Laura Jones-Wilson, Ph.D. ’12: From Cornell to NASA to an icy moon of Jupiter



By Olivia Hall

Laura Jones-Wilson, Ph.D. ’12, has long had her sights set on outer space. “I learned about space at an Earth Day celebration when I was five, and as soon as I found out that people had left the planet, I was like, ‘I’m in, let’s do this!’,” she remembered. “I got the word ‘aerospace engineer’ from watching Star Trek episodes, and by early middle school, that’s what I was convinced I was going to be.”

Indeed, that early enthusiasm and determination have carried the graduate of Cornell's Sibley School of Mechanical and Aerospace Engineering (MAE) right to the forefront of today's space exploration. At NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, she currently serves as the payload verification and validation lead for the Europa Clipper mission, expected to launch in the mid-2020s. Jones-Wilson is tasked with ensuring that a variety of scientific instruments are properly tested and ready to study the surface of an icy moon of Jupiter as the 20-foot-high spacecraft makes approximately 45 close passes to determine its habitability.

"There's a certain romance about aerospace engineering," said Jones-Wilson. "Space lets us see how small we are in the universe and the variety of worlds that are out there. Many of us in the industry are really taken by the idea of the 'exploring the final frontier' aspect of our work."

Internships at NASA's Wallops Flight Facility in Virginia and the Ames Research Center in California during her undergraduate years at Virginia Tech first introduced her to the problem-solving skills required to work at the cutting edge of the unknown. "These NASA internships cultivated a can-do attitude and willingness to 'MacGyver' a project into working," Jones-Wilson said.

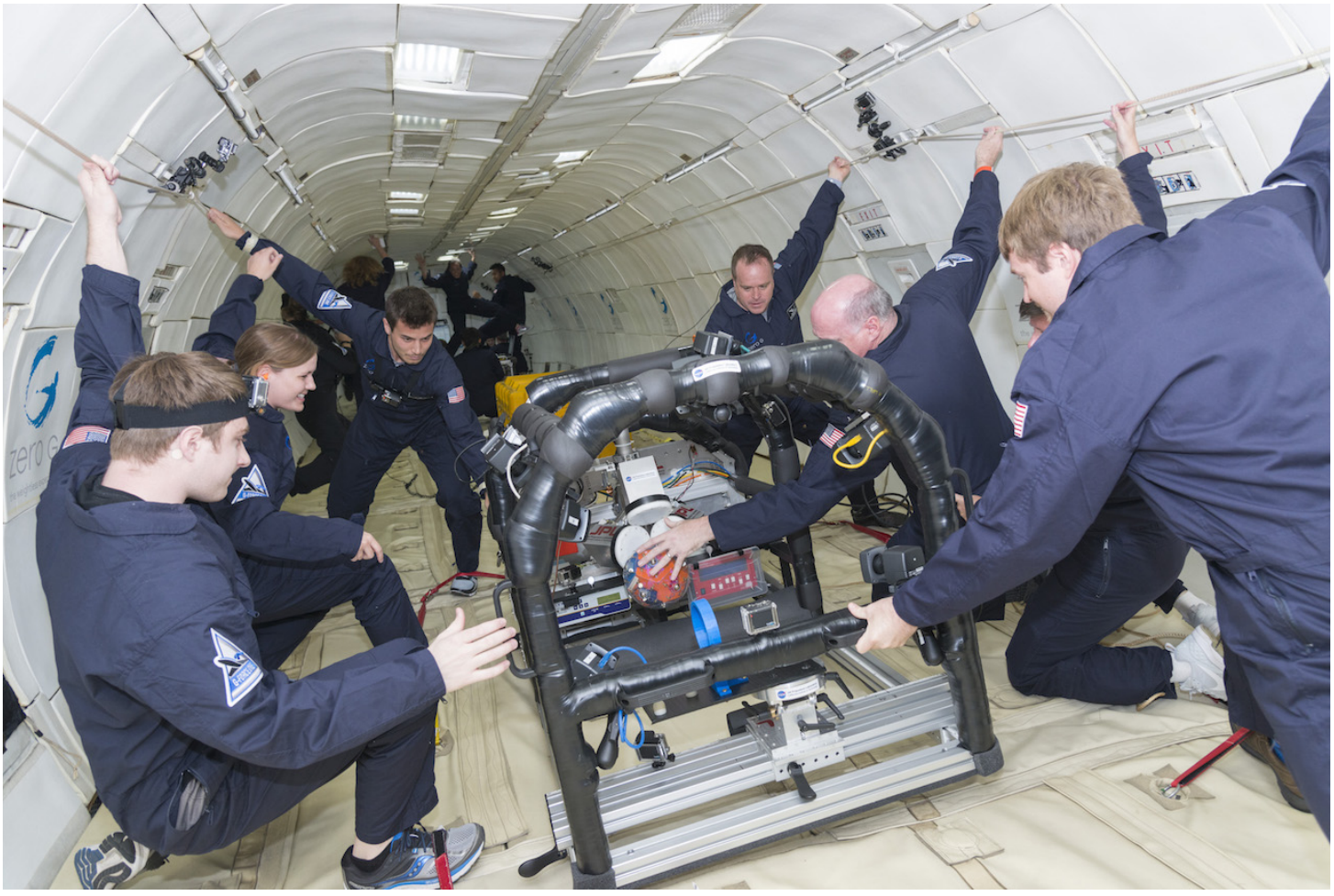
She brought both to her doctoral work at Cornell, attracted not only by the opportunity to work with her advisor, Mason Peck, the Stephen J. Fujikawa '77 Professor of Astronautical Engineering, whom she calls "a visionary in the field," but also by a supportive student body that shared her love for tackling challenges with team work. "Ithaca's gorges also helped," said Jones-Wilson, who enjoys hiking, biking and skiing.

