

Radioactive decay rates vary with the sun's rotation: research

August 31 2010, by Elizabeth K. Gardner

Radioactive decay rates, thought to be unique physical constants and counted on in such fields as medicine and anthropology, may be more variable than once thought.

A team of scientists from Purdue and Stanford universities has found that the decay of radioactive isotopes fluctuates in sync with the rotation of the sun's core.

The fluctuations appear to be very small but could lead to predictive tools for [solar flares](#) and may have an impact on medical radiation treatments.

This adds to evidence of swings in decay rates in response to solar activity and the distance between the Earth and the sun that Purdue researchers Ephraim Fischbach, a professor of physics, and Jere Jenkins, a nuclear engineer, have been gathering for the last four years. The Purdue team previously reported observing a drop in the rate of decay that began a day and half before and peaked during the December 2006 solar flare and an annual fluctuation that appeared to be based on the Earth's orbit of, and changing distance from, the sun, Jenkins said.

"If the relationship between solar activity and decay rates proves to be true, it could lead to a method of predicting solar flares, which could help prevent damage to satellites and electric grids, as well as save the lives of astronauts in space," Jenkins said. "Finding that the decay rates fluctuate in a pattern that matches known and theoretical solar

frequencies is compelling evidence for a solar influence on decay rates."

Jenkins and Fischbach collaborated with Peter Sturrock, a professor emeritus of applied physics at Stanford University and an expert on the inner workings of the sun, to examine data collected at Brookhaven National Laboratory on the rate of decay of the radioactive isotopes silicon-32 and chlorine-36. The team reported in the journal *Astroparticle Physics* that the decay rate for both isotopes varies in a 33-day recurring pattern, which they attribute to the rotation rate of the sun's core.

In general, the fluctuations that Jenkins and Fischbach have found are around a tenth of a percent from what is expected, as they've examined available published data and taken some measurements themselves.

The team has not yet examined isotopes used in medical radiation treatments or for dating of ancient artifacts.

"The fluctuations we're seeing are fractions of a percent and are not likely to radically alter any major anthropological findings," Fischbach said. "One of our next steps is to look into the isotopes used medically to see if there are any variations that would lead to overdosing or underdosing in radiation treatments, but there is no cause for alarm at this point. What is key here is that what was thought to be a constant actually varies and we've discovered a periodic oscillation where there shouldn't be one."

Jenkins and Fischbach suggest that the changes in the decay rates are due to interactions with solar neutrinos, nearly weightless particles created by nuclear reactions within the sun's core that travel almost at the speed of light.

It is estimated that about 60 billion solar neutrinos pass through a

person's fingernail every second, but they are so weakly reactive that they pass right through the body without disturbing or changing anything, Jenkins said.

"We haven't known the solar neutrino to interact significantly with anything, but it fits with the evidence we've gathered as the likely source of these fluctuations," he said. "So, what we're suggesting is that something that can't interact with anything is changing something that can't be changed."

The Purdue team has ruled out the possibility of experimental error or an environmental influence on the detection systems that track the rate of decay as being responsible for the fluctuations and published a series of papers in the journals *Astroparticle Physics*, *Nuclear Instruments and Methods in Physics Research*, and *Space Science Reviews*.

Sturrock said it is an effect that no one yet understands and that if it is not neutrinos that are responsible, then perhaps there is an unknown particle interacting with the atoms.

"It would have to be something we don't know about - an unknown particle that is also emitted by the sun and has this effect - and that would be even more remarkable," he said.

More information: Power spectrum analyses of nuclear decay rates, M.A. Silver et al., *Astroparticle Physics*, Volume 34, Issue 3, October 2010, Pages 173-178. [doi:10.1016/j.astropartphys.2010.06.011](https://doi.org/10.1016/j.astropartphys.2010.06.011)

Provided by Purdue University

Citation: Radioactive decay rates vary with the sun's rotation: research (2010, August 31)

retrieved 24 April 2024 from <https://phys.org/news/2010-08-radioactive-vary-sun-rotation.html>

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