EXPEDITION 42/43 CREW INTERVIEW
SAMANTHA CRISTOFORETTI – FLIGHT ENGINEER 5

Q: Why did you want to be an astronaut?

A: I like to say that it was not me who made the choice. It's not like I chose space, but in a way, I was chosen, because I cannot really find a moment in my life when I made a conscious decision. In a way I always knew that I wanted to travel to space and that goes back to early childhood so it's maybe just a shortcoming of memory, I don't know. Maybe I just don't remember that moment. But for me, and also listening to my parents and other adults, I just always said I want to go to space at some point. Maybe I did not even know that there was such a thing as an astronaut but I knew that I wanted to explore space. I wanted to fly up there. I guess that is probably what distinguishes a passion from an interest. An interest is maybe something you choose but a passion, you are somehow chosen.

I would like to find out more about the background that engendered that passion. Tell me about your hometown and your childhood and what your life was like growing up.

I grew up in a tiny village in the Alps in Italy. It is like a tourist resort, so my parents had a hotel which was a pretty demanding job. People came in summer for some relaxing time in the mountains and in winter mainly to ski. So summers and winters were bustling with life and then the off seasons, like spring and autumn, were extremely quiet in this mountain village. And my life was quite the same. In summer and winter there were a lot of people coming to the hotel which meant new kids to play with, so I got used to, from an early age, meeting new kids all the time and playing with them for a while and then they will be gone and there would be more kids coming. And then off season again it would be quieter. I was very close to nature, especially in summer with the good weather. I was very fortunate to enjoy a childhood in which you can roam around, as a child, unsupervised. You do not have adults with you all the time. You can go and run around and explore and think that just crossing a bridge is really exciting because you are on your own without adults, or going to explore the river. Maybe I even did things that were dangerous and maybe an adult there would have said, hey, don't do that, but it is part of, I think, a valuable childhood experience that you just experience things on your own. Maybe that is where I got the taste for adventure that I think is very much part of that desire I always had to go to space. The other thing is that when you grow up in a mountain village there is very little light pollution so the night sky is something that is very present. There are a lot of stars that are visible. I think in my village around midnight they would turn off most of the street lighting, which was not much anyway, so the night sky and the stars have been a very strong presence in my childhood. I always liked to read and I was very much encouraged by my grandmother, who taught me to read at a very young age. I always loved to read science fiction books and, generally speaking, adventure books, so I think that helped, too. I had really good teachers in elementary school. I actually attended elementary school in this village, and then I went elsewhere and I think I had a very good schooling in my initial years. In the fifth grade we had, at least at that time in Italy you started to teach kids about astronomy and planets and the moon and the sun and I had very good teachers who sparked that interest in me.

Did I understand that at least for part of your high school you left the country?

I was in the 11th grade when I decided that it would be cool to spend the 12th grade somewhere else. That is an option in the Italian school system. It is like the second-to-last year of school, you have this organization that offers you the opportunity of becoming an exchange student for a year, so I chose to come to the United States. Mainly I was very interested in the country itself—again, it was the country that had the most interesting and exciting space program and the country of *Star Trek.* I was also very interested in improving my knowledge of the English language, so I spent a year in a high school in St. Paul, Minnesota, and then went back to Italy where I completed high school in Italy.

And after that on to college. Tell me that story and how you got into the air force and ultimately to the astronaut program.

