

New Mexico State University Engineering Physics External Advisory Board 2018 Report

Report issued May 2018

Engineering Physics External Advisory Board (EPEAB) 2018 Membership

Dr. Steven Castillo, Sandia National Laboratory
*Dr. Candi Cook, Intel Corporation
Ms. Laura Dominik, Honeywell International Inc.
*Mr. Jon Haas, NASA Langley Research Center
*Dr. Alan Lovell, Air Force Research Laboratory (Chair)
*Mr. T. Nathaniel Nunley, EP Alumnus
Prof. David. Probst, Southeast Missouri State University
*Dr. Kurt Schoenberg, Applied Science Enterprises Consulting &
Los Alamos Neutron Science Center (Emeritus)
*Dr. Katyayani Seal, Quantum Design Inc.
*Dr. Michael Strocio, University of Illinois at Chicago
*Mr. Travis Willet-Geis, ATA Aerospace Corporation

*Attended April 2018 EPEAB meeting

Executive Summary

2018 EP External Advisory Board Meeting, Charter, and Membership

The Engineering Physics External Advisory Board (EPEAB) convened for its annual EP Program review on Saturday and Sunday, April 28th and 29th, 2018. The meeting was hosted by the Physics Department and held in Gardiner Hall on the main campus of New Mexico State University (NMSU) in Las Cruces, New Mexico. Additionally, the EPEAB reviewed the EP Program Committee's responses to the 2017 recommendations, and separately, provided comments on the EP Program's draft self-study report (SSR).

The charter of the EPEAB is to:

1. Provide feedback on all aspects of the Engineering Physics Program;
2. Review policies and procedures within the program;
3. Identify potential areas of concern;
4. Evaluate whether the EP Program achieves its Educational Objectives;
5. Provide a written report that includes suggestions on how to improve the program for distribution to the program and the deans.

The EPEAB represents the various constituencies served by the EP Program, with representatives from academia, federal science agencies, industry, and program alumni. The EPEAB has both in-state and out-of-state representation, with both continuous long-term and new membership.

The NMSU Engineering Physics Program was inaugurated in 2001, produced its first graduate in 2004, and gained ABET accreditation in 2007. In addition to a common physics core, EP offers four engineering focus areas: mechanical, electrical, chemical and aerospace. To date, the program has produced 58 graduates and currently has 34 enrolled (down from 39 in April of 2017; though it is noteworthy that 10 students graduated in 2017). EP is a very difficult degree program, and each year a small number of students choose to convert to either a focused engineering degree, or physics; a few leave to other departments. Some losses appear to be the result of students being lured towards engineering programs offering greater scholarship opportunities, which generally do not support EP students. While disappointing, this was not interpreted as a weakness in the EP Program's curricula or outcomes. Recently the Physics Department established an Engineering Physics "current use" scholarship.

The NMSU Physics faculty are to be commended for their dedication to maintaining a program of high educational and scientific content for the benefit of NMSU students and the State of New Mexico.

Program Strengths

Recent acquisition of an Administrative Assistant

Though additional permanent resources are still needed by the EP Program, University-wide budget reductions occurring over the past two years appear to have stabilized. This has resulted in the Physics Department being able to hire an administrative assistant that additionally supports some EP activities. However, EP still lacks a Program Coordinator; EP faculty, particularly in the Physics Department, have assumed many of the duties that would normally be performed by a Program Coordinator. While the faculty's dedication picking up this burden is a commendable strength, it simultaneously represents a risk, discussed below.

Achieving Program Educational Objectives

The EP Program has three educational Objectives:

EP Objective 1: Competitiveness. Graduates are competitive in internationally recognized academic, government, and industrial environments

The EP Program continues to mold and shape its students into capable performers; approximately one-third of EP Program graduates go on to pursue graduate-level studies, while the remainder enter government-related or industrial careers, or engage in business opportunities. The Program maintains good contact with graduates, having regular correspondence with 50 of the 58 past graduates. Unemployment in science and engineering fields is generally very low, with high starting salaries. EP Program graduation rates have been trending, with enrollment indicating good retention (with the exception of 2017). Career choices for graduating EP students are more diverse than for either physics or engineering graduates¹.

