice of research, teaching, journalism, data analysis, hardware development or other projects according to interest. To this end, we are engaged in a plan to identify and reach out to regional companies for collaboration and for mentoring of undergraduate and graduate students. (This is part of a President's Office S&T Proposal submitted in April, 2016.) We are also developing a new junior-level colloquium course to include professional development; a companion to our Freshman colloquium, this new course will help students choose and prepare for a career beyond the Bachelor's degree and further build professional skills. (This course was part of our response to the Provost's prompts in the Fall of 2015.)

Approximately 1-3 students spend time abroad, most often in Europe, which usually involves completing one or more of the major requirements overseas.

(f) Informational Data/Resources: Response to specific questions related to the survey data.

Before discussing the specific points, we note a potential problem with the response rate of the senior survey and the way in which the response rate is reported. The 2013 data, for example, report 13 responses among a total of 16 [physics] graduates, thus an 81% response rate. This may seem like an excellent response rate, but in fact there were approximately 23 students graduating that year with a physics degree.

To give another example, the data in the spreadsheet, *Destination of Choice, Student Engagement, Faculty Contact and Engagement* contains the response totals for 2013. In the category of "2014 National Survey of Student Engagement (NSSE)", there were 15 responses out of a total of 33 seniors for a rate of 45%. In the category of "2013 Graduating Senior Survey," there were 13 responses out of a reported total of 17 seniors for a rate of 76%. These numbers are listed side by side, inviting comparison of these two categories. Possibly the NSSE responses, having a greater participation, should actually carry more weight than the senior survey, even though the latter is reported with a higher response rate. For the NSSE survey, the number of total students (33) is close to the actual number of graduating students. For the senior survey, the number (17) is less than the number of students who graduated in 2013.

This analysis raises the following questions about the data:

- Were *all* of our majors solicited for the surveys? (That is, was the number of students contacted greater than the reported number of graduating students?) If not, then who was solicited and why were the other majors not solicited?
- If the academic units use this information without the true response rate, are we guided by data that has systematic errors in it?

Here are our responses to the specific question asked:

- *Destination of Choice, Overall Effectiveness, Student Progress - One Year Retention*. In 2014, 62% were retained in major. This rate has been climbing slightly for a few years and this is our highest since 2007. It is close to the UMass mean. Those that left UMass had a very low GPA, which may reflect the fact that physics is an academically challenging major. Among our freshman majors, 14% transferred to another dept. Our experience suggests these were to engineering and come about because of the separate admissions process in that College.
- *Destination of Choice, Overall Effectiveness, Student Progress - Four and Six Year Graduation.* 39% in the most recent cohort stayed in physics for 4 years, which is high for CNS and slightly higher than campus average. The numbers vary substantially, however: the F09 and F10 cohorts had low rates of total graduation as well as staying in physics. We do not know the explanation of this difference, but we note that we doubled the number of physics advisors in 2014 and this should help in the future.
- *Destination of Choice, Overall Effectiveness, Student Progress - Time to Degree.* This past year, we had 90% graduating in 4 years or less, which is a success. The 2013-2014 fraction is much lower (57%), but this appears to be an historical anomaly. (Even in that year, we had 100% after 6 years). Once again, we note a concern about the data: the # of students reported (31, 14, 11, 11, for the past 4 years) is considerably lower than the true number of students who graduated with a physics degree in those years.
- *Destination of Choice, Overall Effectiveness, Student Experience (Senior Survey satisfaction – access to classes*) These responses are quite positive. We have been 1 standard deviation above the mean since 2010.
- *Destination of Choice, Overall Effectiveness, Student Experience (Senior Survey satisfaction -- career preparation)*. There is room for growth in this category. We have been close to (usually slightly above) the campus mean for the past 4 years. Our rankings are fairly typical among CNS departments.
- *Destination of Choice, Student Engagement, Faculty Contact and Engagement (NSSE: Quality of interactions with advisors, Senior Survey: Satisfaction with academic advising in your major*). The NSSE rankings are reasonable but there is substantial room for growth. Senior survey rankings are low, but again we are troubled by the fact that the *reported* number of graduating seniors is so low, raising the possibility that many of our student were not surveyed or their results were not included here. (In passing, we also note that the SRTI data appears to be *all* students who took physics, a great majority of whom are not physics majors.)
- *Information/Data on Internships/Co-Ops/Career Placement: Can be obtained from Career Services (Candice Serafino) and/or School/College own database:* We obtained this information. The Career Services data shows almost no internship activity among physics majors, simply because the very large amount of research experience is not counted there. (As reported in sections above, large numbers of our students engage in research and teaching projects that lead to real professional development.)

