Article 5

Cosmic Time Traveller

by Dr Nichole Barry

A TIME TRAVELLER...

I have seen the multitudes of the Universe – black hole jets of hot electrons, the flashlight beams of spinning neutron stars, the remaining cocoons of a star's supernova death. The physical space around us is exciting, alive, and ever-changing. But there is one essence of this Universe that eludes me: time.

I want to be a time traveller. I want to go back to the start to see how we began – not as a species, but as a Universe.

There are so many questions to be answered about the very beginning of everything. But what we do know is that it probably started with a singularity, and that this singularity became Universe-sized, nearly immediately. The Universe was filled with a hot, dense plasma made from the building blocks of atoms and light, reminiscent of a creamy pumpkin soup. And then, suddenly, the soup became transparent.

Thus began the Dark Ages. A Universe filled with gentle, quiet gas, and not much else. This was the calm before the storm, an era that lasted almost half a billion years. How did we develop from this cosmic womb? How did we go from the quietest whisper to the loud, violent Universe of today?

These questions are why I want to be a time traveller. I want to see the very first star ignite, to watch the very first galaxy spin. I want to know what it's like to be the very first astronomical object, to be the first amongst the multitudes to come.

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A COSMOLOGIST...

Amazingly, I don't even need to leave my home planet to be a cosmic time traveller. I don't even need to leave my house. I can travel to the era of the first stars and galaxies from the comfort of my desk chair. As long as I have a telescope that can see radio light, I can look back in time.

Some part of me still wishes for the Contact movie-set romance of listening to the radio Universe from the roof of a 1980s Chevrolet in the New Mexican desert, but I guess the computer chair will have to do.

All I need to do is listen for the faint radio whisper from the gentle, quiet gas of the Dark Ages. It's everywhere around us; it pervades every space. We just need to listen. And if we can hear this whisper from the past, we can trace out where the first stars appeared.

In the beginning, the first stars and galaxies destroyed the surrounding gentle gas, smashing it apart with their harsh light. If we can hear the whisper from the gas, we can find where it disappears, where it goes silent. If we can build a map of whispers, we will be able to understand the formation mechanisms of the first stars: how fast, how big, and how many.

But the whisper from the gentle, quiet gas is phenomenally delicate and hushed — it's like trying to listen for the flutter of hummingbird wings in a Stage 4 hurricane. We haven't heard it yet, but we get closer every day. Listening to this radio whisper is an engineering and computing feat. It requires large, complicated radio telescopes called interferometers, which use quantum mechanics to take measurements of radio light interference.

We have one of these interferometers in our very own backyard in the Murchison Shire, about five hours outside of Geraldton in Western Australia. It takes over four million measurements every two minutes — racks and racks of sophisticated computing equipment hum away as they try to keep up with the data rate.

The next generation of these radio interferometers will be even more data-hungry. The most massive radio interferometer to ever exist is being built next door, and when it starts taking measurements, the data rate will be more massive than the simultaneous streaming of Netflix from all households in Greater Perth. In reality, this is what will be required to hear the sound of a cosmic whisper.

It has taken us cosmologists over a decade to get to this point, with so many important lessons along the way. We've built telescopes only then to tear them down, scratched our heads over puzzling data, and learned that it's easier said than done to "fix it in post" like in the movies. This is the life of a cosmologist; looking far back in the abyss of time is difficult. And thus far, the Universe has been silent.

A PHILOSOPHER...

Sometimes I ask myself if I would want to be a time traveller if it were easy, and I think the answer is no. There is something beautiful about the dedication, the small wins, and the heartache. As John F. Kennedy so poetically phrased: We choose to do these things, not because they are easy, but because they are hard.
It's the pursuit of knowledge that drives me through the rejections, the failures, and the setbacks. The pursuit of a fundamental question to the existence of everything. How did we come into being? Not from a human perspective, but from a cosmic perspective. How did anything come into existence from the gentle, quiet blanket of primordial gas?

To be a cosmologist is to be a philosopher. We ask questions of our reality, and we question the nature of existence. Not how we perceive it through the mind, but how it even exists at all.

Yet, there are practical implications to the research I do. We are constantly pushing technological boundaries, and this has implications for society's fascination for small electronics that beep and vibrate in our pockets and on our wrists. But these curiosities are insignificant compared to the cosmic perspective that we seek.

AN ARTIST...

