GRAVITATIONAL FUSION REACTOR. CONCEPT AND PERSPECTIVE

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Introduction

For the existence of mankind requires energy. With the development of scientific and technological progress of mankind population growing energy needs are growing even faster.

The main source of electricity humanity is a hydrocarbon fuel. But the reserves of this fuel on the planet is rapidly disappearing , and it requires the same in the chemical industry . Getting the same energy from hydrocarbons is almost always accompanied by the release of large amounts of waste , which spoil the ecology of the planet .

Nuclear power tamed by mankind relatively recently. This is a very promising source of electricity. Stockpiles of nuclear fuel from the point of view of the maximum possible energy extracted from them many times the reserves of hydrocarbons. But the nuclear fuel cycle can afford not every state, because nuclear industry requires a large initial investment, a large number of well-educated professionals and sophisticated technology . Especially difficult is dealing with spent nuclear fuel , which must somehow take AESi to bury , without killing the local ecology . In addition, stocks of nuclear fuel is also not infinite. Hydropower is cheap, not very difficult technically realizable, but not all have enough rivers. So that this source is not unlimited.

Other sources of energy can not even consider - their physical and economic efficiency are good only for interesting articles in journals and not for the industry for all of humanity.

For fusion energy are suitable for almost all light nuclei , so the fusion fuel reserves are virtually limitless . Specific energy of thermonuclear fuel higher than nuclear fuel, specific energy which is millions of times greater than that of the hydrocarbon.

Based on the experience of nuclear energy can be assumed that the development of a fundamentally new high-energy industry can be associated with serious accidents. Because in the 21st century , from the time when the first moon landing took place about 55 years, and landing on Mars has been more than 45 years, we can conduct large-scale experiments on the domestication of new energy sources outside of the planet on which we live.

The aim of this work - to describe one of the possible forms of development of fusion energy

The objectives of this work is the description of a possible fusion reactor and justification of reality and the prospects of the project.

The main part. Concept

For realization of fusion needs enormous temperature of about 100 million degrees Kelvin. For realization of fusion efficiency requires positive, the criterion Lawson ($n\tau>10^{14}$ s/cm^3, where n - density of the high-temperature plasma, τ- time keeping it in the system). Thus , the main task in the domestication of fusion is to keep the fusion fuel in the reaction . To do this, mankind has invented to use a magnetic field.

However, if you put the fusion fuel in the center of a massive space object , then hold except the magnetic field will also participate gravity object. This will significantly reduce energy costs on hold thermonuclear reaction , and hence the reaction will maintain a relatively long period of time. This will undoubtedly have a huge contribution to the research and development of fusion technology .

The main part. Choice of fuel

There are many possible thermonuclear reactions. Most of them viewed the following:

$^{2}D+^{2}D \rightarrow ^{3}He+n+3{,}26$ MeV; equiprobable $^{2}D+^{2}D \rightarrow ^{3}T+p+4{,}03$ MeV

$^{3}T+^{2}D \rightarrow ^{4}He+n+17{,}6$ MeV.

$^{6}Li+n \rightarrow ^{4}He+^{3}T+4{,}78$ MeV.

$^{2}D+^{3}He \rightarrow ^{4}He+p+18{,}3$ MeV

Tritium is radioactive, neutrons of these reactions also pose a serious radiation hazard. Because most radiation-reaction can be considered pure reaction $^{2}D+^{3}He$. Of course, in such fuels will inevitably $^{2}D+^{2}D$ reaction, and are respectively $^{3}T+^{2}D$. But it is important that such fuels can be reduced up to 50 times the output of radiation-hazardous products. As a result, biological hazards fusion reactor can be reduced by four to five orders of magnitude as compared to nuclear fission reactors, eliminating the need of industrial processing of radioactive materials and transporting them qualitatively simplifies disposal of radioactive waste, if any, will be.

However, for the implementation of the clean reaction temperature needed is 5 times larger than for the D-T reaction, that is easiest to initiate (500 million degrees to 100 million degrees), but it's not too serious problem.

Deuterium contained in the water, the technology of its receipt the spent long.

^{3}He is gradually accumulated in the regolith over billions of years of exposure the solar wind, a ton of lunar soil contains 0.01 g of ^{3}He and ^{4}He 28 g, this isotopic ratios (~ 0.04%) is significantly higher than in the Earth's atmosphere. Thus, ^{3}He can easily find any type of satellite moon and the moon itself, and hence it is possible to obtain it.

