# Chapter 4: Chasing That Sparkle of Passion

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Don't blink Annalisa, don't blink! My full attention is sharply focused on a single point. It looks like the Sun is getting squeezed between the sky and the horizon; the atmosphere distorts it and pulls it on the sides, then the sun pushes down to a single point. I gasp. Was that green? I turn my head around, nobody there, no one to confirm what my perception had suggested. The grand Atacama Desert all around me, and behind me the gentle giants, the Very Large Telescope, in a frame of marvelous colors. The sky and the desert will soon merge in the darkness of the night, and the center of our home galaxy, the Milky Way, will appear in all its majesty and fill my eyes with its glowing bulge and cosmic dust lanes. But that's for later. For now, back to the control room, quick. One of the giant four telescopes is waiting for me, Kueyen, which means "moon" in the native Mapuche mythology. Back to the many screens on which I monitor potential scientific projects, some technical aspects, and the atmospheric conditions, like the air turbulence, which make stars appear less sharp. The telescope operator is assisting me; she is an engineer responsible for the telescope itself. As a night astronomer, I'm responsible for the science plan and the scientific instruments: X-Shooter, which I like to think of as a goldfish, because it can see simultaneously in visual light, near infrared (redder than red), and near ultraviolet (bluer than blue); UVES, the eagle, because it can decompose light in its frequencies with a very high resolution; and FLAMES, the octopus, because it can observe several targets at once thanks to its multiple "arms." Everything is ready, the goldfish, the eagle, and the octopus, and I have a plan for the night. The telescope dance starts smoothly, target after target, securing high-quality obser-

vations that the astronomer community will use. I roll up my sleeves; we are going to do science tonight.

We have just started the observations of a new target, when a loud alarm goes off throughout the whole control room. Not an earthquake. This time the universe is calling. Countdown has started. The Rapid Response Mode is a system to react promptly to gamma-ray bursts, which are the most energetic explosions after the Big Bang and are associated with the violent death of very massive stars, and we automatically move and point the Very Large Telescope to catch this explosion quickly. In a few hours it might be gone forever. The light from this tremendous explosion took maybe billions of years to reach us, but now we have to be quick to observe it. Three, two, one . . . We got it. These very luminous sources can act as cosmic beacons to suddenly illuminate their very distant host galaxy, which would otherwise go unnoticed, so we can study it in fantastic detail. In my scientific research I like to use these and other sources to study the chemical composition of gas in galaxies, which is a fundamental component for galaxy formation and evolution, from our home galaxy, the Milky Way, to the most distant universe. Stars are formed from gas, and they in turn create many chemical elements that we know, such as oxygen or iron. And then many of these stars will explode, returning their material to the gas form, the so-called interstellar medium. A new generation of stars will be born from this gas, upcycling all the chemical elements that were created by the previous generation.

Science is my driving force. I used to focus mostly on very distant galaxies, things that we could barely see even with our most powerful telescopes, using some bright sources in the background. And because they are so distant, it was difficult to understand their chemical composition, especially because there are particles of cosmic dust that complicate the picture. So, I developed a new way to study gas in galaxies, focusing on the relative abundances of different chemical elements. A few years later, I realized that a similar technique could be useful to study our own home galaxy, the Milky Way. Until then, everyone had assumed that the chemical composition in the gas of the Milky Way was uniform, because the Milky Way rotates and can mix the gas. But,

because of the presence of cosmic dust, nobody had attempted to actually measure it. So, I tried, and I found that, surprisingly, the chemical composition of the Milky Way gas was not at all uniform, and that there had to be chemically poor gas coming from outside the Milky Way and feeding new star formation. I published this result in the journal *Nature* in September 2021, as the lead author. But the craziest part of this publication was actually its submission.

It was a cold Monday morning in December 2020. I was nine months pregnant, due to give birth exactly one week later. In that week I was supposed to have several interviews for a professorship at the University of Geneva. Along with the interviews, I was supposed to also give a public talk, which I had recorded as a backup, in case I would not make it to Wednesday. I was quite nervous that the baby could come earlier. As I entered the building of the Observatory of Geneva, Michel Mayor, who won the Nobel laureate in physics in 2019, saw me with my gigantic belly and approached me with a comforting look. We had barely spoken before then, and he was not aware of my situation. "Don't worry!" he said gently. "The baby will not come earlier, it's so cold outside, and he's comfortable there." I smiled: "Thank you very much. I really hope so." After all, he has a Nobel Prize; I was definitely going to believe him. I got through the week but with no time for resting as there was still a paper to wrap up and submit to *Nature*. On Saturday morning I finally submitted it. On Sunday evening, I went to the hospital in Geneva, and gave birth on Monday evening to my beloved second child. This happened exactly on term, with Swiss punctuality, on the winter solstice. On this night there was also a rare alignment of Jupiter and Saturn in the "great conjunction," where the two planets seem so close together in the sky that they appear like a very bright star. A new chapter began; now we were a family with two children.

