Fermi Paradox

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If you look up in the sky, right now, there is one bright light, and one lesser light, which we call the sun and the moon. Six hours ago you would have seen lots of little lights which we call stars and planets. Our ancestors noticed these lights as well. The Romans thought the planets were Gods and gave them names like Mars and Jupiter. Since then we have learned a lot more about the lights in the sky. People have looked at them with telescopes and discovered that the Earth is a planet and our sun is just one star. Newton realized that the same force that causes apples to fall on Earth keeps the Moon circling the Earth. The heavens have the same rules of physics as are here on Earth. What can happen on Earth can happen elsewhere. So, it is possible that there are other Earth like planets out there with other intelligent beings on them.

There are a lot of stars in the galaxy, and a lot of galaxies in the universe, so where is everyone else? Why have we not met space aliens? Where is Everybody? Enrico Fermi, who is a bit more famous in this town for his construction of the first nuclear reactor, Chicago Pile 1, asked this in 1950, and today, the Fermi Paradox is still a mystery. Where is Everybody?

There are around 100 billion to 400 billion stars in the galaxy. In the last 20 years, we found out that that many of the stars have planets around them. The galaxy has been around for billions of years. Only one of the stars has to produce an interstellar expanding civilization to fill the whole galaxy. We don't know of any technological reason that would stop this from happening. Last year a proposal was made to create starchips, which are small interstellar ships.[1] Pioneer 10 and Voyager 1 and 2 are already headed for the stars, but will not get there for 100s of thousands of years. Once a civilization starts spreading in the galaxy, it can fill the galaxy relatively quickly. Why has this not happened? We don't know the answer to this, but what ever the answer is, it has valuable lessons for us.[2]

Here are the four answers I think most likely:

1. Life is rare.

2. Technological civilizations don't last long.

[1] "Starchip enterprise", in The Economist, 2016-Apr-16

[2] Two good sources for more information on the universe and intelligent life in it that I have read are "The Pale Blue Dot" by Carl Sagan and "Intelligent Life in the Universe" by I. S. Shklovskii and Carl Sagan

3. Technological civilizations hide.

4. We are in a simulation.

The first possibility is that life or technological civilization very rarely starts.[3] The simplest bacteria that exist today are still fairly complicated. Then after that life has to get complicated enough to get intelligence. After that the life has to figure out how to create enough technology to get off the planet. Each of these steps has the possibility of failure. If the reason we don't see any technological civilations is because they very rarely start, we need to be talking about less than a 1 in a billion chance. Even a one in a billion chance of a star having a technological civilization would result in 100 to 400 technological civilizations in this galaxy alone. If the odds are less than one in a billion, then human civilization is a very rare gem, and we need to realize how precious that is.

The second possibility is that technological civilizations usually don't last very long. Maybe technological civilizations happen reasonably often, but they just don't last. For example, nuclear bombs, or a genetically engineered disease could destroy human civilization, and possibly all of humanity. Other possibilities such as autonomous self reproducing military drones are not that far away in the future, and could also destroy humanity. Not only do we know how to destroy ourselves, we are creating new ways to do it. Or maybe just virtual reality gets good enough that everyone just spends all their time entertaining themselves, and stop trying to do things in reality.[4] Or maybe we mess up when we create artificial intelligence. Evolution selects creatures that produce lots of successful offspring, but that might not result in the best creatures for living long term in a finite world.

Of course, in order for technological civilization failure to be the cause of the Fermi paradox, it has to be fairly permanent. If something merely causes a million year delay, then civilization collapses, and then a million years later it springs up again, and then takes over the galaxy. And it would be easier to rebuild civilization than to start from scratch for many of the disaster possibilities. For example, aluminum and other metals are much easier to find in a junkyard than they are naturally. On the other hand, the psychology of restarting would be very different. Archaeological digs would keep discovering that there was this advanced civilization, and it was completely destroyed. That might make the new civilization very cautious about technology. If technological civilizations usually don't last long, then the lesson for us is that we need to be careful to avoid destroying ourselves.

Probably the scariest possibility is that technological civilizations hide, which leads to the question of what are they hiding from?

