Colorado State University – Pueblo Academic Program Assessment Report for AY 2018-2019 **Due: June 1, 2019**

Program: Physics **Date:** June 2, 2019

Completed by: Bruce N. Lundberg

Assessment contributors (other faculty involved in this program's assessment): Drs. Brown and Hurst, our TT-Faculty in Physics

Please complete this form for each undergraduate, minor, certificate, and graduate program (e.g., B.A., B.S., M.S.) in your department. Please copy any addenda (e.g., rubrics) and paste them in this document, and submit it to the dean of your college/school as per the deadline established. The dean will forward it to me as an email attachment before June 1, 2016. You'll also find the form at the assessment website at http://www.colostate-pueblo.edu/Assessment/ResultsAndReports/Pages/default.aspx.

Please describe the 2018-2019 assessment activities for the program in Part I. Use Column H to describe improvements planned for 2019-2020 based on the assessment process. In Part II, please describe activities engaged in during 2018-2019 designed to close-the-loop (improve the program) based on assessment activities and the information gathered in 2017-2018. Thank you.

I. Program student learning outcomes (SLOs) assessed in this cycle, processes, results, and recommendations.

NOTE: There was one Physics Program graduate Fall 18.

A. Which of the program SLOs were assessed during this cycle? **Please include the outcome(s) verbatim from the assessment plan.**	B. When was this SLO last assessed ? Please indicate the semester and year.	C. What method was used for assessing the SLO? **Please include a copy of any rubrics used in the assessment process.**	D. Who was assessed? Please fully describe the student group(s) and the number of students or artifacts involved.	E. What is the expected achievement level and how many or what proportion of students should be at it?	F. What were the results of the assessment?	G. What were the department's conclusions about student performance ?	H. What changes/improvements to the program are planned based on this assessment?
(SLO #2) Understand and apply knowledge of the various subfields of physics at the	Fall 2019 This assessment will be performed every	The assessment tool is a standardized examination: the MFAT in	All graduating physics majors.	Criterion: Overall and in the two breakdown areas of the MFT, ninety percent of CSU – Pueblo	We had one graduate this year: Scored 68th %-tile; 62 %-tile Intro	Criteria satisfied, but our small samples do not facilitate statistical	Make more efforts to gradually build rigor and capabilities in Intro to Physics, and give more research experiences and support at upper division level. This will require a commitment

undergraduate level.	year possible.	Physics		physics majors will score at or above the 50th %-tile on the MFAT standardized exam.	Phys 51 %-tile Adv Phys	conclusions.	to hire, develop and keep at least one more qualified, young and energetic new faculty.
(SLO #3) Effectively communicate their results orally and in writing	Spring 19 (Phys 323); Fall 18 (Phys 493)	Student independent topic research leading to a presentation in Phys 323 to develop them for later senior seminar. One senior thesis presentation F 19.	4 Junior level Physics students. One senior seminar presentation based on senior researcha and thesis.	Chair and some faculty attended 15 minute talks to provided oral and written independent assessment of substance and presentation quality.	All four students presented good substantive talks, with good audience questions, and suggestions for improvements. Senior seminar attended by some faculty, program chair and dean.	Students did well for a first talk, but need more practice in researching and presenting topics in physics. Solid and effective presentation of substantive work.	Ran a new major's seminar for the second time, where talks are given by faculty, visitors and students. Institute mini-research projects with talks in at least two upper level physics courses, Phys 323 (first jr. course) and one other prior to Phys 499.
(SLO #4) Learn independently, locate and use appropriate sources of technical material and make use of modern scientivic and computational tools	Fall 18 (Phys 499), Spr	One senior thesis presentation F 19 in writing and orally.	One senior thesis presentation in writing and orally F 19.	Senior thesis distributed and viewed by all program faculty.		See above.	See above

Comments: See comments below.

II. Follow-up (closing the loop) on results and activities from previous assessment cycles. In this section, please describe actions taken during this cycle that were based on, or implemented to address, the results of assessment from previous cycles.