EP Objective 2: Adaptability. Graduates exhibit success in solving complex technical problems in a broad range of disciplines subject to quality engineering processes.

EP Program graduates are entering advanced programs of graduate study and being hired into a diverse selection of high-tech jobs in industry and government laboratories, with some engaged in entrepreneurship. The employment rates and diversity of opportunities not only demonstrate that the goals of the program are being met, but this also addresses the goals of NMSU. Engineering Physics graduates demonstrate ongoing contributions to New Mexico and the nation with great economic impact. More than 10% of the employed (i.e., not continuing in a program of study) EP graduates report Systems Engineer as their current job title, indicating an interdisciplinary career; the remainder report 16 additional job titles, highlighting the diversity of professional opportunity open to EP graduates.

EP Objective 3: Teamwork and Leadership. Graduates have a proven ability to function as part of and/or lead interdisciplinary teams.

¹ EP Program reported graduation and post-graduate employment statistics

Preparation for leadership of interdisciplinary teams is a generally neglected element of university curricula for engineering and science majors. Simultaneously, the ability to lead interdisciplinary teams and perform complex system integration functions are among the most necessary skills for the success of large engineering and science development projects. EP Program graduates are well-prepared to address this gap. Recent Program statistics record that more than 20% of program graduates list supervisory duties and greater than 90% report working in team environments.

Continued faculty and College commitment to EP Program:

EP is a small program compared with others in the College of Engineering or College of Arts and Sciences. During discussions with University Management (Deans from both the Engineering and Arts and Sciences Colleges, and faculty from the Physics Department and various Engineering Departments), it was clear that the value of EP to the University is recognized.

Student Satisfaction

The EPEAB meets annually with students. Despite the meeting taking place over the weekend, numerous EP students come to discuss their experiences with the board (nearly twenty in 2018). Students uniformly report satisfaction with their educational experience, and particularly identify the Department of Physics as their home department. The Arts and Sciences Deans reported no student issues or complaints arising from the EP program.

The EP Program has better than average retention rates: close to 50% of incoming students remain and graduate in EP, outperforming most other departments at NMSU. Typically, program graduates move on to advanced study in either physics or engineering graduate programs, or to careers in industry. Job placement and graduate school admission rates are above 90%. Both committee interviews and senior exit interviews indicate student satisfaction with the program supported by the following statistics: 70% of graduates are employed immediately upon graduation (80% within 3 months, and 100% within 6 months), with \$70k or higher average salary, and 90% currently employed in a science, education or engineering field.

Society of Engineering Physics (SEPh)

The NMSU EP students with faculty support have demonstrated exceptional dedication through the establishment of the fledgling SEPh. While focused on EP, the society welcomes non-EP students and has a track record of community educational outreach. Despite its small size, in 2017 SEPh was the third most active student-professional society in the College of Engineering, ranking just behind the significantly larger Institute of Electrical and Electronics Engineers (IEEE) and The American Institute of Chemical Engineers (AIChE), in terms of activities performed. Additionally, SEPh is currently unique to NMSU, having been locally created, and is actively pursuing plans to establish itself on a national level. Any support or attention offered to SEPh or its initiatives will pay dividends to the EP Program and the university.

Issues Identified and Recommendations for Continuous Improvement

While EP clearly demonstrates the characteristics of a strong functional program, the EPEAB highlights several opportunities to nurture the program's demonstrated success and offers recommendations for continuous improvement.

Career Preparation

Issue: EP students have expressed a vested interest in participating in career prep opportunities. The Physics Department had provided this resource in a previous year as a course requiring enrollment, and that model was unsuccessful.

Recommendation: A suggestion is to provide the career prep skills as an extracurricular workshop that can include writing resumes, interview practice and job search strategies. Guest speakers (e.g. EP alumni, EPEAB members) could be invited to the workshop to give the students career advice.

EP Student Research Opportunities

Issue: The Advisory Board and EP students have identified a need for greater accessibility to internship and undergraduate research opportunities. The current system consists of a folder with printouts and brochures located in the Physics Department office. Professors and the Department Head may email the students with opportunities as they arise as well. Students have expressed a desire for a more accessible (modernized/central) portal for these positions such as a Department website. The folder was found to be out of date or not well organized and the wide-distribution emails were lost in inbox clutter.