Armed with funding from the National Science Foundation and National Defense Science and Engineering Graduate Fellowship program, Jones-Wilson was free to explore a wide range of projects and technologies with Peck, from small satellites to control moment gyroscope steering laws. For her dissertation, she settled on studying how the phenomenon of magnetic flux pinning might be applied to maintain a specific close-proximity position and orientation between spacecraft without mechanical contact.

"When a type-II superconductor interacts with magnets," she explained, "you can build a magnetic potential well that maintains a stable, pre-selected relative position and orientation between the magnet and superconductor. We can use this phenomenon to levitate the magnet

against a gravity field on earth, but in space we can use the fact that the effect works in all six degrees of freedom to maintain relative position and orientation between spacecraft without the need for an active control system."

Jones-Wilson constructed spacecraft analogues to collect data and better model the flux pinning interface. After first hovering them on a testbed consisting of a sheet of glass with compressed air, she expanded her tests to two microgravity flights at NASA's Johnson Space Center in Houston, Texas, where a modified aircraft temporarily creates a space-like experience of weightlessness during freefall dives from around 30,000 feet. "When you're not constrained by gravity in the same way, you can actually measure the subtle cross-coupling in the dynamics across degrees of freedoms that we were looking to characterize in this interface," she said.



Laura Jones-Wilson, Ph.D. '12, and her colleagues conduct microgravity experiments aboard an aircraft that simulates weightlessness during freefall dives.

To make it happen, Jones-Wilson drew on a broad pool of undergraduate and master's-level talent at Cornell Engineering, from experts at soldering and machining to students focusing on mechanical and electrical design work. "I think at one point I had 20 students working for me,"

she said, “and we were all focusing on different parts of the project. I couldn’t have done it without those teams. It was really empowering to have access to such smart people who were all really interested in the research.”

Jones-Wilson was benefiting from a form of experiential learning — at all levels — that Mason Peck calls a hallmark of Cornell’s programs in aerospace engineering. “As an undergraduate you might expect your time here to include four years, or maybe more if you stick around for the M.Eng. degree, of continuous engagement in a particular project, which I think is rare,” he said. Students get to contribute and take on leadership positions at the level of their abilities, regardless of seniority.

His advisee, for one, “really took ownership of her project,” Peck recalled. “Part of our mission here in advising Ph.D. students is to give them the freedom to be successful — or, I suppose, to fail — on their own terms. And Laura’s tendency to just go ahead and wrestle a problem to the ground is clearly one of her strengths.”

Jones-Wilson also took advantage of the close relationships that exist between MAE and Cornell’s Department of Astronomy in the College of Arts & Sciences. For example, Peck points out, faculty regularly collaborate on large research ventures, and astronomers and engineers come together for summer programs on spacecraft projects.