Part Two: Goals for Academic and Career Advising

(a) Goals . The physics department shares the goals that were outlined in the Chancellor's document and we fill in the details here:

1) *Every first year student will know during their first semester the "routes" (where to go, who to speak with) on campus to receive academic and career advising.*

2) *School/Colleges are asked to identify their goal for % of students who perform an internship or career preparation practicum/experience prior to graduation, and provide plans on how to reach that goal.* The physics department's goal is 100%. However, these projects should not necessarily be in research: they should also include teaching, data analysis, writing/journalism, hardware development, computer programming, or other substantial technical activities, according to the student's career interests.
3) *School/Colleges are asked to identify their goal for increasing student satisfaction with Senior Survey items on Academic Advising and Career preparation and guidance in their major and provide plans on how to reach that goal.* First, we ask for a solution of the problem in which too few of our students are surveyed. As discussed in Part One (f), the problem is not just with the limited number of responses, it is with the very small number of students who are asked. Our goal, naturally, is to reach a high level of satisfaction and in Part Three we provide a plan to get there.
4) *School/Colleges are asked to identify their goal for utilization of the EAB SSC advising tool by their advising faculty and staff.* Our goal is for all advisors to be trained in SSC and to use it as a tool for identifying students who need extra advising help or intervention. Currently, the UPD and some advisors use it.
5) *By a certain point in time (i.e., a student's junior or senior year) the student can articulate curricular and co-curricular preparation they have received to an employer. What goals does the School/College have in supporting all of our students in how to articulate their undergraduate experience and preparation to a potential employer.* Our goal is 100%. Currently, we use our Jr-year Writing class (Physics 381), our Intermediate Lab IE course (Phys440), and our many faculty-led research projects to this end. Going forward, we plan a new jr-level colloquium class for this purpose.

Other goals/ambitions and pathways to get there that have been identified within the School/College in the areas of academic and career advising:

6) Providing students with the training needed for them to pursue career options. This is a primary goal of the major and we meet this goal through our teaching and our research, which act in concert with advising. Specific plans in this area are summarized in Part Three.
7) We aim to increase student success in the Physics GRE test and grad school placement. A new initiative toward this end was already begun n F15.

(b) What types of information would we want to monitor to hold ourselves accountable? For example, to monitor intervention programs, internship placement, job placement, student satisfaction?

i) *More comprehensive information in the senior surveys*. The 2013 numbers, for example, say 13 responses and 16 graduates, thus an 81% response rate. But there were more than 20 graduates that year. Does the survey miss a large fraction of our majors? Our primary need is a review of the method by which the senior survey is conducted and, in particular, an expansion to cover all of our majors.

ii) *Feedback on advising effectiveness in the 4th semester, not just after the 8th*. Such feedback would be informative and might motivate some advisors to do better. To maintain healthy advisor/advise relations, we feel that this process must be anonymous. We plan to conduct a poll of students who are two years away from their stated graduation semester (effectively, sophomores). Questions will ask for what is good about our advising system, what students want to see, and what their concerns are for the coming two years. This poll may be accompanied by a short reflection by each student, up to 140 words.

