Spotlight on Hidden Physicists
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THE COMMUNICATOR

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Twenty-five years ago, I was, like you may have been once, a physics major and Society of Physics Students member. One of my favorite ways of taking a break during a study session at the science library was to go to the newspaper stacks, get the Tuesday New York Times, and read the latest science news. I know what you are thinking—what are newspaper stacks? There’s no hiding the fact that news dissemination has changed dramatically since I was an undergraduate. Technology pushed the stacks aside, and, as a result, it’s now easier than ever to keep up with the latest research advances.

I have been fortunate to be a part of this news evolution, ever since I traded in my college lab notebook for a reporter’s notebook in grad school. Equipped with a bachelor’s in physics and master’s in science journalism, I began my career in science communication. Within a year I was working in the American Physical Society’s newsroom at a major national physics meeting, helping to inform famous science correspondents about a new discovery concerning the afterglow of the big bang that would win the 2006 Nobel Prize in Physics. Between 2007 and 2011, I was the director of media relations at the National Institute of Standards and Technology in Gaithersburg, Maryland, where I got an inside look at physicists developing the latest quantum-computing technology and studying the behavior of ultracold gases unbelievably close to absolute zero. My physics background gave me the ability to understand and communicate these amazing scientific accomplishments to a wide audience, including my non-scientist family members.

To this day, my most treasured experience has been helping to create Inside Science, a nonprofit news service for the general public that covers research developments in all fields of science, technology, engineering, and mathematics. Produced at the American Institute of Physics in College Park, Maryland, Inside Science publishes news articles, videos, guest columns, and blog entries prepared in an accurate, engaging way and picked up by other news outlets. Visit Inside Science’s website (www.insidescience.org) to watch students fire ping-pong balls faster than the speed of sound through solid aluminum, find out how the fascinating D-Wave quantum computer is raising new questions, learn how only eight percent of Usain Bolt’s energy usage contributed to his world-record-setting performance, and read about one physicist’s theory that our universe may be inside a black hole. I never knew a newspaper stack that could deliver all of that in one fell swoop, and it brings me enormous satisfaction to help spread the word about science.

The other two-thirds were dubbed the “hidden physicists,” a term inspired by the hidden symmetries central to the physics of elementary particles and condensed matter systems. “Hidden” behind other job titles and roles, these individuals nonetheless bring to the diverse professions they chose the skills and perspectives of the physicist. These persons may have overlain their physics backgrounds with new identities, but there is still a physicist inside of each of them, and their chosen professions are all the richer for it.

For more information about the genesis of this term, see Radiations, Spring 1996 and Spring 1997 issues.
The Filmmaker

Ian Harnarine

Adjunct Faculty, New York University

When I was an undergraduate at York University in Toronto, I did a lot of work with the high energy physics group. We were part of the international ZEUS Collaboration, which ran a large particle detector at the photon-proton collider at the Deutsches Elektronen-Synchrotron (DESY) in Hamburg, Germany. I helped to construct particle detectors and spent a summer at DESY. That experience changed my life. It was my first time “on my own,” completely immersed in a foreign culture with a foreign language. It was also when I realized that I wanted to pursue graduate studies in physics, because the work I was doing was so awe inspiring. In addition to the experiments at DESY, I also did a research project analyzing images from the Hubble Space Telescope and the extrasolar planet hunter Kepler (then in its development phase).

In grad school at the University of Illinois at Chicago, I was part of the Phobos Collaboration, working on a high energy experiment based at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory in Upton, New York. I worked in the tunnel and did data analysis that resulted in my thesis, “A Study of Pile-up in 200 GeV Au+Au Collisions at RHIC.”

Ultimately, though, I lost my passion for doing research. Don’t get me wrong. I still love physics and the pursuit of knowledge. But when I looked at my grad school friends and professors, I saw that they were really immersed; they could feel fulfilled by hours of solving equations and coding. I just didn’t get as much satisfaction from that kind of work. What I did find fascinating and fulfilling was learning about the people I was working with. I loved hearing their stories and discovering what motivated them to do what they do. That’s when it hit me. I was far more interested in the story of science and scientists than in the actual day-to-day work of being a scientist. I decided to become a filmmaker.

