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Searching for Trends Superimposed on the Exponential Decay Rate of Cs-137

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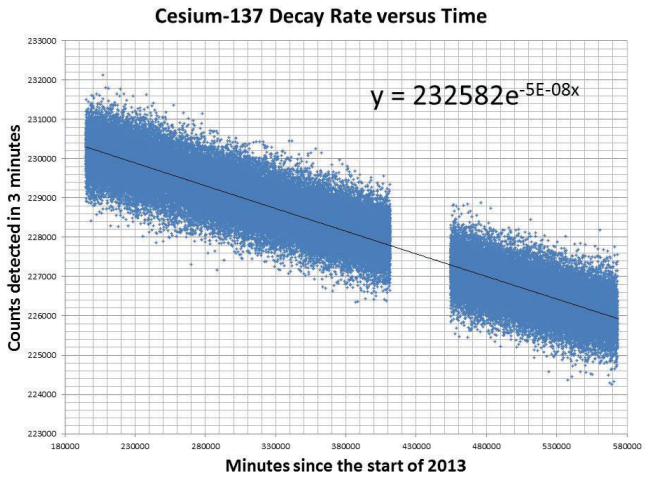
Past experiments measuring the decay rates of beta emitting radioactive elements have observed periodic modulations of the expected exponential decay with amplitudes of a few parts per thousand. One proposed explanation is that beta decay rates are influenced by the solar neutrino flux incident on the Earth, which varies by approximately 7% with the time of year. Other modulation frequencies are sometimes also seen and may correlate with rotational and various oscillatory modes of the sun. We measure the decay rate from 1 microCi of Cs-137, and 1 microCi Am-241 mounted on one detector, with enough statistical precision (better than one part in a thousand) to detect such effects and determine if they are real or instrumental /environmental. The experimental apparatus continuously collects data in 3-minute cycles to minimize the effects of temperature-induced gain shifts. The strong-interaction alpha decay of Am-241 serves as a control for possible instrumental effects, under the assumption that modulations involve only weak beta decays and not strong decays. Each cycle gives a 1024-channel energy spectrum, which is energy-scaled using the sharp Cs-137 gamma ray peak to negate gain drift. Decay rates are calculated by counting the events in a fixed set of energy bins. Data collection started in May 2013 and has run almost continuously since, with a two-week interruption in October 2013. There are no obvious periodic modulations in the counting rate. Data extending continuously for more than a year will allow us to quantify or set limits on annual modulation.

Research advisor Virgil Barnes writes, "This low-cost experiment uses a teaching detector from Phys 340. Confirmation of existing hints of annual variations in radioactive beta decay rates would be beyond the 'standard model'—there is no known mechanism to cause such modulations, cyclical or otherwise."



Decay of Cs-137 as a function of time.

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