I debated for a while whether I wanted to study physics or engineering. It was like my two big interests growing up were science and technology. I decided eventually to become an engineer and I decided I wanted to go to a different country just to, you know, master a different language and just to have that cultural experience. I was always extremely interested in languages and just the fact of experiencing different cultures, not so much in traveling. I mean, I like traveling, too, but I liked to find ways of actually living in a place or somehow share in the experience that the local people live. So I ended up not going very far. I went to the University of Munich in Germany and studied aerospace engineering there. It was a wonderful experience and I think a really good education. While I was there I also had the chance of participating in other programs so, for a while, I did a research project in southern France at the SUPAERO in Toulouse. And then I was always interested in Russia and, of course, I knew that Russian was a very important part of the space program, too. I had first attempted studying Russian back in high school but that had not been very successful. And then it did not look there was an exchange program between Munich and any Russian university, but then, for a twist of fate, eventually I found a professor in Italy, who actually had a good connection and a tradition of sending students to this university in Moscow, so I was able to do the research for my final thesis at the Mendeleev University in Moscow. I spent about eleven months in Moscow between 2000 and 2001. Throughout all those years I was actually thinking about this other passion that had caught my heart which was military flying. Now strangely enough, the Italian military had not accepted women until the year 2000. So in the mid-1990s you could hear talk about a law that soon will allow voluntary military service for women, but this law did not come and I was getting older and older. Normally the age limit to join the academy as a pilot is 21. So at some point I turned 21 and then I turned 22 and that law had not come. And then again, with a twist of fate, when the law finally was passed in ’99 there was a clause that said for female candidates we are going to extend the age limit by three years, so 21 became 24. That was just the fraternization period for the first three years. They wanted to help women out who had waited for so long, like me, so I was actually able to finish my engineering studies and that was that year I spent in Moscow. While I was there I also applied to the air force academy. I had to actually come back a couple of times to do part of that selection process and then basically it was back to back a big rush. So I finished my engineering studies, turned in

my thesis, and almost the next day showed up at the air force academy for my studies there. In a way it was, it was not an obvious choice because in a way I was throwing away my engineering studies fully because I had to start again from scratch with colleagues that basically were out of school and, and so do undergraduate studies again, but in the end it was worth it. So I spent four years there and then went to the United States again for pilot training where I got my wings at Sheppard Air Force Base in northern Texas, which is a NATO school. Then I went back to Italy, had to wait a little bit for further training, and then I did my operational conversion on the AMX which is a single-seat light attack combat aircraft. Then for another twist of fate, pretty much at the same time as I was doing my operational conversion, which is a very, very demanding and selective training, at the same time I was going through the selection process for ESA [European Space Agency], which in a way was a pity because I was again giving up my operational career that was just starting, but in Europe we just do not have selections that often or that regularly. So, in a way, I really felt it was a once in a lifetime opportunity and I had to grab it. That process took a year and then eventually I was lucky enough to be one of the six people who joined ESA as astronauts in 2009.

Was that astronaut selection something that you knew about and applied to or had you just put in an application hoping there would be a selection coming up?

No, there is no unsolicited application. You have to wait for a selection to come up and there had not been one for 15 years or so. I was not somebody who had a lot of connections in the space business, I mean, none at all, so I did not have any insight into when a selection was going to come up. I was in a very demanding training program in the air force, fully engaged in that, and I was very happy in doing what I was doing. But then this news came out and the selection was open, and again it could be another 15 years until the next one comes around, so I really had to grab that chance.

Now that you are an astronaut, do you feel that you are going to be a role model for other European women who have an interest in this field?

That is a question I get asked a lot and in a way I really hope to be a role model for *anybody* who is interested in this field. I don't think the experience is that specific; I mean, there might be some gender connotation but the experience is so specific that you have to compartmentalize your role-modeling role. I think growing up I have looked up to men and women equally and tried to learn from other people who I felt could be role models, something that I could apply in my life. Now, of course, what can be especially important for women is that it can be encouraging to see that women can do that and in fields where there are not that many women it can be quite important, actually. That is certainly a privileged position to be in.

To have this job and to fly in space as you are about to do means that you are accepting some unique risks that most people do not have, but I assume that you think it is worthwhile since you are doing it. I want to know why. What is it that you think we are learning from flying people in space that makes it worth taking that risk?

First of all, I'd like to say, you always weigh the risk that you are taking against how much you want something. For example, you know there is a risk involved in driving on the highway and to go on holiday but you take that risk because you really want to get to that vacation place and so you think the risk is acceptable. I think for most astronauts, and certainly for me, the desire to be part of this is so strong and is so engrained in who I am, it is so part of my identity, that I would probably just take any risk because it just doesn't compare to that desire that you have to participate in this adventure. Overall, of course, if you look at it from the outside and you want to do a cost/benefit analysis, I am one of those people who thinks that even without going down into details of what is the benefit of this, what is the benefit of that, I think there is a sense of destiny in this whole idea of space exploration. I mean, if you ask anybody to imagine humanity in 500 years, do you imagine humanity being still Earth-bound, like we still are not able to go anywhere else? I mean, I think we all intuitively, spontaneously imagining humanity as being able to travel in space, travel to the moon, travel to Mars, travel to asteroids, live there, exploit resources, go on vacation, do all the things that human beings like to do once they have conquered a place. So, to me, it is being part of the first step towards that future that is so obviously part of what is coming for humanity. One other thing I would really like to say is that it is very long term and it is difficult. As human beings, we have a little life span of like 70 years, 80, a hundred, but, you know, if you try and expand to a bigger time scale and think of humanity's presence on Earth, it is dangerous to live only on one planet. So, one day, when that big asteroid comes or whatever, we are going to be happy that we have learned, starting today, how to travel to other places.

