The Subaru Telescope at Maunakea Observatory, Hawai'i. Photo: Sean Goebel, www.sgphotos.com.

# LASER STARS AND THE SUBARU TELESCOPE

Celine D'Orgeville

When we look far away in space we are also looking into the past.

My connection to Japan is not a direct one, it passes through Hawai'i where I used to live. It is through this object: the Subaru Telescope, which is located at the Maunakea Observatory in Hawai'i. The Subaru Telescope is built on a volcano at an altitude of 4200 metres. At that height, there is only sixty per cent of the normal oxygen level.

The Subaru Telescope is one of the largest telescopes in the world at eight metres in diameter. It can observe things throughout the entire universe from the closest objects in our solar system to objects on the far reaches of the universe. When we look far away in space we are also looking into the past. With powerful instruments, such as the Subaru Telescope, we can look back to the very beginnings of the universe with the Big Bang.

I am currently, along with my Japanese colleagues in Hawai'i working on an instrumentation project for the telescope. My background is not in astronomy, but in engineering and optics. What I am working on with the Subaru Telescope is a project in laser optics. We are creating artificial stars using lasers to improve the accuracy of our measurements when we observe space.

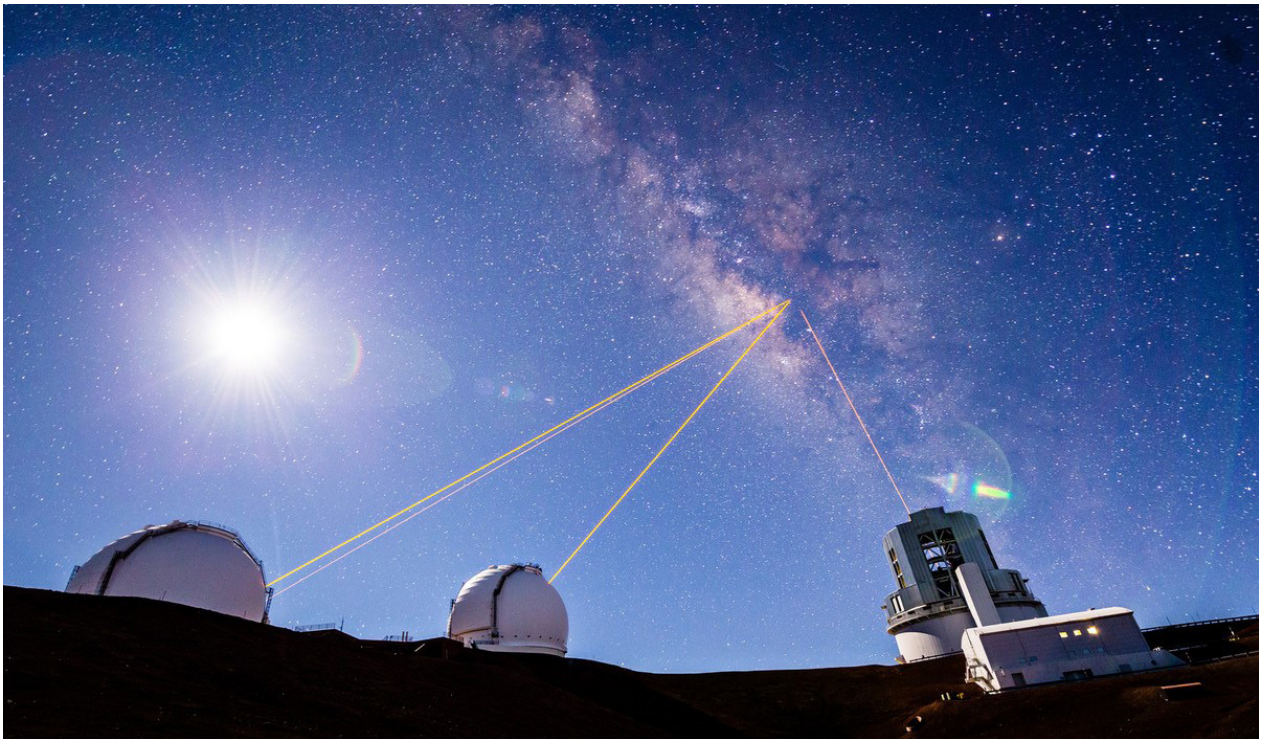
When we observe the universe from the ground on earth, the light from stars and galaxies has to travel through the earth's atmosphere. When the light goes through the earth's atmosphere it gets distorted and this blurs images at the focus of the telescope. This distortion creates difficulties for astronomers who seek to observe the universe

Celine in her laboratory at The Australian National University. Photo courtesy of the author.

in as much detail as possible. This problem could be avoided by sending the telescopes to space, but this is very expensive and technologically difficult.

My research seeks to solve this problem. We have created a technique to accurately measure and counter the distortion of images when viewing space through the earth's atmosphere. We use a technique called adaptive optics, which basically consists of measuring atmospheric turbulence and applying a correction in real time. That is, we calculate the distortion 1000 times per second.

In order to measure atmospheric turbulence you need a bright reference point. So we create an artificial star with a laser next to the object that we want to observe. We can then use this reference point, using adaptive optics techniques, to restore the original sharpness to the object we want to study as if we are observing it from space and not through the earth's atmosphere. My job is to build those lasers and install them onto the telescopes. The next four lasers on the Subaru Telescope will be sitting on the sides of the telescope primary mirror.



The lasers in use at the Subaru Telescope, Hawai'i
Photo: Sean Goebel, www.sgphotos.com

Our project is called Ultimate-Subaru. It consists of a large adaptive optics mirror that will replace the secondary mirror of the telescope and four lasers. This will allow us to observe the universe more clearly and deeply.

The Subaru Telescope has been using their initial laser for about ten years now. They will be using four more lasers over the next ten years. We have a team of Australian and Japanese scientists working together at The Australian National University, where I work, at Tohoku University and at the Subaru Telescope in Hawai'i to develop and operate these lasers. Working collaboratively, we will be able to further develop the necessary technology to discover more about the exquisite objects—the stars, planets, galaxies and black holes—that make up our universe.

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