A. What SLO(s) did you address? Please include the outcome(s) verbatim from the assessment plan.	B. When was this SLO last assessed? Please indicate the semester and year.	C. What were the recommendations for change from the previous assessment?	D. Were the recommendations for change acted upon? If not, why?	E. What were the results of the changes? If the changes were not effective, what are the next steps or the new recommendations?
(SLO #2) Understand and apply knowledge of the various subfields of physics at the undergraduate level.	Spring 2018	Work to strengthen the Phys 221-222 Calc-Based sequence to prepare students for upper division courses. Consider a math methods in physics course to aid student transitioning to advanced physics courses.	Partially—This last year we had a TT PhD in physics for the first time since Spring 2014. We had one VPA with a Physics PhD, who resigned 4 weeks into the Spring 19 term, and was replaced by another VPA. Much discussion and work was done this year on analyzing and strengthening the lecture and lab curriculum and teaching practices.	We gain in quality and morale two young VPA women scholar-teachers. These are now gone, but the new TT shows promise in recovering some continuity and commitment to the program. We need at least one more TT Physicist, and one in Astronomy to begin to thrive. Majors have increased and maintained enough that we have been able to offer our advanced courses regularly again.
(SLO #3) Effectively communicate their results orally and in writing	Spring 18	Refine the new 10-15 minute end of course project and evaluated talk assignment again in Phys 323. And Below.	Partially—in Phys 323 but not yet in another upper division physics course. We need to arrange for more faculty participation and input in Sr. Seminar presentations.	Project and talk assignment have been effective and have faculty participation as attendees and evaluators. Institute mini-research projects with talks in at least two upper level physics courses, Phys 323 (first jr. course) and one other prior to Phys 499.
(SLO #4) Learn independently, locate and use appropriate sources of technical material and make use of modern scientivic and computational tools	Spring 18	Consider implementing the above in another (existing or new) upper division course such as a math methods course or Phys 431 (E & M)	See above.	See above.

Comments: A strong physics service program is critical and central to our excellent engineering, chemistry, biology, exercise science and math and STEM education programs and careers. Also, exciting new potential: discoveries, applications and questions are emerging from physics of late. In the USA, the numbers of physics majors continue to rebound by about 5% per year since 1999, reaching an all-time high of 8633 in 2017. Still, physics BS degrees represented only about 2.8 per 1000 bachelor's degrees in 1999, which rose to 4.4 per 1000 in 2016. US Labor Statistics predicts 7% growth in physics jobs, not counting other technical jobs. We have a long line of prominent and successful physics alumni (a few famous), including recent graduates who have attained or are in PhD programs (U. Mich, Mich State, U of Ariz, CSU-Fort Collins).

Last year a successful search hired our first new Tenure Track hire in physics since 1988, replacing Dr. Marta Wallin who retired Spring 2014. This is a promising start to a rebuilding of our Physics program and service course program. jumped to over 20 majors from the 8 majors shown on the UBB sheet for AY15-16. To put our Physics graduate numbers in perspective, " One quarter of physics BS programs graduate 2 or fewer per year. But note that our Physics program graduate counts on the table UBB provided give 2, 4, 5, 2, 2, 1, 0, 1, 1 graduates for the years 2011-12 through 2018-19. The possibilities for students are bright and exciting with adequate staffing! We are starting to recover from having zero (0) TT PhD faculty members for four years!

It would indeed be a wonder (or perverse) if majors did not decrease once we lost the last of our four physics PhD's in 2014. Adequate staffing is a truly desperate need that cannot be avoided by cancelling the major, which is a small fraction of the service we offer to other departments and Gen Ed. Regarding costs, there seem to be contradictory statements about costs in the feedback form. Our costs are very close to the bottom at $2540/St FTEI strongly challenge any idea that CSU-P could, by dropping the Physics major program, save any money and still maintain minimal quality in the service courses in physical sciences which still must be offered for other majors and Gen Ed, requiring of our Department over 4 FTE faculty per year just to staff the service courses in Physical Sciences. It takes barely over 1 FTE more than what the service program requires in order to run the physics major program. Having the majors program in physics also adds much to the service instruction in quality and sustainability, if the service staffing needs are adequately staffed by full time qualified instructors (e.g. 2 PhD's in physics, plus a lecturer). Without the major, recruitment, development and retention of quality physics instructors will be virtually impossible. Loss of the major would be a great loss to the local region, the chemistry, math, biology, exercise science and engineering programs, and to the University and its students. Much entrepeneurship has, is and will continue to result from those who understand and can imagine the uses of basic principles of physical nature including matter, energy and information.

