

## Fellows at ESO

### Bruno Dias

I am far from being a philosopher, but I have learned something from my experience on Earth so far. Some of it is shared here and I hope it can be useful for someone.

“Life gives you opportunities. Be prepared for them.”

It was the morning of 3 November 1994, my ninth birthday, and I could only think about being ready to see my first total solar eclipse from home. This event made me wonder about the Universe very early on in my life. This did not come as a surprise. My mother gave priority to high-level education for my siblings and me, even if it meant an economic sacrifice. My father always made me question everything and encouraged my interest in how things work in the Universe. Some special teachers guided me through the front door of my future career: the Olympiads of maths, physics and astronomy, as well as science clubs and fairs. All of this happened in the technological city of São José dos Campos, Brazil, where I also had the chance to visit inspiring places such as the National Institute for Space Research (INPE), where Brazilian satellites and rockets were developed, and Embraer which builds aeroplanes used for domestic flights in Europe.

“Work hard and be committed.”

My formal studies started at the University of São Paulo in Brazil, the best in South America, where I received my bachelor's degree in Physics, master's and PhD in Astrophysics (with a prize for the best thesis) under the supervision of Beatriz Barbuy, who was vice-president of the International Astronomical Union (IAU) at that time. During my PhD, I was selected for an ESO studentship for one year in Chile with Ivo Saviane, who was the instrument scientist of the Focal Reducer and low dispersion Spectrograph 2 (FOR2) at that time, and is currently the site manager of La Silla observatory.

My first postdoc position was at Durham University in collaboration with Ray Sharples, the Principal Investigator (PI) of the K-band Multi-Object Spectrograph (KMOS). I came back to ESO as a fellow after that. In fact, given my previous



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experience with FOR2, I volunteered to be its instrument scientist for six months, as there was no staff member available to fill this position. I learned a lot while contributing to ESO. One contribution was the analysis of the virtual slit — a way of elongating the shape of a star along the FOR2 slit to avoid saturation of bright stars when simultaneously observing faint stars using a multi-object spectrograph (MOS). Another contribution was to help a PI with the investigation of systematic errors in the wavelength calibration of blue spectra without strong sky lines. There were also numerous other contributions that eased operations, such as a script to decide which mask should be inserted into FOR2 before a given night.

Over the past decade I developed skills in the photometry and spectroscopy of star clusters in the Milky Way and Magellanic Clouds using FOR2, the Fibre Large Array Multi Element Spectrograph (FLAMES), the UV-Visual Echelle Spectrograph (UVES), the Multi Unit Spectroscopic Explorer (MUSE) at Paranal, and the ESO Faint Object Spectrograph and Camera 2 (EFOSC2) at La Silla. In addition I used several non-ESO facilities, such as the Southern Astrophysical Research (SOAR) Telescope and the Gemini telescopes.

My two major contributions to the field so far are: (i) the definition of a new metallicity scale for Milky Way globular clusters with a significant improvement for bulge metal-rich clusters — this is important to correctly and fully model the chemical enrichment history of the cluster population in our Galaxy, which is still incomplete; and (ii) the discovery of a Small Magellanic Cloud (SMC) region called the west halo, which is being tidally stripped away from the main body of the SMC — this is important because recent proper motion studies have shown that the Magellanic Clouds are on their first close passage towards the Milky Way, and not orbiting it as previously thought. Therefore, a detailed study of all structures in the SMC and Large Magellanic Cloud (LMC) are needed to fully understand their history. My ESO Fellowship has been the perfect period to develop my research, as I have total autonomy and leadership on my science projects.

“List priorities. Make choices. Follow them.”

Discarding bad options is easy but what happens when you do not have time for all of the remaining good options? How you use your time shapes you as a person and determines the type of astronomer you will be. This is not the full story because you only have control over a few aspects of your life — most of your life

does not depend on you. It is not easy. I had two crises during my career. The first one made me doubt whether I should be a professional astronomer, but ended up making my choice even stronger. The second crisis concerned the balance between work and my personal life, and moving from one country to another. Now, I have the happiest family. These crises were very important in making me think hard about what I really wanted from my life. Now I have made my peace with my choices, and am more determined than ever.

During my ESO fellowship, I dedicate 50% of my time to operating NACO (which is made up of the Nasmyth Adaptive Optics System [NAOS] and high-resolution near-infrared camera [CONICA]), KMOS, and FORS2 at UT1 in Paranal, as well as developing some technical projects on FORS2. The other 50% of my time is spent on science projects (which is why I do astronomy), invited classes at local universities, and some outreach. I think it is our duty to communicate what we do to the general public, because science is not only for scientists. In addition, our salary comes from public funds, and so we should “pay it forward”.

“Nobody works alone.”

I learned very early on that being an astronomer means collaboration, so I have attended many conferences, talking to people wherever I am. On many occasions, a cup of coffee in a sunny garden has been much more efficient than a few hours in front of a computer. Working hard is only effective if I know where to direct my efforts. Working in Paranal is also good for my science. The shifts give me no choice but to finish my contribution to a particular project more quickly and to a higher standard before going up to Paranal. When I come back from Paranal my collaborators have delivered their part and I can resume working. We never stop until a paper comes out. Time management and coordination with my network of collaborators are both key to finishing projects and to continue publishing papers.

