

# TPS Enables Study Of Mysterious Pioneer Anomaly

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There's a mystery at the edge of our solar system: Two spacecraft, Pioneers 10 and 11, which were launched to Jupiter and Saturn more than 30 years ago, are hurtling towards the edge of our solar system - but at a slower than expected rate. Called the Pioneer Anomaly, the effect of this slowing is small, but measurable, and so far unexplained.

This riddle has sparked an array of possible explanations, ranging from dark matter to spacecraft equipment to - most provocative of all - a new physics.

More data is what scientists need to solve the mystery, and more data is what they now possess, thanks to Planetary Society members.

Only a fraction of the Pioneer spacecraft navigational data has ever been analyzed to study this anomaly, but much of the more than 30 years of mission data was in disarray, on ancient media, and in danger of being destroyed. That's where The Planetary Society's members stepped in.

Only about 11 years of the Pioneer Doppler data, which measured the spacecrafts' velocity through the Doppler shift of the received frequency of the Pioneer signal, had been analyzed, and no solution to the slowdown had been determined. Much of the remaining data was stored on old 7- and 9-track magnetic tapes and needed to be identified, recovered and saved. No NASA funding was available for that task.

The Planetary Society issued an appeal to its worldwide membership and

raised the funding needed to recover and validate this trove of information.

"We were happy to come to the rescue when no one else would," said Bruce Betts, the society's project manager. "Whether the new data show the anomaly to be caused by some mundane effect from the spacecraft itself or lead to a new understanding of physics, the Pioneer Anomaly has been a mystery calling out to be solved."

After the society initiated the project, NASA's Jet Propulsion Laboratory also contributed in-house funds to further support the Pioneer Anomaly team.

Scientists and engineers led by Slava G. Turyshev at JPL were able to recover much of the more-than-30-year navigational histories of both spacecraft, including data from their Jupiter and Saturn encounters in the 1970s. The data are now being collected, arranged, validated, and written to modern media and will be provided to teams of scientists to analyze.

Success extended beyond the recovery of the velocity data. Information about the spacecraft themselves, as well as science data, was contained in what are called Master Data Records, discovered in storage at NASA Ames Research Center - which operated the Pioneer spacecraft.

Original plans called for that data to be kept for seven years, but fortunately, many records were turned up in the search for more data. Thanks to Viktor Toth, a software designer from Canada, these telemetry data files are also being collected and arranged, all useful data is being extracted, and they are being written to modern media.

What can these additional data tell scientists? For one thing, MDR data include temperatures measured throughout the spacecraft during the course of the missions. These will be critical for modeling the thermal

radiation from the spacecraft, its variations over time, and whether it could help explain the anomaly.

Planetary Society college intern Merek Chertkow is beginning to analyze this information, as are various professional scientists.

The Pioneer Anomaly was discovered when John D. Anderson and colleagues at JPL realized that the trajectories of the two spacecraft were deviating from the known laws of motion.

After about 30 years of travel, the Pioneer Anomaly has resulted in the spacecraft being about 240,000 miles - the Earth-Moon distance - closer to the Sun than expected. That seemingly trivial amount - the Pioneer spacecraft are traveling at 30,000 miles per hour – has intrigued scientists, because no known factor explained the slowdown.

What could be affecting their speed? Many hypotheses have been suggested: the interplanetary plasma and solar wind thermal recoil force due to heat from the spacecraft's nuclear power sources mysterious dark matter in the galaxy a manifestation of new physics.

No hypothesis could be adequately explained by known data, but with the data saved with the help of The Planetary Society, scientists will now have far more information available to help them solve the Pioneer Anomaly.

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