You and your crewmates are next in line to launch to the International Space Station. Tell me what the goals of this flight are and what your job is going to be on this mission.

The International Space Station is this incredible permanent laboratory on low Earth orbit where we can do research in microgravity, so the job of any crew that shows up on station is to continue this scientific research that happens on board. So we will continue experiments that have been running for a while. Sometimes we will wrap up a particular experiment and in some cases we will start a new experiment or several new experiments and that is especially exciting, of course. But then we will also take care of the space station: we will do maintenance work, we will do logistics work, we will take care of cargos coming and leaving, some of us might go on spacewalks, we will do robotics work. And interestingly enough, we will be up there at the beginning of the major reconfiguration work that will take several expeditions and that will set up the space station to be able to run even more robust operations for several years to come.

Is that reconfiguration internal or external?

There is some internal reconfiguration going on, but the main goal is really to move around a few modules, especially the logistics support, so that the arrival and departure of cargos is going to be more flexible. We will be able to host multiple cargo vehicles at the same time.

What are you looking forward to the most about seeing once you get there?

Lots of people would say, I think I will run to the Cupola and watch the Earth and, yes, I am very much looking forward to doing that but, to be honest, after so many years of training and the space station being so much part of my daily life, I am just looking forward to seeing the actual space station, to see it when you approach it, to see it coming up as a light dot and then becoming bigger and bigger, and then you start seeing the features, and then I can see it on the camera or peeking on the periscope of my commander in the Soyuz. I can see the actual image and it becomes greater and greater and make out the details and you end up seeing the solar panels, the stack, your actual docking port. And then actually getting inside, and I just look forward to go ahead and discover all the details of this incredible outpost of humanity in space that, again, has been so much a part of my life. I feel that I know so much about it and I am really looking forward to actually seeing it with my own eyes.

And you are going to be the first female European astronaut to serve as a crew member on board this station. How significant is that for you personally or for the future of European women in space exploration?

I think, as you rightly say, there are two aspects. There is your personal point of view and there is the significance that this can have for others. I do think I am in the position of serving as a role model for young girls and young women in Europe who may be thinking of pursuing a career like this, which is simply a career in science or technology or in military flying which are parts of my background. I think that is important. I think I am in a privileged position. On the other hand, from the personal point of view, I think you have to keep your feet very much grounded and realize you are just a crew member like everybody else. There is no special badge of honor associated with being a female. There is nobody out there trying to make your life harder because you are a female so you try to do your job as well as you can, like everybody else.

You are going to arrive at the station just a few weeks after Alexander Gerst comes home. There must be some significance to the fact that ESA will have an astronaut on board, essentially, for one continuous year.

Yes, and that is a first and I think everybody in the space business in Europe is very excited about it and I really hope that we are able to get the public excited about this as well. I hope, in a way, that the public, just Europeans, get used to having fellow Europeans in space and that they get this feeling because Europe has been a major player in the space business for decades in many aspects, not only in human spaceflight but also more in other fields. But astronauts attract attention and curiosity. The fact that there are actually human beings going up there, that is just fascinating. Everybody is interested and excited about this so I hope, as I said, that people just get used to this thought that there are fellow Europeans in space and get a taste for it and maybe want more and more of Europe in space.

Now that space station assembly is essentially complete, the emphasis is really on the science that is being done up there right now. How do you explain to people the significance of or the potential of what we can learn on board the space station?

