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Fellows at ESO

Julia Bodensteiner

Who would have thought that raspberry ice cream made with liquid nitrogen as a high school student would pave the way for me to become an astronomer. Certainly not me at the time, but it is true.

Although it is often a cliché for astronomers, it is true for me that I've always enjoyed the night sky. Its vast scope and tranquillity continually inspire me, despite only being able to see a handful of twinkling stars from Munich, Germany, where I grew up. I've also always enjoyed being outside, surrounded by nature, for example hiking or cycling. When I was a child, I often went to the mountains with my family. The highlight for me and my brother would always be when we camped outside at the foot of a mountain, where the view of sky was so much better than from the city of Munich.

Unfortunately, during high school the physics curriculum was not particularly inspiring. Physics is also usually not seen as the 'cool' subject, and kids who enjoy physics are often labelled as the weird ones, or the nerds. On top of that I was strongly lacking a female role model. Luckily, my parents kept nudging me towards my scientific interests, for example by gifting me books written by female astronomers.

Despite my interest in physics and astronomy, I never imagined that one day I would actually make a career out of it. And that brings me to one of the important milestone in my youth — a Germany-wide 'Girl's Day' for girls between 14 and 18, which I participated in. Instead of going to school, I spent the day at a solid-state physics lab in the Technical University of Munich (TUM). Not only did I learn a lot about microscopy and the surfaces of materials — but we also had fun doing it. One activity was making raspberry ice cream with liquid nitrogen. From this I realised two things: that physics can actually be really fun, and that 'real' physics is very different from what is taught in schools. I enjoyed the atmosphere of being surrounded by others, mainly girls, and I did not feel judged. So after high-school I decided to study physics at the TUM.

In all honesty, the first years of university felt more like I was more drifting in a river than actually steering a boat: I mainly tried to pass the first-year exams. The third year of my bachelor's degree, however, I spent at the Universidad Complutense de Madrid in the context of the ERASMUS programme, which is where I had my first astronomy lecture. I loved it, and when I came back I searched for a bachelor thesis about an astronomy topic. Specifically, I worked on massive stars in the high-energy group of the Max Planck Institute for Extraterrestrial Physics (MPE) in Munich. It was not only my interest in the topic, but also the welcoming, warm atmosphere in the group at MPE that made me stay on as a job student. In collaboration with a second supervisor at ESO, I continued there to do my master's thesis project investigating circumstellar nebulae around massive stars. Because massive stars, and in particular binaries, always interested me, I sought a PhD position in observational stellar astrophysics and was successful: I got a position to work on spectroscopic observations of massive binaries at the Institute of Astronomy at KU Leuven, Belgium.

A highlight of my career has been visiting La Silla observatory in Chile to observe during my time at MPE. I fell in love with the scenery of the Atacama Desert, the friendliness of the people working at the telescopes, and of course the stunning night sky. So I was very happy when during my PhD I could go observing to the KU Leuven Mercator telescope on the Roque de los Muchachos in La Palma, Spain. I went as often as I could, and so far I have spent more than 50 nights observing in different observatories. This was also one of my main drivers to apply for the ESO fellowship: the strong connection to the observatory, the proximity to telescopes, and the development of new instruments. Now, working at ESO, I have been able to visit Paranal and spend several nights at the telescope. This allowed me to gain invaluable insight into telescopes and how they work, and to better understand the observations themselves. Additionally, I think that Paranal is a really magical place.

What I really enjoy about the scientific environment, not only at ESO but also any other institute or research centre I've visited so far, is the international environment I am exposed to every day. This not only allows me to talk to and interact with many different people from different countries and diverse backgrounds, but also to learn more about other cultures. Most importantly, my research career has taught me openness and has provided me with a better understanding of different ideas and perspectives. In general, I've always enjoyed travelling, which is another aspect that I like about the scientific environment. Going to conferences or meetings at different institutes always means meeting new people and getting to know the world.