Program weaknesses/challenges include the following:

--There are just two tenured (and no tenure-track) physics faculty members.

Response: From Fall 2014 – Spring 2018 we had only one tenured faculty member in Physics (with a PhD in Engineering, not Physics). Spring 18 we hired a tenure-track assistant professor of physics (first such since 1988!), Dr. Travis Hurst, with specialty in Dark matter and capabilities and interests in astronomy. Thus we are back to having two tenure-track physics faculty (one with a physics PhD).

--The number of majors is relatively small.

Response: we recorded 13, 8, 23, 15, 19 and 22 Physics majors at the beginnings of Fall 14, 15, 16, 17, 18, 19 respectively. We lost our only tenured physics PhD Spring 14 (Marta Wallin), and dropped to 8 majors by the next year (Fall 15). Two young visiting physics PhD's helped us 2016-Spring 18.

Nationally, physics graduates are about 3 to 4 per 1000 Bachelors degrees each year. Our CSU-Pueblo proportions of physics graduates from 2011 to 2018 have been 4, 5.2, 6.9, 2.4, 1.2, 1.3, 1.3, 1.3 per 1000. In the context of the very low faculty and financial resources for our program over these years, and the relatively low level of maths and science preparation of many incoming students, these results are actually remarkably good. These results suggest we can resurrect our once thriving program in physics with adequate support, commitment and effort.

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--Undergraduate-level research activities are limited.

Response: A couple of our recent visiting professor of physics (Ahktar, nuclear physics, Rang, Thermo) and one of our professors of mathematics (Lundberg, orbital mechanics modeling and optimization) have stepped in to help mentor students in several projects for physics seniors to make up for the lack of tenured physicists during the years after Dr. Marta Wallin retired Spring 14. But we definitely need annother active Physics PhD with a research program that can involve students. .

--The external reviewer noted significant diversity (both gender and ethnicity) among the students he met with.

Response: This continues, and we are generally much better than national benchmarks, due to our ambient demographics program culture..

--The external reviewer believed that current student learning outcomes and program goals need more refinement, and he recommended that assessment instruments and practices could be enhanced by increasing faculty 'ownership' of the tools.

Response: the PROPEL and CTL have provided expert training from very high quality workshop speakers, and curriculum development grants for improving courses and labs. Physics faculty as individuals and as a group have taken advantage of these opportunities and done much revision and development in these areas, which is continuing.

--The external reviewer also recommended considering a more longitudinal approach to developing effective communication. While lab reports are a significant part of virtually every lab course, and most physics courses come with a corresponding lab, perhaps speaking skills could be enhanced along the student's coursework, rather than addressed solely in the 492/493/499 courses. (And while not mentioned by the external reviewer, there may be virtue in enhancing writing skills other than those focused on in lab reports.)

Response: See the assessment report above on SLO 3 and 4. We have instituted small research projects with evaluated presentations in the Phys 323: Modern Physics course, now for the third year. We intend to introduce this practice into one other upper division course.

--The external reviewer also made reference to pedagogical techniques in the classroom, noting that perhaps those practices could be refined. Our new tenure track Physics hire, Dr. Hurst, is bringing us innovations in pedagogy, including more active and open-ended learning experiences, such as his "Creative Conundrums", lab instruction, dark matter research project involvements for students. Dr. Brown has made use of iClicker technology, as has Dr. Hurst. Astronomy instruction is highly web-based already, with one online section being offered in recent years, and now undergoing further development and inprovment.