Like many aerospace engineering doctoral students, Jones-Wilson took classes such as optical astronomy and planetary science and invited an astronomy faculty member, Professor Terry Herter, to sit on her special committee. “Having access to a world-class engineering program and world-class scientists in one space makes Cornell unique,” she said. “It’s the perfect incubator for what JPL, in particular, is looking for: scientists who understand engineering, and engineers who understand science.”

As a result, “the folks who come out of our program are highly sought after,” Peck said, pointing to the fact that both established companies in the industry, such as Northrup Grumman or SpaceX, as well as newer startups, such as Ithaca-based Ursa Space, actively recruit Cornell graduates. Through research collaborations with faculty, these businesses also help to ensure students’ exposure to the practical considerations of contemporary space technology. “One thing that characterizes our program is being at the cutting edge,” Peck said.

For Jones-Wilson, these connections meant a foot in the door with her dream employer. A visit from JPL leaders to Cornell led to conversations, an interview, and ultimately her first job on the Pasadena campus. For the first five years with NASA, she pursued guidance and control work for small satellites. “A lot of what I found most interesting was talking to the scientists about how to effectively get the science they wanted,” she recalled. She found herself looking increasingly for positions in systems engineering, which brought her to a number of different roles for the Europa Clipper mission.

Now, as the payload verification and validation lead, Jones-Wilson finds that her time at Cornell prepared her well for her job. “Being sensitized to a scientific point of view really enriches the work I do today,” she said. For example, the team was having trouble translating the requirements for scientific data collection at Europa in a way that would allow systems engineers to make informed decisions about how to build the flight system. So Jones-Wilson and a colleague developed a framework for these conversations, a kind of “periodic table” of requirements. By mapping science objectives onto the way measurements need to be collected to achieve them, it shows useful patterns that support analysis and reveals potentially missing requirements to ensure a complete set. “The framework ended up really successfully facilitating key science and systems engineering decisions across the whole project,” Jones-Wilson said. “It’s probably the work I’m most proud of to date.”

And while Jones-Wilson thoroughly enjoys her day-to-day work of meetings, talking to colleagues, writing code, conducting analyses and attending science lectures, what ultimately inspires her efforts is an understanding of what they contribute to. “Figuring out in meetings how you’re going to timestamp a data packet really does come out to — how do you know if there’s a saltwater ocean under the ice shell of Europa? Is this a place that could have been habitable? There are a lot of cool questions we can answer if we get this right,” she said.



Laura Jones-Wilson, Ph.D. ’12, prepares a microgravity experiment to gather data on magnetic flux pinning.

Bitten by the planetary science bug, Jones-Wilson plans to continue helping to find those answers. “The scientists have been cooking up some really exciting missions I hope get funded,” she said. “I know that Mars sample return is going to be a big thing — being able to get actual rocks back from another surface and put them through the laboratories we have on Earth would be really exciting. Being involved in that project would be pretty cool.”

By then, she may have already advanced to working as one of the JPL supervisors, who typically split their time between administration and engineering projects. “I could see myself doing that,” said Jones-Wilson. So could her former advisor. “The key features I’d say that make Laura successful are her dogged insistence on getting things right and being very detail-oriented and thorough,” Peck said. “She’s terrific as an organizational leader, and I’m confident that in the years to come she’ll continue to rise through the ranks of JPL or whatever organizations she finds herself part of.”

Jones-Wilson herself is curious to discover where she may end up. “A lot of careers at JPL are made by just following your heart and doing what’s exciting to you at the time,” she said. For now, that is the Europa Clipper mission, though somehow she also finds time to get trained to serve on JPL’s Team A, a kind of brainstorming group of experts to solve “crazy problems;” occasionally stop into the Small Satellites Dynamics Testbed that she co-founded at JPL with fellow Cornellian Swati Mohan ‘04; continue to collaborate on projects with Peck; and help to pave the path for the next generation of aerospace engineers.

“I’m really grateful to the Cornell community for all the opportunities they’ve given me, so I like mentoring students and bringing them over to do internships at JPL to see what it’s actually like to work on big engineering projects at the scale Clipper has,” Jones-Wilson said. “It’s what I wanted when I was five and thought about exploring the cosmos, and now here we are.”

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