Women who shaped Modern Physics

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Amount requested: $ 10,000

Abstract:

We want to develop a physics core course with an accompanying lab that focuses on women scientists and their areas of research. Many women scientists contributed to research fields in modern physics like nuclear fission and radioactivity. They helped to understand apparent mysteries like pulsars, special relativity and symmetry breaking in nature. Therefore, this course will offer the unique opportunity to explain modern topics in physics and at the same time get to know the personalities of the female scientists who contributed to their understanding. We will explore the historical, religious and scientific background of the scientists' discoveries and emphasize how their research changed our view of the world and our quality of life. We also plan to discuss to what extent their contributions were acknowledged by the scientific community.

"I have more than enough to do with my household, my kids and the work in the laboratory." **Marie Curie in 1905**
Nobel prize in physics in 1903 Nobel prize in chemistry in 1911

Irene Joliot-Curie
Nobel prize in chemistry in 1935

3. Budget:

Summer Stipend for the project directors:	Each $ 4000
Lab assistance: 180 hours a $ 8.50	$ 1530
Equipment: the department supports this course and will buy the necessary equipment for the labs from departmental funds	$ 3000 (from department)
Guest speakers: female research scientists who work in industry or research institutions (P&G, NIOSH, preferably Xavier Graduates)	$ 470 (honorary fees)
Sum:	$ 13 000
Amount requested from the *Women of Excellence* giving circle:	**$ 10 000**

4. Narrative:
What is the need for this interdisciplinary core course in physics, and how was this need identified?

Women are still underrepresented in physics and engineering. The number of students who chose these careers is low. Our economy, however, needs to engage in research in order to compete on the global market with new technologies like alternative energy sources and patents in all fields of industrial production. Even for the general public it is essential to gain knowledge in modern physics in order to understand the implications for society, just as one needs to know about the steam engine to understand how it caused the industrial revolution.
Students in our current core courses have often expressed an interest in topics of modern physics. They are intrigued by apparent mysteries which they get to hear in the media like *string theory, special relativity,* or *quantum teleportation.* They are fascinated by buzz words but cannot grasp the concepts. Physics core courses rarely touch these difficult and very abstract subjects. And it is not well known that women played a significant role in developing these modern physics concepts.

How does this course meet the mission of the *Women of Excellence*?

This course will increase the awareness in the broader public of women in physics. Besides improving the knowledge of modern physics, we will discuss the circumstances for successful careers for women. The students will read the biographies of the scientists with these questions in mind: Did the scientist have a mentor? If the scientist was married, was the mentor her husband? How was, in general, the relationship between husband and wife? Did the life as a (married) couple reflect the partnership as colleagues? Did a network exist which offered support regarding family life or career? A very enlightening insight will be to compare the biographies of Mileva Maric (Einstein's first wife) and Marie Curie. These two scientists lived at approximately the same time and encountered similar circumstances at the beginnings of their careers. But why did their careers take such different paths? Why was one successful and the other one not?

How does this course fulfil the academic mission of Xavier University?

Jesuits have always been good scientists because of this fundamental conviction: God can be seen in all things. The women scientists certainly saw the beauty and the wonder that can be found in nature and science. So do we. We want to convey this to our students, and engage the students intellectually and morally in this interdisciplinary core course. The women scientists will be great role models for a life of service and success. To that end, we will emphasize how the women's discoveries changed our view of the world or our quality of life.

Scope of the project:

Our course will anchor physics topics to the female scientists who helped to discover or understand them, because students often get better access to the material when it has a more personal and human component. Therefore, Dr. Schmitzer and Mrs. Frohlich will read several biographical books on each of the following scientists: Caroline Herschel, Henrietta Swan Leavitt, Jocelyn Bell Burnell, Ada Lovelace, Marie Curie, Rosalyn Yalow,

Lise Meitner, Rosalind Franklin, Maria Goeppert-Mayer, Chien Shiung Wu and Mileva Maric. The ones which fit best our teaching goals (as stated in the second paragraph) will be selected and become reading assignments for the students. In addition, we plan to develop twelve student lab experiences which allow the students to walk in the footsteps of the scientists. We want the twelve lab experiences to be as close as possible to the original work of the physicists. These types of labs cannot be bought from educational supply companies for two reasons: a course like this does not yet exist, and it is impossible to do, for example, a real schoolroom lab on nuclear fission. We have to be creative and come up with alternatives. Our ideas are to either devise a setup which simulates the original experiment or get the original publications with data and have the students process the data and let them arrive at the same conclusions as the scientist. In each case we will have to make hands-on models with which the students can work, write lab manuals, and have lab assistants do a dry-run through the labs to see where pitfalls are.

Timeline:
Phase I from Fall 2009 to Spring 2010: Develop "Women who shaped Modern Physics" as an Honor's Course with the maximum possible scientific rigor by Heidrun Schmitzer

Phase II from Spring 2010 to Fall 2010: Develop as core course "Women who shaped Modern Physics" by Amy Frohlich. Make sure that course meets the standards of the *Diversity* Proposal.

Phase III in Fall 2010: Implement parts in the *Modern Physics* course for physics majors by Heidrun Schmitzer

Phase IV in Spring 2011: Obtain approval from the *Diversity* Proposal Committee

What is the expected impact?

This proposal will have an impact on about 36 to 46 students per semester, or approximately 800 students in 10 years. We hope that they will act as multipliers, and that they spread at least some of what they have learned and experienced to others and their children.

How will the *Women of Excellence* giving circle be recognized as having played a role in the success of our project?

We will introduce this course as a project funded by the *Women of Excellence* giving circle in the first class session. The *Forensics* course that Dr. Schmitzer developed four years ago was featured in the Xavier Magazine. Therefore, we are confident that an article about this course will appear in this magazine as well. The contribution of *Women of Excellence* will be emphasized.

How will we measure the success of the project? How will we inform the larger educational community of our work?

We will have assessments by questionaires about gender issues throughout the semester. A comparative statistical analysis of the questionnaires at the beginning and the end of the semester may lead to a poster presentation at the Lily conference. The poster will indicate the funding by *Women of Excellence* giving circle. And we will, of course, be willing to give a talk about the project.