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Victor V Apollonov

Prokhorov GPI RAS Vavilov str.38, Moscow, 119991, Russia

***Corresponding author**

Victor V Apollonov, Prokhorov GPI RAS Vavilov str.38, Moscow, 119991, Russia; E-mail: vapollo@kapella.gpi.ru

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The US has announced the new program "SHiELD" (Self-protect High Energy Laser Demonstrator) which is a comprehensive program to create a 5-6 the generation fighter with a high energy laser on board to protect it from air-to-air and surface-to-air missiles. It includes the development by Northrop Grumman of a laser beam control system, the development of the actual laser by Lockheed Martin, and the integration of the entire laser weapons (LW) system into a single laser complex by Boeing. Due to the corona virus pandemic and technical difficulties, the US plans to receive these laser aviation systems by the end of the 2022-nd year only. Within the framework of the program, solid-state (SS) LW complexes based on the technology of fiber lasers with spectral beam combining of radiation from single sources were successively created. It was consistently reported on the creation of lasers with an average power of 30 kW, then 60 kW, 100kW and even 300 kW. The choice of a fiber laser as a unit for power summing is determined by the high quality of the radiation, its compactness, and low weight characteristics. To date, the weight factor of such LW complexes has been brought to a level of 5 kg / kW. This factor includes an estimate of the weight of the laser itself, its power source, the heat release system, and the entire platform that holds the system elements as a whole. Lockheed Martin plans to further bring this weight factor to a level of 2 kg / kW. These figures look very bright and promising for the development of tactical LW. The company plans to test a systems with much bigger power, but it seems that created prototype of a 300 kW laser is very close to the physical limit for the fiber technology. For comparison, it should be said that LW complexes on gas, chemical and alkali metal vapors bases, which the US has already abandoned (GDL, CO_2, CO, COIL, HF / DF, alkali metal vapors) gave a weight factor in the range of 200-400 kg / kW , which means that a megawatt LW complex can hardly be placed even in a Hercules-type aircraft carrier. And in order to achieve air supremacy, it is necessary to create and equip serial combat aviation with light and compact tactical LW complexes with a weight of several hundred kilograms. The weighting factor acquires special significance when considering the issue of equipping spacecraft with lasers, since this task is already on the agenda of the US Department of Defense. According to the accumulated experience of operating the LW complexes created in the past, the need to create in the future a very light and compact laser systems with an output power of several tens of Mw is confirmed. Therefore, only SS laser technology allows specialists to look confidently into the future. Only having a developed SS laser technology can we talk about the creation of a whole range of high-energy LW systems that meet the assigned tasks for sure. Thus, the LW complex on a SS basis with a capacity of 10 megawatt, taking into account the weight factor planned for implementation - 2 kg / kW would weigh within 20 tons, which looks like as a quite acceptable! Nevertheless, the technology used by the US for combining fiber laser beams is suitable only for creating tactical LW with a power of up to several hundred kW not more. It is especially true if we are talking about movable LW complexes. Obviously, a different design scheme of a SS laser is needed, which would allow further scaling of the energy of the LW complex while maintaining its characteristic weight factor. As noted above, a laser based on the outdated physical and technical foundations of the previous stage in the development of laser technology would weigh many tens of times more. Taking into account the above, it is important to draw a number of conclusions that affect the general understanding of the problem of LW creation in the world:

I. SS laser technology in the world has reached the level of maturity that allows the creation of high-energy tactical aircraft with reasonable weights and dimensions. Laser complexes created on gas, chemical and alkali metal vapors bases are a matter of the past. It became clear that the light and compact LW systems cannot be obtained on their basis. Very similar situation take place in the case of liquid LW systems, they cannot be efficiently scaled up to the MW class complexes. Today, the technology of tactical LW systems, well developed in the US, is based on fiber and disk types of laser, research on which was begun in Russia and subsequently significantly developed in the US. Nevertheless, due to a number of physical limitations, the creation of compact and lightweight LW complexes based on the indicated bases is limited by the tactical power level. This is the great limitation of these technologies, since not only the strategic level of average power and possible temporal structure of radiation, but also many new effective applications based on them are physically impossible.

II. It is obvious that the new aircraft complex of the LW being created by the US will not only be able to solve the problems of its own defense against missile attack, but also pose a great threat to enemy aircraft and other military equipment. Laser radiation is significantly absorbed and scattered in the high humidity conditions of the Persian Gulf, where many

demonstration tests have been conducted of tactical aircraft systems for countering drones. It is well known that under these conditions the power of the beam drops by three times for every mile of the distance. Actually, this really complicates the application of LW in the high humidity conditions. But this does not lead to the conclusion, stated by some of world experts, that LW is ineffective in principle! It is necessary to increase the output energy of the LW complexes and go to a much higher level of average power and to more effective temporal structure of the radiation generated by them. So, for example, the conversion of the CW mode of radiation generation to the high-frequency pulse-periodic mode allows an order of magnitude to increase the range of the damaging factor with an increase in the peak pulse power by several orders of magnitude in comparison with the power of the CW mode.

