

Episode 13: The Great Voyager Escape

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(** clip: vger will comply...)

- Travis: Welcome to Slacker Astronomy, a podcast about astronomy and anything else that floats over our heads. Every week we cover a news event from the world of astronomy. And when there is no news, we cry for our mommies or daddies.
- Pamela: But, luckily for our dear parents' ears we do have something for this week. Voyager 1 has reached the end of our solar system in a journey that has taken almost 30 years.
- Travis: In 1977 Pamela was three and playing with imaginary friends. Aaron was 2 and playing with Duplo blocks. And me? Well, let's just say I was still a ways off from seeing the light of day.
- Pamela: The world was a dreary place. Disco was king and bell-bottoms ruled the shelves. What could possible be worse? But there was hope on the horizon, and I mean beyond the impending birth of Travis.
- Travis: That hope was in the launch of Voyagers 1 and 2. Together they completely changed the way we looked at our solar system. For millions of years Mankind had stayed on our side of the railroad tracks. But now these Voyagers intended to punch through to the other side. And in the process they would explore worlds more majestic than we ever thought to imagine, even in the most fanciful of science fiction.
- Pamela: And now, 28 years later, their little nuclear powered hearts continue to beat a path right out of our solar system. And they have finally made it. It's the beginning of the end of our solar system, and of Voyager 1.
- Travis: After launch in 1977, Voyager 1 was first sent to Jupiter and then on to Saturn. Along the way it sling shot around the planets and picked up enough speed to become the fastest man-made object ever built. It is currently traveling at a speed of nearly 62,000 kilometers per hour, which is 3 times faster than its sister ship, Voyager 2.
- Pamela: Even though it is numbered 2, Voyager 2 was actually launched first. Further evidence to support Slacker Law #2, astronomers always do things the hard way.
- Travis: Which makes them anything but slackers. So **we** have to make up for it by putting heaping extra doses of slack on their stories.
- Pamela: Ahhhhhhhh, slack. Caring about nothing, and reveling in it.
- Travis: Oh no, the script here says they actually had a good reason!
- Pamela: Since when do astronomers need a reason to be weird?
- Travis: Wow, it was actually a savvy marketing move. Kudos to NASA. Voyager 1 was faster than Voyager 2. So NASA knew Voyager 2 would reach Jupiter **after**

Voyager 1, despite being launched first. And the arrival at Jupiter is what would get the newspaper headlines, not the launch.

Pamela: Now Voyager 1, being so fast, will be the first man made object to speed out of the solar system.

Travis: On June 2nd, 2005 scientists working with data from Voyager 1 announced that it has definitely entered the outer boundary of our solar system, an area called the heliosheath.

Pamela: The heliosheath is about 94 AU from the Sun. AU stands for astronomical unit. It is the distance between the Earth and the Sun. So the heliosheath is almost 100 times as far from the Sun as the Earth.

Travis: It is very cold out there. The ambient temperature is just above 4 degrees Kelvin, or just a little more than 4 degrees above absolute zero, a far cry from the 16 million degrees Kelvin felt in the center of the Sun.

At a paltry 4 Kelvin, particles in this area are receiving most of their heat from the cosmic microwave background, not the Sun.

Pamela: It is dark as well. The Sun is only a pretty bright star at that distance. However, its presence is still felt through the solar wind, which blows at about a million kilometers per hour. The solar wind consists of particles of solar material and ionized gas expelled from the Sun. It is always blowing but its speed varies just like wind on Earth. Sometimes it gusts and sometimes it is relatively quiet. On average it moves at 400 kilometers per second as it passes the Earth's orbit.

Travis: Can I go sailing in the solar wind?

Pamela: Actually, your kids or grandkids may be able to. There is a lot of research underway regarding solar sails. The first prototype of a solar sail is scheduled for launch in early July from a Russian submarine. It was funded privately by the Planetary Society. You can learn more about it in a recent podcast interview by Fraser Cain of the Universe Today. We'll link to it in our show notes.

Travis: But practical solar sails are still a way off. Voyager 1 is powered by the radioactive decay of plutonium. This heat powers its instruments and its 50-watt radio transmitter. It takes over 13 hours for a signal from Voyager 2 to travel those roughly 100 AU to reach Earth.

Pamela: By the time the signal gets to NASA's Deep Space Network here on Earth, Voyager's the signal is down to 10 to the negative 16th watts of power — that's a decimal point followed by 16 zeros and then a 1.

Travis: A digital watch uses 20 billion times that amount of power simply to run.

Pamela: When the solar wind reaches the edge of our solar system it begins to run into background cosmic rays from our galaxy. These collisions slow down the solar wind particles and causes them to bunch up.

