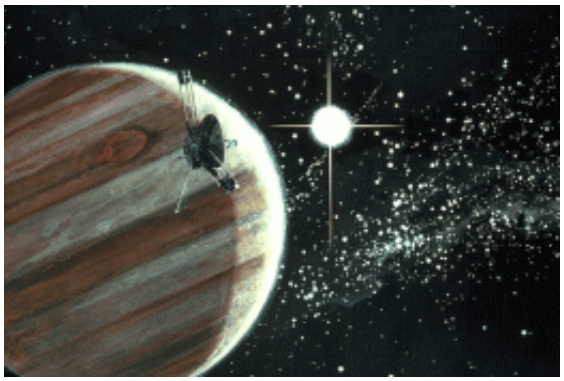
Research team appears to solve the Pioneer anomaly

18 April 2012, by Bob Yirka



An artist's concept of the Pioneer 10 Jupiter encounter. Image: NASA

(Phys.org) -- Back in the early 70's NASA launched two exploratory spacecraft, Pioneer 10 and 11. Their missions were to gather information about the solar system as they made their way through it by flying farther and farther from the sun, until they eventually left altogether. Though neither craft has been heard from since 2003, both have confounded scientists since it was discovered in the 80's that they were not accelerating at the rate that physicists had predicted, a phenomenon that has come to be known as the Pioneer anomaly. Now it appears a small team of dedicated researchers has figured out what is going on, and as they explain in their paper uploaded to the preprint server *arXiv*, it's due to nothing more than the way the propulsion system onboard does its job.

The basic problem was that the spacecraft failed to accelerate at the rate predicted, and it did so at what at first appeared to be a constant rate. Subsequent research in the 90's showed that whatever was preventing the craft from accelerating at the speed expected was lessening, which led some to believe it was tied to the radioisotope thermoelectric generator (RTG's) onboard that created the electricity used by the craft's electronic devices to take measurements and beam them back to Earth. Heat venting could work against the direction of travel if it was being expelled in the opposite direction, which it was. The problem though, was that the plutonium used to power the RTG had a half life of 88 years while the accelerating lessening effect occurred at a half-life equivalent to just 22 years.

To solve the riddle the new research team built a computer simulation using any and all data that could be collected about the now decades old spacecraft. In doing so, they found that heat generated by the RTG likely wasn't the culprit because it emitted heat in all directions. The electronics, on the other hand, because they were mounted on the back of the craft, away from the sun and dissipated heat mainly in that same direction, could indeed account for the discrepancy. But more importantly, they also found something prior researchers had not, and that was the decay in the efficiency of thermocouples that were converting heat to electricity which led to less and less heat being generated over time by the electronics, a rate that when combined with the radioactive decay of the plutonium, just happened to coincide with the rate at which the force that was causing the less than expected acceleration. And that they say, is why the craft have not accelerated at the rate calculated.

More information: Support for the thermal origin of the Pioneer anomaly, arXiv:1204.2507v1 [gr-qc] arxiv.org/abs/1204.2507

Abstract

We investigate the possibility that the anomalous acceleration of the Pioneer 10 and 11 spacecraft is due to the recoil force associated with an anisotropic emission of thermal radiation off the vehicles. To this end, relying on the project and spacecraft design documentation, we constructed a comprehensive finite-element thermal model of the

two spacecraft. Then, we numerically solve thermal conduction and radiation equations using the actual flight telemetry as boundary conditions. We use the results of this model to evaluate the effect of the thermal recoil force on the Pioneer 10 spacecraft at various heliocentric distances. We found that the magnitude, temporal behavior, and direction of the resulting thermal acceleration are all similar to the properties of the observed anomaly. As a novel element of our investigation, we develop a parameterized model for the thermal recoil force and estimate the coefficients of this model independently from navigational Doppler data. We find no statistically significant difference between the two estimates and conclude that once the thermal recoil force is properly accounted for, no anomalous acceleration remains.

via PhysicsWorld

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