

## Fellows at ESO

### Belén Alcalde Pampliega

Since childhood I have been fascinated by Earth and space exploration and eager to understand how things, nature, and even (human) brains work. But almost everything else, from drawing to running, has also piqued my interest. I grew up in a small town in the north of Spain where, like hundreds of other children, I dreamed of one day becoming an astronaut. I took this dream very seriously and knew by heart details such as lunar geography or the dates, spaceships and astronauts that had participated in each lunar landing. However, I must admit that choosing a career was not easy for me. I was full of doubts. I wanted to have it all at once. Engineering, maths, architecture, physics, and aeronautics were the top five.

As an enthusiastic and extremely active person, I found my balance by combining a strong formal education with the fulfilment and harmony I experience when I push my limits while “playing” in nature. The wilderness also awakened in me a deep interest in the mysteries hidden in the starry night, something that became especially important during the last year of my engineering studies when I lived in Hämeenlinna, Finland. The clear, unpolluted sky is the perfect window onto the Universe, not to mention the magic of the Northern Lights. Back then, there was always a book on astronomy on my nightstand.

After obtaining my engineering degree and while studying for a master’s in product design in Barcelona, I decided to take my hobby more seriously and I enrolled in the Distance Learning University of Physics while working to fund a two-year master’s in astrophysics. It was a time of packed, exhausting and endless days, but I believe it was the right decision. As a person with endless curiosity, I discovered a space in the world of science where I could unleash my curiosity by sharing my questions and finding, even if only partially, some answers. My master’s thesis involved the development of a simulator for the design process of the optical Integral-Field Unit and Multi-Object Spectrograph MEGARA, now installed at the largest telescope in the world, and fibre spectrographs in general. My thesis advisor, Armando Gil de Paz, was not

only a great advisor, but also a role model in many ways. He is one of those inspiring people who helps you work towards goals you think you are not capable of.

This experience was key to my being offered the Australian Astronomical Optics (AAO) Instrumentation Fellowship, where I conducted the experiment “Use of coherent guide bundles for adaptive-optics wavefront sensing” under the direction of Michael Goodwin. Since then, my heart has been divided between science and instrumentation. This short research stay in Australia was extremely rewarding, both scientifically and personally. Australia is a wild, vibrant, multicultural country where I was able to rediscover the night sky. At the extremely dark Siding Springs Observatory, only the red-tinted eyes of emus and kangaroos occasionally glowed beneath the awe-inspiring sight of the Large and Small Magellanic Clouds. Back in Sydney, I also fondly recall a lively conversation about ‘current’ challenges in astronomy with a visiting astronomer during a science lunch. It was only at the very end of the conversation, when he was summarising his science and inviting me to the lecture he would give in Spain a few months later, that I found out his name. The gentle, quiet, blue-eyed man was Brian P. Schmidt, who had been awarded the Nobel Prize in Physics in 2011. It was a lesson in humility that I will never forget. Right after that, I joined the Young Graduate Trainee Fellowship at the European Space Agency (ESA), where I searched for binary systems and movement groups in the framework of the Virtual Observatory (VO). There I met Benjamin Montesinos, the current President of the Spanish Society of Astronomy, who was a source of inspiration for me.

Immediately afterwards, I started my PhD thesis, which was supervised by Pablo G. Pérez-González at the Complutense University of Madrid and by Guillermo Barro at UC Berkeley. This gave me the enriching opportunity to experience the scientific life in the astrophysics department at Berkeley during my research stays. In addition, during the latter part of my PhD, I was able to gain hands-on experience as a support astronomer at the 2.5-metre Isaac Newton telescope at Roque de los Muchachos Observatory on



the island of La Palma, thanks to an STFC grant. This was a rewarding and enlightening experience; observatories are to me what playgrounds are to children.

My PhD thesis, which I defended in July 2020, aimed to build a complete census of massive galaxies in the early Universe by adding a hidden population of extremely red sources. This elusive population, which poses a challenge to current models of galaxy formation and evolution, is extremely faint at optical wavelengths because of dust obscuration. However, the light absorbed by the dust is re-emitted at (sub-)millimetre wavelengths. Therefore, my next step was to learn everything I could about submillimetre astronomy and interferometry. My keen interest in observational astronomy along the entire electromagnetic spectrum was key in my decision to apply for the ESO fellowship.