I think the main point is that it is extremely unique. It is an extremely unique environment. Microgravity, which is a fancy word for weightlessness, in the end means that you shut down, you eliminate, the effects of gravity. Mind you, there is gravity in low Earth orbit, we are just not that far from Earth. I mean, the gravitational pull of Earth is still about 90% of what it is on the Earth's surface, but the fact is that we are on orbit, so we are essentially free falling, shuts down, eliminates the effects of gravity, and that is the only way we have to do that on a long-term, permanent basis. You can do parabolic flights and for every parabola you will get maybe 20, 22 seconds of microgravity. There are drop towers where you essentially drop something from a certain height and then for a few seconds, while it drops, you will have some microgravity. There are sounding rockets that will give you a few minutes of microgravity. But to have permanent exposure to this very special, unique environment for research, you have to go to the International Space Station. In human physiology, of course, you have basically learned so much about how the human body functions on so many different levels, I mean, the whole body level when you use astronauts like me as subjects, but then you can work your way down to single systems and all the way down to single tissues and cells: how do cells react to microgravity, all the genomics effect, gene expression. We are really tackling these issues at all kinds of different levels and learning so much about how our human body functions. Then there are the physical sciences. There are so many phenomena where it is hard to study them on the ground because gravity masks some effects, or makes it really difficult to observe some phenomenon because they're masked by gravity, because gravity is a very strong force. So by eliminating those effects all of a sudden other phenomena become observable and you are able to measure and quantify and learn and write equations. It seems very abstract but, in the end, down the line, it might mean that you have developed a lighter material for your car engine which means that your car is lighter which means that when you go to fill it up you are going to just pay a smaller bill.

So are we learning things that have an impact to those of us on the ground?

Yes, yes, I think so. Some things are down the line because it is fundamental research. That is the case for any kind of fundamental research. You just have to learn things and, based on that knowledge, other people, sometimes in the very short-term future, sometimes it takes a while, will invent new technologies to make our life better based on that knowledge that we have gained. But some of the research we do on the space station nowadays has actually pretty immediate applications and that is why, for example, there are not only public research institutes that now research on the space station but we also have some commercial research projects.

As you mentioned, one of the big areas of research is finding out how that environment affects the human body and to try to figure out ways to counter the negative effects of it. In March the station program is going to be sending two crew members up there for a full year to try to learn more about it. You are going to be

one of the people on board to greet them when they arrive. Tell me your thoughts about the year-long mission.

It is exciting, I think, from a research point of view. I think the research community is extremely happy to get this opportunity to actually observe those changes due to microgravity on the human body for a longer term and we might do this again. The first ones are, indeed, Scott Kelly and Misha Kornienko, who will join us on the space station this upcoming March. You also have the perspective of the crew, so you know that you have these two fellow crewmates coming up and they are going to be on board for one year, and as exciting as this is, we also all recognize that it is not easy to be gone for an entire year so, as crewmates, I think we recognize the importance of getting them started on the right footing and supporting them as much as possible while we are on board with them.

If it comes up later again, would you like to make a year-long trip yourself?

It's hard to say for sure. I haven't been up there at all, even for six months, but it does seem pretty exciting and instructive as a perspective.

Give me two or three examples of the experiments in this area that you are going to be working on as we try to learn more about how the weightless environment impacts human beings?

These are actually the experiments that, as astronauts, we know the most about because we are the subjects and so we are trained a lot to perform those experiments. There is one called Drain Brain, which sounds a little bit scary, but nobody is going to drain our brain. The point is to gather data on the venous flow out of your brain. We are used to thinking about the blood supply to your brain, but that blood, the venous blood that flows back to your heart, is actually equally important. It is a pilot project and there might be more done on subjects in the future, but for now the idea is to gather initial data about how microgravity affects that and also to develop a very simple, non-invasive, operator independent system for measuring this venous blood flow. This, of course, has immediate applications on the ground for people who unfortunately have insufficiency in their blood return and it would be very important to validate a technology that makes it easier to monitor their condition. Another one is about sleep. We have known for a while that astronauts' sleep on the space station is not optimal. Most people tend to sleep not as well as they do on the ground. There are continuous micro-wakenings throughout the night, much like people who have sleep issues on the ground, and there is a theory that it might be related to modifications in the mechanics of the heart. The heart is a pump with valves and it pumps all the time. Microgravity might have an effect on these very fine mechanics of the heart and this might be what is causing, in this hypothesis, these micro-wakenings that disturb the sleep of astronauts. So I will be wearing, for several nights in a row several times throughout the mission, a special shirt that has a series of sensors on it and also has like a three-access accelerometer that will be in contact with my sternum and will observe the mechanics of my heart beating while I sleep. Another very interesting one that we are going to start during our mission is going to be Terry Virts