On February 14, 1990, the Voyager 1 space probe turned around and took a picture of the Earth from the edge of the solar system. In this photograph, the Earth is nothing more than a pale blue dot. Carl Sagan, perhaps the most well-known of astronomer-philosophers, epitomised the feeling:

"It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and

to preserve and cherish the pale blue dot, the only home we've ever known."

Perspective is everything. Here on Earth, we are subject to the tunnel-vision of our daily lives and struggles. Keeping up with the news has felt like self-flagellation — an atonement for sins that I did not commit. I feel powerless to the tides of war, famine, and anguish.

But if we all had a more cosmic perspective, I think Earth would be a nicer place. The power that people seek, at the expense of others, is meaningless in the vastness of our Universe. The trials and tribulations of climbing the geopolitical ladder mean nothing if the power that you hold is just a lightly coloured speck of dust on a photograph.

This cosmic perspective is equal parts emptiness and loneliness. It's like looking at a photograph of a loved one who passed away — at some point, looking at the photograph no longer brings you grief, but a kind of gentle, indescribable peace. It is the coldness of space that reminds us that we need to huddle together for warmth.

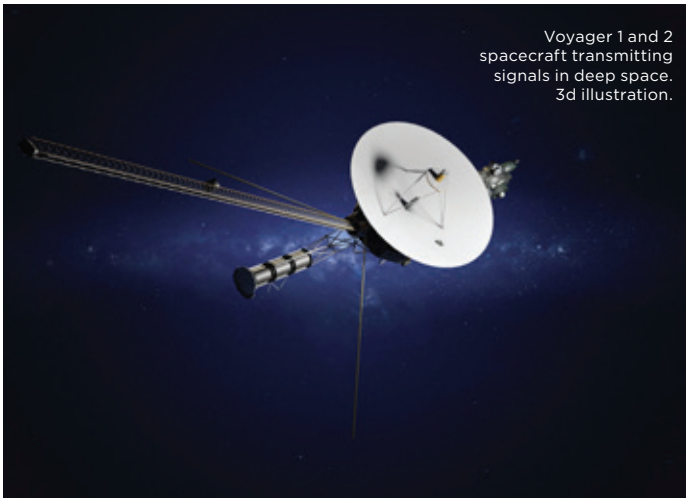
The true value of my research is not measured by the commercial impact it brings, but rather the perspective on the human condition. In this way, I have always viewed my pursuit as art.

To be a cosmologist is to be a painter. Instead of the scratching of a paintbrush on canvas, my art is the delicate rainfall of keys on a keyboard. I strive not to swirl together the starry night over the Saint-Rémy rolling hills, but to tell the story of a cosmic whisper.

A COMMUNITY...

I am eagerly awaiting the first scientific observations from our new, giant interferometer. But I am not alone. Scientists from 16 countries around the world are tapping their fingers in anticipation. The community of cosmologists, astronomers, engineers, and software developers have come together to build something truly great. This is indeed one of the hardest pursuits the radio community has ever attempted.

As we strive to look back in time, it's important that we make sure no one is left behind in the present. Astronomy should not be done at the expense of marginalised people. Great strides have been taken to make sure



Voyager 1 and 2 spacecraft transmitting signals in deep space. 3d illustration.

women are included in science, that Indigenous astronomy is represented, and that the doors are open for anyone to enter. But we can do so much more.

The socio-economic privilege of the white tower of academia is as strong as ever, an endeavour rarely available for someone who needs two jobs to keep up with living costs while attending university. And when we boil down people to their numbers — their school ranking, grades, published papers, citations — what we are really selecting for is societal class, at least at first. We need to do better.

And telescopes shouldn't be built on the lands of Indigenous peoples without their consent. While the planning of our giant interferometer has been in partnership with the Wajarri Yamaji from the very beginning, not every telescope construction has been so thoughtful. We cannot seek the cosmic perspective to build a more understanding and peaceful Earth if we cannot be kind in the pursuit.

As we build bigger and more sensitive telescopes, I will continue to listen for the distant murmur of gentle, quiet gas. We are so close to hearing the secrets of the Universe during the era of the first stars and galaxies. As we dive deeper and farther, we must continue to push the boundaries of what is currently technically feasible. This means faster data rates, bigger telescopes, and astounding accuracy. And all of this must be done with compassion.

MULTITUDES...

I am a time traveller. I am a philosopher. I am an artist. I am a cosmologist. I contain multitudes. We all do. Looking up at the stars with wonder is a part of our humanity, and we must not lose what makes us human.