I have been an ESO/ALMA Fellow since October 2020, combining my research activities with the operation of the Atacama Large Millimeter/submillimeter Array (ALMA). Because of the pandemic, it took me a long time to make it to the Array Operations Site on the Chajnantor Plateau, but the experience was definitely worth the wait. It is not just about enjoying this impressive array in a lunar-like landscape, but more importantly about having the opportunity to share it with experts (of which astronomers are only a tiny fraction) who are always willing to gift a little of their time to answer your questions and share their knowledge. I feel privileged!

## Lukasz Tychoniec

How were the Sun, Earth, and planets formed? How did life originate on Earth? Those are the questions that keep me curious. How did I decide that answering them should be my daily job?

Since I was a kid I have been a keen observer of the night sky. I had a small telescope in my hometown of Nowogard in Poland, and we played a lot with it with my father, mostly looking at planets and the Moon. What probably helped were relatively dark skies, compared with most of the places I lived in afterwards.

Comparing my amateur observations to what I saw on the news, with the Hubble Space Telescope and the Very Large Telescope (VLT) delivering stunning images, I realised that I won't ever afford a telescope that would show me the deepest secrets of the Universe and if I want to get my hands on those facilities, I should become a professional astronomer. That's why I enrolled in astronomy at Adam Mickiewicz University in Poznań. There I met Agata Karska who had just arrived in Poznań with data from the Herschel Space Observatory and I finally could reach for what I've always wanted: to do science with a space telescope.

That's how I also started studying star and planet formation, as Herschel excelled in far-infrared observations of star-forming regions. The thing about studying star formation is that it is really difficult to catch forming stars in the act — they are usually hidden deep inside the clouds from which they form. Luckily, by moving to longer wavelengths we can peer through those clouds and witness the miracle of stellar birth. That's why I also explored much longer wavelengths than infrared in the following years: first, during a summer project at Leiden Observatory with John Tobin, when I looked at protostars with the Very Large Array (VLA) at centimetre wavelengths. This became the topic of my master's thesis which I defended in Poznań in 2016.



I spent a lot of my studies working as a barista (a professional coffee maker) which turned out to be a fantastic hobby. Even though I couldn't pursue this career full-time, visiting coffee places and talking to other baristas is still my main activity, anytime astronomy pushes me to new locations. What I didn't know early on, is that astronomy is an incredibly adventurous career and it's amazing how many places it lets you live in and visit. That is an opportunity I'm very grateful for.

When the time came to choose a place for PhD studies, Ewine van Dishoeck in Leiden invited me to work on preparations for the James Webb Space Telescope (JWST) observations. It was a dream come true for me, to be able to take a front seat and conduct research using world's most powerful space telescope. It turned out also to be a lesson in patience, as I'm still waiting for the data we expected to arrive in 2018. As I write we are days away from the first full set of JWST observations — a momentous and probably the most exciting moment of my career so far.

During my PhD I wasn't just idly waiting for JWST data — I pursued observations of protostars with the Atacama Large Millimeter/submillimeter Array (ALMA).

I focused specifically on jets and outflows from those young stars and how they affect the chemical composition around them. Aside from being a powerful astrochemistry machine, ALMA is also very sensitive to cosmic dust. I used VLA data from my master's project and combined it with ALMA to weigh the dust that is surrounding forming stars. I found out that the protoplanetary discs in the youngest objects are more massive than their evolved counterparts. By comparison with the masses of the exoplanetary systems that were discovered in thousands over the past three decades, I showed that the formation of giant planets needs to begin very early, likely in the first 100 000 years after the beginning of the formation of the host star.

I finished my PhD in 2021 and took a position as a research fellow at ESO. Being amazed by ALMA's capabilities and awaiting data from JWST, ESO seemed a natural place for me to pursue my career as an observer. I wanted to further understand the complexity of interferometric observations with ALMA and I wanted to surround myself with experts on ESO facilities, which would help me to create exciting synergies with JWST. ESO is a fascinating mix of people doing research and those designing, building and organising the work of the telescopes that make research possible.

As a Fellow, I spend a fraction of my time on functional duties for the observatory. I decided to work for ALMA since it allows me to understand better how the observatory that I so keenly used for the past few years operates. Specifically, I work on one of the development studies which is meant to bring ALMA in new directions. In September I will finally visit ALMA for the first time and work there as an astronomer on duty.

With JWST finally delivering data, ESO's Extremely Large Telescope coming up in a few years, and ALMA at its full capacity we are probably in the most exciting decade of observational astronomy and I'm beyond happy to spend a part of it at ESO.