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## After 34 Years in Space, the Voyager Spacecraft Fly On — and On and On

By JEFFREY KLUGER Friday, Nov. 11, 2011



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There are few things as awful as the detritus of the 1970s. An era that gave us crock pots, Pintos, pet rocks, shag carpet, the avocado green refrigerator and the Captain and Tennille is an era best lost to history.

But then, of course, there are the Voyager spacecraft. It was in August and September of 1977 — when Jimmy Carter was in the White House, "Best of My Love" was the No. 1 song, *Laverne & Shirley* the No. 1 show, and the Dow was headed for a year-end close of 831 — that Voyagers 1 and 2 were launched. Their mission was ambitious: fly to Jupiter, then on to Saturn and then, just maybe — if the hardware was working, the gyros were sound and the thrusters hadn't frozen — swing by Uranus and Neptune too. Voyager 2 made that grand tour, flying in the flat straight through the solar system and successfully rendezvousing with Neptune in 1989. Voyager 1 made a gravitational whipsaw below and above Saturn, a trajectory that flung it up and out of the solar-system plane and limited it to a two-planet itinerary.

**(See photos of the shuttle era's final spacewalk.)**

But the ships' primary missions succeeded beyond the giddiest predictions of the engineers who built them.

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And today, improbably, those missions continue, with the creaky old spacecraft adding 330 million miles (530 million km) to their odometers every year — each mile constituting a new distance record for the reach of the human species. This month, NASA engineers young enough to be the grandsons and granddaughters of the people who built the Voyagers announced that they'd taken new power-saving steps to ensure that the missions continue — and it's not just the distance record they're after. The Voyagers are poised to pass at last from the outermost boundary of the solar system into the truly uncharted regions of interstellar space, and NASA wants them fit for duty when they do.

There's no way of knowing exactly where the solar system ends, but the best guess is that it's up to 14 billion miles (23 billion km) from the sun. That's where the last breaths of solar wind — the storm of charged particles the sun pours out all the time — bump up against the tenuous hydrogen and helium that swirl through the cosmos. Fourteen billion miles is about three times the maximum distance of Pluto (which was still a planet when the Voyagers were launched), so scientists always knew there would be a lot of flying to do before the ships crossed that threshold.

That endgame, however, is approaching. Voyager 1 is currently about 11 billion miles (18 billion km) away; Voyager 2 trails a bit at 9 billion miles (14 billion km). In December of last year, Voyager 1 beamed back data showing that the charged particles around it appeared to have come to a standstill, suggesting that it had entered a final transition zone before interstellar space. Such an area of stagnation had not been in the astronomers' models, so they can't predict how thick the particle wall will be.

**(See images from space by an astronaut photographer.)**

"These calculations show we are getting close, but how close?" asked Voyager project scientist Ed Stone at the time the discovery was made.

The fact that the Voyagers have enough juice left to make that crossing is a tribute to the radioisotope thermoelectric generators (RTGs) — otherwise known as teeny, tiny nuclear power plants — onboard. The RTGs are fueled by plutonium-238, which, at the time of launch, was predicted to be good enough to keep the ships going for 50 years. So far those projections are holding, with power expected to last until 2025.

To ensure that it does, engineers have instructed both spacecraft to switch to a backup set of attitude thrusters that had not previously been used in flight. Voyager 1 received that command in 2004, after its primary thrusters had fired 353,000 times. Voyager 2 got the same instruction on Nov. 4 of this year, after 318,000 primary firings. For both ships, the switch is intended to save about 12 watts of power since the heaters that kept the main fuel lines warm can be shut off.

**(See photos of Curiosity, NASA's new Mars rover.)**

It's a measure of how elegant the design of the 34-year-old spacecraft that the 12 watts represents nearly 5% of the total electricity the ships need at any given time — meaning the most durable and distant machines humans have ever built do their work on less energy than it takes to run three light bulbs. And it's a measure of how far that engineering has carried them that it took 14 hours for the thruster command — traveling from Earth at 186,000 miles per second (299,000 km/sec.) — to reach the Voyagers and another 14 for the confirmation to come back. On Nov. 13, Voyager 2 will transmit another signal confirming that

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the backup thrusters are functioning as planned; engineers won't look for it until Nov. 14.

When the twin spacecraft do fall silent, they will continue to serve as earthly messengers. Attached to their flanks are their celebrated golden records — 12-in. (30 cm) gold-plated copper disks containing analog etchings of pictures, music and greetings from Earth. The disks resemble old phonograph records and work like them too — but that, of course, makes sense. In 1977, who in the world had heard of a CD?

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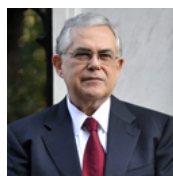


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