A new face for physics

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Graduate student helps to shed stereotype

Physicists have a problem. They are stuck with a stereotype. In this, the World Year of Physics 2005, which celebrates the 100th anniversary of the creation of three seminal papers by one of the most vibrant, engaging and admired personalities of his century, Albert Einstein, the image of physicists has deteriorated.

David Armstrong, associate professor of physics at the College of William and Mary, put it bluntly: “Physicists struggle against the perception that they are weird, that they’re not normal human beings.”

For Armstrong, the perception comes into play when attempting to recruit students. “When we want to attract people into the field, we battle against the pen- and pocket-protector-bearing, slide-rule-carrying, horn-rimmed-glasses-wearing geek image,” he said.

The truth is far different, he continued. For that reason, when the International Union of Pure and Applied Physics declared 2005 to be the World Year of Physics to, in part, recognize the writing of Einstein’s papers on light quanta, Brownian motion and the special theory of relativity, sponsors conceived of hosting the “Quantum Diaries,” a Web blog through which 33 physicists from around the world would provide insights into their daily thoughts and activities.

“We wanted to show what their lives are like,” Armstrong said. “We wanted people to see that physicists are well-rounded individuals who

just happen to be fascinated by the questions of physics—of science—and who want to help contribute to that understanding." Among the quantum diarists, Armstrong has a personal favorite. Sarah Phillips, one of his graduate students, is, in a sense, his ringer.

Phillips blushed at the suggestion that she has become a fresh face for physics—her blushing, in some ways, underscores Armstrong's faith in her ability to sell the discipline. Certainly she is hard core about the science. Having just participated in the massive G-Zero experiment at the Thomas Jefferson National Accelerator Facility, she is working on her analysis of the parity-violating asymmetries in elastic electron-proton scattering in anticipation of earning her doctorate in January.

"The experiment is a really cool one," she said. "It is investigating the fundamental properties of matter—in effect, the stuff behind the stuff. How neat is that?"

Everything around us is made of protons and electrons, she explained, pointing toward chairs, desks and a wall as examples. Protons, however, are not fundamental matter: They are made up of quarks, generally two up quarks and one down quark, along with strange quarks. The strange quarks, which exist as quark-antiquark pairs, generally cancel each other out but exist long enough to contribute, Phillips explained.

In her blog, the experiment is chronicled. For example, in her entry for June 14, she wrote, "For the G-Zero experiment, we sent a polarized electron beam into a liquid hydrogen target (which is basically just protons). The spin of the electrons in the beam were all lined up so that we could choose to have the spin pointing in the same direction as the motion of the electrons or in the opposite direction. … We would take the measurement of how many protons were scattered for a certain amount of time with the electrons polarized in one direction, and then do the same measurement for the same amount of time with the electron

beam polarized in the opposite direction. The numbers are different, by about 10 parts per million or so. … The difference is very small, but very significant, since it tells us how much the weak interaction is present in the interaction, and by comparing this with the electromagnetic interaction, we can get the answer we are looking for: the strange quarks' contribution to the proton's structure."

However, Phillips' blog is about more than science. It also reveals a life—a real life. Among her more recent entries, she discussed learning to play floor hockey at William and Mary, going back to New England for a vacation and taking a first sail on the York River.
Concerning sailing, she wrote this: "As we motored down the creek out to the river, I watched all the herons and egrets fishing in the waters of the marshes. … The birds were absolutely lovely to watch, so graceful as they waded along the shoreline. … Large osprey nests crowned the tops of every post that marked the boat channel in the creek. Most of the nests had an occupant in them, so the birds would squawk at us as we passed by the channel markers bearing their nests. They were really cool. Later in the day, I even saw one flying along carrying a fish that it had caught."

Phillips insisted that the two types of entries do not represent a split in her personality. She cited examples of other diarists interspersing explanations of their work with things like cooking in Asia or hiking in the Alps.

"The purpose of the blog is not only to show what we do but also to show that we do have real lives," she said. "That curiosity about life that led people to become physicists also shows up in what they're interested in doing."

Participating as a quantum diarist has resulted in a bit of celebrity status for Phillips. When she attends conferences, fellow physicists come up to

her and comment on her entries. During this summer's open house at Jefferson Lab, several people attended because they had read her blog and they wanted to see what she was writing about. "One person actually told me that her daughter was trying to do better in her math class because my diary had inspired her," she said. "That made it completely worthwhile." She added, "Plus, I have never had anyone squeal when they saw me before."

Phillips communicates as she lives—her observations are driven by an intense interest in her world. She still remembers the moment when she understood the potency of her own curiosity. She was 7. Her parents had taken her to the SEE Science Center in Manchester, N.H. Among the demonstrations was one involving "big bubbles" and a discussion of why there were different colors on the film. She asked questions that her father, an electrical engineer, and her mother, a registered nurse with a background in biology, could not answer.

Today, she delights, despite her background in physics, in the fact that the world remains a mystery. Whether in the laboratory working at the subatomic level or in the spaces of her own backyard, she is bent on discovery.

"Being a physicist does affect how I see the world, but that is good," she explained. "If you look outside, and you see the way that trees reflect light, knowing a little about the properties of light does affect how you see it, but it still is beautiful. When I go out and take photographs of the flowers in my yard, I want to know why the pigment is such and such a color and why we perceive it as that color. I am fascinated by the fact that honeybees perceive the flower much differently than we do."

As she intersperses her blog with accounts of her discoveries, she knows that the pieces she has written on flowers and bees make her—and by extension, her science—more approachable. "One fun thing is that my

mother told me this is the first time she really has known what I've been doing all day," she said. She remains excited at the response of others.

"It's made people more aware of a field that doesn't necessarily come into contact with the real world," she said. "We discover great things for the good of mankind, but a lot of the people never hear about it."

Armstrong could not be more pleased. Communicating the intricacies of physics, he knows, always has been difficult. "In other sciences, such as biology, for instance, when you talk about a particular fish or bug, everyone knows what a fish or a bug looks like," he said. "These are things that are, in effect, there. Protons are things that definitely are there, but people don't have direct experience with them. At the level of the quark, quarks definitely are there, but people have even less intuition about them. It becomes harder to explain those things."

Phillips and others participating in the Quantum Diaries have helped bring the excitement of their research to light, he believes. What is important is that they have gone further.

"They have shown that physics is not just nerds and technology," he said, "but that it is a real human endeavor."

Source: The College of William and Mary