There is no doubt that my training in physics has a profound impact on me as a filmmaker. It taught me how to think in a disciplined, critical, and unbiased way. It also taught me how to look at a problem from different angles and try different approaches to solving it. When I find myself analyzing films and scripts, there are patterns that appear in every story. I’ve learned how to identify them, use them, and, ultimately, subvert them in my own work.

Like research, filmmaking is an incredibly collaborative effort involving many people. Knowing how to work with others to achieve a single goal is something I learned while being a part of physics collaborations. The ultimate goal is different, but the ins and outs of managing and connecting with people are very much the same.

I’m currently working on the movie Time Traveler with Spike Lee. It’s the true story of Ronald Mallett, who teaches at the University of Connecticut and is trying to build the world’s first time machine. The story is incredible and involves a lot of theoretical physics, but mostly it’s a father-son story. To me, it’s the perfect blend of science and heart.

MORE INFORMATION

Harnarine’s short film, Doubles with Slight Pepper, won the Telefilm Canada Pitch This! contest at the Toronto International Film Festival. Watch it at https://vimeo.com/41997098.
Born in the early 1950s in Southern California, I was a surfer in high school and worked as a draftsman in the evenings and on weekends. After graduating from Los Angeles High School, I enrolled in the engineering program at Wayne State University in Detroit, Michigan, but quickly found out how ill prepared I was for even the most basic math courses. I left college.

Two years after returning to my home state, I completed an associate degree at El Camino College Compton Center, where I passed all of the math and physics courses the school offered. This gave me the opportunity to participate in a programming engineering program run by the Lockheed Corporation in Burbank, California, in which I reviewed specifications for microelectronic devices. I then enlisted in the US Air Force (USAF), becoming a mechanic and serving one tour of duty.

Working at the aircraft company McDonnell Douglas after my time in the USAF, I prepared electrical wire harness assemblies. It was there that I remembered how much I had enjoyed physics. So I applied and was accepted to California State University, Dominguez Hills, where I earned a bachelor’s degree in physics. After graduating I worked for a number of years in the fields of acoustics and vibration before being accepted to the physics masters program at California State University, Long Beach.

As I worked toward that degree, the hands-on nature of experimental physics was very appealing and led me to computer programming. I’ve since written hundreds of scientific software applications. In the field of acoustics, I designed a digital filter for sound attenuation and absorption measurements that processes one-third octave band sound data generated in an anechoic chamber (which completely absorbs sounds) or a reverberation chamber (which creates a diffuse sound field).

I went on to explore several other disciplines. Working in semiconductors, I designed software that used pattern-recognition algorithms to ensure quality control in microelectrical mechanical systems (MEMs) electroplating operations. I then wrote several automatic test equipment applications that programmed the field-programmable gate arrays of advanced avionic flight equipment and performed component and system compliance and reliability tests. I now work in geophysics and petrophysics, writing software that controls experiments in special core analysis and analyzes the properties of rocks.

Almost all of the software applications I’ve written over the years, regardless of the field or the application, contain components of fundamental physics principles hidden inside.

One of the biggest challenges facing undergraduate physics programs when it comes to recruitment and retention can be summed up in one word: JOBS. Although most departments focus primarily (and sometimes exclusively) on preparing students for physics graduate school, in reality only about one in six physics bachelor’s degree recipients eventually earns a PhD in physics, and 40 percent of the physics graduates in the United States enter the workforce within one year of receiving their bachelor’s degree. These graduates commonly pursue engineering and information technology careers, but many go on to become teachers, medical doctors, lawyers, science writers, analysts, and other types of professionals.

Although people who enter the workforce after earning their physics bachelor’s degree have successful, fulfilling, and lucrative careers, physics students often do not know about these opportunities. This is because, in general, faculty members have not worked outside academia and have few professional connections outside of academic circles. Thus students who are deemed by the faculty as “not physics graduate school material” or who are not interested in attending physics graduate school are often left to explore their career options on their own.