Life at Paranal is great for getting people to work as a group, joining forces with astronomers, telescope operators and all specialities of engineers, all with the

common goal of offering state-of-the-art facilities to the astronomical community. During my fellowship, I also organised a local workshop on stellar populations, the ESO python boot camp, and an international ESO conference on the Galactic bulge, and helped as a tutor at the first Network of European Observatories in the North (NEON) school held at La Silla and Vitacura. These events were only possible with the help of many collaborators, mostly based in Chile.

Another perspective is provided by the many prestigious astronomers, scientists and engineers who come to ESO as visitors to observe with our telescopes, many of whom possess the knowledge and/or skills that I am looking for. I have had the chance to discuss science and even start collaborations while I was their support astronomer. I have also organised the science talks in Vitacura for over a year, which also led to many interesting meetings.

“What makes you happy? This should be your ultimate goal.”

I am happy if I manage to accomplish the personal guidelines detailed above. In other words, serving the astronomical community at Paranal, while finishing scientific papers with my collaborators. In addition, organising scientific meetings to answer big questions on astrophysics while sharing the news with the general public. Finally, playing music to relax with friends and spending time with my family. All of my choices are perfectly suited to my personal goals. Now I plan to keep developing myself and producing results as I am sure I am on the right track. 247 nights and days in Paranal so far and counting!

### Anita Zanella

The path that brought me to astronomy has been curved and made up of coincidences and chance.

I have always loved reading and when I was a child I wanted to become a writer. Even my first contact with astronomy happened thanks to literature. During middle school, we were asked by our literature teacher to read a book during the holidays. He brought us a great

collection of titles, spanning the most diverse topics and asked each student to choose one. I remember that I was very undecided. I loved novels, poetry and art. However, that day, I discovered a small volume about black holes in the pile of books. I do not really know why, but curiosity made me choose that book. It turned out to be extremely complicated — not at all appropriate for my young age — but this did not stop me. On the contrary, I went through it several times trying to understand as much as I could and I was completely fascinated.

At the same time, this discovery did not change my conviction of becoming a writer at all, and when the moment came to choose high school, I registered — with no hesitation — at a literature school. What excited me most at that time was the possibility to study Latin, ancient Greek, philosophy, and art. My love for literature kept increasing and my dislike for maths became a deep hatred. It was not unusual to catch me trying to solve equations with tears in my eyes from exasperation, and I used to conduct a personal war against maths, saying that it was totally dry and useless, like searching in a dark room for a black cat that is not there.

However, at 17, I started a chemistry class. The teacher was a researcher who had just left academia. She would sometimes describe the life of researchers. The idea that there were people working all their lives to satisfy their curiosity, studying and discovering the world, fascinated me completely. At that point, I started to think that I would like to become a researcher. But what to research? That book on black holes that I had read so many years before came back to my mind. Astrophysics!

When it came time to choose a university, it was a bit hard to decide to abandon the study of ancient Greek and literature, but the curiosity of the unknown, and a few nights spent with amateur astronomers staring at the sky, made me finally pick astronomy. Needless to say, everybody around me was astonished by my choice and kept telling me that astronomy is full of maths. But I had a goal — studying the Universe — and even equations seemed no obstacle to me.



Anita Zanella

I got both my bachelor's and master's degrees in Astronomy at the University of Padova in Italy. The start was extremely difficult, and I felt quite out of place until I started a class about the formation and evolution of galaxies. I found the topic charming, intriguing, and much closer to my taste. I decided to follow beauty and focus my studies on the formation and evolution of galaxies. I did my master's thesis, partly at the University of Padova and partly at the University of Minnesota (Minneapolis, USA), on passive galaxies and the relationship between their mass and size.

I also continued to investigate galaxies during my PhD, which I carried out in Paris, at CEA Saclay. There, I studied how distant high-redshift galaxies form stars in complexes called clumps. I was particularly interested in understanding how these star-forming regions are assembled, how long they can survive, and whether they can affect the morphological transformation of the host galaxy as time passes (for example, by contributing to the formation of the central galaxy nucleus, called the bulge). I mainly worked with images and spectra taken with the Hubble Space Telescope and ESO's Very Large Telescope (VLT). The beauty of those images always gave me the energy to keep working even during

moments of frustration, and I always found it thrilling that we are studying light that has travelled for billions of years before reaching us, our telescopes, our computers and ultimately our eyes.

During my ESO fellowship, I am pursuing the study of galaxy formation and evolution in both passive and star-forming galaxies. Furthermore, I decided to carry out my "functional duties" at the VLT in Paranal, as I had always worked with observations but had never actually observed at the telescope myself. Great choice! Once again, I have encountered beauty and curiosity; I am always amazed by the night sky that is visible from the desert, and excited when I see the images of the Universe appearing "live" on screen. It is from that same desert that I write this now. The night is finishing, so it is time to go out and watch one of the wonderful sunrises that Paranal offers up.