Something I am particularly grateful for is the scientific freedom afforded me so far in my career. I've always been able to follow my own curiosity and work on the questions that I find the most interesting. During my master's thesis, I wanted to work on a topic that was not particularly the focus of my supervisor. Instead of telling me to change it, he encouraged me to gain a second supervisor complementary in expertise for that topic. Similarly, during my PhD, when I devised a new project halfway through my PhD, my supervisor motivated me to follow my own interests and gave me the opportunity to work on new things that were originally not planned. As an ESO fellow, I enjoy similar scientific freedom: I applied to the ESO fellowship programme with my own project. My focus is the study of a particular type of massive star, classical Be stars, which are interesting because they are rapidly rotating and surrounded by a disc of gaseous material. During my fellowship at ESO, I am investigating whether their rapid rotation is linked to previous interactions in a binary system. For this, I am using spectroscopic observations with both ESO telescopes and the HERMES spectrograph on the Mercator telescope, which I analyse in collaboration with an international team of people. Given my fondness for nature, I called our collaboration HONEYBeeS (which stands for HERMES ObservatioNal survEY of BeOe Stars).

Now my career has brought me back to Munich, where it all began, and I still enjoy going to the mountains in south Germany and looking up at the night sky. I look forward to an exciting future, building on my experience in Germany and Belgium. My favourite flavour of ice cream may have changed, but I think back to that important milestone of how raspberry ice cream made me pursue a career in physics and astronomy. Today, I am grateful to have the opportunity to be involved in the Girl's Day from the other side, where I hope to inspire many girls to pursue a career in astronomy.

Melanie Kaasinen

Recently, my Dad asked me "What happens when light reaches the edge of the Universe? And anyway, why is the speed of light that value (no more, no less)?" I find these questions great fun to explore, which is lucky given that I am also often asked such mind-boggling questions when I do outreach. They are the kind of questions I thought about as a child, when I read books like Brian Greene's *A Fabric of the Cosmos*. At that time, astronomy was a form of escapism for me — beyond this tiny blue dot was an incredibly vast and wondrous Universe that had no concept of us humans and our insignificant problems!

Astronomy may have been an early interest, but it was not my first career goal. I moved from Germany to Brisbane (Australia) aged five and started swimming, which quickly turned into an obsession. A few years later, it was clear that I was far more talented at running. Later, in high school, I also started cycling seriously, leaving Wednesday school sport for my cycling session on the nearby cycling/criterium track. Obviously, I was going to be a triathlete... but alongside the focus on endurance sports, I also loved learning about astronomy. Luckily, my parents were incredibly supportive of both my sport and my education — even moving close to a high school with a focus on aviation. My passion for maths and science was also channelled early on by my wonderful maths teacher, who set me additional challenges. In the end, I was as ambitious academically as athletically and threw myself into my final years of high school to obtain a scholarship that would pay off my bachelor's degree.

After school I dived into an 'accelerated' science degree at the Queensland University of Technology. The challenge of the degree and interaction with like-minded people made me want to pursue astrophysics more seriously. I also realised during this time that I enjoyed outreach and I started to host astronomy workshops for high school students as part of my first paid job — as a STEM ambassador. Astronomy was looking more like a serious career, whereas sport was becoming the hobby. So I had to find a place where I could learn how to do astronomical research. Knock knock the Australian National University (ANU) in Canberra, where I spent the next two, hugely formative, years undertaking my master's.