and me as the first two subjects and then, hopefully, it will continue in the future. It is called Airway Monitoring. It has rather complex experimental setups so is quite challenging. The first experiments will take place in the airlock because we will have to do part of the protocol at the reduced pressure, so it will be Terry and me in the airlock and we will reduce the pressure to about 10 psi [pounds per square inch] and do a series of measurements. The point there is to measure the mechanics of the gas exchange in our lungs and it has, of course, implications for fundamental science. We want to better understand how this gaseous exchange functions and then also validate again some measurement technologies that can help people on the ground who have issues with breathing diseases like asthma which is, unfortunately, extremely widespread on the planet.

The crew members are also working on other experiments in other different areas of science beyond human life sciences. Can you tell me about two or three of those experiments that you are looking forward to taking part in?

There are two areas. One area is that of the life sciences that do not observe the human body as a whole but rather use, for example, cell cultures. There is one called NATO [NAnoparticles based countermeasures for Treatment of microgravity induced Osteoporosis] that will bring to station cultures of bone cells and the idea is to test the effectiveness of some specific nanoparticles in preventing bone reabsorption. We are used to thinking maybe, unless we know something about it, that bone is something stiff and rigid, and we are maybe not used to thinking that it is actually a living tissue, but there is a lot going on there. So the bone is constantly reabsorbed and then reformed in the body, and we rely on this balance between destruction of bone mass and production of new bone mass. In space, and unfortunately on the ground with people with osteoporosis, this balance is disrupted. So we are trying—of course, we have a lot of countermeasures based on exercise—but it is very interesting to try and look for pharmacological countermeasures, so this experiment will look into the effectiveness of these particular nanoparticles in actually diminishing the reabsorption of the bone and so tipping that balance between absorption and production in our favor. The other area is physical sciences. A lot of the physical science experiments on board, you have to be fair, run very much automatically, not requiring a lot of crew interaction. So a lot of time in our training we will be trained on a facility, let's say the Material Science Laboratory, and then, we will be taught, for example, how to change a cartridge. As astronauts, we do not always have a lot of insight in the details of an experiment, but we have to be the hands. We are not scientists necessarily on board, we are like lab technicians. We have to lend our hands to the scientists to physically do a few tasks that, of course, cannot be done from the ground like, for example, changing a cartridge. But once you have done that and you have made sure that everything runs properly, then they can run the experiment from the ground. Sometimes there is a little bit more involvement like, for example, there is an experiment called BCAT [Binary Colloidal Alloy Test], which has been running for several years but with different samples every time, and there is a lot of interest from industry in this field of colloidal physics. There is a little more astronaut involvement in these types of experiments because you actually have to go in and shake the sample with a magnet and then you have to set up a camera in a very specific way so that it can take

pictures at a certain interval, and then the scientists will actually observe those pictures to understand the details in microgravity of colloidal physics.

We sometimes hear station crew members talking with the investigators on the ground in circumstances, I think, that are somewhat like what you have just described. It must be pretty interesting, pretty neat, to get to work with these brilliant people on this science.

It is one of the privileges of being an astronaut that you really work with, I would say hundreds—maybe it's more—of people who are really top experts in their fields and it is a unique position which are in. Sometimes we are actually so busy absorbing information that we do not take full advantage of it, like sometimes I find myself thinking, I just spent 30 minutes talking to that person but if I had had a chance to meet this person years ago when I plenty of time and not so many opportunities, maybe I would have tried to talk to him or her for hours asking questions, but in our life, the way it is set up right now, you talk to him or her and then you move on to the next person, so, in a way, it is unfortunate because you do not take full advantage of these opportunities of interactions you have. On the other hand, as you say, it is an incredible opportunity.

Besides the work that you do with science experiments, the crew members on board are responsible for making sure that the station keeps operating. Tell me about some of the other kinds of work that you do on board during a typical day or week.

