Neutrinos—the not-so-neutral particles

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Of all the assumptions involved in radiometric dating, the constancy of the radioactive decay rate has been considered the most certain, half-life being treated, for all practical reasons, as constant. Even if at the level of individual atoms decay is random (stochastic), it was always considered that if there are enough individual atoms in any analyzed sample, the decay rate of the sample is predictable, i.e. 'constant'. One of the main reasons for such a position was the assumption that no natural processes can and do influence radioactive decay.

This assumption was seriously challenged by recent discoveries. Data from Brookhaven National Laboratory showed a statistical discrepancy of measured decay rates published over the years.[1] Even more interestingly, ^{32}Si measured decay rates revealed seasonal variations (modulation), being slightly (0.1%)[2] faster in the winter than summer. At that point, the variation was dismissed as a technical glitch; some sort of measurement error.

The story gained momentum in 2006 when a clear cause-effect situation was discovered: during a solar flare event, the decay rate of the radioisotope ^{54}Mn was measured to be slightly slower.[2] In early December 2006, Ephraim Fischbach and Jere Jenkins showed that a spike in X-ray flux due to the solar flare coincided with a dip in manganese decay rate. A few days later, another X-ray spike was found to coincide with a dip in manganese decay. On 17 December 2006, a third such situation was documented, the dip being more evident. Regardless of the facts recorded, the paper submitted by the two authors was rejected by *Physical Review Letters* because it lacked a mechanism to back it up!

The two researchers continued their work, however, and studied another set of data from an experiment performed at the Federal Physical and Technical Institute in Germany and found out that ^{226}Ra decay rates also showed seasonal variation. The importance of this discovery lies not only in simply reinforcing the statistics but also in the fact that unlike the previously-mentioned radioisotopes (decaying by β decay), the radium-226 decay is of α type. At about the same time, Fischbach and Jenkins suggested that the culprits were neutrinos[3] in the solar flares. Such an explanation was acceptable for β decay, which is governed by the weak interaction and neutrinos are known to be affected by the weak interaction. Yet α decay should not be influenced by neutrinos.[2]

Proceeding undeterred by the skepticism of most physicists, the two scientists have found that decay-rate modulation is in sync with the earth's orbit.[4–8] Stanford University's professor emeritus Peter Sturrock then suggested that they test if the modulation was also linked to the rotation of the sun, since the neutrino output of our star is not even over its entire surface and the surface rotates over 28 days. What emerged from

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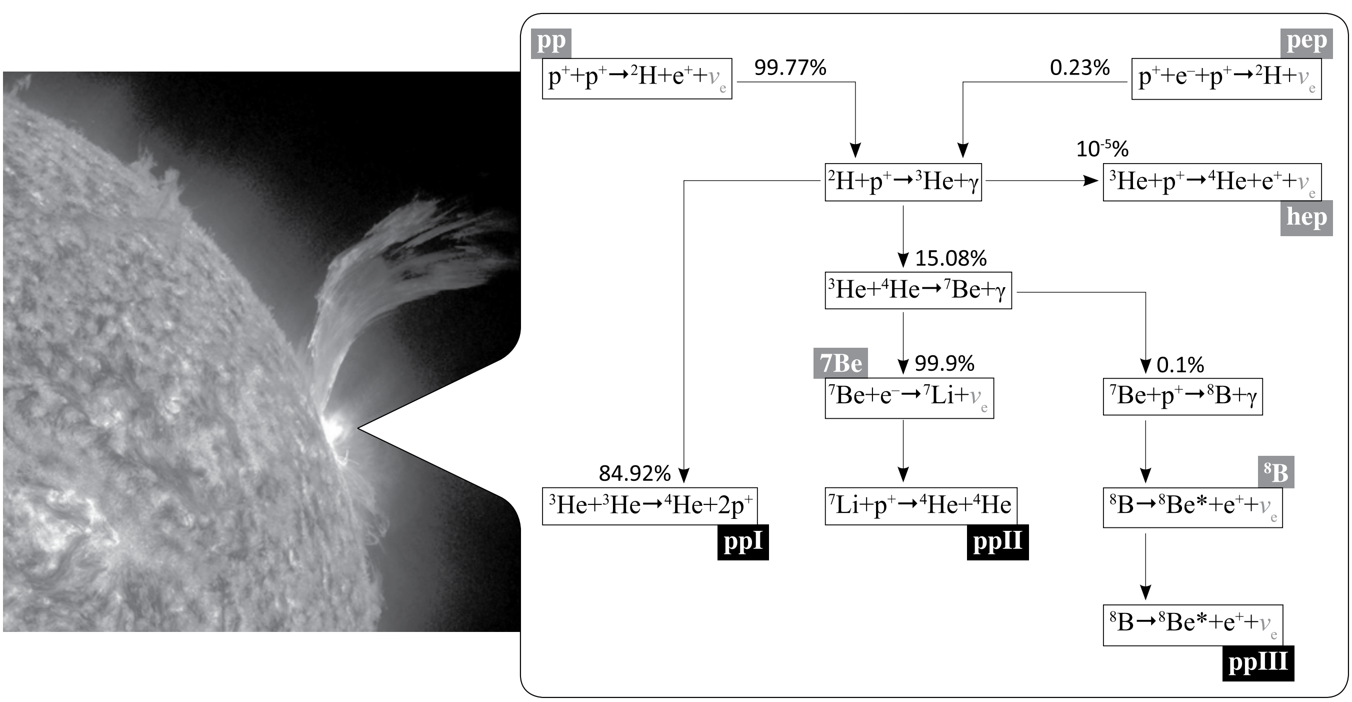