Anecdotal evidence suggests that this lack of knowledge about career opportunities and nearly exclusive focus on getting students ready to enter graduate school can have a significant negative impact on students, as well as on recruitment and retention within the physics major. Students who need or want to go to work after earning a bachelor’s degree may become dissuaded from studying physics and drawn in by other fields with well-known career paths (e.g., engineering), even if their true interests are more aligned with the study of physics. The fact is that a physics degree is excellent preparation for a wide variety of fields, as exemplified by the “hidden physicists” stories featured in each issue of Radiations (see page 16).

Increasing the number of physics bachelor’s degree recipients could add significantly to the “STEM workforce” of people highly trained in problem solving, critical thinking, and valuable technical skills.
In light of these circumstances and with support from the National Science Foundation, the American Institute of Physics—home to Sigma Pi Sigma and the Society of Physics Students—began in 2010 a multiyear Career Pathways Project (CPP). The goals include exploring how physics departments can better prepare students to enter the STEM workforce and how physics students can better prepare themselves to enter the workforce. Sigma Pi Sigma has a history of celebrating physics graduates who use their physics training in unique and interesting ways. This project is a kind of next step in the process of taking the “hidden” out of “hidden physicists” and exposing the many options that are commonly available to physics graduates.

The project began with exploratory site visits to a set of diverse physics departments that graduate high numbers of physics students who enter the STEM workforce upon graduation. The visits did not produce a universal recipe for success, but a number of common features emerged that seem to influence a department’s success in preparing students for the STEM workforce:

**Curricular**

- Varied and high-quality lab courses
- Research opportunities for undergraduates
- Curricular flexibility
- Communication skills as part of the undergraduate physics experience

**Extracurricular**

- Faculty and staff commitment to the success of all students
- Strong community of students
- Connections with alumni
- Relationship with the career services office
- Mentoring and advising physics majors in accordance with their interests and goals
- Opportunities for physics majors to be involved in outreach activities

These results, bolstered by many stories shared during site visits, indicate that alumni connections can play a significant role in educating physics students and departments about career opportunities for physics students and in helping students connect with such opportunities. For example:

- Department seminars that feature alumni speakers are well received and offer students unique insight into career paths that physics faculty members are often not familiar with themselves.

- Alumni who serve on advisory boards or work with students and faculty in other capacities can be excellent resources for networking and identifying research and internship experiences. This is especially true when the alumni are local. (See Jim Gaier’s story on p. 12.)

- Physics students often hear about research, internships, and job opportunities from recent graduates with whom they are still friends. (See Andrew Watson’s story on p. 11.)

- A simple list of physics department graduates and their current employers alongside general physics career information can be a great recruiting tool for potential majors and their parents.

- Some career services offices (or their equivalent) effectively engage alumni in interviewing students during mock interview sessions. Although the site visit teams did not see physics alumni being engaged in this way, doing so may be especially useful for helping physics students learn to communicate their skills in a way that is meaningful to potential employers.

The CPP findings are being disseminated through reports, resources, and workshops aimed at faculty and students. There is also a great opportunity for alumni to step forward and help create a physics community that embraces all students interested in physics, regardless of physics graduate school ambition. So, Sigma Pi Sigma alumni, we encourage you to take a short break from this issue of *Radiations* and send a brief note to the physics department at your alma mater (or a department near where you live) detailing where you are now, what you are doing, and any ways that you are open to engaging with students. Let’s see where this goes. 🌐

**CAREERS TOOLBOX**

The interactive resources presented in the *AIP Career Pathways Workshops* are relevant to all physics students. Even those who go to graduate school will need to get a job someday! Materials center on helping students identify and clearly articulate the knowledge and skills that stem from their physics background, with resources for building an effective resume, interviewing, networking, and other aspects of the job search. Image courtesy of the American Institute of Physics.