Magazine

U-Md.-Goddard programs offer students out-of-this-world opportunities

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Professor Eun-Suk Seo at the University of Maryland Laboratory stands in front of the Cosmic Ray Energetics and Mass detector, which NASA will launch to the International Space Station. (Greg Powers/For The Washington Post)

Dozens of students at the University of Maryland have toiled in the physics lab, some soldering metal parts, some debugging software and some simply slicing black pieces of paper into perfectly sized triangles.

To physics professor Eun-Suk Seo, all of their work is critical. Students are helping her build a payload that is scheduled to launch to the International

Space Station next year, the culmination of more than 10 years of her painstaking work on cosmic rays in a collaboration with NASA.

Seo is one of many faculty members at the University of Maryland at College Park who work with NASA's Goddard Space Flight Center, a partnership that allows professors and students to pioneer on a larger scale than would otherwise be possible — and sometimes to get close to history.

U-Md. ranked fifth in the nation in NASA's research and development budget for colleges in 2012, with the space agency pouring $47 million into the school's research endeavors that year, according to the National Center for Science and Engineering Statistics.

(Johns Hopkins was No. 1 because of the Hopkins Applied Physics Laboratory, one of the few U.S. centers that build spacecraft. Its major project is developing a probe to fly in the corona of the sun, which has never been done. Other projects include a spacecraft currently circling Mercury and one projected to reach Pluto next summer.)

Seo's project — called ISS-CREAM (pronounced "ice cream") for International Space Station Cosmic Ray Energetics and Mass — aims to answer the century-old space mystery of what gives cosmic rays such

incredible energy, and how that affects the universe.

Seo is doing her work using graduate and undergraduate students, some of whom are highly trained in engineering or physics, and others who have a more passing interest and go on to study, say, philosophy or music. Those are the ones she has cutting paper.

“Mission success depends on these jobs,” Seo said. “They have to be done right. I tell them, think about it this way: When you look at this payload at the space station, you’ll see that neat piece of paper you cut. How awesome that will be?”

A student works on the NASA ISS-CREAM Project at the University of Maryland Laboratory (Greg Powers/For The Washington Post)

By nature, being a graduate student often means working on cutting-edge research. U-Md., though, is positioned to foster that through its coordination with NASA.

The College Park campus is about five miles from Goddard’s 1,270-acre Greenbelt complex, which opened as NASA’s first space flight center in 1959. Named for the father of rocketry, Goddard was involved in the first manned space flights in the

1960s, managing communication networks during the Apollo missions and others. Goddard now employs about 10,000 people, making it one of the largest organizations of scientists and engineers in the world that use space observation to study Earth, the solar system and the universe.

“Not everybody [at U-Md.] gets to work on putting something on the International Space Station,” said David Angelaszek, 26, a physics graduate student who is programming software for ISS-CREAM. “That definitely makes it feel a little bit unique and important.”

For more than a half-century, U-Md. professors and students have been involved in developing and executing Goddard missions, as well as gathering and analyzing data once the missions are launched.

Initially, in the 1960s, university researchers took advantage of the quick drive to Goddard and a relationship that was more organic than formal. Now there are contracts and grants, and some professors and students spend more time at Goddard than on campus.

“We’re a research university,” said Jordan Goodman, physics professor and past chairman of the physics department. “I tell students that if you just come here and take courses and leave, it’s like going to

France and seeing the Eiffel Tower and not eating the food. You miss out on the best part."

The collaboration has led to countless advancements, such as those made by professor L. Drake Deming and two graduate students who used NASA telescopes recently to discover traces of water vapor on a planet almost 729 trillion miles from Earth.

The partnership also has resulted in new asteroids being named for U-Md. researchers and an alumnus in honor of their work in solar system studies. Protopapa and Kelleymichael were named for researchers Silvia Protopapa and Mike Kelley, respectively, and Matthewknight was named for alumnus Matthew Knight.

"Our partnership has yielded unique interdisciplinary research and incredible discoveries," said Patrick O'Shea,U-Md.'s chief research officer. "Our ongoing research together is not only preparing our country for future space missions, it is improving our ability to monitor and respond to earthly challenges, ranging from floods, forest fires and storms to changes in our planet's lands, oceans and atmosphere."

Goodman said many students come to U-Md. because of its reputation in physics, engineering and

other science disciplines, but he tries to make sciences accessible to students who come for, say, humanities.

He helped spearhead the new $135 million Physical Sciences Complex that opened this year in part to meet campus research needs, as well as offer scientists more high-tech laboratories.

The building has exacting humidity and climate control for labs, in addition to meeting areas. “We have this video wall that shows really cool stuff like images from satellites, and we have a great cafe and good WiFi, which brings people in,” Goodman said. “At finals time, people of all types are crawling all over the place here. We showed the World Cup on our screens for anyone to come watch.”

