POSSIBLE DEVELOPMENT OF A PROBLEM OF PHYSICS, CHEMISTRY AND TECHNOLOGY OF ANTIMATTER FOR PROJECTS OF ((MACRO → MICRO) - , MICRO - , NANO - SPACESHIPS

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In the brief form features and some possible ways of development of high space technologies of the future (the special attention is given to a problem of physics, chemistry and technology of antimatter) are discussed; to a problem of positron annihilation in a matter (positronics), including in the structure positron processes, positron states and actually annihilation process which is a component of fundamental and practically important problem of antimatter. On the basis of data the Internet the most important applications of antimatter – space technologies of the future are considered.

Keywords: Antimatter, positron, positronics, space technologies, space, the Universe, space engines, interstellar flights.

Introduction

The antimatter problem causes now enough great interest in the World. It includes following basic sections: 1) Physics, chemistry and technology of antimatter; 2) Features of properties of an antimatter; 3) Features of interaction of a matter and an antimatter. These questions can undoubtedly help with studying of fundamental problems of a universe (especially in an unbalance of substance and antimatter in the World). In this connection there is a problem of synthesis of antimatter with application of modern achievements in area of physics of elementary particles and the nuclear physics. On the first the plan there is a problem of synthesis of antiatoms. Reception of heavier antiatoms certainly will demand creation of special accelerators for synthesis of their antinucleuses. In 1965 on the accelerator in the USA has been received antideuteron. In 1969 on the accelerator have opened the nucleus of antihelium-3 consisting of two antiprotons and an antineutron. Then nucleus of antitritium - the heavy antihydrogen, consisting of one antiproton and two antineutrons have been opened also. Basically it is possible to imagine and more

compound antiatoms, and even the big congestions of an antimatter. Researches in this direction proceed.

Now in CERN dares and the problem of synthesis of antihydrogen is already partially solved at interaction of received slow antiprotons with slow positrons. And slow antiprotons turned out on the accelerator in a return mode of slowdown of antiprotons. Slow positrons turned out from - radioactive sources. In Russia the problem of reception of slow positrons dares in Dubna under the direction of I.N.Meshkov within the limits of program LEPTA. The Same bunch of slow positrons can be used in modern nanotechnologies of manufacture for probe of properties of nanoobjects in modern nano - , microelectronics products (for example, dimensioning, concentration and a chemical compound of the atoms surrounding nanoobjects on depth).

During growth of a population on the Earth ecological, economic, sociopolitical and other problems of creative development of a human civilization sharply worsen. Prospects of this development will be undoubtedly connected with development of a space (near and far space, interstellar flights, development of galaxies of our Universe and is possible other Universes), and also an establishment of contacts to extraterrestrial civilizations if those are available. Are available the big number of offered projects of the future space travel based on our knowledge of laws of the nature and a universe. Now there is a point of view that interstellar travel on spacecrafts with application of the advanced physical energy sources are impossible by virtue of their huge duration and impossibility of creation of stocks of fuel and deterioration of materials of space vehicles. There are points of view that these flights are possible only in near and far space and flights to the nearest stars. Development of our galaxy, other galaxies of our Universe and is possible other Universes contacts projects possible quasifantastic the machines of time "deforming" space-time, etc. Therefore the prospect of creative development of a human civilization is undoubtedly connected by projects of quantum teleportation with deep studying laws of a universe with the purpose of creation on their basis of the future space technologies of development of a human civilization. The special role at the first

stage of development of space technologies will be doubtless for playing a problem of physics and chemistry of antimatter.

Apparently, these researches can approach to a solution of questions: whence we in the Universe also what we in it? These are the unsolved secrets facing to mankind. To them concern, perhaps, first of all search reasonable lives and a problem of antimatter (primary matter) in the Universe (see, for example, [1-21], etc.). We shall consider in brief these questions.

