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Fellows at ESO

Darshan Kakkad

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It's a pleasant summer night in Paranal; it just rained and we put the covers over the primary mirror at Unit Telescope 4 (also known as Yepun) for protection. The telescope domes are now closed and all of us are waiting until the weather improves. And here I am, sitting in the control room in the middle of the Atacama desert and, even more than the reader, I myself am wondering how the choices in my life got me here! None of my family members work in areas even remotely related to science. To them, I am the guy who looks through a small telescope in his backyard searching for aliens.

My story begins with a power cut in Delhi. It used to happen quite frequently on summer nights and the terrace in my house used to be the best place to get cool breezes. I was in middle school back then and, along with my siblings, we used to look at the stars and try to identify the constellations that we had learnt at school. Perhaps that was the first time I was interested in becoming an astronomer, although crediting Delhi power cuts does not seem the best "how I got inspired" story! I still remember when I got up early in the morning in 2005 and ran to the same terrace to see the sunrise — or rather, the eclipsed sunrise. It was probably the best eclipse I have seen in my life: the red Sun at the horizon covered by the Moon.

The seed was planted and all it required was some nourishment and a bit of luck. I was adamant about pursuing a career related to space and/or astronomy. After high school, I even went to a selection camp for the Indian Air Force in hopes of becoming a pilot (and, eventually, an astronaut: Teenage Dreams!). However, I was kicked out on the fifth day of selection. As nowhere in India offered an undergraduate degree in astronomy, I decided to settle for physics at the University of Delhi for my bachelor programme. During the first year of my undergraduate course, I got a Kishore Vaigyanik Protsahan Yojana (KVPY) fellowship from the Department of Science and Technology of India, which secured my education funding until the end of a masters degree. The fellowship continued as long as I did a research project in any institution in India each year during the summer. I visited the Giant Metrewave Radio Telescope (GMRT) facility as part of this fellowship to do a project on testing the new broadband feeds using pulsars. After a two-hour bus journey from the city of Pune through the lush, green landscape, I started spotting the antennas one after the other as we entered the observatory. Once there, my cellphone would be switched off for two full months, apart from during the occasional trips when I would go back into the city. Although my first observing run was a disaster, with no useful data acquired, the entire learning experience was something I enjoyed and I was sure of pursuing a PhD in Astronomy after that.

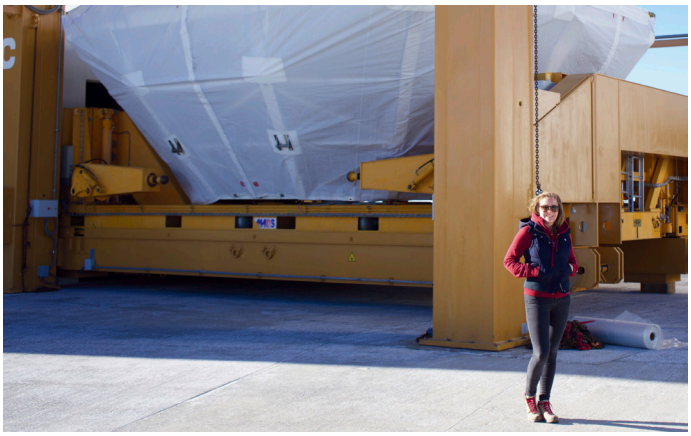
I was therefore excited to get an offer from ESO as part of the International Max Planck Research School (IMPRS) PhD school in Munich where I would change topics to work on active galactic nuclei (AGN) feedback with Vincenzo Mainieri and Paolo Padovani. The thought of working with data from one of the best telescopes in the world was fascinating and I could not wait to get started after my masters degree. Having limited experience with observational astronomy, I had a steep learning curve at the beginning of my PhD. There is a huge difference between doing a two-month internship and a PhD, where solving problems sometimes takes a year. Also, coming from a tropical environment, I wasn't familiar with the white thing they call "snow". So, climate-wise as well, it took me time to get used to the colder weather. Despite these differences, I enjoyed my work, especially the feeling of having solved a problem after some months.

Since my PhD, I have been heavily involved in integral field spectroscopy and sub-millimetre spectroscopy at both low and high redshifts. Using a multi-wavelength approach, I investigate whether the presence of ionised outflows in the host galaxies of X-ray selected AGN has an impact on the global properties of the host galaxy, such as the star formation rate, molecular gas mass or gas densities. I have been using data from the Spectrograph for INtegral Field Observations in the Near Infrared (SINFONI) at the VLT, the Wide-Field Spectrograph (WiFeS) at the Australian National University (ANU) and the Atacama Large Millimeter/submillimeter Array (ALMA) for this purpose, collaborating with people at ESO, the ANU, the Istituto Nazionale di Astrofisica (INAF) in Italy and various institutions in Japan and the UK. As an ESO fellow, I am continuing to work in this field with more diverse and deeper data sets.