Other university-Goddard collaborations include the Joint Space-Science Institute, involving the astronomy and physics departments. The College Park and Baltimore County campuses work with the Universities Space Research Association to study neutron stars, black holes and extremely hot gases. There are many other collaborations in each of the departments within U-Md.’s College of Computer, Mathematical and Natural Sciences.

Katelyn Dolan, a PhD candidate in geographical sciences, started working as an intern with Goddard

while she was a student at the University of New Hampshire in 2007. That led to her master's work using Earth-observing satellites to assess how much damage Hurricane Katrina wreaked on forests.

She came to College Park in 2011 and is now a fellow with U-Md. and Goddard's Joint Global Carbon Cycle Center. "If I have a question about a satellite I'm getting data from, there's someone right there I can ask," Dolan said.

Students like Dolan are part of the "pipeline," said Robert Gabrys, director of education at Goddard.

Some students are exposed to Goddard's educational programs as early as middle school and high school. Others come as undergraduate or graduate students, then go on to PhD research there. A percentage of those stay and become NASA civil servants.

"A lot of our interest in working with schools is systemic work, not one-offs. We like to cultivate interest in areas and then move into an internship experience," Gabrys said. "We keep in touch with our high school students once they go off to college."

He said that last summer there were more U-Md. students who were undergraduate interns at Goddard than from any other university. Out of 467 summer interns from across the country, 50 were from College Park, more than double the number

from any other school, he said.

Blanche Meeson, chief of higher education programs at Goddard, said in part that is because of course offerings that dovetail with Goddard research.

“Take satellite remote sensing: Not a lot of schools have undergrad courses in satellite image processing. Most universities don’t teach it, or they’ll teach it in narrow way,” Meeson said, “It’s a relatively new science. To keep the technology up to date is very expensive.”

Last summer, NASA awarded U-Md. and Goddard a $94 million joint grant for a new instrument on the International Space Station that will stream back data about Earth’s forests, including the forests’ responses to climate change and land use. The Global Ecosystem Dynamics Investigation, called the GEDI Lidar, will use a system of laser beams to map the structure of the vegetation. The instrument, expected to launch in 2018, will involve dozens of graduate and likely undergraduate students, and is an important undertaking for the university.

The model of this type of research has led to successes — and surprises — for decades.

One such surprise involved Michael Coplan, who was a co-lead on a project in which he and his students

created an instrument called the ISEE-3. It was launched on a NASA satellite in 1978, successfully collecting data from the space between the sun and Earth. In 1985 it became the first spacecraft to fly past a comet.

By 1997 the ISEE-3 was retired but continued to drift through space as an orphan. Coplan was not pleased that NASA had abandoned it, because he thought it still could have contributed important information. But Coplan was a busy professor and a productive researcher, and he easily occupied himself with other work.

As he prepared to retire this year to professor emeritus, he cleaned his lab to make room to share it with an active faculty member. He came across piles of his old ISEE-3 notebooks and dumped them in the trash.

Days later, he got an e-mail that astonished him. A group of citizen scientists had started a crowd-funding effort: Figuring the ISEE-3 would be making a pass by Earth, the scientists wanted to make contact with it so they could redirect it and give it a new life measuring space weather. And they had NASA's blessing. Coplan hurried to the dumpsters and peeked inside.

"It was all there," Coplan said of his notebooks. "We

were able to extract information from them I never thought would be useful again. But it was."

The scientists were able to make contact with the ISEE-3, but the thrusters failed, meaning the scientists couldn't redirect the satellite. It sailed by Earth and is expected to pass by again in 17 years.

Was Coplan disappointed? Maybe. Even so, he said it was nice to know the ISEE-3 hadn't been forgotten.

"I look forward to coming to work every day," he said. "I realize what a privileged career I've had. I'm thankful for all of it."

Seo, who is working on her ISS-CREAM payload, has a history of taking on students even if they are light on expertise, and even if they have a science background, she often assigns them to an area they know little about.

"They don't know if they're a chicken or a duck, and I don't either," Seo said. "You put them in the water and see if they can swim. I give them an easy task at first and see how it goes."

Her philosophy is that if they're responsible and smart enough, she can teach them.

Such is the case with Angelaszek, her lead software

programmer, who has been working on his PhD at Maryland for four years. He was a physics major and had just one computer science class as an undergrad. But Seo needed a programmer so she put him on the job.

“I definitely found it challenging, because I’m not a computer science major,” he said. “It took two years until I became an expert in the software. I just learned on the job.”

Seo estimates she has had a hundred students over the years working on her ISS-CREAM research, and she has overseen six successful launches on long-duration balloons circling the South Pole. Her latest project, which will measure the composition of cosmic rays over a broad energy range, is scheduled to launch in February or June.

In the end, Seo and her students will see their work in space, and get large streams of data coming back to them for round-the-clock monitoring and analysis. The agreement with NASA is that the ISS-CREAM will be on the International Space Station for three years.

“Then we will ask for an extension,” Seo said. “Our plan is to stay as long as the space station exists. Nothing will stop us other than the approval process.”

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