The ANU's Research School of Astronomy and Astrophysics on Mt Stromlo is a magical place — a friendly astronomical community atop a hill that is home to

hundreds of vibrant birds and a few kangaroo mobs (including the local alpha male, Bruce). Working with Lisa Kewley (my supervisor, now director of the CfA), Brent Groves (now ICRAR) and Fuyan Bian (now ESO staff), I studied the conditions within the ionised interstellar medium (ISM) of $z \sim 1.5$ star-forming galaxies. This was a hot topic in galaxy evolution at the time; rest-optical lines at $z \sim 2$ had only recently become observable and there was much debate over the source of the 'more extreme' line ratios being observed. By analysing Keck/DEIMOS and Subaru/FMOS observations, I showed that these high line ratios arose in part from the high electron densities and ionisation parameters associated with the high specific star formation rates of $z \sim 2$ galaxies. Alongside my master's, I also continued doing astronomy outreach (night-sky tours, for example) and of course sport. After all, at the bottom of the hill there is a perfect cycling circuit and cross-country running track!

Having relished the supportive science environment of my master's, I was now serious about becoming an astronomer. I had heard about the exciting results coming from ALMA and was keen to jump on board. Luckily, I snagged a PhD with the supervisory dream team: Fabian Walter and Simon Glover, the first an expert on radio astronomy, and the second an expert on the chemistry of the cold ISM. So, I moved across the world to the stunningly picturesque city of Heidelberg — where I again worked at a vibrant institute atop a gorgeous, forest-covered hill (perfect to cycle and run up). During my PhD, I helped to accurately constrain the amount and distribution of molecular gas and dust in galaxies at $z = 1.5$–2. Yes, I was still stuck at Cosmic Noon, but I was studying a different gas phase and delving into VLA, NOEMA and of course ALMA data — gaining experience in millimetre- to radio-wavelength interferometry. I also continued with astronomy outreach, giving planetarium shows and public talks (this time in German) at the Haus der Astronomie.

Ten months before the end of my PhD, and during one of the worst lockdowns, I wrote my application for the ESO fellowship. And a few days before Christmas... I GOT THE ESO FELLOWSHIP!

My excitement was well placed. Since coming to ESO, I have worked on unexpected new projects, like searching for evidence of a $z \sim 13$ galaxy candidate in ALMA data with my ESO colleagues (spoiler alert — no evidence found). I have been lucky enough to help prepare for ESO's Extremely Large Telescope (ELT), working on finding faint new sky lines in VLT/CRIRES observations with fantastic colleagues I never would have worked with otherwise. I have also observed for the first time at a submillimetre telescope. Muchos gracias to Carlos De Breuck for enabling my trip to APEX! It was incredible to be part of this tight-knit community, to explore other people's data as it came in (what are these complex multi-peaked line profiles?!) and to see APEX and ALMA in person. Those antennas are simply surreal in that landscape. I was also lucky enough to visit Paranal for a whole week and receive a tour of the ELT site!

Being an astronomer has been an amazing adventure and I cannot wait to see where it takes me next. Thankfully, I still have the same sense of wonder about the Universe that I had when I was a child. But now I am fortunate enough to be able to share this wonder with others and answer a few of their burning questions.

Marco Berton

I loved science since I was a kid. When I was twelve, after watching a documentary on Italian television, I became certain: I wanted to become an astronomer. By the end of middle school, I had read the astronomy section of the science textbook so many times that I had memorised all the orbital parameters of the (back then) nine planets. I chose my high school because it offered basic astronomy classes in the fifth and final year. Of course, over time, my conviction wasn't as strong as when I began. However, in my last year of high school, I had the chance to participate in a project organised by the Department of Astronomy at the University of Padova, called Il cielo come laboratorio (The sky as a laboratory). Over three observing nights at the Asiago 1.22-metre telescope, we collected the optical spectrum of the spiral galaxy NGC 2748 and determined its gravitational mass from the Hα rotation curve. That was the turning point: observational astronomy truly was the right path for me.