Oh, my two little adorable bundles of joy! Life became something far more precious and meaningful after they came to be. No matter how rough things get, their smiles and kisses charge my brain with love and delight. Having children meant a huge change of lifestyle, which I had anticipated only in part. Do you know the feeling of being overwhelmed with a number of things to do simultaneously, with one deadline after

the other, or on top of each other? That's when one or even both kids play a joker card and get sick, and you discover that you now have to squeeze all that into about 50% of the time you had before. And you just do it. It means extreme flexibility, yet also having strict organization to replan while juggling things around, finding the best-fitting solution, prioritizing, learning to take less time to do things (yes, sometimes sloppily). Of course, it's much more fun when they feel well, and we can play together and learn things. Often it is just pure fun. And often they push you to your limits. Then you must learn about not engaging in direct conflict and finding different ways, listening to them, explaining observed things and consequences without judging, negotiating. Finding that corner where their needs and your needs are both fulfilled, and letting that win-win situation come to the surface. It doesn't always work, but sometimes it does. Working mothers probably get some pretty good field training in leadership skills. And some fathers, too.

I could not do what I do without sharing household duties and childcare with my husband, the father of our children. During his parental leave, he could take full responsibility for the children while I was at work. Once he packed for himself and the kids and came to pick me up at work to go travelling for the weekend. Now we share the household and childcare equally. Having a husband who took a few months of paternity leave was key for me to be able to pursue my career after my maternity leave. It's also beautiful for children to grow up with a caring father, and eventually for men to take on a loving and caring role. This can be so impactful for our society as a whole.

What we do in our universities and departments, how we form and nourish the next generation of scientists and leaders, can also make a difference in society. And astronomy has a unique place in and importance for society, giving the global perspective and inspiring people from across the planet, all under the same sky. I have heard too many times that astronomy is fascinating, but probably a waste of taxpayer money. Today I feel a strong sense of purpose and I believe that I can do something important to promote sustainability, both with the actions I take in my private sphere with my family and in my professional environment.

But when I had just started studying astronomy at university, this was not so clear to me.

Astronomy was perhaps one of my rebellions. I grew up in a tiny, beautiful village in the heart of the Dolomite Alps. A pearl. And wonderful people, as well. Yet, this is a society with strict traditions and ways. Everyone knows everyone, so that people are, on the one hand, protected and, on the other hand, screened and judged according to societal customs and taste. I was the black sheep in my family. As a teen, I was the crazy one who liked strange things (music, arts, clothes, etc.). Being the black sheep afforded me much more freedom, because I no longer needed to conform, and I could express myself with fewer boundaries. Actually, I was not the black sheep; I was a free spirit, not bound by the societal rules. It meant going through storms, and not always with the right sails. I was lucky enough not to get into any serious trouble, so I could pursue my studies. I was good at school, and I loved science, including geology, biology, and genetics. I thought astronomy would be the coolest and most intriguing thing I could study, something that could nourish my curiosity. Starting university, where I pursued a bachelor's in astronomy at the University of Bologna, was a big step. No one in my extended family had ever attempted to do anything like this. In my family, no one from the older generation has a high school degree. I was very much a first-generation student. Little did I know what it meant to enter the academic world, let alone what it would mean to work in the field of astronomy. Naively, I did not think for a single moment whether this would be feasible, or profitable. Instead, I followed my passion. I learned much later that difficulties are always to be found along the path, and that passion is the key to overcome them. My parents were a bit skeptical of my choice of astronomy, because it was not very clear where it would lead me. But they supported me financially and mentally, and gave me one year to try. If I was successful, they would continue paying for my studies and supporting me. So how did my very first exam go? Well, I didn't hear my alarm clock and missed it! Not a good start, Annalisa, not a good start. Focus. Don't blink. Try harder. And I did. I succeeded in my bachelor's and master's in astrophysics, with excellence.

When I moved on for a PhD in Reykjavík, Iceland, prestige was absolutely not on my radar. I didn't care that the University of Iceland was small and not well known for astronomy. The project on gamma-ray bursts seemed very exciting, and I loved the idea of living in Iceland for a while. It was my only application for a PhD position, and it seemed to me the right thing at the right moment. And looking back, I think it was. I had found an exceptional place, a safe corner of the world of exotic and stunning beauty, where I could fully develop professionally: on the one hand, I was supported with care, and on the other hand, I had the full independence to travel abroad to collaborate with international scientists and grow enormously. And I had a lot of fun in this land that is mostly powered by geothermal energy, with its playful warm waters, cold rivers, colorful mountains, white glaciers that sometimes sparkled with black glossy obsidian stones, dramatic lava fields, fluffy moss carpets, staggering green cliffs, spectacular basalt columns, deep black beaches, a mostly clear ocean, and a wonderful diversity of wildlife within.