#### Remco van der Burg

The new ESO Supernova Planetarium & Visitor Centre has just opened its doors, and it has been fantastic to see the amazement on the faces of all those school kids after their visit. It takes me back about 25 years, when my own curiosity about space exploration and the

Universe was sparked. I have never watched Star Wars, nor have I ever owned a telescope myself, so I do not fit the typical cliché image that people may have of astronomers. However, on the occasional cloudless night in the Netherlands — my birthplace — I used to look up at the sky and have long conversations with my father about the vastness of space, and the finite speed of light and its implications. Frankly, we actually talked about other worlds and aliens.

At school, I had a knack for mathematics and physics, at least compared to other subjects such as languages, culture or history. While I often read popular articles about astrophysics, the first time I heard about the possibility of studying astronomy as a major at university was from Arjen van der Wel, my childhood piano teacher. He comes from the same tiny village I grew up in, made a career in astronomy himself, and is now a tenured professor at Ghent University in Belgium. Having lived a stone's throw away from Leiden, it was an easy choice for me to move there in 2004 to study astrophysics. At that point, I did not imagine that I would become an astronomer by profession a decade later. It really happened step by step, but the journey has been a great adventure so far!

I remember in particular that during my second year of undergraduate studies, I was invited to join an observing trip to the 2.5-metre Isaac Newton Telescope on La Palma with a dozen other students. This mind-blowing experience really awakened the observational astronomer in me. Little did I know at that moment that I would return to this telescope many times during my PhD. Every time I went back there, I made observing more of a sport to push the limits of the telescope. I remember the times that I tried to suppress the dome seeing by switching off the heater in the adjacent control room and operate the telescope wearing my winter coat, 10 nights in a row!

During my undergraduate studies, I worked on many different research projects. In my third year, I hunted for transit events that were potentially caused by extrasolar planets in the large photometric dataset from the Optical



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Gravitational Lensing Experiment (OGLE) survey. We actually discovered and confirmed an exoplanet by means of radial velocity measurements using the Ultraviolet and Visual Echelle Spectrograph (UVES) on the Fibre Large Array Multi Element Spectrograph (FLAMES) instrument; this was my first time using ESO instrumentation!

As a fourth-year undergraduate, I studied the thermal dust emission and molecular gas transitions in planet-forming regions around several young stellar systems. During that time, I had my first solo observing run, with the James Clerk Maxwell Telescope (JCMT) on Mauna Kea in Hawaii. This was just three years before the spectacular revolution that the Atacama Large Millimeter/submillimeter Array (ALMA) started to bring to this field. In the final year of my master's degree, I moved to extragalactic astronomy, performing a statistical study of Lyman-break galaxies found in a large dataset taken with the Canada France Hawaii Telescope (CFHT), and investigating the associated star formation in the early Universe.

Around that time, Henk Hoekstra, an expert in weak gravitational lensing, accepted a staff position at Leiden

Observatory. His broad field of research was very exciting to me, and I decided to start a PhD project in his group. While the initial plan was that I would work on projects related to weak lensing, I also gradually became interested in the physical processes affecting star formation in galaxies, in particular in galaxy clusters. I published most of my thesis papers on this broad topic, collaborating with both Henk and Adam Muzzin, who was a postdoc in Leiden at the time.

After my PhD, given my expertise in galaxy clusters, I was offered a postdoctoral research position at the Saclay Nuclear Research Centre (CEA Saclay) in France; this was funded by Monique Arnaud's European Research Council (ERC) Advanced Grant. I worked with her team on the study of galaxy clusters detected in the Planck mission. The multidisciplinary aspect of this ambitious project appealed to me; I got to work with experts in both X-ray studies of galaxy clusters and large hydrodynamical simulations. In turn, I brought my own complementary experience to the analysis of these structures in the optical and near-infrared. I took advantage of our privileged access to the CFHT, but also undertook a number of visitor runs at the William Herschel Telescope at La Palma.

I most recently became interested in the study of large low-surface-brightness galaxies, now dubbed Ultra-Diffuse Galaxies (UDGs). The real mystery about these galaxies is that they appear to be overabundant in clusters, where you may naïvely expect them to be short-lived as a result of frequent interactions and the large tidal forces. UDGs are a particularly hot topic at the moment; even with recent progress (including a number of papers that I have authored and co-authored), much is still unknown about the formation mechanisms of these strange galaxies.

I am grateful that I was able to work in so many different areas during these first years of my career, and I hope to continue doing so at ESO in Garching, where I started a new position as an ESO Fellow at the end of last year. Apart from my research, my functional duty at ESO is to help prepare for ESO's Extremely Large Telescope (ELT), the construction of which will be one of ESO's biggest and most exciting challenges over the next 10 years.

I am spending much of my free time in the nearby Bavarian mountains, which continuously amaze the Dutch "flatlander" in me. I'm also always excited to cook for a selected company of friends, and thus put our friendship to the ultimate test. To take care of the calories accumulated thereby, I minimise my time in the *U-Bahn* and commute between ESO and the city centre of Munich either running or by bike.