

## Fellows at ESO

### Rosita Kokotanekova

My path in astronomy began before I can remember, and it has led to my becoming an ESO Fellow thanks to the support of a long list of teachers, mentors, and friends. However, in the first place, I owe my inspiration to be an astrophysicist to my parents, Joanna Kokotanekova and Dimitar Kokotanekov. They have devoted their lives to outreach and teaching extra-curricular astronomy classes to high-school students in Haskovo and Dimitrograd in Bulgaria.

When my brother Georgi and I were little, our parents took us along to almost every observation they organised: astrophotography sessions, observations of partial and total solar and lunar eclipses, meteor showers, Venus and Mercury transits — you name it. Later, I participated in the Bulgarian National Astronomy Olympiad, as well as in two International Astronomy Olympiads in Crimea (2004) and China (2005). I also completed my first small research projects and had my first contact with ESO, both through the Catch a Star contest<sup>1</sup>.

These experiences convinced me that I would like to become an astrophysicist and in my bachelors degree I chose to study Earth and Space sciences at Jacobs University Bremen, Germany. This programme was a great choice because it allowed me to learn more about geosciences and environmental studies alongside astrophysics. Besides, the education at Jacobs University had a hands-on approach and prepared me very well for a research career.

After only my first year at Jacobs, I contacted Marcus Brüggen and Elke Roediger to ask whether I could work with them on a small research project over the summer. During this summer project and my subsequent bachelors thesis research, Elke taught me a great deal about galaxy clusters and hydrodynamical simulations, but most importantly introduced me to the research process — how to start with an idea and find the right collaborators, and how to complete it and produce a high-quality scientific publication.



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After my second year at Jacobs University — in 2011 — I joined the Laboratory of Astrophysics (LASTRO) at the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland where I worked with Frédéric Courbin, Cécile Faure and Georges Meylan on a six-week project to discover strong gravitational lenses in optical images from the Wide Field Camera 3 (WFC3) on the Hubble Space Telescope (HST). I greatly enjoyed the friendly environment at LASTRO and the Observatory of Geneva, as well as living so close to the Alps, so I decided to go back for another two-month project the year after.

Straight after completing the second internship, I joined the AstroMundus Masters Course in Astrophysics. This program took me on a two-year journey through four different countries, at the University of Innsbruck, the University of Padua, Belgrade University and Göttingen University. After three semesters of courses covering almost every area of astronomy, I spent the final semester of the programme researching X-ray weak quasars with Wolfram Kollatschny at Göttingen University and Luka Popović in Belgrade. This project gave me my first experience of spectroscopy and taught me how to work independently — a skill that has come in handy during my PhD, and especially during the ESO fellowship.

I had reserved the AstroMundus summer break in 2013 for a three-month internship at the Harvard Smithsonian Center for Astrophysics working with Ralph Kraft

and Akos Bogdan. This project was a continuation of my work with Elke Roediger and would not have been possible without her generous efforts to expand my skill set and to develop my resumé. My work at CfA was extremely interesting and introduced me to X-ray and radio observations of galaxy cluster centres. In addition to the amazing science environment at CfA, that summer also brought me many wonderful experiences which I shared with old and new friends in Boston.

The next step of my career was determined by a lucky coincidence. Straight after the internship at CfA, I started looking for PhD positions. While I was fascinated by extragalactic astronomy, and in particular by X-ray observations of galaxy clusters, I was not looking forward to yet another relocation. This motivated me to keep my eyes open for other PhD opportunities that would let me stay in Göttingen or at least in Germany. Then suddenly, in November 2013, the press was filled with reports about the unexpected complete disintegration of comet ISON. This got me very intrigued because up to that point I had not had any courses in Solar System science and I naively thought that small bodies were very well studied, and that their behaviour could be predicted with great accuracy.

That same week, a friend sent me a link to the home page of Pedro Lacerda who was looking for PhD students to join his newly formed research group in Cometary Science at the Max Planck Institute for Solar System Research in Göttingen.

After reading his webpage and meeting him in person, I was captivated by his way of thinking and his approach to doing research. He also managed to convince me that minor planets in the Solar System hide many unanswered questions.