[3] "Rare Earth: Why Complex Life is Uncommon in the Universe" by Peter D. Ward and Donald Brownlee discuss possible reasons why life is rare. See "Life Everywhere" by David Darling for a contrasting view.

[4] See `https://www.1843magazine.com/features/escape-to-another-world` "Escape to Another World" by Ryan Avent for an article about young men spending more time on games, or just see the 1994-Oct-14 Dilbert: `http://dilbert.com/strip/1994-10-14`

Of course, our technological civilization has been detectable at interstellar ranges since the we began altering the spectrum of the light reflected from the atmosphere by burning coal well over a hundred years ago, so since we are still here, there is some evidence that hiding is not needed.

The other possibility for hiding is that advanced civilizations hide from new civilizations, to protect the new civilization's development. This is similar to the "Prime Directive" in Star Trek[5].

Lastly, there is the possibility that we are in a simulation.[6] Basically, if you want to simulate a technological civilization starting up, it is much more efficient to simulate the rest of the universe once, and then basically play a tape for the solar system and do the detailed simulation of just the solar system. In this case, the reason there is no outside life is because whoever is running the simulation is only simulating life in this solar system. I guess the key question here is how long the simulation will run.

As a side note, if there is some kind of universalist life after death, I expect that the most likely reason is that we are living in a simulation, and the creators of the simulation decided that it is more ethical to provide some simulation time to sentient beings after death. So in this case I sorta imagine that I wake up after I die, and am greeted by someone who looks vaguely like Einstein. I am welcomed to the afterlife and told that I can do most things I want, except force other minds to do things, or make any changes to Earth, the world of the living. Of course, it wouldn't be eternity, because eternity is hard to do in reality. While this is the heaven that would surprise me least, I would still be very surprised if I wake up after I am dead.

Of course, if we are in a simulation, we could be in someone's stellar evolution simulation, where life is just a side effect of having a really large scale simulation and the only way we get noticed is if we start disassembling stars, and that probably just gets the simulation restarted. In that simulation, when we die, we cease to exist.

Those are my four possibilities. Which of these four possibilities, or if it is something else, is the solution for the Fermi Paradox is unknown at this time. Figuring out if we are in a sufficiently accurate simulation or not is effectively impossible, but some of the other Fermi Paradox causes are more scientifically testable.

Once we get some better telescopes pointed at extraterrestrial planets, and these can get a spectrum of the atmosphere of the planet, we can start getting an idea of how widespread simple life is. Without plants constantly producing oxygen, Earth's atmosphere would look very different. So we probably can tell the difference between a planet with basically no life versus one with widespread biological life from interstellar distances.

However, if the planet is basically a single point of light, telling the difference between say, a planet with only single cell biology and a planet with say, Ancient Roman or Greek civilization is very difficult.

[5] See for example the Star Trek the Next Generation show, "Who watches the watchers"

[6] `https://www.scientificamerican.com/article/are-we-living-in-a-computer-simulation/` "Are We Living in a Computer Simulation?" by Clara Moskowitz

So, maybe in 20 or 30 years, we will be able to say that basic life is very abundant, or maybe that basic life is very rare. Either is very profound.[7]

Technological civilizations at our level are easier to detect, since we are producing radio waves, and changing what chemicals are in the atmosphere, which are changes that are easier to detect at interstellar distances.

So if we keep doing astronomy, we should know more in the future.

Our human civilization has produced a rare thing in the universe. We have created a civilization that understands enough of science to begin to try and understand the universe and to change the world in ways that have never before happened. We are alone, and we don't have any examples, good or bad, on how to run a technological civilization. Our technological civilization may not last long, and if it doesn't it probably will be our own human mistakes that cause it to fail.[8] It is a big universe out there, and we have to figure out for ourselves how to live in it.

[7] `http://blogs.discovermagazine.com/crux/2014/04/24/` "Why Habitable Exoplanets Are Bad News for Humanitys Future" by Andrew Snyder-Beattie has some discussion on the implications for our future of if life is rare or not.

[8] "Surviving 1000 Centuries" by Roger-Maurice Bonnet and Lodewyk Woltjer has a list of ways humans might be destroyed, and there are some possibilities that are not human caused, but they don't have that high of probability over the next 100,000 years.