About possible various forms of World Reason

Within the limits of quantum field minisuperspaces it is possible to show the theory of the Universe and model a plural birth of the Universes, even if has started to eat anything ("is absent" the space-time, there are no Universes including our parent Universe). Thus, it is possible to consider a birth installed as process inevitable and natural - consequence of the theory of a field of the Universe in which the superpotential depends on time. It enables to draw a dynamic picture of Eternity (Everlasting peace) as original gas of the cooperating Universes, transition between which is possibly possible through so-called molehills (see [3]). The important question of the modern science promoting development of fundamental problems of a science and techniques, search of a reasonable life and new vital spaces in the World surrounding us is therefore. It is possible to tell, that these problems probably are it (is similar) Great geographical to openings the end of the Middle Ages and the beginning of new time in history of mankind, which is promote to unprecedented progress in development of all spheres of its life.

Ideas about interstellar flights, to an essence, first of all assume searches of a reasonable life in the Universe, an establishment of contacts to other civilizations. But these questions as it is underlined in [21] and below, by way of debatable discussion of a possible problem of the concept of World Reason – forms of the matter possessing ability purposefully to develop and learn, both the development, and other forms of a matter. One of examples of the form of World Reason before us exists in reality. It is the maximum form of movement of an alive matter – collective human Reason, that is to an essence that we name a human Civilization, the term «the

humanoid» is sometimes used. In this connection there are following inevitable questions 1) whether exist in the Universe (besides ours) humanoid Civilizations, contact with which, apparently, it is possible to establish others; 2) whether we can – carriers of one of kinds of World Reason, i.e. representatives of a human Civilization to come into contacts to other forms of World Reason. These questions have especially practical character. To solve them it is necessary on high scientific and a technological level in view of all knowledge of laws of development of one of moving forms of a matter – World Reason (a human Civilization).

The sum of knowledge of world around (mean the sum of knowledge of laws of development of all kinds of a moving matter), accumulated by various forms of World Reason as follows from an example of development of a human Civilization, follows approximately on the law $S(t) = S_0[1 - \exp(-\alpha t)]$. In this enough to the naive formula the parameter S_0 represents value « the sums of knowledge », and parameter $\alpha = 1/\tau$, where τ - average time of a life of a civilization. And sizes of parameters S_0 and $\alpha = 1/\tau$ for various forms of World Reason, apparently, are besides various. Thus, assuming, that an opportunity of an establishment of contacts between civilizations are defined by affinity of values of parameters S_0 and $\alpha = 1/\tau$ functions $S(t)$, it is possible to come to rather pessimistic conclusion about casual character of an establishment of contacts. Therefore various forms of World Reason most likely develop and exist independently from each other.. Contacts between them – the phenomenon most likely casual, as well as influences of one form of World Reason on another. It is one of possible paradoxes which expect serious researchers on a problem of a reasonable life in the Universe and-or the Universes. Unfortunately the experiments lead recently on search of a reasonable life in our parent installed distance meanwhile the negative result confirming this possible paradox.

There's also another reason for failure to establish contacts. Main of them is apparently the fact that our civilization has not reached a sufficiently high level of development in scientific and technical terms in order to establish contacts with other highly developed civilizations. These contacts are likely possible on the basis of some

unknown physical forms of communication to humanity (contacts). It is possible that the world around us is eternal (eternity), full of information about other civilizations, their laws and customs of development. This information is in eternity in the interaction with the environment can set the development of other worlds with different laws. So we should wait for Humanity will reach the higher forms of development to be able to detect this information and use it in their benefit.

There is a big number of offered projects of the future space travel based on our knowledge of laws of the nature and a universe. The special role at the first stage of development of space technologies will be doubtless for playing a problem of physics, chemistry and technology of antimatter [1-21].