Diversity is indeed one of the key values for a healthy planet, as well as for a healthy society. I came to realize that social and environmental sustainability are intimately linked. We need a caring society to be able to focus on the collective good for society and the planet. Women have an important role in fostering this. As Riane Eisler found in her research, the status of women is a better indicator of the wealth of a country — its true richness and quality of life — than the GDP.[1] In other words, the well-being of men, women, and children is higher in places where women are better represented in leading positions and participate in important decisions. As a woman in science, I feel the urge and responsibility to add my pieces of the puzzle to a more sustainable society. I try to proactively create a healthy environment wherever I worked, for example by talking about the psychological safety needed for a learning organization, or promoting and organizing exciting activities in the Diversity, Equity, and Inclusion committee of my department, supporting the

1 Riane Eisler and Douglas P. Fry, *Nurturing our Humanity: How Domination and Partnership Shape Our Brains, Lives, and Future* (Oxford University Press, 2019).

mental health of my colleagues and team, or mentoring. I won't change the world alone, but I can do something important to help. At the same time, being a woman in science also meant running a hurdle race along my path.

I used to think that I was really lucky not to have suffered from any form of discrimination. I'm clearly privileged, being a white person born in a family that could afford my education, in a relatively stable European country, without strict social, cultural, and religious limitations, and having no disabilities. In recent years, though, my eyes slowly opened, and blurry things of the past became clearer for what they were. As a child, most women that I knew did not work, and the ones that did worked in the kitchen or as caregivers. Sexist jokes were still widely accepted. I grew up with this implicit idea of a subordinate role of women in society. I could not play with remote-controlled cars or other "boy toys" like my brother did. The only year my brother and I had the same teacher, she put me down for not being as good as my brother — a lovely person, but never brilliant at school. I ended that year with a stress-induced skin rash. I was about eleven. I was called names for being different. I have been ignored in meetings where alpha-male colleagues would dominate the discussion. I went through abuses of power, and I'm so relieved to know that one of the perpetrators was recently removed from his prestigious professorship. I experienced verbal and physical abuse, including some forms of sexual abuse. I cannot say I didn't encounter discriminations. But somehow, I did not let them stop me. I never focused on them. I kept going on my path with determination, despite the difficulties. I'm an incurable optimist. Focusing on the positive side of things helps me overcome the hard ones. It's not always easy, but I am thankful. Don't blink, Annalisa, focus on the positive side of things. Looking back at my experience, I can guess that independence, positivity, and gratefulness are really powerful in building up resilience to overcome the storms.

I found that it is in the worst moments that I could dig deep into my core values, and that introspective reflection is a compass to navigate the stormy sea of life. I spent a full year in Munich out of contract in 2019. The year before, I had been applying for a few positions while I

was on maternity leave, but those applications didn't work out, and my contract ran out. I refused to relocate again, this time with a daughter, only for another temporary research position. And at that point in my career, I thought, either I would get a significant advancement, or I should do something else. It is the hard and narrow bottle-neck that many researchers experience when trying to jump from temporary postdoctoral positions to a more permanent job. I was only applying for tenure-track professorships, permanent research positions, or big grants to lead a research group. During that year, on the one hand, I was applying for positions, and on the other hand, I was studying and training to find my physical strength again, after the pregnancy. It was a hard year, because I realized how painful it would be for me to abandon astronomy. My love for science was deep and rooted. It was a hard year also because I had zero income for almost a year, because the organization I had worked for did not allow for any unemployment benefits after my three-year contract. But I still needed to pay the bills for private daycare for my daughter, otherwise I could not afford the time to study and apply for jobs. The feeling of being about to lose independence was haunting me. It was a hard year. But a number of interesting and positive things came out of that too. First, I could eventually and finally get my paragliding license, after having dreamed about it for a lifetime. This was a pretty good investment to cheer up my mood. And, most importantly, I was pushed to really consider what is important to me and what I would like to do next. Astronomy kept on being on top of my list. Then I came up with three potential directions I wanted to take, as potential alternatives: environment, education, space.

