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About the radioactivity of atomic clocks.
John Willison

Stanford Research Systems manufactures a rubidium frequency standard, the PRS10, also known as an atomic clock. Like all of SRS's products (except software), the device is made from atoms. Mostly people are okay with the idea that products are made from atoms (metal, silicon, paint, plastic, etc.) however, if the word "atomic" appears in the product description, they worry about radiation.

To make matters worse, when the word "isotope" appears in the product description (as it does for our atomic clock) they want disclosures and certifications.

The PRS10 uses about a milligram of rubidium in its lamp and cell. Naturally occurring rubidium consists of two isotopes; about 72% Rb85 and 28% Rb87. We use both natural rubidium and a mixture of Rb87 and natural rubidium in the product.

One component of natural rubidium (Rb87) is weakly radioactive. Because its half-life (the time it takes for half of the atoms to undergo radioactive decay) is very long (more than 47 billion years) no safety precautions are necessary when handling rubidium (either the naturally occurring variety or either of its isotopes.

Still, people worry. "It's radioactive, right?" So a calculation is in order to provide some assurance. We have done those calculations, but most people don't know what the results mean. ("Is a femto-Sievert very much exposure? Is 3000 beta decays/second dangerous?") To facilitate understanding we'll give the results on a different scale: the Banana Scale.

The average banana (the edible fruit, generally recognized as safe) contains 400mg of potassium. Like rubidium, potassium is an alkali metal. Naturally occurring potassium consists of three isotopes: K39 (93%), K40 (0.0117%), and K41 (7%). The K40 isotope is radioactive with a half life of 1.27 billion years.

Now we have all that's needed to compare the radioactivity of the PRS10 atomic clock to that of a banana. For both the atomic clock and the banana we compute the number of atoms of the radioactive isotope divided by the isotope's half-life, and then ratio those numbers to find that the PRS10 contains (approximately) 6% of the radioactivity of a banana. Further, as the rubidium in the PRS10 is sealed in glass which is enclosed in metal and entirely inaccessible to the user, we can reasonably assert that the PRS10's poses no risk whatsoever to its users.