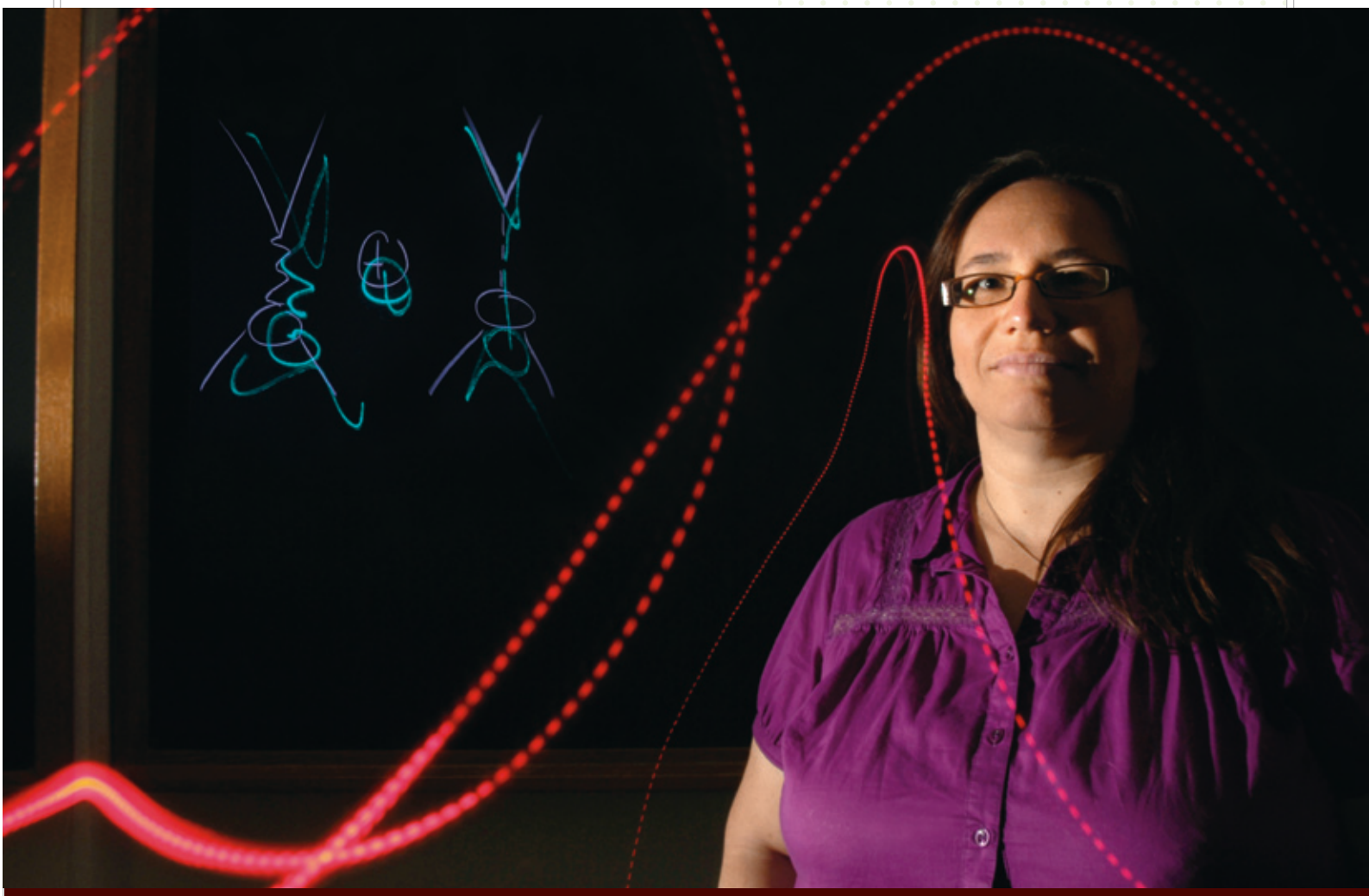

:: PHYSICS AND ASTRONOMY | by Andrea Gibson

The new physics

Scientists launch international experiment that could test standard model of physics theory

To explain the physics of our universe, scientists developed what's known as the "Standard Model" of how subatomic particles and the forces of nature behave. Although the Standard Model has been successfully used in the field, physicists have learned that it doesn't account for everything—for example, the existence of dark matter.

Ohio University physicist Julie Roche is part of a team of 150 scientists now embarking on a study that could either strengthen evidence for the Standard Model or reinforce the notion that there's a whole world beyond it—a concept they call "new physics."

The international team is attempting to make the first precision measurement of the proton's weak charge, an experiment that uses the weak force to shed light on new physics. The weak force is one of the four fundamental forces of nature (the other three are the strong force, electromagnetism, and gravity).

To do this, the team needed to construct a special detector that measures the speed, direction, and energy of scattered electrons. The detector has been installed at the U.S. Department of Energy's Jefferson Laboratory in Newport News, Virginia, considered to be the world's most powerful "microscope" for studying the nucleus of the atom. The lab features an electron beam accelerator buried 25 feet underground. The accelerator can propel electrons around a racetrack, hitting targets in three different experimental halls so that physicists may observe different characteristics of particles and the forces that act on them.

The development of the detector took 10 years. Roche's team contributed to the project by designing the data acquisition and analysis software. In 2010, the project, known as "QWEAK," finally was ready for its launch.

"Despite all the tests and preparation one gets to do, nothing really prepares you," says Roche, whose team now has completed its first year of a two-year data collection process.

Roche seems undaunted by the long development of the detector, noting that she's just as intrigued by the creative process of designing innovative experiments as she is about what the research team may discover.

"We try to do smart experiments to measure new things, but the results are out of our hands–we don't know what we'll find," notes Roche, an assistant professor of physics and astronomy.

The physicist is excited, however, to be part of an international team that could write a new chapter in physics. That's not to say that Roche expects her work to reach a definitive ending.

"Each time you get an answer," she says, "it opens up a new question."

Scientist Julie Roche sketches the process of a major new physics experiment.

 PHOTO: ROBB DECAMP