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Multeity of Nuclides Arising in the Process of Cold Nuclear Transmutations Involving Electrons

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***Abstract*—The calculation of possible changes in the elemental and isotopic composition of matter as a result of energetically favorable rearrangements of nucleons involving electrons and neutrinos has been made. 697082 of possible transformations were detected.**

In processes of cold nuclear transmutation, as experiments show, a certain set of stable nuclides passes into another set of stable nuclides with the release of energy. Neutrons or charged particles are not emitted outside, i.e. the total number of nucleons and the total electric charge remains unchanged. In order to identify fundamentally possible transformations during such processes, it is not necessary to delve into the physical mechanisms of cold nuclear transmutation (you can put them in a black box). At the entrance of this box are stable nuclides, at the exit are also stable nuclides plus energy. In the simplest case, there is one or two nuclides at the input, one or two nuclides at the output, and the number of protons and the number of neutrons at the input is equal to the number of protons and neutrons at the output.

The article [1] discusses the results of a computer program that selects combinations that satisfy above formulated conditions, from possible combinations of 280 stable nuclides, information about which is taken from [2]. Three types of such transformations are considered: the merging (synthesis) of two nuclei into one, the division of a nucleus into two, the transformation of a pair of nuclei into another pair. As a result of the work of this program, 1389 variants of synthesis, 817 variants of division and 516789 variants of rearrangement were revealed. The number of options identified is huge. But this is not all possibilities. More than two nuclei can be involved in processes of this kind; processes involving electrons are also possible.

As a development of research in this direction, a calculation was made of possible processes involving electrons and neutrinos. Usually such processes associated with weak interactions are extremely unlikely. But in inverse beta processes, when not the emission, but the absorption of electronic neutrinos (antineutrinos) occurs, the situation is much better. We can assume two sources of neutrinos (antineutrinos), initiating beta processes. First of all, these are cosmic neutrinos of very low energies ("relic neutrinos"), of which there are a lot of in Cosmos. As shown in [3], [4], [5], the interaction of such "ultracold" neutrinos (antineutrinos) with matter is much more efficient than in the case of high-energy neutrinos (antineutrinos), arising, for example, from nuclear reactions in the Sun.

Another possible source of ultra-low-energy neutrinos is the generation of neutrino and antineutrino as a result of processes in a heated substance, for example, electron collisions. If the mass of an electron neutrino is not higher than 0.28 eV [6], their birth in a substance with a temperature of several thousand degrees (in which there are many particles of kinetic energy of the order of 1 eV) is quite possible.

It is very important that such neutrinos have a de Broglie wavelength significantly exceeding the interatomic distances. If neutrino mass of 0.28 eV and a kinetic energy of 0.1 eV, the de Broglie wavelength is about 5 microns. This means that the interaction region encompasses a huge number of atoms (of the order of 10^{13} in a solid or liquid substance), which makes transformations spanning many atoms and nuclei possible, with the result that even unlikely processes become noticeable. Note that in the process of inverse beta processes, in contrast to the direct, there is no loss of energy carried away by the emitted neutrinos. We also note that in the case of interaction with the electron nuclei there is no problem of the "Coulomb barrier".

In a computer calculation, two types of transformations with the release of energy are considered, in which the laws of conservation of electric, baryon and lepton charges are fulfilled. The black rectangle indicates the obscure physical mechanism of these processes.

Rearrangement of nucleons with absorption of electrons:

$$(A1,Z1)+(A2,Z2)+e^{-}+\tilde{\nu} \rightarrow \blacksquare \rightarrow (A3,Z3)+(A4,Z4)+Q,$$
$$A3+A4=A1+A2, \quad Z3+Z4=Z1+Z2-1$$

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Rearrangement of nucleons with the release of electrons:

$$(A1,Z1)+(A2,Z2)+\nu \to \blacksquare \to (A3,Z3)+(A4,Z4)+e^{-}+Q,$$
$$A3+A4=A1+A2, \quad Z3+Z4=Z1+Z2+1$$

Special cases of these transformations are synthesis (two cores are transformed into one) and division (one core is converted into two).

The computer program found 263,546 variants of transformations of the first type (of which 1,657 variants of synthesis and 74 variants of division) and 433,536 variants of the second type (of which 645 variants of synthesis and 839 variants of division). These results can be obtained from the author of the article as an EXCEL file (58MB).

As an example, we present the reactions involving electrons in hydrogenated nickel (neutrinos or antineutrinos are omitted)

$$^{60}Ni+\,^{1}H+e^{-}\to\,^{61}Ni+7,041\;MeV$$
$$^{61}Ni+\,^{1}H+e^{-}\to\,^{62}Ni+9,808\;MeV$$
$$^{60}Ni+\,^{1}H+e^{-}\to\,^{4}He+\,^{57}Fe+0,569\;MeV$$
$$^{61}Ni+\,^{1}H+e^{-}\to\,^{4}He+\,^{58}Fe+2,794\;MeV$$
$$^{61}Ni+\,^{1}H\to\,^{4}He+\,^{58}Ni+e^{-}+0,865\;MeV$$
$$^{64}Ni+\,^{1}H\to\,^{4}He+\,^{61}Ni+e^{-}+1,98\;MeV$$
$$^{58}Ni+\,^{61}Ni+e^{-}\to\,^{63}Cu+\,^{56}Fe+1,736\;MeV$$
$$^{58}Ni+\,^{64}Ni+e^{-}\to\,^{65}Cu+\,^{57}Fe+0,113\;MeV$$
$$^{58}Ni+\,^{61}Ni+e^{-}\to\,^{59}Co+\,^{60}Ni+2,252\;MeV$$
$$^{60}Ni+\,^{61}Ni+e^{-}\to\,^{59}Co+\,^{62}Ni+0,276\;MeV$$
$$^{61}Ni+\,^{64}Ni\to\,^{65}Cu+\,^{60}Ni+e^{-}+0,409\;MeV$$
$$^{61}Ni+\,^{64}Ni\to\,^{63}Cu+\,^{62}Ni+e^{-}+0,995\;MeV$$

In the corundum tubes (Al_2O_3) after long-term operation, a lot of calcium was found in the nickel-hydrogen reactor [7], [8]. Perhaps this is due to the reaction

$$^{27}Al+\,^{16}O+e^{-}\to\,^{43}Ca+16,460\;MeV$$

The calculation, of course, does not exhaust the whole multeity of transformations involving electrons. For example, the appearance of iron from water in plasma electrolysis reactors [9] may be connected with rearrangements of $3H_2O+4e^{-}\to\,^{54}Fe+87,81$.

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