INTERVIEW WITH Don Pettit

BY KERRY ELLIS

Astronaut Don Pettit began his career with NASA seventeen years ago and has since flown on three spaceflight missions. Logging more than 370 days in space and over 13 spacewalk hours, he lived aboard the International Space Station for five and a half months during Expedition 6, was a member of the STS-126 crew, and again lived aboard station for six and a half months as part of the Expedition 30/31 crew.

ELLIS: What led you to pursue a career as an astronaut?

PETTIT: As a little kid I remember John Glenn flying, like so many people my age. That sat a bit in my mind: wouldn't it be neat if I could fly in space? Then I forgot about it for twenty years and studied what I was interested in. I did not consciously change my course of study with the idea that it would make me more attractive to NASA. And I tell students this when they ask me what they should study. You need to do something technical that speaks to your heart and excel at it. When I was getting out of graduate school, I suddenly realized I was qualified to fly in space.

ELLIS: What additional advice do you give students?

PETTIT: You have to take the hard subjects in school and be really good at math and science and engineering. The reason for this is human beings aren't meant to go into space. If you put a human being in space, you need machines to take you there, keep you alive, and bring you home, so you need to understand how those machines work and how to fix them. Your life depends on that.

ELLIS: You also play several roles as an astronaut: engineer, scientist, doctor ...

PETTIT: You are absolutely right. Jack of all trades and master of a few comes to mind. Our crew size is small yet we have a large number of specialties. If you had a crew size of twenty-five, you could have a cook, a surgeon, a mechanic, an

electrician, a navigator. You could have all these specialties. But when you have a crew size of six, almost everybody has to be able to do medical, navigation, and cooking. But people gravitate toward things they like to do. For example, André Kuipers was on our mission, and he's a medical doctor. When it came time to draw blood, he did his own and then drew everybody else's. Even though I was trained to draw blood, I didn't have to do it much during the mission—which was great because one of the reasons I'm not a medical doctor is I don't like sticking people. I gravitated toward keeping the galley in shape and making sure we all had food deployed in a manner we could eat and weren't running out of things. Any of us could have done it, but I started doing it at the beginning and kept it up for the whole mission.

ELLIS: You also took on blogging during that mission.

PETTIT: I like to write. I have a hard time writing something meaningful in 140 characters, so my style is to write three or four pages at a time instead of for Twitter. Blogging fit my style. Blogging and tweeting are personal, not a piece of being a crew. If you're interested in doing it, you do it.

ELLIS: Great way to reach the public.

PETTIT: It is. And at the same time it's meaningful. For the diary of a space zucchini, I was telling a story from the view of a third person who was part of the crew while also taking time to weave in the technology needed to keep space zucchini alive, and the trials we had to go through, such as lighting and not having dirt. I started to compost food and use the liquid from the compost in an aeroponic potting system I cobbled up to keep the plants alive.

ELLIS: Was space zucchini your favorite experiment during the mission?

PETTIT: Yeah. There are programmatic experiments—the ones that justify the work on space station—that come up from the ground and are well thought-out and well-planned. There are principal investigators on the ground and we, the astronauts, are more like glorified graduate students doing the experiment on their behalf. The stuff I did, like space zucchini, I like to call opportunistic science. It's science of opportunity.

We do this in research labs on the ground: you do your programmatic science, and while you're there and have off-duty time, you may get an idea. Since you have a lab in front of you, you do an opportunistic experiment on the side. A lot of times these things fail, but every once in a while something really neat will come from these opportunistic experiments. And at ground laboratories, they often are the roots for writing a proposal and getting funding to become future programmatic science. Many times the real advances—the eurekas—come from the opportunistic science. Knowing that is how science is advanced on Earth, I use that model on station. I do the programmatic science for the principal investigators, using all the facilities and expendable resources how they want. Then in my off-duty time, I use extra things, like food and water, little bits of wire, and maybe a few things I brought up in my personal kit to do scientific investigations of my own design. Simply because I was there and I could.

ELLIS: Did any of the experiment results or behaviors surprise you?

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PETTIT: Yes. All the time. For example, I had a weekend coming up with some off-duty time scheduled, and I got permission to use one of the research freezers that wasn't currently occupied. What an opportunity. Now I could investigate things at cold temperatures. So I made ice cubes, and then I looked at the ice cubes under polarized light to see the interlocking crystal grains and how the single crystals of ice formed—their morphology. I made hundreds of these ice wafers and took pictures both in white light and polarized light, and there's some interesting behaviors. It's going take months to go through these images, look at the crystal structures, and see whether there's anything unusual about how ice freezes in a weightless environment.

ELLIS: Are there challenges to doing science experiments in space?

