Old textbook knowledge reconfirmed: Decay rates of radioactive substances are constant

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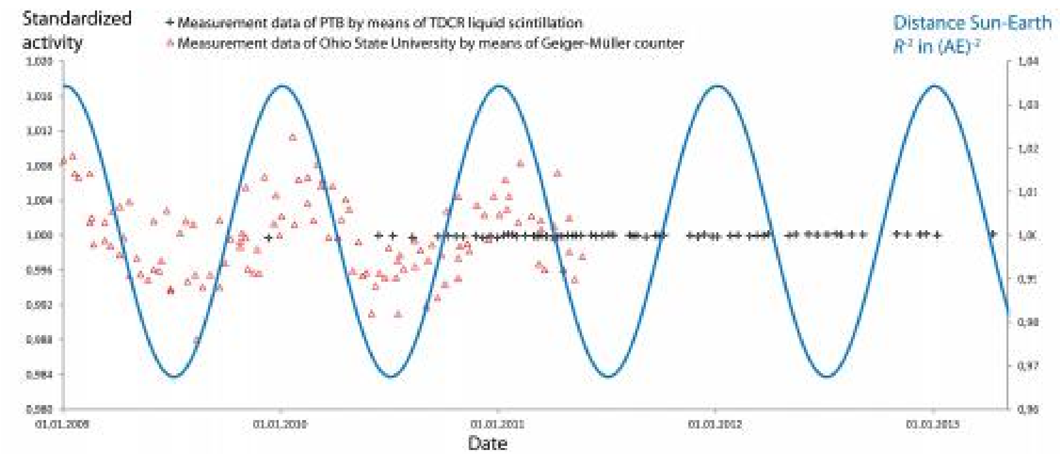

Measurements of the decay of the chlorine isotope 36Cl Between 2009 and 2013, scientists of the Physikalisch-Technische Bundesanstalt and of Ohio State University measured – with a time delay – the standardized activity, i.e. the radioactive decay, of 36chlorine. Whereas the American measurement results vary periodically, this is not the case with the PTB values. The blue curve illustrates the distance between the Earth and the Sun (presented as the reciprocal square of the distance in the astronomic unit AE).

Physikalisch-Technische Bundesanstalt (PTB) researchers refute the assumption that the decay rate of some radioactive nuclides depends on the distance between the Earth and the Sun.

The distance between the Earth and the Sun has no influence on the decay rate of radioactive chlorine. You could ask: "And why should it anyway?", because it is well known that the decay of radionuclides is as reliable as a Swiss clock. Recently, US-American scientists, however, attracted attention when they postulated that the decay rate depends on the flow of solar neutrinos and, thus, also on the distance from the Earth to the Sun. Their assumption was based, among other things, on older measurement data of the Physikalisch-Technische Bundesanstalt (PTB). PTB researchers have now definitively refuted the assumption of the Americans.

The half-life of radioactive isotopes, i.e. the period in which half of all atomic nuclei have decayed, is regarded as invariably stable. In the case of the carbon isotope ^{14}C, this period amounts, for example, to 5700 years. This property is, among other things, made use of for the dating of archeological findings. There was great excitement when a group of US-American scientists recently published measurement data of the radioactive isotope 36Cl which showed seasonal variations and explained this with the influence of solar neutrinos. All the more since billions of neutrinos from the Sun hit every square centimetre of the Earth every second and remain almost ineffective (they penetrate the Earth as if it weren't there).

Scientists of the Physikalisch-Technische Bundesanstalt have now carried out new measurements and have published their results in the journal "Astroparticle Physics". For three years, they checked the activity of samples with ^{36}Cl in order to detect possible seasonal dependencies. Whereas the US-Americans had determined the count rates with gas detectors, PTB used the so-called TDCR liquid scintillation method which largely compensates disturbing influences on the measurements. The result: The measurement results of PTB clearly show fewer variations and do not indicate any seasonal dependence or the influence of solar neutrinos. "We assume that other influences are much more probable as the reason for the observed variations", explains PTB physicist Karsten Kossert. "It is known that changes in the air humidity, in the air pressure and in the temperature can definitively influence sensitive detectors."

Meanwhile, the data of another measurement series – this time for the strontium isotope ^{90}Sr – have been evaluated and submitted for publication. Here too, even sophisticated analyzing methods give no indication of seasonal variations. It can thus be assumed that an influence of solar neutrinos on the radioactive decay does not exist – at least not in the order of magnitude postulated.

More information: Karsten Kossert, Ole J. Nähle: "Long-term measurements of 36Cl to investigate potential solar influence on the decay rate." *Astroparticle Physics* 55 (2014) 33-36

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