The station has to be kept in a good functioning state, so there is normal maintenance that you have to do. It is just like your car, like periodically every so many months you will bring it in and the technicians will take care of replacing certain parts that need to be replaced after a certain time. The space station is the same. There are specialists on the ground that keep track of how often you have to do a specific maintenance on a piece of equipment and, with the station being so big and so complex, there is a lot of that going on. Now unfortunately, of course, sometimes there is also a situation in which things break and then again, as crew members, we work closely with the ground. We describe as much as we can the situation—what broke, how does it look, are there any weird smells, do I have a suggestion on how we could fix it. We take a lot of pictures; the ground teams love pictures, and then, all together, we come up with a solution and we try to fix it. Sometimes occasionally something will break outside and then we actually even have to suit up and, and go outside on a spacewalk to go and fix something. Now that, of course, becomes quite a bit more complex but as recent history shows, the program is actually capable of turning around very quickly and reacting to a failure outside.

Those are what are called contingency spacewalks: something is broken, we have got to go outside. There is a plan for spacewalks during your time on orbit and, although that may change, as these things tend to do, what is the plan for spacewalks during your six months? Who is going to go outside and what are they going to be working on?

The plan is really in flux for our expeditions so it is really hard to say. If you had asked me a month ago I would have told you Terry and Butch Wilmore will go outside on two spacewalks and I will be the IV, the intravehicular support person, who will help them run on the airlock ops and suit up. The plan is for them to deploy a few very long cables that will support the station reconfiguration that is upcoming in 2015. The plan, however, is very much changing every day so we are all perfectly trained to go out on a spacewalk and I think we are ready to perform anything that the space station program would require from us.

That would be exciting if you get to go outside.

I think so, yes, it would be very exciting to go outside. The training already has been very challenging and I think mainly because it was so challenging it was also very rewarding and interesting and, of course, to be able to actually use that training and go outside would be extremely exciting.

You are going to be on orbit for the 50th anniversary of the first spacewalk, by Alexei Leonov. Tell me what you think about how important spacewalking has been to our efforts to explore space.

Well, there would not be a space station if we had not had spacewalking capability. I forget how many hundreds of EVA, extravehicular activity, hours have been put in to actually put the space station together and there were extremely complex spacewalks, especially during the assembly phase where mainly shuttle crews would perform spacewalks. They had a lot of pool time under water specifically for that one spacewalk, so they were extremely efficient and capable of performing very complex, what I like to call, choreographies. Nowadays, of course, we have shifted the attention more towards skills because the plans change quite quickly and it is quite unpredictable what a station crew will actually do. Sometimes the plans change after the crew has completed their training time here in Houston and sometimes they change while they are on orbit. Sometimes there is a need for a contingency, so we have shifted the focus from training very hard and thorough for one specific EVA content towards being extremely flexible and having basic skills that allow us to then perform any kind of EVA that might be required. Of course, we are not going to be as efficient as shuttle crews used to be when they were very specifically trained for an EVA, but that allows us to face any possible task.

These days the space station is getting supplies from a small fleet of uncrewed cargo vehicles. Tell me about the different international vehicles that you expect to see during your time up there.

We see a lot. I think the only one that we will not see is the Japanese HTV [H-II Transfer Vehicle] but, other than that, when we get on board there will be an ATV [Automated Transfer Vehicle] docked, which is ATV-5, *Georges Lemaitre*, which is already on board and docked. An ATV tends to stay quite long on the International Space Station because it also serves for reboost purposes, so the longer we keep it on board the more we can save the other resources for reboost. So it will be on board and I will have the privilege

