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Techlets

RADIOACTIVE DECAY RATES, SPONTANEOUS NUCLEAR REACTIONS, AND SPEED OF LIGHT DECAY.

A question by Dr Robert Gentry, Columbia Union College, Maryland, U.S.A.

There appear to be serious problems if one extrapolates the theory of speed of light decay back to the beginning, some 6,000 years ago. For example, the radioactive decay rates would be so high that spontaneous nuclear reactions would have taken place in uranium ores.

Barry Setterfield replies. . .

The suggestion that for a higher value of c as proposed at the time of Creation about 6000 years ago "the decay rates are so high that spontaneous nuclear reactions would take place in uranium ores" presumably implies that the ores would explode, leaving products different from what are known to exist, if any were left to exist at all! This relates to a particular reaction with neutrons, but let us look at nuclear reactions in general so as to cover the field broadly.

The particles emitted by radioactive decay which would be present in greater quantities then than now on the basis of a higher speed of light are:

(1) Alpha particles — the helium nucleus.
(2) Beta emission — electrons or positrons.
(3) Gamma radiation — if high energy may include a secondary reaction giving
(4) Neutrons.

It should be stated at the outset that the gamma radiation to produce neutrons requires a specialized set of conditions which may not naturally occur. For example, one of the best known reactions takes place when antimony-124, which emits gamma rays of 2.04 MeV, is intimately mixed with powdered beryllium giving the reaction

$${}_4\mathrm{Be}^9 + h\nu \rightarrow {}_4\mathrm{Be}^8 + {}_0\mathrm{n}^1 \qquad \text{................(1)}$$

which supplies the neutrons.[1] Alternatively, under similar conditions, the bombardment of beryllium by alpha particles can also produce neutrons as follows:

$${}_4\mathrm{Be}^9 + {}_2\mathrm{He}^4 \rightarrow {}_6\mathrm{C}^{12} + {}_0\mathrm{n}^1 \qquad \text{................(2)}$$

However, in this case the yield is very small, only 30 neutrons per one million alpha particles.[2] Generally speaking a good yield of neutrons is only obtained from the light elements, as in this case.[3]

$${}_6\mathrm{C}^{12} + {}_2\mathrm{He}^4 \rightarrow {}_8\mathrm{O}^{15} + {}_0\mathrm{n}^1 \qquad \text{................(3)}$$

and these are not usually found in quantities associated with alpha particle sources needed to produce a lot of neutrons.[4] In summary, then, a small quantity of neutrons may be anticipated as being available, but certainly not in an intensive flux under normal conditions, even with the c decay approach.

In considering the nuclear reactions in ores it may be well to remember that nuclear reactions come in four classes[5]:

(a) Alpha particle induced reactions
(b) Gamma ray induced reactions
(c) Neutron induced reactions
(d) Proton or deuteron induced reactions.

Of these four possibilities it will be noted that radioactive decay processes do not qualify as a source for reaction (d), though the proton reaction is important in stars. The conditions do not exist naturally on earth for this process and particle accelerators are required for its study. Again it will be noted that radioactive decay process (2) is not represented in the reaction list and can likewise be forgotten. This then leaves only 3 situations to investigate for ore bodies:

(a) Flux of alpha particles

(b) Gamma ray reactions
(c) Neutron reactions

ALPHA PARTICLES

Let us consider these in order, beginning with the flux of alpha particles that would be expected under conditions of significantly higher c values.

All elements from boron to potassium undergo alpha-induced reactions.[6] In the case of the heavy elements, however, we find that the alpha particles are repelled strongly because of their charge. Because the decay in c produces an effect on the rest-mass of particles such that with higher c the rest-mass is lower ($m — 1/c^2$), it follows that the same charge is going to repel the lower mass more strongly at the same distance by a factor of c^2. Its the same effect as two magnets of fixed strength being brought towards each other with their like poles approaching. If the experiment is tried with very light magnets they push each other apart while still some distance away. If it is tried with more massive magnets of the same strength, however, they approach more closely before repulsion occurs. Because of the conservation of energy, the velocity of the alpha particle is proportional to c and the flux of particles is also proportional to c. These two factors offset the c^2 repulsion exactly giving rise to exactly the same number of alpha particles getting over the top of the potential barrier per unit time then as now. In other words, there will be no more reactions per unit time back in the past than there is now.

However, there is one further point to consider with these alpha particles. These reactions with the heavy elements only occur with fast alphas of high energy. In the change of c approach we are producing fast alphas of THE SAME energy. The same radioactive decay process produces alphas of the same energy as before but the velocity is proportional to c (due to change in rest-mass). Radium disintegrates into radon and an alpha particle releasing 4.87 MeV of energy. For the reverse reaction to occur you would have to bombard the radon nucleus with alphas of about 4.87 MeV constantly for a period of 2340 years (the average life) to have a 50/50 chance of one penetrating to form a radium nucleus. The procedure to follow is to bombard the nucleus with particles of HIGHER energy. Accordingly, we can state that for penetration of heavy nuclei by alpha particles, an energy is required that is higher than that normally possessed by alphas emitted by radioactive decay purposes. Undoubtedly some reactions may occur but it would be a minimal process.