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About the physicist, chemistry and technology of antimatter

The modern problem of physics, chemistry and technology of antimatter includes researches of features of properties of an antimatter and interaction of a matter and an antimatter, and also research of matter by means of antiparticles [22-38]. Special value modern achievements in the physicist, chemistry and have technologies of antimatter for the decision of power problems of mankind (a problem of antihydrogen, quark matters, power problems of cosmology, etc.). Therefore the big interest represents an opportunity of reception of intensive streams of positrons (probably and other antiparticles) at reorganization of physical vacuum in strong fields (for example, it is probable in an electric floor of modern super-power laser beams (http: //www.popmech.ru/part/?articleid=4803&rubricid=3)) and on accelerators. It is probable speech can to go probably about creation of space solar factories on the Moon or asteroids, etc. with use of the transformed energy of radiation of the Sun to electric energy and uses of special traps in space vacuum for reception and storage of positrons. The essence of a method should consist in reception of positrons by means of the transformed energy of the Sun on accelerators or any other methods of streams

of fast positrons with their subsequent delay up to temperatures of the order 0,5 K in some closed area of a space. Thus, significant amounts of positrons can be received. Gathering of such positrons in magnetic traps in states of space vacuum could become effective enough method of accumulation of antimatter.

Special interest is represented with a problem of reception of cold antihydrogen (in special traps at temperature of the order 0,5), developed in CERN [7]. These experiments assume check of fundamental laws of a universe (for example, CPT-SYMMETRY) by means of studying properties of synthesized atoms of antihydrogen. Yielded results of CERN of reception, storage and detecting of antihydrogen can be used in the future with the purpose of reception of antihydrogen in sufficient macro quantities of antideuterons for practical use as annihilation fuel in various impellent installations of space vehicles. Possibly it will be a question of creation of solar factories with use of energy of radiation of the Sun and a space for manufacture and storage of antimatter. The essence of a method should consist in reception by means of the transformed energy of the Sun, for example, in electric energy on accelerators or any other methods of streams of fast antiprotons and positrons with their subsequent delay on technology of CERN [7] up to temperatures of the order 0,5 To in some closed area of a space. The subsequent recombination these cold antiprotons and positrons in this area should lead to formation of cold antihydrogen. Thus the subsequent process of formation of molecules of antihydrogen and their condensation in firm particles in states of temperature of a space is possible. Condensation these particles can lead to reception of enough of the cold antimatter consisting of molecules of antihydrogen. Thus, the importance of a problem about transformation and concentration of energy of sunlight in other forms of energy, suitable antimatter for reception increases in a greater measure. As we see, this process of reception of cold antimatter represents extremely difficult technical problem, it is possible even to tell extremely difficult problem. It is work on for many generations of researchers of all areas of knowledge and specialties.

On a modern level of development of technologies about a plenty of the received antimatter to speak it is not necessary. Besides these processes of reception

of antimatter are very dear. Therefore it is possibly possible to speak only about approximately tens or hundreds nanograms the received antimatter. It the quantity of antimatter, obviously, would be enough for creation of space vehicles (SV) with the sizes in nano- or a micron range (http://www.portalus.ru/modules/science/data/files/prokopiev/Antimatter-Positronics-_ProektEngRus.doc). This fantastic assumption not it is deprived sense in a context of modern development nanotechnologies in the World. All the sizes long devices and details such SV should not exceed the sizes of ranges of micron and nanometer.

Position can change if to consider, that black holes as natural so, it is possible also an artificial origin can become "factories" of antimatter (see http://ipulsar.net/news/1465-sc.html (A.D.Dolgov (ITEP) and others). Gravitation in vicinities of a black hole is so greater, that it is any objects (even photons) cannot leave it. Really, gravitation of a black hole operates more strongly on protons, than on electrons as their weight is much less. As a result the black hole receives a positive electric charge. Thus, if weights of black holes are small enough the electric field in the field of horizon of events can reach critical values. It spends to instability of vacuum and generation electron-positron pairs. As positrons are thrown out from area of an electric field of a black hole, and electrons are grasped, black holes can be considered as factory of antimatter, transforming protons in antiparticles.