PETTIT: The people who are proposing programmatic experiments have never been into space. They're using creativity and imagination to figure out what would be a good space experiment, but in space the behaviors are foreign to our Earth-mode intuition. We can think of things that someone on the ground would never have thought about. The work that I call symphony of spheres is a great example. Before I'd done this experiment, if I wrote a proposal to NASA and said I'm going to make a fixture of water and put a bubble in it and look at droplets bouncing around in the bubble, I'd be laughed out of the room. You'd never get funding for that. But when you're on space station, you can make a hemisphere of water and put a bubble in it, then inject it with droplets and just see what happens. That in turn advances a whole new series of experiments looking at droplets colliding on the interface and the potential for mass transfer across the interface. It's something that you'd never think about doing if you're living on the ground and you've never been in space, but once you get there, these things just come to you.

ELLIS: What else about your perspective has changed as a result of being in space?

PETTIT: You can use the whole volume of your living space. You can sit on the ceiling. You can set your computer on the ceiling. Or you can just free-float and type on your computer. We originally could put a laptop on a desk attached to the wall of space station so we could type as if we were on Earth. We had been provided a desk on a frame that clamps to the wall, so we could put a laptop on it, then float up to it and put our feet under a handrail to hold us in place, and we could sit there and type. That's just like we use laptops on Earth. But what we discovered is we don't need the desk. We can just fold the laptop in the shape of an L and stick it on the wall with Velcro. But because we're Earth polarized, we think we need to put our laptop on a desk. So they make desks for us to put our laptops on. After a while, you realize you don't even need to have a laptop stuck to the wall. You can just free-float with your laptop. We can free-float and type, and if you get close to the wall, you just give it a push with your finger and keep bouncing around like a slow-moving asteroid in a video game. Being Earth-centric, you think you need your computer on a desk; then you realize you don't need a desk, just a wall; then you go one stage further and realize you don't even need the wall.

ELLIS: What else have you learned?

PETTIT: There's all kinds of lessons in terms of how you design something. How many different screws do you specify torque for, and how many screws do you just say get good and tight? Some things are overly complicated and should be simplified. Some things are too simple and should be made more complicated. There's all kinds of lessons to be learned in terms of how to best equip the crew for getting their work done.

ELLIS: For example?

PETTIT: This was something that happened during my mission. I would have one activity that was maybe two hours. But it wouldn't show up on the timeline as a single two-hour activity; it would show up as eleven little slices of things that needed to be done, and I was obligated to open and read all eleven slices. There might be a five-minute slice of time and it might take me five minutes to open the slice just to read it. The overhead of taking a single activity and slicing it up into eleven separate pieces impedes your ability to get a task done. So I talked with the ground about the issue and they were able to fix it so a single activity would appear as a single activity, and you wouldn't have a fragmented instruction set. We worked together to fix the problem, and after that we had streamlined activities that would be easy to read and orchestrate.

ELLIS: They were able to fix the issue while you were still on mission?

PETTIT: Yes. We have flight director meetings every week where you talk to your flight director and tell him the good, the bad, and the ugly of what went on that week. They listen to you and then they in turn will tell you the good, the bad, and the ugly of things that you did. We work together. Crews try to become more efficient in terms of interacting with the ground, and the ground tries to become more efficient at working with the crew. You have a subteam on orbit—the crew—and a subteam on the ground—mission control—but all together you work in concert as a team that transcends both Earth and space.

ELLIS: So being an astronaut requires not only hard training but also being generally curious and willing to learn?

PETTIT: That, and you have to be able to laugh when a change comes about because change happens all the time. NASA changes the name of the game. We don't do everything the way we learned two years ago because now things have changed. This happens all the time—both in training on the ground and on your space mission. It's just the way of life when you're dealing with the frontier. Space station is in a frontier. It's a place where mistakes can cost you dearly. It's a place that's rich in discovery.

ELLIS: What do you enjoy most about being part of that frontier?

PETTIT: I like all phases of it. The training is long and arduous, but it's the next best thing to flying in space. And flying in space is what our job description is. Training can be grueling. It can wear you out over time, but it is blissful fun. Because after you do all this training, you get to fly in space. It doesn't get any better than that.

ELLIS: What's the most difficult part of being on that frontier?

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PETTIT: The most difficult part, and this is always the same answer, is being away from your family. I call it the explorer's dilemma. When you are home with your family, you have this desire to journey off to the frontier. And when you're in the frontier, you have this intense desire to be with your family.

ELLIS: Is it any easier with Internet on station?

PETTIT: Actually, we don't have Internet on station. We have a pseudo-Internet. We have e-mail, but it's not continuous. We get e-mail drops during the day. I send an e-mail out in the evening, and it might be a day or two before I get an answer. But we have great communication. We get a two-way video meeting with our family once a week, so you can stay versed with what's happening with your family. My sons were doing a piano recital during a mission and NASA was able to uplink the video so I could watch them. We have stayed connected now in this era better than any time in the past. Even though you are away from your family, you can maintain this long-distance connection. And perhaps that's the next best thing to being there.

ELLIS: What's coming next for you?

PETTIT: I'm just starting on my ground assignment. I'm flying a desk right now, in NASA vernacular. And I'm back in line for spaceflight. I still meet all the medical requirements and I'm interested in flying again, so I'm in line. It's a long line, and it's moving slow. But it's a good line to be in.