The two reactions that would have to be considered in this latter category (if alphas of sufficient energy were available) in uranium ores would be[7]

$$
\begin{aligned}
{}_{92}U^{238} + {}_{2}He^{4} &\rightarrow {}_{94}Pu^{241} + {}_{0}n^{1} \\
&\rightarrow {}_{95}Am^{241} + {}_{-1}e^{0} \qquad \ldots\ldots\ldots\ldots(4)
\end{aligned}
$$

where the plutonium decays by a beta emission process to give an isotope of americium which is alpha-radioactive with a half-life of 500 years. The other reaction is

$$
{}_{92}U^{235} + {}_{2}He^{4} \rightarrow {}_{94}Pu^{239} \qquad \ldots\ldots\ldots\ldots(5)
$$

the resulting isotope of plutonium being fissionable and also radioactive with a half-life of 24,400 years today. It can undergo a further reaction with more alphas to give rise to a neutron and curium isotope ${}_{96}Cm^{242}$ again if the alphas are of high enough energy naturally, which is unlikely. As the parent nucleus in equation (5) is scarce in natural ores (1 part of U^{235} to 139 parts of U^{238}) it follows that the resultant Pu^{239} is going to be considerably scarcer again, being dependent upon the availability of the high energy alpha particles. It comes as no surprise to learn therefore that "it does not occur in nature in appreciable quantities."[8]

In summary, then, for the alpha particles flux it can be stated that there would have been no more nuclear reactions per unit time back in the past with higher c than there is now due to the effect of the charge repulsion for the reacting nucleus. Again, unless there was a source of alphas of higher energy than is normal in a radioactive decay situation, there was little likelihood of any large-scale reactions occurring, though it is possible that minute quantities of plutonium may be produced.

GAMMA RAY FISSION

Fission can be induced as a nuclear reaction after the manner shown in equation (1). There is a sharp threshold for the required energy which is usually above 5 MeV for most reactions. In practically all cases the yield of resulting products is low and so this cannot be relied upon to produce a large number of reactions. The energy of most decays producing gamma rays is such that the gammas usually lie below 2 MeV. As the energy produced in any given reaction is constant for all c, this energy range will be unchanged in the uranium ores and consequently will be below the threshold for most fission reactions.[9] Accordingly, the number of reactions from gamma rays will be minimal for all c values.

NEUTRONS

Given that there will be some neutrons around from the processes mentioned in equations (1) to (3), let us examine what happens that makes them so important.

First, most reactions produce neutrons of high energy, around 2 MeV, which also means that they will be fast neutrons.[10] Ignoring this point for a moment, it will be apparent that in an ore body there will be some scattering of neutrons taking place. Scattering collisions slow the neutrons, but since the uranium nuclei are 238 times as massive as the neutron it takes many collisions to slow them appreciably and the influence of scattering on the problem is thus usually ignored.[11]

Secondly, fast neutrons are usually absorbed in some non-fissioning manner and thus represent a loss to the process as far as the possibility of a chain reaction is concerned. In the uranium ore body the predominant nuclide will be ${}_{92}U^{238}$ and thus the following reaction is the one that will occur for fast neutrons.[12]

$$ {}_{92}U^{238} + {}_{0}n^{1} \rightarrow {}_{92}U^{239} \rightarrow {}_{93}Np^{239} + {}_{-1}e^{0} \qquad \text{................(6)} $$

The neptunium, which is radioactive with a half-life of 2.33 days, becomes plutonium as

$$ {}_{93}Np^{239} \rightarrow {}_{94}Pu^{239} + {}_{-1}e^{o} \qquad \text{................(7)} $$

It should be pointed out that even though this is a fast neutron reaction, the capture cross-section of the ${}_{92}U^{238}$ increases somewhat as the velocity of the neutron is reduced.[13] This leads us on to the third type of reaction with neutrons, namely fission.

Neutrons may produce fission reactions. A glance at the capture cross- sections for uranium and most other elements shows that those nuclear reactions with neutrons are best induced when the neutron energy is lowest. The reason for this is rather simple to understand.[14] Since there is no Coulomb repulsion, slow neutrons spend more time near the nuclei they pass and therefore the short-range nuclear attractive forces have a better chance to take effect. Thus most nuclides have cross-sections that vary inversely with the velocity of the neutron and so are called 1/v absorbers. In other words, the chance of reaction is greatest when the neutron velocity is lowest. It is a straight velocity factor involved.

Since most neutrons are fast rather than slow, it is usually necessary for them to be slowed down before fission reactions occur. Indeed it is stated that in a natural ore comprising of a mixture of U^{238} and U^{235}, there is very little chance of any neutrons being slowed sufficiently for the probability of U^{235} fission capture to occur, since there is a resonance capture for neutrons by the U^{238} nucleus as the velocity slows down to a neutron energy of 7 eV, whereas the fission capture energy of U^{235} is around 0.025 eV. Under these conditions few fission reactions can occur naturally and certainly none that have enough neutrons produced to be self-sustaining in any natural ore bodies.

