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Humanity is cosmically special. Here's how we know.

A sunrise from the vantage point of the International Space Station. (Scott Kelly/NASA via Associated Press)

By Howard A. Smith November 25, 2016

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As we give thanks for our many obvious blessings, let's reflect on a blessing that is less well known, a gift from modern astronomy: how we view ourselves.

There was a time, back when astronomy put Earth at the center of the universe, that we thought we were special. But after Copernicus kicked Earth off its pedestal, we decided we were cosmically inconsequential, partly because the universe is vast and about the same everywhere. Astronomer Carl Sagan put it this way: "We find that we live on an insignificant planet of a humdrum star." Stephen Hawking was even blunter: "The human race is just a chemical scum on a moderate-sized planet."

An objective look, however, at just two of the most dramatic discoveries of astronomy — big bang cosmology and planets around other stars (exoplanets) — suggests the opposite. We seem to be cosmically special, perhaps even unique — at least as far as we are likely to know for eons.

The first result — the anthropic principle — has been accepted by physicists for 43 years. The universe, far from being a collection of random accidents, appears to be stupendously perfect and fine-tuned for life. The strengths of the four forces that operate in the universe — gravity, electromagnetism, and the strong and weak nuclear interactions (the latter two dominate only at the level of atoms) — for example, have values critically suited for life, and were they even a few percent different, we would not be here. The most extreme example is the big bang creation: Even an infinitesimal change to its explosive expansion value would preclude life. The frequent response from physicists offers a speculative solution: an infinite number of universes — we are

just living in the one with the right value. But modern philosophers such as Thomas Nagel and pioneering quantum physicists such as John Wheeler have argued instead that intelligent beings must somehow be the directed goal of such a curiously fine-tuned cosmos.

It seems likely that exoplanets could host extraterrestrial intelligence. But intelligence is not so easy to produce. Paleontologist Peter Ward and astronomer Donald Brownlee summarize the many constraints in their book "Rare Earth: Why Complex Life is Uncommon in the Universe " and show why it takes vastly more than liquid water and a pleasant environment to give birth even to simple (much less complex) life. At a minimum, it takes an environment stable for billions of years of evolution, plus all the right ingredients. Biologists from Jacques Monod to Stephen Jay Gould have emphasized the extraordinary circumstances that led to intelligence on Earth, while geneticists have found that DNA probably resulted from many accidents. So although the same processes operate everywhere, some sequences could be unlikely, even astronomically unlikely. The evolution of intelligence could certainly be such a sequence.

There is, moreover, a well-known constraint: the finite speed of light, which ensures that even over thousands of years we will only be able to communicate with the comparatively few stars (tens of millions) in our cosmic neighborhood. If the combined astronomical, biological and evolutionary chances for life to form and evolve to intelligence are only 1 in 10 million, then we probably have no one to talk to.

The discovery of exoplanets was dramatic but not unexpected: Since the Greeks, we have imagined planets were common. Textbooks even taught that our solar system was typical. But the exotic diversity of exoplanets came as a surprise. Many have highly elliptical orbits around unstable stars, making evolution over billions of years difficult if not impossible; other systems contain giant planets that may have drifted inward, disrupting orbits; and there are many other unanticipated properties. These unexpected discoveries are helping scientists unravel Earth's complex history.

The bottom line for extraterrestrial intelligence is that it is probably rarer than previously imagined, a conclusion called the misanthropic principle. For all intents and purposes, we could be alone in our cosmic neighborhood, and if we expand the volume of our search we will have to wait even longer to find out. Life might be common in the very distant universe — or it might not be — and we are unlikely to know. We are probably rare — and it seems likely we will be alone for eons. This is the second piece of new evidence that we are not ordinary.

Some of my colleagues strongly reject this notion. They would echo Hawking: "I can't believe the whole universe exists for our benefit." Yes, we all have beliefs — but beliefs are not proof. Hawking's belief presumes that we are nothing but ordinary, a "chemical scum." All the observations so far, however, are consistent with the idea that humanity is not mediocre at all and that we won't know otherwise for a long time. It seems we might even serve some cosmic role. So this season let us be grateful for the amazing gifts of life and awareness, and acknowledge the compelling evidence to date that humanity and our home planet, Earth, are rare and cosmically precious. And may we act accordingly.