Department of Physics and Astronomy Self-Study Executive Summary

Department of Physics and Astronomy Self-Study

I. Goals

In the opinion of the Department of Physics and Astronomy, upon the completion of a physics major at Millikin University, a student should be able to:

1. Solve complex problems that require integrating knowledge from a variety of subfields, including classical mechanics, classical electrodynamics, thermodynamics, atomic and nuclear physics, and quantum mechanics, as well as incorporating sophisticated mathematical techniques such as partial differential equations, tensor mathematics, calculus of vector fields, and linear algebra.

2. Follow the scientific method to design and carry out informative and professionally interesting experiments, utilizing laboratory techniques sufficiently advanced as to allow an easy transition to graduate school or industry.

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3. Effectively communicate scientific knowledge to general audiences as well as colleagues in the field via oral presentations, formal journal articles, and writing for the layperson.

A student who is able to reach these goals successfully will also be satisfying the core goals expressed in the mission statement for Millikin University. All of the departmental goals will help a student achieve , as they are fundamental to the success of any physicist. Meeting all three goals will also contribute to a Millikin graduate being able to be a . Dealing with problems in a global society requires integration of knowledge and strong problem solving skills. Performing informative and interesting experiments is one way a physicist connects with the world, advancing the basic principles of both pure and applied science. Finally, a good physicist must communicate not only what they have done, but why it is important, and communicate these things not just to their colleagues, but to the world at large. A successful Millikin graduate in Physics will also be . This goal is primarily fulfilled by the first and third departmental goal, although depending on the individual, all three goals pertain to it. Being

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The number of students who are physics majors has grown significantly over the past three years. As of Fall 2004, there was one sophomore and three freshmen physics majors. During the 2012-2013 year, we graduated six students, Joe Cheeney, Bret Henderson, Eddie Pluhar, Chris Pelikan, Nikki Tipsword, Jamiahus Walton. Three of the six will be attending graduate school in the fall, and two more are applying. In Fall 2013, we expect to have six seniors (one in the dual-degree program at Washington University), three juniors, five sophomores, and four freshmen enrolled as physics majors.

Most students who pass through courses in Physics or Astronomy are not physics majors, ! 1%" ", "0" 3" 0"3!" ", 1%"!" 1 "10" 1" 03" 0" 3 "1, 1%" 3" 01 In addition, because of the excellent astronomical equipment that the University has, the

253, an introduction to Modern (20th-century) Physics, and PY 325, Mathematical Physics. In , ! " %0 0 012! " 10 +)) " 1 , ! 2 "! 1, 1%" 1 1%" , 01 " 1 " ") opular and powerful computational and analysis software package, and in Mathematical Physics, they will focus on integrating knowledge from a variety of math classes as well as filling in gaps of material not commonly covered in traditional mathematics courses. They will also begin the process of learning how to write scientific articles as well as present their research orally in a seminar-style symposium.

During their junior year, physics majors will take PY 262, Experimental Physics I, focusing on Elec1 , 0 + % %+)) 1 , ! 2 " 1%" 1, 1 ,) 01 2 " 10 1%" industry and academic standard in experimental control and data acquisition. In the spring, they would take PY 362, Experimental Physics II, where they would focus on data acquisition and experimental design. These courses are where students will first experience substantive experimental design, and will also involve instruction in writing of scientific papers. The courses will culminate in seminar

IV. Methods

The goals described in section I will be met in many different courses, which are listed in the curriculum map attached in the appendix. For the purposes of this study, assessment and data collection will take place in the following courses:

Goal 1: Progress towards goal 1 will be measured in two ways:

1) Students in PY 151 will take the Force Concept Inventory as a pre-test and post-test. The FCI is a test containing 30 questions on Newtonian mechanics and is nationally used as a benchmark for student learning in first semester introductory physics classes. The results are reported as average percent gain, (Post Test Pre Test)/(30 Pre Test)*100. This allows us to compare the improvement of students who begin the course with different backgrounds. Data has been collected from thousands of classes at dozens of universities over the last decade, and results for different pedagogical methods are well known. Courses utilizing primarily traditional, lecture-based pedagogies average a 23% gain, while courses utilizing primarily active learning methods average a 48% gain.

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2) PY majors, at the end of their sophomore, junior, and senior years, will take the Physics Major Field Test, administered by the Educational Testing Service. The MFTs were introduced in 1989, and are given, in a variety of disciplines, at over 700 colleges and universities (including the MU Chemistry department). The scores will be tracked over the (up to) three years that students take the exam, and progress will be measured both on how individual students improve as well as how MU students compare to national results. There are three scores reported by ETS a Scaled Score, ranging between 120 and 200 (2004 median score for seniors 144), an Introductory Physics Score, ranging between 20 and 100 (2004 median score for seniors 44), and an Advanced Physics Score, ranging between 20 and 100 (2004 median score for seniors 46).

It is expected that students will improve as they progress through Millikin, so that a satisfactory result for a sophomore would be lower than that for a junior, etc. The departmental goals are listed below (in terms of average percentile ranking for the

Oral Presentations:

Excellent

PY 381, 382 Advanced Topics in Physics	YES	YES	YES
PY 403 Electromagnetism I	YES		YES
PY 404 Electromagnetism II	YES		YES
PY 406 Quantum Mechanics	YES		YES
PY 481, 482 Senior Research	YES	YES	YES