It turned out to be difficult for me to get a job in environmental consulting or international schools, with my growing but still not fluent German, and not much background in the field. But I had the strong experience of operating the Very Large Telescope in the control room. Eventually I got a job offer to work in the control room for the International Space Station module Columbus, the European module where astronauts perform scientific experiments. I was thrilled. This was in the summer of 2019, and we went for a family holiday in the Unites States, to visit a grandaunt. It was a Thursday evening. We were about to come

back to Europe, our flight was on that Saturday, and I was supposed to start with my new job for the International Space Station (ISS) on Monday. Before I could start operating proficiently, I had to undergo training, which would take several months and would involve travelling a few times around the globe. On that Thursday evening, I checked my inbox, and I found the one email that changed again the course of my life and took me back to my beloved stars and galaxies. The Swiss National Science Foundation (SNSF) had awarded me 1.5 million Swiss francs to create and lead my Interstellar One research group, at the University of Geneva! This was the opportunity I had dreamed about so much; I was so full of joy. I told my family right away — we are all going to Geneva! But what about Monday, what about the ISS? I slept over it, and then I wrote them with transparency and respect. I had received a stellar grant, a once in a lifetime occasion for a researcher, and I hoped that my prompt notice would allow them to find another person for the ISS job. Not me at this moment. They were happy for me and wished me good luck. I smiled for days, incredulous that I really had been good and lucky enough to get the SNSF PRIMA grant. Not only would I continue to be an astronomer, I would build a research group, make it a vibrant group of passionate people that grow scientifically and have fun working together to unveil the mysteries of galaxies. Don't blink, Annalisa. What a dream coming true.

The experience of creating and leading a research group has given me momentous joy and motivation: from the day-to-day interaction with the team members, creating a psychologically safe environment for learning and exchanging, listening to their needs and trying to find the best way to support them and make them flourish, adapting and appreciating their own diversities and strengths, giving them opportunities for growth, gradually fostering their independence, all while unfolding the shared scientific vision that fuels and motivates our curiosity and research. The current or past members of the Interstellar One team are researchers from Italy (myself), South Africa, Greece, Denmark, Switzerland, and Ukraine. It's a lot of fun working with them, and I feel quite lucky with such a wonderful group of people! As I truly care for

them, empowering them empowers me, and helping them grow helps me grow.

I found that being explorative, giving space for reflection, being open-minded to changes, open to listening and actually incorporating the changes, are all good ways to find win-win solutions — when things click together with such a good match between my needs and the other person's needs. For example, when I was preparing to go on maternity leave, I designed a grand international tour for the two PhD students working with me to visit scientific collaborators during my absence. At some point though, it became clear that none of it would be possible due to the pandemic. I was talking to people at my department, who suggested trying a specific grant to hire somebody to help. I was sure that this possibility would not be feasible, and I could have stopped there. But I decided to inquire anyways and ask humbly. It turned out that from a different grant it was actually possible to hire a person to act as my deputy during my maternity leave. I had a person in mind, who had the perfect experience to teach the students some special techniques that we use to measure how many atoms of different chemical elements are in the gas in galaxies, among other scientific concepts. And it was the perfect moment for him, since he was in between jobs. When I came back, he ended up staying for a full year as a senior researcher in the group, and it was a wonderful experience for all of us. He left the group for a hard-to-get permanent position as an astronomer. It also meant I had some more funding to hire another researcher for a different project, but I had lots of tight constraints on a very short timing for hiring a new person, because I was slowly planning to leave the country myself. A normal hiring process would not have worked. As the war in Ukraine had started, I decided to invite Ukrainian researchers to apply for the position in my group, and I found a brilliant researcher with very good experience, a bit different from the kind of research we were doing, and very complementary: she studied stars, and I studied gas, but stars are formed from gas, and their chemical composition should be linked. It was a really difficult situation for her, having fled from the occupation with her daughter and having left part of her family behind. But she was able to come eventually, and get a refugee permit that allowed her to

start working in our group immediately. When I started my Interstellar One research group, I could never have guessed that things would go this way. I was very lucky, and I am really grateful to the SNSF for giving me the opportunity to develop my team in this way. Initial planning was essential, but remaining open to new possibilities and actually making them happen made it truly special.

As I write, I have started a new, exciting chapter of my life. I moved from being an assistant professor at the University of Geneva to working as a faculty astronomer at the European Southern Observatory (ESO) in Germany. I am also an invited professor at the University of Geneva, and I keep taking good care of my Interstellar One research group. At ESO, I do astronomical research and work for the observatory. My prime responsibility is to ensure that the selection process for scientific projects to be observed with ESO's telescopes is as fair as possible, finding the most efficient way to select scientific excellence and minimize bias. This is a great responsibility for the larger scientific community. How will our most advanced telescopes be used? What science will the focus be on? Thinking about this, my mind flies over the Atacama Desert, looking at the marvelous Very Large Telescope and the majestic Extremely Large Telescope, the world's biggest eye on the sky with its diameter of 39m, which is currently being built on the 3,046m-high Cerro Armazones, 20km away from its predecessor. The iconic mountain casts a giant shadow on the horizon. On the other side, the sun is ready to be squeezed by the atmosphere and our perception. Don't blink that sparkle away, Annalisa! Dark skies above, inspiring science for all.