But what is the situation with a higher speed of light? Here there is even less possibility of either resonance capture by U^{238} or fission by U^{235}. The reason is that the total energy of the neutrons that have been emitted by the various processes is constant for all c, but due to the fact that the mass of the neutron, like all other rest-masses, is proportional to $1/c^2$, it follows that the **velocity of the neutron will be proportional to c** and the reacting elements are 1/v absorbers. Thus when the speed of light is high, the neutron velocity is so high that neutron induced fission will be well nigh impossible, so the chance of neutron capture is virtually zero. The only reactions that will therefore occur in uranium ores will be those such as reaction (6) and the natural result of (7) that follows. Even here it is apparent that little plutonium will be formed as the capture cross-section is still greatest for the lower value of the neutron velocity, even though it is a fast neutron reaction.

In conclusion, therefore, it is quite apparent that neutron induced reaction in ores will be even more minimal with a higher speed of light than they are today and so no chain reaction will occur. It has also been pointed out that gamma ray fission will be minimal. In addition, the conclusion from the alpha particle flux was that there were no more nuclear reactions per unit time with higher c than there are today. Accordingly, any suggestion of spontaneous nuclear reactions in uranium ores cannot be sustained for a higher value of c in the past.

SPONTANEOUS FISSION

There is one other process which needs to be considered in relation to uranium ores and concentrations of heavy metals, and that is SPONTANEOUS FISSION. In this process the nucleus divides in the ground state without being bombarded by neutrons or other particles. In this respect it appears to be a similar process to radioactive decay and likewise has a half-life. For uranium-238 and certain other heavy nuclei the half-life for this process is today about 10^{16} years[15] where only about 20 nuclei per gram of these elements undergo fission every hour out of a total of about 3×10^{21} atoms that make up the gram of material. During Creation Week with c higher by a factor of 5×10^{11}, the half-life for this process would have been 20,000 years. In other words, during Creation Week in a lump of U^{238} weighing one gram in just one hour some 3 × 10^9 of that gram would undergo spontaneous fission producing neutrons and fission tracks in the surrounding material. Since these neutrons are all fast neutrons they would be unavailable for sustaining a chain reaction, particularly since their speed then would be 5 × 10^{11} faster than they are today. Accordingly, though the rate of spontaneous fission would certainly be higher, there would still not be the conditions available for an explosive reaction to occur and the ore body would be unaffected by the process.

POLONIUM HALOS

This is a convenient place to mention the polonium halo problem, though it is not unique to polonium. Robert Gentry has rightly pointed out that there is a problem with the supposed hydrothermal mode of origin.[16] In each case there is no evidence of the radioactive parent that initiated the decay chain in which the halo appears, just the decaying daughter product and those products below it. The conclusion was that the decaying daughter, such as polonium-218, must have been created there in the host minerals (usually micas in granites) virtually instantaneously since no parent element was there.

However, there is another possibility, based on the decay in the speed of light. In Part 3 Section 1 of my monograph I outline how the first-formed metamorphic and igneous rocks would have resulted from super-saturated cool solutions which would have crystallized extremely rapidly. This is my first point. The second point is that with a high value for the speed of light during Creation Week, the radioactive parent was not 'hanging around' for billions or millions of years, for the uranium-238 (in the case of polonium halos) would only have existed in that form for a short period of days as the half-life for that segment of the sequence was only about 3 days. The scenario that this allows is one in which a solution at the point of crystallization initally carrying U^{238}, which is rapidly decaying, crystallized at a certain critical time encapsuling the daughter product and its subsequent decay halo pattern. The scenario suggests that there should be crystallization at a number of such points in the sequence of decay giving rise to the various polonium halos as well as others. Under these circumstances it is possible to argue that these "emanation halos", as they are also called, are evidence for rapid decay of radioactive parents in the sequence and so support the contention that the speed of light was higher in the past.

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RED-SHIFTS AND A COLLAPSING UNIVERSE

A question from Mr L.K. Appleton, Woodridge, Queensland, Australia.

In Barry Setterfield's tape message entitled **Exploring the Stars** he shows the probability of a very 'young' Universe based on the 'disruption' of Galactic clusters. In one case he states that the rate of disruption is 21,000 km/sec, and shows that this could not have been going on for more than perhaps 10,000 years — certainly nothing like millions and millions of years.

This disruption idea seems to CONFLICT with the 'collapsing' view of the whole universe as proposed by Barry in his booklet entitled **The Velocity of Light and the Age of the Universe**, where he says in the summary on page 1 that, '. . .a close scrutiny of the red-shifts reveals that our Universe **must be COLLAPSING in on us, not expanding outward as conventionally assumed from the red-shift data**'.

If the Universe is in fact collapsing then it would seem likely that galactic clusters should not be moving outwards, but rather they should be moving in an opposite direction!

Is there an answer to this apparent conflict?

Barry Setterfield replies. . .

Your difficulty can be traced to the rate of progress of knowledge! C decay can be shown to produce a red-shift (see the article on this subject in this volume). This red-shift has been taken as indicating Universal expansion. However, if it is simply a measure of the amount by which c has decayed, then