I joined Pedro's research group in October 2014 and chose to work on his large observing programme with ESO's New Technology Telescope (NTT) at La Silla. The programme was awarded 40 nights with the ESO Faint Object Spectrograph and Camera 2 (EFOSC2) to study the rotational light curves and surface colours of up to 60 Trans-Neptunian Objects (TNOs). In only the third week of my PhD, I went for my first observing run at La Silla with my other PhD advisor Colin Snodgrass. This was the first time I had the chance to spend time with Colin, and I quickly became convinced that my PhD was going to lead to many exciting projects and fun trips. Soon after that run, I enrolled as a PhD student at the Open University, UK and Simon Green joined the supervision team as a third advisor. While most people are lucky to find one good advisor, I was fortunate to work with three great mentors on my PhD.

Like most PhDs, mine did not go as planned. The data from the large programme turned out to be very challenging to analyse, and instead I focused on publishing our side projects on photometric observations of Jupiter-family comet (JFC) nuclei. This led to many new ideas and accepted observing proposals on nine different telescopes. The work on that project did not always go smoothly either, but in the end resulted in a coherent PhD thesis, which I managed to write mainly during an eight-week window while being stuck at home with a broken foot.

Ever since my first trip to La Silla, I had been hoping to follow in Colin's footsteps to become an ESO Fellow. When the time came, and I was about to look for postdoc positions, my advisors encouraged me to put my ideas together and design a research programme to propose for the ESO fellowship application.

This led to an offer from ESO and I started my fellowship in November 2018, two months after I defended my PhD



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thesis. At ESO, I chose to take up support astronomer duties on VLT/UT3 as my functional work and now, after four shifts in Paranal, I have finally completed my extensive training as a support astronomer. My duties in Paranal are very challenging but extremely rewarding. On the one hand, the trips to Chile are physically exhausting, but on the other hand I have become part of the amazing Paranal community, and I have already learned even more about the telescopes and instruments than I had hoped.

As this is the first year of my first postdoc, the past twelve months have been full of many new adventures in the world of research. Probably the most rewarding one of them was mentoring a talented and enthusiastic summer student — Abbie Donaldson — during the first ESO Summer Research Programme (see page 57). For the coming year, I have an ambitious plan, which among other things includes: completing a few projects on TNOs and JFC nuclei; organising the second ESO Summer Research Programme together with the other fellows; securing more observing time for the ideas I developed over the past year; four trips to Paranal; many important conferences and meetings; more time spent working with collaborators; and last but not least, a couple of vacations that my husband and I have been looking forward to for years.

#### Links

<sup>1</sup> ESO Catch a Star contest: <http://www.eso.org/public/outreach/eduoff/cas/>

#### Stefano Facchini

Since I was a kid, I have had a passion for science — in, I would say, two different flavours. First of all, I have always been touched and fascinated by the beauty of nature, by the constantly varying shades of colour in the sea, by the powerful heights of the Alps during a hike in the summer, or by the fragility of field flowers in my grandparents' farm. I strongly believe that my sense of awe in front of the beauty and apparent order of nature is one of the main driving forces that led me to become a scientist. Secondly, I have always been interested in and fascinated by mathematics, showing a strong propensity towards scientific topics since my first years at school.

My passion for the night sky grew later, during the first years of high school. I have a clear memory of one evening being in the countryside close to Lake Como in Italy with a friend of mine and his father. His dad started pointing at the sky and naming the constellations that were visible during that summer evening. What impressed me the most is that he had a familiarity with the beauty of the sky we were looking at; he could recognise and name stars, whereas for me everything was beautiful but totally unknown. From that evening, I started studying the constellations of the northern hemisphere, and I developed an enthusiasm for getting to know and being able to describe the beauty of the sky.

I continued to follow my passion for natural sciences, and I started attending

physics courses at the University of Milan in Italy. The choice of the subject of my undergraduate studies was the easiest choice of my life by far! Even though I loved many topics, in particular solid state physics and statistical mechanics, I opted for a masters degree in astrophysics. What attracted me the most is that this subject required one to study and understand many areas of physics: general relativity, classical mechanics, quantum mechanics, molecular physics, etc. All aspects had to be taken into account! One of the topics I loved the most was compact objects — in particular the book *Black holes, white dwarfs and neutron stars: the physics of compact objects* by Teukolsky and Shapiro — where the three main forces of physics interplay to produce beautiful objects such as neutron stars and black holes.