In this connection opportunities of use of researches of the various processes proceeding in extreme states, in the nuclear physics, astrophysics and cosmology can be considered, and also other adjacent areas of a science and techniques for creation of intensive streams of positrons and is possible other antiparticles. Thus, very powerful streams of positrons could be received. Gathering of such positrons in magnetic traps in states of a space can become rather effective method of accumulation of antimatter.

Besides a problem of manufacture there is a problem of safe storage of positrons. Now for storage of antiparticles so-called Penning traps [7,8] are used. Particles are kept in them from collision with walls of a trap by means of a magnetic field. However as positrons are charged equally and make a start from each other, in due course all of them are pulled out from a magnetic field and at collision with a usual

matter is annihilated. In the same way can be manufactured and Penning minitraps.

Firm Positronics Research LLC [8] is engaged in a problem of storage of positrons. Alternatively to Penning traps of scientists of this firm suggest to use also quasistable formations – positronium atoms. Positronium the friend around of the friend to a positron and electron which are kept from collision by electromagnetic fields represents system from rotating.

It is marked [16], that the engine on antimatter (antiprotons) is quite real and can work, for example, as follows. First two clouds from several billions antiprotons which from contact with a matter are kept with an electromagnetic trap are created. Then between them enter fuel particle in weight in 42 nanogram, representing capsule from uranium-238 in which the mix deuterium and helium-3 or deuterium and tritium is concluded. Antiprotons is annihilated instantly with nucleus of uranium also cause their disintegration on fragments. These fragments, together with formed the scale-quantums so strongly warms up an interior of a capsule, that there begins thermonuclear reaction. Its products possessing huge energy are even more strongly dispersed by a magnetic field and leave through aperture the engine, providing a spacecraft extremely greater draft.

As if to flight to Mars for one month for it the American physicists recommend other technology –antiproton nuclear division. Then on all flight it is required 140 nanograms of antiprotons, not including radioactive fuel.

2. About a role of research of positron and positronium states in a matter

By virtue of the set forth above research positron annihilation in a matter (positronics, a being component of a problem of antimatter), including in the structure positron processes, positron (positronium) states and actually process annihilation [12,13], represents fundamental and practically important problem. Positron and positronium states in the basic four states of a matter (gases, liquids, solid state and plasma) can be classified conditionally as follows: 1) free positrons and positronium atoms (Ps) in various energy intervals from termalized up to ultrarelativistic; 2) Wheeler connections (complexes) of structure $e^+e_2^-, e^-e_2^+$; 3) positronium molecules $(Ps)_2$, т. е. $e_2^-e_2^+$, and even more complex polyelectronic systems including in

the structure a positron; 4) the connected states of positrons and Ps on multielectronic atoms and ions (first of all on negative ions); 5) quasipositron and quasipositronium states in the various condensed environments; 6) a positron (Ps)-exiton plasma, for example, in semiconductors at temperature of liquid helium and below; 7) connected positron and Ps states on dot and big defects (free volumes) in crystal both amorphous firm bodies and polymers; 8) connected positron and Ps states on a surface of various matters. Certainly, alongside with above listed can be and other types of states.

Research of properties of such states has great value in a modern science and techniques. Therefore last year's intensive development of positronics of various matters and their states is observed. Interest to studying of positronics not casual. It is connected, on the one hand, with fundamental problems of physics: a birth and evolution of the Universe and -or the Universes, positron astrophysics, interaction of matter and antimatter, with studying new updating Wheeler complexes in matter. On the other hand, – with search of new unique methods of research of electronic structure and some physical and chemical characteristics of matter (including solid state) in addition to already existing methods (optical, electric, magnetic, etc.), and also opportunities of construction of devices and the devices working on the basis of effects of interaction of radiation with matter. The special role is represented with researches in the field of space positronics [14,15].

