US-ELTP Career Profile

Fernando Quirós-Pacheco

Giant Magellan Telescope Senior Adaptive Optics Scientist

> *Take opportunities as they come and realize the power of networking to open doors."*

Fernando envisioned a future in the era of extremely large telescopes. Now as a world expert in adaptive optics, Fernando realized his dream, as he is helping to develop the new generation of ground-based telescopes that will provide astronomers with the ability to peer deeper into space and with greater detail than ever before.

Fernando works for the Giant Magellan Telescope as a Senior Adaptive Optics Scientist in the Wavefront Sensing and Control Group. This group is responsible for ensuring the telescope will achieve its promised image quality. Large telescopes on Earth (as opposed to those in space like Hubble or Webb) need "adaptive optics" to compensate for the distortions suffered by the light coming from an observed astronomical object as it traverses our own atmosphere. Without adaptive optics, the resultant images would be blurry.

Fernando and his team design the "recipes" to compensate for atmospheric distortions. Specifically, Fernando is in charge of one of these recipes, natural guide star adaptive optics, which requires the light of a relatively bright star to measure the distortions due to the atmosphere, and uses this information to deform the telescope's adaptive mirror to compensate for them. These measurements and corrections need to happen at an incredibly fast rate (up to 2000 times per second) as the atmosphere is constantly moving. Fernando's favorite part of his role is being able to use computer simulations to predict and evaluate what the image quality of the telescope will be before it is actually built.

How did you get interested in astronomical telescopes?

I studied electronics engineering at the National Autonomous University of Mexico (UNAM), and I had a group of friends in the School of Engineering that was really into astronomy. They wanted to create an astronomy club dedicated to public outreach but that also served as a bridge between the world of astronomical research and that of engineering and technological development. I got excited about it and joined the effort. In the end, we got full support and funding from our school to found the Astronomical Society of the Faculty of Engineering (SAFIR) and to print a trimestral magazine that we called Sidereus Nuncius, in honor of Galileo Galilei's publication of his first telescope observations. Those years really helped me develop a passion for astronomy, telescopes, and science communication.

When deciding on the topic of our undergraduate theses, my friend Alex Farah and I went to the Institute for Astronomy at UNAM and asked Dr. Elfego Ruiz if we could get involved in an astronomical instrumentation project. The institute had a funded conceptual study

Fun Facts

I enjoy music. I played the organ growing up and now enjoy playing the digital piano.

As a child, I remember my excitement when my father's new computer had the latest operating system of the time - Microsoft Windows 1.0.

for a segmented telescope, a telescope made of many smaller mirrors acting together to collect and focus light, and hired us to develop systems. For this project, I specifically developed a conceptual design for a capacitive sensor to measure the misalignments of the primary mirror segments. I liked this project so much that I knew I wanted to pursue a research career in technological developments for the new generation of large telescopes.

What were some opportunities or challenges you experienced?

I was awarded a prestigious and competitive scholarship from the Mexican government, which afforded me a fully funded PhD in adaptive optics at Imperial College London (UK). At that time, the European Southern Observatory (ESO) had a vision for a 100-meter telescope, referred to as the OverWhelmingly Large (OWL) telescope, and state-of-the-art adaptive optics developments for this project were taking place in Europe. My PhD advisor, Prof. Chris Dainty, put me in contact with the Adaptive Optics Group at ESO and I was offered the opportunity to participate in the MAD project (for Multi-conjugate Adaptive optics Demonstrator). I was so fortunate to be involved in a project of this magnitude for my PhD.

After completing my PhD, I worked as a postdoctoral researcher at the National Institute for Astrophysics of Italy in Florence. I had the opportunity to be part of the Italian team that built the adaptive optics system for the Large Binocular Telescope in Arizona. The system was the first of its kind as it demonstrated technological advances that are critical for the next generation of telescopes, namely large adaptive secondary mirrors and novel wavefront sensors.

Do you have any advice to share with students?

My advice for the next generation would be to take opportunities as they come and realize the power of networking to open doors as you explore your possibilities. This also folds into taking any opportunity to experience and embrace different cultures and learn other languages. From the variety of places I traveled to, the people I met helped to enrich the way I work and live

It is also important to keep investing time in your hobbies and have something other than your career to help balance your mental and physical health.

Fernando's Pathway to Senior Adaptive Optics Scientist