

# Fellows at ESO

## Francesca Fragkoudi

Imagine you're flying through space, at breakneck speed, past stars and galaxies, trying to reach the edge of the Universe. Eventually, you make it there! (queue heroic music). After examining it for a moment, you think, "Well, this can't be right. If the Universe is *everything* that exists, it can't just end – what's beyond the edge? It has to keep going!" So, you keep flying on, until even the stunning views get a bit repetitive, and you decide that this darned Universe must, in fact, end *somewhere*. And so the whole process repeats itself, *ad infinitum*. Or until you fall asleep. This little thought experiment was one of my favourite things to do as a child. My own version of counting sheep, if you will. I had read in a popular science book that the Universe might be infinite, and I tried very hard to figure out – just by thinking about it – whether this could be true and what it would mean. I think you can tell from this story that I was always going to become a theorist.

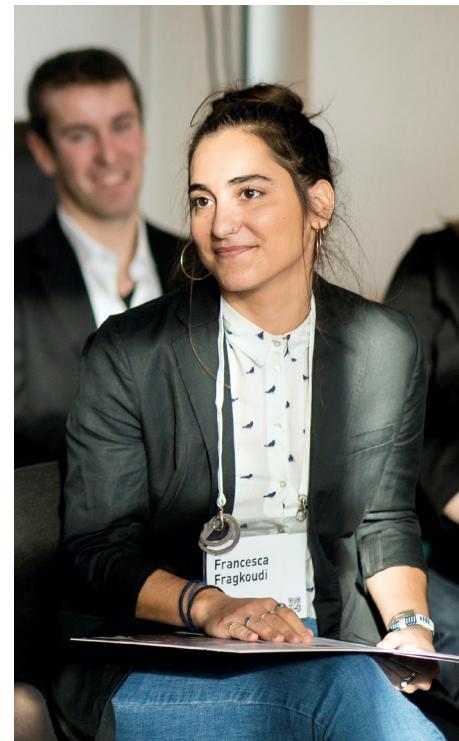
So how did a theoretical astrophysicist end up working at ESO?

Growing up in Cyprus, I was fascinated from an early age by mathematics and physics and annoyed my teachers by asking "why?" a lot, so I decided to study Physics and Philosophy at the University of Bristol. My love affair with philosophy was rather tumultuous, and while I loved the first-year courses, by the end of the second year we had fallen out. My infatuation with physics, on the other hand, was going strong. I eventually dropped philosophy, and earned myself a BSc in physics. After three beautiful years in Bristol, I needed a break from the English weather, so I moved to Barcelona, Spain, to study for a master's degree in astrophysics & cosmology. There, I got my first real taste of research, working on the dark matter bispectrum of large scale structure with Licia Verde and Raul Jimenez. It was a great experience which solidified my desire to pursue a PhD in astrophysics. However, life sometimes takes unexpected turns; I decided that before embarking on a PhD I wanted to see more of the world, so I took a year off the academic path. I first worked for a few months in a restaurant, saved some money, and then spent half a year travel-

ling around South America. Needless to say, this was one of the most formative experiences of my life.

After returning, I started my PhD at the Laboratoire d'Astrophysique de Marseille, with Lia Athanassoula and Albert Bosma, on the dynamics of barred galaxies. During my PhD I studied the orbital structure of galactic bars and their vertically extended part – called the boxy/peanut bulge – exploring how these structures affect their host galaxies. I also developed a dynamical modelling technique that allowed me to determine how much dark matter is present in the innermost regions of barred galaxies and applied this method to the galaxy NGC 1291. After finishing my PhD, I left Marseille (a city that I will always love dearly) and started a postdoc position at the Paris Observatory, working with two wonderful mentors, Paola Di Matteo and Misha Haywood. During my two years in Paris, I applied my knowledge of bar dynamics to our home galaxy, the Milky Way. I was able to show that N-body models of the Galaxy that are composed purely of a thin and thick disc component can reproduce the properties of stellar populations of the inner Milky Way. I did this by comparing – as accurately as possible – the N-body simulations to observations of the Galactic bulge from a large spectroscopic survey called APOGEE. These findings suggest that the Milky Way's bulge has a mostly *in-situ* origin, which contradicts the classical picture of bulge formation through mergers. During my time in Paris, I also started an educational science outreach project called "Columba-Hypatia: Astronomy for Peace". This project uses astronomy as a tool for peace and diplomacy, to promote a sense of global citizenship, in my divided home country of Cyprus. I could spend this whole article talking about Columba, but instead I'll leave you with a link to the project in case you'd like to find out more ([www.columbahypatia-project.org](http://www.columbahypatia-project.org)).

