Private Funds Help Establish Ultrashort Pulse Optics Lab

By Mary Price

This fall, Will Johnston '17 quietly made history when he became the first cadet to work in the Department of Physics and Astronomy's newly established ultrashort pulse optics laboratory.

The lab, the result of an ongoing collaboration between a private investor and a VMI physics professor, opened its doors in the spring, although work toward its establishment began in 2013.

That year, Col. Stacia Vargas, professor of physics and astronomy, teamed up with Lexington resident Tom Chaffee and his company, Attochron, to develop an application of ultrashort pulse lasers for carrying voice and data signals between cell phone towers.

Now, Johnston is helping Vargas to get the kinks out so the technology can be proven. So far this year, he's been working with a digital communication analyzer, a tool that allows its users to find out if the laser is mode-locked. If the laser is mode-locked, then all of its pulses will be aligned, resulting in a strong signal.

"We need to make sure we have one strong beam coming out, versus lots of little pieces," said Johnston, a double major in applied math and physics who plans to commission in the Air Force with the goal of working in research and development.

"Since we're trying to send data on [the signal], it really does need to have a solid mode lock," Vargas added.

The process has not been without hiccups.

"It's very stressful, and very complicated," said Johnston.

Persistence, though, is the name of the game, and Johnston has that in ample supply. Already, he's committed to working in the lab until he graduates, and he's planning on writing an honors thesis next year about his work.

"I'd like to see [the project] through," Johnston commented.

Johnston is also making plans to write a computer program that would make it easier to calibrate the lab equipment. To do so, he'll use LabVIEW, a software package specifically designed for engineering and science applications. Already, Johnston has had training in the software from Col. Merce Brooke IV '94, professor of physics and astronomy.

Like Johnston, Vargas and Chaffee have had help along the way – and part of that help recently came from a dedicated gift.

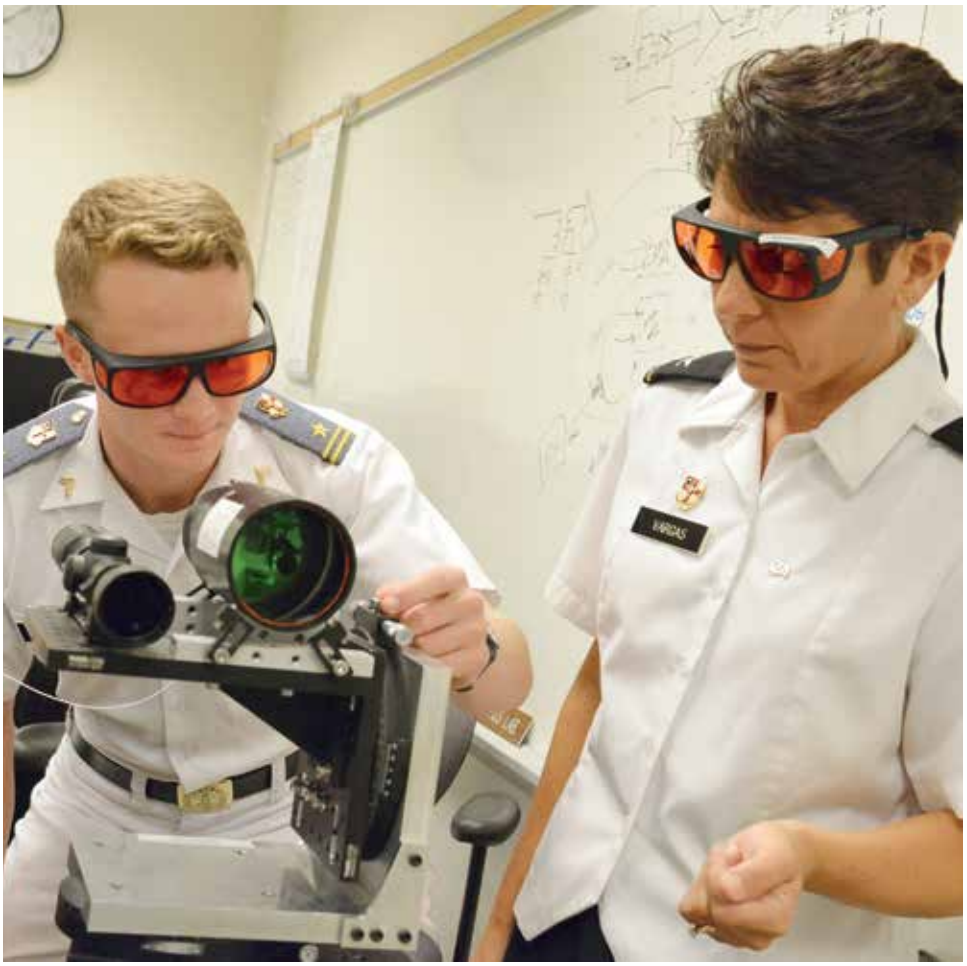
Earlier this year, the ultrashort pulse optics lab got a huge boost when an anonymous physics alumnus gave just under $50,000 as part of the VMI Foundation's ongoing Uncommon Purpose campaign, to be used to support Vargas and Chaffee's work.