iii) *Compiled statistics about research, teaching experience, or other relevant career-training practica or internships*. Experience suggests that advisors are the best placed to collect this information

unless SPIRE can be upgraded to allow students to report it themselves. Currently, Career Services does not collect this information effectively, and clearly the ideal solution will involve close communication between the department and Career Services.

iv) *Job or graduate-school placement after graduation*. (Senior survey only has *plans*, not outcomes.) Can we obtain this information by exit interviews among seniors, or by follow-up correspondence?

v) *More effective monitoring of secondary majors*. We find that many of our second majors come to our advisors even though we do not have a registration hold. The University may wish to consider making SMs no different from primary majors, and imposing a registration hold for all majors.

Part Three: Academic and Career Advising Action Plan

(a) What we can do now, with given resources:

i) Revise and substantially update the handbook to include career options and advice. The advising team already has quite a lot of advice and knowledge to put into such a revision. Among other topics, it will include specific advising grad-school preparation and the GRE, letters, etc.; specific advice on how to get into research or other practicum experience; how to get into teaching; pathways to industry jobs or non-research-based technical careers; and additional examples of courses of study in the three different Physics tracks. Career Services will be included in this, as they already have some of this information in their "…Now What" document.

ii) Create a handbook for advisors. This handbook would contain the accumulated wisdom and experience of the current advising team. (Development of this document is already under way.)

iii) Document the experiential activities of our students, as described in the goals of Part Two. The list should include all research and teaching independent studies, internships, REUs, and other. Such a list will help guide younger students as well as letting us know how we are doing. To start, this should be done using a department-based database but this method requires additional time from advisors. We would value suggestions of more efficient methods.

iv) Expand the physics alumni network. This is potentially a very effective tool for advising students in careers, as well as getting them into specific jobs by recruitment. Work on this plan is already under way through, for example, more effective alumni reunions. (Building an alumni database and using it are also part of the recently submitted S&T proposal by Ross *et al*.) We believe that this activity would also benefit development, so we will solicit the CNS Dean's office for support as needed.

v) Set up regular series of physicists in industry to visit campus for a day, give a public seminar, and meet with students. The focus of these meetings will be mentoring students and recruiting. Visitors will also meet with members of the advising team to provide feedback and ideas regarding student preparation and career advising. We plan to start this series in the Fall of 2016.

vi) Tracking physics majors more effectively, using SSC after grades are posted to find students who fail courses, then asking advisors to reach out.

vii) An annual meeting of all majors of a given year, likely in October. For example all juniors, with their advisors, would meet separately from sophomores, etc. Goals are to build a sense of cohort among students so that they can more effectively help one another, to help them benefit from one another's questions and comments, and to generate discussions to help the advisors. Discussion would ideally focus on the concerns of students at the given level. The venue should be comfortable and relaxing and refreshments should be served.

viii) We will ask students to advise us on effective method(s) to broadcast news and information using social media. We hope that such a method would be a valuable complement to broadcast emails which, by themselves, have limited impact.

ix) Our Freshman colloquium, Phys185-186, has the goal of introducing students to research opportunities. This teaching assignment has traditionally rotated among faculty, who teach it once and then move on. We will change the venue and adopt a set of best practices to maximize effectiveness of the course while also making more efficient use of instructor time.

(b) Actions that require additional resources:

i) *Carry out the new course plans as outlined in the Physics Department's response to the Provost's prompts* last Fall. These plans include a new junior-level colloquium course, a new 500-level "senior experience" course and a new 500-level course on "*Data: The Art of Measurement and Analytics."* These courses are a core part of our teaching goals, as described in the previous document. They are also a core component of effective career preparation and advising.

ii) *Professional advising to help students identify their strengths, weaknesses, and career plans*. The advising team is well positioned to help students meet their career goals. However, helping students assess their interests and *identify* those goals sometimes requires a different skillset. Most likely, effective guidance toward identifying career interests should involve professional advisors working in concert with the Physics advisors.