For my masters thesis, I decided to work with Giuseppe Lodato, who had recently arrived in Milan from the UK. During my thesis, I started working on a research topic that is what I still work on seven years later: protoplanetary discs and planet formation. The thesis project was deeply theoretical, and we were trying to answer the question: what would happen if a protoplanetary disc orbits around a binary that is misaligned with respect to the disc itself? Developing semi-analytical models and hydrodynamical simulations, we figured out that the disc can warp, and in some extreme cases, it can break into separate annuli. At the time I approached this as a theoretical game. How impressed I was years later when high-resolution images of protoplanetary discs started to be available, in particular thanks to the VLT instruments NAOS-CONICA (NACO) and Spectro-Polarimetric High-contrast Exoplanet REsearch (SPHERE), and signatures of these broken discs were directly observed as we had predicted!

The masters thesis was such a great experience that I decided to keep on doing research with a PhD. To do this, I managed to go to Cambridge in the UK, to work with Cathie Clarke on a variety of topics, and in particular on the effects that ultraviolet radiation from massive stars can have on the evolution of protoplanetary discs in young massive clusters. The PhD was mostly theoretical; the

most important thing I learnt is to ask myself the question that Cathie asked me many times: “how do you understand this equation empirically?” In other words, how is this mathematical formula describing a physical phenomenon in a simple way? This way of looking at the mathematical formulation of physics has changed my way of doing theory forever, leading me to understand a physical process with very simple principles.

Towards the end of my PhD, however, I felt that I was lacking something, so much so that I wondered whether to continue to do research. At some point, I understood that I was missing a closer connection to observations, and I tried to find a postdoc that could allow me to develop this new side of research. I was lucky enough that Ewine van Dishoeck invited me to join her group at the Max Planck Institute in Garching, and the three years with her group have been key for who I am today as a scientist. In particular, with her I broadened my expertise, and started working on thermochemical models of discs, and more directly on observations at different wavelengths (from millimetre to ultraviolet). Those same years, since 2015, have been transformational in my field. The tremendous capabilities of the Atacama Large Millimeter/submillimeter Array (ALMA), in terms of sensitivity and angular resolution, together with high-performance infrared imaging instruments such as SPHERE, completely revolutionised the field of planet formation, showing images of the environments where planets form with unprecedented detail. Doing research in a field that was being transformed every six months by a new set of observations has been among the most exciting experiences of my life.

During the last year, I have been working at ESO as a fellow. This has allowed me to move even more towards observational astronomy, getting even more involved with ALMA (through my functional work) and with other instruments on the VLT (such as SPHERE, MUSE, X-Shooter). To me ESO is the perfect environment to do astrophysical research in the way I love: led by observations, but with a strong theoretical background to interpret the data and to predict what to expect. I look forward to the next two

years and to even more exciting discoveries!

### Johanna Hartke

It is hard to pinpoint exactly when I discovered my passion for astronomy. I grew up in the northern German countryside, so even though the skies were relatively dark, it was often cloudy. My parents had a small refracting telescope which stood forgotten in front of the living room window, waiting for clear skies. However, as a child, I was more drawn towards the piano that stood right next to it. One of my first (of many) career goals was to become a pianist, then followed by a desire to be a teacher, an actress, a mathematician, and eventually, a physicist.

Following a summer school on quantum physics for gifted high-school students the year before I graduated high school, I was convinced my career lay in theoretical physics. A year later, I enrolled to study physics at Jacobs University, a small, international university in Bremen. I had a great experience living on campus with students from over a hundred different countries, but soon realised that theory was not my calling. While I enjoyed experimental physics lectures, I was also

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notorious for clumsy accidents in the lab. However, there was one topic I excelled in and that was astrophysics. Unfortunately, the astronomy branch was closed in my second year of study. The subject was not uppermost in my mind anymore, and struggling with the prospect of becoming a researcher, I seriously considered reverting to one of my earlier career choices: becoming a teacher. I had just made it to the state final of a youth music competition in Germany and teaching music and physics in high school seemed like the perfect combination of subjects for me.

