'Faster-ticking clock' indicates early solar system may have evolved faster than we think

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Our solar system is four and a half billion years old, but its formation may have occurred over a shorter period of time than we previously thought, says an international team of researchers from the Hebrew University of Jerusalem and universities and laboratories in the US and Japan..

Establishing chronologies of past events or determining ages of objects require having clocks that tick at different paces, according to how far back one looks. Nuclear clocks, used for dating, are based on the rate of decay of an atomic nucleus expressed by a half-life, the time it takes for half of a number of nuclei to decay, a property of each nuclear species.

Radiocarbon dating for example, invented in Chicago in the late 1940s and refined ever since, can date artifacts back to prehistoric times because the half-life of radiocarbon (carbon-14) is a few thousand years. The evaluation of ages of the history of earth or of the solar system requires extremely "slow-paced" chronometers consisting of nuclear clocks with much longer half-lives.

The activity of one of these clocks, known as nucleus samarium-146 (146Sm), was examined by Michael Paul, the Kalman and Malke Cooper Professor of Nuclear Physics at the Hebrew University of Jerusalem, as well as researchers from the University of Notre Dame and the Argonne National Laboratory in the US and from two Japanese universities.

146Sm belongs to a family of nuclear species which were "live" in our sun and its solar system when they were born. Events thereafter, and within a few hundred million years, are dated by the amount of 146Sm that was left in various mineral archives until its eventual "extinction."

146Sm has become the main tool for establishing the time evolution of the solar system over its first few hundred million years. This by itself owes to a delicate geochemical property of the element samarium, a rare element in nature. It is a sensitive probe for the separation, or differentiation, of the silicate portion of earth and of other planetary bodies.

The main result of the work of the international scientists, detailed in a recent article in the journal *Science*, is a new determination of the half-life of 146Sm, previously adopted as 103 million years, to a much shorter value of 68 million years. The shorter half-life value, like a clock ticking faster, has the effect of shrinking the assessed chronology of events in the early solar system and in planetary differentiation into a shorter time span.

The new time scale, interestingly, is now consistent with a recent and precise dating made on a lunar rock and is in better agreement with the dating obtained with other chronometers.

The measurement of the half-life of 146Sm, performed over several years by the collaborators, involved the use of the ATLAS particle accelerator at Argonne National Laboratory in Illinois.

Provided by Hebrew University of Jerusalem