of supporting the undocking and departure ops for what will actually be the last ATV as we are wrapping up the ATV program. It will be interesting because the re-entry of ATV this time will be very special. We are actually working towards gathering information for something which is still far ahead in the future but it is going to be very challenging which is what do we do with the space station once we are finished operating it? It has to re-enter and it has to re-enter safely and it is obviously the biggest object ever to re-enter the atmosphere and come back to Earth. So the teams have recognized that there is a need to understand better the property of the atmosphere in certain layers to be able to better predict how the station will react, how it will slow down, how it will break up, because, of course, any pieces that do not fully burn up we want to end up in this specific area in the Pacific which is identified for re-entries like that and not, of course, to end up in random places. So to make absolutely sure that we understand this fully, we are going to guide ATV through a shallow re-entry that should mimic what the re-entry of the space station will be at some point in the future. We will have, I think, a hundred or more cameras set up to record this, partly from the space station and partly from the ground station and also ship-based stations on the oceans and there will be some experiments inside the ATV that, in part, I will set up to observe the breakup. I think there is even a camera in there that will actually record from inside the breaking up of ATV so we will have images of that and those will then hopefully survive the re-entry and be recovered. That will be definitely a very interesting time.

You mentioned this is the final ATV that is in the plan. Has this program met the goals that ESA set out for it?

Oh, I think so, definitely. First of all, in terms of the ATV, all five of them, have been extremely successful in the performance on their missions, exceeding all expectations. One of the peculiarities of ATV is its ability to dock in a fully automatic way. That is not the case with the other vehicles, Dragon or Cygnus. They come close to the space station, put themselves in a sort of formation flight about 10 meters from the station, and then the astronauts, the crew members, have to grab them with the robotic arm and then berth them to the space station. The same thing happens when they depart. We actually have to unberth them with the arm and then they will give a burn and leave. ATV does all that automatically. We will still observe it from inside. We are trained as crew members to monitor the rendezvous and intervene if something goes wrong, but there was never a need to intervene. In fact, all ATVs have come in extremely, extremely precisely and with a precision within the order of magnitudes of centimeters. So that is a very interesting technology and very important, instrumentally, for future exploration. If we have to build something in the future in orbit that has to build itself automatically and then maybe be ready for a crew to come in, this ability to dock with extremely high precision is very important and ATV has definitely proven that is possible. ATVs have supplied about seven tons of cargo to the space station on each flight, so the program is definitely a success.

What are you most looking forward to about this experience?

I could think many things but I think it would be diminutive. I think what I am really looking forward is to the experience as a whole, to turn myself into a space human. We are all born on this planet. We grow up, our parents and adults in our lives help us into becoming adult human beings and we are all adapted to be Earth-bound human beings. By the time you are my age, I am a mature adult, we are all very adapted to this and there are very few surprises. Then you find yourself in this completely different environment where you float around all day and it just seems, well, it has this fun component. You are floating around all day, but it also means that you have to relearn a lot of basic skills from the really basic skill that a child has to learn, how to use the restroom, the toilet. You have to relearn that and, and I am pretty sure it is going to be challenging in the first days. How to set up your work environment, how to organize your life, and it is not only the microgravity, it is the space station environment. It is quite complex and I think at the beginning there is a pretty big learning curve where you kind of put together all the things that people have tried to teach you over the years, but also the things that you are learning day by day from your more experienced crewmates or just by making mistakes, I guess. And then I think you progressively turn yourself into this human being who is adapted to living in space and living on the International Space Station. People say that it takes about a couple of months until they sort of reach where that curve sort of flattens out and I am just looking forward to experiencing that and observing myself as I grow into a space human.

As you think about what you are going to do, what would you say it is that we are learning from these missions to the International Space Station that is helping prepare us for future exploration?

I think quite a lot, actually. Sometimes people, especially if they are not too familiar with the space program, will look at it and say, oh, we, we went to the moon in the ’60s and then, what have we done since then, we never went as far again. I like to actually challenge that point of view because, yes, it is true that it was this great human adventure, Apollo, and going to the moon in the ’60s and early ’70s. However, those crews stayed for a very short time and came back, all of the time not quite being sure whether it would work out or not, with a pretty big risk factor. What we are doing now, what we have done in the past 15 years, is robust operations. We have learned how to conduct operations in low Earth orbit in a continuous manner for 15 years with an increasing level of complexity. I mean, people really should not underestimate the complexity of the space station, the space station environment—the technical complexity of this huge outpost of humanity in space. It is just amazing. It is worthy of a science fiction book…and the fact that we can run robust operations for so long *and* involving so many international agencies and countries. If we want to conduct further exploration in a robust manner, those are all lessons that we needed to learn, and I think it will be invaluable for anything we want to do in the future in terms of exploration.