EP students often find themselves passed over for large, traditional internship and research positions due to a lack of understanding on the part of the employer of the value of their degree. Engineering positions may see EP students as physicists and research positions may see the opposite.

Recommendation: It is the opinion of the EPEAB that more personal, one-on-one recommendations and connections will ensure these students are highly valued in summer placements. Even through the traditional application routes such as the *Science Undergraduate Laboratory Internship (SULI)*, a personal contact through a professor provides invaluable assistance in competitive positions.

The EPEAB agrees with the students' sentiments and would encourage the Physics Department to provide information on internships, The National Science Foundation's Research Experiences for Undergraduates (REU) program, and other summer opportunities to the students in a more modern and easily accessible way. The same system would lend itself to career opportunities. As discussed below in this report, an updated and maintained program website (another task for a Program Coordinator) would be an excellent place to provide a career/internship portal. Such a platform could also provide a feedback mechanism for tracking student internship and research placements, which the Physics Department could use as a non-course metric for tracking program

objectives. Given the extensive alumni tracking done by the Department, folding in internship and summer work would extend the picture of student success within their time at NMSU and allow time for correcting trajectories.

Increasing Program Participation and Visibility

Issue: Engineering Physics is a unique and vibrant program with an impressive record of educational accomplishment. The EP Program appears very competitive in preparing students for careers in multidisciplinary science and technology fields. The Program is, however, relatively small and recent enrollment trends are down. EP students are (or at least appear to be) ineligible for scholarships in their Engineering discipline. The Engineering Physics “current use” scholarship alluded to above has not as of yet been well funded; this is likely due to the fact that the Program is still quite young, and few if any EP alumni are far enough along in their career to afford to make large donations.

Recommendation: A concerted effort is recommended to increase EP Program enrollment and visibility. Here, visibility is viewed with respect to peer University programs as well as external (to the University) peer institutions. This effort would entail: 1) increasing various opportunities afforded to EP students, such as research internship opportunities, career preparation, scholarships, and alumni and foundation support; 2) enhanced recruitment for the EP Program.

The Advisory Board believes that increased Departmental support by NMSU is key to meeting this and other recommendations. This support should include:

- Hiring a Program Coordinator who can take on a range of important support functions, many of which are suggested in this document. A Program Coordinator can also help Physics Faculty ensure that the EP Program has good recognition across NMSU and that opportunities for Program growth are fully exploited
- New investments in Laboratory equipment and infrastructure – (Physics faculty should maintain and update a prioritized list of desired equipment)
- Hiring additional faculty consistent with meeting course and Program demands

Regarding recruitment, it is recommended that University-level, College-level, and Departmental-level marketing efforts to high schools (particularly to guidance counselors) and community colleges emphasize the EP Program. This includes a recommendation that the Physics Department coordinate with all NMSU recruiters to provide them with an up-to-date EP Program flyer. These efforts can demonstrate the breadth of the EP degree by highlighting the career successes of EP alumni. It is further recommended that these efforts utilize social media (e.g. Facebook and YouTube) to the largest extent possible. Finally, both the College of Engineering Outreach Office and the Engineering Development Office are advised to work more closely with the Physics Department in promoting the EP Program. (Physics Department faculty report that these two entities have not been particularly responsive to them.)

Regarding scholarships, it is recommended that: 1) University-level and College-level administrators work to provide additional scholarship opportunities for EP students (e.g.

by establishing or redirecting President's Scholarships, Provost's Scholarships, Dean's Scholarships, and existing scholarships in the various Engineering Departments); 2) the Physics Department revisit efforts to fund the Engineering Physics "current use" scholarship, perhaps by creating a "Give Now" button on the EP website (yet another task for an EP Program Coordinator).

Engineering-wide interdisciplinary capstone course

In its 2017 report, the EPEAB recommended that NMSU adopt an interdisciplinary capstone course. In 2018, it appears that such a course will come to fruition. Here, the EPEAB reiterates the positive aspects of this choice.

Issue 1: Because of the current course load of EP students and prerequisites imposed by the various Engineering departments, it is at times difficult for students to complete the required capstone course in their identified Engineering discipline. This problem has existed for many years, without any comprehensive solution to this point in time. An interdisciplinary capstone option would alleviate this problem.