Working with data is amazing in itself, but as a person who aspires to be an astronomer, I felt it was important to have the experience of working in the place where the real action happens — the Observatory itself. I was keen to see how instruments work and experience the challenges that can occur when taking observations. This is what motivated me to join ESO for a fellowship in Chile and, indeed, the experience at the Paranal Observatory is completely different compared to sitting in a chair and looking at the data. It's just amazing how dedicated people at the Observatory are to solving

issues each day in order to have the telescope ready for the observations every night.

And that's what we are doing right now! It's almost 2am. The rain has stopped and the weather officer has given the clearance to open the domes. The telescope operators have put on their helmets to go to the Unit Telescopes and start the opening sequences and within a few minutes we will start observing again. We're all happy to have managed even three hours of observation over the night. People say, "Time is Money". Well over here, "Time is Science!"



Elizabeth Bartlett

Elizabeth Bartlett

In 1995, when I was seven or eight years old, my mum picked up a book called Skywatch for a couple of pounds in a local supermarket. The book had a page of information on each planet, as well as galaxies and different types of stars, along with some pictures and artists' impressions of celestial objects. I often wonder what would have happened if my mum had walked past that book or had picked up something different instead; that book set me on a journey that has taken me around the world and currently has me sitting in Santiago (Chile) after a shift at ESO's Very Large Telescope.

If that book dug the foundations for my future career, then the concrete was set by seeing comet Hale Bopp just a couple of years later through my grandfather's small refracting telescope (usually used for watching passing ships). Eager to fuel this obsession of mine, my grandfather bought me every single astronomy book he found in a charity shop or car boot sale, right up until the day he died. This led to an eclectic personal library, ranging from that first "Skywatch" book, right up to an advanced level textbook about planetary atmospheres, which was way beyond my understanding at 12 years old!

My passion for astronomy remained with me throughout school, but I had no idea that astronomy could be an actual career path until I went to university. I studied Physics and Astronomy at the University of Southampton as, unlike any other institution at the time, the course included the opportunity to visit and take data at a "real" observatory, the Observatorio del Teide in Tenerife, home of the Instituto de Astrofísica de Canarias 80-centimetre (IAC-80) telescope. I remember arriving at the observatory after dark, getting off the bus and really seeing the night sky for the first time — that's when I knew I wanted to be an astronomer. The module was about more than just inspiring us; we learnt about right ascension, declination and hour angles, how to plan an observing run, CCDs, data calibration, and most crucially, how to get along with everyone at 2400 m in a snowstorm! While my other astronomy modules taught me the physics behind the greatest astronomical discoveries, this module taught me *how* these discoveries came about, from data to the resultant paper.

I spent the final year of my degree programme at the Harvard-Smithsonian Center for Astrophysics (CfA) in Boston. Here, I did the research for my Masters thesis in the High Energy Astrophysics Division with Michael Garcia, attempting to do proof-of-concept for X-ray timing techniques with data from the X-ray Multi-Mirror satellite (XMM-Newton) ahead of the, now cancelled, International X-ray Observatory. Working at the CfA gave me a taste for the more day-to-day aspects of life as an astronomer, and working with high-energy space-based data brought a completely different set of challenges.

I returned to Southampton for my PhD, to work with Malcolm Coe as part of the X-ray binary group, monitoring the Magellanic Cloud population. My research focused on multi-wavelength studies of these sources, both individually and as a population. I used simultaneous X-ray spectral and timing analysis to constrain system geometries, and worked on identifying new high-mass X-ray binary candidates by cross-correlating searches of X-ray sources with optical, radio and infra-red catalogues, and developing techniques that make use of multi-wavelength data to discriminate between different types of sources. This multi-wavelength project was particularly appealing as it allowed me to combine my newly gained skills and knowledge in X-ray astronomy with my passion for the night sky. My supervisor promised me several observing trips, and he delivered, with yearly visits to the South African Astronomical Observatory (SAAO) to use the 74-inch Radcliffe telescope and a trip to ESO's La Silla observatory to use the New Technology Telescope.