III. There are so many completely different tasks besides the drone destruction. This is the use of LW in the upper atmosphere and in space. At altitudes of 7-9 km, where a portable anti-aircraft missile system are less dangerous, the air environment is much more transparent and targeting ranges for the destruction of military equipment even for a power level of 100-300 kW can be of many tens of kilometers. And if we are talking about the megawatt level of power, then the work within the SDI has already experimentally proven the reality of the range of active operation at the level of 100 km. with the functional mode of operation. As a matter of fact all that again, is a tactical range of operation and it is necessary to continue to increase the power of the aircraft based laser to achieve a strategic range level of 1000 km or more, with appropriate control of weights and dimensions within reasonable limits. Nowadays, the SS basis as the laser active element is dominating one in the minds of scientists and designers. In particular it is the fiber and disk geometries of the tactical and strategic LW complexes that with great emphasis determine their future for the majority of combat arms.

IV. Now about outer space. There are no air and water vapor at all at this height and, therefore, there are no absorption and scattering of radiation! The effect of the impact will rest only on the optical quality of the generated radiation. But we still need to manage to take this multi-megawatt laser complex into space. For this, the emphasis in US work is placed on SS laser technology, which makes it possible to provide a weight factor of less than 5 kg / kW. It is necessary to remember about the task of the 1st stage set by the US Chiefs of Staff Committee, which refers to the installation of tactical LW systems with a capacity of 100-150 kW on aviation combat vehicles by the end of 2022.

V. A few words about the mechanisms of military equipment destruction by laser light. Forceful defeat will certainly guarantee the fulfillment of the combat mission of destroying the enemy's military equipment. This becomes very clear in the following example. A high-energy laser in the power mode, for example, cuts off the wing of an aircraft or cruise missile, and both of these military equipment after that are guaranteed to stop functioning. With significantly lower laser energy, the functional destruction (smart interaction) to the military equipment is possible only. For example, for the same missile, the laser can illuminate the optoelectronic targeting system. The missile continues to fly and the operator cannot be absolutely sure that the missile will lose its navigational ability to reach the target. And the military people should have such a confidence! We talk about functional mechanism target destruction when we cannot provide the required power density for the force defeat. It is also obvious that if a force mechanism based LW is created, then a functional LW is already fully provided with this fact, especially with an increase in the defeat distance by an order of magnitude. It is important that the power density levels in this case are required much lower. Proceeding from this, it is necessary to strive to create a LW for power hitting a target with minimal weights and dimensions! The functional mechanism based LW, as mentioned above, is obtained automatically in this case. The military did not like the functional mechanism of hitting the target before, and now little has changed in their position. Thus, functional damage is good only when forced one is objectively impossible due to a lack of average laser radiation power at a given distance. And this means that the designers of the LW need to think about a lightweight and compact strategic LW capable of destroying ME in a power mode, i.e. always have a reserve of energy in the beam.

VI. Attempts at spectral combining of a large number of fiber lasers in the US led to the creation of a prototype LW with an average power of 300 kW. Which is more or less ready for tests. The limitations of this approach in terms of further scaling of the general energy of the LW complex are convincingly shown. Stolen in Russia (first paper by N.G. Basov was published in QE 2(9), 1966) and patented by the scientist from Stuttgart (Germany), SS laser technology based on traditional disk geometry (a set of small-diameter disks) also does not allow further scaling of the average power of a single module consisting of several disks above 75 kW level. The only correct and efficient approach to the creation of a strategic SS LW of the second stage is to obtain laser radiation in a single cavity with a large-diameter disk active element. It is on this path, rich in physical, technical and technological difficulties, that it is possible to create the entire line of SS laser systems from the tactical level to the strategic one. The mono-modular disc laser technology, proposed again in Russia, is a solution to this scientific and technical problem. And this is precisely the goal to which the high-energy LW creators of all over the world have been struggled and are struggling up to now. Only in this case can the problems of strategic aircraft be resolved, which are now being brought to the fore because of the US declared goals of creating hypersonic missiles and other tasks related to space. It is this path of development of the strategic LW, which was started together with academicians N.G. Basov and A.M. Prokhorov, will allow significant progress in the creation of efficient, compact and lightweight LW complexes and not only.

Successful developments of high power/energy high repetition rate P-P laser technology is very important for many civil programs as well. The "Impulsar" program makes it possible to foresee the possibility of well conducting channels realization with the length up to several ten and even hundred kilometers for the purpose of energy transfer on significant distances, creation of new and promising systems for the mastering of outer space power engineering and for motivation of significant contribution to be done on that basis to an essential improvements of the global ecology of our planet. One should note that all experimental realizations pointed out above could be conducted with the use of high power/energy lasers with MW class power, while for the injection into orbit of different technologically effective equipment (global network connections, Internet, photo-monitoring of Earth surface, debris cleaning) the radiated power substantially higher is required. Thus, for example, for a space cargo launching with the weight about 1000 kg the laser complex with power not less than 10-15 MW is necessary [1-3].

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