Staff at ESO

Zahed Wahhaj

I arrived at Santiago late in 2012 to join ESO as Faculty Astronomer with duties on Paranal. The SPHERE exoplanet-finding instrument was supposed to arrive at the observatory in late 2013, and I was to be one of three instrument scientists. I had spent the last six years in Hawaii, working on the Gemini NICI Planet-Finding Campaign, trying to directly image exoplanets with the 8-metre Gemini South Telescope. It was thrilling to know that I would get to work with one of the most powerful exoplanet imagers in the world, and that I was joining a vibrant research community at ESO, Santiago. Six months later, I find these expectations are not a bit untrue.

My journey to Chile is just as roundabout as my journey to exoplanets. Age zero to seven I spent in Iraq. The next 11 years I was incubating in my home country, Bangladesh. Then I decided to go to college in Philadelphia, followed by four years in Flagstaff, Arizona, then boomeranged off to Hawaii, finally arriving intact in Chile. In the beginning, I had decided not to be much of anything. Indeed, I had reportedly given up on life and attempted pneumonia a few days after birth. By age seven, I had found meaning in following my mom in prayer. Upon learning to read effectively, I thought my life until aged ten had been wasted, and that I would have a fruitful life in literature. Around age 13, I realised that all that fiction was depriving me of some essential truths. This was when I read a science populariser called *The Omega Point* and became obsessed with the end of the Universe. Also around this time, upon discovering some pictures of constellations in a library book, I decided to check if these were also "true" and climbed the water tank on our roof at night to compare with reality. It hit me then that some of the most interesting things about the Universe were not reaching me.

For the next few years I played with the interesting parts of physics, and then the next few years, the interesting parts of computer science. In college, I thought I should do both and that they would seamlessly combine into a double major. They did, but not seamlessly. In graduate

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school, I turned into a radical high-energy physics enthusiast. This enthusiasm cooled when I realised that the fourth-year enthusiasts had no conference money. In the third year of grad school, I thought back on the water-tank experience and decided that I should have received the message more directly. I went to talk to newly arrived University of Pennsylvania Professor Dave Koerner about the direct imaging of circumstellar matter, and whether he was finding something interesting there.

Dave had just obtained the first resolved images of a debris dust ring around the star HR 4796A using the Keck telescope. The images were obtained at mid-infrared wavelengths, where the thermal emission from the dust ring, formed from collisions between rocky bodies in the system's own exo-Kuiper Belt, was brighter than the star. In such debris disc systems any asymmetries in the dust distribution could be signatures of planets. I would do my PhD thesis on the measurement of the morphology of the dust discs in three young systems, β Pic, HR 4796A and 49 Ceti. This involved trying to match the images of the dust at wavelengths where it was radiating thermally and at shorter wavelengths were it was mainly reflecting stellar light. Dave had introduced me to Bayesian statistics, which I used to obtain probability distributions for the disc properties. Bayesian statistics still has a great attraction for me, because it is essentially about asking a robot about its beliefs after being taught a few logical rules and then supplied with some observations.

Near the end of grad school and as a postdoc in Flagstaff, I worked with the Spitzer Cores to Disks Legacy team. We had been given 400 hours of the Spitzer Space Telescope observing time to study star formation through its disc and planet formation phases, by looking for dust at mid- and far-infrared wavelengths. My work was to figure out the evolutionary status of stars which showed signs of waning disc accretion, indicated by weak Hα emission. I found that these systems exhibited a wide variety of disc opacities but were generally transitioning towards the debris disc phase.

In 2006, I came to Hawaii to join the Gemini NICI Planet-Finding Campaign led by Mike Liu. We had a terrific instrument that was capable of detecting planets half a million times fainter than the star at 0.5-arcsecond projected separation. We imaged hundreds of stars. But bright massive planets are indeed very rare, and we discovered instead mainly brown dwarfs. The campaign was an immense amount of work, involving thousands of hours of data reduction, and careful cataloguing of hundreds of candidates, and follow-up imaging to look for common proper-motion companions. The campaign and pipeline design had also taken many man-years of labour. Our small ragtag team of planet hunters was transformed into a disciplined, hungry, small ragtag team of planet hunters. Currently, we are working on calculating the constraints on the exoplanet population from the campaign results, and dreaming about SPHERE and the Gemini Planet Imager (GPI), the next generation planet-finding instruments.

So with that history I came to join ESO, to support SPHERE's operation. With adaptive optics experts like Julien Girard and Dimitri Mawet behind the instrument scientist team, there's a fantastic excitement around direct imaging efforts at ESO. We have coalesced into a new Direct Imaging Group with PhD students,

ESO Fellows and faculty members interested in planet formation. Our meetings have been rich with ideas and we have already written a few proposals together. I hope for many more.

Observing duties on Paranal make a whole different world. We are telescope operators, engineers, astronomers, and living-support staff engaged in efficient, unrelenting and voluminous production of science. The work is physically hard for all of us up there, but this shared sacrifice, shared responsibility, and moments of shared celebration create perhaps an unusual sense of fellowship between us. We are different up on Paranal from how we are when we are down in Santiago doing our research. I am sure the sharing of arduous and rewarding work and the rotation of supervision roles grew somewhat out of necessity. Although it is not as egalitarian as I am making it sound, I think that whatever camaraderie we experience up there comes from the supportive and unusually interwoven roles we play.

At the end of this piece, I feel obliged to look at the bigger picture. Even now, some of the most interesting things about the world are not reaching us. We may have the most technically advanced communication system in the history of our existence, but it misinforms us to the point of self-destruction. As we have poured our labour into astronomy, I am sure that many of us have tried to work against climate destruction on our planet. We are just past midnight in the century, perhaps a fateful century for humankind. Whatever else I do, I am glad to be doing one of the things that proves that we were worth saving.

It is a cold May night in Santiago. I am going to call my wife now and tell her that I have finished writing. She joins ESO in November. It will be warm in our apartment then.

Fellows at ESO

Gabriel Brammer

Blame it on Hale-Bopp. I was a high-school student who enjoyed physics and mathematics when that comet made its trip through the inner Solar System, becoming easily visible to the naked eye on crisp spring nights in central Iowa. I was captivated by the comet and soon started taking out a small telescope that my parents had bought, exploring planets, nebulae and star clusters visible from only a short drive away from the city lights. I've been an observational astronomer ever since.

Gabriel Brammer

I am fortunate to have studied and worked in the field of astronomy at a time when travelling to remote observatories is still a critical component of research. To efficiently schedule observations at the most advanced, complex observatories in the world, such as the ESO Very Large Telescope, observations are increasingly carried out by professional observers, and the data are shipped electronically to research astronomers around the world. While the quality of the data is spectacular, part of the experience is lost: I feel a visceral connection to the science of astronomy when I watch an enormous telescope track the night sky and I wait, perhaps for many hours, while it soaks up the light from a distant galaxy.

And this is to say nothing of the fact that observing often requires travelling to some of the most beautiful places on Earth. (If you meet an astronomer at a party and run out of things to say, we're always happy to talk about airline frequent-flyer programmes.) My undergraduate and PhD research has taken me all over the world, from telescopes in Arizona to a total solar eclipse in Zambia. Now an ESO Fellow, I spend a week per month on a mountaintop in the Atacama Desert in northern Chile.

My own research, started during my PhD education at Yale University and