The city of Padova, near Venice, is home to one of the oldest universities in the world, with a tradition of astronomy dating back to Galileo Galilei himself. The university offers a bachelor's and master's program entirely focused on astronomy: I couldn't have found a better place to pursue my interests. Having the opportunity to study the nature of various astrophysical objects was simply amazing to me, and I soon realised that active galaxies interested me the most. These accreting supermassive black holes, shining brighter than an entire galaxy, became the subject of both my bachelor's and master's theses. Initially, I analysed the physical properties of ionised gas in a sample of nearby active galaxies using archival data. However, for my master's, I finally had the chance to use new data from a real telescope, the 3.6-metre Telescopio Nazionale Galileo. While I managed to earn my degree, it was only after an incredibly challenging effort. For the first time, I doubted my decision: did I truly want to wrestle with data analysis for the rest of my life? I had to step back and seriously consider my options. Everyone, take note: pursuing a career in astronomy is not a decision to be taken lightly!

It took nearly two years for me to clear my mind once and for all, but my PhD adventure finally began on 1 January 2013. The topic? Active galactic nuclei (AGN), of course! My advisors were Stefano Ciroi in Padova and Luigi Foschini at the Brera Astronomical Observatory, and I couldn't have asked for better advisors. Working with them, I had the opportunity to delve into the physics of jetted AGN across all wavelengths, from radio waves up to gamma rays. I stayed in Padova for five years, completing my PhD and my first postdoc. During that time I spent over 250 nights observing with the Asiago telescopes, mainly to obtain optical spectra for my own work but also for other research groups. I also had my initial experiences of living abroad, with two periods at Purdue University and the University of California Santa Barbara in the USA. These were enriching experiences that introduced me to new people

and allowed me to grow not only as a scientist but also as a person. In terms of research, I continued to study a unique class of AGN known as narrow-line Seyfert 1 (NLS1) galaxies. While some of them do harbour relativistic jets, unlike 'normal' radio galaxies with black hole masses around a billion solar masses, NLS1s are powered by black holes a thousand times smaller that are rapidly accreting matter. In NLS1s, typically hosted in spiral galaxies, the AGN coexists with relativistic jets, star formation, and outflows of ionised and neutral gas. This uniqueness makes them valuable sources, possibly representing an early evolutionary phase in the AGN life cycle. Given the relatively unexplored radio properties of these objects, I undertook the largest and deepest survey in this wavelength range using the Very Large Array in New Mexico. As a fan of the movie Contact, having the opportunity to use such a massive array of 28 antennas was an unparalleled feeling.

In 2018 I eventually left Padova. I secured a fellowship at the Finnish Centre for Astronomy with ESO and worked at the Aalto University Metsähovi Radio Observatory for three years. I cherished every moment spent there. Finland, renowned as the happiest country in the world for good reason, offered wonderful people and nearly untouched natural beauty. Metsähovi, situated 30 kilometres from Helsinki in the heart of a forest, often led to encounters with deer and even moose during my commutes to the office. Unfortunately, I could fully enjoy this only for half of my time there, as the pandemic emerged. Nevertheless, even during those challenging times, taking walks in the woods provided a stress-relieving escape.

As the pandemic neared its end, the time for another move approached. I accepted a position as an ESO fellow in Paranal and relocated to Chile. Honestly, this wasn't an easy decision: I had never worked in such a large observatory before, and the prospect of spending 80 nights a year at Paranal initially seemed daunting. However, it took only a few months for me to realise how fortunate I am. My enthusiasm for the ESO life has grown, and I'm now grateful to be part of the expansive and diverse Paranal community, along with the dynamic scientific atmosphere at ESO Vitacura. Presently, when I'm not studying AGNs in Santiago, I work as a night astronomer on the UT4. With its advanced adaptive optics system, it's the closest approximation we currently have to the ELT. Specifically, I now serve as the second instrument scientist for MUSE, arguably the world's best integral-field spectrograph. The journey that brought me here was long and winding, but I would retrace each step. I now eagerly await what the future holds.

ESO/H. Heyer

This photograph shows the European Southern Observatory's Headquarters in Garching, near Munich, Germany. This is the scientific, technical and administrative centre for ESO's operations, and the base from which many astronomers conduct their research. The scientists, technicians and administrators who work here come from many different backgrounds, but all have one thing in common: a passion for astronomy.