After my PhD I moved to South Africa to take up a Claude-Leon research fellowship at the University of Cape Town. I expanded my work to cover other X-ray emitting massive binaries, such as colliding wind binaries, and became heavily involved with the Southern African Large Telescope (SALT) — technically the biggest single telescope in the Southern Hemisphere. I established a dedicated campaign to monitor the X-ray bright supergiant emission-line sgB[e] stars in the Magellanic clouds, and was also involved in the testing and development of the SALT data pipeline and PySALT python-based software package. SALT shares the SAAO site with smaller telescopes, so while observing on the 74-inch telescope I would often run over to SALT after starting an observation, not

just to use their coffee machine, but also to see operations. SALT is only operated in service mode and closely follows the ESO model (as it is mostly run by ex-ESO fellows, such as, Petri Vaisanen and Eric Depagne). Getting to see my own data being taken was a treat that few astronomers get to experience. I have no doubt that it was the combination of working closely with SALT and working with the older, more hands on, telescopes that made my application attractive to ESO.

My time in South Africa really opened my eyes to the power of astronomy for social change. Observatories are built in remote locations and in developing countries; this often means near disadvantaged communities. To build an observatory you need infrastructure, such as paved roads, electricity, water and the Internet. To maintain an observatory, you need trained engineers on hand who can fix the telescopes and instruments, and staff to take care of the food and lodging for the astronomers. World-class telescopes, such as the VLT, generate interest that leads to tourism providing a huge boost to local economies. Observatories can provide employment across many sectors in regions where there may be few opportunities. One could argue that a telescope's success should not just be measured in the number of papers it produces but on how it enriches the communities that surround it.

Now an ESO fellow, I am part of the science operations team at Paranal Observatory. I spend 80 nights a year observing at Kueyen (Unit Telescope 2 [UT2]), the home of the UV-Visual Echelle Spectrograph (UVES), the wideband ultraviolet-infrared spectrograph X-shooter and the Fibre Large Array Multi Element Spectrograph (FLAMES). While there are many observatories around the world that allow one to gain observing experience, I have the chance to go beyond this by working at ESO's Paranal Observatory and to be part of something truly bigger than me or my work.

Last year I was involved in interventions on all three of the instruments on UT2, including recovering the resolution of the blue arm of UVES and the recommissioning of X-shooter after it was dismounted and dismantled to repair the atmospheric dispersion correctors. I am currently the instrument scientist for FLAMES and enjoy having the opportunity to leave a mark on Paranal beyond my time here — or at least until FLAMES gets decommissioned! I was also fortunate enough to be at Paranal just after the initial detection of the gravitational wave GW170817. Being at the observatory at such a time was an absolute privilege (whilst simultaneously being incredibly stressful!) and the atmosphere in the control room during those nights will stay with me for a long time.

The start of Period 101 coincides with the beginning of my final year of duties at Paranal. I have been awarded 20 hours of X-shooter time to look at my targets in this period and my hope is that I get the chance to execute some of my own observations. That would be a very special moment for me as my time at Paranal draws to a close and would complete my experience as an ESO fellow.

Hau-Yu Lu

I grew up on a very tropical island in East Asia, Taiwan. I studied at the National Taiwan University, where I majored in physics. One of the focuses of the physics department is on particle physics and several professors in the theoretical group were quite stimulating. I particularly enjoyed brainstorming sessions on mathematical physics and used to follow the related group meetings and seminars. In particular, I was very impressed by the culture in the group under Pei-Ming Ho. Thanks to that team I have an attitude of constantly questioning myself until I converge on a position that feels self-consistent and logical. I also became an efficient and motivated self-learner and greatly enjoyed my college life.

I quickly realised that I could understand theoretical and fundamental physics, which I greatly appreciated, but found it difficult to be creative when doing research in these areas. I was capable of working on phenomenological theories based on fundamental physics, on the other hand, but found that the models of dark matter and dark energy were only loosely constrained by experiments. I started thinking about starting again as an observer, although I did not have a concrete idea about what to do. I had a

Hau-Yu Lu

rough idea to use the spatial distributions and motions of galaxies in a cluster to probe the gravitational potential of the dark matter, so surveying galaxy groups or clusters might be a good place to start.

Following up on this simple idea, I joined the group under Tzi-Hong Chiueh in Taiwan University and was introduced to Lihwai Lin and Bau-Ching Hsieh, postdoctoral researchers at the Academia Sinica Institute of Astronomy and Astrophysics (ASIAA). At that point, very massive galaxy clusters could be identified by either X-ray observations, the Sunyaev-Zel'dovich effect, strong lensing, or the photometric red sequence. However, the identification of smaller groups and clusters was ambiguous, largely because of the poor detection limits in relatively shallow photometric surveys as well as the poor completeness of redshift samples. We therefore looked into how to associate sparsely sampled galaxies in the redshift domain using an artificial neural network, and benchmarked our algorithms based on mock galaxy surveys generated from *N*-body simulations.