Application of a method of positron annihilation for studying electronic and defective structure of metals, alloys, semiconductors, ionic crystals, polymers and other matters became possible owing to theoretical and experimental researches of process annihilation in these materials [22-38], allowed to find out the nature positron states and their subsequent annihilation disintegration. Really, by means of the theoretical analysis positron processes and states in these matters communication between the basic characteristics annihilation spectra (the form and width of ADAP curves, time spectra annihilation and relative speed of the account of concurrences 3γ-quantum's) and constants of speeds of formation and disintegration of these states that has enabled to receive the helpful information on investigated samples (monocrystal and polycrystalline samples).

As it has been established, by the most important questions which are solved and can be solved by means of a method annihilation the positrons, not destroying control representing a method, are: definition of electron concentration in metals and alloys; research of anisotropy of electronic density in monocrystals of metals, semiconductors and ionic crystals for various crystal orientations; definition of charging states of atoms in semiconductor connections and ionic crystals; studying quasimetals and phase transitions metal – the semiconductor; definition of mobility of positrons in semiconductors; studying of the nature and density of dispositions in semiconductors; research of amorphous semiconductors and glasses, and also ionic systems with the developed surface; revealing of radiating and other defects in semiconductors and ionic crystals; Research of semiconductors and the ionic crystals irradiated by light, the X-rays charged by particles and neutrons; the analysis of a condition of a surface and surface layers of metals, alloys, semiconductors and ionic crystals. Special interest is represented with opportunities of applications various positron techniques for researches of the sizes and concentration of nanoobjects in technically important materials and nanomaterials [31-39].

Alongside with above listed, are possible, certainly, and other applications of a method annihilation. For example, studying of structure and the nature of relic defects of matters of various geological epoch of development of the Earth and is possible other planets. The method positron an issue tomography is very important.

Special value research of processes of interaction of matter and antimatter (atom-antiatom, a molecule-antimolecule, etc.), having have great value from the astrophysical point of view and synthesis of antiatoms on modern accelerators of elementary particles, also for creation of engines and the energy sources based on annihilation of matter and antimatter.

3. Possible projects of space engines

According to the Internet with the help of antimatter it is possible to deliver the manned ship to Mars for one and a half month. Affirms, that space engines on antimatter where are closer, than it is accepted to think. They can be rather inexpensive and safe. The main idea of company Positronics Research [8] considers,

that fuel for the ships of the future should become positrons, instead of antiprotons or nucleus of antihelium as it was offered earlier. This choice is proved so. At reaction annihilation matters and antimatters are born scale-beams of high energy, that in case of the piloted device entails inclusion in a design of the hardest protection. Not only it is complex to be protected from such beams, them and to use for a drive of the ship inconveniently. The significant part of energy will depart away. Positron annihilation the scale-radiation with energy approximately in 400 times smaller gives rise, that is good from the most different points of view. The first variant of the engine authors of firm «Positronics Research» have named «Positron reactor» (fig. 1).

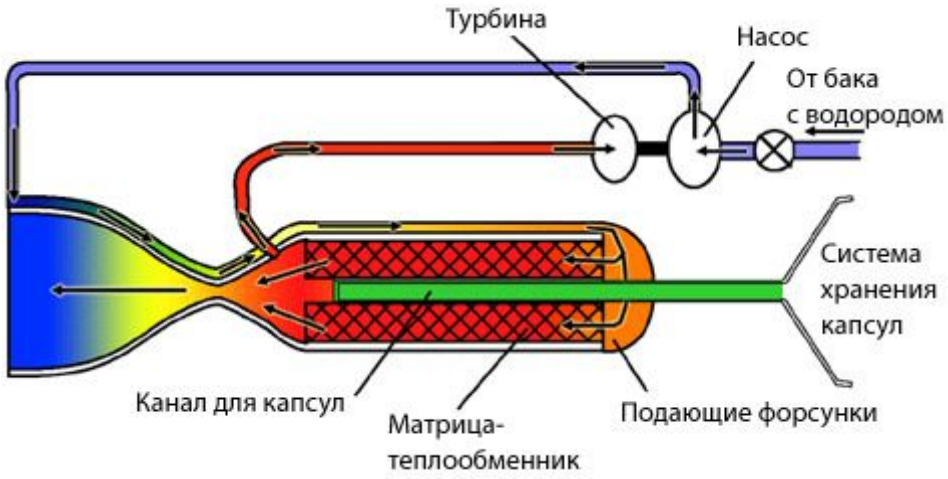


Fig. 1. The scheme of the rocket engine of type « Positron reactor »