And this finally brings me to the Munich part of the story, which in fact started across the street from ESO, at the Max Planck Institute for Astrophysics (MPA). There I spent three fantastic years with an MPA fellowship, during which time my scientific horizons really expanded. I was



able to continue my research on barred galaxies like the Milky Way, now using cosmological simulations. I showed that cosmological simulations corroborate our previous findings, i.e., that the Milky Way has a bulge that is compatible with being formed *in-situ*, and that it has had an unusually quiet merger history. While at MPA, I applied for an ESO fellowship, as I wanted to bridge the gap between the theory and observations being done across the street from each other. As my research has always been at the interface with observations, moving to ESO felt like a natural next step. I've now been here for just over a year, and I can safely say it was a great decision. Even in these odd pandemic times, ESO is a vibrant place to work, and there are few places where one can experience such a broad range of astronomy-related topics, while learning from the inside what it's like to run one of the world's leading observatories. I have had the opportunity to be involved in projects related to developing the new MUSE exposure time calculator and projects related to mitigating the effects of satellite constellations on astronomy, and I've helped organise the ESO Summer Research Programme, all while mentoring and supervising some fantastic students.

I'll be leaving ESO earlier than expected (to take up a faculty position in the UK), but I feel grateful for having had the opportunity to be a part of this organisation that is pushing the frontiers of astronomical research. I can't wait to see the new heights ESO will achieve with the ELT, and to say proudly when that day comes, "You know, I used to work there".

### Alejandro Santamaría Miranda

I was a fortunate child who gazed at the Milky Way during the summer in rural Spain. Like many other astronomers, I grew up in a big city where lights prevented me from seeing the starry sky. Still, I used to spend the summer months in a small village near the mountains in Extremadura, and this was partly what started my vocation to discover the Universe. Even so, I must confess that if there was a defining moment in my life, it was a television interview with the first (and only) Spanish astronaut. At that time, I was about 7 years old, and it was undoubtedly a crucial moment for my future; that was when I decided I wanted to understand the Universe and try to make that my profession. Indeed, in my case, it is pretty clear that having influential figures in early childhood can totally change your life.

Then the path was clear: first a career in physics and afterwards studying astrophysics. But life is not as easy as expected. I have little natural talent for mathematics and physics; it is the memory skills, especially remembering dates and events, where I excel intellectually, so getting my physics degree required a lot of effort on my part. Still, this was the way, and I persevered with it. During my bachelor's degree, I spent two summers working at the Observatorio de Javalambre (Teruel, Spain), while it was still under construction, I studied sky brightness and had my first contact with professional astronomy. These internships kept the flame alive.

I studied physics and a master's degree in astrophysics at the Universidad Complutense de Madrid. My master's thesis, under the supervision of Patricia Sánchez-Blázquez, focused on studying the stellar populations of bulges of spiral

galaxies using 70 000 galaxies from the Sloan survey. We obtained an age and metallicity for each of them. Our main results showed no difference in the stellar populations of classical bulges and pseudobulges if classified by purely structural parameters.

While I was studying for my master's, I did a trainee project at the European Space Agency supervised by Norbert Schartel and María Santos-Lleó, where I learned the daily work of an astronomer. This experience was a keystone in my career for two main reasons. The first is that I realised that I love working in an international environment. The second is that I decided that I wanted to work with ground-based telescopes and be involved in the whole process. ESO is ultimately fulfilling both requirements.

Finding a PhD scholarship in Spain in 2015 was a titanic mission. Unfortunately, the country was still suffering the effects of the economic crisis, so there were few options. However, I found in Chile the opportunities that were not available in my own country. I used to think (and I still do) that if you want to be an excellent observational astronomer, you will do well to work here for a while and use one of the telescopes.

I arrived in Valparaíso, Chile, in August 2015 to start my PhD under the supervision of Matthias Schreiber. Our original project was to work on protoplanetary discs. However, in the end I worked on wide substellar companions around T-Tauri stars. And that is how my project ended up focusing on the origin of brown dwarfs to understand their primary formation mechanism. To accomplish this goal, it was necessary to study the brown dwarfs in their early stages, only visible in the submillimetre range of the spectrum. Therefore, I needed to learn how to work with ALMA, and it was at this point when I applied for the ESO studentship to work with Itziar de Gregorio, an expert in both the formation of brown dwarfs and ALMA. I would like to warmly thank Itziar for her guidance during my PhD. Itziar has been a fundamental pillar during my scientific career, and without her wisdom and support I would not have been able to continue in the scientific field.



During my doctorate, I worked on the early stages (pre-stellar cores to Class II) of brown dwarfs using optical and infrared observations to study the accretion processes and radio observations to study molecular outflows and the dust (disc or envelopes) surrounding brown dwarfs and very low mass stars.

After finishing my thesis in 2019, I immediately started working as an ALMA Fellow, thanks to my acquired knowledge of submillimetre interferometry. Working at ESO has given me the freedom and opportunity to collaborate with several people on various projects outside my main scientific path. For example, my area of interest has expanded to water masers, planet formation in brown dwarfs, and high-mass star formation.

I want to end by talking about my pandemic hobby. I began to brew beer at home at the worst time of the lockdown in Chile. Although I started doing this to avoid working on weekends, it became a regular hobby after brewing several batches. This activity opens a new world to me with different styles, colours, and flavours. Feel free to knock on my door to talk about brown dwarfs, low mass stars, outflows, jets, and beer varieties.