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Why the James Webb Space Telescope promises to answer some, but not all of our most fundamental questions

By Karl Buscheck

A million miles away, the James Webb Space Telescope glides through the cosmos, peering farther back into space, and time, than any telescope ever has before.

A joint project of NASA, the European Space Agency and the Canadian Space Agency, the telescope was $10 billion, 30 years, and countless potential cancellations, budgetary issues and launch delays in the making.

"As you can imagine, most astronomers have been unable to sit still for the last (month) or so - particularly after the first images were released (on July 12)," said Dr. Aaron Lee, an assistant professor in the Saint Mary's Department of Physics and Astronomy.

Those images captured the public imagination after commanding a presidential press conference - trending on social media. Among the most prominent were SMACS 0723 - the deepest infrared image of the universe ever taken - and Carina Nebula, a landscape of soaring orange "mountains" which has an unmistakable artistic beauty to it and looks ready to be framed and hung on a museum wall.

The highest of those mountain tops is seven light-years tall. Carina Nebula, in actuality, is a stellar nursery where stars are forming as we speak.

The idea for the telescope, which launched on Dec. 25, 2021 from French Guiana, hitching a ride on an Ariane 5 rocket, began in 1989. That was a year before the Hubble Telescope, which it has since gone on to supplant, even launched.

"The path to get here, with the James Webb Telescope in the sky, has more or less traversed my entire life," Lee said. "So, this is definitely a very exciting time. This is definitely a new dawn for modern astrophysics."

Now performing research that models the formation of stars and planets - made possible by utilizing some of the most powerful supercomputers in the world - Lee earned his master's degree from Cambridge then went on to get a Ph.D. in astrophysics from UC Berkeley. He didn't realize it at the time, but his astronomy journey began when he was just 3 years old.

For reasons Lee can't explain, his parents gave him an old, fold-out map of the solar system from a National Geographic magazine. And so it started. The map remained on the bedroom wall in his childhood home outside Detroit, Michigan, until he headed off to college at Northwestern.

The magic of space is that because it's so unendingly large and because light travels at a finite speed, the farther an object is away from us, the farther back in time we are actually seeing that object.

"If you're looking at an apple across the room, you're seeing that apple because light travels from that apple to your eye," Lee explained. "But it takes a couple of nanoseconds for that light to leave the surface of the apple and to reach your eye. So, really, you are seeing that apple as it appears a few nanoseconds in the past."

The apple isn't going to mold in a matter of nanoseconds, so there's nothing to worry about. But out in space, where the measurements are in light-years, the amount of distance light travels in one year rather than feet, things get more complicated.

"When you look at the Andromeda galaxy (2.5 billion light-years away), you're actually seeing what the Andromeda galaxy looked like when early hominids were beginning to walk around on the Earth," Lee said.

The Andromeda galaxy is easy enough to find with a small telescope. Imagine what the Webb Telescope, which looks 13.5 billion years back in time, can do.

It's only logical to wonder if the telescope will pry into some distant corner of the universe and provide a final, unequivocal answer to the fundamental question, `Is there anyone else out there?'

Lee said it's "absolutely possible" that the Webb Telescope could accomplish that, but there are some serious caveats.

There are billions and billions of galaxies, he explained. The planets therein are small, appearing mostly as tiny points of light. What the Webb Telescope is able to do is uncover which of those tiny points of light have atmospheres friendly to life. Whether that life is biological or intelligent is another matter.

"Then we have to send the, `Hey, how are you' message and wait the thousand light-years for that message to get there and come back. It would be a very slow introduction."

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