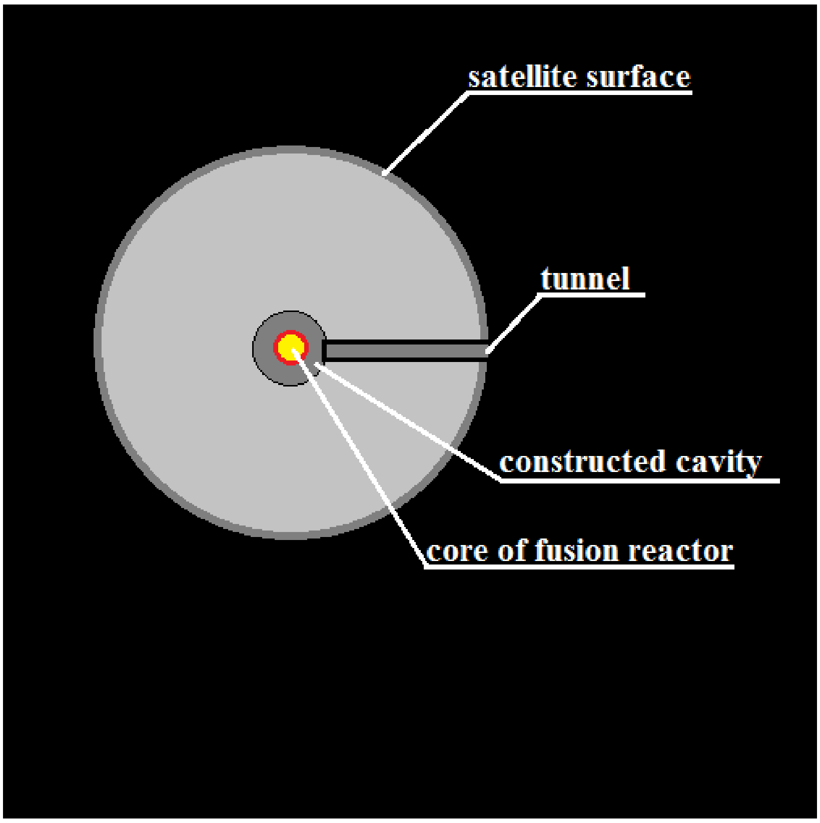
The main part. Selecting an object

As a prospect for the implementation of suitable satellite of Mars, Deimos.

Moon is not suitable because has a core of liquid molten metal. Even if you get an incredible , and it will cool the core , it will inevitably lead to a change in the magnetic field of the Moon . And that could lead to disaster in the world.

Phobos and Deimos are not liquid core, both have a low density. Because these objects are relatively similar to Earth's moon, then we can safely assume that they are sufficiently ^{3}He. But Phobos is inside the Roche limit, so that the satellite can easily collapse when trying to create the mine to the center of the satellite and the cavity inside.

Because Deimos has no hot core and, in principle, "cold", has a low density, the drilling should not cause serious problems.



Results

As a result of research it can be concluded that the most promising is the creation of a fusion reactor in the gravitational center of Deimos. The fuel can be used a mixture of ^{3}He and D. Helium can get satellite, deuterium can be brought from Earth.

The creation of this reactor will not only help the development of terrestrial technology in fusion, but also be able to help in the exploration of Mars, as will be the first and at the same time very powerful power plant in orbit around Mars.

Conclusion

In conclusion, it should be noted that this technology almost sounds fantastic. But at the same time, humanity, in general, that has absolutely everything to try to implement this project.

Project start-up loop Lofstroma can provide cheap space launch the necessary equipment. Flying in space and landing on various space objects mastered half a century ago. Drilling in extreme conditions mastered Kola borehole.

Major powers can afford to spend more than $ 500 billion a year on the military (USA) . Or build a road 48 miles per $ 9 billion (Russia) , which is more expensive programs flight to Mars (USA). But here is to spend $ 10-20 billion on International Thermonuclear Experimental Reactor can not even the whole world.

The Cold War ended, scientific and technical progress in the field of energy and space exploration moves only by inertia. And soon he will get up and go back, because any system or developing or degraded. And because this project is likely fantastic. It can be realized. But almost nobody wants. Modern people do not think about the development and the future, but about greed and present.

References

1. E. R. Dobbs — «Helium Three.», Oxford University press, 2000. ISBN 0-19-850640-6
2. G. Audi, A.H. Wapstra, and C. Thibault — «The AME2003 atomic mass evaluation (II). Tables, graphs, and references.»,Nuclear Physics A , 2003
3. M.M. Basko — «Physical basis of inertial confinement fusion. Tutorial», 2009
4. I.N. Bekman — «Physical basics of nuclear fusion», 2009.
5. www.nasa.gov