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Figure 1. Solar flares, which always mark increase in solar activity, are preceded by an increase in solar neutrino output. In the references the decay rate fluctuations are reported to happen just before solar flares form. pp I–III = proton–proton branches; hep = helium-electron-proton reaction; pep = proton–electron–proton reaction; ν_e = electron neutrino.

Brookhaven National Laboratory was a modulation pattern with a period of 33 days. Since the modulation is now proven to be real and indeed connected to some sort of 33-day solar cyclicity, it is suggested the core rotates slower than the surface because it is the core where nuclear reactions are believed to produce neutrinos.

The question that remains to be answered now is how are solar neutrinos influencing radioactive decay on Earth? As Jenkins puts it: "What we're suggesting is that something that doesn't really interact with anything is changing something that can't be changed."[1] Or maybe neutrinos have nothing to do with this and there is some sort of unknown solar particle that causes decay modulation. The major fact is, as Fischbach puts it: "To summarize, what we are showing is that the decay constant is not really a constant."[2]

Is this helping the creationist cause?

Whoever would like to jump to conclusions and say "that's it, the decay rate is not constant, therefore all radiometric dating methods are invalid" should think twice. Yes, a mental barrier has been breached: there are constants that are not so constant after all. But the very small variation does not change the order of magnitude of the calculated radiometric ages.[9] Most would probably cause errors within a given method's error margin.

I shall not discuss now the whole range of problems radiometric methods have, a topic that is copiously presented in the YEC literature, but I would like to point out another assumption: that only solar neutrinos interfere with radioactive decay on Earth. Since we only have reliable decay rate records for less than half a century, there is no way to verify older anomalies. Is it implausible that other episodes existed in the geological history of the planet that cannot be linked to the sun? This leads to another major question: are there other sources of neutrinos? The answer is "yes".

Other natural sources of neutrinos

Supernovae are known to produce neutrino fluxes, but unless their physics is different from what is commonly held, their distance from Earth would prevent their neutrinos from significantly influencing decay rates.

A much more important and very little understood source of neutrinos can be the central bulge of our galaxy (galactic neutrinos). Depending on its physics (still a matter of speculation, sometimes quite wild!), the neutrino flux from the central bulge can not only be significant and comparable to the sun's but it can also be periodic.

The earth itself produces neutrinos (dubbed 'geoneutrinos') from the β decay of ^{238}U and ^{232}Th, a fact detected and measured through recent research.[10] There is in fact hope that this can lead to accurate tomography of the planet.[11] Some scientists have already suggested that natural nuclear fission may well exist at the centre of the earth[12], an idea probably triggered by the proven existence of the Oklo natural nuclear fission reactor in Gabon. Unfortunately, large experiments meant to prove a continuous or periodic neutrino flux from inside the earth are still in the project phase.

Another possibility

If natural nuclear fission reactors existed deep inside the earth, in the core or/and in the mantle, there is no particular reason why they could not have a pulsating character, periodic or random. It is conceivable that during pulses, massive neutrino fluxes were produced which could have then affected radioactive decay rates of all radioisotopes on the planet.

Conclusion

The combined solar, galactic and geoneutrinos may well have caused significant acceleration of α and β decays in crustal rocks and therefore further weakened the case for radiometric dating. While there is reason for optimism for YEC believers, there is still a long way until a solid scientific case can be built. Research, clearly-focused and well-funded, is needed. Unfortunately, that can not be expected from modern academia which simply refuses to follow any research avenue that points to a young age of the earth.

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