Recommended action items:
Increase communication with other departments, e.g. engineering and biology and chemistry, for multiple reasons:
-To increase potential collaborative research activity (both for undergraduate research projects, and perhaps for faculty-based research, e.g. through the existing space grant).
Results: We have had a few students working on Spacegrant research over these years. Having no Physics PhD tenure-track faculty for several years has greatly depressed these possibilities.

-Potentially increase possibilities for more majors or second majors or minors in physics,
Results: We have made some efforts here that produced results, including an informal "Aerospace" option involving one new course "*Orbital Mechanics*" in edition to existing courses.

-To develop new courses including upper-level courses that may serve other areas (e.g. applied computational methods),
Results: See the reference to our new Orbital Mechanics course above. In this period, we also instituted a new gen-ed course Phys 145: Global Energy Resources, whose implementation and enrollment was unfortunately suppressed by partisan political opposition. A computational physics & high performance computing course was offered as a special topics course to a physics graduate who went on to obtain a PhD.

-Enhance existing courses (e.g. the general studies "Light, Energy and the Atom" course, or the other service courses). Suggested date: ongoing, but at a minimum begin by end of fall 2014.
Results: During this period Phys 140: Light Energy and the Atom was built up to solid enrollment each semester for several years, due to the work of Dr. Zizza and Julie Spangler. Changes in instructor and the programs we serve lead to a recent decline. We also introduced a new Gen-ed course, Phys 145, as described above.

-Attempt to maintain contact with graduating and recently graduated students (e.g. through exit interviews and surveys). Consider insuring that students near graduation if not sooner create a professional social media page (e.g. a LinkedIn page) that is shared with the department. Suggested date: by spring 2015 (or possibly spring 2014).
Results: The Chairs of the physics program (Zizza, Lundberg) have kept contact and records of the activities of most recent physics graduates, including taking them to lunch for a "debriefing", inviting them to give a talk, sending out selected job opportunities, advertising their accomplishments, etc.

-Consider collecting more data from Educational Testing Service's Major Field Achievement Test (MFAT), e.g. disaggregating by subject areas. Suggested date: by spring 2015.
Results: Our numbers are too small for this, beyond the Intro and Advanced subscores.

-Consider a request for a tenure-track hire in physics, to build on recent visiting assistant professor hires over the past few years, if appropriate enrollments exist, as soon as is fiscally possible. Such a new hire would bring a potentially different research interest that would provide more opportunities for students, would allow students to experience a larger variety of instructors, and could potentially enhance recruitment into the program. Suggested date: by mid-fall 2014, or mid-fall 2015 as appropriate.
Results: The layoffs of AY 13-14 left us with no Tenured PhD physics professors and no visiting physics professors! AY 14-15 the physics program and even the physics service program was practically unsupported and certainly unsustainable.
By sacrificing a lecturer position to physics starting Fall 15, we were able to limp through.
Repeated detailed appeals with justifictions for a TT hire to replace Dr. Wallin were prosecuted Summer 15 in a variety of venues (to Dean, in formal budget requests, to Provost, to faculty groups, …). Spring 17 this was finally approved, but too late for a search. We were able to keep a very good visiting person (Shamim Akhtar) for an extra year. Spring 18 we successfully hire our first TT Physics Phd into the program since 1988: Dr. Travis Hurst, who begain Fall 2018. The physics program and number of majors is slowly recovering, along with hope for the future, though we lost our ½ time lab coordinator to the latest layoffs.

-Consider enhancements to courses that emphasize communication (e.g. have students read a paper and report on the contents). Suggested date: by spring 2015.
Results: We implemented student min-project and talks in Phys 323 (Modern Physics, offered each Spring pending enrollment) Spring 17. Spring 15 we had too few faculty, and Spring 16 we had no students sign up for Phys 323. We invite faculty to attend and fill out talk response forms along with the students. This was repeated successfully Spring 18 and Spring 19.

-Consider utilizing physics majors as lab assistants (those that have already fulfilled the major Phys 480 requirement). Suggested date: by spring 2015.
Results:Responsibility for studying, facilitating and supervising student lab assistants was put into the Lab Coordinator's job description. This met with some resistence. Howver, the chair did encourage and recruit a few students desiring more lab assistant experience, sometimes with pay.