When reading papers about how *N*-body simulations were made, I started to realise that mock galaxy surveys were too artificial for my purposes. First, there is the artificial criterion that dark matter overdensities can be regarded as

galaxy-forming dark halos. Then, galaxies were assigned to individual dark halos based on the halo occupation distribution function, which is rather empirical. Finally, galaxies were assumed to have certain luminosities based on yet another empirically assumed mass-to-light distribution function. This same mass-to-light distribution function plays a critical role in allowing us to relate observations to the underlying actual structures. In other words, our conclusions based on observations can be hugely biased if we do not understand this function.

Mass and light are linked by the baryon fraction as well as the "laws" governing how high-mass stars form out of baryons. Star formation laws exist, but are not yet understood from first principles. Not even close! In fact, even just forming a luminous OB cluster is a highly non-trivial phenomenological problem. This is because the radiative feedback from the highest mass stars may destroy the parent molecular cloud as soon as they form. I therefore decided that my PhD thesis topic was to understand how OB stars accrete, and what is the specific parent molecular cloud morphology that would permit the subsequent formation of lower mass stars.

My thesis supervisor was Paul Ho at ASIAA who was leading the SubMillimeter Array (SMA) project, which was the most powerful tool that could be used to spatially resolve detailed molecular cloud structures at that time. For the last three years of my PhD, I went on an exchange to the Harvard-Smithsonian Center for Astrophysics (CfA), to work with Qizhou Zhang. During these years, I had the opportunity to engage more with the SMA community and visited the National Radio Astronomy Observatory in Socorro for several months during the upgrade of the NRAO Karl G. Jansky Very Large Array (JVLA). I would specifically like to thank Melvyn Wright at Berkeley, who is still teaching me about radio interferometry (and writing in English).

After my PhD, I returned to ASIAA as a postdoctoral fellow, and that period also served to substitute for my military service. My research area was significantly broadened during that time and I got my first masters students, Yuxin Lin and I-Hsiu Li — of whom I am extremely proud — to join my journey to investigate how amorphous low-density gas clouds evolve to become OB cluster-forming clouds, and to learn where and when dust grains grow in a protoplanetary disc. However, they were apparently too good as they ended up being recruited to join other researchers' journeys, which I am also very glad about, of course.

These same years also coincided with the start of science operations for the Atacama Large Millimeter/submillimeter Array (ALMA). As ASIAA is a partner institution, I had the opportunity to experience ALMA operations first-hand. All of these experiences formed me and paved the way to my joining ESO as a postdoctoral fellow in Garching, as well as turning me into who I am now. I have also contributed to the report on the QUESO 2017 workshop (p. 46) in this issue of the ESO Messenger, which you might find of interest!

Personnel Movements

Arrivals (1 January–31 March 2018)

Europe

Bezawada, Nagaraja Naidu (UK)	Detector Engineer
Brandt, Daniel (DE)	IT Specialist Database Administrator
Dominguez-Faus, Lidia (ES)	Software Engineer
Gnatz, Amelie (DE)	Documentation Specialist
Hucke, Jannett (DE)	Internal Auditor
Jaillot, Caroline (FR)	Electronic Engineer
Pathak, Prashant (IN)	Fellow
Prole, Daniel (UK)	Student
Sanchis Melchor, Enrique (ES)	Student
Serra, Benoît (FR)	Fellow
Tax, Tomas (CZ)	Student
Vieser, Wolfgang (DE)	ESO Supernova Education Coordinator
Wallace, Mark (AU)	Control Engineer
Zanoni, Carlo (IT)	Opto-Mechanical Engineer

Chile

Bian, Fuyan (CN)	Operation Staff Astronomer
Courtney-Barrer, Benjamin (AU)	Telescope Instruments Operator
Figueira, Pedro (PT)	Operation Staff Astronomer
Leclercq, Julien (FR)	Mechanical Engineer
Parra, Ricardo (CL)	Optical Coating Engineer

Departures (1 January–31 March 2018)

Europe

Allaert, Eric (BE)	Senior Software Engineer
Ghiretti, Paolo (IT)	Civil Engineer
Gonzalez Fernandez, Ariadna Irene (ES)	Student
Zivkov, Viktor (DE)	Student

Chile

Cox, Pierre (FR)	Senior Scientist
Jaffe Ribbi, Yara Lorena (VE)	Fellow
Johnston, Evelyn (UK)	Fellow
Neumann, Justus (DE)	Student
Slusarenko, Nicolas (CL)	Software Engineer