Everything changed, however, when I was selected for a summer internship at Mount Stromlo Observatory of the Australian National University. For the first time, I got an insight into the day-to-day life of a researcher and could work independently on a small project on stellar streams in the Milky Way. My supervisor Ken Freeman introduced me to the beauty and elegance of galaxy dynamics. All of a sudden, I could appreciate classical mechanics as a great tool to describe the motions of the stars. After the internship, I abandoned my idea to go to the conservatory and instead focused on finding an opportunity to carry out my bachelor thesis research project in astronomy; so I found a placement in nearby Groningen to work with Amina Helmi.

I decided to stay at the Kapteyn Institute for another two years to complete my Master of Science, thoroughly enjoying a curriculum centred on astronomy. Soon an opportunity came up to enroll in a course on observational astronomy which was to take place at the Isaac Newton

Telescope on La Palma. During our five nights at the telescope, we experienced first-hand how it felt to be an astronomer and the patience it required in case of bad weather! Yet I had found a new passion. It was rewarding to see our project grow from a little idea in our heads to typing the coordinates of targets into the telescope, and to finally present the science to our peers after reducing the data. One year later, I again found myself on La Palma, this time observing at the William Herschel Telescope for my master thesis project with Eline Tolstoy.

It was clear that I wanted to pursue a PhD in observational astronomy. In the same year, I was accepted into the International Max Planck Research School (IMPRS) on Astrophysics in Munich for a three-year studentship at ESO under the supervision of Magda Arnaboldi. For my PhD, I investigated how the halos of early-type galaxies grow through mergers and accretion. This is a challenging endeavour, as the closest early-type galaxies are already millions of light-years away, but the faint halos are very extended on the sky. I therefore use a particular type of stars — planetary nebulae — which are like green beacons in the sky, and whose velocity can be measured even at a distance of hundreds of millions of light-years.

I enjoyed being in the middle of one of the astronomy hubs in Europe and got to participate in many exciting seminars and conferences that were taking place on campus. I travelled again to La Palma to observe the halos of giant elliptical galaxies with the custom-built Planetary Nebula Spectrograph (PN.S) for my the-

sis. Since the PN.S is a visitor instrument, we spent many afternoons leading up to our observations tuning the filters and aligning the CCDs in the instrument arms. Six months later, I got the opportunity to join my ESO Fellow mentor during his duties at Paranal observatory. At last I was convinced that the next step for me would be an ESO Fellowship in Chile to get even more exposure to the forefront of astronomical research and instrumentation.

And here I am now. I have just completed the first year of my fellowship and therefore the first 80 days and nights as a support astronomer on Paranal. It has been an exciting year with a steep learning curve! I am part of the Multi Unit Spectroscopic Explorer (MUSE) instrument operations team and currently work on a project to investigate how well the adaptive optics improve the image quality. It is great working in an international and interdisciplinary team. I particularly enjoy the ritual of watching the sunset from the platform before the night starts. I also recently started to experiment with astrophotography. I like to share the wonders of the night sky with my friends in the city, where due to the bright lights, one can barely make out the Southern Cross. When I am not observing or working from Vitacura, one is likely to find me rehearsing music. While living in Munich, I was a soprano with the Münchner Motettenchor and spent a good part of my leisure time in churches and concert halls in the region. Now in Santiago, I have again taken up singing, although on a smaller scale. It is a relaxing balance to the academic world and a great way to practise my Spanish.

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## In Memoriam

ESO staff member, Cristian Herrera González, sadly passed away in August 2019 and will be much missed. He joined ESO and the Science Operations Department as Telescope and Instrument Oper-

ator (TIO) in 2001. During his 18 years at Paranal, Cristian worked on most of the telescopes, instruments and subsystems of the observatory. He held the role of nighttime TIO Coordinator for more than

10 years, leading the night crew and was the coordinator of the Instrument Operations Teams activities for the operators during his shifts.