It is supposed, that the certain quantity of positrons (the 100-th shares of gram) would be turned out on terrestrial installations and placed in the big number of tiny magnetic capsules-traps. These capsules by turns, but with the big frequency direct to the center of the reactor filled special heat exchanger – a matrix. In the center of a reactor (fig. 2) a trap switch off, positrons cooperate with its matter and give flash of the radiation which is heating up a matrix. Through a matrix pass hydrogen which is warmed up and with the big speed expires from aperture of the engine. The part of hot hydrogen is allocated for a drive of the pump, and cold hydrogen from a tank

before to get in a reactor, passes through double aperture in walls – for its cooling. Positron reactor could give a specific impulse in 900 seconds. On each gram of the working body (hydrogen) spent for a second it would give 900 grams of draft. It approximately in two-rub times above, than at chemical engines that means similar reduction necessary for flight, for example, to Mars of fuel, decrease in gross weight of the ship, so – decrease in force of draft necessary for its dispersal. We shall notice, ionic engines give a much greater specific impulse, but demand a powerful source of electric energy from the outside or from is monstrous-huge solar panels, or from a small atomic power station onboard. Positron reactor is energetically quite self-sufficient and technically rather simple. And in it its enormous advantage in front of ionic engines. Besides on the given principle nothing prevents to create powerful positron a drive, capable to deduce the ship into a circumterraneous orbit. And ionic engines on it are unable; they are good only for interplanetary flights. That up to hypothetical small capsules with traps for positrons – in such devices just now company Positronics Research [8] of city Santa Fe in state of New Mexico also is engaged.

The second variant of a drive is named «Ablative positron engine». Capsules with magnetic traps in which positrons are stored, here are still covered by a layer of lead. Annihilation of capsules occurs in wide of the chamber of the engine. Lead the scale-radiation from annihilation and again radiates absorbs powerful this stream of energy in the form of X-rays. X-ray beams, unlike scale-radiation, are very well absorbed by the most thin layer of a special covering of the chamber. These layers in the engine gradually evaporate and give draft. The settlement specific impulse of ablative positron a drive makes five thousand seconds. In case of misfortune on start (if for any inconceivable reason capsules-traps will be disconnected all) such ship will not throw out in an atmosphere of radioactive matters. There will be only short scale-flash and explosion, quite let's compare on force with explosion of a usual chemical rocket. So the safety zone around of start can make all kilometer. «On a rough estimate to make 10 milligrams of the positrons necessary for piloted martian mission, it is necessary approximately 250 million doll. with use of technology which

now develops. Other calculations made by scientists NASA, working in Glenn Research Center in Cleveland, have shown, that for reception of one milligram of an antimatter now it would be required about hundred billions dollars – the expensive that this project was interesting from the commercial point of view. There is an instruction, that at a modern level it is required nearby 10 billion dollars For 1 g of annihilation fuel. However, for example, by calculations Hbar Technologies, 17 grams of an antimatter are enough, that the unmanned space vehicle for 40 years has reached a star the Alpha of a Centaur, т. e. has overcome distance in 4,3 light years or 4,068 x 1013 km. For comparison it is possible to recollect, that the distance from the Earth up to the Sun makes 1,496 x 108 km, that in 272 000 times it is less » [6, 7,16]. It is very tempting, but such travel are very dear. Being based on experience of nuclear technology, it seems reasonable to expect, that cost of manufacture of positrons in due course will decrease owing to intensive researches in the field of technology of antimatter, and proceeding from comparative simplicity of positron a drive these figures mean, that flights on an antimatter where are closer to a reality, than it is possible to assume.

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