Issue 2: Engineering Physics is intended to train students to bridge the gap between disciplines. This necessary skill is often lacking in the workplace, whereby team members from different technical backgrounds are unable to effectively communicate. This common problem hinders the development of new technologies. A capstone that highlights the interdisciplinary strengths of senior EP students is desirable as they go on to apply for positions after graduation.

Recommendation: We continue to support the choice of an engineering-wide interdisciplinary capstone course or option. This is an opportunity to strengthen the EP program that will also facilitate the growth of interdisciplinary skills in the engineering college as a whole. This can all be accomplished while maintaining the current goals of the capstone system such as lifelong learning, management, and design skills. This initiative was backed by the EPEAB previously and continues to have our full support.

Web Presence Improvements

Issue: Prospective students and engineering programs are increasingly turning to the internet for information, marketing and recruiting. This is the present-day battlefield where competition for students plays out. While the information on the NMSU EP website is adequate, it would benefit from some enhancements.

Recommendation: We recommend the following updates to the EP website:

- Include descriptions of the type of work EP graduates actually performs in the course of their career (vs. the US Dept. of Labor description); here the Physics Department is advised to contact EP alumni for testimonials to demonstrate the diversity of opportunities available to EP graduates.
- The program flowcharts currently displayed are useful, but the tables recently created for the Program's ABET Self Study Report (possibly with links to current

course catalog descriptions) may be more useful to the prospective student deciding on a course of study.

- Include examples of support available to students vis-à-vis scholarships, internships, and research opportunities.
- Publicly advertising open research or scholarship opportunities is not necessary; however, examples of recently completed activities demonstrates program success. Links to EP events (pictures/videos) will convey the support students provide to each other and the exciting projects and outreach activities in which they participate.
- Include a link to SEPh and other student or professional societies in which EP students are active (e.g. APS and various Engineering societies).

It should be noted once more that the above are key tasks for a Program Coordinator.

Centralized Advising and EP Challenges

Issue 1: EP students have expressed concerns about course availability, pre-requisite requirements, and course phasing. These concerns should be on the radar of the administration. Specifically, the availability of core courses and associated pre-requisites directly affects the time required to complete the EP degree. In most EP concentrations, there is virtually no way to accommodate a semester slip of a “critical path course” (e.g. for an internship opportunity), without delaying the degree by one year. Add to this the fact that many engineering departments are continuously reformulating their curricula and course offerings (sometimes to accommodate reduced credit hour requirements), and some “replacement” courses entail a different set of pre-requisites than the “original” course. This can result in instances where students who were prepared to take one course in a given semester must now take one or two extra courses as pre-requisites for the replacement course. The EP Program Committee reports that it is sometimes possible to negotiate an “equivalent” course when a major conflict exists in an EP student’s course schedule, although this requires careful attention on the part of the academic advisor.

Issue 2: A transition to centralized advising is underway at NMSU, whereby all students will receive their academic advising from a staff of professional advisors as opposed to faculty in their respective departments. While there are identified benefits of this centralization, the EBEAB is concerned that centralized advisors may not be best suited to navigate the complex EP curricula, specifically regarding the issues discussed above, including course scheduling and de-conflicting, satisfying pre-requisites, and negotiating equivalent courses. Student feedback on this proposed change indicates strong apprehension that general advisors won’t understand what individual EP students need in terms of course requirements, as well as preparation to pursue their interests within their technical focus areas.

Recommendation: While the EPEAB is not generally opposed to centralized academic advising for EP students, we strongly recommend that all EP students be required to see

an academic advisor in the Physics Department each semester. This requirement could take the form of either an “academic advisement” or “mentoring” hold on students’ registration—even if this entails a hold in addition to a centralized advising hold. It is our opinion that the Physics faculty are best suited to navigating the curricula for each of the EP concentrations, as well as reacting to changes on the part of the various Engineering course offerings. Furthermore, the Physics faculty have important perspectives for EP students, with regard to course scheduling as well as career-building opportunities. Another key difference is a faculty advisor’s insight into the preparation of a specific student to choose the best pathway given the advisor’s familiarity with the student’s past performance. While the College Deans do understand the importance of expert counseling in complex programs like EP, continued program and departmental communication with the Deans on this issue remains important as the roll-out of centralized advising proceeds.