Travis: It's like a bunch of cars on the highway that suddenly come up on a state trooper. All the cars in the front suddenly slow down because they don't want to pass the cop. So

there is some congestion at the front while in the back, everyone is still traveling quickly. And in front of the cop, traffic is extremely light.

Pamela: Voyager 1 first entered this area of congestion, the heliosheath, in 2003. But scientists were not completely convinced until December of 2004, when a subtle increase in temperature was recorded by Voyager 1. This increase was expected and is caused by the increased density of the solar wind as the particles slow down and bunch up.

Travis: In addition to the rise in temperature, some particles were detected as they skipped along the boundary sideways. These particles ran into the heliosheath and were deflected to the side, and now surf the inside boundary of the heliosheath like a never-ending wave.

Pamela: Dude?

Travis: Dude!

Aaron: Duuude.

Pamela: In fact, the heliosheath does move forward and backward like a wave. It depends on the amount of solar wind pushing it from the inside. If the Sun is active, then the increased pressure of the solar wind will push the heliosheath outward. When the Sun is calm the pressure from the galactic background radiation pushes the heliosheath inward.

Travis: So Voyager 1 may end up having the heliosheath engulf it many times in the next few years as the heliosheath ebbs and flows around the spacecraft. One experiment that is exciting astronomers is an attempt to predict the movement of the heliosheath based on observations of solar flares. They look for flares on the Sun, pick out the ones aimed in the general direction of Voyager 1 and then calculate how long it will take for the energy and particles of the flares to reach it. Then they wait.

Pamela (sarcastic, bored): Sounds like a hot Friday night.

Travis: You got better plans?

Pamela: Stargate, duh!

Travis: The heliosheath is expected to be about 10-15 AU wide. On the other side of it the heliopause. This is the ultimate boundary of our solar system. It is where the background cosmic rays from the galaxy take over from the solar wind and become the dominant force.

Outside of the heliopause is interstellar space.

Pamela: Voyager 1 is expected to reach the heliopause in about ten years. But the uncertainty of that estimate is high. Voyager's nuclear power supply is also expected to run out in about 10 years. So the race is on. Will Voyager reach the heliopause before it runs out of fuel and freezes?

Travis: Will they make it or not? Tune-in in 10 years to episode 2064 of slacker astronomy to find out.

Pamela: And Voyager in even graver danger are budget cuts. There has been much talk about NASA finally closing down the mission. About 12 people are affiliated with Voyager

1. But the real cost of the mission lies in the amount of time NASA has to devote to communicating with Voyager. It takes a lot of effort by NASA's Deep Space Network to exchange signals with Voyager. The time on the network's dishes is very competitive as all of NASA's long range missions must use the same set of communications dishes.

Travis: If you live in the United States and have feelings on the matter, write or call your congressman.

Pamela: Inserting a 20 dollar bill in the envelope always gets their attention.

Travis: That's bribery!

Pamela: That's congress.

Travis: That's cynical.

Pamela: That's the way it works.

(** clip, Bones: Vger's liable to be in for one hell of a dissapointment)

Travis: Why so pessimistic?

Pamela: All this talk about cold, dark, deep space, and end of missions. It's not a cheerful subject like finding water on Mars.

Travis: But it really is. Mankind is finally stepping beyond the bounds of our solar system. Our first toe is about to be dipped into the interstellar medium. We now stop being merely citizens of our solar system and become citizens of our galaxy.

Pamela: And the first thing we do is dump radioactive trash on their doorstep.

Travis: Remember Voyager 1 is also carrying a gold record with data, images and sounds of Earth.

Pamela: That's right, the one that Carl Sagan and Timothy Ferris put together.

Travis: Yep, back in the mid 70's. A time we thought was dreary but in fact held quite a bit of promise. Almost 30 years later, has much really changed?

Pamela: We're growing up and we're finally about to leave our 'hood.

Travis: Watch out galaxy, here we come.

Pamela: Thanks for listening to another edition of Slacker Astronomy. Don't forget that we have a second XML feed on our site with a bunch of extras like monologues and interviews. It's been active lately so stop by slackerastronomy.org to subscribe.

Travis: While you are there take a look at the new home page design. Pamela has been working very hard on it and it shows. Its new and improved and a whole new talk back engine for comments is about to be installed. Props to Pamela!

Pamela: And Props to all of you listener's for taking the time to give us feedback! We live for your comments.

Travis: For Pamela and our trusty author Aaron Price, I'm Travis Searle. Clear skies and clear bandwidth...

Pamela: Oh yeah, sorry about our bandwidth trouble this week. We believe it is all fixed now. And we have Two – count them TWO backup servers setup now!

Travis: ...you've been listening to Slacker Astronomy, a three-person collaboration for you, for fun for the voices in our heads.