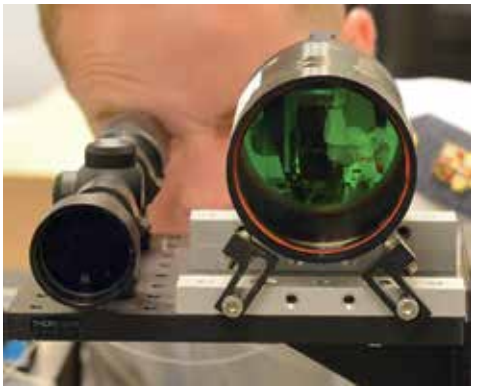
The funds have been used not only to buy much-needed equipment for the lab, but also to support a partial sabbatical for Vargas, so she could focus on the ultrashort pulse laser project, and to pay a small stipend to Johnston. Approximately $78,000 in additional support for the new lab has come from the Jackson-Hope Fund.

Last year, Vargas and Chaffee took the first steps toward demonstrating the utility of ultrashort pulse lasers for telecommunications when they sent the first ultrashort pulse laser signal between an upstairs classroom in Mallory Hall and the press box in Foster Stadium, a distance of approximately 300 yards.

Earlier this year, the two were able to send the signal in a variety of weather conditions, a factor essential for commercial success, with a very small error rate.

"If you have a perfect signal, it's called a zero bit error rate," explained Vargas. "We were getting that zero bit error rate 95 percent of the time."





Col. Stacey Vargas observes as Will Johnston '17 aligns the receiver telescope for the free space optics experimental set up in the lab. – *VMI Photos by Kelly Nye.*

She continued, "At some of the poor weather conditions, we weren't at zero, but we were still at a reasonable bit error rate. We still had a signal that would be acceptable in telecom."

Now, with the 300-meter transmission successfully demonstrated, Vargas and Chaffee have set their sights on a new, higher goal: sending a signal from the greenhouse atop Maury-Brooke Hall to a small building off Randolph Street in Lexington, a distance of approximately 750 yards.

If that goal is met, the next step will be to send the signal from the roof of Maury-Brooke to the roof of Carilion Stonewall Jackson Hospital. That distance is approximately 1.2 kilometers – a distance that excites Vargas because one kilometer is considered the gold standard of industry acceptance.

Another goal for Vargas is to get more cadets and faculty involved, from a variety of disciplines. Col. James "Mac" Baker Jr. and Col. David Livingston, both professors of electrical and computer engineering, have already helped set up the receiver link that went into the press box at Foster Stadium.

"I loved that they came and were willing to talk about what we were doing," said Vargas. "I find myself very eager to have more people who know more, and are interested in learning more."

Johnston, too, is anxious to keep learning, even on the days when things don't quite go as planned.

"I'm getting a knowledge that I wouldn't get inside of a classroom."

To learn more about the ultrashort pulse optics lab, visit *www.vmi.edu/uspoptics*.

Numbers Up in VMI Physics Department

For VMI's Department of Physics and Astronomy, an aggressive recruiting campaign during open houses for prospective cadets has resulted in what's likely a record number of physics majors this fall.

The department, which has traditionally had one of the smallest numbers of majors on post, began the 2015-16 academic year with 24 new majors, a number that Col. Tim Hodges, department head, believes is the largest ever.

That count has since declined to 23, but it still represents more than double last year's enrollment of nine 4th Class physics majors.

There are now 40 physics majors in all classes enrolled.

"We're doing a much better job of selling the program," said Hodges, who became chair in January 2014.

Hodges has added an additional section of the introduction to general physics class, required of all physics majors, to accommodate the additional 4th Class majors as well as engineering majors who typically take the course. Eventually, additional upper-level lab sections may be needed, since each can accommodate only about 10 cadets.

Despite these growing pains, Hodges said he was "very pleased" to see the number of majors increase so markedly this year. When he became chair just under two years ago, the department had approximately 35 majors. His goal as department chair is 60.

– By Mary Price

Parents Weekend

Tailgaters fill the Parade Ground on a beautiful fall morning during Parents Weekend, Oct. 16-17. Activities included a barracks tour, parades Friday and Saturday, a jazz ensemble and Glee Club concert, and a football game against University of Tennessee-Chattanooga. To see more photos, visit *VMINews.tumblr.com*, post date Oct. 17. – *VMI Photos by Kelly Nye.*